doi:10.1038/nature11534

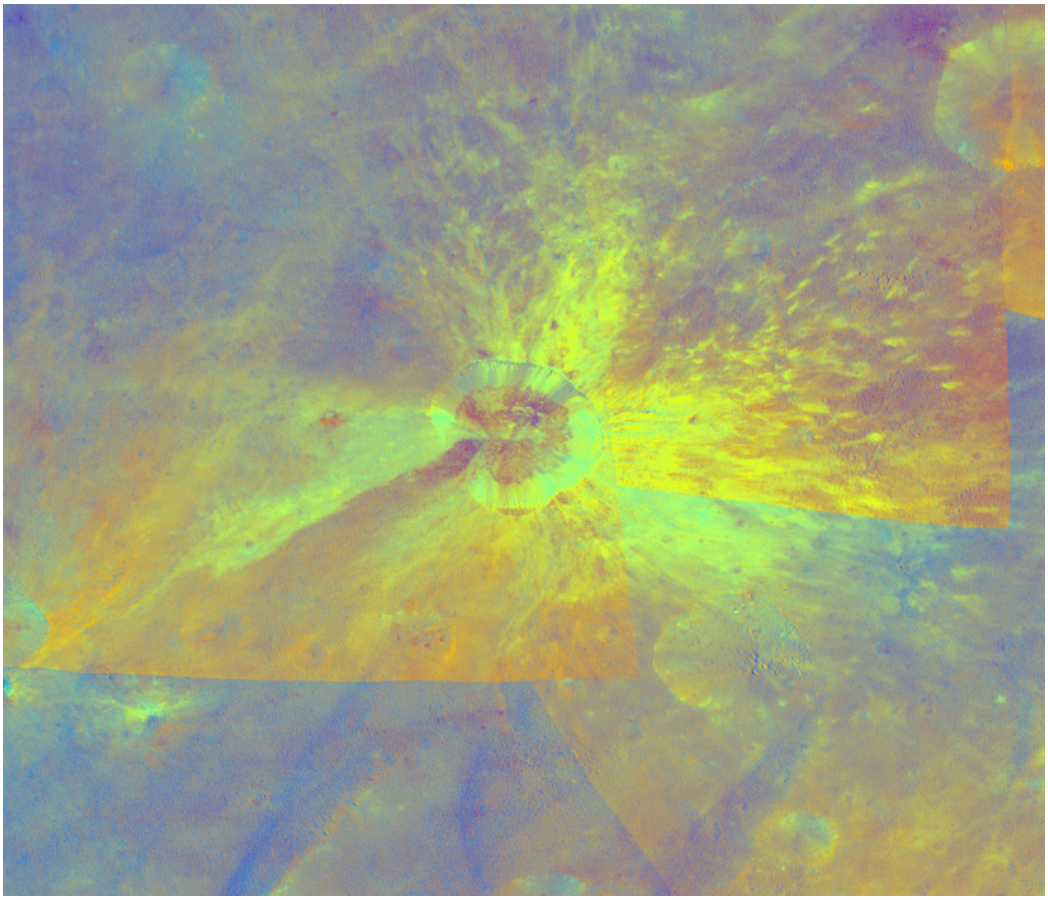

Figure S1. Framing Camera color composite mosaic (R=750/440, G=750/920, B=440/750) of the region around Canuleia from the High Altitude Mapping Orbit (HAMO) phase, illustrating details seen in the freshly exposed material surrounding the crater. In this color composite, green tones indicate the presence of a relatively strong pyroxene absorption near 930 nm due to ferrous iron in the crystal structure.

