Paper 37

Discovery from 3D Visualization and Quantitative Modelling

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ABSTRACT

The Noranda mining camp is one of the richest and oldest discovered base metal mining camps in the Abitibi Greenstone Belt. The area is undergoing a period of renewed exploration by Xstrata Copper with the purpose of finding new ore through the application of new exploration technologies. One of the key tools in the application of new technologies is the use of a 3D-GIS system. A massive compilation program of the entire Noranda Camp was undertaken which included assembling all of the historical and current geology, geochemistry, geophysics, and drillhole databases within a single common software platform. A 3D "Common Earth Model" of the Noranda camp was constructed which involved the importing of multi-disciplinary datasets and the propagation of the data throughout the model. The 3D platform aided in the understanding of the data and defining relationships between the various datasets. A series of well-defined visual and quantitative queries were developed to highlight prospective target areas based on conceptual ore deposit models. The West Ansil deposit is a base metal discovery made by Xstrata Copper and joint venture partner Alexis Minerals, located 14 km north of the Horne smelter in Rouyn-Noranda. The discovery is credited to the use of Gocad software where common earth modelling concepts and 3D-GIS tools were used. The target was defined by a series of quantitative (proximity and property) queries developed from geological conceptual models. The discovery hole assayed an impressive 3.57% Cu over a core length of 52.7 metres, representing the first major base metal discovery in the Central Camp in the last 25 years. New discoveries are possible in mature mining camps thanks to the application of new technologies such as 3D-GIS systems. Quality exploration targets are best developed using all the available data in a common software platform from which multi-disciplinary datasets can be viewed and queried in a 3D environment.

INTRODUCTION

This paper will showcase the applications and results of drillhole targeting with 3D-GIS systems in the Noranda Camp by Xstrata Copper (previously Noranda/Falconbridge). Details of the compilation program undertaken by Noranda, the limitations of compiling with 2D methods and the advantages of using "Common Earth Modelling" (CEM) techniques and 3D-GIS will also be highlighted. The analysis of primary data through basic 3D-GIS queries is a key step in defining relationships between the various datasets, enabling the conversion of conceptual geological model components into quantitative exploration criteria. The criteria can then be incorporated into a series of nested queries used for developing exploration targets. A case study of the West Ansil target will showcase how both quantitative and 3D spatial analysis led to the discovery of this massive sulphide deposit by Xstrata Copper and joint venture partner Alexis Minerals.

The Noranda mining camp is one of the largest and richest base metal camps discovered in the Abitibi Greenstone Belt, located in the northwestern portion of the province of Quebec. It is has a historical production of 2.2Mt of Cu, 1.3Mt of Zn and 500t of Au from more than 22 volcanogenic massive sulphide deposits (Chartrand, 1990). Because of the numerous mines and rich nature of the deposits it has been extensively explored and is one of the most studied volcanogenic massive sulphide camps.

Base metal mineralization was first discovered in the Noranda Camp in 1923 by Edmond Horne. The Horne mine is a world class copper-gold orebody, the largest and richest of the mines in the camp having produced 54.0 Mt at a grade of 2.2% Cu and 6.1 g/t Au (Chartrand, 1990). Since the discovery of the Horne mine hundreds of companies have undertaken exploration programs in search of the next giant volcanogenic massive sulphide deposit while at the same time testing the ground and producing vast amounts of exploration data.

A NEW 3D TARGETING APPROACH

The challenge with compilation programs which contain large amounts of historical data is two-fold: 1) displaying and understanding of all the available exploration data within a common platform; and 2) the interpretation and ability to work

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with the multiple datasets in order to develop quality targets in areas which have not been adequately explored.

During the early years of compilation, and throughout exploration programs, much of the data Noranda geologists worked with was manipulated with software that had inherent 2D limitations. Each software package performed very different functions on a limited subset of the data, with limited interaction between the programs or datasets. Much of the surface or 2D data was treated with commercially available 2D-GIS systems, a technology that brought advancements in the integration of the data and permitted the comparison of various 2D datasets. The typical datasets used with 2D-GIS systems included project-scale and regional surface geology, topographical data, surface geophysical maps, as well as assay and lithochemical samples representing the near surface or 2D surfaces. Elements of the drillhole database including downhole geology, assays and lithochemical data were more commonly handled with software specializing in manipulation of drillholes and 2D vertical sections and plans.

Throughout the decades advances in computer technology have permitted the development of detailed geological models and relational databases, as well as improving the way we can visualize and interrogate the data. The methods of 3D geological modelling in the mine environment for resource estimation have progressed, and are now in general practice and fairly routine. Unfortunately many of the current mine models do not extend much further than the limit of the ore and traditional software is not adequately developed for exploration purposes. It is only recently that 3D modelling has been more rigorously applied in exploration beyond the ore outline, through add-ons to existing 2D-GIS systems or the development of very general 3D earth modelling software such as Gocad (McGaughey, 2006).

