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TRACE ELEMENT-MINERAL ASSOCIATIONS IN THE REGOLITH, SCUDDLES MASSIVE Cu-Zn SULPHIDE DEPOSIT, WESTERN AUSTRALIA

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ABSTRACT

The association between trace elements and regolith minerals has been studied at the Scuddles Cu-Zn sulphide deposit, Golden Grove, Western Australia. The mineralogy and the trace element abundance were characterised using a combination of bulk and *in situ* micro-analytical techniques. The determination of low abundance elements in the minerals was carried out with *in situ* Laser Ablation Inductively Coupled Plasma Mass Spectrometry (LA-ICP-MS).

The Scuddles deposit occurs in a sequence dominated by felsic and intermediate volcanoclastic sediments and lavas. The mineralised horizon is up to 80 m thick. The hanging wall lavas are deeply weathered to a depth exceeding 100 m in places. The regolith consists of a lower saprolite, 10 to > 60 m thick, which roughly coincides with the modern water-table, a 10 to 50 m thick upper saprolite, a mottled zone and a 1 to 2 m thick silicified hardpanned colluvium.

The samples selected for this study are from 2 drill holes located directly above the mineralisation and 4 drill holes intersecting the weathered hanging-wall rocks. Data from Normandy Mining Ltd. indicate anomalies of Sb, In, Bi as well as Cu, Pb and Zn in some samples, directly up dip from mineralisation. In contrast, samples located further west into the hanging wall lavas are enriched in Cu, Pb and Zn, but not in Sb, Bi and In.

Mineralogy

Hanging wall

The lower saprolite consists of quartz, muscovite, kaolinite, corrensites (high and low-charge) and accessory ilmenite, goethite, coronadite and plumbogummite. The upper saprolite is characterized by a decrease in abundance of Mg-rich clays.

Over mineralisation

The saprolite is thin and comprises quartz, chlorite, kaolinite, muscovite and accessory high-charge corrensite, rutile, Mn-oxides (coronadite, coronadite-hollandite and lithiophorite) and plumbogummite. Relicts of mineralised material pseudomorphed by colloform goethite and hematite, and quartz crystals containing inclusions of euhedral pyrite, are widespread in the lower saprolite. The upper saprolite is intensively silicified and locally displays banded concretions of microcrystalline kaolinite and goethite.

Mineral-trace elements associations

The mineralogical and geochemical investigations of the Scuddles regolith have provided new information about the location of trace elements and have improved the understanding of the geochemical dispersion observed in this area.

Hanging wall

Lead, Cu, Mn, Zn and Co are concentrated in the lower saprolite but decrease towards the surface. Manganese is concentrated in coronadite and lithiophorite and Pb in coronadite and plumbogummite. Copper and Zn are hosted in corrensites, smectites, coronadite and goethite. Zinc and Mn are also contained in ilmenite-ecandrewsite. Cobalt and Ni are immobilized in lithiophorite and marginally in corrensites and smectites. Bismuth, Sb, In and Mo are not significantly concentrated. However Mo is locally scavenged by coronadite and iron oxides, and Sb is present in weathered ilmenite and goethite.

Over mineralisation

There is an overall concentration of Sb, Bi, In and Mo immediately above the orebody. Antimony, Mo and In occur predominantly in iron oxides whereas Bi is contained in Pb-Bi phases and rutile. Antimony, Mo and Bi are abundant in rutile present in the bleached and Fe-rich upper saprolite. Fresh sphalerite inclusions in quartz crystals contain In. Copper and Zn are moderately concentrated in Fe and Mn oxides (coronadite and lithiophorite) and in rare corrensite in the lower saprolite. Iron oxides contain abundant Cu and Zn in the upper saprolite reddish mottles. In the lower saprolite, Pb is concentrated in iron oxides -with an affinity for hematite- and in Mn oxides (coronadite and hollandite). It is relatively less depleted than Cu and Zn in the upper saprolite where it is retained in Fe-oxides, plumbogummite, Pb-Bi phases, and sphalerite inclusions.

At Scuddles, trace element dispersion is strongly controlled by the mineralogy of the regolith. Above the mineralisation, potential mineral hosts corrensites and smectites are not abundant enough to immobilise, and as a result Cu, Zn and Pb released from the dissolution of sulphides. Instead, the Mg-clays and Mn oxides concentrate Cu and Zn further west. Bismuth, Mo, Sb and In anomalies are considered residual, with local variations associated with Fe oxides.

It has been shown that Bi, Mo and Sb anomalies are either directly related to the mineralisation or result from the relative accumulation of rutile towards the surface of the regolith. Kaolinite is a barren clay and does not give any base metals signature. For base metal exploration in Scuddles area, Fe-stained kaolinite is the preferred sampling medium instead of bleached kaolinite.