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Monospecific *Lutkevichinella* (Ostracoda) fauna from lower Anisian beds (Middle Triassic) of the Balaton Highland (Hungary)

Emőke TÓTH & Miklós MONOSTORI

Department of Palaeontology, Eötvös University, H-1117 Budapest, Pázmány Péter sétány 1/c,
e-mail: tothemoke.pal@gmail.com, monost@ludens.elte.hu

Abstract

Peculiar monospecific euryhalin ostracod fauna with great numbers of moderately to well-preserved carapaces were extracted from lower Anisian bituminous laminates of lower part of Iszkahegy Limestone exposed on northern slope of Szentkereszthegy in Balaton Highland, Hungary. The ostracod assemblage suggests subtidal restricted lagoonal environment with brackish, dysoxic bottom water conditions due to the weak vertical circulation in the water column. The freshwater input in to the basin can be explained probably by a moist period in the climate during the Anisian.

Keywords: ostracods, Triassic, Anisian, Lutkevichinella, monospecific fauna, Hungary

Introduction

Lutkevichinella is a widely distributed euryhalin genus in Triassic sequences deposited brackish to hypersaline environments in Germanic Basin, Northern Calcareous Alps, Middle East and Precaspian Basin (Table 1). From Hungary, only two species of *Lutkevichinella* had been published by KOZUR (in BUNZA & KOZUR 1971, KOZUR & ORAVECZ-SCHEFFER 1972) from Upper Triassic beds (Carnian and Rhaetian) of Bakony Mts (Table 1.). The description and illustration of the type species as *Lutkevichinella bruttanae* was published by SHNEYDER (in MANDELSHTAM et al. 1956) from Lower Triassic beds deposited in brackish water conditions of Emba in Kazakhstan and Fergana in Uzbekhistan. The main characteristic features of the carapaces are the box-like shape with oblong reticulation on the valve surface, the shallow, narrow more or less developed transverse median sulcus and the thin hinge which consists of median bar terminating small depressions in the left valve and narrow median groove with terminal thickenings in the right valve. Later, KOZUR (1968a) clarifies the definition of the genus, completes the diagnosis with additional outer and inner characters of the valve, such as a rib ventrally, knob or spine posteriorly, the features of the inner lamella, the vestibulum, the normal pores and pore canals which are simple and straight. *Reversiocythere* described by GRÜNDEL (1965), *Cytheressinella* described by SHNEYDER (in MANDELSHTAM et al. 1956) and *Albacythere* described by KOZUR & NICKLAS (1970) can regarded as synonyms of the genus *Lutkevichinella* accepted the opinion of KOZUR (1968b) and URLICHS (1972).

The main aim of the present work is to give a systematic description about the Lower Anisian ostracod fauna of the Iszkahegy Limestone from Szentkereszthegy in the Malomvölgy, Balaton Highland and to summarize the knowledge about the Triassic *Lutkevichinella* genus for the palaeoecological interpretation of the faunal composition which may to complement the knowledge about the depositional environment of the studied Triassic formation.

Geological setting and material

The locality (Szentkereszthegy) are situated near Felsőörs in the Balaton Highland, western Hungary, and part of the Transdanubian Range (Figure 1). Lower Anisian steeply dipping, almost vertical beds of the Iszkahegy Limestone, from where most of the samples were obtained, is exposed on the top of the very steep, tectonically controlled northern slope of the Szentkereszthegy (BUDAI 2008; Figure 2). In the exposed interval dark grey micritic laminates alternate with thicker, bioturbated beds. These lithologies are very characteristic of the lower part of the Iszkahegy Limestone. The formation passes gradually from the underlaying by the lowermost Anisian Aszófő Dolomite

Table 1. Stratigraphical and spatial distribution of Triassic *Lutkevichinella* species with their ecological requirements

