Palaeogeography, Palaeoclimatology, Palaeoecology 451 (2016) 97–109

Contents lists available at ScienceDirect

Palaeogeography, Palaeoclimatology, Palaeoecology

journal homepage: www.elsevier.com/locate/palaeo

The evolution of Late Callovian to Early Kimmeridgian foraminiferal associations from the central part of the Russian Sea (Makar'yev section, Volga River Basin, Russia)

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ARTICLE INFO

Article history:
Received 6 October 2015
Received in revised form 15 March 2016
Accepted 16 March 2016
Available online 23 March 2016

Keywords:
East European Platform
Palaeoecology
Foraminifera
Upper Jurassic

ABSTRACT

Foraminiferal associations from the Upper Callovian to Lower Kimmeridgian beds of the Makar'yev reference section (Volga Basin, East European Platform) provide insights into contemporaneous palaeoecological, palaeoenvironmental and palaeoceanographic conditions. Foraminiferal associations were studied using semi-quantitative methods, morphogroup analyses and various biodiversity indices, and were compared with different abiotic factors, including transgressive and regressive events, variations in temperature, and the content of total organic carbon (TOC). Analyses of the resulting data show that the Makar'yev section was strongly affected by variations in sea level during Oxfordian time and suggest that the environment was mainly associated with the outer part of the middle sublittoral zone on the outer platform.

A regressive event strongly affected the foraminiferal communities at the Early/Middle Oxfordian boundary. This event was followed by a transgressive phase and an increase in water temperature that allowed the opening of a marine pathway and migration of planktonic foraminifera from tropical and sub-boreal latitudes to boreal and sub-arctic latitudes. This phenomenon may explain the increase in foraminiferal biodiversity during the Middle Oxfordian. However, a crisis in microbenthic communities greatly affected foraminifera during the Late Oxfordian. This crisis was probably the result of a combination of two events rather than a single large event: the strong input of organic matter during maximum flooding, and a subsequent second-order regressive event at the transition between the Middle and the Late Oxfordian. This massive injection of organic matter would have increased the quantity of organic carbon as well as decrease the amount of oxygen in bottom water. It ultimately resulted in the development of shallow-water and potentially deep-water infaunal foraminifera, as well as the disappearance of non-adapted taxa from the Late Oxfordian and, particularly, the Kimmeridgian.

1. Introduction

Over the last century, the geology of the East European Platform has been extensively investigated. Among other results, new ammonite biozonations have been proposed (Hantzpergue et al., 1998), basin-water palaeotemperatures have been reconstructed, various geochemical characteristics have been described (Riboulleau et al., 1998; Hantzpergue et al., 1998) and sea-level curves have been evaluated (Sahagian et al., 1996).

Although the fossil record of foraminiferal assemblages is well known all along the East European Platform, it has yet to be used for accurate palaeoenvironmental, palaeobiogeographical, or palaeoceanographical reconstructions. The Makar'yev section is characterized by abundant and diverse foraminiferal assemblages that were strongly affected by variation in sea level caused by tectonic activity during the Late Jurassic (Sasonova and Sasonov, 1967). The study of foraminiferal biodiversity and morphogroups may provide a good model for understanding how foraminiferal assemblages evolved through sea-level changes and physico-chemical modifications of sea-bottom water. Additionally, the Russian Sea was connected with the southern Peri-Tethyan and northern Pechora Seas from the Late Callovian to the Early Kimmeridgian, so they are an important study area for understanding the palaeobiogeographic and palaeoceanographic changes of the Boreal to Peri-Tethyan environments during the Upper Jurassic.

Our contribution is an analysis of foraminiferal associations of the uppermost Callovian, Oxfordian and Lower Kimmeridgian of the Makar'yev reference section located in the Volga Basin of the East European Platform (Fig. 1A). It focuses on palaeoenvironmental and palaeoceanographic changes following sea-level fluctuations and geochemical changes in the seawater and their consequences for microbenthic communities.

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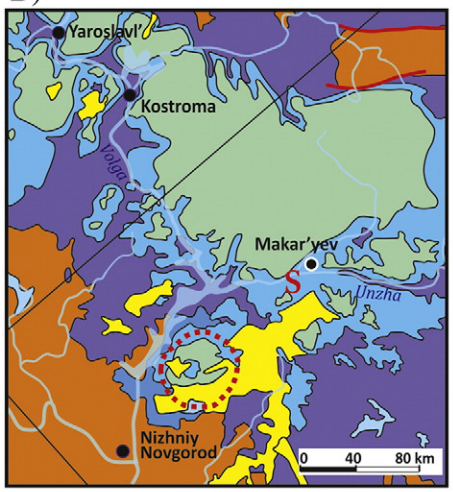
http://dx.doi.org/10.1016/j.palaeo.2016.03.014
0031-0182/



Upper sublittoral zone (~ 0-50 m)
Middle sublittoral zone (~ 50-100 m)

Impact structures
Faults
Permian
Lower Triassic
Lower Jurassic
Middle and Upper Jurassic
Middle Jurassic
Lower Cretaceous
Neogene
S Section