

Mejillonesite, a new acid sodium, magnesium phosphate mineral, from Mejillones, Antofagasta, Chile

DANIEL ATENCIO,^{1,*} NIKITA V. CHUKANOV,² FABRIZIO NESTOLA,³ THOMAS WITZKE,⁴
JOSÉ M.V. COUTINHO,⁵ ALEKSANDR E. ZADOV,⁶ REYNALDO R. CONTREIRA FILHO,⁷ AND
GUNNAR FÄRBER⁸

¹Instituto de Geociências, Universidade de São Paulo, Rua do Lago, 562, 05508-080 São Paulo, SP, Brazil

²Institute of Problems of Chemical Physics, Russian Academy of Sciences, Chernogolovka, Moscow Region 142432, Russia

³Dipartimento di Geoscienze, Università di Padova, Via Gradenigo 6, I-35131, Padova, Italy

⁴Institut für Geologische Wissenschaften, Mineralogie/Geochemie, Von Seckendorff Platz 3, D-06120 Halle, Germany

⁵Instituto de Geociências, Universidade de São Paulo, Rua do Lago, 562, 05508-080 São Paulo, SP, Brazil

⁶SNPP “Teplokhim”, Dmitrovskoye av. 71, Moscow 127238, Russia

⁷Rua Murici 62, 13.098-315 Campinas, SP, Brazil

⁸Bornsche Strasse 9, 39326 Samswegen, Germany

ABSTRACT

Mejillonesite, ideally $\text{NaMg}_2(\text{PO}_3\text{OH})(\text{PO}_4)(\text{OH})\cdot\text{H}_2\text{O}_2$, is a new mineral approved by the CNMNC (IMA 2010-068). It occurs as isolated crystal aggregates in thin zones in fine-grained opal-zeolite aggregate on the north slope of Cerro Mejillones, Antofagasta, Chile. Closely associated minerals are bobierite, opal, clinoptilolite-Na, clinoptilolite-K, and gypsum. Mejillonesite forms orthorhombic, prismatic, and elongated thick tabular crystals up to 6 mm long, usually intergrown in radiating aggregates. The dominant form is pinacoid $\{100\}$. Prisms $\{hk0\}$, $\{h0l\}$, and $\{0kl\}$ are also observed. The crystals are colorless, their streak is white, and the luster is vitreous. The mineral is transparent. It is non-fluorescent under ultraviolet light. Mohs' hardness is 4, tenacity is brittle. Cleavage is perfect on $\{100\}$, good on $\{010\}$ and $\{001\}$, and fracture is stepped. The measured density is 2.36(1) g/cm³; the calculated density is 2.367 g/cm³. Mejillonesite is biaxial (–), $\alpha = 1.507(2)$, $\beta = 1.531(2)$, $\gamma = 1.531(2)$, $2V(\text{meas}) = 15(10)^\circ$, $2V(\text{calc}) = 0^\circ$ (589 nm). Orientation is $X = \mathbf{a}$, $Z =$ elongation direction. The mineral is non-pleochroic. Dispersion is $r > v$, medium. The IR spectrum contains characteristic bands of the Zundel cation (H_5O_2^+ , or $\text{H}^+\cdot 2\text{H}_2\text{O}$) and the groups P-OH and OH[–]. The chemical composition is (by EDS, H₂O by the Alimarin method, wt%): Na₂O 9.19, MgO 26.82, P₂O₅ 46.87, H₂O 19, total 101.88. The empirical formula, based on 11 oxygen atoms, is $\text{Na}_{0.93}\text{Mg}_{2.08}(\text{PO}_3\text{OH})_{1.00}(\text{PO}_4)_{1.06}(\text{OH})_{0.86}\cdot 0.95\text{H}_2\text{O}_2$. The strongest eight X-ray powder-diffraction lines [d in Å(I)(hkl)] are: 8.095(100)(200), 6.846(9)(210), 6.470(8)(111), 3.317(5)(302), 2.959(5)(132), 2.706(12)(113), 2.157(19)(333), and 2.153(9)(622). The crystal structure was solved on a single crystal ($R = 0.055$) and gave the following data: orthorhombic, $Pbca$, $a = 16.295(1)$, $b = 13.009(2)$, $c = 8.434(1)$ Å, $V = 1787.9(4)$ Å³, $Z = 8$. The crystal structure of mejillonesite is based on a sheet (parallel to the $\mathbf{b-c}$ plane) formed by two types of MgO₆ octahedra, isolated tetrahedra PO₄ and PO₃OH whose apical vertices have different orientation with respect to the sheet. The sheets are connected by interlayer, 5-coordinated sodium ions, proton hydration complexes, and hydroxyl groups. The structure of mejillonesite is related to that of angarfite, $\text{NaFe}_3^{3+}(\text{PO}_4)_4(\text{OH})_4\cdot 4\text{H}_2\text{O}$ and bakhchisaraitsevite, $\text{Na}_2\text{Mg}_5(\text{PO}_4)_4\cdot 7\text{H}_2\text{O}$.

Keywords: Mejillonesite, new mineral, Chile, phosphate