

Finding Mines In Canada

INTRODUCTION

The decision to present this paper was taken in November 2002 while listening, dumbfounded, to the story of a ten million dollar exploration program over a huge area in northern Quebec. After some fifty thousand kilometres of airborne Mag, then EM, preceded and followed by geochemistry and geology, only four DDH were drilled on two already known and already drilled showings. Perhaps that company was expecting that, like in many parts of the world characterized by residual soil, a geochemical signature would characterize any valuable orebody. Evidently they forgot that often in Canada, because of the continental glaciations, even Texas Gulf, the world's biggest massive sulphide orebody, has only a short anomaly in the till, never coming to the surface (Ref.1). Perhaps it is time to review what may be the right approach in Canada, as some Canadian companies begin to adopt here similar approaches, or, even worse decide to explore in areas and countries where geochemistry is effective.

DIFFICULTIES OF EXPLORING IN CANADA.

In Canada drilling systematically airborne EM conductors is not necessarily the best solution, as perhaps only one in 10 000 conductors caused by graphite or pyrrhotite is associated with a minable orebody. For example, from 1965 to 1985 Inco probably drilled across Canada over 10 000 strong magnetic conductors, Umex drilled over 2000 anomalies (REF 2), and myself at Soquem over 500. None of these drill holes resulted in a single mine, at most they discovered a few ore shoots. As the odds to discover in mining camps are most likely much higher, in the order of one in one hundred (ref 3) I exclude from the compilation any drilling around "mining camps", where Soquem was lucky to discover Doyon and Louvem, and so Inco was successful in Sudbury and Thompson. For those not familiar with Doyon, it was probably the biggest gold mine in the country when put in production in the early 1980.

Reverse circulation does not seem a solution, as it is expensive. Its most celebrated discovery, the Golden Pond for Inco, was not the result of till sampling, which, as often, resulted in a random pattern. The discovery occurred when the RC drill penetrated into the bedrock and directly hit the gold vein (ref 4).

We already mentioned the difficulties of till sampling to select the valid targets. At Hemlo geochemistry was effective to define the orebody, but only when the ore was directly underlying the moss (ref 5). Removing the moss or prospecting with a sounding bar would have been more effective.

Even in the most intensively prospected area of Canada, between Val d'Or and Rouyn, the ore was hidden under less than 1,5 meter of till on a hill, over an area of 800 meters by 100 meters wide (ref 6). What is even more surprising, a wide area of massive chalcopyrite was hidden only by less than 4 feet of moss, next to the non magnetic conductor neglected by Inco but from hearsay used by some airborne EM crew to check the operation of their EM instruments when flying out of Timmins.

HOW MINES WERE AND STILL OCCASIONALLY ARE FOUND IN CANADA

Period from 1900 to 1945

In spite of the extensive till cover Canada has been for years a heaven for prospectors. Even compilations by a geologists (ref 7) attribute 78 % of the discoveries in North-western Quebec before 1945 to surface prospecting. Across Canada many showings were discovered on outcrops and floats washed clean around lakeshores, easily examined from a canoe. Other discoveries such as Opemisca or the iron ores of Labrador resulted from samples sent with the bundles of furs sent in by first nation trappers. Railroad construction resulted in the discoveries of Sudbury and Sullivan, BC, and later road construction brought their share of discoveries.

Period from 1955 to 1965

From 1955 to 1965 the discoveries are mostly attributed to geophysics. The reality is more complex and prospectors played two roles in that period. A number of discoveries attributed to geophysics were either

trenched or sampled by prospectors before the geophysics was run . Lets mention a few examples of how the role of prospectors can be forgotten:

Brenda mines was extensively trenched before the first IP reading was ever taken, as witnessed by the reaction of a prospector during the presentation in Vancouver of the IP survey by Dave Fountain.

In areas covered by heavy overburden ore floats probably played a major role. A huge 100 ton float of zinc ore was known and visited before the discovery of the Mattagami mine. The float can still be seen in times of drought below the rapids of the Bell River, 15 kilometres south of the Mattagami mine (ref.9). A smaller copper zinc float in a river bed south of today's Selbaie mine probably convinced Selco to drill the, weak Input hole which made in the discovery (ref.10).

At a lecture at Harvard in 1959 H. McKinstry attributed the discovery of a huge nickel orebody, probably Thompson, to a nickel rich sample brought in by a prospector. The sample, probably collected on an outcrop on the edge of Cook Lake, corresponded to a strong conductor, but with a weaker magnetic signature than 2000 gammas. Up to then all the drilling was being done on strongly magnetic conductors. In spite of several hundred of wildcat DDH which tested such conductors only marginal 1 % nickel ores had been discovered until then. After the discovery he was requested by Inco management to revise the exploration criteria (ref. 8).

Period up to today

Lemoine was drilled on an Input target, but at the head of a previously traced train of high grade floats. This is one rare case when full credit is given to the prospecting in the paper describing the discovery.

