Loess and floods: late Pleistocene fine-grained valley-fill deposits in the Flinders Ranges, South Australia

(excerpt from Hans Heysen 1929: “Foothill of the Flinders”, Morgan Thomas Bequest Fund 1939)

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Appendices

Instructions

The numbering of the appendices following the prefix 5 reflects the chapter and subchapter structure of the main thesis. For example, section (5.2.1) and subsections therein present additional material referenced in the Methods chapter Optically Stimulated Luminescence dating (2.1).

Methods

Sample ID	fraction (in µm)	quantity (in g)	method	K	*K error*	U	*U error*	Th	*Th error*	γ dose	*γ error*	H2O	Depth (in cm)		cosmic ray (Gy/ka)	
				(in %)	*(3 %)*	(in ppm)		(in ppm)		(in Gy/ka)		(in %)	(min/	max)	(max/	min)
HK07-D 1	180-212	0.003	XRS + TSAC	**2.184**	*0.066*	**2.562**	*0.394*	**10.131**	*1.308*	-	-	**5.88**	**765**	**-**	0.100	-
HK07-D 2	180-212	0.231	XRS + TSAC	**2.041**	*0.061*	**2.060**	*0.590*	**10.015**	*1.964*	-	-	**3.37**	**490**	**-**	0.128	-
HK07-D 4	180-212	0.265	XRS + TSAC	**1.562**	*0.047*	**0.948**	*0.491*	**11.193**	*1.650*	-	-	**3.68**	**410**	**-**	0.138	-
HK07-D 5	180-212	0.42	gamma corr	**1.360**	*0.041*	**2.098**	*0.218*	**9.738**	*0.396*	**1.052**	*0.023*	**5.05**	**85**	**-**	0.192	-
	180-212	0.42	XRS + TSAC	**1.496**	*0.045*	**1.669**	*0.395*	**6.947**	*1.313*	-	-	**5.05**	**85**	**-**	0.192	-
HK07-L 2	180-212	0.54	gamma corr	**1.709**	*0.043*	**2.035**	*0.223*	**10.719**	*0.405*	**1.212**	*0.027*	**6.01**	**235**	**325**	0.164	-
	180-212	0.54	XRS + TSAC	**1.847**	*0.055*	**2.280**	*0.420*	**8.360**	*1.393*	-	-	**6.01**	**240**	**325**	0.164	-
HK07-L 4	180-212	0.04	XRS + TSAC	**2.204**	*0.066*	**2.393**	*0.273*	**9.084**	*0.904*	-	-	**7.91**	**175**	**265**	0.175	-
HK07-M 1	180-212	?	XRS + TSAC	**1.733**	*0.052*	**2.110**	*0.569*	**11.220**	*1.896*	-	-	**5.33**	**1025**	**-**	0.081	-
HK07-M 3	180-212	?	XRS + TSAC	**1.324**	*0.040*	**2.549**	*0.300*	**6.265**	*0.978*	-	-	**1.94**	**640**	**-**	0.112	-
HK07-M 5	180-212	?	XRS + TSAC	**2.016**	*0.060*	**2.013**	*0.725*	**14.755**	*2.426*	-	-	**7.40**	**40**	**-**	0.201	-
BRA07-G 1	180-212	?	XRS + TSAC	1.905	*0.057*	2.656	*0.368*	11.910	*1.232*	-	-	**3.78**	**1620**	**-**	0.052	-
BRA07-G 2	180-212	?	XRS + TSAC	1.765	*0.053*	3.175	*0.285*	10.560	*0.939*	-	-	**6.63**	**1330**	**-**	0.064	-
BRA07-G 4	180-212	?	XRS + TSAC	1.978	*0.059*	3.225	*0.282*	8.695	*0.927*	-	-	**2.34**	**375**	**-**	0.145	-

H2O (in Gy/ka)	***error***	DR 2.5% H2O	*error*	DR 5% H2O	*error*	10% H2O (in Gy/ka)	*error*	DR (in Gy/ka)	*error*	**(MDN) wght. MEAN DR**		**FMM Pop. 1**	*FMM err. Pop. 1*	FMM % Pop. 1
(mean)	*(mean)*	(mean)	*(mean)*	(mean)	*(mean)*	(mean)	*(mean)*	/ 2)		(in Gy/ka)		(=CAM)		
3.380	***0.144***	3.510	*0.150*	3.413	*0.146*	3.234	*0.138*	3.397	*0.145*	**3.397**	**0.145**	**287.44**	*20.29*	-
3.240	***0.210***	3.271	*0.212*	3.182	*0.206*	3.017	*0.195*	3.211	*0.208*	**3.211**	**0.208**	**384.35**	*32.86*	-
2.607	***0.174***	2.641	*0.177*	2.570	*0.172*	2.439	*0.163*	2.589	*0.173*	**2.589**	**0.173**	**213.43**	*31.84*	0.76
2.689	***0.052***	2.733	*0.053*	2.689	*0.052*	2.609	*0.050*	2.689	*0.052*	**2.565**	**0.096**	**99.82**	*5.84*	0.63
2.440	***0.140***	2.507	*0.144*	2.441	*0.140*	2.320	*0.133*	2.441	*0.14*	**2.565**	**0.096**	**99.82**	*5.84*	0.63
3.054	***0.054***	3.125	*0.055*	3.074	*0.054*	2.980	*0.052*	3.064	*0.054*	**3.014**	**0.102**	**108.86**	*8.16*	0.90
2.947	***0.149***	3.061	*0.155*	2.979	*0.151*	2.827	*0.143*	2.963	*0.15*	**3.014**	**0.102**	**108.86**	*8.16*	0.90
3.289	***0.108***	3.487	*0.114*	3.392	*0.111*	3.219	*0.105*	3.341	*0.1095*	**3.341**	**0.110**	**100.97**	*4.46*	0.92
2.858	***0.186***	2.951	*0.192*	2.869	*0.186*	2.719	*0.176*	2.864	*0.186*	**2.864**	**0.186**	**309.90**	*24.76*	0.57
2.378	***0.106***	2.363	*0.105*	2.299	*0.102*	2.181	*0.097*	2.339	*0.104*	**2.339**	**0.104**	**292.64**	*18.35*	0.90
3.371	***0.231***	3.553	*0.244*	3.458	*0.237*	3.282	*0.224*	3.415	*0.234*	**3.415**	**0.234**	**61.61**	*3.59*	0.54
3.207	***0.131***	*3.255*	*0.132*	3.163	*0.129*	2.996	*0.122*	3.185	*0.13*	**3.185**	**0.130**	**103.07**	*3.21*	0.68
3.019	***0.102***	*3.162*	*0.107*	3.074	*0.104*	2.911	*0.098*	3.047	*0.103*	**3.047**	**0.103**	**93.55**	*7.69*	0.47
3.332	***0.110***	*3.326*	*0.109*	3.235	*0.106*	3.068	*0.101*	3.284	*0.108*	**3.284**	**0.108**	**52.89**	*3.85*	0.74

FMM Pop. 2	*FMM err. Pop. 2*	FMM % Pop. 2	**FMM Pop. 3**	*FMM err. Pop. 3*	FMM % Pop. 3	FMM Pop. 4	*FMM err. Pop. 4*	FMM % Pop. 4	FMM BIC #	sigmab	**Minimum Age De**	Min. Age (lower)	Min. Age (upper)
-	-	-	-	-	-	-	-	-	-	-	**265.06**	226.72	290.31
-	-	-	-	-	-	-	-	-	-	-	**348.27**	299.83	381.28
274.03	*82.05*	0.24	-	-	-	-	-	-	4.18	0.17	**178.06**	155.78	201.35
49.60	*3.55*	0.37	-	-	-	-	-	-	11.85	0.12	**44.56**	38.82	50.11
49.60	*3.55*	0.37	-	-	-	-	-	-	11.85	0.12			
258.20	*68.22*	0.10	-	-	-	-	-	-	11.12	0.20	**86.50**	69.76	92.23
258.20	*68.22*	0.10	-	-	-	-	-	-	11.12	0.20			
38.86	*4.27*	0.08	-	-	-	-	-	-	1.88	0.09	**50.71**	41.80	59.84
65.78	*7.43*	0.25	**162.45**	*28.33*	0.18				36.91	0.20	**57.09**	48.31	67.10
200.15	*40.85*	0.10	-	-	-	-	-	-	3.23	0.15	**228.71**	207.65	247.25
28.18	*2.27*	0.33	**180.34**	*27.57*	0.09	9.45	*2.04*	0.05	58.22	0.15	**15.04**	9.03	18.11
160.15	*12.78*	0.18	**68.94**	*5.56*	0.14	-	-	-	20.26	0.05	**75.98**	67.66	83.89
118.45	*12.86*	0.43	**249.64**	*37.12*	0.10	-	-	-	8.64	0.05	**83.62**	73.49	94.02
87.79	*14.49*	0.26	-	-	-	-	-	-	12.26	0.15	**43.25**	38.30	47.90

MAM	min.	max.	FMM Pop. 1 (=CAM)	FMM err. Pop. 1	MIN FMM (in ka)	sd	MAX FMM (in ka)	sd	FMM Pop. 2	FMM err. Pop. 2	FMM Pop. 3	FMM err. Pop. 3	FMM Pop. 4	FMM err. Pop. 4
78.04	66.75	85.47	84.63	6.98	81.89	6.76	88.88	7.33	-	-	-	-	-	-
108.46	93.38	118.74	119.70	12.84	-	-	-	-	-	-	-	-	-	-
68.79	60.18	77.79	82.45	13.48	80.81	13.22	87.51	14.31	105.87	32.48	-	-	-	-
17.37	15.14	19.54	38.92	2.70	18.15	1.35	19.01	1.41	19.34	1.56	-	-	-	-
					19.78	1.82	21.38	1.96						
28.70	23.15	30.61	36.12	2.97	34.83	2.68	36.53	2.81	85.68	22.82	-	-	-	-
					35.56	3.22	38.51	3.48						
15.18	12.51	17.91	30.23	1.66	28.96	1.59	31.37	1.72	11.63	1.33	-	-	-	-
19.94	16.87	23.43	108.23	11.14	105.02	10.82	113.98	11.72	22.97	2.99	56.73	10.56	-	-
97.80	88.80	105.73	125.14	9.62	84.70	17.69	91.77	19.17	85.59	17.88	-	-	-	-
4.40	2.64	5.30	18.04	1.62	17.34	1.56	18.77	1.68	8.25	0.87	52.82	8.85	2.8	0.6
23.86	21.24	26.34	32.36	1.66	31.67	1.62	34.40	1.76	50.28	4.51	21.65	1.96	-	-
27.45	24.12	30.86	30.71	2.73	29.59	2.63	32.14	2.85	38.88	4.42	81.94	12.50	-	-
13.17	11.66	14.59	16.11	1.29	15.90	1.27	17.24	1.38	26.74	4.50	-	-	-	-

total aliquots	reliant aliquot #	selected aliquot #
12	(5); 2,6,7,9,11	(4); 6, 7, 9, 11
12	(5); 17, 18, 19, 20, 23	(2); 18, 19
12	(9); 25, 26, 27, 28, 31, 32, 33, 35, 36	(6); 25, 26, 27, 32, 33, 36
12	(9); 37, 38, 39, 40, 41, 42, 45, 46, 47	(3); 38, 41, 45
12	(8); 1, 3, 7, 9, 11, 13, 21, 23	(5); 1, 3, 11, 13, 21
12	(8); 1, 3, 7, 9, 11, 13, 21, 23	(5); 1, 3, 11, 13, 21
12	(12); 1 - 12	(11); 25, 27, 29, 31, 33, 35, 37, 39, 43, 45, 47
26	(12); 1, 2, 3, 4, 5, 7, 9, 16, 17, 18, 22, 23	(8); 1, 2, 4, 5, 9, 16, 17, 18
26	(17); 1, 2, 3, 4, 5, 6, 10, 11, 12, 13, 14, 17, 18, 19, 21, 22, 26	(3); 1, 12, 14
26	(13); 3, 4, 5, 9, 10, 11, 12, 13, 18, 19, 21, 23, 24, 26	(8); 4, 5, 11, 12, 18, 19, 21, 26
26	5	(5); 3, 13, 15, 16, 21
13	(10); 1, 2, 3, 4, 5, 8, 9, 11, 12, 13	(5); 4, 5, 8, 9, 12
21	(13), 1, 2, 3, 4, 6, 10, 12, 13, 14, 16, 18, 19, 20	(8), 1, 3, 4, 10, 12, 16, 18, 19

Sample ID	fraction (in µm)	quantity (in g)	method	K	K error	U	U error	Th	Th error	γ dose	γ error	H2O	Depth (in cm)		cosmic ray (Gy/ka)	
WL07-FP 0	180-212	?	XRS + TSAC	2.022	0.061	2.542	0.347	7.495	1.143	-	-	0.05	765	1465	0.100	0.058
WL07-FP 1	180-212	0.249	gamma corr	1.653	0.041	2.765	0.216	8.750	0.366	1.199	0.026	2.99	620	1320	0.114	0.069
	180-212		*gamma spec*	*1.600*	*0.040*	*2.677*	*0.209*	*8.474*	*0.354*	*1.159*	*0.025*	*2.99*	*620*	*1200*	*0.114*	*0.069*
(2nd reading)	180-212	0.249	gamma corr	1.681	0.042	2.509	0.225	10.304	0.391	1.210	0.026	2.99	620	1320	0.114	0.069
	180-212	0.249	XRS + TSAC	1.779	0.053	2.187	0.335	10.208	1.115	-	-	2.99	620	1320	0.114	0.069
WL07-FP 3	125-180	0.506	gamma corr	1.940	0.045	2.169	0.224	11.022	0.390	1.332	0.029	2.50	155	855	0.179	0.093
(gravel topped)	125-180	0.506	gamma corr	1.959	0.048	2.412	0.245	10.663	0.442	1.338	0.029	2.50	155	855	0.179	0.093
	125-180	0.506	XRS + TSAC	2.187	0.066	2.205	0.324	10.419	1.079	-	-	2.50	155	855	0.179	0.093
WL07-FP 5	125-180	0.228	gamma corr	2.099	0.051	2.590	0.253	10.449	0.451	1.369	0.030	8.38	205	255	0.189	0.161
WL07-FP 6 (SA)	125-180	0.074	gamma corr	1.930	0.046	2.335	0.232	10.310	0.412	1.266	0.028	9.69	35	85	0.202	0.192
	125-180	0.074	XRS + TSAC	2.064	0.062	2.331	0.329	8.683	1.091	-	-	9.69	35	85	0.202	0.192
WL07-FP 6 (SG)	125-180	0.134	gamma corr	1.930	0.046	2.335	0.232	10.310	0.412	1.266	0.028	9.37	35	85	0.202	0.192
	125-180	0.134	XRS + TSAC	2.064	0.062	2.331	0.329	8.683	1.091	-	-	9.37	35	85	0.202	0.192
WL07-G 1	180-212	0.205	XRS + TSAC	1.926	0.058	1.546	0.446	10.349	1.494	-	-	9.82	715	-	0.104	-
WL07-G 3	180-212	0.143	XRS + TSAC	2.183	0.065	1.878	0.331	9.556	1.103	-	-	2.98	310	-	0.153	-
WL07-G 5	180-212	0.158	XRS + TSAC	2.149	0.064	2.795	0.318	8.113	1.047	-	-	4.78	160	-	0.178	-
WL07-G 6	180-212	0.262	XRS + TSAC	2.354	0.070	2.049	0.344	10.450	1.147	-	-	3.86	110	-	0.187	-
CAS06-3	125-180	?	XRS + TSAC	1.918	0.05	1.542	0.372	14.215	1.25	-	-	3.31	22	-	0.205	-
CAS06-1	125-180	?	XRS + TSAC	1.441	0.04	1.994	0.335	9.328	1.115	-	-	3.01	609	-	0.115	-

H2O (in Gy/ka)	***error***	DR 2.5% H2O	*error*	DR 5% H2O	*error*	10% H2O (in Gy/ka)	*error*	DR (in Gy/ka)	*error*	**(MDN) wght. MEAN DR**		**FMM Pop. 1**	*FMM err. Pop. 1*	FMM % Pop. 1
3.166	***0.132***	3.067	*0.127*	2.982	*0.124*	2.826	*0.117*	3.074	*0.1278*	**3.074**	**0.128**	**143.61**	*12.88*	0.59
3.042	***0.052***	3.053	*0.052*	3.001	*0.051*	2.906	*0.049*	3.021	*0.051*	**3.021**	**0.052**	**217.69**	*17.42*	0.77
3.077	***0.053***	3.087	*0.053*	3.035	*0.052*	2.938	*0.050*	3.056	*0.052*	**3.021**	**0.052**	**217.69**	*17.42*	0.77
3.019	***0.126***	3.036	*0.127*	2.952	*0.123*	2.798	*0.117*	2.985	*0.125*	**3.021**	**0.052**	**217.69**	*17.42*	0.77
3.238	***0.082***	3.238	*0.082*	3.150	*0.079*	2.987	*0.075*	3.194	*0.0803*	**3.243**	**0.086**	**126.05**	*8.62*	0.69
3.288	***0.088***	3.288	*0.088*	3.198	*0.085*	3.033	*0.058*	3.243	*0.0863*	**3.243**	**0.086**	**126.05**	*8.62*	0.69
3.439	***0.129***	3.439	*0.129*	3.344	*0.126*	3.171	*0.119*	3.392	*0.127*	**3.243**	**0.086**	**126.05**	*8.62*	0.69
3.274	***0.086***	3.488	*0.092*	3.393	*0.089*	3.220	*0.085*	3.334	*0.0875*	**3.334**	**0.088**	**83.01**	*3.93*	0.91
3.268	***0.058***	3.425	*0.061*	3.368	*0.060*	3.262	*0.058*	3.318	*0.059*	**3.259**	**0.092**	**56.57**	*5.12*	0.63
3.116	***0.121***	3.362	*0.131*	3.272	*0.127*	3.106	*0.121*	3.194	*0.124*	**3.259**	**0.092**	**56.57**	*5.12*	0.63
3.275	***0.058***	3.425	*0.061*	3.368	*0.060*	3.262	*0.058*	3.322	*0.059*	**3.259**	**0.092**	**55.63**	*5.03*	0.83
3.126	***0.121***	3.362	*0.131*	3.272	*0.127*	3.106	*0.121*	3.199	*0.124*	**3.259**	**0.092**	**55.63**	*5.03*	0.83
2.804	***0.152***	3.036	*0.164*	2.952	*0.160*	2.799	*0.151*	2.878	*0.156*	**2.878**	**0.156**	**124.91**	*3.36*	0.59
3.333	***0.130***	3.351	*0.131*	3.260	*0.127*	3.092	*0.121*	3.297	*0.1285*	**3.297**	**0.129**	**79.03**	*2.31*	0.64
3.382	***0.123***	3.468	*0.126*	3.374	*0.123*	3.202	*0.116*	3.378	*0.123*	**3.378**	**0.123**	**99.21**	*6.51*	0.62
3.510	***0.129***	3.563	*0.131*	3.467	*0.128*	3.290	*0.121*	3.489	*0.1285*	**3.489**	**0.129**	**59.48**	*4.41*	0.67
3.330	***0.136***	*3.360*	*0.137*	3.270	*0.133*	3.105	*0.126*	3.300	*0.1345*	**3.300**	**0.135**	**76.43**	*1.84*	0.54
2.574	***0.120***	*2.588*	*0.121*	2.518	*0.118*	2.388	*0.111*	2.546	*0.119*	**2.546**	**0.119**	**97.08**	*4.97*	0.51

FMM Pop. 2	*FMM err. Pop. 2*	FMM % Pop. 2	**FMM Pop. 3**	*FMM err. Pop. 3*	FMM % Pop. 3	FMM Pop. 4	*FMM err. Pop. 4*	FMM % Pop. 4	FMM BIC #	sigmab	**Minimum Age De**	Min. Age (lower)	Min. Age (upper)
202.11	*21.61*	0.41	-	-	-	-	-	-	7.38	0.10	**127.43**	113.60	140.25
137.53	*11.63*	0.23	-	-	-	-	-	-	3.87	0.00	**145.09**	119.38	168.52
137.53	*11.63*	0.23	-	-	-	-	-	-	3.87	0.00			
137.53	*11.63*	0.23	-	-	-	-	-	-	3.87	0.00			
73.71	*3.93*	0.31	-	-	-	-	-	-	6.00	0.05	**75.53**	65.36	84.65
73.71	*3.93*	0.31	-	-	-	-	-	-	6.00	0.05			
73.71	*3.93*	0.31	-	-	-	-	-	-	6.00	0.05			
167.61	*30.19*	0.09	-	-	-	-	-	-	2.19	0.10	**69.38**	61.24	76.90
80.25	*7.95*	0.37	-	-	-	-	-	-	11.04	0.10	**47.58**	41.14	53.55
80.25	*7.95*	0.37	-	-	-	-	-	-	11.04	0.10			
24.12	*3.62*	0.09	76.12	*37.35*	0.08	-	-	-	82.98	0.22	**31.97**	29.61	34.30
24.12	*3.62*	0.09	76.12	*37.35*	0.08	-	-	-	82.98	0.22			
69.00	*4.38*	0.32	**46.07**	*4.66*	0.09	-	-	-	24.98	0.00	**54.89**	47.94	61.93
107.59	*4.21*	0.27	**45.60**	*3.62*	0.08	-	-	-	15.28	0.03	**60.63**	56.03	65.03
61.93	*4.06*	0.39	-	-	-	-	-	-	76.54	0.15	**56.26**	53.24	59.26
132.83	*15.75*	0.33	-	-	-	-	-	-	24.42	0.15	**45.46**	39.33	49.11
99.98	*4.38*	0.39	**173.63**	*28.70*	0.07	-	-	-	2.40	0.02	**71.56**	65.43	77.12
74.78	*4.10*	0.49	-	-	-	**-**	-	-	-1.25	0.06	**71.12**	64.11	77.26

MAM	*min.*	*max.*	**FMM Pop. 1**	*FMM err. Pop. 1*	**MIN FMM**	*sd*	**MAX FMM**	*sd*	**FMM Pop. 2**	*FMM err. Pop. 2*	FMM Pop. 3	*FMM err. Pop. 3*	FMM Pop. 4	*FMM err. Pop. 4*
41.46	*36.96*	*45.63*	**46.72**	*4.62*	46.82	*4.63*	50.82	*5.02*	65.75	*7.54*	-	-	-	-
48.03	*39.52*	*55.78*	72.06	*5.90*	45.05	*3.89*	47.33	*4.08*	**45.52**	*3.93*	-	-	-	-
					44.56	*3.84*	46.82	*4.04*						
					45.31	*4.27*	49.16	*4.64*						
23.29	*20.15*	*26.10*	**38.87**	*2.85*	38.93	*2.84*	42.20	*3.07*	22.73	*1.35*	-	-	-	-
					38.33	*2.81*	41.56	*2.95*						
					36.65	*2.86*	39.75	*3.10*						
20.81	*18.37*	*23.07*	**24.90**	*1.35*	23.80	*1.29*	25.78	*1.39*	50.28	*9.15*	-	-	-	-
14.60	*12.63*	*16.43*	**17.36**	*1.65*	16.52	*1.52*	17.34	*1.60*	24.63	*2.54*	-	-	-	-
					16.83	*1.66*	18.21	*1.79*						
9.81	*9.09*	*10.53*	**17.07**	*1.62*	16.24	*1.50*	17.05	*1.57*	7.40	*1.13*	*23.36*	*11.48*	-	-
					16.55	*1.63*	17.91	*1.76*						
19.07	*16.66*	*21.52*	43.40	*2.63*	22.73	*1.89*	24.65	*2.05*	**23.97**	*2.00*	*16.01*	*1.84*	-	-
18.39	*17.00*	*19.73*	**23.97**	*1.17*	23.58	*1.15*	25.56	*1.25*	32.64	*1.80*	*13.83*	*1.22*	-	-
16.65	*15.76*	*17.54*	29.37	*2.20*	17.86	*1.34*	19.34	*1.45*	**18.33**	*1.38*	-	-	-	-
13.03	*11.27*	*14.08*	**17.05**	*1.41*	16.69	*1.38*	18.08	*1.50*	38.08	*4.73*	-	-	-	-
21.68	*19.83*	*23.37*	**23.16**	*1.10*	22.75	*1.08*	24.61	*1.16*	30.30	*1.81*	*52.62*	*8.96*	-	-
27.93	*25.18*	*30.35*	38.13	*2.64*	28.89	*2.08*	31.31	*2.25*	**29.37**	*2.12*	-	-	-	-

total aliquots	reliant aliquot #	selected aliquot #
26	(13); 2, 3, 4, 5, 9, 10, 11, 14, 17, 18, 20, 23, 26	(6); 2, 4, 5, 10, 14, 20
11	(5); 1, 8, 9, 10, 11	(3); 8, 9, 10
11	(5); 1, 8, 9, 10, 11	(3); 8, 9, 10
11	(5); 1, 8, 9, 10, 11	(3); 8, 9, 10
16	(10); 1, 2, 3, 6, 8, 9, 10, 13, 14, 15,	(6); 3, 8, 9, 10 ,14, 15
16	(10); 1, 2, 3, 6, 8, 9, 10, 13, 14, 15,	(6); 3, 8, 9, 10 ,14, 15
16	(10); 1, 2, 3, 6, 8, 9, 10, 13, 14, 15,	(6); 3, 8, 9, 10 ,14, 15
13	(11); 1, 2, 3, 4, 6, 7, 8, 10, 11, 12, 13	(9); 1, 2, 3, 4, 6, 7, 10, 11, 12
13	(12); 1, 2, 3, 4, 5, 7, 8, 9, 10 ,11, 12, 13	(6); 1, 2, 5, 7, 12, 13
13	(12); 1, 2, 3, 4, 5, 7, 8, 9, 10 ,11, 12, 13	(6); 1, 2, 5, 7, 12, 13
5	70 grains	28 grains
5	70 grains	28 grains
500	18 grains	6 grains
500	35 grains	20 grains
500	78 grains	21 grains
300	15 grains	7 grains
14	(14); 1-14	
14	(12); 1-10, 12, 13	

Sample ID	Depth	Density	Depth x ρ	x + d	(x+d) α	(x+d)α+a	x+H	denom	C/denom	Bx	- Bx	exp (-Bx)	Cosmic rays
	in m	*ρ*	*(x)*	*(d=11.69*		*(a=75)*	*(H=212)*	*(G x H)*	*(C=6072)*	*(B=5.5x104)*			*(in Gy/ka (JxM))*
HK07-D1	**7.65**	1.5	11.5	23.1	195.0	270.0	223.5	60342.6	0.101	0.0063	-0.0063	0.994	**0.100**
HK07-D2	**4.9**	1.5	7.4	19.0	140.1	215.1	219.4	47178.3	0.129	0.0040	-0.0040	0.996	**0.128**
HK07-D4	**4.1**	1.5	6.2	17.8	125.5	200.5	218.2	43739.7	0.139	0.0034	-0.0034	0.997	**0.138**
HK07-D5	**0.85**	1.5	1.3	12.9	73.2	148.2	213.3	31602.5	0.192	0.0007	-0.0007	0.999	**0.192**
HK07-L2	**2.4**	1.5	3.6	15.2	96.7	171.7	215.6	37021.9	0.164	0.0020	-0.0020	0.998	**0.164**
HK07-L4	**1.75**	1.5	2.6	14.2	86.5	161.5	214.6	34666.7	0.175	0.0014	-0.0014	0.999	**0.175**
HK07-M1	**10.25**	1.5	15.4	27.0	253.5	328.5	227.4	74697.6	0.081	0.0085	-0.0085	0.992	**0.081**
HK07-M3	**6.4**	1.5	9.6	21.2	169.1	244.1	221.6	54101.2	0.112	0.0053	-0.0053	0.995	**0.112**
HK07-M5	**0.4**	1.5	0.6	12.2	66.8	141.8	212.6	30156.8	0.201	0.0003	-0.0003	1.000	**0.201**
BRA07-G1	**16.2**	1.5	24.3	35.9	409.8	484.8	236.3	114555.3	0.053	0.0134	-0.0134	0.987	**0.052**
BRA07-G2	**13.3**	1.5	20.0	31.6	329.9	404.9	232.0	93905.4	0.065	0.0110	-0.0110	0.989	**0.064**
BRA07-G4	**3.65**	1.5	5.5	17.1	117.6	192.6	217.5	41883.3	0.145	0.0030	-0.0030	0.997	**0.145**
WL07-FP0	**7.65**	1.5	11.5	23.1	195.0	270.0	223.5	60342.6	0.101	0.0063	-0.0063	0.994	**0.100**
WL07-FP0	**14.65**	1.5	22.0	33.6	366.2	441.2	234.0	103227.5	0.059	0.0121	-0.0121	0.988	**0.058**
WL07-FP1	**5.2**	1.5	7.8	19.4	145.7	220.7	219.8	48513.4	0.125	0.0043	-0.0043	0.996	**0.125**
WL07-FP1	**12.2**	1.5	18.3	29.9	301.4	376.4	230.3	86682.4	0.070	0.0101	-0.0101	0.990	**0.069**
WL07-FP3	**1.55**	1.5	2.3	13.9	83.5	158.5	214.3	33966.0	0.179	0.0013	-0.0013	0.999	**0.179**
WL07-FP3	**8.55**	1.5	12.8	24.4	214.6	289.6	224.8	65101.8	0.093	0.0071	-0.0071	0.993	**0.093**
WL07-FP5	**2.55**	1.5	3.8	15.4	99.1	174.1	215.8	37582.3	0.162	0.0021	-0.0021	0.998	**0.161**
WL07-FP6	**0.85**	1.5	1.3	12.9	73.2	148.2	213.3	31602.5	0.192	0.0007	-0.0007	0.999	**0.192**
WL07-G1	**7.15**	1.5	10.7	22.3	184.5	259.5	222.7	57794.6	0.105	0.0059	-0.0059	0.994	**0.104**
WL07-G3	**3.1**	1.5	4.7	16.3	108.2	183.2	216.7	39690.6	0.153	0.0026	-0.0026	0.997	**0.153**
WL07-G5	**1.6**	1.5	2.4	14.0	84.2	159.2	214.4	34140.1	0.178	0.0013	-0.0013	0.999	**0.178**
WL07-G6	**1.1**	1.5	1.7	13.3	76.8	151.8	213.7	32430.6	0.187	0.0009	-0.0009	0.999	**0.187**
CAS06-G3	**0.22**	1.5	0.3	11.9	64.4	139.4	212.3	29594.7	0.205	0.0002	-0.0002	1.000	**0.205**
CAS06-G1	**6.09**	1.5	9.1	20.7	163.0	238.0	221.1	52619.8	0.115	0.0050	-0.0050	0.995	**0.115**

