LATE SMITHIAN (EARLY TRIASSIC) AMMONOIDS FROM THE ANASIBIRITES NEVOLINI ZONE OF SOUTH PRIMORYE, RUSSIAN FAR EAST

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Abstract—One new ammonoid genus (*Ussuriaspenites*) of the family Aspenitidae and 10 new ammonoid species (*Ussuriaspenites evlanovi*, *Monneticeras kalinkini*, *Brayardites involutus*, *Anasibirites simanenkoi*, *Prionites subtuberculatus*, *P. markevichi*, *Anawasatchites specious*, *Kashmirites shevyrevi*, *Xenoceltites? subvariocostatus*, and *Mianwaliites zimini*) are described. The *Anasibirites nevolini* Zone corresponds to late Smithian sequences of the Central Himalayas and Salt Range such as the *Wasatchites distractus*, *Subvishnuites posterus*, and *Glyptophiceras sinuatum* beds.

INTRODUCTION

In spite of significant progress in the study of Early Triassic ammonoids during the past two decades (e.g., Dagys and Ermakova, 1990; Shevyrev, 1990, 1995; Tozer, 1994; Brayard et al., 2006, 2007, 2009; Krystyn et al., 2007; Brayard and Bucher, 2008; Brühwiler et al., 2008, 2010; Shigeta et al., 2009; Ware et al., 2011a,b), our knowledge of that very important invertebrate group remains incomplete, particularly in regard to the late Smithian.

Earlier ammonoid studies of the Late Smithian *Anasibirites nevolini* Zone in the Artyomovka and Kamenushka river basins and Russian Island (South Primorye) were conducted on the basis of collections by Zakharov, (1968, 1978), Burij et al. (1972), Burij and Zharnikova (1972) and Zakharov and Rybalka (1987).

The objective of this paper is not only to describe new ammonoid taxa collected from the late Smithian *Anasibirites nevolini* Zone of the Artyom area (SMID Quarry section, 43°19'09.1''N, 132°10'05.3''E, Fig. 1), but also to investigate the stratigraphic distribution and diversity patterns of its ammonoid/conodont faunas and substantiate the upper boundary of the Milleri Zone in South Primorye. The studied ammonoid collection is kept at the FEGI (Vladivostok) under number 851.

OBSERVATIONS AND RESULTS

Geological Setting

The main area of investigation was a cratonic fragment (the Sergeevka terrane) that was obducted onto a Jurassic accretionary wedge. Together with the Bureya-Jiamusi-Khanka superterrane, it was located between the Sino-Korean craton to the south and the Sikhote-Alin fold belt to the east (Fig. 1A).

The Induan (Dienerian) Lazurnaya Bay Formation consists in the Artyom area mainly of about 120-135 m of shallow marine sandy facies, comprising course-grained clastics and sandstones with lenses of coquina and yielding bivalve and ammonoid remains of the *Gyronites subdharmus* Zone (Markevich and Zakharov, 2004). The overlying Olenekian Zhitkov Cape Formation consists of a deeper silty-pelitic sequence in its lower part, about 106.5 m thick, yielding the abundant and diversified ammonoids of the *Mesohedenstroemia bosphorensis* Zone (Early Smithian) and *Anasibirites nevolini* Zone (Late Smithian) (Markevich and Zakharov, 2004; Zakharov and Mousavi Abnavi, 2012, in press). The Anisian Karazin Cape Formation (> 100 m thick), which consists in the Artyom area mainly of fucoid sandstones with large septarian concretions and tuff layers, is present in isolated tectonic klippes (Markevich and Zakharov, 2004).

Distribution of Late Smithian Ammonoids in the SMID Quarry Section

The 45.6-m-thick sediments representing the late Smithian...
In ascending order, the succession of the lower Zhitkov Cape Formation is as follows:

**Member A (Milleri Zone)**

1. About 18 m of black mudstone with numerous large (7-20 cm diameter) calcareous-marl nodules and thick calcareous-marl lenses (30 cm) at base.

Thick calcareous-marl lenses and mudstone (samples 741-11b, c, d, e; 741-11(20, 21, 22); 743-1(1); 743-1(1, 3)) at the base contain rare rhytchonellid brachiopods, the bivalve *Posidoninia* sp., ammonoids Ussuriaspenites evlanovi gen et sp. nov., Pseudoaspedites sp., Monneticeras kalinkini sp. nov., Juvenites sp., Brayardites involutus sp. nov., Owenites sp., Inyoites sp., Anasibirites nevolini Burij and Zharnikova, A. simanenkoi sp. nov., Anasibirites sp., Hemiprionites klugi Brayard and Bucher, Hemiprionites contortus Burij and Zharnikova, H. ovalis Burij and Zharnikova, Priornites subtuberculatus sp. nov., Anawasatchites specious sp. nov., Hemiprionites cf. H. butleri (Mathews), Churkites syaskoi Zakharov and Shigeta (fragments), conodonts Ellisonia nevadensis Müller, Furnishia triserratus Clark, Hadrodontina sp., Ellisonia triassica (Müller), Neospathodus ex gr. waageni Sweet, Scythogondolella milleri (Müller), *Scythogondolella modesta* (Kozur and Mostler), Scythogondolella sp. (Bondarenko et al., this volume), and vertebrate fragments.

