5.15 Salinity of sampled water

(1) Personnel

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(2) Objective

To provide a calibration for the measurement of salinity of bottle water collected on the CTD casts and The Continuous Sea Surface Water Monitoring System (TSG).

(3) Method

a. Salinity Sample Collection

Seawater samples were collected with 12 liter Niskin-X bottles and TSG. The salinity sample bottle of the 250ml brown glass bottle with screw cap was used for collecting the sample water. Each bottle was rinsed three times with the sample water, and was filled with sample water to the bottle shoulder. The sample bottle was sealed with a plastic inner cap and a screw cap ; the thimble being thoroughly rinsed before use. The bottle was stored for more than 18 hours in the laboratory before the salinity measurement.

The kind and number of samples taken are shown as follows ;

Table 5.15-1 Kind and number of samples

Kind of Samples	Number of Samples(Leg1)	Number of Samples(Leg2)
Samples for CTD	52	58
Samples for TSG	28	32
Total	80	90

b. Instruments and Method

The salinity analysis was carried out on R/V MIRAI during the cruise of MR11-07 Leg1 and Leg2 using the salinometer (Model 8400B “AUTOSAL” ; Guildline Instruments Ltd.: S/N 62556) with an additional peristaltic-type intake pump (Ocean Scientific International, Ltd.). A pair of precision digital thermometers (Model 9540 ; Guildline Instruments Ltd.) were used. The thermometer monitored the ambient temperature and the other monitored a bath temperature.

The specifications of the AUTOSAL salinometer and thermometer 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)

Thermometer (Model 9540 ; Guildline Instruments Ltd.)

Measurement Range	:	-40 to +180 deg C
Resolution	:	0.001
Limits of error ±deg C	:	0.01 (24 hours @ 23 deg C ±1 deg C)
Repeatability	:	±2 least significant digits

The measurement system was almost the same as Aoyama *et al.* (2002). The salinometer was operated in the air-conditioned ship's laboratory at a bath temperature of 24 deg C. The ambient temperature varied from approximately 22 deg C to 24 deg C, while the bath temperature was very stable and varied within +/- 0.002 deg C on rare occasion. The measurement for each sample was done with a double conductivity ratio and defined as the median of 31 readings of the salinometer. Data collection was started 5 seconds after filling the cell with the sample and it took about 10 seconds to collect 31 readings by a personal computer. Data were taken for the sixth and seventh filling of the cell. 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. The measurement was conducted in about 4 hours per day and the cell was cleaned with soap after the measurement of the day.

(4) Results

(4-1)Results of Leg1

a. Standard Seawater

Standardization control of the salinometer was set to 768 and all measurements were done at this setting. The value of STANDBY was 5581 +/- 0001 and that of ZERO was 0.0+0000 or 0.0+0001. The conductivity ratio of IAPSO Standard Seawater batch P153 was 0.99979 (double conductivity ratio was 1.99958) and was used as the standard for salinity. 14 bottles of P153 were measured.

Fig.5.15-1 shows the history of the double conductivity ratio of the Standard Seawater batch P153. The average of the double conductivity ratio was 1.99956 and the standard deviation was 0.00001, which is equivalent to 0.0003 in salinity.

Fig.5.15-2 shows the history of the double conductivity ratio of the Standard Seawater batch P153 after correction. The average of the double conductivity ratio after correction was 1.99958 and the standard deviation was 0.00001, which is equivalent to 0.0001 in salinity.

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

batch	:	P153
conductivity ratio	:	0.99979
salinity	:	34.992
use by	:	8th March 2014

