Supplementary material for:

# OSL-thermochronometry of feldspar from the KTB borehole, Germany

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# Part I – Labwork and Dosimetry

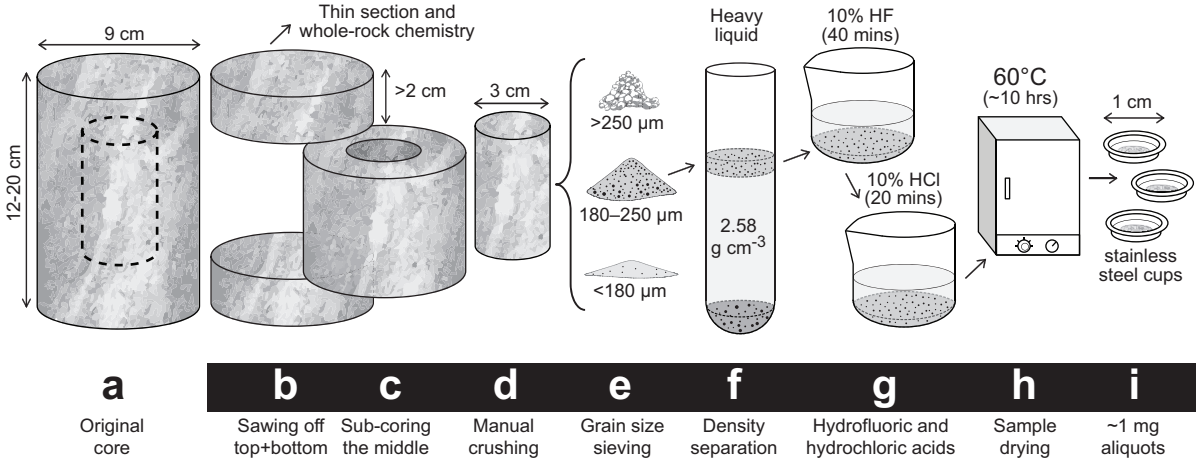


**Figure S1. Laboratory procedures for extraction of feldspar (and quartz) from bedrock.**

**Table S1. Laboratory procedures for extraction feldspar (and quartz) from bedrock.**

| Step | Conditions | Action |
|---|---|---|
| a | Daylight | Acquisition of core samples, with emphasis on avoiding brittle or fractured rocks, or highly inhomogeneous rock textures (e.g. large leucocratic veins that could accelerate the optical bleaching of the minerals within). |
| b | Dark room | The top and bottom sides of the core are slowly sliced off, using a large diamond saw under a continuous and abundant supply of cooling water. One of these slices (~100 g) is milled and sent to chemical analyses; the other is cut to give a geological thin section. |
| c | Dark room | The optically-unbleached middle part of the core is slowly extracted, using a smaller-diameter diamond core drill under a continuous and abundant supply of cooling water. |
| d | Dark room | The optically-unbleached sub-core is thoroughly dried, and crushed by a geological sledge hammer to a target size fraction of 180 – 250 µm. |
| e | Dark room | The crushed material is manually sieved to collect the 180 – 250 µm size fraction. The larger fraction may be re-crushed; the smaller fraction is stored away. |
| f | Dark room | The 180 – 250 µm size fraction is subjected to two density separations in Lithium Sodium Tungstate (LST). After an initial step ($\rho$ = 2.70 g cm$^{-3}$), intended to rid of heavy minerals, the floating $\rho$ < 2.70 g cm$^{-3}$ density fraction is further immersed in $\rho$ = 2.58 g cm$^{-3}$. After sufficient separation, the $\rho$ < 2.58 g cm$^{-3}$ (feldspar) and the 2.58 < $\rho$ < 2.70 g cm$^{-3}$ (quartz) density fractions are collected and thoroughly rinsed in water. |
| g | Dark room | To dissolve the outer rims of grains (affected by external alpha radiation), the $\rho$ < 2.62 g cm$^{-3}$ density fraction (feldspar) is etched in a 10% (vol.) HF solution for 40 minutes, rinsed in distilled water, and subsequently treated with a 10% (vol.) HCl solution for 20 minutes to dissolve fluorides. The $\rho$ > 2.62 g cm$^{-3}$ density fraction (quartz) is etched in a 48% (vol.) HF solution for 60 minutes, rinsed in distilled water, and subsequently treated with a 10% (vol.) HCl solution for 40 minutes. |
| h | Dark room | A thoroughly rinsed sample is dried overnight (~10 hours) in a 60 °C light-tight oven. |
| i | Dark room | The dried sample is used to prepare ~1 mg aliquots, each consisting of a monolayer of grains evenly distributed over the surface (4 – 6 mm in diameter) of a silicone-sprayed stainless-steel cup, which is then loaded into a Risø TL/OSL reader. |

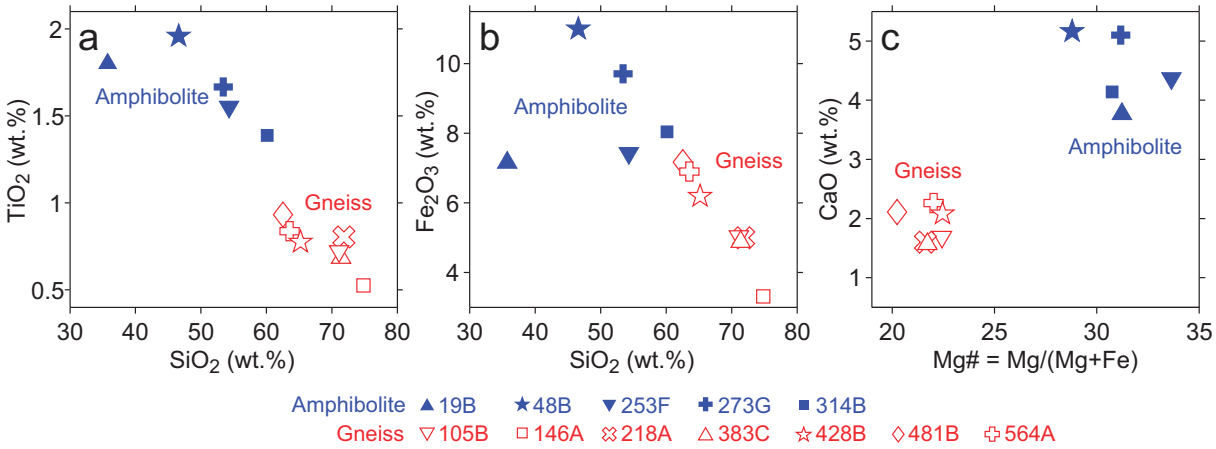


**Figure S2. Whole-rock geochemistry (major elements).** Representative oxide or elemental ratios (**a-c**) for KTB amphibolites (blue) and paragneisses (red) suggest silica-poor protoliths for the amphibolites (mid-ocean ridge basalts), and silica-rich protoliths for the paragneisses (young terrigeneous sediments).

**Table S2. Whole-rock geochemistry (major elements)**.

| Sample | Depth (km) | 0.146 | 0.334 | 0.566 | 0.726 | 0.911 | 1.175 | 1.300 | 1.499 | 1.730 | 1.892 | 2.097 | 2.329 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ID | 19B | 48B | 105B | 146A | 218A | 253F | 273G | 314B | 383C | 428B | 481B | 564A |
| $SiO_2$ (wt.%) | | 35.76 | 46.60 | 71.10 | 74.84 | 71.84 | 54.31 | 53.42 | 60.13 | 71.40 | 65.21 | 62.55 | 63.54 |
| $TiO_2$ | | 1.80 | 1.96 | 0.72 | 0.53 | 0.80 | 1.55 | 1.67 | 1.39 | 0.69 | 0.77 | 0.93 | 0.84 |
| $Al_2O_3$ | | 12.23 | 14.71 | 13.41 | 12.76 | 13.34 | 17.40 | 16.87 | 15.00 | 13.90 | 16.95 | 17.65 | 16.43 |
| $Fe_2O_3$ (Total) | | 7.16 | 11.00 | 5.04 | 3.31 | 5.00 | 7.43 | 9.71 | 8.04 | 4.88 | 6.19 | 7.17 | 6.90 |
| MnO | | 0.21 | 0.17 | 0.10 | 0.05 | 0.07 | 0.13 | 0.19 | 0.13 | 0.09 | 0.09 | 0.15 | 0.10 |
| MgO | | 3.77 | 5.16 | 1.69 | 0.89 | 1.60 | 4.37 | 5.10 | 4.14 | 1.57 | 2.08 | 2.11 | 2.26 |
| CaO | | 18.18 | 12.87 | 1.44 | 1.54 | 1.29 | 7.71 | 7.27 | 6.68 | 1.17 | 0.83 | 1.04 | 1.39 |
| $Na_2O$ | | 3.63 | 3.07 | 2.79 | 3.88 | 2.84 | 4.19 | 3.96 | 3.81 | 3.02 | 2.65 | 2.95 | 3.20 |
| **$K_2O$** | | **1.08** | **0.46** | **1.80** | **1.49** | **2.21** | **1.50** | **0.58** | **0.53** | **2.07** | **2.92** | **2.82** | **2.87** |
| $P_2O_5$ | | 0.42 | 0.27 | 0.10 | 0.12 | 0.11 | 0.23 | 0.21 | 0.18 | 0.12 | 0.10 | 0.14 | 0.14 |
| Loss on ignition | | 15.82 | 3.34 | 2.52 | 1.19 | 1.25 | 1.46 | 0.94 | 0.75 | 1.75 | 2.18 | 2.26 | 1.90 |
| Total | | 100.1 | 99.6 | 100.7 | 100.6 | 100.3 | 100.3 | 99.9 | 100.8 | 100.7 | 100.0 | 99.8 | 99.6 |

Major oxides (in wt.%) were analyzed at Activation Laboratories Ltd. (Ancaster, Ontario) by inductively coupled plasma (ICP) optical emission spectrometry (OES), and mass spectrometry (MS). All oxides were determined on a Varian Vista 735-ES ICP-OES. Estimated instrumental precision is 1.3% for $K_2O$ (marked in bold, used for natural dose-rate estimation), and 2.9% (average for all oxides). Conversion of $K_2O$ (reported here) into K (reported in Table 1 in the main text) is through multiplication by a factor of 0.8301.

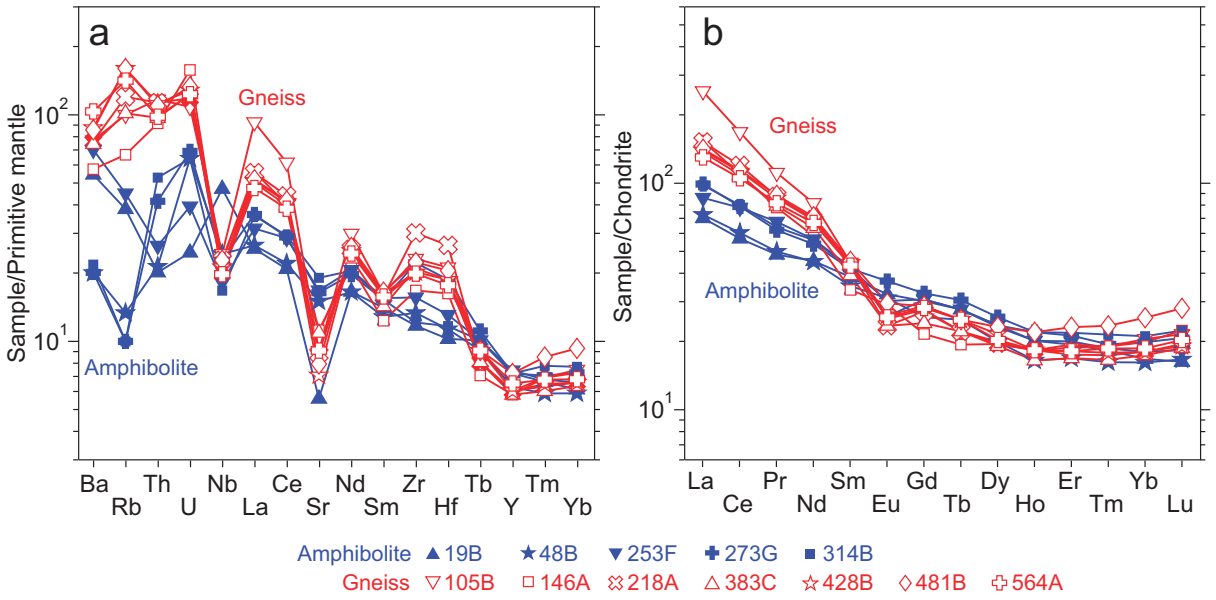


**Figure S3. Whole-rock geochemistry (trace elements).** Trace elements of KTB amphibolites (blue) and paragneisses (red) are shown using standard geochemical normalization to primitive mantle (**a**) and chondrite (**b**), exhibiting a lower-crust (amphibolite) and upper-crust (paragneiss) trace-element fractionation patterns, respectively.

**Table S3. Whole-rock geochemistry (trace elements)**.

| Sample | Depth (km) | 0.146 | 0.334 | 0.566 | 0.726 | 0.911 | 1.175 | 1.300 | 1.499 | 1.730 | 1.892 | 2.097 | 2.329 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ID | 19B | 48B | 105B | 146A | 218A | 253F | 273G | 314B | 383C | 428B | 481B | 564A |
| Sc (ppm) | | 14 | 28 | 14 | 9 | 13 | 25 | 25 | 23 | 13 | 16 | 23 | 18 |
| V | | 128 | 262 | 105 | 70 | 102 | 181 | 180 | 182 | 93 | 127 | 162 | 144 |
| Cr | | 90 | 180 | 80 | 770 | 80 | 80 | 160 | 140 | 70 | 90 | 120 | 90 |
| Co | | 18 | 34 | 14 | 17 | 14 | 22 | 36 | 30 | 14 | 18 | 19 | 19 |
| Ni | | 50 | 80 | 50 | 370 | 50 | < 20 | 90 | 60 | 50 | 60 | 70 | 60 |
| Cu | | 40 | 50 | 20 | 40 | 30 | 30 | 60 | 40 | 30 | 30 | 50 | 40 |
| Zn | | 70 | 100 | 80 | 80 | 90 | 80 | 140 | 90 | 90 | 110 | 110 | 120 |
| Rb | | 23 | 8 | 60 | 40 | 72 | 27 | 6 | 6 | 61 | 96 | 96 | 85 |
| Sr | | 111 | 299 | 180 | 223 | 175 | 334 | 326 | 379 | 217 | 141 | 158 | 181 |
| Y | | 31 | 27 | 26 | 25 | 26 | 32 | 31 | 31 | 25 | 26 | 31 | 28 |
| Zr | | 123 | 140 | 243 | 176 | 316 | 164 | 233 | 127 | 220 | 212 | 234 | 209 |
| Nb | | 31 | 16 | 16 | 13 | 15 | 12 | 15 | 11 | 13 | 14 | 15 | 13 |
| Cs | | 0.6 | < 0.5 | 3.0 | 1.4 | 3.0 | 1.2 | 0.9 | 0.6 | 2.5 | 4.1 | 2.8 | 3.8 |
| Ba | | 359 | 132 | 509 | 380 | 503 | 463 | 133 | 144 | 491 | 578 | 566 | 683 |
| La | | 16.6 | 17.2 | 60.1 | 36.3 | 36.0 | 20.4 | 23.5 | 23.2 | 32.5 | 33.1 | 33.5 | 30.8 |
| Ce | | 34.9 | 37.0 | 103.0 | 67.2 | 73.5 | 47.8 | 48.4 | 49.1 | 66.7 | 69.1 | 69.9 | 64.5 |
| Pr | | 4.5 | 4.6 | 10.3 | 7.2 | 8.1 | 6.3 | 5.8 | 6.0 | 7.4 | 8.0 | 8.2 | 7.6 |
| Nd | | 20.7 | 20.6 | 37.3 | 26.7 | 31.8 | 25.8 | 24.6 | 25.6 | 29.0 | 31.4 | 32.5 | 30.5 |
| Sm | | 5.7 | 5.2 | 6.6 | 5.0 | 6.4 | 6.3 | 6.2 | 6.2 | 5.8 | 6.6 | 6.7 | 6.4 |
| Eu | | 1.8 | 1.8 | 1.4 | 1.6 | 1.3 | 1.5 | 2.1 | 1.7 | 1.3 | 1.5 | 1.7 | 1.4 |
| Gd | | 6.0 | 5.1 | 5.5 | 4.3 | 5.4 | 6.1 | 6.5 | 6.1 | 4.8 | 5.7 | 5.7 | 5.6 |
| Tb | | 1.0 | 0.9 | 0.8 | 0.7 | 0.8 | 1.0 | 1.1 | 1.0 | 0.8 | 0.9 | 0.9 | 0.9 |
| Dy | | 5.7 | 4.9 | 4.9 | 4.8 | 4.8 | 5.8 | 6.3 | 5.8 | 4.7 | 5.3 | 5.7 | 5.0 |
| Ho | | 1.1 | 0.9 | 1.0 | 1.0 | 1.0 | 1.1 | 1.2 | 1.2 | 0.9 | 1.0 | 1.2 | 1.0 |
| Er | | 3.1 | 2.7 | 3.0 | 3.1 | 2.8 | 3.2 | 3.4 | 3.5 | 2.7 | 2.9 | 3.7 | 2.9 |
| Tm | | 0.5 | 0.4 | 0.5 | 0.5 | 0.4 | 0.5 | 0.5 | 0.5 | 0.4 | 0.4 | 0.6 | 0.5 |
| Yb | | 2.7 | 2.6 | 3.3 | 3.2 | 2.9 | 2.9 | 3.2 | 3.4 | 2.8 | 2.9 | 4.1 | 3.0 |
| Lu | | 0.4 | 0.4 | 0.5 | 0.6 | 0.5 | 0.5 | 0.5 | 0.6 | 0.5 | 0.5 | 0.7 | 0.5 |
| Hf | | 2.9 | 3.2 | 6.0 | 4.6 | 7.5 | 3.7 | 5.3 | 3.3 | 5.3 | 5.3 | 5.8 | 5.0 |
| Pb | | < 5 | < 5 | 13 | 20 | 12 | 6 | < 5 | < 5 | 13 | 18 | 18 | 14 |
| **Th** | | **1.6** | **1.7** | **9.3** | **7.3** | **9.0** | **2.1** | **3.3** | **4.2** | **7.7** | **8.9** | **8.7** | **7.8** |
| **U** | | **0.5** | **1.3** | **2.2** | **3.2** | **2.4** | **0.8** | **1.4** | **1.3** | **2.5** | **2.6** | **2.7** | **2.5** |

Trace elements (in ppm.) were analyzed at Activation Laboratories Ltd. (Ancaster, Ontario) by inductively coupled plasma (ICP) optical emission spectrometry (OES), and mass spectrometry (MS). The elements Sc, V, Sr, Y, Zr, Ba were determined on a Varian Vista 735-ES ICP-OES; all other elements were measured on a Perkin Elmer Sciex ELAN 6100/9000 ICP-MS. Estimated instrumental precision is 3.9% for U and Th (marked in bold, used for natural dose-rate estimation), and 3.7% (average for all trace elements).

