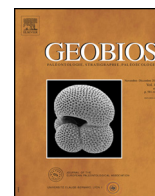




Available online at  
**ScienceDirect**  
[www.sciencedirect.com](http://www.sciencedirect.com)

Elsevier Masson France  
**EM|consulte**  
[www.em-consulte.com](http://www.em-consulte.com)



Original article

## Fish otoliths from the Pliocene Heraklion Basin (Crete Island, Eastern Mediterranean)<sup>☆</sup>



Konstantina Agiadi<sup>a,\*</sup>, Efterpi Koskeridou<sup>a</sup>, Maria Triantaphyllou<sup>a</sup>,  
 Angela Girone<sup>b</sup>, Vasileios Karakitsios<sup>a</sup>

<sup>a</sup>Department of Historical Geology and Palaeontology, Faculty of Geology and Geoenvironment, National and Kapodistrian University of Athens, Panepistimioupolis 15784, Athens, Greece

<sup>b</sup>Facoltà di Scienze, Dipartimento di Geologia e Geofisica, Campus Universitario, Via E. Orabona 4, 70125 Bari, Italy

### ARTICLE INFO

#### Article history:

Received 24 February 2013

Accepted 31 July 2013

Available online 22 October 2013

#### Keywords:

Teleostei

Systematics

Palaeobiogeography

Zanclean

Pliocene

Eastern Mediterranean

### ABSTRACT

The Pliocene Eastern Mediterranean fish record is revealed through the study of a 60-m thick stratigraphic sequence near the village Voutes (Heraklion, Crete). Forty-two species belonging to twenty families are identified. Calcareous nannoplankton biostratigraphy places the studied sequence within the biozone MNN16a (latest Zanclean). The stratigraphic distribution of 31 species is modified. Among these, 12 species are reported for the first time in the Eastern Mediterranean Zanclean, while 19 species are first reported outside the Ionian Sea. The Voutes fish fauna presents a diversified benthic and benthopelagic assemblage filling a significant gap in the fossil record.

© 2013 Elsevier Masson SAS. All rights reserved.

## 1. Introduction

Fish otoliths, the aragonitic incremental structures within the teleostean fish's inner ear, present taxon-specific morphology, which enables fossil fish assemblage reconstruction, since they are highly frequent in sediments of various environmental settings, ranging from lake to deep-sea deposits, and they are generally well preserved (Nolf, 1985). In addition, numerous studies have illustrated their value as palaeoecologic and palaeobathymetric indicators, providing very detailed and accurate palaeobiological and palaeoclimatic information.

The Pliocene Mediterranean fish fauna comprised typical tropical and subtropical taxa, which mostly inhabited the basin following its reconnection to the Atlantic Ocean, after the Messinian Salinity Crisis (Landini and Sorbini, 2005). Pliocene fish remains have been identified through several studies in the Western Mediterranean realm (Nolf and Martinell, 1980; Nolf and Girone, 2006; Girone, 2007). However few studies have been performed in the eastern sub-basin, almost all currently available information coming from fish skeletal remains. New Zanclean otolith-based fish fossil data for the Eastern Mediterranean basin are presented here for the first time, through the systematic study and analysis of the Zanclean fish otolith assemblages of the Voutes section (Heraklion, central Crete).

## 2. Geological setting

The Crete Island originated during the late Miocene through the N-S and E-W extensional deformation of the south Aegean, resulting in the formation of multiple tectonic blocks and late Miocene to Pleistocene sedimentary basins (Meulenkamp et al., 1988; Van Hinsbergen and Meulenkamp, 2006). The Neogene sediments overlie a pile of alpine nappe substratum, which includes the metamorphic Plattenkalk and Phyllites-Quarzites Units followed by the Tripolis and Pindos-Ethia, as well as other minor units (Zachariasse et al., 2011).

The presently emerged area of the Heraklion Basin is a Pliocene graben structure located at the northern part of the central Crete Island, in the southern segment of the Hellenic Arc, between the mountains Psiloritis and Dicti. The alpine basement formations contain a rich mélange of Triassic to Eocene sedimentary and metamorphic rocks, overlain by Neogene and Quaternary sedimentary deposits, recording a great diversity of environments and ecosystems (Symeonidis and Konstadinidis, 1967). The Pliocene Heraklion Basin occurred in a region marked by a great number of successive paleogeographic Miocene frameworks, in the vicinity of the Messara basin. In the latest Tortonian the activation of the E-W-oriented Agia Varvara fault differentiated the two realms, which evolved separately since that time (Delrieu et al., 1991). The Pliocene deposits of the Heraklion Basin are the most extensive ones in the Island. The marine sediments of the lowermost Pliocene generally overlie the late Messinian deposits (Delrieu et al., 1991;

<sup>☆</sup> Corresponding editor: Gilles Escargueil.

\* Corresponding author.

E-mail address: [kagiadi@geol.uoa.gr](mailto:kagiadi@geol.uoa.gr) (K. Agiadi).

