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Metamictisation of natural zircon: accumulation versus thermal annealing of radioactivity-induced damage

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Due to unfortunate mistakes when looking up α-energies from the literature, parts of the calculations in Table 2 were done with incorrect values. The simulations were redone. The corrected table is given below:

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Reference

Firestone RB, Shirley VS (1996) Table of isotopes 2. Wiley, New York

Table 2. Results of Monte Carlo simulations: Average ranges of ^{4}He cores and recoiled heavy daughter nuclei and average numbers of atomic vacancies created per α-decay event

No.	α-decay event	Emitted ^{4}He core (α-particle)			Recoiled daughter nucleus			Total displacements per α-event
		α-energy [MeV] (rel. probability in the decay event) [a]	Range [μm]	Displacements	Nucleus energy [keV]	Range [Å]	Displacements	
^{238}U decay series:								
1	$^{238}U \rightarrow {}^{234}Th$	4.198 (79 %)	10.7	118	71.8	208	593	711
		4.151 (21 %)	10.5	119	71.0	206	587	706
2	$^{234}U \rightarrow {}^{230}Th$	4.775 (71 %)	12.8	122	83.0	225	674	796
		4.722 (28 %)	12.6	122	82.2	223	668	790
3	$^{230}Th \rightarrow {}^{226}Ra$	4.688 (76 %)	12.5	121	83.0	225	673	794
		4.621 (23 %)	12.2	121	81.8	222	658	779
4	$^{226}Ra \rightarrow {}^{222}Rn$	4.784 (99 %)	12.8	123	86.2	231	693	816
5	$^{222}Rn \rightarrow {}^{218}Po$	5.490 (100 %)	15.6	123	100.7	258	792	915
6	$^{218}Po \rightarrow {}^{214}Pb$	6.002 (100 %)	17.8	125	112.2	281	871	996
7	$^{214}Po \rightarrow {}^{210}Pb$	7.687 (100 %)	25.8	134	146.5	329	1100	1234
8	$^{210}Po \rightarrow {}^{206}Pb$	5.304 (100 %)	14.9	122	103.0	261	805	927
^{235}U decay series:								
1	$^{235}U \rightarrow {}^{231}Th$	4.398 (55 %)	11.4	119	76.2	214	624	743
		4.366 (17 %)	11.3	119	75.5	214	620	739
2	$^{231}Pa \rightarrow {}^{227}Ac$	5.014 (25 %)	13.7	122	88.4	234	712	834
		4.951 (23 %)	13.5	122	87.3	232	704	826
		5.028 (20 %)	13.8	123	88.7	234	715	838
		5.059 (11 %)	13.9	124	89.2	234	718	842
3	$^{227}Th \rightarrow {}^{223}Ra$	6.038 (24 %)	18.0	125	108.4	267	855	980
		5.978 (24 %)	17.7	125	107.3	267	841	966
		5.757 (20 %)	16.8	125	103.3	258	814	939
4	$^{223}Ra \rightarrow {}^{219}Rn$	5.716 (53 %)	16.6	126	104.5	261	820	946
		5.607 (26 %)	16.1	124	102.5	258	806	930
5	$^{219}Rn \rightarrow {}^{215}Po$	6.819 (79 %)	21.5	129	126.9	300	979	1108
		6.553 (13 %)	20.3	129	122.0	291	936	1065
6	$^{215}Po \rightarrow {}^{211}Pb$	7.386 (100 %)	24.3	130	140.1	323	1067	1197
7	$^{211}Bi \rightarrow {}^{207}Tl$	6.623 (84 %)	20.6	127	128.0	305	983	1110
		6.278 (16 %)	19.0	126	121.4	293	930	1056
^{232}Th decay series:								
1	$^{232}Th \rightarrow {}^{228}Ra$	4.013 (78 %)	10.0	118	70.4	206	587	705
		3.954 (22 %)	9.9	117	69.6	205	581	698
2	$^{228}Th \rightarrow {}^{224}Ra$	5.423 (71 %)	15.4	124	96.9	250	777	901
		5.340 (28 %)	15.0	123	95.4	246	760	883
3	$^{224}Ra \rightarrow {}^{220}Rn$	5.685 (95 %)	16.5	125	103.4	260	819	944
4	$^{220}Rn \rightarrow {}^{216}Po$	6.288 (100 %)	19.1	130	116.5	284	907	1037
5	$^{216}Po \rightarrow {}^{212}Pb$	6.778 (100 %)	21.3	130	127.9	306	983	1113
6a	$^{212}Po \rightarrow {}^{208}Pb$ (64 %)	8.784 (100 %)	31.7	136	169.0	367	1242	1378
6b	$^{212}Bi \rightarrow {}^{208}Tl$ (36 %)	6.051 (70 %)	18.0	124	116.4	287	897	1011
		6.090 (27 %)	18.2	125	117.2	287	902	1027

[a] Data from Firestone and Shirley (1996), rounded values. Simulations were only done for α-energies with relative probabilities of > 10% in the branching paths