

Gold potential in the Dalradian rocks of NW Northern Ireland: prospectivity analysis using Tellus data

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Geographic Information Systems (GIS) are essential tools for the management and integration of the large amounts of multivariate spatial data used in mineral exploration. GIS allows visualisation and analysis of the data to determine which parameters are critical to the mineralising process. Prospectivity analysis combines these parameters to produce a map showing the distribution of mineral potential for a particular type of mineral deposit. In this example Arc-Spatial Data Modeller software has been used to analyse the prospectivity for mesothermal gold vein mineralisation in the Dalradian rocks of north-western Northern Ireland. A knowledge-driven (Fuzzy Logic) approach was used because of the small number of gold deposits within the area. Fuzzy Logic is used in situations where information is inexact and traditional digital true and false (1 and 0) values are not appropriate. In Fuzzy Logic 0 and 1 are extreme cases of truth but the various states of truth in between can be represented. The key stages of prospectivity analysis are: (1) analysis of the deposit model to determine key exploration indicators; (2) data processing, interpretation and analysis to extract key indicators; (3) assignment of weightings, zones and styles of influence to key indicators; and (4) calculation of prospectivity. This research is based largely on new geochemical and geophysical data resulting from the Tellus Project in Northern Ireland. The Tellus Project involved geochemical and airborne geophysical surveys over the whole of Northern Ireland carried out between 2005–6 with funding from the Government of Northern Ireland.

The study area is underlain mainly by Neoproterozoic rocks of the Dalradian Supergroup (ca. 590 Ma) which form part of the Caledonide orogenic belt. The Dalradian Supergroup comprises a thick succession of semi-pelites, psammites and pelites, with graphitic pelite horizons that host much of the known gold mineralisation. In the Sperrin Mountains two advanced gold projects, Curraghinalt and Golan Burn, and an operating mine, Omagh (Cavanacaw), are hosted by Dalradian rocks. The Dalradian rocks of Northern Ireland were extensively deformed during the Grampian Orogeny and at least four phases of deformation are recognised. On a deposit scale distinct differences are observed between Curraghinalt and Cavanacaw including orientation of principal structures, mineralogy and geochemistry.

The mineral prospectivity analysis integrated a range of datasets including: 1:250 000 scale geological mapping, mineral occurrences, digital fault vectors, Tellus drainage geochemistry and geophysics. In order to assess the differences between the Curraghinalt and Cavanacaw mineral deposit models separate prospectivity models were parameterised. The key differences between the two models relate to the weightings attached to the structural vectors and the significance given to particular elements from the drainage geochemistry.

The prospectivity analysis identified potential for mesothermal gold mineralisation over extensive areas of the Dalradian in NW Northern Ireland. The use of specific models for Curraghinalt and Cavanacaw has produced significant differences in the location and extent of the target areas which provide a basis for focusing exploration for mesothermal gold deposits in this region. Detailed examination of all available data and ground truthing is required in order to validate these targets. Refinement of the approach using additional larger-scale datasets, such as 1:50 000 scale geology and structure, and improved deposit models is likely to yield results that are more effective for targeting exploration at a local scale.