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Tracking the ^{10}Be–^{26}Al source-area signal in sediment-routing systems of arid central Australia

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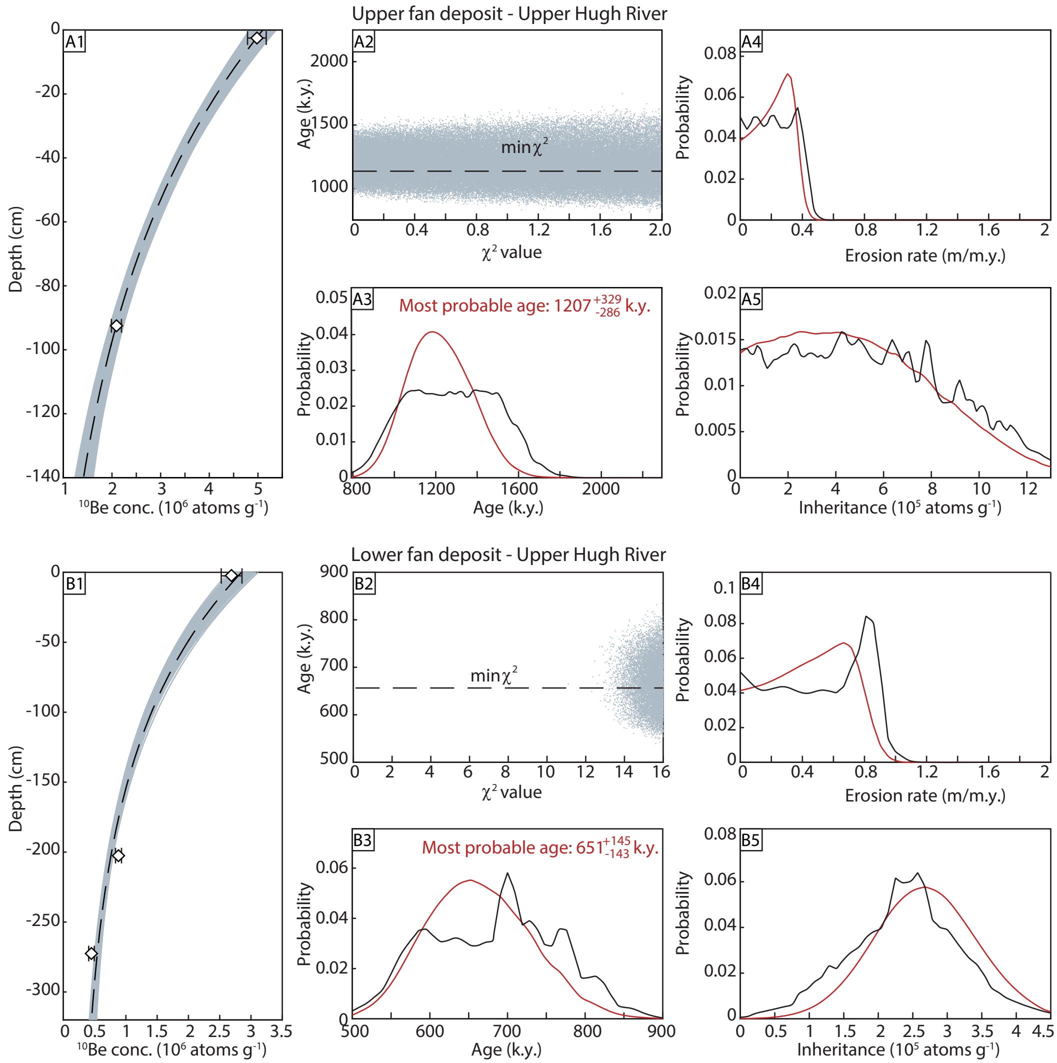

Figure S1. ^{10}Be depth profiles of a fan in the Upper Hugh catchment from A) upper fan deposits (samples UHugh199, UHugh299) and B) lower fan deposits (samples UHugh499, UHugh399, Be122p); all uncertainties are $\pm 2\sigma$. A1) Depth-variation in ^{10}Be abundance (diamonds), with model-generated exponential curves (grey) and the lowest chi-squared fit (black dashes). A2) Age versus chi-squared plot for ^{10}Be, with minimum chi-squared age (dashed line). A3), A4), and A5) Smoothed chi-squared (black) and Bayesian probability density (red) functions for depositional age, erosion rate, and ^{10}Be inheritance, respectively. All calculations follow Hidy et al. (2010, version 1.2), with full model parameters given in Table S2.