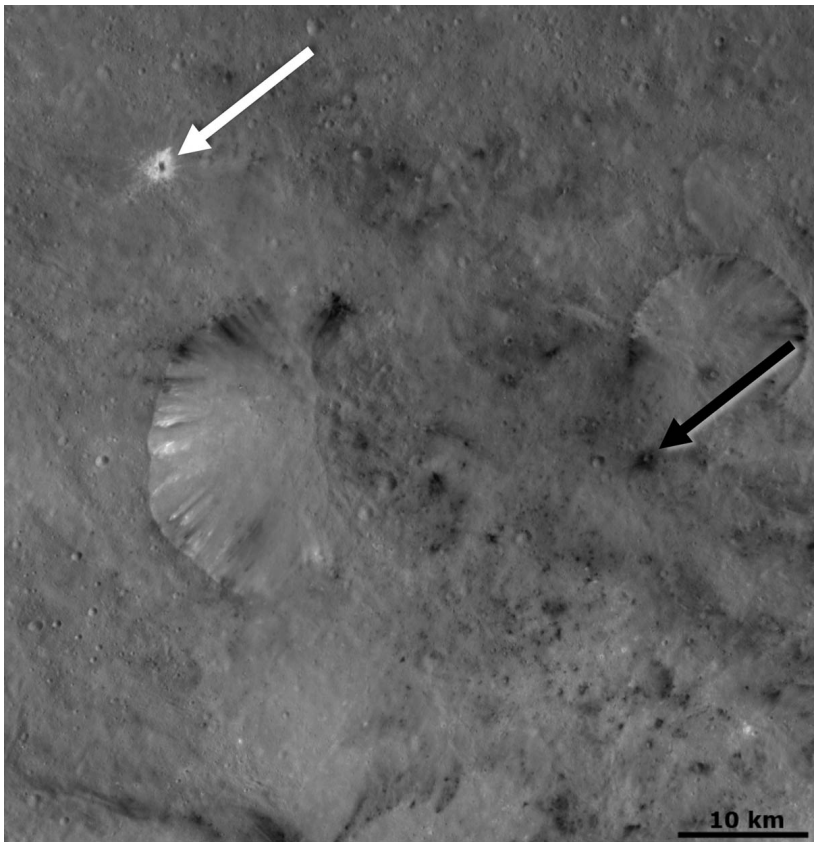

Figure S2. Framing Camera (FC) clear filter image of Helena crater that has been orthorectified and photometrically corrected (without the topographic effects of shading and shadows) illustrating brightness variations across the region. The large arrows indicate the same two small fresh rayed craters shown in Figure 2.

