

# PALEONTOLOGICAL CHARACTERISTICS OF LATE PENNSYLVANIAN IN USOLKA SECTION

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The section is located on the left bank of Usolka River near resort of Krasnousolsk city (Bashkortostan). Moscovian through Artinskian carbonate-siliciclastic deep-water succession with frequent conodont horizons is exposed in the section. Turbiditic fusulinid horizons are rare. Section is previously published [Chuvashov et al., 1990, 1991, 1993; and other] and in this paper only measurements (meters above the base of the section) and beds are used. Thickness of these beds and position of the samples can be seen on the log (Figure).

**Bed 2** (1.2 m): *Idiognathodus* aff. *sagittalis* Kozitskaya, *Id. delicatus* Gunnell, *Id. tersus* Ellison, *Id. swadei* Barrick et Rosscoe, *Id. sulciferus sulciferus* Gunnell, *Streptognathodus cancellosus* (Gunnell), *Gondolella sinuata* Gunnell, *G. merrilli* Gunnell (Plate 1, 2).

**Bed 4/1** (4.7 m): *Streptognathodus firmus* Kozitskaya, *S. gracilis* Stauffer et Plummer, *S. zethus* Chernykh et Reshetkova, *S. pawhuskaensis* Harris et Hollingsworth, *S. praenuntius* Chernykh, *S. aff. pictus* Chernykh, *Idiognathodus* ex gr. *sulciferus* Gunnell, *Id. undatus* Chernykh, *Gondolella merrilli* Gunnell; **Fusulinids**: *Quasifusulina* ex gr. *longissima* (Moeller), *Pseudofusulinella minuta* (Grozdilova), *Ps. pulchra* (Rausser et Belyaev), *Schwageriniformis petchoricus brevis* (Rausser et Belyaev), *Sch. petchoricus varsanofieva* (Z. Mikhailova), *Sch. schwageriniformis mossquensis* (Rosovskaya), *Sch. baisunensis* (Bensh), *Sch. (Tumefactus)* sp., *Rausserites bashkiricus* (Rosovskaya), *R. shikhanensis compactus* (Rosovskaya), *R. dictiophorus* (Rosovskaya).

**Bed 4/2** (4.9 m): *Streptognathodus firmus* Kozitskaya, *S. elegantulus* Stauffer et Plummer, *S. gracilis* Stauffer et Plummer, *S. pictus* Chernykh, *S. makhlinae* Alekseev et Goreva, *S. simulator* Ellison, *S. sinistrum* Chernykh, *S. auritus* Chernykh, *S. pawhuskaensis* Harris et Hollingsworth, *Idiognathodus dolioliformis* Chernykh, *Id. n. sp. 2*.

**Bed 5/1** (6.4 m): *Streptognathodus firmus* Kozitskaya, *S. auritus* Chernykh, *S. pawhuskaensis* Harris et Hollingsworth, *S. luganicus* Kozitskaya, *S. aff. luganicus* Kozitskaya, *S. sinistrum* Chernykh, *S. aff. simulator* Ellison, *Gondolella sublanceolata* Gunnell.

**Bed 7/1** (11.0 m): *Streptognathodus luganicus* Kozitskaya, *S. pawhuskaensis* Harris et Hollingsworth, *S. pictus* Chernykh, *S. aff. simulator* Ellison, *Idiognathodus* ex gr. *sagittalis* Kozitskaya. **Fusulinids (8.2 mab)**: *Pseudofusulinella eopulchra* (Raus.), *Ps. usvae* (Dutk.), *Quasifusulina* cf. *eleganta* Schlyk., *Rausserites compactus*

