

## Aberystwyth University

### *New geomorphological and archaeological evidence for drainage evolution in the Luangwa Valley (Zambia) during the Late Pleistocene*

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Locality	Lithology									Total
	Quartzite	Chert	Metamorphic	Quartz	Black Rock	Granite	Karoo	Sandstone	Unknown	
8.1	4	0	19	0	36	41	0	0	0	100
8.2	0	0	22	0	15	56	0	5	2	100
9.1	48	0	33	0	8	10	1	0	0	100
9.2	35	0	39	0	5	12	6	0	3	100
10.0	73	0	21	3	0	3	0	0	0	100
11.0	83	0	16	0	0	0	0	1	0	100
12.0	95	2	0	3	0	0	0	0	0	100
13.0	96	1	0	3	0	0	0	0	0	100
14.0	0	0	36	0	0	64	0	0	0	100
16.0	85	2	11	0	0	1	0	1	0	100
17.0	63	0	29	8	0	0	0	0	0	100
18.0	81	0	19	0	0	0	0	0	0	100
19.0	28	0	72	0	0	0	0	0	0	100
21.0	95	2	2	0	0	0	0	0	1	100
22.0	99	0	0	0	0	0	0	0	1	100
23.0	99	1	0	0	0	0	0	0	0	100
24.0	11	1	87	0	0	1	0	0	0	100
26.0	100	0	0	0	0	0	0	0	0	100
27.0	99	0	0	0	0	0	1	0	0	100
28.0	94	0	5	0	0	0	0	1	0	100
30.0	98	0	2	0	0	0	0	0	0	100
31.0	93	1	6	0	0	0	0	0	0	100
32.0	71	0	0	0	0	0	29	0	0	100
33.0	46	0	53	0	0	1	0	0	0	100
34.0	0	0	80	8	0	12	0	0	0	100
35.0	0	0	76	14	10	0	0	0	0	100

**SM Table 1**

Clast count lithology data by sampling locality (see text and Figure 2).

Locality	Angularity					
	Very angular	Angular	Sub angular	Sub rounded	Rounded	Well rounded
10.0	1	53	34	11	1	0
12.0	0	13	38	31	18	0
13.0	0	18	30	33	19	0
14.0	0	15	40	39	6	0
16.0	0	29	45	21	5	0
19.0	0	23	45	18	14	0
21.0	1	9	45	27	18	0
22.0	0	10	46	31	13	0
23.0	0	3	39	35	22	1
24.0	2	36	51	10	1	0
26.0	0	29	37	28	5	1
27.0	0	28	43	25	4	0
28.0	0	9	39	32	18	2
31.0	0	13	41	33	12	1
30.0	0	2	39	37	22	0
32.0	0	20	43	26	8	3
33.0	2	21	50	15	12	0

**SM Table 2**

Clast count angularity data by sampling locality (see text and Figure 2).

<b>B axis class</b>									
Locality	2.0 - 2.9	3.0 - 3.9	4.0 - 4.9	5.0 - 5.9	6.0 - 6.9	7.0 - 7.9	8.0 - 8.9	9.0 - 9.9	10 +
10.0	57	17	12	7	5	0	1	0	1
12.0	58	25	6	6	3	1	0	0	1
13.0	34	23	18	10	9	4	1	1	0
16.0	69	20	11	0	0	0	0	0	0
19.0	18	14	19	11	9	10	6	4	9
21.0	44	26	16	12	1	0	0	1	0
22.0	59	26	7	7	0	1	0	0	0
23.0	31	51	13	3	2	0	0	0	0
24.0	57	30	10	1	1	1	0	0	0
26.0	28	33	19	9	3	3	2	0	3
27.0	39	30	21	9	0	0	1	0	0
28.0	46	32	11	7	1	2	0	1	0
31.0	55	28	13	3	0	1	0	0	0
32.0	35	31	20	7	4	1	0	1	1
33.0	35	39	15	5	6	0	0	0	0

