

Distribution of Rare Earth Elements plus Yttrium among Major Mineral Phases of Marine Fe–Mn Crusts from the South China Sea and Western Pacific Ocean: A Comparative Study

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Table S1. Concentrations of REY in the leaches and in bulk crusts investigated in this study.

Sample	Element	Elements of Individual Phases (ppm)				Sum of Leaches	Bulk	Recovery (%)	Percentage Recovery of Individual Phases (%)			
		L1	L2	L3	L4				L1	L2	L3	L4
ST1	La	<0.01	103.7	37.99	4.59	146.3	125.0	117	0	71	26	3
	Ce	<0.01	387.5	393.6	12.59	793.7	598.3	133	0	49	50	2
	Pr	<0.01	15.17	10.14	1.11	26.41	29.53	89	0	57	38	4
	Nd	<0.01	58.77	40.79	4.42	103.98	126.3	82	0	57	39	4
	Sm	<0.01	10.19	11.30	0.86	22.35	27.74	81	0	46	51	4
	Eu	<0.01	2.61	3.45	0.22	6.28	6.94	90	0	42	55	4
	Gd	<0.01	14.58	19.07	0.77	34.42	32.63	105	0	42	55	2
	Tb	<0.01	1.80	3.86	0.11	5.78	6.26	92	0	31	67	2
	Dy	<0.01	9.07	24.62	0.64	34.33	32.99	104	0	26	72	2
	Y	<0.01	43.21	81.26	3.24	127.7	105.3	121	0	34	64	3
	Ho	<0.01	1.77	5.08	0.13	6.99	6.13	114	0	25	73	2
	Er	<0.01	4.71	14.86	0.41	19.97	17.24	116	0	24	74	2
	Tm	<0.01	0.59	2.26	0.06	2.91	2.37	123	0	20	78	2
	Yb	<0.01	3.39	14.77	0.41	18.58	15.20	122	0	18	80	2
	Lu	<0.01	0.53	2.29	0.06	2.89	2.35	123	0	18	79	2
	ΣREY	<0.01	657.6	665.4	29.63	1353	1134	119	0	49	49	2
	%HREY	24.47	12.51	25.78	20.46	19.21	20.05					
	Ce/Ce*	1.78	2.18	4.58	1.28	2.90	2.25					
	Eu/Eu*	0.67	0.96	1.03	1.25	1.00	1.06					
	Y _n /Ho _n	1.66	0.89	0.59	0.89	0.67	0.63					
	La _n /Yb _n	0.83	2.25	0.19	0.82	0.58	0.61					
ZSQD253A	La	<0.01	60.48	18.20	1.41	80.08	101.5	79	0	76	23	2
	Ce	<0.01	309.6	197.5	5.97	513.0	744.2	69	0	60	38	1
	Pr	<0.01	7.85	10.47	0.41	18.74	20.64	91	0	42	56	2

