

Hidden HPR-40 MIMS System for Dissolved Species Analysis



Introduction

The HPR-40 MIMS System is configured for real-time quantitative analysis of **dissolved or evolved gases and vapours**.

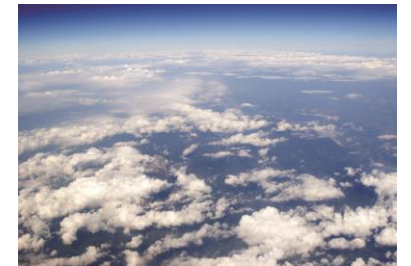
The inlet probe uses a permeable membrane that allows small levels of the dissolved species to pass through and on to the QMS.

The HPR-40 MIMS system has a mass range of 200 AMU (300 AMU option) and **sub ppb detection levels**.

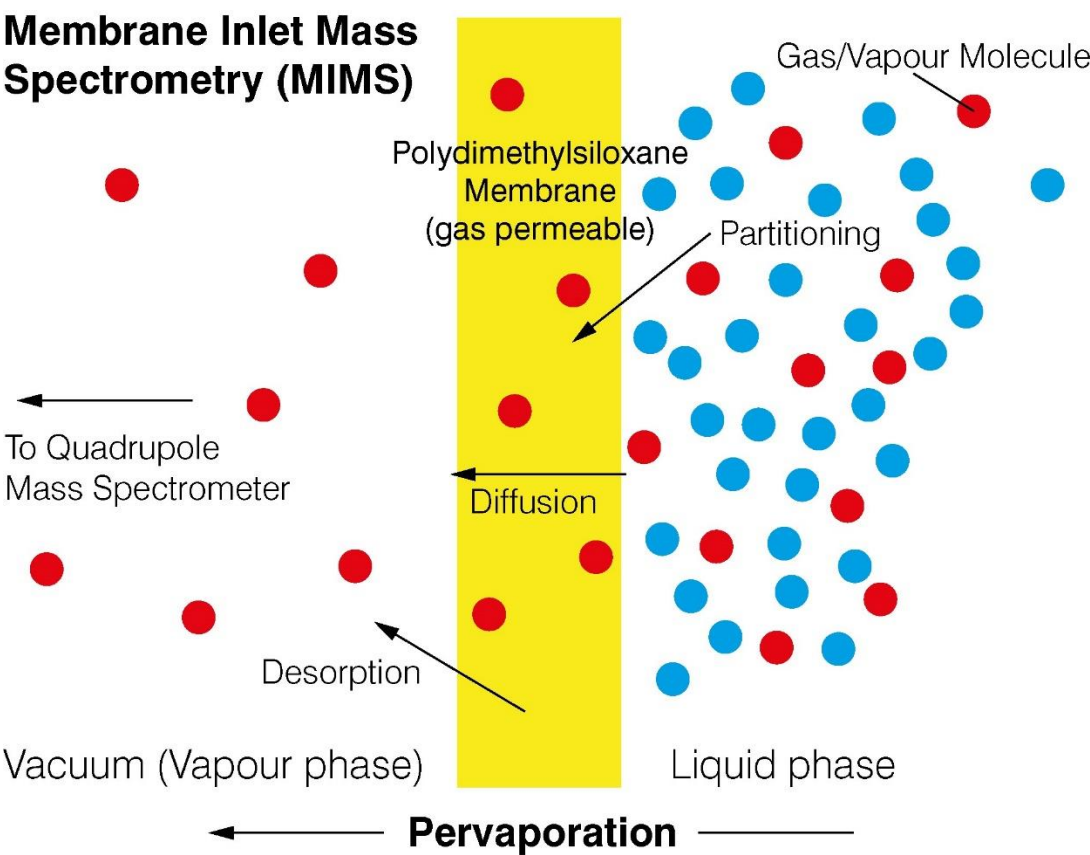
Interchangeable membrane inlet probe types address a broad range of applications.

Applications of HPR-40 MIMS

- Soil core analysis
- Fermentation process analysis
- Water analysis in Estuary, River or Reservoir
- Groundwater studies
- Methane production control
- Microbiological / Enzyme activity studies
- Environmental monitoring

