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Visible and short-wave infrared reflectance spectroscopy of REE fluorocarbonates

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Abstract

An understanding of the mineralogy and petrogenesis of rare earth element deposits has significant implications for their economic viability. Lanthanide-bearing compounds are known to produce sharp absorption features in the visible to short-wave infrared region (VIS-SWIR), however, a significant knowledge gap exists between the fields of hyperspectral reflectance spectroscopy and rare earth element mineralogy. Reflectance spectra were collected from four bastnäsite samples, two parisite samples, and one synchysite sample from the visible into the short-wave infrared. These REE fluorocarbonate mineral samples were characterized via scanning electron microscopy and electron probe microanalysis. Sharp absorptions of REE-bearing minerals are mostly the result of 4*f*-4*f* intraconfigurational electron transitions and for the light REE-enriched fluorocarbonates, the bulk of the features can be ascribed to Nd^{3+}, Pr^{3+}, Sm^{3+}, and Eu^{3+}. The lanthanide-related spectral responses of the REE fluorocarbonates are consistent across the group, supporting the notion that the REE cation site is very similar in each of these minerals. Carbonate-related spectral responses differed between these minerals, supporting the notion that the crystallographic sites for the carbonate radical differ between bastnäsite, synchysite, and parisite. Exploitable spectral differences include a distinct absorption band at 2243 nm that separates bastnäsite from synchysite and parisite. Similarly, for bastnäsite a dominantly Pr^{3+}-related absorption band located is at 1968 nm, while in synchysite and parisite it occurs at 1961 nm.

Keywords: Mineral spectroscopy, rare earth elements, hyperspectral, bastnäsite, parisite, synchysite