Geochemistry in the development of metallogenic models and exploration criteria for SEDEX and MVT base metal deposits

Abstrak (Abstract)

Regional resource evaluation and exploration for metalliferous mineral deposits (particularly at the area selection stage) is based increasingly on the analysis and integration of spatially related datasets using Image Analysis System (IAS) or Geographical Information System (GIS). Such system can be used for the rapid analysis and interaction of one or more images (maps) for a wide range of geological data. In Central Finland, for example, the identification of areas with potential for Cu-Zn mineralization was made by the analysis and integration of more than 70 variables (including geochemical, geophysical, geological and remotely sensed data) using statistical image processing techniques. Areas favourable for gold mineralization in Nova Scotia were also identified by integrating statistical parameters derived from lake sediment geochemistry with geological and geophysical parameters using a GIS. This approach is of particular value in exploration for deposits which are associated with volcanic or plutonic igneous rocks in basement terrains and which have a clear signature in drainage geochemical samples.

Exploration for buried carbonate-hosted Sedimentary Exhalative (SEDEX) and Mississippi Valley Type (MVT) deposits requires a different approach, however, whereby exploration criteria derived from conceptual and fluid flow mineral deposit models are combined using an IAS identify prospective areas. This lecture presents a review of studies carried out to identify areas prospective for buried carbonate-hosted SEDEX or

Warta Geologi (Newsletter of the Geological Society of Malaysia), Vol. 18, No. 5, September-October 1992

MVT deposits in England and Ireland. The methods described include lithogeochemistry and basin analysis which are more commonly employed for hydrocarbon exploration. The two deposit types are shown to be related to different phases in the tectonic evolution of the Foreland of the Hercynian orogen. The SEDEX deposits are related to phases of crustal extension and basin formation associated with the rise of hot asthenosphere beneath the crust, which was characterised by basaltic magmatism, high geothermal gradients and listric faulting. In contrast, MVT deposits were formed following a period characterised by declining geothermal gradients, regional subsidence of the crust, and over-pressuring of sedimentary basin from which ore fluids, similar to oil field brines, were expelled. Specific exploration criteria are developed and detailed models and prospectivity maps presented.

The value of regional geochemical data and the organic and inorganic geochemistry of limestone and shale (the sink and source respectively of the ore fluids) are reviewed in relation to other datasets including remotely sensed (SPOT and TM) and geophysical data. An expert system demonstrator (BURMIN) for identifying the two types of ore deposits in sedimentary basin sequences is discussed.

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