NOBLE GAS (He, Ne, Ar) AND NITROGEN STUDY OF ASTEROIDAL DUST GRAINS RETURNED BY THE HAYABUSA MISSION.

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Introduction: The samples returned from the surface of the asteroid Itokawa by the Hayabusa mission represent a unique opportunity to analyze material from a pristine remnant of the original building blocks of the terrestrial planets. The first and only noble gas study of Itokawa samples revealed high abundances of solar gases and very low concentrations of cosmogenic neon, implying a short exposure of ≤8 Ma of the grains at the surface of the asteroid [1]. However, only a few precise measurements of the noble gas composition of Hayabusa samples exist to date [1,2], and studies of the lunar regolith have shown that different soil grains may record highly variable volatile characteristics [e.g., 3,4]. Therefore, we would like to expand the existing data set in order to assess any variability of the asteroidal volatile signature.

Samples and experimental methods: Two samples were allocated to us by JAXA, i.e., grains RA-QD02-0174 and RA-QD02-0213. In a first step, our goal was to pre-characterize these samples together with grain RA-QD02-0163 (allocated to the French consortium, see Bonal et al., this symposium) using a combination of non-destructive analytical techniques such as Raman and Infrared spectroscopy. Analytical parameters (e.g., laser power on the sample) were optimized to prevent any sample alteration. Raman and IR confocal spectra were acquired at the SMIS beamline of the French national synchrotron facility SOLEIL using spots <2 µm for Raman, and 10-20 µm for IR analyses. Point analyses and automatic mapping were performed. Diffuse reflectance spectra (i=45°, e=0°) in the visible and near-IR wavelength were obtained with an IAS-CSNSM in-home system coupling a fiber spectrometer to an optical microscope, providing a 20 µm spot on sample (see Bonal et al., this symposium). Raman and IR results and implications will be discussed.

Future work: Once the pre-characterization of the samples is completed, we will determine the noble gas (He-Ne-Ar) and nitrogen abundance and isotope characteristics of the grains by CO2 laser heating or UV laser ablation. By identifying and quantifying the proportion of solar and cosmogenic volatiles in Itokawa samples, we will be able to better constrain the residence time of dust particles at the surface of the asteroid, and to determine if any primordial volatile component has survived in the regolith material. In addition, the N isotope signature represents an additional powerful tool to link the Itokawa asteroid with a particular meteorite group. The data will help our understanding of the formation and evolution of solar system bodies and will provide a framework for interpreting the host of physical and chemical data already obtained, and likely forthcoming with Hayabusa-2 and other space missions.