Highly siderophile element geochemistry of komatiites from Pilbara Craton, Western Australia

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The Late veneer hypothesis, which suggests that primitive materials were added to the mantle after core-mantle differentiation, has long been advocated for explaining the excess of highly siderophile elements (HSEs) in the present-day mantle. However, the timing of accretion and mechanisms of subsequent homogenization of the primitive components are not yet well understood. The komatiite magma generated by high degrees of partial melting of mantle is considered to be useful for tracing the chemical evolution of the Archean mantle. Maier et al. (2009) reported that HSE abundances of komatiites in early Archean tend to be lower than those in late Archaean, as a result of the progressive mixing of late veneer materials deep into the mantle. Although this observation and hypothesis may provide a key constraint on the evolution of the Earth’s mantle, the quality and quantity of data are still not satisfactory enough to reveal secular trends of HSE abundances in komatiite sources.
In this study, to further investigate secular trends of HSE abundances in komatiite sources, we focused on the early Archean komatiites from Pilbara craton, Australia. We performed the analyses of Re-Os isotopes and HSE abundances in a series of komatiite flows in the region by using the Carius tube digestion coupled with isotope dilution mass spectrometry. Our primary objective is to test whether the previous data are biased due to (1) low number of measured samples that may underestimate the effects of crystallization differentiation, and (2)less reliable analytical method used (NiS-fire assay digestion coupled with calibration-curve method).
Our results demonstrate that there are systematic variations in HSE abundances and rock types (basalts, basaltic komatiites, olivine cumulates); Os, Ir and Ru (IPGE) show strong positive correlations against MgO contents, whereas Pt, Pd and Re (PPGE) show weak negative correlations against MgO contents. This is broadly consistent with previous indications that IPGE and PPGE behave as compatible and incompatible elements during crystal fractionation, respectively. However, compositional trends regarding Ru and Pt identified in the studied rocks are significantly different from those observed in well-studied komatiites, implying that crystallizing phases controlling HSE abundances are variable between komatiites of different petrogenetic types of lava flow. Although our new data for the komatiite samples in the Pilbara craton are broadly consistent with the previously reported values, effects of crystallization differentiation, particulallry on Ru, must be carefully examined in order to estimate the composition of primitive magma and the source mantle.

Keywords: Komatiite, Re-Os isotope, highly siderophile element

