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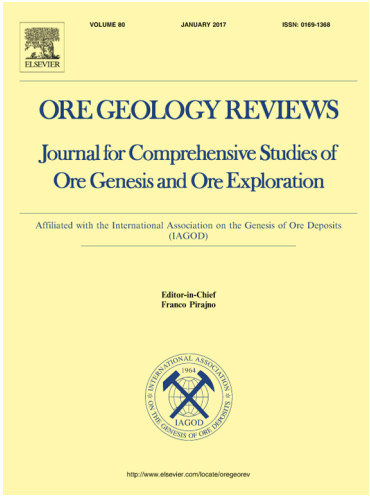

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Textural development in sulfide-matrix ore breccias in the Voisey's Bay Ni-Cu-Co deposit, Labrador, Canada

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Abstract

Magmatic Ni-Cu sulfide ores at Voisey's Bay contain complex assemblages of extremely heterogeneous rocks. These range from polymict breccias, with rock fragments in sulfide-rich and/or sulfide-poor matrices, to heterogeneous "vari-textured" gabbros with rapid short range variations in grain size and content of hydrous phases. Rock fragment populations in the breccias include endogenous gabbros (cumulate and non-cumulate) and cumulate peridotites along with extensively depleted plagioclase-hercynite gneisses interpreted as restites from extensive partial melting of country rock quartzo-feldspathic paragneisses. Using a combination of desk-top microbeam XRF mapping at cm scale and 3D X-ray tomography, we show that both sulfide-poor and sulfide-rich breccias comprise heterolithic assemblages of clasts within a matrix of olivine gabbro. This matrix is characterised by an interconnected 3D framework of plagioclase crystals, highly variable in grain size at mm to cm scale, with interstitial olivine and poikilitic clinopyroxene, and is texturally indistinguishable from clast-free olivine gabbro. Sulfide forms interconnected networks at cm to dm scale and possibly larger. Much of the plagioclase developed by outgrowth from the margins of paragneiss xenoliths when the porosity was occupied by silicate melt. The observed range of textures is explained by a model of percolation of molten sulfide through variably crystalline inter-clast matrix, displacing the silicate melt to leave the refractory plagioclase-olivine or in some cases plagioclase-only component, now entirely within a sulfide matrix. The process is analogous to that believed to have formed interspinifex ore in komatiite-hosted deposits. Biotite rims on plagioclase enclosed in sulfide are interpreted as the result of reaction between plagioclase, olivine and a hydrous component derived from the sulfide melt itself, with a possible component of migrating residual silicate melt wicking along sulfide-silicate contacts. This sulfide infiltration model offers an alternative to the current model for upward emplacement