Imagine a computerized modeling system capable of predic ng the loca on of a mineral deposit.

ALBERT MINING

CARDS 3D

CARDS 3D is a state of the art computer system used by researchers at Albert Mining to produce prospectivity models for the exploration industry. Breakthroughs in 3D geological modelling, geophysical inversion and advanced visualization have made it possible to implement quantitative multi disciplinary data integration in mineral exploration projects.

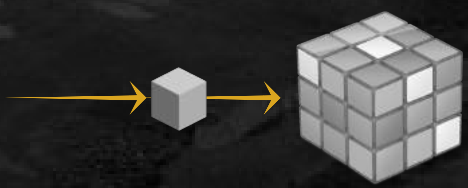
Albert Mining employs 3D computer modelling techniques (Common Earth Model) to integrate all available geological information into a single, 3D environment that can be viewed and queried by CARDS (Computer Aided Resource Detection System). The backbone of CARDS is the MCubiX-KE (Knowledge Extraction) data mining engine. MCubiX-KE uses pattern recognition algorithms to learn the signatures of positive and negative data points and create a model that can make predictions on the positive or negative nature of new data points.

Creating the 3D environment used by CARDS 3D is made by developing a clearly defined litho-structural model based on geology, structural measurements and forward and inverse modelling of available potential field data, such as gravity and magnetic data. With these components, a coherent model of the 3D environment can be put together in a geological time context.

A viable 3D Model for target generation by CARDS requires a significant amount of data, certain data sets in particular are critical. The accuracy and validity of the CARDS 3D targets are directly linked with the 3D model input data.

- Drill hole geology and assay data
- Structural measurements, regional trends of foliation, bedding and signi cant folds with axial traces; geochemical sampling
- Geophysical data (Gravity, Mag, EM, IP)
- Physical rock property (wireline logging)
- Geological maps, both as outcrops and solid geology interpretations
- Alteration minerals / elements
- Tectono-stratigraphic concepts and exploration models

Lithology
Age
Facies
Uncertainty
Density
Conductivity
Disatance to Fault
Magnetics
Au
Cu
Zn



Modified after de Kemp, E.A., 2007

The data is then divided into two databases. The first includes all cells with known **positive** assay results (drill hole data) and is used to develop the model of the geological target you are seeking. The second database includes all cells with **negative** assay results.

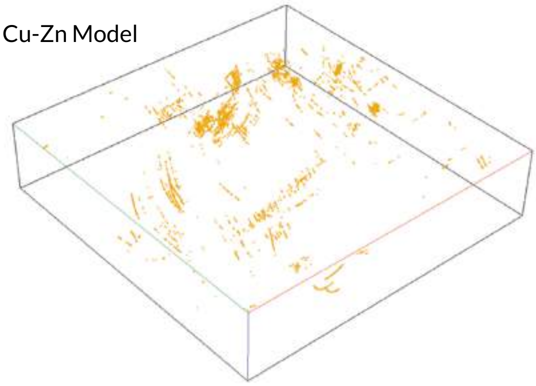
Example of a Prospectivity Model Generation by CARDS 3D

The following shows the positive and negative training cells used in the generation of a Cu-Zn model, above a threshold of 2000 ppm.

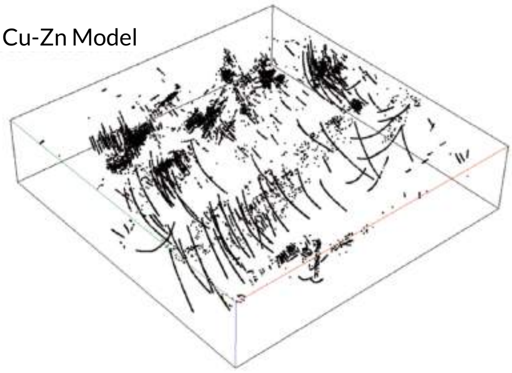
Positives and negatives training cells		
Model	**Positives**	**Negatives**
Cu-Zn	10,441	54,705

The following diagrams show the spatial location of the positive and negative training cells used in the model.

