UK GEOTRACES 2012-2013 report

UK GEOTRACES
micronutrient cycles and paleoproxies in the ocean

NATURAL ENVIRONMENT RESEARCH COUNCIL

GEOTRACES meetings and presentations:

- ASLO (New Orleans, USA)
- Goldschmidt 2013 (Florence, Italy)
- GA10 data synthesis meeting (Oxford, UK)
- GA 06 data synthesis meeting (NOC, UK)
- Participation in GEOTRACES Particle intercomparison led by Pheobe Lam (Hawaii, USA)
- COCA Meeting (Hawaii, USA)

Outputs:

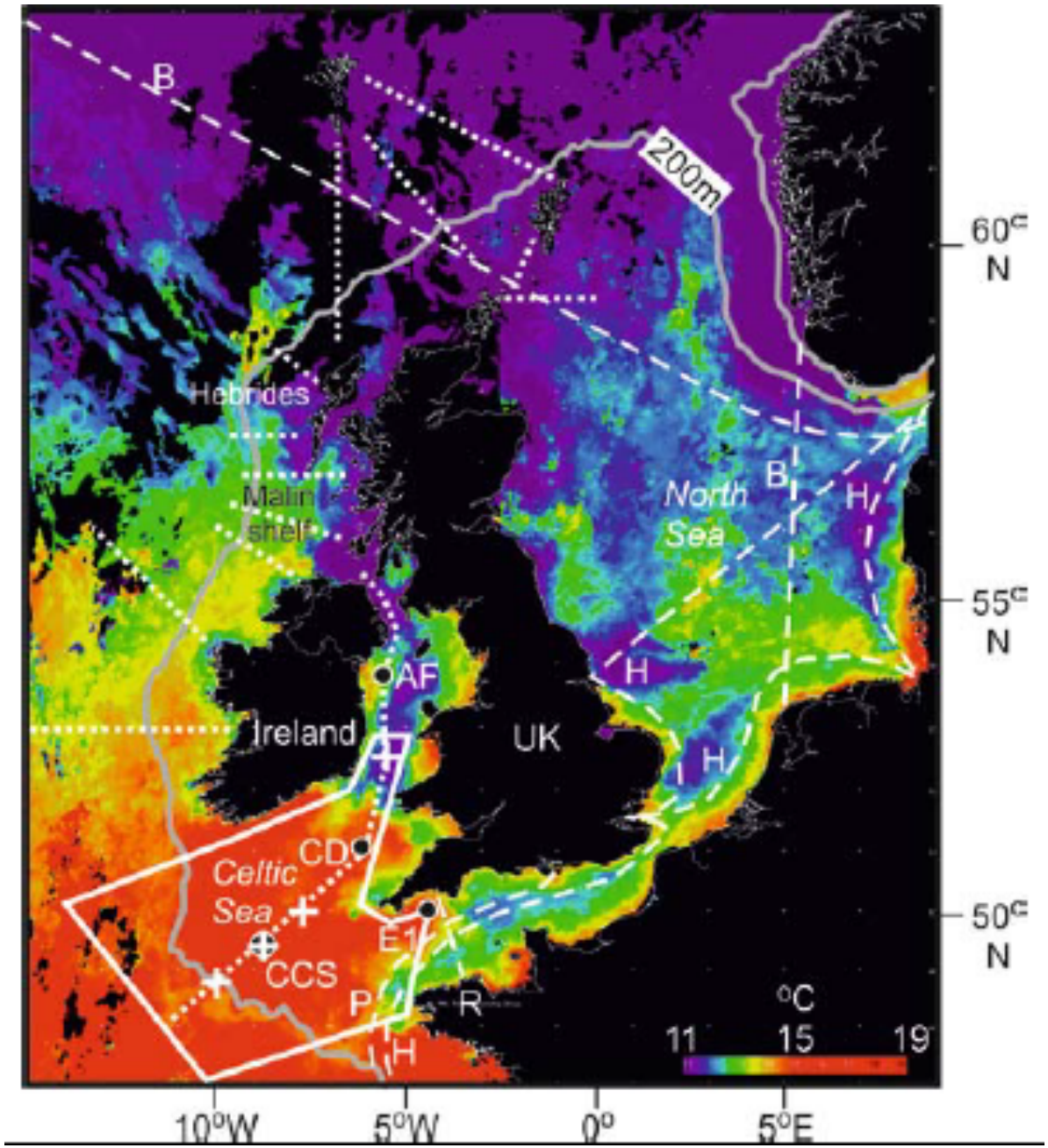
- 5 journal articles reporting GEOTRACES activities published/ accepted 2012-2013
- 6 journal articles reporting GEOTRACES activities submitted

Funding:

