Aurora Australis Marine Science Cruise AU1203 - Oceanographic Field Measurements and Analysis

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1 INTRODUCTION

Oceanographic measurements were collected aboard Aurora Australis cruise au1203, voyage 3 2011/2012, from 5th January to 12th February 2012. The cruise commenced with work around the former Mertz Glacier ice tongue, followed by a south to north occupation of the CLIVAR/WOCE meridional section I9S (Figure 1). Five oceanographic moorings were recovered from the southern end of I9S. Some bottom imaging camera work was conducted during the Antarctic phase, as part of the ongoing CEAMARC biological program. This report discusses the oceanographic data from CTD operations on the cruise.

The primary project was a reoccupation of the I9S transect, previously occupied by the RV Knorr in 1995 (P.I. Mike McCartney, WHOI), and by the Aurora Australis in 2004/05 (Rosenberg et al., unpublished). The primary oceanographic aims of this project are:

* to measure changes in water mass properties and inventories throughout the full ocean depth between Australia and Antarctica along 115E;

* to estimate the transport of mass, heat and other properties south of Australia, and to compare the results to previous occupations of the I9S line and other sections in the Australian sector;

* to identify mechanisms responsible for variability in ocean climate south of Australia;

* to use repeat measurements to assess the skill of ocean and coupled models.

The recovered moorings were deployed two years previously as part of a joint US/Australian project to measure westward recirculation in the subpolar gyre of the southeastern Indian Ocean. Mooring data are to be processed by WHOI, and are not discussed further in this report.

The third oceanographic project was opportunistic, taking CTD measurements in the region formerly occupied by the Mertz glacier tongue (Rosenberg and Rintoul, unpublished). Note that CTD station 2 was at the site occupied by Sir Douglas Mawson in 1911.

A total of 95 CTD vertical profile stations were taken on the cruise, most to within 15 metres of the bottom (Table 1). Over 1500 Niskin bottle water samples were collected for the measurement (Table 2) of salinity, dissolved oxygen, nutrients (phosphate, nitrate+nitrite and silicate), dissolved inorganic carbon (i.e. TCO_2), alkalinity, pH, barium (dissolved), and biological parameters, using a 24 bottle rosette sampler. Full depth current profiles were collected by an LADCP attached to the CTD package, while upper water column current profile data were collected by a ship mounted ADCP. Meteorological and water property data were collected by the array of ship's underway sensors. An array of 5 current meter moorings was recovered from the Antarctic continental slope at the south end of the I9S transect.

This report describes the processing/calibration of the CTD data, and details the data quality. Underway sea surface temperature and salinity data are compared to near surface CTD data. CTD station positions are shown in Figure 1, while CTD station information is summarised in Table 1. Argo float deployments are summarised in Table 13. Further cruise itinerary/summary details can be found in the voyage leader report (Australian Antarctic Division unpublished report: Rintoul, Voyage 3, 2011-2012, RSV Aurora Australis, Voyage Leader's report).

2 CTD INSTRUMENTATION

SeaBird SBE9plus CTD serial 704, with dual temperature and conductivity sensors and a single SBE43 dissolved oxygen sensor (serial 0178, on the primary sensor pump line), was used, mounted on a SeaBird 24 bottle rosette frame, together with a SBE32 24 position pylon and up to 22 x 10 litre General Oceanics Niskin bottles. The following additional sensors/instruments were mounted:

* Wetlabs ECO-AFL/FL fluorometer serial 296
* Biospherical Instruments PAR sensor QCP2300HP, serial 70110
* Wetlabs C-star transmissometer serial 1421DR
* Teledyne RDI lowered ADCP (i.e. LADCP) workhorse monitor – 300 kHz upward looking head; 150 kHz downward looking head; battery housing
* Aanderaa optode serial 576 (stations 1 to 82)
* Tritech 500 kHz altimeter serial 126288 (stations 1 to 91)
* Tritech 500 kHz altimeter serial 76031 (stations 92 to 95)
* Tritech 200 kHz altimeter serial 237622 (stations 1 to 74 and 76 to 79)
* Tritech 200 kHz altimeter serial 126287 (station 75 and 80) (didn't work)
* Tritech 200 kHz altimeter serial 126376 (station 81) (didn't work)
* Tritech 200 kHz altimeter serial 237621 (stations 82 to 95)
* camera system and strobe lighting (stations 2 to 15 and 90 to 95)

CTD data were transmitted up a 6 mm seacable to a SBE11plusV2 deck unit, at a rate of 24 Hz, and data were logged simultaneously on 2 PC's using SeaBird data acquisition software "Seasave" version 7.

The CTD deployment method was as follows:

* CTD initially deployed down to ~10 to 20 m
* after confirmation of pump operation, CTD returned up to just below the surface (depth dependent on sea state)
* after returning to just below the surface, downcast proper commenced

For most casts the package was stopped on the upcast at ~50 m above the bottom, for collection of bottom track data by the LADCP. When the camera system was fitted the package was stopped for several minutes within 5 m of the bottom.

Pre cruise temperature, conductivity and pressure calibrations were performed by SeaBird (Table 3) (June 2011). The SeaBird calibration for the SBE43 oxygen sensor was used for initial data display only. Manufacturer supplied calibrations were used for the fluorometer, transmissometer, PAR and altimeter. Final conductivity and dissolved oxygen calibrations derived from in situ Niskin bottle samples are listed later in the report. Final transmissometer data are referenced to a clean water value (see section 5.5 below). For the optode phase and temperature, slope/offset corrections were applied to the raw voltages (corrections supplied by Craig Neill, CSIRO).

3 PROBLEMS ENCOUNTERED

CTD operations went relatively smoothly, with fewer equipment/gear problems than on the previous cruise. The most significant gear issue was the high loads experienced by the 6 mm sea cable during the deep CTD casts. High loads on the 6 mm cable have always been a concern in the past, but on this occasion there was a load cell to measure them (data not discussed in this report).

Large remnants of the B9B iceberg were still present in the Mertz region, but access to Commonwealth Bay remained straightforward. The time available for the CTD work there was less than hoped for, due to time commitments for the official Mawson's Hut visit, and only 6 shallow CTD's were completed in the area.

Other notable problems were as follows:

* Two hours were lost at station 3, due to CTD gantry problems.

* Nearly a day was lost at station 35, at first due to bad weather, then later awaiting completion of servicing to the ship's generators.

* The seacable was reterminated prior to stations 28 and 40, due to kinking of the wire.

* About halfway through the cruise the tension control procedure by winch operators during bottom approach was changed. The CTD package touched bottom on two occasions as a result (at stations 57 and 71). A further problem occurred during the upcast at station 57, with an unexplained CTD comms crash. Comms were successfully re-established after power cycling the CTD deck unit.

* CTD comms failed near the end of the upcast at station 63, and the last 2 rosette positions were not fired. The electrical termination had failed, requiring another retermination.

* CTD comms crashed during station 82 just after commencement of the upcast, with inability to fire bottles and no data for the upcast. Flooding of the optode was the cause, an identical experience to the previous cruise. After removing the optode the station was repeated.

* At station 89, the package touched bottom for a third time, due to steep bathymetry and unstable altimeter readings.

* The 200 kHz altimeter started to fail during station 73. The problem turned out to be a failing y-cable. All the altimeters were tested over the remainder of the cruise, revealing two bad instruments: serials 126287 and 126376 (both 200 kHz). A third instrument (serial 126288, 500 kHz) failed near the end of the cruise.

4 CTD DATA PROCESSING AND CALIBRATION

Preliminary CTD data processing was done at sea, to confirm correct functioning of instrumentation. Final processing of the data was done in Hobart. The first processing step is application of a suite of the SeaBird "Seasoft" processing programs to the raw data, in order to:
* convert raw data signals to engineering units
* remove the surface pressure offset for each station
* realign the oxygen sensor with respect to time (note that conductivity sensor alignment is done by the deck unit at the time of data logging)
* remove conductivity cell thermal mass effects
* apply a low pass filter to the pressure data
* flag pressure reversals
* search for bad data (e.g. due to sensor fouling etc)

Further processing and data calibration were done in a UNIX environment, using a suite of fortran and matlab programs. Processing steps here include:
* forming upcast burst CTD data for calibration against bottle data, where each upcast burst is the average of 10 seconds of data centered on each Niskin bottle firing
* merging bottle and CTD data, and deriving CTD conductivity calibration coefficients by comparing upcast CTD burst average conductivity data with calculated equivalent bottle sample conductivities
* forming pressure monotonically increasing data, and from there calculating 2 dbar averaged downcast CTD data
* calculating calibrated 2 dbar averaged salinity from the 2 dbar pressure, temperature and conductivity values
* deriving CTD dissolved oxygen calibration coefficients by comparing bottle sample dissolved oxygen values (collected on the upcast) with CTD dissolved oxygen values from the equivalent 2 dbar downcast pressures

Full details of the data calibration and processing methods are given in Rosenberg et al. (unpublished) , referred to hereafter as the *CTD methodology*. Additional processing steps are discussed below in the results section. For calibration of the CTD oxygen data, whole profile fits were used for shallower stations, while split profile fits were used for deeper stations.

Final station header information, including station positions at the start, bottom and end of each CTD cast, were obtained from underway data for the cruise (see section 6 below). Note the following for the station header information:
* All times are UTC.
* "Start of cast" information is at the commencement of the downcast proper, as described above.
* "Bottom of cast" information is at the maximum pressure value.
* "End of cast" information is when the CTD leaves the water at the end of the cast, as indicated by a drop in salinity values.
* All bottom depth values are corrected for local sound speed, where sound speed values are calculated from the CTD data at each station.
* "Bottom of cast" depths are calculated from CTD maximum pressure (converted to depth) and altimeter values at the bottom of the casts.

Lastly, data were converted to MATLAB format, and final data quality checking was done within MATLAB.

5 CTD AND BOTTLE DATA RESULTS AND DATA QUALITY

Data from the primary CTD sensor pair (temperature and conductivity) were used for the whole cruise. Suspect CTD 2 dbar averages are listed in Table 9, while suspect dissolved oxygen bottle samples are listed in Table 11. Nutrient and dissolved oxygen comparisons to previous cruises are made in section 7.

5.1 Conductivity/salinity

The conductivity calibration and equivalent salinity results for the cruise are plotted in Figures 2 and 3, and the derived conductivity calibration coefficients are listed in Tables 4 and 5. Station groupings used for the calibration are included in Table 4. International standard seawater batch number P153 (8th March 2011) was used for salinometer standardisations.

Guildline Autosal serial 62549 was used for the whole cruise, with analyses taking place in lab 5 (usually a refrigerator lab). Salinometer performance was stable, with lab temperature ranging mostly between ~20 and 21.5^{o}C over the course of the cruise (mean lab temperature=20.70^{o}C, standard deviation 0.37^{o}C). Overall salinity accuracy for the cruise is within 0.002 (PSS78).

For the previous cruise au1121 (Rosenberg and Rintoul, unpublished), increased scatter in salinity residuals (i.e. bottle salinity – calibrated salinity) was found for southern stations in the region of the former Mertz Glacier, with the scatter attributed to biological activity and/or cold water effects. Equivalent samples for this cruise (stations 2 to 7) did not show the same large scatter. Conductivity calibrations for these stations were good, with residual scatter only evident for shallower samples in steep vertical gradients.

Pressure dependent salinity residuals are evident for most cruises (Rosenberg and Rintoul, unpublished). For this cruise the residuals, where they occurred, were of the order 0.002 (PSS78) or less over the whole vertical profile. The largest pressure dependent residual was ~0.003 (PSS78) for station 36 (Figure 4). Note from the figure that for many other stations no consistent pressure dependency is evident, and the residual scatter is within calibration accuracy. Also note that where the pressure dependency occurred, the magnitude over the whole profile was often larger for the secondary sensor data (not shown here).

Close inspection of the vertical profiles of the bottle-CTD salinity difference values reveals a slight biasing for a few stations, mostly of the order 0.001 (PSS78), as follows:

station	bottle-CTD bias (PSS78)
25, 33	-0.001
47, 48, 70	-0.0005
60	+0.001

This is most likely due to a combination of factors, including salinometer performance. There is no significant diminishing of overall CTD salinity accuracy from this apparent biasing.

Bad salinity bottle samples (not deleted from the data files) are listed in Table 10.

5.2 Temperature

Temperature differences between the primary and secondary CTD temperature sensors (T_p and T_s respectively), from data at Niskin bottle stops, are shown in Figure 5. The difference $T_s - T_p$ is within the manufacturer quoted sensor accuracy of 0.001°C. Note from the figure that $T_s - T_p$ moves closer to 0, either in colder water or at shallower pressures (difficult to separate the two dependencies).

5.3 Pressure

Surface pressure offsets for each cast (Table 6) were obtained from inspection of the data before the package entered the water. Pressure spiking, a problem on some previous cruises, did not occur, other than during comms problems at stations 57, 63 and 82. For station 83, the first station after a system crash caused by a leaking optode, the surface pressure offset value was noticeably different to the values from surrounding stations (no explanation).

5.4 Dissolved oxygen

CTD oxygen data were calibrated as per the *CTD methodology*, with profiles deeper than 1400 dbar calibrated as split profile fits, and profiles shallower than 1400 dbar (i.e. stations 2 to 7, 9, and 91 to 95) calibrated as whole profile fits. The exceptions were for station 1 (a test cast to ~2900 dbar) and station 12 (a cast to ~1480 dbar), where whole profile fits were used to improve the calibration results. For the following stations, no bottle samples were collected, therefore CTD oxygen data were not calibrated:

8, 10, 13, 16, 19, 22, 26, 37, 55, 56, 61, 62, 65, 71, 74, 76, 77, 82 and 84.

Calibration results are plotted in Figure 6, and the derived calibration coefficients are listed in Table 7. Overall the calibrated CTD oxygen agrees with the bottle data to well within 1% of full scale (where full scale is ~420 µmol/l above 1500 dbar, and ~250 µmol/l below 1500 dbar).

* Bottle overlaps between the shallow and deep fits were varied slightly for the following stations: 11, 14, 15, 45 and 90.

* For station 2, the top section of the oxygen profile was unusable due to missing near surface bottle data.

* For station 6, the lower part of the profile has been flagged as suspect due to a missing bottom bottle sample.

* For station 35, the whole profile calibration result was slightly better than the split profile result, but the split profile result has been retained.

* For station 83, bad CTD oxygen data from ~50 to 100 dbar have been removed.

