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New Late Viséan and Early Serpukhovian Ammonoids in the Verkhnyaya Kardailovka Section (Eastern Slope of the South Urals)

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Abstract—New Late Viséan and Early Serpukhovian ammonoids are described from the Verkhnyaya Kardailovka section (South Urals, Bashkortostan). The ammonoid assemblages allow the recognition of the *Hypergoniatites–Ferganoceras* Genozone and a correlation with the synchronous zonations of North Africa, Spain, and China. The new species *Ferganoceras constrictum* sp. nov., *Dombarites clemens* sp. nov., and *Hypergoniatites kardailovkensis* sp. nov. are described.

Keywords: ammonoids, Carboniferous, Viséan, Serpukhovian, *Hypergoniatites–Ferganoceras*, Verkhnyaya Kardailovka, South Urals

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INTRODUCTION

The Late Viséan–Early Serpukhovian ammonoids of the Urals have recently been a focus of attention in connection with the definition of the base of the Serpukhovian stage and the search for the stratotype of this boundary (GSSP). Previous publications have included several taxonomic papers (Ruzhencev, 1966; Bogoslovskaya, 1966; Ruzhencev and Bogoslovskaya, 1971; Nikolaeva and Konovalova, 2011; Nikolaeva, 2013). On the eastern slope of the South Urals, ammonoids of this age were found only recently, in condensed deep-water limestones (mudstones and wakestones) opened in trenches in the Verkhnyaya Kardailovka Section (Baimak District, Bashkortostan) (Fig. 1), studied in an uninterrupted section of the Viséan–Serpukhovian boundary beds with conodonts, foraminifers, corals, phyllocarids, and holothurian skeletons (Nikolaeva et al., 2009b, 2014; Kulagina et al., 2009; Pazukhin et al., 2010; Nikolaeva and Konovalova, 2015). In this section, the Viséan–Serpukhovian boundary is drawn at the level of the first appearance datum (FAD) of the conodont *Lochriea ziegleri* (Nikolaeva et al., 2009b; Pazukhin et al., 2010). The studied boundary interval contains, in the Viséan portion, the *Goniatites* Genozone (interval 16.30–18.00 m from the base of the section) and the lower part of the *Hypergoniatites–Ferganoceras* Genozone (interval 18.00–21.56 m from the base of the section), and in the Serpukhovian portion—the upper part of the *Hypergoniatites–Ferganoceras* Genozone and part of the *Uralopronorites–Cravenoceras* Genozone (interval above 21.56 m from the base of the section). This section is one of the few sections in the world where the *Hypergoniatites–Ferganoceras* Genozone is found in an uninterrupted succession of several ammonoid genozones and the only known section, in which ammonoids, conodonts, and foraminifers are studied at many levels near the boundary interval.

MATERIAL

The ammonoids studied were collected from the levels 18.50–20.80 m above the base of the Verkhnyaya Kardailovka Section (Bed 21, see Nikolaeva et al., 2009b, Nikolaeva, 2013, text-fig. 1). Ammonoids from Sample 015/5 (17.2–17.3 m), 015/2 (17.7–18.0 m), 015 (18.4–18.52 m), Sample 19.0, 19.20, 19.44, 19.50, 19.55–19.65, 19.72–19.83, 20.30 were mentioned in previous publications on this section (Nikolaeva et al., 2009b, Pazukhin et al., 2010, Nikolaeva, 2013; Nikolaeva et al., 2014). Other occurrences (Samples 18.75, 19.88, 20.20, 20.80, 21.10) are new. The state of preservation of the ammonoid remains is satisfactory, but the external layer of the shells on the last whorls is dissolved. Usually, one flank of a shell is preserved better than the other, because of carbonate dissolution in a deep water environment in a starved basin. Conodont samples from this interval and lithological

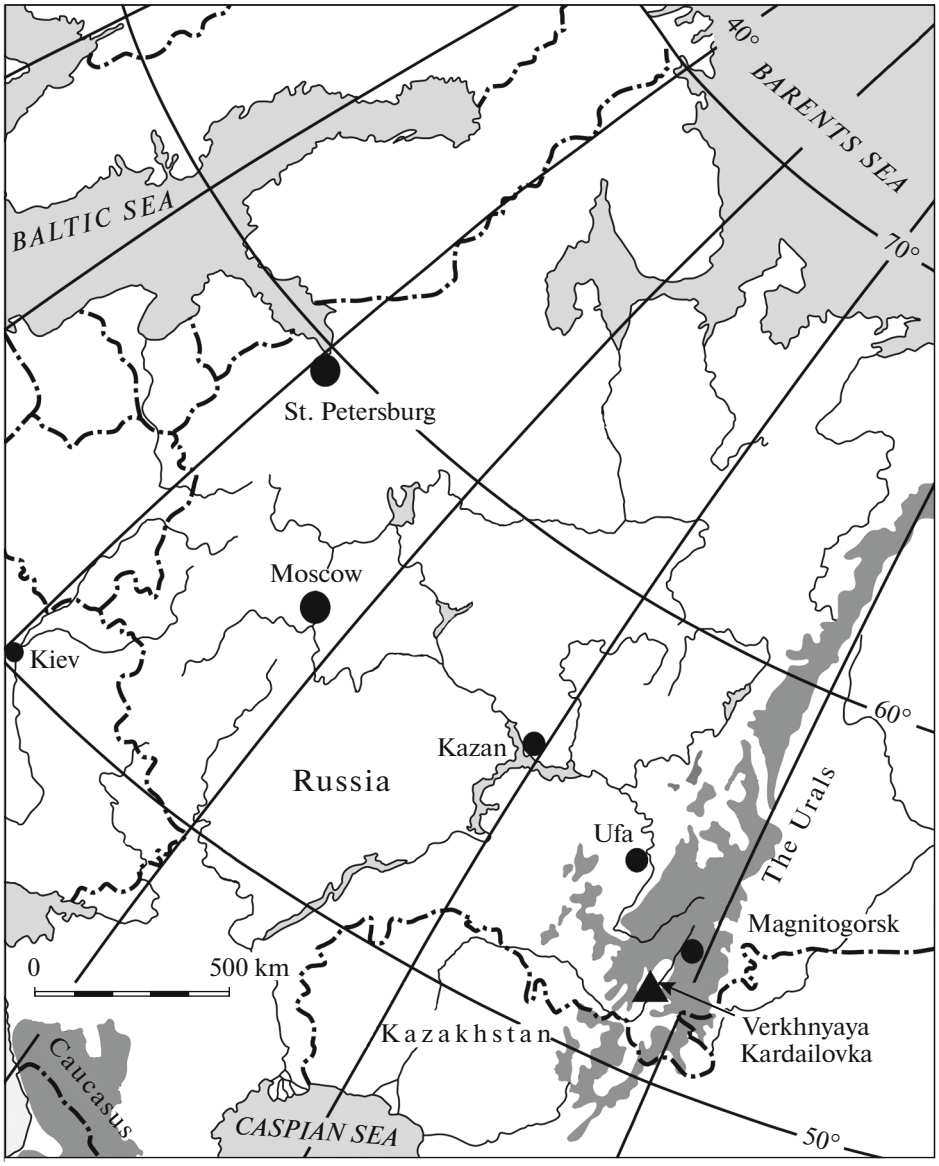


Fig. 1. Location of the Verkhnyaya Kardailovka Section.

