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Original article

Discovery of Early Carboniferous conodonts in Northern Kharaulakh Ranges (lower reaches of the Lena River, northeastern Siberia, Arctic Russia)

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Abstract

Lower Carboniferous type sections of the Upper Bastakh Member and lower Atyrdakh Formation in the lower reaches of the Lena River yielded an assemblage of conodonts comprising representatives of the genera *Neopolygnathus*, *Bispathodus*, *Pseudopolygnathus*, *Mestognathus*, *Spathognathodus*, a new genus and species *Lenathodus bakharevi* Izokh, nov. sp., and a new subspecies *Neopolygnathus communis yazikovi* Izokh nov. ssp. This assemblage suggests a correlation with the upper Tournaisian *Gnathodus typicus*–*Siphonodella isosticha* and *Gnathodus pseudosemiglaber*–*Scaliognathus anchoralis* zones thereby refining the Lower Carboniferous regional stratigraphy of Northern Kharaulakh and improving the reliability of inter-regional correlations.

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Keywords: Conodonts; Biostratigraphy; Tournaisian; Visean; Arctic Russia

1. Introduction

In 2012, a research team of the Institute of Petroleum Geology and Geophysics (Novosibirsk) conducted field work in the lower reaches and delta of the Lena River in the Northern Kharaulakh Ranges, the first one in several decades. The results of the large-scale comprehensive lithological and biostratigraphic studies of exposed Paleozoic sediments, including field observations and laboratory analyses, have been reported in several publications and conferences (Saraev et al., 2013; Yazikov et al., 2013a, b, c, 2015; Yazikov and Sobolev, 2013; Izokh, 2014). This paper is another contribution to the subject this time focusing on the so-called *Southern section* (Fig. 1) logged in a more than 10 km long outcrop in the right bank of the Lena River starting 15.6 km south-southeast of the Crest-Toomsa Cape between the Tababastakh–Yureghe and Kysam rivers (Bogush et al., 1965; Bogush and Yuferev, 1966; Kashirtsev et al., 1966; and other). Stretching in N–S direction, the section comprises a Carboniferous to Permian (up to the Tatar Stage) stratigraphic succession and is a type section for almost all formations in Northern Kharaulakh.

Here we report on the discovery of conodonts in the lowermost stratigraphic interval of the Southern section representing the Upper Bastakh Member and lower Atyrdakh Formation and implications for local and regional stratigraphy.

2. Geological setting

The Upper Devonian and Lower Carboniferous strata are well exposed in steep cliffs along the lower reaches of the Lena River and the Bykovskaya Channel (Fig. 2), as well as on the Kurungnakh–Sise, Kubalakh–Aryta, Stolb, and other islands in the Lena Delta constituting the core of several anticlinal folds within the Verkhoyansk Uplift (megaanticlinorium). The area is heavily faulted and folded, consisting of large monoclinical and complex isoclinal blocks and westward recumbent folds. Most faults are of thrust geometry and are often superimposed by later thrusts or oblique- and reverse-slip faults. The left bank of the Lena River belongs to the Lena Trough which, in turn, is a part of the Verkhoyansk Foredeep. In the northeast, the trough borders the large upthrust Verkhoyansk block with vertical displacement reaching a few kilometers (Gogina, 1979).

According to a recent model (Bol'shiyanov et al., 2014), the area lies at the junction between the Precambrian Siberian Craton and the Mesozoic Khatanga–Laptev Sea plate. The plate

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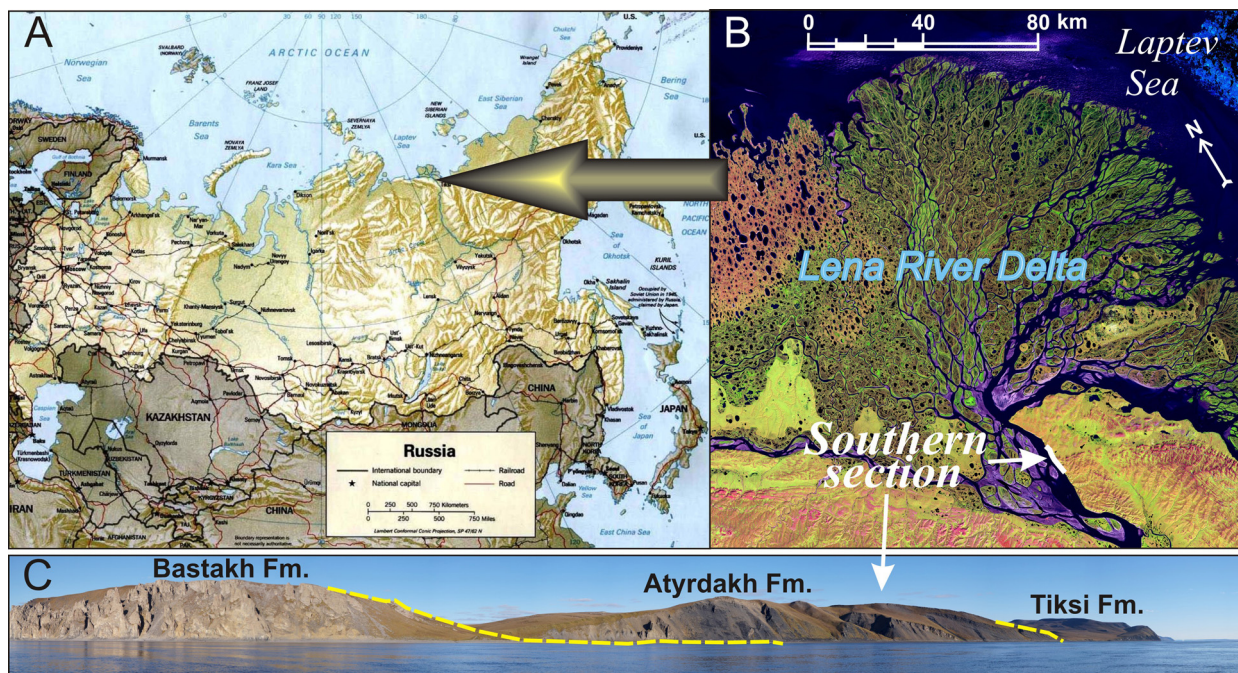


