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ABSTRACT: The lower part of the Garden Valley Formation yields two distinct conodont faunas. One of late Asselian age dominated by *Mesogondolella* and *Streptognathodus* and one of Artinskian age dominated by *Sweetognathus* with *Mesogondolella*. The Asselian fauna contains the same species as those found in the type area of the Asselian in the southern Urals including *Mesogondolella dentiseparata*, described for the first time outside of the Urals. Apparatuses for *Sweetognathus whitei*, *Diplognathodus stevensi*, and *Idioprioniodus* sp. are described. The Garden Valley Formation represents a marine pro-delta basin and platform, and marine and shore fan delta complex deposition. The fan-delta complex was most likely deposited from late Artinskian to late Wordian. The Garden Valley Formation records tremendous swings in depositional setting from shallow-water to basin to shore.

Keywords: Garden Valley Formation, late Asselian, Artinskian, *Mesogondolella dentiseparata*, southern Urals affinities, conodont apparatus

INTRODUCTION

The Garden Valley Formation forms the front ridge of the Sulphur Springs Range in Eureka County, Nevada. It was originally named and described by Nolan et al. (1956). The formation consists of fossiliferous marine limestone at its base and massive ridge-forming siliceous conglomerate near its top. This formation has been the subject of several Master's theses (Amateis 1981; Lipka 1987; Mahoney 1979; Sumsion 1974) but little information has been published. Gallegos et al. (1991) described a section at McCloud Springs that we use here for a composite reference section. The timing of the conglomeratic deposition is key to understanding local tectonic events. Though most of the conglomeratic sequence is devoid of fossils, the basal limestone can be accurately placed in the international Permian time scale (Gradstein et al. 2004, 2012) by its contained conodont faunas.

We report on seven sections of the Garden Valley Formation (text-fig. 1), four through the entire exposed section (TGS-1; TGN-1, 2; SVN; and 88DG) and three through the basal limestone only (TGS-3, MCS-1, MCS-3). Our data has been generated by three separate efforts in the Sulphur Springs Range: by unpublished work by Wardlaw in the Tyrone Gap area beginning in 1970, support for graduate studies at Eastern Washington State University by Morrison and Wardlaw from 1981-1985, and investigations by Snyder and Gallegos in 1988 (published, Gallegos et al. 1991).

Stratigraphy

Nolan et al. (1956) divided the Garden Valley Formation into four informal members: a basal limestone member (member 1), a conglomerate, sandstone and shale member (member 2), a resistant siliceous conglomerate (member 3), and a purple and red shale with conglomerate member (member 4). Member 4 is poorly exposed near Tyrone Gap and is faulted out in our northern sections.

Member 1 consists of three units (text-fig. 2), a lower unit of limestone, a middle unit of mixed thin-bedded limestone and siliciclastics and medium-bedded limestone, and an upper unit of limestone and conglomerate. Unit 1 consist of packstone that appears to represent a deepening upwards sequence going from a cross-stratified, locally pebbly limestone to a fossiliferous limestone dominated by fusulinids and brachiopods with bryozoans, crinoids, and phylloid algae. This unit represents shallow shelf deposition. Unit 2 consists of thin-bedded carbonate mudstone, silty carbonate mudstone, and calcareous siltstone with interbeds of fine-grained silty to sandy packstone. Carbonate mudstone concretions and phosphatic nodules occur in some of the thin siltstone beds and some concretions contain well preserved ammonoids. This unit represents basinal deposition with distal turbiditic flows exemplified by the packstone. The contact between unit 1 and 2 is sharp and the change in depositional environment is dramatic. The boundary is an undulatory surface with localized siliceous alteration and represents either a

TABLE 1
Samples and conodonts recovered. The McCloud Springs section terminates with a fault. MCS-3-140.8 represents a sample above the fault that yielded a Triassic fauna with Garden Valley elements reworked into it.

Sample	mab	1	2	3	4	5	6	7	8	9	10
88DGC20	5.00	-	X	-	X	-	X	-	-	-	
88DGC21	10.00	-	-	-	-	-	-	-	X	-	
88DGC22	23.00	-	-	-	-	-	-	-	-	-	
88DGC23	26.50	-	-	-	-	-	-	-	-	-	
WSS8813	54.00	X	X	-	-	X	-	-	-	X	
88DGC24	66.30	X	-	-	-	-	-	-	-	X	
88DGC25	86.30	-	X	-	-	-	-	-	-	-	
88DGC26	116.30	-	-	-	-	-	-	-	-	-	
88DGC27	142.50	-	X	-	-	-	-	-	-	X	
88DGC28	144.00	-	?	-	-	-	-	-	-	-	
88DGC29	145.70	-	-	-	-	-	-	-	-	-	
88DGC30	152.00	-	?	-	-	-	-	-	-	?	
88DGC31	155.00	-	-	-	-	-	-	-	-	-	
Top Unit 1	159.00										
88DGC32	213.50	-	-	-	-	-	-	-	-	-	
88DGC33	261.50	-	-	-	-	-	-	-	-	-	
88DGC34	228.00	-	-	-	-	-	-	-	-	-	
MCN-1-1.3	1.30	-	-	X	X	-	-	X	X	-	
MCN-1-1.9	1.90	-	-	-	-	-	-	X	X	-	
MCN-1-3.6	3.60	-	-	-	-	-	X	-	X	-	
MCN-1-5.6	5.60	-	-	-	X	-	X	X	X	-	
MCS-3-0.75	0.75	-	X	X	X	-	-	X	-	-	
MCS-3-2.2	2.20	-	X	X	X	-	-	X	-	-	Ordovician
MCS-3-5.8	5.80	-	-	-	X	-	-	X	-	-	
MCS-3-7.3	7.30	-	-	-	X	-	X	X	X	-	
MCS-3-8.8	8.80	-	-	-	X	-	-	X	X	-	
MCS-3-11.8	11.80	-	X	-	X	-	-	X	X	-	
MCS-3-13.4	13.40	-	-	-	X	-	-	-	X	-	
MCS-3-14.5	14.50	-	-	X	X	-	-	-	X	-	
MCS-3-103.1	103.10	-	-	-	-	X	-	-	-	-	
MCS-3-134.65	134.65	-	-	-	-	-	-	-	-	-	Pennsylvanian
MCS-3-140.8	140.80	-	-	-	-	@	-	@	-	-	Permian
SVN-0	0.00	-	?	-	-	-	-	-	-	-	
SVN-5.8	5.80	-	X	-	X	-	X	X	X	-	
SVN-19,1	19.10	-	-	-	X	-	X	-	-	-	
SVN-102.7	102.70	-	-	-	-	X	-	-	-	X	Permian
TGN-1L-0.3	0.30	-	-	-	X	-	-	X	-	-	
TGN-1L-2.9	2.90	-	-	-	-	-	-	?	-	-	
TGN-1L-3.7	3.70	-	-	X	X	-	X	X	-	-	Pennsylvanian
TGN-3.7	3.70	-	X	-	X	-	-	X	-	-	Permian
TGN-1L-6.7	6.70	-	-	-	X	-	-	X	-	-	
TGN-1U-136.5	136.50	-	-	-	-	-	-	-	-	X	
TGN-2L-0	0.00	-	-	-	-	-	-	-	-	-	Pennsylvanian
TGN-2L-2.5	2.50	-	-	-	-	-	?	-	-	-	
TGN-2L-3.9	3.90	-	-	-	-	-	-	X	-	-	
TGS-3L-0	0.00	-	-	-	-	-	?	-	-	-	Pennsylvanian
TGS-3L-3	3.00	-	-	-	-	-	-	-	-	-	Ord.,Dev.,Penn.
TGS-3L-5.8	5.80	-	X	-	-	-	X	-	-	-	Pennsylvanian
TGS-3L-7	7.00	-	X	X	X	-	X	-	-	-	
TGS-3L-9	9.00	-	-	X	X	-	-	X	-	-	
TGS-3L-11.5	11.50	-	-	-	X	-	X	X	-	-	
TGS-3L-14	14.00	-	-	-	X	-	X	X	-	-	
TGS-1L-0	0.00	-	-	-	X	-	X	-	-	-	
TGS-1L-9.4	9.40	-	X	X	X	-	X	X	-	-	
TGS-1L-11.4	11.40	-	X	X	X	-	X	-	-	-	
TGS-1L-14.4	14.40	-	-	-	?	-	-	-	-	-	
TGS-1U-131.3	131.30	-	-	-	-	-	-	-	-	X	

1 *Diplognathodus stevensi*
2 *Hindeodus permicus*
3 *Idioprioniodus* sp.
4 *Mesogondolella dentiseparata*
5 *Mesogondolella bisselli*
6 *Streptognathodus constrictus*
7 *Streptognathodus fusus*
8 *Sweetognathus expansus*
9 *Sweetognathus whitei*
10 Reworked Conodonts

non-deposition (hardground) or exposure surface (with limited paleokarst features). The lack of any Sakmarian fossils in the section (see biostratigraphy) strongly suggests this surface represents an unconformity.

Included in member 1 is a mixed carbonate and siliciclastic unit (unit 3) that in the lower part is packstone with minor sandy carbonate mudstone to calcareous sandstone lenses that is channelized by calcareous sandstone to cobble conglomerate and quartzose sandstone. Cobbles include limestone similar to units 1 and 2 and rocks similar to the locally exposed Mississippian Diamond Peak Formation and suggest reworking of these lower units. The angularity of the clasts suggests a very local source. This unit represents the nearshore depositional environment of a fan-delta complex. The uppermost carbonate mudstone of unit 2 is silicified and the sharp contrast in depositional character represents an unconformity. The upper part of unit 3 is skeletal packstone. The return of packstone deposition in unit 3 suggests a return to shallow-shelf deposition similar to unit 1 that is channelized in its lower part by the distal lobe of a fan-delta.

The units above unit 3 are unfossiliferous in our sections and appear to represent an overall shallowing upwards sequence of a prograding fan-delta.

