

Salp fecal pellets interaction with Iron biogeochemistry Consequences for the carbon pump

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INTRODUCTION

In the Southern Ocean, known as the largest high nutrient low chlorophyll (HNLC) region, **iron (Fe) availability** is paramount in controlling primary productivity with subsequent implications for **atmospheric carbon dioxide concentrations**. In those regions, Fe regenerated, stemmed from **recycling processes**, can account up to **90% of the total biological supply**. Zooplankton species have an important role to play in this contribution.

Salps, pelagic tunicates, are recognized to **strongly contribute to the vertical flux of biogenic carbon** due to the production of large, fast sinking **fecal pellets (FPs)**. Furthermore, their abundance will increase compared to krill (known to have an important role in Fe recycling) in the near future.

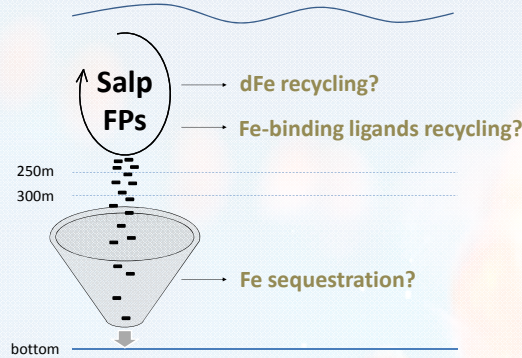


Photo by Brian Hunt (top) & Deborah Steinberg (bottom)

MATERIAL & METHODS

- Salps were sampled at 51°12.38S, 12°39.80W during ANTXXVIII/3 (2012)
- FPs properties at the sampling site:

FPs production rate	(FP.ind ⁻¹ .h ⁻¹)	0.33
FPs carbon content	(mgC.FP ⁻¹)	0.018
FPs release down to 250 m	(FP.m ⁻² .d ⁻¹)	310 ± 126
FPs carbon flux at 300 m	(mgC.m ⁻² .d ⁻¹)	1.33

- Fe chemistry and humic substances (HS-like) analyses → electrochemistry

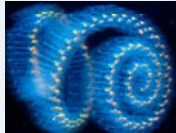
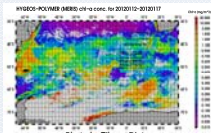
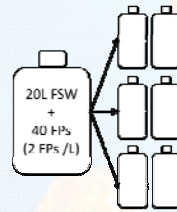


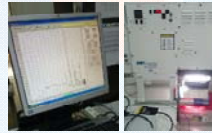
Photo by Tilman Dinter

a) On-board experiment



- Freeze/thaw → 24h dark incubation (SST)
- 24h dark incubation (SST)
- 24h natural sunlight incubation (SST)

b) Laboratory experiment

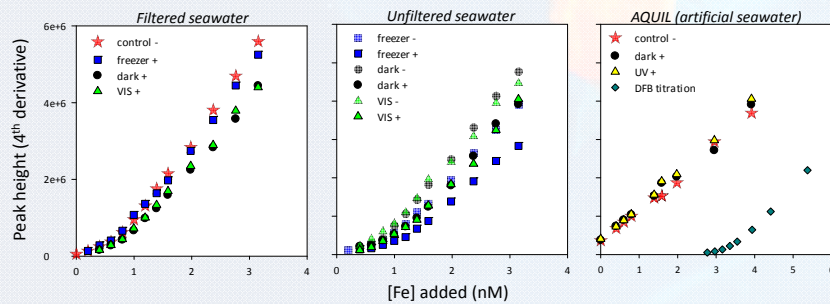


- 30 min UV/VIS light → 24h dark incubation (4°C)
- Total Fe content per FP
- Leachable dFe per FP after 48h (LFe⁴⁸; pH 2.0)

RESULTS

a) dFe & Fe speciation

On-board experiments

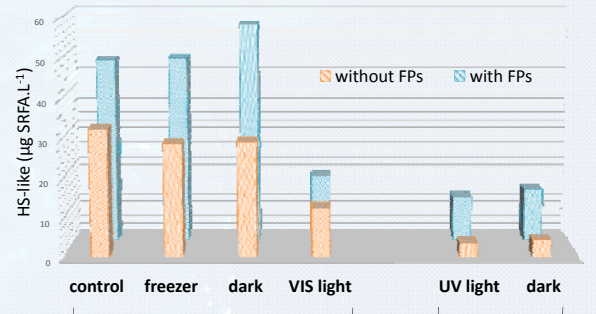


- No significant increase of total ligand concentrations in presence of FPs
- No significant increase of dFe concentrations in presence of FPs

c) LFe⁴⁸ & total Fe content

- > 48 h pH 2.0 (n=6) 0.033 ± 0.04 nmol.FP⁻¹ → "LFe⁴⁸" leachable: 10.23 nmol.m⁻².d⁻¹
- > 2 months pH 1.5 (n=2) 0.33 ± 0.02 nmol.FP⁻¹ → Fe standing stock in FPs, upper 250m: 102 nmol.m⁻².d⁻¹
Fe flux, at 300m: 25 nmol.m⁻².d⁻¹

b) HS-like release



on-board incubation
p=0.031

8.22 ± 4.72 µg.FP⁻¹.d⁻¹
2.55 ± 1.46 mg.m⁻².d⁻¹

laboratory incubation
p=0.002

0.78 ± 0.05 µg.FP⁻¹.d⁻¹
0.24 ± 0.02 mg.m⁻².d⁻¹

DISCUSSION & PERSPECTIVES



- High Fe content that does not seem rapidly released
- No release of strong ligands
- Rapid release of weak Fe-binding ligands
- Island wake → vertical flux of 4 nmol Fe.m⁻².d⁻¹ (a)
- Atmospheric deposition → 3.2 - 51.2 nmol Fe.m⁻².d⁻¹ (b)
- Seasonal sea-ice melt → < 10 - 800 nmol Fe.m⁻².d⁻¹ (c)

Changes in Fe recycling with consequences for Fe limitation

Towards a decrease of Fe solubility?

Towards an enhancement of Fe solubility and an acceleration of Fe uptake?

Our Fe sequestration flux might significantly reduce new Fe supply in remote areas with limited inputs and high salp concentrations.