Table S1: Thermoluminescence deposition age results.

Sample ID	Latitude [°S]	Longitude [°E]	Elevation [m a.s.l.]	Plateau region [°C]	Analysis temperature [°C]	Palaeo-dose [Grays]	K content [% by AES]	Rb content (assumed) [ppm]	Moisture content [weight %]	Specific activity [Bq/kg U+Th]	Cosmic contribution (assumed) [μGy/yr]	Annual radiation dose [μGy/yr]	TL age [k.y.]
MACUMBA catchment													
TL1-40	–27.1729	134.3548	225	300-500	375	110 ± 9	0.865 ± 0.05	100 ± 25	5.7 ± 3	68.8 ± 1.7	150 ± 25	2354 ± 60	46.6 ± 4.2
TL1-100	–27.1729	134.3548	225	300-500	375	263 ± 18	0.865 ± 0.05	100 ± 25	4.0 ± 3	58.3 ± 1.5	150 ± 25	2194 ± 61	120 ± 9
TL1-160	–27.1729	134.3548	225	300-500	375	>191 ± 16	0.730 ± 0.05	100 ± 25	6.2 ± 3	58.4 ± 1.5	140 ± 25	1997 ± 59	>95.5 ± 8.6
TL2-125	–27.1683	134.3703	223	300-500	375	64.7 ± 4.6	0.945 ± 0.05	100 ± 25	3.8 ± 3	84.9 ± 2.7	150 ± 25	2805 ± 68	23.1 ± 1.7

Specific activity was measured by means of calibrated thick source alpha counting over a 42 mm scintillation screen. Values shown assume secular equilibrium for both U and Th decay chains. Uncertainties are expressed at 1-σ level.

Table S2: Parameters used for Monte Carlo modelling of fan deposition ages (Fig. S1).

Site-specific information	**Upper fan deposit**	**Lower fan deposit**
Latitude [°S]	–23.8110	–23.8097
Longitude [°E]	133.1850	133.1921
Elevation [m a.s.l.]	789	765
Shielding		
Topographic shielding	1	1
Cover	1	1
^{10}Be and ^{26}Al production rate		
Spallation production rate [atoms g^{-1} yr^{-1}]	5.37	5.27
Muonic production		
Depth of muon fit [m]	5	5
Slow muon surface production [%]	0.135	0.134
Fast muon surface production [%]	0.101	0.100
Bulk material density		
Minimum density [g cm^{-3}]	1.5	1.5
Maximum density [g cm^{-3}]	1.9	1.9
Monte Carlo parameters[a]		
Chi^2 value	2[b]	16[b]
Number of profiles	100000	100000
Min age [yr]	750000	500000
Max age [yr]	2250000	900000
Min erosion rate [cm/k.y.]	0	0
Max erosion rate [cm/k.y.]	1	1
Min total erosion threshold [cm]	0	0
Max total erosion threshold [cm]	50	50
Min inheritance [atoms/g]	0	0
Max inheritance [atoms/g]	1300000	450000
Neutrons (mean value)	160	160
Neutrons (standard deviation)	5	5

a) For detailed explanation of parameters see Hidy et al. (2010).

b) No solutions were found for lower chi^2 values.

Table S3: Previously published ^{10}Be-^{26}Al data from within the study area.

