

New field mapping, U-Pb zircon geochronology, and geochemistry from the Cobequid Highlands, Nova Scotia, Canada: insights into the Late Neoproterozoic magmatic history of Avalonia

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The Cobequid Highlands of central mainland Nova Scotia form part of Avalonia, a lithotectonic terrane of the northeastern Appalachian orogen situated inboard of Meguma and outboard of Ganderia. New field mapping, U-Pb zircon geochronology, and geochemical data obtained with the highlands indicate that it contains a significant and in part unique record of Late Neoproterozoic magmatism. Currently three distinct Late Neoproterozoic magmatic events are recognized. The oldest, >750 Ma, is comprised of mafic volcanic and volcanoclastic rocks interbedded with orthoquartzite and iron formation. This assemblage is interpreted to have formed on the continental margin of Rodinia via decompression melting of upwelling heterogeneous mantle. Intruding this platformal assemblage is a suite of calc-alkaline intrusive rocks ranging in composition from gabbro to granite. This suite was emplaced between ca. 735–765 Ma and is interpreted to represent the root of a continental margin volcanic arc, perhaps recording the initiation of subduction along the margin of Rodinia related to its eventual breakup. Until recently, this crust was only well-documented within the southeastern highlands. A new ca. 740 Ma U-Pb zircon age for a sub-volcanic porphyry within the central highlands indicates that this crust is significantly more widespread and voluminous than originally thought and that the supracrustal equivalents ca. 735–765 Ma intrusive suite are probably also preserved within the highlands. The youngest and most voluminous Late Neoproterozoic magmatic event is well-represented in terms of both its intrusive and volcanic and volcanoclastic rock record, spanning the period between ca. 590–640 Ma. These rocks range in composition from gabbro-granite (basalt-rhyolite) and most samples (but not all) possess geochemical characteristics consistent with generation within a continental margin volcanic arc setting. This younger magmatic event is well-recognized in other parts of Avalonia within the northeastern Appalachians, the earlier two are not. The potential for discovery of a fourth Late Neoproterozoic volcanic assemblage within the Cobequid Highlands is suggested from the locally significant ca. 650–680 Ma inheritance in ca. 590–640 Ma volcanic and plutonic rocks. Some yet undated (zircon-poor) volcanic rocks in the central highlands (proximal to the most inheritance-rich rocks) possess geochemical similarities to some of the volcanic rocks of the ca. 680 Ma Stirling belt of southeast Cape Breton Island. Abundant Meso- to Latest Paleoproterozoic zircon found within ca. 590–600 Ma volcanoclastic/epiclastic rocks and >750 Ma orthoquartzite may be remnants of the Avalonian basement.