- Process Study:-Shelf Sea Iron Biogeochemistry -6 cruises to be held in 2014

- The Ferricline: Master Variable Controlling the Extent of Iron Limitation? (Tagliabue, Williams, Achterberg, Rijkenberg, Sedwick), Submitted to NERC

- Planned proposal submission for Arctic -January 2014


B
200m
Hebrides
Malin shelf
North Sea
B
H
AF
H
Ireland
UK
H
CD
Celtic Sea
E1
CCS
P
R
H
°C
11
15
19
60°N
55°N
50°N
10°W
5°W
0°
5°E

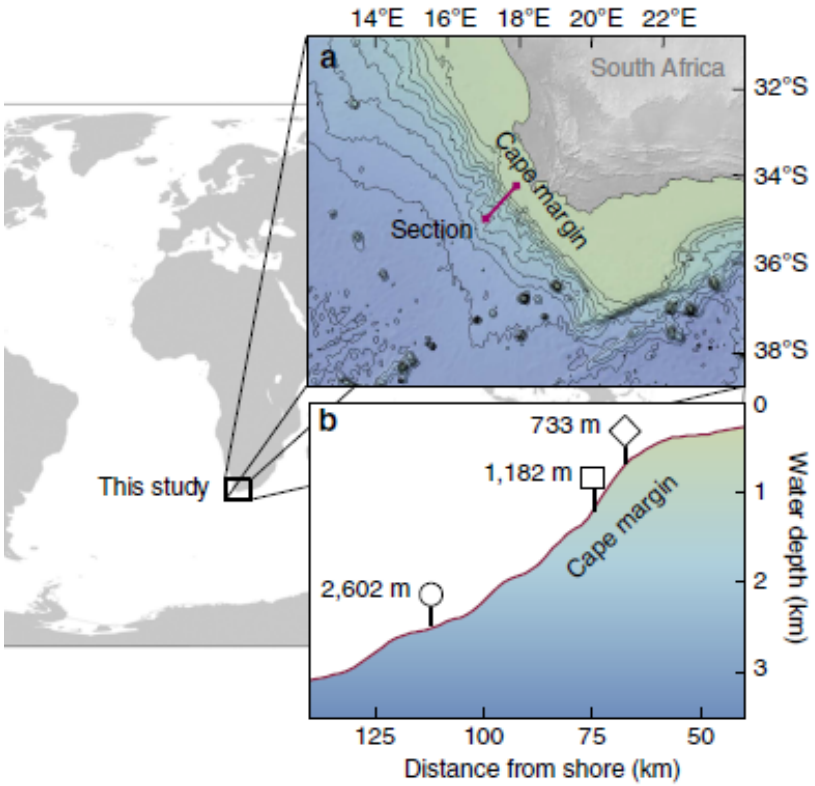
ARTICLE

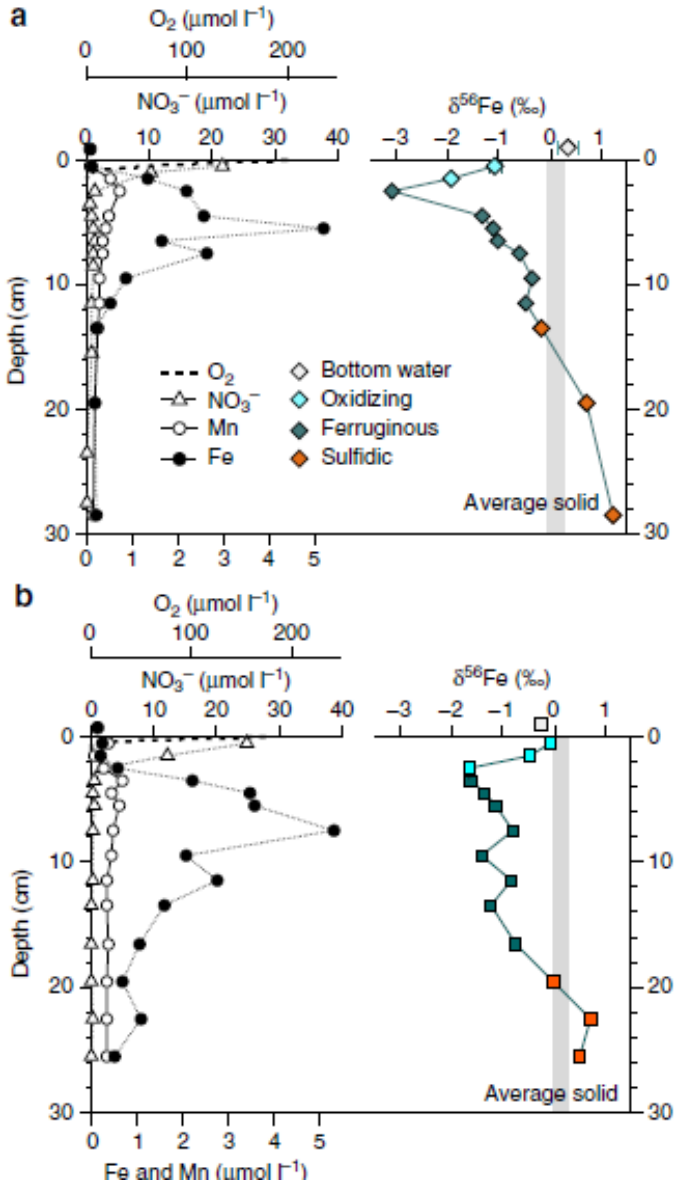
Received 28 Jan 2013 | Accepted 11 Jun 2013 | Published 19 Jul 2013

