Title:

Reactivity of iron minerals in the seabed towards microbial reduction – a comparison of different extraction techniques

Running title: Iron reactivity in sediments

Keywords: Iron, Fe reduction, sulfate reduction, sediment, Arctic, Svalbard

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Supplementary information:

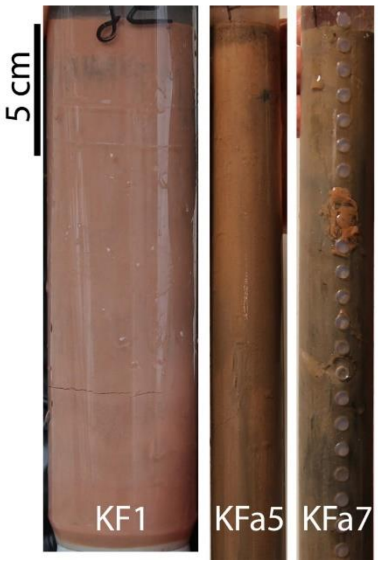

Figure S1: Sediment cores from the transect in Kongsfjorden with increasing distance from the glaciers from left to right.

Figure S2: Tubes with ferrihydrite inoculated (left) with *Shewanella frigidimarina* or uninoculated (right). In the left tube the ferrihydrite was dissolved by bacterial Fe(III) reduction and the liquid became colorless.

