

Usolka section (southern Urals, Russia): a potential candidate for GSSP to define the base of the Gzhelian Stage in the global chronostratigraphic scale

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Abstract

Conodont species *Streptognathodus simulator* Ellison, 1941 has been proposed recently to define the Kasimovian-Gzhelian boundary in the global chronostratigraphic scale. The species distributed globally and traditionally has been used as a marker of the base of the Gzhelian Stage in the type sections in Moscow Basin and Urals. Recent studies of conodont taxonomy and biostratigraphy in southern Urals have established the chronocline with ascendant and descendant to *Streptognathodus simulator* species. Usolka section proposed here as a potential candidate for the GSSP (Global Stratotype Section and Point) to define the global Gzhelian Stage at the FAD of the *Streptognathodus simulator* within the chronocline *Streptognathodus praenuntius* Chernykh, 2005 – *St. simulator* Ellison, 1941 – *St. auritus* Chernykh, 2005. The chronocline recovered within 2.7 m of beds 4 and 5 at the Usolka section, with all three species described and properly figured. No obvious interruptions in sedimentation are recorded within the Kasimovian-Gzhelian transition there. Several volcanic ash beds are present below and above the proposed boundary, making radiometric calibration highly possible in the near future. Mode of preservation of conodonts with a CAI of around 1.0–1.5 provides excellent basis for the geochemical studies. Accessibility presently is adequate, and this exposure will be improved and maintained permanently for interested scientists. Future access will be guaranteed by means of legislative action to create a scientific preserve.

Introduction

In the recent report of the Task Group to establish a Global Stratotype Section and Point (GSSP) at the Kasimovian–Gzhelian boundary (Villa and Task Group, 2005) and in a series of recent publications (Heckel et al., 2005; Chernykh, 2005; Menning et al., 2006; etc.), the conodont species *Streptognathodus simulator* Ellison, 1941 (regarded as *Idiognathodus* by some authors), has been proposed as the best index-fossil for the definition of the base of the global

Gzhelian Stage. This species was originally described from the Heebner Shale Member of the Oread Limestone (Ellison, 1941) in Midcontinent North America, and has been traditionally used as a marker for the boundary in the Moscow Basin (Barskov & Alekseev, 1979) and in the Urals (Chernykh & Reshetkova, 1987; Davydov & Popov, 1991; Chernykh, 2002). Therefore it easily can be adopted in the stratotype region as the event marker for the base of the global Gzhelian Stage. Heckel et al. (2005) have shown that this species is definitely global in

distribution. Moreover, the taxonomy of the species has been updated recently by Bar-rick et al. (2004), who recognize two separate species: *St. simulator* [sensu stricto], the concept of which is based on the holotype from Midcontinent Heebner Shale of the Oread cyclothem, and its potential ancestor *St. aff. simulator*, which occurs in the older Midcontinent Eudora Shale of the Stanton cyclothem and the Merriman-Upper Winchell cyclothem of Texas (Heckel et al., 2005). Current studies of upper Paleozoic stratigraphy and biostratigraphy in the Urals during the last few years (Chuvashov et al., 1990, 1993, 2002; Davydov & Popov, 1986; Leven & Davydov, 2001; Davydov & Leven, 2003) have established a refined biostratigraphic framework for this time interval and described several new conodont species (Chernykh, 2002, 2005). The latter publication establishes a chronocline of *Streptognathodus praenuntius* Chernykh, 2005 – *St. simulator* Ellison, 1941 – *St. auritus* Chernykh, 2005, which is recovered within 2.7 m of beds 4 and 5 at the Usolka section, with all three species described and properly figured. Besides biostratigraphy and sedimentology, comprehensive geochemical study has been done at Usolka section. Numerous and frequent volcanic ashes occur throughout succession in Usolka section (Davydov et al., 2002). One volcanic ash layer very close to the boundary has been dated just recently (Schmitz et al., 2006). There are several more ashes that potentially will precisely constrain proposed boundary in term of radiometric calibration. Strontium study from conodonts also has been performed in Usolka section (Needham et al., 2006). We are envisioning studying $\delta^{18}\text{O}$ isotopes from conodonts as well. We propose here the Usolka section as a potential candidate for establishing a GSSP for the base of the global Gzhelian Stage.

Material

The Usolka section is located approximately 120 km southeast of Ufa and about 60 km northeast of Sterlitamak on the northeastern margin of the city of Krasnousolsk, just north of the Usolka River across from the hot-springs resort, in the Bashkortostan Republic of Russia (Fig. 1). This section is exposed along the roadcut on the right bank of the Usolka River in the core of the meridionally striking Usolkian brachianticline.

The section occurs in the axial part of the Belsk depression in the relatively deeper-water portion of the Preuralian Foredeep, and therefore the sedimentary succession there is likely to be relatively undisturbed.

The section starts with dolomitic limestone with chert nodules and rare volcanic ash beds of the Zilim Formation, approximately 10–12 m thick, which is overlain across a covered interval by the predominantly mixed carbonate-siliciclastic succession of the Kurkin (or Kurortnaya) Formation (Fig. 2). During a 2001 field trip, we collected samples and recovered conodonts from volcanic ash near the top of the Zilim Formation. Conodonts there include typical Moscovian *Neognathodus* and are under current study. The measured thickness between the exposed top of the Zilim Formation and bed 1 of the Kurkin Formation in the section is approximately 5–6 meters.

