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Central Paratethyan Middle Miocene organophosphatic brachiopods (Lingulidae, Discinidae) from Tekeres (Mecsek Hills, Southern Hungary)

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Abstract – Organophosphatic brachiopods are among the rare fossils in the Miocene of Hungary. In the Mecsek Hills of Southern Hungary, a new Badenian site recently discovered near the village of Tekeres has yielded some brachiopods in addition to the rich mollusc and fish remains. Most of the brachiopods belong to the family Platidiidae, but some organophosphatic specimens were also found. Although these are very small and mostly fragmentary, they provide important new data on the Middle Miocene Linguliformea brachiopods of the Central Paratethys. Based on a juvenile *Lingula* cf. *dregeri* Andreae, 1893 shell, Tekeres is the second site in Hungary from where Miocene Linguloidea remains are known. Three Discinoidea fragments belong to the species *Discinisca* cf. *leopolitana* (Friedberg, 1921), based on their external ornamentation consisting of concentric growth lines; this is the first known record of this species in Hungary. For both species, a schematic palaeogeographic map shows their currently known distribution in the Badenian Central Paratethys Sea. With 9 figures.

Keywords – Badenian, *Discinisca*, distribution, inarticulate brachiopods, *Lingula*

INTRODUCTION

Before the 2000s, relatively few publications have dealt with Miocene brachiopods in Hungary. Based on material collected during geological mapping, Matyasovszky (1880) described five new species from the Baranya region belonging to Southern Hungary at that time (*Argiope baanensis*, *A. hofmanni*, *A. baranyaense*, *A. boeckhi*, *Terebratulina parva*). Majer (1915) also described a new species from the Leitha limestone of the Börzsöny Mountains (*Terebratula kemenczeiensis*). The most significant paper was published by Meznerics (1944), who summarized the Tertiary (Eocene, Oligocene, and Miocene) brachiopods

known from Hungary in a small monograph, and in the Miocene chapter she described two new species (*Hemithiris acuta*, *Mühlfeldtia margaritata*).

Over the past two decades, several papers have been published on this subject. Bitner & Dulai (2004) revised the Miocene brachiopods of the Hungarian Natural History Museum, with special regard to the Meznerics collection. They concluded that both new Miocene species described by Meznerics (1944) are junior synonyms [*Hemithiris acuta* = *Aphelesia bipartita* (Brocchi, 1814); *Mühlfeldtia margaritata* = *Megerlia truncata* (Linnaeus, 1767)]. Three brachiopod species were recognised from two Badenian sites in the Bakony Mountains by Dulai (2007) [Bánd, Devecser: *Megathiris detruncata* (Gmelin, 1791), *Argyrotheca cuneata* (Risso, 1826), and *Joania cordata* (Risso, 1826)]. The first known brachiopods (*Joania cordata*) of the famous Szabó sand pit in Várpalota were identified by Dulai (2015), based on screen-washed samples in the Naturalis Biodiversity Center in Leiden. Recently Dulai (2025*a*) revised the five Miocene brachiopod species described by Matyasovszky (1880), based only on descriptions and illustrations due to the lack of the originally examined and described material. He concluded that none of the five species are valid: four of them were junior synonyms (*Argiope baanensis* = *Joania cordata*; *A. hofmanni* = *Argyrotheca cuneata*; *A. baranyaense* = *J. cordata*; *A. boeckhi* = *Megathiris detruncata*), while the fifth was a juvenile Terebratulida, unidentifiable at the species level (*Terebratulina parva* = Terebratulidae juv. indet.). Dulai (2025*b*) elaborated the brachiopod assemblage from a new site discovered at Mecsekpölöske, Nagy Hill and described a new *Bronnothyris* species, which was the first known *Bronnothyris* record from the Miocene and from the Central Paratethys, and also the youngest known representative of the genus *Bronnothyris*.

Organophosphatic brachiopods belonging to the subphylum Linguliformea are much rarer than calcite-shelled species due to their poor fossilization potential (Emig 1990). Only two noteworthy papers have been published on this subject in the Hungarian Miocene. Bitner *et al.* (2012) published the first known Miocene *Lingula* remains from Hungary: *Lingula dregeri* Andreae, 1893 was identified from the upper Badenian Leitha limestones of Budapest (Örs vezér tere). The first Discinidae brachiopods in Hungary were recognized by Dulai (2017): fragmentary *Discradisca* cf. *polonica* (Radwańska & Radwański, 1984) remains were published from the Szabó sand pit in Várpalota and Nyirád site.