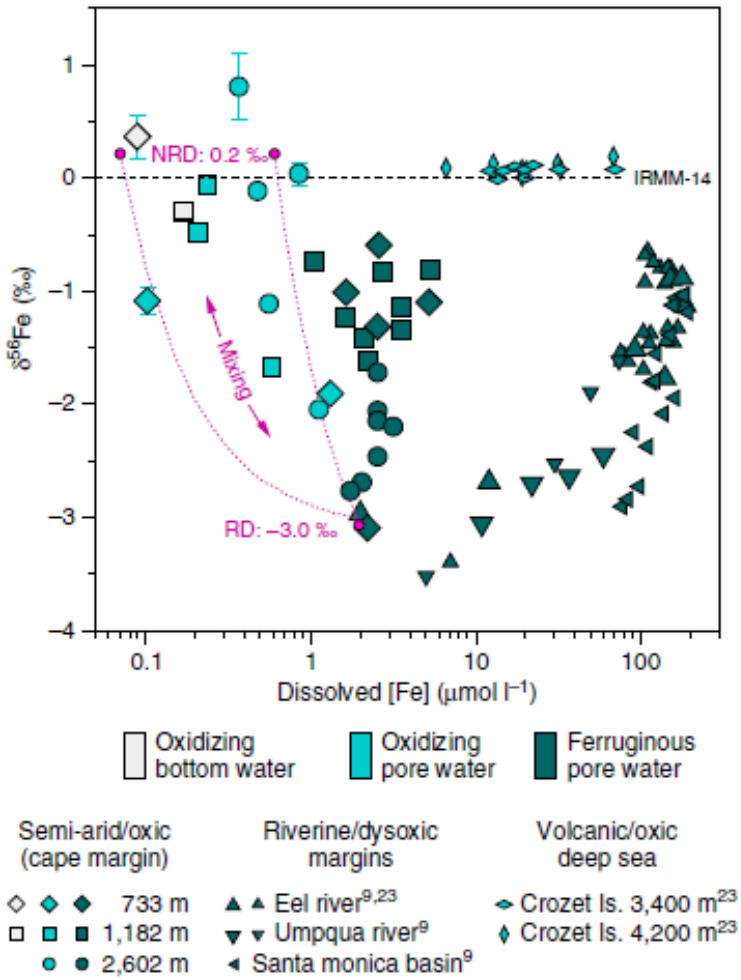
DOI: 10.1038/ncomms3143 OPEN

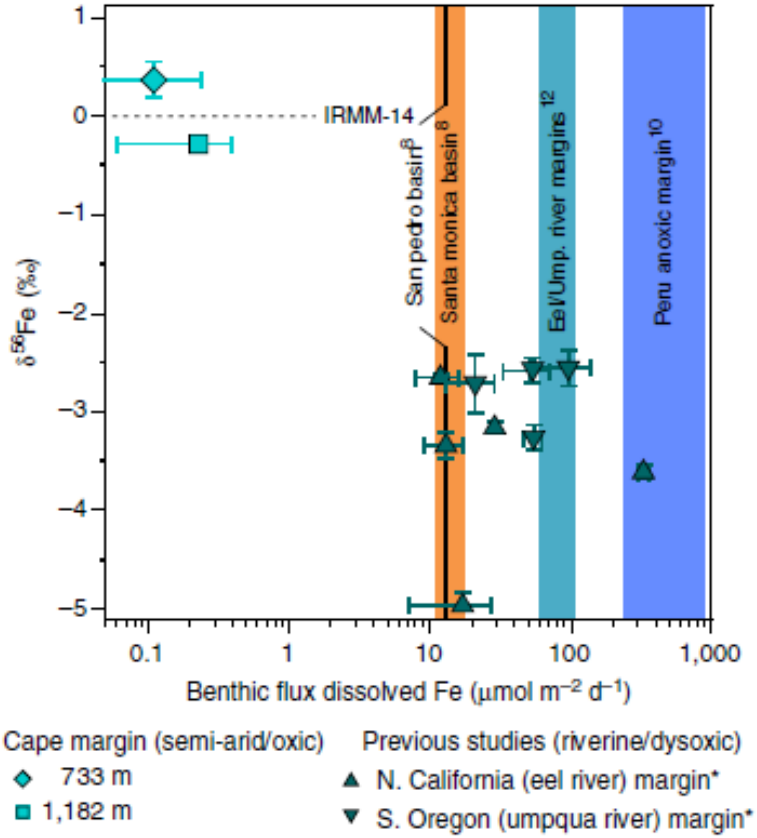
Distinct iron isotopic signatures and supply from marine sediment dissolution

