Characterisation of Fe-bearing particles and colloids in the Lena River basin, NE Russia

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Electronic Annex

	Location	Date	Latitude	Longitude	T Air	T H_2O	pH	Cond	Alkalinity	DOC	POC	D[Fe]	D[Al]
Lena River		**Y-M-D**	**(dec deg)**	**(dec deg)**	**^oC**	**^oC**		**(uS/cm^C)**	**(meqv/l)**	**mg/L**	**mg/L**	**µg/L**	**µg/L**
LR2012-32	Lena upstream outflow of Tuolba/Туолба	2012-07-27	60.6092	124.1884	13	15.7	7.9	174	1.1	12	7.7	97	64
LR2012-31	Lena upstream Kytyl-Diura/Кытыл-Дюра	2012-07-26	60.8722	125.6335	21	16.9	7.2	146	0.6	11	<DL	88	69
LR2012-34	Lena upstream Kytyl-Diura/Кытыл-Дюра	2012-07-27	60.8736	125.6437	22	15.8	7.4	159	1.0	12	6.8	260	190
LR2012-30	Lena at Sinsk/Синск, outflow of Siniaia/Синяя	2012-07-25	61.1079	126.8904	25	16.9	7.7	125	0.6	12	1.4	84	75
LR2012-28	Lena at Bulgunniakhtakh/Булгунняхтах, upstream outflow of Buotama/Буотама	2012-07-24	61.2637	128.7397	23	16.2	7.5	80	0.5	12	1.5	130	120
LR2012-04	Lena downstream Yakutsk/Якутск	2012-07-14	62.1577	129.9080	31	18.7	6.6	81	0.5	12	1.0	160	100
LR2012-01	Lena downstream Tupagino/Тупагино	2012-07-12	62.2626	130.0171	23	16.7	6.8	90	0.4	11	1.0	110	100
LR2012-25	Lena upstream Khatas/Хатас	2012-07-22	62.6491	129.9074	25	19.6	6.9	90	0.5	10	<DL	95	66
LR2012-03	Lena at Stolby/Столбы	2012-07-13	63.0193	129.6846	27	17.2	6.5	84	0.4	11	1.0	130	100
LR2013-78	Lena at Kharyialakh/Харыялах	2013-06-28	63.1326	129.6232	26	19.8	7.6	139	0.7	7.1	0.2	34	39
LR2012-02	Lena upstream outflow of Aldan/Алдан	2012-07-12	63.3879	129.5392	25	16.7	6.6	69	0.4	12	0.8	100	88
LR2013-75	Lena upstream outflow of Belianka/Белянка	2013-06-27	63.5281	128.8599	24	16.3	7.6	92	0.7	8.0	0.1	55	37
LR2013-73	Lena between outflow of Belianka/Белянка and Kengkeme/Кенгкеме	2013-06-27	63.4904	128.8030	23	18.1	7.3	142	0.7	8.1	0.2	38	20
LR2013-71	Lena upstream Sangar/Сангар	2013-06-27	63.8859	127.5421	***	16.1	7.4	85	0.7	8.6	0.4	67	72
LR2013-39	Lena upstream outflow of Viliui/Вилюи	2013-06-12	64.2182	126.8643	25	12.0	7.6	101	1.0	12	0.5	94	47
LR2013-41	Lena downstream outflow of Viliui/Вилюи	2013-06-13	64.3944	126.3658	28	18.9	7.0	140	0.9	15	0.8	84	7
LR2013-57	Lena downstream outflow of Linde/Линде and Dianyshka/Дянышка	2013-06-21	65.0511	124.8055	22	149	7.0	83	0.7	11	0.2	65	53
LR2013-54	Lena channel (close to North Polar circle)	2013-06-19	65.9485	123.9140	18	19.5	7.1	128	0.7	14	0.6	100	17
LR2013-48	Lena upstream outflow of Muna/Муна	2013-06-16	67.8737	123.0922	24	16.1	7.1	121	0.7	13	0.1	120	22
LR2013-49	Lena channel downstream outflow of Muna/Муна	2013-06-16	67.9290	123.0020	28	16.1	7.0	130	0.3	14	0.3	120	19
LR2013-45	Lena downstream Dzhardzhan/Джарджан	2013-06-15	68.7433	123.9965	21	14.2	7.1	91	0.7	10	0.4	84	24

E.A. Table 1. Sample location and measured field parameters for July 2012 and June 2013. Measured field parameters include particualate organic carbon (POC), dissolved organic carbon (DOC) and dissolved (< 0.22 µm) Fe and Al concentrations. Parameters that were not measured are denoted with ***.

