Summary Tectonic Map of the Appalachian–Caledonide Orogen in New England, Atlantic Canada, Ireland, and Britain

showing available detrital zircon and paleomagnetic data.

Supplementary information to accompany

Terrane history of the Iapetus Ocean as preserved in the northern Appalachians and western Caledonides

by John W.F. Waldron, Phil J.A. McCausland, Sandra M. Barr, David I Schofield, Doug Reusch, and Lei Wu

Geological map based on

British Geological Survey, 2007. Bedrock Geology UK, scale 1:625,000.

Hibbard, J.P., van Staal, C.R., Rankin, D.W., Williams, H., 2006. Lithotectonic Map of the Appalachian Orogen, Canada–United States of America. Geological Survey of Canada Map, 2096A, scale 1: 500 000.

McConnell, B., Gatley, S., 2006. Bedrock Geological Map of Ireland, Geological Survey of Ireland, Dublin, scale 1:500,000.

Symbols

Paleopoles

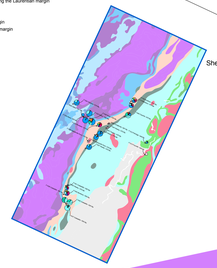
Detrital Zircon Data

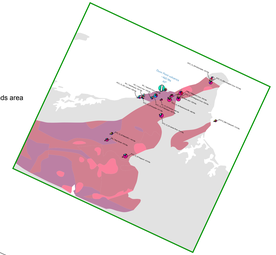
Age
- 0 - 431
- 431 - 458
- 458 - 499
- 499 - 535
- 535 - 1750

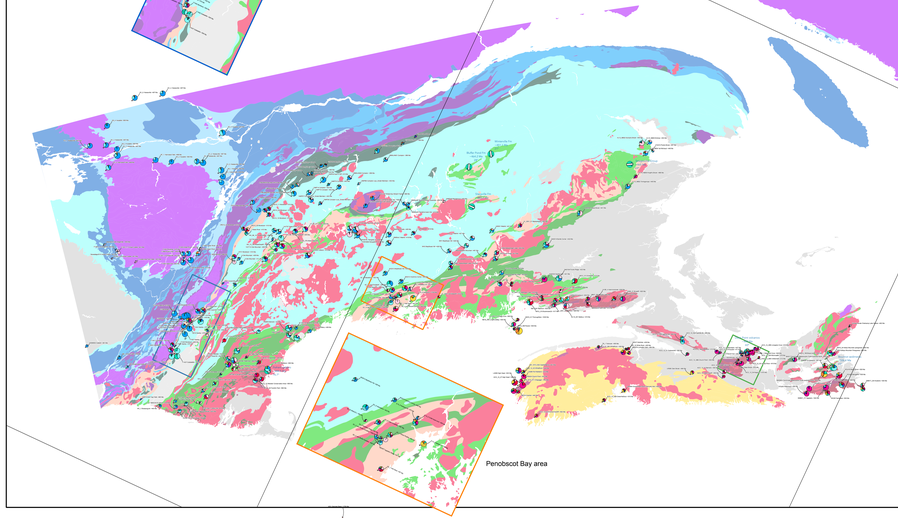
Geology
- Mesozoic and younger rocks
- Rocks formed late in the history of the mountain belt
- Intrusive igneous rocks
- Sedimentary cover of Megumia
- Megumian rocks from Gondwanan margin
- Avalonian shelf
- Arc rocks of Avalonia
- Volcanic arcs and ocean floor emplaced on Laurentian margin
- Rocks deposited on terranes approaching the Laurentian margin
- Accreted volcanic arcs from Ganderia
- Gondwanan basement rocks
- Ganderian rocks from Gondwanan margin
- Rocks formed on the active Laurentian margin
- Taconian foreland basin
- Laurentian slope
- Laurentian shelf
- Laurentian rift
- Laurentian basement

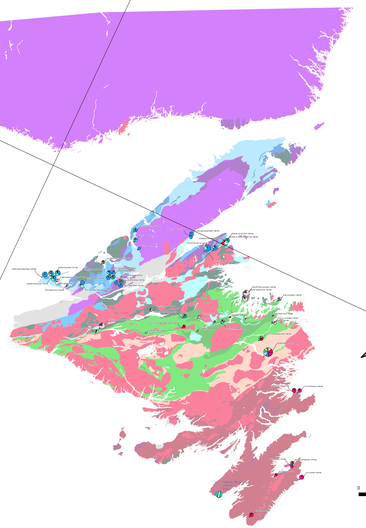
Pie Charts
- 0
- 541
- 600
- 700
- 900
- 1200
- 1600
- 1850
- 2200
- 2500
- 2800
- 3200
- 3600