Large nodules (sample 741-12g) in the upper part yield the ammonoids Churkites syaskoi Zakharov and Shigeta and Monneticeras kalinkini sp. nov.

**Member B (“Hindeodella” Group B Beds)**

2. About 10 m of black mudstone intercalated with white, thin layers (2-3 mm) of calcareous marl (banded mudstone), with numerous 10-17 cm diameter, large, calcareous-marl nodules and rare thick lenses (35 cm) of calcareous marl at base.

A thick calcareous-marl lens (sample 741-12d) at base yields the bivalve *Posidoninia* sp., and ammonoids Brayardites involutus sp. nov., Churkites syaskoi Zakharov and Shigeta (fragments), Dieneroceras sp., Inyoites sp., Anasibirites nevolini Burij and Zharnikova, Anasibirites sp., Hemiprionites ovalis Burij and Zharnikova, Prionites subtuberculatus sp. nov., Anawasatchites specious sp. nov., Glyptophiceras cf. G. sinuatum (Waagen), Xenoceltites? subvariocostatus sp. nov., Hemilecanites discus Burij and Zharnikova, Mianwaliites zimini sp. nov., and conodonts

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**FIGURE 2. Distribution of late Smithian ammonoids in the SMID Quarry section (Anasibirites nevolini Zone).**
Neogondoledil S3-4 element (Group B), Neogondoledil P2 element, and Scythogondoledilla milleri (Müller) (Bondarenko et al., this volume).

Nodules (samples 743-1; 2; 743-1-2a; 743-13c) in the middle part contain ammonoids Arctoceras septentrionale (Diener), Arctoceras subhydaspis (Kiparisova), Churkites syaxaxi Zakharov and Shigeta, Pseudoaspidites multilobatum Noetling, Parussuria sp., Brayaardites involutus sp. nov., Meekoceratidae gen. et sp. nov., Anasibirites nevolini Burij and Zharnikova, Hemipronites klugi Brayard and Bucher, H. contortus Burij and Zharnikova, H. ovalis Burij and Zharnikova, Prionites markevichi sp. nov., Xenoceltites? subvaricostatus sp. nov., and Monneticeras kalinkini sp. nov.

**Member C**

3. About 4.5 m of banded mudstone consisting of black mudstone with intercalated thin, white calcareous marl layers (2-3 mm). Thicker (5-15 cm) calcareous marl lenses (741-12"o"; p; 742-1; 2; 742-12n, m) at the very base contain the ammonoids Monneticeras kalinkini sp. nov., Brayaardites involutus sp. nov., Dieneroceras sp., Anasibirites nevolini Burij and Zharnikova, A. simanenki sp. nov., Anasibirites sp., Hemipronites ovalis Burij and Zharnikova, and conodonts Dicritella discreta (Müller), Furnishius triserratus Clark, Hadrodontina sp., Ellisonia triassica (Müller), Neospathodus novaehollandiae McTavish (Bondarenko et al., this volume).

Similar calcareous marl lenses (741-12R; 742-3) near the base yield the ammonoids Arctoceras septentrionale (Diener), Arctoceras subhydaspis (Kiparisova), Meekoceras suberastatum Kiparisova, and Xenoceltites? subvaricostatus sp. nov.

Similar lenses (742-4; 742-4a, b, c; 742-4 (1, 2, 3, 4) at the top contain the bivalve Posidonia sp., rare gastropods, and numerous ammonoids: Arctoceras septentrionale (Diener), Churkites syaxaxi Zakharov and Shigeta, Ussuriaspenites evlanovi sp. nov., Pseudoaspidites sp., Brayaardites involutus sp. nov., Ovinites sp., Meekoceratidae gen. et sp. nov., Anasibirites nevolini Burij and Zharnikova, A. simanenki sp. nov., Hemipronites klugi Brayard and Bucher, Hemipronites contortus Burij and Zharnikova, Hemipronites ovalis Burij and Zharnikova, Prionites subtuberculatus sp. nov., Prionites markevichi sp. nov., Anawasatchites speciosus sp. nov., Kashmirites shevyrevi sp. nov., Xenoceltites? subvaricostatus sp. nov., Miamwalites zimini sp. nov., and Xenodiscoides? sp.

**Member D**

4. About 4 m of black, massive mudstone with very rare calcareous-marl nodules yields rare Arctoceras septentrionale (Diener) near the base.