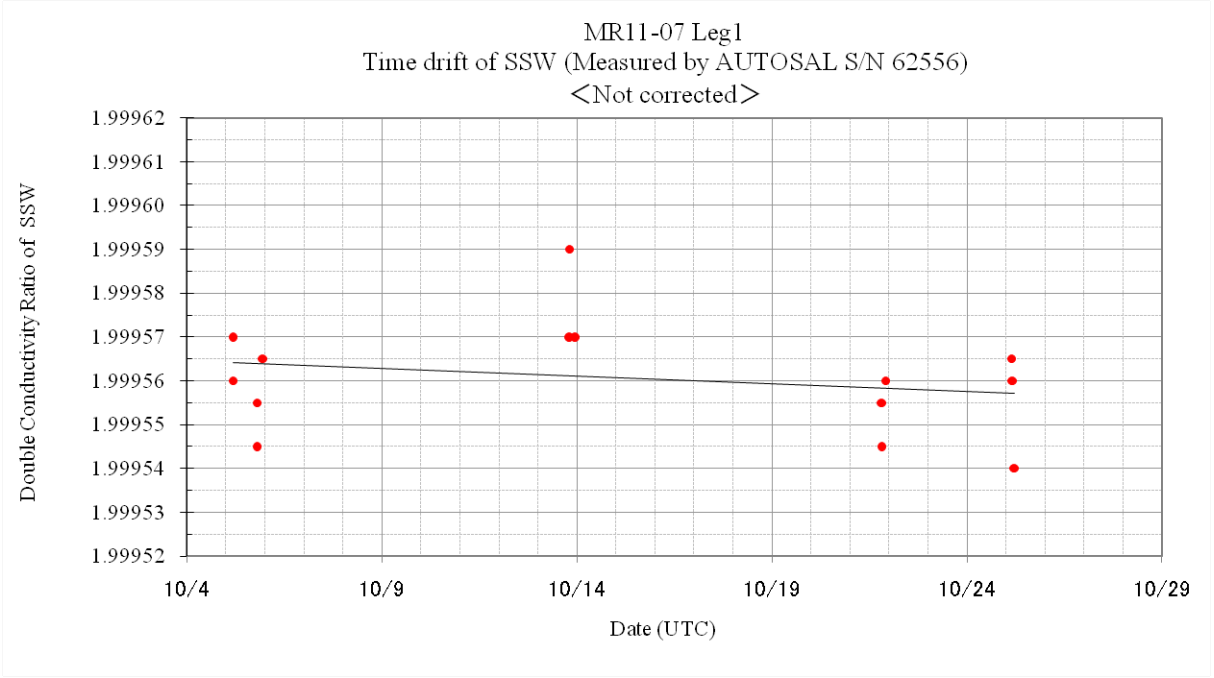

Fig. 5.15-1: History of double conductivity ratio for the Standard Seawater batch P153 (before correction)

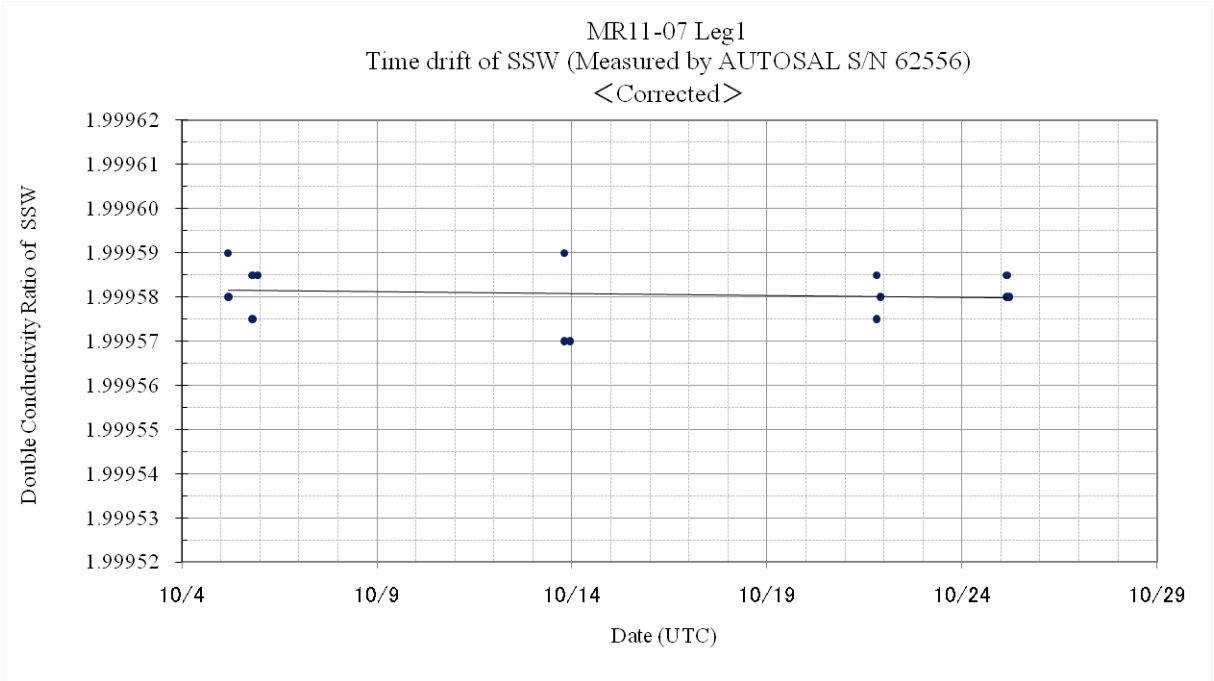

Fig. 5.15-2: History of double conductivity ratio for the Standard Seawater batch P153 (after correction)

