Carbon Measurement in Seawater at ppm Concentrations: The Sercon Hyphenated TOC

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The Importance of Carbon Measurements in Marine Environments

Stable isotope measurement of carbon gives insight into carbon sources, processes and patterns within ecosystem dynamics.

Measurements from seawater samples can be achieved directly using a hyphenated Total Organic Carbon Isotope Ratio Mass Spectrometer (TOC-IRMS) system.

Analytical Challenges of Seawater

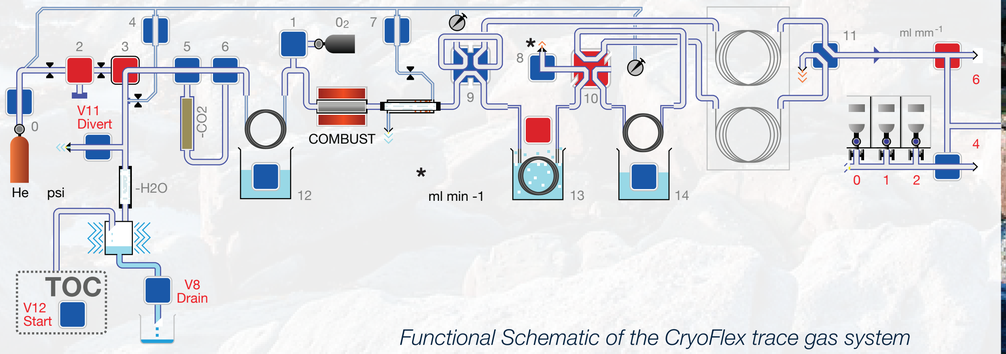
- Samples are typically low concentration
- Sample matrix has a high salinity
- Total combustion must be achieved
- Fractionation of CO_2 throughout the system
- Potential presence of suspended solids

The Sercon TOC IRMS: the world's first fully automated bench-top isotope measurement system

The Sercon Thermalox IRMS

Building on the success of the first Hyphenated TOC-IRMS system* the Thermalox TOC instrument was coupled with an optimised trace gas interface, the CryoFlex, allowing the hyphenation of the TOC to the IRMS. This system allows both fully automated sampling and conversion of TOC to CO_2 via catalytic combustion. The CO_2 is then transferred in a H2 carrier gas stream, dried and cryofocused in the Cryoflex interface before being admitted to the IRMS for measurement.

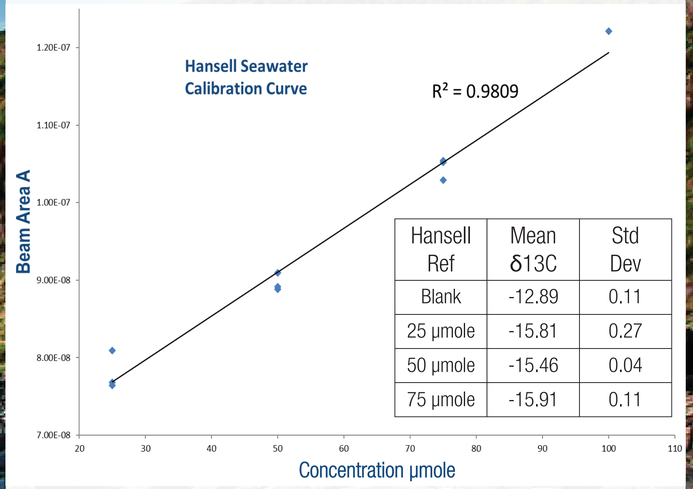
Due to the ability to make measurements with small aliquots only small samples are required, reducing salt build-up and giving robust performance whilst being easier to combust.



Functional Schematic of the CryoFlex trace gas system

Results

The technique was shown to be accurate and precise for the Hansell seawater material provided and ran at PML. Precision of 0.3 SD was observed for low level concentrations of 25 – 100 µmole, suitable for the application.



Hansell Ref	Mean δ13C	Std Dev
Blank	-12.89	0.11
25 µmole	-15.81	0.27
50 µmole	-15.46	0.04
75 µmole	-15.91	0.11

Further Development

The Sercon Thermalox TOC instrument has functionality for Total Nitrogen measurement. This technique can be used for Nitrogen budgeting in marine environments having already been shown to cope with the complex matrices of marine samples.

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*DeTroyer et al 2010 RCM

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