Conodont faunas from a complete basinal succession of the upper part of the Wordian (Middle Permian, Guadalupian, West Texas)

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ABSTRACT: In the southern part of the Patterson Hills just to the west of the Guadalupe Mountains escarpment of West Texas, a 29m outcrop of alternating calcareous siltstone and silty limestone with a few thin fine sandstone interbeds displays the overlap occurrence of a narrow morphotype of *Jinogondolella nankingensis* (herein named *J. nankingensis behnkeni*) with *J. aserrata* near its base. The transition of *Jinogondolella aserrata* to *J. postserrata* is present near the top of this section and marks the Wordian-Capitanian boundary, therefore displaying a significant portion of the upper part of the Wordian in one short continuous section. *Pseudohindeodus brevis* n. sp. and *H. capitanensis* n. sp. are described. *Pseudohindeodus ramovsi*, *Caenodontus serrulatus, Hindeodus wordensis*, *Sweetina triticum*, *Jinogondolella palmata*, and *J. errata* also occur in this succession.

INTRODUCTION

A 29m unit mapped by King (1948) as the Pinery Limestone Member of the Bell Canyon Formation in the southern part of the Patterson Hills and exposed along US Highway Route 62/180 is reinterpreted to be the Hegler and Pinery Limestone Members and displays a significant portion of the range of *Jinogondolella aserrata* including the overlap with *Jinogondolella nankingensis behnkeni* to the overlap with *Jinogondolella postserrata*, therefore spanning a significant portion of the Wordian. The base of the Roadian (basal Guadalupian) is defined at nearby Stratotype Canyon in the base of the western escarpment of the Guadalupe Mountains by the first occurrence of *Jinogondolella nankingensis.* The base of the Wordian is defined at nearby Getaway Ledge in Guadalupe Pass by the first occurrence of *Jinogondolella aserrata*.

The exposure studied is a road cut on the north side of US Highway Route 62/180 about 2km west of the junction of US Highway Route 62/180 and State Highway 54 (text-fig. 1) about 3km south of the southernmost boundary of Guadalupe Mountains National Park, and its base is located at latitude 31.78640°, longitude -104.87542°.

Forty samples were collected from limestone beds in the 29m section of Hegler Limestone Member, intervening sands and silts of the Bell Canyon Formation (undivided) and the lower and upper parts of the Pinery Limestone Member.

Stratigraphy

Approximately 38.5m of strata with 14 units are exposed in the road cut starting with sandstone of the Cherry Canyon Formation and ending with sandstone of the Bell Canyon Formation.

Unit 1: sandstone (4m), massive fine to medium sandstone, Cherry Canyon Formation.

Unit 2: limestone and siltstone (2m), 22cm thick bentonite at the base, medium beds (30cm) of sandy, skeletal limestone, separated by relatively thick calcareous siltstone (5–12cm) intervals, base of the Hegler Limestone Member.

Unit 3: sandstone (1m), medium- to thin-bedded sandstone with one thin interbed of limestone and one thin calcareous siltstone.

Unit 4: limestone and siltstone (1.5m), medium beds of skeletal limestone separated by thin limestone or calcareous siltstone interbeds with a thick (22cm) calcareous siltstone at its base, top of the Hegler Limestone Member.

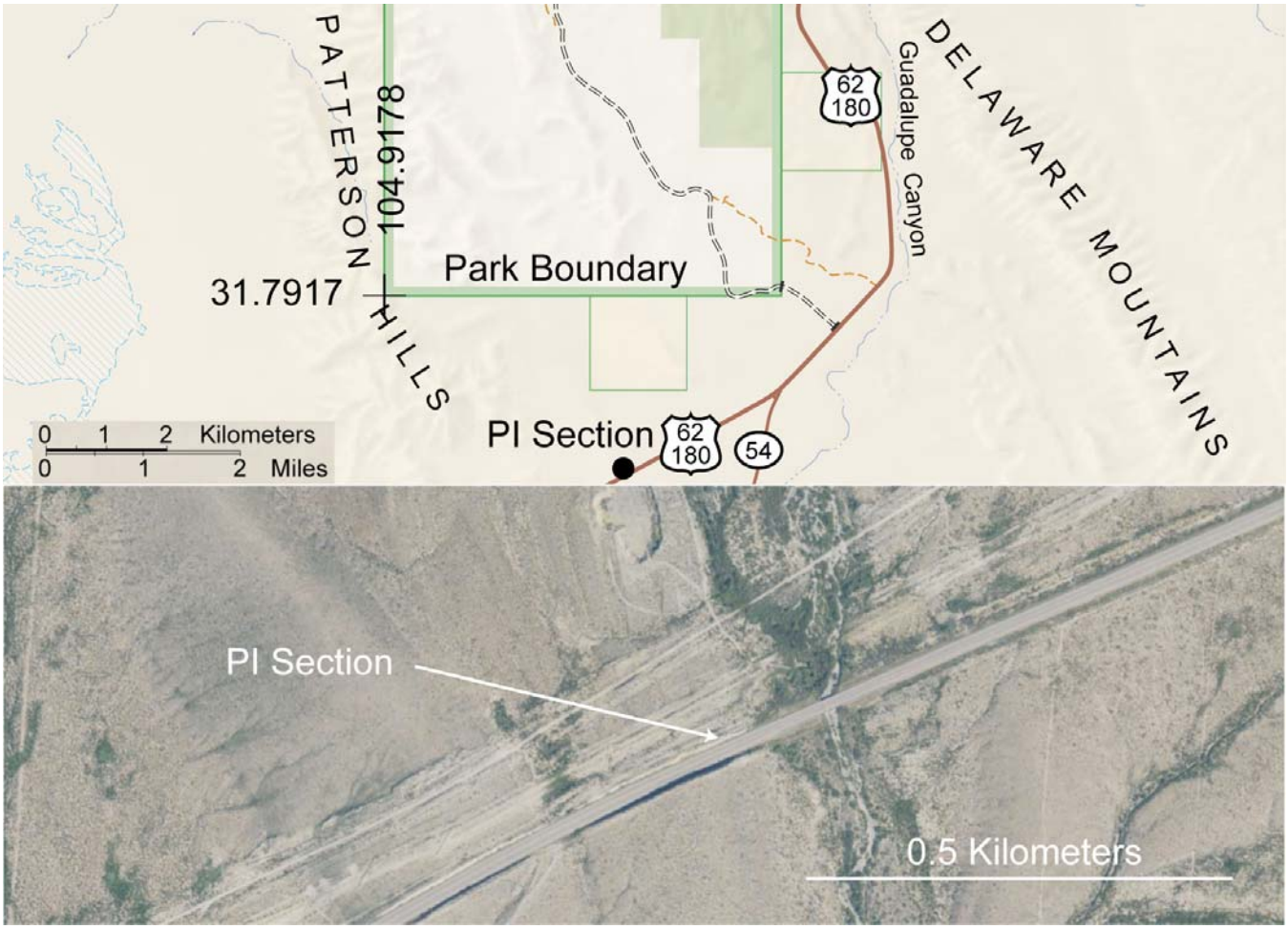
Unit 5: sandstone and siltstone (6.3m), medium beds of sandstone separated by calcareous siltstone, with thin to medium beds and lenses of limestone within the siltstone intervals; one thin bentonite just above the thin limestone bed of sample PI-12, Bell Canyon Formation.

Unit 6: limestone and siltstone (2m), generally medium beds of skeletal limestone, with some thin beds, interbedded with relatively thick siltstone intervals, base of the Pinery Limestone Member.

Unit 7: platy limestone and siltstone (0.53m), thin interbeds of platy silty limestone and calcareous siltstone.

Unit 8: limestone and siltstone (3.33m), medium to thin beds of skeletal limestone separated by 9–18cm intervals of calcareous siltstone with one 5cm interval separating two thin limestone beds at the top, top of the lower Pinery.

Unit 9: silty fine sandstone (4.55m), silty fine sandstone with scattered thin interbeds of fine- to medium-grained sandstone, in an interval of undifferentiated strata of the Bell Canyon Formation.



TEXT-FIGURE 1
Location of PI section. Image copyright Google Earth, March 16, 2014. Lat. 31º47.103' N, Long. 104º52.608' W.

Unit 10: limestone and siltstone (2.3m), mixed medium beds of skeletal limestone and calcareous siltstone intervals with platy limestone and calcareous siltstone intervals, base of the upper Pinery.

Unit 11: platy siltstone and limestone (2.5m), interbedded platy calcareous siltstone and silty limestone with a few thin limestone beds.

Unit 12: thin sandstone and siltstone interbed (0.39m), medium bed of sandstone and a medium bed interval of calcareous siltstone.

Unit 13: limestone and siltstone (2.68m), thin to medium beds of skeletal limestone with one thick (29cm) limestone bed separated by medium to thin intervals of calcareous siltstone, top of the Pinery Limestone Member.

Unit 14: sandstone (5.4m), medium-bedded, fine sandstone, of undivided strata of the Bell Canyon Formation.

The medium to thick limestone beds throughout the section are coarser at the base and fine upwards, being a skeletal wacke-to-packstone at the base fining to silty, skeletal carbonate mudstone at the top. Beds thinner than 10cm tend to be less coarse at the base (i.e., skeletal wackestone to skeletal carbonate mudstone grading upward to finer skeletal carbonate mudstone). Thin limestone beds (1-3cm) start as a fine grained skeletal carbonate mudstone at the base and become a carbonate mudstone upwards or are just carbonate mudstone.