thin sections contain numerous juvenile ammonoid shells and ammonitellae, particularly abundant at 19.44–19.72 m in the matrix (Sample 19.44) and in the intraclasts (Samples 19.65, 19.72). All studied ammonoids are housed in the collection of the Paleontological Institute of the Russian Academy of Sciences (PIN) (coll. no. 4920).

ABBREVIATIONS

Dm—shell diameter, WW—whorl width, WH—whorl height, UW—umbilical width, LW—ventral lobe width, LH—ventral lobe height, SH—median saddle height.

POSITION OF AMMONOID OCCURRENCES IN THE SECTION

The Viséan–Serpukhovian boundary beds with ammonoids in the studied section are described in several papers (Nikolaeva et al., 2002, 2009b, 2014; Pazukhin et al., 2010). At present, the previously covered interval is completely open in trenches and sampled for various macro- and microfossils. Ammonoids are found across the entire section of the boundary interval, which contains three genozones, *Goniatites*, *Hypergoniatites–Ferganoceras* and *Uralopronorites–Cravenoceras*. In this paper we describe ammonoids of the *Hypergoniatites–Ferganoceras* Genozone. The Viséan–Serpukhovian boundary defined by the first appearance of the conodont *Lochriea ziegleri* lies within this genozone

(in the interval 19.53–19.63 m). The lowermost occurrence of the ammonoids of the *Hypergoniatites–Ferganoceras* Genozone is at the level of 17.2 m above the base of the section (Sample 015/5 – Nikolaeva et al., 2009b; Pazukhin et al., 2010), and the highest occurrence is at the level of 20.8 m above the base of the section. The distribution of ammonoids is shown in Fig. 2. The interval of 1.36 m between the last occurrence of the ammonoids of the *Goniatites* Genozone (Sample 16.64) and the first occurrences of the ammonoids of the *Hypergoniatites–Ferganoceras* Genozone is not characterized by ammonoids. The lower boundary of the overlying genozone is drawn at the level of 21.56 m above the base of the section. Previously (Nikolaeva, 2013) it was suggested that this boundary is at the level of 20.3 m above the base of the section based on the occurrence in this interval of *Platygoniatites integer* and *Dombarites* sp. (see Nikolaeva, 2013). However, in 2014 two specimens of *Ferganoceras* (*Ferganoceras constrictum* sp. nov.) were found at 20.8 m from the base of the section. This level is 0.5 m higher than the level of the occurrence of *Platygoniatites integer* Nikolaeva, and most likely, characterizes the upper part of the *Hypergoniatites–Ferganoceras* Genozone. Therefore the base of the *Uralopronorites–Cravenoceras* Genozone should be drawn above the previously assumed level, whereas the occurrences of *Platygoniatites integer* should be assigned to the *Hypergoniatites–Ferganoceras* Genozone.

TAXONOMIC COMPOSITION OF THE *HYPERGONIATITES–FERGANOCERAS* GENOZONE

In the studied section, the assemblage of the genozone contains *Prolecanites librovitchi* Ruzhencev, *Dombarites parafalcatoides* Ruzhencev et Bogoslovskaya, *D. falcatoides* Ruzhencev et Bogoslovskaya, *Neogoniatites milleri* Ruzhencev et Bogoslovskaya, *Platygoniatites integer* Nikolaeva, *Lyrogoniatites* sp., *Ferganoceras constrictum* sp. nov., *Hypergoniatites kardailovkensis* sp. nov., *Dombarites clemens* sp. nov., *Epicanites aktubensis* Ruzhencev sp., and *Dombarocanites* sp. (Pl. 2).

The assemblage contains characteristic taxa allowing dating of the host beds, but its composition is species-poor compared to the synchronous faunas of the western slope of the South Urals, primarily from Dombar (Ruzhencev and Bogoslovskaya, 1971; Nikolaeva et al., 2009a, etc.). The taxonomic impoverishment does not allow the recognition of the *Pachylyroceras cloudi* (Nm1a1) and *Dombarigloria miranda* (Nm1a2) species zones established by Ruzhencev and Bogoslovskaya (1971) on the western slope of the South Urals. Based on the presence of the most common species, Nikolaeva (2013) established the *Dombarites parafalcatoides* Zone, which can correspond to either the Nm1a1 Zone, or the Nm1a2 Zone, but can also correspond to both these zones. The latter is more likely because the Verkhnyaya Kardailovka Section has no visible gaps, and the deposits are strongly condensed.

The assemblage is dominated by early members of the genus *Dombarites*. It also contains other delepinoceratids (genus *Platygoniatites*), advanced goniatitids (genera *Neogoniatites*, *Hypergoniatites*), prolecanitids (*Prolecanites*, *Dombarocanites*, *Epicanites*), ferganoceratids (*Ferganoceras*), and cravenoceratids (*Lyrogoniatites*). The two latter families belong to the superfamily Neoglyphioceratoidea, the appearance of which was one of the main events of this genophase. In the studied interval in the Verkhnyaya Kardailovka Section, this superfamily is represented by the genera *Lyrogoniatites*, *Ferganoceras*, and *Neoglyphioceras*. The origin of this superfamily is unknown, but it is most likely related to Goniatitoidea. The initial genus of the superfamily is *Neoglyphioceras*, which in many sections of the world is found in beds below the beds with *Ferganoceras*. Shells of species of this genus have coarse spiral ornamentation and deep constrictions. In the Verkhnyaya Kardailovka Section, *Neoglyphioceras* appears later than *Ferganoceras*, but this is likely connected with the impoverishment of the assemblage in the basal part of the *Hypergoniatites–Ferganoceras* Genozone. In the studied section, the first representatives of this superfamily, the genus *Lyrogoniatites*, appear at 18.50 m above the base of the section (Sample 015). A new species of the genus *Ferganoceras* appears at a level of 20.8 m above the base of the section. This new species differs from most species of this genus (except *F. torridum*) in that it bears both spiral ornamentation (ventrolateral grooves and spirals) and deep constrictions running across the flanks (which is usual for *Ferganoceras*), and the venter (which is usually observed in other neoglyphioceratoid genera (e.g., *Neoglyphioceras* and *Lusitanites*, but is uncommon in *Ferganoceras*). This combination of characters in the new species supports the hypothesis of Ruzhencev and Bogoslovskaya (1971) that *Ferganoceras* evolved from *Neoglyphioceras*.

