Case Studies using Loupe – Mapping Geology in Near-Surface

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SUMMARY

Surveys were conducted over five prospects in the south-west of Western Australia with aims of mapping, geology, sulphides, graphite and clay. The high resolution of the Loupe system lends itself to a role similar to ground magnetic data in mapping geology with the added value of detection of sulphides and graphite where they are present. A role for the Loupe system in mapping clays for brick making or other purposes is also demonstrated.

Key words: Loupe, TEM, shallow conductivity, mapping

INTRODUCTION

The Loupe portable time domain electromagnetic system was originally planned as a tool for shallow environmental problems (Street et al., 2018).

With environmental and engineering investigations as potential applications the Loupe system was designed to measure primarily in the top 25 metres of the ground, previously the charter of frequency-domain EM systems. Using modern electronics and software we have been able to overcome many of the problems associated with the broad bandwidth needed to define near surface conductivity with a mobile time domain system. Sampling at around 500,000 samples per second and processed to produce a measurement of secondary field every second, the Loupe system provides very high spatial resolution.

This high spatial resolution makes the Loupe system very attractive to mineral sulphide explorers where mineralisation is close to the surface. Loupe also has a potential role in mapping geology in a similar manner to magnetic surveys. In such a role, even in deeply weathered terrain, mapping the changes in a laterite regolith are sufficient to provide valuable information to the explorer.

METHOD AND RESULTS

The Loupe TEM system is a backpack mounted mobile EM survey instrument. It uses a low-frequency pulsed electromagnetic signal to sample the top 25m of the ground surface continuously whilst traversing at walking pace. Sampling at 500,000 samples per second it generates a very high resolution 3-D conductivity section using intelligent signal and post-acquisition processing. The Mark I system uses a 3-component coil receiver with 100 kHz bandwidth from signals generated from a small (660mm) diameter transmitter loop. The receiver and transmitter are each carried by one person on a backpack connected by a 5-20m cable (Street and Duncan, 2018)

In the past three years the Loupe system has been used in a variety of environments to map geology. The results of some of these case studies are presented here.

Munglinup Graphite Deposit
The Munglinup Graphite Project lies approximately 500km SE of Perth, Western Australia and 4 to 5 km north of the hamlet of Munglinup. The graphite deposits occur as discrete layers in a zone of graphitic schists within a sequence of hornblende and hornblende-garnet gneisses. The rocks have been broadly folded about a WNW/ESE axis, with superimposed minor anticlinal and synclinal flexures. Complex small-scale folding and faulting is common in the relatively incompetent graphitic rocks and the enclosing competent hornblendic gneisses appear to be less deformed.

Targeted graphitic mineralisation occurs within saprolite consisting of clays, quartz, graphite (up to 42% flake) and goethite. Weathering extends down to at least 60m.
Ravensthorpe Nickel (Mineral Commodities Ltd, 2021).

With the permission of Mineral Commodities Limited, Loupe Geophysics carried out test surveys using a prototype Loupe TEM system over two areas of graphite mineralisation at Munglinup in July, 2019. Over the main Halberts Deposit a survey collecting approximately 5 km of data was carried out in less than one hour on partly rehabilitated drilling lines and through Mallee scrub (Figure 1 and 2)

At Halberts, the graphite deposit has been drilled extensively. It is outcropping, striking approximately north-south and dipping approximately 45 degrees to the east. Figure 3 illustrates a plan view of a grid of the Channel 22 (late time) vertical component TEM response over the deposit. The traverse path is also shown and mostly consists of east-west lines crossing the deposit. The 3-component Loupe data from Munglinup was modelled in Maxwell EM software (EMIT) and the responses were found to be well-fitted by a plate model (Figure 4) shows a traverse approximately 300m in length with a good fit for a plate model (Duncan and Street, 2019).

Figure 1 Surveying with Loupe system at Munglinup through Mallee scrub.

