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Occurrence of the Lower Cambrian anemone-style trace fossils in the Zabuk Formation (Mardin–Derik, SE Turkey)

Présence de traces de fossiles de type anémone dans le Cambrien inférieur de la formation Zabuk (Mardin–Derik, Sud-Est de la Turquie)

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ABSTRACT

The Zabuk Formation of the Derik Group exposed over much of south-eastern Turkey presents a succession composed of shallow marine and fluvial siliciclastic sedimentary rocks. The Lower Cambrian assemblages containing abundant anemone-style trace fossils are known from most major palaeocontinents such as Laurentia, Baltica, and Gondwana. These have possible affinities with semi-infaunal dwelling anemones on siliciclastic mid-latitude shelves of West Gondwana in early Fortunian deposits. Among them is *Bergaueria*, characterized by plug-shaped burrows as exemplified by *Bergaueria perata*, that is, a characteristic trace fossil of the Cambrian globally.

RÉSUMÉ

La formation Zaduk du groupe Derik qu'on observe dans une grande partie de la Turquie du Sud-Est présente une succession composée de roches sédimentaires siliciclastiques fluviales ou marines de faible profondeur. Les assemblages du Cambrien inférieur qui renferment d'abondantes traces de fossiles de type anémone sont connus dans la plupart des paléocontinents majeurs, tels Laurentia, Baltica et Gondwana. Celles-ci semblent avoir des affinités avec celles des anémones semi-endofauniques des dépôts Fortunien inférieur des plates-formes siliciclastiques de moyenne latitude du Gondwana occidental. Parmi ces traces, celles de *Bergaueria* sont caractérisées par une forme de type cavité avec bouchon, comme l'illustre *Bergaueria perata* à trace fossile caractéristique du Cambrien à l'échelle globale.

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1. Introduction

Precise affinities of complex infaunal behavioural patterns are problematic, such as those that first appeared with the "Small Shelly Fossils" (SSF), trilobites, brachiopods, and hyoliths (Geyer and Landing, 2016). Among these, trilobites have been increasingly used for biostratigraphic correlation of the Cambrian System. However, Early Cambrian pre-trilobite bearing successions with trace fossil assemblages can provide good alternative index fossils in the regional and global stratigraphic subdivisions of the Cambrian (Peng et al., 2012). A characteristic trace fossil was first described under the name *Phycodes pedum* Seilacher, 1955 and is now known either as *Treptichnus pedum* (Jensen, 1997) or *Trichophycus pedum* (Geyer and Uchman, 1995) depending on the interpretation of its mode of formation (Geyer and Landing, 2016).

Numerous studies have been conducted on the Cambrian shelf sediments of the Proto-Tethyan Ocean to characterize their architecture, facies, and discontinuities. Cambrian units of different lithotypes that form parts of thick Palaeozoic sedimentary successions of the North Arabian Peninsula (Fig. 1a), are represented by the tidal quartz-arenite, which include the *Cruziana* ichnofacies with *Dimorphichnus quadrifidus* in the middle part of the Zabuk Formation (Fig. 1b) (Ghienne et al., 2010). Similar distributions of trace fossils can be documented from other Cambrian tide-dominated successions. For example, Erdoğan et al. (2004) documented several ichnotaxa of the *Cruziana* ichnofacies in tidal successions of the Early Cambrian in Taurus Range (south-western Turkey).

Early Cambrian trace fossils such as *Bergaueria* (*B. sucta*, *B. perata*, *B. radiata*, *B. major* and *B. hemispherica*) from several palaeocontinental margins have been attributed to possible actiniarian activity. We present here the first data on plug-shaped burrows (*Bergaueria*) in the Derik Group which shed new light on the Cambrian life recorded in rocks of the south-eastern Turkey. The new records from the lower part of the Zabuk Formation provide important knowledge on the diversity of Early Cambrian trace fossils (Fig. 1b).

2. Geological setting

A Cambrian series of clastic rocks with interbedded carbonates is exposed in south-eastern Turkey and constitutes a west-east trending outcrop belt (Fig. 1a). A thick pile of Early Cambrian marine siliciclastics from the basal Zabuk Formation, with Terreneuvean fluvial sediments were deposited in the northern margin of the Arabian Plate of the West Gondwana in the stable platform regime (Ghienne et al., 2010; Lamsdell et al., 2013). The Lower Cambrian (corresponding to the Terreneuvian and Cambrian Series 2; Peng et al., 2012) of the Derik–Mardin region is represented by a 584–830 m thick siliciclastic series (Kellog, 1960). This complex lithologic framework led to the recognition of several informal units (Dean, 1975). These units have been revised by Ghienne et al. (2010) because of detailed mapping and facies distinction; their lithostratigraphic units are based on the predominance of coarse and fine terrigenous sediment associations. The Neoproterozoic "Derik volcanics" unconformably underlies the Lower Cambrian sequence, which consists of fine to coarse sandstones of the Zabuk Formation. The Koruk Formation conformably overlies the Zabuk Formation. It is composed of dolomites and grey nodular limestones (Fig. 1b). Interbeds of grey, micaceous and clayey limestones occur especially in the upper levels around the highest 7 m, and are followed by brownish silty shales of the basal Sosink Formation. The Late Cambrian Sosink Formation conformably overlies the Koruk Formation and is composed of shale and sandstones with trilobites (Mergl et al., 2018).

