

A new Ultra Clean CTD-system for sampling of trace elements and isotopes

by

Sven Ober

as presenting member of the NIOZ Ultra Clean Dream Team



Royal Netherlands Institute for Sea Research



Scientific embedding of the project:



An international study of biogeochemical
cycles of Trace Elements and Isotopes
in the Arctic and Southern Oceans



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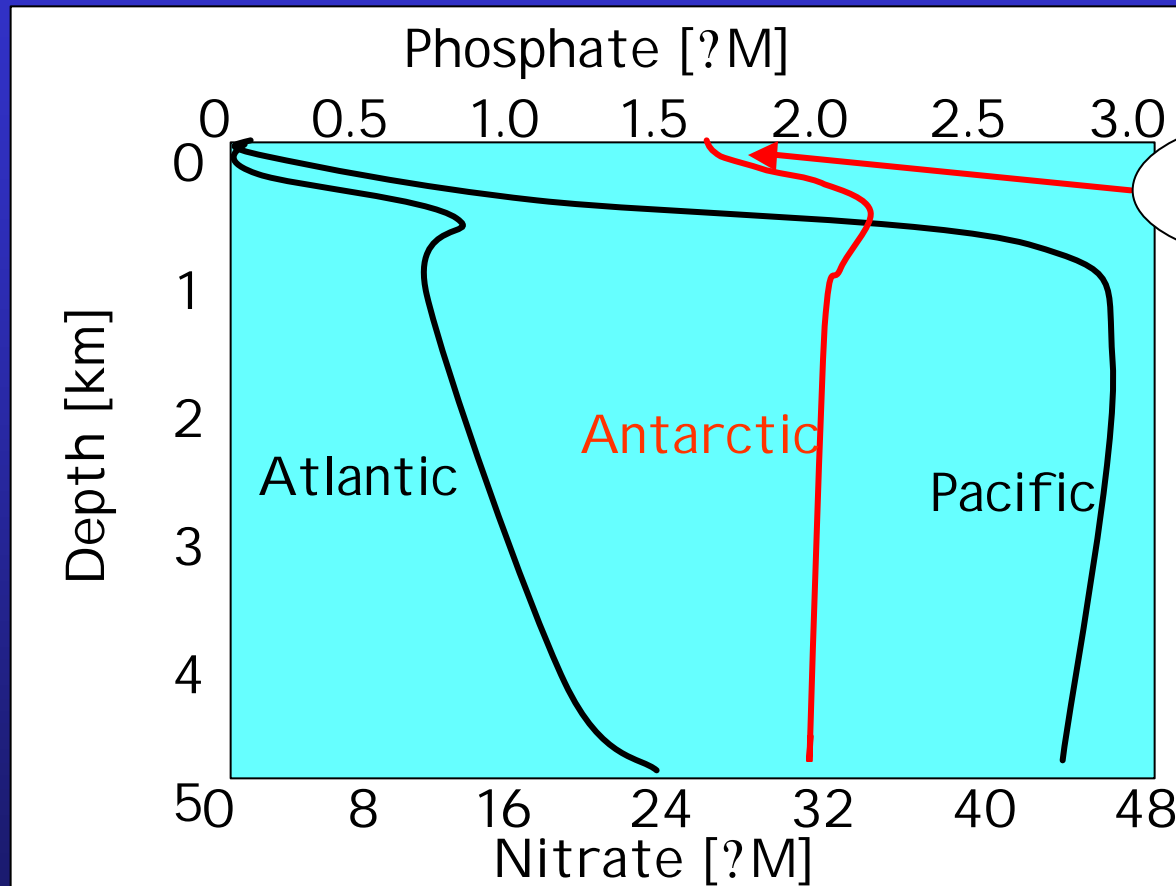


An international study of biogeochemical cycles of Trace Elements and Isotopes in the Arctic and Southern Oceans

Why are Trace Elements important ?