**Member E**

5. About 9 m of black mudstone with numerous 3-4 cm diameter calcareous-marl nodules. Some nodules (741-12t; 742-6, 6a, 7) in the middle part yield Arctoceras septentrionale (Diener) and poor preserved Anawasatchites? sp. indet.

**CONCLUSIONS**

1. The extensive investigation of the Zhitkov Formation has demonstrated that the late Smithian (Olenekian) section in the SMID Quarry, South Primorye, encompassing the Anasibirites nevolini Zone, includes a unique and complete ammonoid succession as well as a nearly complete conodont record.

2. Ammonoids occurring in this section encompass the genera Anasibirites (three species), Anawasatchites (one species), Hemipronites (three species), Miamwalites (one species), Glyptophiceras (one species), and Xenoceltites? (one species), known in the upper Smithian of the Central Himalayas and Salt Range (Brühwiler et al., 2010, 2012a, in press; Ware et al., 2011a). It allows the correlation of the A. nevolini Zone in Primorye with the Wasatchites distresstratus, Subvishnuites posterus and Glyptophiceras simulatum beds, recently documented in Spiti and Nammal.

3. New data allow the correction of our knowledge on the stratigraphic distribution of some Smithian ammonoid genera. Judging from new results on ammonoid diversity of the Anasibirites nevolini Zone of the Artyom area, Brayaardites and Monneticeras, recently described on the basis of material from the middle Smithian of the Salt Range, Central Himalayas and Tibet (Brühwiler et al., 2010, 2012a, in press), as well as Parussuria, Pseudoaspidites, Joventites, and Dieneroceras, common for the middle Smithian in many regions of the world, seem to be middle-late Smithian in age. A similar age for Ovinites, Meekoceras, Arctoceras, Churkites, and Inoites was argued earlier on the basis of data from Kwangsi (Chao, 1959), Nevada and Idaho (Kummel and Steele, 1962; Jenks, 2007), Lower Hingan, Khabarovsk area (Okuneva, 1990), and the Abrek-Russian Island area, South Primorye (Kiparisova, 1961; Markevich and Zakharov, 2004; Shigeta et al., 2009; Zakharov et al., 2009).

4. The conodont “Milleri Zone” (Dagis, 1984; Buryi, 1979; Kopylova, 2008) extends in the SMID Quarry section in South Primorye to Member A of the ammonoid Anasibirites nevolini Zone.

**ACKNOWLEDGMENTS**

The research was carried out with the financial support of Russian FBR and FEB RAS grants (11-05-00785-a, 11-05-98538-r_vostok_a, 12-3-A-08-144 and 12-3-B-08-164). We gratefully acknowledge Prof. F. Hirsch (Japan) and Dr. J.F. Jenks (USA) for remarks and providing valuable editorial comments that substantially improved this paper. Our thanks to Dr. G.I. Buryi for her important remarks, Dr. A.V. Oleinikov and Dr. E.R. Dorokhovskaya for initial information on fossils from the Artyom area, and Dr. Y. Shigeta and Mr. A.A and C.A. Orekhov for help during the sample collection.

**SYSTEMATIC PALAEONTOLOGY**

By Yuri D. Zakharov and Olga P. Smyshlyaeva


Order PROLECANITIDA Miller and Furnish, 1954

Suborder SAGECERATINA Zakharov, 1983

Superfamily Sageceroidae Hyatt, 1884

Family Aspenitidae Spath, 1934

Genus Ussuriaspenites gen. nov.

Type species: Ussuriaspenites evlanovi gen. et sp. nov.

Composition of the genus: Type species only.

Etymology: Ussuri, a region name (old name for Primorye); Aspenites, a genus name.

Diagnosis: Moderately evolve laterally compressed oxyzone with very narrow, concave venter. Suture ceratitic, with small adventitious lobe and long auxiliary series.

Discussion: This genus differs from Pseudoaspidites Spath, 1934 by its narrow, concave venter.

Occurrence: Upper Smithian; South Primorye.

*Ussuriaspenites evlanovi* gen. et sp. nov.

*Fig. 3.5*

Holotype: DVGI 74/851, Figure 3.5.

Etymology: Named after Yuri B. Evlanov (Vladivostok).

Type stratum: Zhitkov Formation, Anasibirites nevolini Zone (samples: (1) from the strict level - 741-11c; (2) from float block – 742-4a).