250
200
150
100
50









0 250 500 km

List of sources for detrital zircon data

Allen, J.R., 2009. Stratigraphic Reconnaissance of the St. Croix Formation, Western New Brunswick (NTS 21G/11). University of Guelph, Ontario, Canada, Unpublished Report to the New Brunswick Department of Natural Resources, 21 p. Appendix 1 p. 1-2 (Appendix 1 p. 1 data from Barr et al., 2007, Appendix 1 p. 2 data from Barr et al., 2008).

Amenomiya, H., Tagiri, M., Tajika, J., Sakuma, S., Asahi, H., Ishiga, H., Matsumoto, R., Hinata, T., Nagao, T., Wrighley, D.C., 2017. Geochronological and stable isotopic studies on the Cambro-Ordovician Ninmaha Formation, Ireland: Implications for the carbonate excursions in Iapetus. Geological Society of London, Special Publications, 448, 1-19. doi:10.1144/SP448.10.

Amenomiya, H., Tagiri, M., Tajika, J., Sakuma, S., Asahi, H., Ishiga, H., Matsumoto, R., Hinata, T., Nagao, T., Wrighley, D.C., 2017. Geochronological and stable isotopic studies on the Cambro-Ordovician Ninmaha Formation, Ireland: Implications for the carbonate excursions in Iapetus. Geological Society of London, Special Publications, 448, 1-19. doi:10.1144/SP448.10.

Bahlburg, H., Fuchs, S., Meinhold, G., Fanning, C.M., 2009. Provenance of the Southern Gondwanan margin in the Cambrian: Detrital zircon ages and Hf isotopes in Ordovician and Cambrian sedimentary rocks, New Brunswick and Nova Scotia, Canada. Gondwana Research, 16, 98–109. doi:10.1016/j.gr.2008.12.002.

Barr, S.M., White, C.E., Jenner, G.M., McNicoll, V.J., van Staal, C.R., 2014. Ordovician and Devonian ages of granites in Eastern Avalonia from detrital zircon geochronology: Implications for the Acadian orogeny in southern New Brunswick, Canada. Canadian Journal of Earth Sciences, 51, 1–18. doi:10.1139/cjes-2013-0212.

Barr, S.M., van Staal, C.R., McNicoll, V.J., White, C.E., Jenner, G.C., 2007. Detrital zircon ages and Hf isotopes of Paleozoic and Precambrian rocks in the Caribou terrane, northern New Brunswick, Canada: Implications for Iapetan tectonics. Canadian Journal of Earth Sciences, 44, 1751–1775. doi:10.1139/e07-044.

Barr, S.M., White, C.E., Jenner, G.C., Fyffe, L.R., 2008. Detrital zircon ages and Hf isotopes in Ordovician and Silurian rocks, Aroostook County, Northern Maine, Central New Brunswick, and Northern Nova Scotia, Canada. Atlantic Geology, 44, 217–239. doi:10.4138/atlgeol.2008.013.

Cawood, P.A., Nemchin, A.A., 2000. Provenance record of Laurentian passive margin, Maine Appalachians. Basin Res. 12, 197–210. doi:10.1046/j.1365-2117.2000.00117.x.

Cawood, P.A., Nemchin, A.A., 2001. Paleogeographic context of the Laurentian margin, Dalradian Basin, Scotland. Geological Magazine, 138, 413–432. doi:10.1017/S0016756801005069.

Cawood, P.A., Nemchin, A.A., Strachan, R.A., Prave, A.R., Krabbendam, M., 2007. Sedimentary provenance record in response to Scandian collision, Caledonides of northern Britain. Journal of the Geological Society, London, 164, 351–363. doi:10.1144/0016-76492006-085.

Cawood, P.A., Strachan, R.A., Cliff, R.A., Prave, A.R., Fetes, D.J., 2010. Structural, stratigraphic and U-Pb dating of detrital zircon and metamorphic age constraints, Grampian Terrane, Scottish Caledonides. Geological Magazine, 147, 465–474.

Cawood, P.A., Strachan, R.A., Smith, M., Leslie, A., 2003. Sources of the Dalradian Supergroup constrained by U-Pb dating of detrital zircon and implications for the evolution of Iapetus, Scottish Caledonides. Geological Magazine, 140, 643–651.

