

# Revisiting the age of the Asha Group in the South Urals

## Revisión de la edad del Grupo de Asha en los Urales meridionales

A.V. Kolesnikov<sup>1,2,3</sup>, N.I. Bobkov<sup>2,4</sup>

<sup>1</sup>Geological Institute, Russian Academy of Sciences, Pygevsky 7, Moscow 119017, Russia. Email: anton.kolesnikov@icloud.com; ORCID ID: <https://orcid.org/0000-0003-1028-9082>

<sup>2</sup>Trofimuk Institute of Petroleum Geology and Geophysics of Siberian Branch Russian Academy of Sciences, prospekt Akademika Koptuyuga 3, Novosibirsk 630090, Russia. ORCID ID: <https://orcid.org/0000-0003-1876-6445>

<sup>3</sup>Moscow State Pedagogical University, Faculty of Geography, Kibalchicha str. 16, Moscow 129626, Russia.

<sup>4</sup>Novosibirsk State University, ulitsa Pirogova 1, Novosibirsk 630090, Russia.

### ABSTRACT

The Asha Group of the South Urals, initially erected by Albert Olli as Palaeozoic sedimentary complex, more than half a century ago was considered as a key section for the Vendian (Ediacaran) of the western slope of the South Urals. However, the ca. 1700 m-thick terrigenous sedimentary sequence is characterised by unusual low biodiversity of Ediacaran macrofossils, which might be explained by relatively young age of the Asha Group and possible mass extinction event in the end of Ediacaran Period. The relatively young age was confirmed by the U-Pb zircon date of  $547.6 \pm 3.8$  Ma obtained from the tuff in the lower part of the Basa Formation as well as finding of ichnospecies *Didymaulichnus tirasensis* in the upper part of Zigan formation. However, in 2018 it has been documented there the mass appearing of *D. tirasensis* in the lowermost part of the Basa Formation. Therefore, the Vendian (Ediacaran) age of the Asha Group of the South Urals can be revisited in favour to terminal Ediacaran-Cambrian or even early Cambrian.

**Keywords:** Asha Group; South Urals; Ediacaran; Cambrian; *Didymaulichnus*; *Palaeopascichnus*.

### RESUMEN

El Grupo de Asha de los Urales meridionales, inicialmente definido por Albert Olli como complejo sedimentario paleozoico, hace más de medio siglo, fue considerado como una sección clave para el Véndico (Ediacárico) de la vertiente occidental de los Urales meridionales. Sin embargo, secuencia sedimentaria terrígena de unos 1.700 m de espesor se caracteriza por una biodiversidad inusualmente baja de macrofósiles ediacaranos, lo que podría explicarse por la edad relativamente temprana del grupo y el posible evento de extinción masiva que marca el final del período Ediacárico. La edad relativamente temprana fue confirmada por la datación de  $547.6 \pm 3.8$  Ma obtenida de una toba en la parte inferior de la Formación de Basa, así como por el hallazgo de la iconoespecie *Didymaulichnus tirasensis* en la parte superior de la Formación de Zigan. Sin embargo, en 2018 se ha documentó la aparición masiva de *D. tirasensis* en la parte más baja de la Formación de Basa. Por lo tanto, la edad Véndico (Ediacárico) del Grupo de Asha de los Urales meridionales puede ser reconsiderada en favor del Ediacárico terminal-Cámbrico o incluso del Cambrian temprano.

**Palabras clave:** Grupo de Asha; Urales meridionales; Ediacárico; Cámbrico; *Didymaulichnus*; *Palaeopascichnus*.

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Recibido el 5 de mayo de 2019; Aceptado el 1 de septiembre de 2019; Publicado online el 21 de noviembre de 2019

**Citation / Cómo citar este artículo:** Kolesnikov, A.V. & Bobkov, N.I. (2019). Revisiting the age of the Asha Group in the South Urals. Estudios Geológicos 75(2): e103. <https://doi.org/10.3989/egeol.43590.558>.

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## Introduction

It is widely accepted by the Russian geologists that there were two stages in evolution of sedimentary cover of the East European Platform: (1) aulacogen stage, which is characterized by the sporadic occurrences of thick sedimentary complexes in rift zones of ancient crystalline basement during Riphean time ( $\sim 1.6\text{--}0.6$  Ga); (2) plate complex development stage, which is featured by a trend to subsidence of basement coincident with its sedimentary covering, with the exception of the Baltic and Ukrainian shields and some areas of the Timan Ridge (Milanovsky, 1981; Khain & Lomize, 2005). Thus, the beginning of plate complex deposition in some way is related to the Vendian or Ediacaran systems.

