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

Allan Perry[1] *& Vernon C. Wilson*[2]
1. World Geoscience Corporation, 65 Brockway Rd, Floreat, W.A. 6104 (formerly of Curtin University of Technology). 2. Department of Exploration Geophysics, Curtin University of Technology, G.P.O. Box U1987, Perth, W.A. 6001.

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

Stephen G. Massey[1] *& Peter Kowalczyk*[2]
1. Placer Exploration Ltd, P.O. Box 764, Cloverdale, W.A. 6105. 2. Placer Dome Incorporated, P.O. Box 49330, Bentall Postal Station, Vancouver, British Columbia V7X 1P1, Canada

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 $n^5 3$. In addition, a strong chargeability of up to 40 mV/V at $n^5 2$ 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

Richard A. Keele
Centre for Ore Deposit and Exploration Studies, Geology Department, University of Tasmania, G.P.O. Box 252C, Hobart, TAS 7001

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

targeting drillholes. A correlation between gold grades and apparent susceptibility at Bounty and Mount Martin suggests that, in some cases, susceptibility measurements can be used as a guide to ore. In deposits containing komatiitic volcanic rocks, such as Queen Margaret and Mount Martin, the susceptibility meter can be used as an effective mapping tool, particularly where facing evidence is required to interpret complex structures.

Magnetic and Electrical Signatures of the Granny Smith Gold Deposits, Western Australia

John H. Coggon[1], Steven G. Massey[2] & William J. Amann[3]
1. Mines Geophysical Services, 16 Victoria Street, Kalgoorlie, W.A. 6430. 2. Placer Exploration Ltd, 5-7 Eyre Street, Belmont, W.A. 6104. 3. Western Mining Corporation Ltd, 5 Stoneham Street, Belmont, W.A. 6104

Abstract

Gold deposits at Granny Smith occur along a shear between a granodiorite intrusion and epiclastic sedimentary units. Three ore zones, Goanna, Granny and Windich, were identified by CSR in 1987, during exploration that included ground magnetic and induced polarisation surveys. Magnetic data were useful in helping to map intrusive rocks, banded iron-formations and less magnetic sedimentary horizons, and some faults. Although magnetite is a minor alteration mineral in the granodiorite, the mineralised zones do not give identifiable magnetic responses. Dipole-dipole induced polarisation surveys also gave valuable, and complementary, mapping information. At Granny, carbonaceous shale in the hangingwall and weakly polarisable footwall granodiorite masked any induced polarisation signal that the mineralisation may have produced. Drillhole measurements showed that oxidised mineralisation is not anomalously polarisable, whereas fresh mineralisation is moderately polarisable (some pyrite accompanies gold). Despite the lack of a direct induced-polarisation anomaly from Granny, the IP surveys delineated the deeply weathered mineralised shear north of Granny, which contributed to the discovery of Goanna. Electromagnetic measurements have also been used effectively for resistivity mapping.

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Magnetic Properties and Magnetic Signatures of BIFS of the Hamersley Basin and Yilgarn Block, Western Australia

David A. Clark & Phillip W. Schmidt
CSIRO Division of Exploration and Mining, P.O .Box 136, North Ryde, N.S.W. 2113

Abstract

Magnetite-rich banded iron-formations (BIFs) exhibit characteristic magnetic properties, including strong anisotropy. Interpretation of the geological structure of BIF units from the associated magnetic anomalies is complicated by anisotropy of susceptibility and, frequently, by remanent magnetisation. The timing of remanence acquisition relative to folding exerts a crucial influence on the form of the anomalies. Neglect of susceptibility anisotropy and remanence can lead to large errors in interpreted dips and thicknesses of BIF units. The effective susceptibility of BIFs parallel to bedding exceeds the susceptibility normal to bedding, typically by a factor of 2 to 4. Bedding-parallel susceptibilities of magnetite-rich BIFs are typically 0.5 to 2.0 SI (0.05-0.16 G/Oe). Remanence directions in BIFs usually lie close to the bedding plane. Koenigsberger ratios (Q) of BIFs vary widely, but characteristic values can often be determined for individual units. Q values in the range 1 to 2 are common. The magnetisations of the haematite-rich supergene-enrichment iron ores are much lower than those of their BIF precursors.

Magnetic properties of outcropping BIFs are usually greatly modified by weathering, which substantially decreases the bulk susceptibility, the degree of anisotropy and the remanence intensity. Deeper and more intense weathering of BIFs is encouraged by faulting and can be associated with reduced magnetic response over intensely faulted zones.

The remanence of BIFs from the Hamersley Basin is carried by late diagenetic to low-grade metamorphic magnetite after primary haematite. At Wittenoom and Paraburdoo, the remanent magnetisation of Brockman Formation BIFs is pre-folding, whereas in an area of higher metamorphic grade, the Turner Syncline, the remanence of the BIFs is probably post-folding. Aeromagnetic signatures over the Turner Syncline clearly reflect anisotropy and remanence.

Anisotropy and remanence effects are also evident in observed magnetic signatures over Archaean BIFs in the Yilgarn Block. Magnetic property measurements on samples from the Mount Magnet area and elsewhere confirm the high anisotropy and strong remanent magnetisations of these rocks.

Geophysics and Iron Ore Exploration: Examples from the Jimblebar and Shay Gap-Yarrie Regions, Western Australia

Tracey L. Kerr[1], Anthony P. O'Sullivan[2], Darryl C. Podmore[3], Richard Turner[4] & Peter Waters[5]
1. BHP Minerals Exploration, 3 Plain Street, East Perth, W.A. 6004. 2. BHP Iron Ore, 200 St George's Terrace, Perth, W.A. 6000. 3. BHP Iron Ore, Shay Gap Mine, Shay Gap, W.A. 6761. 4. Minera BHP de Chile Inc., La Capitana 163, Las Condes, Santiago, Chile. 5. BHP Iron Ore, P.O. Box 655, Newman, W.A. 6753

Abstract

Aeromagnetic and downhole logging data have been acquired for iron ore deposits at Jimblebar and Shay Gap-Yarrie in the Pilbara region of Western Australia. The Jimblebar deposits are from the Archaean-Early Proterozoic Hamersley Group and the Shay Gap-Yarrie deposits are from the Archaean Gorge Creek Megasequence.

Aeromagnetic data are used to assist in regional mapping and generation of exploration targets. In structurally complex areas, a very close line-spacing may be necessary to provide data of sufficient resolution. Careful processing is necessary to reduce the large dynamic range of the data, caused by highly magnetic banded iron-formation (BIF), so that subtle features may be seen. Deposits display both structural and stratigraphic controls which may be evident in aeromagnetic data. In addition, the iron enrichment process alters magnetite within the parent BIF to haematite, which may give rise to subdued responses in aeromagnetic data. The application of the aero-