Geophysical Research Abstracts,
Vol. 10, EGU2008-A-08088, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-08088
EGU General Assembly 2008

Mesoscale structures in Mediterranean Outflow Water in the Gulf of Cadiz: analysis of legacy oceanographic and marine seismic data

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Long-lived eddies are essential mechanisms of momentum, heat and tracer transport in the ocean. Physical oceanographic probes typically provide vertical temperature and salinity data at regular, but too sparse horizontal spacing to understand the fine structure of water masses. On the other hand, marine geophysical methods (seismic reflection profiles) can image thermo-haline structure at a very high lateral resolution (about 10m). One of the main aims of the GO project (www.dur.ac.uk/eu.go) is to acquire collocated, synchronous seismic reflection profiles along with oceanographic data in the Gulf of Cadiz.

Here, we report on the analysis of pre-existing "legacy" data in the region of the Gulf of Cadiz which has been closely studied in the past and where strongly contrasting water masses (Mediterranean Outflow Water and North Atlantic Central Water), meet. We examine two types of data; marine seismic data acquired during the SISMAR academic survey (in April 2001) and during an industrial survey conducted by TGS Nopec (in April 2001), and oceanographic data acquired during the SEMANE cruises (Sept 1995 to July 2002). We demonstrate that a low frequency acoustic source (5 - 70 Hz) provides clear and strong reflectors in the water column in seismic profiles typically in the depth range 750 - 2000 m. In these depths we commonly observe

a homogenous band of horizontal reflectors. Locally more transparent lens shaped zones can be seen, surrounded by highly reflective bands, while in other places dipping structures cross through the entire depth range from 700 m to 1600 m, suggesting mixing of acoustically distinct water bodies. Typically, the strongest reflectivity is observed at roughly 750 m and 1500 m water depth.

The processed industry seismic data yielded the best sections with a high spatial and temporal resolution and show a highly complex reflectivity structure and well defined possible eddy structures away from the margin. By comparing cross-sections of temperature, salinity, and LADCP velocity, one can identify mesoscale water bodies (eddies, veins of MOW), mixing processes (double diffusion, interleaving) and temporal and spatial variability of the MOW.