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Space Weathering and Spectral Change on Mercury

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Reflectance spectra of airless silicate bodies is darkened and reddened with time timescale longer than 108yr. This process is called "space weathering". It is believed that space weathering is caused by formation of nanophase iron particles through high-velocity impact of interplanetary dust particles. Since impact flux and velocity of dust particles on Mercury would be much higher than those on the Moon and asteroid, spectral darkening and reddening on Mercury would be faster [1].
Mariner 10 data and recent ground observation suggest the surface reddening due to the space weathering is prevailing on Mercury [2]. However, Mercury has many craters associate with bright ejecta and rays. Some of them would be compositionally controlled where underlying low-albedo – unweathered – materials would be excavated and ejected. Mercury observation up to now show that relative low-Fe and plagioclase rich surface crust, which would suppress the spectral change by the weathering. But using pulse laser irradiation simulating space weathering [3], we confirmed that plagioclase spectrum should be also reddened by the effect of other minerals such as olivine. On Mercury, probably higher impact flux and velocity of impacting meteoroids would stir the surface regolith more effectively than on the Moon, which may moderate observed spectral change.
Spectral survey of possible young craters on Mercury by Messenger and BepiColombo would clarify the space weathering rate in comparison with relative crater density age. MDM (Mercury Dust Monitor) on board BepiColombo will clarify the present dust flux and velocity onto Mercury. Dust flux causing the spectral change would be mainly due to so-called beta meteoroids, which are produced by mutual collisions or disruptions of interplanetary dust. Dust measurement at Mercury's orbit would give precise distribution of beta-meteoroids.

Keywords: space weathering, interplanetary dust, reflectance spectrum, reddening, nanophase iron particles, regolith.

References

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[2] D. T. Blewett and J. Warrell, LPSC XXXIV #1155 (2003).
[3] S. Sasaki et al., *Nature* 410, 555 (2001).