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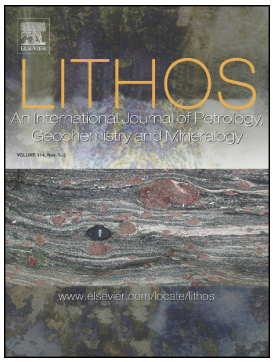

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Pyrite deformation and connections to gold mobility: Insight from micro-structural analysis and trace element mapping

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Abstract

The metamorphic transition of pyrite to pyrrhotite results in the liberation of lattice-bound and nano-particulate metals initially hosted within early sulphide minerals. This process forms the basis for the metamorphic-driven Au-upgrading model applied to many orogenic Au deposits, however the role of syn-metamorphic pyrite deformation in controlling the retention and release of Au and related pathfinder elements is poorly understood. The lower amphibolite facies metamorphic mineral assemblage (Act-Bt-Pl-Ep-Alm±Cal±Qz±Ilm; 550°C) of Canada's giant Detour Lake deposit falls within the range of pressure-temperature conditions (450°C) for crystal plastic deformation in pyrite. We have applied a complementary approach of electron backscatter diffraction (EBSD) mapping and laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS) 2D element mapping on pyrite from the Detour Lake deposit. Chemical element maps document an early generation of Au-rich sieve textured pyrite domains and a later stage of syn-metamorphic oscillatory-zoned Au-poor pyrite. Both pyrite types are cut by Au-rich fractures as a consequence of remobilization of Au with trace element enrichment of first-row transition elements, post-transition metals, chalcogens and metalloids during a late brittle deformation stage. However, similar enrichment in trace elements and Au can be observed along low-angle grain boundaries within otherwise Au-poor pyrite, indicating that heterogeneous microstructural misorientation patterns and higher strain domains are also relatively Au-rich. We therefore propose that the close spatial relationship between pyrite and Au at the microscale,