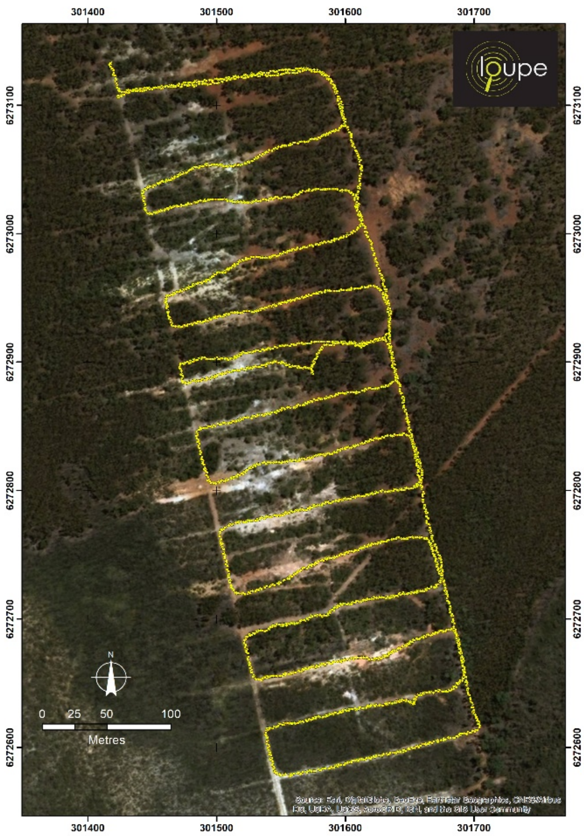

Figure 2 Survey lines over the Halberts Graphite Deposit at Munglinup.

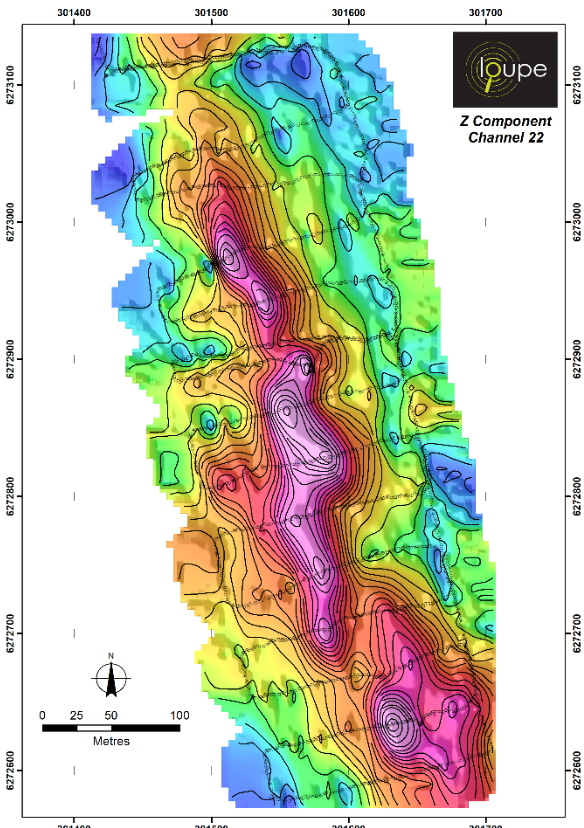

Figure 3. Late time (Channel 22) vertical component Loupe TEM data over the Halberts Graphite Deposit, at Munglinup, Western Australia.

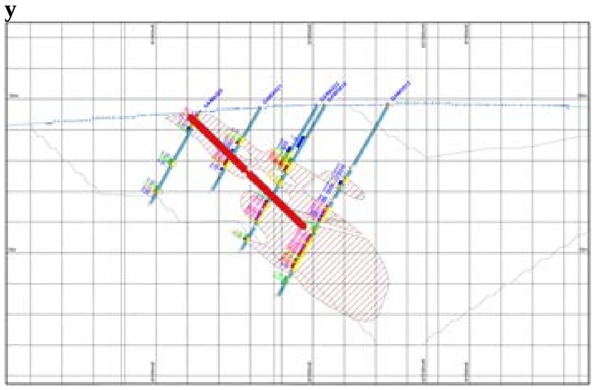

Figure 4 A drill section view from south showing a plate (red) modelled to simulate the Loupe response of the graphite horizons dipping to the east.

Sulphide Deposit in Wheatbelt of WA

Located in the wheatbelt of Western Australia target has minor sulphide mineralisation located by drilling at 85m with massive and disseminated pyrrhotite between 96 and 110m. Surface gossanous material suggest there may be sulphide much closer to the surface. The area is deeply weathered with extensive dryland salinity patches developing both in the creeks and as hillside seeps indicating high salt content in the regolith.

A Loupe survey was conducted using moving transmitter and receiver in March 2021. This survey used normal processing of 2 seconds of data binned to each station. The results indicate a strike-extensive conductor coming close to the surface at around 560m close to position of surface gossan (Figure 5) and dip is interpreted to the east with a zone of alteration including sulphide mineralisation bounded by granitic country rocks.

In addition, a trial on the same line used the Loupe receiver with a fixed loop was carried out showing the potential of the receiver to be used more extensively in mineral exploration (Figure 6).

For the fixed loop survey a Zonge ZT-30 transmitter operating at 25 Hz and 13 Amp current was used with the Loupe receiver and the data binned at 10 second intervals. The result therefore is much smoother than the moving loop survey.

