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AN UPDATED REVIEW OF LATE DEVONIAN–EARLY CARBONIFEROUS OSTRACODS FROM THE LESSER CAUCASUS

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A review of the paraparchitid and geisinid ostracod species known from the Upper Devonian–Lower Carboniferous sequences of the Lesser Caucasus is conducted here with respect to modern taxonomic assignments and updated stratigraphic correlations. These ostracods are known from the upper Famennian–lower Visean successions of Armenia and Nachichevan. Most notably, Geisinidae are known from the upper Famennian *Paurogastroderhynchus nalivkini* Brachiopod Zone to the upper Tournaisian *Spirifer baiani–Marginatia burlingtonensis* Brachiopod Zone. Paraparchitidae are known from the *Paurogastroderhynchus nalivkini* Brachiopod Zone to the lower Visean. Our review highlights the distinguishing characters and updated stratigraphic occurrence of the paraparchitid and geisinid ostracod species documented by Tschigova in the upper Famennian–lower Visean successions of the Lesser Caucasus. Finally, we discuss their global stratigraphic and palaeobiogeographic distribution known so far.

Keywords: Ostracoda; Geisinidae; Paraparchitidae; upper Famennian; lower Tournaisian; Lesser Caucasus.

Introduction

The Late Devonian–Early Carboniferous (Mississipian) interval is a crucial period in Earth's history, as it encompasses significant perturbations in palaeoclimate, geochemical cycles, relative sea-level changes and dramatic changes in biodiversity (e.g., Walliser, 1984; McGhee *et al*., 2013; Kaiser *et al*., 2016; Carmichael *et al*., 2016; Kalvoda *et al*., 2019; Marshall *et al*., 2020; Rakociński *et al*., 2020, 2021). The Devonian–Carboniferous boundary crisis, commonly known as the Hangenberg crisis (Walliser, 1984), is associated with a transgression pulse and the development of marine anoxic conditions and climate warming (e.g., Kaiser *et al*., 2016; Pisarzowska *et al*., 2020; Rakociński *et al*., 2020). This crisis significantly affected both pelagic (particularly ammonoids, conodonts and many vertebrates) and benthic organisms (Kaiser *et al*., 2016 after data from Casier *et al.*, 2004, 2005), including ostracods (e.g., Bless *et al*., 1986, Becker and Blumenstengel, 1995; Kaiser *et al*., 2016).

Ostracods have an abundant and continuous fossil record since their first appearance in the Early Ordovician (e.g., Salas *et al*., 2007; Siveter, 2008; Williams *et al*., 2008), making them a useful tool to study diversity variations during the Phanerozoic. Nowadays, they are represented in all kinds of aquatic environments (e.g., Moore, 1961; Horne, 2005). Their sensitivity to environmental conditions and their changes allows them to be a good tool to make palaeoenvironmental (e.g., Casier, 2017; Song*et al*., 2017) and palaeogeographical reconstructions (e.g., Lethiers, 1983; Lethiers and Feist, 1991; Becker and Braun, 2008), but also biostratigraphic correlations (e.g., Lethiers, 1978; Casier, 1987; Casier and Olempska, 2008).

Moreover, according to the studies of Tschigova (1970), Walliser (1996), Blumenstengel (1993) and Casier *et al*. (2002, 2003, 2004), pelagic ostracod assemblages were more affected by the Hangenberg crisis than those known from neritic shallow-water habitats. However, as noted by Kaiser *et al*. (2016), regrettably, this old summary has not been updated yet. In this regard, the Upper Devonian–Lower Carboniferous sedimentary sequences of the Lesser Caucasus (Central Armenia and Nakhichevan; Fig. 1) are of particular interest because they consist of shallow water, mixed carbonate-siliciclastic deposits and are remarkably continuous, complete (Arakelyan, 1964; Arakelyan *et al*., 1975) and rich in fossil remains (Abrahamyan, 1957, 1974; Serobyan *et al*., 2021, 2023), including ostracods (Tschigova, 1977; Aristov *et al*., 1979; Grechishnikova and Levitskii, 2011). Unlike other fossil groups such as brachiopods (Abich, 1858; Rzhonsnitskaya, 1948; Abrahamyan 1957, 1964, 1974; Alekseeva *et al*., 2018a, b; Serobyan and Mayilyan 2019; Serobyan *et al*., 2019, 2021, 2022a, b, 2023), corals (Sytova *et al*., 1974), chondrichthyan microfossils (Ginter *et al*., 2011), conodonts (Grigoryan *et al*., 2019), trilobites (Crônier *et al*., 2021), and ostracods

from the Lesser Caucasus received relatively little attention. The first study on Upper Devonian–Lower Carboniferous ostracods from this region was conducted by Tschigova in 1977. Since then, no systematic research has been performed on this group, except for some more recent publications on biostratigraphy that also include ostracods (e.g., Grechishnikova and Levitskii, 2011).