Albert Olli, a professor of the Saratov State University, was the first (1948) who suggested erecting the Asha Group from the ‘oldest deposits’ on the South Urals. The Palaeozoic (Cambrian-Ordovician) age of the Asha Group has been argued by the palaeontological findings. However, it was suggested to correlate the Asha Group with Valdai Group of the Vendian of the northwest part of the East European Platform (Keller, 1963). Later, there was established the Vendian age of the Asha Group by K-Ar-glaucinite dating (Garris, 1973). Nevertheless, the relatively recent studies show that there is some evidence of younger age (close to Ediacaran-Cambrian boundary) of the Asha Group (Grazhdankin *et al.*, 2011; Levashova *et al.*, 2013; Kolesnikov *et al.*, 2015). Consequently, the Asha Group age is becoming a subject of debate.

## Geological setting

At the moment, it is suggested to subdivide the ca. 1700-m-thick Asha Group (Fig. 1) into four formations: Uryuk, Basa, Kuk-Karauk and Zigan (Kolesnikov *et al.*, 2015). The 125 m-thick Uryuk Formation is comprised of basal conglomerates and overlying intervals of fine laminated shales and cross-bedded arkosic sandstones. The Basa Formation is 808 m-thick and mainly represents the alternating shales/siltstones and laminar- to wave-bedded siltstones and sandstones complexes. The new stratigraphic level of ichnofossil *Didymaulichnus tirasensis* and skeletal macrofossil *Palaeopascichnus*

*linearis* (Fig. 2) has been found 150-m above the base of the Basa Formation and associated with its lower part. The Kuk-Karauk Formation is presented by relatively thin (ca. 20 m-thick) conglomerate complex, which is missing in some areas of South Urals making difficult to distinguish the overlying Zigan Formation. The 660 m-thick Zigan Formation is dominated by alternating shales/siltstones/sandstones and thick packages of the biolaminated silt- and sandstones with abundant arumberiamorph microbially induced sedimentary structures (Kolesnikov *et al.*, 2017). Taking all things together, the Asha Group of the South Urals is dominated by terrigenous sequence and interpreted as an inner shelf shallow depositional system (Kolesnikov *et al.*, 2015).

## New results and discussion

A U-Pb zircon date of  $547.6 \pm 3.8$  Ma (Levashova *et al.*, 2013) obtained from the volcanic tuffs in a section near the Ust-Katav railway station is being in need of revision and recalculation due to the relatively poor accuracy and the opinion (*sensu* M.L. Bazhenov) that these tuffs are localised in the upper part of the Zigan Formation exposed in outcrop near the station (Fig. 1). For example, a recent research of outcrops and geological settings near the Ust-Katav city contradicts the presence of the Zigan Formation in that area: there is no evidence of arumberiamorph microbially induced sedimentary structures and thick packages of biolaminated sandstones; the Ust-Katav sections overlies the Riphean deposits and begins from the Uryuk Formation, which is also well correlated with the Vyazovaya section (ca. 12 km to east from Ust-Katav), as being part of one fold structure. Thus, the obtained age of  $547.6 \pm 3.8$  Ma (Levashova *et al.*, 2013) has to be placed in the lower part of the Basa Formation exposed in the section near the Ust-Katav railway station. Moreover, in 2018 a new fossil locality in the lower part of Basa Formation has been found in the quarry of Shubino village near the north margin of the Ust-Katav city.

