Hanjiangite, a new barium-vanadium phyllosilicate carbonate mineral from the Shiti barium deposit in the Dabashan region, China

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ABSTRACT

Hanjiangite, ideal formula Ba₄Ca(V³⁺Al)[Si₆Al₂O₂₀(OH)₁₂]F(CO₃)₂, is a new mineral found in the Shiti barium deposit in the Dabashan region, China. Hanjiangite was collected from lenticular witherite ore bodies and witherite-barite-quartz veins cutting carbonaceous slates. It is found as disseminations in both settings. It occurs as thin, euhedral, tetragonal, tabular crystals, and anhedral grains. Grain size commonly varies from 0.05 to 4 mm and occasionally reaches 15 mm. It is yellow-green or dark green, with one well-developed or perfect cleavage on {001}. Other physical properties are: brittle, transparent to translucent, nonfluorescent, vitreous luster, greenish white streak, hardness 4 in the Mohs scale, splintery fracture, and a measured density of 3.69 g/cm³. Hanjiangite is biaxial (−), α = 1.615, β = 1.655, γ = 1.700 (589 nm), and displays strong pleochroism from pale yellow-green to dark green. It is monoclinic, with unit-cell parameters refined from single-crystal X-ray diffraction: a = 5.2050(12), b = 9.033(2), c = 32.077(8) Å, β = 93.49(8)°, V = 1505.4(8) Å³, Z = 4, space group C2. The strongest seven lines of the X-ray powder-diffraction pattern [d(Å)hkl] are: 15.866(7)(002), 5.340(91)(006), 4.100(10)(T14), 3.209(23) (027), 2.676(100) (T1 10), 2.294(29)(T37), and 2.008(11)(228). Chemical analysis by a combination of electron microprobe, HF combustion, IR absorption, thermogravimetric analysis (TGA) and crystal-structure refinement gives SiO₂ 19.64, TiO₂ 1.12, Al₂O₃ 11.19, MgO 0.54, CaO 4.91, BaO 34.89, V₂O₅ 9.93, Cr₂O₃ 1.75, Na₂O 0.20, K₂O 0.06, MnO 0.01, FeO 0.02, NiO 0.01, SrO 0.34, Y₂O₃ 0.85, La₂O₃ 0.14, Nd₂O₃ 0.26, F 1.80, Cl 0.04, CO₂ 10.37, H₂O 1.30, F=O –0.76, Cl=O –0.01, sum 98.60 wt%. The empirical formula is Ba₄Ca₇Al₃Si₂Na₂O₁₂K₀.01[Mg₀.12Y₀.06, Sr₀.03]₂Ba₀.01Nd₀.01V₁.15Al₀.79Cr₀.20Ti₀.21[(Si₁.s₄Al₁.₃)₀.s₁O₂₀(OH)₁₂]F₀.22(CO₃)₀.16. The unit-cell parameters refined from single-crystal X-ray diffraction analysis (sample 2005st-17) was carried out with a Smart APEX CCD system using MoKα (λ = 0.71073 Å) radiation. The structure was solved using direct methods, and refined with the SHELXTL PC (Bruker AXS Inc.) package. Anisotropic refinement using all measured independent data and reflections with I > 2σ(I) resulted in an R factor of 0.08 and wR² of 0.20. The crystal structure is composed of alternating T-O-T and Ba₄Ca(CO₃)₂F layers. The Ba₄Ca(CO₃)₂F layer occurs between the T-O-T layers. The T site contains both Si and Al, and the O site both V³⁺ and Al. The interlayer hosts not only Ba (like in chernykhite) but also Ca atoms and (CO₂) groups. While the coordination of the cations in the TOT layer is obvious, the coordinations of Ca and Ba in the interlayer are not straight forward. A hanjiangite has three polytypes, namely 1M-type, 2M-type, and 3T-type.

Keywords: New mineral, hanjiangite, electron-microprobe data, single-crystal X-ray diffraction, crystal structure, Shiti barium deposit, Ankang County, China

INTRODUCTION

Hanjiangite was discovered in some ore samples from the Shiti barium deposit in southern Shaanxi, China. In the process of surveying the assemblage using backscattered electron (BSE) imaging and energy-dispersive X-ray spectrometry (EDS), a mineral with very unusual barium-rich chemistry was noticed. Subsequent quantitative electron microprobe analyses and single-crystal X-ray studies made it clear that this was a new mineral. The new mineral is named after the Hanjiang River, the largest branch of the Yangtze River, China. Many witherite and barite deposits are located at the vicinity of the middle to upper reaches of the Hanjiang River catchment and the Hanjiang River flows through the Shiti ore district. The new mineral and the name were approved by the International Mineralogical Association, Commission on New Minerals, Nomenclature and Classification (CNMNC) (IMA 2009-082).

Holotype material, including the polished thin section used for microprobe analyses, the single crystal used for the structure analysis, and a macro-crystal of hanjiangite have been deposited...