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The Camelwood and Musket Nickel deposits – Discovery of a new Nickel Sulphide camp in the North-eastern Goldfields of Western Australia

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SUMMARY

The Camelwood and Musket nickel sulphide deposits are significant recent discoveries, located within the Mt Fisher Greenstone Belt, in the northern goldfields region of Western Australia. Camelwood was the first deposit to be discovered, in December 2012, from a reverse circulation (RC) drilling campaign designed to test a coincident airborne electromagnetic (AEM) and geochemical anomaly.

The original objective of the AEM surveys was to detect massive sulphides known to be associated with gold mineralization at the old Mt Fisher gold mine. However, a number of discrete, late-time EM anomalies were identified along an interpreted ultramafic sequence on the eastern boundary of the greenstone belt. The EM anomalies represented classic nickel sulphide mineralisation targets.

Ground time-domain electromagnetic (TEM) surveys, down-hole TEM (DHTEM) surveys, and extensive drilling have been carried out since then, resulting in a JORC compliant resource at Camelwood (1.6Mt @ 2.2% Ni) and the discovery of the Musket deposit.

The application of the AEM method was instrumental in the discovery of the Camelwood nickel deposit. Systematic use of ground and down hole geophysical methods has been valuable in delineating the resource at Camelwood and in the discovery of the Musket deposit. The discovery of Camelwood and Musket proves the potential of the Mt Fisher Greenstone belt to host significant nickel sulphide mineralisation.

Key words: Camelwood, electromagnetic, Musket, nickel, Fisher East.

INTRODUCTION

The Camelwood and Musket nickel deposits form part of the Fisher East Project, in the northern goldfields region, in Western Australia. The project is located about 500 km north of Kalgoorlie and 150 km northeast of Leinster (Figure 1) and is currently being explored by Rox Resources Ltd. (Rox).

Given that the deposits have only been recently discovered, no information has yet been published about them, other than descriptions of the regional geology of the Wiluna 1:250,000 scale sheet, by Farrell (2001).

Systematic application of geophysical and geochemical exploration methods was key to the discovery of nickel sulphide deposits in a project originally focused on gold mineralisation. The Camelwood nickel sulphide deposit was discovered in December 2012, from a reverse circulation (RC) drilling campaign, designed to test a coincident airborne electromagnetic (AEM) and geochemical anomaly. Further exploration work resulted in the discovery of Musket, in December 2013.

These nickel discoveries are significant as they prove the potential of the Mt Fisher Greenstone Belt to host multiple deposits.

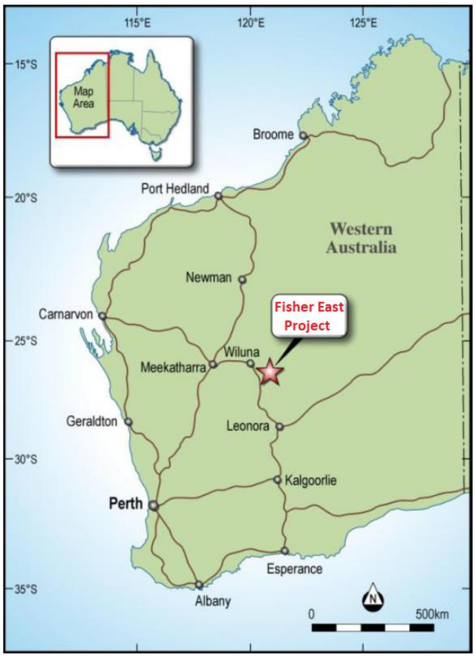

Figure 1. Fisher East Project location (from Mulholland, 2013).

GEOLOGICAL SETTING

The Mount Fisher Greenstone Belt mainly comprises steeply east-dipping, mainly NS- and NW-striking, metamorphosed mafic, ultramafic, sedimentary and subordinate felsic volcanic and intrusive rocks (Farrell, 2001). The sequence has been metamorphosed to greenschist facies (Figure 2).

