# Toward understanding the pre-Carboniferous geological evolution of the Cobequid Highlands, Nova Scotia, Canada: constraints from U–Pb (zircon) geochronology and geochemistry

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Detailed 1:10 000-scale bedrock mapping in the Cobequid Highlands was initiated in 2010 by the Nova Scotia Department of Energy and Mines to follow-up on known and recently discovered rare-earth-element mineralization and gold anomalies. The new mapping, combined with U– Pb zircon geochronology and chemical data, shows that the oldest rocks in the highlands are mafic metavolcanic rocks interbedded with quartzite, metawacke, and minor marble and ironstone located in the faulted-bounded Bass River block along the southern margin of the highlands. Sections dominated by mafic metavolcanic rocks have traditionally been termed the Folly River Formation and sections dominated by metasedimentary rocks are assigned to the Gamble Brook Formation, but the rocks are locally interbedded and interpreted to be of similar age. The age is constrained by detrital zircons to be less than about 1 Ga and by U–Pb zircon from cross-cutting plutons to be more than about 750 Ma. The mafic volcanic rocks have chemical characteristics of continental tholeiite with εNd(t) values of +4.6 to +7.1. Associated gabbroic bodies are also MORB-like with εNd(t) of +6.9 to +7.7. These rocks may have formed in the Early Neoproterozoic during the breakup of the Rodinian supercontinent. Cross-cutting plutons of the ca. 765–735 Ma Mount Ephraim Plutonic Suite consist of calcalkaline gabbro/diorite to granite that show more evolved εNd(t) values of +0.2 to +1.7. They indicate the initiation of subduction along the margin of Rodinia or a Rodinian microcontinental fragment, probably Avalonia. The most extensive Neoproterozoic units in both the Bass River block and the Jeffers block to the north are calc-alkalic, arc-related volcanic and plutonic rocks with more typical Avalonian ages of 640 Ma to 585 Ma and εNd(t) values between -1.5 and +3.7. Many of the dated samples also contain a significant inherited ca. 680–650 Ma zircon component, suggesting the existence of older volcanic/plutonic rocks similar in age to the Stirling belt in Cape Breton Island. The ca. 610–585 Ma ages are similar to those from Avalonian volcanic and plutonic rocks in the Antigonish Highlands to the east and in the Boston area. Small bodies of within-plate syenite to alkali-feldspar granite and gabbro along the southern margin of the highlands yielded zircon ages of 482–480 Ma, slightly older than similar Ordovician plutonic units in the Antigonish Highlands. Fossiliferous sedimentary rocks of the Silurian Wilson Brook Formation unconformably overlie the older rocks of the Cobequid Highlands and are similar to the Arisaig Group in the Antigonish Highlands.

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