Cawood, P.A., Strachan, R.A., Krabbendam, M., Prave, A.R., 2012. Tectonostratigraphy of the Grampian Terrane, Scottish Caledonides: Implications for Iapetus closure. Geological Magazine, 149, 1–20. doi:10.1017/S0016756811000665.

Chen, Y.-D., Liu, X., van Staal, C.R., 2009. Detrital zircon geochronology of a conglomerate in the northeastern Cape Breton Highlands: implications for the Silurian–Devonian tectonic evolution of the northern Canadian Appalachians. Geol. Mag. 146, 1–14. doi:10.1017/S0016756808005293.

Cliff, P.D., Colpo, G., Dunay, R.E., Long, D.G.F., 2010. Silurian, Devon. Pp. 2009. Stratigraphy of Devonian Outcrops in the Cape Breton Highlands, Cape Breton Island, Nova Scotia. Geological Survey of Canada, Open File 6616, 1 CD-ROM.

Dallmeyer, R.D., 1975. Chronology and origin of the Nashoba Thrust Sheet, Massachusetts. Geol. Soc. Am. Bull. 86, 1–12.

Dallmeyer, R.D., 1981. Tectonostratigraphic and tectonometamorphic relationships of the southeastern Quebec orogen: Northern Appalachians. Can. J. Earth Sci. 18, 1–12. doi:10.1139/e81-001.

Dallmeyer, R.D., 1982. Tectonostratigraphic and tectonometamorphic relationships of the southeastern Quebec orogen: Northern Appalachians. Can. J. Earth Sci. 19, 1–12. doi:10.1139/e82-001.

Dunay, R.E., Macdonald, R.W.J., Fanning, C.M., 2009. Geochronology of the Pembroke Complex, Southern New Brunswick (NTS 21G/11). Geological Survey of Canada, Open File 6616, 1 CD-ROM.

Dunay, R.E., Macdonald, R.W.J., Fanning, C.M., 2009. Age-Dating of Devonian Outcrops in the Cape Breton Highlands, Cape Breton Island, Nova Scotia. Geological Survey of Canada, Open File 6616, 1 CD-ROM.