The lower four limestone beds of the Hegler Limestone all yielded practically monospecific conodont faunas of *Pseudohindeodus* which was very abundant in sample PI-7D. The abundance of *Pseudohindeodus* and lack of other conodonts probably indicates a restrictive water mass (hypersaline?). This lower limestone and siltstone unit is followed by a little over a meter of fine sandstone with a thin limestone and siltstone interbeds. This unit, in turn, is followed by a thin limestone, three 30 cm limestone beds, all separated by thin siltstone partings and topped by thin siltstone and limestone interbeds. The first sample with an abundant and diverse conodont fauna is PI-7E, which has abundant *Jinogondolella* with *Pseudohindeodus, Hindeodus,* and *Caenodontus* and probably represents a fauna from a normal-marine water mass. The

TEXT-FIGURE 2
Composite panorama view of outcrop of PI section. ss = sandstone, slts = siltstone

Jinogondolella fauna is diverse with a narrow morphotype of *Jinogondolella nankingensis*, herein referred to as *Jinogondolella nankingensis behnkeni*, transitional forms from *J. nankingensis nankingensis* to *J. aserrata* and *Jinogondolella aserrata*, and thus representing a significant part of the Wordian. The upper thin limestone of the Hegler displays abundant ammonoids on its upper surface. All the limestone beds in the exposure above PI-7E yield a diverse conodont fauna (Table 1) indicating normal marine conditions. However, the relative abundances of *Jinogondolella aserrata* and *J. palmata* vary with *J. aserrata* usually dominating but, with a few samples with *J. palmata* dominating to almost the complete exclusion of *J. aserrata*. Nestell and Wardlaw (2010) alluded to this dominance when describing the species from probable Hegler equivalents in the Apache Mountains and suggested it could be ecological and water mass related.

The first occurrence of *Jinogondolella postserrata* is in sample PI-31. *Jinogondolella postserrata* defines the base of the Capitanian in the global stratotype section and point (GSSP) designated near the top of Nipple Hill in the upper part of the Pinery Limestone Member of the Bell Canyon Formation. There appears to be more carbonate deposition following the introduction of *J. postserrata* in our section than that at Nipple Hill where there appears also to be no "lower part" of the Pinery present.

Paleogeography

Three subspecies of *Jinogondolella nankingensis* are currently recognized; in simple terms, a broad morphotype, a moderate morphotype, and a very thin morphotype. These subspecies are *Jinogondolella nankingensis nankingensis* (Jin)*, J. nankingensis behnkeni* Wardlaw and Nestell (this paper), and *Jinogondolella nankingensis tenuis* Wardlaw (this volume), respectively, and exhibit a very interesting distribution pattern around the northwest edge of Pangaea (text-fig. 5). *Jinogondolella* specimens are abundant in the Delaware Basin with the broad subspecies *nankingensis* dominating, but with the commonly occurring subspecies *behnkeni* present and a single sample present with the thin subspecies *tenuis*. In the Phosphoria Basin, *Jinogondolella* specimens are abundant in the lower part of the Phosphoria Formation section with the very thin subspecies *tenuis* abundant and with common to rare subspecies *behnkeni* present. Specimens of *Jinogondolella* become sporadic in their distribution higher in the section with both subspecies rare, but in some beds commonly present, generally with specimens of *Mesogondolella* dominating the upper faunas. In the Sverdrup Basin *Jinogonodolella* specimens are sparse but, both of the subspecies *tenuis* and *behnkeni* are represented (see Mei and Henderson 2002, pl. 4).

CONODONT TAXONOMY

Phylum CHORDATA Bateson 1886
Subphylum VERTEBRATA Cuvier 1812
Class CONODONTA Pander 1856
Subclass EUCONODONTA Janvier 1996
Order BELODELLIDA Sweet 1988
Family ANSELLIDAE Fåhraeus and Hunter 1985
Genus *Caenodontus* Behnken 1975

Caenodontus serrulatus Behnken 1975
Plate 15, figure 4

Caenodontus serrulatus BEHNKEN 1975, p. 298–302, pl. 2, figs. 5, 7.

Diagnosis: A coniform apparatus with S elements with partially serrated posterior margins (S0) to nearly fully serrated posterior margins (S3) and unserrated "P" elements.

Remarks: *Caenodontus serrulatus* has a multi-element apparatus that mimics the apparatus of the genus *Ansella* perfectly and is placed in that family here, though there are no known members of the family from the post-Ordovician until the Middle Permian. We will deal with the apparatus of this genus in a companion paper (Nestell and Wardlaw 2015, this volume).

Order PRIONIODINIDA Sweet 1988
Family ELLISONIIDAE Clark 1972
Genus *Sweetina* Wardlaw and Collinson 1986

Sweetina triticum Wardlaw and Collinson 1986
Plate 15, figures 1–3

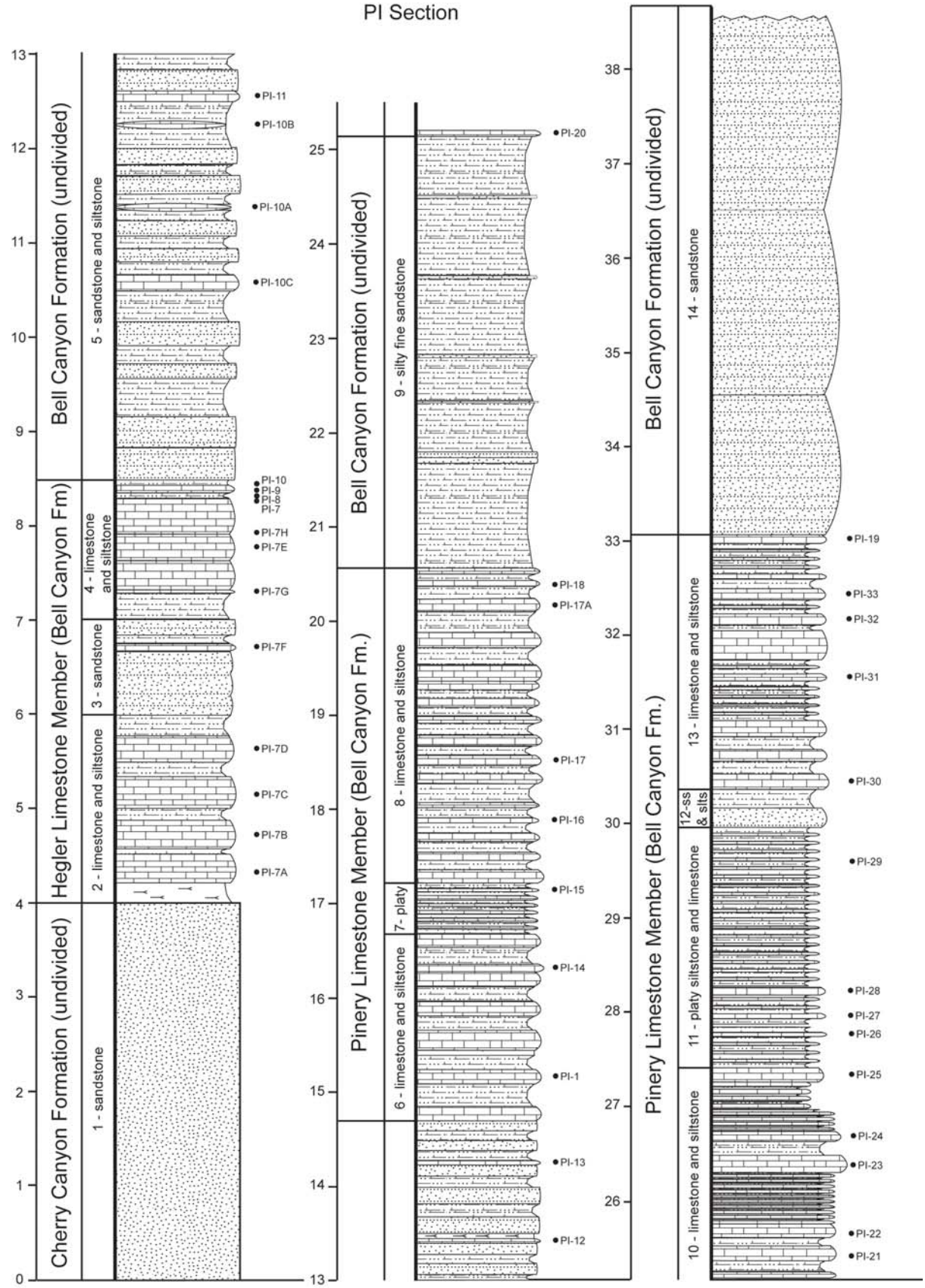
Sweetina triticum WARDLAW and COLLINSON 1986, p. 135, fig. 20:1-20. – WARDLAW 2000, p. 43, pl. 3–13, fig. 19.

Diagnosis: A species of *Sweetina* characterized by a non-platformed pastinate P1 element with a short lateral and anteriorly directed process and with a relatively large slightly flared basal cavity. The remainder of the elements that make up the apparatus are remarkably similar to those of the genus *Merrillina.*

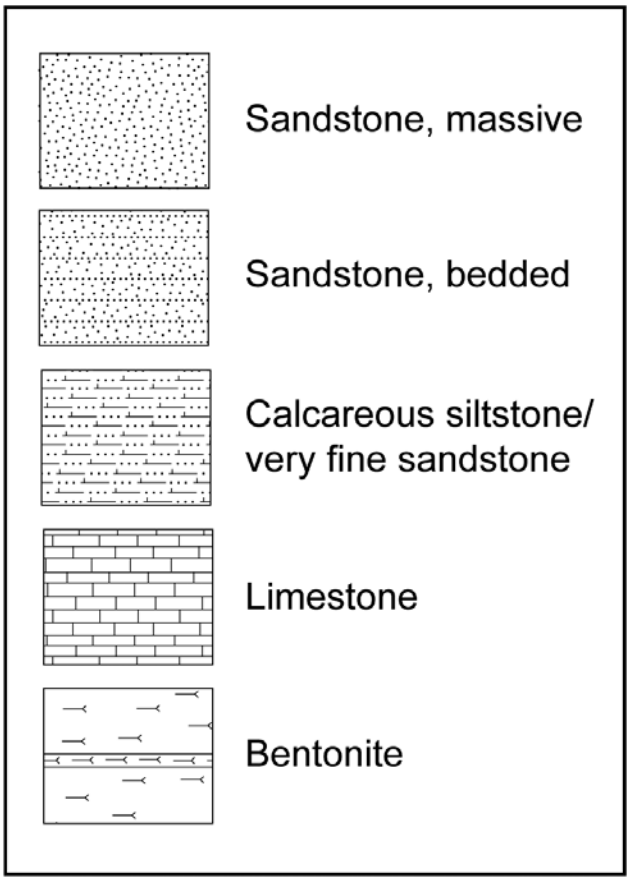
The apparatus of *Sweetina triticum* is illustrated by Wardlaw and Collinson (1986).

