

Last glacial to Holocene productivity and oxygen changes based on benthic foraminiferal assemblages from the western Alboran Sea

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Late glacial to Holocene productivity and oxygen changes in the Alboran Sea were investigated analyzing benthic foraminiferal assemblages from the marine sediment core HER-GC-UB06. This 255 cm-long core was recovered at 946 m water depth in the Alboran Sea (western Mediterranean Sea) and includes homogeneous greyish clays from the last 23 ka. Nowadays, the core site is bathed by the Western Mediterranean Deep Water (WMDW) and near the overlying Levantine Intermediate Water (LIW). Benthic foraminifera from the size fraction $>63 \mu\text{m}$ were identified at species level and counted until reaching at least 300 individuals. Q-mode principal component analyses (PCA) was performed to establish benthic foraminiferal assemblages. In addition, benthic foraminifera were classified according to their microhabitat preferences. Diversity was assessed with several diversity indices. Four benthic foraminiferal assemblages have been identified along the core. The distribution of these assemblages records changes in productivity and oxygen conditions during the last 23 ka. The last glacial and deglaciation interval, 23-12.5 ka, shows low diversity and is characterized by the *Nonionella iridea* assemblage, which includes *Cassidulina laevigata*, *Bolivina dilatata*, *Nonionoides turgida* and *Cibicides pachyderma* as secondary taxa. This assemblage can be interpreted as a moderately oxygenated mesotrophic environment with episodic pulses of fresh organic matter. Although general mesotrophic conditions prevail, the Last Glacial Maximum shows a more oligotrophic and better oxygenated setting as suggested by higher abundance of epifaunal-shallow infaunal taxa. In contrast, along the Bølling-Allerød eutrophic conditions with higher productivity and lower oxygenation are recorded by a deep infaunal taxa maximum. During the Younger Dryas (YD) and the earliest Holocene (12.5-10.5 ka), the *Bolivina dilatata* assemblage dominates coinciding with a lower diversity, especially during the YD. This species and the additional taxa of the assemblage (*Bolivina spathulata*, *Bolivina subspinescens*, *Bulimina marginata*, *Bolivina variabilis* and *Uvigerina peregrina*) also thrive in mesotrophic environments with fresh organic matter supply and moderate oxygen content. The lower part of the early Holocene (10.5-7.3 ka) is dominated by the *Cassidulina obtusa* assemblage including *Bolivina subspinescens*, *Bolivina variabilis*, *Bulimina marginata*, *Gyroidina altiformis*, *Nonionella iridea* and *Quinqueloculina* sp. as associated taxa. A highly diverse mesotrophic setting with slightly higher oxygenation can be inferred for this assemblage. This is supported by the higher abundance of epifaunal-shallow infaunal taxa and the presence of *G. altiformis* and *Quinqueloculina* sp. Finally, the highly diverse *Alabaminella weddellensis* assemblage occurs along the upper part of the core (7.3-0 ka) encompassing the upper early Holocene and late Holocene. Additional species of this assemblages are *Uvigerina mediterranea*, *Melonis barleeanus*, *Cassidulina laevigata*, *Cassidulina obtusa* and *Uvigerina peregrina*. This assemblage suggests mesotrophic conditions with a more continuous organic matter supply as pointed out by the occurrence of *U. mediterranea* and the intermediate infaunal *M. barleeanus* that can feed from more degraded organic matter. The onset of this assemblage around 7.3 ka might be related to the establishment of the semi-permanent productive 'Malaga cell' dated at 7.7 ka.