In the late 1990's Noranda Exploration Ltd. invested in the future of the Noranda Camp by undertaking a detailed and extensive compilation project revisiting more than 80 years of exploration data. Noranda's goal was to learn from the vast amount of historical work, identify key features important in the development of mineralization and develop sound exploration targets. The compilation program involved several years of meticulous work to collect and assemble all the available historical data as well as the conversion from original paper format into a uniform digital database. Much of this work involved a rigorous program of validation and data quality checking.

Noranda Exploration revived base metal exploration in the Noranda Camp in 2002 after a short hiatus because of a projected need for feed sources for the Horne smelter. The objective of this program was to find new ore in the vicinity of the Horne smelter through the application of new exploration technologies. The technology aspect was driven by the development and availability of new geophysical methods such as MegaTEM and VTEM (airborne EM systems), Titan24 (a combined DCIP and MT system designed for deep soundings), and more advanced borehole EM and magnetic survey systems. The advent of new 3D earth modelling technology permitting joint interpretation of both old and new data was a further catalyst.

The use of Gocad, a geological modelling and 3D-GIS environment, was a key element in the application of new technologies by serving as a common 3D repository for all the historical as well as newly collected geological, geochemical and geophysical data. It provided the exploration team a state-of-the-art toolkit for developing 3D Common Earth Models in which all of the data is fully integrated, editable and queryable. 3D-GIS technology permits the integration and extraction of valuable exploration knowledge from models, through quantitative and 3D spatial querying, for the purpose of target generation. The use of a common 3D software platform for all spatial data in the Noranda Camp permitted the merging of our various 2D datasets, and the ability to combine them with existing 3D data. The presence of various datasets within a common platform also permitted validation of the data as well as the construction of a seamless, coherent earth model. Even though the datasets were initially well-compiled and interpretation was fundamentally correct, it was not until the datasets were assembled in a 3D format within a single computer model that discrepancies were identified.

3D EXPLORATION MODELLING

Various geological, geochemical, geophysical and drillhole datasets were imported into the 3D earth model. The data imported into the model included raw or hard data as objects such as points, curves, surfaces or drillholes with various attributes associated to the objects. Key elements of the raw data were interpreted throughout the entire 3D block model using geostatistical interpolation and geophysical inversion methods. This way, each individual cell, or block, is populated with an exhaustive list of properties which can include rock code, structural data, assay value, alteration indices, physical rock properties, mineralization and drillhole data (Figure 1). One of the greatest strengths of this approach is the query capability where various quantitative and spatial queries are applied on multiple objects or sub-sets. A typical targeting query for base metal exploration may include identifying cells that share the following properties:

1. interpreted as rhyolite
2. within a defined distance of a synvolcanic fault
3. interpolated Cu assay greater than the norm
4. a sericite alteration index of greater than the threshold
5. within a defined distance of a borehole EM or magnetic anomaly
6. within close proximity of known massive sulphide mineralization
7. in an area that has not previously been tested, such as measured by distance from existing drillholes.

A volcanogenic massive sulphide deposit is most likely to occur when the first six of these conditions are collocated in space, while the final condition relating to drillholes highlights areas that have not been previously tested.

As well as 3D block model, the 3D modelling software is capable of working with and displaying data in various other 3D formats such as points, curves, surfaces and drillholes. These formats may have a variety of attributes or property data associated with them, much in the same way as the cells in an exploration block model. Examination of the relationships of the various datasets is possible by projecting or transferring property attributes from one object to another. Examples of this may include an exhalite surface in which each node of the modelled surface contains numerous property values such as distance to drillhole, distance to fault structure, gridded assay or alteration index, or geophysical properties (Figure 2). The data on the surface can easily be modified or gridded to fit the appropriate query.

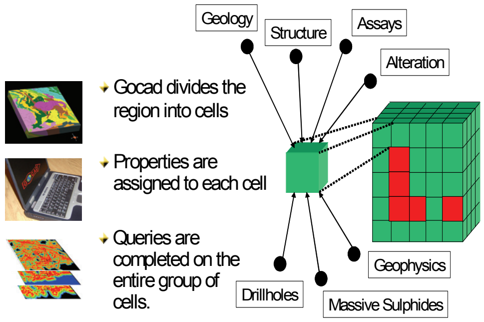

Figure 1: Quantitative 3D block model populated with a variety of properties.