Species	Stratigraphical range and occurrences	Environment	References
L. (*Cytheressinella*) *okrajantzi* (Shneyder, 1956)	Lower Triassic, Emba (Kazakhstan), Precaspian Basin	brackish	Shneyder 1956, 1960
L. (*C.*) *sokolovae* Shneyder, 1960	Lower Triassic, Precaspian Basin	brackish	Shneyder 1960
L. (C.) schneiderae Kozur, 1970	Middle Triassic, Anisian, North-east German Basin	brackish	Kozur 1970
L. (C.) rectagona rectagona (Gründel, 1965)	Middle to Upper Triassic, Polish-, Thuringian- and North-east German basins	brackish	Gründel 1965; Kozur 1970; Styk, 1979, 1982
L. (C.) rectagona postera Kozur, 1970	Middle Triassic, Ladinian, North-east German Basin	brackish	Kozur 1970
L. bruttanae Shneyder, 1956	Lower Triassic, Emba (Kazakhstan), Fergana (Uzbekhistan), Precaspian Basin	brackish	Shneyder 1956, 1960
L.? egeleri Kozur, 1974	Middle to Upper Triassic, Betic Zone, Middle East	slightly hypersaline	Kozur et al. 1974; Basha 1983; Colin et al. 1985
L.? grammi Kozur, 1972	Upper Triassic, Bakony Mts, Hungary	brackish	Kozur & Oravecz-Scheffer, 1972
L. aff. *grammi* Kozur, 1972	Upper Triassic, Dachstein Plateau, Northern Calcareous Alps, Austria	brackish to normal marine	Kozur & Oravecz-Scheffer, 1972; Haas et al. 2007, 2009
L. (Lutkevichinella)? gruendeli Kozur, 1970	Middle Triassic, Northeast German Basin	brackish	Kozur 1970
L. involuta Shneyder, 1960	Lower Triassic, Precaspian Basin	brackish	Shneyder 1960
L.? keuperea (Will, 1969)	Upper Triassic, NW- and SW-German Basin	normal to hypersaline	Will 1969; Urlichs 1972
L. lata Kozur, 1968	Lower to Middle Triassic, Thuringian Basin, and Northeast German Basin	brackish to normal marine	Kozur 1968b
L. lata minuta Kozur, 1968	Middle Triassic, Northeast German Basin	brackish to normal marine	Kozur 1968a
L. levis Kozur, 1968	Middle Triassic, Northeast German Basin	brackish	Kozur 1968a
L. mazurensis Styk, 1972	Lower Triassic, Polish Basin		Styk 1972, 1979, 1982
L. minima Starozhilova, 1968	Lower to Middle Triassic, Precaspian and Polish basins	brackish	Styk 1982
L.? ornata Sohn, 1970	Lower Triassic, Middle East	normal marine	Sohn 1970
L. parva (Kozur & Nicklas, 1970)	Upper Triassic, Northern Calcareous Alps	brackish	Kozur & Nicklas, 1970
L. parva Styk, 1982	Upper Triassic, Polish Basin		Styk 1982
L.? pusilla Diebel, 1965	Middle Triassic, Polish and Thuringian basins	brackish	Diebel, 1965; Styk 1979, 1982
L. pygmea Urlichs, 1972	Upper Triassic, North-west German Basin	normal to hypersaline	Urlichs, 1972
L. rectangularis (Kozur & Nicklas, 1970)	Upper Triassic, Northern Calcareous Alps	brackish	Kozur & Nicklas, 1970
L. reniformis Kozur, 1968	Middle Triassic, North-east German Basin	brackish	Kozur 1968a
L. simplex Kozur, 1968	Middle Triassic, Thuringian and North-east German basins	brackish to normal marine	Kozur 1968b
L. simplex oblonga Kozur, 1971	Upper Triassic, Bakony Mts, Hungary, Northern Calcareous Alps, German and Polish basins	brackish to normal marine	Bunza & Kozur 1971; Styk, 1979, 1982
L. ex gr. *simplex* Kozur, 1968	Middle Triassic, Minorca, Balearic Islands, Spain	normal marine	Vachard & Colin, 1994

of lagoonal and shabkha facies (BUDAI 1991). The lower part of the Iszkahegy Limestone contains of dark grey, generally laminated, bituminous limestone layers without bioturbation and invertebrate macrofossils suggesting dysoxic/anoxic conditions. The upsection is greyish-brown thick bedded, nodular hieroglyph-bearing, limestone with serpulid bioturbation indicating better ventilated conditions, locally with marl interlayers. Its microfacies is usually micritic mudstone or wackestone, with ostracodes, mollusc shells (*Costatoria costata* ZENKER, 1833*, Natiria* sp.), foraminifera (*Meandrospira dinarica* KOCHANSKY-DEVIDÉ & PANTIC, 1965) and subordinately echinoderm skeletons (HAAS &

