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Supplement of

Palaeo-environmental evolution of Central Asia during the Cenozoic: new insights from the continental sedimentary archive of the Valley of Lakes (Mongolia)

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Table S1: Mineralogical composition of the sediments from the Tsagaan Ovoo Fm., Hsanda Gol Fm. and Loh Fm. (Valley of Lakes, Mongolia) determined by XRD analysis.

Sample ID	Position (m)	Feldspat (wt.%)	Illite (wt.%)	Quartz (wt.%)	Hematite (wt.%)	Calcite (wt.%)	SUM (wt.%)
HTE/15	110.13	6.2	44.8	40.3	5.7	3.0	100.00
HTE/14	109.78	5.8	43.8	43.0	5.5	2.0	100.00
HTE/13b	108.98	5.4	41.2	43.4	6.1	4.0	100.00
HTE/12	107.65	2.7	17.1	22.0	2.1	56.1	100.00
HTE/11b	105.78	3.9	17.3	18.2	2.1	58.6	100.00
HTE/11a	104.98	4.5	25.8	40.5	7.2	22.0	100.00
HTE/9b	101.38	4.7	22.0	30.9	4.9	37.4	100.00
HTE/9a	100.97	4.9	36.9	41.9	6.3	9.9	100.00
HTE/8	100.40	6.0	38.2	46.2	2.6	7.0	100.00
HTE/7b	100.00	4.0	23.5	24.0	3.4	45.1	100.00
HTE/7a	98.73	5.0	34.9	45.6	6.6	8.0	100.00
HTE/6	97.90	6.5	30.8	41.2	5.4	16.2	100.00
HTE/5a	96.83	5.6	39.4	45.3	6.3	3.4	100.00
TAT/33b	96.11	9.4	36.2	40.6	5.3	8.6	100.00
HTE/4b	94.90	6.0	40.2	44.0	7.2	2.6	100.00
TAT/32d	94.71	5.8	15.4	11.7	2.6	64.5	100.00
TGR-C/20b	94.61	8.7	36.8	44.4	7.6	2.4	100.00
HTE/3a	94.20	4.8	35.7	35.7	4.8	19.0	100.00
TGR-C/20a	93.78	7.1	34.5	48.5	7.8	2.0	100.00
TAT/32b	93.66	8.2	36.9	40.7	6.1	8.2	100.00
HTE/2b	93.63	8.0	38.5	46.0	4.9	2.6	100.00
TGR-C/19b	93.36	6.8	28.6	35.3	5.3	24.0	100.00
TAT/31	93.07	7.9	37.7	42.4	6.0	6.1	100.00
HTE/2a	92.73	5.9	39.5	45.1	6.9	2.5	100.00
TGR-C/19a	92.49	6.3	26.3	30.9	4.0	32.6	100.00
TAT/30a	92.39	8.4	39.4	43.3	7.1	1.8	100.00
TAT/29b	92.09	8.8	40.3	42.5	7.3	1.1	100.00
TGR-C/18	91.84	6.7	27.3	33.7	4.3	28.0	100.00
TAT/28	91.22	6.7	26.7	25.3	4.1	37.3	100.00
SHG-D/30	91.20	5.3	18.9	22.4	2.5	50.8	100.00
TGR-C/17a	91.18	5.9	28.3	38.8	6.4	20.6	100.00
TAT/27b	91.09	8.2	37.8	38.8	6.9	8.3	100.00
HTE/1d	91.07	6.1	40.2	39.2	4.7	9.9	100.00
SHG-D/29a	90.82	6.3	31.2	41.0	5.7	15.9	100.00
TAT/27a	90.76	7.8	15.2	16.8	1.7	58.4	100.00
HTE/1c	90.63	5.2	18.3	14.6	1.4	60.5	100.00
TGR-C/16b	90.49	8.2	34.6	47.8	7.3	2.0	100.00
SHG-D/28b	90.45	7.3	26.2	32.1	4.8	29.6	100.00
TAT/26	90.38	8.4	21.6	26.9	2.8	40.3	100.00
HTE/1b	90.07	4.8	45.0	42.3	6.2	1.7	100.00
SHG-D/27b	90.05	6.9	37.4	46.0	6.3	3.4	100.00
TAT/25	90.01	10.0	36.5	44.3	7.0	2.3	100.00
TAT/24a	89.85	7.3	17.9	17.3	2.1	55.5	100.00
HTE/1a	89.30	3.6	17.3	12.4	2.1	64.6	100.00
TGR-C/15	89.24	9.1	29.8	47.8	7.3	6.0	100.00
TGR-C/14b trav	88.49	4.4	12.8	15.3	1.7	65.9	100.00

TGR-C/14b	87.96	4.7	13.6	27.9	3.9	49.8	100.00
TAT/22c	87.94	10.4	37.5	34.5	5.4	12.2	100.00
TGR-C/13d	86.91	5.9	38.8	45.2	7.1	3.0	100.00
TAT/22a	86.54	12.9	33.5	38.6	4.7	10.2	100.00
TAT/21a	86.24	11.2	47.9	32.8	7.0	1.1	100.00
TAT/20b	85.94	10.1	38.5	41.9	6.7	2.7	100.00
TGR-C/13b	85.86	11.3	39.1	41.7	5.1	2.9	100.00
TAT/19a	84.92	9.5	40.6	42.6	6.3	1.0	100.00
TGR-C/12	84.77	12.2	29.7	30.0	4.9	23.2	100.00
TGR-C/11b	84.69	8.2	36.4	45.5	6.9	3.0	100.00
TGR-C/11a	84.32	12.1	28.2	25.1	4.4	30.2	100.00
TGR-C/10b	84.14	6.3	10.4	13.0	2.4	67.9	100.00
TAT/18a	83.87	8.4	24.0	18.2	3.5	45.9	100.00
TAT/17b	83.24	8.0	24.6	26.4	4.0	37.0	100.00
TGR-C/10a	83.24	12.1	35.6	33.7	5.4	13.2	100.00
TGR-C/9	82.66	12.1	32.5	26.5	5.8	23.0	100.00
TGR-C/8b	82.39	11.4	42.7	36.9	6.1	3.0	100.00
TAT/16a	82.11	8.7	29.0	37.9	4.2	20.2	100.00
TAT/15c	81.84	10.8	32.7	33.0	4.0	19.6	100.00
TGR-C/8a	81.12	6.1	30.2	34.9	5.1	23.8	100.00
TAT/15a	80.67	9.9	35.8	33.8	4.2	16.3	100.00
TAT/14b	80.09	12.5	36.9	34.8	4.4	11.4	100.00
TGR-C/7b	80.01	11.9	39.8	32.2	5.5	10.5	100.00
TAT/13	79.24	11.3	35.5	43.7	5.1	4.5	100.00
TGR-C/6	78.97	12.5	32.3	26.1	4.5	24.6	100.00
TGR-C/5	78.74	10.5	42.8	29.9	5.3	11.4	100.00
TGR-C/4b	78.57	7.6	29.5	38.3	5.4	19.2	100.00
TAT/12b	78.47	12.2	29.1	33.0	3.9	21.9	100.00
TGR-C/4a	77.87	12.2	37.7	30.5	3.8	15.9	100.00
TGR-C/3A	77.48	6.8	19.1	16.1	2.2	55.9	100.00
TGR-C/3b	76.80	12.1	44.6	34.0	5.5	3.9	100.00
TGR-C/2	75.47	9.6	40.5	31.6	5.2	13.0	100.00
TGR-C/1	75.13	9.6	30.5	31.3	4.8	23.8	100.00
SHG-D/26b	73.05	6.4	22.5	28.0	3.1	40.0	100.00
SHG-D/25	72.32	7.7	29.5	35.4	4.0	23.5	100.00
SHG-D/24	71.98	5.9	36.7	39.1	5.6	12.7	100.00
SHG-D/23j	71.85	5.9	24.5	28.1	4.2	37.3	100.00
SHG-D/23i	71.38	5.3	23.7	24.9	3.9	42.2	100.00
SHG-D/23h	70.91	6.2	27.0	24.7	4.2	37.9	100.00
SHG-D/23f	69.97	4.9	25.1	33.8	4.0	32.2	100.00
TAT/11	69.86	10.1	23.2	29.2	3.4	34.1	100.00
TAT/10	69.59	12.1	33.8	38.7	4.4	11.0	100.00
TAT/9	69.22	13.1	30.8	31.2	3.8	21.0	100.00
SHG-D/23d	69.03	5.1	18.7	20.4	3.2	52.6	100.00
TAT/8b	68.66	12.4	37.7	42.9	4.8	2.3	100.00
SHG-D/23b	68.09	5.7	17.5	25.2	2.5	49.1	100.00
TAT/7b	67.99	12.9	36.9	37.8	4.5	7.9	100.00
SHG-D/23a	67.62	7.6	38.7	42.6	5.1	6.0	100.00
TAT/6b	67.24	11.5	25.4	30.1	3.5	29.5	100.00
SHG-D/22	67.05	4.7	16.0	14.7	1.5	63.1	100.00
TAT/5	66.77	10.7	40.8	32.9	5.3	10.2	100.00
SHG-D/21	66.70	7.3	39.6	44.2	6.0	2.9	100.00
TAT/4a	66.29	8.2	35.7	31.5	5.8	18.9	100.00

