Mesozoic magmatism in Northeastern North America and Canada: A classic A1-type granite province

G. NELSON EBY[1]

[1]Department of Environmental, Earth and Atmospheric Sciences, University of Massachusetts, Lowell, MA, 01854, USA (nelson_eby@uml.edu)

Anorogenic magmatism starts in Northeastern North America at ~250 Ma with the emplacement of alkaline mafic dike swarms in New England and the Maritime Provinces of Canada. Emplacement of largely syenititc and granitic magmas begins at ~200 Ma and continues to ~150 Ma. Most of these magmas are silica-oversaturated, but silica undersaturated magmas were emplaced at Rattlesnake Mountain and Red Hill. A second period of anorogenic magmatism occurs between 130 Ma and 120 Ma and geographically spans the boundary between the North American craton and the folded Appalachians. Magmas emplaced into the craton are generally silica undersaturated while those emplaced into the folded Applachians are silica saturated to oversaturated. The older period of magmatism is dominated by felsic magmas, but significant amounts of mafic magma were emplaced during the younger period. On the standard A-type discriminant diagrams, the felsic rocks formed during this period are all A1.

Petrogenetic modeling suggests that the mafic melts were formed in the region of the transition zone between garnet lherzolite and spinel lherzolite. This inference is supported by trace element data. Thermodynamic modeling supports the hypothesis that the more evolved melts can be generated by fractional crystallization with, in the case of the silica oversaturated melts, some assimilation of crustal material. This contamination occurred at depth because each batch of melt is isotopically homogeneous. Plutons in the folded Appalachians show signifcant positive Pb anomalies on Primitive Mantle normalized multi-element plots while Pb anomalies are absent for plutons in the craton, thus highlighting the significance of magma-crust interaction in producing the silica-oversaturated magmas.

Throughout this entire time of anorogenic magmatism, isotopic (particularly Sr and Pb) data and trace element data show remarkable consistency. The mafic melts were extracted from an enriched lithospheric mantle (similar to the OIB source) and subsequently evolved through fractional crystallization giving rise to both silica-undersaturated and, with some crustal assimilation, the silica oversaturated magmas.