The Application of Geophysics Over the Mount York Gold Deposit, Western Australia

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Abstract

A resource of about 1 Mt of gold at 2.7 g/t has been delineated at Mount York, 120 km south-southeast of Port Hedland in the Pilbara Region of Western Australia. The deposit is contained within a banded iron-formation.

In order to supplement ongoing geological investigations to define the resource, a geophysical programme was undertaken to assist mapping and also delineate primary sulphide zones which could have associated gold mineralisation. Aeromagnetic, spectral induced polarisation, surface and downhole electromagnetic surveys, and downhole density logging were undertaken.

The magnetic data clearly outlined the lateral extent of the banded iron-formation but were unable to delineate subtle structure which was thought to control primary mineralisation. Induced polarisation and electromagnetic surveying provided numerous targets in both the primary and oxidised zones. Drill testing of these primary-zone targets intersected sulphide mineralisation but, unfortunately, no gold mineralisation of economic width and grade. Downhole density logging of the secondary oxide zone allowed the density of the mineralisation to be better defined and hence provided a sound base for resource calculations.

Geophysical Investigations of the Kalgoorlie Goldfield, Western Australia

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Abstract

Leases held by Kalgoorlie Consolidated Gold Mines Pty Ltd over the Kalgoorlie Goldfield have an approximate area of 30 by 10 km, with the main production areas of Fimiston, Mount Charlotte and Mount Percy within the central portion of this tenement block. Due to the proximity of the leases to residential areas, significant portions of land are inaccessible for exploration. Near-surface contamination, as a result of historical mining and prospecting, also presents problems, as do the deep weathering profile and associated conductive overburden, which covers most of the Kalgoorlie Goldfield.

Due to the relatively small size of the lease holdings and the constraints detailed above, the currently employed geophysical techniques mainly involve detailed ground surveys and include petrophysical studies of the three principal styles of mineralisation and the surrounding host rocks. The aims of the surveys are improved definition of geological features, and indirect detection of the three principal styles of mineralisation recognised at Fimiston (Golden Mile), Mount Charlotte and Mount Percy.

The petrophysical data indicate that gravity, magnetics and induced polarisation can be used for the delineation of rock types whereas induced polarisation has potential to identify mineralisation. The combination of gravity and ground magnetic surveys at a prospect scale permits considerable refinement of the structural and lithological features in areas of poor outcrop. Studies are ongoing evaluating the potential use of downhole induced polarization for detection of Mount Charlotte-style stockwork mineralisation, and the use of ground penetrating radar to detect voids for underground mining.

Some Aspects of the Magnetic Signature of the Bottle Creek Gold Deposit, Western Australia

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Abstract

The Bottle Creek gold deposit lies on a north-trending structural break between two major terrains in the Ularring greenstone belt, north of Kalgoorlie. Aeromagnetic data in the vicinity of the deposit suggest several structures which appear to have controlled gold mineralisation. The mineralised horizon lies at a structurally discordant, north-northwest-trending internal junction within a thick mafic sequence in the eastern terrain. Lithological variations within this sequence have been inferred to represent distinct upper and lower groupings, and are structurally determined. Interpreted dips within the eastern terrain are very steep and can be contrasted with much shallower regional dips in the western terrain. Mineralisation within the Emu Formation host, which occupies a sheared zone, contains pyrrhotite but the observed magnetic responses along the structure appear to reflect magnetite-constructive alteration near the boundary. There are two shears; the largest separates western and eastern sequences, which meet acutely but are not mineralised along the shear. There is a lesser parallel structure further east. The structures are separated by a mafic unit which generates a chain of isolated magnetic responses along this structure. The Bottle Creek deposits are associated with sheared and altered junctions along the, apparently, lesser shear. Major deposits appear to be localised where this shear is intersected by large northeast-trending fractures.

Relationship Between Magnetic Anomalism and Epigenetic Gold Mineralisation in the Victory-Defiance Area, Western Australia

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Abstract

The relationship between gold mineralisation, genetically related mineral assemblages, magnetic susceptibility and features observable in ground and airborne magnetic surveying is established at three gold mines in the Victory-Defiance gold camp at Kambalda, Western Australia. The gold mines are Orion, North Orchin and Revenge. There are significant magnetite-stable alteration haloes enveloping the gold lodes comprising these deposits.

The magnetite-stable alteration is peripheral to gold lodes in differentiated dolerites, metabasalts and metasedimentary rocks which have undergone lower to mid-greenschist facies metamorphism. The magnetite alteration is partly coincident with the well-documented chlorite and biotite alteration zones.

