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Athens Sea outfall : geological data collection and evaluation

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From the greater Attiki district, where more than 3 million people live, an estimated 600.000 m^3 of domestic wastes and industrial effluents are discharged per day at the shallow water Keratsini bay, off Piraeus. Additional industrial and domestic wastes are discharged at Elefsis bay as well as along the Attiki coastline. As a results, the area at Keratsini bay and surroundings is heavily polluted , with fatal effects on the fauna and flora as well as on the aesthetic and amenity aspects in the greater area. In order to solve this problem, a sewage treatment and fluid, disposal plan was designed, involving building of a siphon for transferring the sewage from Keratsini to the nearby Psittalia island. At the island a treatment of the wastes will take place, while the remaining fluids will be discharged south of Psittalia by diffuser pipes laid down on the sea floor (Fig. 1).

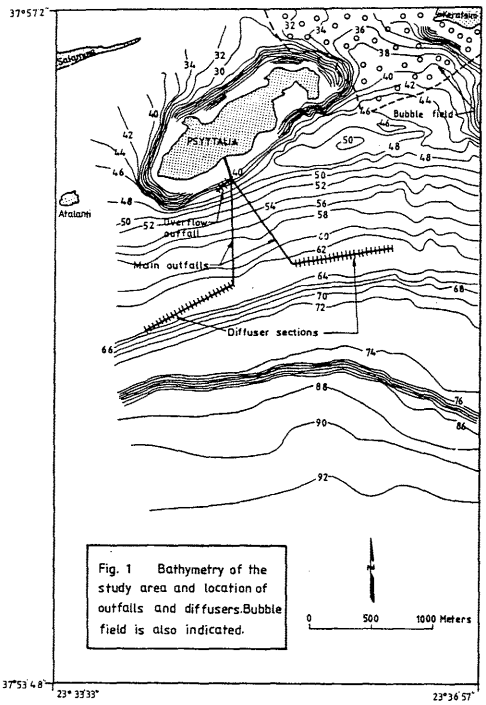
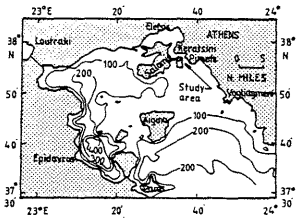
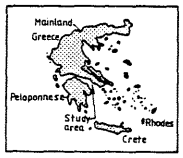


Fig. 1 Bathymetry of the study area and location of outfalls and diffusers. Bubble field is also indicated.





For the examination of the sea floor, where the siphon and pipe emplacement will take place, a detailed seismic and sedimentological research was carried out in the greater area. The seismic profiling was effected by the use of a 3,5 KHz and a Uniboom seismic system. The data showed that the sea floor morphology is smooth, except near the coastline and between the 74 to 86m, contours, where a steep gradient is observed. Also a N-S channel is formed between Keratsini and Psittalia island. The area is covered by a thin layer with transparent character and thickness up to 2m., which was correlated to the unconsolidated surface sediments. At deeper sectors two seismic units were discerned (B and C) having discontinuous and brocken seismic character and correlated with the Quaternary and the Triassic formations which crop out at the island. A different picture was obtained at the Keratsini-Psittalia channel where the seawage deposition has produced an extensive bubble field were the 3,5 KHz and Sparker-seismic systems were unoperational. At this area the Uniboom profiles indicated the presence on the floor of a layer with a thickness up to 6m., which was attributed to sewage deposition (Fig. 1).

Based on the seismic evidence a gravity and vibro coring program was subsequently effected along the lines of the emplacement of the diffuser pipes. The sediment analyses showed that the sea floor at the nearshore areas is covered by poorly sorted coarse biogenic sands, the western part is covered by silty sand while at the eastern part sandy silt predominates. The study of the cores, on the other hand, showed that two horizons are present, a lower one consisted of sand and silty sand and an upper one consisted of sandy silt and silt. The lower unit increases in thickness toward the north indicating derivation from Psittalia island while the upper unit increases in thickness toward the east showing transportation of fine grained material from the sewage area off Keratsini. At the bottom of six cores fragments of hard psammite and biogenic limestone were relieved which belong to the quaternary formation (unit B mentioned above). Thus the thickness of the unconsolidated sedimentary cover at the studied area, south of Psittalia, ranges from 10 to 167 cm.