b. Sub-Standard Seawater

Sub-standard seawater was made from deep-sea water filtered by a pore size of 0.45 micrometer and stored in a 20 liter container made of polyethylene and stirred for at least 24 hours before measuring. It was measured about every 8 samples in order to check for the possible sudden drifts of the salinometer.

c. Replicate Samples

We estimated the precision of this method using 26 pairs of replicate samples taken from the same Niskin bottle. The average and the standard deviation of absolute difference among 26 pairs of replicate samples were 0.0004 and 0.0002 in salinity, respectively.

(4-2)Results of Leg2

a. Standard Seawater

Standardization control of the salinometer was set to 768 until 11th November. During this period, the value of STANDBY was 24+5581 +/- 0001 and that of ZERO was 0.0±0000. Because of changing the standardization value from its first value, the salinometer standardization control was set again to 785 at 11th November. After the day, the value of STANDBY was 24+5594 +/- 0001 and that of ZERO was 0.0±0000. The conductivity ratio of IAPSO Standard Seawater batch P153 was 0.99979 (double conductivity ratio was 1.99958) and was used as the standard for salinity. 27 bottles of P153 were measured.

Fig.5.15-3 shows the history of the double conductivity ratio of the Standard Seawater batch P153. At first period, the average of the double conductivity ratio was 1.99955 and the standard deviation was 0.00002, which is equivalent to 0.0003 in salinity. At second period, the average of the double conductivity ratio was 1.99958 and the standard deviation was 0.00002, which is equivalent to 0.0003 in salinity.

Fig.5.15-4 shows the history of the double conductivity ratio of the Standard Seawater batch P153 after correction. At first period, the average of the double conductivity ratio after correction was 1.99958 and the standard deviation was 0.00002, which is equivalent to 0.0003 in salinity. At second period, the average of the double conductivity ratio was 1.99958 and the standard deviation was 0.00001, which is equivalent to 0.0003 in salinity.

b. Sub-Standard Seawater

Sub-standard seawater was made from deep-sea water filtered by a pore size of 0.45 micrometer and stored in a 20 liter container made of polyethylene and stirred for at least 24 hours before measuring. It was measured about every 6 samples in order to check for the possible sudden drifts of the salinometer.

c. Replicate Samples

We estimated the precision of this method using 29 pairs of replicate samples taken from the same Niskin bottle. The average and the standard deviation of absolute difference among 29 pairs of replicate samples were 0.0003 and 0.0003 in salinity, respectively.