William B. Homoky[1], Seth G. John[2], Tim M. Conway[2] & Rachel A. Mills[1]



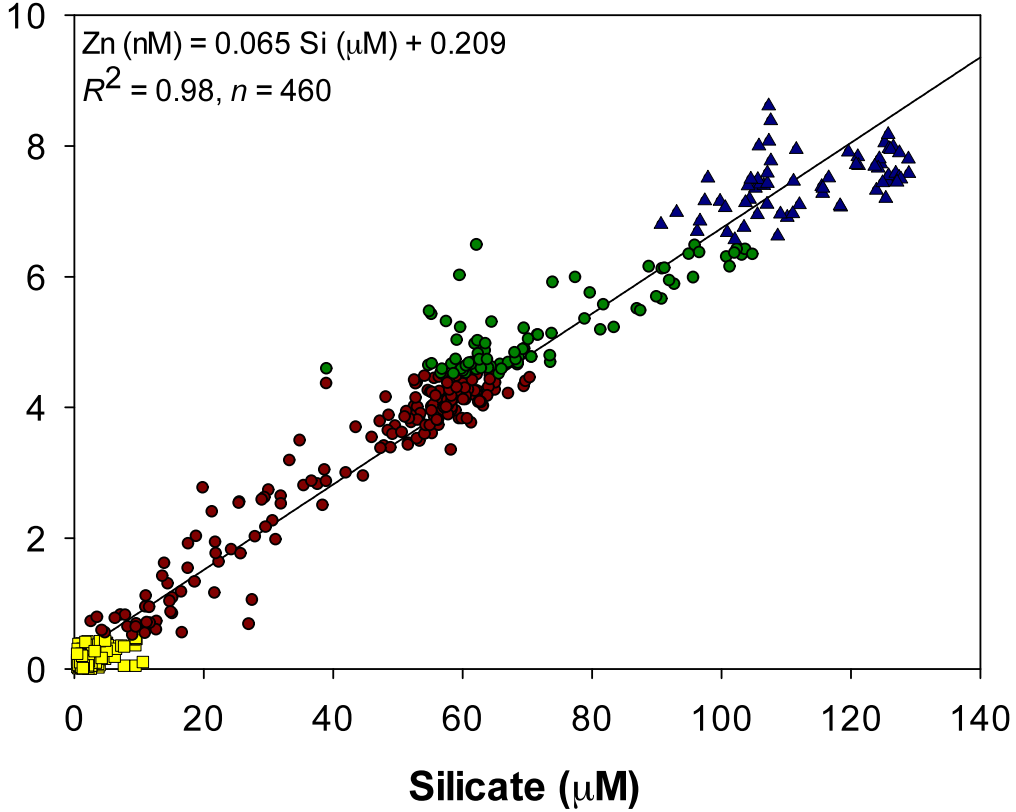






Sediments of the Cape margin (GEOTRACES A10) reveal continental margin fluxes of iron are regionally and isotopically diverse due to different sediment dissolution mechanisms, which may be influenced by geological setting and hydrological processes on land.

