Геолошки анали Балканског полуострва Annales Géologiques de la Péninsule Balkanique	76	11–17	Београд, децембар 2015 Belgrade, December 2015

DOI: 10.2298/GABP1576011R

The role of conodonts in the global stratigraphic correlation on example of southern Siberia (Russia) and eastern Serbia

Sergei A. Rodygin[1]

Abstract. Conodonts are very precise tools for global stratigraphic correlation of Devonian deposits. They can be correlated at the level of standard conodont zones even for basins having very different geological structure. In this paper Devonian conodont correlations between north-western margin of the Kuznetsk Basin (Siberia) and eastern Serbia are demonstrated. The geology of both regions is quite different. East Serbian zone is the southern tip of the Carpathian folded area (Carpatho-Balkanides). Middle Paleozoic carbonate and terrigenous deposits (Silurian, Devonian and Lower Carboniferous) are replaced by Hercynian molasse, and sedimentation continued throughout the Mesozoic and Cenozoic Eras. Rocks were exposed to repeatedly tectonic effects, olistoliths, olistostromes are widespread. Middle Paleozoic sediments, including Devonian, are localized within separate small tectonic blocks, often shifted from its place and form allochthons. In the western part of the Altai-Sayan folded area the Middle Paleozoic sediments have undergone folding and orogeny during the Hercynian phase of tectonic and magmatic activity, but since that time the continental conditions have been dominant in this region. The Devonian deposits are well represented in the marginal parts of the Kuznetsk Basin. In both regions the Devonian rocks have been well studied and the standard conodont zones varcus, gigas (rhenana) – linguiformis, crepida, expansa and praesulcata were established.

Key words: conodonts, correlation, Devonian, Serbia, Siberia.

Апстракт: Конодонти су веома значајни за глобалну стратиграфску корелацију девонских седимената. Они могу послужити за корелацију стандардних конодонтских зона чак и за басене са различитом геолошком структуром. У овом раду приказана је корелација девонских конодоната северозападног обода Кузњетског басена (Сибир) и источне Србије. Геологија ових региона је сасвим различита. Источна Србија представља јужни крај Карпатске наборне области (Карпато-Балканиди). Средњопалеозојски карбонати и теригени седименти (силур, девон и доњи карбона) су замењени херцинским моласама, чија се седиментација наставља кроз мезозоик и кенозоик. Стене су биле изложени вишеструким тектонским утицајима. Олистолити и олистростроме су честе. Средњопалеозојски седименти, укључујући и девонске, налазе се унутар издвојених мањих тектонских блокова и често су премештени са свог места формирајући алохтоне. У западним деловима Алтаи – Саиан наборне области средњоплаеозојски седименти су били подвргнути набирању и орогену током тектонске и магматске активности херцинске фазе После тог времена у овом региону су преовладали континентални услови. Девонски седименти су добро развијени у маргиналним деловима Кузњетског басена. У оба региона девонски седимент су добро проучени и установљене су стандардне конодонтске зоне: varcus, gigas (rhenana) – linguiformis, crepida, expansa и praesulcata.

Кључне речи: конодонти, корелација, девон, Србија, Сибир.

Introduction

The significance of conodonts as a supervising faunistic group for Paleozoic stratigraphy is very high. They were abundant in the Middle Paleozoic seas, particularly in the Devonian ones. The Standard Conodont Zones Scale based on the evolutionary development of deep-sea conodonts. This scale is a recognized world standard of all Devonian boundaries. It was constantly being improved and updated (Fig. 1). Unfortunately, in its latest edition some regular zones names were changed and zones have been divided into several new ones (Becker *et al*. 2012). These innovations do not cause approval from the specialists for other faunal groups. Standard conodont scale cannot be fully used in sections of shallow-water deposits. But conodonts still

[1] Chair of the Paleontology and Historical Geology, Geological and Geographical Faculty, Tomsk State University, Lenin Ave., 36, Tomsk 634050, Russia. E-mail: rodygin@ggf.tsu.ru