Dose Rate calculation with AGE99 software Protocol

In order to run “Age99” (Grün 1994) on Windows Vista, a DOS environment needs to be emulated using the free MS-DOS emulator “DOSBox” (http://www.dosbox.com/). DOSbox.exe is started and a virtual directory is mounted by entering:

*Z:\>**MOUNT C C:\age99***

Next, the age.exe is started by changing the directory to the virtual drive and executing the program file (assuming that Age.exe is located on C:\age99\Age99.exe):

*Z:\>**C:***

*C:\>**Age99.exe***

A new data file is created (F1), named (F2), and quartz entered as sample material (F2)+(F1). The corrected gamma spectrometry or XRS and TSAC values for U, Th and K are entered into the software as demonstrated by the screenshot below:

```
FILE NAME   FP6TR                            SUBROUTINE FOR GRAINS
LOCATION    Wilkawillina
DOSE             [Gy]      59.38±     11.70 U-SEDIMENT      [ppm]       2.34±      0.23
U-CONTENT       [ppm]       0.00±      0.00 Th-SEDIMENT     [ppm]      10.31±      0.41
Th-CONTENT      [ppm]       0.00±      0.00 K-SEDIMENT        [%]       1.93±      0.05
K-CONTENT         [%]       0.00±      0.00 WATER/DRY SOIL    [%]       9.69±      0.00
ALPHA EFFICIENCY            0.05±      0.02 FOR a/ß IRR. ONLY?             Y
BETA ATTENUATION?              Y            EXT. ALPHA    [µGy/a]       0.00±      0.00
DIAMETER         [µm]     150.00±     30.00 av. a-ATTENUATION ?            N
LAYER REMOVED    [µm]       9.00±      2.00 EXT. BETA     [µGy/a]       0.00±      0.00
DENSITY     [g/cm^3]        2.65±      0.00 av. ß-ATTENUATION ?            N
INT. ALPHA   [µGy/a]        0.00±      0.00 EXT. GAMMA    [µGy/a]    1226.00±     28.00
av. a-SELFIRR.     ?           N            WATER ATT. FOR EXT ?           N
INT. BETA    [µGy/a]        0.00±      0.00 COSMIC DR     [µGy/a]     185.00±     18.50
av. ß-SELFIRR.     ?           N

USE CURSOR KEYS AND «ENTER» TO SELECT NEW INPUT
«F1» STARTS CALCULATION    «F5» SAVES DATA FILE
```

1) **Dose** refers to the equivalent dose D_e (only entered if known)
2) **U-, Th-, and K-Content** are left blank because combined in DCF
3) The relative **Alpha Efficiency** amounts to 0.05 ± 0.02 for quartz and has to be reset with every iteration of the program (F1 followed by F2)
4) **Diameter** refers to fully-prepared quartz grains (± for range, in our example 125-180 µm)
5) **Layer Removed** quantifies the effect of HCl-etching on grains (in our example 9 µm)
6) **Density** (quartz = 2.65 for g/cm^3)

7) **U-, Th-, and K-Sediment** refer to the H_2O-content corrected/ dry values of the gamma spectrometer/ laboratory measurements

8) **Water/Dry Soil** refers to the H_2O-content of the sediment samples (either measured or assumed)

9) **FOR α/β IRR. only?** to be answered with **Y**(es) for the gamma spectrometer followed by

10) **Ext. Gamma** refers to the H_2O-content corrected *in-situ* measured total external gamma rate *(convert Gy/ka into µGy/a by multiplying with 100)*

11) **Cosmic DR** refers to the cosmic ray estimate applying a standard error of 10 % *(convert Gy/ka into µGy/a by multiplication with 100)*

The results of DR calculations for varying methodologies and H_2O-contents are presented in appendix 5.2.1.

Thick Source Alpha Counting (TSAC) Protocol

Preparation for 'Thick Source' α-counting (TSAC) consists of measuring the background reading of a clean cell with a zinc sulphide scintillation screen (dull ZnS side up) for long enough to fall below 0.3 counts/ksec (excluding the first 16 ksec from the count).

1) About 50 g of the dry sample are reduced to fine powder. The sample is placed in a clean tungsten carbide vibrating ring mill for 30 sec. The mill is cleaned out by crushed quartz and ethyl alcohol.

2) When the background reading is low enough (usually overnight), the cell containing the ZnS-screen is removed from the counting chamber in subdued light and transferred to the laboratory to be loaded with the sample.

3) Here, after removing the cover disc, the ZnS-screen is covered by ~1 mm of the finely powdered sample, spread and compacted by a spatula.

4) The cell lid is replaced, labelled and dated (on the sticker), noting the ZnS-screen sheet number.

5) The cell is carefully transferred in horizontal position to the counting room and loaded into the chamber.

6) The α-counter (DAYBREAK) is reset to zero and the printer switched on, noting sample ID, batch number, date and time at the head of the paper.

7) Counting continues at least until the total number of counts (excluding the first 16 ksec) exceeds 1000.

8) Finally, the loaded sample and the ZnS-screen are disposed off and the cell is cleaned out by 50 % HCl in a stainless steel box, wiping each item separately with tongs and Kimwipe™ taking care that the aluminium spacing ring is not exposed to the acid more than a few seconds.

9) Each item is rinsed thoroughly under running water and finally cleaned with methanol.

10) The clean and dry cell is transferred back to the laboratory where it is loaded with a new ZnS-screen (dull side up), covered by the spacing ring, retaining ring and the cardboard circle.

11) The screen batch number is recorded on a sticker on the lid and the cell is transferred to the counting room where it is loaded into the counting chamber for background counting.

The calculation of U and Th concentrations follows manually on a designated sheet:

1) First, the background count is calculated by dividing the total counts (excluding the first 16 ksec) by time (in ksec).

2) Then, the total counts and total pairs are calculated, excluding the first 16 ksec and the intervals of anomalous counts. These follow from threshold values for both counts and pairs per interval by applying the Chauvenet's criterion to identify any outliers (Taylor, J R 1997. An Introduction to Error Analysis. 2nd edition. Sausolito, California. University Science Books, 166-8). The Chauvenet's Rejection Value (CRV) is calculated by the following equation:

$$0.3831 * ln(\# \, of \, measurements) + 1.0862$$

Intervals where either counts or pairs fall below or exceed the threshold values are removed from the final equation.

3) The background is subtracted from the counts less rejects/ ksecs.

4) Pairs less rejects are corrected for accidental pairs which for the Daybreak counting chamber is calculated by the following equation:

$$0.00038 * (corrected \, counts/ \, ksec)^2$$

5) Errors are calculated in proportion to those of the total counts less rejects and the total pairs less rejects.

6) The final pairs and counts and their respective values are entered into the conversion table (appendix 5.2.1.5), taking account of the ZnS-batch efficiency.

7) The concentrations for Th and U (in ppm) with respective errors are used for the environmental dose rate calculations using “AGE99” software (Grün 1994) following the protocol in appendix 5.2.1.2.

XRF sample preparation Protocol

Two sets of vials are washed for each XRF sample (one rimmed without lid and the other with lid) by running warm water and detergent using a brush for the vials and soft cloth for the caps. Both sets are rinsed under cold running tap water and consequently three times under filtered water. Clean vials are placed on (clean) glass dishes and dried in the glassware drying oven at 110°. Plastic caps are dried on paper towels placed on the top of the oven.

1) After ~30 min, the rimmed vials are removed from the oven, labelled and filled with ~2 g (1 spatula) of powdered sample material.

2) The samples are dried in the sample drying oven at 110° for at least ~120 min.

3) The dried samples and dry vials with lids are transferred to the balance room after cooling down to room temperature.

4) 1 g of sample material is weighted out (to the 4^{th} digit on the Sartorius scale) and transferred into the clean (labelled) vial with the help of a clean vibrating spatula. Spilled material must be brushed off the scale and the final exact measurements are copied.

5) Consequently, after zeroing the balance 4 g of X-ray flux (to the 4^{th} digit) are added to the sample material, again taking note of the exact measurements. The flux consists of lithium salts (64.7 % lithium metaborate, lithium tetraborate 35.3 %) and must be kept in the desiccator.

6) Lids are placed on the sample vials and the sample-flux blend is shaken by a "super mixer" until distributed uniformly.

7) The sample vials are transferred to the analytical laboratory for fusion.

Preparations for the fusion of XRF discs consist of lighting the pilot flame on the fusion machine, turning on the extraction fans and placing a beaker with 50 % HCl into the sink next to a beaker with running cold water.

1) One sample at a time is transferred into a clean Pt/Au crucible by gentle tapping out the *full* sample content over black paper (to show any spill).

2) The crucible with the sample is placed into the metal support ring over the main burner of the fusion machine by titanium tongs and rotated at an angle of ~45° to ensure complete and homogeneous melting, and to bring air bubbles to the surface.

3) The fusion is occasionally agitated for 4-5 minutes.

4) A matchstick head-sized amount of Ammonium Iodide is added to the fusion by a small spatula to lower the viscosity.

5) After another minute, a clean casting mould is placed on the right burner by pointed tongs and pre-heated for ~2 minutes.

6) Meanwhile, the fusion is swirled occasionally and eventually poured into the centre of the casting mould.

7) The crucible is cooled on the silica triangle and the right burner is turned off and replaced by the air cooling jets for ~2 minutes.

8) The sample disc is labelled on the upper (curved) surface and transferred into a press seal plastic bag without touching the lower surface.

The crucible is cleaned by transferring it to the water beaker with platinum-tipped tongs, sprinkling Na_2CO_3 along the inside walls, and heating it above a 2 cm high blue propane-oxygen flame until it melts and dissolves all sample residue. After letting it cool down for a minute on a silica triangle, it is dropped back into the water beaker, transferred with the plastic coated tongs into 50 % HCl acid. Once, the Na_2CO_3 is fully dissolved, the crucible is rinsed under running tab water and filtered water and dried with Kimwipe™.

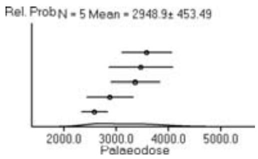
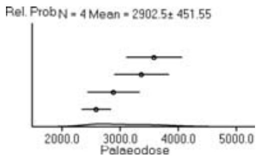
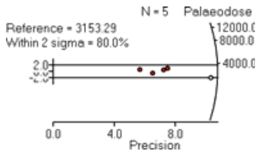
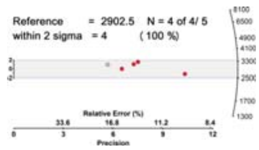
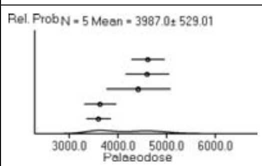
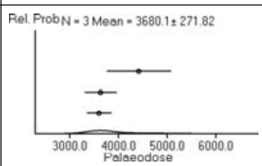
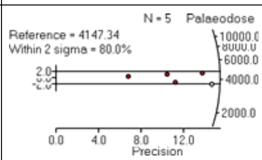
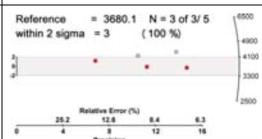
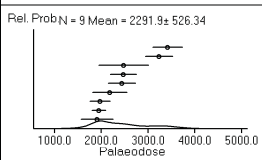
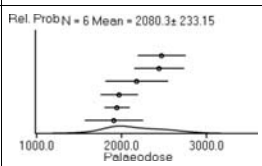
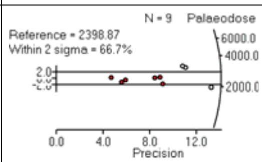
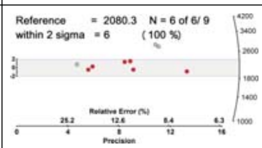
Fused XRF discs must be stored in the desiccator until run on the XRF machine. The results of all runs are presented in appendix 5.2.1.6.

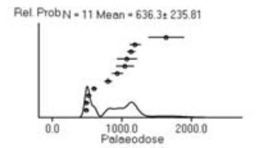
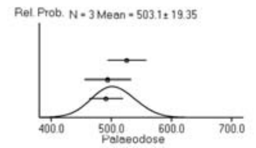
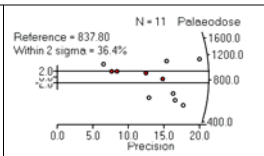
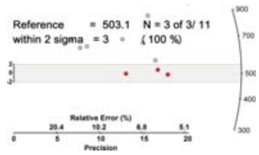
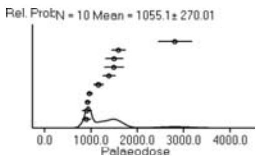
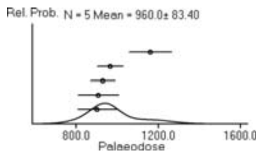
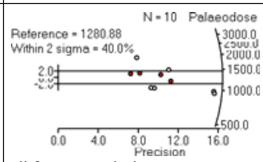
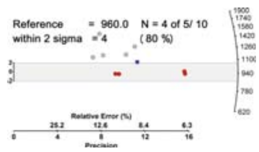
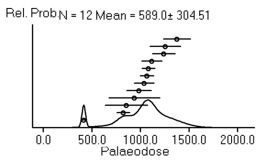
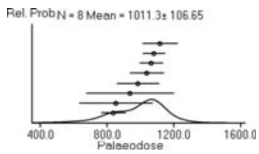
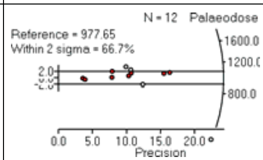
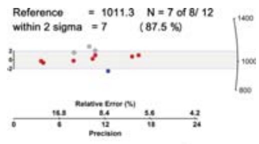
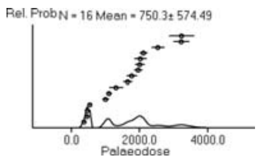
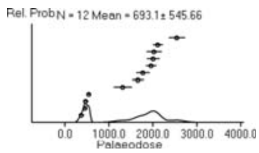
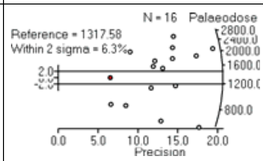
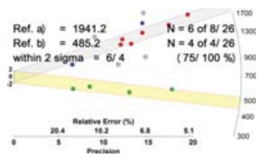
Sample ID	Pairs	*error*	Counts	*error*	Batch efficiency	**U (in ppm)**	*error*	**Th (in ppm)**	*error*	Batch eff. Sq
HK07-D1	0.173	*0.022*	7.906	*0.160*	1.16	**2.562**	*0.394*	**10.131**	*1.308*	1.346
HK07-D2	0.171	*0.033*	7.135	*0.226*	1.16	**2.060**	*0.590*	**10.015**	*1.964*	1.346
HK07-D4	0.191	*0.028*	6.025	*0.162*	1.16	**0.948**	*0.491*	**11.193**	*1.650*	1.346
HK07-D5	0.118	*0.022*	5.295	*0.155*	1.16	**1.669**	*0.395*	**6.947**	*1.313*	1.346
HK07-L2	0.142	*0.024*	6.762	*0.172*	1.16	**2.280**	*0.420*	**8.360**	*1.393*	1.346
HK07-L4	0.155	*0.015*	7.226	*0.111*	1.16	**2.393**	*0.273*	**9.084**	*0.904*	1.346
HK07-M1	0.195	*0.033*	7.775	*0.218*	1.15	**2.110**	*0.569*	**11.220**	*1.896*	1.323
HK07-M3	0.109	*0.017*	6.332	*0.144*	1.15	**2.549**	*0.300*	**6.265**	*0.978*	1.323
HK07-M5	0.256	*0.042*	9.119	*0.264*	1.15	**2.013**	*0.725*	**14.755**	*2.426*	1.323
WL07-FP0	0.130	***0.020***	6.838	*0.151*	1.15	**2.542**	*0.347*	**7.495**	*1.143*	1.323
WL07-FP1	0.174	*0.019*	7.398	*0.133*	1.16	**2.187**	*0.335*	**10.208**	*1.115*	1.346
WL07-FP3	0.178	*0.018*	7.513	*0.126*	1.16	**2.205**	*0.324*	**10.419**	*1.079*	1.346
WL07-FP5	0.151	*0.024*	7.277	*0.174*	1.16	**2.493**	*0.418*	**8.859**	*1.385*	1.346
WL07-FP6	0.148	*0.019*	6.970	*0.133*	1.16	**2.331**	*0.329*	**8.683**	*1.091*	1.346
WL07-G1	0.176	*0.025*	6.534	*0.160*	1.16	**1.546**	*0.446*	**10.349**	*1.494*	1.346
WL07-G3	0.166	*0.019*	6.740	*0.127*	1.15	**1.878**	*0.331*	**9.556**	*1.103*	1.323
WL07-G5	0.141	*0.018*	7.465	*0.141*	1.15	**2.795**	*0.318*	**8.113**	*1.047*	1.323
WL07-G6	0.178	*0.020*	7.300	*0.131*	1.16	**2.049**	*0.344*	**10.450**	*1.147*	1.346

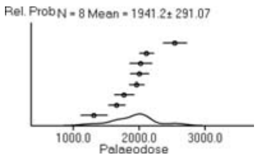
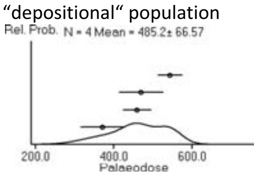
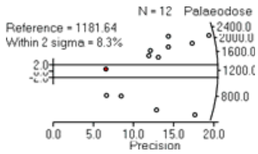
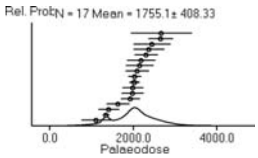
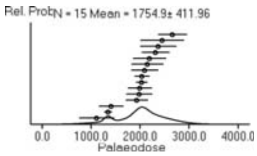
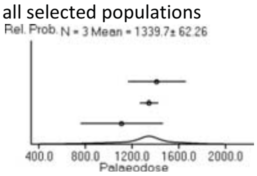
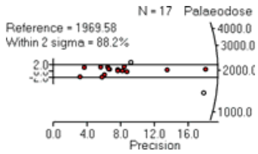
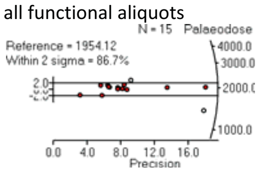
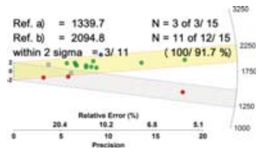
Prs x be sq	Cts x be	Th	Th x 0.483	subtract	U	Ct err x be	Th err			
0.232	9.171	10.131	4.893	4.278	2.562	0.185	1.308	0.632	0.658	0.394347744
0.230	8.277	10.015	4.837	3.439	2.060	0.262	1.964	0.949	0.984	0.589545634
0.257	6.989	11.193	5.406	1.583	0.948	0.188	1.650	0.797	0.819	0.490527122
0.159	6.142	6.947	3.355	2.787	1.669	0.179	1.313	0.634	0.659	0.394692277
0.192	7.843	8.360	4.038	3.806	2.280	0.199	1.393	0.673	0.702	0.420395352
0.208	8.383	9.084	4.388	3.995	2.393	0.129	0.904	0.437	0.455	0.272677961
0.257	8.941	11.220	5.419	3.522	2.110	0.250	1.896	0.916	0.950	0.568803113
0.144	7.282	6.265	3.026	4.256	2.549	0.165	0.978	0.473	0.501	0.299910959
0.338	10.487	14.755	7.127	3.360	2.013	0.303	2.426	1.172	1.210	0.724906069
0.172	7.864	7.495	3.620	4.244	2.542	0.174	1.143	0.552	0.579	0.346615219
0.234	8.582	10.208	4.931	3.651	2.187	0.154	1.115	0.538	0.560	0.335479792
0.239	8.715	10.419	5.033	3.682	2.205	0.146	1.079	0.521	0.541	0.324355149
0.203	8.441	8.859	4.279	4.162	2.493	0.202	1.385	0.669	0.699	0.418426874
0.199	8.085	8.683	4.194	3.891	2.331	0.154	1.091	0.527	0.549	0.328958312
0.237	7.579	10.349	4.999	2.581	1.546	0.186	1.494	0.721	0.745	0.446253502
0.219	7.751	9.556	4.616	3.136	1.878	0.146	1.103	0.533	0.553	0.33103226
0.186	8.585	8.113	3.918	4.667	2.795	0.162	1.047	0.506	0.531	0.31810412
0.240	8.468	10.450	5.047	3.421	2.049	0.152	1.147	0.554	0.574	0.344044047

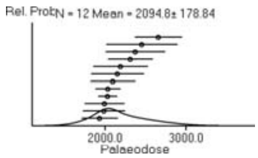
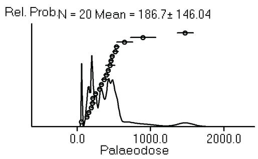
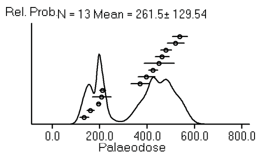
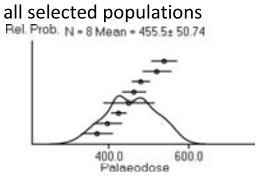
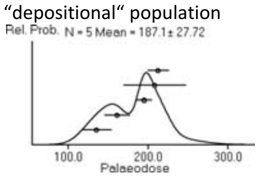
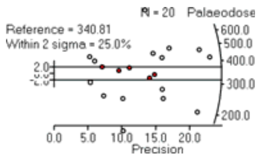
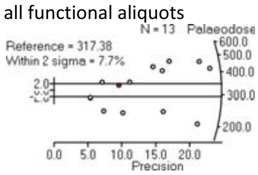
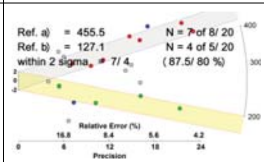
Sample ID	**SiO2**	**Al2O3**	**Fe2O3T**	**MnO**	**MgO**	**CaO**	**Na2O**	**K2O**	**K**	***error***	**TiO2**	**P2O5**	**SO3**	**LOI**	**Total**	**reproducability**
	(in %)	(in %)	(in %)	(in %)	(in %)	(in %)	(in %)	(in %)	(in %)		(in %)	(in %)	(in %)	(in %)	(in %)	(in %)
HK07-D1	55.47	13.67	6.06	0.09	2.67	6.36	1.60	2.632	**2.184**	***0.066***	0.84	0.13	0.35	0.00	89.86	
HK07-D2	58.70	12.80	5.63	0.08	2.27	6.39	1.09	2.459	**2.041**	***0.061***	0.72	0.14	0.33	0.00	90.60	
HK07-D4	60.11	10.47	4.50	0.06	1.94	7.86	1.26	1.882	**1.562**	***0.047***	0.57	0.09	0.12	0.00	88.86	
HK07-D5	50.88	10.95	4.72	0.06	2.71	11.69	1.42	1.803	**1.496**	***0.045***	0.63	0.10	0.12	0.00	85.07	
										0.000						
HK07-L2	58.28	9.96	4.26	0.06	2.43	9.35	1.04	2.226	**1.847**	***0.055***	0.60	0.14	0.18	0.00	88.54	
HK07-L4	57.33	13.52	5.82	0.08	2.86	5.69	1.11	2.656	**2.204**	***0.066***	0.76	0.15	0.52	0.00	90.48	
HK07-M1	81.14	7.27	3.43	0.02	1.25	1.08	0.55	2.088	**1.733**	***0.052***	0.53	0.05	0.06	0.00	97.46	
HK07-M3	81.39	5.85	2.54	0.03	1.04	2.79	0.53	1.595	**1.324**	***0.040***	0.38	0.06	0.05	0.00	96.23	
HK07-M5	63.48	11.57	4.96	0.07	2.24	4.90	1.12	2.429	**2.016**	***0.060***	0.75	0.12	0.10	0.00	91.73	
WL07-FP0	66.23	9.71	5.38	0.06	2.18	5.17	1.05	2.436	**2.022**	***0.061***	0.78	0.09	0.09	0.00	93.17	
WL07-FP1	54.81	8.94	4.64	0.06	2.58	11.47	1.33	2.144	**1.779**	***0.053***	0.67	0.09	0.30	0.00	87.03	
WL07-FP3	60.07	10.31	5.36	0.08	2.85	7.19	1.33	2.635	**2.187**	***0.066***	0.79	0.12	0.13	0.00	90.84	
WL07-FP4	50.78	14.58	6.72	0.26	3.78	5.02	1.56	2.639	**2.190**	***0.066***	0.83	0.12	4.71	0.00	91.01	
WL07-FP6	57.41	11.11	5.33	0.09	4.06	5.94	1.55	2.487	**2.064**	***0.062***	0.73	0.14	0.14	0.00	89.00	
WL07-G1	49.86	11.93	6.28	0.11	3.13	10.17	1.36	2.321	**1.926**	***0.058***	0.71	0.12	0.42	0.00	86.39	
WL07-G1 (2nd)	48.71	11.66	6.14	0.10	3.12	11.18	1.27	2.289	**1.900**	***0.057***	0.69	0.13	0.37	0.00	85.66	1.398
WL07-G3	60.43	11.59	4.99	0.06	2.83	5.63	1.40	2.631	**2.183**	***0.066***	0.81	0.11	1.30	0.00	91.77	
WL07-G3 (2nd)	59.96	11.57	4.92	0.06	2.83	5.89	1.36	2.613	**2.168**	***0.065***	0.80	0.11	1.61	0.00	91.72	0.689
WL07-G5	60.12	12.08	5.46	0.04	2.81	5.28	1.32	2.589	**2.149**	***0.064***	0.79	0.10	0.13	0.00	90.71	
WL07-G5 (2nd)	60.36	12.28	5.53	0.03	2.84	4.97	1.30	2.612	**2.168**	***0.065***	0.81	0.10	0.12	0.00	90.94	0.881
WL07-G6	66.57	13.26	4.35	0.04	2.46	1.85	1.30	2.837	**2.354**	***0.071***	0.88	0.07	0.06	0.00	93.67	
WL07-G6 (2nd)	67.54	12.80	4.06	0.03	2.37	1.91	1.32	2.812	**2.334**	***0.070***	0.88	0.08	0.06	0.00	93.83	0.889

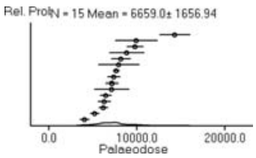
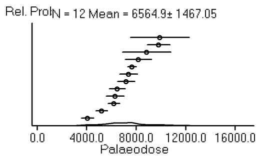
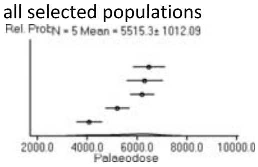
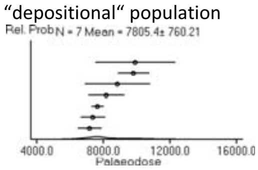
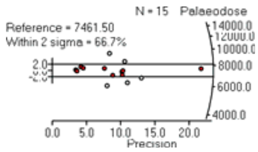
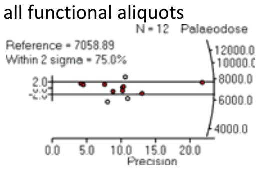
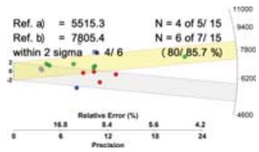
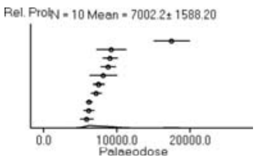
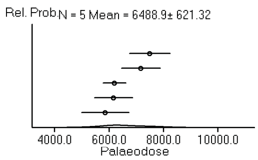
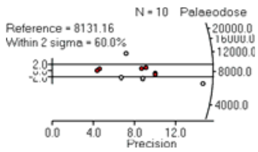
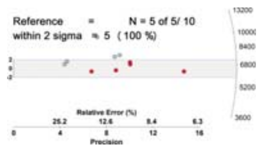
'Manual' D_e-value selection using Analyst 3.22™ and Radial Plot 1.3™ Documentation

