



Supplement of

Amelioration of marine environments at the Smithian–Spathian boundary, Early Triassic

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Sample	Height	$\delta^{13}C_{carb}(\%)$	δ ¹⁸ O(‰)	$\delta^{34}S_{CAS}(\%)$	CAS concentration	Mn	Sr	
*	(m)	VPDB	VPDB	VCDT	(ppm SO ₄ ²⁻)	(ppm)	(ppm)	Mn/Sr
STZT2-12	72.7	-0.59	-6.68					
STZT2-11	67.7	-0.88	-4.83					
STZT2-9	65.6	-2.76	-5.95					
STZT2-8	61.2	0.02	-4.97					
STZT2-6	59.7	-3.02	-5.25					
STZT2-4	54.7	-2.97	-6.63					
STZT2-2	45.7	0.03	-8.45					
STZT2-1	44.9	-3.02	-5.82					
S5TZT-1	44.5	2.17	-6.19					
S1TZT-25	44.3	1.20	-4.50					
S1TZT-24	42.3	1.20	-5.22					
S5TZT-2	41.5	0.76	-5.28					
S1TZT-23	41.3	1.44	-5.31					
S5TZT-3	40.6	1.19	-5.05					
S1TZT-22	40.3	1.03	-5.52					
S5TZT-4	40.0	1.33	-5.35					
S1TZT-21	39.3	0.88	-5.63	24.56	356			
S5TZT-5	39.0	1.14	-5.31					
STTZT-20	38.3	0.63	-5.64			793	898	0.88
S51ZT-6	38.0	0.88	-5.31					
STIZI-19	37.3	1.01	-5.14	26.64	142	1201	820	2.21
S1TZT-10	30.5	1.65	-5.04	20.04	145	1691	820	2.31
S1TZT-16	34.3	1.05	-5.32			3776	1134	3 33
S1TZT-15	33.3	1.15	-3.95			5770	1154	5.55
S1TZT-14	32.3	0.86	-5.22			447	1141	0.39
S1TZT-13	31.3	1.09	-5.07	37.87	23			
S1TZT-12	30.3	1.01	-5.28			296	1210	0.24
S1TZT-11	29.3	0.78	-5.30					
S1TZT-10	28.3	1.09	-5.11			304	857	0.35
S4TZT-4	28.3	0.89	-5.05					
S4TZT-3	28.1	0.87	-5.24					
S4TZT-2	27.8	0.93	-5.27					
S4TZT-1	27.5	0.71	-5.74					
S1TZT-9	27.3	0.16	-5.42					
S3TZT-1	27.2	1.11	-4.67					
S3TZT-2	26.9	1.08	-5.62	23.56	698	1609	531	3.03
S3TZT-3	26.6	0.90	-3.46					
S1TZT-8	26.2	0.75	-3.39					
S3TZT-4	25.8	1.19	-3.74					
S1TZT-7	25.2	0.68	-4.76			1509	821	1.84
S1TZT-6	24.2	1.21	-5.02	27.79	84			
S1TZT-5	23.2	0.26	-4.96			1841	756	2.44
S1TZT-4	22.2	0.52	-4.89					
S1TZT-3	21.2	0.54	-4.58			1943	508	3.82

Table C1. (A) Isotopic and trace element data from the Shitouzhai section

S1TZT-2	20.2	0.03	-5.10	28.52	66			
S1TZT-1	19.2	1.03	-5.19	29.95	429			
S2TZT-1	19.1	0.04	-5.43	23.73	441	1046	1367	0.77
S2TZT-2	18.1	-1.18	-5.85	26.83	3			
S2TZT-3	17.1	-3.12	-5.80	36.74	134	375	1131	0.33
S2TZT-4	16.1	-2.22	-5.92					
S2TZT-5	15.1	-2.02	-4.75					
S2TZT-6	14.1	-1.65	-5.52	37.76	12	230	1609	0.14
S2TZT-7	13.1	-2.45	-5.90					
S2TZT-8	12.1	-2.44	-7.76			230	1609	0.14
S2TZT-9	11.1	-3.18	-5.16	29.67	97			
S2TZT-10	9.1	-1.47	-5.78			377	2095	0.18
S2TZT-11	8.1	-1.34	-6.65					
STZT-28	6.5	-0.38	-6.03	31.06	128			
STZT-27	4.9	-0.81	-5.84			391	1672	0.23
STZT-26	3.3	0.28	-5.75	31.72	8			
STZT-25	1.8	-1.74	-7.22	29.04	27			
STZT-24	0	-0.10	-5.65			254	2160	0.12