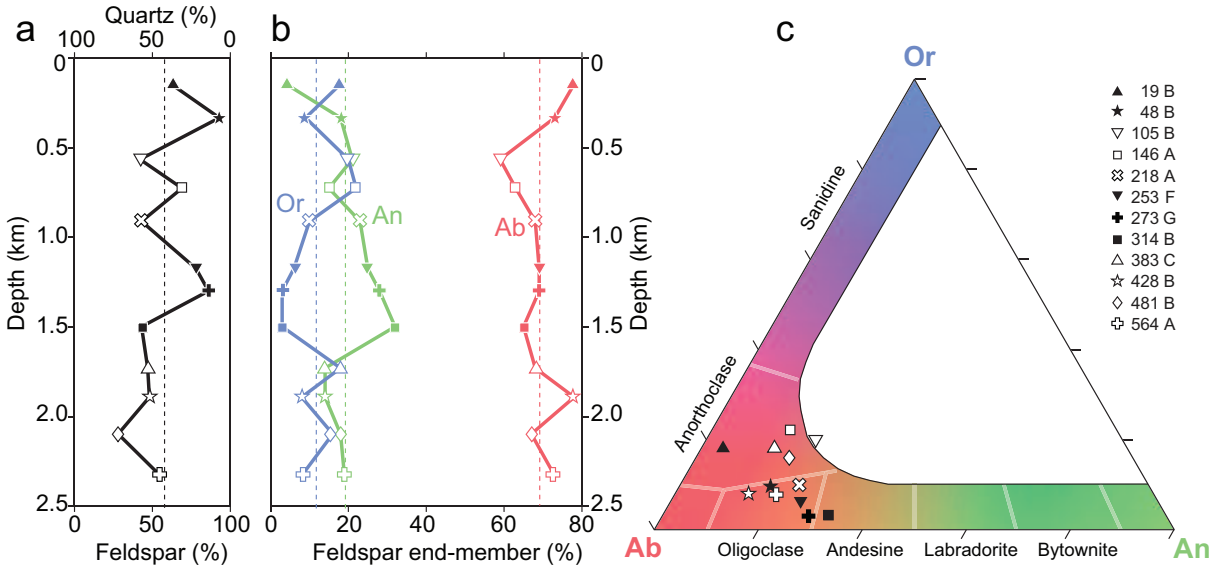


**Figure S4**. **Mineralogical composition of aliquots.** (**a-b**) Aliquot composition vs. sample depth (means are represented by dashed lines), as measured by a prototype X-Ray Fluorescence (XRF) attachment to Risø TL/OSL reader. (**c**) Feldspar composition from (**b**) plotted on a ternary feldspar diagram.

**Table S4. Mineralogical composition of aliquots** and estimation of potassium content in feldspar.

| Sample | | Measurements: Aliquot mineralogy determined by XRF | | | | Calculated values | |
|---|---|---|---|---|---|---|---|
| Depth (km) | ID | Qz (wt. %) | Ab (wt. %) | An (wt. %) | Or (wt. %) | Or/(Ab+An+Or) (wt.%) | $K_{int}$ (wt.%) |
| 0.146 | 19B | 38.0 ± 1.9 | 48.5 ± 2.0 | 2.6 ± 0.1 | 10.9 ± 0.2 | 17.6 | 2.46 |
| 0.334 | 48B | 6.5 ± 1.3 | 67.9 ± 1.6 | 16.9 ± 0.1 | 8.7 ± 0.1 | 9.3 | 1.30 |
| 0.566 | 105B | 57.5 ± 15.0 | 25.1 ± 16.7 | 8.8 ± 0.9 | 8.6 ± 0.9 | 20.2 | 2.82 |
| 0.726 | 146A | 30.7 ± 18.2 | 43.6 ± 21.4 | 10.5 ± 1.3 | 15.2 ± 2.0 | 22.0 | 3.08 |
| 0.911 | 218A | 56.6 ± 3.0 | 29.3 ± 3.4 | 9.8 ± 0.2 | 4.2 ± 0.2 | 9.7 | 1.36 |
| 1.175 | 253F | 21.9 ± 2.6 | 53.8 ± 3.2 | 19.8 ± 0.3 | 4.6 ± 0.3 | 5.9 | 0.82 |
| 1.300 | 273G | 14.1 ± 6.0 | 59.1 ± 8.0 | 24.2 ± 1.4 | 2.6 ± 1.0 | 3.0 | 0.42 |
| 1.499 | 314B | 57.4 ± 2.2 | 27.9 ± 2.6 | 13.6 ± 0.3 | 1.2 ± 0.2 | 2.8 | 0.39 |
| 1.730 | 383C | 52.8 ± 3.2 | 31.9 ± 3.0 | 6.8 ± 0.2 | 8.6 ± 0.3 | 18.1 | 2.54 |
| 1.892 | 428B | 51.5 ± 2.1 | 37.8 ± 2.4 | 6.7 ± 0.2 | 4.0 ± 0.2 | 8.2 | 1.14 |
| 2.097 | 481B | 72.5 ± 8.5 | 18.4 ± 8.5 | 4.9 ± 0.5 | 4.3 ± 0.3 | 15.6 | 2.18 |
| 2.329 | 564A | 45.0 ± 2.7 | 40.2 ± 3.3 | 10.7 ± 0.3 | 4.2 ± 0.3 | 7.7 | 1.08 |

Mineral fractions in a luminescence aliquot, as determined by the Risø XRF attachment (see text). Qz – quartz, Ab – albite, An – anorthite, Or – orthoclase. On average, aliquots consist of ~42% pure quartz and ~58% feldspar ($Ab_{69}An_{19}Or_{12}$). The latter composition, characteristic of anorthoclase-oligoclase, could in fact represent a mix of pure end-members. The fractional weight of the orthoclase end-member (fifth column, average uncertainty of ~15%) is further multiplied by the stochiometric 14% wt.% K in orthoclase to yield an estimate of the total K content in feldspar.

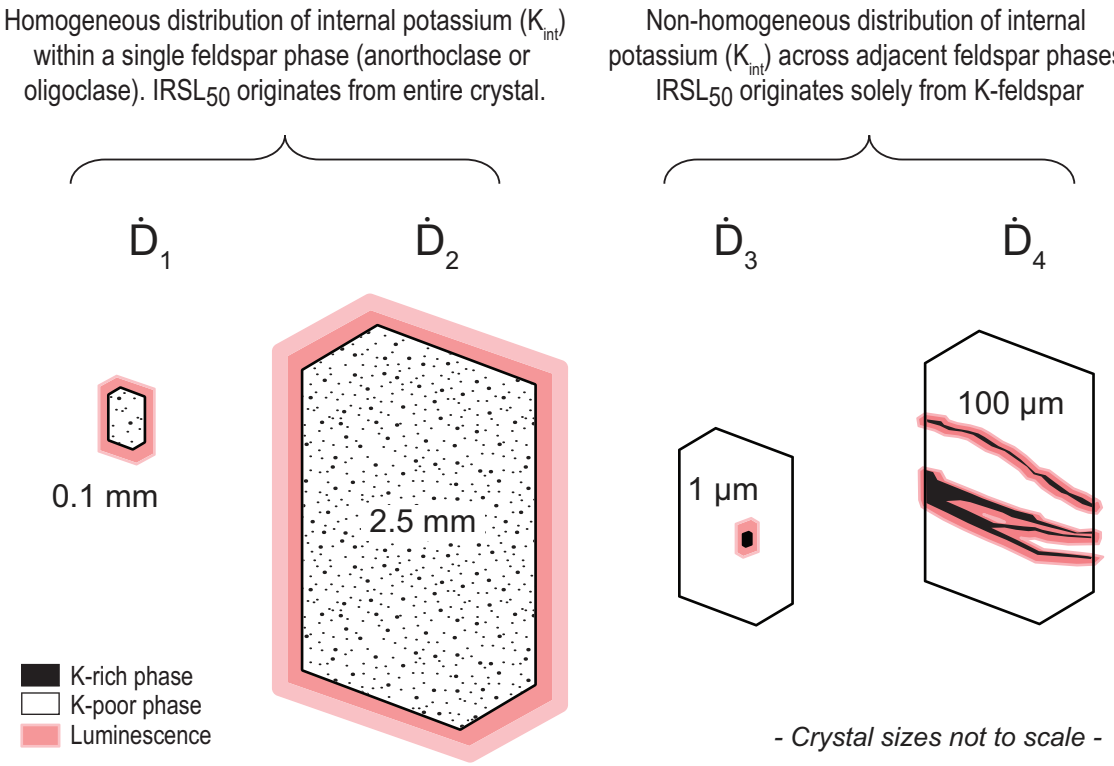


**Figure S5. Dose rate scenarios**. Scenarios $\dot{D}_1$ and $\dot{D}_2$ involve two different crystal sizes of a K-poor feldspar phase, where the internal potassium (black dots) is homogeneously distributed within the entire grain, with luminescence arising from the entire grain as well. Scenarios $\dot{D}_3$ and $\dot{D}_4$ involve two different crystal sizes of a multiphase feldspar mixture, in which luminescence arises only from the K-feldspar phase(s) corresponding to high internal potassium (black areas). The actual KTB rocks are dominated by scenarios $\dot{D}_1$ and $\dot{D}_2$ , but may contain rare instances of $\dot{D}_3$ and $\dot{D}_4$.

**Table S5. Dose rate scenarios**.

| Measurements | | | | | | Model dose rates [c] | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Radionuclides | | | | Anorthoclase / Oligoclase | | Pure orthoclase | | Average |
| Sample | | Whole-rock [a] | | | Feldspar [b] | 0.1 mm | 2.5 mm | 1 µm | 100 µm | |
| Depth (km) | ID | U (ppm) | Th (ppm) | K (wt.%) | $K_{int}$ (wt.%) | $\dot{D}_1$ (Gy ka$^{-1}$) | $\dot{D}_2$ (Gy ka$^{-1}$) | $\dot{D}_3$ (Gy ka$^{-1}$) | $\dot{D}_4$ (Gy ka$^{-1}$) | **$\dot{D}$ (Gy ka$^{-1}$)** |
| 0.146 | 19B | 0.5 | 1.6 | 0.90 | 2.46 | 1.19 ± 0.02 | 2.17 ± 0.28 | 1.17 ± 0.02 | 1.47 ± 0.02 | **1.50** |
| 0.334 | 48B | 1.3 | 1.7 | 0.38 | 1.30 | 0.85 ± 0.01 | 1.27 ± 0.15 | 0.85 ± 0.01 | 1.16 ± 0.02 | **1.03** |
| 0.566 | 105B | 2.2 | 9.3 | 1.49 | 2.82 | 2.74 ± 0.04 | 3.14 ± 0.33 | 2.79 ± 0.04 | 3.01 ± 0.04 | **2.92** |
| 0.726 | 146A | 3.2 | 7.3 | 1.24 | 3.08 | 2.59 ± 0.04 | 3.26 ± 0.36 | 2.63 ± 0.04 | 2.86 ± 0.04 | **2.84** |
| 0.911 | 218A | 2.4 | 9.0 | 1.83 | 1.36 | 3.07 ± 0.05 | 2.20 ± 0.16 | 3.17 ± 0.05 | 3.38 ± 0.05 | **2.96** |
| 1.175 | 253F | 0.8 | 2.1 | 1.25 | 0.82 | 1.60 ± 0.03 | 1.16 ± 0.10 | 1.64 ± 0.03 | 1.93 ± 0.03 | **1.58** |
| 1.300 | 273G | 1.4 | 3.3 | 0.48 | 0.42 | 1.06 ± 0.02 | 0.75 ± 0.05 | 1.10 ± 0.02 | 1.39 ± 0.02 | **1.07** |
| 1.499 | 314B | 1.3 | 4.2 | 0.44 | 0.39 | 1.05 ± 0.02 | 0.74 ± 0.05 | 1.10 ± 0.02 | 1.39 ± 0.02 | **1.07** |
| 1.730 | 383C | 2.5 | 7.7 | 1.72 | 2.54 | 2.92 ± 0.05 | 2.97 ± 0.29 | 2.98 ± 0.04 | 3.20 ± 0.05 | **3.02** |
| 1.892 | 428B | 2.6 | 8.9 | 2.42 | 1.14 | 3.69 ± 0.06 | 2.25 ± 0.14 | 3.82 ± 0.06 | 4.01 ± 0.06 | **3.44** |
| 2.097 | 481B | 2.7 | 8.7 | 2.34 | 2.18 | 3.65 ± 0.06 | 2.97 ± 0.25 | 3.75 ± 0.06 | 3.93 ± 0.06 | **3.57** |
| 2.329 | 564A | 2.5 | 7.8 | 2.38 | 1.08 | 3.55 ± 0.06 | 2.13 ± 0.13 | 3.67 ± 0.06 | 3.86 ± 0.06 | **3.30** |

[a] Whole-rock concentrations of the radioactive elements (U, Th and K=0.8301×$K_2O$) are repeated/recalculated from Tables S2-S3. For external dose-rate calculation, we assume uncertainties of 1.3% for $K_2O$, and 3.9% for U and Th (corresponding to the precision of ICP).

[b] Feldspar concentrations of internal $K_{int}$ in feldspar is repeated from Table S4. For internal dose-rate calculation, we assume uncertainties of 15% (average precision of the XRF data; Table S4).

[c] Dose rates corresponding to each particular scenario (numbered 1-4 accordingly) were calculated using the radionuclide-specific dose rates, beta self-dose parameters, and moisture correction factors from Guérin et al. (2012). Moisture content was estimated at 2±2% for all samples; any contribution of alpha and/or cosmic radiation was neglected. The last column (in bold) is an arithmetic mean of dose rates in the four preceding columns.

# Part II – Luminescence

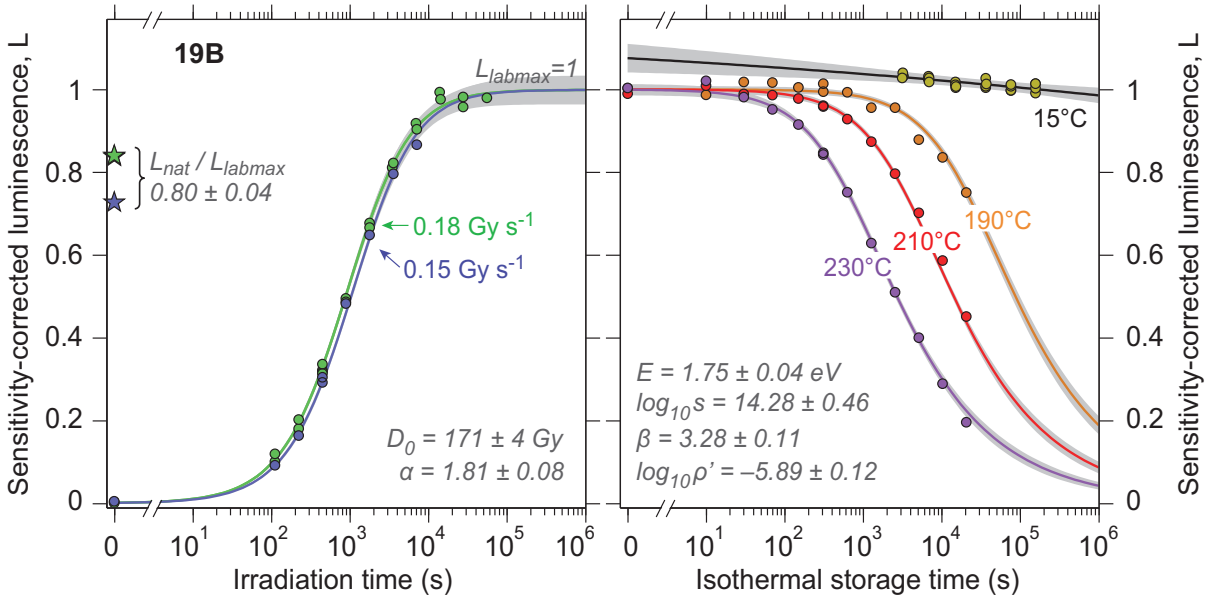


**Figure S6-1. Characterisation of electron trapping and detrapping kinetics (19B).** Radiation-induced growth (circles, left panel) and isothermal decay (circles, right panel) of sample 19B. Stars in left panel denote natural luminescence levels. Note that the y-axis of the shown data and its simultaneous best-fits are arbitrarily rescaled for convenience of presentation (laboratory saturation at L=1 in left panel; initial luminescence of L~1 in right panel).