Sample ID	Weighted histograms (all "functional grains"/ small aliquots)	**Weighted histograms (selected population(s) of grains/ small aliquots)**	Radial plots - **automatic** (all "functional" grains/ small aliquots)	**Radial plots (selected population(s) out of all functional aliquots)**	D_e/ Age For all (in Gy)	**D_e/ Age selected (in Gy)**
HK07-D 1	 all functional aliquots	 all selected aliquots	 all functional aliquots	 final population	276.28 ± 42.49 81.34 ± 12.98	**271.94 ± 42.31** **80.06 ± 12.92**
HK07-D 2	 all functional aliquots	 all selected aliquots	 all functional aliquots	 final population	373.54 ± 49.56 116.33 ± 17.18	**344.79 ± 25.47** **107.38 ± 10.55**
HK07-D 4	 all functional aliquots	 all selected aliquots	 all functional aliquots	 final population	214.73 ± 49.31 82.95 ± 19.84	**194.90 ± 21.84** **75.30 ± 9.83**

HK07-D 5	 all functional aliquots	 all selected aliquots	 all functional aliquots	 final population	59.61 ± 22.09 23.24 ± 8.66	**47.14 ± 1.81** **18.38 ± 0.99**
HK07-L 2	 all functional aliquots	 all selected aliquots	 all functional aliquots	 final population	98.85 ± 25.30 32.80 ± 8.47	**89.94 ± 7.81** **29.85 ± 2.78**
HK07-L 4	 all functional aliquots	 all selected aliquots	 all functional aliquots	 final population	55.18 ± 28.53 16.52 ± 8.56	**94.75 ± 9.99** **28.36 ± 3.13**
HK07-M 1	 all functional aliquots	 all selected populations	 all functional aliquots	 final populations	106.09 ± 81.23 37.05 ± 28.47	**274.49 ± 41.25 &** 68.61 ± 9.41 **95.86 ± 15.69 &**

		 “depositional“ population  “incisional” population	 all selected populations			23.96 ± 3.64
HK07-M 3	 all functional aliquots	 all selected populations  “depositional“ population	 all functional aliquots  all selected populations	 final populations	248.17 ± 57.74 106.12 ± 25.14	**189.43 ± 8.80 &** 296.20 ± 25.29 **81.01 ± 5.21 &** 126.66 ± 12.19

		 “dune” population				
HK07-M 5	 all functional aliquots	 all selected populations  “depositional“ population  “pedogenic” population	 all functional aliquots  all selected populations	 final populations	109.66 ± 87.96 32.11 ± 25.86	**64.41 ± 7.13 &** 17.97 ± 3.92 **18.86 ± 2.46 &** 5.26 ± 1.52

BRA07-G 1	 all functional aliquots	 all selected populations  “depositional“ population  “inherited” population	 all functional aliquots  all selected populations	 final populations	95.22 ± 23.69 29.90 ± 7.54	**78.87 ± 14.47 &** 111.62 ± 10.87 **24.76 ± 4.66 &** 35.04 ± 3.70
BRA07-G 2	 all functional aliquots	 all selected aliquots	 all functional aliquots	 final population	100.13 ± 22.71 32.87 ± 7.54	**92.79 ± 8.88** **30.46 ± 3.09**

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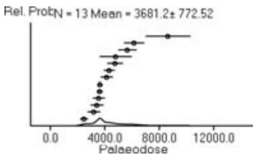
<td>
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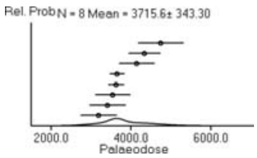
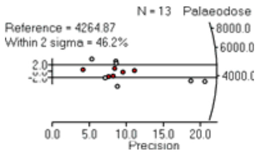
<td>
all selected aliquots</td>
<td>
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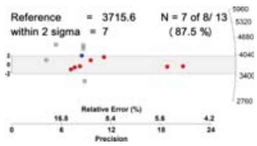
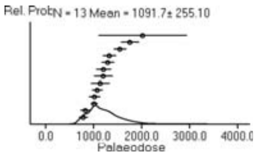
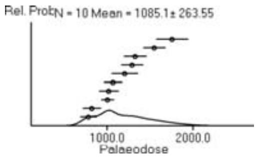
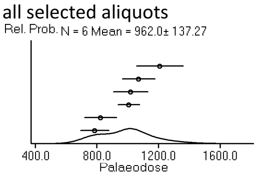
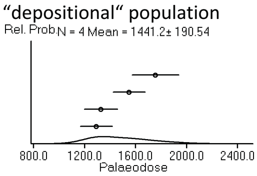
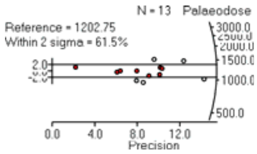
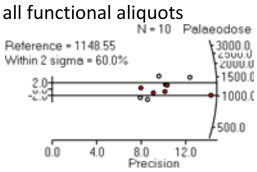
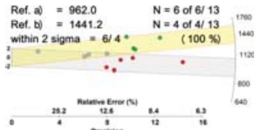
<td>
final population</td>
<td>52.64 ± 11.05

16.03 ± 3.41</td>
<td>53.13 ± 4.91

16.18 ± 1.59</td></tr>
<tr><td>CAS07-1</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CAS07-2</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>WL07-FP 0</td>
<td>
all functional aliquots</td>
<td>
all selected aliquots

“depositional“ population

“inherited” population</td>
<td>
all functional aliquots

all selected populations</td>
<td>
final population</td>
<td>154.37 ± 36.07

50.22 ± 11.92</td>
<td>136.03 ± 19.41 &

203.79 ± 26.94

44.25 ± 6.58 &

66.30 ± 9.19</td></tr>
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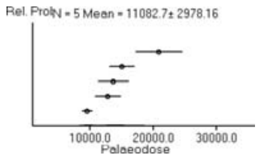
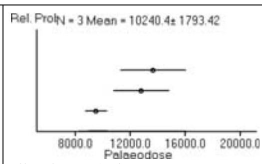
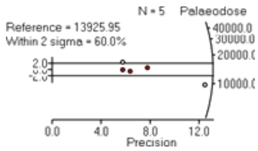
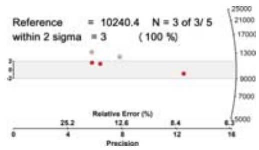
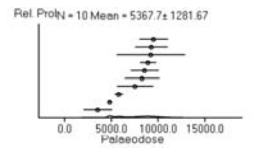
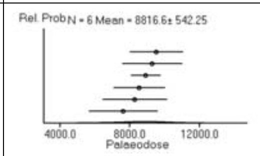
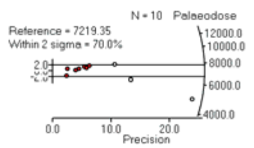
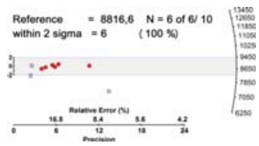
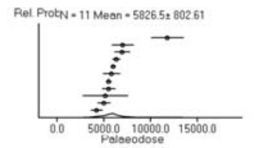
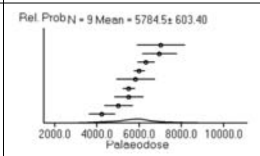
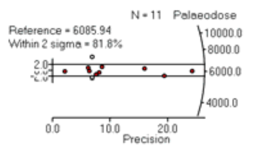
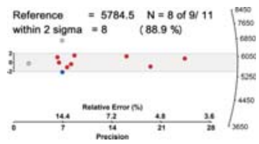
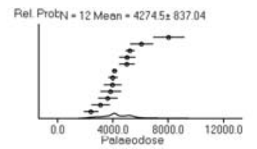
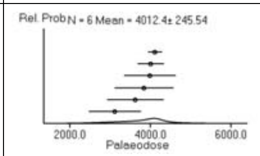
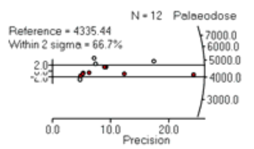
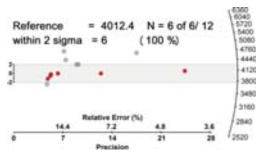
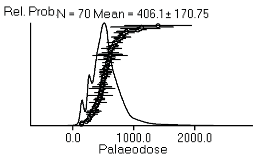
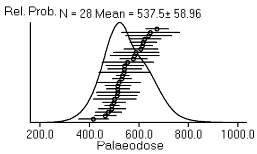
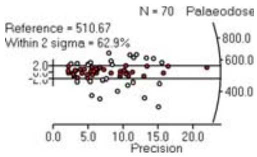
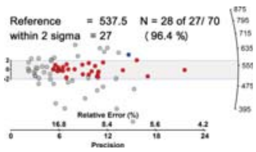
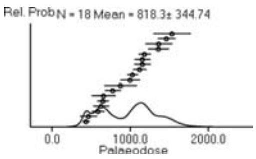
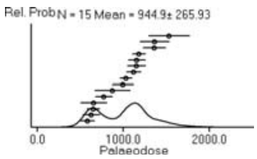
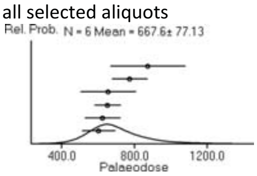
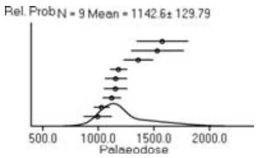
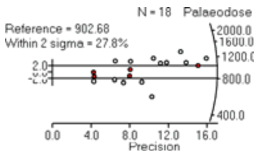
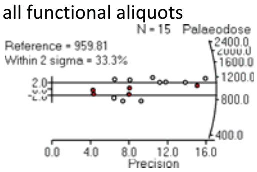
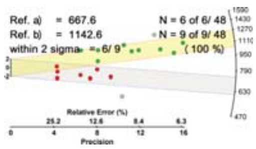
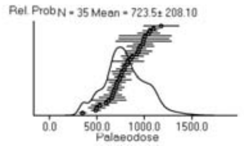
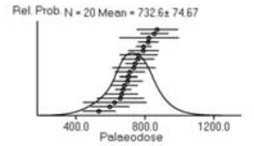
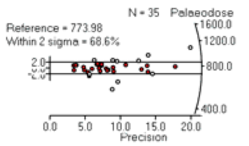
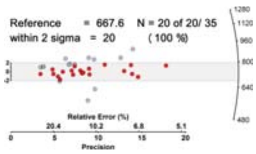
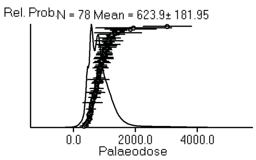
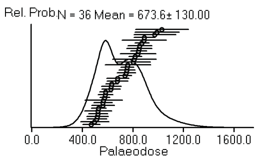
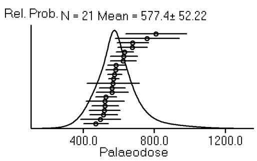
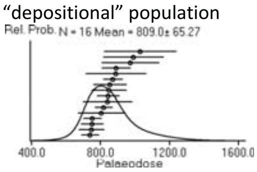
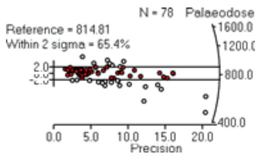
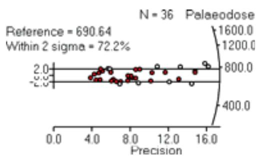
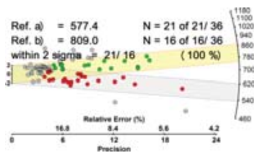
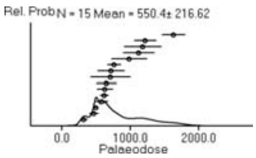
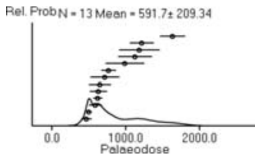
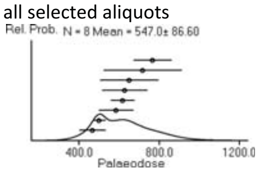
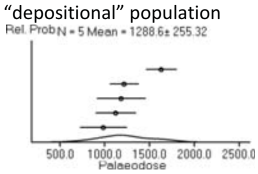
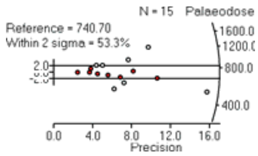
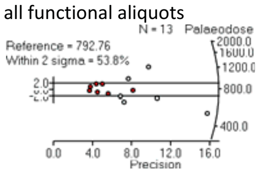
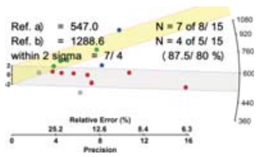
WL07-FP 1	 all functional aliquots	 all selected aliquots	 all functional aliquots	 final population	158.48 ± 42.59 52.46 ± 14.13	**146.44 ± 25.65** **48.47 ± 8.53**
WL07-FP 3	 all functional aliquots	 all selected aliquots	 all functional aliquots	 final population	76.76 ± 18.33 23.67 ± 5.69	**126.08 ± 7.05** **38.88 ± 2.61**
WL07-FP 5	 all functional aliquots	 all selected aliquots	 all functional aliquots	 final population	83.32 ± 11.48 24.99 ± 3.50	**82.72 ± 8.63** **24.81 ± 2.67**
WL07-FP 6 (SA)	 all functional aliquots	 all selected aliquots	 all functional aliquots	 final population	61.13 ± 11.97 18.76 ± 3.71	**57.38 ± 3.51** **17.61 ± 1.19**

WL07-FP 6 (SG)	 all functional aliquots	 all selected aliquots	 all functional aliquots	 final population	42.64 ± 17.93 13.09 ± 5.51	**56.44 ± 6.19** **17.32 ± 1.96**
WL07-G 1	 all functional aliquots	 all selected aliquots  “depositional” population  “inherited” population	 all functional aliquots  all selected aliquots	 final populations	85.92 ± 36.20 29.85 ± 12.68	**70.10 ± 8.10 &** 119.97 ± 13.63 **24.36 ± 3.11 &** 41.69 ± 5.25

WL07-G 3	 all functional aliquots	 all selected aliquots	 all functional aliquots	 final population	75.97 ± 21.85 23.04 ± 6.69	**76.92 ± 7.84** **23.33 ± 2.55**
WL07-G 5	 all functional aliquots	 all selected aliquots  “depositional” population  “inherited” population	 all functional aliquots  all selected aliquots	 final two populations	65.51 ± 19.34 19.39 ± 5.70	**60.63 ± 5.48 &** 84.95 ± 6.85 **17.95 ± 1.75 &** 25.15 ± 2.23

WL07-G 6	 all functional aliquots	 all selected aliquots  “depositional” population  “inherited” population	 all functional aliquots  all selected aliquots	 final two populations	57.79 ± 22.75 16.02 ± 6.33	**57.44 ± 9.09 &** 135.30 ± 26.81 **15.92 ± 2.59 &** 40.05 ± 8.07

For final D_e calculations, **laboratory-specific source calibration factors** (0.09369 for samples from HK07-D and HK07-L; 0.1414 for samples from HK07-M and WL07-FP 0; 0.01430 for the remaining samples from WL07-FP and all samples from BRA07-G; 0.105 for samples from WL07-G) need to be applied (see appendix 5.2.1).

Equivalent Dose sample preparation Protocol

The sample is extracted from the black plastic capped steel cylinders (12.5 cm x 6 cm) under controlled red-light conditions in the dark laboratory. The outward facing 2-3 cm and inward facing 1 cm are removed for immediate moisture content measurements and subsequent DR analysis.

1) Carbonates are dissolved in 20 % HCl (while stirring and heating the sample for 15 min).

2) The fine suspension load is flushed by slowly decanting the sample (for a minimum of 5 repetitions until the water is clear).

3) Clay aggregates are disintegrated by the addition of ~6 NaOH pellets and ultrasonic bath treatment (while stirring the sample).

4) The newly released suspension load is flushed (by a minimum of 3 repetitions until water is clear).

5) Organic complexes are disintegrated by the addition of 30 % H_2O_2 (~1 cm above the sample while stirring and heating until vapour develops, followed by ~15 min rest).

6) The newly released suspension load is flushed (by a minimum of 5 repetitions until water is clear).

7) The sample is rinsed with filtered water, Methanol and Acetone and dried overnight (at ~60°C).

8) The sample is sieved into two grain size fractions: 125-180 µm, and 180-212 µm (treated separately from here on).

9) The outer rind of the grains affected by alpha radiation is etched and feldspar minerals are dissolved in 50 % HF (using a plastic beaker, ~1cm above sample, for 40 min while stirring every 5 min).

10) The sample is transferred back to a glass beaker with filtered water and repeatedly rinsed with 20 % HCl (the second time while stirring and heating until vapour develops, followed by ~15 min rest).

11) The sample is rinsed with RO water (3 times), Methanol and Acetone and dried for 3-4 hrs (at ~60°C).

12) Heavy minerals are separated by suspension in Lithium Polytungstate (with a specific gravity 2.67, allowing 3-4 hrs for settling).

13) The sample is rinsed with RO water (3 times), Methanol and Acetone and dried for 30 min (at ~60°C).

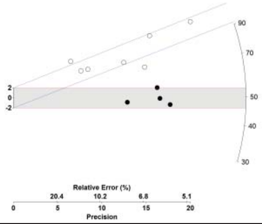
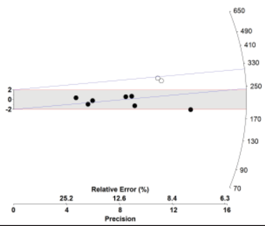
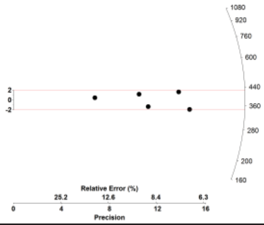
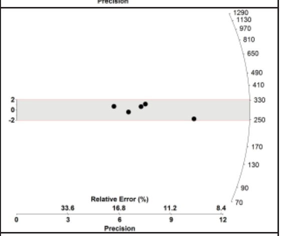
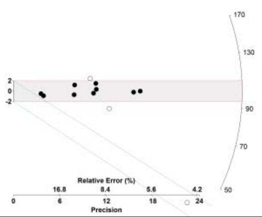
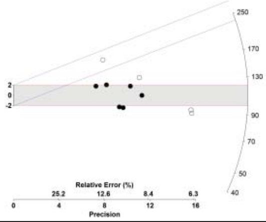
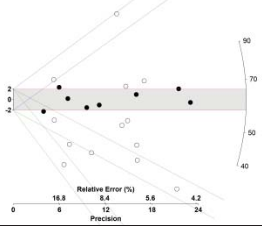
14) Mineral grains with ferrous contaminations that survived the heavy liquid separation are excluded by magnetic separation.

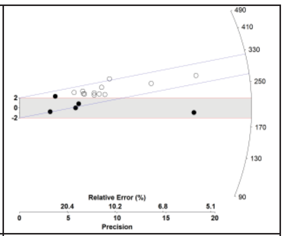
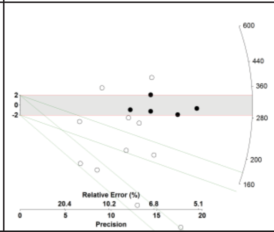
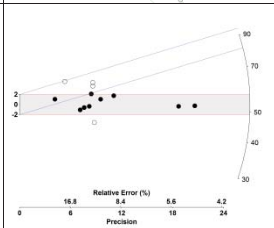
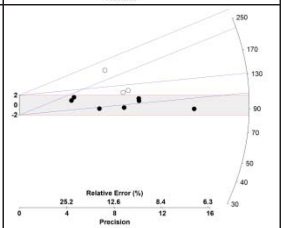
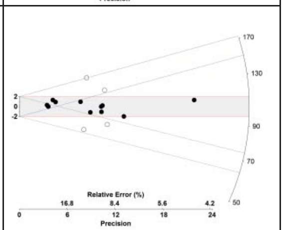
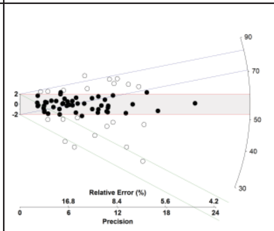
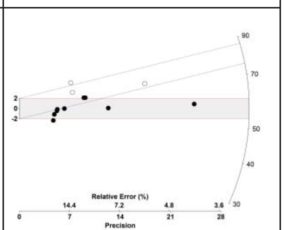
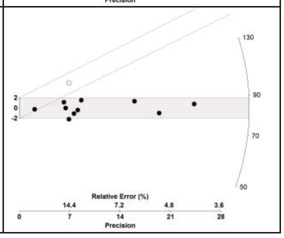
15) The fully treated sample is re-sieved using 90 µm and 150 µm sieves for the 125-180 µm and 180-212 µm fractions respectively, removing broken quartz and feldspar grains that survived the HF treatment.

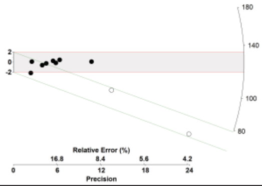
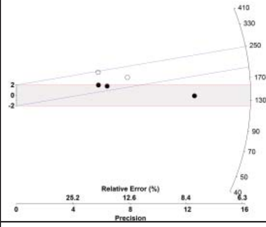
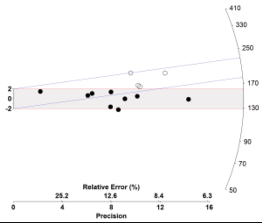
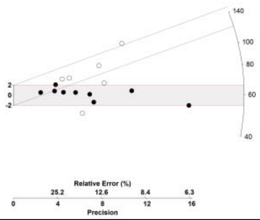
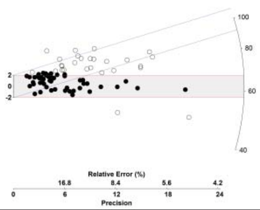
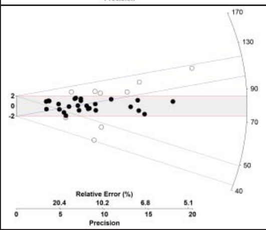
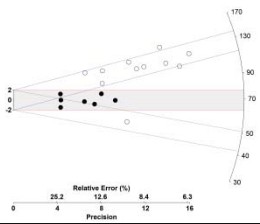
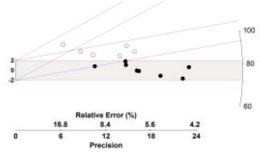
16) The final sample is weighted, packed and labeled and transferred in a dark box to dating laboratory where it is mounted on stainless steel discs either as small aliquots (~20 grains) or single grains (100 grains) for the SAR procedure.

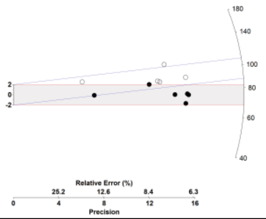
Finite Mixture Model OSL data Table

Environmental Dose Rates (DR) for variable water contents and corresponding Equivalent Dose estimates (ED):

Sample Code	Irradiation data		Environmental DR		FMM/ CDM ED pop.		OD	BIC	Radial Plot
K1890	*U (ppm)*	1.669 ± 0.395	*2.5 %*	2.507 ± 0.144	99.82 ± 5.84	*63 %*	0.12	11.85	
(HK07-D5)	*Th (ppm)*	6.947 ± 1.313	*5.1 %*	2.440 ± 0.140	49.60 ± 3.55	*37 %*			
	K (%)	1.496 ± 0.045	*10 %*	2.320 ± 0.133	-	-			
	Cosmic DR (µGy/a)	192 ± 19.2	*AV %*	2.565 ± 0.096	-	-			
K1889	*U (ppm)*	0.948 ± 0.491	*2.5 %*	2.641 ± 0.177	213.43 ± 31.84	*76 %*	0.17	4.18	
(HK07-D4)	*Th (ppm)*	11.193 ± 1.650	*3.7 %*	2.607 ± 0.174	274.03 ± 82.05	*24 %*			
	K (%)	1.562 ± 0.047	*10 %*	2.439 ± 0.163	-	-			
	Cosmic DR (µGy/a)	138 ± 13.8	*AV %*	2.589 ± 0.173	-	-			
K1888	*U (ppm)*	2.060 ± 0.590	*2.5 %*	3.240 ± 0.210	384.35 ± 32.86	*100 %*	0	-	
(HK07-D2)	*Th (ppm)*	10.015 ± 1.964	*3.4 %*	3.271 ± 0.212	-	-			
	K (%)	2.041 ± 0.061	*10 %*	3.017 ± 0.195	-	-			
	Cosmic DR (µGy/a)	128 ± 12.8	*AV %*	3.211 ± 0.208	-	-			
K1887	*U (ppm)*	2.562 ± 0.394	*2.5 %*	3.380 ± 0.144	287.44 ± 20.29	*100 %*	0	-	
(HK07-D1)	*Th (ppm)*	10.131 ± 1.308	*5.9 %*	3.510 ± 0.150	-	-			
	K (%)	2.184 ± 0.066	*10 %*	3.234 ± 0.138	-	-			
	Cosmic DR (µGy/a)	100 ± 10.0	*AV %*	3.397 ± 0.145	-	-			
K1892	*U (ppm)*	2.393 ± 0.273	*2.5 %*	3.487 ± 0.114	100.97 ± 4.46	*92 %*	0.09	1.88	
(HK07-L4)	*Th (ppm)*	9.084 ± 0.904	*7.9 %*	3.289 ± 0.108	38.86 ± 4.27	*8 %*			
	K (%)	2.204 ± 0.066	*10 %*	3.219 ± 0.105	-	-			
	Cosmic DR (µGy/a)	175 ± 17.5	*AV %*	3.341 ± 0.110	-	-			
K1891	*U (ppm)*	2.280 ± 0.420	*2.5 %*	3.061 ± 0.155	108.86 ± 8.16	*90 %*	0.20	11.12	
(HK07-L2)	*Th (ppm)*	8.360 ± 1.393	*6.0 %*	2.947 ± 0.149	258.20 ± 68.22	*10 %*			
	K (%)	1.847 ± 0.055	*10 %*	2.827 ± 0.143	-	-			
	Cosmic DR (µGy/a)	164 ± 16.4	*AV %*	3.014 ± 0.102	-	-			
AdGL-08006	*U (ppm)*	2.013 ± 0.725	*2.5 %*	3.553 ± 0.244	61.61 ± 3.59	*54 %*	0.15	58.22	
(HK07-M5)	*Th (ppm)*	14.755 ± 2.426	*7.4 %*	3.371 ± 0.231	28.18 ± 2.27	*33 %*			
	K (%)	2.016 ± 0.060	*10 %*	3.282 ± 0.224	180.34 ± 27.57	*9 %*			
	Cosmic DR (µGy/a)	201 ± 20.1	*AV %*	3.415 ± 0.234	9.45 ± 2.04	*5 %*			