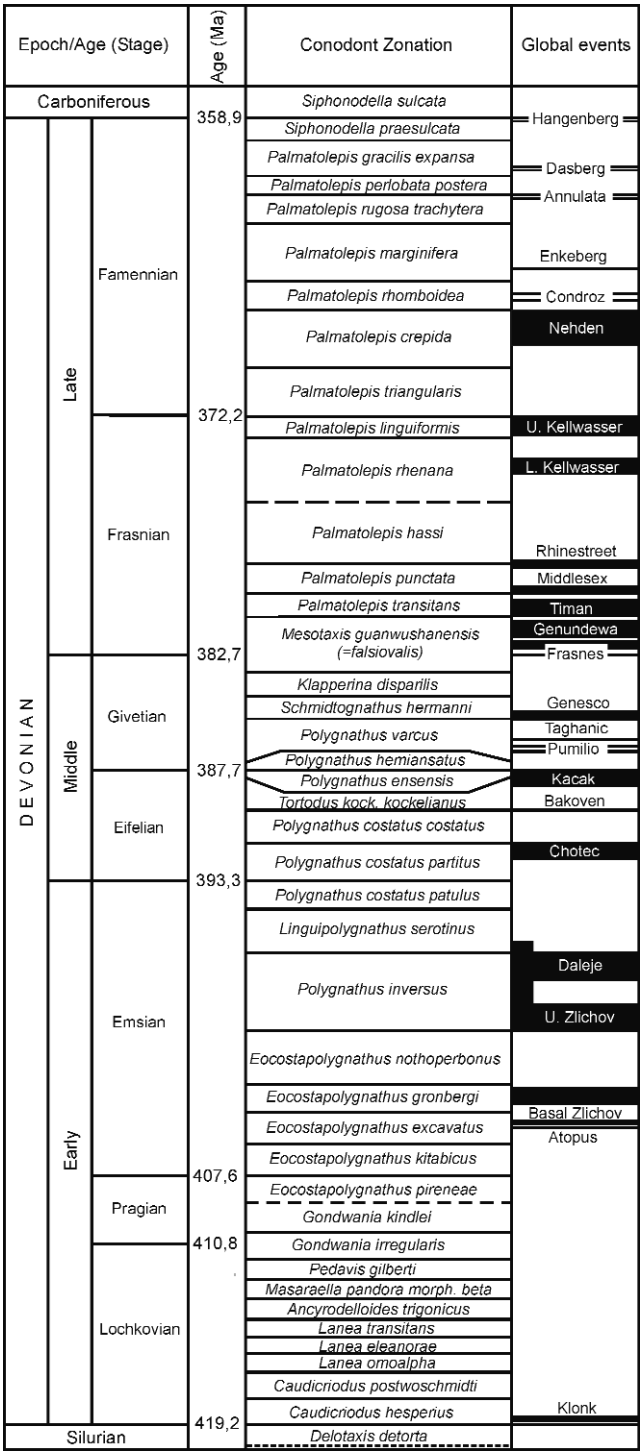


Fig. 1. The Standard Conodont Zonation in the Devonian (BECKER *et al*., 2012, abridged).

remain the major biostratigraphical correlation tools. By studying the distribution of conodonts in certain sections, every specialist tries always to tie their subdivisions to zones of the standard conodont scale and to implement the inter-regional and global correlation of strata. The Devonian subdivisions of southern Siberia and eastern Serbia can serve as an example of such correlation (RODYGIN 2014).

Methods

Ten years ago during geological excursions in eastern Serbia the author could see that the geology of this area is very differing from the geology of southern Siberia. East Serbian zone is the southern tip of the Carpathian folded area (Carpatho-Balkanides). Middle Paleozoic carbonate and terrigenous deposits (Silurian, Devonian and Lower Carboniferous) are replaced here by Hercynian molasse, and sedimentation continued throughout the Mesozoic and Cenozoic Eras (ĆIRIĆ 1996). Rocks were exposed to repeatedly tectonic effects, particularly strong in Alpine phase of tectonic and magmatic reactivation. Overthrusts, olistoliths, olistostromes are widespread there; Middle Paleozoic sediments, including Devonian are localized within separate small tectonic blocks, often shifted from its place and formed allochthons. Tectonic blocks are interpreted as terranes, significantly changed its initial spatial position (KRSTIĆ *et al.* 2004).

In the western part of the Altai-Sayan folded area the Middle Paleozoic sediments have undergone folding and orogeny during the Hercynian phase of tectonic and magmatic activity, but since that time the continental conditions have been dominant in this region. The Kuznetsk coal basin (Kuzbass) began to form. The Kuznetsk Basin is an intermountain depression filled in its middle part by coal-bearing Carboniferous and Permian sediments. The Devonian deposits are well represented in the marginal parts of the Kuzbass. They are confined to the Givetian Stage of the Middle Devonian, to Frasnian and Famennian of the Upper Devonian. The studied sections are located in the vicinity of the town of Anzhero-Sudzhensk, in the Yaya, Barzas rivers basins, in the Tom' basin downstream of the city of Kemerovo (the northern district of the Kemerovo Region) and in the vicinity of village Vassino of the Novosibirsk Region (Type sections, 1992; RODYGIN 2011, 2014). The sections are composed of terrigenous and carbonaceous, mainly shallow deposits bearing rich associations of benthic fauna with brachiopods, rugoses, tabulates and stromatoporoids predominantly. Crinoids, ostracodes, tentaculites, bivalves are encountered; less common are gastropods, cephalopods, trilobites and fish integument fragments. Along with the fauna, stromatolites, algae, vegetable debris and spores were found from certain of the sections.

For many years these sections were tested for conodonts being of great stratigraphic importance. Representative conodont assemblages were established, which enabled the stratigraphical position of horizons to be defined more precisely and the correlation between the sections and the Standard Conodont Scale to be made. L.M. Aksenova and V.G. Halymbadzha took part in studying conodonts jointly with the present author (AKSENOVA *et al*. 1994; Type sections.., 1992; RODYGIN 2011, 2014).

