SOUTH AFRICA

The new kid on the block

Report prepared by Prof AN Roychoudhury
Stellenbosch University, South Africa

Model drawing of the new South African polar research ship being built at STX Europe shipyard in Finland

South Africa has played little role in Geotraces up until now. Once a vibrant community, marine researcher in South Africa has been a dying breed for the last few decades. Main reasons being continually degrading shipboard facilities and a serious lack of capacity to undertake elaborate projects. Barring the regular environmental monitoring of coastal oceans, much of other science related activities were confined to international collaborations and science done in conjunction with logistics voyages to support South African Antarctic base.

Change is on the horizon; however, and the future looks bright. The reasons being the imminent delivery of a brand new polar ship, to be christened SA Agulhas II, in April 2012 and a promise of large financial investment by the government on global environmental change science.

Unlike its predecessor, the second-generation polar ship is made to accommodate cargo, passengers and state of the art science laboratories. Other than the typical wet and dry laboratories found on a research vessel, Geotraces related activities on SA Agulhas II would get an immense boost by the presence of multiple isotope and metal free container clean labs. Specialized Seabird titanium CTD rosette on a 6500 m Kevlar line and a "fish" for continuous underway collection of surface water samples, while the ship steams ahead, would make up the water sampling facilities for trace substances. The ship would also come equipped with a piston corer for sediment sampling.

Activities of interest

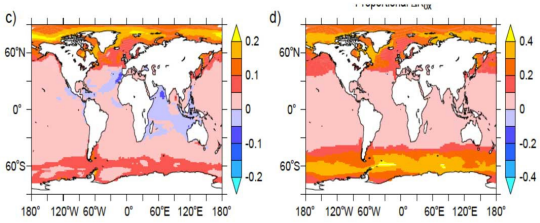
In 2010, South Africa has taken definite steps to enhance Geotraces related research. Much of the focus has been towards developing the capacity and research on iron in the Southern Ocean. The activities include modeling of iron cycling by Dr A. Tagliabue (CSIR) and set-up of FIA for measurement of nano- to picomolar iron in ocean water. Dr Thato Mtshali of CSIR and Raimund Rentel, an MSc student are being trained on FIA in Prof Roychoudhury's laboratory at Stellenbosch University. Once validated, FIA will be used to analyze water samples collected in 2010 on the Goodhope-SANAE-South Georgia line. All of this work will be conducted in a class 100 clean laboratory, equipped with class 10 Picotrace® laminar flow workstations, which is currently under construction at Stellenbosch University.

Fusing iron cycle models and observations

Global and regional ocean biogeochemistry models now routinely include iron and provide a means to test hypotheses and evaluate the importance of certain processes or parameters. Since arriving in Cape Town in November 2010, Alessandro Tagliabue is involved in employing these models in conjunction with in-situ observations and laboratory cultures to address these issues.

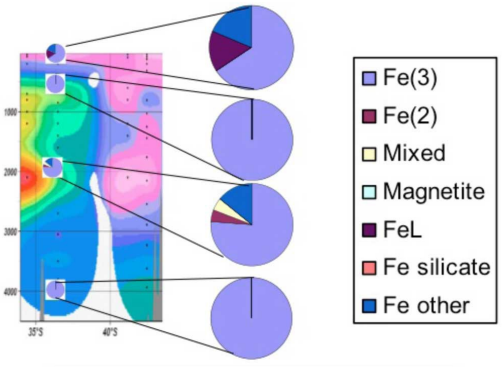
As part of a continuing collaboration with Dr. Christoph Völker of the AWI in Germany, we this year published a paper detailing a cost-effective method of modeling complex iron speciation and cycling in large scale ocean models and use this model to explore the response of iron speciation and bioavailability to future ocean climate change and acidification (Tagliabue and Völker, 2011).

Such predictions rest on experimental evidence garnered from in situ experiments and laboratory cultures. Over the next year, in collaboration with local and international colleagues, we will gain insight into the iron demand of specific Southern Ocean phytoplankton, as a function of environmental variability, as well as documenting and understanding the lability of colloidal iron species.



The proportional change in bioavailable Fe concentrations in 2100 for species that can assimilate organically complexed iron (left hand side) and those that rely solely on free uncomplexed iron (Tagliabue, A. and Völker, C.: Towards accounting for dissolved iron speciation in global ocean models, Biogeosciences Discuss., 8, 2775-2810, doi:10.5194/bgd-8-2775-2011, 2011.

Iron nano-particles in open ocean waters



Particulate iron speciation and distribution in the water column at one station (Cruise D357) Unpublished data (Von der Heyden et al.)

Bjorn von der Heyden, a PhD student of Prof Roychoudhury at Stellenbosch University is investigating the speciation of iron nano-particles in open ocean waters. In 2010, he was fortunate to be able to participate in Geotraces Cruise D357 where he was able to collect depth and surface water samples for dissolved and particulate iron in South Atlantic. In the process he was trained in shipboard clean sampling techniques.

With an in-house developed technique and using the Molecular Environmental Sciences (MES) beamline 11.0.2 at the Advanced Light Source, Lawrence Berkeley National Laboratory, Bjorn was able to identify and show a wide spatial variation in speciation of iron in the water column. These results have major implications on dissolution kinetics and bioavailability of iron.