

The geology and geochemistry of Isla Floreana, Galapagos: A different type of late-stage ocean island volcanism

Karen S Harpp¹, Dennis Geist²

¹Geology Department, Colgate University, USA, ²Department of Geological Sciences, University of Idaho, USA

E-mail: kharpp@colgate.edu

Isla Floreana, the southernmost volcano in the Galapagos Archipelago, has erupted a diverse suite of alkaline basalts continually since 1.5 Ma. Because these basalts have different compositions than xenoliths and older lavas from the deep submarine sector of the volcano, Floreana is interpreted as being in a rejuvenescent or late-stage phase of volcanism. Most lavas contain xenoliths or their disaggregated remains. The xenolithic debris and large ranges in composition, including during single eruptions, indicate that the magmas do not reside in crustal magma chambers as do magmas in the western Galapagos. Floreana lavas have distinctive trace element compositions that are rich in fluid-immobile elements (e.g., Ta, Nb, Th, Zr) and even richer in fluid-mobile elements (e.g., Ba, Sr, Pb). Rare earth element (REE) patterns are light REE-enriched and distinctively concave-up. Neodymium isotopic ratios are comparable to those from Fernandina, at the core of the Galapagos plume, but Floreana has the most radiogenic Sr and Pb isotopic ratios in the archipelago. These trace element patterns and isotopic ratios are attributed to a mixed source originating from within the Galapagos plume, which includes depleted upper mantle, plume material rich in TITAN elements (Ti, Ta, Nb), and recycled oceanic crust that has undergone partial dehydration in an ancient subduction zone. Because Floreana lies at the periphery of the Galapagos plume, melting occurs mostly in the spinel zone, and enriched components dominate. Floreana is the only Galapagos volcano known to have undergone late-stage volcanism. Here, however, the secondary stage activity is more compositionally enriched than the shield-building phase, in contrast to what is observed in Hawaii, suggesting that the mechanism driving late-stage volcanism may vary among ocean island provinces.