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MIDDLE JURASSIC PALYNOLOGICAL ASSEMBLAGES OF THE SHAIM PETROLEUM-BEARING REGION (WESTERN SIBERIA)

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ABSTRACT. The results of palynological analysis allow the determination a Middle Jurassic (Bajocian-Bathonian) age of the sediments from the Tyumenskaya Formation originating from by six boreholes in the Shaim petroleum-bearing region (north-western part of Western Siberia). Study of taxonomic composition and the stratigraphic distribution of spores and pollen grains provide the basis for a local biostratigraphic subdivision of these deposits. The geosequence of two palynostratigraphic units, including five subunits, which are calibrated against the palynozones and beds with spores and pollen grains of the Jurassic palynostratigraphic scale of Siberia, established by Ilyina (1997), have been defined. The succession of the distinguished palynological assemblages reflects climatic migrational changes of the flora in the investigated region.

KEY WORDS: Western Siberia, Bajocian, Bathonian, biostratigraphy, palynological assemblages, palynostratigraphic scale

INTRODUCTION

Western Siberia has been the site of oil and gas exploration during the past decades. High petroleum potential is related with the Middle Jurassic deposits of the Shaim petroleum-bearing region; thus their detailed biostratigraphic subdivision is of practical interest. Previous palynological researches of the Middle Jurassic sediments of this region have been carried out by Zatonskaya (1970) and Rovnina (1972). Bajocian and Bathonian sediments are widespread in this region. A major part of these sediments are represented by non-marine deposits with rare thin marine layers. The purpose of this paper is to present the results of a detailed layer by layer study of the systematic composition and the distribution of spores and pollen grains from the Middle Jurassic sediments for solving some biostratigraphic problems. Geological age of the deposits have been determined using Jurassic palynostratigraphic scale, established by Ilyina (1985) in marine sections in northern Siberia, and followed in some marine and continental deposits in many regions of the Siberian phytogeographic area (Ilyina 1997).

MATERIAL

The investigations center around sections exposed by boreholes of the Symor'yahskaya, Tal'nikovaya, Olymskaya, Lazarevskaya and Vish'enskaya (Fig. 1) exploration areas in the Shaim petroleum-bearing region. All samples used in this study were collected by author in 1991. More than 120 core samples from six boreholes were taken from the Tyumenskaya Formation, which was established and described by Rostovtsev (1955, 1956). At present the age of Tyumenskaya Formation is considered as Middle Jurassic (Shurygin *et al.* 1995).

RESULTS AND INTERPRETATION

Two palynological assemblages comprising five subassemblages have been established within the Middle Jurassic interval. Two palynoassemblages, distinguished in the Lazarevskaya borehole 10126 have been followed in the other boreholes examined, and subsequently a complete continuous sequence of subassemblages has been observed in Lazarevskaya 10126 only. As such, this well was chosen as a reference section (Fig. 2).

The first (lowermost) of the palynological assemblages has been define from deposits of the boreholes Lazarevskaya 10126 at interval 2172–2159.2 m, Vish'enskaya 10055 (2205.5–2205 m), Tal'nikovaya 10177 (1802.3–1768.1 m), Olymskaya 9060 (2004–1993.5 m), and Symor'yahskaya 10255 (2131.3–2106.5 m).

Palynoassemblage 1 is dominated by *Cyathidites minor* Coup. and *Cyathidites* spp. Constant occurrence of *Lycopodiumsporites intortivallus* (Sach. et Iljina) Iljina, *Pinus divulgata* Bolch., and *Dicksonia densa* Bolch. (typical for Bajocian palynofloras) is most important for the age definition. The following taxa are frequent: *C. australis* Coup., *Neoraistrickia* spp. and *N. truncata* (Cook.) Pot., *Lycopodiumsporites* spp., *L. subrotundus* (K.-M.) Vi-

