Mineral favourability mapping using weights of evidence

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Mineral exploration utilizes multiple techniques, and huge volumes of geoscience data are collected to focus the exploration at brownfield and greenfield exploration sites. Because of the large data volumes and the complex data signatures of the deposits of interest, efficient and innovative techniques such as mineral prospectivity mapping that combine expert judgement and machine learning techniques are required. The weights of evidence mathematical modelling technique is used in this study to produce mineral favourability maps by evaluating each evidential layer and their relationship to gold mineralisation. The output of the technique is an a posteriori probability map for gold over the Swayze Greenstone Belt (SGB), accompanied by a series of cross-validation techniques to check the validity of the method. The tool uses Bayesian statistics to calculate and assign weights to each evidential layer based on their spatial relationships with input training points of known deposits. The SGB in northwestern Ontario, Canada, is comprised of felsic-ultramafic metavolcanics assemblages that are overlain by metasedimentary rocks. Gold mineralization in the SGB lies along major breaks or deformational zones. The gold is associated with feldspar porphyry, quartz veins, and breccias. The mineralization in the SGB is considered mesothermal, being characterized by pervasive Fe-carbonate, sericitization, silicification, albitization, potassic alterations, chloritization, carbonatization, and iron sulfide mineralization signatures. Two mineral prospectivity maps were produced from the integration of multiple geoscience datasets. The first map is an integration of geochemistry, geology, and structural datasets, while the second map has aeromagnetic data which can be added to all other geoscience datasets. The aim of these analyses was mainly to check the efficiency of predictions and classification of the model, and how the introduction of geophysical datasets affects the results. The study results over the Northern Swayze show that the efficiency of prediction and classification of the model are 87% and 69%, respectively, which is significant compared with other previous studies. The model also indicated that the inclusion of geophysical data improves the prediction of the favourability sites. The study found that refining input evidential layers and only using layers that have a strong spatial association with gold vastly improves the results. Evidential layers that do not correlate well with training points (known deposits) result in poor predictions and low efficiencies of classifications and predictions.