Petrology of Volcanic Rocks from Bequia and St. Vincent

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Abstract

Volcanism in the Lesser Antilles is a manifestation of the westward subduction of the North American plate beneath the Caribbean plate. The compositions of the igneous rocks produced vary along the arc. The calc-alkaline rock suite, usually typified in its occurrence in subduction zones settings, is not ubiquitous in the Lesser Antilles volcanic arc. There is a chemical variation along the arc axis that can only be explained by the presence of more than one magma series: alkaline in the south, calc-alkaline in the central islands and tholeiitic to the north. The occurrence of different magma series within a close spatial and temporal setting provides an opportunity to assess the factors controlling erupted lava compositions in a modern intra-oceanic volcanic arc. Within this context, the geochemical affinities of neighbouring volcanic islands Bequia and St. Vincent have been found to be transitional between alkalic and calc-alkaline characteristics, reflecting their positions along the arc. Recent research has highlighted a petrological and geochemical boundary between Grenada and St. Vincent, but its position in the Grenadines has not yet been determined. This study uses petrological and geochemical data from lavas of Bequia and La Soufriere, St. Vincent to compare the evolution of the magmatic systems from both localities to help constrain the geochemical transition in the southern segment of the arc.

Phenocryst compositions from Bequia and Soufriere lavas were determined using electron probe micro-analysis. These analyses and petrographical observations were used to explore the roles of differentiation processes involved in each system's magma evolution. The lavas studied consisted of basalts and andesites (Bequia) and basaltic andesites (La Soufriere), the most mafic of which (pyroxene *mg*-number 82) came from Bequia. These phenocryst rich lava suites contained mineral assemblages dominated by mafic phases including clinopyroxene, Ti-magnetite, plagioclase and orthopyroxene for Soufriere, with the addition and exclusion of olivine and spinel respectively for Bequia. Both systems exhibited similar disequilibrium textures with phenocrysts showing evidence of compositional zoning, overgrowths, resorption and exsolution. Bequia olivines provided evidence for post magmatic alteration showing partial to complete replacement to iddingsite. While similar disequilibrium textures and mineral assemblages suggested similar evolutionary histories for both suites, this did not necessarily translate to their mineral chemistries being the same.

A comprehensive comparison of these lavas is not complete without the inclusion of geochemical analyses. Pending the inclusion of whole rock geochemical data, this preliminary study is based on phenocryst chemistry and petrography of the samples analysed, along with data from previous research in these areas.