SHG-D/20a	65.83	6.3	26.6	25.3	3.0	38.8	100.00
TAT/3b	65.79	10.1	46.6	34.0	4.5	4.9	100.00
SHG-D/19	65.42	9.0	34.3	44.5	5.7	6.5	100.00
SHG-D/18	65.11	5.6	23.7	23.1	2.8	44.8	100.00
TAT/2	65.08	10.6	39.5	30.6	5.4	13.8	100.00
SHG-D/17	64.93	7.8	39.4	44.8	5.9	2.0	100.00
TAT/1b	64.47	9.6	31.5	32.3	4.8	21.8	100.00
SHG-D/16b	64.30	8.6	26.7	27.8	3.1	33.7	100.00
SHG-D/15	63.26	9.5	34.5	46.5	5.7	3.8	100.00
SHG-D/14b	62.73	7.4	20.4	31.0	2.9	38.3	100.00
SHG-D/13	61.98	12.7	30.3	48.3	4.1	4.6	100.00
SHG-D/12	60.80	10.5	33.3	50.2	4.3	1.6	100.00
SHG-D/11b	58.45	7.6	36.6	47.0	7.1	1.7	100.00
SHG-D/10	57.28	9.8	37.7	41.6	9.0	1.8	100.00
SHG-D/9d	57.23	9.2	39.4	44.4	6.1	1.0	100.00
SHG-D/9c	56.53	8.6	40.5	43.5	6.3	1.2	100.00
SHG-D/9b	55.83	10.3	39.7	43.6	5.5	0.9	100.00
SHG-D/9a	55.13	9.6	32.5	52.6	3.5	1.8	100.00
SHG-D/8	54.35	6.7	45.9	39.3	6.7	1.4	100.00
SHG-D/7b	54.18	10.0	42.8	39.9	5.7	1.7	100.00
SHG-D/6	51.43	2.8	12.5	13.8	1.9	69.0	100.00
SHG-D/5	50.18	7.7	45.8	37.8	6.9	1.7	100.00
SHG-D/4	49.35	10.2	47.5	35.0	7.1	1.4	101.00
SHG-D/3a	47.55	9.8	40.8	42.4	5.6	1.4	100.00
SHG-D/2	46.68	7.7	33.6	27.6	4.3	26.8	100.00
SHG-D/1	45.76	12.0	41.3	40.0	5.7	1.1	100.00
TGR-AB/35	40.46	11.9	37.5	40.4	5.6	4.6	100.00
TGR-AB/34b	39.83	9.4	39.4	44.1	5.7	1.3	100.00
TGR-AB/33b	38.36	8.4	29.0	31.6	4.5	26.5	100.00
TGR-AB/32l	37.63	6.7	34.0	33.5	4.6	21.1	100.00
TGR-AB/32j	35.70	9.7	38.0	31.5	4.5	16.2	100.00
TGR-AB/32i	34.73	9.4	36.2	36.1	5.3	12.9	100.00
TGR-AB/32h	33.76	8.2	32.7	31.6	4.4	23.2	100.00
TGR-AB/32f	31.83	7.5	34.2	34.5	4.0	19.8	100.00
TGR-AB/32d	29.90	9.4	38.2	29.4	4.5	18.5	100.00
TGR-AB/32a	27.00	8.7	38.0	35.9	4.0	13.5	100.00
TGR-AB/31	25.30	10.9	33.9	46.7	6.8	1.7	100.00
TGR-AB/13	8.15	8.7	45.6	40.7	3.4	1.6	100.00
TGR-AB/12	7.98	9.8	37.0	41.8	9.5	2.0	100.00
TGR-AB/11a	6.82	7.1	39.4	50.3	2.4	0.8	100.00
TGR-AB/9	3.46	13.2	33.2	43.2	9.8	0.6	100.00

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Table S2a: Major element composition of the sediments from the Tsagaan Ovoo Fm., Hsanda Gol Fm. and Loh Fm. (Valley of Lakes, Mongolia) determined by XRF and TIC analysis.

