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Influence of bottom currents on the sedimentary processes at the western tip of the Gulf of Corinth, Greece

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ABSTRACT

We investigated the sedimentary processes that were active during the Holocene in the Gulf of Corinth, using high-resolution seismic reflection profiles and gravity cores. Seismic reflection data clearly show the presence of shallow-water sediment drifts at the western end of the Gulf, close to the Rion sill that links the Gulf to the Ionian Sea. Short cores indicate that drifts are composed of homogenous bioturbated mud in their upper part. The drift deposits flank a wide central area where the seafloor is eroded and where pre-Holocene deposits locally outcrop. The seafloor morphology in this area is marked by furrows oriented in different directions and by a depression attributed to the action of bottom-currents. The magnetic fabric of sediment samples from the drift, shelves, sub-basins and from the basin floor shows a significant anisotropy and a similar orientation of K_{max} axes along core. The largest anisotropy ($P = 1.043 \pm 0.007$) is observed in the drift and is interpreted as resulting from the action of bottom currents. The similar orientation of K_{max} axes in the other cores, collected from areas east of the drifts, suggests that bottom currents also affect sediment deposition in the rest of the study area, even if seismic profiles and core analyses demonstrate that gravitational processes such as submarine landslides and turbidity currents exert the main control on sediment transport and deposition. Average K_{max} axes for four cores were reoriented using the declination of the characteristic remanent magnetization. K_{max} axes show variable orientations relatively to the slope of the seafloor, between along-slope and roughly parallel to the contour lines.

1. Introduction

In the marine realm, water circulation plays an important role in the transfer of heat, sediments, nutrients and pollutants, and also transfer of dissolved salt. In deep-water environments (>2000 m), water-mass movements are largely driven by the global thermohaline circulation. Water circulation along the seafloor takes place in so-called bottom currents and is often responsible for the development of typical depositional and erosional reliefs, contouritic drifts and channels. Contourite depositional systems (CDSs) have been described since the 1960s in many places around the world, mainly in the deep ocean, but also in shallower settings (<300 m) as well as in lakes (e. g. Verdicchio and Trincardi, 2008a,b; Rebesco et al., 2014). In shallow-water environments, the water circulation is controlled by other processes such as winds, tides, and continental fresh water outflows, besides thermohaline mechanisms. Contourite systems at the outlet of semi-enclosed basins such as fjords, gulfs, or seas, such as the Baltic and the Black Sea, the Sea of Marmara, and the Strait of Gibraltar (Kuscu et al., 2002; Sivkov et al., 2002; Hernandez-Molina et al., 2003) are common features, due the strengthening of the flows at narrow passages. This study focuses on a shallow-water area in which bottom currents interact with gravity-driven processes, at the western tip of the Gulf of Corinth, in the Mediterranean Sea (Fig. 1A). The objective is to unravel the