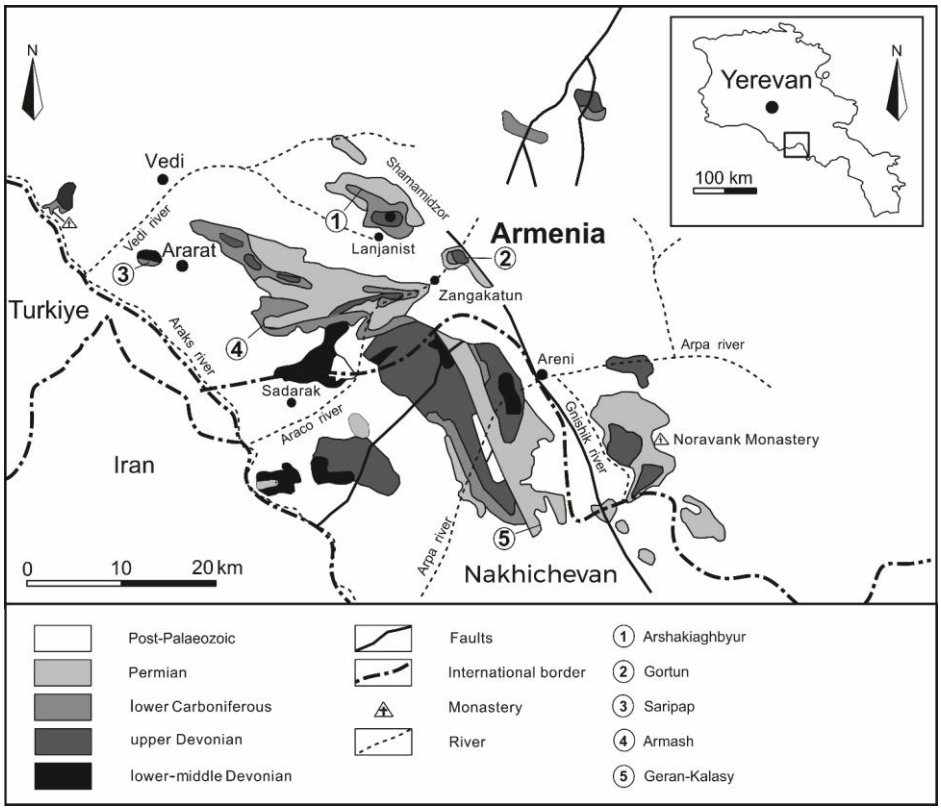

Fig. 1. Schematic geological map of the Upper Palaeozoic sedimentary sequences of Central Armenia and Nakhichevan, including the ostracod-bearing sections (modified after Serobyan *et al.*, 2019).

The main purpose of this study is to update the taxonomic and biostratigraphic information of all paraparchitid and geisinid ostracods from the Devonian–Carboniferous transitional interval of the Lesser Caucasus documented in the literature. We also emphasize their stratigraphic and palaeobiogeographic significance by comparing their record from the northern margin of Gondwana (Lesser Caucasus) with Australia, Laurussia (e.g., Poland, Belgium) and the Yangtze Block (South China). It is worth noting that this review serves as a preliminary step in a broader systematic study of Palaeozoic ostracods in Armenia.

Stratigraphic Setting

The Devonian–Carboniferous sedimentary sequences occur in the southern part of Central Armenia, between the basin of the Vedi River and the middle reaches of the Arpa River, including the northern part of the Vayots Dzor Mountains (Fig. 1). Together with the Palaeozoic deposits of Nakhichevan, they constitute the South Armenian Block (SAB), a microcontinent that was part of the northern margin of Gondwana during the Palaeozoic and became separated during the Jurassic (Sosson *et al*., 2010; Nikogosian *et al*., 2023). The Upper Devonian–Lower Carboniferous sedimentary sequences of the SAB are composed of mixed carbonate-siliciclastic sediments that accumulated on a shallow water platform (Arakelyan, 1964; Ginter *et al*., 2011; Serobyan *et al*., 2022b, 2023). They consist mainly of marly and sandy biogenic limestones rich in brachiopods, with intercalations of compositionally mature sandstones, and shales. The absence of volcanic rocks of contemporaneous age, metamorphism and angular unconformities in the Upper Devonian–Lower Carboniferous sequences indicates the persistence of a vast, tectonically stable platform during this interval (Arakelyan, 1964; Sosson *et al*., 2010). The Upper Devonian–Lower Carboniferous biostratigraphy of the Lesser Caucasus has been systematically studied by Rzhonsnitskaya (1948), Abrahamyan (1957, 1964), Arakelyan (1952, 1964), Abrahamyan *et al*. (1973), Arakelyan *et al*. (1975), Grechishnikova *et al*. (1980, 1982), Mamedov and Rzhonsnitskaya (1985), Rzhonsnitskaya and Mamedov (2000), Aristov (1994), and Serobyan *et al*. (2019, 2021, 2022a, b, 2023). Arakelyan (1964) and Abrahamyan (1964) subdivided this ca. 1500 m thick succession into twelve ‘formations’. However, Serobyan *et al.* (2019, 2021) indicated that these subdivisions can be discriminate only by some index fossils, in particular brachiopods, but cannot be identified by their lithology. Consequently, we consider these subdivisions as horizons and no longer as ‘formations’.

