Title: Vanadates from Somma-Vesuvius: crystal chemistry and genesis

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Research program

Vanadium belongs to the group of critical metals (CM) listed by the European Commission (2020). It is a remarkably versatile element and its use has risen substantially in recent years, as have the number of innovation-driven industries that depend on vanadium for their operations and products (U.S. Geological Survey, https://doi.org/10.3133/mcs2022. Petranikova et al., 2022). Vanadium occurs in many minerals, among which the oxoanions of this metal (i.e. vanadates) being common. Vanadates described in volcanically related environments are restricted to very few worldwide occurrences and are represented by both anhydrous and OH- ± H2O-containing phases. In Italy, V-minerals are rare and they occur in a small number of sites. At Somma-Vesuvius volcano vanadium occurs in vanadates that are mainly associated with historical fumarolic activity.

The proposed project has two main research objectives (ROs):

RO1) to provide a systematic identification of the V-bearing minerals, as well as associated phases, in volcanic rocks of Somma-Vesuvius; these minerals mainly occurring as yellow-greenish encrustations and/or patinas on the surface of some lavas from the recent activity of Vesuvius. The samples will be selected from the vast collection of the Mineralogical Museum of the University of Naples Federico II (Italy) and studied by a multitechnique approach, mainly consisting of Scanning Electron Microscopy (SEM), Energy Dispersion Spectrometry (EDS), Wavelength Dispersive Spectrometry (WDS), X-ray Diffraction (XRD), Raman and FTIR spectroscopy, TEM-HRTEM;

RO2) to define parageneses and genetic features of vanadates and associated minerals, also with the aim to contribute the knowledge of V-bearing minerals as a whole, considering that vanadium and its compounds are of interest for several industrial applications.

European Commission, 2020. Study on the EU's list of Critical Raw Materials – Final Report. https://ec.europa.eu/docsroom/documents/42883/attachments/1/translations/en/renditions/native (accessed May 20 2022).

Petranikova, M., Tkaczyk, A.H., Bartl, A., Amato, A., Lapkovskis, V., Tunsu, C., 2020. Vanadium sustainability in the context of innovative recycling and sourcing development. Waste Management 113, 521–544.

U.S. Geological Survey, 2022. Mineral commodity summaries 2022: U.S. Geological Survey, p. 202 https://doi.org/10.3133/mcs2022.

Proposal for a PhD position

The Department of Earth, Environmental and Resource Sciences (DiSTAR) of the University of Naples, Federico II, will be the main basis for the potential PhD place in Earth Sciences. The PhD research project will be carried out in collaboration with other research institutes (e.g. Departamento

de Geologia and CEACTEMA, Universidad de Jaén, Jaén, Spain; Centro de Instrumentación Científica, CIC, Universidad de Granada; Natural History Museum, London , UK; Department of Sciences, Geological Sciences Section, Roma Tre University, Italy).

The PhD project will be financially supported by specific research programs that are currently at the evaluation stage (e.g. PRIN2022). Moreover, it is part of active collaborations with national and international research groups; thanks to these collaborations, the doctoral student will have free access to highly specialized equipment for his research. The PhD student will also visit foreign research institutions for a period of not less than three months, in order to develop specific aspects of the research project and collaborate with local researchers. The candidate should have a solid background in mineralogy and an adequate knowledge of the main techniques of mineralogical analysis, as well as geochemical and petrographic ones. Knowledge of software dedicated to statistical analysis is welcome.

The proposed PhD research will be developed according to the following timing:

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			
modelling						X	X	X	X	X		
courses	X			X			X					
participation at conferences				X				X		X		X
papers preparation					X		X		X	X	X	X
thesis preparation										X	X	X