Fourier-Transform Infrared Spectroscopy Analysis of Ryugu to Explore its Link to Micrometeorites.

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Samples returned from carbonaceous asteroid 173163 Ryugu represent a new opportunity to evaluate the relationship between micrometeorites and asteroids, their supposed parent bodies. Mineralogical, geochemical and isotopic studies have long hinted at a genetic link between micrometeorites and meteorites [*1–3*]. In particular, some fine-grained unmelted micrometeorites exhibit dehydration cracks and crystallisation of anhydrous silicates which have been interpreted as CI chondritic material thermally altered by atmospheric entry [*4*]. Mid-IR analyses of unmelted fine-grained micrometeorites, as well as partially melted micrometeorites, have allowed a thermal decomposition pathway to be defined, which ranges from slightly heated C1/C2 material preserving obvious signature of parent materials, to highly heated material showing complete replacement of phyllosilicate by an poorly crystallized olivine groundman [*5*]. Comparison of IR spectral properties of fine-grained micrometeorites with C1 and C2 chondrites shows that the latter form the least heated endmember of the aforementioned thermal decomposition pathway.

The similarities between micrometeorites and CI chondrites, combined with the CI-like nature of Ryugu samples studied to date, make fragments returned from asteroid Ryugu the ideal micrometeoroid analogues that can provide crucial information on the sources of micrometeorites [*6*, *7*]. Indeed, micrometeorites are thought to mainly originate from collisional events in the main asteroid belt. Exploring the link between them and Ryugu may provide important clues to the contribution of Near-Earth Asteroids to the flux of dust-sized extraterrestrial matter arriving at Earth.

We report here results of a mid-IR mapping of Ryugu sample A0180 (Fig. 1).

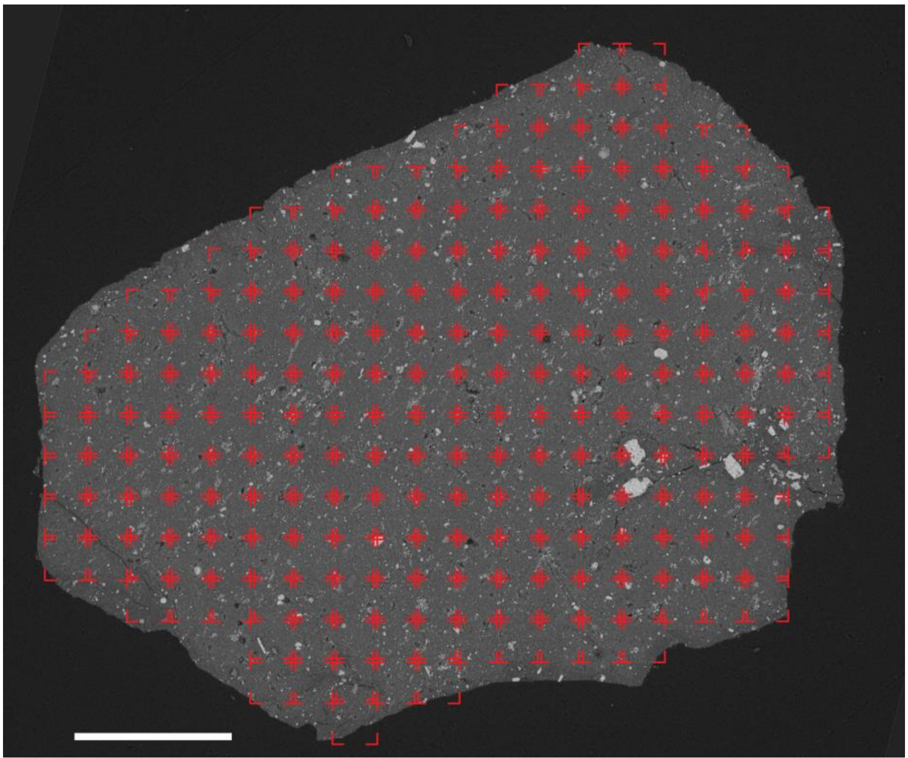

Fig. 1. Scanning electron backscattered image of a section of sample A0180. 50 x 50 µm FTIR analysis sites are displayed as red delineated squares. Scalebar is 200 µm.

A MIR map was acquired on a polished section of sample A0180 using a Thermo Nicolet iS50 bench FTIR spectrometer at the Natural History Museum in London, United Kingdom. The map consists of a grid of 50x50 µm slightly overlapping scanning areas to fully cover the sample (Fig. 1). For analytical consistency when comparison Ryugu's IR spectral properties with other chondritic materials, mid-IR spectra of the following meteorites were acquired: Ivuna (CI1), Alais (CI1), Winchcombe (CM2), Murray (CM2), Cold Bokkeveld (CM2), Colony (CO3.0), Kainsaz (CO3.2) and Ornans (CO3.4).

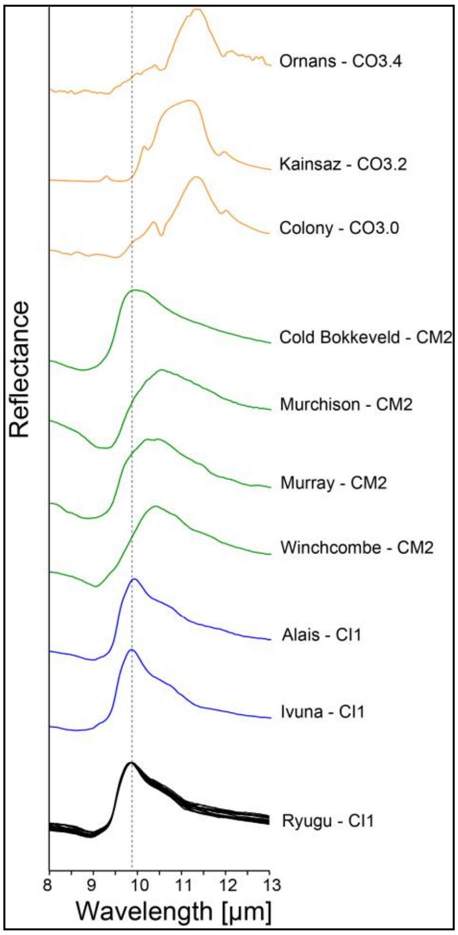

Fig. 2. Comparison of the mid-IR spectra of Ryugu with those of chondritic type specimens.

Petrographic and mineralogical properties of sample A0180 are consistent with CI chondrites [*8*]. The MIR reflectance spectra of A0180 exhibit a Reststrahlen band with a peak at approximately 9.8 µm, indicating a composition rich in phyllosilicates, particularly saponite-like minerals. A shoulder feature around 10.5 µm suggests variability in phyllosilicate compositions, possibly related to serpentine. Overall, spectra are similar those of other Ryugu samples and distinct from those of C2 and C3 chondrites [*6*].

Finally, spectral properties A0180 are consistent with an unheated endmember of the thermal decomposition pathway of micrometeorites [*5*], further strengthening the idea that C1 fine-grained micrometeorites may indeed originate from very primitive aqueously altered asteroids and possibly in part Ryugu itself.

References

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