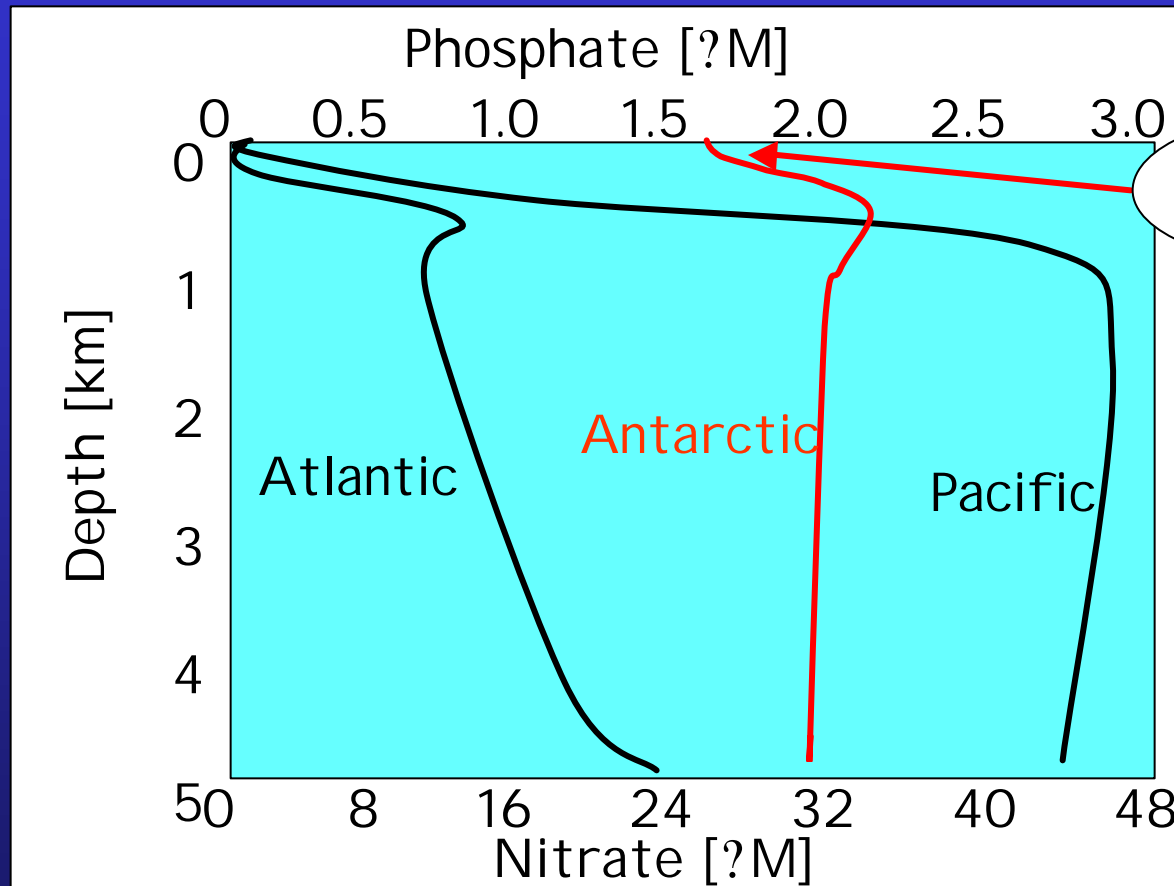


The Antarctic Paradox :



N and P not limiting !

The Antarctic Paradox :



other factors than major nutrients limit phytoplankton growth in the Antarctic: **iron** and **light**



Some key-objectives of GEOTRACES are:

- Determination **global** distributions of Trace Elements (Mn, Fe, Co, Cu, Ni, Zn, Ag, Cd, Ba, Pb, etc.)
Isotopes (^{234}Th , ^{230}Th , ^{231}Pa , $^{143}\text{Nd}/^{144}\text{Nd}$, etc.)
- Basin wide deep ocean sections
- To evaluate the sources, sinks and internal cycling
- Try to understand the role of Trace Elements in processes as photosynthesis, phytoplankton growth, **capturing of CO₂**, etc.
- Estimated duration: 10 years



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In short: we have to sample **a lot** of Ultra Clean water



Traditional ultraclean sampling: single bottles on kevlar wire



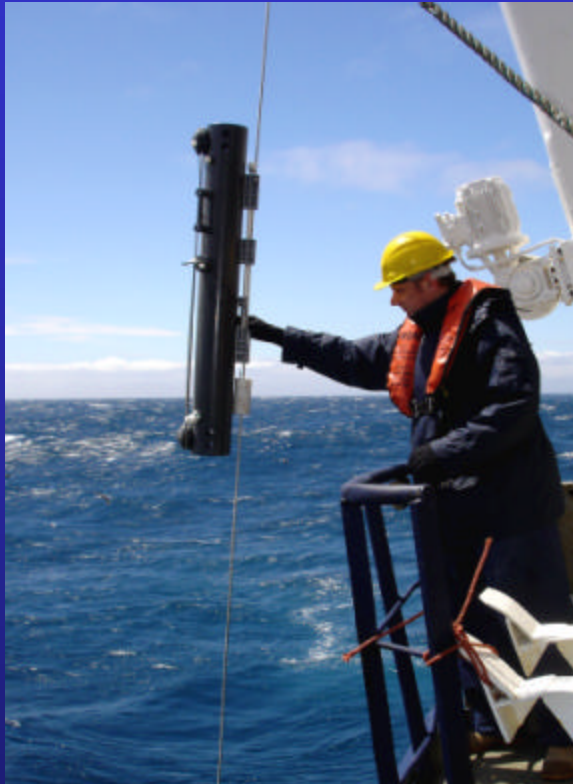
very time-consuming
(shiptime is expensive)



laborious and back-breaking



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Conclusion: we need something better than this



Our wish-list :

- Enabling Ultra Clean sampling
- Enabling sub-sampling + filtering in a Clean Room
- Convenient (scientist-friendly)
- Versatile, reliable and mobile
- Efficient (Time, manpower)

