

Historical coastal evolution of the ancient harbor of Aegina in relation to the Upper Holocene relative sea level changes in the Saronic Gulf, Greece



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ABSTRACT

The extensive ancient harbor installations – today submerged – on the seafront of Kolona in Aegina are associated with the great trading and maritime development of the island from the Middle Bronze Age to the Middle Classical period.

Based on geomorphological and archeological indications, three distinct relative sea levels can be defined at depths of 3.17 ± 0.05 m, 0.97 ± 0.05 m and 0.52 ± 0.05 m. The dating of the sea level changes based on archeological evidence and historical sources shows that the initial sea level change in Aegina occurred certainly after AD 170 and most likely after AD 250. The intermediate change is dated between AD 1586 and AD 1839, and the most recent change occurred between 1839 and 1999. A transgression followed a long period of sea level stability that lasted at least 2200 years, from the Middle Bronze Age (ca. 3900 yr BP) to the Late Roman period (ca. 1700 yr BP).

According to the paleogeographical reconstruction of the coast, the ancient harbor installations stretch along 1600 m of coastline. The north harbor is bounded by the north breakwater, the riprap on the once wide sandy coast, the detached west breakwater, and the uplift morphology of the west end of Kolona Hill. On the south coast, the harbor installations comprise the fortified “closed harbor” with the shipsheeds, the commercial harbor, which is entirely destroyed by the modern port, the anchorage area that is bounded by the west breakwater and built of cone-shaped piles of stones, the tops of which once projected above the sea level, and the south curved breakwater at its southernmost boundary.

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1. Introduction

Sea level rise is the result of a complex eustatic, glacio-hydroisostatic and tectonic process of climatic and geodynamic forcing mechanisms (Morner, 1996; Pirazzoli, 1996; Lambeck and Purcell, 2005; Stocchi and Spada, 2009; Lambeck et al., 2010) that caused extensive changes in the paleogeography of the shoreline in the Upper Holocene. During prehistoric and historical times, the land planning and the cultural, economic and social conditions of coastal communities have been affected by sea level rise.

Ancient harbor installations are sensitive indicators of the recent changes in sea level and the interaction between human activity and the coastal environment. These installations were constructed in direct relation to a past mean sea level, and any change in this had a decisive effect on their functionality. Consequently, the ancient harbor basins are noteworthy information sources where natural and anthropogenic processes are “imprinted” and “entrapped”, thus remaining indelible over time (Marriner and Morhange, 2007).

The Saronic Gulf is an ideal place to study sea level changes and their times of occurrence (Fig. 1a,b). At least six submerged harbors and port installations of Classical and Roman antiquity are found along its coast: the Roman harbor of Kenchreai and the Roman port installations in the bay of ancient Epidaurus on the north and central parts of the west coast of the Saronic Gulf, the Classical harbors in Salamis and in the bays of Zea and Mounichia on the shores of Piraeus to the north, the naval base of the Sounion promontory at the south end of its west coast, and the ancient harbor of Aegina in the middle of the Saronic Gulf.

Although the information is rich in quantity and quality, previous surveys – even from the early twentieth century – estimated different rates of Upper Holocene sea level change for the Saronic Gulf. According to Scranton et al. (1978), in the bay of Kenchreai, the Roman port installations were submerged gradually by 2.30 m during three co-seismic subsidence events. Nixon et al. (2009) argue that the sea level has risen by 2.94 m in the last 5000 years southwards along the west coast of the Saronic Gulf in the bay of Korfos. This submersion, which occurred during five distinct tectonic phases of subsidence, produced a sea level of -1.20 m 4000 yr BP, -0.80 m 2350 yr BP, -0.34 m 1350 yr BP, and the approximate present level of 400 yr BP. Negrís (1904) estimated that the sea level of Classical antiquity was at least 3 m lower than today. Traces of quarrying in the port of Piraeus and Zea Harbor, remains of masonry on the coast of Drapetsona, parts