Type locality: SMID Quarry at the Artyom environs, South Primorye.
FIGURE 3. Late Smithian ammonoids from the Anasibirites nevolini Zone, Artyom area, South Primorye, SMID quarry section (scale bar = 1 cm). 1, Pseudosageceras sp., DVGI 70/851. 2, Pseudosageceras multilobatum Frech, DVGI 71/851. 3-4, Pseudosipidites sp.; 3, DVGI 72/851, 4, DVGI 73/851. 5, Ussuriaspinites evlanovi sp. nov., holotype DVGI 74/851. 6-7, Parussuria sp.; 6, DVGI 76/851, 7, DVGI 77/851. 8-11, Monneticeras kalinkini sp. nov.; 8, holotype DVGI 78/851, 9, DVGI 79/851, 10, DVGI 80/851, 11, DVGI 81/851. 12, Arctoceras septentrionale (Diener), DVGI 82/851.
Material: 4 specimens.

Description: Moderately involute to moderately evolute, laterally very compressed shell with very narrow, convex venter and slightly convex, nearly smooth flanks; umbilicus very shallow, relatively broad, with very low wall and rounded shoulders; suture ceratitic (Fig. 9). Ventral lobe broad, divided by high and broad median saddle into two branches with restricted denticulations at base. One pair of small adventitious lobes was recognized on the median saddle, and second lateral saddle is larger than first and third saddles. L- and U1-lobes deep, with distinct denticulations at base; auxiliary series very short.

Denticulations at base; U1-lobe short with denticulations at base; auxiliary series significantly higher than third saddle. L-lobe is deep and broad, with many distinct denticulations at base; auxiliary series very short.

Dimensions in mm and ratios:

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Occurrence: Type locality and type horizon only.

Order CERATITIDA Hyatt, 1884

Suborder PROPTYCHITINA

Zakharov and Moussavi Abnavi, 2013

Superfamily Proptychitoidea

Zakharov and Moussavi Abnavi, 2013

Family Proptychitidae Waagen, 1895

Genus Monneticeras Brühwiler and Bucher, 2012a, in press

Type species: Monneticeras compressus Brühwiler and Bucher (in Brühwiler et al., 2012a, in press).

Monneticeras kalinkini sp. nov.

Figs. 3.8-3.11

Holotype: DVGI 78/851, Figs. 3.8a-b.

Etymology: Named after Nikolaj Y. Kalinkin (Vladivostok).

Type stratum: Zhiltov Formation, Anasibirites nevolini Zone (samples from the strict levels; e.g., 741-11c; 741-12d; 741-12p; 743-1(3); (2) from float block; e.g., 741-11, 741-11a, 741-11g, 741-12e; 742-4a, 743-1(5)).

Type locality: SMID Quarry near Artyom environs, South Primorye.

Material: 33 specimens.

Description: Moderately evolute, laterally compressed shell with slightly convex flanks. Venter narrowly rounded, with indistinct ventrolateral shoulders. Umbilicus shallow, with low, inclined wall and rounded shoulders. Surface ornamented with radial ribs and folds. Suture ceratitic (Fig. 9); ventral lobe wide and deep, divided by low median saddle into two branches with distinct denticulations at base. Second lateral saddle higher than first saddle; third saddle wide but low; L-lobe deep with denticulations at base; U1-lobe short with denticulations at base; auxiliary series very short.

Dimensions in mm and ratios:

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Remarks: Monneticeras kalinkini sp. nov. closely resembles M. compressus Brühwiler and Bucher (in Brühwiler et al., 2012a, in press), but differs by its more evolute shell and shorter auxiliary series.

Occurrence: Type locality and type horizon only.

Family Arctoceratidae Arthaber, 1911

Genus Brayardites Brühwiler, Bucher and Goudemand, 2010

Type species: Brayardites compressus Brühwiler, Bucher and Goudemand, 2010.

Brayardites involutus sp. nov.

Figs. 4.1-4.6

Holotype: DVGI 86/851, Figs. 4.4a-b.

Etymology: Named for its involute coiling.

Type stratum: Zhiltov Formation, Anasibirites nevolini Zone (samples: (1) from the strict levels - 741-11c; 741-12d; 741-12p; 743-1(3); (2) from float block; e.g., 741-11, 741-11a, 741-11g, 741-12e; 742-4a, 743-1(5)).

Type locality: SMID Quarry near Artyom, South Primorye.

Material: 27 specimens.

Description: Moderately involute shell. Flanks convex, with maximum whorl width near umbilical shoulder area; venter subtabulate with rounded shoulders; umbilicus moderately narrow, deep, with inclined wall and rounded shoulders. Ornamentation consists of radial ribs and folds that develop tubercles near umbilical shoulders and fade out on mid-flanks. Suture ceratitic (Fig. 10); ventral lobe wide, divided by low median saddle into two branches with narrow base, sometimes with two small denticulations; first lateral saddle higher than second saddle and significantly higher than third saddle. L-lobe is deep and broad, with many distinct denticulations at base; auxiliary series very short with denticulations at base; a few small auxiliary elements present on umbilical wall.

Dimensions in mm and ratios:

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Remarks: This species closely resembles B. compressus Brühwiler, Bucher and Goudemand, 2010, but differs by its more involute shell.

