MERCURY'S WEATHER-BEATEN SURFACE: AN EXAMINATION OF THE RELEVANT PROCESSES THROUGH COMPARISONS AND CONSTRASTS WITH THE MOON AND ASTEROIDS.

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Introduction: The physical, chemical, and mineralogical properties of the regoliths of atmosphere-free planetary bodies are altered by a set of processes collectively termed space weathering. These processes include bombardment by micrometeorites, solar wind ions and electrons (or where applicable magnetospheric ions and electrons), thermal processing, and irradiation by photons [e.g. 1, 2]. Intimate mixing of fine-grained constituents has been added to the list of possible processes to explain Vesta's spectral properties [3]. The resulting physical, chemical, and mineraologic changes affect the remote sensing observations (namely color and spectral observations) of these bodies.

Sample returns from the lunar surface, and now from asteroid Itokawa [4, 5], have provided insights into the nature of these alterations. Based on the paper by Domingue et al. (2014) we review the potential role of the major space weathering processes and their application to the surface of Mercury.

Micrometeorite Bombardment. The flux of impactors on Mercury is at least 5.5 times that for the lunar surface, with a mean impact velocity that is 30 – 60 % higher [6, 7]. This results in enhanced melt and vapor production, greater material reduction and devolatilization, and an environment condusive to the added production of nanophase materials compared to either the lunar or asteroidal scenarios [2]. This environment supports the production of thicker rims on grains due to impact melt and vapor deposition in addition to the formation of a greater abundance of agglutinates [2].

Ion and Electron Bombardment. This process both sputters and implants material into the regolith. The net results are to destroy the crystalline lattice of the upper grain layers (thus creating an amorphous rim), premote the production of nanophase material, migrate volatiles within the regolith, and foster the migration of materials within grain centers to grain exteriors [e.g.2]. Mercury's magnetic field operates as an imperfect shield to solar wind and magnetospheric charged particles [8, 9], creating latitudinal variations in surface irradiation (Fig. 1).

Thermal Processing. Mercury experiences large temperature fluxuations due to its proximity to the Sun. Examination of temperature cycling of relevant sulfides [10] has demonstrated spectral changes strongly affect remote determinations of surface composition.

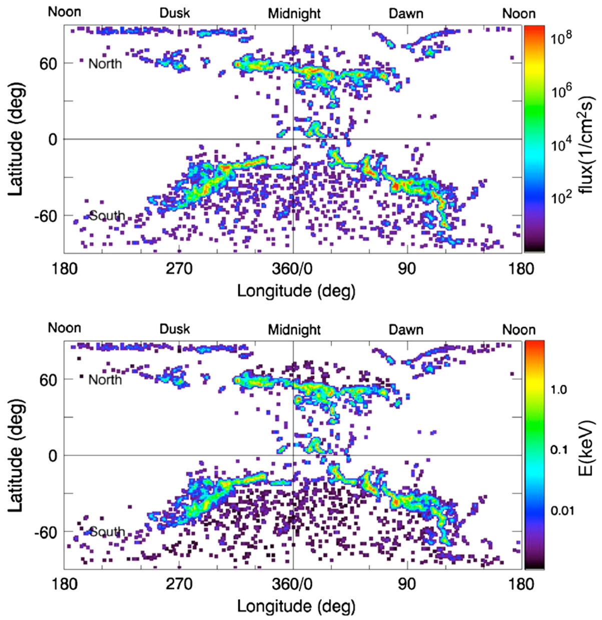

Fig. 1. Taken from Schriver et al. (2011) and Domingue et al. (2014), these graphs show the electron precipitation flux (top) and the electron precipitation energy (bottom) simulation correlating to MESSENGER's first flyby of Mercury. Longitude is a function of local time and not geographic longitude.

Mercury Global Properties. We present examination of global color properties and their correlations to the predicted trends due to particle bombardment and thermal processing. We examine color ratios and color slope analyses commensurate with lunar and asteroid weathering studies as applied to Mercury.

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