

Chelation-Assisted Ion-Exchange Leaching of Rare Earths from Clay Minerals

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Table S1. Individual rare earth extraction levels with 0.25 mol/L $(\text{NH}_4)_2\text{SO}_4$ (AMS) in the presence of various chelating agents (1:1 ratio)

REE	Total Extraction (%) (leaching + washing)									
	0.5M NH_4^+	0.25M NH_4^+	EDTA- 0.25M NH_4^+	CITRIC -0.25M NH_4^+	NTA- 0.25M NH_4^+	EDDS- 0.25M NH_4^+	L- AspAcid- 0.25M NH_4^+	GLY- 0.25M NH_4^+	ASP- 0.25M NH_4^+	NTA- Na_3 - 0.25M NH_4^+
La	95	85	97	88	90	95	95	86	89	98
Ce	13	11	14	11	13	12	12	11	12	14
Pr	50	46	56	49	52	52	52	46	49	55
Nd	93	82	98	87	92	92	88	81	84	95
Sm	90	82	91	85	93	90	88	80	81	94
Eu	79	76	73	71	75	79	66	63	61	66
Gd	97	87	100	89	95	96	93	89	89	97
Tb	16	12	16	13	16	13	16	16	16	17
Dy	63	57	65	58	61	60	60	57	59	62
Ho	59	50	61	56	55	55	59	53	57	62
Er	79	69	80	74	78	76	70	69	70	75
Tm	44	38	50	41	44	46	44	43	42	47
Yb	22	18	21	21	22	21	19	18	18	20
Lu	36	27	33	26	30	23	26	30	25	28
Y	97	87	100	91	96	96	93	91	91	96
TREE	82	72	85	75	79	80	78	73	75	82

Table S2. Individual rare earth extraction levels with simulated sea water (SSW) containing ~ 0.48 mol/L NaCl in the presence of various chelating agents (1:1 ratio)

Total Extraction (%) (leaching + washing)											
REE	SSW	SSW/EDTA	SSW/NTA	SSW/NTA pH adj	SSW/Citric	SSW/Cit pH adj	SSW/AspAcid	SSW/EDDS	SSW_1/1 GLY	SSW/ASP	SSW/NTA-Na ₃
La	67	100	69	89	70	70	62	68	66	60	90
Ce	8	12	12	13	10	11	8	10	7	8	12
Pr	38	47	42	52	41	41	32	44	40	32	51
Nd	48	88	75	89	69	68	54	81	61	53	87
Sm	61	83	69	86	67	67	54	80	66	60	86
Eu	57	60	61	67	54	55	63	65	52	61	61
Gd	55	99	83	94	77	79	62	92	63	60	91
Tb	6	13	13	16	13	14	11	15	10	10	15
Dy	45	59	55	60	50	53	50	61	51	48	57
Ho	57	61	61	58	60	63	59	58	54	58	56
Er	54	73	70	72	62	66	58	76	59	56	68
Tm	24	37	42	45	37	39	30	44	28	27	44
Yb	11	21	20	20	18	19	13	22	14	12	19
Lu	24	30	35	27	24	26	20	35	29	16	26
Y	68	100	87	96	81	88	67	100	80	64	90
TREE	53	80	66	68	62	64	56	71	52	50	76