Family GONDOLELLIDA Linström 1970
Genus *Jinogondolella* Mei, Jin and Wardlaw 1998

Jinogondolella aserrata (Clark and Behnken 1979)
Plate 1, figures 2, 9, 10, 15; Plate 2, figures 7, 9–14, 16; Plate 3, figures 6, 7, 12; Plate 4, figures 4, 11; Plate 5, figures 2, 9; Plate 6, figures 1, 2, 5, 7, 8, 10, 11; Plate 7, figures 1, 4, 5, 7, 8; Plate 8, figures 1–4, 7, 9; Plate 9, figures 1, 2, 5–9; Plate 10, figures 1–4, 6, 7;



TEXT-FIGURE 3
Columnar section of the PI section, scale in meters.



TEXT-FIGURE 4
Lithologic symbols.

TABLE 1
Occurrence of conodont species in the PI section.

Sample	mab	*Caenodontus serrulatus*	*Pseudohindeodus ramovsi*	*Hindeodus brevis*	*Hindeodus wordensis*	*Sweetina triticum*	*Jinogondolella nankingensis nankingensis*	*Jinogondolella nankingensis behnkeni*	Transitional morphotype *J. nankingensis-J. aserrat*	*Jinogondolella aserrata*	*Jinogondolella palmata*	*Hindeodus capitanensis*	*Jinogondolella errata*	*Jinogondolella postserrata*	Transitional morphotype *J. aserrata-J. postserrata*
PI-7A	4.22-4.50	X	X	X											
PI-7B	4.60-4.87		X	X											
PI-7C	5.00-5.33		X	X											
PI-7D	5.50-5.75		X												
PI-7F	6.67-6.73		X		X										
PI-7G	7.27-7.30	X	X	X		X									
PI-7E	7.62-7.89		X	X											
PI-7H	7.93-7.98		X				X	X	X	X					
PI-7	8.13-8.28		X	X				X		X					
PI-8	8.37-8.39														
PI-9A	8.39-8.41		X	X					X	X					
PI-10	8.41-8.43			X					X	X					
PI-10C	10.48-10.67				X		X	X	X	X	X				
PI-10A	11.33-11.42								X	X	X				
PI-10B	12.28-12.30									X					
PI-11	12.50-12.58							X		X	X				
PI-12	13.38-13.43									X	X				
PI-13	14.22-14.28									X	X				
PI-1	15.08-15.23			X						X	X				
PI-14	16.25-16.33				X					X	X				
PI-15	17.12-17.15									X	X				
PI-16	17.84-17.90									X	X				
PI-17	18.47-18.58									X	X				
PI-17A	20.10-20.23									X					
PI-18	20.35-20.43									X					
PI-20	25.13-25.18									X	A				
PI-21	25.38-25.53				X					X	A				
PI-22	25.62-25.75					X				X	A				
PI-23A	26.33-26.41			X	X					X	X				
PI-23B	26.41-26.50			X	X					X	X				
PI-24	26.65-26.75			X		X				X	X				
PI-25	27.25-27.40			X						X					
PI-26	27.72-27.77									X	A				
PI-27	27.90-27.97									X	X				
PI-28	28.18-28.28									X	X				
PI-29	29.58-29.63									X					
PI-30	30.34-30.53					X				X	X	X			
PI-31	31.50-31.58									X	X	X	X	X	
PI-32	32.10-32.23					X				X	X		X		
PI-33	32.37-32.50					X									X
PI-19	32.96-33.07									X	X		X	X	X

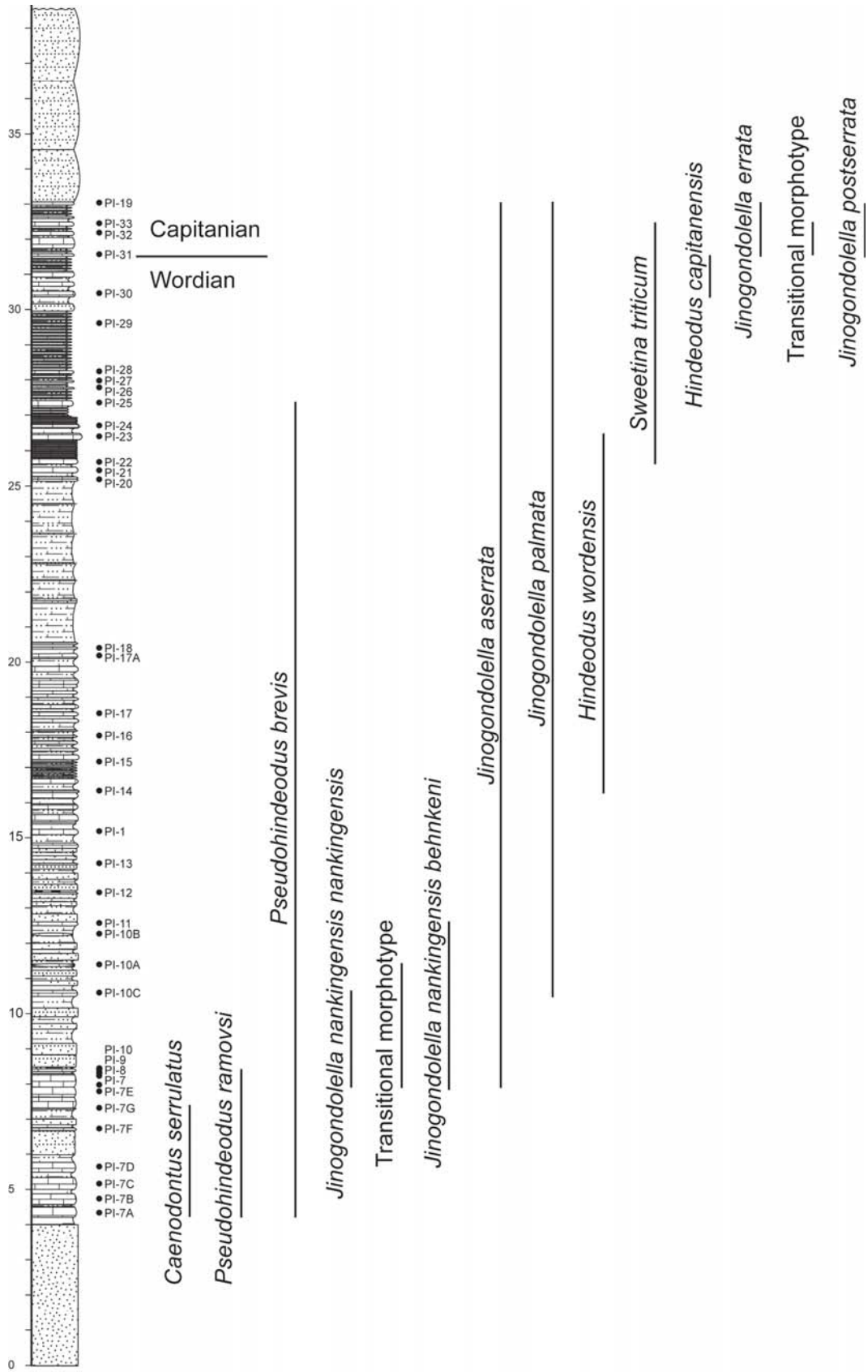
Plate 11, figures 5–8, 10; Plate 12, figures 7–12; Plate 13, figures 1, 2, 4, 7

Jinogondolella aserrata transitional from ***J. nankingensis***
Plate 1, figures 5, 11, 13, 14, 18; Plate 2, figures 1, 4, 6, 17; Plate 3, figures 1, 5

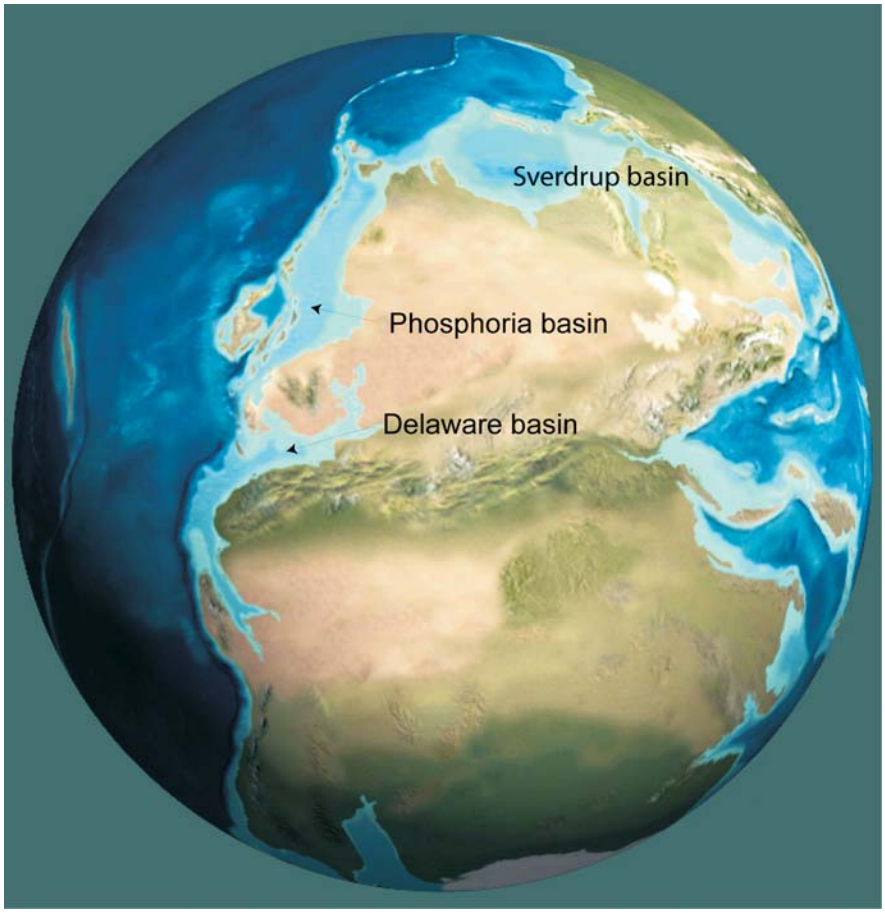
Jinogondolella aserrata transitional to ***J. postserrata***
Plate 12, figures 4, 5