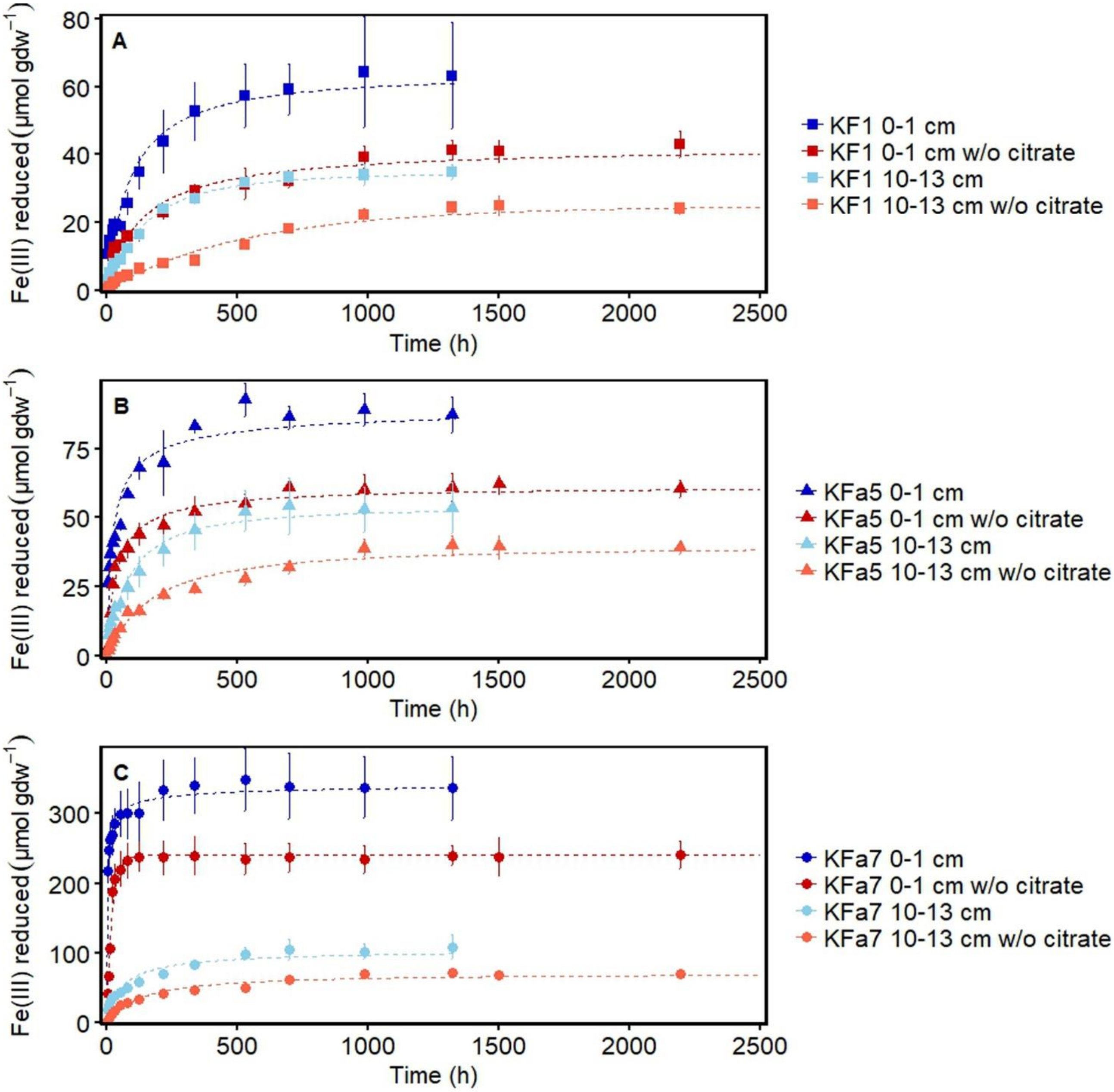

Figure S3. Comparison of the dissolution curves from the No Citrate Tests with the corresponding dissolution curves from the MFeR experiments. A) Station KF1, B) Station KFa5, C) Station KFa7. Dashed lines show fitted reactive continuum model.

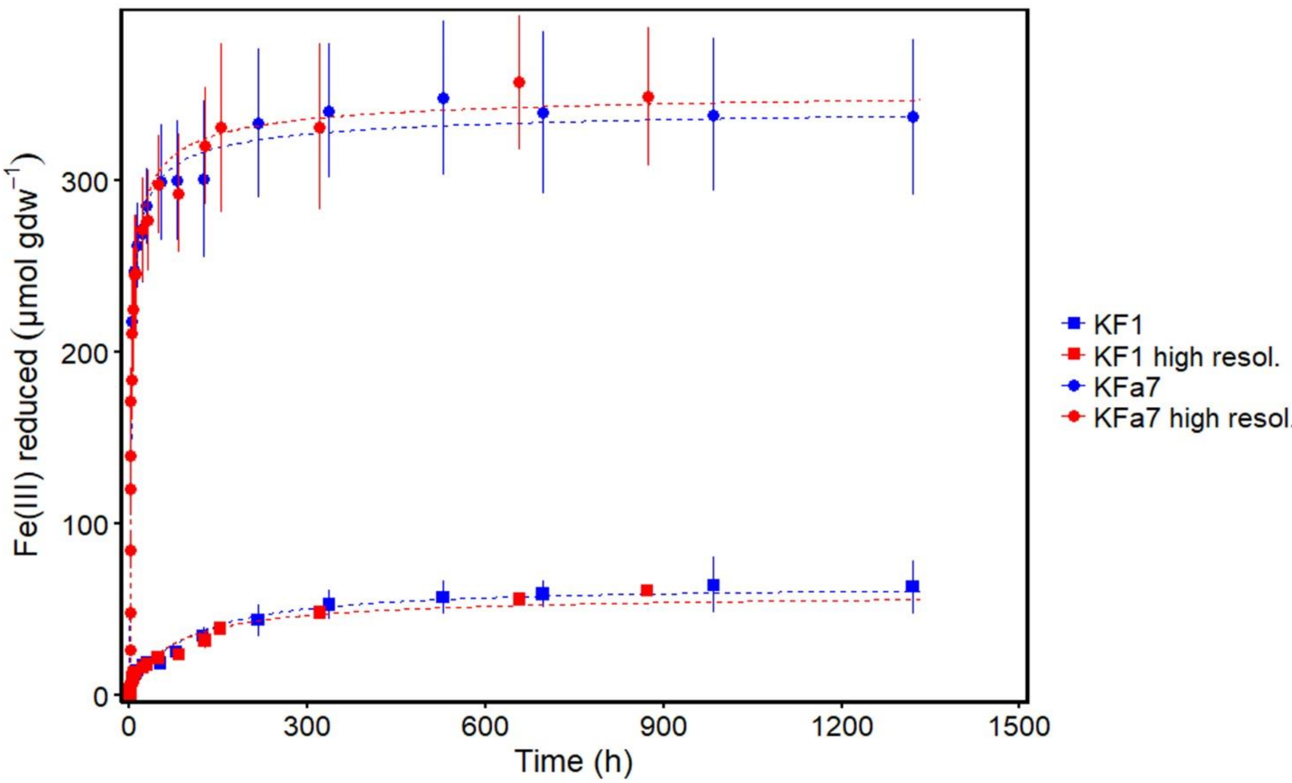

Figure S4. Initial Rate tests. Dissolution curves and fitted continuum reactivity models (dashed lines) for the MFeR experiment data from KF1 and KFa7 0-1 cm and the Initial Rate Tests, with high resolution sampling in the beginning.