Zinc vs. Silcate

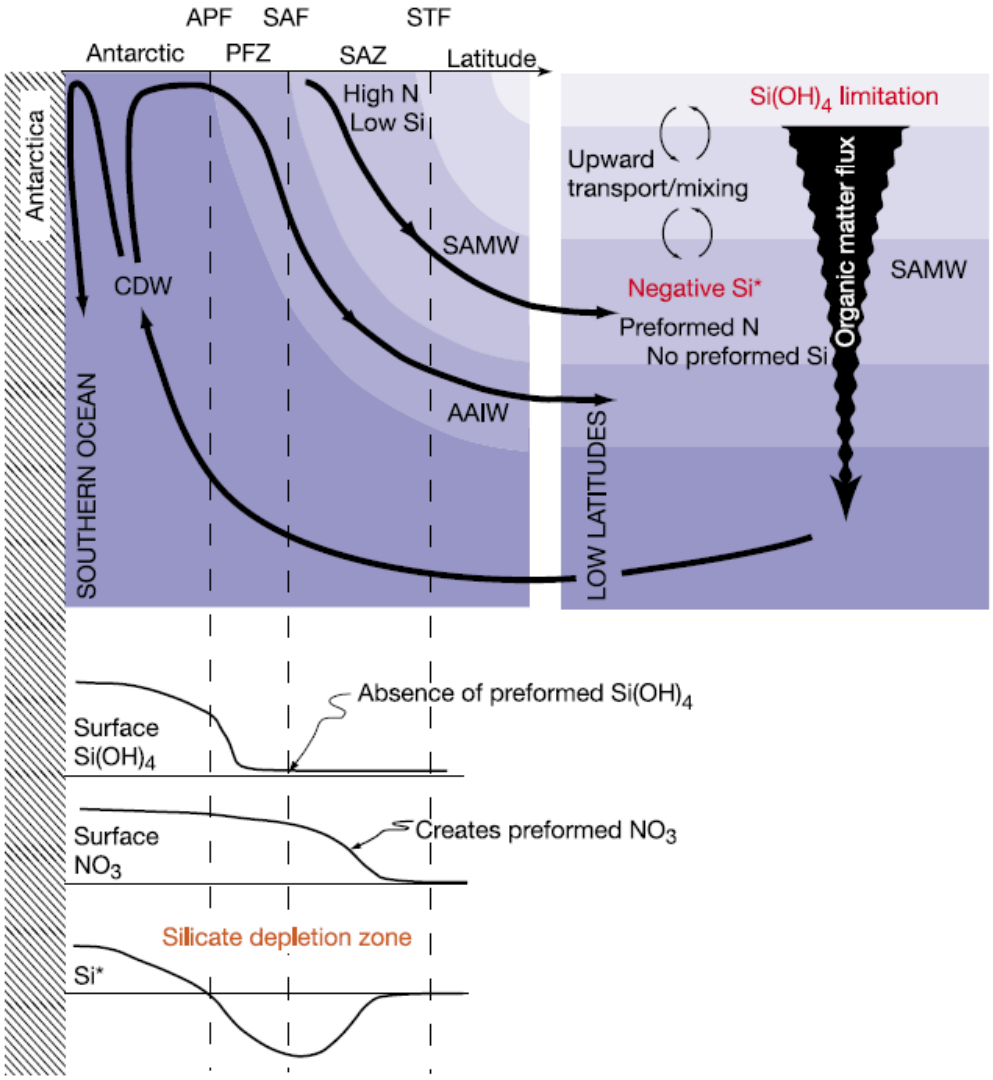


- Strong Zn/Si relationship primarily due to uptake and remineralisation
- Surface ratio lower due to biological uptake.
- Deep water (> 3000 m) ratio suggests a 10% underestimation of dZn in South Atlantic bottom waters.

- Upper 500 m (0.025x +0.111)
- Intermediate waters (0.066x + 0.283)
- NADW (0.051x + 2.71)
- AABW (0.042x + 3.129)

Location	***Slope***	***R^2***	***n***	***Reference***
Global deepwater >1000 m	0.052	0.966	201	Marchitto et al. (2000)
North Pacific	0.054	0.992	43	Bruland (1980)
Drake Passage	0.059	0.941	10	Martin et al. (1990)
Southern Ocean	0.040	0.859	130	Croot et al. (2011)
Polar Front 49° 59´ S	0.038	0.828	11	Löscher et al. (1999)
South Atlantic	**0.065**	**0.981**	**460**	**This study**