The new records of plug-shaped burrows reported here come from the lower part of the Zabuk Formation and are positioned between overlying strata of the arkosic, cross-bedded sandstones, and the underlying strata of siltstones with rippled thin sandstone beds (Fig. 2b). In the field, bedding planes of strata can be seen that consist of red and purple coloured sandstone beds intercalated with thin sandy shales. Sandstones are either structureless or display cross-stratification, parallel lamination, ripple cross-lamination, ripple marks and shale intercalations.

The non-arthropod ichnogenera were discovered during fieldwork undertaken by us in August 2015. Although a part of the ichnotaxa described below are generally associated with sedimentary structure that could be worked in situ in the field because of their position in hard strata in outcrops (Fig. 2a, b), they were only accessible with difficulty.

2.1. Methodology

Study of lithofacies has been carried out bed by bed by İsmail Ömer Yılmaz in the field using cm-scale observation and description made by using visual estimation charts. Fossil analysis and sampling have been carried out by İzzet Hoşgör in the field and identifications of ichnotaxa have been made by Dirk Knaust.

3. Systematic ichnology

Ichnogenus ***Bergaueria*** Prantl, 1945
Type ichnospecies *Bergaueria perata* Prantl, 1945
Bergaueria perata Prantl, 1945
(Fig. 2e–ı)

Material. In situ specimens and field observations preserved as positive hyporeliefs in fine- to very fine-grained sandstone. In the field, 109 burrows were examined and all of them exhibit a hemispherical shape (Fig. 2a, b). We constrain our interpretations to the following taphonomic scheme (Fig. 2a): recognizable, but poorly preserved specimens (44%); poorly preserved specimens 29%; and well-preserved specimens (27%).

Stratigraphical distribution. Lower part of the Zabuk Formation. Fortunian–Stage 2.

Description. Hypichnial, sandstone-filled, regular, wider than deep, cylindrical plug-shaped structure, slightly smoothly conical basal part. Shallow, hemispherical burrows with hemispherical lower termination display a small central depression (Fig. 2e-ı). The whole structure is 7–14.5 mm in diameter, 4–9 mm high, with an apical

