Salinity measurements

(1)Personnel

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(2)Objective

To provide calibrations for the measurements of salinity collected from CTD and underway surface water monitoring (TSG).

(3)Parameters

The specifications of the AUTOSAL salinometer are shown as follows;

Salinometer (Model 8400B "AUTOSAL"; Guildline Instruments Ltd.)

Measurement Range : 0.005 to 42 (PSU)

Accuracy : Better than ±0.002 (PSU) over 24 hours without re-standardization

Maximum Resolution : Better than ±0.0002 (PSU) at 35 (PSU)

(4) Instruments and Methods

a. Salinity Sample Collection

Seawater samples were collected with 2.5 liter Niskin bottles, bucket, and TSG. The salinity sample bottle of 200ml clear glass with inner cap was used for collecting the sample water. Each bottle was rinsed 3 times with the sample water, and was filled with sample water to the bottle shoulder. The bottles were stored for more than 12 hours in the laboratory before the salinity measurement.

Types and numbers (n) of the samples are shown in Table 1.

Table 1 Types and numbers (n) of samples

Types	N
Samples for CTD and bucket	162
Samples for TSG	21
Total	183

b. Instruments and Method

The salinity analysis was carried out on T/V UMITAKA-MARU during the cruise of UM-12-08 using the salinometer (Model 8400B "AUTOSAL"; Guildline Instruments Ltd.: S/N 63904) with an additional peristaltic-type intake pump (Ocean Scientific International, Ltd.).

A handy digital thermometer (8RD200; Citizen Co.) was used for monitoring the ambient temperature of the laboratory.

The specifications of the thermometer are shown as follows;

Thermometer (8RD200; Citizen Co.)

Measurement Range : -10 to +50 deg C

Resolution : 0.1 deg C

Limits of error ±deg C : ±1 deg C

The salinometer was operated in the air-conditioned ship's laboratory at a bath temperature of 27 deg C. The ambient temperature varied from approximately 18 deg C to 26 deg C, while the bath temperature was very stable.

The measurement for each sample was conducted with a double conductivity ratio. Data reading was started 5 seconds after filling the cell with the sample and it took about 15 seconds to determine the stable reading. Data were taken for the sixth and seventh filling of the cell after rinsing 5 times. In the case of the difference between the double conductivity ratio of these two fillings being smaller than 0.00002, the average value of the double conductivity ratio was used to calculate the bottle salinity with the algorithm for the practical salinity scale, 1978 (UNESCO, 1981). If the difference was greater than or equal to 0.00003, an eighth filling of the cell was done. In the case of the difference between the double conductivity ratio of these two fillings being smaller than 0.00002, the average value of the double conductivity ratio was used to calculate the bottle salinity. In the case of the double conductivity ratio of eighth filling did not satisfy the criteria above, the operator measured a ninth or tenth filling of the cell and calculated the bottle salinity above. The cell was cleaned with detergent after the measurement of the day.

(5) Results

a. Standard Seawater (SSW)

The specifications of SSW used in this cruise are shown as follows;

Batch	:	P154
conductivity ratio	:	0.99990
salinity	:	34.996
expiration date	:	20th October 2014

Standardization control of the salinometer S/N 63904 was set to 487 (3rd Jan.) and all measurements were carried out at this setting. The value of STANDBY was 5792 +/- 0001 and that of ZERO was 0.0-0001 +/- 0001. 10 bottles of SSW were measured.

Fig.1 shows the time series of the double conductivity ratio of the Standard Seawater batch P154 before correction. The average of the double conductivity ratio was 1.99978 and the standard deviation was 0.00001, which is equivalent to 0.0003 in salinity.