In the period 2002 - 2005 we were able to build this Ultra Clean Dream Machine:



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TiTan[®]: “The Ultra Clean CTD-system”



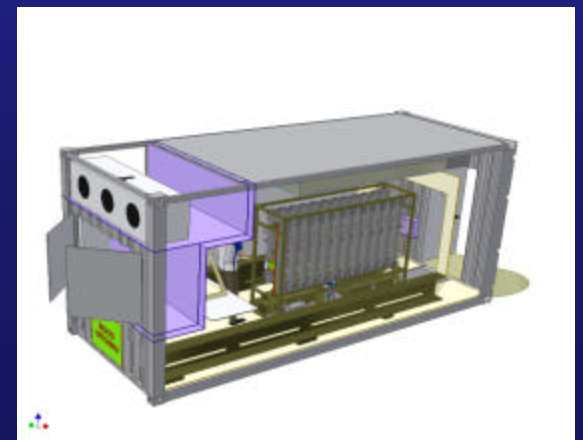
- A mobile winch with 9600 m Super Aramide CTD-cable



- Titanium CTD-frame with 24 GoFlo-bottles



- A temperature-controlled Clean Room container for sub-sampling and filtering

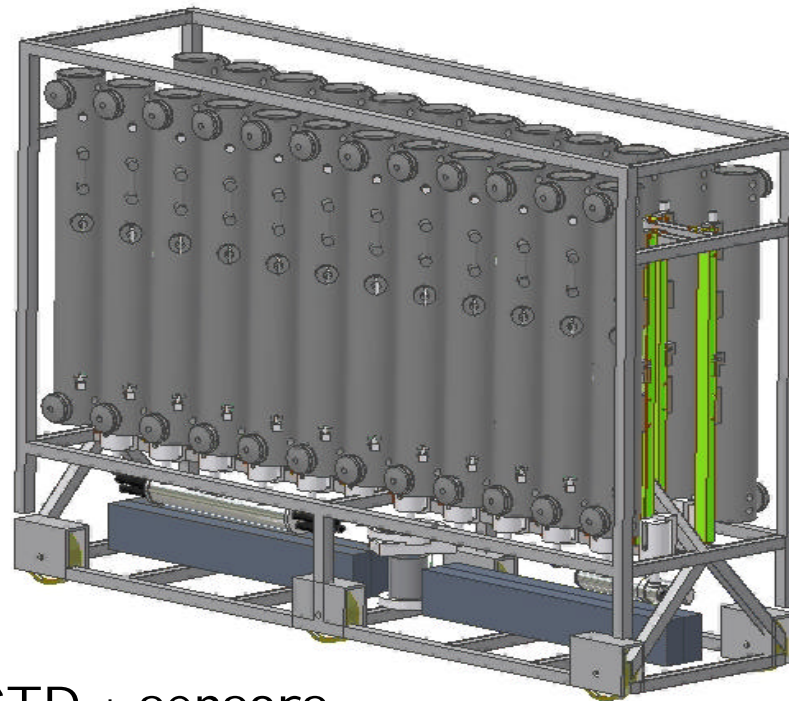


Shipboard winch at standard sea-container size



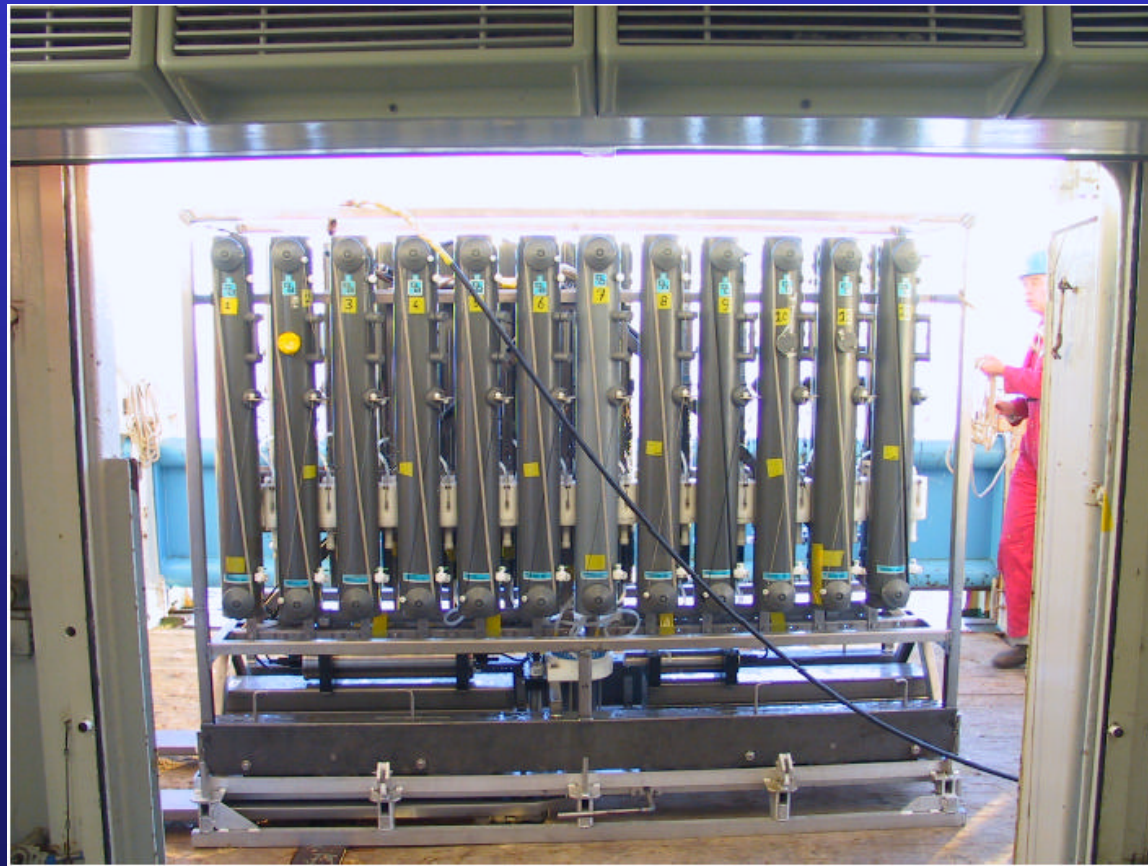
- 9600m super-aramide cable
- 18 mm diameter
- internal conductors