Moreover, subsequent studies have questioned the dating of these horizons. In particular, Abrahamyan (1964, 1974) noted that the Arshakiaghbyur Horizon contains a mixed Upper Devonian and Lower Carboniferous brachiopod fauna, while Arakelyan (1975) dated the lowest part of the horizon as Tournaisian. Aristov (1994) concurred with Abrahamyan (1964, 1974) and placed the Devonian–Carboniferous boundary (D–CB) within the Arshakiaghbyur Horizon. More particularly, Aristov (1994) indicated that the lower–middle part of the Arshakiaghbyur Horizon corresponds to the uppermost Famennian *costatus* Conodont Zone of Ziegler (1962), whereas its upper part corresponds to the lower Tournaisian *sulcata–duplicata* zones of Sandberg *et al*. (1978). Aristov (1994) established three local conodont zones for the uppermost Famennian–lower Tournaisian interval of the Lesser Caucasus, *Pelekysgnathus superstes–Icriodus costatus* Zone, *Pelekysgnathus superstes–Polygnathus inornatus* Zone and *Polygnathus inornatus–Siphonodella* Zone. He indicated that the first two biozones correspond to the uppermost Famennian *costatus* Conodont Zone of

Ziegler (1962), whereas the latter comprises the lower Tournaisian *sulcata* and *isosticha–crenulata* zones of Sandberg *et al*. (1978) (see fig. 2).

However, Rzonsnitskaya and Mamedov (2000) noted that the index conodont species *Polygnathus inornatus*, *P. communis communis*, *P. longiposticus*, *Bispathoudus stabilis* and *Siphonodella duplicata* used to recognize the D–CB have not been reported so far from the Lesser Caucasus. They noted that the D–CB is probably at the base of the Gerankalasy Horizon, based on ostracod, trilobite and brachiopod records. They also specified that the Arshakiaghbyur Horizon may be correlated with the Middle–Upper *costatus* Zone of Ziegler (1962) and *praesulcata* Zone of Sandberg *et al*. (1978), and consequently correspond to the uppermost Famennian. The Sevakavan and Khor Virap sections, covering this particular interval, were studied by Ginter *et al*. (2011), who documented chondrichthyan microfossils from the Famennian–Tournaisian interval. In addition to chondrichthyans, they also reported conodonts from the Arshakiaghbyur Horizon, which point to the Middle *expansa–praesulcata* interval, whereas the limestone sequences of the Gerankalasy Horizon include conodonts indicating an age that is not younger than the Tournaisian *crenulata* Conodont Zone. Therefore, we tentatively place the D–CB at the transition between the Arshakiaghbyur and Gerankalasi horizons, pending a detailed study of this sequence with standard biostratigraphic markers, such as conodonts. According to Tschigova (1960, 1977), Aristov *et al*. (1979), and Grechishnikova and Levitskiy (2011), ostracods are an important component of the Upper Devonian–Lower Carboniferous successions of the Lesser Caucasus. However, formal ostracod biozonations have not yet been established in this area and the biostratigraphic significance of this important microfossil group remains largely unknown.

Systematic Palaeontology

The suprageneric classification adopted herein follows the one suggested by Moore (1961), Becker (2002) and Adamczak (2006).

Order Palaeocopida Henningsmoen, 1953
Suborder Kloedenellocopina Scott, 1961
Superfamily Kloedenelloidea Ulrich and Bassler, 1908
Family Geisinidae Sohn, 1961 [= Knoxitidae Egorov, 1950]

Genus *Electia* Tschigova, 1960

Type species: *Electia dolosa* Tschigova, 1960, by original designation. Lower Visean, Malinovsky deposits, Ulyanovsk Region, Russia.

Diagnosis (from Tschigova, 1960 modified Adamczak, 2006):

With oblique-oval lateral outline of valve; adductorial sulcus short and deep; pre- and postadductorial lobes comparatively prominent, knob-like in appearance; ventral lobe prominent.

Remarks: While erecting the genus *Electia*, Tschigova (1960) provided both diagnosis and description for the type species, but she did not present a diagnosis for the genus. Subsequently, Abushik (1990) and Adamczak (2006), leveraging and synthesizing the information provided by Tschigova (1960), provided a short diagnosis for the genus. We here follow the diagnosis by Adamczak (2006), as it is more detailed.

Electia dolosa Tschigova, 1960

1960 *Electia dolosa* sp. nov.; Tschigova, p. 203, pl. 5, fig. 4.
1967 *Electia dolosa*; Tschigova, p. 197, pl. 3, fig. 6.
2011 *Electia dolosa*; Grechishnikova and Levitskii, p. 30, tab. 3.

Occurrence: *Electia dolosa* was first described by Tschigova (1960) from the lower Visean of the Russian Platform. Later, Tschigova (1967) documented this species from the Upper Devonian–Lower Carboniferous of the Kama-Kinel depression (Russian Platform). Grechishnikova and Levitskii (2011) reported *E. dolosa* from the upper Tournaisian *Spirifer baiani–Marginatia burlingtonensis* Brachiopod Zone of the Geran-Kalasi section (Fig.1).

Genus *Quasiknoxiella* Tschigova, 1977

Type species: *Quasiknoxiella reverenda* Tschigova, 1977. Uppermost Famennian, Armenia and lower Tournaisian, Volga-Ural Region, Russia.

Remarks: Only two species belonging to the genus *Quasiknoxiella* Tschigova, 1977 have been documented so far from the upper Famennian of the Lesser Caucasus: *Quasiknoxiella reverenda* and *Quasiknoxiella* (?) sp. While the former was described and illustrated by Tschigova (1977) and Aristov*et al.* (1979), the presence of the latter species has only been mentioned by Grechishnikova and Levitskii (2011), without provision of any description and/or illustration.