Minerals

	Nd	<0.01	31.12	22.81	1.86	55.78	90.01	62	0	56	41	3
	Sm	<0.01	5.15	5.93	0.42	11.50	21.02	55	0	45	52	4
	Eu	<0.01	1.38	1.70	0.14	3.21	5.49	59	0	43	53	4
	Gd	<0.01	8.56	9.05	0.40	18.01	28.34	64	0	48	50	2
	Tb	<0.01	1.03	1.78	0.05	2.86	3.85	74	0	36	62	2
	Dy	<0.01	5.43	11.71	0.32	17.45	21.60	81	0	31	67	2
	Y	<0.01	33.88	42.21	1.58	77.67	87.51	89	0	44	54	2
	Ho	<0.01	1.16	2.50	0.07	3.73	4.38	85	0	31	67	2
	Er	<0.01	3.21	7.48	0.20	10.89	12.93	84	0	29	69	2
	Tm	<0.01	0.41	1.17	0.03	1.61	1.83	88	0	26	73	2
	Yb	<0.01	2.33	7.92	0.20	10.45	11.97	87	0	22	76	2
	Lu	<0.01	0.39	1.25	0.03	1.67	1.90	88	0	23	75	2
	ΣREY	<0.02	471.9	341.6	13.08	826.7	1157	71	0	57	41	2
	%HREY	22.49	12.24	25.40	23.06	17.85	15.54					
	Ce/Ce*	2.39	3.12	2.97	1.79	3.03	3.72					
	Eu/Eu*	0.59	0.91	1.03	1.61	0.99	1.01					
	Y _n /Ho _n	0.98	1.07	0.62	0.88	0.76	0.73					
	La _n /Yb _n	0.76	1.91	0.17	0.52	0.56	0.62					
ZSQD42A	La	<0.01	96.22	70.73	9.18	176.1	228.5	77	0	55	40	5
	Ce	<0.01	307.2	661.9	54.85	1024	959.0	107	0	30	65	5
	Pr	<0.01	10.16	20.35	2.77	33.28	39.80	84	0	31	61	8
	Nd	<0.01	38.47	76.49	12.37	127.33	168.77	75	0	30	60	10
	Sm	<0.01	5.87	17.88	2.56	26.31	38.29	69	0	22	68	10
	Eu	<0.01	1.57	6.00	0.52	8.09	9.46	85	0	19	74	6
	Gd	<0.01	9.64	38.61	2.05	50.30	46.11	109	0	19	77	4
	Tb	<0.01	1.03	4.23	0.19	5.45	6.34	86	0	19	78	4
	Dy	<0.01	3.46	23.49	0.78	27.74	33.85	82	0	12	85	3
	Y	<0.01	25.29	97.66	3.06	126.0	148.3	85	0	20	77	2

Minerals

	Ho	<0.01	0.73	5.47	0.14	6.34	8.42	75	0	11	86	2
	Er	<0.01	1.91	17.02	0.40	19.33	23.83	81	0	10	88	2
	Tm	<0.01	0.23	2.61	0.06	2.89	3.27	88	0	8	90	2
	Yb	<0.01	1.22	16.88	0.39	18.49	20.63	90	0	7	91	2
	Lu	<0.01	0.19	2.59	0.06	2.84	3.14	90	0	7	91	2
	ΣREY	<0.01	503.2	1062	89.37	1655	1738	95	0	30	64	5
	%HREY	21.15	9.00	20.21	8.55	16.17	17.46					
	Ce/Ce*	2.53	2.09	3.97	2.47	3.05	2.28					
	Eu/Eu*	0.70	0.92	0.95	1.05	0.95	1.03					
	Y _n /Ho _n	0.76	1.28	0.65	0.81	0.73	0.65					
	La _n /Yb _n	0.56	5.80	0.31	1.74	0.70	0.82					
HYD66-2	La	<0.01	80.45	41.87	36.45	158.8	222.9	71	0	51	26	23
	Ce	<0.01	619.7	759.9	299.8	1679	1552	108	0	37	45	18
	Pr	<0.01	13.06	20.79	11.60	45.45	49.33	92	0	29	46	26
	Nd	<0.01	47.03	82.02	52.43	181.5	200.6	90	0	26	45	29
	Sm	<0.01	6.63	20.70	10.90	38.23	45.12	85	0	17	54	29
	Eu	<0.01	2.10	6.03	2.15	10.29	10.91	94	0	20	59	21
	Gd	<0.01	12.07	33.30	8.99	54.37	54.07	101	0	22	61	17
	Tb	<0.01	1.23	3.47	0.70	5.40	7.10	76	0	23	64	13
	Dy	<0.01	2.95	21.93	1.97	26.84	36.48	74	0	11	82	7
	Y	<0.01	17.20	60.32	3.05	80.58	98.03	82	0	21	75	4
	Ho	<0.01	0.60	4.41	0.25	5.27	6.82	77	0	11	84	5
	Er	<0.01	1.61	12.76	0.54	14.91	19.14	78	0	11	86	4
	Tm	<0.01	0.20	1.90	0.05	2.15	2.67	80	0	9	89	2
	Yb	<0.01	1.07	12.32	0.27	13.66	16.89	81	0	8	90	2
	Lu	<0.01	0.17	1.86	0.04	2.07	2.54	82	0	8	90	2
	ΣREY	<0.01	806.1	1084	429.2	2319	2324	100	0	35	47	19
	%HREY	19.32	4.86	14.61	4.20	9.29	10.96					