The Kurkin Formation contains numerous micritic limestone beds and up to 50 volcanic ash layers (Fig. 2) more or less evenly distributed throughout the section (Davydov et al., 2002, 2003). More general information and details on the section can be obtained from several sources (Chuvashov et al., 1991, 1993; Chuvashov & Chernykh, 2002). Chernykh (2005) provided the most comprehensive record of conodont distribution in the section. Because of the undisturbed sedimentary record and abundance of conodonts in the section, higher parts of the Usolka section were proposed as an auxiliary section for the Carboniferous-Permian boundary (Chuvashov et al., 2002), and as a candidate for the GSSP for the base of the Sakmarian Stage (Wardlaw et al., 1999).

The lithology of the Kasimovian-Gzhelian transition is not yet described in great detail, but we plan to re-measure and re-study it in the near future. Our plan is to collect additional conodont samples at a centimeter scale along with samples for fusulinids, smaller foraminifers, and volcanic ash beds where the lithology is appropriate. Below is the latest available description of the Kasimovian-Gzhelian transition (Chuvashov & Chernykh, 2002), in ascending order of numbered beds (with thicknesses based on Fig. 2):

1. Thin-bedded, slightly silicified dark-grey to black siltstone with bioclastic debris in the uppermost part. acritarchs and palinospores are found in siltstone 1.1 m

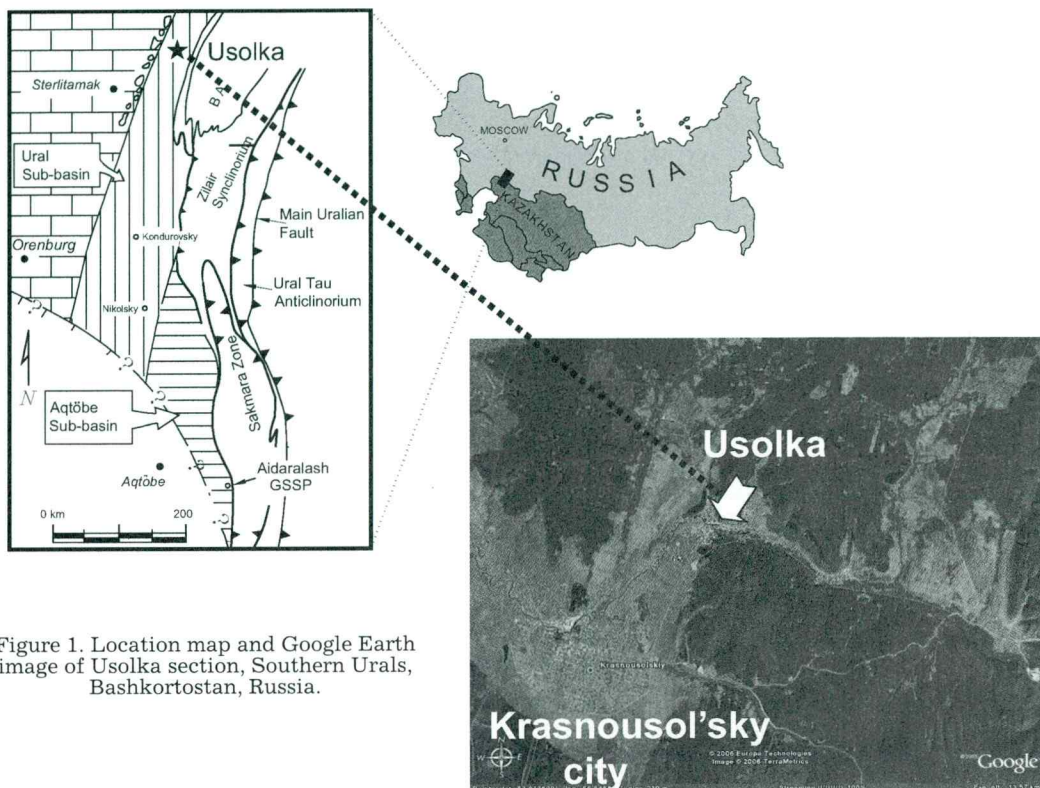


Figure 1. Location map and Google Earth image of Usolka section, Southern Urals, Bashkortostan, Russia.

2. Bluish-grey micritic limestone, strongly silicified in the lower 10–12 centimeters. One orange-yellow volcanic ash layer has been found in this bed. In the middle of the bed, a lens of packstone to grainstone limestone contains smaller foraminifers, rugose corals, brachiopods, crinoids and conodonts *Idiognathodus delicatus* Gunnell, *Id. sagittalis* Kozitskaya, *Id. tersus* Ellison, *Streptognathodus cancellosus* (Gunnell), *Gondolella sinuata* Gunnell, *G. merrilli* Gunnell 0.4 m
3. Bluish-grey, strongly silicified, medium to thin-bedded (5–20 cm), slightly silty micritic limestone interbedded with grayish foliated, silicified siltstone. Two very thin (2–3 cm) orange-yellow volcanic ash layers occur within the lower third of this bed. In the uppermost part of the bed, a few very thin (1–2 cm) layers of packstone to micritic limestone occur. Packstone contains smaller foraminifers, brachiopods, crinoids and other bioclastic debris. Radiolaria and sponge spicules are

found in micritic layers. Conodonts *Idiognathodus delicatus* Gunnell, and *Id. tersus* Ellison are found in this bed 4.0 m