	Location	Date	Latitude	Longitude	T Air	T H_2O	pH	Cond	Alkalinity	DOC	POC	D[Fe]	D[Al]
Aldan River		**Y-M-D**	**(dec deg)**	**(dec deg)**	^{o}C	^{o}C		(uS/cm^{C})	(meqv/l)	mg/L	mg/L	µg/L	µg/L
LR2012-13	Aldan upstream of outflow Amga/Амга	2012-07-19	62.6382	134.9218	18	19.1	7.7	86	0.7	8.4	0.4	77	73
LR2012-11	Aldan upstream Megino-Aldan/Мегино-Алдан,	2012-07-18	62.7105	134.6952	22	18.5	7.3	99	0.7	8.0	<DL	100	67
LR2012-09	Aldan upstream research site Mammals Task	2012-07-18	62.9228	134.1727	***	18.4	7.5	94	0.7	8.7	<DL	110	76
LR2012-08	Aldan downstream outflow of Baraiy/Барайы	2012-07-17	63.2231	133.2461	25	17.9	7.1	92	0.7	8.8	0.3	110	84
LR2012-05	Aldan downstream outflow of Baibakan/Байбакан	2012-07-16	63.3495	131.6770	20	18.3	7.1	91	0.6	8.8	0.4	110	90
LR2012-22	Aldan at outflow	2012-07-21	63.4381	129.6666	***	19.2	6.8	105	0.6	9.5	0.2	150	71
LR2013-38	Aldan upstream outflow of Aldan	2013-06-12	63.4338	129.6398	19	10.9	7.4	86	0.8	13	1.1	100	57
Viliui River													
LR2013-62	Viliui at Viliuisk/Вилюйск	2013-06-23	63.7582	121.5982	25	20.0	7.4	111	0.7	13	0.4	69	8
LR2013-60	Viliui downstream Kysyl-Syr/Кысыл-Сыр	2013-06-23	63.9089	123.1456	24	19.4	7.2	110	0.7	13	0.4	78	7
LR2013-59	Viliui downstream Khatyryk-Khomo/Хатырык-Хомо	2013-06-22	63.8700	125.1667	24	20.0	7.2	110	0.7	13	0.5	28	7
LR2013-66	Viliui 42 km from outflow	2013-06-24	64.0530	126.0691	24	19.4	7.4	112	0.7	13	0.8	53	5
LR2013-40	Viliui by outflow	2013-06-13	64.3279	126.3720	21	17.9	7.2	140	0.9	15	1.0	91	6

E.A. Table 1 continued. Sample location and measured field parameters for July 2012 and June 2013. Measured field parameters include particualate organic carbon (POC), dissolved organic carbon (DOC) and dissolved (< 0.22 µm) Fe and Al concentrations. Parameters that were not measured are denoted with ***.