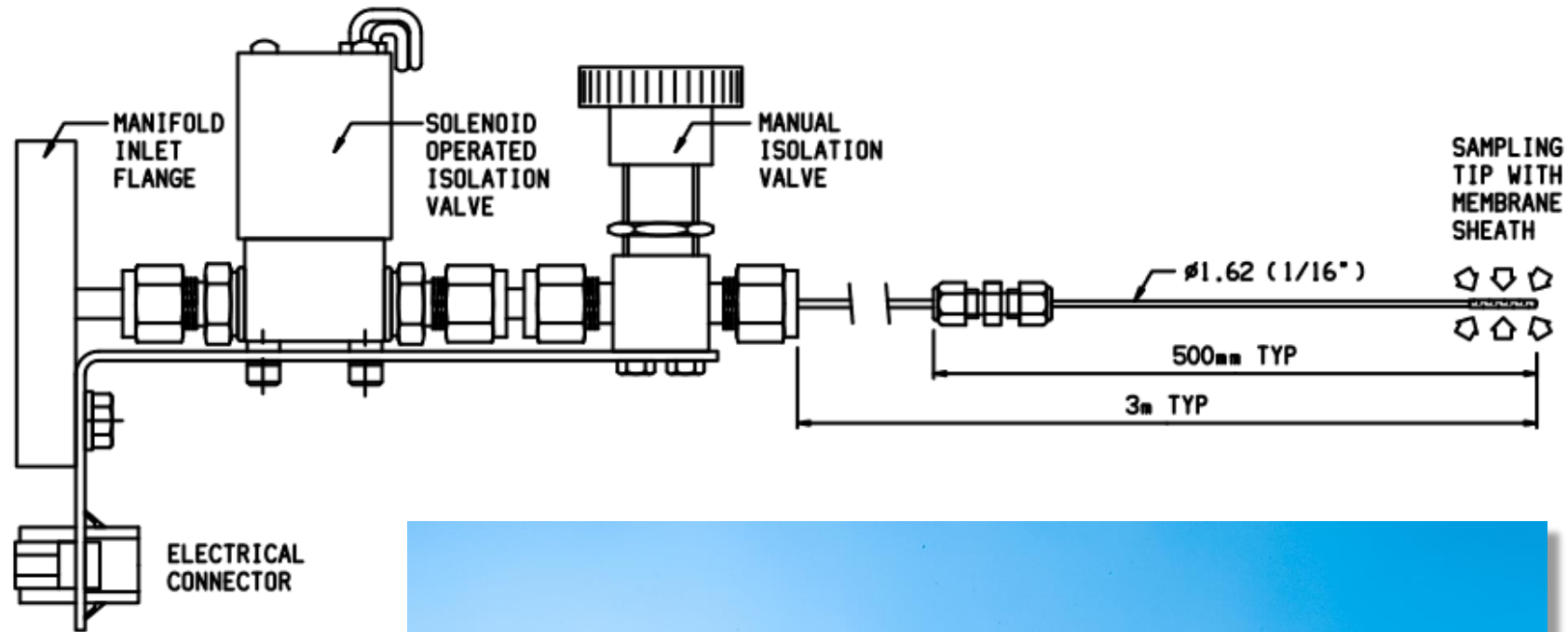


MIMS Overview

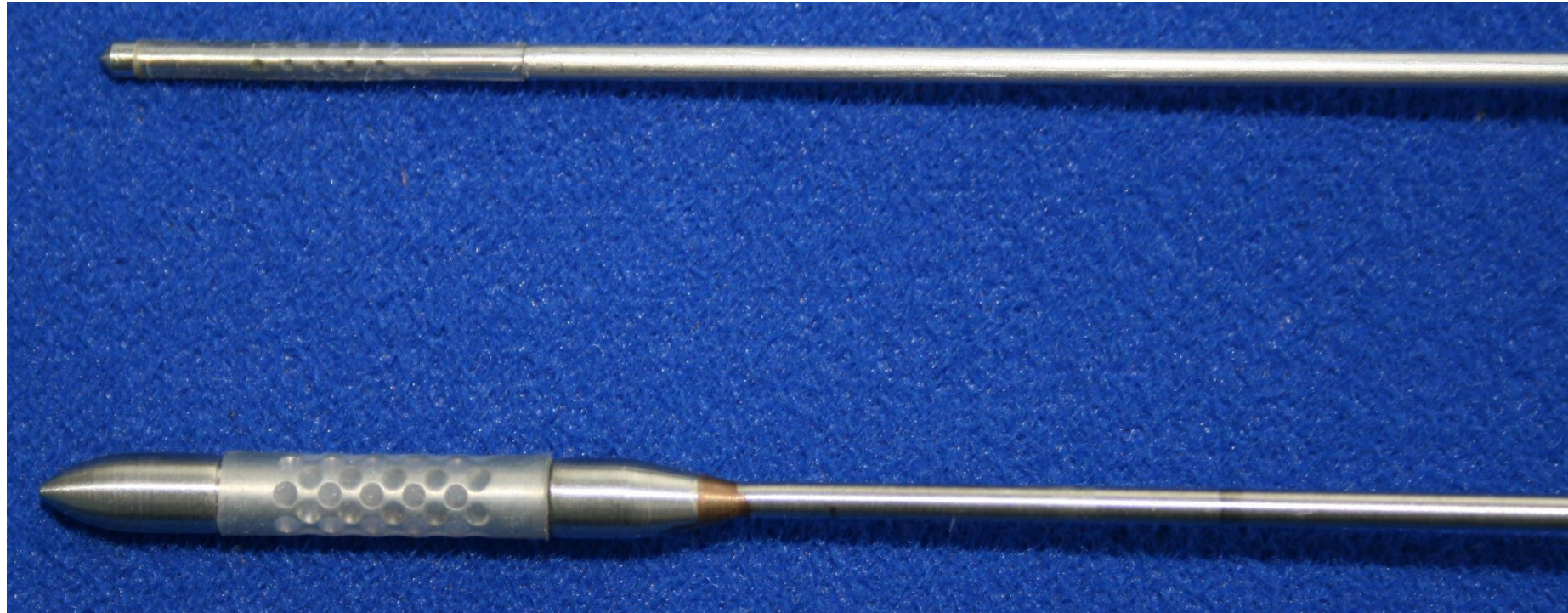


Typical enrichment factors WRT N ₂	
CO ₂	12.0
CH ₄	3.2
C ₃ H ₈	13.6
CH ₃ OH	46.4
SO ₂	50.0
C ₃ H ₆ O	19.6
C ₆ H ₅ CH ₃	30.4

Dissolved Species Membrane Probe



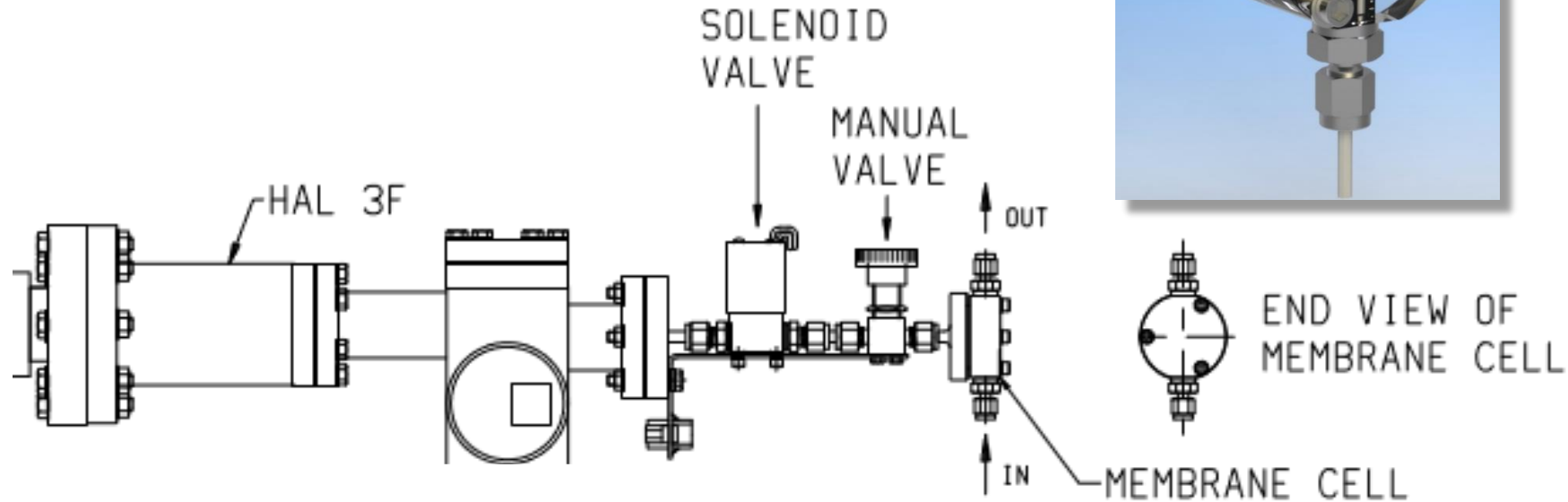
