Argandite, $Mn_7(VO_4)_2(OH)_8$, the V analogue of allactite from the metamorphosed Mn ores at Pipji, Turtmann Valley, Switzerland

JOËL BRUGGER,[1,2,*] PETER ELLIOTT,[1,2] NICOLAS MEISSER,[3] AND STEFAN ANSERMET[3]

[1]Tectonics, Resources and Exploration (TRaX), School of Earth and Environmental Sciences, The University of Adelaide, North Terrace, 5005 Adelaide, South Australia
[2]Division of Mineralogy, South Australian Museum, North Terrace, 5000 Adelaide, South Australia
[3]Musée Géologique Cantonal and Laboratoire des Rayons-X, Institut de Minéralogie et de Géochimie, UNIL-BFSH2, CH-1015 Lausanne-Dorigny, Switzerland

ABSTRACT

Argandite, $Mn_7(VO_4)_2(OH)_8$, is a new mineral from the metamorphosed synsedimentary exhalative Mn deposit located underneath the Pipji glacier (Pipjigletscher) in the Turtmann valley, Central Alps, Switzerland. The mineral is dedicated to the Swiss geologist Émile Argand (1879–1940). Argandite occurs in manganosite-rich ores in association with the V-minerals pyrobelonite, reppiaite, and an unknown silico-vanadate with chemical formula $(Mn,Mg)_{24}(V,As,Si)_4Si_2O_{27}H_{38}$; these minerals result from the remobilization of ore components during the Tertiary Alpine metamorphism under upper greenschist facies conditions (~450 °C, 4–6 kbar). Argandite forms isolated anhedral grains up to 60 μm in diameter. The mineral is transparent, orange in color with a pale orange streak and vitreous luster, Mohs hardness ~3.5–4, D_{calc} 3.67(1), and D_{meas} 3.71(5) g/cm³. It is brittle with one distinct cleavage, probably parallel to {001}. Argandite is biaxial negative, with α ~1.74, β = 1.762(4), γ ~1.77 (white light), $2V$(calc) = ~62°. It shows a distinct pleochroism under polarized light, orange-yellow to orange. The empirical chemical formula is $(Mn_{6.54}Mg_{0.38}Ni_{0.04}Ca_{0.02}Zn_{0.01}Sr_{0.01})_{\Sigma=7.00}(V_{1.46},As_{0.54})_{\Sigma=2.00}O_8(OH)_{8.00}$. Argandite is monoclinic, space group $P2_1/n$, a = 5.5038(2), b = 12.2665(5), c = 10.1055(5) Å, β = 95.559(4)°; V = 679.04(5) Å³; Z = 2. The six strongest lines measured in the X-ray powder diffraction pattern are [d in Å (I)(hkl)]: 3.074 (100)(131), 2.687 (70)(140;113), 3.395 (60)(112), 3.708 (50) (11$\bar{2}$;121), 2.945 (50)(041;11$\bar{3}$), and 2.522 (50)(004;20$\bar{2}$). The crystal structure was solved with direct methods on the basis of 1661 unique reflections with $I > 4\sigma_F$ and refined to R_1 = 3.40%. Argandite is isostructural with allactite, $Mn_7(AsO_4)_2(OH)_8$, and raadeite, $Mn_7(PO_4)_2(OH)_8$.

Keywords: Argandite, new mineral, crystal structure, metamorphosed exhalative Fe-Mn deposit, Turtmann valley, Central Alps, Switzerland