LEAD ISOTOPIC SYSTEMATICS OF MARTIAN METEORITE ZAGAMI.

M. Tobita[1], T. Usui[2], T. Niihara[3], K. Misawa[4, 5] and T. Yokoyama[1], [1]Depatment of Earth and Planetary Sciences, Tokyo Institute of Technology, 2-12-1 Ookayama, Meguro, Tokyo 152-8551, Japan (tobita.m.aa@m.titech.ac.jp), [2]Earth-Life Science Institute, Tokyo Institute of Technology, [3]The University Museum, The University of Tokyo, [4]National Institute of Polar Research, [5]SOKENDAI.

Introduction: Shergottite (Martian basalt) exhibits a large geochemical variation, having an important role in the identification of geochemical reservoirs on Mars. Zagami, a geochemically-enriched shergottite, has multiple lithologies with distinct initial Sr isotopic compositions [1]. The study of Zagami petrogenesis is expected to provide clues to comprehending the shergottite geochemical variation. Lead isotopic systematics is a strong geochemical tracer for studies of basalt petrogenesis because lead has three radiogenic isotopes (^{206}Pb, ^{207}Pb, and ^{208}Pb) from different decay series. Here we apply lead isotopic systematics to the fine-grained lithology (FG) of Zagami that has the most enriched Sr isotopic composition among the four lithologies in Zagami [1].

Experiments: We conducted a five-step acid leaching with 51 mg of Zagami FG. The sample was first rinsed with water (L1) and acetone (L2), and then successively leached with 0.5 M HBr (L3), 1 M HF (L4) and 5 M HCl (L5) at 100 °C for 1 hour, respectively. After the acid leaching, 10% aliquot of the leachates (L1-L5) and the residue (R) was used for the trace element analysis using a quadrupole type ICP-MS (X series II, Thermo-Fisher Scientific), while the reminder was held for Pb isotope analysis using a TIMS (Triton-*plus*, Thermo-Fisher Scientific) at Tokyo Institute of Technology.

Results and Discussion: L3 has REE abundances more than orders of magnitude higher than those of the other leachates (L1, L2, L4, and L5) and the residue (R). L4 and L5 exhibit LREE-depleted patterns with positive Eu anomalies. R exhibits a LREE-depleted pattern with a negative Eu anomaly. These REE signatures suggest that the major contributors in individual fractions are merrillite for L3, maskelynite for L4 and L5, and pyroxene for R in Zagami FG [2].

L3 represents a distinctly low U/Pb ratio. This is inconsistent with the large contribution of merrillite, which typically has a high U/Pb ratio, in L3 as suggested by the REE signatures. Phosphates in Martian meteorites were altered by the percolation of acidic aqueous solution on the Martian surface [3] and/or were contaminated by terrestrial Pb after the fall on Earth [4]. The low U/Pb ratio of L3 should be derived from such secondary Pb added to Zagami on Mars and/or Earth. L5 has a Pb isotopic compositions similar to L3 (Fig. 1), indicating that maskelynite in Zagami FG could be also affected by the same secondary Pb. On the other hand, R has a significantly lower Pb isotopic composition than those of the leachates, suggesting that our 5-step acid leaching successfully removed secondary Pb in Zagami FG. This observation is also supported by the REE pattern; pyroxene is the strongest to the alteration among the major Pb hosts in shergottites.

The Pb isotopic composition of Zagami FG is distinctly more radiogenic than that of the coarse-grained lithology (CG) of Zagami [5] (Fig. 2). This Pb isotopic difference, combined with the previous Sr isotope studies [1], suggests that more than two distinct geochemical reservoirs with different incompatible-element abundances were involved in the Zagami petrogenesis, probably due to magma mixing or crustal assimilation.

References: [1] Nyquist, L. E., Misawa, K., Shih, C.-Y., Niihara, T. and Park, J. (2013) *Symp. Pol. Sci.* **4**, JSC-CN-29722. [2] Wadhwa, M., McSween, H. Y., Crozaz, G. (1994) *GCA* **58**, 4213–4229. [3] Bouvier, A., Blichert-Toft, J., Vervoort, J. D. and Albarède, F. (2005) *EPSL* **240**, 221–233. [4] Gaffney, A. M., Borg, L. E. and Connelly, J. N. (2007) *GCA* **71**, 5016–5031. [5] Borg, L. E., Edmunson, J. E. and Asmerom, Y. (2005) *GCA* **69**, 5819–5830. [6] Tobita, M., Usui, T. and Yokoyama, T. (in press) *Geochemical Journal.*

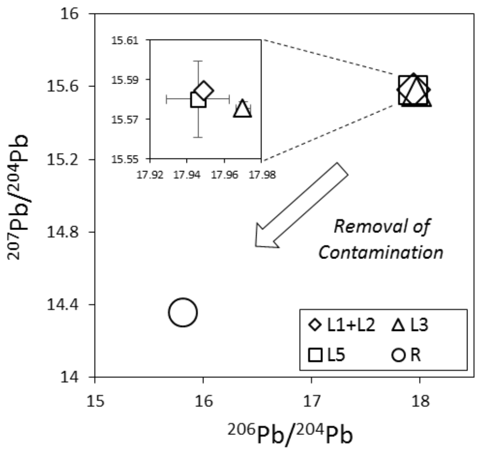

Fig. 1 Pb isotopic compositions of the leachates and residue after the 5-step acid leaching experiment with Zagami FG (see text).

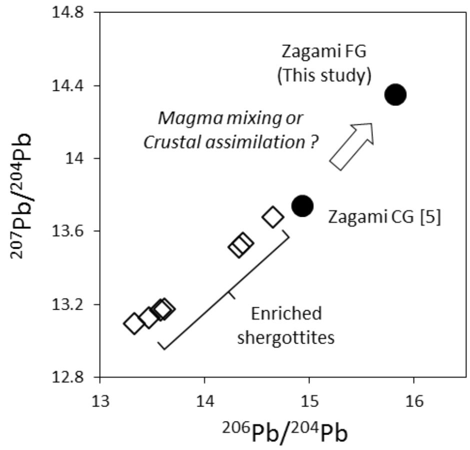

Fig. 2 Pb isotopic compositions of Zagami FG (This study) and CG [5], and other geochemically enriched shergottites (compiled in [6] and references therein).