**N000140410524**
**Profiling Float Observations in the Aegean Sea**

**Cruise II**

# CRUISE REPORT

## 1. Introduction and objectives

The Profiling Float Observations in the Aegean Sea - Cruise II experiment is a joint effort of the **University of Washington, the Hellenic Center for Marine Research and the University of Athens**. The overall objective of this project is to provide a continuous long-term record of temperature and salinity characteristics of the water column in the major deep basins of the Aegean Sea. The results of these measurements can contribute significantly to our understanding of the seasonal and interannual variability of the circulation and water mass characteristics in the region as well as to the connection between the different sub-basins. The project is funded by the **Office of Naval Research** and the **U.S. Office of Naval Research Global**

More specifically, the project is aiming to

- produce an updated climatology of water mass structure in the larger sub-basins of the Aegean Sea

- monitor patterns of the interannual variability in the water mass structure, the circulation and water mass formation of the region

- create a valuable data set for numerical model initialization and assimilation used by the operational near real time models of the region (POSEIDON, ALERMO).


**Figure 1.** The R/V Aegaeo and Float 2041 deployment

In order to achieve these objectives, four (4) profiling floats have been deployed in the Aegean Sea and CTD surveys conducted in the various sub-basins. This report describes the fieldwork carried out during the second cruise (Cruise II) aboard the R/V Aegaeo that took place in February 2006. The shipboard scientific activities consisted of the deployment of the last two (2) profiling floats (prepared by the University of Washington – PI: S. Riser) and a hydrographic survey in the areas of deployment. In order to expand the survey, a series of measurements (in the deep basins and several straits and plateaus) was conducted. Analysis of the experimental data and comparison with previous measurements (CTD surveys and profiling float data) will lead to a better understanding of the water mass characteristics, formation processes, interannual variability of the water column structure as well as the mechanisms of exchange between the various sub-basins.

## 2. Cruise Dates and Personnel

The cruise was carried out aboard the R/V Aegaeo (Figure 2), from February 3 to February 13, 2006. The R/V Aegaeo departed from Piraeus, Greece, on February 3, 2006 and proceeded to the study areas (North Aegean and Cretan Sea). The cruise ended in Piraeus on February 13, 2006.

**TABLE 1. SCIENCE PERSONEL**

| | NAME | INSTITUTE | POSITION |
|---|---|---|---|
| 1 | Alexander Theocharis | Hellenic Center for Marine Research | Researcher (Chief Scientist) |
| 2 | Sarantis Sofianos | University of Athens | Researcher |
| 3 | Eva Krassakopoulou | Hellenic Center for Marine Research | Researcher |
| 4 | Panagiotis Renieris | Hellenic Center for Marine Research | Technician |
| 5 | Athanasios Morphis | Hellenic Center for Marine Research | Technician |
| 6 | Vassilis Vervatis | University of Athens | PhD Student |

## 3. Scientific Activities

### 3.1. CTD Stations

A total of 47 hydrographic (CTD) stations were occupied on the cruise. The location of the CTD stations was selected in the areas of the profiling float deployment to capture the three-dimensional structure and circulation pattern of the specific regions. Twenty eights (28) stations were occupied in various locations around the Aegean Sea basin in order to investigate exchange of water masses between the Aegean Sea sub-basins. The stations were selected in almost all deep sub-basins of the Aegean Sea, in

several straits and plateaus. Another criterion for the selection was the availability of measurements during Cruise I and from the Aegean Sea profiling float data. Table 2 contains station times, locations and depths, and the stations locations are plotted in Figure 2. At each station, profiles of temperature, salinity (conductivity), and dissolved oxygen concentration were collected using a Sea-Bird CTD system. Water samples for the calibration of the oxygen concentration and salinity were collected at six stations.

