# Title: Vanadium and its minerals: crystal-chemical and structural features and enrichment mechanisms of a strategic critical metal in different geological environments

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# Proposal

Vanadium is a strategic transition metal currently used in the steel industry, green chemistry, energy storage, and aeronautics due to its high hardness, tensile strength, and corrosion resistance. Vanadium is now considered a critical metal (CM) by the European Union and the United States. This is due to both the increasing number of technologies that require this metal, with a consequent significant increase in demand in recent years, and the fact that global production of mined vanadium is currently limited to a few countries (China, Russia, South Africa, Brazil). Vanadium (ubiquitous trace element in the upper crust) is found in economic concentrations mainly in four main types of deposits: (1) V-bearing titanomagnetite deposits, (2) shale-hosted deposits, (3) sandstone-hosted deposits, (4) vanadates. Significant concentrations of vanadium can be also found in fossil fuels and other sedimentary deposits. Vanadium-bearing minerals in hydrothermal/fumarolic deposits have also been reported in a few locations worldwide, including Somma-Vesuvius where V occurs as Cu-Pb vanadates. Given the crucial role of this CM in achieving the green and digital transitions, and in the absence of ore deposits in the EU, this type of studies can have important implications for mineral exploration and the supply of critical raw materials.

The proposed project will explore in detail the occurrence of V in various sedimentary and hydrothermal environments (with a focus on the national territory) and the related minerogenetic and depositional characteristics, with the aim of defining the V uptake processes in relation to ore deposit modelling focused on the enrichment processes of this CM in the considered contexts.

# Research Program

This PhD project involves the mineralogical study of various sedimentary deposits potentially containing vanadium. Furthermore, vanadates-rich sublimates from the historical activity of Vesuvius collected in the Royal Mineralogical Museum of the University of Naples Federico II will be further investigated. After an extensive sampling work, the analytical phase will consist of a characterization of various vanadium associations through combined methodologies (optical and scanning electron microscopy SEM, whole-rock chemical analysis XRF and ICP-MS, powder X-ray diffraction XRPD and single crystal SC-XRD, electron microanalysis EDS- WDS, HRTEM-SAED-AEM, infrared spectroscopy FTIR and Raman, thermal analysis TGA-DTA-DSC). The results obtained will also be interpreted using data processing with PCA, AI, etc.

# Timetable

* *First year*: literature collection, sampling work, mineralogical analyses.
* *Second year*: data collection and processing, experience at a foreign scientific institution, drafting and submission of abstracts and scientific articles, congresses participation.
* *Third year*: drafting and submission of scientific articles, congresses participation, preparation and submission of thesis work.

# Scientific collaborations

Active collaborations with Italian and foreign academic and research institutions will allow the PhD student to freely access scientific instrumentations. In addition, thanks international collaborations, the PhD student will stay abroad, to develop and/or improve specific aspects of the research.

* *National collaborations:* Dr. Licia Santoro, Dipartimento di Scienze della Terra, Università di Torino; Dr. Angela Altomare dell'Istituto di Cristallografia, CNR Bari; Prof. Fabio Bellatreccia, Dipartimento di Scienze, Università Roma Tre.
* *International collaborations:* (with possible experience abroad): Prof. Mike Rumsey, Mineral and Planetary Science Curation, Science Department, Natural History Museum, London, UK; Prof. Richard Herrington, Earth Sciences Department, Natural History Museum, London, UK; Prof. Isabel Abad, University of Jaén, Spain.

# Funds

Departmental research funds (granted to the tutor).