EXPLORATION GEOCHEMISTRY IN BRIEF: PAST, PRESENT AND FUTURE

by

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Several areas of work are presented as being of special interest in the next decade. Perhaps the most promising is the use of selective chemical analysis to focus exploration effort on sources of metal in the mineralogical forms most appropriate for exploitation. The role of the Association of Exploration Geochemistry in fostering information exchange, and future joint action with the IAGC working group on geochemical prospecting is discussed.

Historical Perspective

In the early days of the search for metals, the prospector soon became adept at locating mineral deposits by means of characteristic features in the bedrock and surficial environments. Rock and mineral fragments in stream sediments enabled those early prospectors to trace back dispersion trains to the bedrock source. The major difference between the earliest prospector and the modern exploration geochemist is that the prospector utilized mineralogical observations whereas the geochemist uses chemical analyses.

Workers in the U.S.S.R. and Scandinavia first used modern methods of exploration geochemistry in the 1930s. These geochemical exploration surveys were made possible by the introduction of the emission spectrograph, at that time a new technology in the qualitative measurement of trace elements. These first surveys were involved with the search for tin, but soon gave rise to surveys for copper, lead, zinc and other metals. With the continued improvement in spectrography and other methods of chemical analyses, especially colorimetric, came the introduction of geochemical prospecting to Canada then followed by the United States and Africa. Today exploration geochemical techniques are used widely in most countries of the world.

Recent Contributions

Research into the geology and geochemistry of present geothermal systems and their role in the formation of mineral deposits has been carried out over the past 20 years. However, recent intensive efforts in the search for precious metals have brought this work into focus within the exploration community. Epithermal gold deposits occurring in veins, wallrock and exhalites can be linked to modern geothermal systems for a variety of reasons, including comparable geometry, mineralogy, temperatures and fluid characteristics. Advances in the understanding of ore forming processes have allowed the refinement of geochemical exploration methods. The sampling and analytical problems associated with gold exploration are particularly challenging and are under active study. The development and commercial availability of instrumental neutron activation analyses as well as compact atomic absorption spectrometers suitable for field determinations have helped the search for precious metal deposits.

Recent developments in groundwater geochemistry are providing more sophisticated means of evaluating the dispersion of elements in groundwaters derived from concealed mineralization. Thermodynamic and solubility data on mineral and aqueous species are being used to determine chemical speciation of water samples.

This approach attempts to compensate for variations in metal complexing ability between samples, which can obscure the subtle patterns related to mineral deposits. For example, the determination of sulphur species may allow a distinction to be made between sulphur derived from massive sulphide deposits and that from sedimentary or metamorphic sources.

In recent years, multi-element geochemistry has become routine in most geochemical surveys. Computerized data management techniques and statistical procedures are being applied increasingly to the problems of interpreting and presenting these data. By and large, this has resulted from the recognition that statistical techniques can help uncover subtle, though significant, features in multi-element data that are needed to discover harder-to-find orebodies.

Lithochemical methods in the primary environment have also become attractive in prospecting for hidden ore deposits. The use of trace element signatures provides a means of distinguishing favorable from barren host rocks and has been a technique much studied by Soviet geochemists. The best examples are furnished by the relatively simple magmatic deposits.

Sampling stream sediments, Goias State, Brazil.

New Technologies for the 1980s

The mining industry continues to face considerable uncertainty, related for example to increased awareness of the environmental impact of mining, and unpredictable changes in economic parameters. However, over the long term, few industries are more vital than mining. During the 1980s exploration geochemistry must look to new techniques and, perhaps, radical changes in prospecting methods. To put it simply, easily discovered deposits have become rare, and the important task now is to search for hidden orebodies beneath barren cover or transported overburden.

Vapor geochemistry of mineral deposits and oil fields has recently attracted more attention as an exploration technique. As new methods of analysis become available, additional understanding of gaseous dispersion will contribute significantly to mineral exploration. Work on radon, helium and mercury continues and atmospheric and biogenic gas geochemistry hold considerable promise in areas of thick overburden.

Selective and mineral-specific chemical analyses on solid materials have generally received only isolated attention in the past. Recent laboratory and field studies indicate that selective extraction methods are capable of providing greater sensitivity and improving anomaly definition. The concentration of trace elements, such as Te, Se, Bi and Tl, in specific sulphide phases allows selective extractions to be used to detect these elements and so evaluate their dispersive character in the precious metal environment. Probably one of the most significant breakthroughs to be made is in understanding and applying selective and specific extractions so that lithological and environmental effects on metal distribution do not override the signature from mineralization.

Geochemical prospecting has been one of the most encouraging techniques used for mineral exploration in tropical regions. Important studies have been reported on the weathering, mineralogy and trace-element geochemistry of laterites, especially in savannas. However, many more studies are needed, especially in humid tropical environments, in order to assess the variability of weathering and the trace-element distribution under different environmental and geologic conditions. This work will involve detailed studies of soils and vegetation, in addition to regional programs of stream-sediment sampling.

Mineral exploration in the 1980s will challenge the exploration geochemist to increase the role of geochemistry in the progressively more difficult task of locating buried deposits. This problem will be resolved through basic research, the application of geochemical principles and techniques, and perseverance.

Geochemical samples being received in CPRM laboratory in Goiania, Brazil.

Association Activities

One international group active in promoting these activities is the Association of Exploration Geochemists (AEG), founded in 1970 in order to form a focus for persons working in the field of exploration geochemistry. Major objectives are to provide a forum for the exchange of ideas and technical findings, to advance the science of geochemistry through encouraging university and other research, and to provide a united and representative group of persons who can speak for exploration geochemists and geochemistry. The Association has a membership of over 700, drawn from 61 countries. Its largest membership group is in North America (408), followed by Australia and New Zealand (89), Europe (88), Central and South America (55), Africa (45) and Asia (22). AEG publishes an internationally-recognized bi-monthly journal, the *Journal of Geochemical Exploration*. Additional publications include a quarterly newsletter, the *Bibliography of Exploration Geochemistry* and a special volume series.

On a biennial basis the Association sponsors an International Geochemical Exploration Symposium. The next is in Saskatoon, Canada, May 1982, and following that in Helsinki, Finland, September, 1983. The 10th IGES meeting in Helsinki will mark the first joint cooperative action by AEG and the International Association of Geochemistry and Cosmochemistry's working group on Geochemical Prospecting. It is hoped that out of this meeting, and other contacts, that geochemists from all countries will be stimulated to work together through various international programs toward the solution of the challenges of the 1980s.

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