OLIVINE MINERALOGY OF ASTEROID RYUGU SAMPLES AND CI CHONDRITES: FURTHER EVIDENCE FOR THEIR COMMON ORIGIN.

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Introduction: Initial analysis of asteroid Ryugu samples has revealed that they were mm-μm scale breccia mostly composed of aqueously altered phases (e.g., Mg-Fe phyllosilicates, carbonates) and showed remarkable similarities to CI chondrites in mineralogy and chemistry [e.g., 1,2]. Our detailed analysis of Ryugu samples has detected small amounts (<<1 vol.%) of unaltered silicates that would escape severe aqueous alteration [3]. Olivine is the most abundant (>90 vol%) phase among such unaltered silicates. Although most Ryugu olivine grains are smaller than 5 μm, they bear important information about the precursors of the parent Ryugu asteroid. In this abstract we report additional results of olivine mineralogical study of Ryugu samples, and especially compare with olivine grains in CI chondrites (Ivuna and Orgueil) to further discuss their relationship and possible common origin.

Samples and Methods: Polished sections of A0026, A0055, A0063, A0106, C0002, C0023, C0025, C0033, C0040, C0046, C0055, C0076 and C0103 were analyzed using JEOL JXA-8530F FE-EPMA at Univ. of Tokyo. The quantitative analysis was performed at 12 kV accelerating voltage / 30 nA beam current (counting times at peaks: 30 sec), allowing us to obtain accurate compositions even from ~1 μm olivine grain. For comparison, polished sections of Ivuna and Orgueil with similar size to Ryugu samples (a few mm in size) were analyzed by the same method.

Results: Olivine grains are present only in weakly-altered lithologies in Ryugu samples [e.g., 2]. So far we have not found olivine from Chamber A samples. Although we acquired compositions from ~200 additional olivine grains this time, the obtained compositions are basically identical to what we have already obtained [3]. Olivine compositions are clustered at Fo_{99} and extends to Fo_{44}. Most olivine has 0.0-0.7 wt% MnO, and rare (<5%) LIME olivine (MnO/FeO>1 in wt%) grains are present. There is a positive correlation between Mn and Cr in olivine (MnO: 0.0-1.5 wt% vs. Cr_2O_3: 0.0-0.7 wt%) (Fig. 1). Most olivine grains are Ca-poor (CaO: <0.1 wt%).

The comparative analysis of Ivuna and Orgueil has shown that both samples are similarly brecciated to Ryugu samples in size and mineralogy, and we found that weakly-altered lithologies contain tiny (mostly <5 μm) olivine grains. The size, texture, abundance and mineral compositions of olivine in Ivuna and Orgueil are strikingly similar to those of Ryugu olivines both in major and minor elemental compositions (Fig. 1).

Discussion and Conclusion: We found identical olivine mineralogy between Ryugu samples and CI chondrites, further supporting that Ryugu samples are similar to CI chondrites [e.g., 1,2]. Although olivine has been reported in CI chondrites, the reported size is larger than 50 μm in many cases [e.g., 4]. Smaller olivine grains (<5 μm) as found in this study have not been well documented except few cases [e.g., 5]. Because the reported CI olivine composition is slightly different from our CI chondrite data [e.g., 4], there would be multiple origins for olivine in CI chondrites and Ryugu samples. In any case, the presence of small olivine grains (<5 μm) found in Ryugu and CI chondrites is important because such tiny olivine could be common precursors of these chondritic materials.

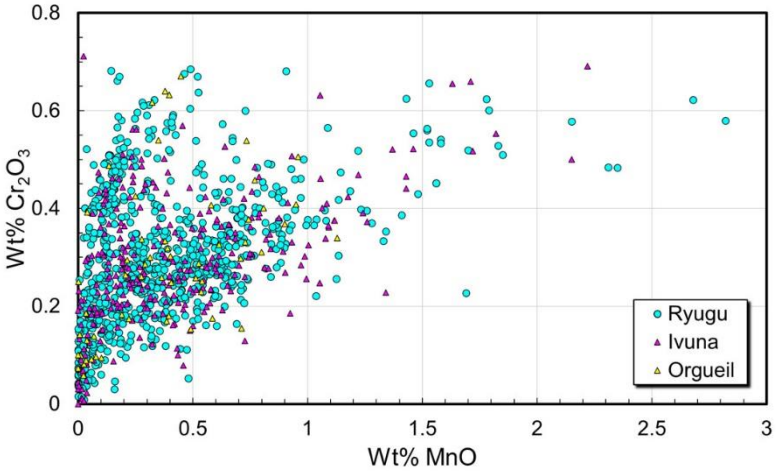

Fig. 1. Mn *vs.* Cr in olivine from Ryugu samples and CI chondrites (Ivuna and Orgueil). Most data are from olivine grains less than 5 μm.

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