Occurrence: Type locality and type horizon only.

Suborder MEEKOCERATINA Druschits and Doguzhaeva, in Druschits et al., 1976

Superfamily Meekoceroidea Waagen, 1895

Family Meekoceratidae Waagen, 1895

Meekoceratidae gen. et sp. nov.

Fig. 4.7

Type stratum: Zhiltov Formation, Anasibirites nevolini Zone (sample from the strict level: 743-1(2a)).

Type locality: SMID Quarry near Artyom, South Primorye.

Material: One sample.

Description: Laterally compressed shell with evolute coiling. Flanks convex; maximum whorl width at the umbilical margin. Venter tabulate with slightly rounded ventrolateral shoulders. Umbilicus is broad with oblique wall and rounded shoulders. Surface ornamented strong radial ribs on inner whorls and low folds on outer whorls. Suture is ceratitic (Fig. 9). Ventral lobe divided by wide median saddle into two narrow branches with only two denticulations at base. First lateral saddle is significantly wider than second lateral saddle, L-lobe deep and wide with many distinct denticulations at base; U1-lobe short with denticulations at base.
FIGURE 4. Late Smithian ammonoids from the *Anasibirites nevolini* Zone, Artyom area, South Primorye, SMID quarry section (scale bar = 1 cm). 1-6, *Brayardites involutus* sp. nov.: 1, DVGI 83/851; 2, DVGI 84/851; 3, DVGI 85/851; 4, holotype DVGI 86/851; 5, DVGI 87/851; 6, DVGI 88/851. 7, Meekoceratidae gen. et sp. nov., DVGI 93/851. 8, *Arctoceras subhydaspis* (Kiparisova), DVGI 82/851.
Dimensions in mm and ratios:

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Remarks: This form seems to be a new genus of the family Meekoceratidae. It is close to Koiloceras Brühwiler and Bucher (in Brühwiler et al., 2012a, in press), from which it differs by lack of a distinct concavity near the umbilical margin, more primitive denticulation of ventral lobe and lack of suture auxiliary elements.

Occurrence: Type locality and type horizon only.

Family Prionitidae Hyatt, 1900
Genus Anasibirites Mojsisovics, 1896

Type species: Sibirites kingianus Waagen, 1895.

Anasibirites simanenkoi sp. nov.
Figs. 6.3-6.8

Holotype: DVGI 21/851, Figure 6.3.

Etymology: Named after Vladimir P. Simanenko (Vladivostok).

Type stratum: Zhitkov Formation, Anasibirites nevolini Zone (samples: (1) from the strict level - 741-11c, 741-12p; (2) from float blocks – e.g., 741-12e, 741-4a, 742-4a, and 743-13a).

Type locality: SMID Quarry near Artyom, South Primorye.

Material: 33 specimens.

Diagnosis: Laterally compressed shell with involute coiling and narrow, distinctive tabulate venter; flanks weakly convex; umbilicus narrow; umbilical wall nearly vertical, with rounded shoulders. Ornamentation consists of fine biconcave ribs. Suture ceratitic (Fig. 9); ventral lobe wide, but short; second lateral saddle significantly higher than first saddle; third saddle wide but low. L-lobe deep with distinct denticulations at base; U1-lobe short with denticulations at base; several auxiliary elements present on adumbilical flank and umbilical wall.

Dimensions in mm and ratios:

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<tr>
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<td>0.29</td>
<td>0.17</td>
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</table>

Remarks: Anasibirites simanenkoi sp. nov. closely resembles A. popowi Burij and Zharnikova, 1972, but differs by its more involute shell and finer ornamentation. From A. nevolini Burij and Zharnikova in Zakharov, 1968 it differs by its more involute and thinner shell and significantly weaker intraspecific variation of shell sculpture.

Occurrence: Type locality and type horizon only.

Genus Hemiprionites Spath, 1929

Type species: Goniodiscus typus Waagen, 1895.

Hemiprionites klugi Brayard and Bucher, 2008
Figs. 6.9-6.10


Type stratum: Zhitkov Formation, Anasibirites nevolini Zone (samples: (1) from the strict level - 741-11c, (2) from float blocks – e.g., 741-11b, 741-4a, 741-12b, 741-12e, 741-13a, and 741-15).

Type locality: SMID Quarry near Artyom, South Primorye.

Material: 22 specimens.

Dimensions in mm and ratios:

<table>
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<tr>
<th>Specimen no.</th>
<th>D</th>
<th>H</th>
<th>W</th>
<th>U</th>
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<td>DVGI 40/851</td>
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<td>6.6</td>
<td>-</td>
<td>2.1</td>
<td></td>
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</tr>
</tbody>
</table>

Remarks: This form closely resembles Hemiprionites klugi Brayard and Bucher, 2008 in overall shell morphology and suture (Fig. 9).

