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Iron Isotope Compositions of Podiform Chromitites from Dazhuqu and Luobusha Ophiolites, Southern Tibet

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Abstract: Podiform chromitites crop out in ophiolitic harzburgites as pod-like bodies associated with dunite envelopes with various thickness. It is widely accepted that the change of melt compositions caused by melt-rock reaction, especially an increase in silica content, plays a crucial role in the generation of podiform chromitite (e.g., Arai and Yurimoto, 1994; Zhou et al., 1994). Due to the presence of ultrahigh pressure and highly reduced minerals, the genesis of some podiform chromitites was attributed to some deep processes (e.g., Arai, 2013; Yang et al., 2007). Although much progress has been achieved, the formation mechanism of podiform chromitites are still in dispute. Iron isotope may be a potential tool to give further insight to the issue, given that some high temperature processes, such as partial melting, metasomatism, magma differentiation and redox change, can result in measurable iron isotopic fractionation to different extent (e.g. Chen et al., 2014; Weyer and Ionov, 2007; Zhao et al., 2009). This study investigates the Fe isotope compositions of chromitites and chromite dunites from Dazhuqu and Luobusha ophiolites. For Dazhuqu chromite dunites, δ^{56}Fe (relative to the standard, IRMM-014) values range from −0.02‰ to 0.11‰ in olivines and from 0.03‰ to 0.08‰ in chromites. Chromites in Dazhuqu chromitites show δ^{56}Fe values varying from −0.03‰ to 0.02‰. In nodular and densely disseminated chromitites from Luobusha, olivines have δ^{56}Fe values of olivines and chromites are 0.09–0.35‰ and −0.15–0.08 ‰, respectively. Chromites from Luobusha massive chromitites have δ^{56}Fe values of 0.07–0.12 ‰.

Based on theorical calculations, chromites should be heavier than olivines in Fe isotope compositions $\Delta^{56}Fe_{Ol\text{-}Chr} \approx -0.08$‰ at 1300 ℃ according to the ionic model (e.g., Macris et al., 2015; Sossi and O'Neill, 2017). However, most of our samples, except for two samples, have $\Delta^{56}Fe_{Ol\text{-}Chr}$ values that are greater than zero, indicating a disequilibrium inter-mineral Fe isotopic fractionation. There is a positive correlation between Fo and δ^{56}Fe (or $\Delta^{56}Fe_{Ol\text{-}Chr}$) of olivines but no positive correlation between $Mg^{\#}$ and δ^{56}Fe (or $\Delta^{56}Fe_{Ol\text{-}Chr}$) of chromites. This phenomenon suggests that the Fe isotopic dis-equilibration may be caused by migrating melts in dunitic channels rather than by the sub-solidus Fe-Mg exchange (Xiao et al., 2016; Zhang et al., 2019). Additionally, the wide δ^{56}Fe range of chromites is similar to those of the subduction-related basalts and boninites, inferring that their parental magmas form in the suprasubduction zone.

Key words: podiform chromitite, iron isotope, Dazhuqu, Luobusha

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