The Hood 10 VHMS deposit of Nunavut, Canada: a case history

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**SUMMARY**

Hood 10 is a small polymetallic (Cu - Zn) VHMS mineral deposit located in the Archean aged Slave Craton in arctic Canada, and is 100% owned by MMG Ltd. The deposit is hosted in the Napaktulik volcanic belt, a bimodal greenstone belt of approximately 2.67Ga age. The deposit was initially discovered in the early 1970’s by Texas Gulf and covered with airborne and ground frequency domain EM (FDEM) and magnetics. The property has changed hands several times over the intervening years, with drill programs in the mid 1970’s, early 1980’s and early 1990’s resulting in a non-JORC compliant resource of 1.2 million tonnes of 4.4% zinc and 4.1% copper, and defining the ore body along a 250 m strike length and to a depth of 220m. The property was acquired by MMG Ltd in 2009. In 2012, MMG Ltd conducted significant geophysical exploration on the property for the first time, acquiring surface and airborne time domain EM (TDEM) coverage of the deposit, as well as TDEM on 11 of 12 holes drilled into Hood 10 in 2012. New geophysical modelling of the TDEM results, drilling results, recent surface geological mapping and structural studies have significantly increased the understanding of the deposit. The current non-JORC compliant resource stands at 2.4 million tonnes of 3.5% zinc and 4.5% copper.

**Key words:** Time-domain electromagnetics, frequency-domain electromagnetics, volcanic-hosted massive sulphide.

**INTRODUCTION**

The Hood project consists of several small polymetallic VHMS-style mineral deposits located in the Archean aged Slave craton in arctic Canada, and is 100% owned by MMG Ltd. The project makes up a portion of the Izok Corridor project, which is currently in feasibility stage. The Izok Corridor project seeks to link the 14.8 million tonne (12.8% zinc and 2.5% copper) Izok Lake deposit with the 17 million tonne (3.4% zinc and 2.3% copper) High Lake deposit via a proposed 325 km long all season road to a proposed port and concentrate storage facility on the Canadian arctic coast. The Hood project is located 40 km north of Izok Lake and offers the potential of contributing additional high grade resources to the proposed mill at Izok. The Hood tenements consist of 2 mining leases totalling 2100 Ha and an Inuit Owned Land parcel totalling 17000 Ha. Exploration of the tenement is currently staged out of Izok Lake, which is equipped with a gravel airstrip and can be accessed by plane from Yellowknife, 420 km to the southeast (Figure 1). As there are no roads or infrastructure in the area, transportation between Izok and Hood is typically via helicopter or float-equipped plane.

Hood 10 is the largest and most prospective of the three principal sulphide bodies identified on the Hood property to date, although the area remains open for discoveries of additional occurrences. The deposit is hosted in the Napaktulik volcanic belt, a bimodal greenstone belt of approximately 2.67Ga age. The deposit was initially discovered in the early 1970’s by Texas Gulf, but the property has changed hands several times over the intervening years, with drill programs in the mid 1970’s, early 1980’s and early 1990’s resulting in a non-JORC compliant resource of 1.2 million tonnes of 4.4% zinc and 4.1% copper. By 1993, the then 1.2 million tonne ore body had been defined along a 250 m strike length and to a depth of 220m; no further drilling was undertaken on the property until 2012. The property was acquired by MMG Ltd in 2009, however most exploration on the Izok Corridor project was concentrated elsewhere until 2012.

**METHOD AND RESULTS**

Upon discovery by Texas Gulf in the early 1970’s, Hood 10 was considered the most promising showing on the tenement due to a highly visible sulphide-bearing gossanous zone with promising geology. In the summer of 1973, frequency domain EM and magnetics were flown over the tenement with a coaxial 390 Hz system and fluxgate magnetometer by Kenting Earth Sciences Ltd using the Canadian Aero Service Ltd. MARK III system. In the area of the showing, the flight lines were spaced at approximately 133m, and a conductive response with an in phase to quadrature ratio of 25:15 was noted on a single line. At the time, the response was rated “poor to fair”, but due to the geological results in the area, the conductor had already been chosen as a drill target and the response was selected for ground geophysical follow up later that summer. A program consisting of VLF measurements using the RADEM system, fluxgate mag and frequency domain VHEM (vertical and horizontal EM) was carried out with somewhat conflicting results. The RADEM located a narrow conductor with limited strike length and depth extent with an interpreted shallow dip angle. The VHEM, however, yielded slightly more promising apparent conductivity results and was interpreted as a conductor with a steep easterly dip. A coincident magnetic response favoured a shallow source of limited depth extent and a vertical dip.

In 1974-1975 22 holes were drilled into the Hood 10 prospect, with the deepest testing the deposit to ~185m below surface.
In 1982 a further drill campaign drilled an additional 10 holes into the deposit, this time testing to a depth of ~340m depth, showing less promising results at depth. Exploration was relatively stagnant on the property until the 1990’s, when it was acquired by Metall Mining Corporation.

