

PPS004-P01

Room:Convention Hall

Time:May 27 10:30-13:00

The metal grain size distribution in the NWA1878 mesosiderite

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Mesosiderites are brecciated meteorites consisting of ~50% silicate and ~50% metal. The silicate part is mostly basaltic and is considered to be derived from the crust of an igneously differentiated parent body. The metal part is generally considered to be derived from either a massive iron-meteorite-like projectile or from the core of the parent body. In the latter case, a large impact event disrupted the parent body and the silicate crust and the metallic core re-assembled to form the mesosiderite parent body. The metal composition is, however, chondritic which means, in the models described above, that the metal has to be molten (and homogeneous) when it was mixed with silicates. This is because many siderophile elements strongly fractionate during solidification as shown by the fractionated siderophile abundances in iron meteorites. NWA 1878 is a type B mesosiderite (which means it contains more pyroxene than plagioclase). To naked eyes, the metal grains appear small, granular and well size sorted, contrary to the expectation of derivation from massive liquid iron. If these observations are substantiated, then the provenance of metal may have to be completely reconsidered. Therefore, I obtained the size distribution of metal grains based on a scanning electron micro scope picture of a polished section. In spite of the granular appearance, the metal grains are somewhat sintered at the contact of two grains. This sintering is presumably due to slow cooling at low temperatures (~400C) which is well documented for mesosiderites in general and also for this mesosiderite in particular based on the metallographic features. Because of this sintering it is not possible to determine a unique size distribution. I have to use instinct and fit a spheroid to each (seemingly independent) grain. Then, a radius of a circle with the same area as a spheroid is calculated for each grain and the size distribution was obtained. The distribution is sharply peaked. The mean radius is ~120 micrometer and the standard deviation is ~36 micrometer. In spite of the ambiguity inherent to the way it was determined, the deviation is very small indicating that they are well size-sorted which may result from aerodynamic effects. The mean size is much smaller than that of chondrules and also that of metallic grains in chondrites. At present it is not known if such well size sorted, small grains could be produced from liquid metal by impact. It seems possible to consider that the metal is similar to the metals found in chondrites. This view is consistent with the chondritic siderophile abundances. Iron abundance systematics among chondrites (Urey-Craig diagram) suggests that some metal grains may have been lost from the L and LL chondrite forming regions. The missing metal grains could be the source of the metal in mesosiderites.

Keywords: size, metal, mesosiderite

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Isotopic compositions of liquid water preserved in ordinary chondrites

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Introduction: Over the past three decades we have become increasingly aware of the fundamental importance of water, and aqueous alteration, on primitive solar-system bodies. Some carbonaceous and ordinary chondrites have been altered by interactions with liquid water within the first 10 million years after formation of their parent asteroids. In fact, millimeter to centimeter-sized aggregates of purple halite containing aqueous fluid inclusions were reported in the matrix of two freshly-fallen brecciated H chondrite falls, Monahans (1998, hereafter simply Monahans) (H5) and Zag (H3-6) [1, 2]. Nevertheless, we do not know the isotopic compositions of the aqueous fluid itself. Here we report hydrogen and oxygen isotopic compositions of the aqueous inclusion fluids by secondary ion mass spectrometry.

Methods: The samples used in this study were fluid inclusion-bearing halite crystals of 0.1 to 1 mm in size picked from fresh fracture surfaces of the chondrites. We synthesized fluid inclusions of known isotopic composition in halite crystals in order to calculate delta-values from measurement data. A Cameca ims-1270 equipped with a cryo-sample-stage of Hokkaido University was prepared for the measurements. The cryo-sample-stage (Techno. I. S. Corp.) was cooled down to c.a. -190 degreeC using liquid nitrogen at which the aqueous fluid in inclusions was frozen into ice. We excavated the salt crystal surfaces to expose the frozen fluids by a 15 keV Cs⁺ beam and measured negative secondary ions. A normal incident electron gun was applied to compensate electrostatic charging for the sputtered regions. The secondary ions from deep craters of ~10 micrometers in depth emitted stably but the intensities changed gradually during measurement cycles because states of charge compensation were shifted.

Results and Discussion: Reproducibility of multiple measurements of standard fluid inclusions resulted in +/-90 permil for delta-D, and +/-29 permil for delta-18O. The relatively poor reproducibility is due to variable states of charge compensation on deep sputtered surface among inclusions. On the other hand, the reproducibility of DELTA-17O is +/-8 permil because the observed variations of isotope ratios follow a mass dependent fractionation law.

Variations of delta-D of asteroidal fluid ranges over -330(90) to +1200(90) permil for Monahans and -300(96) to +90(98) permil for Zag. DELTA 17O of asteroidal fluids range over -16(22) to +18(10) permil for Monahans and +3(10) to +27(11) permil for Zag. The variations are larger than the reproducibility of standard analyses and suggest that isotope equilibria were under way in the asteroidal fluid before trapping into halite. The mean values of delta-D and DELTA-17O are +290 permil and +9 permil, respectively. The mean values and the variations of the asteroidal fluids are different from the representative values of ordinary chondrites, suggesting that the origin of fluid was not indigenous to the H chondrite parent-asteroid but rather was an exogenous fluid delivered onto the asteroid from icy objects such as C, P or D asteroids, comets, or icy satellites of outer planets.

References: [1] Zolensky M. E. et al. 1999. *Science*, 285: 1377-1379. [2] Zolensky M. E. et al., 1999. *MAPS*, 34: A124.

Keywords: chondrite, water, isotope

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Interaction among silicates, organics, and water: (1) the role of amorphous silicate

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We have investigated the chemical interaction of silicate, organics, and water at various temperature conditions to get better understanding of evolution of solid materials in the solar nebula with special interest to the evolution of organic materials on silicate. At first, we have carried out thermodynamic calculation for hydration of the amorphous silicate, and we found that the reaction boundary lies at much higher temperature portion compared to crystalline silicates, that is the hydration of amorphous MgSiO_3 takes place at higher temperatures by ~ 300 C compared to crystalline enstatite, and amorphous Mg_2SiO_4 by ~ 200 C than crystalline forsterite. The results predict that hydrous silicate is easily formed from amorphous silicate, which should be abundant in the precursor material of the solar nebula. Because hydrous silicate are a good candidate for the formation and evolution of organic materials, formation of hydrous silicate at high temperature will enlarge a possibility of organic material formation in the nebula. In order to confirm the calculation results, we have done hydration experiments for crystalline and amorphous silicate in water vapor. The results will be presented.

Keywords: silicate, organics, water, interaction