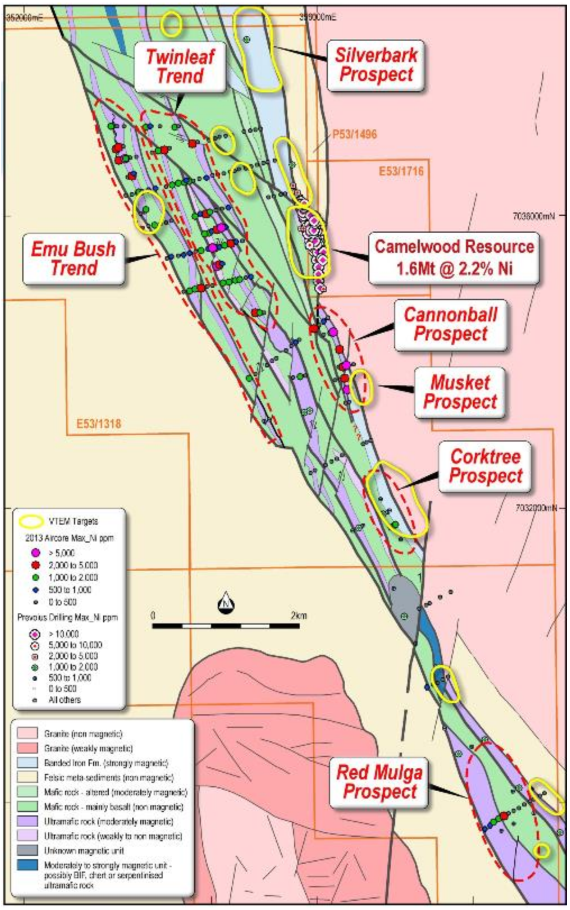

Figure 2. Solid geology map (interpreted from aeromagnetics) of the Fisher East Project, with deposits and prospect locations shown (from Mulholland, 2013)

The Camelwood and Musket deposits are massive nickel sulphide deposits, hosted in an overturned sequence of felsic and ultramafic (plus mafic) units, within a belt of arcuate greenstone units. Primary mineralisation consists of pyrrhotite + pentlandite (+ violarite) + pyrite sulphides in massive, semi-massive (net texture) or disseminated forms. The overall deposit style is similar to the Kambalda nickel sulphide deposits in Western Australia (Mulholland, 2013). At Camelwood, a JORC compliant maiden mineral resource of 1.6 Mt @ 2.2% nickel has been established, over a strike length of 1450m and a depth extent of up to 500m, in the central part of the deposit (Mulholland, 2013). At Musket, exploration is ongoing and a resource estimate has not yet been established. Mineralisation occurs over a strike length of approximately 200m and up to a depth of approximately 400m.

The main lithological units at Camelwood are a felsic hanging-wall, ultramafic host and mafic footwall, all of which form an overturned package that strikes 345° and is moderately dipping (~60°-65°) to the east. The mineralisation is hosted within the ultramafic, immediately adjacent to the felsic (hanging-wall) contact. Sulphide mineralisation has been modelled into disseminated, semi-massive and massive sulphide domains, based on lithological logging. Two distinct lodes, the Main and North zones, have been defined. Three generations of cross-cutting felsic & mafic intrusives transect the mineralisation.

The main structural elements observed over the ultramafic belt, from aeromagnetic data, are NNW-trending faults and shears parallel to the stratigraphy and NW- and N-trending cross-cutting faults.

GEOPHYSICAL SURVEYS

Aeromagnetic Surveys

In March 1993, Aerodata Holdings flew an airborne magnetic and radiometric survey over the Fisher East project area, on behalf of Delta Gold. Data were acquired on 200 m - spaced east-west lines, with a mean terrain clearance of 60m. This was the dataset available at the time Rox started to explore the area in early 2012. In May 2013, UTS Geophysics was contracted to fly a more detailed survey having 50m – spaced lines and 25m terrain clearance. The Camelwood and Musket deposits are located on the eastern margin of the NE-trending mafic-ultramafic belt, which shows a combination of non-, moderately- and strongly- magnetic stratigraphy (Figure 3). Banded Iron Formations (BIF) correlate with the strongly magnetic anomalies present along the eastern margin of the belt, with total magnetic intensity (TMI) amplitudes over 2500 nT. Moderately magnetic anomalies in the central and western parts of the belt correlate with ultramafic rocks and show magnetic responses between 400 and 800 nT. Non-magnetic stratigraphy has been interpreted as mafic and/or felsic volcanics. Unfortunately, the ultramafic unit that hosts the Camelwood and Musket mineralisation is non-magnetic, due to strong talc-carbonate alteration.