	Location	Date	Latitude	Longitude	T Air	T H_2O	pH	Cond	Alkalinity	DOC	POC	D[Fe]	D[Al]
Central Plateau		**Y-M-D**	**(dec deg)**	**(dec deg)**	**^{o}C**	**^{o}C**		**(uS/cm^{C})**	**(meqv/l)**	**mg/L**	**mg/L**	**µg/L**	**µg/L**
LR2012-29	Siniaia/Синяя	2012-07-25	61.1461	126.8620	25	23.4	8.6	163	1.6	25	1.8	92	6
LR2012-36	Siniaia/Синяя	2012-07-28	61.1679	126.8676	23	23.8	9.4	171	1.6	25	1.7	55	7
LR2012-35	Siniaia/Синяя	2012-07-28	61.1650	126.9109	17	22.3	9.0	170	1.6	25	1.7	60	11
LR2013-72	Kengkeme/Кенгкеме	2013-06-27	63.4677	128.7898	23	19.1	7.4	201	0.9	9.4	0.5	76	12
LR2013-69	Berge-Tiugene/Берге-Тюгене	2013-06-26	63.9742	127.0290	22	18.8	7.5	346	1.3	11	0.6	46	1
LR2013-68	Lungkha/Лунгха	2013-06-26	64.1086	126.7405	22	19.6	7.5	288	1.2	11	0.9	68	2
LR2013-61	Tiung/Тюнг	2013-06-23	63.7803	121.5229	25	22.9	7.6	118	1.2	12	0.6	80	2
LR2013-63	Tangnary/Тангнары	2013-06-24	64.0249	123.8851	24	19.2	7.0	50	0.4	14	0.8	190	7
LR2013-64	Bappagai/Баппагай	2013-06-24	64.0276	124.0923	21	17.7	8.4	159	1.1	15	0.6	14	4
LR2013-65	Uoranga/Уоранга	2013-06-24	64.0268	124.3988	25	18.4	7.2	70	0.6	21	2.6	280	6
LR2013-55	Linde/Линде	2013-06-21	64.9520	124.5962	22	20.6	6.7	58	0.5	16	0.8	200	7
LR2013-43	Outflow at Zhigansk/Жиганск	2013-06-14	66.7711	123.3601	26	16.2	6.9	52	0.3	9.4	0.5	170	21
LR2013-52	Khoruogka/Хоруонгка	2013-06-17	67.2141	123.1354	20	21.2	7.3	42	0.3	12	0.6	170	11
LR2013-50	Muna/Муна	2013-06-16	67.8762	123.0364	30	16.9	7.1	134	0.7	13	0.5	130	25
LR2012-37	Oddokun/Оддокун	2012-07-29	61.1946	128.2840	21	12.5	7.3	336	3.5	41	0.9	110	9
LR2012-26	Tamma/Тамма	2012-07-24	61.9038	129.8471	***	19.0	7.2	106	0.7	11	0.5	190	51
LR2012-15		2012-07-19	62.9464	134.0083	19	8.6	6.5	145	1.5	21	<DL	160	29

E.A. Table 1 continued. Sample location and measured field parameters for July 2012 and June 2013. Measured field parameters include particualate organic carbon (POC), dissolved organic carbon (DOC) and dissolved (< 0.22 µm) Fe and Al concentrations. Parameters that were not measured are denoted with ***.

	Location	Date	Latitude	Longitude	T Air	T H_2O	pH	Cond	Alkalinity	DOC	POC	D[Fe]	D[Al]
Verkhoyansk Mountains		**Y-M-D**	**(dec deg)**	**(dec deg)**	**^oC**	**^oC**		**(uS/cm^C)**	**(meqv/l)**	**mg/L**	**mg/L**	**µg/L**	**µg/L**
LR2012-10	Tompo/Томпо	2012-07-18	62.7084	134.7211	22	16.4	7.0	148	1.0	2.6	<DL	12	6
LR2012-16	De pinne/Де пинне, Uiana/Уяна, Paygy/Паыгы	2012-07-20	63.1032	134.0383	23	14.6	6.3	103	0.4	3.9	0.5	87	6
LR2012-07	Baraiy/Барайы/Baraiy	2012-07-17	63.2044	133.2340	25	15.6	7.0	168	0.7	1.6	0.1	22	2
LR2012-18	No name - upstream Urasa iuriage/Ураса Юряге	2012-07-20	63.3677	133.2736	24	19.9	6.6	118	1.1	23	0.3	79	15
LR2012-19	Urasa/iuriage/Ураса Юряге	2012-07-20	63.3858	133.1368	26	14.8	6.6	50	0.2	3.3	0.1	110	7
LR2012-06	Tukulan/Тукулан	2012-07-16	63.3209	131.9309	20	16.4	7.4	206	0.8	1.3	0.1	7	2
LR2012-20	Baibakan/Байбакан	2012-07-20	63.3558	131.7531	***	18.0	6.8	60	0.5	2.7	<DL	32	4
LR2012-21	Kele/Келе	2012-07-21	63.3439	130.3790	22	18.1	7.0	244	0.7	2.0	0.1	80	4
LR2012-23	Tumara/Тумара	2012-07-21	63.4614	129.5693	23	22.3	7.1	170	0.7	4.9	<DL	48	26
LR2013-77	Tumara/Тумара	2013-06-28	63.4680	129.5941	23	15.3	7.6	206	0.8	2.0	0.2	34	2
LR2012-24	Batamai/Батамай	2012-07-21	63.5202	129.3997	***	18.7	6.8	50	0.3	2.8	0.3	45	7
LR2013-76	Batamai/Батамай	2013-06-28	63.5220	129.3962	18	14.8	7.5	49	0.3	2.9	0.1	32	4
LR2013-74	Belianka/Белянка	2013-06-27	63.5202	128.8318	24	17.0	7.8	93	0.6	1.9	0.1	3	2
LR2013-70	Chochuma/Чочума	2013-06-26	64.0191	127.3501	***	19.3	7.4	88	0.6	6.0	0.2	40	9
LR2013-67	Liunkiubei/Люнкюбей	2013-06-26	64.1635	126.9666	25	16.2	7.2	73	0.6	7.1	0.2	35	14
LR2013-58	Liapiske/Ляписке	2013-06-22	64.6001	125.7179	16	15.5	7.1	89	0.7	10	0.1	72	48
LR2013-56	Dianyshka/Дянышка	2013-06-21	65.0055	124.9441	23	14.1	7.3	178	0.7	4.9	0.3	20	15
LR2013-53	Undiuliung/Ундюлюнг	2013-06-18	66.2328	124.1613	27	18.1	7.2	159	0.6	2.8	0.3	20	5
LR2013-51	Sobolokh Maian/Соболох Маян	2013-06-17	67.2521	123.4084	20	15.8	7.4	140	0.7	4.3	0.3	38	10
LR2013-47	Menkere/Менкере	2013-06-16	68.0215	123.4150	28	11.2	7.1	104	0.6	5.3	1.4	39	17
LR2013-46	Natara/Натара	2013-06-15	68.3885	123.9737	19	15.7	7.1	64	0.3	5.7	0.4	84	19
LR2013-44	Dzhardzhan/Джарджан	2013-06-15	68.7325	124.0596	20	18.8	7.2	182	0.9	1.1	0.4	28	4
Stanovoy-Aldan Shield													
LR2012-33	Tuolba/Туолба	2012-07-27	60.5936	124.2726	19	17.7	8.2	305	1.2	43	<DL	21	2
LR2012-12	Amga/Амга	2012-07-19	62.6146	134.9228	18	20.3	8.2	299	2.8	7.0	<DL	21	3
LR2012-27	Buotama/Буотама	2012-07-24	61.2510	128.7695	24	20.6	8.0	310	3.4	6.9	0.5	61	2
LR2012-17	Tatta/Татта	2012-07-20	63.0203	133.4081	23	20.7	7.4	133	1.3	13	1.3	470	56