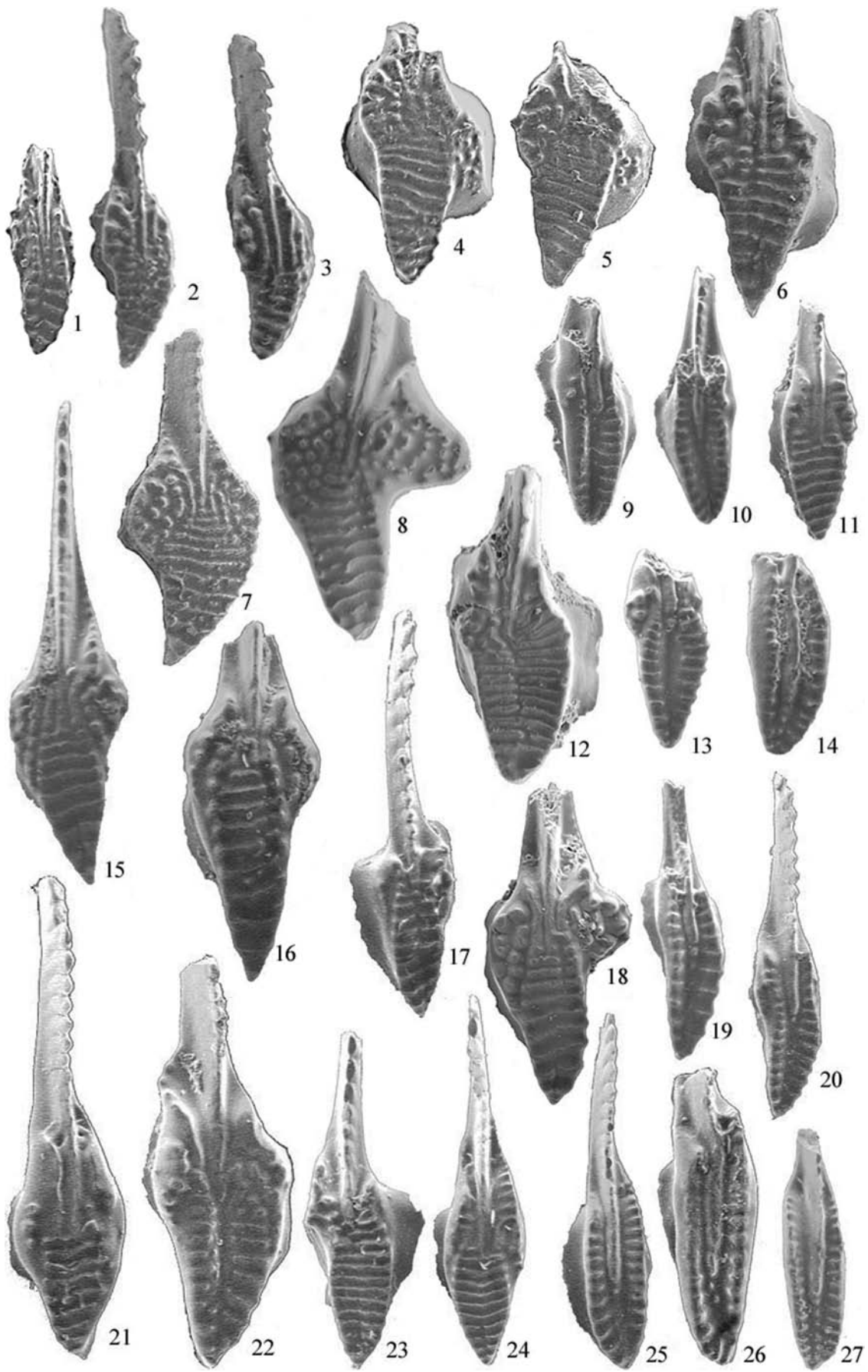
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