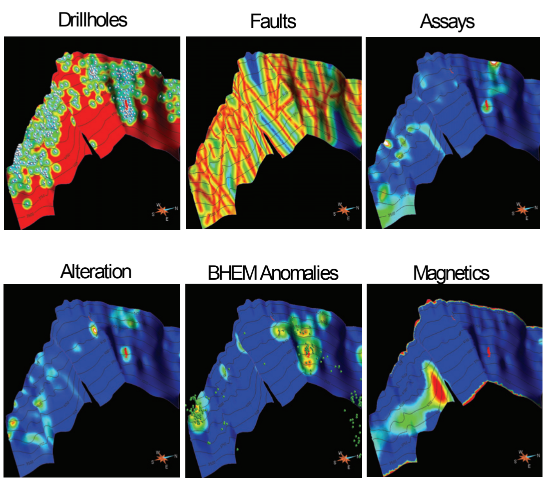

Figure 2: Projecting property attributes from one object or dataset to another.

Model Construction

The procedure used to develop targets with 3D modelling technology in the Noranda Camp included:

1. Defining the limits of the model area and importing the data that was relevant for targeting.
2. Data validation to eliminate any errors, confirm that the current interpretation was correct, and provide a seamless, coherent model. The data was examined within the 3D visualization environment to permit the understanding of the data and to define relationships between the various datasets.
3. A series of well-defined queries, both spatial and quantitative, were developed to highlight prospective target areas. The queries developed were based on observations and from existing conceptual ore deposit models.
4. Target areas were tested by diamond drilling or deep-penetrating geophysics. New results were imported into the model and the model was updated as needed.

Model construction began with defining the limits of the model area and dividing it into a series of cells (the 3D block model). The Central Camp model was constructed over the central part of the Noranda Camp to include the majority of the known base metal mines and the bulk of the historical compilation data. The model covered an area of 320 km2 (17.9 km by 17.9 km) extending to a depth of 2.0 km below surface. This area was selected in order to provide the best training dataset using the known mines and deposits as well as to permit the testing of various ideas or hypotheses. The block model for the Central Camp totals approximately 11,000,000 cells, each measuring 50 x 50 x 25 m.

The 3D geological model was constructed using 2D sectional interpretations developed in the Central Camp from the roughly 10,000 drillholes in both surface and underground drillhole databases. All the historical drillhole data was entered into a digital database and homogenized with a uniform geological coding system. The digital elevation model as well as the surface geological interpretation were merged and imported into Gemcom to aid in the sectional interpretation. The surface geology was beneficial in the interpretation of the sections because of the large amounts of outcrops and quality of detailed mapping previously undertaken in the Central Camp. Interpretation of the geological contacts was completed on 89 east-west sections, spaced at 200 m intervals, totalling 1575 line-kilometres. In areas were information was lacking due to scarcity of outcrops or drill holes, data was projected to depth using the results of a 3D magnetic inversion. The final geological interpretation was simplified and grouped into 36 formational units. Geological sectional contacts and faults in the form of lines were imported into Gocad where the fault and formational contact surfaces were modelled in 3D (Figure 3). Groups of cells in the block model representing individual geological formations were identified by selecting the volumes between contact surfaces and assigning a geological identifier to each cell. Although the Central Camp represents a complex geological setting due to the presence of faults, folds and various phases of early and late intrusions, the 3D geological model construction at this scale was done easily and quickly once the data and sectional interpretations had been finalized.

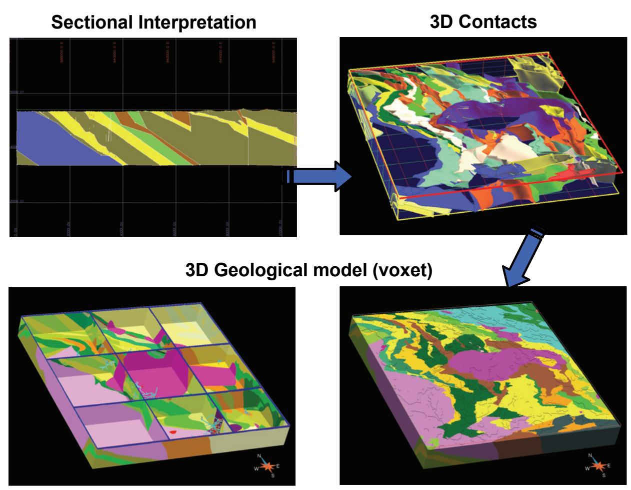

Figure 3: Construction of the 3D model, progressing from sectional interpretation to 3D contacts to the block model.

A large variety of geological, geochemical, geophysical, topographical and drillhole datasets were imported into the model to aid in validation and target development. A total of 18 base metal mines, numerous satellite lenses, mineral deposits and underground development in the Central Camp were digitized from historical mining plans or sections, from which the corresponding 3D orebody surfaces were constructed. This represented the first time that all the deposits originally drawn on the various mine grid systems could uniformly be displayed in 3D using a common coordinate system.

The databases imported included over 100,000 assay samples with associated Cu, Zn, Au and Ag assays, and 40,000 lithochem samples with major oxides and trace elements. This data was used to calculate various alteration indices, normative calculations, and mass gain-loss calculations which were used to identify zones of anomalous hydrothermal activity. Data from the various assay and lithochem sample-point databases were gridded within the 3D block model using geostatistical estimation techniques.