4. Alternations of dolomitic micrite and wackstone and siltstones. Wackstone layers are 0.18–0.3 m thick, dark-grey, with microgranular matrix. They contain smaller foraminifers, brachiopods, crinoids and conodonts. At the top of bed 4 relatively thick (0.7 m) layer of grayish packstone with small lenses of fine grainstone at its base (bed 4–1) occurs. Smaller foraminifers, fusulinids, brachiopods and rugose corals are found in this grainstone. The following species are identified among fusulinids: *Quasifusulina* ex gr. *longissima* (Moeller), *Pseudofusulinella minuta* (Grozdilova), *Ps. pulchra* (Rausser & Belyaev), *Schwageriniformis petchoricus brevis* (Rausser & Belyaev), *Sch. petchoricus varsanofievi* (Z. Mikhailova), *Sch. schwageriniformis mosquensis* (Rosovskaya), *Schwageriniformis baisunensis* (Bensh), *Schwagerinifor-*

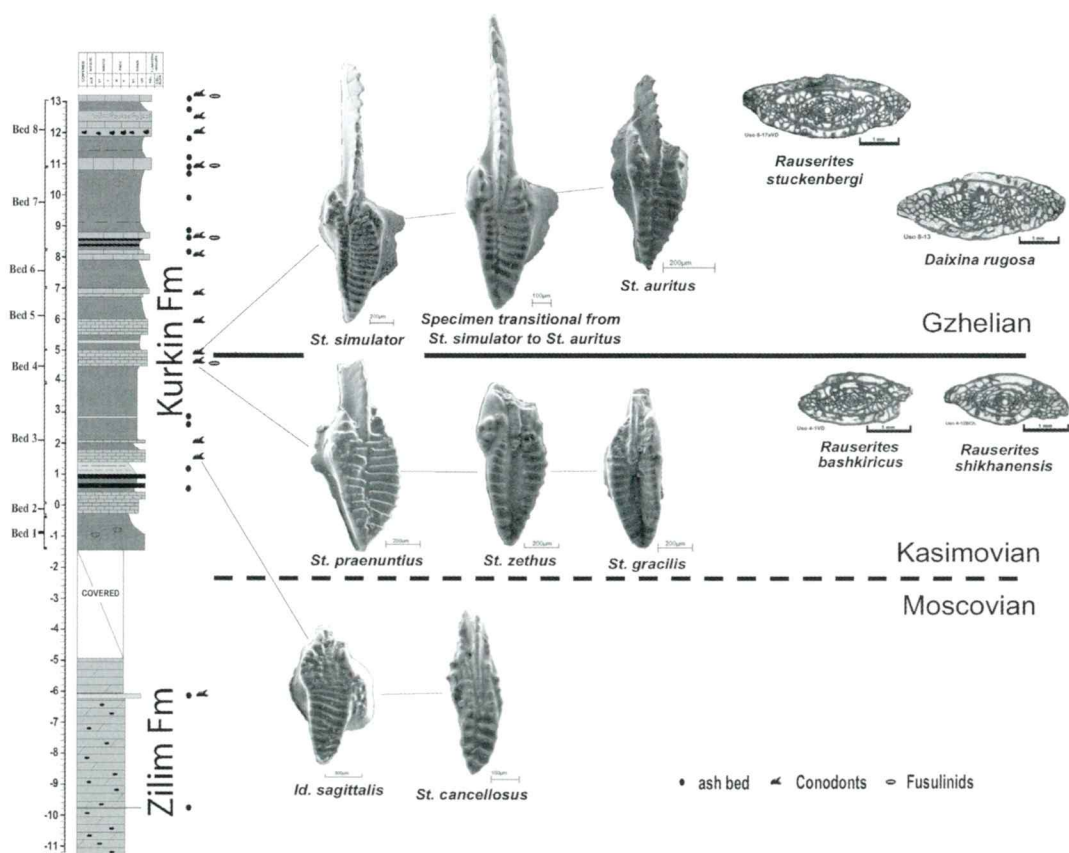


Figure 2. Distribution of conodonts and fusulinids within Kasimovian-Gzhelian transition in Usolka section. Bed boundaries are shown by thick marks across from bed numbers on line to left of metric scale.