Member 2 includes units 4 and 5. Unit 4 is comprised of sheet sandstone, conglomerate and mudstone with little evidence of channels and no marine (fossil) indicators. Conglomerate clasts include siltstone, sandstone, chert, and limestone. This group of rocks is interpreted as a fan delta lobe more distal from shore than unit 3 (Gallegos et al. 1991). Unit 5 is comprised of conglomerate. The clasts are almost entirely chert in the lower bed and that bed channels into the underlying upper sandstone of unit 4.

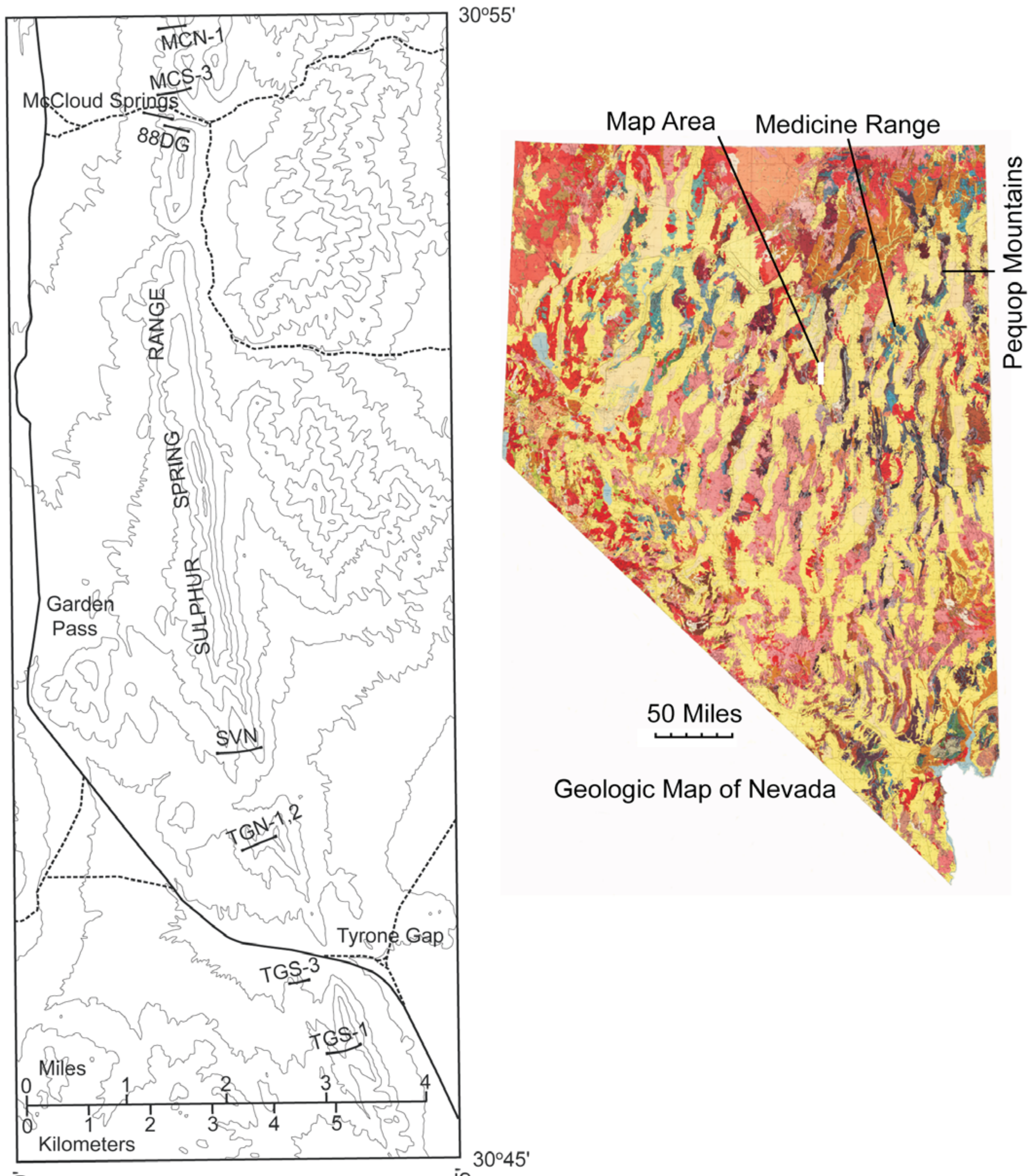
Member 3 includes units 6, 7, and 8. Unit 6 is comprised of channelized conglomerate and pebbly quartzose sandstone. The lower bed is silicified (siliceous cement) marking the base of member 3. The upper part of unit 6 appears to be transitional to unit 7 with interbedded sand and conglomerate and the sand becoming more stratified and less pebbly upward. Unit 7 is a quartzose sandstone with rare channels. This sand is mature with planar cross stratified wedge sets and suggests an upper shoreface to beach environment of deposition. The upper part of unit 7 is covered by debris from the ridge-forming conglomerate of unit 8 and is assumed to be similar to the sand below. Unit 8 is a silicified coarse pebble to cobble conglomerate. Fine pebble conglomerate and rare sandstone also occur within the unit. Large floating clasts also occur in all lithologies. The unit is heavily silicified, hematite stained, and only chert and quartzite clasts were identified. The unit shows shallow cross stratification, parallel stratification, imbricate pebbles, and inverse and normal graded bedding. This unit represents subaerial alluvial fan deposition (Gallegos et al. 1991).

It appears that in the Garden Valley Formation, siliceous cement is an indicator for fresh-water alteration. Each exposure surface is silicified and the silicified conglomerate appears to be a subaerial deposit.

Biostratigraphy

Recovery of conodonts from member 1 is not consistent. A few samples yielded abundant conodonts in each of our sections with most samples yielding just a few conodonts. To better understand the distribution of the contained conodonts we graphically correlated each section (Table 1) to the McCloud Springs Section measured by Gallegos et al. (1991) which was also measured by Morrison and Wardlaw, so gave us a standard for our mixed data sets.

Unit 1 conodont faunas are dominated by *Streptognathodus* and *Mesogondolella*. Unit 2 conodont faunas are dominated by *Sweetognathus*. Graphic correlation (Table 2) suggests that all unit 1 faunas fall within the range of *Streptognathodus constrictus* and *S. fusus.* These two species overlap ranges in Kansas in the Cottonwood Limestone Member of the Beattie Limestone (Boardman et al. 2009).



TEXT-FIGURE 1
Location of sections of the Garden Valley Formation. MCN-1, McCloud Springs-North (measured by S. E. Morrison); MCS-3, McCloud Springs-South (measured by S. E. Morrison); 88DG, McCloud Springs (measured by Gallegos and Snyder); SVN, Spring View North (measured by S. E. Morrison); TGN-1,2, Tyrone Gap North (measured by S. E. Morrison and Wardlaw); TGS-3, Tyrone Gap South 3 (measured by S. E. Morrison and Wardlaw); TGS-1, Tyrone Gap South 1 (measured by S. E. Morrison and Wardlaw).

TABLE 2
Ranges derived from graphic correlation to the McCloud Springs Composite Section.

Species	McCloud Springs Composite First Appearance	Last Appearance
Streptognathodus constrictus	-3.91	10.15
Mesogondolella dentiseparata	-3.91	10.15
Idioprioniodus sp.	0.13	10.00
Hindeodus permicus	0.13	152.00
Streptognathodus fusus	0.64	10.15
Sweetognathus expansus	3.17	10.00
Mesogondolella bisselli	54.00	54.00
Diplognathodus stevensi	54.00	66.30
Sweetognathus whitei	54.00	152.00

Unit 1 matches the *Streptognathodus fusus-postfusus* zone from the Asselian type area in the southern Urals exactly; both contain *S. fusus, S. constrictus, Mesogondolella dentiseparata,* and *Sweetognathus expansus* (Chernykh 2005). It is late Asselian, but not latest. The ensuing zone, *S. barskovi* marks the top of the Asselian and is not present in the Garden Valley.

Sweetognathus whitei is the proposed indicator species for the base of the Artinskian in the southern Urals (Chuvashov et al. 2002). *Sw. whitei* ranges through most of the Artinskian. Kerner (2003) reports the overlap of *Diplognathodus stevensi* and *Mesogondolella bisselli* from the upper part of the lower Artinskian in the Aktasky Hills section, Kazakhstan (not from the lowermost part of the Artinskian that contains a different *Mesogondolella* species). Though conodont faunas are missing in a short interval in the base of unit 2, it appears since the first faunas are not earliest Artinskian that the entire of unit 2 is probably Artinskian in age. No Sakmarian conodonts (or other fossils) have been recovered.

Amateis (1981) recovered some conodonts from the top of the Garden Valley Formation (member 4, not dealt with here) which one author (BRW) identified in 1981 from SEM photos of the specimens as *Mesogondolella bitteri*, a form common to the upper part of the Gerster Limestone in nearby Medicine Range (Wardlaw and Collinson 1979) and indicative of a late Wordian age. We have been unable to replicate this fauna. However, we have recovered Triassic conodonts (mostly *Neospathodus bicuspidatus*, Smithian) with reworked Permian conodonts from isolated fault blocks from the backside of the Sulphur Springs Range (east side) and north of McCloud Springs (text-fig. 1) within the range. The faunas are sparse and their stratigraphic context is hard to ascertain because of poor exposure. However, in nearby ranges, such as the Medicine Range, a *N. bicuspidatus* fauna is typical of the Thaynes Formation (Wardlaw, unpublished material).

The biostratigraphic constraints on tectonic events indicate an unconformity between unit 1 and unit 2 that represents latest Asselian and Sakmarian time. It is possible that some lowest Artinskian strata may also be missing. Fan delta deposition indicating local uplift initiated no earlier than latest Artinskian. If the faunas recovered by Amateis are in place and not reworked, the bulk of conglomerate deposition (members 2 and 3) was latest Artinskian through late Wordian. The consistent presence of Triassic (Smithian) faunas with reworked Permian forms suggests that a feather-edge of the Thaynes Formation was deposited in the area and further suggests that probably all conglomerate deposition ended by Smithian time.

