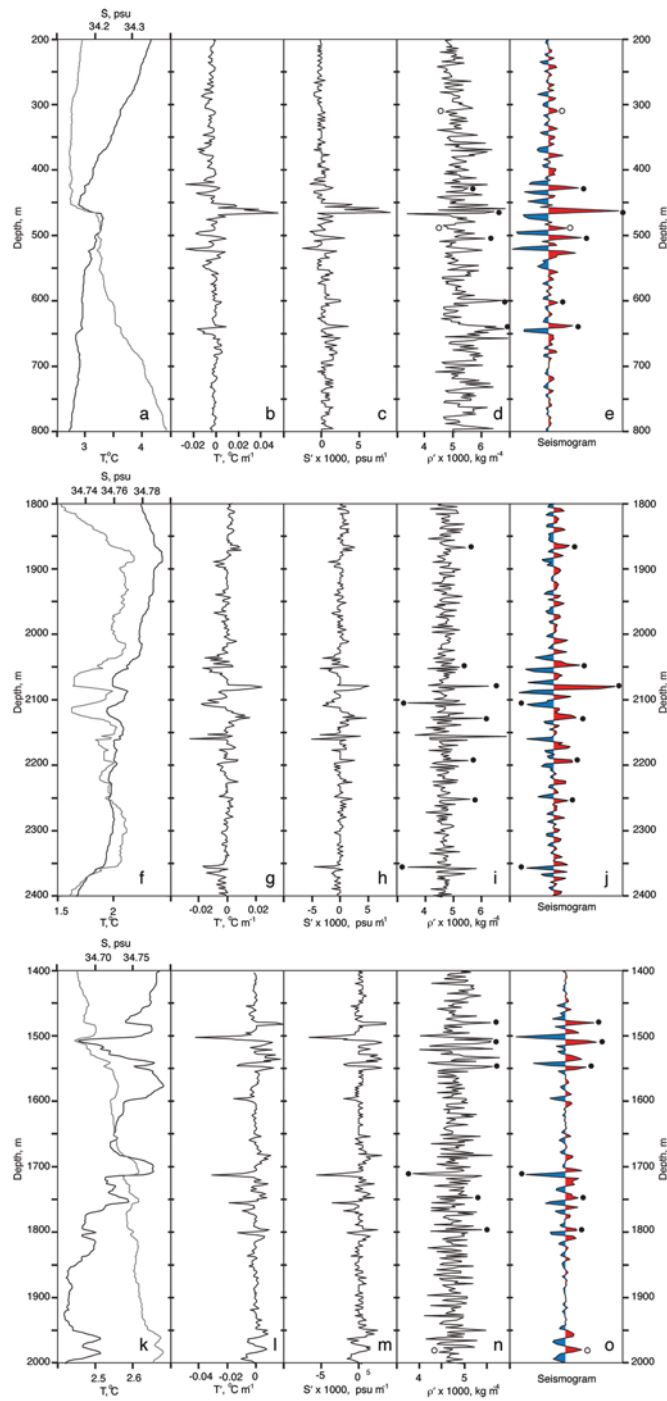


Seismic imaging of a large horizontal vortex at abyssal depths beneath the Sub-Antarctic Front

Figure 1 (Supplementary Figure S1: Analysis of hydrographic data from stations 10, 11 and 12). Analysis of CTD casts 10 (upper panels), 11 (central panels) and 12 (lower panels) from WOCE-A 17. (a), (f) and (k) *In situ* temperature (black) and salinity (grey) measurements; (b), (g) and (l) vertical gradient of temperature; (c), (h) and (m) vertical gradient of salinity; (d), (i) and (n) vertical gradient of density; (e), (j) and (o) seismograms calculated by convolving acoustic impedance, calculated from sound speed and density measurements (i.e. temperature and salinity) with Ricker wavelet of central frequency 50 Hz designed to match bandwidth of seismic experiment. Positive (solid circles) and negative (open circles) correspondences between density gradient and seismic wiggles highlight salinity and temperature dominated density variations, respectively.



