

Table 4. Concentrations of trace elements in sandstone from Huangliu formation (in ppm).

Well	SN	Md/ μm	Ni	Cr	Sc	V	Co	Ba	Rb	Sr	Hf	Zr	Cu	Th	U	B	Cr/Ni	Th/Sc	Cr/Th	La/Sc	Co/Th
	1	120 (vf)	28.52	68.43	11.61	81.99	11.92	424.1	84.14	141.3	8.60	266.1	13.04	12.30	2.00	64.79	2.40	1.06	5.56	3.56	0.97
	2	120 (vf)	27.85	71.72	9.45	77.44	11.76	454.1	76.26	129.0	9.57	280.9	10.70	12.14	1.80	58.57	2.58	1.28	5.91	3.91	0.97
	3	160 (f)	22.11	55.84	7.08	57.05	8.56	335.1	73.76	131.2	7.25	227.8	6.48	9.57	1.47	45.82	2.53	1.35	5.84	4.21	0.89
	4	150 (f)	15.18	48.27	6.35	47.86	5.83	320.7	42.32	179.9	6.23	187.5	5.14	7.93	1.23	35.81	3.18	1.25	6.09	4.46	0.74
B-8	5	150 (f)	21.19	56.82	7.25	61.81	9.06	360.8	80.17	111.2	7.54	220.9	7.60	9.71	1.45	54.49	2.68	1.34	5.85	3.99	0.93
	6	160 (f)	18.70	51.87	6.63	54.78	7.27	394.9	74.87	118.4	6.78	204.9	6.38	8.50	1.33	43.24	2.77	1.28	6.10	4.12	0.86
	7	180 (f)	15.72	61.43	6.24	51.57	6.36	325.8	65.22	77.21	15.27	447.5	5.82	12.84	1.63	42.11	3.91	2.06	4.78	6.12	0.50
	8	170 (f)	19.21	49.76	6.16	49.88	7.79	365.3	74.74	94.75	5.42	168.0	6.02	8.11	1.33	33.33	2.59	1.32	6.13	4.41	0.96
	9	180 (f)	16.86	52.62	6.89	48.08	6.01	425.3	66.60	83.64	7.23	216.6	4.68	7.98	1.16	32.00	3.12	1.16	6.60	4.01	0.75
	10	100 (vf)	19.06	52.73	7.03	57.76	8.39	1008	67.07	122.1	8.27	240.5	7.51	8.56	1.32	54.07	2.77	1.22	6.16	4.09	0.98
	11	90 (vf)	19.48	55.00	7.34	57.33	8.53	1033	65.66	125.9	8.75	254.1	7.14	9.05	1.41	44.74	2.82	1.23	6.07	4.02	0.94
	12	90 (vf)	19.56	54.28	7.03	58.02	8.47	513.2	68.19	114.6	10.09	300.4	7.50	9.50	1.54	45.35	2.78	1.35	5.72	4.48	0.89
	13	90 (vf)	18.24	55.41	7.20	56.90	7.78	448.2	66.40	108.4	11.27	329.8	6.95	10.24	1.53	61.20	3.04	1.42	5.41	5.08	0.76
	14	70 (vf)	28.67	83.09	11.43	91.33	13.36	533.4	110.5	149.2	29.35	887.8	12.84	25.73	3.39	75.64	2.90	2.25	3.23	6.76	0.52
A-2	15	70 (vf)	23.62	62.76	8.75	72.89	10.61	484.6	99.77	223.2	13.27	402.2	10.80	14.07	2.13	61.49	2.66	1.61	4.46	4.65	0.75
	16	100 (vf)	18.71	53.86	6.85	54.28	6.66	519.3	63.31	115.6	10.14	307.7	5.80	8.14	1.26	57.70	2.88	1.19	6.62	4.77	0.82
	17	80 (vf)	23.40	53.83	8.54	58.29	9.89	487.3	76.89	106.8	7.50	237.5	7.99	8.40	1.22	59.62	2.30	0.98	6.41	3.65	1.18
	18	80 (vf)	21.35	53.98	8.05	58.24	8.65	704.3	64.55	118.1	8.40	261.6	7.75	9.61	1.48	57.57	2.53	1.19	5.62	3.87	0.90
	19	80 (vf)	22.62	55.14	8.51	60.82	9.06	426.3	75.05	110.5	8.15	254.3	7.97	8.76	1.41	51.10	2.44	1.03	6.30	3.62	1.03
	20	80 (vf)	22.39	54.23	7.26	57.63	8.94	460.6	74.86	108.2	8.87	272.3	6.98	9.07	1.34	61.07	2.42	1.25	5.98	4.27	0.99
	21	100 (vf)	21.30	54.75	7.29	58.64	8.45	469.6	77.93	117.4	9.23	273.1	7.31	10.02	1.45	65.27	2.57	1.37	5.46	4.31	0.84
	22	80 (vf)	27.56	60.45	10.28	69.70	11.80	463.9	83.33	113.6	9.36	290.9	9.72	9.26	1.65	81.79	2.19	0.90	6.53	3.75	1.27
	23	80 (vf)	25.66	55.20	8.42	62.79	9.84	450.6	72.10	127.7	6.72	216.0	8.23	7.85	1.30	63.72	2.15	0.93	7.03	3.73	1.25
	24	80 (vf)	19.55	48.54	6.50	54.14	7.85	569.8	74.86	101.5	5.84	176.0	9.42	8.20	1.26	66.47	2.48	1.26	5.92	3.71	0.96
A-6	25	100 (vf)	19.31	51.93	9.63	56.41	7.52	418.5	70.72	96.45	9.39	287.3	6.45	9.20	1.32	57.88	2.69	0.96	5.65	3.74	0.82
	26	80 (vf)	21.54	52.93	7.93	59.05	8.37	373.8	76.57	98.16	6.84	198.7	8.16	8.29	1.19	54.68	2.46	1.05	6.38	3.81	1.01
	27	100 (vf)	21.28	53.08	7.28	57.37	8.82	384.0	80.59	121.5	6.59	201.3	7.76	8.33	1.31	69.53	2.49	1.14	6.38	3.76	1.06
	28	90 (vf)	21.02	54.53	7.34	59.63	9.47	343.8	86.61	98.16	7.25	217.4	8.01	10.28	1.51	60.61	2.59	1.40	5.30	4.01	0.92