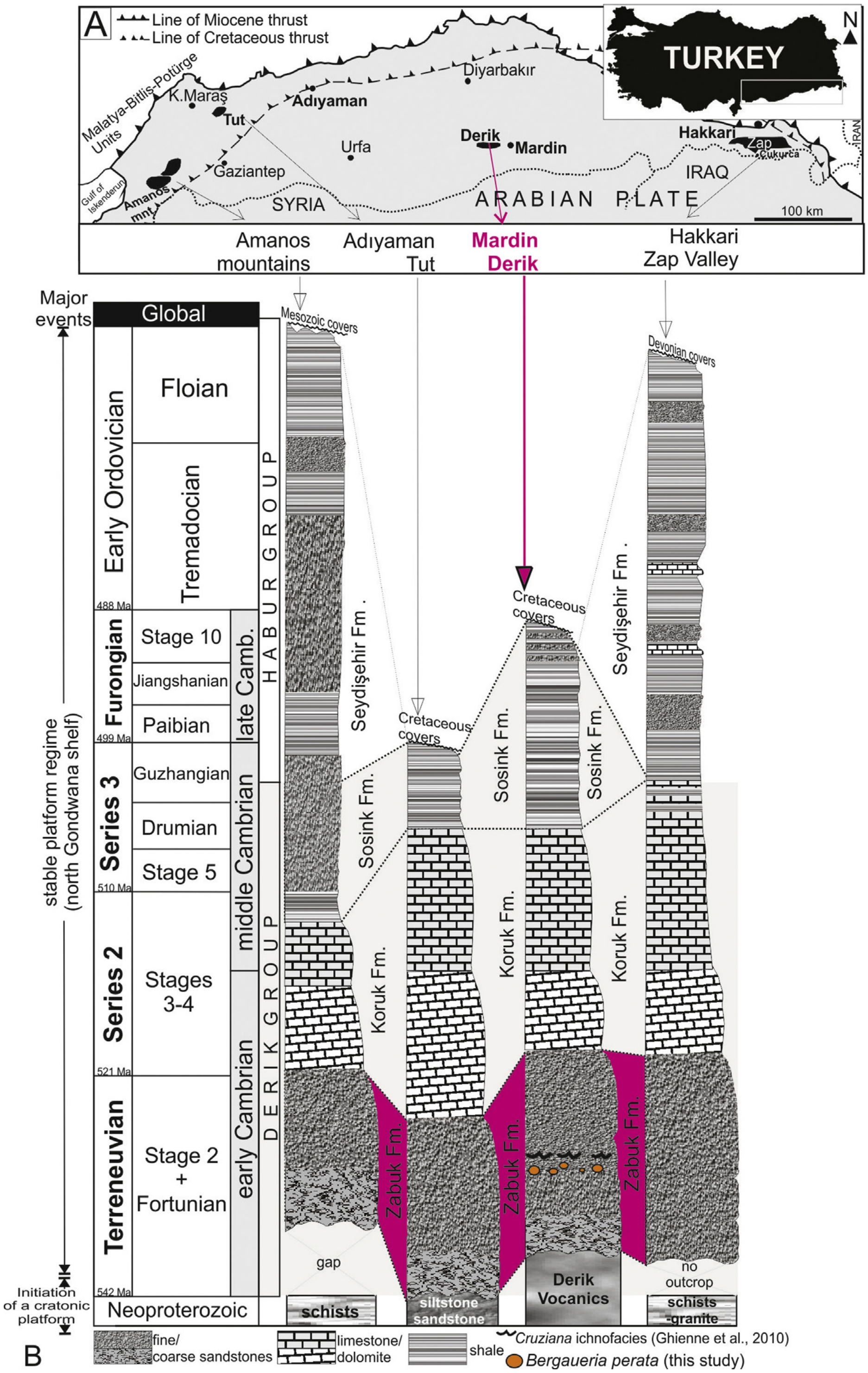

Fig. 1. A. Map of South-East Turkey showing the position of the Derik–Madin area with location of Cambrian-Ordovician non-metamorphic rocks (Lamsdell et al., 2013). B. Synthetic sketch of the lithologies and stratigraphy of the Cambrian and Early Ordovician formations in the south-eastern Turkey with schematic log showing the Cambrian formations of the Derik area (Dean et al., 1997; Ghienne et al., 2010; Lamsdell et al., 2013).

Fig. 1. A. Carte du Sud-Est de la Turquie, montrant la position de la zone de Derik–Mardin avec la localisation des roches cambro-ordoviciennes non métamorphiques (Lamsdell et al., 2013). B. Schéma synthétique des lithologies et de la stratigraphie du Cambrien et de l'Ordovicien inférieur du Sud-Est de la Turquie, avec un log schématique montrant les formations cambriennes de la zone de Derik (Dean et al., 1997; Ghienne et al., 2010; Lamsdell et al., 2013).

