Exploration targeting using artificial neural networks – Background and case studies

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Artificial neural networks (ANN) are a comprehensive data-driven modelling approach for creation of mineral predictive maps. Based on a "self-learning" process, this technology can be used to interpret almost any geo-scientific data for generation of both qualitative (prediction of locations) and quantitative (prediction of grades, tonnages) predictive maps. By analysing the footprints of known mineralisations in the framework of available geo-scientific data, the approach generates trained ANN`s that are further used to generate predictive maps.

The technology provides excellent results if the genetic properties of the target mineralisation are known. In this case, the existing knowledge can be used for preparation of model input data: e.g. separation of favourable lithologies, tectonic structures and stratigraphic units from the database (e.g. geological maps). On the other side, the approach is very helpful to analyse mineralisation-controlling features and better understand the spatial distribution of mineral occurrences: by stepwise adding of single datasets, the controlling parameters can be understood and used for compilation of genetic models and concepts. In reality, usually a mix of the above procedures is used.

By including geochemical and geophysical data as well as their derivatives and comparing them with geological and tectonic structures, the approach is able to use an almost unlimited amount of independent datasets for its calculations.

Prediction results can be verified by different technologies, including the analysis of the network error, the statistic distribution of the prediction results, cross validation, and finally, of course, field verification.

This paper describes the background of the ANN technology and presents different recent exploration targeting case studies: Firstly, in Rwanda, the technology was used to generate national predictive maps. Across an area of approx. 26,000 km², stream sediment geochemistry, airborne geophysical and geological data was used to run prediction scenarios for two different deposit types: for Nb-Ta-mineralisations in pegmatites and for hydrothermal Au-mineralisations in quartz veins. Secondly, in SW-Ghana, the software was used to create predictive maps for the famous gold belts across an area of 60,000 km². For this study site, airborne magnetic and geological data was used to predict two different types of deposits: Au in hard rocks and Au-placers.

Predictive mapping calculations have been executed by using the advangeo® Prediction Software, which provides the ANN technology in an Esri GIS environment.

References

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