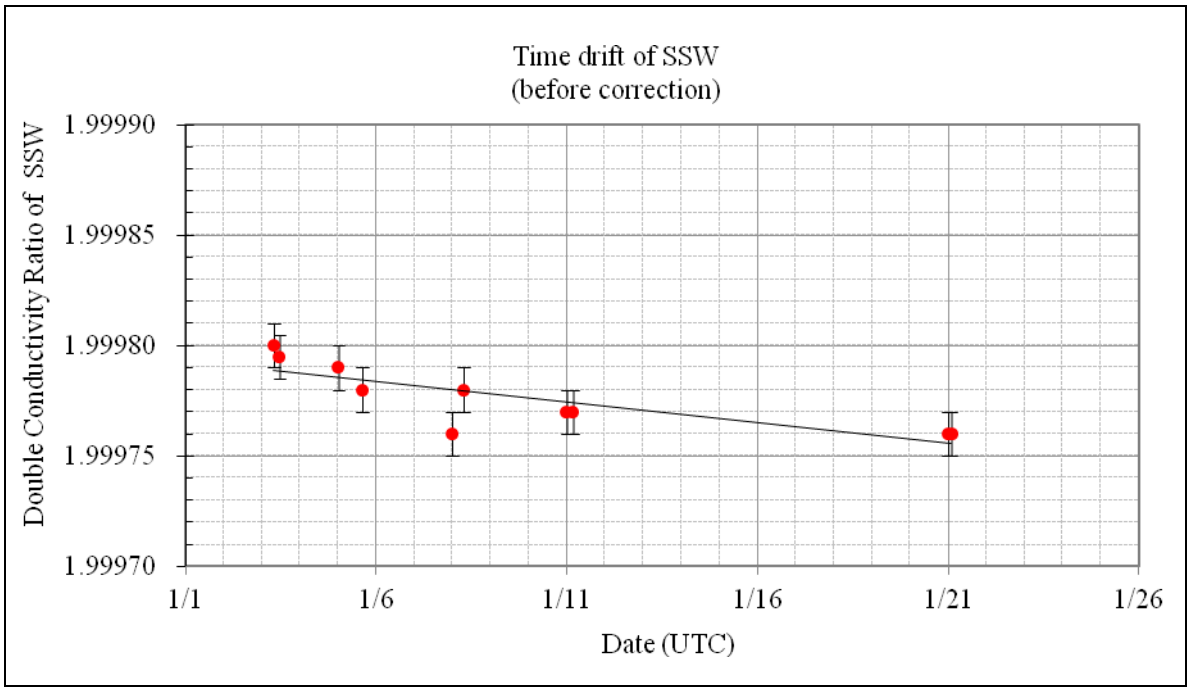

Fig. 1 Time series of double conductivity ratio for the Standard Seawater batch P154 (before correction)

Fig.2 shows the time series of the double conductivity ratio of the Standard Seawater batch P154 after correction. The average of the double conductivity ratio after correction was 1.99980 and the standard deviation was 0.000005, which is equivalent to 0.0001 in salinity.