The compilation of sandstone bed thickness by Wardlaw (2015, this volume) in the Plympton and Gerster Formations (Roadian-Wordian in age) shows a tremendous thickening toward the Sulfur Springs Range and implies that the Garden Valley delta complex was active during Roadian-Wordian time and that the possible late Wordian cessation of fan delta development suggested by Amateis' (1981) conodont faunas may be correct.

Interpretation

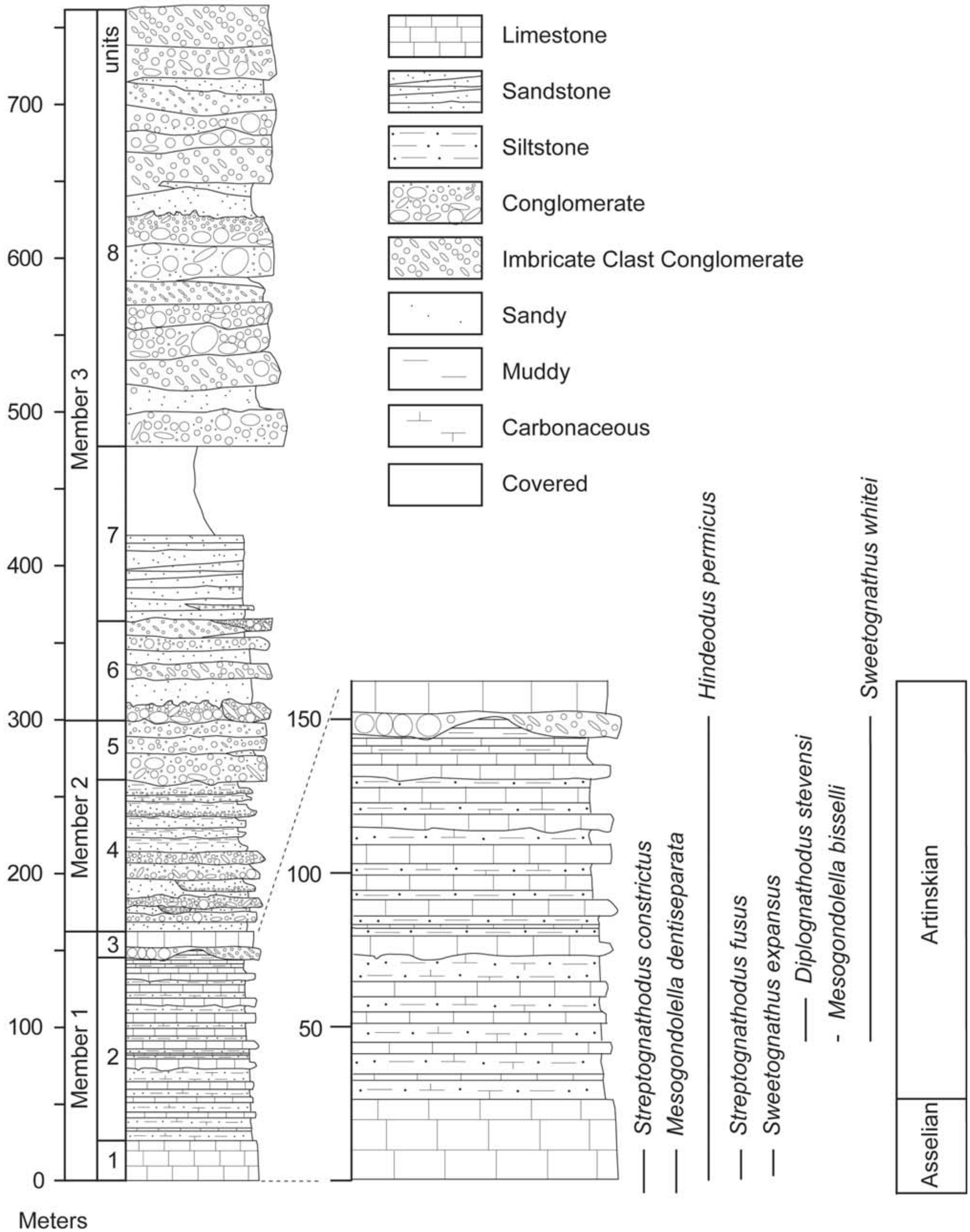
If we recast the stratigraphic section (text-fig. 2) into a grain-size scale modified from the online stratigraphic tools provided by PaleoStrat (now GeoStratSys, text-fig. 3) we get a much better picture to interpret the sequence stratigraphy of the Garden Valley Formation (text-fig. 4). The grain-size scale is applicable to both carbonate and clastic rocks and shows fining-upwards, coarsening upwards, and cyclic sequences much better than a traditional weathering profile stratigraphic column.

Each change in depositional character appears to be related to a major relative sea-level fall and probable exposure surface. Member 1 represents marine deposition. The basinal deposits of unit 2 are bracketed by shallow-shelf carbonate packstone, implying a substantial relative sea-level rise to develop the basinal depositional setting. The regularity of turbiditic carbonate packstone interbedded with carbonate mudstone and siliciclastic siltstone suggests proximity to slope and regular relative sea level fluctuations. The basin was probably never deep, as suggested by the return of shallow shelf deposition; it was probably just far from shore. Member 2 represents marine distal lobe conglomerate and interlobe sand deposition of a fan delta complex. Units 6 and 7 of member 3 represents marginal marine to shore distal lobe conglomerate and sand deposition. Unit 8 of member 3 represents lobe and interlobe subaerial deposition.

The marine to marginal marine distal lobe deposition (units 4-7) probably represents contemporaneous deposition to the Pequop Formation. Unit 8 probably represents deposition contemporaneous with the Plympton and Gerster Formations, but not the uppermost part. The poorly outcropping upper member (member 4) of the Garden Valley Formation probably represents the shoreward feather-edge of the upper Park City Group deposition overlapping the delta complex and that unit is highly eroded and sporadically distributed and overlain by the shoreward feather edge of the Thaynes Formation. Major exposure surfaces appear between the upper Asselian unit 1 and the Artinskian unit 2, between the probably Roadian-Wordian unit 8 and the probably upper Wordian Member 4, and between the probably upper Wordian Member 4 and the Smithian Thaynes Formation. The bulk of Garden Valley deposition appears to be Kungurian-Roadian based on the Artinskian faunas in the upper part of member 1 and the Wordian faunas in member 4. The sand and covered interval of unit 7 may be equivalent to the "Loray" Formation of Steele (1960) as expressed in the Pequop Mountains immediately underlying the rocks of the Park City Group.

CONODONT TAXONOMY

Species of *Diplognathodus, Hindeodus, Idioprioniodus, Mesogondolella, Streptognathodus,* and *Sweetognathus* were recovered. Specimens of the complete apparatus for *Diplognathodus stevensi, Sweetognathus whitei*, and *Idioprioniodus* sp. are illus-



TEXT-FIGURE 2
Columnar section of the Garden Valley Formation at McCloud Springs with blow-up of member 1 (carbonate member) and graphically correlated ranges of conodonts and ages.

trated. Representation of species in Unit 1 is primarily only platform elements, with the exception of *Idioprioniodus*, which is represented by a full complement of elements, though broken and abraded. Apparatus elements are common in Unit 2, with the exception of *Mesogondolella bisselli*, which is rare. Position designations for the apparatal elements follow Purnell et al. (2000).

Phylum CHORDATA Bateson 1886
Subphylum VERTEBRATA Cuvier 1812
Class CONODONTA Pander 1856
Subclass EUCONODONTA Janvier 1996
Order PRIONIODINIDA Sweet 1988
Family PRIONIODINIDAE Bassler 1925
Genus *Idioprioniodus* Gunnell 1933

Idioprioniodus sp.
Plate 2, figures 13–22

Description: P1 element. – Angulate element with a large, thick cusp, moderate anterior process bearing thick, stubby pointed denticles, slightly proclined and a lateral rib on the inner side and a very short posterior process, sometimes only represented by a grove under a posterior "shoulder" to the cusp. The lower side has a large round basal cavity with a moderate pit and circular striations and a well-developed groove under each process.

P2 element. – Angulate element with a large cusp, short posterior and anterior processes bearing short stubby denticles and slightly flared elongate basal cavity.

M element. – Digyrate element with a posteriorly reclined cusp and two short, posteriorly curving lateral process, one with thin short denticles and one with moderate denticles, both processes' denticles decreasing in size distally. The lateral process with stouter denticles curves more sharply downward and is more posteriorly directed, forming the "twisted" appearance common to this element, the lower side has a large posteriorly flared basal cavity.

S0 element. – Alate element with a large thick cusp and short lateral processes with thin erect denticles and a short posterior process with thick denticles, denticles decreasing in size distally, costae extending up the cusp from each process. The lower side has an open triangular basal cavity.

S1 element. – Digyrate element with one very short process with thin denticles and one short process with moderate denticles, costae extending up the cusp from each process, cusp moderately high.

S2 element. – Bipennate element with a large, erect to slightly proclined cusp, a short posterior process with thin denticles and a moderate inwardly curved anterior process with moderate denticles. The first anterior denticle is partly fused to the cusp. A costa is on the sides of each denticle and cusp in line with the processes.

S3 element. – Bipennate element similar to the S2 element with less curvature and the anterior process is less declined.

S4 element. – Bipennate element.

Remarks: The recovered specimens are broken and abraded. The subtle differences in denticles adjacent to the cusp in the S elements suggest four different elements, but the incompleteness of the specimens could place them in almost any order.

Family GONDOLELLIDAE Lindström 1970
Genus *Mesogondolella* Kozur 1989

Mesogondolella bisselli (Clark and Behnken 1971)
Plate 4, figures 3–4

Gondolella bisselli CLARK and BEHNKEN 1971, p. 429, pl. 1, figs. 12–14.
Neogondolella bisselli (Clark and Behnken). – BEHNKEN 1975, p. 306, pl. 1, figs. 27, 31. – RITTER 1986, p. 154, pl. 1, fig. 1. – CHERNYKH and CHUVASHOV 1986, pl. 28, fig. 7, pl. 32, fig. 6?. – CHERNYKH 1990, p. 340–341, pl. 34, figs. 4, 7.
Mesogondolella bisselli (Clark and Behnken). – CHERNYKH 2006, p. 38, pl. 13, figs. 4, 8.