All titanium CTD-frame

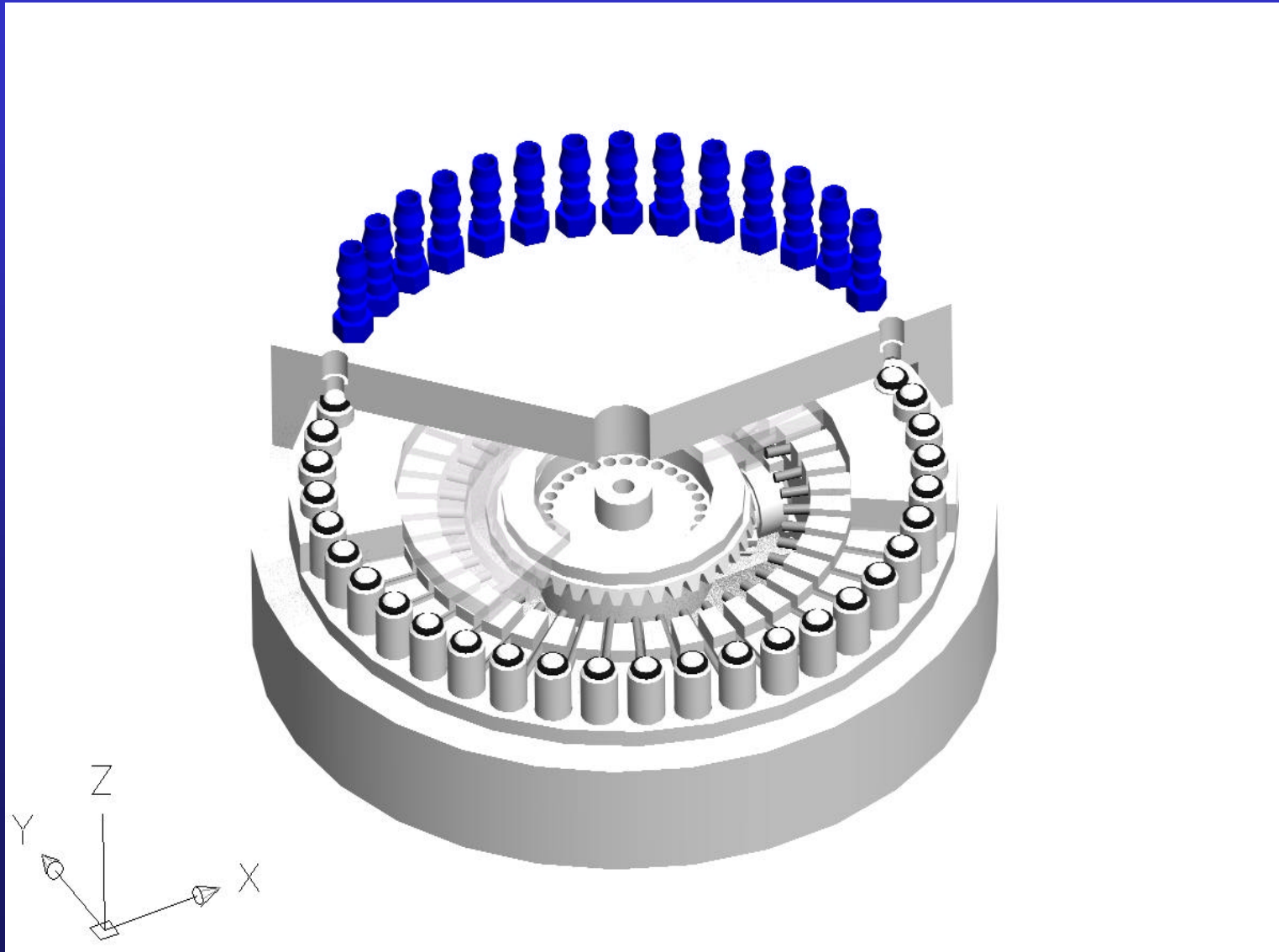


- Seabird CTD + sensors
- 24 GoFlo samplers
- Hydraulic bottle control
- Rectangular + weels



