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XRF-scanning of contourites in the Gulf of Cadiz – elemental composition related to lithology and the variability of the Mediterranean Outflow Water

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During Integrated Ocean Drilling Program Expedition 339 contourite deposits of Pliocene and Quaternary age were drilled in the Gulf of Cadiz. Contourites are sediments which develop due to interaction of bottom currents with the seafloor and accumulate parallel to the continental slope. Since the opening of the Strait of Gibraltar (late Miocene) a significant bottom current, the Mediterranean Outflow Water (MOW), flows in the Gulf of Cadiz and creates such deposits. The velocity of the bottom current is influencing the grain size contribution of the sediment which, hence, can be used to decipher climatic changes in the past. We performed high-resolution XRF scanning on spliced sections of Site U1387, located on the Faro Drift in 559.1 mbsl. Based on a preliminary age model a constant sedimentation rate of approximately 25.7 cm/kyr can be inferred for the Pleistocene. The relative abundance of selected elements in the sediment was examined in detail for the interval 320–370 mcd (∼1.24–1.43 Ma). It appears that the elemental distribution in the sediment is tightly linked to the grain-size distribution of the contourites and therefore to the velocity of the MOW, assuming that (reworked) turbidites are only present as a minor constituent. Statistical analysis including correlation coefficients (R) and Principal Component Analysis (PCA) were used to interpret the XRF – Data. The elemental signals of Zr and Br were particularly remarkable, as they show a behavior independent of typical detrital (e.g. Al, Rb, K, Si, Ti, Fe) or biogenic (Ca, Sr) elements. Elements associated with heavy minerals, here Zr, accumulate in the coarser grain size fraction of the sediment conditioned by gravitational sorting and might be used as a proxy for bottom current strength. Frequency analysis of the Zr/Al ratio for the mid Pleistocene (1.0 – 1.5 Ma) indicates a strong precession signal, which implies a link to the orbital controlled sapropel formation in the Mediterranean Sea. The Br record is associated with marine organic matter in the sediment, which depends on primary productivity and redox conditions at the sea floor. The careful analysis of the XRF data can therefore help to understand the paleoenvironmental conditions and the evolution of the MOW.