Sample ID	AMS ID (Be / Al)	Latitude[a] [°S]	Longitude[a] [°E]	Elevation[a,b] [m a.s.l.]	Depth below surface [cm]	Topographic shielding	Sample mass [g qtz]	^{10}Be/^{9}Be[c,d,e] [10^{-15}]	^{9}Be carrier mass[f] [mg]	^{10}Be conc.[e] [10^3 at. g^{-1}]	^{26}Al/^{27}Al[e,g,h,i] [10^{-15}]	^{27}Al ICP conc. [ppm]	^{26}Al conc.[e] [10^3 at. g^{-1}]	^{26}Al/^{10}Be ratio[e]
Finke catchment - Bedrock														
PIO-BR[j]	B6062/A2788	–23.712295	132.787099	715	0	0.9995	42.327	1163 ± 13[2,C]	0.301[G]	623 ± 16	658 ± 32*[H]	232	3406 ± 239	5.47 ± 0.41
MD-100[k]	-	–23.574000	132.587000	1320	0	-	-	-	-	2025 ± 150	-	-	-	-
MD-101[k]	-	–23.581000	132.574000	1240	0	-	-	-	-	3400 ± 246	-	-	-	-
MD-102[k]	-	–23.579000	132.568000	1180	0	-	-	-	-	2317 ± 388	-	-	-	-
MD-103[k]	-	–23.577000	132.564000	1125	0	-	-	-	-	2993 ± 355	-	-	-	-
MD-104[k]	-	–23.576000	132.555000	1030	0	-	-	-	-	1321 ± 155	-	-	-	-
MD-105[k]	-	–23.573000	132.537000	945	0	-	-	-	-	6500 ± 369	-	-	-	-
MD-106[k]	-	–23.571000	132.534000	940	0	-	-	-	-	2768 ± 179	-	-	-	-
MD-107[k]	-	–23.567000	132.528000	910	0	-	-	-	-	1439 ± 106	-	-	-	-
MD-114[k]	-	–23.699221	132.354850	810	35	-	-	-	-	572 ± 66	-	-	-	-
MD-115[k]	-	–23.699221	132.354850	801	30	-	-	-	-	262 ± 45	-	-	-	-
MD-116[k]	-	–23.699221	132.354850	804	25	-	-	-	-	195 ± 15	-	-	-	-
MD-117[k]	-	–23.699221	132.354850	799	28	-	-	-	-	333 ± 56	-	-	-	-
MD-118[k]	-	–23.699221	132.354850	822	30	-	-	-	-	451 ± 73	-	-	-	-
MD-129[k]	-	–23.724000	132.776000	900	0	-	-	-	-	1260 ± 169	-	-	-	-
MD-130[k]	-	–23.722000	132.772000	900	0	-	-	-	-	2077 ± 284	-	-	-	-
MD-131[k]	-	–23.722000	132.772000	890	0	-	-	-	-	266 ± 69	-	-	-	-
MD-132[k]	-	–23.721000	132.773000	838	0	-	-	-	-	759 ± 125	-	-	-	-
MD-133[k]	-	–23.719000	132.773000	765	0	-	-	-	-	317 ± 43	-	-	-	-
MD-136[k]	-	–23.718000	132.774000	715	0	-	-	-	-	802 ± 154	-	-	-	-
Finke catchment - Hillslope soil														
PIO-TS5[j]	B6183/a436	–23.711949	132.786910	707	0	1.0000	40.293	1425 ± 14[1,D]	0.301[F]	802 ± 19	1641 ± 47[H]	136	4974 ± 247	6.21 ± 0.34
