Zonal Slope of the 20°C Isotherm in the South Pacific During 1982-83

In a previous paper we described an eastward progression of the equatorial thermocline deepening during three El Niño Southern Oscillation (ENSO) events (Donguy *et al.*, 1984). The 1982-83 event was particularly well documented due to the France-U.S. XBT ship-of-opportunity program and supplementary observations by Toole (1983), Leetmaa *et al.* (1983), Eriksen (personal communication of data from R/V *Melville*), and the French Navy (personal communication). This article describes the latitudinal limits of the 1982-83 thermocline depth anomaly and the relation of the wind field to the thermocline topography.

The zonal-temporal variability of the 20°C isotherm depth near 6°S (Figure 1) shows an eastward progression of deepening during late 1982 and early 1983, similar in phase to the 2°N-2°S equatorial pattern described by Donguy *et al.* (1984, Figure 2A).

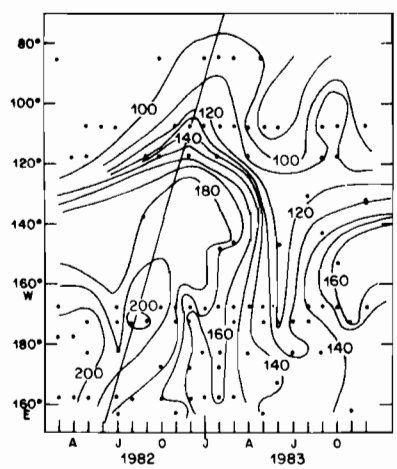

FIGURE 1 (*Donguy et al.*)
Depth (m) of the 20°C isotherm from 4 to 6°S.

Observations at other latitudes (Meyers *et al.*, 1983, Figure 14) indicate that the thermocline depression was confined to the 5°N-10°S region. We note that the anomaly, which is well known at the equator, extends relatively far into the South Pacific. It is first seen in the western Pacific near 170°W during August-September 1982 (Figure 1) and then six months later in the east near 90°W.

Rasmusson *et al.* (1983) noted that the wind anomaly along the equator progressed eastward during the 1982-83 event. According to analyses of the 850 mb wind field throughout the tropics by Arkin *et al.* (1983), the eastward progression of wind anomalies is not exactly symmetric about the equator. During the early phase of the 1982-83 episode (September, October, November), the wind anomaly is mostly in the northwestern Pacific. During the mature phase (December to February), it is located in the central Pacific south of the equator. Later (March, April, May), it is located primarily in the southeastern Pacific. Consequently, progression of the wind anomaly is southeastward rather than eastward. The large wind anomalies in the Southern Hemisphere during the mature and later stages of the episode suggest that eastward progression of thermocline deepening near 6°S was directly forced by the wind.

After May 1983 the usual zonal slope of the thermocline near 6°S (Figure 1) was anomalously flat. The 20°C isotherm depth is 90 m east of 100°W and is remarkably shallow (120 m) at the dateline. The flat thermocline topography is confirmed by a zonal temperature section made near 8°S by the French Naval Vessel *Dumont D'Urville* during a cruise from Callao, Peru to the Marquesas Islands (Figure 2A); the 20°C isotherm depth is approximately 120 m from 80 to 120°W. In contrast, measurements recorded by the French Navy during the same season in 1979, but closer to 14°S, show the usual slope of the thermocline (Figure 2B).

Relaxation of the zonal slope of the thermocline between the equator and 10°S, as seen in Figures 1 and 2A, seems to be directly forced by the southeastward progression of westerly wind anomalies. Leetmaa *et al.* (1983) suggested that the widespread deepening of the thermocline at 85°W is consistent with models in which initial patterns of thermocline deepening are broadened by reflected Rossby waves. We believe that the widespread anomalies are due mostly to the direct effect of

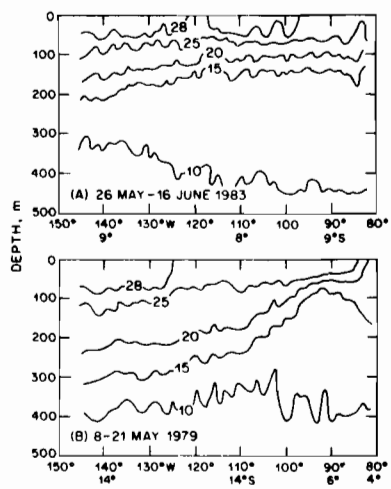

FIGURE 2 (*Donguy et al.*)
Zonal temperature sections made by the French Navy in (A) 26 May-16 June 1983 and (B) 8-21 May 1979.

the wind because we do not find clear indications of westward propagation at 6°S. Comparison of Figures 2A and 2B suggests that the vertical temperature gradient decreased in the 10 to 15°C water and increased in the 20 to 25°C water during 1982-83. This is consistent with Leetmaa *et al.*'s (1983) conclusion that the thermocline variability near 5°S involves more than a single, gravest vertical mode. It is worth noting that the increase in volume of the 10 to 15°C water at 8°S (Figure 2A) combined with Leetmaa *et al.*'s (1983) observation of a decrease in volume of this water closer to the equator suggests a southward displacement of waters in this temperature range.

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