ISSN 0869-5938, Stratigraphy and Geological Correlation, 2010, Vol. 18, No. 5, pp. 550–554. © Pleiades Publishing, Ltd., 2010.
Original Russian Text © S.V. Meledina, A.S. Alifirov, B.N. Shurygin, 2010, published in Stratigrafiya. Geologicheskaya Korrelyatsiya, 2010, Vol. 18, No. 5, pp. 88–91.

DISCUSSION

On Position of the *Praechetaites exoticus* Zone in the Volgian Stage

S. V. Meledina, A. S. Alifirov, and B. N. Shurygin

Trofimuk Institute of Petroleum Geology and Geophysics, Siberian Division, Russian Academy of Sciences, pr. akademika Koptyuga 3, Novosibirsk, 630090 Russia

e-mail: meledina@ipgg.nsc.ru; alifirovas@ipgg.nsc.ru; sguryginbn@ipgg.nsc.ru;

Received January 20, 2010; in final form march 01, 2010

Abstract—The stratigraphic position of the *Praechetaites exoticus* Zone in the Volgian Stage is discussed in the context of published suggestions to place this unit in the middle Volgian Substage.

Key words: Volgian Stage, *Praechetaites exoticus* Zone.

DOI: 10.1134/S0869593810050060

INTRODUCTION

In several recent works published by Russian and foreign authors, the *Praechetaites exoticus* Zone, which was traditionally attributed to the upper Volgian Substage in Siberian biostratigraphic scales, is placed in the middle Volgian Substage (Zakharov and Rogov, 2006, 2008; Rogov and Zakharov, 2007, 2009; Rogov, 2007; *Resolutions...*, 2008). Such a revision is based on new paleontological finds in the Nordvik Peninsula (Cape Urdyuk Khaya), where M.A. Rogov first defined the *Exoticus* Zone, which contains middle Volgian *Laugeites* in addition to *Praechetaites* forms (Zakharov and Rogov, 2008).

In our opinion, the establishment of the *Exoticus* Zone in the Nordvik Peninsula section is erroneous, and the authors' conclusion on its middle Volgian position in the regional scale of Siberia is weak.

THE DEFINING HISTORY OF THE *Praechetaites exoticus* ZONE

In Siberia, the middle–upper Volgian boundary layers contain ammonites of the specific *"Tithonian"* affinity, in addition to boreal genera. N.I. Schulgina attributed them to the genus *Virgatosphinctes* Uhlig, 1910 belonging to the subfamily Virgatosphinctinae (Saks et al., 1965; Schulgina, 1967). She described new Siberian *Virgatosphinctes* species from the Kheta River basin and defined the *Virgatosphinctes* spp. Beds in the regional zonal scale. The latter comprised a middle Volgian *Epivirgatites variabilis* Zone and three upper Volgian zones: *Craspedites okensis, Taimyoceras taimyrense*, and *Chetaites chetae*. In addition, she defined an autonomous *V. exoticus* Subzone in the *C. okensis* Zone based on more abundant, as compared with the middle Volgian Substage, finds of the *Virgatosphinctes* species. This subzone is characterized only by the index species and *V. tenuicostatus* Schulg. and occupies the section interval barren of both middle and typical late Volgian forms.

The bed-by-bed description of Upper Jurassic sediments and their faunal assemblages in the Kheta River basin (Khatanga Depression) is given in (*Reference...*, 1969). For the *Exoticus* Subzone and *Variabilis* Zone, 30 and 3 ammonites finds, respectively, are mentioned; 50 specimens of the genus *Virgatosphinctes* in total were found in the upper Volgian Substage.

The authors of the last work emphasized the conditional attribution of the *Exoticus* Subzone to the upper Volgian *Craspedites okensis* Zone. In their opinion, the regular occurrence of *V. exoticus* and *V. tenuicostatus*, which accompany the upper Volgian *Craspedites* species up to the upper boundary of the Volgian Stage, allow the *Exoticus* Subzone to be attributed to the upper, rather than middle Volgian Substage. Precisely in such understanding, the *Exoticus* Subzone was correlated in the Kheta River sections with the lower part of the *Craspedites okensis* Zone in zonal scales of Siberia (*Zones...*, 1982; Schulgina, 1985; Mesezhnikov, 1984; Zakharov et al., 1997, 2005; Shurygin et al., 2000; *Resolution...*, 2004).

