

The Mikhalenino Section of the Russian Platform: A Key Section for Palaeobiogeography and Ammonite Correlation of the Middle Oxfordian to Lowermost Kimmeridgian in Europe

E. Glowniak¹, D.N. Kiselev², M. Rogov³, A. Wierzbowski^{4*}, J.K. Wright⁵

1. Institute of Geology, University of Warsaw, ul. Zwirki i Wigury 93, 02-089 Warszawa, Poland (E-mail: Glowniak_EK@uw.edu.pl)
2. Geographical Department, Yaroslavl State Pedagogical University, Kotorosl'naya nab. 46, Yaroslavl 150000, Russia (E-mail: dnkiselev@mail.ru)
3. Geological Institute of Russian Academy of Sciences, Pyshevskii Lane 7, Moscow 109017, Russia (E-mail: russianjurassic@gmail.com)
4. Institute of Geology, University of Warsaw, ul. Zwirki i Wigury 93, 02-089 Warszawa, Poland (E-mail: Andrzej.Wierzbowski@uw.edu.pl)
5. Department of Geology, Royal Holloway, Egham, Surrey, TW20 OEX, UK (E-mail: j.wright@es.rhul.ac.uk)

The Oxfordian and lowermost Kimmeridgian deposits which crop out along the Unzha River of the Kostroma District, about 500 km north-east of Moscow, although generally of small thickness, are stratigraphically among the most complete of the Russian Platform, and thus are especially important for wider correlations and palaeobiogeography. The Mikhalenino section located close to the town of Makariev is one of the best sections of the area. It yielded numerous ammonites of the Middle Oxfordian to lowermost Kimmeridgian carefully collected bed by bed by all the authors. The ammonites belong mostly to the Boreal family Cardioceratidae, but also to the Subboreal family Aulacostephanidae; additionally at some levels were collected various Submediterranean ammonites (of the families: Perisphinctidae, Oppeliidae and Aspidoceratidae). The palaeontological and stratigraphical interpretation of these ammonites, and in consequence the correlation of ammonite zonal schemes representative of different ammonite provinces, are the main subjects of the study (Glowniak et al., 2010 in press).

The Boreal ammonites are represented by the genus *Cardioceras* phylogenetically followed by the genus *Amoeboceras* (with subgenera *Amoeboceras*, *Plasmatites* and *Amoebites*). The Middle Oxfordian yielded *Cardioceras* indicative of the Densiplicatum Zone and of the Tenuiserratum Zone. The Upper Oxfordian *Amoeboceras* species make possible recognition of the Glosense Zone (with the Ilovaiskii Subzone especially well represented in the section), the Serratum Zone, the Regulare Zone and the Rosenkrantzi Zone. The lowermost Kimmeridgian is well defined in the section studied by first appearance of *Amoeboceras* (*Plasmatites*) similarly as in the Flodigarry section (Isle of Skye, Scotland; see Matyja et al., 2006) – the main GSSP candidate for the Oxfordian/Kimmeridgian boundary. Similarly, in both sections, the subgenus *Plasmatites* is phylogenetically followed by the subgenus *Amoebites*.

The Subboreal ammonites are represented in the Mikhalenino section by well defined members representing a single lineage. It begins with the genus

Decipia (first occurrence in the Russian Platform), followed by the genus *Ringsteadia* (with representatives similar to the English species); and these make possible recognition here of the NW European Subboreal ammonite zones of the Upper Oxfordian: the Decipiens Zone (Cautisnigrae Zone), and the Pseudocordata Zone – which is the topmost zone of the Subboreal Oxfordian. Younger aulacostephanids in the Mikhalenino section are represented by genera *Vineta*, *Pomerania* (*Pachypictonia*), and a special *Pictonia* species, all of them differing from aulacostephanids known in coeval deposits of the lowermost Kimmeridgian of the NW European part of the Subboreal Province. Their occurrence is thus typical of the lowermost Kimmeridgian of the NE part of the Subboreal Province which embraces the northern Germany, northern Poland (including Pomerania) and Lithuania, and as shown in the material studied – a large part of the Russian Platform. Some ammonites of the NE European Subboreal assemblage in question are moreover known also to occur in the lowermost Kimmeridgian of the Submediterranean Province in Poland and Germany. The data given enables the recognition of the Oxfordian/Kimmeridgian boundary as recognized in the Flodigarry section, Isle of Skye, Scotland, also using the NE European Subboreal ammonites.

The Submediterranean ammonites in the Mikhalenino section occur mostly in the Middle Oxfordian, and lowermost part of the Upper Oxfordian – proving the presence of the Plicatilis Zone, the Transversarium Zone, and the Bifurcatus Zone of the Submediterranean zonal scheme. A well defined assemblage typical of the Elisabethae Subzone of the Transversarium Zone has been found together with Boreal ammonites of the Ilovaiskii Subzone of the Glosense Zone, as well as the Subboreal ammonites of the genus *Decipia* indicative of the Decipiens (Cautisnigrae) Zone. The youngest representatives of the genus *Perisphinctes* indicative of the Bifurcatus Zone, has been found together with Boreal *Amoeboceras* of the Regulare Zone, and the first Subboreal *Ringsteadia* of the lower part of the Subboreal Pseudocordata Zone.



Key words: Ammonites; Biostratigraphy; Correlation; Zonal schemes

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