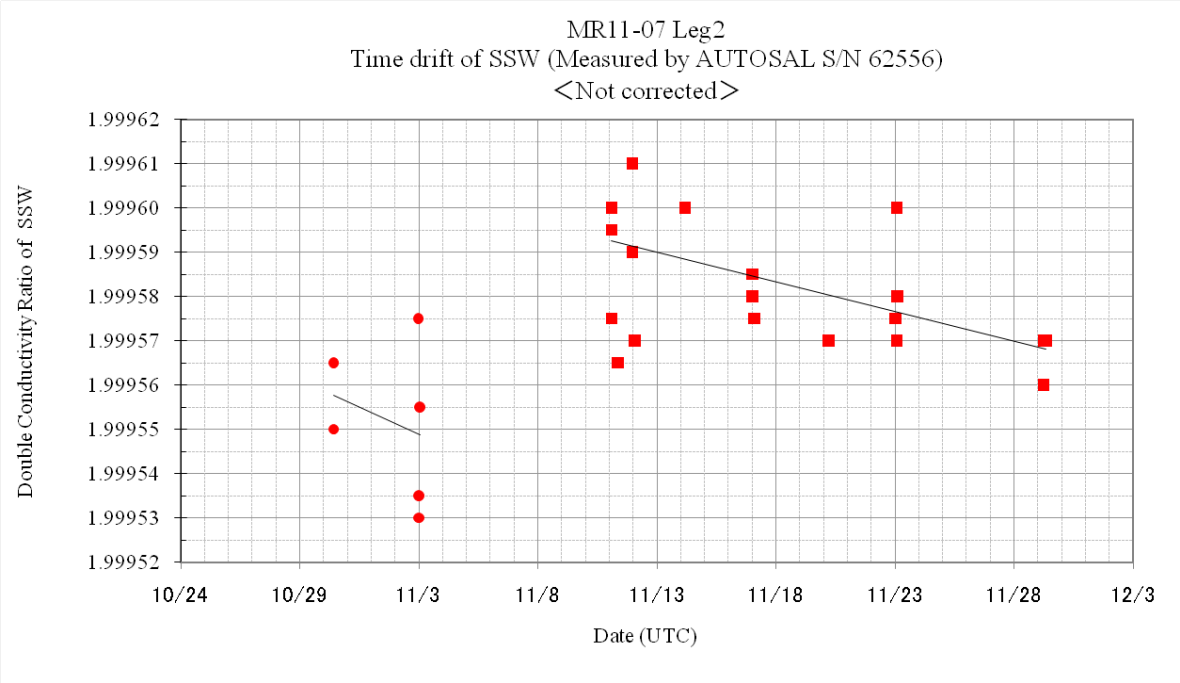

Fig. 5.15-3: History of double conductivity ratio for the Standard Seawater batch P153 (bfore correction).

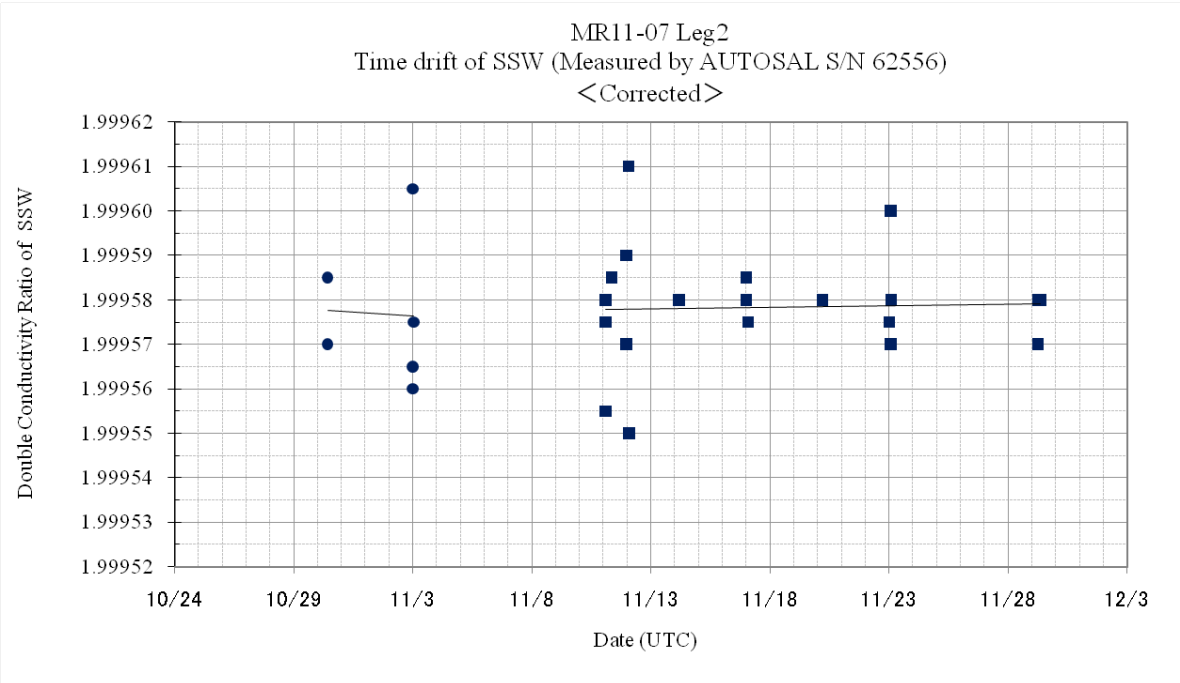

Fig. 5.15-4: History of double conductivity ratio for the Standard Seawater batch P153 (after correction)

(5) Data archive

These raw datasets will be submitted to JAMSTEC Data Management Office (DMO).

(6) Reference

・Aoyama, M., T. Joyce, T. Kawano and Y. Takatsuki : Standard seawater comparison up to P129. Deep-Sea Research, I, Vol. 49, 1103～1114, 2002

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