Investigating the Role of Cdc42 in the Production and Release of Pro-Inflammatory Mediators in Airway Epithelial Cells

by

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Abstract

Epithelial cells line the lung airways providing a protective physical and immunological barrier against inhaled particles and pathogens. Hence, airway epithelial cells express a variety of surface receptors that confer recognition of inhaled toxins, allergens and various pathogens. Receptor engagement is coupled with release of pro-inflammatory molecules that recruit and activate immune cells and orchestrate inflammatory responses at the lungs. While this release is essential for host defense responses against infections, it can exacerbate existing inflammation in the lungs, especially in chronic conditions of asthma and COPD patients. Since the regulation of cytokine gene expression and secretion from epithelial cells is not fully characterized, we sought to investigate whether this process is regulated by Rho GTPase proteins. Rho GTPases act as molecular switches and their downstream signaling mediators control a variety of inflammatory pathways. Specifically, we focus on the GTPase Cdc42 which is implicated in inflammatory gene expression and is known to have a Golgi pool, suggesting a potential role in cytokine trafficking.

In **Chapter 3**, we investigate the role of Cdc42 in bronchial epithelial cell inflammation by ablating its activity to induce a loss of function. This is achieved through the use of the pharmacological inhibitor, ML141, and through genetic silencing mediated by shRNA knockdown. We report that inhibition of Cdc42 with ML141 or shRNA-mediated silencing differentially modulates pro-inflammatory cytokine mRNA levels and as well as their secretion. IL-8 levels increase while MCP-1 levels decrease after ML141 treatment. These effects are concomitant with a disruption of cytokine trafficking patterns through the secretory pathway. In addition, we report a disruption to Golgi structure and integrity. Cdc42 inhibition or knockdown result in an aberrant fragmented phenotype.

In **Chapter 4**, we report on a transcriptome analysis by RNA sequencing to investigate the genome-wide changes occurring at the mRNA level upon inhibition of Cdc42 with ML141. Our analysis reveals a gene enrichment in inflammatory pathways and transcriptional regulators, as well as in ER stress pathways due to ML141 treatment. In addition, we identify differentially expressed signaling proteins that might have a role in mediating these effects. We show that these targets, specifically TRIB3 and DUSP5, are downstream effectors of Cdc42 that couple inflammatory gene expression to Cdc42 inhibition. We also show other targets, namely SESN2 and BMP4, to be involved in maintaining Golgi integrity downstream of Cdc42 as their genetic depletion blocks ML141-induced Golgi fragmentation. We also characterize perturbations to gene sets linked to specific compartments within the Golgi and to different stages along the secretory pathway for changes in gene expression.

In **Chapter 5**, we investigate the effects of Cdc42 mutants with alternative lipidations that result in aberrant localization to subcellular compartments, such as the Golgi and the nucleus. We investigate whether an enrichment at these compartments is associated with trafficking defects or enhancements in order to understand the importance of the different Cdc42 pools in the cell. We do not find significant changes to cytokine trafficking or Golgi integrity. This is likely due to the normal activity of endogenous Cdc42 that obscures the effects of exclusive sequestration in different organelles.

Taken together, our findings reveal a role for Cdc42 as a dual regulator of cytokine dynamics. It can both positively and negatively regulate cytokine production while being a positive regulator of trafficking. In addition, we also interrogate the cellular inflammation network induced by Cdc42 inactivation, characterizing genetically enriched pathways and identifying signaling targets that mediate inflammatory properties.

Preface

Findings presented in Chapter 3, Chapter 4 and Chapter 5 were a result of experiments performed by Rowayna Shouib, with initial training and continued supervision by Dr. Gary Eitzen. Rowayna's contributions included designing experimental plans, developing and optimizing protocols and analyses pipelines, setting up and conducting experiments to collect data, carrying out subsequent analyses, as well as writing and editing of findings for manuscripts.

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AEC: Airway epithelial cells
AP-1: Activating protein-1
BAFF: B cell-activating factor of TNF family
BMP-4: Bone morphogenic factor 4
cFLIP: Cellular FLICE-like inhibitory protein
Cdc42: Cell division control protein 42
COPD: Chronic obstructive pulmonary disease
CRIB: Cdc42- and Rac-interactive binding motif
DAMP: Damage-Associated Molecular Patterns
DC: Dendritic cells
DEG: Differentially Expressed Genes
DMSO: Dimethylsulfoxide
DUSP5: Dual specificity phosphatase-5
ER: Endoplasmic reticulum
ERK: Extracellular signal-regulated kinase
FBS: Fetal bovine serum
FDR: False Discovery Rate
GDI: Guanine nucleotide dissociation inhibitors
GEF: Guanine nucleotide exchange factors
GPCR: G-protein coupled receptors
GH: Growth hormone
Hs: Homo sapiens
IFN: Interferon
IFNs: Interferon (IFN) regulatory factors
IκB: Inhibitor of NF-κB
IL: Interleukin
ILC: Innate lymphoid cells
IQGAP: IQ motif-containing GTPase-activating proteins
IS: Immunological synapse
JAK: Janus Kinase
JNK: c-Jun N-terminal kinase (JNK)
LPS: Lipopolysaccharide
MAPK: MAP kinases
MCP-1: Monocyte chemoattractant protein (also known as CCL2)
MDA5: Melanoma differentiation-associated gene 5
MVB: Multivesicular bodies
MyD88: Myeloid differentiation primary response protein 88
NOD: Nucleotide-binding oligomerization domain
NF-κB: Nuclear factor kappa B
NT: Neurotensin
PAR-2: Protease-activated receptor 2
PAMP: Pathogen-Associated Molecular Patterns
PI3K: Phosphatidylinositol 3
polyI:C: Polyinosinic:polycytidylic acid
RT-PCR: reverse transcription-polymerase chain reaction (PCR)
PRR: Pattern Recognition Receptor
PRS: Pattern Recognition Receptor
Rac1: Ras-related C3 botulinum toxin substrate 1

RhoA: Ras homolog family member A
RIPK1: Receptor-interaction protein kinase 1
SESN2: Sestrin 2
SMC: Smooth muscle cell
STAT: Signal transducer and activator of transcription
TGN: Trans-Golgi Network
Th2: Type 2 helper T cells
TLR: Toll-like receptors
TNF-α: Tumor necrosis factor-alpha
TNFR: TNF-α receptor
TRADD: TNFR1-associated death domain protein
TRAF: TNFR-associated factors
TRIB3: Tribbles homolog 3
Trif: TIR-domain-containing adapter-inducing interferon-β
TSLP: Thymic stromal lymphopoietin
VSV-G: Vesicular stomatitis virus glycoprotein
WASP: Neural Wiskott Aldrich syndrome protein
WAVE: WASP-like verproline-homologous protein

Chapter 1: Background

1.1 Airway Epithelial Cells

1.1.1 Epithelial cells as a protective barrier in the lungs

Airway epithelial cells (AECs) are cells that line the respiratory tract enabling airflow to and from the alveoli and providing a *physical defense* barrier against substances in the inhaled air entering the lung ecosystem [Gohy et al., 2016]. In addition, the release of substances, such as mucins, lysozymes, defensins amongst others that have antimicrobial properties, by the AEC barrier underscores its role as a *chemical barrier*. AECs can orchestrate host innate and adaptive immune responses and initiate inflammatory cascades. Through programming downstream immune responses in the lungs, it has become clear that AECs also comprise an *immunological barrier*. This process is mediated through the release of pro-inflammatory cytokines and chemokines from AECs that recruit and activate immune cells in response to different stimuli (**Figure 1.1**). Crosstalk between epithelial cells and downstream immune cells ensures a homeostatic lung environment characterized by an ability to tolerate innocuous substances and to mount a protective response against harmful or pathogenic substances. Since crosstalk between AECs and immune cells may be facilitated through cytokine signalling, dysfunctional production and release of cytokines is implicated in lung diseases such as asthma, chronic obstructive pulmonary disease (COPD) and an aberrant immune response to allergic challenges.

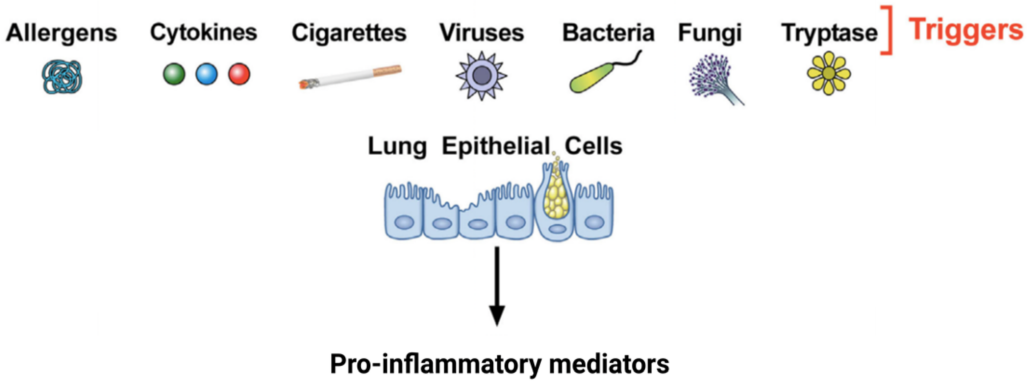

Figure 1.1: Release of pro-inflammatory mediators from epithelial cells in response to inflammatory, toxic and pathogenic triggers in inhaled air. Adapted from Varricchi et al. 2018 [Varricchi et al., 2018]

1.1.2 Epithelial cell receptors

AECs act as signal transducers that couple exposure to allergic, infectious or toxic stimuli to downstream immune response cascades. AECs are known to express a variety of cell surface receptors that confer recognition to the wide array of antigens entering the lungs. Engagement of these receptors with their corresponding antigens activates gene expression and results in the production and release of pro-inflammatory mediators. Although a wide variety of receptors are expressed on epithelial cells that engage in downstream inflammatory signalling, here we will focus on key receptors that are particularly activated by the inflammatory stimuli used in our research. These receptors include the tumor necrosis factor receptors (TNFR), Toll-like receptors (TLR), protease-activated receptors (PAR) and other G-protein coupled receptors (GPCR) [Nhu et al., 2010].

In airway epithelial cells, multiple recognition mechanisms against the variable, and potentially pathogenic, substances in inhaled air exist. One of the key receptor families through which foreign components, particularly of microbial origin, can be detected are the Toll-Like Receptors (TLRs). TLRs are a form of pattern-recognition receptors (PRRs) which provide a rapid response against evolutionarily conserved antigens known as Pathogen-Associated Molecular Patterns or PAMPs [reviewed in Akira et al., 2006]. TLRs are strategically expressed in lung epithelial cells either as cell surface receptors or intracellularly in endosomes and lysosomes, conferring recognition of microbes in the extracellular space or engulfed microbes respectively [Kato & Schleimer, 2007; Kawai & Akira, 2010; Lee & Barton, 2014]. Upon exposure to bacterial or viral stimuli, TLR signalling results in the activation of pro-inflammatory transcription factors such as NF-κB and interferon (IFN) regulatory factors (IRFs) [Benedikz et al., 2019; Groskreutz et al., 2006; Kawai & Akira, 2010]. Studies that employed the administration of TLR2 agonists to BEAS-2B cells, a human bronchial epithelial cell line, showed increased TLR2 activity and TSLP production suggesting that the production of TSLP is TLR2 dependent [Lv et al., 2018]. We used the TLR3 stimulus, polyinosinic:polycytidylic acid (polyI:C), a viral mimetic, in our project to induce cytokine gene expression. Poly I:C is a double-stranded RNA that resembles RNA particles produced during the replication of viruses in host cells, thereby it is capable of inducing an antiviral immune response including the production of interferon (IFN)-α and -β and the pro-inflammatory cytokines IL-6 and TNF-α [Fortier et al., 2004]. Another pro-inflammatory stimulus, lipopolysaccharide (LPS) from gram-negative bacteria, is also recognized via a TLR receptor, TLR4 [Kurt-Jones et al., 2000; Lu et al., 2008]. Other cytoplasmic pathogen recognition receptors also exist in AECs, such as retinoic acid-inducible gene (RIG-I), melanoma differentiation-

associated gene 5 (MDA5), and nucleotide-binding oligomerization domain (NOD), further highlighting the plasticity within epithelial cell sensing mechanisms that allow them to effectively detect and respond to variable pathogenic antigens in the lung environment.

PAR-2 receptors are another type of AECs receptor implicated in allergen recognition. PAR-2 receptors are G-protein coupled receptors that confer recognition to different protease allergens. For example, PAR-2 is activated by proteases in cockroach extract, which is commonly used to mimic the household allergy to cockroaches in lung inflammation and allergic experimental models [Kim et al., 2012; Kondo et al., 2004; Lee et al., 2010; Pomés et al., 2012]. Specifically, serine proteases that are present in cockroach extract cleave the N-terminal exodomain of the PAR-2 receptor thus activating the respective signalling cascade that leads to inflammation [Déry et al., 1998]. However, cockroach extract is also reported to induce downstream inflammatory signalling through other receptors such as TLR2 and TLR8 [Gao, 2012]. Interestingly, cooperative synergies have been shown to exist between PAR-2 and TLRs as agonists of TLR2, TLR3 or TLR4 augment IL-8 transcription resulting from PAR-2 receptor activation [Nhu et al., 2010].

The engagement of cytokine receptors themselves on epithelial cells can result in additional cytokine release cascades that further modulate the immune environment. In particular, TNF-α, one of the most prominent and pleiotropic pro-inflammatory cytokines, upon binding to its receptors, TNFR1 or TNFR2, activates inflammatory phenotypes in the airways including increased cytokine release, expression of adhesion molecules, recruitment and activation of immune cells amongst others [Brightling et al., 2008]. This will be discussed in greater details in upcoming sections.

1.2 Cytokines and Chemokines in Lung Inflammation

1.2.1 Overview of cytokines and chemokines

Cytokines are soluble secreted or membrane-bound proteins that are produced by a cell to act on a target cell [Leonard & Lin, 2023]. Target cells may be the same cell that produced the cytokine (autocrine signaling), a neighbouring cell (paracrine signaling) or a distant cell (endocrine signaling) [Zhang & An, 2007]. Cytokines exert a range of biological functions such as proliferation, differentiation, growth and even cell death [Chang et al., 2012; Y. J. Liu et al., 2007; Olman et al., 2004; C. Y. Wang et al., 1996; Y. M. Zhu et al., 2004]. Functional cytokine-induced signaling entails the processes of cytokine production and release by cells and cytokine receptor expression and engagement on target cells [Leonard & Lin, 2023]. We focus on the regulation of cytokine production and release in this review as it is a core process in our hypotheses and experimental plan.

The term ‘cytokines’ encompasses multiple categories of molecules with immunological implications; these groups include interleukins, interferons, chemokines, colony-stimulating factors, and growth factors [Leonard & Lin, 2023]. Chemokines, which are chemotactic cytokines, are further classified into four groups based on the architecture of their cysteine residues [Bikfalvi & Billottet, 2020]. These four groups are CXC, CC, C and CXXXC chemokines. The CXC subfamily includes CXCL8 (or IL-8), a potent attractant of neutrophils [Cambier et al., 2023; Cesta et al., 2022; Hammond et al., 1995; Lin et al., 2004; Zhang & An, 2007] and a pro-inflammatory cytokine that is prominently implicated in lung injury, asthma and COPD [Cambier et al., 2023; Ordoñez et al., 2000; Richman-Eisenstat et al., 1993; Yokoi et al., 1997; Zhang et al., 2011]. For these reasons, IL-8 was the cytokine extensively examined in our project. Another important chemokine extensively investigated is Monocyte Chemoattractant Protein- 1 (MCP-1), also known as CCL2, that belongs to the CC family [Deshmane et al., 2009]. This chemokine is a chemoattractant of monocytes, as the name suggests, and is also a chemokine that is upregulated in mouse models of asthma and in the bronchioalveolar lavage from asthmatic patients [Lee et al., 2015]. Lastly, we also focused on the three key pro-inflammatory cytokines IL-1β, IL-6 and TNF-α [Moradian et al., 2021]. TNF-α was used as a pro-inflammatory stimulus to induce cellular inflammation. It is important to note that our initial investigation of secreted cytokines, and those perturbed by our experimental manipulations, involved a large panel of cytokines that then became focused on a particular sub-group of cytokines that displayed intriguing trends in expression, trafficking and secretion.

Cytokine production and secretion are tightly regulated processes that result in a specific spatiotemporal cytokine profile to be released into the extracellular milieu [Stanley & Lacy, 2010]. While most cytokines are secreted by constitutive vesicular transport, some require additional processes for release. For instance, the IL-1β cytokine requires activation of a particular cytosolic protein complex, called the inflammasome, for its maturation and secretion [Giuliani et al., 2017]. Inflammasomes are activated in response to a variety of inflammatory and stress stimuli such as the presence of Pathogen Associated Molecular Patterns (PAMPs), Damage Associated Molecular Patterns (DAMPs), toxins or even extracellular ATP derived from dying cells and result in the activation of caspase-1 that cleaves the IL-1β precursor into its mature form. Other regulatory mechanisms of cytokine release include constitutive versus regulated secretion, which ultimately depends on the cell type [Lacy & Stow, 2011]. Regulated secretion involves the release of cytokines in stored granules by certain innate immune cells, known as granulocytes, facilitating rapid release in response to various stimuli.

Some redundancy exists in cytokine signaling as multiple cytokines can trigger similar or identical effects [Leonard & Lin, 2023]. Cytokines are also pleiotropic which means that a single cytokine can induce multiple effects and target multiple cell types. Since chemokines are a subgroup of cytokines, the term cytokines will be used to refer to both cytokines and chemokines throughout this review and in upcoming chapters. Alternatively, they are also referred to as pro-inflammatory mediators. Although many cells release cytokines contributing to airway inflammation such as lymphocytes, basophils, eosinophils, and mast cells, our primary focus will be on epithelial cells as we investigate their role as ‘immune’ cells that provide direct defense mechanisms and activate pro-inflammatory cascades.

1.2.2 Epithelial cell-derived cytokines and chemokines in infection

Epithelial cells can release substances with antimicrobial properties that directly protect against and eliminate pathogens in the airways. These include lysozymes which target proteoglycan on bacterial surface, lactoferrin which chelate iron preventing bacteria from accessing it, and defensins which result in cell wall lysis [Davis & Wypych, 2021]. Alternatively, and more relevant in our context, epithelial cells can also contribute to the clearance of pathogens through priming downstream immune cells resulting in the mounting of a host immune response.

The human immune system is comprised of two arms: innate and adaptive immunity. Innate immunity is mediated through the action of Pathogen Recognition Receptors (PRRs), such as TLRs [Gopallawa et al., 2023; Kato & Schleimer, 2007]. On the other hand, adaptive immunity is a secondary, highly robust response that involves T and B lymphocytes and is characterized by immunological memory against the pathogen involved. Through transducing recognition signals into pro-inflammatory cytokine release, epithelial cells act at the forefront during infections, capable of initiating both innate and adaptive immune responses. This can be observed in the role AECs play in response to viral infections, for instance: innate activation of TLR3 by a synthetic viral dsRNA (polyI:C) results in the release of pro-inflammatory cytokines IL-8, IL-6, RANTES and antiviral interferon- β (IFN-β), a secretion profile that promotes leukocyte infiltration and an antiviral response [Guillot et al., 2005]. Similarly, the recognition of Influenza A virus-derived dsRNA by the RIG-I cytosolic receptor, results in antiviral type I IFNs production [Le Goffic et al., 2007]. Interestingly, activation of ACE2 receptors by SARS-CoV-2 results in CCL20, CXCL1, CXCL2, CXCL3, CXCL5, CXCL6, CXCL16, IL-1β, IL-6, IL-8 and TNF-α release but does not result in significant release of interferons (IFNs) [Blanco-Melo et al., 2020]. The skewed cytokine profile towards pro-inflammatory mediators and neutrophil chemoattractants (IL-8), concomitant with decreased IFNs production, explains the signature phenotype observed in COVID-19 patients characterized by a state of elevated systemic inflammation. This inflammatory state, known as a cytokine storm, is conducive for multi-organ failure, acute lung injury and even death associated with COVID-19 infection [Mustafa et al., 2020].

Bacterial infections also involve cytokine and chemokine release by epithelial cell such as the release of IL-8, GM-CSF or G-CSF in response to *Pseudomonas aeruginosa*, *Staphylococcus aureus* or other bacterial infections which ultimately recruits and activates phagocytic cells [Gómez & Prince, 2008]. In fact, neutralizing chemokine activity in in vivo models of pneumonia reduced infiltration of neutrophils and prevented efficient clearance of pathogens from the lungs and increased mortality [Gómez & Prince, 2008; Tsai et al., 2000]. Interestingly, the surface protein of *Staphylococcus aureus*, Protein A, can engage the TNF-α receptor (TNFR1) causing IL-8 release and excessive immune cell infiltration contributing to the morbidity of the pneumonia [Gómez et al., 2004; Gómez & Prince, 2008]. Epithelial cells have also been shown to release cytokines in response to fungal infections; for instance, the secretion of CXCL1 in *Aspergillus fumigatus* infection which allows for clearing the infection via neutrophil recruitment [Jhingran et al., 2015]. Therefore, it appears that the cytokine profile secreted by AECs in response to a

particular pathogen (or downstream of a particular receptor) dictates the nature of the immune response, and ultimately, success at clearing a pathogen.

Cytokine release from epithelial cells may also activate the adaptive arm of the immune system through activation of dendritic cells (DCs) [Hammad & Lambrecht, 2011]. Epithelial cells are known to activate DCs through the secretion of thymic stromal lymphopoietin (TSLP) cytokine [Soumelis et al., 2002]. In addition, other cytokines such as GM-CSF, IL-1β, IL-25 and IL-33, are also implicated in the activation of DCs by airway epithelial cells [Besnard et al., 2011; Claudio et al., 2015; Stämpfli et al., 1998; Wesa & Galy, 2002]. These activated dendritic cells may then mediate clearance of an infection through a variety of functions including activation of naïve T cells and further production of cytokines and chemokines [T. S. Kim & Braciale, 2009; Nizzoli et al., 2013; Piqueras et al., 2006]. In addition to the DC-mediated activation of T cells by airway epithelial cells, they may also release CXCL9 and CXCL10 that directly recruit T-helper 1 (Th1) cells [Fenwick et al., 2015; Spurrell et al., 2005] or CCL1 and CCL17 that recruit Th2 cells [Kato & Schleimer, 2007b; Montes-Vizuet et al., 2006; Terada et al., 2001]. Similarly, epithelial cells can recruit or activate B cells through the release of CCL28 [Lazarus et al., 2003], B cell-activating factor of TNF family (BAFF) [Kato et al., 2006], or IL-6 [Koch et al., 2013].

Epithelial cells can also directly engage immune cells via cell-cell contact. For instance, CD200 ligand on AECs engages the CD200R on alveolar macrophages which results in regulatory inhibitory signalling preventing excessive inflammation during infection [Davis & Wypych, 2021; Snelgrove et al., 2008]. Consistent with this, cytokines are also required for the resolution of inflammation and lung recovery following an injury. For instance, IL-33 produced by epithelial cells signals innate lymphoid cells (ILCs) to produce amphiregulin, an epidermal growth factor family member, which allows for airway repair following an influenza infection [Monticelli et al., 2011; Zepp & Morrisey, 2019]. This highlights the importance of cytokine signalling not only in instigating host immune defense mechanisms but also in the return to homeostatic conditions following pathogenic challenges.

1.2.3 Epithelial cell-derived cytokines and chemokines in asthma and COPD pathogenesis

Recent estimates on asthma and COPD report that there are over 260 million prevalent cases of asthma globally and over 210 million of COPD [Momtazmanesh et al., 2023]. While a multitude of airway epithelium-related abnormalities occur in asthma and COPD including defects in

mucociliary clearance, shortened cilia on ciliated cells as well as increased mucus production from epithelial cells, our focus here will be on aberrant cytokine signaling, production and release, and the potential implications in asthmatic and COPD-affected airways [J. D. Davis & Wypych, 2021]. Although crucial in priming the immune landscape in the lungs to facilitate the mounting of a host defense response during pathogenic challenges, epithelial cell-derived cytokines may rather mediate destructive effects in asthma and COPD. Because of this, multiple treatment approaches have targeted cytokines, such as TSLP, IL-5, and IL-13, in the airway conferring blockades in cytokine-cytokine receptor interactions [Barnes, 2018; Malaviya et al., 2017].

Inflammation in asthma is characterized by excessive release of TSLP, IL-25 and IL-33 cytokines from epithelial cells that directs helper T cell differentiation into a Th2 phenotype [Al-Shami et al., 2005; An et al., 2020]. Epithelial cell-derived TSLP upregulates OX40 ligand (known as OX40L) which acts as a co-stimulatory molecule that allows the differentiation of naïve $CD4^+$ T cells into pro-inflammatory T-helper 2 (Th2) cell type [Hammad & Lambrecht, 2008; Ito et al., 2005]. TSLP, along with IL-25 and IL-33, may also facilitate activation of downstream naive T cells into Th2 cells by activating other immune cells such as type 2 innate lymphoid cells (ILC-2), eosinophils and basophils [Lambrecht et al., 2019]. Consistent with this, TSLP was found to be over expressed in the airways of asthmatic patients and correlated with airway obstruction and disease severity [Ying et al., 2005]. Cytokines released from activated Th2 cells, such as IL-4, IL-5, IL-9 and IL-13, may also mediate Th2-driven pathogenesis in asthma through exacerbation of eosinophilic inflammation, airway hyperresponsiveness, as well as lung fibrosis [Barnes, 2001; Wynn, 2004]. The IL-8 cytokine, in particular, is strongly associated with asthmatic pathogenesis as elevated levels of IL-8 are detected in the sputum of severe asthmatics which correlates with elevated neutrophil sputum levels, a result of IL-8-mediated neutrophil recruitment [Jatakanon et al., 1999]. In addition, studies by Schuh et al. [Schuh et al., 2002] showed that the knockout of the IL-8 receptor, CXCR2, in mice conferred protection against development of key features of chronic asthma in response to allergic challenge. More specifically, CXCR2-deficient mice showed a decreased Th2 inflammatory response, reduced recruitment of eosinophils and T cells, and an increase in Th1 cytokine and chemokine levels following a fungal challenge. On the other hand, transgenic mice expressing high levels of human IL-8 (hIL-8) displayed detrimental lung remodelling characterized by increased airway inflammation, mucus hypersecretion as well as lung fibrosis [Reynolds et al., 2018]. In addition, the hIL-8 transgenic mice also showed reduced lung function as a result of increased airway resistance and reduced lung compliance while also exhibiting disruptions to the epithelial tight-junction integrity.

Alternatively to the predominance of a Th2 immune profile, asthma may be characterized by a predominant activation of naïve helper T cells into a Th17 phenotype [Lambrecht & Hammad, 2014; Luo et al., 2022]. This type of asthma is also initiated by the release of cytokines, namely IL-6 and TGF-β, from epithelial cells [Kimura et al., 2007; Lambrecht & Hammad, 2014]. The resulting Th17 T cells induce airway remodelling and increase neutrophil accumulation via their release of IL-17. Similarly, epithelial cells also play a fundamental role in eliciting allergic inflammation. For instance, epithelial cells have been shown to upregulate the pro-inflammatory cytokine IL-8 in response to sensitization by cockroach extract allergen [Bhat et al., 2003] and the Th2-promoting cytokines TSLP, IL25 and IL-33 along with GM-CSF in response to sensitization by another household allergen, house dust mite (HDM) allergen [Hammad et al., 2009]. Furthermore, it was also reported that release of the chemokine MCP-1 from epithelial cells is upregulated in response to allergen challenge and contributes to Th2 immunity that underlies pathogenesis in allergic asthma [Lee et al., 2015; Lloyd, 2002].

COPD differs from asthma in terms of displaying neutrophilic inflammation, unlike the predominance of eosinophils in asthma, and in the contributions of cigarette smoke to its pathogenesis [Barnes et al., 2003]. Despite these differences, COPD also presents as another disease state in which AECs induce inflammation that contributes to the progression of the disease. COPD is dependent on an integral role of epithelial cells secreting TNF-α, GM-CSF, IL-8 and IL-1β which are key mediators of downstream inflammation [Barnes et al., 2003; Hellermann et al., 2002; Vitenberga et al., 2019]. Epithelial-derived TGF-β in small airways may also result in local fibrosis [Barnes et al., 2003; Ihn, 2002]. Cigarette smoke, the main causative agent of COPD, was shown to upregulate IL-1β cytokine in bronchial epithelial cells from patients with COPD [J. D. Davis & Wypych, 2021; Rusznak et al., 2012]. This shows an underlying susceptibility to cigarette smoke in COPD epithelial cells characterized by aberrant cytokine regulation.

1.2.4 Cytokine signaling pathways

We have outlined the implications of cytokine and chemokine release from epithelial cells in shaping the immune landscape in the lungs during infections as well as chronic inflammation associated with asthma and COPD. In this section, we review the intracellular signalling mechanisms that couple receptor engagement to cytokine and chemokine gene expression in

airway epithelial cells. Additionally, we also review the signalling pathways activated when certain cytokines themselves bind their receptors.

Activation of different TLRs by their respective stimuli results in a number of key conserved inflammatory pathways becoming activated which ultimately results in cytokine gene expression [Kawai & Akira, 2006]. These pathways act through nuclear factor kappa B (NF-κB) and activator protein (AP-1) transcriptional regulators. NF-κB is sequestered by Inhibitor of NF-κB (IκB) protein in the cytosol under resting conditions. Pro-inflammatory signalling, such as through TLRs, results in the phosphorylation, ubiquitination and degradation of IκBs allowing the functional p65/RelA subunit to translocate to the nucleus where it can modulate gene expression. On the other hand, TLR activation of AP-1 occurs through activation of MAP kinases (MAPKs) such as c-Jun N-terminal kinase (JNK), p38, or extracellular signal-regulated kinase (ERK). Because activation of NF-κB and AP-1 pathways involve proximal signaling downstream of TLRs to the adaptor proteins myeloid differentiation primary response protein 88 (MyD88) or TIR domain-containing adapter inducing IFNβ (Trif), these modes of activation are considered to be MyD88-dependent or Trif-dependent, respectively. In addition to TLRs, GPCRs such as PAR-2 also signal through MAPK and Phosphatidylinositol 3 (PI3K) signalling pathways [Mehta et al., 2020; Rothmeier & Ruf, 2012].

Following their secretion into the extracellular milieu, cytokines engage with their receptors eliciting inflammatory responses which can result in the further release of cytokines, highlighting the positive feedback mechanisms that govern cytokine activation cascades in the lungs. As mentioned previously, TNF-α induces its pro-inflammatory signalling cascades through binding to either of its two receptors; TNFR1, which is ubiquitously expressed, or TNFR2

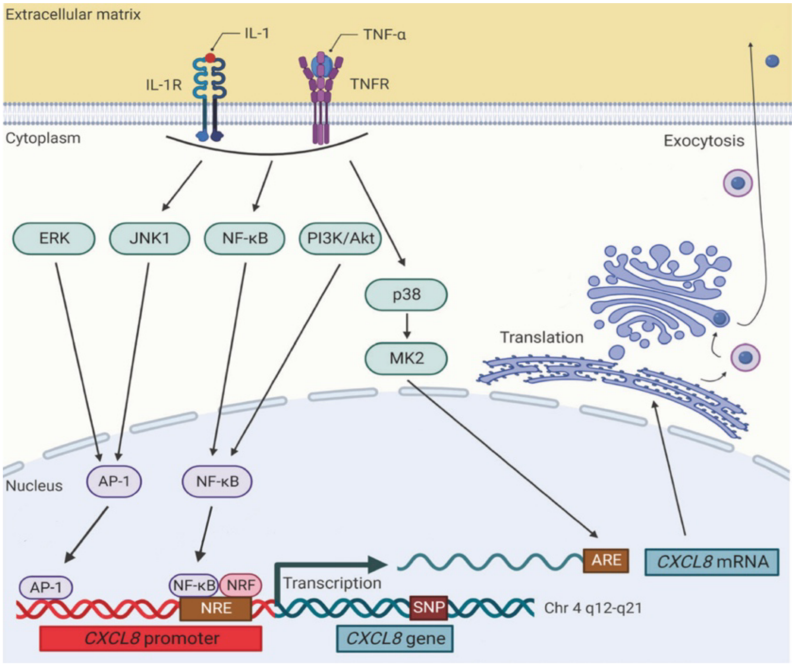

Figure 1.2: Mechanisms of IL-8 production downstream of inflammatory stimuli and associated signalling pathways. Adapted from Cambier et al. 2023 [Cambier et al., 2023].

which is specifically expressed in certain immune cells, nerve cells and endothelial cells [Aggarwal et al., 2012]. Since our focus here is AEC inflammatory signalling, we will focus on TNFR1. Although TNF-α was first discovered for its ability to cause regression of sarcomas in mice, hence the label 'tumor necrosis', the primary signalling complex formed downstream of TNFR1, known as Complex I, mediates gene activation rather than apoptosis or necroptosis [Aggarwal et al., 2012; Annibaldi & Walczak, 2020; Bradley, 2008; Carswell et al., 1975]. Upon binding to TNFR1, the receptor trimerizes followed by the recruitment of TNFR1-associated death domain protein (TRADD), receptor-interaction protein kinase 1 (RIPK1), TNFR-associated factors (TRAFs), the cellular inhibitors of apoptosis (cIAPs) and ultimately NF-κB activation which triggers survival signals and cytokine expression [Annibaldi & Walczak, 2020]. TNFR1 signalling can alternatively mediate apoptosis under certain conditions based on checkpoints that trigger the formation of the death-inducing Complex II [Ting & Bertrand, 2016]. These checkpoints are quite complex but, in brief, involve regulation of caspase-8 activation either through a decrease in cFLIP levels or via a RIPK1-dependent mechanism, ultimately triggering apoptosis. It is generally accepted that low concentrations of TNF-α tip the resulting signalling pathway towards gene activation rather than apoptosis [Rangamani & Sirovich, 2007; Wajant et al., 2003]. Our goal was to use TNF-α as a pro-inflammatory stimulus that results in further cytokine gene expression and release. Therefore, we used TNF-α at relatively low concentrations (10 ng/mL) which is known to activate the survival pathway and gene activation [Lee et al., 2016; Zhang et al., 2017]. NF-κB can also be activated downstream of TNF-α receptors through the PI3K/Akt pathway [Cambier et al., 2023]. Another key signalling pathway activated by cytokines is the Janus Kinase (JAK)-Signal Transducer and activator of Transcription (STAT) pathway. The JAK-STAT pathway involves the nuclear import of STAT transcription factors which mediates transcription of target genes, including those involved in negative feedback regulation of cytokine signalling [Leonard & Lin, 2023; Loh et al., 2019; Morris et al., 2018]. Expression of a single cytokine may involve the convergence of more than one of these signaling pathways. **Figure 1.2** is a simplified diagram illustrating the different signalling pathways involved in the transcription of the CXCL8 gene encoding the IL-8 cytokine [Cambier et al., 2023].

1.2.5 Cytokine trafficking and release mechanisms

In order to maintain homeostasis of cellular architecture, organelle identity, as well as a functional secretory system, proteins made in the cell must be transported between cellular compartments in a regulated, selective and efficient manner [Watson & Stephens, 2005]. Transport mechanisms of cargo between cellular compartments may be through direct contact between organelles, such

as the endoplasmic reticulum (ER) and the nuclear envelope which are continuous with one another, or through transport between organelles through tubular and/or vesicular transport, such as between the ER and Golgi [Schwarz & Blower, 2016; P. Watson & Stephens, 2005]. Vesicles within the secretory system may be coated by COPI, COPII or clathrin coats, which facilitate transport between specific compartments within the cell [Kirchhausen, 2000]. COPI-coated vesicles are primarily implicated in transport between Golgi cisternae and in retrograde transport from the Golgi to the ER [Kirchhausen, 2000; Waters et al., 1991]. COPII vesicles shuttle anterograde cargo from ER to the Golgi [Barlowe et al., 1994; Kirchhausen, 2000]. Clathrin coated vesicles are involved in shuttling cargo between endosomes and the plasma membrane or the Golgi. For our scope, we focus on transport mechanisms that allow for cytokine release from cells. We particularly focus on intra-Golgi transport as well as ER to Golgi transport and the dysfunctional regulation of these processes that may compromise normal cytokine trafficking and ultimately secretion from cells.

In order to gain entry into the secretory system, proteins require the presence of a signal peptide that directs nascent polypeptides to the ER for translocation [Nickel & Rabouille, 2008]. Once proteins are translocated into the ER, they traffic along the ER-Golgi pathway for further modifications and ultimate transport to the plasma membrane or other designated organelles. Since secretory proteins need to be targeted to the plasma membrane so that they can reach the extracellular space, most contain signal peptides that facilitates their entry to the ER-Golgi pathway. Most cytokines, including IL-8, IL-6, and TNF-α, possess a signal peptide that facilitates entry to the ER and secretion via the ER-Golgi complex [Cambier et al., 2023; Kwak et al., 2016; Phulphagar et al., 2021; Rose-John et al., 1993; Stanley & Lacy, 2010]. This secretory route is known as

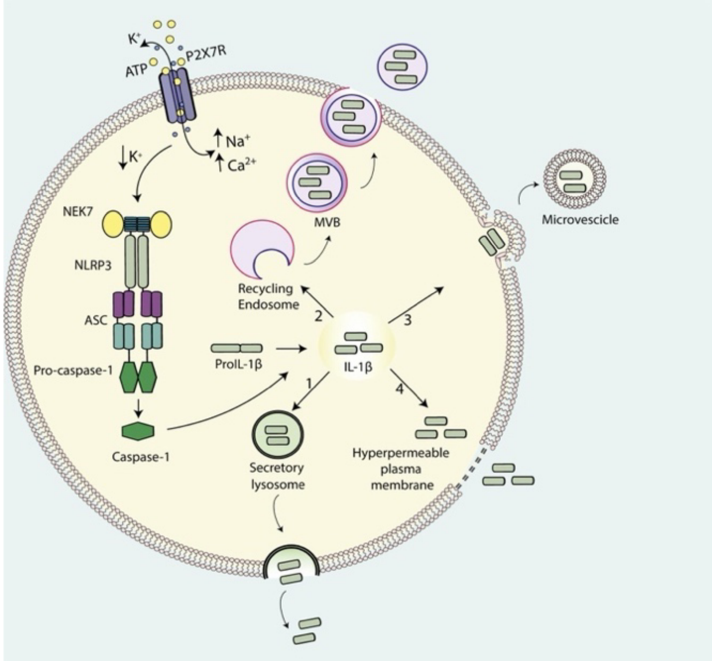

Figure 1.3: Mechanisms of IL-1β release from cells in response to inflammatory stimuli. From Giuliani et al. 2017 [Giuliani et al., 2017]

classical secretion. However, some secretory proteins leave the cell through ER- and Golgi-independent mechanisms through what is known as unconventional secretion [Nickel & Rabouille, 2008]. Unconventional secretion is the trafficking mechanism by which cytosolic proteins, nuclear proteins and even some signal peptide-containing proteins reach the plasma membrane for secretion. Amongst these proteins is the cytokine IL-1β, which lacks a signal peptide and therefore does not enter nor traffic through ER-Golgi machinery [Giuliani et al., 2017]. Instead, IL-1β is directly secreted from the cytosol in response to certain inflammatory stimuli through a variety of mechanisms (**Figure 1.3**). Briefly, following translation on free ribosomes, the precursor pro-IL-1β shuttles to the plasma membrane in lysosomes that also contain caspase-1 facilitating the conversion into mature IL-1β and its ultimate secretion **(Figure 1.3**, mechanism #1**)**. Mature IL-1β can also be released in exosomes from multivesicular bodies (MVBs) which are endosomes that have internalized vesicles (**Figure 1.3**, mechanism #2). Alternatively, mature IL-1β can be released in microvesicles derived from the plasma membrane (**Figure 1.3**, mechanism #3), or during pyroptotic cell death in which the plasma membrane becomes increasingly permeable allowing the passive efflux of IL-1β (**Figure 1.3,** mechanism #4).

Since IL-1β secretion is not affected by ER-Golgi complex blockades [Giuliani et al., 2017; Rubartelli et al., 1990], we used IL-1β as a control cytokine in many of our investigations on cytokine trafficking through the ER-Golgi pathway. If our manipulations (such as Cdc42 inhibition) affect cytokine secretion by specifically perturbing trafficking within the ER-Golgi complex, then cytokines that traffic through that system should be disrupted, whereas IL-1β which utilizes alternative routes, should remain unaffected.

Secretion of cytokines may either be through constitutive or regulated secretion. Constitutive secretion refers to the continuous efflux of secretory vesicles to the plasma membrane for secretion into the extracellular space and is the default exocytosis mechanism that occurs in most cells [Viotti, 2016]. On the other hand, in regulated secretion, secretory vesicles or granules require additional signals for release and this process is typically employed by specialized secretory cells such as endocrine cells and neurons. Constitutive secretion is considered to be the secretory mechanism of cytokine release in lung epithelial cells [Stadnyk, 1994; Stanley & Lacy, 2010]. In our model of inflammation, we employed pro-inflammatory stimuli to induce cytokine gene expression and to increase the basal rate of cytokine release from cells. This

allowed for better detection of reductions or enhancements to cytokine release in response to experimental manipulations.

1.3 Rho GTPase Proteins

1.3.1 Overview of the Rho family of GTPase proteins

Rho proteins are small monomeric GTPases that belong to the Ras superfamily. They act as molecular switches within the cell, and are known to be involved in the active processes of cytoskeletal remodelling, vesicle trafficking, signal transduction and even cell cycle regulation [Chi et al., 2013]. In humans, the Rho family is comprised of 20 members [Hodge & Ridley, 2016; Pichaud et al., 2019], of which RhoA, Rac1, and Cdc42 are the most extensively studied members [Wennerberg & Der, 2004]. Consistent with their categorization within small G proteins, Rho GTPases are typically small in size (190 to 250 amino acid residues) [Wennerberg & Der, 2004]. Rho proteins establish their subcellular localization via C-terminal prenylation along with other C-terminal modifications such as palmitoylation [Hodge & Ridley, 2016; Wennerberg & Der, 2004].

Multiple studies have pointed towards the involvement of Rho proteins in the pathogenesis of asthma and inflammatory signalling in general. One study by André-Grégoire et al. [André-Grégoire et al., 2018] reported the involvement of Rac1 in the smooth muscle cells contraction that contributes to the characteristic bronchoconstriction observed in asthmatic patients. Rac1 inhibition either pharmacologically or via an airway smooth muscle cell (SMC)-specific knockdown resulted in reduced contraction in both murine models and human bronchial cells. The study also reported lower levels of house dust mite extract-induced inflammation in lung sections of mice that were given inhalations of a Rac1 inhibitor, suggesting a potential role for Rac1 in the progression and manifestation of inflammation in the lungs. Rho proteins are also reported to be involved in signalling pathways that results in downstream gene expression via the NF-κB pathway. Zhao et al. [Zhao et al., 2003] reported that RhoA, Cdc42 and Rac1 proteins are activated in response to neurotensin (NT) stimulation in colonic epithelial cells and are essential for IL-8 gene expression via NF-κB activation. In addition, Puls et al. [Puls et al., 1999] reported that TNF-α stimulation results in Cdc42 activation and subsequent Cdc42-mediated filopodia formation in Swiss-3T3 cells.

1.3.2 Regulation of Rho GTPase proteins

Rho proteins exist within cells in either the active GTP-bound form or the inactive GDP-bound form. Cycling between both forms is modulated by three key regulators: guanine nucleotide exchange factors (GEFs), GTPase activating proteins (GAPs), as well as guanine nucleotide dissociation inhibitors (GDIs) **(Figure 1.4)** [Mackay & Hall, 1998]. GEFs activate Rho proteins by facilitating the binding of GTP, GAPs stimulate GTP hydrolysis resulting in inactivation of Rho proteins while GDIs stabilize Rho proteins in cytosol in an inactive form.

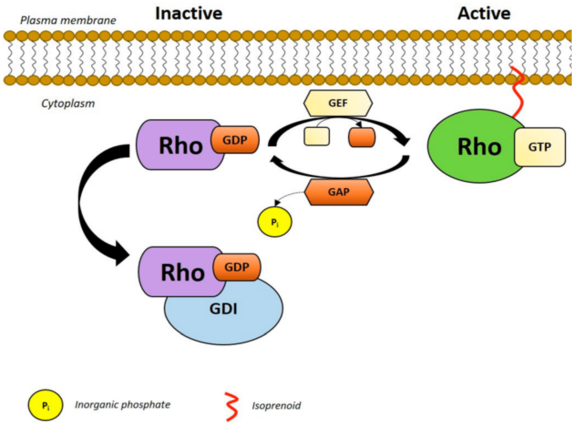

Figure 1.4: Regulation of Rho GTPase activity. Adapted from Pradhan et al. 2021 [Pradhan et al., 2021].

1.4 Cdc42, a Rho GTPase Protein Involved in Signaling and Golgi Transport

1.4.1 Cdc42 functions and effectors

Despite the involvement of RhoA and Rac1 in inflammatory signalling, Cdc42 is particularly well known to regulate multiple steps along the secretory pathway that are conducive to functional release of cargo **(Figure 1.5)** [Chi et al., 2013]. Importantly, Cdc42 is known to have a prominent Golgi pool [Farhan & Hsu, 2016]. However, the exact role of this pool, and whether it serves as a replenishment for the plasma membrane pool or has unique contributions to trafficking and homeostatic Golgi function remains unclear.

The relevance of Cdc42 to signaling pathways and trafficking mechanisms will be investigated in depth in upcoming sections. However, it is important to note that Cdc42 is also known to mediate other functions such as filopodia formation [Nobes & Hall, 1995], cell cycle [Fu et al., 2022; Olson et al., 1995] and cell polarity [Johnson, 1999].

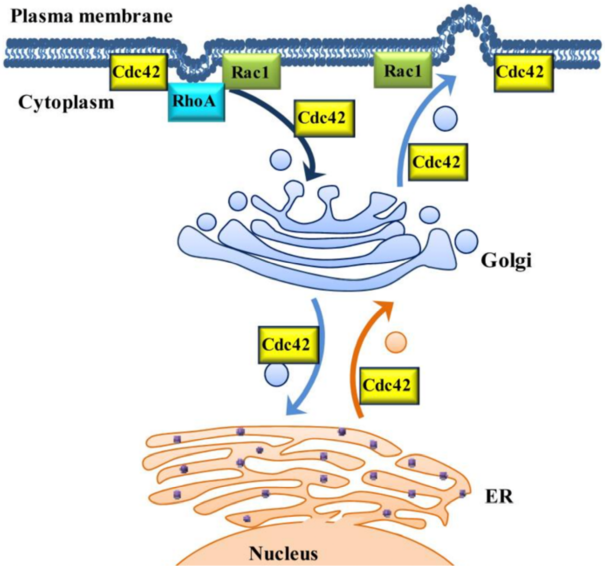

Figure 1.5: Roles of RhoA, Rac1, and Cdc42 GTPases in different trafficking processes in the cell [Chi et al., 2013]

Cdc42 is known to mediate its functions by interacting with at least 45 effectors through binding to their the Cdc42- and Rac-interactive binding motif (CRIB) domain [Burbelo et al., 1995; Pichaud et al., 2019], also known as p21-binding domain (PBD) [Umarao et al., 2022]. Cdc42 effectors regulate a wide repertoire of functions and include proteins involved in signaling pathways, kinases, and actin regulatory proteins such as Wiskott Aldrich syndrome protein (WASP), WASP-like verproline-homologous protein (WAVE), IQ motif-containing GTPase-activating proteins (IQGAP) amongst many others. N-WASP mediates many of the actin-dependent and actin-independent immune functions of Cdc42 as it is reported to be involved in the processes of cytokine release and secretion as well as cytokine signalling and gene expression, respectively [Lang et al., 2013; Prete et al., 2013; Rivers & Thrasher, 2017; Sakuma et al., 2015]. Another important effector of cytoskeleton dynamics, IQGAP, mediates the cross-linking of F-actin by active Cdc42 [Fukata et al., 1997] as well as the stabilization of the plus-ends of microtubules [Farhan & Hsu, 2016; Fukata et al., 2002].

1.4.2 Cdc42 subcellular localization

Cdc42 is known to localize to the plasma membrane, Golgi, ER, intracellular vesicles and the cytosol [Farhan & Hsu, 2016; Osmani et al., 2010]. Subcellular localization of Cdc42 is mediated by a specific type of posttranslational lipid modification: geranylgeranylation at the C-terminus of the protein [Wirth & Ponimaskin, 2023]. Consistent with this, it was discovered that pathogenic C-terminal variants of Cdc42 display alternative lipidations, and subsequently, aberrant subcellular localization [Coppola et al., 2022; Lam et al., 2019]. Interestingly, these mutants are associated with a range of clinical phenotypes centered on inflammatory abnormalities. Therefore, proper Cdc42 localization to its compartments, is essential for homeostatic signalling.

1.4.3 Cdc42 in inflammatory gene expression

Cytokine transcription may be activated downstream of a variety of signal transduction pathways and stimuli. Although previous studies have implicated Cdc42 in signal transduction functions for inflammatory pathways, the exact contributions of Cdc42 to pro-inflammatory gene expression has remained elusive. Cdc42 has been shown to be involved in cytokine gene expression from senescent cells as Cdc42 silencing attenuated senescence-induced MCP-1 expression [Ito et al., 2014]. This group also reported that expression of a dominant-negative Cdc42 mutant results in reduced NF-κB activity concomitant with reduced pro-inflammatory gene expression. However, these results are in contrast with findings that suggest that Cdc42 depletion with siRNA results in increased secretion of IL-8 and MCP-1 from human skin fibroblasts [Deroanne et al., 2005]. In

addition, while some studies have described Cdc42 as a positive regulator of NF-κB downstream of the inflammatory stimulus, TNF-α [Perona et al., 1997; Tong & Tergaonkar, 2014], other reports have suggested that TNF-α-triggered NF-κB translocation is not mediated by Cdc42 as it is not affected by Cdc42 suppression [Puls et al., 1999]. This group also reported that TNF-α-stimulated JNK activation is not dependent on Cdc42, whereas others have reported JNK activation downstream of IL-1 to be Cdc42-mediated, since dominant-negative Cdc42 mutants abrogate JNK activation [Bagrodia et al., 1995]. Furthermore, Cdc42 is also reported to activate PI3K signaling downstream of PAR-2 activation [Rothmeier & Ruf, 2012; P. Wang et al., 2007]. Therefore, although Cdc42 appears to be implicated in inflammatory signal transduction, its exact contributions to pro-inflammatory mediator expression, especially in airway epithelium requires further investigations.

1.4.4 Cdc42 in trafficking and secretion

Recent studies revealed that Cdc42 plays a pivotal role in trafficking through the secretory pathway through its interactions with coatomer, the core component of the COPI coat, originally discovered for its role in the transport of vesicles from the Golgi to the ER [Letourneur et al., 1994; Phuyal & Farhan, 2019]. Interestingly, Cdc42 interactions with coatomer promotes anterograde transport (and impedes retrograde transport) within the Golgi through two distinct mechanisms [Park et al., 2015]. Firstly, Cdc42 was shown to modulate cargo sorting into COPI tubules; this occurs as the dilysine motifs of Cdc42 compete with retrograde (but not anterograde) cargo for binding to coatomer. This preferential enhancement of anterograde transport over retrograde transport in Golgi tubules by Cdc42 is illustrated in **Figure 1.6**. In addition, Cdc42 promotes COPI tubule formation between Golgi cisternae (rather than vesicle formation) through favouring the initial budding of the COPI tubules and inhibiting subsequent fission that results in the formation of vesicles. It has been speculated that this allows Cdc42 to mediate a faster rate of anterograde transport compared to the basal cisternal maturation rate [Farhan & Hsu, 2016; Nakano & Luini, 2010; Park et al., 2015].

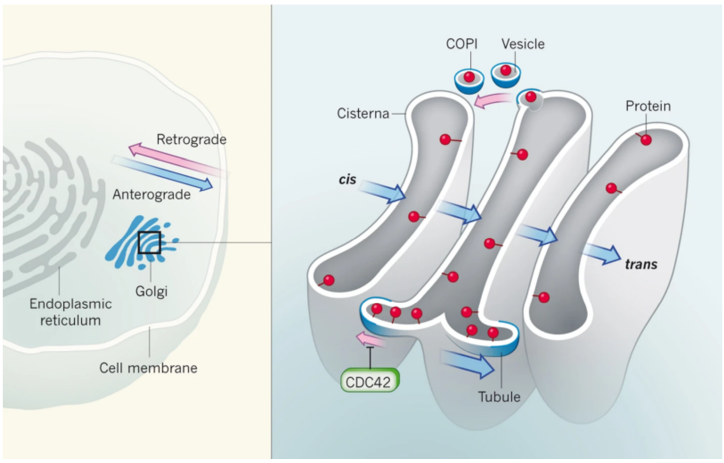

Figure 1.6: Cdc42 promotes transport in the anterograde direction but inhibits retrograde transport of cargo in Golgi tubules [Nakano, 2015].

The differential regulation by Cdc42 of the two arms of bidirectional transport is not only specific to intra-Golgi transport but also extends to transport between the ER and Golgi. For instance, it was shown that Cdc42 GTPase-defective (Cdc42Q61L) and nucleotide-exchange-defective (Cdc42T17N) mutants blocked transport of VSV-G protein, an anterograde cargo, from the ER to the Golgi in COS-7 cells, highlighting the requirement of Cdc42 for proper anterograde trafficking [Wu et al., 2000]. On the other hand, it was shown that expression of the active Cdc42 (Cdc42V12) mutant in HeLa cells delayed transport of KDEL receptor (a retrograde cargo) from the Golgi to the ER [Luna et al., 2002a]. This result suggests that the requirement of Cdc42 for a properly functioning ER-Golgi trafficking system is not only due to the integral role of Cdc42 in intra-Golgi trafficking dynamics, but also in ER-Golgi transport. In addition, this requirement for Cdc42 for proper trafficking also extends to post-Golgi trafficking as it was shown that expression of dominant-negative mutants or RNAi-knockdown of FGD1, an upstream GEF activator of Cdc42, resulted in disruption of VSV-G delivery from the Golgi to the plasma membrane [Egorov et al., 2009]. This group also showed that expression of inactive forms of Cdc42 also resulted in Golgi-plasma membrane transport disruptions, identifying Cdc42 as an important positive regulator in post-Golgi transport. These disruptions were reported to likely be a result of the impaired interactions of trans-Golgi network (TGN) export structures with cytoskeleton components that promote the formation of post-Golgi carriers [Egorov & Polishchuk, 2019; Egorov et al., 2009].

It also appears that Cdc42 is required in exocytosis through its regulation of the actin cytoskeleton. Previous research has demonstrated that constitutively active Cdc42 (Cdc42L61) stimulates exocytosis of growth hormone (GH) granules in PC12 cells through promoting actin filament formation at the cell periphery beneath the plasma membrane [Gasman et al., 2004]. This was concluded since expression of the constitutively active form of Cdc42 or overexpression of its effector, N-WASP, resulted in increased secretion, whereas overexpression of an N-WASP mutant defective in actin polymerization did not. Thus, the positive stimulation of GH granule secretion by Cdc42 is mediated through N-WASP, which is recruited at the plasma membrane by Cdc42 where it promotes F-actin polymerization. Additional studies revealed that Cdc42 activation at the cell periphery is regulated upstream by the GEF intersectin-1L, which activates Cdc42 in response to secretagogue-stimulation thereby promoting exocytosis of GH [Malacombe et al., 2006]. In addition, Cdc42 has also been shown to be required for the secretion of the cytokines MCP-1 from PNMECs (pulmonary neuroendocrine cells) [Langert et al., 2014] and IFN-

γ from T-cells at the immunological synapse (IS) through mediating actin depolymerization [Chemin et al., 2012]. The role of Cdc42 at the IS was further validated by results showing lowered secretion levels in response to Cdc42 siRNA transfection, which could be rescued through mild actin depolymerization by treatment with latrunculin B.

In addition to being required in the dynamic process of transport between or within the organelles involved in trafficking, Cdc42 appears to also be essential for the proper functioning of these organelles. For instance, it was shown that cells expressing an active Cdc42 mutant (Cdc42V12) displayed slower brefeldin A-induced Golgi disassembly, pointing to an integral role for Cdc42 in normal Golgi function and integrity [Luna et al., 2002]. In addition, treatment with nocodozole, which depolymerizes microtubules, is known to disperse Golgi membranes; however, this process is reversible and a nocodazole washout restores regular Golgi morphology [Chen et al., 2005]. Interestingly, a Cdc42 mutant (Cdc42Q61L) defective in recruiting the motor protein, dynein, prevented the restoration of the Golgi following nocodazole washout, suggesting that Cdc42 maintains proper Golgi morphology through regulating microtubules and dynein motor proteins. These results collectively suggest that the effects of Cdc42 on the functional and structural homeostasis of the secretory pathway may be mediated through actin and microtubule cytoskeleton dynamics.

1.5 Rationale and Hypothesis

1.5.1 Outstanding research questions

We have presented a review on the importance of cytokines in the lung landscape during pathogen-triggered and chronic inflammation, the signalling pathways that mediate cytokine gene expression as well as the modes of secretion of inflammatory cargo. In addition, our investigation of existing literature on Cdc42 mediated regulation of inflammatory signaling pathways and its potential implications in trafficking has shown several parallels with the key processes required for cytokine release from cells. Our review has revealed key gaps in current knowledge of inflammatory processes that may be useful for the identification of therapeutic targets and/or treatment approaches. Specifically, our analysis of existing literature identified the following outstanding questions that remain unclear. 1) Although lung epithelium is known to be an initiator of immune cascades through the release of pro-inflammatory mediators, the signalling mechanisms that result in cytokine expression downstream of inflammatory receptor engagement still requires further characterization. 2) Although cytokines are known to undergo conventional or unconventional intracellular trafficking and secretion, the regulation of these processes, especially conventional ER-Golgi trafficking, is still poorly understood. 3) Whether these processes are regulated by Cdc42 as a signal transducer, trafficking regulator, or both, warrants closer examinations.

1.5.2 Rationale

The findings and background information presented in our literature review has collectively pointed to the essential requirement for Cdc42 in signal transduction, trafficking and release of secretory vesicles, as well as the integrity of the ER-Golgi pathway. Therefore, Cdc42 may be an ideal candidate in the regulation of inflammatory gene expression and cargo release. Despite this, how cytokine gene expression and cytokine cargo trafficking through the secretory pathway is regulated by Cdc42, and Rho proteins in general, during inflammation has remained unclear.

For our investigations, we will utilize the immortalized human bronchial epithelial cell line, BEAS-2B [Reddel et al., 1988]. The BEAS-2B cell line is a commonly used transformed cell line derived from normal upper (bronchial) airway tissues [Lujan et al., 2019]. BEAS-2B cells grown in vitro, proliferate rapidly as an even monolayer, display low basal release levels of pro-inflammatory mediators such as IL-6, and show low oxidative stress [Lujan et al., 2019; Stewart et al., 2012]. Cellular signaling cascades that result in cytokine gene expression and subsequent release from

the cells can be elicited through stimulation with pro-inflammatory stimuli such as cockroach extract, polyI:C and TNF-α.

1.5.3 Hypothesis

*We postulate that Cdc42 acts as a signal transducer that couples inflammatory stimuli-receptor engagement to pro-inflammatory signaling cascades and cytokine gene expression. In addition, we hypothesize that Cdc42 regulates trafficking and ultimate secretion of cytokine proteins transported through the secretory pathway (**Figure 1.7**).*

In **Chapter 3**, we examine the effects of Cdc42 inhibition by the pharmacological inhibitor, ML141, and silencing with shRNA-mediated knockdown, on the gene expression, secretion and trafficking of key pro-inflammatory cytokines, as well as the changes to Golgi morphology using a BEAS-2B cell model system.

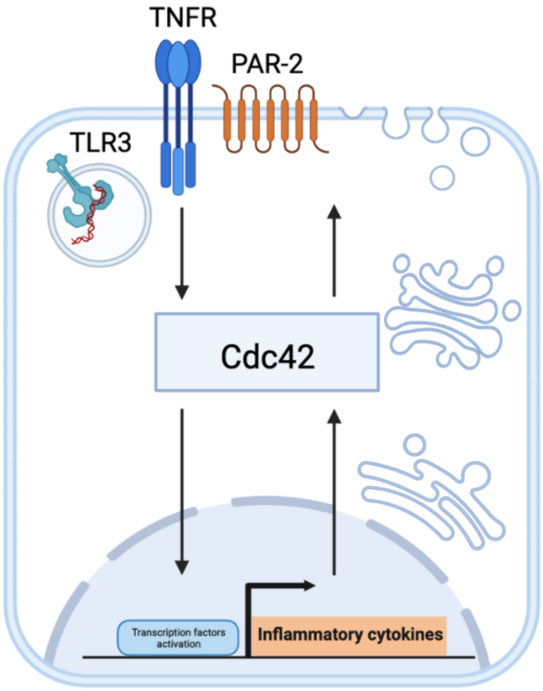

Figure 1.7: Hypothetical model for the role of Cdc42 in the production and trafficking of pro-inflammatory mediators in lung epithelial cells.

In **Chapter 4**, we further interrogate the pro-inflammatory transcriptional profile in response to Cdc42 inhibition by ML141 in BEAS-2B cells by transcriptomic RNA-Seq analysis. We also probe for dysregulation of trafficking pathways at the transcriptional level in response to Cdc42 inhibition. We identify signaling targets differentially expressed in response to Cdc42 inhibition and perform shRNA-mediated knockdowns to investigate whether they couple the inhibition of Cdc42 to downstream perturbations in inflammatory gene expression.

In **Chapter 5**, we examine Cdc42 pathogenic missense mutants that are linked to autoinflammatory immune disorders [Coppola et al., 2022; Lam et al., 2019]. We show some of these mutants lead to Golgi accumulation of Cdc42 when expressed in BEAS-2B cells. Our preliminary characterization suggest these mutants may affect cytokine production and release.

Chapter 2: Materials and Methods

2.1 Materials

2.1.1 Stimuli and drugs

Table 2.1: Stimuli and drugs used for stimulation or treatment of BEAS-2B cells

Stimulus / Drug	Function	Manufacturer	Item no.	Stock Concentration	Working Concentration
Recombinant human TNF-α protein	Pro-inflammatory stimulus – cytokine	NovusBio	NBP2-35076	10 µg/mL	10 ng/mL
Recombinant human IL-8 protein	Cytokine	NovusBio	SRP3098	10 µg/mL	10 ng/mL
Polyinosinic-polycytidylic acid (PolyI:C)	Pro-inflammatory stimulus – viral mimic	NovusBio	NBP2-25288	3 mg/mL	10 µg/mL
Cockroach Extract	Pro-inflammatory stimulus – household allergen	GREER	XPB46D3A4	6 mg/mL	20 µg/mL
ML141	Cdc42 inhibitor	Tocris	#4266	10 mM	20 µM
Monensin	Golgi transport inhibitor	Sigma	22373-78-0	2 mM	2 µM
EHT-1864	Rac1 inhibitor	Tocris	#3872	20 mM	10 µM
Rhosin	RhoA inhibitor	Tocris	#5003	20 mM	10 µM
BAY 11-7082	NF-κB inhibitor	Cayman	10010266	10 mM	10 µM
ZZW-115 trihydrochloride	NUPR1 inhibitor	Sigma	SML3061	10 mM	5 µM
Dimethylsulfoxide (DMSO)	Vehicle control / solvent	Sigma	67-68-5	-	-

2.1.2 Oligonucleotides

Table 2.2: Primer sequences used for quantitative real-time PCR

Gene	Forward/Reverse	Sequence (5' - 3')
IL-8 homo sapiens (hs)	Forward	CCAAGGAGTGCTAAAGAACTTAGA
	Reverse	GTGTGGTCCACTCTCAATCAC
IL-1β hs	Forward	CAAAGGCGGCCAGGATATAA
	Reverse	CTAGGGATTGAGTCCACATTCAG
IL-6 hs	Forward	CACTCACCTCTTCAGAACGAAT
	Reverse	GCTGCTTTCACACATGTTACTC
MCP-1 hs	Forward	GGCTGAGACTAACCCAGAAAC
	Reverse	GAATGAAGGTGGCTGCTATGA
Cdc42 hs	Forward	AAAGTGGGTGCCTGAGATAAC
	Reverse	TGGAGTGATAGGCTTCTGTTT
GAPDH hs	Forward	GGTGTGAACCATGAGAAGTATGA
	Reverse	GAGTCCTTCCACGATACCAAAG
SESN2 hs	Forward	GCGGAACCTCAAGGTCTATATC
	Reverse	AAGTTCACGTGGACCTTCTC
DUSP5 hs	Forward	CGACCCACCTACACTACAAATG
	Reverse	CCCTGACACAGTCAATGAAGTC
TRIB3 hs	Forward	CAACCCGATCCCATCTCTG
	Reverse	AGCCATACAGAACCACTTCTC
BMP4 hs	Forward	GGACTACATGCGGGATCTTTAC
	Reverse	GATACTCAAGACCAGTGCTGTG

All oligonucleotides were ordered from Integrated DNA Technologies (IDT) via the Molecular Biology Service Unit (MBSU) unit at the University of Alberta.

2.1.3 Antibodies and dyes

Table 2.3: Antibodies/fluorescent dyes used in immunofluorescence, flow cytometry or western blotting.

	Type	Antibodies/Dyes Used			
		Antibody/Dye	***Manufacturer***	***Host Species***	***Item no.***
A	Primary antibodies	Anti-IL-8	Biorad Biosciences	Rabbit	AHP781[1]
		Anti-IL-1β antibody cocktail	Invitrogen	Mouse	AHC0612[2]
		Anti-MCP-1	Abcam	Mouse	ab214819[3]
		Anti-NF-κB p65	Santa Cruz Biotechnology	Mouse	sc-8008[4]
		Anti-α-tubulin	Santa Cruz Biotechnology	Mouse	sc-5286[5]
		Anti-GM130	BD Biosciences	Mouse	610823[6]
		Anti-Calnexin	Novus	Mouse	AF-18[7]
		Anti-GGA2	Proteintech	Rabbit	10356-1-AP[8]
		Anti-FLAG	Novus	Rat	NBP1-06712[9]
		Anti-Cdc42	Novus	Rabbit	NBP2-67895
		Anti-β-tubulin	Abcam	Rabbit	ab179513[10]
		Anti-Actin	Abcam	Rabbit	ab179467[11]
B	Secondary antibodies	Alexa Fluor™ 555 anti-Rabbit	Invitrogen	Donkey	A31572
		Alexa Fluor™ 488 anti-Mouse	Invitrogen	Donkey	A21202
		Alexa Fluor™ 647 anti-Mouse	Invitrogen	Donkey	A31571
		Alexa Fluor™ 647 anti-Rat	Invitrogen	Donkey	A48272
		Alexa Fluor™ 680 anti-Rabbit	Invitrogen	Goat	A21076

[1] Referenced in [Fu et al., 2023; Liu et al., 2023; Vazquez Rodriguez et al., 2018]
[2] Referenced in [Kesavalu et al., 2002; Kooijman et al., 2002]
[3] Referenced in [Dai et al., 2022; Z. Zheng et al., 2021]
[4] Referenced in [Su et al., 2021; Q. Zhang et al., 2017] and reviewed in [Slotta et al., 2014]
[5] Referenced in [Moujaber et al., 2019; Y. Wang et al., 2017]
[6] Referenced in [Boncompain et al., 2019; She et al., 2017; Yoshimura et al., 2022]
[7] Referenced in [Launay et al., 2023; Ma et al., 2024]
[8] Referenced in [Kvainickas et al., 2017]
[9] Referenced in [Bajar et al., 2022; F. P. Davis et al., 2020]
[10] Referenced in [Shannon et al., 2021; K. Wu et al., 2022; X. Wu et al., 2020]
[11] Referenced in [Bai et al., 2020; Y. Chen et al., 2022; B. Zhu et al., 2022]

C	Dyes	Oregon Green™ 488 Phalloidin	Thermo Fisher Scientific	-	O7466
		Phalloidin-iFluor 405	Abcam	-	Ab176752
		DAPI	Sigma	-	D9542

Since all primary antibodies were used in BEAS-2B cells, these antibodies react with the human target protein indicated in 'Antibody/Dye Column'.

2.1.4 Plasmids

Table 2.4: Plasmids used for lentiviral shRNA virus production

Type	Gene of Interest	Vector	Details	shRNA clone ID	Target Sequence
Lentiviral system plasmids	-	psPAX.2	Packaging plasmid	-	-
	-	pMD2.g	Envelope plasmid	-	-
shRNA transfer plasmids	Cdc42	pLKO.1	Cdc42-shRNA-1	TRCN0000047629	CGGAATATGTACCGACTGTTT
	Cdc42	pLKO.1	Cdc42-shRNA-2	TRCN0000047632	CAGATGTATTTCTAGTCTGTT
	Cdc42	pLKO.1	Cdc42-shRNA-3	TRCN0000047628	CCCTCTACTATTGAGAAACTT
	TRIB3	pLKO.1	TRIB3-shRNA	TRCN0000037408	TGGATGACAACTTAGATACCG
	SESN2	pLKO.1	SESN2-shRNA	TRCN0000142814	CCGAAGAATGTACAACCTCTT
	DUSP5	pLKO.1	DUSP5-shRNA	TRCN0000002522	TGACCCACCTACACTACAAAT
	BMP4	pLKO.1	BMP4-shRNA	TRCN0000059145	GCGAGCCATGCTAGTTTGATA
	IL-8	pLKO.1	IL-8-shRNA	TRCN0000058031	GCTCTGTGTGAAGGTGCAGTT
	Scramble control	pLKO.1	Scr-shRNA	-	-
Cdc42 constructs	Wildtype	FLAG pcDNA3	Cdc42 wildtype	-	-
	R186C	FLAG pcDNA3	Cdc42 mutant	-	-
	192Cext*24*	FLAG pcDNA3	Cdc42 mutant	-	-
	C188Y	FLAG pcDNA3	Cdc42 mutant	-	-

All transfer plasmids were from Sigma MISSION® Lentiviral shRNA library obtained from the Advanced Cell Exploration Core at the University of Alberta. psPAX2 (#12260) and pMD2.G (#12259) were obtained from Addgene. Details column includes description of plasmid or the name by which the clone is referenced in Chapters 3 and 4. Cdc42 constructs were a gift from Dr. Simona Coppola from the National Centre Rare Diseases, Rome, Italy.

2.2 Methods

2.2.1 Cell culture

BEAS-2B and HEK-293T cells (ATCC) were grown in DMEM (Sigma, #D6429) supplemented with 10% heat-inactivated fetal bovine serum (FBS) (Gibco, #12483-020) and antibiotic-antimycotic at 100 units/mL penicillin, 100 µg/mL streptomycin and 0.25 µg/mL amphotericin B (Gibco, #15240-062). Cells were grown in a humidified incubator at 37°C and 5% CO_2.

2.2.2 Drug treatment and inflammatory stimulation

Prior to stimulation, cells were serum-starved in FBS-free DMEM medium overnight. BEAS-2B cells were pretreated with the drugs, ML141 (Tocris), CASIN (Tocris), Rhosin (Tocris), EHT1864 (Tocris), monensin (Sigma) and BAY 11-7082 (Cayman Chemical) at concentrations indicated in figure legends, or DMSO (vehicle control) for 1 hour. Drugs were used at approximately 10-fold above IC_{50} concentrations to achieve acute inhibition, as we have previously shown for the Rho inhibitors [Sheshachalam et al., 2017]. Cells were subsequently stimulated with TNF-α at 10 ng/mL or poly(I:C) (NovusBio) at 10 µg/mL or cockroach extract at 20 µg/mL (a gift from Dr. H. Vliagoftis, Alberta Respiratory Centre, University of Alberta) for 4 hours for microscopy and quantitative RT-PCR analysis, and 8 hours for secretion analysis, unless otherwise indicated. Cells were alternatively stimulated with IL-8 at 100 ng/mL for 4 hours without prior drug treatment. Stimuli and drugs details are listed in **Table 2.1**. Stimulation with TNF-α showed the greatest change in cytokine levels and was used to further characterize cytokine trafficking and secretion. The kinetics of BEAS-2B response to stimuli was analyzed for changes in gene expression at 4 hours, which has previously been shown to be the peak change in mRNA levels for many cytokines [Ham et al., 1991; Ohmori & Hamilton, 1994]. As shown in **Figure 2.1**, a time course immunofluorescence experiment showed the most prominent post-Golgi staining of cytokines at 4 hours of stimulation by cockroach extract allergen or polyI:C, compared to 6 hours and 8 hours. This is further demonstrated by additional time course results in Chapter 4 (**Figure 4.1, Section 4.2.1**) corroborating the choice of the 4-hour time point by quantifying cytokine mRNA levels at 0, 4, 8 and 16 hours of TNF-α-stimulation**.** Therefore, 4-hour stimulation time periods were used when analyzing protein trafficking by microscopy to examine early movement of cytokines through the Golgi network and also facilitated direct comparison to mRNA expression. Importantly, we also show activation of Cdc42 by TNF-α stimulation, and inhibition of this activation by the ML141 inhibitor, which shows optimal inhibition at 4 hours (**Figure 2.2**). We also show a dose-response curve for ML141 (**Figure 2.3**) with the cytokines extensively investigated

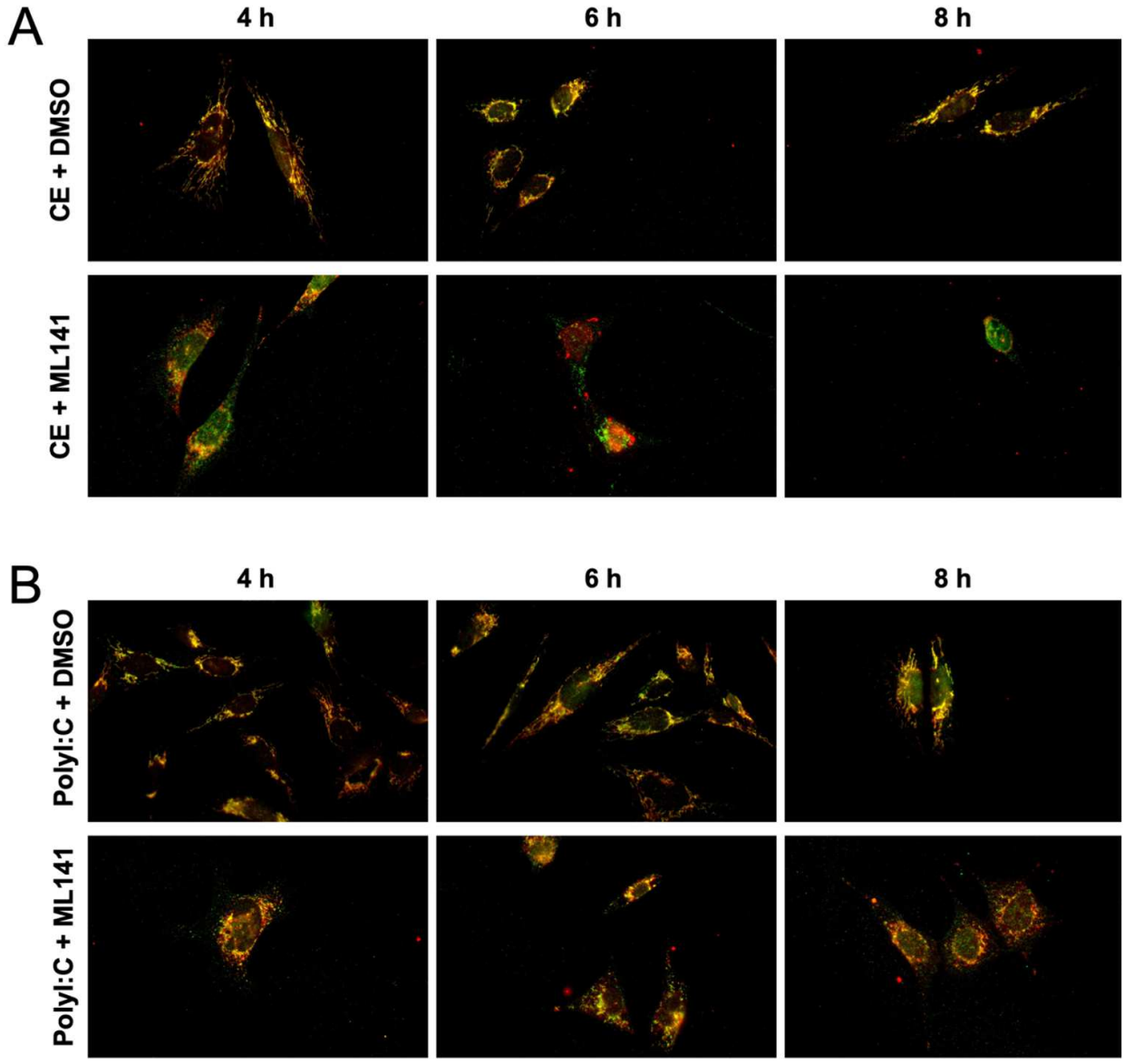

Figure 2.1: IL-8 and TSLP show post-Golgi tubule staining patterns that are affected by Cdc42 inhibition. BEAS-2B cells were pretreated with vehicle (DMSO) or 20 μM ML141 for 1 h, then stimulated with 20 μg/mL cockroach extract (CE) **(A)** or 10 μg/mL poly(I:C) **(B)** for 4 h, 6 h and 8 h. Cells were then fixed and stained with IL-8 (red) and TSLP (green) antibodies. ML141 affects the post-Golgi tubule staining pattern which is most prominently observed at 4 h of stimulation.

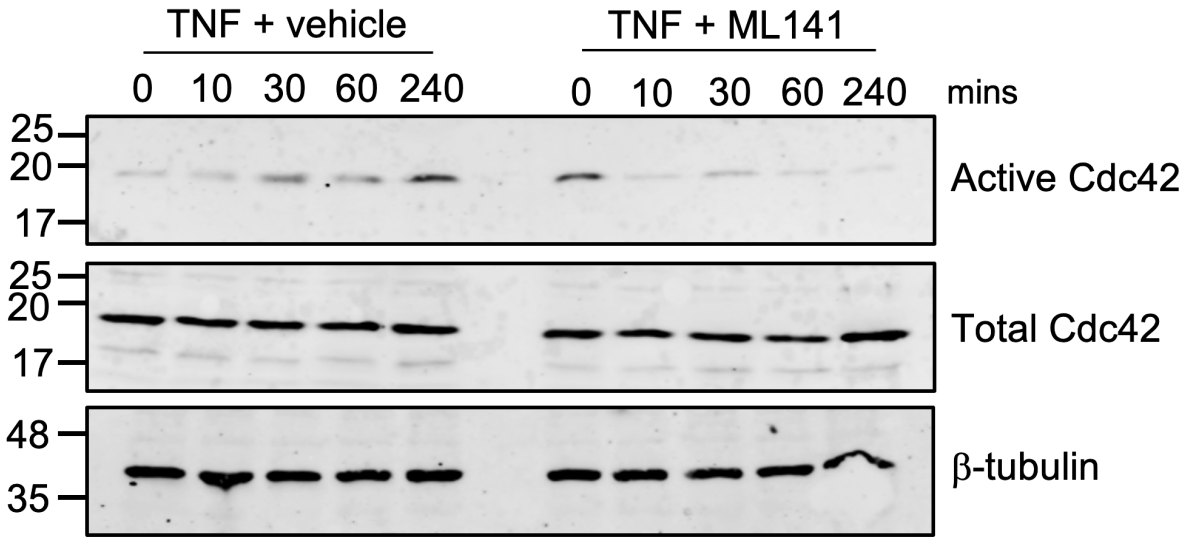

Figure 2.2: Pull-down of active Cdc42 from BEAS-2B cells in response to TNF-α stimulation in the presence of the Cdc42 inhibitor (ML141) or vehicle control (DMSO). Cells were serum-starved overnight and pretreated 20 μM ML141 or DMSO for 15 min then stimulated with 10 ng/mL TNF-α for the indicated times (minutes). Whole cell lysates were probed for active Cdc42 using GST-PAK beads as described in **Section 2.2.11**. Total Cdc42 and β-tubulin in lysates are shown for load comparison. TNF-α activated Cdc42 after 30 minutes of incubation which was inhibited by ML141.

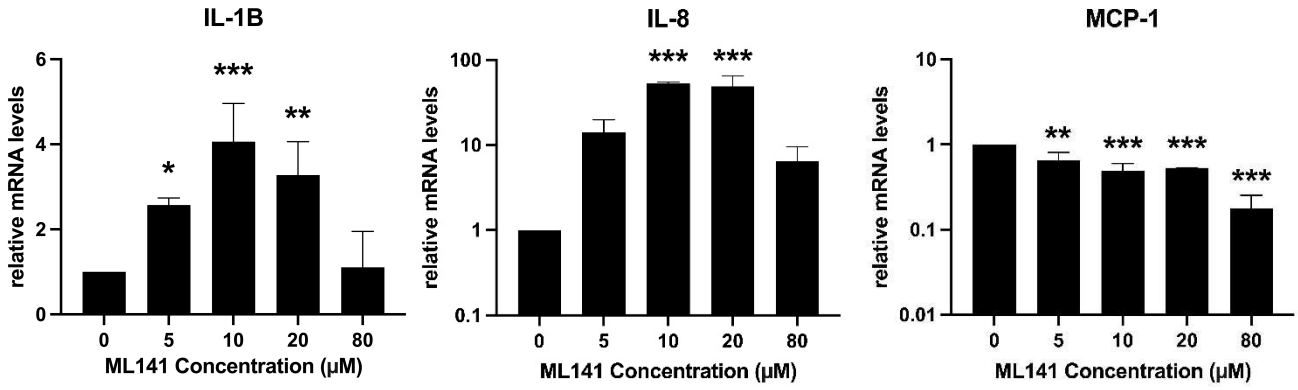

Figure 2.3: ML141 dose-response for IL-1β, IL-8, MCP-1 cytokines. Cells were serum-starved overnight and treated with varying concentrations of ML141 as indicated for 5 hours and harvested for RNA extraction. Relative mRNA levels assessed via quantitative RT-PCR. Asterisks indicate significance of indicated group compared to control (0 μM) control. * <0.05; **< 0.01; *** < 0.001; n = 4.

(IL-8, IL-1β, MCP-1) that highlights how a peak response is obtained at 10 μM or 20 μM (the concentration we utilize) and declines at higher concentrations (80 μM) likely due to increased cell death and the decreased number of cells available for harvest. Stimulation for 8 hours was used when analyzing secreted cytokine levels, since longer times are required for cytokine maturation and extracellular secretion [Stanley & Lacy, 2010]. Cells were treated with ZZW-115 drug for 5 hours without inflammatory stimulation where indicated.

2.2.3 Lentivirus production

Lentivirus particles were produced by transfecting human embryonic kidney 293T (HEK-293T) cells with Mission® TRC library (Sigma) transfer plasmids containing shRNA against: Cdc42 (TRCN0000047628, TRCN0000047629, or TRCN0000047632), SESN2 (TRCN0000142814), TRIB3 (TRCN0000037408), DUSP5 (TRCN0000002522), BMP4 (TRCN0000059145) or IL-8 (TRCN0000058031) as listed in **Table 2.4**. Transfection was performed by incubating 9 μg of shRNA transfer plasmid, 6 μg of psPAX2 packaging plasmid and 3 μg of pMD2.g VSV-G envelope plasmid with 54 μg polyethylenimine in 1 mL Opti-MEM for 20 minutes at room temperature, followed by dropwise addition to HEK-293T cells growing at 60% confluency in a 10 cm dish. Fresh media (10% heat-inactivated FBS-DMEM) was added after 6 hours and conditioned media harboring viral particles was harvested at 48 hours and 96 hours. Conditioned media was spun at 20,000*g* for 15 minutes to pellet any cells and debris and supernatant was harvested.

2.2.4 Stable cell knockdown

Virus supernatants, collected as described in **Section 2.2.3**, were added to BEAS-2B cells growing at 80% confluency in a 10 cm dish with 10 μg/mL polybrene (hexadimethrine bromide, Sigma) at an MOI of 10-15. Transduced cells were selected with DMEM (Sigma) supplemented with 10% heat-inactivated fetal bovine serum (FBS) (Gibco), 10 units/mL penicillin, 100 μg/mL streptomycin and 0.25 μg/mL amphotericin B (Gibco), and importantly, 2 μg/mL puromycin (Gibco). After 7-10 days of selection of mutant cells with puromycin, cells were subject to another round of transduction with viral supernatant followed by puromycin selection for another 7-10 days after which cells were harvested for different experiments.

2.2.5 mRNA levels quantification with quantitative RT-PCR

Following the indicated stimulation times, Total RNA extraction was performed using TRIzol (AmbionTM) according to the manufacturer's protocol. RNA concentrations of samples were

assessed on a NanoVue spectrophotometer (GE Life Sciences). Complementary DNA (cDNA) synthesis was performed with the SuperScript™ II Reverse Transcriptase kit (Invitrogen) according to manufacturer's instructions using 0.5-2 µg RNA and 0.4 µg oligo dT for a total volume of 20 µL. mRNA levels of cytokines, signaling target, or Cdc42 protein were obtained with Mastercycler RealPlex 2 (Eppendorf) thermocycler and either SensiFAST™ SYBR No-ROX Kit BIO-98005 (Meridian) or AzuraView™ GreenFast qPCR Blue Mix LR Cat. #AZ-2305 (Azura Genomics) qPCR mixes. Each well consisted of 10 µL of SensiFAST, 7 µL of nuclease-free water (HyClone), 1 µL (400 nM) of specific primers and 2 µL of cDNA for a total volume of 20 µL. GAPDH was used as the internal control to which mRNA levels were normalized. Data was normalized to GAPDH and a treatment control using the $2^{-\Delta\Delta CT}$ method [Livak & Schmittgen, 2001]. Primer sequences are listed in **Table 2.2**.

2.2.6 Immunofluorescence

100,000 BEAS-2B cells were seeded on coverslips (Fisherbrand, 22mm X 22mm, #1.5) in 6-well plates. The next day, cells were starved overnight and then pre-treated with ML141 or DMSO for 1 hour, stimulated with TNF-α at 10 ng/mL and harvested after 4 hours. Cells were washed with PBS (Fisher, #SH3025601) and fixed with 4% paraformaldehyde dissolved in PBS for 20 minutes. Cells were then permeabilized with 0.2% Triton X-100 for 15 minutes and blocked in 2% BSA (Fisher) for 30 minutes. Primary antibodies against IL-8, IL-1β, MCP-1, GM130, GGA2, NF-κB p65 or calnexin (listed in **Table 2.3A**) were diluted 1:200 in PBS and added onto coverslips for 1 hour. Cells were washed twice with PBS and fluorescently-conjugated secondary antibodies (listed in **Table 2.3B**) diluted 1:500 were then added to label primary antibodies. In addition, phalloidin or DAPI dyes (listed in **Table 2.3C**) were used at 1:1000 dilution to label F-actin or nuclei, respectively. Cells were washed three times with PBS before coverslips were then mounted with Mowiol mounting media (gift from Dr. A. Simmonds, University of Alberta) onto microscope glass slides. Slides were imaged with a Zeiss LSM 700 confocal microscope (Zeiss) using a 63x objective (NA 1.4) and images were acquired using Zen software (Zeiss). Images were subsequently processed with ImageJ Software (U.S. National Institutes of Health).

2.2.7 Flow cytometry

BEAS-2B cells were pretreated with ML141, monensin or vehicle control (DMSO) for 1 hour. Cells were subsequently stimulated with TNF-α for 4 hours, fixed with 4% paraformaldehyde and suspended in flow cytometry buffer composed of 0.1% saponin (Sigma), 1% BSA (Fisher), and PBS (Sigma). Unstained cells were treated with primary antibodies only and used for gating to

eliminate non-specific signals. Cells were stained with primary antibodies against IL-8 and IL-1β and subsequently stained with fluorescently conjugated secondary antibodies (listed in **Table 2.3**). BD LSRFortessa™ Cell Analyzer in the University of Alberta Faculty of Medicine and Dentistry Flow Cytometry Facility (RRID:SCR_019195) was used to detect fluorescence within cells. BD FACSDiva™ software was used for data acquisition and analysis. 10,000 events (indicative of cell numbers) were taken for each sample.

2.2.8 Cytokine secretion assay

Levels of secreted cytokines from BEAS-2B cells were determined by analyzing extracellular supernatants. BEAS-2B cells were left resting or stimulated with 20 µg/mL cockroach extract, 10 µg/mL poly(I:C) or 10 ng/mL TNF-α for 8 h. Following stimulation, media samples were collected and sent for analysis using the Human Cytokine Pro-inflammatory Focused 15-Plex Discovery Assay® Array (HDF15) (EveTechnologies™). This analysis used specific cytokine (GM-CSF, IFNγ, IL-1β, IL-1RA, IL-2, IL-4, IL-5, IL-6, IL-8, IL-10, IL-12p40, IL-12p70, IL-13, MCP-1, and TNFα) capture antibodies cross-linked to beads with unique fluorophor signatures and a second antibody labelled with phycoerythrin. Bio-plex 200 (Bio-Rad) was used to quantify cytokine levels based on a standard curve. To determine the effect of Cdc42 inhibition or knockdown, BEAS-2B cells were pretreated with ML141 drug or vehicle control (DMSO) for 1 hour, or shRNA against Cdc42 5 - 8 days prior to analysis. Cells were subsequently stimulated with TNF-α for 8 hours before collecting extracellular media.

2.2.9 RNA sequencing

Total RNA extraction was performed as previously described for quantitative PCR. There were four experimental groups (Resting + DMSO, Resting + ML141, TNF-α + DMSO, TNF-α + ML141) each with 3 biological replicates for a total of 12 samples. Library preparation and sequencing was performed at the Advanced Cell Exploration Core (University of Alberta, Canada). Sample quality and concentration was assessed with a high sensitivity RNA assay using the Qubit™ Flex Fluorometer (Invitrogen) and fragment length was assessed using Bioanalyzer 2100 (Agilent Technologies). Samples with RNA integrity of 6 or higher were moved into processing and were normalized to an input of 500 ng total RNA. DNA libraries were prepared using Illumina Truseq RNA Library Prep Kit v2 (Illumina) for paired-end sequencing. Final libraries were pooled and run on NextSeq500 (Illumina) using the Nextseq 500/550 High Output kit v2.5 (Illumina). Analysis was performed on a Linux command line. Briefly, Fastq files were obtained and were unzipped and data files from different samples were concatenated together. This read data was submitted

to the NCBI SRA database, BioProject ID: PRJNA1145001, and is available at the following link: http://www.ncbi.nlm.nih.gov/bioproject/1145001.

Sequencing samples were assessed for quality using FastQC [Andrews, 2010] and then adaptor sequences (TruSeq2-PE.fa) and low-quality reads were trimmed using Trimmomatic [Bolger et al., 2014]. FastQC was run again to ensure proper trimming. Trimmed files were aligned with HISAT2 [D. Kim et al., 2015] to the human reference genome (Grch38) [Broad Genome References]. Aligned reads were counted using FeatureCounts [Liao et al., 2014] and .txt gene counts output files were converted to .csv files for use in the R program. Pre-filtering was performed to eliminate low count (<10) genes resulting in 20,930 genes out of 62,712 genes being used for DESeq2 analysis. DESeq2 [Love et al., 2014] was used as part of the Bioconductor package (version 3.17) in R to perform differential gene expression analysis. To identify differentially expressed genes (DEGs) between two different samples, pairwise differential expression analysis was used to compare two samples at a time against each other. The False Discovery Rate (FDR) correction was performed using the Benjamini-Hochberg method to correct for multiple testing [Benjamini et al., 2001]. The conventional p-value cutoff of 0.05 was used and genes with *p-adjusted* values of less than 0.05 were considered to be significantly differentially expressed. Furthermore, to visualize sample clustering based on gene expression patterns, variance was stabilized on count data using Variance Stabilizing Transformation (VST), and subsequently, Principal Component Analysis (PCA) plot was obtained. Gene Set Enrichment Analysis (GSEA) was performed using EasyGSEA (http://www.broad.mit.edu/gsea/) with an ordered list of DEGs sorted by ascending adjusted p-values to outline signaling pathways that are differentially activated between two given samples [Subramanian et al., 2005]. This ordered list was also used for Gene Ontology analysis using GOrilla software which allowed identification of enriched GO terms [Eden et al., 2009]. Volcano plots highlighting differentially expressed genes from a particular gene set were generated in the R program. This was performed by only labeling significant DEGs belonging to a pre-selected gene set on the plot. Gene sets were downloaded from Molecular Signatures Database (MSigDB) at https://www.gsea-msigdb.org/gsea/msigdb/human/genesets.jsp [Liberzon et al., 2011; Mootha et al., 2003; Subramanian et al., 2005]. We chose to investigate the broad inflammatory gene family 'Cytokines and Growth Factors' and specific trafficking gene sets such as the 'REACTOME_ER_TO_GOLGI_ANTEROGRADE_TRANSPORT' gene set (M27097) obtained from MSigDB [Liberzon et al., 2011; Matthews et al., 2009]. Golgi apparatus components gene sets chosen were 'GOCC_GOLGI_APPARATUS' (M845); 'GOCC_GOLGI_MEMBRANE'

(M9395); ‘GOCC_GOLGI_LUMEN’ (M17733); GOCC_GOLGI_ASSOCIATED_VESICLE_MEMBRANE’ (M17169); ‘GOCC_GOLGI_CISTERNA_MEMBRANE’ (M17806); ‘GOCC_TRANS_GOLGI_NETWORK_MEMBRANE’ (M17785) [Aleksander et al., 2023; Ashburner et al., 2000]. Additional gene sets for different steps and components along the secretory pathway included ‘GOBP_ENDOPLASMIC_RETICULUM_TO_GOLGI_VESICLE_MEDIATED_TRANSPORT’ (M12529); ‘GOBP_INTRA_GOLGI_VESICLE_MEDIATED_TRANSPORT’ (M11795); ‘GOBP_POST_GOLGI_VESICLE_MEDIATED_TRANSPORT’ (M19178); ‘REACTOME_INTRA_GOLGI_AND_RETROGRADE_GOLGI_TO_ER_TRAFFIC’ (M27654); ‘REACTOME_COPI_DEPENDENT_GOLGI_TO_ER_RETROGRADE_TRAFFIC’ (M27650); ‘REACTOME_COPI_INDEPENDENT_GOLGI_TO_ER_RETROGRADE_TRAFFIC’ (M27651). Heatmaps for specific gene sets were generated using GSEA software and show only the consistently up or down regulated genes within the gene set [Mootha et al., 2003; Subramanian et al., 2005]. Additionally, heatmaps were generated by IPA (QIAGEN Inc., https://www.qiagenbioinformatics.com/products/ingenuity-pathway-analysis) using core and comparison analysis functions. Heatmap generation for selected set of genes (e.g. tubulin genes) was performed) using Morpheus online visualization tool (https://software.broadinstitute.org/Morpheus).

2.2.10 Transfection with Cdc42 constructs

BEAS-2B cells were seeded in 6-well plates as described in **Section 2.2.6**. Cells were transfected the following day by diluting 2 µg of plasmid DNA (with wildtype, R186C, 192Cext*24* or C188Y gene inserts) in 150 µL of Opti-MEM™ (Gibco) media, diluting 2 µL of Lipofectamine™ 2000 (Invitrogen) transfection reagent in 150 µL of Opti-MEM media and mixing together and letting incubate for 15 minutes. Plasmid-Lipofectamine mixture was then added drop-wise to each well and media was changed to completed FBS-supplemented media after 6 hours. Cells were starved the following day overnight and stimulated with TNF-α for 4 hours and fixed the following day. For flow cytometry, 700,000 cells were seeded into 10 cm plates, cells were placed in FBS-free starvation medium the following day overnight. Cells were treated with Monensin or DMSO control for 1 hour and stimulated with TNF-α for 4 hours. Cells were stained for flow cytometry as described in **Section 2.2.7**. Gating was used to specifically select the transfected population expressing the FLAG tag for further analysis.

2.2.11 Western Blotting and Active Cdc42 pulldown assays

For western blotting, cells were starved overnight and stimulated/drug-treated as indicated in figure legends. Cells were washed twice with PBS and then lysed in a 2% Triton X-100 lysis solution containing protease inhibitor cocktail (Sigma) and scraped with cell scraper. Lysates were then sonicated three times at 20 kHz for 5 seconds each and centrifuged at 20,000*g* and supernatants were obtained. After addition of SDS-PAGE loading buffer, lysates were boiled at 95 °C for 5 minutes and run on an SDS-PAGE gel followed by transfer onto nitrocellulose membrane. Nitrocellulose membranes (Biorad) were blocked in 2% BSA (Fisher) and washed three times for 5 minutes each with a PBST (PBS with 0.1% Tween) wash solution. Membranea were then incubated with primary antibodies against Cdc42 or β-tubulin (listed in **Table 2.3**) for 1 hour and then washed three times with PBST for 10 minutes each followed by incubation with secondary antibodies (also listed in **Table 2.3**) for 30 minutes followed by three washes with PBST for 15 minutes each. Membranes were then washed with distilled water twice for 2 minutes each before scanning on a LI-COR Odyssey CLx imager. For assay of active Cdc42, cells were serum-starved overnight then pretreated ML141 (20 μM) or vehicle (DMSO) for 30 minutes, then stimulated with TNF-α (10 ng/mL) and for the indicated times. Cells were lysed in 20 mM TrisCl, pH 7.5, 150 mM NaCl, 5 mM $MgCl_2$, 1% Triton X-100, centrifuged at 20,000*g* to remove unbroken cells; 10% of the total lysate was saved for loading controls and 90% incubated with Cdc42 activation probe (glutathione S-transferase/GST-tagged Cdc42 binding domain of PAK which has high affinity for GTP-bound (active) Cdc42). The Cdc42 activation probe was immobilized on glutathione agarose.15 μL of glutathione beads was added to 1 mL lysate and incubated for 30 minutes at 7°C with constant mixing. Beads were washed three times with the same buffer and suspended and then analyzed by western blot along with total lysate control.

2.2.12 Statistical analysis

Unpaired Student's t-tests were performed on raw values, or normalized data, for pairwise comparisons using a Bonferroni correction were applicable. For comparisons between multiple groups, one-way ANOVA followed by multiple comparisons testing was used. Specifically, if the data was normalized to the control, a one-way ANOVA was performed with groups compared to the control group, followed by multiple comparisons testing using Dunnett's test [Dunnett, 1955, 1964]. Alternatively, if the one-way ANOVA was performed on raw data that included multiple control groups, groups were compared across one other and followed by Tukey's test [Tukey, 1949]. FDR ratio for RNA-Sequencing data was indicated for each analysis and figure.

Chapter 3: Cdc42 Regulates Cytokine Expression and Trafficking in Bronchial Epithelial Cells

3.1 Brief Introduction

Airway epithelial cells that line the pulmonary tracts provide a relatively impermeable physical and chemical barrier in the lungs [Gohy et al., 2016]. In addition to barrier function, AECs play an important role in immunity. Bronchial epithelial cells, in particular, are involved in immunological processes in the lungs, providing protection against inhaled pathogens through engaging host immune defense mechanisms. This process is orchestrated through the upregulation and release of pro-inflammatory cytokines and chemokines, which signal downstream recruitment and activation of immune cells. AECs are also involved in the dysfunctional regulation of inflammatory processes in the airways associated with major airway disorders such as asthma and chronic obstructive pulmonary disease (COPD). For instance, epithelial-derived cytokines and chemokines such as IL-25, IL-33, GM-CSF and TSLP, are produced upon exposure to allergens and contribute to the state of allergic inflammation and airway damage in asthma [Frey et al., 2020]. The bronchial epithelium of asthmatics also displays increased expression of pro-inflammatory transcription factors such as NF-κB and AP-1 [Holgate et al., 2000]. Abundant release of chemoattractant IL-8, GM-CSF and MCP-1 also results in the recruitment of neutrophils, eosinophils and monocytes, respectively; as well as prolonging their survival in the airway microenvironment [Filep, 2022; Hahn et al., 2006; Uddin et al., 2010]. Thus, these airway-derived mediators may contribute to the pathogenesis of airway diseases, such as severe asthma and COPD [Velden et al., 1998].

It is clear that the process of transcription and secretion of pro-inflammatory mediators allows AECs to modulate early inflammatory events, thereby initiating inflammation or exacerbating existing inflammation if unregulated [Frey et al., 2020]. However, the exact mechanism by which the engagement of epithelial cell receptors with pathogens and allergic stimuli is coupled to the release of pro-inflammatory mediators remains largely unexplained. Small GTPases of the Rho family, known as Rho GTPases, act as molecular switches within the cell. They cycle between active and inactive form and induce a variety of functions upon interacting with their effectors in their active form. These functions include cytoskeletal remodeling, vesicle trafficking and signal transduction [Chi et al., 2013]. Amongst the 20 members of the Rho GTPase family in humans,

RhoA, Rac1, and Cdc42 are the classical well-characterized members in the family. Cdc42 has been shown to be required for pro-inflammatory gene expression in human senescent endothelial cells [Ito et al., 2014]. Although Cdc42 has also been proposed to be involved in the secretory trafficking and exocytosis process in a variety of conditions [Chemin et al., 2012; Egorov et al., 2009; Gasman et al., 2004; Langert et al., 2014; Malacombe et al., 2006; Park et al., 2015], its roles in the trafficking and secretion of pro-inflammatory mediators in lung epithelial cells remains unexamined. With its involvement in cellular trafficking, inflammatory signalling, cytoskeletal remodelling as well as having a Golgi pool, Cdc42 appears to be an ideal candidate in the regulation of cytokine and chemokine signalling and release.

In this section, we report on the effects of inducing a state of inflammation in BEAS-2B cells through the treatment with different allergens and stimulants such as cockroach extract, polyinosinic-polycytidylic acid (poly(I:C)), and TNF-α. BEAS-2B cells are an immortalized human bronchial epithelial cell line that has been widely used as an in vitro cell model for studies related to respiratory disease [Yaqub et al., 2022]. The state of inflammation was assessed through quantifying the production and release of pro-inflammatory cytokines from stimulated cells. Subsequently, we examined the role of Rho proteins in the pro-inflammatory pathways through the use of selective small molecule inhibitors and lentiviral-mediated genetic silencing. We found that Cdc42 is involved in the regulation of cytokine release from epithelial cells including both production and trafficking processes. Our results show that Cdc42 plays a pivotal role in the signal transduction events that lead to upregulation and increased release of cytokines from lung epithelial cells.

3.2 Results

3.2.1 Cytokine expression and secretion in response to inflammatory stimulation in BEAS-2B cells

We examined the response of the human bronchial epithelial cell line, BEAS-2B, to three stimuli that activate different receptors: poly(I:C), which activates TLR3; cockroach extract, which activates the GPCR, PAR-2; and TNF-α, which activates TNFR. BEAS-2B cells were stimulated for 8 hours; this time point was selected to allow the production and release of cytokines to be activated (**Figure 2.1**) [Fujisawa et al., 2000]. Extracellular supernatants were collected after 8 hours of stimulation with these ligands and analyzed for 15 cytokines using a commercially sourced multiplex assay (**Table 3.1**). Of the fifteen factors, IL-8, MCP-1 and IL-6 gave reproducibly detectable responses, with TNF-α eliciting the most significant increase in secreted cytokines (**Figure 3.1A**)**.** Examination of cytokine gene expression by quantitative RT-PCR showed that stimulation with poly(I:C) and cockroach extract induced a 2-fold and 3-fold increase in IL-8 gene expression, respectively, while TNF-α increased IL-8 mRNA >500-fold (**Figure 3.1B**)**.** TNF-α also significantly increased IL-1β and MCP-1 mRNA levels by approximately 30- and 140-fold, respectively. These results show that TNF-α is an effective activator of cytokine production and release from BEAS-2B lung epithelial cells.

Table 3.1: BEAS-2B cytokine secretion levels (pg/mL) after 8 hours of stimulation.

	Replication 1					Replication 2					Replication 3				
	Resting	polyI:C	CE	TNF-α	TNF-α + ML141	Resting	polyI:C	CE	TNF-α	TNF-α + ML141	Resting	polyI:C	CE	TNF-α	TNF-α + ML141
GM-CSF	N/A	N/A	N/A	18.2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	20.7	2.19
IFN-γ	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.3	N/A
IL-1β	N/A	N/A	N/A	0.43	N/A	1.7	1.1	0.8	2.3	2.6	1.1	1.9	1.3	2.1	1.9
IL-Ra	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.5	0.6	0.6	0.7	0.6
IL-2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.2	0.2
IL-4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
IL-5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
IL-6	2.6	4.6	4.3	48.2	83.6	0.3	0.3	0.4	9.9	10.5	2.4	7.5	5.3	31.3	65.6
IL-8	41.5	70.2	56.0	693.0	599.3	5.3	6.7	2.3	85.3	79.6	68.4	135.5	103.7	1993.1	1348.8
IL-10	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
IL-12p40	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.3	1.6	3.4	2.3	3.7	5.5	4.4
IL-12p70	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
IL-13	N/A	N/A	N/A	3.57	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.31	N/A
MCP-1	90.1	116.9	120.8	1625.0	255.9	7.7	8.1	N/A	144.8	37.5	76.4	78.1	126.5	1949.1	332.7
TNF-α	N/A	N/A	N/A	1584.5	1211.2	N/A	N/A	N/A	1046.5	1172.2	N/A	N/A	N/A	7875.1	7656.5

Human cytokine multiplex analysis (HDF15) performed by EveTechnologies™. BEAS-2B cells were stimulated 8 h with 10 μg/mL poly(I:C), 20 μg/mL cockroach extract (CE) or 10 ng/mL TNF-α. ML141 was used at 20 μM and added to cells one hour prior to stimulation. Data represents three independent experiments. N/A – not detected (secretion levels below detection range).

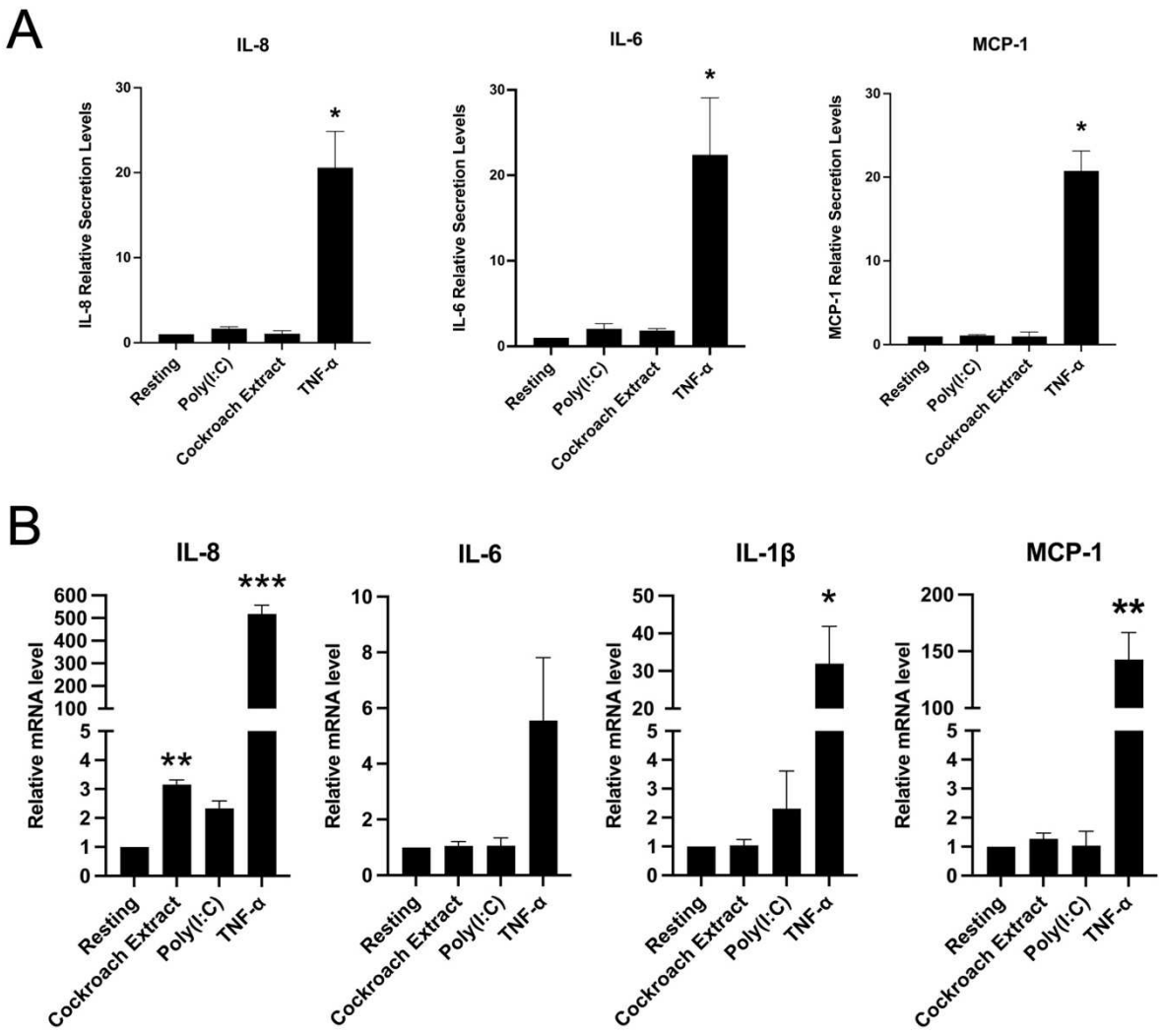

Figure 3.1: BEAS-2B cells respond to pro-inflammatory stimuli with upregulation of cytokine production and release. BEAS-2B cells were stimulated with 10 µg/mL poly(I:C), 20 µg/mL cockroach extract and 10 ng/mL TNF-α. **A)** Relative levels of IL-8, IL-1β, IL-6 and MCP-1 in cell culture media after 8 h of stimulation as detected by multiplex cytokine array assay. Values represent secretion levels normalized to unstimulated samples. **B)** Fold change in mRNA levels of cytokine genes after 4 h of stimulation as detected by quantitative RT-PCR. Values represent ΔΔCt fold changes normalized to unstimulated samples. Bars are the mean ± SEM; n=3; *p < 0.05, **p<0.01, ***p<0.001 by one-way ANOVA followed by Dunnet's (*A*) or Tukey's (*B*) test for multiple comparisons.

