

## **Sr and Nd Isotopic and Elemental Evidence for the Sources of B-As-Li Sediment-Hosted Deposits of West Turkey: Exploration Implications**

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Turkish borate deposits have many similarities to other sediment-hosted B deposits worldwide. Although mined for B, they are also strongly enriched in Li, As, and Sr and, thus, their genesis has implications for exploration worldwide, particularly for Li deposits and especially for those in the Tethyan area.

Field observations, mineralogy, isotopic dates, immobile element concentrations, and biotite compositions indicate that acid magmatism in the Emet and Kirka basins was closely related in both space and time to the deposition of the borate host sediments. The result of the interaction between saline, alkaline waters and dominantly acid igneous products was the generation of an authigenic mineral assemblage comprising mainly calcite, dolomite, borate, trioctahedral smectite, and K-feldspar. These minerals, together with elevated concentrations of As, Sr, and Li, correlate particularly well with borate mineralization.

The geochemistry of the early Miocene acid igneous rocks indicates that acid magmatism represented the source for B and Li, and probably also for As and Sr. Possible mechanisms for the transport of B and other elements from an igneous source to the basin sediments include transfer by igneous-driven geothermal fluids, enriched in B as a result of hydrothermal leaching; magmatic waters and gases; and breakdown of igneous material in saline, alkaline lakes. Differentiation between these mechanisms is, however, difficult.

Trace element data of acid volcanic rocks indicate strong enrichment in B. Nd and Sr isotope data of the acid rocks indicate that the ultimate source of this B was assimilated upper continental crust, perhaps with some component of melted lithospheric mantle. This signature appears spatially limited and may be a regional exploration guide.

Comparison with other sedimentary borate provinces, notably in the Andes and United States, as well as Tibet, shows a common tectonic setting, characterized by former convergence with associated subduction and crustal thickening. Elsewhere in eastern Tethyan terranes, such as northeast Afghanistan and northwest Pakistan, pegmatites and granites are strongly enriched in Li and B, suggesting that erosional level is important in deposit style as well as commercial potential.