Geophysical survey data as well as their corresponding interpretation and modelling by-products were compiled and imported into the Central Camp model. An extensive list of gridded (and sometimes filtered) maps, borehole data channels, inverted physical rock property profiles, plates and 3D models derived from different geophysical techniques (e.g. time-domain EM, magnetic, gravity, DC and IP) now share the same environment (as quantitative entities) with standard geological and geochemical datasets.

The construction of the camp-scale Central Camp model served as a base model from which numerous other 3D models were derived. A larger more regional-scale Noranda Camp model was constructed which encompassed the Blake River Complex, eastwards from the Quebec-Ontario border (Figure 4). This regional model measured 70 km x 45 km and extended to a depth of 1.36 km. Numerous smaller, more property-scale, or specific target-scale models were also developed over selected areas of interest and current drill projects.

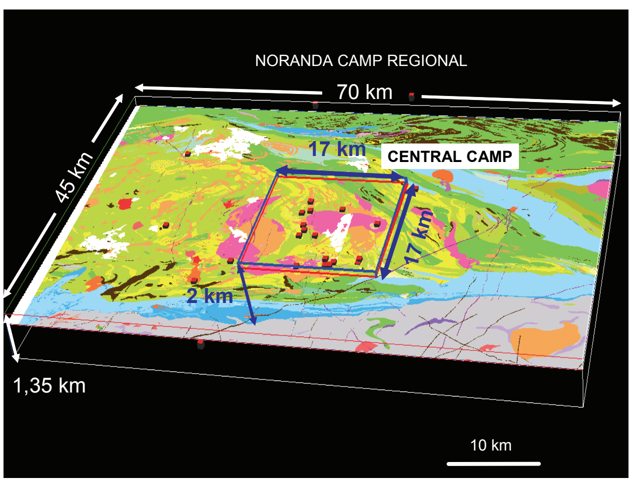

Figure 4: Outline of 3D models constructed in the Noranda Camp.

TARGET GENERATION PROCESS

The volcanogenic massive sulphide deposits of the Noranda Camp are some of the most studied in their class. They have been well documented and have generated various conceptual geological, geochemical and geophysical models related to their ore genesis process. These conceptual models represent a theoretical framework, carrying a set of qualitative characteristics and relationships, that associates exploration datasets with the formation of the ore deposits. Using our ability to query the 3D model, it is possible to quantitatively characterize these datasets, converting qualitative conceptual models into quantitative exploration criteria. Such examples of the quantitative data derived may include:

- Which calculated alteration index best represents the hydrothermal alteration?
- What alteration index threshold value is anomalous?
- What is the maximum distance of the alteration pipe surrounding a deposit?

Quantitative targeting criteria in the Central Camp model can be derived statistically by examining individual properties or the relationship between different datasets. Examples of individual properties may include defining anomalous thresholds for mineralization or alteration indices through the use of histograms, as well as developing variograms to define ranges and trends of individual elements.

Targeting criteria can also be derived by examining the 3D spatial relationship between two independent datasets. Examples of this included defining the distance range of a hydrothermal alteration index surrounding a particular VMS deposit. This was accomplished in the Central Camp by examining the degree of alteration of samples using an alteration index characteristic of VMS deposits, such as the Ishikawa Index (Ishikawa, 1976), calculated as $(MgO+K2O)/(MgO+K2O+CaO+Na2O)$, versus the distance from a known massive sulphide deposit, such as the Ansil mine. The selection of samples based on the distance from the Ansil mine was developed by constructing a series of 3D shells, surrounding the deposit at various distances, and selecting all samples within the defined 3D search radius. Sample points from within each shell were then cross-plotted, comparing intensity of alteration versus distance from the deposit. The resulting graph (Figure 5) showed a gradual decrease in the intensity of alteration as one moves further away from the deposit. At a distance of 500 m the slope of the curve is relatively flat as the samples have reached a constant low background level.

Similar 3D spatial relationships between sample points with a calculated alteration index and the distance from irregularly shaped synvolcanic faults were also examined in the Central Camp (Figure 6). This 3D spatial relationship testing not only permits the identification of the maximum range of alteration surrounding a synvolcanic fault but permits differentiating hydrothermal faults from non-altered faults by the degree of alteration present.

Mineralized trends can be calculated with Gocad on a single ore lens or on a series of lenses by the average slope of these surfaces. Calculations are easily done but at times the power of a visual query can deliver so much more, particularly when examining spatial clusters of deposits. 3D visual examination of the mines and satellite lenses of the Central Camp identified several regional and important mineralized trends. Two of the most pronounced and well-defined trends that extend over a distance of 3 km were defined by the numerous individual lenses of the Amulet A, B, C, D-68, Corbet and Millenbach mines. The two distinct trend directions identified included a northwest-southeast trending Amulet-Millenbach trend and a northeast-southwest trending Corbet-Millenbach trend, with the Millenbach mine located at the intersection of these trends. Knowing with certainty the direction of these well-defined trends, other parallel mineralized structures were also identified in the Central Camp.