Eckelmann, K.M., Barr, S.M., Fanning, C.M., 2014. Detrital zircon ages and Hf isotopes of the Neoproterozoic Rose Brook Formation, Avalon terrane, southeastern Massachusetts, USA. Canadian Journal of Earth Sciences, 51, 1–12. doi:10.1139/cjes-2013-0164.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2014. Detrital zircon ages and Hf isotopes in the Neoproterozoic Dedham Granite and Boston Bay Group, Avalon terrane, eastern Massachusetts, USA. Canadian Journal of Earth Sciences, 51, 1–12. doi:10.1139/cjes-2013-0163.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2015. Detrital zircon ages and Hf isotopes in the Neoproterozoic Marlboro Formation, Avalon terrane, southeastern Massachusetts, USA. Canadian Journal of Earth Sciences, 52, 1–12. doi:10.1139/cjes-2014-0163.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2015. Detrital zircon ages and Hf isotopes in the Neoproterozoic Westerly Granite and Plainfield Formation, Avalon terrane, southeastern Massachusetts, USA. Canadian Journal of Earth Sciences, 52, 1–12. doi:10.1139/cjes-2014-0164.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2016. Detrital zircon ages and Hf isotopes in the Neoproterozoic Tyngsboro Granite, Avalon terrane, southeastern Massachusetts, USA. Canadian Journal of Earth Sciences, 53, 1–12. doi:10.1139/cjes-2015-0164.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2017. Detrital zircon ages and Hf isotopes in the Neoproterozoic Nashoba Formation, Avalon terrane, southeastern Massachusetts, USA. Canadian Journal of Earth Sciences, 54, 1–12. doi:10.1139/cjes-2016-0164.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2017. Detrital zircon ages and Hf isotopes in the Neoproterozoic Milford Pond Formation, Avalon terrane, southeastern Massachusetts, USA. Canadian Journal of Earth Sciences, 54, 1–12. doi:10.1139/cjes-2016-0165.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2017. Detrital zircon ages and Hf isotopes in the Neoproterozoic Dedham Granite and Boston Bay Group, Avalon terrane, eastern Massachusetts, USA. Canadian Journal of Earth Sciences, 54, 1–12. doi:10.1139/cjes-2016-0163.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2018. Detrital zircon ages and Hf isotopes in the Neoproterozoic Marlboro Formation, Avalon terrane, southeastern Massachusetts, USA. Canadian Journal of Earth Sciences, 55, 1–12. doi:10.1139/cjes-2017-0164.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2018. Detrital zircon ages and Hf isotopes in the Neoproterozoic Westerly Granite and Plainfield Formation, Avalon terrane, southeastern Massachusetts, USA. Canadian Journal of Earth Sciences, 55, 1–12. doi:10.1139/cjes-2017-0165.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2018. Detrital zircon ages and Hf isotopes in the Neoproterozoic Tyngsboro Granite, Avalon terrane, southeastern Massachusetts, USA. Canadian Journal of Earth Sciences, 55, 1–12. doi:10.1139/cjes-2017-0166.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2019. Detrital zircon ages and Hf isotopes in the Neoproterozoic Nashoba Formation, Avalon terrane, southeastern Massachusetts, USA. Canadian Journal of Earth Sciences, 56, 1–12. doi:10.1139/cjes-2017-0167.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2019. Detrital zircon ages and Hf isotopes in the Neoproterozoic Milford Pond Formation, Avalon terrane, southeastern Massachusetts, USA. Canadian Journal of Earth Sciences, 56, 1–12. doi:10.1139/cjes-2017-0168.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2020. Detrital zircon ages and Hf isotopes in the Neoproterozoic Dedham Granite and Boston Bay Group, Avalon terrane, eastern Massachusetts, USA. Canadian Journal of Earth Sciences, 57, 1–12. doi:10.1139/cjes-2018-0169.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2020. Detrital zircon ages and Hf isotopes in the Neoproterozoic Marlboro Formation, Avalon terrane, southeastern Massachusetts, USA. Canadian Journal of Earth Sciences, 57, 1–12. doi:10.1139/cjes-2018-0170.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2020. Detrital zircon ages and Hf isotopes in the Neoproterozoic Westerly Granite and Plainfield Formation, Avalon terrane, southeastern Massachusetts, USA. Canadian Journal of Earth Sciences, 57, 1–12. doi:10.1139/cjes-2018-0171.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2020. Detrital zircon ages and Hf isotopes in the Neoproterozoic Tyngsboro Granite, Avalon terrane, southeastern Massachusetts, USA. Canadian Journal of Earth Sciences, 57, 1–12. doi:10.1139/cjes-2018-0172.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2020. Detrital zircon ages and Hf isotopes in the Neoproterozoic Nashoba Formation, Avalon terrane, southeastern Massachusetts, USA. Canadian Journal of Earth Sciences, 57, 1–12. doi:10.1139/cjes-2018-0173.