**SURFACE MATERIAL INVESTIGATIONS BY GROUND BASED OBSERVATIONS AND/OR SPACECRAFT DATA.**

T. H. Burbine. Astronomy Department, Mount Holyoke College, South Hadley, MA 01075, USA. E-mail: tburbine@mtholyoke.edu.

**Introduction:** The last fifteen years has seen considerable advances in determining asteroid mineralogies from remote sensing data. These advances are primarily due to the ease that near-infrared spectral data can now be obtained and the dedicated spacecraft missions that have travelled to numerous asteroids. For example, near-infrared reflectance spectra allows the bulk mineralogy of olivine-pyroxene assemblages to be easily determined from Earth. Spacecraft missions allow high-spatial spectra to be obtained and the ability to correlate mineralogies with geologic features on the surface. Also, geochemical analyses can be obtained using data from instruments that analyze gamma rays, X-rays, or neutrons emitted from the surface.

**Results:** However to believe any mineralogical interpretation from remote sensing data, "ground truth" is needed. Returned samples, which can be studied in detail in the laboratory, will supply this "ground truth." For example, S-type (25143) Itokawa was predicted from ground-based observations to have an LL-chondrite mineralogy [1] by some researchers and an olivine-rich primitive achondrite mineralogy [2] by other researchers. Since Itokawa was the target asteroid for the Hayabusa sample return mission, these predictions could be proved or disproved. Returned grains showed that Itokawa had an LL-chondrite mineralogy [3], confirming that asteroid mineralogies can be determined remotely.

**Future:** But over 600,000 asteroids are known to exist so almost all asteroid mineralogical interpretations will have to be done using just remote-sensing data. The best strategy for making progress in mineralogical analyses of asteroids is to have sample returns from a variety of taxonomic classes. The next scheduled asteroid sample return missions are the Hayabusa 2 mission to C-type (162173) 1999 $JU_3$ and the OSIRIS-REx mission to B-type (101955) Bennu. These missions will help decipher the mineralogies of asteroids that are deemed "primitive" from Earth-based remote sensing observations.

**References:** [1] Binzel R. P. et al. 2001. *Meteoritics & Planetary Science* 36:1167-1172. [2] Abell P. A. et al. 2007. *Meteoritics & Planetary Science* 42:2165-2177. [3] Nakamura T. et al. 2011. *Science* 333:1113-1116.