DEHYDRATION DECOMPOSITION OF PHYLLOSILICATES IN THE C-TYPE ASTEROID RYUGU MATERIAL BY SPACE WEATHERING.

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Introduction: We analyzed more than 800 small Ryugu grains as a part of the initial analysis team [1]. Their average sizes of grains collected from the first and the second touchdown sites are ~70 and ~50 µm, respectively. In addition, we also investigated one and three large grains from the “chemistry” and the “stone” teams, respectively. Our “sand” team investigated these grains using FE-SEM, (S)TEM, STXM-XANES, nanobeam XANES, nano-CT, and APT. Several updated results investigated by our team and some results as collaborative work between teams will be presented at this meeting [e.g. 2-8]. The main scientific goals of our team are to clarify the mineralogy of the fine-grained samples and to reveal the nature of the space weathering of the asteroid Ryugu, which belongs to the most abundant C-type asteroids. The surfaces of Solar System bodies that lack atmospheres are exposed to the space environment and experience gradual alteration, called space weathering [e.g. 9]. Its effects on C-type asteroids are poorly understood [9]. Samples returned from the C-type asteroid Ryugu by Hayabusa2 enable resolution of this issue.

Results and discussion: The mineralogy of most Ryugu grains investigated by (S)TEM is similar to that of CI chondrites, which are chemically the most primitive materials in the Solar System. This result is consistent with other recent studies [10-12]. The major modes of space weathering on Ryugu grains are amorphization and partial melting of phyllosilicate surfaces. Reduction from Fe^{3+} to Fe^{2+} in phyllosilicates and dehydration decomposition of the phyllosilicates are associated with the space weathering. Although the physical processes that cause space weathering on Ryugu (solar wind irradiation and (micro)meteoroid impact) are identical to those on the Moon and the S-type asteroid Itokawa [13], the results are substantially different from space weathering of these anhydrous airless bodies. Space weathering of Ryugu promotes dehydration of abundant phyllosilicates via decomposition of serpentine and saponite that has already lost interlayer water molecules (H_2O) and may, therefore, weaken the 2.7-µm band assigned to hydroxyl (–OH) in reflectance spectra [14]. Therefore, the weak 2.7-µm band of at least a part of C-type asteroids might be caused by space weathering.

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