3.2.2 Cytokine staining patterns in response to inflammatory stimulation

Morphological changes to BEAS-2B cells after stimulation with the three agonists were examined by immunofluorescence microscopy. Cells were stimulated for 4 hours, fixed and stained for F-actin and microtubules to show the cell structure, and IL-8 to show cytokine protein expression and trafficking (**Figure 3.2A**)**.** The imaging showed an overall increase in IL-8 staining upon stimulation with all three agonists compared to the resting (unstimulated) control cells. There was no change in microtubule structures, while an increase in perinuclear F-actin puncta was observed after stimulation, especially with cockroach extract and TNF-α (**Figure 3.2A,** *arrows*). In particular, TNF-α induced a large increase in IL-8 cytokine signal in Golgi and post-Golgi tubular structures (**Figure 3.2A,** *bottom panels*)**.** We proposed that this reflects an increase in intracellular IL-8 protein levels as image acquisition parameters such as exposure time were kept consistent across different treatment groups. A stimulation time course showed cytokine enrichment in Golgi and post-Golgi tubular structures occurred within 4 hours of stimulation (**Figures 2.1A, B***, upper panels,* **Section 2.2.2**). This is the same time point used for gene expression analysis and hence results can be directly compared.

The staining pattern of NF-κB, a prominent inflammatory transcription factor, was assessed when BEAS-2B were treated with the same stimuli. Prior to stimulation, the NF-κB p65 subunit was exclusively cytosolic, however, upon cell stimulation by agonists it was translocated to the nucleus. Although cells stimulated with cockroach extract and poly(I:C) displayed only minimal NF-κB staining in the nucleus, intense nuclear staining, indicative of NF-κB translocation, was observed following TNF-α stimulation (**Figures 3.2B, C**)**.** Therefore, all further analyses were performed using TNF-α as the stimulus.

TNF-α is well known to activate cell death by apoptosis in addition to the upregulation of cytokine production via the NF-κB pathway [Gough & Myles, 2020]. To determine whether cell death was activated in BEAS-2B cells, we examined nuclear fragmentation after TNF-α treatment. Cells treated with 10 ng/mL TNF-α (commonly used in this study to stimulate cytokine production) showed a minimal number of apoptotic cells, comparable to the untreated control cells (**Figure 3.2D**). Apoptosis of BEAS-2B cells was observed at high concentrations of TNF-α (100 ng/mL). There was a significant increase in nuclear-localized NF-κB at 10 ng/mL TNF-α (**Figures 3.2B, C**), which suggests that BEAS-2B cells predominantly respond to TNF-α with cell survival and upregulation of NF-κB-directed gene expression.

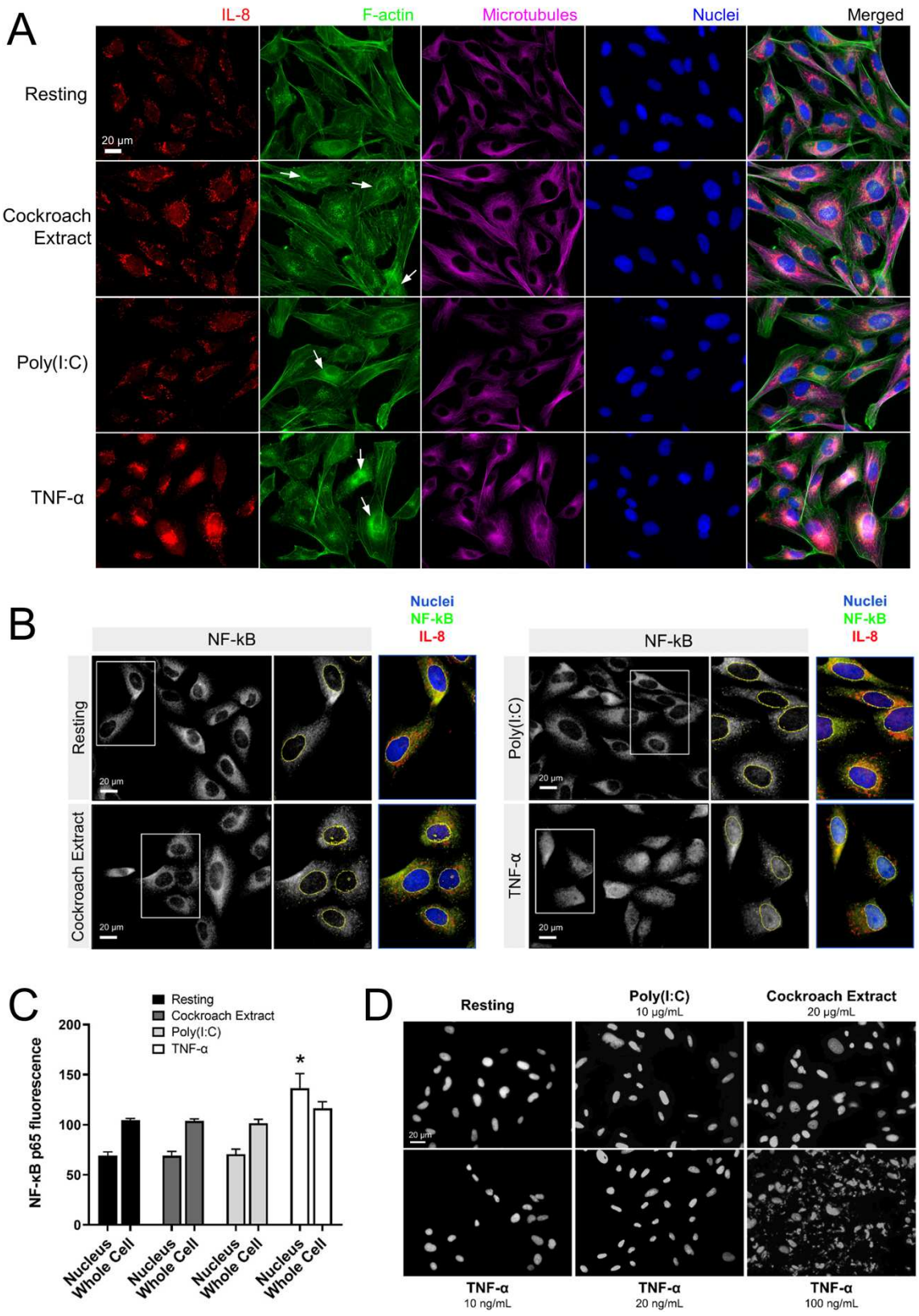

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Figure 3.2: Immunofluorescence microscopy shows cytokine upregulation in response to treatment with pro-inflammatory stimuli. **A, B)** BEAS-2B cells were serum-starved for 16 h, then stimulated with 20 μg/mL cockroach extract, 10 μg/mL poly(I:C) or 10 ng/mL TNF-α. (A) Cells were stimulated for 4 h then fixed and stained with anti-IL8 and anti-β-tubulin antibodies, Alexa546-phalloidin (F-actin), and DAPI (nuclei). **B, C)** Quantification of NF-κB levels in the nucleus from immunofluorescence images. Cells were stimulated for 30 min then fixed and stained with anti-NF-κB (p65 subunit) antibodies and DAPI (nuclei) for immunofluorescence (panel B) and levels of NF-κB staining in the nuclei or whole cells (nuclei and cytosolic regions) were quantified in ImageJ by measuring the fluorescence in the nucleus mask (yellow circle) or in the entire cell (panel C). Bars represent the mean fluorescence in each region of interest (ROI) ± SEM; n=4; *$p < 0.05$ by unpaired two-tailed Student's t-test. **D)** DAPI staining of BEAS-2B cells to assess apoptosis. Cells were treated with the indicated stimuli for 4 h then fixed and stained with DAPI to analyze nuclear fragmentation which indicates apoptosis.

3.2.3 Cytokine expression and secretion in response to Cdc42 inhibitor, ML141, in TNF-α stimulated BEAS-2B cells

Next, we wanted to determine whether Rho GTPases affect cytokine production and release from lung epithelial cells. Several studies have shown links between the Rho GTPases and NF-κB-regulated cytokine production, but these have shown both positive or negative regulatory roles, depending on the context [Montaner et al., 1998; Shimizu et al., 2007; Tong & Tergaonkar, 2014; Zhao et al., 2003, reviewed in Tong & Tergaonkar, 2014]. We examined the role of Rho GTPases using specific Rho inhibitors. BEAS-2B cells were pretreated with Rhosin or EHT1864 which inhibit RhoA and Rac1, respectively [Shang et al., 2012; Shutes et al., 2007; Surviladze et al., 2010]. Then cells were stimulated with 10 ng/mL TNF-α for 4 hours to elicit a response. mRNA was isolated and transcript levels were examined by quantitative RT-PCR. RhoA and Rac1 inhibitors induced consistent, though small, increases in cytokine gene expression. We next aimed to investigate the role of Rho GTPase Cdc42 on cytokine gene expression through the use of the Cdc42 pharmacological inhibitor ML141. ML141 has been widely-used as an effective inhibitor of Cdc42 in a variety of models and physiological contexts [Surviladze et al., 2010; Vargas et al., 2015; Xiao et al., 2018; Yang et al., 2020]. As discussed previously, we justified our choice of time points using fluorescence microscopy of cytokine upregulation (**Figure 2.1, Section 2.2.2**) and demonstrate inhibition of Cdc42 activation by pulldown assay with activation probes (**Figure 2.2, Section 2.2.2**), in response to TNF-α stimulation and ML141 treatment. In addition, we provide data for the use of 20 μM ML141 through a dose-response curve which showed this concentration to be optimal (**Figure 2.3**, **Section 2.2.2**). We found the Cdc42 inhibitor, ML141, to significantly increase IL-6, IL-8 and IL-1β mRNA levels, but reduce MCP-1 mRNA levels (**Figure 3.3A**). We also examined the effects of drugs that regulate either cytokine gene expression or trafficking, for comparison. We found BAY 11-7082, a broad-spectrum inhibitor of inflammation that targets NF-κB, AP-1 and STAT1 amongst other transcription factors, to generally reduce cytokine gene expression while the Golgi trafficking inhibitor, monensin, had minimal effects (**Figure 3.3A**) [Griffiths et al., 1983; J. Lee et al., 2012; Mollenhauer et al., 1990]**.** This shows that the ML141 effect is not a general drug effect. The effects of ML141 on cytokine secretion were also examined. While IL-8 and IL-6 mRNA levels greatly increased when treated with Cdc42 inhibitor, their secretion was not concomitantly increased (**Figure 3.3B**)**.** However, MCP-1, which showed a modest decrease in mRNA levels, showed a drastic reduction in secretion when treated with ML141 (**Figure 3.3B**). ML141 did not affect the translocation of NF-κB into the nucleus, nor the levels of nuclear localized NF-κB compared to vehicle-treated cells (**Figures 3.3C, D**). These results suggest that Cdc42 may negatively regulate gene expression

of a subset of cytokines, however, this is not mediated by the NF-κB pathway. Cdc42 also seems to be required for general cytokine secretion and thus has dual roles in regulating cytokines.

To support these results, we used flow cytometry to quantify intracellular cytokine levels. We used the Golgi transport inhibitor, monensin, as a control to increase intracellular cytokine levels by blocking secretion. As expected, monensin increased intracellular IL-8 and MCP-1 cytokine levels, which indicated a transport block, but did not affect IL-1β levels, a cytokine that is constitutively secreted and does not traffic through the Golgi [Giuliani et al., 2017]. The average level of IL-8 intracellular staining was much higher upon monensin treatment (**Figure 3.3E**), however variability resulted in this effect not being statistically significant. Interestingly, we found that ML141 treatment resulted in an increase in intracellular levels of both IL-8 and IL-1β (**Figure 3.3E**), which is concomitant with their upregulated expression (*see* **Figure 3.3A**). The increase in IL-1β levels are less likely to be affected by Cdc42 at the Golgi; therefore, the effect observed is likely mediated through gene upregulation. However, the increase in intracellular levels of IL-8 could be a combined result of both increased cytokine gene expression and decreased secretion from the cell. We also found that ML141 does not affect MCP-1 intracellular levels (**Figure 3.3E**) despite reducing MCP-1 gene expression (*see* **Figure 3.3A**). This suggests that MCP-1 secretion is blocked, resulting in greater intracellular accumulation.

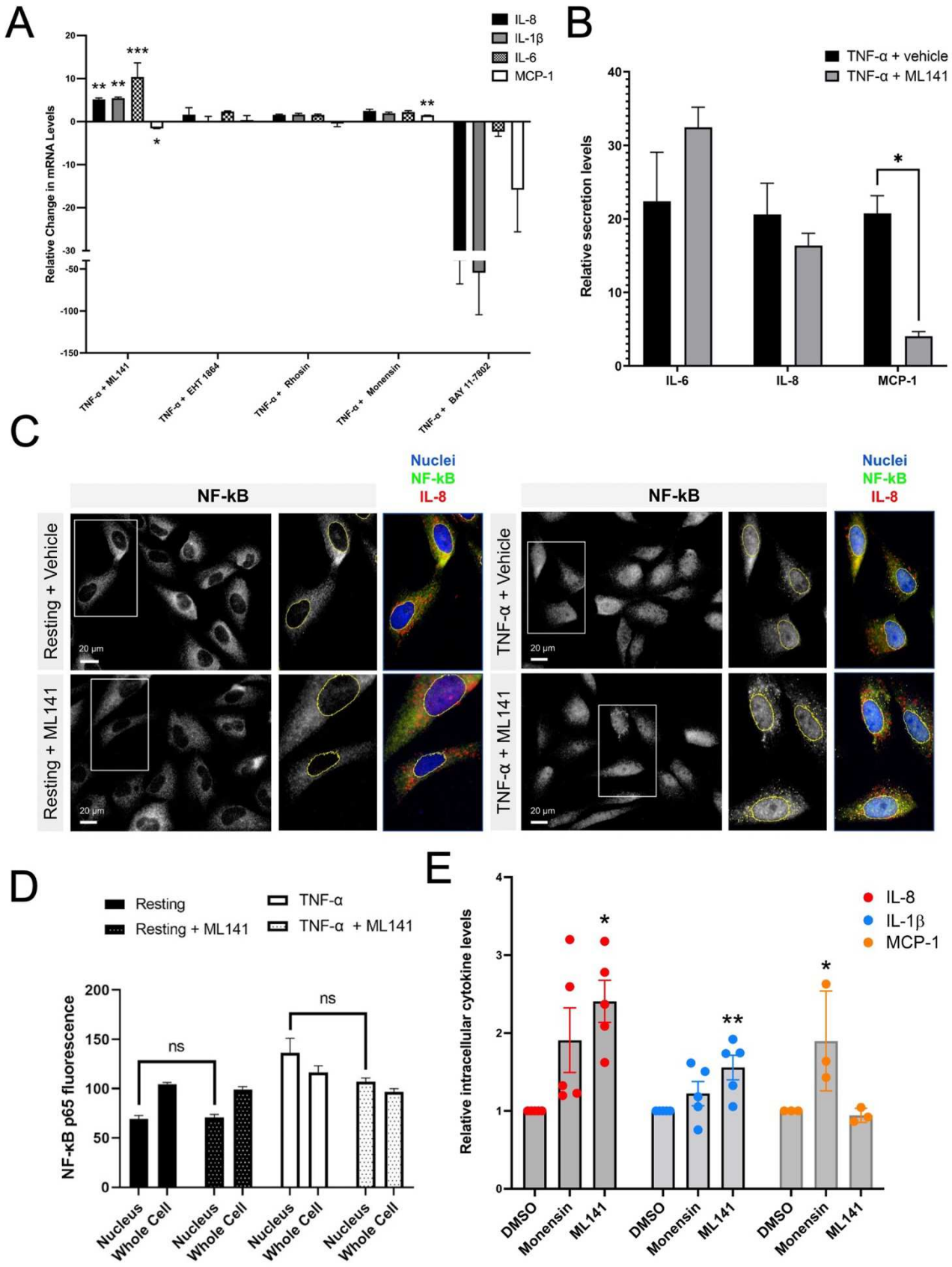

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Figure 3.3: The Cdc42 inhibitor, ML141, affects cytokine production and secretion. **A)** Change in cytokine mRNA levels due to incubation with Rho drugs. BEAS-2B cells were serum-starved for 16 h and pretreated with drugs for 1 h, then stimulated with 10 ng/mL TNF-α for 4 h. Values represent ΔΔCt fold changes in mRNA normalized to vehicle-treated control. Drug concentrations: 20 μM ML141, 10 μM EHT1864, 10 μM Rhosin, 2 μM monensin, 10 μM BAY 11-7082. **B)** Relative levels of secreted IL-6, IL-8 and MCP-1 in cell culture media of BEAS-2B cells. Conditioned media was collected after 8 h of stimulation with 10 ng/mL TNF-α +/- 20 μM ML141, and cytokines detected by human cytokine multiplex assay (EveTechnologies™). Data is normalized to resting control levels shown previously (see Figure 3.1) which is set to 1. **C, D)** Quantification of NF-κB levels in the nucleus. BEAS-2B cells were pre-treated with 20 μM ML141 or vehicle (DMSO) for 1 h, then stimulated for 30 min with 10 ng/mL TNF-α. Cells were fixed and stained with NF-κB antibodies for immunofluorescence (panel C) and levels of NF-κB staining in the nuclei or whole cells (nuclei and cytosolic regions) was quantified (panel D). **E)** Intracellular levels of cytokines in stimulated BEAS-2B cells detected by flow cytometry. Cells were pre-treated with 2 μM monensin, 20 μM ML141 or vehicle (DMSO) for 1 h then stimulated with 10 ng/mL TNF-α for 4 h. Cells were fixed and stained with IL-8, IL-1β, and MCP-1 antibodies. Bars are the mean ± SEM; n=4 (15 – 20 cells from at least 3 different images); *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$, ns, not significant, by one-way ANOVA followed by Tukey's (*A*) or Dunnet's (*B*) test.

3.2.4 Cytokine intracellular staining in response to Cdc42 inhibitor, ML141, in TNF-α-stimulated BEAS-2B cells

Our results show Cdc42 inhibition increases cytokine gene expression, but blocks Golgi-mediated cytokine secretion. To further examine the mechanism behind the apparent discrepancies between the effects of Cdc42 inhibition on gene expression versus overall secretion of cytokines, we performed immunofluorescence microscopy to visualize cytokine trafficking. BEAS-2B cells were either left unstimulated or stimulated for 4 h with TNF-α. IL-8 and IL-1β staining increased after TNF-α stimulation; however, their distribution within the cell was distinct. IL-8 showed perinuclear staining and an increase in peripheral tubule reticular staining after stimulation (**Figure 3.4A**, *upper panels*), while IL-1β showed a general punctate staining pattern (**Figure 3.4B**, *upper panels*). IL-8 and IL-1β staining did not overlap (**Figure 3.5**). Inhibition of Cdc42 with ML141 resulted in the loss of IL-8 tubule staining, and instead, intense punctate staining was observed (**Figure 3.4A**, *lower panels*), while the IL-1β staining pattern was essentially not affected (**Figure 3.4B**, *lower panels*). Tubule staining of IL-8 also occurred when other stimuli were used and these were similarly disrupted by ML141 (**Figure 3.4A**, Cockroach Extract, Poly(I:C); **Figure 2.1**, *lower panels*, **Section 2.2.2**). To confirm ML141 effects were due to Cdc42 inhibition, we treated cells with a second Cdc42 inhibitor, CASIN. IL-8 staining of post-Golgi tubular structures after TNF-α stimulation was largely abolished when cells were pre-treated with 10 μM CASIN, which was similar to that observed with ML141 treatment (**Figure 3.6**). However, nuclear fragmentation was also observed at 10 μM CASIN which indicated a toxic effect and likely the initiation of apoptosis.

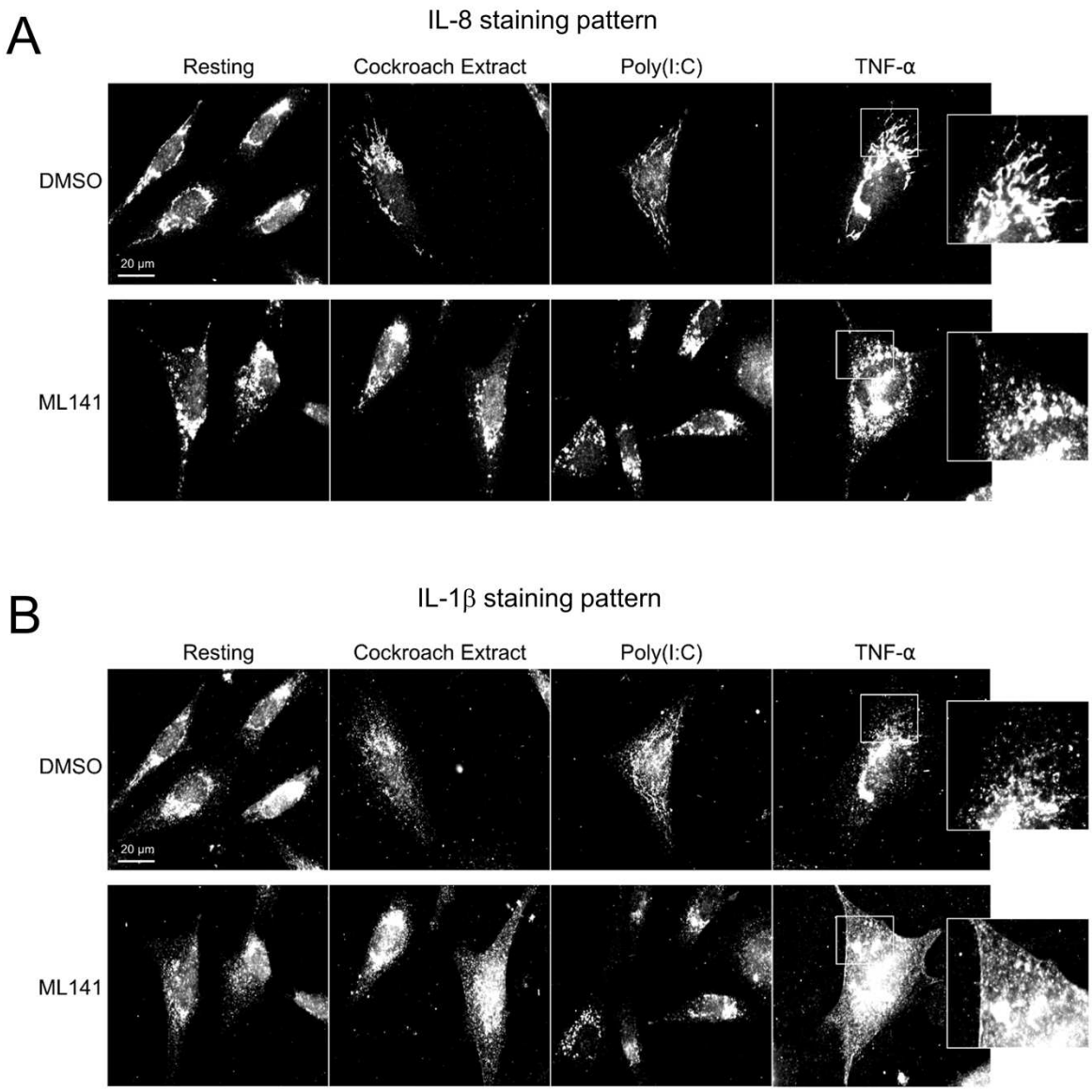

Figure 3.4: Cdc42 inhibition disrupts cytokine trafficking. BEAS-2B cells were pretreated with 20 μM ML141 or vehicle (DMSO) for 1 h, then stimulated with 10 ng/mL TNF-α for 4 h. Cells were then fixed and stained with cytokine antibodies. **A)** IL-8 staining pattern. **B)** IL-1β staining pattern. Zoomed panels show the two cytokines display different characteristic staining patterns upon stimulation. ML141 affects the IL-8 staining pattern but does not affect IL-1β staining.

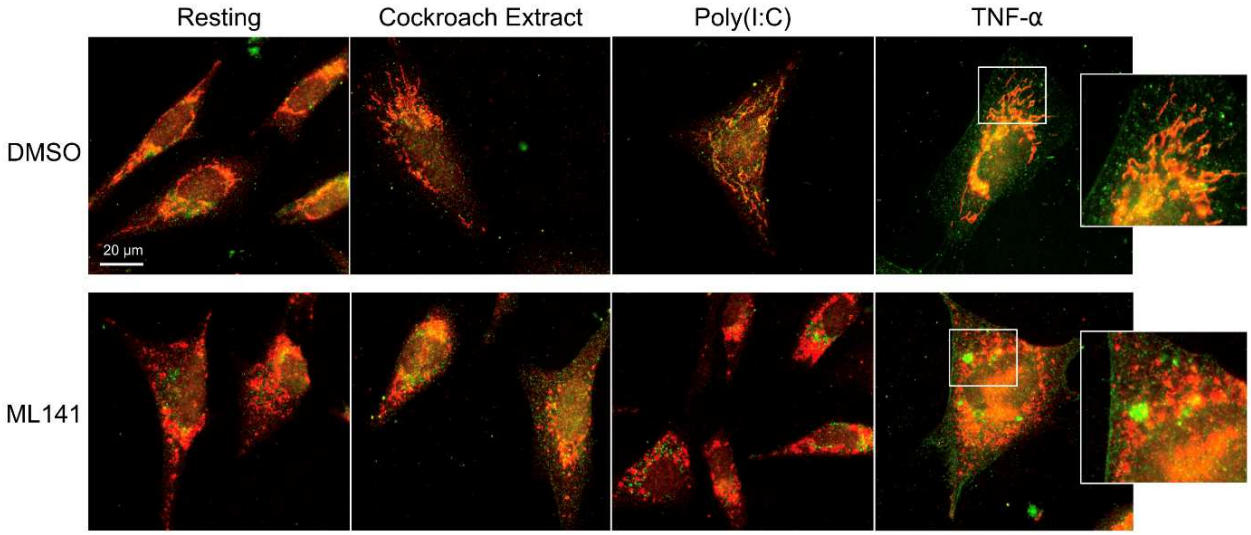

Figure 3.5: Overlay of IL-8 (red) and IL-1β (green) staining in response to ML141. IL-8 and IL-1β show non-overlapping staining patterns and are differentially affected by Cdc42 inhibition. BEAS-2B cells were pretreated with 20 μM ML141 or vehicle (DMSO) for 1 h, then stimulated with 10 ng/mL TNF-α for 4 h. Cells were then fixed and stained with IL-8 (red) and IL-1β (green) antibodies. Zoomed panels show the two cytokines display different characteristic staining patterns. ML141 affects the IL-8 staining pattern but does not affect IL-1β staining.

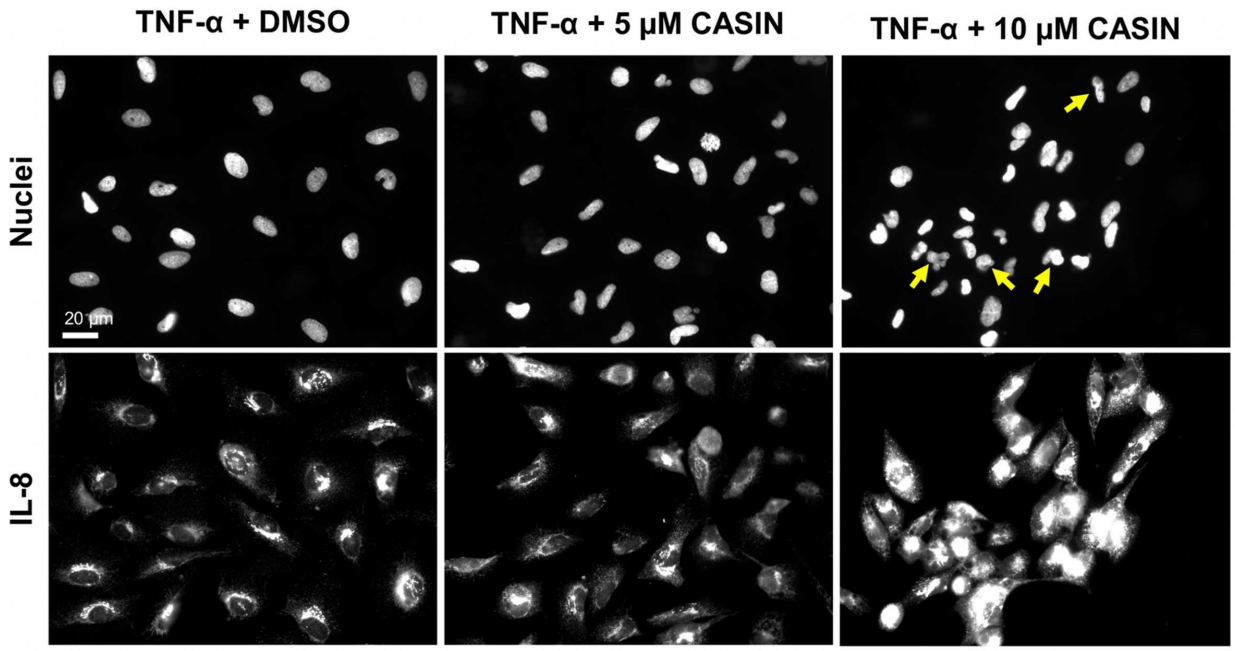

Figure 3.6: Effect of the Cdc42 inhibitor, CASIN, on BEAS-2B cells. BEAS-2B cells were pre-treated with vehicle (DMSO) or CASIN at 5 μM or 10 μM for 1 h. Cells were then stimulated with 10 ng/mL TNF-α for 4 h. Cells were then fixed and stained for immunofluorescence with IL-8 antibodies to assess cytokine trafficking and DAPI to assess nuclear fragmentation, which indicates apoptotic cell death. 10 μM CASIN disrupted IL-8 post-Golgi staining of tubules however, some cells also showed nuclear fragmentation (yellow arrows) indicating a toxic effect. Note that at 20 μM CASIN, no cells remained to image likely due to a highly toxic effect resulting in massive cell death.

3.2.5 Cdc42 inhibitor, ML141, compromises cytokine staining and Golgi integrity

We next examined the cellular distribution of cytokines with respect to the Golgi apparatus since their trafficking and secretion is likely to be Golgi-dependent. In addition to IL-8, MCP-1 distribution was examined since these cytokines are differentially affected by ML141. Prior to stimulation IL-8 and MCP-1 showed Golgi localization that was disrupted by ML141 (**Figures 3.7A, 3.8A**)**.** Both IL-8 and MCP-1 showed an increase in Golgi and post-Golgi staining after 4 h of TNF-α stimulation (**Figures 3.7B, 3.8B**)**.** IL-8 labeled tubules were observed that projected toward the cell periphery (**Figure 3.7B**, DMSO *arrows*), but tubule labeling was not observed for MCP-1 (**Figure 3.8B**, DMSO *arrows*). This suggests that the post-Golgi trafficking pathways of IL-8 and MCP-1 are different. In the presence of monensin, both IL-8 and MCP-1 showed an increase in Golgi staining and reduced post-Golgi staining (**Figures 3.7B, 3.8B**, *monensin*), which defined the Golgi as central to the secretion of both cytokines. Notably, treatment with the Cdc42 inhibitor, ML141, resulted in the loss of post-Golgi tubule staining of IL-8 and increased staining of puncta around the Golgi (**Figure 3.7B**, ML141 *arrows*). Treatment with ML141 resulted in the partial dispersal of the Golgi staining of MCP-1 observed upon treatment with TNF-α, and increased punctate staining pattern around the Golgi (**Figure 3.8B**, ML141 *arrows*). The Golgi marker, GM130, also showed an increase in dispersed punctate staining after ML141 treatment (**Figures 3.7B, 3.8B**, *GM130 channel*). This suggests that Cdc42 is needed for efficient trafficking of cytokines through the Golgi due to its requirement to maintain Golgi structure. A degree of Golgi disruption (apparent from GM130 staining) was also observed in monensin-treated cells, consistent with findings reporting GM130 degradation and Golgi dispersal in response to monensin [Eisenberg-Lerner et al., 2020]. IL-1β showed a general cytosolic staining pattern since it does not traffic through the Golgi and this was not affected by ML141 treatment (*see* **Figure 3.4**).

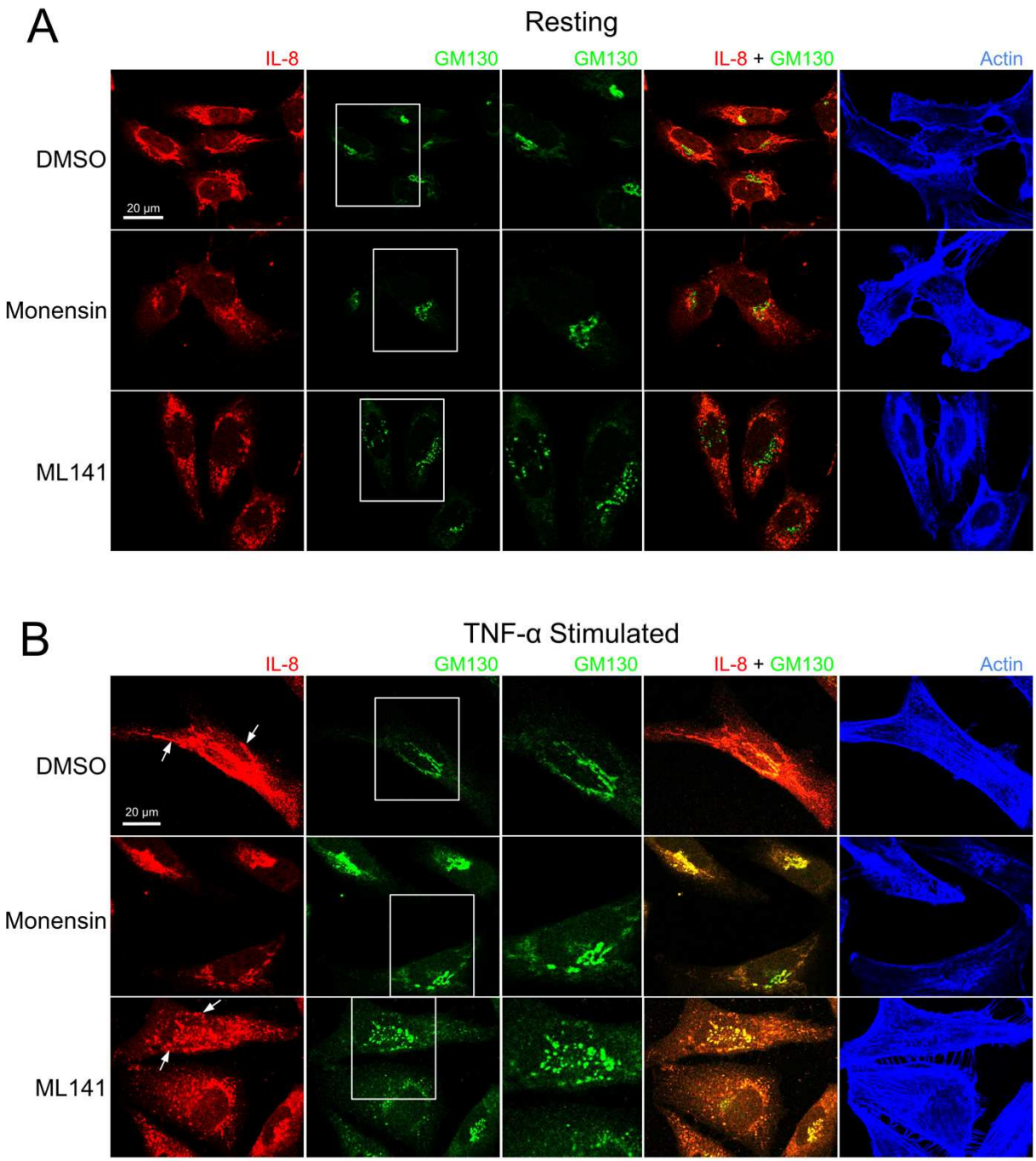

Figure 3.7: Cdc42 inhibition induces changes in Golgi structure and in IL-8 trafficking. BEAS-2B cells were pre-treated with 20 µM ML141, 2 µM monensin or vehicle (DMSO) for 1 h. **A)** Cells left unstimulated (resting) for 4 h. **B)** Cells were stimulated with 10 ng/mL TNF-α for 4 h. Cells were then fixed and stained with IL-8 and GM130 (Golgi marker) antibodies while actin was labeled with phalloidin-iFluor 405 dye. Monensin induced a Golgi-localized staining pattern for IL-8 while ML141 treatment resulted in less Golgi-localized IL-8 and dispersed GM130 staining.

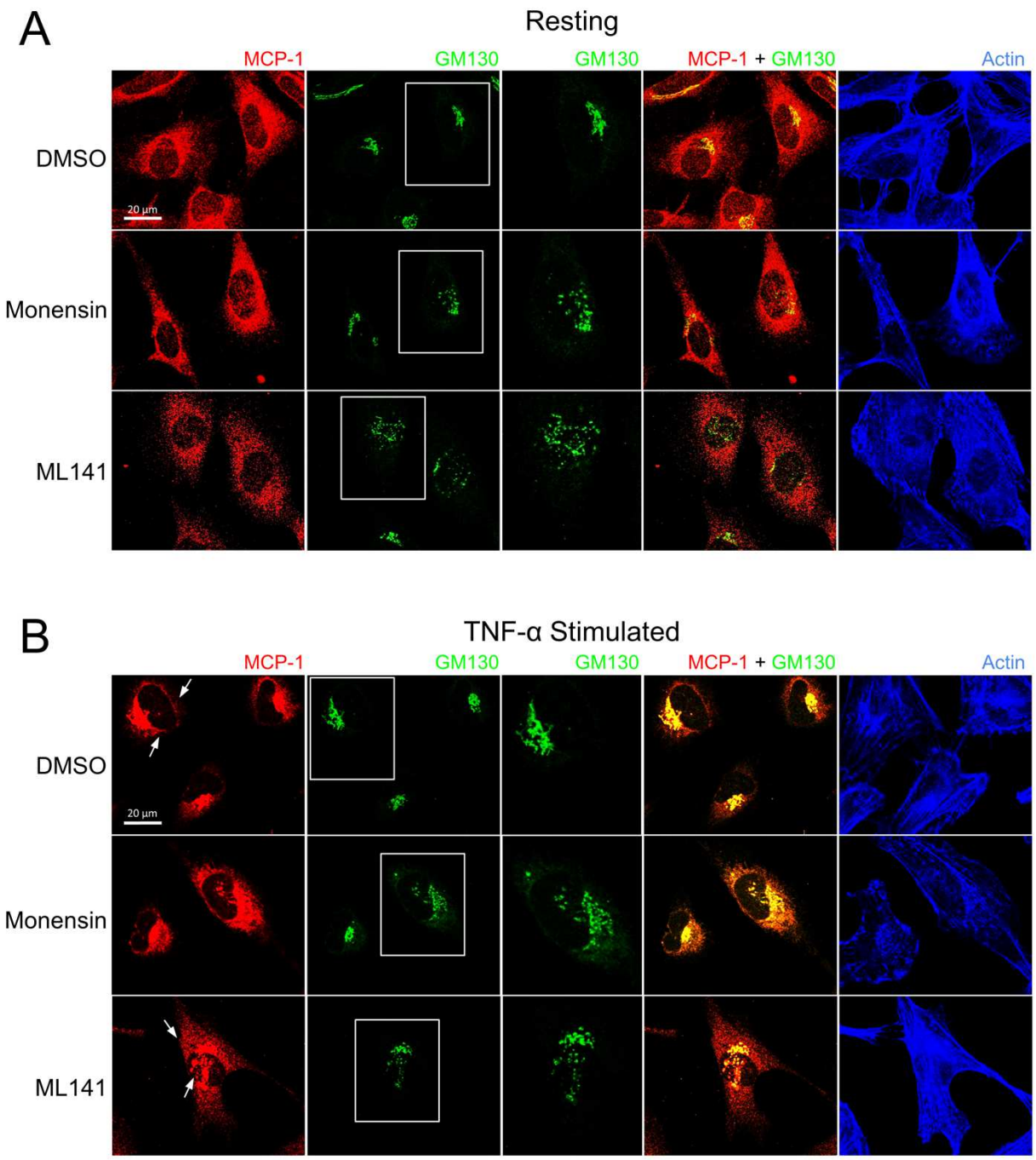

Figure 3.8: Cdc42 inhibition induces changes in Golgi structure and in MCP-1 trafficking. BEAS-2B cells were pre-treated with 20 µM ML141, 2 µM monensin or vehicle (DMSO) for 1 h. **A)** Cells unstimulated (resting) for 4 h. **B)** Cells were stimulated with 10 ng/mL TNF-α for 4 h. Cells were then fixed and stained with MCP-1 and GM130 (Golgi marker) antibodies while actin was labeled with phalloidin-iFluor 405 dye. Monensin did not induced an enrichment of Golgi-localized MCP-1 and ML141 treatment resulted in no change in the MCP-1 staining pattern.

3.2.6 Cdc42 genetic silencing affects cytokine expression

Next we used shRNA to deplete Cdc42 in BEAS-2B cells to validate its functional requirement in cytokine production and trafficking. Cdc42 is essential for viability and therefore we selected healthy strains transduced with lentiviral particles encoding shRNAs to three different target sites that showed 40%, 60% and 75% reduction in Cdc42 mRNA (Cdc42 KD strain 1, strain 2, strain 3, respectively) (**Figure 3.9A**)**.** We also validated the efficiency of our knockdown strains by assessing Cdc42 protein levels by western blot and found Cdc42 proteins levels to be significantly decreased compared to naïve or scrambled-control cells (**Figure 3.10**). In general, Cdc42 knockdown strains showed an increase in IL-8 and IL-1β mRNA levels (**Figure 3.9B**), which was similar to that observed after treatment with the Cdc42 inhibitor ML141 (*see* **Figure 3.3A**). Cdc42 knockdown also appeared to cause consistent decreases in MCP-1 mRNA levels (**Figure 3.9B**), corroborating the findings of pharmacological inhibition, although this modest change appeared statistically-insignificant.

To further investigate the effect of Cdc42 silencing on cytokine production, we performed flow cytometry to assess the intracellular levels of IL-8 and IL-1β proteins. Monensin was used as a control to examine the effect of blocking Golgi transport. As expected, levels of IL-8 and MCP-1, which traffic through the Golgi [Stanley & Lacy, 2010], increased when monensin treated, while levels of IL-1β, which is constitutively secreted [Giuliani et al., 2017], were not affected (**Figure 3.9C**)**.** Cdc42 knockdown resulted in a general increase in the levels of intracellular cytokines, and particularly IL-1β (**Figure 3.9C**, *blue dots*). We found that MCP-1 intracellular protein levels remained the same (**Figure 3.9C**, *yellow dots*), despite the slight reductions in MCP-1 mRNA levels upon Cdc42 depletion (**Figure 3.9B**), also corroborating the findings observed with ML141. This suggests that cytokine accumulation within a cell is due to a block at the trafficking or secretion level. Also consistent with data from the pharmacological inhibition of Cdc42 with ML141, the levels of secreted MCP-1 detected in the extracellular media appeared to be drastically decreased in Cdc42 KD strains (**Figure 3.9D** and **Table 3.2**). On the other hand, secretion levels of IL-8 and other cytokines were unaffected despite increases in gene expression as we speculated is due to trafficking defects. These results support an essential role for Cdc42 in cytokine secretion which appears disrupted when Cdc42 is depleted.

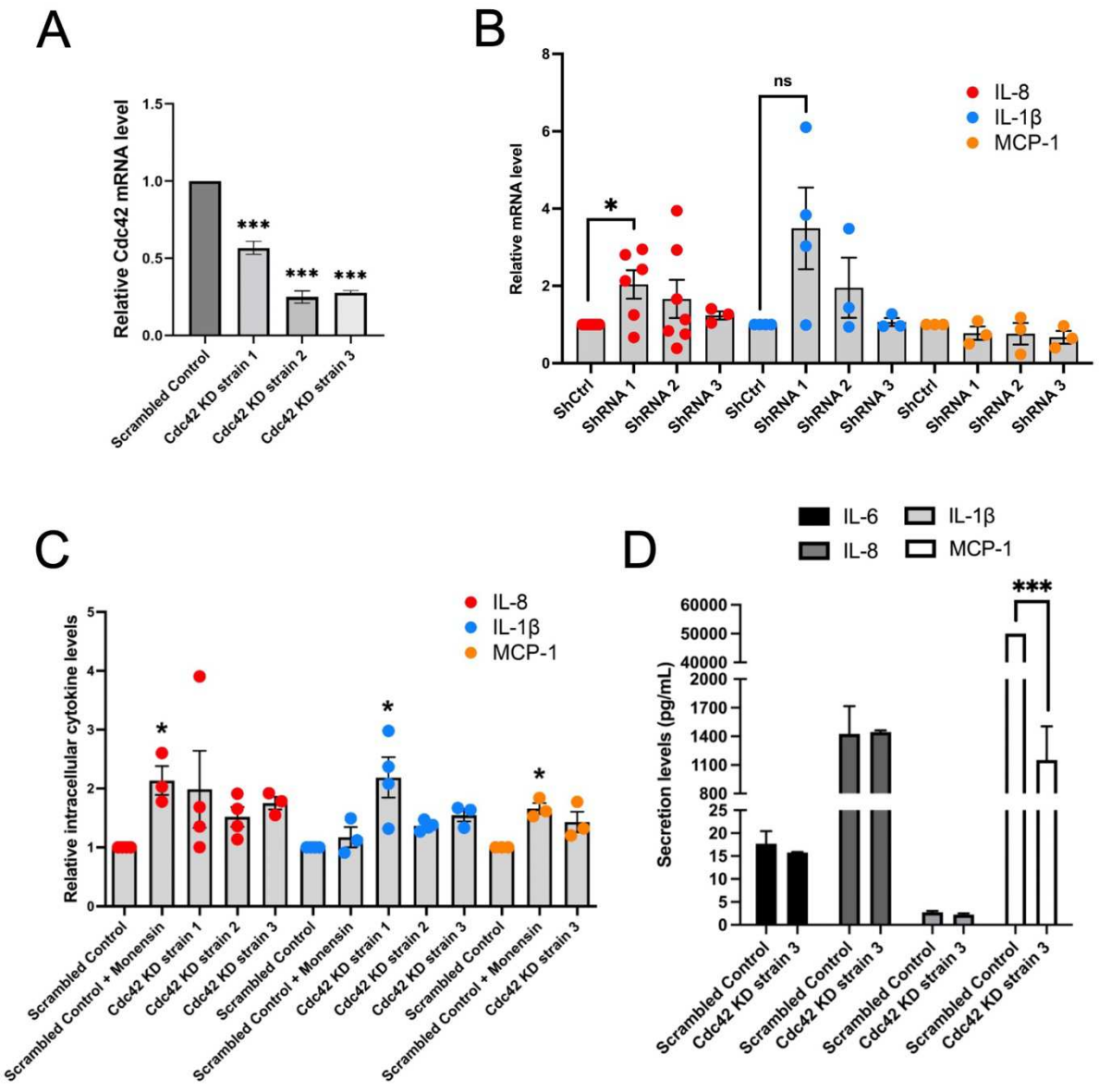

Figure 3.9: Cdc42 knockdown (KD) affects expression and secretion of a subset of cytokines. **A)** Cdc42 mRNA levels detected by quantitative RT-PCR for three Cdc42 KD strains in BEAS-2B cells. Values represent ΔΔCt fold changes normalized to GAPDH internal control and to scrambled control KD group. **B)** mRNA levels of various cytokines detected with quantitative RT-PCR in Cdc42 KD strains compared to scrambled control. All cells were serum-starved for 16 h and stimulated with 10 ng/mL TNF-α for 4 h. Values represent ΔΔCt fold changes normalized to scrambled control. **C)** Intracellular levels of cytokine proteins detected with flow cytometry. Serum-starved cells were treated with 2 μM monensin to block secretion or vehicle control (DMSO) for 1 h. Cells were then stimulated with 10 ng/mL TNF-α for 4 h. Cells were then trypsinized, fixed for staining and analyzed by flow cytometry. **D)** Secretion levels of IL-6, IL-8, IL-1β and MCP-1 cytokines in cell culture media performed by human cytokine multiplex assay (EveTechnologies™). All cells were serum-starved for 16 h then treated with 10 ng/mL TNF-α for 8 h. Data represents three independent experiments. Bars are the mean ± SEM; n=3; * $p < 0.05$, *** $p < 0.001$, ns, not significant, by one-way ANOVA followed by a Tukey's (*B*) or Dunnett's (*C*) test. Data in (*A*) and (*D*) was analyzed by pairwise analysis using Student's t test. Note, secreted levels of MCP-1 for scrambled control samples were at the upper limit of detection and designated as the maximum value for detection, therefore SEM was not shown.

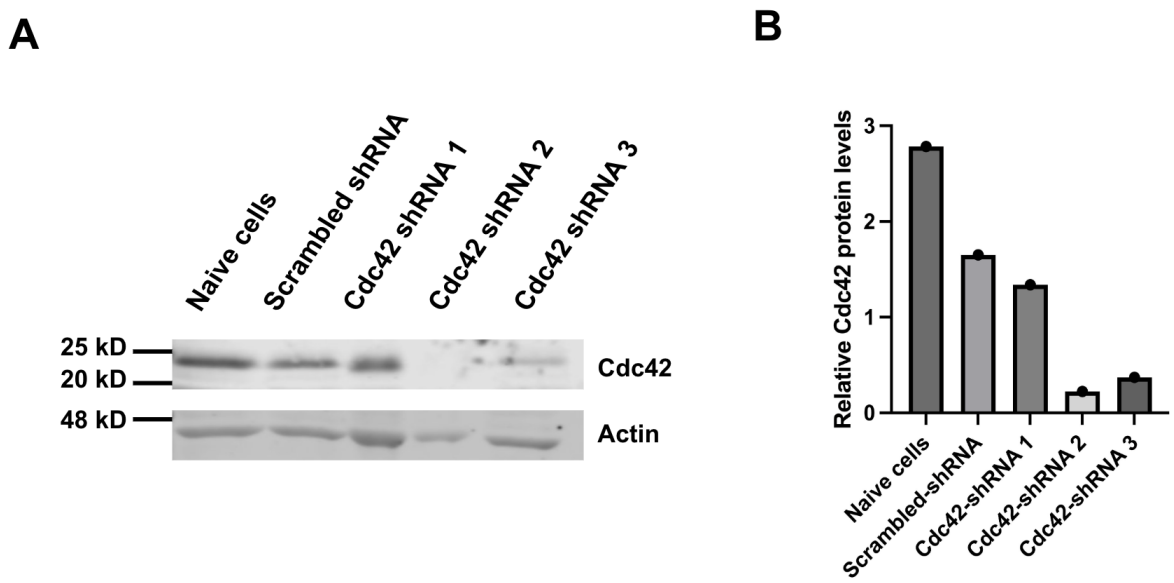

Figure 3.10: Validation of Cdc42 knockdown by western blot analysis of individual Cdc42 shRNA knockdown strains. **A)** Cdc42 is expressed in naïve and scrambled control shRNA-transduced BEAS-2B cells but reduced in knockdown strains 1, 2 and 3. **B)** Densitometry analysis of Cdc42 normalized to α-actin bands intensity. Data is representative of three different immunoblots. Note that Cdc42 shRNA strain 3 was the strain utilized for the majority of the analysis since strain 1 showed minimal Cdc42 depletion while strain 2 had reduced viability.

Table 3.2: Cytokine secretion levels (pg/mL) from BEAS-2B Cdc42 KD and control cells after 8 h of TNF-α stimulation.

	Replication 1		Replication 2		Replication 3	
Cytokine	**ShCtrl**	**Cdc42-shRNA 3**	**ShCtrl**	**Cdc42-shRNA 3**	**ShCtrl**	**Cdc42-shRNA 3**
GM-CSF	6.02	N/A	0.5	N/A	9.89	N/A
IFN-γ	1.24	1.17	0.91	1.25	1.51	1.03
IL-1β	2.58	2.75	2.46	1.87	3.27	2.11
IL-Ra	0.39	0.49	0.38	0.43	0.45	0.38
IL-2	0.14	0.23	0.16	0.17	0.22	0.17
IL-4	0.08	0.05	0.06	0.05	0.06	0.06
IL-5	0.06	0.07	0.05	0.06	0.06	0.05
IL-6	17.3	16	13.3	15.8	22.6	15.5
IL-8	1510	1414	884	1470	1884	1452
IL-10	0.38	0.35	0.3	0.32	0.44	0.34
IL-12p40	4.58	5.25	2.87	4.96	5.16	4.96
IL-12p70	0.33	0.32	0.28	0.25	0.44	0.24
IL-13	5.75	4.98	4.2	5.9	6.5	4.2
MCP-1	50,000	1856	50,000	797	50,000	805
TNF-α	100,000	100,000	100,000	100,000	100,000	100,000

Human cytokine multiplex analysis (HDF15) performed by EveTechnologies™. BEAS-2B Cdc42 KD or scrambled control cells, were stimulated 8 h with 10 ng/mL TNF-α. Data represents three independent experiments. N/A, not detected (secretion levels below detection range); values in orange color, extrapolated secretion levels based on standard curve (above detection range).

3.2.7 Cytokine intracellular staining patterns in Cdc42-depleted cells

Cdc42 depletion resulted in unique cytokine trafficking disruption as visualized with immunofluorescence microscopy. In resting conditions, IL-8 displayed a characteristic staining pattern with tubules extending towards the cell periphery in the mock-depleted cells (**Figure 3.11A,** *top panels*). Tubular staining was greatly reduced by Cdc42 depletion (**Figure 3.11A**, *bottom panels*). This change was more pronounced with TNF-α treatment, where tubule labelling was eliminated and intense staining was observed at the Golgi with punctate peripheral staining (**Figure 3.11B**). This suggests that trafficking from the Golgi to the cell periphery was disrupted. MCP-1 showed similar results to IL-8. In resting conditions, mock-depleted cells showed a diffuse MCP-1 staining pattern with some tubule labelling **(Figure 3.11C**, *top panel*); this was eliminated upon Cdc42 depletion (**Figure 3.11C**, *bottom panel*). Following TNF-α stimulation, MCP-1 displayed a characteristic perinuclear staining, which was observed in both mock and Cdc42-depleted cells (**Figure 3.11D**). No Golgi fragmentation was observed in knockdown cells, as visualized with the Golgi marker GM130 (**Figure 3.11**, *GM130 channel*). This is likely due to cell adaptation because cells with disrupted Golgi cannot survive for prolonged periods of time. This is unlike ML141 treatment (**Figure 3.7** and **Figure 3.8**, *GM130 channels*), where the effects on the Golgi were acute and cells do not have time to adapt.

We then sought to further confirm if the changes observed in IL-8 and MCP-1 trafficking upon Cdc42 silencing are a result of disruptions to the secretory pathway. We expected the diffuse non-localized staining patterns of IL-1β to not be affected since it does not traffic through the classical secretory pathway [Giuliani et al., 2017]. As expected, IL-1β general cytosolic staining appeared to be unaffected and showed no differences in Cdc42-depleted cells compared to mock-depleted cells (**Figure 3.12**). Another marker, GGA2, that localizes to the trans-Golgi Network (TGN), was used to stain the secretory network more broadly [Uemura et al., 2018] highlighting that no significant overlap with IL-1β secretion exists. These effects are consistent with the established mechanism of trafficking and secretion of IL-1β (which does not occur through the Golgi), highlighting that Cdc42 inhibition may target IL-1β gene expression, whereas its effects on the secretory pathway do not significantly affect IL-1β [Giuliani et al., 2017].

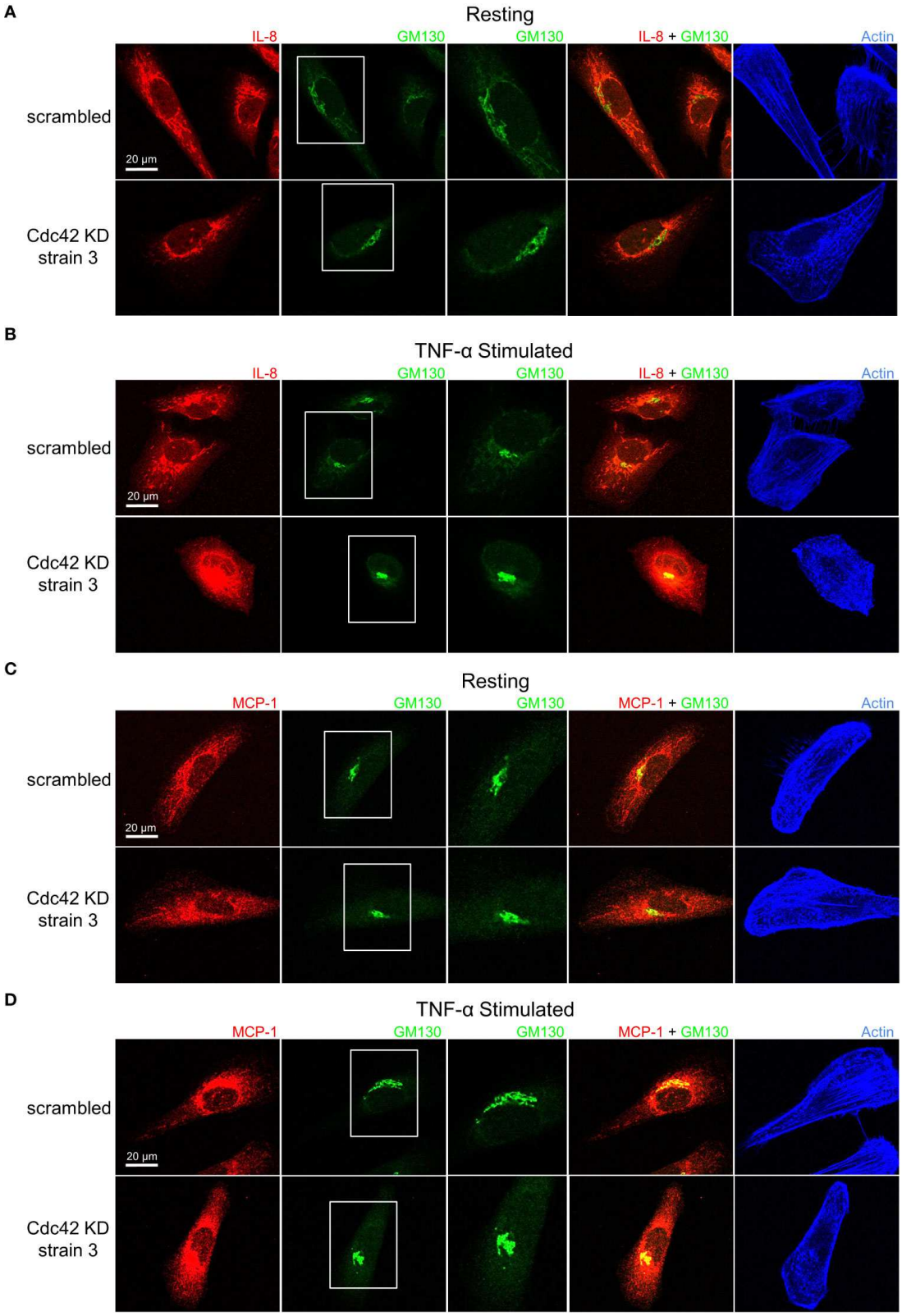

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Figure 3.11: Cdc42 knockdown (KD) induces changes in IL-8 and MCP-1 trafficking. Serum-starved Cdc42 KD and scrambled control BEAS-2B cells were either left unstimulated (panels A, C) or stimulated with 10 ng/mL TNF-α for 4 h (panels B, D). Cells were fixed and stained with IL-8 or MCP-1 cytokine antibodies, GM130 antibody to label Golgi and phalloidin-iFluor 405 dye to label F-actin. **A, B)** IL-8 staining pattern is tubular in control cells (scrambled) but punctate in Cdc42 KD cells, which indicates a significant disruption in trafficking. **C, D)** MCP-1 staining pattern shows Cdc42 KD disrupted MCP-1 trafficking, but had a less pronounced effect compared to IL-8.

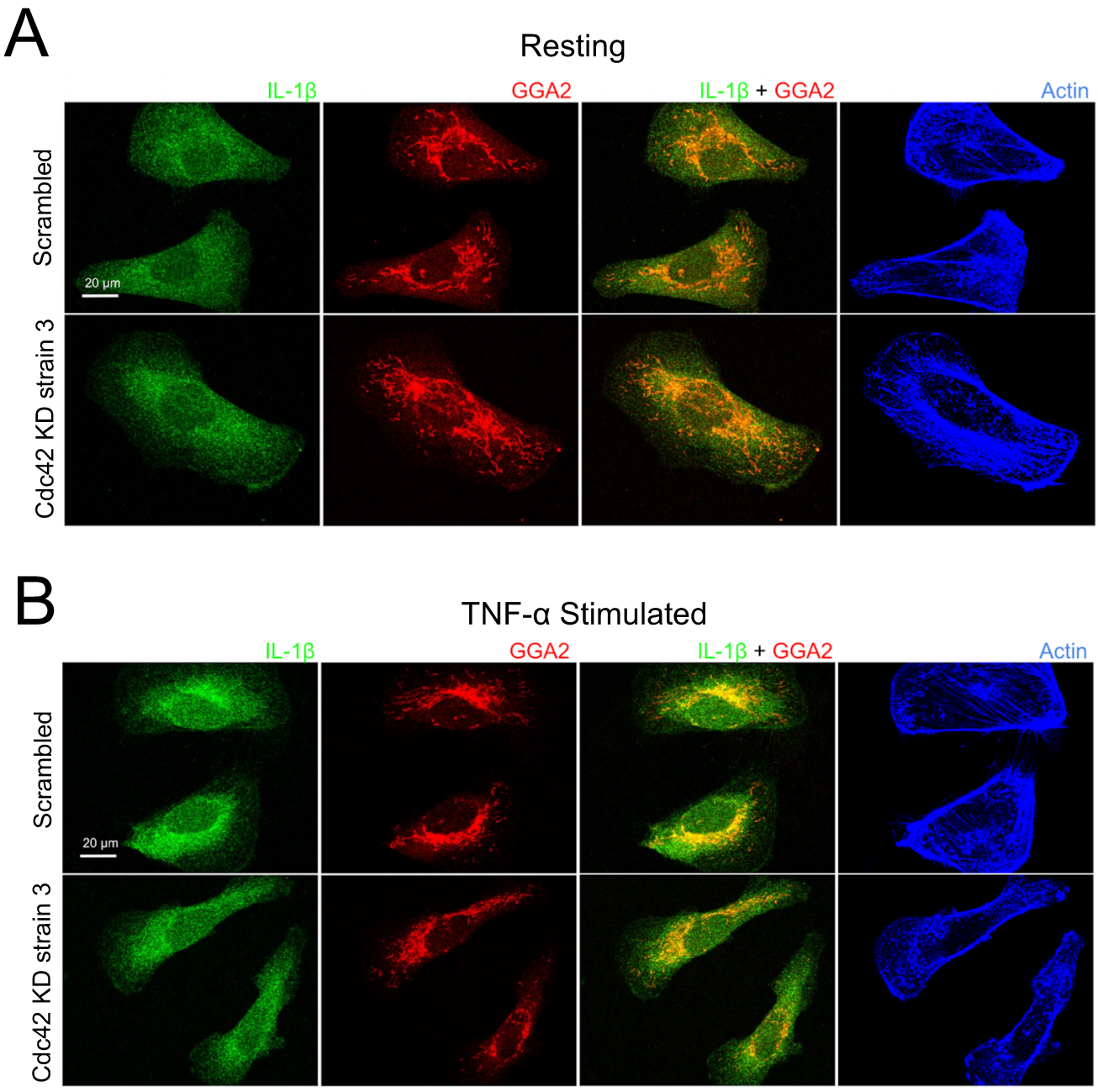

Figure 3.12: Cdc42-depletion does not affect IL-1β cytosolic trafficking under resting **(A)** and TNF-α stimulated **(B)** conditions. BEAS-2B, treated with scrambled control or Cdc42 KD shRNA, were serum-starved overnight, then left unstimulated (resting) or stimulated with 10 ng/mL TNF-α for 4 h. Cells were fixed and labeled with antibodies against IL-1β (green) and the trans-Golgi marker GGA2 (red); F-actin was labeled with phalloidin-iFluor 405 (blue).

3.3 Discussion

The airway epithelium, which primarily provides barrier function, also directly contributes to immune function [Whitsett & Alenghat, 2015]. Studies have shown that airway epithelial cells produce a plethora of cytokines and chemokines with specific profiles in response to specific insults. For example, respiratory viruses trigger interferon production, which in turn upregulate interferon regulated genes to support apoptosis [Hsu et al., 2012; Ioannidis et al., 2012], while IL-6 and IL-8 are significantly upregulated in response to viral and bacterial infection to recruit neutrophils for clearance [Ioannidis et al., 2012; Eckmann et al., 1993; Hedges et al., 1992]. However, airway function can be significantly impaired by uncontrolled or allergic inflammation. Airway epithelial released cytokines can result in the hyper-recruitment of innate immune cells and prolong their survival [Filep, 2022; Hahn et al., 2006; Uddin et al., 2010], and consequently directly contribute to diseases such as asthma and COPD [Frey et al., 2020]. Hence an understanding of how airway epithelial cells regulate immune function may provide therapeutic benefits.

Here we examined how airway epithelial cells regulate pro-inflammatory cytokine production and release. We found TNF-α to be the most potent stimuli over the allergen cockroach extract and the viral mimetic poly(I:C). TNF-α upregulates many epithelial cytokines through NF-κB nuclear translocation, which is known to drive inflammation gene transcription, though it also can activate multiple downstream transcriptional pathways [Makwana et al., 2012; Sheller et al., 2009]. TNF-α was the most potent stimulus, likely because it is a direct immunological stimulus that acts through TNFR which is highly expressed on airway epithelial cells [Saperstein et al., 2009]. Cockroach extract uses the PAR-2 receptor and involves an extra protease activation step through a G-protein coupled receptor signaling pathway, while poly(I:C) is a viral mimetic that acts through TLR3 which resides intracellularly. These additional step might reduce their potency.

We found novel roles for the Rho GTPase, Cdc42, in the regulation of cytokine gene expression and secretion. The effects of pharmacological inhibition of Cdc42 or genetic depletion of Cdc42 were found to be somewhat different depending on the cytokine species. While all of these cytokines were transcriptionally upregulated by pro-inflammatory stimuli, inhibition of Cdc42 resulted in a further upregulation of IL-8, IL-6 and IL-1β, but surprisingly, MCP-1 mRNA levels were reduced. This apparent discrepancy in regulation may be attributed to the fact that MCP-1 (CCL2) and IL-8 (CXCL8) are different classes of chemokines (CC vs CXC) [Hughes & Nibbs,

2018]. Transcription of MCP-1 is known to be differentially regulated than IL-8 [Lakshminarayanan et al., 1997; Roebuck et al., 1999]. However, further studies are required to specifically define their differential regulatory mechanisms.

Cdc42 also affected trafficking of cytokines, which ultimately impacts their observed secretion. We found that only MCP-1 secretion was decreased by Cdc42 inhibition, and there was no effect on IL-8, and IL-6 (*see* **Figure 3.3B, Table 3.1**). However, this observation of 'no net-change' in IL-6 and IL-8 levels may in fact signify a reduction in secretion since the gene expression of these cytokines was significantly upregulated by Cdc42 inhibitor treatment (*see* **Figure 3.3A**). However, their trafficking through the secretory pathway was disrupted (*see* **Figures 3.7B, 3.8B**) which may have counteracted the increase in gene expression. Another pro-inflammatory cytokine, GM-CSF, which regulates the differentiation and function of immune cells [Bhattacharya et al., 2015] was detected in conditioned media from mock-depleted cells but was not detected in Cdc42-depleted cells (*see* **Table 3.2**). This suggests that the observed effect of Cdc42 regulation of pro-inflammatory cytokine secretion also likely includes a variety of other cytokines or pro-inflammatory cargo proteins.

We report a specific role for Cdc42 in the trafficking of cytokine protein products at the Golgi. Trafficking of cytokines regulated by Cdc42 appears to be happening at the level of the Golgi since only MCP-1 and IL-8 trafficking were affected, and not IL-1β. A role for Cdc42 in regulating the Golgi trafficking of proteins is expected given the presence of a Golgi pool of Cdc42 in addition to the plasma membrane pool [Farhan & Hsu, 2016]. Cytokine trafficking patterns of IL-8 and MCP-1 were disrupted upon Cdc42 inhibition by ML141 or Cdc42 depletion. These cytokines showed transport in post-Golgi tubules like structures that became dispersed puncta after Cdc42 inhibition. This is consistent with findings showing that Cdc42 selectively enhanced anterograde transport at the Golgi while inhibiting retrograde transport [Park et al., 2015]. Specifically, Cdc42 can promote the formation of tubules at the Golgi while inhibiting vesicle formation in the retrograde direction. Additionally, our immunofluorescence data suggests that Cdc42 is required for proper Golgi architecture. Immunofluorescence microscopy showed prominent disruption to Golgi architecture in response to Cdc42 inhibition with ML141 (*see* **Figure 3.7** and **Figure 3.8**, *GM130 panels).* Disruption in the staining pattern of the Golgi concur with previous findings showing that pharmacological inhibition of Cdc42 with the small molecule inhibitor, ZCL278, resulted in disruption to Golgi organization in Swiss 3T3 cells [Friesland et al., 2013]. Upon treatment with ZCL278, the characteristic perinuclear staining of GM130, a cytoplasmic protein

that binds Golgi membranes, was dispersed which is similar to our observed effect of ML141 in BEAS-2B cells (*see* **Figure 3.7** and **Figure 3.8**, *GM130 channels*).

Although results from genetic silencing of Cdc42 were by and large similar to that observed with pharmacological inhibition via ML141, not all of the findings were entirely consistent; there was a lack of Golgi fragmentation when Cdc42 was depleted (*see* **Figure 3.11**). This is likely due to adaptation that can take place in knockdown cells that are cultured several days compared to the acute effects due to 4 hours of treatment with ML141 [Rouf et al., 2023]. Cells likely faced high pressure to adapt or compensate for perturbations such as Golgi disruption, increased cytokine production and the reduction of Cdc42 which is an essential protein. Similarly, Cdc42 KO in fibroblastoid cell models did not show disruption in Golgi structure and the percentage of cells displaying a compact Golgi was the same as the control [Kage et al., 2017].

Our results show that Cdc42 has pleiotropic roles in regulating epithelial airway inflammation. In our study, three different cytokines show differential production and trafficking regulation by Cdc42. IL-1β gene expression is negatively regulated by Cdc42. Since IL-1β is constitutively secreted [Giuliani et al., 2017], its trafficking does not appear to be affected by Cdc42 (*see* **Figure 3.4B** and **Figure 3.12**). On the other hand, IL-8 gene expression is negatively regulated (*see* **Figure 3.3A** and **Figure 3.9B**) while its trafficking is positively regulated by Cdc42 (*see* **Figure 3.9B** and **Figure 3.11**). Hence, upon Cdc42 inhibition, it appears as though there is no 'net effect' in secretion (*see* **Figure 3.3B** and **Figure 3.9D**). This is a result of the antagonism between these two effector functions of Cdc42 that together regulate cytokine release. Thirdly, for the MCP-1 cytokine, gene expression (*see* **Figure 3.3A** and **Figure 3.9B**) and trafficking (*see* **Figure 3.8** and **Figure 3.11**) are both positively regulated by Cdc42. Therefore, upon Cdc42 inhibition, we observe drastic reduction in secretion (*see* **Figure 3.3B** and **Figure 3.9D**) as a result of the combined effect of these two effector functions of Cdc42. These three different scenarios suggest that Cdc42 acts as a regulator in different signaling pathways as it acts as a negative transcriptional regulator of some cytokines (such as IL-8, IL-6, IL-1β) and positive regulator of others (such as MCP-1) while also regulating cytokine trafficking through the Golgi. These results imply that Cdc42 may be a highly selective modulator of cytokine release, highlighting the significance of its therapeutic potential. Indeed, characterization of targets that allow the precise control of the cytokine profile secreted from epithelial cells could prove to be extremely beneficial in a variety of pathologies. Here, we show that the release of the neutrophil chemoattractant, MCP-1, is attenuated by Cdc42. This is particularly important in COPD where the neutrophil-

driven inflammation underlies tissue damage and lung function decline [Hoenderdos & Condliffe, 2013].

In summary, we report two roles for Cdc42 as it can both negatively and positively affect cytokine gene expression and concomitantly regulate trafficking and secretion of cytokine protein products. These novel roles for Cdc42 may have implications in allergic pathologies and chronic airway inflammation diseases. However, there may be limitations in extending the interpretation of our results. Our studies utilized BEAS-2B cells which are an immortalized lung epithelial cell line [Reddel et al., 1988]. In future studies it would be important to show that Cdc42 impacts cytokine secretion from more physiologically relevant cellular or in vivo systems. In particular, validation of a role for Cdc42 in primary bronchial epithelial cells, or whether the Cdc42 pathway is dysfunctional in primary cells from lung disease patients should be examined. Testing Cdc42 inhibition in an in vivo system of airway inflammation would be a key goal; there are several mouse models of lung inflammation that have been developed [Nials & Uddin, 2008; Wright et al., 2008]. Progress has been made in the development of Cdc42 inhibitors although none have yet been tested in animal studies [Murphy et al., 2021].

Chapter 4: Inflammatory Gene Regulation by Cdc42 in Airway Epithelial Cells

4.1 Brief Introduction

Rho GTPases, which belong to the Ras superfamily of guanine nucleotide-binding proteins, are known to act as signal transduction 'molecular switches'; when switched on they drive downstream processes through recruitment and activation of effector complexes [Etienne-Manneville & Hall, 2002]. We, and others, have shown that Cdc42, is involved in signaling pathways that result in downstream inflammatory gene expression [Shouib & Eitzen, 2022; Zhao et al., 2003; Ito et al., 2014]. Cdc42 has also been shown to be involved in trafficking and transport through the secretory pathway. It has been shown to promote anterograde transport at the Golgi through the formation of COPI tubules [Farhan & Hsu, 2016]. Hence, Cdc42 can be viewed as a central regulator of pro-inflammatory programs by controlling the trafficking and secretion of cytokines [Hemshekhar et al., 2018; Hobert et al., 2002; Shouib & Eitzen, 2022].

We showed in Chapter 3 that Cdc42 has a role in the regulation of cytokines in lung epithelial cells using the bronchial epithelial cell model BEAS-2B [Shouib & Eitzen, 2022]. Our results revealed that Cdc42 inhibition or genetic silencing results in upregulation of typical airway epithelial cytokines, IL-6 and IL-8, while also downregulating MCP-1. This change in cytokine gene expression in response to Cdc42 was concomitant with trafficking defects that ultimately reduced cytokine secretion from epithelial cells. However, it was unclear how inflammatory pathways were activated in response to the loss of Cdc42 and the signaling mediators orchestrating cytokine gene expression. In this study, we investigate the role of Cdc42 on inflammatory gene expression in detail through RNA sequencing (RNA-Seq) analysis of airway epithelial cells treated with a pro-inflammatory TNF-α stimulus. We first characterize the transcriptome changes induced by TNF-α, and then looked at the effect of Cdc42 inhibition on gene expression. We identified key signaling mediators that are upregulated when Cdc42 is inhibited. Furthermore, we show through shRNA-mediated knockdown of these signaling targets that they are implicated in mediating the increase in cytokine mRNA levels in response to Cdc42 inhibition.

4.2 Results

4.2.1 Cdc42 inhibition results in inflammatory gene expression

We have previously shown that Cdc42 regulates both cytokine production and secretion in airway epithelial cells [Shouib & Eitzen, 2022]. To further investigate the mechanism(s) used by Cdc42 signaling, we performed RNA transcriptome sequencing and an analysis of differentially expressed genes (DEG). First, we performed a time course experiment to determine the optimal analysis time point at which the inflammatory cascade is fully activated in BEAS-2B cells. Cells were stimulated with TNF-α for 4, 8 and 16 hours, or left under resting conditions (0 hours) (**Figure 4.1A**). Cells were also pretreated with ML141 to inhibit Cdc42 activation (*see* **Figure 2.2, Section 2.2.2**) or vehicle (DMSO) for 1 hour prior to TNF-α stimulation. 4 hours of TNF-α stimulation were sufficient, and even optimal in the case of MCP-1, for inducing cytokine gene expression (**Figure 4.1B**). ML141 also induced an increase in IL-8 and IL-1β gene expression that also peaked at 4 hours, and in the case of MCP-1, which shows a reduction in response to Cdc42 inhibition; this effect was also detected at 4 hours. Therefore, we selected 4 hours of TNF-α stimulation with 1 hour of ML141 pre-treatment as our stimulation and drug-treatment conditions for all subsequent experiments. We also investigated the dose-response effects of ML141 for the cytokines investigated in Chapter 3 (IL-1β, IL-8 and MCP-1) to further validate the use of 20 μM of ML141 as an optimal concentration (*see* **Figure 2.3, Section 2.2.2**).

To gain insights into the role of Cdc42 in the regulation of inflammation, we analyzed differences in gene expression after treatment with Cdc42 inhibitor. Transcriptome-level RNA sequencing was done on four distinct treatment groups: Resting + DMSO, Resting + ML141, TNF-α + DMSO, and TNF-α + ML141. Cells were pre-treated for 1 hour with ML141 or vehicle, and then stimulated with TNF-α for 4 hours; total RNA was harvested for library preparation and sequencing. Principal component analysis (PCA) showed that the three biological replicates within the four different treatment groups clustered together (**Figure 4.2A**). The PCA plot showed similarity within biological replicates of each treatment group and variance between different treatment groups as they clustered in separation from one another [Ringnér, 2008], which establishes confidence that results were consistent between biological replicates. Raw RNA-Seq read data was submitted to the NCBI SRA database, BioProject ID: PRJNA1145001, and is available at the following link: http://www.ncbi.nlm.nih.gov/bioproject/1145001.

Hierarchical clustering, which groups genes with similar expression patterns across the different treatment conditions, showed that TNF-α and ML141 treatments resulted in five distinct gene clusters (**Figure 4.2B, Table 4.1**). Two clusters showed synergistic responses. Cluster 3 are genes unaffected by ML141 treatment, increased when TNF-α treated, but highly increased by ML141 + TNF-α combined treatment. Genes found in this cluster included many cytokines that were not directly affected by ML141 alone, but transcript levels were increased significantly in the presence of an inflammatory stimulus (e.g. CXCL1, IL-1β). Likewise, genes in cluster 4 showed an increase in transcript levels when ML141 treated, low or no change when TNF-α treated, but TNF-α + ML141 combined treatment showed a more prominent increase in gene transcript levels than those induced by ML141 treatment alone. Transcripts for cytokines in this cluster were increased by ML141 alone and include IL-8, IL-1α. Cluster 5 are genes that were reduced by ML141 and include the cytokine MCP-1 (CCL2).

Table 4.1: Characteristics of hierarchical clustered genes

	Effect of ML141	Effect of TNF-α	Effect of ML141 and TNF-α
Cluster 1	up	down	none
Cluster 2	down	down	down
Cluster 3	none	up	synergistically up
Cluster 4	up	none/up	synergistically up
Cluster 5	down	up	none/down

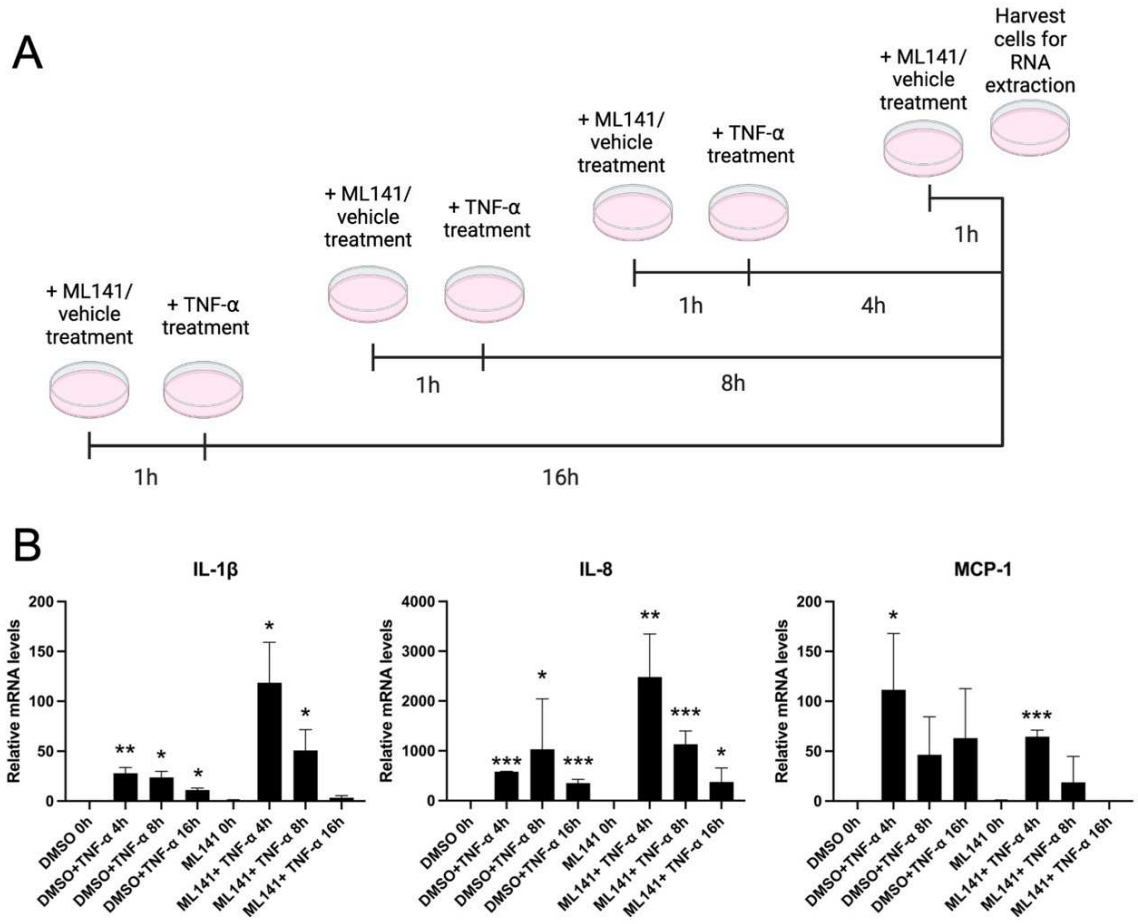

Figure 4.1: Cdc42 inhibition by ML141 induces cytokine gene expression from epithelial cells. **A)** Schematic of the stimulation timeline of BEAS-2B cells treated either by ML141 (20 μM) or vehicle/DMSO control and subsequently stimulated with TNF-α (10 ng/mL) or left in resting conditions for a time course experiment. **B)** mRNA levels of cytokines IL-1β or IL-8 or MCP-1 as determined by quantitative RT-PCR from time course samples pre-treated with ML141 or vehicle/DMSO for 1 hour and subsequently treated with TNF-α for 16, 8, 4 hours or left in resting conditions with no TNF-α. mRNA levels from each treatment group is normalized to 'DMSO 0h' resting control (which is set to 1). Data represents ΔΔCt. ML141, Cdc42 inhibitor; DMSO, vehicle control; TNF-α, Tumor necrosis factor-alpha; IL, interleukin; MCP-1, monocyte chemoattractant protein-1. Error bars represent SEM. Data represent at least three independent experiments. A one-way ANOVA test was performed on ΔCt values followed by a Tukey's multiple comparisons test. *p-value< 0.05, **p<0.01, ***p<0.001.

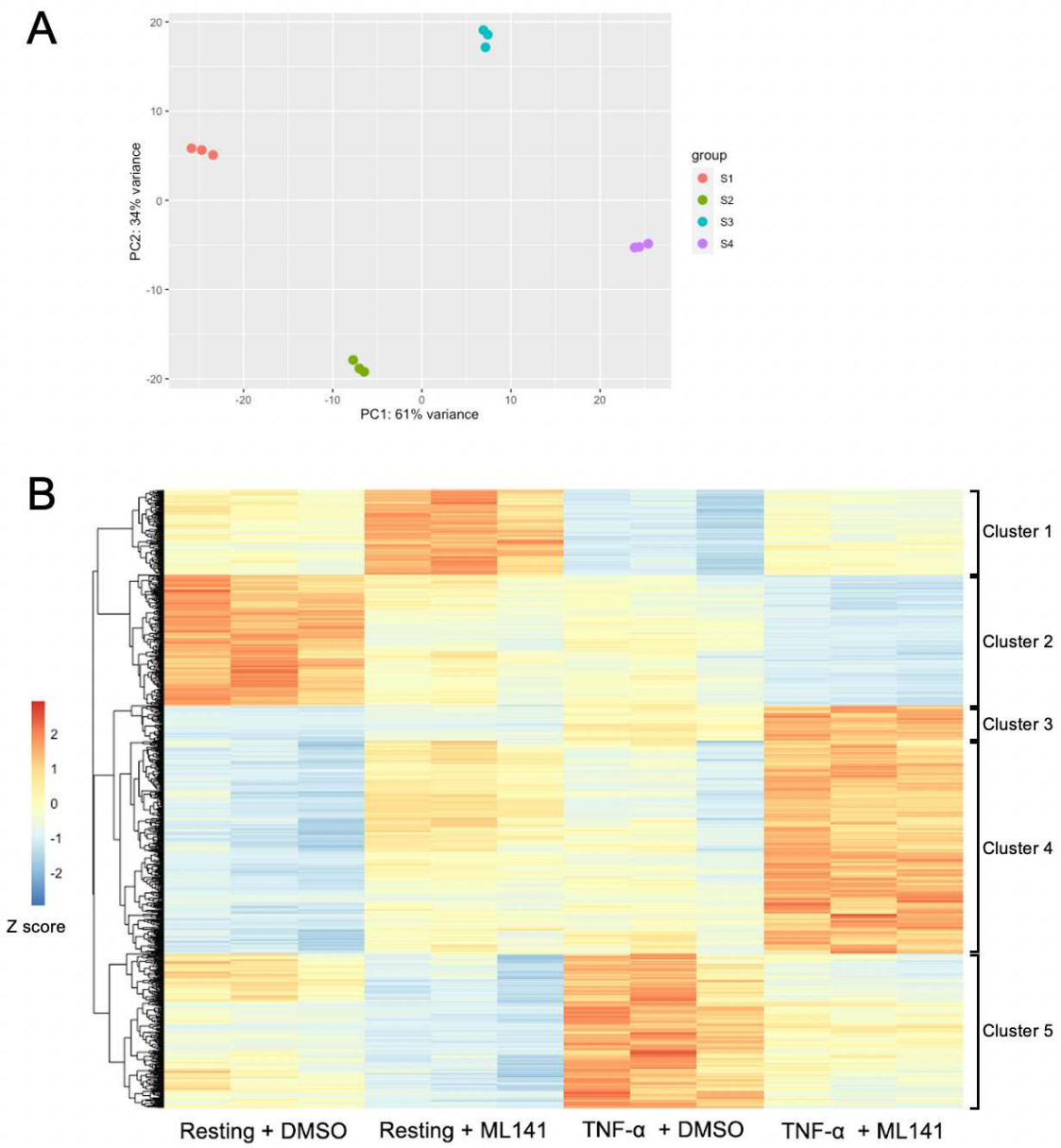

Figure 4.2: Transcriptomic analysis of TNF-α stimulated BEAS-2B cells +/- Cdc42 inhibitor. **A)** Principal component analysis (PCA) showing clustering of samples based on variance. S1: Resting + DMSO; S2: Resting + ML141; TNF-α + DMSO; TNF-α + ML141. Dots of the same color represent biological replicates in the same experimental group (n=3). **B)** Heatmap of unsupervised hierarchical clustering of genes. RNA-seq data was filtered to remove low expressing genes and unsupervised clustering was based on similar patterns of relative expression [Kiselev et al., 2019]. A total of 997 genes are plotted that were significantly differentially expressed genes (FDR < 0.05) in response to TNF-α stimulation or ML141.

4.2.2 TNF-α activates inflammatory pathways in bronchial epithelial cells

Next, we performed pairwise comparisons of differentially expressed genes (DEG analysis) to identify genes and molecular pathways that were most affected by TNF-α. To characterize the effect of TNF-α treatment on BEAS-2B cells, we compared the TNF-α + DMSO group to the Resting + DMSO control group. A large set of genes involved in inflammation were upregulated as expected (**Table S1**, Supplementary Material). We used volcano plots to show all the genes that were significantly differentially expressed (**Figure 4.3A,** *dots*) under TNF-α treatment; the majority of which were upregulated (**Figure 4.3A,** *red dots*). When genes that belong to the human gene family 'Cytokines and Growth Factors' were labelled, a large proportion of DEGs were labelled, showing significant enrichment of inflammatory genes (**Figure 4.3A**, *left panel*). We observed that pro-inflammatory cytokine transcript levels increased (e.g. CXCL2/6/8) and secreted morphogenic ligand transcript levels decreased (e.g. APLN/BMP4/PGF). The gene set displayed in volcano plots are also provided as a heatmap depicting differential expression of individual genes that showed significant changes (**Figure 4.4***, left panel*). Gene ontology (GO) term enrichment analysis was used to identify groups of genes involved in specific biological pathways that were significantly increased (**Figure 4.3B**). This analysis showed that gene sets involved in immune defense and regulation of cell proliferation were differentially regulated.

4.2.3 Effect of TNF-α on trafficking pathways

We also used a volcano plot to show differentially expressed genes from the 'Reactome ER to Golgi Anterograde Transport' gene set (**Figure 4.3A**, *right panel*). A heatmap for individual genes within this gene set are shown in **Figure 4.4** (*right panel*). In contrast to inflammatory genes, changes to transport genes were not as robust. The β-tubulin genes, TUBB2B and TUBB2A that comprise the microtubules network and required for proper vesicle trafficking [Sanders & Kaverina, 2015], were increased in the presence of TNF-α. Genes encoding subunits of the conserved oligomeric Golgi complex (COG2, 6, 7, 8 genes) showed a slight decrease in transcript levels (**Figure 4.4**, *bottom right panel*). COG proteins play a critical role in maintaining Golgi structure and function, in particular for retrograde transport [Unger et al., 2002]; these changes are likely due to increased cytokine secretion requiring anterograde transport.

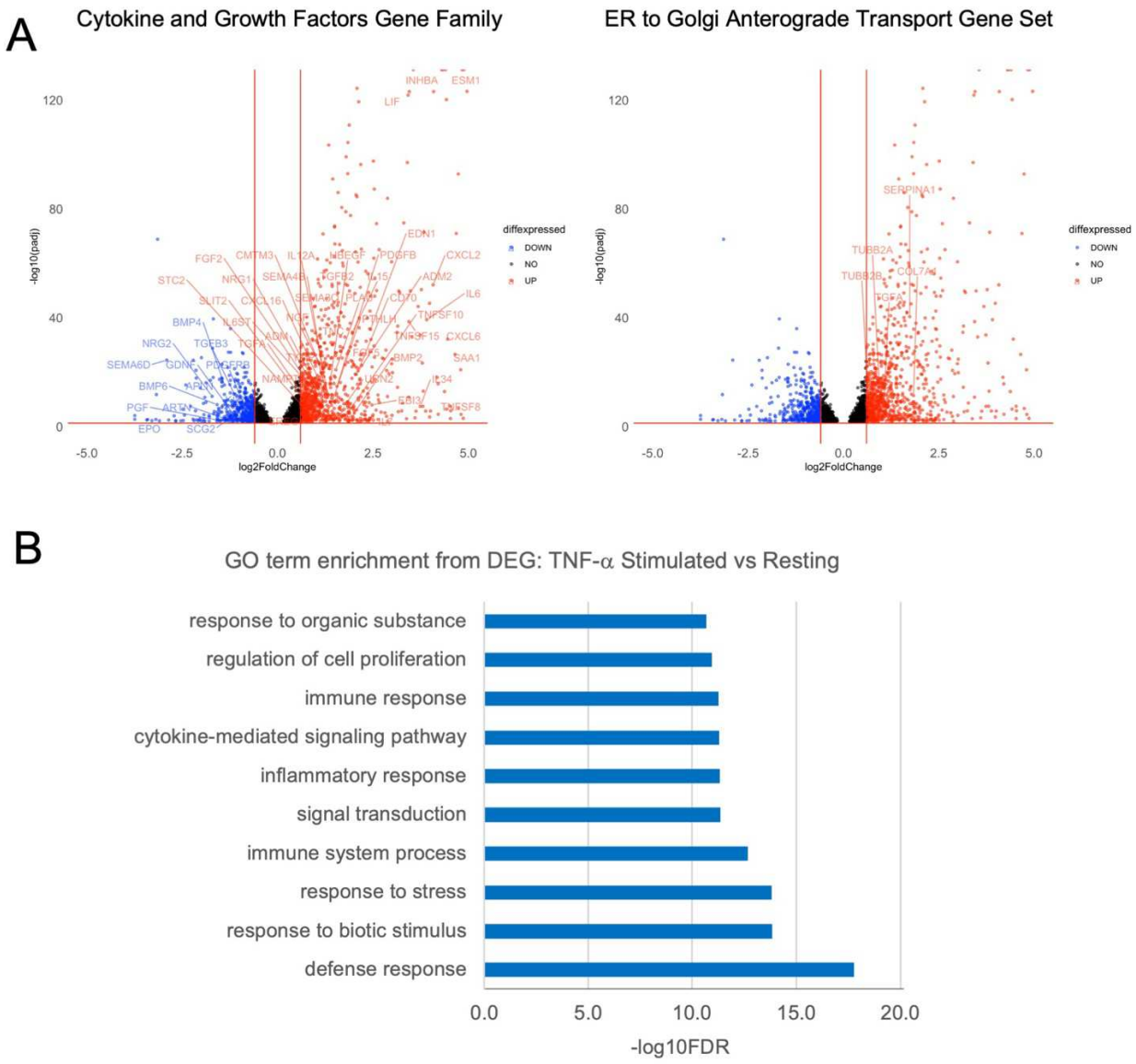

Figure 4.3: DEG Analysis of Resting vs TNF-α stimulated cells. BEAS-2B cells were pre-treated with vehicle (DMSO) for 1 hour then stimulated with 10 ng/mL TNF-α for 4 hours. DESeq was performed on raw counts from RNA-Seq and pairwise comparisons were performed prior to plotting. **A)** Volcano plots of significant differentially expressed genes (FDR < 0.01) plotted using 'ggplot' function in R. Pre-selected gene families/sets of interest are labelled: Cytokines and Growth Factors (left panel) or ER to Golgi Anterograde Transport (right panel) obtained from GSEA. **B)** GO term enrichment showing the top 10 enriched biological processes represented in the differentially expressed genes.

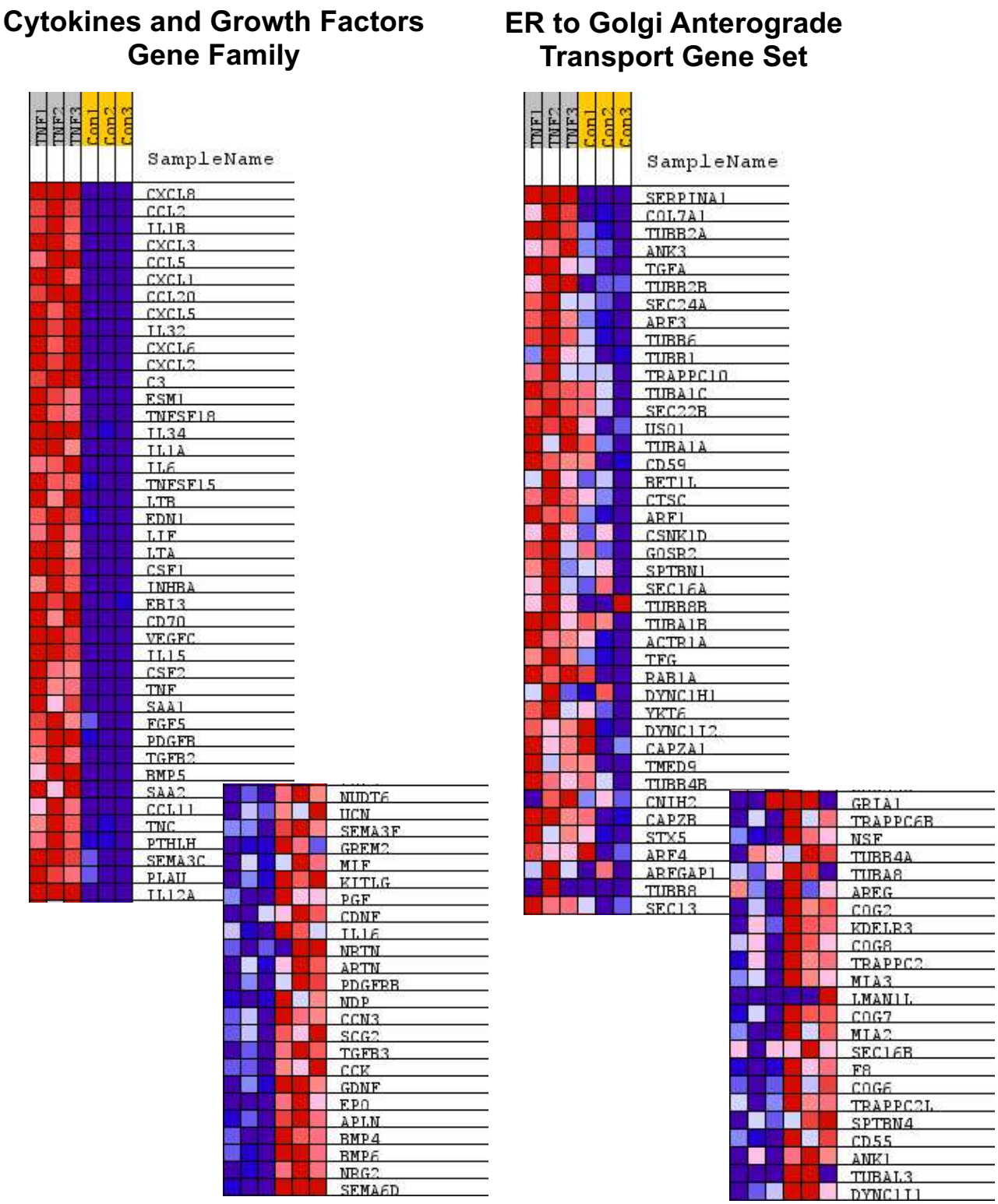

Figure 4.4: Heatmaps of genes within the Cytokine and Growth Factors gene family (left) or ER to Golgi Anterograde Transport gene set (right). Genes sets correspond to the volcano plots in Figure 4.4. Data compares the relative transcript levels in three replicates of 'TNF-α + DMSO' group (labelled as 'TNF') to the control 'Resting + DMSO' group (labelled as 'Con'). Red indicates increased levels and blue indicates lower levels. Heatmaps were cropped to exclude genes that showed little to no significant changes.

4.2.4 Effect of Cdc42 inhibition on inflammatory pathways

We have shown that Cdc42 plays a role in gene expression regulation and Golgi transport of cytokines in BEAS-2B cells [Shouib & Eitzen, 2022]. Cdc42 inhibition with ML141 resulted in Golgi fragmentation and cytokine accumulation but also differential gene expression regulation, with IL-8 expression increasing and MCP-1 decreasing. DEG analysis of RNA-Seq data showed an equal distribution of upregulated and downregulated genes in response to ML141 treatment, both under resting (**Table S2**, Supplementary Material) and TNF-α-stimulated (**Table S3**, Supplementary Material) conditions. Volcano plots show ML141 treatment resulted in the differential expression of a large number of genes from the 'Cytokines and Growth Factors' gene family, both up- and down-regulated (**Figure 4.5A**). Heatmaps for individual genes within this gene set are shown in **Figure 4.6**. Cdc42 inhibitor had similar effects when cells were analyzed in unstimulated (Resting) or TNF-α-stimulated conditions; similar signaling proteins were upregulated (e.g. SESN2, DDIT3, TRIB3) and downregulated (e.g. IFIT family, BMP4) in both conditions. GO term enrichment analysis also showed that some similar gene sets involved in cellular response to stress and ER stress biological pathways were upregulated by both treatments (**Figure 4.5B**). Treatment with both TNF-α and ML141 resulted in enrichment of biological processes that were pro-inflammatory, however, the immune pathways were reduced compared to TNF-α alone (*see* **Figure 4.3B**). This suggests that ML141 treatment may selectively dampen the immune response to TNF-α as cells shift to upregulate ER stress.

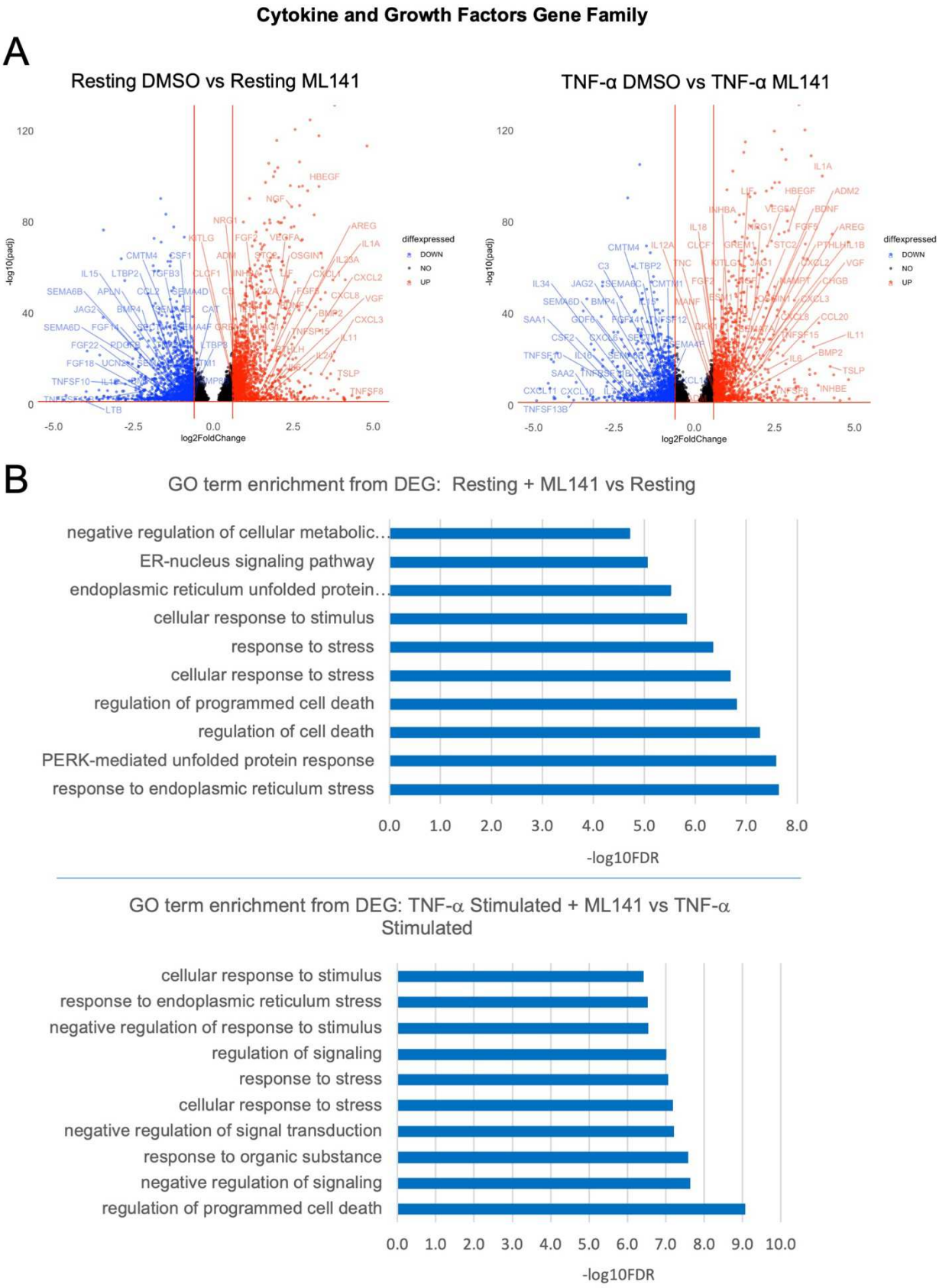

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Figure 4.5: DEG Analysis of the effect of Cdc42 inhibitor ML141. BEAS-2B cells were pre-treated with 20 mM ML141 for 1 hour then left unstimulated (Resting) or stimulated with 10 ng/mL TNF-α for 4 hours. DESeq was performed on raw counts from RNA-Seq and pairwise comparisons were performed prior to plotting. **A)** Volcano plots showing significant differentially expressed genes (FDR < 0.01) that are within the gene family of interest obtained from GSEA: 'Cytokines and Growth Factors'. **B)** GO term enrichment showing the top 10 enriched biological processes represented in the differentially expressed genes.

