Re-evaluating the role of lithogeochemistry in base- and precious-metal exploration

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The last ten years lithogeochemistry is playing an increasingly dominant role in many exploration programs for several reasons: 1) A better understanding of the major and trace element and isotopic characteristics of tectonic regimes containing certain deposit types, and an interest by petrologists in communicating these findings to the explorationist; 2) A refinement and proliferation of techniques used to identify geochemical gradients within hydrothermal alteration systems; 3) Increasing accuracy and cost effectiveness in analytical methods available to commercial laboratories; and 4) The availability of inexpensive, powerful hardware and software to allow the interrogation of lithogeochemical data and its incorporation in layered datasets. This is perhaps a good time to re-evaluate the relative importance of lithogeochemistry within a balanced exploration program, and how it can be integrated more effectively with field observations, petrography, and mineral chemistry to increase efficiency and cost effectiveness.

The role of lithogeochemistry in an exploration program is to: 1) define the composition of the rock suite hosting mineralization; 2) use these compositions to define petrologic affinities, and thereby gain a better understanding of the depositional environment and conditions; and 3) to recognize alteration trends that can be used as vectors towards potential ore deposits. Whereas understanding the criteria that define various rock types is relatively easy, optimization of petrologic and alteration data requires an increasingly detailed and in-depth knowledge of petrogenesis and the systematics of magmatic-hydrothermal fluids, with criteria varying between deposit types. The danger comes when the criteria become too complex, resulting in confusion, mistaken conclusions, and possibly a rejection of lithogeochemistry as an effective exploration tool.

In order to avoid the ineffective use of exploration geochemistry, it is the responsibility of petrologists and hydrothermal geochemists to effectively integrate their knowledge transfer to the mineral industry with field-related geological and mineralogical parameters. Lithogeochemistry should be considered as part of a loop which starts with sound lithological, mineralogical, and structural observations, followed by petrography and geochemistry to provide a quantitative link to the field observations, with results that can be plotted on a map or drill log. Once the connection is made between field-petrographic observations and geochemical data, the confidence level is increased with respect to understanding the geological and mineralogical relationships in the field.