Textural and LA-ICP-MS trace element chemistry analysis of pyrite from Telfer Au-Cu deposit, W.A.: Implications for a multi-stage and/or multi-source ore system

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TEXTURAL AND LA-ICP-MS TRACE ELEMENT CHEMISTRY ANALYSIS OF PYRITE FROM TELFER AU-CU DEPOSIT, W.A.: IMPLICATIONS FOR A MULTI-STAGE AND/OR MULTI-SOURCE ORE SYSTEM

PYRITE ANALYSIS FROM TELFER AU-CU DEPOSIT

ABSTRACT

Latest-generation microanalytical techniques, offering ppm-level precision coupled with micron-scale resolution, represent new methods to decipher the genetic history of an orebody. The 38.5 Moz world-class Au-Cu Telfer deposit is hosted within a sequence of Paleo- to Neoproterozoic marine sediments on the northwestern margin of the Paterson Orogeny, Western Australia. The deposit is characterised by two dome structures hosting a series of stratabound and vertically-stacked ore horizons ('reefs'). Pyrite, a typically refractory mineral, is a common component of Au-ores and is the dominant ore mineral at Telfer. Petrographic analysis and Scanning Electron Microscope back-scatter imaging established four morphologically discrete stages of pyrite and an abundance of associated minerals. Laser-Ablation Inductively Coupled Plasma Mass-Spectrometry spot analysis and element mapping on selected pyrite grains delineated trace element patterns that allow for development of a model of multi-stage ore genesis. Gold distribution in pyrite indicates deformation-induced remobilisation of initially lattice-bound Au. Gold expelled from the sulphide lattice during remobilisation is observed as grains of electrum and native gold within brittle fractures and fissures as well as micro-, and likely also nanoscale inclusions in pyrite. Silver, Bi, Te, Pb, Tl, Co, Sn and As were also seen reconcentrated into micro-fractures and at grain margins. Oscillatory pyrite growth, expressed by zonation of As, Co and Ni are prominent; the latter two suggesting a metal source of mafic origin. Enrichment of Sn, Bi, Cu ± Zn, Te, Au, and associated presence of exsolved stannite, chalcopyrite and accessory bismuthinite, aikinite, calaverite, tetradymite and tsumoite suggest a granitic source for at least one generation of pyrite. The pyrite morphology, and recorded trace element chemistry distribution in pyrite are concordant with a hypothesis by which the Telfer deposit is the product of a protracted multi-stage ore forming system or single mineralising event with multiple sources of metals and/or sulphur.

KEYWORDS

Telfer, Au-Cu, Pyrite, Textures, Laser-Ablation Inductively Coupled Plasma Mass-Spectrometry, grain-scale mapping, multi-stage ore formation

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