Platygoniatites integer appears in this section slightly below *Ferganoceras constrictum*. A similar succession of these genera was previously found in Gara El Itima (Morocco), where *Platygoniatites rhanemensis* enters before *Ferganoceras torridum* (Klug et al., 2006). The taxonomic composition of the *Hypergoniatites–Ferganoceras* Genozone in the Urals and Tien Shan is largely dominated by the families Delepinoceratidae (*Dombarites parafalcatoides*, *D. falcatoides*, *D. clemens* sp. nov., and *Platygoniatites integer*) and Goniatitidae (*Hypergoniatites kardailovkensis* sp. nov., *Neogoniatites milleri* Ruzhencev et Bogoslovskaya, and *Neogoniatites ruginosus* Ruzhencev et Bogoslovskaya). Both families were common in the basins of the Urals and Tien Shan, in Spain, North Africa, and North America. In the basins of Great Britain, Germany, and Portugal these groups at that time profoundly decreased. Of synchronous occurrences outside the

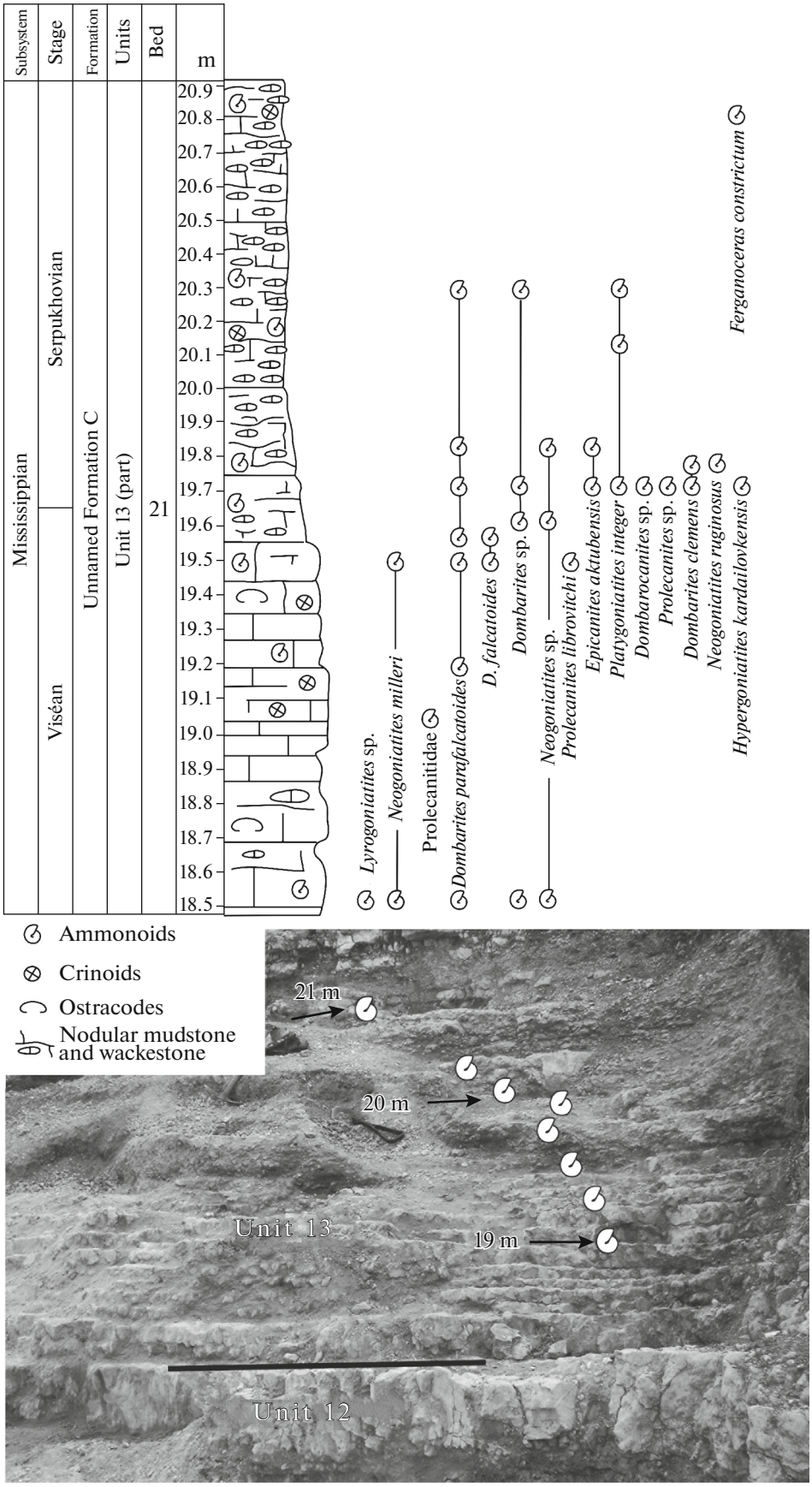


Fig. 2. Distribution of ammonoids in the Viséan–Serpukhovian boundary beds in the Verkhnyaya Kardailovka Section.

Urals and Tien Shan, the most interesting are those of *Dombarites bellornatus* Korn et Ebbighausen in Klug et al., 2006, *Platygoniatites rhanemensis* Korn et Ebbighausen in Klug et al., 2006, and *Ferganoceras torridum* Korn et Ebbighausen in Klug et al., 2006 in Morocco in the G-4–G-6 faunas (Klug et al., 2006), which are similar to species from the Verkhnyaya Kardailovka Section.

Equivalents of the studied assemblage of the *Hypergoniatites–Ferganoceras* Genozone are known in the Southwest Darvaz, South and Middle Tien Shan (Pitinova, 1974; Nikolaeva, 1994, 1995), in Novaya Zemlya (Kuzina and Yatskov, 1988), in the northern Verkhoyansk Region (Kharaulakh Ridge) (Andrianov, 1985), in Sud Oranais, Ksar El Azoudj (Algeria), and in Mondette, Ariège (western Pyrenees) (Delépine, 1935), in Gara El Itima (Anti-Atlas, Morocco) (faunas G-4–G-6) (Korn et al., 1999; Klug et al., 2006), in the Cantabrian Mountains (Spain) (Wagner-Gentis, 1980), Xinjiang and Xizang (China) (Ruan, 1984; Liang and Wang, 1991), in North America (*Lusitanoceras–Pachylyroceras* Genozone (North American Cordillera) and the interval from the *Choctawites kentuckiensis* Zone to the *Lyrogoniatites georgiensis* Zone (American Mid-Continent) (Titus et al., 2015) (Fig. 3).