Neogondolella aserrata CLARK and BEHNKEN 1979, p. 271–272, pl. 1, figs. 1–11.
Neogondolella serrata postserrata BEHNKEN 1975, p. 307–308, pl. 2, figs. 28-30, 33, 34, 36.
Mesogondolella aserrata (Clark and Behnken). – KOZUR 1989, p. 392. – MEI et al. 1994, pl. 1, figs. 4–7, 11, 13. – WARDLAW 2000, p. 45, pl. 3-3, figs. 1–16; pl. 3-5, figs. 1–7; pl. 3-10, figs. 11–17.
Jinogondolella aserrata (Clark and Behnken). – MEI et al. 1994, p. 21. – MEI et al. 1998, pl. 2, fig. 9. – WARDLAW and NESTELL 2010, p. 197–198, pl. 1, figs. 10–18; pl. 2, figs. 1a-b, 6, 12, 13a–b, 15a–b; pl. 3, figs. 1–3, 6–9; pl. 4, figs. 5, 7–8, 10-12, 14–16, 19, 23–24, 27; pl. 5, figs. 4–6, 8–9, 24–25, 28; pl. 6, figs. 1–3, 8, 16, 18–22, 26–28. – KOZUR and WARDLAW 2010, p. 219, pl. 1, figs. 1–3.
Mesogondolella rustaqensis MEI and HENDERSON 2002, p. 535, pl. 6, figs. 1–3, 5, 9–10. – HENDERSON and MEI, 2003, pl. 3, fig. 9.
Mesogondolella idahoensis lamberti MEI and HENDERSON 2002 (part), p. 533–534, pl. 7, figs. 1–4, 6–8. – HENDERSON and MEI 2003, pl. 4, figs. 1–4, 6–8.
Jinogondolella granti Mei and Wardlaw. – LAMBERT et al. 2002 (part), p. 356, pl. 1, figs. 3, 14.
Jinogondolella altudaensis (Kozur). – LAMBERT et al. 2002 (part), p. 350, pl. 1, figs. 4 (transitional morphotype to *J. postserrata*), 16.

Diagnosis: A species of *Jinogondolella* with a multi-element apparatus characterized by a P1 element that is of moderate width and length, slightly arched and bowed, widest posterior to middle, narrowing gradually to anterior from widest point, with a bluntly rounded posterior end with a brim in most large specimens, commonly with a slight to marked inflection along inner lateral margin in the posterior one-third of the specimen, lateral platform margin serrated to smooth on anterior one-third of platform, cusp small to moderate generally elongate and closely spaced to a denticle either posteriorly or anteriorly, denticles generally of varying size and height on posterior one-third to one-half of platform before increasing steadily in size anteriorly, except for the distalmost, which decrease in size, generally denticles in middle section of carina are the lowest and most



TEXT-FIGURE 5
Ranges of conodont species in the PI section, scale in meters.



TEXT-FIGURE 6
Global image of Late Permian (260 Ma) paleogeography from Ron Blakey (2011) showing position of the Delaware, Phosphoria, and Sverdrup basins.

fused, furrows shallow, and lateral platform margins only slightly upturned.

The apparatus of *J. aserrata* is described by Wardlaw and Nestell (2010).

Remarks: Wardlaw and Nestell (2010) showed the subtle differences in the whole apparatuses of *Jingondolella aserrata, J. errata,* and *J. postserrata*. Transitional forms expressed in the P1 element from *J. nankingensis* to *J. aserrata* are well illustrated herein. Transitional forms are placed with *J. aserrata* with a blunt posterior platform termination and a laterally turned posterior carina and cusp, but retains numerous lateral serrations.

Jinogondolella errata Wardlaw and Nestell 2010
Plate 11, figures 4, 9

Jinogondolella errata WARDLAW and NESTELL 2010, p. 198–200, pl. 1, figs. 1–9; pl. 2, figs. 4a–b, 5, 10, 14a–b; pl. 3, figs. 5, 12–17; pl. 4, figs. 1-3, 6, 17, 20, 22, 25, 28; pl. 5, figs. 1, 10, 12–16, 18–19, 23, 26; pl. 6, figs. 5–7, 9–10, 12-13, 23–24.
Jinogondolella granti Mei and Wardlaw. – LAMBERT et al. 2002 (part), p. 356, pl. 1, figs. 1–2, 8–9, 15, *non* pl. 1, figs. 3, 14 (=*J. aserrata*).
Jinogondolella xuanhanensis Mei and Wardlaw. – LAMBERT et al. 2002 (part), p. 356, pl. 1, figs. 5–7, 10–13, 17–18.

Diagnosis: A species of *Jinogondolella* with a multi-element apparatus characterized by a P1 element that is slightly arched and bowed, and is long and narrow to moderately wide, with upturned lateral margins and deeply incised narrow furrows. A few lateral margin serrations are present, poorly expressed and restricted to the anterior eighth of the platform, generally a low cusp, carina and blade, with the anterior middle of the carina in most large specimens forming a fused ridge at a slight angle to the curvature of the platform. Carina bears at least one peg-like denticle (non-pointed, flat topped) near fused carina, except in specimens with a completely fused carina.

The apparatus of *J. errata* is described by Wardlaw and Nestell (2010).

Remarks: *Jinogondolella errata* is restricted in range to the transition from *J. aserrata* to *J. postserrara* and probably is the successor to *J. gladirobusta* with the beginning of a fused carina at angle to the curvature of the platform.

Jinogondolella nankingensis nankingensis (Jin 1960)
Plate 1, figure 6; Plate 6, figure 4

Jinogondolella nankingensis transitional to ***J. aserrata***
Plate 1, figures 1, 3–4, 16; Plate 2, figures 8, 15; Plate 3, figures 2–4; Plate 5, figure 7

Gondolella nankingensis CHING (JIN) 1960, p. 246, pl. 2, figs 5–8.

Gondolella serrata CLARK and ETHINGTON 1962, p. 108–109, pl. 1, figs. 10, 11, 15, 19; pl. 2, figs. 1, 5, 8, 9, 11–14. – CLARK and MOSHER 1966, p. 389, pl. 47, figs. 13–15. – CLARK and BEHNKEN 1971, p. 431, pl. 1, fig. 10.
Neogondolella serrata (Clark and Ethington). – CLARK and BEHNKEN 1979, p. 268–271, pl. 1, fig. 12. – WANG 1978, p. 222, pl. 2, figs. 6–8, 14–15, 20–22. – BEHNKEN et al. 1986 (part), p. 183, fig. 5:21, 24.

Diagnosis: A species of *Jinogondolella* characterized by a P1 element with a low to moderate cusp, elongate circular in cross section, roughly parallel sided on posterior platform margins, narrowing anterior third of platform is serrated, serrations may extend up the posterior platform margins for a variable length. In rare forms nearly the whole platform margin is serrated, although in general, the serrations are limited to the narrowing portion of the platform. The blade is low.

The apparatus is described by Lambert et al. (2007).

Remarks: Transitional forms from *Jiinogondolella nankingensis nankingensis* to *J. aserrata* that retain the circular cusp and anterior lateral serrations, but where the posterior platform termination becomes more blunt and are skewed, are placed with *J. n. nankingensis*.

Jinogondolella nankingensis behnkeni Wardlaw and Nestell, **n. subsp.**
Plate 1, figures 7, 8, 12; Plate 2, figures 2, 5; Plate 5, figure 1

Neogondolella serrata (Clark and Ethington). – WARDLAW and COLLINSON 1984, p. 270, pl. 22, figs. 13–15. – WARDLAW and COLLINSON 1986, figs. 17:7-8. – BEHNKEN et al. 1986 (part), p. 183, fig. 5:20, 23, 26, 29?, 30, 31.
Neogondolella gracilis (Clark and Ethington). – BEHNKEN et al. 1986 (part), p. 177–179, fig. 4:19?, 24, 28.
Jinogondolella nankingensis gracilis (Clark and Ethington). – MEI and HENDERSON 2002 (part), p. 535, pl. 4, figs. 6,11,12.

PLATE 1

All specimens P1 elements ×65, scan numbers represent bed number-specimen number (i.e., 7E-14 means Bed PI-7E, specimen 14)

1a,b *Jinogondolella nankingensis* transitional to *J. aserrata*, upper and oblique upper views, scan 7E-14

2a,b *Jinogondolella aserrata*, upper and oblique upper views, scan 7E-15

3a,b *Jinogondolella nankingensis* transitional to *J. aserrata*, upper and oblique lateral views, scan 7E-16

4a,b *Jinogondolella nankingensis* transitional to *J. aserrata*, oblique upper and oblique lateral views, scan 7E-18

5a,b *Jinogondolella aserrata* transitional from *J. nankingensis*, upper and oblique upper views, scan 7E-9

6a,b *Jinogondolella nankingensis nankingensis*, oblique upper and upper views, scan 7E-1

7a,b *Jinogondolella nankingensis behnkeni*, oblique upper and upper views of holotype, scan 7E-2

8a,b *Jinogondolella nankingensis behnkeni*, upper and oblique upper views, scan 7E-3

9a,b *Jinogondolella aserrata*, upper and oblique upper views, scan 7E-10

10a,b *Jinogondolella aserrata*, upper and oblique upper views, scan 7-1

11a,b *Jinogondolella aserrata* transitional from *J. nankingensis*, upper and oblique upper views, scan 7E-12

12a,b *Jinogondolella nankingensis behnkeni*, oblique upper and upper views, scan 7E-11

13a,b *Jinogondolella aserrata* transitional from *J. nankingensis*, upper and oblique upper views, scan 7E-13

