

Supplemental Information for Bulletin ms. B21865
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Chemical sedimentology and paleoenvironmental history of Lake Olduvai,
a Pliocene lake in northern Tanzania

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TABLE 1. LOCALITY, LITHOLOGY, AND STRATIGRAPHIC POSITION OF ANALYZED SILICATE SAMPLES FROM BED I AND LOWER BED II.

Lab no.	Sample no.	Composition	Locality	Stratigraphic Position
cb-1	478-282	clay	80	Bed I, 30 cm above Tuff IA
cb-2	478-283	clay	80	Bed I, 2.4 m above Tuff IA
cb-3	478-290	clay	80	Bed I, 1.8 m below Tuff iF
cb-4	478-386a	clay	80	Bed II, 20-25 cm above base
cb-5	478-386b	altered tuff	80	Bed II, 25-26 cm above base
cb-6	478-387	clay	80	Bed II, 1.2 m above base
cb-7	NS, -10	clay	80	Bed I, 20 cm below Tuff IF
cb-8	NS, +10	clay	80	Bed II, 10 cm above base
cb-9	89-7-26C	dol. with 30%clay	80	Bed I, from 10 cm bed beneath Tuff IF
el-1	62-6-23D	clay	38	Bed II, 1 m above base
el-2	62-6-25E	clay	14	Bed I, 30 cm below Tuff IB
el-3	64-7-13N	clay	20	Bed II, 6.7 m above base
el-4	67-6-28K	clay	45b	Bed II, ~75 cm above base
el-5	72-7-5J	clay	201	Bed II, 1.5 m above base
el-6	89-7-21C	clay	N. of 45	Bed I, ~7 m below Tuff IF and 0-10 cm below Tuff IC
el-7	89-7-22A	clay	42, tr. 1	Bed II, 30 cm above base
el-8	89-7-30A	clay	45b	Bed I, 50 cm below Tuff IF
el-9	89-7-31B	clay	44, tr. 12	Bed II, 50 cm above base
el-10	89-7-31E	clay	85	Bed II, basal 15 cm
el-11	89-8-3B	clay	44, tr. 13	Bed I, 8-15 cm below Tuff IF
el-12	89-8-3J	clay	45c, tr. 17	Bed II, basal 15 cm
el-13	89-8-6A	clay	45a, tr. 18	Bed II, 30 cm above base
el-14	93-8-14C	clay	45	Bed I, 1.5 m below Tuff IF
el-15	95-7-17B	clay	44, tr. 13	Bed I, 60 cm below Tuff IF
el-16	95-7-18A	clay	38	Bed I, ~30 cm below Tuff IF
el-17	95-7-18B	clay	40a	Bed I, 0-5 cm below Tuff IF
el-18	95-7-19A	clay	45a	Bed I, 15-30 cm below Tuff IF
el-19	95-7-20A	clay	43, tr. 13	Bed I, 0-5 cm below Tuff IF
el-20	95-7-20C	clay	36	Bed I, ~30 cm below Tuff IF
el-21	95-7-21C	clay	45b	Bed I, 15 cm below Tuff IF
el-22	95-7-22A	clay	45	Bed I, 5-10 cm below Tuff IF
el-23	95-7-23B	clay	201	Bed I, ~15cm below Tuff IF
af-1	89-7-25C	clay	27	Bed I, paleosol on Tuff IB
ap-1	64-6-23A	clay	70	Bed I, near top of AP lithofacies
wl-1	89-8-2B	clay	66	upper Bed I, WLM lithofacies

Note: Locality numbers refer to Hay (1976), and abbreviations are: dol., dolomite; and tr, trench, the numbers of which refer to localities in Hay, 1996.

TABLE 2. CHEMICAL ANALYSES OF CLAYS FROM BED I, LOWER BED II, AND NGORONGORO (page 1)