* Bubbles in reagent 2 dispenser caused a few bad oxygen samples.

5.5 Fluorescence, PAR, transmittance, altimeter, optode

All fluorescence, PAR and transmittance data have a manufacturer supplied calibration (Table 3) applied to the data, with transmittance values referenced to clean water. In the CTD 2dbar averaged data files, both downcast and upcast data are supplied for these sensors; and the data are strictly 2 dbar averages (as distinct from other calculations used in previous cruises i.e. au0703, au0803 and au0806).

Fluorescence spikiness was caused by interference from the camera strobe lights, mounted on the CTD package and operating for stations 2 to 15 and 90 to 95. Initially, the SeaBird "filter" program (with a low pass filter value of 1 sec) was used to attempt to smooth the spikes. Some undesirable artefacts were caused by the filtering, and the final fluorescence data were left unfiltered. In general, obvious bad data spikes from deeper water are easily removed. In shallower water however, where the real fluorescence signal occurs, it's very difficult to separate any erroneous data spiking from the real fluorescence signal.

The PAR calibration coefficients in Table 3 were calculated from the manufacturer supplied calibration sheet, using the method described in the following SeaBird documents: page 53 of SeaSave Version 7.2 manual; Application Note No. 11 General; and Application Note No. 11 QSP-L. The PAR calibration "offset" value (Table 3) was derived from deep water voltage values from the previous cruise au1121.

Transmittance data appear reasonable qualitatively, though there's some hysteresis between the down and upcast data, for station 48 onwards, mainly in the top ~1000 dbar. Quantitatively, deck tests indicated the transmissometer calibration was out, with full scale readings of 5 V in air, and dark voltage readings of ~1.2 V (simulated by covering the sensor by hand). Note that station 1 downcast data are suspect for the top ~200 dbar, with transmittance values exceeding 100%, and appearing significantly different to the upcast.

The usual altimeter "artefacts", as seen on previous cruises (described in Rosenberg and Rintoul, unpublished), were observed on both the 200 and 500 kHz Tritech sensors, with false bottom readings often observed before coming within nominal altimeter range. For station 75 onwards, the altimeters were frequently swapped to confirm performance of all 6 units.

For optode data (stations 1 to 82), the following linear calibrations (Craig Neill, CSIRO CMAR) have been applied to the raw voltage data:

optode phase = volts x 12 + 10
optode temperature = volts x 9 - 5

The optode flooded during station 82, as described earlier, and no optode was fitted for station 83 onwards. Note that the optode was fitted for comparison purposes, and only the SBE43 oxygen data should be used in any data analyses.

5.6 Nutrients

Nutrients measured on the cruise were phosphate, total nitrate (i.e. nitrate+nitrite), and silicate, using a Lachat autoanalyser. Most values are an average of twin analyses (done at the time of each sample analysis). Much pre-screening of the nutrient data (including the twin analyses and repeat runs) was done by the hydrochemists, and as a result there are no obviously suspect data flagged in the final data set. Note that full scale for phosphate, nitrate and silicate are respectively 3.0 μmol/l, 35 μmol/l, and 140 μmol/l.

Nitrate+nitrite versus phosphate data are shown in Figure 7. For stations 2 to 7 (from the Mertz region), the data follows a different trend to the remainder of the cruise, and this appears to be a real feature.

* There are no phosphate data for stations 33, 43 and 68, due to analysis problems.

Further assessment of nutrient data quality is given in section 7 below, comparing the data to previous cruises.

Additional nutrient analysis notes from the hydrochemists:

Bad data
* Station 33, phosphate – RMNS and bulk QC significantly lower than expected - data rejected.

* Station 43, phosphate – fresh sample analysis and repeat sample analysis both bad – data rejected.

* Station 68, phosphate – fresh sample analysis and repeat sample analyses all bad – data rejected.

Cautions
* Stations 45, 48 and 50, nitrate – frozen for 6 months and analysed in Hobart. For station 50, the samples were labelled "already thawed and refrozen during voyage".

* Stations 66 and 67, nitrate – from frozen samples, but analysed during the voyage not long after sampling.

* Station 68, nitrate – combined results from frozen samples from during the voyage and from 6 months after the voyage – all within tolerance.

* Station 79, nitrate – the only nitrate run with a suspect calibration; QC and RMNS data show the results are okay.

* Station 34, phosphate – frozen samples analysed during the voyage; single dip analysis.

* Station 69, phosphate – samples frozen for 6 months; phosphate issue^^

* Station 87, all nutrients – an instrument error stopped the run (close to the end of the run); final calibration stitched together; calibration and QC data look good.

* Stations 89, 90 and 91, phosphate – samples frozen for 6 months; phosphate issue^^

* Stations 92 to 95, phosphate – merged from 2 different runs (fresh samples during the voyage, and samples frozen for 6 months). Merged data matches well. phosphate issue^^

^^phosphate issue: for autoanalyser runs 77 onwards (i.e. stations 89 to 95 plus some repeats), there was a significant increase in the expected QC. The calculated concentration of calibrants consistently decreased at this point. Issue currently unresolved.

5.7 Additional CTD data processing/quality notes

* Station 34 – problem with secondary sensors for bottles 18 to 24 i.e. top ~110 dbar of upcast.

* Station 44 – bottle 21 was tripped on the fly.

* The package touched bottom at stations 57, 71 and 89. In all 3 cases disturbance of the bottom sediment is evident from the transmittance data. No sensors were damaged or calibrations shifted as a result of the contacts; and there has been no despiking of any sensor data affected by the disturbed sediment (e.g. bottom 2 dbar salinity bin for station 71).

* Station 63 – the rosette was only fired 20 times before the comms crash, and data collection ended at ~45 dbar on the upcast.

* Station 82 - bad data near the bottom (due to optode failure) have been removed.

* For the XBT yoyo casts (55, 56, 61, 62, 76, 77), depth at the bottom of the cast is from the full depth cast at each of the sites.

6 UNDERWAY MEASUREMENTS

Underway data were logged to an Oracle database on the ship. Quality control for the cruise was largely automated. 12 kHz bathymetry data were quality controlled on the cruise (Graham Campton, Ric Frey, Anthony Moxham and David Sowter, Royal Australian Navy Hydrographic Office).

1 minute instantaneous underway data are contained in the file au1203.ora as column formatted text; and in the file au1203ora.mat as matlab format. Data from the hull mounted underway temperature sensor (T_{dls}) and the underway thermosalinograph salinity (S_{dls}) are compared to CTD temperature and salinity data at 8 dbar (Figures 8 and 9). For temperature (Figure 9a), the agreement is reasonably close down to 5^{o}C; below this the T_{dls}-T_{CTD} difference trends up towards ~0.02 at the lowest temperature values. For salinity (Figure 9b), there's a reasonable amount of scatter, and the bestfit line should not be relied on; overall, the S_{dls}-S_{CTD} difference for the cruise can be estimated at ~-0.06 (PSS78). Note that these comparisons have not been applied to the underway data.

7 INTERCRUISE COMPARISONS

Intercruise comparisons of nutrient and dissolved oxygen data on neutral density (i.e. γ) surfaces are shown in bulk plots, comparing au1203 and au0403 (Figure 10a), and au1203 and i8si9s (1994-95 RV Knorr cruise, P.I. Mike McCartney, CCHDO expocode 316N145_5) (Figure 10b). Note that all au1203 and au0403 nutrient and dissolved oxygen data have been converted here to µmol/kg units (to match the Knorr data). Bulk plots of all the difference data are shown against latitude in Figure 11 (au1203-au0403) and Figure 12 (au1203–i8si9s). Taking averages of the data in Figures 11 and 12, the comparisons can be quantified as follows:

phosphate
au1203 > au0403 by 0.05
au1203 > i8si9s by 0.03

nitrate
au1203 > au0403 by 0.3
au1203 > i8si9s by 0.3

silicate
au1203 > au0403 by 1.8
au1203 > i8si9s by 1.5

dissolved oxygen bottle data
au1203 > au0403 by 0.4
au1203 > i8si9s by 0.2

Closer inspection of the data reveals some variation with latitude, in particular for phosphate and nitrate in the au1203-i8si9s comparison (Figure 12). In both cases there's a shift in the difference values south of ~42^{o}S. Note that this is not necessarily a latitude dependence – rather, it may be related to sample analysis during the cruises.

The intercruise variability for bottle oxygen data are within 1% of full scale. For the nutrient data, the differences are within 1% of full scale for nitrate and just over 1% of full scale for silicate. For phosphates, a clear offset close to 2% of full scale is evident from the au1203-au0403 comparison, most likely due to variation in autoanalyser performance (specific reasons unknown). Phosphate results have previously shown significant intercruise offsets (Rosenberg and Rintoul, unpublished).

8 FILE FORMATS

Data are supplied as column formatted text files, or as matlab files, with all details fully described in the README file included with the data set. Note that all dissolved oxygen and nutrient data in these file versions are in units of µmol/l.

The data are also available in WOCE “Exchange” format files. In these file versions, dissolved oxygen and nutrient data are in units of µmol/kg. For density calculation in the volumetric to gravimetric units conversion, the following were used:

dissolved oxygen – in situ temperature and CTD salinity at which each Niskin bottle was fired; zero pressure

nutrients – laboratory temperature (22.0^{o}C), and in situ CTD salinity at which each Niskin bottle was fired; zero pressure

REFERENCES

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Table 1: Summary of station information for cruise au1203. All times are UTC; "alt" = minimum altimeter value (m), "maxp" = maximum pressure (dbar). "XBT yoyo" = partial casts for XBT comparison tests; "bio dip" = casts for large volume sample collection for microbial biomass.

	------------------------start of CTD------------------------------					-----------------bottom of CTD-----------------				-------------------end of CTD------------------					
CTD station	date	time	latitude	longitude	depth	time	latitude	longitude	depth	time	latitude	longitude	depth	alt	maxp
001 test	08 Jan 2012	075607	55 59.79 S	145 11.41 E	2846	084731	55 59.76 S	145 11.47 E	2856	100634	55 59.99 S	145 11.63 E	2818	14.4	2887
002 Mertz	10 Jan 2012	184628	66 54.64 S	145 23.02 E	709	185830	66 54.62 S	145 23.06 E	708	193543	66 54.77 S	145 23.15 E	712	4.4	712
003 Mertz	11 Jan 2012	004546	67 13.32 S	145 51.54 E	702	010224	67 13.31 S	145 51.28 E	709	013444	67 13.18 S	145 50.54 E	717	2.4	715
004 Mertz	11 Jan 2012	031053	67 08.75 S	145 33.55 E	903	032749	67 08.72 S	145 33.61 E	899	041003	67 08.39 S	145 33.23 E	915	3.7	906
005 Mertz	11 Jan 2012	061738	67 03.02 S	145 10.90 E	1318	064332	67 02.96 S	145 10.67 E	1319	073544	67 02.62 S	145 09.64 E	1269	3.2	1333
006 Mertz	11 Jan 2012	090738	66 54.14 S	144 44.63 E	1001	092951	66 54.14 S	144 44.64 E	1014	101823	66 53.89 S	144 43.84 E	1020	3.8	1023
007 Mertz	11 Jan 2012	114619	66 45.95 S	144 19.60 E	925	120322	66 45.91 S	144 19.04 E	927	124615	66 45.73 S	144 17.77 E	921	5.1	933
008 bio dip	20 Jan 2012	115908	65 22.40 S	112 55.31 E	721	120108	65 22.42 S	112 55.27 E	704	120727	65 22.48 S	112 55.16 E	685	-	49
009 I9S	20 Jan 2012	131104	65 22.91 S	112 54.52 E	628	132439	65 22.99 S	112 54.30 E	658	140442	65 23.26 S	112 53.69 E	494	1.5	664
010 bio dip	20 Jan 2012	182524	65 10.40 S	113 02.91 E	1467	182738	65 10.39 S	113 02.80 E	1466	183452	65 10.40 S	113 02.89 E	1467	-	61
011 I9S	20 Jan 2012	192719	65 10.48 S	113 03.91 E	1459	195609	65 10.51 S	113 03.68 E	1459	205129	65 10.60 S	113 03.27 E	1456	4.0	1475
012 I9S	20 Jan 2012	222954	65 01.51 S	113 09.86 E	1456	225918	65 01.48 S	113 09.58 E	1462	235511	65 01.38 S	113 08.84 E	1479	4.0	1477
013 bio dip	21 Jan 2012	014141	64 53.18 S	113 14.44 E	1480	014334	64 53.20 S	113 14.41 E	1480	015020	64 53.23 S	113 14.29 E	1482	-	62
014 I9S	21 Jan 2012	023424	64 53.93 S	113 14.51 E	1444	030409	64 54.00 S	113 14.18 E	1450	035857	64 54.11 S	113 13.97 E	1444	5.6	1463
015 I9S	21 Jan 2012	063138	64 38.33 S	113 17.74 E	1916	070525	64 38.35 S	113 17.69 E	1912	081156	64 38.35 S	113 17.65 E	1904	3.3	1936
016 bio dip	21 Jan 2012	165459	64 24.07 S	113 22.81 E	2447	165658	64 24.08 S	113 22.77 E	2448	170456	64 24.08 S	113 22.60 E	2448	-	61
017 I9S	21 Jan 2012	175535	64 24.04 S	113 22.43 E	2451	183751	64 24.07 S	113 22.25 E	2449	195043	64 23.86 S	113 21.82 E	2457	9.0	2478
018 I9S	22 Jan 2012	025900	64 01.37 S	113 18.05 E	-	040232	64 01.39 S	113 18.44 E	2978	051849	64 01.55 S	113 18.71 E	-	8.1	3021
019 bio dip	22 Jan 2012	082734	63 38.25 S	113 19.28 E	3265	082926	63 38.24 S	113 19.28 E	3266	083522	63 38.26 S	113 19.33 E	3275	-	71
020 I9S	22 Jan 2012	092619	63 38.69 S	113 20.05 E	3268	101926	63 38.68 S	113 20.29 E	3263	115122	63 38.73 S	113 20.35 E	3268	8.5	3313
021 I9S	22 Jan 2012	145212	63 17.29 S	113 19.76 E	3506	155200	63 17.26 S	113 19.75 E	3505	173135	63 17.26 S	113 19.52 E	3508	5.8	3563
022 bio dip	22 Jan 2012	185923	63 16.25 S	113 21.01 E	3513	190113	63 16.27 S	113 21.01 E	3513	191334	63 16.32 S	113 21.06 E	3514	-	76
023 I9S	23 Jan 2012	024744	62 47.51 S	113 19.04 E	3827	035144	62 47.49 S	113 18.58 E	3822	053153	62 47.84 S	113 17.97 E	-	9.6	3884
024 I9S	23 Jan 2012	084956	62 18.41 S	113 17.91 E	4065	095830	62 18.44 S	113 18.22 E	4068	114103	62 18.26 S	113 19.10 E	4080	8.8	4138
025 I9S	23 Jan 2012	144111	61 52.67 S	113 16.79 E	4200	155840	61 52.48 S	113 16.60 E	4187	174758	61 52.57 S	113 17.35 E	4197	7.3	4262
026 bio dip	24 Jan 2012	001004	61 50.22 S	113 29.21 E	4219	002909	61 50.16 S	113 29.39 E	4220	005701	61 50.13 S	113 29.72 E	4222	-	1101
027 I9S	24 Jan 2012	033447	61 39.84 S	114 08.83 E	4294	044529	61 39.67 S	114 08.78 E	4278	063221	61 39.55 S	114 08.87 E	4287	7.6	4356
028 I9S	24 Jan 2012	110157	61 30.41 S	115 00.88 E	4332	121802	61 30.47 S	115 00.51 E	4330	141208	61 30.76 S	115 00.08 E	4334	8.9	4408
029 I9S	24 Jan 2012	174149	61 00.62 S	115 01.30 E	4392	185448	61 00.71 S	115 00.89 E	4389	204327	61 00.76 S	115 00.23 E	4392	7.2	4470
030 I9S	25 Jan 2012	004135	60 23.82 S	114 59.87 E	4458	015543	60 23.98 S	115 01.71 E	4456	035055	60 24.26 S	115 03.95 E	4460	7.8	4539
031 I9S	25 Jan 2012	073244	59 48.52 S	115 01.66 E	4488	085518	59 48.67 S	115 02.60 E	4495	104432	59 48.86 S	115 04.07 E	4504	9.2	4577
032 I9S	25 Jan 2012	141509	59 12.17 S	114 59.93 E	4536	153105	59 12.40 S	115 00.01 E	4524	172606	59 12.60 S	114 59.86 E	4532	7.2	4609
033 I9S	25 Jan 2012	210522	58 36.12 S	114 59.21 E	4521	222824	58 36.29 S	114 58.99 E	4533	002622	58 36.44 S	114 59.09 E	4542	8.3	4617
034 I9S	26 Jan 2012	045917	58 00.10 S	115 00.19 E	4561	061520	58 00.11 S	115 00.53 E	4559	081656	58 00.14 S	115 00.97 E	4567	7.2	4644
035 I9S	27 Jan 2012	084705	57 24.07 S	114 59.94 E	4556	100300	57 24.47 S	114 59.72 E	4548	115722	57 25.02 S	114 59.72 E	4554	8.2	4632
036 I9S	27 Jan 2012	155237	56 48.22 S	114 59.98 E	4532	170849	56 48.46 S	115 00.36 E	4522	190315	56 48.76 S	115 00.46 E	4534	7.8	4605
037 bio dip	27 Jan 2012	224745	56 11.49 S	115 00.16 E	-	230814	56 11.57 S	115 00.25 E	-	233309	56 11.68 S	115 00.37 E	4711	-	1003
038 I9S	28 Jan 2012	002728	56 11.72 S	115 00.04 E	4720	014837	56 12.09 S	115 00.26 E	4651	033951	56 12.30 S	115 00.73 E	4583	11.4	4734

