

The Application of Electrical Geophysics to Gold Exploration at Mt Wright, North Queensland

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SUMMARY

The gold resource at Mt Wright, located approximately 10km to the northwest of Ravenswood North Queensland, is uneconomic due to its depth. Definition of a shallower resource of similar grade would have a profound effect on the current Ravenswood operation. Recent exploration at and around Mt Wright has been directed toward this end.

Early IP surveys at Mt Wright showed that the mineralised system produced a low resistivity anomaly with moderate chargeability. Trial MIMDAS (MIM Distributed Acquisition System – MIM owned technology), using the pole-dipole/dipole-pole configuration, and CSAMT surveys proved that both techniques have much greater depth of investigation than conventional IP in the Mt Wright area. More than 25 square kilometres have since been 'screened', using MIMDAS and CSAMT, to >400m depth for systems similar to Mt Wright. Infil surveys around Mt Wright have mapped the extent of the alteration system and highlighted anomalous zones away from Mt Wright itself. Some of these have been drill tested.

MIMDAS and CSAMT have proven to be effective exploration tools in the Mt Wright area.

Key words: Gold, Mt Wright, MIMDAS, CSAMT, IP

INTRODUCTION

Mt Wright is located approximately 10km to the northwest of Ravenswood, North Queensland (Figure 1). Total recorded gold production at Ravenswood to end of June 2000, including historical production, was approximately 1.7Moz Au while the total remaining resource was over 2Moz Au at an average grade of just over one gram per tonne (calculated from resources and reserves quoted in MIM Holdings Ltd, 2000 Report to Shareholders). These figures do not include the inferred resource of some 10 million tonnes at 3g/t Au (~0.96Moz) at Mt Wright (Harvey, 1998). At present, the resource at Mt Wright is not economic due to its depth.

Given the low grade of the Ravenswood resource, the economic performance of the operation would be greatly enhanced by the addition of higher grade feed to blend with Ravenswood ore. Recent exploration at Mt Wright has been focussed to this end on both shallow resources amenable to the open cut mining method and deeper, higher grade resources. The discovery and definition of economic ore near Mt Wright would also enhance the prospects of economic

development of the current resource. Electrical geophysics has been the mainstay of recent integrated exploration programs that have been completed at Mt Wright.

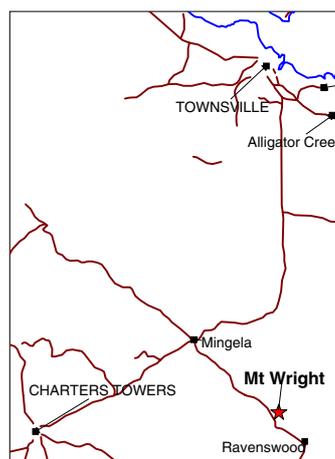


Figure 1. Mt Wright location

Early gradient array and dipole-dipole IP surveys at Mt Wright showed that the mineralised system produced a low resistivity anomaly with moderate chargeability. Further dipole-dipole surveys in 1995 confirmed this and indicated anomalous zones away from Mt Wright at Union Line (Figure 2). Trial CSAMT and MIMDAS surveys in 1995 and 1997 respectively proved the ability of both techniques to explore deeper than conventional IP.

Interpretation of airborne magnetics, particularly the 1996 helimag survey, highlighted a "rhomb" like feature of intersecting structural lows with Mt Wright lying near its southern corner (Figure 3). This feature subsequently became known as "The Mt Wright Rhomb". The more subdued magnetic character within the Rhomb supported the interpretation that the Rhomb was a controlling structural feature during the emplacement of the Mt Wright system. This interpretation placed emphasis on exploration of the Rhomb.

The MIMDAS method was employed during 1999 to 'screen' the Mt Wright Rhomb/ Union Line area for structure controlled alteration similar to that at Mt Wright. Due to commitments for the MIMDAS system elsewhere, CSAMT was used for followup surveys.

