Gold potential in the Dalradian rocks of NW Northern Ireland: GIS-based 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. Prospectivity analysis combines these datasets, in the context of a mineral deposit model, to produce a map showing the distribution of potential for a particular type of mineral deposit. In this example Arc-Spatial Data Modeller software has been used to analyse the prospectivity for orogenic vein gold 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 the use of classical set theory is inappropriate. Fuzzy logic allows assignment of weightings to exploration data on a continuous scale from 1 (full membership) to 0 (full non-membership). This allows a level of uncertainty or 'fuzziness' to be incorporated into the modelling. 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 2004–6 with funding from the Government of Northern Ireland.

The study area (3074 km^2) 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, 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 chemical elements in the drainage geochemical dataset.

The prospectivity analysis identified several areas prospective for orogenic-style gold mineralisation. Many of the prospective zones either coincide with known occurrences of orogenic gold mineralisation or areas considered highly prospective based upon previous work, validating the process and the model results. The use of specific models for the Curraghinalt and Cavanacaw deposits has produced significant differences in the location and extent of the target areas which provide a basis for focusing exploration for orogenic gold deposits in this region. Detailed examination of all available data and ground truthing is required in order to validate these targets. In addition to delineating new areas favourable for gold mineralisation the prospectivity mapping has provided new insight into possible regional controls on the location of mineralisation and into the geology of this area. Please fill in your abstract text.