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Difference of space weathering among the Moon, Mercury, and asteroids

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The surface of airless solid silicate bodies such as the Moon, Mercury and asteroids shows darkening of overall reflectance, spectral reddening, and attenuation of absorption bands in time. "Space weathering" is considered to be responsible for these changes of optical properties, and the presence of regolith is considered as a key for the space weathering. In 2005, Hayabusa observed a small S-type asteroid Itokawa. The rocky small asteroid has weathered surface. High resolution (cm) image on a darker boulder-rich terrain of Itokawa shows various size of dark boulders without fine regolith, which would imply the rock surface is composed of a very thin weathered layer. Moreover, surface mixing caused by impacts would weaken the weathering on the particulate surface. This mixing effect should be prevailing on larger bodies covered with regolith. The older view that the presence of regolith would strengthen the weathering should be corrected.

The Moon and the Mercury are covered with regolith. Mercury has more craters with bright ejecta and rays than the Moon. This might imply that the weathering rate on Mercury is significantly slower than that on the Moon, although dust flux and solar wind flux causing the weathering is one order of magnitude of greater on Mercury than on the Moon. Compositional difference would explain the weathering difference. Another possibility for attenuating the space weathering on Mercury would be deeper mixing depth. The surface mixing by impacts on Mercury is greater than that on the Moon, because of higher impact flux and velocity of incoming meteoroid bodies. Looking at color variation of small craters, MESSENGER as well as BepiColombo may investigate the effect of the surface mixing on the space weathering.