Minerals

	Ce/Ce*	2.54	4.31	5.50	3.30	4.50	3.39					
	Eu/Eu*	0.50	1.01	1.01	1.01	1.01	1.01					
	Y _n /Ho _n	0.96	1.04	0.50	0.45	0.56	0.53					
	La _n /Yb _n	0.46	5.55	0.25	9.98	0.86	0.97					
NASD44-1	La	<0.01	55.32	89.28	59.78	204.4	237.4	86	0	27	44	29
	Ce	0.01	94.33	399.1	278.7	772.2	924.7	84	0	12	52	36
	Pr	<0.01	3.68	16.66	15.46	35.80	45.01	80	0	10	47	43
	Nd	<0.01	12.91	68.61	69.97	151.5	187.0	81	0	9	45	46
	Sm	<0.01	1.71	15.42	13.00	30.13	38.27	79	0	6	51	43
	Eu	<0.01	0.74	4.56	2.76	8.07	9.95	81	0	9	57	34
	Gd	<0.01	3.47	24.20	11.44	39.11	49.78	79	0	9	62	29
	Tb	<0.01	0.40	4.49	0.96	5.86	6.95	84	0	7	77	16
	Dy	<0.01	2.28	29.09	3.00	34.36	40.35	85	0	7	85	9
	Y	<0.01	20.51	108.0	5.49	134.0	146.5	92	0	15	81	4
	Ho	<0.01	0.55	6.30	0.39	7.25	8.36	87	0	8	87	5
	Er	<0.01	1.58	18.69	0.84	21.11	24.76	85	0	8	89	4
	Tm	<0.01	0.20	2.86	0.07	3.12	3.61	86	0	6	91	2
	Yb	<0.01	1.13	18.62	0.38	20.12	23.40	86	0	6	93	2
	Lu	<0.01	0.20	2.88	0.05	3.13	3.65	86	0	6	92	2
	ΣREY	0.01	199.0	808.8	462.3	1470	1750	84	0	14	55	31
	%HREY	18.02	15.61	27.16	5.49	18.78	18.13					
	Ce/Ce*	2.02	1.26	2.36	2.10	2.05	2.04					
	Eu/Eu*	0.47	1.28	1.04	1.05	1.06	1.03					
	Y _n /Ho _n	0.81	1.36	0.63	0.51	0.68	0.64					
	La _n /Yb _n	1.16	3.62	0.35	11.67	0.75	0.75					
MP4SD24-1	La	0.04	88.18	79.59	40.42	208.2	181.8	115	0	42	38	19
	Ce	0.21	184.3	431.4	214.2	830.2	883.1	94	0	22	52	26
	Pr	0.01	4.76	12.19	9.16	26.11	30.37	86	0	18	47	35