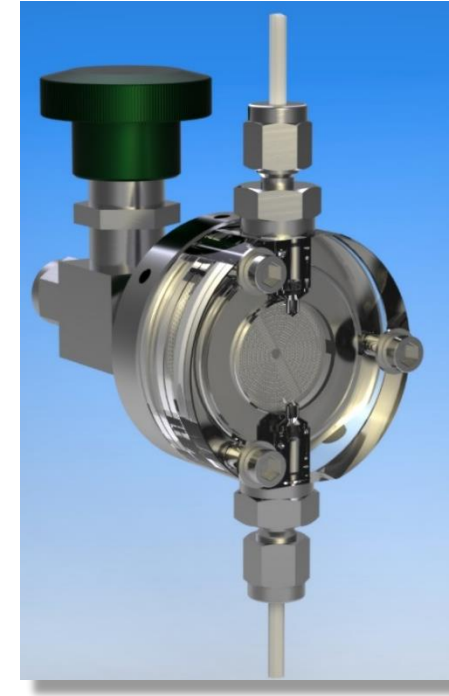
Dissolved Species Membrane Probe (large)



A comparison of the two Dissolved Species Probes. The larger tip is specifically designed for looking at gaseous species in soils, sands and semi-solid moist environments. Both probes are 0.5m in length.