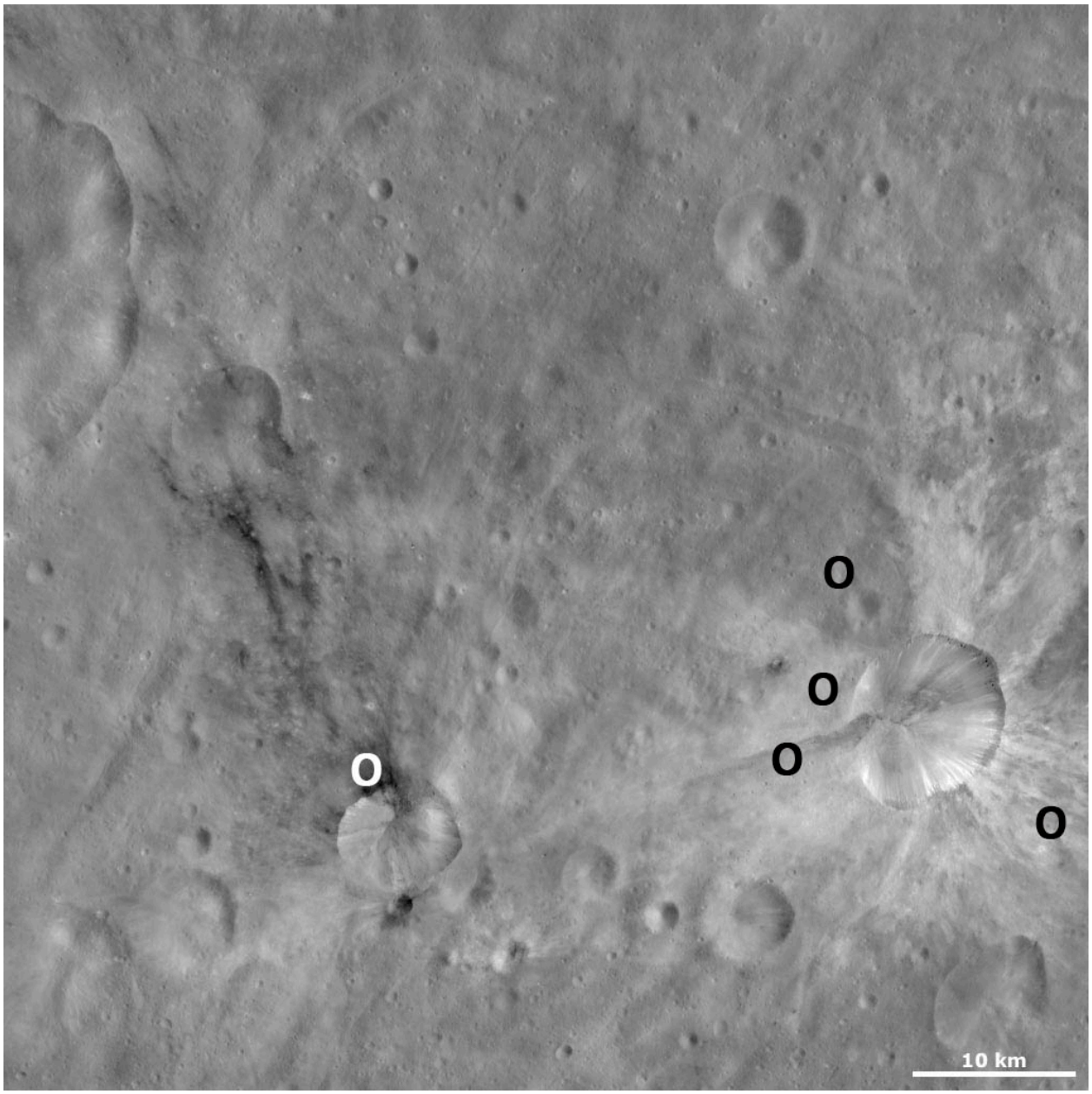

Figure S3. Framing Camera clear filter image of the Canuleia and Sosia region similar to that of Figure 3, but with a photometric correction applied to remove most of the effects due to illumination variations across topographic features. The dark and bright patterns of the ray system of these two moderate size fresh craters are seen prominently. The circles indicate the location of Vesta spectra 1 – 5 in Figure 4. Area 5 (white circle) is associated with a dark ray that extends NNW.

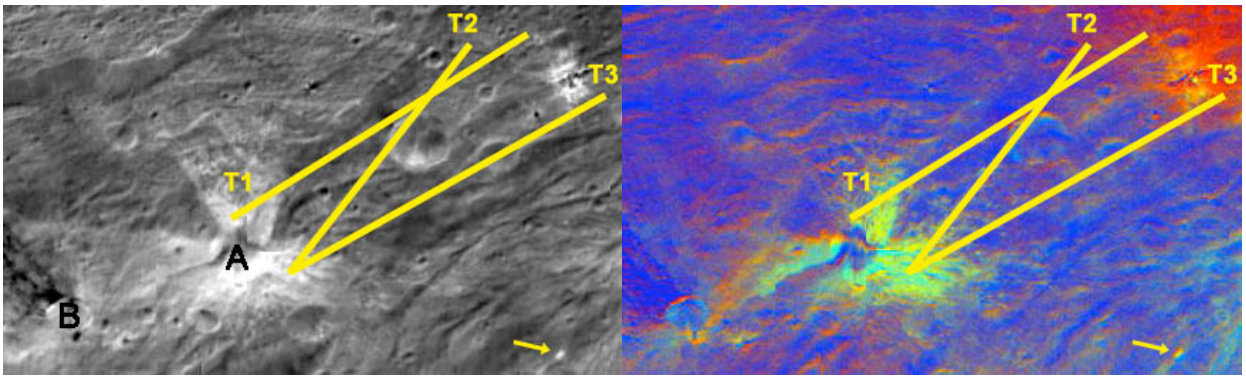

Figure S4A. FC color images from Survey phase showing the location of three traverses from Canuleia (crater A) toward the northeast across a crater of comparable size but without bright rays. Left: 750 nm brightness image. Right: Enhanced color composite image with R=750/440, G=750/920, B=440/750.

