Origin of ultra-refractory mantle domain with ancient osmium isotope signature in the Pacific lithosphere constrained by mantle xenoliths from Tahiti and Moorea Islands, Society Islands

*Norikatsu Akizawa[1,2], Akira Ishikawa[3], Tetsu Kogiso[4], Katsuhiko Suzuki[5], Akira Miyake[6], Itaru Mitsukawa[6]

1. Department of Ocean Floor Geoscience, Atmosphere and Ocean Research Institute, The University of Tokyo, 2. Macquarie University, 3. Department of Earth and Planetary Sciences, Tokyo Institute of Technology, 4. Graduate School of Human and Environmental Studies, Kyoto University, 5. Submarine Resources Research Center, Japan Agency for Marine-Earth Science and Technology, 6. Department of Geology and Mineralogy, Kyoto University

The residual harzburgite layer is expected to be perched atop the fertile lherzolite layer in a hypothetical melting column beneath the mid-ocean ridge. In contrast, it is known that world-wide oceanic peridotites record both recent melt extraction beneath the mid-ocean ridge, and ancient melt exhaustion. Thus, melt depletion histories recorded in the oceanic mantle are thus complex. To better constrain the evolutional process of the oceanic mantle, functional mechanism inducing the mantle heterogeneity in terms of the timing of melt depletion is desired to be deciphered. In the oceanic region, numerous mantle plumes thermally and chemically modify the above oceanic lithosphere and cause compositional heterogeneity due to the thermal erosion and successive "heterogeneous" plume impingement on its base. Here, we aim at evaluating the presence of ancient refractory mantle domain derived from such heterogeneous mantle plume using mineral and bulk chemistry with osmium isotopes.

The rock samples used herein are mantle xenoliths from Tahiti and Moorea Islands, members of Society Islands. These oceanic islands are emplaced on ca. 70 Myr-old oceanic lithosphere, where seismically determined lithosphere thickness decreases from 90 km to 70 km due to thermal erosion by the Society mantle plume. The alkali basalts from Tahiti and Moorea Islands are dated at ca. 1.1–0.5 Ma and 1.7–1.5 Ma, respectively. A total of 38 mantle xenoliths were used: 3 lherzolites, 10 harzburgites, 20 dunites, 2 wehrlites, 1 olivine clinopyroxenite, 1 olivine websterite, and 1 orthopyroxenite. The harzburgites and lherzolites show unradiogenic $^{187}Os/^{188}Os$ compositions, whereas the other lithologies show radiogenic $^{187}Os/^{188}Os$ compositions. This contrast results in a bimodal distribution of $^{187}Os/^{188}Os$ compositions throughout all the mantle xenoliths. Because the dunite and wehrlite are similar in compositions of clinopyroxene trace elements and bulk Nd and Sr isotopes (literature data) with the basalts from the Society Islands, we suggest that they are the products after lithospheric mantle and plume-derived melt reactions. Although some of the harzburgites and lherzolites with unradiogenic $^{187}Os/^{188}Os$ are similarly metasomatized by such plume-derived melt infiltrations, "original" ultra-refractory harzburgites with unradiogenic $^{187}Os/^{188}Os$ were recognized from our sample collection. We will present additional investigations targeted at these original ultra-refractory harzburgites, and discuss their origin considering detailed petrography, pressure-temperature histories, and chemical compositions.

Keywords: Mantle plume, Mantle xenolith, Lithosphere-Asthenosphere boundary, Os isotopes, Ancient melting event

