HEATING EXPERIMENT FOR THE EJECTION OF IRON GLOBULES FROM MELTED CHONDRULES.

M. Uesugi[1], M. Oka[1], K. Saiki[1] and A. Tsuchiyama[1].
[1]Department of Earth and Space Science, Graduate School of Science, Osaka University 1-1 Machikaneyama-cho, Toyonaka-shi, Osaka, Japan.
E-mail: uesugi@astroboy.ess.sci.osaka-u.ac.jp.

Introduction: Chondrules have relatively lower contents of siderophile elements than other elements compared to the solar elemental abundance [e.g. 1]. The origin of this feature is still unknown and has been in debate [2]. Recently, Uesugi et al. [3-4] showed that iron globules were ejected from inside to outside of melted chondrules due to surface tension force, if they could reach the surface during chondrule formation, based on the calculation of kinetic stability. If the energy dissipation of viscosity during the ejection was large, the iron globules would lose their energy of motion, and would be trapped on the surface of the melted chondrule.

We investigated the metal-silicate separation process by heating experiment. Results of our experiment show that the ejection would be an important process for the origin of the chemical composition of chondrules.

Method: A mixture of reagent grade oxides was used as a starting material in the present experiments. We used $CaCO_3$, K_2CO_3, and Na_2CO_3 instead of CaO K_2O and Na_2O. Bulk composition of the sample is solar elemental abundance [5]. The iron was included as FeO in the sample. The sample was compacted into 20 mg pellets with 2 mm radius and 1mm height, and fixed on the Pt wire. The sample and Pt wire were covered with carbon capsule. Furnace was filled by H_2 atmosphere with 4 torr pressure in the experiment. The liquidus temperature of this composition is 1900 K, and we heated the samples to this temperature. The duration of heating was 5 min, and both heating and cooling rate were 100 K/min. The heated samples were observed by X-ray CT at Osaka university, with pixel size 11 μm.

Results and Discussion: There are no metallic-iron globules on the surface of the melted silicate. The globules distribute inside the melted silicate or on the surface of outer carbon capsule. This tendency is consistent with the result of calculations of stability [3], and indicates that the dissipation of energy due to the viscosity during the passage of the surface would be considerably small compared to the kinetic energy of motion of iron globules. The results also indicate the possibility either metallic-iron globule is kinetically unstable on the surface of melted silicate, or reduction from FeO occurs not on the surface but inside the melted silicate material. Though more investigations are needed for the origin of iron globules in natural chondrules and precise kinetics of their ejection, the results of our experiment show the possibility that the iron-silicate separation effectively occurred during chondrule formation.

References: [1] Osborn T. et al. 1973. *Geochimica et Cosmochimica Acta* 38:1359-1378. [2] Grossman J. N. and Wasson J. T. 1985. *Geochimica et Cosmochimica Acta* 49:925-939. [3] Uesugi M., Sekiya M. and Nakamura T. 2008. *Meteoritics & Planetary Science* in press. [4] Uesugi M. et al. 2006. *Meteoritics & Planetary Science* 41:A5172. [5] Anders E. and Grevesse N. 1989. *Geochimica et Cosmochimica Acta* 53:197-214.