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A Late Variscan Sn province: the Arburese region (SW Sardinia, Italy)

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Late Variscan Sn – rich European provinces (e. g. Erzgebirge, Cornwall) are of particular relevance as they offer key insights into crustal evolution, intrusive processes and ore genesis. In Sardinia (Italy), small Sn deposits are only known in the Arburese historical mining region (SW Sardinia), hosted in low-grade metamorphics close to the contacts with intrusives. This region is characterised by two late variscan intrusions, which differ in age and composition: the Arbus and the Monte Linas pluton, aging 304 $\pm$ 1 Ma, and 289 $\pm$ 1 Ma respectively. They emplaced at shallow crustal levels and crosscut the basal thrust between the alloctonous prism and the foreland of the Variscan belt of Sardinia. The Arbus Pluton (AP) is a composite intrusion of piroxene- and amphibole-granodiorites hosting minor amounts of monzogabbroic rocks and cordierite-bearing granites with a wide core of leuco-monzogranites. Tourmaline greisens and pegmatites garnish the contact between the border facies and the host metamorphic rocks. The Monte Linas Pluton (MLP) has biotite monzogranite composition. The pluton is internally zoned, from medium grained monzogranite in the core to hololeucocratic fine-grained rock-types at the top, where often F-greisen, fayalite-pegmatite pods and sill are common.
In both plutons the igneous associations are high-K ilmenite series, suggesting derivation from low- fO_2 magmas possibly linked to a common crustal contribution; however, in the Linas Pluton magnetite in the fine-grained facies may indicate an increase in oxygen fugacity.
The AP-related Sn ores consist of high-temperature As-Sn quartz veins. They are vertically zoned, from quartz-chlorite-cassiterite to large quartz-arsenopyrite veins. Ore microscopy and SEM-EDS analyses evidenced a vein texture made of thick idiomorphic and frequently twinned cassiterite crystals, alternated with several generations of banded/geodic quartz. Chlinoclore aggregates are included into the quartz. The arsenopyrite ore shows alternating bands of microgranular to crystalline millimetric arsenopyrite with quartz. Field and analytical data suggest genetic mechanisms dominated by mobilization of residual Sn by chloride and other complexes in reducing, As- and S- rich, low- fO_2 juvenile fluids. Cassiterite and successive arsenopyrite precipitation occurred under changing physicochemical conditions (e.g. oxygen contents; temperature decrease; pH).
The MLP Sn metallogeny include Sn- Pb-Zn-Cu veins (Canale Serci old mine). Cassiterite occurs as fine-grained corroded crystals. Optical and SEM-EDS analyses evidence a high-temperature oxide stage (quartz-chlorite-cassiterite) followed, after brecciation, by mesothermal sulfide stages, with progressive deposition of sphalerite, pyrite, chalcopyrite, tetrahedrite, galena, marcasite. Arsenopyrite is strikingly absent. These evidences indicate possible derivation of the ore from residual, reducing juvenile fluids, capable to carry Sn- complexes from monzogranite magmas from which cassiterite precipitated in consequence of an increasing in fO_2.
Despite their limited amount, the Sn ores of SW Sardinia have high metallogenic relevance, indicating the persistence, of geochemical conditions,which lasted 15 Ma, favorable to the genesis of a Sn metallogenic province.