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MINERALOGICAL STUDIES OF THE W-Sn VEIN SKARNS OF MONTE TAMARA (NUXIS, SULCIS DISTRICT): INSIGHTS FOR STRATEGIC MINERALS EXPLORATION IN SW SARDINIA (ITALY).

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Skarn deposits are a relevant source of critical raw materials such as W, Sn, and In. Recent studies conducted in South Sardinia pointed out the relationships between various Sn-W-Mo deposits and the early Permian (289-286 Ma) F-bearing, ilmenite-series ferroan granites (e.g., Sulcis pluton). This new evidence triggered a broad re-examination of granite-related deposits including skarn deposits hosted by Cambrian limestones of the low-grade Variscan basement of the Sulcis district (SW Sardinia). With this purpose, field investigations and OM, SEM-EDS, EMPA, and LA-ICP-MS observations, and analyses have been conducted on the skarn ores of Monte Tamara (Nuxis, northern Sulcis) where scheelite has been reported in the old San Pietro and Sinibidraxiu mines. The San Pietro mine exploited a 1-5 m thick and 70 m deep, steeply dipping skarn orebody located at the tectonized contact between early Cambrian sandstones and limestones. The orebody includes layers of Grt-Cpx-Wo, magnetite, and Zn-Pb-Cu-Fe sulfide bands. Prograde and retrograde stages with oxides and sulfides can be recognized. Clinopyroxene is the foremost mineral of the prograde stage; garnets (andradite-grossular) are usually dark green with typical anomalous birefringence and distinctly zoned (Fe-rich cores and Al-rich rims). Hematite turned to mushketovite, and Mo-rich scheelite, followed by In-bearing cassiterite, occasionally occur in the prograde assemblages. Amphiboles and epidotes mark the retrograde stage, together with abundant Zn-Cu-Fe-Pb sulfides and accessory molybdenite, stannite, bismuthinite, and Bi-Ag-Pb sulfosalts. At San Pietro, dominant sphalerite displays highly variable Fe, Mn, and Cd contents. Relict-looking blebs of Fe-Mn-poor Sp are scattered in high-Fe-Mn Sp where Sn EMPA peaks may correlate with cassiterite-stannite micro-inclusions. Galena composition suggests localized intergrowths with micro-inclusions of bismuthinite, Bi-Se, and Bi-Te sulfosalts. The stannite-sphalerite geothermometer provided a temperature range of 325-200°C for the sulfide stage. The Sinibidraxiu old mine exploited a 1,5 m thick and 60 m deep columnar body, hosted in early Cambrian marbles. It consists of a sphalerite-wollastonite assemblage with late sulfides, quartz, and calcite, hosting cm-sized arsenopyrite and scheelite. Scheelite is Mo-poor; Sn-, other Mo-phases and Bi-phases are absent. High-Fe Sp, rimmed by low-Fe Sp and blebby galena, is finely intergrown with wollastonite cockades. The results from this study suggest that a wide range of skarn-related mineralizing phenomena occurred in the Monte Tamara area. Both orebodies resulted from a structurally controlled migration of metasomatic fluids inside the hosting carbonate formation. Mineral zonation and composition of the San Pietro skarn point towards skarn development under varying fO_2 conditions, oxidizing then rapidly turning to moderately reducing within the prograde W-Sn skarn stage and into the sulfide stage. The features of the Sinibidraxiu orebody (e.g., Mo-poor, As-devoid scheelite) suggest a formation from reducing metasomatic fluids but S-poor compared to San Pietro, probably at more distal environments (e.g. low Sn-Bi contents). From this point of view, the Monte Tamara area still maintains an economic potential, linked to the possible presence of proximal skarn ores at depth; thereby representing a key area for further exploration for granite-related strategic and critical metals in SW Sardinia.