Budai 1999). Sedimentary breccias, stromatolites and evaporate pseudomorphs in the uppermost part of the formation suggest peritidal sedimentary environment which established periodically (Haas & Budai 1999). The Iszkahegy Limestone passes upward into dolomite of lagoon facies (lower part of the Megyehegy Dolomite). The trend in the lithology may indicate a decrease in the restriction of the inner shelf lagoon, which can be attributed to a sea-level rise (Budai 1991, 2008).

Four samples from the exposed bituminous laminates were studied for their ostracod content (Figure 1.). Each

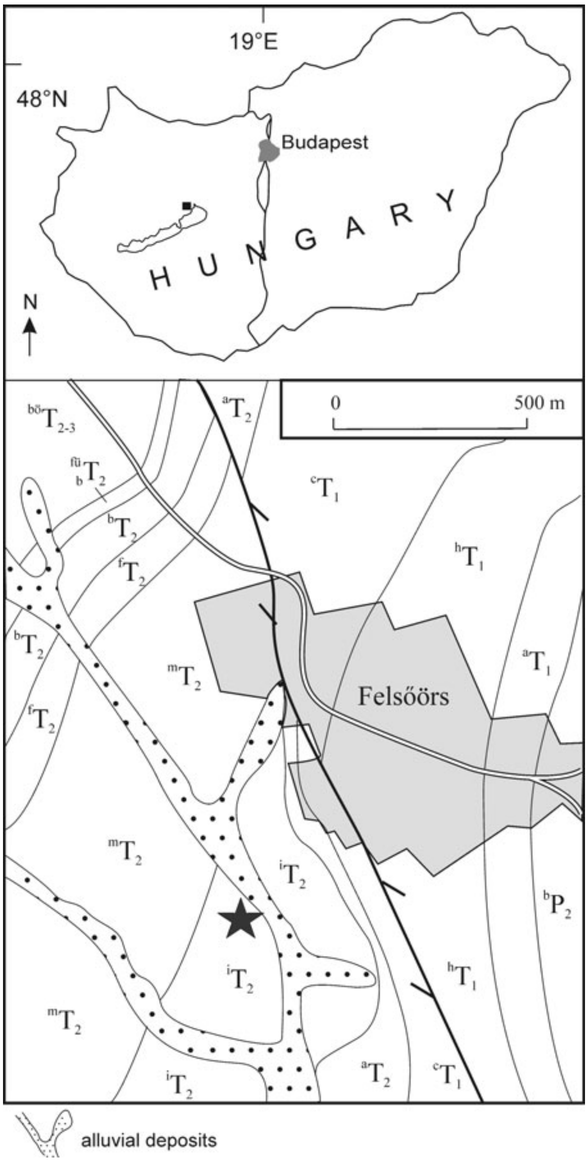

Figure 1. Location of the studied section in a simplified geological map of the region of Felsőörs (modified after Budai 1991 and Budai et al. 2001)
Legend: ${}^{b}P_2$ – Balatonfelvidék Sandstone Fm; ${}^{a}T_1$ – Arács Marl Fm; ${}^{h}T_1$ – Hidegkút Fm; ${}^{c}T_1$ – Csopak Marl Fm ${}^{a}T_2$ – Aszófő Dolomite Fm; ${}^{i}T_2$ – Iszkahegy Limestone Fm; ${}^{m}T_2$ – Megyehegy Dolomite Fm; ${}^{f}T_2$ – Felsőörs Limestone Fm; ${}^{b}T_2$ – Vászoly Fm+ Buchenstein Fm; ${}^{füb}T_2$ – Füredi Limestone Fm+Berekhegy M; ${}^{bö}T_{2-3}$ – Budaörs Dolomite Fm

sample were treated by acetolysis following a protocol originally worked out by Lethiers & Crasquin-Soleau (1988) with a slight modification to extract the carbonate skeletal microfauna. The acetolysis without heating produced very well preserved microfauna but the duration of the extraction was longer (several weeks up to one month).