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2020. Detrital zircon ages and Hf isotopes in the Neoproterozoic Milford Pond Formation, Avalon terrane, southeastern Massachusetts, USA. Canadian Journal of Earth Sciences, 57, 1–12. doi:10.1139/cjes-2018-0174.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2021. Detrital zircon ages and Hf isotopes in the Neoproterozoic Dedham Granite and Boston Bay Group, Avalon terrane, eastern Massachusetts, USA. Canadian Journal of Earth Sciences, 58, 1–12. doi:10.1139/cjes-2019-0175.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2021. Detrital zircon ages and Hf isotopes in the Neoproterozoic Marlboro Formation, Avalon terrane, southeastern Massachusetts, USA. Canadian Journal of Earth Sciences, 58, 1–12. doi:10.1139/cjes-2019-0176.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2021. Detrital zircon ages and Hf isotopes in the Neoproterozoic Westerly Granite and Plainfield Formation, Avalon terrane, southeastern Massachusetts, USA. Canadian Journal of Earth Sciences, 58, 1–12. doi:10.1139/cjes-2019-0177.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2021. Detrital zircon ages and Hf isotopes in the Neoproterozoic Tyngsboro Granite, Avalon terrane, southeastern Massachusetts, USA. Canadian Journal of Earth Sciences, 58, 1–12. doi:10.1139/cjes-2019-0178.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2021. Detrital zircon ages and Hf isotopes in the Neoproterozoic Nashoba Formation, Avalon terrane, southeastern Massachusetts, USA. Canadian Journal of Earth Sciences, 58, 1–12. doi:10.1139/cjes-2019-0179.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2021. Detrital zircon ages and Hf isotopes in the Neoproterozoic Milford Pond Formation, Avalon terrane, southeastern Massachusetts, USA. Canadian Journal of Earth Sciences, 58, 1–12. doi:10.1139/cjes-2019-0180.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2021. Detrital zircon ages and Hf isotopes in the Neoproterozoic Dedham Granite and Boston Bay Group, Avalon terrane, eastern Massachusetts, USA. Canadian Journal of Earth Sciences, 58, 1–12. doi:10.1139/cjes-2019-0181.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2021. Detrital zircon ages and Hf isotopes in the Neoproterozoic Marlboro Formation, Avalon terrane, southeastern Massachusetts, USA. Canadian Journal of Earth Sciences, 58, 1–12. doi:10.1139/cjes-2019-0182.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2021. Detrital zircon ages and Hf isotopes in the Neoproterozoic Westerly Granite and Plainfield Formation, Avalon terrane, southeastern Massachusetts, USA. Canadian Journal of Earth Sciences, 58, 1–12. doi:10.1139/cjes-2019-0183.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2021. Detrital zircon ages and Hf isotopes in the Neoproterozoic Tyngsboro Granite, Avalon terrane, southeastern Massachusetts, USA. Canadian Journal of Earth Sciences, 58, 1–12. doi:10.1139/cjes-2019-0184.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2021. Detrital zircon ages and Hf isotopes in the Neoproterozoic Nashoba Formation, Avalon terrane, southeastern Massachusetts, USA. Canadian Journal of Earth Sciences, 58, 1–12. doi:10.1139/cjes-2019-0185.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2021. Detrital zircon ages and Hf isotopes in the Neoproterozoic Milford Pond Formation, Avalon terrane, southeastern Massachusetts, USA. Canadian Journal of Earth Sciences, 58, 1–12. doi:10.1139/cjes-2019-0186.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2021. Detrital zircon ages and Hf isotopes in the Neoproterozoic Dedham Granite and Boston Bay Group, Avalon terrane, eastern Massachusetts, USA. Canadian Journal of Earth Sciences, 58, 1–12. doi:10.1139/cjes-2019-0187.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2021. Detrital zircon ages and Hf isotopes in the Neoproterozoic Marlboro Formation, Avalon terrane, southeastern Massachusetts, USA. Canadian Journal of Earth Sciences, 58, 1–12. doi:10.1139/cjes-2019-0188.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2021. Detrital zircon ages and Hf isotopes in the Neoproterozoic Westerly Granite and Plainfield Formation, Avalon terrane, southeastern Massachusetts, USA. Canadian Journal of Earth Sciences, 58, 1–12. doi:10.1139/cjes-2019-0189.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2021. Detrital zircon ages and Hf isotopes in the Neoproterozoic Tyngsboro Granite, Avalon terrane, southeastern Massachusetts, USA. Canadian Journal of Earth Sciences, 58, 1–12. doi:10.1139/cjes-2019-0190.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2021. Detrital zircon ages and Hf isotopes in the Neoproterozoic Nashoba Formation, Avalon terrane, southeastern Massachusetts, USA. Canadian Journal of Earth Sciences, 58, 1–12. doi:10.1139/cjes-2019-0191.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2021. Detrital zircon ages and Hf isotopes in the Neoproterozoic Milford Pond Formation, Avalon terrane, southeastern Massachusetts, USA. Canadian Journal of Earth Sciences, 58, 1–12. doi:10.1139/cjes-2019-0192.