the country rock, making magnetics and induced polarisation useful methods. Although there is a density contrast of 1 g/cm3, the gravity method was not used, largely because of the success of electromagnetics, but also because of the steep topography around the deposit.

Its short strike length means that the mineralisation does not make a good airborne target using conventional line spacings.

Application of Geophysics to Nickel Sulphide Exploration in the Kambalda District, Western Australia

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Abstract

The limited geological outcrop within the Kambalda district, when coupled with the favourable physical properties of nickel sulphides, make geophysical methods an important tool in the exploration for Archaean nickel deposits in this area. Present exploration strategy uses detailed airborne and surface magnetics in the targeting of favourable ore environments, structures, and prospective ultramafic-mafic contacts. Surface and downhole electrical and electromagnetic techniques are then applied to optimise prospect drilling and directly detect nickel sulphides. Thick, conductive overburden, magnetic 'noise' originating in near-surface laterites, 'false' anomalies due to conductive sedimentary units, and the extensive blanket of lake sediments in certain areas continue to present challenges to successful exploration.

Geophysical Response of the Rocky's Reward Nickel Sulphide Deposit, Leinster, Western Australia

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Abstract

The Rocky's Reward nickel sulphide deposit is located in the Agnew-Wiluna greenstone belt, about 2 km north of the Perseverance (Agnew) nickel mine. The belt lies within the northern portion of the Eastern Goldfields Province of the Archaean Yilgarn Craton, Western Australia. Ore-grade mineralisation was discovered at Rocky's Reward in 1984 as a result of drill testing a geochemically anomalous gossan.

Geophysical surveys (airborne and ground magnetics, induced polarisation/resistivity) had been carried out over or in the vicinity of the deposit well before the discovery of mineralisation. However, even though a magnetic anomaly was clearly delineated over the Rocky's Reward deposit, the target was not selected for follow up at that stage as the surface geological expression did not fit the existing conceptual geological model.

A large amount and variety of geophysical work, including airborne and surface time-domain electromagnetics, induced polarisation/resistivity, controlled source audiomagnetotellurics, gravity and downhole surveys was subsequently completed following the discovery of mineralisation at Rocky's Reward. The object of these surveys was to map and characterise the deposit geophysically, in order to assist in the delineation of the extent and geometry of the mineralisation, and to evaluate geophysical techniques applicable to further exploration in the area.

The deposit represents an excellent target for several geophysical techniques because of its shallow depth, geometry, and physical property contrasts of the ore and its host with surrounding rocks. A combination of ground magnetics and time-domain electromagnetics proved to be the most definitive and economical for detecting and mapping the deposit.

GOLD

Geophysical Characteristics of the Telfer Gold Deposits, Western Australia

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Abstract

The Telfer gold deposits are hosted by Middle Proterozoic marine sedimentary rocks of the northeastern Paterson Orogen. They occur within two en echelon, asymmetric, doubly plunging anticlines, with ore being extracted from reefs and stockworks.

Regional magnetic and gravity surveys have been undertaken to assist in mapping stratigraphy, intrusions and structures in the Telfer district. These surveys indicate the presence of intrusions close to the Telfer gold deposits, which is regarded as supporting a genetic relationship between granitoids and mineralisation. The Telfer mineralisation itself has no gravity or magnetic signature.

The narrowness of the reefs, deep oxidation and the presence of shallow, thin, electrically resistive beds make the Telfer gold deposits a difficult geophysical target. Direct current resistivity techniques were used to assist mapping of the quartz reefs. Surface and downhole electromagnetic pulse surveys undertaken at Main Dome after overburden stripping detected subtle responses coincident with the Middle Vale Reef.

Geophysical Investigations of the Fortnum Gold System, Western Australia

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Abstract

The Fortnum gold deposit is a structurally controlled gold system hosted by Lower Proterozoic sedimentary and volcaniclastic rocks of the Glengarry Group in the Glengarry Basin of Western Australia. Geophysical techniques applied at Fortnum include ground and airborne magnetics, resistivity, induced polarisation and gravity. Magnetic and resistivity data enabled extrapolation of geological information to areas concealed by transported cover, and the interpretation of structures believed to have influenced gold deposition. Magnetic and gravity data delineated several features for which geological explanations remain speculative. The application of geophysics did not detect mineralisation, nor was it expected to, but has been a valuable tool in advancing our geological knowledge of the system.