**Table S6-1. Characterisation of electron trapping and detrapping kinetics (19B).**

***19B***

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***T* (°C)** | 15 | ***t* (ks)** | Nat | 0.111 | 0.222 | 0.444 | 0.889 | 1.778 | 3.472 | 6.944 | 13.889 | 27.778 | 55.556 | 0.000 | 0.444 | 27.778 |
| ***Ḋ* (Gy/s)** | 0.18 | ***Lx/Tx*** | 3.903 | 0.468 | 0.839 | 1.478 | 2.306 | 3.154 | 3.783 | 4.277 | 4.630 | 4.574 | 4.567 | 0.015 | 1.499 | 4.462 |
| ***T* (°C)** | 15 | ***t* (ks)** | Nat | 0.111 | 0.222 | 0.444 | 0.889 | 1.778 | 3.556 | 7.111 | 14.222 | 0.000 | 0.444 | | | |
| ***Ḋ* (Gy/s)** | 0.18 | ***Lx/Tx*** | 3.695 | 0.525 | 0.889 | 1.379 | 2.141 | 2.929 | 3.616 | 3.975 | 4.293 | 0.005 | 1.481 | | | |
| ***T* (°C)** | 15 | ***t* (ks)** | Nat | 0.111 | 0.222 | 0.444 | 0.889 | 1.778 | 3.556 | 7.111 | 0.000 | 0.444 | | | | |
| ***Ḋ* (Gy/s)** | 0.153 | ***Lx/Tx*** | 3.762 | 0.473 | 0.846 | 1.575 | 2.496 | 3.359 | 4.124 | 4.486 | 0.027 | 1.513 | | | | |
| ***T* (°C)** | 230 | ***t* (ks)** | 0.000 | 0.010 | 0.030 | 0.070 | 0.150 | 0.310 | 0.630 | 1.270 | 2.550 | 5.110 | 10.230 | 20.470 | 0.310 | |
| ***Ḋ* (Gy/s)** | 0 | ***Lx/Tx*** | 0.885 | 0.899 | 0.865 | 0.839 | 0.807 | 0.742 | 0.663 | 0.553 | 0.449 | 0.352 | 0.254 | 0.172 | 0.746 | |
| ***T* (°C)** | 210 | ***t* (ks)** | 0.000 | 0.010 | 0.030 | 0.070 | 0.150 | 0.310 | 0.630 | 1.270 | 2.550 | 5.110 | 10.230 | 20.470 | 0.310 | |
| ***Ḋ* (Gy/s)** | 0 | ***Lx/Tx*** | 0.942 | 0.960 | 0.941 | 0.938 | 0.930 | 0.914 | 0.883 | 0.831 | 0.757 | 0.667 | 0.557 | 0.429 | 0.912 | |
| ***T* (°C)** | 190 | ***t* (ks)** | 0.000 | 0.010 | 0.030 | 0.070 | 0.150 | 0.310 | 0.630 | 1.270 | 2.550 | 5.110 | 10.230 | 20.470 | 0.310 | |
| ***Ḋ* (Gy/s)** | 0 | ***Lx/Tx*** | 0.970 | 0.954 | 0.985 | 0.983 | 0.972 | 0.962 | 0.960 | 0.924 | 0.925 | 0.850 | 0.808 | 0.726 | 0.981 | |
| ***T* (°C)** | 15 | ***t* (ks)** | ~~0.351~~ | ~~1.410~~ | 3.247 | 6.742 | 14.932 | 36.427 | 75.917 | 156.33 | | | | | | |
| ***Ḋ* (Gy/s)** | 0 | ***Lx/Tx*** | ~~0.912~~ | ~~0.913~~ | 0.925 | 0.918 | 0.912 | 0.920 | 0.894 | 0.888 | | | | | | |
| ***T* (°C)** | 15 | ***t* (ks)** | ~~0.352~~ | ~~1.377~~ | 3.215 | 6.829 | 15.019 | 36.513 | 76.004 | 156.42 | | | | | | |
| ***Ḋ* (Gy/s)** | 0 | ***Lx/Tx*** | ~~0.982~~ | ~~0.962~~ | 0.985 | 0.985 | 0.965 | 0.958 | 0.952 | 0.968 | | | | | | |
| ***T* (°C)** | 15 | ***t* (ks)** | ~~0.351~~ | ~~1.344~~ | 3.181 | 6.855 | 15.103 | 36.598 | 76.088 | 156.50 | | | | | | |
| ***Ḋ* (Gy/s)** | 0 | ***Lx/Tx*** | ~~1.022~~ | ~~1.041~~ | 1.048 | 1.036 | 1.013 | 1.016 | 1.016 | 1.010 | | | | | | |
| ***T* (°C)** | 15 | ***t* (ks)** | ~~0.352~~ | ~~1.344~~ | 3.149 | 6.856 | 15.190 | 36.684 | 76.174 | 156.59 | | | | | | |
| ***Ḋ* (Gy/s)** | 0 | ***Lx/Tx*** | ~~0.894~~ | ~~0.887~~ | 0.905 | 0.896 | 0.886 | 0.892 | 0.891 | 0.893 | | | | | | |

*Observations in grey strikethrough are deemed as laboratory artefacts (unexplained signal growth rather than its athermal decay) and hence rejected.*

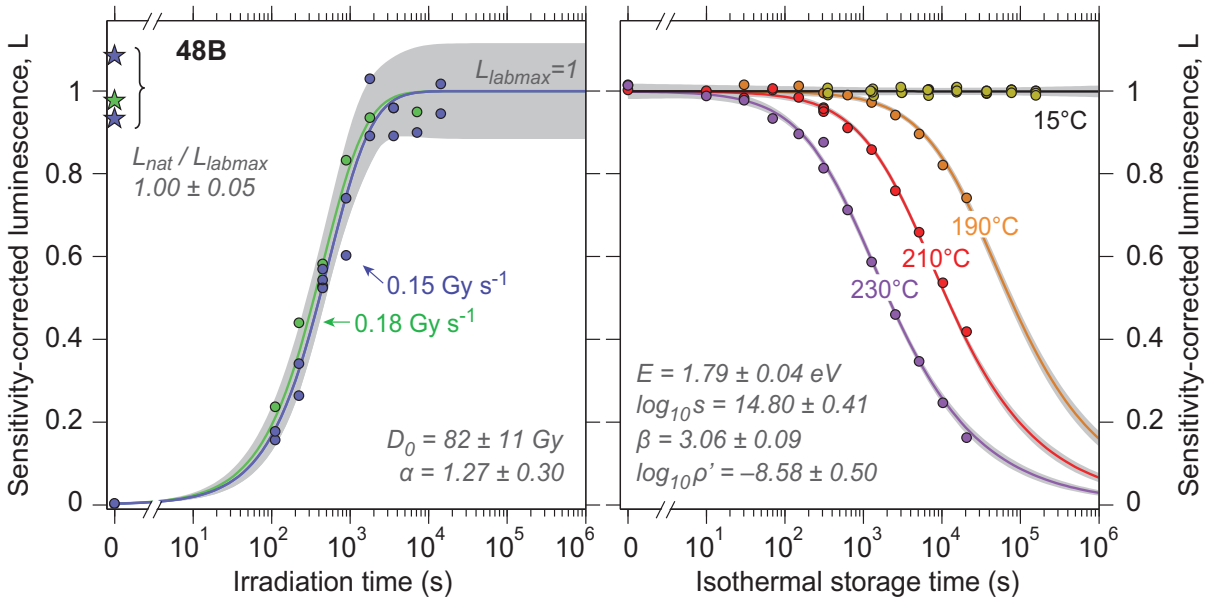


**Figure S6-2. Characterisation of electron trapping and detrapping kinetics (48B).** Radiation-induced growth (circles, left panel) and isothermal decay (circles, right panel) of sample 48B. Stars in left panel denote natural luminescence levels. Note that the y-axis of the shown data and its simultaneous best-fits are arbitrarily rescaled for convenience of presentation (laboratory saturation at L=1 in left panel; initial luminescence of L~1 in right panel).

**Table S6-2. Characterisation of electron trapping and detrapping kinetics (48B).**

| ***48B*** | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***T (°C)*** | 15 | ***t (ks)*** | Nat | 0.111 | 0.222 | 0.444 | 0.889 | 1.778 | 3.556 | 7.111 | | | | | |
| ***Ḋ (Gy/s)*** | 0.18 | ***Lx/Tx*** | 1.786 | 0.432 | 0.804 | 1.064 | 1.523 | 1.712 | 1.755 | 1.737 | | | | | |
| ***T (°C)*** | 15 | ***t (ks)*** | Nat | 0.111 | 0.222 | 0.444 | 0.889 | 1.778 | 3.556 | 7.111 | 14.222 | 0.000 | 0.444 | | |
| ***Ḋ (Gy/s)*** | 0.153 | ***Lx/Tx*** | 2.051 | 0.343 | 0.749 | 1.162 | 1.323 | 1.959 | 1.959 | 2.702 | 2.078 | 0.003 | 1.252 | | |
| ***T (°C)*** | 15 | ***t (ks)*** | Nat | 0.111 | 0.222 | 0.444 | 0.889 | 1.778 | 3.556 | 7.111 | 14.222 | 0.000 | 0.444 | | |
| ***Ḋ (Gy/s)*** | 0.153 | ***Lx/Tx*** | 2.483 | 0.405 | 0.601 | 1.242 | 1.694 | 2.355 | 2.195 | 2.057 | 2.327 | 0.005 | 1.199 | | |
| ***T (°C)*** | 230 | ***t (ks)*** | 0.000 | 0.010 | 0.030 | 0.070 | 0.150 | 0.310 | 0.630 | 1.270 | 2.550 | 5.110 | 10.230 | 20.470 | 0.310 |
| ***Ḋ (Gy/s)*** | 0 | ***Lx/Tx*** | 0.865 | 0.844 | 0.835 | 0.797 | 0.765 | 0.695 | 0.608 | 0.501 | 0.393 | 0.296 | 0.210 | 0.138 | 0.748 |
| ***T (°C)*** | 210 | ***t (ks)*** | 0.000 | 0.010 | 0.030 | 0.070 | 0.150 | 0.310 | 0.630 | 1.270 | 2.550 | 5.110 | 10.230 | 20.470 | 0.310 |
| ***Ḋ (Gy/s)*** | 0 | ***Lx/Tx*** | 0.951 | 0.948 | 0.932 | 0.954 | 0.934 | 0.901 | 0.863 | 0.813 | 0.719 | 0.624 | 0.508 | 0.396 | 0.907 |
| ***T (°C)*** | 190 | ***t (ks)*** | 0.000 | 0.010 | 0.030 | 0.070 | 0.150 | 0.310 | 0.630 | 1.270 | 2.550 | 5.110 | 10.230 | 20.470 | 0.310 |
| ***Ḋ (Gy/s)*** | 0 | ***Lx/Tx*** | 0.992 | 0.976 | 0.992 | 0.979 | 0.989 | 0.972 | 0.968 | 0.950 | 0.921 | 0.876 | 0.802 | 0.725 | 0.938 |
| ***T (°C)*** | 15 | ***t (ks)*** | 0.352 | 1.344 | 3.116 | 6.823 | 15.275 | 36.769 | 76.259 | 156.67 | | | | | |
| ***Ḋ (Gy/s)*** | 0 | ***Lx/Tx*** | 0.911 | 0.903 | 0.911 | 0.917 | 0.921 | 0.908 | 0.917 | 0.914 | | | | | |
| ***T (°C)*** | 15 | ***t (ks)*** | 0.351 | 1.311 | 3.082 | 6.757 | 15.328 | 36.822 | 76.311 | 156.72 | | | | | |
| ***Ḋ (Gy/s)*** | 0 | ***Lx/Tx*** | 0.919 | 0.917 | 0.911 | 0.902 | 0.909 | 0.908 | 0.913 | 0.912 | | | | | |
| ***T (°C)*** | 15 | ***t (ks)*** | 0.352 | 1.280 | 3.051 | 6.693 | 15.382 | 36.876 | 76.365 | 156.78 | | | | | |
| ***Ḋ (Gy/s)*** | 0 | ***Lx/Tx*** | 0.889 | 0.896 | 0.894 | 0.900 | 0.907 | 0.898 | 0.900 | 0.893 | | | | | |
| ***T (°C)*** | 15 | ***t (ks)*** | 0.352 | 1.222 | 2.961 | 6.570 | 15.378 | 36.872 | 76.361 | 156.77 | | | | | |
| ***Ḋ (Gy/s)*** | 0 | ***Lx/Tx*** | 0.912 | 0.917 | 0.926 | 0.919 | 0.917 | 0.916 | 0.912 | 0.907 | | | | | |

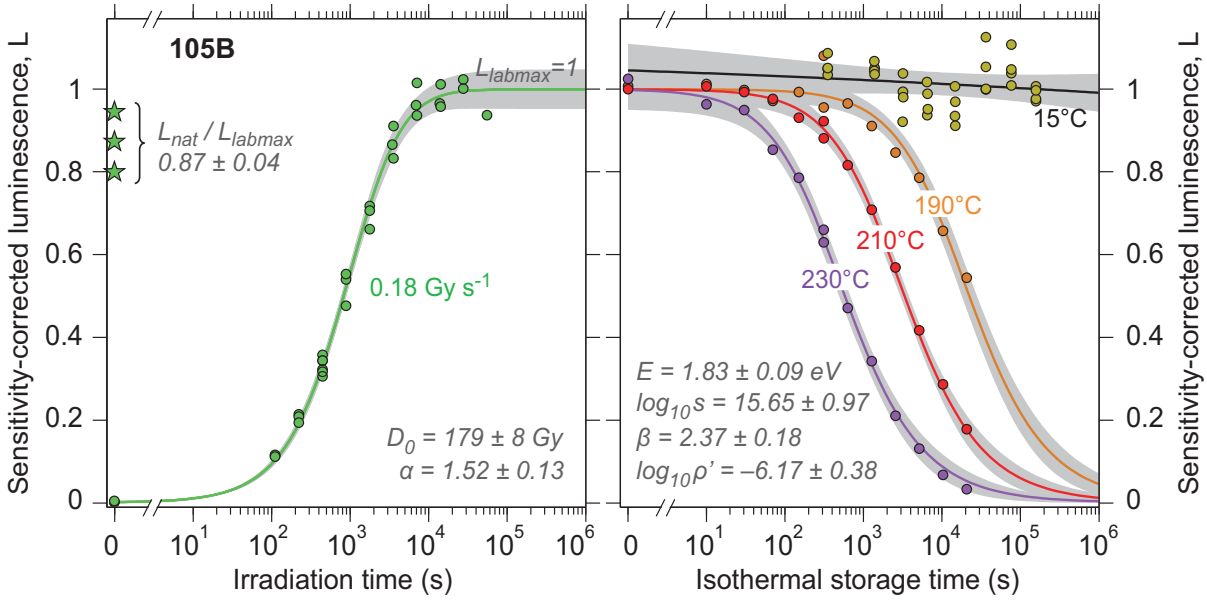


**Figure S6-3. Characterisation of electron trapping and detrapping kinetics (105B).** Radiation-induced growth (circles, left panel) and isothermal decay (circles, right panel) of sample 105B. Stars in left panel denote natural luminescence levels. Note that the y-axis of the shown data and its simultaneous best-fits are arbitrarily rescaled for convenience of presentation (laboratory saturation at L=1 in left panel; initial luminescence of L~1 in right panel).

**Table S6-3. Characterisation of electron trapping and detrapping kinetics (105B).**

| ***105B*** | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***T (°C)*** | 15 | ***t (ks)*** | Nat | 0.111 | 0.222 | 0.444 | 0.889 | 1.778 | 3.472 | 6.944 | 13.889 | 27.778 | 55.556 | 0.000 | 0.444 | 27.778 |
| ***Ḋ (Gy/s)*** | 0.18 | ***Lx/Tx*** | 4.319 | 0.516 | 0.976 | 1.568 | 2.464 | 3.279 | 3.960 | 4.394 | 4.410 | 4.575 | 4.283 | 0.003 | 1.630 | 4.678 |
| ***T (°C)*** | 15 | ***t (ks)*** | Nat | 0.111 | 0.222 | 0.444 | 0.889 | 1.778 | 3.556 | 7.111 | 14.222 | 0.000 | 0.444 | | | |
| ***Ḋ (Gy/s)*** | 0.18 | ***Lx/Tx*** | 4.154 | 0.551 | 0.987 | 1.532 | 2.631 | 3.360 | 3.964 | 4.454 | 4.813 | 0.009 | 1.632 | | | |
| ***T (°C)*** | 15 | ***t (ks)*** | Nat | 0.111 | 0.222 | 0.444 | 0.889 | 1.778 | 3.556 | 7.111 | 14.222 | 0.000 | 0.444 | | | |
| ***Ḋ (Gy/s)*** | 0.18 | ***Lx/Tx*** | 3.896 | 0.541 | 0.943 | 1.489 | 2.320 | 3.223 | 4.439 | 4.950 | 4.668 | 0.021 | 1.543 | | | |
| ***T (°C)*** | 230 | ***t (ks)*** | 0.000 | 0.010 | 0.030 | 0.070 | 0.150 | 0.310 | 0.630 | 1.270 | 2.550 | 5.110 | 10.230 | 20.470 | 0.310 | |
| ***Ḋ (Gy/s)*** | 0 | ***Lx/Tx*** | 0.923 | 0.867 | 0.855 | 0.769 | 0.707 | 0.567 | 0.424 | 0.308 | 0.189 | 0.117 | 0.060 | 0.029 | 0.595 | |
| ***T (°C)*** | 210 | ***t (ks)*** | 0.000 | 0.010 | 0.030 | 0.070 | 0.150 | 0.310 | 0.630 | 1.270 | 2.550 | 5.110 | 10.230 | 20.470 | 0.310 | |
| ***Ḋ (Gy/s)*** | 0 | ***Lx/Tx*** | 0.930 | 0.936 | 0.923 | 0.908 | 0.866 | 0.819 | 0.759 | 0.659 | 0.529 | 0.388 | 0.266 | 0.166 | 0.858 | |
| ***T (°C)*** | 190 | ***t (ks)*** | 0.000 | 0.010 | 0.030 | 0.070 | 0.150 | 0.310 | 0.630 | 1.270 | 2.550 | 5.110 | 10.230 | 20.470 | 0.310 | |
| ***Ḋ (Gy/s)*** | 0 | ***Lx/Tx*** | 0.886 | 0.889 | 0.877 | 0.854 | 0.872 | 0.840 | 0.848 | 0.800 | 0.744 | 0.690 | 0.577 | 0.478 | 0.950 | |
| ***T (°C)*** | 15 | ***t (ks)*** | 0.350 | 1.380 | 3.158 | 6.435 | 14.587 | 36.043 | 75.494 | 155.87 | | | | | | |
| ***Ḋ (Gy/s)*** | 0 | ***Lx/Tx*** | 1.004 | 1.006 | 0.951 | 0.897 | 0.895 | 1.078 | 0.995 | 0.929 | | | | | | |
| ***T (°C)*** | 15 | ***t (ks)*** | 0.350 | 1.369 | 3.137 | 6.407 | 14.543 | 35.983 | 75.420 | 155.78 | | | | | | |
| ***Ḋ (Gy/s)*** | 0 | ***Lx/Tx*** | 0.929 | 0.938 | 0.828 | 0.914 | 0.905 | 0.947 | 0.941 | 0.877 | | | | | | |
| ***T (°C)*** | 15 | ***t (ks)*** | 0.350 | 1.379 | 3.187 | 6.540 | 14.692 | 36.149 | 75.599 | 155.98 | | | | | | |
| ***Ḋ (Gy/s)*** | 0 | ***Lx/Tx*** | 0.973 | 0.959 | 0.908 | 0.881 | 0.897 | 0.925 | 1.025 | 0.932 | | | | | | |
| ***T (°C)*** | 15 | ***t (ks)*** | 0.349 | 1.368 | 3.164 | 6.507 | 14.643 | 36.083 | 75.520 | 155.88 | | | | | | |
| ***Ḋ (Gy/s)*** | 0 | ***Lx/Tx*** | 1.003 | 0.984 | 0.957 | 0.911 | 0.840 | 0.923 | 0.930 | 0.919 | | | | | | |