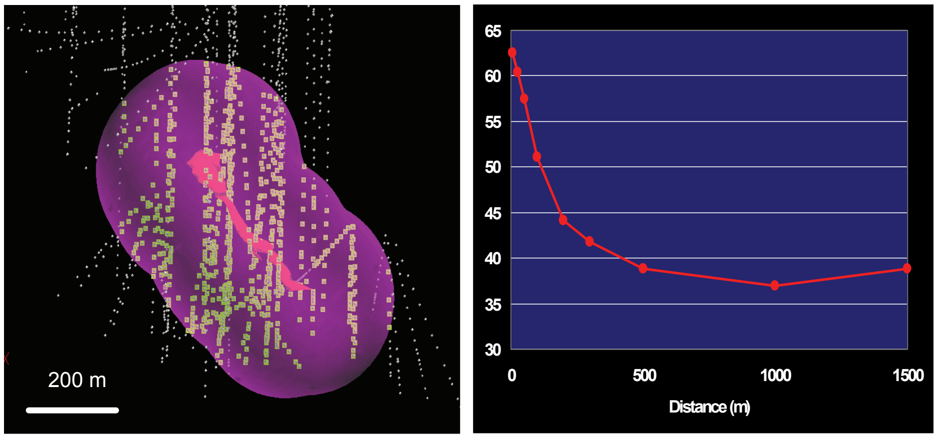

Figure 5: Selection and spatial relationship between the intensity of Ishikawa alteration from lithochem samples on the y-axis and the distance from the Ansil deposit on the x-axis.

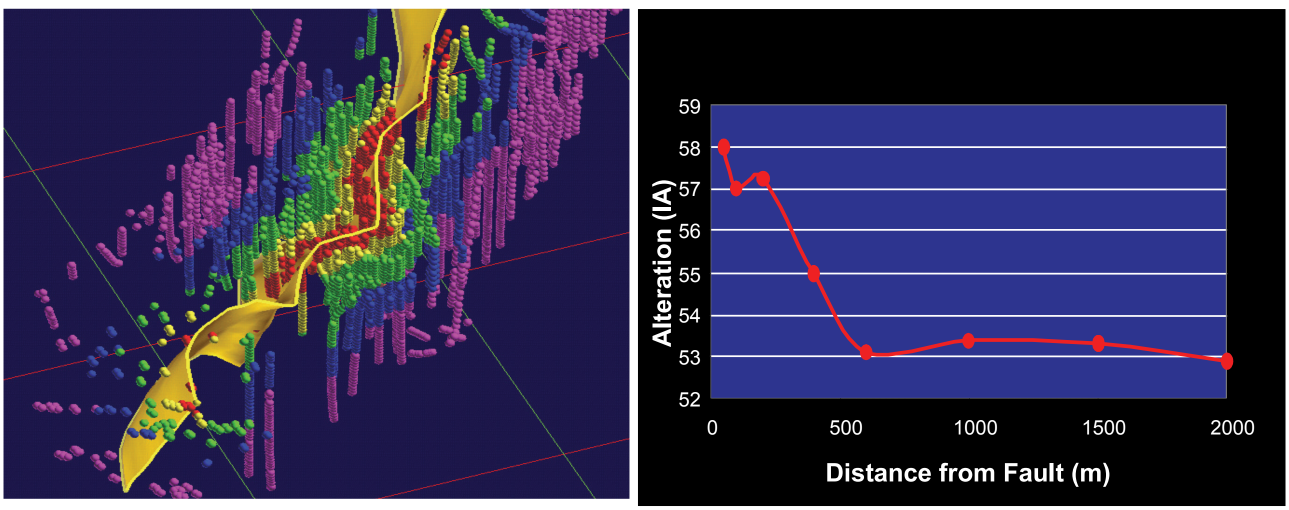

Figure 6: Selection and spatial relationships between the intensity of Ishikawa alteration from lithochem samples on the y-axis and the distance from a synvolcanic fault on the x-axis.

RESULTS

The discovery of the West Ansil deposit is the result of the exploration campaign lead by Xstrata Copper (previously Noranda/Falconbridge) and their joint venture partner Alexis Minerals in 2005. The deposit is located within the Central Camp, 1.8 km to the southwest of the Ansil mine, and 14 km north of the Horne smelter. It can be termed a brownfields environment in a mature mining camp, and the area may have easily been overlooked in the past because of the significant amount of historical drilling already completed in the area.