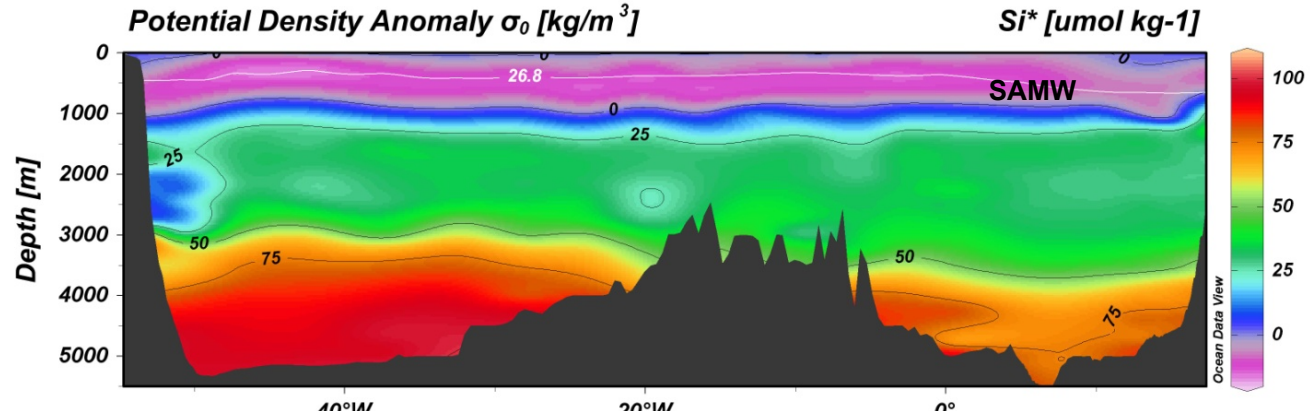
SAMW and Si*



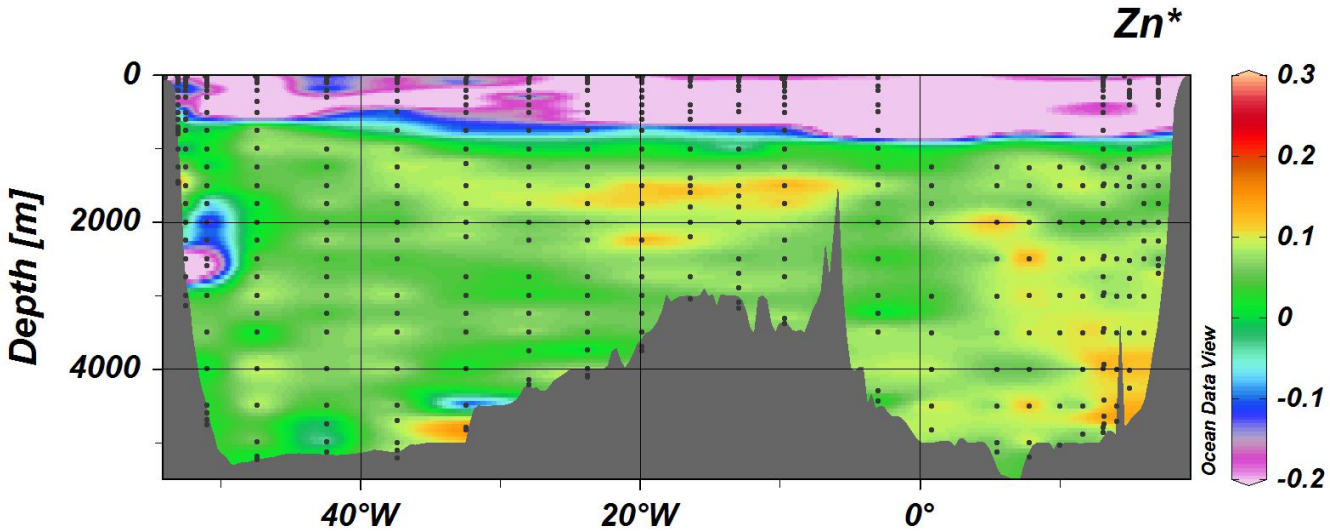
Sarmiento et al. (2004)

- SAMW is main nutrient return path from deep waters of the Southern Ocean to thermocline Atlantic Ocean.
- SAMW characterised by high nitrate but low silicate.
- $Si^* = Si(OH)_4 - NO_3^-$ used to trace movement of SAMW

Potential Zn limitation



- Si* tracer of SAMW (400- 500 m) at 40°S
- Negative Si* observed down to 1000m – includes AAIW



