Correlation of Depth of Differentiation to Tectonic Setting: Evidence from Plagioclase Ultraphyric Basalts

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Plagioclase ultraphyric basalts (PUB) are a subset of mid-ocean ridge basalts (MORB) characterized by abundant plagioclase megacrysts. PUB lavas are produced by entrainment of plagioclase formed in the lower crust and upper mantle [1]. PUB megacrysts and their melt inclusions (MI) have been used to document the compositional array of magmas present in the upper mantle and crust prior to mixing and fractionation. Recent estimates of the depth of formation using plagioclase-hosted MI CO_2 abundances on a limited number of samples [2, 3] are consistent with formation at pressures equivalent to the lower oceanic crust/upper mantle (1-7 kbar; ~3-20 km). However, we do not know if the depth of formation varies as a function of tectonic setting within MOR or magma supply.

To address the question of how tectonic setting and magma supply may influence the range of depths where active processes operate, we analyzed plagioclase megacrysts and their MI from PUB samples collected at four different tectonic settings: intra-transform pull-apart basins, off-axis seamounts, on-axis hotspot influenced ridges, and axial valleys. CO_2 measurements were obtained by SIMS on MI to estimate the minimum depth of entrapment along with major and trace element concentrations on both MI and their plagioclase host. These data were used to tie the depth of formation to the level of fractionation, different degrees for melting, and mixing. For example, samples from the Garrett Fracture Zone (intra-transform pull-apart basin) exhibited ultra-depleted trace element concentrations (Zr <2ppm), primitive major element composition (e.g., Mg# of MI up to 75) and depths of entrapment up to ~20km. A subset of these characteristics has been seen in MI from other PUB lavas (e.g., Gorda Ridge). However these new data differ from most previous MI data in that they include host and MI major and trace element analyses together with CO_2 abundances.

[1] Lange et al. (2013) *Geochem Geophys Geosyst.,* **14**, 3382-3296. [2] Drignon et al. (2019) *Geochem Geophys Geosyst*., **20**, 109-199. [3] Bennett et al. (2019) *Contrib Mineral Petrol.*, **174**, 49-71.