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PALAEO

Palaeogeography, Palaeoclimatology, Palaeoecology 225 (2005) 266–282

www.elsevier.com/locate/palaeo

Ostracod diversity and sea-level changes in the Late Cretaceous of southern England

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Abstract

The available data of ostracod ranges for the Cenomanian, Campanian and Maastrichtian stages of the Late Cretaceous of the northern part of the Anglo-Paris Basin were examined and combined with new data from the Turonian, Santonian and Coniacian stages. A new cumulative species diversity curve is presented for the Ostracoda of the Late Cretaceous of Britain. The results obtained challenge the method of chronoecologic charts to determine sea-level from diversity. When a more complete data set is applied, and compared with published sea-level curves, the result is the inverse of that previously predicted by employing chronoecologic charts. A model is presented of changing sea-levels in S.E. England from the Cenomanian through to the Santonian, which integrates the new diversity data with published sea-level changes and curves of stable isotopes of oxygen and carbon. In the earliest Cenomanian, low diversity is associated with a deeper water depositional environment and warmer temperatures. The mid-Cenomanian diversity maximum corresponds to a regressive trough and cooler water. Over the Cenomanian–Turonian boundary interval the diversity minimum is correlated with global sea-level and temperature maxima. The proportion of ostracods possessing eye tubercles falls to a minimum over this period. After the diversity crash, the Cenomanian fauna was replaced by the new Turonian fauna; east–west migrations into the Anglo-Paris Basin were facilitated by the sea-level rise overcoming marginal basin highs. The pattern seen in the mid-Cenomanian is also present at the Turonian–Coniacian boundary interval; that of high diversity corresponding with a regressive trough on a long-term regressive trend with cooling conditions. The model for this northern part of the Anglo-Paris Basin then associates high diversity with regressive cooler conditions, and low diversity with deeper and warmer water.

Keywords: Ostracods; Late Cretaceous; Diversity; Sea-level changes; Southeast England

1. Introduction

There have been many studies of the Late Cretaceous Ostracoda of the British Isles in the last 150 years, most of which have been taxonomical (Jones, 1849, 1870; Jones and Hinde, 1890; Kaye, 1964; Keen and Siddiqi, 1971; King, 1968; Weaver, 1982; Wilkinson, 1988; Slipper, 1997), others have addressed the stratigraphical distribution (Neale, 1978; Horne et al., 1990; Slipper, 1996; Wilkinson, 1988), while some have used the stratigraphical and taxonomic distribu-

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doi:10.1016/j.palaeo.2005.06.014

tions to analyse palaeoenvironments (Horne and Rosenfeld in Jarvis et al., 1988; Slipper, 1998). With the exception of the very early work, the monographic works have concentrated on a limited stratigraphical span, usually bounded by the chronostratigraphic stage boundaries, while the stratigraphical works have concentrated on one interesting aspect within the Late Cretaceous. Neale (1978) presented a synthesis of stratigraphically significant species for the Cretaceous period, but to date there has been no attempt to examine the total Late Cretaceous fauna in terms of the palaeoenvironmental signals which may be present in the distribution of the taxa through time.

Ostracoda are well known for their ability to reflect palaeoenvironments in broad terms of fresh, brackish and marine waters, and are particularly sensitive indicators where fluctuating salinity is a significant control. In the fully marine and stable environment that existed for 30 million years and resulted in the deposition of the chalk facies, it is more difficult to determine any changes within the palaeoenvironment from a simple species based investigation. In order to examine the controls on distribution (temperature, salinity, depth, light, oxygen concentration, food supply, substrate) it is necessary to look at the fauna as a whole, over longer periods of time.

With the publication of eustatic sea-level curves (Haq et al., 1988) it is possible to assess the response of the Ostracoda to long-term changes in palaeoenvironment.

In more stressful conditions, such as fluctuating salinity or energy regimes, or reduced supply of nutrients or food, organisms decline in number and become less diverse, often leaving very high numbers of fewer species to survive. Conversely under more bountiful conditions, such as stable salinity or energy and abundant nutrients, organisms will thrive with the consequent probability that diversity will increase. By combining the diversity of Ostracoda through the Late Cretaceous with various assessments of depth, light, food supply, oxygen concentration and salinity, it is hoped that a consistent picture will emerge. This then is an attempt to combine the stratigraphic ranges all the currently known Late Cretaceous Ostracoda for southern England together in one dataset and assess the response to changing sea-levels through time.

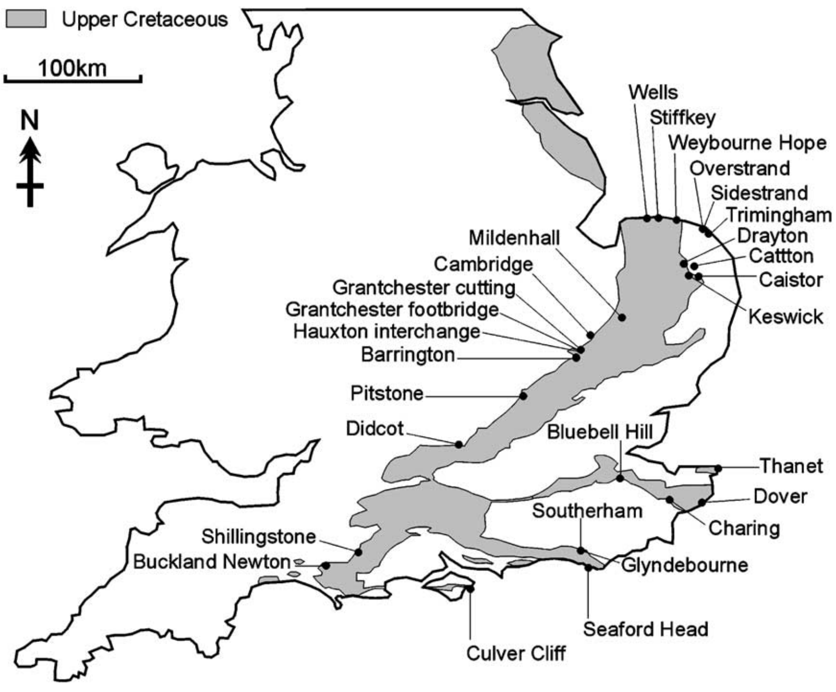

Fig. 1. Distribution of Upper Cretaceous strata in southern England. Named locations are the sampled sites of Wilkinson (1988), Weaver (1982), Jarvis et al. (1988), Horne et al. (1990), Slipper (1996, 1997, 1998), King (1968) and other sites used by author for this work.