

Geophysical Signature of the Ellendale Lamproite Pipes, Western Australia

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Abstract

The Ellendale lamproite diatremes are located in the West Kimberley 125 km east-southeast of Derby. They are of Miocene age and occur in Lennard Shelf sedimentary rocks which overlie the King Leopold intracratonic Mobile Zone. The Ellendale province was discovered by the Ashton Joint Venture during stream sampling of the West Kimberley in 1976. Follow-up of indicator minerals led to the discovery of the diamondiferous vent, Ellendale 4, and nearby vents were then rapidly delineated by an aeromagnetic survey. Two pipes, Ellendale 4 and Ellendale 9, have significant diamond content but are subeconomic at present diamond prices.

The Ellendale province contains 48 lamproite intrusions in an elongate cluster, 40 km long by 10 km wide, oriented west-northwest, parallel to the major faults in the area. The lamproites are intruded into flat-lying Permian sandstones and Devonian to Carboniferous shales and limestones. The terrain is fairly flat with low hills bordering some vents.

A range of airborne and ground geophysical techniques has been used over the Ellendale lamproites.

Aeromagnetic, helicopter magnetic and ground magnetic surveys proved to be very effective, since the response of the weakly magnetic lamproites is quite clear against a background devoid of other shallow magnetic features. Airborne radiometric surveys proved effective in mapping areas covered by black soils and gave clear responses over a number of diatremes. Electromagnetic surveys were used to explore for lamproites which may not have a clear magnetic response. INPUT, DIGHEM, Turam and SIROTEM produced good responses in the more resistive areas but pipe responses were ambiguous in areas covered by conductive black soil.

PLACER DEPOSITS

Geophysical Characteristics of the Tertiary Palaeochannels in the Yilgarn Block, Western Australia

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Abstract

The precise geometric definition of the Tertiary palaeochannels in the Yilgarn Block of Western Australia is important in the exploration for uranium and for secondary and placer gold which occur in the channel sediments. The positions of the palaeochannels normally show considerable displacement from the positions of the present-day drainages. Physical property contrasts which exist between the channel sediments and the underlying Archaean bedrock can be differentiated by geophysical methods to locate the best parts of the channels for follow-up drilling. The low densities of the channel-fill sediments in many areas give rise to 1 to 2 mGal gravity lows

and the gravity technique can be used to define the broad shape and depth of the channel. The deepest parts of the channel, which correspond to the zones of highest salinity, can then be delineated using time-domain electromagnetics. Downhole gamma logs are useful in identifying and quantifying prospective uranium zones.

Geophysical Surveys of the Eneabba Heavy-Mineral Sand Field, Eneabba, Western Australia

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Abstract

Magnetic petrophysical studies of ilmenite concentrates from the Eneabba area have shown that ilmenite-rich placer deposits can be detected with high-resolution magnetic surveys and that some of them can be remanently magnetised. Airborne magnetic surveys have been of limited use as the magnetic response of widespread surface laterite and cultural sources such as roads and buildings can mask the weak target anomalies. However, routine use of low-cost, high-resolution ground magnetics on east-west survey lines of up to 20 km length and spaced 1 km apart has proved successful in detecting the very weak anomalies which are typically less than 10 nT in amplitude. The results have been used to target exploratory drilling.

Airborne radiometrics has failed to detect buried thorium-rich monazite placers except where exposed by mining. Although induced polarisation and resistivity surveys have been used to detect ilmenite elsewhere, relatively high costs have precluded their use at Eneabba. Ground-penetrating radar failed to detect the buried mineralised placers.

Rutile-, zircon- and monazite-rich placers, which have minor concentrations of ilmenite, do not produce an observable magnetic response so extensive drilling is a necessary exploration technique. Because drilling is necessary and inexpensive, the routine application of geophysical techniques is restricted to ground magnetics, which is also inexpensive and able to quickly locate ilmenite-rich placers.

MULTISPECTRAL SCANNERS

Geoscan Airborne Multi-Spectral Scanners as Exploration Tools for Western Australian Diamond and Gold Deposits

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Abstract

The use of remote sensing in mineral exploration has evolved from basic photo-geology to interpretation of more sophisticated satellite and airborne multi-spectral data sets. Although the mineral mapping capabilities of Geoscan airborne multi-spectral scanners have been demonstrated for well-exposed and arid terrains, the question remains as to their effectiveness in deeply weathered regimes such as Western Australia.

Geoscan airborne multi-spectral data have been collected for a number of Western Australian mineral deposits and prospects. The applicability of the data to exploration for similar deposits, based upon a series of simple image-processing treatments derived according to the known reflectance spectra of associated alteration minerals, has been assessed.

Spectral characteristics of ultramafic rock such as kimberlite or lamproite are recognisable at Blue Well, but not over the Aries kimberlite pipe which has a spectral response dominated by the reworking and removal of desert varnish from detritus derived from its surrounding sandstone host. Shear-zone-hosted gold mineralisation in the deeply weathered Yilgarn Block is characterised by spectral signatures related to the

presence of sericite, silica and iron oxides. The same minerals and spectral variations are also apparent in Carlin-style mineralisation at Kazput Pool.

In each example studied, simple image-processing treatments are used to enhance the spectral characteristics of the deposit. These signatures are dominated by the present-day surface mineralogy of the deposit and are the result of the interaction between hydrothermal and supergene alteration. In an exploration mode, a method has been successfully developed and cost-effectively applied for first-pass testing for the basic spectral criteria of each geological model, followed by more detailed spectral discrimination of key mineral assemblages and early geochemical follow-up.