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Temporal Magmatic Variation at Boqueron Volcano, El Salvador

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Abstract. The relative ages of 21 lavas from Boqueron volcano in El Salvador were determined by superposition. The lavas are grey to black, porphyritic basalts, basaltic andesites and andesites with phenocrysts of plagioclase, augite, olivine, and magnetite. The andesitic lavas appear to have evolved from basaltic magma by fractionation of the observed phenocryst phases.

The temporal variation in the chemical composition of the lavas at Boqueron is composed of three components. First, there is a crudely cyclical alternation of basalts and andesites. Second, these cycles are progressively shifted toward higher SiO_2 contents. Third, approximately in the middle of the stratigraphic section sampled, there is an abrupt change in chemical variation trends from an Al-rich and Fe-poor trend to an Fe-rich and Al-poor trend. This change is interpreted to have been caused by an increased proportion of plagioclase fractionation and a decreased porportion of augite fractionation. The crudely cyclical change in SiO_2 content with time is interpreted as a combination of crystal fractionation that increases SiO_2 content, followed by influxes of basaltic magma that mix with residual magma to decrease SiO_2 content. Successive cycles are shifted toward higher SiO_2 content because there is a significant volume of fractionated magma remaining in the chamber before each influx of basalt.

Introduction

Andesitic volcanic rocks found at convergent plate margins have been explained as products of fractional crystallization of basalt (Osborn, 1959, 1969). Others have proposed that andesitic liquids are produced by hydrous partial melting of peridotite (Yoder, 1969; Kushiro, 1972) or subducted oceanic crust (Green and Ringwood, 1968). A wide range of views on the origin of andesitic rocks exists (Boettcher, 1973; McBirney, 1976), and it is possible that andesites have been produced by several of the proposed mechanisms.

The origin of andesitic rocks at a particular volcanic center is best understood when the entire volcanic history of the center is defined. If fractional crystallization is the governing process, then a gradual evolution from basalt to andesite should be found. Alternatively, if partial fusion directly produces an andesitic liquid, rather uniform andesitic rocks should be found. Usually, it is not possible to sample the entire magmatic history of composite cones, however, large pyroclastic eruptions that cause deep craters or calderas expose stratigraphic sections of composite cones. Detailed sampling of such sections has allowed Katsui et al. (1975) and Rose et al. (1977) to define the temporal magmatic evolution of composite volcanos in Hokkaido, Japan and western Guatemala, respectively. A common feature of the magmatic histories of these composite volcanos is that the andesitic rocks, which make up the outer part of the cone, have gradually evolved from basaltic rocks that make up much of the interior of the cone. The observed magmatic histories of these volcanos strongly suggest that their andesitic lavas are a product of fractional crystallization of basalt.

Boqueron volcano is one of 41 historically active Central American volcanos. This volcanic chain, which extends over 1100 km from Guatemala to Costa Rica is located above a well-defined inclined seismic zone that marks the convergence of the Caribbean and Cocos plates (Molnar and Sykes, 1969).

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