The fossil assemblage is presented by abundant complex of ichnofossils *Didymaulichnus tirasensis* and skeletal macrofossils *Palaeopascichnus linearis*. The ichnofossils *Didymaulichnus tirasensis* (Fig. 2A-D) are preserved as relatively short (10–20 mm) to long (up to 25 cm) bilobed positive

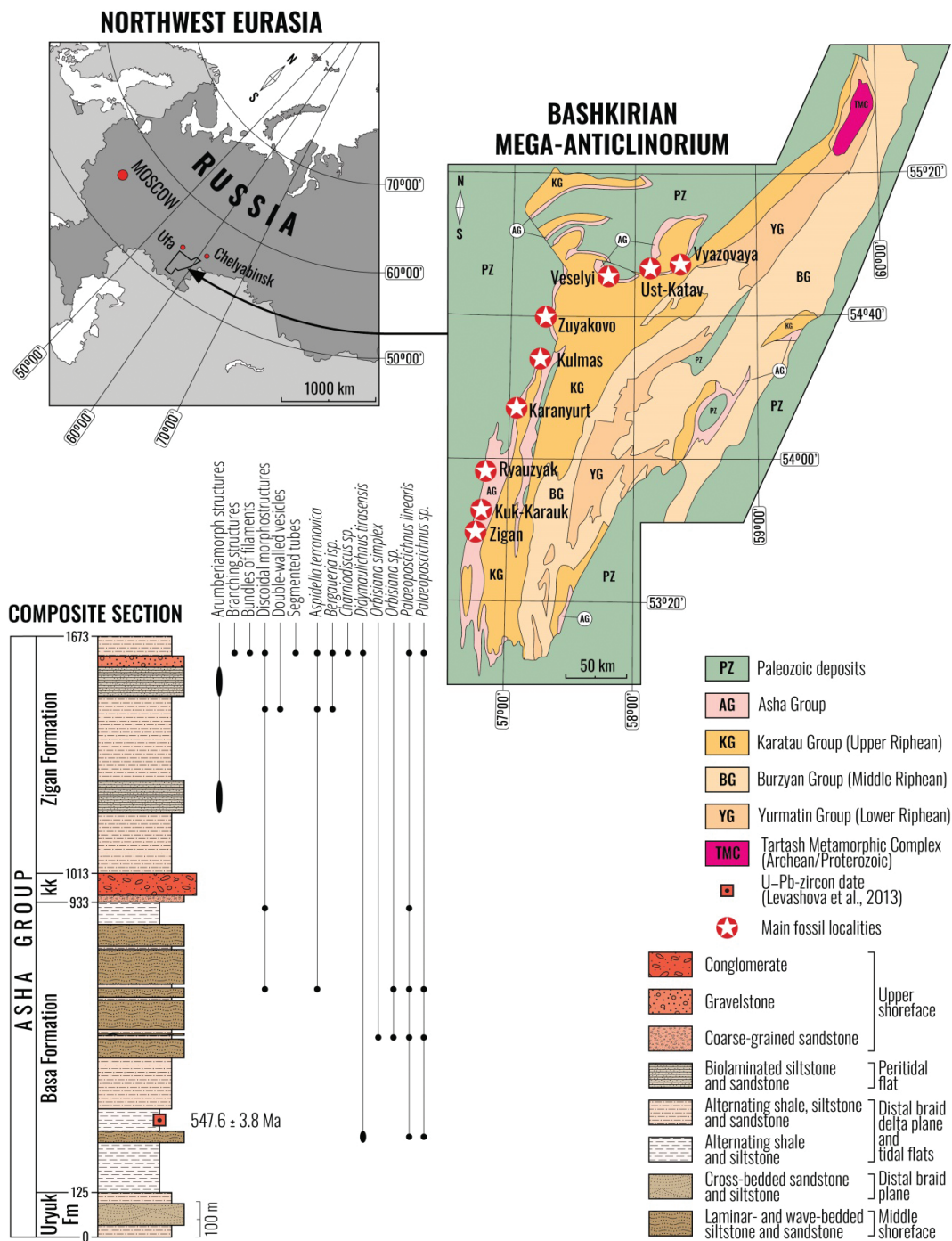


Figure 1.—Distribution of Ediacaran macrofossils and new stratigraphic level of the *Didymaulichnus tirsasensis* in the Asha Group of the South Urals.

hyporelief sand bodies resulted from continuous repetition of deepening and shallowing of a burrowing organism. The skeletal macrofossil of the *Palaeopascichnus delicatus* is preserved on bedding

surface as series of ellipsoidal flattened chambers (Fig. 2E). A new occurrence of the *Didymaulichnus tirsasensis* together with *Palaeopascichnus linearis* near the Shubino village can be coincident with a

