Cu-U-V stratabound deposits in red beds in the Catalan Pyrenees: Structure and Mineralogy

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The Eureka mining group (La Plana de Mont-Ros, Pyrenees, Catalonia) has one of the best outcrops of Cu-U-V stratabound deposits in red-beds of Western Europe. The deposit was mined in surface trenches and underground galleries. This has allowed an accurate mineralogical and textural study of this deposit, which can be used as a model to explain the relationships between Cu-U-V minerals during precipitation of primary mineralization and supergenic stages.

The deposit is hosted by Lower Triassic detritic series, which are arranged approximately in an E-W direction, and were deformed during the Alpine Orogeny.

Field mapping and a study of the mineral assemblages, with the petrographic microscope, SEM-BSE-EDS and EMPA, have enabled to distinguish three mineralization stages:

1. Stratabound mineralization: this concentrates the main part of the stock. It is directly related to centimetric coal levels interbedded with greenish greywackes and conglomerates. This reducing trap caused the precipitation of redox sensitive elements (U, V, Cu, Sb, Bi, Ag, As, Se, Ni and Co) from a fluid with low S activity. Ores comprise native metals (silver, bismuth), pyrite, sphalerite, galena, Cu sulphides (djurleite, digenite, anilite), Ni-Co sulphoarsenides (gersdorffite, cobaltite), sulphosalts (wittichenite, tetraedrite, tennantite), selenides (chlausthalite and aguilarite) and uraninite. These ore minerals are found as a late cement of the detritic rocks, and replace an early calcitic cement. The general sequence starts with pyrite, which is replaced by copper sulphides, Ni-Co sulphoarsenides and sulphosalts. The matrix of the greywackes is made up of roscoelite and V-rich illite.

2. Vein mineralization: during the alpine compression, Cu remobilization took place and generated mm-sized veins filling small joints with chalcopyrite and bornite, along with quartz and ankerite.

3. Supergenic mineralization: oxidized minerals associated with supergenic alteration, like sulphates (brochantite), arsenates (zeunerite, erythrite, chenevixite), vanadates (carnotite, tyuyamunite, sengierite), carbonates (malachite, azurite), selenites (demesmaekerite and haynesite), and phosphates (torbernite) appear as crusts and efflorescences on the surface of the outcrop, as pseudomorphs or filling small cracks. On the other hand, leaching of the ores by ground waters produces the precipitation of a suite of recently-formed carbonates (cejkaite, andersonite) and sulphates (zippeite, uranopilite) in the galleries. Hence, these minerals fix the uranium again.

This study shows that acid fluids generated by alteration of sulphides can produce the leaching of U and RSE. Vanadates, arsenates and phosphates fix U in the supergene zone; the remaining U can be remobilized and reprecipitated, forming crusts of U carbonates on the mine walls. These observations could be considered in the management of radioactive waste products.