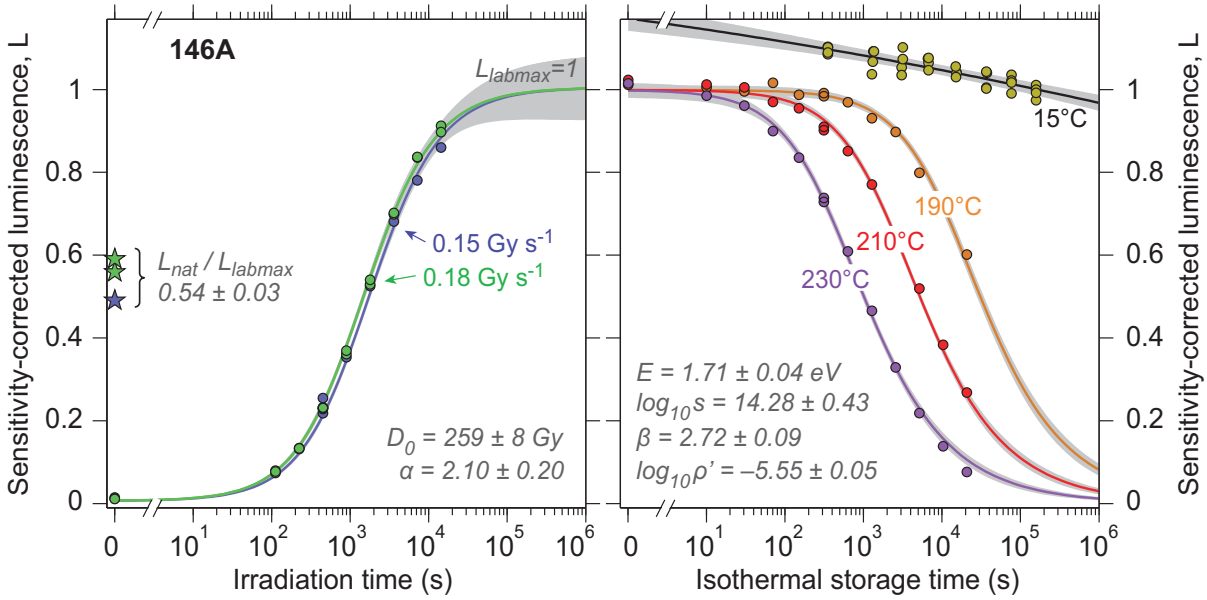


**Figure S6-4. Characterisation of electron trapping and detrapping kinetics (146A).** Radiation-induced growth (circles, left panel) and isothermal decay (circles, right panel) of sample 146A. Stars in left panel denote natural luminescence levels. Note that the y-axis of the shown data and its simultaneous best-fits are arbitrarily rescaled for convenience of presentation (laboratory saturation at L=1 in left panel; initial luminescence of L~1 in right panel).

**Table S6-4. Characterisation of electron trapping and detrapping kinetics (146A).**

| ***146A*** | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***T (°C)*** | 15 | ***t (ks)*** | Nat | 0.111 | 0.222 | 0.444 | 0.889 | 1.778 | 3.556 | 7.111 | 14.222 | 0.000 | 0.444 | | |
| ***Ḋ (Gy/s)*** | 0.18 | ***Lx/Tx*** | 3.940 | 0.479 | 0.908 | 1.581 | 2.528 | 3.728 | 4.937 | 5.914 | 6.464 | 0.039 | 1.601 | | |
| ***T (°C)*** | 15 | ***t (ks)*** | Nat | 0.111 | 0.222 | 0.444 | 0.889 | 1.778 | 3.556 | 7.111 | 14.222 | 0.000 | 0.444 | | |
| ***Ḋ (Gy/s)*** | 0.18 | ***Lx/Tx*** | 4.121 | 0.499 | 0.892 | 1.581 | 2.562 | 3.770 | 4.904 | 5.860 | 6.285 | 0.032 | 1.593 | | |
| ***T (°C)*** | 15 | ***t (ks)*** | Nat | 0.111 | 0.222 | 0.444 | 0.889 | 1.778 | 3.556 | 7.111 | 14.222 | 0.000 | 0.444 | | |
| ***Ḋ (Gy/s)*** | 0.153 | ***Lx/Tx*** | 3.603 | 0.541 | 0.932 | 1.847 | 2.585 | 3.865 | 5.030 | 5.769 | 6.356 | 0.058 | 1.578 | | |
| ***T (°C)*** | 230 | ***t (ks)*** | 0.000 | 0.010 | 0.030 | 0.070 | 0.150 | 0.310 | 0.630 | 1.270 | 2.550 | 5.110 | 10.230 | 20.470 | 0.310 |
| ***Ḋ (Gy/s)*** | 0 | ***Lx/Tx*** | 0.974 | 0.946 | 0.923 | 0.864 | 0.802 | 0.699 | 0.584 | 0.447 | 0.316 | 0.209 | 0.132 | 0.073 | 0.709 |
| ***T (°C)*** | 210 | ***t (ks)*** | 0.000 | 0.010 | 0.030 | 0.070 | 0.150 | 0.310 | 0.630 | 1.270 | 2.550 | 5.110 | 10.230 | 20.470 | 0.310 |
| ***Ḋ (Gy/s)*** | 0 | ***Lx/Tx*** | 1.004 | 0.993 | 0.986 | 0.952 | 0.937 | 0.893 | 0.835 | 0.756 | 0.631 | 0.509 | 0.376 | 0.262 | 0.885 |
| ***T (°C)*** | 190 | ***t (ks)*** | 0.000 | 0.010 | 0.030 | 0.070 | 0.150 | 0.310 | 0.630 | 1.270 | 2.550 | 5.110 | 10.230 | 20.470 | 0.310 |
| ***Ḋ (Gy/s)*** | 0 | ***Lx/Tx*** | 0.966 | 0.961 | 0.951 | 0.971 | 0.943 | 0.940 | 0.926 | 0.889 | 0.857 | 0.763 | 0.684 | 0.575 | 0.947 |
| ***T (°C)*** | 15 | ***t (ks)*** | 0.351 | 1.267 | 3.018 | 6.602 | 15.201 | 36.650 | 76.092 | 156.46 | | | | | |
| ***Ḋ (Gy/s)*** | 0 | ***Lx/Tx*** | 0.980 | 0.936 | 0.951 | 0.971 | 0.940 | 0.940 | 0.935 | 0.913 | | | | | |
| ***T (°C)*** | 15 | ***t (ks)*** | 0.351 | 1.295 | 3.045 | 6.659 | 15.152 | 36.602 | 76.043 | 156.41 | | | | | |
| ***Ḋ (Gy/s)*** | 0 | ***Lx/Tx*** | 0.980 | 0.948 | 0.918 | 0.946 | 0.923 | 0.926 | 0.907 | 0.887 | | | | | |
| ***T (°C)*** | 15 | ***t (ks)*** | 0.351 | 1.320 | 3.119 | 6.722 | 14.909 | 36.385 | 75.815 | 156.17 | | | | | |
| ***Ḋ (Gy/s)*** | 0 | ***Lx/Tx*** | 0.974 | 0.965 | 0.949 | 0.951 | 0.911 | 0.888 | 0.899 | 0.861 | | | | | |
| ***T (°C)*** | 15 | ***t (ks)*** | 0.350 | 1.341 | 3.136 | 6.681 | 14.817 | 36.257 | 75.693 | 156.05 | | | | | |
| ***Ḋ (Gy/s)*** | 0 | ***Lx/Tx*** | 0.984 | 0.985 | 0.994 | 0.944 | 0.953 | 0.904 | 0.894 | 0.895 | | | | | |

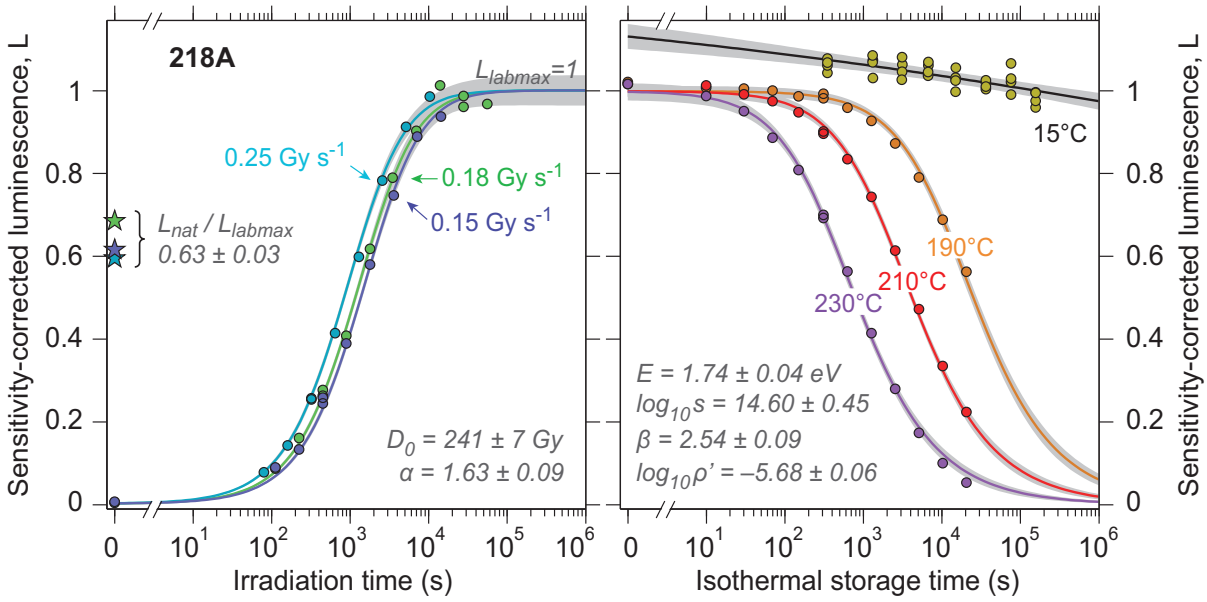


**Figure S6-5. Characterisation of electron trapping and detrapping kinetics (218A).** Radiation-induced growth (circles, left panel) and isothermal decay (circles, right panel) of sample 218A. Stars in left panel denote natural luminescence levels. Note that the y-axis of the shown data and its simultaneous best-fits are arbitrarily rescaled for convenience of presentation (laboratory saturation at L=1 in left panel; initial luminescence of L~1 in right panel).

**Table S6-5. Characterisation of electron trapping and detrapping kinetics (218A).**

| ***218A*** | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***T (°C)*** | 15 | ***t (ks)*** | Nat | 0.080 | 0.160 | 0.320 | 0.640 | 1.280 | 2.560 | 5.120 | 10.240 | 0.000 | 0.320 | | | |
| ***Ḋ (Gy/s)*** | 0.25 | ***Lx/Tx*** | 3.714 | 0.475 | 0.881 | 1.575 | 2.581 | 3.736 | 4.894 | 5.705 | 6.168 | 0.015 | 1.596 | | | |
| ***T (°C)*** | 15 | ***t (ks)*** | Nat | 0.111 | 0.222 | 0.444 | 0.889 | 1.778 | 3.472 | 6.944 | 13.889 | 27.778 | 55.556 | 0.000 | 0.444 | 27.778 |
| ***Ḋ (Gy/s)*** | 0.18 | ***Lx/Tx*** | 3.926 | 0.489 | 0.910 | 1.500 | 2.333 | 3.540 | 4.532 | 5.181 | 5.811 | 5.512 | 5.554 | 0.018 | 1.578 | 5.664 |
| ***T (°C)*** | 15 | ***t (ks)*** | Nat | 0.111 | 0.222 | 0.444 | 0.889 | 1.778 | 3.556 | 7.111 | 14.222 | 0.000 | 0.444 | | | |
| ***Ḋ (Gy/s)*** | 0.153 | ***Lx/Tx*** | 4.006 | 0.568 | 0.858 | 1.670 | 2.528 | 3.770 | 4.861 | 5.789 | 6.107 | 0.032 | 1.582 | | | |
| ***T (°C)*** | 230 | ***t (ks)*** | 0.000 | 0.010 | 0.030 | 0.070 | 0.150 | 0.310 | 0.630 | 1.270 | 2.550 | 5.110 | 10.230 | 20.470 | 0.310 | |
| ***Ḋ (Gy/s)*** | 0 | ***Lx/Tx*** | 0.970 | 0.942 | 0.907 | 0.846 | 0.772 | 0.661 | 0.537 | 0.395 | 0.267 | 0.165 | 0.095 | 0.050 | 0.668 | |
| ***T (°C)*** | 210 | ***t (ks)*** | 0.000 | 0.010 | 0.030 | 0.070 | 0.150 | 0.310 | 0.630 | 1.270 | 2.550 | 5.110 | 10.230 | 20.470 | 0.310 | |
| ***Ḋ (Gy/s)*** | 0 | ***Lx/Tx*** | 0.990 | 0.987 | 0.966 | 0.950 | 0.923 | 0.878 | 0.813 | 0.724 | 0.598 | 0.460 | 0.326 | 0.218 | 0.873 | |
| ***T (°C)*** | 190 | ***t (ks)*** | 0.000 | 0.010 | 0.030 | 0.070 | 0.150 | 0.310 | 0.630 | 1.270 | 2.550 | 5.110 | 10.230 | 20.470 | 0.310 | |
| ***Ḋ (Gy/s)*** | 0 | ***Lx/Tx*** | 0.988 | 0.975 | 0.973 | 0.969 | 0.955 | 0.951 | 0.928 | 0.897 | 0.845 | 0.765 | 0.666 | 0.545 | 0.962 | |
| ***T (°C)*** | 15 | ***t (ks)*** | 0.351 | 1.323 | 3.130 | 6.745 | 14.952 | 36.409 | 75.859 | 156.23 | | | | | | |
| ***Ḋ (Gy/s)*** | 0 | ***Lx/Tx*** | 0.962 | 0.991 | 0.981 | 0.979 | 0.921 | 0.940 | 0.983 | 0.886 | | | | | | |
| ***T (°C)*** | 15 | ***t (ks)*** | 0.350 | 1.314 | 3.109 | 6.701 | 14.890 | 36.329 | 75.765 | 156.12 | | | | | | |
| ***Ḋ (Gy/s)*** | 0 | ***Lx/Tx*** | 1.142 | 1.150 | 1.126 | 1.115 | 1.110 | 1.103 | 1.099 | 1.072 | | | | | | |
| ***T (°C)*** | 15 | ***t (ks)*** | 0.350 | 1.322 | 3.102 | 6.745 | 15.028 | 36.484 | 75.935 | 156.31 | | | | | | |
| ***Ḋ (Gy/s)*** | 0 | ***Lx/Tx*** | 0.998 | 0.955 | 1.001 | 0.990 | 0.978 | 0.930 | 0.918 | 0.903 | | | | | | |
| ***T (°C)*** | 15 | ***t (ks)*** | 0.349 | 1.313 | 3.082 | 6.701 | 14.963 | 36.402 | 75.838 | 156.20 | | | | | | |
| ***Ḋ (Gy/s)*** | 0 | ***Lx/Tx*** | 1.171 | 1.189 | 1.125 | 1.145 | 1.123 | 1.106 | 1.129 | 1.091 | | | | | | |

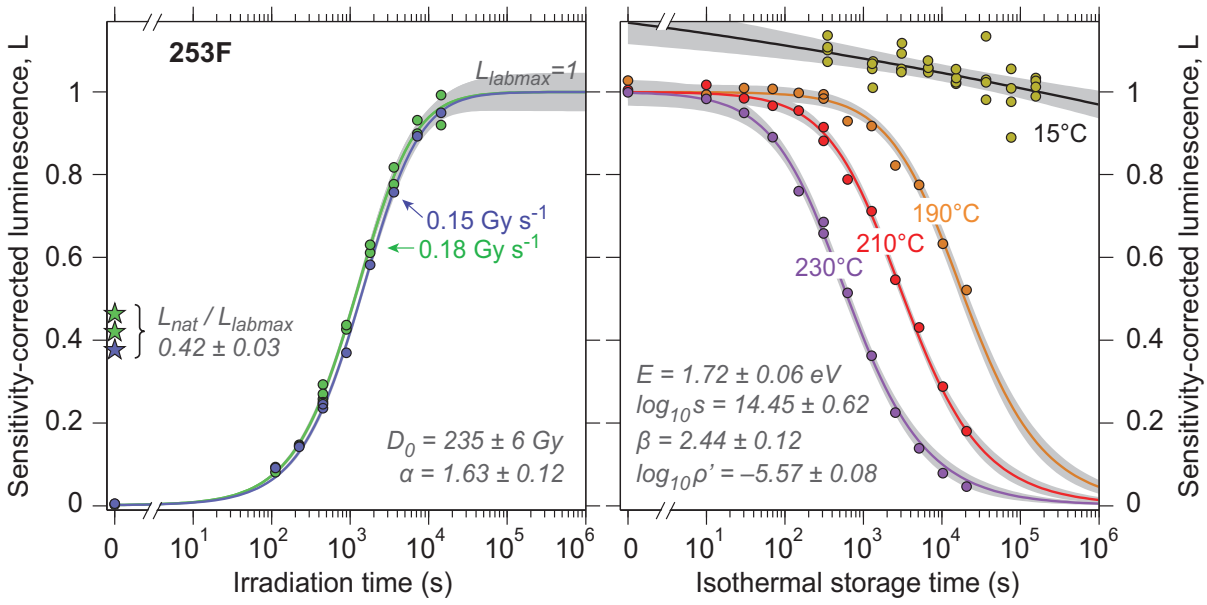


**Figure S6-6. Characterisation of electron trapping and detrapping kinetics (253F).** Radiation-induced growth (circles, left panel) and isothermal decay (circles, right panel) of sample 253F. Stars in left panel denote natural luminescence levels. Note that the y-axis of the shown data and its simultaneous best-fits are arbitrarily rescaled for convenience of presentation (laboratory saturation at L=1 in left panel; initial luminescence of L~1 in right panel).