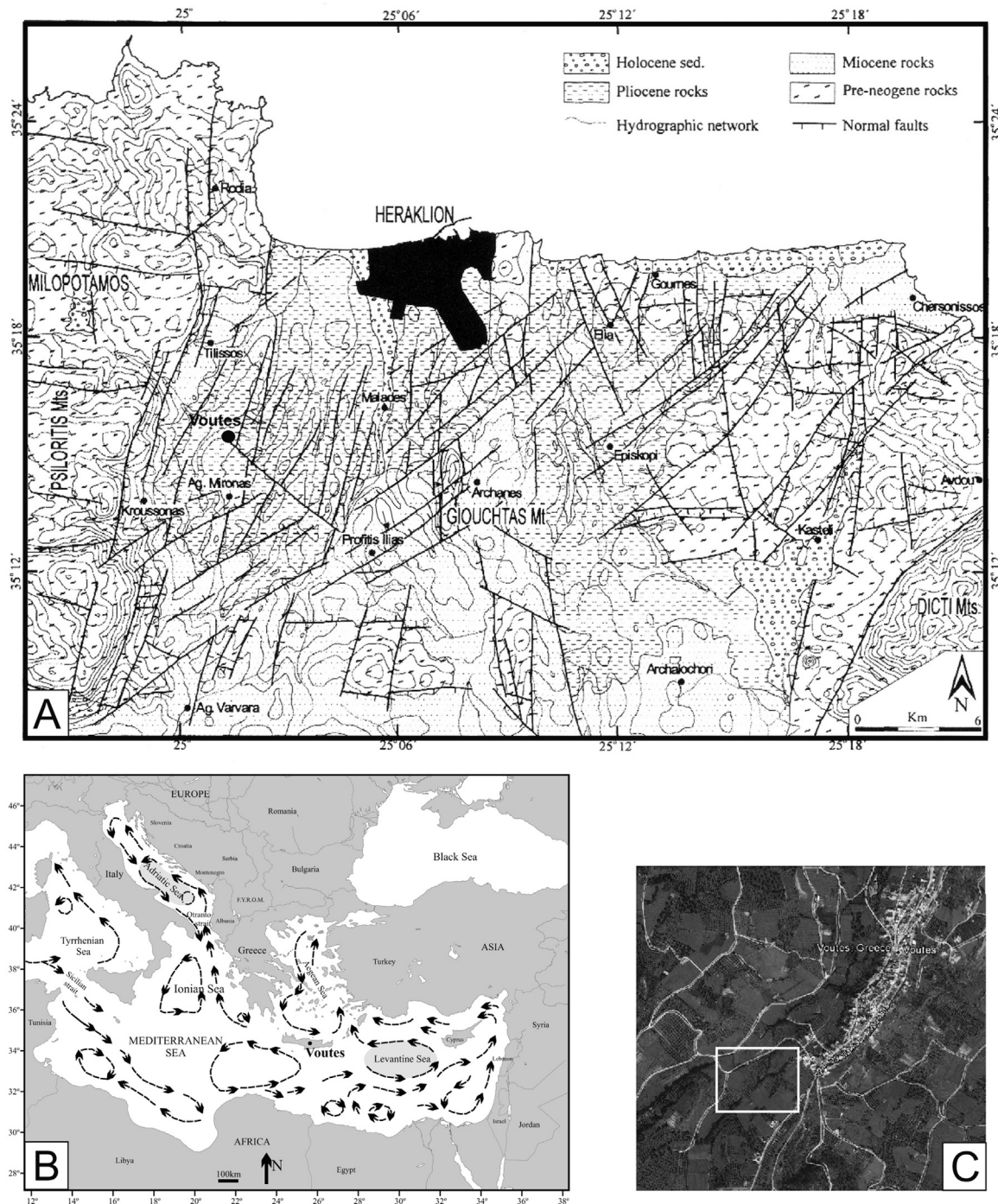
Meulenkamp et al., 1979, 1994), and consist of whitish marls and marly limestones of deep-water origin, reflecting the Pliocene flooding which followed the lago-mare episode immediately after the Mediterranean Salinity Crisis.

The studied Voutes section is located southwest of the village Voutes in central Crete, south of Heraklion city. Geologically it is situated in the western section of the Heraklion Basin (Fig. 1). The section sediments may be placed within the Finikia lithostratigraphic group of Benda et al. (1974) and Meulenkamp et al. (1979); they include more than 60 m of marls and sandy marls (Figs. 2–4). On the lower part of the section, strong gravity flows have formed a

series of sand lenses with distinctive sedimentological attributes and characteristic fauna (Fig. 5). The upper part of the section presents three diatomite horizons.

### 3. Material and methods

Overall, nine sediment samples were taken; 25 kg each, along the Voutes section (Figs. 2 and 3). Sample 1 was taken from the uppermost diatomite horizon, which is bare of other faunal remains. Sample 2 was collected from the uppermost marls, which present a rather rich macro-invertebrate fauna, including



**Fig. 1.** Location of the study area. **A.** Geological map of the Heraklion area (simplified after Fassoulas, 2001), indicating the Voutes village. **B.** Map of the Eastern Mediterranean including the major circulation patterns. Grey sea areas denote deep-water formation regions. **C.** Photograph of the study area (obtained from Google Earth). The square marks the extent of the Voutes outcrop.

Download English Version:

<https://daneshyari.com/en/article/4748056>

Download Persian Version:

<https://daneshyari.com/article/4748056>

[Daneshyari.com](https://daneshyari.com)