Observations of the Pacific North Equatorial Current Bifurcation at the Philippine Coast

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Hydrographic surveys were conducted off the Philippine coast in September 1987 and April 1988 as part of the United States/People's Republic of China cooperative research program. These cruises sampled the western Pacific Ocean where the North Equatorial Current (NEC) meets the western boundary and divides into the Kuroshio and Mindanao Currents. The requirement for mass conservation within a region enclosed by stations is utilized here to obtain absolute circulation fields for the two surveys. In both realizations, the surface flow of the NEC was observed to bifurcate near latitude 13°N; NEC flow poleward of this latitude turned north as the Kuroshio while flow to the south fed the Mindanao Current. Most striking was a twofold increase in the strength of the current system in spring 1988 as compared with fall 1987. The potential vorticity (Q) distributions of the surface waters were examined to explore the dynamics of the bifurcation. Within the NEC, Q was nearly constant (layer thickness change balanced meridional planetary vorticity variation.) Within the Kuroshio and Mindanao currents, near constant Q (with magnitude comparable to that in the NEC) was also found with a balance between relative vorticity variation and layer depth change as would be expected for inertial boundary currents.

Table 1. Mass transport observed on US/PRC Cruises 3 and 4 as determined by the inverse models. Units: 10^9 kg.s^{-1}

	Kuroshio	NEC	Mindanao
Cruise 3 Layer 1	12.3	32.5	14.0
Cruise 4 Layer 1	30.6	61.2	30.5
Toole et al. (1988)	15.7 (25)	43.6	17.9 (13)
Cruise 3 Total mass	21.4	13.7	-8.0
Cruise 4 Total mass	50.7	78.4	27.7

Note : Layer 1 was defined as all water above σ_θ = 26.25. Toole et al. (1988) estimated transport above the 12°C potential temperature surface relative to 1000 db. In the Philippine Basin, the σ_θ = 26.25 kg.m^{-3} and the θ = 12°C surfaces are within 20 m. Shown in parenthesis are their Kuroshio and Mindanao transports based on a 12°N NEC bifurcation.

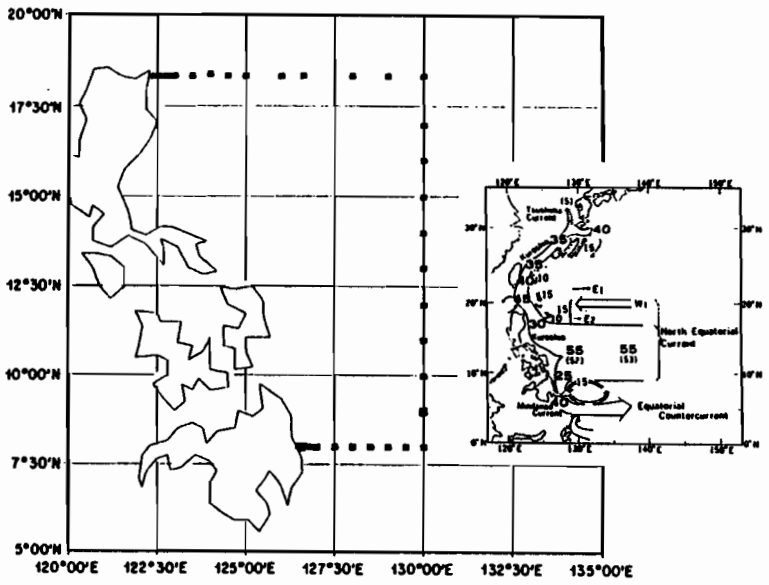

FIG.1. Station map for CTD/O_2 casts obtained by the US/PRC cooperative program in the Philippine Basin. The insert depicts a schematic of the upper ocean flow field in this region after Nitani (1972).

