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Radon emanation coefficients of several minerals: How they vary with physical and mineralogical properties

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Abstract

The escape rates of radon gas from rocks and minerals are of great relevance to many branches of geosciences, and it is, thus, important to understand the physical and mineralogical properties that control radon emanation rates. Mechanisms of radon loss from minerals have direct bearing on the reliability of U-Pb and U-Th-He geochronology. Fourteen minerals from three different mineral groups and with localities spanning three continents were selected for this study. The radon emanation coefficients (REC) for each mineral were measured as a function of grain size, temperature, ^{238}U and ^{232}Th activities, total absorbed α-dose, density, and mineral melting temperature. The measured ^{238}U and ^{232}Th activities ranged from 0.01 to 6487 Bq/g and from below detection limit to 776 Bq/g, respectively. The REC values for unheated, pulverized samples ranged from 0.083 to 7.0%, which is comparable to previously reported ranges (except for zircon). An inverse correlation between grain size and REC was observed. Full annealing of fission tracks resulted in an overall decrease in REC values, suggesting that nuclear tracks could possibly act as conduits for radon release. While activity, α dose, density, and melting temperatures are not strongly correlated with REC values, it was observed that minerals with high melting points (≥1400 °C) have lower REC values, most likely due to inhibition of radon release by compact crystal-lattice structures. This is the first attempt, to our knowledge, to correlate REC values with melting temperature, and this study reports six minerals for which no REC values have been previously reported.

Keywords: Radon emanation, REC, metamict minerals, nuclear track annealing, uranium, Invited Centennial article