Lead isotopic systematics of Martian meteorite Zagami

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Introduction: Shergottites (Martian basalts) exhibit a large geochemical variation, having an important role in the identification of geochemical reservoirs on Mars. Zagami, a geochemically-enriched shergottite, consists of multiple lithologies with distinct initial Sr isotopic compositions [1]. This study applies the Pb isotopic systematics to the fine-grained (FG) and coarse-grained (CG) lithologies of Zagami in order to constrain not only the petrogenesis of Zagami but also the origin of enriched shergottite source reservoir.

Experiments: We conducted a five-step acid leaching [2] using whole-rock powders of Zagami FG and CG lithologies. Trace element abundances and Pb isotopic compositions of the five leachates and residues for the individual lithologies were determined with ICP-MS and TIMS, respectively.

Results and Discussion: Trace element signitures of the leachates and residues indicated that the Pb isotopic compositions of leachates were seriously contaminated by secondary Pb, while those of the residues reflect indigineous magmatic Pb components derived from the Zagami parental magma(s). The initial Pb isotopic composition of Zagami FG residue is slightly more radiogenic than that of CG residue. This Pb isotopic difference, combined with the results of previous Sr isotope studies [1], suggests that more than two geochemical reservoirs with different incompatible-element abundances were involved in the Zagami petrogenesis.

Enriched shergottites including the residue samples of Zagami FG and CG form a linear array in the $^{207}Pb/^{204}Pb$ vs. $^{206}Pb/^{204}Pb$ diagram. The initial Pb isotopic heterogeneity within a single meteorite Zagami suggests that the linear variation were formed in mixing two geochemical components. This result, coupled with the other geochemical characteristics of shergottites (e.g., Sr-Nd-Hf isotopes, redox states, and D/H ratios), reinforces that a geochemically-fertillized mantle and the crust on Mars are involved in the formation of enriched shergottites [3].

References: [1] Nyquist, L. E. *et al.* (2013) *Symp. Pol. Sci.* **4**, JSC-CN-29722. [2] Tobita *et al.* (2015) *Goldschmidt2015*, #3138. [3] Tobita *et al.* (2017) *Geochem. J.* **51**, 81–94.