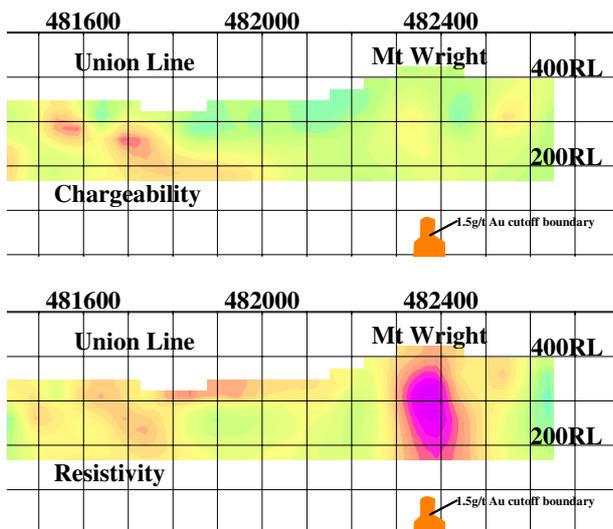


Figure 2. Inversion results for Line 4000N dipole-dipole IP. Warm colours represent high chargeability. Warm colours represent low resistivity.

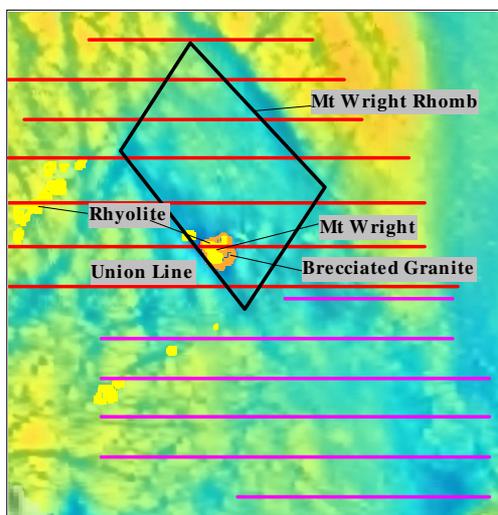


Figure 3. Pseudocolour RTP airborne magnetics over first vertical derivative of RTP. The Mt Wright Rhomb is indicated, as are line locations for the “screening” MIMDAS (red) and CSAMT (magenta) surveys.

GEOLOGY AND MINERALISATION

The Mt Wright gold deposit is hosted by a Permo-Carboniferous vertical pipe-like rhyolite breccia emplaced into a granitic Ordovician host. The rhyolite has a northwest striking, crudely elliptical shape in plan (~200m by ~100m) and extends to a depth of at least 1000m. A sericite altered granite breccia is developed on its eastern side. A small gold deposit (the Mother Lode - ~90,000t @ ~4.5g/t) within the granite breccia was mined by Carpentaria Gold during 1992-93. A halo of sericite altered granite surrounds the entire rhyolite/granite breccia complex (A-Izzeddin, *et al.*, 1995 and Harvey, 1998).

The deposit has an Inferred Resource of 10Mt @ 3g/t Au (Harvey, 1998). It has a considerable vertical dimension with the 1.5g/t Au cutoff boundary extending from about 250mRL

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to below -550mRL. Maximum horizontal dimensions for this boundary are 200m by 50m at -200mRL. The bulk of the resource lies below 100mRL, some 350m below the top of Mt Wright.

Mt Wright sits near the intersection of northwest and northeast trending structures, at the southern end of a broad northwest trending magnetic low (Figure 3, Figure 4). This low represents the southwest boundary of the “Mt Wright Rhomb”. The whole area is structurally complex with variably sericite altered north-south, northwest, northeast and east-west striking fractures and faults having been mapped and/or interpreted from magnetics. Sulphide and gold bearing veins have predominantly northeast strikes with subvertical dips.

