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Mesoscale to fine-scale structures related to the Mediterranean Outflow Water: A correlation of joint seismic reflection and physical oceanographic data acquired during the GO cruise

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During the GO cruise (HMS Discovery) in April 2007, 2000 km of seismic reflection profiles were acquired synchronously with collocated oceanographic data (500 XBT and 40 CTD) in the Gulf of Cadiz (www.dur.ac.uk/eu.go). To investigate the seismic response of water boundary layers related to the warm, saline Mediterranean Outflow Water (MOW), three types of seismic sources were used: a high-resolution (HR - 117 cu in, 15-350 Hz), low-resolution (LR - 2000 cu in, 10-60 Hz) and medium resolution source (MR - 10-60 Hz and 20-120 Hz). The expected vertical resolution is 2.5, 15 and 7.5 m respectively. The horizontal resolution of the continuous seismic profiles (10m) is much higher than that of oceanographic data, which is typically 10km.

Here, we examine the spectra of seismic reflectivity and of oceanographic profiles and analyse histograms to determine the characteristic vertical and horizontal scales of the structures imaged by both methods on the continental slope and in a Meddy. Similar structures are observed at the boundaries between water masses with the different sources at high spatial resolution. In particular, a Meddy seen in the LR and MR profiles presents strong, laterally continuous (about 10 km) reflectors. The low-frequency source offers better images of the deep boundary of the Meddy. The HR source reveals more fine-scale structures with horizontal scales on the order of 10 km, and a thickness of 20 m : in the mixed layer, these reflectors are due to the temperature (and thus density) gradient, while above the Meddy, the gradient of sound velocity is more marked, and is influenced by salinity.

At the edge of the Meddy, structures are revealed by wavelet analysis. The wavelengths (8, 12, 32m) of these structures, between 800 and 1300m depth, indicate lateral intrusions. The study is also done in the Mediterranean Water and in the continental slope. The structures in the continental slope are found at 600m depth where the upper vein of Mediterranean Water is located.