In 1979, Sasonova and Sasonov attributed the genus *Virgatosphinctes* to the genus *Praechetaites* with the type species *P. exoticus* (Schulg.). The authors provided no list of species belonging to this new genus and all the Siberian *"Virgatosphinctes"* species were identified as belonging to the *exoticus* group and automatically placed in the new genus. The family belonging of the genus was never discussed (?Dorsoplanitidae). The new generic name, which replaced the former *Vir-*

gatosphinctes was accepted by foreign and, subsequently, Russian paleontologists. In all the recent scales, the biostratigraphic unit *Praechetaites exoticus* is shown as either a subzone (in most Siberian schemes) or zone (Callomon and Birkelund, 1982; Baraboshkin, 2004; Zakharov et al., 2005; Rogov and Zakharov, 2007, 2009; Zakharov and Rogov, 2006, 2008). When providing the taxonomic characteristic of *P. exoticus*, Baraboshkin notes that the lower and upper boundaries of the zone are placed at the appearance levels of *Praechetaites* and *Craspedites* representatives, respectively. Only *Praechetaites* forms are mentioned in the zonal characteristic.

This biostratigraphic unit in the rank of *P. tenuicostatus* Beds is defined in eastern Greenland and western Spitsbergen (Surlyk, 1978; Ershova, 1983). The lower boundary of the *P. tenuicostatus* Beds in continuous sections of Svalbard was drawn based on the disappearance of *Laugeites* and the mass appearance of *Praechetaites* (*"Virgatosphinctes"*) specimens. The nominal beds were attributed to the upper Volgian Substage and, similar to Siberia, are overlain higher in the section by the *Craspedites okensis* Zone. Recently, the *P. tenuicostatus* Beds in western Spitsbergen are replaced for the *P. exoticus* Zone (Rogov and Zakharov, 2009).

The *Praechetaites* finds were also noted in the *Craspedites okensis* Zone of the Nordvik Peninsula (Cape Urdyuk Khaya) (Basov et al., 1970, p.71). The species "*V.*" *bicostatus* Schulg. was reported from the lower 2.5 m of the zone represented by Member VI, while the species *Craspedites okensis* characterized the entire member, except for its lower 1.0–1.5 m. The authors decided against defining the lower part of the member as an autonomous biostratigraphic unit with *"Virgatosphinctes"*.

According to Mesezhnikov (1984), who described the species *"Virgatosphinctes" subtenuicostatus* (Mesezhn.) from the *Taimyrosphinctes excentricus* Zone in the Taimyr Peninsula, the genus *Praechetaites* (*"Virgatosphinctes"*) also occurs in the middle Volgian *Dorsoplanites maximus* Zone, while in Spitsbergen (Rogov and Zakharov, 2009), it appears even lower, in the *Ilovaiskii* Zone. Mesezhnikov (1984, p. 54) mentioned once *Taimyrosphinctes (T.)* cf. *trikraniformoides* Mesezhn. from the *Exoticus* Subzone (7 m) of the *Okensis* Zone, in addition to diverse *Praechetaites* forms.

Recently, the *Praechetaites exoticus* Zone was defined by M.A. Rogov in the Volgian Stage of the Nordvik Peninsula, where the Siberian reference section of Jurassic–Cretaceous boundary strata is located (Zakharov and Rogov, 2006, 2008).

The last authors attributed to the *P. exoticus* Zone the section interval characterized by *Laugeites* and *Praechetaites* representatives. They arrived at the conclusion, that in this section the zone belongs to the middle Volgian Stage and included as such into the regional scale of Siberia, which was made, in our opinion, without any grounds.