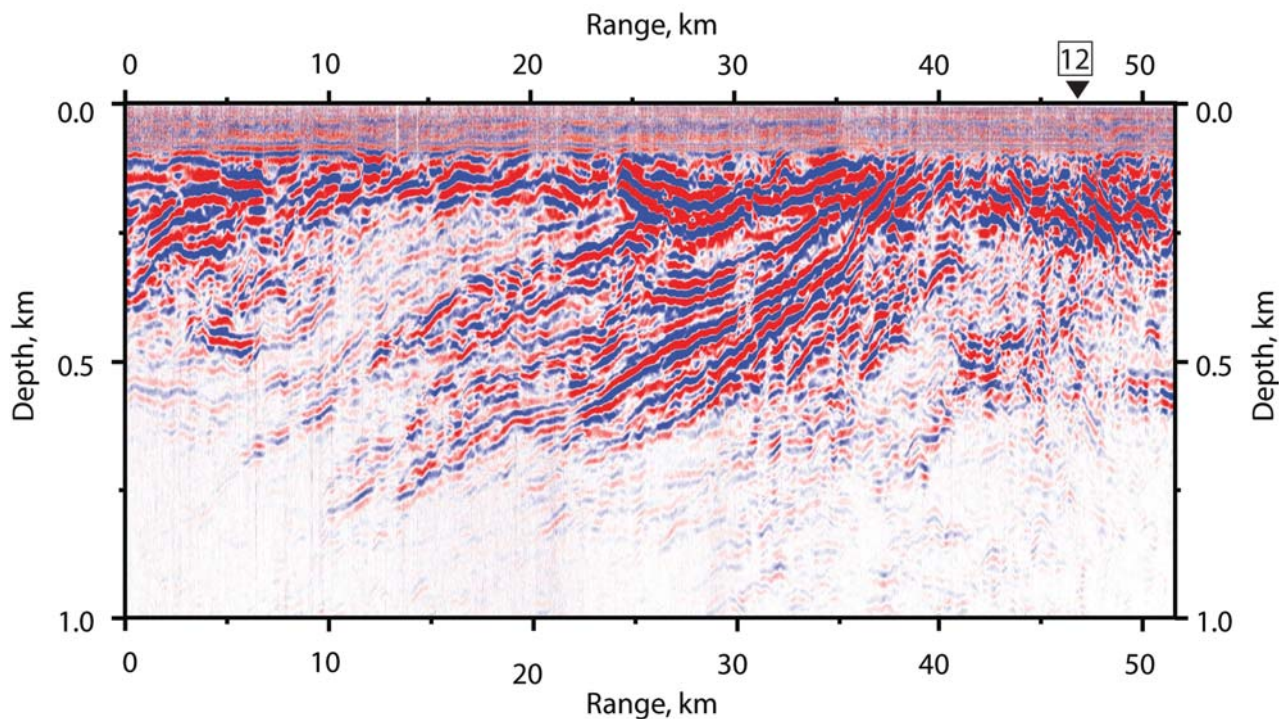


Figure 2 (Supplementary Figure S2: Detailed image of Sub-Antarctic Front). Enlargement of seismic image shown in Figure 2a which shows detailed structure of Sub-Antarctic Front at NE end.