**SM Table 3a.** Clast count b-axis data by sampling locality.

A						Levene's Test for Equality of Variances		t-test for Equality of Means						
B-axis groups	N	Mean	Std. Deviation	Std. Error Mean		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
													Lower	Upper
1. Cobbles behind Chipembele Ridge. Counts 26,27 & 13	300	3.817	1.6948	.0978	Equal variances assumed	23.600	.000	5.282	798	.000	.5403	.1023	.3395	.7411
2. Cobbles on the nw bank of the Luangwa. Counts 21,22,28,23 & 12	500	3.277	1.1900	.0532	Equal variances not assumed			4.851	477.060	.000	.5403	.1114	.3215	.7592
B						Levene's Test for Equality of Variances		t-test for Equality of Means						
B-axis groups	N	Mean	Std. Deviation	Std. Error Mean		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
													Lower	Upper
1. Cobbles on the se side of the Luangwa. Counts 10 & 31.	200	3.172	1.2554	.0888	Equal variances assumed	.731	.393	1.043	698	.297	-.1055	.1012	-.3041	.0931
2. Conglomerates on the nw side of the Luangwa. Counts 28,21,22,12, & 23.	500	3.277	1.1900	.0532	Equal variances not assumed			1.019	349.756	.309	-.1055	.1035	-.3091	.0981

Table 3b. Paired t-tests of b-axis cobble size measurements (A) between two groups on the north-western bank of the Luangwa River, one distant (behind Chipembele Ridge), and one proximal (near the Luangwa) showing a significant difference in the sizes of the clasts further away from the Luangwa; B compares cobble size on the south-east bank of the Luangwa River at the base of the Nchindeni Hills, with the cobbles on the north-west bank and shows no significant difference in size either side of the Luangwa River.

**Block 3 cross-tabulation of surface abrasion by raw material and level**

Count

Surface			Level							Total	
			2	3	4	5	6	7	8		9
no visible	Material	milky quartz	3	2				0			5
		quartzite	1	1				1			3
		chert	3	2				0			5
		fossil wood	1	0				0			1
	Total		8	5				1			14
sharp	Material	milky quartz	1	0	0	0	1	1	0	1	4
		quartzite	4	1	1	0	2	5	2	3	18
		chert	0	0	0	1	0	0	1	0	2
		fossil wood	0	0	0	0	0	0	1	1	2
	conglomerate	0	0	0	0	0	1	0	0	1	
Total		5	1	1	1	3	7	4	5	27	
moderate	Material	milky quartz	0	2		0	3	2	0	1	8
		quartzite	1	1		1	5	4	5	1	18
		fossil wood	0	0		0	0	0	2	0	2
Total		1	3		1	8	6	7	2	28	
worn	Material	milky quartz	0		0	3	1	2	2	2	10
		quartzite	1		1	0	4	4	7	2	19
		chert	0		0	0	0	0	1	0	1
Total		1		1	3	5	6	10	4	30	
very worn	Material	milky quartz	1		3	1	1	1	1	0	8
		quartzite	1		2	0	2	4	1	1	11
		chert	0		0	0	0	1	0	0	1
Total		2		5	1	3	6	2	1	20	
Total	Material	milky quartz	5	4	3	4	6	6	3	4	35
		quartzite	8	3	4	1	13	18	15	7	69
		chert	3	2	0	1	0	1	2	0	9
		fossil wood	1	0	0	0	0	0	3	1	5
	conglomerate	0	0	0	0	0	1	0	0	1	
Total		17	9	7	6	19	26	23	12	119	

**SM Table 4:** Block 3 cross-tabulation of surface abrasion by raw material and level for whole flakes.

**Block 1 Area 1 surface abrasion by raw material and level**

Count

Surface			Level						Total
			A11	A12	A13	A14	A15	A16	
no abrasion	Material	milky quartz	2	1		2		3	8
		quartzite	0	0		1		1	2
		chert	3	0		0		0	3
		Total	5	1		3		4	13
sharp	Material	milky quartz	2	0	2	1	1	2	8
		quartzite	0	2	1	1	0	1	5
		chert	2	0	0	3	0	0	5
		Total	4	2	3	5	1	3	18
moderate	Material	milky quartz	3	2	1	15	2	6	29
		quartzite	0	0	1	4	0	4	9
		chert	0	0	0	0	0	2	2
		Total	3	2	2	19	2	12	40
worn	Material	milky quartz	3	3	2	13	7	4	32
		quartzite	0	2	3	3	0	3	11
		Total	3	5	5	16	7	7	43
very worn	Material	milky quartz	0			4	2	4	10
		quartzite	0			0	0	1	1
		chert	1			0	0	0	1
		Total	1			4	2	5	12
Total	Material	milky quartz	10	6	5	35	12	19	87
		quartzite	0	4	5	9	0	10	28
		chert	6	0	0	3	0	2	11
		Total	16	10	10	47	12	31	126

