American Mineralogist, Volume 97, pages 1187–1192, 2012

Reynoldsite, $Pb_2Mn^{4+}_2O_5(CrO_4)$, a new phyllomanganate-chromate from the Blue Bell claims, California and the Red Lead mine, Tasmania

Anthony R. Kampf,[1,*] Stuart J. Mills,[2] Robert M. Housley,[3] Ralph S. Bottrill,[4] and Uwe Kolitsch[5,6]

[1]Mineral Sciences Department, Natural History Museum of Los Angeles County, 900 Exposition Boulevard, Los Angeles, California 90007, U.S.A.
[2]Geosciences, Museum Victoria, GPO Box 666, Melbourne 3001, Victoria, Australia
[3]Division of Geological and Planetary Sciences, California Institute of Technology, Pasadena, California 91125, U.S.A.
[4]Mineral Resources Tasmania, P.O. Box 56, Rosny Park, Tasmania 7018, Australia
[5]Mineralogisch-Petrographische Abt., Naturhistorisches Museum, Burgring 7, A-1010 Wien, Austria
[6]Institut für Mineralogie und Kristallographie, Universität Wien, Geozentrum, Althanstrasse 14, A-1090 Wien, Austria

Abstract

The new mineral reynoldsite, $Pb_2Mn^{4+}_2O_5(CrO_4)$, occurs at the Blue Bell claims, near Baker, San Bernardino County, California, U.S.A., and at the Red Lead mine, Dundas, Tasmania, Australia. At the Blue Bell claims, reynoldsite occurs in subparallel growths and divergent sprays of thin prisms with a square cross section. At the Red Lead mine, it occurs as thin rectangular blades. At both occurrences, crystals are small (≤0.2 mm), and ubiquitously and multiply twinned. At both deposits, reynoldsite formed as a secondary mineral derived from the weathering of primary minerals including oxides and sulfides in the presence of acidic groundwater. Reynoldsite is dark orange-brown to black in color and has a dark orange-brown streak. Its luster is subadamantine and its Mohs hardness is about 4½. The mineral is brittle with irregular to splintery fracture and a poorly developed {001} cleavage. The calculated density is 6.574 g/cm^3 (Red Lead mine). The very high indices of refraction and dark color permitted only partial determination of the transmitted light optical properties. Electron microprobe analyses of Blue Bell and Red Lead reynoldsite provided the empirical formulas (based on nine O atoms): $Pb_{1.97}Mn_{2.01}O_5(Cr_{1.01}O_4)$ and $(Pb_{2.07}Sr_{0.04})_{\Sigma 2.11}Mn_{2.15}O_5(Cr_{0.87}O_4)$, respectively. The strongest powder X-ray diffraction lines for Red Lead reynoldsite are [*d*(*hkl*)*I*]: 3.427(0$\bar{2}$1,110)52, 3.254(021,1$\bar{1}$2,1$\bar{2}$1)85, 3.052($\bar{1}$ $\bar{1}$2,111,0$\bar{2}$2,$\bar{1}$03)100, 2.923(013,$\bar{1}$22)40, 2.5015(004,$\bar{2}$11,$\bar{1}$30)47, 1.9818(0$\bar{1}$5,$\bar{1}$05,202,2$\bar{3}$1)42, 1.7694(1$\bar{1}$5,1$\bar{3}$4,203,$\bar{1}$42,$\bar{1}$ $\bar{3}$3)36, and 1.6368($\bar{2}$ $\bar{2}$3,0$\bar{4}$3,221,124,2$\bar{2}$4)36. Reynoldsite is triclinic with space group $P\bar{1}$ and unit-cell parameters: a = 5.0278(7), b = 7.5865(11), c = 10.2808(15) Å, α = 91.968(12), β = 99.405(12), γ = 109.159(10)°, V = 363.81(9) Å^3, and Z = 2 (for a Red Lead mine crystal). The crystal structure of reynoldsite (R_1 = 10.2% for 902 reflections with $F_o > 4\sigma F$ for a Red Lead crystal) contains close-packed layers of edge-sharing $Mn^{4+}O_6$ octahedra parallel to {001}. These layers are composed of edge-sharing double chains of octahedra extending along [100], which in turn are linked to one another by sharing edges in the [010] direction. The thick interlayer region contains Pb^{2+} cations and CrO_4 tetrahedra. The $6s^2$ lone-electron pair of the Pb^{2+} is stereochemically active, resulting in a one-sided Pb-O coordination arrangement. The structure bears strong similarities to those of the phyllomanganates, such as chalcophanite and birnessite.

Keywords: Reynoldsite, new mineral, crystal structure, phyllomanganate, chromate, Pb^{2+} $6s^2$ lone-electron pair, Blue Bell claims, California, Red Lead mine, Tasmania