THERMAL HISTORY OF CARBONACEOUS CHONDRITE PECORA ESCARPMENT 02012.

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Introduction: Thermally metamorphosed carbonaceous chondrites (TMCCs) are plausible candidate for Ryugu surface materials based on the spectroscopic observation [1]. Based on the previous studies, not only Ryugu but also several C-complex main-belt asteroids show similar VIR spectra with the TMCCs [e.g., 2]. Constraints on metamorphic processes that affected these asteroids may come from the study of a significant number of TMCCs [e. g., 3, 4, 5]. Studies of TMCCs indicate that the conditions of thermal metamorphism experienced by these meteorites may have been quite variable, suggesting that metamorphism of the TMCCs was complex [e.g., 6, 7]. We have investigated the Antarctic find, Pecora Escarpment (PCA) 02012 as a unique TMCC [8, 9]. Here we report additional information on the petrology, mineralogy, and organic structure and estimate the thermal history of PCA02012.

Results and Discussion: Studies of PCA 02012 show that it is one of the strongly TMCCs, like B-7904 [8, 9]. In addition, its bulk oxygen isotope composition suggests that PCA 02012 might have been a CM2 chondrite before thermal metamorphism [8]. However, the constituent minerals of the matrix are quite different from the other CMs and TMCCs. The matrix mainly consists of Fe-rich olivine, pyroxene, plagioclase (Ab15-78) and Fe-sulfide. Fe-Ni metal and Fe-rich spinel were also found as minor phases. Based on TEM observations, any phyllosilicates and their pseudomorphs are not observed even though they are observed in experimentally heated Murchison at 900 ℃ for 96 hours.

FEGSEM observation shows that chondrule rims and matrix consist of a mixture of three texture: granoblastic, coarse-grained, and fine-grained (Fig. 1). The granoblastic texture is especially dominant in matrix rather than the rim (Fig.1b). The granoblastic texture in PCA 02012 is similar to amoeboid olivine aggregates (AOAs) in C2 - C3 chondrites, but is much finer grained (100 nm c.f. microns to 10s of microns in AOAs). Annealed textures similar to those in AOAs have been reproduced by heating experiments on anorthite and San Carlos olivine at various temperature for 3 - 100 h [10]. The texture consisting of silicate grains ~10 µm in size formed after 3 h at 1288 ºC. TEM observation of PCA 02012 revealed that this characteristic texture formed with olivine, pyroxene, and plagioclase is the same as the other fine- and coarse-grained textures in the matrix. Therefore, coexistence of these three textures consisting of the same materials suggests that PCA 02012 has suffered thermal metamorphism heterogeneously.

The structural changes of organic material during heating carry important clues to understand the thermal history of PCA 02012. We performed STXM-XANES analyses at the carbon edgeof PCA 02012 matrix and compared of the results to Allende (CV3) and experimentallyheated Murchison. PCA 02012 and heated Murchison show the absence of the graphene feature (~291.6 eV) that corresponds to a 1s-σ* exciton [11] for carbon. In contrast, Allende which suffered long duration thermal metamorphism induced by short-lived radio nuclide decay shows a clear peak of graphene. This result indicatesthat PCA 02012 experienced relatively short duration heating that was too rapid to drive graphitization of the organic material.

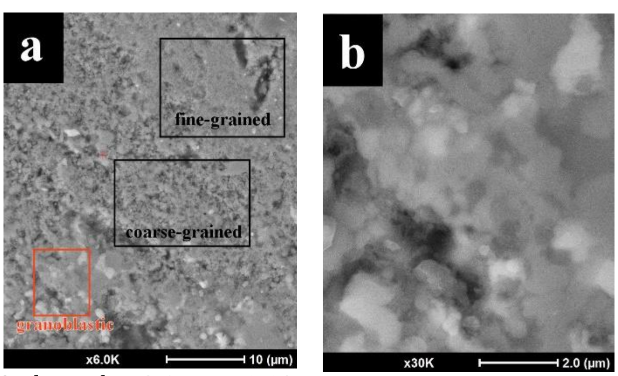

Figure 1. BSE images of PCA 02012. (a) A matrix image. Three textures: granoblastic, fine-grained, coarse-grained, coexist in the matrix. (b) An enlarged-view of granoblastic area in (a).

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