

August 27, 2002

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CRUISE REPORT

VESSEL: *Townsend Cromwell*, Cruise 02-05 (TC-279)

CRUISE PERIOD: 11-30 July 2002

AREA OF OPERATION: Waters south of the Hawaiian Archipelago along a sampling line between 21°N and 7°N latitudes (Fig. 1).

ITINERARY:

- 11 July - Departed Snug Harbor, Honolulu, at 1000. On board were Christina DeSiato, Robert Marshall, Anita L. Sederstrom, Michael P. Seki, Erica Tavangari, and Scott Wiesnner. At 1530, arrived at first station of the NE-SW sampling transect located at lat. 21°00.0'N, long. 158°31.8'W; commenced oceanographic and fishing operations.
- 11-26 July - Continued oceanographic and fishing operations along the scheduled NE-SW transect at stations positioned approximately 30 nmi apart to the southernmost station at lat. 7°00.0'N, long. 163°00.6'W.
- 26 July - Completed last scheduled fishing operation (makeup station for operations lost on southward transit due to adverse weather and sea conditions) at lat. 13°00.0'N, long. 161°45.6'W. Proceeded to waters in the lee of Kauai to conduct temperature-depth-recorders (TDR) calibration casts.
- 29 July - Arrived at lat. 21° 57.3'N, long. 159° 54.2'W and conducted series of 300-m (conductivity-temperature-depth) CTD-TDR calibration casts. Proceeded to Snug Harbor.
- 30 July - Arrived at Snug Harbor. Disembarked DeSiato, Marshall, Sederstrom, Seki, Tavangari, and Wiesnner. End of cruise.

MISSIONS AND RESULTS:

- A. Describe the physical oceanographic environment traversed by the survey through regularly spaced CTD casts and continuous acoustic Doppler current profiler (ADCP) and thermosalinograph (TSG) measurements.

A total of twenty-nine 1,000-m CTD casts were conducted with a SBE 9/11+ CTD system about 30 nmi apart along a NE-SW transect that followed a path similarly occupied by the TOPEX/POSEIDON satellite overpass (Fig. 1). Vertical sections (Fig. 2) and temperature-salinity (TS) diagrams (Fig. 3) from the straight line survey (lat. 21°00.0'N, long. 158°31.8'W to lat. 7°00.0'N, long. 163°00.6'W) reveal three markedly distinct water masses encountered along the transect. In the subtropics north of 12°N latitude, waters were highly stratified and had a clearly defined shallow subsurface salinity maximum and a deeper salinity minimum. Upon crossing the 12°N latitude, a sharp change in hydrography was observed. In this region, an 80-m surface mixed layer overlaid a steep thermocline ($\Delta T \approx 14^\circ\text{C}$) to about 150 m. Coincident with the thermocline was an equally pronounced oxycline, where dissolved oxygen concentrations below the base of the gradient (i.e., below ~150 m) measured $<1.0 \text{ ml L}^{-1}$ (with a CTD-mounted Beckman polarographic oxygen sensor); concentrations were considerably lower than adjacent waters to the north or to the south. Farther to the south around 10°N latitude and the Intertropical Convergence Zone (ITCZ), surface salinities were much lower, but at depths below the thermocline, they were similar to the adjacent waters to the north. These data together with continuous observations obtained from the ship-mounted ADCP suggest the encountering effects and influence of the North Equatorial Current (NEC) at about latitude 12°N.

- B. Assess the influence of the physical dynamics on biological productivity by collecting CTD-mounted fluorometer measurements and discrete depth water samples with Niskin bottles for extracted chlorophyll and accessory pigment determinations.

Total chloropigment was estimated in situ with a Seapoint CTD-mounted fluorometer at all 29 CTD stations. In addition, water samples from discrete depths were collected for determination of extracted chlorophyll and accessory pigments (high performance liquid chromatography (HPLC)). For discrete depth-extracted phytoplankton analyses, seawater was acquired from depths of 200 m, 150 m, 125 m, 100 m, 80 m, 65 m, 50 m, 35 m, 20 m, and at the surface. Water samples of volumes 1-L for extracted chlorophyll via fluorescence and 2-L for HPLC were vacuum filtered through 47 mm diameter, 0.7 μm Gelman TCLP glass fiber filters. Measurements of fluorescence (using acidification techniques) to yield total chlorophyll, chl-*a*, and phaeophytin concentrations were made at sea on a Turner Designs model 10-AU fluorometer after 24-h extraction in acetone. Filters containing pigments for HPLC were frozen in liquid nitrogen and returned to the University of Hawaii for analysis. Light (photosynthetically available radiation (PAR)) through the water column was measured with a CTD-mounted Biospherical Instruments QSP-2300 scalar irradiance sensor. The profiled Seapoint chloropigment was adjusted to

concurrently collected discrete depth-extracted total chlorophyll determinations with a least squares linear regression as follows:

$$\text{TChl}_{\text{corr}} = 2.05(\text{TChl}_{\text{in situ}}) + 0.0315 \quad (n = 264, r^2 = 0.81).$$

