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# Laboratory and field characterization of visible to near-infrared spectral reflectance of nitrate minerals from the Atacama Desert, Chile, and implications for Mars

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## ABSTRACT

Large amounts of nitrate salts occur in very specific environments and somewhat rare hyper-arid conditions, which may provide clues to fundamentally different nitrogen cycling and life survival mechanisms. Remote detection of ancient and modern nitrates on Earth and on other planetary bodies where they may occur requires a detailed understanding of their visible to near infrared (VNIR) spectral signatures. This study explores the VNIR spectral characteristics of several synthetic nitrate salts, sulfate minerals, and nitrate-bearing field samples from the Atacama Desert, Chile, to identify diagnostic spectral features of nitrate and possible interferences from other coexisting minerals. Results indicated that most of the nitrate salts have characteristic absorptions around 1.81, 1.94, 2.06, 2.21, and 2.42 μm. A significant positive correlation exists between the continuum-removed band depths of the 2.42 μm absorption and nitrate contents for the Atacama regolith samples, especially for samples with >10 wt% nitrate. The five absorption features of nitrate in the field spectra collected from multiple nitrate-rich regions in the Atacama Desert were then evaluated to determine the variabilities in these features in natural settings, while the band depths of 2.42 μm absorption were further calculated on the continuum-removed field spectra to estimate the nitrate abundances at the study sites. This work will supplement spectral libraries where nitrate spectra are lacking and have implications for future comparisons to planetary spectra to search for potentially life-related nitrate on Mars.

**Keywords:** Nitrate, Atacama Desert, Mars, visible to near infrared reflectance; Earth Analogs for Martian Geological Materials and Processes