DISCUSSION

The *P. exoticus* Zone in the Nordvik Peninsula is characterized by *Laugeites* sp. nov. aff. *parvus* (=*L. parvus* in Kiselev and Rogov, 2005) and single *Praechetaites exoticus* (Schulg) and *P.* cf. *bicostatus* (Schulg.) (Zakharov and Rogov, 2008). The last authors note the specific feature of representatives of *Laugeites* consisting of the disappearance of ornamentation on the early whorls, which in their opinion links these forms with *Laugeites* from the middle Volgian *Epivirgatites nikitini* Zone of the East European Platform. Therefore, the *P. exoticus* Zone was placed into the middle Volgian Substage. This conclusion, placing this zone in the Nordvik Peninsula into the middle (instead of the upper) substage was then extrapolated onto sections of the Kheta River basin, where the stratotype of the zone is located and where the genus *Praechetaites* is characterized by a wide stratigraphic range: middle (partly) and upper Volgian substages. Dissimilar to the Kheta River sections, no *Praechetaites* finds were recorded above the *C. okensis* Zone in the section of the Nordvik Peninsula.

The stratigraphic range of *Praechetaites* representatives in the Nordvik section is substantially narrower as compared with that in the Kheta River section. To determine its correlation with some part of the *Praechetaites* Zone in the Kheta River section is possible only based on accompanying species, which are used for the Volgian Stage zonal stratigraphy.

Long-term studies of this section by different researchers, scientists from the Institute of Petroleum Geology and Geophysics (Siberian Division, Russian Academy of Sciences) during 2009 including, revealed that in the Volgian Stage of the Nordvik Peninsula, ammonites with an exactly established position in the section are rare (single specimens).

Zakharov and Rogov justly attributed the layers with co-occurring *Laugeites* and *Praechetaites* to the middle Volgian Substage. Previously, *Praechetaites* ("*Virgatosphinctes*") *bicostatus* (Schulg.), *"V."* cf. *tenuicostatus* (Schulg.), *"V"* sp., and *Laugeites* sp. (the latter found in talus) were described from the middle Volgian *Epivirgatites variabilis* Zone in the Kheta River basin (Schulgina, 1967; *Reference...*, 1969). Recent studies in the Nordvik Peninsula revealed both *Praechetaites bicostatus* and *P. exoticus* (Schulg.), which was never mentioned by Schulgina from the middle Volgian Substage. The comparison between the Nordvik and Kheta sections led the researchers to the conclusion on the complete correlation of sediments,

which overly in both sections the middle Volgian *Variabilis* Zone and replaced higher in the section by the upper Volgian *Okensis* Zone. At the same time, these sediments enclose *Praechetaites* and *Laugeites* sp. (*"Exoticus"* Subzone) in the Nordvik Peninsula and only *Praechetaites* (*Exoticus* Zone) in the Kheta River section. Therefore, such a correlation cannot be unconditionally accepted until the question of presence/absence of sediments containing only *Praechetaites* representatives in the Volgian Sage is solved.

According to as yet unquestioned data, such an interval containing only *Praechetaites* specimens exists in the Volgian Stage not only in the Kheta River basin but also in other regions. These are the *"Virgatosphinctes" tenuicostatus* Beds in western Spitsbergen (Ershova, 1983) and the synonymous zone in eastern Greenland (Surlyk, 1978; Callomon and Birkelund, 1982). The selection of different regional index species is not of major importance.

Rogov (in press, fig. 2) found in the Cape Festningen area of western Spitsbergen the layers characterized by *Praechetaites* sp. and *Laugeites* sp. nov. above the middle Volgian *Groenlandicus* Zone and overlain by beds containing only *Praechetaites* sp., which are, in turn, overlain by the upper Volgian *Okensis* Zone. He attributes the entire interval to the *Exoticus* Zone and considers the latter as belonging to the middle Volgian Substage, although the finds of *Laugeites* sp. nov. are confined to basal layers of the zone (*L.* sp. nov. Member). In our opinion, only the basal part of the *"Exoticus"* Zone may be confidently attributed to the middle Volgian Substage; similar to the Nordvik Peninsula, the index species for this zone should be selected from the genus *Laugeites*.. The *Exoticus* name should be attributed to overlying sediments characterized only by *Praechetaites* sp.