Circular Membrane Cell

- Dissolved species circular membrane inlet carrier (with potential for integrated thermocouple).
- Includes liquid flow connections, ideal for circulation applications

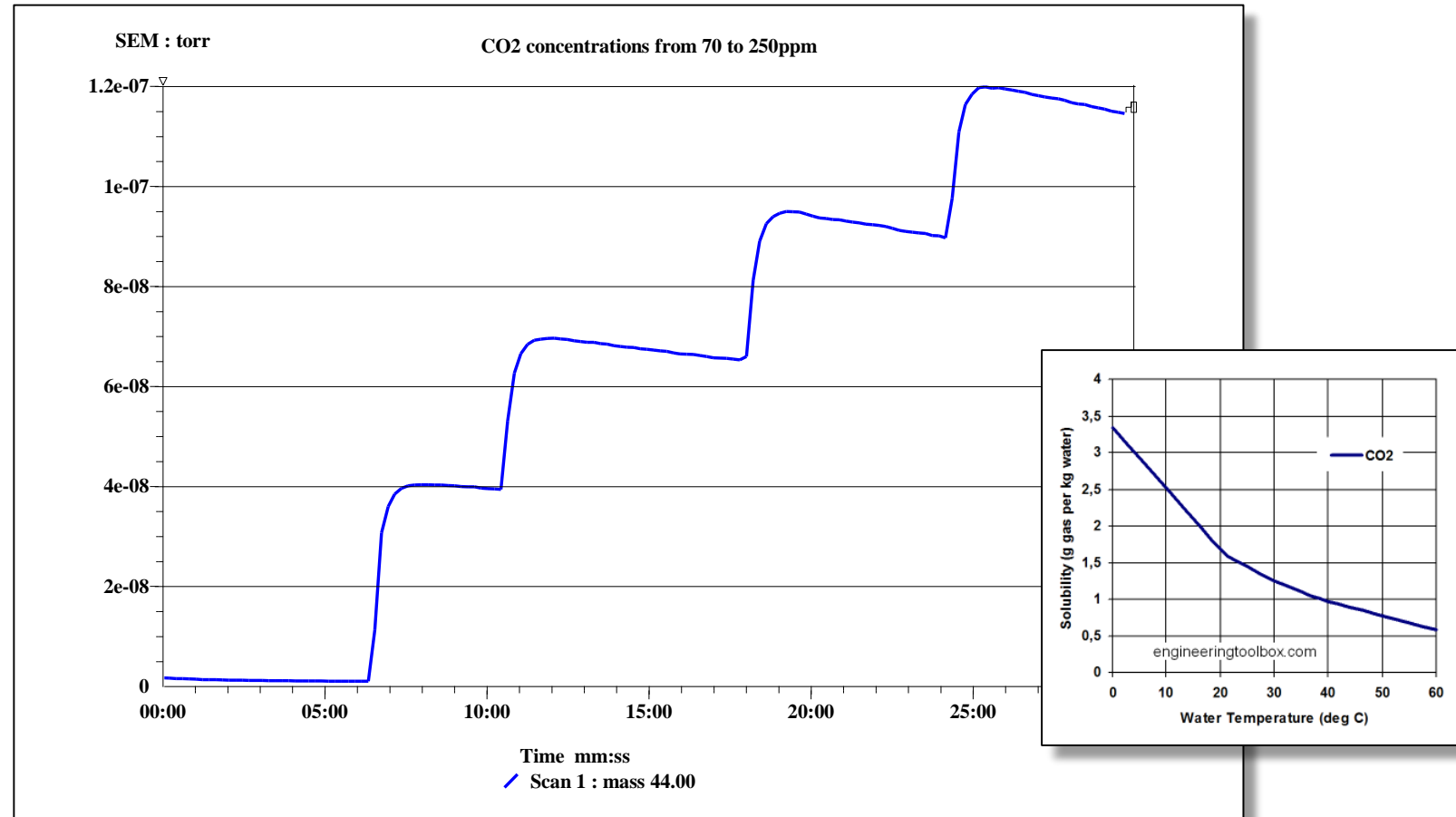


Cuvette Style Cell

- Dual volume construction (25 and 50ml) cuvette including liquid flow connections
- Integrated thermocouple and fluid agitation mechanism
- Ideal for algal biofuel studies and other aquatic or fermentation studies



Calibration Data



The figure shows the addition of 10mL aliquots of a CO₂-saturated H₂O solution (1.5g CO₂ per 1 kg H₂O at 23 deg C as per inset graph) to 200 mL pure H₂O. Therefore, the concentrations of CO₂ are approximately 0, 70, 140, 200, and 250 ppm for the 5 time steps shown.