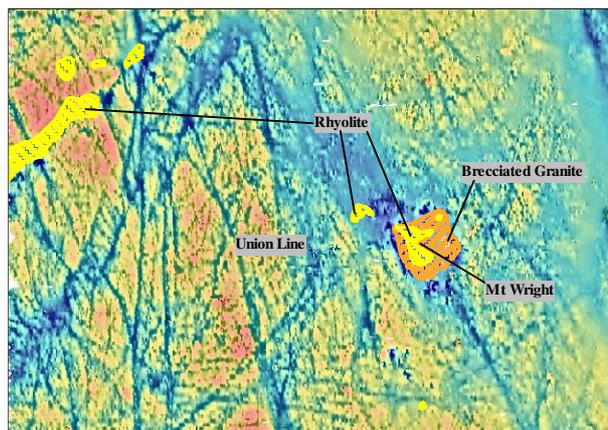


Figure 4. Pseudocolour RTP ground magnetics over first vertical derivative of RTP. Structures are highlighted by low magnetics due to magnetite destructive sericite alteration.

Sericite, siderite, silica, chlorite alteration is strongly developed within the orebody and the breccia complex (Croxford, 1992a, 1992b; Pontual, 1994; Furniss, 1998; Harvey, 1998). Away from Mt Wright, similar alteration occurs as selvages to carbonate - quartz - sulphide veins, adjacent to thin rhyolite dykes and within faults and shear zones. The main sulphides are pyrite, marcasite, sphalerite, chalcopryrite, arsenopyrite, galena. Pyrrhotite is locally common at depth (>300m) and in veins away from Mt Wright. Gangue minerals include quartz, siderite/ ankerite, sericite and late calcite.

Surface geochemistry has included stream sediment and rock chip sampling and an extensive soil sampling program. Au, Pb, Cu, As and Zn are anomalous over the breccia system (A-Izzeddin, *et al.*, 1995). There is a vertical variation through the deposit with Zn, Ag, Pb, (As) enriched toward the top (James, 1997; Harvey, 1998). Gold values are low at the top, but increase with depth. The richest part of the deposit is at ~700m depth while a smaller Au peak occurs at ~400m. Copper and bismuth correlate best with gold. (James, 1997). Similar correlations are observed at Mt Leyshon (Orr, 1995).

EARLY GEOPHYSICS

From the late 1980’s through to the mid 1990’s gradient array IP, airborne magnetic and radiometrics, ground magnetics and dipole-dipole IP surveys were conducted over Mt Wright. Borehole electromagnetic, IP, resistivity and physical property

logs were also conducted. Each of these surveys played a role in improving our understanding of the Mt Wright system and surrounding areas.

Two lines of trial CSAMT, surveyed during the 1995 dipole-dipole IP programme, showed the benefits of the method's greater depth of investigation (Figure 5). Borehole logging showed that strong alteration resulted in a decrease in resistivity by about two orders of magnitude (from >2000 ohm-m to <200 ohm-m) and, where sulphides are present, elevated chargeability. It was clear from this that electrical geophysics, preferably IP, should prove to be effective in the search for Mt Wright style alteration/ mineralisation.

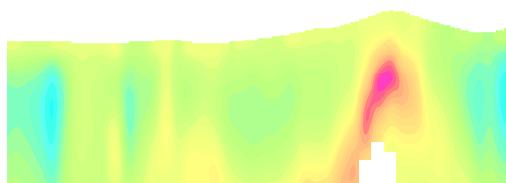


Figure 5. CSAMT 1D resistivity inversion results for Line 4200N. Warm colours represent low resistivities. The 1.5g/t cutoff boundary has been projected from 50m to the south.

In mid 1997 a trial line of MIMDAS pole-dipole IP/ MT was read over Mt Wright. Due to difficult terrain and the position of the Glory Hole (the Mother Lode open pit), the line could not be run directly over the centre of the resource. This presented some problems with interpretation, mainly due to "conductive structures" running subparallel to the survey line. This problem is unavoidable in a structurally complex area. Despite this, results indicated that MIMDAS could "see" the target and has even better depth of investigation than CSAMT in this area.

MT WRIGHT RHOMB MIMDAS

Based on results from the 1997 trial MIMDAS pole-dipole/dipole-pole line, a "screening" survey was designed to cover the Rhomb and Union Line with 500m line spacing, 100m receiver dipole length. Line locations are shown in Figure 3. The 500m line spacing was considered to be optimum as this would provide complete coverage at depth. It was considered that intervening shallower zones of sufficient size to be economic would have other indicators in geochemistry and/ or magnetics. The target was structure controlled alteration which would appear as zones of low resistivity/ elevated chargeability. Any such zones detected would then be subject to followup surveys.

