Jingwenite-(Y) from the Yushui Cu deposit, South China: The first occurrence of a V-HREE-bearing silicate mineral

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ABSTRACT

Jingwenite-(Y), Y2Al2V2(VO4)4(OH)2, the first V-HREE-bearing silicate mineral discovered in nature, is an abundant component of a sediment-hosted stratiform Cu (SSC) deposit, Yushui, South China. The mineral occurs in bedded/massive sulfide-bearing ore and is associated with bornite, chalcopyrite, galena, xenotime-(Y), nolanite, thortveitite, roscoelite, barite, and quartz. Optically, jingwenite-(Y) is biaxial (+), with α = 1.92(4), β = 1.95(2), γ = 1.99(3) (white light), and 2V (calculated) = 83°. The dispersion is medium with r < v, and the pleochroism is with X = light brown, Y = brown, Z = dark brown. The color, streak, luster, and hardness (Mohs) are light brown, yellowish gray, vitreous, and 4½–5, respectively.

Jingwenite-(Y) is monoclinic, with space group 2/a, Z = 4, and unit-cell parameters a = 9.4821(2) Å, b = 5.8781(1) Å, c = 19.3987(4) Å, β = 90.165(2)°, and V = 1081.21(4) Å³. The structure of jingwenite-(Y) has chains of edge-sharing Al(V,Fe)-O octahedra and V(Ti)-O octahedra extending along the b-axis and linked by insular Si-O tetrahedra, leaving open channels occupied by HREEs. Jingwenite-(Y) is a new nesosilicate structural type.

Sm-Nd dating and Nd isotope signatures of jingwenite-(Y) reveal an epigenetic origin and suggest that HREEs and V were added to the SSC system via leaching of abundant heavy minerals in the footwall red sandstone by oxidized basinal brines. The abundance of jingwenite-(Y) at Yushui indicates that it could potentially be a valuable resource for HREE and V. Moreover, HREE and V mineralization can also occur in the same sediment-hosted Cu mineral system.

Keywords: New mineral, jingwenite-(Y), heavy rare earth elements, Yushui

INTRODUCTION

Both heavy rare earth elements (HREE: Gd-Lu+Y) and vanadium (V) are critical and highly valuable metals increasingly needed for high-technology applications, e.g., in the aerospace industry and in the transition to low-carbon energy generation (Hatch 2012). Here we report a new mineral, jingwenite-(Y), ideally Y2Al2V2(VO4)4(OH)2, the first V-HREE-bearing silicate mineral discovered in nature. It occurs as an abundant phase in a sediment-hosted stratiform Cu deposit (SSC) (Liu et al. in review), the Yushui deposit, South China, which could potentially be a valuable resource of HREE and V. Jingwenite-(Y) has been approved by the International Mineralogical Association Commission on New Minerals, Nomenclature and Classification (IMA2021-070). The new mineral jingwenite-(Y) is named in honor of Jingwen Mao (born in 1956). He is a leading Chinese economic geologist at the China University of Geosciences (Beijing), with global impact from his publication output and significant contribution to international professional associations. Type material is deposited in the mineralogical collections of the Geological Museum of China, catalog number M16122.

OCCURRENCE AND ASSOCIATED MINERALS

Jingwenite-(Y) is found in Cu-sulfide ore from the Yushui deposit, an SSC ore system located about 16 km northeast of Meizhou City, Guangdong Province, China (24°25′18″N, 116°11′48″E) (Fig. 1a). The Yushui deposit is concealed beneath Late-Jurassic volcanic cover and is hosted mainly within sedimentary rocks at the unconformity between Upper Carboniferous dark-gray dolostone and a >300 m thick sequence of Lower Carboniferous red sandstone (Fig. 1b) characterized by an abundance of heavy minerals including xenotime-(Y), rutile, zircon, and hematite. There are three ore types: (1) bedded/massive; (2) disseminated; and (3) vein-type. Jingwenite-(Y) occurs mainly in bedded/massive ore (orebody V1), where associated minerals are bornite, chalcopyrite, galena, xenotime-(Y), nolanite, thortveitite, roscoelite, barite, quartz, and an as-yet unnamed V-HREE-Sc-bearing silicate mineral phase (Fig. 2).

ANALYTICAL METHODS

Polished sections were prepared from the jingwenite-(Y) specimen for major element and Sm-Nd isotope analysis.

Chemical composition analysis

Quantitative major-element analysis of minerals was done at the State Key Laboratory of Mineral Deposits Research, School of Earth Sciences and Engi-