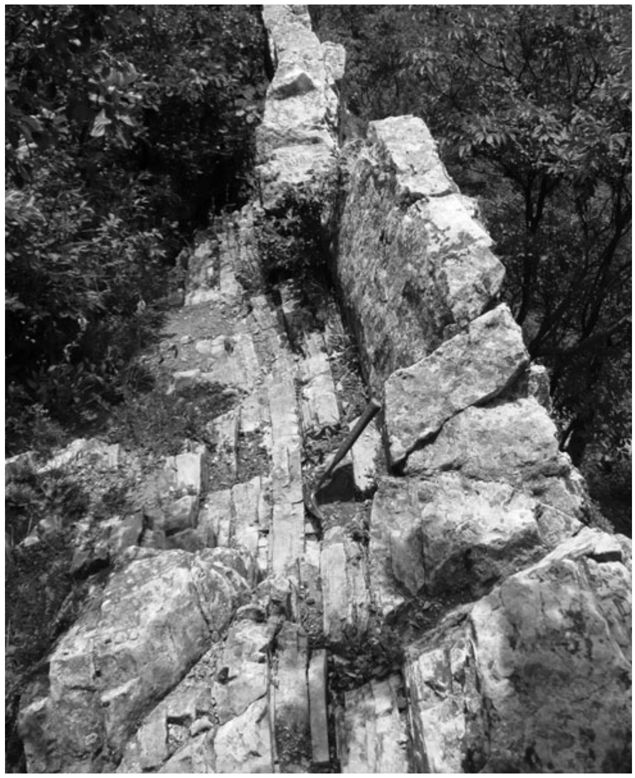

Figure 2. Studied section on the top of the northern slope of the Szentkereszthegy

Systematic palaeontology

Classification of the ostracods follows that of Martin & Davis (2001) and that of Moore & Pitrat (1961). The specimens are deposited in the Department of Palaeontology of Eötvös University and in the Eötvös Museum of Natural History (Budapest, Hungary). Abbreviations: L=length, H=height.

Class Ostracoda Latreille, 1802
Subclass Podocopa Müller, 1894
Order Podocopida Müller, 1894
Superfamily Cytheroidea Baird, 1850
Family Cytherissinellidae Kashevarova, 1958
Genus *Lutkevichinella* Shneyder, 1956
Type species: *Lutkevichinella bruttanae* Shneyder, 1956

Lutkevichinella lata Kozur, 1968 (Figure 3)

1968b *Lutkevichinella lata* n. sp.; Kozur, pp. 503–504, pl. 1, figs 5, 7, 9–14, 17.

Material: Iszkahegy Limestone, Szentkereszthegy: c. 300 carapaces.