Table 1: (continued)

	------start of CTD------					------bottom of CTD------				------end of CTD------					
CTD station	date	time	latitude	longitude	depth	time	latitude	longitude	depth	time	latitude	longitude	depth	alt	maxp
039 I9S	28 Jan 2012	071819	55 35.93 S	115 00.52 E	-	083653	55 35.97 S	115 00.76 E	4608	103218	55 36.14 S	115 01.06 E	-	7.5	4694
040 I9S	28 Jan 2012	142439	55 00.19 S	115 00.23 E	-	153939	55 00.27 S	115 00.14 E	4484	173903	55 00.58 S	115 00.67 E	-	8.2	4565
041 I9S	28 Jan 2012	215552	54 23.85 S	115 00.58 E	-	230947	54 23.84 S	115 00.38 E	4175	005411	54 24.08 S	115 00.75 E	-	7.9	4247
042 I9S	29 Jan 2012	050611	53 48.37 S	115 00.44 E	-	061608	53 48.42 S	115 00.50 E	4003	080829	53 48.59 S	115 01.00 E	-	8.0	4069
043 I9S	29 Jan 2012	125106	53 12.31 S	115 00.49 E	-	135848	53 12.58 S	115 00.96 E	3968	154615	53 12.79 S	115 01.31 E	-	8.5	4033
044 I9S	29 Jan 2012	200324	52 36.55 S	115 00.26 E	-	210622	52 36.68 S	115 00.10 E	3771	224522	52 36.74 S	115 00.00 E	-	12.1	3826
045 I9S	30 Jan 2012	021146	51 58.58 S	115 00.04 E	-	031356	51 58.45 S	114 59.92 E	3679	050909	51 58.51 S	115 00.01 E	-	11.0	3733
046 I9S	30 Jan 2012	080500	51 28.44 S	115 00.41 E	-	090332	51 28.48 S	115 00.91 E	3511	104532	51 28.21 S	115 01.73 E	-	5.0	3566
047 I9S	30 Jan 2012	133711	50 59.98 S	115 00.28 E	-	144742	50 59.64 S	115 01.01 E	4001	163806	50 59.64 S	115 02.52 E	-	8.9	4065
048 I9S	30 Jan 2012	193427	50 29.28 S	114 59.96 E	-	202643	50 29.50 S	115 00.52 E	3059	215453	50 29.72 S	115 01.31 E	-	11.9	3096
049 I9S	31 Jan 2012	004814	49 59.48 S	115 00.21 E	-	015202	49 59.68 S	115 01.01 E	3868	033038	49 59.96 S	115 02.13 E	-	11.4	3926
050 I9S	31 Jan 2012	062306	49 30.16 S	115 00.55 E	-	072302	49 30.02 S	115 01.52 E	3418	090045	49 29.97 S	115 02.72 E	-	7.5	3468
051 I9S	31 Jan 2012	121738	48 59.24 S	115 01.00 E	-	132823	48 59.04 S	115 01.42 E	3948	151847	48 58.99 S	115 01.94 E	-	7.4	4012
052 I9S	31 Jan 2012	183233	48 28.07 S	115 00.01 E	-	194250	48 27.89 S	115 00.22 E	3913	212628	48 27.47 S	115 00.59 E	-	13.2	3970
053 I9S	31 Jan 2012	235701	47 59.82 S	114 59.99 E	-	005608	47 59.55 S	115 00.40 E	3611	023500	47 59.39 S	115 00.79 E	-	12.8	3660
054 I9S	01 Feb 2012	052336	47 30.19 S	115 00.16 E	-	062539	47 29.95 S	115 00.79 E	3732	080059	47 29.89 S	115 01.30 E	-	7.9	3789
055 XBT yoyo	01 Feb 2012	104344	47 00.31 S	115 00.08 E	-	105933	47 00.19 S	115 00.16 E	3922	111306	47 00.10 S	115 00.34 E	-	-	899
056 XBT yoyo	01 Feb 2012	111830	47 00.07 S	115 00.39 E	-	113247	46 59.99 S	115 00.64 E	3922	114639	46 59.94 S	115 00.73 E	-	-	901
057 I9S	01 Feb 2012	114946	46 59.92 S	115 00.74 E	-	125828	46 59.57 S	115 01.17 E	3922	144616	46 58.89 S	115 01.93 E	-	0.0	3992
058 I9S	01 Feb 2012	173738	46 30.62 S	115 00.33 E	4011	184423	46 30.02 S	115 00.81 E	4141	202428	46 29.08 S	115 01.64 E	-	14.1	4203
059 I9S	01 Feb 2012	225541	46 00.95 S	115 00.05 E	4138	000255	46 00.32 S	115 00.07 E	4115	014646	45 59.56 S	115 00.30 E	4209	12.4	4177
060 I9S	02 Feb 2012	042326	45 29.75 S	115 00.00 E	4164	054000	45 29.13 S	115 00.29 E	4195	072726	45 28.37 S	115 00.62 E	4225	7.6	4265
061 XBT yoyo	02 Feb 2012	104451	45 00.20 S	115 00.06 E	-	110030	45 00.19 S	115 00.12 E	4276	111352	45 00.17 S	115 00.23 E	-	-	901
062 XBT yoyo	02 Feb 2012	111511	45 00.16 S	115 00.23 E	-	113242	45 00.10 S	115 00.35 E	4276	114556	45 00.15 S	115 00.46 E	-	-	900
063 I9S	02 Feb 2012	114805	45 00.15 S	115 00.45 E	-	125916	44 59.87 S	115 00.58 E	4276	143801	44 59.51 S	115 01.07 E	-	7.0	4348
064 I9S	02 Feb 2012	183057	44 29.20 S	114 59.98 E	4324	194324	44 28.99 S	115 00.14 E	4426	212604	44 28.49 S	115 00.39 E	-	12.5	4496
065 bio dip	03 Feb 2012	003708	43 59.30 S	114 59.98 E	4328	014937	43 59.16 S	115 00.17 E	4336	025937	43 58.97 S	115 00.40 E	4349	15.2	4401
066 I9S	03 Feb 2012	035148	43 59.32 S	114 59.87 E	-	050539	43 59.17 S	114 59.93 E	4337	065716	43 58.66 S	114 59.79 E	-	8.4	4408
067 I9S	03 Feb 2012	101653	43 29.98 S	115 00.11 E	-	114306	43 29.95 S	115 00.19 E	4442	135024	43 29.48 S	115 00.06 E	-	6.6	4518
068 I9S	04 Feb 2012	055234	43 00.20 S	114 59.48 E	-	071259	43 00.08 S	114 59.39 E	4386	093600	42 59.88 S	114 59.17 E	-	6.9	4461
069 I9S	04 Feb 2012	131145	42 30.28 S	114 59.72 E	-	144000	42 30.13 S	114 59.79 E	4325	164654	42 29.78 S	114 59.02 E	-	7.8	4396
070 I9S	04 Feb 2012	200604	41 59.78 S	115 00.09 E	-	212116	41 59.65 S	114 59.92 E	4543	230905	41 59.38 S	114 59.80 E	-	12.2	4616
071 bio dip	05 Feb 2012	022649	41 30.88 S	115 00.10 E	4590	034145	41 30.64 S	115 00.04 E	4619	050736	41 30.28 S	115 00.28 E	4618	0.0	4706
072 I9S	05 Feb 2012	060344	41 30.43 S	115 00.22 E	4619	072832	41 29.94 S	115 00.16 E	4625	092300	41 29.86 S	114 59.56 E	4619	7.4	4705
073 I9S	05 Feb 2012	134021	40 52.48 S	115 00.15 E	4634	150350	40 52.24 S	115 00.17 E	4650	165818	40 51.89 S	115 00.19 E	-	14.6	4723
074 bio dip	05 Feb 2012	204059	40 17.69 S	114 59.95 E	4667	220230	40 17.52 S	114 59.68 E	4705	232414	40 17.44 S	114 59.77 E	4698	17.1	4777
075 I9S	06 Feb 2012	003536	40 17.90 S	115 00.00 E	4670	015455	40 17.74 S	114 59.92 E	4683	033307	40 17.60 S	114 59.92 E	-	13.1	4759
076 XBT yoyo	06 Feb 2012	071737	39 41.96 S	114 59.81 E	-	073406	39 41.99 S	114 59.73 E	4752	074923	39 41.96 S	114 59.71 E	-	-	901
077 XBT yoyo	06 Feb 2012	075107	39 41.96 S	114 59.69 E	-	080851	39 41.96 S	114 59.63 E	4752	082336	39 41.91 S	114 59.68 E	-	-	900

Table 1: (continued)

	start of CTD					bottom of CTD				end of CTD					
CTD station	date	time	latitude	longitude	depth	time	latitude	longitude	depth	time	latitude	longitude	depth	alt	maxp
078 I9S	06 Feb 2012	082552	39 41.89 S	114 59.71 E	-	095103	39 42.04 S	114 59.51 E	4752	115650	39 42.17 S	114 59.29 E	-	9.0	4833
079 I9S	06 Feb 2012	154236	39 06.35 S	114 59.99 E	4664	170653	39 06.11 S	114 59.54 E	4835	190045	39 05.93 S	114 59.48 E	-	11.6	4916
080 I9S	06 Feb 2012	225725	38 29.98 S	115 00.17 E	4656	002416	38 29.73 S	115 00.35 E	4695	021914	38 29.54 S	114 59.97 E	4697	13.5	4769
081 I9S	07 Feb 2012	052511	37 59.93 S	115 00.14 E	4789	064700	37 59.94 S	114 59.99 E	4779	085640	37 59.84 S	115 00.01 E	4817	8.5	4861
082 I9S	07 Feb 2012	120659	37 29.95 S	115 00.08 E	-	134238	37 30.41 S	115 00.80 E	5223	134531	37 30.42 S	115 00.80 E	-	7.4	5320
083 I9S	07 Feb 2012	162351	37 30.58 S	115 01.36 E	5163	174917	37 30.50 S	115 01.79 E	5231	200615	37 30.74 S	115 02.62 E	5144	13.7	5322
084 bio dip	07 Feb 2012	231924	37 02.27 S	115 00.11 E	5638	005901	37 02.53 S	114 59.15 E	5726	031158	37 02.88 S	114 58.23 E	5734	17.4	5829
085 I9S	08 Feb 2012	040705	37 02.21 S	114 59.93 E	-	055210	37 02.38 S	114 59.34 E	5727	083138	37 02.61 S	114 58.38 E	-	8.9	5839
086 I9S	08 Feb 2012	115708	36 31.70 S	114 59.73 E	-	135747	36 32.07 S	114 58.80 E	5380	163751	36 32.31 S	114 57.64 E	-	7.9	5481
087 I9S	08 Feb 2012	202533	36 00.47 S	114 59.83 E	5247	215759	36 01.03 S	114 58.95 E	5252	000451	36 01.32 S	114 58.12 E	-	14.1	5343
088 I9S	09 Feb 2012	030052	35 39.14 S	115 00.00 E	-	043828	35 40.00 S	114 59.63 E	5096	070038	35 41.10 S	114 59.45 E	-	14.5	5180
089 I9S	09 Feb 2012	085052	35 30.58 S	114 59.90 E	2336	093551	35 31.20 S	114 59.87 E	2427	111256	35 32.48 S	114 59.64 E	2560	0.0	2459
090 I9S	09 Feb 2012	141250	35 12.13 S	114 59.83 E	1474	144507	35 12.56 S	114 59.79 E	1540	153845	35 13.33 S	114 59.93 E	-	24.7	1532
091 I9S	09 Feb 2012	174330	35 03.25 S	115 00.36 E	756	175913	35 03.38 S	115 00.43 E	768	183146	35 03.70 S	115 00.44 E	779	15.3	760
092 I9S	09 Feb 2012	194017	34 57.18 S	115 00.38 E	224	194437	34 57.20 S	115 00.46 E	224	200105	34 57.29 S	115 00.64 E	231	12.8	212
093 I9S	09 Feb 2012	211533	34 49.03 S	114 59.97 E	153	211934	34 49.02 S	114 59.96 E	147	213245	34 49.02 S	114 59.95 E	156	14.5	133
094 I9S	09 Feb 2012	231021	34 36.19 S	115 02.78 E	108	231256	34 36.20 S	115 02.83 E	106	232028	34 36.21 S	115 02.83 E	108	14.1	92
095 I9S	10 Feb 2012	003444	34 27.43 S	115 05.12 E	55	003632	34 27.43 S	115 05.15 E	51	004143	34 27.43 S	115 05.19 E	54	13.4	38

