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Taphonomic bias in *Cloudina* distribution data from Siberia

Sesgo tafonómico en los datos de distribución de Cloudina en Siberia

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ABSTRACT

Cloudina-morph fossils in Siberia have been traditionally regarded as a taphonomic mode of *Anabarites* tests inserted one into another under specific hydrodynamic conditions. Clusters of telescoped conical tests are ubiquitous in the Kessyusa Group and coeval strata across Siberia and not all of them can be easily interpreted as a result of simple mechanical stacking. It remains to be confirmed whether any of these clusters actually represents a life association of a *Cloudina*-morph structure.

Keywords: *Cloudina*; *Anabarites*; Taphonomy; Ediacaran; Siberia.

RESUMEN

En Siberia los morfotipos de *Cloudina* han sido tradicionalmente considerados como una variedad tafonómica de conchas de *Anabarites*, insertadas una dentro de otra, bajo condiciones hidrodinámicas específicas. Las asociaciones de conchas cónicas telescópicas son omnipresentes en el Grupode Kessyusa y en estratos contemporáneos a lo largo de Siberia, y no todos ellos pueden ser fácilmente interpretados como resultado de un simple apilamiento mecánico. Queda por ver si alguna de estas bioacumulaciones representa una asociación de vida de una estructura morfotípica de tipo *Cloudina*.

Palabras clave: *Cloudina*; *Anabarites*; Tafonomía; Ediacárico; Siberia.

Introduction

Representatives of the fossil genus *Cloudina*, a potential terminal Ediacaran index-taxon, are preserved in the form of conico-tubular calcareous structure built of numerous nested funnel-shaped elements, with concentrically placed circular to ellipsoid layers in cross section. It is one of the most geographically widespread and numerically abundant fossil in uppermost Ediacaran strata; however, the paucity of this taxon in Siberia has been puzzling (Zhuravlev *et al.*, 2012; Grazhdankin *et al.*, 2015). Fossiliferous strata in the north-western slope of the Olenek Uplift, arctic Siberia offer an exceptional view of terminal Ediacaran and Terreneuvian palaeobiology. In particular, the Ediacaran strata contain the youngest assemblage of Ediacaran Avalon-type macrofossils preserved as mouldic imprints in

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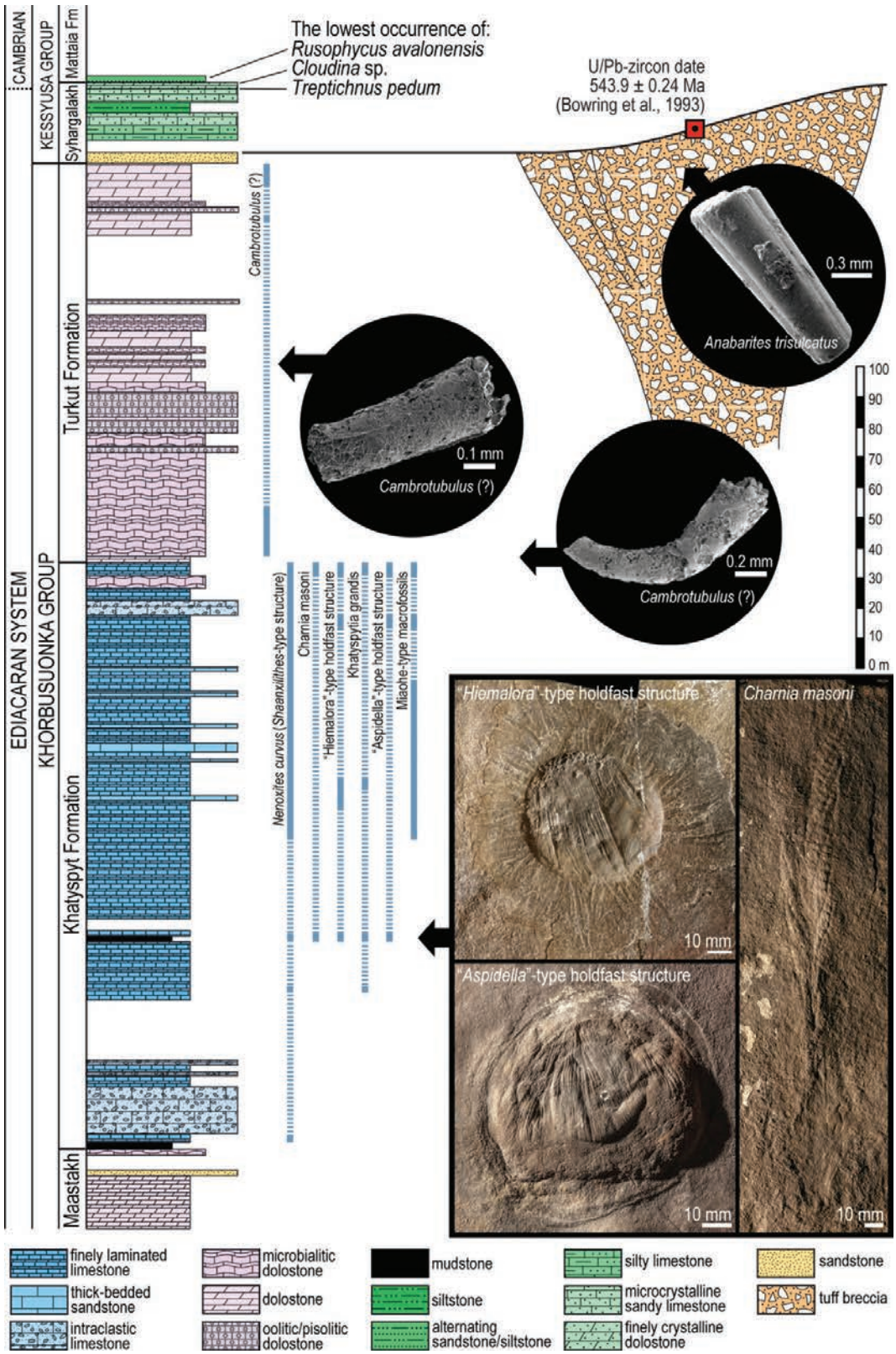

