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Oligocene dinoflagellate cyst biostratigraphy of the southern North Sea Basin

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Abstract

The Rupelian (Lower Oligocene) and Chattian (Upper Oligocene) stratotype sections are both defined on the basis of the southern North Sea Basin sedimentary successions. The characterisation of biotic events occurring within the stratotypes (and equivalents) is vital for the recognition of these stages outside the North Sea Basin. Although the restricted marine setting of the North Sea Basin during most of the Paleogene clearly hampers 'traditional' calcareous microfossil calibration, organic-walled dinoflagellate cysts (dinocysts) are increasingly successful in the stratigraphic analysis and calibration of the marginal-marine North Sea Basin successions. Here we present a high-resolution Oligocene dinocyst biostratigraphic zonation scheme for the southern North Sea Basin based on previously published and new dinocyst studies from Belgium, northern Germany and The Netherlands. Eight (southern) North Sea Oligocene (NSO) dinocyst zones (biozones) and four subzones are here defined. Their application on a regional and inter-regional scale is discussed. The stratigraphic important Late Oligocene dinocyst taxon *Triphragmadinium demaniae* gen. and sp. nov. is formally described.

Keywords: Oligocene; dinoflagellate cysts; biostratigraphy; North Sea Basin

1. Introduction

The Paleogene successions of the North Sea Basin (Fig. 1) rank among the best-documented passive margin systems worldwide, e.g., in terms of facies history, biostratigraphy and sequence stratigraphy. Yet, despite the fact that local biostratigraphies achieve very high resolution and accurate regional correlations, chronostratigraphic calibration of the successions to 'international' time scales (e.g., Berggren et al., 1995) remains problematic. This is due to: (1) the marginal marine, siliciclastic nature of most deposits, leading to the near absence of age-indicative planktonic calcareous microfossils; (2) the effect of

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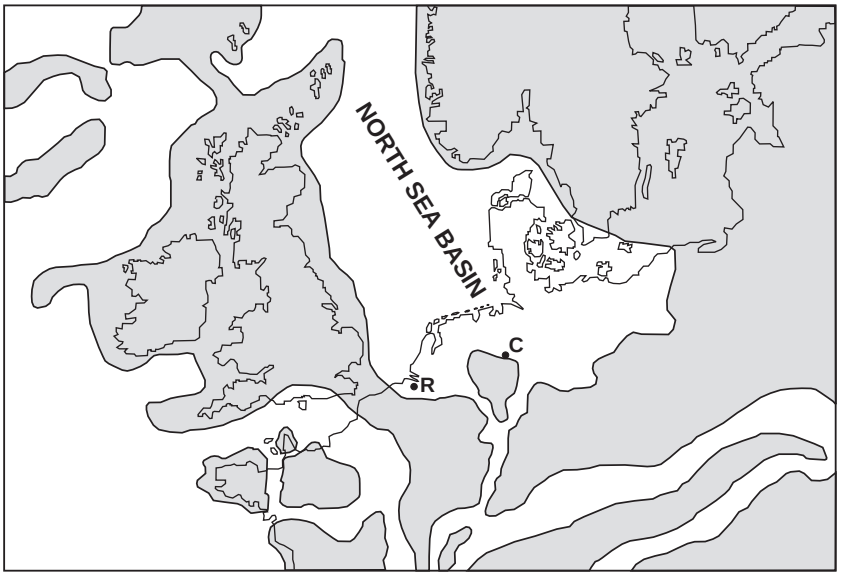

Fig. 1. Paleogeographic reconstruction of the mid-Oligocene North Sea Basin, showing the location of the Rupelian (R) and Chattian (C) unit-stratotypes (modified after Ziegler, 1990; Verbeek et al., 2002 and Sissingh, 2003).

weak paleomagnetic signals; and (3) the widespread occurrence of tectonically and/or eustatically induced unconformities. Moreover, many of the Late Eocene and Oligocene biostratigraphic calibration problems arise from the additional effects of global climatic cooling (e.g., Zachos et al., 2001; DeConto and Pollard, 2003). Changing surface temperatures had a severe impact on the biotic communities; species migrated towards lower (warmer) latitudes, resulting in the notoriously diachronous nature of many biotic events at this time (e.g., Wei and Wise, 1990; Brinkhuis and Visscher, 1995; Prothero et al., 2003). In addition, and as a result, many of the biotic events used in various 'standard' Oligocene zonations are not recorded at middle and high latitudes, or occur diachronously. Other correlation and calibration problems arise from the apparently restricted marine setting of the North Sea Basin during the Oligocene. The semi-enclosed basin only had two narrow outlets: a northern connection with the North Atlantic and temporary southern connections with the para-Tethys (Fig. 1). This aspect clearly enhanced an endemic flora and fauna. While noting the calibration problems, dinocysts are increasingly successful in the stratigraphic analysis and calibration of the marginal-marine Paleogene and Neogene North Sea Basin successions (Powell, 1992; Bujak and Mudge, 1994; Stover and Hardenbol, 1994; Powell et al., 1996; Louwye et al., 1999, 2000; Dybkjær and Rasmussen, 2000; Eldrett et al., 2004). Many of the dinocyst events are now recognised outside the North Sea Basin, indicating their potential for inter-regional chronostratigraphic correlations. In order to explore this potential further, we here provide an updated, detailed dinocyst zonation scheme for the southern North Sea Basin Oligocene successions by integrating previously published information with results from recent studies of outcrops and boreholes in Belgium, The Netherlands, and northern Germany.

2. Material and methods

The southern North Sea Basin Oligocene successions are important in that they contain the Rupelian (Lower Oligocene) and Chattian (Upper Oligocene) stratotype sections. The stiff clays outcropping along the Rupel River in NW Belgium constitute the type-Rupelian, while the Doberg section in northern Germany comprises the type-Chattian (Fig. 1). Despite the many (micro)paleontological studies on the type- and paratype sections (for an overview see Van Simaeys et al., 2004), until a decade ago, dinocyst biostratigraphy suffered from poor resolution (e.g.,