<u>Table 2:</u> Cruise au1203 summary of samples drawn from Niskin bottles at each station, including "sal"= salinity, "ox"=dissolved oxygen, "nuts"= nutrients (i.e. phosphate, nitrate+nitrite, silicate), "CO2"=dissolved inorganic carbon (i.e. TCO_2), alkalinity and pH, and "bar"=barium. Note: biological samples not included here.

station	sal	ox	nuts	CO2	bar
1	X	X	X	X	
2	X	X	X	X	
3	X	X	X	X	
4	X	X	X	X	
5	X	X	X	X	
6	X	X	X	X	
7	X	X	X	X	
8					
9	X	X	X	X	X
10					
11	X	X	X	X	
12	X	X	X	X	X
13					
14	X	X	X	X	
15	X	X	X	X	
16					
17	X	X	X	X	
18	X	X	X	X	X
19					
20	X	X	X	X	
21	X	X	X	X	
22					
23	X	X	X	X	X
24	X	X	X	X	
25	X	X	X	X	
26					
27	X	X	X	X	
28	X	X	X	X	
29	X	X	X	X	X
30	X	X	X	X	
31	X	X	X	X	
32	X	X	X	X	
33	X	X	X	X	
34	X	X	X	X	X
35	X	X	X	X	
36	X	X	X	X	
37					
38	X	X	X	X	
39	X	X	X	X	
40	X	X	X	X	X
41	X	X	X	X	
42	X	X	X	X	
43	X	X	X	X	
44	X	X	X	X	
45	X	X	X	X	X
46	X	X	X	X	
47	X	X	X	X	
48	X	X	X	X	
49	X	X	X	X	X
50	X	X	X	X	
51	X	X	X	X	
52	X	X	X	X	
53	X	X	X	X	X
54	X	X	X	X	
55					
56					
57	X	X	X	X	
58	X	X	X	X	
59	X	X	X	X	X
60	X	X	X	X	
61					
62					
63	X	X	X	X	
64	X	X	X	X	
65					
66	X	X	X	X	
67	X	X	X	X	
68	X	X	X	X	
69	X	X	X	X	
70	X	X	X	X	X
71					
72	X	X	X	X	
73	X	X	X	X	
74					
75	X	X	X	X	
76					
77					
78	X	X	X	X	
79	X	X	X	X	
80	X	X	X	X	
81	X	X	X	X	X
82					
83	X	X	X	X	
84					
85	X	X	X	X	
86	X	X	X	X	
87	X	X	X	X	
88	X	X	X	X	
89	X	X	X	X	X
90	X	X	X	X	
91	X	X	X	X	
92	X	X	X	X	
93	X	X	X	X	
94	X	X	X	X	
95	X	X	X	X	

Table 3: CTD calibration coefficients and calibration dates for cruise au1203. Note that platinum temperature calibrations are for the ITS-90 scale. Pressure slope/offset, temperature, conductivity and oxygen values are from SeaBird calibrations. Fluorometer and PAR values are manufacturer supplied (with the PAR offset value updated from dark voltage values observed on the previous cruise au1121). Transmissometer values are a rescaling of the manufacturer supplied coefficients to give transmittance as a %, referenced to clean water. For oxygen, the final calibration uses in situ bottle measurements (the manufacturer supplied coefficients are not used).

Primary Temperature, serial 4248, 24/06/2011

G	: 4.38734078e-003
H	: 6.51084537e-004
I	: 2.33705079e-005
J	: 1.88450468e-006
F0	: 1000.000
Slope	: 1.0000000
Offset	: 0.0000

Secondary Temperature, serial 4245, 24/06/2011

G	: 4.38197932e-003
H	: 6.45467901e-004
I	: 2.24514415e-005
J	: 1.83970320e-006
F0	: 1000.000
Slope	: 1.0000000
Offset	: 0.0000

Primary Conductivity, serial 2788, 15/06/2011

G	: -9.73059028e+000
H	: 1.42821430e+000
I	: -4.65465822e-004
J	: 1.30723926e-004
CTcor	: 3.2500e-006
CPcor	: -9.5700000e-008
Slope	: 1.00000000
Offset	: 0.00000

Secondary Conductivity, serial 2821, 15/06/2011

G	: -1.05889611e+001
H	: 1.43367529e+000
I	: 1.28798195e-003
J	: -8.53192987e-006
CTcor	: 3.2500e-006
CPcor	: -9.5700000e-008
Slope	: 1.00000000
Offset	: 0.00000

CTD704 Pressure, serial 89084, 29/06/2011
(for slope, offset only)

C1	: -5.337692e+004
C2	: -5.768735e-001
C3	: 1.541700e-002
D1	: 3.853800e-002
D2	: 0.000000e+000
T1	: 2.984003e+001
T2	: -4.090591e-004
T3	: 3.693030e-006
T4	: 3.386020e-009
T5	: 0.000000e+000
Slope	: 0.99987000
Offset	: 0.57220 (dbar)
AD590M	: 1.283280e-002
AD590B	: -9.705660e+000

Oxygen, serial 0178, 01/07/2011
(for display at time of logging only)

Soc	: 4.06400e-001
Voffset	: -4.91400e-001
A	: -2.55850e-001
B	: 1.21500e-004
C	: -1.43500e-006
E	: 3.60000e-002
Tau20	: 1.59000e+000
D1	: 1.92634e-004
D2	: -4.64803e-002
H1	: -3.30000e-002
H2	: 5.00000e+003
H3	: 1.45000e+003

Transmissometer, serial 1421DR, 04/05/2011
(referenced to clean water)

M	: 21.1193
B	: -0.3379

Path length: 0.25 (m)

Fluorometer, serial 296, 23/05/2005

Vblank	: 0.12
Scale factor	: 7.000e+000

PAR, serial 70110, QCP2300HP, 06/12/2006

M	: 1.000
B	: 0.000
Cal. Constant	: 1.6474465e+010
Multiplier	: 1.0
Offset	: -6.104e-002

(note: offset value derived using previous cruise au1121 dark voltage data)

Table 4: **CTD conductivity calibration coefficients for cruise au1203. F_1 , F_2 and F_3 are respectively conductivity bias, slope and station-dependent correction calibration terms. n is the number of samples retained for calibration in each station grouping; σ is the standard deviation of the conductivity residual for the n samples in the station grouping.**

stn grouping	F_1	F_2	F_3	n	σ
001 to 014	0.14055716E-01	0.99972891E-03	-0.41388055E-08	133	0.000840
015 to 024	0.17739976E-01	0.99964722E-03	-0.69680813E-08	129	0.000536
025 to 052	-0.16177788E-02	0.10002174E-02	-0.31723660E-08	528	0.000711
053 to 069	0.41345837E-02	0.99995463E-03	-0.18174856E-08	245	0.000540
070 to 090	0.64810743E-02	0.99986070E-03	-0.14005320E-08	290	0.000704
091 to 095	0.10850986E-01	0.99934832E-03	0.29738833E-08	26	0.001191

Table 5: **Station-dependent-corrected conductivity slope term (F_2 + F_3 . N), for station number N, and F_2 and F_3 the conductivity slope and station-dependent correction calibration terms respectively, for cruise au1203.**

station number	(F_2 + F_3 . N)	station number	(F_2 + F_3 . N)	station number	(F_2 + F_3 . N)
1	0.99972477E-03	33	0.10001127E-02	65	0.99983649E-03
2	0.99972063E-03	34	0.10001096E-02	66	0.99983468E-03
3	0.99971649E-03	35	0.10001064E-02	67	0.99983286E-03
4	0.99971236E-03	36	0.10001032E-02	68	0.99983104E-03
5	0.99970822E-03	37	0.10001001E-02	69	0.99982922E-03
6	0.99970408E-03	38	0.10000969E-02	70	0.99976267E-03
7	0.99969994E-03	39	0.10000937E-02	71	0.99976127E-03
8	0.99969580E-03	40	0.10000905E-02	72	0.99975986E-03
9	0.99969166E-03	41	0.10000874E-02	73	0.99975846E-03
10	0.99968752E-03	42	0.10000842E-02	74	0.99975706E-03
11	0.99968338E-03	43	0.10000810E-02	75	0.99975566E-03
12	0.99967925E-03	44	0.10000779E-02	76	0.99975426E-03
13	0.99967511E-03	45	0.10000747E-02	77	0.99975286E-03
14	0.99967097E-03	46	0.10000715E-02	78	0.99975146E-03
15	0.99956832E-03	47	0.10000683E-02	79	0.99975006E-03
16	0.99956128E-03	48	0.10000652E-02	80	0.99974866E-03
17	0.99955423E-03	49	0.10000620E-02	81	0.99974726E-03
18	0.99954719E-03	50	0.10000588E-02	82	0.99974586E-03
19	0.99954014E-03	51	0.10000556E-02	83	0.99974446E-03
20	0.99953310E-03	52	0.10000525E-02	84	0.99974306E-03
21	0.99952606E-03	53	0.99985830E-03	85	0.99974166E-03
22	0.99951901E-03	54	0.99985648E-03	86	0.99974026E-03
23	0.99951197E-03	55	0.99985467E-03	87	0.99973886E-03
24	0.99950492E-03	56	0.99985285E-03	88	0.99973746E-03
25	0.10001381E-02	57	0.99985103E-03	89	0.99973606E-03
26	0.10001350E-02	58	0.99984921E-03	90	0.99973465E-03
27	0.10001318E-02	59	0.99984740E-03	91	0.99961894E-03
28	0.10001286E-02	60	0.99984558E-03	92	0.99962192E-03
29	0.10001254E-02	61	0.99984376E-03	93	0.99962489E-03
30	0.10001223E-02	62	0.99984195E-03	94	0.99962787E-03
31	0.10001191E-02	63	0.99984013E-03	95	0.99963084E-03
32	0.10001159E-02	64	0.99983831E-03		

Table 6: Surface pressure offsets (i.e. poff, in dbar) for cruise au1203. For each station, these values are subtracted from the pressure calibration "offset" value in Table 3.

stn	poff	stn	poff	stn	poff	stn	poff
1	0.30	26	0.30	51	0.63	76	0.72
2	0.36	27	0.27	52	0.62	77	0.72
3	0.23	28	0.30	53	0.62	78	0.72
4	0.24	29	0.34	54	0.63	79	0.78
5	0.16	30	0.38	55	0.63	80	0.83
6	0.19	31	0.46	56	0.63	81	0.76
7	0.20	32	0.46	57	0.63	82	0.80
8	0.26	33	0.21	58	0.60	83	0.06
9	0.50	34	0.17	59	0.64	84	0.84
10	0.21	35	0.45	60	0.63	85	0.20
11	0.36	36	0.44	61	0.66	86	0.80
12	0.17	37	0.46	62	0.66	87	0.81
13	0.12	38	0.46	63	0.66	88	0.81
14	0.22	39	0.50	64	0.57	89	0.58
15	0.10	40	0.58	65	0.62	90	0.75
16	0.13	41	0.60	66	0.33	91	0.58
17	0.32	42	0.61	67	0.62	92	0.61
18	0.18	43	0.60	68	0.72	93	0.71
19	0.18	44	0.61	69	0.79	94	0.75
20	0.38	45	0.60	70	0.77	95	0.77
21	0.27	46	0.59	71	0.77		
22	0.20	47	0.60	72	0.36		
23	0.31	48	0.61	73	0.78		
24	0.27	49	0.64	74	0.81		
25	0.32	50	0.63	75	0.48		

Table 7: CTD dissolved oxygen calibration coefficients for cruise au1203: slope, bias, tcor (= temperature correction term), and pcor (= pressure correction term). dox is equal to 2.8σ , for σ as defined in the *CTD Methodology*. For deep stations, coefficients are given for both the shallow and deep part of the profile, according to the profile split used for calibration (see section 5.4 in the text); whole profile fit used for stations shallower than 1400 dbar (i.e. stations with only "shallow" set of coefficients in the table), plus stations 1 and 12.