NOMENCLATURE OF THE *HYPERGONIATITES–FERGANOCERAS* GENOZONE

Titus et al. (2015) considered that the Uralian representatives assigned by Ruzhencev and Bogoslovskaya (1971) to *Pachylyroceras cloudi* are different from the holotype of this species (USNM 113011 in the Smithsonian Institution, USA) and should be assigned to a new genus and species, and proposed the new name *Uralyroceras arcuatum*. If they are correct, the name of the *P. cloudi* Zone in the Urals will need to be replaced. Titus et al. (2015) indicated that the Uralian specimens are distinguished from the holotype by the "absence" of the ventral sinus on the constrictions. However, the Uralian specimens do have a sinus (similar to that in the holotype of *P. cloudi*), which is mentioned at least twice in the description given by Ruzhencev and Bogoslovskaya (1971, pp. 244–245). Ruzhencev and Bogoslovskaya noted the presence of the sinus distinguishing *P. cloudi* from most other species of the genus *Pachylyroceras*. It is evident that the Uralian specimens differ from the holotype of *P. cloudi* in the whorl width and the size of the umbilicus, i.e., their whorl and umbilicus are slightly wider than in the American specimens (at D = 30 mm, WW/Dm = 0.60, instead of 0.55 in the holotype, whereas UW/Dm = 0.50 instead of 0.42 in the holotype). However, these differences are not of generic level, because these proportions often vary even within the same species. Titus et al. (2015) proposed to assign all species from the Urals that resemble *Pachylyroceras*, to a new genus *Uralyroceras* with the type species *Pachylyroceras constrictum* Ruzhencev et Bogoslovskaya 1971. In *P. constrictum*, as in many other Uralian species, the constrictions are either straight or form a projection with no ventral sinus, but the sinus is present in the species which Titus et al. (2015) proposed to rename as *Uralyroceras arcuatum*. The taxonomy of this genus is beyond the scope of this paper, but until it is revised, we leave the zonal name *Pachylyroceras cloudi* unchanged.

AMMONOID HABITATS IN THE *HYPERGONIATITES–FERGANOCERAS* GENOPHASE IN THE SOUTH URALS

In the South Urals, ammonoid occurrences of this age are mainly connected with deep-water basins with small but consistent currents and predominantly carbonate sedimentation (e.g., troughs near the end of carbonate platforms or deep depressions at the base of island arcs) (Gorozhanina et al., 2009). The most diverse assemblages are found in the western subregion of the South Urals, in Dombar, where sedimentation occurred in a deep carbonate basin near crinoid platforms (Nikolaeva et al., 2009a). In the eastern subregion of the South Urals (in the Verkhnyaya Kardailovka Section), the rocks contain a large proportion of pyroclastic material (Pazukhin et al., 2010) spread from the adjacent regions of active volcanism. The presence of the volcanic ashes in the water and sediment following the ash fall had a detrimental impact on the cephalopod community, causing its decline. It is possible that some families (e.g., neoglyphioceratids) were more sensitive to the increased waster turbidity, reduced amount of light, and acidification, and are therefore scarcely present in the Verkhnyaya Kardailovka Section. In contrast, this family is abundantly represented in Dombar (western subregion of the South Urals), in clean crinoidal limestones with little siliciclastic admixture and no pyroclastics.

THE VISÉAN–SERPUKHOVIAN BOUNDARY AND AMMONOID BIOSTRATIGRAPHY

Until the first decade of the 21st century the Viséan–Serpukhovian boundary was traditionally placed at the base of the beds with the ammonoids *Cravenoceras* and/or *Edmooroceras pseudocoronula* (Nikolaeva and Kullmann, 2003). At the same time the Genozone *Hypergoniatites–Ferganoceras* was considered certainly Viséan, although it was clear that at least in the Urals, the ammonoid assemblage of this genozone is closely related to that of the succeeding *Uralopronorites–Cravenoceras* Genozone (Ruzhencev and Bogoslovskaya, 1971). As *Cravenoceras* and *Edmooroceras pseudocoronula* have a restricted geographical distribution, a better Viséan–Serpukhovian boundary marker has been sought from the end of the 1990s. It has been suggested that the boundary can be drawn at the level of the first appearance of the cono-