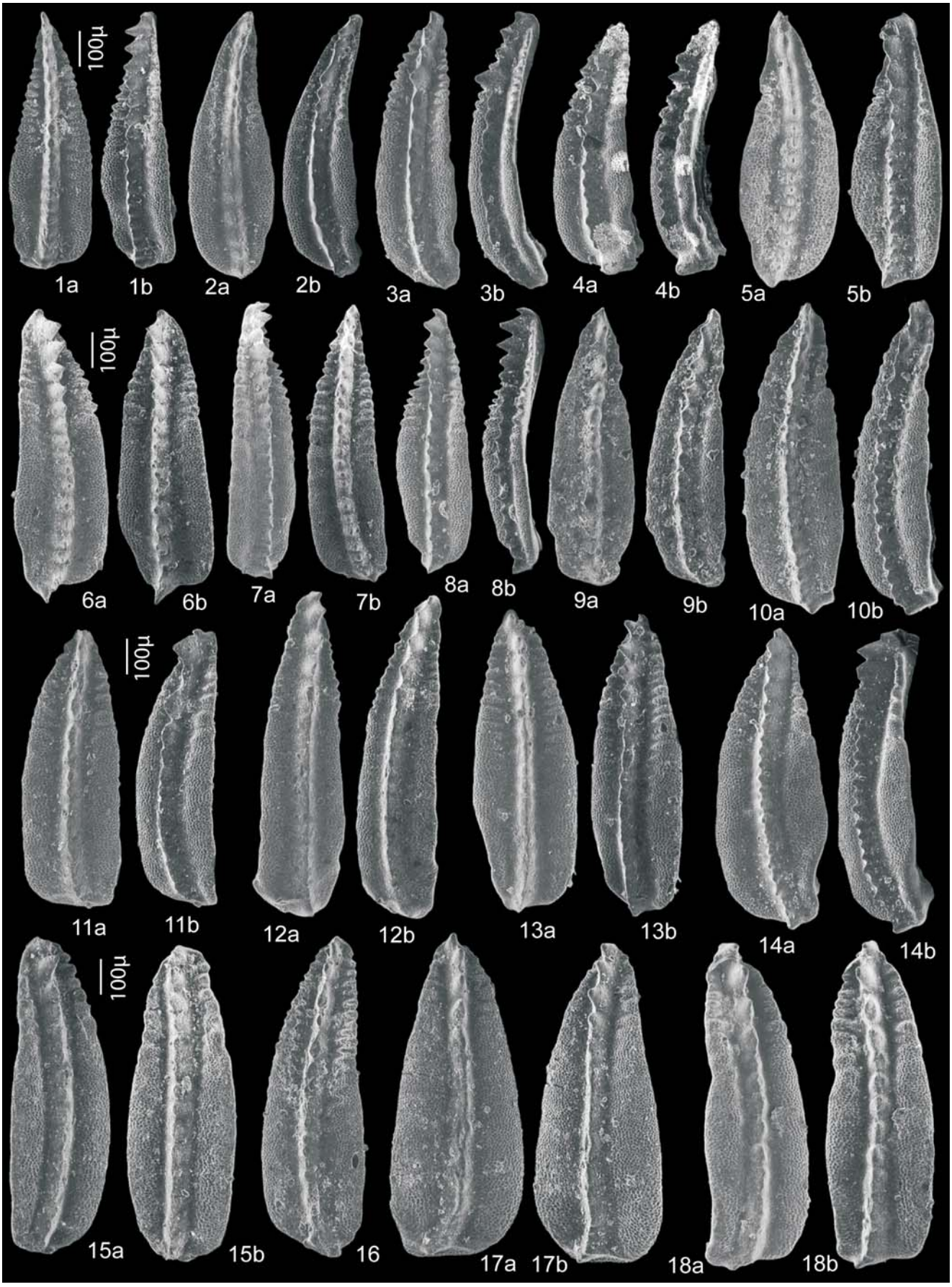
14a,b *Jinogondolella aserrata* transitional from *J. nankingensis*, upper and oblique lateral views, scan 7E-8

15a,b *Jinogondolella aserrata*, oblique upper and upper views, scan 7E-5

16 *Jinogondolella nankingensis* transitional to *J. aserrata*, upper view, scan 7E-6

17a,b *Jinogondolella palmata*, upper and oblique upper views, scan 7E-7

18a,b *Jinogondolella aserrata* transitional from *J. nankingensis*, oblique upper and upper views, scan 7E-4.


100µ
1a
1b
2a
2b
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Diagnosis: A subspecies of *Jinogondolella nankingensis* characterized by a P1 element with a moderate recurved cusp and a narrow to moderate width platform with faint to marked anterior serrated platform margins and a low blade.

Description: P1 element carminiscaphate, slightly arched and bowed, with lateral margins that narrow very gradually to the anterior from widest point, widest at various places on posterior portion behind anterior lateral serrations, cusp moderate, recurved, with circular cross-section, carina denticles low, with a low fixed blade, lateral serrations on anterior one-third of platform, variably expressed from pronounced to faint, adcarinal furrows narrow.

Holotype: Plate 1, figure 7, sample PI-7E, Hegler Limestone Member, Bell Canyon Formation.

Remarks: Because *Jinogondolella nankingensis behnkeni* is not the dominant subspecies in any of our samples from the Guadalupian of the Delaware or the Phosphoria basins, we have not been able to reconstruct its apparatus.

Jinogondolella nankingensis tenuis Wardlaw 2015
Plate 15, figures 10a, 10b

Jinogondolella nankingensis tenuis WARDLAW [this issue], pl. 1, figs. 1–3, 6, 9, 10; pl. 2, figs. 2–9, 11, 13, 14; pl. 5, fig. 12.
Neogondolella serrata (Clark and Ethington). – BEHNKEN et al. 1986 (part), p. 183, fig. 5:25, 27–28.
Jinogondolella nankingensis gracilis (Clark and Ethington). – MEI and HENDERSON 2002 (part), p. 535, pl. 3, figs. 1–12, 14–16; pl. 4, figs. 1-5, 7–10, 13–18.

Diagnosis: A subspecies of *Jinogondolella nankingensis* characterized by a P1 element with a high recurved to procline cusp and a narrow width platform with faint serrated platform margins and a low blade.

A partial apparatus is illustrated by Mei and Henderson (2002, pl. 3, figs. 10–12, 14–16, non fig. 13).

Remarks: We have recovered this subspecies from only one sample of our material from West Texas, a sample from the Williams Ranch Member of the Cutoff Formation collected at the small quarry at the base of Guadalupe Pass. We illustrate an example herein.

Jinogondolella palmata Nestell and Wardlaw 2010
Plate 1, figure 17; Plate 2, figure 3; Plate 3, figures 8–11; Plate 4, figures 1–3, 5-10; Plate 5, figures 3–6, 8, 10; Plate 6, figures 3, 6,

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PLATE 2
All specimens P1 elements ×65

1a,b *Jinogondolella aserrata* transitional from *J. nankingensis*, oblique upper and lateral views, scan 9A-6

2a,b *Jinogondolella nankingensis behnkeni*, upper and oblique upper views, scan 7-2

3a,b *Jinogondolella palmata*, oblique upper and upper views, scan 10C-12

4a,b *Jinogondolella aserrata* transitional from *J. nankingensis*, oblique upper and upper views, scan 10C-17

5a,b *Jinogondolella nankingensis behnkeni*, upper and oblique upper views, scan 10C-15

6a,b *Jinogondolella aserrata* transitional from *J. nankingensis*, upper and oblique lateral views, scan 10C-20

7a,b *Jinogondolella aserrata*, oblique upper and upper views, scan 10C-16

8 *Jinogondolella nankingensis* transitional to *J. aserrata*, oblique upper view, scan 9A-7

9a,b *Jinogondolella aserrata*, upper and oblique lateral views, scan 7-7

10a,b *Jinogondolella aserrata*, upper and oblique upper views, scan 9A-2

11a,b *Jinogondolella aserrata*, upper and oblique upper views, scan 7-3

12a,b *Jinogondolella aserrata*, oblique upper and upper views, scan 7-4

13a,b *Jinogondolella aserrata*, upper and oblique lateral views, scan 7-5

14a,b *Jinogondolella aserrata*, upper and oblique upper views, scan 7-8

15a,b *Jinogondolella nankingensis* transitional to *J. aserrata*, upper and oblique upper views, scan 9A-1

16a,b *Jinogondolella aserrata*, upper and oblique lateral views, scan 9A-5

17a,b *Jinogondolella aserrata* transitional from *J. nankingensis*, oblique lateral and upper views, 9A-8.


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9, 12; Plate 7, figures 2, 3, 6; Plate 8, figures 5, 6, 8; Plate 9, figures 3, 4; Plate 10, figures 5, 8–11; Plate 13, figures 3, 5, 6, 8, 9

Jinogondolella palmata NESTELL and WARDLAW 2010, p. 188–192, pl. 1, figs. 1–26, pl. 2, figs. 1–10, pl. 3, figs. 1–9. – WARDLAW 2015 [this volume], pl. 6, figs. 7, 9.
Jinogondolella n. sp. A KOZUR and WARDLAW 2010, p. 220, pl. 1, fig. 14, pl. 3, fig 19.

Diagnosis: A species of *Jinogondolella* with a multi-element apparatus characterized by a broad, robust P1 element that is widest near the middle, with narrow adcarinal furrows, a platform that encloses or nearly so the entire blade and carina, a partly fused to very fused middle portion of the carina, and a short (fixed) blade of 3-4 large denticles.

The apparatus of *J. palmata* is described by Nestell and Wardlaw (2010).

Remarks: Kozur and Wardlaw (2010) and Wardlaw (this volume) illustrate *Jinogondolella palmata* from Oman and Idaho, respectively. Though it is rare outside of West Texas, it appears to be widespread in the Permian.

Jinogondolella postserrata (Behnken 1975)
Plate 11, figures 2–3; Plate 12, figures 1–3, 6

Neogondolella serrata postserrata BEHNKEN 1975, p. 307–308, pl. 2, figs. 31, 32, 35.
Neogondolella postserrata Behnken. – CLARK and BEHNKEN 1979, p. 272, pl. 1, figs. 13–17, 21.
Neogondolella babcocki CLARK and BEHNKEN 1979, p. 273–274, pl. 2, figs. 5, 6, 11–15, 17, 18.
Neogondolella denticulata CLARK and BEHNKEN 1979, p. 272, pl. 1, figs. 18–20, 22, 23.
Neogondolella rosenkrantzi (Bender and Stoppel). – CLARK and BEHNKEN 1979, p. 272-273, pl. 2, figs. 1–4, 7–9.
Mesogondolella "babcocki" (Clark and Behnken). – KOZUR 1992 (part) , p. 103, fig. 4.
Mesogondolella postserrata (Behnken). – MEI et al. 1994, p. 20–21, pl. 1, figs. 8–10, 12, 14–17, 19–25. – WARDLAW 2000, p. 45–46, pl. 3–4, fig. 28; pl. 3–5, figs. 13–20; pl. 3–6, figs. 1–7; pl. 3–7, figs. 1–11; pl. 3–10, figs. 18, 19; pl. 3–11, figs. 1–4.
Jinogondolella postserrata (Behnken). – MEI et al. 1998, pl. 6, figs. 1–7, 9, 10, 12. – NESTELL et al. 2006, p. 184–186, pl. 11, figs. 2–5, 8–9, 11, 13, 15; pl. 12, figs. 3, 6, 10–11.
Xaniognathus hydraensis Nestell and Wardlaw. – WARDLAW 2000, p. 47, pl. 3-4, figs. 1–13; pl. 3-12, figs. 3–5.