	shallow					deep				
stn	slope	bias	tcor	pcor	dox	slope	bias	tcor	pcor	dox
1	0.411673	-0.191162	-0.001253	0.000137	0.036439					
2	0.385816	-0.155410	-0.022114	0.000149	0.036543					
3	0.412551	-0.187780	-0.006808	0.000132	0.160361					
4	0.428835	-0.271978	-0.038031	0.000138	0.057750					
5	0.413831	-0.173752	0.012316	0.000145	0.090548					
6	0.380910	-0.068995	0.028730	0.000144	0.124522					
7	0.352552	0.088823	0.083049	0.000128	0.172928					
8	-	-	-	-	-					
9	0.412147	-0.197134	-0.003955	0.000160	0.121828					
10	-	-	-	-	-					
11	0.386923	-0.135667	-0.009318	0.000129	0.072673	0.303031	0.004349	0.013055	0.000135	0.012641
12	0.426779	-0.221069	0.003879	0.000149	0.132052					
13	-	-	-	-	-					
14	0.410566	-0.181804	0.001779	0.000127	0.148308	0.156610	0.359743	-0.091644	0.000013	0.011265
15	0.414021	-0.194387	-0.000156	0.000139	0.116212	0.250995	0.168257	-0.102304	0.000049	0.027765
16	-	-	-	-	-					
17	0.436968	-0.280211	0.044977	0.000193	0.082736	0.052215	0.537793	-0.100548	0.000020	0.025491
18	0.429087	-0.251496	0.024297	0.000175	0.118764	0.490394	-0.312745	-0.033139	0.000132	0.023565
19	-	-	-	-	-					
20	0.425989	-0.241703	0.018240	0.000167	0.081153	0.391924	-0.144757	-0.010530	0.000123	0.038505
21	0.429846	-0.268069	0.039348	0.000184	0.081998	0.410149	-0.187140	0.000980	0.000134	0.016167
22	-	-	-	-	-					
23	0.424115	-0.232175	0.011999	0.000158	0.088255	0.369101	-0.094243	-0.018456	0.000111	0.013967
24	0.409350	-0.175515	-0.011772	0.000127	0.078099	0.439713	-0.230266	-0.006791	0.000133	0.015223
25	0.417562	-0.202614	-0.001226	0.000140	0.065120	0.490998	-0.309231	-0.022595	0.000138	0.024652

Table 7: (continued)

26	-	-	-	-	-					
27	0.419334	-0.210748	0.003047	0.000145	0.079524	0.411991	-0.186553	0.001146	0.000132	0.027940
28	0.414608	-0.197841	-0.003254	0.000141	0.054051	0.401106	-0.159089	-0.009889	0.000123	0.017270
29	0.424450	-0.226509	0.004441	0.000152	0.117172	0.410609	-0.187660	0.003642	0.000133	0.024303
30	0.422280	-0.220370	0.007549	0.000146	0.099315	0.501214	-0.342837	-0.014795	0.000152	0.020581
31	0.413274	-0.196081	-0.000835	0.000139	0.035206	0.490297	-0.308644	-0.019062	0.000140	0.025448
32	0.419066	-0.199123	-0.006398	0.000137	0.054031	0.490057	-0.308990	-0.018301	0.000141	0.022692
33	0.414828	-0.201669	0.000733	0.000144	0.039965	0.492406	-0.307338	-0.020834	0.000137	0.021183
34	0.418806	-0.198162	-0.003976	0.000135	0.052063	0.368506	-0.091274	-0.014237	0.000110	0.020654
35	0.433510	-0.216146	-0.010333	0.000134	0.061109	0.488954	-0.308437	-0.015184	0.000142	0.031668
36	0.437203	-0.219106	-0.014085	0.000134	0.050755	0.367919	-0.086267	-0.015966	0.000108	0.023364
37	-	-	-	-	-					
38	0.412635	-0.194197	0.000048	0.000139	0.037855	0.443323	-0.223516	-0.015073	0.000129	0.021873
39	0.397061	-0.177971	0.008403	0.000143	0.049863	0.403576	-0.146840	-0.018186	0.000115	0.016690
40	0.410963	-0.196330	0.002675	0.000144	0.090792	0.399680	-0.144393	-0.013461	0.000116	0.021426
41	0.402286	-0.186090	0.006096	0.000145	0.116232	0.412777	-0.187644	-0.000226	0.000132	0.022000
42	0.403423	-0.188567	0.004718	0.000146	0.034039	0.411276	-0.188262	0.000742	0.000134	0.018965
43	0.422377	-0.197188	-0.005195	0.000128	0.117133	0.412016	-0.188121	0.000940	0.000133	0.020133
44	0.419711	-0.198530	-0.004173	0.000134	0.101213	0.411570	-0.187961	-0.000504	0.000134	0.019284
45	0.422205	-0.204182	-0.004154	0.000136	0.073662	0.492755	-0.307334	-0.019345	0.000138	0.020614
46	0.348771	-0.127901	0.030045	0.000160	0.100331	0.410292	-0.188367	0.000035	0.000135	0.019624
47	0.394436	-0.181485	0.009042	0.000152	0.076890	0.403422	-0.146911	-0.016778	0.000114	0.027438
48	0.414404	-0.198562	-0.000420	0.000142	0.051045	0.405092	-0.191979	0.007806	0.000142	0.020622
49	0.396806	-0.176601	0.003811	0.000145	0.073783	0.411067	-0.190372	0.002383	0.000134	0.022547
50	0.410459	-0.195783	0.000566	0.000144	0.055649	0.407745	-0.191463	0.004302	0.000138	0.023263
51	0.402298	-0.176236	0.000593	0.000134	0.117795	0.412656	-0.192680	0.001566	0.000134	0.023593
52	0.383667	-0.122694	0.001868	0.000100	0.088511	0.375804	-0.080233	-0.021488	0.000099	0.065202
53	0.404542	-0.183845	0.001759	0.000139	0.050549	0.408631	-0.193359	0.005192	0.000139	0.023026
54	0.440336	-0.232511	-0.004020	0.000140	0.123565	0.408772	-0.190512	0.003164	0.000137	0.033510
55	-	-	-	-	-					
56	-	-	-	-	-					
57	0.405306	-0.188804	0.001827	0.000141	0.072686	0.409480	-0.191132	0.001818	0.000136	0.052351
58	0.404484	-0.192848	0.001986	0.000149	0.054889	0.411157	-0.194837	0.004268	0.000136	0.033140
59	0.407576	-0.182050	0.000980	0.000130	0.085533	0.411326	-0.190704	0.001173	0.000134	0.027215
60	0.408910	-0.191153	0.001714	0.000140	0.103249	0.415664	-0.158475	-0.017611	0.000113	0.017321
61	-	-	-	-	-					
62	-	-	-	-	-					
63	0.413684	-0.209585	0.001633	0.000156	0.092008	0.406686	-0.104850	-0.035826	0.000093	0.034291
64	0.412260	-0.198563	0.000584	0.000144	0.055344	0.411693	-0.191953	0.002412	0.000134	0.021946
65	-	-	-	-	-					
66	0.414527	-0.199826	0.000423	0.000141	0.059860	0.404915	-0.196854	0.010014	0.000143	0.038173
67	0.411108	-0.187076	0.000024	0.000131	0.049577	0.414506	-0.193737	0.000562	0.000133	0.030651
68	0.416600	-0.193565	-0.000318	0.000129	0.085813	0.400446	-0.191410	0.008845	0.000145	0.048327
69	0.409770	-0.197855	0.001477	0.000146	0.082516	0.412151	-0.191676	0.001154	0.000134	0.030514
70	0.399942	-0.183504	0.002400	0.000144	0.025610	0.415045	-0.195392	0.001375	0.000134	0.028283
71	-	-	-	-	-					
72	0.410248	-0.189282	0.000821	0.000136	0.076219	0.429280	-0.198492	-0.010659	0.000126	0.017787
73	0.409950	-0.182176	0.000123	0.000127	0.089415	0.444783	-0.218272	-0.008850	0.000125	0.030842
74	-	-	-	-	-					
75	0.408694	-0.187417	0.001442	0.000134	0.072840	0.459483	-0.219811	-0.020438	0.000117	0.034207
76	-	-	-	-	-					
77	-	-	-	-	-					
78	0.398712	-0.170410	0.002266	0.000129	0.039386	0.442672	-0.215195	-0.010177	0.000126	0.029130
79	0.404687	-0.175863	0.000852	0.000130	0.066652	0.415585	-0.155987	-0.016992	0.000112	0.031068
80	0.410191	-0.188021	0.001297	0.000132	0.100722	0.435394	-0.190916	-0.018465	0.000118	0.018872
81	0.396724	-0.174721	0.002264	0.000142	0.105500	0.449068	-0.241148	0.000231	0.000135	0.052679
82	-	-	-	-	-					
83	0.408062	-0.194302	0.001520	0.000146	0.023855	0.422919	-0.150213	-0.029441	0.000107	0.021668
84	-	-	-	-	-					
85	0.397585	-0.170165	0.002401	0.000133	0.033762	0.442044	-0.202811	-0.017963	0.000122	0.022786
86	0.394150	-0.148397	0.001526	0.000111	0.101393	0.389024	-0.049018	-0.056791	0.000082	0.025091
87	0.401513	-0.176597	0.001921	0.000137	0.073057	0.428593	-0.159520	-0.032547	0.000109	0.021401
88	0.408228	-0.182239	0.001138	0.000132	0.045558	0.436812	-0.162829	-0.038550	0.000107	0.035779
89	0.398644	-0.154059	0.000824	0.000108	0.083568	0.490527	-0.190182	-0.056637	0.000079	0.018975
90	0.388889	-0.106599	0.000248	0.000051	0.067207	0.407614	-0.186678	0.001447	0.000138	0.035820
91	0.397875	-0.142061	0.000958	0.000079	0.055809					
92	0.494181	-0.408477	0.000249	0.000151	0.014889					
93	0.394631	-0.115603	-0.000059	0.000087	0.016121					
94	0.202539	0.407378	0.000753	0.000012	0.019730					
95	0.394753	-0.114023	-0.000337	0.000062	0.018342					

<u>Table 8:</u> Missing data points in 2 dbar-averaged files for cruise au1203. "x" indicates missing data for the indicated parameters: T=temperature; S/C=salinity and conductivity; O=oxygen; F=fluorescence downcast; PAR=photosynthetically active radiation downcast; TR=transmittance downcast; F_up=fluorescence upcast; PAR_up=photosynthetically active radiation upcast; TR_up=transmittance upcast.
Note: 2 and 4 dbar values not included here - 2 dbar value missing for most casts, 4 dbar value missing for many casts.

station	pressure (dbar) where data missing	T	S/C	O	F	PAR	TR	F_up	PAR_up	TR_up
2	266,288,652,654				x					
2	660							x		
8	6-48			x						
10	6-62			x						
13	6	x	x	x	x	x	x			
13	8-62			x						
14	6-12	x	x	x	x	x	x			
15	6-8	x	x	x	x	x	x			
16	6-62			x						
19	6-72			x						
22	6-76			x						
23	6-8	x	x	x	x	x	x			
26	6-1100			x						
30	6-8	x	x	x	x	x	x			
33	6	x	x	x	x	x	x			
37	6	x	x	x	x	x	x			
37	8-1004			x						
38-39	6	x	x	x	x	x	x			
43	6-8	x	x	x	x	x	x			
46	6-8	x	x	x	x	x	x			
50-53	6	x	x	x	x	x	x			
55	6	x	x	x	x	x	x	x	x	x
55	8-16							x	x	x
55	8-900			x						
56	6-18	x	x	x	x	x	x	x	x	x
56	20-26	x	x	x	x	x	x			
56	28-902			x						
57	6	x	x	x	x	x	x			
61	6-16	x	x	x	x	x	x	x	x	x
61	18	x	x	x	x	x	x			
61	20-902			x						
62	6-16	x	x	x	x	x	x	x	x	x
62	18	x	x	x	x	x	x			
62	20-900			x						
63	6-8	x	x	x	x	x	x	x	x	x
63	10-40							x	x	x
64	6	x	x	x	x	x	x			
65	6-8	x	x	x	x	x	x			
65	10-4400			x						
66	6-8	x	x	x	x	x	x			
67	6	x	x	x	x	x	x			
68	6-12	x	x	x	x	x	x			
69	6-8	x	x	x	x	x	x			
71	6	x	x	x	x	x	x			
71	8-4706			x						
72	6-8	x	x	x	x	x	x			
73	6	x	x	x	x	x	x			
74	6-4776			x						
74	4778			x				x	x	x

Table 8: (continued)

76	6-18	x	x	x	x	x	x	x	x	x
76	20-902			x						
77	6-16	x	x	x	x	x	x	x	x	x
77	18-20	x	x	x	x	x	x			
77	22-900			x						
78	6-8	x	x	x	x	x	x			
82	6-5144			x				x	x	x
82	5146-5268			x			x	x	x	x
82	5270-5320			x			x			
83	52-108			x						
84	6-5830			x						
85	6-8	x	x	x	x	x	x			
86	5482							x	x	x
87	6-8	x	x	x	x	x	x			
88	6	x	x	x	x	x	x			
89-90	6-8	x	x	x	x	x	x			
91	6-10	x	x	x	x	x	x			
92	6-8	x	x	x	x	x	x			
93	6	x	x	x	x	x	x			
94	6-8	x	x	x	x	x	x			
95	6	x	x	x	x	x	x			

Table 9: Suspect CTD 2 dbar averages (not deleted from the CTD 2 dbar average files) for the indicated parameters, for cruise au1203.

station	suspect 2 dbar value (dbar)	parameters	comment
1	2-200	transmittance (downcast)	values up to 103% (too high)
6	904-1024	oxygen	reduced accuracy as no bottom bottle sample
71	4706	salinity	possible fouling from bottom contact

Table 10: Bad salinity bottle samples (not deleted from bottle data file) for cruise au1203.

station	rosette position
2	9
4	16
5	16
46	2
66	3
79	10

Table 11: Suspect dissolved oxygen bottle values (not deleted from bottle data file) for cruise au1203.

station	rosette position
50	20, 19

Table 12: Scientific personnel (cruise participants) for cruise au1203.