Cytokines and Growth Factors Gene Family

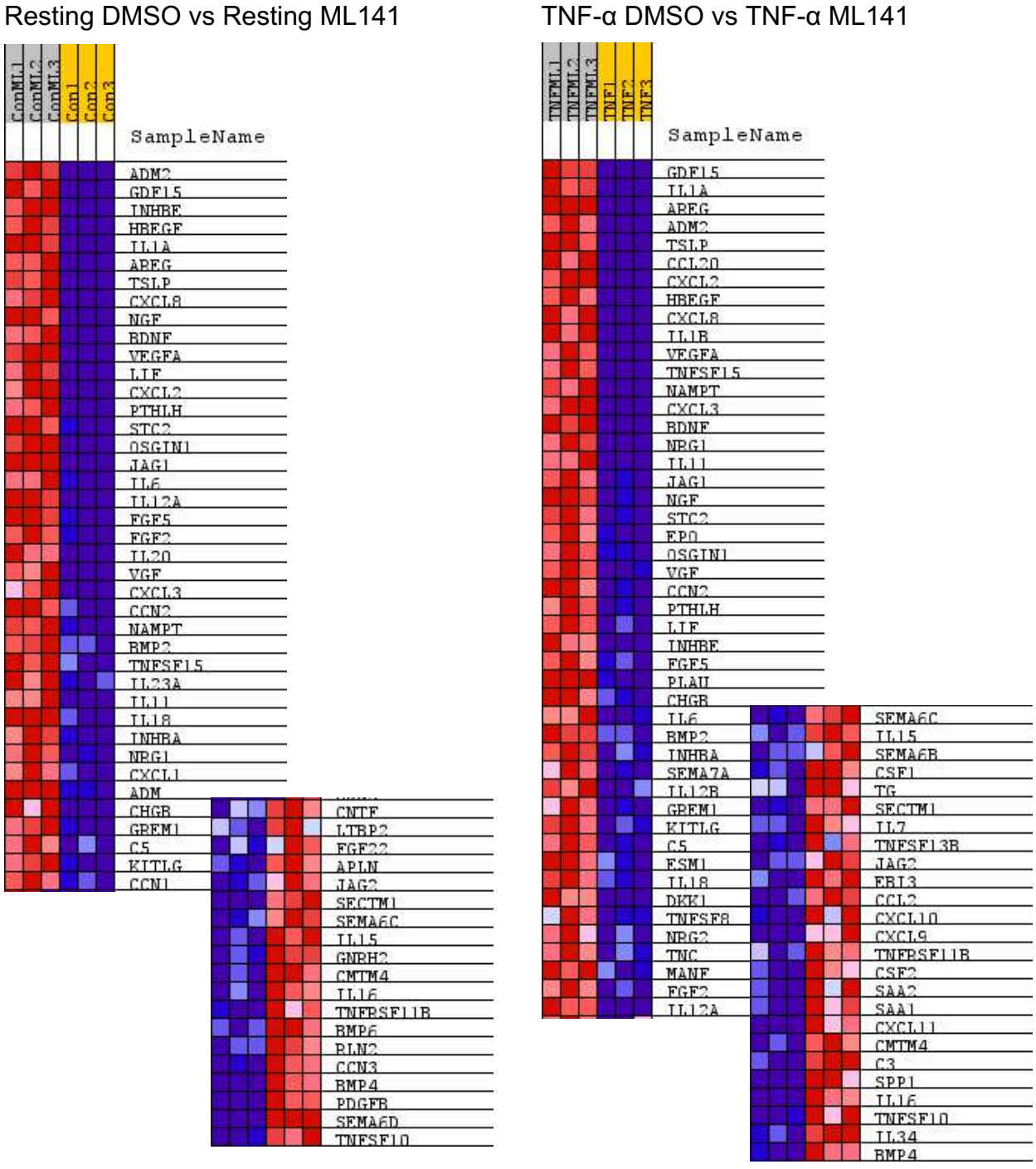


Figure 4.6: Heatmaps of genes within Cytokine and Growth Factors gene family in response to ML141 treatment under resting (left) or TNF-α stimulation (right). Genes sets correspond to the volcano plots in Figure 4.5. On the left, data shows mRNA expression in three replicates of 'Resting + ML141' group (labelled as 'ConML') compared to 'Resting + DMSO' control' (labelled as Con'). On the right, 'TNF-α + ML141' group (labelled as 'TNFML') is compared to 'TNF-α + DMSO' group (labelled as 'TNF'). Red indicates increased expression and blue indicates lower expression. Heatmaps were cropped to exclude genes that showed little to no significant changes.

4.2.5 Effect of Cdc42 inhibition on trafficking pathways

We previously showed that Cdc42 inhibition results in a disruption to Golgi integrity and cytokine trafficking through the secretory pathway [Shouib & Eitzen, 2022]. Therefore, we examined DEG data sets for specific effects on gene sets involved in anterograde transport. To do so, we selectively labeled significant DEGs from the 'ER to Golgi Anterograde Transport' gene set on volcano plots. Cdc42 inhibition with ML141 resulted in considerable modulation of trafficking gene expression where more transport genes were perturbed as observed by the greater number of differentially expressed genes from the 'ER to Golgi Anterograde Transport' gene set (**Figure 4.7A**) compared to TNF-α stimulation alone (*see* **Figure 4.3A**, *right panel*). Heatmaps for individual genes in the gene sets are shown in **Figure 4.8**. Interestingly, as opposed to TNF-α stimulation which upregulated tubulin genes, ML141 treatment resulted in a downregulation in tubulin genes (**Figure 4.7B**). This highlights the effect of Cdc42 inhibition in inducing dysfunction to normal Golgi structure and homeostasis which requires an intact microtubule network [Cole et al., 1996; Thyberg & Moskalewski, 1985].

GO enrichment analysis of pathways activated in response to ML141 showed a particular enrichment in ER stress response pathways as well as signal transduction pathways (*see* **Figure 4.4B**). This suggests that Cdc42 inhibition by ML141 may affect cytokine gene expression via the ER stress response mechanisms which are known to impact transcription [Almanza et al., 2019; Arensdorf et al., 2013]. ER stress response in turn may be due to trafficking defects caused by ML141 [Halloran et al., 2020; Preston et al., 2009]. Therefore, we next examined DEGs at each step of the secretory pathway in the 'TNF-α + ML141' group compared to the 'TNF-α + DMSO' control group. This revealed that a large proportion of genes in the 'ER to Golgi Vesicle Transport' and the 'Intra-Golgi and Golgi to ER Retrograde Transport' gene sets were differentially expressed (**Figure 4.9**). Heatmaps for individual genes in the gene sets are shown in **Figure 4.10**. Furthermore, the number of upregulated genes from the 'COPI-dependent Golgi to ER Retrograde Transport' gene set was higher than the number of upregulated genes from the 'COPI-independent Golgi to ER Retrograde Transport' gene set. This suggests that Cdc42 inhibition specifically enhances COPI-mediated retrograde transport. This is consistent with findings by Park et al. [Park et al., 2015] that illustrate how Cdc42 competes with retrograde cargo for binding to COPI.

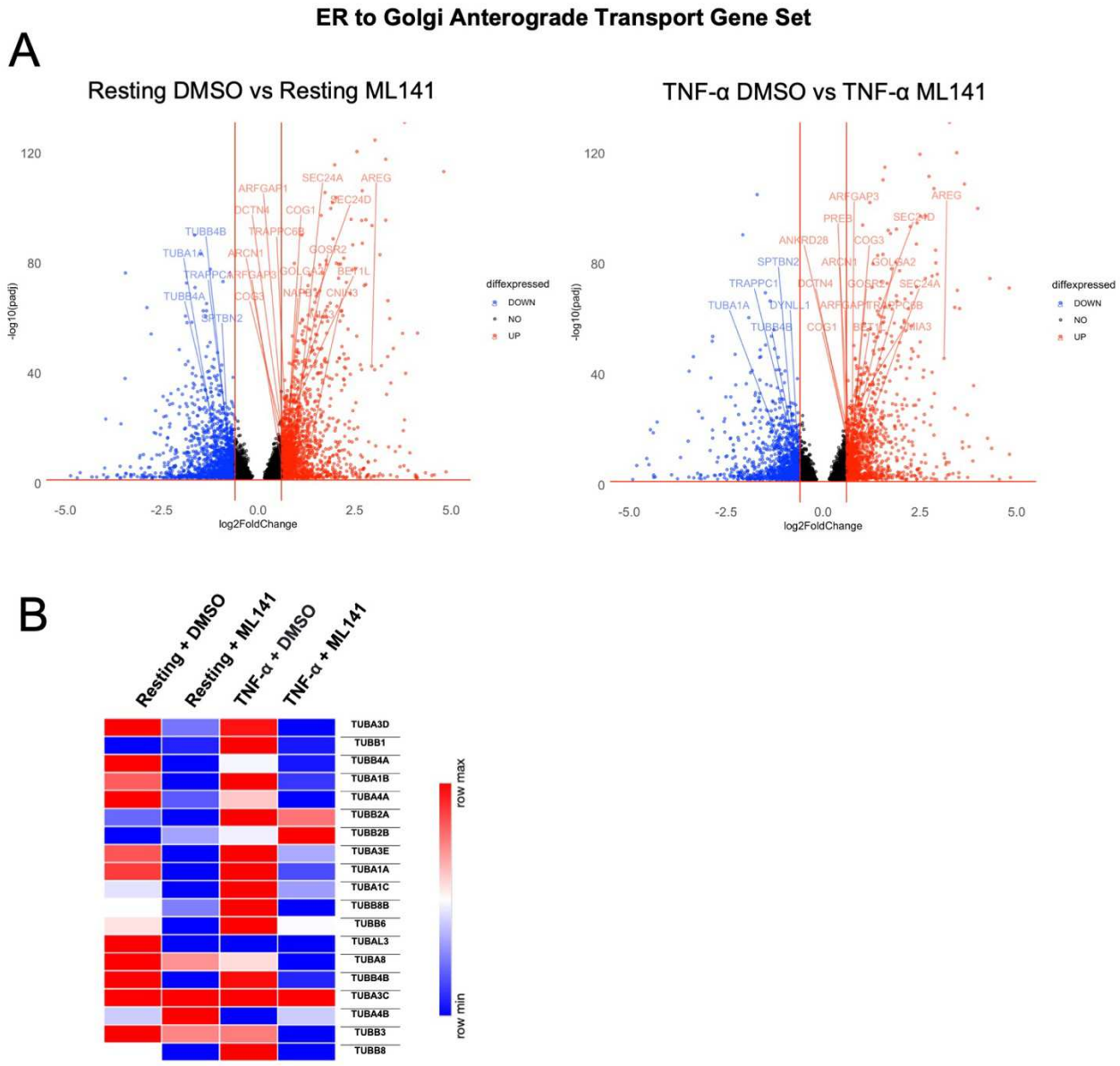
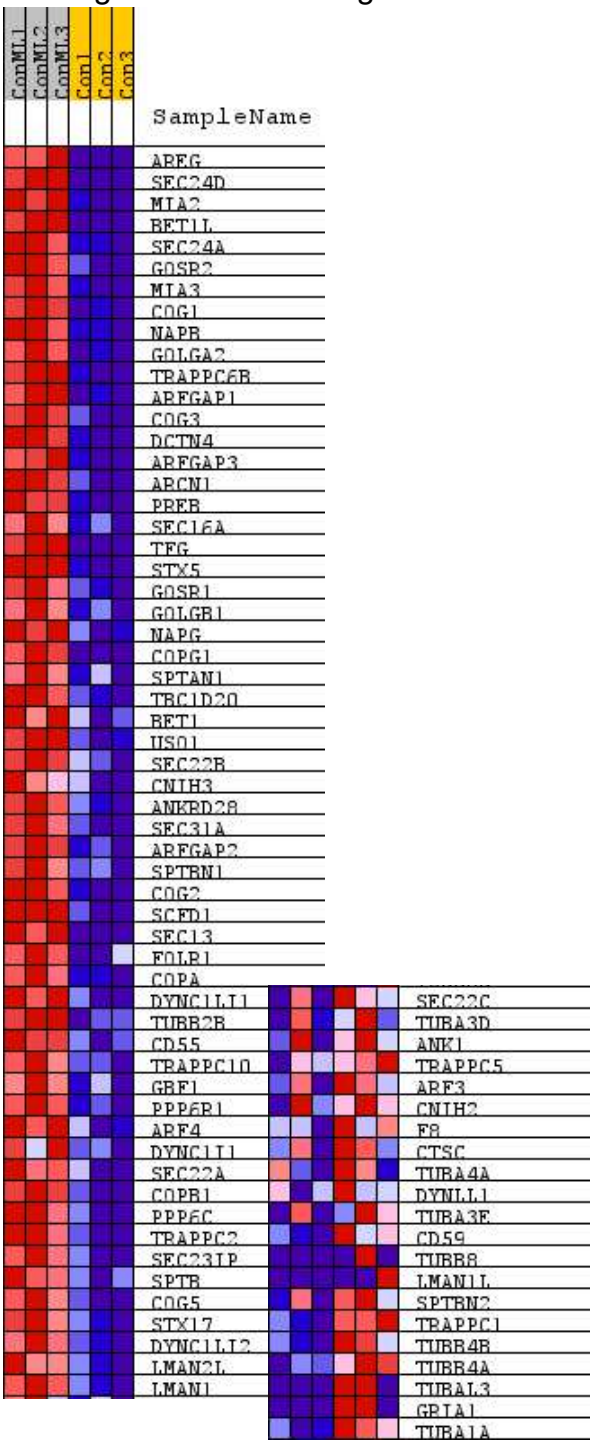


Figure 4.7: Effect of Cdc42 inhibition with ML141 on ER to Golgi trafficking. **A)** Volcano plots showing significant differentially expressed genes (FDR < 0.01) that are within the gene sets of interest obtained from GSEA: 'ER to Golgi Anterograde Transport'. DESeq was performed on raw counts from RNA-Seq and pairwise comparisons were performed prior to plotting. **B)** Heatmap of tubulin genes from the 'Reactome ER to Golgi Anterograde Transport' GSEA gene set. The heatmap shows relative expression of genes from three data sets based on raw counts as plotted by Morpheus online heatmapping tool.

ER to Golgi Anterograde Transport Gene Set

Resting DMSO vs Resting ML141



TNF-α DMSO vs TNF-α ML141

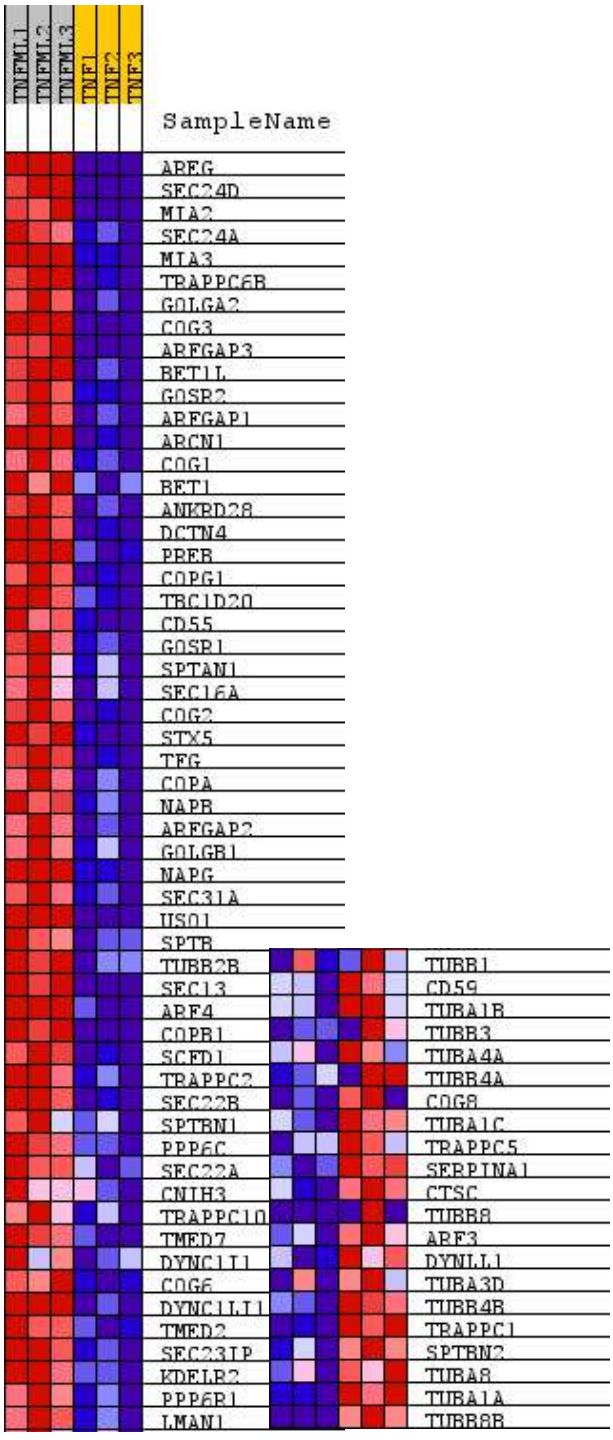


Figure 4.8: Heatmaps of genes within ER to Golgi Anterograde Transport gene set in response to ML141 treatment under resting (left) or TNF-α stimulation (right). Genes sets correspond to the volcano plots in Figure 4.7. On the left, data compares expression in three replicates of 'Resting + ML141' group (labelled as 'ConML') to 'Resting + DMSO' (labelled as 'Con'). On the right, 'TNF-α + ML141' group (labelled as 'TNFML') is compared to 'TNF-α + DMSO' group (labelled as 'TNF'). Red indicates increased expression and blue indicates lower expression. Heatmaps were cropped to exclude genes that showed little to no significant changes.

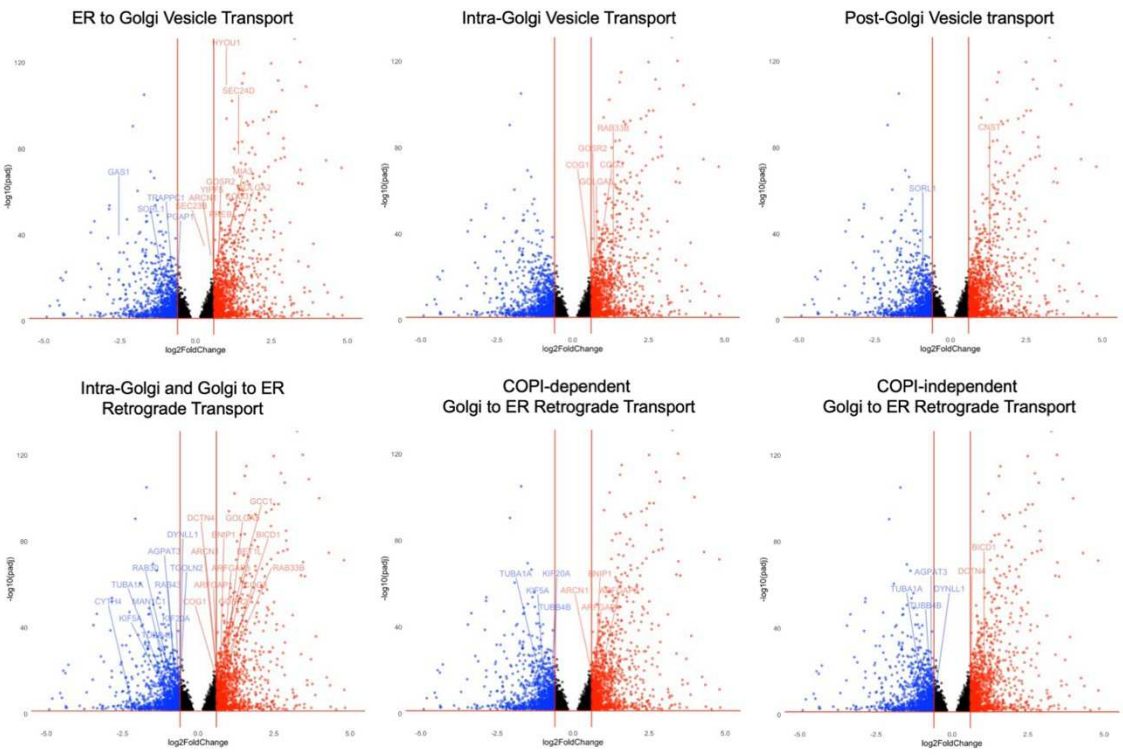


Figure 4.9: Differential expression of genes implicated in each step of the secretory pathway. Volcano plots showing significant differentially expressed genes (FDR < 0.01) in different Golgi compartments in 'TNF-α + ML141' samples compared to 'TNF-α + DMSO' control. Significant DEGs from a pre-selected genes set of interest were obtained from GSEA. Specific gene set heatmaps are provided in Figure 4.10

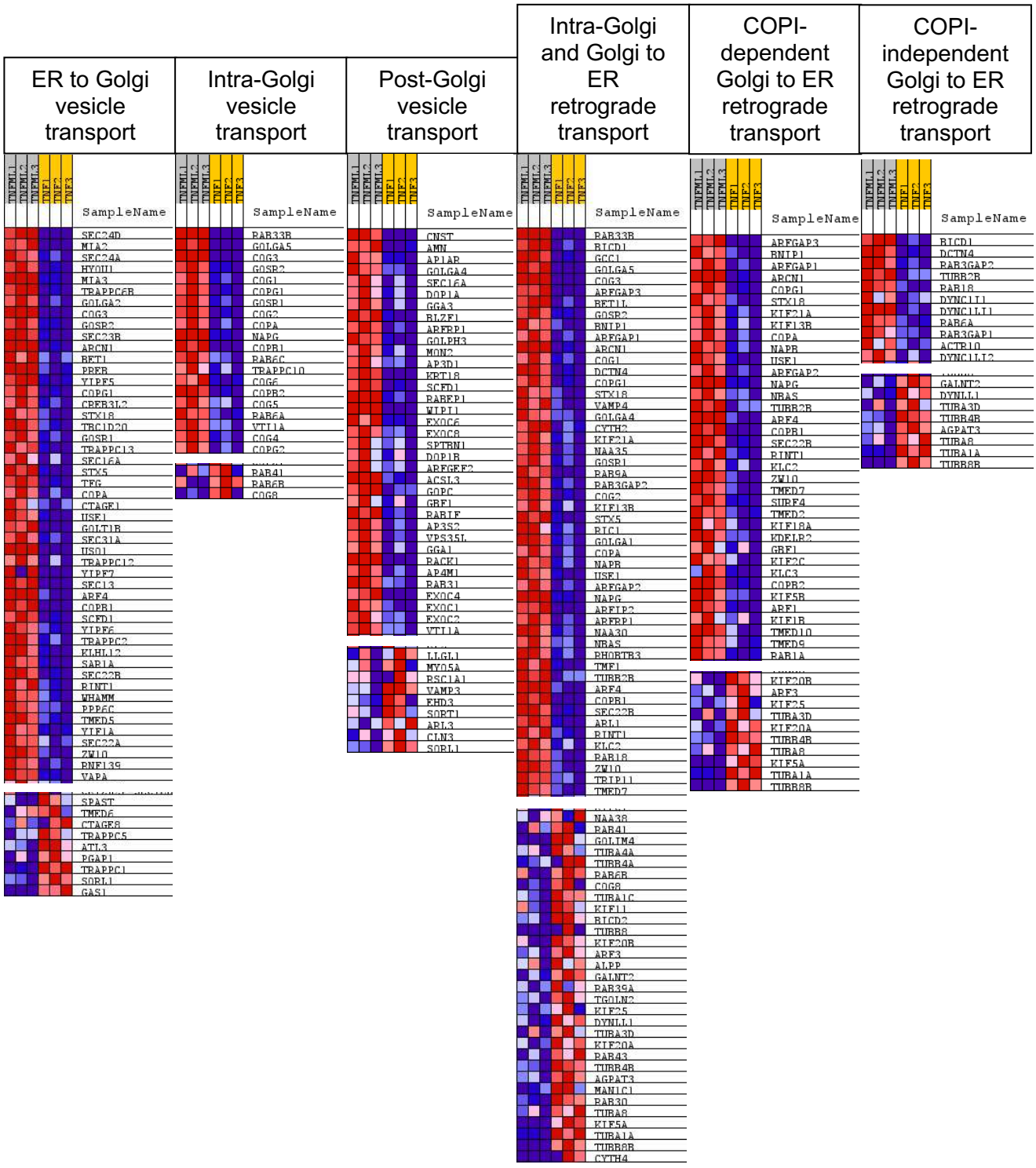


Figure 4.10: Heatmaps of genes within gene sets implicated in trafficking steps along the secretory pathway. Genes sets correspond to the volcano plots in Figure 4.9. For all gene sets, data shows expression in three replicates of 'TNF-α + ML141' group (labelled as 'TNFML') compared to 'TNF-α + DMSO' (labelled as 'TNF') group. Red indicates increased expression and blue indicates lower expression. Heatmaps were cropped to exclude genes that showed little to no significant changes.

4.2.6 Differential expression of genes implicated in Golgi structure and function

Next, we probed for genes that might have a role in the mechanisms by which ML141 induces Golgi fragmentation. We speculated that ML141-induced disruption at the Golgi may result from underlying changes in gene expression of Golgi structural and functional genes. Although we analyzed trafficking gene sets for potential transcriptomic changes in different transport processes, we sought to further examine DEGs implicated in the different compartment structures of the Golgi apparatus. The 'TNF-α + ML141' group was compared to the 'TNF-α + DMSO' control group. Our results revealed a differential regulation of genes involved in different Golgi compartments (**Figure 4.11A**, *top row*). Heatmaps for individual genes in the gene sets are shown in **Figure 4.12**. Particularly, the Golgi membrane gene set showed a large number of significant DEGs. We probed for significant DEGs in the different compartments of the Golgi membrane in response to ML141 treatment. However, this did not show any particular enrichment (**Figure 4.11A**, *bottom row*, **Figure 4.12**).

4.2.7 Cdc42 inhibition also results in ER fragmentation

Since our RNA-seq DEG analysis and gene set enrichment data pointed towards increased ER stress in response to ML141 treatment, and since Cdc42 inhibition appears to modulate transport to and from the ER, we sought to further investigate ER structure under ML141 treatment. To do so, we investigated the localization pattern of the ER chaperone, calnexin, via indirect immunofluorescence [Bergeron et al., 1994; Müller-Taubenberger et al., 2001; Paskevicius et al., 2023]. This would allow us to further investigate if defects observed in Golgi morphology are also occurring earlier in the secretory pathway. Indeed, calnexin staining showed a fragmented phenotype characterized by increased puncta and abolition of the ER tubular structures observed in DMSO-treated control cell (**Figure 4.11B**). ER fragmentation could be a result of abnormal Golgi function, or perhaps could result in Golgi fragmentation.

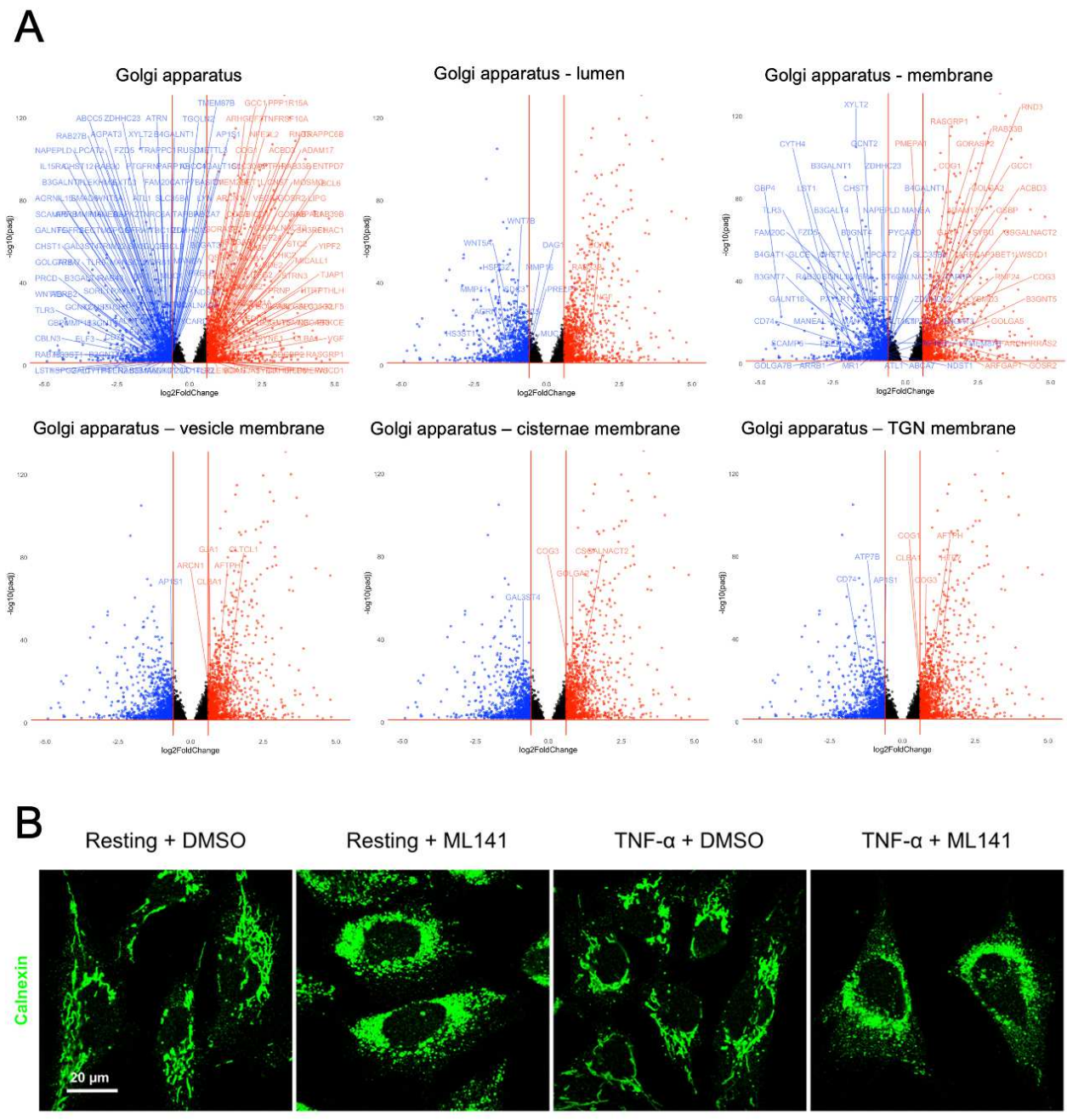


Figure 4.11: Cdc42 is implicated in Golgi and ER structure and function. **A)** Differential expression of genes involved in different Golgi compartments. Volcano plots showing significant differentially expressed genes (FDR < 0.01) in different Golgi compartments in 'TNF-α + ML141' samples compared to 'TNF-α + DMSO' control. Significant DEGs from a pre-selected genes set of interest were obtained from GSEA. **B)** Immunofluorescence microscopy images showing staining of BEAS-2B cells with the ER marker, calnexin. Cells were pre-treated for 30 min with vehicle (DMSO) or 20 μM ML141, then either left unstimulated (Resting) or stimulated with 10 ng/mL TNF-α for 4 hours. Cells were then fixed and labelled with antibodies against calnexin.

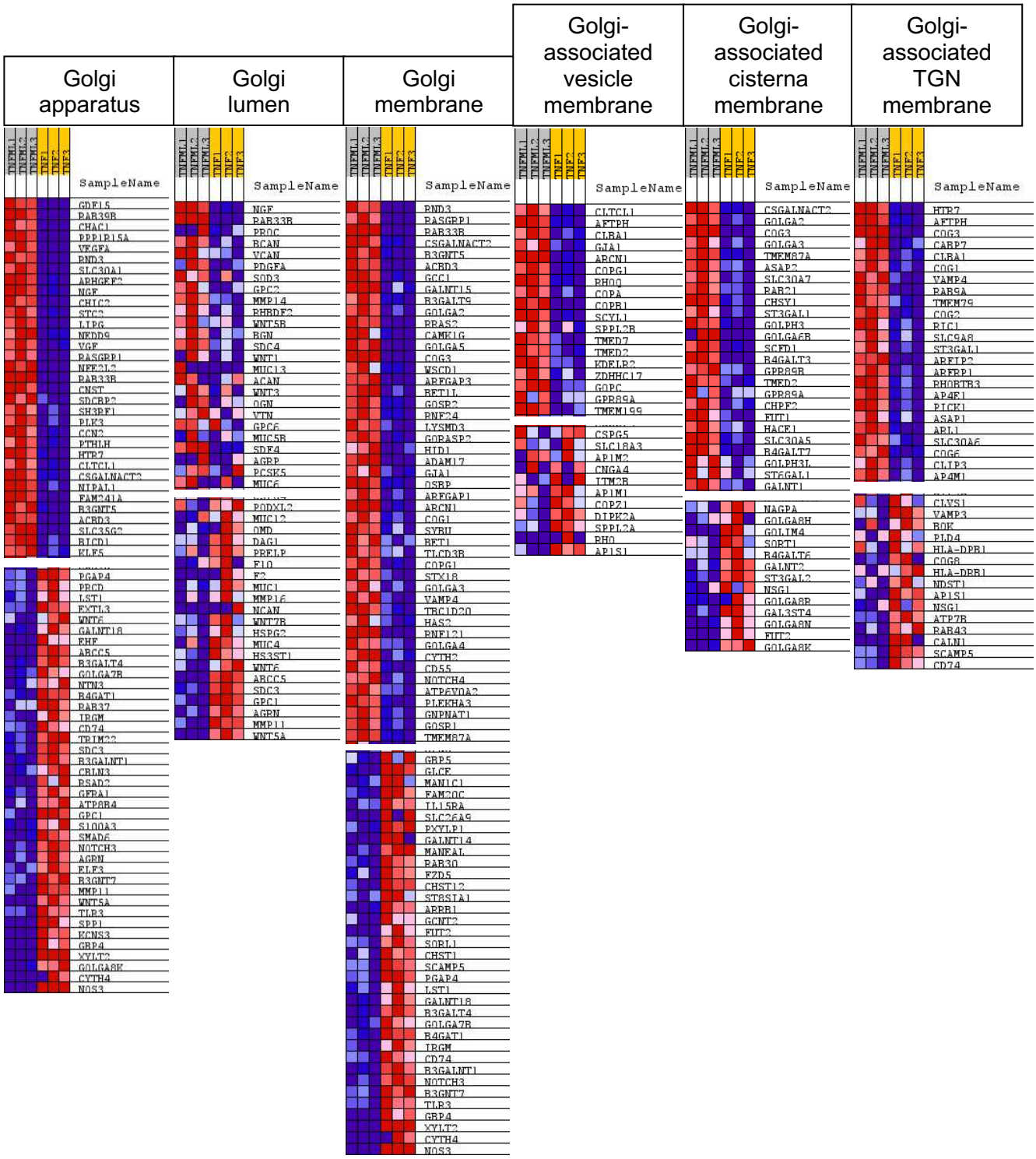


Figure 4.12: Heatmaps of genes within gene sets associated with different Golgi compartments. Genes sets correspond to the volcano plots in Figure 4.11A. For all gene sets, data shows expression in three replicates of 'TNF-α + ML141' group (labelled as 'TNFML') compared to 'TNF-α + DMSO' group (labelled as 'TNF'). Red indicates increased expression and blue indicates lower expression. Heatmaps were cropped to exclude genes that showed little to no significant changes.

4.2.8 Combined effects of TNF-α and Cdc42 inhibition on gene expression

A heatmap showing effects on cytokine-specific signaling pathways further elucidated the inflammatory gene expression patterns in response to TNF-α and the additional effect of ML141 treatment (**Figure 4.13A**). TNF-α signaling pathways showed the highest positive activation z-score, as expected. Most pathways implicated in cytokine signaling, interferon signaling, and NF-κB signaling were upregulated, while anti-inflammatory molecules such as IL-10 and IL-1RN (receptor antagonist) were reduced. A heatmap showing effects on transcriptional regulator signaling pathways showed activation of some transcriptional regulators, such as Nuclear Protein 1 (NUPR1) pathway which responded specifically to ML141 (**Figure 4.13B**). Many transcriptional factor pathways, such as STATs and IRFs, responded more robustly to TNF-α stimulation. ML141 did not profoundly reduce any transcripts that were increased by TNF-α stimulation.

We speculated that activation of the NUPR1 transcription factor could be mediating the observed changes in cytokine gene expression (i.e. an upregulation in IL-8 and IL-1β and a downregulation of MCP-1) in response to ML141. To investigate this, we treated BEAS-2B cells with the NUPR1 inhibitor ZZW-115 and examined transcript levels of these cytokines. ZZW-115 induced similar effects to ML141, characterized by an increase in IL-8 and IL-1β and a decrease in MCP-1 (**Figure 4.14**). This suggests that the activation of NUPR1 downstream of Cdc42 inhibition by ML141 is not mediating the observed changes in the mRNA levels of IL-8 and IL-1β and MCP-1.

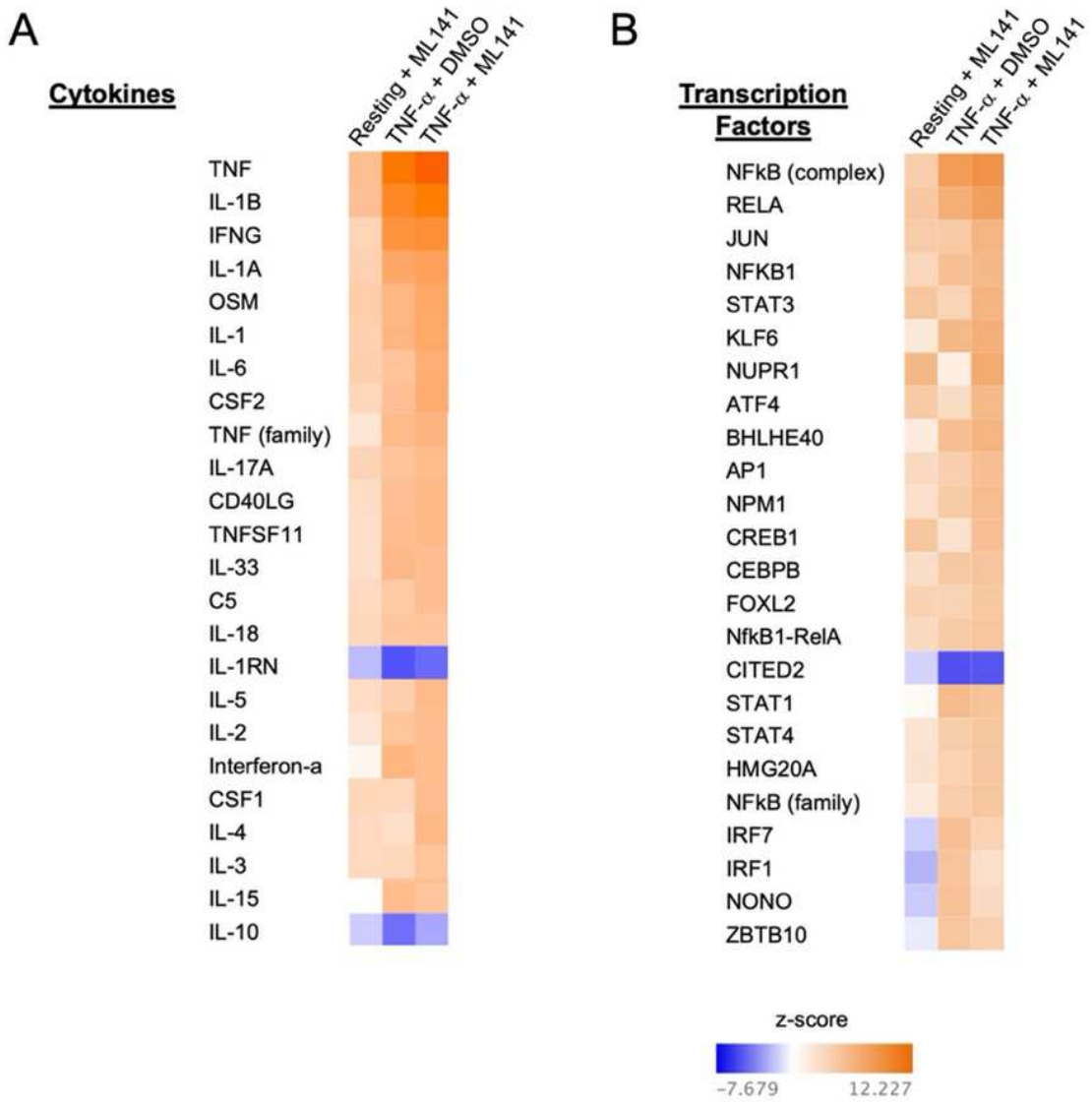


Figure 4.13: Combined effects of TNF-α and Cdc42 inhibition on gene expression signaling pathways. Heatmaps for **A)** Cytokine and **B)** Transcription Factor signaling pathways were generated using Ingenuity Pathways Analysis (IPA). Comparisons made in reference to the 'Resting + DMSO' control group.

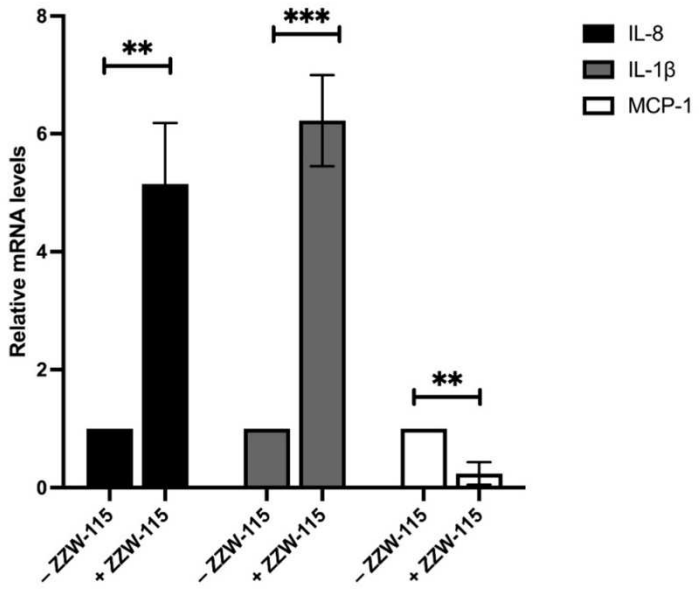


Figure 4.14: Effect of the NUPR1 inhibitor, ZZW-115, on cytokine gene expression. BEAS-2B cells were treated with 5 μM ZZW-115 for 5 hours or DMSO for control then harvest for RNA extraction. Relative mRNA levels were calculated as $\Delta\Delta C_T$ values from RT-qPCR analysis. Data was normalized to the untreated '-ZZW-115' control. Statistical analysis was by Student's test. Asterisks indicate significance compared to the '-ZZW-115' control. * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$, $n = 4$.

4.2.9 Role of signaling proteins in ML141-induced effects

To more closely examine the top differentially expressed genes induced by Cdc42 inhibition, we plotted a heat map showing the top 75 differentially expressed genes in ascending order of FDR based on the effects of ML141 (**Figure 4.15A**). We chose SESN2 (Sestrin 2), BMP4 (Bone morphogenic factor 4), DUSP5 (Dual Specificity Phosphatase-5) and TRIB3 (Tribbles homolog 3) for further analysis on the bases of their FDR and fold change values in response to ML141 treatment (**Table 4.2**). These proteins are all part of signaling pathways relevant to inflammatory pathways [Cao et al., 2014; Fang et al., 2014; Hwang et al., 2017; Pegorier et al., 2010; Seo et al., 2017; Yu et al., 2015]. quantitative RT-PCR validated that the gene expression changes of these targets in response to ML141 were consistent with our RNA-Seq results (**Figure 4.15B**).

Table 4.2: Selected target signaling proteins for further studies.

Signaling Target	log_2 Fold Change	False Discovery Rate (FDR)
DUSP5	3.059555607	$8.34x\ 10^{-127}$
TRIB3	3.264000866	0
SESN2	3.645353058	1.27×10^{-109}
BMP4	-2.25595784	5.93×10^{-37}

Log_2FC and FDR shown for 'TNF-α + ML141' treatment group compared to the 'TNF-α + DMSO' group.

We speculated that these signaling proteins may be involved in Cdc42-regulated gene expression, or Cdc42-mediated Golgi trafficking. With the exception of BMP4, these targets are negatively regulated by Cdc42. We propose that if these target proteins mediate enhanced cytokine gene expression when Cdc42 is inhibited, then knockdown of these target genes should diminish the effect of Cdc42 inhibition, resulting in a decrease in cytokine transcript levels. Therefore, to determine if these identified targets couple Cdc42 inhibition to an increased cytokine gene expression, we generated stable knockdown (KD) cell lines for SESN2, BMP4, DUSP5 and TRIB3 (**Figure 4.16A**) and analyzed the effect of ML141 treatment. Indeed, shRNA KD of these target genes reduced ML141-induced cytokine gene expression (**Figure 4.16B**). In particular, TRIB3 KD resulted in 64% reduction in IL-8 expression in ML141 treated cells, and a 51% reduction in IL-8 expression in vehicle treated cells. DUSP5 KD significantly reduced MCP-1 levels, but only slightly reduced IL-8 levels. This selective regulation of different cytokines by different signaling molecules might explain why they show differential regulation in response to ML141 treatment, for example an increase in IL-8 but a decrease in MCP-1. SESN2 KD and BMP4 KD did not affect ML141-induced alterations to cytokine expression (**Figure 4.16B**). We also investigated if the lentiviral transduction protocol itself affects the expression of these targets

or Cdc42 levels and found no significant changes in cells transduced with a scrambled control vector in comparison to naïve BEAS-2B cells (**Figure 4.17**).

It is possible that the increase in expression of these candidate signaling genes could be driven by the increased IL-8 expression induced by ML141 rather than being a direct downstream effect of ML141 treatment. To investigate this, we examined the effect of IL-8 depletion by genetic knockdown, and response to treatment with recombinant IL-8. Transcript levels of SESN2, DUSP5 and TRIB3 increased, and BMP4 decrease (as expected) in response to ML141 in Scr control BEAS-2B cell lines (**Figure 4.18B**). IL-8 KD resulted in no changes to SESN2, BMP4 and DUSP5 mRNA levels, but did result in a significant decrease in TRIB3 mRNA levels in response to ML141. Treatment with recombinant IL-8 resulted in no significant changes in mRNA levels (**Figure 4.18C**). However, the trend for TRIB3 mRNA levels was an increase in response to IL-8 treatment. These results suggest that IL-8 may have an effect in driving TRIB3 expression in response to ML141.

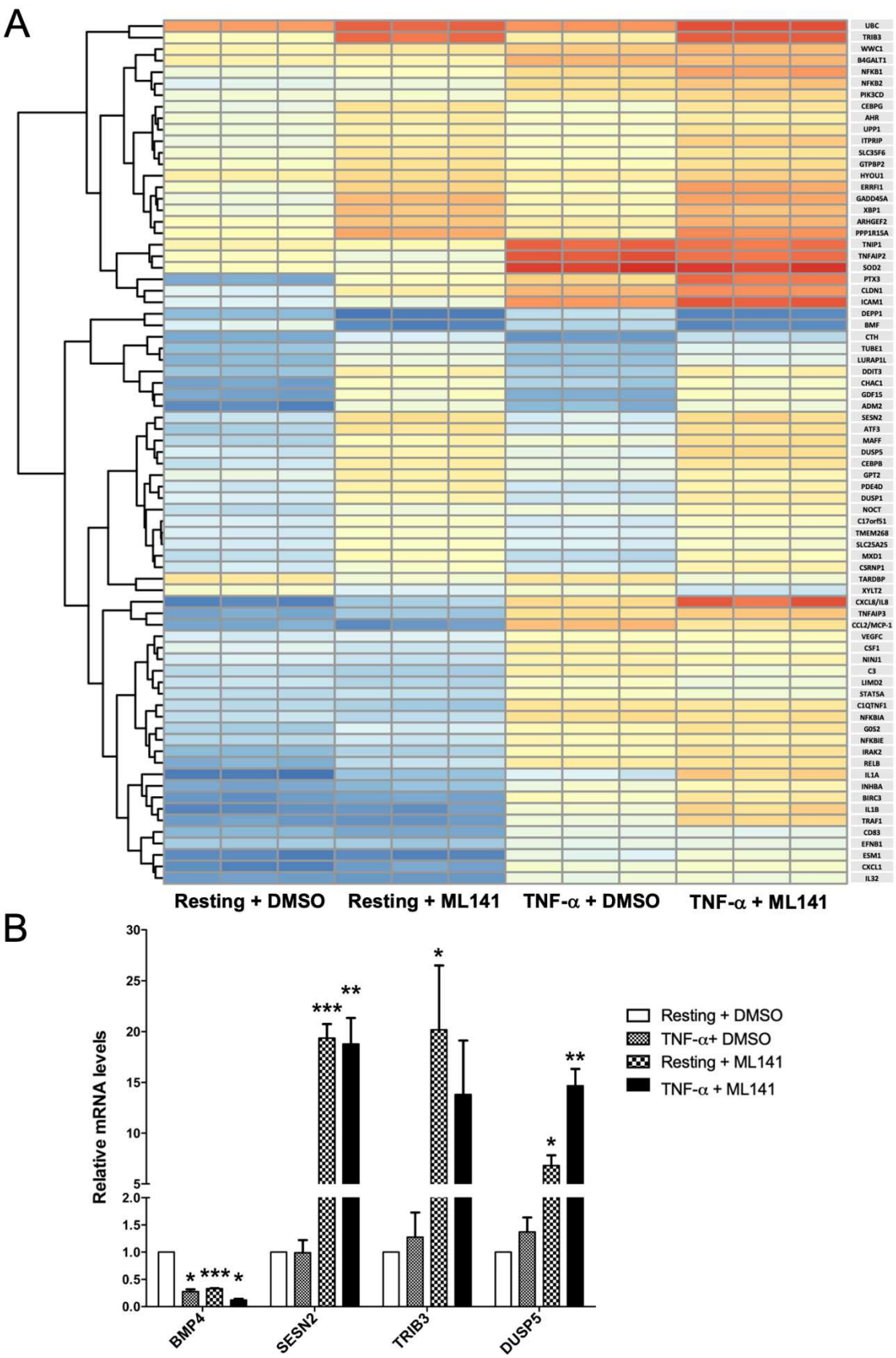


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Figure 4.15: Transcriptomic analysis of BEAS-2B cells stimulated with TNF-α +/- ML141. **A)** Heatmap of top 75 significantly differentially expressed genes (FDR < 0.05) in response to TNF-α stimulation +/- ML141 treatment. DESeq was performed on raw counts and pairwise comparisons were performed prior to mapping. Blanks indicate unidentified genes. **B)** Verification via quantitative RT-PCR of increased (TRIB3, SESN2, DUSP5) or decreased (BMP4) transcript level of signaling targets identified by RNA-seq. Samples were pre-treated with vehicle or 20 μM ML141 for 1 hour and then 10 ng/mL TNF-α for 4 hours. mRNA levels from each treatment group is normalized to 'Resting + DMSO' control. A one-way ANOVA test was performed on ΔCt values followed by a Tukey's multiple comparisons test. *p-value< 0.05, **p<0.01, ***p<0.001, n =4.

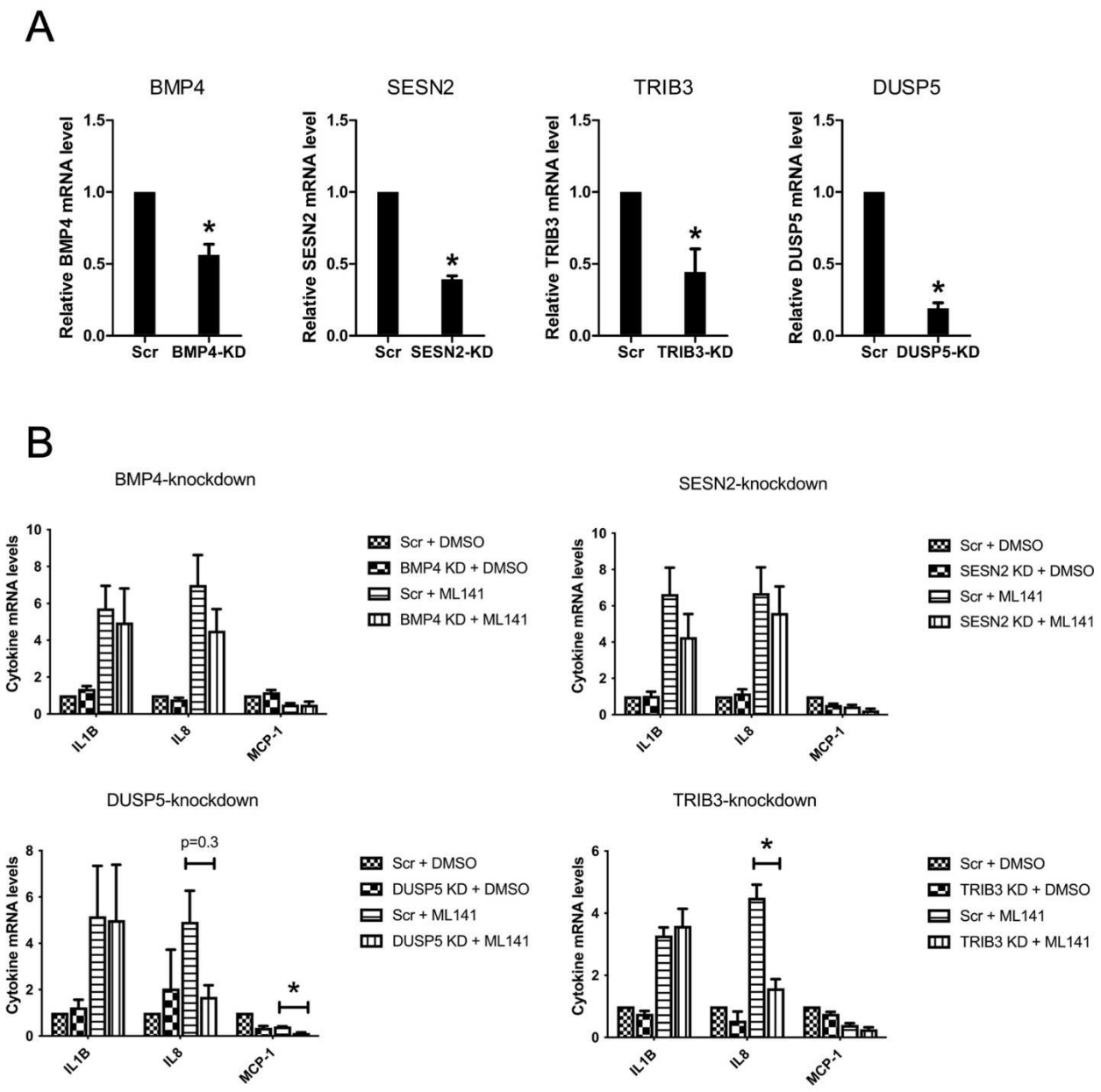

Figure 4.16: Effect of target KD on ML141-enhanced gene expression. **A)** Verification of genetic silencing of BMP4, SESN2, TRIB3 and DUSP5 genes. Level of each signaling target is normalized to scrambled control. **B)** Relative mRNA levels of cytokines in BMP4, SESN2, TRIB3, and DUSP5 KD strains, treated with vehicle or 20 μM ML141. Error bars represent SEM. Data represent at least three independent experiments. Data was analyzed using student's t test (A) or one-way ANOVA followed by a Tukey's test for multiple comparisons (B). * p-value < 0.05, n = 4.

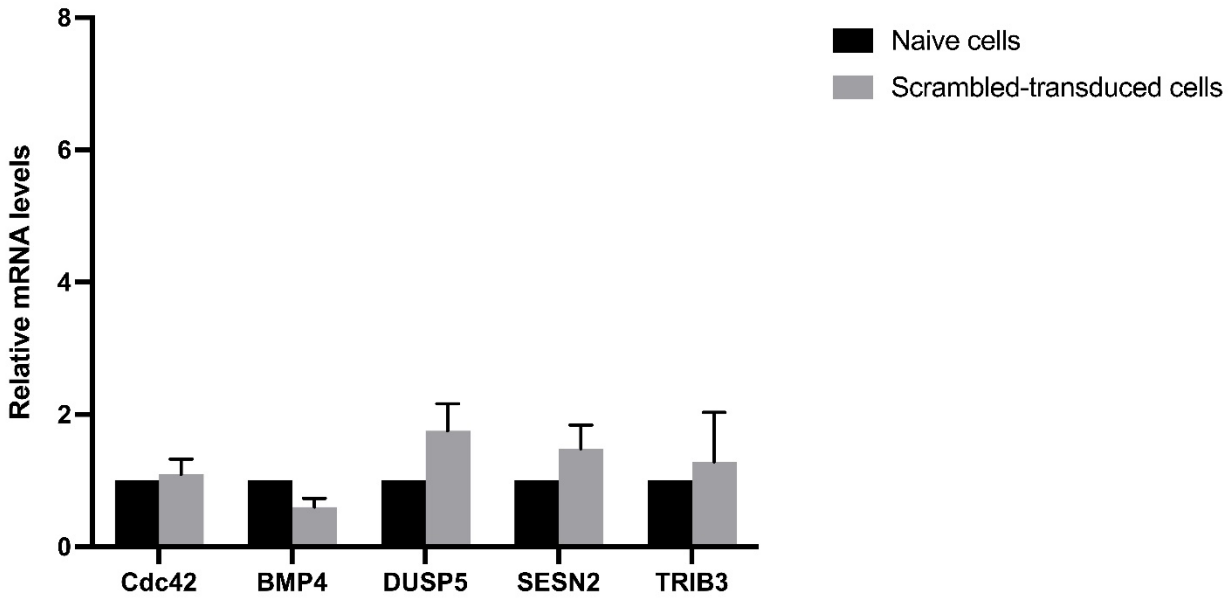

Figure 4.17: Relative expression of Cdc42 and targets chosen for analysis as signaling mediators downstream of Cdc42 inhibition in naïve cells versus cells transduced with scrambled-control vector as assessed by quantitative PCR. RNA was harvested from cells that were either left uninduced (Naïve cells) or after 4-6 weeks of viral transduction and scrambled shRNA selection with 2 µg/mL puromycin (Scrambled-transduced cells). n = 3.

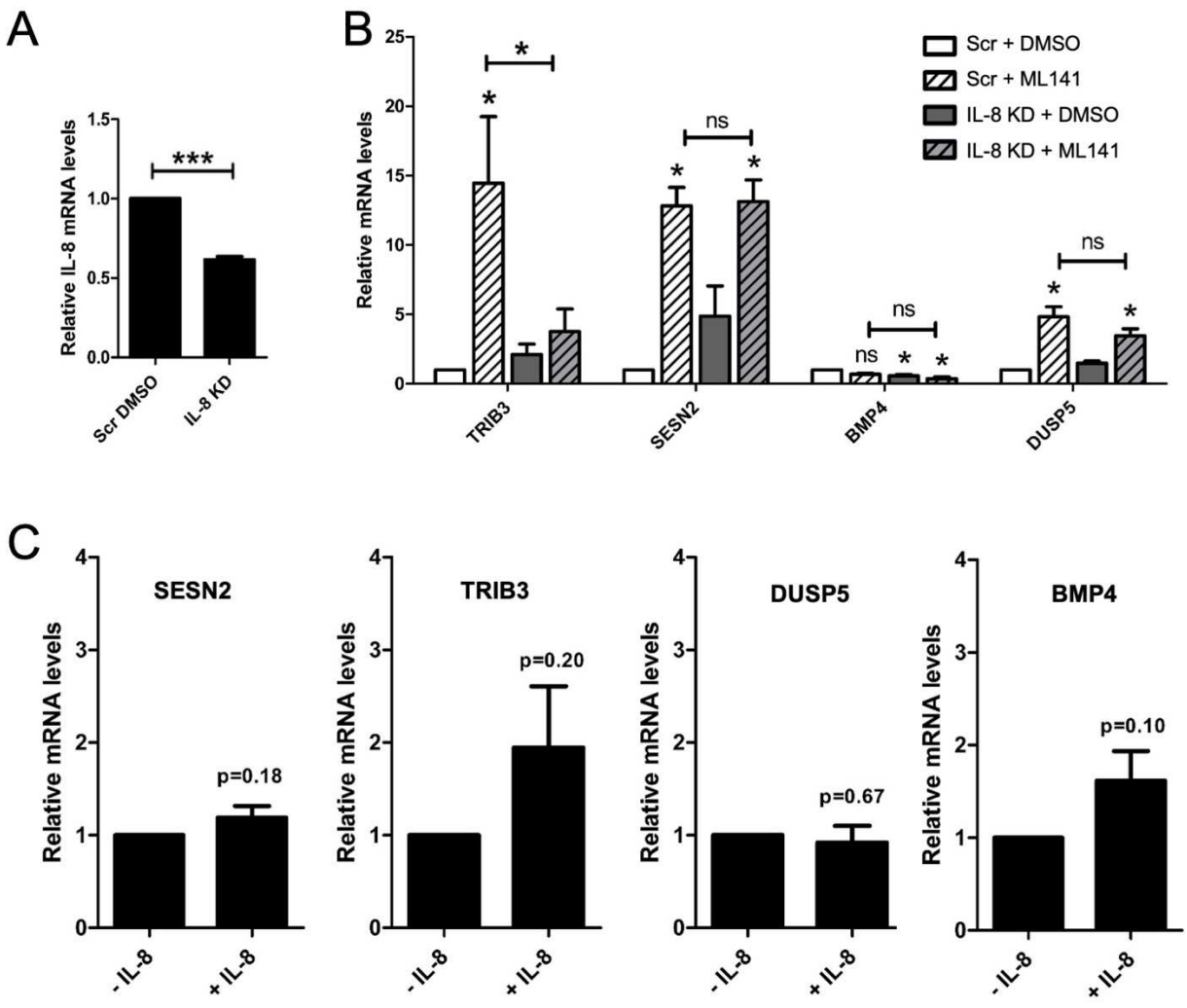

Figure 4.18: Effect of IL-8 depletion and exogenous treatment on expression of signaling candidates. BEAS-2B cells were either depleted of IL-8 by shRNA-mediated knockdown or treated by the addition of exogenous recombinant IL-8. The effect of these treatment on the expression of signaling candidates was examined by RT-qPCR. **A)** Knockdown efficiency of IL-8 in the IL-8 KD strain compared to Scr control. Data was normalized to the Scr control strain. *** $p < 0.001$, $n = 4$. **B)** IL-8 KD and Scr control strains were treated with either DMSO or 20 μM ML141 for 5 hours and and harvested for RNA extraction. Relative mRNA levels were calculated as $\Delta\Delta C_T$ values from RT-qPCR analysis, normalized to the 'Scr + DMSO' control. Data were analyzed using a one-way ANOVA followed by a Tukey's test. * $p < 0.05$, comparisons were to 'Scr + DMSO' or indicated by bars, $n = 4$. **C)** BEAS-2B cells were incubated with 100 ng/mL human recombinant IL-8 for 4 hours after which cells were harvested for RNA extraction. Relative mRNA levels were calculated as $\Delta\Delta C_T$ values from RT-qPCR analysis. Data was normalized to the unstimulated '-IL-8' control group which was set to 1. Data was analyzed using a Student's test with p-values indicated in comparison to the '-IL-8' control.

4.2.10 Role of signaling proteins in ML141-induced Golgi fragmentation

In addition, to the depletion of microtubule-associated genes (*see* **Figure 4.7B**), we have previously reported that Cdc42 inhibition also results in an aberrant Golgi morphology characterized by fragmentation of the Golgi into puncta rather than compact cisternae [Shouib & Eitzen, 2022]. Immunofluorescence microscopy was used to investigate whether ML141-induced Golgi fragmentation may also be mediated by any of the signaling proteins identified through RNA-Seq (SESN2, BMP4, DUSP5, TRIB3). GM130 antibodies, a cis-Golgi marker [Nakamura et al., 1995; Shamseldin et al., 2016], was used to label Golgi structures and F-actin was stained to visualize overall cell size and area. As expected, ML141 treatment of control cells (Scr, scrambled shRNA) resulted in prominent Golgi fragmentation, while BMP4 KD blocked ML141-induced Golgi fragmentation (**Figure 4.19A**). SESN2 KD also showed reduced Golgi fragmentation (**Figure 4.19A**). Quantification of Golgi fragmentation morphologies showed a significant reduction in BMP4 KD cells while the difference was not statistically significant in SESN2 KD cells (**Figure 4.19B**). Golgi fragmentation did not appear to be altered in TRIB3 KD cells. Although quantification of DUSP5 KD Golgi morphologies indicated no significant changes to Golgi fragmentation, the DUSP5 KD group had a limited number of viable cells for analysis which precluded the ability to make meaningful conclusions.

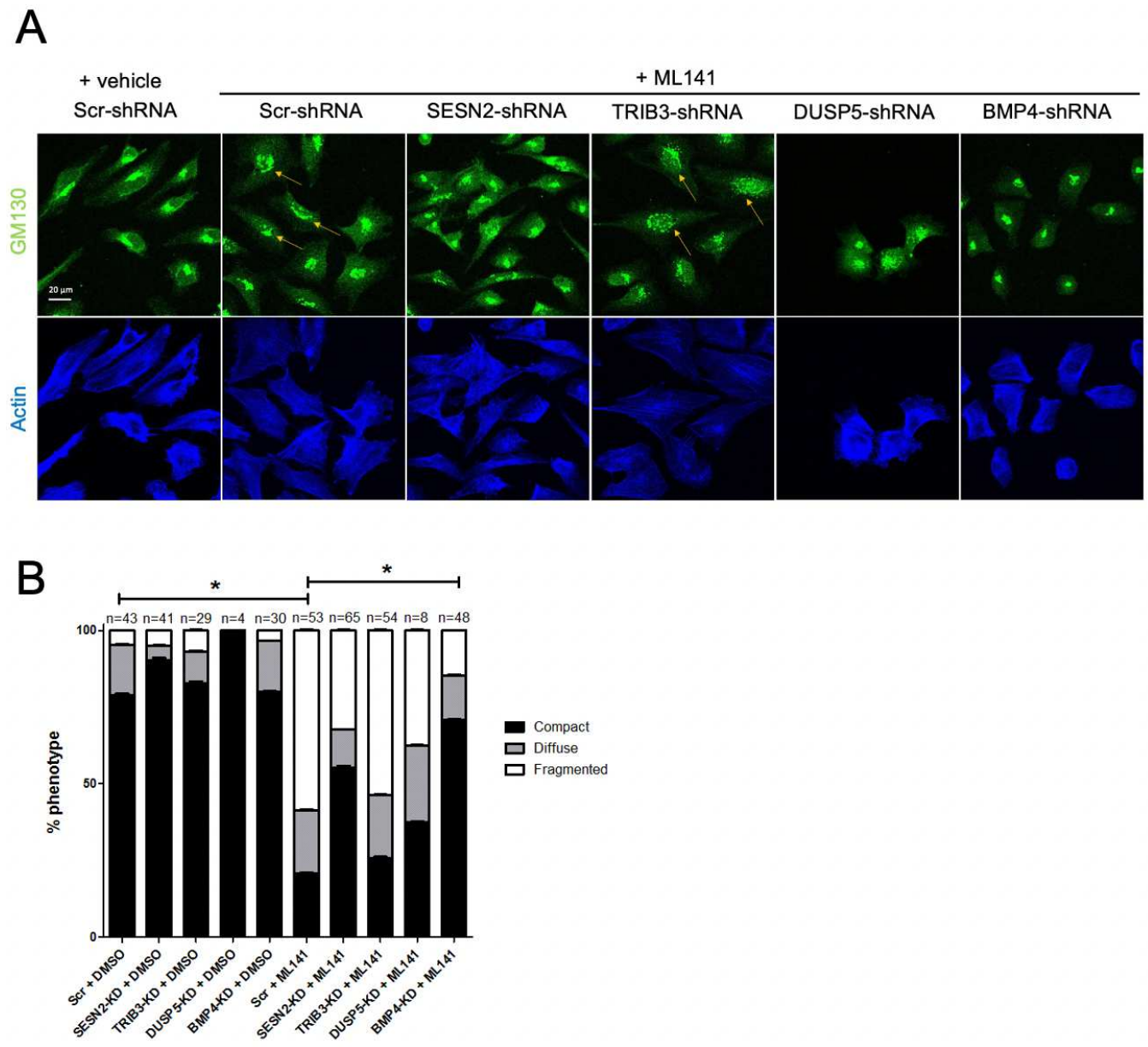

Figure 4.19: BMP4-knockdown rescues ML141-induced Golgi fragmentation. **A)** Immunofluorescence microscopy images showing staining of Golgi marker with GM130 and F-actin with phalloidin-405 stain. **B)** Quantification of Golgi morphologies in cells, scrambled control (Scr) or signaling target knockdowns, treated with vehicle (DMSO) or ML141 (20 µM). All samples were pre-treated with either vehicle (DMSO) or ML141 for 1 hour and then TNF-α (10 ng/mL) for 4 hours. Cells deemed to show a fragmented morphology were those with dispersed puncta GM130 staining. Diffuse morphology was when Golgi staining did not appear intact and showed aberrant spreading or minor fragmentation, but still appeared perinuclear. Cells displaying an intact perinuclear Golgi were deemed as compact, with normal Golgi cisternae [Kage et al., 2017; Petrosyan, 2019]. Significance shown indicates significant differences in 'fragmented' morphologies; a one-way ANOVA was performed on fragmented counts for DMSO or ML141-treated samples followed by a Dunnet's multiple comparisons test. Student's t-test was performed to specifically compare Scr + ML141 to Scr + DMSO group. Error bars represent SEM; n = number of viable cells used for counting; *p-value < 0.05. Note that DUSP5 had a low number of viable cells for analysis, hence the low n-value, and was excluded from analysis of statistical significance.

4.3 Discussion

In this study, we present new findings on the role of Cdc42 in regulating airway epithelial cell inflammation. To examine the role of Cdc42 we used the inhibitor ML141. We found incubation times of 4 to 8 hours were required for this inhibitor to show effects on cytokine mRNA levels and therefore was not an acute inhibitory event. Genome-wide transcriptomic analysis via RNA-Seq, followed by a computational pipeline, identified the differential expression of genes and biological pathways largely affected in response to TNF-α-mediated inflammation. Our analysis focused on interrogation of two pathways, cytokine gene expression as well as Golgi integrity which affects trafficking and secretion of cytokines. Our previous work revealed that Cdc42 impacts these pathways [Shouib & Eitzen, 2022].

TNF-α is one of the three main pro-inflammatory cytokines that initiates crucial inflammatory and immune cascades in response to a variety of stressors such as infection or toxins [Dinarello, 2000]. The role of TNF-α in initiating cellular inflammation in airway epithelial cells as well as other immune cells [Bradley, 2008; Mukhopadhyay et al., 2006; Shouib & Eitzen, 2022]. Upon exposure to TNF-α, cells undergo cytokine and pro-inflammatory gene expression via NF-κB activation, but under certain conditions can alternatively trigger apoptosis [Chu et al., 1997; Kreuz et al., 2001; Wang et al., 1998]. In our characterization of the inflammatory response instigated in response to TNF-α treatment, we found an increase in transcripts associated with inflammatory pathways, including cytokines, and upstream regulators such as receptors and transcription factors (*see* **Table S1**). This data is consistent with TNF-α-induced effects from other models such as macrophages [Loh et al., 2019], monocytes [Xia et al., 2022] and even cancer cells [Ando et al., 2021]. Although gene signatures in response to TNF-α have been previously reported in alveolar epithelial cells [Katsura et al., 2019], macrophages [Loh et al., 2019] and fibroblasts [Ngo et al., 2020] amongst other models, this is the first report in bronchial epithelial cells (BEAS-2B cells) in the context of inflammation to our knowledge. It is also important to note that gene signatures (i.e. increases or decreases of particular transcripts) could be due to either transcriptional upregulation or changes to mRNA stability and degradation; the former is most consistent with TNF-α response.

Our DEG analysis revealed that ML141 activates a subset of inflammatory genes, in the absence of TNF-α (e.g. IL-8, IL-11) and synergistically in the presence of TNF-α (e.g. IL-8, IL-1α, CXCL-2). In addition, our analysis of genes involved in ER stress and the unfolded protein response pathways showed consistent differential expression levels when treated with Cdc42 inhibitor (*see*

Figure 4.5B). Cdc42 has been shown to have a role in the regulation of ER stress. For instance, ATF3 and ATF4 pathways were upregulated by Cdc42 inhibition (*see* **Table S2 and Table S3**), resulting in an enrichment of biological processes associated with endoplasmic reticulum (ER) stress (*see* **Figure 4.5B**) [Jiang et al., 2004; Z. Liu et al., 2016; Rzymski et al., 2009]. In addition, Cdc42 was proposed to be a regulator of NUPR1, a nuclear protein and transcriptional regulator that responds to ER stress [Gironella et al., 2009]. However, it has been previously reported that Cdc42 silencing downregulates NUPR1 in melanoma cells [Jia et al., 2016], whereas we demonstrate an increase in NUPR1 transcript levels in response to Cdc42 inhibition by ML141 (*see* **Figure 4.13B**). However, our experiments using an inhibitor of NUPR1, ZZW-115, replicated the effect of ML141 rather than reverse the increase in cytokine mRNA levels, suggesting that NUPR1 is likely not the transcription factor driving the cytokine expression induced by ML141 in BEAS-2B cells (*see* **Figure 4.14**). Cdc42 was also found in a *C. elegans* screen for regulators of the unfolded protein response pathway, which is activated due to ER stress [Caruso et al., 2008]. Cdc42 has a significant role in Golgi trafficking [Chen et al., 2005; Shouib & Eitzen, 2022; Watson et al., 2014]. We speculate that disruption of trafficking through the secretory pathway via Cdc42 inhibition results in an ER stress response. In addition to ER stress, we also report an aberrant ER morphology, characterized by ER fragmentation in response to Cdc42 inhibition (*see* **Figure 4.11B**).

We speculate that the mechanism behind the increase in inflammatory gene expression due to Cdc42 inhibition could be through differentially regulated signaling proteins. To test this, we depleted signaling proteins that ranked high in our DEG analysis in the presence of Cdc42 inhibitor and examined whether Cdc42 inhibition no longer increases inflammatory cytokine gene expression. DUSP5 and TRIB3 knockdown resulted in significant changes to ML141-induced cytokine gene expression. DUSP5 is implicated in inflammation downstream of lipopolysaccharide induction and is known to negatively regulate NF-kB and AP-1 transcription factors [Seo et al., 2017]. While DUSP5 knockdown showed reduced IL-8 levels in response to ML141 treatment, MCP-1 levels were also reduced which was not expected. This suggests DUSP5 is not the signaling mediator mediating MCP-1 downregulation, but rather DUSP5 may be a positive regulator of MCP-1 since DUSP5 knockdown results in even further reductions in MCP-1 than that induced by ML141 treatment alone. Our results are consistent with findings reporting that DUSP5 KO in rats results in reduced MCP-1 expression in the renal cortex [Zhang et al., 2019]. On the other hand, TRIB3 is known to activate NF-κB signaling [Fang et al., 2014; Yu et al., 2015]. In response to Cdc42 inhibition, our RNA-Seq results showed an increase in

TRIB3 gene expression levels and an increase in IL-8 cytokine levels. We hypothesized that TRIB3 most likely acts through NF-κB to increase IL-8 levels. Indeed, knockdown of TRIB3 prevented ML141-induced increase in IL-8 mRNA levels. These findings reveal that Cdc42 inhibition is, at least partially, mediating IL-8 upregulation via TRIB3. Surprisingly, we also found that IL-8 may have a role in regulating TRIB3 gene expression since IL-8 knockdown appeared to reduce ML141-induced TRIB3 gene expression (**Figure 4.18B**) while addition of recombinant IL-8 seemed to increase TRIB3 gene expression (**Figure 4.18C**). These data point to a potential role for ML141-induced IL-8 gene expression contributing to TRIB3 expression, which is essential for IL-8 release downstream of ML141, highlighting the possibility of a positive feedback loop.

SESN2 and BMP4 knockdown did not show significant changes to gene expression of cytokines and thus unlikely to be transcriptional signaling mediators downstream of Cdc42. Surprisingly however, BMP4 appeared to be important for ML141-induced Golgi fragmentation (*see* **Figure 4.19**). BMP4 knockdown cells showed limited ML141-induced Golgi fragmentation. This finding is counterintuitive since BMP4 was downregulated by ML141; This implies that BMP4 downregulation could be a cellular response to improve Golgi function and alleviate the fragmentation induced by ML141. We also note that BMP4 knockdown cells are slightly smaller in size compared to scrambled controls which could be a potential confounding factor causing a more compact Golgi to be apparent due to the reduced overall size of the cell. Since we have previously shown that Cdc42 inhibition and silencing causes a reduction in MCP-1 secretion (*see* **Figure 3.3B and 3.9D**, respectively), further investigations using secretion assays could determine if BMP4 knockdown also causes a concomitant rescue of MCP-1 secretion levels indicating the restoration of a functional Golgi. There was a slight reduction in Golgi fragmentation in SESN2 knockdown cells observed by immunofluorescence microscopy and subsequent quantification. SESN2 is a stress response protein that has been shown to provide protection against ER stress [Han et al., 2022; Lu et al., 2023; Park et al., 2014; Sundaramoorthy et al., 2015]. Therefore SESN2 may be upregulated in response to ML141 to reduce downstream effects of ER stress, resulting in less Golgi fragmentation.

To further probe the underlying mechanism through which Cdc42 may be inducing Golgi fragmentation, we examined changes in gene expression of Golgi structural and functional genes. Upon examining the broad ‘Golgi apparatus’ gene set obtained from GSEA, it appeared that Cdc42 inhibition perturbed a large number of genes within the Golgi landscape. Further examination of specific compartments revealed that Cdc42 inhibition resulted in differential gene

expression of Golgi membrane-associated genes. These DEGs included key genes involved in the structural organization of the Golgi such as GM130 (encoded by GOLGA2) [Nakamura, 2010]. Interestingly, we found that the gene set 'COPI-dependent Golgi to ER Retrograde Transport' had a larger number of upregulated genes compared to the 'COPI-independent Golgi to ER Retrograde Transport' gene set (*see* **Figure 4.9**)**.** This is consistent with the findings reported by Park et al. [Park et al., 2015] that Cdc42 competes with, and inhibits, COP-I mediated transport of cargo in the retrograde direction. Hence, Cdc42 inhibition by ML141 treatment results in increased COPI-mediated traffic in the retrograde direction. We propose that this is the mechanism by which trafficking is disrupted; through the favoring of vesicle transport in the retrograde direction over anterograde transport [Farhan & Hsu, 2016]. Anterograde transport via microtubules generally mediates a fast rate of trafficking through the Golgi. Microtubule genes were upregulated by TNF-α but downregulated by ML141 which likely contributes to Golgi trafficking defects and fragmentation.

In conclusion, we characterize a novel role for Cdc42 in TNF-α-mediated inflammation and identified key biological pathways impacted. Cdc42 inhibition resulted in upregulation of pro-inflammatory genes, even in the absence of an activator such as TNF-α (*see* **Figure 4.5A and Figure 4.6**). Transcription factors involved in ER stress response, such as ATF3 and ATF4 [Jiang et al., 2004; Liu et al., 2016; Rzymski et al., 2009], were also increased (*see* **Table S2, Table S3 and Figure 4.13**). Cdc42 inhibition triggered Golgi fragmentation (*see* **Figure 4.19**) and whether this was a direct result of ER stress response, or whether this is due to trafficking defects that then lead to ER stress is uncertain. Our data point towards trafficking defects resulting in ER stress since expression changes in gene sets of specific steps within the secretory pathway reveal greater perturbations (higher number of DEGs) in 'ER to Golgi Vesicle Transport' and 'Intra-Golgi and Golgi to ER Retrograde Transport' compared to 'Post-Golgi Vesicle Transport' (*see* **Figure 4.9 and Figure 4.10**). In addition, we also show that ML141 results in a reduction of tubulin gene expression (*see* **Figure 4.7**) which may also be an underlying contributing factor in the mechanism of Golgi fragmentation and trafficking defects since the microtubule network is necessary for proper intracellular trafficking, Golgi integrity and organelle anchoring [Sanders & Kaverina, 2015]. Future investigations will be needed to determine whether ER stress associated with Cdc42 may be a result of inflammatory protein overload, or downstream effects on Golgi trafficking. In addition, future characterization of downstream effectors and their roles in mediating the inflammatory and trafficking changes caused by the inhibition of Cdc42 activity can help further define the pathways through which Cdc42 acts.

Chapter 5: Investigating effects of mis-localizing Cdc42 mutants on cytokine production

5.1 Brief Introduction

In its active state, GTP-bound Cdc42 localizes to cellular membranes where it interacts with its effectors to mediate downstream functions. The pool of Cdc42 at the plasma membrane has been well-studied and characterized in terms of cytoskeleton-related functions [Farhan & Hsu, 2016; Gasman et al., 2004; Herrington et al., 2017; Ledoux et al., 2023]. Cdc42 is also localized to the Golgi complex; however, the role of the Golgi pool has been less clearly characterized. Potential hypotheses have been proposed that Cdc42 at the Golgi functions as a reservoir that replenishes Cdc42 at the plasma membrane (**Figure 5.1A**), mediates specific functions independently of the plasma membrane pool (**Figure 5.1B**), or acts along with Cdc42 at the plasma membrane synergistically to carry out particular functions (**Figure 5.1C**) [Farhan & Hsu, 2016].

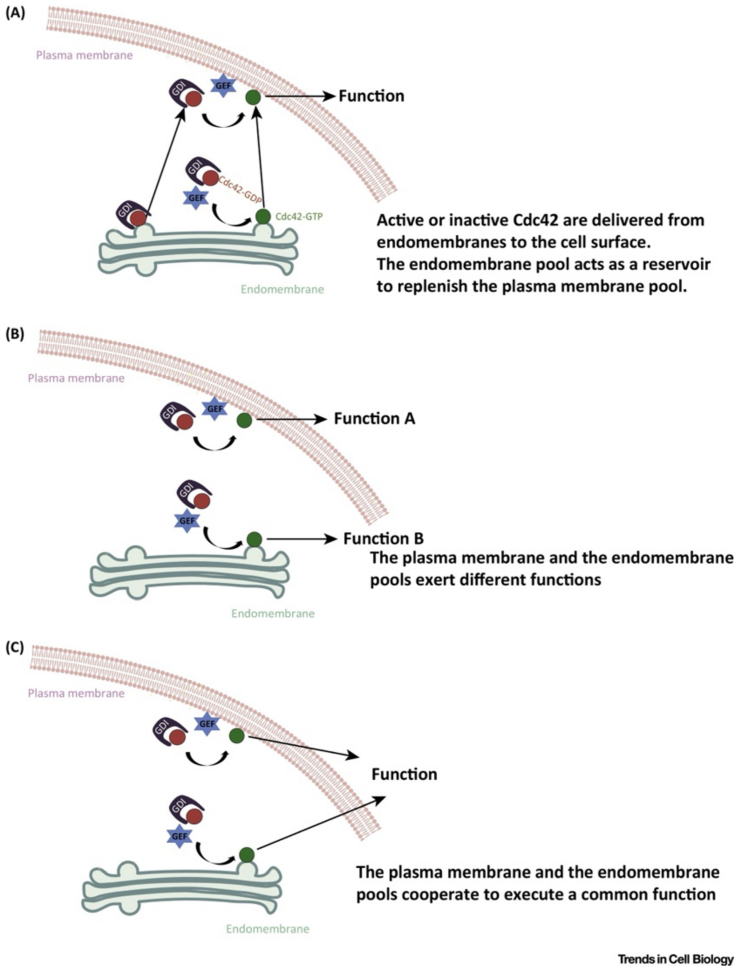

Figure 5.1: Potential functions and contributions of Cdc42 pool at the Golgi and the ER to cellular functions [Farhan & Hsu, 2016].

As discussed previously, Cdc42 is important for transport through the secretory pathway in both the retrograde [Hehnly et al., 2009; Luna et al., 2002; Park et al., 2015] and anterograde [Egorov et al., 2009; Gasman et al., 2004; Malacombe et al., 2006; Park et al., 2015; Wu et al., 2000] directions. However, discerning whether the Cdc42 Golgi pool mediates these functions remains unknown and studies on Cdc42 activity at the Golgi has sometimes yielded unexpected results. For instance, it

was shown that Golgi-localized guanine nucleotide exchange factors (GEF) that activate Cdc42, such as FGD1, are required for Cdc42 activity at the plasma membrane rather than at the Golgi [Herrington et al., 2017]. In addition, studying the functional importance of the Golgi pool of Cdc42 has remained unclear due to the limited ability to study this reservoir in isolation through typical means that selectively ablate or enhance its activity.

The subcellular compartmentalization of Cdc42 offers a level of spatial regulation of Cdc42 activity [Farhan & Hsu, 2016]. Therefore, proper localization of Cdc42 to membrane compartments, which include the plasma membrane, Golgi and ER membranes, is required for proper Cdc42 signaling. Consistent with this, mutants of Cdc42 that show an exclusive sequestration on the Golgi or the nucleus due to alternative lipidation have been identified. These mutants are known to be pathogenic and implicated in a wide array of inflammatory disorders [Coppola et al., 2022; Lam et al., 2019]. Two of these mutants, R186C and 192Cext*24* (which contains a 24 amino acid C-terminal extension), are sequestered exclusively on the Golgi due to aberrant C-terminal palmitoylation, whereas a C188Y pathogenic mutant is sequestered in the nucleus due to the lack of geranyl-geranylation (**Figure 5.2**). Surprisingly, patients that carried the R186C mutation show severe inflammation characterized by an excessive activation of immune cells presenting a condition known as hemophagocytic lymphohistiocytosis (HLH) [Lam et al., 2019]. Furthermore, it was shown that the R186C mutant, which is associated with severe clinical outcomes, is known to induce an autoinflammatory phenotype that has been effectively treated with IL-1β inhibition [Bekhouche et al., 2020; Gernez et al., 2019; Nishitani-Isa et al., 2022]. Recent evidence revealed that the R186C mutant results in NF-κB hyperactivation and increased cytokine production, particularly, IL-6 and IL-8, consistent with the systemic inflammation displayed in patients with this mutation [Bekhouche et al., 2020]. This NF-κB hyperactivation was dependent on the Golgi localization of Cdc42, as the use of palmitoylation inhibitors that reverse localization of the R186C mutant to the Golgi, also reversed the increased activation of NF-κB. In addition, it has also been shown that the R186C [Bekhouche et al., 2020; Nishitani-Isa et al., 2022] and the

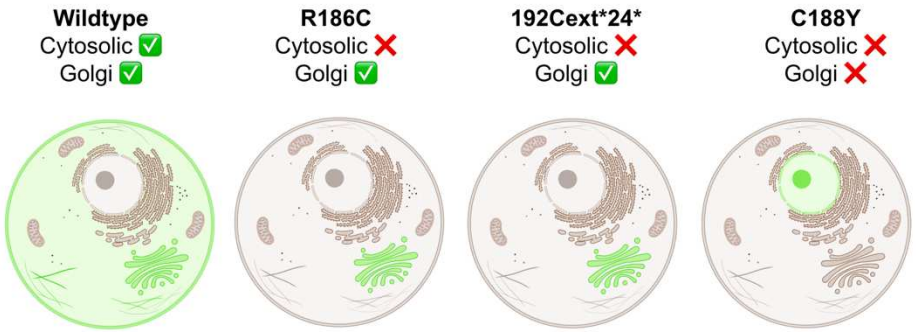

Figure 5.2: Illustration of aberrant Cdc42 localization to different compartments (shown in green) of different pathogenic Cdc42 mutants.

192Cext*24* [Nishitani-Isa et al., 2022] mutants are associated with increased production of IL-1β as a result of aberrant activation of the pyrin inflammasome [Nishitani-Isa et al., 2022]. Furthermore, it was demonstrated that R186C and 192Cext*24* do not impair COPI-mediated transport in either the anterograde or retrograde directions. Therefore, the pathogenic inflammatory effects do not seem to be due to perturbations to cytokine trafficking. Cdc42 mutants such as R186C were shown to display impaired binding to effectors of Cdc42 including IQGAP1 and WASP [Lam et al., 2019]. Hence, disruptions in signalling or upregulation of cytokine production or secretion by these mutants could also reveal the importance of these Cdc42 effectors in particular processes involved in inflammation.

These findings shed light on how Golgi localization of Cdc42 may not only be relevant to the regulation of bidirectional transport at the Golgi, but may also be essential to inflammatory signalling. They reveal new insights into the importance of the Golgi pool of Cdc42 and implications of its aberrant enrichment. They also raise new questions on the how this specific enrichment of Cdc42 at the Golgi may affect production or trafficking of cytokines, as our past studies using an airway epithelial cell model of inflammation defined a regulatory role for Cdc42 in these processes. We propose that these mutants could be used to interrogate the effects of Cdc42 enrichment in particular compartments such as the Golgi, on the trafficking of inflammatory cargo, such as cytokines.

5.2 Results

5.2.1 Cdc42 mutants show aberrant enrichment to subcellular compartments

Several pathogenic missense mutations of Cdc42 cause its aberrant localization [Coppola et al., 2022; Lam et al., 2019]. We expressed these Cdc42 mutants in BEAS-2B cells to corroborate their aberrant localization. BEAS-2B cells were transfected with wildtype or R186C, 192Cext*24*, or C188Y Cdc42 plasmid constructs (**Figure 5.3**). These constructs also contained an N-terminal FLAG-tag; we used anti-FLAG antibodies to examine the subcellular localization of these Cdc42 mutants. Our data confirmed a cytosolic localization for wildtype Cdc42, prominent Golgi-localization for R186C and 192Cext*24* mutants and an enrichment at the nucleus for the C188Y mutant. The C188Y mutant appeared to show staining in the cytosol as well. In each image, control non-transfected cells, without FLAG staining, are also shown. Examination of IL-8 staining in transfected Cdc42 mutant-expressing cells compared to control non-transfected cells revealed no changes in the IL-8 staining patterns. In addition, staining of the cis-Golgi with GM130 antibodies revealed no changes to the Golgi structure; it appeared compact in transfected cells and similar in morphology to untransfected cells [Nakamura et al., 1995]. We also investigated the effects of the expression of these mutants on MCP-1 staining and found no significant changes (**Figure 5.4**). We could not image BEAS-2B cells expressing the 192Cext*24* mutant which seemed to be toxic as no transfected cells were found in samples with MCP-1 labelled.

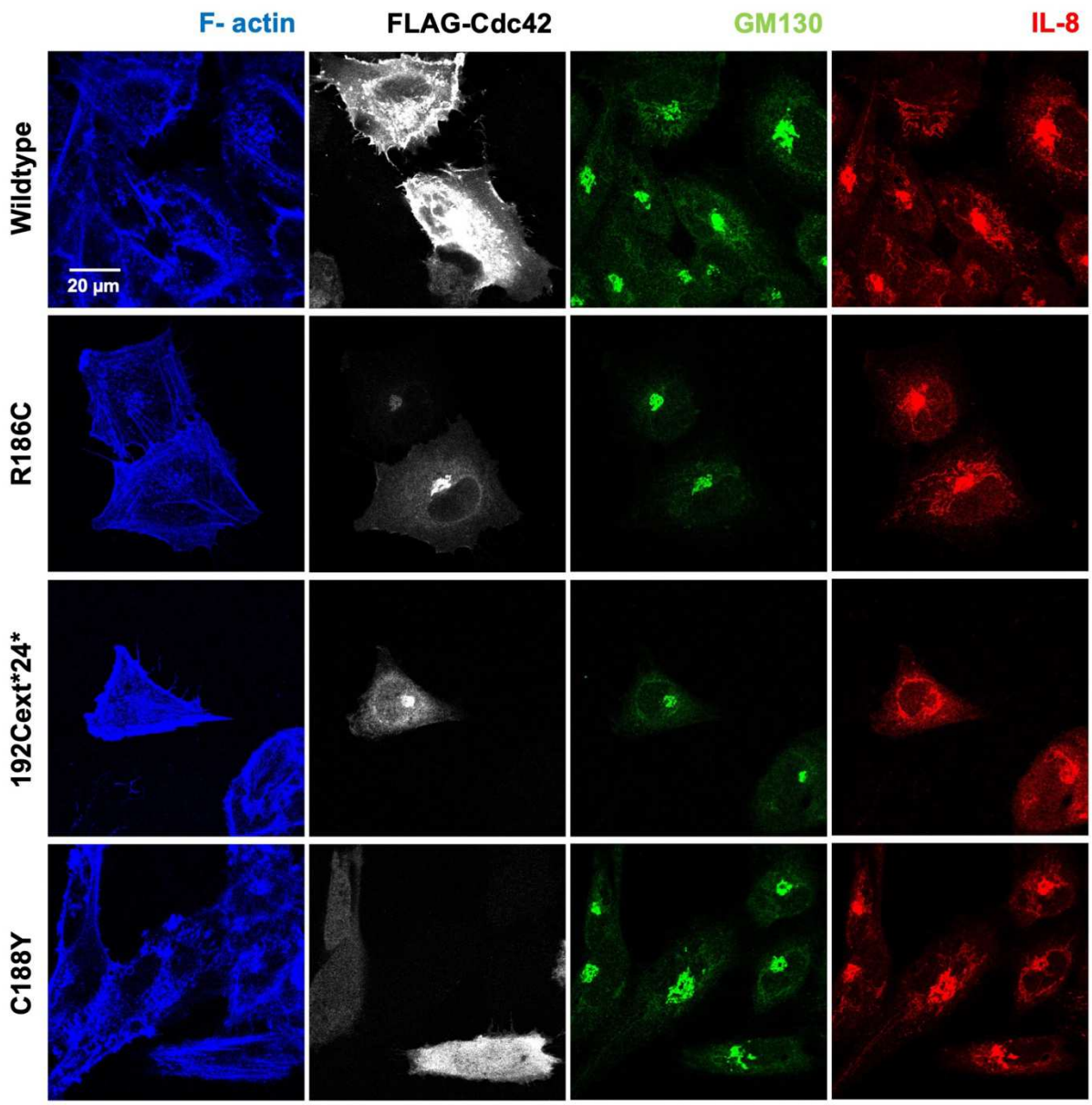

Figure 5.3: Transfection of BEAS-2B cells with Cdc42 mutants does not affect IL-8 localization. Immunofluorescence microscopy images showing staining F-actin with phalloidin-405 stain (blue), FLAG-Cdc42 wildtype and mutant constructs (white), cis-Golgi with GM130 (green) and the IL-8 cytokine (red). Cells were serum-starved overnight and stimulated with TNF-α (10 ng/mL) for 4 hours after which cells were fixed and stained. Wildtype Cdc42 localized throughout the cytoplasm and cell periphery but excluded from the nucleus, while the C188Y mutant localized to the cytoplasm and nucleus. The R186C and 192Cext*24* mutants showed prominent Golgi staining. The IL-8 localization pattern was similar in all cases.

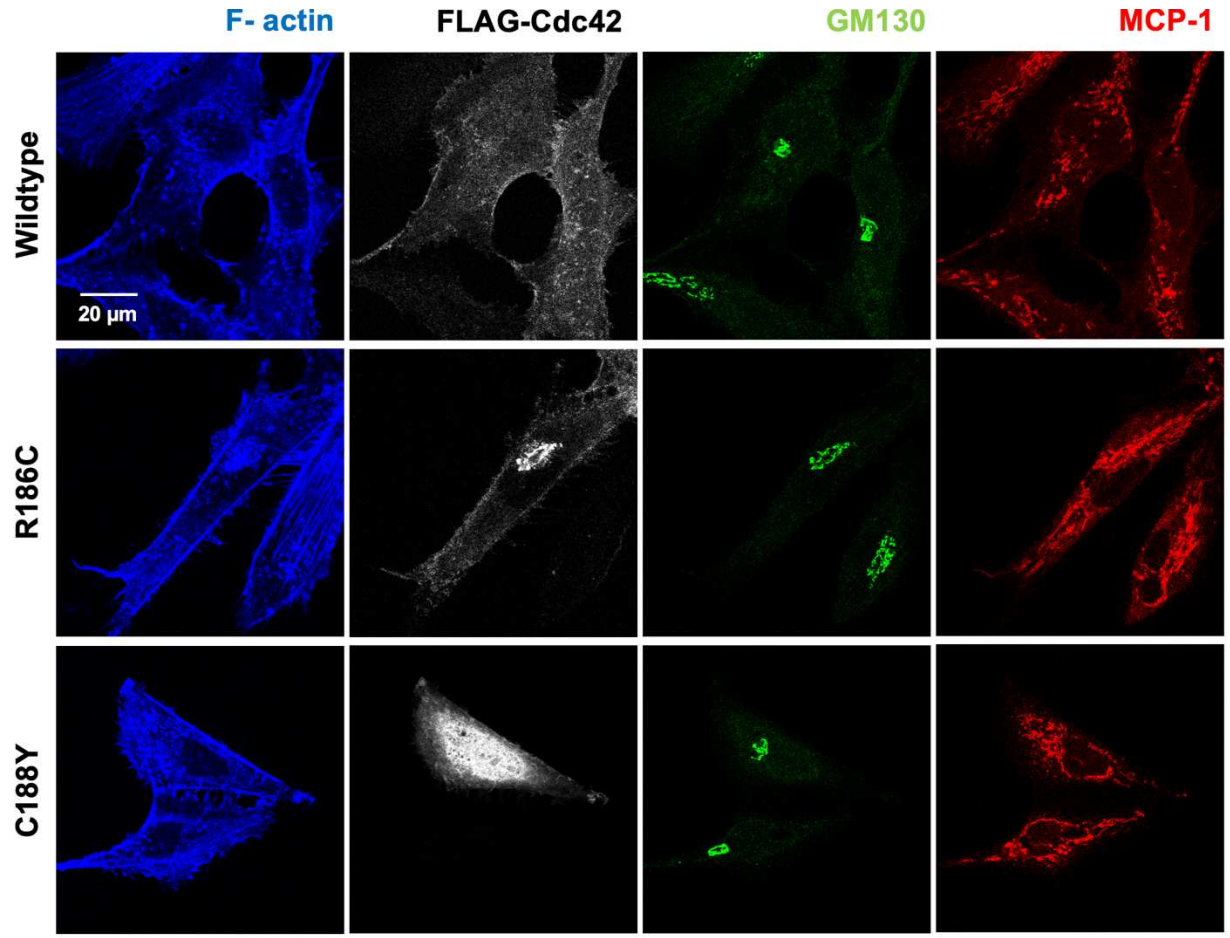

Figure 5.4: Transfection of BEAS-2B cells with Cdc42 mutants does not affect MCP-1 localization. Immunofluorescence microscopy images showing staining of F-actin with phalloidin-405 stain (blue), FLAG-Cdc42 wildtype and mutant constructs (white), cis-Golgi with GM130 (green) and the MCP-1 cytokine (red). Cells were serum-starved overnight and stimulated with TNF-α (10 ng/mL) for 4 hours after which cells were fixed and stained. Wildtype Cdc42 localized throughout the cytoplasm and cell periphery but excluded from the nucleus. The R186C and 192Cext*24* mutants showed prominent Golgi staining. The MCP-1 localization pattern was similar in all cases.

5.2.2 Cdc42 mutants do not cause intracellular accumulation of cytokines

We next wanted to quantitatively investigate whether cytokines accumulate in BEAS-2B cells transfected with Cdc42 mutants. We utilized flow cytometry to examine how cytokine production or release may be affected by the expression of these constructs. Flow cytometry allowed for the selective investigation of the transfected cell population, based on anti-FLAG staining, which represented a fraction of the entire cell population. Therefore, in addition to gating to eliminate unhealthy cells and debris, we also specifically gated on cells that expressed high levels of FLAG-tagged Cdc42, using mock-transfected cells for a negative control to set the gate (**Figure 5.5A**). We next examined the expression levels of IL-8 (**Figure 5.5B**), IL-1β (**Figure 5.5C**), and MCP-1 (**Figure 5.5D**) in cells transfected with FLAG-tagged wildtype Cdc42, and R186C, 192Cext*24*, C188Y mutant Cdc42 constructs. For control, wildtype cells were also incubated with the Golgi trafficking inhibitor monensin which should result in elevated cytokines levels.

Monensin generally resulted in greater accumulation of IL-8 and MCP-1, cytokines that transit through the Golgi and the secretory pathway, but did not affect IL-1β cytokine levels which is secreted independent of Golgi function. This was as expected and as previously shown in Chapter 3 (*see* **Figure 3.7** and **Figure 3.8**). The intracellular levels of cytokines in cells transfected with different Cdc42 mutants showed no significant increases or reductions compared to the wildtype-transfected control. The lack of an effect on cytokine levels may be due to contributions of endogenous Cdc42 that would be properly localized and contribute normal activity. This may obscure perturbations (loss or gain of function) induced by expression of these Cdc42 mutant proteins.

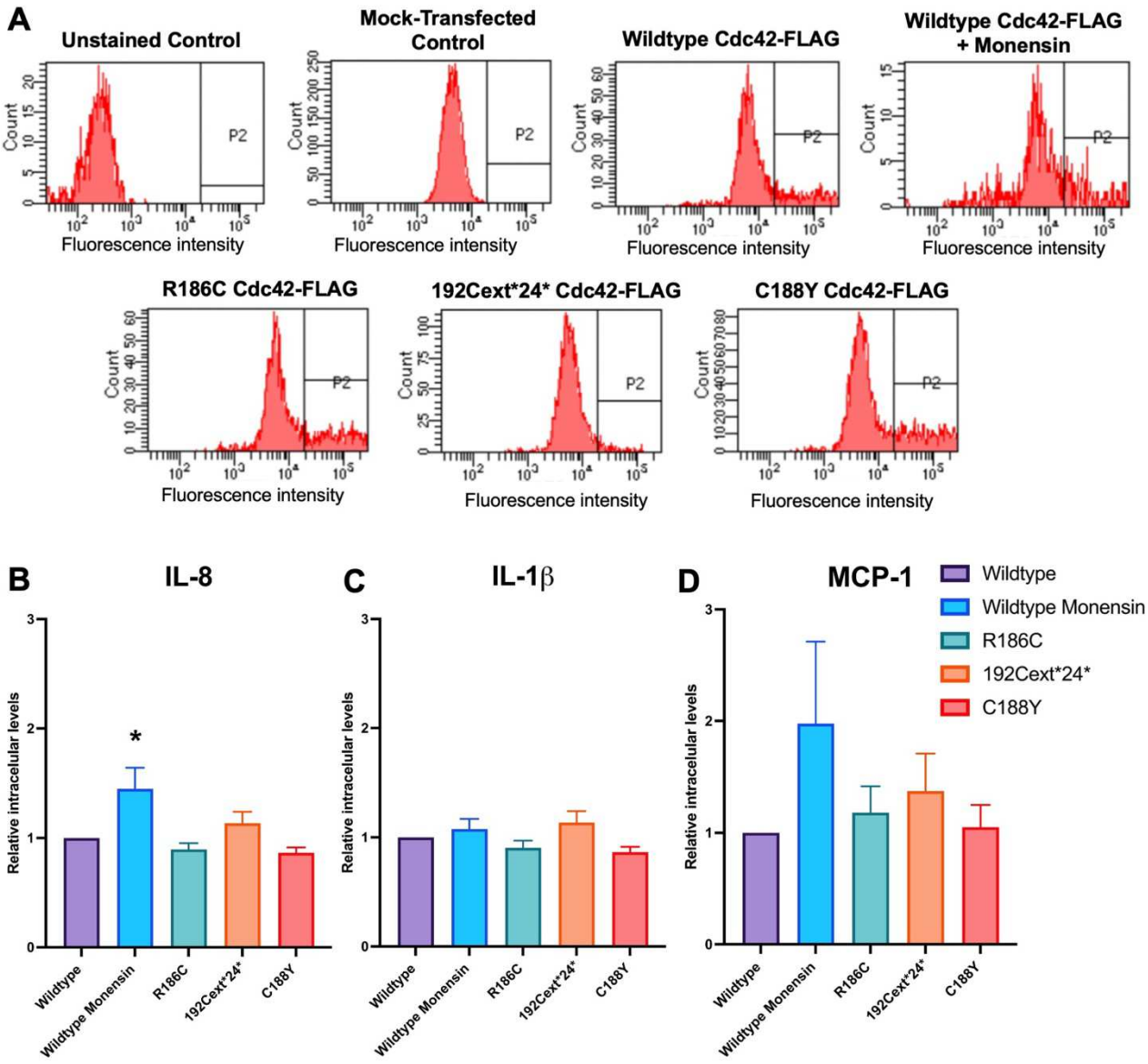

Figure 5.5: Transfection of BEAS-2B cells with Cdc42 mutant constructs (wildtype, R186C, C188Y, 192Cext*24*) does not affect intracellular accumulation of cytokines (IL-8, IL-1β, and MCP-1). **A)** Gating strategy for selection of transfected cells expressing FLAG-Cdc42 constructs. X-axis represents fluorescence intensity of FLAG staining. Results representative of three independent experiments. **B)** Expression of cytokines in the transfected FLAG-expressing cell population. Monensin was used as a Golgi transport inhibitor control affecting IL-8 and MCP-1 but not IL-1β. Cells were pre-treated with monensin (2 μM) or DMSO vehicle control for 1 hour and subsequently stimulated with TNF-α (10 ng/mL) for 4 hours after which cells were harvested and immunostained. Cells were gated to eliminate unhealthy cells, debris and doublet cells prior to gating for expression of FLAG (to select for transfected cells) using mock-transfected cells as a control. Data was analyzed by one-way ANOVA followed by a Dunnett's test for multiple comparisons. * $p<0.05$; $n = 4$.

5.3 Discussion

The Cdc42 R186C, 192Cext*24*, and C188Y mutants offer novel mechanisms for the enrichment of Cdc42 in specific cellular compartments. These pathogenic mutants are associated with aberrant inflammatory phenotypes, as well as show compromised interactions with Cdc42 effectors [Coppola et al., 2022; Lam et al., 2019; Nishitani-Isa et al., 2022]. We postulated that these are ideal molecular tools to further characterize how specific subcellular pools of Cdc42 may regulate inflammation in epithelial cells. In this chapter, we show preliminary data on the effects of expression Cdc42 mis-localization mutants in BEAS-2B cells. Our microscopy data corroborate localization of the R186C and 192Cex*24* mutants to the Golgi. The C188Y mutant was aberrantly localized to the nucleus, but not enriched in the nucleus. Our results revealed that the expression of these constructs did not affect IL-8 and MCP-1 trafficking nor Golgi structure, as visualized with immunofluorescence microscopy. In addition, investigations into the intracellular levels of IL-8, IL-1β and MCP-1 cytokines in cells transfected with wildtype or Cdc42 mutants also revealed no significant changes to the accumulation of cytokines in cells. This may be due to the fact that endogenous Cdc42 allows for normal cellular functions.

Future investigations of these mutants, where the selective enrichment at these compartments by these particular mutants, would need to be combined with knockdown of endogenous Cdc42. That is, inducing a knockdown of Cdc42 in cells and determining whether pro-inflammatory readouts can be rescued by expressing either with wildtype or R186C, 192Cext*24*, C188Y mutants. This approach will result in specific and *exclusive* expression of Cdc42 in the subcellular compartments to which they aberrantly localize resulting in a gain of function, combined with a loss of function at organelles from which they are sequestered away from. This could be performed by generating lentiviral vectors with Cdc42 shRNA to the 3'-untranslated region so that stable cell lines can be obtained that have endogenous Cdc42 silenced but do not effect plasmid expression (clones lack the 3'-untranslated region). This could also involve performing site-directed mutagenesis for Cdc42 mutant constructs so that they are not targeted by RNA interference machinery driven by Cdc42 shRNA. A potential limitation of this approach is that Cdc42 knockdown and Cdc42 mutant expression could have a major effect on cell viability. In addition, a major limitation of our data presented here, is the relatively low transfection efficiency amongst cells transfected with the Cdc42 constructs. This precluded us from further investigating the effects of these mutants with additional quantitative methods, for example analysis of secreted cytokine levels, as the effect of the mutant effects would be diluted by the untransfected

cells. Generation of stable cell lines would allow quantitative methods such as cytokine secretion assays and gene expression quantification by quantitative RT-PCR to be performed since the entire cell population following selection would show expression of Cdc42 constructs concomitant with endogenous Cdc42 activity ablation.

A major strength of the approach to studying Golgi-localized Cdc42 mutants (R186C and 192Cext*24*) would be the determination of whether an enrichment of the Golgi pool of Cdc42 can further accelerate cytokine trafficking and enhance secretion. On the other hand, Cdc42 mutants that are sequestered in the nucleus (C188Y), and therefore absent from the Golgi, could elucidate the consequences of the reduction of Cdc42 activity at the Golgi, while likely being less harmful to cells than a complete Cdc42 knockdown. Results from such studies may provide evidence for the pathogenicity of the Cdc42 mutant, elucidating the underlying mechanisms that contribute to the genetically linked inflammatory disorders [Coppola et al., 2022; Lam et al., 2019; Nishitani-Isa et al., 2022].

Chapter 6: Concluding Remarks and Future Directions

6.1 Conclusions

Small GTPases of the Rho family act as molecular switches within the cell and are known to be involved in signal transduction events that include control of cytoskeletal remodeling, vesicle trafficking and gene transcription [Bustelo et al., 2007; Jaffe & Hall, 2005]. In particular, the Rho GTPase Cdc42 is implicated in inflammatory signalling, although findings on its involvement in inflammation are somewhat contradictory among different model systems [Bagrodia et al., 1995; Deroanne et al., 2005; Ito et al., 2014; Perona et al., 1997; Puls et al., 1999; Tong & Tergaonkar, 2014]. In addition, Cdc42 is reported to modulate trafficking through the ER-Golgi secretory pathway with specific enhancement of anterograde but not retrograde trafficking [Farhan & Hsu, 2016; Park et al., 2015]. We postulated that Cdc42 couples inflammatory signalling initiated by different stimuli to cytokine gene expression cues as well as acting as a regulator of cytokine trafficking and secretion.