PIO-TS7[j]	B6063/A2789	–23.711771	132.786813	705	0	1.0000	40.795	1372 ± 13[2,C]	0.302[G]	766 ± 19	1141 ± 59*[H]	197	5031 ± 361	6.56 ± 0.50
PIO-TS9[j]	B6180/a433	–23.711548	132.786719	704	0	1.0000	40.525	2409 ± 72[1,D]	0.299[F]	1338 ± 50	2451 ± 73[H]	148	8111 ± 410	6.06 ± 0.38
PIO-TS11/DP0[j]	B6064/A2790	–23.711174	132.786723	703	0	0.9996	41.336	2714 ± 20[2,C]	0.303[G]	1497 ± 35	2498 ± 109*[H]	154	8585 ± 569	5.73 ± 0.40
PIO-TS13[j]	B6181/a434	–23.710823	132.786700	702	0	1.0000	40.621	3298 ± 59[1,D]	0.298[F]	1821 ± 52	3119 ± 72[H]	149	10379 ± 486	5.70 ± 0.30
PIO-TS17[j]	B6065/A2791	–23.710096	132.786775	700	0	1.0000	40.534	3411 ± 24[2,C]	0.303[G]	1922 ± 45	3854 ± 94*[H]	126	10798 ± 601	5.62 ± 0.34
PIO-TS18[j]	B6184/a441	–23.709762	132.786800	699	0	1.0000	40.517	3950 ± 52[1,D]	0.301[F]	2213 ± 58	4370 ± 100[H]	130	12664 ± 592	5.72 ± 0.31
PIO-DP30[j]	B6182/a435	–23.711174	132.786723	703	30	0.9996	40.413	2018 ± 19[1,D]	0.299[F]	1126 ± 27	2164 ± 65[H]	131	6251 ± 322	5.64 ± 0.32
PIO-DP60[j]	B6186/a442	–23.711174	132.786723	703	60	0.9996	40.169	1646 ± 13[1,D]	0.301[F]	930 ± 22	2038 ± 61[H]	104	4714 ± 239	5.07 ± 0.28
PIO-DP100[j]	B6066/A2792	–23.711174	132.786723	703	100	0.9996	40.401	1577 ± 15[2,C]	0.303[G]	892 ± 22	1690 ± 80*[H]	131	4945 ± 340	5.54 ± 0.40
PIO-DP150[j]	B6187/a443	–23.711174	132.786723	703	150	0.9996	40.497	1239 ± 12[1,D]	0.301[F]	694 ± 17	1101 ± 36[H]	130	3203 ± 167	4.61 ± 0.27
PIO-DP200[j]	B6188/a444	–23.711174	132.786723	703	200	0.9996	40.343	961 ± 28[1,D]	0.301[F]	541 ± 20	872 ± 27[H]	148	2885 ± 147	5.33 ± 0.34
PIO-DP250[j]	B6189/a445	–23.711174	132.786723	703	250	0.9996	40.185	913 ± 13[1,D]	0.301[F]	515 ± 14	731 ± 25[H]	146	2385 ± 128	4.63 ± 0.28
PIO-DP285[j]	B6190/A2827	–23.711174	132.786723	703	285	0.9996	40.326	924 ± 14[1,D]	0.302[F]	521 ± 14	715 ± 37*[H]	156	2489 ± 180	4.78 ± 0.37
MD-135[k]	-	–23.718000	132.772000	720	0	-	-	-	-	324 ± 57	-	-	-	-

