Title: Identification of critical elements in hydrothermal and supergene ore deposits and recovery optimization

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Research program

There is a growing global concern over the long-term availability of secure and adequate supplies of the metals needed by contemporary society. The definition "Critical Elements" (CE) or "Critical Metals" (CMs) is assigned by the "European Union Ad-hoc Working Group on defining critical raw materials" to those metals and raw materials that are characterized by high supply risk and high importance for EU economy. As shown by a recent report of the European Commission (https://ec.europa.eu/growth/sectors/raw-materials/areas-specific-interest/critical-raw-materials_en), the COVID crisis has revealed just how fast and how deeply global supply chains can be disrupted. It is recognized that recycling can only provide a limited contribution to this supply, particularly for those critical metals that are incorporated into infrastructures or into products with a long life.

The CMs are often "co-products", related to the production of metals of much larger distribution and use, such as Al, Pb, Zn and Cu. In recent years, it has been shown that hydrothermal and supergene ore deposits concentrate CMs during metallogenetic processes. The proposed project has two main research objectives (ROs):

RO1) to determine the fractionation processes affecting certain CMs (e.g. Co, V, Ge) in the ores,

RO2) to propose new techniques for identifying CM and optimizing their recovery, preventing their final disposal in waste dumps and tailings.

RO1 will be pursued through sampling and analysis of selected ores, and modeling the geochemical processes promoting the concentration of CMs in specific phases. RO2 will be pursued through the definition of the behavior of CMs during mineral processing and metallurgy.

Proposal for a PhD position

The Department of Earth, Environmental, and Resources Sciences (DiSTAR) at the University of Naples, Federico II will be the main base for the potential PhD position in Earth Sciences. The PhD research project will be carried out in collaboration with the Natural History Museum, London (NHM), and the Dipartimento di Scienze della Terra, University of Torino. The involved departments are home to nationally or internationally acknowledged consultancy for the minerals industry, offering a range of services linked to key skills in geology and mineralogy.

The project will be conducted with the support of mining companies (specific agreements will be signed). The spatial distribution of CMs will be evaluated in primary and secondary ores. Models of the mineralogical and chemical evolution of the ores will be elaborated in order to follow the pathways of CMs, highlighting the relationships between the protores and the secondary deposits.

The PhD project will be financially supported by specific research programs that are currently at the evaluation stage (e.g. PRIN2022), in collaboration with mining companies.

The candidate is expected to have a solid background in mineral deposit geology and mineralogy. Knowledge of programming techniques and software for statistical analysis is desirable but not necessary.

months	**0-3**	**3-6**	**6-9**	**9-12**	**12-15**	**15-18**	**18-21**	**21-24**	**24-27**	**27-30**	**30-33**	**33-36**
bibliographic research	X											
sample selection/preparation		X	X			X						
basic geochemical and mineralogical analyses		X	X	X	X	X						
detailed geochemical and mineralogical analyses						X	X	X	X			
ore deposits modeling						X	X	X	X	X		
courses	X			X			X					
participation at conferences				X				X		X		X
papers preparation					X		X		X	X	X	X
Completion of the thesis work										X	X	X