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Menezesite, the first natural heteropolyniobate, from Cajati, São Paulo, Brazil: Description and crystal structure

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Abstract

Menezesite, ideally $Ba_2MgZr_4(BaNb_{12}O_{42})\cdot 12H_2O$, occurs as a vug mineral in the contact zone between dolomite carbonatite and "jacupirangite" (=a pyroxenite) at the Jacupiranga mine, in Cajati county, São Paulo state, Brazil, associated with dolomite, calcite, magnetite, clinohumite, phlogopite, ancylite-(Ce), strontianite, pyrite, and tochilinite. This is also the type locality for quintinite-2*H*. The mineral forms rhombododecahedra up to 1 mm, isolated or in aggregates. Menezesite is transparent and displays a vitreous luster; it is reddish brown with a white streak. It is non-fluorescent. Mohs hardness is about 4. Calculated density derived from the empirical formula is 4.181 g/cm^3. It is isotropic, $n_{meas} > 1.93(1)$ (white light); $n_{calc} = 2.034$. Menezesite exhibits weak anomalous birefringence. The empirical formula is $(Ba_{1.47}K_{0.53}Ca_{0.31}Ce_{0.17}Nd_{0.10}Na_{0.06}La_{0.02})_{\Sigma 2.66}(Mg_{0.94}Mn_{0.23}Fe_{0.23}Al_{0.03})_{\Sigma 1.43}(Zr_{2.75}Ti_{0.96}Th_{0.29})_{\Sigma 4.00}[(Ba_{0.72}Th_{0.26}U_{0.02})_{\Sigma 1.00}(Nb_{9.23}Ti_{2.29}Ta_{0.36}Si_{0.12})_{\Sigma 12.00}O_{42}]\cdot 12H_2O$. The mineral is cubic, space group $Im\overline{3}$ (204), $a = 13.017(1)$ Å, $V = 2206(1)$ Å^3, $Z = 2$. Menezesite is isostructural with the synthetic compound $Mg_7[MgW_{12}O_{42}](OH)_4\cdot 8H_2O$. The mineral was named in honor of Luiz Alberto Dias Menezes Filho (born 1950), mining engineer, mineral collector and merchant. Both the description and the name were approved by the CNMMN-IMA (Nomenclature Proposal 2005-023). Menezesite is the first natural heteropolyniobate. Heteropolyanions have been employed in a range of applications that include virus-binding inorganic drugs (including the AIDs virus), homogeneous and heterogeneous catalysts, electro-optic and electrochromic materials, metal and protein binding, and as building blocks for nanostructuring of materials.

Keywords: Menezesite, new mineral, polyoxometalates, heteropolyniobate, heteropolyanions, crystal structure, chemical composition, Jacupiranga mine, Cajati, Brazil