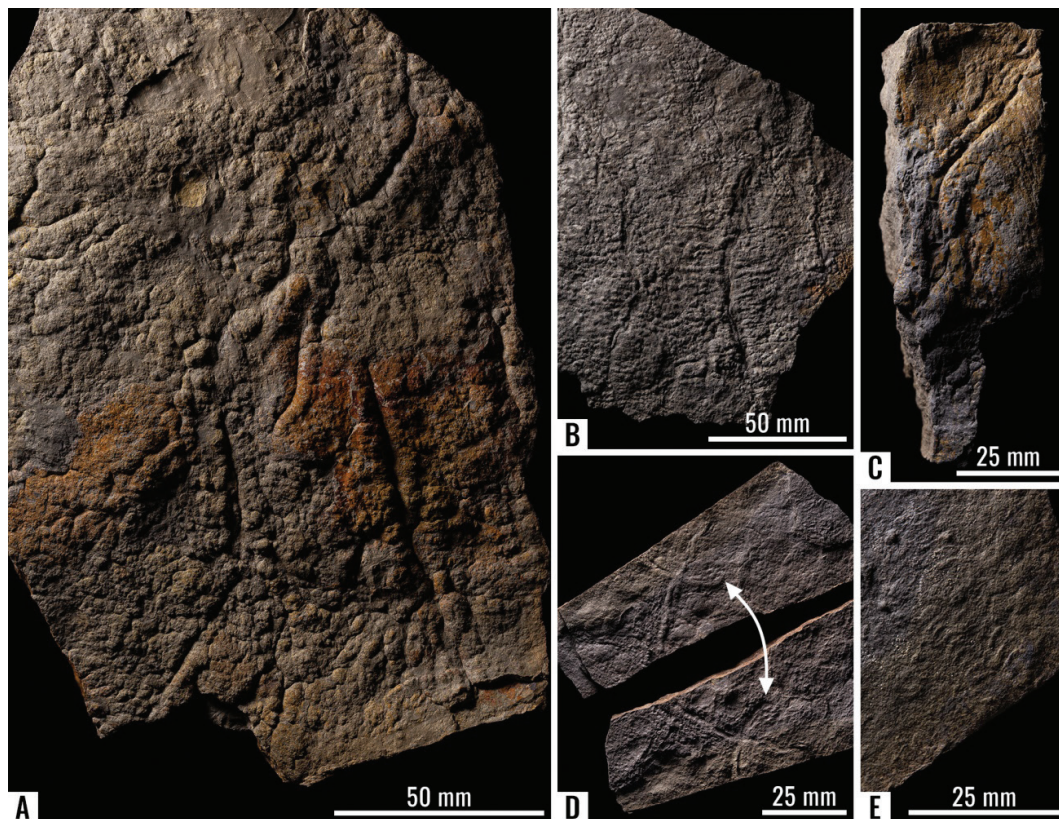


Figure 2.—Specimens from the fossil locality in the new quarry near the Ust-Katav city, lower part of the Basa formation: A-C. Ichnofossils *Didymaulichnus tirasensis* preserved as bilobed positive hyporelief sand bodies on the bedding surfaces. D. *Didymaulichnus tirasensis* preserved as sand bilobed body and its counter-impression. E. Skeletal macrofossil *Palaeopascichnus linearis*. The illustrated material is deposited in the Trofimuk Institute of Petroleum Geology and Geophysics SB RAS in Novosibirsk, Russia.

section of the Basa Formation in Vesolyi Creek, which is featured by the same fossils of *P. linearis* and new occurrence of *Orbisiana simplex* (Kolesnikov *et al.*, 2018a, b, 2019). It also indicates that several representatives of palaeopascichnid organisms were survived during the Ediacaran–Cambrian traditional time interval.

## Conclusions

Over the course of decades, the Vendian age was considered for the Asha Group of the South Urals. Now it can be seen that the weighty arguments of its relatively young age are beginning to emerge, and it can be concluded also that Prof. Albert Olli, over seventy years ago, was right in his assessment of the early Palaeozoic age of the Asha Group. A reassessment of the age of the Asha

Group of the South Urals reveals evidence of a significant inequality of sedimentary cover forming time on the southeastern part of the East European Platform.

## ACKNOWLEDGEMENTS

This research has been supported by the Russian Science Foundation [grant No. 19-77-00028]. Authors thank D.V. Grazhdankin and A.V. Maslov for their helpful and constructive comments.

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