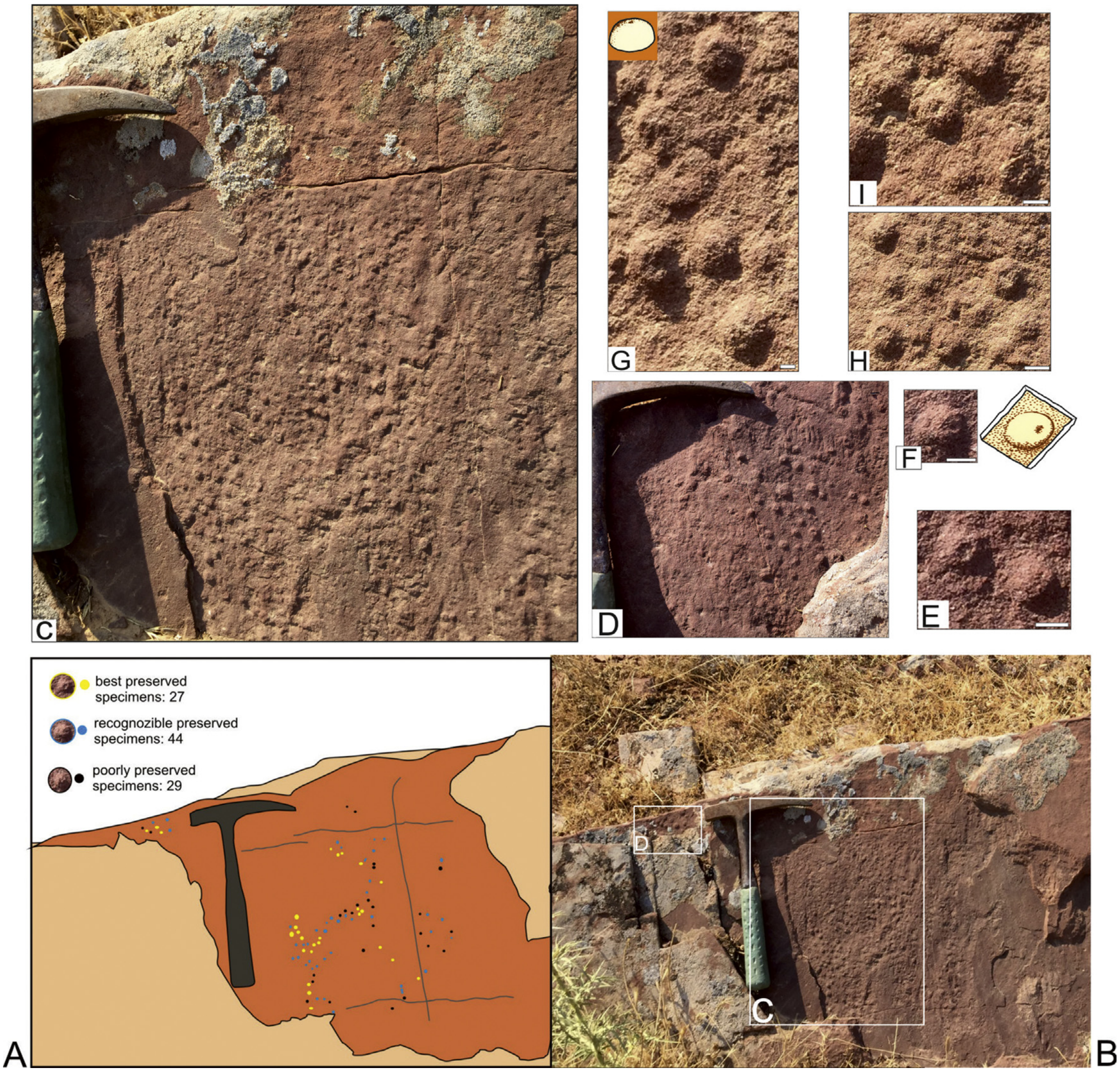

Fig. 2. A–B. *Bergaueria perata* from the early Cambrian of Zabuk Formation and a mono-ichnospecific entity of the surface positive hyporeliefs *Bergaueria*. C–D. Plan-view photographs of specimens from the study site, illustrating typical morphological characteristics, including: radial sand-infilled cracks. E–I. Apical view of samples, scale = 5 mm.

Fig. 2. A–B. *Bergaueria perata* du Cambrien inférieur de la formation Zabuk et entité mono-ichnospécifique des hyporeliefs positifs de surface de *Bergaueria*. C–D. Photographies en vue plane de spécimens du site de l'étude, illustrant les caractéristiques morphologiques typiques, incluant des craquelures radiales remplies de sable. E–I. Vue apicale des échantillons, barre d'échelle = 5 mm.

depression, which is 2–3 mm wide. The depth of the figured specimen is 3 mm (Fig. 2f). Numerous specimens of different diameter may co-occur on the same bedding plane. This structure shows smooth, unornamented side margins.

Remarks. Previous work has assumed anemone producers for the ichnogenera *Bergaueria*, *Conichnus*, *Conostichus* and *Dolopichnus* (*Laevicyclus*, according to Knaust, 2015) (e.g., Alpert, 1973; Prantl, 1945). The hemispherical and slightly conical shape of the basal part relates the described specimens to the typical *Bergaueria perata* from the Upper Ordovician Letná Formation of Czech Republic (Prantl, 1945, p. 52–53, pl. 1, figs. 1–2), the Lower Cambrian of India (Singh et al., 2014, p. 1674, figs. 8e, 9e, 10b; Sudan and Sharma, 2001, p. 162, pl. 1. I), Canada (Pemberton and Magwood, 1990, p. 437, figs. 2.1–2.3, 3.3), Sweden (Jensen and Grant, 1998, fig. 5c) and the Upper Cambrian of Poland (Radwański and Roniewicz, 1963, p. 271, pl. 9, figs. 1–3) and to trace fossils from the Lower and Middle Cambrian of the South American part of Gondwana (Pickerill, 1989a). The Goczałkowice Formation of southern Poland contains anemone-style trace fossils assignable to *Bergaueria* (32–56 mm in length), *Conichnus* (15–76 mm in length), and *Conostichus* (35–40 mm in length) in lower and upper shoreface deposits (Paczešna, 2010). The trace fossil most closely similar to *Bergaureria* is *Conostichus* Lesquereux, 1876, from Early Cambrian successions of Baltica and Laurentia also believed to be the casts of actinian burrows (Alpert, 1973; Paczešna, 2010). The main morphological differences indicate that *Conostichus* is larger (average size about 65 mm in height and 45 mm in diameter) and more conical than cylindrical or hemispherical in shape (Chamberlain, 1971; Pemberton et al., 1988). *B. perata* differs from *B. radiata* (Pemberton and Magwood, 1990, p. 438, figs. 2.1, 2.4) and *B. hemispherica* (Pemberton and Magwood, 1990, p. 437, figs. 2.1, 3.1–2) by the absence of faint radial ridges. *B. perata* is morphologically close to *Guanshanichnus* isp., which is a knob-shaped vertical burrows (Weber et al., 2013, p. 226, fig. 18a) from the Lower Cambrian (Stage 2) of the Malyi Karatau area (SE Kazakhstan). However, *B. perata* tends to be hemispherical in shape with a deeper central depression.