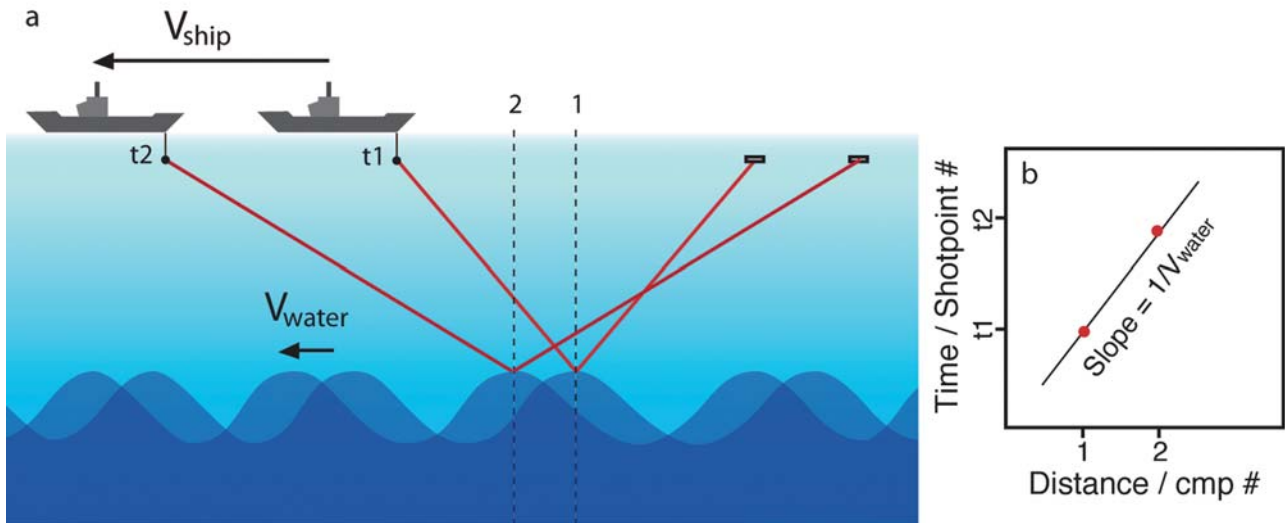


Figure 3 (Supplementary Figure S3: Estimating velocity of internal waves). (a) Cartoon showing how in-plane horizontal velocity of internal wave is measured from seismic reflection data. At time, t_1 , shotpoint-receiver raypath samples common mid-point 1 located at crest of internal wave (i.e. peak of seismic reflection). At some later time, t_2 , crest of internal wave has moved and is now sampled by different shotpoint-receiver raypath, as indicated. (b) Time-distance plot shows loci of t_1 -cmp 1 and t_2 -cmp 2 whose slope defines velocity of crest of internal wave.

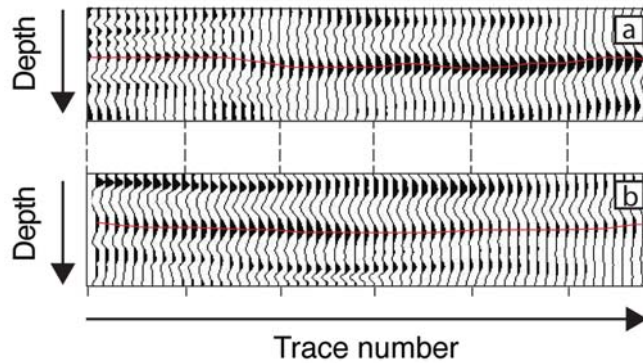


Figure 4 (Supplementary Figure S4: Watching internal waves move across seismic data).

Portions of two common mid-point gathers at different depths within vortex, which have been corrected for time delay across hydrophone groups and filtered. Black wiggles = seismic traces at different receiver groups and shotpoints; black infill = positive amplitude; undulating red lines = locus of undulating reflections from interval waves. (a) wave travelling toward common mid-point; (b) wave travelling away from common mid-point.

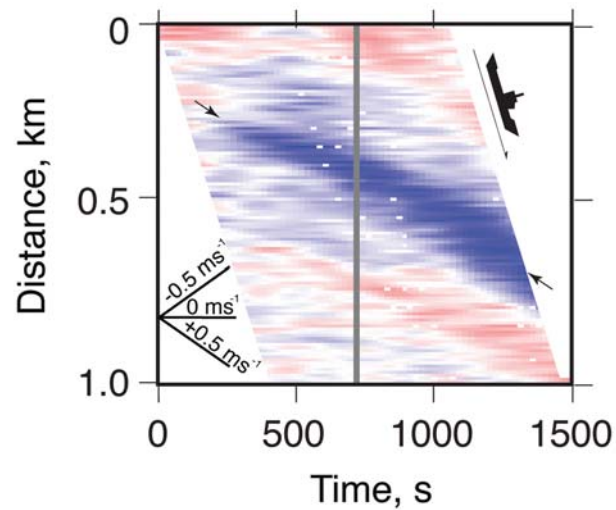


Figure 5 (Supplementary Figure S5: Time-distance plot for estimating internal wave velocity). Observed time-distance plot showing amplitude of acoustic reflections as function of time (i.e. shotpoint) and distance (i.e. common mid-point). Ship symbol with arrow = vessel's velocity ($\sim 2 \text{ m s}^{-1}$); bright blue patch indicated by black arrows = coherent band of reflectivity whose slope ($+0.4 \pm 0.1 \text{ m s}^{-1}$) represents in-plane component of horizontal velocity of internal wave; vertical gray line = data gap.