AdGL-08005 (HK07-M3)	*U (ppm)*	2.549 ± 0.300	*1.9 %*	2.378 ± 0.106	292.64 ± 18.35	*90 %*	0.15	3.23	
	Th (ppm)	6.265 ± 0.978	*2.5 %*	2.363 ± 0.105	200.15 ± 40.85	*10 %*			
	K (%)	1.324 ± 0.040	*10 %*	2.181 ± 0.097	-	-			
	Cosmic DR (µGy/a)	112 ± 11.2	*AV %*	2.339 ± 0.104	-	-			
AdGL-08004 (HK07-M1)	*U (ppm)*	2.110 ± 0.569	*2.5 %*	2.951 ± 0.192	309.90 ± 24.76	*57 %*	0.20	36.91	
	Th (ppm)	11.220 ± 1.896	*5.3 %*	2.858 ± 0.186	65.78 ± 7.43	*25 %*			
	K (%)	1.733 ± 0.052	*10 %*	2.719 ± 0.176	162.45 ± 28.33	*18 %*			
	Cosmic DR (µGy/a)	81 ± 8.1	*AV %*	2.864 ± 0.186	-	-			
AdGL08004 (BRA07-G4)	*U (ppm)*	3.225 ± 0.282	*2.3 %*	3.332 ± 0.110	52.89 ± 3.85	*74 %*	0.15	12.26	
	Th (ppm)	8.695 ± 0.927	*2.5 %*	3.326 ± 0.109	87.79 ± 14.49	*26 %*			
	K (%)	1.978 ± 0.059	*10 %*	3.068 ± 0.101	-	-			
	Cosmic DR (µGy/a)	145 ± 14.45	*AV %*	3.284 ± 0.108	-	-			
AdGL08002 (BRA07-G2)	*U (ppm)*	3.175 ± 0.285	*2.5 %*	3.162 ± 0.107	93.55 ± 7.69	*47 %*	0.05	8.64	
	Th (ppm)	10.560 ± 0.939	*6.6 %*	3.019 ± 0.102	118.45 ± 12.86	*43 %*			
	K (%)	1.765 ± 0.053	*10 %*	2.911 ± 0.098	249.64 ± 37.12	*10 %*			
	Cosmic DR (µGy/a)	64 ± 6.4	*AV %*	3.047 ± 0.103	-	-			
AdGL08001 (BRA07-G 1)	*U (ppm)*	2.656 ± 0.368	*2.5 %*	3.255 ± 0.132	103.07 ± 3.21	*68 %*	0.05	20.26	
	Th (ppm)	11.910 ± 1.232	*3.8 %*	3.207 ± 0.131	160.15 ± 12.78	*18 %*			
	K (%)	1.905 ± 0.057	*10 %*	2.996 ± 0.122	68.94 ± 5.56	*14 %*			
	Cosmic DR (µGy/a)	52 ± 5.2	*AV %*	3.185 ± 0.130	-	-			
CLW-95/4 (WL07-FP6-SG)	*U (ppm)*	2.331 ± 0.329	*2.5 %*	3.362 ± 0.131	55.63 ± 5.03	*83 %*	0.22	82.98	
	Th (ppm)	8.683 ± 1.091	*9.4 %*	3.126 ± 0.121	24.12 ± 3.62	*9 %*			
	K (%)	2.064 ± 0.062	*10 %*	3.106 ± 0.121	76.12 ± 37.35	*8 %*			
	Cosmic DR (µGy/a)	202 ± 20.2/ 190 ± 19.0	*AV %*	3.259 ± 0.092	-	-			
AdGL-08009 (WL07-FP6-SA)	*U (ppm)*	2.331 ± 0.329	*2.5 %*	3.362 ± 0.131	56.57 ± 5.12	*63 %*	0.1	11.85	
	Th (ppm)	8.683 ± 1.091	*9.7 %*	3.116 ± 0.121	80.25 ± 7.95	*37 %*			
	K (%)	2.064 ± 0.062	*10 %*	3.106 ± 0.121	-	-			
	Cosmic DR (µGy/a)	202 ± 20.2/ 190 ± 19.0	*AV %*	3.259 ± 0.092	-	-			
AdGL-07008 (WL07-FP5)	*U (ppm)*	2.590 ± 0.253	*2.5 %*	3.488 ± 0.092	83.01 ± 3.93	*91 %*	0.10	2.19	
	Th (ppm)	10.449 ± 0.451	*8.4 %*	3.274 ± 0.086	167.61 ± 30.19	*9 %*			
	K (%)	2.099 ± 0.051	*10 %*	3.220 ± 0.085	-	-			
	Cosmic DR (µGy/a)	189 ± 18.9/ 160 ± 16.0	*AV %*	3.334 ± 0.088	-	-			

AdGL-07007	*U (ppm)*	2.205 ± 0.324	*2.5 %*	3.439 ± 0.129	126.05 ± 8.62	*69 %*	0.05	6.00	
(WL07-FP3)	*Th (ppm)*	10.419 ± 1.079	*2.5 %*	3.439 ± 0.129	73.71 ± 3.93	*31 %*			
	K (%)	2.187 ± 0.066	*10 %*	3.171 ± 0.119	-	-			
	Cosmic DR (µGy/a)	179 ± 17.9/ 90 ± 9.0	*AV %*	3.243 ± 0.086	-	-			
AdGL-07006	*U (ppm)*	2.187 ± 0.335	*2.5 %*	3.036 ± 0.127	217.69 ± 17.42	*77 %*	0	3.87	
(WL07-FP1)	*Th (ppm)*	10.208 ± 1.115	*3.0 %*	3.019 ± 0.126	137.53 ± 11.63	*23 %*			
	K (%)	1.779 ± 0.053	*10 %*	2.798 ± 0.117	-	-			
	Cosmic DR (µGy/a)	114 ± 11.4/ 70 ± 0.7	*AV %*	3.021 ± 0.052	-	-			
AdGL-08007	*U (ppm)*	2.542 ± 0.347	*0.1 %*	3.166 ± 0.132	143.61 ± 12.88	*59 %*	0.10	7.38	
(WL07-FP0)	*Th (ppm)*	7.495 ± 1.143	*2.5 %*	3.067 ± 0.127	202.11 ± 21.61	*41 %*			
	K (%)	2.022 ± 0.061	*10 %*	2.826 ± 0.117	-	-			
	Cosmic DR (µGy/a)	100 ± 10.0/ 60 ± 0.6	*AV %*	3.074 ± 0.128	-	-			
CLW-95/5	*U (ppm)*	2.049 ± 0.344	*2.5 %*	3.685 ± 0.139	59.48 ± 4.41	*67 %*	0.15	24.42	
(WL07-G6)	*Th (ppm)*	10.450 ± 1.147	*3.9 %*	3.630 ± 0.137	132.83 ± 15.75	*33 %*			
	K (%)	2.354 ± 0.070	*10 %*	3.402 ± 0.128	-	-			
	Cosmic DR (µGy/a)	187 ± 18.7	*AV %*	3.608 ± 0.136	-	-			
CLW-95/3	*U (ppm)*	2.795 ± 0.318	*2.5 %*	3.468 ± 0.126	99.21 ± 6.51	*61 %*	0.15	76.54	
(WL07-G5)	*Th (ppm)*	8.113 ± 1.047	*4.8 %*	3.382 ± 0.123	61.93 ± 4.06	*39 %*			
	K (%)	2.149 ± 0.064	*10 %*	3.202 ± 0.116	-	-			
	Cosmic DR (µGy/a)	178 ± 17.8	*AV %*	3.378 ± 0.123	-	-			
CLW-95/2	*U (ppm)*	1.878 ± 0.331	*2.5 %*	3.351 ± 0.131	79.03 ± 2.31	*64 %*	0.03	15.28	
(WL07-G3)	*Th (ppm)*	9.556 ± 1.103	*3.0 %*	3.333 ± 0.130	107.59 ± 4.21	*27 %*			
	K (%)	2.183 ± 0.065	*10 %*	3.092 ± 0.121	45.60 ± 3.62	*8 %*			
	Cosmic DR (µGy/a)	153 ± 15.3	*AV %*	3.297 ± 0.129	-	-			
CLW-95/1	*U (ppm)*	1.546 ± 0.446	*2.5 %*	3.036 ± 0.164	124.91 ± 3.36	*59 %*	0	24.98	
(WL07-G1)	*Th (ppm)*	10.349 ± 1.494	*9.8 %*	2.804 ± 0.152	69.00 ± 4.38	*32 %*			
	K (%)	1.926 ± 0.058	*10 %*	2.799 ± 0.151	46.07 ± 4.66	*9 %*			
	Cosmic DR (µGy/a)	104 ± 10.4	*AV %*	2.878 ± 0.156	-	-			
AdGl07002	*U (ppm)*	1.542 ± 0.372	*2.5 %*	3.360 ± 0.137	76.43 ± 1.84	*54 %*	0.02	2.40	
(CAS06-1 3)	*Th (ppm)*	14.215 ± 1.25	*3.3 %*	3.330 ± 0.136	99.98 ± 4.38	*39 %*			
	K (%)	1.918 ± 0.05	*10 %*	3.105 ± 0.126	173.63 ± 28.70	*7 %*			
	Cosmic DR (µGy/a)	115 ± 11.5	*AV %*	3.300 ± 0.135	-	-			

AdGl07001 (CAS06-1 1)	*U (ppm)*	1.994 ± 0.335	*2.5 %*	2.588 ± 0.121	97.08 ± 4.97	*51 %*	0.06	-1.25	
	Th (ppm)	9.328 ± 1.115	*3.3 %*	2.574 ± 0.120	74.78 ± 4.10	*49 %*			
	K (%)	1.441 ± 0.04	*10 %*	2.388 ± 0.111	-	-			
	Cosmic DR (µGy/a)	205 ± 20.5	*AV %*	2.546 ± 0.119	-	-			

Discrete D_e-populations are calculated using the Finite Mixture Model (FMM) “fmix.s” (Galbraith 2005), and numerically listed by their relative proportion in the sample. The number of D_e-populations and the over-dispersion factor (OD) is largely determined by the lowest Bayesian information criterion value (BIC). Where D_e -values fall into one discrete population, the Central Dose Model (CDM) “cdose.s” (Galbraith 2005) is employed. All aliquots/grains are presented as radial plots, i.e. as points with precision values plotted against the x-axis (increasing towards the right), and D_e-values plotted against the y-axis (bands indicating 2 STs from a given central value or “radial line”), (Olley & Reed 2003). The D_e-population interpreted to relate to the last deposition of the sediment is emphasised in black. D_e-populations consisting of <25 % are indicated in grey and treated as outliers and not converted into ages.

Section name Sample code	elevation of TOP (in m) **Depth** from TOP (in cm)	Sample material	14C-Age Estimates (14C a BP ± err)	14C-Age Estimates (a calBP, 1 STD) OSL-Age Estimates (FMM depositional population/ CDM)	14C-Age Estimates (a calBP, 2 STD) OSL-Age Estimates (**MAM** with 1 STD range)	OSL-Age Estimates (**FMM inherited** populations)	OSL-Age Estimates (**FMM post-depositional** populations)	d13C (in ppm) **H_2O content** (in %)	Comments
HK07-D	elev. 193	(S 31.77733°, E 138.31807°)							**Hookina Section D**
K1890	85	Q SA		**19,340 ± 1,560**	17,370 (15,140 - 19,540)	38,920 ± 2,700	-	5.1	below uppermost Bca-horizon
K1889	410	Q SA		**82,450 ± 13,480**	68,790 (60,180 - 77,790)		-	7.2	chromatic band topping 2 pronounced Bca-horizons
K1888	490	Q SA		**-**	108,460 (93,380 - 118,740)	119,700 ± 12,840	-	4.2	chromatic band between 2 pronounced Bca-horizons
K1887	765	Q SA		**84,630 ± 6,980**	78,040 (66,750 - 85,470)	-	-	5.5	base of lowermost Bca-horizon
a1139869									
HK07-L	elev. 162	(S 31.80446°, E 138.26218°)							**Hookina Section L**
K1892	265	Q SA		**30,230 ± 1,660**	15,180 (12,510 - 17,910)	-		6.5	upper band of chromatic "twin marker horizon"
K1891	325	Q SA		**36,120 ± 2,970**	28,700 (23,150 - 30,610)		-	5.5	lower band of chromatic "twin marker horizon"
HK07-M	elev. 154	(S 31.79532°, E 138.25908°)							**Hookina Section M**
AdGL-08006	40	Q SA		**18,040 ± 1,620**	4,400 (2,640 - 5,300)		8,250 ± 0,870	6.2	uppermost Bca-horizon
AdGL-08005	637	Q SA		**85,590 ± 17,880**	97,800 (88,800 - 105,730)	125,140 ± 9,620	-	3.5	"orange Sf band" (reworked dune?)
AdGL-08004	1075	Q SA		**108,230 ± 11,140**	19,940 (16,870 - 23,430)	-	22,970 ± 2,990	5.2	onset of Silts, below major cut & fill
BRA-SA		~(S 31.337°, E 138.619°)					**BRA-SA**		**Brachina Section A**
OZE022	405	S	18,500 ± 180	**22,170 ± 310**	21,550 - 22,790			-4.74	(Williams et al. 2001)
OZC706	440	C	17,300 ± 200	**20,790 ± 240**	20,310 - 21,270			-25	(Williams et al. 2001)
OZC705	440	C	18,150 ± 350	**21,860 ± 450**	20,960 - 22,760			-25	(Williams et al. 2001)
OZC704	440	S	19,100 ± 180	**22,980 ± 210**	22,560 - 23,400			0	(Williams et al. 2001)
Beta-84140	550	C	20,320 ± 90	**24,290 ± 180**	23,930 - 24,650			-	(Williams et al. 2001)
Beta-84141	600	C	20,840 ± 90	**24,830 ± 80**	24,670 - 24,990			-	(Williams et al. 2001)
BRA-SG	elev. 344	(S 31.3388°, E 138.611°)							**Brachina Section G**
Wk-6548	20	S	14,827 ± 87	**18,100 ± 240**	17,620 - 18,580			-6.6 ± 0.2	(Williams et al. 2001)
Wk-6554	55	S	15,891 ± 85	**18,970 ± 110**	18,750 - 19,190			-8.1 ± 0.2	(Williams et al. 2001)
Wk-6555	72	S	16,173 ± 89	**19,340 ± 160**	19,020 - 19,660			-7.6 ± 0.2	(Williams et al. 2001)
Wk-6552	78	S	16,172 ± 93	**19,340 ± 160**	19,020 - 19,660			-7.4 ± 0.2	(Williams et al. 2001)
Wk-6550	93	S	16,365 ± 94	**19,620 ± 160**	19,300 - 19,940			-8.3 ± 0.2	(Williams et al. 2001)
Wk-6549	117	S	16,960 ± 100	**20,390 ± 110**	20,170 - 20,610			-9.1 ± 0.2	(Williams et al. 2001)
Wk-6553	150	S	16,928 ± 94	**20,360 ± 100**	20,160 - 20,560			-6.8 ± 0.2	(Williams et al. 2001)
Wk-6556	165	S	17,148 ± 96	**20,600 ± 120**	20,360 - 20,840			-7.7 ± 0.2	(Williams et al. 2001)
BRA07-SD	elev. 340	(S 31.337339°, E 138.60660°)							**Slippery Dip**
SSAMS ANU-4107	51	OV	15,160 ± 100	**18,280 ± 230**	17,820 - 18,740			-26 ± 3	topmost undisturbed organic veneer
SSAMS ANU-4109	94	C	16,170 ± 120	**19,340 ± 200**	18,940 - 19,740			-26 ± 3	topmost undisturbed light band
SSAMS ANU-4207	116	OV	17,420 ± 120	**20,920 ± 170**	20,580 - 21,260			-22 ± 3	base of central light band
AdGL-96005	~160	Q LA		**18,000 ± 1,200**	-			5.3	(Williams et al. 2001) based on TSAC/ XRS DR
SSAMS ANU-4206	198	OV	18,410 ± 100	**22,110 ± 250**	21,610 - 22,610			-20 ± 3	top of light "5er marker bands"
SSAMS ANU-4110	213	OV	18,520 ± 120	**22,230 ± 260**	21,710 - 22,750			-19 ± 3	base of light "5er marker bands"
SSAMS ANU-4111	244	OV	18,610 ± 130	**22,410 ± 180**	22,050 - 22,770			-14 ± 3	top of continuous "tufa band"
SSAMS ANU-4112	264	OV	19,360 ± 140	**23,230 ± 150**	22,930 - 23,530			-27 ± 3	top of light "4er marker bands"
AdGL-96007	~325	Q LA		**22,400 ± 2,300**	-			23.7	(Williams et al. 2001) based on TSAC/ XRS DR
SSAMS ANU-4113	338	OV	20,130 ± 160	**24,080 ± 240**	24,560 - 23,600			-25 ± 3	topping central light band of "3er marker bands"
SSAMS ANU-4114	341	C	18,880 ± 140	**22,680 ± 150**	22,380 - 22,980			-22 ± 3	central light band of "3er marker bands"
OZJ905	~353	S	20,460 ± 140	**24,450 ± 190**	24,070 - 24,830			-7.4	from monolith
SSAMS ANU-4209	372	OV	19,670 ± 120	**23,540 ± 120**	23,300 - 23,780			-18 ± 3	tufa capping lower light band of "3er marker bands"
SSAMS ANU-4116	437	OV/ C	21,120 ± 150	**25,160 ± 240**	24,680 - 25,640			-29 ± 3	top of "pink band"
AdGL-96004	~475	Q LA		**21,600 ± 1,200**	-			9.5	(Williams et al. 2001) based on TSAC/ XRS DR

Section name / Sample code	elevation of **TOP** (in m) / **Depth** from TOP (in cm)	Sample material	14C-Age Estimates (14C a BP ± err)	14C-Age Estimates (a calBP, 1 STD) / **OSL-Age Estimates** (**FMM depositional** population/ CDM)	14C-Age Estimates (a calBP, 2 STD) / OSL-Age Estimates (**MAM** with 1 STD range)	OSL-Age Estimates (**FMM inherited** populations)	OSL-Age Estimates (**FMM post-depositional** populations)	d13C (in ppm) / **H_2O content** (in %)	Comments
SSAMS ANU-2030	474	C	21,890 ± 160	**26,260 ± 310**	25,640 - 26,880			-28 ± 2	"pink band"
SSAMS ANU-2035	495	C	24,110 ± 210	**28,990 ± 390**	28,210 - 29,770			-26 ± 3	base of lowermost light band
SSAMS ANU-4117	505	OV	19,820 ± 180	**23,710 ± 200**	23,310 - 24,110			-15 ± 3	lowermost organic veneer
SSAMS ANU-4205	505	OV	19,910 ± 180	**23,830 ± 250**	23,330 - 24,330			-21 ± 3	lowermost organic veneer
OZJ909	508	S	21,510 ± 310	**25,660 ± 460**	24,740 - 26,580			-	top of "palaeosol"
SSAMS ANU-2036	516	C	27,630 ± 280	**32,210 ± 260**	31,690 - 32,730			-24 ± 2	base of "palaeosol"
SSAMS ANU-2037	516	C	27,740 ± 290	**32,310 ± 290**	31,730 - 32,890			-29 ± 2	independent run of SSAMS ANU-2036
Beta-96166	~565	S	28,120 ± 160	**32,570 ± 260**	32,050 - 33,090			-6	(Cock et al. 1999) - Section C
Beta-96679	~565	C	29.,80 ± 180	**33,560 ± 300**	32,960 - 34,160			-25.8	(Cock et al. 1999) - Section C
AdGL-96003	~600	Q LA		**32,800 ± 2,800**	-			18.3	(Williams et al. 2001) based on TSAC/ XRS DR
AdGL-96006	~635	Q LA		**24,900 ± 1,400**	-			17.4	(Williams et al. 2001) based on TSAC/ XRS DR
OZJ904	632	C	29,160 ± 380	**33,570 ± 410**	32,750 - 34,390			-24.5	large piece of charcoal (8 x 2 cm)
OZJ908	639	S	27,990 ± 710	**32,640 ± 630**	31,380 - 33,900			-	Lower Unit lighter band
OZJ907	667	S	27,320 ± 280	**31,970 ± 200**	31,570 - 32,370			-7.1	Lower Unit darker band
OZJ906	684	S	27,200 ± 500	**31,900 ± 390**	31,120 - 32,680			-	Lower Unit darker band with large calc. rhizocretes
SSAMS ANU-2039	695	C	23,600 ± 300	**28,560 ± 420**	27,720 - 29,400			-27 ± 2	present base of Lower Unit
SSAMS ANU-1811	695	S	23,270 ± 90	**28,080 ± 80**	27,920 - 28,240			-23 ± 2	present base of Lower Unit
AdGL-96008	~830	Q LA coarse		**24,000 ± 1,600**	-			19.4	independent run of AdGL-96002 on coarser fraction
AdGL-96002	~830	Q LA		**24,900 ± 2,500**	-			19.4	(Williams et al. 2001) based on TSAC/ XRS DR
Southern End (Section D)	elev. 341	~(S 31.33935°, E 138.60737°)							
Beta-96169	~120	S	16,150 ± 80	**19,300 ± 140**	19,020 - 19,580			-8.2	(Cock et al. 1999), ~250 m downstream of BRA07-SD
Beta-96168	~145	S	16,200 ± 60	**19,380 ± 120**	19,140 - 19,620			-9.1	(Cock et al. 1999), ~250 m downstream of BRA07-SD
Beta-96167	~195	S	17,070 ± 70	**20,500 ± 90**	20,320 - 20,680			-7.9	(Cock et al. 1999), ~250 m downstream of BRA07-SD
OZC710	255	S	17,450 ± 350	**20,930 ± 390**	20,150 - 21,710			0	-
OZC709	285	S	17,650 ± 140	**21,160 ± 170**	20,820 - 21,500			0	-
Beta-96170	~455	S	20,650 ± 80	**24,680 ± 80**	24,520 - 24,840			-9.6	(Cock et al. 1999), ~250 m downstream of BRA07-SD
BRA-LW	elev. 333	~(S 31.33593°, E 138.60231°)							**Lubra Waterhole**
Wk-6558	1150	C	26,430 ± 350	**31,210 ± 380**	30,450 - 31,970			-26.0 ± 0.2	disturbed Silts towards base of 1350 cm section
Wk-6562	1230	C	25,330 ± 310	**30,240 ± 290**	29,660 - 30,820			-23.1 ± 0.2	disturbed Silts towards base of 1350 cm section
OZC707	1265	C	27,100 ± 260	**31,820 ± 160**	31,500 - 32,140			-25	disturbed Silts towards base of 1350 cm section
Beta-96171	1265	C	27,710 ± 220	**32,250 ± 230**	32,710 - 31,790			-24.9	disturbed Silts towards base of 1350 cm section
Wk-6561	1275	C	13,715 ± 98	**16,940 ± 70**	16,800 - 17,080			-24.4 ± 0.2	disturbed Silts towards base of 1350 cm section
Wk-6564	1300	C	16,380 ± 120	**19,650 ± 190**	19,270 - 20,030			-23.0 ± 0.2	disturbed Silts towards base of 1350 cm section
BRA-ABC	elev. 316	~(S 31.3334°, E 138.594°)							**Brachina ABC Narrows**
OZE086	15	T	11,650 ± 110	**13,540 ± 130**	13,280 - 13,800			0	topmost tufa cap
Wk-7295	52	OC	15,780 ± 140	**18,910 ± 140**	18,630 - 19,190			-23.8 ± 0.2	30 cm black organic clay band below tufa (Williams et al. 2001)
BRA07-AR	elev. 300	(S 31.32897°, E 138.58563°)							**Brachina AR**
OZK516	155	S	15,550 ± 130	**18,710 ± 70**	18,570 - 18,850			-9.3	uppermost gravel-Silts couplet
OZK002	253	S	16,280 ± 130	**19,500 ± 210**	19,080 - 19,920			-7.6	gravel-Silts couplet
OZK003	338	S	15,750 ± 120	**18,860 ± 110**	18,640 - 19,080			-8.5	gravel-Silts couplet
SSAMS ANU-1812	380	S	14,470 ± 60	**17,720 ± 60**	17,600 - 17,840			-17 ± 1	lowermost gravel-Silts couplet
SSAMS ANU-2038	380	C	15,210 ± 220	**18,310 ± 270**	17,770 - 18,850			-23 ± 2	lowermost gravel-Silts couplet
OZK517	508	C	16,820 ± 180	**20,210 ± 220**	19,770 - 20,650			-24.9	clast-supported basal gravel (up to ~25 cm)

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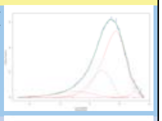
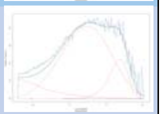
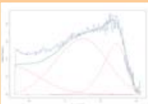
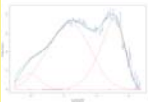
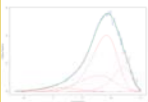
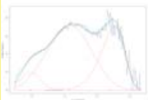
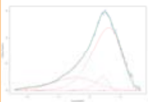
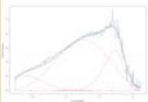
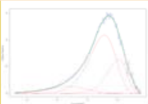
BRA07-G	elev. 270	(S 31.34134°, E 138.56968°)							**Brachina 18M Section**
AdGL-08003	375	Q SA		**16,110 ± 1,290**	13,170 (11,660 - 14,590)	26,740 ± 4,500	-	3.7	towards base of final wedge of local colluvium
AdGL-08002		Q SA		**30,710 ± 2,730**	27,450 (24,120 - 30,860)	38,880 ± 4,420	-	5.8	below onset of multiple gravel sheets
ANU BG42	1350	S	24,000 ± 240	**28,900 ± 410**	28,080 - 29,720			-	(Williams et al. 2001)
ANU BG27	1400	S	30,400 ± 480	**34,630 ± 400**	33,830 - 35,430			-	(Williams et al. 2001)
AdGL-08001	1620	Q SA		**32,360 ± 1,660**	23,860 (21,240 - 26,340)			4.4	lowermost exposed band of Silts
								2	
WL08-UFP	elev. 399	(S 31.27082°, E 138.85221°)							**Wilkawillina Upper FP**
Wk23464	20	S	7,390 ± 45	**8,240 ± 60**	8,120 - 8,360			-	uppermost "red drape"
Wk23465	75	C	13,021 ± 52	**15,640 ± 100**	15,440 - 15,840			-25.5 ± 0.2	towards base of Silts-capping gravel band
Wk23524	733	S	25,084 ± 176	**30,010 ± 160**	29,690 - 30,330			-	within "chromatic band"
Wk23467	780	S	19,034 ± 127	**22,930 ± 180**	22,570 - 23,290			-	within incipient Bca-horizon below "chromatic band"
Wk23525	853	S	31,398 ± 367	**35,300 ± 390**	34,520 - 36,080			-7.1 ± 0.2	pocket of intact shells below 2nd Bca-horizon in lowermost "chromatic band"
WL07-FP	elev. 382	(S 31.26960°, E 138.86783°)							**Wilkawillina Floodplain**
CLW-95/4	85	Q SG		**17,070 ± 1,620**	9,810 (9,090 - 10,530)			7.2	2-3cm below "red drape" within incipient Bca-horizon
AdGL-07009	85	Q SA		**17,360 ± 1,650**	14,600 (12,630 - 16,430)	24,630 ± 2,540	-	7.3	2-3cm below "red drape" within incipient Bca-horizon
SSAMS ANU-1813	240	S	18,500 ± 60	**22,350 ± 110**	22,130 - 22,570			-6 ± 1	upper of red "twin Sf marker bands"
AdGL-07008	255	Q SA		**24,900 ± 1,350**	20,810 (18,370 - 23,070)		-	6.7	between red "twin Sf marker bands"
OZK014	268	S	18,610 ± 180	**22,310 ± 310**	21,690 - 22,930			-5.7	lower of red "twin Sf marker bands"
SSAMS ANU-2033	500	C	24,440 ± 200	**29,290 ± 360**	28,570 - 30,010			-26 ± 2	onset of Silts above widespread gravel sheet
SSAMS ANU-2032	520	C	22,800 ± 170	**27,500 ± 360**	26,780 - 28,220			-23 ± 2	onset of Silts above widespread gravel sheet
OZK012	745	C	32,760 ± 430	**37,120 ± 840**	35,440 - 38,800			-24.7	massive Silts below multiple gravel bands
OZK013	750	C	32,210 ± 400	**36,650 ± 930**	34,790 - 38,510			-25.5	massive Silts below multiple gravel bands
OZK011	760	S	29,300 ± 300	**33,700 ± 350**	33,000 - 34,400			-2.2	massive Silts below multiple gravel bands
AdGL-07007	855	Q SA		**38,870 ± 2,850**	23,290 (20,150 - 26,100)	-	22,730 ± 1,350	3.8	massive Silts below gravel drape of lower section
OZK010	880	C	36,630 ± 580	**41,690 ± 410**	40,870 - 42,510			-23.8	massive Silts below gravel drape of lower section
AdGL-07006	1320	Q SA		**45,520 ± 3,930**	48,030 (39,520 - 55,780)	72,060 ± 5,900	-	4.0	lowermost Bca-horizon
AdGL-08007	1467	Q SA		**46,720 ± 4,620**	41,460 (36,960 - 45,630)	65,750 ± 7,540	-	2.5	onset of Silts aggradation below calcrete pans
WL07-S	elev. 376	(S 31.26887°, E 138.88176°)							**Wilkawillina Slackwater**
SSAMS ANU-2001	85	C/ OV	29,590 ± 370	**33,890 ± 360**	33,170 - 34,610			-25 ± 2	topmost organic veneer above more "chromatic Silts"
SSAMS ANU-2227	235	OV	21,410 ± 120	**25,440 ± 230**	24,980 - 25,900			-15.6 ±	lowermost gravel-Silts couplet
SSAMS ANU-2229	275	OV	24,520 ± 190	**29,410 ± 300**	28,810 - 30,010			-14.7 ±	lowermost organic veneer
WL07-G	elev. 367	(S 31.27243°, E 138.87921°)							**Wilkawillina Gorge**
CLW-95/5	107	Q SG		**17,050 ± 1,410**	13,030 (11,270 - 14,080)	38,080 ± 4,730	-	4.4	distinct light band sandwiched by organic veneers
CLW-95/3	156	Q SG		**18,330 ± 1,380**	16,650 (15,760 - 17,540)	29,370 ± 2,200	-	4.9	termination of massive disturbed Silts below gravel
CLW-95/2	310	Q SG		**23,970 ± 1,170**	18,390 (17,000 - 19,730)	32,640 ± 1,800		4.0	light Silts with organic veneers
OZK019	360	C	19,800 ± 160	**23,670 ± 170**	23,330 - 24,010			-25.8	onset of light disurbed Silts
OZK020	370	C	19,760 ± 210	**23,660 ± 220**	23,220 - 24,100			-24.6	onset of light disurbed Silts
CLW-95/1	715	Q SG		**23,970 ± 2,000**	19,070 (16,660 - 21,520)	43,400 ± 2,630		7.4	second brown Silts band from base incorporating platy gravel and kankar