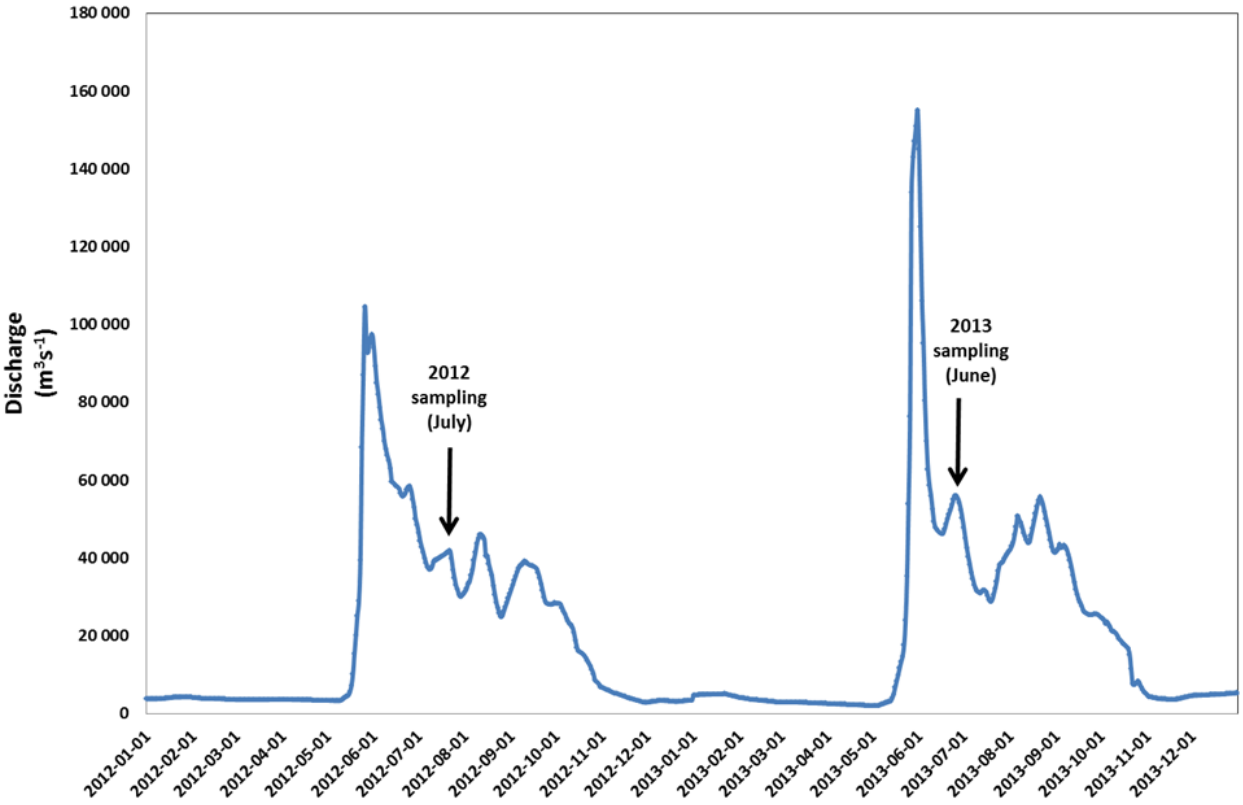
E.A. Table 1 continued. Sample location and measured field parameters for July 2012 and June 2013. Measured field parameters include particualate organic carbon (POC), dissolved organic carbon (DOC) and dissolved (< 0.22 µm) Fe and Al concentrations. Parameters that were not measured are denoted with ***.

