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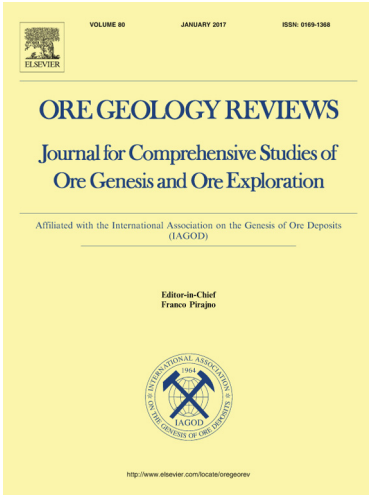

Primary stratigraphic controls on ore mineral assemblages in the Wannaway komatiite-hosted nickel-sulfide deposit, Kambalda camp, Western Australia

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TITLE

Primary stratigraphic controls on ore mineral assemblages in the Wannaway komatiite-hosted nickel-sulfide deposit, Kambalda camp, Western Australia

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Abstract

The 18 m-long UWA-04-02 drillcore from the Fe-Ni-Cu-PGE Wannaway deposit in the Widiemooltha Dome district (Eastern Goldfields, Western Australia) intersects the whole sequence of a komatiite-hosted layer of metal-rich sulfide magma. In spite of regional deformation and amphibolite facies metamorphism the sequence in the drillcore still preserves some of the original, magmatic textures and assemblages and these were examined in a great detail. The magmatic orebody typically consists of basal massive sulfides grading to net-textured (matrix) and disseminated sulfide mineralization upward into the komatiite host. The ore zone is underlined by sulfide-rich black shale passing to basalts. Country rock xenoliths are locally enclosed in the massive sulfides. Portions of the drillcore untouched by penetrative deformation and with minimal imprint by late-stage serpentinization allow the construction of a fairly complex framework where mineral assemblages and mineral chemistry of sulfides, spinels and silicates vary systematically with stratigraphy and may reflect original conditions of ore deposition. The general ore assemblage is dominated by Fe-sulfide and pentlandite, with minor sphalerite and chalcopyrite, spinels (Zn-rich chromite, Ti-magnetite), alabandite (MnS), accessory PGE-rich sulfarsenides and tellurides and rare molybdenite. Monoclinic and high-S hexagonal pyrrhotite and fresh Zn-Mn-rich chromite characterize the basal massive facies, whereas the matrix ore facies is marked by magnetite, sphalerite and a gradually S-depleted and reduced assemblage now represented by troilite exsolving low-S hexagonal pyrrhotite and alabandite. Compositional modifications of the Fe-sulfides across the whole orebody and occurrence of alabandite testify to progressive sulfur loss concomitant with the establishment of low fO_2 conditions over several meters upsequence in the matrix ore facies. PGE-rich sulfarsenides disseminated across the whole mineralized sequence display igneous textures and PGE fractionation trends. The composition of olivine intergrown with matrix sulfides and in the serpentinized hangingwall komatiite deviates from the typical unmetamorphosed komatiite-related, highly-forsteritic type. However the Fe, Mn and Zn contents of olivine crystals decrease systematically and gradually with distance from mineralization towards the hangingwall komatiite. Contamination may be an alternative to metamorphic recrystallization of olivine as the cause of these trends. The role of contamination is also shown by the trends of whole-rock data from the mineralized sequence across the entire drillcore. Textures and mineral chemistry of minerals from the different rock facies in the drillcore are evaluated in terms of metamorphic effects, although the remarkable relationship observed between stratigraphy and several major and accessory phases over metric distances is suggestive of alternative options including primary processes involving the komatiitic lava flow in its interaction both with the black shale substrate and with the sulfide melt ponding at its base.

Keywords: Fe-Ni-(PGE) sulfide deposits; pyrrhotite-troilite; alabandite; Ni-Co sulfarsenides; komatiite; contamination