Oceanic Studies

HPR-40 used to detect and analyse low level concentrations of DMS in British Columbian water (Dimethylsulphide, a trace substance implicated in global climate change and regulation).

The HPR-40 configured with a triple filter QMS provides detection levels into the parts per trillion range.

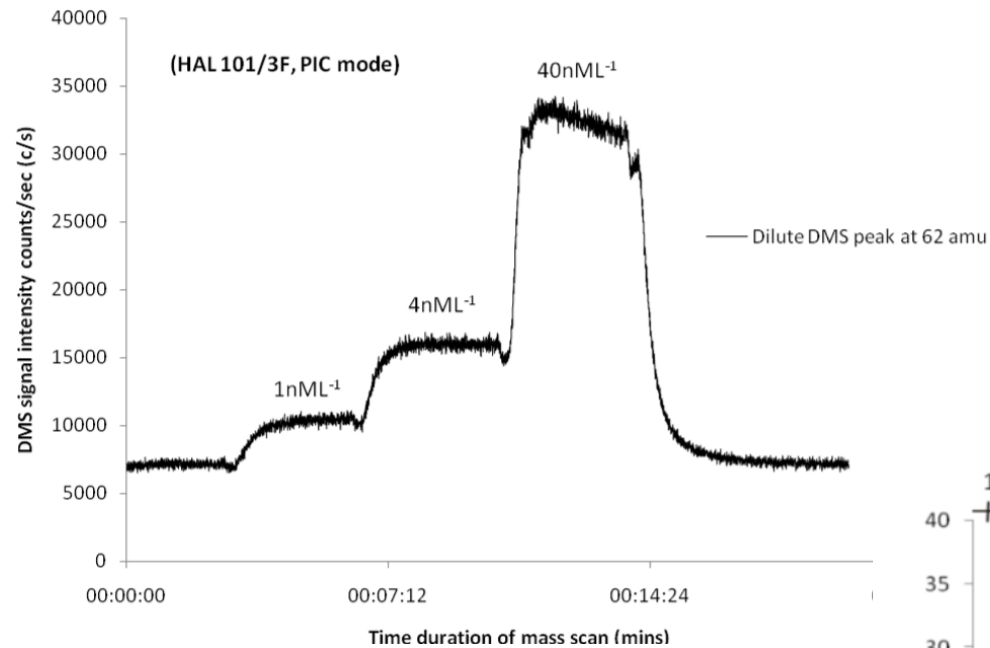
Corresponds to dilute DMS levels of $\leq 1 \text{ nmol/L}$

Influence of regional climate forcing on surface water pCO_2 , DO_2 /Ar and dimethylsulphide (DMS) along the southern British Columbia coast.

PD Tortell, A Merzouk, D Ianson, R Pawlowicz and D Yelland *Continental Shelf Research* 2012 **47** 119–132