Archaean BIF-Hosted Gold, Mount Morgans, Western Australia: A Geophysical Case History

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Abstract

The Mount Morgans Archaean gold deposit is hosted by banded iron-formation and has produced over 25 t of gold to date. The gold is associated with sulphides which have replaced magnetite.

Aeromagnetic data covering the Mount Morgans deposit show a variably depleted magnetic effect caused by the replacement of magnetite by non-magnetic minerals, chiefly pyrite. Coincident with the magnetic effect is a conductive response recorded using airborne electromagnetics. The likely source of this conductivity anomaly is the weathering profile.

The main ground geophysical surveys over the deposit are magnetics and 50 m dipole-dipole induced polarisation. The induced polarisation detected a chargeability anomaly associated with the sulphide mineralisation and a conductive response associated with the weathering of sheared rocks. Surveys of magnetometric resistivity and very low-frequency electromagnetics have been conducted over the Mount Morgans North resource, a similar but smaller gold resource located on the BIF ridge north of the main Mount Morgans deposit. The responses observed over this resource confirm the conductive and chargeable nature of the sulphide mineralisation associated with the gold.

Bounty Gold Deposit, Western Australia: Magnetic and Electromagnetic Responses

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Abstract

Mineralisation at the Bounty gold deposit is in a steeply plunging zone within a sheared iron-formation in the Archaean Forrestania greenstone belt. The gold was deposited together with pyrrhotite, replacing magnetite, but later dyke intrusion has converted pyrrhotite to magnetite adjacent to the dyke. Geophysical surveys have included magnetic and transient electromagnetic measurements. Magnetic data show the Bounty mineralisation is highly magnetic. The magnetic information has mainly been used to help map stratigraphy and structure, seeking favourable sites for mineralisation. An orientation transient electromagnetic survey showed that the Bounty orebody is a good conductor. More extensive surveys delineated an anomaly over the North Bounty deposit also, and discovered several other conductive zones which, so far, have been found only to be barren sulphidic shale and chert horizons.

Geophysical Setting of BIF-Hosted Gold Deposits at Tuckabianna, Western Australia

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Abstract

Tuckabianna Gold Mine is located about 25 km east of Cue, on the Mount Magnet-Meekatharra Shear Zone. The mine sequence consists largely of basalt, dolerite to gabbro, mafic schists, banded iron-formation (BIF), and intrusive quartz-feldspar porphyry dykes and sills. Gold mineralisation is hosted by the NE-striking, E-dipping BIFs with shears localising the ore zones. Laterite derived from the weathering of these BIFs may contain a significant gold resource.

Downhole logging has shown that the BIFs typically have lower relative gamma activity and higher densities, resistivities and susceptibilities compared with the mafic units and porphyry.

Petrophysical measurements of magnetic susceptibility, anisotropy of magnetic susceptibility and natural remanent magnetisation have characterised two BIF types, although no relationship between gold mineralisation and the BIF types has been conclusively demonstrated.

Tuckabianna's regional geophysical dataset consists of Bureau of Mineral Resources (BMR) aeromagnetic and gravity data and high-resolution aeromagnetic and radiometric data. Of these, the most useful have been the high-resolution aeromagnetic data, because they clearly define the BIFs and structures which can localise gold mineralisation. Such lithological and structural detail cannot be recognised in either the BMR regional magnetic and gravity datasets or the high-resolution radiometric dataset.

The Geoscan remote-sensing system has been flown over Tuckabianna. However, the laterite cover (1-21 m thick) has blanketed much of the geology and only some rock types and major lineaments can be identified from the data.

Ground geophysical surveys have been dominated by the magnetic method, which has been extremely useful in delineating the BIFs and structural features, as has the gravity method. Electrical surveys, including magnetometric resistivity, induced polarisation (frequency and time-domain) and electromagnetic methods have also been used. These electrical techniques have not been completely successful in the direct detection of mineralised zones. However, the resistive nature of the BIF is such that these methods may be successfully used to locate the BIF and porphyry, in addition to delineating some structures.