Graham Campton	RAN Hydrographic Office
David Sowter	RAN Hydrographic Office
Ric Frey	RAN Hydrographic Office
Anthony Moxham	RAN Hydrographic Office
John van den Hoff	phytoplankton
Karen Westwood	phytoplankton
Alicia Navidad	hydrochemistry
Sheree Yau	genetics
Christine Rees	hydrochemistry
Nick Roden	carbon
Graham Simpkins	CTD
Kate Berry	carbon
Mark Rayner	hydrochemistry
Brian Hogue	moorings, CTD
Marvin Alfaro	CTD
Donna Roberts	RMT
Deb Bourke	RMT
Sue Reynolds	hydrochemistry
Adam Swadling	carbon
Peter (Elwood) Mantel	electronics, deck support
Kim Briggs	electronics
John Raymond	programmer
Aaron Spurr	gear officer
Chris Broinowski	gear officer
Beatriz Pena Molino	CTD
Laura Herraiz Borreguero	CTD
David Ellyard	voyage blog
Craig Neill	carbon
David Wilkins	genetics
Tim Williams	genetics
Peter Schuller	doctor
Lance Cowled	weather forecaster
Matthew Longmire	comms
Robyn Chawner	comms
Wendy Sharpe	artist
Mark Rosenberg	CTD, moorings
Esmee van Wijk	CTD
Delphine Dissard	RMT
Kelly Strzepek	RMT, carbon
Michael Field	electronics
Elizabeth Shadwick	carbon
Stephane Thanassekos	carbon
Jake Vanderjagt	helicopters
Robert Hoffman	helicopters
Dave Pullinger	helicopters
Simon Taylor	helicopters
Robert Rogel	helicopters
Mel van Twest	doctor
Barbara Frankel	deputy voyage leader
Steve Rintoul	CTD, voyage leader

<u>Table 13:</u> Summary of APEX Argo float and SOLO polar profiling float deployments on cruise au1203.

hull ID	position	time	depth (m)
APEX 5938i	46^{o} 11.81' S 147^{o} 01.52' E	0740, 06/01/2012	1813
APEX 5940i	51^{o} 53.80' S 145^{o} 59.70' E	1120, 07/01/2012	3923
APEX 4580i	55^{o} 59.85' S 145^{o} 10.02' E	0520, 08/01/2012	2892
APEX 5943i	60^{o} 31.46' S 145^{o} 36.32' E	0842, 09/01/2012	3955
SOLO 1035/122360	66^{o} 54.75' S 145^{o} 23.18' E	2020, 10/01/2012	714
SOLO 1034/78560	67^{o} 02.77' S 145^{o} 09.96' E	0740, 11/01/2012	1263
SOLO 1033/75460	66^{o} 45.76' S 144^{o} 18.00' E	1252, 11/01/2012	918
APEX 5944i	62^{o} 47.80' S 113^{o} 17.98' E	0537, 23/01/2012	3817
APEX 5941i	58^{o} 36.44' S 114^{o} 58.96' E	0029, 26/01/2012	4542
APEX 5073A	53^{o} 48.56' S 115^{o} 01.03' E	0816, 29/01/2012	4023
APEX 5075A	49^{o} 59.91' S 115^{o} 02.04' E	0337, 31/01/2012	3652
APEX 5939i	47^{o} 58.60' S 115^{o} 00.13' E	0253, 01/02/2012	3637

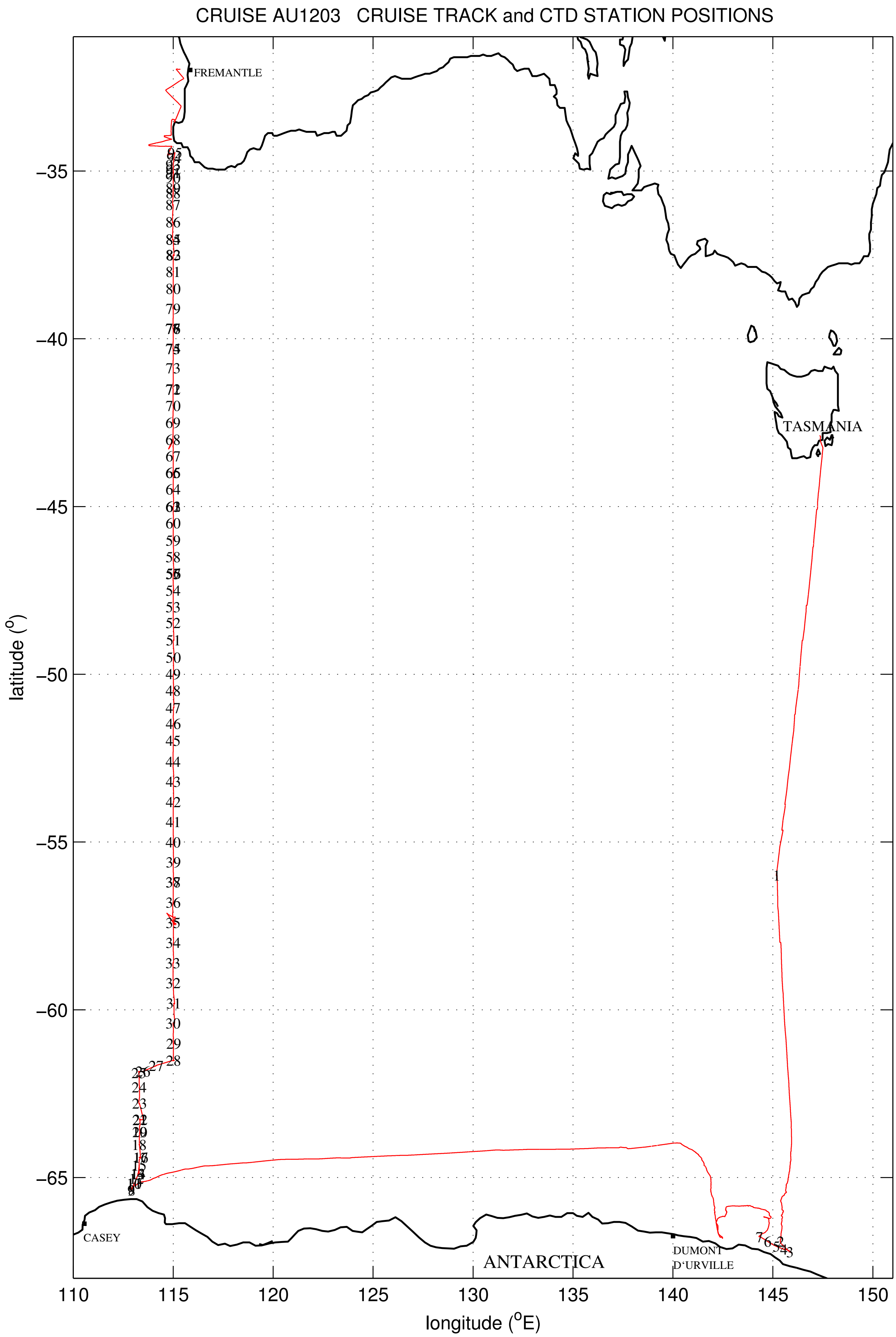
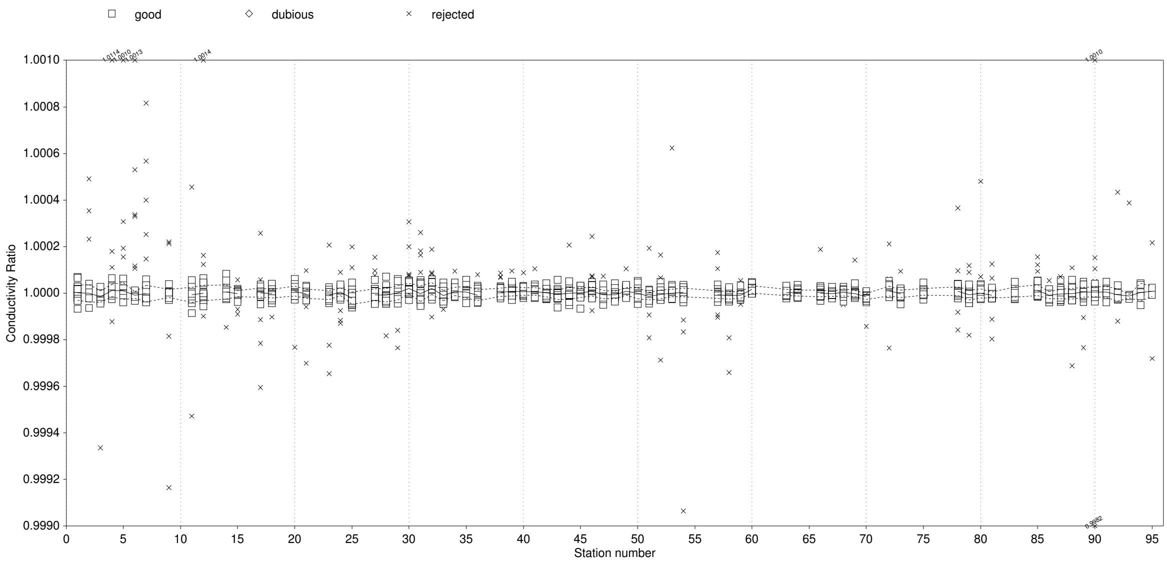


Figure 1: **CTD station positions and ship's track for cruise au1203.**



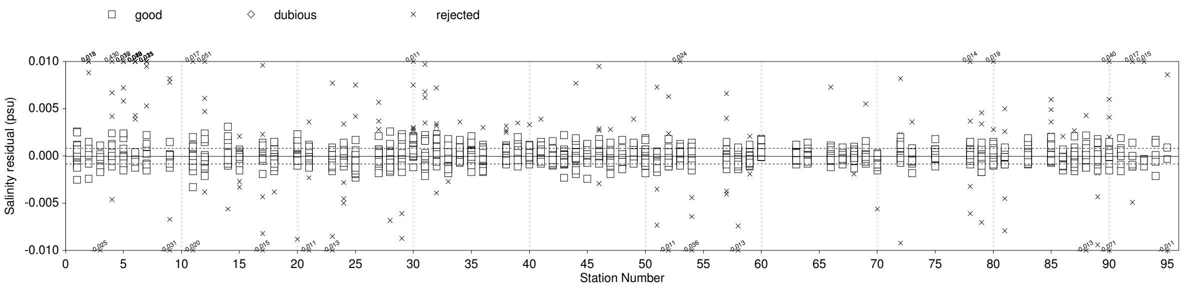
Calibration data for cruise : au1203

Calibration file : a1203.bot

Conductivity s.d. = 0.00002

Number of bottles used = 1352 out of 1506 Mean ratio for all bottles = 1.00000

<u>Figure 2:</u> Conductivity ratio c_{btl}/c_{cal} versus station number for cruise au1203. The solid line follows the mean of the residuals for each station; the broken lines are ± the standard deviation of the residuals for each station. c_{cal} = calibrated CTD conductivity from the CTD upcast burst data; c_{btl} = 'in situ' Niskin bottle conductivity, found by using CTD pressure and temperature from the CTD upcast burst data in the conversion of Niskin bottle salinity to conductivity.



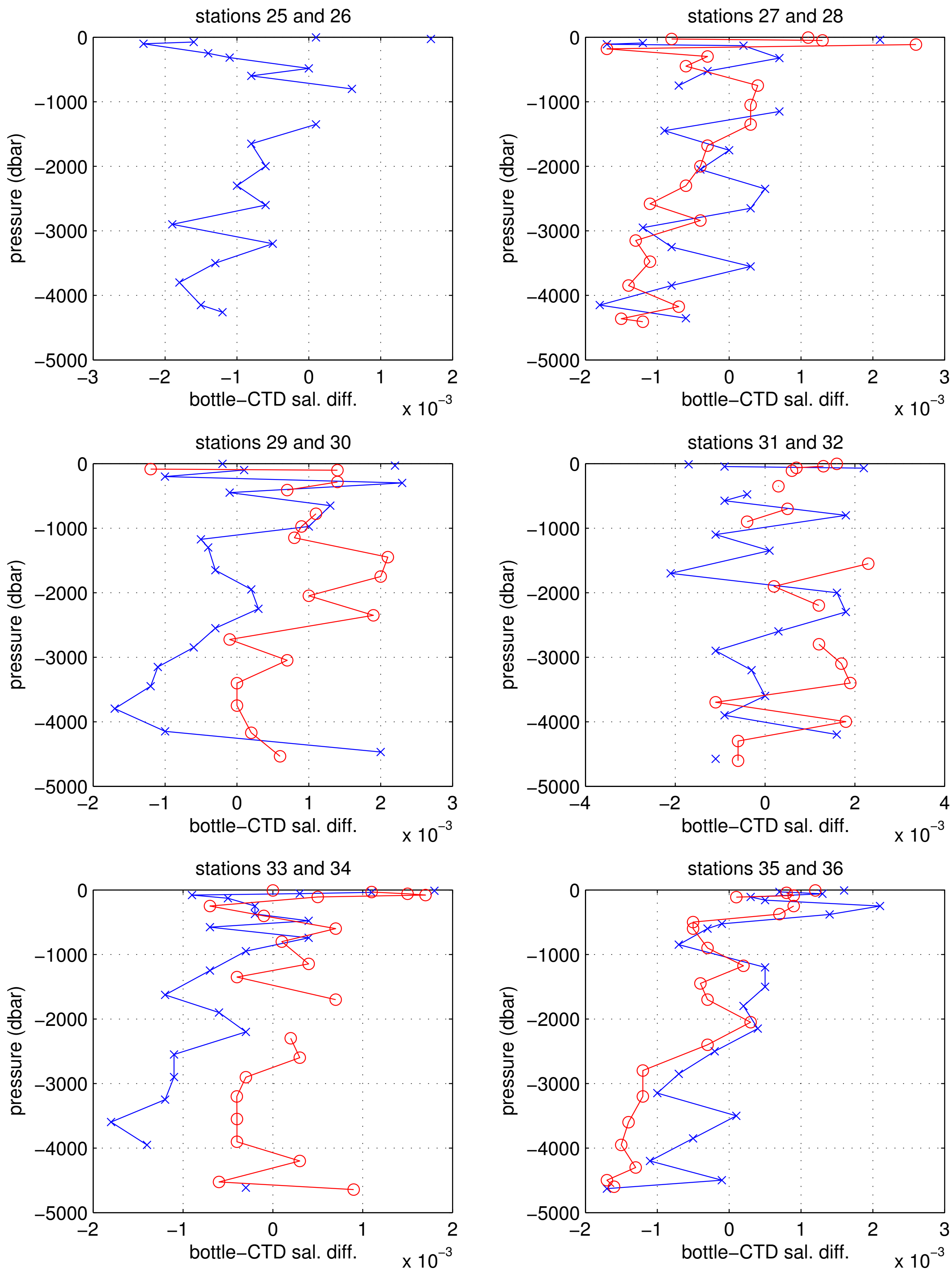
Calibration data for cruise : au1203

Calibration file : a1203.bot

Mean offset salinity = 0.0000psu (s.d. = 0.0008 psu)