Quasiknoxiella reverenda Tschigova, 1977

1977 *Quasiknoxiella reverenda* sp. nov.; Tschigova, p. 163, pl. 37, figs. 5–6.
1979 *Quasiknoxiella reverenda*; Aristov *et al*., pp. 90, 94.
2011 *Quasiknoxiella reverenda*; Grechishnikova and Levitskii, p. 35, tab. 3.

Occurrence: *Quasiknoxiella reverenda* was first described by Tschigova (1977) from the uppermost Famennian Arshakiaghbyur Horizon of the Lanjanist section (Kadrlu) (Armenia: Fig. 1), and from the lower Tournaisian Malevkian and Upian horizons of Volga-Ural Region (Russia). Aristov *et al*. (1979) reported this species from the uppermost Famennian *Sphenospira julii–Spinocarinifera nigra* and lower Tournaisian *Unispirfer praeulbanensis–Rugauris curtirostris* brachiopod zones. Later, it was reported by Grechishnikova and Levitskii (2011) from the uppermost Famennian *Sphenospira julii–Spinocarinifera nigra* Brachiopod Zone of the Geran-Kalasi section (Nakhichevan: Fig.1).

Superfamily Paraparchitoidea Scott, 1959
Family Paraparchitidae Scott, 1959
Genus *Armenites* Tschigova, 1977
[= *Etrenites* Tschigova, 1961, nomen nudum]

Type species: Armenites quaesitus Tschigova, 1977. Uppermost Famennian, Arshakiaghbyur Horizon, Armenia.

Diagnosis (English translation from Russian in Tschigova, 1977): Shell large, massive, truncated-oval, hinge undivided; dorsal margin and hinge line straight; ventral margin convex, oblique towards posterior end; ends of valves rounded, anterior higher than the posterior, projecting forward. Cardinal angles obtuse. Left valve slightly larger than the right one, maximum overlap in ventral part; posterodorsal spines massive and hollow, anterodorsal spines, when developed, represent a flattened projection of the valve; rib runs parallel to the free margin and are more clearly expressed on the right valve. Female's shells with a large anteroventral brood chamber noticeably or faintly separated from the remainder of the carapace.

Armenites philippovae Tschigova, 1977

1977 *Armenites philippovae* sp. nov.; Tschigova, p. 129, pl. 17, fig. 1.
2004 *Armenites philippovae*; Jones, pp. 197, 204.
2011 *Armenites philippovae*; Grechishnikova and Levitskii, pp. 25, 35, tab. 3.

Occurrence: Armenites philippovae was first described by Tschigova (1977) from the upper Famennian–lower Tournaisian Zelenetsky Horizon of the East European Platform, Timan region. Later it was reported by Grechishnikova and Levitskii (2011) from the upper Famennian *Paurogastroderhynchus nalivkini* Brachiopod Zone of the Geran-Kalasi section, Lesser Caucasus (Nakhichevan: Fig.1).

Armenites quaesitus Tschigova, 1977

1977 *Armenites quaesitus*sp. nov.; Tschigova, p. 128, pl. 16, fig. 34.
1979 *Armenites quaesitus*; Aristov *et al*., pp. 90, 94.
2004 *Armenites quaesitus*; Jones, pp. 197, 203, 204.
2011 *Armenites quaesitus*; Grechishnikova and Levitskii, p. 35, tab. 3.

Remark: *Armenites quaesitus* differs from *A. philipovae* by a significantly narrower posterior end of the valves, by the outline of free edge and a more swollen and sharply defined brood pouch.

Occurrence:*Armenites quaesitus* was first documented by Tschigova (1977) from the uppermost Famennian Arshakiaghbyur Horizon of the Lanjanist (Kadrlu) and Chanakhchi sections (Lesser Caucasus: fig.1), and the Russian Platform. Aristov *et al*. (1979) reported this species from the lower Tournaisian *Sphenospira julii–Spinocarinifera nigra* and *Unispirifer praeulbanensis–Rugauris curtirostris* brachiopod zones of the Lesser Caucasus. Later it was reported by Grechishnikova and Levitskii (2011) from the uppermost Famennian

Sphenospira julii–Spinocarinifera nigra Brachiopod Zone of the Geran-Kalasi section (Nakhichevan: fig.1).

Genus *Shishaella* Sohn, 1971

Type species: Paraparchites nicklesi var. *cyclopea* Girty, 1910. Late Mississippian (Chesterian), Fayetteville Shale, Arkansas, USA.

Remarks: In the Lesser Caucasus, representatives of the genus *Shishaella* (*Shishaella electa* Tschigova, 1977 and *Shishaella* sp. in Grechisnikova and Levitskii, 2011) are known from the upper Famennian–lower Tournaisian interval (see Fig.2). *Shishaella ferox* is mentioned by Aristov *et al*. (1979) and Grechisnikova and Levitskii (2011) from the lower Tournaisian *Sphenospira julii–Spinocarinifera nigra* and *Unispirfer praeulbanensis–Rugauris curtirostris* brachiopod zones, but none of these studies provides any description or photographic illustration or any reference specifying when the species was erected. The species name *Shishaella ferox* appears to be derived from an unpublished work of Tschigova that was sent for review to Rafael Arakelyan, the Head of the Laboratory of Regional geology and Stratigraphy of the Institute of Geological Sciences of Armenian SSR (1960s–1970s). Therefore, *S. ferox* should be regarded as invalid (*nomen nudum*). *S.* sp. was reported by Grechisnikova and Levitskii (2011) from the uppermost Famennian *Sphenospira julii–Spinocarinifera nigra* Brachiopod Zone of the Geran-Kalasi section (Fig.1).

