LUNAR SWIRLS, SPACE WEATHERING, AND LATITUDINAL SPECTRAL TRENDS. I. Garrick-Bethell[1,2], [1]Department of Earth and Planetary Sciences, University of California, Santa Cruz (igarrick@ucsc.edu), [2]School of Space Research, Kyung Hee University, South Korea.

Introduction: Lunar swirls are high-albedo features correlated with crustal magnetic anomalies [1, 2]. Swirls exhibit low amounts of space weathering and low relative abundances of hydroxyl/water molecules [3]. Therefore, swirls are at the intersection of several important fields in lunar and planetary science. Here I highlight some of the recent work on the formation and properties of these features, and show how they have provided fundamental insights into space weathering.

Formation theories: The dominant theory for swirl formation has been that the magnetic field is able to stand off the solar wind, a weathering agent, from the lunar surface [1]. Lesser attention has been given to the comet impact model [4], largely due to difficulties producing remanent magnetism in the crust, but the idea has been revived [5]. The newest ideas have focused on processes that modify the structure of the regolith, either by lofted dust due to electrostatic fields generated by magnetic field-plasma interactions [6], or due to modifications of the putative "fairy castle" structure of the regolith [7]. To date, however, radar observations [8], thermal inertia studies [9], and considerations of magnetic field geometry [10] have failed to support such theories. Photometric anomalies that have been reported at swirls remain a puzzle that helps keeps the soil modification theories alive.

Optical properties and space weathering implications: One of the most recent insights is that while swirl soils are optically immature, they are distinct from classically immature soils [6]. Interestingly, their spectral properties mimic the spectral properties found at high latitudes [11] (Fig. 1). This suggests that the solar wind flux, rather than the accumulated dose, controls how space weathering manifests itself – a fundamental result. This discovery has been supported by differences found between the pole and equator facing slopes of high latitude craters [12] (each have different angles of attack with respect to the solar wind), and has implications for interpreting spectra in polar regions.

Other latitude-dependent spectral trends: Supporting evidence for latitude-dependent space weathering effects has recently been reported by Jeong et al. [13], who finds that regolith grain size increases at high latitudes. This has been interpreted to be due to the roughly ecliptic population of micrometeoroids, and their reduced flux and weathering efficiency at high latitudes (Fig. 2). Other latitude-dependent spectral trends have also been reported [14].

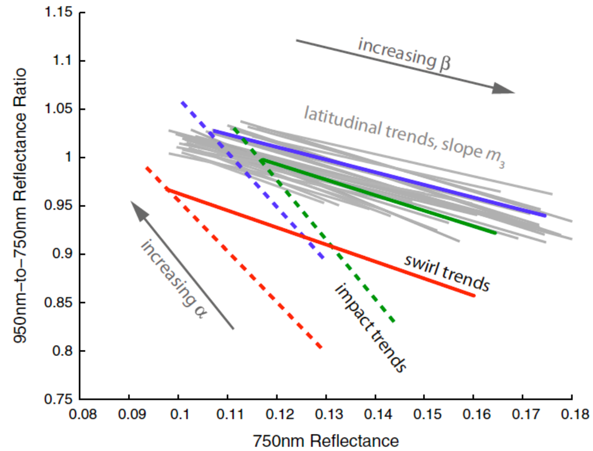

Figure 1. Latitudinal variation in spectral properties match the variations across lunar swirls [11].

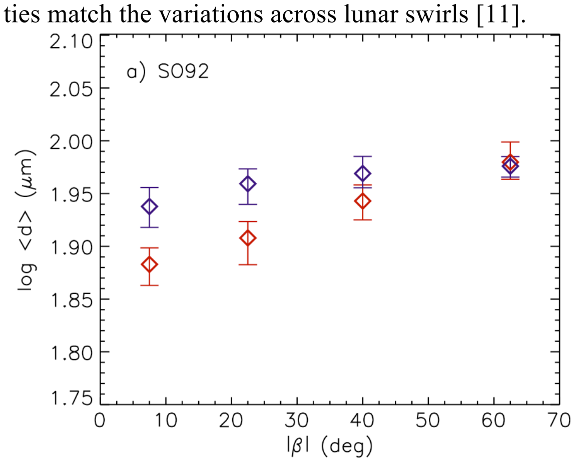

Figure 2. Latitudinal variation in regolith grain size (*d*) for maria (blue) and highlands (red), as inferred from polarimetry measurements [13].

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