SYLVITE AND HALITE CRYSTALS ON ITOKAWA PARTICLES: SALTS ON ITOKAWA?

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Introduction: The parent bodies of ordinary chondrites are likely to be currently almost anhydrous. However, equilibrated ordinary chondrites show the latent clues of aqueous activity before thermal metamorphism [1], and aqueous activity after thermal metamorphism has recorded in two H chondrites regolith breccias Zag and Monahans, in which halite NaCl and sylvite KCl crystallized from fluids have been discovered [2, 3]. But it is still unsolved whether the halides precipitated from indigenous fluids derived from the interiors of their parent bodies or from exogenous fluids that were added as water-containing material to the regolith later [3, 4].

25143 Itokawa is an S-type asteroid Itokawa [5], and particles returned by the Hayabusa spacecraft showed mineralogical and isotopic affinities to LL5-6 chondrites [6, 7]. Nevertheless, the initial analysis of the Itokawa particles reported rare halite (2 among ~1500 particles) among fine-grained (average diameter ~4 μm) particles collected on a Teflon spatula [6]. But their occurrence and origin have been unclear yet because high magnification scanning electron microscopy has not been performed yet. We looked for subtle clues for aqueous activity on the surface of Itokawa particles.

Results and discussion: RA-QD02-0034 is a flat-shaped particle composed of olivine, low-Ca pyroxene, troilite, and high-Ca pyroxene and shows sporadic distribution of micrometer- to submicrometer-sized sylvite crystals on its external surface. STEM observation shows that the sylvite crystals had been enclosed in epoxy resin when the sample was ultramicrotomed. The external surface of RA-QD02-0034 was coated by the same epoxy resin at the Planetary Material Sample Curation Facility of JAXA (PMSCF/JAXA) to minimize the contact with the air just after it was withdrawn from the Clean Chamber #2 [6]. Therefore, it is plausible that the sylvite crystals and the embedding amorphous material had existed on the external surface of RA-QD02-0034 when it was in the chamber. The embedding amorphous material is enriched in O, Na, and Si. Unfortunately, because of their small sizes, further analysis has not been performed yet. Therefore, there is no conclusive evidence for the extraterrestrial origin of the sylvite. But, interestingly, an additional Itokawa particle RA-QD02-0129 that has ~5 μm-sized halite NaCl crystals attached on its external surface particle were identified [8]. We mention here that salts may exist more abundant than previously thought on the surface of anhydrous S-type asteroids if they found in this study are preterrestrial because we encountered sylvite after observation of only ~10% external surface of the twelve particles by STEM [9].

References: [1] Grossman et al. 2000 MAPS 35: 467-486. [2] Zolensky et al. 1999 Science 285: 1377-1379. [3] Rubin et al. 2002 *MAPS* 37: 125-141. [4] Brearley et al. 2005 In: MESS II. [5] Binzel et al., 2001 MAPS 36: 1167-1172. [6] Nakamura et al. 2011. *Science* 333:1113-1116. [7] Yurimoto et al. 2011. *Science* 333:1116-1119. [8] http://hayabusaao.isas.jaxa.jp/catalog/CO/ [9] Noguchi et al. 2011 Science 333: 1121-1125.