The survey was completed as designed in mid 1999. Thirty four line km of both pole-dipole IP and MT data were collected on seven lines. One line was specifically located over the northern end of the resource in order to obtain a better signature than was obtained from the trial line.

IP data collected during the survey were inverted using Zonge Engineering's 2D inversion programme, "RS2DIP". Chargeability inversion results confirmed the anomaly over the Mt Wright mineralisation (Figure 6) and highlighted several other anomalies. Resistivity inversion results also clearly show that the main zone of alteration is restricted to the Mt Wright – Union Line area, apparently independent of

the Rhomb (Figure 7). The anomaly over this alteration was not completely closed off to the south by this survey. Several weak, narrow low resistivity zones occur elsewhere in the survey area, indicating restricted alteration along faults.

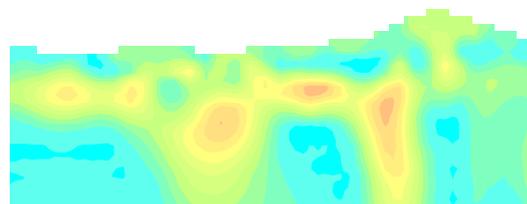


Figure 6. 2D chargeability inversion results for MIMDAS pole-dipole/ dipole-pole IP on Line 4150N. Higher chargeabilities are shown as warm colours.

INFILL CSAMT

Eleven lines (28 line km) of infill CSAMT were surveyed over the Mt Wright – Union Line alteration system. Line spacing was variable but generally 100-150m. Receiver dipole spacing was 50m. This survey confirmed and refined MIMDAS resistivity anomalies, essentially closed the anomaly to the south, and improved structural resolution.

CSAMT data were then integrated with MIMDAS and other exploration data and specific CSAMT/ MIMDAS anomalies were drill tested. Drilling confirmed the presence of strong alteration and sulphides in almost all cases.

SOUTHERN EXTENSION

Following the success of the Rhomb survey, it was decided to extend the "screening" to the south. CSAMT was used for logistical and availability reasons. Six lines totalling 24 line km were read with a receiver dipole spacing of 50m. Line spacing was 500m. Line locations are shown in Figure 3. Although no "Mt Wright – like" zones of low resistivity were detected, the survey successfully mapped structure. This structural information is currently being fed back into the interpretation of the Mt Wright region.

CONCLUSIONS

Electrical geophysics, particularly resistivity, has greatly enhanced our understanding of the Mt Wright mineralised system. Both MIMDAS pole-dipole IP and CSAMT have proven to be very effective for "screening" large areas of prospective ground. The lateral extent of the Mt Wright – Union Line alteration system has been defined as has structure within and away from the system. Specific targets within the alteration system have also been defined. The importance of the Mt Wright Rhomb has been downgraded and exploration has been refocussed on the Mt Wright/ Union Line area.

MIMDAS is the preferred method as it provides chargeability information, is less susceptible to static effects and has greater depth of investigation than CSAMT. Used in "2D mode", both methods can present problems for interpretation, particularly where there are sources, such as alteration along faults, running subparallel to the survey line.