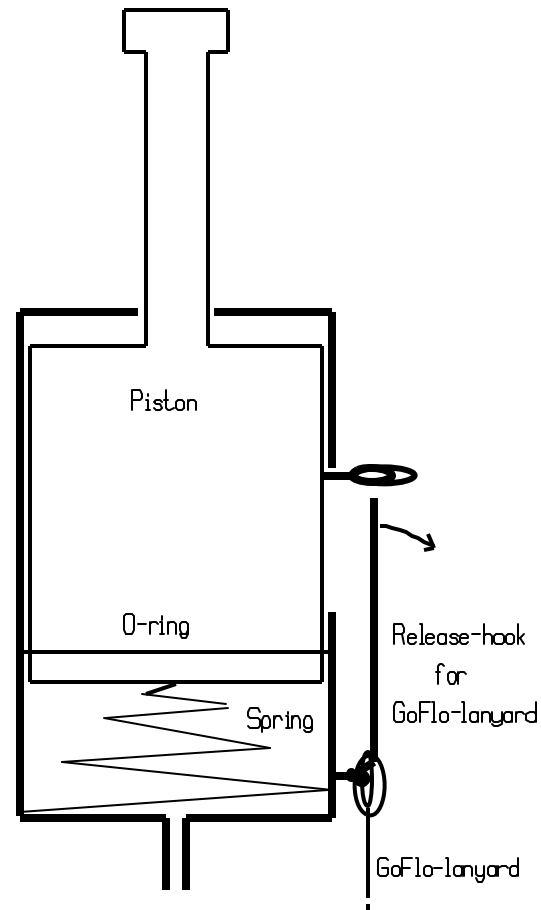


Inside view of the "Multivalve"