No.	Size, μm	SiO ₂	Al ₂ O ₃	TiO ₂	Fe ₂ O ₃ ²	MnO	MgO	CaO	Na ₂ O	K ₂ O
cb-1x*	<2.0	52.8	3.40	0.72	3.20	0.05	18.2	2.38	0.55	2.39
cb-1p	<0.5	54.18	1.97	0.45	3.29	0.06	21.73	0.56	4.39	1.55
cb-2x*	<2.0	51.3	6.75	1.16	6.20	0.06	15.3	1.90	0.52	4.50
cb-3x*	<1.5	50.7	9.43	1.84	8.42**	0.16	11.0	1.66	1.00	5.59
cb-4p*	<0.5	54.38	3.46	1.13	4.16	0.07	19.22	2.20	0.61	2.37
cb-6p*	<0.5	52.78	8.28	2.32	9.24	0.11	9.65	1.94	0.66	6.17
cb-8p	<0.5	54.04	2.74	0.76	3.56	0.08	20.16	0.52	3.42	2.19
el-1p	<2.0	52.73	11.01	1.55	11.73	0.07	8.19	0.29	3.54	1.76
el-2p	<2.0	54.25	9.33	1.51	10.22	0.28	10.10	0.18	3.03	3.00
el-3w	<2.0	52.58	8.51	2.36	9.38**	0.06	8.11	0.22	2.28	2.38
el-6p	<2.0	54.55	4.31	0.51	7.26	0.09	17.91	0.22	3.66	2.11
el-7x*	<2.0	54.1	10.4	1.22	7.24**	0.04	8.65	3.54	0.17	1.07
el-8p	<2.0	52.62	1.79	0.27	1.38	0.01	23.8	0.22	4.94	0.42
el-10x*	<2.0	52.6	7.03	1.03	5.36**	0.04	13.4	3.30	0.26	1.34
el-11x*	<2.0	56.4	0.93	0.35	0.67**	0.02	24.5	3.16	0.26	0.22
el-12p	<2.0	53.28	4.06	0.54	2.59	0.03	18.83	0.05	3.42	0.68
el-13p	<2.0	56.07	7.82	0.91	6.02	0.04	13.69	0.19	3.63	2.26
el-14p	<2.0	50.53	4.02	0.55	4.00	0.09	19.49	0.47	3.44	1.31
el-15x*	<2.0	46.9	8.08	0.95	6.33	0.04	8.79	2.62	0.73	0.68
el-16x*	<2.0	47.0	9.08	1.09	6.72	0.10	9.25	3.29	0.28	1.29
el-17p	n.d.	49.26	7.00	1.13	6.54	0.10	14.76	0.28	4.24	2.42
el-18x*	<2.0	47.7	3.22	0.46	3.15	0.05	19.1	2.55	0.23	0.77
el-19p	n.d.	51.96	5.38	1.20	7.01	0.10	15.10	0.27	3.22	2.06
el-20x*	<2.0	46.0	8.89	1.17	7.27	0.16	8.69	3.25	0.32	1.39
el-21p	n.d.	49.91	4.38	0.77	4.95	0.07	18.69	0.02	2.73	2.67
el-22x*	<2.0	47.0	4.56	0.98	6.30	0.12	14.7	2.66	0.32	1.68
el-23x*	<0.5	44.6	8.53	1.26	7.26	0.14	10.9	3.74	0.50	3.42
af-1p	<2.0	57.21	14.83	0.77	8.05	0.07	3.41	0.48	5.24	1.04
wl-1p	<2.0	52.13	13.75	2.43	10.37	0.21	4.84	1.24	1.54	5.31
ap-1p	<2.0	50.83	10.72	1.82	12.95	0.11	5.30	0.16	2.88	6.14
ng-1x*	<2.0	52.4	8.64	1.36	5.65**	0.18	10.6	2.15	0.25	5.22
ng-2x*	<2.0	44.4	20.4	2.19	10.8	0.29	2.30	2.01	0.16	2.71

Notes: x, p, and w refer to chemical analysis by X-ray fluorescence, electron microprobe, and wet-chemical methods, respectively. Symbol * indicates analysis of Ca-exchanged sample, and ** indicates samples for which FeO is given in Table 3.

TABLE 2 . CHEMICAL ANALYSES OF CLAYS ((page 2).