Fig. 1. Geographic position of the Carboniferous-Permian *Southern section* in the lower reaches of the Lena River (A–B) and a panoramic view of the outcrop with Bastakh, Atyrdakh and Tiksi formations (C).

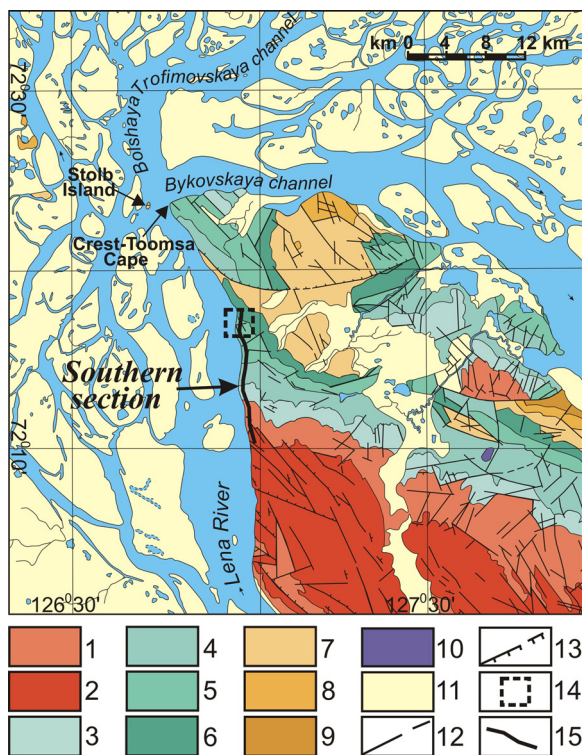


Fig. 2. Geological map of the Northern Kharaulakh Ranges in the Lena River lower reaches and delta, after Gogina (1979). Legend: (1) Permian Kharaulakh Formation; (2) Permian Verkhoyansk Formation; (3) Carboniferous Tugasir Formation; (4) Carboniferous Tiksi Formation; (5) Carboniferous Atyrdakh Formation; (6) Carboniferous Bastakh Formation; (7) Devonian Ebelyakh Formation and Stolb Beds; (8) Devonian Orto-Khaya Beds; (9) Middle Devonian; (10) dolerite; (11) post-Palaeozoic rocks; (12) inferred and observed faults; (13) inferred and observed faults with slip direction; (14) location of sampled sections; (15) Carboniferous–Permian *Southern section*.

has a Late Kimmeridgian basement exposed within the East Taimyr–Olenek thrust-fold belt, which belongs to the Upper Kolyma fold area and separates the craton and the plate.

Upper Devonian and Lower Carboniferous stratigraphy

Stratigraphic subdivision of the Upper Devonian and Lower Carboniferous strata of Northern Kharaulakh Ranges into formations follows the scheme proposed by Mezhluk (1958) with minor subsequent improvements and modifications. Biostratigraphy of the section was developed before the mid-1980s (Abramov and Grigorieva, 1986). Although subsequent fossil collection provided updates to the regional stratigraphic model (e.g., Klets, 2005; Kutugin, 2009), the biostratigraphic research has effectively slowed down. All previous constraints were based primarily on brachiopods and foraminifers, occasionally ostracods, corals, and ammonoids. We were the first to discover representative conodont assemblages first in Upper Devonian of the Stolb Island (Yazikov et al., 2013a, b, c; Izokh, 2014) and then in Lower Carboniferous of the Kharaulakh Ranges (this study). The conodont data also improve the reliability of global-scale correlations of the Lena Delta sections.

The studied composite Upper Devonian to Lower Carboniferous section comprises several units described below in the ascending order (Fig. 3).

Orto-Khaya Beds are exposed in bluffs along the Bykovskaya Channel and in the Lena Delta islands. The oldest biostratigraphically reliable Upper Devonian strata have been documented in outcrops in the Crest-Khomo Bay and Amerika-Khaya Hill in the Kurungnakh-Sise Island. The Frasnian section begins with a ~50 m thick package of red and variegated mudstone, siltstone, and carbonates with fine-grained detrital limestone interbeds containing a diverse assemblage of brachiopods. The Early Frasnian age of the sediments is

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