**Table S6-6. Characterisation of electron trapping and detrapping kinetics (253F).**

| ***253F*** | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***T (°C)*** | 15 | ***t (ks)*** | Nat | 0.111 | 0.222 | 0.444 | 0.889 | 1.778 | 3.556 | 7.111 | 14.222 | 0.000 | 0.444 | | |
| ***Ḋ (Gy/s)*** | 0.18 | ***Lx/Tx*** | 2.842 | 0.489 | 0.898 | 1.579 | 2.608 | 3.749 | 4.767 | 5.516 | 6.091 | 0.020 | 1.794 | | |
| ***T (°C)*** | 15 | ***t (ks)*** | Nat | 0.111 | 0.222 | 0.444 | 0.889 | 1.778 | 3.556 | 7.111 | 14.222 | 0.000 | 0.444 | | |
| ***Ḋ (Gy/s)*** | 0.18 | ***Lx/Tx*** | 2.573 | 0.563 | 0.882 | 1.649 | 2.672 | 3.863 | 5.010 | 5.710 | 5.637 | 0.007 | 1.529 | | |
| ***T (°C)*** | 15 | ***t (ks)*** | Nat | 0.111 | 0.222 | 0.444 | 0.889 | 1.778 | 3.556 | 7.111 | 14.222 | 0.000 | 0.444 | | |
| ***Ḋ (Gy/s)*** | 0.153 | ***Lx/Tx*** | 2.601 | 0.624 | 0.979 | 1.626 | 2.554 | 4.030 | 5.243 | 6.185 | 6.573 | 0.024 | 1.691 | | |
| ***T (°C)*** | 230 | ***t (ks)*** | 0.000 | 0.010 | 0.030 | 0.070 | 0.150 | 0.310 | 0.630 | 1.270 | 2.550 | 5.110 | 10.230 | 20.470 | 0.310 |
| ***Ḋ (Gy/s)*** | 0 | ***Lx/Tx*** | 0.928 | 0.913 | 0.882 | 0.827 | 0.706 | 0.611 | 0.478 | 0.336 | 0.208 | 0.128 | 0.073 | 0.042 | 0.636 |
| ***T (°C)*** | 210 | ***t (ks)*** | 0.000 | 0.010 | 0.030 | 0.070 | 0.150 | 0.310 | 0.630 | 1.270 | 2.550 | 5.110 | 10.230 | 20.470 | 0.310 |
| ***Ḋ (Gy/s)*** | 0 | ***Lx/Tx*** | 0.958 | 0.970 | 0.939 | 0.922 | 0.911 | 0.841 | 0.752 | 0.679 | 0.520 | 0.411 | 0.274 | 0.171 | 0.873 |
| ***T (°C)*** | 190 | ***t (ks)*** | 0.000 | 0.010 | 0.030 | 0.070 | 0.150 | 0.310 | 0.630 | 1.270 | 2.550 | 5.110 | 10.230 | 20.470 | 0.310 |
| ***Ḋ (Gy/s)*** | 0 | ***Lx/Tx*** | 0.992 | 0.960 | 0.975 | 0.973 | 0.964 | 0.960 | 0.897 | 0.887 | 0.794 | 0.748 | 0.611 | 0.503 | 0.950 |
| ***T (°C)*** | 15 | ***t (ks)*** | 0.350 | 1.323 | 3.073 | 6.717 | 15.106 | 36.561 | 76.012 | 156.39 | | | | | |
| ***Ḋ (Gy/s)*** | 0 | ***Lx/Tx*** | 0.937 | 0.937 | 0.976 | 0.922 | 0.891 | 0.857 | 0.922 | 0.864 | | | | | |
| ***T (°C)*** | 15 | ***t (ks)*** | 0.349 | 1.313 | 3.054 | 6.673 | 15.036 | 36.475 | 75.911 | 156.27 | | | | | |
| ***Ḋ (Gy/s)*** | 0 | ***Lx/Tx*** | 0.846 | 0.752 | 0.813 | 0.779 | 0.761 | 0.845 | 0.662 | 0.769 | | | | | |
| ***T (°C)*** | 15 | ***t (ks)*** | 0.350 | 1.294 | 3.045 | 6.660 | 15.154 | 36.610 | 76.060 | 156.44 | | | | | |
| ***Ḋ (Gy/s)*** | 0 | ***Lx/Tx*** | 0.938 | 0.899 | 0.899 | 0.901 | 0.880 | 0.877 | 0.859 | 0.874 | | | | | |
| ***T (°C)*** | 15 | ***t (ks)*** | 0.350 | 1.286 | 3.027 | 6.618 | 15.081 | 36.520 | 75.956 | 156.32 | | | | | |
| ***Ḋ (Gy/s)*** | 0 | ***Lx/Tx*** | 0.868 | 0.837 | 0.821 | 0.843 | 0.826 | 0.801 | 0.765 | 0.793 | | | | | |

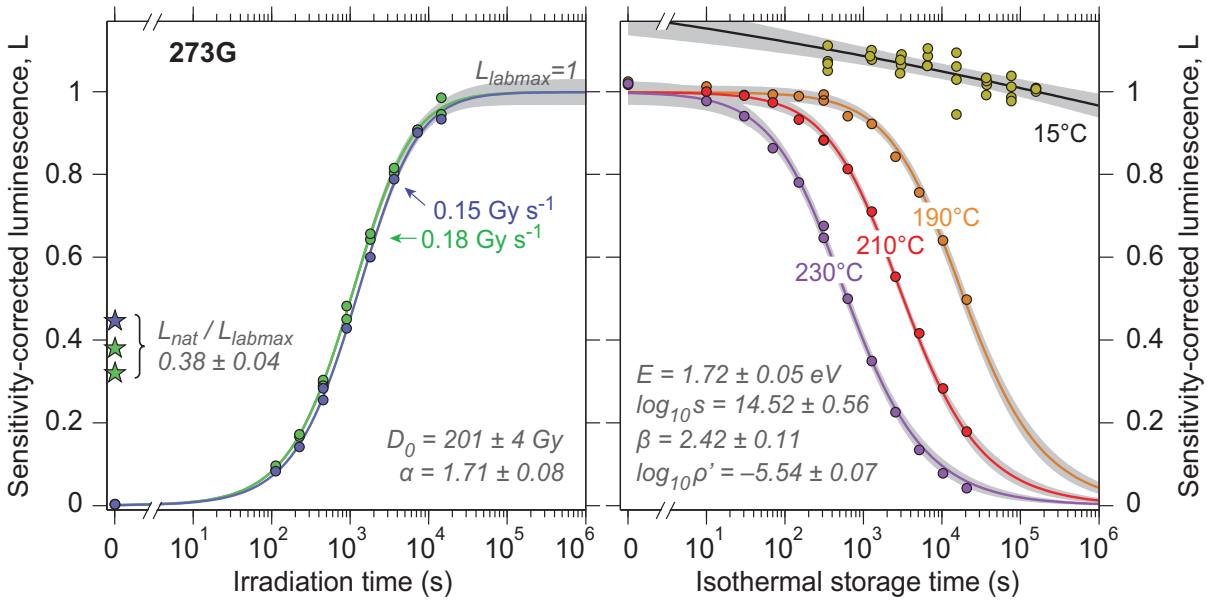


**Figure S6-7. Characterisation of electron trapping and detrapping kinetics (273G).** Radiation-induced growth (circles, left panel) and isothermal decay (circles, right panel) of sample 273G. Stars in left panel denote natural luminescence levels. Note that the y-axis of the shown data and its simultaneous best-fits are arbitrarily rescaled for convenience of presentation (laboratory saturation at L=1 in left panel; initial luminescence of L~1 in right panel).

**Table S6-7. Characterisation of electron trapping and detrapping kinetics (273G).**

| ***273G*** | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***T (°C)*** | 15 | ***t (ks)*** | Nat | 0.111 | 0.222 | 0.444 | 0.889 | 1.778 | 3.556 | 7.111 | 14.222 | 0.000 | 0.444 | | |
| ***Ḋ (Gy/s)*** | 0.18 | ***Lx/Tx*** | 1.791 | 0.485 | 0.935 | 1.602 | 2.521 | 3.601 | 4.501 | 5.081 | 5.520 | 0.018 | 1.661 | | |
| ***T (°C)*** | 15 | ***t (ks)*** | Nat | 0.111 | 0.222 | 0.444 | 0.889 | 1.778 | 3.556 | 7.111 | 14.222 | 0.000 | 0.444 | | |
| ***Ḋ (Gy/s)*** | 0.18 | ***Lx/Tx*** | 2.055 | 0.522 | 0.931 | 1.564 | 2.606 | 3.552 | 4.411 | 4.911 | 5.116 | 0.011 | 1.639 | | |
| ***T (°C)*** | 15 | ***t (ks)*** | Nat | 0.111 | 0.222 | 0.444 | 0.889 | 1.778 | 3.556 | 7.111 | 14.222 | 0.000 | 0.444 | | |
| ***Ḋ (Gy/s)*** | 0.153 | ***Lx/Tx*** | 2.795 | 0.520 | 0.888 | 1.599 | 2.684 | 3.762 | 4.943 | 5.651 | 5.852 | 0.017 | 1.772 | | |
| ***T (°C)*** | 230 | ***t (ks)*** | 0.000 | 0.010 | 0.030 | 0.070 | 0.150 | 0.310 | 0.630 | 1.270 | 2.550 | 5.110 | 10.230 | 20.470 | 0.310 |
| ***Ḋ (Gy/s)*** | 0 | ***Lx/Tx*** | 0.927 | 0.889 | 0.855 | 0.785 | 0.710 | 0.589 | 0.455 | 0.317 | 0.205 | 0.122 | 0.070 | 0.038 | 0.614 |
| ***T (°C)*** | 210 | ***t (ks)*** | 0.000 | 0.010 | 0.030 | 0.070 | 0.150 | 0.310 | 0.630 | 1.270 | 2.550 | 5.110 | 10.230 | 20.470 | 0.310 |
| ***Ḋ (Gy/s)*** | 0 | ***Lx/Tx*** | 0.986 | 0.970 | 0.960 | 0.944 | 0.904 | 0.856 | 0.788 | 0.688 | 0.536 | 0.403 | 0.274 | 0.173 | 0.855 |
| ***T (°C)*** | 190 | ***t (ks)*** | 0.000 | 0.010 | 0.030 | 0.070 | 0.150 | 0.310 | 0.630 | 1.270 | 2.550 | 5.110 | 10.230 | 20.470 | 0.310 |
| ***Ḋ (Gy/s)*** | 0 | ***Lx/Tx*** | 0.962 | 0.950 | 0.932 | 0.933 | 0.929 | 0.919 | 0.883 | 0.866 | 0.791 | 0.710 | 0.601 | 0.467 | 0.933 |
| ***T (°C)*** | 15 | ***t (ks)*** | 0.350 | 1.265 | 3.015 | 6.601 | 15.201 | 36.657 | 76.108 | 156.48 | | | | | |
| ***Ḋ (Gy/s)*** | 0 | ***Lx/Tx*** | 0.919 | 0.922 | 0.933 | 0.929 | 0.908 | 0.870 | 0.844 | 0.856 | | | | | |
| ***T (°C)*** | 15 | ***t (ks)*** | 0.350 | 1.260 | 3.001 | 6.565 | 15.128 | 36.567 | 76.003 | 156.36 | | | | | |
| ***Ḋ (Gy/s)*** | 0 | ***Lx/Tx*** | 0.886 | 0.928 | 0.898 | 0.932 | 0.923 | 0.837 | 0.824 | 0.851 | | | | | |
| ***T (°C)*** | 15 | ***t (ks)*** | 0.350 | 1.211 | 2.932 | 6.491 | 15.196 | 36.651 | 76.102 | 156.48 | | | | | |
| ***Ḋ (Gy/s)*** | 0 | ***Lx/Tx*** | 0.915 | 0.931 | 0.923 | 0.912 | 0.883 | 0.880 | 0.890 | 0.864 | | | | | |
| ***T (°C)*** | 15 | ***t (ks)*** | 0.350 | 1.207 | 2.921 | 6.457 | 15.121 | 36.560 | 75.995 | 156.36 | | | | | |
| ***Ḋ (Gy/s)*** | 0 | ***Lx/Tx*** | 0.948 | 1.002 | 0.891 | 0.907 | 0.806 | 0.882 | 0.864 | 0.859 | | | | | |

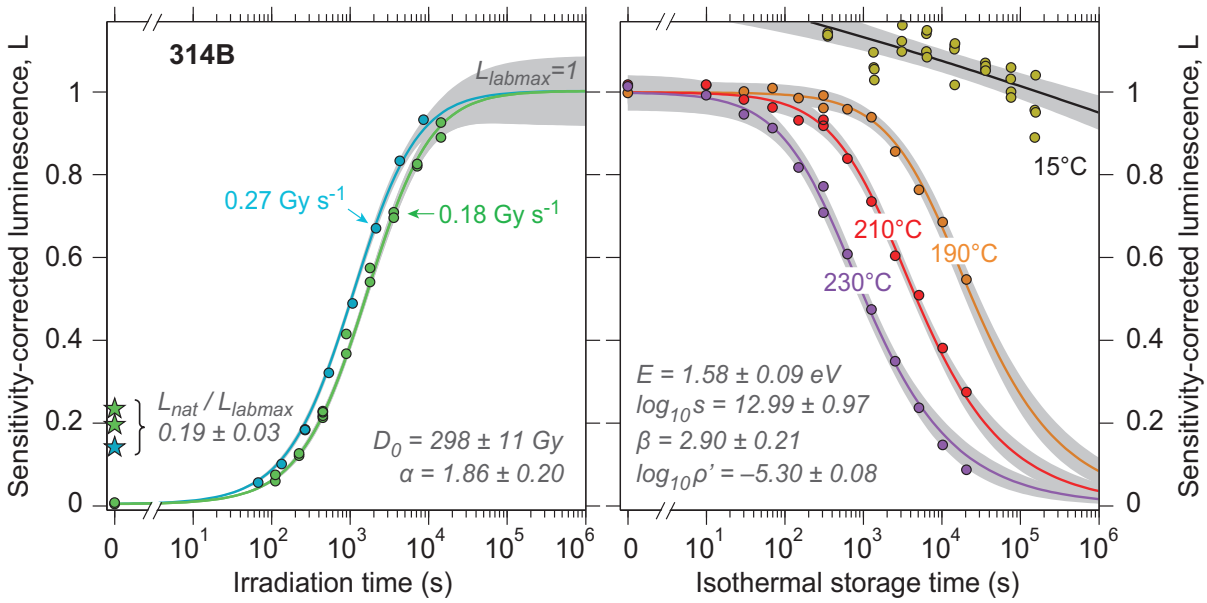


**Figure S6-8. Characterisation of electron trapping and detrapping kinetics (314B).** Radiation-induced growth (circles, left panel) and isothermal decay (circles, right panel) of sample 314B. Stars in left panel denote natural luminescence levels. Note that the y-axis of the shown data and its simultaneous best-fits are arbitrarily rescaled for convenience of presentation (laboratory saturation at L=1 in left panel; initial luminescence of L~1 in right panel).