mis (*Tumefactus*) sp., *Rauserites bashkiricus* (Rosovskaya), *R. shikhanensis compactus* (Rosovskaya), *Rauserites dictiophorus* (Rosovskaya). Conodonts in the lower part of this 0.7 m limestone layer are: *Streptognathodus firmus* Kozitskaya, *St. gracilis* Stauffer & Plummer, *St. zethus* Chernykh & Reshetkova, *St. pawhuskaensis* Harris & Hollingsworth, *St. praenuntius* Chernykh, *Gondolella merrilli* Gunnell, and some other conodonts that are undergoing study. 20 centimeters above, in bed 4–2 (Fig. 2), the assemblage of conodonts is more diverse and includes: *Streptognathodus elegantulus* (Stauffer & Plummer), *St. firmus* Kozitskaya 1978, *St. gracilis* Stauffer & Plummer, *St. makhlinae* Alekseev et Goreva, *St. simulator* Ellison, *St. dolioliformis* Chernykh 2005, *St. pic-*

tus Chernykh 2005, and *Id. undatus* Chernykh, 2005 1.1 m

5. Alteration of predominantly micritic limestone (0.05 to 0.2 m thick layers), with a few thin (0.1–0.2 m) siltstone layers. Micritic limestone contains conodonts *Idiognathodus lobulatus* Kozitskaya, *Id. brevisulcatus* Chernykh 2005, *Id. pictus* Chernykh 2005, *Streptognathodus luganicus* Kozitskaya, *St. pawhuskaensis* (Harris & Hollingsworth), *St. simulator* Ellison, *St. auritus* Chernykh 2005, and *Gondolella sublancoolata* Gunnell 2.1 m
6. Grey silicified siltstone and thin layers of micritic limestone. Three volcanic ash layers are found in the upper third of this bed 1.2 m
7. A band of silty brownish-grey, fine-grained dolomite with conchoidal cleavage (0.3 m thick) forms the bot-

tom of this bed; overlain by brownish-grey siltstone with numerous calcareous and phosphatic small concretions (3–5 cm) and one orange-yellow 3 cm thick ash layer. The upper part of the bed consists of grey dolomitized packstone with one ash layer near the top. The packstone contains smaller foraminifers, poorly preserved fusulinids, brachiopods, crinoids and conodonts. The latter are *Streptognathodus auritus* Chernykh, 2005, *St. elegantulus* (Stauffer & Plummer), *St. luganicus* Kozitskaya, *St. pawhuskaensis* (Harris & Hollingsworth), *St. simulator* Ellison, *Idiognathodus pictus* Chernykh, 2005 and *Id. sagittalis* Kozitskaya. The following species are found among fusulinids: *Pseudofusulinella eopulchra* (Rauser), *Ps. usvae* (Dutkevich), *Quasifusulina* cf. *elegantula* Schlykova, *Rauserites dictiophorus* (Rosovskaya), *R. shikhanensis* (Rosovskaya), *R. cf. cybea* (Putrja) 2.6 m

8. Alternation of dolomitic marl and grey foliated siltstone. A lens of graded grainstone occurs 10 cm above the base of the bed. Five volcanic ash layers are recognized within bed 8. The lower part of the grainstone contains fish remains, brachiopods, and diverse fusulinid and conodont assemblages. Conodonts: *Idiognathodus lobulatus* Kozitskaya, *Id. tersus* Ellison, *Streptognathodus simulator* Ellison, *St. eccentricus* Ellison, *St. pawhuskaensis* (Harris & Hollingsworth), *St. elegantulus* (Stauffer & Plummer), *St. insignitus* Akhmetshina. Fusulinids: *Quasifusulina eleganta* Schlykova, *Rauserites stuckenbergi* (Rauser), *R. petchoricus* (Rauser & Belyaev), *R. triangulus* (Rosovskaya), *R. elongatissimus* (Rosovskaya), *R. mogutovensis* Rosovskaya, *R. noinskyi* (Rauser), *R. tjanshanensis* (Bensh), *R. samaricus* (Rauser), *R. sphaericus* Rosovskaya, *R. variabilis* (Rosovskaya), *Schwageriniformis kurshabensis* (Bensh), *Sch. perstabilis* (Scherbovich), *Sch. baisunensis* (Bensh), *Sch. fusiformis* (Bensh), *Daixina rugosa* Rosovskaya 2.2 m.

Analysis

In the described succession (Fig. 2), bed 1 was not sampled for either conodonts or

foraminifers and therefore its age cannot be determined. However, because conodonts recovered 6 meters below the top of the Zilim Formation are Moscovian *Neognathodus*, bed 1 is in a transitional position between the Moscovian and Kasimovian stages. Beds 2 and 3 have yielded the typical Kasimovian conodonts *Id. sagittalis* Kozitskaya and *Streptognathodus cancellosus* (Gunnell), and thus belong to the Kasimovian Stage. Bed 3 was not properly sampled in the past, so we will re-sample it in greater detail. In the lower part of bed 4 (4–1) at 4.7 meters above the base of the section (mab), the conodont species are more advanced than in bed 3, with *St. zethus* Chernykh & Reshetkova and *St. pawhuskaensis* Harris & Hollingsworth, of which the former marks the base of the regional Virgilian Stage in North America (Heckel, 2004). The newly described species *St. praenuntius* Chernykh, 2005, which closely resembles *St. simulator*, also occurs in this level (Fig. 2). The fusulinid assemblage that is found at the same level is usually characteristic of the late Kasimovian, although some species range up into the early Gzhelian. In the upper part of bed 4 (4–2), starting from 4.9 mab, conodonts *St. elegantulus* and *St. simulator* occur. The latter species, as mentioned above, is the traditional index for determining the base of the Gzhelian Stage in the Moscow Basin and the Urals and is recently proposed index of the base of the global Gzhelian Stage (Heckel et al., 2005). Upwards, in bed 5 at 6.4 mab, the conodont assemblage is very similar to that from bed 4–2, except that new and more advanced forms that resemble *St. simulator* occur. These forms were recently described as a new species *St. auritus* Chernykh, 2005 (Figs. 2–3). No fusulinids were found in beds 5 or 6, and the fusulinids that were recovered from bed 7 (8.2 mab) are poorly preserved. In bed 8 (10.8 mab), the typical Gzhelian species *Rauserites stuckenbergi* and *Daixina rugosa* were recovered among other fusulinid species (Fig. 2).