It can be regarded as certain that the middle Volgian section in both the Nordvik Peninsula and western Spitsbergen includes the interval with co-occurring *Praechetaites* and *Laugeites* (*Exoticus* Zone, after Zakharov and Rogov). It should be noted that when presenting the sketch of the Volgian Stage section (Zakharov and Rogov, 2008, fig. 1), the authors mistook the age interpretation of beds taken from Zakharov et al. (1983, pp. 70, 71). Bed 32/2 should correspond to Bed 33/9 or its part, not build on the latter in a manner shown in Zakharov and Rogov, 2008, fig. 1), where Bed 32/3 overlies Bed 33/9. In this case, the thickness of the *P. exoticus* Zone corresponding in fig. 1 to Bed 32/2 and, partly, 32/3 (approximately 1.8 m) should be reduced by 0.7 m, i.e., constitutes around 1.1 m. When the lower boundary of the zone is drawn at the *Praechetaites* appearance level (which is logical), the thickness of the zone is reduced by an additional 0.5 m. It is also unclear why the upper boundary of the zone is shown 0.3 m below Bed 32/4, not placed at the *Craspedites* appearance level, similar to that in the stratotype of the *Exoticus* Zone.

Judging from other sections, the *"Exoticus"* Zone in the Volgian Stage of the Nordvik Peninsula characterized by *Laugeites* sp. nov. aff. *parvus* (=*L. parvus*, in Kiselev and Rogov, 2005), *Praechetaites exoticus* (Schulg.), and *P.* cf. *bicostatus* (Schulg.) and justly placed into the upper part of the middle Volgian Substage (Zakharov and Rogov, 2008; *Resolutions...*, 2008) is not a complete age analog of the synonymous subzone in its stratotype in the Kheta River basin.

It should be noted that the typical middle Volgian genus *Laugeites* (=Jeletzky, 1965, pl. VIII, 7) in the Nordvik Peninsula section is indicated from the upper Volgian Substage, which may be doubtful.

In the Kheta River basin, the occurrence of layers with *Praechetaites* and *Laugeites* is still unproven, although there is the *Exoticus* Subzone with the only genus *Praechetaites*. This subzone is located between the middle and upper Volgian substages and its exact stratigraphic position remains uncertain. The analogs of the Nordvik *"Exoticus"* Zone in this section are probably missing. The most complete succession of all the biostratigraphic units from the middle Volgian *Variabilis* Zone and its age analogs to the upper Volgian *Okensis* Zone is evidently preserved in western Spitsbergen (Rogov, in press).

CONCLUSIONS

The stratigraphic position of the true *Praechetaites exoticus* Zone (Subzone) in the middle or upper Volgian substages is still unclear and cannot be solved in the Nordvik section.

In our opinion, the interval of the Nordvik section attributed to the *Exoticus* Zone should be renamed: the new name should reflect the taxonomic specifics of the assemblage. The unit could be named after peculiar *Laugeites* forms mentioned in Zakharov and Rogov (2008), although their moderate preservation cast doubt on identifications and corresponding correlations. One of two species of the genus *Praechetaites* (*P. costatus*) is also characterized by peculiar features. The large size of its shells (macroconchs) and smoother ornamentation as compared with that in the type representatives of *P. bicostatus* caused Rogov to attribute them to a new species.

Despite the previous *Praechetaites* finds, the *Praechetaites exoticus* Zone (Subzone) was never defined in the Volgian Stage of the Nordvik Peninsula (Cape Urdyuk Khaya area), where it is probably absent.

We suggest preserving the *Exoticus* Zone (Subzone) in the Siberian regional scale, corresponding to the

lower part of the upper Volgian Substage, instead of terminating the middle Volgian Substage with the latter, as is proposed in a recent variant of the boreal Jurassic standard (*Resolutions...*, 2008). Otherwise, if the lower boundary of the upper Volgian Substage is drawn at the appearance level of *Craspedites okensis* (d'Orb.), i.e., at the base of the *Okensis* Zone, the underlying *Exoticus* Zone (Subzone) is automatically placed into the upper part of the middle Volgian Substage, although direct arguments for the revision of the zone position are still missing.

ACKNOWLEDGMENTS

We are grateful to reviewers for constructive discussions of the problem discussed in this paper.

This work was supported by the Earth Sciences Branch of the Russian Academy of Sciences (Programs 15 and 17) and the Russian Foundation for Basic Research (project no. 09-05-00136).

Reviewers V.A. Zakharov
and M.A. Rogov

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