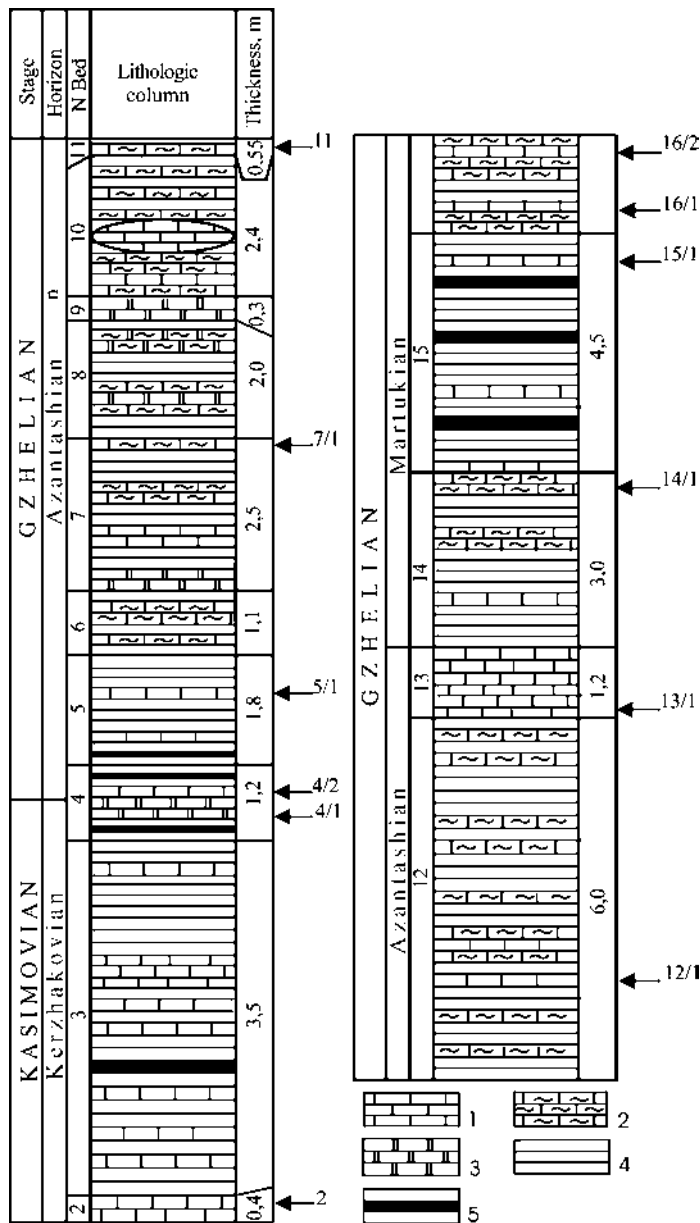
## Plate 1 (all figures are ×50, except otherwise mentioned)