Discussion

The traditional base of the Gzhelian in the Moscow Basin was proposed by Nikitin (1890) at the base of the Rusavkino unit in a limestone near Gzhel village that disconformably overlies the Troshkovo unit of the Kasimovian (Ivanova & Khvorova, 1955). Makhlina et al. (1979) recognized four sed-

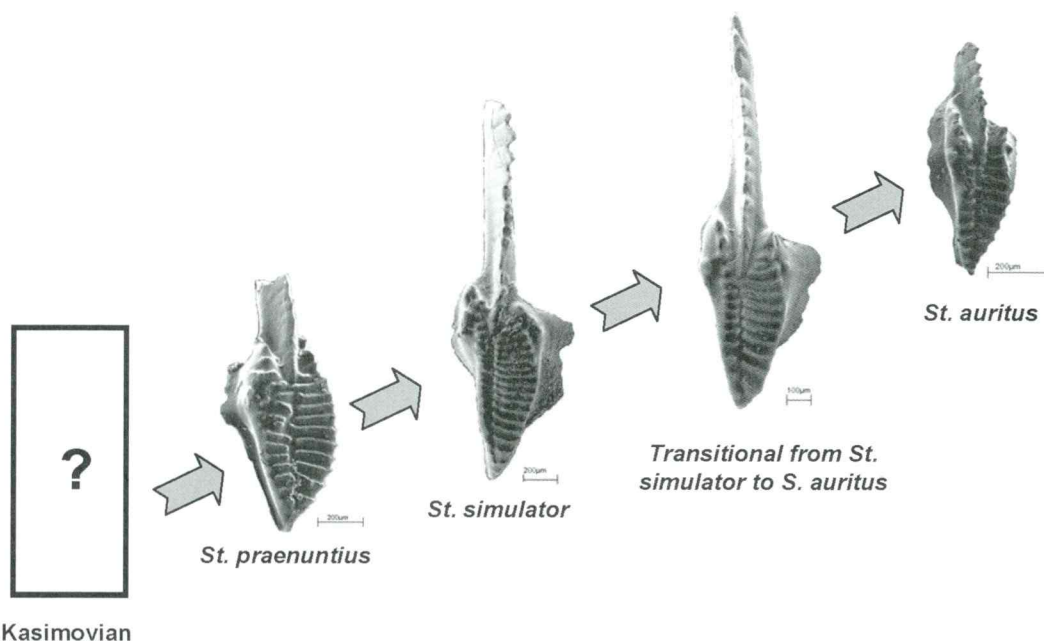


Figure 3. Evolutionary trend within the chronocline of *St. simulator* and related species.

imentary cycles within the Rusavkino. However, more recently the Rusavkino has been divided into three cycles: Lower, Middle, and Upper Rusavkino (Heckel et al., 2005). The conodonts *Streptognathodus zethus*, *St. firmus* and *St. pawhuskaensis* are reported in the Lower and Middle Rusavkino, and *Streptognathodus simulator* is added to this assemblage in the Upper Rusavkino. The younger Amerevo unit contains the conodonts *St. ruzhenzevi* and *St. vitali* (Heckel et al., 2005). No fusulinids were shown for the Lower and Middle Rusavkino (although the presence of fusulinids in the lowermost

Rusavkino was noted by Makhklina et al., 1979). *Rauserites rossicus* is recorded in the Upper Rusavkino, and *Rauserites stuckenbergi* in the Amerevo unit. Based on this observation, the FAD of *St. simulator* in the Usolka section at 4.9 mab corresponds to the Upper Rusavkino and the newly redefined base of the Gzhelian Stage.

In the Usolka section (Fig. 2) the FAD of *St. simulator* is recorded within the evolutionary morphocline (Fig. 3): *Streptognathodus praenuntius* – *St. simulator* – *St. auritus* within 2.7 m of beds 4 and 5. The undisturbed character of sedimentation in

Plate 1 (scale bar 300 microns)

Conodonts from uppermost part of the Kasimovian Stage, bed 4/1. IGG – Institute Geology and Geochemistry Uralian Branch of Russian Academy of Sciences, Ekaterinburg, Russia.

