PETROGENESIS OF GEOCHEMICALLY ENRICHED LHERZOLITIC SHERGOTTITES RBT 04261 AND RBT 04262.

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Introduction: Shergottites sampled two distinct geochemical reservoirs that produce correlations in their magmatic oxidation states, oxygen and radiogenic isotope compositions, and trace element abundances. However, these reservoirs do not correlate with mineralogical and major element compositions. Basaltic and olivine-phyric shergottites individually sampled both geochemically enriched and depleted reservoirs, whereas lherzolitic shergottites are known only to have sampled the depleted one. Here we show that recently discovered shergottites RBT 04261 and RBT 04262 are the first examples of lherzolitic shergottites originating from the geochemically enriched reservoir based on petrographic observations and rare earth element (REE) compositions of minerals.

Results and discussions: RBT 04261 and RBT 04262, which were initially identified as olivine-phyric shergottites, are actually lherzolitic shergottites [1]. Both meteorites exhibit similar textures and mineral compositions, suggesting that they should be paired. Each consists of two distinct textures: poikilitic and non-poikilitic. The poikilitic areas are composed of pyroxene oikocrysts enclosing olivine grains; all pyroxene oikocrysts have pigeonite cores mantled by augite. The non-poikilitic areas are composed of olivine, pyroxene, plagioclase (maskelynite) and minor amounts of merrillite, chromite and Ti-magnetite. Olivines and pyroxenes show the lowest Mg# (~58 for olivine and ~62 for pyroxene), and plagioclase is the poorest in An component (~4) among the lherzolitic shergottites. Moreover, the modal abundances of maskelynite in these two meteorites (20.2 vol% for RBT 04261 and 15.9 vol% for RBT 04262) are distinctly higher than any other lherzolitic shergottites, although further investigation will be required to determine if the studied thin sections are representative.

The REE budgets of RBT 04261 and RBT 04262 are dominated by merrillite (La~190×CI). The slightly LREE-enriched pattern of this mineral ($[La/Yb]_{CI}$~1.6) is similar to that of merrillite in the geochemically enriched basaltic shergottites Shergotty and Zagami, and unlike the LREE-depleted pattern of merrillite in the other lherzolitic shergottites [2]. REE patterns of both high- and low-Ca pyroxenes are also similar to those in Shergotty and Zagami. The calculated REE patterns of melts in equilibrium with the pyroxenes are parallel to that of RBT 04262 whole-rock [3] as well as other geochemically enriched basaltic shergottites.

Conclusions: These petrographic and geochemical observations suggest that RBT 04261 and RBT 04262 represent the most evolved magma among the lherzolitic shergottites and that this magma originated from the geochemically enriched reservoir. Despite having separate launch ages (and sites), all three shergottite types sampled both the depleted and enriched reservoirs.

References: [1] Mikouchi T. et al. 2008. Abstract #2403. 39th Lunar & Planetary Science Conference. [2] Sanborn M. E. et al. 2008. Abstract #912. 18th Goldschmidt Conference. [3] Anand M. et al. 2008. Abstract #2173. 39th Lunar & Planetary Science Conference.