Shishaella electa Tschigova, 1977

1968 *Paraparchites* sp. cf. *P. nicklesi* (Ulrich, 1891); Jones, pp. 44, 45, pl. 5. figs. 2, 3, 4 (non fig. 1 = *Chamishaella* aff. *obscura* Tschigova, 1977).

1975 *Shishaella*sp.; Jones, pp. 320–323, pl. 57, figs. 280, 281, 283–286; text-fig. 36.

1977 *Shishaella electa* sp. nov.; Tschigova, p. 154, pl. 29, fig. 1 (a–d).

1979 *Shishaella electa*; Aristov *et al*., pp. 90, 94.

1984 *Shishaella electa*; Buschmina *et al*., pl. 25, fig. 11.

1986 *Shishaella electa*; Buschmina, p. 125, pl. 28, figs. 4, 5.

1988 *Shishaella electa*; Wang, p. 216, pl. 55, figs. 1–3.

2000 *Shishaella electa*; Matyja *et al*., pp. 208, 212, 214, figs. 12, 16 (1), App. 2.

2004 *Shishaella electa*; Jones, pp. 211–215, figs. 17A–K, 18, 19.

2011 *Shishaella electa*; Jones, pp. 267–277, fig. 4G–J.

2011 *Shishaella electa*; Grechishnikova and Levitskii, pp. 27, 35, tab. 3.

Remarks: Jones (2004, 2011) considered that the ‘pre-adult instars’ of *Paraparchites* cf. *nicklesi* in Jones (1968) and the specimens identified as *Shishaella* sp. in Jones (1975) belong to *Shishaella electa* Tschigova, 1977.

Occurrence: Shishaella electa was first reported by Jones (1968, 1975) from the Upper Devonian–Lower Carboniferous strata of the Bonaparte Gulf Basin (northwestern Australia). Later, Tschigova (1977) described this species from the

uppermost Famennian–lower Tournaisian of the Russian Platform and mentioned the presence of *S. electa* in the Tournaisian of the Feluy section in Belgium. Buschmina *et al*. (1984) and Buschmina (1986) documented this species from Western Siberia in sedimentary sequences of an early upper Tournaisian age. Later, Wang (1988) described *S. electa* from the lower Tournaisian of Nanbiancun section (South China). In the Lesser Caucasus, *S. electa* is known from the studies of Aristov *et al*. (1979) and Grechishnikova and Levitskii (2011), who both indicate the presence of this species only in the lower Tournaisian *Unispirifer praeulbanensis–Rugauris curtirostris* Brachiopod Zone.

Genus *Shivaella* Sohn, 1971

Type species: *Shivaella suppetia* Sohn, 1971 subsequently designated by Sohn (1971). Middle Mississippian (Meramecian), Alapah Limestone, Brooks Range, Alaska.

Shivaella longa (Tschigova, 1960)

1960 *Paraparchites longa* sp. nov.; Tschigova, p. 175, pl. 3, figs. 2–4.
1967 *Paraparchites longa*; Tschigova, p. 213, pl. 13, figs. 1–3.
1971 *Shivaella longa*; Sohn, p. 9.
2000 *Shivaella longa*; Matyja *et al*., pp. 208, 210, 214, figs. 13 (5), 15 (2), App. 2.
2004 *Shivaella longa*; Jones, p. 223.
2011 *Shivaella longa*; Grechishnikova and Levitskii, pp. 30, 35, tab.3.
2018° *Shivaella longa*; Grechishnikova in Alekseeva *et al*., p. 45.

Diagnosis (English translation from Russian in Tschigova, 1960): Shell large, elongated; anterior end higher than the posterior one; both valves possess a massive posterodorsal spine, in front of which a depression is observed that is more prominent in the larval shells.

Remarks: This species was initially attributed to *Paraparchites* Ulrich and Bassler, 1906 based on its smooth valve, the presence of a small tubercle in posterior-cardinal third of each valve observed occasionally and dorsal edges usually unequal on both valves with the left slightly more prominent. Later, Sohn (1971) emended the Superfamily Paraparchitacea Scott, 1959, mainly on the basis of material from the Lower Carboniferous of Northern Alaska and erected several new genera and species. He erected the genus *Shivaella* and reattributed the material of *Paraparchites longa* Tschigova, 1960 to *Shivaella*, based on the presence of a posterodorsal spines on both valves, diagnostic of this genus (Sohn, 1971).

Occurrence: *Shivaella longa* was first described by Tschigova (1960) from the Upper Devonian–Lower Carboniferous strata of the Russian Platform. Tschigova (1967) also documented this species from the Lower Carboniferous of the Volga-Ural region (Russia). Matyja *et al*. (2000) reported *S. longa* from the Tournaisian of western Pomerania (Poland). In the Lesser Caucasus, this species was documented by Grechishnikova and Levitskii (2011), who mentioned its

presence in the upper Tournaisian *Spirifer baiani–Marginata burlingtonensis* Brachiopod Zone of the Geran-Kalasi section (Nakhichevan: Fig. 1) and indicated that it extends to the lower Visean.