Sample ID	Position (m)	SiO2 (wt.%)	Al2O3 (wt.%)	Fe2O3 (wt.%)	MnO (wt.%)	MgO (wt.%)	CaO (wt.%)	Na2O (wt.%)	K2O (wt.%)	TiO2 (wt.%)	P2O5 (wt.%)	LOI (wt.%)	SUM (wt.%)	CaO* (wt%)
HTE/15	110.13	61.2	16.1	6.0	0.1	2.6	1.1	0.5	3.2	0.8	0.3	8.2	100.0	0.25
HTE/14	109.78	61.0	16.0	6.3	0.2	2.6	1.1	0.4	3.1	0.8	0.2	8.2	100.0	0.31
HTE/13b	108.98	61.3	16.2	6.2	0.1	2.9	1.1	0.3	3.1	0.8	0.2	7.8	100.0	0.23
HTE/12	107.65	27.7	7.0	2.7	0.1	1.5	30.3	0.3	1.3	0.3	0.1	28.6	100.0	0.56
HTE/11b	105.78	25.5	6.6	2.6	0.1	1.4	32.2	0.2	1.3	0.3	0.5	29.2	100.0	0.58
HTE/11a	104.98	49.6	11.8	7.0	0.1	2.0	12.4	0.2	2.1	0.6	0.1	14.1	100.0	0.36
HTE/9b	101.38	40.4	10.1	4.6	2.5	1.8	18.2	0.5	1.9	0.5	0.1	19.5	100.0	0.39
HTE/9a	100.97	58.3	14.8	6.1	0.1	2.1	3.7	0.3	2.7	0.8	0.1	11.0	100.0	0.55
HTE/8	100.40	66.6	11.9	3.9	0.1	1.2	4.0	0.8	3.5	0.6	0.1	7.2	100.0	0.38
HTE/7b	100.00	32.4	8.1	3.0	0.3	1.4	26.7	0.3	1.5	0.4	0.1	25.9	100.0	0.18
HTE/7a	98.73	61.7	15.5	6.1	0.1	2.1	3.1	0.4	2.8	0.8	0.1	7.5	100.0	0.55
HTE/6	97.90	54.5	13.1	5.3	0.1	1.8	8.5	0.3	2.4	0.7	0.4	13.0	100.0	0.30
HTE/5a	96.83	61.7	16.1	6.3	0.1	1.8	1.1	0.3	2.8	0.8	0.1	8.9	100.0	0.45
HTE/4b	94.90	60.6	16.3	6.3	0.1	2.1	1.4	0.4	2.9	0.8	0.1	9.2	100.0	0.52
HTE/3a	94.20	50.6	13.4	5.2	0.4	1.7	10.7	0.2	2.4	0.7	0.3	14.4	100.0	0.45
TGR-C/19b	93.36	47.0	12.6	5.2	0.2	2.1	14.3	0.6	2.3	0.6	0.2	15.0	100.0	0.26
TGR-C/19a	92.49	40.2	10.6	4.3	0.3	1.7	19.4	0.5	1.9	0.5	0.1	20.6	100.0	0.53
TGR-C/18	91.84	45.2	11.8	4.8	0.2	1.8	15.1	0.6	2.1	0.6	0.2	17.7	100.0	0.18
TGR-C/17a	91.18	50.8	12.9	5.2	0.2	1.8	10.9	0.5	2.2	0.7	0.1	14.9	100.0	0.21
TGR-C/16b	90.49	62.1	15.7	6.3	0.1	1.9	1.0	0.6	2.5	0.8	0.0	9.0	100.0	0.54
TGR-C/15	89.24	59.3	15.4	6.2	0.1	1.8	2.7	0.5	2.4	0.8	0.0	10.8	100.0	0.33
TGR-C/14b trav	88.49	19.9	5.4	2.0	0.1	0.9	36.6	0.0	0.8	0.3	0.1	33.9	100.0	0.29
TGR-C/14b	87.96	32.4	8.6	3.4	0.1	1.0	26.8	0.4	1.2	0.4	0.1	25.5	100.0	0.42
TGR-C/13d	86.91	60.9	17.0	6.8	0.0	1.6	0.9	0.5	2.7	0.8	0.1	8.7	100.0	0.51
TGR-C/13b	85.86	58.4	15.8	6.3	0.1	2.3	1.5	1.9	3.3	0.8	0.1	9.5	100.0	0.36
TGR-C/12	84.77	46.1	12.3	4.8	0.1	2.1	12.9	1.7	2.6	0.6	0.1	16.7	100.0	0.38
TGR-C/11b	84.69	60.4	16.6	6.5	0.2	1.7	1.5	0.9	2.8	0.8	0.1	8.6	100.0	0.19
TGR-C/11a	84.32	41.4	11.0	4.3	0.1	1.9	17.4	1.5	2.3	0.5	0.1	19.4	100.0	0.42
TGR-C/10b	84.14	16.8	4.4	1.7	0.1	1.0	38.7	0.5	0.8	0.2	0.1	35.8	100.0	0.40
TGR-C/10a	83.24	52.2	13.9	5.5	0.1	2.3	7.3	2.0	2.9	0.7	0.1	13.1	100.0	0.09
TGR-C/9	82.66	45.5	12.1	4.8	0.1	2.1	12.9	2.2	2.6	0.6	0.2	16.9	100.0	0.32
TGR-C/8b	82.39	59.0	15.4	6.1	0.1	2.7	1.6	2.1	3.4	0.8	0.1	8.8	100.0	0.37
TGR-C/8a	81.12	47.3	12.6	5.0	0.0	2.0	13.3	0.7	2.5	0.6	0.1	15.8	100.0	0.56
TGR-C/7b	80.01	55.0	14.4	5.7	0.1	2.4	5.2	2.2	3.2	0.7	0.2	10.9	100.0	0.20
TGR-C/6	78.97	43.8	11.4	4.5	0.1	2.1	14.7	2.1	2.5	0.6	0.3	17.9	100.0	0.21
TGR-C/5	78.74	54.3	14.1	5.6	0.2	2.3	6.2	2.0	3.4	0.7	0.5	10.6	100.0	0.19
TGR-C/4b	78.57	49.2	13.5	5.4	0.2	2.0	10.7	0.9	2.7	0.7	0.1	14.5	100.0	0.10
TGR-C/4a	77.87	50.2	12.8	5.0	0.1	2.2	10.1	2.1	3.1	0.6	0.1	13.7	100.0	0.15
TGR-C/3A	77.48	24.8	6.8	2.7	0.0	1.2	32.4	0.4	1.4	0.3	0.1	29.9	100.0	0.32
TGR-C/3b	76.80	59.0	14.9	5.9	0.1	2.5	2.3	2.2	3.8	0.7	0.1	8.6	100.0	0.44
TGR-C/2	75.47	53.7	13.7	5.4	0.1	2.2	7.4	1.7	3.4	0.7	0.1	11.7	100.0	0.33
TGR-C/1	75.13	47.0	11.9	4.8	0.1	2.2	13.2	1.4	2.6	0.6	0.1	16.0	100.0	0.24
SHG-D/26b	73.05	36.5	9.4	3.7	0.3	1.6	23.5	0.4	1.8	0.5	0.0	22.3	100.0	0.55
SHG-D/25	72.32	47.9	12.3	4.9	0.1	1.9	14.2	0.6	2.5	0.6	0.1	14.9	100.0	0.36
SHG-D/24	71.98	55.2	14.3	5.7	0.1	2.2	7.0	0.7	2.8	0.7	0.1	11.2	100.0	0.22
SHG-D/23j	71.85	39.7	10.3	4.0	0.1	1.7	20.9	0.5	2.1	0.5	0.1	20.1	100.0	0.25
SHG-D/23i	71.38	35.0	9.1	3.6	0.2	1.5	24.7	0.4	1.8	0.4	0.1	23.2	100.0	0.45

