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Fish otoliths in superficial sediments of the Mediterranean Sea

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ABSTRACT

Otoliths represent a significant biogenic carbonate component in marine sediments that may provide valuable information for paleoenvironmental and biogeographic reconstructions. In spite of their importance, relatively little is still known about the taxonomic composition, abundance and early taphonomic characteristics of recent otolith death-assemblages, which would add to their value to interpret situations in the geological record. Here we present data on the distribution of fish otoliths from bottom sediments collected in the central Mediterranean Sea ranging in depth from 51 to 3300 m. The preservation of otoliths ranges from fresh semi-translucent (white) specimens to dull-coloured (dark) ones, although whitish specimens are predominant across all the samples. This diversity in lustre and colour and at times texture reflects the degree of early taphonomic processes undergone by these aragonitic bodies *post-mortem* under submarine conditions, never being exposed to diagenetic processes on-land. In general, a correlation with depth is observed, with best preservation observed in otoliths sampled at depths <500 m, while more degraded specimens occur deeper. In the upper depth range (<500 m), a substantial number of benthic and benthopelagic taxa is counted with respect to mesopelagic taxa, which prevail from 500 down to 3300 m. The taxonomic composition and relative abundance of each taxon of otolith death-assemblages at various depths conform well to the distribution of related Mediterranean modern fish communities. The occurrence of pre-modern subfossil taxa in the death-assemblages is evidenced at some bathyal sites by the overwhelming presence of many highly-degraded (worn, chalky, opaque and patinated) otoliths and locally extinct species. This is the case of *Protomyctophum arcticum*, a mesopelagic myctophid absent in the modern Mediterranean Basin that represents an Atlantic Pleistocene 'cold guest' fish in the Pleistocene of this basin.

1. Introduction

Saccular fish otoliths represent a significant biogenic component of marine sediments although their major abundance is documented from the Cenozoic onwards (Nolf, 1985, 2013). They may at times even predominate in fossil assemblages, and this is especially true in hemipelagic and bathyal situations where other skeletal macrocomponents could be less represented in the sediments. Otoliths hold an important and independent role to achieve paleoenvironmental reconstructions since they are shed by mobile organisms from a variety of taxa living in different parts of the water column, from surface down to the benthic layer, in a wide bathymetric range and responding to a vast spectrum of salinity and oxygen content (e.g., Limburg et al., 2015). Besides their value as ecological indicators, these mineralized skeletal parts prove useful also as archives to unravel delicate ecological as well as oceanographic problems (e.g., Brickle et al., 2016; Iacumin et al., 1992; Zazzo et al., 2006). Finally, their ecostratigraphic value is also significant (Kotlarczyk et al., 2006).

Since otoliths are calcified as metastable aragonite and more rarely as vaterite (Gauldie, 1993; Kalish, 1993), they are easily and quickly exposed to post-mortem taphonomic processes that could alter their texture until their ultimate dissolution (Cherns and Wright, 2009; Flügel, 2010). Otolith survival in the fossil record, therefore, largely results from certain ambient conditions, such as burial in fine-grained sediments. This explains also why fossil otoliths are more commonly found in muddy and mudstone lithologies deposited in outer-shelf to bathyal conditions (e.g., Brzobohatý et al., 2003; Girone et al., 2010; Lin et al., 2016b; Nolf and Steurbaut, 2004; Radwańska, 1992; Schwarzhans, 1985; Stringer, 1998), although they have been reported as abundant also from considerably shallower settings, such as the Eocene shallow neritic otolith assemblages from the Anglo-Belgian-Parisian Basin (Nolf, 1972; Nolf and Cappetta, 1976; Nolf and Lapierre,

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