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Vesta Phase Reddening as seen by Dawn

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The Dawn spacecraft has been in orbit around the asteroid Vesta since July, 2011. The on-board Framing Camera has acquired thousands of high-resolution images of the regolith-covered surface through one clear and seven narrow-band filters in the visual and near-IR wavelength range. The availability of this data set allows us to study the phenomenon of phase reddening. The reflectance spectrum of atmosphereless solar system bodies is known to vary with phase angle. This is known as phase reddening, because the spectrum is usually (but not always) observed to become redder with increasing phase. It has been found for a variety of bodies like the Moon and asteroids. Phase reddening has also been demonstrated in laboratory studies using regolith simulants. It is not fully understood. We determine how the spectrum of Vesta changes as the phase angle of observation increases. First, the slope in the visual part of the spectrum increases (becomes redder), and second, the 1-micron pyroxene absorption band deepens. Analysis of the VIR 2-micron band depth shows a similar trend (Capaccioni et al, LPSC 2012). These effects are qualitatively similar to those determined from ground based observations, but are dramatically weaker. These differences must be related to either the different observation geometry (for disk-integrated observations, a large portion of the disk has large emission angles) or inaccuracies in the calibration. We compare our results to those for other asteroids, and interpret them in terms of geometric optics simulations. In the end, our findings will contribute to a deeper understanding of the physical properties of the regolith like grain size, mineralogical composition, aggregation state (glasses, agglutinates), and degree of space weathering.