Discussion

The stratigraphic distribution of ostracod species known from the Upper Devonian–Lower Carboniferous sequences of the Lesser Caucasus is shown in Fig. 2, in which are also included some taxa reported by Grechishnikova and Levitskii (2011), but left in open nomenclature, probably due to their poor state of preservation (i.e., *Blessites* sp., *Knoxiella* sp. *Quasiknoxiella* (?) sp. and *Shivaella* sp.). In this area, the earliest occurrence of Palaeocopida is recorded in the upper Famennian Gortun Horizon, corresponding to the *Paurogastroderhynchus nalivkini* Brachiopod Zone, which includes four different species. Three of them are identified at the genus level (*Blessites* sp., *Knoxiella* sp. and *Quasiknoxiella* (?) sp.) and belong to the family Geisinidae, whereas the family Paraparchitidae is represented only by the species *Armenites philippovae* Tschigova, 1977. The overlying Arshakiaghbyur Horizon, which may be correlated with the uppermost Famennian *Sphenospira julii–Spinocarinifera nigra* Brachiopod Zone, is characterized by the appearance of two paraparchitid taxa, namely *Armenites quaesitus* Tschigova, 1977 and *Shishaella* sp. and one Geisinid species, *Quasiknoxiella reverenda* Tschigova, 1977. *A. quaesitus* Tschigova, 1977 and *Q. reveranda* Tschigova, 1977 were also reported from the lower Tournaisian *Unispirifer praeulbanensis–Rugauris curtirostris* Brachiopod Zone, corresponding to the Gerankalasy Horizon (Grechishnikova and Levitskii, 2011). *Shishaella electa* Tschigova, 1977 known from the uppermost Famennian (Aristov *et al*., 1979), is also present in the lower Tournaisian (Grechishnikova and Levitskii, 2011).No ostracod species has been described from the *Unispirifer tornacensis–Rhipidomella michelini* Zone, whereas two ostracod species, namely *Shivaella longa* (Tschigova, 1960) and *Electia dolosa* Tschigova, 1960 are found in the *Spirifer baiani–Marginatia burlingtonensis* Zone. The former is known in the late Tournaisian and extends to the Visean. The palaeobiogeographic distribution of Paraparchitidae and Geisinidae in the upper Famennian–Tournaisian sequences of the Lesser Caucasus suggests that ostracod communities thriving on the shallow water carbonate platform of the SAB were composed ofspecies commonly found in the north-eastern part of Gondwana, but also in Laurussia (Belgium, Poland, Russian platform), the Yangtze Block (South China) and Siberia (Fig.3). However, the data are still too scarce to discuss in depth the affinities of Famennian–Tournaisian ostracod faunas from the Lesser Caucasus.

