

## Evidence for a heterogeneous mantle at 9°30'N EPR

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A recent study of lavas recovered by Alvin from the 9°17'N-9°50'N segment of the East Pacific Rise (EPR) demonstrated that axial lavas were generated from an isotopically homogeneous mantle source with respect to <sup>87</sup>Sr/<sup>86</sup>Sr, <sup>143</sup>Nd/<sup>144</sup>Nd, <sup>176</sup>Hf/<sup>177</sup>Hf, and <sup>208</sup>Pb/<sup>206</sup>Pb [1]. NMORB (K<sub>2</sub>O/TiO<sub>2</sub> < 0.10) collected < 4km off-axis in the 9°50'N region are isotopically indistinguishable from the axial lavas [2]. However, off-axis surveys in the 9°30'N-9°50'N region have documented the presence of EMORB (K<sub>2</sub>O/TiO<sub>2</sub> > 0.15) [3, 4, 5]. To date, no EMORB have been recovered from the axial region. The existence and off-axis location of EMORB suggests that basalt genesis at 9°30'N-9°50'N EPR is more complicated than inferred solely from NMORB compositions.

To clarify petrogenetic links between NMORB and EMORB in this magmatically active region of the EPR, we have undertaken a study to measure major element, trace element, and Sr, Nd, Pb, and Hf isotopic compositions for a suite of 17 off-axis MORB glasses. The samples include both off-axis NMORB and eight EMORB from 9°30'N. These new data provide important constraints on the origin of EMORB at 9°30'N-9°50'N EPR and demonstrate the existence of a heterogeneous mantle source beneath the 9-10°N region of the EPR. Furthermore, our results indicate distinct mantle source compositions between the 9°30'N and 9°50'N regions. Axial lavas from 9°30'N-9°50'N are all NMORB and their compositions are consistent with variable degrees of melting of a compositionally and lithologically homogeneous source [1]. The range of off-axis lava compositions from 9°30'N results from mixing of deep, enriched, low-degree melts of a garnet-bearing lithology with more volumetrically significant, depleted melts generated at shallower depths.

[1] Sims *et al.* (2002) *GCA* **66**, 3481-3504. [2] Sims *et al.* (2003) *G3* **4(10)**, 2002GC000443. [3] Batiza & Niu (1992) *JGR*. **97**, 6779-6797. [4] Perfit *et al.* (1994) *Geology* **22**, 375-379. [5] Smith *et al.* (2001) *G3* **2**, 2000GC000134.

## Diffusive isotope fractionation experiments and the structural components of silicate liquids

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Diffusion in silicate liquids is usually presented and modeled in terms of simple oxide components, despite the fact that the oxides cannot be the actual diffusing entities. However, what species are diffusing is difficult to specify due to uncertainty regarding the nature and longevity of silicate liquid structures and their dependence on composition.

Recent experimental studies suggest that the magnitude of diffusive isotopic fractionation may provide information on silicate liquid structures and/or the mechanism by which different major-elements diffuse. Richter *et al.* [1] performed interdiffusion experiments between silicate liquids of basalt and rhyolite and measured significant Ca and Li isotope fractionation. The diffusive fractionation of Ca isotopes is small when considering the elemental mass ratio (44/40), as if Ca is associated with larger structural units. Li isotopes exhibit a greater fractionation that suggests the diffusing species are comparable in size to the elemental masses.

To further investigate the relationship between diffusive isotopic fractionation and liquid structure, we have performed similar experiments using different mafic liquid compositions. We find that the degree of Ca isotopic fractionation varies with composition (liquid structure) and that diffusive coupling between Ca and Al affects Ca isotopic fractionations. Both observations indicate that Ca diffuses as part of larger structural units, and there is some indication that there are two or more Ca-bearing units involved.

We are also conducting Soret diffusion experiments using normative endmember compositions (e.g., albite and anorthite). Previous Soret diffusion studies on multi-component basaltic liquids have shown that these components fractionate along a thermal gradient, suggesting their importance as diffusing species and/or in establishing the thermodynamic driving force for thermal segregation. Using a synthetic albite melt we are testing whether Soret diffusion in normative endmember components can be described as single component (NaAlSi<sub>3</sub>O<sub>8</sub>) or multicomponent (e.g., Na<sub>2</sub>O+Al<sub>2</sub>O<sub>3</sub>+SiO<sub>2</sub>) transport. Initial results indicate that albite liquid is a one-component system that does not separate chemically in the presence of a thermal gradient. Results from experiments using anorthite, where Ca isotopes can be monitored as well, will be presented.

[1] Richter, F.M., Davis, A.M., DePaolo, D.J. & Watson, E.B. (2003) *Geochim. Cosmochim. Acta* **67** 3905-3923.