



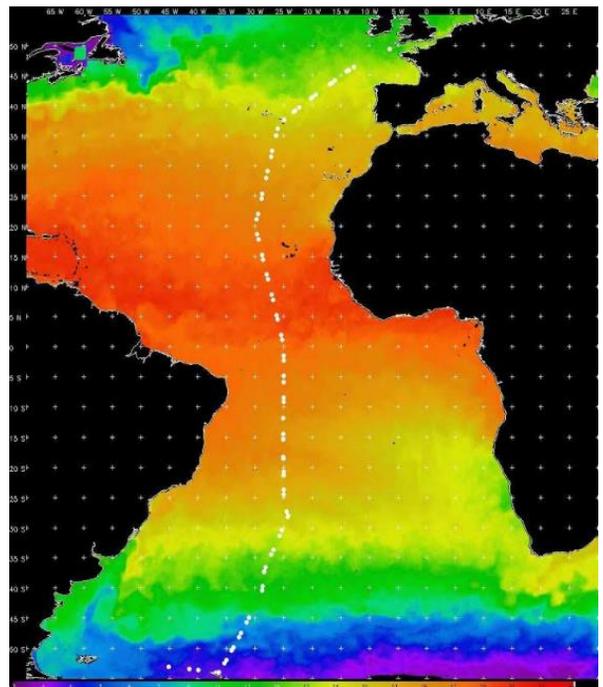
sercon
innovators in isotopes

Application note 034 – Ship based CN measurements with the Integra

The Atlantic Meridional Transect (AMT) is an annual oceanographic expedition between the UK and the South Atlantic which has been operational since 1995. For the 2017 research cruise between Southampton and the Falkland Islands a collaboration between Sercon Ltd and Andy Rees of the Plymouth Marine Laboratory saw a Sercon Integra deployed at sea for the first time. The Integra2 is a combined EA-IRMS, it's unique design makes it suitable for field campaigns including those on board ships and in remote research stations. The Integra2 is smaller, lighter and more portable than other EA-IRMS solutions. It has a very low flow of helium (25 ml/min in low volume mode) and does not require a reference gas – a sample is combusted and held within a loop to tune the source, and standard-sample bracketing is used to calibrate the samples. Furthermore, there is no delicate exposed silica and a permanent magnet means the instrument is less susceptible to temperature fluctuations.

Aims of the AMT programme include making measurements of plankton diversity and activity in the upper layers of the Atlantic Ocean. Some of these measurements, including those of bacterial and zooplankton abundance have occurred on each of the 27 cruises completed. During this voyage Rees and his team enhanced these routinely made measurements by using ^{13}C and ^{15}N signatures to inform on the distribution and trophic condition of plankton communities. This has been done using two approaches

- 1) An investigation of the natural variability of both isotopes
- 2) using tracer additions of ^{15}N and ^{13}C to follow the fixation of nitrogen and carbon by diazotrophic (nitrogen fixing) and photosynthetic organisms.



Route of the AMT expedition

Experimental procedures:

A) Each day zooplankton samples were collected from between 200m and the surface. 1 ml from each concentrated sample was collected onto ashed GF/F filters, dried at 50°C and analysed in the Integra using standard conditions of combustion and reduction.

Early results indicate that the nutritional status of zooplankton communities which is reflected by their isotopic signature can be seen to align with ocean provinces as indicated by the temperature and salinity of surface seawater. This technique may prove invaluable in assessing the bio-geography of plankton communities.

B) Triplicate 2.4L bottles were filled with surface seawater and amended with $^{15}\text{N-N}_2$ (daily) to determine N-fixation and with ^{13}C -bicarbonate (alternate days) to determine C-fixation. Rates of these critical biological processes have not been calculated at this time, as supporting data required is still in a raw format. **Probably the first time ever that isotopic data has been produced before the ecosystem variables needed to complete the analysis.** Despite this it is possible to see positive enrichment of ^{15}N (blue in figure) and ^{13}C (red in figure) at most ocean stations occupied.