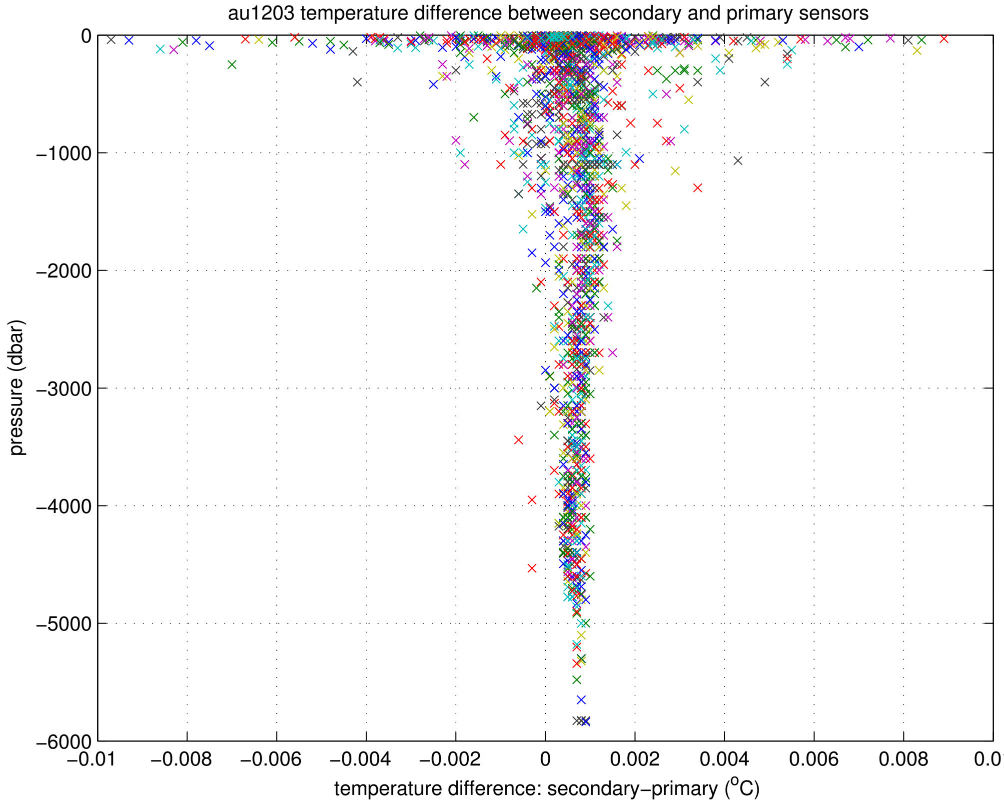
Number of bottles used = 1352 out of 1506

<u>Figure 3:</u> Salinity residual (s_{btl} - s_{cal}) versus station number for cruise au1203. The solid line is the mean of all the residuals; the broken lines are ± the standard deviation of all the residuals. s_{cal} = calibrated CTD salinity; s_{btl} = Niskin bottle salinity value.

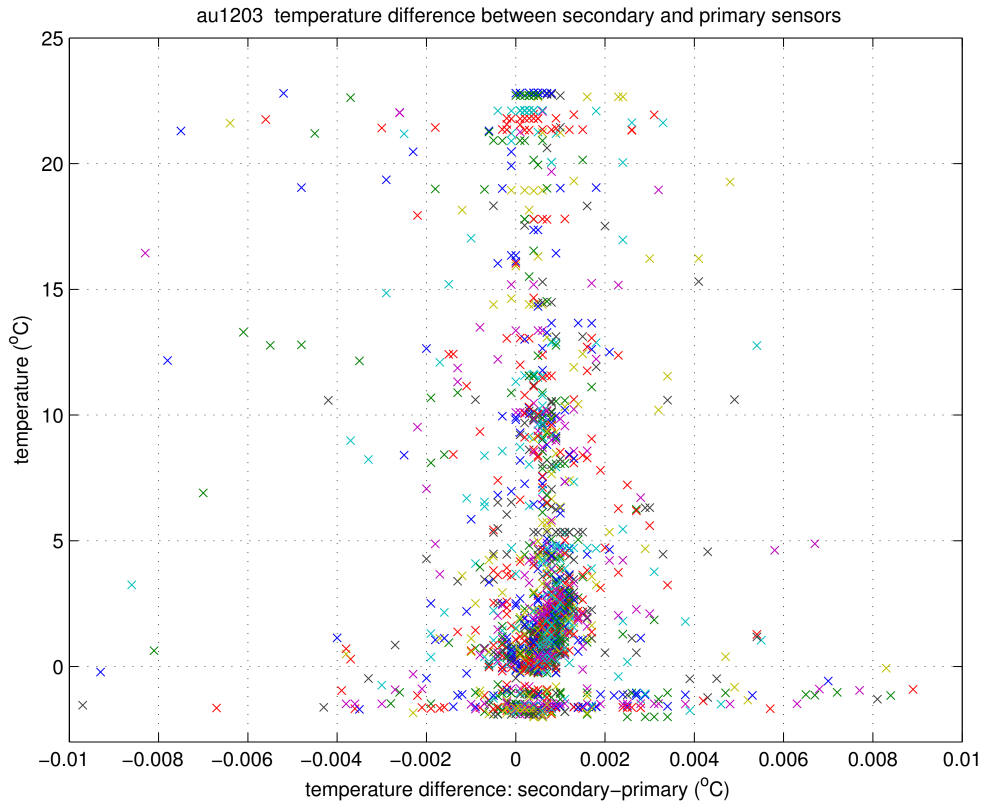


<u>Figure 4:</u> Vertical profiles of salinity residuals (i.e. bottle – CTD salinity) for example stations.

(a)



(b)



<u>Figure 5:</u> Difference between secondary and primary temperature sensors with (a) pressure, and (b) temperature. Data are from the upcast CTD data bursts at Niskin bottle stops.

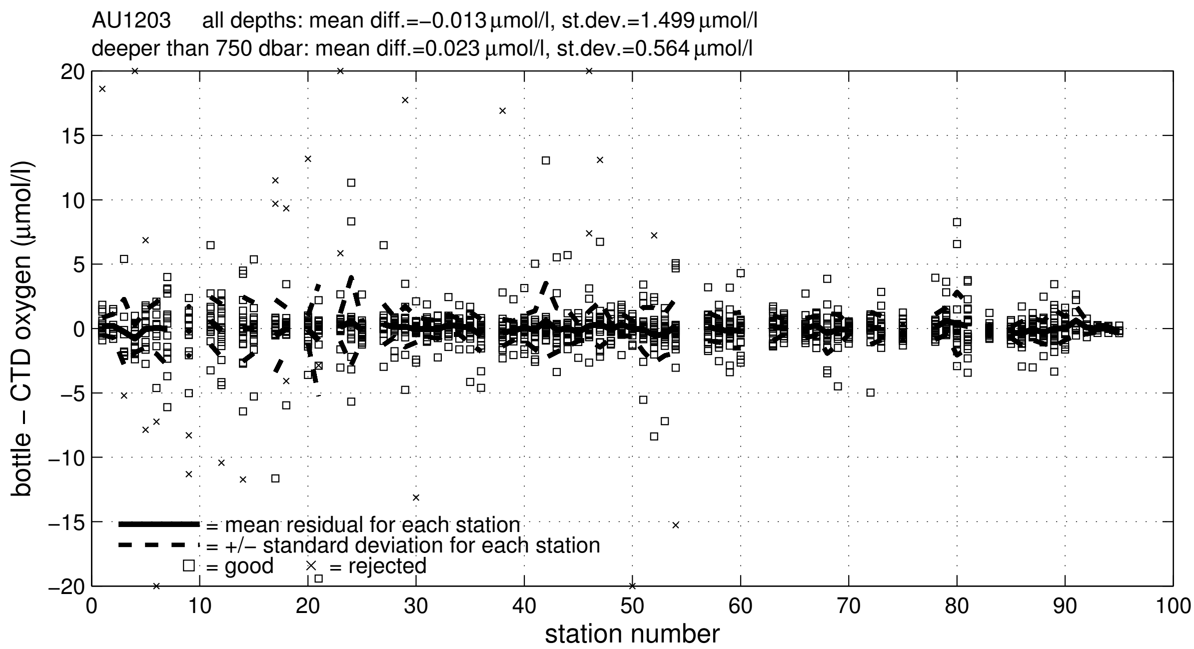


Figure 6: **Dissolved oxygen residual (o_{btl} - o_{cal}) versus station number for cruise au1203. The solid line follows the mean residual for each station; the broken lines are ± the standard deviation of the residuals for each station. o_{cal}=calibrated downcast CTD dissolved oxygen; o_{btl}=Niskin bottle dissolved oxygen value. Note: values outside vertical axes are plotted on axes limits.**

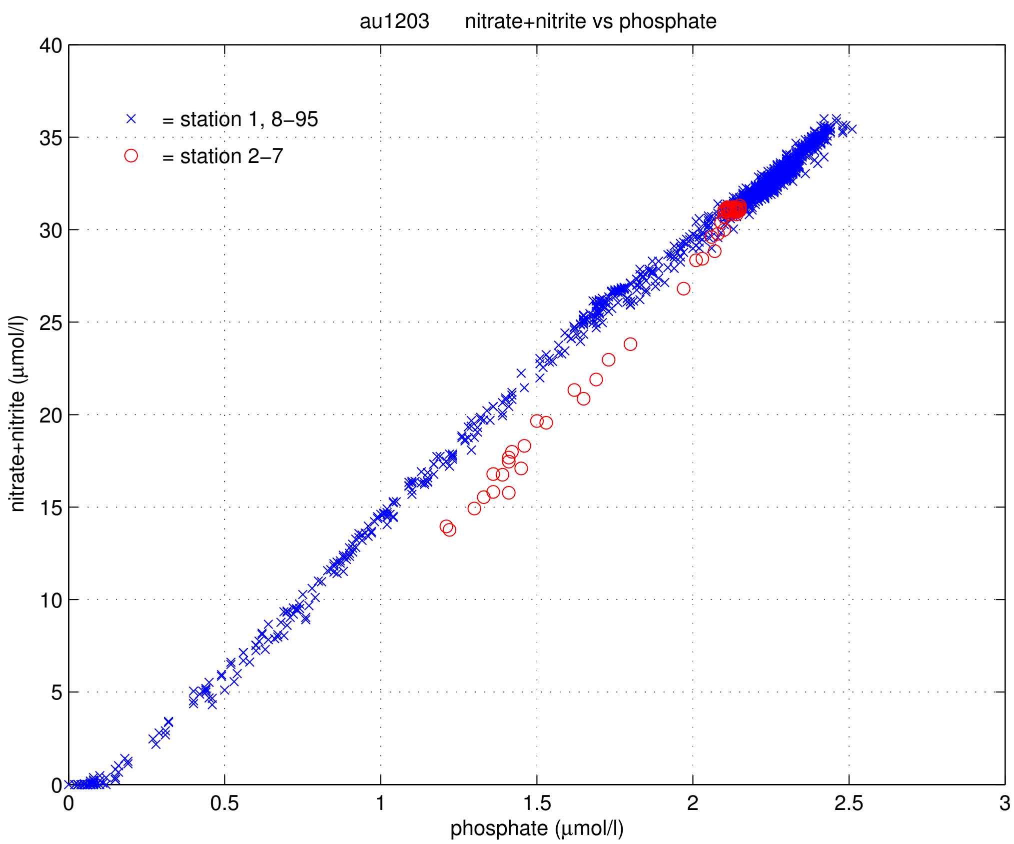
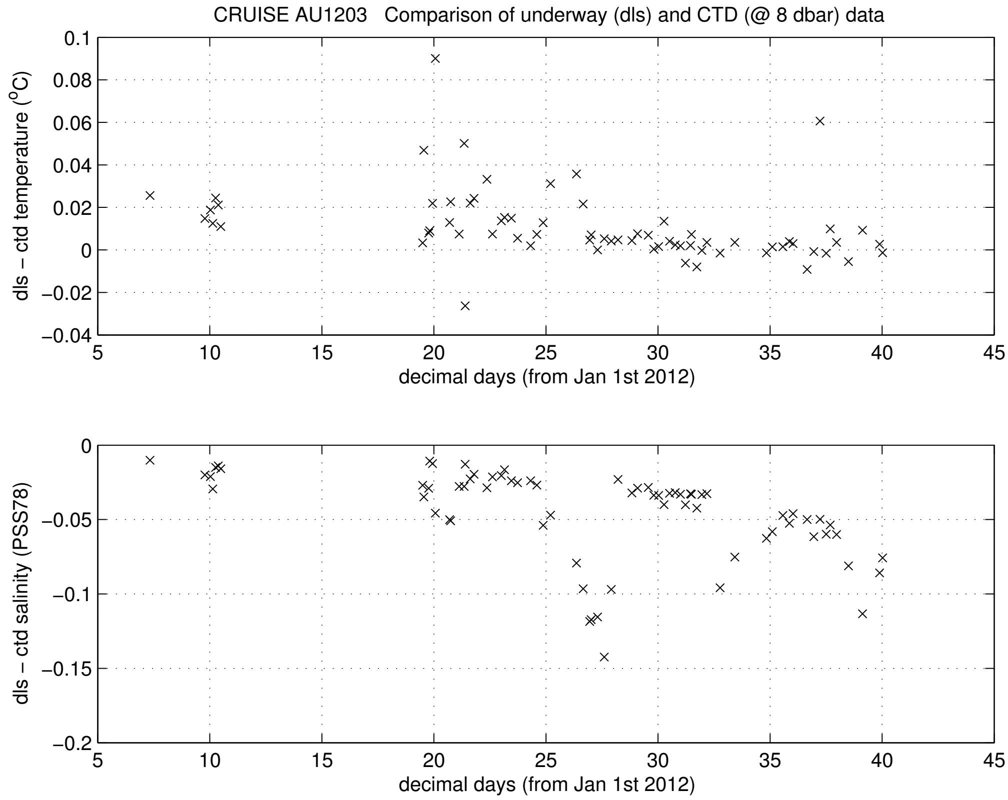
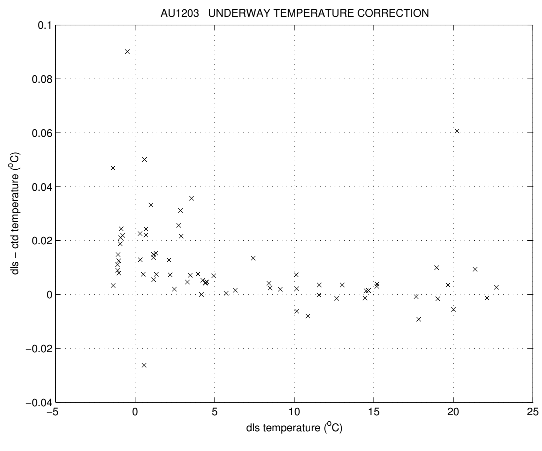


Figure 7: **Nitrate+nitrite versus phosphate data for cruise au1203.**

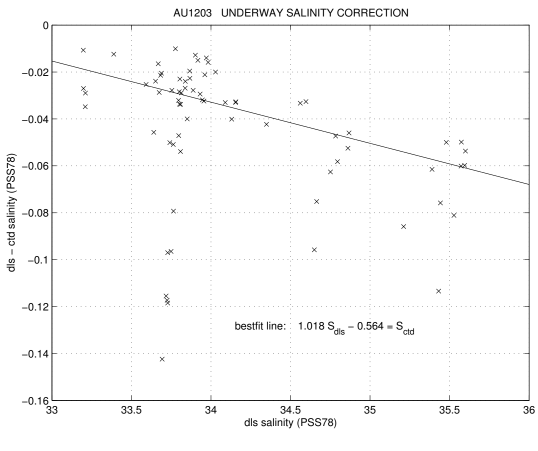


<u>Figure 8:</u> au1203 comparison of underway temperature and salinity data to CTD data, with time.