In Chapter 3, we showed how pharmacological inhibition and genetic silencing of Cdc42 in BEAS-2B cells differentially modulates transcript levels of different cytokines, highlighting Cdc42 as both a positive and negative regulator in pro-inflammatory cytokine gene expression. This was highly dependent on the class of cytokine; CXC cytokines were upregulated while the CC cytokine MCP-1 was downregulated. In addition, we demonstrated that Cdc42 inhibition resulted in dysregulated cytokine trafficking concomitant with an aberrant fragmented Golgi morphology. The combined effects on cytokine gene expression (both increased or decreased) along with disruption of trafficking in response to Cdc42 inhibition or silencing translated into an overall reduction in cytokine secretion levels [Shouib & Eitzen, 2022].

In Chapter 4, we defined the pro-inflammatory transcriptome profile activated in response to TNF-α treatment of BEAS-2B cells using genome-wide transcriptomic RNA-Seq analysis. To interrogate the role of Cdc42 in inflammatory gene expression, we utilized a pharmacological inhibitor of Cdc42, ML141, and determined the transcriptome profile induced by Cdc42 inhibition. Our results showed that Cdc42 inhibition with ML141 resulted in an inflammatory phenotype, trafficking defects concomitant with increased ER stress gene transcripts, implicating Cdc42 in the homeostatic regulation of these processes. To further interrogate the inflammatory signalling pathways regulated by Cdc42, we identified signaling target proteins that showed significant

differential expression in response to Cdc42 inhibition. Our shRNA-mediated knockdown of these signaling proteins revealed that silencing their activity rescued ML141-induced effects, suggesting that they coupled the inhibition of Cdc42 to inflammatory gene expression. In particular, our results identified TRIB3 and DUSP5 signaling proteins to be implicated in IL-8 and MCP-1 cytokine expression, respectively. Additionally, BMP4 and SESN2 appear to be implicated in the Golgi fragmentation induced by Cdc42 inhibition, as we observe reduced Golgi fragmentation in response to ML141-treatment.

In Chapter 5, we reported our investigations into the effects of expressing Cdc42 mutant constructs that show alternative enrichment to different cellular compartments due to aberrant lipidation. However, we did not find that expression of these mutants resulted in significant changes to cytokine trafficking or accumulation within cells. Further investigations where these constructs show significant expression levels in the background of cells that have endogenous Cdc42 silenced may better reveal whether an enrichment different compartments, such as the Golgi, affects cytokine trafficking through the secretory pathway.

Examining the secretion of cytokines from bronchial epithelial cells into the extracellular milieu in response to Cdc42 inhibition revealed that Cdc42 plays a role in cytokine release. We conclude that this observation is due to the coordination of several intracellular processes regulated by Cdc42 including pro-inflammatory signalling, cytokine gene expression, Golgi integrity, trafficking through the secretory pathway, as well as ER stress.

6.2 Challenges and Limitations

In careful critical analysis of our findings, we suggest that a major limitation of our approach is the use of only one pharmacological inhibitor, ML141, for Cdc42 inhibition. Corroborating data using a second Cdc42 inhibitor would be desirable, however, we found the other commonly-used inhibitor, CASIN [Xiao et al., 2018], to be toxic to BEAS-2B cells even at low concentrations. We therefore also utilized lentiviral shRNA-mediated knockdown of Cdc42 to replicate the effect of pharmacologically ablating Cdc42 activity in our cells. Although shRNA-mediated knockdown generally induces less off-target effects compared to siRNA [Rao et al., 2009], a significant limitation is that shRNA may function as microRNAs and potentially affect the expression of many off-target genes. Therefore, we used three different shRNA plasmids that target different sequences along the Cdc42 coding sequence. Since there were some differences in the

phenotypes induced by the different shRNA strains, this did not preclude the possibility of off-target effects. Nonetheless, we found shRNA strains to corroborate specific ML141-induced effects such the increase of IL-8 and IL-1β and the decrease in MCP-1 cytokine gene expression as well as the drastic decrease in MCP-1 secretion that was evident in both cells treated with ML141 or transduced with shRNA against Cdc42. In addition, since RNA interference (RNAi)-mediated knockdown is associated with a possibility for adaptation in long term cultures [Zheng et al., 2005], we established knockdown cell lines through two rounds of viral transduction and then rapidly proceeded to downstream assays following selection.

Although we had previously confirmed Cdc42 knockdown by shRNA lentiviral vectors using both quantitative PCR and western blotting, in Chapter 4 we confirmed knockdown of signalling mediators only by quantitative PCR due to the limited availability of antibodies against the selected protein targets. Notable to mention, although we did not validate the primary antibodies used throughout this thesis, we used extensively cited antibodies that are often considered gold-standard antibodies against the protein of interest when possible (*see* **Section 2.1.3**). In addition, our analyses were further corroborated by positive control outcomes that indicate correct and specific labelling of the targeted proteins; for instance, the IL-1β cytokine which does not traffic through the ER-Golgi secretory pathway and is synthesized in the cytosol, showed a mostly cytosolic staining pattern by immunofluorescence (*see* **Figure 3.4**) and was not affected by monensin-induced Golgi transport blockade as observed with flow cytometry (*see* **Figure 3.3** and **Figure 3.9**). Alternatively, IL-8 and MCP-1, which traffic through the secretory pathway, showed reticular staining that was affected by monensin-induced Golgi transport blockade (*see* **Figure 3.7** and **Figure 3.8**).

Another limitation was the low transfection efficiency when analyzing pathogenic Cdc42 mutant constructs in Chapter 5. This compromised our ability to perform quantitative assays that may have revealed important changes to cytokine gene expression or secretion. We suggest the addition of a knockdown of endogenous Cdc42 followed by a rescue with either wild-type or mutant Cdc42 constructs (R186C, 192Cext*24*, or C188Y) in Chapter 5. Such an investigation will be insightful in more precisely defining the implications of expressing these mutants. These pathogenic Cdc42 mutants are associated with inflammatory pathologies, and therefore studies on cytokine production and inflammatory signalling in our model of airway epithelial cells may contribute to a mechanistic understanding of these diseases. Although this investigation would also reveal the contributions of the Cdc42 Golgi pool through promoting a specific enrichment at

the organelle, we propose another future direction that aims to dissect the importance of the Golgi pool of Cdc42. This includes inducing a loss of function, rather than enrichment, of Cdc42 activity at the Golgi, which may be achieved through the use of Golgi-localizing dominant-negative Cdc42 mutants. This would result in a localized and robust 'turning off' or a loss of function of Cdc42 specifically at the Golgi. This would involve constructing mutant proteins comprised of dominant-negative Cdc42-T17N and sequences for Golgi localization. In addition, since the mis-localized Cdc42 mutants are reported to also be physiologically relevant in inflammation [Coppola et al., 2022; Lam et al., 2019; Nishitani-Isa et al., 2022], characterizing compromised interactions with different effectors implicated in signalling such as N-WASP, can yield insights into the mechanisms through which these mutants induce inflammatory dysregulation [Rivers & Thrasher, 2017].

6.3 Future Directions

The findings presented raise several intriguing questions that direct multiple future explorations. One of the surprising findings we report is that Cdc42 regulates different cytokines differently, highlighting how Cdc42 may be involved in multiple inflammatory signaling pathways. In order to probe the mechanism behind these differential effects, we can examine how our results from Chapter 3 and Chapter 4 complement one another. In Chapter 3, we report how cytokines such as IL-8 and IL-1β are upregulated, and MCP-1 is downregulated. Chapter 4 describes our screen of different signaling targets to investigate whether they mediate any of the ML141-induced effects. We found that TRIB3 knockdown particularly abolished ML141-induced increases in IL-8 highlighting its involvement downstream of Cdc42 inhibition to mediate this perturbation. Interestingly, we found that DUSP5 knockdown resulted in even further decreases in MCP-1 expression than that induced by ML141 alone. Although this suggests that DUSP5 was not in fact the signaling target mediating the decrease in MCP-1, it sheds light onto potential upstream regulators of MCP-1. We found DUSP5 to be a positive regulator of MCP-1, and since DUSP5 is known to inhibit NF-kB, AP-1 and ERK [Seo et al., 2017], this further highlights that MCP-1 may be regulated independently of NF-kB and AP-1 and hence shows a different response to other cytokines that may be regulated by these transcription factors. Future experiments that directly silence different transcription factors or test their activation in response to Cdc42 inhibition or depletion would further unravel the exact mechanisms through which Cdc42 regulates inflammatory signalling pathways. These methods also present relevant follow-up investigations for Chapter 3, where we assessed changes to cytokine mRNA and protein levels by quantitative

RT-PCR and flow cytometry, respectively, in response to inflammatory stimuli or perturbations that ablate Cdc42 activity in the cell. Since assessing mRNA and protein levels may be subject to changes in either mRNA production (transcriptional upregulation) or mRNA stability, future assays would be needed that directly interrogate transcription rates of cytokines. For instance, through the use of bioluminescence reporter assays that test promoter activation or high-throughput sequencing experiments that investigate transcription factor binding, such as ChIP-seq [Buenrostro et al., 2015].

Two additional processes regulated prominently by Cdc42 were trafficking through the Golgi and the maintenance of proper Golgi structure. Some of the signalling targets (BMP4, SESN2) investigated appeared to also be implicated in the Golgi fragmentation induced by ML141 as knockdown of these signaling targets appeared to rescue ML141-induced Golgi fragmentation. This finding raises the importance of further investigating a larger panel of signalling targets, especially those that are involved in ER stress and secretory pathway trafficking. Factors that show increased levels in response to ML141 as can be inferred from the RNA-Seq data. Furthermore, since BMP4 knockdown restored Golgi integrity and rescued ML141-induced Golgi fragmentation (*see* **Figure 4.19**), further studies could utilize cytokine secretion assays to assess if secretion levels (such as those of MCP-1 cytokine) are also restored. This will not only reveal the role of BMP4 and other signalling targets in cytokine trafficking but also further elucidate how Golgi fragmentation has functional implications on cytokine trafficking in epithelial cells.

Concomitant with trafficking defects and Golgi fragmentation, there was also a robust ER stress response mechanism activated in response to Cdc42 inhibition. Further studies are required to discern whether ER stress is caused by protein accumulation resulting from increased cytokine protein production that does not traffic properly along the secretory pathway, or whether ER stress itself causes the dysregulation of ER/Golgi integrity and trafficking. Studies that impose a translation block could provide insightful information. Such experiment could employ the use of the translation inhibitor, cycloheximide for instance, which would allow decoupling of the Cdc42-inhibition-induced effects on the interdependent processes of gene expression and trafficking/secretion [Schneider-Poetsch et al., 2010]. This would facilitate study of the trafficking pathway in isolation. Since cycloheximide is known to alleviate ER stress, observing an alleviation in trafficking defects under Cdc42 inhi[Szegezdi et al., 2006].

Our studies have investigated the biological actions of Cdc42 through imposing a loss of function perturbation (through ML141 inhibitor or shRNA-mediated genetic silencing). Examining effects of Cdc42 overexpression or expression of mutants with enhanced activity can provide deeper insights into the roles of Cdc42. A good candidate for such a study would be the Cdc42F28L mutant which can complete a GTP binding and hydrolysis cycle, but cycles rapidly (not needing Cdc42 GEFs and GAPs) and is predominantly in the active form [Luna et al., 2002; Wu et al., 2000]. In fact, expression of this Cdc42F28L fast-cycling mutant was reported to enhance ER to Golgi transport, corroborating the conclusions from our model [Wu et al., 2000]. Therefore, further investigations of cytokine production and release using constitutively active or fast-cycling Cdc42 mutants can yield yet another novel model that interrogates the importance of Cdc42 in these processes.

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Appendix I: Supplementary Material

Tables of Differential Expression of Genes (DEG)

Table S1: DEG Analysis - TNF-alpha-Stimulated vs Control (Resting)

gene name	gene ID	baseMean	log2FC	lfcSE	stat	pvalue	padj	filter
CXCL8	ENSG00000169429	9728.218	7.68521	0.147901	51.96195	0	0	1
TNFRSF9	ENSG00000049249	948.9319	6.978792	0.21075	33.11413	1.86E-240	1.08E-237	1
CCL2	ENSG00000108691	15814.53	6.72723	0.136862	49.1534	0	0	1
PTX3	ENSG00000163661	10973.05	6.273044	0.127821	49.07673	0	0	1
TNFAIP3	ENSG00000118503	8670.046	5.823645	0.154481	37.69802	0	0	1
CXCL1	ENSG00000163739	1882.893	5.426497	0.159218	34.08221	1.35E-254	9.51E-252	1
IL1B	ENSG00000125538	1980.255	5.060476	0.160315	31.56586	1.09E-218	5.35E-216	1
RELB	ENSG00000104856	5869.002	5.034138	0.146786	34.29565	9.11E-258	7.47E-255	1
BIRC3	ENSG00000023445	2946.847	5.021892	0.167319	30.01394	6.46E-198	2.76E-195	1
ICAM1	ENSG00000090339	26612.83	4.718376	0.074982	62.92698	0	0	1
CXCL5	ENSG00000163735	539.8954	4.714702	0.211153	22.32839	1.96E-110	5.35E-108	1
	ENSG00000291237	87452.95	4.635807	0.120067	38.61007	0	0	1
IL1A	ENSG00000115008	742.9305	4.526482	0.213966	21.15515	2.47E-99	5.41E-97	1
ESM1	ENSG00000164283	1065.572	4.279824	0.194746	21.97642	4.84E-107	1.19E-104	1
TNFAIP2	ENSG00000185215	62123.72	4.274387	0.084066	50.84538	0	0	1
IRAK2	ENSG00000134070	3705.297	4.20371	0.086674	48.49997	0	0	1
CLDN1	ENSG00000163347	17617.38	4.14433	0.097416	42.54266	0	0	1
EFNA1	ENSG00000169242	8151.125	4.050676	0.154988	26.13545	1.44E-150	5.26E-148	1
IL32	ENSG00000008517	1567.808	3.995279	0.140786	28.3784	3.74E-177	1.53E-174	1
C1QTNF1	ENSG00000173918	7735.901	3.918529	0.081374	48.15434	0	0	1
TRAF1	ENSG00000056558	1631.651	3.914745	0.154202	25.38716	3.50E-142	1.15E-139	1
NFKBIA	ENSG00000100906	9752.284	3.88843	0.114218	34.04405	4.97E-254	3.26E-251	1
INHBA	ENSG00000122641	1888.382	3.673183	0.172231	21.32703	6.37E-101	1.43E-98	1
TNIP1	ENSG00000145901	54742.86	3.457002	0.079498	43.48513	0	0	1
G0S2	ENSG00000123689	4021.734	3.456434	0.103663	33.34293	9.22E-244	5.67E-241	1
TLR2	ENSG00000137462	949.1738	3.398497	0.178716	19.01615	1.25E-80	2.16E-78	1
C3	ENSG00000125730	5519.328	3.30504	0.12358	26.74416	1.44E-157	5.68E-155	1
DRAM1	ENSG00000136048	15576.87	3.304653	0.105506	31.32184	2.35E-215	1.10E-212	1
IL6	ENSG00000136244	444.6781	3.265663	0.210788	15.49261	3.89E-54	4.30E-52	1
LIF	ENSG00000128342	9076.903	3.176583	0.143538	22.13058	1.60E-108	4.27E-106	1
RFLNA	ENSG00000178882	917.0435	3.169912	0.197352	16.06225	4.69E-58	5.85E-56	1
NEDD9	ENSG00000111859	3437.95	3.15005	0.14441	21.81323	1.74E-105	4.17E-103	1
NFKB2	ENSG00000077150	10549.32	3.102383	0.096307	32.21332	1.15E-227	5.95E-225	1
NFKBIE	ENSG00000146232	4080.609	3.06764	0.089853	34.14068	1.84E-255	1.39E-252	1
CTSS	ENSG00000163131	485.7704	2.990659	0.163217	18.32321	5.40E-75	8.86E-73	1
INAVA	ENSG00000163362	589.7278	2.87531	0.160611	17.90236	1.13E-71	1.77E-69	1
CD83	ENSG00000112149	1375.951	2.787922	0.108174	25.77253	1.80E-146	6.34E-144	1
GBP1	ENSG00000117228	9450.248	2.694774	0.133663	20.16096	2.16E-90	4.24E-88	1
IRF1	ENSG00000125347	5574.598	2.544873	0.08397	30.30686	9.31E-202	4.16E-199	1
STAT5A	ENSG00000126561	3309.403	2.505481	0.094387	26.54481	2.95E-155	1.12E-152	1
NFKB1	ENSG00000109320	11635.36	2.503612	0.077532	32.29129	9.27E-229	5.07E-226	1
SAMD9L	ENSG00000177409	3247.572	2.468663	0.139761	17.66349	8.01E-70	1.21E-67	1
IKBKE	ENSG00000263528	2604.117	2.449389	0.119183	20.55155	7.45E-94	1.56E-91	1

GPRC5B	ENSG00000167191	4365.609	2.449046	0.111209	22.02203	1.77E-107	4.47E-105	1
NINJ1	ENSG00000131669	5273.798	2.434997	0.097442	24.9892	8.01E-138	2.54E-135	1
MMP3	ENSG00000149968	330.7763	2.41332	0.263005	9.175958	4.48E-20	1.52E-18	1
ANO9	ENSG00000185101	444.698	2.408706	0.226119	10.65237	1.70E-26	7.97E-25	1
LAMB3	ENSG00000196878	4314.574	2.385398	0.125768	18.96665	3.22E-80	5.46E-78	1
MX1	ENSG00000157601	783.047	2.374259	0.208443	11.39044	4.67E-30	2.51E-28	1
SERPINE1	ENSG00000106366	85832.71	2.374206	0.1332	17.82433	4.58E-71	7.04E-69	1
NUAK2	ENSG00000163545	3634.458	2.365827	0.122576	19.30085	5.28E-83	9.45E-81	1
COL27A1	ENSG00000196739	992.9709	2.341985	0.13799	16.97209	1.32E-64	1.81E-62	1
MSC	ENSG00000178860	941.3718	2.341756	0.206628	11.33317	8.99E-30	4.76E-28	1
OAS2	ENSG00000111335	559.5409	2.307196	0.224109	10.29498	7.42E-25	3.23E-23	1
AC009549	ENSG00000270607	706.6383	2.267923	0.174981	12.96095	2.04E-38	1.48E-36	1
TRIM47	ENSG00000132481	2142.122	2.245181	0.142197	15.78926	3.69E-56	4.48E-54	1
JUNB	ENSG00000171223	1539.021	2.219951	0.133969	16.57065	1.14E-61	1.47E-59	1
IL7R	ENSG00000168685	1458.569	2.198534	0.158396	13.87996	8.38E-44	7.30E-42	1
ETS1	ENSG00000134954	40852.64	2.198148	0.139738	15.73054	9.34E-56	1.12E-53	1
CSF1	ENSG00000184371	5799.005	2.185677	0.094898	23.03185	2.24E-117	6.29E-115	1
NRP2	ENSG00000118257	859.2693	2.17502	0.166123	13.09281	3.62E-39	2.78E-37	1
MAFF	ENSG00000185022	2259.964	2.16398	0.130138	16.62841	4.34E-62	5.69E-60	1
BDKRB2	ENSG00000168398	467.9882	2.158242	0.201491	10.71137	9.00E-27	4.32E-25	1
APOL3	ENSG00000128284	913.555	2.151804	0.189935	11.32914	9.41E-30	4.95E-28	1
GBP2	ENSG00000162645	1055.479	2.084433	0.200215	10.41098	2.21E-25	9.88E-24	1
APOL6	ENSG00000221963	5403.967	2.066691	0.104238	19.82659	1.76E-87	3.33E-85	1
FOSL1	ENSG00000175592	11187.52	2.049748	0.181113	11.31751	1.07E-29	5.60E-28	1
HIVEP2	ENSG00000010818	6950.652	2.044027	0.12736	16.04918	5.79E-58	7.13E-56	1
ZNF697	ENSG00000143067	1802.379	2.041353	0.137012	14.89908	3.34E-50	3.46E-48	1
PDLIM4	ENSG00000131435	6192.8	2.034009	0.098011	20.7528	1.16E-95	2.47E-93	1
SDC4	ENSG00000124145	47513.82	2.028714	0.082076	24.71764	6.91E-135	2.13E-132	1
TIFA	ENSG00000145365	4110.689	2.015612	0.11998	16.79957	2.46E-63	3.31E-61	1
GBP3	ENSG00000117226	4496.516	2.013808	0.16077	12.52601	5.38E-36	3.70E-34	1
PIK3CD	ENSG00000171608	9795.237	2.006204	0.098169	20.43616	7.98E-93	1.60E-90	1
GFPT2	ENSG00000131459	8831.555	2.003352	0.106396	18.82927	4.35E-79	7.25E-77	1
EFNB1	ENSG00000090776	1490.999	2.000927	0.09044	22.12441	1.84E-108	4.77E-106	1
IER3	ENSG00000137331	4245.553	1.997251	0.092245	21.6516	5.87E-104	1.34E-101	1
IFIT3	ENSG00000119917	5961.758	1.991472	0.14819	13.4386	3.59E-41	3.02E-39	1
RIPK2	ENSG00000104312	2829.985	1.982626	0.084485	23.46706	8.85E-122	2.56E-119	1
LIMD2	ENSG00000136490	3015.125	1.978723	0.096624	20.47868	3.34E-93	6.84E-91	1
IFIT2	ENSG00000119922	2257.949	1.963975	0.171919	11.42382	3.18E-30	1.73E-28	1
IFIH1	ENSG00000115267	1893.709	1.957358	0.147287	13.28944	2.67E-40	2.17E-38	1
ZSWIM4	ENSG00000132003	1343.239	1.943213	0.106906	18.1769	7.86E-74	1.25E-71	1
VEGFC	ENSG00000150630	3608.954	1.922575	0.081284	23.65265	1.11E-123	3.31E-121	1
TAP1	ENSG00000168394	6986.898	1.92003	0.109756	17.49359	1.60E-68	2.39E-66	1
BCL3	ENSG00000069399	1480.852	1.918234	0.177502	10.80684	3.19E-27	1.56E-25	1
PDCD1LG2	ENSG00000197646	1158.59	1.91178	0.18257	10.47146	1.17E-25	5.27E-24	1
CD70	ENSG00000125726	1890.681	1.907645	0.158677	12.02218	2.72E-33	1.73E-31	1

CITED4	ENSG00000179862	1018.684	1.887203	0.13519	13.95968	2.75E-44	2.41E-42	1
NPAS2	ENSG00000170485	1230.097	1.841764	0.180546	10.20109	1.96E-24	8.25E-23	1
CFLAR	ENSG00000003402	6247.184	1.83162	0.09436	19.41099	6.23E-84	1.16E-81	1
IL15	ENSG00000164136	478.1949	1.814951	0.138304	13.12289	2.43E-39	1.90E-37	1
IL15RA	ENSG00000134470	724.7403	1.813439	0.135432	13.39003	6.92E-41	5.77E-39	1
NFKBIZ	ENSG00000144802	1246.21	1.811121	0.159889	11.32735	9.61E-30	5.03E-28	1
B4GALT1	ENSG00000086062	22142.7	1.80441	0.070608	25.55517	4.81E-144	1.63E-141	1
TNFRSF10	ENSG00000120889	12373.29	1.800565	0.090816	19.82653	1.76E-87	3.33E-85	1
NTN1	ENSG00000065320	669.9764	1.797513	0.190718	9.424973	4.30E-21	1.52E-19	1
CD82	ENSG00000085117	5279.354	1.766043	0.147467	11.97585	4.76E-33	2.94E-31	1
HDAC9	ENSG00000048052	1910.079	1.765121	0.180449	9.781816	1.35E-22	5.18E-21	1
FGF5	ENSG00000138675	9541.068	1.761212	0.170246	10.34512	4.40E-25	1.93E-23	1
TRIB1	ENSG00000173334	575.4809	1.760059	0.141527	12.43618	1.66E-35	1.13E-33	1
NEDD4L	ENSG00000049759	28460.5	1.755513	0.131403	13.35981	1.04E-40	8.59E-39	1
PML	ENSG00000140464	11954.81	1.752607	0.100801	17.38687	1.04E-67	1.50E-65	1
ARHGEF40	ENSG00000165801	4944.761	1.748484	0.142419	12.27705	1.20E-34	7.88E-33	1
GATA6	ENSG00000141448	639.1795	1.748193	0.215046	8.12938	4.31E-16	1.18E-14	1
NOCT	ENSG00000151014	2049.887	1.746786	0.106979	16.32827	6.21E-60	7.94E-58	1
APOL2	ENSG00000128335	7210.616	1.742792	0.123925	14.06325	6.39E-45	5.88E-43	1
ZC3H12A	ENSG00000163874	1115.274	1.731646	0.174534	9.921541	3.36E-23	1.33E-21	1
MRPS24	ENSG00000062582	498.8847	1.718266	0.191245	8.98464	2.60E-19	8.54E-18	1
HIVEP1	ENSG00000095951	4755.005	1.715085	0.130623	13.13	2.22E-39	1.75E-37	1
LACC1	ENSG00000179630	1283.858	1.712134	0.130998	13.06993	4.89E-39	3.73E-37	1
TMEM132	ENSG00000006118	5717.783	1.698812	0.108467	15.66196	2.75E-55	3.23E-53	1
ZNF469	ENSG00000225614	2018.906	1.695088	0.193272	8.770481	1.78E-18	5.59E-17	1
TRIM16	ENSG00000221926	1176.958	1.692123	0.108117	15.65088	3.28E-55	3.79E-53	1
CEBPD	ENSG00000221869	713.5673	1.672721	0.170252	9.824962	8.79E-23	3.41E-21	1
RASSF4	ENSG00000107551	994.3969	1.668788	0.111128	15.01674	5.70E-51	6.10E-49	1
OLR1	ENSG00000173391	507.5533	1.663649	0.160473	10.36715	3.50E-25	1.54E-23	1
GCH1	ENSG00000131979	3062.819	1.645107	0.126676	12.98678	1.45E-38	1.08E-36	1
BBC3	ENSG00000105327	972.1149	1.644241	0.140362	11.7143	1.08E-31	6.27E-30	1
SLC25A37	ENSG00000147454	13631.99	1.622274	0.103797	15.62933	4.60E-55	5.20E-53	1
HELZ2	ENSG00000130589	12321.13	1.619687	0.110292	14.68549	7.99E-49	8.02E-47	1
THBD	ENSG00000178726	1994.302	1.613103	0.150909	10.68923	1.14E-26	5.43E-25	1
COL7A1	ENSG00000114270	6411.222	1.602445	0.184962	8.663621	4.57E-18	1.40E-16	1
CHAC1	ENSG00000128965	420.298	1.602395	0.215631	7.431175	1.08E-13	2.39E-12	1
SERPINA1	ENSG00000197249	591.2863	1.600747	0.136075	11.76367	6.01E-32	3.54E-30	1
EHD1	ENSG00000110047	24230.35	1.598048	0.11369	14.05624	7.05E-45	6.43E-43	1
SLC2A6	ENSG00000160326	11448.9	1.588754	0.108242	14.67785	8.94E-49	8.88E-47	1
PPIF	ENSG00000108179	13194.86	1.58795	0.097683	16.25624	2.02E-59	2.55E-57	1
IRF2	ENSG00000168310	3413.891	1.584213	0.124316	12.74341	3.39E-37	2.44E-35	1
B3GNT5	ENSG00000176597	2395.587	1.579078	0.128594	12.27961	1.17E-34	7.70E-33	1
ISG20	ENSG00000172183	687.6381	1.560346	0.16978	9.19041	3.91E-20	1.34E-18	1
TNFAIP8	ENSG00000145779	5749.502	1.556146	0.085304	18.24233	2.38E-74	3.84E-72	1
IL4R	ENSG00000077238	2779.848	1.555176	0.089828	17.31279	3.77E-67	5.30E-65	1
ELOVL7	ENSG00000164181	671.9172	1.552791	0.124388	12.4834	9.20E-36	6.29E-34	1

IL27RA	ENSG00000104998	867.9608	1.548675	0.116115	13.3374	1.40E-40	1.15E-38	1
SHB	ENSG00000107338	2302.32	1.54779	0.15645	9.893209	4.46E-23	1.75E-21	1
NKX3-1	ENSG00000167034	4055.578	1.546116	0.129308	11.95684	5.98E-33	3.65E-31	1
SAMD4A	ENSG00000020577	11785.71	1.538426	0.127833	12.0347	2.33E-33	1.49E-31	1
BIRC2	ENSG00000110330	8727.079	1.536764	0.12142	12.65658	1.03E-36	7.23E-35	1
NAV3	ENSG00000067798	1197.828	1.526336	0.196502	7.767545	8.00E-15	1.98E-13	1
WWC1	ENSG00000113645	17065.17	1.526155	0.080255	19.01641	1.25E-80	2.16E-78	1
ATP2B1	ENSG00000070961	16361.19	1.519966	0.086942	17.48262	1.94E-68	2.85E-66	1
PARP14	ENSG00000173193	9892.506	1.516097	0.10227	14.82451	1.02E-49	1.03E-47	1
USP43	ENSG00000154914	1862.022	1.516087	0.114587	13.23089	5.82E-40	4.66E-38	1
PLK3	ENSG00000173846	1474.912	1.514473	0.149028	10.16233	2.92E-24	1.21E-22	1
IFNGR2	ENSG00000159128	5723.226	1.501991	0.088439	16.98343	1.09E-64	1.51E-62	1
TGFB2	ENSG00000092969	9856.117	1.485614	0.126958	11.70163	1.25E-31	7.20E-30	1
NFE2L3	ENSG00000050344	4876.601	1.484467	0.123516	12.0184	2.84E-33	1.79E-31	1
SMAD3	ENSG00000166949	28938.98	1.473498	0.123737	11.90829	1.07E-32	6.47E-31	1
PDGFB	ENSG00000100311	2557.573	1.469715	0.11152	13.17892	1.16E-39	9.21E-38	1
DAPK2	ENSG00000035664	551.7834	1.465369	0.135715	10.79743	3.54E-27	1.71E-25	1
AMIGO2	ENSG00000139211	10313.75	1.445353	0.116489	12.40765	2.38E-35	1.59E-33	1
PLK2	ENSG00000145632	37001.93	1.427463	0.090907	15.70241	1.46E-55	1.73E-53	1
ZC3H7B	ENSG00000100403	25877.62	1.418482	0.100998	14.04467	8.31E-45	7.50E-43	1
SQSTM1	ENSG00000161011	31285.2	1.418461	0.103928	13.64854	2.06E-42	1.76E-40	1
MT2A	ENSG00000125148	22934.06	1.416336	0.114652	12.3533	4.68E-35	3.11E-33	1
SERPINE2	ENSG00000135919	9597.778	1.415693	0.123186	11.49228	1.44E-30	8.02E-29	1
LINC00839	ENSG00000185904	2335.315	1.409262	0.097205	14.49781	1.25E-47	1.22E-45	1
PLAU	ENSG00000122861	16657.4	1.405941	0.141496	9.936272	2.89E-23	1.15E-21	1
ERN1	ENSG00000178607	1482.006	1.405541	0.128836	10.90955	1.04E-27	5.16E-26	1
TAPBP	ENSG00000231925	10049.12	1.404453	0.099323	14.14025	2.15E-45	1.99E-43	1
RHBDF2	ENSG00000129667	4533.951	1.399986	0.136363	10.26659	9.97E-25	4.30E-23	1
EFHD2	ENSG00000142634	10956.28	1.390413	0.071949	19.32508	3.30E-83	6.02E-81	1
ARHGAP31	ENSG00000031081	3999.365	1.387127	0.089791	15.44837	7.74E-54	8.46E-52	1
RAB42	ENSG00000188060	736.6344	1.386385	0.114592	12.09846	1.08E-33	6.92E-32	1
FRMD6	ENSG00000139926	60946.11	1.381526	0.115455	11.9659	5.36E-33	3.30E-31	1
COTL1	ENSG00000103187	14551.43	1.370943	0.081786	16.76254	4.59E-63	6.10E-61	1
SEMA3C	ENSG00000075223	17799.97	1.362151	0.093537	14.56263	4.85E-48	4.78E-46	1
OAS1	ENSG00000089127	403.8099	1.360858	0.23414	5.812149	6.17E-09	8.86E-08	1
ZNFX1	ENSG00000124201	19286.95	1.360421	0.090773	14.98711	8.92E-51	9.43E-49	1
ETV6	ENSG00000139083	2347.078	1.356916	0.100915	13.44609	3.25E-41	2.75E-39	1
TNC	ENSG00000041982	48024.3	1.356615	0.138892	9.767435	1.55E-22	5.90E-21	1
DEPP1	ENSG00000165507	675.5207	1.346557	0.123198	10.93002	8.28E-28	4.14E-26	1
C3orf52	ENSG00000114529	955.199	1.339096	0.125737	10.64997	1.74E-26	8.14E-25	1
NAV2	ENSG00000166833	18433.93	1.335927	0.185409	7.205288	5.79E-13	1.22E-11	1
MUC1	ENSG00000185499	1340.802	1.332109	0.163199	8.162461	3.28E-16	9.05E-15	1
OXTR	ENSG00000180914	1766.536	1.319919	0.106197	12.42893	1.82E-35	1.23E-33	1
PLPP3	ENSG00000162407	1097.678	1.314939	0.12776	10.29222	7.64E-25	3.31E-23	1
HLA-F	ENSG00000204642	922.9557	1.305448	0.115083	11.34357	7.98E-30	4.25E-28	1
TNKS1BP1	ENSG00000149115	15297.5	1.299054	0.108116	12.01542	2.95E-33	1.85E-31	1

TFPI2	ENSG00000105825	1012.73	1.29867	0.138976	9.344564	9.23E-21	3.23E-19	1
WTAP	ENSG00000146457	9795.246	1.294554	0.101711	12.72781	4.14E-37	2.95E-35	1
BID	ENSG00000015475	4104.206	1.290655	0.121452	10.62691	2.23E-26	1.02E-24	1
PANX1	ENSG00000110218	5199.337	1.288578	0.07425	17.3545	1.82E-67	2.60E-65	1
GADD45A	ENSG00000116717	5752.499	1.286891	0.139024	9.256605	2.11E-20	7.26E-19	1
SLC41A2	ENSG00000136052	2853.568	1.282176	0.082457	15.54968	1.60E-54	1.79E-52	1
LTB	ENSG00000227507	372.3115	1.279604	0.271898	4.706196	2.52E-06	2.50E-05	1
CD274	ENSG00000120217	1390.905	1.277129	0.143462	8.902226	5.47E-19	1.78E-17	1
OAS3	ENSG00000111331	9644.209	1.268122	0.108812	11.65428	2.18E-31	1.23E-29	1
STOML1	ENSG00000067221	1076.568	1.2672	0.09537	13.28721	2.75E-40	2.22E-38	1
P4HA2	ENSG00000072682	11798.05	1.266487	0.108438	11.67933	1.63E-31	9.30E-30	1
PRICKLE3	ENSG00000012211	544.424	1.256071	0.137647	9.125292	7.15E-20	2.41E-18	1
BAHCC1	ENSG00000266074	4263.31	1.246072	0.183437	6.792903	1.10E-11	2.11E-10	1
MTSS1	ENSG00000170873	1120.044	1.244842	0.148047	8.408447	4.15E-17	1.21E-15	1
MAP2K3	ENSG00000034152	7035.557	1.242504	0.116244	10.68873	1.15E-26	5.44E-25	1
FAM20C	ENSG00000177706	7807.362	1.236355	0.079103	15.62974	4.57E-55	5.20E-53	1
HBEGF	ENSG00000113070	4058.467	1.226688	0.169003	7.258401	3.92E-13	8.33E-12	1
FNDC3B	ENSG00000075420	14489.96	1.222899	0.08186	14.93897	1.84E-50	1.92E-48	1
ASS1	ENSG00000130707	723.7324	1.22282	0.186184	6.567807	5.11E-11	9.27E-10	1
LOX	ENSG00000113083	17935.42	1.220766	0.102508	11.90895	1.06E-32	6.46E-31	1
MAML2	ENSG00000184384	2904.283	1.219355	0.135916	8.971382	2.93E-19	9.61E-18	1
ABTB2	ENSG00000166016	4405.356	1.204751	0.12046	10.00125	1.50E-23	6.04E-22	1
SEC14L2	ENSG00000100003	3091.178	1.204014	0.087391	13.77727	3.49E-43	3.01E-41	1
COL4A1	ENSG00000187498	18726.77	1.20387	0.083041	14.4973	1.26E-47	1.22E-45	1
SLC25A22	ENSG00000177542	2517.24	1.197999	0.114614	10.45251	1.43E-25	6.41E-24	1
PSMB10	ENSG00000205220	777.6341	1.195005	0.15918	7.507266	6.04E-14	1.37E-12	1
PTGFR	ENSG00000122420	1307.597	1.186963	0.148516	7.992159	1.33E-15	3.51E-14	1
CDV3	ENSG00000091527	37857.93	1.179912	0.121405	9.718837	2.51E-22	9.38E-21	1
TRIM25	ENSG00000121060	19116.47	1.178009	0.076284	15.44251	8.47E-54	9.16E-52	1
SERPINB8	ENSG00000166401	4884.657	1.170831	0.093138	12.57092	3.05E-36	2.11E-34	1
ELF4	ENSG00000102034	14327.47	1.170366	0.147739	7.921865	2.34E-15	6.08E-14	1
TAP2	ENSG00000204267	2837.082	1.170289	0.120112	9.743284	1.97E-22	7.40E-21	1
FST	ENSG00000134363	1151.6	1.168348	0.154443	7.564923	3.88E-14	9.01E-13	1
PARP12	ENSG00000059378	3222.522	1.164933	0.082998	14.03561	9.44E-45	8.44E-43	1
PLAUR	ENSG00000011422	3230.512	1.163397	0.080813	14.39615	5.47E-47	5.23E-45	1
TBC1D10A	ENSG00000099992	1070.183	1.158538	0.106447	10.88374	1.38E-27	6.78E-26	1
SOX4	ENSG00000124766	2965.595	1.151229	0.179952	6.397416	1.58E-10	2.76E-09	1
SNAI2	ENSG00000019549	1965.331	1.149091	0.144629	7.94507	1.94E-15	5.07E-14	1
FLI1	ENSG00000151702	3135.592	1.1485	0.118338	9.70528	2.86E-22	1.06E-20	1
GSAP	ENSG00000186088	849.2109	1.146311	0.117525	9.753767	1.78E-22	6.73E-21	1
TRIM21	ENSG00000132109	2603.56	1.145059	0.152879	7.48996	6.89E-14	1.56E-12	1
CTGF	ENSG00000118523	20325.8	1.142832	0.142717	8.007698	1.17E-15	3.10E-14	1
FMNL3	ENSG00000161791	8188.955	1.137716	0.079877	14.24337	4.93E-46	4.62E-44	1
ANKRD33B	ENSG00000164236	3776.121	1.129032	0.159146	7.094297	1.30E-12	2.67E-11	1
DUSP10	ENSG00000143507	713.2102	1.123955	0.130748	8.596373	8.23E-18	2.49E-16	1
RCAN1	ENSG00000159200	2461.036	1.118433	0.100306	11.15022	7.14E-29	3.64E-27	1

SGK1	ENSG00000118515	2896.449	1.11709	0.118061	9.461998	3.02E-21	1.08E-19	1
EGFR	ENSG00000146648	39701.15	1.115726	0.155918	7.155869	8.31E-13	1.73E-11	1
SEMA4B	ENSG00000185033	6726.603	1.114169	0.093748	11.88472	1.42E-32	8.53E-31	1
TRAF3	ENSG00000131323	5986.432	1.113493	0.085472	13.02758	8.53E-39	6.41E-37	1
FOXC2	ENSG00000176692	903.0756	1.11067	0.141057	7.873896	3.44E-15	8.74E-14	1
THSD1	ENSG00000136114	1128.364	1.109995	0.114339	9.707952	2.79E-22	1.04E-20	1
S1PR3	ENSG00000213694	2737.306	1.109074	0.100811	11.00157	3.76E-28	1.91E-26	1
ITGA2	ENSG00000164171	2445.46	1.103955	0.100818	10.94999	6.65E-28	3.34E-26	1
ATF3	ENSG00000162772	1090.377	1.099887	0.156743	7.017126	2.26E-12	4.59E-11	1
ITGA5	ENSG00000161638	15317.54	1.097543	0.078264	14.02353	1.12E-44	9.92E-43	1
SLFN5	ENSG00000166750	5245.725	1.094901	0.073762	14.84364	7.65E-50	7.84E-48	1
STARD10	ENSG00000214530	1339.75	1.094643	0.122096	8.965426	3.09E-19	1.01E-17	1
ABAT	ENSG00000183044	510.3193	1.093484	0.142097	7.695322	1.41E-14	3.43E-13	1
NGF	ENSG00000134259	705.8318	1.085651	0.156416	6.940811	3.90E-12	7.80E-11	1
LSR	ENSG00000105699	2105.623	1.079437	0.092783	11.63403	2.77E-31	1.55E-29	1
MYBL1	ENSG00000185697	17527.21	1.078887	0.114152	9.451278	3.35E-21	1.19E-19	1
RNF207	ENSG00000158286	1157.032	1.078512	0.214976	5.016896	5.25E-07	5.82E-06	1
PHLDA2	ENSG00000181649	3246.349	1.073532	0.104071	10.3154	6.00E-25	2.63E-23	1
F2RL1	ENSG00000164251	2851.552	1.071384	0.095729	11.19187	4.47E-29	2.30E-27	1
TNFAIP1	ENSG00000109079	13104.18	1.068433	0.074964	14.25259	4.32E-46	4.09E-44	1
DTX3L	ENSG00000163840	7040.927	1.068007	0.087748	12.17125	4.42E-34	2.86E-32	1
C11orf68	ENSG00000175573	4567.604	1.066099	0.084413	12.62954	1.45E-36	1.01E-34	1
NFKBIB	ENSG00000104825	2214.049	1.063988	0.086668	12.27667	1.21E-34	7.88E-33	1
CEBPB	ENSG00000172216	1984.667	1.060908	0.131964	8.039394	9.03E-16	2.43E-14	1
BCAR3	ENSG00000137936	8957.422	1.05851	0.105197	10.06221	8.12E-24	3.31E-22	1
SMOX	ENSG00000088826	2169.391	1.057276	0.141601	7.466609	8.23E-14	1.84E-12	1
CD40	ENSG00000101017	774.4456	1.055849	0.126743	8.330623	8.04E-17	2.32E-15	1
ADM	ENSG00000148926	4801.515	1.053187	0.140407	7.500981	6.33E-14	1.44E-12	1
ECE1	ENSG00000117298	25048.47	1.044176	0.10502	9.942619	2.72E-23	1.08E-21	1
SPHK1	ENSG00000176170	7650.106	1.043765	0.102749	10.15841	3.04E-24	1.26E-22	1
LHFPL2	ENSG00000145685	13334.27	1.041691	0.108044	9.64132	5.35E-22	1.96E-20	1
IFIT5	ENSG00000152778	3471.553	1.041029	0.130812	7.958228	1.75E-15	4.58E-14	1
ADGRG1	ENSG00000205336	6341.96	1.040788	0.176906	5.883291	4.02E-09	5.88E-08	1
PRDM8	ENSG00000152784	827.9004	1.040215	0.12573	8.273395	1.30E-16	3.69E-15	1
PHLDB2	ENSG00000144824	30774.41	1.038912	0.095317	10.89953	1.16E-27	5.73E-26	1
C15orf39	ENSG00000167173	2693.591	1.029048	0.097544	10.54953	5.11E-26	2.33E-24	1
TAF4B	ENSG00000141384	505.4791	1.028695	0.166685	6.171484	6.77E-10	1.09E-08	1
OTUD4	ENSG00000164164	11289.12	1.027106	0.134428	7.640545	2.16E-14	5.14E-13	1
SBNO2	ENSG00000064932	7966.704	1.021703	0.130246	7.844416	4.35E-15	1.09E-13	1
PDZD2	ENSG00000133401	2325.042	1.020328	0.170658	5.978782	2.25E-09	3.37E-08	1
PRKCD	ENSG00000163932	2962.248	1.019077	0.087082	11.70248	1.24E-31	7.17E-30	1
RND3	ENSG00000115963	12842.16	1.019045	0.089125	11.43385	2.83E-30	1.55E-28	1
KCTD11	ENSG00000213859	1583.483	1.015539	0.109021	9.31512	1.22E-20	4.25E-19	1
CCDC85B	ENSG00000175602	6173.111	1.012572	0.116397	8.699283	3.34E-18	1.04E-16	1
PTPRE	ENSG00000132334	2773.295	1.010573	0.106303	9.506527	1.97E-21	7.11E-20	1
XBP1	ENSG00000100219	5477.79	1.010374	0.097149	10.40022	2.47E-25	1.10E-23	1

BMPER	ENSG00000164619	1649.255	1.009961	0.116471	8.67135	4.27E-18	1.32E-16	1
CASP3	ENSG00000164305	8207.843	1.008247	0.13469	7.48567	7.12E-14	1.60E-12	1
PSMB9	ENSG00000240065	2294.684	1.007702	0.148813	6.771593	1.27E-11	2.42E-10	1
TICAM1	ENSG00000127666	1980.419	1.007581	0.1024	9.839661	7.60E-23	2.95E-21	1
RANGAP1	ENSG00000100401	22662.47	1.006668	0.085518	11.7714	5.48E-32	3.25E-30	1
PARP8	ENSG00000151883	2878.717	1.002726	0.07717	12.99377	1.33E-38	9.89E-37	1
TBX3	ENSG00000135111	2033.053	0.999147	0.130432	7.660321	1.85E-14	4.45E-13	1
PTPRK	ENSG00000152894	13745.87	0.997341	0.099567	10.0168	1.29E-23	5.23E-22	1
MMP1	ENSG00000196611	632.2219	0.996886	0.197764	5.040791	4.64E-07	5.20E-06	1
KLF10	ENSG00000155090	2991.175	0.994434	0.092916	10.70249	9.91E-27	4.73E-25	1
ALS2CL	ENSG00000178038	1023.821	0.992453	0.176221	5.631857	1.78E-08	2.43E-07	1
ACO1	ENSG00000122729	14949.4	0.991074	0.086409	11.46954	1.88E-30	1.03E-28	1
MAP3K5	ENSG00000197442	1514.129	0.99093	0.135355	7.320957	2.46E-13	5.30E-12	1
CCDC69	ENSG00000198624	870.3596	0.988348	0.141568	6.981419	2.92E-12	5.87E-11	1
ZC3H12C	ENSG00000149289	3203.95	0.987418	0.173601	5.687868	1.29E-08	1.78E-07	1
CCDC9B	ENSG00000188549	12948.32	0.983616	0.135414	7.263786	3.76E-13	8.02E-12	1
PDP1	ENSG00000164951	8800.124	0.981712	0.093674	10.48006	1.07E-25	4.84E-24	1
SAT1	ENSG00000130066	2796.683	0.979923	0.158062	6.199599	5.66E-10	9.24E-09	1
NNMT	ENSG00000166741	6123.501	0.979196	0.260614	3.757262	0.0001718	0.0011659	1
LAMC2	ENSG00000058085	3440.084	0.975884	0.123888	7.877121	3.35E-15	8.54E-14	1
CDK6	ENSG00000105810	10039.13	0.975611	0.128659	7.582933	3.38E-14	7.88E-13	1
NCOA7	ENSG00000111912	3896.747	0.975589	0.083727	11.65205	2.24E-31	1.26E-29	1
RNF144B	ENSG00000137393	1933.514	0.968089	0.082505	11.73367	8.57E-32	5.02E-30	1
OPTN	ENSG00000123240	23549.91	0.967353	0.135768	7.125052	1.04E-12	2.16E-11	1
CD74	ENSG00000019582	653.3362	0.967231	0.170295	5.679741	1.35E-08	1.86E-07	1
NIFK	ENSG00000155438	3456.696	0.965746	0.108347	8.913451	4.95E-19	1.61E-17	1
SHISAL1	ENSG00000138944	3571.713	0.96008	0.169111	5.677217	1.37E-08	1.88E-07	1
MBNL2	ENSG00000139793	8888.29	0.957521	0.094828	10.0975	5.67E-24	2.32E-22	1
PPP3CC	ENSG00000120910	1669.321	0.955366	0.103032	9.272538	1.82E-20	6.32E-19	1
AC020916	ENSG00000267519	876.4748	0.955052	0.183293	5.210519	1.88E-07	2.23E-06	1
ALPK2	ENSG00000198796	747.4851	0.951532	0.205249	4.635987	3.55E-06	3.42E-05	1
DUSP6	ENSG00000139318	682.599	0.951259	0.224447	4.238224	2.25E-05	0.000186	1
STX11	ENSG00000135604	1032.601	0.950197	0.111924	8.48966	2.07E-17	6.14E-16	1
SRGN	ENSG00000122862	7369.153	0.944726	0.101963	9.265409	1.94E-20	6.73E-19	1
NRG1	ENSG00000157168	878.3077	0.944041	0.146606	6.439319	1.20E-10	2.12E-09	1
KLHL5	ENSG00000109790	10515.89	0.942705	0.086733	10.86899	1.62E-27	7.93E-26	1
CD47	ENSG00000196776	10392.83	0.942632	0.084271	11.18578	4.79E-29	2.45E-27	1
CMTM3	ENSG00000140931	3473.831	0.939018	0.091977	10.20925	1.80E-24	7.61E-23	1
WARS	ENSG00000140105	10713.25	0.938745	0.071833	13.06836	4.99E-39	3.78E-37	1
CNTNAP1	ENSG00000108797	3525.345	0.936147	0.151563	6.176607	6.55E-10	1.06E-08	1
ALDH1B1	ENSG00000137124	4425.802	0.93573	0.095763	9.771344	1.49E-22	5.70E-21	1
HMGA2	ENSG00000149948	1567.707	0.934326	0.152475	6.127724	8.91E-10	1.41E-08	1
HHIP	ENSG00000164161	1549.706	0.933986	0.162805	5.73684	9.65E-09	1.37E-07	1
SLC39A14	ENSG00000104635	15186.63	0.932547	0.086358	10.79864	3.49E-27	1.69E-25	1
FGF2	ENSG00000138685	6059.493	0.92715	0.117227	7.908983	2.60E-15	6.67E-14	1
CHST15	ENSG00000182022	6856.974	0.926718	0.109912	8.431489	3.41E-17	1.00E-15	1

TGIF1	ENSG00000177426	2187.836	0.925542	0.122912	7.530113	5.07E-14	1.16E-12	1
PIM3	ENSG00000198355	2873.835	0.92514	0.122586	7.546843	4.46E-14	1.03E-12	1
AEN	ENSG00000181026	3620.901	0.924535	0.125263	7.380768	1.57E-13	3.46E-12	1
PALM2-AK	ENSG00000157654	72987.76	0.916682	0.121371	7.552738	4.26E-14	9.85E-13	1
TRIM36	ENSG00000152503	613.0359	0.916117	0.137395	6.667736	2.60E-11	4.85E-10	1
TGFA	ENSG00000163235	1425.374	0.914735	0.173629	5.268315	1.38E-07	1.66E-06	1
CDCP1	ENSG00000163814	7403.817	0.912948	0.146716	6.222551	4.89E-10	8.05E-09	1
BAZ1A	ENSG00000198604	7277.938	0.912888	0.091284	10.00049	1.52E-23	6.07E-22	1
APOL1	ENSG00000100342	2567.685	0.912657	0.134491	6.785998	1.15E-11	2.20E-10	1
COL5A3	ENSG00000080573	541.2118	0.911417	0.235589	3.868669	0.0001094	0.0007815	1
TP53BP2	ENSG00000143514	7935.521	0.910486	0.094798	9.604506	7.65E-22	2.80E-20	1
AF117829.	ENSG00000251136	503.6023	0.910253	0.210485	4.324557	1.53E-05	0.000131	1
SMURF2	ENSG00000108854	22776.3	0.908149	0.119057	7.627855	2.39E-14	5.63E-13	1
KLF6	ENSG00000067082	28052.13	0.907772	0.088621	10.24331	1.27E-24	5.43E-23	1
TRIM56	ENSG00000169871	11852.31	0.907236	0.123634	7.338098	2.17E-13	4.71E-12	1
ST3GAL4	ENSG00000110080	2059.232	0.902319	0.111234	8.111894	4.98E-16	1.36E-14	1
KIAA1217	ENSG00000120549	5298.456	0.898734	0.139619	6.437035	1.22E-10	2.15E-09	1
SIX1	ENSG00000126778	1069.179	0.897526	0.120936	7.421472	1.16E-13	2.56E-12	1
PAPPA	ENSG00000182752	712.9276	0.895964	0.167748	5.341128	9.24E-08	1.14E-06	1
KSR1	ENSG00000141068	1659.301	0.895322	0.120364	7.438472	1.02E-13	2.26E-12	1
PLEKHA4	ENSG00000105559	1821.891	0.895163	0.113121	7.913311	2.51E-15	6.47E-14	1
KRT17	ENSG00000128422	10121.07	0.894898	0.101022	8.85845	8.11E-19	2.60E-17	1
TMEM51	ENSG00000171729	3014.111	0.893553	0.122371	7.30201	2.83E-13	6.08E-12	1
JUN	ENSG00000177606	15193.29	0.893416	0.136175	6.560784	5.35E-11	9.70E-10	1
MAP3K8	ENSG00000107968	702.9204	0.890383	0.127537	6.981364	2.92E-12	5.87E-11	1
OGFR	ENSG00000060491	6993.331	0.887263	0.083382	10.64092	1.92E-26	8.88E-25	1
SH3PXD2B	ENSG00000174705	6965.815	0.887111	0.074792	11.86097	1.89E-32	1.13E-30	1
ICOSLG	ENSG00000160223	416.6925	0.885242	0.293303	3.018184	0.0025429	0.0125881	1
NAMPT	ENSG00000105835	8328.966	0.879968	0.124223	7.083777	1.40E-12	2.88E-11	1
TUBB2A	ENSG00000137267	3010.628	0.878286	0.090102	9.747647	1.89E-22	7.12E-21	1
TGFBR2	ENSG00000163513	23546.4	0.876803	0.085672	10.23443	1.39E-24	5.92E-23	1
BTBD19	ENSG00000222009	576.6916	0.87623	0.2457	3.566267	0.0003621	0.0022828	1
BAMBI	ENSG00000095739	1299.886	0.87142	0.104508	8.338295	7.54E-17	2.18E-15	1
C6orf132	ENSG00000188112	3945.231	0.871148	0.120481	7.230573	4.81E-13	1.02E-11	1
CD44	ENSG00000026508	41465.72	0.870304	0.10459	8.321104	8.71E-17	2.50E-15	1
ST3GAL1	ENSG00000008513	515.5614	0.870247	0.143828	6.050619	1.44E-09	2.22E-08	1
MYADM	ENSG00000179820	9201.833	0.865888	0.115507	7.496402	6.56E-14	1.48E-12	1
CASZ1	ENSG00000130940	766.27	0.864317	0.138396	6.245252	4.23E-10	7.03E-09	1
PSD4	ENSG00000125637	943.1562	0.864155	0.140478	6.15154	7.67E-10	1.23E-08	1
IFNGR1	ENSG00000027697	3156.677	0.861797	0.141618	6.085354	1.16E-09	1.81E-08	1
PLEKHO2	ENSG00000241839	2306.252	0.85939	0.103578	8.29704	1.07E-16	3.04E-15	1
AMPD3	ENSG00000133805	1558.848	0.858481	0.087477	9.813835	9.82E-23	3.79E-21	1
CYLD	ENSG00000083799	10787.64	0.858271	0.075297	11.39843	4.26E-30	2.30E-28	1
GNA15	ENSG00000060558	2202.596	0.855722	0.100902	8.480761	2.24E-17	6.61E-16	1
ABCA1	ENSG00000165029	813.6932	0.855459	0.155326	5.507503	3.64E-08	4.74E-07	1
SLC7A11	ENSG00000151012	4879.425	0.853344	0.264289	3.228825	0.001243	0.0068147	1

FAM241A	ENSG00000174749	636.2459	0.851489	0.140727	6.050664	1.44E-09	2.22E-08	1
COL16A1	ENSG00000084636	608.4884	0.850911	0.129188	6.586597	4.50E-11	8.25E-10	1
TRIP10	ENSG00000125733	7928.892	0.843868	0.075003	11.25112	2.29E-29	1.18E-27	1
MSANTD3	ENSG00000066697	5145.277	0.842578	0.116365	7.240807	4.46E-13	9.44E-12	1
EXT1	ENSG00000182197	27820.08	0.841555	0.088143	9.547612	1.33E-21	4.84E-20	1
SYNGR3	ENSG00000127561	618.902	0.839461	0.1571	5.343496	9.12E-08	1.13E-06	1
SPSB1	ENSG00000171621	2344.122	0.837831	0.118794	7.052803	1.75E-12	3.57E-11	1
SQOR	ENSG00000137767	1644.542	0.837751	0.098233	8.528227	1.49E-17	4.49E-16	1
TAB3	ENSG00000157625	3925.356	0.83752	0.111201	7.531573	5.01E-14	1.15E-12	1
DMD	ENSG00000198947	1104.042	0.835403	0.13415	6.227401	4.74E-10	7.83E-09	1
SLC43A2	ENSG00000167703	3247.314	0.833653	0.104382	7.986526	1.39E-15	3.66E-14	1
EPHA2	ENSG00000142627	12340.93	0.832415	0.146313	5.689294	1.28E-08	1.77E-07	1
SLC16A1-A	ENSG00000226419	731.9534	0.831307	0.141938	5.856831	4.72E-09	6.85E-08	1
NECAP2	ENSG00000157191	6870.059	0.829882	0.101345	8.188672	2.64E-16	7.34E-15	1
PIEZO1	ENSG00000103335	14365.04	0.828939	0.152245	5.444761	5.19E-08	6.63E-07	1
DDX60	ENSG00000137628	1401.386	0.826257	0.105508	7.831213	4.83E-15	1.21E-13	1
SUSD6	ENSG00000100647	3628.66	0.824474	0.075153	10.97057	5.29E-28	2.67E-26	1
METRNL	ENSG00000176845	4418.256	0.821232	0.105492	7.78478	6.98E-15	1.74E-13	1
ARHGEF2	ENSG00000116584	8284.873	0.819795	0.102338	8.01063	1.14E-15	3.04E-14	1
GNPTAB	ENSG00000111670	8515.312	0.819616	0.082988	9.876341	5.27E-23	2.06E-21	1
SH3TC1	ENSG00000125089	755.3776	0.817793	0.16539	4.944627	7.63E-07	8.24E-06	1
CMIP	ENSG00000153815	3227.58	0.810878	0.136585	5.936822	2.91E-09	4.29E-08	1
RAPH1	ENSG00000173166	2199.524	0.809076	0.167607	4.827214	1.38E-06	1.43E-05	1
ITPRIP	ENSG00000148841	4161.045	0.807411	0.094712	8.52489	1.53E-17	4.58E-16	1
UGCG	ENSG00000148154	24998.93	0.806308	0.091063	8.8544	8.41E-19	2.69E-17	1
IRF2BP2	ENSG00000168264	4931.599	0.804297	0.079292	10.14352	3.54E-24	1.46E-22	1
IKZF2	ENSG00000030419	848.6978	0.803824	0.144219	5.573629	2.49E-08	3.32E-07	1
MYO1B	ENSG00000128641	18466.14	0.801796	0.090565	8.853253	8.50E-19	2.71E-17	1
PNKD	ENSG00000127838	3083.847	0.800501	0.109344	7.320944	2.46E-13	5.30E-12	1
TLNRD1	ENSG00000140406	3664.399	0.798642	0.07514	10.62875	2.19E-26	1.01E-24	1
GPX3	ENSG00000211445	1010.748	0.798108	0.129184	6.178051	6.49E-10	1.05E-08	1
SLIT2	ENSG00000145147	1211.79	0.796748	0.183035	4.352972	1.34E-05	0.0001166	1
TM4SF1	ENSG00000169908	4908.185	0.795784	0.149998	5.305279	1.13E-07	1.38E-06	1
AKAP12	ENSG00000131016	25572.97	0.792203	0.127254	6.225364	4.80E-10	7.92E-09	1
CHST11	ENSG00000171310	1384.93	0.790554	0.091334	8.655669	4.90E-18	1.49E-16	1
ARRDC4	ENSG00000140450	1173.975	0.78894	0.13777	5.726504	1.03E-08	1.44E-07	1
ZNF267	ENSG00000185947	1913.728	0.786705	0.133957	5.87284	4.28E-09	6.24E-08	1
MAP4K4	ENSG00000071054	26595.96	0.786295	0.079572	9.881544	5.01E-23	1.96E-21	1
ANKRD18B	ENSG00000230453	623.6816	0.784493	0.160008	4.902839	9.45E-07	1.00E-05	1
FZD1	ENSG00000157240	1555.546	0.783929	0.134475	5.829555	5.56E-09	8.01E-08	1
RBMS1	ENSG00000153250	7430.085	0.782543	0.127858	6.120392	9.33E-10	1.48E-08	1
NMI	ENSG00000123609	2038.23	0.780242	0.135699	5.749812	8.93E-09	1.27E-07	1
UXS1	ENSG00000115652	3945.121	0.780086	0.103016	7.572464	3.66E-14	8.52E-13	1
ZEB2	ENSG00000169554	6626.159	0.779195	0.074899	10.40324	2.40E-25	1.07E-23	1
ZFP36L1	ENSG00000185650	12108.32	0.779089	0.09839	7.918337	2.41E-15	6.23E-14	1
RRS1	ENSG00000179041	1426.692	0.779007	0.129127	6.03288	1.61E-09	2.47E-08	1

TRIO	ENSG00000038382	36068.05	0.775205	0.157575	4.919578	8.67E-07	9.30E-06	1
METTL1	ENSG00000037897	758.4186	0.774334	0.124957	6.196803	5.76E-10	9.39E-09	1
PMAIP1	ENSG00000141682	2627.747	0.771375	0.107309	7.188328	6.56E-13	1.37E-11	1
PPARD	ENSG00000112033	6022.147	0.771339	0.087954	8.769836	1.79E-18	5.61E-17	1
FAM167A	ENSG00000154319	600.3642	0.771147	0.156455	4.928888	8.27E-07	8.90E-06	1
DENND3	ENSG00000105339	5564.113	0.767837	0.140659	5.45885	4.79E-08	6.16E-07	1
AC241952	ENSG00000275131	598.0062	0.765521	0.221031	3.463406	0.0005334	0.0032124	1
TMEM87B	ENSG00000153214	4161.616	0.764668	0.092119	8.300861	1.03E-16	2.96E-15	1
WDR4	ENSG00000160193	1363.99	0.763751	0.119211	6.406704	1.49E-10	2.60E-09	1
DCBLD1	ENSG00000164465	5529.842	0.761424	0.136009	5.598329	2.16E-08	2.92E-07	1
MT1E	ENSG00000169715	3981.38	0.754186	0.097035	7.772321	7.71E-15	1.91E-13	1
TRIB3	ENSG00000101255	8981.615	0.751634	0.094999	7.912013	2.53E-15	6.52E-14	1
ETS2	ENSG00000157557	8637.188	0.748057	0.097427	7.678111	1.61E-14	3.88E-13	1
ATF4	ENSG00000128272	22459.73	0.747935	0.091585	8.166544	3.17E-16	8.77E-15	1
RALA	ENSG00000006451	11993.76	0.747851	0.12402	6.030069	1.64E-09	2.50E-08	1
ARNT2	ENSG00000172379	1068.33	0.746841	0.128185	5.826256	5.67E-09	8.16E-08	1
SNAPC4	ENSG00000165684	2014.393	0.745588	0.125081	5.960864	2.51E-09	3.74E-08	1
PMEPA1	ENSG00000124225	5054.499	0.744721	0.133015	5.598782	2.16E-08	2.91E-07	1
FRMD4A	ENSG00000151474	12258.42	0.743584	0.088496	8.402486	4.37E-17	1.27E-15	1
RNF24	ENSG00000101236	3659.548	0.742146	0.098143	7.561864	3.97E-14	9.20E-13	1
CLDN11	ENSG00000013297	7270.057	0.74156	0.095356	7.77677	7.44E-15	1.85E-13	1
DNAJA1	ENSG00000086061	26549.88	0.74067	0.122967	6.023343	1.71E-09	2.60E-08	1
IL6ST	ENSG00000134352	40332.4	0.740069	0.090496	8.177887	2.89E-16	8.01E-15	1
UBE2Z	ENSG00000159202	25880.83	0.738647	0.063334	11.66282	1.97E-31	1.12E-29	1
DUSP5	ENSG00000138166	1845.223	0.738113	0.145833	5.061356	4.16E-07	4.72E-06	1
SDCBP	ENSG00000137575	23896.65	0.737167	0.093628	7.873368	3.45E-15	8.76E-14	1
JMJD6	ENSG00000070495	3297.958	0.73712	0.09626	7.657628	1.89E-14	4.52E-13	1
HRH1	ENSG00000196639	3088.031	0.735109	0.098176	7.487675	7.01E-14	1.58E-12	1
PUS1	ENSG00000177192	1247.157	0.7341	0.106583	6.887585	5.67E-12	1.12E-10	1
ERAP1	ENSG00000164307	8457.244	0.733433	0.093229	7.867026	3.63E-15	9.19E-14	1
DHX58	ENSG00000108771	859.7335	0.732224	0.136033	5.382677	7.34E-08	9.16E-07	1
SLC22A4	ENSG00000197208	1540.292	0.731509	0.103699	7.054185	1.74E-12	3.54E-11	1
NAMPTP1	ENSG00000229644	752.7551	0.731095	0.141103	5.18127	2.20E-07	2.58E-06	1
LOXL1-AS1	ENSG00000261801	2450.101	0.729197	0.0995	7.328631	2.33E-13	5.03E-12	1
RELA	ENSG00000173039	9281.451	0.72869	0.096996	7.512562	5.80E-14	1.32E-12	1
ANKLE2	ENSG00000176915	19419.37	0.727681	0.072744	10.00328	1.47E-23	5.95E-22	1
DAPK3	ENSG00000167657	6789.079	0.726743	0.091362	7.954552	1.80E-15	4.71E-14	1
TNIP2	ENSG00000168884	3141.289	0.724616	0.084976	8.527275	1.50E-17	4.51E-16	1
RNF19B	ENSG00000116514	2582.619	0.724425	0.086516	8.373334	5.60E-17	1.63E-15	1
NCF2	ENSG00000116701	662.9419	0.723627	0.212855	3.399622	0.0006748	0.0039657	1
RIPOR1	ENSG00000039523	8607.52	0.723252	0.081938	8.826826	1.08E-18	3.42E-17	1
GRAMD2B	ENSG00000155324	5866.048	0.723077	0.070916	10.19627	2.06E-24	8.63E-23	1
TLDC1	ENSG00000140950	1822.635	0.719425	0.108272	6.644581	3.04E-11	5.65E-10	1
ABR	ENSG00000159842	16608.98	0.719045	0.090946	7.906269	2.65E-15	6.80E-14	1
LITAF	ENSG00000189067	15790.34	0.717151	0.091802	7.811927	5.63E-15	1.41E-13	1
FGD6	ENSG00000180263	2476.384	0.714924	0.111726	6.398918	1.56E-10	2.74E-09	1

MAPK6	ENSG00000069956	9217.483	0.714331	0.107693	6.63303	3.29E-11	6.09E-10	1
PPP1R18	ENSG00000146112	10635.94	0.714059	0.076199	9.371029	7.18E-21	2.52E-19	1
MFHAS1	ENSG00000147324	5598.564	0.713766	0.114523	6.232506	4.59E-10	7.59E-09	1
AKR1B1	ENSG00000085662	10042.02	0.713143	0.125643	5.675948	1.38E-08	1.90E-07	1
TSKU	ENSG00000182704	2378.859	0.707268	0.106962	6.612313	3.78E-11	6.99E-10	1
KDM6B	ENSG00000132510	885.9539	0.704041	0.169065	4.164326	3.12E-05	0.00025	1
TRIM14	ENSG00000106785	4965.553	0.703453	0.080583	8.729549	2.56E-18	7.96E-17	1
EREG	ENSG00000124882	1438.426	0.703381	0.200359	3.510602	0.0004471	0.0027585	1
SRFBP1	ENSG00000151304	1871.561	0.701191	0.119346	5.875275	4.22E-09	6.15E-08	1
MYC	ENSG00000136997	4993.563	0.700675	0.122804	5.705653	1.16E-08	1.62E-07	1
LAYN	ENSG00000204381	6332.493	0.699633	0.09479	7.380914	1.57E-13	3.46E-12	1
STK10	ENSG00000072786	11643.17	0.699177	0.093767	7.456536	8.88E-14	1.98E-12	1
CASP4	ENSG00000196954	1781.578	0.698999	0.127768	5.470834	4.48E-08	5.76E-07	1
SLC35G1	ENSG00000176273	1335.568	0.69885	0.116911	5.977636	2.26E-09	3.39E-08	1
SMAD1	ENSG00000170365	1935.571	0.697473	0.084671	8.237429	1.76E-16	4.95E-15	1
CCDC102A	ENSG00000135736	1059.862	0.696621	0.143328	4.860317	1.17E-06	1.22E-05	1
ATP13A3	ENSG00000133657	33671.96	0.696365	0.109317	6.370146	1.89E-10	3.27E-09	1
LRRC1	ENSG00000137269	1111.368	0.695017	0.095379	7.286906	3.17E-13	6.79E-12	1
TP53	ENSG00000141510	9442.562	0.694394	0.090986	7.631876	2.31E-14	5.47E-13	1
GRB10	ENSG00000106070	7768.856	0.694198	0.103781	6.689098	2.25E-11	4.22E-10	1
RAB32	ENSG00000118508	9048.901	0.692942	0.137266	5.04816	4.46E-07	5.04E-06	1
DAXX	ENSG00000204209	6098.814	0.691648	0.089133	7.759763	8.51E-15	2.10E-13	1
ZNF319	ENSG00000166188	1479.072	0.691231	0.113002	6.116976	9.54E-10	1.51E-08	1
STC2	ENSG00000113739	42226.75	0.690813	0.147026	4.698569	2.62E-06	2.59E-05	1
ZFPM2	ENSG00000169946	1023.273	0.688692	0.150166	4.586206	4.51E-06	4.27E-05	1
NOTCH2	ENSG00000134250	46186.05	0.688487	0.134933	5.102431	3.35E-07	3.83E-06	1
ACSL5	ENSG00000197142	695.7978	0.6883	0.155812	4.417494	9.99E-06	8.92E-05	1
A4GALT	ENSG00000128274	869.0232	0.68762	0.144299	4.765236	1.89E-06	1.91E-05	1
ISG15	ENSG00000187608	1683.908	0.683599	0.184471	3.705725	0.0002108	0.0013988	1
TPBG	ENSG00000146242	3844.501	0.683424	0.100421	6.805559	1.01E-11	1.94E-10	1
CDKN1A	ENSG00000124762	8795.885	0.683316	0.102535	6.664216	2.66E-11	4.96E-10	1
SLC30A7	ENSG00000162695	4599.979	0.682247	0.09796	6.964546	3.29E-12	6.60E-11	1
DSE	ENSG00000111817	6374.448	0.681299	0.078579	8.670211	4.31E-18	1.33E-16	1
VDR	ENSG00000111424	2842.089	0.678226	0.111348	6.091068	1.12E-09	1.75E-08	1
	ENSG00000287263	588.6366	0.677994	0.141796	4.781489	1.74E-06	1.77E-05	1
LRRC49	ENSG00000137821	971.1573	0.675462	0.138564	4.874726	1.09E-06	1.14E-05	1
PIM1	ENSG00000137193	1759.577	0.675172	0.151002	4.471283	7.78E-06	7.07E-05	1
EVA1A	ENSG00000115363	1394.945	0.675105	0.132332	5.101618	3.37E-07	3.84E-06	1
CCDC71L	ENSG00000253276	1149.727	0.673215	0.109325	6.157912	7.37E-10	1.19E-08	1
SLC9A8	ENSG00000197818	2539.35	0.672808	0.128069	5.253493	1.49E-07	1.79E-06	1
SH2B3	ENSG00000111252	6816.292	0.672591	0.10305	6.526861	6.72E-11	1.21E-09	1
PISD	ENSG00000241878	3051.688	0.671914	0.109772	6.120993	9.30E-10	1.47E-08	1
ARFRP1	ENSG00000101246	4325.239	0.670631	0.104592	6.411881	1.44E-10	2.52E-09	1
ITGAV	ENSG00000138448	18673.98	0.66989	0.079223	8.4557	2.77E-17	8.15E-16	1
RFTN1	ENSG00000131378	5420.559	0.66899	0.123045	5.436964	5.42E-08	6.91E-07	1
HMGA1	ENSG00000137309	27243.82	0.666434	0.132884	5.015164	5.30E-07	5.87E-06	1

PPP1R15A	ENSG00000087074	8306.53	0.666253	0.121003	5.506103	3.67E-08	4.77E-07	1
B4GALT5	ENSG00000158470	15788.12	0.665001	0.064994	10.23175	1.43E-24	6.06E-23	1
BHLHE40	ENSG00000134107	7139.369	0.662306	0.159543	4.151257	3.31E-05	0.0002631	1
BCL10	ENSG00000142867	2164.526	0.660702	0.106903	6.180415	6.39E-10	1.04E-08	1
DDX21	ENSG00000165732	20719.98	0.660252	0.121911	5.415839	6.10E-08	7.68E-07	1
SMURF1	ENSG00000198742	3724.11	0.660064	0.121042	5.453201	4.95E-08	6.35E-07	1
VHL	ENSG00000134086	4161.969	0.659422	0.082027	8.039059	9.05E-16	2.43E-14	1
UHRF1BP1	ENSG00000065060	5737.747	0.656391	0.112319	5.843976	5.10E-09	7.36E-08	1
BCOR	ENSG00000183337	4571.788	0.654953	0.114968	5.69683	1.22E-08	1.70E-07	1
TNFRSF10	ENSG00000104689	1325.619	0.651064	0.107589	6.051377	1.44E-09	2.22E-08	1
CD276	ENSG00000103855	7663.561	0.650842	0.075145	8.661103	4.67E-18	1.43E-16	1
IER2	ENSG00000160888	1204.519	0.650051	0.099802	6.513439	7.34E-11	1.31E-09	1
TRIM8	ENSG00000171206	7588.076	0.647997	0.098844	6.555765	5.54E-11	1.00E-09	1
PIK3IP1	ENSG00000100100	2226.373	0.647358	0.193427	3.346787	0.0008175	0.0047368	1
MAP7D1	ENSG00000116871	19309.72	0.645356	0.071376	9.041669	1.54E-19	5.10E-18	1
MOB3C	ENSG00000142961	1513.624	0.643129	0.088451	7.271034	3.57E-13	7.62E-12	1
STAT6	ENSG00000166888	12540.79	0.642706	0.072281	8.891803	6.01E-19	1.95E-17	1
CANT1	ENSG00000171302	12395.76	0.642007	0.068035	9.43646	3.86E-21	1.36E-19	1
BACH1	ENSG00000156273	5658.103	0.64043	0.099113	6.461645	1.04E-10	1.84E-09	1
ATG16L2	ENSG00000168010	1507.359	0.640142	0.202466	3.161728	0.0015684	0.0083248	1
FTH1	ENSG00000167996	24888.16	0.639327	0.119919	5.331314	9.75E-08	1.21E-06	1
ADAR	ENSG00000160710	29943.97	0.639307	0.069321	9.222374	2.91E-20	9.96E-19	1
KLF13	ENSG00000169926	6026.187	0.638815	0.090571	7.053193	1.75E-12	3.56E-11	1
ARRDC2	ENSG00000105643	1137.506	0.637671	0.103612	6.154441	7.53E-10	1.21E-08	1
MICAL2	ENSG00000133816	16294.96	0.637024	0.141694	4.495779	6.93E-06	6.38E-05	1
ADAMTS1	ENSG00000145536	1091.244	0.635723	0.13293	4.782387	1.73E-06	1.76E-05	1
YPEL2	ENSG00000175155	1311.003	0.634948	0.190178	3.338704	0.0008417	0.0048553	1
CYR61	ENSG00000142871	42390.99	0.633794	0.127861	4.956909	7.16E-07	7.79E-06	1
	ENSG00000291067	833.5967	0.633425	0.122737	5.16085	2.46E-07	2.86E-06	1
ZNF710	ENSG00000140548	1450.254	0.632648	0.122449	5.166616	2.38E-07	2.78E-06	1
CARS	ENSG00000110619	4826.936	0.631102	0.081603	7.733831	1.04E-14	2.57E-13	1
LRIG1	ENSG00000144749	2452.901	0.630439	0.091751	6.871158	6.37E-12	1.26E-10	1
PLD1	ENSG00000075651	1879.949	0.630009	0.128895	4.887783	1.02E-06	1.07E-05	1
CDC42SE1	ENSG00000197622	6550.032	0.629441	0.104575	6.019023	1.75E-09	2.66E-08	1
PID1	ENSG00000153823	754.931	0.629346	0.142671	4.411174	1.03E-05	9.14E-05	1
MLKL	ENSG00000168404	631.5488	0.628767	0.147844	4.252897	2.11E-05	0.0001752	1
LUZP1	ENSG00000169641	15085.96	0.627309	0.082389	7.614003	2.66E-14	6.26E-13	1
SPOCD1	ENSG00000134668	1473.358	0.623889	0.182333	3.421699	0.0006223	0.0036893	1
HDX	ENSG00000165259	612.0694	0.622559	0.126852	4.907778	9.21E-07	9.80E-06	1
LACTB	ENSG00000103642	5826.462	0.62242	0.094502	6.586347	4.51E-11	8.25E-10	1
HLA-E	ENSG00000204592	11109.87	0.622297	0.080897	7.692465	1.44E-14	3.49E-13	1
IFIT1	ENSG00000185745	1370.367	0.620689	0.2253	2.754947	0.0058702	0.0255612	1
TDRD7	ENSG00000196116	3419.277	0.619616	0.092682	6.685427	2.30E-11	4.32E-10	1
KIF3C	ENSG00000084731	6970.001	0.61896	0.090781	6.818176	9.22E-12	1.79E-10	1
HIVEP3	ENSG00000127124	1283.4	0.61805	0.17935	3.446048	0.0005688	0.0034051	1
SRPK1	ENSG00000096063	5701.752	0.617147	0.081978	7.528231	5.14E-14	1.18E-12	1

HES4	ENSG00000188290	1367.359	0.616908	0.142302	4.335204	1.46E-05	0.0001257	1
IGSF3	ENSG00000143061	6741.602	0.616818	0.096965	6.36126	2.00E-10	3.45E-09	1
LHFPL6	ENSG00000183722	5350.352	0.616426	0.067343	9.153498	5.51E-20	1.87E-18	1
SP140L	ENSG00000185404	1900.511	0.612978	0.096348	6.362117	1.99E-10	3.44E-09	1
LAP3	ENSG00000002549	4842.738	0.612693	0.121781	5.031094	4.88E-07	5.45E-06	1
FBLIM1	ENSG00000162458	5413.326	0.611202	0.098353	6.214383	5.15E-10	8.45E-09	1
SPRY4	ENSG00000187678	1156.074	0.610817	0.190703	3.202969	0.0013602	0.0073734	1
EPSTI1	ENSG00000133106	1305.551	0.609693	0.133054	4.582315	4.60E-06	4.35E-05	1
DOCK10	ENSG00000135905	4863.63	0.60876	0.090957	6.692831	2.19E-11	4.12E-10	1
FBN1	ENSG00000166147	32577.47	0.608663	0.158337	3.844093	0.000121	0.0008554	1
PATL1	ENSG00000166889	12287.84	0.607763	0.087945	6.910726	4.82E-12	9.61E-11	1
LAMA1	ENSG00000101680	682.9067	0.607582	0.163799	3.709303	0.0002078	0.0013819	1
STK40	ENSG00000196182	1850.962	0.606518	0.09582	6.329757	2.46E-10	4.20E-09	1
COL4A2	ENSG00000134871	29811.86	0.60628	0.066481	9.119589	7.54E-20	2.53E-18	1
TRNP1	ENSG00000253368	598.6445	0.604815	0.116053	5.211522	1.87E-07	2.22E-06	1
GORAB	ENSG00000120370	798.9104	0.604019	0.113506	5.321474	1.03E-07	1.27E-06	1
ZC3HAV1	ENSG00000105939	4531.597	0.602935	0.127086	4.744289	2.09E-06	2.10E-05	1
RGS20	ENSG00000147509	633.4534	0.602541	0.122964	4.90014	9.58E-07	1.01E-05	1
RASA2	ENSG00000155903	3461.405	0.601879	0.115148	5.226999	1.72E-07	2.06E-06	1
MMP14	ENSG00000157227	17788.77	0.601287	0.091543	6.568383	5.09E-11	9.25E-10	1
DENND5A	ENSG00000184014	14739.59	0.601276	0.061942	9.707128	2.81E-22	1.04E-20	1
PVT1	ENSG00000249859	838.3641	0.598624	0.204557	2.926447	0.0034286	0.0162293	1
SLC35E4	ENSG00000100036	976.4031	0.598594	0.131106	4.565711	4.98E-06	4.67E-05	1
KIFC3	ENSG00000140859	10305.39	0.597993	0.095408	6.267762	3.66E-10	6.12E-09	1
MYO10	ENSG00000145555	7950.835	0.597691	0.129538	4.614004	3.95E-06	3.78E-05	1
UBE2L6	ENSG00000156587	2370.257	0.595659	0.138262	4.308177	1.65E-05	0.0001399	1
LRCH1	ENSG00000136141	3357.671	0.595486	0.082784	7.19328	6.33E-13	1.33E-11	1
RRP12	ENSG00000052749	2421.027	0.595274	0.122039	4.87773	1.07E-06	1.12E-05	1
TRANK1	ENSG00000168016	1789.423	0.595231	0.104345	5.704427	1.17E-08	1.63E-07	1
KLF9	ENSG00000119138	2065.267	0.593818	0.121623	4.882447	1.05E-06	1.10E-05	1
LIPG	ENSG00000101670	751.9253	0.591375	0.117879	5.016783	5.25E-07	5.82E-06	1
FMNL1	ENSG00000184922	3089.866	0.59059	0.099144	5.956908	2.57E-09	3.82E-08	1
TNS3	ENSG00000136205	18073.52	0.590042	0.115624	5.103097	3.34E-07	3.82E-06	1
ABCC3	ENSG00000108846	3330.632	0.589817	0.180235	3.272489	0.0010661	0.0059473	1
ARID5A	ENSG00000196843	896.0112	0.587146	0.132035	4.446883	8.71E-06	7.84E-05	1
NUB1	ENSG00000013374	4520.622	0.58702	0.11955	4.910245	9.10E-07	9.69E-06	1
GPR176	ENSG00000166073	8331.988	0.586991	0.073165	8.022819	1.03E-15	2.76E-14	1
NIN	ENSG00000100503	14608.32	0.586656	0.118506	4.950414	7.41E-07	8.02E-06	1
HNRNPCP	ENSG00000204253	1027.351	0.585407	0.190201	3.07783	0.0020851	0.0106038	1
FILIP1L	ENSG00000168386	19035.5	0.585345	0.13076	4.476476	7.59E-06	6.92E-05	1
URGCP	ENSG00000106608	5146.612	0.585217	0.090877	6.439675	1.20E-10	2.12E-09	1
TUBB2B	ENSG00000137285	1694.558	0.585207	0.150487	3.888763	0.0001008	0.0007269	1
CALHM2	ENSG00000138172	1475.488	-0.58534	0.11915	-4.9126	8.99E-07	9.59E-06	-1
SCML2	ENSG00000102098	561.8337	-0.5869	0.149355	-3.9296	8.51E-05	0.0006286	-1
CORO6	ENSG00000167549	492.2589	-0.58818	0.178166	-3.3013	0.0009624	0.0054337	-1
SUOX	ENSG00000139531	1092.306	-0.58836	0.125447	-4.69008	2.73E-06	2.69E-05	-1

TRIM62	ENSG00000116525	1478.487	-0.58844	0.120837	-4.86968	1.12E-06	1.17E-05	-1
EYA2	ENSG00000064655	3272.507	-0.58868	0.111104	-5.2985	1.17E-07	1.42E-06	-1
SKP2	ENSG00000145604	3890.911	-0.58929	0.092557	-6.3668	1.93E-10	3.34E-09	-1
MISP	ENSG00000099812	583.7472	-0.58979	0.14586	-4.0435	5.27E-05	0.0004055	-1
ITPR1	ENSG00000150995	884.7119	-0.5914	0.140544	-4.20797	2.58E-05	0.0002104	-1
SMIM3	ENSG00000256235	798.2501	-0.59248	0.146694	-4.03887	5.37E-05	0.0004129	-1
TBC1D8	ENSG00000204634	1829.257	-0.59473	0.126041	-4.71853	2.38E-06	2.37E-05	-1
ABCC5	ENSG00000114770	1861.906	-0.59486	0.107479	-5.53468	3.12E-08	4.11E-07	-1
LINC02057	ENSG00000249279	609.1023	-0.59798	0.167154	-3.5774	0.000347	0.0021991	-1
NDRG1	ENSG00000104419	3564.446	-0.59942	0.11025	-5.43691	5.42E-08	6.91E-07	-1
GPR137C	ENSG00000180998	1878.065	-0.60013	0.095629	-6.27564	3.48E-10	5.85E-09	-1
ARHGEF26	ENSG00000114790	764.0233	-0.60021	0.155205	-3.8672	0.0001101	0.0007857	-1
ZBTB44	ENSG00000196323	3977.02	-0.60048	0.090562	-6.63056	3.34E-11	6.19E-10	-1
SSBP2	ENSG00000145687	1389.952	-0.60082	0.120001	-5.00674	5.54E-07	6.12E-06	-1
MXI1	ENSG00000119950	1414.602	-0.60332	0.180939	-3.33439	0.0008549	0.0049198	-1
RALGPS2	ENSG00000116191	7745.197	-0.60373	0.09517	-6.34369	2.24E-10	3.84E-09	-1
CDC25C	ENSG00000158402	2985.375	-0.60393	0.131068	-4.60778	4.07E-06	3.88E-05	-1
NRP1	ENSG00000099250	17030.36	-0.60587	0.096642	-6.26927	3.63E-10	6.07E-09	-1
ELFN2	ENSG00000166897	2379.291	-0.60679	0.158179	-3.83609	0.000125	0.0008794	-1
AC015813	ENSG00000279207	610.0815	-0.6076	0.158109	-3.84288	0.0001216	0.0008578	-1
LGR4	ENSG00000205213	5054.867	-0.6076	0.068386	-8.88484	6.40E-19	2.07E-17	-1
RDH10	ENSG00000121039	664.5264	-0.60781	0.137594	-4.41742	9.99E-06	8.92E-05	-1
SETDB2	ENSG00000136169	1003.727	-0.61061	0.111148	-5.49369	3.94E-08	5.10E-07	-1
ZFP14	ENSG00000142065	560.859	-0.61112	0.147191	-4.15189	3.30E-05	0.0002625	-1
FOXN3	ENSG00000053254	3506.282	-0.61181	0.112772	-5.42519	5.79E-08	7.33E-07	-1
CROT	ENSG00000005469	900.3738	-0.61356	0.117621	-5.21641	1.82E-07	2.17E-06	-1
SNTB1	ENSG00000172164	1396.678	-0.61385	0.122075	-5.02845	4.94E-07	5.52E-06	-1
ATG4C	ENSG00000125703	663.122	-0.61386	0.154956	-3.96153	7.45E-05	0.0005561	-1
SLC46A3	ENSG00000139508	889.5255	-0.61391	0.119408	-5.14129	2.73E-07	3.16E-06	-1
LDB1	ENSG00000198728	4037.34	-0.61549	0.131543	-4.67899	2.88E-06	2.83E-05	-1
LINC02210	ENSG00000204650	542.3826	-0.61783	0.132417	-4.66581	3.07E-06	3.01E-05	-1
LRRC20	ENSG00000172731	2031.706	-0.61865	0.099581	-6.21257	5.21E-10	8.53E-09	-1
INPP5J	ENSG00000185133	535.0781	-0.61899	0.182018	-3.40071	0.0006721	0.0039559	-1
AASDH	ENSG00000157426	629.0864	-0.61932	0.13219	-4.68511	2.80E-06	2.75E-05	-1
KITLG	ENSG00000049130	2095.835	-0.62127	0.118105	-5.26034	1.44E-07	1.73E-06	-1
ZNF248	ENSG00000198105	1086.857	-0.6221	0.124504	-4.99666	5.83E-07	6.41E-06	-1
IER5L	ENSG00000188483	561.55	-0.62291	0.216005	-2.88376	0.0039296	0.0181982	-1
NIPAL3	ENSG00000001461	5575.929	-0.62512	0.081853	-7.63719	2.22E-14	5.26E-13	-1
THRB	ENSG00000151090	2395.732	-0.62536	0.142706	-4.38216	1.18E-05	0.0001028	-1
TP53INP1	ENSG00000164938	3647.705	-0.62727	0.083347	-7.52594	5.23E-14	1.20E-12	-1
CD24	ENSG00000272398	30458.31	-0.62875	0.110436	-5.69333	1.25E-08	1.73E-07	-1
SYTL2	ENSG00000137501	939.3561	-0.62881	0.107445	-5.8524	4.85E-09	7.01E-08	-1
NAPEPLD	ENSG00000161048	786.325	-0.62966	0.121121	-5.19863	2.01E-07	2.38E-06	-1
CEP97	ENSG00000182504	3255.119	-0.6301	0.09481	-6.64585	3.01E-11	5.61E-10	-1
IRS1	ENSG00000169047	3610.081	-0.63129	0.136034	-4.64068	3.47E-06	3.36E-05	-1
DAGLB	ENSG00000164535	2386.083	-0.63258	0.116377	-5.43563	5.46E-08	6.95E-07	-1

CREB3L4	ENSG00000143578	672.9079	-0.63318	0.143862	-4.40126	1.08E-05	9.49E-05	-1
ZNF618	ENSG00000157657	2683.964	-0.63545	0.120614	-5.26843	1.38E-07	1.66E-06	-1
PLSCR4	ENSG00000114698	925.1584	-0.63812	0.145922	-4.37301	1.23E-05	0.0001071	-1
ALDH3A2	ENSG00000072210	3103.066	-0.63844	0.088638	-7.20278	5.90E-13	1.24E-11	-1
ZNF589	ENSG00000164048	683.4257	-0.6408	0.114473	-5.59785	2.17E-08	2.92E-07	-1
NT5DC3	ENSG00000111696	2146.893	-0.64283	0.154023	-4.17362	3.00E-05	0.000241	-1
KLHL24	ENSG00000114796	2246.966	-0.64338	0.163826	-3.92719	8.59E-05	0.000634	-1
DENND5B	ENSG00000170456	5372.676	-0.64342	0.099482	-6.46771	9.95E-11	1.77E-09	-1
PPM1K	ENSG00000163644	651.6134	-0.64498	0.148799	-4.33462	1.46E-05	0.0001258	-1
ATXN7L1	ENSG00000146776	604.7227	-0.64545	0.124517	-5.18358	2.18E-07	2.56E-06	-1
DNAJC6	ENSG00000116675	4089.596	-0.64592	0.136811	-4.72128	2.34E-06	2.34E-05	-1
PCMTD1	ENSG00000168300	1690.651	-0.64602	0.118619	-5.44619	5.15E-08	6.59E-07	-1
ZBTB18	ENSG00000179456	2604.864	-0.64679	0.096541	-6.69967	2.09E-11	3.94E-10	-1
HR	ENSG00000168453	903.1305	-0.64815	0.119244	-5.43552	5.46E-08	6.95E-07	-1
ZNF362	ENSG00000160094	1695.58	-0.6491	0.125507	-5.17184	2.32E-07	2.71E-06	-1
CNKSR3	ENSG00000153721	1382.273	-0.64935	0.120464	-5.39038	7.03E-08	8.79E-07	-1
ATF7IP	ENSG00000171681	4178.4	-0.65095	0.108359	-6.00737	1.89E-09	2.85E-08	-1
TMOD2	ENSG00000128872	5567.23	-0.65158	0.071676	-9.09058	9.85E-20	3.30E-18	-1
HSF2	ENSG00000025156	1664.675	-0.65246	0.087459	-7.46012	8.64E-14	1.93E-12	-1
CITED2	ENSG00000164442	7900.666	-0.65466	0.107036	-6.11627	9.58E-10	1.51E-08	-1
DIO2	ENSG00000211448	430.5507	-0.65801	0.241369	-2.72615	0.0064077	0.0275004	-1
CYB5RL	ENSG00000215883	1250.976	-0.65805	0.100793	-6.52866	6.64E-11	1.19E-09	-1
PIK3R3	ENSG00000117461	2910.44	-0.65904	0.117654	-5.60147	2.13E-08	2.88E-07	-1
ASB13	ENSG00000196372	989.4448	-0.6601	0.105629	-6.24921	4.13E-10	6.87E-09	-1
AGFG2	ENSG00000106351	1096.152	-0.66158	0.127713	-5.18019	2.22E-07	2.60E-06	-1
IRX1	ENSG00000170549	705.6728	-0.66411	0.15053	-4.41182	1.03E-05	9.13E-05	-1
MBD5	ENSG00000204406	1118.384	-0.66699	0.129754	-5.14043	2.74E-07	3.17E-06	-1
GABRE	ENSG00000102287	1418.472	-0.66731	0.219366	-3.04199	0.0023502	0.0117581	-1
STAMBPL1	ENSG00000138134	650.2961	-0.66833	0.158941	-4.20489	2.61E-05	0.0002126	-1
SLC2A13	ENSG00000151229	650.6207	-0.66834	0.140328	-4.76271	1.91E-06	1.93E-05	-1
CYP2U1	ENSG00000155016	1528.008	-0.6697	0.111613	-6.00014	1.97E-09	2.97E-08	-1
TSHZ1	ENSG00000179981	1049.268	-0.6703	0.106367	-6.3017	2.94E-10	4.99E-09	-1
FLRT2	ENSG00000185070	2387.88	-0.67072	0.120674	-5.55811	2.73E-08	3.61E-07	-1
TACSTD2	ENSG00000184292	30270.46	-0.67507	0.172764	-3.90747	9.33E-05	0.0006779	-1
MBLAC2	ENSG00000176055	682.341	-0.67595	0.140926	-4.7965	1.61E-06	1.65E-05	-1
FAM217B	ENSG00000196227	2448.791	-0.67621	0.123349	-5.48212	4.20E-08	5.42E-07	-1
ZFHX4	ENSG00000091656	5904.094	-0.67641	0.196166	-3.44818	0.0005644	0.0033804	-1
ARRDC3	ENSG00000113369	2771.707	-0.67944	0.137209	-4.95185	7.35E-07	7.97E-06	-1
ICK	ENSG00000112144	3570.726	-0.67986	0.111864	-6.07755	1.22E-09	1.89E-08	-1
RTKN2	ENSG00000182010	2692.514	-0.68046	0.113388	-6.00117	1.96E-09	2.95E-08	-1
ARHGAP18	ENSG00000146376	1949.679	-0.68295	0.124342	-5.4925	3.96E-08	5.13E-07	-1
RIN2	ENSG00000132669	2222.881	-0.68423	0.083076	-8.2362	1.78E-16	4.98E-15	-1
HLTF	ENSG00000071794	2637.805	-0.68541	0.094535	-7.25034	4.16E-13	8.82E-12	-1
KANK2	ENSG00000197256	11798.26	-0.68579	0.117142	-5.85436	4.79E-09	6.94E-08	-1
EPHB4	ENSG00000196411	6850.663	-0.68805	0.109073	-6.30814	2.82E-10	4.81E-09	-1
OSGEPL1	ENSG00000128694	582.145	-0.6912	0.120102	-5.75512	8.66E-09	1.24E-07	-1

INPP4B	ENSG00000109452	2652.81	-0.69137	0.10007	-6.90891	4.88E-12	9.71E-11	-1
SLC2A10	ENSG00000197496	651.7469	-0.6914	0.154003	-4.48951	7.14E-06	6.55E-05	-1
ARSK	ENSG00000164291	1331.672	-0.69151	0.130681	-5.29161	1.21E-07	1.47E-06	-1
BAZ2B	ENSG00000123636	1980.653	-0.69374	0.094612	-7.33251	2.26E-13	4.90E-12	-1
SLC2A1	ENSG00000117394	11455.26	-0.69996	0.080086	-8.74017	2.33E-18	7.27E-17	-1
SLC12A6	ENSG00000140199	3787.384	-0.70127	0.106395	-6.59122	4.36E-11	8.01E-10	-1
FOXA1	ENSG00000129514	1030.523	-0.70302	0.136575	-5.14753	2.64E-07	3.06E-06	-1
NEXN	ENSG00000162614	2875.28	-0.70327	0.114322	-6.15168	7.67E-10	1.23E-08	-1
MXD3	ENSG00000213347	2256.634	-0.70441	0.109542	-6.43051	1.27E-10	2.24E-09	-1
FGD4	ENSG00000139132	660.7991	-0.7078	0.123973	-5.70929	1.13E-08	1.59E-07	-1
VASH2	ENSG00000143494	620.3141	-0.70794	0.173382	-4.08312	4.44E-05	0.0003468	-1
ABHD4	ENSG00000100439	6897.407	-0.70807	0.117416	-6.03046	1.63E-09	2.50E-08	-1
KMT5C	ENSG00000133247	663.127	-0.70848	0.123493	-5.73702	9.64E-09	1.37E-07	-1
STXBP4	ENSG00000166263	1322.808	-0.70963	0.092703	-7.65482	1.94E-14	4.61E-13	-1
MLPH	ENSG00000115648	1211.041	-0.70965	0.119296	-5.94861	2.70E-09	4.01E-08	-1
IGIP	ENSG00000182700	544.9952	-0.71156	0.159331	-4.46593	7.97E-06	7.23E-05	-1
PXMP4	ENSG00000101417	3046.012	-0.71308	0.080811	-8.82412	1.10E-18	3.49E-17	-1
BRD8	ENSG00000112983	8030.52	-0.71382	0.097217	-7.34252	2.10E-13	4.56E-12	-1
MGARP	ENSG00000137463	576.718	-0.71396	0.143101	-4.98921	6.06E-07	6.66E-06	-1
DHRS3	ENSG00000162496	788.3453	-0.71412	0.207622	-3.43952	0.0005827	0.003482	-1
LBHD1	ENSG00000162194	589.0461	-0.71959	0.219054	-3.28497	0.0010199	0.0057093	-1
GRAMD1B	ENSG00000023171	1393.611	-0.7205	0.118251	-6.09298	1.11E-09	1.73E-08	-1
INSR	ENSG00000171105	1500.105	-0.72065	0.12877	-5.5964	2.19E-08	2.94E-07	-1
ZC3H6	ENSG00000188177	850.1959	-0.72172	0.114558	-6.30004	2.98E-10	5.03E-09	-1
KIZ	ENSG00000088970	523.3667	-0.72179	0.138119	-5.22581	1.73E-07	2.07E-06	-1
SLC45A4	ENSG00000022567	571.7446	-0.72336	0.155257	-4.6591	3.18E-06	3.09E-05	-1
FAM102B	ENSG00000162636	2244.14	-0.72519	0.112493	-6.44653	1.14E-10	2.03E-09	-1
KBTBD7	ENSG00000120696	577.2828	-0.72617	0.136199	-5.33165	9.73E-08	1.20E-06	-1
SMAD9	ENSG00000120693	746.937	-0.72868	0.159322	-4.57364	4.79E-06	4.52E-05	-1
RGS9	ENSG00000108370	536.0212	-0.73116	0.148818	-4.91309	8.97E-07	9.58E-06	-1
CCDC77	ENSG00000120647	1748.821	-0.7322	0.16106	-4.54613	5.46E-06	5.07E-05	-1
MTUS1	ENSG00000129422	3306.415	-0.73849	0.081678	-9.04148	1.55E-19	5.10E-18	-1
PDGFRB	ENSG00000113721	3555.003	-0.74094	0.161364	-4.5917	4.40E-06	4.17E-05	-1
KIAA0513	ENSG00000135709	666.6912	-0.74161	0.1332	-5.56766	2.58E-08	3.43E-07	-1
IL17RD	ENSG00000144730	984.6227	-0.74437	0.143239	-5.19668	2.03E-07	2.40E-06	-1
EGR1	ENSG00000120738	671.3426	-0.746	0.225054	-3.31477	0.0009172	0.0052264	-1
USP30	ENSG00000135093	846.8335	-0.7514	0.119436	-6.29124	3.15E-10	5.31E-09	-1
FOXO4	ENSG00000184481	526.2193	-0.75242	0.172673	-4.35746	1.32E-05	0.0001143	-1
AFAP1L2	ENSG00000169129	676.2394	-0.75451	0.15083	-5.00241	5.66E-07	6.25E-06	-1
DENND2A	ENSG00000146966	2503.758	-0.76305	0.112272	-6.79643	1.07E-11	2.06E-10	-1
KAT6B	ENSG00000156650	2428.206	-0.76547	0.108564	-7.05087	1.78E-12	3.61E-11	-1
PGPEP1	ENSG00000130517	1470.563	-0.7666	0.092857	-8.25571	1.51E-16	4.26E-15	-1
APOLD1	ENSG00000178878	1287.121	-0.76836	0.134004	-5.73388	9.82E-09	1.39E-07	-1
NATD1	ENSG00000274180	1837.832	-0.76988	0.12077	-6.3748	1.83E-10	3.18E-09	-1
SYNE1	ENSG00000131018	1136.737	-0.77089	0.165287	-4.66396	3.10E-06	3.03E-05	-1
TNRC6B	ENSG00000100354	2650.928	-0.77244	0.145972	-5.29169	1.21E-07	1.47E-06	-1

EPB41L4B	ENSG00000095203	1095.589	-0.77743	0.182514	-4.25954	2.05E-05	0.000171	-1
AKAP5	ENSG00000179841	804.9108	-0.78194	0.115154	-6.79041	1.12E-11	2.14E-10	-1
PLEKHM3	ENSG00000178385	1549.637	-0.7855	0.126317	-6.21847	5.02E-10	8.25E-09	-1
TNS2	ENSG00000111077	2277.141	-0.79109	0.139126	-5.68616	1.30E-08	1.80E-07	-1
FAT4	ENSG00000196159	3308.148	-0.7912	0.277531	-2.85086	0.0043602	0.0199112	-1
GALNT5	ENSG00000136542	699.4284	-0.79362	0.157416	-5.04151	4.62E-07	5.19E-06	-1
SNPH	ENSG00000101298	727.393	-0.79415	0.150266	-5.28496	1.26E-07	1.53E-06	-1
THAP10	ENSG00000129028	734.1241	-0.79576	0.126867	-6.27238	3.56E-10	5.96E-09	-1
PPP1R3C	ENSG00000119938	612.078	-0.80078	0.161701	-4.9522	7.34E-07	7.96E-06	-1
RAB11FIP1	ENSG00000156675	2685.302	-0.80151	0.139722	-5.73647	9.67E-09	1.37E-07	-1
SASH1	ENSG00000111961	1638.381	-0.80468	0.123451	-6.51823	7.11E-11	1.28E-09	-1
LINC02035	ENSG00000273033	502.0738	-0.80557	0.149274	-5.39661	6.79E-08	8.51E-07	-1
MTSS1L	ENSG00000132613	1866.855	-0.81348	0.095407	-8.52649	1.51E-17	4.53E-16	-1
PBX1	ENSG00000185630	761.6652	-0.8136	0.193225	-4.21064	2.55E-05	0.0002083	-1
CCDC134	ENSG00000100147	1673.413	-0.81748	0.093182	-8.77297	1.74E-18	5.49E-17	-1
PTPN13	ENSG00000163629	719.3741	-0.81835	0.128782	-6.35457	2.09E-10	3.59E-09	-1
CDC42EP3	ENSG00000163171	5484.608	-0.81856	0.117229	-6.98262	2.90E-12	5.84E-11	-1
ZMYM3	ENSG00000147130	2966.331	-0.82019	0.147271	-5.56926	2.56E-08	3.40E-07	-1
RPS6KA5	ENSG00000100784	1684.175	-0.82299	0.102479	-8.03081	9.68E-16	2.59E-14	-1
SPTLC3	ENSG00000172296	1735.172	-0.82372	0.135375	-6.08473	1.17E-09	1.81E-08	-1
ZNF483	ENSG00000173258	738.0315	-0.82726	0.18158	-4.55589	5.22E-06	4.87E-05	-1
SMAD6	ENSG00000137834	562.8043	-0.82995	0.123378	-6.72689	1.73E-11	3.28E-10	-1
RIN1	ENSG00000174791	1681.299	-0.83197	0.180133	-4.61861	3.86E-06	3.71E-05	-1
ABHD10	ENSG00000144827	1424.831	-0.8335	0.104985	-7.93919	2.04E-15	5.30E-14	-1
ZNF395	ENSG00000186918	5177.311	-0.83611	0.101978	-8.19895	2.43E-16	6.76E-15	-1
SMO	ENSG00000128602	574.0858	-0.83638	0.158764	-5.26808	1.38E-07	1.66E-06	-1
CDKN2C	ENSG00000123080	6440.685	-0.83714	0.098518	-8.49737	1.94E-17	5.77E-16	-1
JMY	ENSG00000152409	2772.36	-0.84055	0.113964	-7.3756	1.64E-13	3.59E-12	-1
B4GAT1	ENSG00000174684	1604.104	-0.8419	0.120372	-6.99415	2.67E-12	5.39E-11	-1
CACFD1	ENSG00000160325	798.8542	-0.84552	0.111436	-7.58751	3.26E-14	7.64E-13	-1
CNNM2	ENSG00000148842	869.5723	-0.8457	0.125371	-6.74561	1.52E-11	2.90E-10	-1
ADORA1	ENSG00000163485	583.4107	-0.8485	0.13962	-6.07725	1.22E-09	1.89E-08	-1
IRX2	ENSG00000170561	5011.242	-0.85168	0.103772	-8.20718	2.26E-16	6.33E-15	-1
FAM8A1	ENSG00000137414	1735.648	-0.85903	0.105279	-8.1595	3.36E-16	9.25E-15	-1
WFS1	ENSG00000109501	3951.285	-0.86648	0.127858	-6.77686	1.23E-11	2.34E-10	-1
DIS3L	ENSG00000166938	2860.964	-0.86713	0.126952	-6.83041	8.47E-12	1.65E-10	-1
THRA	ENSG00000126351	1872.746	-0.8673	0.095695	-9.06316	1.27E-19	4.21E-18	-1
LBH	ENSG00000213626	1334.02	-0.86812	0.183158	-4.73975	2.14E-06	2.14E-05	-1
AVPI1	ENSG00000119986	1324.288	-0.87598	0.123274	-7.10596	1.19E-12	2.47E-11	-1
CDON	ENSG00000064309	573.1696	-0.87698	0.143373	-6.11676	9.55E-10	1.51E-08	-1
RBM43	ENSG00000184898	722.0594	-0.87884	0.142172	-6.18156	6.35E-10	1.03E-08	-1
FAM212B	ENSG00000197852	1851.341	-0.88466	0.096753	-9.14348	6.05E-20	2.05E-18	-1
ST6GALNA	ENSG00000117069	633.7287	-0.88641	0.173613	-5.10564	3.30E-07	3.77E-06	-1
S1PR1	ENSG00000170989	503.0402	-0.89277	0.140482	-6.35504	2.08E-10	3.58E-09	-1
ACACB	ENSG00000076555	723.5246	-0.90018	0.19855	-4.53375	5.79E-06	5.36E-05	-1
FBXL20	ENSG00000108306	1349.333	-0.90684	0.102369	-8.85846	8.11E-19	2.60E-17	-1