- 1, 2 *Idiognathodus sagittalis* Kozitskaya, 1978. 1 – IGG U12-6; 2 – IGG U12-21
- 3, 4 *Swadelina* sp. 3 – IGG U12-3; 4 – IGG U12-5, specimen with weakly developed median trough
- 5 *Streptognathodus cancellosus* Gunnell, 1933. IGG U12-27, juvenile form (Note that scale bar for this specimen slightly enlarged)
6. *Idiognathodus delicatus* Gunnell, 1931. IGG U12-18
- 7, 8 *Gondolella merrilli* Gunnell, 1933. 7 – IGG U12-12; 8 – IGG U12-20
- 9 *Streptognathodus gracilis* Stauffer et Plummer, 1933. IGG U12-16
- 10 *Streptognathodus pictus* Chernykh, 2005. IGG U15-35
- 11, 12 *Streptognathodus zethus* Chernykh et Reshetkova, 1987. 11 – IGG U15-20; 12 – IGG U15-30
- 13-15 *Streptognathodus praenuntius* Chernykh, 2005. 13 – U13-23; 14 – IGG U13-11; 15 – IGG U13-11; (note that scale bar for this specimen slightly reduced)



this interval and the data on conodont evolution suggest that there are no documented breaks in sedimentation during this transition, and allow the Usolka section to be considered as a candidate for the Global Stratotype Section and Point (GSSP) for the base of the Gzhelian Stage. *St. praenuntius* in the established chronocline possess strong similarity to *St. simulator*, but differs from the latter in a less eccentric and less well developed trough along the medial line of the platform element (Fig. 2). The phylogenetic evolutionary relation between *Streptognathodus praenuntius* and *St. simulator* is proposed because: (1) these two species appear in successive order, and (2) there are numerous transitional forms from an almost undeveloped and nearly symmetric trough (assigned to *St. praenuntius*) to those with the clear and well-developed trough that is significantly shifted toward one side of the platform (assigned to *St. simulator*). This trend indicates that *Streptognathodus praenuntius* is the most probable ancestor of *St. simulator*. A very similar trend in conodont evolution is observed in Midcontinent North America. “*Idiognathodus*” n. sp. aff. *Id. simulator* (Barrick et al., 2004, pl. 5, fig. 11) from the Eudora Shale (middle Stanton cyclothem) most probably belongs to *St. praenuntius* Chernykh. *St. simulator* there occurs in Heebner Shale of Oread Limestone (Oread-Heebner cyclothem). *Streptognathodus praenuntius* and *St. simulator* in North America occur in the same successive order as in the southern Urals. The next step in the evolutionary development of *Streptognathodus simulator* resulted in the appearance of *St. auritus* Chernykh, 2005 (Fig. 3). The latter species has a slightly eccentric trough similar to *St. simulator*, but also has small nodes on one (inner) or both sides of the platform.