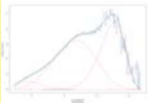
Section name	elevation of **TOP** (in m)	**Sample material**	**14C-Age Estimates**	**14C-Age Estimates** (a calBP, 1 STD)	**14C-Age Estimates** (a calBP, 2 STD)	**OSL-Age Estimates**	**OSL-Age Estimates**	**d13C** (in ppm)	**Comments**
Sample code	**Depth** from TOP (in cm)		(14C a BP ± err)	**OSL-Age Estimates** (**FMM depositional** population/ CDM)	OSL-Age Estimates (**MAM** with 1 STD range)	(**FMM inherited** populations)	(**FMM post-depositional** populations)	**H_2O content** (in %)	
CAS06-1	elev. 332	(S 31.15334°, E 138.56692°)/ (S 31.15365°, E 138.57011°)							**Cascades 1**
AdGL07002	22	Q SA		**23,160 ± 1,100**	21,680 (19,830 - 23,370)	30,300 ± 1,810	-	4.2	TOP without Bca-horizon
OZJ893	75	C	15,080 ± 110	18,250 ± 230	17,790 - 18,710			-25	<100 µg! run on ANTARES accelerator
OZJ895	225	C	21,560 ± 250	**25,670 ± 400**	24,870 - 26,470			-25.4	run on STAR accelerator
OZJ897	265	C	22,590 ± 260	**27,310 ± 400**	26,510 - 28,110			-24	run on STAR accelerator
OZJ892	300	C	3,940 ± 190	4,400 ± 280	3,840 - 4,960			-25	<100 µg! run on ANTARES accelerator
OZJ894	382	C	10,370 ± 200	12,160 ± 350	11,460 - 12,860			-25	<100 µg! run on ANTARES
OZJ896	477	C	12,790 ± 180	15,310 ± 270	14,770 - 15,850			-25	<100 µg! run on ANTARES
AdGL07001	609	Q SA		**29,370 ± 2,120**	27,930 (25,180 - 30,350)	38,130 ± 2,640	-	4.0	disturbed Silts at base of section
Other									**Other**
OZE026	70	C	300 ± 60	**390 ± 70**	530 - 250			-9.84	between eroded burial and palaeosol
OZE025	70	S	3,450 ± 70	**3,730 ± 90**	3,910 - 3,550			-1.65	between eroded burial and palaeosol
OZC713	-	E	40,300 ± 3,300	**44,470 ± 2,870**	38,730 - 50,210			0	dune site on Hawker/ Parachilna road (palaeosol)
OZJ902	TOP	S	14,620 ± 140	**17,770 ± 90**	17,590 - 17,950			-8.2	termination of Silts capped by tufa bench at CAS06-2
OZE021	~700	S	33,250 ± 1,050	**38,170 ± 1,800**	34,570 - 41,770			-8.59	from 10 m terrace sampled 1998
OZE023	420	C	27,900 ± 300	**32,430 ± 320**	31,790 - 33,070			-26.05	Price Creek bank section, 5.8 m terrace
OZE024	850	C	28,900 ± 500	**33,330 ± 520**	32,290 - 34,370			-25.0	Bunyeroo Creek, 10 m terrace, red-brown clay

Tab. 1) Flinders Silts Age Sheet listing all age estimates within stratigraphic order in type sections. Sample material is indicated; **Q** - quartz (**SA** - small aliquots, **SG** - single grains, **LA** -large aliquots), **C** - charcoal, **S** - carbonate shells of aquatic gastropods, **OV** - veneers of organic detritus, **OC** - organic clay, **T** - tufa, **E** - emu egg shell. All radiocarbon ages are calibrated using the CalPal-2007Hulu-calibration data set (Weninger and Jöris 2008) as part of the CalPal-2007 calibration and palaeoclimate research software package (Weninger et al. 2008). The OSL age estimates are calculated using the Finite Mixture Model (**FMM**) of Galbraith (2005). The discrete "age populations" are interpreted as "depositional", "inherited" and "post-depositional". Wherever the equivalent dose rates are restricted to a single population, the Central Dose Model (**CDM**) is employed (Galbraith 2005). For comparison,

	A	B	C	D	E	F	G	H	I	J	K
1	**Sample ID**	**relative prop. (in %)**	**CP modes (in µm)**	pi	mu (log10)	**sigma**	**fixpi**	**fixmu**	**fixsigma**	Mixdist parameters	**CPA screenshot**
2	**BRA07-300 MD**	**0.0**	**3**	0.0000	0.4771	0.2142	FALSE	TRUE	FALSE	mix(AR300_MD,mixparam(	
3		**4.2**	**13**	0.0424	1.1292	0.3050	FALSE	TRUE	FALSE		
4		**22.8**	**48**	0.2277	1.6812	0.2436	FALSE	TRUE	FALSE		
5		**66.3**	**74**	0.6627	1.8715	0.2367	FALSE	FALSE	FALSE		
6		**6.7**	**167**	0.0672	2.2227	0.1345	FALSE	TRUE	FALSE		
7	**BRA07-300 FD**	**15.3**	**3**	0.1530	0.4771	0.2000	TRUE	TRUE	TRUE	mix(AR300_FD,mixparam(	
8		**69.3**	**13**	0.6930	1.1292	0.3150	FALSE	FALSE	TRUE		
9		**15.4**	**48**	0.1540	1.6812	0.1350	TRUE	TRUE	TRUE		
10		**0.0**	**74**	0.0000	1.8715	0.0000	-	-	-		
11		**0.0**	**167**	0.0000	2.2227	0.0000	-	-	-		
12	**BRA07-303 MD**	**0.2**	**3**	0.0017	0.4771	0.0997	FALSE	TRUE	FALSE	mix(AR303_MD,mixparam(	
13		**9.1**	**16**	0.0913	1.2133	0.2941	FALSE	TRUE	FALSE		
14		**23.7**	**44**	0.2374	1.6435	0.1912	FALSE	TRUE	FALSE		
15		**64.5**	**74**	0.6452	1.8680	0.2080	FALSE	FALSE	FALSE		
16		**2.4**	**176**	0.0244	2.2463	0.0830	FALSE	FALSE	FALSE		
17	**BRA07-303 FD**	**16.1**	**3**	0.1610	0.4771	0.3550	TRUE	TRUE	TRUE	mix(AR303_FD,mixparam(	
18		**69.6**	**16**	0.6961	1.2133	0.3300	FALSE	FALSE	TRUE		
19		**14.3**	**44**	0.1429	1.6435	0.1400	FALSE	TRUE	TRUE		
20		**0.0**	**74**	0.0000	1.8680	0.0000	-	-	-		
21		**0.0**	**176**	0.0000	2.2463	0.0000	-	-	-		
22	**BRA07-304 MD**	**0.5**	**3**	0.0053	0.4771	0.1095	FALSE	TRUE	FALSE	mix(AR304_MD,mixparam(	
23		**12.0**	**16**	0.1196	1.2172	0.3144	FALSE	TRUE	FALSE		
24		**20.6**	**46**	0.2057	1.6628	0.1750	FALSE	TRUE	FALSE		
25		**66.9**	**59**	0.6694	1.7743	0.2146	FALSE	FALSE	FALSE		
26											
27	**BRA07-304 FD**	**21.5**	**3**	0.2150	0.4771	0.2950	FALSE	TRUE	TRUE	mix(AR304_FD,mixparam(	
28		**56.0**	**16**	0.5600	1.2172	0.3425	TRUE	TRUE	FALSE		
29		**22.5**	**46**	0.2250	1.6628	0.1671	TRUE	TRUE	FALSE		
30		**0.0**	**59**	0.0000	1.7743	0.0000	-	-	-		
31											
32	**BRA07-305 MD**	**0.0**	**3**	0.0000	0.4771	0.1925	FALSE	TRUE	FALSE	mix(AR305_MD,mixparam(	
33		**4.4**	**12**	0.0442	1.0736	0.2640	FALSE	TRUE	FALSE		
34		**22.1**	**51**	0.2211	1.7076	0.2837	FALSE	TRUE	FALSE		
35		**60.0**	**75**	0.5995	1.8765	0.2180	FALSE	FALSE	FALSE		
36		**13.5**	**170**	0.1352	2.2292	0.1546	FALSE	TRUE	FALSE		

	A	B	C	D	E	F	G	H	I	J	K
37	**BRA07-305 FD**	**6.5**	**3**	0.0655	0.4771	0.1500	FALSE	TRUE	TRUE	mix(AR305_FD,mixparam(	
38		**57.7**	**12**	0.5774	1.0736	0.3150	FALSE	FALSE	TRUE		
39		**35.7**	**51**	0.3572	1.7076	0.2050	FALSE	TRUE	TRUE		
40		**0.0**	**75**	0.0000	1.8765	0.0000	-	-	-		
41		**0.0**	**170**	0.0000	2.2292	0.0000	-	-	-	mix(AR305_FD,mixparam(	
42	**BRA07-306 MD**	**0.5**	**4**	0.0046	0.6021	0.1107	FALSE	TRUE	FALSE	mix(AR306_MD,mixparam(	
43		**10.2**	**16**	0.1025	1.2153	0.2646	FALSE	TRUE	FALSE		
44		**10.2**	**47**	0.1022	1.6677	0.1559	FALSE	TRUE	FALSE		
45		**79.1**	**60**	0.7907	1.7790	0.2644	FALSE	FALSE	FALSE		
46											
47	**BRA07-306 FD**	**12.3**	**4**	0.1230	0.6021	0.2800	TRUE	TRUE	TRUE	mix(AR306_FD,mixparam(	
48		**52.0**	**16**	0.5200	1.2153	0.2900	TRUE	FALSE	TRUE		
49		**35.7**	**47**	0.3570	1.6677	0.1850	FALSE	TRUE	TRUE		
50		**0.0**	**60**	0.0000	1.7790	0.0000	-	-	-		
51											
52	**BRA07-307 MD**	**0.0**	**3**	0.0000	0.4771	0.1880	FALSE	TRUE	FALSE	mix(AR307_MD,mixparam(	
53		**5.1**	**12**	0.0511	1.0717	0.2816	FALSE	TRUE	FALSE		
54		**21.1**	**51**	0.2111	1.7034	0.3099	FALSE	TRUE	FALSE		
55		**55.8**	**69**	0.5575	1.8405	0.2322	FALSE	FALSE	FALSE		
56		**18.0**	**141**	0.1803	2.1487	0.1793	FALSE	TRUE	FALSE		
57	**BRA07-307 FD**	**7.3**	**3**	0.0726	0.4771	0.1450	FALSE	TRUE	TRUE	mix(AR307_FD,mixparam(	
58		**60.5**	**12**	0.6050	1.0717	0.3242	TRUE	FALSE	FALSE		
59		**32.2**	**51**	0.3224	1.7034	0.1950	FALSE	TRUE	TRUE		
60		**0.0**	**69**	0.0000	1.8405	0.0000	-	-	-		
61		**0.0**	**141**	0.0000	2.1487	0.0000	-	-	-	mix(AR307_FD,mixparam(	
62	**BRA07-314 MD**	**2.1**	**4**	0.0205	0.6021	0.1769	FALSE	TRUE	FALSE	mix(AR314_MD,mixparam(	
63		**20.2**	**18**	0.2020	1.2660	0.3310	FALSE	TRUE	FALSE		
64		**42.3**	**60**	0.4226	1.7776	0.2638	FALSE	TRUE	FALSE		
65		**30.1**	**61**	0.3011	1.7825	0.2627	FALSE	FALSE	FALSE		
66		**5.4**	**194**	0.0539	2.2877	0.0936	FALSE	TRUE	FALSE		
67	**BRA07-314 FD**	**16.0**	**4**	0.1600	0.6021	0.2800	TRUE	TRUE	TRUE	mix(AR314_FD,mixparam(	
68		**41.8**	**18**	0.4182	1.2669	0.3500	FALSE	TRUE	TRUE		
69		**42.2**	**60**	0.4218	1.7776	0.1600	FALSE	FALSE	TRUE		
70		**0.0**	**61**	0.0000	1.7825	0.0000	-	-	-		
71		**0.0**	**194**	0.0000	2.2877	0.0000	-	-	-		

	A	B	C	D	E	F	G	H	I	J	K
72	**BRA07-317 MD**	**0.9**	**3**	0.0094	0.4771	0.1096	FALSE	TRUE	FALSE	mix(AR317_MD,mixparam(	
73		**21.1**	**17**	0.2105	1.2428	0.3439	FALSE	TRUE	FALSE		
74		**6.3**	**47**	0.0629	1.6758	0.1114	FALSE	TRUE	FALSE		
75		**71.7**	**54**	0.7171	1.7358	0.2492	FALSE	FALSE	FALSE		
76											
77	**BRA07-317 FD**	**11.5**	**3**	0.1150	0.4771	0.2250	TRUE	TRUE	TRUE	mix(AR317_FD,mixparam(	
78		**67.9**	**17**	0.6786	1.2428	0.3650	FALSE	TRUE	TRUE		
79		**20.6**	**47**	0.2064	1.6758	0.1610	FALSE	FALSE	TRUE		
80		**0.0**	**54**	0.0000	1.7358	0.0000	-	-	-		
81											
82	**BRA07-324 MD**	**0.8**	**4**	0.0080	0.5769	0.1925	FALSE	TRUE	FALSE	mix(AR324_MD,mixparam(	
83		**7.1**	**13**	0.0710	1.1260	0.2415	FALSE	TRUE	FALSE		
84		**42.3**	**46**	0.4228	1.6625	0.2327	FALSE	TRUE	FALSE		
85		**26.8**	**95**	0.2675	1.9766	0.1643	FALSE	FALSE	FALSE		
86		**23.1**	**158**	0.2307	2.1987	0.1613	FALSE	TRUE	FALSE		
87	**BRA07-324 FD**	**7.8**	**4**	0.0780	0.5769	0.1900	FALSE	FALSE	TRUE	mix(AR324_FD,mixparam(	
88		**69.5**	**13**	0.6948	1.1260	0.2850	FALSE	TRUE	TRUE		
89		**22.7**	**46**	0.2272	1.6625	0.2000	FALSE	TRUE	TRUE		
90		**0.0**	**95**	0.0000	1.9766	0.0000	-	-	-		
91		**0.0**	**158**	0.0000	2.1987	0.0000	-	-	-	mix(AR324_FD,mixparam(	
92	**BRA07-327 MD**	**0.7**	**3**	0.0067	0.4771	0.1079	FALSE	TRUE	FALSE	mix(AR327_MD,mixparam(	
93		**16.0**	**17**	0.1601	1.2422	0.3402	FALSE	TRUE	FALSE		
94		**40.7**	**48**	0.4071	1.6836	0.2003	FALSE	TRUE	FALSE		
95		**42.6**	**81**	0.4262	1.9086	0.2304	FALSE	FALSE	FALSE		
96											
97	**BRA07-327 FD**	**6.7**	**3**	0.0670	0.4771	0.1900	FALSE	TRUE	TRUE	mix(AR327_FD,mixparam(	
98		**77.4**	**17**	0.7736	1.2422	0.3850	FALSE	FALSE	TRUE		
99		**15.9**	**48**	0.1594	1.6836	0.1450	FALSE	TRUE	TRUE		
100		**0.0**	**81**	0.0000	1.9086	0.0000	-	-	-		
101											
102	**BRA07-328 MD**	**0.5**	**3**	0.0048	0.4771	0.1055	FALSE	TRUE	FALSE	mix(AR328_MD,mixparam(	
103		**10.8**	**14**	0.1078	1.1555	0.3071	FALSE	TRUE	FALSE		
104		**60.3**	**51**	0.6026	1.7076	0.2312	FALSE	TRUE	FALSE		
105		**25.9**	**89**	0.2588	1.9513	0.1773	FALSE	FALSE	FALSE		
106		**2.6**	**165**	0.0259	2.2185	0.0874	FALSE	FALSE	FALSE		

	A	B	C	D	E	F	G	H	I	J	K
107	**BRA07-328 FD**	**5.0**	**3**	0.0500	0.4771	0.1830	TRUE	TRUE	TRUE	mix(AR328_FD,mixparam(	
108		**52.1**	**14**	0.5210	1.1544	0.3100	FALSE	FALSE	TRUE		
109		**42.9**	**51**	0.4290	1.7076	0.2020	FALSE	TRUE	TRUE		
110		**0.0**	**89**	0.0000	1.9513	0.0000	-	-	-		
111		**0.0**	**165**	0.0000	2.2185	0.0000	-	-	-	mix(AR328_FD,mixparam(	
112											
113	**CPA Statistics:**	**CPA MEAN (Weibull)**	**CPA MEDIAN (Weibull)**	CPA STDEV (Weibull)	**CPA MEAN relative % MD**	**CPA MEAN relative % FD**	**Changes MD => FD (in %)**				
114	**light MD c a**	166	**166**	16	**12**	**0**	**- 12**				
115	**light MD f a**	77	**75**	12	**44**	**0**	**- 44**				
116	**light MD c p**	51	**51**	4	**35**	**32**	**- 3**				
117	**light MD m p**	14	**13**	2	**9**	**58**	**+ 49**				
118	**light MD f p**	3	**3**	0	**1**	**10**	**+ 9**				
119	**dark MD a**	64	**60**	10	**65**	**0**	**- 65**				
120	**dark MD c p**	47	**47**	1	**19**	**24**	**+ 5**				
121	**dark MD m p**	17	**17**	1	**15**	**63**	**+ 48**				
122	**dark MD f p**	3	**3**	0	**1**	**13**	**+ 12**				

Cell: B1
Comment: relative proportions of component populations (Weibull distribution)

Cell: C1
Comment: means (modes) of component populations (Weibull distribution)

Cell: D1
Comment: relative proportions of component populations (Weibull distribution)

Cell: E1
Comment: means (modes) of component populations (Weibull distribution, log10)

Cell: F1
Comment: Weibull distributions of component populations

Cell: G1
Comment: constraints on relative proportions (Weibull distribution)

Cell: H1
Comment: constraints on means (modes, Weibull distribution)

Cell: I1
Comment: constraints on sigma values (Weibull distribution)

Cell: J1
Comment: partially-constrained input parameters (final command line)

Cell: K1
Comment: curve-fits for MD and FD sample expressions (Weibull distribution, partially-constrained CPA)

Cell: A113
Comment: summary statistics of partially-constrained Component Population Analysis

Cell: B113
Comment: averaged mean (mode) across all corresponding component populations (Weibull distribution, in μm)

Cell: C113
Comment: averaged median across all corresponding component populations (Weibull distribution, in μm)

Cell: D113
Comment: averaged standard deviation across all corresponding component populations (Weibull distribution, in μm)

Cell: E113
Comment: average relative proportions of corresponding component populations of minimally-dispersed samples (Weibull distribution)

Cell: F113
Comment: average relative proportions of corresponding component populations of fully-dispersed samples (Weibull distribution)

Cell: G113

Comment: relative decreases and increases within corresponding component populations from minimally- to fully-dispersed condition

Cell: A114
Comment: coarse aggregated component population in minimally-dispersed "light bands"

Cell: A115
Comment: fine aggregated component population in minimally-dispersed "light bands"

Cell: A116
Comment: coarse particulate component population in "light bands"

Cell: A117
Comment: moderate particulate component population in "light bands"

Cell: A118
Comment: fine particulate component population in "light bands"

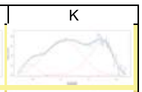
Cell: A119
Comment: single aggregated component population in minimally-dispersed "dark bands"

Cell: A120
Comment: coarse particulate component population in "dark bands"

Cell: A121
Comment: moderate particulate component population in "dark bands"

Cell: A122
Comment: fine particulate component population in "dark bands"

	A	B	C	D	E	F	G	H	I	J	K
1	**Sample ID**	**pi (Gaussian)**	mu (Gaussian)	**sigma (Gaussian)**	**3 CP modes (Gaussian, µm)**	**pi (Weibull)**	mu (Weibull)	**sigma (Weibull)**	**3 CP modes (Weibull, µm)**	**CPA screenshot (Gaussian)**	**CPA screenshot (Weibull)**
2		conpi, conmu, consigma = "NONE"				conpi, conmu, consigma = "NONE"					
3	**BRA07-300 MD**	0.1606	1.432	0.3497	**27**	0.05635	1.24	0.3482	**17**		
4		0.6287	1.826	0.2115	**67**	0.87594	1.827	0.251	**67**		
5		0.2107	2.1	0.1491	**126**	0.06772	2.222	0.1334	**167**		
6	**BRA07-300 FD**	0.12	0.478	0.1122	**3**	0.08625	0.4475	0.09693	**3**		
7		0.7044	1.103	0.3068	**13**	0.68195	1.0482	0.30952	**11**		
8		0.1756	1.685	0.1431	**48**	0.23179	1.6269	0.19497	**42**		
9	**BRA07-303 MD**	0.1382	1.317	0.3503	**21**	0.07439	1.19	0.34072	**15**		
10		0.4992	1.735	0.2085	**54**	0.90177	1.797	0.23975	**63**		
11		0.3626	1.968	0.1618	**93**	0.02384	2.23	0.09063	**170**		
12	**BRA07-303 FD**	0.0952	0.4994	0.1227	**3**	0.06044	0.4571	0.1001	**3**		
13		0.6399	1.1385	0.2972	**14**	0.5996	1.0765	0.309	**12**		
14		0.2649	1.6408	0.1627	**44**	0.33996	1.5824	0.2122	**38**		
15	**BRA07-304 MD**	0.0469	0.8799	0.274	**8**	0.09704	1.146	0.3652	**14**		
16		0.2924	1.4998	0.2343	**32**	0.20281	1.735	0.1762	**54**		
17		0.6607	1.8138	0.1623	**65**	0.70015	1.735	0.2341	**54**		
18	**BRA07-304 FD**	0.1436	0.4854	0.122	**3**	0.08605	0.434	0.09112	**3**		
19		0.5737	1.1152	0.3136	**13**	0.53357	1.004	0.32191	**10**		
20		0.2827	1.6671	0.1541	**46**	0.38038	1.6	0.20762	**40**		
21	**BRA07-305 MD**	0.20326	1.474	0.3624	**30**	0.04943	1.102	0.28528	**13**		
22		0.7221	1.916	0.2097	**82**	0.91766	1.873	0.26056	**75**		
23		0.07464	2.254	0.1177	**179**	0.03291	2.369	0.08346	**234**		
24	**BRA07-305 FD**	0.08853	0.5024	0.1354	**3**	0.05351	0.4506	0.1083	**3**		
25		0.62688	1.1413	0.3202	**14**	0.58242	1.0613	0.3167	**12**		
26		0.28459	1.7669	0.1606	**58**	0.36407	1.7051	0.2135	**51**		
27	**BRA07-306 MD**	0.03078	0.868	0.2151	**7**	0.3193	1.519	0.3793	**33**		
28		0.37788	1.522	0.2629	**33**	0.5521	1.73	0.2074	**54**		
29		0.59134	1.865	0.1961	**73**	0.1286	2.057	0.1327	**114**		
30	**BRA07-306 FD**	0.09914	0.6168	0.1388	**4**	0.06057	0.5692	0.1146	**4**		
31		0.59512	1.2523	0.2887	**18**	0.42893	1.0994	0.2735	**13**		
32		0.30574	1.7177	0.1535	**52**	0.5105	1.6172	0.2253	**41**		
33	**BRA07-307 MD**	0.2194	1.438	0.3638	**27**	0.1047	1.268	0.3477	**19**		
34		0.6423	1.883	0.2061	**76**	0.7947	1.85	0.2443	**71**		
35		0.1383	2.187	0.1263	**154**	0.1005	2.233	0.1361	**171**		

	A	B	C	D	E	F	G	H	I	J	K
36	**BRA07-307 FD**	0.1013	0.5045	0.1383	**3**	0.06307	0.4576	0.114	**3**		
37		0.6193	1.1213	0.3164	**13**	0.57303	1.0366	0.3117	**11**		
38		0.2794	1.7487	0.1663	**56**	0.3639	1.6803	0.2221	**48**		
39	**BRA07-314 MD**	0.31158	1.298	0.3976	**20**	0.1746	1.149	0.3871	**14**		
40		0.66168	1.833	0.2396	**68**	0.777	1.76	0.2772	**58**		
41		0.02673	2.321	0.0489	**209**	0.0484	2.292	0.0905	**196**		
42	**BRA07-314 FD**	0.09628	0.6039	0.1318	**4**	0.05889	0.5539	0.1046	**4**		
43		0.42405	1.1833	0.3054	**15**	0.3278	1.0095	0.264	**10**		
44		0.47967	1.775	0.1583	**60**	0.61331	1.7086	0.2128	**51**		
45	**BRA07-317 MD**	0.03812	0.6642	0.1915	**5**	0.16083	1.116	0.3656	**13**		
46		0.33888	1.3926	0.28	**25**	0.77021	1.685	0.2383	**48**		
47		0.62299	1.7961	0.1917	**63**	0.06896	2.023	0.1504	**105**		
48	**BRA07-317 FD**	0.1198	0.5219	0.161	**3**	0.04968	0.4188	0.1047	**3**		
49		0.5763	1.1805	0.3068	**15**	0.51254	1.0406	0.329	**11**		
50		0.3039	1.6877	0.1586	**49**	0.43777	1.6033	0.2227	**40**		
51	**BRA07-324 MD**	0.2131	1.382	0.3827	**24**	0.1164	1.272	0.3917	**19**		
52		0.5383	1.836	0.2303	**69**	0.7044	1.819	0.2758	**66**		
53		0.2486	2.176	0.1443	**150**	0.1792	2.2	0.1629	**158**		
54	**BRA07-324 FD**	0.09904	0.5728	0.1684	**4**	0.05154	0.5033	0.1396	**3**		
55		0.74382	1.1827	0.2899	**15**	0.73342	1.1242	0.3002	**13**		
56		0.15713	1.7204	0.1534	**53**	0.21505	1.6573	0.2087	**45**		
57	**BRA07-327 MD**	0.021	0.619	0.1789	**4**	0.118	1.128	0.3723	**13**		
58		0.2538	1.396	0.3074	**25**	0.8392	1.756	0.2449	**57**		
59		0.7252	1.84	0.2134	**69**	0.0427	2.212	0.1017	**163**		
60	**BRA07-327 FD**	0.07352	0.4628	0.1312	**3**	0.03276	0.3774	0.08102	**2**		
61		0.60687	1.1359	0.3225	**14**	0.53019	1.0375	0.33472	**11**		
62		0.31961	1.6863	0.1831	**49**	0.43705	1.6022	0.24541	**40**		
63	**BRA07-328 MD**	0.1197	1.144	0.3506	**14**	0.1293	1.204	0.3731	**16**		
64		0.405	1.644	0.2316	**44**	0.8239	1.775	0.2421	**60**		
65		0.4753	1.927	0.1724	**85**	0.0468	2.144	0.1215	**139**		
66	**BRA07-328 FD**	0.06664	0.5276	0.1565	**3**	0.03029	0.434	0.1095	**3**		
67		0.56719	1.2123	0.3117	**16**	0.46597	1.096	0.3162	**12**		
68		0.36617	1.7491	0.1791	**56**	0.50374	1.667	0.2422	**46**		

	A	B	C	D	E	F	G	H	I	J	K
70	**unconstrained CPA Statistics:**	**3 CP MEAN (Gaussian)**	**3 CP MEDIAN (Gaussian)**	3 CP % MEAN (Gaussian)	3 CP STDEV (Gaussian)	**3 CP MEAN (Weibull)**	**3 CP MEDIAN (Weibull)**	3 CP % MEAN (Weibull)	3 CP STDEV (Weibull)	3 CPs Range (Gaussian)	3 CPs Range (Weibull)
71	**light MD c**	151	**152**	123	39	178	**169**	169	30	85 - 209	139 - 234
72	**light MD m**	68	**68**	70	12	66	**67**	66	6	44 - 82	58 - 75
73	**light MD f**	24	**26**	24	5	16	**17**	16	2	14 - 30	13 - 19
74	**light FD c**	55	**56**	56	4	47	**47**	48	3	48 - 60	42 - 51
75	**light FD m**	14	**15**	14	1	12	**11**	12	1	13 - 16	10 - 13
76	**light FD f**	3	**3**	3	0	3	**3**	3	0	3 - 4	3 - 4
77	**dark MD c**	68	**67**	67	4	109	**110**	71	39	63 - 73	54 - 163
78	**dark MD m**	29	**28**	29	4	53	**54**	53	3	25 - 33	57 - 48
79	**dark MD f**	6	**6**	6	2	18	**14**	22	8	4 - 8	13 - 33
80	**dark FD c**	49	**49**	49	2	40	**40**	40	1	49 - 52	40 - 41
81	**dark FD m**	15	**14**	15	2	11	**11**	11	1	13 - 18	10 - 13
82	**dark FD f**	3	**3**	3	0	3	**3**	3	1	3 - 4	2 - 4

Cell: B1
Comment: relative proportions of 3 unconstrained component populations (Gaussian distribution)

Cell: C1
Comment: means (modes) of 3 unconstrained component populations (Gaussian distribution, log10)

Cell: D1
Comment: sigma values of 3 unconstrained component populations (Gaussian distribution)

Cell: E1
Comment: means (modes) of 3 component populations (Gaussian distribution, in µm)

Cell: F1
Comment: relative proportions of 3 unconstrained component populations (Weibull distribution)

Cell: G1
Comment: means (modes) of 3 unconstrained component populations (Weibull distribution, log10)

Cell: H1
Comment: sigma values of 3 unconstrained component populations (Weibull distribution)

Cell: I1
Comment: means (modes) of 3 component populations (Weibull distribution, in µm)

Cell: J1
Comment: curve-fits for MD and FD sample expressions (Gaussian distribution, unconstrained CPA)

Cell: K1
Comment: curve-fits for MD and FD sample expressions (Weibull distribution, unconstrained CPA)

Cell: I16
Comment: single population?

