Characterization of Alaska Tintina Gold Belt Stibnite Ores Using X-Ray Fluorescence (XRF), X-Ray Diffraction (XRD), Scanning Electron Microscopy (SEM), and Energy Dispersive Spectrometry (EDS) for Antimony and Rare Earth Elements

Albert Miezah Ackah[1]*, Emmanuel Abotar[1], Tathagata Ghosh[1], Nathan Graham[2], Brent Sheets[1], Hans Hoffman[3], Guven Akdogan[1]

[1] Department of Mining and Mineral Engineering, University of Alaska Fairbanks, USA
[2]Advanced Instrumentation Laboratory, University of Alaska Fairbanks, USA
[3]Nova Mineral Corporation, USA
Email: * amackah@alaska.edu

Abstract

Antimony, a critical mineral essential to U.S. defense and industrial operations, has significant potential in Alaska to support domestic production and to strengthen national security supply chains. Intrusion-related gold systems of the Tintina Gold Belt in Alaska represent one of the most promising settings for re-establishing a domestic supply. This study presents an integrated mineralogical and geochemical characterization of the Stibnite ore, a quartz-stibnite vein sample from the Estelle gold-antimony project in the Alaska Range, using wavelength-dispersive X-ray fluorescence (XRF), powder X-ray diffraction (XRD) with Rietveld refinement, and scanning electron microscopy coupled with energy-dispersive spectrometry (SEM-EDS). Stibnite samples (Styx), 3-5 inches in size, were stage-crushed, milled, and screened to a -75 μm analytical powder, from which a pressed pellet and a slurry smear were prepared for XRF and XRD, respectively; a polished epoxy grain mount was prepared for SEM-EDS. Whole-rock chemistry is dominated by SiO_2 (50.16 wt.%), SO_3 (22.60 wt.%), and Sb (18.89 wt.%), with enrichment in As (2,930 ppm), Se (350 ppm), Ag (184 ppm), Pb (256 ppm), and light rare earth elements (LREEs) of La 307 ppm, Ce 280 ppm). Rietveld-refined XRD returned a simple two-phase modal mineralogy of quartz (81 wt.%) and stibnite (19 wt.%), and backscattered-electron imaging confirmed coarse, reticulated quartz-stibnite intergrowths with both phases free of visible inclusions. The high stibnite grade, coarse intergrowth texture, and absence of clay minerals and discrete arsenopyrite indicate a metallurgically favorable ore relative to refractory clay-rich stibnite deposits. Although elevated As and Se contents will require environmental management during processing and smelting, the results support the classification of the Stibnite prospect as part of a reduced intrusion-related gold-antimony system with meaningful critical-mineral potential.