

Raman and Nd³⁺ luminescence spectroscopy of the rare earth carbonate bastnäesite-(Ce) to 30 GPa

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Bastnäesite-(Ce) is a rare earth element (REE) bearing carbonate, (Ce,La,Y,Nd)CO₃F, which crystallizes in the hexagonal crystal system (space group *P-62c*). Bastnäesite is one of the most common REE-bearing minerals, and has importance from both economic and geologic perspectives due to its large REE concentration. Geochemically, REEs are generally incompatible in silicate minerals, but their concentration in carbonatite melts (with bastnäesite as their crystallization product) is large, so probing the high-pressure stability of a REE carbonate has importance for understanding the potential behavior of REE at depth. We report Raman vibrational and Nd³⁺ luminescence spectra of natural bastnäesite-(Ce) to 30 GPa. Bastnäesite remains notably unaffected by pressure up to 25 GPa, where it undergoes a subtle phase transition produced by a change in symmetry of the carbonate ion. At the transition, the intensity of Raman modes changes in the in-plane bend and out of plane bend regions, and the peak associated with the symmetric stretch both broadens and a new component emerges to its lower frequency side. The Nd³⁺ luminescence shows an increased separation of the energy levels associated with the f-orbitals with greater pressure: this is likely caused by a minor, but increasing, distortion of the neodymium site. All changes observed are reversible on decompression, with the material reverting to its ambient pressure phase.