The West Ansil deposit is a discovery credited by the company to the use of Gocad, where common earth modelling concepts and 3D-GIS tools were applied. Its discovery came after only one year of targeting using these techniques and represents the first significant base metal find in the Central Camp since the discovery of the Ansil mine almost a quarter-century ago.

The target was defined by a series of nested, quantitative queries based on geological conceptual models derived from research on volcanic massive sulphide (VMS) deposits and the Noranda Camp by Lydon (1984, 1988) and by Gibson and Watkinson (1990), illustrated in Figure 7. The model by Lydon postulated that massive sulphide mineralization associated with

VMS deposits may represent semi-conformable bodies adjacent to, or immediately below, more regionally extensive exhalite horizons. They are underlain by discordant pipe-like features represented by stringer mineralization and hydrothermal alteration. The model by Gibson and Watkinson, for the Noranda Camp, highlighted the occurrence of base metal deposits in the camp at key stratigraphic interfaces along, or very close to, the intersection of synvolcanic faults. These structures are important in transporting ore-bearing fluids from depth. The different conceptual models highlighted the importance of several 3D model components such as presence of exhalites, alteration, and synvolcanic faults as important criteria in locating VMS deposits but did not go into detail of the quantitative aspects of these features. The relationship queries developed with our 3D-GIS approach did, however, define appropriate quantitative limits for the maximum distance ranges and alteration thresholds to be used for drillhole targeting.

The selected properties and defined quantitative queries were input into the 3D model in order to define the best target areas from a relatively large area. The specific queries included proximity queries to select all cells within the model that were within 150 m of the nearest synvolcanic fault structure, and all cells within 150 m of the nearest exhalite surfaces (Figure 8). In addition a property query was applied which included the selection of all cells with anomalous hydrothermal alteration based on the interpolation of the samples using a calculated Ishikawa Index. Table 1 shows the number of cells per individual query and nested queries as well the percentage of cells included when compared to the entire block model. Volcanic massive sulphide deposits are most likely to occur when all three properties are collocated in space. The West Ansil discovery is based on a Boolean-type query selecting only the cells that have all three criteria present. The nested queries were applied to the total volume of the model, totalling roughly 11,000,000 cells, and reduced the selection down to 0.3% of the total volume.

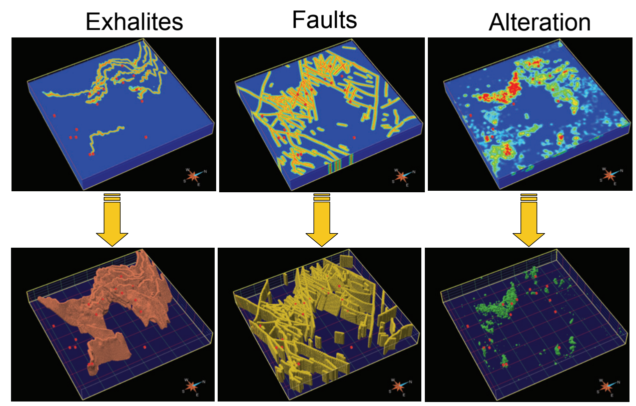

Figure 8: Quantitative queries on the Central Camp model selecting cells within 150 m from the exhalites, 150 m from faults, and cells with Ishikawa Index greater than 60.

Table 1: Cells per query

Region	# cells	% of total area
Total model size	10,929,740	100.00%
Faults (150 m)	2,998,063	27.43%
Exhalites (150 m)	1,421,563	13.01%
Alteration (Ishikawa)	84,015	0.77%
Queries		
Flts/Exhal/Altn	33,064	0.30%
Flts/Exhal/Altn/ddh	9,389	0.09%
Flts/Exhal/Altn/ddh/Geoph	6,860	0.06%

