

## CO<sub>2</sub> and H<sub>2</sub>O in Plagioclase-Hosted Melt Inclusions from Ocean-Ridge Lavas: An Indicator of Crystallization in the Lower Oceanic Crust

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### Abstract

Interpretation of erupted products we observe on the seafloor requires that we understand the petrogenesis of melts in the oceanic crust and where crystallization initially takes place. Our work focuses on estimating depth of crystallization of the plagioclase megacrysts using CO<sub>2</sub> and H<sub>2</sub>O concentrations from plagioclase ultraphyric basalts (PUBs). Samples were analyzed from the Lucky Strike segment on the Mid-Atlantic Ridge and from three locations on the Juan de Fuca Ridge (West Valley, Endeavor Segment, and Axial Segment). Melt inclusions were re-homogenized to remove the effects of post-entrapment crystallization. The CO<sub>2</sub> in the vapor bubbles present in the melt inclusions were analyzed at Virginia Tech using Raman spectroscopy, and associated glassy melt inclusions were analyzed at WHOI using the ion microprobe for CO<sub>2</sub> and H<sub>2</sub>O. Vapor-saturation pressures calculated from these volatiles stored in melt inclusions and vapor bubbles range from 359-3994 bars, corresponding to depths of 1.0-11.4 km below the sea floor. The proportion of CO<sub>2</sub> partitioned in the bubbles range from 11-98%. In summary, about 14% of the melt inclusions from Lucky Strike record crystallization depths of 3-4 km, consistent with the depth of the seismically imaged melt lens, whereas ~55% of melt inclusions crystallized at depths >4 km with a maximum at 9.8 km. These data are similar to depths of formation determined through olivine-hosted melt inclusions from the same segment (Wanless et al., 2015), although a greater portion of plagioclase-hosted melt inclusions record crystallization below the melt lens. At the Juan de Fuca ridge, ~24% of the melt inclusions record crystallization depths of 2-3 km, consistent with a seismically imaged mid-crustal magma chamber at the Endeavor Segment, while an additional ~62% crystallize at depths >3 km with a maximum at 11.4 km. This suggests that while crystallization can be focused within the melt lenses and magma chambers at these ridge

localities, a significant and greater proportion of the megacrysts were sampled from the lower crust or upper mantle.

Wanless, V. D., A. M. Shaw, M. D. Behn, S. A. Soule, J. Escartin, and C. Hamelin (2015), Magmatic plumbing at Lucky Strike volcano based on olivine-hosted melt inclusion compositions, *Geochem. Geophys. Geosyst.*, 16, 126-147, doi:10.1002/2014GC005517.

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