

Sample NO.	CaO	SiO <sub>2</sub>	Al <sub>2</sub> O <sub>3</sub>	Na <sub>2</sub> O	SO <sub>3</sub>	Fe <sub>2</sub> O <sub>3</sub>	MnO	K <sub>2</sub> O	P <sub>2</sub> O <sub>5</sub>	Cr <sub>2</sub> O <sub>3</sub>	L.O.I	Total
C1	87.60	5.01	1.60	1.26	1.01	0.99	0.08	0.14	0.12	0.07	2.10	100.00
C2	89.39	4.73	1.54	0.49	1.10	0.91	0.07	0.09	0.12	0.06	1.50	100.00
C3	87.81	5.02	1.64	1.01	0.91	1.08	0.09	0.13	0.14	0.07	2.10	100.00
C4	88.35	4.46	1.53	1.25	1.06	0.88	0.06	0.15	0.11	0.07	2.07	100.00
C5	90.70	4.09	1.04	0.45	0.84	1.09	N.D.	0.12	0.08	0.09	1.50	100.00
C6	90.91	4.42	1.12	0.44	0.61	1.11	0.05	0.16	0.11	0.09	0.99	100.00
C7	90.49	4.37	1.14	0.32	1.21	1.18	0.08	N.D.	0.10	0.07	1.04	100.00
C8	89.33	4.88	1.18	0.40	1.37	1.24	0.06	0.15	0.09	0.06	1.23	100.00
M1	84.31	4.64	1.22	0.50	2.18	3.12	1.57	0.14	0.20	N.D.	1.96	99.83

Sample NO.	Li	Be	Sc	V	Cr	Co	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb
C1	12.394	0.151	1.327	9.067	6.101	7.499	16.927	16.284	8.453	2.272	1415.280	7.398	5.971	0.774
C2	14.326	0.030	1.541	9.584	6.823	8.314	14.787	22.730	12.296	1.971	1570.712	7.794	6.433	0.710
C3	9.924	0.060	1.452	10.544	7.200	16.402	13.308	14.540	6.429	2.073	1408.932	8.692	6.449	0.841
C4	5.187	0.070	1.229	8.446	5.837	5.697	10.295	13.203	8.925	3.008	1355.301	6.697	4.917	0.650
C5	9.269	0.050	1.427	6.355	4.520	3.033	9.568	27.786	10.845	2.794	1105.468	12.841	6.884	0.549
C6	7.282	0.150	1.307	6.643	4.289	3.621	8.299	15.830	9.795	3.092	1071.291	9.646	6.613	0.579
C7	6.185	0.150	1.556	7.123	4.938	6.265	23.184	12.959	15.942	2.823	1071.415	11.043	6.335	0.579

<b>C8</b>	8.970	0.160	1.804	8.559	5.833	8.389	22.501	16.538	11.005	3.067	1210.755	17.159	8.369	0.842
<b>M1</b>	17.389	0.270	2.805	76.871	7.806	432.418	111.399	29.926	38.920	4.272	1389.487	32.831	21.581	3.863

Sample NO.	Mo	In	Cs	Ba	La	Ce	Pr	Nd	Sm	Eu	Gd	Tb	Dy	Ho	Er
<b>C1</b>	0.342	0.010	0.101	161.53 1	4.724	5.981	0.965	4.342	0.824	0.231	1.076	0.151	0.955	0.221	0.613
<b>C2</b>	0.340	0.000	0.110	157.97 2	4.802	6.363	0.990	4.482	0.950	0.250	1.020	0.160	1.010	0.220	0.620
<b>C3</b>	0.391	0.010	0.100	171.93 6	5.397	7.801	1.122	4.867	0.921	0.270	1.182	0.170	1.081	0.250	0.751
<b>C4</b>	0.220	0.010	0.180	131.33 2	4.188	4.987	0.870	3.528	0.730	0.210	0.880	0.120	0.880	0.190	0.570
<b>C5</b>	0.150	0.010	0.180	14.327	5.757	4.879	1.137	4.879	0.978	0.259	1.167	0.190	1.267	0.319	0.938
<b>C6</b>	0.160	0.010	0.180	13.665	4.818	4.768	1.017	4.269	0.888	0.219	1.077	0.160	1.057	0.229	0.728
<b>C7</b>	0.319	0.010	0.140	19.573	5.357	5.367	1.067	4.599	0.978	0.209	1.227	0.170	1.197	0.279	0.838
<b>C8</b>	0.261	0.010	0.110	18.141	7.497	6.344	1.413	6.254	1.213	0.321	1.674	0.251	1.724	0.421	1.293
<b>M1</b>	6.498	0.020	0.150	69.355	23.288	82.052	4.831	21.082	4.342	1.058	5.500	0.789	4.991	1.098	3.204

Sample NO.	Tm	Yb	Lu	Hf	Ta	Tl	Pb	Th	U	ΣREE	LREE	HREE	LREE/H REE	δEu	δCe	Ce <sub>anom</sub>
<b>C1</b>	0.090	0.573	0.080	0.181	0.161	0.020	3.699	0.684	0.251	20.83	17.07	3.76	4.54	0.75	0.63	-0.20
<b>C2</b>	0.090	0.560	0.090	0.220	0.180	0.050	4.142	0.730	0.260	21.61	17.84	3.77	4.73	0.77	0.65	-0.18
<b>C3</b>	0.100	0.721	0.100	0.230	0.140	0.020	2.283	0.801	0.240	24.73	20.38	4.36	4.68	0.79	0.71	-0.15
<b>C4</b>	0.070	0.530	0.080	0.170	0.130	0.020	0.300	0.590	0.210	17.83	14.51	3.32	4.37	0.80	0.59	-0.23
<b>C5</b>	0.140	0.948	0.150	0.210	0.110	0.010	0.708	0.529	0.249	23.01	17.89	5.12	3.50	0.74	0.43	-0.37
<b>C6</b>	0.110	0.648	0.110	0.190	0.140	0.010	0.608	0.549	0.269	20.10	15.98	4.12	3.88	0.69	0.48	-0.31

