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Seismic evidence for Messinian salt deformation and fluid circulation on the South Balearic margin (Western Mediterranean)

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The south Balearic margin is characterized by an abrupt tectonically-controlled transition between a steep continental slope (Emile Baudot escarpment) and the Algero-Balearic abyssal plain, in which Messinain salt-induced deformation affects the seafloor morphology. Multichannel seismic profiles, multibeam bathymetry, and shallow seismic data demonstrate that the extent of salt deformation does not coincide with the bathymetric plain-slope transition. Instead, deformation occurs south of linear structure in the abyssal plain located some tens of kilometres from the base of the slope. The quality of the multi-channel seismic record in the deep water deformed area is severely decreased by the three dimensional character of the salt structures. However, the abyssal plain near the base of the slope reveals details on the Messinian sequence, its structure, post-Messinan deformation, and relation with subsurface fluids.

The analysis of part of the EUROFLEETS SALTFLU multichannel seismic data set has included detailed RMS velocity analysis, post-stack and pre-stack time migration. An anomalously thick (up to 800 ms twt) acoustically laminated unit comprising the Messinian Upper Unit (UU) is present near the base of the slope and is characterized by syn-sedimentary gentle symmetric folding. The crests of such folds are affected by small-offset, layer-bound fractures and faults propagating from the upper part to the UU to the Plio-Quaternary sequence. Amplitude anomalies, polarity inversion and at times acoustic blanking reveal the presence of fluids (presumably gas) within the Messinian sequence. A clear seismic evidence for the Mobile Unit (MU, or salt layer) is missing in this area. Seismic evidence for the MU exists south of the linear structural boundary, where salt induced deformation has created vertical displacements of several hundreds of metres, diapiric growth, and at least two salt/mud piercement structures at the seafloor. In the highly deformed area, the UU and the Lower Unit (LU) appear to amalgamate as a consequence of complete salt withdrawal around diapirs.

The seismic analysis is focussed on determining whether the boundary between low and high degree of deformation in the abyssal plain is determined by the limit of the salt distribution. In this case the northern limit of the Messinian pure salt basin would not coincide with the present day continental slope, thus requiring either a strong control of Messinian tectonic structures an salt deposition and/or a contamination of salt with clastics.