P2O5	Cl	LOI	Total
0.03	n.d.	15.6	99.4
n.d.	1.03	n.d.	89.21
0.07	n.d.	10.4	98.2
0.09	n.d.	9.16	99.0
n.d.	0.17	n.d.	87.77
n.d.	0.03	n.d.	91.18
0.03	n.d.	n.d.	87.50
n.d.	0.024	n.d.	90.89
n.d.	0.02	n.d.	91.74
0.05	n.d.	14.37	100.30
n.d.	0.14	n.d.	90.76
0.09	n.d.	13.7	100.2
n.d.	2.56	n.d.	88.01
0.05	n.d.	14.3	98.7
0.03	n.d.	12.2	98.8
0.02	n.d.	n.d.	83.50
n.d.	0.30	n.d.	90.95
0.23	n.d.	n.d.	84.13
0.02	<0.03	27.5	102.6
0.10	n.d.	23.3	101.5
n.d.	n.d.	n.d.	85.73
<0.01	<0.02	23.2	100.4
0.10	n.d.	n.d.	86.40
0.12	n.d.	24.2	101.5
0.03	n.d.	n.d.	84.22
0.26	<0.03	22.6	101.2
0.15	<0.02	20.4	100.9
n.d.	0.02	n.d.	91.12
n.d.	0.01	n.d.	91.94
0.13	n.d.	n.d.	91.04
0.30	n.d.	12.3	99.9
0.29	n.d.	14.7	100.3

TABLE 3. SELECTED TRACE ELEMENTS IN CLAYS FROM BED I, LOWER BED II, AND NGORONGORO

Sample & size	Mineral composition	F	Li	FeO %	Cr	Rb	Zr	Nb	Sr
cb-1 <2 µm	S82 K14 I4	n.d.	n.d.	n.d.	90	351	135	48	153
cb-2 <2 µm	I68 S28 K6	n.d.	170	n.d.	68	264	215	90	255
cb-3 <1.5 µm	I97 A3	>10,000	120	0.4	54	242	434	190	278
el-3 <2 µm	I10 S90	n.d.	n.d.	0.67	n.d.	n.d.	n.d.	n.d.	n.d.
el-7 <2 µm	S100	>10,000	180	0.2	138	138	440	145	529
el-10 <2 µm	S95 I5	>10,000	210	0.2	138	165	343	107	429
el-11 <2 µm	S100	>10,000	970	0.1	16	23	77	43	515
ng-1 <2 µm	I90 K6 P4	10,000	88	0.8	49	198	320	107	548
ng-2 <2 µm	I40 S+Ka60	n.d.	n.c.	n.d.	89	<10	970	357	496

Notes: All values are in parts per million except FeO. Abbreviations are A, analcime, I, illite; S, smectite + I/S; K, K-feldspar; Ka, kaolinite and/or halloysite; P, phillipsite; and n.d., not determined. Mineral amounts are in percent. Analysis of el-3 is by John Muysson, and all others are by XRAL Laboratories.

TABLE 4. ISOTOPIC COMPOSITION OF CALCITE AND DOLOMITE FROM BED I AND LOWER BED II, WITH d18OH2O VALUES CALCULATED FOR 15°C

CB unit	Sample	Mineral#	Locality	Strat. position	d13C ‰ (PDB)	d18O ‰ (SMOW)	d18O of H2O	Lab
CB	99-7-5B	calcite xx	49	~1.9 m	-0.6	30.3	-0.3	K
#4	99-7-7D	calcite xx	53	+1.6 m	+2.7	33.7	+3.1	K
	99-7-9B2	calcite nx	80	+1.0 m	+6.1	29.5	-1.1	D
	99-7-9B2	calcite n	80	+1.0 m	-2.2	29.0	-1.6	K
	NS + 60	calcite x	80	+60 cm	+6.5	31.1	+0.5	K
	NS + 40	calcite x	80	+40 cm	+5.5	28.6	-2.0	K
	CB-4	calcite x	80	+25 cm	+5.4	28.5	-2.1	O
	CB-8	calcite x	80	+10 cm	+5.9	29.0	-1.6	K
#3	TUFF IF			0				
	CB-9	dolomite	80	~-5 cm	-2.1	28.4	-5.2	K
	93-1	dolomite	near 82a	~-5 cm	-2.1	28.4	-5.2	K
	53-2A	calcite n	53	<10 cm	-2.5	26.1	-4.5	Q
	53-2B	calcite n	53	<10 cm	-5.1	26.8	-3.8	Q
	99-7-7E1	calcite n	54	-2-5 cm	-4.9	26.9	-3.7	K
	CB-7	calcite x	80	-20 cm	+6.4	29.2	-1.4	K
	NS - 30	calcite x	80	-40 cm	+7.2	29.3	-1.3	K
	99-7-7F	calcite x	60a	-50 cm	+4.9	29.8	-0.8	D
	NS - 60	calcite x	80	-70 cm	+6.8	29.1	-1.5	K
	NS - 80	calcite x	80	-90 cm	+5.9	30.2	-0.4	K
	99-7-10G	calcite n	80	-1.1 m	-2.7	26.9	-3.7	K
	CB-3	calcite x	80	-1.8 m	+5.5	30.1	-0.5	O
	TZ81-79-1	calcite x	near 82a	-3.5 m	+6.9	31.0	+0.4	C
	99-7-7G1	calcite n	54	-3.6 m	-3.1	27.2	-3.4	K
#2	TUFF IB		80	-5.1 m				
	7-9B	calcite x	77	-5.3 m	+6.1	29.8	-0.8	O
	6-17G16	calcite x	80	-5.4 m	+6.1	31.5	+0.9	O
	72-6-30C	calcite n	82a	-8.0 m	-6.3	26.1	-4.5	K
	62-6-12C	calcite x	80	-8.3 m	+7.3	28.5	-2.1	O
	6-17G13	calcite x	80	-8.8 m	+5.6	29.3	-1.3	O
	TZ81-79-2	calcite x	near 82a	-11.2 m	+6.2	29.5	-1.1	C
	TZ81-79-3	calcite x	near 82a	-11.2 m	+6.8	29.8	-0.8	C