4. Discussion

4.1. Palaeoecological and palaeoenvironmental aspects

In the majority of the Phanerozoic settings, the mixed layer (typically 8 to 10 cm thick) is affected by biological activities, most notably by metazoan bioturbation (Bromley, 1996). Hagadorn and Bottjer (1999) pointed out that during the Precambrian–Cambrian transition and Cambrian period, the sedimentologic “pendulum” shifted (triangular diagrams in Fig. 3a) towards increasing metazoan influence, and by the post-Ordovician, the remarkable factors affecting marine siliciclastic successions were physical and metazoan processes. It is widely assumed that surface traces have a low preservation potential in marine settings (Buatois et al., 2017).

Hemispherical, conical to subconical, and cylindrical to subcylindrical burrows are included in the vertical plug-shaped burrows category (Buatois et al., 2017). These morphologies represent resting or dwelling trace fossils mostly produced by actinarian or ceriantharian sea anemones (Buatois et al., 2017; Pemberton et al., 1988).

The greatest diversity of Cambrian trace fossils may be found on bedding planes heterolithic sediments showing moderately thin, generally centimetre-scale, often sharp-based sand and siltstone beds (Jensen et al., 2005). According to Paczesna (2010), the plug-shaped burrows related to the activity of sea anemones are characterized particularly by the columnar shape, ornamentation or lining of the burrow margin and sculpture of the basal part. Orłowski and Radwnański (1986) discussed the sea-anemone burrows of the Middle Devonian shallow-water succession in the Holy Cross Mountains (Central Poland), documenting the presence of abundant, gregarious occurrences of the swarmy populated by sea anemones in structureless sand.

The action of burrowing anemones is recorded in morphological details of *Bergaueria*. Dwelling sea anemones are potential producers of *Bergaureria*-like traces in modern sandy bottom (Knaust, 2017) (Fig. 3b). These trace makers have fairly narrow grain size preferences and the majority live in sandy substrates. Sea anemones that burrow through the mud-sand interface may leave trace fossils that are preserved on the base of the sandstone (Chamberlain, 1971). *Bergaueria* preserved on thin sand layers represent shallow burrows, which were generally no more than a few centimetres in deep (Knaust, 2017; Mata et al., 2012). Burrows in mud may be scoured by currents and filled by sand (Fig. 3b).

4.2. Palaeogeographical approach

Early Cambrian trace fossils have been described from various localities worldwide. However, a majority of them are restricted either to siliciclastic facies or to a periphery of calcareous facies. With the beginning of the Cambrian period, highly developed and complex faunas from the shallow shelf areas of Laurentia, Baltica and Gondwanaland, consisting of (McIlory and Logan, 1999; Weber et al., 2007) rich Early Cambrian ichnoassemblages, occur in Sweden (Jensen, 1997), NW Argentina (Mángano et al., 2005), NW Canada (MacNaughton and Narbonne, 1999), Namibia (Geyer and Uchman, 1995), South Spain (Vintaned et al., 2006), Czech Republic (Central Bohemia, Mikuláš, 1995, 2000), India (Spiti Basin, Parcha and Pandey, 2011, Sudan and Sharma, 2001; Bikaner–Nagaur Basin, Pandey et al., 2014; Rajasthan Basin, Singh et al., 2014), SE Kazakhstan (Weber et al., 2013) or South China (Weber et al., 2007), with more than 42 ichnogenera for the Fortunian and 43 ichnogenera for the Stage 2 (Mángano and Buatois, 2014).

