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ON THE SUBTROPICAL COUNTERCURRENT IN THE WESTERN NORTH PACIFIC

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ABSTRACT

Recent dynamic computations of zonal flow and analysis of oceanographic data of CSK in winter indicate year-to-year variations in the location and dynamic structure of the Subtropical Countercurrent in the western North Pacific. In January 1966, the Subtropical Countercurrent migrated southward to 21°-22°N Lat in association with the subsurface Subtropical Convergence. At the area of 25°-26°N Lat, another surface thermal front was formed along which a stronger eastward flow of approximately 0.4 kt is seen.

On the section of 142°E Long in January 1967, eastward flow appears at every interval of 2° latitude in the northern waters of 20° N Lat.

INTRODUCTION

After the theoretical prediction of the existence of an eastward Subtropical Countercurrent (Yoshida and Kidokro, 1967a, 1967b) on the basis of the surface wind-stress (Hidaka, 1958) distributions, Uda and Hasunuma (1969) indicated the existence of a new eastward Subtropical Countercurrent along the Tropic of Cancer in the subtropical region of the western North Pacific. They indicated the countercurrent at 20°-25°N Lat on the surface dynamic topographic charts referred to 800 decibar surface. The countercurrent, which is associated with a subsurface thermal front, or the Subtropical Convergence (Uda, 1955), was thought to be continued as far as 160°E Long. Some authors presented the conclusion that the Subtropical Countercurrent is extended farther to the east (Reed, 1968; Seckel, 1968). Robinson(1969) predicted the Subtropical Countercurrent by the computations of monthly thermocline depth based on the oceanographic data including BT.

Present dynamic computations of zonal flow and analysis of oceanographic data by the author in the western North Pacific indicate year-to-year variations in the location and dynamic structure of the countercurrent, as well as the property distributions in association with the countercurrent.

DATA AND METHOD

By use of the oceanographic data of CSK (1966-1968), the zonal geostrophic currents were calculated along the meridian of 142° E Long with reference to 1200 and 800 db surfaces by the following formula:

$$V_a - V_b = \frac{\Delta D_b - \Delta D_a}{2\omega \sin\phi \cdot L}$$

where V denotes the current velocity, ΔD_b and ΔD_a the dynamic depth anomaly, ω the angular velocity of the rotation of the earth, ϕ the geographic latitude and L the distance between oceanographic stations a and b.

RESULTS AND DISCUSSION

Results of dynamic computation of zonal geostrophic current relative to 800 db and 1200 db surfaces along the meridian of 142°E Long in 1966-1968 are shown in Figs. 1-3.

These demonstrate that there are two or more eastward zonal flow on the sections along the meridian. We may see the existence of a narrow and slow eastward flow at the upper layer of 20°-22° N Lat in January every year from 1966 to 1968. The speed of the narrow eastward flow doesn't seem to exceed 0.5 kt.

At the upper layer shallower than 200 m in the vicinity of the Tropic of Cancer, an eastward Subtropical Countercurrent is seen in January 1967 as suggested by Uda and Hasunuma (1969). The maximum speed of the current was estimated to be approximately 0.8 kt at the upper layer shallower than 200 m.

In January 1966, however, an eastward flow which seems to be the Subtropical Countercurrent migrated southward flow-

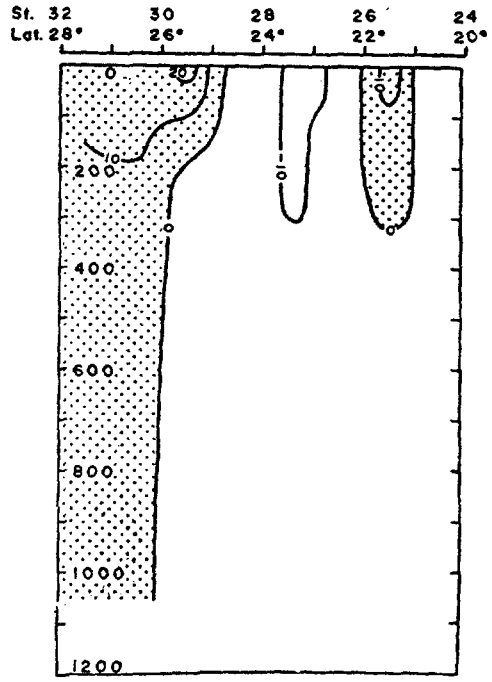

Fig. 1. Zonal geostrophic current in cm/sec relative to 1200 decibar surface at approximately 142°E Long in January 1966 (*Oshoro Maru*).