Continued on next page.

Table S3 continued from previous page.

Sample ID	AMS ID (Be / Al)	Latitude[a] [°S]	Longitude[a] [°E]	Elevation[a,b] [m a.s.l.]	Depth below surface [cm]	Topographic shielding	Sample mass [g qtz]	^{10}Be/^{9}Be[c,d,e] [10^{-15}]	^{9}Be carrier mass[f] [mg]	^{10}Be conc.[e] [10^{3} at. g^{-1}]	^{26}Al/^{27}Al[e,g,h,i] [10^{-15}]	^{27}Al ICP conc. [ppm]	^{26}Al conc.[e] [10^{3} at. g^{-1}]	^{26}Al/^{10}Be ratio[e]
Finke catchment - Stream sediment														
MD-108S / H8[k]	-	–23.591873	132.569973	1061	-	-	-	-	-	5185 ± 235	-	-	-	-
MD-109S / H9[k]	-	–23.589848	132.560118	972	-	-	-	-	-	1202 ± 103	-	-	-	-
MD-110S / H10[k]	-	–23.590801	132.535687	820	-	-	-	-	-	3701 ± 265	-	-	-	-
MD-111S / H11[k]	-	–23.660723	132.363925	812	-	-	-	-	-	588 ± 94	-	-	-	-
MD-119S / H19[k]	-	–23.699221	132.354850	791	-	-	-	-	-	461 ± 38	-	-	-	-
MD-137 / H37[k]	-	–23.716000	132.773000	771	-	-	-	-	-	502 ± 69	-	-	-	-
Macumba catchment - Bedrock														
TD-BR[j]	B5949/A2682	–27.179882	134.394553	275	0	1.0000	40.146	9231 ± 75[1,A]	0.310[F]	5189 ± 123	13050 ± 773*[I]	64	18667 ± 1447	3.60 ± 0.29
G499[l]	-	–27.180967	134.399817	250	0	-	-	-	-	7669 ± 287	-	-	-	-
Macumba catchment - Hillslope soil														
TD-TS1[j]	B5950/A2683	–27.180339	134.391464	270	0	1.0000	40.127	9578 ± 118[1,A]	0.311[F]	5399 ± 138	12341 ± 280*[I]	60	16420 ± 902	3.04 ± 0.18
TD-TS4[j]	B6230/A2737	–27.174990	134.386994	237	0	1.0000	11.065	2379 ± 27[1,E]	0.297[F]	4817 ± 121	12324 ± 631*[H]	68	18642 ± 1334	3.87 ± 0.29
TD-TS9[j]	B6030/A2738	–27.166352	134.378727	201	0	1.0000	40.122	9602 ± 52[1,B]	0.296[F]	5331 ± 123	13120 ± 183*[H]	65	19175 ± 995	3.60 ± 0.20
G199[l]	-	–27.163533	134.401667	220	0	-	-	-	-	6133 ± 287	-	-	-	-
Neales catchment - Bedrock														
NIL-BR1[j]	B5944/A2677	–28.478932	136.015858	391	0	0.9992	40.136	2511 ± 29[1,A]	0.317[F]	1443 ± 36	4125 ± 131*[I]	92	8435 ± 499	5.85 ± 0.38
NIL-BR2[j]	B6058/ -	–28.478985	136.015451	380	0	0.9779	41.973	770 ± 14[2,C]	0.300[G]	415 ± 12	-	-	-	-
Neales catchment - Hillslope soil														
NIL-TS0[j]	B6059/A2785	–28.477696	136.018166	407	0	1.0000	40.214	2353 ± 18[2,C]	0.302[G]	1333 ± 31	1661 ± 85*[H]	179	6622 ± 472	4.97 ± 0.37
NIL-TS4[j]	B6060/a431	–28.478241	136.016897	405	0	1.0000	41.610	1863 ± 18[2,C]	0.302[G]	1019 ± 25	1075 ± 38[H]	192	4598 ± 247	4.51 ± 0.27
NIL-TS6[j]	B5945/A2678	–28.478486	136.016399	403	0	1.0000	40.337	2355 ± 35[1,A]	0.317[F]	1348 ± 36	2553 ± 193*[I]	126	7190 ± 651	5.33 ± 0.50
NIL-TS8[j]	B6061/a432	–28.478696	136.015943	397	0	1.0000	40.464	1851 ± 24[2,C]	0.303[G]	1044 ± 27	1033 ± 36[H]	192	4432 ± 237	4.25 ± 0.25
NIL-TS10[j]	B5946/a465	–28.478856	136.015606	387	0	1.0000	40.096	1115 ± 26[1,A]	0.317[F]	643 ± 21	1716 ± 46[J]	97	3702 ± 181	5.76 ± 0.34
NIL-TOP-0[j]	B5942/A2675	–28.479819	136.017803	406	0	1.0000	40.292	4888 ± 37[1,A]	0.308[F]	2722 ± 64	3675 ± 208*[I]	132	10796 ± 816	3.97 ± 0.31
NIL-TOP-70[j]	B5943/A2676	–28.479819	136.017803	406	70	1.0000	40.044	2137 ± 26[1,A]	0.317[F]	1230 ± 31	1515 ± 121*[I]	152	5146 ± 486	4.18 ± 0.41

a) Coordinates determined using hand held GPS and referenced to WGS84 Datum.