Diagnosis (modified from Clark and Behnken 1971): A species of *Mesogondolella* characterized by a P1 element that is tear-drop shaped that is nearly flat on upper side with low mostly discrete denticles, terminal cusp, and narrow, shallow smooth adcarinal furrows.

Description: P1 element.—Elongate, tear-drop shaped segminiplanate element, widest posterior to middle of element with erect prominent elongate cusp and largely discrete denticles, increasing in size anteriorly, anteriormost partially fused. The adcarinal furrows are smooth, shallow and narrow and there may or may not be a short free blade. The lower side is marked by a slightly elevated "v" shaped groove, elongate pit and elevated simple loop. The groove is striated and occupies a third to a half of the width of the platform.

Remarks: The two nearly complete specimens recovered are illustrated.

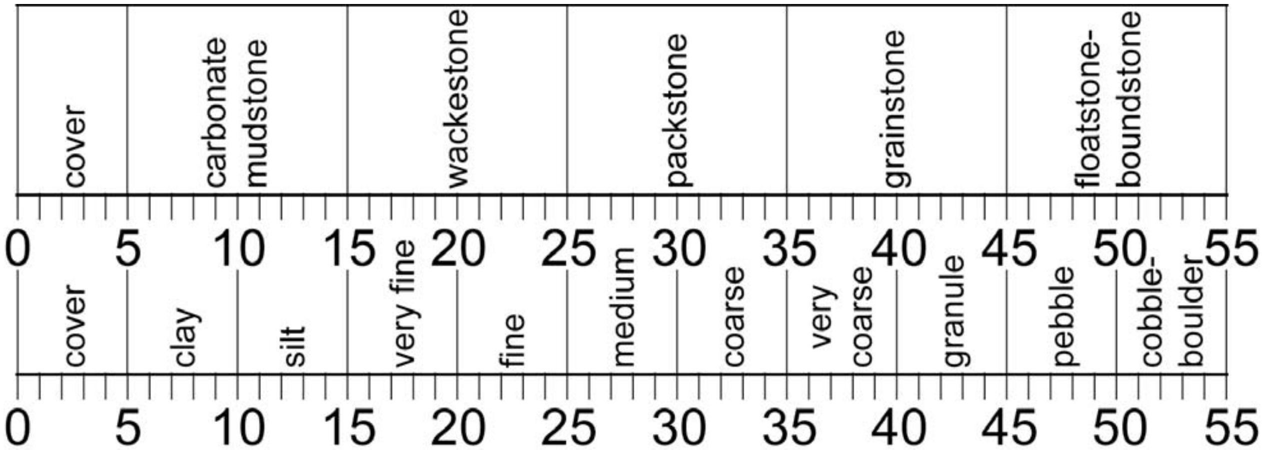
Mesogondolella dentiseparata (Reshetkova and Chernykh 1986)
Plate 2, figure 23; Plate 3, figures 1–15

Neogondolella dentiseparata RESHETKOVA and CHERNYKH 1986, p. 101–102, fig. 1, a–h (in English), p. 109–111, fig. 1, a–c (in Russian). – CHERNYKH and CHUVASHOV 1986, pl. 27, figs. 25–28, pl. 28, figs. 8–10.
Mesogondolella dentiseparata (Reshetkova and Chernykh). – CHERNYKH 2006, p. 38, pl. 27, fig. 5.

Diagnosis (modified from Reshetkova and Chernykh 1986): A species of *Mesogonodolella* characterized by a P1 element that is long, parallel-sided for the posterior two-thirds of its length and gradually narrowing to the anterior in its anterior third, bearing discrete low denticles and a cusp that is terminal (at the posterior-most end) and erect to recurved (bent to the posterior) and no free blade.

Description: P1 element. – Narrow, parallel-sided segminiplanate element with a prominent erect to recurved conical cusp and clearly separate, discrete denticles with only a slight amount of fusion in the anterior-most few denticles in the largest specimens. The adcarinal furrows are smooth and irregular, generally narrow and shallow and there is no free blade. The lower side is marked by a slightly elevated "v" shaped groove, elongate pit and elevated simple loop. The groove is striated and occupies a third of the width of the platform.

Remarks: The specimens illustrated match those from the type area in the Urals. It brought one author (Chernykh) to tears when he first saw the specimens that his species was finally found outside the type area.



TEXT-FIGURE 3
Scale for clastic and carbonate rock classification and representation in columnar section based on grain size (modified from GeoStratSys).

Order OZARKODINIDA Dzik 1976
Family ANCHIGNATHODONTIDAE Clark 1972
Genus *Hindeodus* Rexroad and Furnish 1964

Hindeodus permicus (Igo 1981)
Plate 4, figures 1–2

Anchignathodus minutus permicus IGO 1981, p. 26–27, pl. 10, figs. 1–4.
Anchignathodus minutus minutus (Ellison). – IGO 1981 (part), p. 26, pl. 10, fig. 5.
Anchignathodus typicalis Sweet. – IGO 1981 (part), p. 27, pl. 10, figs. 7, 12.

Diagnosis (modified from Igo 1981): A species of *Hindeodus* characterized by a P1 element with a large triangular cusp, rarely with 2–3 small denticles on the anticusp, and anterior and posterior margins are subparallel, declining sharply, anterior at about 80 degrees from the upper margin and posterior at about 90 degrees from the upper margin, denticles are rounded, stubby and mostly fused, on anterior part are of subequal height, declining in posterior fourth or third before sharp declination at posterior end.

Description: P1 element. – Scaphate element with a moderate cusp, only slightly higher than nearest denticles, denticles decline posteriorly from cusp, about equal sized, rounded, stubby with rounded terminations, most at least partly discrete. There is a sharp decline in the upper platform profile at the posterior end that varies with size, sharp in small specimens and moderate in large specimens, posteriormost denticles on the profile decline are smaller and more fused than the denticles anterior to the decline. The lower side of the element is a thin groove directly beneath the cusp and flared basal cavity posteriorly; basal cavity extends for ½ to ¾ the length of the platform.

Remarks: This species, though common in our material, is represented by very poorly preserved P1 elements.

Family SWEETOGNATHIDAE Ritter 1986
Genus *Diplognathodus* Kozur and Merrill 1975

Diplognathodus stevensi Clark and Carr 1982
Plate 2, figures 1–12

Diplognathodus stevensi CLARK and CARR 1982 (part), p. 132, pl. 1, figs. 1, 3, 8, 9–13. – RITTER 1986, p. 147, pl. 3, figs. 3, 5. – CHERNYKH 2006, pl. 12, figs. 1a, b, 2a, b.
Diplognathodus aff. stevensi Clark and Carr. – CHERNYKH 2005, fig. 28.1.

Diagnosis: A species of *Diplognathodus* distinguished by a P1 element with a relatively flat posterior carina ornamented by medially aligned minute chevron-shaped spicules.

Description: P1 element. – Small scaphate element with a short blade comprised of 3–4 rising denticles and generally three denticles on the anterior declination from the highest denticle or cusp; a short carina that is anteriorly denticulate and posteriorly nodose in small specimens and becomes increasingly fused in larger specimens so that moderate to large specimens have a posteriorly declining fused ridge, ridge is ornamented by a row of medially aligned, minute chevron-shaped spicules. The posterior half to two thirds of the element has a widely flared basal cavity that is spatulate in shape from upper or lower view.

P2 element. – Angulate element with a moderate cusp and a declining anterior process with mostly discrete pointed denticles, increasing in size distally and a short, straight posterior process bearing denticles that decrease in height distally.

M element. – Dolobrate element with a small cusp, sharp anticusp and long sharply declining posterior process, the whole element twists inwardly, denticles of near equal size, increasing from cusp to about the fifth denticle, then slightly decreasing in size for the remainder of the process; small inwardly flared basal cavity.

S0 element. – Alate element with moderate cusp, short downwardly turned lateral processes and a moderate, slightly bowed posterior process, with denticles increasing in size and becoming more reclined posteriorly.

S1 element. – Bipennate element with a short to moderate anterior process that is downturned and slightly twisted inward, largest denticle near posterior end, with at least two pairs of alternating moderate and small denticles before the denticles nearest the cusp which decline in size toward the cusp; cusp moderate in size; the posterior process is very much like that of the S0 element with denticles increasing in size and become more reclined posteriorly, with a few small denticles interspersed along the process, disrupting the general trend; the process is slightly bowed. The lower surface has a narrow groove.

S2 element. – Bipennate element with a short to moderate anterior process that is slightly downturned and not twisted laterally, bears denticles in a pattern similar to the S1 element, but denticles are less disparate in size; cusp is small to moderate in size; the posterior process is bowed and bears denticles that increase in size for the first few denticles then remain nearly the same size for the remainder of the process; denticles become more reclined distally, but all are slightly recurved. The lower surface has a narrow groove.

S3 element. – Bipennate element with a short to moderate anterior process that is downturned and slightly twisted inward that bears small denticles of nearly equal size that alternate from slightly larger to slightly smaller; cusp is small; posterior process is nearly straight and bears small denticles that generally increase slightly in height and become more reclined near the posterior end, and alternate in size with most small and a few slightly higher denticles dispersed along the length of the element. The lower surface has a narrow groove.

S4 element. – Bipennate element with a short to moderate anterior process that is nearly straight, denticles reclined, element only slightly bowed.

Remarks: The S1–S4 elements bear denticles that have a general trend to increase in size away from the cusp both anteriorly and posteriorly, except for the most posterior few, which decrease in size. Wang (1993) and Van Hofwegan (1995) illustrate examples of *Diplognathodus stevensi* in their unpublished Master's theses from Secret Canyon and Diamond Range in Nevada.