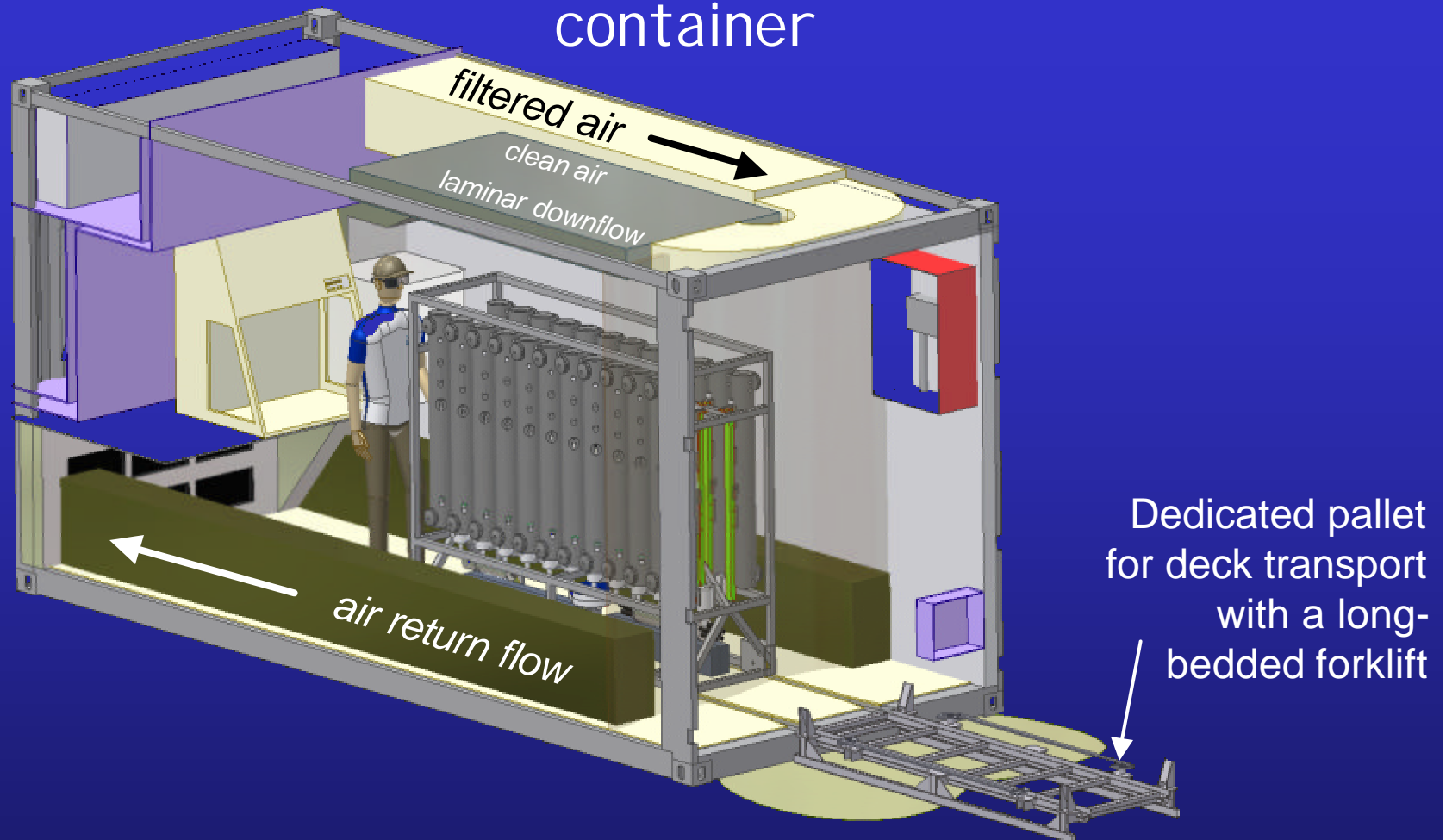
Hydraulic release unit

HYDRAULIC RELEASE UNIT



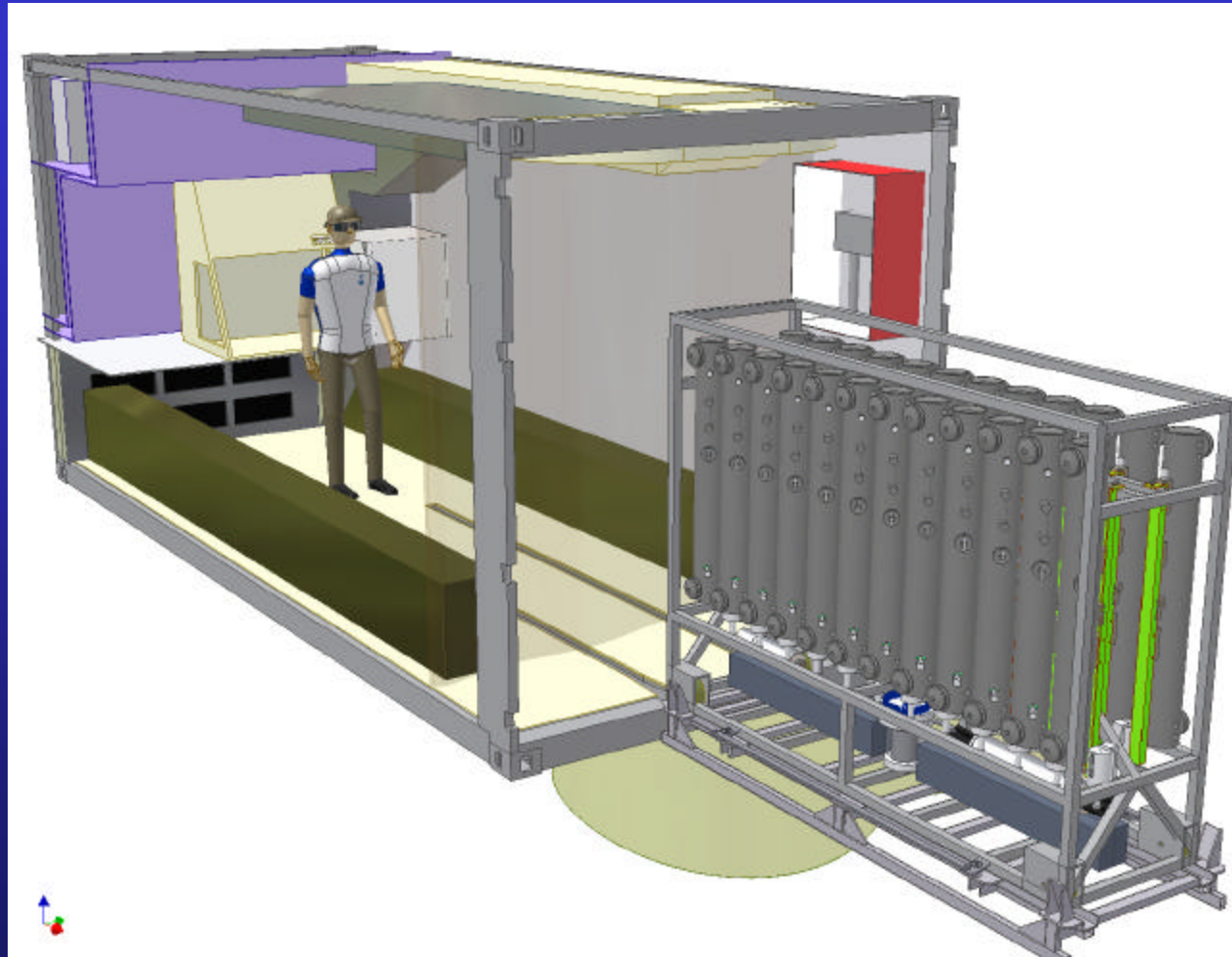


An all-titanium frame in its own Clean-Room container



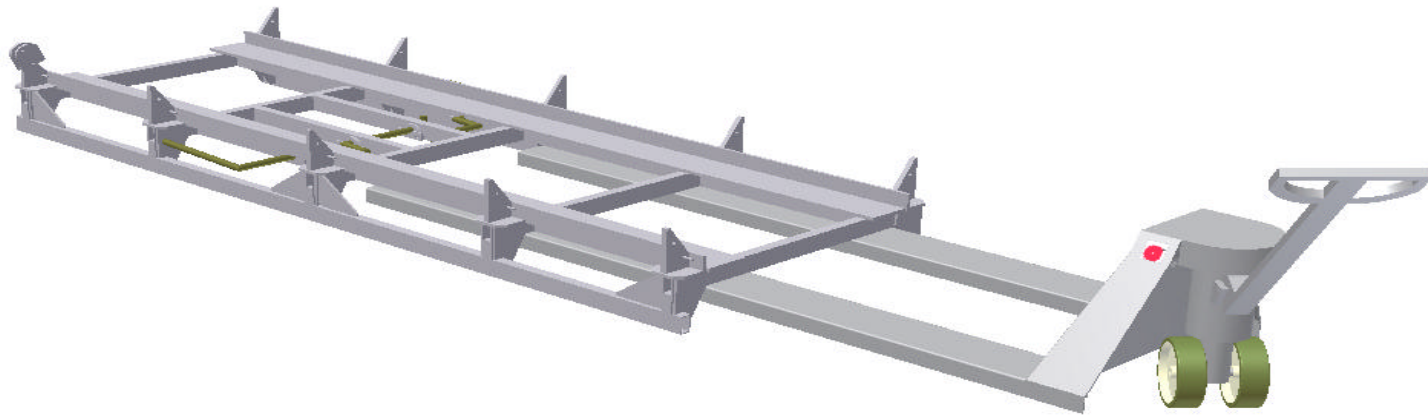
- Long rectangular frame fits well in standard size sea-container
- Samplers do not have to be taken off the frame anymore
