Space Weathering on Mercury

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Space weathering on Mercury is informed by lunar, asteroid, and laboratory studies, along with extrapolations, predictions, and measurements acquired during MESSENGER's Mercury flybys. Space weathering describes a set of processes and their effects on the physical, chemical, and mineralogical properties of regoliths on airless bodies. Much of our understanding of these processes comes from examination of lunar samples and lunar remote-sensing observations that reveal the primary space weathering products are agglutinates and nanophase iron ($NpFe^0$), which increase in proportion to soil maturity. The effects of agglutinates and $NpFe^0$ on the ultraviolet–visible–near-infrared spectrum of lunar soils include spectral darkening, reddening, and subdued absorptions bands. Comparison of asteroid reflectance spectra with the spectra of meteorites and laboratory experiments of space weathering processes also provides important information.

Space weathering processes include solar wind and energetic particle bombardment, solar radiation, and impact by meteoroids and cometary debris. The flux, energy, and composition of particles or materials each play a role in the type and magnitude of the physical (comminution, vaporization, and gardening), chemical (production of $NpFe^0$, sputtering, and hydration), and mineralogical (glass/agglutinate production, devitrification, and metamorphism) alterations experienced on a given body.

Space weathering products on Mercury need not be the same as those found in lunar soils. In general, such products are likely to depend on the specific environmental conditions under which they were produced. For example, the characteristics of a planetary object's magnetic field can shield the surface, or can focus ions onto specific and localized surface regions, thus influencing the magnitude of space weathering effects and possibly introducing regional variations.