SHG-D/23h	70.91	38.5	10.0	4.0	0.1	1.7	21.8	0.5	2.0	0.5	0.1	20.8	100.0	0.11
SHG-D/23f	69.97	43.2	11.3	4.4	0.1	1.6	18.0	0.6	2.3	0.6	0.1	17.7	100.0	0.17
SHG-D/23d	69.03	26.9	7.0	2.7	0.2	1.2	30.7	0.6	1.5	0.3	0.1	28.8	100.0	0.57
SHG-D/23b	68.09	31.6	8.0	3.1	0.2	1.4	27.5	0.6	1.6	0.4	0.1	25.6	100.0	0.54
SHG-D/23a	67.62	60.2	15.6	6.2	0.1	2.3	3.3	0.9	3.1	0.8	0.1	7.4	100.0	0.37
SHG-D/22	67.05	19.2	4.9	1.9	0.1	1.2	37.0	0.3	1.0	0.2	0.1	34.0	100.0	0.29
SHG-D/21	66.70	61.2	15.9	6.2	0.1	2.4	1.5	0.9	3.2	0.8	0.1	7.7	100.0	0.26
SHG-D/20a	65.83	37.5	9.6	3.8	0.2	1.6	22.2	0.6	2.0	0.5	0.2	21.8	100.0	0.34
SHG-D/19	65.42	59.3	15.1	5.9	0.2	2.4	2.9	1.1	3.2	0.8	0.1	9.0	100.0	0.43
SHG-D/18	65.11	35.6	9.0	3.5	0.2	1.6	24.0	0.6	1.9	0.4	0.1	23.1	100.0	0.51
SHG-D/17	64.93	61.5	15.6	6.1	0.1	2.4	1.6	1.0	3.3	0.8	0.1	7.6	100.0	0.30
SHG-D/16b	64.30	41.1	10.2	4.0	0.2	1.7	20.0	0.8	2.2	0.5	0.1	19.2	100.0	0.18
SHG-D/15	63.26	62.3	15.3	5.9	0.1	2.3	2.0	1.2	3.2	0.8	0.1	6.8	100.0	0.42
SHG-D/14b	62.73	40.2	9.6	3.6	0.2	1.5	20.9	0.8	2.0	0.5	0.1	20.6	100.0	0.53
SHG-D/13	61.98	64.0	14.2	5.1	0.1	2.0	2.0	1.6	2.8	0.8	0.2	7.3	100.0	0.18
SHG-D/12	60.80	68.8	14.3	4.4	0.1	1.7	1.1	1.8	2.9	0.8	0.1	4.1	100.0	0.09
SHG-D/11b	58.45	61.6	16.8	7.3	0.1	2.3	0.8	0.7	3.0	0.8	0.1	6.6	100.0	0.28
SHG-D/10	57.28	57.7	16.9	10.2	0.3	2.5	0.7	0.6	3.2	0.8	0.1	6.9	100.0	0.44
SHG-D/9d	57.23	61.0	16.5	6.3	1.4	2.4	0.8	0.8	3.2	0.8	0.1	6.7	100.0	0.60
SHG-D/9c	56.53	62.7	16.6	6.5	0.1	2.4	0.6	0.8	3.4	0.8	0.1	5.9	100.0	0.27
SHG-D/9b	55.83	66.0	15.0	5.7	0.1	2.3	0.5	1.5	3.2	0.8	0.1	4.8	100.0	0.21
SHG-D/9a	55.13	69.1	12.7	4.4	0.0	2.1	0.9	1.8	2.6	0.8	0.0	5.6	100.0	0.56
SHG-D/8	54.35	60.3	17.7	7.1	0.1	2.9	0.6	0.6	3.7	0.8	0.0	6.2	100.0	0.34
SHG-D/7b	54.18	60.4	15.6	6.4	0.1	3.1	0.9	1.2	3.5	0.8	0.1	7.9	100.0	0.33
SHG-D/6	51.43	18.4	5.2	2.1	0.1	1.1	37.4	0.2	1.1	0.2	0.6	33.5	100.0	0.50
SHG-D/5	50.18	59.4	17.3	7.3	0.1	2.8	0.8	0.8	3.7	0.8	0.1	6.9	100.0	0.26
SHG-D/4	49.35	58.7	17.0	7.5	0.1	3.0	0.6	1.0	3.9	0.7	0.1	7.3	100.0	0.32
SHG-D/3a	47.55	62.5	16.2	6.6	0.1	2.8	0.3	1.2	3.8	0.8	0.1	5.5	100.0	0.39
SHG-D/2	46.68	46.3	12.5	5.5	0.3	2.2	13.8	0.8	3.0	0.6	0.2	14.8	100.0	0.52
SHG-D/1	45.76	61.6	15.3	6.0	0.1	3.3	0.6	2.1	3.5	0.7	0.3	6.6	100.0	0.11
TGR-AB/35	40.46	61.6	13.4	6.7	0.0	2.8	1.9	1.5	3.0	0.6	0.5	7.9	100.0	0.58
TGR-AB/34b	39.83	64.3	15.4	6.1	0.1	3.6	0.7	1.0	3.6	0.8	0.1	4.4	100.0	0.30
TGR-AB/33b	38.36	45.5	11.5	4.5	0.1	2.4	16.3	0.8	2.7	0.6	0.1	15.5	100.0	0.22
TGR-AB/32l	37.63	52.4	13.5	5.3	0.1	2.7	10.2	1.0	3.2	0.7	0.2	10.8	100.0	0.16
TGR-AB/32j	35.70	52.4	13.5	5.3	0.1	2.7	10.2	1.0	3.2	0.7	0.2	10.8	100.0	0.31
TGR-AB/32i	34.73	56.7	14.1	5.6	0.1	2.4	6.6	1.0	3.4	0.7	0.1	9.2	100.0	0.11
TGR-AB/32h	33.76	48.8	12.3	4.8	0.1	2.6	13.2	0.8	2.9	0.6	0.1	13.9	100.0	0.30
TGR-AB/32f	31.83	49.5	12.5	4.9	0.2	2.6	12.2	0.9	2.9	0.6	0.1	13.8	100.0	0.35
TGR-AB/32d	29.90	49.9	12.6	4.7	0.4	2.3	11.3	1.4	3.2	0.6	0.2	13.4	100.0	0.43
TGR-AB/32a	27.00	55.3	13.9	5.2	0.2	2.3	8.1	0.9	3.2	0.7	0.2	10.0	100.0	0.52
TGR-AB/31	25.30	64.7	14.9	7.0	0.1	2.0	1.0	1.6	3.1	0.8	0.1	4.7	100.0	0.48
TGR-AB/13	8.15	66.4	16.5	4.7	0.0	1.3	0.9	1.3	3.4	0.8	0.1	4.6	100.0	0.56
TGR-AB/12	7.98	56.7	16.5	10.6	1.8	1.7	0.9	0.8	2.9	0.8	0.1	7.2	100.0	0.54
TGR-AB/11a	6.82	70.8	13.7	3.8	0.0	1.4	0.5	1.5	3.7	0.5	0.0	4.1	100.0	0.21
TGR-AB/9	3.46	59.3	16.8	11.0	0.1	1.2	0.3	1.6	3.0	0.7	0.2	5.8	100.0	0.31

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Table S2b: Minor and trace element composition (in mg/kg) of the sediments from the Tsagaan Ovoo Fm., Hsanda Gol Fm. and Loh Fm. (Valley of Lakes, Mongolia) determined by XRF analysis.

Sample ID	Ba	Ce	Co	Cr	Cu	Ga	Hf	La	Nb	Ni	Pb	Rb	Sc	Sr	Th	U	V	Y	Zn	Zr
HTE/15	433	80	<20	74	33	20	<15	46	<20	50	21	128	20	118	20	<20	94	31	102	170
HTE/14	520	75	<20	72	38	24	<15	44	<20	50	32	126	20	122	20	<20	108	29	100	189
HTE/13b	469	89	<20	75	33	21	<15	44	20	50	20	126	20	116	20	<20	108	34	100	160
HTE/12	207	55	<20	41	<20	10	<15	86	<20	23	19.6	56	25.1	239	20	<20	59	16	42	88
HTE/11b	158	56	<20	49	<20	<10	<15	72	<20	29	<20	57	20	164	20	<20	33	27	42	70
HTE/11a	354	88	<20	52	34	13	<15	48	<20	32	31	97	20	211	20	<20	98	34	73	124
HTE/9b	1468	53	<20	59	34	12	<15	39	<20	27	<20	81	20	238	20	<20	123	18	68	125
HTE/9a	398	82	20	74	32	19	<15	46	<20	37	34	124	20	141	20	<20	103	22	83	170
HTE/8	606	88	<20	49	24	13	<15	64	<20	27	36	135	20	184	20	<20	71	17	53	146
HTE/7b	560	30	<20	51	<20	11	<15	63	<20	29	<20	68	27	212	20	<20	72	19	46	90
HTE/7a	391	83	24	83	44	20	<15	44	<20	42	26.5	126	21.1	142	20	<20	105	20	88	167
HTE/6	352	126	<20	63	26	20	<15	44	<20	33	30	110	20	177	20	<20	93	31	79	175
HTE/5a	369	88	<20	87	31	21	<15	43	<20	36	23	133	20	108	20	<20	100	23	97	187
HTE/4b	384	54	<20	78	33	24	<15	42	<20	38	28	139	20	109	20	<20	118	19	97	160
HTE/3a	600	79	<20	72	29	20	<15	30	<20	38	23	111	20	152	20	<20	96	22	81	144
TGR-C/19b	332	77	<20	57	30	16	<15	34	<20	39	25	102	25	117	20	<20	90	31	71	152
TGR-C/19a	503	59	<20	54	27	15	<15	30	<20	29	<20	85	20	134	20	<20	78	26	58	141
TGR-C/18	338	49	<20	48	25	17	<15	32	<20	30	<20	95	20	152	20	<20	77	28	62	150
TGR-C/17a	407	91	<20	52	29	17	<15	30	<20	33	35	106	20	144	20	<20	70	23	67	185
TGR-C/16b	379	81	<20	81	37	23	<15	51	<20	34	31	129	20	119	20	<20	113	24	77	192
TGR-C/15	355	51	<20	74	26	21	<15	32	<20	29	31	124	20	120	20	<20	106	23	88	190
TGR-C/14b trav	240	51	<20	36	<20	<10	<15	101	22	<20	<20	48	26	214	20	<20	35	54	32	56
TGR-C/14b	263	71	<20	48	27	<10	<15	80	<20	27	26	72	30	167	20	<20	69	17	51	115
TGR-C/13d	329	82	<20	90	38	22	<15	55	<20	33	31	140	20	95	20	<20	120	21	95	180
TGR-C/13b	479	88	<20	68	41	22	<15	68	<20	44	31	133	20	149	8	<20	109	25	98	161
TGR-C/12	341	52	<20	53	33	16	<15	41	<20	29	20	103	20	188	9	<20	94	26	75	142
TGR-C/11b	578	76	23	78	37	24	<15	61	<20	45	26	140	20	108	20	<20	118	23	90	184
TGR-C/11a	282	56	<20	51	29	12	<15	30	<20	29	<20	91	20	197	10	<20	92	21	70	136
TGR-C/10b	204	30	<20	42	<20	<10	<15	92	<20	<20	<20	39	29	189	20	<20	33	15	29	61
TGR-C/10a	424	93	<20	63	38	19	<15	30	<20	35	32	117	20	177	11	<20	104	24	87	172
TGR-C/9	356	76	<20	48	37	16	<15	30	<20	27	25	101	20	227	12	<20	99	23	78	133
TGR-C/8b	411	74	<20	67	44	20	<15	35	<20	39	25	135	20	193	13	<20	116	21	95	170
TGR-C/8a	314	72	<20	70	30	18	<15	34	<20	29	25	109	24	121	20	<20	93	23	81	152
TGR-C/7b	380	64	<20	70	41	19	<15	44	<20	40	26	129	20	136	14	<20	119	26	92	160
TGR-C/6	291	70	<20	53	35	14	<15	30	<20	28	23	98	20	235	15	<20	95	29	75	134
TGR-C/5	1119	69	<20	59	46	18	<15	54	<20	49	30	126	20	235	16	<20	115	31	98	157
TGR-C/4b	578	72	20	68	36	16	<15	30	<20	38	37	121	20	127	20	<20	103	28	90	171
TGR-C/4a	353	74	<20	59	37	18	<15	30	<20	28	23	116	20	166	17	<20	104	21	85	152
TGR-C/3A	171	33	<20	49	<20	<10	<15	77	<20	20	22	61	20	148	20	<20	44	19	46	103
TGR-C/3b	649	75	<20	63	49	19	<15	30	<20	39	27	136	20	140	18	<20	125	22	99	175
TGR-C/2	347	72	<20	67	45	17	<15	40	<20	32	20	123	20	133	19	<20	116	25	89	158
TGR-C/1	325	67	<20	108	77	16	<15	30	<20	46	21	103	20	193	20	<20	92	22	79	142
SHG-D/26b	547	56	22	45	25	13	<15	30	<20	35	26	81	20	302	20	<20	75	32	59	112
SHG-D/25	444	51	<20	54	35	14	<15	30	<20	32	22	104	20	191	20	<20	101	25	80	131
SHG-D/24	437	60	<20	57	42	16	<15	30	<20	43	29	121	20	197	20	<20	113	23	89	167
SHG-D/23j	386	45	<20	55	29	12	<15	30	<20	29	26	87	20	186	20	<20	88	24	67	136