All above show that rather minor technical work will be needed for the emplacement of the diffuser pipes.

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Tectonisation and sedimentation processes in the Cretan Sea

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In 1986 geological-geophysical studies were undertaken in the Cretan Sea with the research vessel SONNE (cruise SO 41).

The sedimentary record of recent and subrecent processes of sedimentation, as well as a mapping of tectonic lineaments, confirm the continuing subsidence and stretching of the coastal basins.

The Cretan Trough lies within two W-E trending fault systems. Intensive blockfaulting dissected the trough into numerous horsts and grabens (Fig. 1). Strong strechting of the continental crust in this region produced this tectonic structure. The Cretan Sea block was not only formed by vertical tectonic movements, but also through lateral slip-slide faulting. These lateral displacement were produced by different faces of drift- and rotation movements occuring between the African and Agais plates.

The study area revealed the presence of an oval shaped, flat basin in the area, which lies at depth of 1800 m. This place is recognized as the stress-release point between NW-SE and NE-SW trending lateral displacements. Subsidence is specially higher in this district.

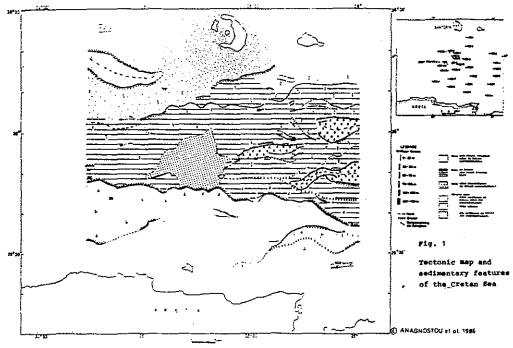

Fig. 1
Tectonic map and sedimentary features of the Cretan Sea

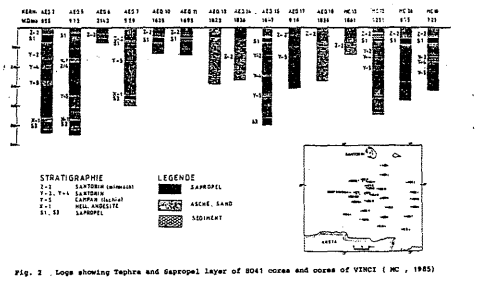

Fig. 2 . Logs showing Tephra and Sapropel layer of SO41 cores and cores of VINCI (MC , 1985)

In compiled potential field maps of the Cretan Trough, gravimetric and magnetic anomalies correlate with weak zones and tectonic structures.

In the deep sea sediments of the Cretan Sea, several Tephra- and Sapropel layers form, which further document, very well the tectonic nature of the region and its associated volcanic activity. In the study area piston core samples were also collected. Geochemical analysis of the Tephra layers and a differentation based on their chemical background yielded ash-like layering-pattern. Based on this manner of layering and the behavior between K_2O, Rb, Zr and Y versus SiO_2 , their volcanic origin could be established. A correlation of these ashes with those of existing Tephra- and Sapropel-chronologies give the age of the ashes in our research area (Fig. 2). Most Tephra originated from the volcanic eruptions of the greek archepelago, their main source being the eruption of the Santorin about 3.500 years ago. Another prominent source is the Ischia-layer , wich can be traced back to the Eruption of the Campanian Region (Southern Italy) about 34.000 years ago. They form reliable sources for determining the rates of sedimentation in the Cretan Sea. The high rate of sedimentation accounts for the continuing subsidence. This subsidence (5.00 to 7.7 cm pro 1000 years) is clearly higher than that of other regions in the Agais and southern Crete.

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