The DeGrussa Au-Cu-VMS Deposit, Western Australia: Element Dispersion in a Tertiary Palaeochannel System

Ignacio González-Álvarez,[1]* Walid Salama,[1] Monica leGra,[1] Paul Hilliard,[2] and Richard Beckley[2]

[1]CSIRO, Mineral Resources Flagship, Discovery Program, Perth, Western Australia
[2]Sandfire Resources Ltd., West Perth, Western Australia

*E-mail, ignacio.gonzalez-alvarez@csiro.au

In the context of deeply weathered landscapes, sedimentary packages with exotic mineral and geochemical features contribute to increase the total thickness of the regolith profile. This overburden acts as a filter or impermeable barrier to vertical geochemical dispersion. Sedimentary systems associated with ore deposits may act as mechanical dispersion agents of pathfinder elements at the local and regional scale.

The DeGrussa Cu-Au VMS deposit is hosted in Proterozoic turbidites, mafic basalts, and intrusive dolerites and is located in the Naracoota Formation in the Bryah basin, east of the edge of a Tertiary paleodrainage system. Three main weathering events have been identified previously in this part of Australia at ~60, ~30, and ~18–6 Ma. These events had significant effects on erosional rates and on the geochemistry of the paleochannel infill. To the west of the DeGrussa deposits, the regolith profile is divided into in situ regolith (up to 100 m thick) overlain by a transported cover (3–100 m thick).

The regolith to the west of DeGrussa is subdivided into ferruginous saprolite at depth, which vertically changes into kaolinitic saprolite, sporadically capped by a ferruginous or siliceous duricrust. This is overlain by a sedimentary package of Tertiary paleochannel clays and gravel, topped by Quaternary alluvium/colluvium that may be partly silicified.

The geochemical signature (based on 5 samples) of the ore deposit comprises concentrations of Cu, Zn, Au, and Ag up to 7.1, 2.3 wt %, 5.1 and 18 ppm, respectively, as well as In (3–18 ppm), Mo (6–35 ppm), Se (800–90 ppm), Te (25–85 ppm), Bi (10–175 ppm), As (100–1550 ppm) and Co (230–600 ppm), and significant depletion of Nb, Hf, Th, REE, Cr, Ni, V, Sc, and Ba.

The clay-rich palaeochannel sediments have mean Chemical Index of Alteration (CIA) values of ~95, with low absolute contents of Sr, Ca, K, Mg and Na, and high concentrations of Al_2O_3 (mean ~22 wt%) and CIA-Eu/Eu* covariation of extreme values. This is interpreted as the result of exceptionally intense postdepositional weathering and/or deposition of already weathered sediments. Strikingly, Cr (~370 ppm), Ni (~60 ppm), V (~350 ppm) and Sc (~35 ppm) are widely enriched in the sedimentary cover as well as in the fresh sedimentary basement rocks (turbidites, siltstones), although these elements are significantly depleted in the ore. Copper, Ag, In, As, and Se are enriched throughout the sedimentary cover relative to UCC. Sedimentary units above the Tertiary channel package have higher anomalous concentrations of As and Mo compared to As and Mo in the channel clays.

Covariation of CIA-Eu/Eu*, CIA-ΣREE, and Sr-Eu/Eu* could be indicative of a large catchment area. However, the pervasive metal enrichment of the sedimentary cover suggests that the drainage system had a restricted catchment with a sediment provenance linked to the area of the local mineral system or to the Proterozoic basement rocks enriched in Cu, Ag, Cr, Ni, V, and Sc. Further work will determine the relative significance of overprinting by vertical chemical dispersion from fresh basement rocks versus mechanical dispersion due to sedimentary dynamics.