The magnetic susceptibilities of the magnetite-stable alteration assemblages range to 100 x 10-3 SI units. It is noted that the magnetic properties of the Kapai Slate vary considerably on a regional scale but appear to be consistently high (up to 400 x 10-3 SI units) within the Victory-Defiance gold camp.

Magnetic maxima are coincident with all three gold deposits. The amplitude of the maxima observed in low-level aeromagnetic surveys are 30, 300 and 400 nT for Orion, North Orchin and Revenge, respectively.

Detailed Ground Radiometric and Magnetic Surveys of the Leviathan and South Venus Gold Prospects, Western Australia

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Abstract

In Western Australia, exploration for low-grade gold mineralisation is hindered by the presence of a deep mantle of weathering. Application of geophysical techniques at two prospects near Southern Cross, South Venus and Leviathan, shows that ground magnetic surveys are useful for lithological mapping and structural interpretation, and potassium alteration associated with gold mineralisation can be mapped directly using radiometric surveys. Radiometric measurements indicate that potassium signals of up to 5%eK are associated with wallrock alteration adjacent to gold mineralisation, whereas the potassium signal from the main mineralised zone is close to 0%eK. Potassium signals associated with alteration are generally two to five times the width of the zone of gold mineralisation. Comparison of surface and drillhole radiometric sampling indicates that weathering does not seriously effect surface radiometric surveys except where transported soils cover the residual weathered profile.

Geophysics of the Big Bell Gold Deposit, Western Australia

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Abstract

The Big Bell gold deposit is hosted by a felsic volcanic sequence of Archaean age. The alteration mineral assemblages within the host- and wallrock units of the deposit produce measurable geophysical anomalies. The deposit and altered wallrocks which contain up to 10 vol. % sulphide are chargeable, producing induced polarisation anomalies in dipole-dipole data of up to 30 mV/V at n^53. In addition, a strong chargeability of up to 40 mV/V at n^52 is evident in the dipole-dipole data, and corresponds to a graphitic and sulphidic horizon in the immediate footwall to the deposit. This unit has been mapped with the gradient array over the entire extent of the leases, providing a useful marker at the top of the felsic volcanic sequence.

The strong potassic alteration accompanying the gold mineralisation is delineated in downhole spectral radiometric logs in which highly anomalous potassium values of up to 8 wt % are comparable with those derived by chemical analysis. The downhole logs also indicate that alteration has not enriched or depleted uranium or thorium in the ore zone. There are also ground radiometric potassium anomalies over outcropping lode rocks.

Airborne and ground magnetic anomalies adjacent to the lode are due to sources with very high magnetic susceptibility values, measured in pyrrhotite- and magnetite-altered wallrocks by downhole geophysics. The values measured in the logs are 0.14 SI units in the pyrrhotite-altered zone, and range between 0.025 and 0.5 SI units in the magnetite-altered zone.

Target generation within the remainder of the Big Bell greenstone belt has relied heavily on geophysics, with the highest ranking being given to magnetic, potassium and induced polarisation anomalies within the felsic volcanic sequence.

Magnetic Susceptibilities of Rocks Associated with Some Archaean Gold Deposits in Western Australia

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Abstract

Magnetic susceptibility measurements of rocks obtained from a number of Archaean mesothermal gold deposits have aided the interpretation of their geological and geophysical settings. Five deposits within the Yilgarn Craton were chosen on the basis of their magnetic host rocks: Youanmi (tholeiitic basalts), Greenfields (layered differentiated gabbro), Mount Martin (strongly sheared komatiitic sequence), Queen Margaret (serpentinised komatiitic peridotite) and Bounty (banded iron-formation). Iron-rich minerals associated with the gold ores include: weakly magnetic pyrrhotite (Greenfields and Bounty), magnetite (Mount Martin and Bounty) and non-magnetic pyrite (Youanmi and Queen Margaret).

The existence of two styles of mineralisation, whose apparent susceptibilities are either less than, or greater than, the host rocks, is a consequence of the geochemical interaction between the hydrothermal fluids and the wallrocks. This can have important implications for exploration since the target magnetic anomalies will be different in each case. Where apparent susceptibility values in the ore are greater than the host rocks, the mineralisation would be expected to be represented by a secondary positive anomaly on the flanks of a larger regional anomaly; where they are less, any local magnetic minima could be highly significant in terms of