The aim of this paper is to briefly describe the organophosphatic brachiopods found in the screen-washed samples of a new excavation (Tekeres, Kopasz-hegy) on the edge of the Mecsek Hills and to summarize the distribution of the two identified species within the Badenian Central Paratethys Sea.

GEOLOGICAL SETTING

The Paratethys was a large network of inland seas intermittently connected to the Mediterranean (Rögl 1998; Popov *et al.* 2004). The biogeographic differentiation necessitated the establishment of a regional stratigraphic scheme (Harzhauser & Piller 2007). The Badenian (16.303 to 12.829 Ma; Hohenegger *et al.* 2014) is a regional stage used in the Central Paratethys for part of the Middle Miocene (Langhian to middle Serravallian) (Papp *et al.* 1978).

The village of Tekeres is located in the northwestern foothills of the Mecsek Hills and the Lake Herman Ottó lies northeast of Tekeres (Fig. 1). The geology and stratigraphy of the area have been discussed by Sebe *et al.* (2015) and Szabó *et al.* (2022); see there for further references. The excavation site is located about 100 m from the eastern shore of Lake Herman Ottó, on the southwestern side of Kopasz Hill. It was discovered by private collector Tamás Németh in 2010. No identifiable stratigraphic sequence can be observed in the approximately 5 m wide and 2 m high artificial excavation (Fig. 2). The grayish-brown clayey aleurolite contains smaller and larger lenses of brown, fine-grained sand (Tekeres Schlier Member of the Baden Formation; Selmeczi *et al.* 2024). The sand lenses contain very abundant and diverse Mollusca and fish remains. The dominance of *Turritella* and *Varicorbula* species (Dávid *et al.* 2023) suggests that the studied layers belong to the uppermost part of the Tekeres Schlier, near the boundary between the Tekeres Schlier Member and the Szilágy Clay Member above it (Szabó *et al.* 2022). From the mollusc fauna, remains belonging to the Muricidae (Kovács 2020; Kovács & Vicián 2024), Cancellariidae (Kovács & Vicián 2021), and Rissooidea (Kovács & Stein 2025) have been processed so far. A conference abstract has been published on the preliminary results of the rich otolith material (Bosnakoff 2013). The extremely diverse chondrichthyan assemblage was published in detail by Szabó *et al.* (2022). Both the fish remains and the associated microfauna (foraminifers, ostracods) showed a mixture of shallow neritic and deeper water taxa (Szabó *et al.* 2022), referring to a deep-sea benthic environment with resedimented and eroded shallow-sea fossils in the sand lenses.

MATERIAL AND METHODS

The investigated limited material consists of a juvenile *Lingula* valve, and three fragments of *Discinisca*. All specimens were found in samples screen-washed between 2022 and 2024 from Tekeres site by the second author (MSz). The photos were taken with a CANON EOS 700D camera with a CANON MP-E 65 mm lens.

The studied material is housed in the palaeontological collection of the Hungarian Natural History Museum, Budapest under the inventory numbers HNHM INV 2026.1–4.

Fig. 1. Geographic location of Tekeres site at the eastern shore of Lake Herman Ottó (Mecsek Hills, Southern Hungary)

SYSTEMATIC PALAEONTOLOGY

Phylum Brachiopoda Duméril, 1805
Subphylum Linguliformea Williams, Carlson, Brunton, Holmer et Popov, 1996
Class Lingulata Gorjansky et Popov, 1985
Order Lingulida Waagen, 1885
Superfamily Linguloidea Menke, 1828
Family Lingulidae Menke, 1828
Genus *Lingula* Bruguière, 1791
Type species – *Lingula anatina* Lamarck, 1801.

Lingula cf. *dregeri* Andreae, 1893 juv.
(Figs 3–4)

1889 *Lingula Suessi* n. sp. – Dreger, p. 182, pl. 1, figs 17–18.
1911 *Lingula* cf. *dregeri* Andreae – Dreger, pp. 132–136, fig. 1a–b.
1921 *Lingula* aff. *Dumortieri* Nyst – Friedberg, p. 5, pl. 1, fig. 1.
1944 *Lingula Dregeri* Andreae, 1893 – Meznerics, p. 19.
1977 *Lingula dumortieri* Nyst, 1843 – Barczyk & Popiel-Barczyk, p. 159, pl. 1, figs 8–9.

