DIFFERENCE OF SPACE WEATHERING DEGREE ON ASTEROIDS OF VARIOUS SIZES

S. Sasaki[1] and T. Hiroi[2], [1]RISE Project, National Astronomical Observatory of Japan, 2-12 Hoshigaoka, Mizusawa, Oshu, Iwate 023-0861, Japan (sho@miz.nao.ac.jp), [2]Department of Geological Science, Brown University, Providence, RI 02912, U.S.A.

Introduction - Space Weathering: The surface of airless silicate bodies in the solar system show darkening of overall reflectance, spectral reddening, and attenuation of absorption bands in time. Space weathering is considered to be responsible for these optical signatures. According to the space weathering, the surface of airless silicate bodies show darkening, spectral reddening and weakening of absorption bands in time. Formation of nanophase metallic iron particles in soil coatings would be responsible for the process [1]. Those nanoparticles were confirmed in lunar soils as well as meteorite sample [2, 3] and they would derive from the deposition of ferrous silicate vapor, which was formed by high velocity dust impacts as well as sputtering by solar wind. Nano Fe particles were also confirmed by laboratory simulation using pulse laser shots [4].

Regolith or Not: Spacecraft observation of large (>10km) S-type asteroids shows regolith-covered weathered surface as expected. Spectral slopes of near-Earth asteroids suggest that the transition from Q-type (ordinary chondrite-like) objects to S-type objects occurs around the size range 0.1 to 5km [5]. It was considered that the presence of regolith on larger bodies should enhance the space weathering and that smaller regolith-free bodies would not have weathered surface.

However, observation of 550m Itokawa by Hayabusa suggested that the rocky small asteroids should be weathered although they are lack of regolith [6]. High resolution (a few cm) image on a darker terrain of Itokawa shows various size of dark boulders without fine regolith. Some large boulders have brigher scratches and dots on the surface. These can be explained by impact of small meteoroids on the rock surface coated with a very thin weathered layer.

Pulse laser irradiation simulating space weathering on meteorites revealed, surface of ordinary chondrite pieces can have darkened/reddened coating [7]. The irradiation experiments also show that rocky surface is less likely to be weathered than particulate surface. However, surface mixing probably caused by impacts would have weakened the weathering on the particulate surface. This effect should be taken into account for regolith-covered larger bodies such as Eros, Ida, and, of course, the Moon.

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