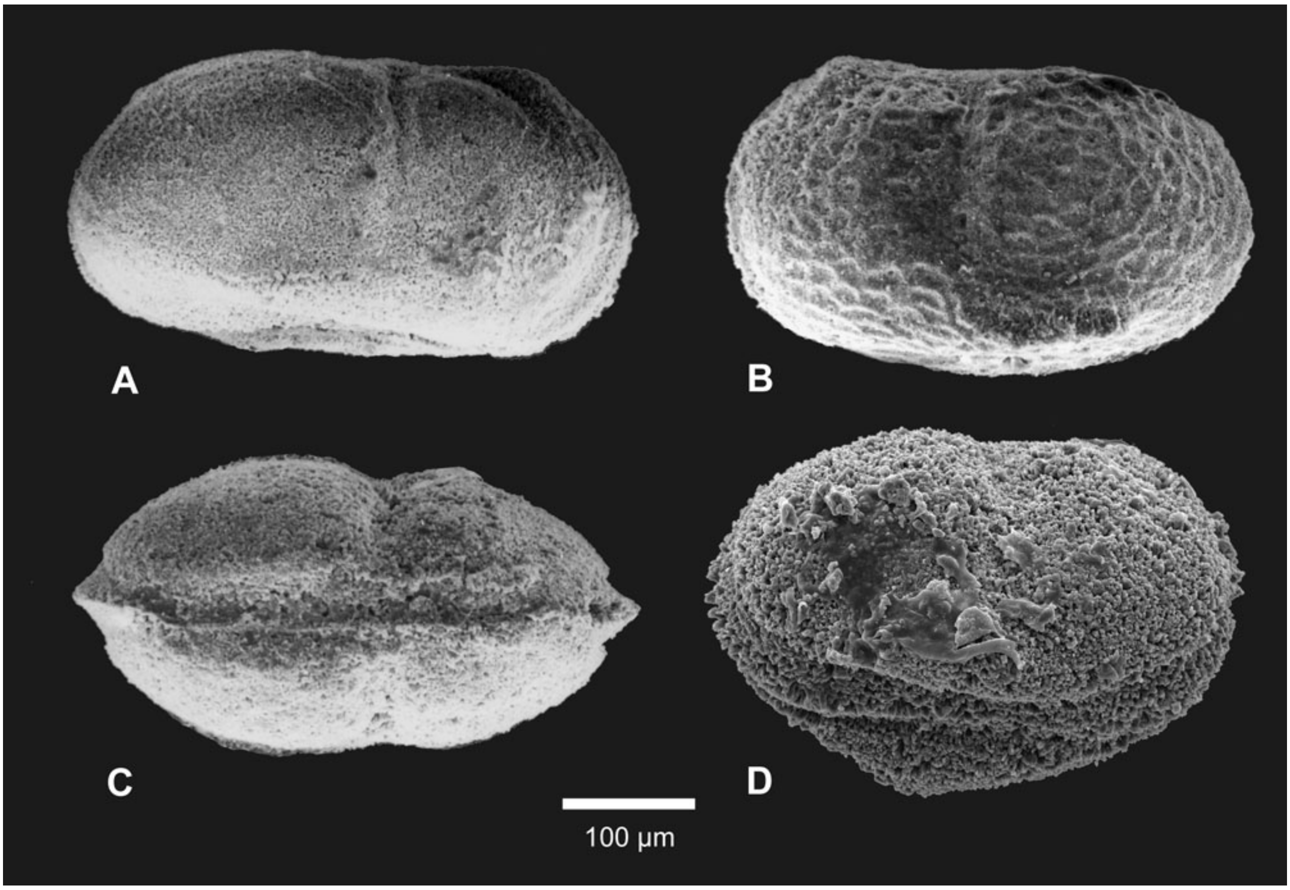

Figure 3. *Lutkevichinell lata* Kozur, 1968 (A) carapace in right view, Iszkahegy Limestone, Szentkereszthegy, (B) carapace in left view, Iszkahegy Limestone, Szentkereszthegy, (C–D) carapace in ventral view, Iszkahegy Limestone, Szentkereszthegy. Scale bar = 100 μm

Remarks: The outer characters of the studied specimens are identical to the holotype. Stubby, subrectangular form with dense reticulation on valve surface, limen-like structure (=sulcus) at the 1/3 of the length and a distinct rib ventrally. The reticulation pattern cannot be recognized in all cases depending on the preservation potential.

Dimensions: L=0.4–0.56 mm, H=0.21–0.29 mm, L/H=1.75–2.04.

Occurrence: Thuringian and North German basins: Lower to Middle Triassic (Kozur 1968b).

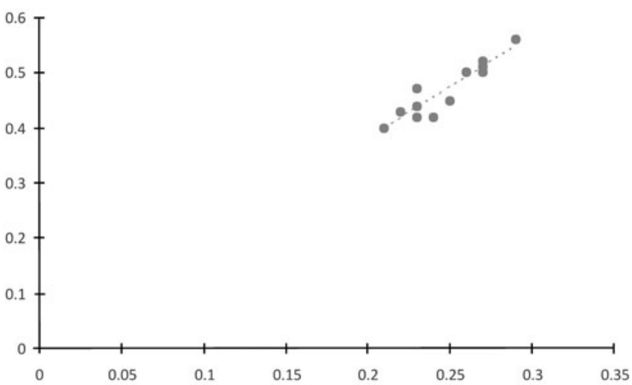

Figure 4. Length/height diagram in mm of *Lutkevichinella lata*

Characteristics and palaeoecological significance of the studied Anisian ostracod fauna

