ASTEROID ITOKAWA STUDIED BY RAMAN AND INFRARED SPECTROSCOPY, X-RAY TOMOGRAPHY AND HIGH-SENSITIVITY NOBLE GAS ANALYSIS.

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Introduction: S-type asteroid 25143 Itokawa has been successfully sampled by JAXA's Hayabusa mission, representing, hence, the third planetary body probed by sample return. It consists mostly of type LL5-6 material and experienced severe space weathering and intense surface losses [1-6]. We received material to study the noble gases combined with Raman (RS) and Infrared (IR) spectroscopy, and synchrotron radiation X-ray tomographic microscopy (SRXTM). Here, we summarize our consortium's results, which provide characterizations of grain volumes and mass, mineralogy, structure and noble gas abundances.

Samples & Methods: The allocated samples, including three continuously stored in N_2 to prevent air contamination, are listed in [7]. Methods are detailed there [7-9], too, as well as in companion abstracts presented at this symposium [10-11].

Results: All samples have been examined by RS and revealed the expected mixture of, occasionally relatively fine-grained, minerals; mainly olivine, with some samples containing also plagioclase and pyroxene, and micron-sized, non-siliceous metal-bearing inclusions, mostly troilite, possibly taenite or chromite [1]. Goethite, likely due to terrestrial surface alteration of troilite, was found in a few areas in one of the polished "potted butts". Carbon (including diamond) was also found only on those samples, stemming from the coating for preceding SIMS analysis and polishing [2]. The olivine composition, as determined by IR and RS [9], is Fo_{60} ±15%, broadly consistent with previous analyses [1,12], and expectations for LL5-6 chondritic material. A lack of anisotropy found by IR suggests olivine to consist of small crystals. SRXTM of six grains revealed their 3D shape, mineral distributions, precise total and mineral phase volumes, and hence, mass, and the location of the denser, non-siliceous inclusions. Due to instrumental difficulties with both high-sensitivity mass spectrometers (He-Ne in Zurich [8,10] and Xe in Manchester), only one particle (RQ-QD02-0035) has been analyzed for noble gases so far. It shows the expected presence of abundant solar wind He and Ne. A cosmic-ray exposure age of ~1-3 Ma [10], smaller, but consistent with the upper limit of 8 Ma given earlier [6] could be determined. This range, if can be substantiated with further grains, implies either a young, continuously sputtered regolith in the Muses-C region [6], or may have resulted from a recent event that produced and exposed material that was previously shielded from cosmic rays, which, perhaps, could have contributed to the present shape of asteroid Itokawa.

References: [1] Nakamura T. et al. [2] Yurimoto H. et al. [3] Ebihara M. et al. [4] Noguchi T. et al. [5] Tsuchiyama et al. [6] Nagao K. et al. all: 2011. *Science* 333: 1113-1131. [7] Busemann H. et al. [8] Meier M.M.M. et al. [9] Böttger U. et al. all: 2013. *LPSC* 44: abstracts #2243, #1937, #2092. [10] Meier M.M.M. et al. [11] Böttger U. et al. both 2013. this volume. [12] Noguchi T. et al. 2012. *Bunseki Kagaku* 61:299-310.