

The Bi Te of Au: A geometallurgical assessment of Bi and Te deportment during ore processing at the Pogo Au Deposit, Alaska, USA

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Bismuth (Bi) and tellurium (Te) are technologically critical elements which are primarily recovered as secondary byproducts in the extraction of lead and copper, respectively. Both Bi and Te can be enriched in gold (Au) deposits, but are not typically recovered from them. Bi and Te can behave similarly to Au in the extraction process and increase production costs. Identifying which Bi and Te minerals are present throughout the Au extraction process is essential to both identifying where these elements might be economically recovered and reducing Au production costs.

Here we present the results of an elemental composition and mineralogical analysis of samples from the Pogo Mine Mill (Interior Alaska, USA) via XRD, WD-XRF, ICP-MS, and electron microscopy. Feed ore contains ~4 mg kg⁻¹ Au, ~30 mg kg⁻¹ Bi, and ~40 mg kg⁻¹ Te. Electron microscopy indicates Bi is present as native Bi and maldonite (Au₂Bi), and that both Bi and Te are present as minerals in the Bi-Te-S system. Outside of the gravity circuit which concentrates free gold by density, the Bi and Te minerals track the sulfide behavior, concentrating in the flotation concentrate (~200 mg kg⁻¹ Bi, ~100 mg kg⁻¹ Te). Similar Bi and Te values are measured in the carbon-in-pulp tails. Analysis of the pregnant solutions (Bi and Te below detection limits) and loaded carbon (17 mg kg⁻¹ Bi, 9 mg kg⁻¹ Te) show that Bi and Te minerals do not dissolve in the cyanide circuit. The gravity table concentrate is not subject to flotation or cyanide treatment and it goes directly to the refinery. We pinpoint the gravity table as the source of the Bi in the doré due to the similar densities of Au and Bi minerals. A potential recovery target for Bi and Te as secondary metals that would also improve Au recoveries would be refinements at the gravity table. Similar geometallurgical studies of the mineralogy and geochemistry at other Au mines could yield comparable locations where Bi and Te might successfully be extracted and also yield improved gold recoveries.