Paper Number: 1571

Fuzzy logic prospectivity model for gold within the Paleoproterozoic Peräpohja Belt, Northern Fennoscandian Shield, Finland

Nykänen, V.M. [1], Molnár, F.[2], Niiranen, T. [1], Lahti I.[1], Korhonen, K.[2], Cook, N.[3] and Skyttä P. [4]

[1]Geological Survey of Finland, P.O. Box 77, FI-96101 Rovaniemi, Finland
[2]Geological Survey of Finland, P.O. Box 96, FI-02151 Espoo, Finland
[3]Mawson Resources Ltd., Australia
[4]Universtiy of Turku, Department of Geography and Geology, FI-20014 Turun Yliopisto, Finland

_____

A mineral prospectivity model defines and delineates areas favorable for a mineral deposit type of interest. There are two main approaches to compile a prospectivity model: 1) empirical or data driven and 2) conceptual or knowledge driven [1]. For the empirical models we need known examples of the mineral deposits within the study area, whereas a conceptual prospectivity model can be constructed without prior knowledge of existence of the deposits. The current paper combines these two approaches by using a spatial statistical technique called receiver operating characteristics (ROC) method to optimize the rescaling process of the input data sets and the data integration process when using a fuzzy logic prospectivity mapping method. In addition the ROC method is used to validate the models. This methodology is tested in an active mineral exploration terrain which is located within the Paleoproterozoic Peräpohja Belt (PB) in the Northern Fennoscandian Shield, Finland.

The PB comprises a greenschist to amphibolite facies, complexly deformed supracrustal sequence of variable quartzites, mafic volcanic rocks and volcaniclastic rocks, carbonate rocks, black shales, mica schists and greywackes. These formations were deposited on the 2.44 Ga layered intrusions, during the prolonged rifting of the Archaean basement (2.44-1.92 Ga). Later intrusive units comprise 2.20-2.13 Ga gabbroic sills or dikes and 1.98 Ga A-type granites. Metamorphism and complex deformation of the basin fill took place during the Svecofennian orogeny (1.9-1.8 Ga) and was followed by intrusions of post-orogenic granitoids (1.81-1.77 Ga) [2] [3].

The recent mineral exploration activities have indicated several gold bearing mineral occurrences within the PB. For example, The Rompas Au-U mineralisation is hosted within deformed and metamorphosed dolomite-quartz veins enclosed within mafic volcanic rocks and contains uranium bearing zones without gold and very high grade (>10 000 g/t Au) gold pockets with uraninite.

The exploration criteria translated into a fuzzy logic prospectivity model included data derived from regional till geochemistry (Fe, Cu, Co, Ni, Au, Te, K), high resolution airborne geophysics (magnetic field total intensity, apparent resistivity, gamma radiation), regional gravity and regional bedrock map (structures). The current exploration licenses for gold were used as the examples of known mineral occurrences to validate the knowledge driven mineral prospectivity model.

References:

[1] Bonham-Carter (1994) Geographic Information Systems for Geoscientists: Modelling with GIS. Pergamon, Oxford.

[2] Perttunen and Vaasjoki (2001) Geol. Surv. Finland Spec. Pap. 33, 45-84.

[3] Hanski et al. (2005) Bull. Geol. Soc. Finland, 82, 31-62.