

Evidence for vertical motility in Campanian deep-water agglutinated foraminifera: The Furlo volcanic ash layer

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ABSTRACT

Evidence for vertical motility has been observed among six Campanian deep-water agglutinated foraminiferal species from the Furlo Bentonite in the Umbria-Marche Basin, Italy.

INTRODUCTION

Modern agglutinated foraminifera inhabit a variety of habitats within the sediment column, and some species have been observed to burrow beneath the sediment surface (Kaminski *et al.*, 1988). Vertical motility among modern agglutinated foraminifera has been observed directly in experimental studies (e.g., Ernst *et al.*, 2000). However, the phenomenon of vertical motility in fossil assemblages remains a matter for speculation.

In this study, we report evidence for vertical motility among certain Campanian deep-water agglutinated foraminifera. Near the town of Furlo, Italy a 15 cm-thick bentonite layer occurs within the Scaglia Rossa Formation of the Umbria-Marche Basin. The deposition of this volcanoclastic layer caused mass mortality among benthic foraminifera, and an interesting succession of recolonisation assemblages has been documented in the Scaglia limestone directly overlying the bentonite (Galeotti *et al.*, 2000). Previous analysis failed to find evidence for the presence of benthic foraminifera within the bentonite layer. For this study, we resampled the basal 3 cm of the Furlo bentonite in an effort to determine whether or not any of the benthic foraminifera were able to partially exhume themselves following the deposition of the volcanic ash layer.

RESULTS

A large sample (ca. 250 g) from the basal portion of the Furlo bentonite was washed and examined for foraminifera. Twenty-one specimens were found, belonging to six species: *Glomospira serpens*, *Clavulinoides subparisiensis*, *Glomospirella* sp., *Recurvoides* sp., *Saccammina* sp., and *Paratrochamminoides* sp. The bulk of the ash layer is barren of foraminifera.

DISCUSSION

We believe the DWAF specimens recovered from the basal portion of the bentonite attempted to actively exhume themselves after being buried by over 15 cm of volcanic ash. We exclude the possibility that these specimens were mixed upward by bioturbation, because we did not find any specimens of planktonic foraminifera in our sample. Beneath the Furlo bentonite the P/B ratio in the Scaglia Rossa is very high (ca.

99%), and if our specimens were passively mixed into the ash we would expect to find numerous planktonics. Furthermore, the bulk of the agglutinated assemblage beneath the ash consists of tubular forms such as *Rhizammina*. These were absent in our sample.

The finding of specimens that mostly belonging to tapered, elongate morphotypes such as *Glomospira serpens* and *Clavulinoides subparisiensis* confirms our prior assumptions about the link between morphology and life position. The tapered elongate forms are presumed to live in a deeper infaunal habitat, and possess the optimal shape for burrowing activity. *Glomospirids* and *Saccammina* are assumed to occupy a shallow infaunal habitat, and actively crawl beneath the sediment surface. Motility has been observed in living specimens of *Ammodiscus*.

Our findings confirm observations of Hess & Kuhnt (1996), who found Rose Bengal stained agglutinated foraminifera in the basal portion of the 1991 Mt. Pinatubo ash layer in the South China Sea. These authors found that within three years following the deposition of the ash, certain species of DWAF were able to crawl upwards 1-2 cm into the ash layer. The reason for this vertical motility may be to escape oxygen depletion beneath the volcanic ash layer, as benthic organisms consumed the oxygen in pore waters. However, in both the modern and Campanian examples, the ability of the foraminifera to exhume themselves is apparently limited, and the deposition of more than about two cm of volcanic ash results in total mass mortality among the benthic foraminiferal fauna.

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