^{222}Rn emanations from selected metamict minerals

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Radiation Damage. Emanation Coefficient of ^{222}Rn

Metamict minerals contain uranium and thorium that degrade the crystal structure of the minerals mainly by α-decay events. This presentation reports the relantionship between the results of ^{222}Rn emanations and absorbed α-dose for a representative group of metamict oxides, phosphates and silicates [1]. The radon isotope ^{222}Rn ($T_{1/2}$ = 3.64 d) belongs to the ^{238}U decay series, and occurs as an inert gas that is detectible in U bearing mineral phases. The α-decay of ^{226}Ra (E_α = 4.77 MeV) is accompanied by recoil of the ^{222}Rn nucleus with an energy of 86 keV. Emanation coefficients of ^{222}Rn (e_{222}, expressed in percentage) measure the number of radon atoms released per the number of radon atoms produced within the ^{238}U decay series for a given mineral. This ratio provides a quantitative measure of the quality of the mineral's internal structure.

Results

The ^{222}Rn emanation coefficients for the presented minerals vary widely from 5 x 10^{-5}% (uraninite) to 2.5% (turkestanite). Emanation coefficients for ^{222}Rn generally decrease with increasing total absorbed α-dose, D_T (Fig. 1).

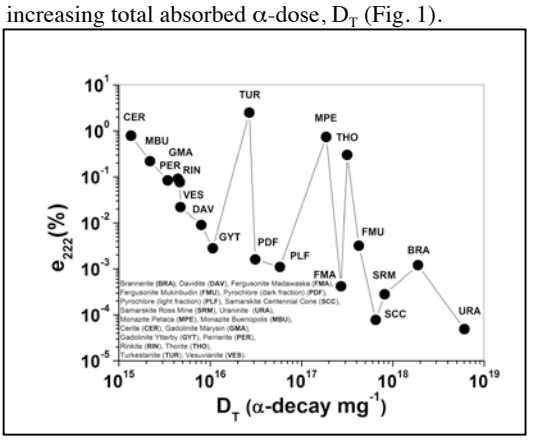

Figure 1: ^{222}Rn emanation coefficients (e_{222}) for metamict minerals vs. total absorbed α-dose.

Figure 1 also shows that ^{222}Rn emanations produce visible peaks for metamict phases having considerable concentrations of ^{232}Th in excess of 2.8 wt.% and D_{232} > 26 x 10^{15} α-decay mg^{-1} (TUR, FMU, BRA, MPE, and THO). Excluding these observations, the relationship between e_{222} and total dose (D_T) values can be fitted by an exponential function. Metamict oxides showed the lowest ^{222}Rn emanation coefficients for the highest absorbed α-dose.

[1] Malczewski & Dziurowicz (2015) *Am. Mineral.* **100,** 1378-1385.