**TABLE 2. CTD STATIONS**

| | Latitude | Longitude | DATE YY | MM | DD | TIME | Max Depth | Calibration |
|---|---|---|---|---|---|---|---|---|
| 1 | 37 30.962 | 25 28.091 | 06 | 02 | 03 | 20:10 | 308 | |
| 2 | 37 57.166 | 24 36.810 | 06 | 02 | 04 | 01:10 | 246 | |
| 3 | 38 41.999 | 24 41.978 | 06 | 02 | 04 | 05:10 | 1035 | |
| 4 | 39 05.955 | 24 42.994 | 06 | 02 | 04 | 07:50 | 820 | |
| 5 | 39 45.748 | 24 11.571 | 06 | 02 | 04 | 12:20 | 994 | Sal |
| 6 | 39 57.887 | 24 18.735 | 06 | 02 | 04 | 16:00 | 1190 | |
| 7 | 40 05.968 | 25 15.956 | 06 | 02 | 04 | 23:25 | 240 | |
| 8 | 40 13.855 | 25 16.150 | 06 | 02 | 05 | 00:20 | 1545 | |
| 9 | 40 17.761 | 25 16.128 | 06 | 02 | 05 | 01:40 | 725 | |
| 10 | 40 24.698 | 25 16.034 | 06 | 02 | 05 | 02:50 | 108 | |
| 11 | 40 32.703 | 25 05.073 | 06 | 02 | 05 | 04:05 | 167 | |
| 12 | 39 46.751 | 25 38.490 | 06 | 02 | 08 | 14:40 | 90 | |
| 13 | 39 34.130 | 25 43.170 | 06 | 02 | 08 | 16:00 | 123 | |
| 14 | 39 14.103 | 25 40.006 | 06 | 02 | 08 | 17:55 | 325 | |
| 15 | 39 09.068 | 25 48.052 | 06 | 02 | 08 | 19:55 | 130 | |
| 16 | 38 51.420 | 25 34.186 | 06 | 02 | 08 | 21:55 | 278 | |
| 17 | 38 39.018 | 25 24.880 | 06 | 02 | 08 | 23:30 | 430 | |
| 18 | 38 25.027 | 25 09.641 | 06 | 02 | 09 | 01:30 | 580 | |
| 19 | 38 24.790 | 25 18.661 | 06 | 02 | 09 | 02:35 | 470 | |
| 20 | 38 24.844 | 25 28.644 | 06 | 02 | 09 | 03:43 | 965 | |
| 21 | 38 24.991 | 25 38.943 | 06 | 02 | 09 | 05:20 | 867 | |
| 22 | 38 09.907 | 25 39.393 | 06 | 02 | 09 | 07:10 | 458 | |
| 23 | 38 09.919 | 25 29.108 | 06 | 02 | 09 | 08:10 | 560 | |
| 24 | 38 09.957 | 25 21.951 | 06 | 02 | 09 | 09:05 | 535 | $O_2$, Sal |
| 25 | 38 09.816 | 25 11.161 | 06 | 02 | 09 | 10:15 | 595 | |
| 26 | 37 54.920 | 25 09.071 | 06 | 02 | 09 | 12:05 | 450 | |
| 27 | 37 55.013 | 25 28.964 | 06 | 02 | 09 | 14:05 | 830 | $O_2$,Sal |
| 28 | 37 43.258 | 26 07.699 | 06 | 02 | 09 | 20:15 | 1190 | Sal,$O_2$ |
| 29 | 37 34.697 | 25 47.492 | 06 | 02 | 09 | 22:55 | 540 | |
| 30 | 36 47.303 | 25 24.085 | 06 | 02 | 11 | 06:35 | 93 | |
| 31 | 36 15.077 | 25 29.964 | 06 | 02 | 11 | 10:40 | 295 | |
| 32 | 36 05.104 | 25 15.009 | 06 | 02 | 11 | 12:20 | 1810 | Sal |
| 33 | 36 04.951 | 25 04.491 | 06 | 02 | 11 | 14:25 | 1565 | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 34 | 35 55.043 | 25 04.992 | 06 | 02 | 11 | 16:15 | 1855 | |
| 35 | 35 45.045 | 25 05.043 | 06 | 02 | 11 | 18:30 | 1508 | |
| 36 | 35 45.019 | 25 14.735 | 06 | 02 | 11 | 20:10 | 1535 | |
| 37 | 35 54.699 | 25 14.808 | 06 | 02 | 11 | 22:00 | 1585 | |
| 38 | 35 44.841 | 25 24.775 | 06 | 02 | 12 | 00:10 | 1405 | |
| 39 | 35 40.527 | 26 06.265 | 06 | 02 | 12 | 03:55 | 2315 | |
| 40 | 35 37.007 | 25 38.961 | 06 | 02 | 12 | 09:25 | 390 | |
| 41 | 35 55.057 | 25 25.085 | 06 | 02 | 12 | 11:30 | 1765 | |
| 42 | 36 05.246 | 25 25.279 | 06 | 02 | 12 | 13:35 | 1345 | $O_2$,Sal |
| 43 | 36 18.437 | 25 18.454 | 06 | 02 | 12 | 19:25 | 545 | |
| 44 | 36 20.411 | 25 00.375 | 06 | 02 | 12 | 21:10 | 530 | |
| 45 | 36 18.838 | 24 12.116 | 06 | 02 | 13 | 01:10 | 980 | |
| 46 | 36 51.935 | 24 01.991 | 06 | 02 | 13 | 05:05 | 1040 | |
| 47 | 37 08.010 | 23 53.945 | 06 | 02 | 13 | 07:20 | 910 | |