A trench dug across the gold vein of , was predating most likely any airborne survey, as it crossed a trappers portage between two tiny lakes. The trench was noted while running the MaxMin survey over the area by a Geosig crew in 1982.

The OK orebody in North-western Canada was also discovered thanks to a float sampled by Georges Manners while field checking the geology prior to the airborne survey. After sampling a zinc rich float on the shore of a lake in early spring, he grabbed his VLF and defined a conductor under the lake by walking on the ice. Georges Podolsky (ref. 11) right away mobilized a drill before the ice melted, so that he actually took a picture of the helicopter flying the EM survey over the drill while examining the core of the discovery. In spite of the picture, this orebody is also listed as an airborne EM discovery.

Prospecting by trenching played also a major role in bringing discoveries from 1955 to 1970. Thousands of trenches were dug with pick and shovels to check airborne EM anomalies. Prospectors selecter their targets to pit and trench with dip needles, small vertical loops, and in the early sixties with VLF EM to flag the axis of the airborne anomalies. They tested then along the axis with steel pins to find where the bedrock was the closest to the surface, then trenched the anomaly. For example, in that period, the geologists for Noranda in Rouyn-Noranda did not drill an anomaly unless prospectors found a showing on it. While prospecting with Beep Mats, EG encountered many of these trenches, occasionally dug too short and thus missing a dipping conductor. The EM survey over a dipping conductor displaces the axis of the conductor a few meters down dip.

Prospecting was also the starting point of the discovery of Troylus. The discovery of a large rusty but not conductive gold bearing float convinced Stephan Lopatka to run an IP survey and drill the resulting anomaly. Previously the program had consisted to follow up and drill over fifty barren airborne EM targets, but the discovery and the assaying of the gold float changed the approach. Of course he did not earn even a small share of the discovery bonus distributed when the mine was started.

THE FUTURE OF EXPLORATION FOR METALS IN CANADA

We expect that the future of exploration for Canada will lie in the examination by Beep mats of the millions of already known airborne and ground conductors left undrilled in the past surveys filed in the provincial

statutory exploration files. Their localization will be helped by the use of the GPS. The areas to prospect will be selected on the showing the depth of overburden, such as the detailed maps prepared by Anne Moricette for the Quebec Department of Forestry. Huge areas of outcrop and areas covered by less than 1.5 meters of till are accurately outlined on those maps. These conductors can easily be sampled. The same maps define also areas covered by deeper till favourable to prospect for floats. Even if we did not yet try to compile from the maps what is the percentage of the province suitable for Beep Mat prospecting, it should represent perhaps as much as 40 % of the surface of the volcanic belts in which the conductors occur. The Kidd Creek orebody, which was finally drilled by Texas Gulf because their geologists observed next to the conductor a rhyolite outcrop trenched by an unknown prospector. The trenches contained some zinc mineralization which motivated that company to drill there their 150th DDH, the first one not barren.

MANY MINES ARE POOR CONDUCTORS BUT BEEP MATS MAY OFTEN FIND THEM

The most astonishing and least known result of our 20 years experience with Beep Mats is that most sulphides are practically non conductors for EM surveys of any kind. The only common sulphide that is always very conductive is Pyrrhotite. Chalcopyrite, when absolutely massive, is also a moderate conductor. but our SSW drill hole probes went through two meter wide chalcopyrite veins at Opemisca grading 10% copper by assay without registering a single blip. Galena is the only other sulphide that we observed to be conductive, but only when containing significant silver values. The silver may strain the crystal structure of galena, doping it like the surface impurities in a transistor and rendering it conductive. We never observed a conductive pyrite, even in perfect crystals. Of course every one knows that sphalerite is non conductive, but perhaps less known is that it does not react to IP surveys.

Because sulphides are not conductors, our first public demonstration of Beep Mats almost became a disaster. During a field trip of the CIM Geophysics for Gold mining convention organized in Val d'Or in 198*, I dragged in front of 50 delegates the Beep Mat across the stripped and washed 20 meter wide surface exposure of the zinc-gold orebody of Agnico Eagle which became the Laronde mine. In spite of the visible presence of massive sulphides not even the weakest beep was heard across the first ten meters, then it beeped across a 50 centimetre wide zone of graphite, perhaps with some pyrrhotite, the again a complete silence to the end of the sulphides. Yet the ore was discovered by a MaxMin survey, which evidently detected the graphite but not the sulphides. Of course anyone trenching the Beep mat response would have discovered the ore, but the ore did not react.

On the other hand the extraordinary potential of Beep Mats was demonstrated on the single outcrop stripped of its moss cover of the Sillidor gold quartz vein. The outcrop measured some 25 meters long by 5 meters wide. While an IP crew was demonstrating that the very minor sulphides in the vein did not give rise to the slightest anomaly, a Beep Mat, brought by Michel Petit and Brian Mackenzy, two Noranda Mines prospectors, localized by a loud beep a one millimetre wide pyrrhotite veinlet extending across the whole width of the vein. Had the Beep Mat been run before the orebody had been drilled, a sample would have returned a one ounce a ton rich gold assay. The demonstration was quite convincing, except it was done this time only to Maurice Rive and Rejean Pineault, respectively resident geologist and Noranda mines geophysicist. In spite of this success we did not hear that the **** batholith, even if much exposed, was ever prospected with Beep Mats.