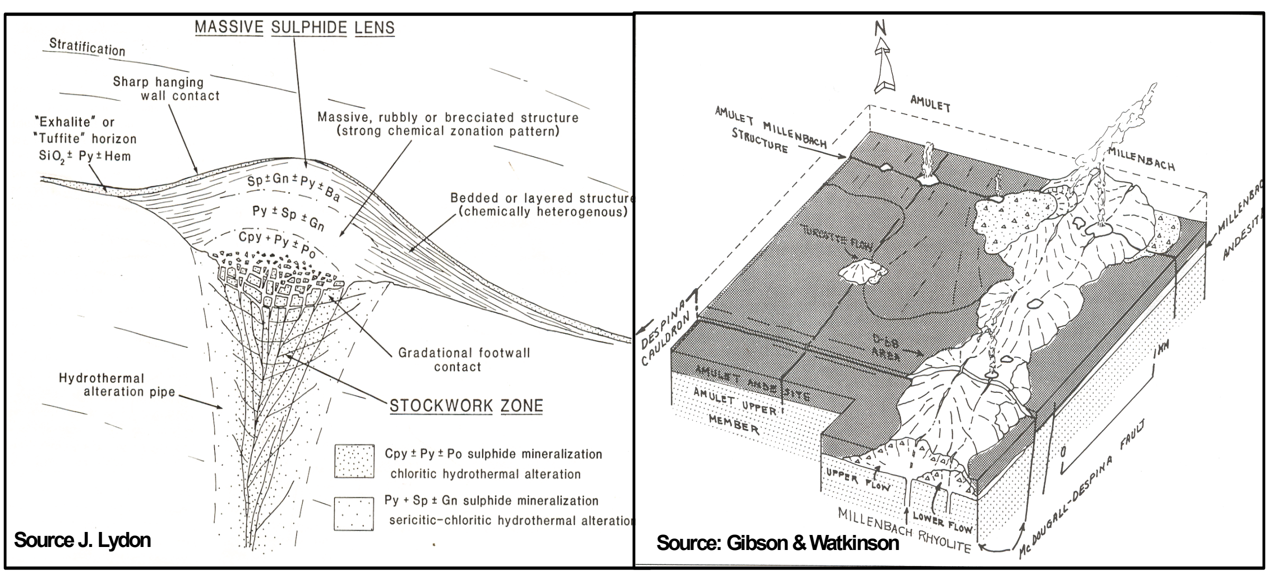

Figure 7: Conceptual models of volcanic massive sulphide deposits as defined by Lydon (1984; 1988) and Gibson and Watkinson (1990).

Two additional queries were applied to the resulting selection to again reduce the amount of volume to investigate. All cells within 100 m of existing drillholes were removed to eliminate areas between closely spaced drillholes and show only untested areas that could host a deposit of economic size. All cells within 200 m from the surface were also removed as this area had been investigated by the recent MegaTEM survey. The resulting selection is now a total of only 0.06% of our original area of investigation, which includes a series of 37 cells in the area of the West Ansil discovery.

Once a target is defined, its validity is checked by visualizing it in 3D space against the raw (non-interpreted) data that contributed to its creation. This is done as a quality check to insure that the target is not a consequence or artifact made while propagating the information contained in the raw data to the entire volume defined by the 3D earth model. The target area was highlighted by examining the occurrence of the known sulphide deposits along several key synvolcanic structures. The resulting visual query (Figure 9) shows that the sulphide deposits are located along synvolcanic faults and commonly at the intersection of such structures. These structures represent significant pathways along which the hydrothermal and mineral enriched fluids travelled. The West Ansil target was selected on the Lewis Exhalite at the junction with the intersection of two synvolcanic faults. The Lewis exhalite represents an interesting exhalite horizon to target, due to the rich nature of the nearby Ansil mine (historical production of 7.04% Cu, 4.02% Zn, 26.29 g/Ag, 2.21 g/t Au), the only known mine located along this particular exhalative horizon (Riverin, 1990).

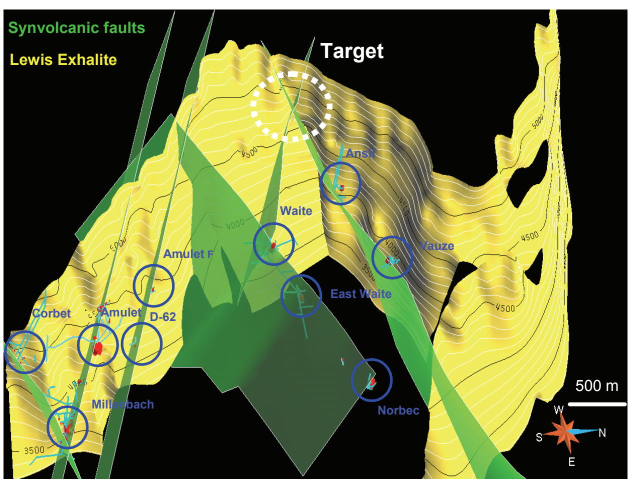

Figure 9: Lewis Exhalite with synvolcanic faults and position of ore deposits.

In examining the target area with the intersection points of the drillholes plotted on the exhalite we noticed that a very limited number of holes had gone deep enough to test the Lewis Exhalite and that there remained sufficient room for a sizeable deposit (Figure 10). Many of the historical holes in the camp had tested the exhalites in the upper part of the stratigraphy which included the Main and C-Contacts but had not been drilled deep enough to test the lower Lewis Exhalite.

