DISCOVERY OF NEW MINERAL ADDIBISCHOFFITE, Ca₂Al₆Al₆O₂₀, IN A Ca-Al-RICH REFRACATORY INCLUSION FROM THE ACFER 214 CH3 METEORITE.

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Introduction: During a mineralogy investigation of the Acfer 214 CH3 carbonaceous chondrite, a new calcium aluminate mineral, named “addibischoffite”, Ca₂Al₆Al₆O₂₀ with the P-1 aenigmatite structure, was identified in a Ca-Al-rich inclusion (CAI). Field-emission scanning electron microscope, electron back-scatter diffraction, electron microprobe and ion microprobe were used to characterize its chemical and oxygen-isotope compositions, structure, and associated phases. Synthetic Ca₆AlO₁₀ was reported but not fully characterized [e.g., 1]. Presented here is its first natural occurrence as a new refractory mineral in a primitive meteorite. The mineral has been approved by the Commission on New Minerals, Nomenclature and Classification of the International Mineralogical Association (IMA 2015-006). The name is in honor of Addi Bischoff, a cosmochemist at Münster University, Germany, for his many contributions to research on CAIs in carbonaceous chondrites, including CH chondrites.

Occurrence, Chemistry, Oxygen Isotopes and Crystallography: Addibischoffite occurs as one irregular crystal, 9 μm × 3.5 μm in size, with hibonite, perovskite, kushiroite, spinel, melilite, anorthite, Ni-bearing iron in the mantle-center area of this CAI, surrounded by an igneous Ti-poor Al-diopside rim intergrown with small grains of low-Ca pyroxene (Fig. 1). Addibischoffite and hibonite have similar ¹⁶O-rich compositions (Δ¹⁷O = −24±2‰); the Al-diopside rim is ¹⁶O-depleted (Δ¹⁷O = −6±3‰). The CAI is ~50 μm in diameter in section Acfer 214-1580.

The mean chemical composition of the holotype addibischoffite is (wt%) Al₂O₃ 44.63, CaO 15.36, SiO₂ 14.62, V₂O₅ 10.64, MgO 9.13, TiO₂ 4.70, FeO 0.46, total 99.55, giving rise to an empirical formula of (Ca₂.00)(Al₂.55Mg₁.73V₁.08Ti₀.50Ca₀.09Fe₂⁺₀.05)(Al₄Si₁.86)O₂₀. The general formula is Ca₂(Al,Mg,V,Ti)₆(Al,Si)₆O₂₀. The end-member formula is Ca₂Al₆Al₆O₂₀. Electron back-scatter diffraction patterns of this new mineral can be indexed only by the P-1 aenigmatite structure and give a best fit using the Allende rhönite structure from [2] with unit cell dimensions: a = 10.367 Å, b = 10.756 Å, c = 8.895 Å, α = 106.0°, β = 96.0°, γ = 124.7°, V = 739.7 Å³, and Z = 2. Its calculated density is 3.414 g cm⁻³ using the empirical formula.

Origin and Significance: Addibischoffite Ca₂Al₆Al₆O₂₀ is a new member of the warkite group. It is the Al-analog of warkite CaSc₆Al₆O₂₀, or beckettite Ca₂V₆Al₆O₂₀. Addibischoffite is a new refractory phase, like warkite [3], being among the first solid materials formed in the solar nebula, most likely formed by crystallization from an ¹⁶O-rich Ca, Al-rich melt, whereas beckettite [4] is a secondary alteration phase formed in parent body.