

Dissolved organic matter fluxes at the Iberian margin

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1 BACKGROUND

Dissolved organic carbon (DOC) is the largest oceanic reservoir of organic carbon, calculated to have a carbon load equivalent to atmospheric CO₂ (Hedges, 1992). In addition to its important role in global carbon cycling, DOC is inextricably linked to the marine biogeochemical cycling of nitrogen and phosphorous (Mantoura *et al.*, 1991). We have developed a rapid, high-precision system for the simultaneous determination of DOC and total dissolved nitrogen (TDN), from which dissolved organic nitrogen (DON) may be simply derived (Alvarez-Salgado and Miller, 1998). Investigations into DOC/DON in coastal and shelf environments are few and there is no published DOM data for the NW Iberian margin. This project contributes to *Work Package II* and *Work Package IV*. Dissolved organic matter (DOM) studies are focussed on Task 2, to track the upwelling and downwelling seasonal distribution of DOC/DON throughout the water column across the NW Iberian shelf into oceanic waters.

2 OBJECTIVES

2.1 To investigate the fluxes of Dissolved Organic Carbon (DOC) and Dissolved Organic Nitrogen (DON) across the NW Iberian shelf and shelf-break, in order to construct a 3-D picture of Dissolved Organic Matter (DOM) delivery into the NE Atlantic.

2.2 Comparison between OMEX I (Goban Spur), LOIS SES (Hebridean Shelf) and OMEX II-II (Iberian Shelf) data, to provide estimates of the magnitude of spatial variability in cross-shelf DOM transport along the NE Atlantic ocean margin.

2.3 Undertake surface DOC mapping for potential ground truthing remotely sensed ocean colour satellite data for the SeaWiFS programme.

3 TASK-SPECIFIC PROGRESS

Below are listed the WP II Tasks for which the *DOM fluxes* project is a contributory scientific component. Descriptions of relevant components, and the progress so far, shall be addressed by *Technical Annex subtask deliverables* thereafter. Reference will only be made to those subtasks on which progress has been made.

Task II.4 *Nutrient distribution, speciation, upwelling and fluxes*

Task II.6 *Dissolved organic carbon*

Task II.12 *Remote Sensing and Biogeochemical algorithms*

Subtasks II.4.1 Nutrient oceanography

II.6.1 Seasonal and spatial distribution of DOC

II.6.2 Planktonic production of DOC

II.6.3 Bacterial utilisation of DOC

3.1 Intercalibration on preserved samples taken during OMEX cruises

Under ‘*Methodology*’ it is stated that intercalibrations for DOC will be carried out by PML-*a*, UOviedo and UVI. This is not quite correct, as the only partners responsible for measurements of DOC using comparable techniques are actually IIM (WP I) and PML-*a* (WP II). UVI are measuring DOC production using radiochemical counting techniques: intercomparison of results is not possible for reasons of safety and instrument sensitivity.

DON (actually TDN) distributions will only be measured by PML-*a* (WP II). Therefore, intercalibration is not required to demonstrate consistency between data sets. However, measures have been and are continuing to be taken as a matter of course, to ensure consistency between the analytical facilities at IIM and PML:

(i) A manuscript: “Simultaneous determination of dissolved organic carbon and total dissolved nitrogen in sea water by high temperature catalytic oxidation: conditions for precise shipboard measurements”, by Xosé A. Álvarez-Salgado (IIM) and Axel E.J. Miller (PML-*a*), has been published in *Marine Chemistry* (62(3/4), 325-333, 1998). This details work carried out by the authors during the period of OMEX I; which has resulted in much valuable collaboration and common experience in the analytical methodologies that will be employed during OMEX II-II.

(ii) Georgina Spyres (PML-*a*) has collected samples from two oceanographic profiles (a total of approximately 20 samples) in the Iberian Shelf, during August 1998 and January 1999. Replicates of these samples were analysed on-board (PML-*a*), and further preserved aliquots will be analysed in the laboratories of PML-*a* and IIM. Results from this exercise are not yet available.

(iii) Both PML-*a* and IIM groups are part of an on-going international DOC intercomparison programme, organised by Jonathan Sharp (Univ. Delaware) and Dennis Hansell (Bermuda BSR). This programme collects and circulates ampoules of deep Sargasso Sea water, of known DOC concentration, to all registered members of the international community, with formal analytical and reporting protocols. This is an extremely important move towards wide-scale analytical consistency, and will be included at all stages of the PML-*a* and IIM OMEX DOC measurement programmes. The combined results from these activities will result in repeatedly intercalibrated DOC analysis methods, producing consistent data sets for both WP I (IIM) and WP II (PML-*a*).