**Kasimovian; bed 2.** Figure: **1, 2, 3.** *Idiognathodus swadei* Barrick et Rosscoe, 2009: 1 — No U12-27 (×70); 2 — No U12-29; 3 — No U12-24 (×70). **4, 5.** *Idiognathodus* n. sp. (×40): 4 — No U12-6; 5 — No U12-2. **6.** *Idiognathodus* ex gr. *sulcifer sulcifer* Gunnell, 1933, No U12-5. **7.** *Idiognathodus delicatus* Gunnell, 1931 (×40), No U12-18.

**Kasimovian, firmus-zethus zone; bed 4/1.** Figure: **8.** *Idiognathodus undatus* Chernykh, 2005, (×40), holotype No U13-3. **9.** *Streptognathodus pawhuskaensis* Harris et Hollingsworth, 1933 (×60), No U15-7. **10, 19.** *Streptognathodus gracilis* Stauffer et Plummer, 1932: 10 — No U15-16 (×60); 19 — No U15-34. **11.** *Streptognathodus* aff. *pictus* Chernykh, 2005, No U15-35. **12.** *Streptognathodus praenuntius* Chernykh, 2005, (×40), No U13-22. **13.** *Streptognathodus zethus* Chernykh et Reshetkova, 1987, No U15-20. **14.** *Streptognathodus firmus* Kozitskaya, 1978, (×40), No U15-26. **15, 16.** *Idiognathodus* ex gr. *sulciferus* Gunnell, 1933: 15 — No U15-5; 16 — No U15-35. **17.** *Streptognathodus* aff. *simulator* Ellison, 1941, No U15-27. **18.** *Idiognathodus magnificus* Stauffer et Plummer, 1932, (×40), No U13-13.