Diagnosis: A species of *Jinogondolella* with a multi-element apparatus characterized by a P1 element that is slightly arched, bears lateral margin serrations on the anterior third of the platform. The platform is narrow with subparallel posterior platform margins, generally with a slight inflection on the inner

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PLATE 3
All specimens P1 elements ×65

1a,b *Jinogondolella aserrata* transitional from *J. nankingensis*, upper and oblique lateral views, scan 10-1

2a,b *Jinogondolella nankingensis* transitional to *J. aserrata*, oblique upper and upper views, scan 10-2

3a,b *Jinogondolella nankingensis*, transitional to *J. aserrata*, oblique upper and oblique lateral views, scan 10-3

4a,b *Jinogondolella nankingensis* transitional to *J. aserrata*, oblique upper and oblique lateral views, scan 10-5

5 *Jinogondolella aserrata* transitional from *J. nankingensis*, upper view, scan 10-4

6a,b *Jinogondolella aserrata*, upper and oblique upper views, scan 10-6

7a,b *Jinogondolella aserrata*, upper and oblique upper views, scan 10A-5

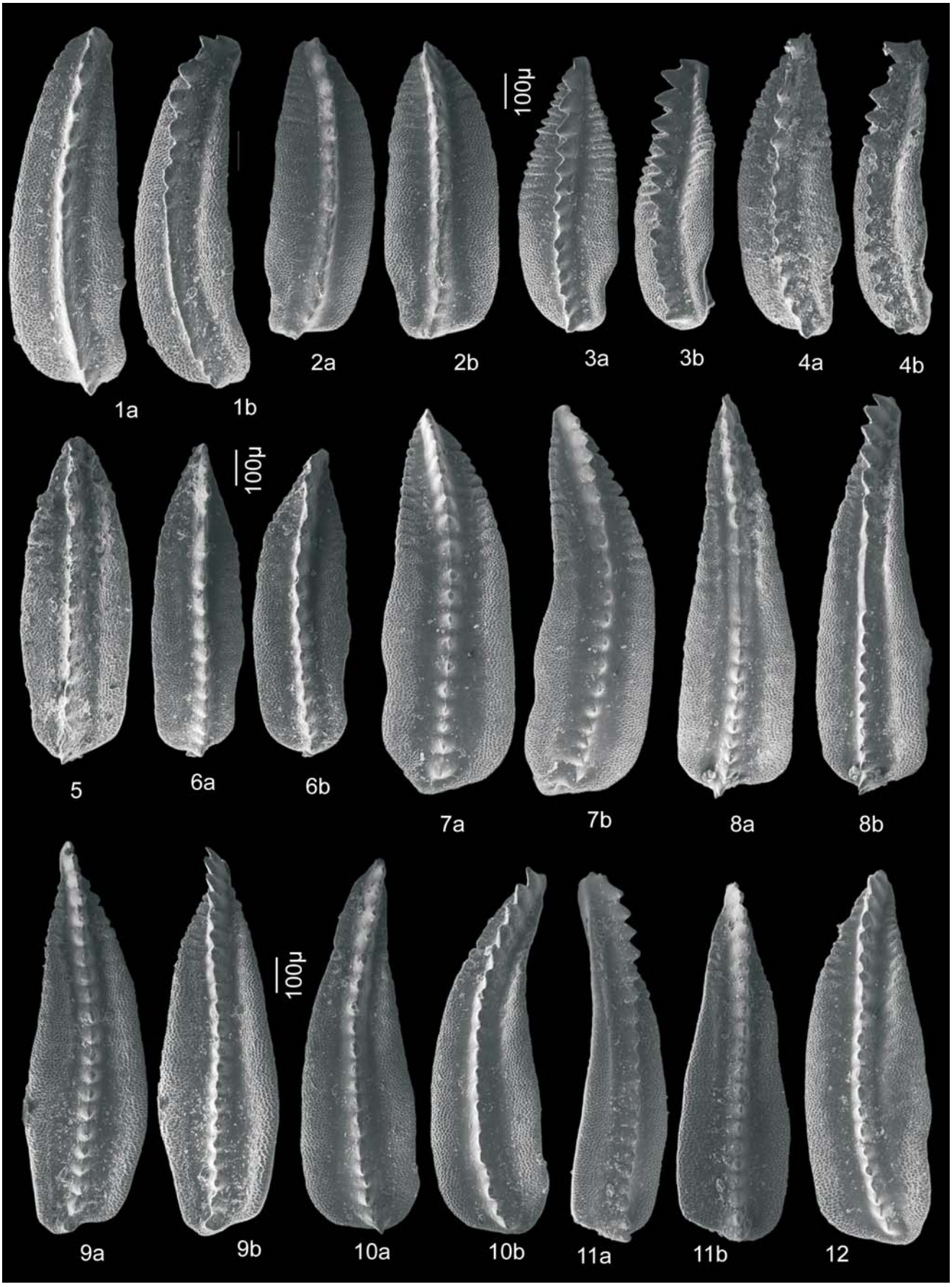
8a,b *Jinogondolella palmata*, upper and oblique upper view, scan 10A-4

9a,b *Jinogondolella palmata*, upper and oblique upper view, scan 10A-1

10a,b *Jinogondolella palmata*, upper and oblique upper view, scan 10A-2

11a,b *Jinogondolella palmata*, oblique lateral and upper view, scan 10A-3

12 *Jinogondolella aserrata*, upper view, scan 10A-6.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posterior margin, smooth well-incised furrows, erect cusp and denticles, carinal denticles decreasing in size toward middle of platform, and forming a smooth arch in lateral profile.

The apparatus of *J. postserrata* is described by Wardlaw and Nestell (2010).

Remarks: The appearance of *Jinogondolella postserrata* is very similar with a transitional morphotype from *J. aserrata* and a brief overlap of ranges at sections of the upper part of the Pinery Limestone Member at Nipple Hill, behind Pine Springs, and our PI section.

Family ANCHIGNATHODONTIDAE Clark 1972
Genus *Hindeodus* Rexroad and Furnish 1964

Hindeodus wordensis Wardlaw 2000
Plate 14, figures 5, 10, 16–19

Hindeodus wordensis transitional to ***H. capitanensis***
Plate 14, figure 20

Hindeodus wordensis WARDLAW 2000, p. 47–48, pl. 3-4, figs. 24, 25; pl. 3–12, figs. 1, 2. – ANGIOLINI et al. 2003, pl. 2, figs. 3-8.
Hindeodus evcavatus (Behnken). – WARDLAW and COLLINSON 1984, p. 268–269, pl. 5, figs. 1, 2, 4-9. – WARDLAW and GRANT 1990, p. A6, pl. 2, figs. 1–15; pl. 3, figs. 4, 5, 9-11. – GULLO and KOZUR 1992, p. 218, fig. 5E. – ANGIOLINI et al. 1998, p. 338, pl. 1, figs. 1–3, 12-15; pl. 2, figs. 2–3, 7, 9–12.

Diagnosis: A species of *Hindeodus* characterized by a P1 element that is slightly bowed with a large cusp with a gently sloping anticusp and bluntly pointed denticles that decline slowly to the anterior and thicken in width (especially longitudinally) and slightly in height, generally forming a slight posterior bulge in profile, then decease in size down a generally sharp posterior termination; a large, flared basal cavity apron behind the cusp that slopes gently downward.

The apparatus is described by Wardlaw and Collinson (1984).

Remarks: *Hindeodus wordensis* gave rise to *H. capitanensis* by infilling the spaces between denticles with small denticles (pl. 14, fig. 20) that merge with the larger denticle to form the peg-like denticles diagnostic of *H. capitanensis*.

Hindeodus capitanensis Wardlaw and Nestell**, n. sp.**
Plate 11, figure 1; Plate 14, figures 21, 22

Hindeodus typicalis (Sweet). – KOZUR 1992, fig. 19.

Diagnosis: A species of *Hindeodus* characterized by a P1 element that is slightly bowed with a moderate cusp, steep anticusp, and rounded and peg-like denticles that gently decline

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PLATE 4
All specimens P1 elements ×65