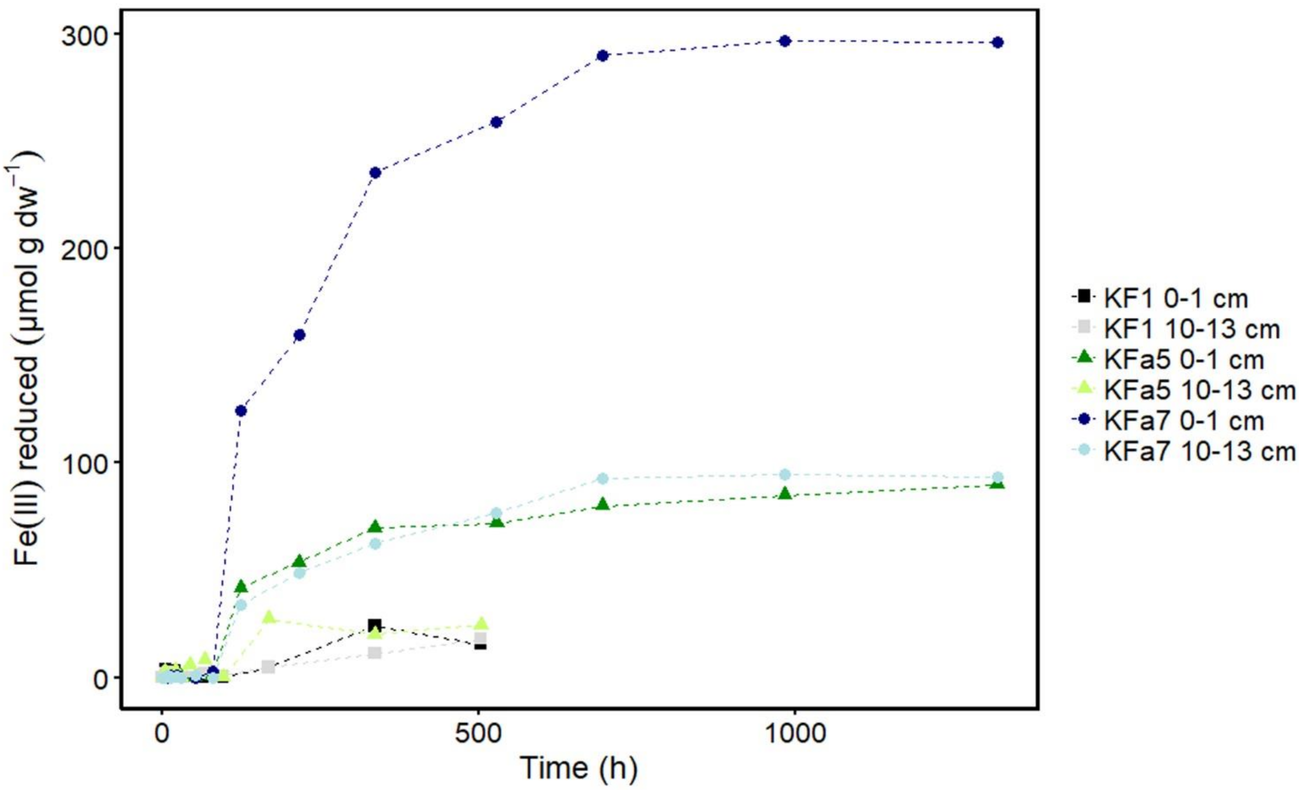

Figure S5. Fe(III) reduction of the native iron reducing community which served as controls for MFeR experiments without *S. frigidimarina*.

Table S1: Overview of tests performed to optimize the MFeR protocol. (FH = ferrihydrite).