**Gzhelian, simulator zone; bed 4/2.** Figure: **20.** *Streptognathodus gracilis* Stauffer et Plummer, 1932, No U14-29. **21.** *Idiognathodus dolioliformis* Chernykh, 2005, holotype No U14-5. **22.** *Streptognathodus makhlinae* Alekseev et Goreva, 2001, No U14-1. **23.** *Idiognathodus* sp., No U14-3, transitional specimen to *S. simulator* Ellison, 1941. **24.** *Streptognathodus pictus* Chernykh, 2005, No U14-22. **25.** *Streptognathodus elegantulus* Stauffer et Plummer, 1932, No U14-28. **26, 27.** *Streptognathodus firmus* Kozitskaya, 1978: 26 — No U14-12; 27 — No U14-27.





**Figure. Distribution of late Pennsylvanian conodonts in Usovka section**

Limestone: 1 — micritic; 2 — silty; 3 — dolomitized; 4 — siltstone; 5 — phosphatic concretions

(Ros.), *R. cybea* (Putrja), *R. shikhanensis* (Ros.), *R. dictiophorus* (Ros.); **(10.8 mab)**: *Quasifusulina cf. eleganta* Schlyk., *Rauserites petchoricus* (Raus. and Bel.), *R. triangulus* (Ros.), *R. elongatissimus* (Ros.), *R. variabilis* (Ros.), *R. mogutovensis* Ros., *R. noinskyi* (Raus.), *R. tjanshanensis* (Bensch), *R. samaricus* (Raus.), *R. sphaericus* Ros., *Daixina rugosa* Ros., *Schwageriniformis kurshabensis* (Bensch), *S. perstabilis* (Scherb.), *S. baisunensis* (Bensch), *S. fusiformis* (Bensch)

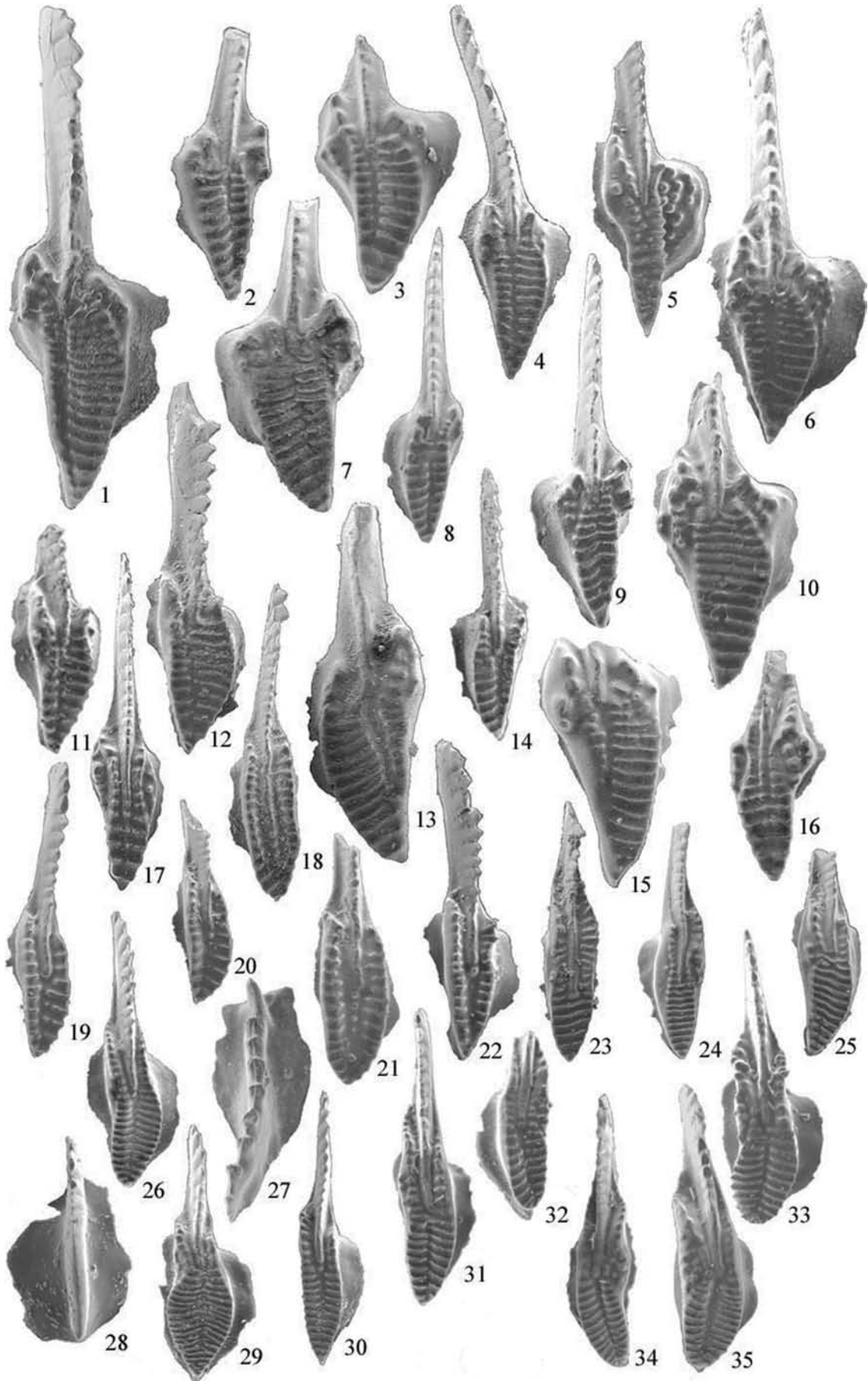
**Bed 11 (16.0 m)**: *Streptognathodus virgilicus* Ritter, *S. oppletus* Ellison, *S. pawhuskaensis* Harris et Hollingsworth, *Idiognathodus sulciferus* Gunnell.

