

INITIAL NOBLE GAS RESULTS FROM RYUGU INSOLUBLE ORGANIC MATTER (IOM) AND OTHER SAMPLES.

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Introduction: JAXA's Hayabusa2 mission successfully returned precious material from C-type asteroid Ryugu [1]. Initial analysis showed that Ryugu is most consistent with CI chondrite material [e.g., 2]. Noble gases in small bulk samples were reported in [3], consistent with CI classification, trapped noble gas components typical for primitive, aqueously altered carbonaceous chondrites (CC) and only short exposure to cosmic rays. Here we present first initial results from analysis of IOM extracted from Ryugu material [4].

Samples and Methods: We analyzed (i) two *Ryugu IOM samples* (A0106-IOM, 26.2±0.5 µg, and C0107-IOM, 4.3±0.5 µg), (ii) two *Ryugu fragment samples* (A0105-02 #2 and C0106-01 #17, masses unknown, hence only elemental and isotope ratios will be discussed), (iii) two *samples of CM1/2 Allan Hills (ALH) 83100* (ALH 83100-1, 15.0±0.8 µg, and ALH 83100-2, 30.5±1.1 µg) and various blank Pt sample container materials. The IOM was produced by demineralization with HF and HCl of bulk material that was beforehand treated by water and solvents to extract soluble organic matter [4]. The fragment samples remained after production of pellets for noble gas examination [3]. Fragment A0105-02 #2 is dominated by probably man-made contamination. Powdered bulk ALH 83100 material was added for verification of the methods and to assess sample heterogeneity at µg-scale by comparing the results with those of a 22 mg sample measured "conventionally" (see [5] for details).

Each sample, wrapped in Pt and preheated at 110 °C for several days, was degassed by heating with a Nd:YAG infrared laser ($\lambda=1064$ nm, ~60 µm laser spot) for 2 min at variable output power >70 % (100 % = 16 W; e.g. [6]), sufficient to degas the sample material, while the Pt remained essentially unmelted. All He to Xe isotopes were measured using an in-house-built static-vacuum sector-field noble gas mass spectrometer equipped with a Baur-Signer ion source [7]. For details on the instrument and the gas cleaning and separation procedures see, e.g., [8].

Large Ne blanks (both air Ne and doubly charged CO₂ on ²²Ne, contributed at minimum ~20% and 10%, respectively) affected the determination of the Ne isotopic compositions of all samples.

Results and Discussion: Most importantly, we were able to determine the noble gas contents in Ryugu IOM. Concentrations of Ryugu IOM are generally lower than those in residues extracted from aqueously altered CCs [9]. Neon isotopes are consistent with a mixture of HL and Q but no abundant Ne-R/G (Ne-E), albeit with large uncertainties [cf., e.g., 9]. The ³He/⁴He ratios in both IOM samples are in the range $1-2 \times 10^{-4}$, typical for HL, P3 or Q in meteoritic residues [9]. The ⁴⁰Ar/³⁶Ar ratios are higher than those reported for meteoritic residues (>>1), suggesting blank Ar, to be corrected for when the run is finished, or remaining K-bearing minerals in the residues. The Xe isotope ratios in A0106-IOM detected with sufficient precision (¹²⁸⁻¹³⁶Xe/¹³²Xe) are consistent with Q, without a significant contribution of HL. As expected, there is no discernable cosmogenic ²¹Ne nor solar wind in the IOM. In general, the concentrations in the micro-samples of ALH 83100 agree well with the large sample. All noble gas concentrations are in the range expected for strongly aqueously altered CMs [5]. Noble gas ratios measured in fragment C0106-01 #17 are consistent with pellet data given in [3], while A0105-02 #2 shows extremely small He-Ar concentrations consistent with the blank and Kr and Xe concentrations only a few times above the blank.

Our preliminary IOM data show surprisingly small gas concentrations, essentially within the range (within a factor of ~0.7-2.7) of the bulk measurements from the pelletized samples measured at ETH [3]. If this depletion did not occur during IOM preparation [e.g., 11], this may indicate distinct parent body processing on Ryugu compared to the parent bodies of the CC meteorites. More detailed comparisons with demineralized residues of aqueously altered type 1-2 CCs including CIs, C-ung, CMs and a CR1 [12] will be presented at the meeting.

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