Geochemistry and Tectonic Significance of Siluro-Devonian Mafic Volcanic Rocks in the Chaleur and Tobique Zones, New Brunswick

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Representative samples of Siluro-Devonian mafic volcanic rocks from five areas within the Tobique and Chaleur zones of the Matapedia Cover Sequence in northwestern New Brunswick have been analyzed for major and trace element content. Submarine mafic volcanic rocks, interbedded with marine sedimentary and (predominantly) subaerial felsic volcanic rocks, were erupted on inferred continental crust of the Miramichi Terrane. In the Tobique Zone, subalkalic basalts and andesites from the Wapske-Odell, Stickney and Millville areas show close chemical similarities and calc-alkaline affinities, whereas basalts from the New Denmark area are somewhat less evolved and show a weak iron-enrichment trend. In the Chaleur Zone, Silurian and Lower Devonian calc-alkaline suites include subalkalic (and locally alkalic) basalts and andesites with major- and trace-element chemistry similar to mafic volcanic rocks of the Tobique Zone.

Immobile trace element data, plotted on discrimination diagrams, commonly used to define tectonic setting, are consistent with an orogenic (volcanic-arc) environment, and MORB-normalized trace-element variations show close similarities with active, continental margin, orogenic basalt patterns. High values of the incompatible elements K, Rb, Ba, and Th are typical of orogenic, i.e., subduction-related basalts of both oceanic and continental settings. The observed enrichment in Nb, Zr, P, and particularly Ti closely parallels that documented in active, continental margin, volcanic provinces such as Chile or the western United States. Cr and Ni values are relatively high in the Tobique Zone compared to typical orogenic basalts, and may be due to (1) the absence of extensive fractionation suggested by average Mg* values for the various suites, ranging from 56 to 62; or (2) to high levels of these elements in the parent magma.

Partial melting of enriched, subcrustal lithosphere has been proposed as the source for the high values of Zr, Ti, P and Nb in continental margin, mafic volcanic rocks, whereas K, Rb, Ba and Th enrichment during subduction of oceanic crust or to contamination by continental crust. These processes can be interpreted to have played a role in the genesis of orogenic calc-alkaline volcanic rocks in the Tobique and Chaleur zones.

Northwestward subduction of decoupled subcontinental lithosphere during Acadian continental collision is suggested as a possible mechanism for generating the observed geochemical signatures.