The role of marine microphytoplankton in the Ordovician Biodiversification Event.

[Le rôle du microphytoplancton marin dans la biodiversification ordovicienne]

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Mots-Clefs : Radiation ordovicienne ; diversité des fossiles ; biodiversification ; microphytoplancton ; acritarches ; production primaire

Introduction

The Ordovician fossil record provides evidence of the most rapid, long sustained burst of biotic diversification in the history of marine life on Earth (The Great Ordovician Biodiversification Event, WEBBY *et alii*, 2004). Radiation events during Early and Middle Ordovician times caused the tripling of marine biodiversity and the establishment of Palaeozoic and Mesozoic evolutionary faunas which have the greater relevance to present-day biotic communities. Throughout the Ordovician, great ecological changes were associated with intense tectonic and volcanic activity and major reorganization of the plate-tectonic global assembly.

Which were the causes of the Great Ordovician Biodiversification? By comparing the fossil diversity curves with the timing of major palaeoenvironmental changes, several authors suggested that the biological radiation (and extinction) events are directly correlated with changes in the physical environment caused by tectonic evolution, volcanic eruptions, opening and closing of oceanic basins, sea-level oscillations, and/or climatic changes.

However, as SEPKOSKI & SHEEHAN (1983) have already pointed out, there seems to be "no immediately obvious physical trigger for such a great burst of evolutionary activity" that could have caused the Ordovician biodiversification.

Aim of the study, methods and data

We analyze the relationships between biodiversification patterns observed in marine invertebrates and in oceanic microphytoplankton during Ordovician times, with the aim of a better understanding of the role of primary production in the Great Ordovician Biodiversification Event. For this, we take into account the biodiversification curves of organismal stocks at various trophic levels, from the primary producers (phytoplankton) to the carnivore consumers.

Data analysed in this study have been taken mainly, but not exclusively, from the book "The Great Ordovician Biodiversification Event" by WEBBY *et alii* (2004), which is a compilation of Ordovician diversity of all the major fossil clades.

Discussion

The fossil record of oceanic primary producers in the Palaeozoic is largely dominated by acritarchs. In spite of uncertainties regarding their precise biological affinities, acritarchs are currently considered to represent the resting cysts of algal protists; their morphological and biogeochemical characteristics, and mode of occurrence in the marine sedimentary record are very close to those of dinoflagellate or chlorophycean algae cysts. However, it is not clear how palaeoecological information derivable from the fossil record of acritarchs

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can be related to oceanic productivity. The easiest parameter to be quantified, the diversity of the microphytoplanktonic cysts (acritarchs), cannot be taken directly as a proxy for palaeoproductivity (VECOLI & LE HÉRISSÉ, 2004). The abundance of microfossils in the sediments is a complex function of these variables: cyst production, hydrodynamic sorting, and preservation of organic matter. These give no direct information on the density of the microphytoplankton in the water column.

However, the fossil record of consumers seems to indicate that primary production increased strikingly during the Ordovician. An increasing complexity in food webs during Ordovician times is suggested by the following facts:
1) the first appearance and radiation of graptolites, of phyllocarids, of several groups of echinoderms, and of the chitinozoans, along with the diversification of radiolarians;
2) the innovation of planktotrophy in molluscan larvae;
3) the bursts in diversity observed in the great majority of the macroinvertebrate groups;
4) the innovations and increasing complexity in benthic and reef communities on the shelf including filtering organisms such as sponges, corals, and stromatoporoids.

Conclusions

The existence of major diversification events in all fossil groups implies drastic changes in the basal food chain and a tremendous increase in primary production ("plankton explosions"). This increase - a major change - was possibly the main trigger for the "Great Ordovician Biodiversification Event".

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