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Correlation of Depth of Formation with Petrogenetic Processes: Evidence from Plagioclase-Hosted Melt Inclusions

OLIVIA DAYNES[1], K. GOKCE USTUNISIK[1,2], ROGER L NIELSEN[3], MADISON X BETTS[3] AND GLENN GAETANI[4]

[1]South Dakota Mines

[2]American Museum of Natural History

[3]South Dakota School of Mines and Technology

[4]Woods Hole Oceanographic Institution

Presenting Author: daynesolivia@gmail.com

Plagioclase ultraphyric basalts (PUB) are a subset of mid-ocean ridge basalts (MORB) characterized by abundant anorthitic plagioclase megacrysts. PUB lavas are produced by disruption and entrainment of plagioclase formed in the lower crust and upper mantle [1]. These megacrysts and their melt inclusions (MI) have been used to document the compositional diversity of magmas present in the upper mantle and crust prior to mixing and fractionation during transport, storage, and eruption. Recent estimates of the depth of formation using plagioclase megacryst- based CO_2 abundances have been made on a limited number of samples [2, 3]. Those estimates are consistent with formation at pressures equivalent to the lower crust/upper mantle. However, we do not know if the depth of formation varies from ridge to ridge, or if the depth of formation is different among various settings.

To address this question, we analyzed plagioclase megacrysts and their inclusions from a number of PUB samples from slow to intermediate spreading rate ridges distributed globally to establish the nature and extent of the active differentiation processes, together with CO_2 measurements to be used to establish the minimum depth at which those processes operate. In essence, the major and trace element signature and estimated depth of formation will allow us to examine the correlation of process vectors related to fractionation, degree of partial melting, mixing, and degassing with depth. Depending on how the megacrysts are sampled from their environment of formation, we may see multiple populations of megacrysts that are derived from processes active at different depths from different precursors. Therefore, CO_2-derived depths of formation can be used in conjunction with process vectors to model how the magmatic plumbing system beneath mid-ocean ridges varies among different tectonic settings.

[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.