Fig. 2. Artificial excavation at southwestern side of the Kopasz Hill (Tekeres): Tekeres Schlier Member of the Baden Formation (Photo by Márton Szabó)

1984 *Lingula* sp. – Bărbulescu & Rado, pl. 1, figs 1–2.
1990 *Lingula dregeri* Andreae, 1893 – Popiel-Barczy & Barczyk, p. 161, pl. 1, figs 9–10.
1996 *Lingula dregeri* Andreae, 1893 – Popiel-Barczyk, pp. 654–655, pl. 185, figs 3–4.
2001 *Lingula dregeri* Andreae – Schmid *et al.*, p. 16, pl. 1, fig. 4.
2005 *Lingula dregeri* Andreae, 1893 – Emig & Bitner, pp. 181–183, fig. 2.
2007 *Lingula dregeri* Andreae, 1893 – Emig *et al.*, pp. 264–267, figs 2–3.
2012 *Lingula dregeri* Andreae, 1893 – Bitner *et al.*, pp. 40–42, text-fig. 2A–D.
2012 *Lingula dregeri* Andreae – Kocsis *et al.*, p. 69, fig. 3.A2.
2012 *Lingula dregeri* Andreae, 1893 – Mikuž *et al.*, pp. 272–273, text-fig. 3.
2015 *Lingula* cf. *dregeri* Andreae, 1893 – Dulai, p. 190, pl. 1, figs 1–4.

Figs 3–4. *Lingula* cf. *dregeri* Andreae, 1893, juvenile dorsal valve, Tekeres, Middle Miocene (Badenian). – **Fig. 3.** External view. – **Fig. 4.** Internal view. Scale bar: 1 mm

Material – 1 juvenile dorsal valve (HNHM INV 2026.1.).

Notes – The Central Paratethyan Miocene lingulides were first described as *Lingula Suessi* from the Vienna Basin by Dreger (1889). However, the species name *suessi* was preoccupied by an Upper Triassic species of *Lingula*, therefore Andreae (1893) proposed the replace name *dregeri*. Later, Middle Miocene lingulides were reported from several Central Paratethyan sites, mostly under the name *dregeri* (see synonym list), but sometimes as *dumortieri* (Barczyk & Popiel-Barczyk 1977) or aff. *dumortieri* (Friedberg 1921). The various Miocene lingulide records in Poland were revised by Emig & Bitner (2005),

who concluded that all known occurrences can be classified as *dregeri*. Dreger's (1889) original description contained rather general observations, and a more detailed description was provided by Emig & Bitner (2005) based on well-preserved dorsal valves from Poland. The characters of the ventral valve and the first diagnosis of the species were published by Emig *et al.* (2007) based on Middle Miocene assemblage from SW France (Aquitaine Basin).

