



# Quaternary Continental and Marine Deposits in the Caves of the Aegean Islands, Crete and Coastal Peloponessus and their Importance for Understanding Past Environmental Changes

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## Abstract

Aegean sea islands and Crete make up one of the few areas worldwide with continental sediments rich in fossils of endemic Quaternary Mammals and in few cases with marine sediments also. On the other hand mainland caves are rich in Quaternary Mammals of normal size. During the last 30 years studies carried out by the University of Athens has brought to light impressive continental fossils from the past and new localities, which have provided science with *some* of the hidden bits of data from the past. In parallel a lot of effort has been given for dating upper Quaternary fossil Mammals, sea Molluscs and marine Terraces. All these bits of information represent pieces from the puzzle of the past environmental changes. We have just to collect all available pieces hidden in caves, arrange them together and get the final picture from our past.

Greece is rich in fossiliferous caves or in caves containing archaeological findings. Studying the fossiliferous caves we are obliged to deal with two different categories in respect to their Quaternary fossil fauna. Caves on the mainland have yielded non endemic fauna. It is important to note that continental fossils can be used for direct biostratigraphical correlation. The same is true for marine sediments. On the contrary this is not true for the fossiliferous sediments from the caves of the islands. Island caves include endemic fossil mammals. Endemic Island fossils can be correlated only with the help of adequate absolute dates. What is more important, there are only very few areas in the whole world, where endemic Quaternary mammals can be excavated and studied. There are also some Greek islands where Quaternary fauna includes continental forms (Kythera, Kefallonia). This occurs because these islands were not completely isolated during critical periods. Isolation events can be correlated with the major climatic events of the Quaternary. The same is true for the mainland caves. During cold periods, and low sea level a lot of coastal caves were accessible to land mammals. During cold periods, the decrease of the sea level minimized the distance of some islands from the nearby mainland. At these moments Mammals with good swimming capabilities managed to cross the sea corridors toward the islands. Migration is believed to have occurred in a sweepstake mode, but I feel that we must accept migration of small groups capable to give descendants and not the migration of lonely animals incapable to find partners of the opposite sex to give birth. These Mammals include elephants, hippopotamus and deer, all very good swimmers capable to cross the sea corridors to the nearby islands. After the first trip to the island, with no return ticket, they had to stay there, survive and evolve or become almost instantly extinct. The area of the islands was during cold periods larger than today. Due to the absence of natural enemies (big carnivores and man) on these islands Mammals did not have any good reason to cross the same sea corridor in the opposite direction. Even if they sometimes managed to do it, we cannot prove it. They stayed on the islands and they evolved to endemic forms, usually smaller than their mainland ancestors. They had a nice quite life, with some bad moments. Once in a while nearby volcanoes through up in the air great quantities of volcanic ash that covered the islands, polluted surface water and destroyed the grasslands necessary for providing food. When the phenomena were intensive, the endemic forms could not survive. When the phenomena were mild, endemic forms managed to go on, for thousand of years, up to the next period of unfavorable conditions (THEODOROU, 1988). Some times the islands endemics were lucky enough to meet new incomers from the mainland. The interbreeding provided new genetic material and new forms evolved. The change of world climate and the increase of temperature had as result the flooding of the available low grasslands on the islands. Sometimes water flooded even the places where Mammals used to live. Other times Mammals were not lucky because man arrived on their islands, possibly at a moment when they had taken already the one-way to their extinction from natural causes. During the critical period that followed the last sea transgression after the last major climatic minimum around 18.000 y ago, man, volcanism and climatic conditions competed each other. The looser was always the lively endemic Mammals, on the islands but also their non endemic cousins on the mainland though the influence of Volcanism was insignificant on mainland where animals could easily go away and avoid the falling volcanic ash. Sea level changes can be documented in addition to the depositional events by destruction events or traces available in numerous caves in the wider Aegean area by notches and traces of

sea level indicators. And the same must be true for Earthquake events of long periods causing some caves or cave roofs to collapse, though no serious work has been done in this field. Some times man has left his traces in the same sediments. The processes mentioned continue to our times. It's not a coincidence that sea otters, only a few steps away from their extinction are hiding and breeding today in the small coastal caves of the Nature Reserve of North Sporades, protected, at least on paper, from the greediness and ignorance of man. The story continues, only the actors have changed. The last words have not been written yet, since sediments continue to be deposited in hundreds of caves, typing slowly the archives of the future. The magnificent information for this story is not stored only in the few caves mentioned in this paper as examples. It is stored in numerous caves, in the hard disks of the Quaternary and in the continental and marine sediments of Aegean Archipelago wider area.

Charkadio cave on the small island of Tilos (Dodecanese) (SYMEONIDIS, 1972. BACHMAYER *et al.*, 1984, THEODOROU 1983, 1988, <http://www.tilos.edu.gr>) has given endemic deer, which became extinct by the fury of the volcanic activity of the majestic Aegean Volcanic Arc, before about 140.000 y. The last European Elephants became extinct on the same island just about 4.000 to 3.500 y ago as it is shown by their valuable remains in the same cave after prospering on the Island for more than 40.000 y. We are still working hard excavating the necessary information to find out, and document beyond reasonable doubt, who has given the final shot for their extinction, man or nature?

The numerous coastal caves of northern Crete (KUSS 1975, SONDAAR *et al.* 1986, SONDAAR 1986, MARINOS *et al.* 1976, THEODOROU 1985, SYMEONIDIS *et al.* 2000) only slightly scratched by the modern palaeontologist, still hide in their extremely rich sediments fossils, of deer and elephants and sometimes hippos, micro mammals and fossil birds. The fantastic myth about Odysseus and the one eyed Cyclopes represents the first attempt of man to explain the occurrence of bones, tusks and elephant skulls (with the unique nasal opening for the trunk - the Central Eye of the mythical Cyclopes) on Crete and possibly on other Mediterranean islands. The submerged elephant bones at the Vamos cave near Chania Crete belonging to a new endemic elephant species - *E. chaniensis*, first presented to science just a few months ago (SYMEONIDIS *et al.* 2000) and the submerged hippopotamus fossils of Diros Cave on southern Peloponessus oblige the most doubtful of us to accept that environment was drastically changing long before the Ozone problem, or the CO<sup>2</sup> crisis. Long before the first internal combustion engine. If we want to understand what happens now with climatic changes we have to understand what happened at the past. We have to look closely to the caves and their magnificent dirty, ugly, wet mud or hardened sediment deposits and look well at the broken or fallen, by past earthquakes, stalagmites and stalactites. Science has just started to download from the cave sediments the well coded information about the environment that man faced at this corner of our planet a few thousands year ago. We should do one more step. We must correlate carefully and date (ZACHARIAS, 1998, BASSIAKOS *et al.*, 2001) all major events, with a multi-methodological approach the information from CON-(tinental) sediments with MAR-(ine) sediments found in numerous caves of Eastern Mediterranean Sea in a joint CONMAR - approach. The real problem is that only scientists with adequate speleological background, and field experience in promising cave systems can understand and evaluate correctly the quality and magnitude of information and the hidden possibilities that cave sediments can offer to us, only if we look carefully.

Caves sediments, continental and/or marine make up the real playground of Quaternary climate. Speleologists, scientists or experienced cavers, have learned to look well below the surface.

A lot of data wait to be recovered.

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