Intermediate Circulation in the Northwestern North Pacific Derived from Subsurface Float Movements (1998-2002)

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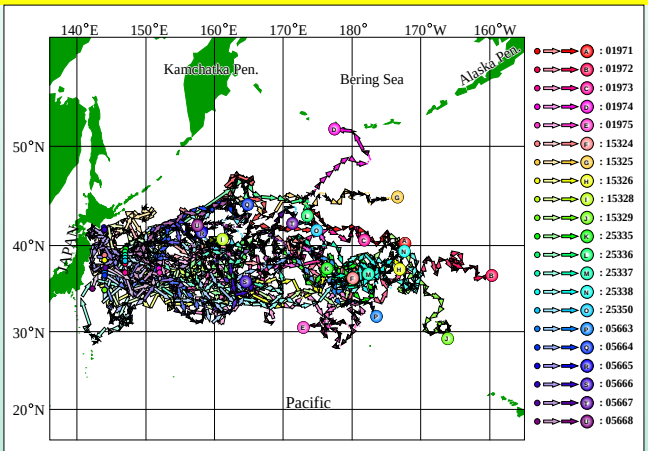

Fig.1 Entire trajectories of the 21 subsurface floats updated by November, 2002. Ten PALACEs, five isobaric APEXs and six isopycnal APEXs were deployed and a series of 2081 float trajectory data were obtained. Thirteen floats among 21 floats have no salinity sensor.

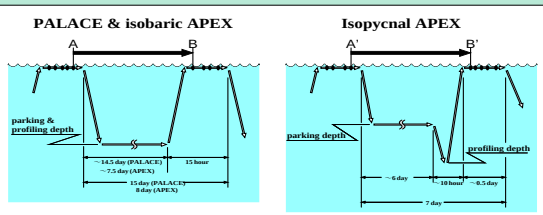

Fig.2 Outlines of the float mission. Float velocities were estimated by the vector AB or A'B'.

Abstract

A Eulerian image of the intermediate layer (26.6 - 27.0 σ_θ) circulation in the northwestern North Pacific was obtained by the combined analysis of the movements of 21 subsurface floats and the historical hydrographic observations (WODA98+JMA+Argo etc). The obtained flow field shows stronger flow speeds in general than that of the climatological geostrophic flow field. 8 Sv of Oyashio and Kuroshio waters are found flowing into the sea east of Japan. Three strong eastward flows are seen in the region from 150E to 170E (northernmost: Subarctic Current (5.5 Sv), middle: along the Subarctic Boundary (5 Sv), southernmost: Kuroshio Extension or North Pacific Current (5.5 Sv)). The percentage of the Oyashio water component is 70% in the Subarctic Current, 40% in the Subarctic Boundary and 35% in the Kuroshio Extension.

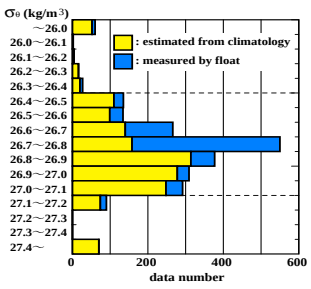

Fig.3 Histogram of the parking depth of the floats. The data in the 26.4 - 27.1σ_θ layer were used for analysis (1842 trajectories).

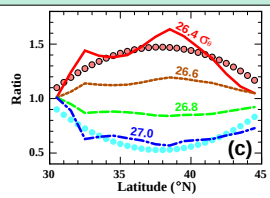

Fig.4 Latitudinal distribution of flow speed ratio relative to that on the 26.7σ_θ surface estimated from the climatology (lines). Each float speed was corrected for each isopycnal surface by the following equation (circles):
$V\sigma = V_{26.7} \times R\sigma$
$R\sigma = (0.02294 \times L^2 - 1.737 \times L + 31.3) \times (\sigma - 26.7) + 1$
L : latitude(degree), σ : measured or estimated density (σ_θ)

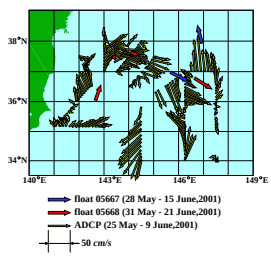

Fig.5 Comparison between corrected float velocities and ADCP velocities on the 26.7 σ_θ isopycnal surface.