- Much faster sampling just like regular CTD/rosette saves costly shiptime

Deck-logistics





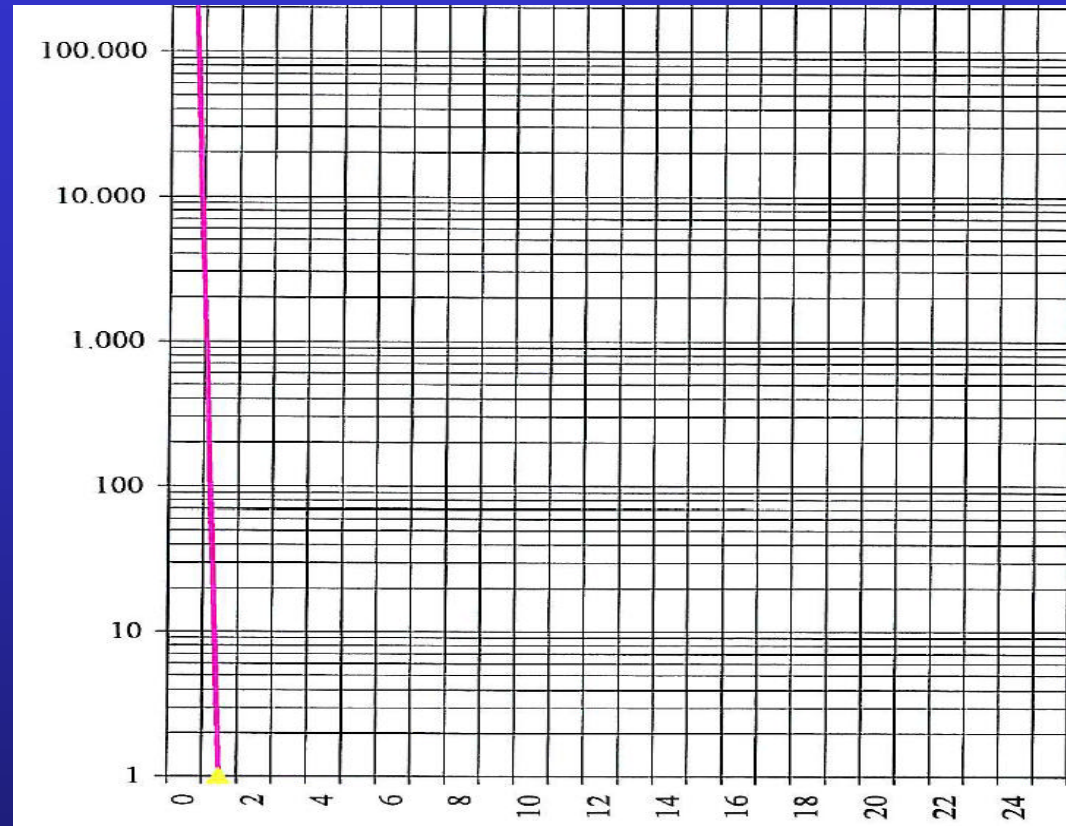
Dedicated pallet with long bedded forklift





excellent cleanliness of air in container

Number of Particles > 0.5 μm
per cubic meter



Time in minutes

- After closing the door, the number of particles in air drops rapidly
- Within 2 minutes: Clean Room Class 1000 quality