Cell: I17
Comment: single population?

Cell: A70
Comment: summary statistics of unconstrained Component Population Analysis

Cell: B70
Comment: averaged mean (mode) across 3 corresponding unconstrained component populations (Gaussian distribution, in µm)

Cell: C70
Comment: averaged median across 3 corresponding unconstrained component populations (Gaussian distribution, in µm)

Cell: D70
Comment: averaged weighted mean (mode) across 3 corresponding unconstrained component populations (Gaussian distribution, in µm)

Cell: E70

Comment: averaged standard deviation across 3 corresponding unconstrained component populations (Gaussian distribution, in µm)

Cell: F70
Comment: averaged mean (mode) across 3 corresponding unconstrained component populations (Weibull distribution, in µm)

Cell: G70
Comment: averaged median across 3 corresponding unconstrained component populations (Weibull distribution, in µm)

Cell: H70
Comment: averaged weighted mean (mode) across 3 corresponding unconstrained component populations (Weibull distribution, in µm)

Cell: I70
Comment: averaged standard deviation across 3 corresponding unconstrained component populations (Weibull distribution, in µm)

Cell: J70
Comment: range of modes within 3 corresponding unconstrained component populations (Gaussian distribution, in µm)

Cell: K70
Comment: range of modes within 3 corresponding unconstrained component populations (Weibull distribution, in µm)

Cell: A71
Comment: coarse component population in minimally-dispersed "light bands"

Cell: A72
Comment: moderate component population in minimally-dispersed "light bands"

Cell: A73
Comment: fine component population in minimally-dispersed "light bands"

Cell: A74
Comment: coarse component population in fully-dispersed "light bands"

Cell: A75
Comment: moderate component population in fully-dispersed "light bands"

Cell: A76
Comment: fine component population in fully-dispersed "light bands"

Cell: A77
Comment: coarse component population in minimally-dispersed "dark bands"

Cell: I77
Comment: high value reflecting BRA07-AR 304 (MD) lacking coarse population?

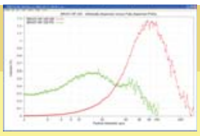
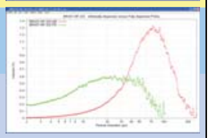
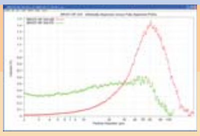
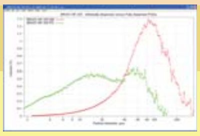
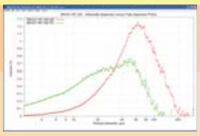
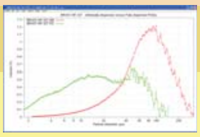
Cell: A78
Comment: moderate component population in minimally-dispersed "dark bands"

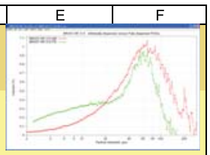
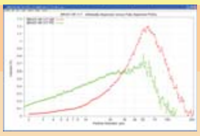
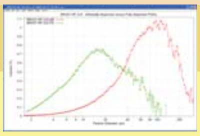
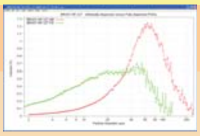
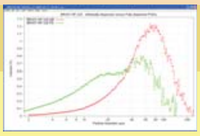
Cell: A79
Comment: fine component population in minimally-dispersed "dark bands"

Cell: A80
Comment: coarse component population in fully-dispersed "dark bands"

Cell: A81
Comment: moderate component population in fully-dispersed "dark bands"

Cell: A82
Comment: fine component population in fully-dispersed "dark bands"

	A	B	C	D	E	F
1	Sample ID	Mean (in µm)	Median (in µm)	Mode (in µm)	PSA screenshot	
2	BRA07-300 MD	83.01	73.07	76.05		
3						
4						
5	BRA07-300 FD	21.05	13.98	17.86		
6						
7						
8	BRA07-303 MD	71.82	65.01	74		
9						
10						
11	BRA07-303 FD	24.14	17.86	37.95		
12						
13						
14	BRA07-304 MD	58.27	55.11	61.65		
15						
16						
17	BRA07-304 FD	24.41	17	44.84		
18						
19						
20	BRA07-305 MD	90.84	79.37	83.52		
21						
22						
23	BRA07-305 FD	29.95	19.25	58.98		
24						
25						
26	BRA07-306 MD	64.47	56.86	62.79		
27						
28						
29	BRA07-306 FD	31.13	24.4	47.67		
30						
31						
32	BRA07-307 MD	87.12	76.24	100.3		
33						
34						
35	BRA07-307 FD	28.31	17.87	46.5		
36						
37						

	A	B	C	D	E	F
38	**BRA07-314 MD**	68.41	55.82	67.91		
39						
40						
41	**BRA07-314 FD**	39.78	34.63	68.7		
42						
43						
44	**BRA07-317 MD**	54.34	49	58.45		
45						
46						
47	**BRA07-317 FD**	27.84	20.81	51.06		
48						
49						
50	**BRA07-324 MD**	91.04	76.78	109.9		
51						
52						
53	**BRA07-324 FD**	23.7	16.61	14.91		
54						
55						
56	**BRA07-327 MD**	65.92	58.28	64.34		
57						
58						
59	**BRA07-327 FD**	28.52	20.44	54.34		
60						
61						
62	**BRA07-328 MD**	67.5	60.78	68.03		
63						
64						
65	**BRA07-328 FD**	35.11	26.52	51.54		
66						
67						
68						
69	**PSA statistics:**	**PSD MEAN**	**PSD MEDIAN**	**PSD MODE**		
70	**light MD**	81	70	84		
71	**light FD**	**30**	**21**	**43**		
72	**dark MD**	61	55	62		
73	**dark FD**	**28**	**21**	**49**		

Cell: B1
Comment: means for minimally- and fully-dispersed samples returned by the Beckman Coulter Multisizer software (v.3.51)

Cell: C1
Comment: medians for minimally- and fully-dispersed samples returned by the Beckman Coulter Multisizer software (v.3.51)

Cell: D1
Comment: modes for minimally- and fully-dispersed samples returned by the Beckman Coulter Multisizer software (v.3.51)

Cell: E1
Comment: Coulter Multisizer 3 frequency particle size-distributions (PSD) of minimally- and fully-dispersed samples (log normal)

Cell: A69
Comment: summary statistics of standard Particle Size Analysis (PSA) performed by the Beckman Coulter Multisizer software (v.3.51)

Cell: B69
Comment: average mean across corresponding samples

Cell: C69
Comment: average median across corresponding samples

Cell: D69
Comment: average mode across corresponding samples

Cell: A70
Comment: minimally-dispersed "light bands"

Cell: A71
Comment: fully-dispersed "light bands"

Cell: A72
Comment: minimally-dispersed "dark bands"

Cell: A73
Comment: fully-dispersed "dark bands"

	A	B	C	D
1	**Sample ID**	**Depth (in cm)**	**CPA shorthand**	**Detailed description**
2	BRA07-280	280 - 300	gravel band	massive layer of clast-supported orange-mottled pebbles (Bunyeroo shales), pinching out in upstream section face, increase in sub-angular tufa clasts towards base, erosive contact to underlying
3	**BRA07-300**	300 - 303	light band	Silt band marked by tufa fragments, lightly disturbed by material incorporated from overlying gravel layer
4	**BRA07-303**	303 - 304	tufa band	discontinuous lenses of small tufa fragments, partially interfingering with veneers of organic detritus
5	**BRA07-304**	304 - 305	dark band	Silt band marked by distinct complex of multiple veneers of organic detritus, 3 mm thick where protected by overlying tufa
6	**BRA07-305**	305 - 306	light band	light band of grey fine-grained Silts, largely undisturbed
7	**BRA07-306**	306 - 307	dark band	Silt band marked by thin (<1 mm) but distinct complex of multiple veneers of organic detritus
8	**BRA07-307**	307 - 310	light band	light band of grey fine-grained Silts, partially mottled, some charcoal fragments and gastropod shells towards base
9	BRA07-310	310 - 314	gravel band	thin layer of clast-supported orange-mottled pebbles (Bunyeroo shales), increase in sub-angular tufa clasts towards top and base, erosive contact to underlying
10	**BRA07-314**	314 - 317	light band	light band of grey fine-grained Silts, partially disturbed by material incorporated from overlying gravel layer, few remnants of organic veneers, gastropod shell fragments
11	**BRA07-317**	317 - 318	dark band	Silt band marked by thin (<1 mm) but distinct complex of multiple veneers of organic detritus, the lower complex mantling the near-horizontal gravel unit
12	BRA07-318	318 - 324	gravel band	thin layer of clast-supported orange-mottled pebbles (Bunyeroo shales), increase in sub-angular tufa clasts (<4 cm) towards base, clear-cut contact with overlying but erosive contact to underlying unit (partly incorporating Silts)
13	**BRA07-324**	324 - 327	light band	light band of fine-grained Silts with tufa fragments, partially disturbed with material incorporated from overlying gravel, where the gravel layer pinches out its lateral equivalent is marked by 3 veneers of organic detritus, tufa and gastropod shell fragments
14	**BRA07-327**	327 - 328	dark band	undulating Silt band marked by complex of multiple veneers of organic detritus, thin but distinct (< 1 mm) where undisturbed
15	**BRA07-328**	328 - 330	light band	light band of grey fine-grained Silts, in places traces of up to 3 veneers of organic detritus
16	BRA07-330	330 - 340	gravel band	massive layer of clast-supported orange-mottled pebbles (Bunyeroo shales), occasional rounded to sub-rounded quartz pebbles, large (~6 cm x 4 cm) clasts of tufa concentrating towards base, imbrication indicating paleoflow from present day Brachina trunk channel into Aroona tributary (50°), few charcoal pieces, upper part of unit in places matrix-supported by grey Silts, basal transition is erosional and in places mixed with underlying brown Silts

Cell: B1
Comment: CPA sub-section specific depth (from TOP)

Cell: A13
Comment: 2 separate samples collected and sized to test consistency of PSA/ CPA results

	A	B	C	D	E
1	**Depth (cm from TOP)**	**Munsell Soil Colour (moist)**	**AMS ages (in a calBP)**	**Shorthand**	**Detailed description**
2	**TOP - 060**	7.5YR5/4 - 4/4		"red drape"	reddish sandy unit, in places up to 100 cm thick with small calcareous nodules (weakly-developed Bca-horizon), further downstream erosional gravel-filled chutes
3	**060 - 090**			fresh gravel	lenses of unweathered matrix-supported gravel, incising into underlying unit, lithology indicative of Aroona catchment
4	**090 - 130**	7.5YR6/3 - 5/4		transitional	disturbed transitional zone, largely consisting of Silts, channels and burrows with "pink" infill (from above), gypsum precipitation on channel walls
5	**130 - 140**	2.5YR7/2 - 5/2		Silts	grey Silts, hosting topmost discernible remnants of veneers of organic detritus in section, intact gastropods, few tufa fragments
6	**140 - 155**	2.5Y6/8 - 5/6		gravel	layer of clast-supported orange-mottled pebbles (Bunyeroo shales), greatly varying in thickness (channel lenses)
7	**155 - 160**	2.5YR7/2 - 5/2	18.820 ± 227	Silts	grey Silts, thin undulating band sandwiched between gravel units
8	**160 -170**	2.5Y6/8 - 5/6		gravel	layer of clast-supported orange-mottled pebbles (Bunyeroo shales), discontinuous, pinching out in upstream section
9	**170 - 175**	2.5YR7/2 - 5/2		Silts	grey Silts, thin undulating band sandwiched between gravel units
10	**175 - 200**	2.5Y6/8 - 5/6		gravel	massive layer of clast-supported orange-mottled pebbles (Bunyeroo shales), in places topped by tufa fragments, one largely unweathered sub-angular coarse gravel (~20 cm, grey shale) placed on top
11	**200 - 220**			Silts/ gravel	grey Silts hosting two prominent bands of clast-supported orange-mottled pebbles (Bunyeroo shales), pinching out in downstream section, gravel laterally replaced by Silts with tufa fragments partially protecting underlying organic veneers from erosion, topmost well-defined band of multiple veneers of organic detritus in section
12	**220 - 230**	2.5Y6/8 - 5/6		gravel/ tufa	layer of clast-supported orange-mottled pebbles (Bunyeroo shales), continuous and near-level, increase in sub-angular tufa clasts towards base (up to 8 cm)
13	**230 - 240**			Silts/ tufa	grey Silts, lower half hosting streaks of tufa (up to 5 cm thick, partially formed in-situ and topped by veneers of organic detritus)
14	**240 - 250**	2.5Y6/8 - 5/6		gravel	layer of clast-supported orange-mottled shale pebbles, near-level, pinching out in upstream section, increase in sub-angular tufa clasts towards base
15	**250 - 255**		19.465 ± 337	Silts/ tufa	thin grey Silts with marked band of tufa (up to 5 cm thick), topping underlying gravel unit, tufa partly formed in-situ but incorporating clasts
16	**255 - 275**	2.5Y6/8 - 5/6		gravel, mud pebbles	massive layer of clast-supported orange-mottled pebbles (Bunyeroo shales), tufa clasts, few purple (5YR6/2 - 4/2)) mud pebbles (~5 cm) towards base
17	**275 - 370**		18.991 ± 238	6 couplets	stacked unit of six ~5 cm thick undulating bands of clast-supported pebbles (Bunyeroo shales) with tufa clasts, each topped by grey Silts comprising up to 3 complexes of multiple veneers of organic detritus
18	**370 - 380**	7.5YR4/2	*18.357 ± 303*	brown Silts	brown Silts, lowermost distinct massive Silt unit, chromatic, disturbed, remnants of veneers of organic detritus
19	**380 - 400**			gravel	mottled matrix-supported fine (<2 cm) gravel in dark clayey-silty matrix, charcoal pieces
20	**400 - 415**	7.5YR4/2		mud	dark clayey-silty unit, disturbed, occasional mottled gravel
21	**415 - 425**	10YR5/6		gravel	layer of mottled matrix-supported small (<2 cm) gravel in dark clayey-silty matrix, charcoal pieces, gradually upward-fining sequence with orange-mottled sand and fine gravel
22	**425 - 440**			gravel, calcrete	layer of clast-supported orange-mottled pebbles (Bunyeroo shales), ~40% fresh larger sub-angular to sub-rounded clasts from various upstream provenances (grey ABC Quartzite, red Bonney Sandstone), resting on ~1 cm calcrete pan
23	**440 - 455**	10YR5/6		fine gravel	orange-mottled fine gravel (<1 cm), ~30% pockets of purple (5YR4/2) Silts
24	**455 - 520**		20.039 ± 333	coarse gravel	multiple units of upward-fining successions of clast-supported gravel, large basal clasts (up to ~25 cm) sourced from variable upstream lithology (Brachina trunk channel), pockets of purple Silts (5YR4/2, mud pebbles) and thin Silt bands, large (~1.5 cm) charcoal pieces

Cell: C7
Comment: OZK516, AMS sample from intact gastropods in topmost Silt layer underlying orange-mottled shales, tufa fragments (@150-160)

Cell: C15
Comment: OZK002, AMS sample from broken gastropods in Silt layer overlying topmost orange-mottled shales of CPA sub-section (@250-255/ [275-280 in CPA section])

Cell: C17
Comment: OZK003, AMS sample from broken gastropods in Silt layer underlying basal orange-mottled shales of CPA sub-section (@~335-340/ [340-345 in PSA section])

Cell: C18
Comment: SSAMS1812 & SSAMS 2038, 2 AMS samples from fragile pieces of charcoal from veneer of organic detritus and 2 small unbroken gastropods, respectively

Cell: D22
Comment: shift in imbrication: lower large allochthonous gravel indicate paleoflow direction towards 170° (S), mottled gravel units above paleoflow directions between 230° (SW) and 50° (NE)

Cell: C24
Comment: OZK517, AMS sample from large (~1.5 cm) piece of charcoal at base of pit (@ 507-508) in purple silt lens level with large (~25 cm) gravel clasts

Particle-Sizing Protocol

The Multisizer™ 3 COULTER COUNTER® instrument here employed to size the samples is based on the Coulter electrical impedance method coupled with a Digital Pulse Processing technology. It provides 3-D particle sizing and counting statistics (Beckman Coulter 2002). The sizing range is limited by the aperture diameter of the selected orifice tubes separating the two electrodes. The size-range restrictions prevent blocking of the orifice and ensure normalised sizing sensitivities. The maximum nominal particle diameters for all orifice tubes selected for the present study are listed below (Table 1). All samples were wet-sieved into the listed size fractions and sized by the full range of orifice tubes.

Table 1)

aperture (in µm)	**min.** nominal **range** (in µm)	**max.** nominal **range** (in µm)	calibration beads	**sieve size** (in µm)
50	1.0	30.0	5-10 (10)	**< 38**
140	2.8	84.0	14-28 (20)	**< 90**
280	5.6	168.0	28-56 (43)	**< 180**
560	11.2	336.0	56-112 (90)	**< 355**

Nominal orifice tube data for the Multisizer™ 3 COULTER COUNTER®

The electrolyte used for wet-sieving and diluting the sample suspensions is triple-filtered (0.22 µm Millipore™ nitrocellulose membranes) 1% NaCl (ISOTON II). Particle-suspension concentrations were maintained at 5-10%. The results from the array of orifice tubes were merged into sample particle-size distributions using the Beckman Coulter Multisizer 3© software (version 3.51).

Calibration

Prior to sizing the samples, all orifice tubes were calibrated with COULTER™ latex beads in ISOTON II (Table 1). Nine calibration runs were carried out for each orifice tube. The median was calculated and entered in the 'Change Aperture Tube Wizard'.

Sample preparation

Two separate sample pre-treatment protocols were applied to all samples; the first sizing transport-stable aggregates among particles to describe the minimally-dispersed (MD) sample expression, the second sizing only elementary particles to describe the fully-dispersed (FD) sample expression.

Pre-treatment and sizing of minimally-dispersed samples

Minimally-dispersed (MD) samples were treated with the aim to size partially-aggregated suspension load which would behave transport-stable within turbulent fluvial flow.

1) A representative subsample of the sediments is reduced to ~2-3 g avoiding direct touch or cutting.

2) An equivalent of 100 ml of electrolyte per gram of sample material is added in a clean baffled beaker and left to soak for 60 seconds.

3) The slaked sample is stirred into a uniform suspension by a magnetic flee for 60 secs.

4) One subsample per orifice tube are collected by pipette ~1/3 above and to the side of the magnetic stirring flee. Sample quantities vary between ~3-10 ml, depending on the orifice diameter and targeted total counts.

5) The suspension is gently passed through respective sieves (Table 1) by a squeeze bottle filled with electrolyte. Rare particles retained by the largest sieve (355 µm) are collected for observation under binocular microscope and recorded.

6) Sample suspensions are diluted with electrolyte until they reach a concentration of 5-10% and sized in a clean Multisizer™ beaker by the selected array of orifice tubes, starting with the 560 µm aperture. The stirrer of the Multisizer™ 3 COULTER COUNTER® is adjusted to maintain the sample in suspension without introducing excess turbulence and air bubbles; i.e. 40=560 µm tube, 35=280 µm tube, 30=140 µm tube, 15-20=50 µm tube.

7) All subsamples are sized to their maximum count (or a minimum of 300,000 individual coincidence-corrected counts). Due to the tendency of the 50 µm aperture to block, necessitating a reset of the count and purge of the system, fewer counts may be recorded for the smallest orifice tube. The electric pulses are saved as RAW data and converted to 300 discrete size bins per tube. Subsequently, the spread in bins is manually limited to the sample- and tube-specific effective size range. The data is plotted as particle diameters (in µm) against the x-axis (log scale) and volume (in %) against the y-axis (linear scale).

8) The individual orifice tube measurements for each sample are merged using the ‘Multi-tube Overlap’ function. Software-generated defaults based on best curve-fits are documented and, where necessary, adjusted by user-adjusted reruns (Fig. 1)

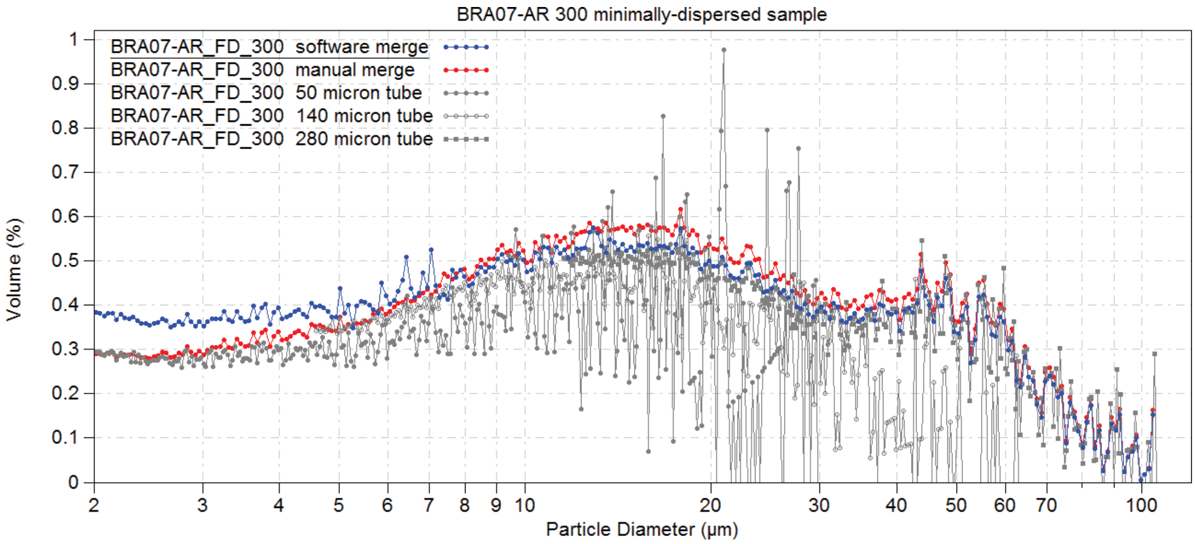


Fig. 1) *Software-generated default (in blue) and user-adjusted multi-tube merges (in red) across individual orifice tube data (in grey) for sample 'BRA07-AR 300' (FD).*

Pre-treatment and sizing of fully-dispersed samples

Fully-dispersed (FD) samples are treated with the aim to size disaggregated suspension load consisting entirely of elementary particles.

1) 3 ml of 32% HCl are added per 100 ml of sample suspension.

2) The beaker with the acidified sample is immersed into an ultrasonic bath (Branson 2200 sonifier, 472Hz/ 60W) for 30 min, while stirring the suspension every 10 minutes.

3) The sample suspension is analysed under binocular microscope and if found thoroughly dispersed subsampled, sized and analysed according to the same protocol employed for the MD sample expressions.

'Cliffing effect'

Some samples recorded an abnormal high count towards the fine end of the sizing range, thereby skewing the overall particle-size distribution. This effect proved particularly problematic for the smallest diameter orifice tube (50 µm). Comparison with ICP-MS data suggested that elevated iron contents might be responsible by interfering with the electrical sensing method. As a result, the data required correction prior to the multi-tube merge and calculation of statistics. The lowermost affected size bins were truncated by manually adjusting the lower sizing threshold to the onset of the 'cliffing effect', and reconverting the remaining continuous pulse data to 300 discrete size bins. Sufficient overlap was provided by employing the large number of orifice tubes. The correction worked fine with all samples but limited the lowermost effective size range to ~3 µm.

Component Population Analysis Protocol

In order to establish the principle particle size populations that make up the sediment samples, the particle-size distributions (PSDs) are statistically resolved into discrete component populations (CPs) of aggregates and elementary particles. The present parametric approach is based on the open source software package Mixdist version 0.52 (Macdonald & Du 2004), compiled to run in the 'R software environment for statistical computing' (R Foundation for Statistical Computing 2009) and freely distributed online via CRAN (The Comprehensive R Archive Network). Alternatively, it can be downloaded here: http://cran.r-project.org/web/packages/mixdist/index.html (10/2009). Mixdist fits finite mixture distribution models to grouped and conditional data using a Newton-type and Expectation-Maximisation algorithms based on the method of maximum likelihood. Detailed documentation of the software package and syntax is presented here: http://rss.acs.unt.edu/Rdoc/library/mixdist/html/00Index.html (10/2009).

Data conversion from Multisizer™ 3 COULTER COUNTER® to Mixdist

Mixdist can only read a specific tab-delimited text file format, requiring prior data conversion:

1) Merged Multisizer™ 3 data sets (both minimally- and fully-dispersed expressions) are exported as tab-delimited size lists (run file -> export data -> tab-delimited size listing), opened in OpenOffice Calc (or Microsoft® Office Excel) and reduced to two columns; 256 size fractions reflecting lower size-bin diameters (in µm) and corresponding volume percentages. The base-10 logarithm is calculated for all size fractions in a separate column to the left of the volume using the formula [=log10(cell)].

2) All 256 size fractions (as expressed as base-10 logarithm values) and their corresponding volume percentages are limited to 10 decimal places and copied into a tab-delimited text file via the clipboard function. This text file is saved in the data directory of the Mixdist package (e.g. C:\Program Files\R\R-2.7.2\library\mixdist\data\sample_name.txt).

Unconstrained parametric analysis using Mixdist

'R' is opened and the Mixdist package installed either from the local zip-file or via the selected CRAN mirror.

1) The Mixdist package is loaded by entering the command

> library(mixdist)

2) The sample data file is imported

> data(sample_name)

and converted into a Mixdist object by entering

> sample_name <- as.mixdata(sample_name)

3) The PSD of the converted data is plotted

> plot(sample_name)

and compared for consistency with the original Multisizer™ 3 PSD.

4) The PSD is now decomposed into multiple discrete populations by entering the following syntax

> new_sample_name <-
mix(sample_name,mixparam(mu=c(...),sigma=c(...),pi=c(...)),"sample_distribution",mixconstr(conpi="NONE", conmu="NONE", consigma="NONE", fixpi=c(NULL), fixmu=c(NULL), fixsigma=c(NULL)))

Mixdist requires a set of initial assumptions to start the computation; i.e. expected number, means and vectors of standard deviations (sigma values) of CPs, and the type of probability distribution function. This step has potentially large implications for the final outcome of the analysis and must be considered by an experimental design. It is here suggested to start with an unlikely high number of populations set equal distances apart; e.g. for a unimodal distribution ranging from 2–350 µm five populations are suggested with (converted base-10 log) mu [means of component distribution] =c(0.3,0.75,1.25,1.75,2.5). Vectors of standard deviations are kept minimal so that potential minor (narrow) components are registered; e.g. sigma=c(0.2). The relative proportions of all populations are expressed as a near equal contributions, letting the software determine main and minor components; e.g. pi [mixing proportions of components] =c(0.2). Finally, the type of probability function is specified; e.g. Gaussian (“norm”) or Weibull power distribution (“weibull”). All parameters are initial suggestions only and must be left unconstrained by defining the arguments “conpi”, “conmu” and “consigma” as ="NONE" and corresponding “fixpi”, “fixmu” and “fixsigma” as =c(NULL).

5) The computed populations are plotted by entering

> plot(new_sample_name)

and activating the graphics window in ‘R’.

6) Subsequently, the parameters for all computed CPs are listed numerically

>list(new_sample_name)

7) Improbable small and near-duplicate population (resulting in error messages) are excluded from consequent runs by adjusting the input parameters.

The protocol is repeated until the minimum number of modes resulting in a good description of the PSD is established. The process may be duplicated for alternative probability distribution types (e.g.

Weibull or Gaussian). Repeatability and reliability of the final results are tested by adjusting the returned values for mean, sigma and proportions to different values.

On the matter of choosing a distribution type, our experimental observations suggest that partially-aggregated sediments are best described by the asymmetric Weibull power distribution, perhaps by allowing for tails of 'break-up' products that must be expected from the sample pre-treatment and sizing protocol (see section 5.2.3.1). On the other hand, populations of elementary particles might better be described by Gaussian distributions. The distribution type with superior curve-fit can be visually determined. Mixdist also analyses the variance table and returns goodness-of-fit chi-square (Chisq) statistics which can be accessed by entering:

> *anova(new_sample_name)*

However, strictly statistically this value is not valid for data in which bin frequencies represent volume percentages. Neither are the returned values for standard errors associated with each population (accessed via > *summary(new_sample_name)*). Chi-square and standard errors are based on multi-nomial distributions that apply only when bin frequencies are expressed as number of individuals.

8) The numerical results are transferred to a spreadsheet. The modes of populations are converted back into µm by the function [=POWER(10;(cell)], and relative proportions are presented as percentages.

9) It is good practise to copy the syntax line for documentation and save a screenshot of the plot via the GUI.