The combined results from these activities will result in repeatedly intercalibrated DOC and TDN analysis methods, producing data sets WP II.

3.2 DOC/DON distributions

Georgina Spyres participated in the R.V. *Professor Shtokman* WP II cruise *OMEX0898*, during August 1998 and R.V. *Meteor* WP III cruise *M43/2*, during January 1999. In the first instance, investigations were designed to determine the summer distribution of DOC/TDN through the water column, across the NW Iberian shelf and shelf-break into deep oceanic water. Upwelling conditions were encountered for the duration of the cruise. Water column samples were collected from 20 appointed stations along the OMEX transects N, P and S. Due to lack of non-toxic supply facilities, samples could not be collected from the surface whilst underway.

Participation in the *Meteor* cruise was particularly important for comparison with *CD110b* – providing inter-annual variability of distributions during winter. As this was a WP III cruise, the

opportunity for collecting samples of direct interest to our work was limited. However, it did provide the opportunity to collect a relatively large data set from eight stations along OMEX transect S, from inshore at S200 to oceanic water at S2700. This had not been possible during *CD110b*.

Shipboard HTCO-DOC/TDN measurements were made wherever possible. During the *Professor Shtokman* cruise aliquots of all samples were preserved and archived for analysis at PML. After final quality control of the results, the complete data set should be submitted to BODC in summer, 1999. Representative data for inshore (N220; Figure 1) and offshore (N2300; Figure 2) are presented. The background DOC concentrations inshore were 54-58 μMC , with a large increase ($\sim 24 \mu\text{MC}$) observed at 60 m. It is suggested that nutrient-rich upwelled waters are stimulating primary production, as indicated by the high Chl *a* concentration at ~ 30 m. The increased productivity may be producing higher DOC concentrations through phytoplankton activity (*i.e.*, exudation, cell lysis), or zooplankton grazing on phytoplankton. DOC concentrations below 500 m at station N2300 (Figure 2a) were generally characteristic of the water masses present. At the MOW maximum (~ 1000 m; Figure 2b) DOC was lowest ($42 \pm 2 \mu\text{MC}$), reflecting the oligotrophic character of this water mass. In the upper 200 m, DOC and Chl *a* concentrations were strongly correlated (0.98).

During the summer cruise DOC/TDN samples were taken in collaboration with *bacterial DOC uptake* experiments (UAL). Data will be used to estimate the relative contribution of phytoplankton production to the DOC reservoir over the course of shipboard incubations.

Surface samples were collected during the Meteor cruise to provide accurate DOC measurements for algorithm development of SeaWiFS remotely sensed data to enable basin scale mapping of DOC distributions to be undertaken in collaboration with the remote sensing group (NSS).

4 PLANS FOR YEAR 3

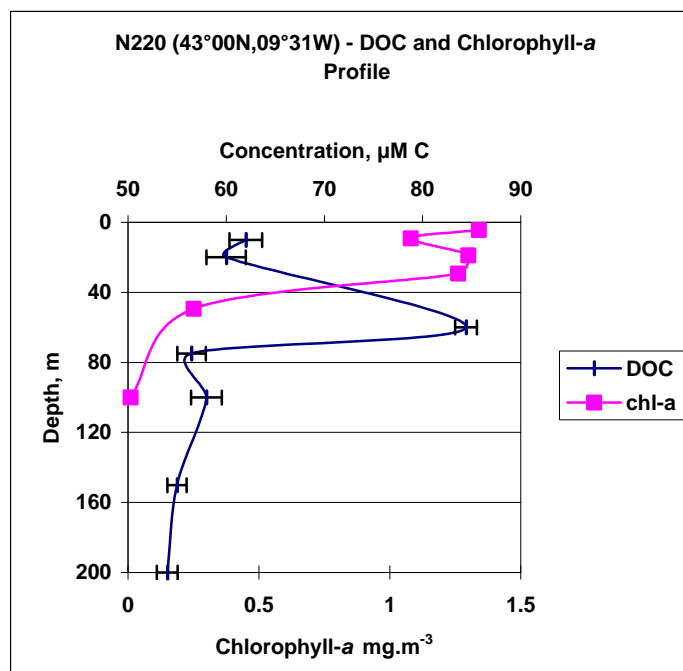
- (i) Analysis of OMEX-community and international intercomparison samples (PML-*a*, IIM).
- (ii) Participation in autumn WP II cruise (September 1999) fronted by Dr. Lei Chou (ULB). The survey will focus on *OMEX Reference Lines*. This will allow replication of a number of stations sampled during the previous cruises, thus providing seasonally comparative data.
- (iii) Development of ultrafiltration methodology for the size-fractionation of DOM. Samples will be collected during the autumn cruise, providing a breakdown of the size-classes of material on horizontal and vertical scales.

