Case History: Discovery of the Maria Deposit
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Summary
A massive copper sulphide breccia orebody within a porphyry system, known as the Maria deposit, was discovered in the 1980s through the use of new geophysical technology and methodology. This case study details the events and theories leading up to the discovery and innovative use of the new (at that time) UTEM technology.

Introduction
The Maria deposit, a massive copper sulphide breccia orebody, is situated within the historic Cananea Mining District of Sonora, Mexico. Although the discovery of this deposit occurred over 30 years ago, the uniqueness of a very rich “massive sulphide” discovery within a prominent porphyry system and the use of very new geophysical technology, directed Cominco Ltd. to keep the details behind the discovery very quiet. Only recently, has Teck Resources Limited (the resulting company from the merger of Cominco and Teck) permitted the story behind this discovery to be told. This story is recounted by Jules LaJoie and Syd Visser, two individuals familiar with the events leading up to the discovery.

Figure 1: Mexico Geology and Location of Mina Maria

The Cananea Mining District consists of three main deposit types:

- Supergene enriched, disseminated, porphyry style mineralization accounting for most of the production from the Cananea open pit mine.
- Numerous porphyry copper related hydrothermal breccia pipes with grades of 1 to 2% Cu accounting for about 12% of the mineralized endowment.
- The massive La Colorada quartz sulfide pegmatite breccia pipe grading greater than 7% Cu and accounting for >20% of the mineral endowment. The Maria mineralization is of this type which has only been reported at a few other locations.

Figure 1: Mexico Geology and Location of Mina Maria

The story begins in 1971 when this region of northern Sonora, Mexico was recognized from regional mapping and stream silt sampling as having high potential. As a result, the Maria property was staked over the northern portion of this region. In 1973, Seigel Associates (now Scintrex) was contracted to do 25 km of four separation pole-dipole Induced Polarization (IP) on five lines covering the favorable Cuitaca granodiorite. The results showed many strong IP responses, clearly due to high levels of disseminated pyrite. In spite of many other strong IP results, the first drill hole M-1 was collared on a breccia zone forming a knobby hill. The breccia outcrop contained leached sulphides and scattered concentrations of quartz sericite pyrite veins and had a moderate IP response of about 36ms and the lowest resistivity values of the survey, down around 145 ohm-m. Drill hole M-1 intersected 0.8% Cu over 100m in a granodiorite porphyry zone, which was very encouraging.

The next six holes (leading up to February 1975) were selected to follow up on the geophysics by mainly targeting the IP responses. The results were very disappointing, intersecting Cu grades under 0.1%, with the IP anomalies being mainly caused by pyrite.

Moving ahead a year to 1976, Ken Zonge had completed his doctorate at the University of Arizona on spectral IP. New interest arose in Maria, maybe there was hope in differentiating copper rich against copper poor IP responses based on their spectral IP response. To test the theory, Ken was asked to try this spectral IP method on the Maria property. In those days, this was expensive, slow work and only three short lines were surveyed with this new method. Two lines were located crossing over hole M-1, one local grid North-South and one local grid East-West. A third line (orientated local grid North-South)
crossed over hole M-2 which targeted a strong average IP high.

As for the results of the spectral IP responses, the analysis of the data by Ken at the time suggested two weak chalcopyrite spectral signatures, one in the vicinity of hole M-1 into the breccia zone and the second at approximately 400N on the north-south line, situated on the edge of the IP response. A number of drill holes were drilled to target these spectral responses. Similar to the previous holes, the drill results were not very encouraging. Work again slowed down on the property.

By 1979, assessment work was required on both claims. It was agreed to collar a drill hole right on the claim boundary in order to be able to split the assessment credit between the two claims. The question became where to drill. A road cut indicated a swarm of quartz veins striking east from the knob. These types of veins are typically a good indicator of porphyry systems of underlying mineralization. Thus it was decided to collar the drill hole at the intersection of the projection of these quartz veins and the claim boundary. The hole intersected a massive sulphide mineralized region 87m down with 10m of 17.3% Cu, 1% Mo, and 84g/t Ag and another 3m of 10% Cu, 0.5% Mo, and 67g/t Ag at 100m depth. Although the context of the mineralized intersection was not understood, further drilling was clearly warranted. A number of surrounding holes did not indicate more of the massive mineralization.

In 1980, a HLEM (Max-Min) test survey was conducted over the discovery hole. The geophysical data set indicated a strong anomaly correlating to the discovery region. Based on the positive test results, the surrounding region was surveyed using Max-Min. The results of the survey area indicated 2 main anomalous trends. This raised much discussion as to what could be going on to explain these new results.

The first theory was that the HLEM responses were sourced in the massive sulphides at depth did not seem to fit the conductance nor the depth interpretations. The conductance was low (in the 1 to 2 mho range) and depth was too shallow. The second theory was that the geophysical signature might be due to a fault zone, meaning fault gouge. The third theory was that the responses were caused by a steeply dipping massive sulphide zone which M-15 just happened to intersect. A number of detailed surveys including shoot back EM and magnetic surveys were conducted in order to answer these questions to no avail.

An additional five holes were planned from the HLEM results. Hole M-25 was collared in September, 1981 with encouraging results: 15.8m of massive sulphides were intersected grading 10% Cu and 64g/t Ag. However, all the other holes based on the HLEM anomaly again proved discouraging.

In 1981 Cominco had accepted delivery of a new LaMontagne UTEM-3 system. In early 1982, a final effort to understand the Maria deposit was initiated by surveying the region with this new technology. It was hoped that with this new technology something in the data would shed some light on the geological model and salvage something from all the work completed on the Maria property.
Discovery of the Maria Deposit

The transmitter loop was laid out to the north, with the idea being to resurvey all the previous HLEM lines. The results were discouraging showing very similar results to the HLEM. After examining all of the historical geophysics, the latest UTEM data, and the drilling results, it was reasoned that the bulk of the EM response was likely due to a high angle conductive fault to the north of the discovery hole. A method for nullifying the EM response of the conductive fault needed to be devised. The decision was made to try, at that time, an unorthodox method of conducting an “inside the large loop” survey by placing the loop such to null couple as much as possible with the conductive fault.

Other external factors also needed to be considered. The region had significant cultural interference within the survey regions. Both power lines and a pipeline existed on the property. To improve on the noise to signal quality, the data required stacks of up to 64k samples to get reasonably clean data. The results were amazing. The in-loop survey was able to remove the effects of the conductive fault thus revealing a relatively small, very conductive zone south of the discovery drill hole and the main HLEM anomaly previously mapped. The results also indicated that without any doubt that it was relatively flat lying. Further drilling proved the interpretation to be correct to within metres.

The reserve figures at the mine start up was 1.6mT @ 6% Cu, 0.36% Mo, 31 g/t Ag. The production decline was started in 1989 with the first ore being shipped to smelter in October 1990.

Other UTEM-3 systems led to other discoveries for Cominco such as the Helleyer deposit in Western Tasmania. The UTEM system with some upgrades is still being used today.

Conclusion

The discovery of the Maria deposit in Mexico in the 1980s paved the way for the use of a new geophysical technology, the UTEM system. The UTEM system is still being used today, attesting to its value and longevity with respect to geophysical surveys. This discovery also serves as a reminder the importance of understanding the geology, geophysics and designing a survey to meet the project objectives. The case study also demonstrates that innovative, non-standard methods should be considered in order to achieve results. This sometimes involves thinking outside the box.

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