Manganese mine of Tawakalan in Kurdistan - Iran: A rare Mn mineralization process

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Abstract: In the Kurdistan Province (west of Iran), manganese mineralization has occurred in several locations including Shahini (south west of Sanandaj), Sianaw (west of Mariwan), Tawakalan (west of Diwandareh) and Golchidar (east of Marivan), but Tawakalan mineralization has characteristics which cannot be interpreted by Petrological principles. This mineralization is located at the end of northwest of Sanandaj-Sirjan zone and is located in Paleozoic formations. In this mine, ore deposits is a paragenesis of high temperature silicates like spessartite and rhodonite sometimes accompanied by tephroite that usually crystalize at high temperature and occur in absence of water; while ore deposits of Tawakalan appear as lens-shaped segments, intercalated within the shale, sandstone, volcanic tufts and radiolarites untouched by temperature and where no intrusive bodies are seen in the region. The order of crystallization of these minerals in ore deposits is: 1- spessartite and rhodonite, 2- bementite, 3- Hydrous silicates of manganese, 4- rhodochrosite, 5- manganese oxides. hydrous silicates of manganese include orientite, caryopilite, zussmanite, and manganese oxides is pyrolusite and Rancieite. Gangue is composed of quartz (mostly in form of Jaspe), minor amount of magnetite and antigorite. The carbonate and manganese oxides are secondary products of metasomatism of manganese silicates. Field studies, laboratory experiments and comparison of manganese of the Tawakalan mine with other locations in the world, suggest a two phase formation process of high temperature paragenesis as follows: in the first phase, the sedimentary manganese oxides are formed in the volcano-sedimentary layers and in the second phase, after a period of orogenese, metamorphism and plutonism, high temperature fluids released from solidification of profound plutonic body dissolve manganese oxides of the first phase and cause recrystallization of manganese in shallow levels as high temperature silicates. Metasomatism of silicates and production of carbonate and Mn oxides occur at the end of the second phase when the fluids cool down.

Keywords: manganese; spessartite; rhodonite; mineralization; Kurdestan.

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