

Economic Geology

BULLETIN OF THE SOCIETY OF ECONOMIC GEOLOGISTS

VOL. 98

May 2003

No. 3

Invisible Gold and Tellurium in Arsenic-Rich Pyrite from the Emperor Gold Deposit, Fiji: Implications for Gold Distribution and Deposition

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Abstract

Gold is found in three different forms in the Emperor gold deposit: as “invisible” or submicrometer-size inclusions of gold in arsenian pyrite, as visible native gold and/or electrum, and as tellurides (calaverite, krennerite, sylvanite, and petzite). Similarly, Te occurs as invisible tellurium or submicrometer-size inclusions of tellurium in arsenian pyrite, as visible native tellurium, and as tellurides. Scanning electron microscopy (SEM), electron probe microanalysis (EPMA), and secondary ion mass spectroscopy (SIMS) show that pyrite from Emperor is among the most Au- (up to 11,057 ppm Au), Te- (up to 5,796 ppm Te), and As-rich (up to 16.60 wt % As) yet reported from any mineral deposit type. Arsenian pyrite manifests itself as uniformly distributed grains, as As-rich rims on preexisting grains, or as As-rich cores. The estimated proportion of Au as invisible gold at Emperor ranges from 47 to 92 percent, with the remainder of Au occurring predominantly as gold-bearing tellurides. Native gold constitutes <1 percent of the Au budget. Invisible gold is incorporated in the structure of arsenian pyrite, probably as a Au-bearing complex where Au is coordinated as ionic gold (Au⁺). The unusually high Au content of Te-bearing arsenian pyrite at Emperor most likely is due to the presence of lamellae of As- and Au-bearing marcasite or Au-bearing arsenopyrite, or a structurally bound Au-Te-bearing complex that allows for greater amounts of Au and As to be incorporated in pyrite than is generally associated with Te-deficient complexes.

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