SHG-D/23i	395	61	<20	58	27	10	<15	30	<20	28	<20	79	20	203	20	<20	71	17	59	104
SHG-D/23h	399	46	<20	142	22	14	<15	30	<20	53	<20	83	20	214	20	<20	85	24	63	105
SHG-D/23f	432	68	<20	62	30	14	<15	30	<20	24	23	95	20	184	20	<20	79	25	74	107
SHG-D/23d	338	46	<20	54	<20	10	<15	97	<20	28	<20	60	20	213	20	<20	49	18	50	97
SHG-D/23b	475	44	<20	53	27	<10	<15	66	<20	28	22	68	21	180	20	<20	71	22	52	96
SHG-D/23a	483	82	<20	73	37	18	<15	29	<20	41	31	134	20	162	20	<20	124	23	92	173
SHG-D/22	196	33	<20	38	<20	<10	<15	80	<20	21	<20	42	31	247	20	<20	31	16	38	77
SHG-D/21	484	78	<20	93	39	21	<15	41	<20	50	32	135	20	179	20	<20	120	24	99	173
SHG-D/20a	424	55	<20	48	24	15	<15	30	<20	27	23	84	23	152	20	<20	72	19	61	109
SHG-D/19	652	96	31	68	43	21	<15	68	<20	44	30	131	20	170	20	<20	122	22	96	165
SHG-D/18	473	37	<20	47	27	12	<15	30	<20	27	<20	79	24	161	20	<20	77	19	56	95
SHG-D/17	463	64	<20	72	37	20	<15	45	<20	40	31	135	20	152	20	<20	114	25	97	184
SHG-D/16b	472	69	<20	52	25	13	<15	30	<20	28	<20	90	20	159	20	<20	83	21	63	134
SHG-D/15	463	88	<20	73	31	17	<15	55	<20	39	32	135	20	191	20	<20	112	28	95	174
SHG-D/14b	425	65	<20	45	25	13	<15	31	<20	24	23	86	20	167	20	<20	67	29	61	130
SHG-D/13	423	86	<20	54	34	19	<15	74	21	32	28	133	20	210	23	<20	89	34	85	205
SHG-D/12	475	103	<20	55	28	17	<15	60	<20	25	26	138	20	183	20	<20	65	31	76	249
SHG-D/11b	481	101	21	82	40	23	<15	39	21	43	30	155	20	264	23	<20	149	32	113	156
SHG-D/10	636	59	26	88	45	24	<15	47	<20	46	28	157	20	252	21	<20	200	25	119	143
SHG-D/9d	2439	99	<20	68	39	21	<15	65	22	72	27	150	20	283	20	<20	139	37	107	170
SHG-D/9c	414	81	<20	76	32	23	<15	53	<20	35	<20	151	20	173	20	<20	109	27	103	176
SHG-D/9b	435	81	<20	67	28	22	<15	59	<20	40	41	134	20	170	20	<20	89	30	90	189
SHG-D/9a	332	88	<20	60	31	15	<15	61	<20	31	<20	110	20	291	20	<20	72	28	69	273
SHG-D/8	456	56	22	87	43	22	<15	64	<20	49	36	159	20	242	20	<20	122	27	115	171
SHG-D/7b	444	100	<20	69	40	21	<15	59	<20	49	26	136	20	268	20	<20	108	30	102	164
SHG-D/6	185	51	<20	46	<20	<10	<15	106	26	<20	<20	49	22	183	20	<20	39	65	36	71
SHG-D/5	496	71	<20	80	38	22	<15	49	<20	45	37	159	20	216	20	<20	120	33	114	133
SHG-D/4	503	100	<20	76	34	23	<15	45	<20	43	<20	151	20	160	20	<20	122	25	109	153
SHG-D/3a	484	68	<20	82	38	20	<15	30	<20	47	20	141	20	169	20	<20	109	29	104	184
SHG-D/2	693	51	<20	71	29	17	<15	32	<20	40	24	110	20	169	20	<20	97	24	84	152
SHG-D/1	465	83	<20	67	36	19	<15	48	20	42	26	133	20	127	20	<20	117	35	98	199
TGR-AB/35	492	49	24	75	66	24	<15	30	26	72	25	79	20	273	20	<20	56	13	63	165
TGR-AB/34b	445	70	21	67	72	21	<15	44	<20	54	31	155	20	137	20	<20	85	26	111	171
TGR-AB/33b	310	85	<20	63	28	14	<15	30	<20	31	27	117	20	107	20	<20	75	24	72	144
TGR-AB/32l	380	91	<20	65	32	15	<15	30	<20	34	22	130	20	126	20	<20	89	25	89	176
TGR-AB/32j	380	91	<20	65	32	15	<15	30	<20	34	22	130	20	126	20	<20	89	25	89	176
TGR-AB/32i	424	86	<20	62	27	18	<15	57	<20	34	31	135	20	159	20	<20	107	28	93	160
TGR-AB/32h	286	63	<20	61	30	16	<15	30	<20	30	<20	119	22	107	20	<20	89	23	79	135
TGR-AB/32f	400	68	<20	61	32	13	<15	49	<20	31	24	119	20	152	20	<20	85	23	78	173
TGR-AB/32d	854	61	<20	61	30	16	<15	30	<20	35	23	125	20	179	20	<20	82	28	82	156
TGR-AB/32a	532	99	<20	61	25	18	<15	49	<20	32	40	144	20	165	21	<20	83	25	84	169
TGR-AB/31	441	93	<20	75	32	20	<15	53	<20	37	25	141	20	186	22	<20	115	25	92	270
TGR-AB/13	495	98	<20	59	22	21	<15	67	<20	<20	20	159	20	153	24	<20	58	28	66	316
TGR-AB/12	4111	62	46	72	40	23	<15	47	<20	50	24	151	20	252	31	<20	250	27	95	230
TGR-AB/11a	481	54	<20	32	<20	16	<15	31	<20	<20	20	145	20	142	20	<20	47	18	51	227
TGR-AB/9	481	62	28	83	46	24	<15	30	<20	64	37	139	20	123	27	<20	160	20	76	274

