Application of artificial neural networks to the mineral potential and the metallogeny of gold in the Val d'Or - Malartic area, Abitibi Greenstone Belt, Quebec.

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1. Introduction
Recent technological developments in computer and GIS technologies have made it possible to study large volumes of geophysical data in a relatively short time. The aim of this study is to combine two GIS mapping tools with artificial neural networks to predict gold potential at the regional scale. The work was carried out on the basis of a database of 72 gold deposits and 4342 cells, but only 72 cells contain known gold deposits.

2. Mineral potential mapping by geophysical and artificial neural networks
Mineral potential mapping techniques can generally be subdivided into two groups. a. Knowledge-Driven (KDD): (Direct deposits, hydrothermal zones, etc.) are considered in gold potential calculations.

b. Data-driven (DD): Artificial neural networks (ANN). Artificial neural network models perform a very basic processing. Neurons are interconnected to form networks. The artificial neural network is trained on a training database. When trained, the network is applied to new data to predict the output that it generates. Artificial neural networks are particularly advantageous based on the ability to model and simulate complex systems. Each neuron is simply a linear function, and a set of linear functions does not have the necessary complexity to simulate complex systems. An Artificial Neural Network (ANN) is a non-linear system of interconnected, interacting and self-organizing neurons that are capable of learning and simulating complex systems. It is interesting to study the results of applying this technique to the results of the model in various parts of the study area.

3. Study area and gold deposits
The Val d’Or-Malartic area (Fig. 1) is one of the most important gold districts in the Superior Province, with a total gold production exceeding 320 million ounces (MRNF, 2006). The area is extensively mineralized with several major lodes, such as those near the town of Val d’Or (32C) and the town of Malartic (32D).

4. Raw and derived input layers
The following systems were used as inputs to the neural network:
- Distance to geophysical lineaments of various orientations (Faure, 2003);
- Distance to the Cadillac-Larder Lake tectonic zone;
- Metamorphism and its horizontal gradient (Gauthier et al., 2007);
- Specific competency contrasts of lithologies (modified from Groves et al., 1998).

5. Data processing
The neural potential map (Fig. 5) is produced by the artificial neural network system. The system consists of a perceptron model with four hidden layers. The output is the relative gold potential for each 500 x 500 m cells. The classification of the cells into mining-camp scale metallotects recognized in orogenic gold deposits (Groves et al., 1998).

6. Results and comparison
Consistent results on all cell types (gold, barren, and non-gold) were obtained by the trained network. The accuracy of each cell type is higher than 85% for the whole set of deposits. The model contains a total of 72 cell types, containing known gold deposits. The model contains a total of 72 cell types containing known gold deposits. The model contains a total of 72 cell types containing known gold deposits.

7. Discussion and conclusions
The mineral potential map (Fig. 6) is produced by the artificial neural network system. The system consists of a perceptron model with four hidden layers. The output is the relative gold potential for each 500 x 500 m cells. The classification of the cells into mining-camp scale metallotects recognized in orogenic gold deposits (Groves et al., 1998).

8. References


