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Critical Metals in Orogens (CMiO): Assessing the role of deformation and metamorphic recrystallization in the mobility of critical metals.

BÉNÉDICTE CENKI[1] AND ALEXANDRE CUGERONE[2]

[1]Université de Montpellier
[2]University of Geneva

The CMiO project (Critical Metals in Orogens, **CMiO ANR-23-CE01-0017**) is funded by the French Research Agency and focusses on unravelling the role of metamorphism and deformation on the mobility of critical metals (CM) such as germanium (Ge), gallium (Ga), and indium (In). Those are commonly mined as by-products of base metals (i.e., Zn, Fe, Cu) with similar chemical affinities. Metamorphism can significantly influence the distribution of critical metals in base metal deposits, either upgrading or decreasing their economic importance. Critical metals deposits are frequently hosted in orogenic setting, but may be pre- syn- or post-orogenesis. In this contribution, we will focus on the primary sedimentary deposits (MVT, SEDEX, VMS) that might have suffered metamorphism and fluid-assisted deformation during orogenesis, evaluating the role of deformation and metamorphic recrystallization on the mobility of critical metals. This contribution sheds a novel light on the role of metamorphism, deformation, static or dynamic recrystallization and associated fluid flow in modifying the distribution of CM concentrations from primary-sedimentary into secondary-metamorphosed deposits, in a systematic manner from the large plate tectonic scale to the small mineral scale. Orogenic critical metals (OCM) can be broadly defined as the large-scale remobilization or sample-scale redistribution product of pre-existing CM concentrations, present in the primary ore, that have been triggered by metamorphism and/or tectonic processes (e.g., deformation, static or dynamic recrystallization, fluid and thermodynamic conditions). Metamorphic processes may potentially create favorable conditions for redistributing CM in ore minerals (containing several wt% of CM) that may make them more accessible for industry if exploration/recovery strategies are adapted. In this contribution, the mineralogy and ore textures of *ca.* 200 deposits reported in the literature have been extracted in a systematic manner and in three regions of the world (Australia, China, and Europe). Based on quantitative estimations from the literature in these three districts, base metal resources, potentially hosting CM, are often found in orogens, and many show features of superimposed deformation and metamorphism. A general model is proposed, representing metamorphic and structural conditions enhancing the formation of OCM.

