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## Crossroads in Earth and Planetary Materials

# Octahedral chemistry of 2:1 clay minerals and hydroxyl band position in the near-infrared: Application to Mars

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## Abstract

With the arrival of Curiosity on Mars, the MSL has started its ground validation of some of the phyllosilicate characterization carried out with remote sensing near-IR spectroscopy from orbital instruments. However, given the limited range of action of the rover, phyllosilicate identification and characterization will have to rely mainly on orbital near-IR data. Investigation of Earth analogs can greatly assist interpretation of martian spectra and enable more robust analyses. In this contribution, Mg/Fe-rich clays from submarine hydrothermal origin that had been thoroughly characterized previously were investigated with near-IR reflectance spectroscopy. The clays are mixed-layer glauconite-nontronite, talc-nontronite, talc-saponite, and nontronite samples. The hydroxyl bands in the range 2.1–2.35 μm were decomposed into their several individual components to investigate correlations between the octahedral chemistry of the samples and the normalized intensity of several bands. Good correlations were found for the samples of exclusive dioctahedral character (glauconite-nontronite and nontronite), whereas poor or no correlations emerged for the samples with one (talc-nontronite) or two (talc-saponite) trioctahedral layer components, indicating a more complex spectral response. Because these bands analyzed are a combination of the fundamental OH stretching and OH bending vibrations, the response of these fundamental bands to octahedral chemistry was considered. For 2:1 dioctahedral phyllosilicates, Fe and Mg substitution for Al displaces both fundamental bands to lower wavenumbers (longer wavelengths), so that their effect on the position of the combination band is coherent. In contrast, for trioctahedral clays, Al and $Fe^{3+}$ substitution of octahedral Mg displaces the OH stretching band to lower wavenumber values, and the OH bending band to higher wavenumber values, resulting in partial or total mutual cancelation of their effects. As a result, clays with near-IR spectra indicating Mg-dominated octahedral compositions may in fact contain abundant Fe and some Al substitution. Thus, remote-sensing near-IR mineralogical and chemical identification of clays on Mars appears relatively straightforward for dioctahedral clay minerals but more problematic for trioctahedral clays, for which it may require a more detailed investigation of their near-IR spectra.

**Keywords:** Infrared observations, Mars, mineralogy