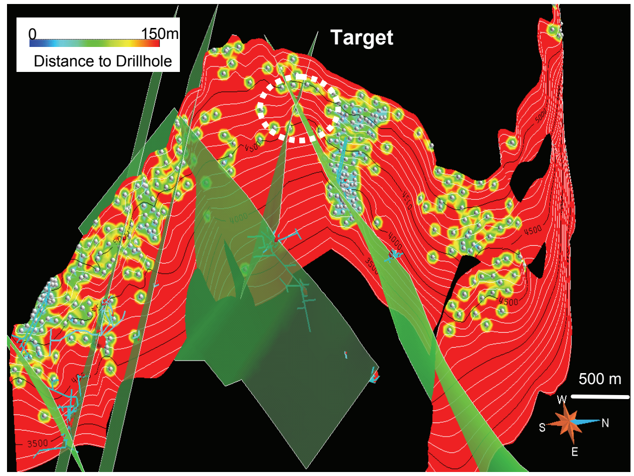

Figure 10: Drillhole intersection points and distance to drillhole property on the Lewis Exhalite

Visually comparing altered versus non-altered samples in the area by highlighting the Ishikawa Index we defined zones of increased hydrothermal alteration. The samples along the drillholes in the target area progressed from non-altered near surface and the upper part of the drillholes to more altered at depth (Figure 11). Many of these holes had been stopped within alteration.

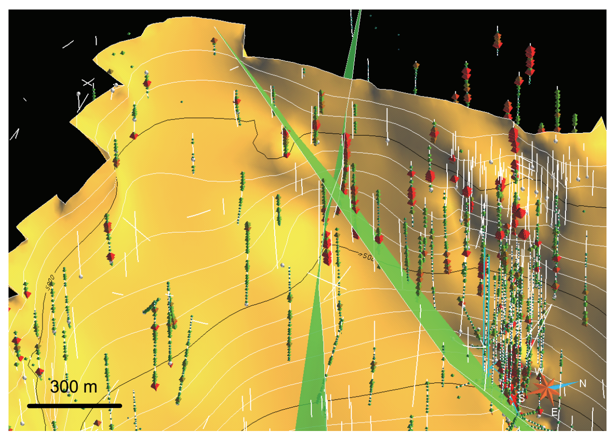

Figure 11: Altered versus non-altered samples in the West Ansil target area.

Testing of this target was accomplished by extending one of the existing drillholes in the area beyond the alteration and through the Lewis Exhalite. Unfortunately the extension of hole AN-66 did not intersect any economic sulphides. The subsequent borehole EM survey in this hole, however, resulted in a long distance, large wavelength offhole anomaly. A large conductive plate was modeled and the interpreted conductor was located to the west of the hole. This conductive plate represented a second generation and more direct follow-up target. As drilling progressed encouragement continued with the occurrence of stronger chlorite alteration, stringer mineralization, and geophysical EM responses that produced multiple shorter wavelength offhole anomalies. All the factors indicated that we were approaching a mineralized source.

The West Ansil discovery hole, AN-05-04, intersected massive pyrrhotite and chalcopyrite as well as sections of massive magnetite, a mineralogy typical to the nearby Ansil mine (Riverin, 1990). The discovery hole assayed an impressive 3.57% Cu over a core length of 52.7 m. Delineation drilling of the Upper, Middle and Lower massive sulphide lens was completed with 18 drill holes totaling 11,017 metres. Table 2 summarizes the NI 43-101 resource calculation completed on the West Ansil discovery by Falconbridge geologists, which outlined an indicated resource of 0.53 Mt grading 3.4% Cu and 1.4 g/t Au plus an inferred resource of 0.60 Mt of 3.3% Cu and 0.3 g/t. This resource was outlined between 150 m to 550 m depth. The discovery resulted in Falconbridge Ltd and partner Alexis Minerals being awarded the prestigious "Prospector of the Year" award from the Quebec Mineral Exploration Association in November 2005.

Table 2: Resource calculation from West Ansil

Category	Tons (MT)	Cu %	Zn %	Au g/t	Ag g/t
Indicated Resource:	0.53	3.4	0.4	1.4	9.2
Inferred Resource:	0.60	3.3	0.2	0.3	0.3

CONCLUSIONS

New discoveries are possible in a mature and historical mining camp like Noranda. The West Ansil deposit is a prime example of how the applications of new technologies such as 3D integrated modelling and 3D-GIS systems can give us a better understanding of our existing data. 3D models are no longer static objects but an exploration tool that can have various types of datasets dynamically associated with it. We can now update, modify and query the models.

Validation and targeting are best done by integrating all the data in a single platform. We selected Gocad as a versatile program that permits working with geological, geochemical, geophysical and drillhole databases in a uniform 3D format. A powerful 3D visualization and sophisticated query-based environment are critical to the process.

Due to its quantitative nature, proper query construction for drillhole targeting forces the exploration team to work closely together to understand the various exploration models and their datasets. The use of database relationships is important in converting qualitative models into quantitative criteria such as distance ranges, rock property values, or threshold limits.

Challenges in working with the models can come from limited distribution of the data and incorrect interpretation or interpolation of the data. Other factors affecting targeting may include the improper application of the conceptual ore deposit models, or the quantitative parameters we have developed for the queries. 3D-GIS targeting systems are continuously evolving. It is taking a more prominent role in exploration targeting in both brownfields and greenfields environments.

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