

Geochemistry and Origin of the Magnetite-Vonsenite Mineralization of the Monchi Mine (SW Iberia)

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The Monchi Mine (SW Iberia) is a high-grade iron deposit with an unusual mineral assemblage that is currently interpreted as a sub-type of magnetite-(apatite) systems. The mineral assemblage includes dominant massive magnetite and vonsenite along with smaller amounts of cobaltite, löllingite-safflorite, allanite, uraninite, cassiterite, and monazite; the ore contains only sparse amounts of pyrite, chalcopyrite, and gold. The mineralization is located at the western margin of the Burguillos del Cerro Plutonic Complex, a Variscan, concentrically zoned pluton from gabbro to granodiorite. This part of the complex is adjacent to a significant N-S-trending dextral strike-slip shear zone. Within this zone, Ediacaran to early Cambrian metapelitic and calc-silicate hornfels and marble crop up. The magnetite-vonsenite mineralization is adjacent to the metasedimentary units forming sizeable lens-shaped bodies with sharp contacts with the intrusive rocks and is locally mylonitized. Subordinately, a U-REE-bearing Fe-pyroxenite is intimately associated, which is locally brecciated and cemented by a pegmatite composed of albite, K-feldspar, quartz, clinoamphibole, biotite, and axinite. Within the metasediment layer, there is a post-tectonic exoskarn, also with magnetite mineralization. Allanite U-Pb TIMS dating from the U-REE-rich pyroxenite yields 337.13 ± 0.99 Ma, within the age range of the Burguillos Plutonic Complex (335-340 Ma). Whole-rock analysis on the pyroxenite shows an enrichment in REEs (La, Ce, Pr, Nd) and U (up to 47 ppm). Ore geochemistry analysis reveals high values of Co (6 %), Ni (1 %), Sn (501 ppm), U (518 ppm), and Ta (127 ppm). The origin of the mineralization remains unknown, although could be explained by I) crystallization of a B-bearing iron melt, similar to the magnetite-(apatite) deposits but with boron as the fluxing agent, and being immiscible with the pyroxenite melt; or II) the result of a syn-magmatic interaction of Ca-rich rocks with deep-sourced fluids focused along thrusts.