Occurrence: Type locality and type horizon only.

Genus Prionites Waagen, 1895

Type species: Prionites tuberculatus Waagen, 1895.

Prionites tuberculatus sp. nov.
Figs. 6.18-6.19; 7.1-7.2

Holotype: DVGI 42/851, Figure 6.18.

Etymology: Sub- (Latin) next; P. tuberculatus, a species name.

Type stratum: Zhitkov Formation, Anasibirites nevolini Zone (samples: (1) from the strict level - 741-11c, 741-12d, 741-12p, (2) from float blocks – e.g., 742-12e, 742-4a).

Type locality: SMID Quarry near Artyom, South Primorye.

Material: 27 specimens.

Diagnosis: Moderately involute shell with egressive coiling at maturity and maximum whorl width at about upper third of flank; venter tabulate with angular or rounded shoulders. Umbilicus fairly narrow, deep, with incline wall and rounded shoulders. Growth lines and folds biconcave. Suture ceratitic (Fig. 10); ventral lobe moderately wide and short, divided by narrow median saddle into two branches with four strong denticulations; all lateral saddles wide, but third one lower than first and second saddles; L- and U1-loupe deep with many strong denticulations at base; denticulated adjacent lobe short and wide.

Dimensions in mm and ratios:

<table>
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<tr>
<th>Specimen no.</th>
<th>D</th>
<th>H</th>
<th>W</th>
<th>U</th>
<th>H/D</th>
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<td>4.9</td>
<td>0.36</td>
<td>0.17</td>
<td>0.14</td>
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</tbody>
</table>

Remarks: Prionites subtuberculatus sp. nov. closely resembles P. tuberculatus Waagen, 1895, but differs by its more involute shell and lack of distant bulae or tubercles on inner flank.

Occurrence: Type locality and type horizon only.

Prionites markevichi sp. nov.
Figs. 6.20-6.21

Holotype: DVGI 48/851, Figure 6.20.

Etymology: Named after Pavel V. Markevich (Vladivostok).
FIGURE 6. Late Smithian ammonoids from the Anasibirites nevolini Zone, Artyom area, South Primorye, SMID quarry section (scale bar = 1 cm). 1-2, Anasibirites nevolini Burij and Zharnikova: 1, DVGI 26/851; 2, DVGI 27/851. 3-8, Anasibirites simanenki sp. nov.: 3, holotype DVGI 21/851; 4, DVGI 28/851; 5, DVGI 29/851; 6, DVGI 30/851; 7, DVGI 31/851; 8, DVGI 32/851. 9-10, Hemipriionites klugi Brayard and Bucher: 9, DVGI 34/851; 10, DVGI 33/851. 11-12, Hemipriionites contortus Burij and Zharnikova: 11, DVGI 36/851; 12, DVGI 35/851. 13-17, Hemipriionites ovalis Burij and Zharnikova: 13, DVGI 39/851; 14, DVGI 40/851; 15, DVGI 38/851; 16, DVGI 37/851; 17, DVGI 37/851. 18-19, Prionites subthuberculatus sp. nov.: 18, holotype DVGI 42/851; 19, DVGI 44/851. 20-21, Prionites markevichi sp. nov.: 20, holotype DVGI 48/851; 21, DVGI 49/851.
Type stratum: Zhitkov Formation, *Anasibirites nevolini* Zone (samples from float blocks: 742-4a-1 and 741-4a-2).

**Type locality**: SMID Quarry at Artyom, South Primorye.

**Material**: Two specimens.

**Description**: Moderately involute shell with regressive coiling at maturity and maximum whorl width at about upper third of flank; venter tabulate with angular shoulders; umbilicus from moderately narrow to moderately wide, deep, with incline wall and rounded shoulders; growth lines and distinct folds biconcave. Suture is ceratitic (Fig. 10); ventral lobe moderately wide and very short, divided by narrow median saddle into two branches with strong denticulations at base; first and third lateral saddles significantly lower than second saddle; L- and U1-lobes with many strong denticulations at base; many auxiliary elements present on adumbilical flank and umbilical wall.

**Dimensions in mm and ratios**:

<table>
<thead>
<tr>
<th>Specimen no.</th>
<th>D</th>
<th>H</th>
<th>W</th>
<th>U</th>
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<td>12.9</td>
<td>0.44</td>
<td>0.31</td>
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</table>

**Remarks**: This species closely resembles *P. subteberculatus* sp. nov., but differs by its more evolute shell and significantly higher second saddle of suture.