Partially-constrained parametric analysis using Mixdist

Corresponding CPs of minimally- and fully-dispersed sample expressions can be compared by partially constraining individual parameters; i.e. modes, relative proportions and/or sigma values of specific populations. Such data manipulation can alter the results and must be addressed by a documented experimental design. For the present study, parameters are partially constrained to account for the adverse effect of truncated populations at the fine end of the PSD and to quantify aggregation within sediment samples. Partial constraints were imposed by the following protocol:

1) Both partially-aggregated/minimally-dispersed (MD) and fully-dispersed (FD) expressions of the sample are analysed in unconstrained mode as detailed above and results are recorded.

2) Subsequently, the modes returned for the FD sample expression are copied and used as constraints to resolve corresponding MD particle-size distributions.

The rationale behind this approach is that the same elementary particle populations, or composites of them if aggregated, must be present in both distributions. Therefore, individual CPs comprising entirely of aggregates, in the MD size distributions simply register with a near-zero relative proportion in corresponding FD size distributions. This approach has the advantage that identical CPs are quantified in both sample expressions, thereby allowing aggregation *per se* to be quantified.

3) Data not accounted for by constrained elementary particle modes reflect additional aggregated CPs absent in the FD sample expression. These must be quantified unconstrained, employing the same protocol as described above. Here is an example of the syntax for a MD sample with three constrained fine modes and two additional unconstrained aggregate populations. Only the means of the finer modes (a, b and c) are fixed. Their relative proportions and sigma values remain unconstrained for they are likely to change. Note also that "conmu" is expressed as "MFX" with corresponding fixmu=c(TRUE,TRUE,TRUE – for the three constrained modes *a*,*b* and *c*, and FALSE,FALSE for the two unconstrained coarse modes *d* and *e*).

> new_sample_name_FD <-
mix(sample_name_MD,mixparam(mu=c(a,b,c,d,e),sigma=c(0.2),pi=c(0.2)),"weibull",mixconstr(conpi="NONE", conmu="MFX", consigma="NONE", fixpi=(NULL),
fixmu=c(TRUE,TRUE,TRUE,FALSE,FALSE,FALSE), fixsigma=c(NULL)))

4) Results are copied to a spreadsheet and converted. Corresponding minimally- and fully-dispersed sample expressions are compared by establishing the differences in their relative sample contributions, i.e. increases in elementary particle populations and disappearance of aggregated populations.

The workflow can be improved by using arrow keys to replicate (and change) previous command lines, and by the use of single letter file names that are overwritten in subsequent runs.

Subsection	below TOP (in cm)	Lithostratigraphic units	Type section units	Depth in type section (in cm)	Munsell Soil Colors (dry-moist)	Fine-grained units description	Gravel description	Pedogenic description	$\delta^{13}C$ samples description	^{14}C sample references	OSL ages (Williams et al. 2001)
Top Section		surface drape	surface drape	**000-010**	(5YR 6/6 dry - 5YR 4/6 moist)						
Top Section	000-010	transitional silts	surface drape	**000-010**		very loose soft silts (sodic?)					
Top Section	010-035	calcic horizon	transitional silts	**010-050**		brown mottled silt matrix with minor sand component, platy structure	platy, largely angular and few sub-rounded locally-derived shales (purple and grey) of the Brachina Formation, most clasts are $CaCO_3$-encrusted and occur as sheets sub-parallel to the surface, some concentrations in minor channels	calcareous cutans and towards the base soft vertical calcareous nodules			
Top Section	035-040	calcic horizon	transitional silts	**010-050**		brown silt matrix, pronounced orange mottles	distinct undulating sheet of pebbles	pronounced onset of vertical (in-situ) calcareous nodules at ~38 cm			
Top Section	040-056	calcic horizon	transitional silts	**010-050**		brown silt matrix		calcified root casts and nodules			
Top Section	056-057	disturbed organic veneers	disturbed silts	**050-078**		uppermost discernable veneers of organic detritus, disturbed			charcoal fragments from disturbed organic veneers	**SSAMS ANU 4107 (051)**	
Top Section	057-66	disturbed massive silts & organic veneers	disturbed silts	**050-078**		massive orange-mottled silts with traces of veneers of organic detritus		calcified root casts			
Top Section	066-067	organic veneers	disturbed silts	**050-078**		uppermost partially intact pronounced veneer of organic detritus		few calcified root casts	disturbed organic veneers		
Top Section	067-068	disturbed yellow band	disturbed silts	**050-078**		uppermost discrete yellow band, thin and disturbed		few calcified root casts			
Top Section	068-077	disturbed massive silts & organic veneers	disturbed silts	**050-078**		overall darker disturbed silts		few calcified root casts			
Top Section	077-078	disturbed organic veneers	organic veneers	**078-093**		partially pronounced but largely disturbed veneers of organic detritus		few calcified root casts			
Top Section	078-088	disturbed massive silts & organic veneers	organic veneers	**078-093**		lighter disturbed silts		few calcified root casts			
Top Section	088-095	continuous yellow band	yellow band	**093-100**		uppermost distinct continuous yellow band of massive silts, blurred upper boundary (bioturbation)		lowermost occurence of pedogenic carbonates		**SSAMS ANU 4109 (094)**	
Top Section	095-098	organic veneers	organic veneers	**100-105**		distinct massive unit of multiple veneers of organic detritus, partially disturbed			disturbed organic veneers		

Subsection	below TOP (in cm)	Lithostratigraphic units	Type section units	Depth in type section (in cm)	Munsell Soil Colors (dry-moist)	Fine-grained units description	Gravel description	Pedogenic description	δ13C samples description	14C sample references	OSL ages (Williams et al. 2001)
Top Section	098-100	yellow band	organic veneers	**100-105**		thin yellow band of massive silts					
Top Section	100-104	organic veneers	organic veneers	**100-105**		dark band of disturbed veneers of organic detritus in massive silts, more pronounced towards top					
Top Section	104-111	yellow band	yellow band	**105-117**		distinct continuous yellow band of massive silts, blurred upper boundary (bioturbation)					
Top Section	111-113	disturbed organic veneers	yellow band	**105-117**		partially-disturbed undulating dark band of veneers of organic detritus			well-preserved organic veneers	**SSAMS ANU 4207 (116)**	
Top Section	113-115	yellow band	organic veneers	**117-125**		undulating partially disturbed yellow band of massive silts					
Top Section	115-117	organic veneers	organic veneers	**117-125**		dark band of veneers of organic detritus, in places well-preserved					
Top Section	117-137	disturbed massive silts & organic veneers	disturbed yellow band	**125-135**		overall darker disturbed and orange-mottled silts of varying thickness, traces of veneers of organic detritus					
Top Section	137-138	disturbed organic veneers	organic veneers	**135-145**		disturbed undulating darker band of veneers of organic detritus					
Top Section	138-141	disturbed yellow band	organic veneers	**135-145**		more pronounced thin partly orange-mottled massive band					
Top Section	141-143	disturbed organic veneers	organic veneers	**135-145**		disturbed undulating darker band of veneers of organic detritus, veneers towards base and top more pronounced			disturbed organic veneers, mottled, gypsum		
Top Section	143-145	yellow band	disturbed silts	**145-160**		distinct yellow band with blurred boundaries					**17.700 ± 1.100 (145)**
Top Section	145-150	disturbed organic veneers	disturbed silts	**145-160**		disturbed undulating darker band of veneers of organic detritus					
Top Section	150-155	disturbed yellow band	disturbed silts	**145-160**		poorly pronounced orange-mottled massive band					
Top Section	155-157	disturbed organic veneers	disturbed silts	**145-160**		poorly pronounced darker band of veneers of organic detritus					
Top Section	157-164	disturbed massive silts & organic veneers	disturbed silts	**160-187**		orange-mottled massive silts with traces of veneers of organic detritus					
Top Section	164-168	disturbed organic veneers	disturbed silts	**160-187**		dark band of disturbed veneers of organic detritus, likely two discrete populations			disturbed organic veneers, mottled, gypsum		
Top Section	168-172	yellow band	disturbed silts	**160-187**		distinct yellow band of massive silts, orange-mottled towards base					
Top Section	172-174	disturbed organic veneers	disturbed silts	**160-187**		dark band of veneers of organic detritus, partially-disturbed			little disturbed organic veneers		
Top Section	174-178	yellow band	disturbed silts	**160-187**		undulating partially discontinuous yellow band of massive silts					
Top Section	178-179	disturbed organic veneers	disturbed silts	**160-187**		wedge of disturbed veneers of organic detritus					
Top Section	179-182	yellow band	disturbed silts	**160-187**		undulating partially discontinuous yellow band of massive silts					

Subsection	below TOP (in cm)	Lithostratigraphic units	Type section units	Depth in type section (in cm)	Munsell Soil Colors (dry-moist)	Fine-grained units description	Gravel description	Pedogenic description	δ13C samples description	14C sample references	OSL ages (Williams et al. 2001)
Top Section	182-183	disturbed organic veneers	disturbed silts	**160-187**		dark band of veneers of organic detritus, partially-disturbed and discontinuous			discontinuous organic veneers		
Top Section	183-199	disturbed massive silts & organic veneers	disturbed silts	**187-195**		orange-mottled disturbed unit, vertical tubes extending from overlying band of organic veneers (bioturbation), gypsum efflorescence, traces of veneers of organic detritus					
Top Section	199-201	organic veneers	organic veneers	**195-200**		dark band of veneers of organic detritus			multiple organic veneers	**SSAMS ANU 4206 (198)**	
Top Section	201-203	yellow band	yellow band	**200-208**		well-preserved thin couplets of yellow bands of massive silts					
Top Section	203-204	organic veneers	yellow band	**200-208**		dark band of veneers of organic detritus			multiple organic veneers		
Top Section	204-208	yellow band	yellow band	**200-208**		well-preserved thin couplets of yellow bands of massive silts					
Top Section	208-209	organic veneers	organic veneers	**208-210**		dark band of veneers of organic detritus			less distinct organic veneers		
Top Section	209-210	yellow band	organic veneers	**208-210**		well-preserved thin couplets of yellow bands of massive silts					**20.100 ± 2.100 (210)**
Top Section	210-211	organic veneers	organic veneers	**208-210**		dark band of veneers of organic detritus					
Top Section	211-212	yellow band	disturbed silts	**210-244**		well-preserved thin couplets of yellow bands of massive silts					
Top Section	212-215	organic veneers	disturbed silts	**210-244**		dark band of two veneers of organic detritus, sandwiching orange-mottled massive band			multiple organic veneers (base of 4er)	**SSAMS ANU 4110 (213)**	
Top Section	215-220	disturbed yellow band	disturbed silts	**210-244**		orange-mottled massive silts, vertical tubes extending from overlying band of organic veneers (bioturbation), gypsum efflorescence					
Top Section	220-225	disturbed organic veneers	disturbed silts	**210-244**		dark band of 3-4 veneers of organic detritus in massive, partially orange-mottled matrix			multiple organic veneers (224-225)		
Top Section	225-229	disturbed yellow band	disturbed silts	**210-244**		orange-mottled massive silts, gypsum efflorescence					
Top Section	229-231	disturbed organic veneers	disturbed silts	**210-244**		dark band of 2 veneers of organic detritus in massive, partially orange-mottled matrix			multiple organic veneers		
Top Section	231-233	disturbed yellow band	disturbed silts	**210-244**		orange-mottled massive silts, gypsum-lined vertical tubes extending from overlying band of organic veneers (bioturbation)					
Top Section	233-234	organic veneers	disturbed silts	**210-244**		discontinuous dark band of veneers of organic detritus					
Top Section	234-235	disturbed yellow band	disturbed silts	**210-244**		thin band of orange-mottled massive silts					
Top Section	235-236	organic veneers	disturbed silts	**210-244**		dark band of veneers of organic detritus			multiple organic veneers		
Top Section	236-240	disturbed massive silts & organic veneers	disturbed silts	**210-244**		orange-mottled massive silts, indistinct traces of veneers of organic detritus					

Subsection	below TOP (in cm)	Lithostratigraphic units	Type section units	Depth in type section (in cm)	Munsell Soil Colors (dry-moist)	Fine-grained units description	Gravel description	Pedogenic description	δ13C samples description	14C sample references	OSL ages (Williams et al. 2001)
Top Section	240-241	organic veneers	disturbed silts	**210-244**		dark band of 2 veneers of organic detritus in massive, partially orange-mottled matrix					
Top Section	241-244	disturbed massive silts & organic veneers	disturbed silts	**210-244**		orange-mottled massive silts, indistinct traces of veneers of organic detritus					
Top Section	244-245	organic veneers	disturbed silts	**210-244**		dark band of multiple veneers of organic detritus overlying tufa marker layer			multiple organic veneers (248-249 Upper Section)	**SSAMS ANU 4111 (244)**	

Subsection	below TOP (in cm)	Lithostratigraphic units	Type section units	Depth in type section (in cm)	Munsell Soil Colors (dry-moist)	Fine-grained units description	Gravel description	Pedogenic description	δ13C samples description	14C sample references	OSL ages (Williams et al. 2001)
Upper Section	249-251	tufa band	tufa band	**244-250**		distinct continuous band of tufa in fine-grained matrix					
Upper Section	251-252	organic veneers	tufa band	**244-250**		dark band of multiple veneers of organic detritus underlying tufa marker layer			multiple organic veneers		
Upper Section	252-254	yellow band	yellow band	**250-255**		distinct continuous yellow band of massive silts					
Upper Section	254-256	organic veneers	yellow band	**250-255**		dark band of multiple compact veneers of organic detritus			multiple organic veneers		
Upper Section	256-260	disturbed yellow band	yellow band	**250-255**		massive orange-mottled silts with streaks of tufa					
Upper Section	260-262	disturbed tufa band	laminated unit	**255-270**		discontinuous band of tufa					
Upper Section	262-270	disturbed massive silts & organic veneers	laminated unit	**255-270**		orange-mottled massive silts with streaks of tufa and patches of veneers of organic detritus					
Upper Section	270-271	organic veneers	laminated unit	**255-270**		dark band of 2 veneers of organic detritus			less distinct organic veneer below mottled zone	**SSAMS ANU 4112 (264)**	
Upper Section	271-274	yellow band	laminated unit	**255-270**		massive silts with traces of veneers of organic detritus					
Upper Section	274-275	organic veneers	laminated unit	**255-270**		distinct dark band of multiple veneers of organic detritus			multiple organic veneers		
Upper Section	275-278	yellow band	laminated unit	**255-270**		massive silts with traces of veneers of organic detritus					
Upper Section	278-281	organic veneers	organic veneers	**270-275**		dark band of multiple compact veneers of organic detritus			multiple organic veneers		
Upper Section	281-291	yellow band	yellow band	**275-285**		distinct continuous yellow band of massive silts, in places sandwiching up to 2 cm thick patches of veneers of organic detritus					
Upper Section	291-292	disturbed organic veneers	yellow band	**275-285**		indistinct dark band of veneers of organic detritus			multiple organic veneers		
Upper Section	292-298	disturbed yellow band	yellow band	**275-285**		massive silts darkening becoming increasingly disturbed and mixed with overlying veneers of organic detritus					
Upper Section	298-299	organic veneers	disturbed silts	**285-305**		dark band of multiple veneers of organic detritus			multiple organic veneers topping tufa (orange-mottled)		
Upper Section	299-301	disturbed tufa band	disturbed silts	**285-305**		discontinuous band of tufa in orange-mottled silts					
Upper Section	301-306	disturbed yellow band	disturbed silts	**285-305**		orange-mottled massive silts, vertical tubes extending from overlying band of organic veneers (bioturbation), gypsum efflorescence					
Upper Section	306-307	disturbed organic veneers	disturbed silts	**285-305**		dark band of veneers of organic detritus, partially-disturbed and discontinuous					
Upper Section	307-315	disturbed yellow band	disturbed silts	**285-305**		orange-mottled massive silts, traces of organic veneers, gypsum efflorescence and root casts					

Subsection	below TOP (in cm)	Lithostratigraphic units	Type section units	Depth in type section (in cm)	Munsell Soil Colors (dry-moist)	Fine-grained units description	Gravel description	Pedogenic description	δ13C samples description	14C sample references	OSL ages (Williams et al. 2001)
Upper Section	315-317	organic veneers	disturbed silts	**285-305**		dark band of multiple veneers of organic detritus			less distinct organic veneers, tiny charcoal fragments		
Upper Section	317-319	yellow band	disturbed silts	**285-305**		undulating yellow band of massive silts, orange-mottled towards base					
Upper Section	319-320	organic veneers	disturbed organic veneers	**305-315**		dark band of multiple veneers of organic detritus			multiple organic veneers		
Upper Section	320-323	yellow band	disturbed organic veneers	**305-315**		massive silts with traces of veneers of organic detritus and streaks of tufa					
Upper Section	323-326	disturbed yellow band	disturbed organic veneers	**305-315**		orange-mottled massive silts, traces of organic veneers					
Upper Section	326-330	disturbed organic veneers	disturbed organic veneers	**305-315**		dark band of veneers of organic detritus mixed with massive silts, topmost veneers is best preserved			multiple organic veneers, gypsum efflorescence (326-327)		
Upper Section	330-332	disturbed yellow band	disturbed organic veneers	**305-315**		massive silts mixed with veneers of organic detritus					
Upper Section	332-336	yellow band	yellow band	**315-322**		distinct continuous yellow band of massive silts					

Subsection	below TOP (in cm)	Lithostratigraphic units	Type section units	Depth in type section (in cm)	Munsell Soil Colors (dry-moist)	Fine-grained units description	Gravel description	Pedogenic description	δ13C samples description	14C sample references	OSL ages (Williams et al. 2001)
Extended PSA Section	344-352	yellow band	yellow band	**315-322**	5Y 7/2 - 5/2	distinct continuous yellow band of massive silts					
Extended PSA Section	352-355	disturbed organic veneers	disturbed organic veneers	**322-335**		dark band of veneers of organic detritus in massive, partially orange-mottled matrix			disturbed organic veneers, mottled		
Extended PSA Section	355-359	disturbed tufa band	disturbed organic veneers	**322-335**		band of streaks of tufa and veneers of organic detritus					
Extended PSA Section	359-363	disturbed organic veneers	disturbed organic veneers	**322-335**		dark band of veneers of organic detritus in massive, partially orange-mottled matrix, root casts lined with gypsum efflorescence			disturbed organic veneers, mottled (361-363)		
Extended PSA Section	363-367	yellow band	disturbed organic veneers	**322-335**		distinct albeit discontinuous yellow band of massive silts, sandwiched by veneers of organic detritus					
Extended PSA Section	367-368	organic veneers	disturbed organic veneers	**322-335**		discontinuous dark band of multiple compact veneers of organic detritus			multiple organic veneers		
Extended PSA Section	368-370	yellow band	yellow band	**335-343**		thin discontinuous yellow band of massive silts					
Extended PSA Section	370-371	organic veneers	yellow band	**335-343**		discontinuous dark band of multiple compact veneers of organic detritus			multiple organic veneers		
Extended PSA Section	371-372	disturbed yellow band	yellow band	**335-343**		thin band of orange-mottled massive silts					
Extended PSA Section	372-374	disturbed organic veneers	yellow band	**335-343**		dark band of veneers of organic detritus in massive, partially orange-mottled matrix and streaks of tufa			multiple organic veneers (topping continuous yellow band)	**SSAMS ANU 4113 (338)**	
Extended PSA Section	374-381	yellow band	yellow band	**335-343**	2.5Y 7/2 - 6/2	distinct continuous yellow band of massive silts, more chromatic (pink) then other massive bands in the sequence				**SSAMS ANU 4114 (341)**	
Extended PSA Section	381-383	organic veneers	organic veneers	**343-348**		distinct dark band of multiple veneers of organic detritus, partially in orange-mottled matrix and associated with streaks of tufa			multiple organic veneers		
Extended PSA Section	383-387	yellow band	yellow band	**348-355**		undulating yellow band of massive silts				**OZJ905 (353)**	
Extended PSA Section	387-401	disturbed organic veneers	laminated unit	**355-373**		massive unit of multiple veneers of organic detritus separated by discontinuous bands of massive silts			well-developed organic veneers , strongly attached to clay (391-392)/ multiple organic veneers (400-401)		
Extended PSA Section	401-408	disturbed yellow band	laminated unit	**355-373**		massive silts, partially orange-mottled and mixed with veneers of organic detritus					
Extended PSA Section	408-409	organic veneers	laminated unit	**355-373**		discontinuous dark band of multiple compact veneers of organic detritus					
Extended PSA Section	409-410	yellow band	laminated unit	**355-373**		thin discontinuous yellow band of massive silts					

Subsection	below TOP (in cm)	Lithostratigraphic units	Type section units	Depth in type section (in cm)	Munsell Soil Colors (dry-moist)	Fine-grained units description	Gravel description	Pedogenic description	δ13C samples description	14C sample references	OSL ages (Williams et al. 2001)
Extended PSA Section	410-411	organic veneers	laminated unit	**355-373**		discontinuous dark band of multiple compact veneers of organic detritus			multiple organic veneers (topping continuous yellow band)	**SSAMS ANU 4209 (372)**	
Extended PSA Section	411-413	disturbed tufa band	laminated unit	**355-373**		weathered band of streaks of tufa and veneers of organic detritus					
Extended PSA Section	413-423	yellow band	yellow band	**373-380**		distinct continuous yellow band of massive silts					

Subsection	below TOP (in cm)	Lithostratigraphic units	Type section units	Depth in type section (in cm)	Munsell Soil Colors (dry-moist)	Fine-grained units description	Gravel description	Pedogenic description	δ13C samples description	14C sample references	OSL ages (Williams et al. 2001)
Lower PSA Section	423-426	organic veneers	laminated unit	**380-465**		dark band of multiple veneers of organic detritus, capped and protected by tufa			multiple organic veneers		
Lower PSA Section	426-430	disturbed yellow band	laminated unit	**380-465**		orange-mottled massive silts, traces of organic veneers and dispersed tufa					
Lower PSA Section	430-431	disturbed organic veneers	laminated unit	**380-465**		dark band of veneers of organic detritus mixed with tufa, topmost veneers is best preserved					
Lower PSA Section	431-433	disturbed tufa band	laminated unit	**380-465**		discontinuous band of streaks of tufa in orange-mottled matrix					
Lower PSA Section	433-438	disturbed yellow band	laminated unit	**380-465**		orange-mottled massive silts, traces of organic veneers and dispersed tufa			lens of organic veneers at base of mottled unit		
Lower PSA Section	438-442	tufa band	laminated unit	**380-465**		distinct but discontinuous band of tufa in orange-mottled silts					
Lower PSA Section	442-443	organic veneers	laminated unit	**380-465**		dark band of multiple veneers of organic detritus, streaks of tufa			multiple organic veneers		
Lower PSA Section	443-447	yellow band	laminated unit	**380-465**		band of massive silts, traces of veneers of organic detritus and dispersed tufa					
Lower PSA Section	447-449	disturbed tufa band	laminated unit	**380-465**		distinct but discontinuous streaks of tufa					
Lower PSA Section	449-452	yellow band	laminated unit	**380-465**		thin discontinuous yellow band of massive silts					
Lower PSA Section	452-453	disturbed organic veneers	laminated unit	**380-465**		dark band of veneers of organic detritus, disturbed					
Lower PSA Section	453-458	disturbed massive silts & organic veneers	laminated unit	**380-465**		orange-mottled massive silts, traces of veneers of organic detritus and streaks of tufa					
Lower PSA Section	458-460	organic veneers	laminated unit	**380-465**		dark band of multiple veneers of organic detritus, streaks of tufa and partially mottled			multiple organic veneers, charcoal (457-458)	**SSAMS ANU 4116 (437)**	
Lower PSA Section	460-461	yellow band	laminated unit	**380-465**		band of massive silts, traces of veneers of organic detritus					**21.600 ± 1.000 (460)**
Lower PSA Section	461-462	disturbed tufa band	laminated unit	**380-465**		thin undulating streaks of dense tufa, partially associated with veneers of organic detritus					
Lower PSA Section	462-465	yellow band	laminated unit	**380-465**		band of massive silts, traces of veneers of organic detritus and dispersed tufa					
Lower PSA Section	465-466	disturbed organic veneers	laminated unit	**380-465**		dark band of veneers of organic detritus, thin and discontinuous					
Lower PSA Section	466-467	disturbed tufa band	laminated unit	**380-465**		thin undulating streaks of dense tufa, partially associated with veneers of organic detritus					
Lower PSA Section	467-468	yellow band	laminated unit	**380-465**		band of massive silts, traces of veneers of organic detritus					
Lower PSA Section	468-469	organic veneers	laminated unit	**380-465**		dark band of multiple veneers of organic detritus in clayey matrix					
Lower PSA Section	469-470	disturbed tufa band	laminated unit	**380-465**		distinct but discontinuous streaks of tufa					
Lower PSA Section	470-474	yellow band	laminated unit	**380-465**		thin discontinuous yellow band of massive silts sandwiched by veneers of organic detritus					

Subsection	below TOP (in cm)	Lithostratigraphic units	Type section units	Depth in type section (in cm)	Munsell Soil Colors (dry-moist)	Fine-grained units description	Gravel description	Pedogenic description	δ13C samples description	14C sample references	OSL ages (Williams et al. 2001)
Lower PSA Section	474-475	organic veneers	laminated unit	**380-465**		dark band of multiple veneers of organic detritus					
Lower PSA Section	475-479	disturbed organic veneers	organic veneers	**465-470**		multiple dark bands of veneers of organic detritus, transitional base with streaks of tufa			composite of veneers topping red band (470-479)		
Lower PSA Section	479-486	red band	red band	**470-479**	(5YR 6/3 dry - 7.5YR 6/3 moist)	distinct continuous red band of massive silts				**SSAMS ANU 2030 (474)**	
Lower PSA Section	486-488	organic veneers	laminated unit	**479-492**		dark band of multiple veneers of organic detritus, streaks of tufa			veneers at base of red band		
Lower PSA Section	488-490	tufa band	laminated unit	**479-492**		discontinuous band of tufa in fine-grained matrix, pockets of larger tufa clasts, gradual transition towards top (up to 485)					
Lower PSA Section	490-492	disturbed yellow band	laminated unit	**479-492**		undulating band of orange-mottled massive silts, dispersed tufa, more clayey towards top					
Lower PSA Section	492-493	tufa band	laminated unit	**479-492**		discontinuous band of tufa in fine-grained matrix					
Lower PSA Section	493-494	disturbed yellow band	laminated unit	**479-492**		undulating band of orange-mottled massive silts, traces of veneer of organic detritus					
Lower PSA Section	494-495	organic veneers	laminated unit	**479-492**		dark band of veneers of organic detritus					
Lower PSA Section	495-496	tufa band	laminated unit	**479-492**		discontinuous band of tufa in fine-grained matrix			charcoal towards top of yellow band		
Lower PSA Section	496-497	disturbed yellow band	laminated unit	**479-492**		undulating band of orange-mottled massive silts, dispersed tufa					
Lower PSA Section	497-498	disturbed organic veneers	laminated unit	**479-492**		dark band of veneers of organic detritus, thin and discontinuous					
Lower PSA Section	498-499	tufa band	laminated unit	**479-492**		discontinuous band of tufa in fine-grained matrix					
Lower PSA Section	499-505	yellow band	yellow band	**492-500**	2.5Y 6/4 - 5/4	distinct continuous yellow band of massive silts, in places tufa fragment from overlying tufa band (bioturbation)			multiple organic veneers (topping continuous yellow band)	**SSAMS ANU 2035 (495)**	
Lower PSA Section	505-510	tufa band	tufa band	**500-506**		thick band of streaks of tufa, veneers of organic detritus, gradual transition towards base			organic veneers topping palaeosol	**SSAMS ANU 4117 & 4205 (505)**	

Subsection	below TOP (in cm)	Lithostratigraphic units	Type section units	Depth in type section (in cm)	Munsell Soil Colors (dry-moist)	Fine-grained units description	Gravel description	Pedogenic description	δ13C samples description	14C sample references	OSL ages (Williams et al. 2001)
Base Section	506-516	palaeosol	palaeosol	**506-516**	(5YR 6/1 dry - 7.5YR 5/1 moist)	distinct brown horizon/boundary between underlying chromatic basal unit (I) and overlying laminated units, where well-defined prismatic to blocky structure			large charcoal at base of palaeosol (514-518)	**OZJ909 (508) & SSAMS ANU 2036 & 2037 (516)**	
Base Section	516-530	lighter band	lighter band	**516-530**		chromatic lighter band of massive silts, gradual upper and lower transition					
Base Section	530-541	darker band	indistinct darker band	**530-541**	2.5Y 6/2 - 5/2	indistinct darker band, wedging out downstream					
Base Section	541-548	lighter band	lighter band	**541-548**	2.5Y 7/3 - 5/3	chromatic lighter band of massive silts, gradual upper and lower transition			large charcoal (542-543)		
Base Section	548-570	darker band	darker band	**548-570**	2.5Y 5/2 - 4/2	indistinct darker band, more pronounced towards top			small charcoal (563-564)		
Base Section	570-575	tufa clasts	lighter band	**570-603**	2.5Y 7/4 - 5/4	discontinuous sheet of tufa clasts at downstream end, concentration of shells and charcoal			large charcoal at base of darker band (572-573), (573-574)		
Base Section	575-580	lighter band	lighter band	**570-604**	2.5Y 7/4 - 5/4	chromatic lighter band of massive silts, gradual upper and lower transition					
Base Section	580-585	pebble sheet	lighter band	**570-606**	2.5Y 7/4 - 5/4		discontinuous sheet of well-rounded small pebbles (mm up to occasional 1 cm), shells		charcoal fragments at base of gravel sheet (584-585)	**Beta 96679 & 96116 (565)**	
Base Section	585-603	lighter band	lighter band	**570-607**	2.5Y 7/4 - 5/4	chromatic lighter band of massive silts, sheets of rolled detrital pedogenic carbonates					**36.100 ± 2.700 (585)**
Base Section	603-627	darker band	darker band	**603-627**	2.5Y 6/2 - 5/3	darker band, more pronounced towards top			large charcoal towards top of darker band (602-603), charcoal (617-618)		**25.300 ± 1.400 (620)**
Base Section	627-647	lighter band	lighter band	**627-647**	2.5Y 7/3 - 5/4	chromatic lighter band of massive silts, gradual upper and lower transition			charcoal fragments (641-644)	**OZJ904 (632) & OZJ908 (639)**	
Base Section	647-671	darker band	darker band	**647-671**	2.5Y 6/2 - 5/3	darker band, more pronounced towards top		top few well-developed large (fist-sized) calcareous rhizocretes	small charcoal towards top of darker band (648-649), charcoal fragments towards base of darker band (658-661)	**OZJ907 (667)**	