PRICKLE1	ENSG00000139174	1132.169	-0.91843	0.108526	-8.46279	2.61E-17	7.69E-16	-1
MMP16	ENSG00000156103	998.249	-0.9271	0.136377	-6.79808	1.06E-11	2.04E-10	-1
SYNM	ENSG00000182253	1448.161	-0.9272	0.140905	-6.58031	4.69E-11	8.57E-10	-1
TUB	ENSG00000166402	829.9095	-0.92784	0.18557	-4.99993	5.74E-07	6.32E-06	-1
FMN2	ENSG00000155816	691.5257	-0.92805	0.197174	-4.70674	2.52E-06	2.50E-05	-1
CBX7	ENSG00000100307	934.8154	-0.92847	0.162208	-5.72394	1.04E-08	1.46E-07	-1
MEIS1	ENSG00000143995	1454.51	-0.92862	0.094992	-9.7758	1.43E-22	5.48E-21	-1
PPL	ENSG00000118898	5420.317	-0.93249	0.155085	-6.01275	1.82E-09	2.76E-08	-1
FIGN	ENSG00000182263	1838.614	-0.93427	0.145131	-6.43743	1.22E-10	2.15E-09	-1
NFIA	ENSG00000162599	1196.546	-0.93732	0.123596	-7.58373	3.36E-14	7.85E-13	-1
LRRC75A	ENSG00000181350	515.8475	-0.95101	0.139245	-6.82979	8.50E-12	1.66E-10	-1
LMCD1	ENSG00000071282	722.7954	-0.95502	0.134399	-7.10583	1.20E-12	2.47E-11	-1
SALL2	ENSG00000165821	829.3652	-0.95506	0.134452	-7.10331	1.22E-12	2.51E-11	-1
SMPDL3A	ENSG00000172594	546.4182	-0.96033	0.120671	-7.95824	1.75E-15	4.58E-14	-1
SLC43A1	ENSG00000149150	538.6972	-0.96191	0.130212	-7.38726	1.50E-13	3.31E-12	-1
SLC38A4	ENSG00000139209	741.5468	-0.99107	0.118978	-8.32982	8.10E-17	2.33E-15	-1
FZD2	ENSG00000180340	4719.655	-1.00124	0.129615	-7.72468	1.12E-14	2.74E-13	-1
MINDY1	ENSG00000143409	487.7556	-1.02205	0.132288	-7.72591	1.11E-14	2.72E-13	-1

CXADR	ENSG00000154639	755.4401	-1.02361	0.107739	-9.50081	2.08E-21	7.48E-20	-1
DAPK1	ENSG00000196730	6201.404	-1.03131	0.118716	-8.68727	3.71E-18	1.15E-16	-1
GJA1	ENSG00000152661	1785.379	-1.03588	0.140564	-7.36944	1.71E-13	3.75E-12	-1
AR	ENSG00000169083	935.6848	-1.04204	0.164054	-6.3518	2.13E-10	3.65E-09	-1
TOB1	ENSG00000141232	2905.824	-1.04529	0.110325	-9.47467	2.68E-21	9.58E-20	-1
TRIM2	ENSG00000109654	1346.733	-1.04626	0.126217	-8.28941	1.14E-16	3.24E-15	-1
SH3TC2	ENSG00000169247	634.995	-1.07043	0.162336	-6.59389	4.28E-11	7.88E-10	-1
KRT80	ENSG00000167767	4276.159	-1.07545	0.084905	-12.6666	9.06E-37	6.41E-35	-1
FAM117A	ENSG00000121104	1195.581	-1.08358	0.164896	-6.5713	4.99E-11	9.09E-10	-1
CASTOR2	ENSG00000274070	1144.848	-1.08819	0.135302	-8.04274	8.79E-16	2.38E-14	-1
PLEKHA7	ENSG00000166689	1175.949	-1.09012	0.141665	-7.69507	1.41E-14	3.43E-13	-1
YPEL3	ENSG00000090238	1341.45	-1.09464	0.175416	-6.24029	4.37E-10	7.25E-09	-1
SLC25A42	ENSG00000181035	552.1634	-1.09522	0.120752	-9.07004	1.19E-19	3.97E-18	-1
NANOS1	ENSG00000188613	1149.17	-1.11302	0.097041	-11.4696	1.88E-30	1.03E-28	-1
MIR503HG	ENSG00000223749	483.2914	-1.11436	0.221991	-5.01986	5.17E-07	5.75E-06	-1
VASN	ENSG00000168140	2977.539	-1.11586	0.115108	-9.69398	3.20E-22	1.18E-20	-1
PRAG1	ENSG00000275342	1914.217	-1.17576	0.15044	-7.81549	5.48E-15	1.37E-13	-1
ADAMTS1	ENSG00000166106	473.0744	-1.20026	0.207665	-5.77978	7.48E-09	1.07E-07	-1
MEGF9	ENSG00000106780	3895.65	-1.20681	0.126791	-9.51817	1.76E-21	6.38E-20	-1
PGF	ENSG00000119630	531.6636	-1.2075	0.246673	-4.89513	9.82E-07	1.04E-05	-1
FAM214A	ENSG00000047346	1185.341	-1.2201	0.107476	-11.3523	7.23E-30	3.86E-28	-1
TRERF1	ENSG00000124496	1597.078	-1.22677	0.132407	-9.26516	1.95E-20	6.73E-19	-1
RAB30	ENSG00000137502	2763.169	-1.22781	0.095103	-12.9103	3.94E-38	2.85E-36	-1
ST3GAL5	ENSG00000115525	893.5911	-1.27342	0.119661	-10.6419	1.90E-26	8.83E-25	-1
EYA1	ENSG00000104313	1259.384	-1.27599	0.106329	-12.0003	3.54E-33	2.20E-31	-1
BMF	ENSG00000104081	1448.823	-1.30426	0.169697	-7.68579	1.52E-14	3.67E-13	-1
WNT9A	ENSG00000143816	454.9922	-1.32526	0.187612	-7.06383	1.62E-12	3.31E-11	-1
BMP4	ENSG00000125378	1787.111	-1.33989	0.140526	-9.53483	1.50E-21	5.45E-20	-1
APLN	ENSG00000171388	444.7209	-1.34509	0.174555	-7.70582	1.30E-14	3.17E-13	-1
PIK3C2B	ENSG00000133056	517.3851	-1.3591	0.1692	-8.03249	9.55E-16	2.56E-14	-1
BCL2L11	ENSG00000153094	2410.896	-1.40698	0.131784	-10.6764	1.31E-26	6.18E-25	-1
GLCCI1	ENSG00000106415	806.9925	-1.43033	0.110194	-12.9802	1.59E-38	1.16E-36	-1
ERBB3	ENSG00000065361	697.1597	-1.50385	0.194619	-7.72719	1.10E-14	2.70E-13	-1
ATOH8	ENSG00000168874	1490.437	-1.59985	0.15992	-10.004	1.46E-23	5.93E-22	-1
FAXDC2	ENSG00000170271	1171.955	-1.63635	0.124846	-13.1069	3.01E-39	2.33E-37	-1
SLC2A12	ENSG00000146411	459.468	-1.82196	0.177757	-10.2497	1.19E-24	5.10E-23	-1
HLF	ENSG00000108924	470.7431	-1.82924	0.211937	-8.63108	6.08E-18	1.85E-16	-1
KCNB1	ENSG00000158445	445.5821	-1.90823	0.187603	-10.1716	2.65E-24	1.11E-22	-1
KIT	ENSG00000157404	1219.449	-2.98374	0.137402	-21.7154	1.47E-104	3.44E-102	-1

Table S2: DEG Analysis - Control (Resting) + ML141 vs Control (Resting)

gene name	gene id	baseMean	log2FC	lfcSE	stat	pvalue	padj	filter
ADM2	ENSG00000128165	1798.625	5.086926	0.16214	31.37358	4.64E-216	9.21E-213	1
PTX3	ENSG00000163661	3195.625	4.535934	0.132823	34.15011	1.33E-255	6.61E-252	1
CHAC1	ENSG00000128965	2654.475	4.535774	0.157638	28.77331	4.63E-182	4.59E-179	1
GDF15	ENSG00000130513	2634.232	4.483631	0.157469	28.47312	2.52E-178	2.27E-175	1
ATF3	ENSG00000162772	7930.626	4.259407	0.136598	31.18195	1.87E-213	3.10E-210	1
DDIT3	ENSG00000175197	5125.058	4.172637	0.125433	33.26579	1.21E-242	3.99E-239	1
SESN2	ENSG00000130766	9990.002	3.777891	0.13044	28.96256	1.95E-184	2.15E-181	1
TRIB3	ENSG00000101255	51311.7	3.68175	0.09724	37.86242	0	0	1
MT-RNR2	ENSG00000210082	382758.7	3.235971	0.146551	22.08081	4.83E-108	1.71E-105	1
GADD45A	ENSG00000116717	18590.3	3.21913	0.109861	29.30176	9.85E-189	1.22E-185	1
HBEGF	ENSG00000113070	12988	3.20099	0.100475	31.85873	9.97E-223	2.47E-219	1
MT-RNR1	ENSG00000211459	70877.26	3.178815	0.15397	20.64571	1.07E-94	2.94E-92	1
MAFF	ENSG00000185022	4378.586	3.150397	0.135821	23.19525	5.08E-119	2.02E-116	1
LURAP1L	ENSG00000153714	1795.785	3.108906	0.119977	25.91252	4.81E-148	3.18E-145	1
EGR1	ENSG00000120738	5125.323	3.098676	0.1828	16.95122	1.89E-64	2.40E-62	1
CXCL8	ENSG00000169429	397.301	3.058969	0.23792	12.85714	7.84E-38	4.19E-36	1
NEDD9	ENSG00000111859	3132.676	3.027038	0.119852	25.2565	9.61E-141	5.61E-138	1
CEBPB	ENSG00000172216	6342.431	2.987409	0.128043	23.33125	2.14E-120	9.22E-118	1
XBP1	ENSG00000100219	17141.34	2.923792	0.104433	27.99677	1.78E-172	1.47E-169	1
ULBP1	ENSG00000111981	501.9868	2.883257	0.207178	13.9168	5.01E-44	3.29E-42	1
NFIL3	ENSG00000165030	5049.703	2.836047	0.116147	24.41774	1.11E-131	5.79E-129	1
PDE4D	ENSG00000113448	5879.612	2.827839	0.106835	26.46917	2.20E-154	1.68E-151	1
AREG	ENSG00000109321	601.2416	2.671326	0.202478	13.19316	9.61E-40	5.48E-38	1
CD274	ENSG00000120217	3220.214	2.659136	0.130948	20.30674	1.12E-91	2.93E-89	1
SNHG8	ENSG00000269893	805.2956	2.649068	0.138079	19.1852	4.92E-82	1.08E-79	1
KLF4	ENSG00000136826	1486.43	2.622376	0.128399	20.42371	1.03E-92	2.76E-90	1
MXD1	ENSG00000059728	3908.489	2.603824	0.099127	26.26764	4.50E-152	3.19E-149	1
PPP1R15A	ENSG00000087074	24334.47	2.587793	0.08482	30.50909	1.97E-204	2.80E-201	1
DUSP5	ENSG00000138166	5246.566	2.586049	0.104967	24.63667	5.11E-134	2.82E-131	1
CTH	ENSG00000116761	920.8202	2.567985	0.13132	19.55512	3.73E-85	8.81E-83	1
NFKBIZ	ENSG00000144802	1964.559	2.513436	0.159635	15.74492	7.44E-56	7.24E-54	1
SPRY4	ENSG00000187678	3370.368	2.500615	0.150559	16.60891	6.01E-62	7.01E-60	1
TUBE1	ENSG00000074935	1620.65	2.488045	0.116778	21.30568	1.01E-100	3.12E-98	1
CEBPG	ENSG00000153879	9908.462	2.468409	0.103566	23.83412	1.48E-125	6.99E-123	1
CLDN1	ENSG00000163347	6239.882	2.442998	0.116585	20.9546	1.70E-97	4.97E-95	1
PMAIP1	ENSG00000141682	6779.087	2.422347	0.113834	21.27966	1.75E-100	5.27E-98	1
KCNG1	ENSG00000026559	1110.873	2.389153	0.156416	15.27435	1.13E-52	1.01E-50	1
ERRFI1	ENSG00000116285	13989.56	2.352675	0.098129	23.97529	5.04E-127	2.50E-124	1
DMBT1	ENSG00000187908	622.2664	2.331448	0.180992	12.8815	5.72E-38	3.08E-36	1
NGF	ENSG00000134259	1459.777	2.322356	0.13414	17.31289	3.76E-67	5.18E-65	1
DUSP1	ENSG00000120129	5253.192	2.303754	0.118603	19.42402	4.84E-84	1.09E-81	1
IL11	ENSG00000095752	6086.119	2.299874	0.290175	7.925807	2.27E-15	3.03E-14	1
ALDH1L2	ENSG00000136010	3265.223	2.261931	0.139475	16.21746	3.80E-59	4.01E-57	1
MFSD2A	ENSG00000168389	625.6169	2.250456	0.144449	15.57964	1.00E-54	9.20E-53	1

HK2	ENSG00000159399	8166.151	2.210886	0.140169	15.77298	4.77E-56	4.69E-54	1
RND3	ENSG00000115963	25772.92	2.193373	0.106179	20.65726	8.40E-95	2.38E-92	1
SLC7A11	ENSG00000151012	9552.913	2.161638	0.190133	11.36908	5.96E-30	2.19E-28	1
PSAT1	ENSG00000135069	11371.85	2.148055	0.130333	16.48128	5.00E-61	5.70E-59	1
ANKRD1	ENSG00000148677	3325.986	2.1444	0.196576	10.90875	1.05E-27	3.50E-26	1
DDIT4	ENSG00000168209	9471.692	2.124803	0.113879	18.65847	1.08E-77	2.18E-75	1
IFRD1	ENSG00000006652	1064.792	2.11106	0.129007	16.36394	3.46E-60	3.81E-58	1
ERN1	ENSG00000178607	2382.114	2.110832	0.166191	12.70123	5.82E-37	2.98E-35	1
ARHGEF2	ENSG00000116584	17134.47	2.10834	0.082381	25.59253	1.85E-144	1.15E-141	1
DNAJB9	ENSG00000128590	4831.785	2.107409	0.123847	17.01619	6.23E-65	8.13E-63	1
KDM7A	ENSG00000006459	742.2631	2.106878	0.146119	14.41893	3.93E-47	2.85E-45	1
SNHG15	ENSG00000232956	1929.35	2.078367	0.134338	15.47114	5.43E-54	4.95E-52	1
VEGFA	ENSG00000112715	8708.909	2.075968	0.110409	18.8025	7.20E-79	1.52E-76	1
BDNF	ENSG00000176697	1971.989	2.070344	0.164502	12.58555	2.54E-36	1.26E-34	1
ARID5A	ENSG00000196843	2032.877	2.065611	0.123838	16.67992	1.83E-62	2.17E-60	1
SNHG1	ENSG00000255717	9460.359	2.058676	0.087868	23.42915	2.16E-121	9.73E-119	1
ZNF697	ENSG00000143067	1875.007	2.050107	0.125617	16.3203	7.08E-60	7.63E-58	1
SNHG12	ENSG00000197989	1889.294	2.033266	0.143433	14.17575	1.29E-45	8.86E-44	1
HERPUD1	ENSG00000051108	9037.557	2.026239	0.109259	18.5453	8.90E-77	1.67E-74	1
MTHFD2	ENSG00000065911	22246.95	2.004203	0.098796	20.28635	1.70E-91	4.32E-89	1
AEN	ENSG00000181026	6728.257	2.001734	0.106509	18.79396	8.46E-79	1.75E-76	1
LIF	ENSG00000128342	4380.423	1.995596	0.133004	15.00404	6.91E-51	5.76E-49	1
STC2	ENSG00000113739	87588.09	1.988085	0.135655	14.6554	1.24E-48	9.50E-47	1
SAT1	ENSG00000130066	4974.971	1.949737	0.155934	12.50361	7.13E-36	3.47E-34	1
PLK3	ENSG00000173846	1929.432	1.949686	0.11136	17.5079	1.25E-68	1.82E-66	1
GPT2	ENSG00000166123	6778.225	1.943281	0.088847	21.8722	4.78E-106	1.64E-103	1
IER3	ENSG00000137331	4398.224	1.942891	0.108604	17.88971	1.42E-71	2.27E-69	1
ADAMTS6	ENSG00000049192	4791.217	1.942518	0.113705	17.08389	1.96E-65	2.59E-63	1
ITPRIP	ENSG00000148841	7767.428	1.9038	0.097886	19.44914	2.96E-84	6.84E-82	1
EDA2R	ENSG00000131080	410.9847	1.875131	0.181024	10.35844	3.83E-25	1.07E-23	1
PCK2	ENSG00000100889	7600.595	1.870544	0.086061	21.73499	9.58E-105	3.17E-102	1
RELB	ENSG00000104856	727.0241	1.862363	0.189535	9.825956	8.70E-23	2.11E-21	1
NOCT	ENSG00000151014	2288.91	1.851758	0.092889	19.93516	2.02E-88	5.00E-86	1
SNAI2	ENSG00000019549	2936.381	1.839428	0.093717	19.62757	8.99E-86	2.18E-83	1
MSC	ENSG00000178860	647.4834	1.819214	0.203142	8.955366	3.39E-19	6.51E-18	1
SLC25A25	ENSG00000148339	3555.263	1.812487	0.083547	21.69435	2.32E-104	7.42E-102	1
MYC	ENSG00000136997	9144.383	1.788137	0.106015	16.86684	7.89E-64	9.91E-62	1
SLFN5	ENSG00000166750	8398.005	1.769512	0.186166	9.504998	2.00E-21	4.52E-20	1
TSC22D3	ENSG00000157514	5623.398	1.748356	0.122011	14.32948	1.43E-46	1.01E-44	1
GARS	ENSG00000106105	25167.24	1.729876	0.095498	18.11426	2.46E-73	4.14E-71	1
BTG1	ENSG00000133639	4291.6	1.719944	0.098665	17.43212	4.71E-68	6.67E-66	1
DUSP8	ENSG00000184545	2279.103	1.71328	0.154471	11.09131	1.38E-28	4.71E-27	1
SLC30A1	ENSG00000170385	9065.414	1.707042	0.091562	18.64358	1.42E-77	2.77E-75	1
JAG1	ENSG00000101384	4173.051	1.70457	0.091377	18.65429	1.17E-77	2.31E-75	1
CREB5	ENSG00000146592	6939.286	1.703445	0.158334	10.75855	5.40E-27	1.72E-25	1
HSPA5	ENSG00000044574	61643.78	1.701179	0.097153	17.51036	1.19E-68	1.77E-66	1
GTPBP2	ENSG00000172432	11465.84	1.693042	0.075148	22.52955	2.13E-112	8.13E-110	1

MAP1LC3B	ENSG00000140941	8768.379	1.690429	0.111431	15.17014	5.58E-52	4.90E-50	1
C17orf51	ENSG00000212719	3501.176	1.688241	0.091953	18.35985	2.75E-75	4.88E-73	1
UAP1	ENSG00000117143	29251.49	1.683165	0.100104	16.81413	1.92E-63	2.33E-61	1
SLC35F6	ENSG00000213699	9542.179	1.678832	0.07534	22.28328	5.37E-110	1.97E-107	1
CSRNP1	ENSG00000144655	3151.985	1.678185	0.141418	11.86682	1.76E-32	7.22E-31	1
PER2	ENSG00000132326	817.1477	1.668477	0.169698	9.83205	8.19E-23	1.99E-21	1
FGF5	ENSG00000138675	9197.077	1.66634	0.153837	10.83184	2.43E-27	7.91E-26	1
TMEM268	ENSG00000157693	3220.061	1.664979	0.089684	18.565	6.17E-77	1.18E-74	1
PSPH	ENSG00000146733	2389.355	1.649696	0.111232	14.83107	9.22E-50	7.21E-48	1
USP53	ENSG00000145390	4333.377	1.648196	0.094904	17.36699	1.47E-67	2.05E-65	1
MOCOS	ENSG00000075643	3320.625	1.64475	0.123288	13.34075	1.34E-40	7.92E-39	1
SGK1	ENSG00000118515	4015.873	1.63324	0.115053	14.1956	9.75E-46	6.72E-44	1
FICD	ENSG00000198855	2155.066	1.605456	0.086772	18.50194	1.99E-76	3.66E-74	1
PPP1R3B	ENSG00000173281	2776.671	1.591024	0.096533	16.48173	4.96E-61	5.70E-59	1
PVR	ENSG00000073008	26194.55	1.587709	0.090906	17.4654	2.63E-68	3.78E-66	1
ZNF773	ENSG00000152439	1251.909	1.584783	0.117056	13.53865	9.25E-42	5.66E-40	1
ADPRM	ENSG00000170222	709.9592	1.581631	0.184492	8.572897	1.01E-17	1.70E-16	1
GRPEL2	ENSG00000164284	5866.657	1.576842	0.098543	16.0015	1.25E-57	1.29E-55	1
FAM84B	ENSG00000168672	1188.506	1.570814	0.114	13.77911	3.40E-43	2.17E-41	1
AHR	ENSG00000106546	8193.343	1.568043	0.08572	18.29268	9.46E-75	1.65E-72	1
EPB41L4A-	ENSG00000224032	1564.798	1.566127	0.149651	10.46521	1.25E-25	3.62E-24	1
AL031985.	ENSG00000260920	770.8612	1.56597	0.143023	10.94908	6.71E-28	2.25E-26	1
RCAN1	ENSG00000159200	3297.512	1.56432	0.104786	14.92876	2.14E-50	1.74E-48	1
DUSP10	ENSG00000143507	939.0805	1.54768	0.124692	12.41204	2.25E-35	1.06E-33	1
ATF4	ENSG00000128272	35309.38	1.538826	0.094453	16.29194	1.13E-59	1.20E-57	1
SLC25A33	ENSG00000171612	1555.728	1.532939	0.139237	11.0096	3.44E-28	1.16E-26	1
ETS2	ENSG00000157557	13478.82	1.531579	0.085645	17.8829	1.60E-71	2.52E-69	1
HTR7	ENSG00000148680	1119.75	1.524416	0.151947	10.03254	1.10E-23	2.82E-22	1
ZNF202	ENSG00000166261	1942.233	1.523899	0.09643	15.80315	2.96E-56	2.94E-54	1
GEM	ENSG00000164949	1487.536	1.515911	0.136337	11.11883	1.02E-28	3.49E-27	1
CHIC2	ENSG00000109220	3278.486	1.515377	0.127511	11.88426	1.43E-32	5.93E-31	1
CBARP	ENSG00000099625	529.0129	1.511366	0.186287	8.113114	4.93E-16	7.09E-15	1
DDR2	ENSG00000162733	550.0303	1.510785	0.205463	7.353077	1.94E-13	2.08E-12	1
FAM241A	ENSG00000174749	940.8747	1.505688	0.143296	10.50757	7.97E-26	2.36E-24	1
DLC1	ENSG00000164741	27381.67	1.500162	0.103565	14.48524	1.50E-47	1.10E-45	1
ZFP69B	ENSG00000187801	933.3169	1.490163	0.132851	11.21677	3.37E-29	1.19E-27	1
SMOX	ENSG00000088826	2874.325	1.481488	0.154457	9.591558	8.68E-22	2.00E-20	1
USP36	ENSG00000055483	12020.89	1.480665	0.098779	14.98963	8.58E-51	7.10E-49	1
FOSL1	ENSG00000175592	8003.977	1.480508	0.16067	9.21459	3.12E-20	6.55E-19	1
LARP6	ENSG00000166173	6189.46	1.476564	0.104528	14.12602	2.63E-45	1.78E-43	1
TMEM39A	ENSG00000176142	3960.966	1.473844	0.083005	17.75607	1.55E-70	2.36E-68	1
PPRC1	ENSG00000148840	8001.609	1.471762	0.108397	13.57749	5.45E-42	3.40E-40	1
SHMT2	ENSG00000182199	20150.08	1.468134	0.087058	16.86387	8.30E-64	1.03E-61	1
THAP9-AS1	ENSG00000251022	1997.391	1.466405	0.092169	15.91	5.40E-57	5.47E-55	1
AL365181.	ENSG00000272405	555.1272	1.464886	0.183499	7.983082	1.43E-15	1.96E-14	1
TUFT1	ENSG00000143367	16597.41	1.463837	0.077038	19.00142	1.66E-80	3.58E-78	1
PDCD1LG2	ENSG00000197646	914.4243	1.457926	0.199444	7.309966	2.67E-13	2.83E-12	1

FOXC1	ENSG00000054598	1522.242	1.456212	0.122464	11.8909	1.32E-32	5.50E-31	1
UPP1	ENSG00000183696	6850.565	1.437051	0.095301	15.07907	2.22E-51	1.90E-49	1
RRP12	ENSG00000052749	3813.125	1.423917	0.095544	14.90325	3.14E-50	2.53E-48	1
RASEF	ENSG00000165105	3077.483	1.419654	0.10242	13.86107	1.09E-43	6.98E-42	1
IER2	ENSG00000160888	1850.313	1.415251	0.09023	15.68488	1.92E-55	1.81E-53	1
EIF5	ENSG00000100664	31080.63	1.415008	0.078734	17.97192	3.23E-72	5.26E-70	1
CARS	ENSG00000110619	7444.572	1.407022	0.07724	18.2162	3.84E-74	6.57E-72	1
AUNIP	ENSG00000127423	1852.725	1.405836	0.114032	12.32842	6.37E-35	2.95E-33	1
CNST	ENSG00000162852	3634.517	1.405027	0.103522	13.57231	5.84E-42	3.62E-40	1
SEC24D	ENSG00000150961	8678.736	1.401623	0.09301	15.06956	2.57E-51	2.18E-49	1
AMIGO2	ENSG00000139211	10647.49	1.398637	0.11078	12.62533	1.53E-36	7.79E-35	1
ZBTB21	ENSG00000173276	8493.031	1.39801	0.095906	14.5769	3.94E-48	2.98E-46	1
C12orf66	ENSG00000174206	612.1304	1.395543	0.147776	9.443667	3.60E-21	7.97E-20	1
FGF2	ENSG00000138685	8070.449	1.387902	0.102784	13.5031	1.50E-41	9.13E-40	1
CTGF	ENSG00000118523	24287.5	1.386559	0.136755	10.139	3.71E-24	9.68E-23	1
METTL1	ENSG00000037897	1087.691	1.384686	0.122006	11.34937	7.47E-30	2.72E-28	1
ETV5	ENSG00000244405	4077.879	1.382444	0.156186	8.851276	8.65E-19	1.60E-17	1
SLC9A1	ENSG00000090020	7989.571	1.381354	0.133048	10.38237	2.98E-25	8.38E-24	1
SH3TC1	ENSG00000125089	1051.906	1.379317	0.147522	9.349937	8.77E-21	1.89E-19	1
TAF1A	ENSG00000143498	737.987	1.367593	0.152469	8.96966	2.97E-19	5.76E-18	1
CBX4	ENSG00000141582	1646.944	1.36683	0.13463	10.1525	3.23E-24	8.48E-23	1
SH3RF1	ENSG00000154447	9050.159	1.363633	0.1098	12.41919	2.06E-35	9.86E-34	1
RAB33B	ENSG00000172007	2580.271	1.355687	0.107692	12.58856	2.44E-36	1.22E-34	1
CDK17	ENSG00000059758	6490.232	1.353843	0.090927	14.8894	3.86E-50	3.09E-48	1
ZNF354A	ENSG00000169131	2404.941	1.346625	0.165032	8.159768	3.36E-16	4.90E-15	1
SNHG17	ENSG00000196756	4971.097	1.332602	0.094684	14.07426	5.47E-45	3.69E-43	1
PPARD	ENSG00000112033	8417.438	1.331745	0.091507	14.55346	5.55E-48	4.14E-46	1
TRIB1	ENSG00000173334	485.675	1.32728	0.184434	7.196499	6.18E-13	6.33E-12	1
YARS	ENSG00000134684	15013.5	1.320876	0.080697	16.36841	3.22E-60	3.58E-58	1
WDR43	ENSG00000163811	6779.983	1.315574	0.118964	11.0586	1.99E-28	6.74E-27	1
STX1A	ENSG00000106089	785.7429	1.313817	0.132683	9.901937	4.08E-23	1.01E-21	1
CDKN2AIP	ENSG00000168564	3812.598	1.30844	0.107019	12.2263	2.25E-34	1.01E-32	1
ZFP36L1	ENSG00000185650	16589.43	1.303595	0.090742	14.366	8.46E-47	6.08E-45	1
NFE2L2	ENSG00000116044	12398.49	1.299106	0.07174	18.10857	2.73E-73	4.51E-71	1
CDKN1A	ENSG00000124762	12537.97	1.288984	0.110246	11.69184	1.40E-31	5.50E-30	1
XPOT	ENSG00000184575	21256.65	1.284043	0.103059	12.45931	1.24E-35	5.99E-34	1
TNFRSF12A	ENSG00000006327	25473.68	1.282773	0.097431	13.16591	1.38E-39	7.82E-38	1
TNFRSF10B	ENSG00000120889	9993.005	1.280908	0.081494	15.71773	1.14E-55	1.09E-53	1
SNAI3-AS1	ENSG00000260630	586.476	1.280538	0.203271	6.299668	2.98E-10	2.22E-09	1
GFPT1	ENSG00000198380	12459.47	1.278181	0.089044	14.35457	9.97E-47	7.12E-45	1
RASSF1	ENSG00000068028	7308.43	1.27625	0.089494	14.26078	3.84E-46	2.68E-44	1
STK40	ENSG00000196182	2693.658	1.271901	0.085477	14.88004	4.44E-50	3.50E-48	1
	ENSG00000291152	1387.828	1.267181	0.176074	7.196862	6.16E-13	6.32E-12	1
NRBF2	ENSG00000148572	2691.206	1.263624	0.148366	8.516953	1.64E-17	2.71E-16	1
KCTD15	ENSG00000153885	572.1706	1.261191	0.161734	7.797922	6.29E-15	8.08E-14	1
AC073869.	ENSG00000152117	2697.871	1.258249	0.166951	7.53665	4.82E-14	5.52E-13	1
IL1RAP	ENSG00000196083	4143.322	1.251241	0.122994	10.17316	2.61E-24	6.89E-23	1

NABP1	ENSG00000173559	7263.842	1.249033	0.119783	10.42743	1.86E-25	5.28E-24	1
TGIF1	ENSG00000177426	2730.002	1.247716	0.127204	9.808766	1.03E-22	2.49E-21	1
C6orf48	ENSG00000204387	1681.366	1.247021	0.132454	9.414755	4.74E-21	1.04E-19	1
SOCS2	ENSG00000120833	1188.472	1.242253	0.131247	9.464965	2.94E-21	6.58E-20	1
PLEKHF1	ENSG00000166289	2040.043	1.240989	0.136928	9.063086	1.27E-19	2.54E-18	1
DUSP6	ENSG00000139318	808.0803	1.239201	0.210723	5.880716	4.08E-09	2.62E-08	1
EFNB2	ENSG00000125266	509.8566	1.238614	0.156924	7.893059	2.95E-15	3.92E-14	1
PRR3	ENSG00000204576	1738.342	1.237044	0.098014	12.62113	1.61E-36	8.17E-35	1
CPEB4	ENSG00000113742	5706.003	1.237	0.092432	13.38278	7.62E-41	4.58E-39	1
KDM6B	ENSG00000132510	1225.246	1.236671	0.180932	6.835001	8.20E-12	7.19E-11	1
GPCPD1	ENSG00000125772	6981.343	1.235133	0.081375	15.17831	4.92E-52	4.36E-50	1
TBX3	ENSG00000135111	2400.981	1.233867	0.093774	13.1579	1.53E-39	8.64E-38	1
POLR3D	ENSG00000168495	3891.848	1.232354	0.076554	16.09793	2.64E-58	2.75E-56	1
NAMPT	ENSG00000105835	10527.35	1.231073	0.127292	9.671276	3.99E-22	9.30E-21	1
PAPPA	ENSG00000182752	878.2811	1.228613	0.139747	8.791728	1.47E-18	2.67E-17	1
C3orf52	ENSG00000114529	951.8451	1.221203	0.122788	9.945599	2.64E-23	6.64E-22	1
PXDC1	ENSG00000168994	7901.668	1.220068	0.099654	12.243	1.83E-34	8.26E-33	1
PIGA	ENSG00000165195	1768.19	1.220028	0.114694	10.63727	2.00E-26	6.14E-25	1
MIR100HG	ENSG00000255248	1261.1	1.218587	0.178854	6.81332	9.54E-12	8.27E-11	1
SERPINE1	ENSG00000106366	46184.85	1.218486	0.093848	12.98367	1.51E-38	8.26E-37	1
TAF1D	ENSG00000166012	6448.637	1.21546	0.100038	12.14997	5.74E-34	2.53E-32	1
PHLDA1	ENSG00000139289	16594.68	1.214644	0.134014	9.06354	1.26E-19	2.53E-18	1
G0S2	ENSG00000123689	1129.926	1.210499	0.128323	9.43319	3.98E-21	8.79E-20	1
ZMYM5	ENSG00000132950	2167.945	1.208736	0.108672	11.12277	9.72E-29	3.35E-27	1
SIAH2	ENSG00000181788	2511.62	1.203981	0.100051	12.03364	2.36E-33	1.00E-31	1
RNF41	ENSG00000181852	5047.596	1.201173	0.084495	14.2159	7.30E-46	5.06E-44	1
NFXL1	ENSG00000170448	1506.885	1.199386	0.107692	11.13723	8.26E-29	2.88E-27	1
CCDC174	ENSG00000154781	1971.015	1.199076	0.114801	10.44478	1.55E-25	4.44E-24	1
ZNF550	ENSG00000251369	1419.51	1.198501	0.106655	11.2372	2.68E-29	9.55E-28	1
ZFAS1	ENSG00000177410	1881.813	1.198373	0.17546	6.829881	8.50E-12	7.42E-11	1
PPP1R3C	ENSG00000119938	1428.16	1.196213	0.133763	8.94278	3.80E-19	7.25E-18	1
JUNB	ENSG00000171223	911.2274	1.193328	0.14293	8.349014	6.88E-17	1.07E-15	1
E2F7	ENSG00000165891	18975.13	1.192649	0.098808	12.0704	1.51E-33	6.56E-32	1
MTHFD1L	ENSG00000120254	6064	1.191464	0.103208	11.54431	7.89E-31	3.01E-29	1
	ENSG00000291201	956.2354	1.190271	0.237778	5.005817	5.56E-07	2.62E-06	1
JUN	ENSG00000177606	18508.83	1.188522	0.112555	10.55949	4.59E-26	1.37E-24	1
ZC3H8	ENSG00000144161	1209.865	1.185844	0.109458	10.83382	2.38E-27	7.77E-26	1
MEX3B	ENSG00000183496	2227.811	1.185176	0.140056	8.46219	2.62E-17	4.24E-16	1
PDP1	ENSG00000164951	10490.49	1.185062	0.138782	8.539037	1.35E-17	2.26E-16	1
CTAGE5	ENSG00000150527	2239.937	1.175908	0.124329	9.458008	3.14E-21	7.01E-20	1
JDP2	ENSG00000140044	2993.407	1.174854	0.10182	11.5386	8.43E-31	3.20E-29	1
NAMPTP1	ENSG00000229644	992.5926	1.171417	0.151535	7.730343	1.07E-14	1.33E-13	1
FSBP	ENSG00000265817	587.366	1.170131	0.165353	7.07658	1.48E-12	1.42E-11	1
RABGGTB	ENSG00000137955	4864.618	1.170021	0.083403	14.02846	1.04E-44	7.00E-43	1
ZCCHC8	ENSG00000033030	4954.736	1.169806	0.080319	14.56453	4.72E-48	3.55E-46	1
JUND	ENSG00000130522	12698.25	1.165927	0.155378	7.503808	6.20E-14	7.03E-13	1
SLC1A5	ENSG00000105281	12570.42	1.163537	0.090693	12.82942	1.12E-37	5.92E-36	1

SARS	ENSG00000031698	19279.76	1.1627	0.078115	14.88452	4.15E-50	3.30E-48	1
NFX1	ENSG00000086102	7617.381	1.160484	0.075047	15.46344	6.12E-54	5.52E-52	1
SLC7A1	ENSG00000139514	29979.16	1.16009	0.123662	9.381135	6.53E-21	1.42E-19	1
PUS1	ENSG00000177192	1620.187	1.153843	0.102973	11.20533	3.84E-29	1.35E-27	1
CCNB1IP1	ENSG00000100814	3340.406	1.151597	0.126448	9.107267	8.45E-20	1.71E-18	1
CEP72	ENSG00000112877	2781.099	1.149637	0.108782	10.56824	4.18E-26	1.26E-24	1
USP2	ENSG00000036672	619.2645	1.148534	0.153111	7.501298	6.32E-14	7.15E-13	1
ZNF408	ENSG00000175213	1547.092	1.147452	0.114981	9.979447	1.88E-23	4.78E-22	1
TOE1	ENSG00000132773	2204.641	1.146095	0.093533	12.25336	1.61E-34	7.30E-33	1
PVT1	ENSG00000249859	1125.372	1.14234	0.145714	7.839616	4.52E-15	5.92E-14	1
FSD1L	ENSG00000106701	1534.768	1.142313	0.106169	10.75935	5.35E-27	1.71E-25	1
LINC-PINT	ENSG00000231721	668.5726	1.140986	0.201775	5.654758	1.56E-08	9.24E-08	1
PER1	ENSG00000179094	1341.178	1.135469	0.173793	6.533476	6.43E-11	5.17E-10	1
SLC39A14	ENSG00000104635	17862.97	1.134658	0.083134	13.64862	2.06E-42	1.30E-40	1
GAS5	ENSG00000234741	6596.904	1.132212	0.144833	7.817346	5.39E-15	7.02E-14	1
MARS	ENSG00000166986	16384.9	1.130709	0.085365	13.24561	4.78E-40	2.79E-38	1
LMO4	ENSG00000143013	2663.797	1.130237	0.094821	11.91965	9.35E-33	3.91E-31	1
LIPG	ENSG00000101670	1035.242	1.124663	0.144273	7.795404	6.42E-15	8.23E-14	1
EIF2AK3	ENSG00000172071	3818.213	1.120314	0.077203	14.51131	1.03E-47	7.61E-46	1
NNMT	ENSG00000166741	6625.888	1.117951	0.286827	3.897649	9.71E-05	0.0003046	1
CCDC9	ENSG00000105321	2423.625	1.117536	0.113458	9.849777	6.87E-23	1.67E-21	1
WDR4	ENSG00000160193	1717.781	1.115308	0.121282	9.196023	3.71E-20	7.74E-19	1
RAPH1	ENSG00000173166	2667.429	1.112437	0.136352	8.158553	3.39E-16	4.94E-15	1
DDX21	ENSG00000165732	27243.17	1.111807	0.113438	9.801004	1.11E-22	2.68E-21	1
NBPF12	ENSG00000268043	1516.345	1.108185	0.157584	7.032341	2.03E-12	1.92E-11	1
ZBTB49	ENSG00000168826	541.7816	1.107666	0.144945	7.641994	2.14E-14	2.59E-13	1
GLIS3	ENSG00000107249	5474.799	1.106029	0.127938	8.645014	5.38E-18	9.30E-17	1
CCDC171	ENSG00000164989	552.9271	1.103175	0.143521	7.686508	1.51E-14	1.86E-13	1
METRNL	ENSG00000176845	5388.017	1.103006	0.108111	10.20253	1.93E-24	5.14E-23	1
ALDOA	ENSG00000285043	750.292	1.102904	0.138295	7.97504	1.52E-15	2.08E-14	1
PMM2	ENSG00000140650	1792.255	1.101032	0.095198	11.56573	6.15E-31	2.36E-29	1
ZNF598	ENSG00000167962	6147.472	1.097305	0.098636	11.12482	9.50E-29	3.28E-27	1
NHSL1	ENSG00000135540	1265.461	1.093375	0.130325	8.389572	4.88E-17	7.67E-16	1
NXT1	ENSG00000132661	2207.487	1.09244	0.143515	7.612017	2.70E-14	3.18E-13	1
SNX18	ENSG00000178996	6572.073	1.08974	0.084579	12.88431	5.52E-38	2.99E-36	1
INTS7	ENSG00000143493	6649.961	1.087827	0.075199	14.46592	1.99E-47	1.45E-45	1
SRFBP1	ENSG00000151304	2388.106	1.087446	0.111662	9.738752	2.06E-22	4.87E-21	1
LONP1	ENSG00000196365	11977.12	1.085145	0.083415	13.00901	1.09E-38	5.99E-37	1
ATP2B1	ENSG00000070961	14023	1.084869	0.087833	12.35153	4.78E-35	2.24E-33	1
TGDS	ENSG00000088451	903.773	1.083454	0.167071	6.484981	8.87E-11	7.00E-10	1
PALM2-AK	ENSG00000157654	83669.62	1.0795	0.102721	10.50905	7.85E-26	2.33E-24	1
SLC35G2	ENSG00000168917	824.1643	1.079078	0.159526	6.764268	1.34E-11	1.15E-10	1
GCC1	ENSG00000179562	3727.905	1.079078	0.079623	13.55234	7.67E-42	4.73E-40	1
LETM2	ENSG00000165046	643.9329	1.078161	0.12509	8.61905	6.75E-18	1.15E-16	1
ARL13B	ENSG00000169379	3504.676	1.077829	0.111643	9.654264	4.72E-22	1.10E-20	1
UBC	ENSG00000150991	79716.61	1.074155	0.075313	14.26246	3.75E-46	2.64E-44	1
LONRF1	ENSG00000154359	1884.224	1.073115	0.111504	9.624027	6.33E-22	1.46E-20	1

ZFAND2A	ENSG00000178381	1021.924	1.072937	0.173197	6.19491	5.83E-10	4.18E-09	1
AVPI1	ENSG00000119986	2949.819	1.068522	0.156454	6.82964	8.51E-12	7.42E-11	1
BBC3	ENSG00000105327	756.5016	1.063833	0.155673	6.833773	8.27E-12	7.24E-11	1
EIF1	ENSG00000173812	32918.42	1.063166	0.089157	11.92463	8.81E-33	3.70E-31	1
	ENSG00000290927	728.4626	1.062909	0.142084	7.48083	7.39E-14	8.26E-13	1
NDEL1	ENSG00000166579	5489.423	1.058968	0.097965	10.80971	3.10E-27	1.00E-25	1
NOP14-AS1	ENSG00000249673	1746.392	1.056576	0.135592	7.792311	6.58E-15	8.42E-14	1
ZNF181	ENSG00000197841	998.3478	1.056158	0.162357	6.505147	7.76E-11	6.19E-10	1
ELAC1	ENSG00000141642	538.342	1.046664	0.138265	7.569976	3.73E-14	4.34E-13	1
ARAP2	ENSG00000047365	1574.557	1.045507	0.146852	7.119446	1.08E-12	1.07E-11	1
ZNF26	ENSG00000198393	1571.653	1.0432	0.099415	10.49339	9.26E-26	2.72E-24	1
ZNF829	ENSG00000185869	961.876	1.039639	0.164166	6.332869	2.41E-10	1.81E-09	1
DYRK3	ENSG00000143479	3672.725	1.03502	0.098929	10.46224	1.29E-25	3.71E-24	1
RIPK2	ENSG00000104312	1841.082	1.031309	0.10238	10.07331	7.25E-24	1.88E-22	1
IQCB1	ENSG00000173226	1860.809	1.030346	0.094578	10.89419	1.23E-27	4.09E-26	1
PRKAB1	ENSG00000111725	3057.309	1.028293	0.07816	13.15628	1.57E-39	8.78E-38	1
RGS3	ENSG00000138835	1899.121	1.028018	0.126196	8.146182	3.76E-16	5.45E-15	1
ZNF222	ENSG00000159885	504.5705	1.02657	0.205863	4.986672	6.14E-07	2.87E-06	1
ZNF330	ENSG00000109445	2609.19	1.026436	0.10595	9.687916	3.39E-22	7.92E-21	1
SPSB1	ENSG00000171621	2725.277	1.025285	0.113157	9.060705	1.30E-19	2.59E-18	1
ZNF502	ENSG00000196653	584.6984	1.021899	0.15405	6.633554	3.28E-11	2.73E-10	1
SERTAD1	ENSG00000197019	1713.29	1.021407	0.145615	7.014419	2.31E-12	2.17E-11	1
FILIP1L	ENSG00000168386	24644.44	1.01765	0.10714	9.498285	2.13E-21	4.81E-20	1
ACBD3	ENSG00000182827	6317.011	1.017476	0.086952	11.70159	1.25E-31	4.92E-30	1
PYROXD1	ENSG00000121350	986.4186	1.016608	0.145044	7.008952	2.40E-12	2.25E-11	1
CLTCL1	ENSG00000070371	3502.22	1.012944	0.133176	7.60608	2.83E-14	3.32E-13	1
ZNF583	ENSG00000198440	709.6957	1.012365	0.17686	5.724102	1.04E-08	6.32E-08	1
ARL4A	ENSG00000122644	1640.817	1.010422	0.1553	6.506262	7.70E-11	6.14E-10	1
IL18	ENSG00000150782	2887.104	1.008382	0.125388	8.042088	8.83E-16	1.24E-14	1
BICD1	ENSG00000151746	4009.694	1.007096	0.096453	10.44129	1.61E-25	4.59E-24	1
ZNF674	ENSG00000251192	537.9544	1.00684	0.131242	7.671606	1.70E-14	2.07E-13	1
ZNF324B	ENSG00000249471	662.7565	1.006371	0.12145	8.28629	1.17E-16	1.78E-15	1
ZNF620	ENSG00000177842	585.7382	1.00602	0.153651	6.547449	5.85E-11	4.73E-10	1
MYSM1	ENSG00000162601	3347.853	1.003679	0.134289	7.474002	7.78E-14	8.68E-13	1
HDAC9	ENSG00000048052	1533.648	1.003255	0.34333	2.922129	0.0034765	0.0077422	1
CSGALNAC	ENSG00000169826	5034.69	1.002354	0.109355	9.166034	4.91E-20	1.02E-18	1
RCL1	ENSG00000120158	1619.24	1.000566	0.118856	8.418297	3.82E-17	6.06E-16	1
ETS1	ENSG00000134954	22036.88	0.999565	0.131311	7.612205	2.69E-14	3.18E-13	1
SLC16A1-A	ENSG00000226419	840.1742	0.997865	0.135939	7.340539	2.13E-13	2.27E-12	1
NAT9	ENSG00000109065	3940.518	0.997517	0.081339	12.26373	1.42E-34	6.51E-33	1
GTPBP4	ENSG00000107937	8040.75	0.996939	0.091031	10.95163	6.53E-28	2.19E-26	1
GPR89A	ENSG00000117262	746.6829	0.996909	0.23208	4.295541	1.74E-05	6.35E-05	1
IVNS1ABP	ENSG00000116679	14636.94	0.990827	0.086788	11.41665	3.45E-30	1.29E-28	1
SLC3A2	ENSG00000168003	59228.54	0.990482	0.071177	13.9158	5.08E-44	3.31E-42	1
TIGD6	ENSG00000164296	765.8421	0.989717	0.132403	7.475054	7.72E-14	8.62E-13	1
HSPA13	ENSG00000155304	9300.908	0.986818	0.113712	8.678227	4.02E-18	7.02E-17	1
POLR3C	ENSG00000186141	5462.218	0.985802	0.08172	12.06322	1.65E-33	7.13E-32	1

TRMO	ENSG00000136932	1439.434	0.985364	0.111556	8.832894	1.02E-18	1.87E-17	1
PTPRH	ENSG00000080031	702.5393	0.984912	0.139118	7.079701	1.44E-12	1.39E-11	1
COX19	ENSG00000240230	1492.714	0.983991	0.100728	9.768831	1.53E-22	3.65E-21	1
IARS	ENSG00000196305	28037.53	0.982618	0.082966	11.84366	2.32E-32	9.48E-31	1
JMJD4	ENSG00000081692	505.0076	0.981419	0.162865	6.025954	1.68E-09	1.14E-08	1
ARNTL	ENSG00000133794	1678.365	0.980574	0.115704	8.474861	2.35E-17	3.82E-16	1
NFKBIL1	ENSG00000204498	1405.75	0.980509	0.123871	7.915582	2.46E-15	3.28E-14	1
SPIRE1	ENSG00000134278	9854.159	0.980394	0.078157	12.54389	4.29E-36	2.10E-34	1
SPATA2L	ENSG00000158792	552.136	0.977839	0.186647	5.238972	1.61E-07	8.28E-07	1
URB2	ENSG00000135763	2986.818	0.977291	0.094418	10.35063	4.16E-25	1.15E-23	1
NIFK	ENSG00000155438	3710.044	0.976496	0.113608	8.595293	8.31E-18	1.41E-16	1
INTS6	ENSG00000102786	5670.31	0.975762	0.085657	11.39145	4.61E-30	1.70E-28	1
FEM1C	ENSG00000145780	6900.319	0.974992	0.080938	12.04614	2.03E-33	8.69E-32	1
ZNF827	ENSG00000151612	2617.906	0.974719	0.104322	9.343393	9.33E-21	2.01E-19	1
EIF2S2P4	ENSG00000128692	1827.323	0.97294	0.175436	5.545855	2.93E-08	1.66E-07	1
FHL2	ENSG00000115641	19767.77	0.972577	0.074035	13.13669	2.03E-39	1.13E-37	1
RP9	ENSG00000164610	950.7684	0.971297	0.137809	7.048149	1.81E-12	1.72E-11	1
ZNF777	ENSG00000196453	2515.064	0.971021	0.091269	10.63913	1.96E-26	6.04E-25	1
PUM3	ENSG00000080608	5374.976	0.970733	0.106232	9.137874	6.37E-20	1.31E-18	1
OSBPL6	ENSG00000079156	2480.125	0.970267	0.116436	8.333058	7.88E-17	1.21E-15	1
TNFRSF10A	ENSG00000104689	1635.979	0.968888	0.105006	9.226977	2.78E-20	5.85E-19	1
WDR25	ENSG00000176473	679.2686	0.968814	0.128354	7.547997	4.42E-14	5.08E-13	1
OTUD1	ENSG00000165312	1734.887	0.968469	0.135187	7.163947	7.84E-13	7.91E-12	1
WARS	ENSG00000140105	11630.58	0.967458	0.075997	12.73026	4.02E-37	2.07E-35	1
SH2B3	ENSG00000111252	8319.046	0.966862	0.094257	10.25769	1.09E-24	2.95E-23	1
SGTB	ENSG00000197860	4218.148	0.963407	0.114423	8.419693	3.77E-17	6.00E-16	1
SRGAP2B	ENSG00000196369	979.6663	0.962794	0.220027	4.375789	1.21E-05	4.53E-05	1
CD200	ENSG00000091972	590.2569	0.962713	0.215088	4.47591	7.61E-06	2.96E-05	1
EIF2S2	ENSG00000125977	22328.38	0.962126	0.138291	6.957273	3.47E-12	3.20E-11	1
ZNF280C	ENSG00000056277	793.1266	0.9621	0.123138	7.813183	5.58E-15	7.21E-14	1
HSPA9	ENSG00000113013	49009.62	0.961435	0.079188	12.14112	6.39E-34	2.81E-32	1
ALG2	ENSG00000119523	3037.812	0.958468	0.093092	10.29595	7.35E-25	2.01E-23	1
ING3	ENSG00000071243	2302.719	0.9579	0.096619	9.914235	3.61E-23	8.95E-22	1
FOXD1	ENSG00000251493	2910.164	0.957679	0.117175	8.173071	3.01E-16	4.42E-15	1
ZNF770	ENSG00000198146	5985.356	0.956688	0.103044	9.284277	1.63E-20	3.47E-19	1
CHAC2	ENSG00000143942	629.7863	0.95653	0.166045	5.760651	8.38E-09	5.16E-08	1
PYCR1	ENSG00000183010	5023.645	0.951885	0.095917	9.924081	3.27E-23	8.13E-22	1
CITED2	ENSG00000164442	15479.55	0.951068	0.117403	8.100858	5.46E-16	7.81E-15	1
TIMM44	ENSG00000104980	3548.927	0.950866	0.080021	11.88267	1.46E-32	6.02E-31	1
SIK1B	ENSG00000275993	1062.369	0.950474	0.361563	2.628796	0.0085688	0.017389	1
RIOX2	ENSG00000170854	1724.953	0.948396	0.095525	9.928254	3.14E-23	7.82E-22	1
DCUN1D3	ENSG00000188215	1107.435	0.947957	0.107751	8.797688	1.40E-18	2.54E-17	1
ZNF587B	ENSG00000269343	1714.833	0.946284	0.165883	5.704531	1.17E-08	7.04E-08	1
ZNF783	ENSG00000204946	942.5547	0.945921	0.131195	7.210016	5.59E-13	5.76E-12	1
BCAR3	ENSG00000137936	9051.345	0.945841	0.104536	9.047993	1.46E-19	2.88E-18	1
SLC6A9	ENSG00000196517	2688.432	0.94445	0.115545	8.173872	2.99E-16	4.40E-15	1
RGMB-AS1	ENSG00000246763	917.5762	0.944229	0.174976	5.396332	6.80E-08	3.69E-07	1

CACNB1	ENSG00000067191	1591.894	0.942687	0.149848	6.290957	3.16E-10	2.34E-09	1
ALPK2	ENSG00000198796	755.8388	0.941182	0.152022	6.191091	5.97E-10	4.28E-09	1
ZCCHC7	ENSG00000147905	1945.017	0.940444	0.126788	7.417438	1.19E-13	1.31E-12	1
TARS	ENSG00000113407	20748.12	0.939675	0.09344	10.05648	8.60E-24	2.22E-22	1
EPHA2	ENSG00000142627	13731.5	0.939638	0.131806	7.128951	1.01E-12	1.00E-11	1
RNF19B	ENSG00000116514	3059.896	0.93926	0.1118	8.401275	4.42E-17	6.97E-16	1
NOP58	ENSG00000055044	6226.193	0.937693	0.123048	7.620556	2.53E-14	3.01E-13	1
SLC43A3	ENSG00000134802	5819.263	0.936398	0.102948	9.09584	9.39E-20	1.90E-18	1
NMD3	ENSG00000169251	4545.656	0.935843	0.126824	7.379087	1.59E-13	1.72E-12	1
TIMM9	ENSG00000100575	1459.151	0.935288	0.132863	7.039506	1.93E-12	1.82E-11	1
INO80	ENSG00000128908	5544.823	0.935242	0.080352	11.63929	2.60E-31	1.01E-29	1
MIS12	ENSG00000167842	4237.114	0.933542	0.091754	10.17434	2.58E-24	6.83E-23	1
POLR3F	ENSG00000132664	2783.463	0.92877	0.113546	8.179683	2.85E-16	4.20E-15	1
BACH1	ENSG00000156273	6901.901	0.928687	0.10909	8.513053	1.69E-17	2.80E-16	1
BET1L	ENSG00000177951	3842.15	0.927599	0.098958	9.373692	7.00E-21	1.52E-19	1
GORAB	ENSG00000120370	987.2039	0.92716	0.111719	8.299057	1.05E-16	1.60E-15	1
GAS2L3	ENSG00000139354	7822.129	0.925131	0.105753	8.748039	2.17E-18	3.88E-17	1
C10orf88	ENSG00000119965	2010.197	0.925099	0.096697	9.567011	1.10E-21	2.51E-20	1
AARS	ENSG00000090861	24513.79	0.924037	0.094968	9.730009	2.25E-22	5.28E-21	1
KANSL2	ENSG00000139620	2947.066	0.920289	0.117152	7.855496	3.98E-15	5.23E-14	1
MAK16	ENSG00000198042	2356.781	0.919986	0.132296	6.953994	3.55E-12	3.26E-11	1
LARP1B	ENSG00000138709	2372.138	0.918832	0.108349	8.480265	2.25E-17	3.65E-16	1
TP53BP2	ENSG00000143514	8483.737	0.918532	0.068135	13.48107	2.02E-41	1.22E-39	1
XPC	ENSG00000154767	3672.598	0.917683	0.096704	9.489589	2.32E-21	5.22E-20	1
PHLDB3	ENSG00000176531	930.7369	0.916974	0.118135	7.762064	8.36E-15	1.06E-13	1
ZNF787	ENSG00000142409	2231.785	0.916122	0.096959	9.448588	3.43E-21	7.62E-20	1
UHRF1BP1	ENSG00000065060	6900.955	0.91574	0.119218	7.681246	1.58E-14	1.93E-13	1
USP37	ENSG00000135913	4412.785	0.913384	0.088919	10.27208	9.42E-25	2.56E-23	1
CCDC59	ENSG00000133773	2288.711	0.91127	0.15438	5.90277	3.57E-09	2.31E-08	1
FRMD5	ENSG00000171877	6321.304	0.911232	0.104511	8.719032	2.81E-18	4.95E-17	1
OSBP2	ENSG00000184792	2633.925	0.911037	0.129015	7.061509	1.65E-12	1.57E-11	1
TMEM263	ENSG00000151135	8404.659	0.910807	0.119907	7.595973	3.05E-14	3.58E-13	1
COQ10B	ENSG00000115520	3364.727	0.908777	0.128362	7.079782	1.44E-12	1.39E-11	1
ADORA2B	ENSG00000170425	4337.463	0.908276	0.100321	9.053716	1.38E-19	2.75E-18	1
SH2D5	ENSG00000189410	5128.123	0.907063	0.126232	7.185696	6.69E-13	6.81E-12	1
ATG101	ENSG00000123395	2738.955	0.906404	0.105232	8.613362	7.09E-18	1.21E-16	1
SRSF7	ENSG00000115875	16013.92	0.905387	0.094682	9.562382	1.15E-21	2.62E-20	1
DUSP12	ENSG00000081721	1418.631	0.903821	0.131002	6.899286	5.23E-12	4.67E-11	1
DHX34	ENSG00000134815	2092.304	0.90107	0.144601	6.231417	4.62E-10	3.35E-09	1
SUPV3L1	ENSG00000156502	2802.032	0.900284	0.084161	10.69715	1.05E-26	3.31E-25	1
INTS12	ENSG00000138785	1199.125	0.900171	0.136053	6.616313	3.68E-11	3.05E-10	1
IRAK2	ENSG00000134070	557.8411	0.899816	0.12769	7.046903	1.83E-12	1.74E-11	1
SRSF6	ENSG00000124193	16808.79	0.897928	0.097998	9.16276	5.06E-20	1.05E-18	1
ZSWIM6	ENSG00000130449	12482.1	0.897736	0.097538	9.203938	3.45E-20	7.21E-19	1
ZXDA	ENSG00000198205	550.5523	0.897528	0.135707	6.613727	3.75E-11	3.10E-10	1
ZNF513	ENSG00000163795	1310.773	0.89694	0.113378	7.911088	2.55E-15	3.40E-14	1
TRIM35	ENSG00000104228	2881.429	0.89672	0.079001	11.35068	7.36E-30	2.69E-28	1

TSTD2	ENSG00000136925	1765.508	0.896335	0.107032	8.374469	5.55E-17	8.71E-16	1
SEC24A	ENSG00000113615	7539.195	0.89629	0.09233	9.707461	2.80E-22	6.57E-21	1
C1orf109	ENSG00000116922	2896.066	0.895773	0.12028	7.447398	9.52E-14	1.05E-12	1
NCOA7	ENSG00000111912	4016.737	0.895303	0.083715	10.69469	1.08E-26	3.38E-25	1
KRCC1	ENSG00000172086	2351.733	0.894872	0.186815	4.790151	1.67E-06	7.33E-06	1
LRRC37B	ENSG00000185158	1051.647	0.892688	0.115176	7.750647	9.14E-15	1.15E-13	1
CDC42EP1	ENSG00000128283	7895.432	0.89225	0.106677	8.364047	6.06E-17	9.44E-16	1
IFI16	ENSG00000163565	7550.876	0.892005	0.114364	7.799717	6.20E-15	7.98E-14	1
MKRN2	ENSG00000075975	2050.463	0.891918	0.086777	10.27829	8.83E-25	2.41E-23	1
LRIF1	ENSG00000121931	2097.08	0.891515	0.150741	5.914217	3.33E-09	2.17E-08	1
ANKRD50	ENSG00000151458	7318.635	0.888993	0.113441	7.836609	4.63E-15	6.05E-14	1
KRT17	ENSG00000128422	10866.35	0.886213	0.14595	6.072038	1.26E-09	8.67E-09	1
CLBA1	ENSG00000140104	797.4937	0.885686	0.145068	6.105315	1.03E-09	7.11E-09	1
HYOU1	ENSG00000149428	16745.98	0.884987	0.072172	12.26214	1.45E-34	6.61E-33	1
OXNAD1	ENSG00000154814	1034.19	0.884887	0.134548	6.57672	4.81E-11	3.93E-10	1
TRIM39	ENSG00000204599	1156.39	0.88394	0.104312	8.473984	2.37E-17	3.84E-16	1
NOL8	ENSG00000198000	5818.628	0.882685	0.081663	10.80887	3.12E-27	1.01E-25	1
RIOK1	ENSG00000124784	2165.094	0.882528	0.117438	7.514835	5.70E-14	6.48E-13	1
PISD	ENSG00000241878	3579.217	0.882333	0.100207	8.805082	1.31E-18	2.38E-17	1
LATS2	ENSG00000150457	6989.157	0.881349	0.09483	9.293984	1.49E-20	3.18E-19	1
REXO5	ENSG00000005189	1620.927	0.881096	0.109357	8.057041	7.82E-16	1.10E-14	1
CCSER2	ENSG00000107771	11361.42	0.880332	0.082572	10.66144	1.54E-26	4.78E-25	1
PAK1IP1	ENSG00000111845	2651.066	0.880263	0.154422	5.700374	1.20E-08	7.20E-08	1
PHC2	ENSG00000134686	12113.9	0.879902	0.110561	7.958519	1.74E-15	2.36E-14	1
PDRG1	ENSG00000088356	3671.708	0.879879	0.122291	7.194953	6.25E-13	6.39E-12	1
PLAUR	ENSG00000011422	3021.686	0.878488	0.085675	10.25378	1.14E-24	3.06E-23	1
MEX3C	ENSG00000176624	4763.03	0.877016	0.081985	10.69734	1.05E-26	3.31E-25	1
CSRNP2	ENSG00000110925	4456.894	0.876693	0.084681	10.35284	4.06E-25	1.13E-23	1
03-Mar	ENSG00000173926	2921.552	0.876102	0.10105	8.669991	4.32E-18	7.53E-17	1
MITF	ENSG00000187098	1170.607	0.872688	0.105187	8.29654	1.07E-16	1.64E-15	1
MBD1	ENSG00000141644	10245.42	0.870468	0.083107	10.47402	1.14E-25	3.32E-24	1
YRDC	ENSG00000196449	1127.462	0.869521	0.106434	8.169615	3.09E-16	4.53E-15	1
SLC31A1	ENSG00000136868	7255.467	0.868177	0.102076	8.505161	1.81E-17	2.99E-16	1
COA7	ENSG00000162377	4709.052	0.867781	0.099065	8.759745	1.96E-18	3.50E-17	1
MAP3K14	ENSG00000006062	1620.239	0.867712	0.137953	6.289895	3.18E-10	2.35E-09	1
BCL6	ENSG00000113916	836.9366	0.867177	0.14497	5.981778	2.21E-09	1.47E-08	1
VCPKMT	ENSG00000100483	668.2641	0.865401	0.131753	6.56836	5.09E-11	4.14E-10	1
NBPF11	ENSG00000263956	1166.699	0.86532	0.174163	4.96846	6.75E-07	3.14E-06	1
FANCE	ENSG00000112039	2559.605	0.86443	0.103449	8.356074	6.48E-17	1.01E-15	1
GTF2H2C	ENSG00000183474	1051.567	0.863622	0.220942	3.908818	9.27E-05	0.0002921	1
TRMT6	ENSG00000089195	4944.522	0.863399	0.101539	8.503116	1.85E-17	3.04E-16	1
STK38L	ENSG00000211455	2578.474	0.862134	0.098765	8.72913	2.57E-18	4.55E-17	1
DNAJB5	ENSG00000137094	2616.758	0.862058	0.109989	7.837664	4.59E-15	6.01E-14	1
NRG1	ENSG00000157168	894.8183	0.861646	0.147532	5.840406	5.21E-09	3.29E-08	1
ZNF584	ENSG00000171574	1886.573	0.860348	0.098847	8.703835	3.21E-18	5.64E-17	1
FST	ENSG00000134363	1040.528	0.859295	0.150667	5.703261	1.18E-08	7.09E-08	1
DDX28	ENSG00000182810	1105.175	0.857538	0.111423	7.696256	1.40E-14	1.73E-13	1

ZFAND1	ENSG00000104231	1741.654	0.856723	0.115551	7.414222	1.22E-13	1.34E-12	1
ZBED9	ENSG00000232040	621.4728	0.856342	0.146988	5.825936	5.68E-09	3.58E-08	1
PELI1	ENSG00000197329	1856.476	0.854422	0.104616	8.167225	3.16E-16	4.61E-15	1
RELT	ENSG00000054967	1362.113	0.85424	0.127515	6.69912	2.10E-11	1.77E-10	1
DNAJC25	ENSG00000059769	922.3281	0.854102	0.142087	6.01112	1.84E-09	1.24E-08	1
BRPF1	ENSG00000156983	4154.784	0.852309	0.093384	9.126968	7.04E-20	1.44E-18	1
RTL5	ENSG00000242732	841.5293	0.850236	0.161651	5.259692	1.44E-07	7.47E-07	1
DUS3L	ENSG00000141994	1141.752	0.849939	0.127289	6.677246	2.43E-11	2.04E-10	1
BTBD19	ENSG00000222009	571.0036	0.84987	0.24312	3.495681	0.0004729	0.0012856	1
TRNT1	ENSG00000072756	2645.944	0.848758	0.088161	9.627321	6.13E-22	1.42E-20	1
EREG	ENSG00000124882	1624.919	0.84785	0.210804	4.021982	5.77E-05	0.0001891	1
FOSL2	ENSG00000075426	23672.76	0.847473	0.096712	8.762879	1.90E-18	3.41E-17	1
PPP2R5B	ENSG00000068971	2941.22	0.847461	0.094407	8.976685	2.79E-19	5.43E-18	1
ATAD3B	ENSG00000160072	2187.375	0.847073	0.139569	6.069196	1.29E-09	8.81E-09	1
RIOK2	ENSG00000058729	3842.176	0.84632	0.125423	6.747748	1.50E-11	1.28E-10	1
MICAL2	ENSG00000133816	19044.66	0.845732	0.131393	6.436662	1.22E-10	9.47E-10	1
PXK	ENSG00000168297	1830.127	0.843489	0.113042	7.461706	8.54E-14	9.49E-13	1
GTPBP10	ENSG00000105793	2136.321	0.842765	0.095255	8.847427	8.96E-19	1.65E-17	1
ZNF324	ENSG00000083812	1579.409	0.842386	0.118738	7.094494	1.30E-12	1.27E-11	1
TOP1	ENSG00000198900	15644.22	0.84181	0.120588	6.980881	2.93E-12	2.73E-11	1
POGK	ENSG00000143157	7943.901	0.840881	0.080353	10.46481	1.25E-25	3.63E-24	1
GOSR2	ENSG00000108433	4130.903	0.840439	0.093317	9.006325	2.13E-19	4.19E-18	1
FAM53C	ENSG00000120709	11020.93	0.838247	0.078538	10.67318	1.36E-26	4.23E-25	1
MAGOHB	ENSG00000111196	1857.84	0.837422	0.125864	6.653399	2.86E-11	2.40E-10	1
SLC25A38	ENSG00000144659	2834.907	0.837346	0.084254	9.938381	2.83E-23	7.12E-22	1
ZNF568	ENSG00000198453	559.8358	0.837326	0.14757	5.674103	1.39E-08	8.32E-08	1
PLCB4	ENSG00000101333	4538.988	0.836157	0.099276	8.42258	3.68E-17	5.86E-16	1
BRD2	ENSG00000204256	22153.97	0.83393	0.078481	10.62591	2.26E-26	6.87E-25	1
ZNF416	ENSG00000083817	698.6065	0.83308	0.162456	5.128053	2.93E-07	1.44E-06	1
ZNF131	ENSG00000172262	4884.163	0.833043	0.091311	9.123165	7.30E-20	1.49E-18	1
NIT1	ENSG00000158793	1804.992	0.831912	0.123613	6.729978	1.70E-11	1.44E-10	1
RALA	ENSG00000006451	13313.73	0.831539	0.131571	6.320071	2.61E-10	1.96E-09	1
CCNL1	ENSG00000163660	6473.342	0.830542	0.128651	6.455764	1.08E-10	8.38E-10	1
SH3RF2	ENSG00000156463	1800.957	0.830158	0.17839	4.653611	3.26E-06	1.36E-05	1
SDE2	ENSG00000143751	4271.418	0.830114	0.097595	8.505702	1.81E-17	2.98E-16	1
LYAR	ENSG00000145220	1952.142	0.829827	0.132055	6.283933	3.30E-10	2.44E-09	1
ZHX2	ENSG00000178764	1512.621	0.829772	0.137138	6.050616	1.44E-09	9.85E-09	1
ZBED3	ENSG00000132846	2290.808	0.829269	0.119715	6.927039	4.30E-12	3.91E-11	1
SPHK1	ENSG00000176170	7367.484	0.828753	0.089963	9.212183	3.20E-20	6.69E-19	1
LENG1	ENSG00000105617	815.3629	0.828697	0.151353	5.475253	4.37E-08	2.42E-07	1
TBL2	ENSG00000106638	3498.931	0.826867	0.09652	8.566777	1.06E-17	1.79E-16	1
SOCS3	ENSG00000184557	2307.358	0.825649	0.154872	5.331155	9.76E-08	5.16E-07	1
	ENSG00000291087	757.4244	0.82321	0.114429	7.19408	6.29E-13	6.42E-12	1
NSRP1	ENSG00000126653	4255.482	0.823175	0.092264	8.921998	4.58E-19	8.65E-18	1
ADM	ENSG00000148926	4514.338	0.823165	0.080454	10.2315	1.43E-24	3.82E-23	1
F3	ENSG00000117525	13650.19	0.821925	0.177754	4.623955	3.76E-06	1.56E-05	1
BYSL	ENSG00000112578	2820.128	0.82173	0.095697	8.586754	8.95E-18	1.51E-16	1

HKR1	ENSG00000181666	2365.074	0.820972	0.091409	8.981253	2.68E-19	5.22E-18	1
TWNK	ENSG00000107815	1997.175	0.820954	0.106991	7.67311	1.68E-14	2.05E-13	1
FAM131A	ENSG00000175182	1695.208	0.820723	0.104995	7.816799	5.42E-15	7.05E-14	1
MTO1	ENSG00000135297	2489.649	0.820633	0.101706	8.068691	7.11E-16	1.00E-14	1
GZF1	ENSG00000125812	4482.044	0.820346	0.075644	10.84484	2.11E-27	6.91E-26	1
ARHGEF5	ENSG00000050327	614.9699	0.819693	0.181278	4.521751	6.13E-06	2.44E-05	1
PIM1	ENSG00000137193	2032.23	0.819276	0.20718	3.954419	7.67E-05	0.0002454	1
ZNF419	ENSG00000105136	839.4179	0.818887	0.121026	6.76621	1.32E-11	1.13E-10	1
SIAH1	ENSG00000196470	827.0082	0.818019	0.114942	7.116768	1.10E-12	1.09E-11	1
MIR22HG	ENSG00000186594	3515.076	0.817016	0.113526	7.196726	6.17E-13	6.32E-12	1
BRPF3	ENSG00000096070	7343.268	0.816054	0.089228	9.145687	5.93E-20	1.22E-18	1
CDCP1	ENSG00000163814	7476.438	0.815443	0.133343	6.115393	9.63E-10	6.70E-09	1
OCLN	ENSG00000197822	3397.139	0.815219	0.126773	6.430554	1.27E-10	9.85E-10	1
ZNF800	ENSG00000048405	3059.42	0.813649	0.111315	7.309444	2.68E-13	2.84E-12	1
BNC1	ENSG00000169594	12661.73	0.81282	0.076018	10.69252	1.10E-26	3.45E-25	1
GOLGA5	ENSG00000066455	5167.468	0.812266	0.100309	8.097633	5.60E-16	7.98E-15	1
MICU3	ENSG00000155970	773.3153	0.810639	0.132996	6.095234	1.09E-09	7.55E-09	1
SIK3	ENSG00000160584	4004.174	0.809933	0.113143	7.158504	8.16E-13	8.19E-12	1
VPS37A	ENSG00000155975	3272.125	0.809302	0.088633	9.130967	6.79E-20	1.39E-18	1
RPL22L1	ENSG00000163584	1257.492	0.80838	0.122264	6.611736	3.80E-11	3.14E-10	1
EVC2	ENSG00000173040	1032.453	0.808053	0.109238	7.397193	1.39E-13	1.51E-12	1
ABL1	ENSG00000097007	17184.22	0.807842	0.077796	10.38411	2.93E-25	8.25E-24	1
MED8	ENSG00000159479	2988.303	0.807194	0.105745	7.633428	2.29E-14	2.75E-13	1
MOCS3	ENSG00000124217	1808.361	0.806673	0.093483	8.629107	6.18E-18	1.06E-16	1
ZNF18	ENSG00000154957	534.8006	0.806014	0.131323	6.137664	8.37E-10	5.87E-09	1
UTP4	ENSG00000141076	6629.484	0.805707	0.078748	10.2315	1.43E-24	3.82E-23	1
SNHG11	ENSG00000174365	1233.171	0.80512	0.129078	6.237486	4.45E-10	3.23E-09	1
GEMIN2	ENSG00000092208	1155.351	0.80501	0.178107	4.519814	6.19E-06	2.46E-05	1
CGAS	ENSG00000164430	2542.409	0.804872	0.09866	8.15802	3.41E-16	4.95E-15	1
SDCCAG8	ENSG00000054282	1317.028	0.803478	0.118639	6.772456	1.27E-11	1.09E-10	1
RPS6KL1	ENSG00000198208	1137.346	0.803033	0.126798	6.33315	2.40E-10	1.81E-09	1
ORAOV1	ENSG00000149716	1919.481	0.801814	0.096067	8.346405	7.04E-17	1.09E-15	1
TBCK	ENSG00000145348	1016.917	0.80081	0.125463	6.382816	1.74E-10	1.33E-09	1
DAPK3	ENSG00000167657	7506.948	0.800739	0.092168	8.687848	3.69E-18	6.47E-17	1
MEF2A	ENSG00000068305	5596.107	0.800574	0.095357	8.395587	4.64E-17	7.30E-16	1
ZNF621	ENSG00000172888	4875.581	0.800352	0.099148	8.072311	6.90E-16	9.79E-15	1
SETD4	ENSG00000185917	1351.555	0.799982	0.105571	7.577664	3.52E-14	4.10E-13	1
CHD2	ENSG00000173575	11835.18	0.7999	0.116334	6.875882	6.16E-12	5.48E-11	1
RAB23	ENSG00000112210	3491.039	0.799824	0.1229	6.507944	7.62E-11	6.08E-10	1
FAM210A	ENSG00000177150	3717.341	0.799396	0.136826	5.842433	5.14E-09	3.27E-08	1
UGDH	ENSG00000109814	3812.94	0.799384	0.118874	6.724642	1.76E-11	1.49E-10	1
C6orf132	ENSG00000188112	4053.493	0.798644	0.100159	7.973746	1.54E-15	2.10E-14	1
ADAMTS16	ENSG00000145536	1250.191	0.797732	0.125888	6.336831	2.35E-10	1.77E-09	1
ZNF121	ENSG00000197961	2088.547	0.797669	0.089502	8.912334	5.00E-19	9.35E-18	1
SFXN2	ENSG00000156398	892.7428	0.797647	0.17603	4.531319	5.86E-06	2.34E-05	1
NUFIP1	ENSG00000083635	1801.859	0.797413	0.114911	6.939394	3.94E-12	3.60E-11	1
EIF4EBP1	ENSG00000187840	4973.414	0.797384	0.091736	8.692142	3.56E-18	6.25E-17	1

ADAM17	ENSG00000151694	7000.799	0.796302	0.087636	9.086462	1.02E-19	2.06E-18	1
CDC6	ENSG00000094804	18134.82	0.79612	0.084204	9.454625	3.24E-21	7.23E-20	1
KRBOX4	ENSG00000147121	914.4111	0.795493	0.134001	5.93647	2.91E-09	1.91E-08	1
HSPA14	ENSG00000284024	4263.502	0.795482	0.09031	8.808396	1.27E-18	2.32E-17	1
SGF29	ENSG00000176476	1119.603	0.795072	0.120438	6.601502	4.07E-11	3.35E-10	1
NBPF9	ENSG00000269713	3947.355	0.7947	0.152085	5.225358	1.74E-07	8.87E-07	1
MYNN	ENSG00000085274	1600.635	0.794694	0.116913	6.797325	1.07E-11	9.22E-11	1
CDC37L1	ENSG00000106993	1347.177	0.793937	0.154509	5.138436	2.77E-07	1.37E-06	1
INPP1	ENSG00000151689	3282.37	0.792191	0.090047	8.797494	1.40E-18	2.54E-17	1
TOX2	ENSG00000124191	2256.29	0.792056	0.085698	9.242433	2.41E-20	5.08E-19	1
LINS1	ENSG00000140471	1317.554	0.791825	0.104694	7.563227	3.93E-14	4.55E-13	1
AC118549.	ENSG00000036549	6996.909	0.790856	0.100284	7.886163	3.12E-15	4.13E-14	1
METTL6	ENSG00000206562	2095.857	0.790556	0.100538	7.863218	3.74E-15	4.93E-14	1
MID1IP1	ENSG00000165175	7128.89	0.79001	0.131209	6.020991	1.73E-09	1.17E-08	1
CDV3	ENSG00000091527	33316.18	0.789697	0.106732	7.398911	1.37E-13	1.50E-12	1
MARK3	ENSG00000075413	8666.377	0.789637	0.079526	9.929288	3.10E-23	7.76E-22	1
ZNF75A	ENSG00000162086	1571.397	0.789332	0.110941	7.114889	1.12E-12	1.10E-11	1
ATXN2L	ENSG00000168488	17573.2	0.788952	0.133502	5.909647	3.43E-09	2.22E-08	1
CRCP	ENSG00000241258	3570.837	0.788872	0.088828	8.880871	6.63E-19	1.23E-17	1
NOC3L	ENSG00000173145	3961.757	0.78696	0.121702	6.466268	1.00E-10	7.87E-10	1
MIR503HG	ENSG00000223749	1051.252	0.786721	0.218115	3.606903	0.0003099	0.0008771	1
AKIRIN1	ENSG00000174574	4925.24	0.786691	0.107928	7.289023	3.12E-13	3.29E-12	1
ZNF805	ENSG00000204524	880.8297	0.786607	0.158855	4.951744	7.36E-07	3.39E-06	1
KPNA4	ENSG00000186432	14815.71	0.78588	0.100908	7.788117	6.80E-15	8.68E-14	1
RNF19A	ENSG00000034677	7265.007	0.785176	0.090824	8.645044	5.38E-18	9.30E-17	1
DLG4	ENSG00000132535	2065.648	0.785058	0.149389	5.255138	1.48E-07	7.64E-07	1
SRP19	ENSG00000153037	1922.185	0.784851	0.1028	7.63475	2.26E-14	2.72E-13	1
TP53RK	ENSG00000172315	2723.097	0.78484	0.121382	6.465854	1.01E-10	7.89E-10	1
SERP1	ENSG00000120742	8615.202	0.784485	0.092662	8.466063	2.54E-17	4.11E-16	1
MUS81	ENSG00000172732	3329.694	0.784346	0.078805	9.953	2.45E-23	6.22E-22	1
ZNF484	ENSG00000127081	709.7031	0.784299	0.144407	5.431155	5.60E-08	3.07E-07	1
NR4A1	ENSG00000123358	601.7106	0.784048	0.175958	4.455877	8.36E-06	3.23E-05	1
CCDC130	ENSG00000104957	1607.68	0.784034	0.138057	5.679043	1.35E-08	8.10E-08	1
RNF25	ENSG00000163481	2583.521	0.782321	0.095188	8.21869	2.06E-16	3.09E-15	1
ZKSCAN7	ENSG00000196345	568.6115	0.782079	0.127491	6.134377	8.55E-10	5.97E-09	1
MAP1B	ENSG00000131711	59059.56	0.780107	0.139854	5.57801	2.43E-08	1.40E-07	1
AKNA	ENSG00000106948	1191.685	0.779392	0.114012	6.83608	8.14E-12	7.15E-11	1
LRIG3	ENSG00000139263	2433.555	0.779346	0.12927	6.028803	1.65E-09	1.12E-08	1
FAM83G	ENSG00000188522	6142.708	0.779287	0.092491	8.425564	3.59E-17	5.73E-16	1
DLEU2	ENSG00000231607	529.3727	0.777781	0.192986	4.030252	5.57E-05	0.0001836	1
OTUD6B	ENSG00000155100	1967.272	0.777744	0.125961	6.174477	6.64E-10	4.72E-09	1
CITED4	ENSG00000179862	607.4802	0.776391	0.18519	4.192394	2.76E-05	9.60E-05	1
RBAK	ENSG00000146587	2557.893	0.775856	0.111094	6.983795	2.87E-12	2.68E-11	1
RSRC2	ENSG00000111011	7886.315	0.775798	0.104018	7.458287	8.77E-14	9.73E-13	1
KLF6	ENSG00000067082	28314.14	0.775657	0.102257	7.585352	3.32E-14	3.87E-13	1
GDAP2	ENSG00000196505	1505.83	0.775363	0.099927	7.759284	8.54E-15	1.08E-13	1
ZNF529	ENSG00000186020	1678.83	0.774954	0.096991	7.989965	1.35E-15	1.86E-14	1

ZNF134	ENSG00000213762	2571.271	0.774308	0.099117	7.812065	5.63E-15	7.27E-14	1
TMEM161	ENSG00000164180	2361.679	0.773673	0.100041	7.733554	1.05E-14	1.30E-13	1
ZBTB17	ENSG00000116809	2570.329	0.773559	0.103039	7.507427	6.03E-14	6.85E-13	1
TXNL4B	ENSG00000140830	1901.352	0.773252	0.12988	5.953607	2.62E-09	1.73E-08	1
RRN3	ENSG00000085721	4711.205	0.773099	0.11036	7.005223	2.47E-12	2.30E-11	1
TRIM36	ENSG00000152503	610.3867	0.77255	0.146583	5.270398	1.36E-07	7.07E-07	1
ZNF197	ENSG00000186448	2736.735	0.772336	0.108678	7.10668	1.19E-12	1.17E-11	1
ZNF766	ENSG00000196214	1827.835	0.772322	0.091037	8.483644	2.18E-17	3.56E-16	1
TRMT61A	ENSG00000166166	2283.386	0.771842	0.097835	7.889246	3.04E-15	4.04E-14	1
BHLHE40	ENSG00000134107	7954.655	0.770012	0.155245	4.959971	7.05E-07	3.27E-06	1
ORC5	ENSG00000164815	2482.399	0.769761	0.110273	6.980495	2.94E-12	2.73E-11	1
RIMKLB	ENSG00000166532	3600.042	0.769729	0.110687	6.954088	3.55E-12	3.26E-11	1
GOT1	ENSG00000120053	8859.197	0.768511	0.083019	9.257074	2.10E-20	4.44E-19	1
RUSC2	ENSG00000198853	8079.284	0.767321	0.122048	6.287042	3.24E-10	2.39E-09	1
NT5C3A	ENSG00000122643	2157.051	0.765815	0.131115	5.840799	5.20E-09	3.29E-08	1
SYVN1	ENSG00000162298	4708.654	0.765196	0.116273	6.581012	4.67E-11	3.82E-10	1
MIA3	ENSG00000154305	7881.162	0.762999	0.078015	9.780199	1.37E-22	3.27E-21	1
RAB32	ENSG00000118508	9948.604	0.762964	0.133471	5.716335	1.09E-08	6.60E-08	1
MTRR	ENSG00000124275	3094.834	0.762923	0.08926	8.547171	1.26E-17	2.11E-16	1
ZBTB2	ENSG00000181472	2862.195	0.762591	0.105707	7.214186	5.43E-13	5.60E-12	1
C5orf51	ENSG00000205765	7608.282	0.762382	0.089439	8.524001	1.54E-17	2.56E-16	1
RMND1	ENSG00000155906	2071.149	0.762087	0.098071	7.77074	7.80E-15	9.89E-14	1
DCLK2	ENSG00000170390	1571.761	0.760927	0.159155	4.781052	1.74E-06	7.65E-06	1
NARS	ENSG00000134440	16252.5	0.760572	0.076588	9.930719	3.06E-23	7.67E-22	1
AFTPH	ENSG00000119844	3716.436	0.760217	0.084288	9.019282	1.89E-19	3.74E-18	1
TBRG1	ENSG00000154144	2318.481	0.760214	0.101566	7.484958	7.16E-14	8.01E-13	1
CRY1	ENSG00000008405	5198.479	0.759238	0.084245	9.012299	2.02E-19	3.97E-18	1
ZNF263	ENSG00000006194	1301.158	0.758637	0.109572	6.923662	4.40E-12	3.99E-11	1
ZNF146	ENSG00000167635	8153.322	0.758534	0.095487	7.943826	1.96E-15	2.64E-14	1
	ENSG00000291136	1381.583	0.758115	0.174179	4.3525	1.35E-05	4.99E-05	1
RNF24	ENSG00000101236	3941.307	0.757123	0.099291	7.625313	2.43E-14	2.91E-13	1
ZNF316	ENSG00000205903	3998.383	0.757044	0.12867	5.883612	4.01E-09	2.59E-08	1
HSPBAP1	ENSG00000169087	978.7633	0.756635	0.120501	6.279083	3.41E-10	2.52E-09	1
GLRX2	ENSG00000023572	2955.647	0.756194	0.093641	8.075419	6.72E-16	9.56E-15	1
LINC01578	ENSG00000272888	1834.621	0.756154	0.121499	6.22355	4.86E-10	3.51E-09	1
PIP5K1A	ENSG00000143398	11475.14	0.754716	0.076475	9.868727	5.69E-23	1.40E-21	1
RNF138	ENSG00000134758	3236.611	0.754255	0.116804	6.457443	1.06E-10	8.31E-10	1
DNAJA3	ENSG00000103423	5373.964	0.753959	0.08454	8.918337	4.73E-19	8.93E-18	1
NDUFAF4	ENSG00000123545	932.6166	0.753923	0.122043	6.177536	6.51E-10	4.63E-09	1
NEAT1	ENSG00000245532	32175.35	0.753485	0.307055	2.45391	0.0141313	0.0271015	1
MEG3	ENSG00000214548	998.6538	0.751644	0.233609	3.217534	0.001293	0.0031925	1
ZRANB3	ENSG00000121988	625.0364	0.751546	0.151444	4.962523	6.96E-07	3.23E-06	1
ABTB2	ENSG00000166016	3761.477	0.750789	0.107021	7.015322	2.29E-12	2.15E-11	1
KLF16	ENSG00000129911	1785.564	0.75005	0.14453	5.189596	2.11E-07	1.06E-06	1
AC138932.	ENSG00000183458	640.3549	0.746494	0.21919	3.405693	0.00066	0.0017363	1
TFB2M	ENSG00000162851	1377.72	0.746167	0.109171	6.834831	8.21E-12	7.20E-11	1
DDX31	ENSG00000125485	1490.081	0.745909	0.10524	7.08768	1.36E-12	1.32E-11	1

AZIN1	ENSG00000155096	16427.14	0.745422	0.100527	7.415124	1.22E-13	1.33E-12	1
FAM208B	ENSG00000108021	12570.7	0.745108	0.096327	7.735187	1.03E-14	1.28E-13	1
PITHD1	ENSG00000057757	4125.569	0.744781	0.08458	8.805639	1.30E-18	2.38E-17	1
POLR3E	ENSG00000058600	2021.344	0.744688	0.09304	8.003976	1.20E-15	1.67E-14	1
NANP	ENSG00000170191	2679.315	0.744625	0.124379	5.986758	2.14E-09	1.43E-08	1
UTP15	ENSG00000164338	3712.442	0.743396	0.09919	7.494647	6.65E-14	7.49E-13	1
HIVEP1	ENSG00000095951	3057.224	0.743032	0.125364	5.927011	3.08E-09	2.01E-08	1
AP1AR	ENSG00000138660	2657.618	0.742524	0.09914	7.489674	6.90E-14	7.74E-13	1
NTMT1	ENSG00000148335	1919.378	0.741951	0.132717	5.590464	2.26E-08	1.31E-07	1
FHL3	ENSG00000183386	2033.255	0.741685	0.129567	5.724332	1.04E-08	6.31E-08	1
SRPRB	ENSG00000144867	3403.419	0.741534	0.148675	4.987613	6.11E-07	2.86E-06	1
NBPF1	ENSG00000219481	5195.156	0.740904	0.130609	5.672671	1.41E-08	8.38E-08	1
HIVEP2	ENSG00000010818	3679.263	0.740176	0.088456	8.367727	5.87E-17	9.16E-16	1
TMEM136	ENSG00000181264	1326.312	0.738988	0.119933	6.161678	7.20E-10	5.08E-09	1
EAF1	ENSG00000144597	2065.339	0.738672	0.103743	7.120235	1.08E-12	1.06E-11	1
RAD52	ENSG00000002016	826.4511	0.738449	0.12718	5.806312	6.39E-09	4.01E-08	1
ZNF79	ENSG00000196152	846.6902	0.738383	0.119177	6.195666	5.80E-10	4.16E-09	1
TTC19	ENSG00000011295	4644.604	0.737467	0.082062	8.986757	2.55E-19	4.98E-18	1
CYP20A1	ENSG00000119004	2202.357	0.73741	0.095015	7.76097	8.43E-15	1.06E-13	1
FAM133B	ENSG00000234545	1470.824	0.735282	0.11401	6.449269	1.12E-10	8.75E-10	1
C19orf48	ENSG00000167747	7702.371	0.735107	0.1018	7.221085	5.16E-13	5.34E-12	1
ZNF354B	ENSG00000178338	1401.145	0.73471	0.109359	6.718306	1.84E-11	1.56E-10	1
BRD4	ENSG00000141867	9900.573	0.73424	0.123353	5.952344	2.64E-09	1.74E-08	1
ZNF451	ENSG00000112200	5408.988	0.73418	0.082022	8.951004	3.52E-19	6.75E-18	1
ZNF420	ENSG00000197050	1018.224	0.734142	0.156881	4.679618	2.87E-06	1.22E-05	1
NME6	ENSG00000172113	2309.089	0.732755	0.089717	8.167397	3.15E-16	4.61E-15	1
ARHGAP39	ENSG00000147799	1369.863	0.73162	0.17445	4.193874	2.74E-05	9.54E-05	1
ST7L	ENSG00000007341	1325.751	0.730873	0.100545	7.269139	3.62E-13	3.79E-12	1
NSUN6	ENSG00000241058	776.3996	0.73045	0.117201	6.23244	4.59E-10	3.33E-09	1
EPRS	ENSG00000136628	21067.03	0.730215	0.072589	10.05965	8.33E-24	2.15E-22	1
SLC20A1	ENSG00000144136	14934.36	0.730214	0.091496	7.98083	1.45E-15	1.99E-14	1
STK17A	ENSG00000164543	4219.986	0.729666	0.136746	5.335925	9.51E-08	5.04E-07	1
ZNF569	ENSG00000196437	1287.037	0.728699	0.150285	4.848792	1.24E-06	5.56E-06	1
DUSP16	ENSG00000111266	4199.025	0.728285	0.13779	5.285464	1.25E-07	6.53E-07	1
RRAS2	ENSG00000133818	13301.3	0.728126	0.089782	8.109955	5.06E-16	7.27E-15	1
ZNF14	ENSG00000105708	772.1073	0.728011	0.144595	5.034844	4.78E-07	2.28E-06	1
ZBTB48	ENSG00000204859	1422.683	0.727869	0.104915	6.937691	3.99E-12	3.64E-11	1
TRIM62	ENSG00000116525	2586.567	0.727461	0.151486	4.802175	1.57E-06	6.93E-06	1
GK	ENSG00000198814	640.7506	0.725517	0.121232	5.984516	2.17E-09	1.44E-08	1
WDFY2	ENSG00000139668	4187.609	0.723647	0.118754	6.093673	1.10E-09	7.61E-09	1
TTPAL	ENSG00000124120	5348.043	0.723625	0.087713	8.249954	1.58E-16	2.39E-15	1
ZNF473	ENSG00000142528	2227.609	0.723525	0.105291	6.871672	6.35E-12	5.64E-11	1
COG1	ENSG00000166685	5396.301	0.722832	0.091157	7.929554	2.20E-15	2.95E-14	1
PPP4R3A	ENSG00000100796	7463.999	0.72277	0.072406	9.982219	1.82E-23	4.66E-22	1
AMMECR1	ENSG00000144233	4875.902	0.722704	0.085724	8.430643	3.44E-17	5.49E-16	1
ARHGAP26	ENSG00000145819	3447.436	0.722063	0.134749	5.358571	8.39E-08	4.49E-07	1
PRAG1	ENSG00000275342	3876.215	0.721741	0.121286	5.950716	2.67E-09	1.76E-08	1

DDX42	ENSG00000198231	22528.38	0.721559	0.077005	9.370336	7.23E-21	1.57E-19	1
PAWR	ENSG00000177425	19250.91	0.720718	0.084507	8.528461	1.48E-17	2.47E-16	1
TMEM216	ENSG00000187049	770.689	0.719175	0.129974	5.533221	3.14E-08	1.78E-07	1
ZSCAN32	ENSG00000140987	1445.238	0.719153	0.110237	6.523725	6.86E-11	5.50E-10	1
ICAM1	ENSG00000090339	2638.748	0.718238	0.10378	6.920767	4.49E-12	4.06E-11	1
BTN2A1	ENSG00000112763	3691.101	0.717993	0.095849	7.490859	6.84E-14	7.69E-13	1
ING2	ENSG00000168556	1502.231	0.71743	0.133807	5.361664	8.25E-08	4.42E-07	1
MUL1	ENSG00000090432	4039.821	0.716271	0.089782	7.97789	1.49E-15	2.04E-14	1
VAMP4	ENSG00000117533	1387.535	0.715868	0.129828	5.513968	3.51E-08	1.97E-07	1
TOP3A	ENSG00000177302	7984.695	0.715364	0.086156	8.303178	1.01E-16	1.55E-15	1
LZTS3	ENSG00000088899	3059.539	0.712568	0.166499	4.279713	1.87E-05	6.78E-05	1
MICALL1	ENSG00000100139	11705.33	0.712008	0.096828	7.353342	1.93E-13	2.08E-12	1
UVRAG	ENSG00000198382	2679.462	0.71014	0.097881	7.255159	4.01E-13	4.19E-12	1
MOK	ENSG00000080823	2122.823	0.709925	0.109884	6.460659	1.04E-10	8.14E-10	1
NVL	ENSG00000143748	2387.569	0.709852	0.097567	7.275552	3.45E-13	3.63E-12	1
TTC39B	ENSG00000155158	780.1752	0.709819	0.192095	3.695149	0.0002198	0.0006418	1
FOXO3B	ENSG00000240445	1017.681	0.709155	0.132816	5.339389	9.33E-08	4.95E-07	1
GPATCH2	ENSG00000092978	1760.138	0.70879	0.118138	5.999669	1.98E-09	1.32E-08	1
GORASP2	ENSG00000115806	10557.05	0.708751	0.07206	9.835544	7.91E-23	1.92E-21	1
SAMD4A	ENSG00000020577	8252.383	0.70493	0.132523	5.319283	1.04E-07	5.48E-07	1
KCMF1	ENSG00000176407	7495.33	0.703865	0.09044	7.782661	7.10E-15	9.06E-14	1
NAPB	ENSG00000125814	1573.284	0.703005	0.098385	7.145458	8.97E-13	8.94E-12	1
ZNF597	ENSG00000167981	1062.45	0.702229	0.117513	5.975733	2.29E-09	1.52E-08	1
NRIP1	ENSG00000180530	3941.017	0.701857	0.088113	7.96541	1.65E-15	2.24E-14	1
ABHD5	ENSG00000011198	5099.734	0.701604	0.116599	6.017252	1.77E-09	1.20E-08	1
DDX59	ENSG00000118197	1526.326	0.70057	0.113167	6.190593	5.99E-10	4.29E-09	1
MAFG	ENSG00000197063	7488.499	0.700195	0.091237	7.674423	1.66E-14	2.03E-13	1
RAB3IL1	ENSG00000167994	1691.756	0.700174	0.103779	6.746807	1.51E-11	1.28E-10	1
ANKS3	ENSG00000168096	1265.122	0.699706	0.111031	6.301883	2.94E-10	2.19E-09	1
ZNF619	ENSG00000177873	942.9964	0.698636	0.116836	5.979628	2.24E-09	1.48E-08	1
DMD	ENSG00000198947	1104.088	0.698428	0.135588	5.151089	2.59E-07	1.28E-06	1
NAXD	ENSG00000213995	3405.326	0.69837	0.086226	8.099326	5.53E-16	7.90E-15	1
PHLDB2	ENSG00000144824	28130.36	0.698299	0.092515	7.54794	4.42E-14	5.08E-13	1
ZNF16	ENSG00000170631	1456.824	0.697308	0.099716	6.992932	2.69E-12	2.51E-11	1
TIGD2	ENSG00000180346	862.1955	0.695627	0.157432	4.418575	9.94E-06	3.79E-05	1
SLC1A4	ENSG00000115902	11590.17	0.69505	0.100486	6.916873	4.62E-12	4.16E-11	1
TSC22D2	ENSG00000196428	5567.28	0.694733	0.084742	8.198261	2.44E-16	3.63E-15	1
LYSMD4	ENSG00000183060	1033.269	0.694324	0.10786	6.437256	1.22E-10	9.44E-10	1
GOLGA2	ENSG00000167110	11369.8	0.694101	0.106811	6.498417	8.12E-11	6.46E-10	1
ATXN7	ENSG00000163635	5144.859	0.693655	0.100155	6.925825	4.33E-12	3.94E-11	1
MARS2	ENSG00000247626	698.5413	0.69337	0.124876	5.552478	2.82E-08	1.60E-07	1
MARVELD2	ENSG00000152939	907.0239	0.693017	0.148853	4.655706	3.23E-06	1.35E-05	1
BRCA2	ENSG00000139618	9496.256	0.693013	0.122074	5.676987	1.37E-08	8.19E-08	1
MCPH1	ENSG00000147316	2901.948	0.692785	0.086733	7.987557	1.38E-15	1.89E-14	1
POLR1B	ENSG00000125630	3850.676	0.692754	0.089982	7.698826	1.37E-14	1.69E-13	1
UTP14A	ENSG00000156697	2163.407	0.692244	0.107848	6.418698	1.37E-10	1.06E-09	1
ORC6	ENSG00000091651	5596.245	0.692168	0.094389	7.333151	2.25E-13	2.40E-12	1

USP47	ENSG00000170242	6664.447	0.691487	0.085969	8.043414	8.74E-16	1.22E-14	1
PGGT1B	ENSG00000164219	3735.467	0.691446	0.096717	7.149197	8.73E-13	8.71E-12	1
ZNF518B	ENSG00000178163	2115.227	0.690643	0.141452	4.882517	1.05E-06	4.74E-06	1
WDR31	ENSG00000148225	716.0129	0.690323	0.132477	5.210868	1.88E-07	9.54E-07	1
THUMPD2	ENSG00000138050	844.0975	0.690214	0.145063	4.758031	1.95E-06	8.52E-06	1
BRAP	ENSG00000089234	3523.777	0.689969	0.076041	9.073656	1.15E-19	2.32E-18	1
ZFP28	ENSG00000196867	634.7034	0.689572	0.124403	5.543036	2.97E-08	1.69E-07	1
BCL2	ENSG00000171791	1657.972	0.689476	0.113638	6.067296	1.30E-09	8.90E-09	1
WWC1	ENSG00000113645	12187.08	0.68918	0.080046	8.609761	7.32E-18	1.25E-16	1
SNHG16	ENSG00000163597	2310.9	0.689053	0.139293	4.946777	7.55E-07	3.48E-06	1
LINC00511	ENSG00000227036	1740.492	0.688636	0.114686	6.004535	1.92E-09	1.29E-08	1
BNIP1	ENSG00000113734	1013.525	0.68796	0.175494	3.920142	8.85E-05	0.0002801	1
ASAH2B	ENSG00000204147	789.894	0.687864	0.136963	5.022248	5.11E-07	2.42E-06	1
GREM1	ENSG00000166923	20816.07	0.687206	0.111927	6.139774	8.26E-10	5.80E-09	1
URB1	ENSG00000142207	5691.648	0.687192	0.114255	6.014548	1.80E-09	1.21E-08	1
KAT7	ENSG00000136504	8464.469	0.685495	0.105504	6.497332	8.18E-11	6.50E-10	1
MSTO1	ENSG00000125459	824.5093	0.68548	0.146798	4.669559	3.02E-06	1.27E-05	1
BCL10	ENSG00000142867	2343.312	0.685433	0.115871	5.915509	3.31E-09	2.15E-08	1
PNO1	ENSG00000115946	1884.594	0.683548	0.144893	4.717597	2.39E-06	1.03E-05	1
ZNF334	ENSG00000198185	1609.011	0.683486	0.104629	6.5325	6.47E-11	5.20E-10	1
SUPT20H	ENSG00000102710	3375.905	0.682498	0.089859	7.595252	3.07E-14	3.59E-13	1
CHD1	ENSG00000153922	9760.984	0.6824	0.080461	8.48109	2.23E-17	3.63E-16	1
MTPAP	ENSG00000107951	2235.112	0.681251	0.092539	7.361776	1.81E-13	1.95E-12	1
CEP128	ENSG00000100629	2608.129	0.681078	0.082766	8.22897	1.89E-16	2.84E-15	1
ZRSR2	ENSG00000169249	624.4752	0.680978	0.129641	5.252792	1.50E-07	7.72E-07	1
RNF216P1	ENSG00000196204	757.7076	0.680685	0.119246	5.708242	1.14E-08	6.91E-08	1
UBAP1	ENSG00000165006	5577.5	0.680121	0.1005	6.76736	1.31E-11	1.12E-10	1
PSMC3IP	ENSG00000131470	1949.568	0.67938	0.097981	6.933766	4.10E-12	3.74E-11	1
KMT5A	ENSG00000183955	6042.487	0.67884	0.114111	5.948958	2.70E-09	1.77E-08	1
ZFAND3	ENSG00000156639	9830.046	0.678801	0.084573	8.026235	1.01E-15	1.40E-14	1
ITFG2	ENSG00000111203	1437.127	0.678542	0.103393	6.56275	5.28E-11	4.30E-10	1
CDKN2B	ENSG00000147883	11159.75	0.6783	0.104078	6.51721	7.16E-11	5.72E-10	1
ZNF496	ENSG00000162714	5609.786	0.676684	0.084078	8.048245	8.40E-16	1.18E-14	1
TRAPPC6B	ENSG00000182400	891.8464	0.676561	0.115141	5.875913	4.21E-09	2.70E-08	1
YY1AP1	ENSG00000163374	4003.547	0.676223	0.078101	8.658302	4.79E-18	8.33E-17	1
PRNP	ENSG00000171867	34343.83	0.676015	0.104172	6.489385	8.62E-11	6.81E-10	1
PRIMPOL	ENSG00000164306	1044.465	0.675247	0.107017	6.309713	2.80E-10	2.09E-09	1
OPLAH	ENSG00000178814	2006.416	0.674805	0.136722	4.935585	7.99E-07	3.67E-06	1
TYW1	ENSG00000198874	2108.292	0.67443	0.137577	4.902209	9.48E-07	4.31E-06	1
NAF1	ENSG00000145414	1109.471	0.674396	0.107919	6.249075	4.13E-10	3.01E-09	1
C12orf4	ENSG00000047621	3836.609	0.674298	0.116771	5.774536	7.72E-09	4.77E-08	1
ASNSD1	ENSG00000138381	2157.147	0.674031	0.141533	4.762371	1.91E-06	8.35E-06	1
GRB10	ENSG00000106070	8222.279	0.673541	0.091164	7.388199	1.49E-13	1.61E-12	1
ZNF445	ENSG00000185219	5623.956	0.67343	0.107425	6.268836	3.64E-10	2.68E-09	1
DLGAP4	ENSG00000080845	12865.72	0.672266	0.085221	7.888477	3.06E-15	4.06E-14	1
FAM161B	ENSG00000156050	977.4209	0.670996	0.121308	5.531346	3.18E-08	1.79E-07	1
ZNF462	ENSG00000148143	6113.756	0.670895	0.145305	4.617147	3.89E-06	1.61E-05	1

TOM1	ENSG00000100284	4428.195	0.670233	0.081795	8.194056	2.53E-16	3.75E-15	1
ZFY	ENSG00000067646	3106.378	0.669661	0.089364	7.493646	6.70E-14	7.54E-13	1
NOP16	ENSG00000048162	1715.962	0.669257	0.117223	5.709263	1.13E-08	6.88E-08	1
ABRAXAS2	ENSG00000165660	2974.675	0.669156	0.106587	6.278053	3.43E-10	2.53E-09	1
PTCD2	ENSG00000049883	2767.383	0.668223	0.091884	7.272428	3.53E-13	3.71E-12	1
WHRN	ENSG00000095397	561.357	0.668216	0.217599	3.070854	0.0021345	0.004992	1
USP25	ENSG00000155313	7562.525	0.667539	0.096632	6.908038	4.91E-12	4.41E-11	1
RBM39	ENSG00000131051	28256.01	0.667512	0.083694	7.975597	1.52E-15	2.07E-14	1
FERMT2	ENSG00000073712	13582.6	0.667197	0.096821	6.891039	5.54E-12	4.95E-11	1
TMEM214	ENSG00000119777	11490.5	0.666862	0.081893	8.143114	3.85E-16	5.57E-15	1
ZNF566	ENSG00000186017	1382.155	0.666638	0.127881	5.212972	1.86E-07	9.45E-07	1
ARL14EP	ENSG00000152219	2085.87	0.665879	0.118601	5.614442	1.97E-08	1.15E-07	1
EPC2	ENSG00000135999	4316.518	0.665767	0.081343	8.184674	2.73E-16	4.04E-15	1
RELL2	ENSG00000164620	1081.202	0.665723	0.107761	6.177744	6.50E-10	4.63E-09	1
MED10	ENSG00000133398	2793.129	0.665648	0.090888	7.323868	2.41E-13	2.56E-12	1
ZNF48	ENSG00000180035	1419.139	0.665352	0.126319	5.267253	1.38E-07	7.19E-07	1
CGRRF1	ENSG00000100532	1230.806	0.664621	0.146536	4.535534	5.75E-06	2.30E-05	1
OSGIN2	ENSG00000164823	2479.073	0.664181	0.108503	6.121335	9.28E-10	6.46E-09	1
DMTF1	ENSG00000135164	4298.77	0.663918	0.118009	5.626005	1.84E-08	1.08E-07	1
BRIX1	ENSG00000113460	3672.762	0.663464	0.102457	6.475527	9.45E-11	7.43E-10	1
TRA2A	ENSG00000164548	6678.152	0.663346	0.069579	9.533707	1.52E-21	3.45E-20	1
CUTC	ENSG00000119929	1011.842	0.662939	0.112269	5.904935	3.53E-09	2.29E-08	1
DTL	ENSG00000143476	13498.75	0.66172	0.073805	8.965735	3.08E-19	5.95E-18	1
BCL2L1	ENSG00000171552	11503.19	0.661402	0.118551	5.579048	2.42E-08	1.39E-07	1
RBCK1	ENSG00000125826	10537.35	0.661218	0.080603	8.203411	2.34E-16	3.50E-15	1
RANBP9	ENSG00000010017	6777.657	0.660202	0.075668	8.724999	2.66E-18	4.71E-17	1
HAUS8	ENSG00000131351	2381.456	0.660198	0.100409	6.575108	4.86E-11	3.97E-10	1
MLPH	ENSG00000115648	2115.968	0.659659	0.123312	5.349512	8.82E-08	4.70E-07	1
CCDC15	ENSG00000149548	1892.593	0.658922	0.117645	5.600929	2.13E-08	1.24E-07	1
STX11	ENSG00000135604	968.6495	0.657601	0.141449	4.649042	3.33E-06	1.39E-05	1
ALKBH1	ENSG00000100601	1228.108	0.65732	0.138492	4.746263	2.07E-06	9.00E-06	1
TYW5	ENSG00000162971	1326.848	0.656903	0.10487	6.263995	3.75E-10	2.75E-09	1
RPF2	ENSG00000197498	2596.398	0.65667	0.145371	4.517201	6.27E-06	2.48E-05	1
PPP1R15B	ENSG00000158615	6398.379	0.656089	0.083436	7.86338	3.74E-15	4.93E-14	1
PHGDH	ENSG00000092621	11455.13	0.654845	0.097046	6.74777	1.50E-11	1.28E-10	1
AXIN1	ENSG00000103126	3429.209	0.654357	0.085676	7.637599	2.21E-14	2.67E-13	1
STX18	ENSG00000168818	1894.922	0.654305	0.123531	5.296665	1.18E-07	6.16E-07	1
NUDT4	ENSG00000173598	2349.75	0.654034	0.14718	4.443776	8.84E-06	3.40E-05	1
B3GNT5	ENSG00000176597	1606.71	0.654006	0.144062	4.539758	5.63E-06	2.26E-05	1
DCUN1D5	ENSG00000137692	2953.425	0.6537	0.129327	5.054619	4.31E-07	2.07E-06	1
MCM9	ENSG00000111877	1585.904	0.652904	0.110768	5.894328	3.76E-09	2.43E-08	1
DGKE	ENSG00000153933	3191.574	0.652615	0.140256	4.653022	3.27E-06	1.37E-05	1
STRIP2	ENSG00000128578	4265.355	0.651731	0.095388	6.832424	8.35E-12	7.30E-11	1
TIPIN	ENSG00000075131	1508.772	0.651704	0.106392	6.125496	9.04E-10	6.30E-09	1
NIPAL1	ENSG00000163293	1068.144	0.65115	0.138488	4.701844	2.58E-06	1.10E-05	1
RFX1	ENSG00000132005	1594.115	0.651101	0.152006	4.283379	1.84E-05	6.68E-05	1
ERFE	ENSG00000178752	1203.879	0.650367	0.111102	5.853782	4.81E-09	3.07E-08	1

