CHAPTER V
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DISTRIBUTION OF POTENTIAL VORTICITY
BETWEEN DIFFERENT STERIC SURFACES

Potential vorticity is a local measure of vertical homogeneity of a water mass and it is conserved in the absence of vertical mixing. Therefore it gives an indication of water masses and current structure. Hence, the potential vorticity maps between different steric surfaces are presented in this chapter in Figs 40 to 42 to study the water characteristics and current structure of the intermediate waters in the Arabian Sea.

5.1.1. Potential vorticity between 110 and 90 cl/t surfaces

In the interior of the ocean, for large scale processes, relative vorticity is negligible compared to planetary vorticity as mentioned in chapter one. As a result, potential vorticity increases towards higher latitudes (in the northern hemisphere) at a particular level, in the absence of any significant differences in water characteristics. However, in the Arabian Sea, potential vorticity between 110 and 90 cl/t surfaces increases with latitude up to 6°N and shows a northward decrease in the southeast of Socotra Island and again
FIG 40: POTENTIAL VORTICITY \(10^{-14} \text{ cm}^{-1} \text{ s}^{-1}\) BETWEEN 110 AND 90 c1/t SURFACES
increases towards north. Similar northward decrease in potential vorticity is seen off the southwest coast of India and in the western part of the northern Arabian Sea. These areas are potentially baroclinically unstable (McDowell et al., 1982). Intense horizontal mixing is noticed at these areas in the distribution of properties on 100-cl/t surface and in the vertical sections of salinity. In regions of intense horizontal mixing, baroclinic instabilities can be developed if the mixing is not uniform in all places, resulting in the formation of distinct water characteristics at different places within the regions of horizontal mixing.

Similar northward decrease in potential vorticity is observed in the North Atlantic Ocean by McDowell et al. (1982). Stramma (1984) also reported such a situation on the equatorial side of the subtropical gyre in the North Atlantic Ocean.

From the comparison between the potential vorticity of the layer and the distribution of acceleration potential on 100-cl/t surface, it is inferred that some of the closed eddy type circulation are formed due to the manifestations of baroclinic instability prevailing in these areas. It is well known...
that baroclinic instability is one of the main reasons for eddy formation in the sea (Gill et al., 1974; Orlanski and Cox, 1973; Pedlosky, 1974, 1975; Orlansky, 1969) apart from topographic effects.

The distribution of potential vorticity of the layer also indicates southward flow along the Somali Coast which is confirmed on the distribution of acceleration potential. In general, it is found that the geostrophic flow is consistent with the distribution of the potential vorticity (Stramma, 1984).

Strong gradients in the distribution of potential vorticity observed off the northern Somali Coast, eastern and northern Arabian Sea indicate that the waters are relatively more heterogeneous as seen in the scatter diagrams. Such areas coincide with the regions of intense horizontal mixing as revealed in the distribution of properties on 100-cl/t surface and in the vertical sections of salinity. Hence, the heterogeneity inferred from the distribution of potential vorticity is because of strong horizontal mixing.

On the contrary, the waters are more homogeneous near the equator and off the southeast coast of Arabia as evident from the relatively weak gradients in the
potential vorticity distribution. The homogeneity is because of vertical mixing as confirmed in the distribution of salinity on 100-cl/t surface, in the vertical sections of salinity and in the scatter diagrams.

The distribution of potential vorticity, in general, resembles that of the salinity distribution on 100-cl/t surface. Sarmiento et al. (1982) also found such features in the North Atlantic Ocean.

5.1.2. Potential vorticity between 90 and 70 cl/t surfaces

The distribution of potential vorticity between 90 and 70 cl/t surfaces is more or less similar to the upper layer. Northward decrease in potential vorticity is noticed in the southeast of Socotra Island, northeastern and northern Arabian Sea, indicating the baroclinic instability conditions. Relatively strong gradients in potential vorticity are seen in the northern and eastern Arabian Sea and in the southeast of Socotra Island suggesting heterogeneous water. The heterogeneity is because of the horizontal mixing as noticed in the distributions of salinity on 80-cl/t surface, in the vertical sections of salinity and in the scatter diagrams. Comparatively weak gradients are observed in the central and southeastern Arabian Sea indicating homogeneous water as a result of vertical mixing which is in confirmation with the results inferred from the previous chapters.
5.1.3. **Potential vorticity between 70 and 50 cl/t surfaces**

Almost all the features noticed between 70 and 50 cl/t surfaces are similar to the upper layers, but the gradients are generally weak. Regions of baroclinic instability are found south of Socotra Island, northern and northeastern Arabian Sea as indicated by the northward decrease in potential vorticity.

As in the upper two layers, gradients in potential vorticity are relatively higher south of Socotra Island and in the eastern Arabian Sea indicating heterogeneity. Such a condition coincides with the horizontal mixing noticed in the distribution of properties in the previous chapters. On the contrary, comparatively weak gradients are seen near the equator, suggesting homogeneity as a result of vertical mixing.