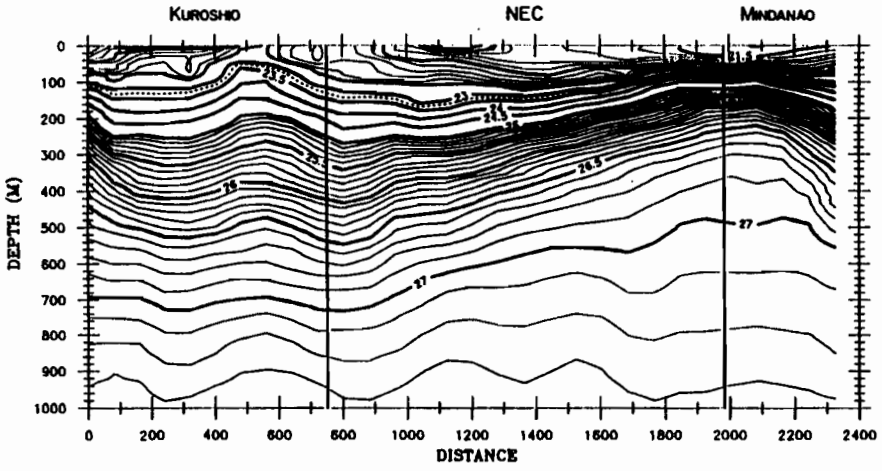

FIG.2. Section of potential density across the Kuroshio, NEC and Mindanao Currents obtained in spring 1988. The section runs clockwise around the stations shown in Fig.1. The distance axis begins at the coastal station on the 18°20'N section. The locations of the northeast and southeast corners of the station grid are marked.

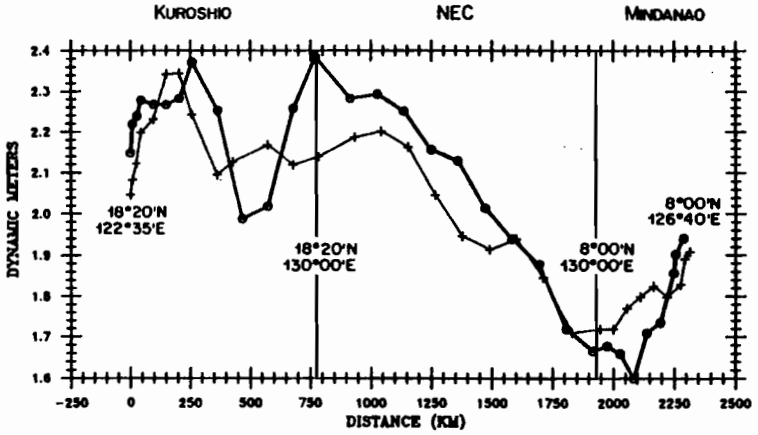

FIG.3. Dynamic height (0/1000db) observed on US/PRC Cruise 3 (thin line) and Cruise 4 (thick line). The plot runs clockwise around the grid of stations in figure 1 as discussed in the figure 2 caption.

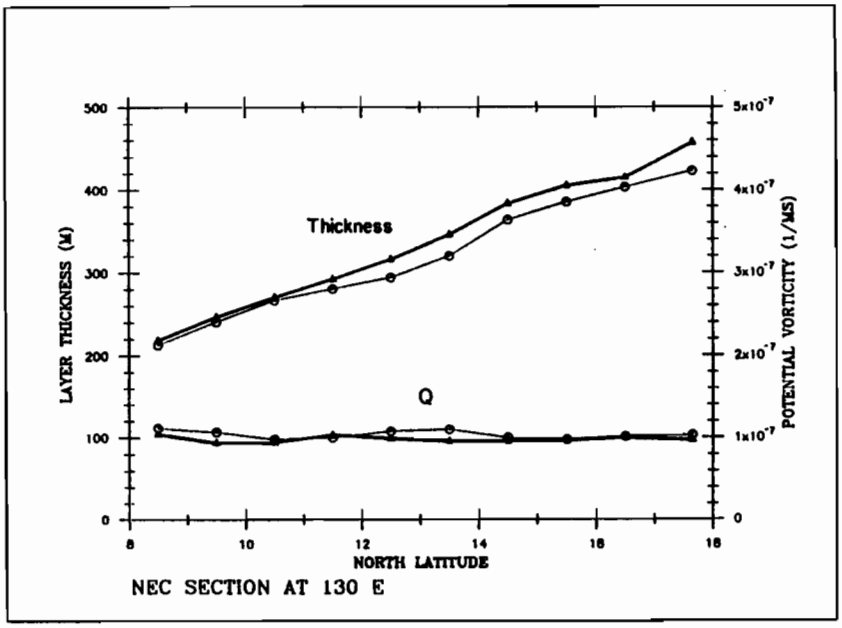

FIG.4. The latitudinal variation of layer 1 thickness and potential vorticity along the 130°E sections. The thin line is for the Cruise 3 data and the thick line is for Cruise 4.