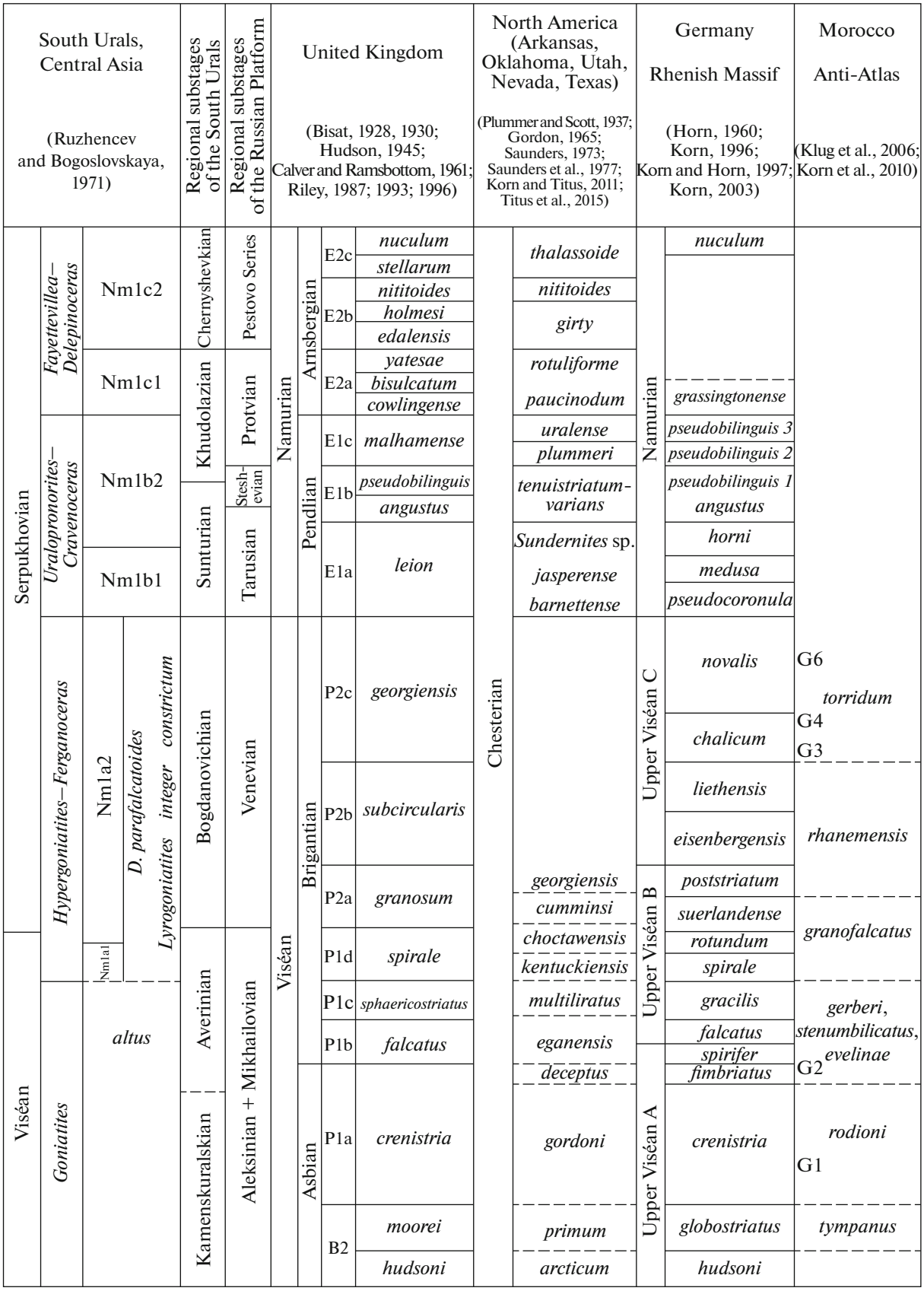


Fig. 3. Correlation of the Upper Viséan–Serpukhovian ammonoid zones (for references see Nikolaeva and Kullmann, 2003; Titus et al., 2015).

dont *Lochriea ziegleri* (Skompski et al., 1995; Nikolaeva et al., 2002, 2005; Cózar et al., 2008), i.e., at a level close to the traditional boundary. It was shown (Nikolaeva et al., 2009a) that the base of the Serpukhovian defined by the first appearance datum (FAD) of the conodont *L. ziegleri* lies within the *Hypergoniatites–Ferganoceras* Genozone. In the Dombar section, this level lies within the upper zone of the *Hypergoniatites–Ferganoceras* Genozone–*Dombarigloria miranda* (Nm1a2), and therefore the "*Pachylyroceras cloudi*" (Nm1a1) Zone falls completely in the Upper Viséan, whereas the *Dombarigloria miranda* (Nm1a2) Zone is partly Viséan, and partly Serpukhovian. This is supported by the distribution of ammonoids from Verkhnyaya Kardailovka. In the Verkhnyaya Kardailovka Section, the base of the Serpukhovian defined by *L. ziegleri* is in the interval of 19.53–19.63 m and hence also falls within the *Hypergoniatites–Ferganoceras* Genozone (Nikolaeva et al., 2009b, 2014; Pazukhin et al., 2010). Thus, ammonoid occurrences above 19.58 m (mid-interval) should be considered Serpukhovian. Note that in Dombar, the occurrences of *Ferganoceras* are found below the FAD of *L. ziegleri* (Nikolaeva et al., 2009a).

SYSTEMATIC PALEONTOLOGY

Superfamily Neoglyphioceratoidea Plummer et Scott, 1937

Family Ferganoceratidae Ruzhencev, 1960

Genus *Ferganoceras* Librovitch, 1957

***Ferganoceras constrictum* Nikolaeva et Konovalova sp. nov.**

Plate 2, figs. 5, 6

Etymology. From the Latin *constrictus* (constricted).

Holotype. PIN, no. 4920/300; Bashkortostan, Baimak District, right bank of the Ural River, 2 km east-northeast of the Ural branch of the Zilair collective farm (Prigorodnyi Village), Verkhnyaya Kardailovka Section, level 20.8 m; Serpukhovian Stage, *Hypergoniatites–Ferganoceras* Genozone, *Dombarites parafalcatoides* Zone, pl. 2, fig. 5.

Description. *Shell shape*. The shell is subdiscoconic, with completely involute whorls. The venter is narrow and convex. The ventral margin is rounded. The flanks are wide and flattened. The umbilical margin is rounded. The umbilical wall is very narrow and weakly convex. The umbilicus is narrow.

Dimensions in mm and ratios:

Specimen. no.	Dm	WH	WW	UW	WH/Dm	WW/Dm	UW/Dm
4920/301	13.9	5.4	6.7	2.9	0.39	0.48	0.14
4920/300 holotype	9.9	4.1	5.0	1.6	0.41	0.51	0.16

Ornamentation. The flanks possess spirals, 20 on each flank. The spirals on the venter are not preserved.

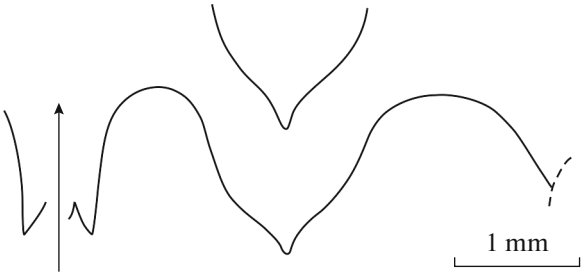


Fig. 4. Sutural outline of *Ferganoceras constrictum* sp. nov.: holotype PIN, no. 4920/300 at WH = 3.5 mm, WW = 5.2 mm, Serpukhovian, *Hypergoniatites–Ferganoceras* Genozone. Scale bar 1 mm.

A groove is developed on the ventrolateral margin, with a more strongly raised external side. The transverse striae are considerably weaker than the spirals and form a lateral sinus. The venter and the flanks have deep, undulating constrictions, three per whorl, forming a deep ventral sinus and a wide ventrolateral projection.

Suture (Fig. 4). The ventral lobe is relatively narrow (LW/LH = 0.49, the width is measured at the level of the median saddle), with almost straight sides, weakly divergent at the top. The lobe width near its base is 0.35 of its width at the top. The ventral prongs are wedge-like and angular. The medial saddle is low (0.16 of the depth of the ventral lobe). The first lateral saddle is rounded, asymmetrical, with a straight external side and concave internal side. The lateral lobe is deeper than the ventral, symmetrical, wine glass-shaped, with convex sides and a short, narrow termination.