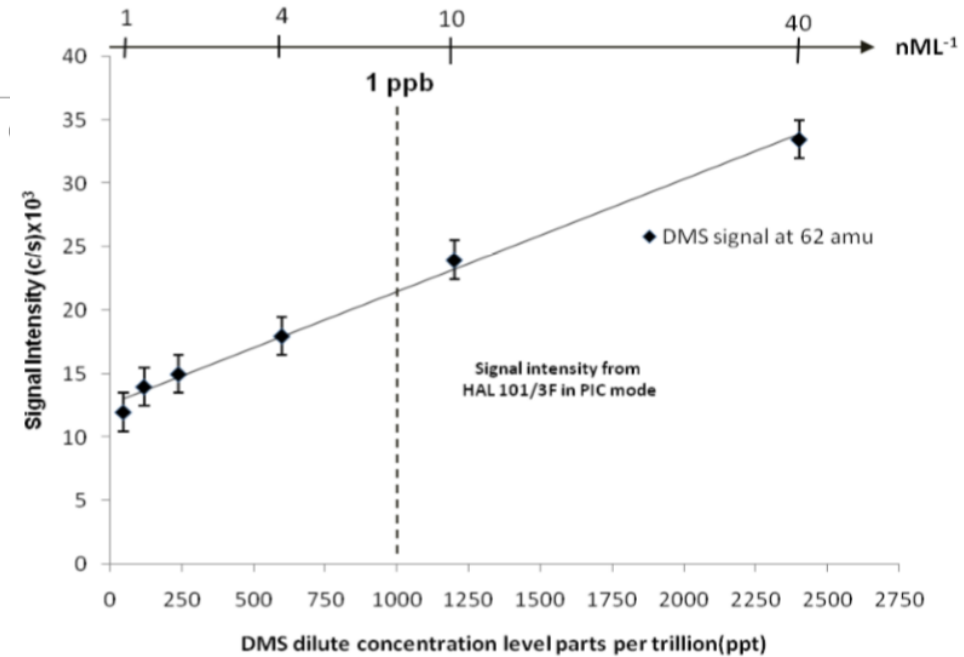


Quadrupole Mass Spectrometers for Advanced Science



Data obtained shows sub
ppb detection levels
(≤ 60 ppt)

*Data obtained with assistance from P.D.
Tortell, Department of Botany, University of
British Columbia*



Denitrification study

Continuous real-time measurement of gases enabled the dynamics of the process to be investigated.

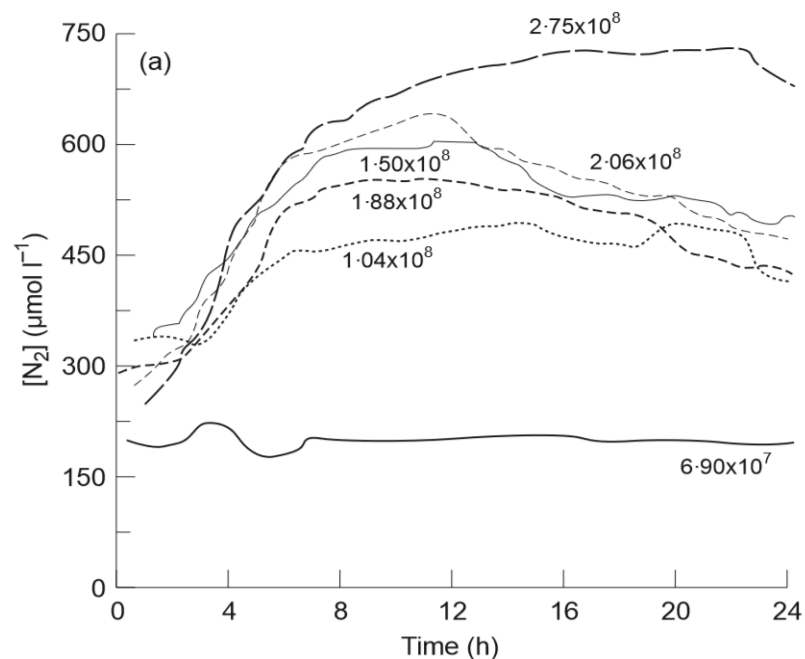
Concentrations of between 10 and 17 mmol/L were optimal.

Rate of denitrification dependant on cell concentration and required MIMS to model environmental conditions with low numbers of bacteria.

Denitrification by *Pseudomonas stutzeri* in a sterile lake water microcosm supplemented with succinate and nitrate.

JR Firth and C Edwards *Journal of Applied Microbiology* 2000 **88** 853-859

Data Obtained in Denitrification Studies



Data shows the effect of cell concentration on denitrification by *Pseudomonas stutzeri*. The lowest change in N_2 level measured was $40 \mu\text{mol l}^{-1}$ (Figure (a)).