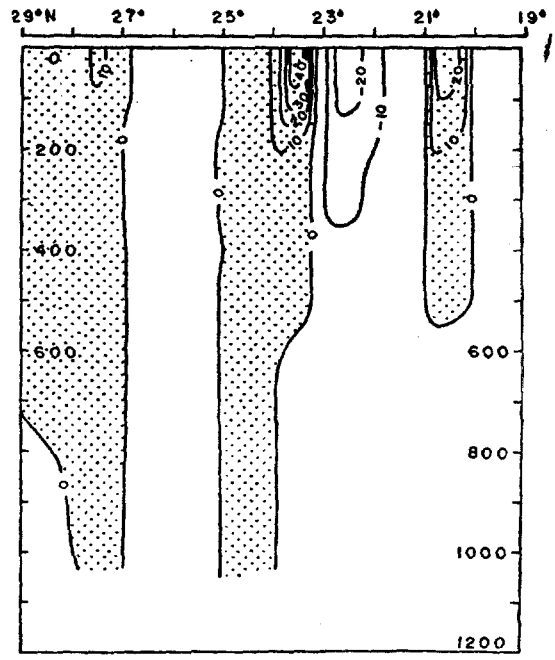

Fig. 2. Zonal geostrophic current in cm/sec relative to 1200 decibar surface at approximately 142°E Long in January 1967 (*Oshoro Maru*).

ing along the latitudes between 21°-22° N at a maximum speed of approximately 0.2 kt. A distinct thermal front was located at the same latitude in accordance with the countercurrent, too (Figs. 4-5). The surface thermal front was found at 25°-26° N Lat indicated by the 22°-24℃ isotherms. These fronts would probably be the Subtropical Convergence explained by Uda(1955). A stronger eastward flow of approximately 0.4 kt is seen along the surface front. The so-called Subtropical Mode Water(Masuzawa, 1967) which corresponds to the 18℃ Water(Worthington, 1959) in the North Atlantic is seen around 200 m depth between the seasonal thermocline and the main thermocline (Fig. 4).

On the section of January 1967, eastward flow appears at every interval of 2°- latitude in the northern waters of 20° N Lat. The width of the Subtropical Countercurrent was approximately 120 nautical miles, or two degrees of latitude, too.

In January 1968, a sign of sluggish eastward flow was found in southern waters of the Tropic of Cancer centering 21°N Lat. A stronger eastward flow (approximately 0.4 kt) was seen at the northern waters of the North Equatorial Current.

When the speed of the Subtropical Countercurrent is low(1966), the northern eastward flow is faster; on the other hand, when the former flows fast(1967), the latter is slow.

Voorhis and Hersey(1964) measured eastward surface current as fast as 60cm /sec along thermal fronts in the surface mixed layer of the Sargasso Sea. It is

