BULK CHEMICAL COMPOSITIONS OF TINY GRAINS RECOVERED BY THE HAYABUSA SPACECRAFT – A NAA STUDY

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Introduction: As a part of the initial analysis of the returned samples from Itokawa, we conducted bulk chemical analysis of a tiny single grain by using instrumental neutron activation analysis (INAA). Our result was included in the *Science* issue [1]. We again performed a similar experiment for additional two grains as the second run of the initial analysis and will present the analytical results on these grains here.

Samples: Two rocky grain samples (RA-QD02-0064 and RB-QD04-0049; about 50 μm x 50 μm in size for both) were chosen for this study. RA-QD02-0064 (hereafter, A0064), which was recovered from the chamber A of the sample catcher, was one of the samples used for the first run of the initial analysis. RB-QD04-0049 (hereafter, B0049) was recovered from the chamber B and newly released for second run of the initial analysis. A0064 consists mosltly of olivine whereas B0049 is composed of olivine, plagioclase, pyroxe and Ca-phosphate.

Analytical procedure: The samples were first inspected by X-ray tomography at the X-ray syncrotron facility (Spring-8) and then analyzed by INAA for bulk chemical compositions. The samples was irradiated for 27 h by reactor neutrons at Kyoto University Research Reactor Institute (KURRI) with thermal neutron flux of 8.2 x 10^{13} $cm^{-2}s^{-1}$. The γ-ray measurement was done at KURRI by using a Ge detector.

Result and discussion: A total of 15 elements (Na, K, Sc, Cr, Mn, Fe, Co, Ni, Zn, La, Ce, Nd, Sm, Eu and Au) were determined. Anomalously high Au content was observed in B0049-2, possible due to contamination before INAA.

Five REEs (La, Ce, Nd, Sm and Eu) were determined for B0049. Although this grain was observed to contains Ca-phosphate minerals by X-ray tomography, obtained values of five REEs were too high to be exlained by the presence of Ca-phophate. In fact, abudnaces for light REEs are much higher than those in Ca-phosphate separates from oridinary chondrites [2]. Two possible explanations can be available for such REEs.

Two B0049 samples and A0064 show similarly low Co/Ni ratios. Such an extreme fractionation can be seen in taenite and terta-taenite metal phases [3] although no metal grains were observed in these samples by X-ray tomography.

Both A0064 and B0049 have relatively high FeO/Sc ratios, which are similar to those for olivine separates from ordinary chondrites. This clearly shows that these grains are extraterrestrial in origin and are similar to olivine in ordinary chondrites.

References: [1] Ebihara M. et al. (2011) *Science* 333 : 1119-1121. [2] Ebihara M. and Honda M. (1984) *Earth and Planetary Science letters* 63 : 433-445. [3] Kong P. and Ebihara M. (1997) *Geochimca et Cosmochimica Acta* 60 : 2667-2680.