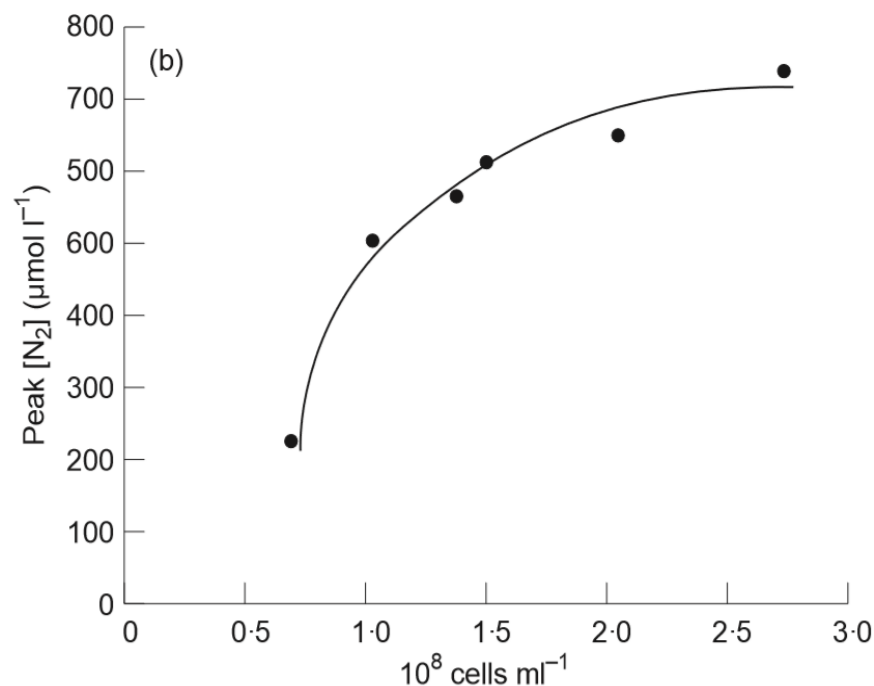
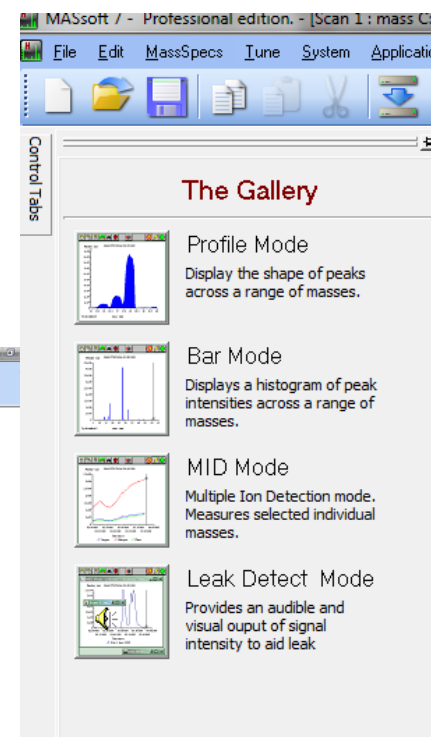
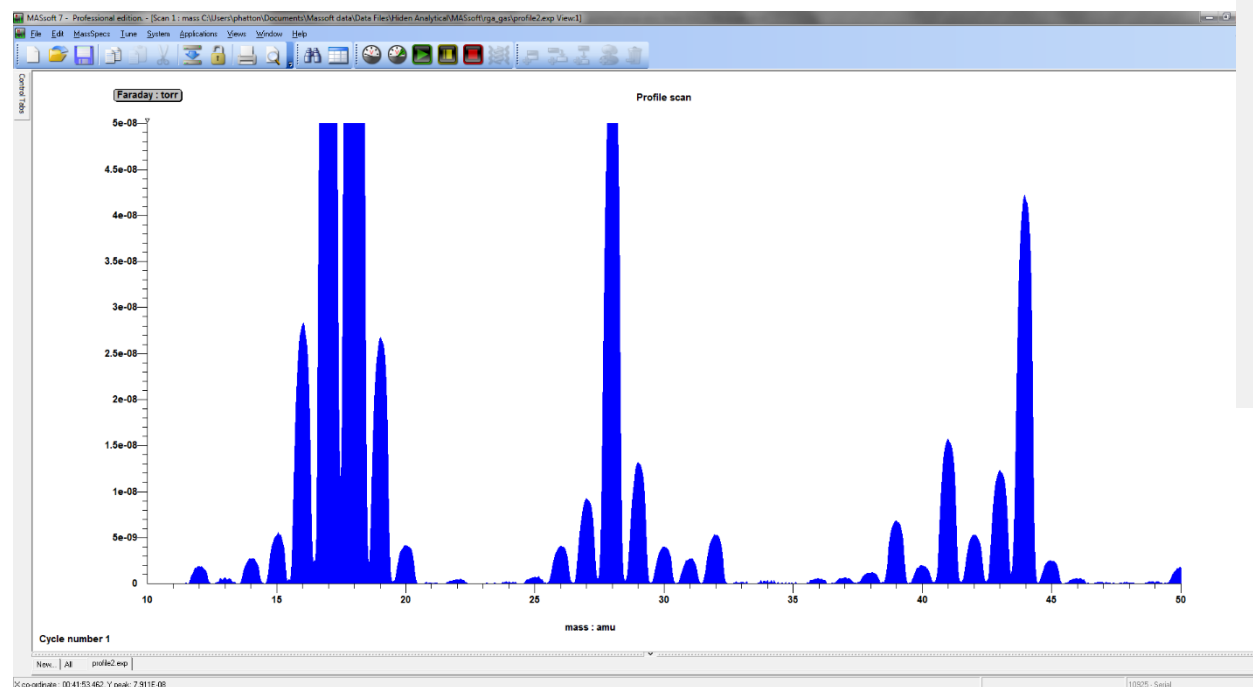


Figure (b) demonstrates that a cell density in excess of 2×10^8 cells ml^{-1} did not unduly increase the amount of N_2 produced.