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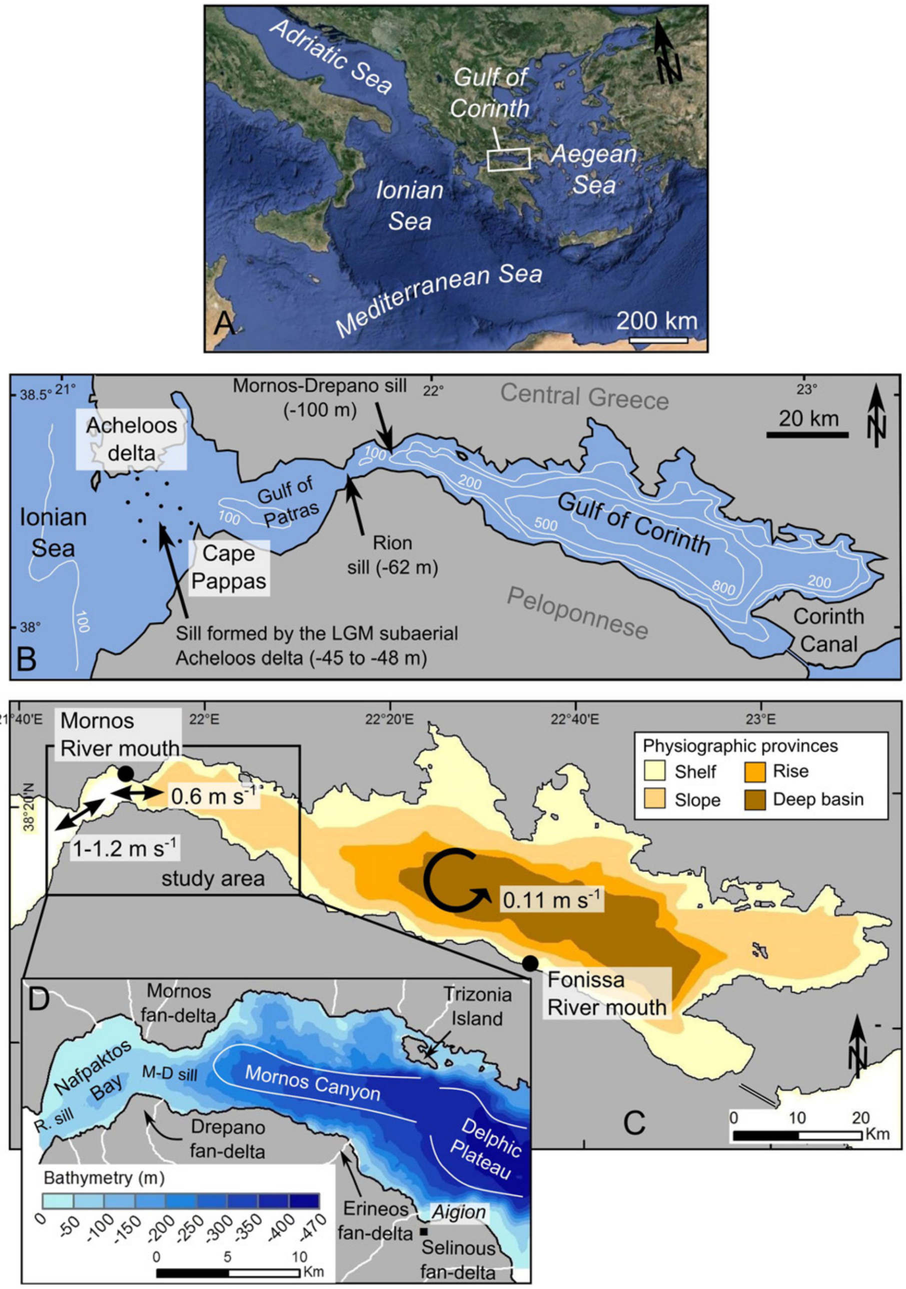

Fig. 1. Location, morphology, physiographic provinces and available current data for the Gulf of Corinth. A) Location of the Gulf of Corinth within the Mediterranean Sea. B) Map view of the connections between the Gulf of Corinth, the Gulf of Patras, and the Ionian Sea. C) Physiographic provinces according to Poulos et al. (1996) and current data from the literature (1–1.2 m s^{-1} from Hadjitheodorou et al., 1992 in Fourniotis and Horsch, 2010; 0.6 m s^{-1} from Lascaratos et al., 1989 and 0.11 m s^{-1} according to modeling in Lascaratos et al., 1989). D) Bathymetry of the study area and location of the sites presented in this study. R. sill = Rion sill, M.–D. sill = Mornos–Drepano sill.

influence of bottom currents in relation to the other sedimentary processes. The analysis is based on high resolution seismic profiles and short gravity cores. The main morphosedimentary features and the Holocene deposits lateral distribution in the area are presented. An attempt is made to investigate the influence of bottom currents based on a combination of sediment magnetic fabric and grain-size data.

2. Regional setting

2.1. Physiographic setting

The Gulf of Corinth is a 120 km long, up to 30 km wide, and 867 m deep water body connected to the Ionian Sea, in Greece (Fig. 1A and B). The Gulf separates continental Greece to the north from the Peloponnese to the south. Today, the Gulf is connected at its western tip to the Mediterranean Sea through three shallow sills (Fig. 1B). The 62 m deep Rion sill and the 100 m deep Mornos–Drepano sill connect the Gulf of Corinth to the 138 m deep Gulf of Patras (Perissoratis et al., 2000). Farther to the west, the Gulf of Patras joins the Ionian Sea through a third, 45–48 m deep, sill that lies along the line Acheloos delta to Cape Pappas (Piper et al., 1988). This sill is covered by 5–7 m of Holocene sediments (G. Ferentinos, pers. comm.). This regional physiographic setting implies that the Gulf of Corinth was disconnected from the World Ocean during the Late Quaternary lowstands. This has been proved by coring for the last glacial period (Collier et al., 2000; Moretti et al., 2004; Campos et al., 2013a). Since 1893, the Gulf of Corinth is also artificially connected to the Aegean Sea at its eastern tip through the Corinthian canal. In the Gulf of Corinth itself, different physiographic

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