Airborne Electromagnetic Survey

In August 2010, Geotech airborne flew a versatile time domain EM (VTEM) survey over the NE-trending eastern ultramafic sequence as part of a larger program that included the central and eastern parts of the Mt Fisher Greenstone belt. The survey was flown along 150 m – spaced east-west trending lines, at a nominal terrain clearance of 50m. A number of discrete, late time anomalies were identified in prospective geological settings for nickel sulphide mineralization (Figure 4). The anomaly which lead to the discovery of Camelwood, at the time named MFA_04, is a clear double peak, late-time anomaly, occurring over four survey lines. Thin plate modelling suggested a conductive source (~180 S) of approximately 750 m strike length and 400m depth extent, dipping at 70 degrees to the east and at a depth of approximately 70m below surface (Figure 5).

The Musket deposit was discovered by an RC drilling campaign designed to test the prospective basal ultramafic contact south of Camelwood. Re-assessment of the VTEM data identified a weak, late-time anomaly, coincident with disseminated sulphides intersected at Musket.

Moving Loop TEM Survey

In November 2012, following the drilling campaign which identified anomalous nickel values within gossanous material, four lines of moving loop TEM (MLTEM) were collected over the Camelwood mineralisation. The survey was contracted to Outer Rim Exploration and utilised 200 m x 200 m, double turn, transmitter loops (32 A effective current), with a 200 m line spacing and 100 m and 50 m spaced stations. A B-field LANDTEM sensor was used for in-loop measurements. Challenging weather and ground conditions lead to early termination of the MLTEM survey, which originally comprised over 14 survey lines. However, the four completed lines were sufficient to generate a reliable model to help guide subsequent drilling.

A well-defined double peak anomaly was delineated by the MLTEM data. Due to the longer time base utilised, compared to the VTEM data, a higher conductivity source (~2150 S) was modelled from the MLTEM data (Figure 5). No MLTEM survey was carried out over the Musket deposit.

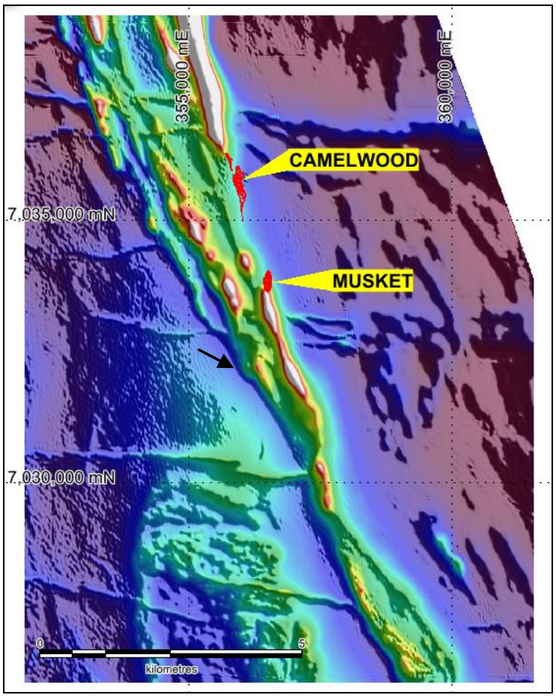

Figure 3. Reduced to Pole magnetic image, shaded from the NE, of the Fisher East Project, from the 2013 50m-spaced survey. Mineralisation outlines are shown in red.

