

## ANTARES 4 AMMONIUM PROFILES

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### *Method of analysis*

Ammonia was analysed using gas-diffusion flow-injection analysis with fluorescence detection. The technique used is a modification of a technique by Jones (1991, *Limnology and Oceanography*, 36: 814-819). Ammonium in the sample is converted to ammonia and then diffuses across a teflon membrane into a phosphate buffer. The ammonia reacts with *ortho*-phthalaldehyde and sulphite, at 70°C, and then is detected by fluorescence.

Samples were collected in triplicate into 10ml polypropylene tubes and are used as one tube for a single injection. This is to minimize contamination between samples. Samples were analysed either within 2-3 hours of collection or were frozen for later analysis. To minimize contamination from atmospheric ammonia in the lab, a perspex glove box purged with N<sub>2</sub> was used to store reagents and as an ammonia free environment for manually injecting samples into the flow system.

A total of 730 samples were collected. In general samples are from within the top 300m of the water column. On some occasions the full depth of the water column was sampled.

### *Results*

Essentially three types of ammonium profiles (upper 300m of water column) can be distinguished:

- (1) Profiles showing low NH<sub>4</sub><sup>+</sup> concentrations (< 50 nM) in surface waters and a shallow (at 50 to 60m) small NH<sub>4</sub><sup>+</sup> maximum (< 200 nM); below this maximum concentrations decrease very sharply back to low concentrations (< 50 nM), similar to those present in surface waters (Figure 1). Eventually the subsurface maximum can be very weak. This situation is observed in the northeastern part of the investigated area, around 43°S and between 62°30' – 63°30'E, that is in the Subtropical Zone (Figure 4).
- (2) Profiles showing surface water NH<sub>4</sub><sup>+</sup> concentrations between 100 and 200 nM, followed by a sharp increase towards a maximum at about 50m. This maximum stays generally below 1,000 nM and typical values range between 500 and 800 nM. Further down in the water column concentration drop very sharply to reach low (< 50 nM) and more or less constant values on from 60 to 70 m towards greater depths (Figure 2). This situation is characteristic for the area comprised between the Agulhas Front and the Subtropical Front (Figure 4)
- (3) Profiles having high NH<sub>4</sub><sup>+</sup> concentrations (200 to 250 nM) in the surface waters (upper 50m). On from 50m concentrations increase sharply to reach maximal values exceeding 2,000 nM (absolute maximum is 4,300 nM at ANT 4017) at depths between 80 to 130m). Further down in the water column concentrations decrease sharply to reach low values (< 50 nM) on from 150 to 200m (Figure 3).

This situation is characteristic for the Subantarctic Zone region, south of the SAF (Figure 5)

The few profiles extending to depths  $> 300\text{m}$  show that  $\text{NH}_4^+$  concentrations remain low ( $< 50\text{nM}$ ) for the whole of the intermediate and deep waters.

Figures 4 and 5 show the spatial distribution of ammonium at the 50 and 100m depth horizons. Approximate positions of fronts, as redrawn from Y. Park, are indicated. Clearly, at 50m the area stretching in a southwest – northeast direction, comprised between the AF and the STF shows the highest concentrations, together also with the SAZ stations around  $46^\circ\text{S} - 63^\circ\text{E}$ . As concerns the 100m depth horizon it is the stations in the SAZ which show highest concentrations.

So, clearly the frontal structures are separating the area in three provinces as regards the nitrogen cycling. North of the SAF - STF regeneration is shallow, with highest  $\text{NH}_4^+$  contents reached close to 50m. This holds also for the region north of the AF, except that concentrations there are overall much lower. South of the SAF regeneration appears to reach much greater depths (100 – 120m). In general, concentrations in surface waters and in the ammonium maximum show a clear decreasing trend from SAZ over STZ to subtropical waters.

No data are as yet available concerning the N-uptake regime during Antares 4. However, judging from the above it is most probable that these will show significant spatial variability, closely following the one of ammonium. Based on knowledge gathered during the SAZ '98 expedition in the SAZ region south of Australia, we may expect a south to north increase in utilisation rate of  $\text{NH}_4^+$  paralleled by a decrease in  $f$ -ratio.