**Table S6-8. Characterisation of electron trapping and detrapping kinetics (314B).**

***314B***

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***T (°C)*** | 15 | ***t (ks)*** | Nat | 0.067 | 0.133 | 0.267 | 0.533 | 1.067 | 2.133 | 4.267 | 8.533 | 0.000 | 0.267 | | |
| ***Ḋ (Gy/s)*** | 0.27 | ***Lx/Tx*** | 1.299 | 0.498 | 0.915 | 1.706 | 3.000 | 4.577 | 6.288 | 7.832 | 8.768 | 0.018 | 1.689 | | |
| ***T (°C)*** | 15 | ***t (ks)*** | Nat | 0.111 | 0.222 | 0.444 | 0.889 | 1.778 | 3.556 | 7.111 | 14.222 | 0.000 | 0.444 | | |
| ***Ḋ (Gy/s)*** | 0.18 | ***Lx/Tx*** | 1.800 | 0.434 | 0.916 | 1.628 | 3.214 | 4.455 | 5.507 | 6.371 | 6.914 | 0.004 | 1.670 | | |
| ***T (°C)*** | 15 | ***t (ks)*** | Nat | 0.111 | 0.222 | 0.444 | 0.889 | 1.778 | 3.556 | 7.111 | 14.222 | 0.000 | 0.444 | | |
| ***Ḋ (Gy/s)*** | 0.18 | ***Lx/Tx*** | 1.428 | 0.528 | 0.914 | 1.659 | 2.712 | 4.007 | 5.162 | 6.131 | 6.872 | 0.029 | 1.679 | | |
| ***T (°C)*** | 230 | ***t (ks)*** | 0.000 | 0.010 | 0.030 | 0.070 | 0.150 | 0.310 | 0.630 | 1.270 | 2.550 | 5.110 | 10.230 | 20.470 | 0.310 |
| ***Ḋ (Gy/s)*** | 0 | ***Lx/Tx*** | 0.927 | 0.908 | 0.866 | 0.835 | 0.748 | 0.648 | 0.556 | 0.434 | 0.320 | 0.217 | 0.134 | 0.079 | 0.706 |
| ***T (°C)*** | 210 | ***t (ks)*** | 0.000 | 0.010 | 0.030 | 0.070 | 0.150 | 0.310 | 0.630 | 1.270 | 2.550 | 5.110 | 10.230 | 20.470 | 0.310 |
| ***Ḋ (Gy/s)*** | 0 | ***Lx/Tx*** | 0.972 | 0.972 | 0.938 | 0.918 | 0.889 | 0.876 | 0.801 | 0.701 | 0.576 | 0.485 | 0.364 | 0.262 | 0.890 |
| ***T (°C)*** | 190 | ***t (ks)*** | 0.000 | 0.010 | 0.030 | 0.070 | 0.150 | 0.310 | 0.630 | 1.270 | 2.550 | 5.110 | 10.230 | 20.470 | 0.310 |
| ***Ḋ (Gy/s)*** | 0 | ***Lx/Tx*** | 0.994 | 1.012 | 0.997 | 1.005 | 0.982 | 0.988 | 0.955 | 0.935 | 0.853 | 0.761 | 0.683 | 0.544 | 0.957 |
| ***T (°C)*** | 15 | ***t (ks)*** | 0.352 | 1.359 | 3.092 | 6.368 | 14.521 | 35.978 | 75.429 | 152.20 | | | | | |
| ***Ḋ (Gy/s)*** | 0 | ***Lx/Tx*** | 1.034 | 0.958 | 1.015 | 1.031 | 1.006 | 0.967 | 0.904 | 0.864 | | | | | |
| ***T (°C)*** | 15 | ***t (ks)*** | 0.352 | 1.348 | 3.071 | 6.341 | 14.479 | 35.920 | 75.355 | 155.72 | | | | | |
| ***Ḋ (Gy/s)*** | 0 | ***Lx/Tx*** | 1.133 | 1.059 | 1.062 | 1.062 | 1.066 | 1.018 | 0.997 | 0.919 | | | | | |
| ***T (°C)*** | 15 | ***t (ks)*** | 0.352 | 1.384 | 3.146 | 6.476 | 14.629 | 36.086 | 75.537 | 152.31 | | | | | |
| ***Ḋ (Gy/s)*** | 0 | ***Lx/Tx*** | 1.021 | 0.926 | 1.045 | 1.034 | 1.005 | 0.956 | 0.953 | 0.801 | | | | | |
| ***T (°C)*** | 15 | ***t (ks)*** | 0.352 | 1.373 | 3.123 | 6.444 | 14.582 | 36.022 | 75.458 | 155.82 | | | | | |
| ***Ḋ (Gy/s)*** | 0 | ***Lx/Tx*** | 1.039 | 0.964 | 1.125 | 0.990 | 0.929 | 0.960 | 0.901 | 0.950 | | | | | |

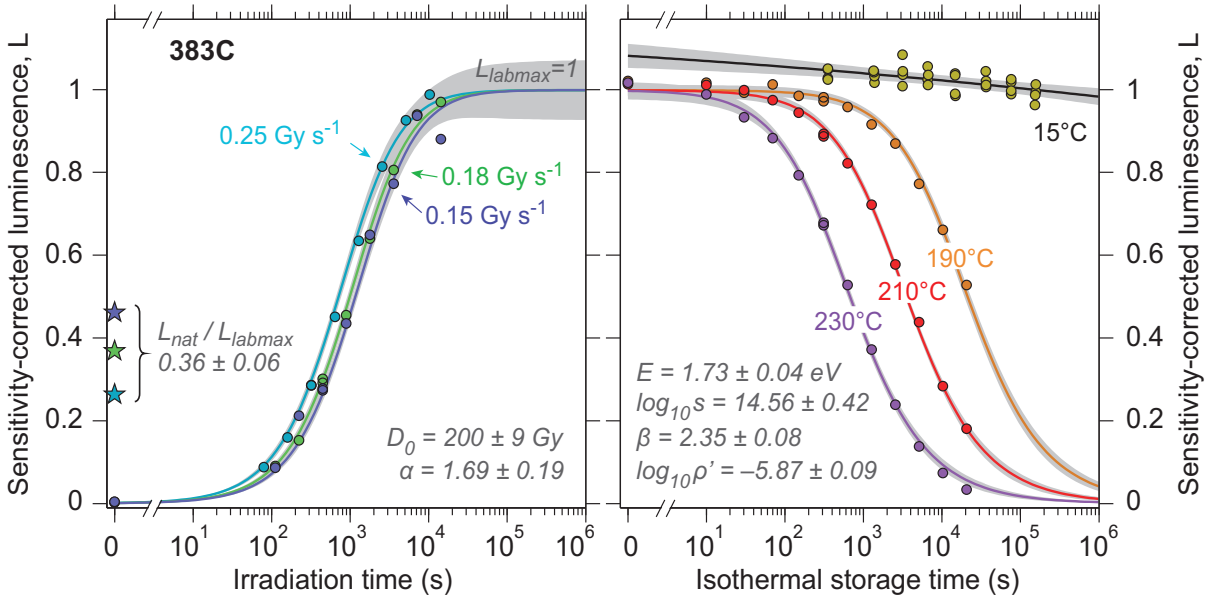


**Figure S6-9. Characterisation of electron trapping and detrapping kinetics (383C).** Radiation-induced growth (circles, left panel) and isothermal decay (circles, right panel) of sample 383C. Stars in left panel denote natural luminescence levels. Note that the y-axis of the shown data and its simultaneous best-fits are arbitrarily rescaled for convenience of presentation (laboratory saturation at L=1 in left panel; initial luminescence of L~1 in right panel).

**Table S6-9. Characterisation of electron trapping and detrapping kinetics (383C).**

| ***383C*** | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***T (°C)*** | 15 | ***t (ks)*** | Nat | 0.080 | 0.160 | 0.320 | 0.640 | 1.280 | 2.560 | 5.120 | 10.240 | 0.000 | 0.320 | | |
| ***Ḋ (Gy/s)*** | 0.25 | ***Lx/Tx*** | 1.426 | 0.473 | 0.866 | 1.548 | 2.445 | 3.439 | 4.413 | 5.021 | 5.357 | 0.012 | 1.548 | | |
| ***T (°C)*** | 15 | ***t (ks)*** | Nat | 0.111 | 0.222 | 0.444 | 0.889 | 1.778 | 3.556 | 7.111 | 14.222 | 0.000 | 0.444 | | |
| ***Ḋ (Gy/s)*** | 0.18 | ***Lx/Tx*** | 1.926 | 0.472 | 0.801 | 1.526 | 2.381 | 3.350 | 4.216 | 4.917 | 5.078 | 0.017 | 1.575 | | |
| ***T (°C)*** | 15 | ***t (ks)*** | Nat | 0.111 | 0.222 | 0.444 | 0.889 | 1.778 | 3.556 | 7.111 | 14.222 | 0.000 | 0.444 | | |
| ***Ḋ (Gy/s)*** | 0.153 | ***Lx/Tx*** | 2.653 | 0.500 | 1.219 | 1.596 | 2.503 | 3.734 | 4.448 | 5.392 | 5.068 | 0.023 | 1.573 | | |
| ***T (°C)*** | 230 | ***t (ks)*** | 0.000 | 0.010 | 0.030 | 0.070 | 0.150 | 0.310 | 0.630 | 1.270 | 2.550 | 5.110 | 10.230 | 20.470 | 0.310 |
| ***Ḋ (Gy/s)*** | 0 | ***Lx/Tx*** | 0.958 | 0.930 | 0.879 | 0.831 | 0.746 | 0.633 | 0.497 | 0.351 | 0.225 | 0.130 | 0.070 | 0.032 | 0.638 |
| ***T (°C)*** | 210 | ***t (ks)*** | 0.000 | 0.010 | 0.030 | 0.070 | 0.150 | 0.310 | 0.630 | 1.270 | 2.550 | 5.110 | 10.230 | 20.470 | 0.310 |
| ***Ḋ (Gy/s)*** | 0 | ***Lx/Tx*** | 0.976 | 0.974 | 0.961 | 0.939 | 0.909 | 0.854 | 0.792 | 0.695 | 0.556 | 0.422 | 0.273 | 0.174 | 0.860 |
| ***T (°C)*** | 190 | ***t (ks)*** | 0.000 | 0.010 | 0.030 | 0.070 | 0.150 | 0.310 | 0.630 | 1.270 | 2.550 | 5.110 | 10.230 | 20.470 | 0.310 |
| ***Ḋ (Gy/s)*** | 0 | ***Lx/Tx*** | 0.975 | 0.971 | 0.948 | 0.967 | 0.941 | 0.938 | 0.915 | 0.874 | 0.830 | 0.738 | 0.632 | 0.504 | 0.928 |
| ***T (°C)*** | 15 | ***t (ks)*** | 0.353 | 1.384 | 3.171 | 6.584 | 14.737 | 36.193 | 75.644 | 152.42 | | | | | |
| ***Ḋ (Gy/s)*** | 0 | ***Lx/Tx*** | 1.002 | 0.991 | 1.010 | 1.029 | 1.013 | 0.995 | 0.993 | 0.939 | | | | | |
| ***T (°C)*** | 15 | ***t (ks)*** | 0.352 | 1.373 | 3.148 | 6.547 | 14.684 | 36.125 | 75.560 | 155.92 | | | | | |
| ***Ḋ (Gy/s)*** | 0 | ***Lx/Tx*** | 1.005 | 0.990 | 0.967 | 0.982 | 0.992 | 1.002 | 0.948 | 0.954 | | | | | |
| ***T (°C)*** | 15 | ***t (ks)*** | 0.353 | 1.356 | 3.167 | 6.663 | 14.816 | 36.273 | 75.723 | 152.50 | | | | | |
| ***Ḋ (Gy/s)*** | 0 | ***Lx/Tx*** | 1.019 | 1.010 | 1.012 | 1.004 | 0.955 | 0.976 | 0.994 | 0.956 | | | | | |
| ***T (°C)*** | 15 | ***t (ks)*** | 0.352 | 1.345 | 3.146 | 6.621 | 14.759 | 36.200 | 75.635 | 156.00 | | | | | |
| ***Ḋ (Gy/s)*** | 0 | ***Lx/Tx*** | 1.002 | 1.023 | 1.061 | 0.988 | 0.968 | 0.988 | 0.975 | 0.990 | | | | | |

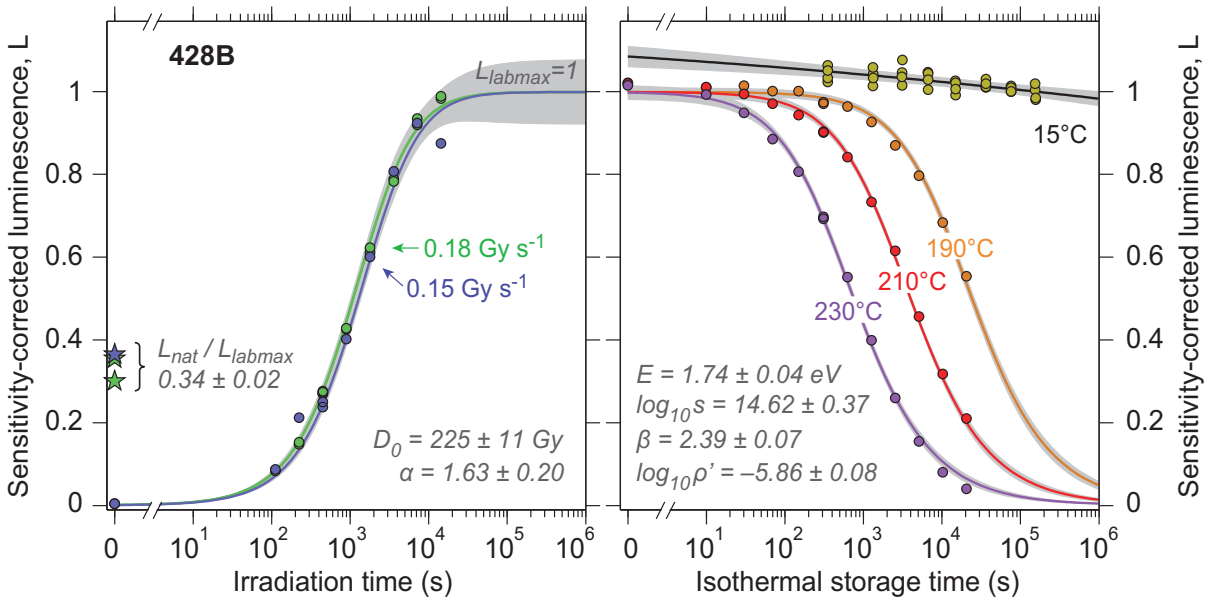


**Figure S6-10. Characterisation of electron trapping and detrapping kinetics (428B).** Radiation-induced growth (circles, left panel) and isothermal decay (circles, right panel) of sample 428B. Stars in left panel denote natural luminescence levels. Note that the y-axis of the shown data and its simultaneous best-fits are arbitrarily rescaled for convenience of presentation (laboratory saturation at L=1 in left panel; initial luminescence of L~1 in right panel).

**Table S6-10. Characterisation of electron trapping and detrapping kinetics (428B).**

***428B***

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***T (°C)*** | 15 | ***t (ks)*** | Nat | 0.111 | 0.222 | 0.444 | 0.889 | 1.778 | 3.556 | 7.111 | 14.222 | 0.000 | 0.444 | | |
| ***Ḋ (Gy/s)*** | 0.18 | ***Lx/Tx*** | 1.758 | 0.493 | 0.864 | 1.581 | 2.495 | 3.578 | 4.622 | 5.477 | 5.761 | 0.024 | 1.581 | | |
| ***T (°C)*** | 15 | ***t (ks)*** | Nat | 0.111 | 0.222 | 0.444 | 0.889 | 1.778 | 3.556 | 7.111 | 14.222 | 0.000 | 0.444 | | |
| ***Ḋ (Gy/s)*** | 0.18 | ***Lx/Tx*** | 2.055 | 0.482 | 0.883 | 1.597 | 2.478 | 3.609 | 4.533 | 5.328 | 5.727 | 0.023 | 1.582 | | |
| ***T (°C)*** | 15 | ***t (ks)*** | Nat | 0.111 | 0.222 | 0.444 | 0.889 | 1.778 | 3.556 | 7.111 | 14.222 | 0.000 | 0.444 | | |
| ***Ḋ (Gy/s)*** | 0.153 | ***Lx/Tx*** | 2.302 | 0.548 | 1.336 | 1.500 | 2.535 | 3.786 | 5.090 | 5.830 | 5.517 | 0.027 | 1.577 | | |
| ***T (°C)*** | 230 | ***t (ks)*** | 0.000 | 0.010 | 0.030 | 0.070 | 0.150 | 0.310 | 0.630 | 1.270 | 2.550 | 5.110 | 10.230 | 20.470 | 0.310 |
| ***Ḋ (Gy/s)*** | 0 | ***Lx/Tx*** | 0.982 | 0.961 | 0.919 | 0.857 | 0.781 | 0.670 | 0.534 | 0.386 | 0.251 | 0.150 | 0.077 | 0.039 | 0.676 |
| ***T (°C)*** | 210 | ***t (ks)*** | 0.000 | 0.010 | 0.030 | 0.070 | 0.150 | 0.310 | 0.630 | 1.270 | 2.550 | 5.110 | 10.230 | 20.470 | 0.310 |
| ***Ḋ (Gy/s)*** | 0 | ***Lx/Tx*** | 0.982 | 0.974 | 0.958 | 0.935 | 0.908 | 0.867 | 0.810 | 0.706 | 0.593 | 0.439 | 0.305 | 0.202 | 0.870 |
| ***T (°C)*** | 190 | ***t (ks)*** | 0.000 | 0.010 | 0.030 | 0.070 | 0.150 | 0.310 | 0.630 | 1.270 | 2.550 | 5.110 | 10.230 | 20.470 | 0.310 |
| ***Ḋ (Gy/s)*** | 0 | ***Lx/Tx*** | 0.993 | 0.982 | 0.986 | 0.973 | 0.973 | 0.947 | 0.937 | 0.900 | 0.846 | 0.774 | 0.665 | 0.538 | 0.944 |
| ***T (°C)*** | 15 | ***t (ks)*** | 0.352 | 1.327 | 3.138 | 6.687 | 14.894 | 36.351 | 75.801 | 152.58 | | | | | |
| ***Ḋ (Gy/s)*** | 0 | ***Lx/Tx*** | 0.959 | 0.976 | 1.008 | 0.941 | 0.929 | 0.965 | 0.950 | 0.940 | | | | | |
| ***T (°C)*** | 15 | ***t (ks)*** | 0.352 | 1.318 | 3.118 | 6.643 | 14.833 | 36.275 | 75.710 | 156.07 | | | | | |
| ***Ḋ (Gy/s)*** | 0 | ***Lx/Tx*** | 1.040 | 0.991 | 1.022 | 1.023 | 1.004 | 0.988 | 0.977 | 0.958 | | | | | |
| ***T (°C)*** | 15 | ***t (ks)*** | 0.352 | 1.327 | 3.110 | 6.712 | 14.973 | 36.430 | 75.881 | 152.66 | | | | | |
| ***Ḋ (Gy/s)*** | 0 | ***Lx/Tx*** | 1.002 | 1.003 | 0.985 | 1.014 | 0.991 | 0.981 | 0.980 | 0.990 | | | | | |
| ***T (°C)*** | 15 | ***t (ks)*** | 0.352 | 1.318 | 3.091 | 6.668 | 14.909 | 36.351 | 75.786 | 156.15 | | | | | |
| ***Ḋ (Gy/s)*** | 0 | ***Lx/Tx*** | 1.050 | 1.057 | 1.035 | 1.028 | 1.005 | 1.018 | 0.999 | 0.984 | | | | | |

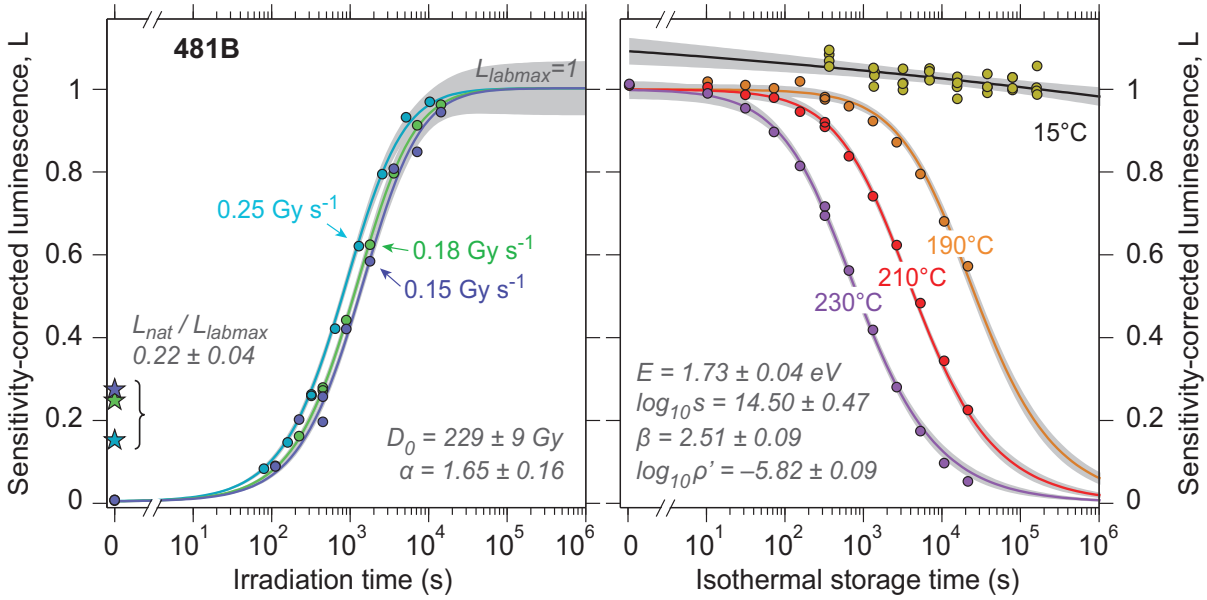


**Figure S6-11. Characterisation of electron trapping and detrapping kinetics (481B).** Radiation-induced growth (circles, left panel) and isothermal decay (circles, right panel) of sample 481B. Stars in left panel denote natural luminescence levels. Note that the y-axis of the shown data and its simultaneous best-fits are arbitrarily rescaled for convenience of presentation (laboratory saturation at L=1 in left panel; initial luminescence of L~1 in right panel).