Comparison. The new species is most closely similar to *F. torridum* Korn et Ebbighausen in Klug et al., 2006, from which it differs in the narrower umbilicus (0.16 instead of 0.25) and the number of constrictions. It is distinguished from other species of the genus in the presence of constrictions on the venter.

Material. Apart from the holotype, 1 specimen from the type locality.

Superfamily Goniatitoidea, Haan, 1825

Family Delepinoceratidae Ruzhencev, 1957

Subfamily Dombaritinae Kullmann, 2007

Genus *Dombarites* Librovitch, 1957

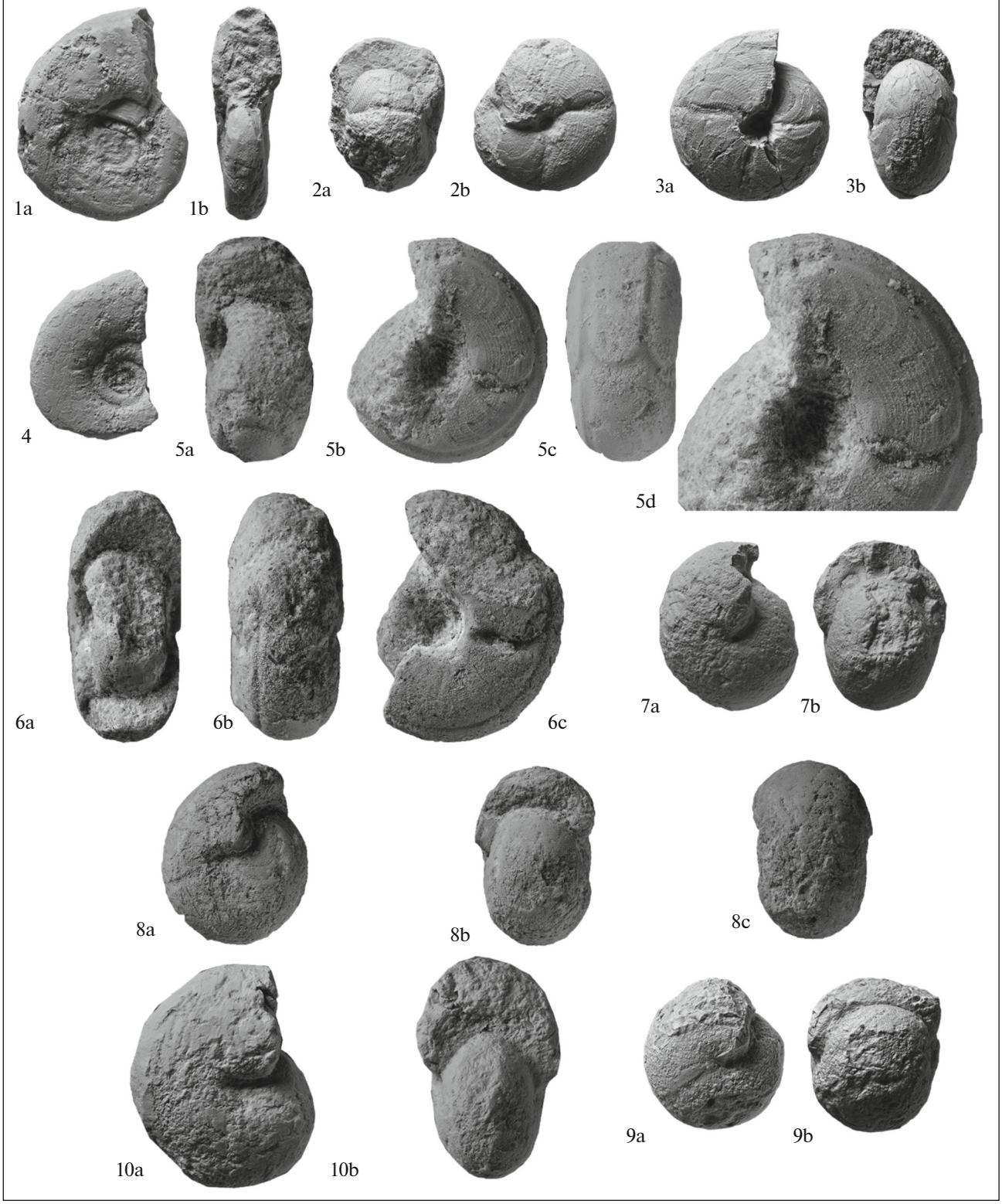
***Dombarites clemens* Nikolaeva et Konovalova sp. nov.**

Plate 2, figs. 7–9

Etymology. From the Latin *clemens* (peaceful).

Holotype. PIN, no. 4920/250; Bashkortostan, Baimak District, right bank of the Ural River, 2 km east-northeast of the Ural branch of the Zilair collective farm (Prigorodnyi Village), Verkhnyaya Kardailovka Section, level 19.75–19.80 m above the base of the section; Serpukhovian Stage, *Hypergoniatites–*

Plate 2



Explanation of Plate 2

All figured specimens are from Bashkortostan, Baimak District, right bank of the Ural River, 2 km east-northeast of the Ural branch of the Zilair collective farm (Prigorodnyi Village), Verkhnyaya Kardailovka Section, *Hypergoniatites–Ferganoceras* Genozone, *Dombarites parafalcatoides* Zone.

Fig. 1. *Epicanites* sp.; specimen PIN, no. 4920/140; ×1; level 19.7 m.

Fig. 2. *Dombarites falcatoides* Ruzhencev et Bogoslovskaya, 1970; specimen PIN, no. 4920/400; ×1.5; level 19.6 m.

Fig. 3. *Dombarites parafalcatoides* Ruzhencev et Bogoslovskaya, 1971; specimen PIN, no. 4920/253; ×1.5; level 19.7 m.

Fig. 4. *Dombarocanites* sp.; specimen PIN, no. 4920/143, x1.5; level 19.7 m.

Figs. 5 and 6. *Ferganoceras constrictum* sp. nov.: (5) holotype PIN, no. 4920/300: (a–c) general view, ×3, (d) ornamentation, ×5; level 20.8 m; (6) specimen PIN, no. 4920/301; ×3; level 20.8 m.

Figs. 7–9. *Dombarites clemens* sp. nov.: (7) holotype PIN, no. 4920/250, ×1.5; level 19.75–19.80 m; (8) specimen PIN, no. 4920/275 (×1.5); level 19.77–19.88 m; (9) specimen PIN, no. 4920/251; ×1.5; the same level.

Fig. 10. *Hypergoniatites kardailovkensis* sp. nov.: holotype PIN, no. 4920/215; × 2; level 19.7 m.

Ferganoceras Genozone, *Dombarites parafalcatoides* Zone, pl. 2, fig. 7.