**Bed 12/1 (18.2 m)**: *Streptognathodus vitali* Chernykh, *S. pawhuskaensis* Harris et Hollingsworth, *S. zethus* Chernykh et Reshetkova, *Idiognathodus swadei* Barrick et Rosscoe, *I. aff. lobulatus* Kozitskaya.

**Bed 13/1 (22.8 m)**: *Streptognathodus vitali* Chernykh, *S. aff. virgilicus* Ritter, *S. triangularis* Chernykh, *S. oppletus* Ellison, *Idiognathodus aff. lobulatus* Kozitskaya, *Id. n. sp. 1*, *Id. n. sp. 2*. **Fusulinids**: *Daixina azantashiensis* Dav., *D. enormis* Scherb., *D. jaikensis* Dav., *Schellwienia*

**Plate 2 (all figures are  $\times 40$ , except otherwise mentioned)**

**Gzhelian, simulator zone.** Figure: **1, 3, 7.** *Streptognathodus simulator* Ellison, 1941: 1 — No U1-5, dextral; 3 — No U1-4, dextral; 7 — No U1-8, sinistral; bed 4/2. **2.** *Streptognathodus sinistrum* Chernykh, 2005, holotype No U1-9; bed 4/2. **4.** *Streptognathodus auritus* Chernykh, 2005, holotype No U1-18; bed 4/2. **5.** *Idiognathodus* n. sp. 2, No U14-24; bed 4/2. **6.** *Streptognathodus* aff. *simulator* Ellison, 1941, No U1-26, separation of transverse ridges, without laying the median furrow; bed 4/2. **8.** *Streptognathodus* aff. *luganicus* Kozitskaya, 1978, No U1-22, sinistral with poorly developed median furrow; bed 4/2. **9.** *Streptognathodus* aff. *simulator* Ellison, 1941, No U1-25, sinistral with pronounced median furrow; bed 4/2. **10, 12.** *Streptognathodus auritus* Chernykh, 2005: 10 — No U2-15; 12 — No U2-23, dextral with fairly developed median furrow; bed 5/1. **11, 13.** *Streptognathodus* n. sp. 1, No U2-1; bed 5/1. **14.** *Streptognathodus luganicus* Kozitskaya, 1978, No U2-5; bed 5/1. **15.** *Streptognathodus* aff. *simulator* Ellison, 1941, No U3-4; bed 7/1. **16.** *Idiognathodus* ex gr. *sagittalis* Kozitskaya, 1978, No U3-12; bed 7/1. **Gzhelian, vitali zone.** Figure: **17.** *Idiognathodus swadei* Barrick et Rosscoe, 2009, ( $\times 50$ ), No U43-42; bed 12/1. **18, 21.** *Streptognathodus vitali* Chernykh, 2002: 18 — No U43-14; bed 12/1; 21 — No U4-16. **19, 20.** *Streptognathodus* ex gr. *virgilicus* Ritter, 1995: 19 — No U45-3; 20 — No U45-2; evolutionary advanced forms; bed 13/1. **22.** *Streptognathodus triangularis* Chernykh, 2005, No U45-7; bed 13/1. **23.** *Streptognathodus oppletus* Ellison, 1941, No U45-14; bed 13/1. **24.** *Idiognathodus* n. sp. 1, No U45-5; bed 13/1. **25.** *Idiognathodus* n. sp. 2, No U45-15; bed 13/1. **Gzhelian, bellus zone.** Figure: **26.** *Streptognathodus bellus* Chernykh et Ritter, 1997, No U17-2; bed 14/1. **27.** *Solkagnathus velivolus* Chernykh, 2005, ( $\times 50$ ), holotype No U17-7; bed 14/1. **28.** *Diplognathodus expansus* (Perlmutter), 1975, ( $\times 100$ ), No U17-25; bed 14/1. **29.** *Streptognathodus variabilis* Chernykh, 2005, No U18-3; bed 15/1. **Gzhelian, wabaunsensis zone.** Figure: **30.** *Streptognathodus longus* Chernykh, 2005, No U19-25; bed 16/1. **31, 32, 34, 35.** *Streptognathodus wabaunsensis* Gunnell, 1933: 31 — No U19-11; 32 — No U19-16; bed 16/1; 34 — No U20-2; 35 — No U20-1; bed 16/2. **33.** *treptognathodus bonus* Chernykh, 2005, holotype No U19-6; bed 16/1



*arctica* (Schellw.), *Sch. biformis* (Bensh), *Sch. malkovslyi* (Ketat), *Sch. krushiensis* (Alksne), *Quasifusulina longissima* (Moeller) etc.

**Bed 14/1** (24.9 m): *Streptognathodus bellus* Chernykh et Ritter, *S. tenuialveus* Chernykh et Ritter, *S. longilatus* Chernykh et Ritter, *Diplognathodus expansus* (Plummer), *Gondolella kazakhstanica* Akhmetshina, *Solkagnathus velivolus* Chernykh.

**Bed 15/1** (29.0 m): *Streptognathodus bellus* Chernykh et Ritter, *S. fissus* Chernykh, *S. variabilis* Chernykh, *S. tenuialveus* Chernykh et Ritter, *S. longilatus* Chernykh et Ritter, *S. pseudonodatus* n. sp.  
**Fusulinids:** *Schellwienia* cf. *ulukensis* (Bensh).

**Bed 16/1** (30.0 m): *Streptognathodus bonus* Chernykh, *S. acuminatus* Gunnell, *S. longus* Chernykh, *S. aff. longilatus* Chernykh et Ritter, *S. wabaunsensis* Gunnell.

**Bed 16/2** (30.1 m): *Streptognathodus acuminatus* Gunnell, *S. wabaunsensis* Gunnell, *S. flangulatus* Gunnell, *S. rectangulatus* Chernykh et Ritter.

**Bed 16/3** (32.5 m), First appearance of *Streptognathodus isolatus* Chernykh, Ritter et Wardlaw, of Lower Asselian, Cisuralian.

### Conclusions:

1. Beds 2–4/1 belong to Kasimovian; first appearance of morphotype *Streptognathodus zethus* in bed 4/1 (5.1 mab) suggest upper Kasimovin.
2. The FAD of *St. simulator* and therefore the base of the Gzhelian Stage is at 4/2 (4.9 m).
3. Gzhelian divided into following conodont zones: *simulator* (beds 4/2–10?), *virgilicus* (bed 11), *vitali* (beds 12–13), *bellus* (beds 14–15), *wabaunsensis* (beds 16/1–16/2).

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