**Table S6-11. Characterisation of electron trapping and detrapping kinetics (481B).**

***481B***

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***T (°C)*** | 15 | ***t (ks)*** | Nat | 0.080 | 0.160 | 0.320 | 0.640 | 1.280 | 2.560 | 5.120 | 10.240 | 0.000 | 0.320 | | |
| ***Ḋ (Gy/s)*** | 0.25 | ***Lx/Tx*** | 0.897 | 0.483 | 0.867 | 1.549 | 2.537 | 3.745 | 4.799 | 5.632 | 5.862 | 0.014 | 1.570 | | |
| ***T (°C)*** | 15 | ***t (ks)*** | Nat | 0.111 | 0.222 | 0.444 | 0.889 | 1.778 | 3.556 | 7.111 | 14.222 | 0.000 | 0.444 | | |
| ***Ḋ (Gy/s)*** | 0.18 | ***Lx/Tx*** | 1.386 | 0.490 | 0.898 | 1.526 | 2.490 | 3.524 | 4.504 | 5.163 | 5.447 | 0.023 | 1.564 | | |
| ***T (°C)*** | 15 | ***t (ks)*** | Nat | 0.111 | 0.222 | 0.444 | 0.889 | 1.778 | 3.556 | 7.111 | 14.222 | 0.000 | 0.444 | | |
| ***Ḋ (Gy/s)*** | 0.153 | ***Lx/Tx*** | 1.645 | 0.514 | 1.202 | 1.171 | 2.532 | 3.529 | 4.885 | 5.134 | 5.717 | 0.021 | 1.539 | | |
| ***T (°C)*** | 230 | ***t (ks)*** | 0.000 | 0.010 | 0.030 | 0.070 | 0.150 | 0.310 | 0.630 | 1.270 | 2.550 | 5.110 | 10.230 | 20.470 | 0.310 |
| ***Ḋ (Gy/s)*** | 0 | ***Lx/Tx*** | 0.975 | 0.953 | 0.919 | 0.863 | 0.784 | 0.668 | 0.540 | 0.402 | 0.270 | 0.167 | 0.092 | 0.050 | 0.690 |
| ***T (°C)*** | 210 | ***t (ks)*** | 0.000 | 0.010 | 0.030 | 0.070 | 0.150 | 0.310 | 0.630 | 1.270 | 2.550 | 5.110 | 10.230 | 20.470 | 0.310 |
| ***Ḋ (Gy/s)*** | 0 | ***Lx/Tx*** | 0.981 | 0.978 | 0.959 | 0.953 | 0.920 | 0.884 | 0.815 | 0.721 | 0.606 | 0.469 | 0.334 | 0.218 | 0.895 |
| ***T (°C)*** | 190 | ***t (ks)*** | 0.000 | 0.010 | 0.030 | 0.070 | 0.150 | 0.310 | 0.630 | 1.270 | 2.550 | 5.110 | 10.230 | 20.470 | 0.310 |
| ***Ḋ (Gy/s)*** | 0 | ***Lx/Tx*** | 0.983 | 0.992 | 0.983 | 0.976 | 0.993 | 0.950 | 0.934 | 0.899 | 0.849 | 0.775 | 0.663 | 0.557 | 0.955 |
| ***T (°C)*** | 15 | ***t (ks)*** | 0.353 | 1.327 | 3.082 | 6.709 | 15.053 | 36.510 | 75.960 | 152.73 | | | | | |
| ***Ḋ (Gy/s)*** | 0 | ***Lx/Tx*** | 1.010 | 0.970 | 0.946 | 0.979 | 0.911 | 0.937 | 0.959 | 0.936 | | | | | |
| ***T (°C)*** | 15 | ***t (ks)*** | 0.352 | 1.319 | 3.064 | 6.667 | 14.985 | 36.426 | 75.861 | 156.22 | | | | | |
| ***Ḋ (Gy/s)*** | 0 | ***Lx/Tx*** | 1.040 | 1.005 | 0.971 | 0.998 | 0.979 | 0.965 | 1.001 | 1.028 | | | | | |
| ***T (°C)*** | 15 | ***t (ks)*** | 0.353 | 1.299 | 3.053 | 6.676 | 15.102 | 36.559 | 76.010 | 152.78 | | | | | |
| ***Ḋ (Gy/s)*** | 0 | ***Lx/Tx*** | 1.032 | 0.948 | 0.989 | 0.962 | 0.970 | 0.948 | 0.940 | 0.939 | | | | | |
| ***T (°C)*** | 15 | ***t (ks)*** | 0.352 | 1.291 | 3.037 | 6.637 | 15.033 | 36.474 | 75.910 | 156.27 | | | | | |
| ***Ḋ (Gy/s)*** | 0 | ***Lx/Tx*** | 1.034 | 1.031 | 0.993 | 1.022 | 0.996 | 1.016 | 0.983 | 0.968 | | | | | |

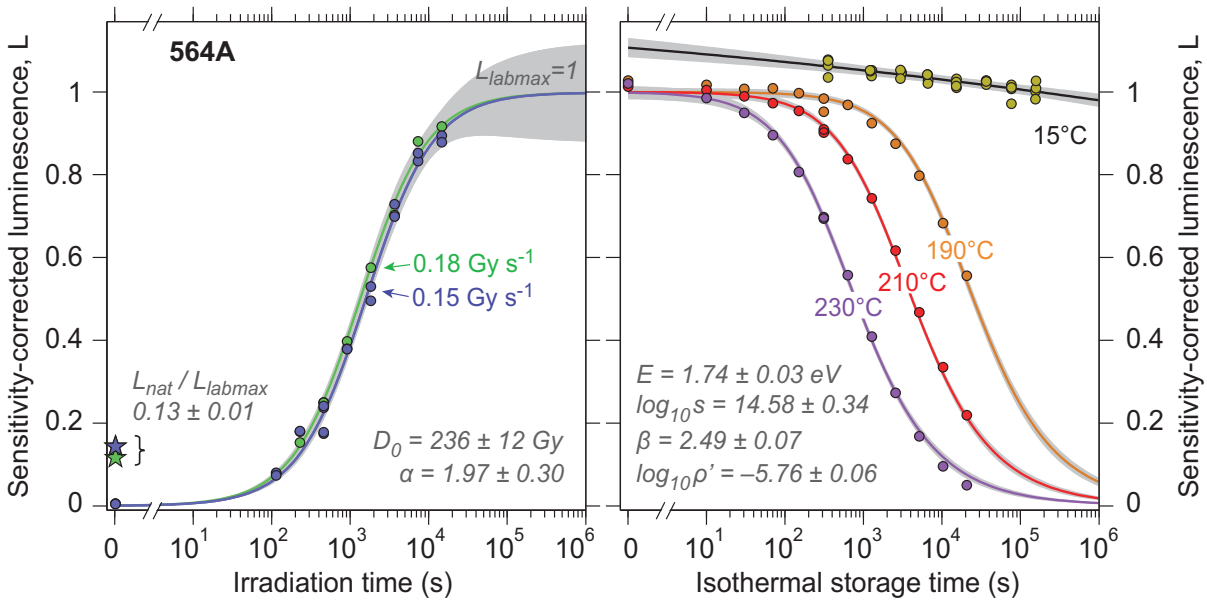


**Figure S6-12. Characterisation of electron trapping and detrapping kinetics (564A).** Radiation-induced growth (circles, left panel) and isothermal decay (circles, right panel) of sample 564A. Stars in left panel denote natural luminescence levels. Note that the y-axis of the shown data and its simultaneous best-fits are arbitrarily rescaled for convenience of presentation (laboratory saturation at L=1 in left panel; initial luminescence of L~1 in right panel).

**Table S6-12. Characterisation of electron trapping and detrapping kinetics (564A).**

| ***564A*** | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***T (°C)*** | 15 | ***t (ks)*** | Nat | 0.111 | 0.222 | 0.444 | 0.889 | 1.778 | 3.556 | 7.111 | 14.222 | 0.000 | 0.444 | | |
| ***Ḋ (Gy/s)*** | 0.18 | ***Lx/Tx*** | 0.728 | 0.493 | 0.963 | 1.569 | 2.496 | 3.612 | 4.411 | 5.529 | 5.756 | 0.032 | 1.566 | | |
| ***T (°C)*** | 15 | ***t (ks)*** | Nat | 0.111 | 0.222 | 0.444 | 0.889 | 1.778 | 3.556 | 7.111 | 14.222 | 0.000 | 0.444 | | |
| ***Ḋ (Gy/s)*** | 0.153 | ***Lx/Tx*** | 0.950 | 0.528 | 1.186 | 1.152 | 2.505 | 3.274 | 4.819 | 5.504 | 5.914 | 0.035 | 1.568 | | |
| ***T (°C)*** | 15 | ***t (ks)*** | Nat | 0.111 | 0.222 | 0.444 | 0.889 | 1.778 | 3.556 | 7.111 | 14.222 | 0.000 | 0.444 | | |
| ***Ḋ (Gy/s)*** | 0.153 | ***Lx/Tx*** | 0.963 | 0.494 | 1.214 | 1.198 | 2.546 | 3.562 | 4.703 | 5.731 | 5.906 | 0.031 | 1.621 | | |
| ***T (°C)*** | 230 | ***t (ks)*** | 0.000 | 0.010 | 0.030 | 0.070 | 0.150 | 0.310 | 0.630 | 1.270 | 2.550 | 5.110 | 10.230 | 20.470 | 0.310 |
| ***Ḋ (Gy/s)*** | 0 | ***Lx/Tx*** | 0.973 | 0.940 | 0.905 | 0.854 | 0.769 | 0.662 | 0.531 | 0.389 | 0.260 | 0.159 | 0.090 | 0.047 | 0.665 |
| ***T (°C)*** | 210 | ***t (ks)*** | 0.000 | 0.010 | 0.030 | 0.070 | 0.150 | 0.310 | 0.630 | 1.270 | 2.550 | 5.110 | 10.230 | 20.470 | 0.310 |
| ***Ḋ (Gy/s)*** | 0 | ***Lx/Tx*** | 0.982 | 0.974 | 0.959 | 0.943 | 0.925 | 0.874 | 0.812 | 0.720 | 0.597 | 0.453 | 0.324 | 0.211 | 0.881 |
| ***T (°C)*** | 190 | ***t (ks)*** | 0.000 | 0.010 | 0.030 | 0.070 | 0.150 | 0.310 | 0.630 | 1.270 | 2.550 | 5.110 | 10.230 | 20.470 | 0.310 |
| ***Ḋ (Gy/s)*** | 0 | ***Lx/Tx*** | 1.022 | 1.011 | 1.003 | 1.004 | 0.992 | 0.979 | 0.963 | 0.919 | 0.870 | 0.793 | 0.679 | 0.553 | 0.947 |
| ***T (°C)*** | 15 | ***t (ks)*** | 0.352 | 1.270 | 3.025 | 6.619 | 15.153 | 36.610 | 76.060 | 152.83 | | | | | |
| ***Ḋ (Gy/s)*** | 0 | ***Lx/Tx*** | 0.979 | 0.995 | 0.990 | 0.972 | 0.975 | 0.970 | 0.962 | 0.947 | | | | | |
| ***T (°C)*** | 15 | ***t (ks)*** | 0.352 | 1.264 | 3.011 | 6.584 | 15.081 | 36.523 | 75.958 | 156.32 | | | | | |
| ***Ḋ (Gy/s)*** | 0 | ***Lx/Tx*** | 1.073 | 1.033 | 1.039 | 1.016 | 1.019 | 1.013 | 1.003 | 1.005 | | | | | |
| ***T (°C)*** | 15 | ***t (ks)*** | 0.353 | 1.216 | 2.943 | 6.509 | 15.150 | 36.606 | 76.057 | 152.83 | | | | | |
| ***Ḋ (Gy/s)*** | 0 | ***Lx/Tx*** | 1.040 | 1.026 | 1.029 | 1.019 | 0.987 | 1.004 | 0.988 | 0.960 | | | | | |
| ***T (°C)*** | 15 | ***t (ks)*** | 0.353 | 1.213 | 2.931 | 6.478 | 15.078 | 36.520 | 75.955 | 156.31 | | | | | |
| ***Ḋ (Gy/s)*** | 0 | ***Lx/Tx*** | 1.032 | 1.010 | 0.991 | 1.000 | 0.973 | 0.984 | 0.932 | 0.986 | | | | | |

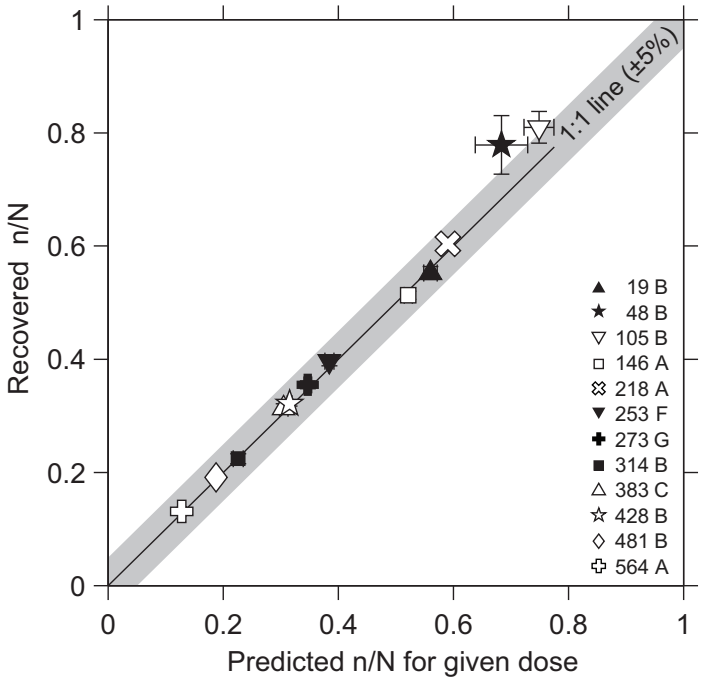


**Figure S7. Validation of the dosimetric protocol**. Successful recovery of known doses by the SAR protocol is visualized by the 1:1 relationship between predicted (horizontal axis) and recovered (vertical axis) trapped electron concentrations (n/N).

**Table S7. Validation of the dosimetric protocol.**

| Sample | | Measurements | | Model |
|---|---|---|---|---|
| Depth (km) | ID | Given dose (Gy) | Recovered n/N | Predicted n/N |
| 0.146 | 19B | 200 ± 10 | 0.56 ± 0.01 | 0.55 ± 0.01 |
| 0.334 | 48B | 130 ± 7 | 0.69 ± 0.05 | 0.79 ± 0.06 |
| 0.566 | 105B | 400 ± 20 | 0.75 ± 0.02 | 0.81 ± 0.02 |
| 0.726 | 146A | 300 ± 15 | 0.52 ± 0.01 | 0.51 ± 0.01 |
| 0.911 | 218A | 300 ± 15 | 0.59 ± 0.01 | 0.60 ± 0.01 |
| 1.175 | 253F | 150 ± 8 | 0.39 ± 0.01 | 0.40 ± 0.01 |
| 1.300 | 273G | 100 ± 5 | 0.35 ± 0.01 | 0.35 ± 0.01 |
| 1.499 | 314B | 75 ± 4 | 0.23 ± 0.01 | 0.22 ± 0.01 |
| 1.730 | 383C | 90 ± 5 | 0.30 ± 0.01 | 0.31 ± 0.01 |
| 1.892 | 428B | 100 ± 5 | 0.31 ± 0.01 | 0.32 ± 0.01 |
| 2.097 | 481B | 50 ± 3 | 0.19 ± 0.01 | 0.19 ± 0.01 |
| 2.329 | 564A | 35 ± 2 | 0.13 ± 0.01 | 0.13 ± 0.01 |

Given doses were within 30% of the natural dose of each sample. The average ratio between recovered and predicted trap filling ratios (n/N) is 0.97 ± 0.04.

