ONE YEAR ON! A SUMMARY OF THE ANALYTICAL WORK ON RYUGU PARTICLES CONDUCTED BY PHASE2 KOCHI CURATION.

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Detailed analytical work on Ryugu particles started in June 2021 and involved six initial analysis teams and two Phase2 curation teams (total sample mass ~450 mg, of which 300 mg for the initial analysis teams and ~150 mg for Phase2 curation teams) [1-7]. During this first stage of activity, Phase2 curation Kochi (Ph2K), in association with JAXA curation, has been focused on elucidating the nature, origin and evolutionary history of asteroid Ryugu.

Here we report the analytical results from the first year of Phase2 Kochi curation's integrated bulk and micro-analytical study of Ryugu particles. A particular focus was to investigate the similarities to and/or differences from other known extraterrestrial samples, such as chondritic meteorites, IDPs and returned cometary samples collected by the NASA Stardust mission [1]. Petrological, mineralogical, bulk elemental, and high-precision O isotopic characteristics [1, 8, 9] indicate that the Ryugu particles are very similar to CI chondrites [e.g., 11-13], while excluding the possibility of a connection with the CY chondrites. The bulk analytical results we obtained on our allocated Ryugu particles are in good agreement with those of the initial analysis teams [2, 3, 10]. An important finding is the absence of ferrihydrite and sulfate in the Ryugu particles, which indicates that these minerals in CI chondrites formed due to terrestrial weathering [e.g., 14].

Based on the results of coordinated micro-analysis, utilizing FIB, STXM (carbon-NEXAFS), NanoSIMS and TEM, we have gained a unique insight into the relationship between aliphatic-rich organics and the surrounding hydrous minerals at sub-micrometer scale, formed during water-rock interactions [1]. The aliphatic-rich organics may be widely distributed in C-type asteroids and exist in close association with phyllosilicates. This is consistent with the previous report of aliphatic/aromatic CH in the Ryugu particles demonstrated by the MicrOmega instrument [15]. An important, and as yet unresolved, question is whether the unique nature of the aliphatic carbon-rich organics associated with coarse-grained phyllosilicates observed in this study is found only in material from the Ryugu asteroid [1].

H and N in the FIB sections (total seven sections of the Ryugu particles from Chambers A and C) generally show heavy isotopic compositions. These isotopic variations show similarities with those seen in IDPs, but are slightly higher than CM and CI chondrites [16, 17]. Note that the range of δD in Stardust cometary samples is larger than that of Ryugu [18]. Given the similar isotopic variations of δD and $\delta^{15}N$ in Ryugu particles and IDPs, they could have formed from materials that came from the outer Solar System region [1].

Our findings clearly demonstrate the importance of direct sampling of primitive asteroids and the need to transport returned samples in totally inert and sterile conditions. The evidence presented here shows that Ryugu particles are undoubtedly among the most uncontaminated Solar System materials available for laboratory study and ongoing investigations of these precious samples will certainly expand our understanding of early Solar System processes.

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