KECK GEOLOGY CONSORTIUM

PROCEEDINGS OF THE TWENTY-FIFTH ANNUAL KECK RESEARCH SYMPOSIUM IN GEOLOGY

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ERICA WINELAND-THOMSON**,** Colorado College
Research Advisor: Jeff Noblett

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PETROLOGIC AND GEOCHEMICAL CHARACTERIZATION OF BASALTIC AND INTERMEDIATE MAGMAS IN AN ABANDONED TERTIARY RIFT, NORTHWEST ICELAND

ERICA WINELAND-THOMSON, Colorado College
Research Advisor: Jeff Noblett

INTRODUCTION

Iceland is located at an intersection between the Icelandic mantle plume and the Mid-Atlantic Ridge. Rifting that represents the mid-ocean ridge spreading axis has shifted eastward in several jumps to newer rift systems in relation to the mantle plume (Hardarson et al., 1997). This relocation is due to the westward movement of the plate boundary and can be observed through two extinct rifts: the Skagi-Snaefellsnes rift zone and an extinct rift formed along a NE-SW strike off shore of the northwest of Iceland.

Hrafnfjordur is the oldest of the central volcanoes investigated in the four Iceland Keck projects to date. This volcano represents the early, hotspot-centered phase of the rift zone. This 2011 Keck project seeks to understand the origin(s) and process(es) of the formation of lavas in the Hrafnfjordur central volcano that erupted heterogeneous igneous rocks. This study will address the following questions: 1) what is the nature and origin(s) of the source magma(s); and 2) how do the individual units relate to one another including possible magma mingling/mixing, and/or fractional crystallization.

In Iceland rift zone volcanoes produce tholeiitic basalts, but the flank zone volcanoes, produce alkaline and transitional basalts (Saemundsson, 1979). More than 90% of the volcanic rocks found on Iceland are of basaltic composition, where the other 10% are of intermediate and silicic composition (Beloussov and Milanovsky, 1977). The processes that formed these silicic rocks, either fractional crystallization or magma mixing are of great interest and are much debated.

The thermal state of the crust has a large influence on the genesis of the silicic magma; the silicic magmas formed within or close to the rift zone are generated by crustal melting whereas those formed in flank zones are generated by fractional crystallization (Martin and Sigmarsson, 2007). Fractional crystallization is dominant in cooler crust, and crustal melting with warmer crust. The silicic rocks in Iceland are characterized as dacites, trachytes, low-alkali rhyolites and alkalic rhyolites. The trachytes and alkalic rhyolites are produced from the volcanoes in the flank zones and the dacites and low-alkali rhyolites are mostly found in the rift zones. Overall, these silicic rocks are Fe-rich and Ca-poor in comparison to silicic rocks in general, which indicates that these rocks were generated in magma low in water pressure (Jonasson, 2007).

The Tertiary basalts are very diverse. Martin and Sigmarsson (2007) propose three distinct potential mantle components in order to explain this diversity: depleted upper mantle source, enriched mantle plume and recycled oceanic crust. The recycled oceanic crust is most likely to have a variable composition forming garnet pyroxenite or ecgolite at depth and would undergo partial melting, which would yield either ne-normative alkali basalts or qz-normative basalts. As the melt mixes with lherzolite, the initial melt becomes diluted in incompatible elements before reaching the surface. Pyroxenites in the mantle source help to explain the diverse range in composition of basalts in the off-rift volcanic zones, ranging from alkali basalts through transitional alkali basalts. Since the farthest area away from the plume center has the lowest mantle temperature, the ne-normative pyroxenite melts would be least diluted by lherzolite and thus, incompatible elements. There is evidence that the most alkaline basalts, those closer to the periphery of the off-rift volcanic zones, represent melts of distinct pyroxenitic lithology's. Individual volcanic systems are very diverse and there seems to be a correlation between them and the heterogeneity of the magma. Mantle melts having both diverse characteristics tend to have similar isotope ratios at the surface