FOSSIL CARBONATE CHIMNEYS DISCOVERED IN LOWER PLEISTOCENE MARINE SEDIMENTS OF SOUTHERN PELOPONESE, GREECE

Dimitris Sakellariou [1] *, Ioannis Fountoulis [2] and Vasilios Lykousis [1]
[1] Hellenic Centre for Marine Research, 19013 Anavysos, Greece - sakell@ath.hcmr.gr
[2] Dptm of Geology, University of Athens, Greece

Abstract
Herewith we report the first discovery and sampling of a field of fossil, non volcanic, carbonate chimneys at the coasts of Neapolis, Lakonia region in South Peloponese, Greece. Several hundreds of weathered but still erosion-resisting, pipe like chimneys, up to 2.5m high, rise vertically through marine Lower Pleistocene sediments. X-ray diffraction and X-ray fluorescence analyses yielded calcite composition for the chimneys tubes and siliceous composition for the orifices infill. Although the origin of the chimneys is not yet clear, we strongly suggest that they are associated with methane related cold seepages in the extensional basins of the Hellenic Forearc.
Keywords : Hellenic Arc, Mud Volcanoes.

Introduction
Cold seepages and related features (mud volcanoes, gas chimneys, authigenic sedimentation) have been reported and studied from modern submarine environments worldwide and the Mediterranean region particularly. Onshore active mud volcanoes occur in the northern Apennines while ancient seep/vent formations of various ages are known from the Appenines, the Moroccan Rif Belt, Algeria and the Middle Atlas[1]. Herewith we report the discovery of a vast field of carbonate chimneys and related structures, possibly associated with fluid seepages of non volcanic origin, in marine Pleistocene deposits of Southern Peloponese, Greece. The field is located along the shoreline of Agia Marina bay at the southern coast of Maleas Peninsula, south west of Neapolis town.

Field Observations and Laboratory Analyses
Marine pelites of Lower Pleistocene age form the low coastal area of the Agia Marina bay and are being locally overlain by biogenic carbonate formations or stromatolites. The Quaternary deposits may be as thick as 250-300m and cover unconformably alpine deformed, Triassic-Jurassic limestones [2]. On flat wave-cut terraces, developed parallel to the bedding planes of the pelites at 1-2m above the sea-level, pipe-like, upright standing, up to 2.5m high and 1m in diameter chimneys show a wide range of morphological types (cylindrical, conical, mushroom-like and mounded) and form a spectacular field, which covers an area of about 200x2000m or more (Fig.1& 2). Similar morphological types of chimneys have been reported from the Gulf of Cadiz [3]. Local people call Agia Marina field petrified forest but the positive structures are of carbonate composition and there is no evidence supporting this characterization. The chimneys are composed of hard but weathered, several cm thick, whitish, carbonate tube. The central orifice of the chimneys is filled up with dark grey, argillaceous material with numerous whitish, mm-thin, carbonate veins. Concentration of fossil biogenic communities composed of cm-large bivalves, echinoids and worm tubes occur together with the chimneys.

Fig. 1. View of cylindrical chimneys in Lower Pleistocene pelites of Agia Marina, Greece

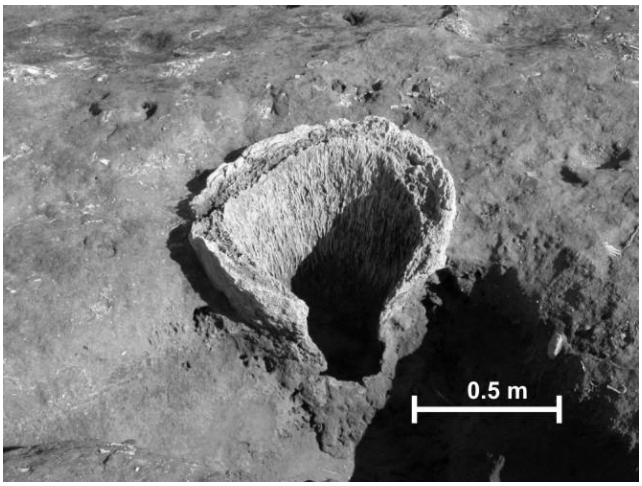

Fig. 2. Close view of conical carbonate chimney in the Agia Marina field.

The latter are commonly aligned on vertical E-W or NE-SW trending fractures sealed also by carbonate material and mm-thick veins, indicating that tectonic elements may have controlled the development of the chimneys and have been used as conduits for the upward fluid flow. Samples were taken from the least weathered chimneys and veins which seal the fractures. The bulk mineralogy was determined using X-ray diffraction (XRD) on powdered samples. The bulk rock chemical composition and major and trace elements were analyzed by X-ray fluorescence. The tube of the chimneys and the thin veins are mainly composed of calcite with subordinate quartz, while the significantly weathered fill of the orifices displays siliceous composition and muddy character.
Discussion
The impressive Agia Marina field of carbonate chimneys provides insights into the geodynamic regime of the sedimentary basins developed along the Hellenic Forearc in Lower Pleistocene. It implies new considerations on the importance of cold seepages and eventually the role of possible mud volcanism in post-alpine basins of the Hellenic Orogenic Arc.

References

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