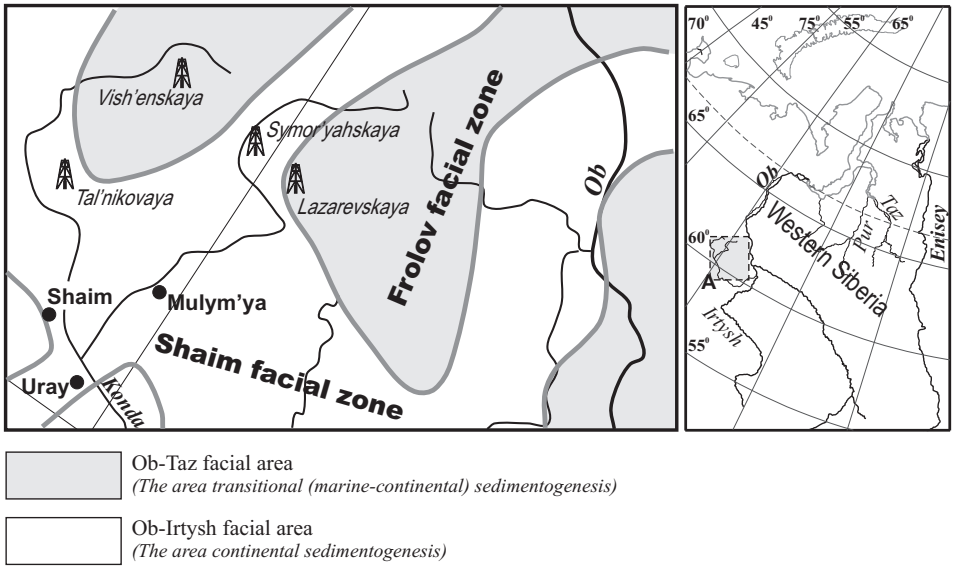

Fig. 1. Locations of wells in Shaim petroleum region

nogr., *L. marginatus* Singh., *Pilasporites marcidus* Balme, *Stereisporites* spp., *Osmundacidites* spp., *Alisporites bisaccus* Rousei. *Contignisporites problematicus* (Coup.) Dor., *Duplexisporites annogrammensis* (K.-M.) Schug., *Obtusisporis junctus* (K.-M.) Pocock., *Tripartina variabilis* Mal., *Piceapollenites variabiliformis* (Mal.) Petr., *Podocarpidites rousei* Pocock, *Pinuspollenites* sp., *Camptotriletes cerebriformis* Naum. ex Jarosh. are rare and some others species have been observed as well. Boundaries of this palynostratigraphic unit are based upon the presence of a characteristic assemblage with *Neorastrickia rotundiformis* (K.-M.) Taras, *Lycopodiumsporites intortivallus*, *Pinus divulgata*, and *Dicksonia densa*. Such a systematic composition of palynoassemblage 1 allows it to calibrate it against characterictic palynoassemblage of Palynozone 9 – *Neoraistrickia rotundiformis, Lycopodiumsporites intortivallus*, *Pinus divulgata* of palynostratigraphic scale of the Middle Jurassic in Siberia by Ilyina (1997). The geological age of deposits is Early-Late Bajocian.

Subassemblage 1.1 has been distinguished in the lower part of Bajocian sediments of the borehole Lazarevskaya 10126 (2172–2170.5 m). The assemblage is characterized by poor taxonomic diversity. *Cyathidites minor* and *C.* spp. are predominant. Frequent *Lycopodiumsporites* spp., *L. subrotundus*, *L. marginatus*, *Neoraistrickia rotundiformis*, *N. truncata, Camptotriletes cerebriformis, Osmundacidites* spp., *Tripartina variabilis*, *Piceapollenites variabiliformis*, rare specimens of *Stereisporites* spp., including *S. compactus* (Bolch.) Iljina and *S. psilatus* (Ross.) Pflug., and *L. intortivallus* have been observed. *Dicksonia densa* is absent. This subassemblage may correspond to the Beds with spores and pollen grains 9a of Palynozone 9 – *Neoraistrickia rotundiformis* K.-M.) Taras., *Lycopodiumsporites intortivallus*, *Pinus divulgata* of palynostratigraphic scale of Siberia; thus the geological age of this unit may be considered as approximately Earlymost Bajocian. During that period climatic conditions in Siberia were similar to those of the Late Aalenian. It resulted in a gradual change of the flora at the boundary of the Aalenian and Bajocian.

