Relating opaline silica hydration and maturity to geologic settings on Mars

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Hydrated or opaline silica has been detected in situ and by orbital near-infrared reflectance spectroscopy on Mars, and it is now recognized as an important product of water-rock interaction on that planet. Variations in hydration and maturity (opal-A/CT/C) that result from different geologic processes may be linked to variability in spectral data. Here we demonstrate that such variations on Mars are linked to geologic setting and thus may reflect formation or diagenetic conditions. We compare orbital CRISM data from a global survey of hydrated silica detections with laboratory spectra of terrestrial silica from hot spring and fumarolic environments.

Spectra of terrestrial silica suggest samples with increased hydration and crystallinity tend to have a higher band depth ratio of the 2.26/2.21 µm absorptions and a 1.4 µm feature that is centered at longer wavelengths. Martian hydrated silica deposits show similar spectral variation across the globe, but detections occupy distinct fields when sorted by geologic setting, with the strongest distinctions between lithified bedrock and eolian deposits (Fig. 1). These spectral variations could relate to silica maturity or the ability of a particular silica deposit to adsorb H_2O. The former case would suggest hydrated silica found in bedrock is less mature (e.g., opal-A) than eolian counterparts, which may be closer to opal-CT/C.

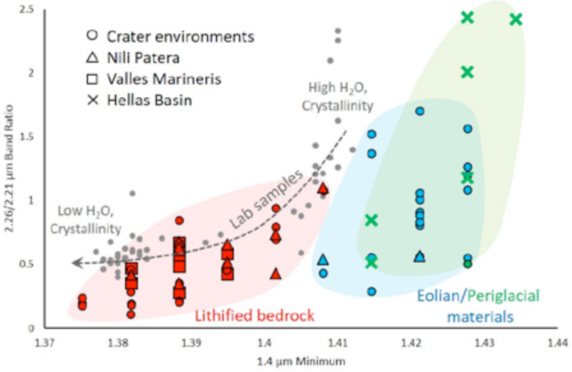

Figure 1: Plot of the 1.4 μm minimum against the 2.26/2.21 μm band ratio for lab samples (grey) and CRISM spectra (colored). A trendline shows the progression from hydrated, crystalline lab samples to dehydrated, less-crystalline lab samples.