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GEOCHEMICAL EXPLORATION FOR GEOTHERMAL SYSTEMS:
FIVE EXAMPLES IN THE BASIN AND RANGE

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ABSTRACT

Chemical interaction of hydrothermal fluids with reservoir rocks of geothermal systems results in the development of characteristic geochemical dispersion patterns which can prove useful for exploration. This paper reviews the trace element dispersion patterns developed about five Basin and Range geothermal systems: the Roosevelt Hot Springs and Cove Fort-Sulphurdale areas in Utah and the Beowawe, Colorado and Dixie Valley thermal areas in Nevada.

Despite significant differences in geology, temperature, fluid chemistry, and ages of these systems, common geochemical features exist. The pathfinder elements recognized as being useful for geothermal exploration - As, Hg, Li, Sb, (Ag, Au, Ba, Be, Cu, Pb, Sr, Tl, W and Zn) - are very similar to the suite of elements distributed about epithermal mineral systems. The abundance of any particular element mobilized within the geothermal environment depends upon the availability of that element in the source rocks at depth as well as upon the chemical and physical properties of the fluids.

Elements are deposited at distinct positions within and about the geothermal system in response to changing physicochemical conditions. Boiling, cooling, and oxidation of the fluid in particular appear to be important processes. The geochemical enrichments are not, in general, widespread, pervasively-developed zones of regular form and dimension as are typical of many ore-forming hydrothermal systems, but rather reflect the configuration of the flow-controlling structures. As the geometry and conditions within the geothermal system change with time, the geochemical enrichments of the reservoir rocks preserve a time-integrated history of the system.

In all five areas, present geothermal activity is located at or near the location of at least one older hydrothermal event. Differences in the geochemical suites remobilized in sequential events or slight differences in system location may permit a distinction between the different geochemical dispersions to be made. In some cases, differences cannot be recognized.

Geochemical methods are useful throughout the exploration process for defining the position and interpreting the history of the geothermal system. As in any application, the most valuable contributions can be made when geochemical information is interpreted in conjunction with other geological and geophysical information.