**Occurrence**: Type locality and type horizon only.

**Genus Anawasatchites** McLearn, 1945

**Type species**: *Anawasatchites tardus* McLearn, 1945.

**Anawasatchites speciosus** sp. nov.

Figs. 7.3-7.4

**Holotype**: DVGI 110/851, Figure 7.3.

**Etymology**: Latin for “beautiful.”

**Type stratum**: Zhitkov Formation, *Anasibirites nevolini* Zone (samples: (1) from the strict levels - 741-12d, 743-1(3); (2) from float blocks - e.g., 741-11b, 742-4a).

**Type locality**: SMID Quarry at Artyom, South Primorye.

**Material**: Five specimens.

**Description**: Moderately involute shell with egressive coiling at maturity and maximum whorl width at adumbilical flank; venter tabulate with angular shoulders. Umbilicus is moderately broad, deep, with almost vertical wall and rounded shoulders. Ornamentation consists of strong bifurcated radial ribs with tubercles on adumbilical flank and ventral shoulders. Suture ceratitic (Fig. 10D); ventral lobe deep, divided by narrow median saddle into two branches with denticulations at base; first lateral saddle somewhat higher than second saddle, third saddle small; L-lobe deep and wide, with many strong denticulations at base; U1-lobe significantly lower and shorter than L-lobe with some denticulations at base; several auxiliary elements present on umbilical wall.

**Dimensions in mm and ratios**:

<table>
<thead>
<tr>
<th>Specimen no.</th>
<th>D</th>
<th>H</th>
<th>W</th>
<th>U</th>
<th>H/D</th>
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<td>20.0</td>
<td>0.43</td>
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</tbody>
</table>

**Remarks**: *Anawasatchites speciosus* sp. nov. resembles closely *A. vlasovii* Burij and Zhanrikova, 1972, but differs by its more involute shell and deeper ventral lobe.

**Occurrence**: Type locality and type horizon only.

**Superfamily Xenodiscoidea** Frech, 1902

**Family Xenoceltitidae** Spath, 1930

**Genus Kashmirites** Diener, 1913

**Type species**: *Celtites armatus* Waagen, 1895.

**Kashmirites shevyrevi** sp. nov.

Figs. 7.8-7.9

**Holotype**: DVGI 115/851, Figs. 7.8a-b.

**Etymology**: Named after Alexander A. Shevyrev (Moscow).

**Type stratum**: Zhitkov Formation, *Anasibirites nevolini* Zone (samples) from float blocks: 742-4a-1 and 742-4a-2.

**Type locality**: SMID Quarry at Artyom, South Primorye.

**Material**: Two specimens.

**Description**: Moderately involute, serpentionic shell with broad, arched venter, rounded ventrolateral shoulders, and generally flat, parallel flanks. Umbilicus moderately narrow with high, incline wall and rounded shoulders. Radial ribs arising on umbilical shoulders, becoming weakly projected and fading on ventrolateral shoulders. Suture ceratitic (Fig. 10); ventral lobe short, divided by narrow median saddle into two branches with very small denticulations at base; first and second lateral saddles high; third saddle small; L-lobe deep and wide, with four strong denticulations at base; U1-lobe significantly shorter than L-lobe with some denticulations at base; next lobe on umbilical wall very small.

**Dimensions in mm and ratios**:

<table>
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<tr>
<th>Specimen no.</th>
<th>D</th>
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<th>U</th>
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<td>16.0</td>
<td>0.41</td>
<td>0.33</td>
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</table>

**Remarks**: *Kashmirites shevyrevi* sp. nov. closely resembles *K. subdimorphus* Kiparissova, 1961, but differs by its more involute shell and denticulated ventral lobe.

**Occurrence**: Type locality and type horizon only.

**Genus Xenocellites** Spath, 1930

**Type species**: *Xenocellites subvariocostatus* Frebold, 1930.

**Xenocellites? subvariocostatus** sp. nov.

Figs. 8.1-8.4

**Holotype**: DVGI 56/851, Figs. 8.1a-b.

**Etymology**: Sub- (latin), next, *X. variocostatus*, a species with variable ribs.

**Type stratum**: Zhitkov Formation, *Anasibirites nevolini* Zone (samples: (1) from the strict levels - 741-11c, 741-12d, 741-12p, (2) from float blocks - e.g., samples 741-12e, 742-4a, and 742-4g).

**Type locality**: SMID Quarry of the Artyom environs, South Primorye.

**Material**: 24 specimens.

**Description**: Moderately evolute, compressed platicone with narrow rounded venter, rounded ventrolateral shoulders, and slightly convex flanks. Umbilicus is moderately broad, with low vertical wall and rounded shoulders. Flanks ornamented with radial ribs and folds, which are strongest on inner whorls, but become finer on outer whorls. Flanks of one of sample ornamented additionally with fine striation. Suture ceratitic (Fig. 11); ventral lobe wide, but short; first lateral saddle somewhat higher than second saddle; third saddle wide but low. L-lobe deep with many distinct denticulations at base; U1-lobe short with distinct denticulations at base; small auxiliary elements present on adumbilical flank and umbilical wall.

