

Rare metals in recrystallized Pb-Zn mineralizations: new insights from the Pyrenean sphalerite

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In our high-tech societies, the rare metal market is growing associated to various key industrial applications such as optical fiber (Ge), solar panels (Ga) or electronic devices (In). Rare metals are mainly mined as by-products of Pb-Zn(-Cu) deposits, hosted in sphalerite (ZnS) crystallographic lattice and occurring in trace content (ppm levels). Nonetheless, these rare metals may be present in specific mineral assemblages (wt.% levels) but their natural mechanisms of concentration are poorly known.

Germanium minerals appear in the Pyrenean Axial Zone hosted in polyphased Pb-Zn ores. In Vein ore, partly-recrystallized texture of sphalerite is observed with electron back-scattered diffraction (EBSD) and contains patchy-oscillatory Ge and Ga zonations mapped with laser induced breakdown spectroscopy (LIBS). Indeed, dynamic recrystallization of sphalerite results to the redistribution without loss of Ge and Ga contents associated to intragranular diffusion and fluid-rock reaction processes. Ge-minerals occur in grain boundaries of Ge-poor recrystallized sphalerite or in twin-boundaries of Ge-rich parent sphalerite. Rare metals concentrations are herein controlled by circulation of low- temperature (< 250°C, microthermometry) fluid, probably during Pyrenean deformation.

These results have important implications in rare metal exploration of deformed Pb-Zn(-Cu) deposits. Indeed, a complete understanding of these heterogeneities is now crucial to assess the rare metal potential, and associated extraction processes of deformed base-metal ores, the largest Pb-Zn resources in the world.