Results

Lower Devonian and Eifelian deposits are absent in this region. The Givetian deposits compose the Mazalovsko-Kitatskyi Horizon subdivided into the Mazalovsko-Kitatskaya, Siberian-Lebedyanskaya and formations. The Mazalovsko-Kitatskaya Formation encloses the conodonts: *Polygnathus timorensis* KLAPPER, PHILIP *et* JACKSON, *Icriodus obliquimarginatus* BISCHOFF *et* ZIEGLER, *I. brevis* STAUFFER and others indicating its belonging to the Lower varcus conodont zone. The Siberian-Lebedyanskaya Formation containing the Conodont species *Polygnathus ansatus* ZIEGLER *et* KLAPPER, *P. timorensis* KLAPPER, PHILIP *et* JACKSON, *P. ovatinodosus* ZIEGLER *et* KLAPPER, *P. varcus* STAUFFER, *Icriodus brevis* STAUFFER, *Ozarkodina semialternans* (WIRTH), among others, is assigned to the Middle and Upper varcus zones and, probably, to the hermanni-cristatus zone. The Izylinskaya Formation, containing *Polygnathus* cf. *webbi* STAUFFER, *P.* cf. *decorosus* STAUFFER, *P. dubius* HINDE, *Icriodus brevis* STAUFFER, *I. difficilis* ZIEGLER *et* KLAPPER, *I.* cf. *difficilis* ZIEGLER *et* KLAPPER, *I.* aff. *expansus* BRANSON *et* MEHL, *I. expansus* BRANSON *et* MEHL and other conodont species, is correlatable to the Early falsiovalis (norrisi) zone (RODYGIN 2011, 2014).

The Frasnian Stage of the Kuzbass is subdivided into the Vassinskyi, Glubokinskyi and Solominskyi horizons. The Vassinskyi Horizon contains the conodont assemblage including the following species: *Polygnathus webbi* STAUFFER, *P. alatus* HUDDLE, *P. decorosus* STAUFFER, *P. aequalis* KLAPPER *et* LANE, *P.* aff. *angustidiscus* YOUNGQUIST, *Ancyrodella lobata* BRANSON *et* MEHL, *Icriodus expansus* BRANSON *et* MEHL, *I. brevis angustulus* SEDDON, *I. subterminus* YOUNGQUIST, and others. This horizon can be confined to the interval of the falsiovalis – hassi – jamieae zones. In the limestones of the Glubokinskyi horizon (Izvestkoviy Zavod section) follows conodonts were found: *Polygnathus* ex gr. *brevilaminus* BRANSON *et* MEHL, *P. alatus* HUDDLE, *P. foliatus* BRYANT, *Ancyrodella nodosa* ULRICH *et* BASSLER, *Icriodus symmetricus* BRANSON *et* MEHL, *I. brevis angustulus* SEDDON, allowing to position the horizon to the interval of the hassi – jamieae zones. The Solominskyi Horizon contains the conodont assemblage composed of *Polygnathus decorosus* STAUFFER, *P. evidens* KLAPPER *et* LANE, *P.* cf. *normalis* MILLER *et* YOUNGQUIST, *P. webbi* STAUFFER, *Ozarkodina gradata* YOUNGQUIST and others is confined to the interval of the rhenana – linguiformis conodont zones (RODYGIN 2011, 2014).

In the Famennian Stage (northern margin of the Kuzbass) the Kosoutesovskyi, Mitikhinskyi, Podoninskyi and Topkinskyi horizons are established. The conodont assemblage distinguished in the Kosoutesovskyi Horizon includes *Palmatolepis triangularis* SANNEMANN, *Pa. minuta minuta* BRANSON *et* MEHL, *Pa. subperlobata* BRANSON *et* MEHL, *Pa. delicatula delicatula* MILLER *et* YOUNGQUIST, *Pa.* aff. *quadrantinodosalobata* SANNEMANN, *Polygnathus brevilaminus* BRANSON *et* MEHL, *P. politus* OVNATANOVA, *P.* aff. *xylus* STAUFFER, *Icriodus iowaensis ancylus* YOUNGQUIST *et* PETERSON, *I.* cf. *subterminus* YOUNGQUIST, *I. alternatus* BRANSON *et* MEHL, *I. cornutus* SANNEMANN, etc. This assemblage is indicative of the possibility to confine this horizon to the interval of the conodont triangularis – trachytera zones. There is very small conodont assemblage in the Mitikhinskyi Horizon deposits. Only quite recently some conodonts were collected from the Mitikhinskyi Horizon stratotype and Glubokaya River section, but their study yet will be implemented. The Podoninskyi Horizon contains the conodont complex (J.M. Gutak's sampling) composed of *Polygnathus delicatulus* ULRICH *et* BASSLER, *P. inornatus* E.R. BRANSON, *Siphonodella praesulcata* SANDBERG, and some others, which is characteristic for the praesulcata zones of the uppermost Famennian. In the limestones of the Topkinskyi Horizon the following conodonts are distinguished (Plate 1): *Polygnathus* aff. *parapetus* DRUCE, *Neopolygnathus lectus* KONONOVA, *Polygnathus inornatus* E.R. BRANSON, *Icriodus costatus costatus* (THOMAS), *Icriodus costatus darbyensis* KLAPPER Morphotype 2, *Pseudopolygnathus primus* BRANSON *et* MEHL; *Mehlina strigosa* (BRANSON *et* MEHL). They are widely occurring in the expansa and praesulcata zones of the uppermost Devonian (GUTAK *et al*. 2004; 2007; GUTAK & RODYGIN 2011; RODYGIN 2011, 2014).