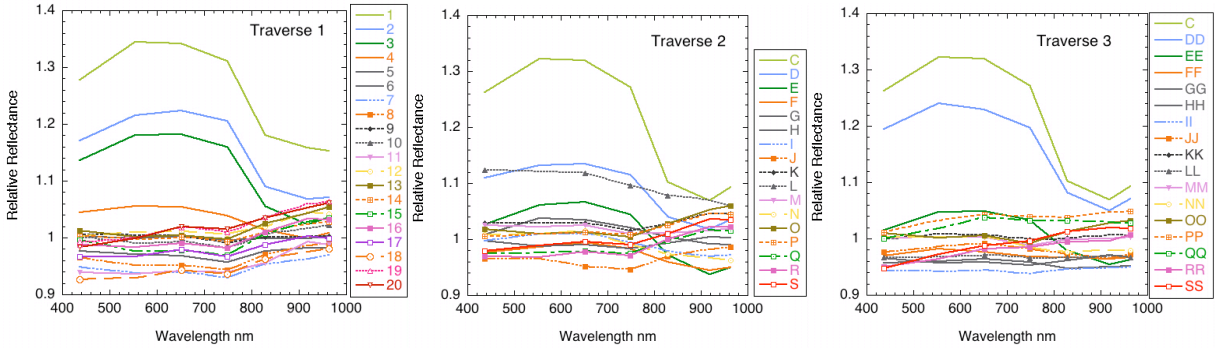

Figure S4B. The three traverses for FC 7-color relative reflectance data starting from Canuleia (crater A) toward the northeast across an unnamed crater of the same size. These traverses illustrate the spatial and spectral change from freshly exposed regions into background material across Vesta, comparable to the spectra shown in Figure 4e. Relative spectra are produced by ratioing to the spectrum of a standard background area

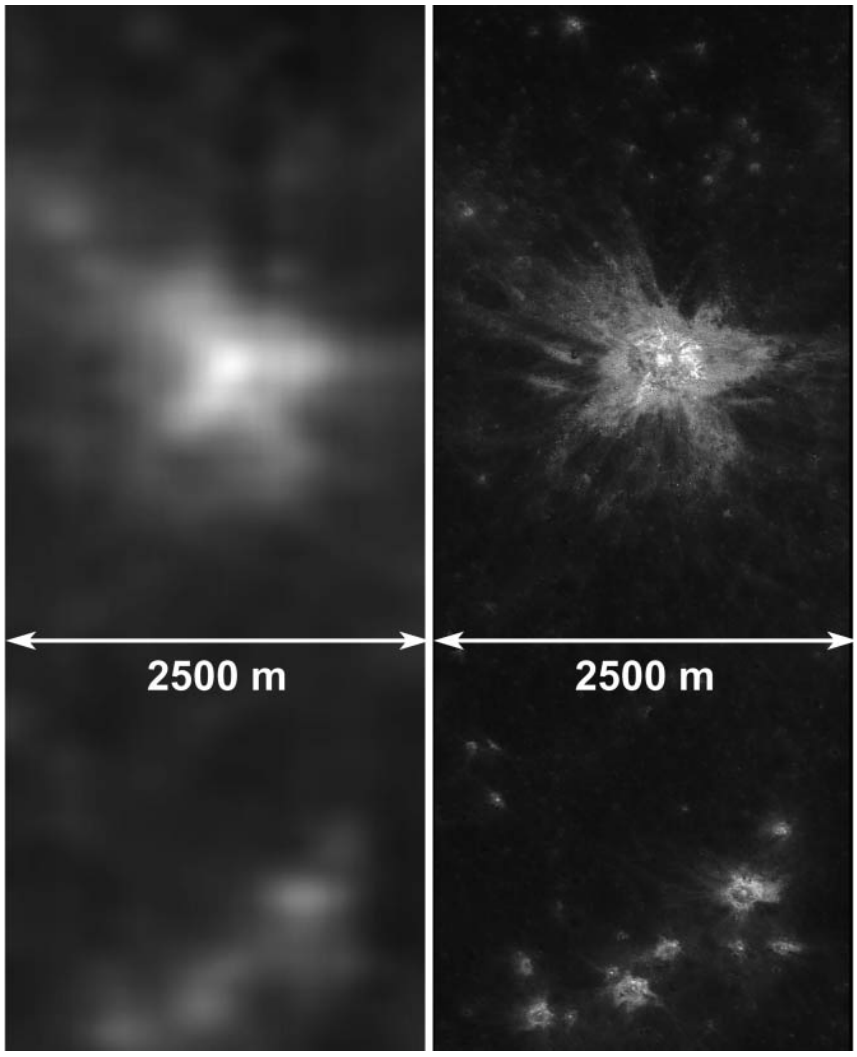

Figure S5. Co-registered images across a fresh lunar crater in Mare Crisium obtained by the Moon Mineralogy Mapper (M^3) [left] and the Lunar Reconnaissance Orbiter Narrow Angle Camera (LRO-NAC) [right]. The traverse of M3 spectra shown in Figure 4a & 4c starts from the center of the large crater near the top center and proceeds toward the east for another ~1000 m beyond the edge of this image. These fresh craters are located in a basaltic terrain and are believed to be secondary craters from the very young crater Giordano Bruno[32].

