

Hydrothermal alteration in the Linares–La Carolina Ba–Pb–Zn–Cu–(Ag) vein district, Spain: mineralogical data from El Cobre vein

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The Linares–La Carolina Ba–Pb–Zn–Cu–(Ag) vein deposits, Spain (Fig. 1), which were developed principally in the period 1875–1920, constituted one of the most outstanding mining districts of Europe, with an average lead production of 65 000 t/year and up to 500 g/t silver obtained as a by-product. The workings were concentrated on vein-type

hydrothermal mineralization hosted by granitoids and metasediments.

The El Cobre vein, a cordilleran vein-type deposit (*sensu* Gilbert and Park⁷), is representative of the veins in the district and is also one of the largest. It strikes northeast–southwest for about 5 km, has an average thickness of 2–3 m and is hosted by monzogranitic rocks (the so-called Monzogranito de Linares) and minor Carboniferous metasediments. The Linares monzogranite belongs to the Los Pedroches batholith—a large, late-Hercynian (312–308 m.y.)^{4,5} intrusive unit comprising granodiorites, monzogranites, tonalites, diorites and quartzdiorites.^{8,11} The Linares monzogranite is a medium- to coarse-grained, moderately peraluminous rock consisting of quartz (25–30 vol%), plagioclase (25–45 vol%; An₃₄ and albite-rich An_{12–6}), K-feldspar (10–30 vol%; Or_{97–93} Ab_{3–7}) and biotite (4–11 vol%; Al^{VI} = 0.21–0.18 atoms per formula unit). Pseudo-primary muscovite is very rare.

The El Cobre vein records three stages of mineralization, which were separated by major brecciation events (Fig. 2). The first stage was characterized by deposition of quartz and

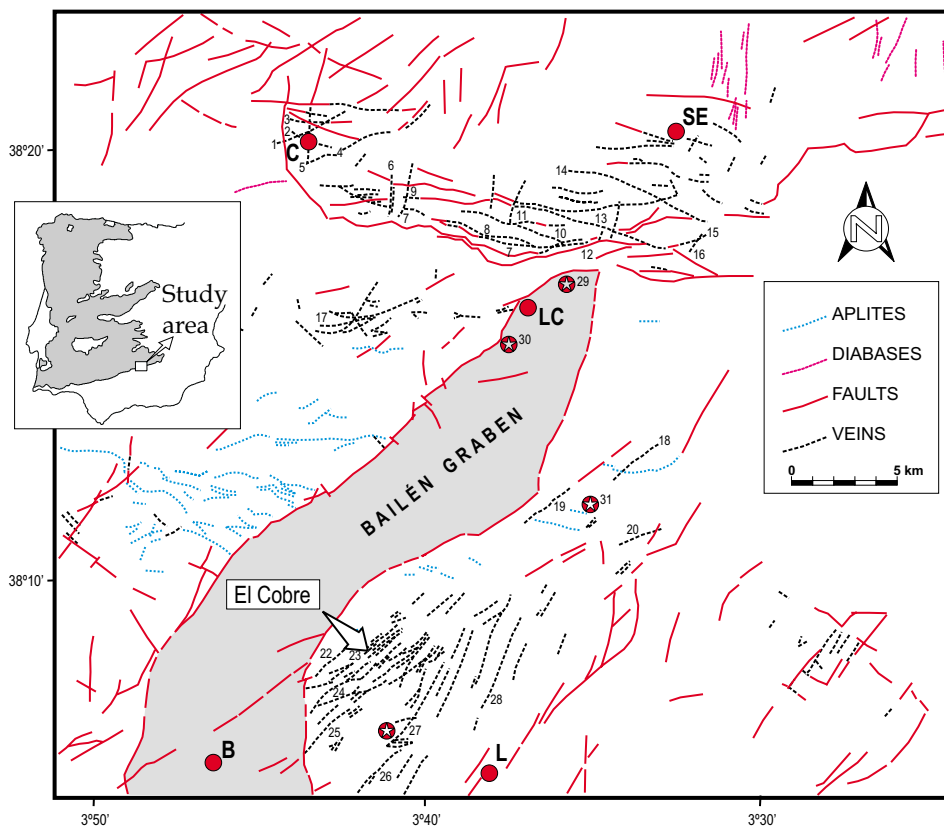


Fig. 1 Spatial distribution of veins in Linares–La Carolina district. (Villages: C, El Centenillo; SE, Santa Elena; LC, La Carolina; B, Bailén; L, Linares)

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minor amounts of arsenopyrite, Ag sulphosalts, pyrite and chalcopyrite. The end of the first stage and the beginning of the second were marked by the deposition of significant amounts of galena and minor sphalerite. The main part of the second stage was characterized by deposition of pyrite, Cu