1a,b *Jinogondolella palmata*, oblique upper and upper views, scan 10C-4

2a,b *Jinogondolella palmata*, upper and oblique lateral views, scan 10C-11

3a,b *Jinogondolella palmata*, upper and oblique lateral views, scan 10C-10

4a,b *Jinogondolella aserrata*, oblique upper and upper views, scan 10C-8

5a,b *Jinogondolella palmata*, upper and oblique upper views, scan 10C-1

6a,b *Jinogondolella palmata*, upper and oblique upper views, scan 10C-2

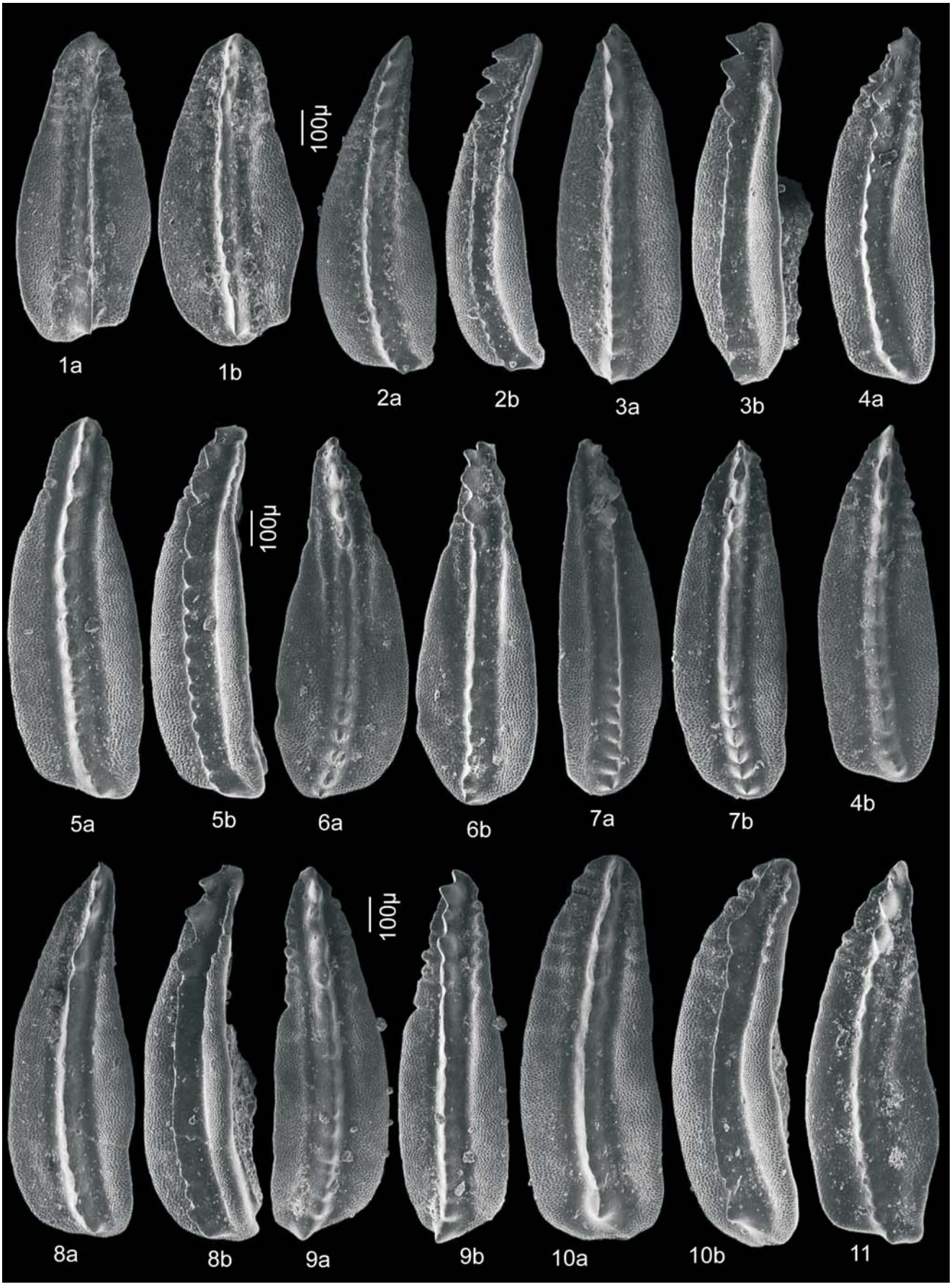
7a,b *Jinogondolella palmata*, oblique upper and upper views, scan 10C-9

8a,b *Jinogondolella palmata*, upper and oblique lateral views, scan 10C-5

9a,b *Jinogondolella palmata*, upper and oblique upper views, scan 10C-6

10a,b *Jinogondolella palmata*, upper and oblique lateral views, scan 10C-7

11 *Jinogondolella aserrata*, upper view, scan 10C-3.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to a sharp posterior termination, first denticle behind cusp is higher, on the posterior slope of the cusp, 3-5 denticles on posterior of the carina are peg-like, posterior termination with a small denticle before sharp decline with a small posterior lip to the basal cavity apron, basal cavity flared with a gently sloping basal cavity apron.

Description: As diagnosis.

Holotype: Plate 14, figure 22, sample PI-31, Pinery Limestone Member, Bell Canyon Formation.

Remarks: The peg-like posterior denticles set this species apart from other *Hindeodus* species.

Family SWEETOGNATHIDAE Ritter 1986

Pseudohindeodus ramovsi Gullo and Kozur 1992
Plate 15, figures 5, 6, 7, 8, 9

Pseudohindeodus ramovsi GULLO and KOZUR 1992, p. 223–224, fig.4A–H. – WARDLAW 2000, p. 49–50, pl. 3-1, figs. 5–24.

A partial apparatus is described by Wardlaw (2000).

Remarks: The apparatus of *Pseudohindeodus ramovsi* is well represented in our material and will be described in another paper.

Pseudohindeodus brevis Wardlaw and Nestell, **n. sp.**
Plate 14, figures 1–4, 5–9, 11–15, 19

Anchignathodus typicalis Sweet. – BEHNKEN 1975, p. 297–298, pl. 2, fig. 12.

Diagnosis: A species of *Pseudohindeodus* characterized by a P1 element that is straight with narrow cusp, very steeply sloping anticusp and sharply pointed denticles that are very appressed (closely crowded) next to the cusp that decline gradually to the posterior, and become wider and more discrete and wider spaced posteriorly, except for the last two which are smaller, but still continue becoming wider spaced; a sharply flared basal cavity apron that has a lateral crimp, but does not continue around the posterior end of the element.

Description: As diagnosis.

Holotype: Plate 14, figure 2, sample PI-7B, Hegler Limestone Member, Bell Canyon Formation.

PLATE 5
All specimens P1 elements ×65

1a,b *Jinogondolella nankingensis behnkeni*, upper and oblique upper views, scan 11-9

2a,b *Jinogondolella aserrata*, oblique upper and oblique lateral views, scan 10B-1

3a,b *Jinogondolella palmata*, oblique lateral and oblique upper views, scan 10A-13

4 *Jinogondolella palmata*, upper view, scan 10A-11

5a,b *Jinogondolella palmata*, upper and oblique upper views, scan 10A-9

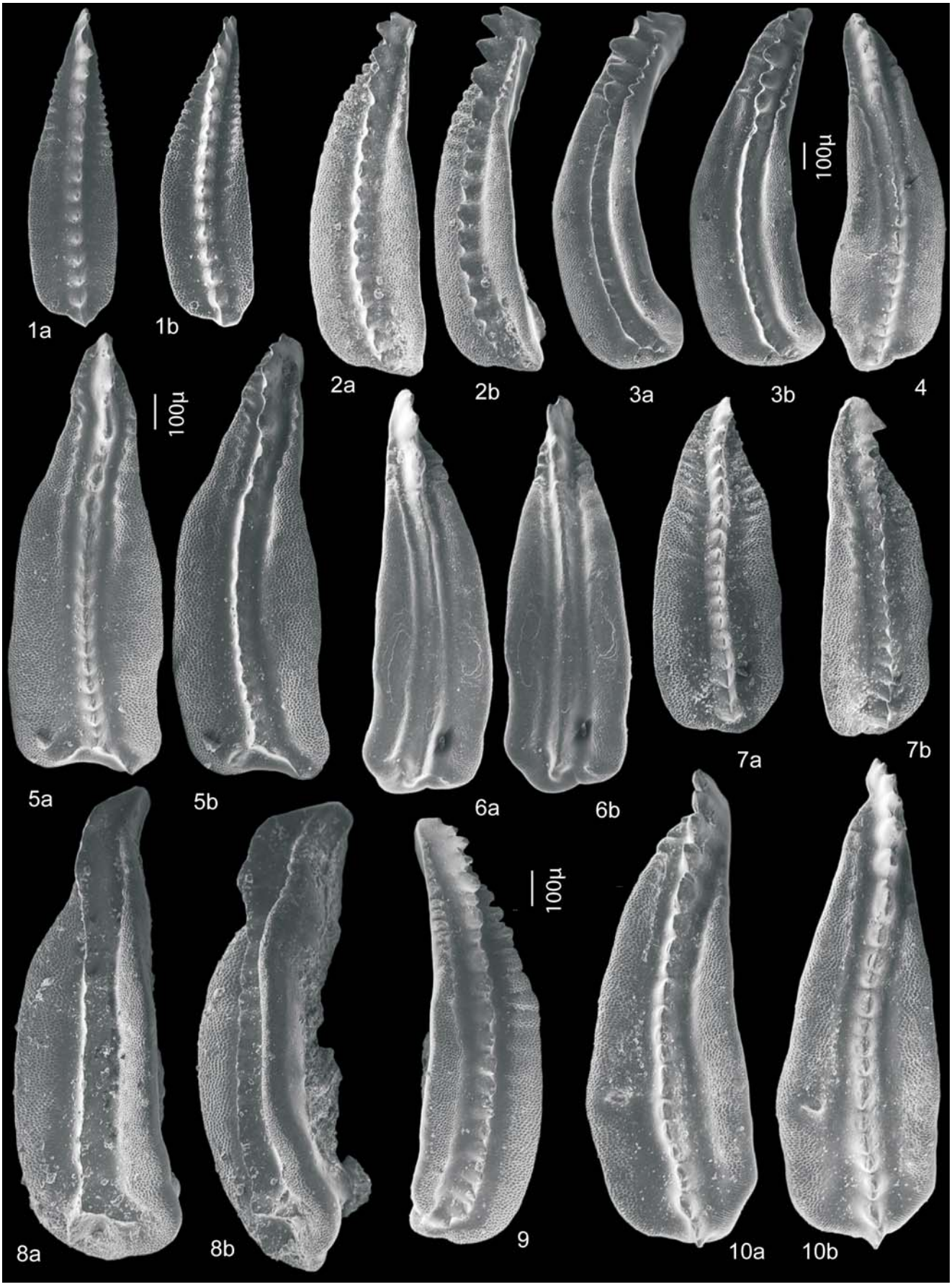
6a,b *Jinogondolella palmata*, oblique upper and upper views, scan 10A-14

7a,b *Jinogondolella nankingensis* transitional to *J. aserrata*, upper and oblique upper views, scan 10A-15

8a,b *Jinogondolella palmata*, oblique upper and oblique lateral views, scan 10A-10

9 *Jinogondolella aserrata*, oblique upper view, scan 10A-8

10a,b *Jinogondolella palmata*, oblique upper and upper views, scan 10A-12.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Remarks: The flared basal cavity with only a partially encircling crimp, not a completely encircling crimp and sharply pointed denticles on a short element differentiate *Pseudohindeodus brevis* from *P. ramovsi*.

CONCLUSIONS

The Hegler and Pinery Limestone Members at the PI section represent basinal deposition of graded carbonate flow units interbedded with fine sandsone and siltstone. The conodont faunas indicate a restrictive water source for initial depositon of the Hegler and normal marine deposition for the upper part of the Hegler and all of the Pinery Limestone Member and for the intervening undivided portion of the Bell Canyon Formation.