Typical of waters in the subtropical gyre, very low chlorophyll concentrations were observed in the upper water column, and the subsurface chlorophyll maximum (Chl_{max}), deeply positioned at about 125 m deep, was about $0.3 \text{ mg}\cdot\text{m}^{-3}$. A twofold increase in concentration and considerable shoaling of the Chl_{max} were observed in waters at the southern part of the survey track (south of the NEC).

- C. Collect zooplankton samples for evaluation of the faunal composition associated with the sonic scattering layer (SSL) in support of ongoing sea turtle pelagic habitat studies.

Seventy-seven Issacs-Kidd Midwater trawl (IKMT) micronekton tows at seven stations approximately 120 nmi apart were made to examine possible forage habitat of olive ridley sea turtles (*Lepidochelys olivacea*). The sampling protocol called for a series of day and night tows targeting 40 m and 100 m deep for gelatinous zooplankton. Real-time monitoring of actual net towing depth was accomplished by rigging the trawl with a Seabird SBE-39 temperature-pressure sensor and a serial data feed through the electromechanical conducting cable. The net was also equipped with a General Oceanics flowmeter to help monitor the amount of water filtered and a Lotek temperature-depth-recorder (TDR) as a backup record of actual depths fished. Sample depths were determined a posteriori as those frequented by olive ridleys from information obtained earlier from turtles instrumented with pop off satellite archival tags (PSATs); ongoing studies have identified gelatinous zooplankton as key components in the olive ridley diets. All samples were fixed in a 10% formalin-sea mixture and returned to the Honolulu Laboratory for later analysis.

