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Highly siderophile element geochemistry of high-Mg basalts from Pacific large igneous provinces

Akira Ishikawa^{1*}, Takashi Sano², Ryoko Senda³, Qing Chang³, Katsuhiko Suzuki³

¹University of Tokyo, ²National Museum of Nature and Science, ³JAMSTEC

Highly siderophile elements (HSEs: Re, Au, Ir, Os, Ru, Rh, Pt, Pd) and the Re-Os isotope system embedded within these elements are recognized as unique geochemical tools for assessing causal mechanism of large igneous provinces (LIPs), because they are potentially effective tracers of core-mantle interaction. HSE-rich signatures in some of the Ontong Java Plateau (OJP) basalts have been previously attributed to the involvement of outer core material in accordance with the plume-head model. However, the model is not universally accepted because other explanations, such as meteoritic contamination in the context of bolide impact model, cannot be rejected. Furthermore, the HSE enrichment could be simply explained by their high degrees of partial melting and be shared by other hot-spot volcanism and continental LIPs hosting major platinum-group mineral deposits. To date, geochemical behaviors of HSEs during magma genesis and evolution of oceanic LIPs are poorly constrained largely due to lack of comprehensive datasets.

In this study, we have developed a renewed analytical protocol that is suitable for small amount of basaltic sample powders (<2 g), with the aim of obtaining accurate ¹⁸⁷Os/¹⁸⁸Os ratios and HSE concentrations (except for mono-isotopic Rh and Au) for oceanic LIP basalts recovered by drilling program. The method includes the regular inverse aqua regia attack at 240 degree C in carius tubes followed by a desilicification step with HF in order to liberate HSEs contained in residual silicates. The effectiveness of our method, which includes the significance of the desilicification step, will be demonstrated by results of replicate analyses of basaltic reference materials BIR-1 and TDB-1 through the comparison of dissolutions with and without HF. We will discuss the possible causes of HSE variations in oceanic LIP magmas based on the data for (1) the high-Mg basalts from Hole U1349A on summit site of Ori massif of the Shatsky Rise (IODP Expedition 324) and (2) Kroenke-type basalts from the OJP (ODP Leg 192).

Keywords: Large Igneous Province, Integrated Ocean Drilling Program, oceanic plateau, plume, highly siderophile elements, Re-Os isotopes