		Fe Recovery	Fe	Al Recovery	Al	Mg Recovery	Mg	Mn Recovery	Mn
Sample Number	**Standard (+ filter)**	**%**	**µg/sample**	**%**	**µg/sample**	**%**	**µg/sample**	**%**	**µg/sample**
J1	BCR-2, filter	82	3900	120	4500	98	1100	90	69
L1	BCR-2, filter	96	7100	120	6600	110	1800	100	120
J2	BCR-2	94	5700	120	5500	100	1400	99	95
L2	BCR-2	160	6700	200	6600	170	1600	160	110
K1	W1, filter	88	8500	37	7200	52	4200	71	150
M1	W1, filter	96	5700	60	7200	63	3200	77	100
K2	W1, filter	95	9100	43	8300	52	4200	72	150
M2	W1	97	6200	61	8000	64	3500	77	110
N3	Lena Filter	***	420	***	290	***	41	***	16
H3	BCR-2, filter	87	8400	67	4800	26	560	80	120
I1	BCR-2, filter	89	8600	70	5000	27	580	73	110
H4	BCR-2, filter	92	8900	67	4800	31	660	81	120
I2	BCR-2, filter	84	8100	65	4700	32	690	76	120
H1	W1, filter	87	6600	27	4100	18	1200	64	110
I3	W1, filter	88	6700	32	4900	20	1300	62	100
H2	W1	***	***	26	3900	17	1100	***	***
I4	W1	80	6100	28	4200	19	1200	59	99