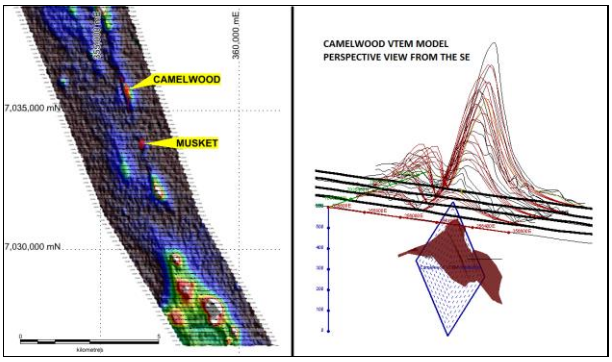

Figure 4. Left: Late-time VTEM channel 46 amplitude image, with deposit outlines shown in red. Right: Thin plate model of the Camelwood VTEM anomaly (perspective view from the southeast). The modelled plate is shown in blue, known mineralisation as a red polygon, field data in black and the forward model response in red.

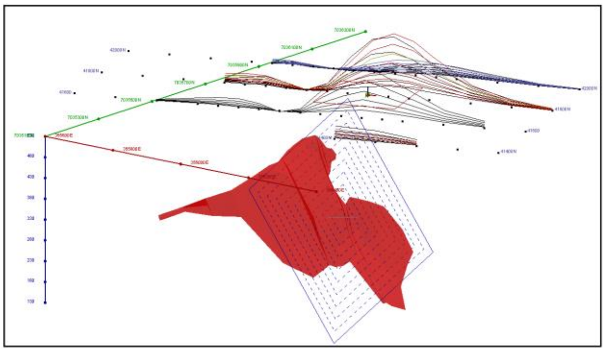

Figure 5. Thin plate model of the Camelwood MLTEM anomaly (perspective view from the southeast). The modelled plate is shown in blue, known mineralisation as a red polygon, field data in black and the forward model response in red.

Fixed Loop TEM Survey

In January-February 2013, a large fixed-loop EM (FLEM) program covered 7 km of prospective ultramafic belt, between the Silverbark and the Corktree prospects. The survey was carried out by Outer Rim Exploration and utilised a total of 8 contiguous 1400 m x 600 m transmitter loops, carrying a current of 40 A. A Smartem24 receiver was used, coupled with a 3-component fluxgate sensor. Each loop was surveyed with 11 lines spaced 100 m apart and having a 100 m station spacing.

The FLEM data over Camelwood was effective in highlighting the thicker and deeper part of the known mineralization with a strong late time anomaly. A highly conductive plate (~1500 S) of 450m strike length and over 600 m depth extent was used to fit the observed data (Figure 6).

At the time the FLEM data were being interpreted, the Musket deposit was not yet known about. It is not clear why the massive sulphide mineralisation from Musket did not generate a definitive late-time response. A weakly conductive mid-time anomaly is coincident with the southern portion of Musket, but it is not clear if the anomaly is sourced by nickel sulphides or by sulphidic sediments present under or on top of the ultramafic contact.

Down Hole TEM Surveys

Down hole TEM (DHTEM) surveys have been carried out routinely on selected holes over the Camelwood and Musket deposits throughout the resource delineation process. Transmitter loops used are usually between 400 m x 400 m and 600 m x 600 m, depending on the drill hole depth. A 3-component DigiAtlantis B-field probe was preferred over dB/dt sensors, as the expected targets are highly conductive.

At Camelwood, a total of 16 drill holes were surveyed. Peripheral holes were particularly useful as they helped define the limits of the mineralization and are effective in identifying the thicker parts of the deposit; information that was very useful for drill hole planning. Due to the absence of conductive sediments over Camelwood, the massive nickel sulphide mineralization was a relatively simple target (Figure 7).

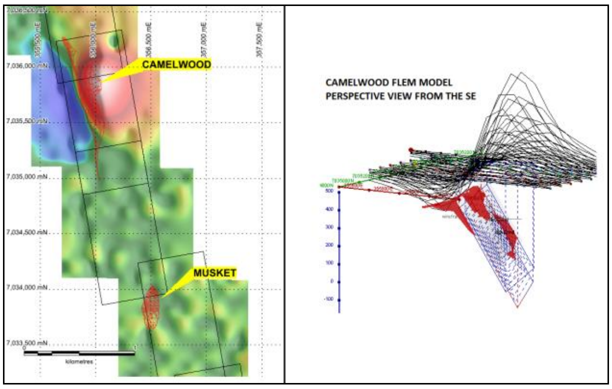

Figure 6. Left: Late-time FLTEM channel 34 amplitude image, with deposit outlines shown in red. Right: Thin plate model of the Camelwood FLTEM anomaly (perspective view from the southeast). The modelled plate is shown in blue, known mineralisation as a red polygon, field data in black and the forward model response in red.