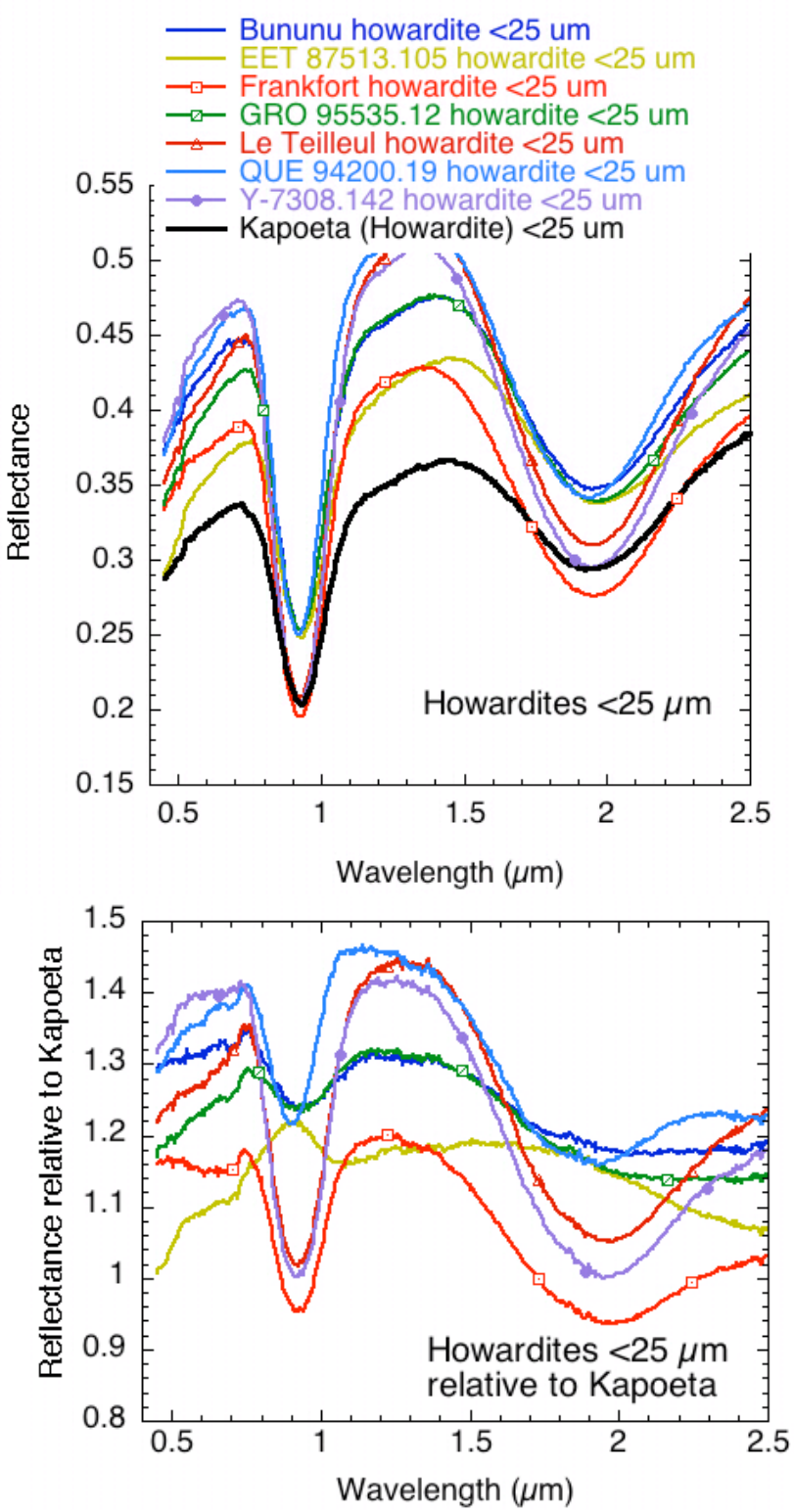

Figure S6. Bidirectional reflectance spectra of representative howardite meteorites, prepared to <25 μm[33]. These are directly comparable to Figures 4b and 4f and show the same general characteristics as VIR measurements of Vesta: variable ferrous band strength near 1 μm, lack of coordinated NIR continuum slope 0.7-1.5 μm, and highly variable continuum in the visible.

References

32. Basilevsky, A. T., and Head, J. W. Age of Giordano Bruno crater as deduced from the morphology of its secondaries at the Luna 24 landing site, submitted to *Planetary and Space Science* (2012).
33. RELAB Public Data, Takahiro Hiroi, Sample Investigator, [http://www.planetary.brown.edu/relabdata/]