

First find of merrillite, $\text{Ca}_3(\text{PO}_4)_2$, in a terrestrial environment as an inclusion in lower-mantle diamond

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ABSTRACT

Merrillite, ideally $\text{Ca}_{18}\text{Na}_2\text{Mg}_2(\text{PO}_4)_{14}$ (Dana No: 38.03.04.04; Strunz No: 08.AC.45), an analog to synthetic tricalcium phosphate $\beta\text{-Ca}_3(\text{PO}_4)_2$, was identified as an inclusion in lower-mantle diamonds from the Rio Soriso area, Brazil. It was associated with former bridgmanite, CaSi- and CaTi-perovskites, and ferropericlasite. This is the first report of merrillite in a terrestrial environment; previously, it was known only in meteorites and lunar rocks. The compositions of merrillite vary in different localities; the Rio Soriso sample was enriched in SO_3 (2.03 wt%). Merrillite from lower-mantle diamonds may be a retrograde phase of the tuite [$\gamma\text{-Ca}_3(\text{PO}_4)_2$]. Owing to their crystal structures, both merrillite and tuite may be important potential hosts for rare earth elements (REE) and large ion lithophile elements (LILE), including Sr and Ba, in the deep Earth. The find of merrillite suggests a larger variety of mineral species in the lower mantle than previously assumed.

Keywords: Merrillite, tuite, whitlockite, diamond, phosphates, lower mantle, Raman spectra