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Table S3: Chemical weathering indices calculated for the sediments from the Tsagaan Ovoo Fm., Hsanda Gol Fm. and Loh Fm. (Valley of Lakes, Mongolia) based on XRF and TIC data.

Sample ID	Position (m)	CIA	CIW	PIA
HTE/15	110.13	80	95	94
HTE/14	109.78	81	96	95
HTE/13b	108.98	82	97	96
HTE/12	107.65	76	89	87
HTE/11b	105.78	76	89	87
HTE/11a	104.98	81	95	94
HTE/9b	101.38	79	92	90
HTE/9a	100.97	80	94	93
HTE/8	100.40	72	91	88
HTE/7b	100.00	80	94	93
HTE/7a	98.73	81	95	93
HTE/6	97.90	82	96	95
HTE/5a	96.83	82	96	95
HTE/4b	94.90	81	95	94
HTE/3a	94.20	81	95	94
TGR-C/19b	93.36	80	94	92
TGR-C/19a	92.49	78	91	89
TGR-C/18	91.84	81	94	93
TGR-C/17a	91.18	82	95	94
TGR-C/16b	90.49	81	93	92
TGR-C/15	89.24	83	95	94
TGR-C/14b trav	88.49	83	94	93
TGR-C/14b	87.96	81	91	90
TGR-C/13d	86.91	82	95	94
TGR-C/13b	85.86	74	88	85
TGR-C/12	84.77	72	85	82
TGR-C/11b	84.69	81	94	93
TGR-C/11a	84.32	72	85	82
TGR-C/10b	84.14	72	83	80
TGR-C/10a	83.24	74	87	84
TGR-C/9	82.66	70	83	79
TGR-C/8b	82.39	72	86	83
TGR-C/8a	81.12	77	91	89
TGR-C/7b	80.01	72	86	82
TGR-C/6	78.97	70	83	79
TGR-C/5	78.74	72	86	83
TGR-C/4b	78.57	78	93	91
TGR-C/4a	77.87	70	85	81
TGR-C/3A	77.48	76	91	88
TGR-C/3b	76.80	70	85	81
TGR-C/2	75.47	72	87	84
TGR-C/1	75.13	73	88	85
SHG-D/26b	73.05	77	91	89
SHG-D/25	72.32	78	93	91
SHG-D/24	71.98	79	94	92
SHG-D/23j	71.85	79	93	92

SHG-D/23i	71.38	77	91	89
SHG-D/23h	70.91	79	94	93
SHG-D/23f	69.97	79	94	93
SHG-D/23d	69.03	73	85	82
SHG-D/23b	68.09	75	88	85
SHG-D/23a	67.62	78	92	91
SHG-D/22	67.05	75	89	86
SHG-D/21	66.70	78	93	92
SHG-D/20a	65.83	76	91	89
SHG-D/19	65.42	76	91	89
SHG-D/18	65.11	75	89	87
SHG-D/17	64.93	77	93	91
SHG-D/16b	64.30	76	91	89
SHG-D/15	63.26	76	91	88
SHG-D/14b	62.73	75	88	85
SHG-D/13	61.98	76	89	87
SHG-D/12	60.80	75	88	86
SHG-D/11b	58.45	81	95	93
SHG-D/10	57.28	80	94	93
SHG-D/9d	57.23	78	92	91
SHG-D/9c	56.53	79	94	92
SHG-D/9b	55.83	75	90	87
SHG-D/9a	55.13	72	84	81
SHG-D/8	54.35	79	95	94
SHG-D/7b	54.18	76	91	89
SHG-D/6	51.43	75	88	85
SHG-D/5	50.18	78	94	93
SHG-D/4	49.35	76	93	91
SHG-D/3a	47.55	75	91	89
SHG-D/2	46.68	74	90	88
SHG-D/1	45.76	73	87	84
TGR-AB/35	40.46	73	87	84
TGR-AB/34b	39.83	76	92	90
TGR-AB/33b	38.36	76	92	90
TGR-AB/32l	37.63	76	92	90
TGR-AB/32j	35.70	75	91	89
TGR-AB/32i	34.73	76	93	90
TGR-AB/32h	33.76	75	92	90
TGR-AB/32f	31.83	75	91	89
TGR-AB/32d	29.90	72	87	84
TGR-AB/32a	27.00	75	91	88
TGR-AB/31	25.30	74	88	85
TGR-AB/13	8.15	76	90	88
TGR-AB/12	7.98	80	92	91
TGR-AB/11a	6.82	72	89	85
TGR-AB/9	3.46	77	90	88

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Table S4: $\delta^{18}O$ and $\delta^{13}C$ values of the soil carbonates from the Tsagaan Ovoo Fm., Hsanda Gol Fm. and Loh Fm. (Valley of Lakes, Mongolia).

Sample ID	Position (m)	BIOZONE	$\delta^{13}C_{carb}$ (‰, V-PDB)	$\delta^{18}O_{carb}$ (‰, V-PDB)
HTE/13a carb	108.42	biozone D	-8.1	-10.2
HTE/12 carb	107.65	biozone D	-4.4	-8.6
HTE/11b carb	105.78	biozone D	-5.4	-8.9
HTE/11a carb	104.98	biozone D	-7.3	-11.0
HTE/9b carb	101.38	biozone D	-5.1	-9.5
HTE/9a carb	100.97	biozone D	-6.3	-11.2
HTE/8 carb	100.40	biozone D	-6.1	-10.6
HTE/7b carb	100.00	biozone D	-5.7	-8.9
HTE/7a carb	98.73	biozone D	-6.4	-11.7
HTE/6 carb	97.90	biozone C1-D	-6.3	-10.3
HTE/5b carb	97.50	biozone C1-D	-8.9	-10.2
TAT/33b	96.11	biozone C1-D	-5.3	-9.6
TAT/33a	95.18	biozone C1-D	-4.9	-9.7
HTE/4b carb	94.90	biozone C1-D	-9.0	-12.9
TAT/32d	94.71	biozone C1-D	-4.7	-8.8
HTE/4a carb	94.43	biozone C1-D	-6.3	-9.6
HTE/3A carb	94.20	biozone C1-D	-9.4	-11.0
TAT/32c	94.19	biozone C1-D	-5.1	-9.6
HTE/3 carb	94.00	biozone C1-D	-8.8	-11.0
TAT/32b	93.66	biozone C1-D	-5.4	-9.5
TGR-C/19b	93.36	biozone C1-D	-3.8	-8.7
TAT/32a	93.14	biozone C1-D	-5.1	-9.0
TAT/31	93.07	biozone C1-D	-5.4	-8.9
TAT/30b	92.99	biozone C1-D	-5.6	-9.4
TGR-C/19a	92.49	biozone C1-D	-4.8	-8.5
TGR-C/18	91.84	biozone C1	-4.7	-7.8
TGR-C/17b	91.41	biozone C1	-5.0	-8.6
TAT/28	91.22	biozone C1	-4.9	-9.0
SHG-D/30	91.20	biozone C1	-5.5	-8.1
TGR-C/17a	91.18	biozone C1	-4.5	-8.3
TAT/27b	91.09	biozone C1	-5.4	-9.5
TGR-C/16c	91.06	biozone C1	-4.9	-8.5
SHG-D/29b	91.00	biozone C1	-5.7	-8.2
SHG-D/29a	90.82	biozone C1	-5.4	-8.8
TAT/27a	90.76	biozone C1	-5.2	-9.3
SHG-D/28a	90.18	biozone C1	-5.4	-8.4
TAT/25	90.01	biozone C1	-5.0	-8.4
SHG-D/26b	89.55	biozone C1	-5.6	-8.8
TGR-C/15	89.24	biozone C1	-6.1	-7.8
SHG-D/26a	89.15	biozone C1	-5.5	-10.3
TAT/23	88.81	biozone C1	-5.2	-9.0
TAT/22d	88.64	biozone C1	-5.2	-9.3
TGR-C/14b	88.49	biozone C1	-6.1	-9.1
TAT/22c	87.94	biozone C1	-4.9	-9.2
TAT/22b	87.24	biozone C1	-4.9	-8.9
TAT/22a	86.54	biozone C1	-4.9	-9.2