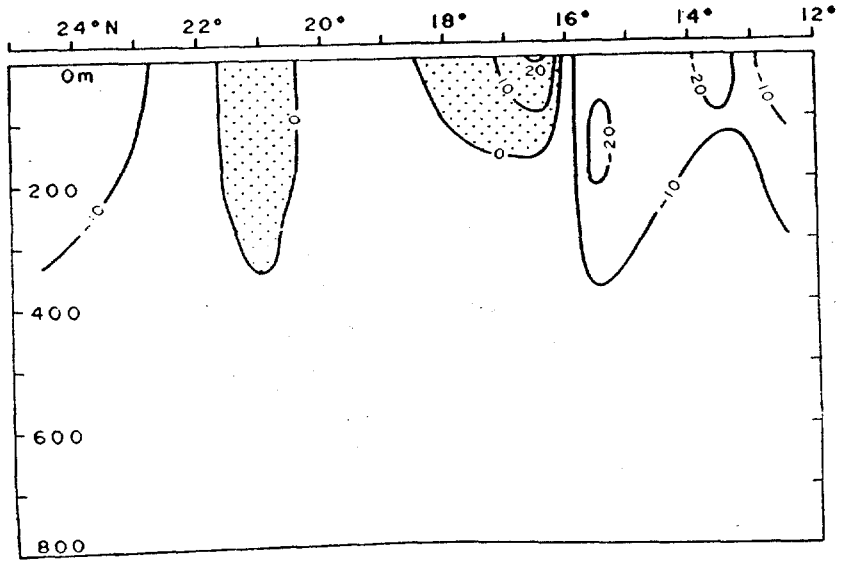

Fig. 3. Zonal geostrophic current incm/sec relative to 800 decibar surface at approximately 142°E Long in January 1968 (*Oshoro Maru*).

recommended that more detailed oceanographic observations perpendicular to the flow as well as direct measurement of the countercurrent in the Pacific.

Further extensive investigations would be necessary to explain the mechanism controlling the north-south movement and the variation of the structure of the countercurrent.

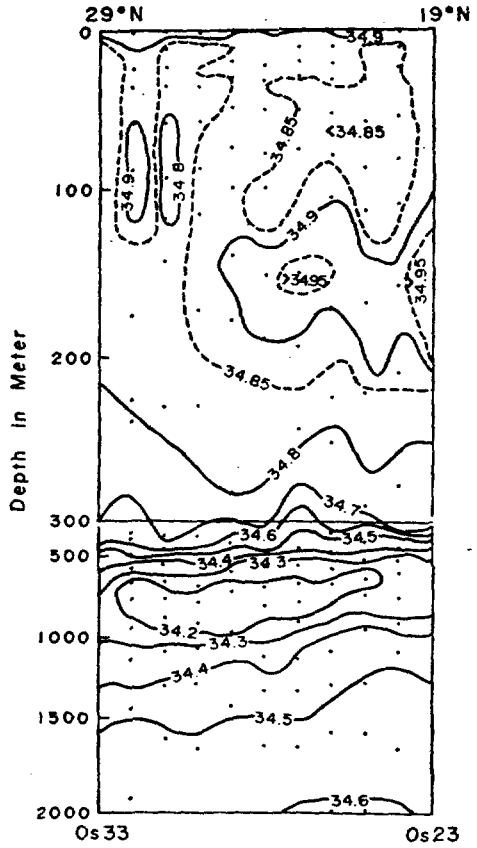

Fig. 4. Vertical temperature section along the meridian of 142°E Long in January 1966(*Oshoro Maru*).

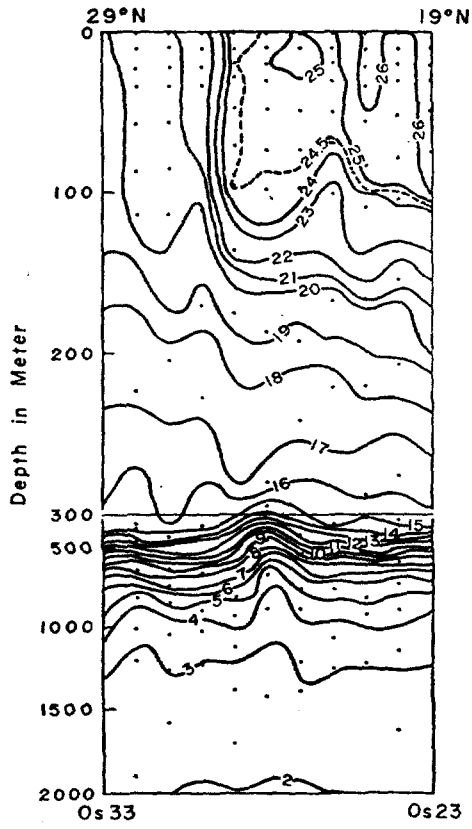

Fig. 5. Vertical salinity section along the meridian of 142°E Long in January 1966 (*Oshoro Maru*).

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