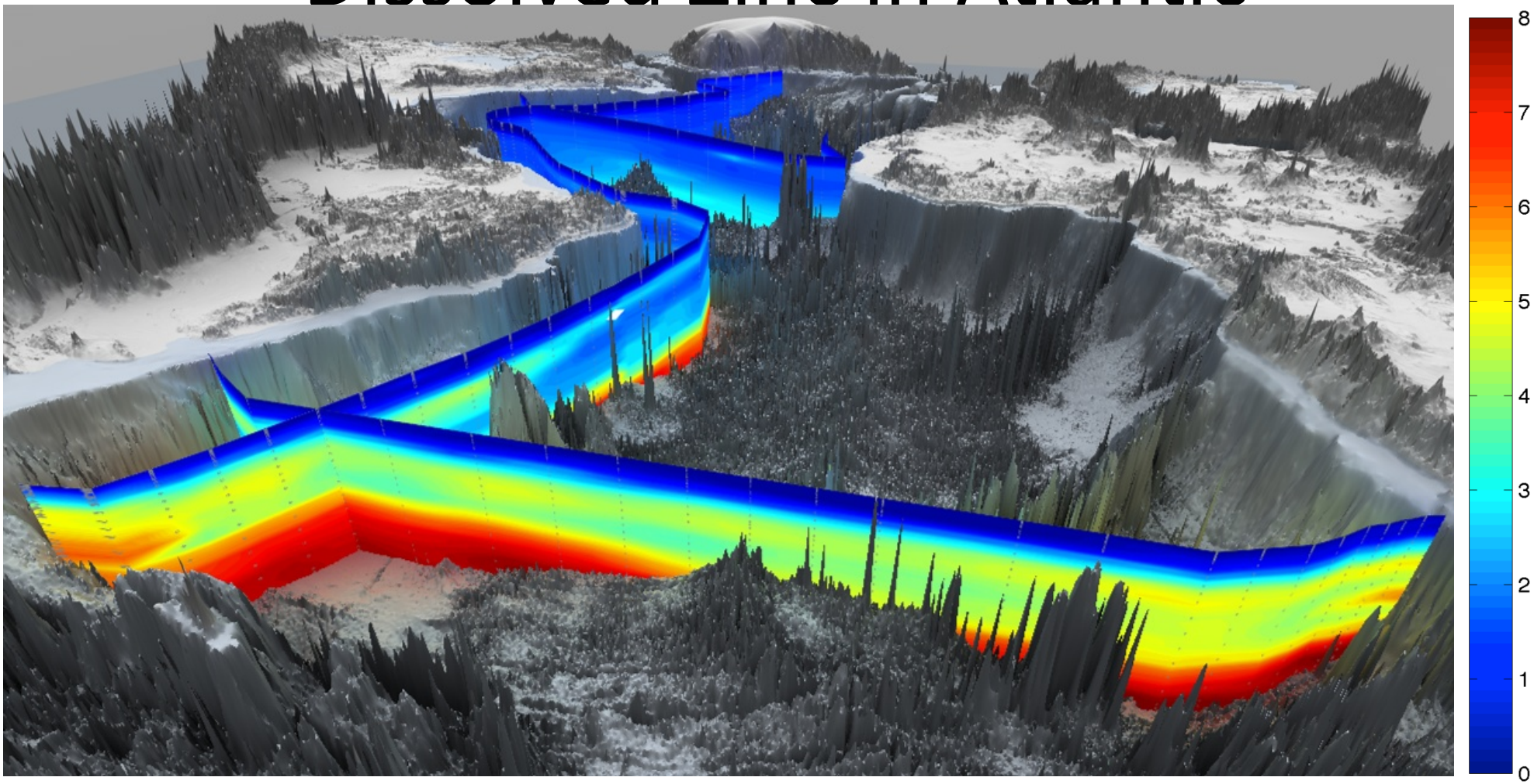
Zn* = Zn – (0.065 x Si + 0.209)

- Negative Zn* observed down to ~ 1000m – includes AAIW

- Zn* remains constant if sources (remineralisation) and sinks (uptake) of Zn and Si occur at ratio of Zn:Si (0.065) and the intercept (0.029) fixes the deep water Zn* to zero

- Zn* indicates the transport of negative Zn* values from the PFZ and SAZ to intermediate depth (down to ~1000m) at 40°S

Dissolved Zinc in Atlantic



Data from: 40oS Neil Wyatt & M Lohan

N-S Rob Middag & Ken Bruland, Hein deBaar

US E-W Tim Conway & Seth John

Produced by Steven van Heuven-with The Mathworks MATLAB and MAXON Cinema4D, using ETOPO2 bathymetric data (ref1) and GEOTRACES cruise results

Papers published & Accepted

1. Homoky, W.B., John, S.G., Conway, T.M. & Mills, R.A. (2013). Distinct iron isotopic signatures and supply from marine sediment dissolution. Nature Communications DOI: 10.1038

2. Saito, M., A. Noble, A. Tagliabue, T. Goepfert, C. Lamborg and W. Jenkins (2013) Slow-spreading submarine ridges in the South Atlantic as a significant oceanic iron source. Nature Geoscience.

3. Geibert, W., Rodellas, V., Annett, A., van Beek, P., Garcia-Orellana, J. Hsieh, Y.-T., Masque, P. (in revision) 226Ra determination via the rate of 222Rn ingrowth with the Radium Delayed Coincidence Counter (RaDeCC). Limnol. & Oceanogr. Methods

4. Wyatt, N.W., Milne, A., Woodward, E.M.S., Rees, A.P., Browing, T.J., Bouman, H.A., Worsfold, P.J. & Lohan M.C. (in revision). Biogeochemical cycling of dissolved zinc along the GEOTRACES South Atlantic transect GA10 at 40^{o}S. GBC

5. Hernandez-Sanchez, M.T., Homoky, W.B., Pancost, R.D. (in revision). Occurrence of 1-)-monoalkyl glycerol ether lipids in ocean waters and sediments. Organic Geochemistry

Papers submitted

1. Browning, T., Bouman, H.A., Moore, C.M., Schlosser, C., Tarran, G.A., Woodward, E.M.S. & Henderson, G.M. Nutrient regimes control phytoplankton ecophysiology in the South Atlantic. Biogeosciences.