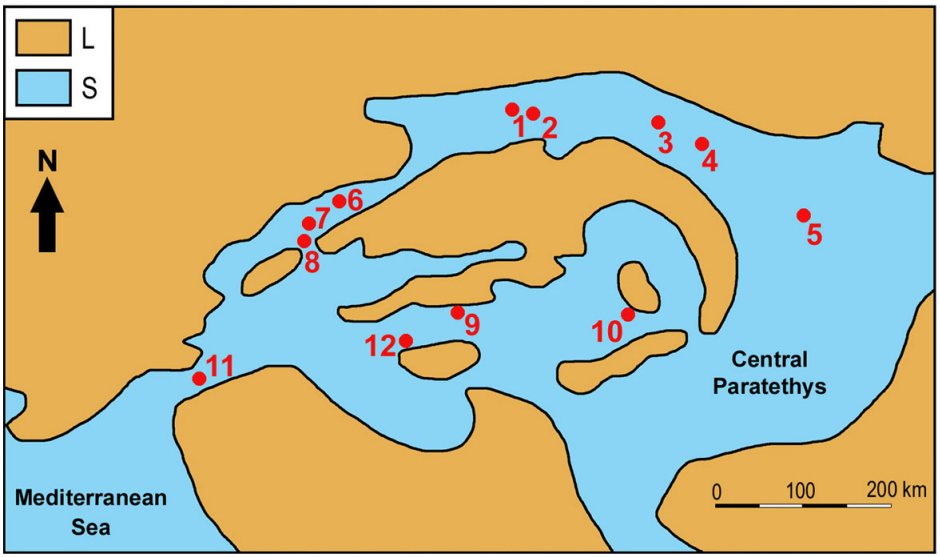

Fig. 5. Distribution of *Lingula dregeri* Andreae within the Middle Miocene Central Paratethys (map modified from Rögl 1998, and Bitner *et al.* 2012). L = land; S = sea; 1 = Korytnica, Poland (Barczyk & Popiel-Barczyk 1977; Emig & Bitner 2005); 2 = Wójcza-Pińczów Range, Poland (Popiel-Barczyk & Barczyk 1990; Emig & Bitner 2005); 3 = Węglin, Poland (Bitner *et al.* 2012); 4 = Huta Lubycka, Poland (Popiel-Barczyk 1980; Emig & Bitner 2005); 5 = Obertasów, Ukraine (Friedberg 1921); 6 = Austränk, Austria (Dreger 1889); 7 = Loretto, Austria (Dreger 1889); 8 = St. Margarethen, Austria (Meznerics 1944; Schmid *et al.* 2001); 9 = Budapest, Hungary (Bitner *et al.* 2012); 10 = Lăpugiu, Romania (Bărbulescu & Rado 1984); 11 = Trbovlje, Slovenia (Mikuž *et al.* 2012); 12 = Tekeres, Hungary (this paper)

Distribution within the Central Paratethys – The species *Lingula dregeri* occurs mainly in the Central Paratethys (Fig. 5), but some records are also known from the Miocene of the Atlantic Ocean (Emig *et al.* 2007) and the Miocene of the Mediterranean (Dreger 1911). Fragmentary *Lingula* remains, which cannot be identified to species, have also been reported from the Upper Miocene (Bertolaso *et al.* 2009; Dulai 2019) and the Upper Pliocene (Di Cencio *et al.* 2022) of the Mediterranean, which suggests that the Neogene distribution of *Lingula* is underestimated in the Mediterranean due to collecting bias.

Superfamily Discinoidea Gray, 1840
Family Discinidae Gray, 1840
Genus *Discinisca* Dall, 1871
Type species – *Orbicula lamellosa* Broderip, 1833.

Discinisca cf. *leopolitana* (Friedberg, 1921)
(Figs 6–8)

1897 *Discina leopolitana* n. sp. – Łomnicki, p. 17.
1921 *Discina leopolitana* M. Łom. in litt. – Friedberg, pp. 6–7, pl. 1, fig. 2.
2001 *Discinisca* cf. *leopolitana* (Friedberg) – Schmid *et al.*, pp. 16–17.
2004 *Discinisca leopolitana* (Friedberg, 1921) – Radwański & Wysocka, p. 390, pl. 8, fig. 3.
2012 *Discinisca leopolitana* (Friedberg) – Kocsis *et al.*, p. 69, fig. 3.A4.
2015 *Discinisca leopolitana* (Friedberg, 1921) – Dulai, p. 191, pl. 2, figs 1–4.

Material – 3 fragments of dorsal valves (HNHM INV 2026.2–4).

Notes – Although the Discinidae remains found in the screen-washed samples are very fragmentary, it is clear from all three specimens that they do not have radial ribs, but are ornamented with growth lines of varying thickness, more or less concentric (but slightly irregular in shape) on the outer surface of the dorsal shells. This suggests that the fragmentary valves do not belong to the genus *Discradisca*, which has previously been found in the Miocene of Hungary (Dulai 2017), but rather to the genus *Discinisca*. In the Central Paratethyan region, *Discinisca leopolitana* is the only known similar species, so despite the fragmentary preservation, we provisionally classify the remains found in Tekeres as belonging to this taxon, in the hope that better-preserved finds will later

Figs 6–8. *Discinisca* cf. *leopolitana* (Friedberg, 1921), fragmentary dorsal valves, Tekeres, Middle Miocene (Badenian), external views. – **Fig. 6.** HNHM INV 2026.2. – **Fig. 7.** HNHM INV 2026.3. – **Fig. 8.** HNHM INV 2026.4. Scale bars: 1 mm

confirm this identification. *D. leopolitana* was first noted by Łomnicki (1897) but formally was described later by Friedberg (1921) (see details in Radwańska & Radwański 1984).

