

Firstly, we would like to thank the anonymous reviewer #1 for his/her good comments that helped us to improve the manuscript.

1. Resolution of altimetry and HYCOM:

Here we apply the analogy method with previous studies. (1) The extensively studied Meddies are on the lateral scale of 40-100 km in diameter, which is comparable to the subsurface lens (SL, ~60 km, or the so-called current core) in this study. Although the Meddies are deeper than the SL, it has been proved that the Meddies could also affect the sea surface height of the ocean sometimes, i.e., the altimetry could detect the deep buried mesoscale structures (Oliveira et al., 2000). But in our study, we do not consider that the SL is responsible to the sea surface anomaly, but for the baroclinic sea surface eddy whose signal would be much stronger (Figs 5 and 6). (2) The HYCOM is an eddy-resolving and data-assimilating ocean circulation model. According to the previous observation of the intermediate eddy by Xie et al. (2011) in the northern South China Sea, we also analogize that the high resolution HYCOM can resolve the mesoscale structure in the southern South China Sea. Although the resolvabilities of the HYCOM and seismic method are quite different, their general features would be consistent on the mesoscale aspect. A current's velocity field from HYCOM may include the current core (main water mass) and its surrounding waters driven by lateral shear of the main current, or even laterally smoothed by the spatial filtering. So, it would be wider than the actual width of the current apparently. As mentioned before, here we consider that the current core is the whole SL, rather than the inner homogeneous reflections (thermostad/pycnostad) only, which would be missing by HYCOM as the reviewer pointed out.

2. Physical interpretation of the lens:

We quite agree with the reviewer's interpretation of the pycnostad for the low reflectivity of the SL's center, which could be caused by the strong mixing of the vigorous current center. Thus, a thermostad/pycnostad with slight vertical varying of the temperature/density would be formed. Such a thermostad/pycnostad could be used to distinguish the subsurface current by analogy with the Equatorial Undercurrent (Lukas, 1986; Brown et al., 2001). Therefore, a thermostad/pycnostad might be an appearance of a current itself, not alien. Recently, the lens-like structure of the Mediterranean Water Undercurrent also has been imaged (Quentel et al., 2011). To some extent, the curvature of the lens' periphery could be regarded as the slope caused from the geostrophic adjustment. However, we could not exclude the reviewer's good suggestion that the subsurface lens with pycnostad was carried by the southwestward currents in the intermediate layer from somewhere else. It would be an alternative hypothesis of the SL.

3. Hydrographic surveys:

As a common defect for the legacy seismic data, no in-situ hydrographic observations were conducted during the seismic data acquisition (P3743 line 6). However, the good correlations between the seismic images and the in-situ hydrographic data have

been proved extensively by many previous works (Mirshak et al., 2010). The relationship between the seismic responses and hydrographic components could be deduced analytically (Ruddick et al., 2009). From one of our new works at the northern South China Sea, we also find that the correspondences between the seismic and the hydrographic observations are perfect (Fig. S1-1).

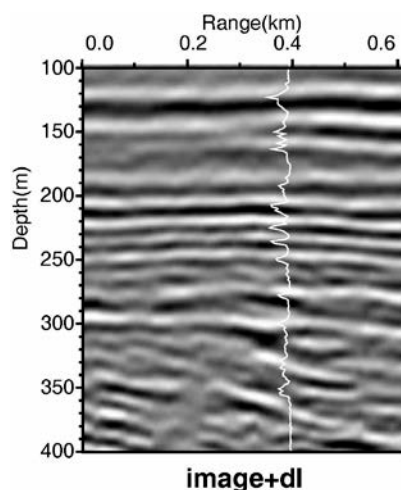


Figure S1-1: Correspondence between seismic image and the vertical gradients of the acoustic impedance at an XBT station (white line). Seismic image represents the convolution between the acoustic impedance contrast and the source wavelet.

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