Figure 1.–Stratigraphic range of the earliest '*Cambrotubulus*' fossils in the northwestern slope of the Olenek Uplift, Siberia postdates a diverse assemblage of Ediacaran macrofossils including meniscate trace fossils *Nenoxites curvus* that is often confused with compressed tubular fossils of *Shaanxilithes*, and predates the first occurrence of small skeletal fossils *Anabarites trisulcatus* found in clasts of the stratiform breccia of the Tas-Yuryakh Volcanic Complex (Rogov *et al.*, 2015).

Figure 2.–*Cloudina*-morph fossils from the lower (A-D), middle (E) and uppermost strata (F-G) of the Kessyusa Group, Terreneuvian, Olenek Uplift, Siberia.

limestones; diverse carbonaceous compression macrofossils; probably the planet's oldest known occurrence of diverse taxonomically identifiable skeletal fossils; taxonomically, numerically and ecologically abundant trace fossils; and key radiometric and chemostratigraphic records – all in a single 400-m-thick continuous succession (Fig. 1). Fragments of conicotubular calcareous moulds found throughout the Turkut Formation and predating the lowest occurrence of fossil anabaritids in the section have been traditionally regarded as poorly preserved fossils of *Cambrotubulus decurvatus* (Nagovitsin *et al.*, 2015).

Results and discussion

The first occurrence of *Cloudina*-morph small skeletal fossils in the Olenek Uplift is found in the uppermost Syhargalakh Formation of the Kessyusa Group (Fig. 1). Here the *Cloudina*-morph fossils are all allochthonous (Fig. 2A-D) forming a laterally continuous coquina deposit that rests upon the stratiform breccia of the Tas-Yuryakh Volcanic Complex and appears to be coeval with the lowest stratigraphic occurrence in the section of the Cambrian index fossil *Treptichnus pedum*. Furthermore, the coquina deposit is immediately overlain by alternating sandstone and siltstone of the lowermost Mattaia Formation that yielded arthropod trace fossils *Rusophycus avalonensis* (Fig. 1). *Cloudina*-morphs in South China, Maly Karatau and Siberia have been known to occur together with small skeletal fossils of early Cambrian appearance (Zhuravlev *et al.*, 2012; Yang *et al.*, 2016). The section of the Olenek Uplift in Siberia provides the first record of the *Cloudina*-morph fossils postdating the Cambrian index-taxon *Treptichnus pedum*. Supposing our interpretation of the earliest '*Cambrotubulus*' fossils from

Figure 3.–Clusters of telescoped tests of *Anabarites* in lateral (A-D; scale: 1000 μm) and cross-sectional (A'-D'; scale: 500 μm) view from the lowermost Mattaia Formation. A hemispherical base of one of the tests in lateral and plane view showing a central cavity (E; scale: 1000 μm) from the Syhargalakh Formation.

the Turkut Formation is correct, the stratigraphic range of *Cloudina*-morph fossils in Siberia commences with the strata predating the first occurrence of *Anabarites trisulcatus* and extends into the *Purella antiqua* Assemblage Zone. Some of the *Cloudina*-morph fossils occur in strata that are demonstrably part of the Cambrian Stage 2 (Fig. 2E-G).

Concluding remarks

Cloudina-morph fossils in Siberia have always been interpreted as a taphonomic mode of *Anabarites* tests inserted one into another under specific hydrodynamic conditions. Clusters of telescoped conical tests are ubiquitous in the Kessyusa Group and coeval strata across Siberia but not all of them can be easily interpreted as a result of simple mechanical stacking (Fig. 3). We suggest that these fossils represent internal moulds of disarticulated *Cloudina* specimens. Disarticulation, internal mould formation, diagenetic dissolution and recrystallisation of tubes represent an under-explored taphonomic pathway in the preservation of *Cloudina*. If borne out by future studies, the entire early Nemakit-Daldynian fossil record of Siberia must be reevaluated to remove the bias in the *Cloudina* distribution data.

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