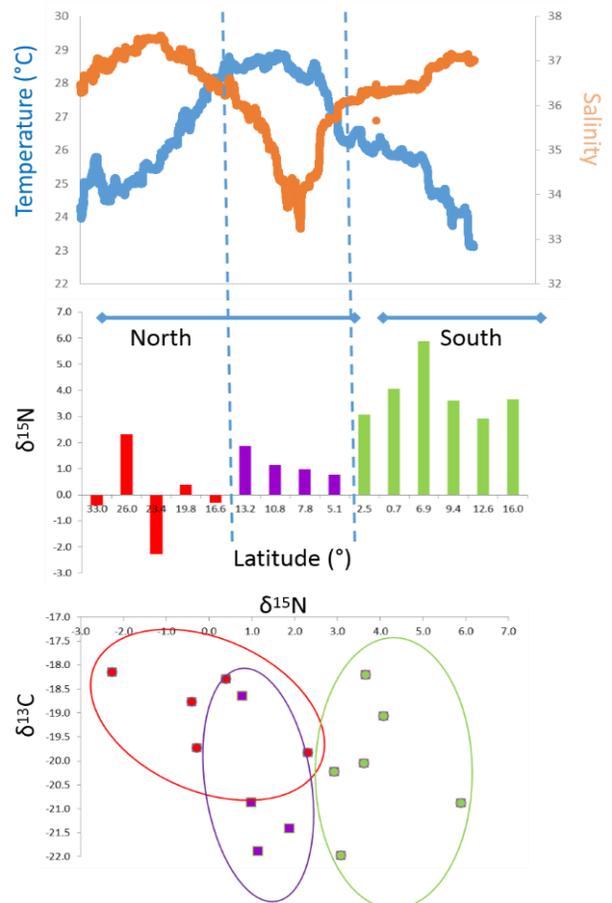


Figure 2 ^{15}N ^{13}C variation with Temperature and Latitude

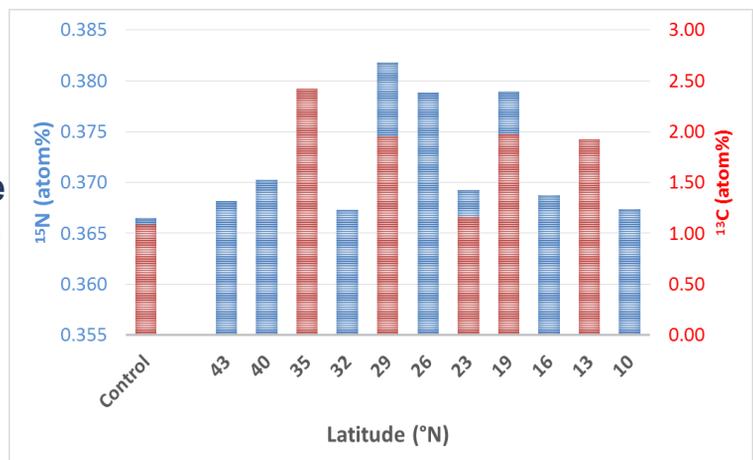


Figure 3 Atom% of ^{15}N and ^{13}C determined during AMT27 voyage in the Atlantic Ocean

Credit to Andrew P. Rees, Plymouth Marine Laboratory, Plymouth, PL1 3DH, UK

Table 1: Typical precision from Integra runs during AMT27

	$\mu\text{mol N}$	Mean	SD	n
Atom% ^{15}N				
Methionine	2	0.36641	0.00061	3
Ammonium Chloride	1.8 – 2.6	0.36649	0.00025	8
$\delta^{15}\text{N}$				
Ammonium Chloride	1.8 – 5.2	0.35	0.21	9
	$\mu\text{mol C}$	Mean	SD	n
Atom% ^{13}C				
Methionine	10	1.07479	0.00054	3
Beet Sugar	11 - 19	1.09290	0.00278	8
$\delta^{13}\text{C}$				
Beet Sugar	11 - 38	-25.69	0.15	9

The Integra from Sercon, a truly portable benchtop EA IRMS