**SCIENTIFIC
PERSONNEL:**

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Attachments

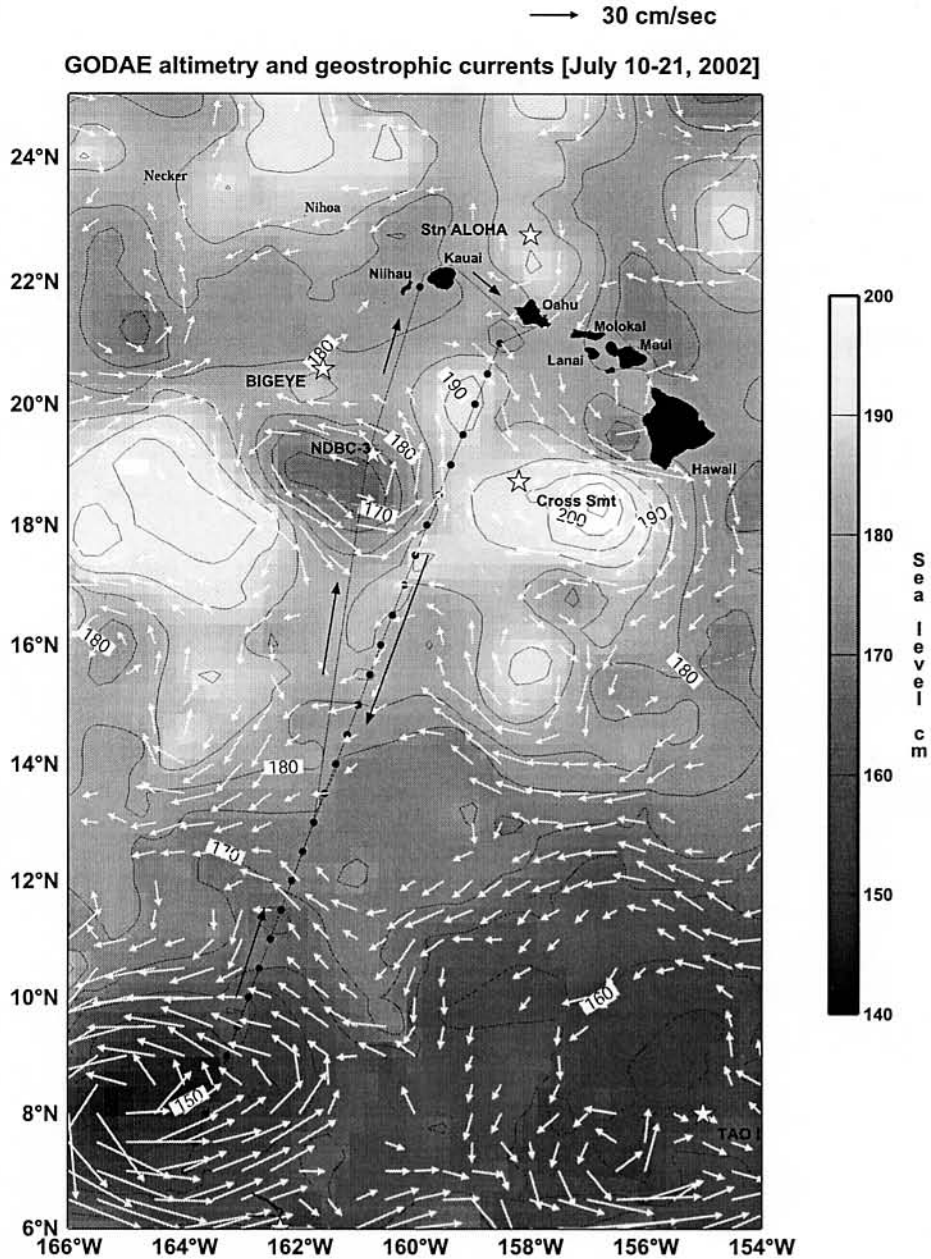


Figure 1. Trackline of the *Townsend Cromwell* cruise 02-05, 11-30 July 2002 and concurrent sea level height (with the Levitus long term mean dynamic height at 1000 m added) from the altimeter aboard TOPEX/POSEIDON, 10-21 July 2002. Greyscale shading and 5 cm contours represent altimetry gridded at 0.1° resolution and a smoothing radius of 6.5° . Corresponding geostrophic current velocities (vectors) are presented for 0.5° spatial resolution; only velocities >10 cm s $^{-1}$ are shown. Black dots represent station locations.

