Water Content Analyses on Apatite Grains in H Chondrites by NanoSIMS : Application of Indium Mounting Method

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Although ordinary chondrites have been thought as anhydrous, existence of halite [NaCl] is reported in some fallen H chondrites [1][2], which implies that parent bodies of H chondrites were involved with water. The origin of water in the parent bodies of ordinary chondrites is still unknown. It is proposed that the water might be taken into parent bodies at the time of accretion, or added when icy objects, like comets, had collisions with the parent bodies [1]. Revealing the origin of water in ordinary chondrite parent bodies is significant for understanding the behavior of water in the early solar system. In this study, we focused on H type chondrites.

Apatite [Ca5(PO4)3(F,Cl,OH)] is a phosphate mineral which contains OH^- , F^- or Cl^-. Apatite grains are commonly found on meteorites including H chondrites, and they retain information about volatile elements such as water or halogen [3]. Moreover, it is proposed that formation process of some apatite grains in H chondrites is related to halite [2]. Therefore, apatite grains are expected to be important for understanding the behavior of water in the parent bodies. However, measuring water content of apatite grains in H chondrites had a technical difficulty due to their low water content (~100-1000 ppm [2]). Secondary Ion Mass Spectrometer (SIMS) is an effective method to know in-situ water content of samples with low water content. For SIMS method, meteorite samples are generally mounted in epoxy resins. As epoxy resins fill voids in samples well, the method is suitable for fragile samples including meteorites. However, resins have large influence on water analyses because the resins, which is organic materials, get into the voids. For water content or hydrogen isotopic ratio measurements of meteorite samples, the epoxy-resin method is not suitable due to the contamination from resins because meteorite samples generally have a lot of voids.

Therefore, we focused on another method; mounting solid samples in metallic indium [4][5][6]. Indium has a low melting temperature (~156˚C), and it can be easily cut or formed into preferable shapes. Indium-mounted samples have less influence than samples in epoxy resins, because indium contains smaller amount of water and get into voids less than resins, though the samples in indium is not fixed as those in epoxy resins. Therefore, it is expected that we can conduct water content or hydrogen isotopic ratio analyses on the samples with lower water content (H2O~100-1000ppm) by SIMS using the indium-mounting method. In fact, the indium-mounting method is confirmed to be effective for reducing hydrogen background counts of SIMS analyses; De Hoog et al. (2014) [4] report that H^+ background counts were 165-180 cps for samples mounted in epoxy resins, and 18-21 cps for indium-mounted samples, in their measurements on zircon from Mid-Atlantic Ridge by Cameca 4f.

We conducted water content and hydrogen isotopic ratio analyses on apatite standards and terrestrial olivine (from San Carlos, Arizona) mounted in epoxy resins and indium by NanoSIMS 50 at Atmosphere and Ocean Research Institute, the University of Tokyo, to compare with each other. Moreover, we conducted water content analyses on apatite grains in H chondrites mounted in indium and discussed the origin of water in parent bodies of H chondrites.

References:

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