Note: SN=sample number. M=mean grain size from thin section; f=fine-grained sandstone; vf=very fine-grained sandstone

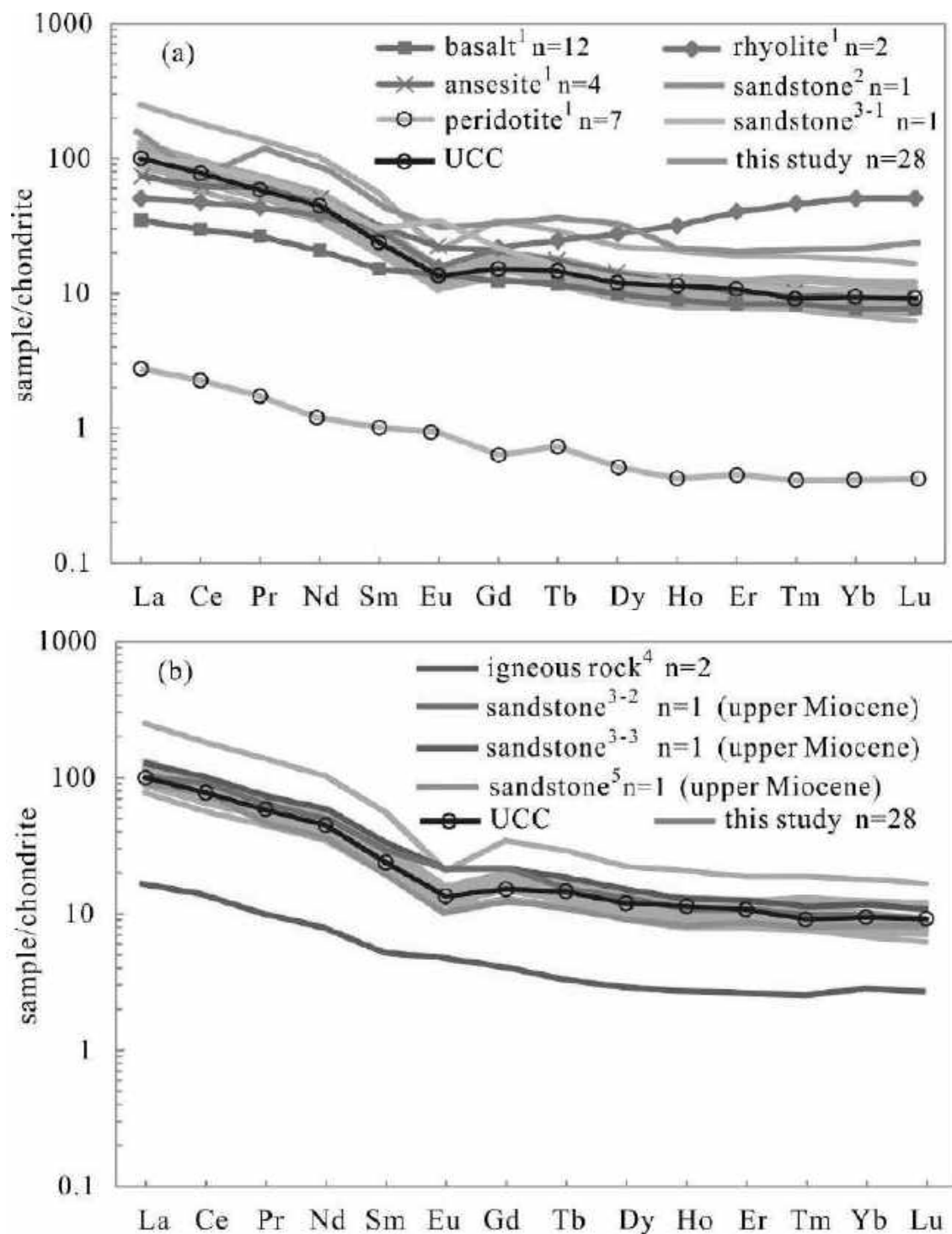


Fig.7. (a) Comparison of REE patterns of sandstone in this study with that of source rocks from Red River shear zone (b) and with the upper Miocene sandstones sourced from Vietnam and Hainan Island. (n=number of samples; 14—REE pattern from Shen *et al.* (1998), Clift *et al.* (2008), Zhao *et al.* (2013), Shao *et al.* (2010) and Cao *et al.* (2015), respectively. See Fig.1 for locations. Chondrite normalization values and UCC data are from Henderson (1984) and Rudnick & Gao (2003), respectively).