Minerals

Nd	0.03	18.09	46.98	43.02	108.1	130.4	83	0	17	43	40
Sm	0.01	2.38	9.76	7.99	20.14	25.34	79	0	12	48	40
Eu	<0.01	1.23	3.29	1.63	6.16	7.21	85	0	20	53	27
Gd	0.01	5.07	21.87	7.05	33.99	33.75	101	0	15	64	21
Tb	<0.01	0.23	2.41	0.57	3.21	3.51	91	0	7	75	18
Dy	0.01	1.30	20.21	1.82	23.35	23.53	99	0	6	87	8
Y	0.03	14.19	97.17	5.11	116.5	123.0	95	0	12	83	4
Ho	<0.01	0.33	5.00	0.27	5.59	6.19	90	0	6	89	5
Er	<0.01	0.96	16.24	0.65	17.85	20.13	89	0	5	91	4
Tm	<0.01	0.12	2.53	0.07	2.72	2.86	95	0	4	93	2
Yb	<0.01	0.67	16.60	0.40	17.68	18.89	94	0	4	94	2
Lu	<0.01	0.12	2.64	0.06	2.82	3.22	88	0	4	94	2
ΣREY	0.35	321.9	767.9	332.4	1423	1493	95	0	23	54	23
%HREY	16.81	7.52	24.48	5.30	16.16	16.22					
Ce/Ce*	2.78	1.61	3.10	2.55	2.46	2.68					
Eu/Eu*	0.98	1.48	0.93	1.01	1.03	1.11					
Y _n /Ho _n	0.79	1.59	0.71	0.70	0.76	0.73					
La _n /Yb _n	0.76	9.70	0.35	7.36	0.87	0.71					

Table S2. Correlation coefficient matrix for the growth rate and REY in different mineral phases.

	Growth rate	Total REY	REY in L2	REY in L3	REY in L4
Growth rate	1				
Total REY	−0.84	1			
REY in L2	0.18	0.22	1		
REY in L3	−0.71	0.91	0.17	1	
REY in L4	−0.77	0.79	−0.22	0.66	1

Note: please find Table S3 in File 2.

