# Middle Proterozoic evolution of the eastern Grenville Province and Grenvillian-Sveconorwegian orogenesis

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There have been five principal developments in the understanding of the eastern Grenville Province in the last decade: (i) the recognition of a major magmatic and orogenic event between 1710 and 1620 Ma, that includes Trans-Labradorian magmatism and the Labradorian orogeny, (ii) greater knowledge of the extent of Middle Proterozoic anorogenic magmatism, (iii) the recognition of Grenvillian plutonism, (iv) the identification of distinct crustal segments (lithotectonic terranes) that achieved their final configuration during the Grenvillian orogeny, and (v) the refinement of Middle Proterozoic intercontinental correlations between Laurentia and Baltica, and the accompanying development of craton-scale tectonic models.

Although extending from 1710 Ma to 1620 Ma, the Labradorian orogeny culminated between 1680 and 1640 Ma, resulting in the formation of extensive new crust south of the previously stabilized Archean-Lower Proterozoic cratons. Large volumes of granitoid plutonic rocks and layered mafic to anorthositic intrusions were emplaced into widespread, dominantly pelitic metasedimentary rocks that were formed adjacent to an older cratonic margin to the north. All rocks were subsequently metamorphosed to high-grade assemblages during Labradorian orogenesis. The northern region of granitoid plutonism, marginal to and within the Grenville Province, has been referred to as the Trans-Labrador batholith, but plutonic rocks of similar age probably extend across much of the eastern Grenville Province. High precision U-Pb geochronology has suggested cycles of plutonism and orogenesis in eastern Labrador between 1680 and 1660 Ma, and between 1655 and 1630 Ma.

Middle Proterozoic anorogenic magmatism in eastern Canada was a period of massif-type anorthosite-granite emplacement, mafic sheet intrusion, felsic and peralkaline magmatism, mafic volcanism and associated terrestrial sedimentation, all of which are best displayed north of the Grenville Province. Representatives of these types of activity are also found within, or bordering the eastern Grenville Province, and include the following, (i) mafic sheets variously referred to as the Michael Gabbro (ca. 1426 Ma), Shabogamo Gabbro (>1379 Ma) and Mealy dykes (ca. 1380 Ma), (ii) intrusions (mainly felsic and peralkaline) of the Arc Lake, Arrowhead Lake and Upper North River plutons (1337 Ma, 1307 Ma and 1296 Ma, respectively) and Red Wine Intrusive Suite (ca. 1317 Ma) and compositionally similar volcanic rocks of the Letitia Lake Group (ca. 1327 Ma), (iii) volcanic and sedimentary rocks of the Seal Lake and Wakeham groups (ca. 1323 Ma and ca. 1271 Ma, respectively). The presence of

these rocks emplaced within ca. 1650 Ma crust strengthens comparisons between eastern Laurentia, Baltica and mid-continental U. S. A.

From comparison with Baltica, it was predicted that, as mapping and geochronological studies extended knowledge of the interior eastern Grenville Province, evidence for plutonism of Grenvillian age would be found. Such plutonism is now known to be extensive in the eastern Grenville Province; 11 plutons, having ages between 1130 to 956 Ma, have been dated and many others can be readily interpreted from magnetic patterns, even in areas yet to be mapped.

A greater structural emphasis in mapping of the Grenville Province in the last decade has resulted in proposals for the existence of discrete terranes, identified by specific internal characteristics and bounded by zones of deformation. A gradation exists between the more northerly terranes (Groswater Bay, Lake Melville, Churchill Falls, Gagnon, Molson Lake) and the southerly terranes (Mealy Mountains, Hawke River, Wilson Lake, Lac Joseph), in that the northerly terranes experienced more severe Grenvillian deformation and metamorphism. This is interpreted to indicate overthrusting and burial of the northerly terranes by the more southerly terranes, which themselves escaped Grenvillian burial.

Continued investigations have affirmed Lower and Middle Proterozoic protolith correlations between Laurentia and Baltica. U-Pb geochronology has shown that parts of the Transscandinavian Granite-Porphyry belt are older than previously thought (ca. 1780 Ma rather than 1650 Ma) and similarly that some plutons previously regarded as Trans-Labradorian (ca. 1650 Ma) are now known to be post-Makkovikian (ca. 1800 Ma). In both the eastern Grenville Province and Sveconorwegian orogenic belt, the presence of widespread, newly-formed late Lower Proterozoic crust, intruded by later crustally-derived Middle Proterozoic anorogenic magmatic products has been demonstrated and the widespread existence of Grenvillian-age plutonism documented.

Mapping has provided geological evidence in support of proposals for Middle Proterozoic rotation of the Baltic Shield relative to North America. This evidence includes a distinct departure in structural and magnetic trends in easternmost Labrador from the remainder of the Grenville Province and evidence of southwest-directed uplift and thrusting of the Hawke River terrane onto more interior terranes in the eastern Grenville Province. A model of separation, combined with rotation, of the Baltic Shield to initiate intermittent Middle Proterozoic rifting/crustal thinning is developed further from published suggestions. The rotation of the Baltic Shield eventually led to progressive mutual collision along the (previous) southern sides of the North American and Baltic Shields (about an eastern Labrador pivot?) and caused a crustal pile-up where the Archean Superior Province bulges into the central Grenville Province (hence explaining the large negative gravity anomaly along the Grenville front in Quebec). By this model, the Grenville and Sveconorwegian fronts were sited over parts of the same tectonic margin during the first part of the Middle Proterozoic, but became opposing tectonic margins during Grenvillian orogenesis. Farther north, rotation of the Baltic Shield led to crustal 'tearing' between North America and the Baltic Shield, which, as it propagated south, led to the formation of Iapetus ocean.