



Palynological and microfacies analysis of the Famennian part of the Russkiy Brod Quarry section, Central Devonian Field, Russia

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ABSTRACT

Palynological investigations of samples from the Upper Devonian of the Russkiy Brod Quarry section (Zadonsk Horizon, Central Devonian Field, Russia) revealed the presence of the CZ (*Cyrtospora cristifera-Diaphanospora zadonica*) miospore Zone, in particular its upper part, the Za (*Convolutispora zadonica*) Subzone. This discovery indicates one of the lowest part of the Famennian (*crepida* conodont Zone). Palynofacies and microfacies analysis confirmed that deposition occurred in a shallow, marginal-marine environment. The good state of preservation of the palynomorphs enabled the recognition of additional internal exine layers in the structure of *Tergobulaspores immensus* and *Crumenasporites monosaccus* megaspore species.

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1. Introduction

Palynological samples from the Famennian deposits of the Russkiy Brod Quarry (Central Devonian Field, Russia) yielded interesting data, not only in a palynostratigraphical or palynofacies context, but also from a taxonomical point of view. Post-Precambrian sediments deposited on the old Precambrian platform (the East European Platform) are generally free from unfavourable post-depositional conditions, such as tectonic phenomena, folding and contact metamorphism. Therefore, palynomorphs are generally better preserved in such conditions. Previous palynological investigations in this region and adjacent areas revealed the presence of well-preserved organic remains, rich in palynomorphs, in the Frasnian-Famennian stratigraphical sequences (e.g. Obukhovskaya et al., 2000; Filipiak and Zbukova, 2006; Raskatova et al., 2014).

In the study area (Voronezh region, western Russia; Fig. 1), the Frasnian-Famennian (F-F) transition is characterised by a break in sedimentation, assigned to the interval between the Livny (upper Frasnian) and Zadonsk Horizons (lower Famennian; see, e.g., Alekseev et al., 1996; Mantsurova, 2003). Furthermore, the upper Frasnian strata, deposited in shallow, hypersaline, marine conditions (Rodionova et al., 1995), are poor in conodonts and other stratigraphically useful fauna, which

make faunal biostratigraphy difficult. Therefore, it was necessary to support and verify a stratigraphical investigation using other independent tools, e.g. miospores, which are produced on land. Fortunately, some lower Famennian conodonts were obtained from the same palynological samples, thus the palynological results are supported by conodont data. Different stratigraphically important and independent tools, such as palynomorphs and conodonts, occurring in the same samples, may help to integrate zonal schemes to a greater extent in the future.

The main aim of this article is to establish a palynostratigraphy and to characterise in a palaeoenvironmental context the palynofacies and carbonate microfacies in the lower Famennian deposits of the Russkiy Brod Quarry section (Central Devonian Field, Voronezh region, western Russia).

Additionally, the new data acquired from observations of the internal structure of two miospore taxa (Filipiak, 2014) enabled improvement of their descriptions. Those observations confirmed some earlier theoretical hypotheses (Turnau, 2002), concerning their botanical affinities as megaspores.

2. Material and methods

In total, eighteen limestone samples (~25–30 g each) were collected from the Livny Horizon (Frasnian) and five from the Zadonsk Horizon (Famennian) of the Russkiy Brod Quarry (52° 34' 27.00" N, 37° 19'

