HEATING EXPERIMENTS OF TAGISH LAKE METEORITE: INVESTIGATION OF THERMAL EVOLUTION PROCESS OF THE DEHYDRATED CARBONACEOUS CHONDRITES

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Introduction: More than 20 thermally metamorphosed carbonaceous chondrites (TMCCs) have been identified based on the mineralogy, petrology, and organic materials [e.g., 1]. On the other hand, reflectance spectra of C-type asteroids suggest that some of them have dehydrated surface [2]. Therefore, the asteroids which experienced dehydration caused by heating after aqueous alteration can be the parent bodies of TMCCs. The Belgica group represents strongly heated TMCCs consisting of secondary silicates formed by decomposition of hydrous minerals during heating [e.g., 1]. Although the petrography of the Belgica group is apparently similar to typical CM2 chondrites, they are also similar to the Tagish Lake carbonate-poor lithology with respect to their bulk oxygen isotopic compositions and the chemical composition of the matrix [3]. To understand the formation process of the Belgica group TMCCs, we have performed heating experiments on fragments of the Tagish Lake meteorite and observed the mineralogical changes as a function of temperature and duration of heating.

Experimental procedures: To identify the Tagish Lake carbonate-poor lithology, X-ray computed tomography was carried out. Tagish Lake samples consisting of the carbonate-poor lithology were experimentally heated at four different conditions: 600 ºC for 1 hour (hereafter 600 ºC/1 h), 600 ºC/96 h, 900 ºC/1 h, and 900 ºC/96 h. During the heating period, the oxygen fugacity was kept at the IW buffer in order to reproduce the secondary iron-bearing minerals in the Belgica group meteorites. The mineralogy of the matrix was determined using synchrotron X-ray diffraction (XRD) analysis at KEK BL-3A. SEM/EDS observation was performed for the petrography. Organic materials of the heating experiment products were studied using the STXM technique and XANES analysis at KEK BL-13A. In addition, detailed mineralogy and chemical analysis were obtained by TEM observations.

Results and discussion: The weight loss of the matrix during heating is 11% for the heating products at 600 ºC, 17 % for 900 ºC/1 h, and 20 % for 900 ºC/96 h, respectively. The relative degrees of transformation of the Tagish Lake meteorite can be estimated as following; 600 ºC/1 h ≤ 600 ºC/96 h < 900 ºC/1 h < 900 ºC/96 h. These degrees are obtained by observation of mineralogical changes of opaque minerals and crystallinity of secondary silicates as a heating parameter obtained by XRD analysis and SEM observation. The heating products at lower temperature, the constituent minerals are similar to unheated Tagish Lake. Hydrous minerals and framboidal magnetite can be observed throughout the entire matrix. In the samples heated at 900 ºC, it is quite different from samples heated at 600 ºC. Magnetite and hydrous minerals were not detected. Instead of these common phases, Fe-Ni metal, troilite, and low crystallized secondary silicates, olivine and pyroxene, dominate in the matrix. A comparison of the mineralogy of our experimental results to the Belgica group meteorites shows that the sample heated at 900 ºC reproduces the mineralogical and textural characteristics of the Belgica group meteorites. We will present results of XANES analysis and TEM observation of the matrices in these heating products. The coordinated study of organics and mineralogy in heating products will give us new information to understand dehydration process on C-type asteroids.

[1] Nakato A. et al. 2008. *Earth, Planets and Space, 60,* 855-854. [2] Hiroi T. et al. 1993.

Science, 261, 1016-1018. [3] Ivanova M. et al. 2010. *Meteoritics & planetary Science,* 45, 1108-1123.

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