In addition to the average size of 3–4 mm (Dulai 2015) or 4–5 mm (Radwański & Wysocka 2004), several authors have also mentioned larger specimens (Dulai 2015: 6.6 mm; Radwański & Wysocka 2004: 8 mm; Friedberg 1921: 9 mm). The curve of the outline of one of the specimens from Tekeres (Fig. 8) suggests that shells with a diameter of 8–9 mm may also occur in this assemblage. Dulai & Stachacz (2011) found very similar fragmentary specimens at the Szydłów site in Poland, but those specimens were not ultimately classified as belonging to the *leopolitana* species, but were referred to by the open nomenclature as *Discinisca* sp.

Distribution within the Central Paratethys – *D. leopolitana* is known only from the Middle Miocene sediments of the Central Paratethys (Fig. 9), primarily from the northernmost area (Poland, and Ukraine). Two further records are

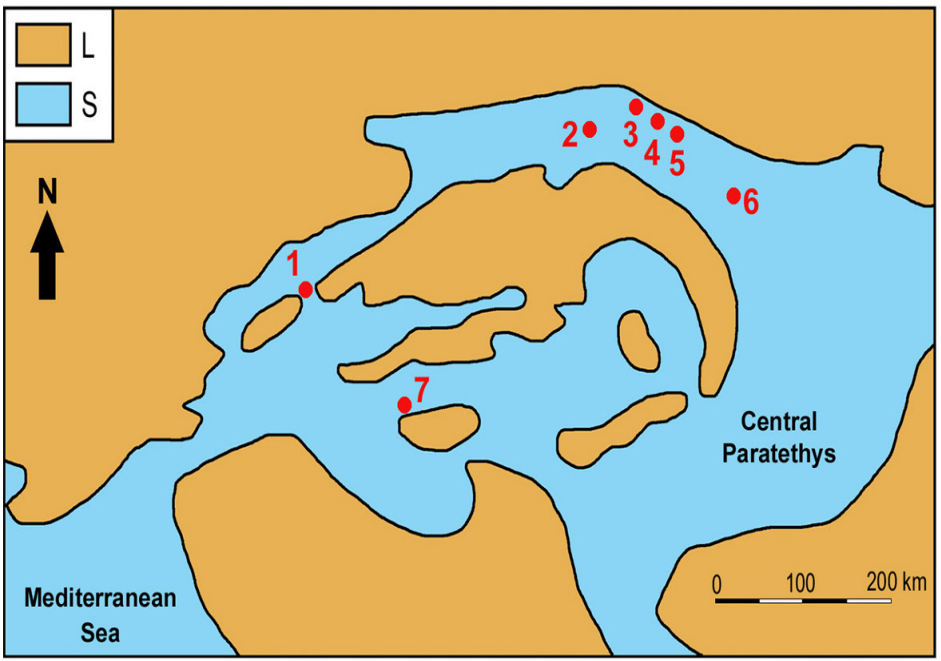

Fig. 9. Distribution of *Discinisca leopolitana* Friedberg within the Middle Miocene Central Paratethys (map modified from Rögl 1998). L = land; S = sea; 1 = St. Margarethen, Austria (Schmid *et al.* 2001); 2 = Świniary, Poland (Radwański & Wysocka 2004); 3 – Rybnica, Poland (Dulai 2015); 4 = Huta Lubycka, Poland (Kocsis *et al.* 2012); 5 = Monastyrz, Poland (Dulai 2015); 6 = Lviv, Ukraine (Łomnicki 1897; Friedberg 1921); 7 = Tekeres, Hungary (this paper)

known from the Vienna Basin (Austria) and the Mecsek Hills (Hungary, this paper). The material published here represents the southernmost occurrence of the species currently known.

CONCLUSIONS

Due to the low fossilization potential of organophosphatic brachiopods, Lingulidae and Discinidae remains are not very common in the Miocene sediments of the Central Paratethys. Despite intensive research conducted in recent years at the Tekeres site discovered by private collectors, relatively few brachiopod remains have been found, the vast majority of which belong to the family Platidiidae, but some organophosphatic brachiopod shell fragments have also been found. Although the available material is very limited, it still provides useful new faunistic data for the Central Paratethys. Based on the juvenile *Lingula* cf. *dregeri* shell, Tekeres is the second known site in Hungary where Miocene *Lingula* has been found. The previously published *Lingula* remains from the Central Paratethys were mostly adult specimens, so the very young shell from Tekeres site provides useful new information on the juvenile morphology of this species. The *Discinisca* fragments refer to the species *D.* cf. *leopolitana*, which is the first known occurrence of this species in Hungary and also the southernmost known occurrence of the species in the Central Paratethys.

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