Consequently, the deposits of the northern margin of the Kuznetsk Basin represent the section that is almost continuously characterized by conodonts and confidently comparable with the Standard Conodont Zones Scale.

Discussion

B. KRSTIĆ and M. SUDAR during 1989–1994 made efforts on the conodonts study of the Devonian in Eastern Serbia. These researchers had complexes similar to those that we have been identified in Kuzbass. This is particularly important, given that both regions have quite different geological history (KRSTIĆ & SUDAR 1989, 1990a, b, 1991, 1992, 1993, 1994).

For example, the conodont complex found in the location of Donja Nevlja: *Polygnathus linguiformis linguiformis* gamma Morphotype Bultynck, *P. pseudofoliatus* WITTEKINDT, *P. varcus* STAUFFER, *P. xylus xylus* STAUFFER is typical for Givetian Lower varcus zone (KRSTIĆ & SUDAR, 1990b), connecting these beds with the Mazalovsko-Kitatskaya formation developed on the river Mazalovskyi Kitat near the town of Anzhero-Sudzhensk (RODYGIN, 2014).

In the south-eastern Serbia, near the spa Zvonačka Banja in a small interlayer of dolomitic limestone among clastic rocks, quite a rich conodont complex was found: *Palmatolepis gigas* MILLER *et* YOUNG-

QUIST, *Pa. semichatovae* OVNATANOVA, *Pa. subrecta* MILLER *et* YOUNGQUIST, *Pa. linguiformis* MÜLLER, *Ancyrodella lobata* BRANSON *et* MEHL, *Anc. curvata* (BRANSON *et* MEHL), *Anc. nodosa* ULRICH *et* BASSLER, *Polygnathus decorosus* STAUFFER, *P. webbi* STAUFFER, *Icriodus alternatus* BRANSON *et* MEHL. These conodonts occur together at the top of the Frasnian, gigas (rhenana) – linguiformis zone (KRSTIĆ & SUDAR, 1989). In Devonian of the Kuznetsk Basin margins similar complex conodonts was established on the top of Vassinskyi and Solominskyi horizons.

In the Rtanj Mts., southern Srpska Kosa, such conodonts are present: *Icriodus alternatus alternatus* BRANSON *et* MEHL, *I. alternatus helmsi* SANDBERG *et* DREESEN, *Palmatolepis crepida* SANNEMANN, *Pa. minuta loba* HELMS, *Pa. quadrantinodosalobata* SANNEMANN, *Pa. subperlobata subperlobata* BRANSON *et* MEHL, *Polygnathus brevilaminus* BRANSON *et* MEHL etc. They are of the crepida zone characteristic (KRSTIĆ & SUDAR, 1990b). Towards the bottom of the same zone treat conodonts from the vicinity of the village Miljkovac: *Icriodus alternatus alternatus* BRANSON *et* MEHL, *Palmatolepis triangularis* SANNEMANN, *Pa. quadrantinodosaloba-ta* SANNEMANN (KRSTIĆ & SUDAR, 1993). These conodonts bring enclosing beds together with Kosoutesovskyi horizon on the Kuzbass margins (Tom' River).

Variety of conodonts were extracted from olistoliths of Kučaj-Zvonce flysch near Gornja Studena on Suva Planina (KRSTIĆ & SUDAR, 1991). Among them there are Famennian conodonts: *Polygnathus inornatus* E.R. BRANSON, *P. communis communis* BRANSON *et* MEHL, *Mehlina strigosa* (BRANSON *et* MEHL) etc., which resemble conodont complexes of expansa and praesulcata zones of Podoninskyi and Topkinskyi horizons in Kuzbass (RODYGIN, 2014).

Conclusions

Eastern Serbia and Kuznetsk Basin with their margins both have different geological structure and history. Devonian terrigenous-carbonate deposits on Kuzbass margins were mainly deposited in shallow marine conditions, with often reef constructions, brachiopod banks and rich benthic fauna. Along Devonian sections near the town of Anzhero-Sudzhensk, rivers Yaya and Tom, representative conodont complexes were collected and standard conodont zones of Middle and Upper Devonian and regional stratigraphic horizons were established. But in the north-western margins of Kuzbass a complete stratigraphic Devonian succession was not preserved. In the absence of zonal conodont species, the age was sometimes determined on benthic fauna (RODYGIN 2011, 2014). In the Eastern Serbia the Devonian sediments are preserved in separate tectonic blocks. There are both autochthonous and allochthonous blocks. From rare limestone beds the representative collection of conodonts containing many zonal species was obtained (KRSTIĆ & SUDAR, 1995; RODYGIN, 2014). Standard conodont zones were established for the Devonian beds of Eastern Serbia. Conodonts have high correlation potential, whereby the opportunity to compare the Devonian of Eastern Serbia with many regions around the world, in particular, with the margins of the Kuznetsk Basin in southern Siberia, where similar conodont complexes were also found and the standard conodont zones were established.