5 REFERENCES

- Alvarez-Salgado, X.A. and Miller, A.E.J., 1998. Simultaneous determination of dissolved organic carbon and total dissolved nitrogen in sea water by high temperature catalytic oxidation: conditions for precise shipboard measurements. *Mar. Chem.*, 62: 325-333
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- Mantoura, R.F.C., Martin, J.-M. and Wollast, R. (eds.), 1991. *Ocean Margin Processes in Global Change*. Wiley-Interscience, Chichester, 469 pp.
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Figure 1 (a) Dissolved organic carbon and Chl a profiles and (b) temperature and salinity, for station N220 during summer cruise ST0898.

(a)



(b)

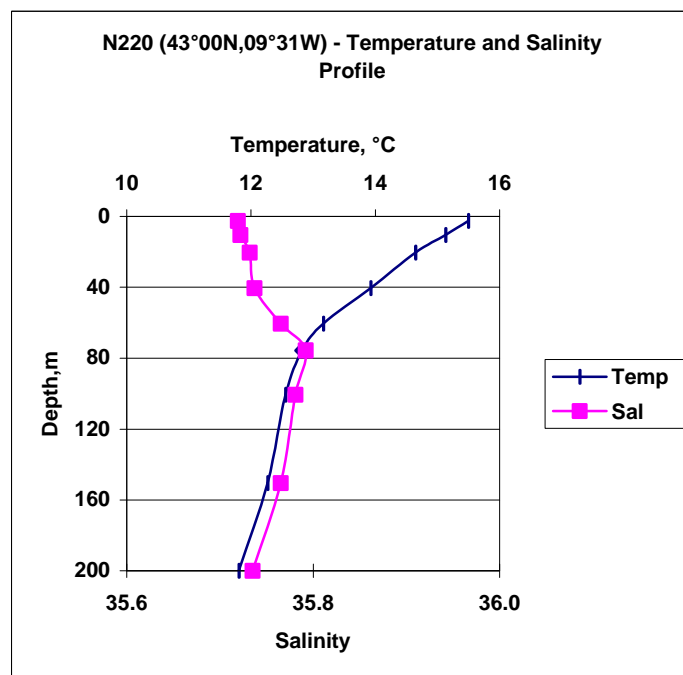
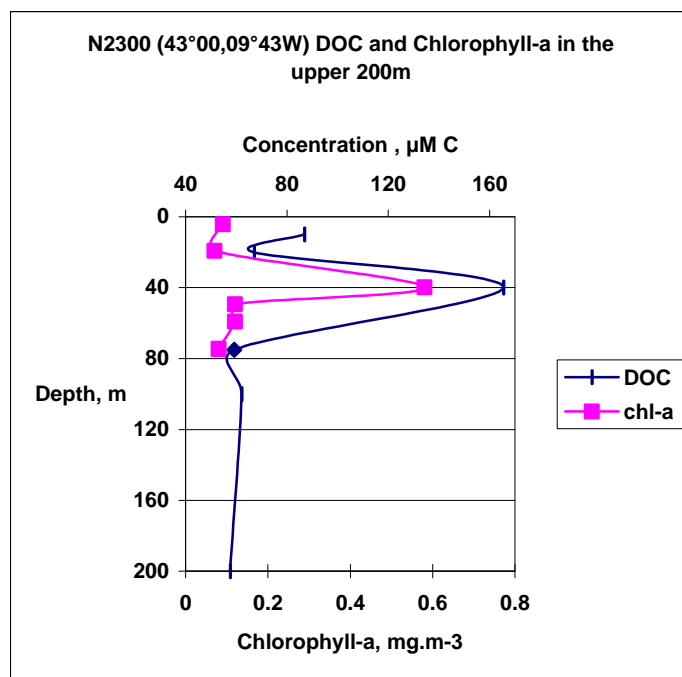


Figure 2 (a) Dissolved organic carbon and Chl a profiles and (b) temperature and salinity, for station N2300 during summer cruise ST0898.

(a)



(b)

