

SPECTRAL VARIATION ON ASTEROID ITOKAWA SUGGESTING REGIONAL RESURFACING.

S. C. Koga¹, S. Sugita¹, S. Kamata², M. Ishiguro³, T. Hiroi⁴ and S. Sasaki⁵, ¹Dept. of Complexity Sci. and Engr., Univ. of Tokyo, ²Dept. of Earth and Planetary Sci., UC Santa Cruz, ³Dept. of Phys. and Astr., Seoul National Univ., ⁴Dept. of Geological Sci., Brown Univ., ⁵Dept. of Earth and Space Sci., Osaka Univ., E-mail: koga@astrobio.k.u-tokyo.ac.jp.

Introduction: Itokawa samples brought back by Hayabusa mission have been extensively analyzed, leading to a variety of results, such as cosmic exposure age [1] and evidence for space weathering [2]. However, accurate interpretation of these data require geologic context within the Itokawa surface variation. In order to obtain such geologic context of the sampling site, we examine the spectral variation on Itokawa surface in this study.

Principal component analysis method: Many spectroscopic taxonomical schemes of asteroids have been constructed using principal component (PC) analysis [e.g., 3,4]. We decomposed multi-band visible spectra of Itokawa surfaces, obtained by AMICA (Asteroid Multi-band Imaging Camera, [5,6]), with the PC's defined by 540 asteroids observed in ECAS (Eight-Color Asteroid Survey) [7] consisting mainly of main-belt asteroids (MBA's). We also decomposed and compared meteorite spectra in pulse-laser irradiation experiments that simulated space weathering by micrometeoroid bombardment [8,9] in the PC space.

Itokawa spectral variation: All the spectra of Itokawa surfaces, ECAS asteroids, and the meteorites were plotted in the PC1-2 space. Itokawa surface spectra turned out to span widely along a line from around Q-type area, spectrally young [10], to the central area of the S-type cluster, spectrally more matured (more space-weathered). The spectroscopic distribution of Itokawa surfaces along a narrow linear trend in the PC1-2 space defined by the MBA spectra coincides with the spectral change of meteorites due to laser irradiation [11]. PC score spatial distribution reveals that some regions, such as a crater interior and the top of large boulders, exhibit lower degree of weathering and that other areas, such as smooth terrains, more weathered. The shift distance of meteorites spectra along Itokawa distribution in the PC space was approximately logarithmic function of cumulative irradiation energy. The spectral age of the most mature areas on Itokawa was estimated to be 2-4 times as old as the freshest.

Implication for regional resurfacing on asteroids: Global resurfacing due to tidal forcing during Earth encounters has been proposed for young spectral age for Q-type asteroids [12,13]. Such a process, however, would not explain heterogeneous degree of space weathering found on Itokawa. Regional or local processes, such as impact cratering and land slides, on an asteroid may also play an important role in resurfacing asteroid surfaces. An accurate understanding of such regional variations would be important for interpretations for the analyses of Itokawa samples.

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