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Evolution of the Gulf of Cadiz Margin and southwest Portugal from IODP Expedition 339 results

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The contourite depositional systems (CDS) along the southwestern Iberian Margin (SIM), within the Gulf of Cadiz and offshore areas of western Portugal bear the unmistakable signal of Mediterranean Outflow Water (MOW) exiting the Strait of Gibraltar. This locality records key information concerning the effects of tectonic activity on margin sedimentation, the effects of MOW dynamics on Atlantic circulation, and how these factors may have influenced global climate. The Integrated Ocean Drilling Program (IODP) Expedition 339 recently drilled five sites in the Gulf of Cadiz and two sites on the western Iberian margin [1]. The integration of core and borehole data with other geophysical databases leads us to propose a new stratigraphic framework. Interpretation of IODP Exp. 339 data along with that from industry sources and onshore outcrop analysis helps refine our understanding of the SIM's sedimentary evolution.

We identify significant changes in sedimentation style and dominant sedimentary processes, coupled with widespread depositional hiatuses along the SIM within the Cadiz, Sanlucar, Doñana, Algarve and Alentejo basins [2]. Following the 4.5 Ma cessation of a previous phase of tectonic activity related to the Miocene-Pliocene boundary, tectonics continued to influence margin development, downslope sediment transport and CDS evolution. Sedimentary features indicate tectonic pulses of about 0.8-0.9 Ma duration with a pronounced overprint of ~2 - 2.5 Ma cycles. These more protracted cycles relate to the westward rollback of subducted lithosphere at the convergent Africa-Eurasia plate boundary as its previous NW-SE compressional regime shifted to a WNW-ESE direction. Two major compressional events affecting to the Neogene basins at 3.2-3 Ma and 2-2.3 Ma help constrain the three main stages of CDS evolution. The stages include: 1) the initial-drift stage (5.33-3.2 Ma) with a weak MOW, 2) a transitional-drift stage (3.2-2 Ma) and 3) a growth-drift stage (2 Ma-present time) with enhanced MOW circulation into the Atlantic and associated contourite development due to greater bottom-current velocity. Two minor Pleistocene discontinuities at 0.7-0.9 Ma and 0.3-0.6 Ma record the effects of

renewed tectonic activity on basin evolution. Several discontinuities bounding major and minor units appear on seismic profiles. Quaternary records offer the clearest example of this, with major units of about 0.8-0.9 Ma and sub-units of 0.4-0.5 Ma. Sedimentation is controlled by a combination of tectonics, sediment supply, sea-level and climate. This research identifies time scales of tectonic controls on deep-marine sedimentation, specifically over periods of 2.5 - >0.4 Ma. Shorter-term climatic (orbital) mechanisms control sedimentation at time scales of ≤0.4 Ma.

References:

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