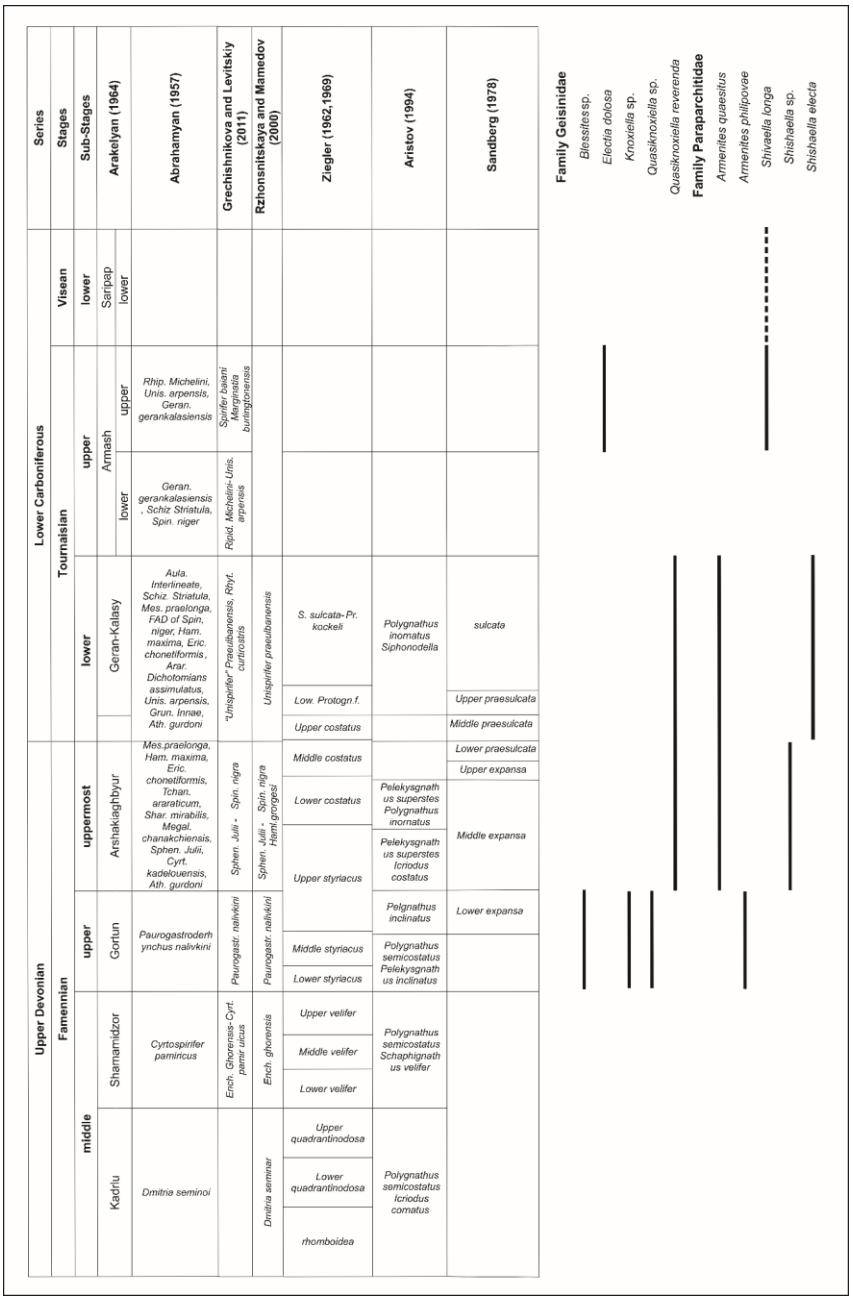

Fig.2. Stratigraphic distribution of Geisinidae and Paraparchitidae ostracods reported from the upper Fammenian–lower Tournaisean interval of the Lesser Caucasus (Biozones after Abrahamyan 1957, Rzhonsnitskaya and Mamedov 2000, Gretchishnikova and Levitskii 2011, "formations" after Arakelyan 1964; Ziegler 1962, 1969, Sandberg *et al*., 1978). Abbreviations: Mes.: *Mesoplica*; Ench.: *Enchondrospirifer*; Paurogastr.: *Paurogastroderhynchus*; Sphen.: *Sphenospira*; Spin.: *Spinocarinifera*; Ham., Haml.: *Hamlingella*; Cyrt.: *Cyrtospirifer*; Unis.: *Unispirifer*; Rhip.: *Rhipidomella*; Eric.: *Ericiata*; Tchan.: *Tchanakhtchirostrum*, Shar.: *Sharovaella*; Megal.: *Megalopterorhynchus*; Ath.:*Athyris*; Aula.: *Aulacella*; Schiz.: *Schizophoria*; Arar.: *Araratella*, Grun.; *Gruntathyris*; Geran.: *Gerankalasiella*; S.: *Siphonodella*; Pr., Protogn.: *Protognathodus*; Low.: Lower; FAD: First Appearance Datum.

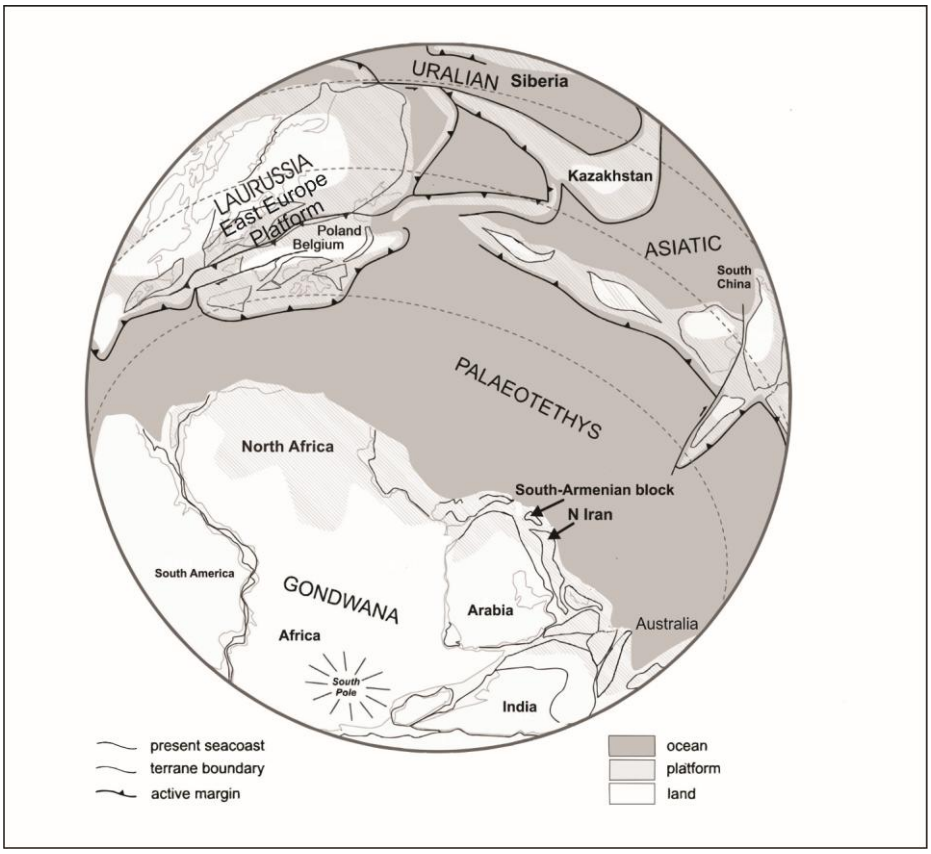

Fig.3. Late Devonian palaeogeographic reconstruction of the Palaeotethys Ocean and its surrounding continents, including the position of the South Armenian Block (modified after Denayer and Hoşgör 2014, based on the maps of Stampfi *et al*., 2002).