Positive Cells for Cu-Zn Model



Negative Cells for Cu-Zn Model



The analysis of each cell in the model as well as the characteristics of all cells within a specified distance of the cell or neighbourhood is weighed into the evaluation of that cell.

In this manner, cells lacking data can still be highlighted by CARDS 3D if the combination of their limited characteristics and their proximity to cells with other significant characteristics is similar to that of cells in the system with known positive results.

Exploration targets are then derived from the cells that have scored a high similitude to the positive dataset.

The complex algorithms of MCubiX-KE are then used through a workflow of discriminating decision trees, to identify cells that have a high similarity to the signatures of the known positive cells.

Modelling variables used in the Cu-Zn model:

Variables	Descriptions
Chlorite	100 * (MgO + Fe_2O_3) / (MgO + Fe_2O_3 + 2CaO + 2Na_2O)
Dist2faults	Distance to fault
Dist2faultsIntersection	Distance to fault intersection
Dist 2 felsic contacts	Distance to felsic contact
Dist 2 Ma c contacts	Distance to ma c contact
Dist 2 drillholes	Distance to drill hole
Dist 2 Chlorite > 40	Distance to Chlorite > 40
Dist 2 IPYRO >1	Distance to IPYRO >1
Dist 2 ISER > 40	Distance to ISER > 40
Dist 2 ZrY > 6.5	Distance to ZrY > 6.5
Dolomite	Normative Dolomite calculated with Mathieu Piché Nortmat software
ICARB	Ankerite + Calcite + Dolemite + Magnesite + Siderite
ICHLO	Hydrothermal Chlorite * 100 / (MIN. FRAIS + MIN. ALT)
IFRAIS	MIN. FRAIS * 100 / (MIN.FRAIS + MIN.ALT)
IPYRO	Hydrothermal Pyrophyllite * 100 / (MIN. FRAIS + MIN. ALT)
ISER	Hydrothermal Sericite * 100 / (MIN. FRAIS + MIN. ALT)
ISHIKAWA	100 * (MgO + K_2O) / (MgO + K_2O + Na_2O + CaO)
METAL_INDEX	Cu / (Cu + Zn) * 100
MNO	MnO content
Magnetic susceptibility Inversion	Magnetic susceptibility Inversion
NA2O	NA_2O content
Rock Code	Lithological Rock Code
Resistivity (Titan24)	Resistivity (Titan24)
Sericite Mag Sus calculated from	
Geochem samples	Mag Sus calculated from Geochem samples
Spitz index	Al_2O_3 / Na_2O
Vent Inde	(Zn/Na_2O) * 10
Zr_Y ratio	RATIO Zr/Y

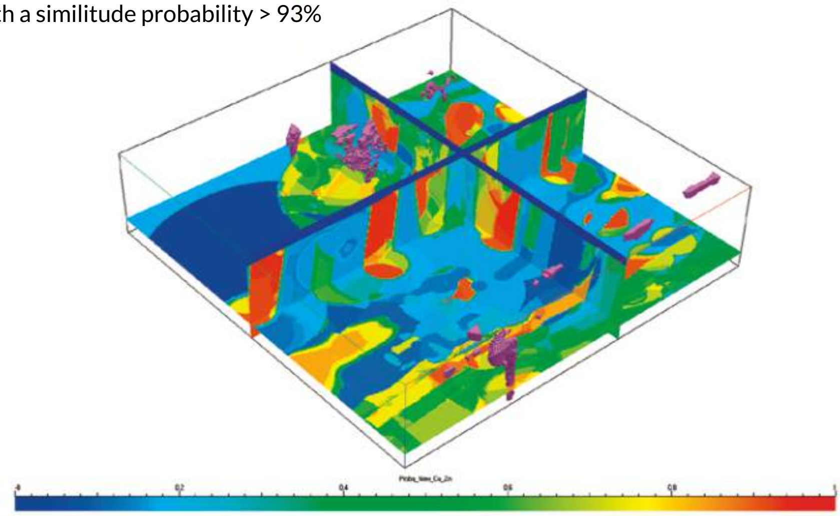
Below is the average good classification rate for the Cu-Zn model.