Both the wide palaeogeographic distribution and extensive stratigraphic range of *Bergaueria* suggest that suitable environmental conditions (low carbonate soft substrates) for production and preservation of plug-shaped burrows were relatively widespread over several palaeocontinental margins of Baltica, Gondwana and Laurentia and persisted during the Early Palaeozoic (Fig. 3c). Nine ichnospecies of *Bergaueria* Prantl, 1945 (*Bergaueria perata*, *B. major*, *B. hemispherica*, *B. sucta*, *B. radiata*, *B. phallica*, *B. elliptica*, *B. langi* and *B. prantli*) have previously been recognized in the Lower Palaeozoic of these regions (Alpert, 1973; Buatois et al., 2017; Gibert et al., 2011; Jensen and Grant, 1998; Knaust, 2004; Knaust, 2017; Mángano and Buatois, 2004; Mángano et al., 2013; Mata et al., 2012; McIlroy and Braiser, 2016; Mikuláš, 1993; Mikuláš, 2000; Orłowski, 1989; Orlowski and Żylińska, 1996; Paczesna, 2010; Palij, 1976; Pemberton and Magwood, 1990; Pickerill, 1989a, 1989b; Radwański and Roniewicz, 1963; Seilacher, 2007; Stachacz, 2016; Sudan and Sharma, 2001; Vintaned et al., 2006; Weber et al., 2007).

Although there are many important younger records (e.g., from the late Anisian Middle Muschelkalk; Knaust, 2007), *Bergaueria perata* ranges mostly from the Early Cambrian (Fortunian) to the Late Silurian (Ludlow) and represents a stratigraphic indicator in mid-latitude regions of Baltica in Sweden and Poland (Orlowski and Żylińska, 1996; Jensen and Grant, 1998; Seilacher, 2007; Paczesna, 2010; Stachacz, 2016) (Table 1). It occurs also in Gondwana in Czech Republic, Spain, SE Turkey, Iran, India, or NW Argentina (Bayet-Goll and Carvalho, 2017; Mángano and Buatois, 2004; Mikuláš, 2000; Prantl, 1945; Radwański and Roniewicz, 1963; Sudan and Sharma, 2001; Vintaned et al., 2006; this study) and in Laurentia (North America) (Alpert, 1973; Pemberton and Magwood, 1990; Pickerill, 1989a, 1989b; Seilacher, 2007) (Fig. 3c). Regional lithostratigraphic similarities (mainly siliciclastic facies) indicate that SE Turkey shared a common Cambrian and Ordovician depositional history with Spain, central Bohemia, Jordan,

Table 1
Selected Cambrian–Silurian *Bergaueria* occurrences.
Tableau 1
Occurrences de *Bergaueria* du Cambrien–Silurien (sélection).

Ichnospecies	Stratigraphical unit and location	Age	Host rock	Depositional environment	References
B. perata	Nagaur Sandstone, Nagaur Group, India	Lower Cambrian	Sandstone	Shallow marine	Singh et al., 2014, p. 1674, fig. 10B
	Pedroche Fm, S Spain	Lower Cambrian	Shale-Sandstone	Shallow marine	Vintaned et al., 2006, p. 449, fig. 6 (1–4)
	Torneträsk Fm, Sweden	Lower Cambrian	Siltstone	Shallow marine	Jensen and Grant, 1998, fig. 5 C
	Mickwitzia Sandstone, Ostergötland, Sweden	Lower Cambrian	Sandstone	Shallow marine	Jensen, 1997, p. 37, fig. 24
	Ocieşęki Fm, Holy Cross Mountains, Central Poland	Lower Cambrian	Sandstone – Quartz arenites	Shallow marine	Stachacz, 2016, p. 9, figs. 11B–C
	Mesón Group, NW Argentina	Lower-middle Cambrian	Sandstone	Macrotidal shallow-marine	Mángano and Buatois, 2004, p. 26, fig. 7A
	Kunzum La Fm, Spiti Basin, India	Middle Cambrian	Sandstone	Shallow marine	Sudan and Sharma, 2001
	Barrandian area, Central Bohemia, Czech Republic	Middle Cambrian	Shale-Sandstone	Shallow marine	Mikuláš, 2000, p. 12, pl. 31, figs. 1–2
	Holy Cross Mountains, Central Poland	Upper Cambrian	Sandstone	Shallow marine	Orlowski and Źylińska, 1996, p. 403–404, fig. 11C–F
	Shahmirzad area, Alborz Mountains of northern Iran	Lower Ordovician	Sandstone	Deltaic-non-deltaic	Bayet-Goll and Carvalho, 2017, fig. 6H
	Lower Palaeozoic Fault Complex, Cape George, USA	Upper Silurian	Sandstone	Shallow marine	Pickerill, 1989, p. 192–193, fig. 3
B. sucta	Mickwitzia Sandstone, Lugnås, Sweden	Lower Cambrian	Sandstone	Shallow marine	Jensen, 1997, p. 38, fig. 25A
	Hanneh Member, Wadi Uhaymir, Jordan	Middle Cambrian	Sandstone	Prodelta to distal delta front	Mángano et al., 2013
	Holy Cross Mountains, southern Poland	Upper Cambrian	Sandstone	Shallow marine	Knaust, 2017, fig. 5.18
	Hawaz Fm, W Libya	Middle Ordovician	Sandstone	Subtidal	Gibert et al., 2011, p. 32, fig. 4 C
B. major	Upper Silesian Block, S Poland	Lower Cambrian	Sandstone	Shallow marine	Pacześna, 2010, p. 96, figs. 3A, 4Cb
	Lower Breidvika Member, N Norway	Lower Cambrian	Mudstone-Sandstone	Shallow marine	McIlroy and Braiser, 2016, fig. 6E–G
B. hemisphaerica	Moraine Lake Member, Gog Group, W Canada	Lower Cambrian	Sandstone	Shallow marine	Buatois et al., 2017, p. 133, fig. 34A
	Santa Rosita Fm, NW Argentina	Upper Cambrian-Lower Ordovician	Sandstone	Shallow marine	Mángano et al., 2005, p. 646, fig. 2F
B. radiata	Harkless Fm, California	Lower Cambrian	Shale-Sandstone	Shallow marine	Alpert, 1973 p. 921–922, pl. 1, figs. 1–4
B. elliptica	Central Poland	Upper Cambrian	Sandstone	Shallow marine	Orlowski and Źylińska, 1996
B. prantli	SW Norway	Lower Ordovician	Sandstone	Tidal influence – Shallow marine	Knaust, 2004
Bergaueria isp.	Paseky Shale, Czech Republic	Lower Cambrian	Shale	Brackish lagoon	Mikuláš, 1995, p. 38, pl. 4, figs. 1–8, pl. 5, figs. 1–2, 5–6
Bergaueria isp.	Yangtze Platform, S China	Lower Cambrian	Dolostone-Siltstone	Shallow marine	Weber et al., 2007, p. 339, fig. 14
Bergaueria isp.	Spiti Basin, India	Middle Cambrian	Sandstone	Shallow marine	Parcha and Pandey, 2011
Bergaueria isp.	Dobrotiva Fm. Czech Republic	Lower Ordovician	Shale-Sandstone	Shallow marine	Mikuláš, 1993