Lower Anisian deposits in the studied section of Szentkereszthegy are characterized by a monospecific podocopid ostracod fauna. The specimens of *Lutkevichinella lata* were extracted in great abundance from the bituminous laminates and represented by moderately to well-preserved carapaces. The characteristic reticulation on the valve surface cannot be studied in most cases due to different preservation potential of the carapaces. The occurrences of the identified genus were reported from many Triassic sections of Germanic and Precaspian basins, from Northern Calcareous Alps, from Betic Zone and from Middle East (Table 1.). For studies of the stratigraphical and spatial distribution of the genus, certain published taxa were excluded because of the absence of the sulcus on the carapaces which is important on generic not only subgeneric level contrary to the opinion of Kozur (Kozur & Oravecz-Scheffer, 1972). These taxa are the following:

Lutkevichinella brotzenorum (Sohn, 1968) described by Wienholz & Kozur (1970) from Upper Triassic beds of Germanic Basin deposited under brackish, shallow water conditions.

L. brotzenorum alpina (BUNZA & KOZUR, 1971) and *L. germanica* (WIENHOLZ & KOZUR, 1970) described by STYK (1982) from Upper Triassic beds of Polish Basin.

Relatively long range of the identified species *Lutkevichinella lata* have made them not so good index fossils but they are very useful palaeoenvironmental indicators. All species of genus *Lutkevichinella* lived in great abundance on the sea bottom mainly under brackish or sometimes hypersaline conditions in the Triassic age (Table 1). The main characters of *Lutkevichinella* are very similar to the living *Limnocythere* genus which prefers very low salinity and even freshwater environments. Only few differences can be observed between the two genera such as their size, concavity of the ventral margin, calcification of the carapaces and details of the hinge. The living *Limnocythere* is considered as a descendant of the Triassic *Lutkevichinella* because transitional forms (e. g. *L.*? *grammi*, *L.*? *gruendeli*, *L.*? *keuperea*, *L.*? l*evis* and *L.*? *reniformis*) were described from Triassic sequences (KOZUR & ORAVECZ-SCHEFFER 1972). The holotype of *Lutkevichinella lata* were described by KOZUR (1968b) also from Middle Triassic brackish deposits of Thuringian Basin.

Beside the salinity, the oxygen level is also very important evolving factor in faunal composition. The shape and limen-like structure (=sulcus) of the carapace of *Lutkevichinella* is very similar to the normal marine platycopid ostracods which very well adapt to low oxygenated or oligotrophic conditions because of their filter-feeding lifestyle contrary to the deposit-feeding podocopids (WHATLEY 1990, 1991). The nutrition of living filter-feeders are nano- and picoplankton and they create a permanent and enhanced water circulation over their ventral respiratory surface with their numerous branchial plates (HORNE et al. 2011). The sedimentological characteristics of the studied outcrop, the bituminous laminated grey marly layers supposed also stratified water column with low oxygenated conditions in a shallow marine environment. Summarizing the palaeoecolgical interpretation, the faunal composition, this *Lutkevichinella* dominated monospecific ostracod fauna indicate restricted lagoon with almost fully stratified water column with oxygen depleted bottom water conditions as depositional environment of the Iszkahegy Limestone. Development of this stratified water column can be explained by freshwater influx into this restricted basin which was only partly mixed with the seawater. The presence of this bituminous limestone series between the Aszófő and Megyehegy Dolomite of lagoonal and shabkha facies is probably caused by a short moist period in the climate during the Anisian. Very similar phenomenon were recognized and documented in Anisian sequences of the Dolomites based on sedimentological and palaeobotanical data (KUSTATSCHER et al. 2010; STEFANI et al. 2010).

Conclusions

Moderately and well-preserved monospecific ostracod fauna were described from Iszkahegy Limestone of Szentkereszthegy of the Balaton Highland. Detailed systematic description are given for the identified species (*Lutkevichinella lata*) belonging to the family Cytheressinellidae, superfamily Cytheroidea and order Podocopida. The faunal composition, the great abundance of this euryhalin taxon indicates shallow marine rather brackish lagoonal environment with dysaerob bottom water conditions caused by the restricted circulation in the water column. The freshwater input can be explained by a moist period, a short excursion in the climate during the Anisian in this region of the Tethys. This result refined and completed the former conception of the depositional environment of Iszkahegy Limestone.

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