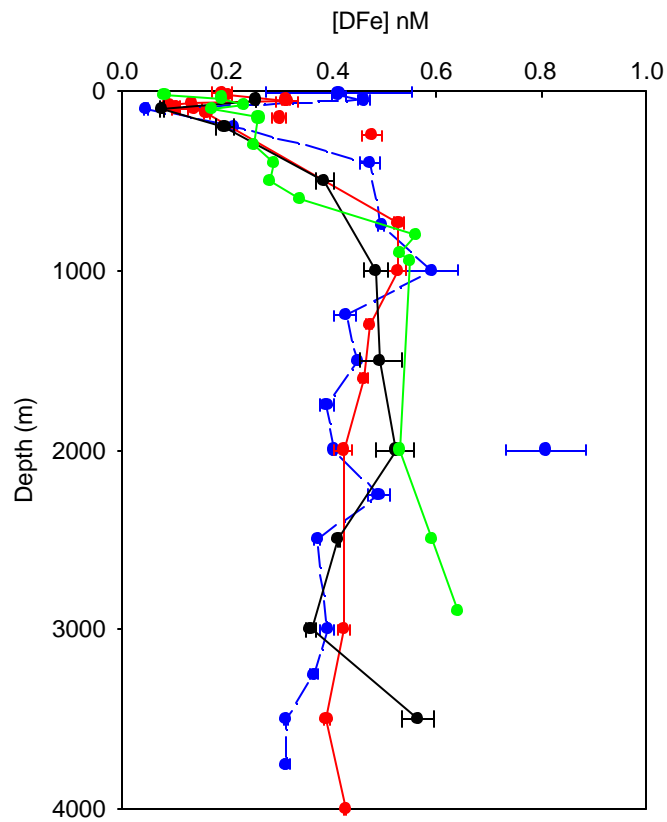
2005 Test Cruise in Canary Basin





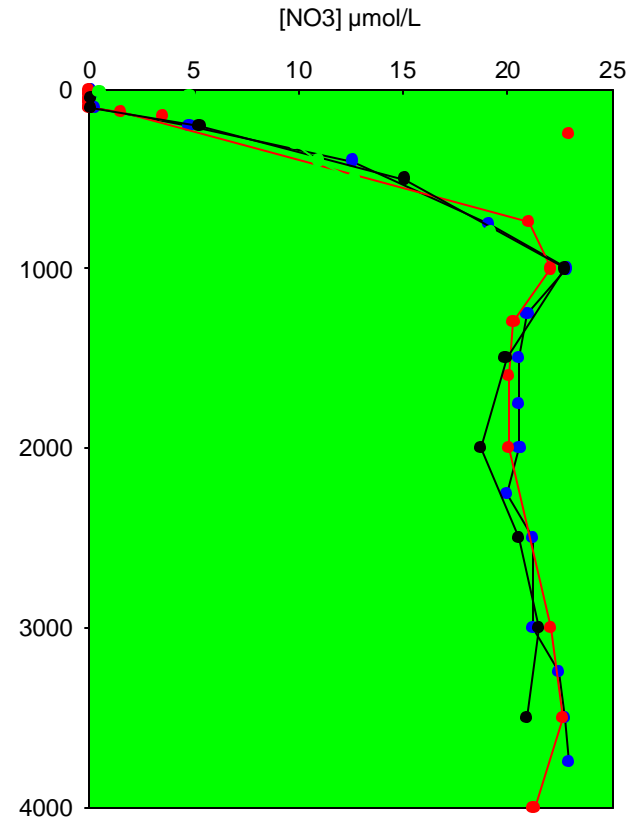
Results

Dissolved iron



- [DFe] nM new titanium frame 2005
- [DFe] nM Prototype frame IRONAGES 2002
- [DFe] nM traditional Kevlar wire cast
- Martin et al. NABE 2005

Nitrate



- [NO3] μmol/L new titanium frame 2005
- [NO3] μmol/L Prototype frame IRONAGES 2002
- [NO3] μmol/L traditional Kevlar wire cast
- [NO3] μmol/L Martin et al. NABE 2005



Conclusions:

TiTan[®] is:

- 1) Proven clean: Excellent results for DFe
- 2) Efficient: 4 times faster than the traditional method
- 3) Convenient and practical: Reduced handling & manpower
- 4) Versatile and mobile



The Ultra Clean Dream Team

Klaas Timmermans, Hein de Baar, Harry de Porto, Sven Ober
Patrick Laan, Marcel Bakker, Jack Schilling, Loes Gerringa and Marck Smit



Questions ?

