

Oboniobite (Mg₄Nb₂O₉), a new magnesian-niobic oxide mineral from the Bayan Obo deposit, China

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ABSTRACT

A new magnesian-niobic oxide mineral, oboniobite (IMA 2023-118a), ideally Mg₄Nb₂O₉, has been discovered in the Bayan Obo REE-Nb-Fe deposit, China. The mineral occurs in a Meso-Proterozoic dolomite-calcite carbonatite dike and is associated with fersmite, columbite, pyrochlore, apatite, magnetite, dolomite, and calcite. Individual crystals range in size from 15 to 70 μm, and no twinning is observed. The mineral is yellowish-brown to brown in color and transparent, with a vitreous luster. The calculated density is 4.585 g/cm³. Seventeen electron microprobe analyses yielded the main compositions of oboniobite (total 97.61 wt%): Nb₂O₅ (57.65 wt%), MgO (27.24 wt%), FeO (6.15 wt%), MnO (5.98 wt%), and TiO₂ (0.59 wt%). The empirical formula calculated on the basis of O = 9 apfu is Mg¹(Mg_{1.42}Fe_{0.30}Mn_{0.24})Σ_{1.96}Mg²(Mg_{1.71}Fe_{0.10}Mn_{0.15})Σ_{1.96}(Nb_{2.01}Ti_{0.03})Σ_{2.04}O₉, and the simplified formula is (Mg,Fe,Mn)₄(Nb,Ti)₂O₉.

Oboniobite is trigonal, with corundum-related structure, space group $P\bar{3}c1$ (#165), $Z = 2$, and unit-cell parameters $a = b = 5.18043(19)$ Å, $c = 14.0768(6)$ Å, $\alpha = \beta = 90^\circ$, $\gamma = 120^\circ$, and $V = 327.16(3)$ Å³. The crystal structure of oboniobite has infinite layers of metal-centered MO₆ octahedra along the c -axis, and Mg and Nb atoms are all hexacoordinated with oxygen. Isolated Nb₂O₉ spindles formed from face-sharing NbO₆ octahedra are interspersed in the open hexagonal channels, which are formed by the Mg₂O₉ spindles sharing edges of O2-O2 along the c -axis.

Oboniobite shares a similar chemical composition with columbite-(Mg) and ternovite, yet it is notably different in its crystallographic, physical, and optical properties compared to the other two minerals. Columbite-(Mg) forms needle-like opaque crystals, has a higher density of 5.04 g/cm³, contains more Nb₂O₅ at 68.36 wt% than oboniobite, and belongs to the orthorhombic system with the $Pcan$ space group. Ternovite typically appears as radial translucent aggregates, has a low density of 2.95 g/cm³, has the highest Nb₂O₅ content at 70.24 wt% among the three minerals, and possesses a monoclinic symmetry with the $P2/m$ or $P2$ or Pm space group. Therefore, oboniobite is not a variant of columbite-(Mg) and ternovite; instead, it is a unique new mineral species that contains niobium and magnesium.

Keywords: New mineral, oboniobite, magnesian-niobic oxide, crystal structure, X-ray diffraction, Raman spectroscopy, electron microprobe analysis, Bayan Obo deposit