

Mineralogy and Metasomatic Evolution of Distal Strata-Bound Scheelite Skarns in the Riba de Alva Mine, Northeastern Portugal

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Abstract

The metasediment-hosted distal scheelite skarns from the Riba de Alva mine, Barca de Alva-Escalhão region, northeastern Portugal, consist of three main levels of strata-bound, boudin-shaped, 0.5- to 4m-thick bodies, having a total resource of 380,000 tons (t) with an average grade of 0.51 percent WO_3 . The boudinage of the Cambrian metasedimentary rocks of the Slate Greywacke Complex occurred early during the Hercynian orogeny, prior to the Granitic Complex intrusion and the skarn-forming process. The Granitic Complex corresponds to reduced, highly evolved, and metallogenically specialized S-type leucogranites, comparable to those commonly associated with Mo-poor W-F skarns.

Four different skarn types were recognized: pyroxene skarn with Fe diopside ± anorthite; amphibole-epidote skarns with actinolite + clinozoisite ± bytownite ± phlogopite; ore skarn with clinozoisite + scheelite + fluorite + calcite ± labradorite ± apatite ± Fe axinite ± armenite ± scapolite; and late-stage veins with quartz (or fluorite or calcite) ± clinozoisite ± andesine (or albite) ± adularia.

Clinopyroxene ranges from $Di_{80}Hd_{20}$ to $Di_{60}Hd_{40}$. Amphibole compositions range from actinolite to Mg hornblende and are F rich (0.5-1.9 wt %). Clinozoisite, often zoned with Fe-poor cores, shows little compositional variation in the skarn types, having a low pistacitic component (5-13% Ps). Plagioclase compositions grade from anorthite in pyroxene skarn through andesine and albite in late-stage veins. Phlogopite, as amphibole, is F rich (2.45-4.70 wt %). An extremely pure Mo-free scheelite, the only ore mineral present, is restricted to the ore skarn type.

The Riba de Alva skarns were formed, after intrusion of the Hercynian Granitic Complex, by selective infiltrative metasomatic alteration of argillaceous dolomitic limestone. An early stage of prograde alteration led to the formation of the pyroxene skarn, through reaction with an Si-rich and Fe-bearing fluid. Scheelite mineralization occurred during retrograde alteration, which was mainly fracture controlled and is characterized by a pervasive infiltration metasomatism with minor diffusion in the skarn walls. This alteration started with hydration reactions to form amphibole-epidote skarns, probably under lower X_{CO_2} conditions. Ore skarn formation, with scheelite deposition, took place later during this retrograde stage, mainly along veins within the strata-bound boudins, as the result of a decrease in temperature and/or significant changes in the activity of some fluid components such as W, F, Na, Mn, P,

and B, and particularly an increase in a_{Ca} . Monomineralic late-stage veins represent the waning stage of the skarn-forming process.