CTD Data for Cruise Discovery DI211
(9 October - 11 November 1994)

1) Instrumentation

The 46 CTD profiles were taken with an RVS Neil Brown Systems Mk3B CTD incorporating a pressure sensor, conductivity cell, platinum resistance thermometer and a Beckman dissolved oxygen sensor. The CTD unit was mounted vertically in the centre of a protective cage approximately 1.5 m square. Attached to the bars of the frame were a Chelsea Instruments Aquatracka fluorometer and a SeaTech red light (661 nm) transmissometer with a 25 cm path length. For the first cast, PML 2-pi PAR scalar irradiance sensors were fitted to the top and the base of the frame. These measured downwelling and upwelling irradiance respectively.

A General Oceanics rosette sampler fitted with 12, 10 litre Niskin bottles was mounted above the frame. The bases of the bottles were 0.75 m above the pressure head with their tops 1.55 m above it. One of the bottles was fitted with a holder for up to three digital reversing thermometers mounted 1.38 m above the CTD temperature sensor.

Lowering rates were generally in the range of 0.5-1.0 m/sec but could be up to 1.5 m/sec.

2) Data Acquisition

The CTD sampled at a frequency of 32 Hz. These data were reduced in real time to a 1-second time series by the RVS Level A microcomputer system. These data were logged as raw counts on the Level C workstation via a Level B data buffer.

3) On-Board Data Processing

RVS software on the Level C (a SUN workstation) was used to convert the raw counts into engineering units (Volts for the transmissometer and fluorometer, ml/l for oxygen, mmho cm^{-1} for conductivity and ℃ for temperature,).

Salinity (Practical Salinity Units, as defined by the Practical Salinity Scale (Fofonoff and Millard 1982)) was calculated from the conductivity ratios (conductivity / 42.914) and a time lagged temperature.

Data were written onto Quarter Inch Cartridge tapes in RVS internal format and submitted to BODC for post-cruise processing and data banking.

4) Post-Cruise Processing

4.1) Reformatting

The data were converted into the BODC internal format (PXF) to allow the use of in-house software tools, notably the workstation graphics editor. In addition to reformatting, the transfer program applied the following modifications to the data:

Dissolved oxygen was converted from ml/l to μM by multiplying the values by 44.66.

The raw transmissometer voltages were corrected for light source decay using a correction ratio. An air value of 4.762 V was used. This was based on air readings taken during cruises DI210 and DI212 when the same instrument was deployed. The manufacturer's figure for the new instrument was 4.802 V.

Transmissometer voltages were converted to percentage transmission by multiplying them by 20 and attenuance computed using algorithm: -

$$\text{attenuance} = -4 * \ln(\text{percent transmittance} / 100)$$

4.2) Editing

Using a custom in-house graphics editor, the downcasts and upcasts were differentiated and the limits of the downcasts were manually flagged. Spikes on any of the downcast channels were manually flagged 'suspect' by modification of the associated quality control flag. In this way none of the original data values were edited or deleted during quality control.

The pressure ranges over which the bottle samples were taken were logged by manual interaction with the editor. Usually, the marked reaction of the oxygen sensor to the bottle firing sequence was used to determine this. These pressure ranges were subsequently used, in conjunction with a geometrical correction for the position of the water bottles with respect to the CTD pressure transducer, to determine the pressure range of data to be averaged for calibration purposes.

Once screened, the CTD downcasts were loaded into a database under the Oracle relational database management system.

4.3) Calibration

With the exception of pressure, calibrations were done by comparison of CTD data against measurements made on water bottle samples or, in the case of temperature, against reversing thermometer data. In general, values were averaged from the CTD downcasts but where inspection on a graphics workstation showed significant hysteresis, values were manually extracted from the CTD upcasts.

All calibrations described here have been applied to the data.

Pressure

The pressure offset was determined by looking at the pressures recorded when the CTD was clearly logging in air (readily apparent from the conductivity channel). Only one cast had data logged in air and the correction has been based on this:

$$P_{corrected} = P_{observed} - 0.05 \text{ db}$$

Temperature

The CTD temperatures were in reasonable agreement with the digital reversing thermometer readings on the preceding and following cruises that both used the same CTD. Hence no temperature calibration has been applied.

Salinity

No salinity bottle data were available for this cruise. Initially, it was hoped that the salinity calibration at the end of DI210 would match that at the beginning of DI212. However, this was not the case. The calibration for DI210 was +0.012 PSU whilst that for DI212 was +0.036 PSU.

No dramatic jumps in salinity were observed during screening and the deep water salinities were internally consistent throughout DI211. It was therefore concluded that the change in CTD salinity calibration was due to undocumented maintenance either prior to, or after, DI211.

The T/S curves from the deep casts from DI211 were compared with those from calibrated casts in the same vicinity from DI209, DI210 or DI212. These showed the DI211 data to be consistently between 0.03 and 0.04 PSU low. Consequently, the DI212 calibration of +0.036 has been adopted for DI211.

Oxygen

No dissolved oxygen bottle data were available for this cruise. The following calibration, obtained for cruise DI212, has been adopted:

$$O_{corrected} = O_{raw} * 2.82 – 1.04$$

Oxygen saturation values in the data files were computed using the algorithm presented in Benson and Krause (1984).

Note that the reliability of the absolute oxygen values may be questioned as the calibration from another cruise has been used. However, inspection of the oxygen saturation data shows them to be credible.

Chlorophyll

No extracted chlorophyll data were available for this cruise. The calibrations for DI210 and DI212 were significantly different, indicating that the fluorescence yield of the phytoplankton community had changed. Consequently, it was concluded that taking a fluorometer calibration from another cruise could not be justified and the data have been left as voltages.

Note that the BODC processing system has dropped these from the final archived version of the data set (only data calibrated as chlorophyll are retained). However,

the intermediate, working version of the data has been systematically archived and this may be obtained on request from BODC.

PAR

The PAR voltages were converted to units of W/m^2 using the following equations that were based on laboratory calibrations of the instruments done in February 1990.

Downwelling:	PAR = exp (Volts*-5.09 + 6.647) / 100
Upwelling:	PAR = exp (Volts*-4.978 + 6.777) / 100

The light meters used have been empirically calibrated to obtain data in units of $\mu E/m^2/s$. This is achieved by multiplying the value in W/m^2 by 3.75.

4.4) Data Reduction

Once all screening and calibration procedures were completed, the data set was binned to 2 db by averaging. The binning algorithm excluded any data points flagged suspect and attempted linear interpolation over gaps up to 3 bins wide. If any gaps larger than this were encountered, the data in the gaps were set null.

5) Data Warnings

No calibration sample data were available for this cruise other than pressure readings in air for a single cast. The temperature, salinity and oxygen calibrations have been based on other cruises in the same area immediately before and immediately after this cruise. Whilst there is reasonable confidence in the result, there remains a greater degree of uncertainty in the data.

6) Bibliography

Benson B.B. and Krause D. jnr. 1984. The concentration and isotopic fractionation of oxygen dissolved in fresh water and sea water in equilibrium with the atmosphere. ***Limnol. Oceanogr.*** 29 pp.620-632.

Fofonoff N.P. and Millard R.C. 1982. Algorithms for computation of fundamental properties of seawater. ***UNESCO Technical Papers in Marine Science.*** 44.