Test name	Conditions and parameters varied
Amendment Tests	Triplicate tubes with 1.5 x 10^9 cells ml^{-1} of *S. frigidimarina* in ASW medium with either: (i) 10 mM FH, 10 mM lactate (ii) 10 mM FH, 10 mM lactate and 20 mM molybdate (iii) 10 mM FH, 10 mM lactate, 20 mM molybdate and 170 mM citrate
Citrate Concentration Test	1.5 x 10^9 cells ml^{-1} of *S. frigidimarina* in ASW medium with 10 mM lactate, 20 mM molybdate and A) 10 mM FH and (i) 10 mM citrate (ii) 20 mM citrate (iii) 50 mM citrate (iv) 10 mM citrate (v) 170 mM citrate (vi) 250 mM citrate B) 0.2-0.3 g fjord sediment (station P) and (i) 10 mM citrate (ii) 20 mM citrate (iii) 50 mM citrate (iv) 10 mM citrate (v) 170 mM citrate (vi) 250 mM citrate
No Citrate Test	Triplicate tubes with 3.5 x 10^9 cells ml^{-1} of *S. frigidimarina* in ASW medium with 10 mM lactate, 20 mM molybdate and 0.1-0.4 g of sediment from: (i) Station KF1 0-1 cm (ii) Station KFa5 0-1 cm (iii) Station KFa7 0-1 cm (iv) Station KF1 10-13 cm (v) Station KFa5 10-13 cm (vi) Station KFa7 10-13 cm
Cell Concentration Test	ASW with 10 mM lactate, 20 mM molybdate and 170 mM citrate with: (i) Fixed amount of fjord sediment (station P) and varying cell numbers of *S. frigidimarina* (uninoculated control to 1 x 10^{12} cells gdw^{-1}). (ii) Fixed cell number of *S. frigidimarina* (1.0 x 10^9 cells ml^{-1}) and varying amount of sediment (0.013-0.390 g) to reach cell concentrations of 6.7 x 10^{10} – 2x10^{12} cells gdw^{-1}.
Initial Rate Test	Triplicate tubes with 2.9 x 10^9 cells ml^{-1} of *S. frigidimarina* in ASW medium with with 10 mM lactate, 20 mM molybdate and 170 mM citrate and 0.1-0.2 g of sediment from: (i) KF1 0-1 cm (ii) KFa7 0-1 cm High frequency of samplings in first 10 h.

Table S2: Sulfate concentrations in sediment cores from the transect.

Sediment depth (cm)	Sulfate in pore water (mM)		
	KF1	KFa5	KFa7
0-1	28.3	27.0	28.1
1-2	27.8	27.7	28.6
2-3	28.5	28.3	28.6
3-4	n.d.	28.5	28.3
4-6	n.d.	27.9	28.4
6-8	n.d.	28.1	27.4
8-10	n.d.	27.7	28.1
10-13	n.d.	27.1	n.d.

Table S3: Results from sequential Fe extractions. HAHCl and Dithionite are reductive dissolution methods, thus all extracted Fe was Fe(II).

Station and depth (cm)	Extractant (Fe concentrations are in µmol gdw^{-1})									
	0.5 M HCl		6 M HCl		Na-acetate		HAHCl	Dithionite	Oxalate	
	Fe (II)	Fe (III)	Fe(II)	Fe(III)	Fe(II)	Fe(III)	Fe(II)	Fe(II)	Fe(II)	Fe(III)
KF1 0-1	60	11	250	310	36	16	52	91	60	10
KF1 1-2	73	12	350	240	35	9.7	41	77	46	9.4
KF1 3-4	68	15	210	290	24	12.0	42	72	42	7.9
KF1 6-8	49	13	190	230	28	7.7	42	70	36	7.0
KF1 10-13	45	5.8	190	220	23	8.0	40	65	32	9.0
KFa5 0-1	60	26	250	310	43	32	64	120	56	7.7
KFa5 1-2	190	35	570	770	41	48	96	160	70	14
KFa5 3-4	97	16	240	320	48	22	69	120	50	12
KFa5 6-8	110	21	300	390	44	24	46	110	60	5.0
KFa5 10-13	45	9.8	190	220	43	19	50	120	70	7.2
KFa7 0-1	40	220	300	280	14	230	150.0	120	34	12
KFa7 1-2	120	160	380	360	43	150	140	150	42	14
KFa7 3-4	200	84	430	300	92	13	76	140	45	8.1
KFa7 6-8	150	39	360	320	110	5.5	72	130	44	7.0
KFa7 10-13	170	8.3	340	340	80	43	92	130	54	5.3

Table S4: Concentrations of reactive Fe(III) as µmol cm^{-3}

	0.5 M HCl Fe(III) (µmol cm^{-3})	$M_{(0)}$ AFeR (µmol cm^{-3})
KF1 0-1	7.0	12
KF1 1-2	9.6	14
KF1 3-4	18	22
KF1 6-8	17	18
KF1 10-13	8.2	14
KFa5 0-1	12	24
KFa5 1-2	12	17
KFa5 3-4	11	25
KFa5 6-8	19	32
KFa5 10-13	9.4	15
KFa7 0-1	110	92
KFa7 1-2	89	77
KFa7 3-4	57	54
KFa7 6-8	31	51
KFa7 10-13	6.8	47