(a)

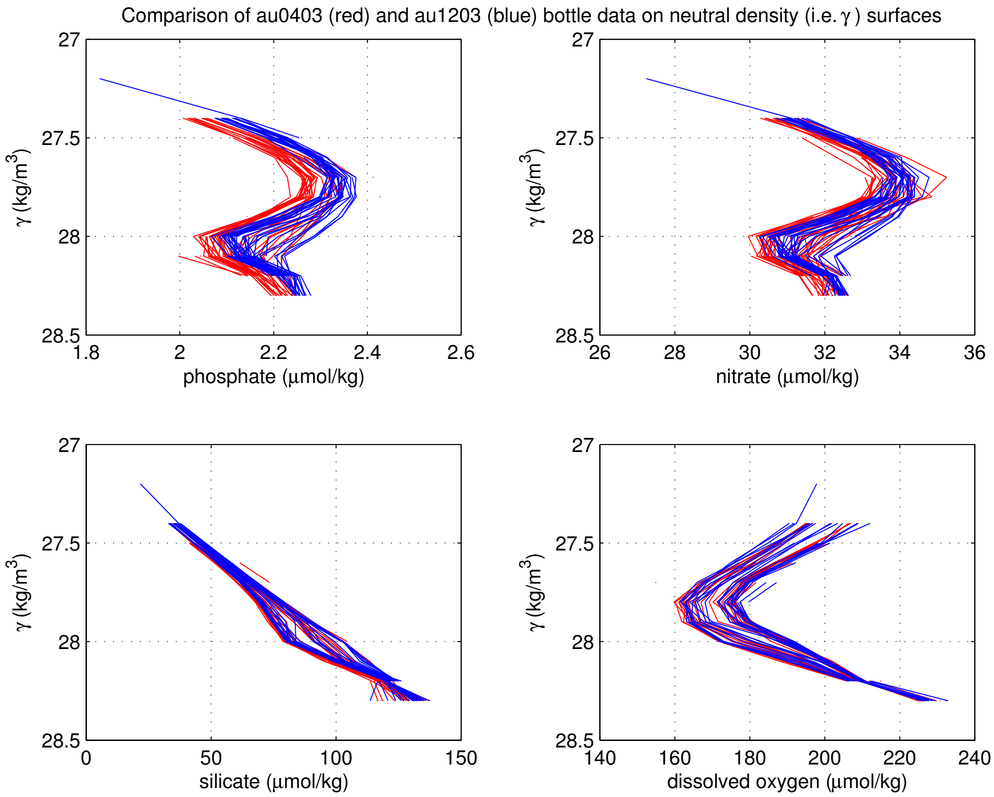


(b)

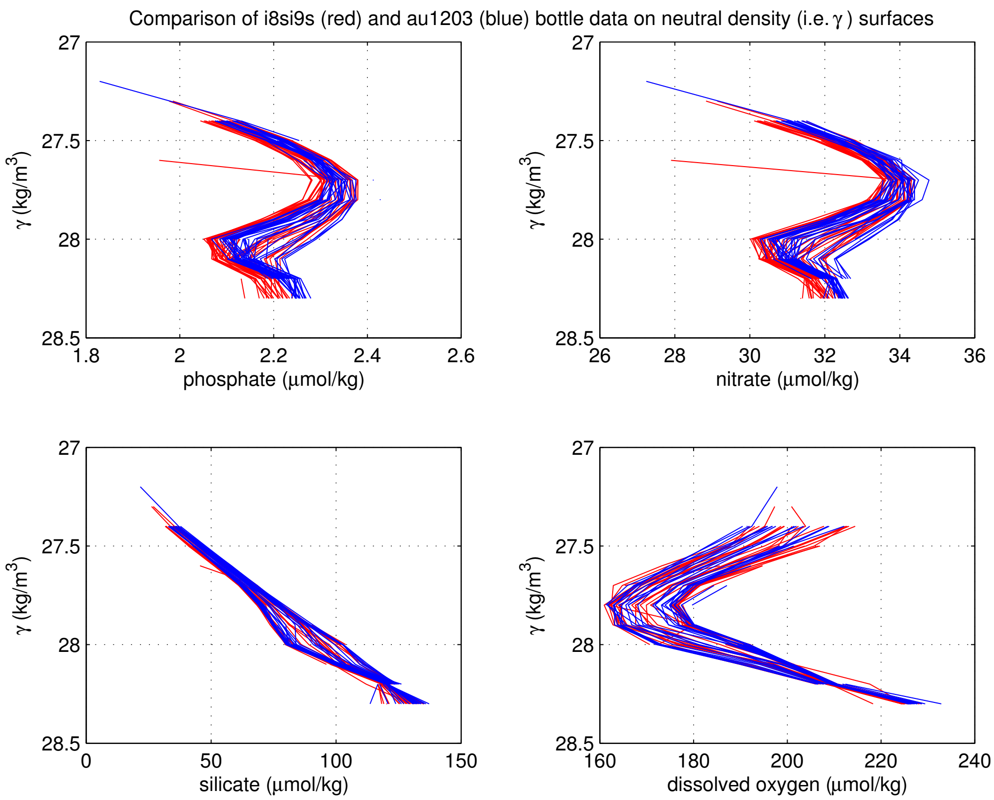


<u>Figure 9a and b:</u> au1203 comparison between (a) CTD and underway temperature data (i.e. hull mounted temperature sensor), and (b) CTD and underway salinity data. Note: dls refers to underway data. Note that due to the large scatter these corrections have not been applied to the underway data.

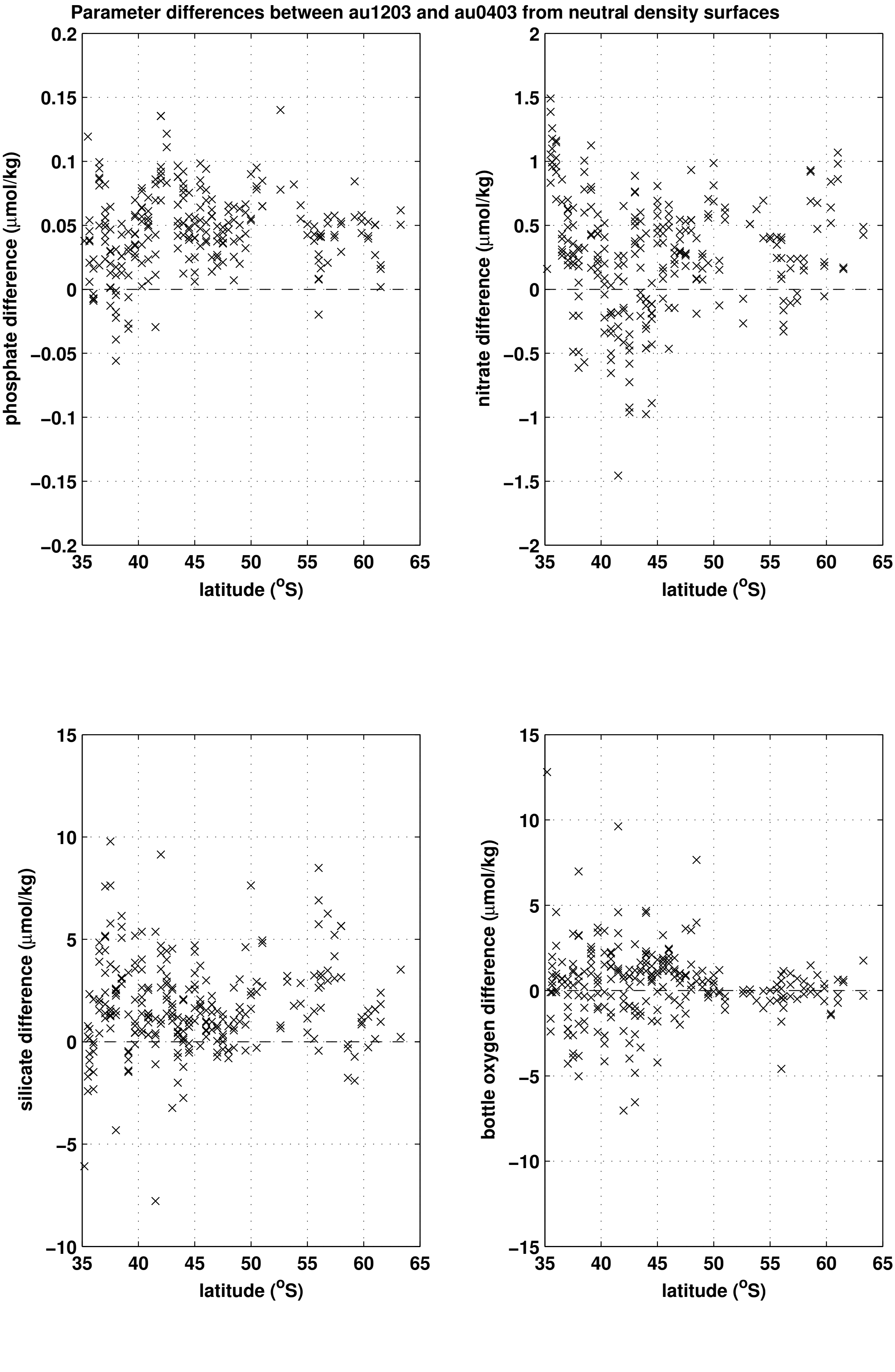
(a)



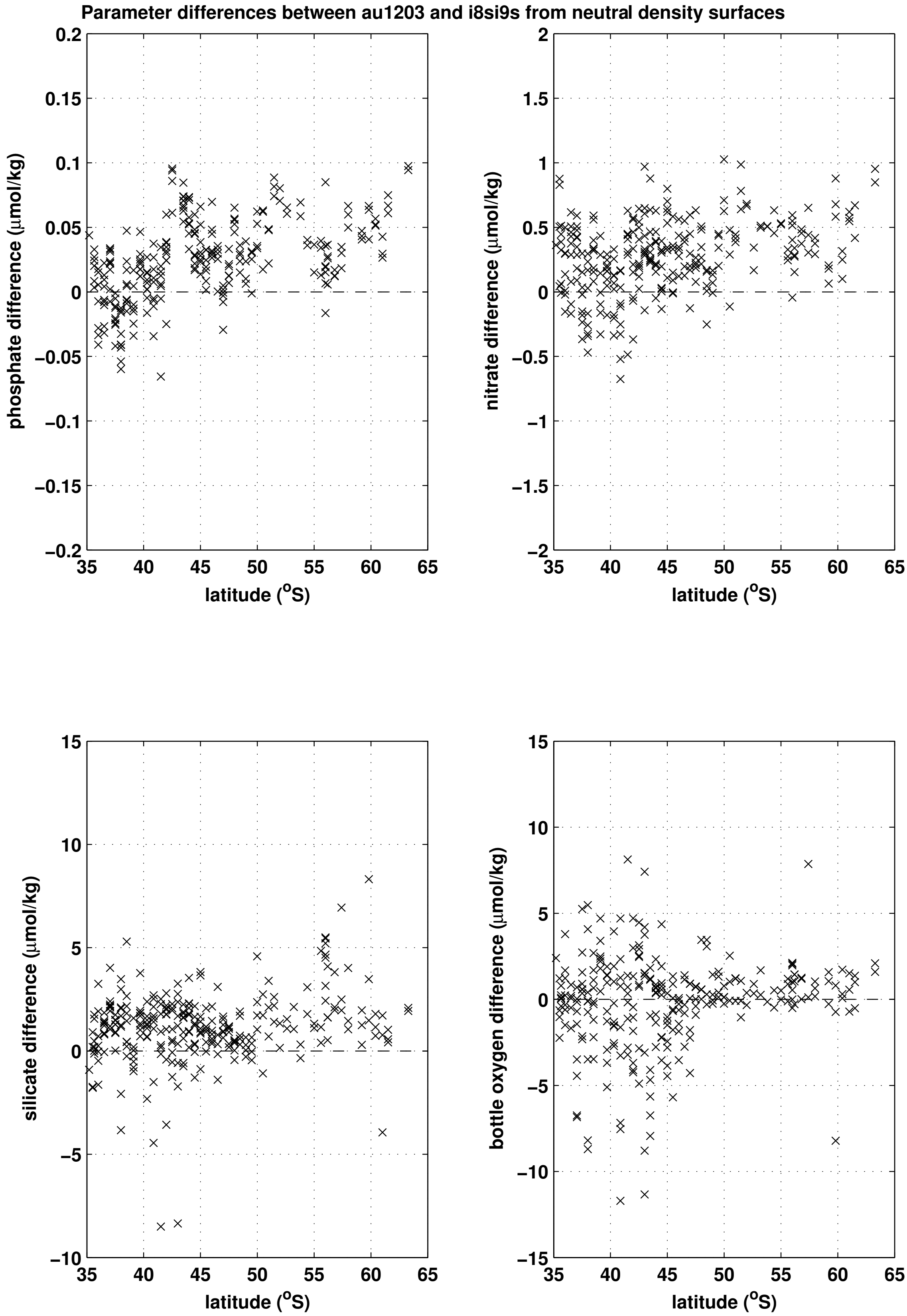
(b)



<u>Figure 10:</u> Bulk plots showing intercruise comparisons of nutrient and oxygen data on neutral density (i.e. γ) surfaces for (a) au1203 and au0403, and (b) au1203 and i8si9s. Note that all units are µmol/kg.



<u>Figure 11:</u> Parameter differences with latitude (from comparisons done on neutral density surfaces, not shown here) for au1203 - au0403. Note that all units are µmol/kg.



<u>Figure 12:</u> Parameter differences with latitude (from comparisons done on neutral density surfaces, not shown here) for au1203 – i8si9s. Note that all units are µmol/kg.