Data obtained by JR Firth and C Edwards, School of Biological Sciences, University of Liverpool, UK

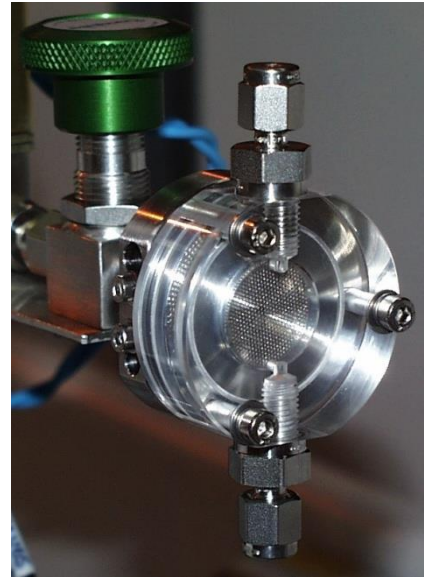
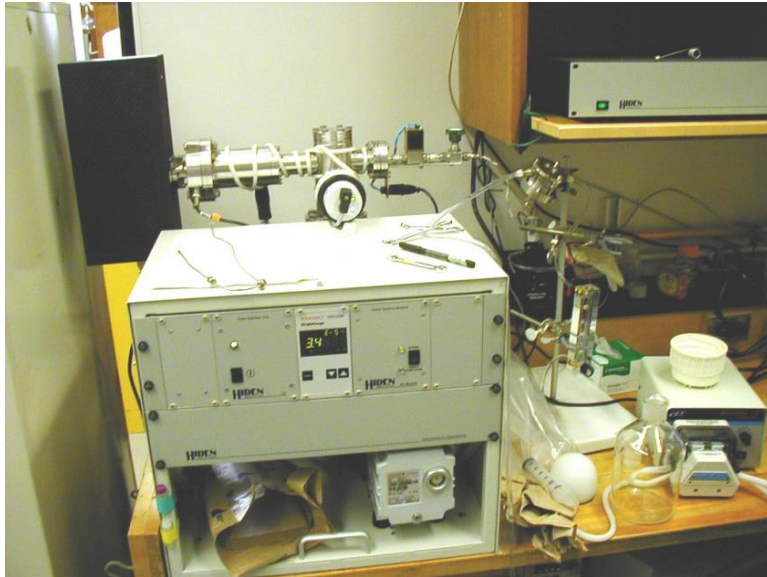
MASsoft Professional control software

- Template driven quick start operation
- Real time data display
- Mixed mode scanning including trend analysis
- Statistical analysis and peak integration
- Integrated mass spectral library



Summary

- Membrane Inlet Mass Spectrometer for Dissolved Species Analysis
- Designed and manufactured by Hiden in the UK
- Configurable species probe inlets can be used for a wide variety of scientific applications



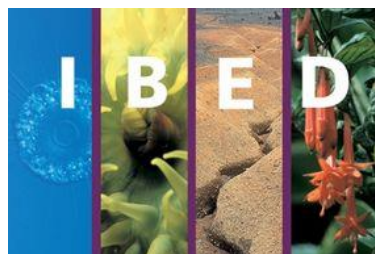
Academic References

- Denitrification by *Pseudomonas stutzeri* in a sterile lake water microcosm supplemented with succinate and nitrate. JR Firth and C Edwards *Journal of Applied Microbiology* 2000 **88** 853-859
- Development of membrane inlet mass spectrometry for examination of fermentation processes. J-R Bastidas-Oyanedel, Z Mohd-Zaki, S Pratt, J-P Steyer and DJ Batstone *Talanta, The International Journal of Pure and Applied Analytical Chemistry* 2010 **83** 482-492
- Influence of regional climate forcing on surface water pCO₂, DO₂ /Ar and dimethylsulfide (DMS) along the southern British Columbia coast. PD Tortell, A Merzouk, D Ianson, R Pawlowicz and D Yelland *Continental Shelf Research* 2012 **47** 119-132
- High resolution measurement of Southern Ocean CO₂ and O₂/Ar by membrane inlet mass spectrometry. C Gu ´ eguen and PD Tortell *Marine Chemistry* 2007 **108** 184-194

Hidden HPR-40 Users



廈門大學
XIAMEN UNIVERSITY



UNIVERSITY OF
EASTERN FINLAND



UNIVERSITY OF
LIVERPOOL

- Trent University
- Forest Research Institution (SCION)
 - Xiamen University
 - University of Kuopio
 - Cardiff University
 - University of Wales
 - Ricoh
 - University of Queensland
 - University of Newcastle
- University of California, Berkeley
 - Liverpool University
- Institute for Biodiversity and Ecosystem Dynamics
 - National Institute of Oceanography, Goa
 - GBA Laborgruppe
 - University of Rennes





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