b) Ridge top elevation determined using hand held GPS and elevation of subsequent points downslope determined using laser rangefinder.

c) ^{10}Be/^{9}Be ratios were normalised to standards 1) SRM KN-5-2 (nominal ratio 8,558 x 10^{-15}), and 2) KN-5-3 (nominal ratio 6,320 x 10^{-15}) (Nishiizumi et al., 2007).

d) Corrected for batch procedural blanks: A) 7.83 ± 2.10 x 10^{-15}, B) 5.77 ± 0.56 x 10^{-15}, C) 4.15 ± 1.06 x 10^{-15}, D) 3.59 ± 0.85 x 10^{-15}, E) 1.69 ± 0.92 x 10^{-15}.

e) Uncertainties expressed at 1-σ level.

f) Concentrations of ^{9}Be solutions are: F) 1090 ± 15 ppm, and G) 1128 ± 22 ppm.

g) ^{26}Al/^{27}Al ratios marked with * were blank-corrected using the respective blank's ^{26}Al count rate.

h) ^{26}Al/^{27}Al ratios were normalised to SRM KN-4-2 with a nominal ratio of 30,960 x 10^{-15} (Nishiizumi, 2004).

i) Corrected for batch procedural blanks of: H) 22.06 ± 5.35 x 10^{-15}, I) 10.36 ± 3.76 x 10^{-15}, J) 13.57 ± 2.36 x 10^{-15}.

j) Published in Struck et al. (2018).

k) Published in Heimsath et al. (2010). ^{10}Be concentrations were re-normalised to the Nishiizumi 2007 ^{10}Be AMS standard (Nishiizumi et al., 2007).

l) Published in Fujioka et al. (2005). ^{10}Be concentrations were re-normalised to the Nishiizumi 2007 ^{10}Be AMS standard (Nishiizumi et al., 2007)

References

Fujioka, T., Chappell, J., Honda, M., Yatsevich, I., Fifield, K., and Fabel, D.: Global cooling initiated stony deserts in central Australia 2–4 Ma, dated by cosmogenic 21Ne-10Be, Geology, 33, 993, https://doi.org/10.1130/g21746.1, 2005.

Heimsath, A. M., Chappell, J., and Fifield, K.: Eroding Australia: rates and processes from Bega Valley to Arnhem Land, Geological Society, London, Special Publications, 346, 225–241, https://doi.org/10.1144/sp346.12, 2010.

Hidy, A. J., Gosse, J. C., Pederson, J. L., Mattern, J. P., and Finkel, R. C.: A geologically constrained Monte Carlo approach to modeling exposure ages from profiles of cosmogenic nuclides: An example from Lees Ferry, Arizona, Geochemistry, Geophysics, Geosystems, 11, https://doi.org/10.1029/2010gc003084, 2010.

Nishiizumi, K.: Preparation of 26Al AMS standards, Nuclear Instruments and Methods in Physics Research Section B: Beam Interactions with Materials and Atoms, 223, 388–392, https://doi.org/10.1016/j.nimb.2004.04.075, 2004.

Nishiizumi, K., Imamura, M., Caffee, M. W., Southon, J. R., Finkel, R. C., and McAninch, J.: Absolute calibration of 10Be AMS standards, Nuclear Instruments and Methods in Physics Research Section B: Beam Interactions with Materials and Atoms, 258, 403–413, https://doi.org/10.1016/j.nimb.2007.01.297, 2007.

Struck, M., Jansen, J. D., Fujioka, T., Codilean, A. T., Fink, D., Egholm, D. L., Fülöp, R.-H., Wilcken, K. M., and Kotevski, S.: Soil production and transport on postorogenic desert hillslopes quantified with 10Be and 26Al, Geological Society of America Bulletin, https://doi.org/10.1130/B31767.1, 2018.