<b>C7</b>	0.120	0.778	0.130	0.209	0.100	0.010	1.905	0.549	0.259	22.32	17.58	4.74	3.71	0.58	0.50	-0.30
<b>C8</b>	0.190	1.243	0.200	0.281	0.120	0.020	2.486	0.712	0.271	30.04	23.04	7.00	3.29	0.69	0.43	-0.37
<b>M1</b>	0.429	2.865	0.429	0.669	0.180	0.200	60.850	4.003	0.858	155.96	136.65	19.31	7.08	0.66	1.74	0.24

$$\delta\text{Eu} = (\text{Eu})_N / 0.5(\text{Sm} + \text{Nd})_N$$

$$\delta\text{Ce} = (\text{Ce})_N / 0.5(\text{La} + \text{Pr})_N$$

$$\text{Ce}_{\text{anom}} = \log(\text{Ce} / \text{Ce}^*)_{\text{SN}} = \log [ 2\text{Ce}_{\text{SN}} / (\text{La}_{\text{SN}} + \text{Pr}_{\text{SN}}) ]$$

**Supplement Table 1** Geochemical character parameters of Carbonate rocks. C1-C4 represent the gray sediment infilled in the burrows, C5-C8 represent the white carbonate and M1 represent the thin black ferromanganese crusts, some white part may be mix unavoidable.

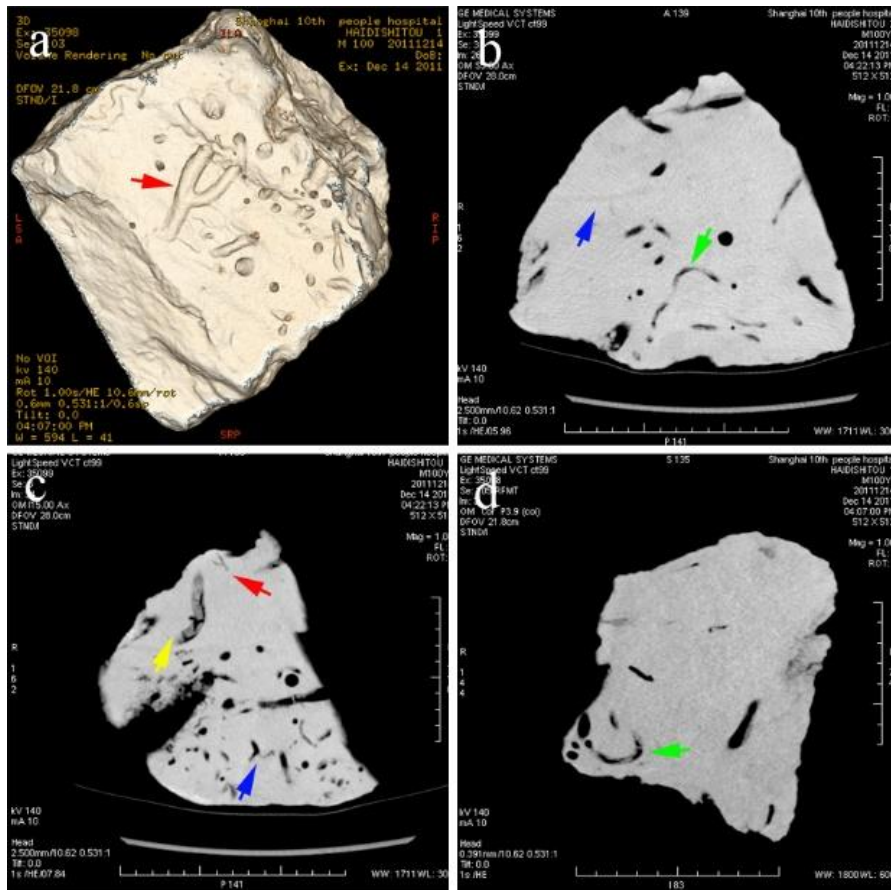
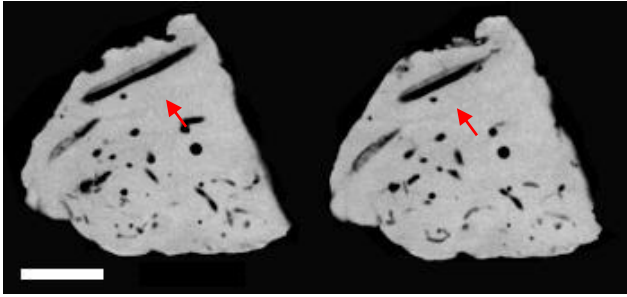


Figure r1 CT images of chalk samples. Arrows in different colors represent different shape of burrows. Red -- Y-shaped, blue -- branched, yellow -- J-shaped and Green -- U-shaped.



*Figure r2, CT slides of same carbonate sample. Scale bar=10cm*