A hydrothermal origin for the Shizilishan Sr-(Pb-Zn) deposit, China

QIAO-QIAO ZHU[1,2], NIGEL J. COOK[2], GUI-QING XIE[1], CRISTIANA L. CIOBANU[2]

[1] Institute of Mineral Resources, CAGS, Beijing, 100037, China (zhuqiaoqiao@cags.ac.cn, xieguiqing@cags.ac.cn)
[2] The University of Adelaide, S.A. 5005, Australia (nigel.cook @adelaide.edu.au, cristiana.ciobanu@adelaide.edu.au)

Despite the high crustal abundance of strontium (Sr), celestine ($SrSO_4$), the dominant source of Sr, is increasingly regarded as a critical mineral due to the lack of resources with sufficiently low Ca and Ba content to allow economic exploitation. This has prompted a resurgence of interest in understanding how Sr resources form. The largest known celestine deposits mostly occur within coastal carbonate and evaporite sequences and are classically interpreted to precipitate via seawater evaporation during transition from the carbonate- to gypsum-stage of evaporation [1]. Later models invoke epigenetic, early diagenetic replacement of carbonates and sulfates involving Sr-rich basinal fluids (e.g., [2]). Genetic relationships between Sr mineralization and magmatic-hydrothermal activity associated with igneous rocks are poorly documented in the literature.

The ~5 Mt Shizilishan Sr-(Pb-Zn) deposit, Eastern China, is located at the contact between a Lower Cretaceous (~139 Ma) quartz diorite porphyry stock and Triassic evaporite-bearing limestone/dolomite sequences [3]. Here we show that multiple generations of celestine, pyrite and marcasite can be recognized from micron-scale textures (BSE imaging), compositions (EPMA) and trace element signatures (LA-ICP-MS). The complex growth zoning, dissolution and recrystallization textures displayed by celestine, as well as increased Ba content in later generations, are suggestive of evolving fluid compositions and physicochemical conditions. Relationships between pyrite and marcasite suggest a pH change from low to high. Geological relationships in the mine, alteration assemblages, deposit-scale zoning, analysis of ore textures, and the geochemical signatures preserved in ore and gangue minerals, allow us to interpret the Shizilishan deposit as an example of relatively low-temperature hydrothermal mineralization emplaced proximal to an intrusion. Such a genetic model, involving low-salinity fluids, may account for large celestine deposits if conditions of extensive water-rock interaction, protracted flow of fluids, moderate dissolved sulfate, and high Sr/Ba ratios are met.

[1] de Brodtkorb et al. (1982) Mineral. Deposita 17, 423–436.
[2] García-Veigas et al. (2015) Ore Geol. Rev. 64, 187–199.
[3] Zhu et al. (2017) Acta Petrol. Sin. 33, 3484–3494.