D e s c r i p t i o n. *Shell shape*. The shell is thickly discoidal to spheroconic, with completely involute whorls at all growth stages. The venter is rounded, smoothly fused with the convex flanks. The ventral margin is not developed. The umbilical margin is indistinct. The umbilical wall is narrow and vertical. The umbilicus is very narrow, almost closed.

D i m e n s i o n s i n m m a n d r a t i o s:

Specimen. no.	Dm	WH	WW	UW	WH/Dm	WW/Dm	UW/Dm
4920/351	29.6	15.4	22.0	0.6	0.52	0.74	0.02
4920/ 250 holotype	21.5	11.5	17.0	0.4	0.53	0.79	0.02
4920/251	18.4	8.9	16.6	0.5	0.48	0.9	0.03
4920/352	13.0	6.7	10.4	0.4	0.51	0.8	0.03

Ornamentation. The ornamentation is poorly preserved. Some specimens show fragments of thin spirals and very faint growth striae.

Suture (Fig. 5). The ventral lobe is bipartite, moderately wide for the genus, with sides divergent at the top. The first lateral saddle is angular. The median saddle is medium-sized, around 0.5–0.6 of the depth of the ventral lobe. The lateral lobe is as wide as the ventral lobe, or slightly narrower, with angular sides and a long tubular process. The second lateral saddle is widely rounded. The umbilical lobe is not visible.

C o m p a r i s o n. It its sutural outline, this species is similar to *D. falcatoides* Ruzhencev et Bogoslovskaya, 1970, *D. parafalcatoides* Ruzhencev et Bogoslovskaya, 1971, and *D. bellornatus* Korn et Ebbighausen in Klug et al., 2006, from which it is distinguished by the very narrow, almost closed umbilicus. In addition, it differs from *D. falcatoides* Ruzhencev et Bogoslovskaya, 1970 in the absence of the triangular-spheroconic stage in the early whorls, and in the absence of constrictions. It is distinguished from *D. parafalcatoides* Ruzhencev et Bogoslovskaya, 1971 by the wider shell (at Dm = 30 mm, WW/Dm = 0.74 instead of 0.65) and by the absence of constrictions. It is different from all other species of the genus in the narrow, almost closed umbilicus and the wider shell.

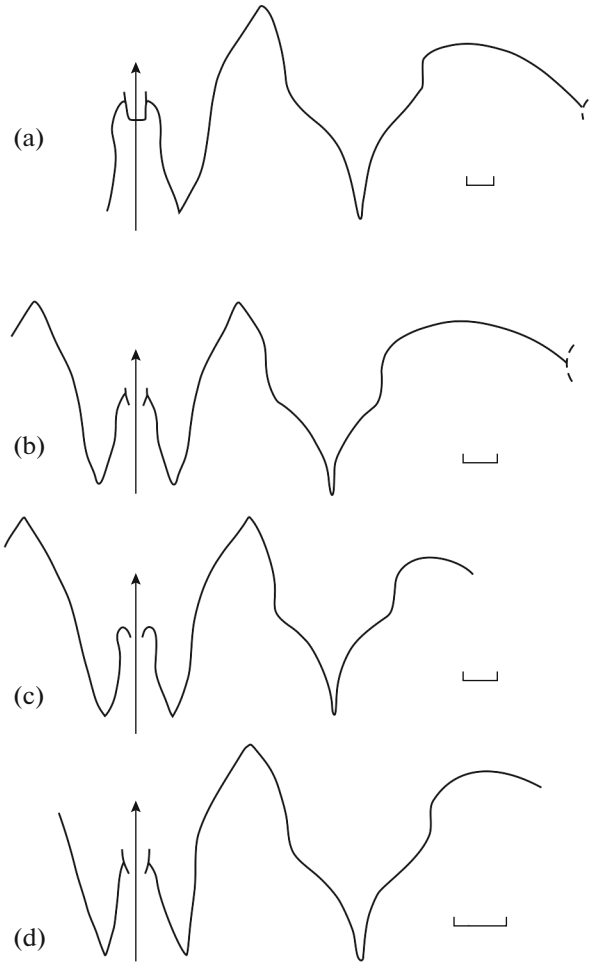


Fig. 5. Sutural outlines of *Dombarites clemens* sp. nov. from the Verkhnyaya Kardailovka Section, *Hypergoniatites–Ferganoceras* Genozone, *Dombarites parafalcatoides* Zone: (a) specimen PIN, no. 4920/351 at WH = 16.6 mm, level 19.7 m; (b) holotype PIN, no. 4920/250 at WH = 9.2 mm, level 19.75–19.80 m; (c) specimen PIN, no. 4920/251 at WH = 8.7 mm, the same level; (d) specimen PIN, no. 4920/352 at WH = 5.9 mm, level 19.7 m. Scale bar 1 mm.

Remarks. The taxonomy of the genus *Dombarites* has been developed recently, mainly due to the description of large Mississippian faunas of North Africa (Klug et al., 2006, etc.) and Upper Viséan–Serpukhovian assemblages of Utah, Nevada, and Texas (Titus, 1999; Korn and Titus, 2011; Titus et al., 2015). The changes mainly concern the taxonomy of species of this genus and classification of family-group taxa. Originally, representatives of goniatitids and delepinoceratids from Spain, Morocco, Algeria, and North America were assigned either to *Goniatites* or to *Dombarites* without taking their shell ontogeny into account. Nikolaeva and Konovalova (2005) showed that *Dombarites* should include species, in which the initial whorls are involute, because the type species of the genus is represented by this morphotype. At the same time in some similar North American and North African species (e.g., "*Goniatites choctawensis*" Shumard, 1863 from Texas or "*Goniatites granofalcatus*" Kullmann, 1961), which were assigned by some authors to *Dombarites* (Klug et al., 2006), the initial whorls are evolute, hence they should not be assigned to *Dombarites*. Recently Titus et al. (2015) followed the case, and assigned *G. choctawensis* Shumard, 1863 to the genus *Choctawites* Titus et al., 2015, and the species *G. granofalcatus* Kullmann, 1961 was assigned to the genus *Revilloceras* Wagner-Gentis, 1980. On the whole, we agree with this solution, although we hold some doubts regarding the genus *Revilloceras* Wagner-Gentis, 1980, because the interior whorls of "*Mesoglyphioceras granosus* var. *barruelense*" Wagner-Gentis, 1963, the type species of this genus, are still unknown. Although Titus et al. (2015, Table 6) indicated that *Revilloceras* has evolute initial whorls, this conclusion is most likely based on the material from the well-known species *G. granofalcatus* Kullmann, 1961, whereas no new data were given regarding the initial whorls of the type species of *Revilloceras* (*R. barruelense*). Until the initial whorls of the type species *R. barruelense* are studied, it cannot be completely excluded that *G. granofalcatus* Kullmann, 1961 indeed belongs to *Revilloceras*, or a new generic name should be proposed to accommodate this species. A few remarks should be made regarding the family assignment of the genus *Dombarites* Librovitch, 1957. Ruzhencev and Bogoslovskaya (1971) assigned this genus to the family Agathiceratidae Arthaber, 1911. This large family is in need of serious revision, as it has been shown (Nikolaeva and Konovalova, 2005; Kullmann et al., 2007; Titus et al., 2015) that the genus *Dombarites* is more similar to the genera *Lusitanoceras*, *Deleshumardites*, *Platygoniatites*, and *Delepinoceras* than to *Agathiceras*. It should also be considered that the genus *Agathiceras*, which has a central siphuncle, most likely represents an aberrant group, which some authors proposed to assign to Tornoceratina (Leonova, 2002). The solution of this problematic assignment is only possible after a careful re-examination of the material of Carboniferous "agathiceratids", and is beyond the scope of this paper. We consider useful to accept the subfamily Dombaritinae Kullmann, 2007, which includes the genera *Dombarites* Librovitch, 1957, *Revilloceras* Wagner-Gentis, 1980, *Lusitanoceras* Pereira de Sousa, 1923, *Choctawites* Shumard, 1923, *Deleshumardites* Kullmann, 2007, and *Proshumardites* Rauser-Tschernoussowa, 1928, although this subfamily should probably include new genera for species which do not entirely agree with the diagnoses of the presently known genera of this family (e.g., *D. dilatatus* (Pareyn, 1961), *D. applanatus* Kusina, 1999, and *D. insolitus* Kusina, 1999).