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REFERENCES

- A-Izzeddin, D., Harvey, K. J., and McIntosh, D. C., 1995. Mount Wright Gold Deposits, Ravenswood District. in *Mineral Deposits of Northeast Queensland: Geology and Geochemistry, Contribution 52* (Ed. S. D. Beams), pp. 109 - 115. (Economic Geology Research Unit, James Cook University of North Queensland: Townsville).
- Croxford, N. J. W., 1992a. Petrology Report No. 1092-853 (Unpublished Report to MIM Exploration Pty. Ltd.).
- Croxford, N. J. W., 1992b. Petrology Report No. 858 (Unpublished Report to MIM Exploration Pty. Ltd.).
- England, R. N., 2000. Petrographic Notes for 23 Samples from Mount Wright. (Unpublished Report to MIM Exploration Pty. Ltd.).
- Furniss, R., 1998. Paragenesis and Petrology of the Mount Wright Intrusive Complex, Mineralisation and Associated Alteration. (Unpublished M.Sc. Thesis - James Cook University of North Queensland: Townsville).
- Harvey, K. J., 1998. Mount Wright Gold Deposit. in *Geology of Australian and Papua New Guinea Mineral Deposits* (Eds: D. A. Berkman and D. H. Mackenzie), pp. 675 - 678. (The Australasian Institute of Mining and Metallurgy: Melbourne).
- James, B. A., 1997. MIM Exploration Pty. Ltd. Technical Memorandum No. 1997/022. (Unpublished).
- Orr, T. H., 1995. The Mount Leyshon Gold Mine: Geology and Mineralisation in *Mineral Deposits of Northeast Queensland: Geology and Geochemistry, Contribution 52* (Ed. S. D. Beams), pp. 117 - 135. (Economic Geology Research Unit, James Cook University of North Queensland: Townsville).
- Pontual, S., 1994. Spectral Analysis of the Alteration Mineralogy in Samples from Mount Wright, Mount Success and Nolans, North Queensland: a Pilot Study. (Unpublished Report to MIM Exploration Pty. Ltd.).

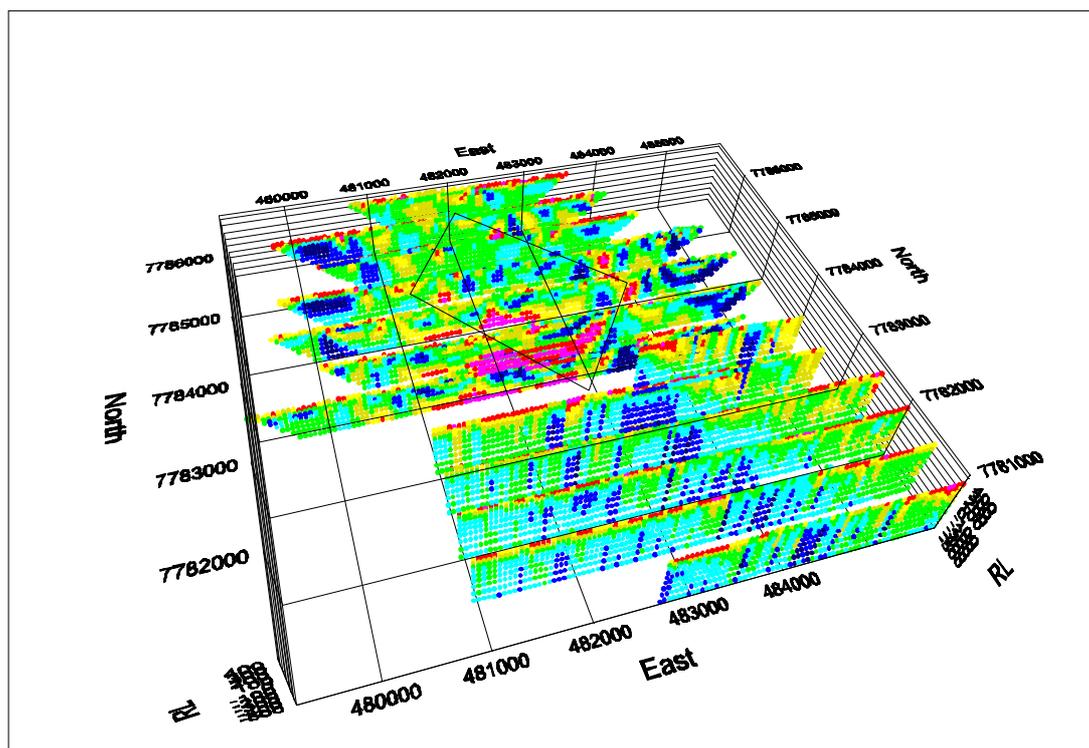


Figure 7. Perspective 3D presentation of resistivity inversion results for MIMDAS and CSAMT “screening” surveys. The Mt Wright Rhomb boundary is shown as a black line. Warm colours, representing low resistivity, clearly indicate the Mt Wright – Union Line alteration system.