Metall undertook time domain EM surveys across various prospects on the tenement in 1992-1994 using the Crane PEM system. Metall covered the Hood 10 deposit with a 1 x 1 km transmitter loop and recorded vertical field measurements along 200 m lines inside the loop. The time domain EM revealed a response on two of the lines. While drilling had by now ascertained the steep dip of the ore body, and an in-loop survey can be assumed to have provided less ideal coupling to a steeply dipping body, the time domain EM was interpreted to show a vertically dipping and northerly plunging body with strike length of at least 200m. The different responses of the airborne EM, RADEM, VHEM and PEM had variable interpretations, and a coherent understanding of the geophysics of the deposit remained elusive. Two further holes were drilled into Hood 10 in 1992, and borehole EM was acquired using a 5 loop transmitter pattern and axial component downhole probe measurements. The borehole EM indicated a second nearby horizon, named the “shadow” horizon as it had not been visible to date in surface geophysical coverage. The borehole EM also, naturally, responded to the H10 horizon, which was seen as a broad off-hole conductor in the data. A third conductor was also identified, and was interpreted to be up dip of the hole and to the south of any known mineralization, potentially extending the strike length of the deposit. Metall drilled this interpreted conductor later in the 1992 season and intersected only 1.5 m of stringer mineralization grading 2.5% copper, presumably ascribing this intersected stringer material as the source of the conductive response. Similarly, two holes into the newly recognized Shadow horizon response did not yield any economic intersects of mineralization. Metall returned in the 1993 season to complete two further holes into the deposit. They surveyed one of these holes with borehole EM, and interpreted the results, in conjunction with the geological results, as an indication that the mineralization did not continue down plunge in the deposit.

A Fugro DIGHEM survey was flown in 1998 and clearly showed H10 as a small footprint resistivity low, but no further drilling was undertaken on the property at that time. In 2009 MMG Ltd acquired the Hood tenement, but no significant exploration was conducted until 2012. In 2012, MMG undertook a second fixed loop time domain EM survey over H10, and drilled 12 holes. Of these holes, 11 were used to measure borehole EM using a three component probe, with magnetic field and temperature readings acquired as part of these measurements to allow probe rotation and monitoring of drillhole temperature in the permafrost environment.

The surface EM work was acquired using an out of loop configuration in order to couple better with the steeply dipping deposit, but showed a short strike-length shallow, flat lying response. This was in conflict with the downhole EM response, which required two steeply dipping conductive plates to describe it. The drilling results extended the Hood 10 deposit an additional ~220m in depth on some sections, and assays of the drill core indicated a strong bimodal zonation of the mineralization. Two copper-rich areas in the deposit are linked by a more zinc dominant area, with the borehole EM responding much more strongly to the chalcopyrite dominant zones. A strong copper-dominant zone at depth (Figure 2) explains the borehole EM response first identified by Metall in 1992, while the shallow, flat lying conductor evident in surface pulse EM measurements is likely the result of two near surface ore zones of stringer-style mineralization masking the response of the higher grade mineralization at depth. The use of 3D modelling has allowed good agreement between the borehole EM results, drillhole intersections of mineralization and surface response of the ore body (Figure 3).

**CONCLUSIONS**

The additional geological and geophysical work, in conjunction with the latest drill results, has significantly increased the understanding of the geophysical response of the deposit. The use of 3D modelling and further information gained from additional exploration on the deposit has led to new interpretations of historical data, and allowed the resource of the Hood 10 deposit to be increased from a non-JORC compliant resource of 1.2 million tonnes of 4.1% copper and 4.4% zinc to one of 2.4 million tonnes of 4.5% copper and 3.5% zinc at a 1% copper cutoff (Figure 4). The strike length of the ore body remains ~250m, but the average depth has been extended from ~220m to ~360m.
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Figure 1: Location of the Hood deposit in relation to the other deposits of the Izok Corridor project (Izok and High Lake), and the city of Yellowknife from which the properties are accessed (modified from Google maps).

Figure 2: A high grade copper intersect from the Hood 10 deposit. Hole H10-037, drilled in 2012, cut 23.6m (est. true thickness) 11.40% copper, 1.09% zinc. This is the thickest and highest grade intercept drilled in the deposit to date.
Figure 3: Modeled borehole EM profile of hole H10–40, drilled in 2012. The left panel shows the drillhole trace in relation to the wireframed ore body (gray) and modelled EM plates (red), while the right panel shows the three component time domain EM measurements along the hole in black, with the modelled results in red.

Figure 4: View of Hood 10 current resource and drillhole traces, looking west. Drill traces from 2012 are shown in blue, and additional mineralization added in 2012 is shown in red.