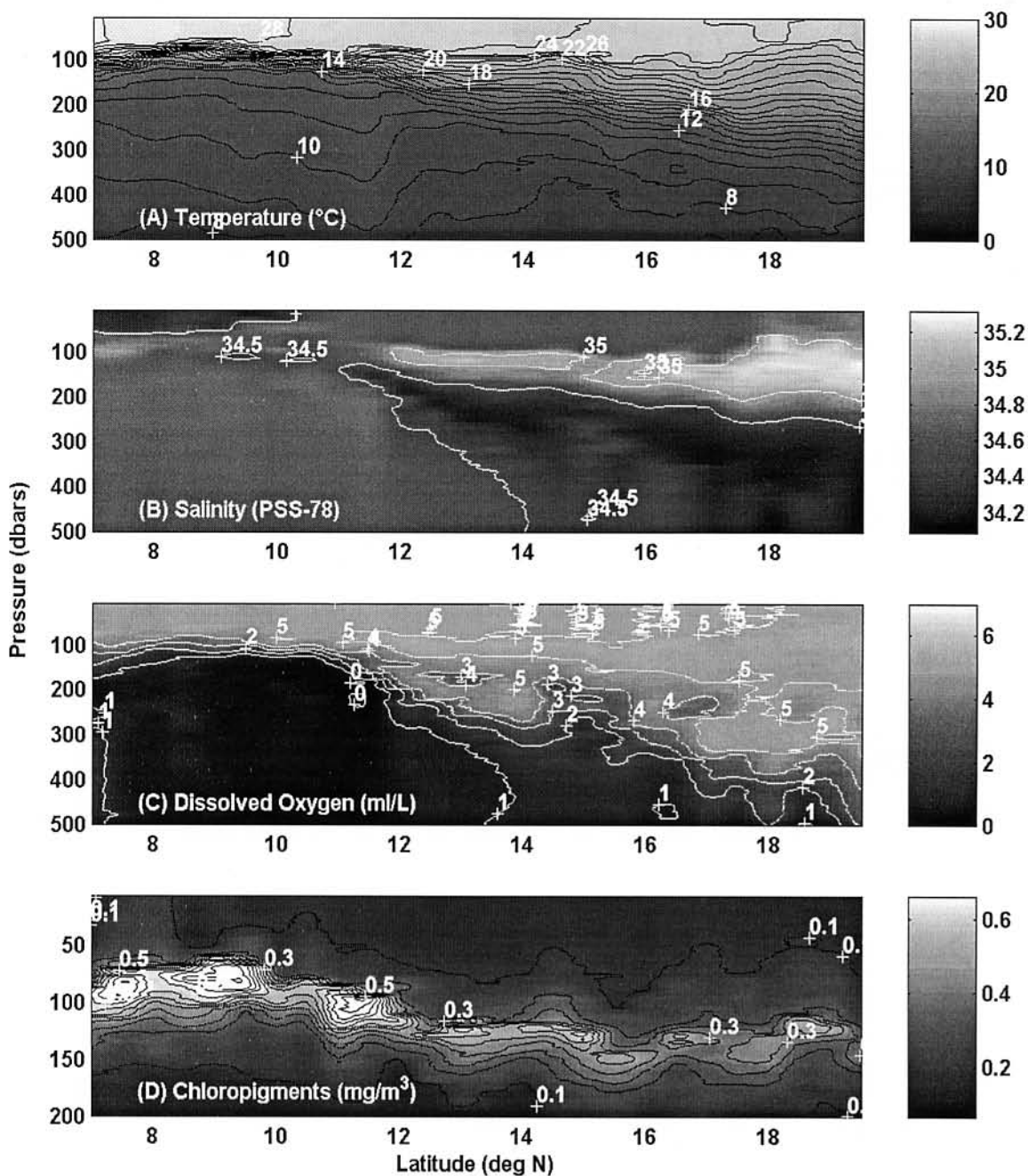


Figure 2. Vertical section of (A) temperature ($^{\circ}\text{C}$), (B) salinity, (C) dissolved oxygen ($\text{ml}\cdot\text{L}^{-1}$), and (D) chlorophylls ($\text{mg}\cdot\text{m}^{-3}$) along TC 02-05 survey line – lat. $21^{\circ}00.0'\text{N}$, long. $158^{\circ}31.8'\text{W}$ to lat. $7^{\circ}00.0'\text{N}$, long. $163^{\circ}00.6'\text{W}$, 11-24 July 2002.

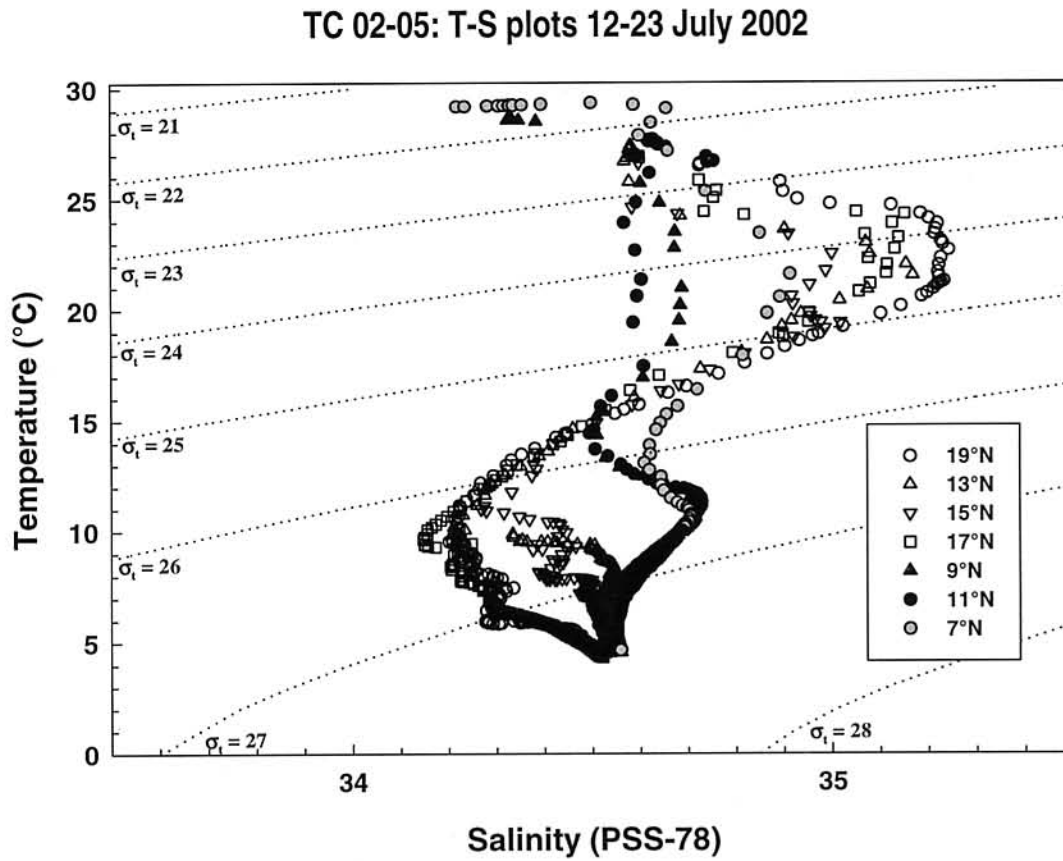


Figure 3. Temperature-salinity (T-S) diagrams for 5-m bin averaged, 1000 m CTD casts conducted on TC 02-05, 12-23 July 2002. Only casts at stations located at odd number whole latitudes (i.e., 120 nmi apart) are presented.