

Nannoplankton in the manganese deposits of the Mozambique Ridge and Mozambique Basin, southwestern Indian Ocean

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Introduction

During the SO-183 cruise of the RV *Sonne* (Jokat 2006), dredging of the Mozambique Ridge and the Jaguar seamount in the Mozambique Channel resulted in the collection of a suite of manganese nodules and encrustations (Watkeys *et al.* 2006). In this paper the age of the manganese mineralization is obtained from nannofossil assemblages that occur as cores to nodules, as basal layers to the manganese encrustations, and as interlayers within the encrustations. Nannofossils are proved to be very useful tool for the identification of the age of deposits (Bosman *et al.* 2007), especially when very small quantities of sediments are available for analysis.

Material and methods

The nannoplankton assemblages come from samples collected from three localities on the Mozambique Ridge and one on the Jaguar seamount. The preservation of nannofossils is generally good and moderate. Standard techniques of nannoplankton identification and description of assemblages were employed for all 21 samples (Bosman *et al.* 2007; Green *et al.* 2008). In this study we have used the most popular scheme by Gartner (1977) for Pleistocene biostratigraphic zonation. The definition of the Pliocene/Pleistocene boundary we recognize by the first occurrence of *Gephyrocapsa oceanica* s.l. (Green *et al.* 2008). The standard zonation by Martini (1971) has been used for the Pliocene interval. Rio *et al.* (1990) proposed a very detail Pliocene–Pleistocene zonation for the Mediterranean region.

Results and conclusions

Almost all samples contained representative nannoplankton assemblages, which include 62 species, with 10 species being reworked from Upper Cretaceous, Upper Oligocene, Middle Miocene, and Lower Pliocene (Table 1, Fig. 1).

In general, all samples can be referred to various parts of the interval of Zones NN15–NN21 (Gartner 1977; Martini 1971) or Zones MNN14–MNN21 (Rio *et al.* 1990), i.e. their origin can be dated by the Early Pliocene–Holocene.

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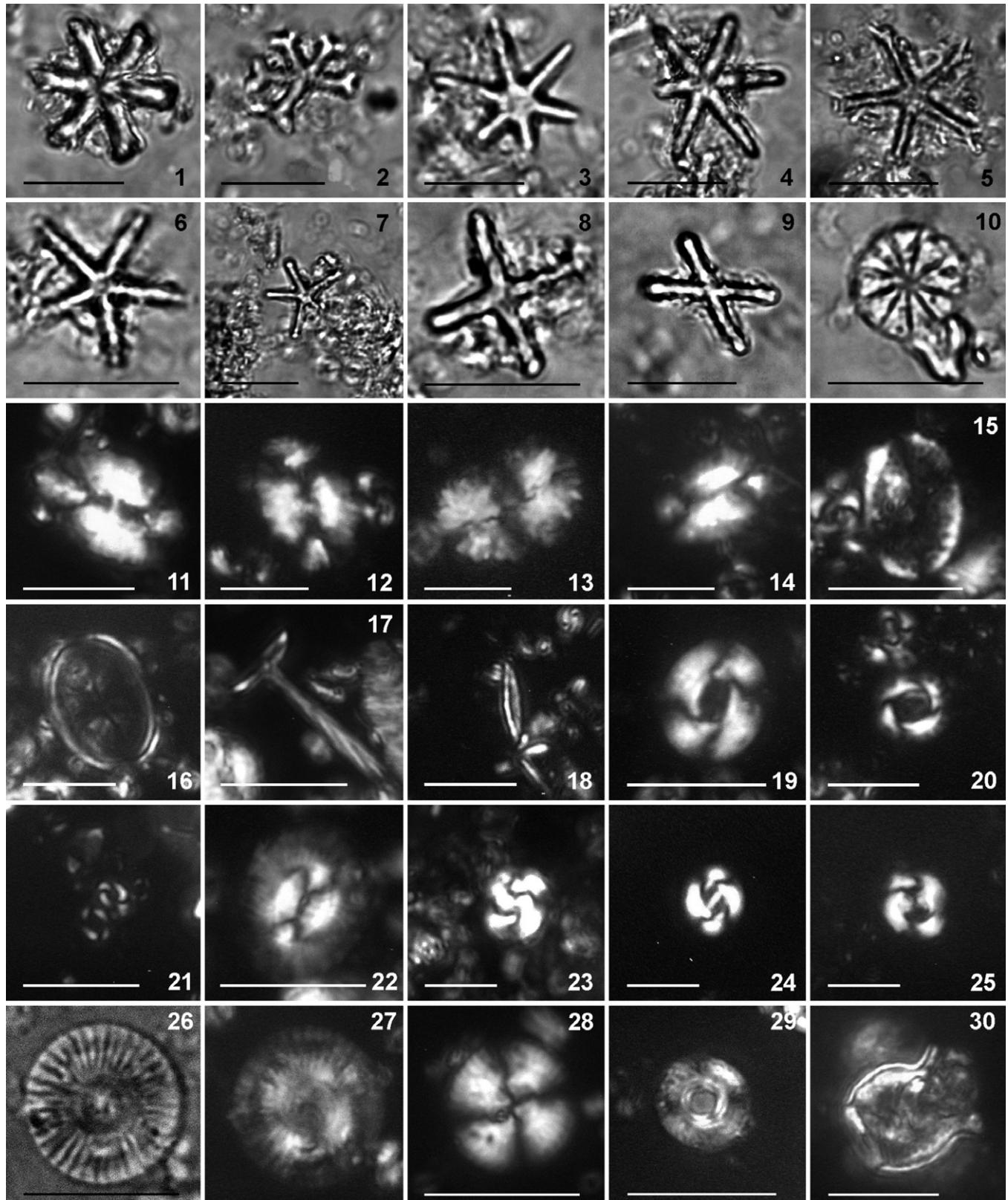