Average of good classi cation rate for each model		
Model	Training	Cross-validation
Cu-Zn	88.2 %	84.6 %

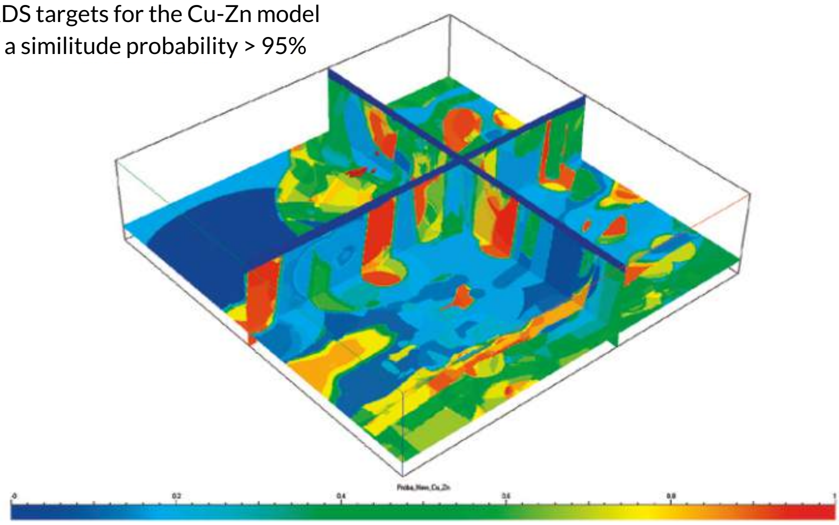
The following variables have been identified as the most discriminating for the model.

Model Cu-Zn
dist2_contacts_maf
dist2_ichlo_sup40
dist2_all_faults_int
Ms (Magnetic susceptibility)
Resisitivity
dist2_ipyro_sup1

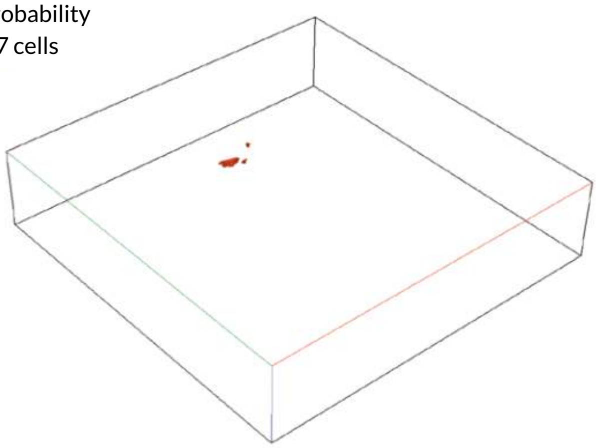
CARDS targets for the Cu-Zn model
with a similitude probability > 93%



CARDS targets for the Cu-Zn model
with a similitude probability > 95%



CARDS targets for the Cu-Zn model
>95% similitude probability
corresponds to 237 cells



The prospectivity model generated by CARDS is a tool for the mineral exploration industry and requires being validated using raw data and expert knowledge.

However, the advantages for using CARDS 3D are:

▪ Artificial Intelligence analysis can detect patterns invisible to the eye, even with 3D visualisation software
▪ No geological model bias: stochastic approach
▪ Relatively fast target generation

3D data representation is emerging as the standard environment in which all geosciences experts along with manage- ment, can take better control of their data and enhance its value through targeting exercises such as CARDS 3D.

Target generation by CARDS 3D allows for innovative Arti cial Intelligence and data mining techniques to optimize knowledge extraction from available data and repre- sents an exciting leap forward for the ex- ploration industry.

Contact us
For additional information on how CARDS can work for you, contact

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