Acknowledgement

I thank you YAROSLAV GUTAK, IVAN DULIC, RADMILO JOVANOVIC, MILAN SUDAR, NENAD BANJAC and all Serbian friends – companions on a trip to eastern Serbia in August 2005. I am grateful to Dr. Mu. RAMKUMAR and Dr. HAYLAY Tsegab Gebretsadik for their help in preparing the manuscript for publication.

References

AKSENOVA, L.M., RODYGIN, S.A. & HALYMBADZHA, V.G. 1994. Conodonts of the Middle-Upper Devonian boundary deposits on the northern margin of the Kuzbass. *Geological Matters of Siberia*, 2: 320–337. (in Russian).

BECKER, R.T., GRADSTEIN, F.M. & HAMMER, O. 2012. The Devonian Period. *In*: GRADSTEIN, F.M., OGG, J.G., SCHMITZ, M.D. & OGG, G.M. (Eds.), *The Geologic Time Scale*. 559–601.

ĆIRIĆ, B. 1996. Geology of Serbia. Geokarta, Belgrade, 273 p. (in Serbian).

GUTAK, YA. M. & RODYGIN, S.A. 2004. Conodonts, Brachiopods and the Stratigraphy of the Middle-Upper Devonian Boundary Deposits of the Altay-Sayan Folded Area (Russia). *Bulletin de l'Academie Serbe des sciences et des arts*, *Classe des sciences mathematiques et naturelles*, T. CXXVIII*,* Sciences naturelles, 42: 131–138.

GUTAK, YA.M., RODYGIN, S.A. & TOLOKONNIKOVA, Z.A. 2007. The Carboniferous Lower Boundary in the western part of the Altay-Sayan Folded Area. Upper Palaeozoic in Russia: Stratigraphy and Palaeogeography. Kazan' Univ. Press., 94–97. (in Russian).

GUTAK, YA.M. & RODYGIN, S.A. 2011. Late Famennian shallow conodonts of the Kuznetsky Basin. *Proceeding of the Sixth International Conference "Environmental Micropaleontology, Microbiology and Meiobenthology",* Russia, Moscow, September 19-22., Moscow: PIN RAS, 116–117.

KRSTIĆ, B. & SUDAR, M. 1989. Paleozojski konodonti istočne Srbije, Jugoslavija, I. Konodonti franskog kata iz okoline Zvonačke banje. *Geološki anali Balkanskoga poluostrva*, 53: 305–318. (in Serbian).

KRSTIĆ, B. & SUDAR, M. 1990a. Paleozojski konodonti istočne Srbije, Jugoslavija, II. Konodonti gornjeg silura – ladlovskog kata Kucajskih planina (Paleozoic conodonts of Eastern Serbia, Yugoslavia, II. Conodonts of the Upper Silurian, Ludlovian of Kucaj Mts.). *Geološki anali Balkanskoga poluostrva* 54: 237–258.

Krstić, B. & Sudar, M. 1990b. Paleozojski konodonti istocne Srbije, Jugoslavija, III. *Radovi Geoinstituta*, 24: 193–211. (in Serbian).

Krstić, B. & Sudar, M. 1991. Paleozojski konodonti istocne Srbije, Jugoslavija, IV. Gornjodevonski (famenski) i donjokarbonski (turneski) konodonti iz olistostroma Suve planine (Paleozoic conodonts of Eastern Serbia, Yugoslavia, IV. Upper Devonian (Famennian) and Lower Carboniferous (Tournaisian) Conodonts from Olistostromes of Suva Planina). *Geološki anali Balkanskoga poluostrva*, 55/1: 131–162.

Krstić, B. & Sudar, M. 1992. Paleozojski konodonti istocne Srbije, Jugoslavija, V. (Paleozoic conodonts of Eastern Serbia, Yugoslavia, V). – Ibid., 56/1, Beograd, 185-210.

Krstić, B. & Sudar, M. 1993. Paleozojski konodonti istocne Srbije, Jugoslavija, VI. (Paleozoic conodonts of Eastern Serbia, Yugoslavia, VI). *Geološki anali Balkanskoga poluostrva*, 57/1: 139–158.

Krstić, B. & Sudar, M. 1994. Paleozojski konodonti istocne Srbije, Jugoslavija, VII. (Paleozoic conodonts of Eastern Serbia, Yugoslavia, VII). *Geološki anali Balkanskoga poluostrva*, 58/1: 139–148.