2. Schlosser, C., Klar, J., Wake, B., Snow, J., Honey, D., Woodward, E.M.S., Lohan, M.C., Achterberg, E.P. & Moore, C.M. Seasonal ITZ migration dynamically controls the location of the sub-tropical Atlantic biogeochemical divide. PNAS

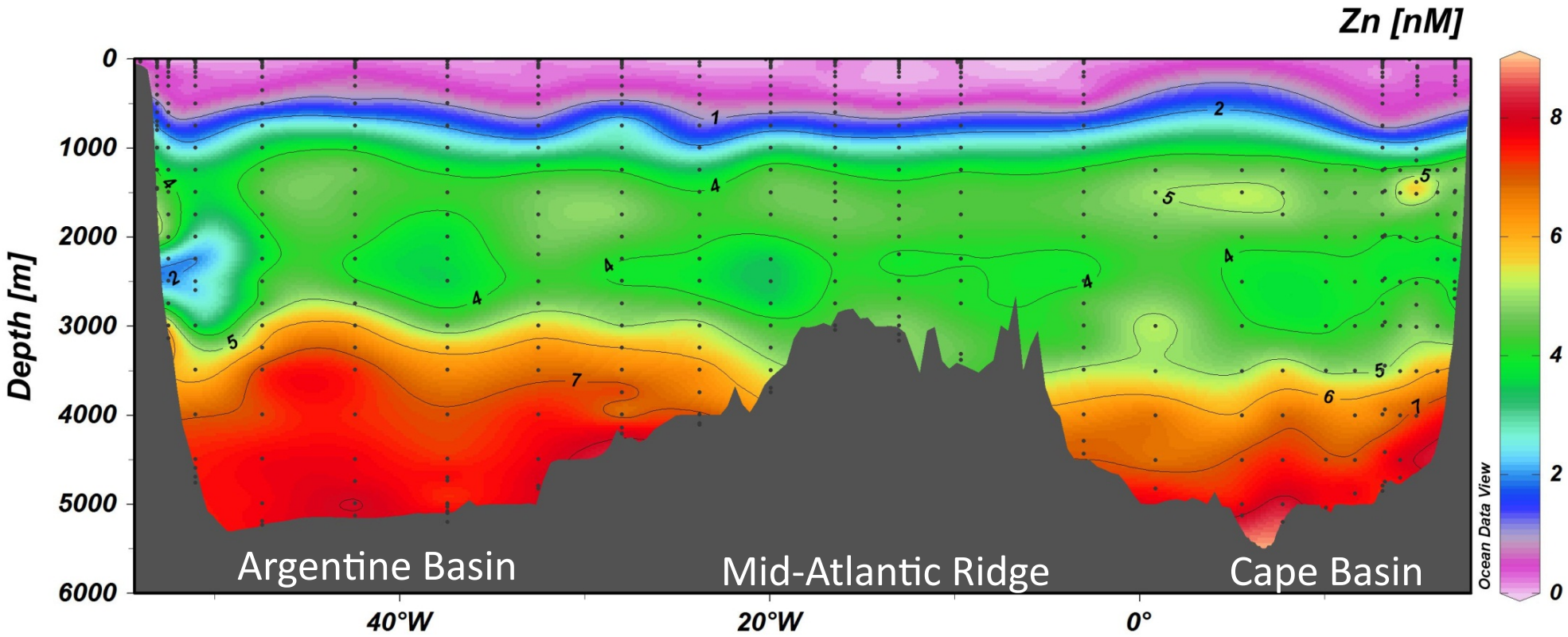
3. Horner, T.J., Homoky, W.B., Georgiev, S.V., Hannah, J.L., Mills, R.A., Rehkamper, M. & Henderson ,G.M. Suboxic sediments as the oceanic sink of isotopically-light cadmium. GCA.

4. Hernandez-Sanchez, M.T., Woodward, E.M.S. Tayloer, K.W., Henderson, G., Pancost, R.D. Subsurface export of thaumarchaeotal lipids to sediments of the South Atlantic. Geochim. Cosmochim. Acta

5. Tagliabue, A., et al., The impact of different external sources of iron on the global carbon cycle, Geophys. Res. Lett.

6. Tagliabue A., et al., Towards reconciling seasonal iron supply and biological utilisation in the Southern Ocean, Nature Geoscience

Dissolved Zinc



- Very low surface concentrations 15 pM- 0.4 nM
- Concentrations increase with depth up to 8.5 nM but there is a decrease between 1500 – 2500 m in NADW
- Nutrient type distribution which tracks the major water masses