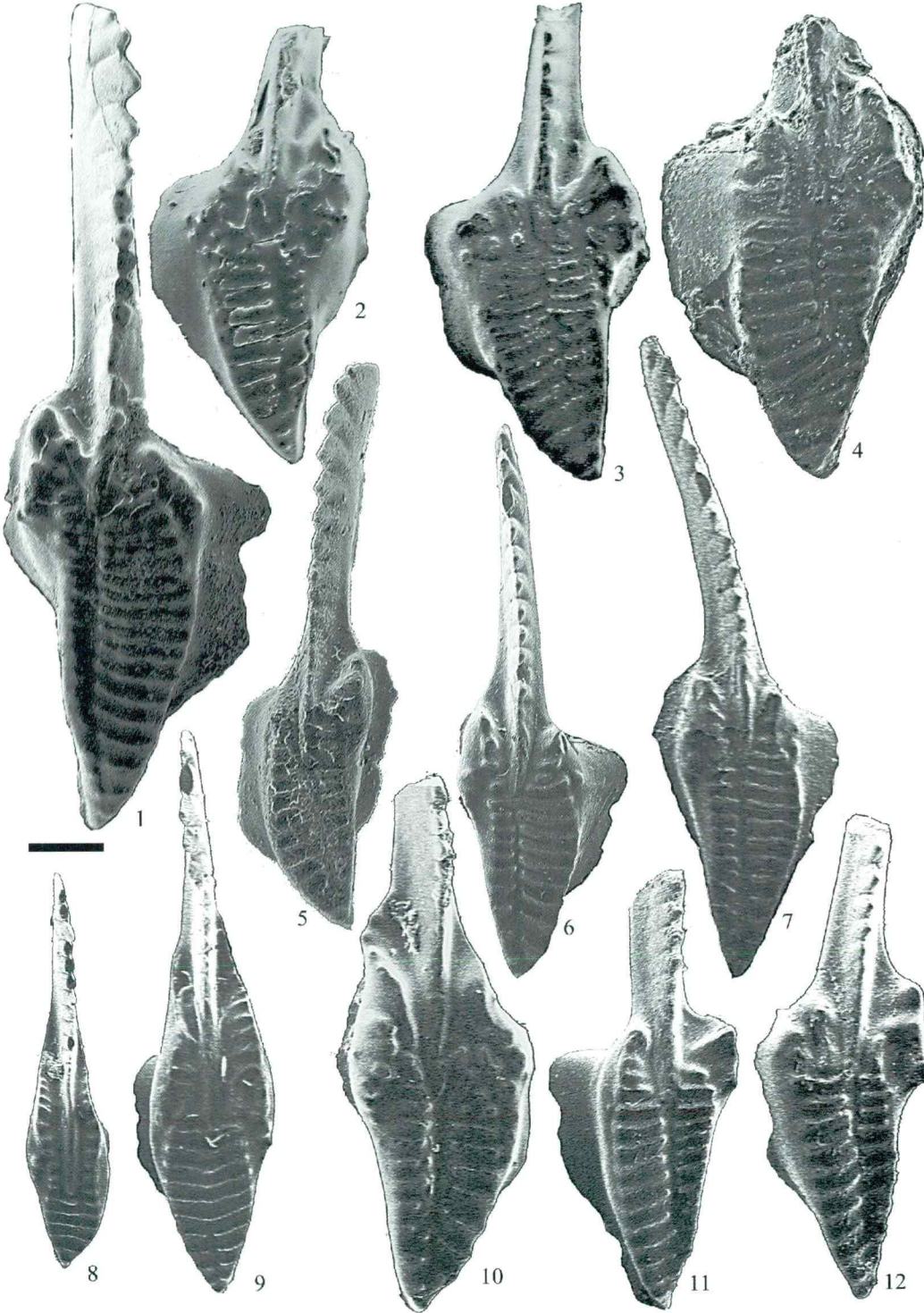
Conclusions

1. Although the proposed definition of the base of the global Gzhelian Stage, the FAD of *St. simulator* is slightly above its traditional position in the Moscow region, this does not affect regional and interregional stratigraphy and correlation, and therefore would be supported and accepted by the geologic communities.
2. The Usolka section is one of the best candidates so far known for the GSSP that will define the global Gzhelian, although additional study is still required. No obvious interruptions in sedimentation are recorded within the Kasimovian-Gzhelian transition there. The chronocline that defines the FAD of *St. simulator* is established within 20 cm of undisturbed sedimentary sequence. Several volcanic ash beds are present below and above the proposed boundary, making radiometric calibration highly possible in the near future (Schmitz et al., 2005).
3. The relatively deeper water facies and the mode of preservation of conodonts with a CAI of around 1.0–1.5 suggest that chemostratigraphic and paleomagnetic studies would be highly possible. The first steps in this direction, Sr isotope studies, are already in progress (Needham et al., 2006).
4. Accessibility presently is adequate, and we have an agreement with the Bashkirian Academy of Sciences via the Institute of Geology in Ufa, Bashkortostan, Russia, that this exposure will be improved and maintained permanently for interested scientists. Future access will be guaranteed by means of legislative action to create a scientific preserve.

Plate 2 (scale bar 200 microns)

Conodonts from lowermost part of the Gzhelian Stage, bed 4/2.

- 1–5 *Streptognathodus simulator* Ellison, 1941. 1 – IGG U1–5, right element; 2 – IGG U1–7, left element; 3 – IGG U1–8, left element; 4 – IGG U1–28, left element; 5 – IGG U1–6, juvenile right element.
- 6, 7 *Streptognathodus auritus* Chernykh, 2005. 6 – IGG U1–29, form transition from *S. simulator* Ellison to *S. auritus* Chernykh; 7 – holotype IGG 1–18.
- 8, 9 *Streptognathodus pictus* Chernykh, 2005. 8 – holotype IGG U14–32, right element; 9 – IGG U14–22, left element.
- 10 *Swadelina* sp., IGG U14–1.
- 11–12 *Streptognathodus sinistrum* Chernykh, 2005. 11 – IGG U1–11; 12 – holotype IGG U1–9.



5. A better relationship among conodont, fusulinid, and ammonoid biozonations and other fossil groups must still be worked out.

Acknowledgements

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Plate 3 (scale bar 10 mm; magnification for all figures x20, except 4, 15 and 17, that is x 15)

Figures 1–9: bed 4–1 (4.7 meters above the base of the section [mab])