Subassemblage 1.2 has been defined from the deposits of boreholes Lazarevskaya 10126 (2170.5–2160.7 m), Vish'enskaya 10055 (2205.5–2205 m), Tal'nikovaya 10177 (1802.3–1802.2 m). It is characterized by the appearance of such species as *Hemitelia parva* (Dor.) Timosh, *Levisporites decorus* Iljina and *Leiotriletes adiantiformis* Vinogr.. The assemblage is dominated by the *Leiotriletes* group, comprising *Cyathidites* spp., *C. minor*, *C. australis.* Spores of the genus *Stereisporites*, which are considered to have close affinities with Sphagnales (Filatoff 1975), are represented by 6 species. It is the second peak of *Stereisporites* abundance in Siberia after the Late Pliensbachian maximum (Ilyina 1985). The composition of the investigated palynoassemblage is characterized not only by Siberian palynomorphs, but also by various spore and pollen taxa, widespread in different palaeofloristic provinces. Late Early Bajocian warming caused the migration of plants, characteristic for southern palaeofloristic areas, especially for the Middle Asian one, into the Siberian area. There are, for example, *Microlepedites crassirimosus* Timosh., *Hemitelia parva* (Dor.) Timosh. and *Leiotriletes adiantiformis* which is characteristic feature of Bajocian-Bathonian in Mangyshlak (Timoshina & Men'shikova 1980). *Pilasporites marcidus*, described from Jurassic sediments of Western Australia (Filatoff 1975) and considered having affinities with *Equisetites*, are rare. The assemblage