**Dimensions in mm and ratios**:

<table>
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<tr>
<th>Specimen no.</th>
<th>D</th>
<th>H</th>
<th>W</th>
<th>U</th>
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<td>10.2</td>
<td>15.0</td>
<td>0.37</td>
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</tbody>
</table>

**Remarks**: The new species apparently closely resembles *X. variocostatus* Braynard and Bucher, 2008, but differs by a more evolute shell, ornamentation and presence of auxiliary elements.
FIGURE 7. Late Smithian ammonoids from the Anasibirites nevolini Zone, Artyom area, South Primorye, SMID quarry section (scale bar = 1 cm). 1-2, Prionites subtuberculatus sp. nov.: 1, DVGI 108/851; 2, DVGI 109/851. 3-4, Anawasatchites speciosus sp. nov.: 3, holotype DVGI 110/851; 4, DVGI 111/851. 5-7, Anawasatchites vlasovi Burij and Zharnikova: 5, DVGI 112/851; 6, DVGI 113/851; 7, DVGI 114/851. 8-9, Kashmirites shevyrevi sp. nov.: 8, holotype DVGI 115/851; 9, DVGI 116/851.

Type species: *Xenodiscus perplicatus* (Frech, 1905).

*Fig. 8.9*

**Type stratum:** Zhitkov Formation, *Anasibrites nevolini* Zone (sample from float block: 742-2a).

**Type locality:** SMID Quarry at Artyom, South Primorye.

**Material:** One sample.

**Description:** Evolute, laterally compressed shell with slightly convex flanks. Venter subtabulate with rounded ventrolateral shoulders. Umbilicus is broad, with low vertical wall and rounded shoulders. Flanks ornamented with strong radial ribs and folds, become weak on ventrolateral area. Suture is ceratitic (Fig. 11); ventral lobe short; first lateral saddle somewhat lower but significantly narrower than second saddle; third saddle small. L-lobe deep with many distinct denticulations at base; U1-lobe short with distinct denticulations at base; distinct auxiliary elements present on adumbilical flank and umbilical wall.

**Dimensions in mm and ratios:**

<table>
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<tr>
<th>Specimen no.</th>
<th>D</th>
<th>H</th>
<th>W</th>
<th>U</th>
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<td>0.18</td>
<td>0.40</td>
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</table>

**Remarks:** This species resembles *X. involutus* (Frech, 1905), but differs by its more evolute shell and stronger ornamentation of outer whorls.

**Occurrence:** Type locality and type horizon only.

**Family Palaeophyllitidae** Popow, in Kiparisova and Popow, 1958

**Genus *Mianwaliites*** Brühwiler and Bucher, in Brühwiler et al., 2012a, in press

**Type species:** *Mianwaliites multiradiatus* Brühwiler and Bucher, in Brühwiler et al., 2012a, in press.

*Figures 8.10-8.15*

**Holotype:** DVGI 120/851, Figure 8.13.

**Etymology:** Named after Stepan S. Zimin (Vladivostok).

**Type stratum:** Zhitkov Formation, *Anasibrites nevolini* Zone (samples: (1) from the strict level - 741-12d, (2) from float blocks - e.g., - 741-12e and 742-5a).

**Type locality:** SMID Quarry at Artyom, South Primorye.

**Material:** 12 specimens.

**Description:** Evolute, laterally compressed shell with slightly convex flanks. Venter narrow rounded with indistinct ventrolateral shoulders. Umbilicus is broad, with oblique wall and rounded shoulders. Flanks ornamented with distinct, inclined radial ribs on inner whorls and folds on outer whorls. Suture ceratitic (Fig. 11); ventral lobe very short with narrow branches; first lateral saddle somewhat higher than second saddle, which is weakly phylloid; third saddle wide but low. L-lobe is deep with many distinct denticulations at base; U1-lobe very narrow with distinct denticulations at base; small U2-lobe with no any denticulations.

**Dimensions in mm and ratios:**

<table>
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<th>Specimen no.</th>
<th>D</th>
<th>H</th>
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<td>0.38</td>
<td>0.22</td>
<td>0.45</td>
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</table>

**Remarks:** New species apparently closely resembles *M. multiradiatus* Brühwiler and Bucher (in Brühwiler et al., 2012), but differs by its more evolute shell, and presence of significantly narrower branches of the ventral lobe, characterized by more primitive denticulation.

**Occurrence:** Type locality and type horizon only.
Ware, D., Jenks, J.F., and Hauptschlagar, M., 2011b, Dienerian (Early Triassic) ammonoids from the Candelaria Hills (Nevada, USA) and their significance for palaeobiogeography and palaeocenography: Swiss Journal of Geoscience. DOI 10.1007/s00015-011-0055-3.