EXPERIMENTAL REPRODUCTION OF VOIDS IN CHONDRULES UNDER LOW PRESSURE LIKE PREMITIVE SOLER NEBULA.

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

Introduction: 3-D observation of chondrules shows that voids are commonly present in chondrules although their amounts are small (up to 3 vol. %) [1]. If the voids were formed in chondrule formation process, we can obtain information of chondrule formation, such as ambient pressure, heating temperature, and heating time, by investigating the origin of them. Nakashima et al. [2] performed experimental reproduction of voids in chondrules by heating dust ball of mineral grains at 1 atm. They observed many voids but could not reproduce low porosities of natural chondrules. One of the possible origins for the voids in chondrules is interstitial gas among mineral grains in a precursor dust ball, which became voids by melting. If this is the case, the inconsistency between the natural chondrules and experimental products in [2] should be due to the difference of ambient gas pressures between them.

In this study, we performed a new heating experiment under low pressures, which are expected in the primitive solar nebula, to reproduce voids in chondrules.

Method: An FeO-rich analog composition with a low liquidus temperature (~1200℃) to natural chondrules was used as a starting material (FeO~50 wt.%). They were prepared from a mixture of mineral grains of olivine, clinopyroxene, orthopyroxene, and plagioclase. We heated them at 1040 - 1400℃ for 30 s - 40 min at 10^{-3} atm, in a mixing gas of H_2 and CO_2 (H_2 15 ml/min, CO_2 15 ml/min). We observed run products using X-ray CT, and obtained the porosity of run products, connectivity, number density of voids by image analysis.

Results and Discussion: Voids were present in run products heated at more than 1080℃. Many of the run products had higher porosities than natural chondrules as in the case of 1 atm experiments [2]. The porosity does not decrease monotonously, but the void formation occurred intermittently like bubbling. This result shows that the origin of voids in the experiments is not the interstitial gas among mineral grains. Moreover, the voids still existed in the run products even if we removed H_2O by heating at 400 ºC for 1 hour, or Na by taking out plagioclase from the starting materials. This may suggest that voids are formed by vaporization of major elements, such as Fe or Si. The low porosities of natural chondrules might be due to low degrees of vaporization of the major elements. We will obtain more restrictions on the heating conditions of chondrules by obtaining conditions which can suppress vaporization of the major elements at low pressures.

References: [1] Tsuchiyama A. et al. 2003. Abstract #1271. Lunar & Planetary Science Conference. [2] Nakashima R. et al. 2005. 2005 Fall Meeting of the Japanese Society for Planetary Sciences, 104.