Subsection	below TOP (in cm)	Lithostratigraphic units	Type section units	Depth in type section (in cm)	Munsell Soil Colors (dry-moist)	Fine-grained units description	Gravel description	Pedogenic description	δ13C samples description	14C sample references	OSL ages (Williams et al. 2001)
Base Section	671-...	lighter band	lighter band	**671-...**	2.5Y 7/3 - 5/3	chromatic lighter band of massive silts, gradual upper and lower transition		well-developed large (fist-sized) calcareous in-situ rhizomorphs		**OZJ906 (684) & SSAMS 1811 (695) & SSAMS 2039 (695)**	**24.500 ± 1.600 (840)**

ID	North (in °)	East (in °)	Imbrication (in ° mag.)	Imbrication (true N in °)	Depth from TOP (in m)	Geometry	Lithology (remarks)	Location (remarks)
BG1	**31.3365**	**138.61281**	250	**243**	?, but towards base	channel-fill, 200 cm thick	various	main creek bank, lower gravel unit
BG2	**31.3364**	**138.61443**	185	**178**	1	sheet, 30 cm thick	various, largely < 5 cm	in side gully of Brachina Silts
BG3	**31.3362**	**138.61447**	185	**178**	2 ?, but ~0.8 surface drape	sheet, 30-40 cm thick	various, largely < 5 cm	in side gully of Brachina Silts, fine gravel in grey unit towards TOP
BG4	**31.3358**	**138.61534**	190	**183**	3	sheet, 30-40 cm thick	various, largely < 5 cm	in side gully of Brachina Silts, in red-brown unit
BG5	**31.3353**	**138.61604**	190 (180-200)	**183**	2.5	sheet, 40-50 cm thick	various, largely < 5 cm, few local angular platy shales	in side gully of Brachina Silts, erosional basal contact in red-brown unit, sheet with small chutes
BG6	**31.334**	**138.61584**	10, upstream direction	**3**	lag, partially overlying bedrock outcrop		various, large, CaCO3-encrusted, mixed with large (50x30x20 cm) angular blocks of local shale in silty matrix	in side gully from range front, mixed matrix-supported gravel unit is apparently deposited upstream into local gully from nearby older gravel terrace remnant?
BG7	**31.3338**	**138.61569**	290	**283**	2 m gravel-free Silts	30 cm upstream a gully	various, large	in side gully from range front, termination of allochthonous gravel band int sheltered embayment?
BG8	**31.3338**	**138.61569**	135	**128**	3	sheet, 20-30 cm thick	matrix-supported mainly local angular platy shales, associated allochthonous gravel < 2 cm	in side gully of Brachina Silts
BG9 (a)	**31.3326**	**138.6188**	230	**223**	5, 1 m above local bedrock	channel-fill, 40-50 cm	matrix-supported mainly local angular large platy clasts (up to 10 cm), associated allochthonous gravel	in main creek, small tributary (225°) confluence, alluvial fan?, the upstream end of the fan front is confined by a bedrock narrow (60 m) which is flanked by a massive 4-5 m thick and 30 m wide tufa indicating present trunk channel blockage over the aggradation of silts
BG9 (b)	**31.3326**	**138.6188**	250	**243**	1.5	sheet, 30 cm thick	matrix-supported largely allochthonous gravel (shale?, but rounded), CaCO3-encrusted, matrix-supported	in main creek, small tributary (225°) confluence, alluvial fan?, the upstream end of the fan front is confined by a bedrock narrow (60 m) which is flanked by a massive 4-5 m thick and 30 m wide tufa indicating present trunk channel blockage over the aggradation of silts
BG10 (a)	**31.3333**	**138.6192**	210	**203**	see BG9 (a)	150 cm thick	large local angular clasts in lithic sands	in main creek, small tributary (225°) confluence, alluvial fan?, the upstream end of the fan front is confined by a bedrock narrow (60 m) which is flanked by a massive 4-5 m thick and 30 m wide tufa indicating present trunk channel blockage over the aggradation of silts
BG10 (b)	**31.3333**	**138.6192**	280	**273**	1.5	35 cm thick, 100 m wide	various, partially CaCO3-encrusted, rounded, well-rounded boulders towards base of band	in main creek, small tributary (225°) confluence, alluvial fan?, the upstream end of the fan front is confined by a bedrock narrow (60 m) which is flanked by a massive 4-5 m thick and 30 m wide tufa indicating present trunk channel blockage over the aggradation of silts
BG11	**31.3352**	**138.61862**	230	**223**	below surface drape, in upstream continuation overlying silts rapidly increase to up to 2 m	sheet, <200 c?, but only 40 m upstream thinning out to < 20 cm	various, upward-fining with largest clasts 10 cm, both allochthonous and local pebbles are well-rounded	in main creek, widespread topmost gravel sheet above downstream confining bedrock outcrop, mantelled by surface drape
BG12	**31.336**	**138.61838**	185	**178**	below surface drape, cut-and-fill into red-brown silts	40 cm thick, 10 m wide chute	various	in main creek, topmost gravel unit
BG13 (a)	**31.3365**	**138.61847**	235	**228**	4	200 cm thick, 4 m wide chute	various, coarse gravel ~ 10 cm	in main creek, lowermost gravel unit of three stacked generations of chutes
BG13 (b)	**31.3365**	**138.61847**	235	**228**		100 cm thick, 3 m wide chute, similar loci	various, finer gravel ~ 5 cm	in main creek, central gravel unit of three stacked generations of chutes
BG13 (c)	**31.3365**	**138.61847**	235	**228**	below surface drape	sheet, discontinuous 20 cm thick	various	in main creek, topmost gravel unit of three stacked generations of chutes

ID	North (in °)	East (in °)	Imbrication (in ° mag.)	**Imbrication (true N in °)**	Depth from TOP (in m)	Geometry	Lithology (remarks)	Location (remarks)
BG14	**31.3368**	**138.61858**	190	**183**		200 cm thick, 4 m wide chute	various, finer gravel ~ 5 cm	in main creek, central gravel unit of three stacked generations of chutes
BG15 (a)	**31.3368**	**138.61876**	230	**223**		150 cm thick, 4 m wide chute	various	in main creek, central gravel unit of three stacked generations of chutes
BG15 (b)	**31.3368**	**138.61876**	170	**163**	below surface drape	150 cm thick, 4 m wide chute	various	in main creek, topmost gravel unit of three stacked generations of chutes
BG16	**31.3369**	**138.61928**	195	**188**	4	200 cm thick, 3 m wide chute	various	in main creek, central gravel unit of three stacked generations of chutes
BG17	**31.3386**	**138.61227**	265	**258**	4 ?, but overlying outcrop	30 cm thick, 30 m wide	up to 20 cm well-rounded partially CaCO3-encrusted clasts among finer allochthonous gravel	in Etina Creek which here becomes a bedrock-confined channel (30 m, later 25 m width until and beyond downstream confluence)
BG18	**31.3412**	**138.60826**	260	**253**		300 cm thick, 45 m wide channel	various, partially CaCO3-encrusted, rounded, well-rounded boulders towards base and up to 100x40x30 cm large angular local shales in silt matrix topped by at least another meter of gravel	in Etina Creek, 15 m downstream of bedrock-confined channel construction
BG19	**31.3417**	**138.60841**	?	**?**	gravel lag	widespread sheet	various	in Etina Creek at confluence with large local tributary
BG20	**31.3402**	**138.60609**	255	**248**	4	small chute	platy angular to rounded pebbles of various lithology in lithic-sands matrix, distinctly orange-mottled, at the base large angular clasts up to 10 cm	small chute just upstream Brachina of the confluence, in slackwater deposit
BG21	**31.3401**	**138.60857**	280-330	**198**	1.5	multiple discontinuous sheets, 10-20 cm thick, ~100 m wide	various, well-rounded small	resting on continuous bedrock outcrop separating Etina and Brachina Creeks
BG22	**31.3403**	**138.60811**	330	**323**	below surface drape	additional uppermost sheet, up to 40 cm thick	various, well-rounded small	resting on continuous bedrock outcrop separating Etina and Brachina Creeks
BG23	**31.3407**	**138.60823**	?	**?**	gravel lag	widespread sheet, m wide	various	continuation of gravel lag across the Etina from the tributary?
BG24	**31.3379**	**138.63074**	285	**278**	1	120 cm thick, 25 m wide chute	various, mix of platy (~80%), largely 5-10 cm	just 50 m downstream of Nuccaleena Formation (laminated dolomite 620-610 Ma) standing out as a prominent ridge confining the Brachina Silts limited to the Brachina Formation (siltstone & shale 600-610 Ma), perhaps the cut-and-fill)
BG25 (a)	**31.3371**	**138.62952**	265	**258**	2	120-150 cm thick, 60 m wide, multiple sheets of gravel	matrix-supported and open boxwork mostly platy sub-rounded shales (at least 3 events)	20 m wide and 2 m thick tufa plug at downstream end with some reed fill inclined to 190°, in proximity to raised older gravel terrace remnants
BG25 (b)	**31.3371**	**138.62952**	220	**213**	2.2	chute among gravel sheets	open boxwork	20 m wide and 2 m thick tufa plug at downstream end with some reed fill inclined to 190°, in proximity to raised older gravel terrace remnants
BG26	**31.3367**	**138.62749**	220	**213**	0.3, below surface drape	30-40 cm thick, 25 m wide	various, partially CaCO3-encrusted, rounded, well-rounded boulders with ~30cm diameter, partially matrix-supported, pebbles ~3 cm up to 10 cm	topmost gravel sheet

ID	North (in °)	East (in °)	Imbrication (in ° mag.)	Imbrication (true N in °)	Depth from TOP (in m)	Geometry	Lithology (remarks)	Location (remarks)
BG27	**31.3371**	**138.62624**	165-180	**165**	top of gravel bench elevated above the Brachina Silts, bedrock terrace ~5 m from present level of incision	up to 200 cm thick, 70m wide	mix of rounded and angular large pebbles (~10 cm) and boulders (some 40x20x20 cm)	gravel unit resting unconformately on bedrock (Brachina shales), partially up to 1 m thick pockets of silt-coloured tufa matrix incorporating weathered (shattered) pebbles, pebble bench sourced from older gravel terrace remnants within the Brachina Silts. These older gravel terrace remnants consist of allochthonous, rounded, partially CaCO3-encrusted pebbles and boulders (up to ~1 m!), resting on bedrock outcrops (Brachina shales), and can attain heights of up to ~8 m above the Brachina Silts. They present a local source of CaCO3-encrusted rounded pebbles of various lithology and predate the fine-grained aggradation. Tufa dams occur upstream of narrow trunk channel confinements, are attached to the bedrock (Brachina shales), consist of at least 2 generation fluvial in nature, as demonstrated by imbricated near-horizontal gravel (angular local shales). Towards the top up the sequence, detrital tufa clasts and blocks are incorporated.
BG28	**31.3385**	**138.62312**	215	**208**	no TOP	~150 cm thick(?), ~100 m wide	various, partially CaCO3-encrusted, rounded gravel, some weathered and shattered, mostly matrix-supported, few boulders up to 40x30x20 cm	gully section from Etina Creek, gravel lag sourced from nearby older grave terrace remnant, few block were transported as tufa-cemented clasts
BG29 (a)	**31.339**	**138.62244**	290-320	**298**	below surface drape	combined 250 cm thick, 70 m wide	various, matrix-supported	topmost generation of gravel sheet in silts extending laterally above the tufa structure
BG29 (b)	**31.339**	**138.62244**	300	**293**	1	central chute up to 250 cm thick	various, open boxwork	central chute, just downstream of bedrock outcrop with channel located between bedrock outcrop and tufa structure (incorporating local pebbles aligned a 10-15 degree slope
BG29 (c)	**31.339**	**138.62244**	290-320	**298**	1.5	combined 250 cm thick, 70 m wide	various, matrix-supported	lowermost generation of gravel sheet
BG30	**31.3391**	**138.61951**	?	**?**	gravel lag	gravel lag, at least 100 m wide radius around elevated older gravel terrace remnant	various, CaCO3-encrusted rounded pebbles and boulders, matrix-supported	gravel sourced from nearby older gravel terrace remnant (100 m in 190°, elevated ~2 m above Brachina Silts), strongly weathered and partially shattered ~1 m blocks (tillite?), tufa
BG31	**31.3406**	**138.61911**	285	**278**	below surface drape	200 cm thick, 20 m wide (outcroping?, but more extensive) gravel sheet	various, CaCO3-encrusted rounded pebbles (5-10 cm) and boulders (up to 30 cm), matrix-supported	in side gully from Etina Creek, extensive gravel sheet partially resting on bedrock outcrop and covered by surface drape, sourced from nearby older gravel terrace remnant
BG32	**31.3406**	**138.61841**	330	**323**	4	100 cm thick, 6 m wide chute	various, CaCO3-encrusted rounded pebbles (~5 cm, sorted) in grey unit	in side gully from Etina Creek, gravel unit resting on bedrock within grey unit The grey unit in locations of its furthest lateral extent rests on local bedroc (Brachina Shales) incorporating gravel in its discoloured matrix at its base it is ~ 1.5 m thick followed by 0.5 m transitional brown and 2.5 m red-brown silts and likely represents a water-logged environment. It can be subdivided into a discreet unit with gravel alluviation at its fringes, followed by dark grey units with abundant gypsum efflorescence, larger root channels (partially lined with red-brown silts). The grey unit is clearly confined to a central unit aggrading over peak the LGM

ID	North (in °)	East (in °)	Imbrication (in ° mag.)	**Imbrication (true N in °)**	Depth from TOP (in m)	Geometry	Lithology (remarks)	Location (remarks)
BG33	**31.3396**	**138.61501**	350 (?)	**343**	4.5	20-30 cm, all in all ~ 400 m!	various, CaCO3-encrusted rounded pebbles (~5 cm, sorted) in grey unit	extensive gravel sheet extending towards Etina Creek, sitting on yellow/orange-mottled silts, ~2.5 m of grey unit resting on gravel sheet above
BG34	**31.3356**	**138.62054**	195-210	**195**	2 (?)	150 cm thick, 60 m wide	even mix of large angular local platy shales (~40x20x10 cm) and ~10 cm rounded CaCO3-encrusted pebbles of various lithology (ranging from 5-20 cm), lower half finer, well-sorted and imbricated	gravel chute topped by at least 1 m of silts
BG35	**31.3371**	**138.60.689**	90 or 270	**83**	0.25 below yellow band in basal unit (I) of BRA-SD	10 cm thick, 30 cm wide single line of up to 4 clasts	parallel rounded CaCO3-encrusted clasts of various lithology and tufa in silts of basal unit (I), partially weathered (from some local older gravel terrace remnant?)	single narrow line of gravel coming out of BRA-SD in the uppermost basal unit (I)
BG36 (a)	**31.3391**	**138.60744**	230-250	**233**	1.5	30 cm thick, ~5 m wide	largely matrix-supported larger (5-10 cm) CaCO3-encrusted rounded grave of various lithology	lower restricted gravel sheet in grey unit
BG36 (b)	**31.3391**	**138.60744**	270	**263**	0.5	10 cm thick, few m wide	lithic sand-supported largely platy?, but rounded fine (1-2 cm) gravel	upper restricted gravel sheet just below uppermost well-developed calcic horizon
BG37	**31.3398**	**138.60623**	270-280	**268**	1	100 cm thick, 30 m wide (?)	matrix-supported mainly local angular platy shales (5-10 cm), ~20% allochthonous rounded gravel	prominent gravel sheet
BG38	**31.3401**	**138.60577**	255	**248**	4 ?, but overlying outcrop	200 cm thick (5 couplets), 11 m wide	platy angular to rounded pebbles of various lithology in lithic-sands matrix, distinctly orange-mottled, at the base large angular clasts up to 10 cm	side gully succession of at least 5 bands of orange-mottled gravels separated by ~10 cm thick bands of light to purple silts, pebble units are associated with tufa clasts up to ~10 cm and often topped by discontinuous sheets of tufa (in-situ), separating light Silt bands (Sf) are similar to massive yellow/ pink bands and partially exhibit faint cross-bedding, not clearly a cut-and-fill structure, one line to BG20!
BG39	**31.3395**	**138.60583**	260-330, and 10	**3**	2	300 cm thick (multiple couplets), 30 m wide	platy angular to rounded pebbles of various lithology in lithic-sands matrix, distinctly orange-mottled, with unmottled units towards the top of the unit	in side gully: succession of multiple bands of orange-mottled and fresh gravel separated by ~10 cm light and darker mottled Silts, reverse flow imbrication (herringbone pattern) within grey silts, lateral continuation of the orange-mottled bands in form of bog iron concretions in yellow silt matrix similar to those found in the basal (I) and uppermost (IV) units of BRA-SD downstream end of the section, while imbrication is ambiguous ir the mottled units it is more clear in the fresh gravel (10°), a laminated BRA SD equivalent section is close by (80 m)
BG40	**31.3401**	**138.60533**	230-250, many reversals at 10	**233**	2	400 cm thick (12 couplets), 6 m wide	largely platy unsorted (1-10 cm) matrix-/ lithic sand-supported gravel o various lithology, partially orange mottled, some incorporating tufa clasts	from Brachina Creek, channel-fill of 12 slackwater couplets resting on 2.5 m of grey silts which bank against bedrock (present exposure 3 m), gravel occurs in bands of 10-50 cm thickness alternating with 5-10 cm thick massive light silts, gravel bands often topped by discontinuous sheets of tufa

Cell: E1
Comment: magnetic inclination corrected based on the latest International Geomagnetic Reference Field (IGRF) model (http://www.ngdc.noaa.gov/geomagmodels/struts/calcDeclination)

	A	B	C	D	E	F	G	H	I	J
1	**Sample ID** (condition)	**1st population** (in µm)	***proportion*** *(in %)*	**sigma**	**2nd popuplation** (in µm)	***proportion*** *(in %)*	**sigma**	**3rd population** (in µm)	***proportion*** *(in %)*	**sigma**
2	**drape** (FD)	**54**	*66.6*	0.2	**14**	*29.0*	0.2	5	*3.9*	0.1
3	**drape** (MD)	**62**	*72.8*	0.2	**20**	*21.2*	0.1	133	*11.2*	0.1
4	**000-010** (FD)	**61**	*42.8*	0.2	**15**	*50.4*	0.3	5	*6.8*	0.1
5	**000-010** (MD)	**78**	*75.3*	0.2	**25**	*21.0*	0.2	242	*3.7*	0.1
6	**093-100** (FD)	**43**	*78.6*	0.2	**11**	*18.6*	0.3	4	*2.7*	0.1
7	**093-100** (MD)	**53**	*54.3*	0.1	**30**	*41.1*	0.2	10	*4.6*	0.1
8	**244-250** (FD)	**40**	*78.8*	0.2	**14**	*19.1*	0.2	5	*2.0*	0.1
9	**244-250** (MD)	**42**	*65.1*	0.1	**18**	*29.2*	0.2	8	*5.8*	0.1
10	**275-285** (FD)	**64**	*78.0*	0.2	**16**	*16.9*	0.3	5	*3.1*	0.1
11	**275-285** (MD)	**71**	*80.9*	0.2	**24**	*11.6*	0.2	207	*4.5*	0.1
12	**348-355** (FD)	**63**	*72.2*	0.2	**23**	*24.4*	0.3	5	*3.4*	0.1
13	**348-355** (MD)	**65**	*66.8*	0.2	**32**	*29.1*	0.2	10	*4.1*	0.1
14	**373-380** (FD)	**51**	*82.3*	0.2	**12**	*15.2*	0.3	4	*2.5*	0.1
15	**373-380** (MD)	**49**	*94.5*	0.2	**12**	*5.6*	0.2	19	*0.0*	0.2
16	**470-479** (FD)	**59**	*89.3*	0.2	**13**	*9.0*	0.3	4	*1.7*	0.1
17	**470-479** (MD)	**59**	*93.4*	0.2	**15**	*4.8*	0.2	9	*1.7*	0.1
18	**492-500** (FD)	**52**	*61.7*	0.1	**30**	*31.4*	0.2	7	*6.9*	0.2
19	**492-500** (MD)	**51**	*68.3*	0.1	**27**	*27.5*	0.2	9	*4.2*	0.1
20	**506-516** (FD)	**63**	*65.3*	0.2	**13**	*22.8*	0.3	5	*11.0*	0.1
21	**506-516** (MD)	**59**	*81.1*	0.2	**12**	*14.1*	0.1	7	*4.7*	0.0
22	**650-660** (FD)	**54**	*56.1*	0.2	**85**	*34.5*	0.2	12	*9.4*	0.3
23	**650-660** (MD)	**65**	*82.2*	0.2	**14**	*10.6*	0.2	166	*7.3*	0.1

	A	K	L	M	N	O	P	Q	R	S	T
1	**Sample ID** (condition)	**silt** (in %)	**very-fine sand** (in %)	**fine sand** (in %)	**rest** (in %)	**>200µm %, wet-sieved**	**mean** (MS3)	**median** (MS3)	**mode** (MS3)	**skewness** (MS3, %)	**kurtosis** (MS3, %)
2	**drape** (FD)	73	23	3	1	27.0	46.8	42.4	55.2	1.4	3.1
3	**drape** (MD)	52	37	11	0		69.5	60.8	62.3	1.1	1.2
4	**000-010** (FD)	77	18	3	2	38.0	39.4	26.1	50.8	1.6	2.7
5	**000-010** (MD)	44	39	15	2		82.7	69.4	78.7	1.5	2.5
6	**093-100** (FD)	82	15	0	2	1.1	40.1	40.4	53.1	0.2	-0.4
7	**093-100** (MD)	81	19	0	0		45.1	44.3	51.3	0.6	0.8
8	**244-250** (FD)	89	10	0	1	1.1	37.6	37.0	50.2	0.3	-0.4
9	**244-250** (MD)	92	8	0	0		35.4	33.6	43.6	0.7	0.4
10	**275-285** (FD)	56	36	8	1	9.5	63.6	57.1	62.3	1.5	3.4
11	**275-285** (MD)	46	40	14	1		77.9	66.2	71.6	1.3	1.9
12	**348-355** (FD)	59	38	3	0	0.5	57.0	55.5	63.2	0.6	0.6
13	**348-355** (MD)	60	38	2	0		58.0	55.6	62.2	0.6	0.4
14	**373-380** (FD)	68	29	0	2	0.6	48.5	49.0	59.0	0.2	-0.3
15	**373-380** (MD)	68	32	1	0		52.8	51.2	59.6	0.5	0.4
16	**470-479** (FD)	53	45	2	1	0.7	60.1	59.8	71.2	0.2	0.1
17	**470-479** (MD)	52	46	2	0		61.8	60.8	69.3	0.4	0.3
18	**492-500** (FD)	79	19	0	1	0.4	45.1	45.5	54.1	0.2	0.1
19	**492-500** (MD)	80	20	0	0		46.1	44.9	54.4	0.5	0.5
20	**506-516** (FD)	61	30	6	4	0.5	52.4	47.7	62.4	1.2	2.3
21	**506-516** (MD)	61	31	7	0		58.7	51.8	60.1	1.4	2.8
22	**650-660** (FD)	51	39	9	1	8.7	68.8	61.4	61.8	1.4	2.8
23	**650-660** (MD)	48	38	14	1		75.6	64.5	64.2	1.3	1.8

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Conference abstracts

Haberlah, D., Williams, M.A.J., Hill, S.M., Halverson, G. and Glasby, P. (2007) 'A terminal Last Glacial Maximum (LGM) loess-derived palaeoflood record from South Australia.
Quaternary International, v. 167-168, suppl. 15.

NOTE: This publication is included on pages 303-304 in the print copy of the thesis held in the University of Adelaide Library.

The Flinders Silts: a last glacial alluvial loess record from South Australia

(7th International Conference on Geomorphology 2009, Melbourne)

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Remnants of late Pleistocene loess-derived valley-fills (Silts) are a common occurrence in mountainous catchments downwind of deserts, formerly exposed continental shelf areas and large playa lakes. The Namib Silts within the Great Escarpment of Namibia and the Sinai Silts of Egypt have been studied by Quaternary geomorphologists for decades. However, their depositional nature remains a matter of controversy, making it difficult to interpret their rich palaeo-environmental archives. Here we present the largely unnoticed but equally spectacular Flinders Silts from South Australia. Situated in the midst of the last glacial continental "dust bowl", the longitudinal Flinders Ranges trapped large quantities of proximal dust. At present, the Silts are entrenched up to 18 meters by ephemeral traction load streams. Fifteen stratigraphic sections from four catchments were logged and dated by 94 AMS radiocarbon and 30 OSL ages. All sections are put in geomorphological context by stratigraphic mapping, and, within the Brachina catchment, by means of a differential GPS survey. Multi-proxy studies involving high-resolution parametric particle-size analyses, magnetic susceptibility, ICP-MS, carbon, oxygen, and nitrogen isotope geochemistry and spectral mineralogy employing HyChips™ and QEMSCAN® technologies were performed. The results of the regional study indicate that over the last glacial cycle, particularly over its culmination in the Last Glacial Maximum (21±3 ka), loess blown into the catchments was episodically entrained and re-deposited by floods, choking narrow gorges and backflooding into tributaries and embayments. Here, successive floods resulted in the deposition of layered to laminated slackwater deposits, presenting a near continuous terrestrial palaeo-environmental archive. The multi-proxy record

suggests that the last glacial represents an overall arid but complex interval, significantly altering the landscape by dust storms and flood events. The study of fine-grained valley-fills from south-eastern Australia can help to resolve the prolonged discussion over the nature of Silts in other parts of the world.

Dust fingerprinting in regolith: an integrated high-resolution parametric particle-size analysis quantitative spectral mineralogy approach

(7th International Conference on Geomorphology 2009, Melbourne)

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Loess-derived alluvium is widely recognised in; mountainous catchments downwind of deserts, formerly exposed continental shelf areas and large playa lakes. A prominent example from South Australia is the late Pleistocene Flinders Silts; up to 18 m thick fine-grained valley-fill deposits choking narrow gorges and mantling the piedmont plains of the Flinders Ranges. In order to assess their impact on landscape evolution, deposition rates of dust need to be estimated for a given time period and area. This is best achieved by quantitatively differentiating the allochthonous aeolian component from in-situ weathering products within chronostratigraphic sequences along a downwind transect. Here, we present the results of an integrated approach employing high-resolution three-dimensional particle-size analyses using a Multisizer 3 COULTER COUNTER® and automated mineralogical QEMSCAN® technology, a combination of features found in other analytic instruments such as Scanning Electron Microscopes (SEM) and Electron Probe Micro Analysers (EPMA). Parametric analysis of the particle-size data is performed on both fully-dispersed and minimally-dispersed sediment samples, the latter approximating transport-stable conditions in turbulent fluvial flow. Aggregation is further explored by "mapping" the sample mineralogy, thus visualising the spatial distribution of minerals in the form of discrete particles and compound aggregates. Disaggregation is digitally performed by the software package iDiscover™. The results underline the importance of analysing soils and sediments in its naturally-occurring partially-aggregated state, with certain forms of aggregation being indicative of fluvial transport. Apart from the palaeo-environmental implications, there are many other potential fields of application of

integrated quantitative dust fingerprinting in regolith, ranging from more efficient prospecting and mining to monitoring of human health and climate change.

Haberlah. D., Hrstka, T., Jaime, P., Butcher, A.R. and McTainsh, G.H. (2009) Last glacial dust cycles in South Australia: employing advanced Automated Mineralogy and sediment-size analyses in the study of provenance, transport and depositional palaeo-environments.
15th International Joint Seminar on the Regional Deposition Processes in the Atmosphere (RDPA) and Climate Change 2009, Taipei.

NOTE: This publication is included on pages 309-317 in the print copy of the thesis held in the University of Adelaide Library.