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2021. Detrital zircon ages and Hf isotopes in the Neoproterozoic Dedham Granite and Boston Bay Group, Avalon terrane, eastern Massachusetts, USA. Canadian Journal of Earth Sciences, 58, 1–12. doi:10.1139/cjes-2019-0193.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2021. Detrital zircon ages and Hf isotopes in the Neoproterozoic Marlboro Formation, Avalon terrane, southeastern Massachusetts, USA. Canadian Journal of Earth Sciences, 58, 1–12. doi:10.1139/cjes-2019-0194.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2021. Detrital zircon ages and Hf isotopes in the Neoproterozoic Westerly Granite and Plainfield Formation, Avalon terrane, southeastern Massachusetts, USA. Canadian Journal of Earth Sciences, 58, 1–12. doi:10.1139/cjes-2019-0195.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2021. Detrital zircon ages and Hf isotopes in the Neoproterozoic Tyngsboro Granite, Avalon terrane, southeastern Massachusetts, USA. Canadian Journal of Earth Sciences, 58, 1–12. doi:10.1139/cjes-2019-0196.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2021. Detrital zircon ages and Hf isotopes in the Neoproterozoic Nashoba Formation, Avalon terrane, southeastern Massachusetts, USA. Canadian Journal of Earth Sciences, 58, 1–12. doi:10.1139/cjes-2019-0197.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2021. Detrital zircon ages and Hf isotopes in the Neoproterozoic Milford Pond Formation, Avalon terrane, southeastern Massachusetts, USA. Canadian Journal of Earth Sciences, 58, 1–12. doi:10.1139/cjes-2019-0198.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2021. Detrital zircon ages and Hf isotopes in the Neoproterozoic Dedham Granite and Boston Bay Group, Avalon terrane, eastern Massachusetts, USA. Canadian Journal of Earth Sciences, 58, 1–12. doi:10.1139/cjes-2019-0199.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2021. Detrital zircon ages and Hf isotopes in the Neoproterozoic Marlboro Formation, Avalon terrane, southeastern Massachusetts, USA. Canadian Journal of Earth Sciences, 58, 1–12. doi:10.1139/cjes-2019-0200.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2021. Detrital zircon ages and Hf isotopes in the Neoproterozoic Westerly Granite and Plainfield Formation, Avalon terrane, southeastern Massachusetts, USA. Canadian Journal of Earth Sciences, 58, 1–12. doi:10.1139/cjes-2019-0201.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2021. Detrital zircon ages and Hf isotopes in the Neoproterozoic Tyngsboro Granite, Avalon terrane, southeastern Massachusetts, USA. Canadian Journal of Earth Sciences, 58, 1–12. doi:10.1139/cjes-2019-0202.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2021. Detrital zircon ages and Hf isotopes in the Neoproterozoic Nashoba Formation, Avalon terrane, southeastern Massachusetts, USA. Canadian Journal of Earth Sciences, 58, 1–12. doi:10.1139/cjes-2019-0203.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2021. Detrital zircon ages and Hf isotopes in the Neoproterozoic Milford Pond Formation, Avalon terrane, southeastern Massachusetts, USA. Canadian Journal of Earth Sciences, 58, 1–12. doi:10.1139/cjes-2019-0204.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2021. Detrital zircon ages and Hf isotopes in the Neoproterozoic Dedham Granite and Boston Bay Group, Avalon terrane, eastern Massachusetts, USA. Canadian Journal of Earth Sciences, 58, 1–12. doi:10.1139/cjes-2019-0205.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2021. Detrital zircon ages and Hf isotopes in the Neoproterozoic Marlboro Formation, Avalon terrane, southeastern Massachusetts, USA. Canadian Journal of Earth Sciences, 58, 1–12. doi:10.1139/cjes-2019-0206.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2021. Detrital zircon ages and Hf isotopes in the Neoproterozoic Westerly Granite and Plainfield Formation, Avalon terrane, southeastern Massachusetts, USA. Canadian Journal of Earth Sciences, 58, 1–12. doi:10.1139/cjes-2019-0207.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2021. Detrital zircon ages and Hf isotopes in the Neoproterozoic Tyngsboro Granite, Avalon terrane, southeastern Massachusetts, USA. Canadian Journal of Earth Sciences, 58, 1–12. doi:10.1139/cjes-2019-0208.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2021. Detrital zircon ages and Hf isotopes in the Neoproterozoic Nashoba Formation, Avalon terrane, southeastern Massachusetts, USA. Canadian Journal of Earth Sciences, 58, 1–12. doi:10.1139/cjes-2019-0209.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2021. Detrital zircon ages and Hf isotopes in the Neoproterozoic Milford Pond Formation, Avalon terrane, southeastern Massachusetts, USA. Canadian Journal of Earth Sciences, 58, 1–12. doi:10.1139/cjes-2019-0210.