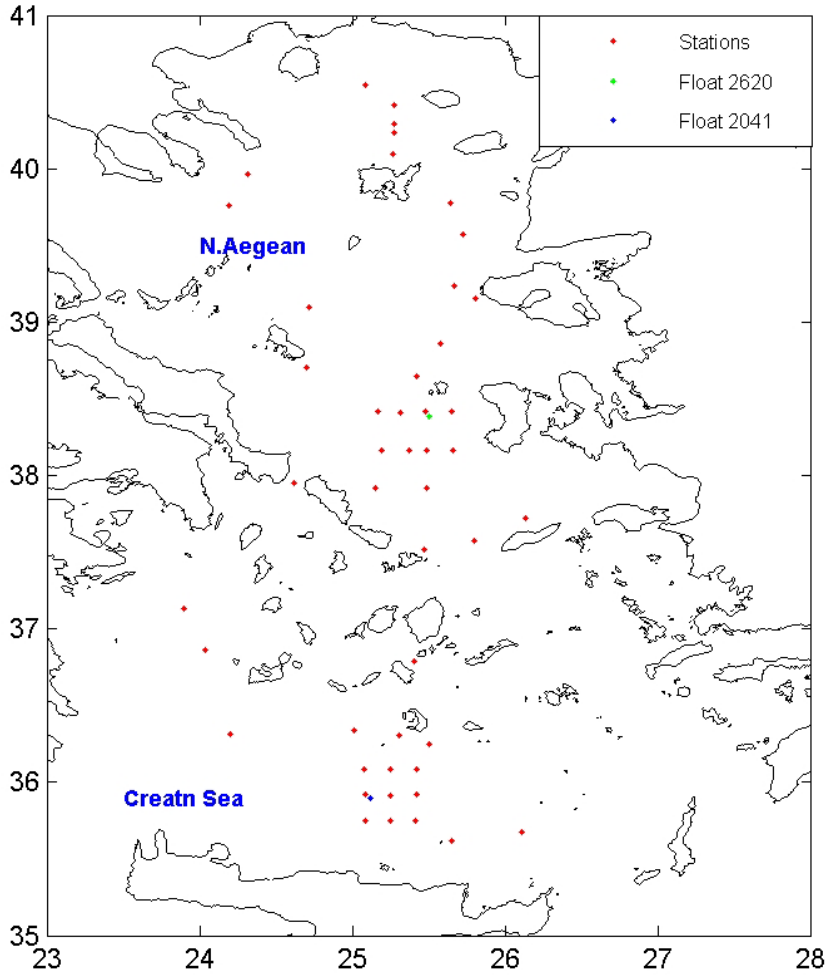


**Figure 2.** Locations of the CTD stations (red dot) and the profiling floats deployment (Chios basin: green dot; Central Cretan Sea: blue dot).

### 3.2. Profiling floats

The last two profiling floats received by University of Washington were deployed during the cruise at two deep sub-basins of the Aegean Sea (Table 3), namely Chios basin and central Cretan Sea. These floats are APEX-style profiling floats with Sea-Bird CTD sensors, constructed at the University of Washington in Seattle from components purchased from Webb Research Corporation. The parking depths were selected at intermediate depths (400 m) to decrease malfunction possibilities (observed in the first two profiling floats) and the profile depth at 1000m in order to measure the biggest part of the water column. Density transects from CTD stations closest to the deployment site are presented in Figures 3 and 4.

| TABLE 3. Profiling Float Deployment | | | | | |
|---|---|---|---|---|---|
| **ARGOS No.** | **Reset Time (UTC)** | **Date** | **Deployment Time (Local)** | **Latitude** | **Longitude** |
| 2620 | 02:15 | 09/02/2006 | 02:30 | 38° 24’ | 25° 28.827’ |
| 2041 | 14:32 | 11/02/2006 | 14:55 | 35° 54.954’ | 25° 05.695’ |

