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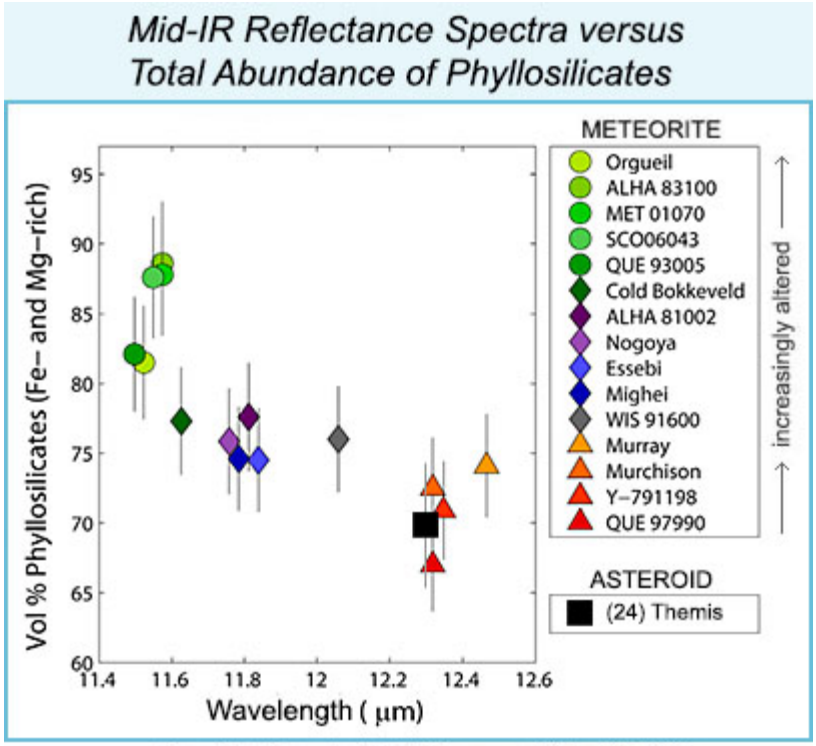
Mineralogical–Spectral Details of Meteorites Shed Light on Dark Asteroids

Researchers are adding to the mineralogical–spectral database of meteorites in order to improve the spectral analyses of asteroids.

Maggie McAdam and Jessica Sunshine (University of Maryland), Kieren Howard (Kingsborough CC/CUNY, AMNH, NHM/London) and Tim McCoy (Smithsonian Institution) report the visible/near-infrared and mid-infrared reflectance spectra for a suite of well-characterized CM and CI ***carbonaceous chondrite*** meteorites. Their spectral studies add to the modal mineralogy, relative ferric iron content derived from Mössbauer spectra, and petrologic classification of the meteorite powders that were established in previous studies.

These CM and CI meteorite samples are particularly interesting because their mineral assemblages (***phyllosilicates***, primarily serpentine) record aqueous alteration by melted ice on the asteroidal parent bodies. In general, the total abundance and magnesium content of phyllosilicates in these meteorites increase with greater aqueous alteration—trends that McAdam and colleagues found in the mid-IR spectra (see diagram).



(From McAdam *et al.*, 2015, *Icarus*, v. 245, p. 320-332, doi:10.1016/j.icarus.2014.09.041)

Diagram showing positions of absorption peaks in mid-infrared reflectance spectra versus total abundance of phyllosilicates for 15 aqueously altered meteorites. Peak positions are sensitive to total abundance of phyllosilicates—markers of aqueous alteration. Also shown is the emissivity minimum for asteroid (24) Themis for comparison. Error bars are 5%.

This work has broad applications. The laboratory data can be compared to telescopic or remote sensing observations of asteroids to estimate the degree of alteration on asteroid surfaces. Using ***emissivity*** data from the Spitzer Space Telescope Infrared Spectrograph and taking into account all the factors affecting these data (e.g. grain sizes of the minerals, interstitial gas pressure, temperature) McAdam and colleagues show that asteroid (24) Themis is most similar to the less altered meteorites in their dataset. They estimate Themis has ~70 vol.% phyllosilicates on its surface. The technique is being applied to other dark asteroids. Additionally, future asteroid missions will benefit from the mineralogical–spectral studies of meteorites. Missions such as JAXA's Hayabusa 2 (launched in December, 2014) and NASA's OSIRIS-REx (launch scheduled for 2016) will collect spectra and samples for return to Earth, and what researchers have already learned from meteorites will help them interpret the new data.

See Reference:

· McAdam, M. M., Sunshine, J. M., Howard, K. T., and McCoy, T. M. (2015) Aqueous Alteration on Asteroids: Linking the Mineralogy and Spectroscopy of CM and CI Chondrites, *Icarus,* v. 245, p. 320-332, doi:10.1016/j.icarus.2014.09.041. [***abstract***]

See also:

· ***Asteroid Explorer Hayabusa 2*** mission, from Japan Aerospace Exploration Agency.

· ***OSIRIS-REx*** mission, from NASA.

Related **PSRD** report:

· ***Asteroid Itokawa Samples***.

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