Crustal evolution in the Makkovik Province of Labrador: evidence from geochemical and isotopic studies of plutonic rocks

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The regionally extensive plutonic rocks of the Early Proterozoic Makkovik Province are divisible into two broad groups, both of which can be correlated with volcanic sequences of similar age and affinity. The Makkovikian Assemblage is dominated by syn- and post-tectonic granitoid rocks of ca. 1800 Ma age, that probably represent a single magmatic pulse that outlasted final deformation associated with the Makkovikian orogeny. Distinctive post-tectonic granites of ca. 1720 Ma age are regarded as late Makkovikian intrusions of partly anorogenic character. Plutonic rocks of both age-groups are highly evolved, and have strong affinities with so-called "A-type" or "within-plate" granites. The less abundant Labradorian Assemblage is of ca. 1650 Ma age, and includes gabbro-diorite-monzonite-syenite suites, derived from mafic parent magmas, and a variety of leucocratic granites. The mafic rocks resemble high-K calc-alkaline to shoshonitic basalts. Labradorian granitoid rocks mostly lack the "A-type" affinity of their Makkovikian counterparts.

Makkovikian igneous suites display striking geographic variation in their initial Nd isotopic compositions, expressed as ε_{Nd}CHUR. In the West, negative ε values indicate ancient (probably Archean) crustal material in their sources, but they were not derived entirely from such material. In the east, positive ε_{Nd} values indicate juvenile, Proterozoic sources, and gneissic rocks representing possible basement have depleted-mantle model

ages of ca. 2100 Ma. These contrasts define a fundamental subsurface boundary between the Archean Nain Craton and a younger (accreted?) Proterozoic crustal domain. Makkovikian magmas were probably produced via melting and assimilation of lower crustal rocks by anhydrous, hot, mantle-derived mafic magmas. This accompanied or followed accretion of the Proterozoic domain to the Archean craton, possibly in response to thermal insulation of hot mantle.

Labradorian igneous suites derived from mafic parental magmas have ε_{Nd} values significantly below postulated values for concurrent depleted mantle. This crustal component was possibly introduced directly to the mantle via subduction of continent-derived sediments, as invoked for modern arc magmas. They may therefore be a distal manifestation of northward-directed subduction within the area now represented by the Grenville Province. Some Labradorian granites, however, may have been drived by anatexis of slightly older Makkovikian materials.

It is unlikely that Makkovikian and Labradorian magmatic events are related to completely separate orogenic cycles separated by a rifting and spreading episode. An alternative model is that they represent two sequential stages in the long-term evolution of a single convergent plate boundary, perhaps analogous (in a general sense) to the Phanerozoic development of southern South America.