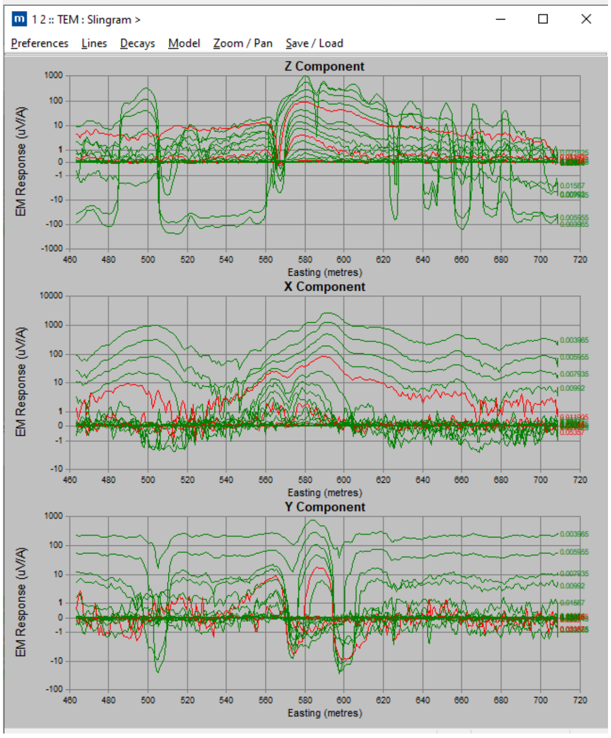

Figure 5 Loupe data collected using ‘conventional Loupe system with moving transmitter and receiver

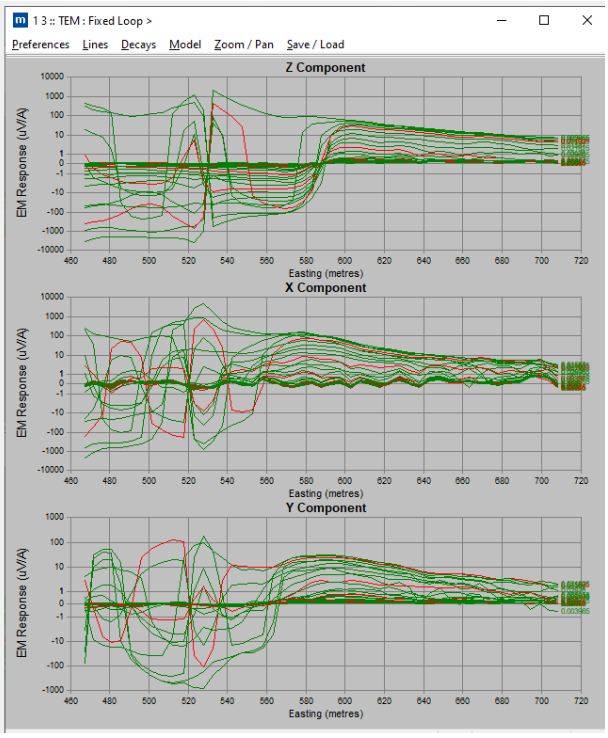

Figure 6. Data collected over sulphide target using the Loupe receiver and fixed transmitter loop.

Nelson Resources

Nelson Resources has been using exploring a gold geochemical anomalous zones located at the boundary between the Proterozoic Albany-Fraser Orogen and the Archean Yilgarn-Craton.

In late 2020 Nelson used the Loupe system to collect high resolution conductivity data over a number of areas within a vast tenement package. The results were used to guide a follow-up RC drilling program.

Figure 7 shows the Loupe data in nanoVolts over the Socrates prospect.

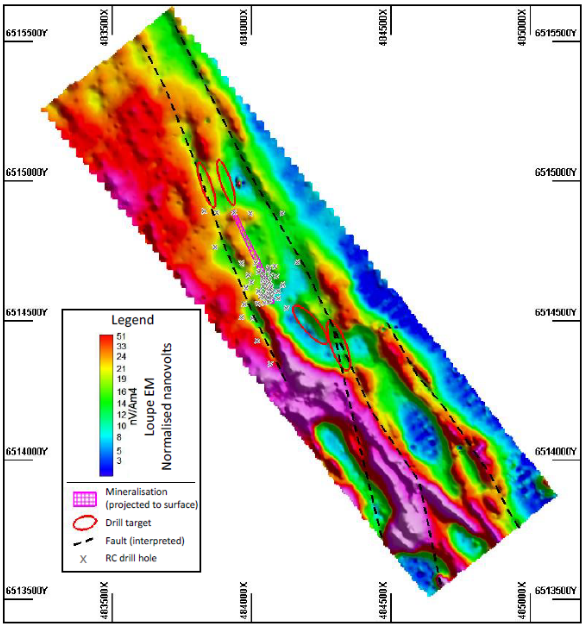

Figure 7 Preliminary data from Socrates Loupe electromagnetic survey showing existing RC drill holes, interpreted faults and targets for drilling in 2021 (Nelson Resources 2020.