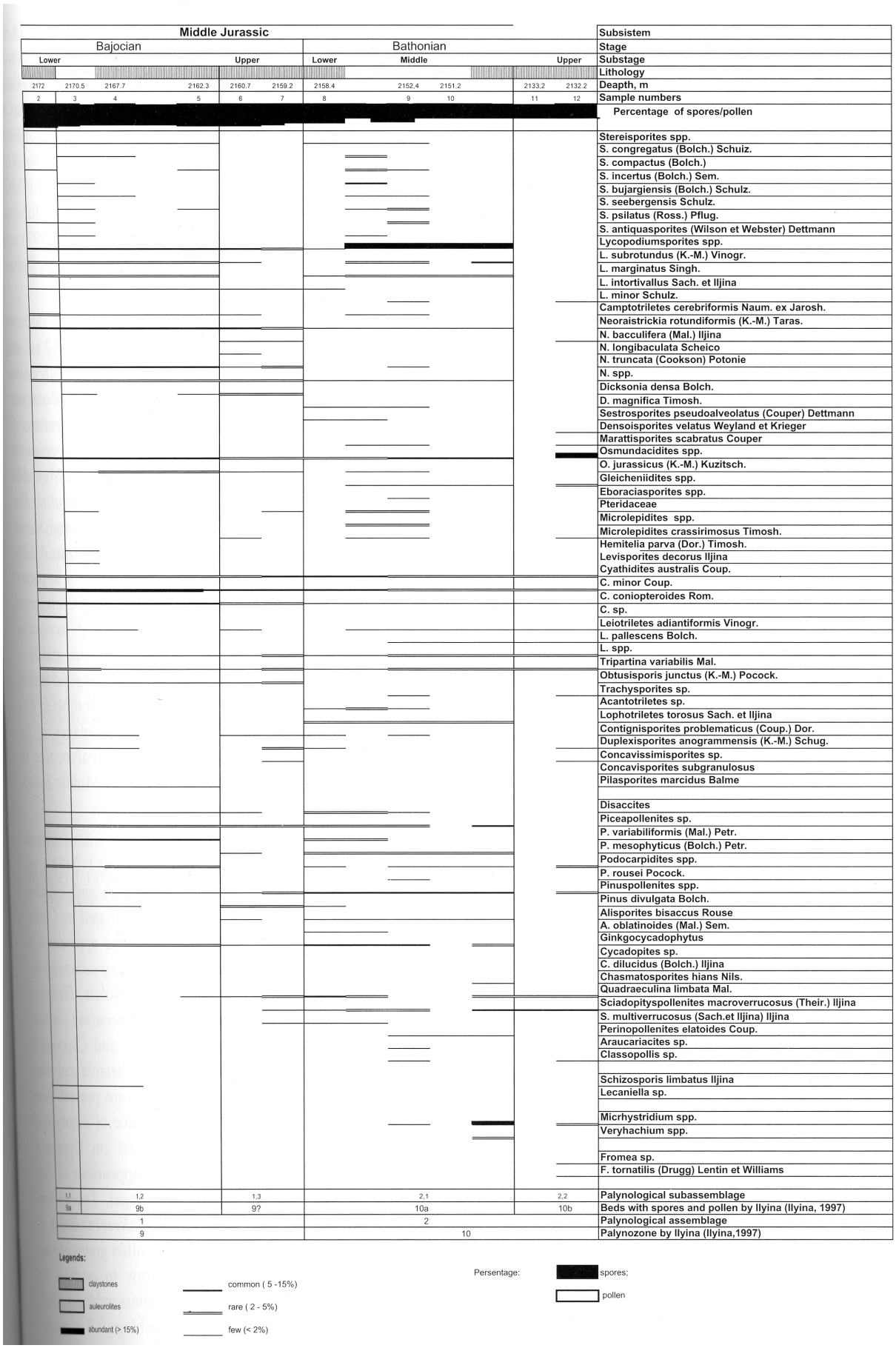

Fig. 2. Microphytofossils distribution in the section from borehole Lazarevskaya 10126

is characterized by various and relatively frequent *Neorastrickia* spp., including *N. rotundiformis* and *N. truncata.* It is a distinctive feature of Bajocian and Bajocian-Bathonian assemblages of a many regions of Eurasia, and Australia (Filatoff 1975). Thus spore/pollen composition of subassemblage 1.2 corresponds to the maximum of total climatic humidization all over the globe during Bajocian time. Among the transitional species of *Lycopodiumsporites,* the appearance of *L. intortivallus* has been observed. This species has a relatively limited stratigraphic range: Bajocian-Bathonian, very rarely Callovian. Taxonomic composition of subassemblage 1.2 permitted to calibrate it against characteristic assemblage of the Palynozone 9, Beds 9b of the Siberian palynostratigraphic scale and to define its age as Early Bajocian.

Subassemblage 1.3 has been established in the upper part of Bajocian deposits of the Lazarevskaya 10126 (2159.2–2158.4 m) and Tal'nikovaya 10177 (1766.6–1766.4 m).

Taxonomic composition of the assemblage is less varied. At the same time features, similar with palynological assemblage 1, remained. The peak of variety of *Neoraistrickia,* caused by appearance of some new species (*N. longibaculata* Scheico*, N. bacculifera* (Mal) Iljina*,* is typical for this subassemblage. This assemblage may reflect Late Bajocian climatic minimum. Boundaries of this unit are based upon the occurrence of a typical assemblage, characterised by the extinction of *Hemitelia parva*, *Levisporites decorus*, *Microlepidites crassirimosus* and reduced quantity of *Stereisporites*. The unit with subassemblage 1.3 corresponds to 9c Beds of palynozone 9 of the palynostratigraphic scale by Ilyina (1997). Geological age of these deposits is approximately Late Bajocian.

Palynological assemblage 2 has been distinguished from sediments of boreholes Lazarevskaya 10126 (2152.4–2132.2 m), Tal'nikovaya 10177 (1756.5–1742.1 m), Olymskaya 9060 (1992–1978.4 m), Symor'yahskaya 10255 (2121.4–2044.5 m) and Vish'enskaya 10055 (2159.1–2090.5 m). The following taxa are characteristic: *Cyathidites* sp., *C. minor*, *C. australis*, *Dicksonia magnifica* Timosh.*, Sestrosporites pseudoalveolatus* (Coup.) Dettm., *Gleicheniidites* spp., *Lophotriletes torosus* Sach. et Iljina*, Quadraeculina limbata* Mal., *Sciadopityspollenites macroverrucosus* (Their) Iljina*, S. multiverrucosus* (Sach. et Iljina) Iljina. Besides, common presence of *Lycopodiumsporites* spp., *Osmundacidites* spp, *Piceapollenites* spp., *Ginkgocycadophytus*, *Cycadopites* sp. and *Pinuspollenites* spp. has been observed. The percentage and variety of the Gymnospermae increase. *Microlepedites crassirimosus*, *Leiotriletes adiantiformis*, *Monolites couperi*, *Pteridaceae* and some Middle Asia taxa reappear. Boundaries of this palynostratigraphic unit have been based upon the appearance of *Lophotriletes torosus, Quadraeculina limbata*, *Sciadopityspollenites macroverrucosus, S. multiverrucosus*, *Gleicheniidites* spp.. The occurrence of this characteristic assemblage of spores and pollen grains allows us to consider palynoassemblage 2 corresponding to characteristic assemblage of Palynozone 10 – *Lophotriletes torosus*, *Gleicheniidites* spp*., Quadraeculina limbata, Sciadopityspollenites macroverrucosus* of the Jurassic palynostratigraphic scale of Siberia by Ilyina (1997) and to define the geological age of these sediments as Bathonian.