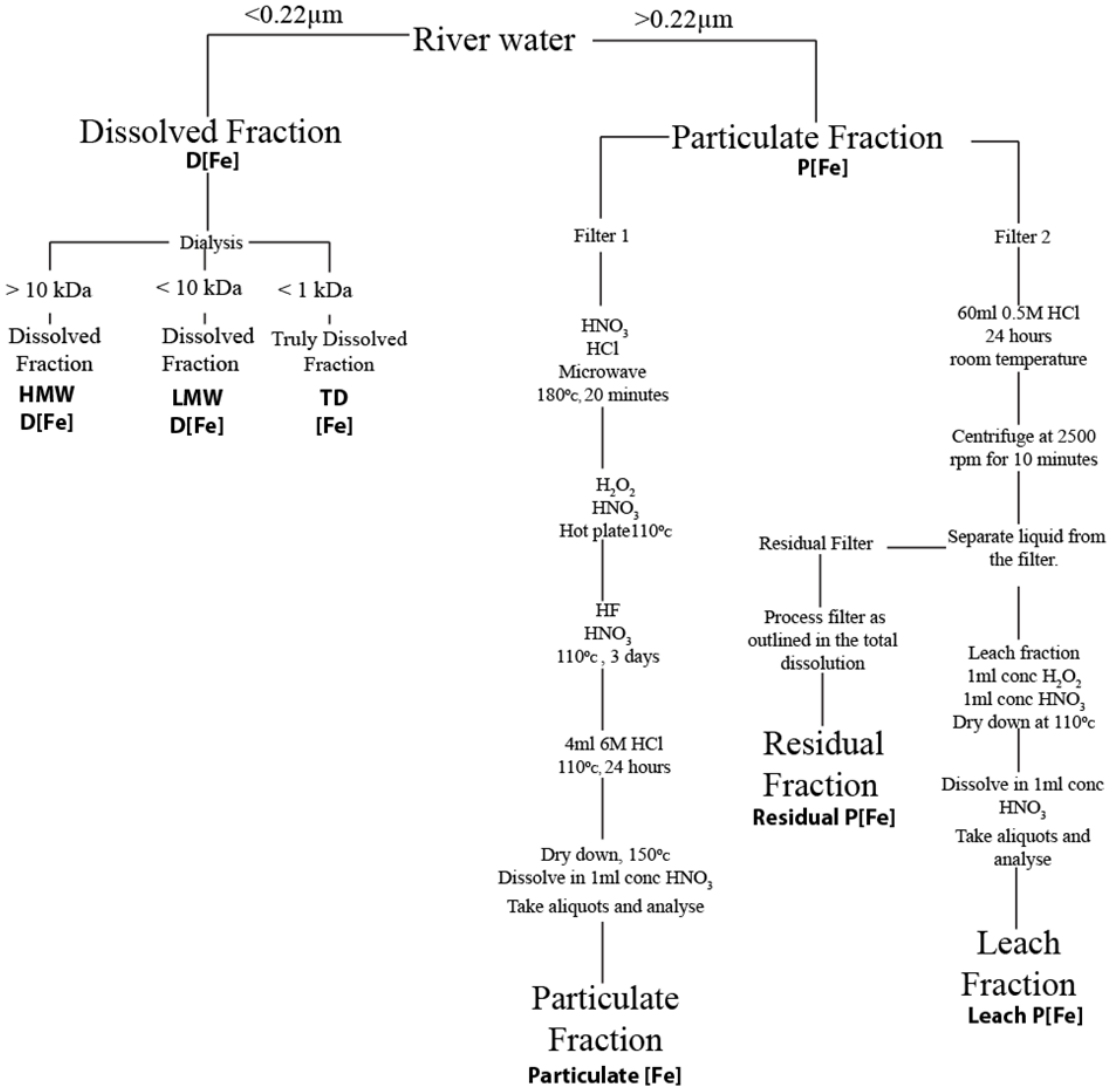
E.A. Table 2. Results from filter dissolution method development. Standard (BCR-2, basalt; W1, diorite) percentage recoveries of Fe, Al, Mg and Mn after total dissolution procedure (E.A. Fig. 2). The recoveries were tested both with and without a filter. All values are stated to 2 significant figures (2 s.f.).

	POC $_{>0.7\mu m}$	DOC $_{<0.7\mu m}$	DOC $_{< 10\ kDa}$	DOC $_{< 1\ kDa}$	P[Fe]	D[Fe] $_{<0.22\mu m}$	D[Fe] $_{<10kDa}$	D[Fe] $_{<1kDa}$
Lena River		**mg/L**				**µg/L**		
LR1	0.7	11	***	11	450	120	***	3
LR28	1.5	12	***	5.9	***	130	***	2
LR30	1.5	12	7.0	4.5	***	84	4	1
LR45	0.4	10	6.5	4.5	270	84	5	3
LR54	0.6	14	8.7	7.5	***	100	7	4
Aldan River								
LR5	0.4	8.8	***	6.4	220	110	7	4
LR9	<DL	***	***	***	***	110	6	7
LR38	1.2	13	6.4	4.4	***	100	7	5
Viliui River								
LR40	1.0	14	12	8,1	***	90	8	4
LR59	0.5	12	9.0	6.8	160	30	5	3
Central Plateau								
LR35	1.8	25	18	14	***	***	***	***
LR42	0.6	11	6.9	5.9	270	170	5	4
LR52	0.6	11	6.9	5.9	270	170	5	4
LR61	0.7	***	***	***	32	130	7	5
LR63	0.9	14	8.4	6.3	220	190	3	3
LR69	0.6	10	8.1	8.0	70	50	5	4
Verkhoyansk Mountains								
LR16	0.5	5.3	***	3.9	460	87	***	3
LR19	0.1	3.8	3.3	2.7	***	110	1	***
LR24	0.3	4.5	3.5	2.8	***	45	2	2
LR44	0.4	2.5	2.9	1.1	***	28	5	4
LR46	0.4	5.7	3.9	3.4	170	84	3	3
LR47	1.4	5.3	4.0	3.0	***	39	1	0
LR51	0.4	4.3	***	***	***	38	2	0
LR53	0.3	2.8	***	***	360	26	***	2
LR56	0.3	4.9	4.0	3.3	***	20	***	***
LR67	0.2	7.1	***	<DL	170	35	3	2
Stanovoy-Aldan Shield								
LR27	0.5	6.9	***	7.0	70	61	***	2
LR33	<DL	14	9.2	7.4	32	21	7	4