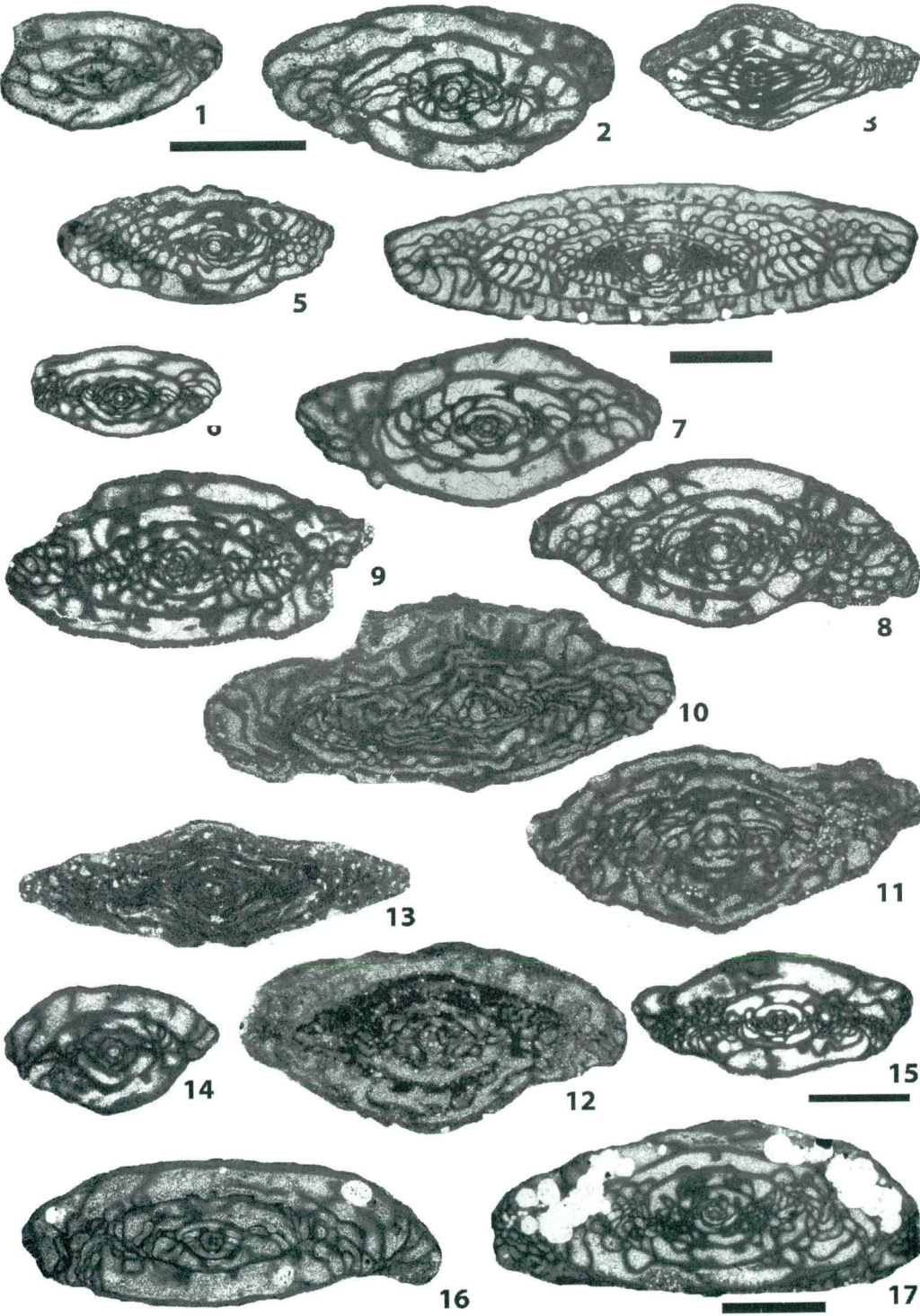
- 1 *Schwageriniformis (Tumefactus)?* sp.. USO–4–6BCh.
- 2, 7 *Schwageriniformis schwageriniformis mosquensis* (Rosovskaya). 2 – USO–4–11BCh; 7 – USO–4–4BCh.
- 3 *Pseudofusulinella pulchra* (Rauser–Chernousova). USO–4–5BCh.
- 4 *Quasifusulina brevis* Brazhnikova. USO–4–10BCh.
- 6 *Schwageriniformis baisunensis* (Bensh). USO–4–2BCh.
- 8 *Rauserites shikhanensis compactus* (Rosovskaya). USO–4–12BCh.
- 9 *Rauserites bashkiricus* (Rosovskaya). USO–4–1BCh.

Figures 10–13: bed 7 (8.2 mab)

- 10 *Rauserites shikhanensis* (Rosovskaya). USO–7–6aVD.
- 11 *Rauserites dictiophorus* (Rosovskaya). USO–7–6bVD.
- 12 *Rauserites cf. compactus* (Rosovskaya). USO–7–3VD.
- 13 *Pseudofusulinella usvae* (Dutkevitch). USO–7–2VD.

Figures 14–17: bed 8 (10.8 mab)

- 14 *Schwageriniformis* sp. 1. USO–8–17VD.
- 15, 17 *Schwageriniformis schwageriniformis mosquensis* (Rosovskaya). 15 – USO–8–12BCh; 17 – USO–8–29VD.
- 16 *Schwageriniformis kurshabensis* (Bensh). USO–8–3VD.



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Plate 4 (scale bars 10mm, magnification for all figures x 15, except 2 and 3 that are x 10)

All figures are from bed 8 (10.8 meters above the base of the section)

1 *Pseudofusulinella pulchra* (Rauser–Chernousova). USO–8–34BCh.

2, 3 *Quasifusulina eleganta* (Schlykova). 2 – USO–8–4BCh; 3 – USO–8–9VD.

4–5, 7 *Rauserites elongatissimus* (Rosovskaya). 4 – USO–8–22VD; 5 – USO–8–12VD; 7 – USO–8–4VD.

6 *Rauserites triangulus* (Rosovskaya). USO–8–2VD.

8 *Rauserites sphaericus* (Rosovskaya). USO–8–11VD.

9 *Rauserites samaricus* (Rauser–Chernousova). USO–8–10VD.

10 *Rauserites mogutovensis* Rosovskaya. USO–8–5VD.

11 *Rauserites tjanshanensis* (Besnh). USO–8–7VD.

12–14 *Rauserites stuckenbergi* (Rauser–Chernousova). 12 – USO–8–21BCh; 13 – USO–8–19BCh; 14 – USO–8–17BCh.

15 *Daixina rugosa* (Rosovskaya). USO–8–13VD.