Krstić, B., Maslarević, Lj., Ercegovac, M., Sudar, M. & Djajić, S. 2004. Devonian in the Carpatho-Balkanides of Eastern Serbia. *Bulletin de l'Academie Serbe des sciences et des arts, Classe des sciences mathematiques et naturelles*, T. CXXVIII, Sciences naturelles, 42: 7–16.

Rodygin, S.A. 2011. Conodonts in Middle and Upper Devonian sections from the Kuznetsk Basin margins. Biostratigraphy, paleogeography and events in Devonian and Lower Carboniferous (SDS – IGCP 596 joint field meeting): Contributions of International Conference in memory of Evgeny A. Yolkin. Ufa, Novosibirsk, July 20 – August 10, 2011., Novosibirsk: Publishing House of SB RAS., 139–140.

Rodygin, S.A. 2014. Conodonts as an instrument of global correlation by the example of southern Siberia (Russia) and eastern Serbia. Optimal research and sustainable usage of the geological resources: Proceedings of the XVI Serbian Geological Congress (Donji Milanovac, 22-25.05.2014). – Belgrade: Serbian Geological Society. 135–139.

Type sections of the boundary Middle and Upper Devonian beds, Frasnian and Famennian Stages of the Kuznetsk Basin's margins. 1992. Edited by V.I. Krasnov & M.A. Rzhonsnitskaya. – Novosibirsk: SNIIGGiMS. – 136 p. (In Russian)

Резиме

Улога конодоната у глобалној стратиграфској корелацији на примеру јужног Сибира (Русија) и источне Србије

Стандардне конодонтске зоне засноване су на еволуционом развоју дубоководних конодоната. Ове зоне представљају стандард за све девонске границе. Према новијим подацима неке већ познате зоне су подељене у неколико нових зона. Сваки специјалиста који проучава конодонте покушава да их употреби за међурегионалну и глобалну корелацију слојева. Девонска подела јужног Сибира и источне Србије може да буде пример такве корелације.

Аутор је пре десет година, током геолошке екскурзије у источној Србији приметио да је геологија ових простора веома различита од геологије јужног Сибира. Источна Србија представља јужни крај Карпатске наборне области (Карпато-Балканиди). Средње палеозојске карбонатне и теригене стене биле су изложене учесталим тектонским покретима. Навлаке, олистолити и олистостроме су широко распрострањени. Средњопалеозојски седименти, укључујући и девонске, налазе се унутар издвојених мањих тектонских блокова.

За време тектонске и магматске активности херцинске фазе у западном делу Алтаи – Саиан наборне области средњопалеозојски седимети су подвргнути набирањима и орогену, али након тога у овој области доминирају континентални услови. Кузњетски басен је међупланинска депресија која је у средишњим деловима запуњена угљоносним карбонским и пермским седиментима. Девонски седименти су добро развијени у ободним деловима Кузбаса. Изданци су изграђени од теригених и карбонатних стена, углавном плитководних, са богатом асоцијацијом бентонске фауне у којој преовлађују брахиоподи, корали (Rugosa и Tabulata) и строматопориди.

Живетски седименти који изграђују Мазаловско-Китатски хоризонт су подељени у следеће формације: Мазаловско-Китатска, Сибирско-Лебедианска и Изилинска. Мазаловско-Китатска формација садржи конодонте: *Polygnathus timorensis* Klapper, Philip *et* Jackson, *Icriodus obliquimarginatus* Bischoff *et* Ziegler, *I. brevis* Stauffer и др. (доња varcus конодонтна зона). У Сибирско-Лебедианска формацији од конодоната се јављају: *Polygnathus ansatus* Ziegler *et* Klapper, *P. timorensis* Klapper, Philip *et* Jackson, *P. ovatinodosus* Ziegler *et* Klapper, *P. varcus* Stauffer, *Icriodus brevis* Stauffer (средњи и горњи део varcus зона). Изилинска формација садржи: *Polygnathus* cf. *webbi* Stauffer, *P. dubius* Hinde, *Icriodus brevis* Stauffer, *I. difficilis* Ziegler *et* Klapper, *I. expansus* Branson et Mehl etc. (доњи део falsiovalis (norrisi) зоне).

Фразниан Кузбаса је подељен на Васински, Глубокински и Соломински хоризонт. Васински хоризонт садржи конодонтску заједницу: *Polygnathus webbi* Stauffer, *P. alatus* Huddle, *P. decorosus* Stauffer, *P. aequalis* Klapper *et* Lane, *Ancyrodella lobata* Branson *et* Mehl, *Icriodus expansus* Branson *et* Mehl, *I. brevis angustulus* Seddon, *I. subterminus* Youngquist и др. (falsiovalis – hassi – jamieae зоне). Глубокински хоризонт садржи сле-

ђе конодонте: *Polygnathus* ex gr. *brevilaminus* BRANSON *et* MEHL, *P. alatus* HUDDLE, *P. foliatus* BRYANT, *Ancyrodella nodosa* ULRICH *et* BASSLER, *Icriodus symmetricus* BRANSON *et* MEHL, *I. brevis angustulus* SEDDON (hassi – jamieae зоне). Соломински хоризонт садржи: *Polygnathus decorosus* STAUFFER, *P. evidens* KLAPPER *et* LANE, *P. webbi* STAUFFER, *Ozarkodina gradata* YOUNGQUIST и др. (rhenana – linguiformis конодонтске зоне).

