Archaeological topographical survey and marine geophysical investigation at ancient and medieval harbour of Kyllini/Glarentza (NW Peloponnese, Greece)

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The present study presents the preliminary results of the interdisciplinary topographical, underwater archaeological and marine geophysical survey conducted in NW Peloponnese, Greece, in order to shed light on the ancient harbour site and Crusader's port of Kyllini/Glarentza. Built by the Franks in the 13th century, it developed as one of the major ports during the Crusaders' period in NW Greece. The medieval harbour installations were built on the ancient port of Kyllini of the Classical period. It was an important naval base and harbour serving the sanctuary of Olympia.

The Kyllene Harbour Project is a joint project of the Finnish Archaeological Institute at Athens and the Department of Underwater Antiquities (Ministry of Culture). It is conducted in collaboration with the Departament of History, Archaeology and Cultural Resources Management, University of the Peloponnese, and the Laboratory of Marine Geology and Physical Oceanography, Department of Geology, University of Patras.

The remains of harbour installations of the medieval port are very extensive, including an inner and an outer harbour, demonstrating that the flourishing Crusaders' port consisted of different sections. One of the principal purposes of the interdisciplinary study is a detailed survey of the submerged remains in order to comprehend the layout of the harbour and to reconstruct the coastline for the different construction phases of the port (Classical and Medieval).

The coastal area under study is located at the northern end of the promontory of the Chlemoutsi headland, at the northwestern coast of the Peloponnese. Geologically, the area is a segment of a large coastal sandy plain with barrier lagoons, the Elis coastal plain, extending along the western coast of the Peloponnese. The coastal formations consist of Holocene alluvial deposits made up of colluvium, fluvio-torrential sediments, coastal dunes and beach material. At present, the shoreline of the Elis coastal plain is controlled by transgression and erosion, but in the past the coastal evolution had been controlled by the eustatic sea-level signal, local tectonic instability and diapirism.

The archaeological survey concentrated on the precise 3D topographical investigation using total stations to measure details of the harbour remains and shallow-water features. The marine geophysical study has, so far, employed a 3.5 kHz sub-bottom profiler system in order to examine the seafloor bathymetry and the recent sub-bottom stratigraphy of the coastal area. A side-scan sonar system was employed in order to examine the seafloor surface composition and the existence of potential targets on the seafloor. Furthermore, an Overhauser magnetometer survey was conducted in order to investigate the magnetic signature of the seafloor, especially in the area where the harbour remains are concentrated.

In the field campaigns of 2007-2009, the marine geophysical instrumentation carried out a dense grid of parallel and vertical lines to the shoreline, whilst the topographic survey of the underwater remains recorded more than 30 000 points which give detailed picture of the archaeological remains and their current setting. The water depths recorded by the echosounder and the shallow-water topographical survey were combined to present the total bathymetry of the area. All the collected data were georeferenced and displayed in a G.I.S. environment.

The synthesis of the collected data revealed the aerial distribution of the submerged harbour remains and the seafloor morphology related to the different ancient port

installations. Furthermore, it revealed targets of potential archaeological interest. Finally, the study demonstrated that the use of remote sensing techniques in conjunction with detailed archaeological and topographical survey in shallow-water coastal sites could be an effective methodological approach for the study of submerged ancient ports and coastal installations in the eastern Mediterranean.

Regional conceptual model of Upper Pliocene - Pleistocene aquifer formations from Dacian Basin in southern part of Romania

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The conceptual models of main aquifer structures from Southern Romania were carried out by spatial bounding of porous media, recharge and discharge area contouring, ground water flow description and by taking in consideration geomorphologic, climatologic and hydrologic factors.

The conceptual model represents the base of groundwater flow numerical simulation. Accurate groundwater flow conditions assessment underlies by clarifying the models such as geomorphological, climatological, hydrological, geophysical, geological and structural – tectonic, hydro-geological, hydro-geochemical, etc.

In accordance with spatial bounding, three major aquifer structures have been set out. The first one with largest extension from Dacian Basin corresponds of Dacian granular deposits. The second aquifer structure occurs in Lower Romanian permeable deposits and Upper Romanian - Lower Pleistocene aquifer formation is in the upper part of Neogene sequence. The porous formations from Dacian and Romanian are at shallow depths on the border regions of Dacian Basin. The aquifer formation of Lower Pleistocene with small depths has large extension, so that is of great interest for drinking water.

Vastly, the aquifer structures follow the Dacic Basin tectonic profile. In the Getic Depression, Carpathian Foredeep and in the connection zone between cratonic areas of the Moesian Platform with depression zone, both the depths and thickness of permeable deposits substantially increase. On these lines, in the eastern part from Olt River, in the Getic Depression area, the permeable deposits of Dacian and Romanian are deeper than 1500 – 1700 m, respectively 800 – 1400 m. In these conditions, the groundwater mineralization is very high.

The conceptual models development involve aquifer structures, spatial bounding and also identification of recharges and discharge area. The recharge zones cover large surfaces in the northern part of Dacic Basin. The natural groundwater discharge by line of springs, in surface waters, or other aquifer transfer zone exists in the southern part of the Moesian Platform. In the aquifer deposit outcrops, the recharge is by direct percolation of rain water, water losses from surface water network, shallow aquifers, etc. The recharge elevations have large variation from 70 - 80 m in plain area up to 800 - 850 m in northern regions. An important quantity of water recharge from granular deposits of the Lower Pleistocene formation provides by leakage of water from Dambovita - Arges, Prahova - Teleajen, Buzau and Putna alluvial cones.

In case of mathematical simulation of groundwater flow and groundwater resources assessment, of great importance is to understand all the factors which influence the groundwater movement. For quantitative assessment of groundwater resources on the regional scale, from a multitude of factors only some elements have representation. By consequence, excepted recharge and discharge elevations, rainfall, evapotranspiration, surface and underground water flow, the great importance have porous knowledge, aquifers storage, conductivities, leakage factors and parameters distribution.