Austal Bricks Cardup Clay Deposit

Austal Bricks a subsidiary of Brickworks Limited has a brick manufacturing facility to the SE of Byford, in Western Australia.

There have been bricks manufactured at the site since the 1890s due to the proximity to good clay deposits close to the City of Perth. Clay is extracted from deeply weathered Archean rocks on the eroding face of the Darling Scarp. Two types of clay are used in brick manufacture derived from dolerite or shale primary rocks.

In August 2020, Loupe Geophysics carried out a Loupe TEM survey (Figure 8) over a site to the north-east of the existing factory where drilling had identified a new clay deposit. Around 4000 metres of survey lines were collected in a little over an hour in relatively steep terrain.

Figure 8 Surveying with Loupe at Cardup clay deposit.

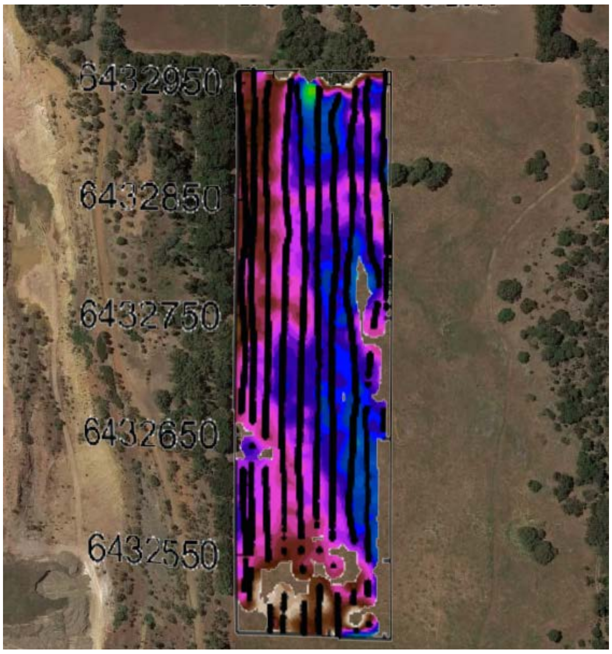

Figure 9 Inverted Loupe conductivity data from RL of 90m with reading points as black dots.

Figure 9 shows inverted conductivity for RL of 90m and figure 10 shows a map of shale bedrock projected to the surface for the same area. The shale is the primary source rock for the clay deposit in the regolith although there are also some dolerite dykes in the area. There is a strong similarity in the pattern in the Loupe data and the interpreted geology with the clay over the shale basement showing as more resistive than surrounding regolith. Differences in the patterns seen in the tow figures are interpreted as partly due to the higher resolution of the Loupe data over wider spaced drillholes and drill lines. The Loupe data suggests a series of folds rather than faults interpreted from the drilling data.

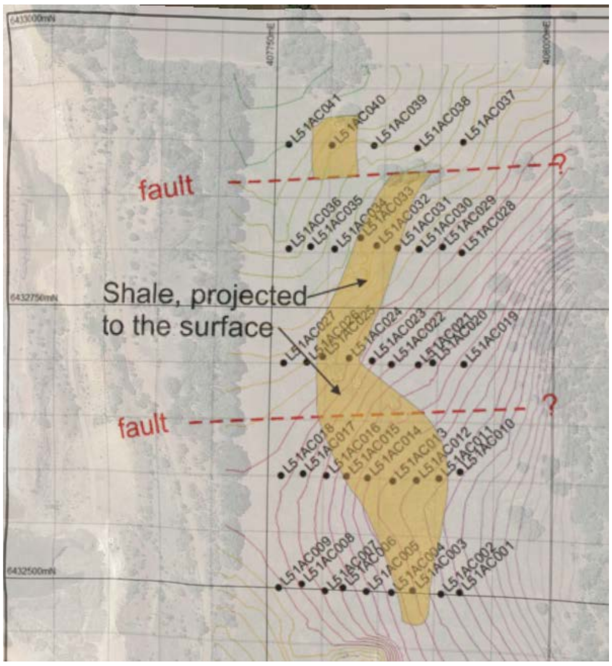

Figure 10 Map of drill lines with area of shale projected to surface. It is presumed the shale is the main source of clay.

CONCLUSIONS

Loupe TEM surveys were conducted over different targets in the south-west of Western Australia. These surveys demonstrated the potential for the Loupe system to quickly map geology and shallow drill targets. Inversion results and drilling indicate the Loupe system is measuring conductivity down to at least 20 metres with penetration depths of around 35 to 40 metres in ideal conditions.

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