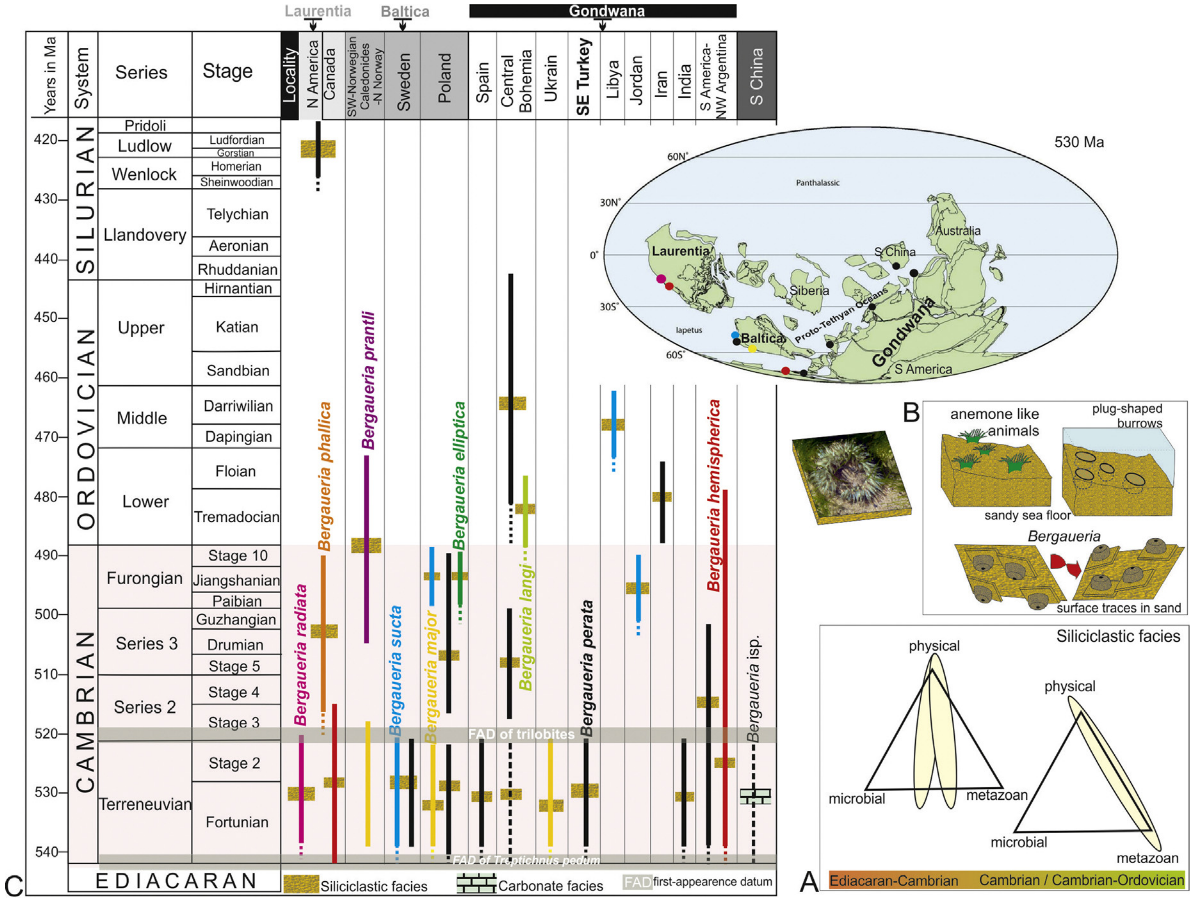

Fig. 3. A. Schematic illustration of shifts in dominant factors influencing the marine siliciclastic sedimentary record during the Ediacaran to Ordovician (Hagadorn and Bottjer, 1999). B. Reconstruction of anemone like animals recorded as plug-shaped burrows on upper bedding surfaces and possible scenarios for trace fossil preservation with particular emphasis on preservation of shallow tiers in a sandy sea floor (Chamberlain, 1971; Orłowski and Radwnański, 1986). Sea anemones produce *Bergaueria*-like traces in modern sediments (modified from Seilacher, 2007; Knaust, 2017). C. Stratigraphic range of *Bergaueria* and latitudinal distribution of *Bergaueria* ichnospecies on the Proto-Tethys Ocean during the Early Palaeozoic (Prantl, 1945; Radwański and Roniewicz, 1963; Alpert, 1973; Palij, 1976; Orłowski, 1989; Pickerill, 1989; Pemberton and Magwood, 1990; Mikuláš, 1993, 1995; Orlowski and Żylińska, 1996; Jensen and Grant, 1998; Mikuláš, 2000; Sudan and Sharma, 2001; Knaust, 2004; Mángano and Buatois, 2004; Mángano et al., 2005; Vintaned et al., 2006; Seilacher, 2007; Weber et al., 2007; Pacześna, 2010; Gibert et al., 2011; Mángano et al., 2013; Singh et al., 2014; McIlroy and Braiser, 2016; Stachacz, 2016; Bayet-Goll and Carvalho, 2017; Buatois et al., 2017; Knaust, 2017).

Fig. 3. A. Illustration schématique des changements de facteurs dominants influençant le registre sédimentaire siliciclastique marin de l'Ediacarien à l'Ordovicien (Hagadorn et Bottjer, 1999). B. Reconstitution des animaux de type anémone répertoriés sous forme de cavités à bouchon sur la partie superficielle des lits et scénarios possibles pour la préservation des traces de fossiles, l'accent étant mis sur la préservation de rangées étroites sur le plancher marin sableux (Chamberlain, 1971; Orłowski et Radwański, 1986). Les anémones marines produisent des traces de type *Bergaueria* dans les sédiments modernes (modifié d'après Knaust, 2017; Seilacher, 2007). C. Étendue stratigraphique de *Bergaueria* et distribution latitudinale de l'ichnoespèce dans l'océan Proto-Téthysien pendant le Paléozoïque inférieur.