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2021. Detrital zircon ages and Hf isotopes in the Neoproterozoic Dedham Granite and Boston Bay Group, Avalon terrane, eastern Massachusetts, USA. Canadian Journal of Earth Sciences, 58, 1–12. doi:10.1139/cjes-2019-0211.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2021. Detrital zircon ages and Hf isotopes in the Neoproterozoic Marlboro Formation, Avalon terrane, southeastern Massachusetts, USA. Canadian Journal of Earth Sciences, 58, 1–12. doi:10.1139/cjes-2019-0212.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2021. Detrital zircon ages and Hf isotopes in the Neoproterozoic Westerly Granite and Plainfield Formation, Avalon terrane, southeastern Massachusetts, USA. Canadian Journal of Earth Sciences, 58, 1–12. doi:10.1139/cjes-2019-0213.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2021. Detrital zircon ages and Hf isotopes in the Neoproterozoic Tyngsboro Granite, Avalon terrane, southeastern Massachusetts, USA. Canadian Journal of Earth Sciences, 58, 1–12. doi:10.1139/cjes-2019-0214.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2021. Detrital zircon ages and Hf isotopes in the Neoproterozoic Nashoba Formation, Avalon terrane, southeastern Massachusetts, USA. Canadian Journal of Earth Sciences, 58, 1–12. doi:10.1139/cjes-2019-0215.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2021. Detrital zircon ages and Hf isotopes in the Neoproterozoic Milford Pond Formation, Avalon terrane, southeastern Massachusetts, USA. Canadian Journal of Earth Sciences, 58, 1–12. doi:10.1139/cjes-2019-0216.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2021. Detrital zircon ages and Hf isotopes in the Neoproterozoic Dedham Granite and Boston Bay Group, Avalon terrane, eastern Massachusetts, USA. Canadian Journal of Earth Sciences, 58, 1–12. doi:10.1139/cjes-2019-0217.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2021. Detrital zircon ages and Hf isotopes in the Neoproterozoic Marlboro Formation, Avalon terrane, southeastern Massachusetts, USA. Canadian Journal of Earth Sciences, 58, 1–12. doi:10.1139/cjes-2019-0218.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2021. Detrital zircon ages and Hf isotopes in the Neoproterozoic Westerly Granite and Plainfield Formation, Avalon terrane, southeastern Massachusetts, USA. Canadian Journal of Earth Sciences, 58, 1–12. doi:10.1139/cjes-2019-0219.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2021. Detrital zircon ages and Hf isotopes in the Neoproterozoic Tyngsboro Granite, Avalon terrane, southeastern Massachusetts, USA. Canadian Journal of Earth Sciences, 58, 1–12. doi:10.1139/cjes-2019-0220.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2021. Detrital zircon ages and Hf isotopes in the Neoproterozoic Nashoba Formation, Avalon terrane, southeastern Massachusetts, USA. Canadian Journal of Earth Sciences, 58, 1–12. doi:10.1139/cjes-2019-0221.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2021. Detrital zircon ages and Hf isotopes in the Neoproterozoic Milford Pond Formation, Avalon terrane, southeastern Massachusetts, USA. Canadian Journal of Earth Sciences, 58, 1–12. doi:10.1139/cjes-2019-0222.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2021. Detrital zircon ages and Hf isotopes in the Neoproterozoic Dedham Granite and Boston Bay Group, Avalon terrane, eastern Massachusetts, USA. Canadian Journal of Earth Sciences, 58, 1–12. doi:10.1139/cjes-2019-0223.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2021. Detrital zircon ages and Hf isotopes in the Neoproterozoic Marlboro Formation, Avalon terrane, southeastern Massachusetts, USA. Canadian Journal of Earth Sciences, 58, 1–12. doi:10.1139/cjes-2019-0224.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2021. Detrital zircon ages and Hf isotopes in the Neoproterozoic Westerly Granite and Plainfield Formation, Avalon terrane, southeastern Massachusetts, USA. Canadian Journal of Earth Sciences, 58, 1–12. doi:10.1139/cjes-2019-0225.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2021. Detrital zircon ages and Hf isotopes in the Neoproterozoic Tyngsboro Granite, Avalon terrane, southeastern Massachusetts, USA. Canadian Journal of Earth Sciences, 58, 1–12. doi:10.1139/cjes-2019-0226.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2021. Detrital zircon ages and Hf isotopes in the Neoproterozoic Nashoba Formation, Avalon terrane, southeastern Massachusetts, USA. Canadian Journal of Earth Sciences, 58, 1–12. doi:10.1139/cjes-2019-0227.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2021. Detrital zircon ages and Hf isotopes in the Neoproterozoic Milford Pond Formation, Avalon terrane, southeastern Massachusetts, USA. Canadian Journal of Earth Sciences, 58, 1–12. doi:10.1139/cjes-2019-0228.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2021. Detrital zircon ages and Hf isotopes in the Neoproterozoic Dedham Granite and Boston Bay Group, Avalon terrane, eastern Massachusetts, USA. Canadian Journal of Earth Sciences, 58, 1–12. doi:10.1139/cjes-2019-0229.