RAMAN, IR AND OPTICAL MICRO-SPECTROSCOPIC INVESTIGATION OF HAYABUSA PARTICLE RA-QD02-0163.

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HAYABUSA grains offer a unique perspective to better understand the link between asteroids and cosmomaterials available in laboratory and to get an insight on the early stages of surface space weathering. The scientific objectives of our consortium are threefold: (i) the characterization of asteroidal surface processes (space weathering and influence of the water/-OH presence); *(ii)* the assessment of parent-body alteration processes; *(iii)* the search for a possible association between S-type asteroids and micrometeorites. To this aim, our strategy is based on a combination of analytical techniques. Here we report a first series of results obtained through Raman, Infrared and optical reflectance spectroscopy of the Hayabusa sample RA-QD02-0163 (#163 hereafter), provided by JAXA to our consortium.

In a first step, our main objective was to get a maximum of information without altering #163. Reported results were thus obtained on the raw particle, both *(i)* in its original container (through the quartz windows), and *(ii)* deposited on a diamond window. Analytical parameters (e.g., laser power on the sample) were optimized to prevent any damage. 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.

Results: Preliminary Raman and IR results reveal a heterogeneous mixing of minerals, mostly olivine (Fo_{76}), and Ca-rich (Es_{50}, Wo_{50}) and Ca-poor (Fs_{15}) pyroxenes. The modal distribution of these minerals will be later determined based on the spectral maps. The mineral compositions of #163 are consistent with those previously reported on distinct Hayabusa particles [e.g., 1]. The Itokawa materials are compatible with an LL4-6 chondrite classification based on O isotopes and chemical compositions of minerals [e.g., 1, 2]. In particular, #163 might be related to the least metamorphosed particles (LL4), based on the low Fa content of the olivine [1]. The reflectance spectrum (diffuse, visible wavelengths) of #163 is perfectly consistent with the presence of the three main mineral groups detected via Raman. The spectrum is also compatible with the ground-based observations of the asteroid Itokawa [3] both in terms of 1-µm band depth and spectral slope. This is another example that the connection between cosmomaterials available in laboratory and asteroids can be tightened based on reflectance spectroscopy. The moderately red visible spectral slope of #163 also suggests that this particle may include some Fe-rich nanoparticles similarly to what detected on other Itokawa particles [4].

References: [1] Nakamura T. et al. (2011) *Science* 333, 1113-1116. [2] Yurimoto H. et al. (2011) *Science* 333, 1116-1119. [3] Lowry S.C. (2005) *Icarus* 176, 408-417. [4] Noguchi T. et al. (2011) *Science* 333, 1121-1125.