

Assessment of Mineral Potential Using Cross-Validation Techniques and Statistical Analysis: A Case Study from the Paleoproterozoic of West Greenland

BO M. STENSGAARD,[†]

Geological Survey of Denmark and Greenland, Øster Voldgade 10, DK-1350 Copenhagen K, Denmark

CHANG-JO CHUNG,

Geological Survey of Canada, 601 Booth Street, Ottawa, Ontario, Canada K1A 0E8

THORKILD M. RASMUSSEN, AND HENRIK STENDAL

Geological Survey of Denmark and Greenland, Øster Voldgade 10, DK-1350 Copenhagen K, Denmark

Abstract

An ideal mineral exploration program characterizes all types of data by describing its relationship to an integrated mineral deposit and exploration model. The model is used to interpret the mineralization and plays a role in the decision making for exploration activities and investments. Successful application of the model depends on validated techniques that quantify the signatures of geologic features, combine data, and lead to parameters that can be expressed in economic terms. A step-by-step procedure for assessment of mineral potential is proposed here based on probabilistic models, on empirical analysis, and on location and quantitative characterization of known mineral occurrences. Mineral potential maps are constructed as a part of the procedure. The reliability of the results is evaluated mathematically by cross validations and prediction rate curves. Estimations of the probability for new discoveries are made and the results are discussed in economic terms.

To illustrate the procedure we apply the method to exploration for volcanogenic massive sulfide deposits in a poorly to moderately explored area of about 25,800 km² within the Paleoproterozoic Nagsugtoqidian orogen of West Greenland. The input data for the analysis include 67 noneconomic occurrences and 15 different types of geophysical and geochemical data. Based on statistical characterizations, 36 of the occurrences were divided into three groups (the Naternaq, Arfersiorfik, and Ataneq groups). The remaining 31 occurrences did not have consistent characteristics in terms of the 15 geophysical and geochemical parameters, and these were excluded from further statistical study. A consistent set of geophysical and geochemical characteristics was established for each of the three groups and used to construct mineral potential maps of the exploration area. Each potential map was divided into 200 equal-size classes of 129 km² each (0.5% of the entire study area). The probability that the most favorable 129 km² will host an occurrence of the type assigned to a particular group is estimated as 71, 32, and 100 percent for the three groups (Naternaq, Arfersiorfik, and Ataneq). The probabilities of new discoveries within a specific minimum prospective area targeted for exploration are also discussed. The probabilities of new discoveries within 1 km² of the 129 km² most favorable area were estimated as 1.0, 0.3, and 23 percent, respectively for the three types of occurrences.

[†] Corresponding author: e-mail, bmst@geus.dk