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Lithium-boron and helium-neon analyses on asteroidal regolith returned by the Hayabusa mission.

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The Itokawa asteroidal regolith was sampled by a Japanese spacecraft, Hayabusa. The sample contains abundant solar wind (SW) noble gases [1]. In this study, we analyzed SW Li and B as well as He and Ne shallowly implanted into the Hayabusa sample. The allocated samples RA-QD02-0167 and RA-QD02-0209, ~50 μm sized olivine grains, were pressed into Au foil. First we obtained depth profiles of secondary $^{6,7}Li^+$, $^{10,11}B^+$ and $^{30}Si^+$ ions, using the NanoSIMS at MPI. Subsequently, we measured He and Ne isotopes at ETH Zürich. We found that RA-QD02-0167 is clearly enriched in ^{10}B by ~16 %, with $^{10}B/^{11}B = 0.288 \pm 0.023$ (2σ; solar = 0.248) and a B concentration of 250 ppb at >30 nm depth. If the ^{10}B excess is attributed to cosmogenic B, the exposure age would be ~10^{10} yr, highly unrealistic. Instead, we invoke SW implantation to explain the ^{10}B excess. The inefficient Coulomb drag model predicts isotope fractionation between SW and the Sun with ^{10}B excess up to ~40 % [2]. In this case, the corresponding SW irradiation age is $10^{4\text{-}5}$ yr. The data reduction of the noble gas analysis is in progress.

[1] Nagao K. et al. 2011. Science 333:1128. [2] Heber V. S. et al. 2012. ApJ 759:121.

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