Genus *Sweetognathus* Clark 1972

Sweetognathus expansus (Perlmutter 1975)
Plate 1, figure 1

Ozarkodina expansa PERLMUTTER 1975, p. 98–99, pl. 3, figs. 1–27.
Sweetognathus expansus Perlmutter. – VON BITTER and MERRILL 1990, p. 107, pl. 3, A–O. – RITTER 1995, fig. 10.7. – MEI et al. 2002, p. 84, fig. 10.27. – CHERNYKH 2005, pl. 20, figs. 1, 9, 10. – CHERNYKH 2006, fig. 9.1, pl. 12, figs. 3–4. – BOARDMANN et al. 2009, p. 140, pl. 17; fig. 7, pl. 20, fig. 13; pl. 24, figs. 5–6; pl. 25, figs. 16–19; pl. 26, figs. 1–12, 14–18; pl. 27, figs. 9, 13–14; pl. 29, figs. 1–11.
Sweetognathus adenticulatus RITTER 1986, p. 149, pl. 4, figs. 18–19, 21.
Sweetognathus inornatus RITTER 1986 (part), p. 150, pl. 3, figs. 1, 6, 13, 15; pl. 4, figs. 2, 9.
Diplognathodus sp. KANG et al. 1987, pl. II, fig. 15.
Diplognathodus expansus (Perlmutter). – CHERNYKH 2005, figs. 27.1. 27.2.
Wardlawella expansus (Perlmutter). – KOZUR 1995, p. 168.

Diagnosis (modified from Perlmutter 1975): A multielement apparatus of the *Ozarkodina*-type characterized by a P1 element that has a widely expanded basal cavity, a short free blade of 3 to 4 denticles of subequal height, a gap in denticulation between the free blade and carina in which a few small denticles are present, and a carina of fused denticles forming a ridge, distinctly lower than the free blade [and ornamented with small pustules].

Description: P1 element.—Carminiscaphate element with a short blade and a posteriorly declining carina that bears two faint nodes at the blade/carina transition and is vaguely nodose or bulbous along its length; the upper surface of the carina is entirely covered with small pustules.

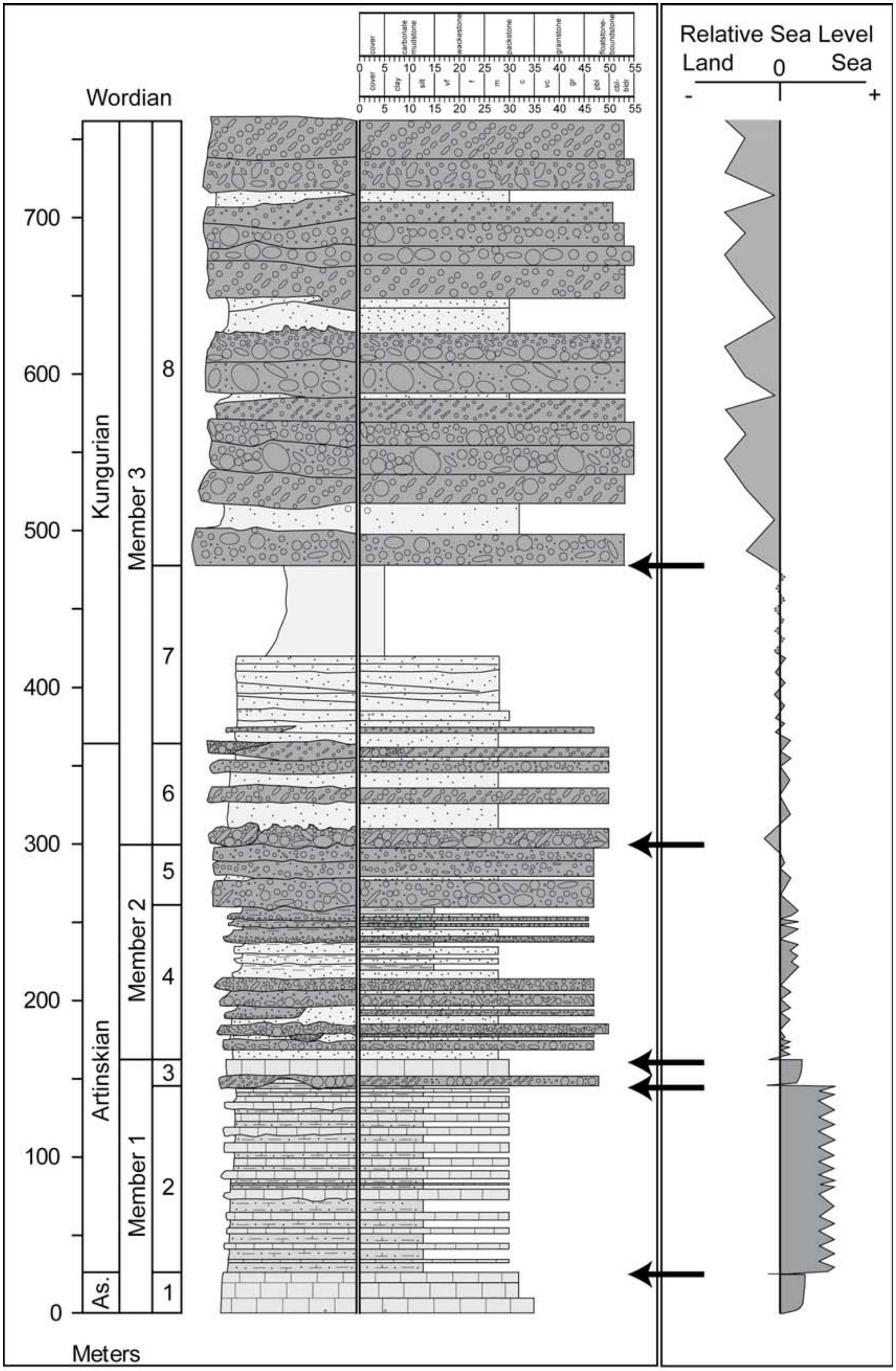
Remarks: See Boardman et al. (2009) for a complete discussion of the synonymy of this species.

Sweetognathus whitei **(Rhodes 1963)**
Plate 1, figures 2–19

Spathognathodus whitei RHODES 1963, p. 464–465, pl. 47, figs. 4, 9, 10, 25, 26. – CLARK and BEHNKEN 1971, pl. 1, figs. 2–6.
Sweetognathus whitei (Rhodes). – BEHNKEN 1975, p. 312, pl. 1, fig. 26. – IGO 1981 (part) p. 44, pl. 6, figs. 17, 19–21; pl. 7, figs. 1–7. – HENDERSON and MCGUGAN 1986, figs. 7.4–7.7. – RITTER 1986, p. 151–152, pl. 3, figs. 2, 4, 8–11, 16–21. – SUAREZ RIGLOS et al. 1987, pl. 19.2, figs. 8–13; pl. 19.3, figs. 12–16. – ORCHARD and FORSTER 1988, pl. 1, figs. 10, 11, 13–15, 20. – CHERNYKH 1990, pl. 38, figs. 10–11. – BEAUCHAMP and HENDERSON 1994, fig. 20.5. – WANG 1994, pl. 4, fig. 5. – WANG and SHEN 1994, pl. 42, fig. 8. – MEI et al. 2002, p. 86–88, figs. 10.25, 13.2. – UENO et al. 2002, p. 747–748, figs. 4.14–4.16, 4.18. – CHERNYKH 2005, p. 148–149, pl. 24, figs. 6, 7, 11. – BOARDMAN et al. 2009, p. 140, pl. 24, fig. 2; pl. 27, figs. 1–8, 10–12; pl. 28, fig. 10; pl. 30, figs. 6–9.
Sweetognathus aff. whitei (Rhodes) – VAN DEN BOOGAARD 1987, fig. 6E. – CHERNYKH 1990, pl. 38, fig. 9.
Sweetognathus anceps CHERNYKH 2005 (part), p. 144, p. 21, fig.13.
Sweetognathus behnkeni KOZUR 1975, p. 3–4. – RITTER 1986, pl. 2, figs. 11–15. – ORCHARD and FORSTER 1988, pl. 1, fig. 21.
Sweetognathus cf. behnkeni Kozur. – VAN DEN BOOGAARD 1987, fig. 6A.
Sweetognathus aff. *binodosus* CHERNYKH 2005, pl. 24, fig. 5.
Sweetognathus clarki (Kozur). – CHERNYKH 2005, pl. 21, fig. 16.
Sweetognathus aff. *clarki* (Kozur). – CHERNYKH 2005, p. 21, fig. 12.
Sweetognathus guizhouensis Bando et al. – KANG et al. 1987, pl. 4, fig. 19.
Sweetognathus inornatus RITTER 1986 (part), pl. 3, figs. 12–15, pl. 4, figs. 2, 9, 13–14. – DING and WAN 1990; pl. 2, figs. 9–20. – WANG 1994, pl. 4, figs. 2–4, 9. – WANG and SHEN 1994, pl. 42, fig. 6.
Sweetognathus primus CHERNYKH 1990, p. 349, pl. 41, figs. 1–7. – CHERNYKH 2005, p. 147, pl. 24, figs. 1–3.
Sweetognathus rhomboides CHERNYKH 2005, p. 147–148, pl. 25, figs. 1–5.
Sweetognathus n. sp. 2 CHERNYKH 2005, pl. 25, figs. 7–9.
Sweetognathus n. sp. A KANG et al. 1987, pl. 4, fig. 3.
Sweetognathus n. sp. C KANG et al. 1987, pl. 4, fig. 4, 5.
Sweetognathus n. sp. D KANG et al. 1987, pl. 4, fig. 10.
Gnathodus whitei (Rhodes). – RABE 1977, pl. 4, figs. 7–9.
Neostreptognathodus toriyamai IGO 1981 (part), p. 42–43, pl. 5, figs.1, 4, 7, 10, 12, 15.

Diagnosis (modified from Rhodes 1963): A species of *Sweetognathus* characterized by a P1 element that is ornamented by pustulose denticles that appear subcrescentric to suboval to dumbbell in shape.

