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Petrographic observations of hibonite-bearing inclusions from Murchison using SEM-EDS.

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Hibonite is one of the minerals which condense from the solar nebula at the highest temperature ranges. Therefore, hibonite-bearing refractory inclusions may have important information in the earliest history of the solar system formation. Hibonite-bearing inclusions found in Murchison (CM2) meteorite are morphologically classified into several groups such as SHIBs (Spinel-HIBonite inclusions), PLACs (PLAty Crystals), BAGs (Blue AGgregates) (Ireland, 1988), and each group has its own significant isotopic characteristics (Ireland, 1988; Liu et al., 2009). PLACs and BAGs show large isotopic anomalies in Ca and Ti, and to less extent in Mg (delta-25Mg), but their inferred initial 26Al/27Al ratios are low or even negative. On the contrary, SHIBs show almost canonical 26Al/27Al ratios (˜4.5x10E-5) but almost no anomalies in Ca and Ti. These characteristics may reflect the presence of distinct isotopic reservoirs and their mixing processes in the early solar system.

In order to better understand these isotopically distinct reservoirs and their mixing processes, we recovered about ˜30 of hibonite-bearing inclusions from the Murchison (CM2) meteorite. About 10 grams of the Murchison chips were disaggregated using the freeze-thaw method. Then we applied size separations, magnetic separations, and density separations (using methylene iodide: ˜3.3 g/cm3). Candidates of hibonite-bearing inclusions (containing blue or light blue minerals) were hand-picked under an optical microscope from non-magnetic, dense fractions of the separated grains. After preliminary examinations of these grains with SEM-EDS, they were fixed on a glass slide with epoxy and were examined using an optical microscope. Finally the glass slide was polished so that surfaces of most of the grains were exposed together. They were petrographycally analyzed with SEM-EDS. In the present study, we have recovered 21 SHIBs, 3 PLACs, 2 BAGs, 3 grains either SHIBs or BAGs, and 2 unidentified ones. In addition, some hibonite-free inclusions, especially spinel-rich ones, and a few large spinel grains were also recovered. In the present report, we will show petrographic characteristics of these hibonite-bearing grains in detail and compare them with those of previously reported grains. We will make isotopic analyses (e.g., Al-Mg isotope analysis) on these grains in near future.

References: Ireland T. R. (1988) Geochim. Cosmochim. Acta 52, 2827-2839. Liu et al. (2009) Geochim. Cosmochim. Acta 73, 5051-5079.

Keywords: hibonite, refractory inclusion, isotopic anomaly, Al-Mg chronology, Murchison meteorite