Subassemblages 2.1 has been defined from the deposits of boreholes Lazarevskaya 10126 (2152.4–2133.2 m), Tal'nikovaya 10177 (1756.5–1754.6 m) and Vish'enskaya (2159.1–2117.6 m). The following taxa dominate: *Cyathidites* sp., *C. minor*, *C. australis.* The appearance of *Dicksonia magnifica,* which is a typical species for Bathonian palynoassemblages (Timoshina & Men'shikova 1980, Ilyina 1985), as well as *Quadraeculina limbata*, *Sciadopityspollenites macroverrucosus* and *S. multiverrucosus, Sestrosporites pseudoalveolatus*, *Gleicheniidites* spp*., Lophotriletes torosus* are very important for age determination*.* There is a peak of *Stereisporites* variety (six species). The appearance of acritarchs, which are represented by *Micrhystridium* spp. and *Verychachium* spp., may be attributed to the marginal ingression of the epicontinental sea. This subassemblage may correspond to characteristic palynoassemblages of the Beds with spores and pollen grains 10a of Palynozone 10 established for the Lower-lower part of Middle Bathonian in palynostratigraphic scale of Siberia.

Subassemblage 2.2 has been established from sediments of boreholes Lazarevskaya 10126 (2132.1–2132.3 m), Vish'enskaya 10055 (2113.9–2090.5 m) and Tal'nikovaya 10177 (1742 1742.2 m). It is dominated by *Cyathidites* spp. and *Osmundacidites* spp.. The appearance of *Perinopollenites elatoides* Coup., *Lycopodiumsporites minor* Schulz., *Leiotriletes pallescens* Bolch., *Dicksonia magnifica*, the abundance of *Quadraeculina limbata, Sciadopityspollenites macroverrucosus* and *Classopollis* spp. are typical for this assemblage. Variable and abundant pollen grains of Gymnospermae are present. Acritarchs are abundant too. The appearance of dinocysts of the genus *Fromea* allows to suggest on Uppermost Bathonian age for the deposits. The appearance of *Densoisporites velatus* Weyland et Krieger, *Lycopodiumsporites minor* Schulz., *Leiotriletes pallescens* Bolch. as well as the composition of spores, pollen grains and microphytoplankton on the whole allow to establish the boundary between 2.1 and 2.2 subassemblages. Such systematic composition of subassemblage 2.2 is comparable to the characteristic palynoassemblage of Palynozone 10 (the 10b Beds with spores and pollen) of palynostratigraphic scale of Middle Jurassic in Siberia by Ily-

ina (1997) established for Upper part of Bathonian. Palynological data as well as general geological and lithological analyses evidence of the transgression, had begun in uppermost Middle or in Upper Bathonian. The gradual transition from the Upper Bathonian palynoassemblage to a Callovian one does not allow to precisely determine the boundary between these two stratigraphic units.

CONCLUSIONS

As a result, it can be noticed that the flora of the Shaim petroleum-bearing region was very similar to other Siberian floras during the Bajocian substage, when floristic differentiation was not expressed within Siberia (a uniform Siberian palaeofloristic area). The difference between the Bathonian flora of the Shaim petroleum-bearing region and other Siberian floras were caused by a latitudinal floristic differentiation in Siberia, which became especially pronounced during the Bathonian and Late Jurassic epoch.

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