Supplementary material – Hassler and Schoemann

Intracellular and extracellular Fe pool were normalised in an attempt to identify parameters explaining the variability of Fe uptake for Antarctic phytoplankton (Table 1). The least variability was observed when Fe pool was normalised per surface area. The surface to volume, Chl *a* content or volume could not explain the variable Fe uptake for the 4 strains selected in this study. Contrary to what can be calculated for nutrient diffusive supply to phytoplankton (Pahlow et al., 1997), previous studies also showed a weak dependence for the maximal growth rate and Fe requirement for Antarctic phytoplankton on cell size, surface area or shape factor (Sommer 1989, Timmermans et al., 2004). However, Fe biological requirement for growth are usually higher for larger Antarctic diatoms (Timmermans et al., 2004). It is known that variable micro-organisms have different uptake strategies and that Fe uptake can be up-regulated under limiting conditions (e.g. Hutchins et al., 1999, Volker and Wolf-Gladow 1999). In addition, Fe limitation is also known to affect pigments and cellular Chl *a* composition (van Leeuwe and Stefels, 1998), cell size (Sunda and Huntsman, 1995) or Fe biological requirement (e.g. flavodoxin replacement of ferredoxin, e.g. Mc Kay et al., 2005). Fe biological requirement is also very different for variable phytoplankton. Fe half saturation constant for diatom growth in the Southern Ocean were 0.62 nM for a large *Thalassiosira* sp. (A = 12'000 μm^2), 0.19 nM for *Fragilariopsis kerguelensis* and estimated to 0.0006 nM for the small *Chaetoceros brevis* (A = 61 μm^2, Timmermans et al., 2001; 2004). Under these circumstances, it is not surprising that the variability of Fe uptake for the strains selected could not be explained by Chl *a*, surface to volume ratio or volume.

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Table 1. Intracellular Fe uptake rate (amole Fe cell-1 h-1) and extracellular Fe pool (amole Fe cell-1) normalised against cellular Chl *a* (pg Chl *a* $cell^{-1}$, determined by fluorimetry), surface area (A, μm^2), and cell aspect ratio (surface area to volume ratio, A/V, μm^{-1}) for *Phaeocystis sp.(Phaeo)*, *Chaetoceros sp.(Chaet)*, *Thalasiossira antarctica Comber* (*Thal*) and *Fragilariopsis kerguelensis* (*Frag*). For *Fragilariopsis* Fe/chain was normalised against A and A/V considering the average cells number per chain measured (27.7 cells/chain). The average of two replicates for each strain is shown with its half interval. Minimal and maximal inter-strain variation is shown for each parameter.

	Treatment	**Cellular fraction**	***Phaeo***	***Chaet***	***Thal***	***Frag***	**Min**	**Max**
Fe/cell	CONT	Fe int	0.89 ± 0.01	0.36 ± 0.01	3.27 ± 0.11	1.86 ± 0.05	1.8	9.0
		Fe ext	1.42 ± 0.01	0.58 ± 0.01	4.04 ± 0.23	9.76 ± 0.64	1.2	7.0
	Fe	Fe int	1.22 ± 0.04	0.59 ± 0.13	10.94 ± 0.05	2.22 ± 0.01	4.9	18.5
		Fe ext	4.24 ± 0.02	3.06 ± 0.13	9.76 ± 0.64	15.38 ± 0.36	1.6	5.0
Fe/Chl *a*	CONT	Fe int	1.45 ± 0.02	2.82 ± 0.08	0.03 ± 0.00	0.03 ± 0.00	1.9	88.1
		Fe ext	2.30 ± 0.01	4.49 ± 0.08	0.04 ± 0.00	0.06 ± 0.01	2.3	119.5
	Fe	Fe int	1.98 ± 0.06	4.59 ± 1.01	0.11 ± 0.00	0.04 ± 0.00	1.9	109.5
		Fe ext	6.86 ± 0.03	23.74 ±1.01	0.10 ± 0.01	0.27 ± 0.01	3.5	237.4
Fe/A	CONT ×100	Fe int	1.13 ± 0.02	0.59 ± 0.02	0.41 ± 0.01	0.20 ±0.01	1.4	5.7
		Fe ext	1.80 ± 0.01	0.94 ± 0.02	0.50 ± 0.03	1.05 ±0.07	1.1	3.6
	Fe ×100	Fe int	1.55 ±	0.96 ±	1.37 ±	0.24	1.1	6.5

			0.05	0.21	0.01	±0.001		
		Fe ext	5.37 ± 0.02	4.94 ± 0.13	1.22 ± 0.08	1.65 ±0.04	1.1	4.4
Fe/ (A/V)	CONT	Fe int	0.72 ± 0.01	0.12 ±0.000	6.95 ± 0.22	429.4 ± 11.5	6.0	383
		Fe ext	1.14 ± 0.01	0.29 ± 0.003	8.60 ± 0.49	2253 ± 147.7	3.9	7769
	Fe	Fe int	0.98 ± 0.03	0.30 ± 0.04	23.28 ± 0.10	512.4 ± 2.31	3.3	1708
		Fe ext	3.39 ± 0.02	1.53 ± 0.004	20.77 ± 1.36	3550 ± 83.1	2.2	2320
Fe/V	CONT ×100	Fe int	1.30 ± 0.02	1.18 ± 0.03	0.19 ± 0.01	0.02 ± 0.00	1.1	57
		Fe ext	2.06 ± 0.01	1.87 ± 0.03	0.23 ± 0.01	0.04 ± 0.01	1.1	49.2
	Fe ×100	Fe int	1.77 ± 0.05	1.91 ± 0.42	0.63 ± 0.00	0.03 ± 0.00	1.1	70.2
		Fe ext	6.15 ± 0.03	9.88 ± 0.51	0.56 ± 0.04	0.19 ± 0.00	1.6	52.3

Table 2. Short-term (2h) cellular carbon uptake rate (C_{int}, f mole C $cell^{-1}$ h^{-1}) in the control treatment (filtered Antarctic seawater) normalised against cellular Chl *a* (pg Chl *a* $cell^{-1}$), biovolume (V), surface area (A, μm^2 $cell^{-1}$), and surface to volume ratio (A/V, μm^{-1}) for *Phaeocystis sp. (Phaeo)*, *Chaetoceros sp.(Chaet)*, *Thalasiossira antarctica Comber (Thal)* and *Fragilariopsis kerguelensis (Frag).* For *Fragilariopsis* Fe/chain was normalised against A and A/V considering the average cells number per chain measured (27.7 cells/chain).The average of two replicates for each strain is shown with its half interval. Minimal and maximal inter-strain variation is shown for each parameter.

	Phaeo	***Chaet***	***Thal***	***Frag***	**Min**	**Max**
C/cell	61.2 ± 3.50	19.1 ± 0.39	937.6 ± 20.6	2417 ± 127	2.6	126.4
C/ Chl *a*	99.0 ± 5.66	148 ± 3.04	9.59 ± 0.21	41.8 ± 2.19	1.5	15.5
C/A	0.77 ± 0.04	0.31 ± 0.01	1.17 ± 0.03	2.59 ± 0.14	1.5	8.4
C/(A/V)	76.5 ± 4.37	9.51 ± 0.19	1995 ± 43.7	557991 ± 29218	8.0	58674
C/V	0.89 ± 0.05	0.62 ± 0.01	0.54 ± 0.01	0.31 ± 0.02	1.1	2.9