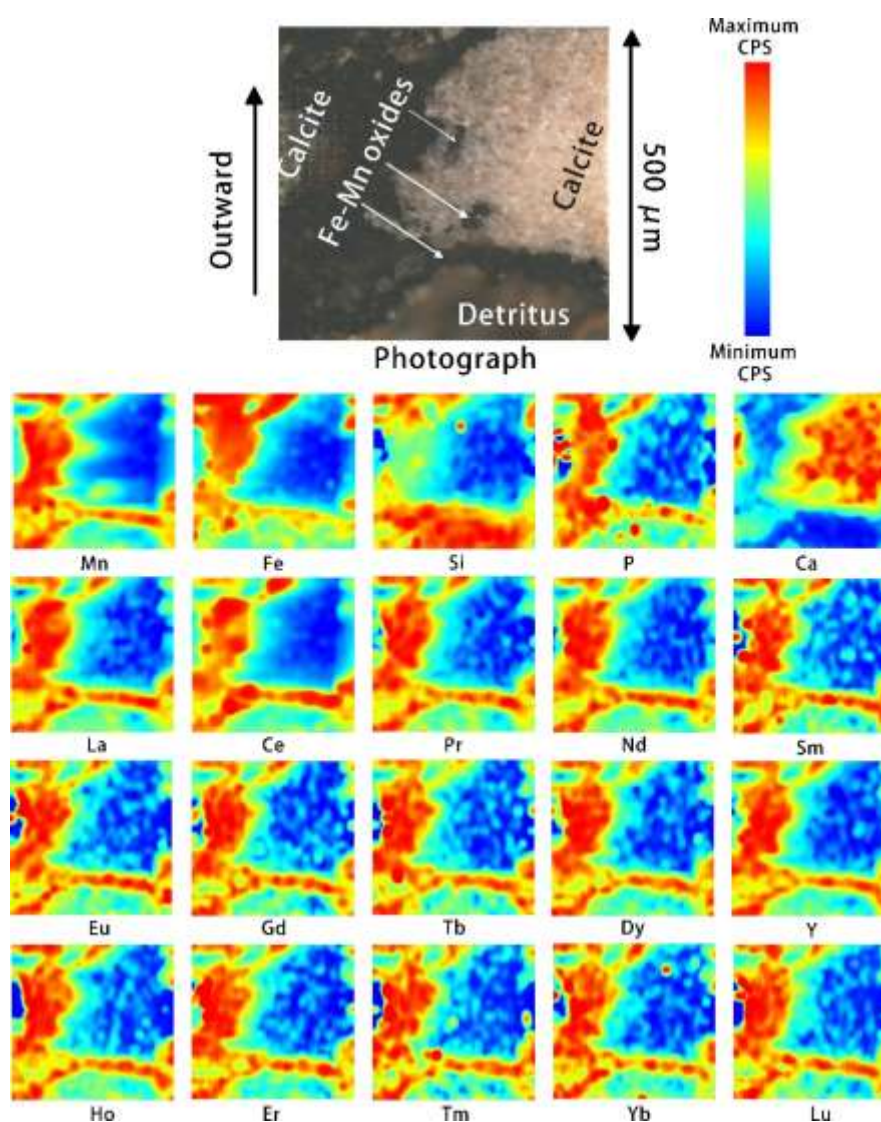


Figure S1. Microscope photograph of sample ST1 and the elemental maps determined by LA-ICP-MS.

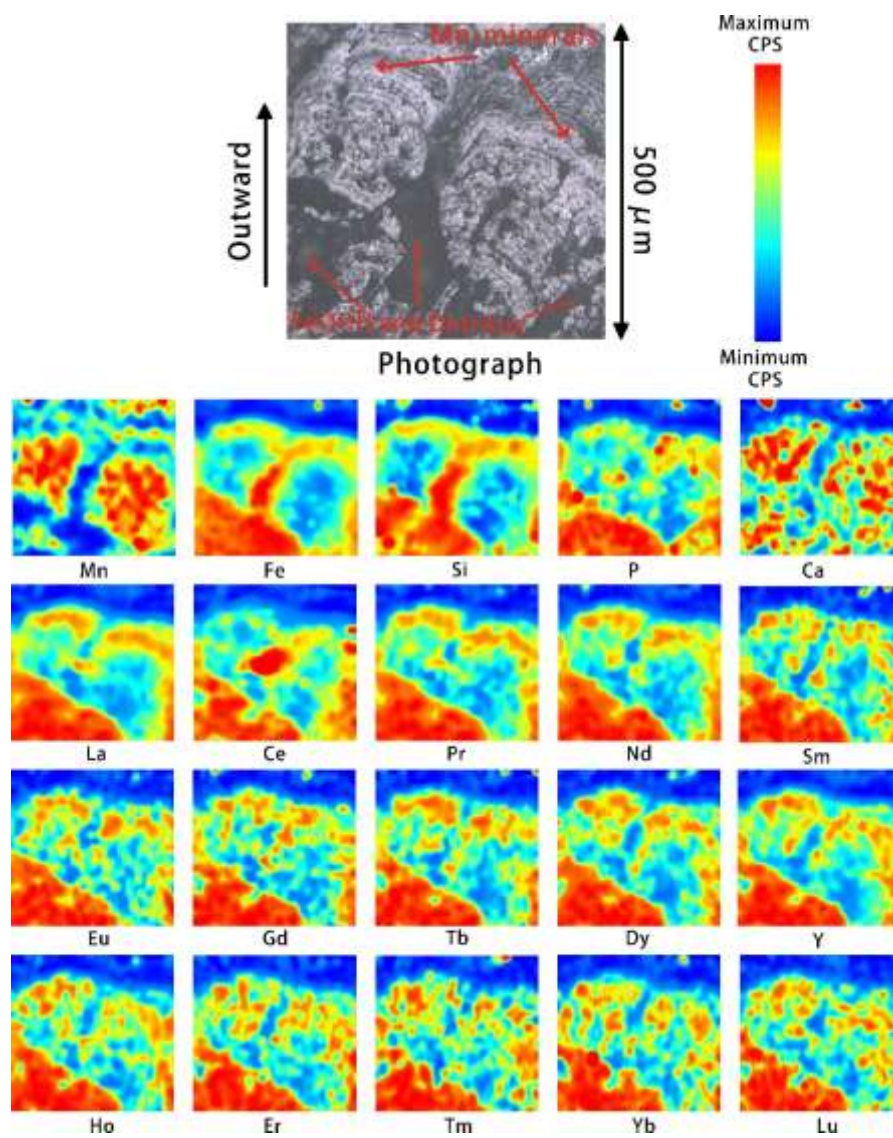


Figure S2. Microscope photograph of sample HYD66-2 and the elemental maps determined by LA-ICP-MS.

