# Nature and Stability of Radiation-Induced Defects in Natural Kaolinites: New Results and a Reappraisal of Published Works

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**Abstract:** A new appraisal of radiation-induced defects (RID) in natural kaolinite, i.e., positive trapped holes on oxygen atoms, has been undertaken using Q-band EPR spectra, recorded at 93 K, of irradiated annealed and oriented kaolinite samples originating from various environments. Three different centers were identified. Two of the centers, A- and A′ -centers, are trapped holes on oxygen from Si-O bonds. They have a distinct signature and orthogonal orientation, i.e., perpendicular and parallel to the (ab) plane, respectively. The third center, the B-center, is a hole trapped on the oxygen bonding Al in adjacent octahedral positions ($Al_{VI}$-$O^-$-$Al_{VI}$ bridge). This confirmed some previous assignments from the literature, some others are no longer considered as valid.

A least squares fitting procedure is proposed to assess the RID concentration in any kaolinite. It allows a quantitative approach of the thermal stability of RID. Isochronal annealing shows that the thermal stability of the centers decreases in the order A, A′ , B over the temperature range 0 – 450° C (1) B-center is completely annealed above 300° C (2) A′ -center can be annealed by heating at 400° C for more than two hours; (3) A-center is stable up to 450° C. The activation energy and the magnitude of the mean half-life for A-center is evaluated through isothermal annealing at 350, 375 and 400° C, with $E_a$ = 2.0 eV ± 0.2, and $t_{½}$, > $10^{12}$ years at 300 K. The stability of A-center seems to decrease with increasing crystalline disorder. Nevertheless, it is high enough for radiation dosimetry using kaolinites from any environment on the Earth's surface.

**Key Words:** EPR • Kaolinite • Radiation induced defects • RID

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