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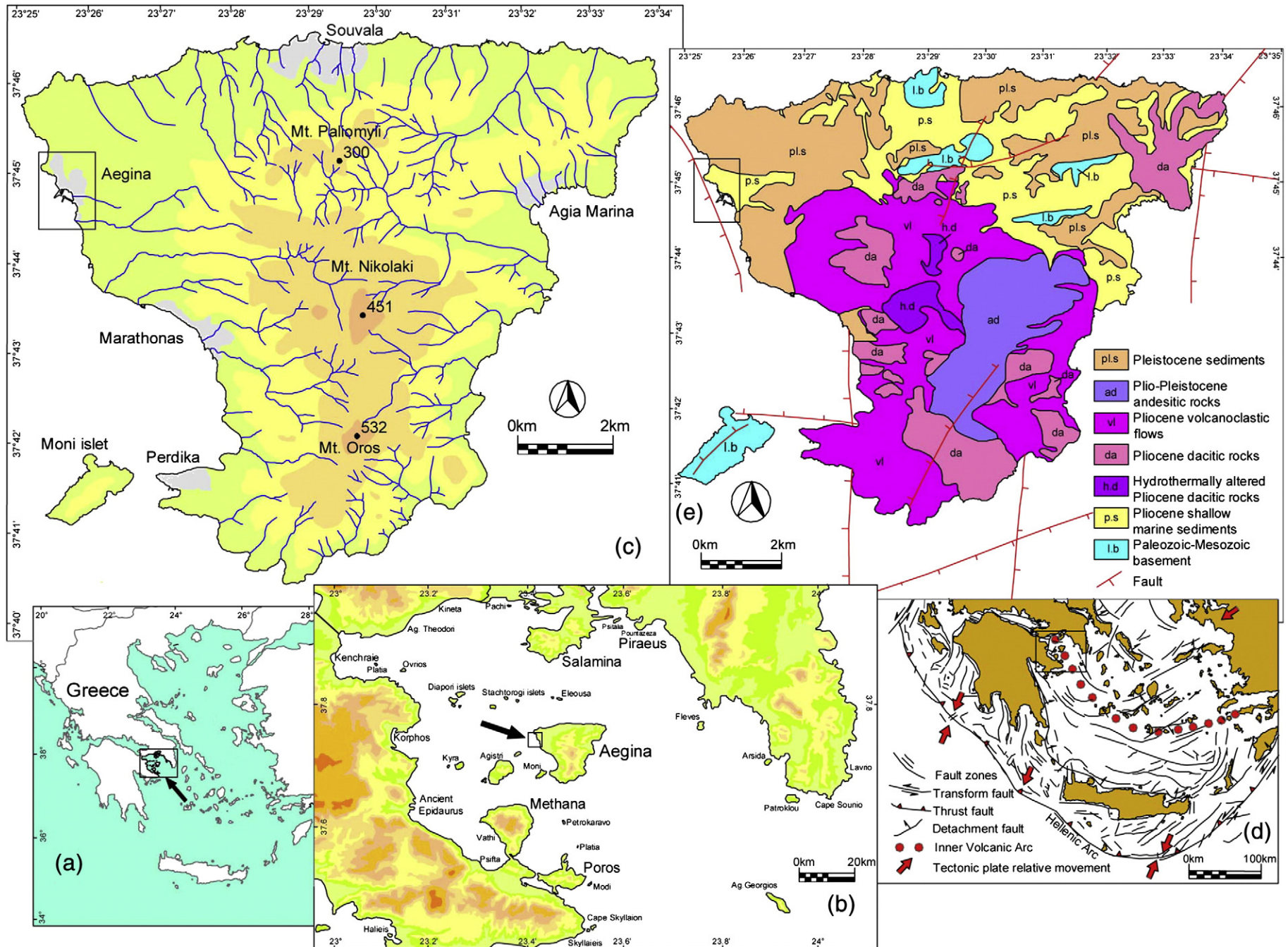


Fig. 1. (a), (b): Location maps of the Saronic Gulf, (c): map of Aegina island indicating the study area (rectangle), (d): geodynamic frame of the Hellenic Arc, (e): geological map of Aegina.

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