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SEM-EDS and Polarized Optical Microscope Analysis of Granite Quarry Waste to Reveal Potential Unconventional Sources of Critical Raw Materials

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SEM-EDS and polarized optical microscopy analysis of granite blocks taken from decorative rocks quarry waste landfills in Sardinia were used in mining prospecting to evaluate potential unconventional sources of critical raw materials (CRMs). Achieving the goals outlined in the European Green Deal regarding the green and digital transition may face significant challenges due to the substantial increase in demand for CRMs in the near future so access to CRMs is a strategic security issue for the European Union.

Because of the similar chemical properties that characterize Rare Earth group elements among themselves, there are few effectively exploitable deposits in the world. Predominantly in carbonatite complexes and pegmatitic granitoid bodies, the subtle variations in the properties of RE (Rare Earth) group elements allow significant fractionation and economically exploitable enrichment of small intrusive bodies and/or intrusive veins consisting of one or more REE minerals, such as allanite, REE oxides, apatites, and carbonates.

Sardinia's ornamental granite quarries have in the past generated high concentrations of unmarketable waste (mostly pegmatite bodies and veins with REE-enriched late-magmatic and deuteric mineralogical phases). The huge amount of these waste accumulations has resulted in high land consumption and landscape distortions, but with the increased REE demand they now represent an important resource, as they can contribute to the implementation of the EU Critical Raw Materials Act.

This study reports the results of SEM-EDS investigations combined with polarized optical microscope observations conducted on thin sections of granite obtained from waste samples from the numerous leucogranite quarries of Buddusò (Northern Sardinia, Italy). These granites are composed primarily of quartz, plagioclase, K-feldspar, and biotite, with accessory minerals including zircon, epidote, titanite, ilmenite, apatite, and xenotime. Feldspars have recently been included in the list of Critical Raw Materials[2]; therefore, the identification of solutions for their exploitation (which represent a significant portion of the rocks investigated) could provide a strong contribution to the needs of the European Union. Epidotes often appear in these rocks as allanite enriched in light rare earth elements.

In this context, it could be very interesting to evaluate the possibility of applying physical mineral separation methodologies to obtain, on the one hand, mineral concentrates containing Rare Earth Elements for the extractive metallurgy industry. On the other hand, feldspars have recently been included in the list of Critical Raw Materials [1]; therefore, identifying solutions for their exploitation (which represent a significant portion of the investigated rocks) could provide a strong contribution to the needs of the European Union.

This study of the quartz and feldspar phases and REE concentrations in accessory minerals will be useful in optimizing the physical separation methodologies of minerals useful to obtain CRMs for industry and the ceramic and glass manufacturing sectors.

Reference:

[1] Grohol, M., C. Veeh, DG GROW, e European Commission. «Study on the Critical Raw Materials for the Europe - Final Report». Luxembourg: European Union, 2023.

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