VMS DEPOSITS

Abra Lead-Silver-Copper-Gold Deposit, Western Australia: A Geophysical Case History

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Abstract

The Abra base-metal deposit is a large, deeply buried, low-grade mineralised body located in the Jillawarra mineralised belt in the Bangemall Basin, Western Australia. It has no surface geological or geochemical expression. The deposit was discovered in 1981 by drill testing a 270 m deep target, based on the detailed modelling of a 400 nT bullseye magnetic anomaly which had a coincident weak residual gravity anomaly. Follow-up drilling broadly confirmed the original magnetic interpretation, and outlined an estimated 200 Mt of low-grade iron-barium-lead-silver-copper-gold mineralisation.

Both moving-loop and large fixed-loop time-domain electromagnetic surveys recorded a broad anomaly over the Abra mineralised system. The anomalous time-domain electromagnetic transients have an exponential decay with a time constant of about 1.3 ms, indicative of low conductance. Downhole time-domain electromagnetic and mise-a-la-masse surveying confirms that the whole of the mineralised system, including both the stratiform zone and the underlying stringer zone, is weakly and uniformly conductive. No specific zones of locally greater conductance, which might be indicative of higher-grade mineralisation, were detected in the surface time-domain electromagnetic work. In the downhole time-domain electromagnetic surveying, the broad response to the bulk mineralised body is complicated by the use of relatively small transmitter loops which have 'selectively' energised portions of the large conductive body, resulting in both 'in-hole' and 'off-hole' responses being recorded, depending upon the relative transmitter loop-conductor-drillhole geometry. Several localised secondary conductor responses (both in-hole and off-hole) were also detected but, to date, this work has not successfully demonstrated the presence of discrete high-grade zones of significant dimensions within the overall system.

Geophysical Responses Over the Scuddles VMS Deposit

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Abstract

The Scuddles copper-zinc deposit was discovered in 1979. Before mining commenced in 1990, many exploration techniques were tested over the deposit. Of the geophysical techniques, aeromagnetics and gravity have proved the best regional mapping tools. For direct detection of the mineralisation, time-domain electromagnetics from both surface and drillhole has been the most effective. Mise-a-la-masse successfully outlined the limits of the mineralisation whereas IP responded to shallow mineralisation only.

Several airborne electromagnetic surveys have been flown over the nearby Gossan Hill deposit, which has similar characteristics to Scuddles but is considerably shallower. All have failed to produce anomalies which would warrant follow up on a regional exploration survey.

Geophysical Signature of the Mons Cupri VMS Deposit, Western Australia

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Abstract

Mons Cupri is an Archaean proximal, volcanogenic massive-sulphide deposit in the west Pilbara of Western Australia. Mineralisation occurs in the Mons Cupri Volcanics of the Whim Creek Belt. Stockwork copper-sulphides in altered Mount Brown Rhyolite are overlain by shallowly dipping, massive, copper-lead-zinc sulphides in volcaniclastic sedimentary rocks.

Two airborne magnetic surveys detected a 70 nT anomaly in broad correlation with the outline of the mineralisation. The likely source of this anomaly is magnetite within a chlorite alteration pipe. One trial and two surveys with airborne electromagnetics have been conducted. None of the systems, including GEOTEM II, yielded anomalies over Mons Cupri itself.

Seven trials and one survey with ground electromagnetics were also completed. Again, none produced anomalous results attributable to the mineralisation.

Two induced polarisation surveys detected slightly lower resistivities over the stockwork mineralisation; a magnetic induced polarisation survey obtained the opposite result. However, higher percentage frequency effects, chargeabilities, and relative phase shifts clearly coincided with the stockwork mineralisation. None of the systems unequivocally detected the massive sulphides at depth.

Mons Cupri is a difficult geophysical target. Low total-sulphide content, deep massive sulphides and a lack of electrical continuity combine to produce an enigmatic response and to defeat detection by electromagnetic systems.

NICKEL

Geophysical Signature of the Sally Malay Nickel Deposit, Western Australia

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Abstract

The Sally Malay nickel deposit has clear physical property contrasts with its host rocks and therefore lends itself to detection and mapping by geophysical methods. Conductivities as high as 30,000 S/m compared to the resistive country rock mean that electromagnetics is the best method for locating and mapping such a deposit. The magnetic susceptibility and chargeability are two orders of magnitude higher than

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