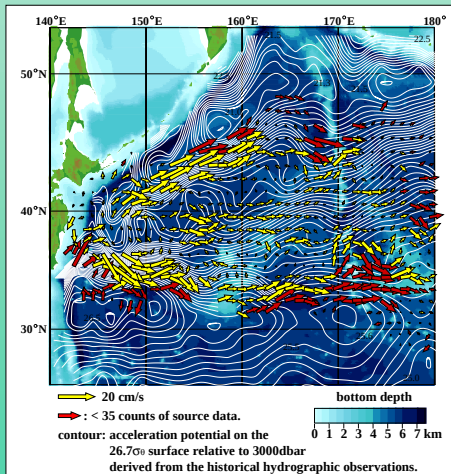

Fig.6 Composite flow on the 26.7 σ_θ surface estimated from float movements.
Velocity at each grid point was obtained by averaging the corrected float velocities within a 250km circle from grid point, weighted with Gaussian-type weight, with e-folding scale of 100km.
Three strong eastward flows are seen at 150E to 170E.
A tendency of large special variations of current direction around large topographical structures such as the Shatsky Rise, the Emperor Ridge and the Hess Rise, is evident.

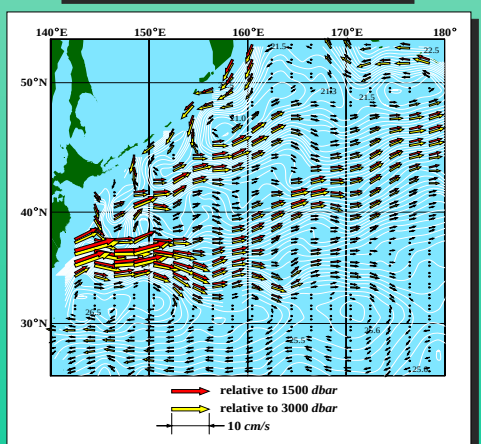

Fig.7 Climatological geostrophic flow field on the 26.7 σ_θ surface relative to 1500dbar(red) and 3000 dbar (yellow) . Generally, the geostrophic flows are slower than float flows (fig.6).
Note that the speed scale is half of Fig. 6.

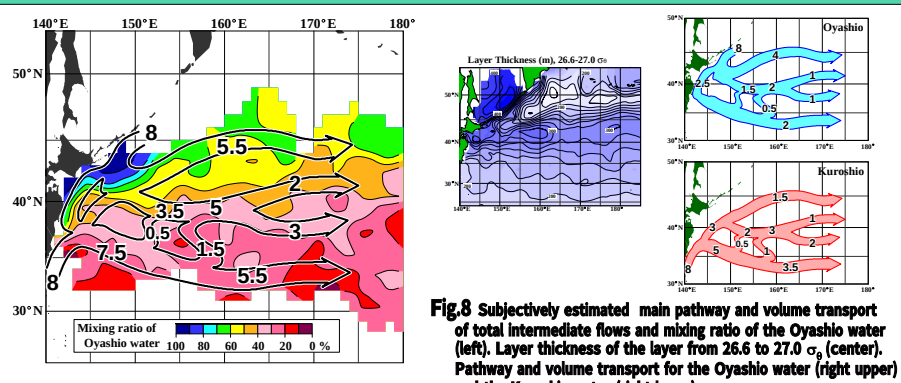

Fig.8 Subjectively estimated main pathway and volume transport of total intermediate flows and mixing ratio of the Oyashio water (left). Layer thickness of the layer from 26.6 to 27.0 σ_θ (center). Pathway and volume transport for the Oyashio water (right upper) and the Kuroshio water (right lower).