

## Hydrothermal alteration experiments of the Allende meteorite

IIKUNI, Tsuneyuki<sup>1\*</sup> ; TOMEOKA, Kazushige<sup>1</sup> ; SETO, Yusuke<sup>1</sup>

<sup>1</sup>Graduate school of Science, Kobe University

Among the processes that have affected early cosmic materials including carbonaceous chondrites, water perhaps played the most significant role in the chemical and mineralogical evolution of a range of small asteroidal bodies, by modifying the primary mineralogical characteristics of precursor materials. The obvious effect of aqueous alteration is the formation of secondary phases, such as serpentine and smectite. The diversity in alteration assemblages among various chondrites likely reflect the aqueous environment (e.g., temperature, dissolved ion, duration, water/rock ratio,  $fO_2$ , etc.) of the parent bodies. Although several hydrothermal experiments were made on olivine or pyroxene as starting materials<sup>#1-#2</sup>, little is known about the actual behavior of chondrite toward aqueous fluid<sup>#3</sup>. Here we report hydrothermal alteration experiments of Allende meteorites.

We use Allende meteorites as starting materials. In order to observe micro-textures before and after alterations, we cut out block-shaped samples (2.5 mm×2.5 mm×6 mm) and never crushed. Hydrothermal alteration experiments were performed with PTFE double-vessels (1 ml and 25 ml) loaded into a steel autoclave. In order to maintain a reducing ambient,  $H_2$  gas was generated in the outer vessel by reaction with HCl and magnesium,. All experiments were carried out at temperature of 200 deg.C, where the saturated vapor pressure reaches about 15 bar. As to reaction fluids, we use different pH solution (7, 8.5, 10, 14)<sup>#4</sup> with different water/rock (W/R) ratios (0.5, 2, 8 vol./vol.)<sup>#5</sup>. All run durations are 168 hours. Recovered products were analyzed by synchrotron X-ray diffraction (SR-XRD), scanning electron microscope (SEM) equipped with an energy-dispersive X-ray spectrometer (EDS).

As the results, except for condition of pH 7 and W/R 0.5, serpentine is observed in matrix, which formed at interstitial space of olivine grains of the matrix. As pH value increases, more abundance of matrix olivine are replaced by serpentine. Smectite is observed only under the condition of pH 14 and W/R 0.5. Calcite ( $CaCO_3$ ) is formed on the sample surface under almost all conditions. Under pH 7 condition, anhydrite ( $CaSO_4$ ) is also formed on the sample surface. The results of this study indicate that hydrated mineral formation easily proceeds compared with the previous studies where olivine or pyroxene were used as starting materials.

#1 Ohnishi and Tomeoka (2007) MPS, 42, 49-61. #2 Iishi and Han (2000) Neues Jahrbuch Fur Mineralogie-Monatshefte 2:49-59. #3 Jones and Brearley (2006) GCA, 70, 1040-1058. #4 Zolensky et al. (1989) Icarus, 78, 411-425. #5 Clayton and Mayede (1998) GCA, 63, 2089-2104.

Keywords: carbonaceous chondrite, hydrothermal experiments, hydrated minerals, Allende