Geophysical Research Abstracts,
Vol. 11, EGU2009-2276, 2009
EGU General Assembly 2009

Mineral Potential Mapping in a Frontier Region

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Mineral potential mapping using Geographic Information Systems (GIS) allows for rapid evaluation of spatial geoscience data and has the potential to delineate areas which may be prospective for hosting mineral deposits. Popular methods for evaluating digital data include weights of evidence, fuzzy logic and probabilistic neural networks. To date, such methods have been mostly applied to terrains that are well-studied, well-explored, and for which high-quality data is readily available. However, despite lacking protracted exploration histories and high-quality data, many frontier regions may have high-potential for hosting world-class mineral deposits and may benefit from mineral potential mapping exercises. Sovereign risk factors can limit the scope of previous work in a frontier region, and previous research in such areas is often limited and/or inaccessible, publicly available literature and data can be restricted, and any available data may also be unreliable.

Mineral potential mapping using GIS in a frontier region presents many challenges in terms of the data availability (eg. non-existent information, lack of digital data) and data quality (eg. inaccuracy, incomplete coverage). The quality of the final mineral potential map is limited by the quality of the input data and as such, is affected by data availability and quality. Such issues are not limited to frontier regions, but they are often compounded by having multiple weaknesses within the same dataset, which is uncommon for data in more well-explored, data-rich areas.

We show how mineral potential mapping can be successfully applied to frontier regions in order to delineate targets with high potential for hosting a mineral deposit despite the data challenges posed. Data is evaluated using the weights of evidence and fuzzy logic methods due to their effectiveness in dealing with incomplete geoscientific datasets.

Weights of evidence may be employed as a data driven method for indirectly evaluating the quality of the data. In a frontier region, the quality of both the training data (mineral deposits) and evidential layers (geological features) may be questionable. Statistical measures can be used to verify whether the data exhibits logical inconsistencies which may be the result of inaccurate training data or inaccurate data in the evidential layer. Expert geological knowledge may be used to exclude, refine or modify such datasets for further analysis using an iterative weights of evidence process.

After verification of the datasets using weights of evidence, fuzzy logic can be used to prepare a mineral potential map using expert geological knowledge. Fuzzy logic is suited to new areas where data availability may be poor, and allows a geologist to select the evidential layers they believe are the most critical for the particular ore deposit style being investigated, as specific deposit models for the area may not yet exist. These critical layers can then be quantified based on expert opinion.

The results of the mineral potential mapping can be verified by their ability to predict known ore deposits within the study area.