Material. Apart from the holotype, four well-preserved specimens from the type locality.

Family Goniatitidae Haan, 1825

Genus *Hypergoniatites* Ruzhencev et Bogoslovskaya, 1970

Hypergoniatites kardailovkensis Nikolaeva et Konovalova sp. nov.

Plate 2, fig. 10

Etymology. From the village of Verkhnyaya Kardailovka.

Holotype. PIN, no. 4920/215; Bashkortostan, Baimak District, right bank of the Ural River, 2 km east-northeast of the Ural branch of the Zilair collective farm (Prigorodnyi Village), Verkhnyaya Kardailovka Section, level 19.7 m; Serpukhovian Stage, *Hypergoniatites–Ferganoceras* Genozone, *Dombarites parafalcatoides* Zone, pl. 2, fig. 10.

Description. *Shell shape.* The shell is thickly discoidal, with completely involute whorls at all growth stage. The venter is rounded, gradually becoming flanks. The ventral shoulder is not present. The umbilical shoulder is indistinct. The umbilical wall is narrow and vertical. The umbilicus is very narrow, almost closed

Dimensions in mm and ratios:

Specimen. no.	Dm	WH	WW	UW	WH/Dm	WW/Dm	UW/Dm
4920/ 215 holotype	19.5	10.2	12.4	0.9	0.52	0.64	0.05

Ornamentation. The ornamentation is not preserved.

Sutural outline (Fig. 6). The ventral lobe is not very wide for the genus, with strongly divergent, almost straight sides. At the top, its width is almost five times the width at the base. The median saddle is narrow (SH/LH = 0.43). The first lateral saddle is angular, approximately as wide as the ventral lobe. The lateral lobe is narrow, with weakly bent sides and a small narrow termination; as deep as the ventral lobe. The second lateral saddle is low, broadly rounded. The umbilical lobe is not visible.

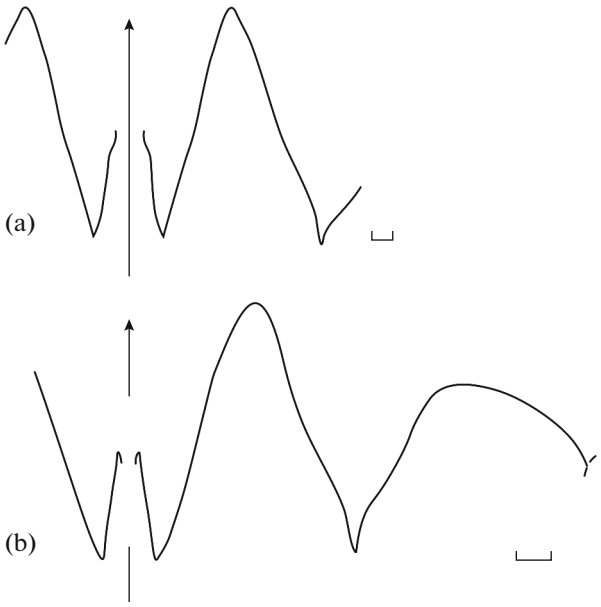


Fig. 6. Sutural outlines of *Hypergoniatites kardailovkensis* sp. nov. from the Verkhnyaya Kardailovka Section, *Hypergoniatites–Ferganoceras* Genozone: (a) specimen PIN, no. 4920/113 at WH = 20.1 mm, collected loose above 16.64 m; (b) holotype PIN, no. 4920/215 at WH = 9.1 mm, level 19.7 m. Scale bar 1 mm.

C o m p a r i s o n. The shell shape in the new species is similar to *Hypergoniatites fusiger* Korn et Ebbighausen, 2006 and *H. tenuiliratus* Ruzhencev et Bogoslovskaya, 1971. It differs from *Hypergoniatites fusiger* Korn et Ebbighausen, 2006 in the broader lateral saddle and a different shape of the lateral lobe, the sides of which are more strongly bent in the new species. It is distinguished from *H. tenuiliratus* Ruzhencev et Bogoslovskaya, 1971 by the narrower ventral lobe (the ratio of the width of the ventral lobe at its top to its width at the base is 5 instead of 6–7 in *H. tenuiliratus*) and in the higher median saddle: SH/LH = 0.43 instead of 0.35 at a similar whorl height. The new species is similar in the sutural outline to *H. exiguus* Ruzhencev et Bogoslovskaya, 1971, but lacks constrictions present in *H. exiguus*. It is distinguished from *H. aberratus* Kuzina et Yatskov, 1988 by the wide shell (WW/Dm = 0.64 instead of 0.52 at Dm = 19.5 and 20, respectively), and also in the shape of the ventral lobe, in which the sides are considerably more divergent. It differs from *H. reticulatus* Wagner-Gentis, 1980 in the lack of constrictions and the wider ventral lobe (the ratio of the width of the ventral lobe at its top to its width at the base is 5 instead of 3.8).

Material. Apart from the holotype, one specimen from the type locality.

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