TGR-C/13b	85.86	biozone C1	-5.7	-9.1
TGR-C/12	84.77	biozone C1	-5.4	-7.7
TGR-C/11a	84.32	biozone C1	-6.8	-9.1
TGR-C/10b	84.14	biozone C1	-5.9	-9.6
TAT/18a	83.87	biozone C1	-5.0	-9.3
TAT/17c	83.54	biozone C	-4.7	-8.8
TAT/17b	83.24	biozone C	-4.8	-9.0
TGR-C/10a	83.22	biozone C	-5.7	-7.8
TAT/17a	82.94	biozone C	-4.8	-9.2
TGR-C/9	82.66	biozone C	-5.8	-8.8
TAT/16b	82.64	biozone C	-4.8	-9.7
TGR-C/8b	82.39	biozone C	-5.6	-7.6
TAT/16a	82.11	biozone C	-4.9	-9.6
TAT/15c	81.84	biozone C	-4.8	-9.2
TAT/15b	81.26	biozone C	-4.2	-8.6
TGR-C/8a	81.12	biozone C	-5.8	-8.3
TAT/15a	80.67	biozone C	-5.5	-9.7
TGR-C/7c	80.49	biozone C	-5.5	-9.1
TAT/14b	80.09	biozone C	-4.9	-9.2
TGR-C/7b	80.01	biozone C	-5.4	-9.3
TAT/14a	79.59	biozone C	-4.9	-9.0
TGR-C/7a	79.52	biozone C	-5.9	-7.6
TAT/12c	79.04	biozone C	-4.8	-8.8
TGR-C/6	78.97	biozone C	-5.9	-9.2
TGR-C/5	78.74	biozone C	-5.4	-9.2
TGR-C/4b	78.57	biozone C	-5.6	-8.1
TAT/12b	78.47	biozone C	-4.8	-8.6
TAT/12a	77.91	biozone C	-4.8	-8.9
TGR-C/4a	77.87	biozone C	-5.6	-8.7
TGR-C/3A	77.48	biozone C	-6.1	-8.8
TGR-C/3c	77.40	biozone C	-5.1	-7.0
TGR-C/3b	76.80	biozone C	-5.5	-8.8
TGR-C/3a	76.20	biozone C	-5.3	-8.6
TGR-C/2	75.47	biozone C	-5.9	-8.6
TGR-C/1	75.13	biozone C	-5.9	-9.2
SHG-D/25	72.32	biozone B	-5.4	-8.8
SHG-D/24	71.98	biozone B	-5.2	-9.3
SHG-D/23j	71.85	biozone B	-5.5	-8.5
SHG-D/23i	71.38	biozone B	-5.3	-8.3
SHG-D/23h	70.91	biozone B	-5.4	-8.5
SHG-D/23g	70.44	biozone B	-5.0	-8.2
SHG-D/23f	69.97	biozone B	-5.2	-8.3
SHG-D/23e	69.50	biozone B	-5.3	-7.9
SHG-D/23d	69.03	biozone B	-5.4	-8.1
TAT/8c	68.99	biozone B	-4.7	-8.7
SHG-D/23c	68.56	biozone B	-4.6	-7.8
SHG-D/23b	68.09	biozone B	-5.4	-8.3
TAT/8a	68.32	biozone B	-4.5	-8.9
TAT/7b	67.99	biozone B	-4.7	-8.8
TAT/7a	67.62	biozone B	-4.6	-8.7
SHG-D/23a	67.61	biozone B	-5.0	-8.9
TAT/6c	67.44	biozone B	-4.5	-8.8
TAT/6b	67.24	biozone B	-4.6	-8.8
SHG-D/22	67.05	biozone B	-5.2	-8.8

TAT/6a	67.04	biozone B	-4.6	-8.9
TAT/5	66.77	biozone B	-4.6	-8.7
SHG-D/21	66.70	biozone B	-5.1	-9.1
SHG-D/20b	66.40	biozone B	-5.5	-8.3
TAT/4b	66.62	biozone B	-4.6	-8.7
TAT/4a	66.29	biozone B	-4.7	-9.1
TAT/3c	66.12	biozone B	-4.8	-9.4
SHG-D/20a	65.83	biozone B	-5.8	-7.9
TAT/3b	65.79	biozone B	-4.5	-8.3
SHG-D/19	65.42	biozone B	-4.9	-8.1
SHG-D/18	65.11	biozone B	-5.3	-8.1
TAT/2	65.08	biozone B	-4.8	-8.8
TAT/1c	65.00	biozone B	-4.7	-8.7
SHG-D/17	64.93	biozone B	-5.1	-9.2
SHG-D/16c	64.73	biozone B	-5.6	-7.8
TAT/1b	64.47	biozone B	-4.9	-9.3
SHG-D/16b	64.30	biozone B	-5.6	-8.3
TAT/1a	63.93	biozone B	-4.8	-9.1
SHG-D/16a	63.86	biozone B	-5.5	-7.9
SHG-D/15	63.26	biozone B	-5.1	-8.6
SHG-D/14b	62.73	biozone B	-5.9	-8.0
SHG-D/14a	62.43	biozone B	-5.6	-8.6
SHG-D/13	61.98	biozone B	-5.3	-7.6
SHG-D/6	51.43	biozone B	-7.3	-8.5
SHG-D/2	46.68	biozone B	-7.6	-8.7
TGR-AB/33c	38.73	biozone A	-9.2	-9.1
TGR-AB/33b	38.36	biozone A	-8.3	-8.6
TGR-AB/33a	38.00	biozone A	-7.2	-9.3
TGR-AB/32l	37.63	biozone A	-7.5	-8.4
TGR-AB/32k	36.66	biozone A	-7.0	-8.9
TGR-AB/32j	35.70	biozone A	-7.0	-4.6
TGR-AB/32i	34.73	biozone A	-6.8	-1.5
TGR-AB/32h	33.76	biozone A	-6.9	-7.2
TGR-AB/32g	32.80	biozone A	-6.6	-8.6
TGR-AB/32f	31.83	biozone A	-6.8	-2.6
TGR-AB/32e	30.86	biozone A	-6.8	-0.2
TGR-AB/32d	29.90	biozone A	-6.7	-5.8
TGR-AB/32c	28.93	biozone A	-6.4	-8.4
TGR-AB/32b	27.96	biozone A	-7.2	-6.1
TGR-AB/32a	27.00	biozone A	-7.0	-6.9