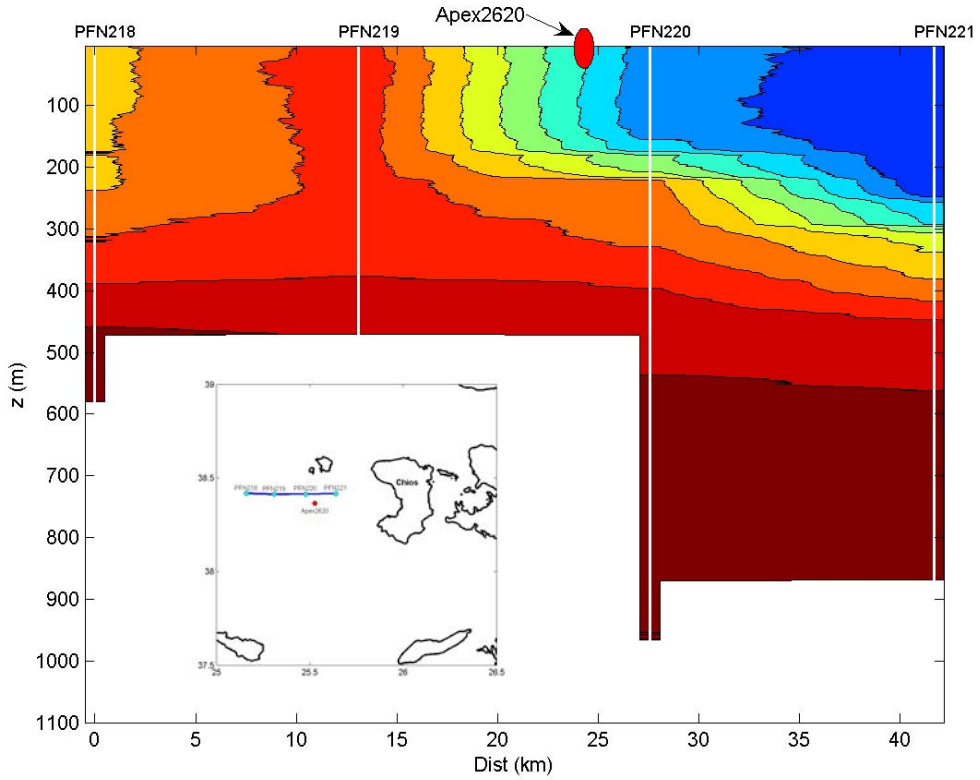


**Figure 3.** Sigma-theta transect from CTD station closest to the deployment site in the Chios basin (North Aegean).

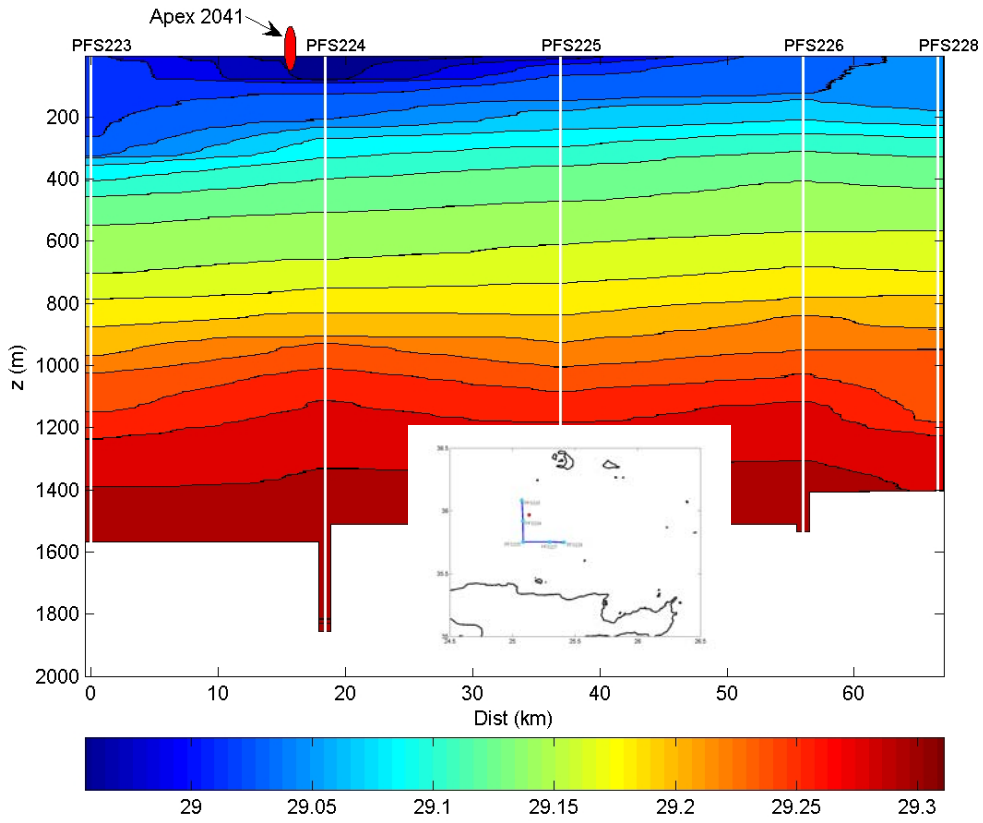


**Figure 4.** Sigma-theta transect from CTD station closest to the deployment site in the central Cretan Sea (Southern Aegean).

The two profiling floats were deployed successfully and results (for all Aegean Sea profiling floats observations) can be viewed at the website: http://runt.ocean.washington.edu/uoa

## 4. Preliminary findings and future work

The hydrographic measurements will be processed and used together with the profiling float measurements to investigate the water column stratification of the region. They will be compared with results from Cruise I in order to establish patterns of interannual variability. They are also used as part of a PhD thesis in the University of Athens in relation to comparative modeling experiments. Figure 5 presents a summary of the temperature/salinity characteristics measured during the hydrographic survey. The ranges of temperature and salinity characteristics are very large. At the surface layers this can be attributed to the presence of the Black Sea Water in the northern basin (inflowing to the Aegean from the Dardanelles strait with very low temperature and salinity), while in the Cretan Sea surface waters are influenced by the warmer and more saline waters of Levantine origin. Remarkable differences occur also in the intermediate and deep layers, even at sub-basins located very close to each other. It becomes evident that the basin scale circulation interacts with the sub-basin scale and mesoscale dynamics (largely influenced by the complex topography of the region) creating a complex circulation and stratification pattern. The results from the cruises and float observations are compared with operational model results, for

validation purposes and in order to identify patterns and mechanisms of the regional dynamics.