У фамениану су успостављени Косоутесовски, Митихински, Подонински и Топкински хоризонти. Конодонтску заједницу Косоутесовског хоризонта чине: *Palmatolepis triangularis* SANNEMANN, *Pa. minuta minuta* BRANSON *et* MEHL, *Pa. subperlobata* BRANSON *et* MEHL, *Pa. delicatula delicatula* MILLER *et* YOUNGQUIST, *Pa.* aff. *quadrantinodosalobata* SANNEMANN, *Polygnathus brevilaminus* BRANSON *et* MEHL, *P. politus* OVNATANOVA, *Icriodus iowaensis ancylus* YOUNGQUIST *et* PETERSON, *I. alternatus* BRANSON *et* MEHL, *I. cornutus* SANNEMANN и др. (triangularis – trachytera зоне). Подонински хоризонт садржи: *Polygnathus delicatulus* ULRICH *et* BASSLER, *P. inornatus* E.R. BRANSON, *Siphonodella praesulcata* SANDBERG и др. (praesulcata зона највишег фамениана). У Топкинском хоризонту срећу се: *Polygnathus* aff. *parapetus* DRUCE, *Neopolygnathus lectus* KONONOVA, *Polygnathus inornatus* E.R. BRANSON, *Icriodus costatus costatus* (THOMAS), *Icriodus costatus darbyensis* KLAPPER Morph. 2, *Pseudopolygnathus primus* BRANSON *et* MEHL; *Mehlina strigosa* (BRANSON *et* MEHL). Ове врсте су широко распрострањени у ehpansa и praesulcata зонама највишег девона.

Б. КРСТИЋ & М. СУДАР (1989–1994) су детаљно проучавали девонске конодонте источне Србије. Поменути истраживачи су издвојили јединице сличне онима које су утврђене у Кузбасу.

На пример, конодонтска асоцијација нађена у локалитету Доња Невља садржи: *Polygnathus linguiformis linguiformis* gamma morph. BULTYNCK, *P. pseudofoliatus* WITTEKINDT, *P. varcus* STAUFFER, *P. xylus xylus* STAUFFER (доња varcus зоне), повезује ове слојеве са Мазаловско-Китатском формацијом.

У југоисточној Србији, у близини Звоначке Бање, у танким прослојцима доломитичних кречњака између кластичних стена нађена је богата конодонтска асоијацијација: *Palmatolepis gigas* MILLER *et* YOUNGQUIST, *Pa. semichatovae* OVNATANOVA, *Pa. subrecta* MILLER *et* YOUNGQUIST, *Pa. linguiformis* MÜLLER, *Ancyrodella lobata* BRANSON *et* MEHL, *Anc. curvata* (BRANSON *et* MEHL), *Anc. nodosa* ULRICH *et* BASSLER, *Polygnathus decorosus* STAUFFER, *P. webbi* STAUFFER, *Icriodus alternatus* BRANSON *et* MEHL (gigas (rhenana) – linguiformis зоне). Слична девонска асоцијација такође је нађена у ободу Кузњетског басена, при врху Васинског и Соломинског хоризонта.

На Ртњу, јужна Српска Коса, слична конодонтска асоцијација је представљена са: *Icriodus alternatus alternatus* BRANSON *et* MEHL, *I. alternatus helmsi* SANDBERG *et* DREESEN, *Palmatolepis crepida* SANNEMANN, *Pa. minuta loba* HELMS, *Pa. quadrantinodosalobata* SANNEMANN, *Pa. subperlobata subperlobata* BRANSON *et* MEHL, *Polygnathus brevilaminus* BRANSON *et* MEHL и др. Они имају карактеристике crepida зоне. Према бази исте зоне, у близини села Миљковац, одређени су: *Icriodus alternatus alternatus* BRANSON *et* MEHL, *Palmatolepis triangularis* SANNEMANN, *Pa. quadrantinodosalobata* SANNEMANN. Ови конодонти су такође нађени у Косоутесовском хоризонту Кузбаске маргине (река Томј).

Разноврсна конодонтска асоцијација је издвојена из олистолита Кучајско-звоначког флиша, близу Горње Студене на Сувој планини. Међу њима су фаменски конодонти: *Polygnathus inornatus* E.R. BRANSON, *P. communis communis* BRANSON *et* MEHL, *Mehlina strigosa* (BRANSON *et* MEHL) и др. који су блиски конодонтним комплексима expansa и praesulcata зона Подонинског и Топкинског хоризоната Кузбаса.