	6-17G10	calcite x	80	-11.2 m	+7.9	34.5	+3.9	O
#1	6-17G8	calcite x	80	-12.3 m	+7.3	29.5	-1.1	O
	99-7-6A1	calcite nx	60a	-12.3 m	+5.0	31.4	+0.8	D
	99-7-6A1	calcite n	60a	~12.6 m	-5.2	25.0	-5.6	K
	7-9U	calcite x	near 53b	~-12.7 m	+6.4	30.7	+0.1	O
	6-17G7	calcite x	80	-13.8 m	+5.2	32.4	+1.8	O
	99-7-9C2	dolomite	80	-14.0 m	+2.0	32.5	-1.1	K
	7-14H	calcite xs	80	-16.4 m	+4.7	34.9	+4.3	K
	7-9V	calcite x	near 53b	~-17.8 m	+6.0	30.7	+0.1	O
	6-17G3	calcite x	80	-18.4 m	+5.2	30.0	-0.6	O
	99-7-16C	dolomite	80	-18.6	+3.5	34.4	+0.8	K
	478-301	dolomite	80	-20.7 m	+3.4	34.8	+1.2	K
	478-282	calcite x	80	-21.8 m	+4.7	30.0	-0.6	O
	478-302	dolomite	81	-22.0	+2.8	32.3	-1.3	K
ELM	478-426	calcite nl	45a	+2.4 m	-3.9	25.4	-5.2	C
#4	478-425	calcite n	45a	+1.0 m	-4.1	24.7	-5.9	C
	NS, tr. 13	calcite n	44	+60 cm	-3.9	25.4	-5.2	S
	NS, tr 11	calcite n	43	+50 cm	-5.7	25.0	-5.6	S
	NS, tr. 10	calcite n	42	+10 cm	-4.3	25.4	-5.2	S
	NS, tr. 15	calcite n	46c	+10 cm	-5.6	24.5	-6.1	S
	TUFF IF							
#3	79-8-20A	calcite nl	43	-10-15 cm	-3.9	25.4	-5.2	C
	79-8-20C	calcite r	43	-10 cm	-5.5	23.6	-7.0	C
	89-8-7A	calcite nl	85	-15 cm	-4.1	25.8	-4.8	S
	79-8-20B	calcite n	43	-20-30 cm	-3.7	25.4	-5.2	C
	62-6-11B	calcite n	45	-1.0 m	-5.8	24.1	-6.5	O
	FLK-I	calcite n	45	-7.0 m	-5.7	24.5	-6.1	O

Notes: Positive measurements refer to distance above Tuff IF; negative measurements refer to the distance below. Analytical laboratories are abbreviated as follows: D, D. Dettman; K, T. K. Kyser; O, J. R. O'Neil, Q, J. Quade; and S, N. E. Sikes. C refers to data from Cerling and Hay (1986).

#Calcite occurrence is indicated by x, sand-size crystals in claystone; xx, aggregates of crystals in concentrations; xs, lamina of silt-size crystals in claystone; n, nodule; nx, sand-size crystal in nodule; nl, nodular layer; and r, replacement of gypsum rosettes.