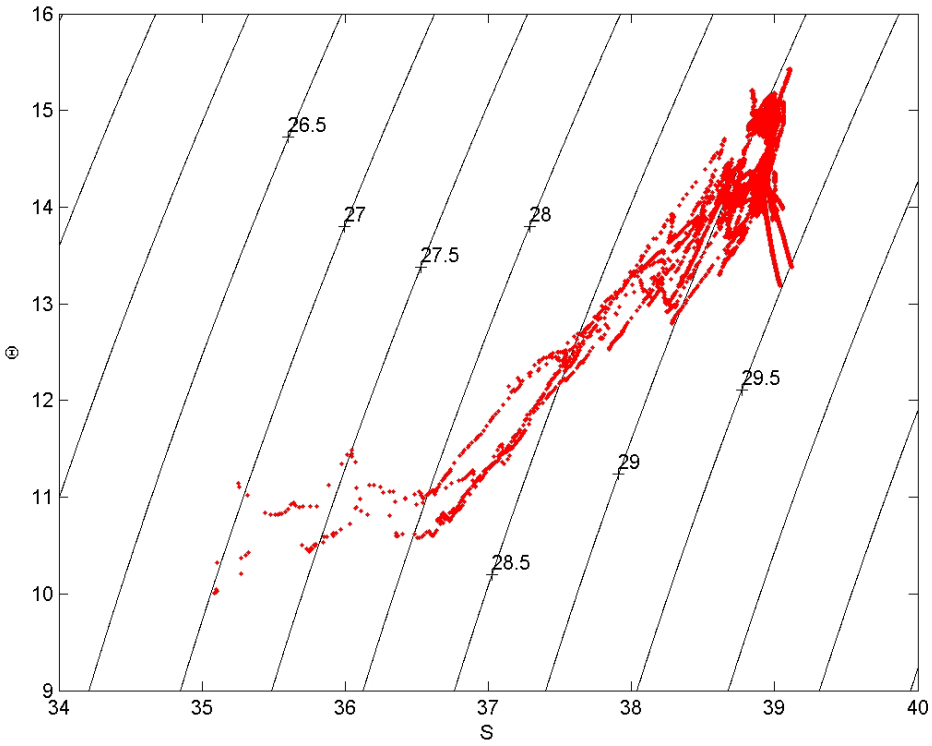


**Figure 5.** Temperature/salinity characteristics from the CTD stations occupied during CRUISE II

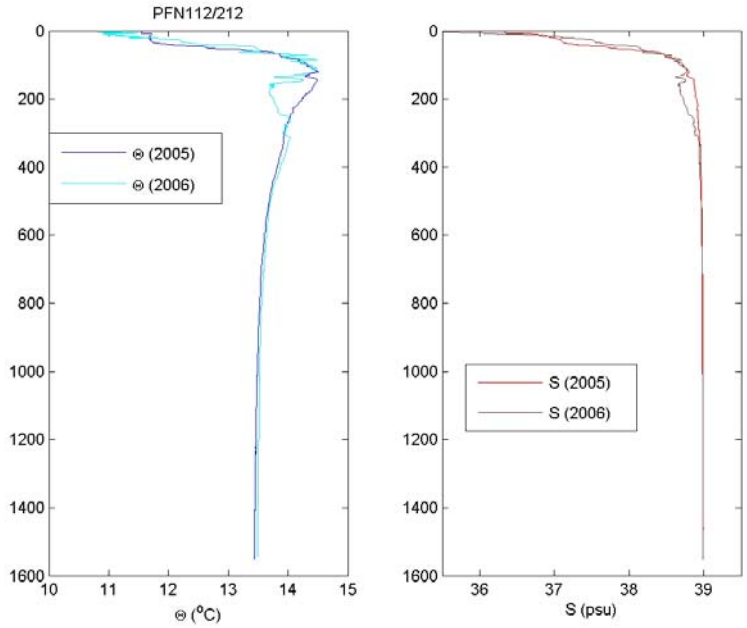


**Figure 6.** CTD profiles at the deepest location of Limnos basin (North Aegean) acquired during CRUISE I (March 2005) and Cruise II (February 2006).

Another noteworthy result is the very large variability observed during the two cruises (CRUISE I and II), that took place almost the same time of the year. Figures 6 and 7 present temperature and salinity profiles from the CTD stations occupied at the deepest points of the north and south Aegean Sea during both cruises (the location of the first two profiling float deployments). The stratification and water mass characteristics present large differences, associated with water mass formation and changes in the circulation patterns and exchanges between various sub-basins.

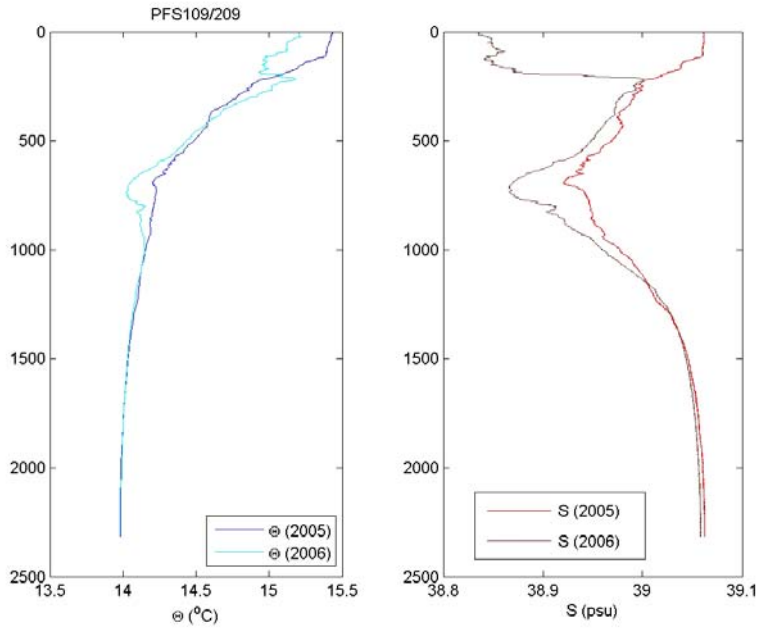


**Figure 7.** Comparison of CTD profiles at the deepest location of Cretan Sea (South Aegean) acquired during CRUISE I (March 2005) and Cruise II (February 2006).