JRKL	ENSG00000183340	1497.433	0.649791	0.120557	5.389894	7.05E-08	3.81E-07	1
ZNF195	ENSG00000005801	2013.603	0.649445	0.11049	5.877873	4.16E-09	2.67E-08	1
RRS1	ENSG00000179041	1434.265	0.64944	0.128606	5.049838	4.42E-07	2.12E-06	1
AKAP17A	ENSG00000197976	2409.482	0.64869	0.125693	5.160915	2.46E-07	1.22E-06	1
AFF4	ENSG00000072364	26333.33	0.648264	0.101048	6.415386	1.40E-10	1.08E-09	1
PIGL	ENSG00000108474	940.8043	0.647673	0.123289	5.253274	1.49E-07	7.70E-07	1
RBBP8	ENSG00000101773	8832.023	0.647249	0.130522	4.958921	7.09E-07	3.28E-06	1
VLDLR	ENSG00000147852	2113.979	0.647137	0.09235	7.007427	2.43E-12	2.27E-11	1
MACO1	ENSG00000204178	3326.688	0.646885	0.09021	7.170843	7.45E-13	7.55E-12	1
HMGCR	ENSG00000113161	87097.69	0.646554	0.109033	5.929896	3.03E-09	1.98E-08	1
SMURF2	ENSG00000108854	21527.03	0.646388	0.104948	6.159116	7.32E-10	5.16E-09	1
SLC9A8	ENSG00000197818	2672.148	0.646247	0.115541	5.593249	2.23E-08	1.29E-07	1
ZNF841	ENSG00000197608	1314.943	0.646241	0.134434	4.807116	1.53E-06	6.78E-06	1
NFKBIB	ENSG00000104825	1957.853	0.645842	0.088188	7.3235	2.42E-13	2.57E-12	1
GFPT2	ENSG00000131459	4699.162	0.645754	0.117223	5.508764	3.61E-08	2.03E-07	1
EEF2KMT	ENSG00000118894	694.9146	0.644921	0.12499	5.159798	2.47E-07	1.23E-06	1
NSUN5	ENSG00000130305	1541.193	0.644399	0.106729	6.037684	1.56E-09	1.06E-08	1
GNPNAT1	ENSG00000100522	4069.956	0.6439	0.105105	6.126263	9.00E-10	6.27E-09	1
RNF6	ENSG00000127870	7030.923	0.643837	0.08501	7.573622	3.63E-14	4.22E-13	1
PLEKHM1	ENSG00000225190	4805.08	0.643552	0.102169	6.298892	3.00E-10	2.23E-09	1
FBXO31	ENSG00000103264	1654.742	0.643513	0.09726	6.616391	3.68E-11	3.05E-10	1
FAM122A	ENSG00000187866	1693.205	0.642512	0.09645	6.661618	2.71E-11	2.27E-10	1
SDCCAG3	ENSG00000165689	3654.818	0.642288	0.083623	7.68079	1.58E-14	1.93E-13	1
ZNF669	ENSG00000188295	713.6255	0.641918	0.153778	4.174313	2.99E-05	0.0001035	1
QTRT2	ENSG00000151576	3108.307	0.641729	0.101269	6.336898	2.34E-10	1.77E-09	1
FOXN2	ENSG00000170802	3516.232	0.641548	0.097282	6.594718	4.26E-11	3.49E-10	1
FIP1L1	ENSG00000145216	2352.575	0.641227	0.092599	6.924769	4.37E-12	3.97E-11	1
CCNJ	ENSG00000107443	943.7077	0.640701	0.131812	4.860729	1.17E-06	5.25E-06	1
C5orf22	ENSG00000082213	3605.033	0.639481	0.096793	6.60667	3.93E-11	3.24E-10	1
STRN3	ENSG00000196792	3682.822	0.639322	0.091643	6.976252	3.03E-12	2.81E-11	1
RBM12	ENSG00000244462	9198.091	0.639081	0.160485	3.982198	6.83E-05	0.0002204	1
NBPF8	ENSG00000270231	1967.301	0.639019	0.134719	4.743341	2.10E-06	9.13E-06	1
TYW1B	ENSG00000277149	834.1775	0.638858	0.149882	4.262394	2.02E-05	7.28E-05	1
OSMR	ENSG00000145623	18403.31	0.638196	0.06871	9.288325	1.57E-20	3.34E-19	1
ADPRHL2	ENSG00000116863	4321.799	0.637997	0.090382	7.058928	1.68E-12	1.60E-11	1
DNAJC30	ENSG00000176410	905.6933	0.637857	0.11661	5.470012	4.50E-08	2.49E-07	1
KCTD5	ENSG00000167977	4086.387	0.636282	0.082808	7.68378	1.54E-14	1.89E-13	1
PQLC2	ENSG00000040487	2746.375	0.635818	0.110829	5.736941	9.64E-09	5.87E-08	1
ZYX	ENSG00000159840	33497.81	0.635778	0.089028	7.141357	9.24E-13	9.21E-12	1
ANKRD26	ENSG00000107890	3246.43	0.635474	0.089952	7.064568	1.61E-12	1.54E-11	1
DTNBP1	ENSG00000047579	2053.467	0.635343	0.114007	5.572857	2.51E-08	1.44E-07	1
ZRANB1	ENSG00000019995	3878.638	0.634841	0.078988	8.037174	9.19E-16	1.28E-14	1
RMC1	ENSG00000141452	2690.107	0.634734	0.080565	7.878506	3.31E-15	4.37E-14	1
CLCF1	ENSG00000175505	772.8723	0.634223	0.20823	3.045783	0.0023208	0.0053921	1
ZNF623	ENSG00000183309	6123.054	0.63406	0.085746	7.394666	1.42E-13	1.54E-12	1
POLI	ENSG00000101751	1520.3	0.633933	0.118978	5.328163	9.92E-08	5.23E-07	1
TAPT1	ENSG00000169762	1996.873	0.63379	0.090469	7.00561	2.46E-12	2.30E-11	1

ULBP2	ENSG00000131015	1250.991	0.633538	0.15507	4.085511	4.40E-05	0.0001479	1
GMPPB	ENSG00000173540	4008.715	0.632896	0.08706	7.269627	3.60E-13	3.78E-12	1
PCGF6	ENSG00000156374	1939.741	0.631725	0.108424	5.826412	5.66E-09	3.57E-08	1
USP1	ENSG00000162607	22061.61	0.630924	0.10549	5.980884	2.22E-09	1.47E-08	1
E2F6	ENSG00000169016	1544.374	0.630923	0.158069	3.991446	6.57E-05	0.0002125	1
KIAA0753	ENSG00000198920	2064.951	0.630884	0.093163	6.771803	1.27E-11	1.09E-10	1
PGBD2	ENSG00000185220	942.4031	0.630671	0.12662	4.980825	6.33E-07	2.96E-06	1
REPS1	ENSG00000135597	3067.477	0.630147	0.097036	6.493952	8.36E-11	6.64E-10	1
RRP1	ENSG00000160214	3733.563	0.628997	0.088923	7.073477	1.51E-12	1.45E-11	1
CDC73	ENSG00000134371	6122.413	0.628382	0.082393	7.626616	2.41E-14	2.89E-13	1
PALB2	ENSG00000083093	4587.512	0.628316	0.100772	6.234997	4.52E-10	3.28E-09	1
C8orf33	ENSG00000182307	5878.306	0.628195	0.078175	8.035725	9.30E-16	1.30E-14	1
TRMT11	ENSG00000066651	1186.456	0.627757	0.155867	4.027525	5.64E-05	0.0001853	1
ARFGAP1	ENSG00000101199	10098.64	0.627668	0.109014	5.757693	8.53E-09	5.24E-08	1
KLHL29	ENSG00000119771	3258.855	0.627549	0.15263	4.111561	3.93E-05	0.0001334	1
COG3	ENSG00000136152	3526.225	0.627084	0.08212	7.636173	2.24E-14	2.70E-13	1
ZNF12	ENSG00000164631	3464.069	0.627063	0.107795	5.817204	5.98E-09	3.76E-08	1
CHAMP1	ENSG00000198824	7100.6	0.626589	0.098479	6.362672	1.98E-10	1.51E-09	1
RSL1D1	ENSG00000171490	5511.474	0.626312	0.13779	4.545419	5.48E-06	2.20E-05	1
NR1D2	ENSG00000174738	7038.912	0.625835	0.097966	6.388322	1.68E-10	1.28E-09	1
OTUD7B	ENSG00000264522	4998.756	0.625745	0.073101	8.559976	1.13E-17	1.90E-16	1
IRF7	ENSG00000185507	1415.236	0.625648	0.163931	3.816541	0.0001353	0.0004102	1
CTU2	ENSG00000174177	601.3203	0.625099	0.128665	4.858355	1.18E-06	5.31E-06	1
CA5B	ENSG00000169239	533.9735	0.624425	0.173893	3.590856	0.0003296	0.0009276	1
CDR2	ENSG00000140743	6695.292	0.623741	0.102623	6.078008	1.22E-09	8.37E-09	1
APBB2	ENSG00000163697	8995.257	0.623186	0.106836	5.833118	5.44E-09	3.43E-08	1
ABHD11	ENSG00000106077	1559.253	0.622697	0.093985	6.625495	3.46E-11	2.87E-10	1
CEP295	ENSG00000166004	3409.474	0.622292	0.084717	7.34554	2.05E-13	2.19E-12	1
FAM212B	ENSG00000197852	3307.923	0.622037	0.091794	6.776419	1.23E-11	1.06E-10	1
CNOT3	ENSG00000088038	5321.142	0.621856	0.106472	5.840578	5.20E-09	3.29E-08	1
RUNX1	ENSG00000159216	12992.36	0.621783	0.156221	3.980155	6.89E-05	0.0002221	1
THAP6	ENSG00000174796	1425.373	0.621754	0.126168	4.927986	8.31E-07	3.81E-06	1
LSM12P1	ENSG00000232024	700.2917	0.621323	0.214569	2.895674	0.0037835	0.0083468	1
NFKB1	ENSG00000109320	4642.91	0.621248	0.085337	7.279901	3.34E-13	3.51E-12	1
ZNF317	ENSG00000130803	4356.004	0.621104	0.0748	8.30358	1.01E-16	1.55E-15	1
LCMT2	ENSG00000168806	1900.398	0.620441	0.089631	6.922163	4.45E-12	4.03E-11	1
YIPF2	ENSG00000130733	2051.159	0.620308	0.095825	6.473335	9.59E-11	7.54E-10	1
FAM13B	ENSG00000031003	11321.37	0.620187	0.094016	6.596578	4.21E-11	3.46E-10	1
C17orf53	ENSG00000125319	1911.244	0.619954	0.098496	6.294174	3.09E-10	2.30E-09	1
CXorf40B	ENSG00000197021	2035.441	0.619761	0.17726	3.496343	0.0004717	0.0012831	1
STK19	ENSG00000204344	817.0412	0.619587	0.132696	4.669208	3.02E-06	1.27E-05	1
EIF3J	ENSG00000104131	9740.752	0.61936	0.102936	6.016916	1.78E-09	1.20E-08	1
DDX19B	ENSG00000157349	1052.66	0.618992	0.132102	4.685703	2.79E-06	1.18E-05	1
CPSF4	ENSG00000160917	3407.773	0.618921	0.085221	7.26256	3.80E-13	3.97E-12	1
SRSF3	ENSG00000112081	29356.79	0.618658	0.113768	5.437905	5.39E-08	2.96E-07	1
SCAF8	ENSG00000213079	6068.917	0.61862	0.081449	7.59523	3.07E-14	3.59E-13	1
ELL	ENSG00000105656	1756.164	0.618466	0.10902	5.672937	1.40E-08	8.37E-08	1

PDE8A	ENSG00000073417	4789.138	0.618279	0.07618	8.116069	4.82E-16	6.94E-15	1
NT5C2	ENSG00000076685	4759.831	0.617926	0.082417	7.497542	6.50E-14	7.34E-13	1
NEK8	ENSG00000160602	1184.951	0.617798	0.179542	3.440974	0.0005796	0.0015418	1
PHLDA2	ENSG00000181649	2817.662	0.617374	0.124165	4.972217	6.62E-07	3.08E-06	1
ANKRD11	ENSG00000167522	8201.482	0.617271	0.172551	3.577332	0.0003471	0.0009701	1
SRGAP2C	ENSG00000171943	2474.815	0.615755	0.199355	3.088735	0.0020101	0.0047369	1
SPRY2	ENSG00000136158	965.488	0.615169	0.143078	4.299523	1.71E-05	6.25E-05	1
YDJC	ENSG00000161179	1996.458	0.61508	0.122611	5.016507	5.26E-07	2.49E-06	1
FAM118A	ENSG00000100376	1450.626	0.61484	0.100763	6.101856	1.05E-09	7.26E-09	1
TXLNG	ENSG00000086712	2440.919	0.613897	0.102015	6.017728	1.77E-09	1.19E-08	1
TRMT44	ENSG00000155275	892.922	0.613493	0.117136	5.237436	1.63E-07	8.34E-07	1
MIOS	ENSG00000164654	2568.837	0.613063	0.099076	6.187797	6.10E-10	4.35E-09	1
TRIM11	ENSG00000154370	3054.227	0.612843	0.117401	5.220071	1.79E-07	9.10E-07	1
GOLGA3	ENSG00000090615	10979.99	0.612728	0.134275	4.563228	5.04E-06	2.03E-05	1
SLC41A2	ENSG00000136052	2241.029	0.612694	0.106458	5.755242	8.65E-09	5.31E-08	1
ZFYVE27	ENSG00000155256	2547.423	0.612541	0.084367	7.260443	3.86E-13	4.03E-12	1
SIRPA	ENSG00000198053	19731.94	0.612076	0.11706	5.228716	1.71E-07	8.72E-07	1
SYDE2	ENSG00000097096	1012.873	0.612013	0.162647	3.762835	0.000168	0.0004998	1
NOL6	ENSG00000165271	6343.829	0.61162	0.099195	6.165805	7.01E-10	4.97E-09	1
ERBIN	ENSG00000112851	47558.22	0.611575	0.080295	7.616621	2.60E-14	3.09E-13	1
TAF13	ENSG00000197780	2883.756	0.610579	0.099077	6.162694	7.15E-10	5.05E-09	1
PFDN2	ENSG00000143256	4625.001	0.610486	0.111114	5.494209	3.92E-08	2.19E-07	1
THBD	ENSG00000178726	1260.468	0.609791	0.140286	4.346756	1.38E-05	5.11E-05	1
NUP58	ENSG00000139496	12083.23	0.609648	0.074248	8.210925	2.19E-16	3.29E-15	1
TCEA1	ENSG00000187735	9533.714	0.609644	0.137271	4.441158	8.95E-06	3.43E-05	1
TFB1M	ENSG00000029639	1537.74	0.609296	0.130301	4.67606	2.92E-06	1.24E-05	1
ELL2	ENSG00000118985	10731.68	0.608943	0.106523	5.716543	1.09E-08	6.60E-08	1
BANP	ENSG00000172530	929.5663	0.608528	0.141349	4.305151	1.67E-05	6.10E-05	1
RNF111	ENSG00000157450	4678.628	0.608328	0.074383	8.178357	2.88E-16	4.24E-15	1
SPTY2D1	ENSG00000179119	3883.893	0.608016	0.093647	6.492674	8.43E-11	6.68E-10	1
BCAT1	ENSG00000060982	4834.237	0.6077	0.129502	4.692595	2.70E-06	1.15E-05	1
TBC1D7	ENSG00000145979	935.7024	0.60699	0.167618	3.62126	0.0002932	0.0008332	1
TICAM1	ENSG00000127666	1762.236	0.606903	0.093999	6.456503	1.07E-10	8.35E-10	1
BAMBI	ENSG00000095739	1238.432	0.606625	0.13319	4.55458	5.25E-06	2.11E-05	1
LIAS	ENSG00000121897	693.0914	0.606268	0.117172	5.174155	2.29E-07	1.15E-06	1
POLR1C	ENSG00000171453	1307.52	0.606153	0.102113	5.936071	2.92E-09	1.91E-08	1
TTLL4	ENSG00000135912	3055.112	0.604971	0.086177	7.020076	2.22E-12	2.08E-11	1
ZBTB10	ENSG00000205189	1683.708	0.604388	0.114207	5.29204	1.21E-07	6.31E-07	1
ZNF329	ENSG00000181894	1219.238	0.60407	0.11988	5.038947	4.68E-07	2.23E-06	1
NLE1	ENSG00000073536	2292.385	0.603976	0.089401	6.755809	1.42E-11	1.21E-10	1
USP15	ENSG00000135655	3718.754	0.603973	0.110671	5.457384	4.83E-08	2.67E-07	1
HSD17B7	ENSG00000132196	5808.018	0.60347	0.119177	5.06365	4.11E-07	1.98E-06	1
SURF6	ENSG00000148296	3092.823	0.603368	0.079081	7.629747	2.35E-14	2.83E-13	1
C7orf43	ENSG00000146826	1377.872	0.60321	0.109935	5.486955	4.09E-08	2.28E-07	1
PPP3CC	ENSG00000120910	1524.258	0.602874	0.116734	5.164506	2.41E-07	1.20E-06	1
THOC6	ENSG00000131652	2138.422	0.602508	0.117655	5.120972	3.04E-07	1.49E-06	1
MDM4	ENSG00000198625	2271.196	0.602479	0.189052	3.186839	0.0014384	0.0035087	1

FAM129A	ENSG00000135842	24523.21	0.602213	0.101781	5.91674	3.28E-09	2.14E-08	1
CEP95	ENSG00000258890	3402.377	0.602164	0.091966	6.547652	5.84E-11	4.73E-10	1
DNAJC1	ENSG00000136770	3657.418	0.602092	0.133207	4.519986	6.18E-06	2.46E-05	1
YTHDF1	ENSG00000149658	8107.021	0.601853	0.074273	8.103278	5.35E-16	7.67E-15	1
PPP1R13B	ENSG00000088808	2063.431	0.601699	0.110505	5.445001	5.18E-08	2.85E-07	1
PICALM	ENSG00000073921	26744.69	0.601628	0.103985	5.785736	7.22E-09	4.48E-08	1
KITLG	ENSG00000049130	3482.129	0.601477	0.11796	5.098971	3.42E-07	1.67E-06	1
GPATCH8	ENSG00000186566	10074.58	0.601333	0.087664	6.859531	6.91E-12	6.11E-11	1
BCL7B	ENSG00000106635	5370.859	0.60087	0.080566	7.458085	8.78E-14	9.73E-13	1
PAG1	ENSG00000076641	2334.716	0.600319	0.172732	3.47543	0.00051	0.0013746	1
LYSMD3	ENSG00000176018	4929.781	0.600266	0.10685	5.61783	1.93E-08	1.13E-07	1
PLEKHF2	ENSG00000175895	2262.476	0.600071	0.123364	4.864247	1.15E-06	5.17E-06	1
DDX11	ENSG00000013573	6393.875	0.599657	0.176021	3.406737	0.0006574	0.0017301	1
TADA2A	ENSG00000276234	2287.39	0.599011	0.087773	6.824573	8.82E-12	7.67E-11	1
RALGAPA1	ENSG00000174373	2195.142	0.598881	0.161515	3.707884	0.000209	0.0006129	1
TEX30	ENSG00000151287	1934.439	0.598597	0.171895	3.482343	0.000497	0.001344	1
METTL22	ENSG00000067365	695.7128	0.59723	0.147672	4.044308	5.25E-05	0.0001739	1
KIN	ENSG00000151657	1482.475	0.597196	0.128527	4.64647	3.38E-06	1.41E-05	1
ZNF414	ENSG00000133250	999.5037	0.596847	0.13323	4.47981	7.47E-06	2.92E-05	1
ARMCX5	ENSG00000125962	588.3866	0.595473	0.152437	3.906352	9.37E-05	0.0002947	1
FOXC2	ENSG00000176692	751.3141	0.595423	0.142619	4.174908	2.98E-05	0.0001033	1
ARFRP1	ENSG00000101246	4471.174	0.594877	0.094778	6.276513	3.46E-10	2.55E-09	1
LUC7L	ENSG00000007392	3700.102	0.594808	0.111344	5.342076	9.19E-08	4.88E-07	1
TSEN2	ENSG00000154743	629.8789	0.594478	0.139605	4.258288	2.06E-05	7.40E-05	1
SCAPER	ENSG00000140386	1618.482	0.594151	0.101197	5.871244	4.33E-09	2.77E-08	1
SUCO	ENSG00000094975	6743.312	0.594073	0.082453	7.204956	5.81E-13	5.97E-12	1
NCKAP5L	ENSG00000167566	3546.705	0.593719	0.120859	4.912473	8.99E-07	4.10E-06	1
ZNF649	ENSG00000198093	770.6608	0.59342	0.13308	4.459111	8.23E-06	3.19E-05	1
ITCH	ENSG00000078747	4787.336	0.593387	0.10261	5.782939	7.34E-09	4.55E-08	1
QRSL1	ENSG00000130348	2254.566	0.59328	0.088551	6.699904	2.09E-11	1.76E-10	1
PLAA	ENSG00000137055	4983.673	0.593141	0.08685	6.829466	8.52E-12	7.42E-11	1
BOD1	ENSG00000145919	6814.317	0.592175	0.104506	5.666428	1.46E-08	8.68E-08	1
DCTN4	ENSG00000132912	12544.79	0.592131	0.070721	8.37281	5.63E-17	8.82E-16	1
CDC42SE1	ENSG00000197622	6895.256	0.591874	0.101926	5.806894	6.36E-09	3.99E-08	1
PKP2	ENSG00000057294	4333.727	0.591569	0.084151	7.029824	2.07E-12	1.95E-11	1
PUS3	ENSG00000110060	876.0699	0.59131	0.157104	3.763806	0.0001673	0.0004981	1
PGPEP1	ENSG00000130517	2514.196	0.590893	0.086485	6.832302	8.36E-12	7.30E-11	1
LINC02057	ENSG00000249279	1009.72	0.590873	0.122382	4.82811	1.38E-06	6.13E-06	1
RAB28	ENSG00000157869	1322.876	0.590784	0.119011	4.964111	6.90E-07	3.20E-06	1
THAP5	ENSG00000177683	2972.663	0.590442	0.114591	5.152607	2.57E-07	1.27E-06	1
PSTK	ENSG00000179988	638.8924	0.590425	0.142281	4.149727	3.33E-05	0.0001144	1
ZPR1	ENSG00000109917	4409.328	0.590281	0.084815	6.959657	3.41E-12	3.15E-11	1
TMEM40	ENSG00000088726	603.9473	0.589894	0.176404	3.343988	0.0008258	0.0021259	1
TMEM51	ENSG00000171729	2799.948	0.589799	0.115569	5.103438	3.34E-07	1.63E-06	1
RHOQ	ENSG00000119729	5456.99	0.589767	0.110681	5.328506	9.90E-08	5.23E-07	1
MAP3K10	ENSG00000130758	1028.556	0.589254	0.122772	4.799576	1.59E-06	7.02E-06	1
POFUT2	ENSG00000186866	2371.658	0.588893	0.13045	4.514339	6.35E-06	2.52E-05	1

SRP68	ENSG00000167881	11968.32	0.588891	0.066172	8.899345	5.62E-19	1.05E-17	1
MCL1	ENSG00000143384	29809.44	0.588294	0.089302	6.587709	4.47E-11	3.66E-10	1
ADO	ENSG00000181915	2871.742	0.588136	0.095268	6.173492	6.68E-10	4.74E-09	1
FBXL12	ENSG00000127452	2071.778	0.587886	0.118485	4.961688	6.99E-07	3.24E-06	1
NOLC1	ENSG00000166197	13128.07	0.587721	0.07785	7.549397	4.37E-14	5.03E-13	1
TRMT1	ENSG00000104907	2629.897	0.587277	0.109957	5.340958	9.25E-08	4.91E-07	1
ZNF558	ENSG00000167785	1980.518	0.587018	0.108981	5.386417	7.19E-08	3.88E-07	1
TBC1D10A	ENSG00000099992	879.2049	0.587005	0.129943	4.517393	6.26E-06	2.48E-05	1
ZNF17	ENSG00000186272	575.4387	0.586705	0.154533	3.796634	0.0001467	0.0004419	1
LINC00909	ENSG00000264247	614.608	0.586195	0.121258	4.834286	1.34E-06	5.96E-06	1
ZNF654	ENSG00000175105	2717.259	0.585445	0.110477	5.299232	1.16E-07	6.09E-07	1
TTC17	ENSG00000052841	5224.94	0.585148	0.08456	6.919921	4.52E-12	4.07E-11	1
STARD8	ENSG00000130052	662.3703	0.585044	0.147902	3.95563	7.63E-05	0.0002443	1
FAM20B	ENSG00000116199	7874.967	-0.58518	0.08462	-6.91541	4.67E-12	4.20E-11	-1
MRPL34	ENSG00000130312	1143.611	-0.58528	0.163179	-3.58677	0.0003348	0.0009402	-1
08-Mar	ENSG00000165406	2633.633	-0.58538	0.105455	-5.55101	2.84E-08	1.62E-07	-1
NQO1	ENSG00000181019	10592.39	-0.58549	0.097647	-5.99594	2.02E-09	1.35E-08	-1
ENY2	ENSG00000120533	3462.67	-0.58554	0.114334	-5.12125	3.04E-07	1.49E-06	-1
PRTFDC1	ENSG00000099256	945.6579	-0.58582	0.116002	-5.05009	4.42E-07	2.11E-06	-1
ITGA6	ENSG00000091409	10475.48	-0.5865	0.125814	-4.66162	3.14E-06	1.31E-05	-1
TSPAN10	ENSG00000182612	617.8116	-0.58651	0.129016	-4.54605	5.47E-06	2.20E-05	-1
DAGLA	ENSG00000134780	1193.728	-0.58662	0.15136	-3.87568	0.0001063	0.0003309	-1
PBXIP1	ENSG00000163346	4245.031	-0.58674	0.101354	-5.78899	7.08E-09	4.40E-08	-1
PIK3CB	ENSG00000051382	3467.025	-0.58682	0.096885	-6.05687	1.39E-09	9.48E-09	-1
PAQR4	ENSG00000162073	1912.228	-0.58686	0.114453	-5.12751	2.94E-07	1.44E-06	-1
TMEM218	ENSG00000150433	1033.512	-0.58699	0.122233	-4.80224	1.57E-06	6.93E-06	-1
PUDP	ENSG00000130021	950.1987	-0.58707	0.153225	-3.83143	0.0001274	0.0003887	-1
HSPB11	ENSG00000081870	2320.878	-0.58752	0.130352	-4.50717	6.57E-06	2.59E-05	-1
VSTM2L	ENSG00000132821	1044.341	-0.58755	0.123002	-4.77671	1.78E-06	7.80E-06	-1
LIX1L	ENSG00000271601	3677.161	-0.58813	0.080273	-7.3267	2.36E-13	2.51E-12	-1
MYD88	ENSG00000172936	2938.664	-0.58849	0.083207	-7.07256	1.52E-12	1.46E-11	-1
PPP2R5C	ENSG00000078304	5951.067	-0.58871	0.101878	-5.77862	7.53E-09	4.66E-08	-1
IGF1R	ENSG00000140443	7086.42	-0.58886	0.149668	-3.93441	8.34E-05	0.0002653	-1
FSCN1	ENSG00000075618	6804.108	-0.59023	0.116554	-5.06399	4.11E-07	1.98E-06	-1
CCNA2	ENSG00000145386	10961.7	-0.59034	0.146677	-4.02473	5.70E-05	0.0001872	-1
TM7SF3	ENSG00000064115	4590.606	-0.59067	0.089293	-6.61503	3.71E-11	3.07E-10	-1
TNS2	ENSG00000111077	2596.556	-0.59108	0.12963	-4.55977	5.12E-06	2.06E-05	-1
OGFR	ENSG00000060491	4338.08	-0.59153	0.083378	-7.09457	1.30E-12	1.27E-11	-1
ST3GAL2	ENSG00000157350	2639.573	-0.59202	0.085548	-6.92033	4.51E-12	4.07E-11	-1
ZCCHC24	ENSG00000165424	2181.644	-0.59301	0.093319	-6.35465	2.09E-10	1.59E-09	-1
IMP3	ENSG00000177971	949.9049	-0.59351	0.132008	-4.496	6.92E-06	2.72E-05	-1
SYPL1	ENSG00000008282	8365.168	-0.59352	0.085327	-6.95581	3.51E-12	3.23E-11	-1
B4GALNT1	ENSG00000135454	2905.149	-0.59393	0.106588	-5.57224	2.51E-08	1.44E-07	-1
MAP4K2	ENSG00000168067	1557.761	-0.59441	0.116494	-5.10249	3.35E-07	1.64E-06	-1
FBXL20	ENSG00000108306	1576.174	-0.59457	0.107311	-5.54064	3.01E-08	1.71E-07	-1
THY1	ENSG00000154096	11150.86	-0.59495	0.086919	-6.84488	7.65E-12	6.73E-11	-1
NRGN	ENSG00000154146	1269.609	-0.59521	0.120012	-4.95961	7.06E-07	3.27E-06	-1

CALM1	ENSG00000198668	20714.95	-0.59528	0.084073	-7.08042	1.44E-12	1.39E-11	-1
KIF20B	ENSG00000138182	8687.756	-0.59549	0.1091	-5.45826	4.81E-08	2.65E-07	-1
DCP2	ENSG00000172795	5213.376	-0.59571	0.087461	-6.81114	9.68E-12	8.38E-11	-1
MOSPD3	ENSG00000106330	1000.647	-0.59617	0.131253	-4.54214	5.57E-06	2.23E-05	-1
METTL3	ENSG00000165819	2468.661	-0.59634	0.103763	-5.74717	9.07E-09	5.55E-08	-1
CLN8	ENSG00000182372	1330.086	-0.59637	0.12478	-4.77936	1.76E-06	7.71E-06	-1
TMEM123	ENSG00000152558	32069.09	-0.59681	0.099671	-5.98776	2.13E-09	1.42E-08	-1
TLE3	ENSG00000140332	1963.441	-0.59901	0.106391	-5.63024	1.80E-08	1.06E-07	-1
RBM24	ENSG00000112183	613.2943	-0.5993	0.158478	-3.78163	0.0001558	0.0004666	-1
FRMD8	ENSG00000126391	3912.626	-0.59989	0.085903	-6.98332	2.88E-12	2.68E-11	-1
TMEM25	ENSG00000149582	1150.588	-0.60004	0.109492	-5.48026	4.25E-08	2.36E-07	-1
GXYLT2	ENSG00000172986	1506.303	-0.60014	0.118986	-5.04378	4.56E-07	2.18E-06	-1
COX10-AS1	ENSG00000236088	787.9984	-0.60069	0.165283	-3.63429	0.0002787	0.0007958	-1
PLXNB1	ENSG00000164050	3551.836	-0.60165	0.141041	-4.26577	1.99E-05	7.18E-05	-1
ITGAV	ENSG00000138448	12744.15	-0.60187	0.084611	-7.1134	1.13E-12	1.11E-11	-1
GSTM3	ENSG00000134202	1502.402	-0.60322	0.116393	-5.18259	2.19E-07	1.10E-06	-1
DNASE1	ENSG00000213918	1297.375	-0.60339	0.19618	-3.0757	0.0021001	0.0049256	-1
PBK	ENSG00000168078	5612.456	-0.60428	0.135498	-4.4597	8.21E-06	3.18E-05	-1
WDR81	ENSG00000167716	3544.672	-0.60433	0.11737	-5.14888	2.62E-07	1.30E-06	-1
SPR	ENSG00000116096	1189.74	-0.60456	0.108809	-5.55618	2.76E-08	1.57E-07	-1
TMEM64	ENSG00000180694	2511.863	-0.60459	0.091156	-6.63245	3.30E-11	2.74E-10	-1
ABCC4	ENSG00000125257	4930.719	-0.60469	0.106719	-5.6662	1.46E-08	8.68E-08	-1
GLI2	ENSG00000074047	1978.106	-0.60559	0.141802	-4.2707	1.95E-05	7.04E-05	-1
FAM173B	ENSG00000150756	916.3267	-0.60563	0.121019	-5.00441	5.60E-07	2.64E-06	-1
TMEM60	ENSG00000135211	1123.133	-0.60733	0.101564	-5.97972	2.24E-09	1.48E-08	-1
PRDM15	ENSG00000141956	715.6895	-0.60757	0.174925	-3.47333	0.000514	0.0013847	-1
SDF2	ENSG00000132581	1915.637	-0.60797	0.105846	-5.74393	9.25E-09	5.65E-08	-1
DAB2IP	ENSG00000136848	2078.608	-0.60821	0.124988	-4.86612	1.14E-06	5.12E-06	-1
IKBKE	ENSG00000263528	667.5323	-0.60827	0.141074	-4.3117	1.62E-05	5.94E-05	-1
DDB2	ENSG00000134574	2880.655	-0.60862	0.120221	-5.06256	4.14E-07	1.99E-06	-1
ARSK	ENSG00000164291	1466.317	-0.60879	0.154338	-3.9445	8.00E-05	0.0002549	-1
PEX2	ENSG00000164751	1931.149	-0.60986	0.151408	-4.02795	5.63E-05	0.000185	-1
S100A13	ENSG00000189171	1233.418	-0.61018	0.163541	-3.73104	0.0001907	0.0005622	-1
MYRF	ENSG00000124920	1060.964	-0.61026	0.16839	-3.6241	0.00029	0.0008255	-1
TSPAN17	ENSG00000048140	4062.996	-0.61045	0.074064	-8.24215	1.69E-16	2.55E-15	-1
PCLAF	ENSG00000166803	2566.553	-0.61082	0.098578	-6.19638	5.78E-10	4.15E-09	-1
DBI	ENSG00000155368	10597.71	-0.61105	0.130824	-4.6708	3.00E-06	1.26E-05	-1
SPCS3	ENSG00000129128	14300.27	-0.61113	0.10987	-5.56231	2.66E-08	1.52E-07	-1
TRIM21	ENSG00000132109	1371.859	-0.61116	0.133013	-4.59475	4.33E-06	1.77E-05	-1
SNTB1	ENSG00000172164	1507.23	-0.61145	0.114716	-5.33013	9.81E-08	5.19E-07	-1
SLC38A10	ENSG00000157637	7358.301	-0.61152	0.142295	-4.29755	1.73E-05	6.30E-05	-1
C5orf15	ENSG00000113583	7920.868	-0.6117	0.106579	-5.73944	9.50E-09	5.79E-08	-1
ZFP64	ENSG00000020256	1458.041	-0.61221	0.110181	-5.55645	2.75E-08	1.57E-07	-1
08-Sep	ENSG00000164402	9233.746	-0.61249	0.075627	-8.09891	5.55E-16	7.92E-15	-1
NDUFB1	ENSG00000183648	1758.797	-0.61272	0.151883	-4.03413	5.48E-05	0.0001808	-1
CCDC9B	ENSG00000188549	7484	-0.61301	0.108819	-5.63333	1.77E-08	1.04E-07	-1
LMNB1	ENSG00000113368	20319.61	-0.61312	0.067763	-9.04801	1.46E-19	2.88E-18	-1

SNX33	ENSG00000173548	4984.29	-0.6141	0.09365	-6.55738	5.48E-11	4.44E-10	-1
DPY19L4	ENSG00000156162	3352.866	-0.61429	0.098817	-6.21643	5.09E-10	3.67E-09	-1
SUMO3	ENSG00000184900	9362.163	-0.61446	0.084836	-7.24295	4.39E-13	4.58E-12	-1
TMEM255	ENSG00000184497	1475.086	-0.61521	0.143599	-4.28425	1.83E-05	6.66E-05	-1
NAT1	ENSG00000171428	528.435	-0.61526	0.185382	-3.31887	0.0009038	0.0023087	-1
ARPP19	ENSG00000128989	18859.44	-0.61548	0.090728	-6.78378	1.17E-11	1.01E-10	-1
ACBD7	ENSG00000176244	1315.32	-0.6162	0.117188	-5.25824	1.45E-07	7.52E-07	-1
TRPM4	ENSG00000130529	872.4316	-0.6166	0.131656	-4.68344	2.82E-06	1.20E-05	-1
GAS6	ENSG00000183087	33652.18	-0.61662	0.124434	-4.95542	7.22E-07	3.33E-06	-1
LMBRD1	ENSG00000168216	1124.974	-0.61706	0.12792	-4.8238	1.41E-06	6.26E-06	-1
ZNF362	ENSG00000160094	1841.587	-0.6175	0.131127	-4.70917	2.49E-06	1.07E-05	-1
RSRP1	ENSG00000117616	2863.184	-0.6175	0.125834	-4.90728	9.23E-07	4.21E-06	-1
EDIL3	ENSG00000164176	14244	-0.61785	0.136238	-4.53509	5.76E-06	2.30E-05	-1
ATP5PF	ENSG00000154723	3288.304	-0.6179	0.117209	-5.27172	1.35E-07	7.02E-07	-1
PTPRF	ENSG00000142949	35881.03	-0.61841	0.106732	-5.79409	6.87E-09	4.28E-08	-1
F2R	ENSG00000181104	14650.32	-0.61901	0.07396	-8.36951	5.79E-17	9.04E-16	-1
TWSG1	ENSG00000128791	7381.9	-0.6191	0.104677	-5.91443	3.33E-09	2.17E-08	-1
SPOCK1	ENSG00000152377	14042.14	-0.61919	0.082376	-7.51661	5.62E-14	6.40E-13	-1
ESPL1	ENSG00000135476	7386.869	-0.61944	0.105996	-5.84395	5.10E-09	3.24E-08	-1
CD59	ENSG00000085063	19488.95	-0.61959	0.089306	-6.93782	3.98E-12	3.64E-11	-1
CD99L2	ENSG00000102181	5318.404	-0.61963	0.091624	-6.76272	1.35E-11	1.16E-10	-1
SFN	ENSG00000175793	10936.52	-0.6199	0.103162	-6.00897	1.87E-09	1.25E-08	-1
SIX2	ENSG00000170577	1661.261	-0.62005	0.104614	-5.92697	3.09E-09	2.01E-08	-1
MARCKSL1	ENSG00000175130	3507.669	-0.62042	0.097831	-6.34177	2.27E-10	1.72E-09	-1
MAPRE2	ENSG00000166974	4155.386	-0.62114	0.096429	-6.44138	1.18E-10	9.20E-10	-1
ZMYM3	ENSG00000147130	3378.055	-0.62126	0.151163	-4.10986	3.96E-05	0.0001342	-1
ITGB4	ENSG00000132470	18303.69	-0.62153	0.098001	-6.34202	2.27E-10	1.72E-09	-1
ATP2B4	ENSG00000058668	10507.8	-0.62175	0.133319	-4.66365	3.11E-06	1.30E-05	-1
ZFHX4	ENSG00000091656	6513.066	-0.62196	0.190399	-3.26664	0.0010883	0.0027321	-1
ATXN3	ENSG00000066427	1557.84	-0.62218	0.115845	-5.37084	7.84E-08	4.21E-07	-1
ATG9A	ENSG00000198925	3524.598	-0.62255	0.103185	-6.03334	1.61E-09	1.09E-08	-1
DOK4	ENSG00000125170	1272.435	-0.62315	0.119825	-5.20045	1.99E-07	1.01E-06	-1
RPS27L	ENSG00000185088	5726.724	-0.62368	0.142738	-4.36941	1.25E-05	4.65E-05	-1
STOM	ENSG00000148175	7817.405	-0.62395	0.089393	-6.97992	2.95E-12	2.74E-11	-1
	ENSG00000289194	646.3561	-0.62414	0.15447	-4.04052	5.33E-05	0.0001764	-1
C11orf68	ENSG00000175573	2577.923	-0.62448	0.091907	-6.79466	1.09E-11	9.38E-11	-1
	ENSG00000291091	1011.355	-0.62509	0.148221	-4.21728	2.47E-05	8.70E-05	-1
DEPDC1B	ENSG00000035499	2207.102	-0.62554	0.14078	-4.44337	8.86E-06	3.40E-05	-1
BMT2	ENSG00000164603	788.9773	-0.62659	0.156017	-4.01614	5.92E-05	0.0001936	-1
BCL9	ENSG00000116128	1119.53	-0.62779	0.111784	-5.61606	1.95E-08	1.14E-07	-1
IL31RA	ENSG00000164509	887.6861	-0.62877	0.18498	-3.39912	0.000676	0.0017734	-1
ABCA7	ENSG00000064687	866.0656	-0.62887	0.171047	-3.67657	0.0002364	0.0006863	-1
SYNPO	ENSG00000171992	4529.265	-0.62896	0.130011	-4.83772	1.31E-06	5.87E-06	-1
INCENP	ENSG00000149503	6729.931	-0.62999	0.079919	-7.88291	3.20E-15	4.23E-14	-1
SPPL2A	ENSG00000138600	5987.606	-0.63045	0.088362	-7.13477	9.69E-13	9.63E-12	-1
LDB1	ENSG00000198728	4332.373	-0.63081	0.131461	-4.79847	1.60E-06	7.05E-06	-1
UBL5	ENSG00000198258	3667.347	-0.63106	0.156657	-4.02833	5.62E-05	0.0001849	-1

ZMYND8	ENSG00000101040	5493.881	-0.63119	0.089683	-7.03795	1.95E-12	1.84E-11	-1
ATP5MPL	ENSG00000156411	2705.684	-0.63128	0.096655	-6.53126	6.52E-11	5.24E-10	-1
ABCD1	ENSG00000101986	2117.59	-0.63136	0.131765	-4.79154	1.66E-06	7.28E-06	-1
ARPC5	ENSG00000162704	15177.38	-0.63145	0.112424	-5.61672	1.95E-08	1.14E-07	-1
COA3	ENSG00000183978	1708.25	-0.63184	0.107405	-5.88281	4.03E-09	2.60E-08	-1
FAM46B	ENSG00000158246	1211.178	-0.63206	0.145054	-4.3574	1.32E-05	4.90E-05	-1
CUTA	ENSG00000112514	12072.84	-0.63209	0.095984	-6.58536	4.54E-11	3.71E-10	-1
KBTBD4	ENSG00000123444	752.7704	-0.63213	0.118612	-5.32943	9.85E-08	5.20E-07	-1
COX14	ENSG00000178449	1053.857	-0.63222	0.168574	-3.75039	0.0001766	0.0005234	-1
BCOR	ENSG00000183337	3087.197	-0.63261	0.111122	-5.6929	1.25E-08	7.50E-08	-1
TMCC2	ENSG00000133069	854.9441	-0.63423	0.139021	-4.56213	5.06E-06	2.04E-05	-1
CLDN11	ENSG00000013297	4747.388	-0.63424	0.088953	-7.13003	1.00E-12	9.95E-12	-1
JPH2	ENSG00000149596	1977.139	-0.63449	0.13093	-4.846	1.26E-06	5.63E-06	-1
FASTKD1	ENSG00000138399	1012.064	-0.6347	0.129466	-4.90247	9.46E-07	4.30E-06	-1
REEP5	ENSG00000129625	12211.61	-0.63547	0.098338	-6.46211	1.03E-10	8.08E-10	-1
HSBP1	ENSG00000230989	2405.009	-0.63613	0.144605	-4.3991	1.09E-05	4.11E-05	-1
TSPAN9	ENSG00000011105	1842.509	-0.63743	0.130846	-4.87156	1.11E-06	4.99E-06	-1
LRP10	ENSG00000197324	14386.25	-0.63752	0.072444	-8.80013	1.37E-18	2.49E-17	-1
PSMB9	ENSG00000240065	1292.086	-0.63764	0.126275	-5.04961	4.43E-07	2.12E-06	-1
SFXN5	ENSG00000144040	1688.363	-0.63819	0.113124	-5.64148	1.69E-08	9.96E-08	-1
NATD1	ENSG00000274180	2051.3	-0.6384	0.128608	-4.96396	6.91E-07	3.20E-06	-1
PDZD2	ENSG00000133401	1274.511	-0.63908	0.173419	-3.68515	0.0002286	0.0006656	-1
OIP5-AS1	ENSG00000247556	16316.54	-0.63961	0.097466	-6.56242	5.29E-11	4.31E-10	-1
CENPF	ENSG00000117724	24040.7	-0.64008	0.110921	-5.77066	7.90E-09	4.87E-08	-1
CCDC127	ENSG00000164366	3720.979	-0.64043	0.07891	-8.11601	4.82E-16	6.94E-15	-1
GABPB2	ENSG00000143458	801.6976	-0.64055	0.140208	-4.56859	4.91E-06	1.99E-05	-1
CCNF	ENSG00000162063	4946.746	-0.64058	0.104415	-6.13493	8.52E-10	5.96E-09	-1
SLC37A2	ENSG00000134955	1564.052	-0.6413	0.119206	-5.37972	7.46E-08	4.02E-07	-1
TOB1	ENSG00000141232	3464.942	-0.64174	0.118286	-5.42534	5.78E-08	3.16E-07	-1
SBF1	ENSG00000100241	9472.711	-0.6421	0.114123	-5.62642	1.84E-08	1.08E-07	-1
ATP5ME	ENSG00000169020	852.5242	-0.64295	0.153092	-4.19978	2.67E-05	9.32E-05	-1
APOBEC3B	ENSG00000179750	1750.774	-0.64328	0.121037	-5.31472	1.07E-07	5.60E-07	-1
FGD5-AS1	ENSG00000225733	14241.27	-0.64364	0.077927	-8.25943	1.46E-16	2.21E-15	-1
LAMA3	ENSG00000053747	5000.769	-0.64374	0.162808	-3.95394	7.69E-05	0.0002457	-1
MPP5	ENSG00000072415	5531.249	-0.64431	0.072612	-8.8733	7.10E-19	1.31E-17	-1
DPYSL2	ENSG00000092964	16036.1	-0.64451	0.076707	-8.40221	4.38E-17	6.92E-16	-1
ENDOD1	ENSG00000149218	2008.757	-0.64474	0.107125	-6.01851	1.76E-09	1.19E-08	-1
LEPR	ENSG00000116678	1237.992	-0.64483	0.112159	-5.74926	8.96E-09	5.49E-08	-1
MAN2B1	ENSG00000104774	3100.155	-0.64509	0.099598	-6.47696	9.36E-11	7.37E-10	-1
IFIH1	ENSG00000115267	627.566	-0.64524	0.124903	-5.16593	2.39E-07	1.19E-06	-1
ABRACL	ENSG00000146386	1847.944	-0.64535	0.175549	-3.67616	0.0002368	0.0006872	-1
SYNGR1	ENSG00000100321	985.5474	-0.64617	0.146301	-4.41675	1.00E-05	3.82E-05	-1
B3GAT3	ENSG00000149541	1582.458	-0.64751	0.138474	-4.67602	2.92E-06	1.24E-05	-1
MLLT3	ENSG00000171843	626.7613	-0.64959	0.164715	-3.94373	8.02E-05	0.0002555	-1
ANO8	ENSG00000074855	1196.377	-0.65004	0.15322	-4.24256	2.21E-05	7.89E-05	-1
TMEM56	ENSG00000152078	2361.508	-0.65017	0.09378	-6.93294	4.12E-12	3.75E-11	-1
CYB5A	ENSG00000166347	1853.15	-0.65094	0.13769	-4.7276	2.27E-06	9.83E-06	-1

TOR4A	ENSG00000198113	4303.284	-0.65098	0.09365	-6.95113	3.62E-12	3.33E-11	-1
CAVIN3	ENSG00000170955	2726.779	-0.6512	0.129747	-5.019	5.19E-07	2.46E-06	-1
SKP1	ENSG00000113558	1586.084	-0.65144	0.097951	-6.65071	2.92E-11	2.44E-10	-1
CELSR1	ENSG00000075275	4089.875	-0.65154	0.175907	-3.70391	0.0002123	0.0006217	-1
LRIG1	ENSG00000144749	1673.863	-0.65176	0.107749	-6.04892	1.46E-09	9.94E-09	-1
ADAMTS3	ENSG00000156140	786.8777	-0.65255	0.164051	-3.97775	6.96E-05	0.0002242	-1
BRD3	ENSG00000169925	3337.545	-0.65333	0.085427	-7.64776	2.05E-14	2.48E-13	-1
UBL4A	ENSG00000102178	5286.545	-0.65418	0.081942	-7.98346	1.42E-15	1.96E-14	-1
GMPR	ENSG00000137198	910.6515	-0.65478	0.108703	-6.02355	1.71E-09	1.15E-08	-1
TMEM248	ENSG00000106609	10425.48	-0.65525	0.069822	-9.38461	6.31E-21	1.38E-19	-1
KIF11	ENSG00000138160	15105.44	-0.65529	0.091125	-7.19115	6.42E-13	6.55E-12	-1
ARHGEF17	ENSG00000110237	7565.929	-0.65556	0.145099	-4.51801	6.24E-06	2.48E-05	-1
ESRP2	ENSG00000103067	645.2663	-0.65561	0.15092	-4.3441	1.40E-05	5.17E-05	-1
POLH	ENSG00000170734	2991.457	-0.65651	0.122723	-5.34948	8.82E-08	4.70E-07	-1
MRPL51	ENSG00000111639	5380.934	-0.65813	0.14213	-4.63047	3.65E-06	1.51E-05	-1
CEP97	ENSG00000182504	3475.755	-0.65893	0.086518	-7.61613	2.61E-14	3.09E-13	-1
CYHR1	ENSG00000187954	1426.008	-0.66014	0.178902	-3.68997	0.0002243	0.0006537	-1
LZTS1	ENSG00000061337	736.1943	-0.66041	0.148314	-4.45276	8.48E-06	3.27E-05	-1
ORAI3	ENSG00000175938	977.6008	-0.66062	0.11785	-5.60561	2.08E-08	1.21E-07	-1
ATP1B1	ENSG00000143153	4355.409	-0.66072	0.089054	-7.41932	1.18E-13	1.29E-12	-1
MUC1	ENSG00000185499	620.7091	-0.66087	0.17909	-3.69014	0.0002241	0.0006534	-1
UBXN7	ENSG00000163960	7165.853	-0.66098	0.095929	-6.89031	5.57E-12	4.96E-11	-1
NHEJ1	ENSG00000187736	566.1769	-0.66219	0.147199	-4.49861	6.84E-06	2.69E-05	-1
LEPROT	ENSG00000213625	5390.986	-0.66249	0.095356	-6.94749	3.72E-12	3.41E-11	-1
LNPEP	ENSG00000113441	8175.363	-0.66273	0.136402	-4.85866	1.18E-06	5.31E-06	-1
LTBP3	ENSG00000168056	4389.244	-0.66362	0.147154	-4.50966	6.49E-06	2.57E-05	-1
KCTD20	ENSG00000112078	7939.981	-0.66435	0.10931	-6.07766	1.22E-09	8.38E-09	-1
CYP2U1	ENSG00000155016	1647.156	-0.66489	0.11837	-5.61705	1.94E-08	1.14E-07	-1
SMIM14	ENSG00000163683	2788.683	-0.66494	0.120179	-5.53293	3.15E-08	1.78E-07	-1
CSPG4	ENSG00000173546	6562.81	-0.66519	0.135135	-4.9224	8.55E-07	3.91E-06	-1
MINOS1	ENSG00000173436	691.7547	-0.66537	0.143825	-4.62623	3.72E-06	1.54E-05	-1
NPR2	ENSG00000159899	813.4281	-0.66636	0.131809	-5.05553	4.29E-07	2.06E-06	-1
DPY19L1	ENSG00000173852	6835.559	-0.6664	0.078952	-8.44051	3.16E-17	5.06E-16	-1
PFDN6	ENSG00000204220	1510.57	-0.66655	0.142078	-4.69144	2.71E-06	1.16E-05	-1
AK4	ENSG00000162433	2463.265	-0.66708	0.143948	-4.6342	3.58E-06	1.49E-05	-1
B3GLCT	ENSG00000187676	2731.898	-0.66767	0.096739	-6.9018	5.13E-12	4.60E-11	-1
KLHL36	ENSG00000135686	2060.268	-0.66885	0.123571	-5.41266	6.21E-08	3.37E-07	-1
KLHL24	ENSG00000114796	2423.561	-0.66893	0.122501	-5.46061	4.75E-08	2.62E-07	-1
SAPCD2	ENSG00000186193	972.8065	-0.66899	0.112547	-5.94413	2.78E-09	1.82E-08	-1
LPIN3	ENSG00000132793	1329.046	-0.66904	0.128855	-5.1922	2.08E-07	1.05E-06	-1
KBTBD6	ENSG00000165572	1613.736	-0.67039	0.127652	-5.2517	1.51E-07	7.76E-07	-1
LINC00294	ENSG00000280798	953.9728	-0.67078	0.137837	-4.86649	1.14E-06	5.11E-06	-1
AK3	ENSG00000147853	4612.864	-0.67129	0.109648	-6.12225	9.23E-10	6.42E-09	-1
CPOX	ENSG00000080819	1934.078	-0.67168	0.104224	-6.44455	1.16E-10	9.01E-10	-1
BRWD1	ENSG00000185658	5168.887	-0.67189	0.094339	-7.12214	1.06E-12	1.05E-11	-1
CDIPT	ENSG00000103502	2931.788	-0.67257	0.10012	-6.71767	1.85E-11	1.56E-10	-1
APOLD1	ENSG00000178878	1420.12	-0.67283	0.162751	-4.13415	3.56E-05	0.000122	-1

CENPW	ENSG00000203760	2111.807	-0.67305	0.126237	-5.33167	9.73E-08	5.15E-07	-1
SEM1	ENSG00000127922	3969.327	-0.67307	0.084585	-7.95728	1.76E-15	2.38E-14	-1
PQLC3	ENSG00000162976	1146.382	-0.67317	0.122614	-5.49014	4.02E-08	2.24E-07	-1
SCARA3	ENSG00000168077	7695.374	-0.67475	0.080948	-8.33563	7.71E-17	1.19E-15	-1
MR1	ENSG00000153029	675.6213	-0.67531	0.135783	-4.97348	6.58E-07	3.06E-06	-1
TRIM47	ENSG00000132481	589.0743	-0.67572	0.193217	-3.49719	0.0004702	0.0012794	-1
LIMD2	ENSG00000136490	1027.196	-0.67631	0.11546	-5.85753	4.70E-09	3.00E-08	-1
HSD17B11	ENSG00000198189	1346.688	-0.67652	0.148343	-4.56048	5.10E-06	2.06E-05	-1
SNX30	ENSG00000148158	3514.471	-0.67753	0.087382	-7.75367	8.93E-15	1.12E-13	-1
CAV1	ENSG00000105974	39237.43	-0.67786	0.088203	-7.68524	1.53E-14	1.88E-13	-1
GALC	ENSG00000054983	1199.282	-0.6783	0.113188	-5.99272	2.06E-09	1.38E-08	-1
WDR37	ENSG00000047056	3857.982	-0.67857	0.102241	-6.6369	3.20E-11	2.67E-10	-1
COL4A6	ENSG00000197565	1074.669	-0.67934	0.13888	-4.89159	1.00E-06	4.53E-06	-1
CDK19	ENSG00000155111	3948.322	-0.67937	0.087746	-7.74246	9.75E-15	1.22E-13	-1
HLF	ENSG00000108924	663.9854	-0.67986	0.177996	-3.81955	0.0001337	0.0004055	-1
AP1S1	ENSG00000106367	2998.836	-0.68003	0.11046	-6.1563	7.45E-10	5.24E-09	-1
ATP9A	ENSG00000054793	2297.703	-0.68025	0.095462	-7.12579	1.03E-12	1.02E-11	-1
TNFAIP8L1	ENSG00000185361	1433.213	-0.68059	0.116643	-5.83487	5.38E-09	3.40E-08	-1
ABHD8	ENSG00000127220	634.318	-0.68063	0.161093	-4.22507	2.39E-05	8.44E-05	-1
HHIP	ENSG00000164161	881.5308	-0.68109	0.180546	-3.77237	0.0001617	0.0004829	-1
TXN	ENSG00000136810	10367.06	-0.68116	0.098396	-6.92259	4.43E-12	4.02E-11	-1
ARSB	ENSG00000113273	2070.288	-0.68125	0.112006	-6.08225	1.19E-09	8.16E-09	-1
CCND1	ENSG00000110092	5846.79	-0.68161	0.296768	-2.29677	0.0216322	0.0396257	-1
PLD1	ENSG00000075651	1259.164	-0.68167	0.142073	-4.79802	1.60E-06	7.07E-06	-1
ZDHHC12	ENSG00000160446	3003.985	-0.68188	0.116737	-5.84119	5.18E-09	3.29E-08	-1
DMAC1	ENSG00000137038	1118.947	-0.6823	0.107465	-6.34903	2.17E-10	1.64E-09	-1
SORT1	ENSG00000134243	13677.9	-0.68338	0.096202	-7.10363	1.22E-12	1.19E-11	-1
TPRG1L	ENSG00000158109	3148.831	-0.68346	0.090743	-7.53185	5.00E-14	5.72E-13	-1
NCOA2	ENSG00000140396	3241.002	-0.6835	0.10855	-6.29665	3.04E-10	2.26E-09	-1
C9orf3	ENSG00000148120	2184.432	-0.68369	0.124397	-5.49606	3.88E-08	2.17E-07	-1
NDRG1	ENSG00000104419	3749.678	-0.68425	0.113874	-6.00887	1.87E-09	1.25E-08	-1
ARID2	ENSG00000189079	3390.719	-0.68515	0.118082	-5.80234	6.54E-09	4.09E-08	-1
C2orf68	ENSG00000168887	1877.525	-0.68537	0.106805	-6.41702	1.39E-10	1.07E-09	-1
CABLES1	ENSG00000134508	792.6647	-0.68544	0.116545	-5.88135	4.07E-09	2.62E-08	-1
CASP6	ENSG00000138794	809.7905	-0.6858	0.15054	-4.55559	5.22E-06	2.11E-05	-1
GLUL	ENSG00000135821	5956.161	-0.68624	0.086451	-7.93793	2.06E-15	2.76E-14	-1
CALM2	ENSG00000143933	54685.83	-0.68695	0.148731	-4.61876	3.86E-06	1.60E-05	-1
MLEC	ENSG00000110917	13224.95	-0.68813	0.075886	-9.06785	1.21E-19	2.44E-18	-1
RCN2	ENSG00000117906	6042.985	-0.68911	0.093274	-7.38807	1.49E-13	1.61E-12	-1
ERBB2	ENSG00000141736	6788.299	-0.68913	0.093361	-7.3814	1.57E-13	1.69E-12	-1
AC006058.	ENSG00000261786	654.4224	-0.68938	0.217009	-3.17676	0.0014893	0.0036179	-1
GALNT7	ENSG00000109586	6025.653	-0.68989	0.081163	-8.50002	1.90E-17	3.11E-16	-1
ATF7IP	ENSG00000171681	4452.488	-0.69062	0.097416	-7.08937	1.35E-12	1.31E-11	-1
LDOC1	ENSG00000182195	4181.838	-0.69083	0.1091	-6.33202	2.42E-10	1.82E-09	-1
SEMA4F	ENSG00000135622	1766.546	-0.69199	0.09651	-7.17012	7.49E-13	7.58E-12	-1
ATF5	ENSG00000169136	883.7682	-0.69213	0.111692	-6.19676	5.76E-10	4.14E-09	-1
MDGA1	ENSG00000112139	852.5275	-0.69332	0.158267	-4.3807	1.18E-05	4.44E-05	-1

EFCAB14	ENSG00000159658	9530.023	-0.69346	0.093872	-7.38731	1.50E-13	1.62E-12	-1
RMND5A	ENSG00000153561	4087.709	-0.69352	0.090145	-7.69344	1.43E-14	1.76E-13	-1
ZDHHC24	ENSG00000174165	1243.747	-0.69364	0.123568	-5.61345	1.98E-08	1.16E-07	-1
LINC02210	ENSG00000204650	571.5733	-0.69498	0.147745	-4.70394	2.55E-06	1.09E-05	-1
FURIN	ENSG00000140564	5704.849	-0.69509	0.079254	-8.77037	1.78E-18	3.20E-17	-1
SORBS2	ENSG00000154556	965.4576	-0.69638	0.136446	-5.10373	3.33E-07	1.63E-06	-1
MT-ND6	ENSG00000198695	14450.19	-0.69655	0.150174	-4.63826	3.51E-06	1.46E-05	-1
NDUFA1	ENSG00000125356	2673.313	-0.69708	0.164535	-4.23668	2.27E-05	8.08E-05	-1
LDHA	ENSG00000134333	43855.78	-0.69781	0.099292	-7.02786	2.10E-12	1.97E-11	-1
ZNF469	ENSG00000225614	713.5297	-0.69783	0.208111	-3.35315	0.000799	0.0020664	-1
GRK5	ENSG00000198873	771.6127	-0.6988	0.120677	-5.79065	7.01E-09	4.36E-08	-1
GPD1L	ENSG00000152642	1286.758	-0.69884	0.097581	-7.16165	7.97E-13	8.02E-12	-1
KLHL21	ENSG00000162413	4025.695	-0.69979	0.133628	-5.23688	1.63E-07	8.35E-07	-1
SHROOM3	ENSG00000138771	2702.047	-0.69984	0.09194	-7.61187	2.70E-14	3.18E-13	-1
CCDC77	ENSG00000120647	1915.697	-0.69985	0.130511	-5.36236	8.21E-08	4.40E-07	-1
SMAD9	ENSG00000120693	814.4217	-0.70084	0.151339	-4.63093	3.64E-06	1.51E-05	-1
ALS2CL	ENSG00000178038	556.9366	-0.70124	0.179332	-3.91031	9.22E-05	0.0002908	-1
PTTG1	ENSG00000164611	6937.726	-0.70134	0.119484	-5.86975	4.36E-09	2.80E-08	-1
IDH1	ENSG00000138413	6726.287	-0.70144	0.082309	-8.52201	1.57E-17	2.60E-16	-1
BRD8	ENSG00000112983	8675.707	-0.70155	0.089664	-7.82422	5.11E-15	6.66E-14	-1
NCAPD2	ENSG00000010292	21073.97	-0.70161	0.078349	-8.95496	3.40E-19	6.52E-18	-1
ADAMTS7	ENSG00000136378	1747.055	-0.70187	0.12956	-5.41734	6.05E-08	3.29E-07	-1
CAT	ENSG00000121691	2100.971	-0.70239	0.119145	-5.89525	3.74E-09	2.41E-08	-1
SH3BGRL	ENSG00000131171	2518.37	-0.70294	0.12574	-5.59043	2.27E-08	1.31E-07	-1
AGPAT3	ENSG00000160216	6296.865	-0.70298	0.143913	-4.88476	1.04E-06	4.68E-06	-1
ADAMTS14	ENSG00000138316	1521.796	-0.70366	0.105663	-6.65949	2.75E-11	2.30E-10	-1
PORCN	ENSG00000102312	1874.558	-0.70433	0.108905	-6.46735	9.97E-11	7.82E-10	-1
BNIP3L	ENSG00000104765	13297.82	-0.70654	0.103543	-6.82361	8.88E-12	7.72E-11	-1
MIEF2	ENSG00000177427	1453.612	-0.7066	0.108296	-6.5247	6.81E-11	5.46E-10	-1
PLEC	ENSG00000178209	89817.3	-0.70702	0.310919	-2.27398	0.0229671	0.0417933	-1
PTK7	ENSG00000112655	8915.343	-0.70754	0.089367	-7.91724	2.43E-15	3.24E-14	-1
SLC4A8	ENSG00000050438	2881.775	-0.70766	0.083239	-8.50151	1.87E-17	3.07E-16	-1
TMEM30A	ENSG00000112697	14194.71	-0.70791	0.076005	-9.31399	1.23E-20	2.64E-19	-1
AGO4	ENSG00000134698	2678.27	-0.70842	0.093629	-7.5663	3.84E-14	4.45E-13	-1
HCG11	ENSG00000228223	642.2624	-0.70853	0.132643	-5.34158	9.21E-08	4.89E-07	-1
FOXK1	ENSG00000164916	2781.829	-0.70866	0.12737	-5.56382	2.64E-08	1.51E-07	-1
HDAC5	ENSG00000108840	3676.781	-0.70877	0.13126	-5.39979	6.67E-08	3.62E-07	-1
ANLN	ENSG00000011426	40612.02	-0.71102	0.084096	-8.45488	2.79E-17	4.51E-16	-1
SETD1B	ENSG00000139718	2018.474	-0.71115	0.142109	-5.00428	5.61E-07	2.64E-06	-1
KIAA1549	ENSG00000122778	965.5543	-0.71178	0.176063	-4.04278	5.28E-05	0.0001747	-1
GPRC5B	ENSG00000167191	1097.139	-0.71252	0.143084	-4.97972	6.37E-07	2.97E-06	-1
LIPA	ENSG00000107798	10537.23	-0.71255	0.111345	-6.3995	1.56E-10	1.19E-09	-1
TMEM173	ENSG00000184584	1741.491	-0.71296	0.111172	-6.41312	1.43E-10	1.10E-09	-1
TCEANC2	ENSG00000116205	1281.23	-0.71331	0.136145	-5.23936	1.61E-07	8.27E-07	-1
S100A10	ENSG00000197747	24532.46	-0.71454	0.083361	-8.57165	1.02E-17	1.72E-16	-1
CEBPZOS	ENSG00000218739	1985.877	-0.71465	0.109555	-6.5232	6.88E-11	5.51E-10	-1
VKORC1L1	ENSG00000196715	6198.033	-0.71481	0.103503	-6.90623	4.98E-12	4.46E-11	-1

MELTF	ENSG00000163975	7780.713	-0.71542	0.113286	-6.31519	2.70E-10	2.02E-09	-1
TAP1	ENSG00000168394	2416.639	-0.71661	0.095317	-7.51813	5.56E-14	6.34E-13	-1
MAP3K5	ENSG00000197442	842.3224	-0.71725	0.169864	-4.2225	2.42E-05	8.52E-05	-1
MAST3	ENSG00000099308	860.8906	-0.71741	0.145693	-4.92411	8.47E-07	3.88E-06	-1
NDUFA4	ENSG00000189043	4241.765	-0.71747	0.165331	-4.33958	1.43E-05	5.26E-05	-1
CD9	ENSG00000010278	10553.26	-0.71779	0.12954	-5.54109	3.01E-08	1.70E-07	-1
RTL8C	ENSG00000134590	6316.781	-0.71779	0.083289	-8.61809	6.81E-18	1.16E-16	-1
TBL1XR1	ENSG00000177565	7634.345	-0.7181	0.073158	-9.81573	9.63E-23	2.33E-21	-1
TPST2	ENSG00000128294	2803.978	-0.71922	0.087055	-8.26171	1.44E-16	2.18E-15	-1
SNRPD2	ENSG00000125743	6822.837	-0.71981	0.183444	-3.92386	8.71E-05	0.0002763	-1
ATL1	ENSG00000198513	978.2805	-0.71988	0.123108	-5.84755	4.99E-09	3.18E-08	-1
HACD4	ENSG00000188921	555.3472	-0.72023	0.130577	-5.51577	3.47E-08	1.96E-07	-1
SHISA2	ENSG00000180730	3563.288	-0.7205	0.159207	-4.52554	6.02E-06	2.40E-05	-1
IQSEC1	ENSG00000144711	2529.92	-0.72076	0.155109	-4.64678	3.37E-06	1.41E-05	-1
WFS1	ENSG00000109501	4423.485	-0.72086	0.126909	-5.68011	1.35E-08	8.06E-08	-1
EIF2AK2	ENSG00000055332	6951.701	-0.7211	0.082468	-8.74401	2.25E-18	4.01E-17	-1
ABTB1	ENSG00000114626	1892.353	-0.72129	0.117246	-6.15194	7.65E-10	5.38E-09	-1
ARHGAP23	ENSG00000275832	11467.58	-0.72288	0.117144	-6.17082	6.79E-10	4.82E-09	-1
AMPD3	ENSG00000133805	943.3208	-0.72309	0.105417	-6.8593	6.92E-12	6.11E-11	-1
STXBP4	ENSG00000166263	1415.119	-0.72317	0.117714	-6.14348	8.07E-10	5.67E-09	-1
NDUFS5	ENSG00000168653	5776.403	-0.72327	0.110221	-6.56193	5.31E-11	4.32E-10	-1
RBX1	ENSG00000100387	3331.935	-0.72339	0.167183	-4.3269	1.51E-05	5.56E-05	-1
CD109	ENSG00000156535	10588.92	-0.72365	0.100125	-7.22747	4.92E-13	5.10E-12	-1
IMPDH1	ENSG00000106348	5046.593	-0.72468	0.093045	-7.78846	6.78E-15	8.67E-14	-1
ACYP1	ENSG00000119640	601.9788	-0.72593	0.163293	-4.44554	8.77E-06	3.38E-05	-1
METRN	ENSG00000103260	2149.749	-0.72659	0.130942	-5.54893	2.87E-08	1.64E-07	-1
TYRO3	ENSG00000092445	2907.317	-0.7268	0.080792	-8.99589	2.34E-19	4.59E-18	-1
SLC35B4	ENSG00000205060	3650.343	-0.72719	0.093786	-7.75364	8.93E-15	1.12E-13	-1
EXTL2	ENSG00000162694	1644.832	-0.7273	0.113123	-6.42923	1.28E-10	9.92E-10	-1
ANKRD52	ENSG00000139645	13224.39	-0.7296	0.130129	-5.60675	2.06E-08	1.20E-07	-1
NRM	ENSG00000137404	3919.245	-0.7301	0.101663	-7.1816	6.89E-13	7.00E-12	-1
TAPBP	ENSG00000231925	4622.137	-0.73045	0.102992	-7.09231	1.32E-12	1.28E-11	-1
C1QTNF1	ENSG00000173918	778.6983	-0.73064	0.139035	-5.25506	1.48E-07	7.64E-07	-1
NT5DC2	ENSG00000168268	8625.529	-0.73084	0.095998	-7.61304	2.68E-14	3.16E-13	-1
PTPRJ	ENSG00000149177	5051.752	-0.73099	0.122862	-5.94967	2.69E-09	1.77E-08	-1
GTF2H5	ENSG00000272047	1803.694	-0.73141	0.10887	-6.71819	1.84E-11	1.56E-10	-1
SEMA4D	ENSG00000187764	635.313	-0.73149	0.137736	-5.31085	1.09E-07	5.72E-07	-1
FGD4	ENSG00000139132	705.8352	-0.73195	0.141492	-5.17311	2.30E-07	1.15E-06	-1
TMSB10	ENSG00000034510	54448.58	-0.73196	0.147929	-4.94805	7.50E-07	3.46E-06	-1
FLOT2	ENSG00000132589	8169.32	-0.73214	0.08044	-9.10164	8.90E-20	1.80E-18	-1
OAS3	ENSG00000111331	4723.305	-0.73214	0.134756	-5.43306	5.54E-08	3.04E-07	-1
BNC2	ENSG00000173068	1073.334	-0.73254	0.136628	-5.36156	8.25E-08	4.42E-07	-1
TSPYL4	ENSG00000187189	3716.051	-0.73273	0.102332	-7.16028	8.05E-13	8.09E-12	-1
FHDC1	ENSG00000137460	1533.636	-0.73289	0.183448	-3.99511	6.47E-05	0.0002103	-1
PRKCD	ENSG00000163932	1658.503	-0.73326	0.103659	-7.07378	1.51E-12	1.45E-11	-1
ANKRD9	ENSG00000156381	3023.914	-0.73375	0.119178	-6.15674	7.43E-10	5.23E-09	-1
RBBP6	ENSG00000122257	5619.073	-0.73557	0.084256	-8.73017	2.54E-18	4.51E-17	-1

FAM213B	ENSG00000157870	1875.865	-0.73626	0.112918	-6.52028	7.02E-11	5.61E-10	-1
TNRC6A	ENSG00000090905	5919.843	-0.7366	0.084257	-8.74231	2.28E-18	4.07E-17	-1
SLC17A5	ENSG00000119899	1810.03	-0.73683	0.108123	-6.81477	9.44E-12	8.20E-11	-1
RNPC3	ENSG00000185946	860.6216	-0.738	0.15407	-4.79006	1.67E-06	7.33E-06	-1
NEO1	ENSG00000067141	2790.34	-0.73813	0.101925	-7.24186	4.43E-13	4.61E-12	-1
TMEM50A	ENSG00000183726	9615.742	-0.73852	0.095296	-7.74974	9.21E-15	1.15E-13	-1
DAG1	ENSG00000173402	21922.97	-0.7387	0.092059	-8.02419	1.02E-15	1.42E-14	-1
FAIM	ENSG00000158234	576.8944	-0.73928	0.139995	-5.28077	1.29E-07	6.70E-07	-1
MGST3	ENSG00000143198	5196.408	-0.73962	0.082809	-8.93162	4.20E-19	7.99E-18	-1
HPCAL1	ENSG00000115756	11121.63	-0.73986	0.113524	-6.51716	7.17E-11	5.72E-10	-1
USP46	ENSG00000109189	2078.483	-0.74107	0.095795	-7.73601	1.03E-14	1.28E-13	-1
ABCD3	ENSG00000117528	4080.446	-0.74205	0.084918	-8.73834	2.37E-18	4.21E-17	-1
SLC27A3	ENSG00000143554	987.2329	-0.74224	0.133345	-5.56628	2.60E-08	1.49E-07	-1
MATN2	ENSG00000132561	8204.04	-0.74318	0.115711	-6.42273	1.34E-10	1.04E-09	-1
PIGZ	ENSG00000119227	601.4795	-0.74342	0.167817	-4.42992	9.43E-06	3.61E-05	-1
SNTB2	ENSG00000168807	4511.001	-0.74363	0.107672	-6.90643	4.97E-12	4.46E-11	-1
MREG	ENSG00000118242	599.7895	-0.7437	0.168607	-4.41085	1.03E-05	3.91E-05	-1
H2AFV	ENSG00000105968	21478.83	-0.74386	0.077624	-9.58289	9.44E-22	2.17E-20	-1
ATP5MF	ENSG00000241468	1550.852	-0.74455	0.162809	-4.57316	4.80E-06	1.95E-05	-1
TBC1D4	ENSG00000136111	2505.926	-0.74456	0.09706	-7.67118	1.70E-14	2.07E-13	-1
GALNT2	ENSG00000143641	13907.39	-0.74484	0.090823	-8.20101	2.38E-16	3.56E-15	-1
CRYZ	ENSG00000116791	1762.121	-0.74599	0.128871	-5.78862	7.10E-09	4.41E-08	-1
HBP1	ENSG00000105856	2559.729	-0.74658	0.12886	-5.79371	6.88E-09	4.29E-08	-1
TCTN2	ENSG00000168778	1303.568	-0.74697	0.118804	-6.28743	3.23E-10	2.39E-09	-1
PIP4K2B	ENSG00000276293	7391.116	-0.74949	0.127996	-5.8556	4.75E-09	3.03E-08	-1
CAB39L	ENSG00000102547	539.9521	-0.74967	0.172459	-4.34696	1.38E-05	5.11E-05	-1
SPTBN2	ENSG00000173898	1235.094	-0.74974	0.160374	-4.67493	2.94E-06	1.24E-05	-1
ATP6V0E1	ENSG00000113732	7601.26	-0.75105	0.11191	-6.71124	1.93E-11	1.63E-10	-1
B3GALNT1	ENSG00000169255	607.5198	-0.75108	0.163579	-4.59154	4.40E-06	1.80E-05	-1
	ENSG00000288558	753.1144	-0.75112	0.133062	-5.64486	1.65E-08	9.78E-08	-1
UBE4B	ENSG00000130939	5816.345	-0.75129	0.117251	-6.40753	1.48E-10	1.14E-09	-1
UHMK1	ENSG00000152332	17501.9	-0.75159	0.112985	-6.65212	2.89E-11	2.42E-10	-1
PCF11	ENSG00000165494	3403.636	-0.75161	0.102037	-7.3661	1.76E-13	1.89E-12	-1
TYSND1	ENSG00000156521	1122.269	-0.752	0.114685	-6.55711	5.49E-11	4.45E-10	-1
CSF1	ENSG00000184371	1721.746	-0.7522	0.098169	-7.66238	1.83E-14	2.21E-13	-1
FAM8A1	ENSG00000137414	1921.349	-0.75243	0.104995	-7.16632	7.70E-13	7.78E-12	-1
COX7A2	ENSG00000112695	3806.893	-0.75248	0.172698	-4.35722	1.32E-05	4.90E-05	-1
MED31	ENSG00000108590	557.8425	-0.75353	0.22217	-3.3917	0.0006946	0.0018187	-1
KLHDC3	ENSG00000124702	5917.822	-0.75553	0.099197	-7.61648	2.61E-14	3.09E-13	-1
ADAMTS12	ENSG00000151388	4745.373	-0.75611	0.118502	-6.38059	1.76E-10	1.35E-09	-1
FZD7	ENSG00000155760	2612.498	-0.75681	0.107139	-7.06383	1.62E-12	1.55E-11	-1
SPACA6	ENSG00000182310	524.618	-0.75698	0.169078	-4.47711	7.57E-06	2.95E-05	-1
NPTXR	ENSG00000221890	1874.959	-0.75744	0.142509	-5.31498	1.07E-07	5.60E-07	-1
RIN1	ENSG00000174791	1863.925	-0.75795	0.162017	-4.67822	2.89E-06	1.22E-05	-1
GEMIN6	ENSG00000152147	791.7088	-0.75898	0.165591	-4.58348	4.57E-06	1.86E-05	-1
LAMTOR4	ENSG00000188186	2134.014	-0.7597	0.128864	-5.89537	3.74E-09	2.41E-08	-1
TRIM25	ENSG00000121060	9844.099	-0.75978	0.13112	-5.79454	6.85E-09	4.28E-08	-1

CCDC85C	ENSG00000205476	3505.883	-0.76056	0.134483	-5.65542	1.55E-08	9.21E-08	-1
ATP5MD	ENSG00000173915	3184.464	-0.76152	0.12494	-6.09507	1.09E-09	7.55E-09	-1
GNPTAB	ENSG00000111670	5204.102	-0.76155	0.088483	-8.6068	7.51E-18	1.28E-16	-1
TMEM245	ENSG00000106771	11020.54	-0.76184	0.095018	-8.01789	1.08E-15	1.49E-14	-1
CCDC102A	ENSG00000135736	669.6809	-0.76269	0.161479	-4.72316	2.32E-06	1.00E-05	-1
ZFC3H1	ENSG00000133858	3785.038	-0.76301	0.121555	-6.27707	3.45E-10	2.54E-09	-1
EVPL	ENSG00000167880	1684.755	-0.76321	0.140828	-5.41946	5.98E-08	3.26E-07	-1
TMEM132	ENSG00000006118	2211.66	-0.76442	0.107718	-7.09651	1.28E-12	1.25E-11	-1
FAM53B	ENSG00000189319	1190.818	-0.76487	0.149665	-5.11055	3.21E-07	1.58E-06	-1
CEP68	ENSG00000011523	1605.667	-0.76625	0.100632	-7.6144	2.65E-14	3.13E-13	-1
TFAP2A	ENSG00000137203	4514.673	-0.76689	0.133362	-5.7505	8.90E-09	5.45E-08	-1
TRANK1	ENSG00000168016	1178.9	-0.76696	0.22553	-3.40069	0.0006722	0.0017637	-1
CALM3	ENSG00000160014	20474.39	-0.77058	0.073664	-10.4608	1.31E-25	3.76E-24	-1
TRAPPC1	ENSG00000170043	4104.291	-0.77101	0.103193	-7.47152	7.93E-14	8.84E-13	-1
MFSD5	ENSG00000182544	1807.994	-0.77205	0.08937	-8.63885	5.68E-18	9.80E-17	-1
ARL10	ENSG00000175414	3471.347	-0.77244	0.149649	-5.1617	2.45E-07	1.22E-06	-1
	ENSG00000289353	574.3497	-0.77581	0.151506	-5.12068	3.04E-07	1.50E-06	-1
C21orf58	ENSG00000160298	1868.697	-0.7773	0.132432	-5.86941	4.37E-09	2.80E-08	-1
MEST	ENSG00000106484	9718.066	-0.77735	0.089264	-8.70847	3.08E-18	5.43E-17	-1
UBA7	ENSG00000182179	1737.741	-0.77829	0.109924	-7.08021	1.44E-12	1.39E-11	-1
SACS	ENSG00000151835	10343.58	-0.7794	0.283256	-2.75158	0.0059309	0.0124741	-1
RGS4	ENSG00000117152	2215.546	-0.77947	0.207338	-3.75941	0.0001703	0.0005059	-1
LRRC17	ENSG00000128606	998.4535	-0.77953	0.177089	-4.40189	1.07E-05	4.07E-05	-1
CERK	ENSG00000100422	4862.286	-0.77958	0.084949	-9.17713	4.43E-20	9.21E-19	-1
RAB3B	ENSG00000169213	15424.43	-0.78007	0.123282	-6.3275	2.49E-10	1.87E-09	-1
PANK1	ENSG00000152782	903.157	-0.78045	0.197026	-3.96116	7.46E-05	0.0002389	-1
SLC12A9	ENSG00000146828	2652.425	-0.78059	0.121943	-6.40127	1.54E-10	1.18E-09	-1
SEMA4B	ENSG00000185033	3545.717	-0.78174	0.100029	-7.81519	5.49E-15	7.12E-14	-1
ZBTB44	ENSG00000196323	4072.631	-0.782	0.092675	-8.43808	3.23E-17	5.16E-16	-1
MGAT5	ENSG00000152127	4743.816	-0.78312	0.097618	-8.02224	1.04E-15	1.44E-14	-1
NDST1	ENSG00000070614	28419.31	-0.78322	0.111064	-7.052	1.76E-12	1.68E-11	-1
WBP1L	ENSG00000166272	4503.395	-0.78455	0.129909	-6.03925	1.55E-09	1.05E-08	-1
PCDHGB7	ENSG00000254122	828.558	-0.78465	0.143546	-5.46617	4.60E-08	2.54E-07	-1
FAM46A	ENSG00000112773	696.5595	-0.78514	0.131967	-5.94947	2.69E-09	1.77E-08	-1
SMO	ENSG00000128602	628.1151	-0.78547	0.170754	-4.6	4.23E-06	1.73E-05	-1
GXYLT1	ENSG00000151233	4052.159	-0.78554	0.105196	-7.46737	8.18E-14	9.10E-13	-1
SYNM	ENSG00000182253	1616.777	-0.78649	0.156465	-5.02663	4.99E-07	2.37E-06	-1
TUBB	ENSG00000196230	124160.8	-0.7888	0.086588	-9.10984	8.25E-20	1.68E-18	-1
PLXNB2	ENSG00000196576	19111.45	-0.7896	0.113127	-6.9798	2.96E-12	2.74E-11	-1
CYBRD1	ENSG00000071967	16537.24	-0.79078	0.110097	-7.18259	6.84E-13	6.96E-12	-1
TOP2A	ENSG00000131747	39348.11	-0.79098	0.108296	-7.30392	2.79E-13	2.96E-12	-1
ELMOD2	ENSG00000179387	2073.036	-0.79111	0.128944	-6.13531	8.50E-10	5.95E-09	-1
PGAP1	ENSG00000197121	1515.867	-0.79377	0.153279	-5.1786	2.24E-07	1.12E-06	-1
MT-ND3	ENSG00000198840	13636.34	-0.79417	0.164563	-4.82593	1.39E-06	6.20E-06	-1
NALCN	ENSG00000102452	849.2561	-0.79497	0.141116	-5.63346	1.77E-08	1.04E-07	-1
FITM2	ENSG00000197296	1380.417	-0.79498	0.105595	-7.52852	5.13E-14	5.87E-13	-1
EIF4E2	ENSG00000135930	4175.716	-0.79536	0.106726	-7.45233	9.17E-14	1.01E-12	-1

SIX5	ENSG00000177045	517.6124	-0.79576	0.169217	-4.70261	2.57E-06	1.10E-05	-1
TUBB4B	ENSG00000188229	43685.94	-0.79669	0.088933	-8.95828	3.30E-19	6.35E-18	-1
ARHGAP19	ENSG00000213390	1880.93	-0.79874	0.10228	-7.80929	5.75E-15	7.42E-14	-1
TCFL5	ENSG00000101190	1392.063	-0.79937	0.123397	-6.47805	9.29E-11	7.32E-10	-1
ATP5MC3	ENSG00000154518	6666.537	-0.79943	0.111991	-7.13837	9.44E-13	9.40E-12	-1
EID1	ENSG00000255302	13713.96	-0.80059	0.091092	-8.78881	1.51E-18	2.73E-17	-1
FZD1	ENSG00000157240	940.2713	-0.80137	0.127384	-6.29104	3.15E-10	2.34E-09	-1
DLGAP5	ENSG00000126787	6839.366	-0.80299	0.152289	-5.27279	1.34E-07	6.99E-07	-1
RARG	ENSG00000172819	3126.914	-0.8055	0.134834	-5.97399	2.32E-09	1.53E-08	-1
TTK	ENSG00000112742	5322.737	-0.80562	0.1241	-6.49168	8.49E-11	6.72E-10	-1
APOBEC3C	ENSG00000244509	3206.878	-0.80562	0.114394	-7.0425	1.89E-12	1.79E-11	-1
IGFL2-AS1	ENSG00000268621	617.087	-0.80591	0.221981	-3.63053	0.0002828	0.0008068	-1
ADGRL2	ENSG00000117114	9169.9	-0.80664	0.084179	-9.58246	9.48E-22	2.17E-20	-1
IGFBP4	ENSG00000141753	15302.82	-0.80763	0.164305	-4.91541	8.86E-07	4.05E-06	-1
TMEM80	ENSG00000177042	1326.858	-0.80934	0.153121	-5.28565	1.25E-07	6.53E-07	-1
MANEA	ENSG00000172469	1355.66	-0.80946	0.11284	-7.17352	7.31E-13	7.41E-12	-1
SLC16A2	ENSG00000147100	1319.546	-0.81019	0.140325	-5.77368	7.76E-09	4.79E-08	-1
RPS6KA4	ENSG00000162302	4771.119	-0.81174	0.099062	-8.19428	2.52E-16	3.75E-15	-1
OLFML2A	ENSG00000185585	2794.724	-0.81234	0.106878	-7.60059	2.95E-14	3.46E-13	-1
ST3GAL5	ENSG00000115525	1072.401	-0.81235	0.118251	-6.86966	6.44E-12	5.71E-11	-1
FAM210B	ENSG00000124098	4626.731	-0.81268	0.099764	-8.14609	3.76E-16	5.45E-15	-1
CCDC80	ENSG00000091986	12672.13	-0.81342	0.115059	-7.06958	1.55E-12	1.49E-11	-1
NFIA	ENSG00000162599	1323.467	-0.81517	0.162722	-5.00959	5.45E-07	2.57E-06	-1
ICK	ENSG00000112144	3707.008	-0.81757	0.118303	-6.91084	4.82E-12	4.33E-11	-1
TSPAN18	ENSG00000157570	1182.646	-0.81772	0.132915	-6.15223	7.64E-10	5.38E-09	-1
EML1	ENSG00000066629	924.898	-0.81837	0.119139	-6.86909	6.46E-12	5.72E-11	-1
SLC25A12	ENSG00000115840	1065.451	-0.81926	0.119496	-6.85591	7.09E-12	6.25E-11	-1
CDKN2D	ENSG00000129355	983.8669	-0.81954	0.143638	-5.70557	1.16E-08	7.01E-08	-1
FAM102B	ENSG00000162636	2359.693	-0.82024	0.107359	-7.64013	2.17E-14	2.62E-13	-1
GPR161	ENSG00000143147	3900.441	-0.8205	0.104989	-7.81506	5.49E-15	7.12E-14	-1
ZBED1	ENSG00000214717	1547.836	-0.82061	0.113955	-7.20116	5.97E-13	6.13E-12	-1
WRB	ENSG00000182093	968.366	-0.82103	0.120956	-6.78784	1.14E-11	9.82E-11	-1
NDUFB4	ENSG00000065518	2508.196	-0.82106	0.085734	-9.57686	1.00E-21	2.29E-20	-1
SLC38A4	ENSG00000139209	832.2103	-0.82143	0.13706	-5.99319	2.06E-09	1.37E-08	-1
HOXB7	ENSG00000260027	997.7507	-0.82182	0.160993	-5.10467	3.31E-07	1.62E-06	-1
LPCAT4	ENSG00000176454	1605.872	-0.82262	0.107975	-7.61866	2.56E-14	3.05E-13	-1
AHNAK	ENSG00000124942	94302.53	-0.82304	0.319536	-2.57574	0.0100026	0.0199388	-1
DSTYK	ENSG00000133059	4121.275	-0.8238	0.119017	-6.92169	4.46E-12	4.04E-11	-1
SAMD1	ENSG00000141858	3195.583	-0.8239	0.104919	-7.85267	4.07E-15	5.34E-14	-1
ADCY1	ENSG00000164742	794.9962	-0.82398	0.179925	-4.5796	4.66E-06	1.90E-05	-1
SCAI	ENSG00000173611	999.7472	-0.82419	0.118556	-6.95188	3.60E-12	3.31E-11	-1
MARVELD1	ENSG00000155254	5344.388	-0.82503	0.109399	-7.54152	4.65E-14	5.33E-13	-1
SLC44A1	ENSG00000070214	4507.992	-0.826	0.092393	-8.94012	3.89E-19	7.42E-18	-1
TRIM22	ENSG00000132274	730.6261	-0.82633	0.15949	-5.18107	2.21E-07	1.11E-06	-1
VASH1	ENSG00000071246	1088.035	-0.82885	0.134439	-6.16525	7.04E-10	4.98E-09	-1
BUB1B	ENSG00000156970	7682.391	-0.83053	0.119484	-6.95098	3.63E-12	3.33E-11	-1
ABHD15	ENSG00000168792	1384.847	-0.83058	0.099777	-8.32436	8.48E-17	1.30E-15	-1

PDK2	ENSG00000005882	2305.729	-0.83111	0.135115	-6.15114	7.69E-10	5.41E-09	-1
VASH2	ENSG00000143494	650.4383	-0.83405	0.164415	-5.07286	3.92E-07	1.89E-06	-1
C1QTNF2	ENSG00000145861	564.2535	-0.83533	0.147152	-5.67663	1.37E-08	8.21E-08	-1
NARF	ENSG00000141562	3365.364	-0.83824	0.102299	-8.19404	2.53E-16	3.75E-15	-1
NUP210	ENSG00000132182	2275.043	-0.83831	0.167997	-4.99006	6.04E-07	2.83E-06	-1
KLHDC8B	ENSG00000185909	826.139	-0.8385	0.163171	-5.13882	2.76E-07	1.37E-06	-1
GAS6-AS2	ENSG00000272695	785.0759	-0.83935	0.117004	-7.17366	7.30E-13	7.41E-12	-1
ATL3	ENSG00000184743	11929.62	-0.83963	0.097302	-8.62915	6.18E-18	1.06E-16	-1
DGCR2	ENSG00000070413	5913.38	-0.83984	0.112462	-7.46777	8.16E-14	9.08E-13	-1
MST1R	ENSG00000164078	505.325	-0.83992	0.153846	-5.45948	4.78E-08	2.64E-07	-1
NXPE3	ENSG00000144815	4790.827	-0.84011	0.100618	-8.34954	6.85E-17	1.06E-15	-1
NPEPPS	ENSG00000141279	13435.03	-0.84017	0.102217	-8.21941	2.05E-16	3.07E-15	-1
ANP32A	ENSG00000140350	5234.523	-0.84021	0.082578	-10.1747	2.57E-24	6.82E-23	-1
FUCA1	ENSG00000179163	1028.74	-0.84244	0.106033	-7.94506	1.94E-15	2.62E-14	-1
TMEM255	ENSG00000125355	2515.311	-0.84296	0.101091	-8.33865	7.51E-17	1.16E-15	-1
PIN4	ENSG00000102309	912.455	-0.84323	0.123398	-6.8334	8.29E-12	7.25E-11	-1
TBC1D14	ENSG00000132405	2103.122	-0.84414	0.094525	-8.93036	4.25E-19	8.07E-18	-1
TMEM189	ENSG00000240849	3441.993	-0.84505	0.081459	-10.374	3.26E-25	9.13E-24	-1
B4GALT6	ENSG00000118276	1573.038	-0.85052	0.168154	-5.05798	4.24E-07	2.03E-06	-1
PML	ENSG00000140464	4411.038	-0.85088	0.11096	-7.66836	1.74E-14	2.12E-13	-1
FBXO33	ENSG00000165355	1498.314	-0.85238	0.114886	-7.41933	1.18E-13	1.29E-12	-1
COL4A1	ENSG00000187498	9290.958	-0.85259	0.119498	-7.13475	9.70E-13	9.63E-12	-1
MANSC1	ENSG00000111261	731.3247	-0.85311	0.136406	-6.25423	3.99E-10	2.92E-09	-1
VANGL1	ENSG00000173218	5330.34	-0.85344	0.119156	-7.16243	7.93E-13	7.99E-12	-1
NXT2	ENSG00000101888	933.2604	-0.8553	0.136709	-6.25635	3.94E-10	2.88E-09	-1
CYP27C1	ENSG00000186684	720.1717	-0.85542	0.120404	-7.10456	1.21E-12	1.18E-11	-1
RIPK4	ENSG00000183421	1527.108	-0.85576	0.14033	-6.09818	1.07E-09	7.42E-09	-1
SUMF1	ENSG00000144455	2377.633	-0.85757	0.108103	-7.93291	2.14E-15	2.87E-14	-1
ADCY9	ENSG00000162104	4631.259	-0.85838	0.130155	-6.59504	4.25E-11	3.49E-10	-1
SLC7A5	ENSG00000103257	124641.9	-0.85847	0.092351	-9.29574	1.46E-20	3.13E-19	-1
OLFML2B	ENSG00000162745	745.729	-0.85853	0.147112	-5.83591	5.35E-09	3.38E-08	-1
AL160006.	ENSG00000258634	524.6726	-0.85856	0.200513	-4.28183	1.85E-05	6.72E-05	-1
PSD3	ENSG00000156011	2666.653	-0.85913	0.155045	-5.54116	3.00E-08	1.70E-07	-1
ADCY6	ENSG00000174233	3993.188	-0.86007	0.134871	-6.37694	1.81E-10	1.37E-09	-1
S100A2	ENSG00000196754	838.2554	-0.86171	0.194732	-4.42509	9.64E-06	3.68E-05	-1
HEG1	ENSG00000173706	12706.75	-0.86378	0.111076	-7.77644	7.46E-15	9.46E-14	-1
SESTD1	ENSG00000187231	2537.061	-0.86447	0.095855	-9.01849	1.91E-19	3.76E-18	-1
ZNF483	ENSG00000173258	792.6131	-0.86464	0.183177	-4.72026	2.36E-06	1.01E-05	-1
ELOVL6	ENSG00000170522	10365.08	-0.87234	0.11164	-7.81387	5.55E-15	7.18E-14	-1
SYNJ2BP	ENSG00000213463	3170.92	-0.87283	0.098298	-8.87951	6.72E-19	1.25E-17	-1
ADGRB2	ENSG00000121753	1636.903	-0.87333	0.147502	-5.92082	3.20E-09	2.09E-08	-1
SLC46A3	ENSG00000139508	894.9625	-0.87401	0.113235	-7.71849	1.18E-14	1.46E-13	-1
KBTBD7	ENSG00000120696	597.5508	-0.8764	0.157358	-5.56948	2.56E-08	1.46E-07	-1
CRIPT	ENSG00000119878	1222.119	-0.87719	0.140295	-6.25247	4.04E-10	2.95E-09	-1
DAZAP2	ENSG00000183283	12666.12	-0.87989	0.077087	-11.4142	3.55E-30	1.32E-28	-1
ASIC1	ENSG00000110881	1240.287	-0.88135	0.138777	-6.35082	2.14E-10	1.62E-09	-1
RGS9	ENSG00000108370	556.0311	-0.88296	0.160233	-5.51045	3.58E-08	2.01E-07	-1

MYL6	ENSG00000092841	34061.87	-0.8834	0.147999	-5.96896	2.39E-09	1.58E-08	-1
BTN3A1	ENSG00000026950	885.1645	-0.88448	0.136378	-6.48553	8.84E-11	6.98E-10	-1
VAMP8	ENSG00000118640	1999.65	-0.88469	0.160647	-5.50702	3.65E-08	2.05E-07	-1
AR	ENSG00000169083	1051.432	-0.88602	0.169165	-5.23763	1.63E-07	8.33E-07	-1
OAZ2	ENSG00000180304	3885.627	-0.88647	0.08585	-10.3257	5.39E-25	1.49E-23	-1
C11orf95	ENSG00000188070	1119.409	-0.88786	0.106681	-8.32252	8.61E-17	1.32E-15	-1
SNRNP35	ENSG00000184209	782.7209	-0.88862	0.114402	-7.76754	8.00E-15	1.01E-13	-1
ACOT1	ENSG00000184227	610.4352	-0.89028	0.187329	-4.75252	2.01E-06	8.75E-06	-1
EOGT	ENSG00000163378	3796.412	-0.89077	0.095035	-9.37309	7.04E-21	1.53E-19	-1
VAMP1	ENSG00000139190	536.7039	-0.8908	0.167407	-5.32116	1.03E-07	5.43E-07	-1
POMK	ENSG00000185900	3163.287	-0.89414	0.087054	-10.2712	9.51E-25	2.58E-23	-1
AC125807.	ENSG00000250899	1382.505	-0.89542	0.155864	-5.74491	9.20E-09	5.62E-08	-1
APOL6	ENSG00000221963	1639.165	-0.89553	0.142959	-6.26423	3.75E-10	2.75E-09	-1
UNKL	ENSG00000059145	658.387	-0.89608	0.153685	-5.83061	5.52E-09	3.48E-08	-1
C2CD2	ENSG00000157617	6585.475	-0.89631	0.123395	-7.26374	3.77E-13	3.94E-12	-1
ADAM15	ENSG00000143537	8220.633	-0.89718	0.082931	-10.8184	2.82E-27	9.13E-26	-1
TLDC1	ENSG00000140950	1116.827	-0.89739	0.121718	-7.37274	1.67E-13	1.80E-12	-1
PIF1	ENSG00000140451	976.7839	-0.89837	0.130177	-6.9012	5.16E-12	4.61E-11	-1
CARHSP1	ENSG00000153048	1843.87	-0.89938	0.119546	-7.52331	5.34E-14	6.10E-13	-1
PLEKHM3	ENSG00000178385	1620.683	-0.89999	0.137438	-6.54833	5.82E-11	4.71E-10	-1
TRAM2	ENSG00000065308	38037.39	-0.90139	0.095623	-9.42651	4.24E-21	9.35E-20	-1
TGFBR3	ENSG00000069702	1659.866	-0.90536	0.15159	-5.9724	2.34E-09	1.55E-08	-1
C1GALT1C	ENSG00000171155	1519.796	-0.90639	0.138752	-6.53244	6.47E-11	5.20E-10	-1
GNG11	ENSG00000127920	1023.754	-0.90953	0.179098	-5.07841	3.81E-07	1.84E-06	-1
PLXNA1	ENSG00000114554	6472.206	-0.9114	0.121467	-7.50325	6.23E-14	7.05E-13	-1
NDUFB3	ENSG00000119013	1680.246	-0.91284	0.157302	-5.80311	6.51E-09	4.08E-08	-1
LOXL1-AS1	ENSG00000261801	1495.593	-0.91289	0.097462	-9.36655	7.49E-21	1.62E-19	-1
ARL6IP1	ENSG00000170540	17123.66	-0.91324	0.142033	-6.42978	1.28E-10	9.90E-10	-1
RTL8B	ENSG00000212747	1000.066	-0.91628	0.128053	-7.15544	8.34E-13	8.37E-12	-1
TNFAIP2	ENSG00000185215	4702.301	-0.91864	0.091129	-10.0807	6.73E-24	1.75E-22	-1
TMEM107	ENSG00000179029	616.9194	-0.92102	0.147098	-6.2613	3.82E-10	2.80E-09	-1
TUB	ENSG00000166402	905.2271	-0.92199	0.173002	-5.32935	9.86E-08	5.20E-07	-1
LAMC1	ENSG00000135862	25371.91	-0.92314	0.102751	-8.98428	2.60E-19	5.09E-18	-1
SUFU	ENSG00000107882	1627.306	-0.92739	0.130937	-7.08273	1.41E-12	1.37E-11	-1
PCMTD1	ENSG00000168300	1694.193	-0.92762	0.113536	-8.17026	3.08E-16	4.52E-15	-1
PPT2	ENSG00000221988	527.6538	-0.9293	0.165676	-5.60912	2.03E-08	1.18E-07	-1
TMEM168	ENSG00000146802	726.2472	-0.93054	0.179652	-5.1797	2.22E-07	1.12E-06	-1
CBX2	ENSG00000173894	750.3708	-0.93134	0.128805	-7.23067	4.81E-13	4.99E-12	-1
LRRC15	ENSG00000172061	621.1737	-0.93174	0.187122	-4.97933	6.38E-07	2.98E-06	-1
GATA2	ENSG00000179348	1398.756	-0.93518	0.127328	-7.34467	2.06E-13	2.21E-12	-1
RBFOX2	ENSG00000100320	15785.98	-0.93563	0.090016	-10.3941	2.64E-25	7.45E-24	-1
CDS2	ENSG00000101290	7343.355	-0.94496	0.07575	-12.4747	1.03E-35	4.97E-34	-1
C4orf3	ENSG00000164096	3322.593	-0.94555	0.083692	-11.298	1.34E-29	4.83E-28	-1
VASN	ENSG00000168140	3320.516	-0.94642	0.156645	-6.0418	1.52E-09	1.04E-08	-1
FAT4	ENSG00000196159	3510.385	-0.947	0.321658	-2.94413	0.0032386	0.0072676	-1
DUBR	ENSG00000243701	813.0878	-0.94976	0.132616	-7.16171	7.97E-13	8.02E-12	-1
MMP16	ENSG00000156103	1068.876	-0.95067	0.155724	-6.10483	1.03E-09	7.13E-09	-1

SUOX	ENSG00000139531	1069.759	-0.95192	0.126957	-7.49796	6.48E-14	7.32E-13	-1
ATRN	ENSG00000088812	9016.393	-0.95326	0.095806	-9.94986	2.53E-23	6.39E-22	-1
EEF2K	ENSG00000103319	2499.284	-0.95395	0.108202	-8.81632	1.18E-18	2.17E-17	-1
ARRDC3	ENSG00000113369	2789.285	-0.95401	0.132122	-7.22067	5.17E-13	5.35E-12	-1
EFNA5	ENSG00000184349	1450.05	-0.9541	0.135491	-7.04177	1.90E-12	1.80E-11	-1
ZBTB7B	ENSG00000160685	1197.183	-0.95444	0.134716	-7.08477	1.39E-12	1.35E-11	-1
STARD4-AS	ENSG00000246859	545.6831	-0.95475	0.252288	-3.78436	0.0001541	0.0004623	-1
CXADR	ENSG00000154639	825.9602	-0.95556	0.122832	-7.77944	7.28E-15	9.25E-14	-1
KIAA1147	ENSG00000257093	1892.012	-0.95925	0.109153	-8.78806	1.52E-18	2.74E-17	-1
LSM3	ENSG00000170860	3527.533	-0.96027	0.089088	-10.7789	4.33E-27	1.39E-25	-1
SAP30L	ENSG00000164576	5368.74	-0.9605	0.078372	-12.2557	1.57E-34	7.13E-33	-1
PDPN	ENSG00000162493	569.4408	-0.96093	0.15677	-6.12953	8.81E-10	6.15E-09	-1
SFT2D2	ENSG00000213064	4873.227	-0.96134	0.145512	-6.60664	3.93E-11	3.24E-10	-1
MARCKS	ENSG00000277443	23339.43	-0.9635	0.082531	-11.6743	1.72E-31	6.74E-30	-1
EHD1	ENSG00000110047	9397.249	-0.96381	0.105196	-9.16209	5.09E-20	1.05E-18	-1
ATP13A2	ENSG00000159363	3589.486	-0.96713	0.12491	-7.74262	9.74E-15	1.22E-13	-1
CCDC134	ENSG00000100147	1735.775	-0.96738	0.09212	-10.5013	8.52E-26	2.51E-24	-1
TM4SF1	ENSG00000169908	2814.464	-0.96971	0.130359	-7.43879	1.02E-13	1.12E-12	-1
MINDY1	ENSG00000143409	532.7205	-0.96995	0.139047	-6.97572	3.04E-12	2.82E-11	-1
PRSS23	ENSG00000150687	22005.95	-0.97007	0.079939	-12.1353	6.87E-34	3.00E-32	-1
VSIG10	ENSG00000176834	2104.915	-0.97036	0.092961	-10.4384	1.66E-25	4.72E-24	-1
MMP2	ENSG00000087245	6745.326	-0.97046	0.105756	-9.17642	4.46E-20	9.25E-19	-1
PLEKHG4B	ENSG00000153404	556.5185	-0.97149	0.215575	-4.5065	6.59E-06	2.60E-05	-1
SNRPD3	ENSG00000100028	2508.388	-0.97287	0.108949	-8.92956	4.28E-19	8.11E-18	-1
LRP4	ENSG00000134569	724.839	-0.97388	0.161125	-6.04426	1.50E-09	1.02E-08	-1
KIF20A	ENSG00000112984	13198.7	-0.97442	0.11538	-8.4453	3.03E-17	4.88E-16	-1
BCL2L11	ENSG00000153094	2846.226	-0.97676	0.15568	-6.27417	3.52E-10	2.59E-09	-1
KLF12	ENSG00000118922	2828.004	-0.97683	0.139068	-7.02412	2.15E-12	2.03E-11	-1
PARP9	ENSG00000138496	1138.419	-0.9803	0.135941	-7.21122	5.55E-13	5.71E-12	-1
PDE4A	ENSG00000065989	578.6961	-0.98055	0.188999	-5.18813	2.12E-07	1.07E-06	-1
AMMECR1	ENSG00000101935	1735.515	-0.9812	0.16941	-5.79186	6.96E-09	4.34E-08	-1
JRK	ENSG00000234616	4590.995	-0.98465	0.136371	-7.2204	5.18E-13	5.35E-12	-1
SLC12A6	ENSG00000140199	3792.237	-0.98532	0.115157	-8.55628	1.17E-17	1.95E-16	-1
PIANP	ENSG00000139200	742.62	-0.98749	0.176017	-5.6102	2.02E-08	1.18E-07	-1
PNPLA6	ENSG00000032444	4053.282	-0.9879	0.123464	-8.00158	1.23E-15	1.70E-14	-1
COX6B1	ENSG00000126267	4204.961	-0.98893	0.111168	-8.89587	5.80E-19	1.08E-17	-1
INSR	ENSG00000171105	1512.098	-0.98944	0.12261	-8.06979	7.04E-16	9.97E-15	-1
SCAMP5	ENSG00000198794	559.928	-0.99239	0.18669	-5.31573	1.06E-07	5.58E-07	-1
BTD	ENSG00000169814	4159.78	-0.99413	0.097896	-10.155	3.15E-24	8.29E-23	-1
NACC2	ENSG00000148411	2640.379	-0.99445	0.101755	-9.77295	1.47E-22	3.51E-21	-1
ADORA1	ENSG00000163485	604.8807	-0.99494	0.169529	-5.86883	4.39E-09	2.81E-08	-1
AC092747.	ENSG00000275764	665.9084	-0.99551	0.160644	-6.197	5.76E-10	4.14E-09	-1
EXTL3	ENSG00000012232	3580.586	-0.99644	0.097309	-10.2399	1.31E-24	3.52E-23	-1
NIPAL3	ENSG00000001461	5454.814	-0.99699	0.084238	-11.8354	2.56E-32	1.04E-30	-1
FBXO3	ENSG00000110429	2035.355	-0.9994	0.107929	-9.25975	2.05E-20	4.33E-19	-1
GLCE	ENSG00000138604	3927.699	-1.00082	0.097581	-10.2563	1.11E-24	2.99E-23	-1
ABCC5	ENSG00000114770	1799.066	-1.00182	0.134766	-7.43378	1.06E-13	1.16E-12	-1

