Estimating Magmaic Temperatures and Source Lithologies for Off-Axis Alkaline Magmas
Snaefellsnes, Western Iceland
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Introduction
Iceland is a hotspot influenced, subaerial segment of the Mid-Atlantic Ridge. The active rift volcanics are tholeiitic magmas generated by decompression melting enhanced by the added temperature flux and/or more fusible lithologies inferred to be due to a mantle plume. The Snaefellsnes Peninsula (SNP) is an off-axis area that has recent (<1 Ma) alkaline volcanism unconformably overlying older Neogene flood basalts. The SNP alkaline basalts are enriched in radiogenic isotopes (87Sr/86Sr and 143Nd/144Nd) and incompatible trace elements (higher La/Sm and Nb/Zr) relative to the rift tholeiites, indicating smaller degrees of melting of a more enriched mantle. It is unclear what role mantle temperature and source lithology (e.g., enriched peridotite vs pyroxenite) have in generating this off-axis volcanism in an area of limited crustal extension. In order to address these questions, high precision analyses of olivine macrocrysts and spinel inclusions were carried out on representative lavas from throughout the Snaefellsnes Peninsula.

High Precision Olivine Analyses
EPMA analyses of olivine macrocrysts, focusing on high Fe-olivines (Mg/Mg+Fe atomic ratio). Following the model developed by Sobolev et al., (2007), the trace element composition of the olivines are plotted and a source dominant (bright white). Contrast and brightness variable, which has implications for calculating crystallization temperatures.

Phosphorus zoning in an olivine – showing that there is heterogeneity at a trace element level. Al concentrations in olivine are also variable, which has implications for calculating crystallization temperatures.

Conclusions
1) The mantle source lithology for the volcanism on Snaefellsnes is peridotite (same as the rift).
2) Despite a greater distance from the hotspot, magmatic temperatures for Snaefellsnes are elevated compared to MORB

Implications
- The enriched character of off-axis volcanism is due to preferential melting of a more fertile peridotite lithology compared to the rift tholeiites, and there is no evidence for melting of distinct lithologies such as pyroxenite or eclogite.
- Temperature is not the main control on compositional differences between the rift and SNP, but hotter mantle is being melted, even on the periphery of the Iceland plume.

References