Description: P1 element. – Carminiscaphate element with a short, curving blade and a platform surface ornamented by pustulose denticles that appear "subcrescentic to suboval to dumbbell shaped in top view" (Rhodes 1963) with a carina that is alternately a thin ridge and small round to oval denticles that variously connect to large rounded to laterally elongate marginal denticles that curve more posteriorly in larger specimens. At least one set of carinal denticle and marginal denticles forms a dumbbell pattern (small round carinal denticle connected to large round marginal denticles on each side by a narrow ridge) in almost every specimen. In most specimens the carinal denticles are higher than the marginal denticles. The lower side



TEXT-FIGURE 4
Columnar section of the Garden Valley Formation modified into grain size scale to show sequences and develop relative sea level curve. Arrows indicate horizons of silicification or initiation of silica cement.

has a slightly flared open basal cavity beneath the platform and a narrow groove below the blade.

P2 element. – Angulate element with relatively short declining processes, anterior process with longitudinally wide (laterally compressed) very fused slightly recurved denticles, posterior process with partly fused, laterally compressed, reclined denticles. The three closest denticles to the high longitudinally wide cusp are small on each process, then increasing in size (height and width) distally, except for distal-most one or two that are smaller. The lower side has a groove along each process and a small basal cavity with a small flared lateral lip.

M element. – Dolobrate element with a thin, but long anticusp that may develop one small denticle near its lower end, a high narrow cusp, and a sharply declining posterior process, posterior denticles are erect, narrow, partly fused, and generally increasing in size distally. The lower side has a small basal cavity with a small flared lip on the inner side and a groove under the process.

S0 element. – Alate element with short declining lateral processes that are about at right angles to the posterior process, a high cusp with a circular cross-section and a long posterior process. The first three denticles away from the cusp on any process are small and fused to the side of the cusp

S1 element. – Bipennate element with a sharply inward turned anterior process that is short, has a long downward extension and bears a few small denticles next to the cusp and three strong denticles increasing in size distally and one small distal-most denticle may be developed. The cusp is high and has a circular cross section. The posterior process is long and bears denticles of varying size mostly small, with one to a few moderate length denticles along its length and several long denticles at its distal end.

S2 element. – Bipennate element with a slightly inward turned anterior process that is short, moderately declining and bears a few small denticles next to the cusp and three moderate denticles distally. The cusp is high with a circular cross-section. The posterior process is long and bears alternating short and moderate denticles after a few short denticles proximal to the cusp. The moderate denticles generally become larger posteriorly and the process ends with a few large denticles.

S3 element. – Bipennate element with a nearly straight (not turned) anterior process that is only slightly declining and bears several small and moderate denticles. The cusp is short, no larger than several of the moderate denticles. The posterior process is long and bears varying sized denticles, mostly small, with a few short-to-moderate length denticles.

S4 element. – Bipennate element, not illustrated.

PLATE 1

Sweetognathus, all specimens ×90

1 *Sweetognathus expansus*, upper view, P1 element, 88DG-21a

2 *Sweetognathus whitei*, lateral view, P2 element, WSS-8813a

3 *Sweetognathus whitei*, lateral view, P2 element, WSS-8813c

4 *Sweetognathus whitei*, lateral view, P2 element, WSS-8813k

5 *Sweetognathus whitei*, lateral view, S0 element, WSS-8813j

6 *Sweetognathus whitei*, inner lateral view, S1 element, WSS-8813e

7 *Sweetognathus whitei*, lateral view, S3 element, WSS-8813x

8 *Sweetognathus whitei*, inner lateral view, S2 element, WSS-8813s

9 *Sweetognathus whitei*, inner lateral view, M element, WSS-8813g

10 *Sweetognathus whitei*, outer lateral view, M element, WSS-8813d

11 *Sweetognathus whitei*, upper view, P1 element, WSS-8813i

12 *Sweetognathus whitei*, upper view, P1 element, WSS-8813f

13 *Sweetognathus whitei*, upper view, P1 element, SVN-102.7a

14 *Sweetognathus whitei*, upper view, P1 element, SVN-102.7d

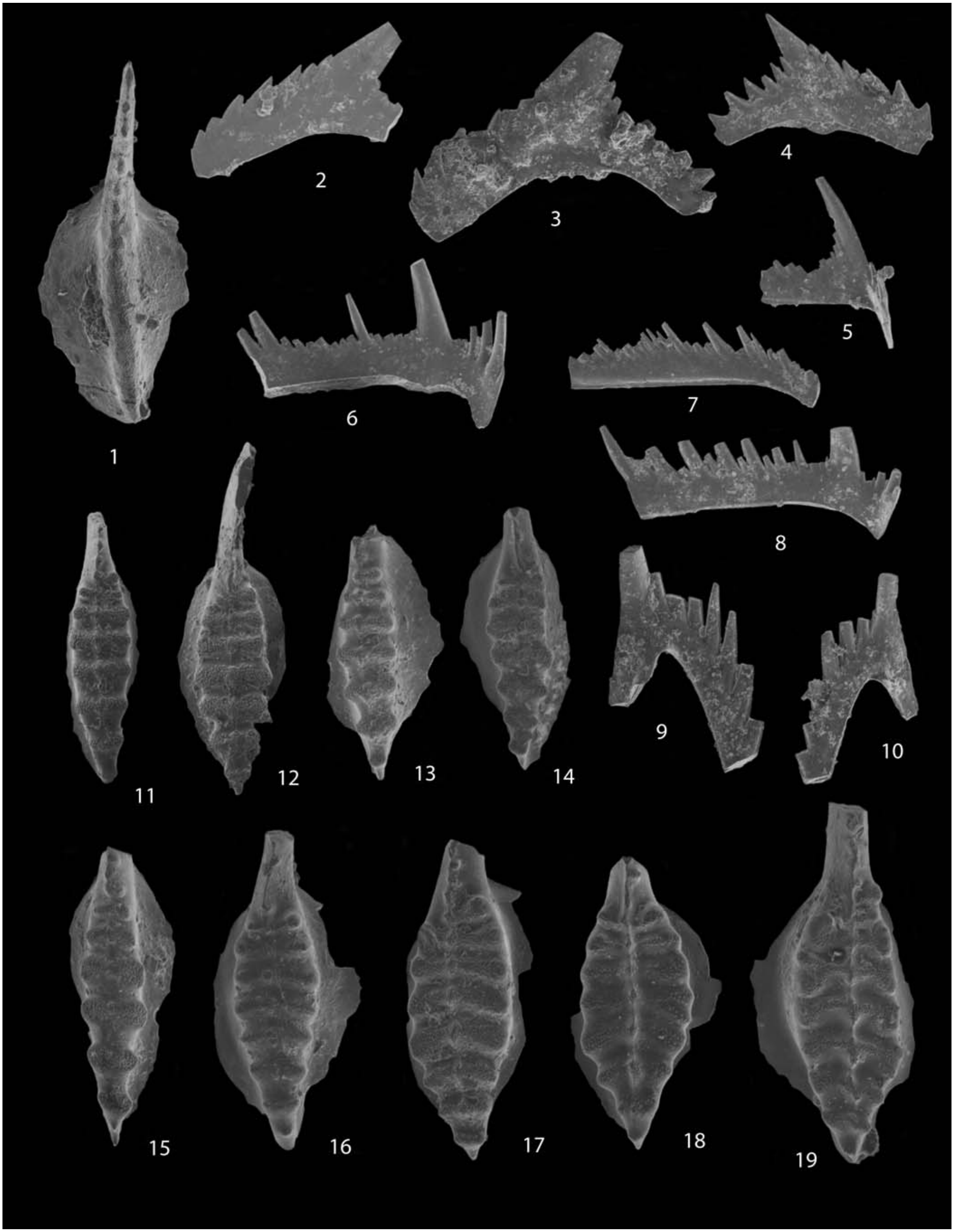
15 *Sweetognathus whitei*, upper view, P1 element, SVN-102.7b

16 *Sweetognathus whitei*, upper view, P1 element, SVN-102.7c

17 *Sweetognathus whitei*, upper view, P1 element, SVN-102.7g

18 *Sweetognathus whitei*, upper view, P1 element, SVN-102.7i

19 *Sweetognathus whitei*, upper view, P1 element, SVN-102.7h.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Remarks: *Sweetognathus* is a very plastic group (showing lots of variability) and especially *Sw. whitei* that shows significant changes through its growth. Until each species is adequately documented through its growth stages, we are reluctant to recognize the many species assigned to *Sweetognathus*.

Family IDIOGNATHODONTIDAE Harris and Hollingsworth 1933

Genus ***Streptognathodus*** Stauffer and Plummer 1932

Streptognathodus species are characterized by their P1 elements which occur as asymmetric pairs of a sinistral and dextral element. In some taxonomic work, both sinistral and dextral elements are described as separate species, a practice that still occurs even to this day. Add to that that most taxonomic works shorten or neglect synonymies, and we have the complicated synonymies for *Streptognathodus constrictus* and *S. fusus* listed below.

Streptognathodus constrictus Reshetkova and Chernykh 1986
Plate 4, figures 6-8, 12

Streptognathodus constrictus RESHETKOVA and CHERNYKH 1986, p. 102-103, fig. 1, i-r (in English), p. 111, fig. 1, L-R (in Russian). - BOARDMAN et al. 2009, p. 126-127, pl. 17, figs. 2, 10; pl. 18, fig. 6; pl. 20, fig. 6; pl. 21, figs. 12, 15. – CHERNYKH 2006 (part), p. 43, pl. 7, figs. 16-18, 20; pl. 8, figs. 11, 15-17, 20-23.
Streptognathodus mizensi CHERNYKH 2005, p. 132, pl. 15, figs. 5-14. – CHERNYKH 2006 (part), p. 47, pl. 7, figs. 1-5.
Streptognathodus postsigmoidalis CHERNYKH 2005 (part), p. 134-135, pl. 18, fig. 14.
Streptognathodus verus CHERNYKH 2005, p. 143, pl. 18, figs. 1-9. - CHERNYKH 2006, p. 51, pl. 9, figs. 12-21.