Let's mention rapidly a few more outstanding not conducting orebodies. The copper-zinc rich ore of the small Estrade orebody mined by Breakwater was not conductive. It was discovered by a DDH oriented to intersect what turned out to be a graphitic conductor. The pulse EM survey defined the huge graphite anomaly, but it detected only a tiny and narrow conductive veinlet vis a vis the ore. In the Mattagami camp often the rich recent discoveries often did not react to the pulse survey even when the pulse probe crossed the ore. The Lemoine extremely rich copper zinc ores were also probably non conductive : the DDH checking the conductor was stopped short of the ore, after having crossed the graphitic layer. The ore body was discovered only as the diamond driller decided anyway to deepen the hole anyway. Of course Marcel Larouche was not only the owner of the drill but he became later famous for the many innovations he introduced to the trade.

ADVANTAGES OF THE BEEP MAT APPROACH .

The first and probably the most important advantage is that there are very few geologists or engineers on earth and just as few managers of exploration that can support the stress of drilling one after another tens then hundreds of barren DDH. One can rationalize as much as one cares, that there is no point to find anomalies of any kind if one does not check them, I remember too well that my colleagues at Soquem considered me just plain crazy to fight for additional drilling budgets to check conductors associated to gravity highs. Even when I told them that such a combination of targets may have a probability as high as one in one hundred to be a mine, they only answered : how do you dare to drill such a poor target!

To understand their uneasiness think of a civil engineer who would see 99 percent of its bridges or houses crumble a few days after their completion. He would be fired overnight. So it is much easier to recommend a gravity check, a geochemical survey, etc, rather than to destroy the target by a DDH. I you have doubts of the reality of this feeling, please believe that I got phone calls from young field geologists supervising drilling programs revolting from their superior (John Harvey) after only a dozen barren holes, and accusing him of having become mad. That time John hit the Mattabi deposit shortly afterwards. to reduce the stress geologists often recommend to do additional drilling on previous marginal discoveries, like that company in northern Quebec. By drilling hole at an 25 meter interval to fill in the drilling pattern of a mineralized but uneconomic deposit one intersects mineralization and avoids the stress of barren holes

Of course the second evident advantage is that sampling a conductor by a Beep Mat survey costs only one or two thousands dollars, or one or two percent of the cost of a diamond drill hole. Even if a hundred meter wildcat DDH hole costs only 10 000 dollars for the contractor and the supervision, it requires on the average over 20 000 dollars of line cutting, then at least as much first for geophysics, then for geochemistry, geology, management meetings., administration etc. And often even before the first drill hole there are budget restriction, and the project is abandoned before the first DDH. When I published a paper called Stop Screening Start Drilling several exploration managers claimed that they were spending 50 % of their budget on diamond drilling, but when we reviewed the figures, they had included in their compilation the cost to drill out reserves at future mine sites or on uneconomic deposits. The ratio of drilling expenditures to total expenditures on wildcat exploration projects almost always stood between a high of 5 % and a low of 1 %. Beep Mats check targets much more efficiently.

Ref 1: Fortescue, J.A.C. and Holbrook, E.H.W. 1969 Progress Report , Geological Survey of Canada, Paper 67-23 Part II, 101p..

RJ Garrett, 1969, CIM special Volume II, Geochemical study of Louvicourt Twp, Pages 157-159.

But this is not always the case: R. DiLabio (GSC Bulletin 323, 1981) mapped in a till an extensive copper anomaly which extended down ice right from the outcrop of the Icon orebody. It was so rich in chalcopyrite that it was successfully mined and treated in the sink and float concentrator.

Ref 2: R. Coda, ex manager of Umex, personal communication

Ref 3: M. Moreau, ex president Eldorado Mining, from his experience around FlinFlon, MN.

Ref 4: Conclusion of EG examination of over 100 RC holes, with T. Podolsky, in 1985 V.P. Exploration for Inco.

Ref.5: C. Gleason, personal communication

Ref. 6: Roger Doucet, personal communication, confirmed by a visit of E.G. to the open pit at the beginning of the mining operation.

Ref.7 : Lulin, J.M. (1990). Une analyse du développement minier du Nord-ouest québécois, p.17-34, CIM Special Volume 43.

Ref.8 : Hugh Frazer (1985). The Great Thompson Nickel Discovery, pages 126, 143, 226, 273.
Ref.9 : Roger Lambert, personal communication.
Ref.10: Reed Laurie E. personal communication.
Ref.11: Georges Podolski, Oral presentation at the 1975 Society of Exploration Geophysics Convention in Denver.

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