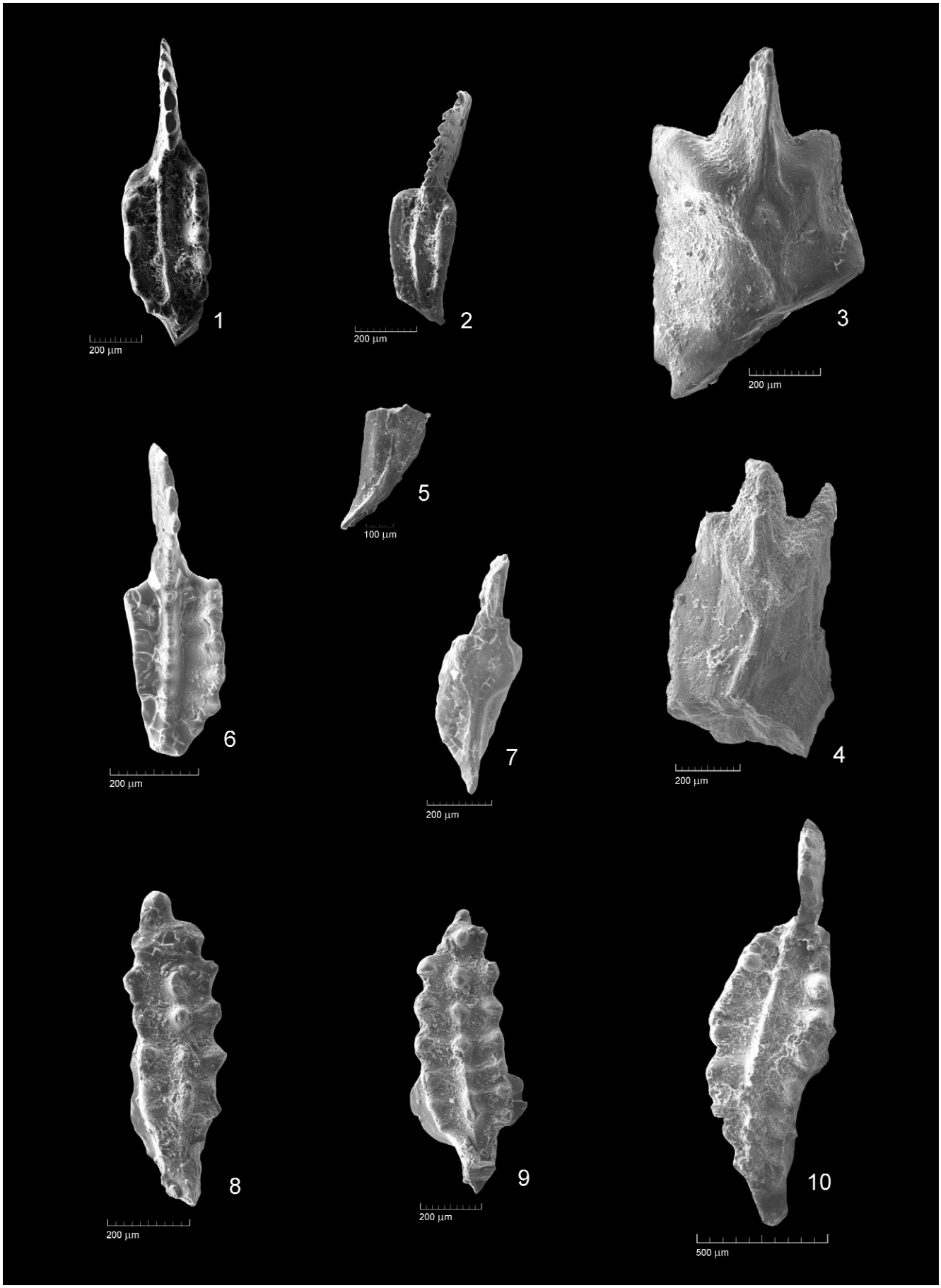
Конодонти пружају велику могућност за корелацију, девона источне Србије са многим регионима у свету а нарочито са ободом Кузњетског басена у јужном Сибиру где су такође пронађене сличне конодонтске асоцијације и установљене стандарне конодонтске зоне.

Б. Р.

PLATE 1.

Late Famennian Conodonts from Topkinskyi Horizon of the Kuznetsk Basin:
(see also GUTAK & RODYGIN, 2011). Sample G-08-46, Collection of TSU Paleontological Museum, No. 68:

Figs. 1, 6, 7. *Polygnathus* aff. *parapetus* DRUCE
Figs. 2, 5. *Neopolygnathus lectus* KONONOVA
Figs. 3, 4. *Polygnathus inornatus* E.R. BRANSON
Fig. 8. *Icriodus costatus costatus* (THOMAS)
Fig. 9. *Icriodus costatus darbyensis* KLAPPER, Morphotype 2
Fig. 10. *Pseudopolygnathus primus* BRANSON ET MEHL


1
200 µm
2
200 µm
3
200 µm
5
100 µm
6
200 µm
7
200 µm
4
200 µm
8
200 µm
9
200 µm
10
500 µm