Libya and western India, along the Proto-Tethyan margin of Gondwana (Fig. 3c; Amireh et al., 1994). The Early Cambrian *Bergaueria perata* described in this paper is the first ichnospecies of *Bergaueria* from the northern Arabian Plate (Mardin–Derik, SE Turkey) and it represents the plug-shaped burrows from the northern Gondwana.

5. Conclusions

Knowledge of the Early Cambrian sedimentary history of the western Gondwana is advanced by new data from the south-eastern Turkey. In comparison to other geologic periods, ichnologic reports from Cambrian shallow marine siliciclastic successions are relatively sparse, whereas this study from the northern margin of the Arabian Plate demonstrates a behaviour of anemones from the Early Cambrian successions of the Mardin–Derik area. The Zabuk Formation gives an idea of the semi-infaunal dwelling anemones that lived in the northern Arabian siliciclastic mid-latitude shelves of West Gondwana took place since the early Fortunian. These cnidarians proliferated in shallow arenaceous shelves during the Terreneuvian in all palaeocontinents except for the tropical South China. *Bergaueria* represents an important part of Early Cambrian non-arthropod communities, and they can be easily found in fine-grained clastic sediments from across the Cambrian palaeocontinents. In the West Gondwana, the carbonate sedimentation was unfavourable for their mode of life.

Sessile cnidarians spread from the tropical to subtropical areas to low latitudes, but always preferred a siliciclastic sea floor during the Early Palaeozoic.

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