# Part III – Interpretation

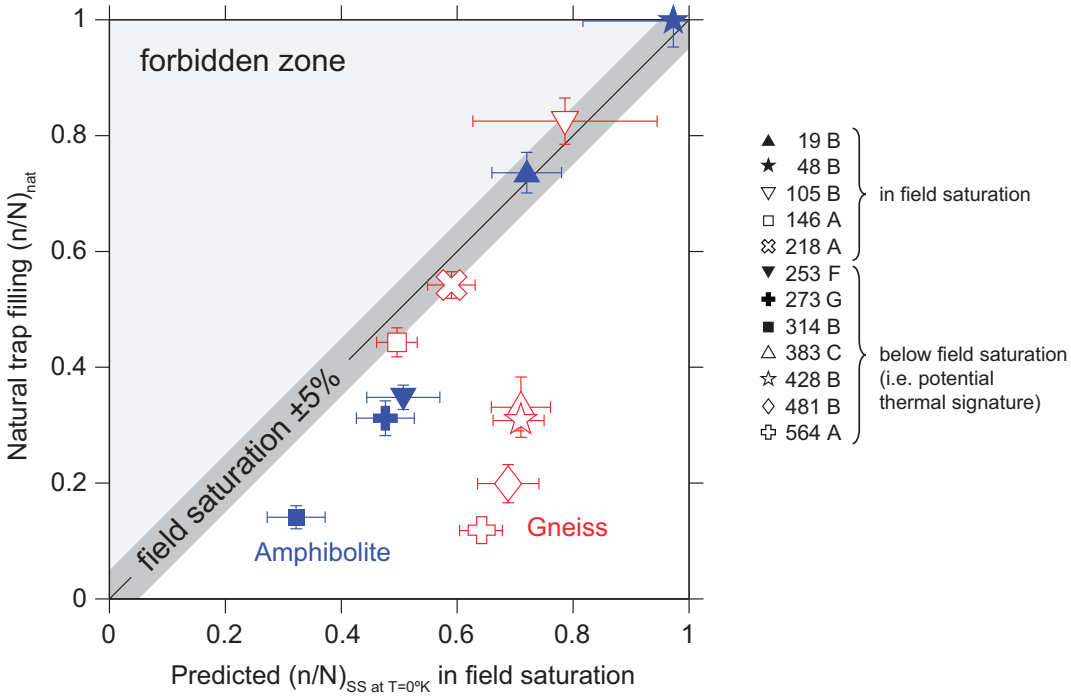


**Figure S8. Screening of field-saturated samples**. Extending the approach of Kars et al. (2008) to predict trap filling levels in an athermal field steady-state (i.e. mutually-balancing general order trapping and athermal losses; Eqs. 1-2 with $E \rightarrow \infty$ in the main text), we find that the top five KTB samples are in field-saturation in respect to their environmental dose rate and athermal fading, while the bottom seven samples from the borehole are not. Note, that no lithological control over field saturation is observed.

**Table S8. Screening of field-saturated samples.**

| Measurements | | | Model | | | | | | | Interpretation |
|---|---|---|---|---|---|---|---|---|---|---|
| Sample | | Natural signal | Predicted field saturation $(n/N)_{SS\ at\ T=0\ °K}$ as a function of dose rate | | | | | | | |
| Depth (km) | ID | $(n/N)_{nat}$ | $\dot{D}$ | $\dot{D}_1$ | $\dot{D}_2$ | $\dot{D}_3$ | $\dot{D}_4$ | $3\dot{D}$ | $\dot{D}/3$ | Natural signal is… |
| 0.146 | 19B | 0.74 ± 0.03 | **0.72 ± 0.06** | 0.73 | 0.74 | 0.73 | 0.73 | 0.74 | 0.72 | in field saturation |
| 0.334 | 28B | 1.00 ± 0.04 | **0.97 ± 0.16** | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | in field saturation |
| 0.566 | 105B | 0.83 ± 0.04 | **0.79 ± 0.16** | 0.83 | 0.83 | 0.83 | 0.83 | 0.84 | 0.82 | in field saturation |
| 0.726 | 146A | 0.44 ± 0.02 | **0.50 ± 0.04** | 0.50 | 0.50 | 0.50 | 0.50 | 0.52 | 0.48 | in field saturation |
| 0.911 | 218A | 0.54 ± 0.02 | **0.59 ± 0.04** | 0.59 | 0.59 | 0.59 | 0.60 | 0.61 | 0.58 | in field saturation |
| 1.175 | 253F | 0.35 ± 0.02 | **0.51 ± 0.06** | 0.51 | 0.51 | 0.51 | 0.51 | 0.53 | 0.50 | below field saturation |
| 1.300 | 273G | 0.31 ± 0.03 | **0.48 ± 0.05** | 0.48 | 0.47 | 0.48 | 0.48 | 0.50 | 0.46 | below field saturation |
| 1.499 | 314B | 0.14 ± 0.02 | **0.32 ± 0.05** | 0.33 | 0.32 | 0.33 | 0.33 | 0.35 | 0.31 | below field saturation |
| 1.730 | 383C | 0.33 ± 0.05 | **0.71 ± 0.05** | 0.72 | 0.72 | 0.72 | 0.72 | 0.73 | 0.70 | below field saturation |
| 1.892 | 428B | 0.31 ± 0.02 | **0.71 ± 0.04** | 0.71 | 0.70 | 0.71 | 0.71 | 0.72 | 0.69 | below field saturation |
| 2.097 | 481B | 0.20 ± 0.03 | **0.69 ± 0.05** | 0.69 | 0.69 | 0.69 | 0.69 | 0.70 | 0.68 | below field saturation |
| 2.329 | 564A | 0.12 ± 0.01 | **0.64 ± 0.04** | 0.65 | 0.64 | 0.65 | 0.65 | 0.66 | 0.63 | below field saturation |

Dose rate scenarios $\dot{D}_1$ through $\dot{D}_4$, and their arithmetic average $\dot{D}$, are introduced in Supplementary Figure and Table S5. Here, two additional scenarios involving a threefold higher ($3\dot{D}$) and a threefold lower ($\dot{D}/3$) dose rates (relative to $\dot{D}$) are further used to demonstrate, that across approximately one order of magnitude of environmental radioactivity, the predicted field saturation of the $IRSL_{50}$ electron traps remains essentially the same. Values in bold are further compared against the observed trap filling levels in Supplementary Figure S8.

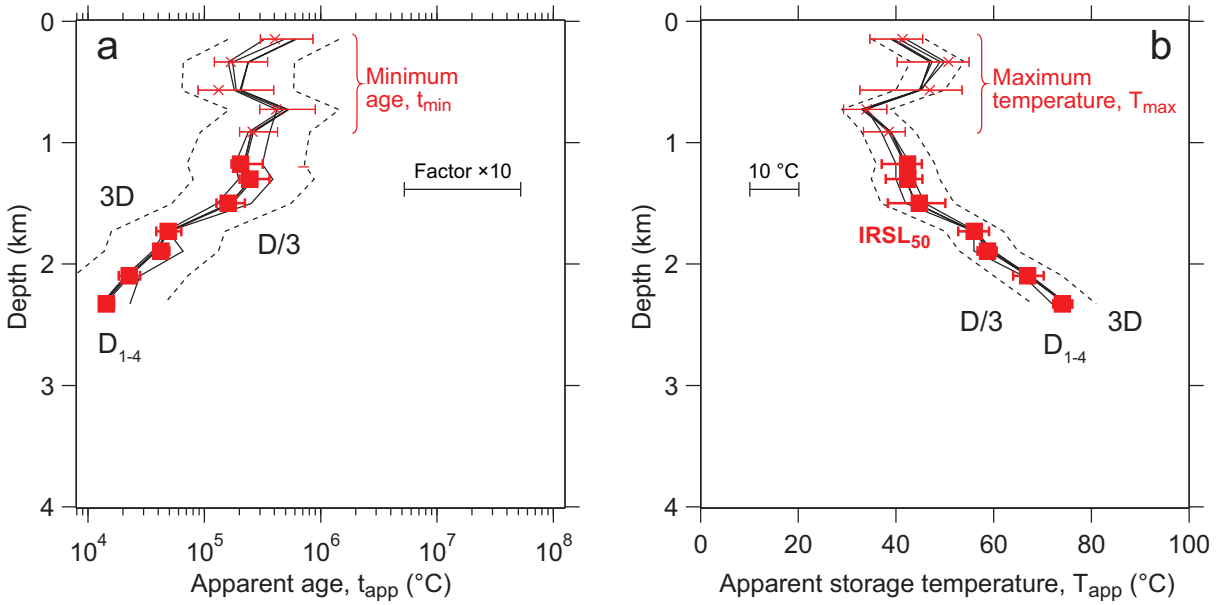


**Figure S9. Sensitivity of $t_{app}$ and $T_{app}$ to natural dose rate**. (**a**) Apparent and limiting ages ($t_{app}$ and $t_{min}$) as calculated for the average-scenario dose rate $\dot{D}$ (red squares and crosses; repeating data from Fig. 4a in the main text), and for alternative dose rate scenarios (lines). Note that a threefold increase ($3\dot{D}$) or decrease ($\dot{D}/3$) in dose rate (dashed lines) leads to a tenfold variation in ages. (**b**) Apparent and limiting temperatures ($T_{app}$ and $T_{max}$) as calculated for the average-scenario dose rate $\dot{D}$ (red squares and crosses; repeating data from Fig. 4b in the main text), and for alternative dose rates (lines). Note that $T_{app}$ obtained for a threefold increase or decrease in dose rate (dashed lines) remain well within <10 °C of the average-scenario dose rate.

**Table S9. Sensitivity of the inversion to natural dose rate.**

| Sample | | Apparent or limiting age, $t_{app}$ or $t_{min}$ (ka) as a function of dose rate | | | | | | | Apparent or limiting storage temperature $T_{app}$ or $T_{max}$ (°C) as a function of dose rate | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Depth (km) | ID | $\dot{D}$ | $\dot{D}_1$ | $\dot{D}_2$ | $\dot{D}_3$ | $\dot{D}_4$ | $3\dot{D}$ | $\dot{D}/3$ | $\dot{D}$ | $\dot{D}_1$ | $\dot{D}_2$ | $\dot{D}_3$ | $\dot{D}_4$ | $3\dot{D}$ | $\dot{D}/3$ |
| 0.146 | 19B | **>403** $^{+456}_{-100}$ | >602 | >331 | >613 | >487 | >160 | >1443 | **<41** $^{+4}_{-7}$ | <39 | <42 | <39 | <40 | <46 | <35 |
| 0.334 | 28B | **>169** $^{+181}_{-47}$ | >240 | >161 | >240 | >176 | >66 | >600 | **<51** $^{+4}_{-10}$ | <47 | <50 | <47 | <49 | <54 | <43 |
| 0.566 | 105B | **>133** $^{+262}_{-45}$ | >208 | >181 | >204 | >189 | >65 | >588 | **<47** $^{+7}_{-14}$ | <45 | <45 | <45 | <45 | <50 | <40 |
| 0.726 | 146A | **>415** $^{+485}_{-115}$ | >532 | >423 | >524 | >482 | >164 | >1456 | **<34** $^{+4}_{-5}$ | <33 | <34 | <33 | <34 | <39 | <29 |
| 0.911 | 218A | **>260** $^{+166}_{-57}$ | >264 | >367 | >256 | >240 | >93 | >811 | **<39** $^{+3}_{-5}$ | <39 | <37 | <39 | <39 | <44 | <33 |
| 1.175 | 253F | **205** $^{+112}_{-34}$ | 226 | 317 | 220 | 185 | 71 | 729 | **42** $^{+3}_{-5}$ | 42 | 40 | 42 | 43 | 48 | 36 |
| 1.300 | 273G | **247** $^{+117}_{-46}$ | 266 | 390 | 255 | 198 | 81 | 887 | **42** $^{+3}_{-5}$ | 42 | 40 | 42 | 44 | 49 | 35 |
| 1.499 | 314B | **160** $^{+63}_{-33}$ | 174 | 253 | 166 | 129 | 53 | 557 | **45** $^{+5}_{-6}$ | 44 | 42 | 44 | 46 | 52 | 37 |
| 1.730 | 383C | **49** $^{+14}_{-10}$ | 50 | 49 | 49 | 46 | 16 | 151 | **56** $^{+3}_{-3}$ | 56 | 56 | 56 | 56 | 62 | 50 |
| 1.892 | 428B | **42** $^{+8}_{-6}$ | 39 | 66 | 38 | 36 | 14 | 133 | **59** $^{+2}_{-2}$ | 59 | 56 | 60 | 60 | 65 | 53 |
| 2.097 | 481B | **23** $^{+5}_{-4}$ | 23 | 28 | 22 | 21 | 8 | 72 | **67** $^{+3}_{-3}$ | 67 | 66 | 67 | 68 | 74 | 60 |
| 2.329 | 564A | **14** $^{+2}_{-2}$ | 14 | 23 | 13 | 13 | 5 | 45 | **74** $^{+2}_{-2}$ | 75 | 72 | 75 | 75 | 81 | 68 |

Dose rate scenarios $\dot{D}_1$ through $\dot{D}_4$ , and their arithmetic average $\dot{D}$, are introduced in Supplementary Figure and Table S5. As in Supplementary Figure and Table S8, here we also use two additional scenarios involving a threefold higher ($3\dot{D}$) and lower ($\dot{D}/3$) dose rates, to demonstrate that while apparent ages are strongly (linearly) dependent on the dose rate, its effect on apparent storage temperatures is weak (logarithmic). Values in bold are apparent/limiting ages and temperatures as reported in Table 4 in the main text.

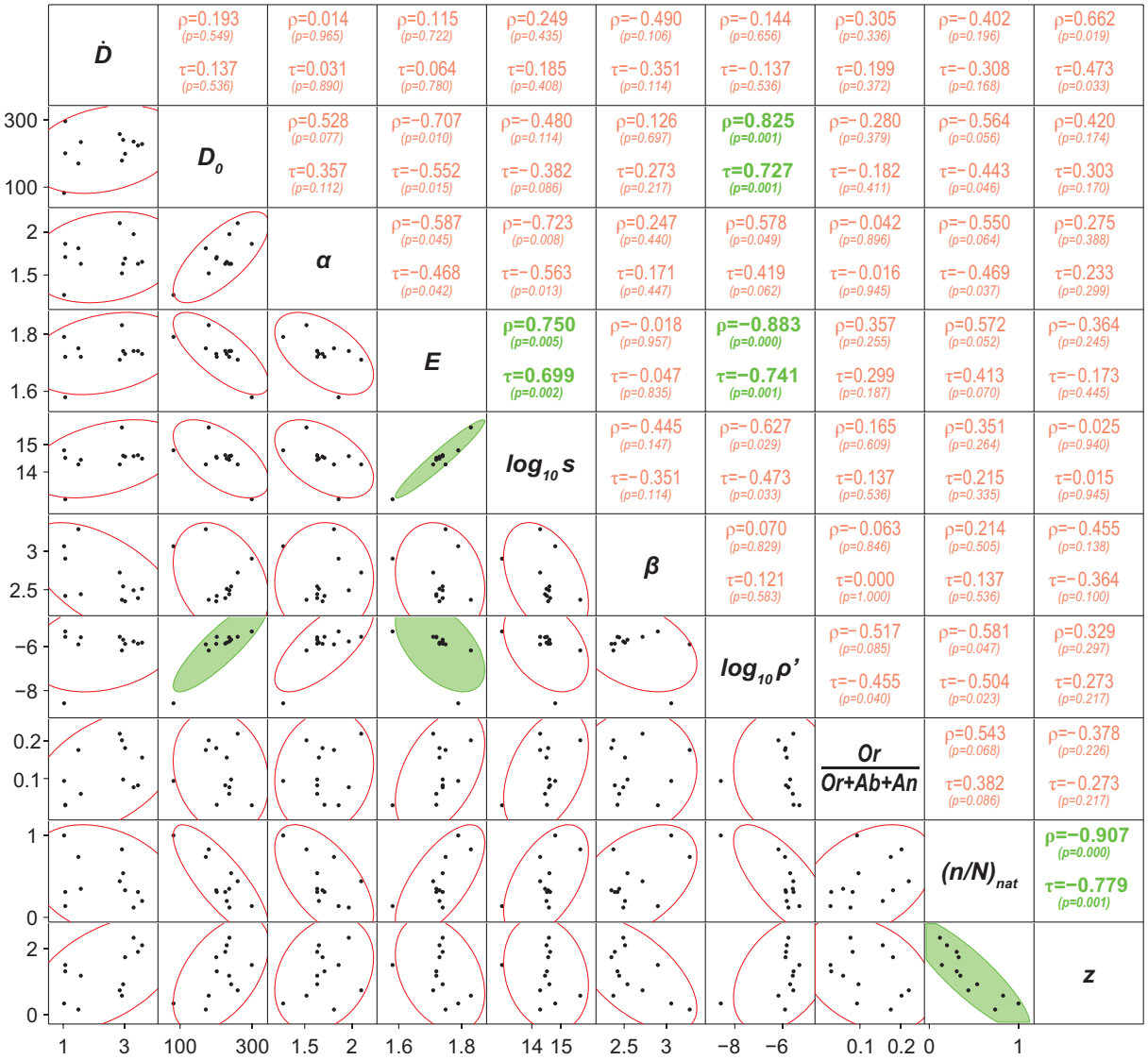


**Figure and Table S10. Multivariate statistics on model parameters and observations**. Non-parametric rank correlation coefficients due to Spearman (ρ) and Kendall (τ), and the probabilities to obtain lower coefficients (p-values, below). The strongest correlation is observed between natural electron trap filling $(n/N)_{nat}$ and sample depth (z), with ρ=-0.907 and τ=-0.779. Four of the strongest correlations (corresponding to the top 10%-percentile) are marked in green; the probability of these correlations being statistically insignificant is <1%. Due to the small sample size (12 observations), we discard all other correlations (whose probability of being insignificant exceeds 1%) as statistically unsupported, pending further proof. Most strikingly, no correlation is observed between depth and any of the kinetic parameters; this strengthens the use of feldspar luminescence for transient cooling conditions, where geological samples move from hot depths towards a colder surface.