EXPERIMENTAL HEATING OF MURRAY CM CARBONACEOUS CHONDRITE AT 800°C IN THE PRESENCE OF WATER.

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Introduction: In the early solar system, materials in the interior of large hydrous asteroids might have been heated in the presence of water. When the temperature of heating was low and not exceeding phyllosilicate decomposition temperature, the interior material has experienced aqueous alteration to varying degrees, as were observed in CI, CM, and CR chondrites. This hydrous alteration was also examined experimentally (e.g., [1]). On the other hand, when the temperature of heating was higher than phyllosilicate decomposition temperature, then the material was thermally metamorphosed in the presence of water like terrestrial metamorphic rocks. In the present study, we have carried out experimental heating of hydrous carbonaceous chondrite in the presence of water, in order to understand water-assisted dehydration and crystallization process and to investigate differences to dehydration reactions in dry conditions.

Experiments: A small chip (~3mm in size) of Murray CM chondrite and water were encapsulated in Au tube with water/rock ratio of approximately 4. The Au tube was then encapsulated in Pt tube with water and Fe metal. The Pt tube was heated and kept at 800°C and 76 MPa for 100 hours. We performed the same experiment twice and made two experimentally heated Murray samples, S15L and S15S. The experimental products were analyzed by synchrotron X-ray diffraction and a field-emission scanning electron microscope (FE-SEM).

Results and discussion: Three and five small matrix particles approximately 100 μm in size were separated from S15S and S15L, respectively, and analyzed by synchrotron X-ray diffraction. All the particles show similar X-ray patterns: major phases are low-Ca pyroxene and magnetite (or maghemite) and less abundant phases are olivine and albitic plagioclase. No phyllosilicates and no amphibole such as anthophyllite were detected. Since unheated Murray matrix consists mainly of serpentine and TCIs, X-ray diffraction data indicate that all hydrous phases in the original Murray samples were decomposed and dehydrated.

FE-SEM observation revealed that experimental heating in the presence of water changed Murray matrix greatly: matrix of the heated samples consists predominantly of whisker-shape low-Ca pyroxene and submicron-size Fe oxides of magnetite or maghemite. Whisker pyroxene is typically smaller than 10μm in length. Olivine and low-Ca and high-Ca pyroxene in chondrules survived the experimental heating, but TCIs in chondrules are changed to Fe-oxides and possibly chromite.

Heating of hydrous carbonaceous chondrites without water results in dehydration of phyllosilicates into secondary anhydrous silicates. The reaction is well characterized in natural hydrous carbonaceous chondrites (e.g., [2]) and was reproduced experimentally (e.g., [3]). Experimental products of *heating with water* show dehydration and recrystallization process that is quite different from those of *heating without water*, i.e., Murchison heated at 900°C and ~100 hours without water [3]. Apparent differences are found in matrix mineralogy. Heating with water made large (~10μm) whisker-shape low-Ca pyroxene, while heating without water made very small (~100nm) anhydrous silicates mainly of olivine.

References: [1] Jones C. L.and Brearley A. J. 2006. *Geochimica et Cosmochimica Acta*, 70:1040-1058. [2] Nakamura T. 2005. *Journal of Mineralogical and Petrological Sciences*, 100:260-272. [3] Nakato A., Nakamura T., Kitajima F., and Noguchi T. 2008. *Earth, Planets and Space*, 60:855-864.