Diagnosis (modified from Reshetkova and Chernykh 1986): A species of *Streptognathodus* characterized by a P1 element that is elongate and slightly curved, with well-developed [adcarinal] furrows in its anterior part, and a distinct constriction in the middle part, and no supplementary lobes.

Description: P1 element. – Slightly asymmetrical paired carminiscaphate P1 elements that are narrow, elongate and

PLATE 2
Diplognathodus, Idioprioniodus, Mesogondolella, all specimens ×90 except 4b, ×270

1 *Diplognathodus stevensi,* lateral view, P1 element, WSS-8813y

2 *Diplognathodus stevensi,* lateral view, P1 element, WSS-8813r

3 *Diplognathodus stevensi,* lateral view, P1 element, WSS-8813o

4a-b *Diplognathodus stevensi,* upper views, P1 element, b, enlarged portion of carina, WSS-8813t

5 *Diplognathodus stevensi,* inner lateral view, P2 element, WSS-8813l

6 *Diplognathodus stevensi,* inner lateral view, M element, WSS-8813p

7 *Diplognathodus stevensi,* inner lateral view, M element, WSS-8813w

8 *Diplognathodus stevensi,* lateral view, S0 element, WSS-8813q

9 *Diplognathodus stevensi,* lateral view, S1 element, WSS-8813v

10 *Diplognathodus stevensi,* lateral view, S4 element, WSS-8813b

11 *Diplognathodus stevensi,* inner lateral view, S3 element, WSS-8813m

12 *Diplognathodus stevensi,* inner lateral view, S2 element, WSS-8813n

13 *Idioprioniodus* sp., posterior view, S0 element, TGS3L-7.0b

14 *Idioprioniodus* sp., anterior-lateral view, S0 element, TGS3L-7.0g

15 *Idioprioniodus* sp., posterior-lateral view, S1 element, TGS3L-7.0d

16 *Idioprioniodus* sp., posterior view, M element, TGS1L-9.4d

17 *Idioprioniodus* sp., inner lateral view, S2 element, TGS1L-9.4a

18 *Idioprioniodus* sp., inner lateral view, S3 element, TGS3L-7.0f

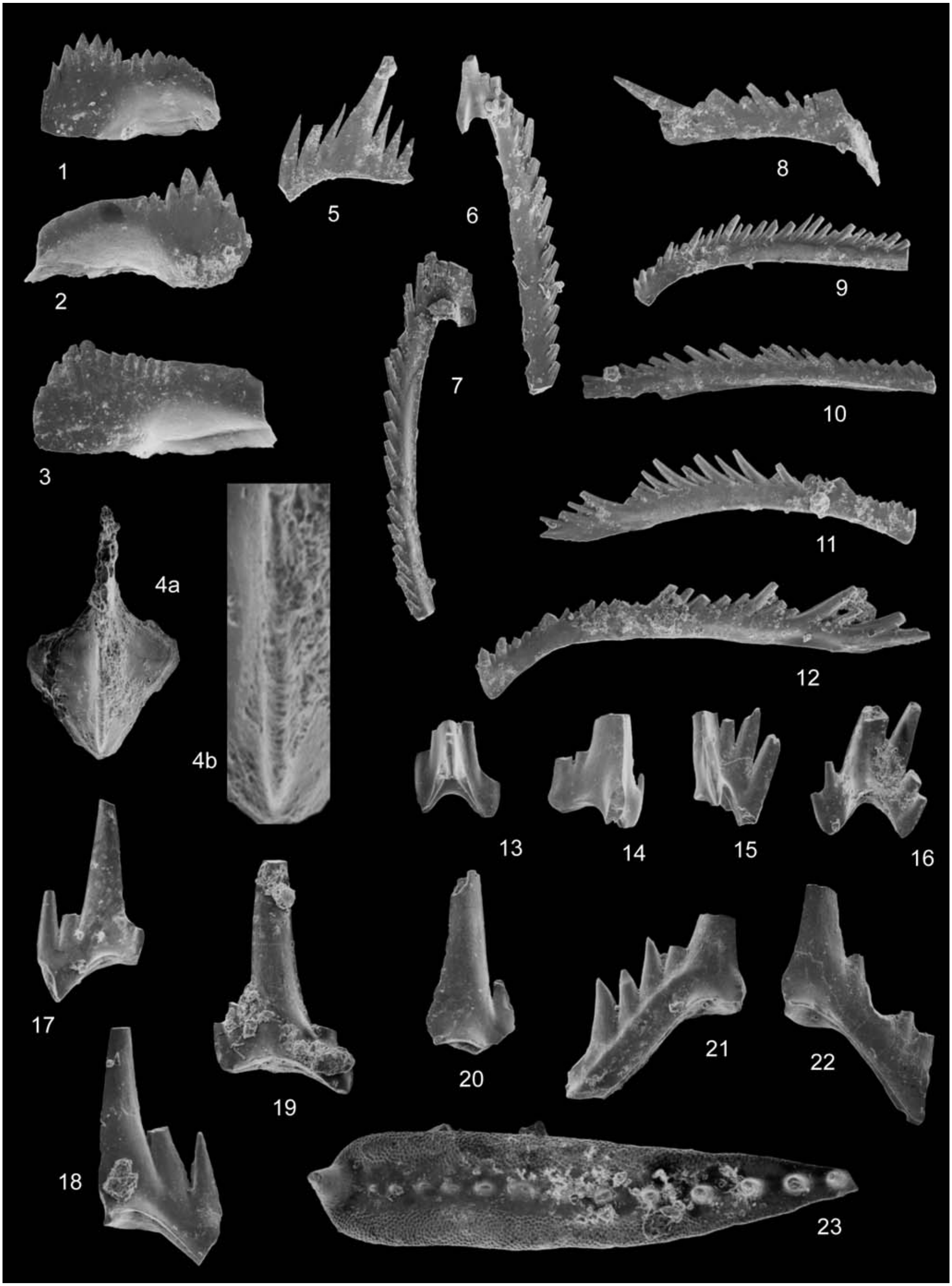
19 *Idioprioniodus* sp., lateral view P2 element, TGS1L-9.4c

20 *Idioprioniodus* sp., lateral view of S4 element fragment, TGS3L-7.0a

21 *Idioprioniodus* sp., inner lateral view, P1 element, TGS1L-9.4b

22 *Idioprioniodus* sp. outer lateral view, P1 element, TGS3L-7.0c

23 *Mesogondolella dentiseparata*, upper view, P1 element, TGS1L-9.4g.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bowed inwardly, with a marked inflection on the inner side of the platform opposite or behind the posterior end of the carina and a slightly flared anterior inner parapet so that the inflection and flared parapet form a "constriction" in the platform; outer anterior parapet is generally also slightly flared, parapets decline anteriorly at about the same point, carinal denticles are fused.

Streptognathodus fusus Chernykh and Reshetkova 1987
Plate 4, figs. 5, 9-11, 13-17.

Streptognathodus fusus CHERNYKH and RESHETKOVA 1987, p. 70, pl. I, figs. 12-14. - BOARDMAN et al. 2009, p. 131-132, pl. 17, figs. 1, 4, 6, 8-9, 11, 13, 15-16; pl. 20, figs. 5, 7. – CHERNYKH 2006, p. 44-45, pl. 9, figs. 1-3, 6-11; pl. 10, figs. 1-10.
Streptognathodus constrictus Chernykh and Reshetkova. – CHERNYKH and RITTER 1997 (part), p. 464, figs. 8.14, 8.15.
Streptognathodus mizensi CHERNYKH 2006 (part), p. 47, pl. 7, fig. 6; pl. 9, figs. 4, 5.
Streptognathodus postsigmoidalis CHERNYKH 2005, p. 134-135, pl. 16, fig. 2, pl. 18, figs. 15-19. – CHERNYKH 2006, p. 49, pl. 7, figs. 7-10 (10=*S. aff. postsigmoidalis* CHERNYKH 2005, p. 18, fig. 20).
Streptognathodus adversus CHERNYKH 2005 (part), p. 123-124, pl. 17, fig. 6, pl. 18, figs. 10-13. – CHERNYKH 2006, p. 42, pl. 7, fig. 11.
Streptognathodus constrictus Reshetkova and Chernykh. – CHERNYKH 2006 (part), p. 43, pl. 7, figs. 12-15, 19, pl. 8, fig. 13.

Diagnosis (modified from Chernykh and Reshetkova 1987): A species of *Streptognathodus* characterized by a P1 element that is elongate with an asymmetrically placed "median" furrow on posterior of platform, carina occupies less than half the length of the platform, the inner parapet is laterally flared, forming a deep scoop-shaped trough between it and the carina, outer adcarinal furrow is narrow and slit-shaped, platform is ornamented by regular ribs posteriorly, that break-up into denticles at the narrowing of the platform at the posterior termination of the carina.

Description: P1 element. – Asymmetrically paired carminiscaphate P1 elements with a robust dextral element and an elongate sinistral element, both distinguished by a high flared inner adcarinal parapet, few to no accessory denticles, short fused carina, furrow is deep and "scoop" shaped anteriorly becoming thin and shallow posteriorly and ends several denticles before the posterior termination of the platform. The inner portion of the platform at and just posterior to the posterior carinal termination is conspicuously raised on both dextral and sinistral elements. The inner high parapet extends much further anteriorly than the outer and it declines at about the carina-fixed blade transition where the outer declines near the middle of the carina.