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2021. Detrital zircon ages and Hf isotopes in the Neoproterozoic Marlboro Formation, Avalon terrane, southeastern Massachusetts, USA. Canadian Journal of Earth Sciences, 58, 1–12. doi:10.1139/cjes-2019-0230.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2021. Detrital zircon ages and Hf isotopes in the Neoproterozoic Westerly Granite and Plainfield Formation, Avalon terrane, southeastern Massachusetts, USA. Canadian Journal of Earth Sciences, 58, 1–12. doi:10.1139/cjes-2019-0231.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2021. Detrital zircon ages and Hf isotopes in the Neoproterozoic Tyngsboro Granite, Avalon terrane, southeastern Massachusetts, USA. Canadian Journal of Earth Sciences, 58, 1–12. doi:10.1139/cjes-2019-0232.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2021. Detrital zircon ages and Hf isotopes in the Neoproterozoic Nashoba Formation, Avalon terrane, southeastern Massachusetts, USA. Canadian Journal of Earth Sciences, 58, 1–12. doi:10.1139/cjes-2019-0233.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2021. Detrital zircon ages and Hf isotopes in the Neoproterozoic Milford Pond Formation, Avalon terrane, southeastern Massachusetts, USA. Canadian Journal of Earth Sciences, 58, 1–12. doi:10.1139/cjes-2019-0234.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2021. Detrital zircon ages and Hf isotopes in the Neoproterozoic Dedham Granite and Boston Bay Group, Avalon terrane, eastern Massachusetts, USA. Canadian Journal of Earth Sciences, 58, 1–12. doi:10.1139/cjes-2019-0235.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2021. Detrital zircon ages and Hf isotopes in the Neoproterozoic Marlboro Formation, Avalon terrane, southeastern Massachusetts, USA. Canadian Journal of Earth Sciences, 58, 1–12. doi:10.1139/cjes-2019-0236.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2021. Detrital zircon ages and Hf isotopes in the Neoproterozoic Westerly Granite and Plainfield Formation, Avalon terrane, southeastern Massachusetts, USA. Canadian Journal of Earth Sciences, 58, 1–12. doi:10.1139/cjes-2019-0237.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2021. Detrital zircon ages and Hf isotopes in the Neoproterozoic Tyngsboro Granite, Avalon terrane, southeastern Massachusetts, USA. Canadian Journal of Earth Sciences, 58, 1–12. doi:10.1139/cjes-2019-0238.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2021. Detrital zircon ages and Hf isotopes in the Neoproterozoic Nashoba Formation, Avalon terrane, southeastern Massachusetts, USA. Canadian Journal of Earth Sciences, 58, 1–12. doi:10.1139/cjes-2019-0239.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2021. Detrital zircon ages and Hf isotopes in the Neoproterozoic Milford Pond Formation, Avalon terrane, southeastern Massachusetts, USA. Canadian Journal of Earth Sciences, 58, 1–12. doi:10.1139/cjes-2019-0240.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2021. Detrital zircon ages and Hf isotopes in the Neoproterozoic Dedham Granite and Boston Bay Group, Avalon terrane, eastern Massachusetts, USA. Canadian Journal of Earth Sciences, 58, 1–12. doi:10.1139/cjes-2019-0241.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2021. Detrital zircon ages and Hf isotopes in the Neoproterozoic Marlboro Formation, Avalon terrane, southeastern Massachusetts, USA. Canadian Journal of Earth Sciences, 58, 1–12. doi:10.1139/cjes-2019-0242.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2021. Detrital zircon ages and Hf isotopes in the Neoproterozoic Westerly Granite and Plainfield Formation, Avalon terrane, southeastern Massachusetts, USA. Canadian Journal of Earth Sciences, 58, 1–12. doi:10.1139/cjes-2019-0243.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2021. Detrital zircon ages and Hf isotopes in the Neoproterozoic Tyngsboro Granite, Avalon terrane, southeastern Massachusetts, USA. Canadian Journal of Earth Sciences, 58, 1–12. doi:10.1139/cjes-2019-0244.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2021. Detrital zircon ages and Hf isotopes in the Neoproterozoic Nashoba Formation, Avalon terrane, southeastern Massachusetts, USA. Canadian Journal of Earth Sciences, 58, 1–12. doi:10.1139/cjes-2019-0245.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2021. Detrital zircon ages and Hf isotopes in the Neoproterozoic Milford Pond Formation, Avalon terrane, southeastern Massachusetts, USA. Canadian Journal of Earth Sciences, 58, 1–12. doi:10.1139/cjes-2019-0246.

Eckelmann, K., Barr, S.M., Fanning, C.M., 2021. Detrital zircon ages and Hf isotopes in the Neoproterozoic Dedham Granite and Boston Bay Group, Avalon terrane, eastern Massachusetts, USA. Canadian Journal of Earth Sciences, 58, 1–12. doi:10.1139/cjes-2019-0247.

Eckelmann, K., Barr, S.M., Fanning, C.M.,