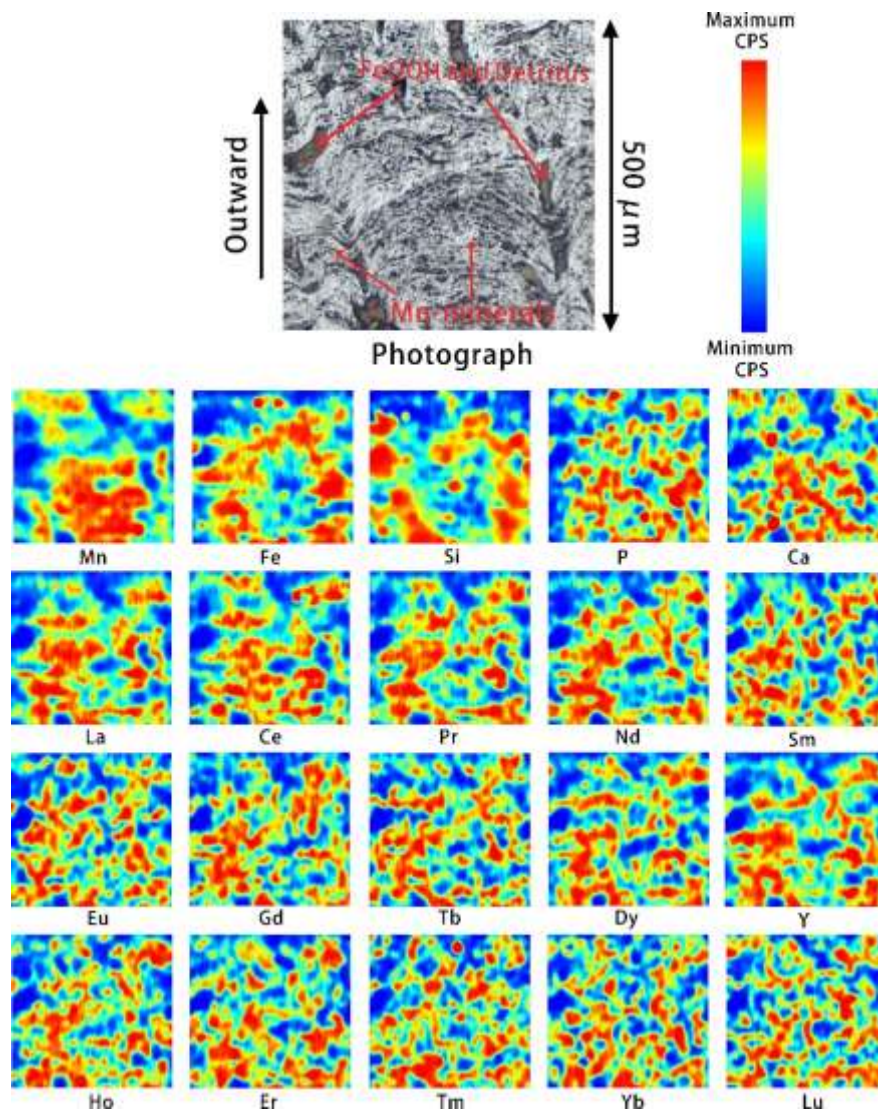


Figure S3. Microscope photograph of sample NASD44-1 and the elemental maps determined by LA-ICP-MS.