Tectonic control on melting condition of heterogeneous plume: implications for the cause of high $^3He/^4He$ ratio of FOZO

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Isotopic compositions of OIB are usually explained by mixing of geochemical reservoirs in the mantle, such as DMM, EMs and HIMU [1]. Among the reservoirs, FOZO is distinct from other reservoirs in its high $^3He/^4He$ ratio [2]. Due to this helium isotopic signature, it has been inferred that FOZO could represent material derived from primitive or less degassed region in the mantle. Another notable isotopic feature of FOZO is its intermediate Pb, Nd and Sr isotopic composition between DMM and EMs/HIMU. As this isotope composition differs from the estimated bulk silicate earth composition, it has been suggested that source region of FOZO had experienced differentiation process, meaning that FOZO is not a simple derivative of the primitive mantle.

A recent study has pointed out that Pb, Nd and Sr isotopic composition of FOZO can be explained by recycling of oceanic crust [3], suggesting decoupling between He and Pb-Nd-Sr isotopic systems. Nevertheless, an important feature of the FOZO is their apparent association with a component having $^3He/^4He$ ratios. On the basis of this notion, it is probable that there should be some process linking recycled oceanic crust to a high-$^3He/^4He$ component.

One argument for a link between a high-$^3He/^4He$ component and recycled oceanic crust is that a heterogeneous plume beneath thick lithosphere would tend to preferentially melt enriched components due to their lower solidus temperature, whereas a plume beneath thin lithosphere would yield melts closer in composition to DMM owing to its higher degree of partial melting [4, 5]. In this study, we will evaluate the effect of thickness of lithosphere beneath hotspots and estimate mixing ratios of recycled oceanic crust, DMM and primitive or less degassed material in heterogeneous plumes to constrain geochemical character of FOZO.

[1] Zindler & Hart (1986). *Ann. Rev. Earth Planet. Sc*i., **14**, 493–571. [2] Hart et al. (1992) *Science* **256,** 517–520. [3] Shimoda & Kogiso (2019) *Geochem. Geophys. Geosyst.* **20**, 5549-5472. [4] Ito & Mahoney (2005a) *EPSL*, **230**, 29–46. [5] Ito & Mahoney (2005b) *EPSL*, **230**, 47-63.