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

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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, Siberia, Serbia.

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...
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 (ČIRIĆ 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).

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

Lower Devonian and Eifelian deposits are absent in this region. The Givetian deposits compose the Masalovsky-Kitatskoy Horizon subdivided into the Masalovsky-Kitatskoy, Siberian-Lebedyanskaia and formations. The Masalovsky-Kitatskoy 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-Lebedyanskaia Formation containing the Conodont species *Polygnathus ansatus* ZIEGLER et KLAPPER, *P. timorensis* KLAPPER, PHILIP et JACKSON, *P. ovatino nodosus* ZIEGLER et KLAPPER, *P. varcus* STAUFFER, *Icriodus brevis* STAUFFER, *Ozarkodina semial ternans* (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. decor osus* 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. decor osus* STAUFFER, *P. aequalis* KLAPPER et LANE, *P. aff. angustidiscus* YOUNGQUIST, *Ancy rodella 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 the expansa and praesulcata zones of the uppermost Famen nian. In the limestones of the Topkinskyi Horizon the following conodonts are distinguished (Plate 1): *Polygnathus aff. parapetus* DRUCE, Neopolygnathus lectus KONO NOVA, *Polygnathus inornatus* E.R. BRANSON, *Icriodus costatus costatus* (THOMAS), *Icriodus costatus darbyensis* KLAPPER Morphotype 2, *Pseudopoly gnathus 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 linguisformis linguisformis* gamma Morphotype Bultynck, *Pseudopolygnathus parapetus* DRUCE, *P. varcus* STAUFFER, *P. xylus* YOUNGQUIST is typical for Givetian Lower varcus zone (KRSTIĆ & SUDAR, 1990b), connecting these beds with the Mazalskovo-Kitatskaya formation developed on the river Mazalskovo 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: *Palmato lepis gigas* MILLER et YOUNG-
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 (Rodigin 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 (Kristić & Sudar, 1995; Rodigin, 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.

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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 процежава конодонте поштује 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 експузије у источној Србији приметио да је геолошка област различита од геолошке област конодоната. Средње палеозојске карбонатне и теригене стене биле су изложене учесталлим тектонским коретама. Навлаке, олистолити и олистостроме се широко распрострањују. Улога конодоната у глобалној корелацији на примеру јужног Сибира и источне Србије

Због супериорних сутрених анехонтских и магматских активности херцинске фазе у западном делу Алтаи – Сибирске плате област су подељена у неколико нових зона. Сваки специјалиста који процежава конодонте поштује да их употреби за међурегионалну и глобалну корелацију слојева.
деће конодонте: Polygnathus ex gr. brevilaminus Branson et Mehl, P. alatus Huddell, P. foliatus Bryant, Ancyrodella nodosa Ulrich et Bassler, Icriodus symmetricus Branson et Mehl, I. brevis angustulus Seddon (hassi – jamiaeae zone). Соломински хориzioni садржали: Polygnathus decoror us Stauffer, P. evidens Klapper et Lane, P. webbi Stauffer, Ozarkodina gradata Youngquist и dr. (rhenana – linguiformis конодонтске зоне).

У фаменинама су успостављени Косоутесовски, Митихински, Подонински и Топкински хоризонти. Конодонтску заједницу Косоутесовског хоризонта чине: Palmatelepis triangularis Sannemann, Pa. minuta minuta Branson et Mehl, Pa. subperlobata Branson et Mehl, Pa. delicatula delicatula Miller et Youngquist, Pa. aff. quadratinodosalobata Sannemann, Polygnathus brevilaminus Branson et Mehl, P. politus Ovnanova, Icriodus iowaensis ancyclus Youngquist et Peterson, I. alternatus Branson et Mehl, I. cornutus Sannemann и dr. (triangularis – trachytera zone). Подонински хоризонт садржава Polygnathus delicatula Ulrich et Bassler, P. inornatus E.R. Branson, Siphonodella praesulcata Sandberg и dr. (praesulcata zone највишег девона).

На Ртњу, јужна Српска Коса, слична конодонтска асоцијација је представљена са: Icriodus alternatus Branson et Mehl, I. alternatus helmsi Sandberg et Dreesen, Palmatelepis crepida Sannemann, Pa. minuta loba Helms, Pa. quadratinodosalobata Sannemann, Pa. subperlobata subperlobata Branson et Mehl, Polygnathus brevilaminus Branson et Mehl и dr. Они имају карактеристике crepida zone. Према бази исте zone, у близини села Миљковац, одређени су: Icriodus alternatus alternatus Branson et Mehl, Palmatelepis triangularis Sannemann, Pa. quadratinodosalobata Sannemann. Ови конодонти су такође нађени у Косоутесовском хоризонту Кузбасе маригене (река Том).

Разноврсна конодонтска асоцијација је извођена 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, Mehлина стригоса (Branson et Mehl). Ове врсте су широко растрепане у европским и раесулката зонама Њемачке и раесулката конодонтског комплекса Мохен Њемачкој, близу Угарске и Словачке. Њихова налазица обично се одржава из донолитних и аномалних локација југозападне Србије.

Б. Р. Крстић и М. Судар (1989–1994) су детаљно проучавали девонске конодонте највеће регионе у Југослави, с посебним акцентом на Северност Србију, Топкински хоризонт и Косоутесовски хоризонт. Највеће проналаска конодонтих стена нађена је у ријетко посјеченим локализатама Жеровица, Добасня и близу Горње Студене на Сувој планини. Многе зоне, укључујући и описано стендова на Непоњу, у југоисточној Србији, при воденим и близак конодонтским хоризонтима.

Б. Р.
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