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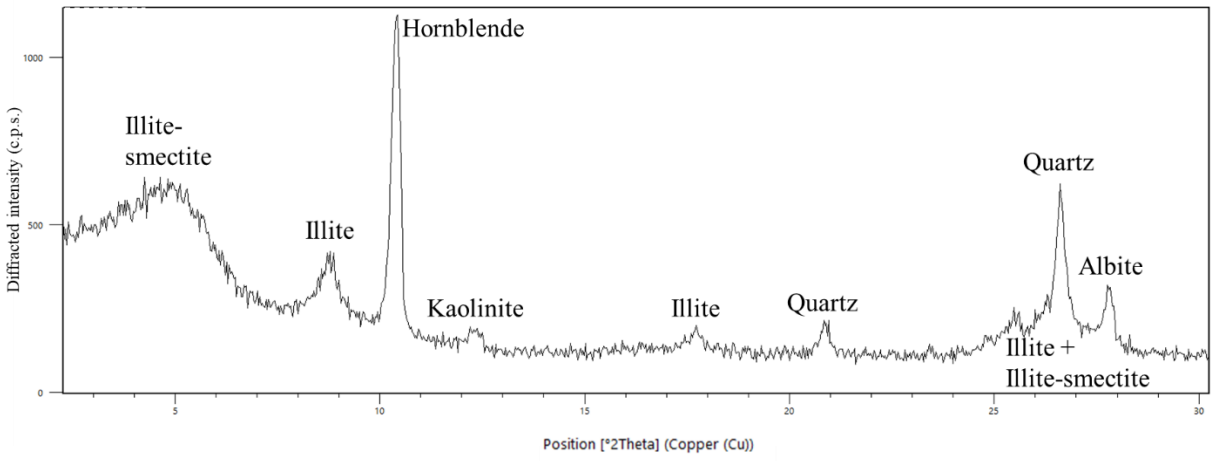

Figure S1: XRD pattern (oriented clay film; EG-solvated) of a sample from the TAT section (~90.5 m; close to the basalt II group), Hsanda Gol Formation, Valley of Lakes, Mongolia.

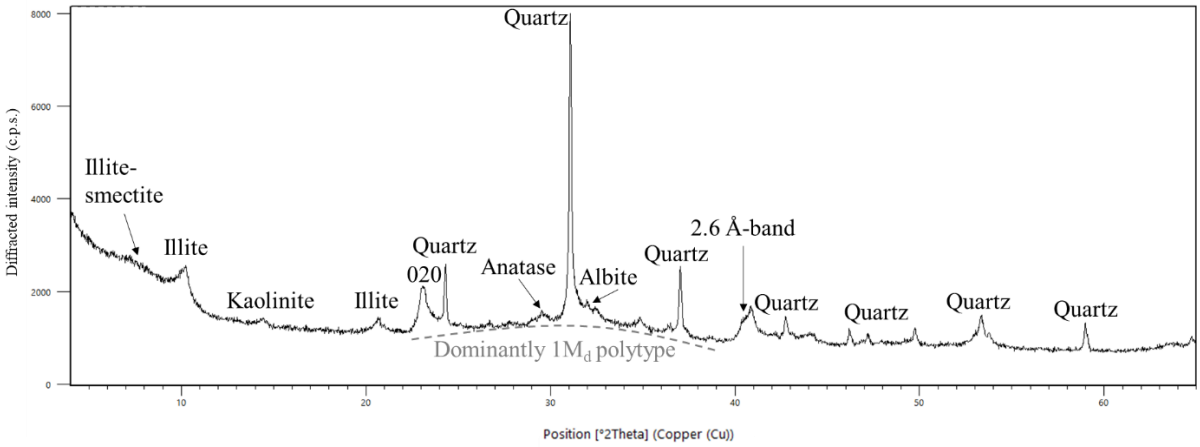

Figure S2: XRD pattern (randomly oriented clay preparation) of a sample (carbonate-free; 1-2 µm size fraction) from the TGR-C section (~78.0 m), Hsanda Gol Formation, Valley of Lakes, Mongolia, demonstrating the dominance of the $1M_d$ polytype of illite.

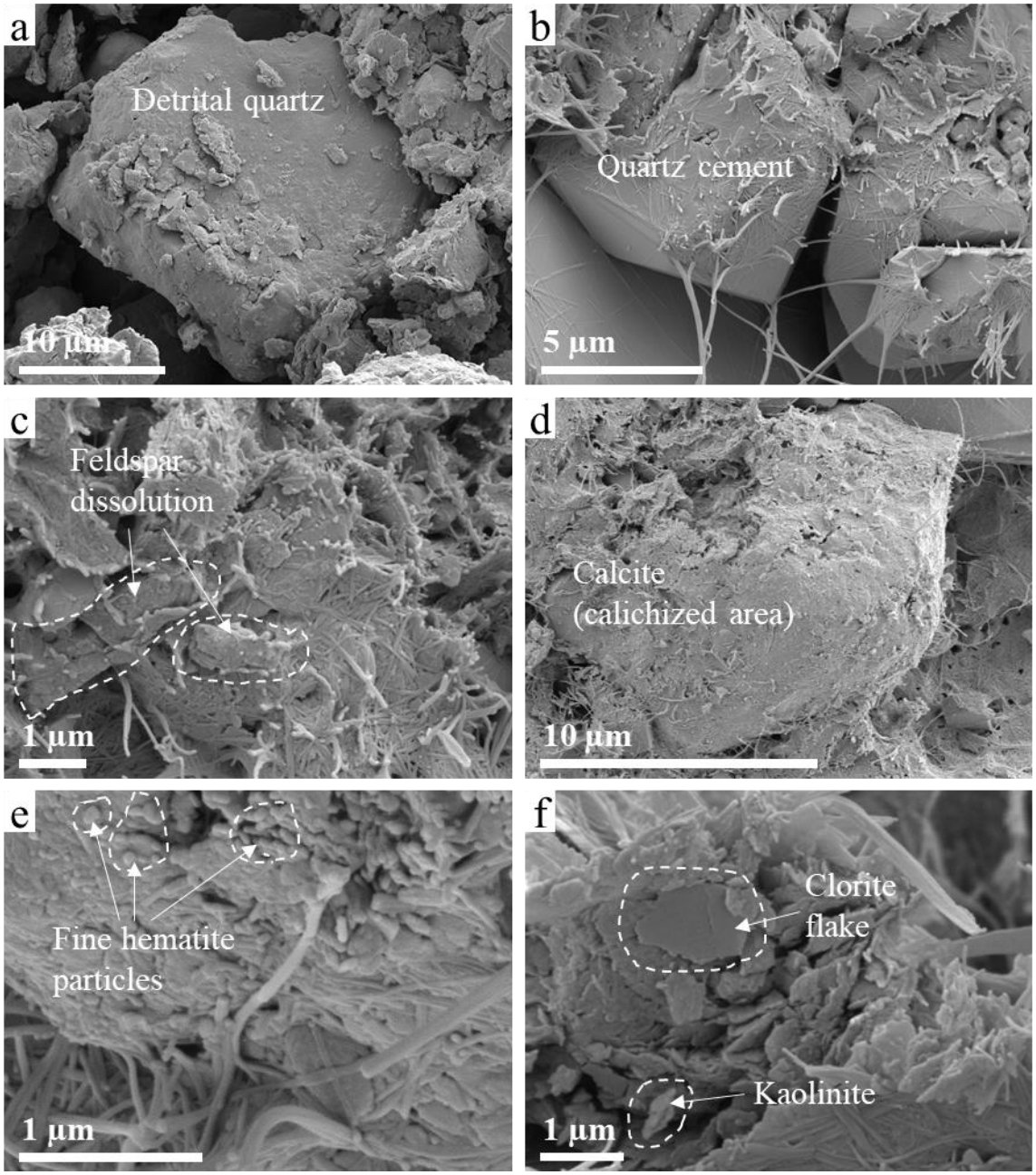

Figure S3: Secondary electron images of weakly consolidated samples taken from the Hsanda Gol Formation, Valley of Lakes, showing (a) (sub)angular to rounded detrital quartz grains, (b) diagenetic quartz cement, (c) partially dissolved feldspar grains, (d) calichized areas made of calcite spar, (e) fine hematite particles covering detrital components and (f) coarse chlorite flakes and tiny rounded kaolinite particles.