A Geological and Mineralogical Approach to Understanding Radiological Hazards in Apulian and Iblean Materials.

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The assessment and monitoring of historically and artistically significant construction materials require a detailed understanding of their intrinsic properties (porosity, density, mineralogic composition) and geological provenance. This study examines two carbonate calcarenites widely employed in Southern Italy's architectural heritage—Lecce Stone (Apulian Foreland) and Comiso Stone (Hyblean Foreland)—by correlating their mineralogical features with radiological parameters, such as the specific activity of ^{226}Ra, ^{232}Th, ^{40}K as well as the ^{222}Rn exhalation rate.

A comprehensive geological interpretation—considering diagenesis, condensation of phosphatic layers, eustatic fluctuations, and tectonic activity—is essential to contextualize instrumental data, such as X-ray diffraction (XRD) analyses. For example, XRD analysis revealed the presence of fluorapatite in Lecce Stone, a uranium-hosting mineral accounting for its significantly higher ^{226}Ra activity (163 Bq/kg) compared to Comiso Stone (21.9 Bq/kg).

The mineralogical data offer valuable insights into radionuclide distribution, thereby supporting comprehensive radiological evaluations.

Interestingly, despite Lecce Stone's significantly higher total porosity (30–45%), the measured ^{222}Rn exhalation rates are similar for both stones (~30 Bq/m^3). This unexpected outcome highlights the importance of effective porosity and the radon exhalation rate. The high porosity in Lecce Stone could be due to closed or poorly connected pores, limiting radon diffusion. Conversely, the lower porosity observed in Comiso Stone likely corresponds to a more interconnected pore network, enhancing radon mobility despite its lower radionuclide content.

This multidisciplinary approach underscores how geological and mineralogical factors may contribute to a deeper understanding of radiological risk and support the development of targeted conservation strategies for culturally significant architectural heritage.