

Accessing Hidden Heterogeneity of Convecting Mantle

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The Earth's mantle's chemical, mineralogical, and isotopic heterogeneity is well-known. Mantle-derived magmas reveal convecting mantle composition. However, their inherited source heterogeneities were likely homogenized during ascent and eruption. This results in visibility of only large-scale heterogeneities, which are revealed by studies of isolated from each other volcanic systems such as the Loa and Kea lineaments of the Hawaiian Plume [1]. Another challenge is to identify heterogeneities in refractory compositions depleted in incompatible elements due to their higher melting temperatures and susceptibility to overprinting by more fertile components. Melt inclusions in early olivine crystals often exhibit considerable chemical variability, which decreases in inclusions found in more evolved olivines of the same sample [2]. This feature was interpreted as being the result of sampling of various primary melts during the initial crystallization phase and their subsequent mixing at the later stage. This presentation will show how olivine-hosted melt inclusions can reveal heterogeneities in mantle plume sources that are not visible in bulk lava composition studies.

The decoupling of Sr and Nd isotopes in ultra-depleted olivine-hosted melt inclusions of Song Da (Emeishan LIP, [3]) and Gorgona (Caribbean LIP) picrites without evidence of contamination suggests that refractory harzburgite, derived from recycled dehydrated serpentinite, may be a significant component of corresponding mantle plumes. Nevertheless, the melting of this component is only visible in a specific region of the plume, which is distinguished by the absence of fertile components and sufficiently elevated temperature and H₂O contents. The host lavas exhibit these characteristics in a significantly more restricted manner. Another example is ultra-depleted melt included in olivine from Mauna Loa, Hawaii, but never found as a bulk rock sample.

References.

- Abouchami, W. et al. (2005). Lead isotopes reveal bilateral asymmetry and vertical continuity in the Hawaiian mantle plume, *Nature* 434, 851-856.
- Sobolev, A.V. (1996). Melt inclusions in minerals as a source of principal petrological information. *Petrology* 4 (3), 209-220.
- Kazzy, C. et al. (2025). Strontium isotope and trace element compositions of olivine-hosted melt inclusions from the Song Da

ultramafic volcanic suite, northern Vietnam: Implications for chemical heterogeneity in mantle plumes. *Chemical Geology* 674, 122564.