Figure 1. Calcareous nannoplankton from the Mozambique Ridge and the Jaguar seamount in the Mozambique Channel. All illustrations are light micrographs. The abbreviations 'pol' and 'tr' denote polarized and transmitted light, respectively. Scale bar of samples 1–10, 15, 17, 19, 22, 26–30 is 10 µm. Scale bar of samples 11–14, 16, 18, 20, 21, 23–25 is 5 µm. 1, *Discoaster surculus*, sample 05–34, tr; 2, *D. variabilis*, sample 05–34, tr; 3, *D. brouweri*, sample 05–36, tr; 4, *D. cf. brouweri*, sample 05–34, tr; 5, *D. pentaradiatus*, sample 05–36, tr; 6, *D. quinqueramus*, sample 05–34, tr; 7, *D. asymmetricus*, sample 05–37, tr; 8, *D. tamalis*, sample 05–36, tr; 9, *D. blackstockae*, sample 05–43, tr; 10, *Hayaster perplexus*, sample 05–34, tr; 11, *Helicosphaera sellii*, sample 05–48, pol; 12, *H. sellii*, sample 05–43, pol; 13, *H. kampfneri*, sample 05–48, pol; 14, *H. carteri*, sample 05–48, pol; 15, *Pontosphaera discopora*, sample 05–43, pol; 16, *Syracosphaera pulchra*, sample 05–38, pol; 17, *Rhabdosphaera claviger*, sample 05–53, pol; 18, *Scapholithus fossilis*, sample 05–34, pol; 19, *Reticulofenestra pseudoumbilicus*, sample 05–34, pol; 20, *Pseudoemiliania lacunosa*, sample 05–38, pol; 21, *Emiliania huxleyi*, sample 05–01, pol; 22, *Coccolithus pelagicus*, sample 05–36, pol; 23, *Gephyrocapsa caribbeanica*, sample 05–53, pol; 24, *G. oceanica*, sample 05–48, pol; 25, *G. sp.*, sample 05–48, pol; 26, *Calcidiscus macintyrei*, sample 05–48, tr; 27, *C. macintyrei*, sample 05–48, pol; 28, *C. leptoporus*, sample 05–36, pol; 29, *Umbilicosphaera sibogae*, sample 05–36, pol; 30, *Scyphosphaera cf. globulata*, sample 05–37, pol.

Table 1. Taxonomic list of calcareous nannofossils from the samples of the manganese deposits of the Mozambique Ridge and Mozambique Basin with abundance (Liu *et al.* 1996) and preservation observations (Shafik *et al.* 1998). A, abundant; C, common; F, few; R, rare; RR, very rare; G, good; M, moderate; P, poor; r, reworked. Nannofossil Zones: H.s., *Helicospaera selliti*; s.G., small *Gephyrocapsa*.