**SM Table 5**

The frequency of whole flakes by level, raw material and by abrasion type in Block 1, Area 1.

**Block 1 Area 1 cross-tabulation of core type with raw material by level**

Count			Level						Total	
Material	Type		A1	A2	A3	A4	A5	A6		
quartz crystal	Type	2 platforms right angles	1						1	
		single platform	1						1	
		bipolar	1						1	
		split cobble,1-2 flakes	1						1	
		<b>Total</b>		4						4
milky quartz	Type	chunk	0	1	0	0	0	0	1	2
		2 platforms right angles	4	0	0	1	2	0	7	
		radial	0	0	0	0	1	1	2	
		single platform	4	1	0	4	2	3	14	
		multiple, irregular	2	1	0	2	1	0	6	
		prepared	0	0	0	0	0	1	1	
		bipolar	1	1	0	1	0	0	3	
		flake as core	0	0	1	0	0	0	1	
		opposed platforms	0	0	0	1	0	2	3	
		disc	1	0	0	0	0	0	1	
		split cobble, centripetal	0	0	0	4	1	1	6	
		split cobble, flaked periphery	0	0	0	3	0	0	3	
		bipolar	0	1	0	0	0	0	1	
		split cobble, unflaked	1	4	0	4	1	3	13	
		split cobble,1-2 flakes	1	0	0	0	0	2	3	
	<b>Total</b>		14	9	1	20	8	14	66	
quartzite	Type	chunk	0		0	0		1	1	
		2 platforms right angles	0		0	0		2	2	
		radial	0		0	1		0	1	
		single platform	0		2	2		4	8	
		prepared	0		0	1		0	1	
		bipolar	0		0	1		0	1	
		opposed platforms	0		0	2		0	2	
		disc	0		0	1		0	1	
		split cobble, centripetal	0		0	1		2	3	
		split cobble, flaked periphery	1		0	1		0	2	
		split cobble, unflaked	0		0	0		1	1	
		split cobble,1-2 flakes	0		1	0		0	1	
		<b>Total</b>		1		3	10		10	24
	chert	Type	chunk	1		0	0		0	1
		2 platforms right angles	0		0	0		2	2	
		change of form	0		0	1		0	1	
		split cobble, centripetal	0		0	1		0	1	
		split cobble, flaked periphery	0		0	0		1	1	
		split cobble,1-2 flakes	0		2	0		0	2	
	<b>Total</b>		1		2	2		3	8	
conglomerate	Type	radial						1	1	
	<b>Total</b>							1	1	
Total	Type	chunk	1	1	0	0	0	2	4	
		2 platforms right angles	5	0	0	1	2	4	12	
		radial	0	0	0	1	1	2	4	
		single platform	5	1	2	6	2	7	23	
		multiple, irregular	2	1	0	2	1	0	6	
		prepared	0	0	0	1	0	1	2	
		bipolar	2	1	0	2	0	0	5	
		flake as core	0	0	1	0	0	0	1	
		change of form	0	0	0	1	0	0	1	
		opposed platforms	0	0	0	3	0	2	5	
		disc	1	0	0	1	0	0	2	
		split cobble, centripetal	0	0	0	6	1	3	10	
		split cobble, flaked periphery	1	0	0	4	0	1	6	
		bipolar	0	1	0	0	0	0	1	
		split cobble, unflaked	1	4	0	4	1	4	14	
	split cobble,1-2 flakes	2	0	3	0	0	2	7		
	<b>Total</b>		20	9	6	32	8	28	103	

**SM Table 6**

The frequencies of cores by level, type and raw material in Block 1, Area 1.