Sample	S1TZT- 20	S1TZT- 18	S1TZT- 16	S1TZT- 14	S1TZT- 12	S1TZT- 10	S3TZT- 2	S1TZT- 7	S1TZT- 5	S1TZT- 3	S2TZT- 1	S2TZT- 3	S2TZT- 6	S2TZT- 8	S2TZT- 10	STZT- 27	STZT- 24
Age(Ma)	249.64	249.74	249.83	249.93	250.02	250.12	250.18	250.27	250.36	250.46	250.55	250.60	250.67	250.72	250.79	250.88	251.00
Depth(m)	38.3	36.3	34.3	32.3	30.3	28.3	26.9	25.2	23.2	21.2	19.13	17.13	14.13	12.13	9.13	4.93	0
La	5.00	4.34	4.93	6.05	7.72	5.01	6.05	4.54	3.89	2.73	8.35	7.99	6.05	9.50	11.59	9.73	9.11
Ce	8.46	7.50	8.29	10.37	13.23	8.54	9.40	7.48	6.77	5.03	15.85	14.74	11.24	17.71	21.63	17.95	16.91
Pr	1.11	0.91	1.01	1.34	1.74	1.10	1.39	0.95	0.80	0.61	1.96	1.77	1.39	2.16	2.64	2.20	2.16
Nd	4.34	3.43	3.81	5.20	6.70	4.35	5.23	3.68	3.23	2.28	7.46	6.95	5.45	8.39	10.13	8.65	8.72
Sm	0.84	0.64	0.71	1.03	1.36	0.89	1.18	0.71	0.61	0.46	1.60	1.51	1.08	1.85	2.26	1.78	1.92
Eu	0.17	0.12	0.15	0.21	0.25	0.18	0.24	0.16	0.12	0.10	0.30	0.30	0.23	0.35	0.41	0.36	0.39
Gd	0.83	0.63	0.68	0.96	1.22	0.80	1.13	0.76	0.55	0.39	1.47	1.31	1.02	1.64	1.92	1.66	1.78
Tb	0.13	0.09	0.11	0.14	0.18	0.12	0.18	0.11	0.09	0.07	0.23	0.21	0.17	0.24	0.31	0.25	0.27
Dy	0.77	0.62	0.67	0.84	1.11	0.71	1.08	0.60	0.56	0.41	1.30	1.25	1.02	1.35	1.77	1.53	1.58
Но	0.15	0.12	0.14	0.17	0.20	0.13	0.22	0.14	0.11	0.08	0.25	0.24	0.20	0.26	0.35	0.31	0.30
Er	0.41	0.33	0.43	0.48	0.56	0.40	0.59	0.42	0.33	0.24	0.75	0.72	0.56	0.74	0.99	0.79	0.91
Tm	0.06	0.05	0.06	0.06	0.08	0.06	0.08	0.06	0.05	0.03	0.11	0.08	0.08	0.11	0.14	0.12	0.12
Yb	0.36	0.28	0.36	0.40	0.50	0.37	0.55	0.37	0.27	0.20	0.66	0.53	0.47	0.67	0.89	0.76	0.71
Lu	0.05	0.05	0.05	0.06	0.08	0.05	0.08	0.06	0.04	0.03	0.09	0.08	0.07	0.10	0.12	0.11	0.12
Y	5.37	4.05	4.82	5.65	6.80	4.87	7.87	5.25	3.72	2.78	8.51	7.98	6.93	9.23	11.20	9.48	9.94
Th	1.14	1.16	1.30	1.69	1.97	1.36	1.47	1.25	1.23	0.83	2.36	2.81	1.65	2.99	3.96	3.29	2.86
U	2.02	1.42	1.23	1.76	2.22	2.24	2.57	3.74	3.22	2.46	2.83	1.99	2.11	2.06	2.53	2.49	2.34
Al_2O_3	1.01	1.02	1.19	1.46	1.67	1.12	1.51	1.31	1.41	0.77	2.72	3.31	2.21	3.41	4.19	3.96	3.06
K_2O	0.26	0.29	0.34	0.43	0.50	0.32	0.44	0.40	0.46	0.23	0.76	0.94	0.57	0.89	1.11	1.04	0.85
Na ₂ O	0.14	0.12	0.15	0.13	0.14	0.11	0.18	0.10	0.10	0.11	0.13	0.12	0.07	0.22	0.15	0.15	0.08
Σ REE	22.67	19.12	21.39	27.33	34.93	22.71	27.41	20.03	17.43	12.67	40.37	37.68	29.04	45.07	55.18	46.19	44.97
Ce/Ce*	0.79	0.83	0.82	0.80	0.80	0.80	0.73	0.79	0.83	0.87	0.88	0.86	0.86	0.87	0.87	0.86	0.84
Eu/Eu*	0.97	0.90	1.03	1.01	0.95	1.02	1.01	1.05	1.02	1.20	0.94	1.03	1.06	0.97	0.96	1.01	1.02
Th/Th*	0.106	0.108	0.121	0.158	0.184	0.127	0.138	0.117	0.115	0.078	0.221	0.263	0.155	0.279	0.37	0.307	0.268
$Sm_N/Yb_N \\$	1.17	1.13	0.99	1.28	1.37	1.21	1.08	0.98	1.14	1.18	1.21	1.42	1.14	1.38	1.27	1.17	1.35
Th/U	0.56	0.82	1.06	0.96	0.89	0.61	0.57	0.34	0.38	0.34	0.84	1.42	0.78	1.45	1.56	1.32	1.22

Table C2. Major and trace element concentrations and ratios from the Shitouzhai section[†]

Y/Ho	35.70	34.16	35.05	33.59	33.27	36.83	35.01	37.17	34.66	34.72	33.73	33.94	35.05	35.05	31.50	30.70	33.69
LSR	21.07	21.07	21.07	21.07	21.07	21.07	21.07	21.07	21.07	21.25	28.37	42.64	42.64	42.64	42.64	42.64	42.64
BAR	5.27	5.27	5.27	5.27	5.27	5.27	5.27	5.27	5.27	5.31	7.09	10.66	10.66	10.66	10.66	10.66	10.66
Clay MAR	0.56	0.57	0.64	0.83	0.97	0.67	0.73	0.62	0.61	0.41	1.57	2.80	1.65	2.98	3.94	3.28	2.85
Carb MAR	4.71	4.70	4.63	4.43	4.30	4.60	4.54	4.65	4.66	4.90	5.52	7.86	9.01	7.68	6.72	7.38	7.81
CIA	0.72	0.71	0.71	0.72	0.72	0.72	0.71	0.72	0.72	0.69	0.75	0.76	0.78	0.75	0.77	0.77	0.77

⁺ REE concentrations were normalized to the average upper crustal composition of McLennan (2001). The units of major and trace elements are percent (%) and parts per million (ppm), respectively.