Conclusions

A review of the available literature about the taxonomy and stratigraphic distribution of ostracods from the Famennian–Tournaisian sequences of the Lesser Caucasus allows to establish the occurrence of four paraparchitid and two geisinid ostracod species and some other morphotypes left in open nomenclature. These species have been reported from the Gortun, Arshakiaghbyur, Gerankalasy and Armash horizons. Their stratigraphic distribution suggests that some of them were restricted to these horizons; it is unknown at this stage whether this stratigraphic distribution has some biostratigraphic or palaeoenvironmental significance. Most notably, *Armenites philippovae* Tschigova, 1977 appears to be restricted to the upper Famennian *Paurogastroderhynchus nalivkini* Brachiopod Zone (Gortun Horizon). The uppermost Famennian Arshakiaghbyur Horizon is distinguished by the presence of the species *Armenites quaesitus* Tschigova, 1977 and *Quasiknoxiella reverenda* Tschigova, 1977, which extend to the lower Tournaisian Gerankalasy Horizon. The only species useful for distinguishing the lower Tournaisian from the uppermost Famennian is possibly *Shishaella electa*

Tschigova, 1977, which only occurs within the lower Tournaisian *Unispirifer praeulbanensis–Rugauris curtirostris* Brachiopod Zone. However, ostracod data from the Famennian–Tournaisian of the Lesser Caucasus are still insufficient to discuss their biostratigraphic significance.

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ՈՒՇ ԴԵՎՈՆՅԱՆ-ՎԱՂ ՔԱՐԱԾԽԱՅԻՆ ԺԱՄԱՆԱԿԱՇՐՋԱՆԻՕՍՏՐԱԿՈԴՆԵՐԸ ՓՈՔՐ ԿՈՎԿԱՍԻՑ. ԹԱՐՄԱՑՎԱԾ ԱԿՆԱՐԿ

Համբարձումյան Թամարա, Մերոբյան Վահրամ, Գիլամ Էլվիս, Հայրապետիան Վաչիկ, Դանելիան Տանիել, Գրիգորյան Արայիկ

Ամփոփում

Հոդվածում քննարկվում են Փոքր Կովկասի վերին դևոն-ստորին քարածխային նստվածքային հաջորդականություններից հայտնի Paraparchitidae և Geisinidae ընտանիքներին պատկանող օստրակոդների տեսակները՝ հաշվի առնելով ժամանակակից տաքսոնոմիական դասակարգումները և թարմացված շերտագրական կորելացիաները: Այս օստրակոդները հայտնի են Հայաստանի և Նախիջևանի վերին ֆամենից մինչև ստորին վիզե: Հատկանշական է, որ Geisinidae-ները հայտնի են վերին ֆամենի *Paurogastroderhynchus nalivkini* բրախիոպոդային զոնայից մինչև վերին տուրնեի *Spirifer baiani–Marginatia burlingtonensis* բրախիոպոդային զոնա: Paraparchitidae-ները հայտնի են *Paurogastroderhynchus nalivkini* բրախիոպոդային զոնայից մինչև ստորին վիզե: Մեր վերանայումն ընդգծում է Փոքր Կովկասի վերին ֆամեն-ստորին վիզեի հաջորդականություններից Չիժովայի կողմից նկարագրված paraparchitid և geisinid օստրակոդների ընտանիքների տեսակների տաքսոնոմիական և շերտագրական առանձնահատկությունները: Ի վերջո, մենք քննարկում ենք նրանց գլոբալ շերտագրական և հնաէկոսաշխարհագրական տարածվածությունը՝ այս պահի դրությամբ հայտնի տվյալներով:

ОБНОВЛЕННЫЙ ОБЗОР ОСТРАКОД ПОЗДНЕГО ДЕВОНА – РАННЕГО КАРБОНА МАЛОГО КАВКАЗА

Амбарцумян Тамара, Серобян Ваграм, Гиллам Элвис, Айрапетиан Вачик, Данелиан Таниэл, Григорян Араик

Резюме

В данной статье рассматриваются виды остракод из семейств Paraparchitidae и Geisinidae,известные из верхнедевонских и нижнекарбоновых осадочных толщ Малого Кавказа, с учётом современных таксономических системизаций и обновлённых стратиграфических корреляций. Эти остракоды известны из верхнего фамена донижнего визеАрмении и Нахичевани. Примечательно, что Geisinidae известны из верхнефаменской брахиоподовой зоны *Paurogastroderhynchus nalivkini* до верхнетурнейской зоны *Spirifer baiani–Marginatia burlingtonensis*. Paraparchitidae известны из зоны брахиоподовой зоны *Paurogastroderhynchus nalivkini* до нижнего визе. Наш обзор подчеркивает отличительные характеристики и обновленное стратиграфическое распространение видов остракодиз семейств Paraparchitidae и Geisinidae, выявленных Чижовой из верхнефаменских–нижневизейских последовательностях Малого Кавказа. Наконец, мы обсуждаем их глобальное стратиграфическое и палеобиогеографическое распространение, известное на данный момент.