Diffusion-driven Zn isotope fractionation in olivine of intra-plate alkaline basalt in Shandong, Eastern China

CHUN YANG[1], SHENG-AO LIU[1*], ZE-ZHOU WANG[2], HONG-JIE WU[1], SHU-GUANG LI[1]

[1] State Key Laboratory of Geological Processes and Mineral Resources, China University of Geosciences, Beijing 100083, China (Correspondence: lsa@cugb.edu.cn)

[2] Isotope Laboratory, Department of Earth and Space Sciences, University of Washington, Seattle, 98195, USA;

To investigate the petrogenesis of intro-plate alkaline basalts in Eastern China, previous studies reported several metal isotope compositions (e.g. Mg, Zn, etc.) of whole-rock analyses, and the data shows distinct isotopic fractionations toward marine carbonates rather than the mantle. For example, the elevated Zn isotope compositions (average $\delta^{66}Zn_{JMC-3709L}$ of ~0.50‰, and ~0.16‰ for mantle) of Cenozoic alkaline basalts in Eastern China are proposed to reflect deep subduction of surface carbonate into the mantle [1]. However, the possible effect of kinetic process on the bulk-rock isotopic compositions has not been well discussed.

Diffusion between solid phase and liquid plays an important role during magmatic process such as olivine accumulation, and a linearly large-scale co-variation of Zn and Fe isotopic ratios of olivine fragments in picritic lava was reported [2]. In this study, we present in-situ trace element data and Zn isotope compositions for 16 olivine crystalls in alkaline basalts from Shandong province, Eastern China. The olivines are divided into two groups, phenocrysts and xenocrysts, which depend on different Mg# and CaO contents of the crystall core. Nevertheless, Zn isotope ratios for olivine phenocryst exhibit clearly much lighter compositions compared with whole-rock, which cannot be explained by the equilibrium isotope fractionation between olivine and melt [3]. In addition, the correlation between $\delta^{66}Zn$ values and several element contents in olivine further demonstrate a diffusion-driven kinetic fractionation during magma differentiation. The data is fit using an effective model resulting in a β factor of ~0.07 and the large Zn activity gradient between olivine and melt caused the fractionation. Our study therefore demonstrate that Zn isotope of bulk-rock analyses can be used in tracing the mantle heterogeneity.

[1] Liu et al. (2016) *EPSL,* **444***,* 169-178; [2] McCoy-West et al. (2018) *GCA*, **238**, 542-562; [3] Sossi et al. (2018), *CG*, **477**, 73-84.