Geochemistry and petrogenesis of felsic volcanic rocks from contrasting structural/stratigraphic settings in the Big Bald Mountain area, Bathurst Mining Camp

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The east-west-trending Moose Lake-Tomogonops (MLT) shear zone divides the Bathurst Mining Camp into northern and southern structural and stratigraphic domains in the Big Bald Mountain area. In each domain, felsic volcanic rocks of the Tetagouche Group overlie dark grey siltstones and shales of the Miramichi Group, and are overlain by alkalic basalts, shales and wackes of the Boucher Brook Formation. In the north, Tetagouche felsic volcanic rocks are assigned to the Nepisiguit Falls and Flat Landing Brook formations; in the south, the Clearwater Stream and Sevogle River formations are the respective stratigraphic equivalents.

The Flat Landing Brook Formation is chemically distinguished from the Nepisiguit Falls Formation by greater abundances of high-field-strength elements (HFSE) and rare-earth elements (REE), as well as by steeper slopes (higher La/Yb ratios) and a less prominent negative Eu anomaly (higher Eu/Sm ratios) on REE distribution profiles. However, considerable variation exists within the Flat Landing Brook Formation, and some compositional overlap with the Nepisiguit Falls Formation is locally evident. HFSE ratios of the two units suggest a common lower crustal source, although the higher HFSE and REE abundances in the Flat Landing Brook Formation likely reflect a second stage of partial melting. The crystal-rich pyroclastic rocks of the Nepisiguit Falls Formation are interpreted to have been generated under lower temperatures and higher water fugacities than the crystal-poor lavas of the Flat Landing Brook Formation.

South of the MLT Fault, the Clearwater Stream Formation is dominantly dacitic, whereas the overlying Sevogle River Formation is dominantly rhyolitic; again, some compositional overlap is noted among samples collected near the interpreted contact. Despite differences in major element chemistry, HFSE and REE abundances in the two units are comparable, and, in general, are higher than in felsic units north of the MLT Fault. Trace-element ratios are also very similar except for those that involve Ti, V, Sc, or Cr; the greater abundance of these elements in the Clearwater Stream Formation reflect its more intermediate composition. On REE distribution profiles, the Clearwater Stream Formation shows higher La/Yb and Eu/Sm ratios than the younger Sevogle River Formation (in contrast with REE profiles of felsic units north of the MLT Fault, where the older rocks (Nepisiguit Falls Formation) feature the lower La/Yb and Eu/Sm ratios).

REE systematics suggest that the Sevogle River Formation may be related to the Clearwater Stream Formation by fractional crystallization. Models that attempt to derive major-element Sevogle River geochemistry by fractional crystallization of a Clearwater Stream-like parent must take into account their similar trace element contents; the simplest scenario involves tapping of a Clearwater Stream-type magma before significant differentiation occurred, followed by a prolonged period of fractionation, producing a zoned chamber with an Sevogle River-type melt at the top.