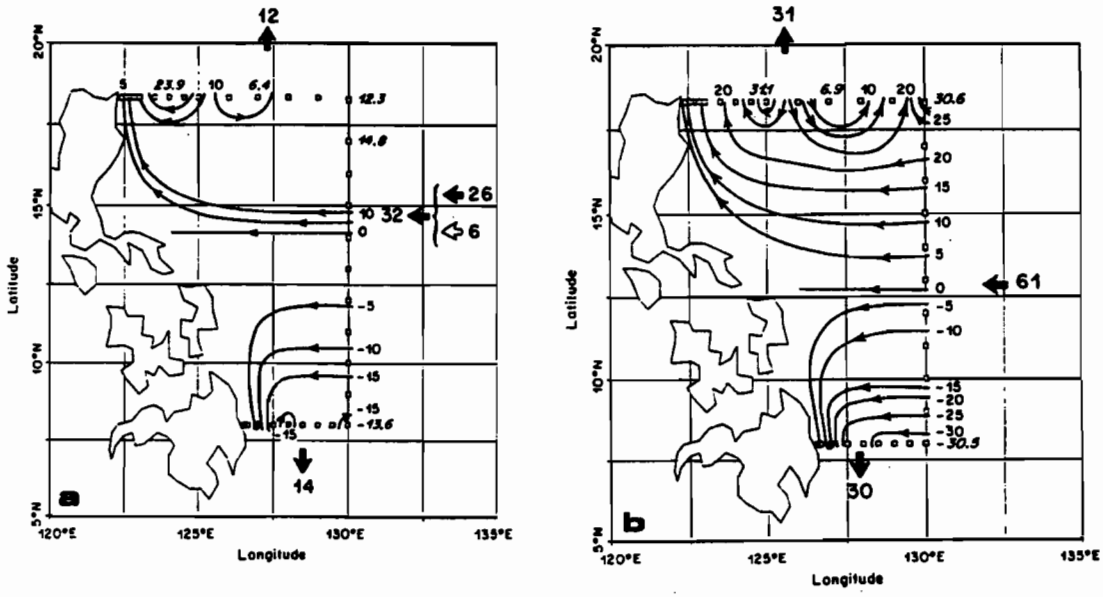

FIG.5. Maps of layer 1 mass transport streamfunction for Cruise 3 (panel a) and Cruise 4 (panel b). Between each contour is a transport of $5*10^9$ kg.s^{-1}. Solid arrows mark the section net transports. In panel a, the open arrow represents the convergent part of the layer 1 flow.

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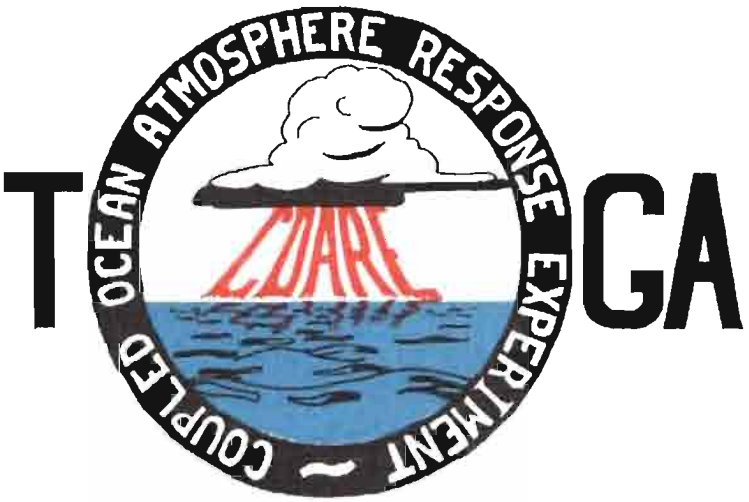

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