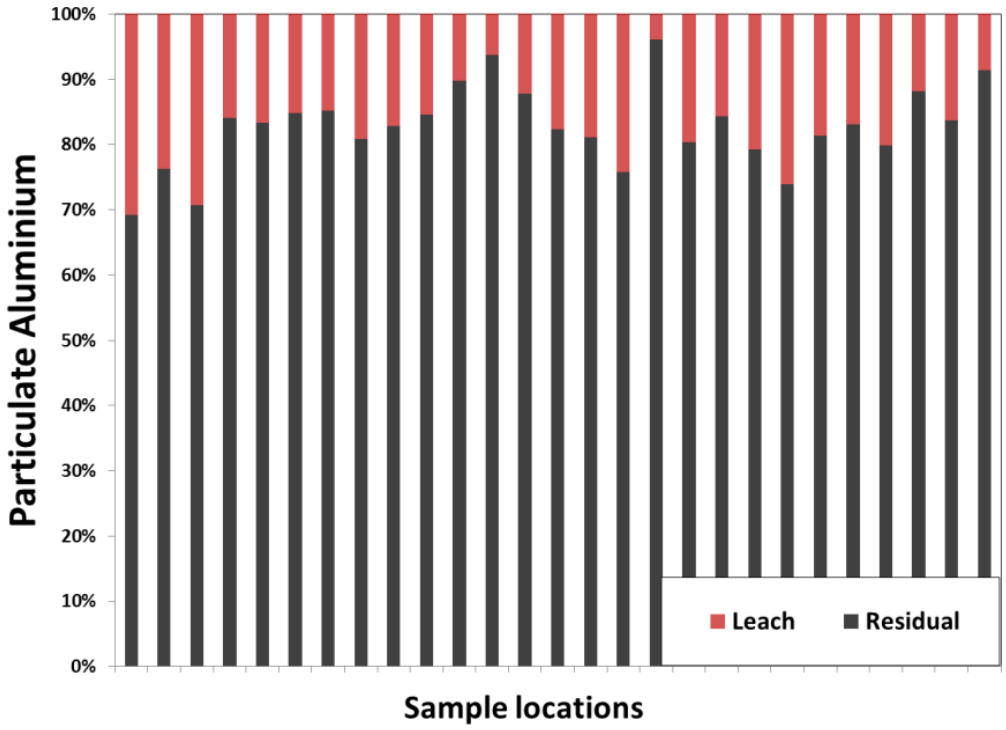
E.A. Table 3. Concentration of Fe and OC in the particulate and dissolved fractions in samples for which dialysis and/or particulate Fe and OC were analysed. Samples that were not analysed are denoted with ***. Samples below the detection limit are denoted with <DL. All values are stated to 2 significant figures.



E.A. Fig. 1 Lena River hydrograph, showing mean daily discharge measured at the Kusur hydrological station (70.68 N 127.39 E) and dates of sampling for the 2012 and 2013 field campaigns. Data is from the Arctic Great Rivers Observatory (NSF-1107774).



E.A. Fig. 2 Schematic diagram showing the Fe size and chemical separation methods used to isolate the Dissolved D[Fe], Leach P[Fe], Residual P[Fe] and Particulate [Fe] fractions.



E.A. Fig. 3 The average distribution of Al in the Leach P[Fe] and Residual P[Fe] fractions from the different sampled regions within the Lena River catchment area. In all regions, Al is predominantly in the residual fraction (>70 %). The HCl leach is an upper estimation of chemically reactive Fe in the catchment area, as some crystalline oxides, incorporating Al as a substitute cation, may also be dissolved.