ARHGDIB	ENSG00000111348	1895.323	-1.00272	0.128133	-7.82567	5.05E-15	6.59E-14	-1
FIGN	ENSG00000182263	1953.173	-1.00314	0.145766	-6.88188	5.91E-12	5.26E-11	-1
MMP15	ENSG00000102996	3272.261	-1.00474	0.126017	-7.97302	1.55E-15	2.11E-14	-1
TMEM246	ENSG00000165152	1632.737	-1.00501	0.095093	-10.5687	4.16E-26	1.26E-24	-1
ST6GALNA	ENSG00000117069	666.1346	-1.00775	0.178121	-5.65766	1.53E-08	9.11E-08	-1
HSPA1B	ENSG00000204388	1950.936	-1.01098	0.123308	-8.19887	2.43E-16	3.62E-15	-1
TSHZ1	ENSG00000179981	1037.093	-1.01125	0.103704	-9.75123	1.82E-22	4.33E-21	-1
KCTD3	ENSG00000136636	5873.474	-1.0124	0.095782	-10.5699	4.11E-26	1.24E-24	-1
HMGB3	ENSG00000029993	8236.939	-1.01748	0.091657	-11.1009	1.24E-28	4.25E-27	-1
LTBP2	ENSG00000119681	6326.603	-1.01832	0.148772	-6.84486	7.65E-12	6.73E-11	-1
CBX7	ENSG00000100307	990.2418	-1.01893	0.161067	-6.32612	2.51E-10	1.89E-09	-1
ERMP1	ENSG00000099219	879.3338	-1.01927	0.152525	-6.68268	2.35E-11	1.97E-10	-1
PTGFRN	ENSG00000134247	5507.86	-1.02014	0.088076	-11.5825	5.05E-31	1.95E-29	-1
ZMAT3	ENSG00000172667	2046.708	-1.02039	0.159452	-6.39936	1.56E-10	1.19E-09	-1
ERAP2	ENSG00000164308	8477.324	-1.02083	0.118	-8.65116	5.10E-18	8.84E-17	-1
ARRB1	ENSG00000137486	471.4836	-1.02212	0.183013	-5.58496	2.34E-08	1.35E-07	-1
PKP1	ENSG00000081277	628.6947	-1.02318	0.167787	-6.09807	1.07E-09	7.42E-09	-1
ABHD17C	ENSG00000136379	1055.922	-1.02386	0.105103	-9.7415	2.01E-22	4.75E-21	-1
FBXL16	ENSG00000127585	1825.659	-1.02404	0.137354	-7.45551	8.95E-14	9.91E-13	-1
PRR12	ENSG00000126464	2684.739	-1.0272	0.159007	-6.46007	1.05E-10	8.17E-10	-1
UNC119B	ENSG00000175970	3159.609	-1.02836	0.115934	-8.87023	7.30E-19	1.35E-17	-1
AHDC1	ENSG00000126705	2894.644	-1.02963	0.128264	-8.02746	9.95E-16	1.39E-14	-1
SMIM30	ENSG00000214194	532.2591	-1.03856	0.187358	-5.54319	2.97E-08	1.68E-07	-1
BAIAP2-AS	ENSG00000226137	1432.796	-1.03909	0.143683	-7.23181	4.77E-13	4.96E-12	-1
PSRC1	ENSG00000134222	2270.793	-1.04002	0.136456	-7.62167	2.50E-14	2.99E-13	-1
SEMA6B	ENSG00000167680	598.5796	-1.04021	0.245235	-4.24168	2.22E-05	7.92E-05	-1
BTN3A2	ENSG00000186470	1887.164	-1.04124	0.120569	-8.63607	5.82E-18	1.00E-16	-1
PXMP4	ENSG00000101417	3019.722	-1.04265	0.084319	-12.3655	4.01E-35	1.89E-33	-1
FLG	ENSG00000143631	747.1056	-1.04283	0.263038	-3.96456	7.35E-05	0.0002359	-1
PMP22	ENSG00000109099	3978.007	-1.04961	0.124182	-8.45221	2.86E-17	4.60E-16	-1
PXYLP1	ENSG00000155893	588.9173	-1.05079	0.153167	-6.8604	6.87E-12	6.08E-11	-1
KIF5A	ENSG00000155980	773.9436	-1.05124	0.185316	-5.67272	1.41E-08	8.38E-08	-1
RAB30	ENSG00000137502	3084.702	-1.05462	0.111615	-9.44875	3.43E-21	7.62E-20	-1
KATNAL1	ENSG00000102781	4266.336	-1.05835	0.091532	-11.5627	6.37E-31	2.44E-29	-1
C1orf21	ENSG00000116667	2042.247	-1.05879	0.125808	-8.41594	3.90E-17	6.18E-16	-1
TFDP2	ENSG00000114126	3552.594	-1.06195	0.089908	-11.8114	3.41E-32	1.37E-30	-1
POU2F1	ENSG00000143190	1581.654	-1.06283	0.128205	-8.29007	1.13E-16	1.72E-15	-1
CSTF3	ENSG00000176102	1962.917	-1.06597	0.161392	-6.60484	3.98E-11	3.27E-10	-1
SAMD9L	ENSG00000177409	710.3316	-1.06893	0.144736	-7.38538	1.52E-13	1.64E-12	-1
MGEA5	ENSG00000198408	12139.52	-1.07079	0.119371	-8.97024	2.96E-19	5.74E-18	-1
SOGA1	ENSG00000149639	16454.3	-1.07305	0.146582	-7.32045	2.47E-13	2.63E-12	-1
RAB40B	ENSG00000141542	1251.483	-1.07433	0.120483	-8.91689	4.80E-19	9.03E-18	-1
SOX12	ENSG00000177732	2726.578	-1.07503	0.150282	-7.15344	8.46E-13	8.47E-12	-1
ITPKB	ENSG00000143772	809.9109	-1.07947	0.14168	-7.61907	2.56E-14	3.04E-13	-1
PCYOX1	ENSG00000116005	8942.087	-1.0796	0.085857	-12.5744	2.92E-36	1.44E-34	-1
TTYH3	ENSG00000136295	4851.741	-1.07992	0.116368	-9.28017	1.69E-20	3.59E-19	-1
CDKN2C	ENSG00000123080	6540.851	-1.08119	0.101669	-10.6344	2.06E-26	6.31E-25	-1

TNS1	ENSG00000079308	3493.905	-1.08362	0.157262	-6.89057	5.56E-12	4.96E-11	-1
SUN2	ENSG00000100242	7855.497	-1.08417	0.078021	-13.8959	6.71E-44	4.35E-42	-1
C1RL	ENSG00000139178	623.3284	-1.08806	0.14396	-7.55811	4.09E-14	4.72E-13	-1
TUBBP1	ENSG00000127589	2050.605	-1.09066	0.198836	-5.48522	4.13E-08	2.30E-07	-1
TMEM14A	ENSG00000096092	1592.617	-1.09091	0.160163	-6.81125	9.68E-12	8.38E-11	-1
IRF2BPL	ENSG00000119669	1643.222	-1.09286	0.168906	-6.47022	9.79E-11	7.68E-10	-1
TUBA1A	ENSG00000167552	34277.64	-1.09329	0.127425	-8.5799	9.50E-18	1.60E-16	-1
NDUFA2	ENSG00000131495	1737.234	-1.10165	0.182109	-6.04941	1.45E-09	9.92E-09	-1
MEIS1	ENSG00000143995	1503.308	-1.10204	0.09662	-11.4058	3.91E-30	1.45E-28	-1
CHST12	ENSG00000136213	1164.205	-1.10271	0.149233	-7.38916	1.48E-13	1.60E-12	-1
EFNA1	ENSG00000169242	577.6985	-1.10292	0.178915	-6.16447	7.07E-10	5.00E-09	-1
GCNT2	ENSG00000111846	752.5256	-1.10528	0.168167	-6.57247	4.95E-11	4.03E-10	-1
HMGN3	ENSG00000118418	992.7618	-1.10736	0.134056	-8.26042	1.45E-16	2.20E-15	-1
NDRG4	ENSG00000103034	679.9847	-1.10925	0.150985	-7.34679	2.03E-13	2.18E-12	-1
SLC6A6	ENSG00000131389	7385.551	-1.10998	0.100228	-11.0745	1.67E-28	5.66E-27	-1
DHRS3	ENSG00000162496	773.7185	-1.11016	0.229537	-4.83653	1.32E-06	5.90E-06	-1
COX7B	ENSG00000131174	3190.87	-1.11021	0.186599	-5.9497	2.69E-09	1.77E-08	-1
SPC24	ENSG00000161888	2681.2	-1.11072	0.107742	-10.3091	6.41E-25	1.76E-23	-1
CROT	ENSG00000005469	855.0067	-1.11192	0.128424	-8.65816	4.79E-18	8.33E-17	-1
APAF1	ENSG00000120868	3258.253	-1.11404	0.090788	-12.2707	1.30E-34	6.00E-33	-1
ADAM19	ENSG00000135074	3465.17	-1.11785	0.150296	-7.43766	1.02E-13	1.13E-12	-1
TNRC6B	ENSG00000100354	2630.652	-1.11975	0.144563	-7.74574	9.50E-15	1.19E-13	-1
MTURN	ENSG00000180354	2347.727	-1.12317	0.090482	-12.4132	2.22E-35	1.05E-33	-1
CNPY4	ENSG00000166997	876.8649	-1.12701	0.115132	-9.78881	1.26E-22	3.01E-21	-1
SMAD3	ENSG00000166949	11477.09	-1.12788	0.119095	-9.47045	2.79E-21	6.25E-20	-1
LPCAT2	ENSG00000087253	5424.733	-1.12816	0.115941	-9.73054	2.23E-22	5.26E-21	-1
PCTP	ENSG00000141179	1238.741	-1.12848	0.124697	-9.04982	1.43E-19	2.85E-18	-1
COL4A5	ENSG00000188153	2413.94	-1.12893	0.1413	-7.98956	1.35E-15	1.87E-14	-1
BCL9L	ENSG00000186174	3931.808	-1.13774	0.143023	-7.95496	1.79E-15	2.42E-14	-1
ARL6IP5	ENSG00000144746	5760.06	-1.14072	0.115682	-9.86085	6.15E-23	1.51E-21	-1
ABCA3	ENSG00000167972	2919.384	-1.14195	0.141635	-8.06262	7.47E-16	1.05E-14	-1
ARNT2	ENSG00000172379	604.9943	-1.14361	0.149958	-7.62625	2.42E-14	2.89E-13	-1
HSPG2	ENSG00000142798	16099.4	-1.14528	0.33952	-3.37322	0.0007429	0.0019356	-1
APOL2	ENSG00000128335	2452.29	-1.15247	0.116522	-9.89052	4.58E-23	1.13E-21	-1
POLR2L	ENSG00000177700	5234.121	-1.15332	0.115458	-9.98909	1.70E-23	4.36E-22	-1
APLN	ENSG00000171388	504.8862	-1.15491	0.151801	-7.60804	2.78E-14	3.27E-13	-1
ASPM	ENSG00000066279	15096.1	-1.15572	0.098594	-11.722	9.83E-32	3.90E-30	-1
LYPD6	ENSG00000187123	592.3458	-1.1574	0.196694	-5.88427	4.00E-09	2.58E-08	-1
LINC00649	ENSG00000237945	655.6968	-1.15787	0.153256	-7.55509	4.19E-14	4.82E-13	-1
PCDHGC3	ENSG00000240184	3644.32	-1.16287	0.085352	-13.6243	2.87E-42	1.80E-40	-1
CARD6	ENSG00000132357	590.8437	-1.16477	0.162237	-7.17944	7.00E-13	7.11E-12	-1
ALDH1A3	ENSG00000184254	4639.18	-1.16706	0.09773	-11.9417	7.18E-33	3.03E-31	-1
GM2A	ENSG00000196743	3749.368	-1.16776	0.100664	-11.6005	4.10E-31	1.59E-29	-1
FAM172A	ENSG00000113391	1938.884	-1.169	0.094756	-12.3369	5.73E-35	2.67E-33	-1
CELSR2	ENSG00000143126	1879.39	-1.1695	0.178727	-6.5435	6.01E-11	4.86E-10	-1
HOXB4	ENSG00000182742	748.4369	-1.17504	0.145098	-8.09822	5.58E-16	7.95E-15	-1
TNS3	ENSG00000136205	10965.78	-1.18224	0.119531	-9.89059	4.57E-23	1.13E-21	-1

EYA1	ENSG00000104313	1380.95	-1.18266	0.126013	-9.38525	6.28E-21	1.37E-19	-1
MBOAT1	ENSG00000172197	858.0882	-1.1838	0.112064	-10.5636	4.39E-26	1.32E-24	-1
LINC00641	ENSG00000258441	523.3546	-1.18677	0.254511	-4.66293	3.12E-06	1.31E-05	-1
CYB561D1	ENSG00000174151	992.8902	-1.18914	0.130434	-9.11686	7.73E-20	1.58E-18	-1
ITGB8	ENSG00000105855	3695.122	-1.19061	0.147512	-8.0713	6.96E-16	9.86E-15	-1
RBM43	ENSG00000184898	722.9071	-1.19386	0.163499	-7.30198	2.84E-13	3.00E-12	-1
MXD4	ENSG00000123933	6200.528	-1.19783	0.112499	-10.6475	1.79E-26	5.54E-25	-1
NAPEPLD	ENSG00000161048	730.4769	-1.20222	0.176452	-6.81328	9.54E-12	8.27E-11	-1
ATP5MC1	ENSG00000159199	3009.816	-1.20276	0.096888	-12.414	2.19E-35	1.05E-33	-1
LRP5	ENSG00000162337	3993.402	-1.20549	0.134398	-8.96954	2.98E-19	5.76E-18	-1
APOL1	ENSG00000100342	1320.925	-1.20943	0.156708	-7.71776	1.18E-14	1.46E-13	-1
WNT9A	ENSG00000143816	508.191	-1.2098	0.180657	-6.69668	2.13E-11	1.79E-10	-1
LINC01224	ENSG00000269416	1351.624	-1.20999	0.105772	-11.4397	2.65E-30	9.92E-29	-1
ITGA11	ENSG00000137809	951.3226	-1.21303	0.125067	-9.69908	3.04E-22	7.12E-21	-1
COL4A2	ENSG00000134871	17961.25	-1.21365	0.1276	-9.51137	1.88E-21	4.26E-20	-1
CDON	ENSG00000064309	568.7192	-1.21412	0.183141	-6.62945	3.37E-11	2.80E-10	-1
TCEA1P2	ENSG00000230409	602.091	-1.21589	0.24628	-4.93701	7.93E-07	3.65E-06	-1
PRDX1	ENSG00000117450	9262.103	-1.21766	0.096882	-12.5684	3.15E-36	1.55E-34	-1
ALDH3A2	ENSG00000072210	2900.12	-1.21884	0.096696	-12.6049	1.98E-36	9.99E-35	-1
TMOD2	ENSG00000128872	5198.108	-1.22473	0.112514	-10.8851	1.36E-27	4.49E-26	-1
CYP1B1	ENSG00000138061	26158.73	-1.22477	0.112709	-10.8667	1.66E-27	5.47E-26	-1
DIXDC1	ENSG00000150764	1164.504	-1.22773	0.119035	-10.314	6.09E-25	1.67E-23	-1
HR	ENSG00000168453	843.9474	-1.22935	0.130877	-9.39311	5.83E-21	1.28E-19	-1
KANK1	ENSG00000107104	517.8463	-1.2306	0.148352	-8.29516	1.08E-16	1.65E-15	-1
FAM69A	ENSG00000154511	1068.523	-1.23346	0.109888	-11.2247	3.09E-29	1.10E-27	-1
FZD2	ENSG00000180340	4825.033	-1.24948	0.119184	-10.4837	1.03E-25	3.01E-24	-1
JADE2	ENSG00000043143	3904.968	-1.24999	0.103028	-12.1325	7.10E-34	3.09E-32	-1
CBX5	ENSG00000094916	24747.93	-1.25505	0.126181	-9.94638	2.62E-23	6.60E-22	-1
ZFP14	ENSG00000142065	514.3146	-1.25624	0.177239	-7.08783	1.36E-12	1.32E-11	-1
EPB41L4B	ENSG00000095203	1065.154	-1.25747	0.161614	-7.78071	7.21E-15	9.18E-14	-1
PIK3IP1	ENSG00000100100	1253.938	-1.25891	0.162638	-7.74053	9.90E-15	1.24E-13	-1
RCAN3	ENSG00000117602	2573.627	-1.26233	0.098349	-12.8352	1.04E-37	5.52E-36	-1
PM20D2	ENSG00000146281	7609.771	-1.26679	0.077526	-16.3401	5.11E-60	5.58E-58	-1
NEURL1B	ENSG00000214357	2758.722	-1.2693	0.094993	-13.362	1.01E-40	5.99E-39	-1
GLCCI1	ENSG00000106415	891.9773	-1.27114	0.156051	-8.14568	3.77E-16	5.46E-15	-1
SEMA6C	ENSG00000143434	616.6556	-1.27114	0.198243	-6.41204	1.44E-10	1.11E-09	-1
TCAF1	ENSG00000198420	1754.333	-1.27254	0.187453	-6.78861	1.13E-11	9.78E-11	-1
C1QTNF6	ENSG00000133466	523.9805	-1.27808	0.156191	-8.1828	2.77E-16	4.10E-15	-1
PRX	ENSG00000105227	542.2726	-1.28546	0.200526	-6.41047	1.45E-10	1.11E-09	-1
MXD3	ENSG00000213347	2119.389	-1.28567	0.113289	-11.3486	7.54E-30	2.74E-28	-1
	ENSG00000291006	1030.988	-1.29086	0.144801	-8.91473	4.89E-19	9.19E-18	-1
HSPA2	ENSG00000126803	899.1503	-1.29471	0.130092	-9.95233	2.46E-23	6.25E-22	-1
LGR4	ENSG00000205213	4605.063	-1.29752	0.085986	-15.0899	1.89E-51	1.63E-49	-1
LINC02035	ENSG00000273033	481.5875	-1.30562	0.172083	-7.58716	3.27E-14	3.82E-13	-1
NOL4L	ENSG00000197183	709.0694	-1.30626	0.162085	-8.0591	7.69E-16	1.08E-14	-1
LAMA5	ENSG00000130702	1446.591	-1.30803	0.17427	-7.50578	6.11E-14	6.93E-13	-1
EPHB4	ENSG00000196411	6378.694	-1.3091	0.104014	-12.5858	2.53E-36	1.26E-34	-1

WNT7B	ENSG00000188064	1138.779	-1.32082	0.211462	-6.24614	4.21E-10	3.06E-09	-1
CBX6	ENSG00000183741	4904.272	-1.32224	0.108407	-12.1969	3.23E-34	1.44E-32	-1
ELFN2	ENSG00000166897	2162.791	-1.32517	0.148663	-8.91396	4.92E-19	9.24E-18	-1
CRISPLD2	ENSG00000103196	1434.02	-1.32634	0.124748	-10.6322	2.11E-26	6.45E-25	-1
SECTM1	ENSG00000141574	4066.803	-1.32793	0.128715	-10.3168	5.91E-25	1.63E-23	-1
PIK3R3	ENSG00000117461	2673.73	-1.32816	0.130956	-10.1421	3.59E-24	9.41E-23	-1
KANK2	ENSG00000197256	10938.58	-1.3298	0.110353	-12.0504	1.93E-33	8.29E-32	-1
MYORG	ENSG00000164976	1950.712	-1.33083	0.095823	-13.8884	7.45E-44	4.80E-42	-1
KREMEN1	ENSG00000183762	599.0898	-1.33524	0.151927	-8.78872	1.51E-18	2.73E-17	-1
IGSF3	ENSG00000143061	3917.392	-1.34532	0.133221	-10.0984	5.61E-24	1.46E-22	-1
ADGRA3	ENSG00000152990	2428.833	-1.35334	0.106131	-12.7516	3.05E-37	1.59E-35	-1
GALNT5	ENSG00000136542	662.4291	-1.35705	0.178031	-7.62251	2.49E-14	2.97E-13	-1
CTDSP2	ENSG00000175215	11443.07	-1.35845	0.102886	-13.2035	8.38E-40	4.80E-38	-1
NREP	ENSG00000134986	679.2754	-1.36019	0.121258	-11.2173	3.35E-29	1.19E-27	-1
KLF9	ENSG00000119138	1191.294	-1.36371	0.188589	-7.2311	4.79E-13	4.98E-12	-1
GFRA1	ENSG00000151892	3437.095	-1.3687	0.103473	-13.2276	6.08E-40	3.53E-38	-1
TMTC4	ENSG00000125247	1030.125	-1.37517	0.1313	-10.4735	1.14E-25	3.33E-24	-1
SLC43A2	ENSG00000167703	1701.908	-1.3789	0.113401	-12.1595	5.11E-34	2.26E-32	-1
SDC3	ENSG00000162512	12367.6	-1.3824	0.094009	-14.705	5.99E-49	4.60E-47	-1
BRI3BP	ENSG00000184992	1762.168	-1.38245	0.131626	-10.5028	8.38E-26	2.48E-24	-1
COL18A1	ENSG00000182871	1368.693	-1.38296	0.171426	-8.06736	7.18E-16	1.01E-14	-1
ZBED6CL	ENSG00000188707	629.3941	-1.39562	0.165323	-8.4418	3.12E-17	5.02E-16	-1
HSPA1A	ENSG00000204389	2412.306	-1.39714	0.1309	-10.6734	1.36E-26	4.23E-25	-1
SLC39A10	ENSG00000196950	1453.459	-1.3976	0.12359	-11.3083	1.19E-29	4.31E-28	-1
PNRC1	ENSG00000146278	2204.558	-1.40468	0.129371	-10.8577	1.83E-27	6.02E-26	-1
PDK3	ENSG00000067992	842.9259	-1.40767	0.164893	-8.53691	1.38E-17	2.30E-16	-1
ZC3HAV1	ENSG00000105939	2593.044	-1.42325	0.132346	-10.754	5.67E-27	1.80E-25	-1
EIF4EBP2	ENSG00000148730	10587.94	-1.4253	0.153666	-9.27533	1.77E-20	3.75E-19	-1
MRC2	ENSG00000011028	9193.26	-1.43555	0.095418	-15.045	3.73E-51	3.13E-49	-1
YPEL3	ENSG00000090238	1358.025	-1.43596	0.170764	-8.40902	4.13E-17	6.54E-16	-1
RXRA	ENSG00000186350	3845.052	-1.43645	0.111725	-12.8571	7.85E-38	4.19E-36	-1
ACVR2B	ENSG00000114739	519.9482	-1.43844	0.194328	-7.40212	1.34E-13	1.46E-12	-1
IGIP	ENSG00000182700	478.1405	-1.46548	0.279838	-5.23688	1.63E-07	8.35E-07	-1
CMTM4	ENSG00000183723	2918.589	-1.46781	0.114625	-12.8053	1.53E-37	8.04E-36	-1
ERBB3	ENSG00000065361	765.3212	-1.47236	0.194825	-7.55735	4.11E-14	4.75E-13	-1
GPC1	ENSG00000063660	15916.57	-1.4727	0.085273	-17.2705	7.85E-67	1.07E-64	-1
XKR8	ENSG00000158156	699.2592	-1.47921	0.130631	-11.3236	1.00E-29	3.63E-28	-1
ADAMTS15	ENSG00000166106	491.1969	-1.48069	0.191297	-7.74029	9.92E-15	1.24E-13	-1
ZMIZ1	ENSG00000108175	9485.534	-1.49275	0.143251	-10.4205	2.00E-25	5.67E-24	-1
RIN2	ENSG00000132669	1978.071	-1.49965	0.144679	-10.3654	3.56E-25	9.96E-24	-1
TRERF1	ENSG00000124496	1635.175	-1.50181	0.126876	-11.8369	2.52E-32	1.02E-30	-1
ABCA2	ENSG00000107331	2560.445	-1.50712	0.168909	-8.92266	4.55E-19	8.62E-18	-1
XYLT2	ENSG00000015532	3425.258	-1.5097	0.091776	-16.4498	8.42E-61	9.49E-59	-1
ZNF618	ENSG00000157657	2358.095	-1.5181	0.144106	-10.5346	5.98E-26	1.78E-24	-1
SH3TC2	ENSG00000169247	625.5677	-1.52419	0.175469	-8.68639	3.74E-18	6.55E-17	-1
LINC01963	ENSG00000260804	775.3655	-1.54206	0.203769	-7.5677	3.80E-14	4.41E-13	-1
ZNF608	ENSG00000168916	1084.022	-1.55327	0.13947	-11.137	8.29E-29	2.88E-27	-1

PLSCR4	ENSG00000114698	814.037	-1.55414	0.129025	-12.0453	2.05E-33	8.75E-32	-1
SALL2	ENSG00000165821	788.8266	-1.55689	0.145423	-10.7059	9.55E-27	3.03E-25	-1
FZD4	ENSG00000174804	587.3477	-1.5581	0.158173	-9.85063	6.81E-23	1.66E-21	-1
COL5A1	ENSG00000130635	11096.27	-1.56798	0.132495	-11.8342	2.60E-32	1.05E-30	-1
PIK3C2B	ENSG00000133056	538.666	-1.57441	0.176756	-8.90725	5.23E-19	9.77E-18	-1
AC012513.	ENSG00000279348	531.6687	-1.59117	0.220255	-7.22423	5.04E-13	5.22E-12	-1
CXXC5	ENSG00000171604	2519.412	-1.59428	0.134325	-11.8688	1.72E-32	7.08E-31	-1
B4GAT1	ENSG00000174684	1468.991	-1.60351	0.136529	-11.7448	7.51E-32	2.99E-30	-1
KCNB1	ENSG00000158445	509.6301	-1.60876	0.186339	-8.63349	5.95E-18	1.02E-16	-1
ANKRD33B	ENSG00000164236	1570.545	-1.63689	0.192582	-8.4997	1.90E-17	3.11E-16	-1
SAMD9	ENSG00000205413	3319.138	-1.63752	0.122472	-13.3705	8.99E-41	5.37E-39	-1
IRF2	ENSG00000168310	1127.171	-1.64144	0.229554	-7.15054	8.64E-13	8.64E-12	-1
TNFRSF10D	ENSG00000173530	1157.212	-1.64326	0.124299	-13.2203	6.70E-40	3.87E-38	-1
AC015813.	ENSG00000279207	506.5803	-1.64684	0.263059	-6.26037	3.84E-10	2.81E-09	-1
LYNX1	ENSG00000180155	670.3865	-1.64991	0.155838	-10.5874	3.41E-26	1.03E-24	-1
THRA	ENSG00000126351	1714.377	-1.65215	0.096584	-17.1059	1.34E-65	1.80E-63	-1
TP53INP1	ENSG00000164938	3124.834	-1.66727	0.090529	-18.417	9.60E-76	1.73E-73	-1
SMAD6	ENSG00000137834	508.2116	-1.66763	0.142487	-11.7037	1.22E-31	4.82E-30	-1
NANOS1	ENSG00000188613	1105.595	-1.68109	0.128911	-13.0407	7.18E-39	3.98E-37	-1
FAM217B	ENSG00000196227	2126.017	-1.68474	0.111419	-15.1208	1.18E-51	1.03E-49	-1
TMPO-AS1	ENSG00000257167	560.0419	-1.68583	0.143273	-11.7666	5.80E-32	2.32E-30	-1
COL1A1	ENSG00000108821	7703.349	-1.69305	0.106443	-15.9057	5.79E-57	5.80E-55	-1
CYGB	ENSG00000161544	2969.624	-1.69457	0.130286	-13.0066	1.12E-38	6.15E-37	-1
MEGF6	ENSG00000162591	10864.48	-1.72054	0.115078	-14.9511	1.53E-50	1.26E-48	-1
SHISAL1	ENSG00000138944	1576.141	-1.75207	0.206244	-8.49512	1.98E-17	3.23E-16	-1
KIT	ENSG00000157404	1509.661	-1.79613	0.107464	-16.7138	1.04E-62	1.24E-60	-1
TACSTD2	ENSG00000184292	25873.65	-1.79614	0.160567	-11.1863	4.76E-29	1.66E-27	-1
BAHCC1	ENSG00000266074	1585.098	-1.80724	0.187449	-9.64124	5.35E-22	1.24E-20	-1
TMEM19	ENSG00000139291	2047.343	-1.81364	0.11566	-15.6808	2.05E-55	1.91E-53	-1
ATOH8	ENSG00000168874	1555.393	-1.82344	0.167389	-10.8934	1.24E-27	4.11E-26	-1
MEGF8	ENSG00000105429	3901.086	-1.82555	0.15875	-11.4995	1.33E-30	5.01E-29	-1
MEGF9	ENSG00000106780	3761.151	-1.8344	0.114865	-15.9701	2.06E-57	2.11E-55	-1
TARDBP	ENSG00000120948	9219.306	-1.8482	0.118252	-15.6294	4.59E-55	4.26E-53	-1
SKP2	ENSG00000145604	3201.36	-1.85076	0.103959	-17.8028	6.72E-71	1.04E-68	-1
WNT5A	ENSG00000114251	1829.378	-1.85905	0.139409	-13.3353	1.44E-40	8.47E-39	-1
CALHM2	ENSG00000138172	1210.123	-1.87556	0.119241	-15.7292	9.54E-56	9.19E-54	-1
AGRN	ENSG00000188157	25423.93	-1.90757	0.166629	-11.4481	2.40E-30	9.04E-29	-1
CASTOR2	ENSG00000274070	1046.861	-2.01041	0.143348	-14.0247	1.10E-44	7.33E-43	-1
CCNG2	ENSG00000138764	4876.386	-2.02336	0.11896	-17.0087	7.08E-65	9.12E-63	-1
BMP4	ENSG00000125378	1721.909	-2.06357	0.116298	-17.7437	1.93E-70	2.90E-68	-1
SLC2A12	ENSG00000146411	476.0809	-2.17275	0.177843	-12.2172	2.52E-34	1.12E-32	-1
PDGFB	ENSG00000100311	855.1379	-2.18948	0.129974	-16.8455	1.13E-63	1.39E-61	-1
MN1	ENSG00000169184	1200.009	-2.21972	0.197181	-11.2573	2.13E-29	7.64E-28	-1
IFIT3	ENSG00000119917	1421.535	-2.22171	0.159201	-13.9554	2.92E-44	1.93E-42	-1
IFIT2	ENSG00000119922	523.178	-2.27654	0.178678	-12.7411	3.50E-37	1.82E-35	-1
SERTAD4	ENSG00000082497	937.2548	-2.35432	0.210218	-11.1995	4.10E-29	1.44E-27	-1
GAS1	ENSG00000180447	594.8233	-2.46413	0.213841	-11.5232	1.01E-30	3.82E-29	-1

IFIT1	ENSG00000185745	631.9238	-2.49827	0.196375	-12.7219	4.47E-37	2.30E-35	-1
RIMS3	ENSG00000117016	425.1548	-2.73948	0.184779	-14.8257	9.99E-50	7.74E-48	-1
BMF	ENSG00000104081	1165.82	-4.80737	0.207032	-23.2204	2.83E-119	1.17E-116	-1

Table S3: DEG Analysis - TNF-alpha-Stimulated + ML141 vs TNF-alpha-Stimulated

gene name	gene ID	baseMean	log2FC	lfcSE	stat	pvalue	padj	filter
GDF15	ENSG00000130513	2457.075	4.197743	0.107864	38.91686	0	0	1
EGR1	ENSG00000120738	4520.935	3.868566	0.199975	19.34527	2.23E-83	4.49E-81	1
DDIT3	ENSG00000175197	4767.458	3.816121	0.125195	30.48144	4.59E-204	8.86E-201	1
IL1A	ENSG00000115008	11511.69	3.706705	0.166832	22.21814	2.29E-109	9.28E-107	1
SESN2	ENSG00000130766	10421.34	3.361881	0.174986	19.21228	2.92E-82	5.53E-80	1
IL11	ENSG00000095752	6996.178	3.345356	0.200471	16.68746	1.62E-62	2.03E-60	1
ATF3	ENSG00000162772	8490.906	3.299856	0.122319	26.97755	2.71E-160	2.38E-157	1
MT-RNR1	ENSG00000211459	76251.95	3.250118	0.154671	21.01311	4.98E-98	1.50E-95	1
MT-RNR2	ENSG00000210082	386321.6	3.238199	0.17792	18.20028	5.13E-74	8.54E-72	1
TRIB3	ENSG00000101255	56617.34	3.192923	0.071814	44.4612	0	0	1
DUSP1	ENSG00000120129	6009.795	3.072374	0.1014	30.29958	1.16E-201	1.87E-198	1
ADM2	ENSG00000128165	1771.107	3.067804	0.195385	15.70133	1.48E-55	1.41E-53	1
AREG	ENSG00000109321	498.6721	2.936413	0.147203	19.94809	1.56E-88	3.76E-86	1
DUSP5	ENSG00000138166	10292.53	2.919508	0.126785	23.02726	2.49E-117	1.09E-114	1
MXD1	ENSG00000059728	3760.794	2.856846	0.137699	20.747	1.30E-95	3.70E-93	1
PDE4D	ENSG00000113448	4694.76	2.846441	0.075916	37.49483	1.12E-307	2.70E-304	1
ERRFI1	ENSG00000116285	23153.5	2.729358	0.123072	22.17699	5.73E-109	2.21E-106	1
KLF4	ENSG00000136826	1665.838	2.696743	0.164812	16.36249	3.54E-60	4.07E-58	1
HBEGF	ENSG00000113070	23818.66	2.695275	0.179514	15.01425	5.92E-51	4.84E-49	1
CTH	ENSG00000116761	506.92	2.674205	0.170679	15.668	2.50E-55	2.37E-53	1
DDIT4	ENSG00000168209	14471.45	2.669025	0.131335	20.32229	8.17E-92	2.13E-89	1
TRAF1	ENSG00000056558	11149.18	2.664279	0.070198	37.95392	0	0	1
ANKRD1	ENSG00000148677	3510.361	2.589324	0.17281	14.98365	9.39E-51	7.55E-49	1
CSRNP1	ENSG00000144655	4911.605	2.549434	0.105303	24.21037	1.73E-129	8.78E-127	1
CHAC1	ENSG00000128965	2500.361	2.545358	0.189147	13.45704	2.80E-41	1.48E-39	1
NFIL3	ENSG00000165030	4744.759	2.519396	0.120107	20.97634	1.08E-97	3.15E-95	1
CXCL2	ENSG00000081041	1109.309	2.442248	0.137978	17.70023	4.18E-70	6.29E-68	1
SPRY4	ENSG00000187678	4745.919	2.400652	0.167343	14.3457	1.13E-46	7.87E-45	1
PPP1R15A	ENSG00000087074	32152.59	2.390536	0.113143	21.12841	4.36E-99	1.40E-96	1
LURAP1L	ENSG00000153714	1262.555	2.386237	0.124248	19.20544	3.33E-82	6.18E-80	1
CEBPB	ENSG00000172216	8076.936	2.335159	0.081485	28.65757	1.29E-180	1.56E-177	1
KCNG1	ENSG00000026559	1212.846	2.33261	0.158472	14.71938	4.84E-49	3.62E-47	1
GADD45A	ENSG00000116717	24832.81	2.315769	0.114494	20.22609	5.77E-91	1.43E-88	1
DNAJB9	ENSG00000128590	5215.39	2.309782	0.14508	15.92078	4.55E-57	4.62E-55	1
CXCL8	ENSG00000169429	59702.85	2.306637	0.152553	15.12019	1.19E-51	1.02E-49	1
SNHG8	ENSG00000269893	700.5965	2.300014	0.116248	19.78547	3.97E-87	9.35E-85	1
IL1B	ENSG00000125538	11364.53	2.222301	0.155566	14.28524	2.70E-46	1.84E-44	1
GEM	ENSG00000164949	1296.262	2.190627	0.138118	15.86049	1.19E-56	1.20E-54	1
CD274	ENSG00000120217	5537.336	2.172435	0.121217	17.92186	7.96E-72	1.26E-69	1
SAT1	ENSG00000130066	10798.62	2.170241	0.160131	13.55291	7.62E-42	4.15E-40	1
MAFF	ENSG00000185022	10327.36	2.170117	0.118582	18.30051	8.20E-75	1.39E-72	1
VEGFA	ENSG00000112715	9627.02	2.159966	0.128421	16.81938	1.76E-63	2.26E-61	1
ITPRIP	ENSG00000148841	14148.61	2.146349	0.077331	27.75543	1.50E-169	1.61E-166	1
TUBE1	ENSG00000074935	1176.329	2.13873	0.12253	17.45481	3.16E-68	4.56E-66	1

HERPUD1	ENSG00000051108	11170.87	2.115461	0.101992	20.74138	1.47E-95	4.04E-93	1
KDM7A	ENSG00000006459	780.0279	2.10665	0.143321	14.69883	6.56E-49	4.87E-47	1
CBS	ENSG00000160200	448.9389	2.052717	0.240836	8.523299	1.55E-17	2.15E-16	1
PMAIP1	ENSG00000141682	8478.115	2.052106	0.097447	21.05865	1.91E-98	5.93E-96	1
LRRC49	ENSG00000137821	3035.975	2.046645	0.081494	25.11401	3.50E-139	2.11E-136	1
ERN1	ENSG00000178607	5606.266	2.035881	0.131736	15.45429	7.06E-54	6.36E-52	1
XBP1	ENSG00000100219	18325.8	2.020024	0.090919	22.21787	2.31E-109	9.28E-107	1
NAMPTP1	ENSG00000229644	2448.722	1.996979	0.161554	12.36108	4.24E-35	1.71E-33	1
ACKR3	ENSG00000144476	5555.48	1.980943	0.165601	11.96214	5.61E-33	2.05E-31	1
MFSD2A	ENSG00000168389	934.3863	1.980656	0.133028	14.88902	3.88E-50	3.05E-48	1
TNFSF15	ENSG00000181634	1465.22	1.970312	0.148518	13.26646	3.62E-40	1.84E-38	1
NAMPT	ENSG00000105835	27232.26	1.962162	0.150451	13.04186	7.07E-39	3.39E-37	1
RND3	ENSG00000115963	41207.91	1.946463	0.088772	21.92647	1.45E-106	5.39E-104	1
CXCL3	ENSG00000163734	578.3895	1.904859	0.165485	11.51074	1.16E-30	3.81E-29	1
BTG1	ENSG00000133639	4783.475	1.899821	0.093446	20.33068	6.88E-92	1.84E-89	1
ARID5A	ENSG00000196843	2569.24	1.892998	0.132716	14.26347	3.70E-46	2.49E-44	1
ZNF773	ENSG00000152439	1520.244	1.888801	0.110343	17.1176	1.10E-65	1.51E-63	1
KDM6B	ENSG00000132510	2689.924	1.888783	0.15773	11.9748	4.82E-33	1.78E-31	1
KCNK3	ENSG00000171303	764.6218	1.861778	0.18639	9.988599	1.71E-23	3.63E-22	1
CEBPG	ENSG00000153879	9067.55	1.845742	0.068812	26.82288	1.75E-158	1.41E-155	1
HSPA5	ENSG00000044574	64256.54	1.83351	0.0734	24.97968	1.02E-137	5.77E-135	1
PTX3	ENSG00000163661	49137.65	1.825752	0.121133	15.07224	2.47E-51	2.07E-49	1
TMEM217	ENSG00000172738	1138.05	1.817767	0.18787	9.675658	3.83E-22	7.50E-21	1
EPB41L4A-	ENSG00000224032	1252.813	1.812869	0.120354	15.06286	2.84E-51	2.36E-49	1
JAG1	ENSG00000101384	5996.604	1.812423	0.149637	12.11214	9.11E-34	3.46E-32	1
C17orf51	ENSG00000212719	3143.545	1.807767	0.107984	16.74102	6.59E-63	8.36E-61	1
BDNF	ENSG00000176697	1132.836	1.807302	0.120153	15.04162	3.92E-51	3.23E-49	1
SIK1B	ENSG00000275993	1241.857	1.796977	0.192288	9.345244	9.17E-21	1.63E-19	1
TUFT1	ENSG00000143367	11970.39	1.774262	0.122911	14.43536	3.10E-47	2.18E-45	1
NRG1	ENSG00000157168	2581.344	1.750429	0.144193	12.13952	6.52E-34	2.49E-32	1
HK2	ENSG00000159399	6949.282	1.74548	0.15082	11.57324	5.63E-31	1.87E-29	1
SNHG1	ENSG00000255717	7222.728	1.731037	0.129076	13.41098	5.21E-41	2.70E-39	1
RCAN1	ENSG00000159200	7104.617	1.716079	0.080864	21.22185	6.00E-100	2.07E-97	1
MAP1LC3B	ENSG00000140941	9615.425	1.708631	0.066091	25.85258	2.28E-147	1.69E-144	1
SLC30A1	ENSG00000170385	8438.07	1.701125	0.086153	19.7454	8.79E-87	2.02E-84	1
MAP1LC3B	ENSG00000258102	483.0625	1.69967	0.107713	15.77962	4.30E-56	4.27E-54	1
SOCS3	ENSG00000184557	2796.639	1.690566	0.124199	13.61178	3.41E-42	1.89E-40	1
MMP3	ENSG00000149968	1878.479	1.685453	0.321487	5.242683	1.58E-07	7.66E-07	1
UPP1	ENSG00000183696	9626.354	1.685151	0.057934	29.0872	5.21E-186	7.18E-183	1
IL6	ENSG00000136244	2318.523	1.679021	0.303382	5.534339	3.12E-08	1.68E-07	1
NFKBIZ	ENSG00000144802	4347.69	1.674493	0.191773	8.731633	2.51E-18	3.70E-17	1
CREB5	ENSG00000146592	7182.059	1.668735	0.183705	9.083763	1.05E-19	1.73E-18	1
SNHG15	ENSG00000232956	1881.729	1.655787	0.085138	19.44837	3.01E-84	6.31E-82	1
NFATC2	ENSG00000101096	603.672	1.640834	0.219667	7.469652	8.04E-14	8.00E-13	1
EFNB2	ENSG00000125266	789.9759	1.63952	0.20116	8.150337	3.63E-16	4.51E-15	1
PPP1R3B	ENSG00000173281	3721.857	1.635544	0.099199	16.48757	4.51E-61	5.37E-59	1
USP2	ENSG00000036672	479.6832	1.617636	0.227467	7.11151	1.15E-12	1.02E-11	1

ARHGEF2	ENSG00000116584	21116.57	1.614236	0.084702	19.05791	5.65E-81	1.03E-78	1
FICD	ENSG00000198855	1796.428	1.588037	0.089428	17.75765	1.50E-70	2.30E-68	1
TBX3	ENSG00000135111	5686.694	1.584688	0.188989	8.385077	5.07E-17	6.72E-16	1
ADPRM	ENSG00000170222	640.1117	1.581293	0.123076	12.84806	8.82E-38	4.07E-36	1
TRIB1	ENSG00000173334	1805.958	1.571892	0.149415	10.52029	6.97E-26	1.74E-24	1
USP53	ENSG00000145390	4501.248	1.565919	0.092884	16.85883	9.04E-64	1.18E-61	1
SLC35F6	ENSG00000213699	9716.457	1.541991	0.06572	23.46321	9.69E-122	4.67E-119	1
TMEM39A	ENSG00000176142	3463.692	1.528698	0.083484	18.31128	6.73E-75	1.16E-72	1
MTHFD2	ENSG00000065911	22756.83	1.526492	0.079393	19.22712	2.19E-82	4.23E-80	1
IFRD1	ENSG00000006652	1058.739	1.519462	0.093684	16.21909	3.70E-59	4.15E-57	1
NGF	ENSG00000134259	1866.355	1.519351	0.115694	13.13251	2.14E-39	1.06E-37	1
AL365181.	ENSG00000272405	454.5583	1.511927	0.21389	7.068712	1.56E-12	1.36E-11	1
UAP1	ENSG00000117143	34476.96	1.506659	0.061151	24.63842	4.90E-134	2.63E-131	1
CDK17	ENSG00000059758	8577.086	1.499798	0.08781	17.08012	2.09E-65	2.84E-63	1
DLC1	ENSG00000164741	27636.39	1.497947	0.148219	10.10632	5.18E-24	1.14E-22	1
DUSP10	ENSG00000143507	1847.174	1.491599	0.093119	16.01825	9.53E-58	9.99E-56	1
PPP1R3C	ENSG00000119938	828.8307	1.488256	0.157955	9.422033	4.42E-21	8.10E-20	1
RASEF	ENSG00000165105	3854.891	1.486144	0.11697	12.70529	5.53E-37	2.48E-35	1
LARP6	ENSG00000166173	5481.095	1.485191	0.110113	13.48789	1.84E-41	9.88E-40	1
SGK1	ENSG00000118515	7458.692	1.482018	0.103401	14.33275	1.37E-46	9.36E-45	1
TMEM268	ENSG00000157693	3018.998	1.479742	0.090006	16.44048	9.81E-61	1.14E-58	1
GTPBP2	ENSG00000172432	11510.98	1.478979	0.094143	15.70991	1.29E-55	1.25E-53	1
SNHG12	ENSG00000197989	1922.958	1.472513	0.168625	8.732469	2.49E-18	3.68E-17	1
CHIC2	ENSG00000109220	3207.577	1.461222	0.106651	13.70095	1.00E-42	5.75E-41	1
SLC9A1	ENSG00000090020	9622.741	1.46118	0.151098	9.670388	4.03E-22	7.87E-21	1
GPT2	ENSG00000166123	5174.386	1.458485	0.092706	15.73231	9.08E-56	8.85E-54	1
FOXC1	ENSG00000054598	1963.899	1.456849	0.104999	13.87487	9.00E-44	5.46E-42	1
STC2	ENSG00000113739	97171.39	1.450609	0.116289	12.47417	1.03E-35	4.31E-34	1
PPARD	ENSG00000112033	13812.89	1.444323	0.076422	18.89923	1.16E-79	2.03E-77	1
PSAT1	ENSG00000135069	9764.428	1.444203	0.138182	10.45143	1.44E-25	3.53E-24	1
KRT34	ENSG00000131737	627.3921	1.443148	0.142554	10.1235	4.35E-24	9.59E-23	1
ALDH1L2	ENSG00000136010	2529.559	1.439148	0.176573	8.150434	3.63E-16	4.51E-15	1
PER1	ENSG00000179094	1177.612	1.435645	0.094068	15.26182	1.37E-52	1.19E-50	1
LIPG	ENSG00000101670	1653.48	1.43406	0.104844	13.67798	1.37E-42	7.71E-41	1
GRPEL2	ENSG00000164284	5114.719	1.42686	0.091772	15.54796	1.64E-54	1.51E-52	1
CDKN1A	ENSG00000124762	19444.65	1.424077	0.052431	27.16102	1.88E-162	1.81E-159	1
STX1A	ENSG00000106089	802.9893	1.419825	0.151266	9.386291	6.22E-21	1.12E-19	1
TSC22D3	ENSG00000157514	4514.499	1.418757	0.106076	13.37494	8.47E-41	4.37E-39	1
AEN	ENSG00000181026	8612.729	1.418549	0.095921	14.78872	1.73E-49	1.34E-47	1
ETS2	ENSG00000157557	19389.42	1.407436	0.086522	16.2669	1.70E-59	1.92E-57	1
SLC25A25	ENSG00000148339	2838.025	1.405496	0.105151	13.36641	9.50E-41	4.88E-39	1
IER3	ENSG00000137331	12216.09	1.405463	0.100372	14.00251	1.50E-44	9.55E-43	1
ROBO4	ENSG00000154133	744.1715	1.403174	0.137974	10.16982	2.70E-24	6.02E-23	1
DUSP6	ENSG00000139318	1737.145	1.401783	0.16909	8.290159	1.13E-16	1.47E-15	1
SMOX	ENSG00000088826	5388.053	1.401456	0.138651	10.10782	5.10E-24	1.12E-22	1
NRBF2	ENSG00000148572	3376.595	1.394208	0.118192	11.79612	4.09E-32	1.44E-30	1
SPSB1	ENSG00000171621	5381.144	1.388008	0.105881	13.10913	2.92E-39	1.43E-37	1

DUSP8	ENSG00000184545	1765.747	1.383938	0.129365	10.69794	1.04E-26	2.75E-25	1
SEC24D	ENSG00000150961	8062.676	1.375153	0.06981	19.69845	2.22E-86	4.99E-84	1
PCK2	ENSG00000100889	6707.19	1.369792	0.112582	12.16708	4.65E-34	1.81E-32	1
PER2	ENSG00000132326	797.4391	1.364237	0.179471	7.601434	2.93E-14	3.02E-13	1
MYC	ENSG00000136997	10859.42	1.357319	0.097129	13.97434	2.24E-44	1.40E-42	1
GARS	ENSG00000106105	25930.79	1.355954	0.097769	13.86899	9.76E-44	5.89E-42	1
IER2	ENSG00000160888	2557.818	1.349369	0.086455	15.6078	6.44E-55	6.03E-53	1
GFPT1	ENSG00000198380	11893.53	1.348333	0.087279	15.44849	7.72E-54	6.90E-52	1
EIF5	ENSG00000100664	31374.16	1.343125	0.070627	19.01715	1.23E-80	2.20E-78	1
NEDD9	ENSG00000111859	11179.11	1.341664	0.170209	7.882476	3.21E-15	3.64E-14	1
PVR	ENSG00000073008	30645.32	1.334466	0.101754	13.1147	2.71E-39	1.34E-37	1
PXDC1	ENSG00000168994	8106.449	1.333311	0.094356	14.13067	2.46E-45	1.62E-43	1
CBARP	ENSG00000099625	519.4606	1.333201	0.120852	11.03165	2.69E-28	7.84E-27	1
NHSL1	ENSG00000135540	1889.402	1.331773	0.150128	8.87093	7.25E-19	1.11E-17	1
ZNF697	ENSG00000143067	5049.516	1.315508	0.112296	11.71463	1.07E-31	3.72E-30	1
NFE2L2	ENSG00000116044	15684.48	1.307604	0.082009	15.9447	3.10E-57	3.18E-55	1
ZFAS1	ENSG00000177410	1715.616	1.293588	0.141139	9.165375	4.94E-20	8.40E-19	1
SNAI2	ENSG00000019549	4754.354	1.290023	0.161175	8.003854	1.21E-15	1.43E-14	1
RAB33B	ENSG00000172007	1990.474	1.287091	0.075055	17.14864	6.43E-66	9.00E-64	1
TGIF1	ENSG00000177426	4921.052	1.286011	0.131541	9.776478	1.42E-22	2.86E-21	1
CTAGE5	ENSG00000150527	1681.185	1.283543	0.116938	10.97625	4.97E-28	1.43E-26	1
ZFP69B	ENSG00000187801	1105.096	1.277134	0.111601	11.44377	2.53E-30	8.15E-29	1
SH3RF1	ENSG00000154447	7397.09	1.275522	0.158669	8.038912	9.06E-16	1.09E-14	1
NOCT	ENSG00000151014	5289.594	1.265405	0.088935	14.22849	6.10E-46	4.06E-44	1
MOCOS	ENSG00000075643	2742.748	1.263874	0.121413	10.40967	2.24E-25	5.39E-24	1
FGF5	ENSG00000138675	25662.27	1.261489	0.155373	8.119103	4.70E-16	5.79E-15	1
SEMA7A	ENSG00000138623	5404.747	1.259221	0.177009	7.113891	1.13E-12	1.00E-11	1
EPHA2	ENSG00000142627	26668.01	1.259016	0.110051	11.4403	2.63E-30	8.46E-29	1
LMO4	ENSG00000143013	2802.191	1.258024	0.078454	16.03509	7.27E-58	7.70E-56	1
LMCD1	ENSG00000071282	812.8579	1.253672	0.163794	7.653948	1.95E-14	2.05E-13	1
LIF	ENSG00000128342	27859.92	1.253374	0.146812	8.5373	1.37E-17	1.92E-16	1
ZNF202	ENSG00000166261	1916.809	1.250829	0.091344	13.69365	1.11E-42	6.32E-41	1
THAP9-AS1	ENSG00000251022	1594.534	1.250461	0.140092	8.926014	4.42E-19	6.86E-18	1
ADAMTS6	ENSG00000049192	4524.823	1.244855	0.174671	7.126869	1.03E-12	9.17E-12	1
CNST	ENSG00000162852	3069.774	1.242716	0.074758	16.62315	4.74E-62	5.79E-60	1
SHMT2	ENSG00000182199	19959.71	1.242518	0.0636	19.53638	5.39E-85	1.15E-82	1
SLC25A33	ENSG00000171612	1327.072	1.238382	0.114432	10.82203	2.71E-27	7.36E-26	1
MAP3K14	ENSG00000006062	1760.291	1.236997	0.089318	13.84932	1.28E-43	7.60E-42	1
FHL2	ENSG00000115641	15014.38	1.236399	0.093068	13.28487	2.83E-40	1.45E-38	1
PIGA	ENSG00000165195	1934.015	1.23185	0.083689	14.71931	4.85E-49	3.62E-47	1
TP53BP2	ENSG00000143514	16956.79	1.224788	0.094475	12.96414	1.95E-38	9.29E-37	1
TNFRSF12A	ENSG00000006327	26179.35	1.220408	0.075511	16.16195	9.36E-59	1.04E-56	1
SUSD6	ENSG00000100647	7577.852	1.220248	0.10522	11.59711	4.26E-31	1.42E-29	1
RGS3	ENSG00000138835	1554.973	1.2194	0.094539	12.89841	4.59E-38	2.17E-36	1
SH3TC1	ENSG00000125089	1620.434	1.219333	0.141938	8.590615	8.65E-18	1.23E-16	1
HSPA13	ENSG00000155304	8546.219	1.218591	0.087906	13.86237	1.07E-43	6.42E-42	1
BCL2A1	ENSG00000140379	543.1861	1.215344	0.17968	6.763926	1.34E-11	1.06E-10	1

INTS7	ENSG00000143493	5433.444	1.214476	0.057381	21.16507	2.00E-99	6.67E-97	1
ZBTB21	ENSG00000173276	8848.901	1.212112	0.120498	10.0592	8.37E-24	1.81E-22	1
PLEKHF1	ENSG00000166289	1793.422	1.209469	0.116038	10.42302	1.95E-25	4.71E-24	1
PHLDA1	ENSG00000139289	23029.34	1.208359	0.130941	9.228251	2.75E-20	4.76E-19	1
ZFP36L1	ENSG00000185650	24965.53	1.208233	0.113141	10.67904	1.28E-26	3.34E-25	1
CCDC174	ENSG00000154781	1663.622	1.207633	0.102141	11.82321	2.96E-32	1.05E-30	1
USP36	ENSG00000055483	14435.01	1.206208	0.130354	9.253332	2.18E-20	3.79E-19	1
TGDS	ENSG00000088451	692.9265	1.206202	0.114168	10.56516	4.32E-26	1.09E-24	1
PLK3	ENSG00000173846	3641.159	1.206156	0.137279	8.786189	1.55E-18	2.32E-17	1
PSPH	ENSG00000146733	1764.786	1.202938	0.08941	13.45418	2.91E-41	1.53E-39	1
JUNB	ENSG00000171223	4212.43	1.202741	0.145845	8.246684	1.63E-16	2.09E-15	1
RNF19B	ENSG00000116514	5177.294	1.201873	0.074909	16.0444	6.26E-58	6.71E-56	1
CBX4	ENSG00000141582	1030.559	1.194834	0.099065	12.06108	1.70E-33	6.34E-32	1
CTGF	ENSG00000118523	45887.23	1.192077	0.121849	9.783221	1.33E-22	2.68E-21	1
SERTAD1	ENSG00000197019	1765.814	1.188023	0.150066	7.916642	2.44E-15	2.80E-14	1
OTUD1	ENSG00000165312	1379.781	1.182947	0.130658	9.053784	1.38E-19	2.24E-18	1
AUNIP	ENSG00000127423	1459.212	1.178277	0.099482	11.84413	2.31E-32	8.31E-31	1
MIS12	ENSG00000167842	3826.807	1.167534	0.070372	16.59079	8.12E-62	9.80E-60	1
GREM1	ENSG00000166923	27816.36	1.167106	0.171984	6.786148	1.15E-11	9.15E-11	1
DYRK3	ENSG00000143479	4101.468	1.165386	0.085131	13.68938	1.18E-42	6.67E-41	1
CLTCL1	ENSG00000070371	2769.817	1.164202	0.151188	7.700361	1.36E-14	1.45E-13	1
NFKB1	ENSG00000109320	31312.26	1.163408	0.085799	13.55973	6.94E-42	3.83E-40	1
UBC	ENSG00000150991	86769.65	1.160511	0.053133	21.84175	9.31E-106	3.33E-103	1
TMCC3	ENSG00000057704	1385.193	1.154391	0.102745	11.23545	2.73E-29	8.44E-28	1
ZSWIM6	ENSG00000130449	10326.03	1.151722	0.140823	8.178511	2.87E-16	3.60E-15	1
NFXL1	ENSG00000170448	1196.5	1.151034	0.099541	11.5634	6.32E-31	2.09E-29	1
SOCS2	ENSG00000120833	797.6811	1.145867	0.117251	9.77275	1.47E-22	2.96E-21	1
SYNE1	ENSG00000131018	1323.445	1.142791	0.194261	5.882755	4.03E-09	2.45E-08	1
GAS5	ENSG00000234741	5605.047	1.140226	0.121298	9.400227	5.44E-21	9.91E-20	1
FAM84B	ENSG00000168672	1284.748	1.138709	0.125691	9.059606	1.31E-19	2.13E-18	1
STK40	ENSG00000196182	3493.55	1.133948	0.09471	11.97285	4.93E-33	1.82E-31	1
CPEB4	ENSG00000113742	4888.38	1.133767	0.148645	7.627359	2.40E-14	2.50E-13	1
AMIGO2	ENSG00000139211	23963.63	1.131784	0.130857	8.649024	5.19E-18	7.45E-17	1
CYP27B1	ENSG00000111012	562.2317	1.13102	0.136202	8.303969	1.01E-16	1.32E-15	1
ICAM1	ENSG00000090339	79440.07	1.127975	0.077264	14.59902	2.85E-48	2.07E-46	1
STARD8	ENSG00000130052	1100.035	1.125761	0.164194	6.856297	7.07E-12	5.72E-11	1
TSC22D1	ENSG00000102804	11103.67	1.122656	0.102753	10.92573	8.68E-28	2.45E-26	1
C6orf48	ENSG00000204387	1509.396	1.122427	0.149915	7.487072	7.04E-14	7.08E-13	1
GAS2L3	ENSG00000139354	6120.199	1.11947	0.101666	11.01126	3.37E-28	9.77E-27	1
AVPI1	ENSG00000119986	1430.873	1.113953	0.139718	7.972873	1.55E-15	1.83E-14	1
AL031985.	ENSG00000260920	874.3836	1.108081	0.139825	7.924758	2.29E-15	2.64E-14	1
SLC7A11	ENSG00000151012	10855.9	1.105402	0.198527	5.568015	2.58E-08	1.40E-07	1
XPC	ENSG00000154767	2584.405	1.103484	0.085946	12.8393	9.88E-38	4.54E-36	1
ZNF550	ENSG00000251369	1098.82	1.102971	0.11017	10.01155	1.36E-23	2.89E-22	1
NDEL1	ENSG00000166579	5469.93	1.102127	0.061242	17.99613	2.09E-72	3.36E-70	1
RNF41	ENSG00000181852	3745.984	1.101349	0.068852	15.99598	1.36E-57	1.41E-55	1
NABP1	ENSG00000173559	8404.92	1.101304	0.184373	5.973251	2.33E-09	1.44E-08	1

HTR7	ENSG00000148680	1091.201	1.101263	0.103859	10.60341	2.87E-26	7.33E-25	1
SARS	ENSG00000031698	19583.26	1.099643	0.060677	18.12291	2.10E-73	3.44E-71	1
E2F7	ENSG00000165891	23476.44	1.097954	0.142209	7.720726	1.16E-14	1.25E-13	1
HMOX1	ENSG00000100292	11530.81	1.094935	0.169768	6.449585	1.12E-10	7.99E-10	1
ZMYM5	ENSG00000132950	1493.433	1.093333	0.129876	8.418303	3.82E-17	5.10E-16	1
AC073869.	ENSG00000152117	2360.414	1.092604	0.152792	7.150906	8.62E-13	7.78E-12	1
TAF1A	ENSG00000143498	646.7442	1.091505	0.14108	7.736757	1.02E-14	1.11E-13	1
PLAU	ENSG00000122861	37498.97	1.089839	0.096251	11.32283	1.01E-29	3.18E-28	1
PRAG1	ENSG00000275342	1745.079	1.088525	0.156783	6.942896	3.84E-12	3.20E-11	1
ZNF354A	ENSG00000169131	2429.317	1.08598	0.089274	12.16453	4.80E-34	1.85E-32	1
CSGALNAC	ENSG00000169826	5751.542	1.08587	0.067488	16.08984	3.01E-58	3.26E-56	1
PRR3	ENSG00000204576	1472.458	1.085366	0.099913	10.86308	1.73E-27	4.74E-26	1
SLFN5	ENSG00000166750	10880.33	1.081869	0.092642	11.67789	1.65E-31	5.62E-30	1
ARAP2	ENSG00000047365	1653.168	1.075086	0.102319	10.50721	8.00E-26	1.99E-24	1
ATP2B1	ENSG00000070961	36652.52	1.073833	0.05309	20.22677	5.69E-91	1.43E-88	1
ETV5	ENSG00000244405	3196.898	1.070054	0.114112	9.377251	6.77E-21	1.22E-19	1
UGDH	ENSG00000109814	4620.591	1.068475	0.107327	9.95529	2.39E-23	5.03E-22	1
ATF4	ENSG00000128272	42400.47	1.063288	0.075644	14.05638	7.04E-45	4.56E-43	1
SIAH2	ENSG00000181788	2494.369	1.062964	0.113442	9.370079	7.25E-21	1.30E-19	1
SH3RF2	ENSG00000156463	2478.152	1.057782	0.233619	4.527802	5.96E-06	2.26E-05	1
PPRC1	ENSG00000148840	8567.713	1.056344	0.146189	7.225899	4.98E-13	4.61E-12	1
FAM241A	ENSG00000174749	1239.288	1.054929	0.07675	13.74502	5.46E-43	3.19E-41	1
CCNB1IP1	ENSG00000100814	2938.194	1.052797	0.102835	10.23774	1.34E-24	3.06E-23	1
NIPAL1	ENSG00000163293	1627.554	1.046458	0.110332	9.4846	2.43E-21	4.54E-20	1
EIF2AK3	ENSG00000172071	3247.255	1.045907	0.067541	15.48557	4.34E-54	3.95E-52	1
B3GNT5	ENSG00000176597	5435.817	1.043429	0.103612	10.07051	7.46E-24	1.61E-22	1
ZHX2	ENSG00000178764	1366.69	1.039595	0.115185	9.025444	1.79E-19	2.86E-18	1
PDCD1LG2	ENSG00000197646	2809.594	1.034857	0.103243	10.02348	1.20E-23	2.58E-22	1
RAPH1	ENSG00000173166	4351.654	1.03162	0.180232	5.723831	1.04E-08	5.94E-08	1
SPIRE1	ENSG00000134278	7940.097	1.031355	0.107779	9.569127	1.08E-21	2.05E-20	1
HDAC9	ENSG00000048052	4570.913	1.030558	0.144665	7.123776	1.05E-12	9.35E-12	1
KRCC1	ENSG00000172086	1772.792	1.029608	0.179922	5.722514	1.05E-08	5.98E-08	1
NFX1	ENSG00000086102	6707.525	1.027772	0.078565	13.08177	4.19E-39	2.04E-37	1
ALG2	ENSG00000119523	3055.249	1.027447	0.08264	12.43281	1.73E-35	7.21E-34	1
DEDD2	ENSG00000160570	1628.18	1.027216	0.148481	6.918155	4.58E-12	3.78E-11	1
IRAK2	ENSG00000134070	10377.67	1.027178	0.068616	14.97005	1.15E-50	9.19E-49	1
IFI16	ENSG00000163565	6899.192	1.027048	0.12144	8.457259	2.74E-17	3.72E-16	1
ACBD3	ENSG00000182827	5413.179	1.022414	0.072994	14.00673	1.42E-44	9.06E-43	1
INHBA	ENSG00000122641	5365.461	1.020049	0.167379	6.094261	1.10E-09	7.06E-09	1
MYSM1	ENSG00000162601	2432.255	1.018596	0.207659	4.905135	9.34E-07	4.06E-06	1
DCUN1D3	ENSG00000188215	1476.674	1.018236	0.093061	10.94164	7.29E-28	2.07E-26	1
LARP1B	ENSG00000138709	1998.253	1.016198	0.079937	12.71256	5.04E-37	2.27E-35	1
PFKFB3	ENSG00000170525	4144.479	1.013354	0.085674	11.82808	2.79E-32	9.99E-31	1
ALDOA	ENSG00000285043	563.7193	1.009864	0.125777	8.029027	9.82E-16	1.18E-14	1
SLC35G2	ENSG00000168917	817.8879	1.008303	0.103764	9.717285	2.54E-22	5.03E-21	1
AHR	ENSG00000106546	7808.339	1.004841	0.060361	16.64713	3.17E-62	3.93E-60	1
XPOT	ENSG00000184575	18906.13	1.002416	0.079936	12.54023	4.50E-36	1.95E-34	1

SYVN1	ENSG00000162298	4370.599	1.002347	0.10448	9.593672	8.50E-22	1.63E-20	1
GOT1	ENSG00000120053	8077.082	1.000475	0.051941	19.26186	1.12E-82	2.21E-80	1
BTN2A2	ENSG00000124508	2922.942	0.999953	0.089858	11.12819	9.15E-29	2.72E-27	1
PIM3	ENSG00000198355	5548.76	0.996879	0.100064	9.962439	2.23E-23	4.69E-22	1
RABGGTB	ENSG00000137955	4123.101	0.99617	0.129292	7.704834	1.31E-14	1.40E-13	1
ARL13B	ENSG00000169379	2981.424	0.991828	0.084266	11.77016	5.56E-32	1.96E-30	1
FOXD1	ENSG00000251493	3129.792	0.986966	0.108642	9.084577	1.04E-19	1.72E-18	1
BICD1	ENSG00000151746	3104.058	0.986702	0.113214	8.715359	2.90E-18	4.25E-17	1
SEC24A	ENSG00000113615	10025.29	0.9833	0.113355	8.674522	4.15E-18	6.01E-17	1
BIRC3	ENSG00000023445	8480.612	0.982901	0.152405	6.449251	1.12E-10	8.00E-10	1
WDR43	ENSG00000163811	6631.751	0.981105	0.075476	12.9989	1.24E-38	5.93E-37	1
C3orf52	ENSG00000114529	2019.676	0.980962	0.124398	7.885693	3.13E-15	3.55E-14	1
PELI1	ENSG00000197329	1600.987	0.980745	0.104188	9.413268	4.81E-21	8.77E-20	1
HRH1	ENSG00000196639	5591.517	0.976412	0.087149	11.20391	3.90E-29	1.18E-27	1
FANCE	ENSG00000112039	1956.897	0.975803	0.102847	9.487934	2.36E-21	4.41E-20	1
HYOU1	ENSG00000149428	16263.46	0.975584	0.057155	17.06923	2.51E-65	3.37E-63	1
LINC01583	ENSG00000259518	519.9052	0.974165	0.262154	3.716007	0.000202	0.000586	1
ZNF408	ENSG00000175213	1454.678	0.971146	0.0964	10.07412	7.19E-24	1.56E-22	1
REXO5	ENSG00000005189	1477.242	0.969335	0.08395	11.54658	7.68E-31	2.53E-29	1
TNFRSF10B	ENSG00000120889	27807.94	0.968002	0.090767	10.66473	1.49E-26	3.87E-25	1
DLG4	ENSG00000132535	1466.538	0.965503	0.108113	8.930486	4.24E-19	6.60E-18	1
DNAJB5	ENSG00000137094	2220.42	0.965457	0.110221	8.759243	1.97E-18	2.93E-17	1
G0S2	ENSG00000123689	10644.35	0.965321	0.091438	10.55709	4.71E-26	1.18E-24	1
BHLHE40	ENSG00000134107	12931.01	0.960812	0.155492	6.179169	6.44E-10	4.25E-09	1
ZNF770	ENSG00000198146	4865.53	0.960109	0.063514	15.11645	1.26E-51	1.07E-49	1
RTL5	ENSG00000242732	574.2113	0.959519	0.150279	6.384932	1.71E-10	1.19E-09	1
TSPYL2	ENSG00000184205	2099.027	0.955735	0.134745	7.09294	1.31E-12	1.16E-11	1
CARS	ENSG00000110619	8362.375	0.94948	0.075981	12.49629	7.82E-36	3.32E-34	1
SNHG17	ENSG00000196756	5023.127	0.949393	0.109331	8.683695	3.83E-18	5.56E-17	1
SLC43A3	ENSG00000134802	7495.699	0.940433	0.075265	12.49488	7.96E-36	3.37E-34	1
NR4A1	ENSG00000123358	662.2926	0.937	0.124097	7.550534	4.33E-14	4.43E-13	1
FSTL3	ENSG00000070404	7449.582	0.936196	0.117903	7.940423	2.01E-15	2.33E-14	1
TAF1D	ENSG00000166012	5742.411	0.935263	0.121647	7.688368	1.49E-14	1.58E-13	1
TMEM41B	ENSG00000166471	4821.698	0.935004	0.071583	13.06176	5.45E-39	2.63E-37	1
OSBP2	ENSG00000184792	2401.812	0.934742	0.14263	6.553618	5.62E-11	4.13E-10	1
RYBP	ENSG00000163602	5707.114	0.934118	0.075224	12.41785	2.09E-35	8.62E-34	1
FOXA1	ENSG00000129514	1094.75	0.933958	0.120514	7.749774	9.21E-15	1.01E-13	1
IVNS1ABP	ENSG00000116679	12768	0.933929	0.085125	10.97129	5.25E-28	1.50E-26	1
PLAUR	ENSG00000011422	6323.294	0.932733	0.070563	13.21839	6.87E-40	3.45E-38	1
CEP72	ENSG00000112877	2735.348	0.932005	0.096032	9.705112	2.87E-22	5.66E-21	1
FOXP1	ENSG00000114861	2583.805	0.930771	0.126729	7.344563	2.06E-13	1.99E-12	1
YARS	ENSG00000134684	14724.58	0.930471	0.088045	10.56808	4.19E-26	1.06E-24	1
MTHFD1L	ENSG00000120254	6193.564	0.92988	0.101229	9.185913	4.08E-20	7.00E-19	1
ZBTB49	ENSG00000168826	512.5539	0.927273	0.152942	6.062902	1.34E-09	8.50E-09	1
HSPA9	ENSG00000113013	48658.89	0.927184	0.053617	17.29266	5.34E-67	7.58E-65	1
WDR25	ENSG00000176473	660.9268	0.926299	0.106509	8.696938	3.41E-18	4.96E-17	1
SPRY2	ENSG00000136158	946.2806	0.924991	0.142093	6.509748	7.53E-11	5.46E-10	1

ABL1	ENSG00000097007	23057.32	0.924595	0.089859	10.28939	7.87E-25	1.84E-23	1
LONP1	ENSG00000196365	10747.14	0.924471	0.07555	12.23661	1.98E-34	7.74E-33	1
KLF5	ENSG00000102554	3158.076	0.923737	0.14349	6.437629	1.21E-10	8.55E-10	1
ZNF330	ENSG00000109445	2054.473	0.923257	0.071652	12.88537	5.44E-38	2.55E-36	1
LRIF1	ENSG00000121931	1687.087	0.922276	0.122474	7.530381	5.06E-14	5.15E-13	1
JUND	ENSG00000130522	11860.46	0.922199	0.101875	9.05223	1.40E-19	2.26E-18	1
	ENSG00000290927	646.0968	0.922143	0.149964	6.149076	7.79E-10	5.08E-09	1
USP37	ENSG00000135913	3439.111	0.920276	0.091944	10.00907	1.39E-23	2.95E-22	1
CDC6	ENSG00000094804	14030.1	0.919932	0.069838	13.17236	1.27E-39	6.33E-38	1
RRP12	ENSG00000052749	4143.407	0.917902	0.119792	7.662487	1.82E-14	1.93E-13	1
RASSF1	ENSG00000068028	6525.94	0.914952	0.094826	9.648792	4.97E-22	9.67E-21	1
TRMO	ENSG00000136932	1145.662	0.914234	0.09289	9.842126	7.41E-23	1.52E-21	1
BACH1	ENSG00000156273	9733.67	0.912321	0.11048	8.257827	1.48E-16	1.92E-15	1
ZCCHC8	ENSG00000033030	4170.983	0.911761	0.071768	12.70436	5.59E-37	2.50E-35	1
ELL	ENSG00000105656	2519.799	0.907469	0.088773	10.22237	1.57E-24	3.57E-23	1
POLR3D	ENSG00000168495	4329.958	0.906671	0.079867	11.35228	7.23E-30	2.29E-28	1
LAMB3	ENSG00000196878	10230.46	0.903154	0.093796	9.62887	6.04E-22	1.17E-20	1
ARL5B	ENSG00000165997	3902.333	0.900261	0.080971	11.11837	1.02E-28	3.01E-27	1
PGPEP1	ENSG00000130517	1500.653	0.899948	0.085093	10.57602	3.85E-26	9.77E-25	1
CCDC9	ENSG00000105321	2473.08	0.897038	0.106074	8.456706	2.75E-17	3.74E-16	1
HIVEP2	ENSG00000010818	15866.36	0.896733	0.123496	7.261222	3.84E-13	3.60E-12	1
ING3	ENSG00000071243	1609.623	0.894016	0.096158	9.297344	1.44E-20	2.53E-19	1
ZFAND1	ENSG00000104231	1367.845	0.892424	0.108877	8.196597	2.47E-16	3.12E-15	1
SDCCAG8	ENSG00000054282	1020.067	0.889468	0.084485	10.52815	6.41E-26	1.61E-24	1
MIR22HG	ENSG00000186594	3582.727	0.888176	0.148	6.001196	1.96E-09	1.22E-08	1
AFTPH	ENSG00000119844	3230.105	0.886254	0.075518	11.73562	8.37E-32	2.93E-30	1
ERFE	ENSG00000178752	1396.165	0.883886	0.131662	6.713273	1.90E-11	1.48E-10	1
ZNF419	ENSG00000105136	656.5256	0.880585	0.103025	8.547257	1.26E-17	1.76E-16	1
CDKN2AIP	ENSG00000168564	2929.869	0.879974	0.106999	8.22416	1.97E-16	2.50E-15	1
	ENSG00000291152	1331.734	0.879902	0.107708	8.16932	3.10E-16	3.88E-15	1
MEF2A	ENSG00000068305	5640.358	0.879826	0.067357	13.06206	5.42E-39	2.63E-37	1
GCC1	ENSG00000179562	3459.468	0.878924	0.059987	14.65178	1.31E-48	9.59E-47	1
FAM53C	ENSG00000120709	7535.002	0.87836	0.063929	13.73968	5.87E-43	3.41E-41	1
BCL6	ENSG00000113916	1059.241	0.876204	0.122212	7.169536	7.53E-13	6.86E-12	1
TMEM263	ENSG00000151135	7032.041	0.87456	0.107769	8.115152	4.85E-16	5.97E-15	1
FEM1C	ENSG00000145780	6795.715	0.873332	0.071786	12.16575	4.73E-34	1.83E-32	1
RWDD2A	ENSG00000013392	1286.815	0.87328	0.13304	6.56404	5.24E-11	3.86E-10	1
SGPP2	ENSG00000163082	832.6987	0.870297	0.093152	9.34272	9.39E-21	1.67E-19	1
SLC31A1	ENSG00000136868	7249.103	0.869647	0.080812	10.7613	5.24E-27	1.41E-25	1
CDCP1	ENSG00000163814	13564.63	0.866969	0.12864	6.73949	1.59E-11	1.25E-10	1
ENTPD7	ENSG00000198018	5019.777	0.865076	0.126006	6.865378	6.63E-12	5.38E-11	1
HSPBAP1	ENSG00000169087	729.0668	0.86403	0.114908	7.519298	5.51E-14	5.59E-13	1
FAXDC2	ENSG00000170271	752.4617	0.863837	0.12358	6.9901	2.75E-12	2.32E-11	1
GFPT2	ENSG00000131459	19687.13	0.863436	0.131113	6.585436	4.54E-11	3.37E-10	1
MIR100HG	ENSG00000255248	970.2738	0.863066	0.153486	5.623087	1.88E-08	1.04E-07	1
SNX18	ENSG00000178996	4070.686	0.86298	0.062307	13.85045	1.26E-43	7.53E-42	1
ZNF416	ENSG00000083817	661.0688	0.862903	0.160206	5.386207	7.20E-08	3.67E-07	1

TSTD2	ENSG00000136925	1541.248	0.862795	0.084049	10.26532	1.01E-24	2.33E-23	1
	ENSG00000291201	777.3651	0.862722	0.248961	3.465286	0.00053	0.0014069	1
IL1RAP	ENSG00000196083	4295.448	0.862632	0.075781	11.38325	5.07E-30	1.62E-28	1
COX19	ENSG00000240230	1386.098	0.861193	0.094502	9.113012	8.01E-20	1.34E-18	1
LINC-PINT	ENSG00000231721	930.3179	0.860507	0.217894	3.949198	7.84E-05	0.0002455	1
MEX3B	ENSG00000183496	2255.533	0.857813	0.112904	7.597748	3.01E-14	3.10E-13	1
NOP14-AS1	ENSG00000249673	2070.315	0.857545	0.157402	5.448118	5.09E-08	2.66E-07	1
SLC3A2	ENSG00000168003	57285.3	0.855442	0.06011	14.2313	5.86E-46	3.92E-44	1
DNAJC25	ENSG00000059769	826.0281	0.854352	0.091745	9.312198	1.25E-20	2.21E-19	1
MARS	ENSG00000166986	17557.49	0.853335	0.077301	11.03911	2.47E-28	7.23E-27	1
ZNF529	ENSG00000186020	1480.683	0.85295	0.111915	7.621411	2.51E-14	2.61E-13	1
ZNF620	ENSG00000177842	483.5897	0.852599	0.15142	5.630702	1.79E-08	9.94E-08	1
BNC1	ENSG00000169594	11021.42	0.852152	0.094198	9.046348	1.48E-19	2.38E-18	1
SLCO4A1	ENSG00000101187	780.0412	0.852051	0.147318	5.783755	7.31E-09	4.27E-08	1
SUPV3L1	ENSG00000156502	2627.931	0.849131	0.061073	13.90359	6.02E-44	3.68E-42	1
RALA	ENSG00000006451	20587.39	0.84763	0.078785	10.75877	5.39E-27	1.45E-25	1
GPCPD1	ENSG00000125772	4839.741	0.847469	0.090345	9.380335	6.58E-21	1.19E-19	1
PIM1	ENSG00000137193	3036.247	0.847014	0.169774	4.989065	6.07E-07	2.71E-06	1
EIF1	ENSG00000173812	36235.28	0.843575	0.060557	13.93029	4.15E-44	2.56E-42	1
C9orf72	ENSG00000147894	574.6798	0.842758	0.116297	7.246609	4.27E-13	3.99E-12	1
TBCK	ENSG00000145348	701.8238	0.839519	0.127701	6.574118	4.89E-11	3.62E-10	1
STK38L	ENSG00000211455	1917.885	0.838921	0.099406	8.439299	3.19E-17	4.30E-16	1
SLC7A1	ENSG00000139514	34910.73	0.838795	0.156651	5.354549	8.58E-08	4.33E-07	1
PRNP	ENSG00000171867	34723.62	0.838697	0.081685	10.26749	9.87E-25	2.28E-23	1
MEX3C	ENSG00000176624	4947.857	0.835635	0.059333	14.08374	4.78E-45	3.14E-43	1
PLAT	ENSG00000104368	5346.07	0.834854	0.107677	7.753291	8.95E-15	9.82E-14	1
TNFRSF10A	ENSG00000104689	2202.166	0.83422	0.093338	8.937668	3.97E-19	6.19E-18	1
MCL1	ENSG00000143384	41683.02	0.832736	0.065261	12.76001	2.74E-37	1.24E-35	1
SDE2	ENSG00000143751	3721.726	0.830619	0.087788	9.461693	3.03E-21	5.62E-20	1
SLC1A5	ENSG00000105281	11597.44	0.829733	0.118202	7.019632	2.22E-12	1.90E-11	1
FAM212B	ENSG00000197852	1734.995	0.829253	0.09948	8.335902	7.69E-17	1.01E-15	1
R3HDM2	ENSG00000179912	1861.77	0.828708	0.115649	7.165702	7.74E-13	7.03E-12	1
NNMT	ENSG00000166741	12893.89	0.828501	0.277057	2.990367	0.002786	0.0063145	1
IQCB1	ENSG00000173226	1743.249	0.827466	0.101153	8.180321	2.83E-16	3.55E-15	1
MIA3	ENSG00000154305	5961.82	0.825326	0.069521	11.87162	1.66E-32	6.03E-31	1
DCLK2	ENSG00000170390	1490.115	0.825007	0.151312	5.452346	4.97E-08	2.60E-07	1
SIK3	ENSG00000160584	2911.737	0.823255	0.115798	7.109437	1.17E-12	1.03E-11	1
GORAB	ENSG00000120370	1304.154	0.822586	0.096207	8.550124	1.23E-17	1.72E-16	1
BRPF3	ENSG00000096070	6109.877	0.821993	0.071724	11.46046	2.08E-30	6.77E-29	1
MSC	ENSG00000178860	2305.458	0.821959	0.232059	3.542032	0.000397	0.0010857	1
AARS	ENSG00000090861	20910.7	0.82086	0.06789	12.09105	1.18E-33	4.42E-32	1
ITGA2	ENSG00000164171	4594.235	0.82077	0.167201	4.908895	9.16E-07	3.99E-06	1
NIT1	ENSG00000158793	1441.87	0.819937	0.091583	8.952944	3.46E-19	5.42E-18	1
CCDC15	ENSG00000149548	2255.116	0.816945	0.073214	11.15827	6.53E-29	1.96E-27	1
SPHK1	ENSG00000176170	13966.37	0.816861	0.115341	7.082127	1.42E-12	1.24E-11	1
PALM2-AK	ENSG00000157654	129520.6	0.816851	0.108441	7.532649	4.97E-14	5.07E-13	1
RANBP9	ENSG00000010017	5277.765	0.815778	0.059102	13.80299	2.45E-43	1.44E-41	1

GADD45B	ENSG00000099860	3962.199	0.814821	0.10253	7.947123	1.91E-15	2.22E-14	1
MBD1	ENSG00000141644	9502.621	0.814758	0.077147	10.56106	4.52E-26	1.14E-24	1
FOSL1	ENSG00000175592	25280.15	0.813864	0.164624	4.943782	7.66E-07	3.38E-06	1
SGF29	ENSG00000176476	853.7214	0.812181	0.094309	8.611931	7.18E-18	1.03E-16	1
OSBPL6	ENSG00000079156	2244.309	0.809767	0.117475	6.893122	5.46E-12	4.49E-11	1
ULBP2	ENSG00000131015	1228.743	0.808685	0.162877	4.965	6.87E-07	3.04E-06	1
CCDC59	ENSG00000133773	2129.249	0.808668	0.13428	6.022247	1.72E-09	1.08E-08	1
ZNF121	ENSG00000197961	1951.986	0.80835	0.080741	10.01162	1.36E-23	2.89E-22	1
NCOA7	ENSG00000111912	6953.474	0.807486	0.114588	7.04687	1.83E-12	1.58E-11	1
NSRP1	ENSG00000126653	3693.924	0.807463	0.064479	12.52283	5.60E-36	2.40E-34	1
TIMM44	ENSG00000104980	3317.925	0.806005	0.066623	12.09806	1.08E-33	4.09E-32	1
CDC42EP3	ENSG00000163171	5260.441	0.805893	0.142429	5.658209	1.53E-08	8.54E-08	1
SERP1	ENSG00000120742	8065.154	0.805373	0.07779	10.35315	4.05E-25	9.62E-24	1
KITLG	ENSG00000049130	2180.379	0.804735	0.107274	7.501653	6.30E-14	6.37E-13	1
COQ10B	ENSG00000115520	3472.74	0.804059	0.127146	6.323915	2.55E-10	1.74E-09	1
PPL	ENSG00000118898	4798.439	0.804005	0.098235	8.184533	2.73E-16	3.43E-15	1
RIOK2	ENSG00000058729	3128.779	0.803619	0.101469	7.919851	2.38E-15	2.73E-14	1
RNF19A	ENSG00000034677	7784.379	0.80358	0.063324	12.68991	6.73E-37	2.99E-35	1
CITED4	ENSG00000179862	2178.635	0.803418	0.112446	7.144889	9.01E-13	8.08E-12	1
IFFO2	ENSG00000169991	4284.261	0.801206	0.150908	5.309247	1.10E-07	5.47E-07	1
IARS	ENSG00000196305	26055.83	0.801048	0.091319	8.771927	1.76E-18	2.63E-17	1
MTSS1L	ENSG00000132613	1788.503	0.799411	0.114378	6.989215	2.76E-12	2.33E-11	1
HIVEP1	ENSG00000095951	9957.268	0.797534	0.155229	5.137794	2.78E-07	1.31E-06	1
PAPPA	ENSG00000182752	1276.013	0.79699	0.15967	4.99149	5.99E-07	2.68E-06	1
ZNF26	ENSG00000198393	1543.874	0.796724	0.120705	6.600612	4.09E-11	3.05E-10	1
NFKBIL1	ENSG00000204498	1350.833	0.795459	0.122228	6.50801	7.62E-11	5.52E-10	1
ZNF777	ENSG00000196453	2080.503	0.793406	0.076598	10.358	3.85E-25	9.17E-24	1
KANSL2	ENSG00000139620	2378.032	0.793086	0.105456	7.520551	5.45E-14	5.54E-13	1
LATS2	ENSG00000150457	6806.696	0.79207	0.102967	7.692435	1.44E-14	1.54E-13	1
GLIS3	ENSG00000107249	5548.265	0.790947	0.135916	5.819364	5.91E-09	3.49E-08	1
KLF6	ENSG00000067082	48491.64	0.788974	0.056497	13.96493	2.55E-44	1.59E-42	1
SLC39A14	ENSG00000104635	26380.13	0.785711	0.063385	12.39578	2.75E-35	1.11E-33	1
ZNF829	ENSG00000185869	679.9468	0.784745	0.106277	7.383991	1.54E-13	1.50E-12	1
INTS6	ENSG00000102786	5011.16	0.784456	0.065145	12.04164	2.15E-33	7.96E-32	1
CRY1	ENSG00000008405	4172.282	0.784117	0.083851	9.351276	8.66E-21	1.54E-19	1
PIP5K1A	ENSG00000143398	9991.521	0.782817	0.059184	13.22695	6.13E-40	3.10E-38	1
MKRN2	ENSG00000075975	1761.515	0.780477	0.069159	11.2852	1.55E-29	4.83E-28	1
THAP5	ENSG00000177683	2309.707	0.780026	0.099566	7.834236	4.72E-15	5.30E-14	1
BRD2	ENSG00000204256	18599.65	0.779731	0.068842	11.32637	9.71E-30	3.06E-28	1
MLPH	ENSG00000115648	1201.526	0.779136	0.128014	6.086317	1.16E-09	7.39E-09	1
CHD2	ENSG00000173575	10725.8	0.779081	0.117144	6.650613	2.92E-11	2.21E-10	1
TOP1	ENSG00000198900	14378.88	0.778808	0.084968	9.165882	4.91E-20	8.38E-19	1
KCNJ12	ENSG00000184185	810.0737	0.778707	0.217287	3.583766	0.000339	0.000937	1
FSD1L	ENSG00000106701	1296.305	0.778471	0.141727	5.492762	3.96E-08	2.10E-07	1
TRAPPC6B	ENSG00000182400	734.7256	0.777989	0.094165	8.261967	1.43E-16	1.86E-15	1
ITPKC	ENSG00000086544	1127.052	0.776493	0.094571	8.210727	2.20E-16	2.78E-15	1
ZNF513	ENSG00000163795	1186.413	0.776116	0.091013	8.52755	1.49E-17	2.08E-16	1

METTL1	ENSG00000037897	1274.374	0.775969	0.103652	7.486305	7.08E-14	7.11E-13	1
BCAR3	ENSG00000137936	16029.33	0.775174	0.083409	9.293641	1.49E-20	2.61E-19	1
SLC20A1	ENSG00000144136	14415.81	0.775121	0.08558	9.057291	1.34E-19	2.17E-18	1
TBC1D7	ENSG00000145979	855.6793	0.774981	0.179226	4.324054	1.53E-05	5.44E-05	1
C1orf109	ENSG00000116922	2317.325	0.774844	0.101573	7.628466	2.38E-14	2.48E-13	1
LONRF1	ENSG00000154359	2098.93	0.772411	0.115268	6.701026	2.07E-11	1.60E-10	1
INPP1	ENSG00000151689	3071.148	0.771734	0.072969	10.57621	3.84E-26	9.77E-25	1
ZC3H8	ENSG00000144161	830.9353	0.770876	0.085515	9.014506	1.98E-19	3.15E-18	1
ESM1	ENSG00000164283	2733.134	0.769889	0.141632	5.435833	5.45E-08	2.83E-07	1
AC118549.	ENSG00000036549	5473.277	0.767792	0.064696	11.86776	1.74E-32	6.29E-31	1
NAT9	ENSG00000109065	3584.508	0.766812	0.056756	13.51075	1.35E-41	7.28E-40	1
ZFAND2A	ENSG00000178381	1104.944	0.766079	0.134285	5.70488	1.16E-08	6.60E-08	1
GOLGA2	ENSG00000167110	9785.063	0.765476	0.095813	7.989268	1.36E-15	1.61E-14	1
TIGD6	ENSG00000164296	554.4847	0.765397	0.11555	6.62397	3.50E-11	2.63E-10	1
JMY	ENSG00000152409	2568.018	0.764612	0.109045	7.011887	2.35E-12	2.00E-11	1
ZNF263	ENSG00000006194	1293.528	0.764588	0.090361	8.461431	2.64E-17	3.60E-16	1
ARL4A	ENSG00000122644	1555.392	0.76246	0.120283	6.338873	2.31E-10	1.59E-09	1
ZNF805	ENSG00000204524	823.0599	0.761848	0.138874	5.485905	4.11E-08	2.18E-07	1
TSC22D2	ENSG00000196428	4400.969	0.761503	0.088006	8.652892	5.02E-18	7.22E-17	1
NMD3	ENSG00000169251	3734.355	0.76076	0.099573	7.640196	2.17E-14	2.28E-13	1
TMEM161	ENSG00000164180	1879.886	0.760494	0.132819	5.725802	1.03E-08	5.89E-08	1
RRAS2	ENSG00000133818	14449.46	0.760038	0.077911	9.755271	1.75E-22	3.50E-21	1
CDC42EP1	ENSG00000128283	6801.144	0.758442	0.124454	6.094138	1.10E-09	7.06E-09	1
FAM83G	ENSG00000188522	6954.615	0.757054	0.111913	6.764662	1.34E-11	1.06E-10	1
UBAP1	ENSG00000165006	5140.652	0.756968	0.070553	10.72899	7.44E-27	1.98E-25	1
CSRNP2	ENSG00000110925	4340.25	0.756173	0.066843	11.31274	1.13E-29	3.55E-28	1
RUSC2	ENSG00000198853	8066.117	0.755768	0.138596	5.453029	4.95E-08	2.59E-07	1
BAMBI	ENSG00000095739	2219.36	0.755487	0.126778	5.959137	2.54E-09	1.57E-08	1
PHLDB3	ENSG00000176531	730.225	0.755431	0.099971	7.556502	4.14E-14	4.24E-13	1
USP47	ENSG00000170242	5398.652	0.755308	0.104418	7.233526	4.71E-13	4.37E-12	1
ZNF280C	ENSG00000056277	607.7657	0.754814	0.126564	5.963868	2.46E-09	1.52E-08	1
VLDLR	ENSG00000147852	1725.806	0.754536	0.094834	7.956341	1.77E-15	2.08E-14	1
AKAP17A	ENSG00000197976	2327.84	0.754484	0.09779	7.715358	1.21E-14	1.30E-13	1
TIPIN	ENSG00000075131	1275.068	0.753363	0.087854	8.575177	9.89E-18	1.39E-16	1
FAM131A	ENSG00000175182	1518.547	0.751726	0.083399	9.013591	1.99E-19	3.17E-18	1
ZCCHC7	ENSG00000147905	1879.293	0.750713	0.136855	5.485472	4.12E-08	2.18E-07	1
SYDE2	ENSG00000097096	642.3787	0.74975	0.152822	4.906018	9.29E-07	4.04E-06	1
OSMR	ENSG00000145623	25872.52	0.749232	0.066866	11.20503	3.85E-29	1.17E-27	1
FERMT2	ENSG00000073712	14860.77	0.74724	0.059302	12.60055	2.10E-36	9.24E-35	1
ZNF827	ENSG00000151612	2765.691	0.744688	0.1232	6.044565	1.50E-09	9.49E-09	1
OSER1	ENSG00000132823	6090.193	0.743692	0.115351	6.447186	1.14E-10	8.09E-10	1
TFPI2	ENSG00000105825	1927.305	0.742655	0.169204	4.389106	1.14E-05	4.12E-05	1
ZNF324	ENSG00000083812	1504.662	0.741252	0.095193	7.786813	6.87E-15	7.61E-14	1
RPL22L1	ENSG00000163584	1191.154	0.740689	0.105493	7.021246	2.20E-12	1.88E-11	1
SRFBP1	ENSG00000151304	3030.024	0.739742	0.101428	7.293267	3.03E-13	2.87E-12	1
GOLGA5	ENSG00000066455	4506.712	0.739604	0.099093	7.463742	8.41E-14	8.35E-13	1
CLDN1	ENSG00000163347	43230.56	0.73919	0.067181	11.00295	3.70E-28	1.07E-26	1

NBPF12	ENSG00000268043	1459.971	0.739084	0.11777	6.27565	3.48E-10	2.35E-09	1
ELL2	ENSG00000118985	12309.04	0.737447	0.049925	14.77111	2.25E-49	1.72E-47	1
DENND4A	ENSG00000174485	3397.801	0.736615	0.088721	8.302641	1.02E-16	1.33E-15	1
POLR3C	ENSG00000186141	4985.051	0.735971	0.068319	10.77251	4.64E-27	1.25E-25	1
GEMIN2	ENSG00000092208	900.7671	0.735749	0.178921	4.112138	3.92E-05	0.0001296	1
TBL2	ENSG00000106638	3128.773	0.7357	0.074222	9.912202	3.68E-23	7.64E-22	1
NUFIP1	ENSG00000083635	1612.406	0.735106	0.087666	8.385293	5.06E-17	6.71E-16	1
SPATA2L	ENSG00000158792	645.1379	0.734303	0.13084	5.612242	2.00E-08	1.10E-07	1
COG3	ENSG00000136152	3209.995	0.734117	0.068392	10.734	7.05E-27	1.88E-25	1
RCL1	ENSG00000120158	1632.18	0.73358	0.104261	7.035964	1.98E-12	1.70E-11	1
MICAL2	ENSG00000133816	26074.12	0.733506	0.132776	5.524385	3.31E-08	1.77E-07	1
AC240274.	ENSG00000271254	4125.669	0.733243	0.069093	10.61238	2.61E-26	6.68E-25	1
METTL22	ENSG00000067365	608.8357	0.733017	0.114306	6.412779	1.43E-10	1.00E-09	1
FSBP	ENSG00000265817	598.8247	0.732017	0.15096	4.849081	1.24E-06	5.28E-06	1
CCSER2	ENSG00000107771	10651.21	0.730904	0.058124	12.57494	2.90E-36	1.27E-34	1
TXLNG	ENSG00000086712	2175.866	0.730766	0.072473	10.08323	6.55E-24	1.43E-22	1
NXT1	ENSG00000132661	2573.559	0.730761	0.151699	4.817164	1.46E-06	6.11E-06	1
RIOK1	ENSG00000124784	2093.092	0.730509	0.102605	7.119597	1.08E-12	9.63E-12	1
EREG	ENSG00000124882	2433.041	0.730345	0.20848	3.503183	0.00046	0.0012409	1
ARHGAP39	ENSG00000147799	1023.448	0.729652	0.148691	4.907183	9.24E-07	4.02E-06	1
TOE1	ENSG00000132773	1929.455	0.729194	0.079353	9.189268	3.96E-20	6.80E-19	1
HSPA14	ENSG00000284024	3593.382	0.729087	0.075672	9.634769	5.70E-22	1.11E-20	1
IL18	ENSG00000150782	2357.258	0.72751	0.09885	7.35976	1.84E-13	1.78E-12	1
CDR2	ENSG00000140743	5452.123	0.726837	0.09693	7.498538	6.45E-14	6.51E-13	1
SRSF6	ENSG00000124193	13851.13	0.725376	0.104431	6.945969	3.76E-12	3.13E-11	1
LRP12	ENSG00000147650	4455.867	0.723392	0.08771	8.247501	1.62E-16	2.08E-15	1
SGTB	ENSG00000197860	3681.213	0.721078	0.069503	10.37484	3.23E-25	7.73E-24	1
ATG101	ENSG00000123395	2898.49	0.720795	0.075412	9.558036	1.20E-21	2.27E-20	1
PVT1	ENSG00000249859	1363.431	0.720599	0.1962	3.672771	0.00024	0.0006835	1
NOP58	ENSG00000055044	5808.976	0.719534	0.091972	7.823395	5.14E-15	5.74E-14	1
LENG1	ENSG00000105617	748.6459	0.719519	0.136471	5.272317	1.35E-07	6.60E-07	1
POLR3F	ENSG00000132664	2439.615	0.718514	0.079933	8.988987	2.50E-19	3.94E-18	1
PDRG1	ENSG00000088356	3322.818	0.718444	0.121633	5.906653	3.49E-09	2.14E-08	1
RAB23	ENSG00000112210	3061.792	0.717935	0.091765	7.823586	5.13E-15	5.74E-14	1
LINC02057	ENSG00000249279	616.1456	0.717746	0.172884	4.151605	3.30E-05	0.0001104	1
HKR1	ENSG00000181666	1877.112	0.717028	0.10729	6.683106	2.34E-11	1.80E-10	1
PHC2	ENSG00000134686	14770.81	0.715822	0.057644	12.41804	2.09E-35	8.62E-34	1
GZF1	ENSG00000125812	3999.721	0.715779	0.068572	10.43837	1.66E-25	4.03E-24	1
PRKAB1	ENSG00000111725	2699.995	0.715594	0.069773	10.25599	1.11E-24	2.55E-23	1
FOXC2	ENSG00000176692	1619.776	0.715442	0.142561	5.018485	5.21E-07	2.35E-06	1
TAPT1	ENSG00000169762	1387.051	0.715396	0.08382	8.534911	1.40E-17	1.96E-16	1
YRDC	ENSG00000196449	1227.549	0.714029	0.083293	8.572456	1.01E-17	1.42E-16	1
EPRS	ENSG00000136628	18808.36	0.712859	0.075979	9.382344	6.45E-21	1.17E-19	1
CDC37L1	ENSG00000106993	1076.06	0.711128	0.161327	4.407986	1.04E-05	3.80E-05	1
RBCK1	ENSG00000125826	13415.88	0.711068	0.088015	8.078978	6.53E-16	7.95E-15	1
ST7L	ENSG00000007341	1206.306	0.71098	0.074349	9.562741	1.15E-21	2.17E-20	1
DDX21	ENSG00000165732	32657.74	0.710678	0.078403	9.064416	1.25E-19	2.05E-18	1

MED8	ENSG00000159479	2929.02	0.710126	0.083712	8.482975	2.20E-17	3.01E-16	1
TIMM9	ENSG00000100575	1218.566	0.709789	0.101117	7.019469	2.23E-12	1.90E-11	1
LINS1	ENSG00000140471	1013.282	0.709067	0.086957	8.154191	3.52E-16	4.38E-15	1
ARNTL	ENSG00000133794	1503.367	0.708342	0.123015	5.758181	8.50E-09	4.91E-08	1
CLCF1	ENSG00000175505	771.9828	0.707373	0.22769	3.106739	0.001892	0.004439	1
MYNN	ENSG00000085274	1296.247	0.70699	0.115912	6.099369	1.06E-09	6.85E-09	1
MITF	ENSG00000187098	695.7048	0.70542	0.105575	6.681681	2.36E-11	1.81E-10	1
ZBTB48	ENSG00000204859	1126.531	0.705085	0.079947	8.819407	1.15E-18	1.74E-17	1
	ENSG00000291087	646.2576	0.704596	0.094265	7.474634	7.74E-14	7.72E-13	1
TRIM39	ENSG00000204599	1006.506	0.70436	0.093851	7.50509	6.14E-14	6.21E-13	1
NT5C3A	ENSG00000122643	1910.274	0.704221	0.080995	8.694594	3.48E-18	5.06E-17	1
FOXL1	ENSG00000176678	562.9489	0.704194	0.149167	4.72085	2.35E-06	9.56E-06	1
TOX2	ENSG00000124191	1797.694	0.704002	0.116861	6.024286	1.70E-09	1.07E-08	1
RMND1	ENSG00000155906	1326.835	0.703888	0.082045	8.579263	9.55E-18	1.35E-16	1
FLRT2	ENSG00000185070	2334.48	0.703177	0.140244	5.013947	5.33E-07	2.41E-06	1
HMGCR	ENSG00000113161	74206.18	0.702813	0.092955	7.560765	4.01E-14	4.10E-13	1
PRKCE	ENSG00000171132	1314.541	0.702791	0.144521	4.862891	1.16E-06	4.94E-06	1
C10orf88	ENSG00000119965	1550.678	0.702263	0.090301	7.776923	7.43E-15	8.20E-14	1
ZNF134	ENSG00000213762	2222.993	0.702115	0.087578	8.017031	1.08E-15	1.30E-14	1
PMM2	ENSG00000140650	2023.258	0.701796	0.096602	7.264799	3.74E-13	3.52E-12	1
TAB2	ENSG00000055208	15022.6	0.701722	0.070091	10.01162	1.36E-23	2.89E-22	1
MAK16	ENSG00000198042	2411.154	0.701449	0.065982	10.63097	2.14E-26	5.52E-25	1
C5orf51	ENSG00000205765	5214.895	0.70142	0.077474	9.053641	1.38E-19	2.24E-18	1
PELO	ENSG00000152684	3806.21	0.701134	0.094322	7.433384	1.06E-13	1.04E-12	1
ZBED3	ENSG00000132846	1318.481	0.700861	0.184211	3.804668	0.000142	0.0004245	1
RGMB-AS1	ENSG00000246763	1204.987	0.700241	0.245695	2.850042	0.004371	0.0094701	1
ABTB2	ENSG00000166016	7927.068	0.699828	0.11159	6.271399	3.58E-10	2.41E-09	1
MCPH1	ENSG00000147316	2379.323	0.698477	0.068629	10.17754	2.50E-24	5.60E-23	1
VPS37B	ENSG00000139722	3562.616	0.698448	0.083192	8.395617	4.63E-17	6.17E-16	1
INO80	ENSG00000128908	5329.87	0.697834	0.090223	7.734562	1.04E-14	1.13E-13	1
FHL3	ENSG00000183386	1932.239	0.696853	0.149501	4.661198	3.14E-06	1.25E-05	1
PPP3CC	ENSG00000120910	2815.093	0.696506	0.081111	8.587051	8.92E-18	1.26E-16	1
ADAMTS16	ENSG00000145536	1717.769	0.696069	0.144518	4.816491	1.46E-06	6.13E-06	1
ZNF583	ENSG00000198440	660.2356	0.695944	0.120698	5.766003	8.12E-09	4.71E-08	1
TTC17	ENSG00000052841	4340.894	0.694837	0.075974	9.145777	5.92E-20	9.95E-19	1
PISD	ENSG00000241878	4787.261	0.694548	0.08619	8.058319	7.74E-16	9.36E-15	1
BRPF1	ENSG00000156983	3886.075	0.694544	0.087659	7.923261	2.31E-15	2.67E-14	1
TMEM214	ENSG00000119777	10913.38	0.694513	0.067476	10.2928	7.59E-25	1.78E-23	1
SYNE3	ENSG00000176438	1866.608	0.693999	0.172675	4.019093	5.84E-05	0.0001872	1
FGF2	ENSG00000138685	10266.35	0.693937	0.147045	4.71921	2.37E-06	9.63E-06	1
BET1L	ENSG00000177951	3659.795	0.691978	0.093004	7.440309	1.00E-13	9.93E-13	1
GOSR2	ENSG00000108433	4064.726	0.691064	0.080534	8.581002	9.41E-18	1.33E-16	1
DUSP12	ENSG00000081721	1380.182	0.691005	0.084493	8.178225	2.88E-16	3.60E-15	1
CYP20A1	ENSG00000119004	1919.766	0.690816	0.08294	8.329119	8.14E-17	1.07E-15	1
ABHD5	ENSG00000011198	3802.598	0.690545	0.085489	8.077605	6.61E-16	8.03E-15	1
METRNL	ENSG00000176845	7186.105	0.690453	0.075816	9.106905	8.48E-20	1.41E-18	1
ARFGAP3	ENSG00000242247	5462.125	0.690124	0.096568	7.14652	8.90E-13	7.99E-12	1