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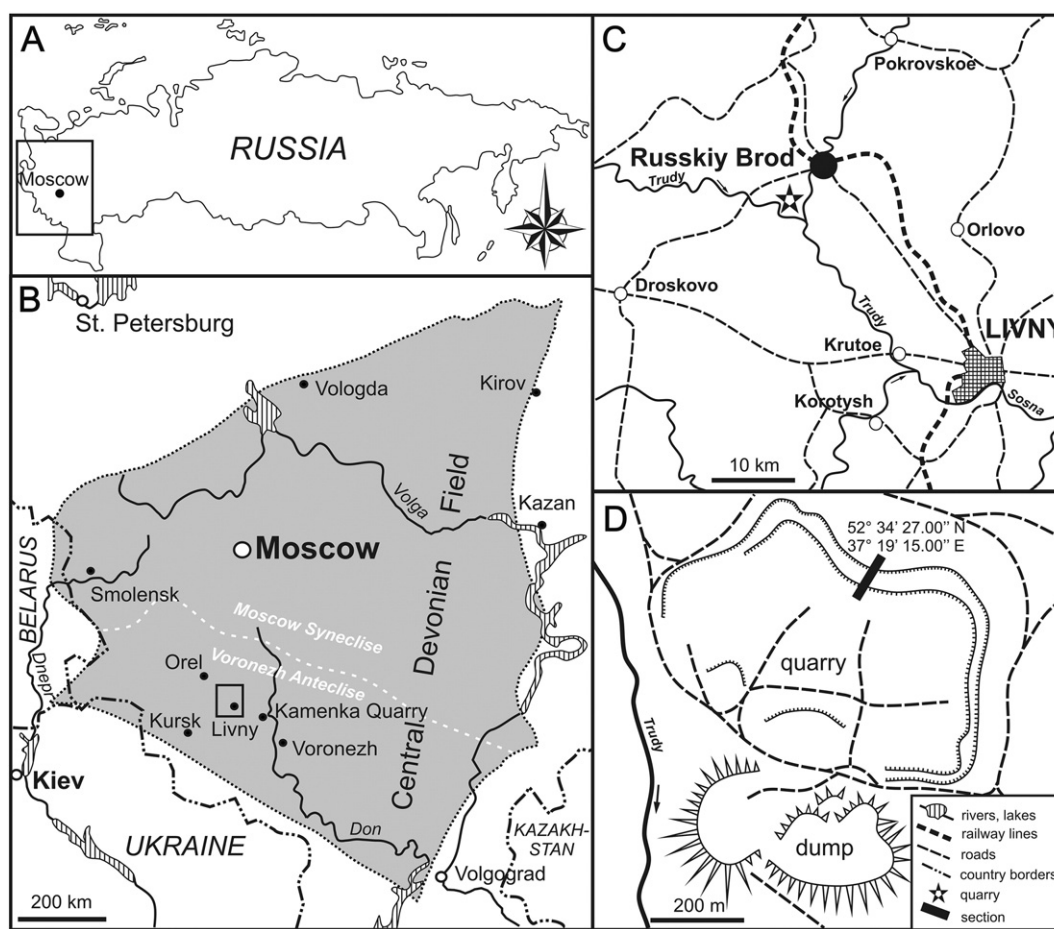


Fig. 1. Location of the study area. A. Map of Russia showing the location of the Central Devonian Field. B. Central Devonian Field. C. Location of the Russkiy Brod Quarry. D. Plan of the quarry with location of the section investigated.

15.00° E; see Fig. 1C, D). The samples were processed using standard HCl-HF-HCl palynological procedures (Wood et al., 1996). All samples from the Livny Horizon are barren (weathered), but those from the Zadonsk Horizon are rich in palynomorphs. Among these, one sample is clayey-siliciclastic (D02/1); two samples are limestone (D02/2, D02/3); and two are represented by intraclasts (intraclasts no. 17 and no. 23; see Fig. 2). The microfungal content of the intraclasts varies: the miospore assemblage from sample no. 23 is more taxonomically differentiated and better preserved than that from no. 17. Five slides were prepared from each residue. Generally, the preservation of the palynomorphs is good or very good. Observation and documentation were completed, using a transmitted light microscope (Olympus BX51 with a DS-U3 controller and a Nikon NIS-Elements imaging software suite).

The palynological slides, residues and thin sections are housed at the Department of Earth Sciences of the University of Silesia, in Sosnowiec (GIUS 4-3625). The miospore and other microflora species identified are listed in Appendices 1 and 2. Photographs of thin sections are shown in Plate I; selected, stratigraphically and environmentally important palynoflora species are illustrated in Plates II–V.

3. Geological framework

3.1. Geological setting

The Russkiy Brod Quarry is located in the Devonian outcrop area of the central-western part of the East European Platform, known

as the Central Devonian Field (Fig. 1A, B). The study area occupies the central part of the Voronezh Anteclise, which borders the Moscow Syncline (Fig. 1B) to the north. During the Late Devonian, this area was an epicratonic, marine, shallow-water basin, connected with the Uralian Ocean to the east and also linked by narrow straits with the Palaeotethys Ocean (Golonka et al., 1994). Palaeogeographically, the area was part of the subtropical climatic zone, with a dry, hot climate. Therefore, the Late Devonian nearshore marine waters were hypersaline (Rodionova et al., 1995; Tikhomirov, 1995).

Lithologically, the Frasnian-Famennian (F-F) section is composed mainly of shallow-water carbonate and clayey sediments and comprises two regional stages (horizons), the Livny and the Zadonsk (Fig. 3). More precisely, the F-F boundary corresponds to the stratigraphic hiatus between the Livny and Zadonsk Horizons (see, e.g., Mantsurova, 2003; Filipiak and Zbukova, 2006).

The Livny Horizon is a monotonous succession of predominantly carbonate, shallow-water deposits. This part of the section corresponds to the latest Frasnian eustatic regression, cycle IId (sensu Johnson et al., 1985). The regression maximum is assumed to be located at the F-F boundary interval, resulting in a hiatus, comprising, in this area, the entire Volgograd Horizon (Aleksiev et al., 1996; Fig. 3). In biostratigraphic terms (Ziegler and Sandberg, 1990), the hiatus comprises the complete *Palmatolepis triangularis* conodont Zone (equivalent of the VV miospore Zone, Avkhimovitch et al., 1993; Fig. 3). Shallow-water carbonate sediments are overlain by mainly clayey-siliciclastic deposits of the lower Zadonsk Horizon.

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