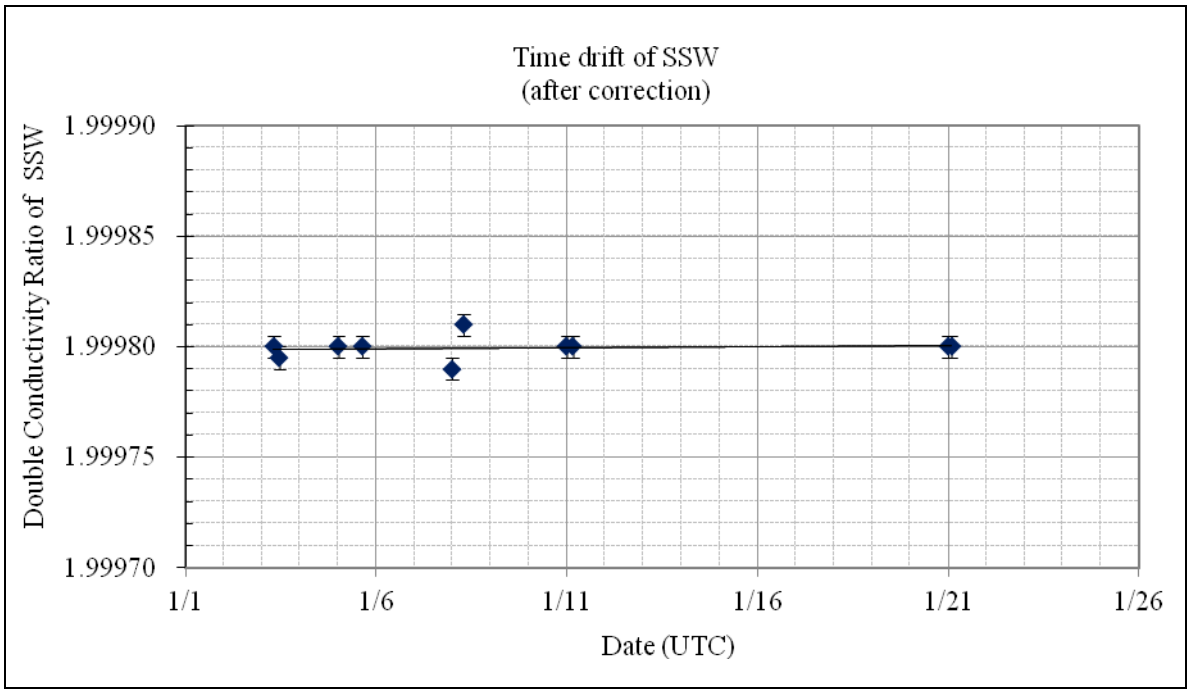

Fig. 2 Time series of double conductivity ratio for the Standard Seawater batch P154 (after correction)

b. Sub-Standard Seawater

Sub-standard seawater was made from surface-sea water (poor in nutrient) filtered by a pore size of 0.22 micrometer and stored in a 20 liter container made of polyethylene and stirred for at least 24 hours before measuring. It was measured between every station in order to check for the possible sudden drifts of the salinometer.

c. Replicate Samples

The precision of this method was estimated by using 23 pairs of replicate samples taken from the same Niskin bottle.

Fig.3 shows the histogram of the absolute difference between each pair of replicate samples. The average and the standard deviation of absolute difference among 23 pairs were 0.0005 and 0.0006 in salinity, respectively.

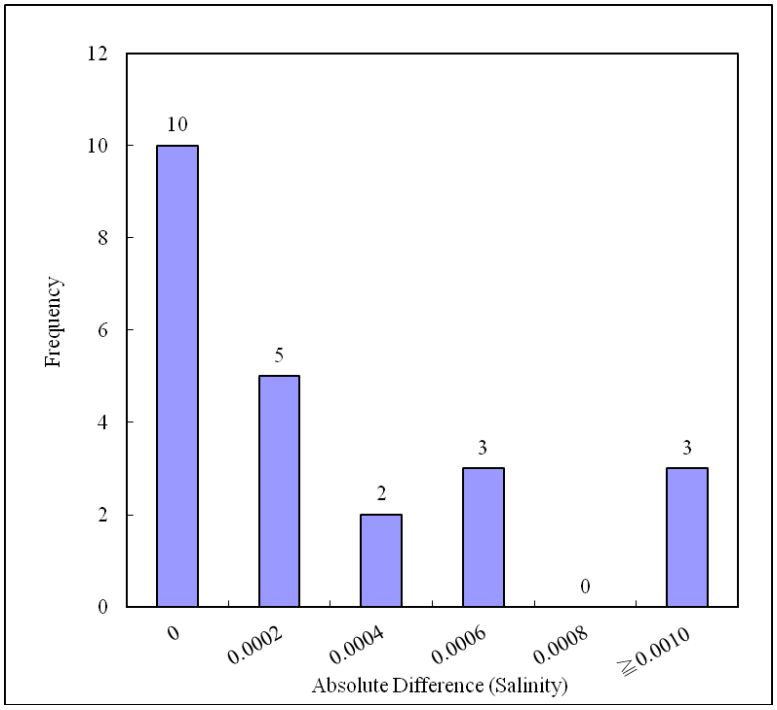

Fig. 3 Histogram of the Absolute Difference between Replicate Samples

d. Data Correction for Samples

All data were corrected according to the result of the offset correction for SSW.

(6) Reference

・UNESCO : Tenth report of the Joint Panel on Oceanographic Tables and Standards. UNESCO Tech. Papers in Mar. Sci., 36, 25 pp., 1981