SIAH1	ENSG00000196470	742.1992	0.689757	0.105613	6.531009	6.53E-11	4.78E-10	1
PITHD1	ENSG00000057757	3363.314	0.689553	0.067938	10.14976	3.32E-24	7.38E-23	1
METTL6	ENSG00000206562	1820.571	0.689148	0.084742	8.13226	4.21E-16	5.21E-15	1
GTPBP4	ENSG00000107937	8621.203	0.688956	0.071927	9.578575	9.84E-22	1.88E-20	1
STRIP2	ENSG00000128578	3429.043	0.688542	0.10759	6.39968	1.56E-10	1.09E-09	1
SLC6A9	ENSG00000196517	2601.265	0.687988	0.103417	6.652541	2.88E-11	2.18E-10	1
ZNF451	ENSG00000112200	4594.222	0.687951	0.067794	10.14761	3.40E-24	7.53E-23	1
CITED2	ENSG00000164442	7694.066	0.687936	0.096534	7.126368	1.03E-12	9.20E-12	1
DKK1	ENSG00000107984	5550.876	0.687571	0.13496	5.094612	3.49E-07	1.63E-06	1
NAF1	ENSG00000145414	931.0723	0.687005	0.114416	6.00443	1.92E-09	1.20E-08	1
RNF24	ENSG00000101236	5812.137	0.68683	0.06572	10.45082	1.45E-25	3.55E-24	1
FOSL2	ENSG00000075426	28712.49	0.68571	0.083299	8.23196	1.84E-16	2.35E-15	1
ZNF800	ENSG00000048405	3172.819	0.685284	0.138499	4.947938	7.50E-07	3.31E-06	1
ZNF787	ENSG00000142409	2251.128	0.685166	0.084295	8.128158	4.36E-16	5.38E-15	1
AMMECR1	ENSG00000144233	5176.939	0.684136	0.064115	10.67041	1.40E-26	3.66E-25	1
DNAJB1	ENSG00000132002	13356.26	0.683981	0.091878	7.444416	9.74E-14	9.64E-13	1
RIPK2	ENSG00000104312	5729.449	0.682883	0.080003	8.535766	1.39E-17	1.94E-16	1
BCL2	ENSG00000171791	1198.885	0.682095	0.102702	6.641482	3.11E-11	2.34E-10	1
ZNF445	ENSG00000185219	4155.269	0.680375	0.10905	6.239119	4.40E-10	2.95E-09	1
PYCR1	ENSG00000183010	4793.465	0.679949	0.060978	11.15072	7.10E-29	2.12E-27	1
MASTL	ENSG00000120539	8597.017	0.679529	0.092305	7.361763	1.81E-13	1.76E-12	1
MAPK6	ENSG00000069956	14531.46	0.679523	0.087467	7.768908	7.92E-15	8.73E-14	1
BCL2L1	ENSG00000171552	12104.88	0.678925	0.117754	5.7656	8.14E-09	4.72E-08	1
PRPSAP2	ENSG00000141127	1777.214	0.678902	0.095081	7.140214	9.32E-13	8.35E-12	1
MTPAP	ENSG00000107951	1965.619	0.678429	0.073346	9.249762	2.25E-20	3.91E-19	1
BTN2A1	ENSG00000112763	3678.97	0.678317	0.10555	6.42653	1.31E-10	9.15E-10	1
GLRX	ENSG00000173221	3135.13	0.678298	0.129239	5.248386	1.53E-07	7.45E-07	1
MUL1	ENSG00000090432	3949.301	0.678133	0.104348	6.498773	8.10E-11	5.84E-10	1
ZBTB17	ENSG00000116809	2481.835	0.677826	0.077871	8.704489	3.19E-18	4.65E-17	1
PKP2	ENSG00000057294	2818.159	0.677784	0.111511	6.078188	1.22E-09	7.74E-09	1
RRN3	ENSG00000085721	4543.484	0.677648	0.077417	8.753191	2.07E-18	3.08E-17	1
ZRANB1	ENSG00000019995	2779.696	0.676531	0.08309	8.142118	3.88E-16	4.82E-15	1
ALPK2	ENSG00000198796	1319.451	0.675972	0.206038	3.28081	0.001035	0.0025729	1
VPS37A	ENSG00000155975	2895.443	0.67514	0.095514	7.068487	1.57E-12	1.36E-11	1
ORC5	ENSG00000164815	1911.808	0.675056	0.104843	6.438741	1.20E-10	8.50E-10	1
CGRRF1	ENSG00000100532	1072.13	0.674968	0.137551	4.907051	9.25E-07	4.02E-06	1
RFC1	ENSG00000035928	9470.096	0.674772	0.066676	10.12019	4.50E-24	9.90E-23	1
NIFK	ENSG00000155438	5795.684	0.674238	0.08717	7.734781	1.04E-14	1.13E-13	1
HAUS8	ENSG00000131351	2120.405	0.674072	0.107101	6.293802	3.10E-10	2.10E-09	1
DTL	ENSG00000143476	10781.93	0.673763	0.066516	10.12927	4.10E-24	9.07E-23	1
SRP68	ENSG00000167881	10894.74	0.673715	0.059967	11.23484	2.75E-29	8.48E-28	1
TOM1	ENSG00000100284	4213.738	0.673511	0.086029	7.828855	4.92E-15	5.52E-14	1
LRRC37B	ENSG00000185158	769.5798	0.672811	0.094622	7.110518	1.16E-12	1.02E-11	1
MARK3	ENSG00000075413	8570.723	0.671933	0.0629	10.68256	1.23E-26	3.23E-25	1
PYROXD1	ENSG00000121350	952.9094	0.671835	0.106365	6.316305	2.68E-10	1.82E-09	1
PPP2R5B	ENSG00000068971	2606.087	0.669906	0.09575	6.9964	2.63E-12	2.22E-11	1
SELENOK	ENSG00000113811	1864.058	0.669151	0.161628	4.140067	3.47E-05	0.0001157	1

ZDBF2	ENSG00000204186	902.5631	0.668017	0.136702	4.886683	1.03E-06	4.42E-06	1
MTO1	ENSG00000135297	2015.864	0.668002	0.081094	8.23734	1.76E-16	2.25E-15	1
STRN3	ENSG00000196792	3062.125	0.667744	0.083848	7.963703	1.67E-15	1.96E-14	1
REL	ENSG00000162924	1173.042	0.667466	0.158372	4.214558	2.50E-05	8.58E-05	1
LYSMD3	ENSG00000176018	3965.567	0.666917	0.096794	6.890064	5.58E-12	4.57E-11	1
DGKD	ENSG00000077044	5534.419	0.663551	0.161512	4.108378	3.98E-05	0.0001314	1
GORASP2	ENSG00000115806	10245.27	0.662734	0.052956	12.51477	6.20E-36	2.65E-34	1
PAWR	ENSG00000177425	13915.56	0.662383	0.104102	6.362797	1.98E-10	1.37E-09	1
MID1IP1	ENSG00000165175	6621.153	0.662382	0.077637	8.531809	1.44E-17	2.01E-16	1
OSGIN2	ENSG00000164823	2399.802	0.662252	0.067953	9.745791	1.92E-22	3.82E-21	1
RAB5A	ENSG00000144566	5224.692	0.661235	0.068198	9.695779	3.14E-22	6.17E-21	1
MAGOHB	ENSG00000111196	1581.447	0.66013	0.083133	7.940636	2.01E-15	2.33E-14	1
ZNF79	ENSG00000196152	717.3594	0.659705	0.095966	6.874372	6.23E-12	5.08E-11	1
ZNF274	ENSG00000171606	1177.216	0.659641	0.082362	8.009075	1.16E-15	1.37E-14	1
THAP6	ENSG00000174796	1052.365	0.659016	0.087112	7.565123	3.87E-14	3.97E-13	1
NFAT5	ENSG00000102908	7596.288	0.658451	0.203375	3.237618	0.001205	0.0029542	1
RBM15	ENSG00000162775	1448.126	0.65754	0.110075	5.973546	2.32E-09	1.44E-08	1
PPP1R15B	ENSG00000158615	6512.526	0.656909	0.086045	7.634486	2.27E-14	2.37E-13	1
CEBPD	ENSG00000221869	1431.525	0.655981	0.212109	3.092664	0.001984	0.0046392	1
PLEKHF2	ENSG00000175895	2182.384	0.65563	0.095202	6.88671	5.71E-12	4.68E-11	1
TES	ENSG00000135269	10403.13	0.655172	0.080744	8.1142	4.89E-16	6.01E-15	1
TMEM136	ENSG00000181264	1018.462	0.655163	0.086142	7.605586	2.84E-14	2.94E-13	1
GK	ENSG00000198814	569.8694	0.655135	0.112996	5.797864	6.72E-09	3.94E-08	1
MOSMO	ENSG00000185716	1246.626	0.655088	0.090917	7.205322	5.79E-13	5.34E-12	1
KCTD11	ENSG00000213859	2684.394	0.654292	0.140493	4.657124	3.21E-06	1.27E-05	1
DAPK3	ENSG00000167657	10587.75	0.654265	0.076086	8.599071	8.04E-18	1.14E-16	1
ZNF48	ENSG00000180035	1216.201	0.653855	0.10121	6.4604	1.04E-10	7.47E-10	1
RBAK	ENSG00000146587	2077.01	0.653227	0.090292	7.234616	4.67E-13	4.33E-12	1
PID1	ENSG00000153823	1169.029	0.652331	0.159465	4.090744	4.30E-05	0.000141	1
BYSL	ENSG00000112578	2823.692	0.652053	0.085478	7.628321	2.38E-14	2.48E-13	1
JMJD1C	ENSG00000171988	9667.804	0.651974	0.101124	6.44729	1.14E-10	8.09E-10	1
RBBP8	ENSG00000101773	7571.134	0.651099	0.102307	6.364177	1.96E-10	1.36E-09	1
DDX28	ENSG00000182810	993.1167	0.650884	0.087517	7.437246	1.03E-13	1.01E-12	1
C19orf48	ENSG00000167747	6748.653	0.650051	0.063156	10.29283	7.59E-25	1.78E-23	1
C15orf48	ENSG00000166920	667.3453	0.649301	0.241508	2.688526	0.007177	0.0147402	1
ABL2	ENSG00000143322	21782.61	0.648191	0.188472	3.439189	0.000583	0.0015349	1
ZFY	ENSG00000067646	2454.145	0.648037	0.081582	7.943337	1.97E-15	2.28E-14	1
ISG20	ENSG00000172183	1335.03	0.647755	0.183603	3.528013	0.000419	0.0011394	1
GTF2IRD1	ENSG00000006704	2669.017	0.647405	0.1179	5.491139	3.99E-08	2.12E-07	1
EPC2	ENSG00000135999	3435.908	0.647094	0.094122	6.875068	6.20E-12	5.06E-11	1
UHRF1BP1	ENSG00000065060	8811.999	0.646838	0.113355	5.706298	1.15E-08	6.54E-08	1
ERBIN	ENSG00000112851	42017.88	0.646398	0.098685	6.550095	5.75E-11	4.22E-10	1
EIF2S2P4	ENSG00000128692	1877.697	0.646249	0.123056	5.251678	1.51E-07	7.34E-07	1
ADAM17	ENSG00000151694	8876.084	0.645794	0.070348	9.180025	4.31E-20	7.36E-19	1
SH2B3	ENSG00000111252	10471.8	0.645122	0.096255	6.702187	2.05E-11	1.59E-10	1
TRA2A	ENSG00000164548	5508.631	0.64451	0.057953	11.1213	9.88E-29	2.92E-27	1
CCNL1	ENSG00000163660	7073.876	0.644003	0.165926	3.881276	0.000104	0.0003183	1

ZNF131	ENSG00000172262	3999.931	0.643439	0.077625	8.289052	1.14E-16	1.48E-15	1
ITCH	ENSG00000078747	4483.287	0.643299	0.055671	11.55534	6.94E-31	2.29E-29	1
DUSP16	ENSG00000111266	4261.192	0.643064	0.076255	8.433014	3.37E-17	4.53E-16	1
ADARB1	ENSG00000197381	1357.567	0.641644	0.119072	5.388691	7.10E-08	3.62E-07	1
OXNAD1	ENSG00000154814	697.6467	0.641038	0.109855	5.835327	5.37E-09	3.19E-08	1
TRMT6	ENSG00000089195	4717.539	0.640631	0.059568	10.75458	5.64E-27	1.51E-25	1
INTS12	ENSG00000138785	982.621	0.640001	0.105464	6.068426	1.29E-09	8.23E-09	1
NARS	ENSG00000134440	15147.98	0.637601	0.05294	12.04396	2.09E-33	7.77E-32	1
TNC	ENSG00000041982	87421.85	0.637538	0.133508	4.775276	1.79E-06	7.44E-06	1
EVC2	ENSG00000173040	1245.467	0.637474	0.086702	7.352434	1.95E-13	1.88E-12	1
KCMF1	ENSG00000176407	7347.836	0.637317	0.078838	8.083836	6.28E-16	7.64E-15	1
ZNF569	ENSG00000196437	898.5263	0.63727	0.124545	5.116782	3.11E-07	1.46E-06	1
SENP5	ENSG00000119231	4213.779	0.636306	0.094621	6.724818	1.76E-11	1.37E-10	1
USP1	ENSG00000162607	18905.51	0.636133	0.086257	7.374853	1.65E-13	1.60E-12	1
STK17A	ENSG00000164543	3415.747	0.636131	0.090395	7.037222	1.96E-12	1.68E-11	1
ELMSAN1	ENSG00000156030	5223.774	0.635865	0.13222	4.809137	1.52E-06	6.35E-06	1
PHLDB2	ENSG00000144824	51515.01	0.635428	0.087317	7.277241	3.41E-13	3.22E-12	1
BCL10	ENSG00000142867	3296.207	0.635404	0.077276	8.2225	1.99E-16	2.53E-15	1
EIF4EBP1	ENSG00000187840	4721.518	0.634962	0.072426	8.767099	1.83E-18	2.73E-17	1
NCKAP5L	ENSG00000167566	2604.214	0.634496	0.080068	7.924455	2.29E-15	2.64E-14	1
ZNF75A	ENSG00000162086	1298.467	0.634418	0.108143	5.866459	4.45E-09	2.68E-08	1
CDKN2B	ENSG00000147883	10340.95	0.63392	0.110476	5.73808	9.58E-09	5.50E-08	1
MANF	ENSG00000145050	5342.409	0.633813	0.141283	4.486113	7.25E-06	2.71E-05	1
NANP	ENSG00000170191	2395.008	0.633523	0.097507	6.49718	8.18E-11	5.90E-10	1
DMTF1	ENSG00000135164	3939.299	0.632549	0.126496	5.000562	5.72E-07	2.57E-06	1
BNIP1	ENSG00000113734	1004.213	0.631904	0.150917	4.187108	2.83E-05	9.60E-05	1
C16orf72	ENSG00000182831	2627.777	0.631823	0.083143	7.599261	2.98E-14	3.07E-13	1
CEP128	ENSG00000100629	2108.841	0.631464	0.072838	8.669479	4.34E-18	6.25E-17	1
SLC19A2	ENSG00000117479	1061.845	0.630467	0.111465	5.656175	1.55E-08	8.64E-08	1
JDP2	ENSG00000140044	2879.415	0.62965	0.07912	7.95813	1.75E-15	2.05E-14	1
NDUFAF4	ENSG00000123545	881.432	0.629408	0.09327	6.748197	1.50E-11	1.18E-10	1
RPAIN	ENSG00000129197	1688.539	0.629296	0.093647	6.719912	1.82E-11	1.41E-10	1
SH2D5	ENSG00000189410	5155.673	0.629149	0.156753	4.013624	5.98E-05	0.000191	1
SRPRB	ENSG00000144867	2959.887	0.628695	0.115931	5.423005	5.86E-08	3.03E-07	1
RFX1	ENSG00000132005	1347.552	0.628292	0.111876	5.615945	1.95E-08	1.08E-07	1
ATXN2L	ENSG00000168488	18028.2	0.627543	0.143805	4.36385	1.28E-05	4.58E-05	1
KPNA4	ENSG00000186432	15540.07	0.626932	0.057838	10.8395	2.24E-27	6.10E-26	1
EXOG	ENSG00000157036	1185.183	0.626617	0.100503	6.234796	4.52E-10	3.03E-09	1
LYAR	ENSG00000145220	1816.922	0.62648	0.104753	5.98054	2.22E-09	1.38E-08	1
TARS	ENSG00000113407	20480.62	0.626349	0.068475	9.147055	5.85E-20	9.85E-19	1
TRMT44	ENSG00000155275	751.4169	0.625662	0.12155	5.147358	2.64E-07	1.25E-06	1
NUP58	ENSG00000139496	11714.41	0.62435	0.059684	10.46086	1.31E-25	3.22E-24	1
TICAM1	ENSG00000127666	3277.68	0.623923	0.084412	7.391401	1.45E-13	1.42E-12	1
HSPH1	ENSG00000120694	15131.06	0.623656	0.060669	10.27971	8.70E-25	2.02E-23	1
AFF4	ENSG00000072364	24667.85	0.623089	0.122657	5.079947	3.78E-07	1.75E-06	1
TEX30	ENSG00000151287	1659.441	0.623025	0.140996	4.41873	9.93E-06	3.63E-05	1
	ENSG00000285517	636.0902	0.62249	0.223716	2.782499	0.005394	0.0114243	1

ORC6	ENSG00000091651	4786.322	0.622469	0.101316	6.14383	8.06E-10	5.24E-09	1
OSBP	ENSG00000110048	8590.796	0.622135	0.05997	10.37416	3.25E-25	7.76E-24	1
ING2	ENSG00000168556	1328.002	0.621922	0.094609	6.573587	4.91E-11	3.63E-10	1
NOL8	ENSG00000198000	4695.174	0.621766	0.059889	10.38194	3.00E-25	7.19E-24	1
SEC23B	ENSG00000101310	8954.443	0.62127	0.058253	10.66496	1.48E-26	3.87E-25	1
ETS1	ENSG00000134954	84214.86	0.621115	0.124059	5.006604	5.54E-07	2.49E-06	1
PLCB4	ENSG00000101333	4361.816	0.620956	0.150601	4.123173	3.74E-05	0.0001239	1
PXK	ENSG00000168297	2009.274	0.620175	0.095516	6.492901	8.42E-11	6.06E-10	1
CBLB	ENSG00000114423	1183.483	0.619093	0.14129	4.381734	1.18E-05	4.25E-05	1
AZIN1	ENSG00000155096	20343.73	0.618153	0.050456	12.25129	1.65E-34	6.51E-33	1
MDM4	ENSG00000198625	1980.335	0.618038	0.205197	3.011921	0.002596	0.0059233	1
POLR3E	ENSG00000058600	1879.08	0.61615	0.084375	7.302499	2.82E-13	2.69E-12	1
ARCN1	ENSG00000095139	20035.79	0.615821	0.055204	11.15536	6.74E-29	2.02E-27	1
TXNL4B	ENSG00000140830	1589.562	0.614156	0.107512	5.712436	1.11E-08	6.33E-08	1
ZBTB2	ENSG00000181472	2804.202	0.613995	0.079363	7.736574	1.02E-14	1.11E-13	1
PIGL	ENSG00000108474	771.2806	0.612768	0.132464	4.625917	3.73E-06	1.46E-05	1
USP20	ENSG00000136878	1152.691	0.612559	0.080698	7.590735	3.18E-14	3.27E-13	1
CLBA1	ENSG00000140104	601.1931	0.612385	0.147799	4.143377	3.42E-05	0.0001142	1
ATP13A3	ENSG00000133657	51418.5	0.611997	0.105245	5.814989	6.06E-09	3.58E-08	1
ITFG2	ENSG00000111203	1067.71	0.611711	0.11274	5.425842	5.77E-08	2.99E-07	1
PRIMPOL	ENSG00000164306	813.8075	0.611223	0.1015	6.02192	1.72E-09	1.08E-08	1
CHAMP1	ENSG00000198824	5754.928	0.611199	0.113414	5.389096	7.08E-08	3.62E-07	1
RBM39	ENSG00000131051	24196.72	0.611037	0.079357	7.699816	1.36E-14	1.45E-13	1
ARFGAP1	ENSG00000101199	9666.203	0.610909	0.089964	6.790557	1.12E-11	8.88E-11	1
BRAP	ENSG00000089234	3086.813	0.610416	0.068445	8.918326	4.73E-19	7.33E-18	1
GTPBP10	ENSG00000105793	1973.579	0.610353	0.085656	7.12562	1.04E-12	9.24E-12	1
ZNF566	ENSG00000186017	856.6012	0.610254	0.121384	5.027474	4.97E-07	2.25E-06	1
SLC1A4	ENSG00000115902	9233.667	0.610125	0.111935	5.450701	5.02E-08	2.62E-07	1
DDX59	ENSG00000118197	1285.761	0.609852	0.11102	5.493186	3.95E-08	2.10E-07	1
MACO1	ENSG00000204178	2819.431	0.607766	0.096488	6.298844	3.00E-10	2.04E-09	1
ZNF621	ENSG00000172888	4548.445	0.60776	0.085974	7.069127	1.56E-12	1.36E-11	1
PGM3	ENSG00000013375	8209.321	0.606913	0.082648	7.343338	2.08E-13	2.00E-12	1
ANKRD50	ENSG00000151458	6043.387	0.606787	0.135624	4.474041	7.68E-06	2.86E-05	1
RNF138	ENSG00000134758	2713.877	0.606219	0.066167	9.161993	5.09E-20	8.65E-19	1
UFM1	ENSG00000120686	4972.939	0.605848	0.067555	8.968172	3.01E-19	4.74E-18	1
SFXN2	ENSG00000156398	650.9103	0.604899	0.17393	3.47784	0.000505	0.0013508	1
TAF13	ENSG00000197780	3172.632	0.604583	0.075247	8.034662	9.38E-16	1.13E-14	1
COG1	ENSG00000166685	4707.839	0.603505	0.09981	6.04654	1.48E-09	9.38E-09	1
MSTO1	ENSG00000125459	788.5711	0.602969	0.140998	4.276452	1.90E-05	6.64E-05	1
ZNF699	ENSG00000196110	1241.696	0.602799	0.109002	5.530149	3.20E-08	1.72E-07	1
PARP6	ENSG00000137817	3389.707	0.602778	0.124635	4.836327	1.32E-06	5.60E-06	1
NEK8	ENSG00000160602	998.9573	0.602477	0.174118	3.460166	0.00054	0.0014299	1
SERPINE1	ENSG00000106366	180866.2	0.602112	0.181818	3.311624	0.000928	0.002329	1
ZNF420	ENSG00000197050	688.2314	0.601475	0.18428	3.263913	0.001099	0.0027167	1
CFLAR	ENSG00000003402	11968.97	0.600799	0.08588	6.995762	2.64E-12	2.23E-11	1
SPOCD1	ENSG00000134668	2284.019	0.600742	0.220508	2.724351	0.006443	0.0133377	1
ORAOV1	ENSG00000149716	1746.08	0.600535	0.092039	6.52481	6.81E-11	4.96E-10	1

NECAP1	ENSG00000089818	1563.593	0.600297	0.080147	7.489921	6.89E-14	6.93E-13	1
TMEM209	ENSG00000146842	2222.739	0.59994	0.076674	7.824517	5.10E-15	5.70E-14	1
ZNF598	ENSG00000167962	5686.234	0.599103	0.101785	5.885977	3.96E-09	2.40E-08	1
SRSF10	ENSG00000188529	12444.42	0.598898	0.067719	8.843821	9.25E-19	1.41E-17	1
ZNF181	ENSG00000197841	659.6883	0.598465	0.168005	3.562181	0.000368	0.0010108	1
GPATCH8	ENSG00000186566	8297.314	0.597655	0.07998	7.472581	7.86E-14	7.83E-13	1
FBXO31	ENSG00000103264	1574.331	0.597508	0.079529	7.513059	5.78E-14	5.85E-13	1
CNNM4	ENSG00000158158	1183.716	0.597439	0.104451	5.719825	1.07E-08	6.08E-08	1
CHD1	ENSG00000153922	9340.256	0.597336	0.071652	8.336663	7.64E-17	1.01E-15	1
GJA1	ENSG00000152661	1397.955	0.597214	0.171619	3.479884	0.000502	0.001342	1
PPP4R3A	ENSG00000100796	6539.51	0.597198	0.05845	10.21721	1.66E-24	3.76E-23	1
DNAJA3	ENSG00000103423	4618.144	0.596248	0.075318	7.916404	2.44E-15	2.80E-14	1
JUN	ENSG00000177606	24412.99	0.595919	0.118175	5.042688	4.59E-07	2.09E-06	1
SEPSECS	ENSG00000109618	841.6485	0.59501	0.104137	5.713727	1.11E-08	6.28E-08	1
ANKRD28	ENSG00000206560	13867.08	0.594448	0.076947	7.725453	1.11E-14	1.20E-13	1
SOWAHC	ENSG00000198142	3088.704	0.594281	0.062801	9.462911	2.99E-21	5.57E-20	1
ZNF16	ENSG00000170631	1107.557	0.593552	0.089778	6.611353	3.81E-11	2.85E-10	1
NTMT1	ENSG00000148335	1721.996	0.592808	0.101013	5.868661	4.39E-09	2.64E-08	1
TNFAIP3	ENSG00000118503	20828.82	0.592671	0.107305	5.523235	3.33E-08	1.78E-07	1
PDP1	ENSG00000164951	14286.64	0.59237	0.10064	5.886044	3.96E-09	2.40E-08	1
SRP19	ENSG00000153037	1748.47	0.591489	0.071801	8.23785	1.75E-16	2.24E-15	1
ZNF146	ENSG00000167635	7070.7	0.591123	0.059299	9.968513	2.09E-23	4.43E-22	1
FLCN	ENSG00000154803	3912.971	0.590698	0.08053	7.335131	2.22E-13	2.13E-12	1
ADORA2B	ENSG00000170425	3125.528	0.590663	0.065342	9.039583	1.57E-19	2.53E-18	1
DCTN4	ENSG00000132912	10287.97	0.590556	0.052599	11.22746	2.99E-29	9.18E-28	1
ALKBH1	ENSG00000100601	1012.913	0.590539	0.136756	4.318196	1.57E-05	5.58E-05	1
POGK	ENSG00000143157	8368.133	0.590478	0.069309	8.519509	1.60E-17	2.21E-16	1
EAF1	ENSG00000144597	1882.789	0.590258	0.112849	5.230531	1.69E-07	8.16E-07	1
MICALL1	ENSG00000100139	13134.91	0.590109	0.122284	4.82574	1.39E-06	5.87E-06	1
ABRAXAS2	ENSG00000165660	2480.99	0.590052	0.097564	6.04784	1.47E-09	9.31E-09	1
RIOX2	ENSG00000170854	1453.866	0.589675	0.077633	7.595699	3.06E-14	3.15E-13	1
MTRR	ENSG00000124275	2763.959	0.589188	0.062388	9.443917	3.59E-21	6.62E-20	1
ZNF496	ENSG00000162714	5317.699	0.588475	0.081298	7.238514	4.54E-13	4.22E-12	1
FBXO11	ENSG00000138081	3875.796	0.587904	0.095653	6.146217	7.94E-10	5.16E-09	1
ARHGAP26	ENSG00000145819	2530.006	0.586754	0.134095	4.375654	1.21E-05	4.36E-05	1
PUS1	ENSG00000177192	1897.967	0.586375	0.082412	7.11516	1.12E-12	9.94E-12	1
BBC3	ENSG00000105327	1812.376	0.585723	0.079978	7.323544	2.42E-13	2.31E-12	1
FRMD5	ENSG00000171877	5419.419	0.585338	0.07595	7.706931	1.29E-14	1.38E-13	1
SCAPER	ENSG00000140386	1285.921	0.585156	0.085168	6.870593	6.39E-12	5.21E-11	1
PSMC3IP	ENSG00000131470	1780.507	0.585107	0.077719	7.528533	5.13E-14	5.22E-13	1
CDYL2	ENSG00000166446	727.941	-0.58503	0.110248	-5.30646	1.12E-07	5.54E-07	-1
HPS6	ENSG00000166189	2081.198	-0.58519	0.075172	-7.78469	6.99E-15	7.72E-14	-1
CNTNAP1	ENSG00000108797	3763.799	-0.58523	0.120705	-4.84843	1.24E-06	5.29E-06	-1
ELMOD2	ENSG00000179387	1556.691	-0.58625	0.078996	-7.42125	1.16E-13	1.14E-12	-1
NT5DC2	ENSG00000168268	7918.441	-0.58645	0.064908	-9.03517	1.64E-19	2.62E-18	-1
ATP5ME	ENSG00000169020	776.145	-0.58692	0.149666	-3.92153	8.80E-05	0.0002728	-1
FBXO33	ENSG00000165355	1171.422	-0.58741	0.090705	-6.47609	9.41E-11	6.74E-10	-1

NEO1	ENSG00000067141	2696.846	-0.58833	0.066668	-8.8247	1.10E-18	1.66E-17	-1
RTL8C	ENSG00000134590	6118.995	-0.58847	0.081659	-7.20636	5.75E-13	5.30E-12	-1
GALNT2	ENSG00000143641	14998.27	-0.58899	0.086148	-6.83696	8.09E-12	6.51E-11	-1
TMSB10	ENSG00000034510	55675.12	-0.58938	0.165072	-3.57044	0.000356	0.0009817	-1
MAPK11	ENSG00000185386	1154.038	-0.58992	0.093947	-6.27925	3.40E-10	2.30E-09	-1
ATL3	ENSG00000184743	9778.078	-0.59011	0.070987	-8.31297	9.33E-17	1.22E-15	-1
B3GLCT	ENSG00000187676	2372.9	-0.59091	0.079707	-7.41356	1.23E-13	1.21E-12	-1
LRP1	ENSG00000123384	26714.57	-0.59105	0.206548	-2.86159	0.004215	0.0091629	-1
BMPR1A	ENSG00000107779	3058.036	-0.59136	0.088629	-6.67237	2.52E-11	1.93E-10	-1
NLRC5	ENSG00000140853	3714.956	-0.59143	0.100942	-5.8591	4.65E-09	2.79E-08	-1
RPS27L	ENSG00000185088	5177.037	-0.59158	0.132189	-4.47526	7.63E-06	2.84E-05	-1
DOLK	ENSG00000175283	1393.478	-0.59168	0.103949	-5.69199	1.26E-08	7.08E-08	-1
PKP1	ENSG00000081277	585.0784	-0.5918	0.165777	-3.56983	0.000357	0.0009835	-1
NR2F2	ENSG00000185551	13598.28	-0.59182	0.125657	-4.70979	2.48E-06	1.00E-05	-1
FAS	ENSG00000026103	599.1207	-0.59305	0.140091	-4.23333	2.30E-05	7.95E-05	-1
C19orf66	ENSG00000130813	1336.66	-0.59326	0.090138	-6.58164	4.65E-11	3.45E-10	-1
JAZF1	ENSG00000153814	759.6202	-0.59343	0.100816	-5.8862	3.95E-09	2.40E-08	-1
NHLRC3	ENSG00000188811	1241.809	-0.59366	0.100143	-5.92806	3.07E-09	1.89E-08	-1
PSMD10	ENSG00000101843	1766.663	-0.5946	0.142588	-4.17002	3.05E-05	0.0001027	-1
NDUFS5	ENSG00000168653	5604.811	-0.59477	0.121549	-4.89327	9.92E-07	4.28E-06	-1
ZBTB7A	ENSG00000178951	4134.432	-0.59531	0.072572	-8.20299	2.34E-16	2.96E-15	-1
ALS2CL	ENSG00000178038	1107.647	-0.59558	0.166437	-3.57844	0.000346	0.0009543	-1
XPO1	ENSG00000082898	20069.92	-0.59694	0.047535	-12.5579	3.60E-36	1.56E-34	-1
MGAT5	ENSG00000152127	4637.648	-0.59881	0.096759	-6.1886	6.07E-10	4.01E-09	-1
UBL5	ENSG00000198258	3479.283	-0.59922	0.181003	-3.31056	0.000931	0.0023355	-1
AMIGO1	ENSG00000181754	565.1247	-0.60052	0.108849	-5.51703	3.45E-08	1.84E-07	-1
ORAI3	ENSG00000175938	647.6281	-0.60055	0.119014	-5.0461	4.51E-07	2.06E-06	-1
C9orf64	ENSG00000165118	1775.412	-0.60063	0.084735	-7.0884	1.36E-12	1.19E-11	-1
ANO9	ENSG00000185101	618.7969	-0.60125	0.207479	-2.8979	0.003757	0.0082441	-1
BRD3	ENSG00000169925	2641.804	-0.60134	0.078503	-7.66007	1.86E-14	1.96E-13	-1
DLGAP5	ENSG00000126787	5032.172	-0.60253	0.163528	-3.68453	0.000229	0.0006572	-1
EML1	ENSG00000066629	683.4011	-0.60277	0.117823	-5.11594	3.12E-07	1.46E-06	-1
RAB3B	ENSG00000169213	13001.1	-0.604	0.130114	-4.64204	3.45E-06	1.36E-05	-1
C1R	ENSG00000159403	1487.633	-0.60413	0.198894	-3.03744	0.002386	0.0054869	-1
NMI	ENSG00000123609	2070.31	-0.60466	0.132718	-4.55599	5.21E-06	2.00E-05	-1
IGFBP4	ENSG00000141753	14743.29	-0.60505	0.164674	-3.67423	0.000239	0.0006812	-1
HR	ENSG00000168453	551.9368	-0.60721	0.12128	-5.00663	5.54E-07	2.49E-06	-1
TRIM21	ENSG00000132109	2892.802	-0.60755	0.155053	-3.91835	8.92E-05	0.0002761	-1
CENPF	ENSG00000117724	18133.05	-0.60794	0.103347	-5.88249	4.04E-09	2.45E-08	-1
SEMA4B	ENSG00000185033	7370.241	-0.60798	0.098418	-6.17752	6.51E-10	4.29E-09	-1
IFITM2	ENSG00000185201	2649.552	-0.60817	0.085712	-7.09555	1.29E-12	1.14E-11	-1
TMEM80	ENSG00000177042	1039.406	-0.60837	0.136763	-4.44839	8.65E-06	3.19E-05	-1
DICER1	ENSG00000100697	5157.273	-0.60859	0.160613	-3.78917	0.000151	0.0004501	-1
FAM213B	ENSG00000157870	1505.37	-0.60889	0.103158	-5.90247	3.58E-09	2.19E-08	-1
NEXN	ENSG00000162614	1717.865	-0.60933	0.10322	-5.90322	3.56E-09	2.18E-08	-1
TMEM30A	ENSG00000112697	12600.91	-0.60996	0.052194	-11.6865	1.49E-31	5.09E-30	-1
LNPEP	ENSG00000113441	6409.349	-0.61008	0.123266	-4.94927	7.45E-07	3.29E-06	-1

ARMC7	ENSG00000125449	1434.485	-0.61037	0.092928	-6.56827	5.09E-11	3.75E-10	-1
ARHGAP23	ENSG00000275832	10477.93	-0.61267	0.115126	-5.32176	1.03E-07	5.12E-07	-1
RBM12B	ENSG00000183808	1209.042	-0.61299	0.11445	-5.35595	8.51E-08	4.30E-07	-1
MATN2	ENSG00000132561	7857.224	-0.61317	0.087983	-6.96917	3.19E-12	2.67E-11	-1
ZDHHC24	ENSG00000174165	1070.067	-0.61351	0.10524	-5.82964	5.55E-09	3.29E-08	-1
SUMO3	ENSG00000184900	8368.685	-0.61415	0.076196	-8.06011	7.62E-16	9.24E-15	-1
MRPL51	ENSG00000111639	5017.26	-0.61458	0.148785	-4.13069	3.62E-05	0.0001202	-1
GAS6-AS2	ENSG00000272695	750.8088	-0.61465	0.102848	-5.97633	2.28E-09	1.42E-08	-1
C12orf45	ENSG00000151131	687.7177	-0.615	0.140505	-4.37709	1.20E-05	4.33E-05	-1
DOK4	ENSG00000125170	1125.654	-0.61545	0.112692	-5.46134	4.73E-08	2.48E-07	-1
LIMD2	ENSG00000136490	3851.652	-0.61724	0.081136	-7.6075	2.79E-14	2.90E-13	-1
PSMB10	ENSG00000205220	873.0668	-0.61731	0.149793	-4.1211	3.77E-05	0.0001249	-1
C8orf59	ENSG00000176731	560.0967	-0.61737	0.112409	-5.49218	3.97E-08	2.11E-07	-1
MMP2	ENSG00000087245	5430.214	-0.61757	0.105021	-5.88039	4.09E-09	2.47E-08	-1
INAVA	ENSG00000163362	832.8808	-0.61769	0.17779	-3.47427	0.000512	0.0013677	-1
RFLNA	ENSG00000178882	1330.482	-0.61782	0.201332	-3.06868	0.00215	0.0049932	-1
TXNIP	ENSG00000265972	6607.216	-0.61795	0.150278	-4.11202	3.92E-05	0.0001296	-1
PQLC3	ENSG00000162976	1053.509	-0.6182	0.087905	-7.03264	2.03E-12	1.73E-11	-1
LDOC1	ENSG00000182195	3532.607	-0.61829	0.10488	-5.89521	3.74E-09	2.28E-08	-1
ANKRD13B	ENSG00000198720	525.0365	-0.61836	0.141657	-4.36522	1.27E-05	4.55E-05	-1
LIPA	ENSG00000107798	9156.185	-0.61847	0.098945	-6.25063	4.09E-10	2.75E-09	-1
PCF11	ENSG00000165494	3341.383	-0.61854	0.101388	-6.10073	1.06E-09	6.79E-09	-1
ZNF175	ENSG00000105497	881.1857	-0.61964	0.089309	-6.93815	3.97E-12	3.30E-11	-1
CD82	ENSG00000085117	6598.615	-0.61969	0.10063	-6.15814	7.36E-10	4.82E-09	-1
TLR2	ENSG00000137462	1400.758	-0.61993	0.130694	-4.74338	2.10E-06	8.64E-06	-1
MPP5	ENSG00000072415	3631.611	-0.61993	0.079473	-7.8006	6.16E-15	6.84E-14	-1
MGST3	ENSG00000143198	4923.611	-0.6203	0.080285	-7.72624	1.11E-14	1.20E-13	-1
ADCY1	ENSG00000164742	596.5366	-0.62051	0.130364	-4.75982	1.94E-06	8.00E-06	-1
CCDC80	ENSG00000091986	10059.51	-0.62078	0.105988	-5.85712	4.71E-09	2.82E-08	-1
NDST1	ENSG00000070614	25179.6	-0.62245	0.142116	-4.37985	1.19E-05	4.28E-05	-1
SEM1	ENSG00000127922	3742.498	-0.62279	0.073078	-8.52223	1.57E-17	2.17E-16	-1
CABLES1	ENSG00000134508	526.9687	-0.623	0.116895	-5.32961	9.84E-08	4.93E-07	-1
ECE1	ENSG00000117298	27006.36	-0.62321	0.05935	-10.5006	8.59E-26	2.13E-24	-1
MBNL1	ENSG00000152601	10483.09	-0.62343	0.08828	-7.06205	1.64E-12	1.42E-11	-1
PTPRF	ENSG00000142949	35658.76	-0.62402	0.09631	-6.47932	9.21E-11	6.61E-10	-1
ICK	ENSG00000112144	2143.752	-0.62453	0.126519	-4.93626	7.96E-07	3.50E-06	-1
BUB1B	ENSG00000156970	5435.33	-0.62486	0.130555	-4.78621	1.70E-06	7.07E-06	-1
METTL3	ENSG00000165819	2189.815	-0.62513	0.086876	-7.19564	6.22E-13	5.71E-12	-1
ERMP1	ENSG00000099219	687.3028	-0.62553	0.160492	-3.89757	9.72E-05	0.000299	-1
DAG1	ENSG00000173402	18652.52	-0.62585	0.09398	-6.65947	2.75E-11	2.10E-10	-1
NEDD8	ENSG00000129559	1799.507	-0.62615	0.137622	-4.54979	5.37E-06	2.05E-05	-1
B3GAT3	ENSG00000149541	1469.255	-0.62642	0.094	-6.66399	2.66E-11	2.04E-10	-1
INCENP	ENSG00000149503	5615.393	-0.6266	0.081072	-7.72898	1.08E-14	1.17E-13	-1
CEP68	ENSG00000011523	1077.319	-0.62773	0.109645	-5.72511	1.03E-08	5.90E-08	-1
NR2F6	ENSG00000160113	1475.054	-0.62817	0.117792	-5.33289	9.67E-08	4.85E-07	-1
CDC25B	ENSG00000101224	14087.47	-0.62855	0.089778	-7.0012	2.54E-12	2.15E-11	-1
BRWD1	ENSG00000185658	4538.202	-0.62861	0.085963	-7.31259	2.62E-13	2.50E-12	-1

S100A10	ENSG00000197747	27100.75	-0.6289	0.065347	-9.62402	6.33E-22	1.22E-20	-1
MELTF	ENSG00000163975	7427.317	-0.62917	0.088453	-7.11304	1.14E-12	1.01E-11	-1
LDHA	ENSG00000134333	41790.46	-0.63013	0.074819	-8.42207	3.70E-17	4.96E-16	-1
ST3GAL2	ENSG00000157350	2903.058	-0.63022	0.061482	-10.2504	1.18E-24	2.70E-23	-1
TGOLN2	ENSG00000152291	23516.49	-0.63043	0.074867	-8.4206	3.75E-17	5.01E-16	-1
FBXO3	ENSG00000110429	1509.239	-0.63151	0.107673	-5.86507	4.49E-09	2.70E-08	-1
BCORL1	ENSG00000085185	1038.087	-0.63176	0.094939	-6.65441	2.84E-11	2.16E-10	-1
MT-ND6	ENSG00000198695	14325.51	-0.63192	0.21217	-2.97836	0.002898	0.0065365	-1
SAMHD1	ENSG00000101347	7583.901	-0.632	0.074697	-8.46088	2.65E-17	3.62E-16	-1
PTK7	ENSG00000112655	7632.972	-0.63236	0.059509	-10.6263	2.25E-26	5.77E-25	-1
MYL6	ENSG00000092841	34461.29	-0.6328	0.144383	-4.38283	1.17E-05	4.23E-05	-1
BTN3A2	ENSG00000186470	1997.907	-0.63302	0.119604	-5.29265	1.21E-07	5.94E-07	-1
EFCAB14	ENSG00000159658	8964.333	-0.63313	0.078181	-8.09832	5.57E-16	6.81E-15	-1
ATP5MD	ENSG00000173915	2899.758	-0.63323	0.120744	-5.24439	1.57E-07	7.60E-07	-1
PCMTD1	ENSG00000168300	1026.037	-0.63342	0.130976	-4.83616	1.32E-06	5.60E-06	-1
FBXL19	ENSG00000099364	1843.366	-0.63353	0.107248	-5.90714	3.48E-09	2.13E-08	-1
MVP	ENSG00000013364	9982.909	-0.63354	0.067136	-9.43675	3.85E-21	7.08E-20	-1
BTN3A3	ENSG00000111801	549.6203	-0.63371	0.186713	-3.39404	0.000689	0.0017793	-1
DPY19L1	ENSG00000173852	5995.411	-0.63416	0.086462	-7.33451	2.23E-13	2.13E-12	-1
HPCAL1	ENSG00000115756	12325.15	-0.63462	0.07984	-7.94873	1.88E-15	2.20E-14	-1
ZBTB42	ENSG00000179627	803.8813	-0.63463	0.086966	-7.29743	2.93E-13	2.79E-12	-1
DYNLL1	ENSG00000088986	9002.792	-0.63513	0.119798	-5.30171	1.15E-07	5.67E-07	-1
TMEM87B	ENSG00000153214	4163.701	-0.6354	0.079073	-8.0357	9.30E-16	1.12E-14	-1
SNX33	ENSG00000173548	4251.311	-0.63632	0.060986	-10.4338	1.74E-25	4.21E-24	-1
GNB4	ENSG00000114450	6017.31	-0.63693	0.061147	-10.4163	2.09E-25	5.04E-24	-1
TTK	ENSG00000112742	4001.934	-0.63697	0.149052	-4.27346	1.92E-05	6.72E-05	-1
NCOA2	ENSG00000140396	2063.964	-0.63729	0.09161	-6.95651	3.49E-12	2.92E-11	-1
RMND5A	ENSG00000153561	2627.329	-0.64016	0.094399	-6.78147	1.19E-11	9.44E-11	-1
ABCG2	ENSG00000118777	539.7016	-0.64053	0.123075	-5.20439	1.95E-07	9.33E-07	-1
RUSC1	ENSG00000160753	5367.039	-0.64187	0.080466	-7.97686	1.50E-15	1.77E-14	-1
CYP27C1	ENSG00000186684	640.515	-0.64235	0.105272	-6.10181	1.05E-09	6.75E-09	-1
TUBBP1	ENSG00000127589	1783.05	-0.64242	0.094875	-6.77122	1.28E-11	1.01E-10	-1
TMEM50A	ENSG00000183726	9674.406	-0.64282	0.094482	-6.80368	1.02E-11	8.15E-11	-1
KLHL5	ENSG00000109790	10986.41	-0.64294	0.051525	-12.4783	9.81E-36	4.11E-34	-1
DDX60	ENSG00000137628	1422.068	-0.64418	0.096369	-6.68448	2.32E-11	1.78E-10	-1
FAM210B	ENSG00000124098	3767.332	-0.6443	0.080997	-7.95463	1.80E-15	2.10E-14	-1
SCRIB	ENSG00000180900	8445.205	-0.64474	0.106922	-6.02999	1.64E-09	1.03E-08	-1
KIF20A	ENSG00000112984	8668.123	-0.64489	0.138911	-4.64246	3.44E-06	1.36E-05	-1
ATP6V0E1	ENSG00000113732	7386.262	-0.64496	0.125556	-5.13682	2.79E-07	1.32E-06	-1
INSR	ENSG00000171105	876.5422	-0.64512	0.109493	-5.89187	3.82E-09	2.32E-08	-1
ABCC4	ENSG00000125257	4932.566	-0.64606	0.089256	-7.23827	4.54E-13	4.23E-12	-1
SUMO2	ENSG00000188612	14054.12	-0.64607	0.08807	-7.33579	2.20E-13	2.12E-12	-1
TOR4A	ENSG00000198113	5071.2	-0.64661	0.095884	-6.74365	1.54E-11	1.22E-10	-1
DMAC1	ENSG00000137038	1001.534	-0.6475	0.131118	-4.93833	7.88E-07	3.46E-06	-1
ZNF107	ENSG00000196247	1489.057	-0.64796	0.144433	-4.48624	7.25E-06	2.71E-05	-1
ERBB2	ENSG00000141736	5639.625	-0.64801	0.069683	-9.29941	1.41E-20	2.49E-19	-1
MT-ND3	ENSG00000198840	13149.04	-0.64821	0.176033	-3.68234	0.000231	0.0006619	-1

RBBP6	ENSG00000122257	4495.513	-0.64863	0.092093	-7.0432	1.88E-12	1.62E-11	-1
TMEM189	ENSG00000240849	3467.847	-0.64885	0.08157	-7.95455	1.80E-15	2.10E-14	-1
TNFRSF14	ENSG00000157873	649.4218	-0.649	0.146989	-4.4153	1.01E-05	3.68E-05	-1
NXT2	ENSG00000101888	910.4118	-0.65013	0.099878	-6.50929	7.55E-11	5.47E-10	-1
STAT5A	ENSG00000126561	4462.231	-0.65064	0.079854	-8.14789	3.70E-16	4.60E-15	-1
VASH1	ENSG00000071246	700.8715	-0.65133	0.122915	-5.29901	1.16E-07	5.75E-07	-1
TAPBP	ENSG00000231925	11555.38	-0.65149	0.102981	-6.32632	2.51E-10	1.72E-09	-1
PGAP1	ENSG00000197121	1111.078	-0.6533	0.141715	-4.60994	4.03E-06	1.57E-05	-1
HSPA1B	ENSG00000204388	1617.342	-0.65375	0.123141	-5.30895	1.10E-07	5.47E-07	-1
HSPE1	ENSG00000115541	1071.098	-0.65398	0.113676	-5.75307	8.76E-09	5.05E-08	-1
RIN1	ENSG00000174791	898.4949	-0.65412	0.189485	-3.45209	0.000556	0.0014698	-1
NAT6	ENSG00000243477	576.2586	-0.65419	0.156697	-4.17488	2.98E-05	0.0001009	-1
SLC19A1	ENSG00000173638	1010.575	-0.65464	0.1636	-4.00145	6.30E-05	0.0002003	-1
FAM53B	ENSG00000189319	816.7858	-0.6582	0.123145	-5.34494	9.04E-08	4.54E-07	-1
AP1S1	ENSG00000106367	2877.611	-0.65936	0.117213	-5.62536	1.85E-08	1.02E-07	-1
FITM2	ENSG00000197296	926.1306	-0.65968	0.085953	-7.67485	1.66E-14	1.76E-13	-1
ARHGEF10	ENSG00000074964	1235.505	-0.6604	0.102542	-6.44027	1.19E-10	8.43E-10	-1
HACD4	ENSG00000188921	658.1459	-0.66057	0.130604	-5.05778	4.24E-07	1.94E-06	-1
SLC44A1	ENSG00000070214	3548.786	-0.66252	0.078748	-8.41311	3.99E-17	5.32E-16	-1
CEP97	ENSG00000182504	1982.902	-0.66377	0.123988	-5.35353	8.63E-08	4.35E-07	-1
ALDH3A2	ENSG00000072210	1890.572	-0.66379	0.092103	-7.20698	5.72E-13	5.28E-12	-1
LYN	ENSG00000254087	1564.769	-0.66387	0.102994	-6.44566	1.15E-10	8.15E-10	-1
TBC1D4	ENSG00000136111	2161.238	-0.66432	0.105494	-6.2972	3.03E-10	2.06E-09	-1
LSM7	ENSG00000130332	1573.554	-0.66493	0.087162	-7.62864	2.37E-14	2.48E-13	-1
KBTBD4	ENSG00000123444	608.7761	-0.66537	0.102371	-6.49962	8.05E-11	5.81E-10	-1
ASIC1	ENSG00000110881	1025.603	-0.66626	0.134035	-4.97079	6.67E-07	2.96E-06	-1
OGFR	ENSG00000060491	7150.979	-0.66684	0.074939	-8.89841	5.67E-19	8.73E-18	-1
TSPAN18	ENSG00000157570	1008.17	-0.66713	0.146524	-4.55307	5.29E-06	2.02E-05	-1
ABRACL	ENSG00000146386	1890.081	-0.6673	0.166435	-4.00938	6.09E-05	0.0001941	-1
MRC2	ENSG00000011028	10066.38	-0.66761	0.126963	-5.25831	1.45E-07	7.09E-07	-1
TYSND1	ENSG00000156521	685.1003	-0.6677	0.092005	-7.25727	3.95E-13	3.70E-12	-1
YPEL3	ENSG00000090238	626.0623	-0.66815	0.178327	-3.74677	0.000179	0.0005259	-1
TMOD2	ENSG00000128872	3379.226	-0.6684	0.078572	-8.50693	1.79E-17	2.46E-16	-1
IFITM1	ENSG00000185885	612.7473	-0.67127	0.190494	-3.52382	0.000425	0.001156	-1
SP110	ENSG00000135899	2172.521	-0.67174	0.123878	-5.42257	5.87E-08	3.03E-07	-1
TSPAN17	ENSG00000048140	3795.262	-0.67198	0.07416	-9.0613	1.29E-19	2.10E-18	-1
UNKL	ENSG00000059145	795.5319	-0.67274	0.095528	-7.04237	1.89E-12	1.63E-11	-1
SPR	ENSG00000116096	1159.605	-0.67278	0.132803	-5.06604	4.06E-07	1.87E-06	-1
TUBB	ENSG00000196230	129061.7	-0.67338	0.074284	-9.06483	1.25E-19	2.04E-18	-1
MANEA	ENSG00000172469	875.2209	-0.67408	0.086414	-7.80058	6.16E-15	6.84E-14	-1
TRAM2	ENSG00000065308	29672.6	-0.67415	0.132348	-5.09376	3.51E-07	1.63E-06	-1
ARRDC4	ENSG00000140450	1172.702	-0.67433	0.132328	-5.09592	3.47E-07	1.62E-06	-1
CD47	ENSG00000196776	10748.57	-0.6746	0.076907	-8.77161	1.76E-18	2.63E-17	-1
LRFN3	ENSG00000126243	1024.897	-0.67565	0.127777	-5.28772	1.24E-07	6.08E-07	-1
SLC27A3	ENSG00000143554	728.8507	-0.67578	0.095884	-7.04787	1.82E-12	1.57E-11	-1
FUCA1	ENSG00000179163	798.9522	-0.67597	0.107071	-6.3133	2.73E-10	1.86E-09	-1
ZDHHC12	ENSG00000160446	2736.572	-0.67717	0.104521	-6.47875	9.25E-11	6.63E-10	-1

ADGRB2	ENSG00000121753	1603.938	-0.67792	0.118854	-5.70378	1.17E-08	6.63E-08	-1
IMP3	ENSG00000177971	771.4434	-0.67913	0.148841	-4.56282	5.05E-06	1.94E-05	-1
FRMD8	ENSG00000126391	3896.224	-0.67936	0.068814	-9.8723	5.49E-23	1.14E-21	-1
SYNGR3	ENSG00000127561	628.4949	-0.68076	0.126178	-5.39523	6.84E-08	3.50E-07	-1
ZBTB7B	ENSG00000160685	978.9281	-0.68199	0.114147	-5.97467	2.31E-09	1.43E-08	-1
UBL4A	ENSG00000102178	4757.541	-0.68223	0.087877	-7.76347	8.26E-15	9.09E-14	-1
TYRO3	ENSG00000092445	2777.046	-0.68285	0.064188	-10.6382	1.98E-26	5.12E-25	-1
UHMK1	ENSG00000152332	15394.6	-0.68413	0.094503	-7.23923	4.51E-13	4.21E-12	-1
BCL9	ENSG00000116128	808.4473	-0.68455	0.116395	-5.88122	4.07E-09	2.46E-08	-1
C5orf15	ENSG00000113583	9612.15	-0.68457	0.098678	-6.93742	3.99E-12	3.32E-11	-1
CRIPT	ENSG00000119878	908.4755	-0.68463	0.114534	-5.97757	2.26E-09	1.41E-08	-1
ARRDC2	ENSG00000105643	1082.464	-0.68487	0.126022	-5.43452	5.49E-08	2.85E-07	-1
NPEPPS	ENSG00000141279	10504.71	-0.68546	0.072471	-9.45841	3.13E-21	5.79E-20	-1
B4GALNT1	ENSG00000135454	2930.77	-0.68579	0.083438	-8.2192	2.05E-16	2.60E-15	-1
LAMTOR4	ENSG00000188186	1865.214	-0.6858	0.18472	-3.71266	0.000205	0.0005933	-1
	ENSG00000288558	688.8536	-0.68634	0.144941	-4.73527	2.19E-06	8.96E-06	-1
ABCA7	ENSG00000064687	631.3177	-0.68634	0.109887	-6.2459	4.21E-10	2.83E-09	-1
PMP22	ENSG00000109099	4190.966	-0.68638	0.091702	-7.48487	7.16E-14	7.18E-13	-1
MAMDC2	ENSG00000165072	1277.097	-0.68815	0.144285	-4.76939	1.85E-06	7.65E-06	-1
LPCAT4	ENSG00000176454	1136.525	-0.68902	0.109675	-6.28236	3.33E-10	2.25E-09	-1
SUMF1	ENSG00000144455	2116.891	-0.69014	0.092321	-7.47542	7.70E-14	7.68E-13	-1
MUC1	ENSG00000185499	1518.45	-0.69021	0.15658	-4.40804	1.04E-05	3.80E-05	-1
SEMA4F	ENSG00000135622	1477.342	-0.69162	0.096932	-7.13515	9.67E-13	8.65E-12	-1
FAM96A	ENSG00000166797	1858.969	-0.69234	0.172757	-4.00757	6.13E-05	0.0001955	-1
C1GALT1C	ENSG00000171155	1400.344	-0.69386	0.124553	-5.57083	2.54E-08	1.38E-07	-1
CDS2	ENSG00000101290	6689.423	-0.69459	0.063969	-10.8582	1.82E-27	4.98E-26	-1
SNTB2	ENSG00000168807	4052.962	-0.69467	0.081741	-8.4984	1.92E-17	2.65E-16	-1
ATP5MC3	ENSG00000154518	5983.046	-0.69506	0.112031	-6.20415	5.50E-10	3.65E-09	-1
METRN	ENSG00000103260	2042.145	-0.69934	0.091671	-7.6288	2.37E-14	2.48E-13	-1
ARRDC3	ENSG00000113369	1618.755	-0.69987	0.131404	-5.32607	1.00E-07	5.01E-07	-1
PCYOX1	ENSG00000116005	6609.179	-0.69992	0.075445	-9.27726	1.74E-20	3.04E-19	-1
TEAD2	ENSG00000074219	899.236	-0.70008	0.104857	-6.67652	2.45E-11	1.88E-10	-1
S100A2	ENSG00000196754	883.355	-0.70018	0.174091	-4.02193	5.77E-05	0.0001852	-1
HEG1	ENSG00000173706	10885.05	-0.70024	0.14742	-4.74996	2.03E-06	8.38E-06	-1
LMNB1	ENSG00000113368	15581.95	-0.70061	0.063574	-11.0205	3.04E-28	8.84E-27	-1
08-Sep	ENSG00000164402	9994.965	-0.70116	0.052263	-13.416	4.88E-41	2.54E-39	-1
TCFL5	ENSG00000101190	986.2089	-0.7014	0.099063	-7.08032	1.44E-12	1.25E-11	-1
ATL1	ENSG00000198513	913.039	-0.70457	0.11694	-6.02509	1.69E-09	1.06E-08	-1
NXPE3	ENSG00000144815	4069.611	-0.70508	0.079817	-8.83367	1.01E-18	1.54E-17	-1
GTF2H5	ENSG00000272047	1563.763	-0.70552	0.120556	-5.85218	4.85E-09	2.90E-08	-1
VSIG10	ENSG00000176834	1529.938	-0.70574	0.072504	-9.73377	2.16E-22	4.30E-21	-1
WBP1L	ENSG00000166272	5583.236	-0.7059	0.114551	-6.16228	7.17E-10	4.70E-09	-1
DCP2	ENSG00000172795	4409.249	-0.70736	0.058235	-12.1467	5.98E-34	2.30E-32	-1
TRIM25	ENSG00000121060	20607.5	-0.70764	0.105069	-6.73505	1.64E-11	1.29E-10	-1
IMPDH1	ENSG00000106348	4628.735	-0.70837	0.080084	-8.84532	9.13E-19	1.39E-17	-1
PARP10	ENSG00000178685	2956.201	-0.70853	0.077766	-9.1111	8.15E-20	1.36E-18	-1
RNF44	ENSG00000146083	1446.717	-0.70869	0.107048	-6.6203	3.58E-11	2.69E-10	-1

SLC35B4	ENSG00000205060	2864.209	-0.70931	0.099942	-7.09723	1.27E-12	1.12E-11	-1
C21orf58	ENSG00000160298	1180.177	-0.71033	0.116065	-6.12016	9.35E-10	6.04E-09	-1
CCDC9B	ENSG00000188549	13441.01	-0.71038	0.132054	-5.37947	7.47E-08	3.80E-07	-1
PLXNB2	ENSG00000196576	22798.39	-0.71054	0.079954	-8.88694	6.28E-19	9.65E-18	-1
PIN4	ENSG00000102309	804.0239	-0.71151	0.107149	-6.64041	3.13E-11	2.35E-10	-1
CYB5A	ENSG00000166347	2256.719	-0.71205	0.129812	-5.48526	4.13E-08	2.18E-07	-1
RBM25	ENSG00000119707	8669.069	-0.71243	0.138142	-5.15725	2.51E-07	1.19E-06	-1
FHDC1	ENSG00000137460	1357.296	-0.71347	0.166806	-4.27724	1.89E-05	6.63E-05	-1
CRYZ	ENSG00000116791	1498.826	-0.71546	0.10634	-6.72804	1.72E-11	1.34E-10	-1
ARL10	ENSG00000175414	3557.632	-0.71656	0.146593	-4.88809	1.02E-06	4.39E-06	-1
FOXK1	ENSG00000164916	3755.786	-0.71681	0.102686	-6.98054	2.94E-12	2.48E-11	-1
MTURN	ENSG00000180354	2689.197	-0.71786	0.072943	-9.84131	7.47E-23	1.53E-21	-1
PIF1	ENSG00000140451	673.287	-0.71815	0.101375	-7.08409	1.40E-12	1.23E-11	-1
LTB	ENSG00000227507	563.0972	-0.71935	0.2077	-3.4634	0.000533	0.0014152	-1
AGPAT3	ENSG00000160216	6917.414	-0.71972	0.08246	-8.72808	2.59E-18	3.81E-17	-1
TUBB4B	ENSG00000188229	44346.08	-0.71994	0.077446	-9.29593	1.46E-20	2.56E-19	-1
ATP5MF	ENSG00000241468	1424.108	-0.72107	0.171631	-4.20129	2.65E-05	9.07E-05	-1
LYSMD2	ENSG00000140280	510.1924	-0.72134	0.166592	-4.32997	1.49E-05	5.30E-05	-1
RNF207	ENSG00000158286	1237.855	-0.7244	0.225126	-3.21774	0.001292	0.0031452	-1
SAMD1	ENSG00000141858	2568.951	-0.72463	0.109014	-6.64711	2.99E-11	2.25E-10	-1
ELOVL6	ENSG00000170522	7857.711	-0.72467	0.112296	-6.45323	1.09E-10	7.82E-10	-1
EFNA1	ENSG00000169242	11899.15	-0.72564	0.162565	-4.46367	8.06E-06	2.98E-05	-1
C9orf3	ENSG00000148120	1843.919	-0.72626	0.080231	-9.05217	1.40E-19	2.26E-18	-1
ANKRD9	ENSG00000156381	2607.937	-0.72769	0.075877	-9.59037	8.78E-22	1.68E-20	-1
RAB42	ENSG00000188060	823.4185	-0.72825	0.161562	-4.50755	6.56E-06	2.47E-05	-1
SPTBN2	ENSG00000173898	1109.083	-0.72836	0.116968	-6.227	4.75E-10	3.17E-09	-1
LAMC1	ENSG00000135862	26912.17	-0.72842	0.102179	-7.12881	1.01E-12	9.05E-12	-1
RIPK4	ENSG00000183421	1678.992	-0.72887	0.141986	-5.13338	2.85E-07	1.34E-06	-1
PORCN	ENSG00000102312	1802.823	-0.72902	0.103206	-7.06368	1.62E-12	1.41E-11	-1
MIEF2	ENSG00000177427	988.8002	-0.7293	0.088932	-8.20063	2.39E-16	3.02E-15	-1
TRIM65	ENSG00000141569	2360.875	-0.73505	0.07683	-9.56723	1.10E-21	2.09E-20	-1
TBL1XR1	ENSG00000177565	6632.499	-0.73551	0.055945	-13.147	1.77E-39	8.81E-38	-1
DGCR2	ENSG00000070413	4243.882	-0.73567	0.099345	-7.40516	1.31E-13	1.28E-12	-1
MARCKSL1	ENSG00000175130	3930.568	-0.73568	0.119646	-6.14882	7.81E-10	5.09E-09	-1
KLHL36	ENSG00000135686	2183.696	-0.73588	0.100416	-7.3283	2.33E-13	2.23E-12	-1
LPCAT2	ENSG00000087253	3672.587	-0.73646	0.081118	-9.07888	1.10E-19	1.81E-18	-1
USP35	ENSG00000118369	583.6717	-0.73694	0.116479	-6.32683	2.50E-10	1.71E-09	-1
TRNP1	ENSG00000253368	556.9053	-0.73766	0.130877	-5.63629	1.74E-08	9.66E-08	-1
HHIP	ENSG00000164161	1578.047	-0.73871	0.176755	-4.1793	2.92E-05	9.92E-05	-1
C1orf21	ENSG00000116667	1633.347	-0.73882	0.097082	-7.61032	2.73E-14	2.84E-13	-1
USP46	ENSG00000109189	1736.932	-0.73922	0.075032	-9.85202	6.72E-23	1.38E-21	-1
TRAPPC1	ENSG00000170043	3756.306	-0.7393	0.077644	-9.52162	1.70E-21	3.19E-20	-1
CCND1	ENSG00000110092	9770.401	-0.74017	0.1891	-3.91419	9.07E-05	0.0002804	-1
SLFN12	ENSG00000172123	1773.132	-0.74054	0.099001	-7.48017	7.42E-14	7.43E-13	-1
NDUFB4	ENSG00000065518	2322.655	-0.74087	0.102851	-7.20331	5.88E-13	5.41E-12	-1
CALM3	ENSG00000160014	18294.65	-0.74113	0.082197	-9.01652	1.94E-19	3.10E-18	-1
GXYLT1	ENSG00000151233	3202.315	-0.74177	0.067951	-10.9162	9.64E-28	2.70E-26	-1

ZNF469	ENSG00000225614	2404.961	-0.74206	0.223178	-3.32497	0.000884	0.0022319	-1
EVPL	ENSG00000167880	1123.689	-0.74246	0.119	-6.23913	4.40E-10	2.95E-09	-1
BMT2	ENSG00000164603	565.8147	-0.74278	0.168568	-4.40644	1.05E-05	3.82E-05	-1
NARF	ENSG00000141562	2831.812	-0.74292	0.083248	-8.92412	4.49E-19	6.97E-18	-1
ICOSLG	ENSG00000160223	495.3748	-0.74298	0.152501	-4.872	1.10E-06	4.74E-06	-1
AC125807.	ENSG00000250899	1156.575	-0.74306	0.161658	-4.59649	4.30E-06	1.67E-05	-1
ZFP30	ENSG00000120784	582.811	-0.74423	0.130391	-5.70767	1.15E-08	6.50E-08	-1
C11orf68	ENSG00000175573	4768.616	-0.74507	0.086379	-8.62559	6.38E-18	9.11E-17	-1
SAC3D1	ENSG00000168061	1572.172	-0.7452	0.081358	-9.1595	5.21E-20	8.84E-19	-1
PRSS23	ENSG00000150687	17216.91	-0.74582	0.073181	-10.1915	2.16E-24	4.88E-23	-1
TMEM185	ENSG00000269556	1175.383	-0.74653	0.105349	-7.08624	1.38E-12	1.21E-11	-1
TBC1D14	ENSG00000132405	1646.981	-0.74766	0.084496	-8.84842	8.88E-19	1.36E-17	-1
ADCY6	ENSG00000174233	3234.144	-0.7518	0.07381	-10.1856	2.30E-24	5.17E-23	-1
APOBEC3C	ENSG00000244509	2820.757	-0.75271	0.11008	-6.83783	8.04E-12	6.48E-11	-1
DAZAP2	ENSG00000183283	12235.88	-0.75286	0.060646	-12.414	2.20E-35	8.97E-34	-1
WRB	ENSG00000182093	778.9836	-0.75304	0.088888	-8.47174	2.42E-17	3.31E-16	-1
SIX5	ENSG00000177045	671.7384	-0.7531	0.097346	-7.73639	1.02E-14	1.11E-13	-1
EIF4E2	ENSG00000135930	3988.902	-0.75528	0.117052	-6.45248	1.10E-10	7.85E-10	-1
TNFAIP8L1	ENSG00000185361	1280.455	-0.75713	0.090284	-8.38609	5.03E-17	6.68E-16	-1
KLF12	ENSG00000118922	2602.567	-0.75865	0.129812	-5.84419	5.09E-09	3.03E-08	-1
ADCY9	ENSG00000162104	3302.217	-0.75963	0.11011	-6.89884	5.24E-12	4.32E-11	-1
FASTKD1	ENSG00000138399	705.5949	-0.76072	0.123042	-6.18262	6.30E-10	4.16E-09	-1
UBA7	ENSG00000182179	1687.276	-0.76267	0.118304	-6.44669	1.14E-10	8.10E-10	-1
ATRN	ENSG00000088812	7359.041	-0.76295	0.07377	-10.3423	4.54E-25	1.08E-23	-1
CPOX	ENSG00000080819	1357.325	-0.76322	0.109786	-6.95189	3.60E-12	3.01E-11	-1
PRKCD	ENSG00000163932	3047.536	-0.76383	0.076793	-9.94655	2.61E-23	5.48E-22	-1
CCDC102A	ENSG00000135736	1011.494	-0.76468	0.105744	-7.23145	4.78E-13	4.43E-12	-1
DAB2IP	ENSG00000136848	1719.228	-0.76474	0.083555	-9.1526	5.56E-20	9.39E-19	-1
WDR81	ENSG00000167716	3116.034	-0.76534	0.088959	-8.60325	7.75E-18	1.10E-16	-1
GATA2	ENSG00000179348	933.3738	-0.76554	0.111099	-6.89062	5.56E-12	4.56E-11	-1
UBE2L6	ENSG00000156587	2189.105	-0.76649	0.13541	-5.66051	1.51E-08	8.45E-08	-1
SETD1B	ENSG00000139718	2095.681	-0.76841	0.083558	-9.19614	3.71E-20	6.39E-19	-1
ANP32A	ENSG00000140350	4155.7	-0.77353	0.072784	-10.6277	2.21E-26	5.70E-25	-1
	ENSG00000289194	556.2817	-0.77392	0.163026	-4.74725	2.06E-06	8.49E-06	-1
LOXL1-AS1	ENSG00000261801	2334.191	-0.77849	0.108386	-7.18255	6.84E-13	6.25E-12	-1
SNRPD3	ENSG00000100028	2116.038	-0.77889	0.085087	-9.15405	5.48E-20	9.28E-19	-1
ZMIZ1	ENSG00000108175	13314.46	-0.77988	0.179574	-4.34294	1.41E-05	5.01E-05	-1
MR1	ENSG00000153029	508.6189	-0.78015	0.104305	-7.47952	7.46E-14	7.46E-13	-1
AK4	ENSG00000162433	2522.923	-0.78096	0.088901	-8.78459	1.57E-18	2.35E-17	-1
HOXB3	ENSG00000120093	666.5861	-0.78099	0.163144	-4.78714	1.69E-06	7.04E-06	-1
CSTF3	ENSG00000176102	1710.625	-0.78264	0.079597	-9.83256	8.15E-23	1.67E-21	-1
GNG11	ENSG00000127920	919.5978	-0.78457	0.187979	-4.1737	3.00E-05	0.0001013	-1
ATF5	ENSG00000169136	1043.229	-0.78506	0.09014	-8.70931	3.06E-18	4.47E-17	-1
SCAI	ENSG00000173611	620.4764	-0.78615	0.131214	-5.99134	2.08E-09	1.30E-08	-1
NTN4	ENSG00000074527	5898.399	-0.78622	0.093136	-8.44161	3.13E-17	4.23E-16	-1
PXMP4	ENSG00000101417	1742.406	-0.78713	0.079375	-9.91651	3.53E-23	7.34E-22	-1
RAB27B	ENSG00000041353	1412.814	-0.7875	0.108119	-7.28365	3.25E-13	3.08E-12	-1

PDPN	ENSG00000162493	655.6855	-0.78823	0.173571	-4.54123	5.59E-06	2.13E-05	-1
GPR161	ENSG00000143147	3757.749	-0.78907	0.062826	-12.5597	3.52E-36	1.54E-34	-1
TLDC1	ENSG00000140950	1727.914	-0.79155	0.108876	-7.27017	3.59E-13	3.39E-12	-1
PIP4K2B	ENSG00000276293	5901.82	-0.79271	0.091426	-8.67057	4.30E-18	6.20E-17	-1
TRPM4	ENSG00000130529	924.0905	-0.79379	0.123045	-6.45122	1.11E-10	7.91E-10	-1
NACC2	ENSG00000148411	2376.52	-0.79412	0.087659	-9.05922	1.31E-19	2.14E-18	-1
COX6B1	ENSG00000126267	4010.864	-0.79468	0.122219	-6.5021	7.92E-11	5.72E-10	-1
LINC00641	ENSG00000258441	689.5769	-0.79589	0.264138	-3.01315	0.002585	0.0059021	-1
RBFOX2	ENSG00000100320	13681.19	-0.79616	0.081611	-9.75558	1.75E-22	3.49E-21	-1
ZFP64	ENSG00000020256	1140.03	-0.79726	0.117252	-6.79952	1.05E-11	8.37E-11	-1
JCAD	ENSG00000165757	951.4541	-0.79876	0.117235	-6.81334	9.54E-12	7.65E-11	-1
CRISPLD2	ENSG00000103196	1627.59	-0.79943	0.107466	-7.43893	1.02E-13	1.00E-12	-1
LPIN3	ENSG00000132793	1174.133	-0.79959	0.135349	-5.90761	3.47E-09	2.13E-08	-1
FAM172A	ENSG00000113391	1487.353	-0.80054	0.076693	-10.4383	1.66E-25	4.03E-24	-1
EOGT	ENSG00000163378	3293.986	-0.80096	0.088166	-9.08468	1.04E-19	1.72E-18	-1
ARHGDIB	ENSG00000111348	1756.988	-0.80134	0.121408	-6.60038	4.10E-11	3.05E-10	-1
PM20D2	ENSG00000146281	5376.415	-0.80147	0.070651	-11.344	7.94E-30	2.51E-28	-1
PTPRJ	ENSG00000149177	5917.319	-0.80236	0.100959	-7.94741	1.90E-15	2.22E-14	-1
EPB41L4B	ENSG00000095203	573.0772	-0.80333	0.215886	-3.7211	0.000198	0.0005755	-1
TWIST1	ENSG00000122691	614.0672	-0.80502	0.144458	-5.57269	2.51E-08	1.37E-07	-1
FAM69A	ENSG00000154511	977.811	-0.80616	0.088582	-9.10079	8.97E-20	1.49E-18	-1
VAMP8	ENSG00000118640	1866.893	-0.80816	0.180403	-4.47977	7.47E-06	2.79E-05	-1
PPP1R3D	ENSG00000132825	620.4407	-0.8086	0.103302	-7.82754	4.97E-15	5.57E-14	-1
NDUFB3	ENSG00000119013	1600	-0.80871	0.148031	-5.46314	4.68E-08	2.45E-07	-1
TCTN2	ENSG00000168778	1151.711	-0.80978	0.097396	-8.3143	9.23E-17	1.21E-15	-1
DSTYK	ENSG00000133059	2756.599	-0.80984	0.099279	-8.15722	3.43E-16	4.28E-15	-1
PLEKHM3	ENSG00000178385	840.6777	-0.8112	0.119358	-6.79636	1.07E-11	8.55E-11	-1
IL15RA	ENSG00000134470	861.3292	-0.81134	0.132291	-6.13301	8.62E-10	5.58E-09	-1
VANGL1	ENSG00000173218	5134.369	-0.81139	0.1025	-7.91595	2.45E-15	2.81E-14	-1
TCEANC2	ENSG00000116205	863.2756	-0.81311	0.145487	-5.58892	2.28E-08	1.25E-07	-1
MRPL34	ENSG00000130312	896.1972	-0.81471	0.19692	-4.13728	3.51E-05	0.0001171	-1
APOL2	ENSG00000128335	8419.428	-0.81492	0.152039	-5.35995	8.32E-08	4.21E-07	-1
DAPK2	ENSG00000035664	618.9877	-0.81517	0.112308	-7.25836	3.92E-13	3.68E-12	-1
CDKN1B	ENSG00000111276	4309.735	-0.81579	0.114143	-7.14708	8.86E-13	7.96E-12	-1
OAZ2	ENSG00000180304	3226.23	-0.81734	0.091822	-8.90144	5.51E-19	8.51E-18	-1
GLCE	ENSG00000138604	3611.258	-0.81838	0.065335	-12.5258	5.39E-36	2.32E-34	-1
RPS6KA4	ENSG00000162302	5094.187	-0.81876	0.075195	-10.8886	1.31E-27	3.61E-26	-1
FAM160A1	ENSG00000164142	1699.648	-0.81898	0.093666	-8.74369	2.26E-18	3.33E-17	-1
CCDC134	ENSG00000100147	902.9023	-0.81961	0.093002	-8.81282	1.22E-18	1.84E-17	-1
PRICKLE3	ENSG00000012211	584.6604	-0.8206	0.12419	-6.60762	3.91E-11	2.92E-10	-1
PML	ENSG00000140464	13996.99	-0.82467	0.071018	-11.6121	3.58E-31	1.20E-29	-1
C4orf3	ENSG00000164096	2948.429	-0.82491	0.085739	-9.6212	6.51E-22	1.25E-20	-1
LSM3	ENSG00000170860	3253.302	-0.82538	0.093623	-8.81597	1.19E-18	1.79E-17	-1
LTBP2	ENSG00000119681	6669.847	-0.82596	0.135013	-6.11764	9.50E-10	6.14E-09	-1
PARP12	ENSG00000059378	3364.781	-0.82651	0.093715	-8.81944	1.15E-18	1.74E-17	-1
PLXNA1	ENSG00000114554	8230.333	-0.83047	0.121438	-6.83865	7.99E-12	6.45E-11	-1
FAM20C	ENSG00000177706	8279.254	-0.83081	0.067842	-12.2462	1.76E-34	6.90E-33	-1

LRP4	ENSG00000134569	547.0016	-0.83137	0.102704	-8.09486	5.73E-16	7.00E-15	-1
TFAP2A	ENSG00000137203	4265.585	-0.83202	0.116207	-7.15976	8.08E-13	7.32E-12	-1
ZBED1	ENSG00000214717	1553.347	-0.83255	0.077125	-10.7948	3.64E-27	9.87E-26	-1
AHNAK	ENSG00000124942	91732.27	-0.83315	0.2972	-2.80333	0.005058	0.0107732	-1
PAQR4	ENSG00000162073	1680.629	-0.83459	0.119752	-6.96932	3.18E-12	2.67E-11	-1
NUP210	ENSG00000132182	1964.879	-0.83654	0.124341	-6.72781	1.72E-11	1.34E-10	-1
RTL8B	ENSG00000212747	796.8768	-0.84165	0.117271	-7.17698	7.13E-13	6.50E-12	-1
ADAM15	ENSG00000143537	9284.075	-0.84182	0.065314	-12.8889	5.20E-38	2.45E-36	-1
RNF144B	ENSG00000137393	1917.406	-0.84819	0.109509	-7.7454	9.53E-15	1.04E-13	-1
MANEAL	ENSG00000185090	663.9633	-0.84982	0.106087	-8.0106	1.14E-15	1.36E-14	-1
TAP2	ENSG00000204267	2961.787	-0.85141	0.107014	-7.95604	1.78E-15	2.08E-14	-1
ARL6IP5	ENSG00000144746	5632.209	-0.85175	0.117245	-7.26466	3.74E-13	3.52E-12	-1
RAB30	ENSG00000137502	1213.038	-0.85177	0.098721	-8.6281	6.24E-18	8.93E-17	-1
PRDX1	ENSG00000117450	8982.715	-0.85277	0.074381	-11.4649	1.98E-30	6.45E-29	-1
TLR4	ENSG00000136869	2225.907	-0.85453	0.129423	-6.60257	4.04E-11	3.01E-10	-1
KATNAL1	ENSG00000102781	3977.982	-0.86085	0.089373	-9.63213	5.85E-22	1.13E-20	-1
ATP13A2	ENSG00000159363	3117.507	-0.8611	0.130077	-6.61995	3.59E-11	2.69E-10	-1
SYNJ2BP	ENSG00000213463	2608.299	-0.86235	0.063946	-13.4857	1.90E-41	1.01E-39	-1
LRFN4	ENSG00000173621	1633.659	-0.86243	0.085542	-10.0819	6.64E-24	1.45E-22	-1
SUN2	ENSG00000100242	7888.066	-0.8625	0.070085	-12.3065	8.35E-35	3.33E-33	-1
FZD5	ENSG00000163251	936.2046	-0.86679	0.111689	-7.76077	8.44E-15	9.28E-14	-1
PSMB9	ENSG00000240065	2293.302	-0.86806	0.171064	-5.07448	3.89E-07	1.79E-06	-1
PANK1	ENSG00000152782	531.3194	-0.86807	0.134829	-6.43831	1.21E-10	8.51E-10	-1
PIANP	ENSG00000139200	496.1438	-0.8686	0.20705	-4.19513	2.73E-05	9.29E-05	-1
CHST12	ENSG00000136213	801.4349	-0.86943	0.103193	-8.42529	3.60E-17	4.83E-16	-1
PTGFRN	ENSG00000134247	4883.143	-0.87067	0.073576	-11.8336	2.62E-32	9.38E-31	-1
UNC119B	ENSG00000175970	2750.576	-0.87119	0.09187	-9.48285	2.47E-21	4.61E-20	-1
ADRB2	ENSG00000169252	853.0307	-0.87142	0.192923	-4.51693	6.27E-06	2.37E-05	-1
FAT4	ENSG00000196159	1454.87	-0.87176	0.226814	-3.8435	0.000121	0.0003667	-1
ARRB1	ENSG00000137486	601.1642	-0.87219	0.124562	-7.00209	2.52E-12	2.14E-11	-1
COX7B	ENSG00000131174	2894.758	-0.87684	0.18321	-4.78599	1.70E-06	7.07E-06	-1
IL15	ENSG00000164136	558.8225	-0.8772	0.136569	-6.42317	1.33E-10	9.35E-10	-1
EIF2AK2	ENSG00000055332	6163.21	-0.87986	0.060392	-14.5692	4.41E-48	3.13E-46	-1
ZNF224	ENSG00000267680	552.2283	-0.88122	0.160459	-5.4919	3.98E-08	2.11E-07	-1
KCTD3	ENSG00000136636	3969.867	-0.88325	0.073042	-12.0924	1.16E-33	4.37E-32	-1
CARHSP1	ENSG00000153048	1757.225	-0.8874	0.0868	-10.2236	1.55E-24	3.54E-23	-1
HMGB3	ENSG00000029993	7478.688	-0.89325	0.089611	-9.96813	2.10E-23	4.44E-22	-1
PSRC1	ENSG00000134222	1634.615	-0.89392	0.159664	-5.59875	2.16E-08	1.18E-07	-1
TNRC6A	ENSG00000090905	4269.323	-0.89493	0.087683	-10.2064	1.86E-24	4.19E-23	-1
MXD4	ENSG00000123933	4351.377	-0.89696	0.084231	-10.6488	1.77E-26	4.58E-25	-1
MFSD5	ENSG00000182544	1857.383	-0.89734	0.091463	-9.81099	1.01E-22	2.06E-21	-1
COL4A5	ENSG00000188153	2105.708	-0.89762	0.072325	-12.411	2.28E-35	9.27E-34	-1
SPC24	ENSG00000161888	1702.205	-0.90188	0.128554	-7.01557	2.29E-12	1.95E-11	-1
KBTBD6	ENSG00000165572	1000.071	-0.90211	0.106607	-8.46197	2.63E-17	3.59E-16	-1
SUOX	ENSG00000139531	634.4945	-0.90322	0.100548	-8.98294	2.64E-19	4.16E-18	-1
RASSF7	ENSG00000099849	2702.551	-0.9036	0.108831	-8.30276	1.02E-16	1.33E-15	-1
CDKN2D	ENSG00000129355	872.061	-0.90559	0.145295	-6.23275	4.58E-10	3.06E-09	-1

LYPD6	ENSG00000187123	581.0928	-0.91047	0.172582	-5.2756	1.32E-07	6.49E-07	-1
TSHZ1	ENSG00000179981	588.5628	-0.91234	0.109342	-8.34386	7.19E-17	9.50E-16	-1
KIF5A	ENSG00000155980	466.6177	-0.91258	0.150826	-6.05057	1.44E-09	9.17E-09	-1
IFIT5	ENSG00000152778	3469.027	-0.91279	0.123628	-7.3834	1.54E-13	1.50E-12	-1
TM4SF1	ENSG00000169908	4604.958	-0.91399	0.163355	-5.5951	2.20E-08	1.21E-07	-1
ZMAT3	ENSG00000172667	1725.431	-0.9146	0.168792	-5.41854	6.01E-08	3.09E-07	-1
ANKRD52	ENSG00000139645	12768.83	-0.91672	0.12333	-7.43309	1.06E-13	1.04E-12	-1
GM2A	ENSG00000196743	3654.528	-0.91781	0.089262	-10.2823	8.47E-25	1.97E-23	-1
NOL4L	ENSG00000197183	655.1804	-0.91881	0.151154	-6.0786	1.21E-09	7.73E-09	-1
CSF1	ENSG00000184371	7034.385	-0.9208	0.084143	-10.9432	7.16E-28	2.04E-26	-1
MMP15	ENSG00000102996	2957.854	-0.92108	0.108517	-8.4879	2.10E-17	2.89E-16	-1
ISG15	ENSG00000187608	1534.105	-0.92117	0.190831	-4.82717	1.38E-06	5.83E-06	-1
SAP30L	ENSG00000164576	4897.706	-0.92388	0.090225	-10.2397	1.32E-24	3.01E-23	-1
THRA	ENSG00000126351	960.6096	-0.92547	0.102394	-9.03838	1.59E-19	2.55E-18	-1
APOL1	ENSG00000100342	2471.169	-0.9257	0.153174	-6.04348	1.51E-09	9.55E-09	-1
MARVELD1	ENSG00000155254	5195.864	-0.92593	0.113001	-8.19394	2.53E-16	3.18E-15	-1
TACSTD2	ENSG00000184292	16483.77	-0.92621	0.135729	-6.82397	8.86E-12	7.11E-11	-1
CCNO	ENSG00000152669	638.8211	-0.93091	0.136125	-6.83866	7.99E-12	6.45E-11	-1
SESTD1	ENSG00000187231	2122.432	-0.9315	0.090436	-10.3	7.04E-25	1.66E-23	-1
ASPM	ENSG00000066279	10604.41	-0.93168	0.099906	-9.32561	1.10E-20	1.95E-19	-1
ACSL5	ENSG00000197142	637.1374	-0.93202	0.107401	-8.67793	4.03E-18	5.84E-17	-1
TNRC6B	ENSG00000100354	1394.427	-0.93305	0.117275	-7.95608	1.78E-15	2.08E-14	-1
JRK	ENSG00000234616	3697.164	-0.93391	0.132478	-7.04954	1.80E-12	1.55E-11	-1
PNPLA6	ENSG00000032444	3733.473	-0.93492	0.072947	-12.8165	1.33E-37	6.06E-36	-1
ELFN2	ENSG00000166897	1340.687	-0.93719	0.140955	-6.64889	2.95E-11	2.23E-10	-1
SECTM1	ENSG00000141574	3484.31	-0.93904	0.117314	-8.00453	1.20E-15	1.42E-14	-1
CDKN2C	ENSG00000123080	3336.095	-0.94076	0.100413	-9.36883	7.33E-21	1.31E-19	-1
ALDH1A3	ENSG00000184254	4723.448	-0.94169	0.0768	-12.2615	1.46E-34	5.76E-33	-1
SHROOM3	ENSG00000138771	1997.785	-0.94624	0.096667	-9.78861	1.26E-22	2.55E-21	-1
POMK	ENSG00000185900	2472.077	-0.9479	0.070605	-13.4253	4.30E-41	2.25E-39	-1
BAIAP2-AS	ENSG00000226137	932.21	-0.94823	0.107415	-8.82769	1.07E-18	1.62E-17	-1
GPX3	ENSG00000211445	942.3505	-0.94957	0.123183	-7.70862	1.27E-14	1.36E-13	-1
CBX5	ENSG00000094916	20160.56	-0.95227	0.101746	-9.35926	8.03E-21	1.43E-19	-1
SOGA1	ENSG00000149639	13830.49	-0.95655	0.128392	-7.45024	9.32E-14	9.24E-13	-1
SUFU	ENSG00000107882	1019.189	-0.9574	0.140746	-6.80229	1.03E-11	8.22E-11	-1
EYA1	ENSG00000104313	521.8249	-0.95884	0.119351	-8.03374	9.45E-16	1.13E-14	-1
TGFBR3	ENSG00000069702	1094.327	-0.95887	0.180966	-5.29863	1.17E-07	5.76E-07	-1
TRANK1	ENSG00000168016	1573.663	-0.95961	0.096758	-9.9176	3.49E-23	7.27E-22	-1
MYD88	ENSG00000172936	3164.398	-0.96325	0.088458	-10.8894	1.30E-27	3.59E-26	-1
SLC25A12	ENSG00000115840	845.0445	-0.96353	0.103239	-9.333	1.03E-20	1.82E-19	-1
ERAP2	ENSG00000164308	9485.846	-0.96703	0.106438	-9.08544	1.03E-19	1.71E-18	-1
RAB40B	ENSG00000141542	978.6663	-0.96744	0.106662	-9.07018	1.19E-19	1.95E-18	-1
TUBA1A	ENSG00000167552	38193.33	-0.96778	0.096248	-10.055	8.73E-24	1.88E-22	-1
TRIM14	ENSG00000106785	4479.985	-0.97078	0.086864	-11.1759	5.35E-29	1.61E-27	-1
ZFHX4	ENSG00000091656	3104.353	-0.97644	0.188094	-5.19124	2.09E-07	9.98E-07	-1
FBXL16	ENSG00000127585	1493.681	-0.97737	0.099668	-9.80627	1.06E-22	2.14E-21	-1
GCNT2	ENSG00000111846	953.3931	-0.97743	0.195884	-4.98982	6.04E-07	2.71E-06	-1

LRP5	ENSG00000162337	2970.486	-0.97806	0.084116	-11.6275	2.99E-31	1.01E-29	-1
EFNA5	ENSG00000184349	1001.512	-0.98028	0.14552	-6.73637	1.62E-11	1.28E-10	-1
PARP14	ENSG00000173193	10673.84	-0.98305	0.109648	-8.96556	3.09E-19	4.84E-18	-1
AC092747.	ENSG00000275764	496.8691	-0.98709	0.142645	-6.91993	4.52E-12	3.74E-11	-1
C1RL	ENSG00000139178	757.1143	-0.98789	0.179012	-5.51856	3.42E-08	1.83E-07	-1
TMEM246	ENSG00000165152	1027.443	-0.98877	0.102428	-9.65337	4.76E-22	9.27E-21	-1
MXD3	ENSG00000213347	1220.857	-0.99315	0.117678	-8.43954	3.19E-17	4.30E-16	-1
EXTL3	ENSG00000012232	3307.165	-0.9939	0.092807	-10.7093	9.20E-27	2.44E-25	-1
CNPY4	ENSG00000166997	714.6705	-0.99444	0.120553	-8.24899	1.60E-16	2.06E-15	-1
EPHB4	ENSG00000196411	3740.921	-1.00005	0.081478	-12.2738	1.25E-34	4.97E-33	-1
WNT7B	ENSG00000188064	1031.295	-1.00086	0.228984	-4.37088	1.24E-05	4.45E-05	-1
GEMIN6	ENSG00000152147	573.2046	-1.00262	0.166245	-6.031	1.63E-09	1.03E-08	-1
SNRNP35	ENSG00000184209	641.9071	-1.00718	0.110664	-9.10125	8.93E-20	1.49E-18	-1
CLDN11	ENSG00000013297	6582.792	-1.00744	0.078874	-12.7729	2.32E-37	1.06E-35	-1
HSPG2	ENSG00000142798	27747.99	-1.01089	0.30193	-3.3481	0.000814	0.002069	-1
PDK3	ENSG00000067992	565.2305	-1.01198	0.123529	-8.19227	2.56E-16	3.22E-15	-1
TTYH3	ENSG00000136295	5278.218	-1.01257	0.092717	-10.9212	9.13E-28	2.57E-26	-1
FIGN	ENSG00000182263	872.6183	-1.01273	0.155146	-6.5276	6.68E-11	4.88E-10	-1
HSPA1A	ENSG00000204389	2366.127	-1.01543	0.122483	-8.29039	1.13E-16	1.47E-15	-1
SFT2D2	ENSG00000213064	5263.992	-1.01549	0.138608	-7.32635	2.37E-13	2.26E-12	-1
STARD4-AS	ENSG00000246859	511.6054	-1.01889	0.242502	-4.20158	2.65E-05	9.06E-05	-1
AMMECR1	ENSG00000101935	1398.478	-1.02197	0.113902	-8.97232	2.90E-19	4.57E-18	-1
KLF9	ENSG00000119138	1790.181	-1.02514	0.105373	-9.72867	2.28E-22	4.51E-21	-1
NFE2L3	ENSG00000050344	5201.286	-1.02594	0.110255	-9.3052	1.34E-20	2.36E-19	-1
KIAA1147	ENSG00000257093	1726.766	-1.02733	0.071577	-14.3529	1.02E-46	7.14E-45	-1
TMEM168	ENSG00000146802	551.5682	-1.03259	0.139656	-7.39377	1.43E-13	1.39E-12	-1
ABCC5	ENSG00000114770	1049.816	-1.03696	0.09133	-11.3539	7.09E-30	2.26E-28	-1
MBOAT1	ENSG00000172197	642.265	-1.0383	0.121821	-8.52316	1.55E-17	2.15E-16	-1
EEF2K	ENSG00000103319	1633.375	-1.03937	0.104519	-9.94427	2.67E-23	5.59E-22	-1
C11orf95	ENSG00000188070	1020.522	-1.04271	0.115919	-8.99512	2.36E-19	3.73E-18	-1
COL16A1	ENSG00000084636	563.1642	-1.04358	0.116651	-8.94618	3.68E-19	5.74E-18	-1
MAST3	ENSG00000099308	560.296	-1.04485	0.14999	-6.96615	3.26E-12	2.73E-11	-1
CARD6	ENSG00000132357	690.0607	-1.04536	0.109535	-9.54369	1.38E-21	2.59E-20	-1
IRF2	ENSG00000168310	3668.151	-1.05015	0.146545	-7.16607	7.72E-13	7.02E-12	-1
IL27RA	ENSG00000104998	922.5623	-1.05025	0.16104	-6.52167	6.95E-11	5.06E-10	-1
SMAD3	ENSG00000166949	30596.87	-1.05475	0.109036	-9.67345	3.91E-22	7.65E-21	-1
NANOS1	ENSG00000188613	500.7949	-1.05789	0.184455	-5.73521	9.74E-09	5.58E-08	-1
KANK2	ENSG00000197256	6340.423	-1.05868	0.099088	-10.6842	1.21E-26	3.18E-25	-1
SIX2	ENSG00000170577	1528.558	-1.06375	0.101653	-10.4645	1.26E-25	3.10E-24	-1
CELSR2	ENSG00000143126	1207.221	-1.06645	0.142515	-7.48307	7.26E-14	7.27E-13	-1
TNS3	ENSG00000136205	15483.04	-1.06764	0.104946	-10.1732	2.61E-24	5.83E-23	-1
TMEM14A	ENSG00000096092	1213.941	-1.07042	0.160879	-6.65359	2.86E-11	2.17E-10	-1
HOXB7	ENSG00000260027	666.9708	-1.07117	0.149807	-7.15035	8.66E-13	7.80E-12	-1
NDUFA2	ENSG00000131495	1568.841	-1.07528	0.199984	-5.37683	7.58E-08	3.85E-07	-1
SHISA2	ENSG00000180730	2600.935	-1.07683	0.169785	-6.34231	2.26E-10	1.56E-09	-1
PCDHGC3	ENSG00000240184	3115.776	-1.08207	0.093181	-11.6127	3.55E-31	1.19E-29	-1
MEIS1	ENSG00000143995	698.6826	-1.08405	0.105014	-10.3229	5.55E-25	1.31E-23	-1

B4GAT1	ENSG00000174684	795.6913	-1.08514	0.110649	-9.80708	1.05E-22	2.13E-21	-1
AHDC1	ENSG00000126705	2454.91	-1.09039	0.070042	-15.5677	1.21E-54	1.12E-52	-1
CD74	ENSG00000019582	615.6818	-1.09059	0.177297	-6.1512	7.69E-10	5.03E-09	-1
LINC01224	ENSG00000269416	982.6345	-1.09237	0.11412	-9.57213	1.05E-21	2.00E-20	-1
PIK3R3	ENSG00000117461	1561.162	-1.09584	0.140702	-7.78841	6.79E-15	7.52E-14	-1
CTDSP2	ENSG00000175215	8793.482	-1.10174	0.074767	-14.7357	3.80E-49	2.89E-47	-1
HMGN3	ENSG00000118418	775.3044	-1.11226	0.134836	-8.24895	1.60E-16	2.06E-15	-1
POU2F1	ENSG00000143190	1101.289	-1.11951	0.122545	-9.13548	6.51E-20	1.09E-18	-1
HSPA2	ENSG00000126803	724.7296	-1.12105	0.128195	-8.74491	2.23E-18	3.31E-17	-1
APAF1	ENSG00000120868	2789.297	-1.12124	0.091067	-12.3122	7.79E-35	3.12E-33	-1
RASSF4	ENSG00000107551	1069.472	-1.12151	0.106931	-10.4882	9.79E-26	2.42E-24	-1
CCL2	ENSG00000108691	21882.58	-1.12574	0.128745	-8.74391	2.25E-18	3.33E-17	-1
MGEA5	ENSG00000198408	10800.24	-1.12577	0.14593	-7.7145	1.21E-14	1.30E-13	-1
OAS3	ENSG00000111331	9635.144	-1.12821	0.080658	-13.9877	1.85E-44	1.17E-42	-1
PARP9	ENSG00000138496	1447.621	-1.13049	0.138877	-8.14027	3.94E-16	4.88E-15	-1
DIXDC1	ENSG00000150764	1176.048	-1.13062	0.123144	-9.18129	4.26E-20	7.29E-19	-1
SHISAL1	ENSG00000138944	3348.222	-1.13218	0.144902	-7.81346	5.56E-15	6.20E-14	-1
RCAN3	ENSG00000117602	2188.545	-1.1322	0.074335	-15.2311	2.20E-52	1.89E-50	-1
ARNT2	ENSG00000172379	944.1908	-1.13333	0.099742	-11.3626	6.42E-30	2.05E-28	-1
TRIM22	ENSG00000132274	831.018	-1.13373	0.107956	-10.5018	8.48E-26	2.11E-24	-1
LINC01963	ENSG00000260804	625.0349	-1.13744	0.206091	-5.5191	3.41E-08	1.82E-07	-1
POLR2L	ENSG00000177700	5017.348	-1.13964	0.132485	-8.60205	7.83E-18	1.11E-16	-1
ABCA3	ENSG00000167972	2409.771	-1.14001	0.103188	-11.0479	2.25E-28	6.58E-27	-1
LGR4	ENSG00000205213	2781.759	-1.14267	0.097758	-11.6888	1.45E-31	4.97E-30	-1
B3GALNT1	ENSG00000169255	546.9602	-1.14334	0.104012	-10.9923	4.16E-28	1.20E-26	-1
DUBR	ENSG00000243701	920.6442	-1.14577	0.136156	-8.41514	3.92E-17	5.24E-16	-1
SDC3	ENSG00000162512	11455.72	-1.14675	0.089144	-12.864	7.17E-38	3.34E-36	-1
SOX12	ENSG00000177732	1589.844	-1.15063	0.119483	-9.63007	5.97E-22	1.15E-20	-1
ATP5MC1	ENSG00000159199	2929.199	-1.16099	0.099313	-11.6903	1.43E-31	4.91E-30	-1
TAP1	ENSG00000168394	7717.891	-1.16552	0.126071	-9.2449	2.35E-20	4.09E-19	-1
CYB561D1	ENSG00000174151	947.1529	-1.17365	0.173881	-6.74974	1.48E-11	1.17E-10	-1
TRERF1	ENSG00000124496	633.536	-1.17517	0.157911	-7.44198	9.92E-14	9.81E-13	-1
VAMP1	ENSG00000139190	518.3003	-1.17641	0.189567	-6.20577	5.44E-10	3.61E-09	-1
EIF4EBP2	ENSG00000148730	8942.881	-1.17815	0.094904	-12.4142	2.19E-35	8.97E-34	-1
FZD7	ENSG00000155760	2004.231	-1.17838	0.083987	-14.0305	1.01E-44	6.53E-43	-1
KREMEN1	ENSG00000183762	594.3961	-1.1795	0.128442	-9.18309	4.19E-20	7.18E-19	-1
COL5A1	ENSG00000130635	12622.69	-1.18003	0.130979	-9.00933	2.07E-19	3.29E-18	-1
GFRA1	ENSG00000151892	3834.41	-1.18401	0.113242	-10.4556	1.38E-25	3.39E-24	-1
	ENSG00000291006	644.4352	-1.19066	0.105384	-11.2983	1.34E-29	4.17E-28	-1
IGSF3	ENSG00000143061	5644.891	-1.1977	0.103782	-11.5405	8.25E-31	2.71E-29	-1
GPC1	ENSG00000063660	15363.8	-1.2042	0.110309	-10.9167	9.60E-28	2.69E-26	-1
TMTC4	ENSG00000125247	723.7606	-1.20812	0.103323	-11.6927	1.39E-31	4.80E-30	-1
MYORG	ENSG00000164976	1699.136	-1.21358	0.104141	-11.6532	2.21E-31	7.48E-30	-1
COL18A1	ENSG00000182871	1307.821	-1.22029	0.129848	-9.39779	5.57E-21	1.01E-19	-1
MLKL	ENSG00000168404	529.6805	-1.22601	0.128357	-9.55151	1.28E-21	2.41E-20	-1
IKBKE	ENSG00000263528	3029.899	-1.23434	0.131116	-9.41411	4.77E-21	8.72E-20	-1
ITGA11	ENSG00000137809	759.4548	-1.2426	0.103839	-11.9666	5.31E-33	1.95E-31	-1

CXXC5	ENSG00000171604	2452.605	-1.24357	0.154853	-8.03067	9.69E-16	1.16E-14	-1
SMIM30	ENSG00000214194	431.9582	-1.25034	0.214391	-5.83209	5.47E-09	3.25E-08	-1
AGRN	ENSG00000188157	37729.13	-1.25242	0.126238	-9.92109	3.37E-23	7.04E-22	-1
GPRC5B	ENSG00000167191	5083.807	-1.25788	0.064826	-19.4041	7.13E-84	1.46E-81	-1
ZC3HAV1	ENSG00000105939	3731.584	-1.26277	0.125226	-10.084	6.50E-24	1.42E-22	-1
SLC39A10	ENSG00000196950	1338.567	-1.26917	0.129043	-9.83526	7.94E-23	1.63E-21	-1
ABHD17C	ENSG00000136379	1029.985	-1.27164	0.086733	-14.6615	1.14E-48	8.37E-47	-1
BRI3BP	ENSG00000184992	1473.622	-1.27398	0.130397	-9.77004	1.51E-22	3.04E-21	-1
NREP	ENSG00000134986	681.188	-1.27585	0.158083	-8.07076	6.99E-16	8.48E-15	-1
ABCA2	ENSG00000107331	2114.874	-1.28201	0.131509	-9.74849	1.87E-22	3.73E-21	-1
CBX6	ENSG00000183741	3848.24	-1.28346	0.124947	-10.272	9.42E-25	2.18E-23	-1
ABHD15	ENSG00000168792	975.9639	-1.28454	0.088104	-14.5797	3.78E-48	2.72E-46	-1
IFIH1	ENSG00000115267	2057.957	-1.28493	0.158768	-8.09316	5.81E-16	7.09E-15	-1
LAMA5	ENSG00000130702	1382.525	-1.29213	0.202206	-6.39018	1.66E-10	1.15E-09	-1
CMTM4	ENSG00000183723	2365.201	-1.29767	0.125985	-10.3002	7.03E-25	1.66E-23	-1
ANKRD33B	ENSG00000164236	3535.969	-1.30537	0.150499	-8.67362	4.19E-18	6.05E-17	-1
C3	ENSG00000125730	6799.909	-1.30656	0.117336	-11.1352	8.46E-29	2.52E-27	-1
FZD1	ENSG00000157240	1330.43	-1.32346	0.131416	-10.0707	7.44E-24	1.61E-22	-1
TNFRSF10D	ENSG00000173530	1320.544	-1.32671	0.130388	-10.1751	2.56E-24	5.73E-23	-1
BCL9L	ENSG00000186174	4540.723	-1.32995	0.118348	-11.2377	2.66E-29	8.26E-28	-1
ZNF618	ENSG00000157657	1386.518	-1.33215	0.12155	-10.9597	5.97E-28	1.70E-26	-1
FZD2	ENSG00000180340	2048.359	-1.34201	0.106161	-12.6413	1.25E-36	5.53E-35	-1
PCTP	ENSG00000141179	917.9701	-1.34642	0.123516	-10.9008	1.14E-27	3.19E-26	-1
COL1A1	ENSG00000108821	10739.09	-1.3492	0.154983	-8.70546	3.16E-18	4.62E-17	-1
RXRA	ENSG00000186350	3001.31	-1.35205	0.075817	-17.8331	3.91E-71	6.09E-69	-1
PLSCR4	ENSG00000114698	467.3028	-1.35453	0.176075	-7.69291	1.44E-14	1.53E-13	-1
MEGF6	ENSG00000162591	12495.05	-1.36018	0.091717	-14.8302	9.34E-50	7.27E-48	-1
ADGRA3	ENSG00000152990	2054.737	-1.38127	0.092361	-14.9551	1.44E-50	1.14E-48	-1
PRR12	ENSG00000126464	1918.292	-1.41981	0.104717	-13.5585	7.06E-42	3.87E-40	-1
CCNG2	ENSG00000138764	3177.465	-1.4271	0.16764	-8.51289	1.70E-17	2.34E-16	-1
TMEM19	ENSG00000139291	1418.122	-1.43012	0.104496	-13.6859	1.23E-42	6.96E-41	-1
CBX2	ENSG00000173894	671.7214	-1.45326	0.123919	-11.7275	9.22E-32	3.21E-30	-1
BAHCC1	ENSG00000266074	3987.724	-1.46169	0.172994	-8.44933	2.93E-17	3.97E-16	-1
WNT5A	ENSG00000114251	1612.961	-1.46496	0.105333	-13.9078	5.68E-44	3.49E-42	-1
JADE2	ENSG00000043143	4853.581	-1.49228	0.090544	-16.4813	5.00E-61	5.89E-59	-1
TP53INP1	ENSG00000164938	1851.715	-1.50762	0.076919	-19.6002	1.54E-85	3.38E-83	-1
CYGB	ENSG00000161544	2506.543	-1.54312	0.13755	-11.2186	3.30E-29	1.01E-27	-1
TCAF1	ENSG00000198420	1114.023	-1.55315	0.100892	-15.3941	1.79E-53	1.57E-51	-1
CTSS	ENSG00000163131	560.3056	-1.57081	0.143754	-10.9271	8.55E-28	2.42E-26	-1
CASTOR2	ENSG00000274070	451.2218	-1.58293	0.141138	-11.2155	3.42E-29	1.04E-27	-1
FAM46A	ENSG00000112773	797.8027	-1.59325	0.117876	-13.5162	1.25E-41	6.80E-40	-1
XKR8	ENSG00000158156	520.5686	-1.61017	0.125248	-12.8559	7.97E-38	3.70E-36	-1
CALHM2	ENSG00000138172	737.4594	-1.62224	0.135857	-11.9408	7.26E-33	2.64E-31	-1
SLC43A2	ENSG00000167703	2659.731	-1.62837	0.092488	-17.6062	2.21E-69	3.28E-67	-1
CYP1B1	ENSG00000138061	20224.42	-1.63091	0.119639	-13.6319	2.59E-42	1.44E-40	-1
KANK1	ENSG00000107104	627.2353	-1.63392	0.139154	-11.7419	7.78E-32	2.73E-30	-1
SIX1	ENSG00000126778	886.3886	-1.63553	0.131856	-12.4039	2.49E-35	1.01E-33	-1

MEGF9	ENSG00000106780	1420.656	-1.69307	0.155331	-10.8998	1.16E-27	3.21E-26	-1
HOXB4	ENSG00000182742	541.5598	-1.70967	0.14468	-11.8169	3.19E-32	1.13E-30	-1
CSF2	ENSG00000164400	1339.427	-1.71174	0.212549	-8.05338	8.05E-16	9.74E-15	-1
XYLT2	ENSG00000015532	2617.624	-1.71884	0.073717	-23.3167	3.00E-120	1.38E-117	-1
RIN2	ENSG00000132669	1055.119	-1.72026	0.125443	-13.7135	8.43E-43	4.87E-41	-1
SAMD9	ENSG00000205413	3586.256	-1.73666	0.115849	-14.9906	8.45E-51	6.85E-49	-1
MEGF8	ENSG00000105429	3354.588	-1.75836	0.144767	-12.1462	6.01E-34	2.30E-32	-1
LYNX1	ENSG00000180155	576.5071	-1.80665	0.123931	-14.5779	3.88E-48	2.78E-46	-1
FAM217B	ENSG00000196227	1135.624	-1.84942	0.117476	-15.7429	7.68E-56	7.56E-54	-1
SKP2	ENSG00000145604	1872.387	-1.90519	0.108792	-17.5123	1.16E-68	1.69E-66	-1
ZNF608	ENSG00000168916	661.8722	-1.90589	0.16303	-11.6905	1.43E-31	4.91E-30	-1
MN1	ENSG00000169184	731.9693	-1.92504	0.176846	-10.8854	1.35E-27	3.73E-26	-1
SERTAD4	ENSG00000082497	729.6648	-2.05011	0.230456	-8.89589	5.80E-19	8.92E-18	-1
TARDBP	ENSG00000120948	9145.08	-2.07872	0.082086	-25.3236	1.75E-141	1.21E-138	-1
BMP4	ENSG00000125378	562.6269	-2.14092	0.171475	-12.4853	8.98E-36	3.78E-34	-1
SAMD9L	ENSG00000177409	3242.959	-2.20826	0.136982	-16.1208	1.82E-58	2.00E-56	-1
IFIT3	ENSG00000119917	5561.517	-2.28436	0.159382	-14.3326	1.37E-46	9.36E-45	-1
MX1	ENSG00000157601	769.9775	-2.30904	0.21489	-10.7452	6.24E-27	1.67E-25	-1
GAS1	ENSG00000180447	587.8617	-2.32972	0.203342	-11.4572	2.16E-30	7.01E-29	-1
OAS1	ENSG00000089127	338.2813	-2.3492	0.269216	-8.72608	2.64E-18	3.87E-17	-1
OAS2	ENSG00000111335	525.9035	-2.59638	0.263269	-9.86206	6.08E-23	1.26E-21	-1
IFIT2	ENSG00000119922	2015.957	-2.68814	0.191233	-14.0569	6.99E-45	4.56E-43	-1
IFIT1	ENSG00000185745	918.1379	-2.76199	0.246818	-11.1904	4.54E-29	1.37E-27	-1
BMF	ENSG00000104081	413.183	-3.11733	0.184405	-16.9048	4.15E-64	5.48E-62	-1
APOL3	ENSG00000128284	810.4988	-3.15564	0.204821	-15.4068	1.47E-53	1.30E-51	-1
DEPP1	ENSG00000165507	504.259	-3.74552	0.148673	-25.193	4.78E-140	3.07E-137	-1