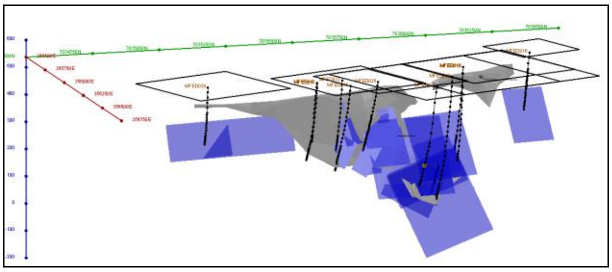

Figure 7. Thin plate models from the Camelwood DHTEM surveys. DHTEM models are shown in blue and the outline of known mineralisation in grey.

At Musket, DHTEM has been the only EM method to clearly detect the conductive massive sulphide mineralisation. A total of 7 drillholes have been surveyed. The deeper, higher grade nickel mineralisation correlates well with modelled thin plates. However, late-time anomalies detected on the southernmost drill holes have been confirmed to be sourced by sulphidic sediments within banded iron formations (Figure 8).

PHYSICAL PROPERTIES

Laboratory physical property measurements were undertaken by Don Emerson (Systems Exploration (NSW) Pty. Ltd.) on 10 drill core samples. Even though only a small number of samples where tested, they are representative of the local geology. The samples comprised two each of nickeliferous massive, matrix, and disseminated sulphides, and four country rocks (mafic, ultramafic and BIF) from the Musket and Camelwood deposits.

The outstanding physical properties from the samples are the conductivity and density of the massive sulphides. Both Camelwood and Musket showed high densities, of approximately 4.45 g/cm^3. The Camelwood massive sulphide showed an EM conductivity of 5800 S/m, while Musket was significantly more conductive at 11100 S/m.

The data also show a clear decrease of resistivity with density, as the sulphide content increased and its networking improved. The disseminated sulphides, felsic country rock and BIF samples are resistive to highly resistive. The BIF sample is highly magnetic with a magnetic susceptibility of 0.46 SI. In general, magnetic susceptibility increases with density, reflecting the influence of pyrrhotite and magnetite content.

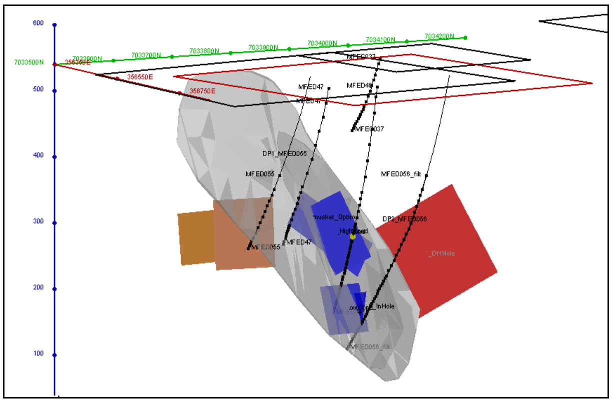

Figure 8. Thin plate models from the Musket DHTEM surveys. Confirmed nickel sulphide conductors are shown in blue, sulphidic sediment conductors in orange, untested conductors in red and the outline of known mineralisation in grey.

CONCLUSIONS

The application of the AEM method was instrumental in the discovery of the Camelwood nickel deposit. Systematic use of ground and down hole geophysical methods has been valuable in delineating the resource at Camelwood.

The Musket deposit is detectable by the DHTEM method, but did not produce clear responses in the airborne and surface EM surveys; this could be caused by mineralogical differences in the top part of the deposit (e.g. low pyrrhotite content) or because the mineralisation is “poddy”, or discontinuous, affecting the overall conductivity response.

Geological data and physical property studies on core samples from the deposits and surrounding geology suggest that they are similar to the Kambalda-style deposits of Western Australia.

The discovery of Camelwood and Musket proves the potential of the Mt Fisher Greenstone belt to host significant nickel sulphide mineralisation.

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