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PLATE 3
Mesogondolella, all specimens ×72

1 *Mesogondolella dentiseparata*, upper view, P1 element, MCs2-2.2f

2 *Mesogondolella dentiseparata*, upper view, P1 element, MCS3-2.2d

3 *Mesogondolella dentiseparata*, lower view, P1 element, MCS3-2.2g

4 *Mesogondolella dentiseparata*, lower view, P1 element, SVN-5.8l

5 *Mesogondolella dentiseparata*, lower view, P1 element, SVN-5.8j

6 *Mesogondolella dentiseparata*, lower view, P1 element, TGS3L-11.5g

7 *Mesogondolella dentiseparata*, upper view, P1 element, TGS3L-11.5d

8 *Mesogondolella dentiseparata*, upper view, P1 element, TGS3L-11.5e

9 *Mesogondolella dentiseparata*, upper view, P1 element, TGS3L-11.5f

10 *Mesogondolella dentiseparata*, upper view, P1 element, TGS1L-9.4e

11 *Mesogondolella dentiseparata*, upper view, P1 element, SVN-5.8i

12 *Mesogondolella dentiseparata*, upper view, P1 element, SVN-5.8e

13 *Mesogondolella dentiseparata*,, upper view, P1 element, SVN-5.8a

14 *Mesogondolella dentiseparata*, upper view, P1 element, TGS1L-9.4f

15 *Mesogondolella dentiseparata*, upper view, P1 element, TGS3L-11.5c.

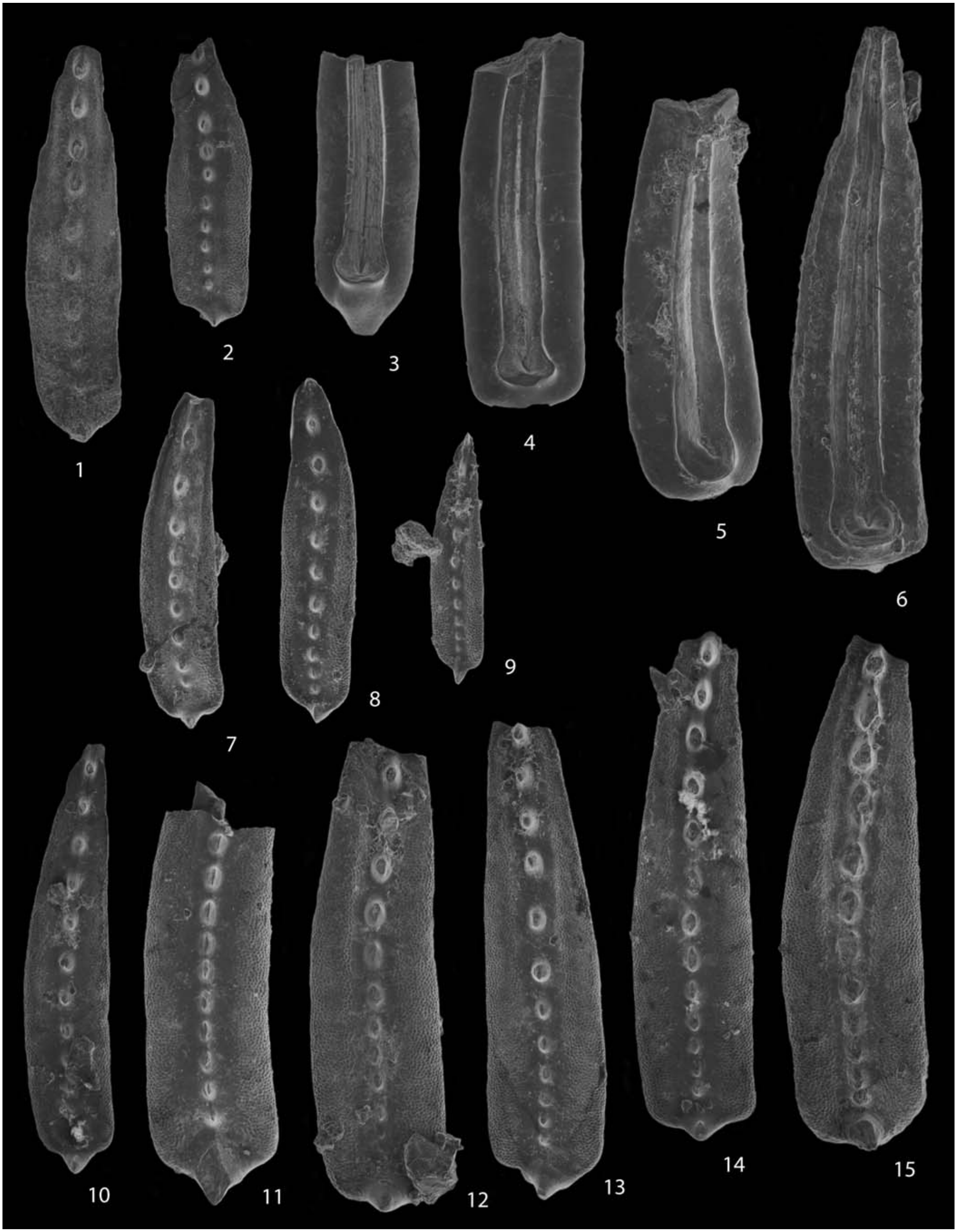
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PLATE 4

Hindeodus, Mesogondolella, Streptognathodus, all specimens ×90

1 *Hindeodus permicus*, lateral view, P1 element, MCS3-2.2b

2 *Hindeodus permicus*, lateral view, P1 element, MCS3-2.2c

3 *Mesogondolella bisselli*, upper view, P1 element SVN-102.7f

4 *Mesogondolella bisselli*, upper view, P1 element, SVN-102.7e

5 *Streptognathodus fusus*, upper view, P1 element, MCS3-2.2e

6 *Streptognathodus constrictus*, upper view, P1 element, MCS3-2.2a

7 *Streptognathodus constrictus*, upper view, P1 element, SVN-5.8b

8 *Streptognathodus constrictus*, upper view, P1 element, SVN-5.8h

9 *Streptognathodus fusus*, upper view, P1 element, SVN-5.8d

10 *Streptognathodus fusus*, upper view, P1 element, SVN-5.8m

11 *Streptognathodus fusus*, upper view, P1 element, SVN-5.8f

12 *Streptognathodus constrictus*, upper view, P1 element, TGS3L-11.5a

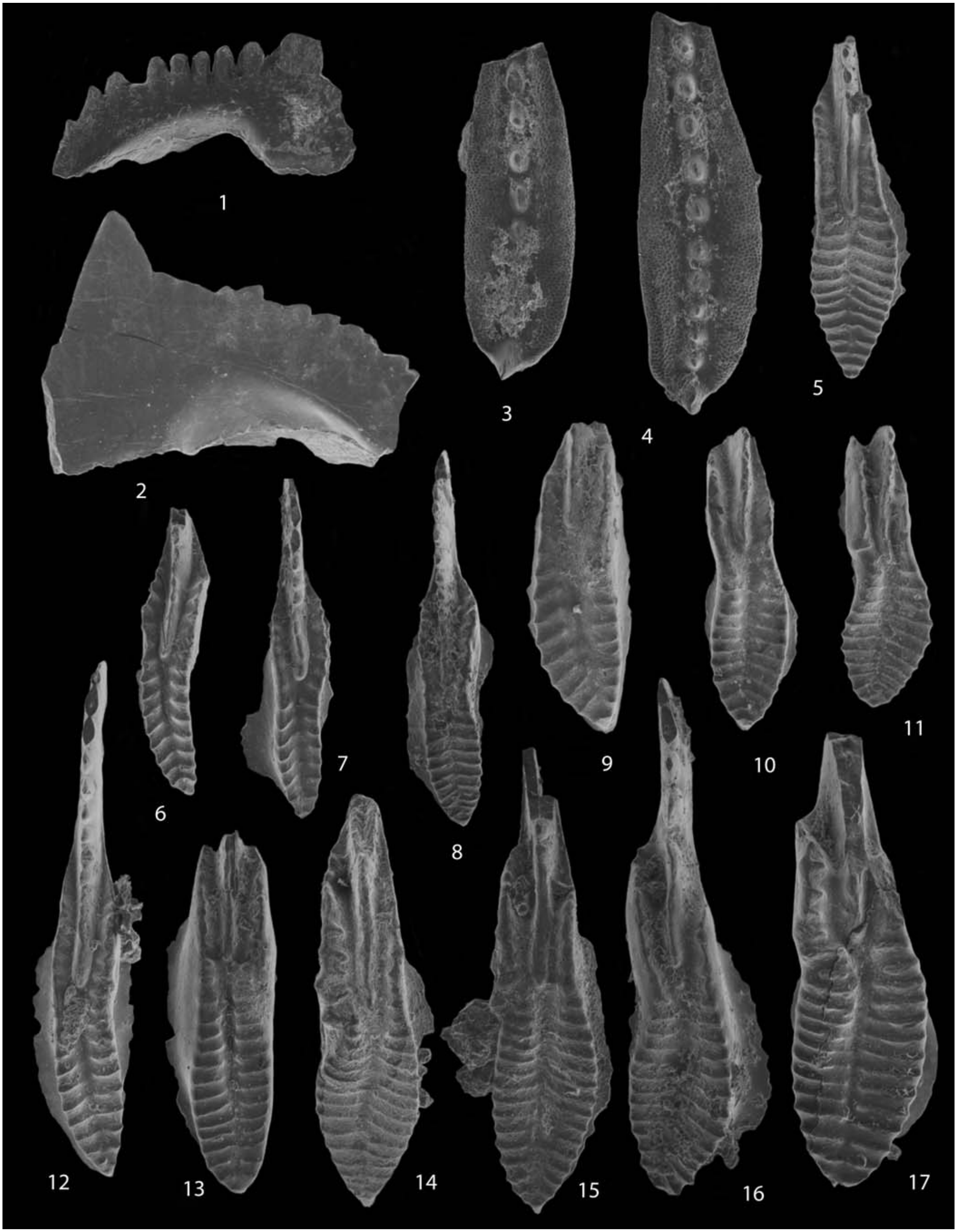
13 *Streptognathodus fusus*, upper view, P1 element, SVN-5.8k

14 *Streptognathodus fusus*, upper view, P1 element, MCS3-2.2b

15 *Streptognathodus fusus*, upper view, P1 element, 88DGC-20a

16 *Streptognathodus fusus*, upper view, P1 element, SVN-5.8c

17 *Streptognathodus fusus*, upper view, P1 element, TGS3L-11.5b.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