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PLATE 6

All specimens P1 elements ×65

1a,b *Jinogondolella aserrata*, transitional, upper and oblique lateral views, scan 10C-13

2a,b *Jinogondolella aserrata*, upper and oblique upper views, scan 10C-14

3a,b *Jinogondolella palmata*, upper and oblique upper views, scan 10C-18

4a,b *Jinogondolella nankingensis nankingensis*, upper and oblique upper views, scan 10C-19

5a,b *Jinogondolella aserrata*, oblique upper and upper views, scan 11-3

6a,b *Jinogondolella palmata*, upper and oblique upper views, scan 11-4

7 *Jinogondolella aserrata*, upper view, scan 11-5

8a,b *Jinogondolella aserrata*, oblique upper and upper views, scan 11-7

9a,b *Jinogondolella palmata*, upper and oblique upper views, scan 12-6

10a,b *Jinogondolella aserrata*, upper and oblique upper views, scan 12-7

11a,b *Jinogondolella aserrata*, upper and oblique upper views, scan 12-10

12a,b *Jinogondolella palmata*, upper and oblique upper views, scan 13-3.

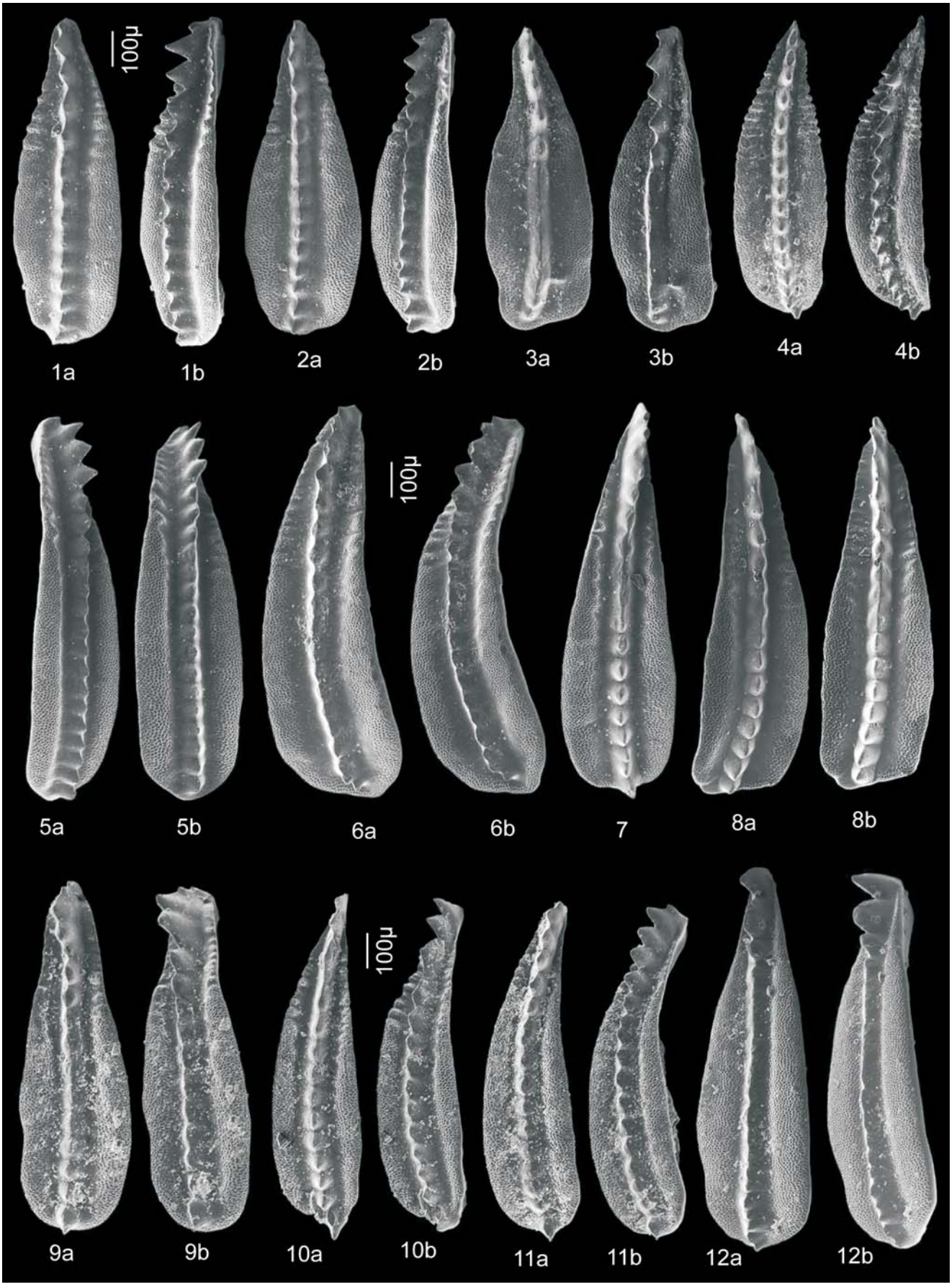
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PLATE 7

All specimens P1 elements ×65 except 3a and 5c ×300

1a,b *Jinogondolella aserrata*, upper and oblique upper views, scan 13-8

2a,b *Jinogondolella palmata*, oblique upper and upper views, scan 13-10

3a,b,c *Jinogondolella palmata*, carina enlargement, upper, and oblique lateral views, scan 1-4

4a,b *Jinogondolella aserrata*, upper and oblique upper views, scan 1-6

5a,b,c *Jinogondolella aserrata*, upper, oblique upper, and carina enlargement, scan 1-5

6a,b *Jinogondolella palmata*, upper and oblique upper views, scan 14-2

7a,b *Jinogondolella aserrata,* oblique upper and upper views, scan 14-3

8a,b *Jinogondolella aserrata* (approaching *J. palmata* in form), oblique upper and upper views, scan 14-1.

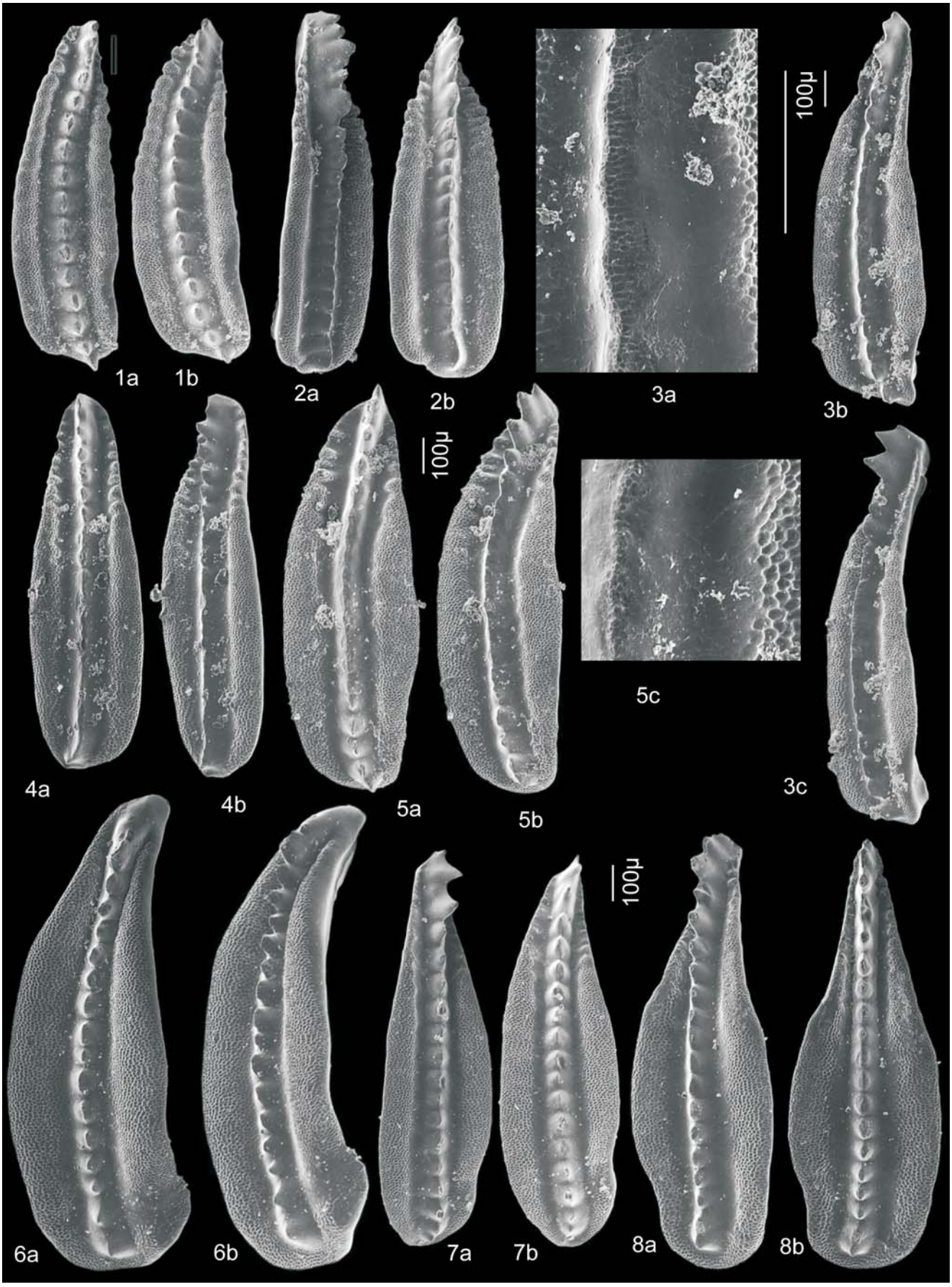
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PLATE 8

All specimens P1 elements ×65 except 5c, 8c, and 9c ×300

1a,b *Jinogondolella aserrata*, upper and oblique lateral views, scan 17A-1

2a,b *Jinogondolella aserrata*, upper and oblique upper views, scan 17-2

3a,b *Jinogondolella aserrata*, oblique upper and upper views, scan 17A-4

4a,b *Jinogondolella aserrata*, oblique upper and upper views, scan 14-9

5a,b,c *Jinogondolella palmata*, upper, oblique upper and carina enlargement, scan 17-1

6a,b *Jinogondolella palmata*, upper and oblique upper views, scan 14-8

7a,b *Jinogondolella aserrata,* upper and oblique upper views, scan 14-5

8a,b,c *Jinogondolella palmata*, oblique upper, upper and carina enlargement, scan 16-3

9a,b,c *Jinogondolella aserrata*, oblique upper, upper and carina enlargement, scan 16-2.

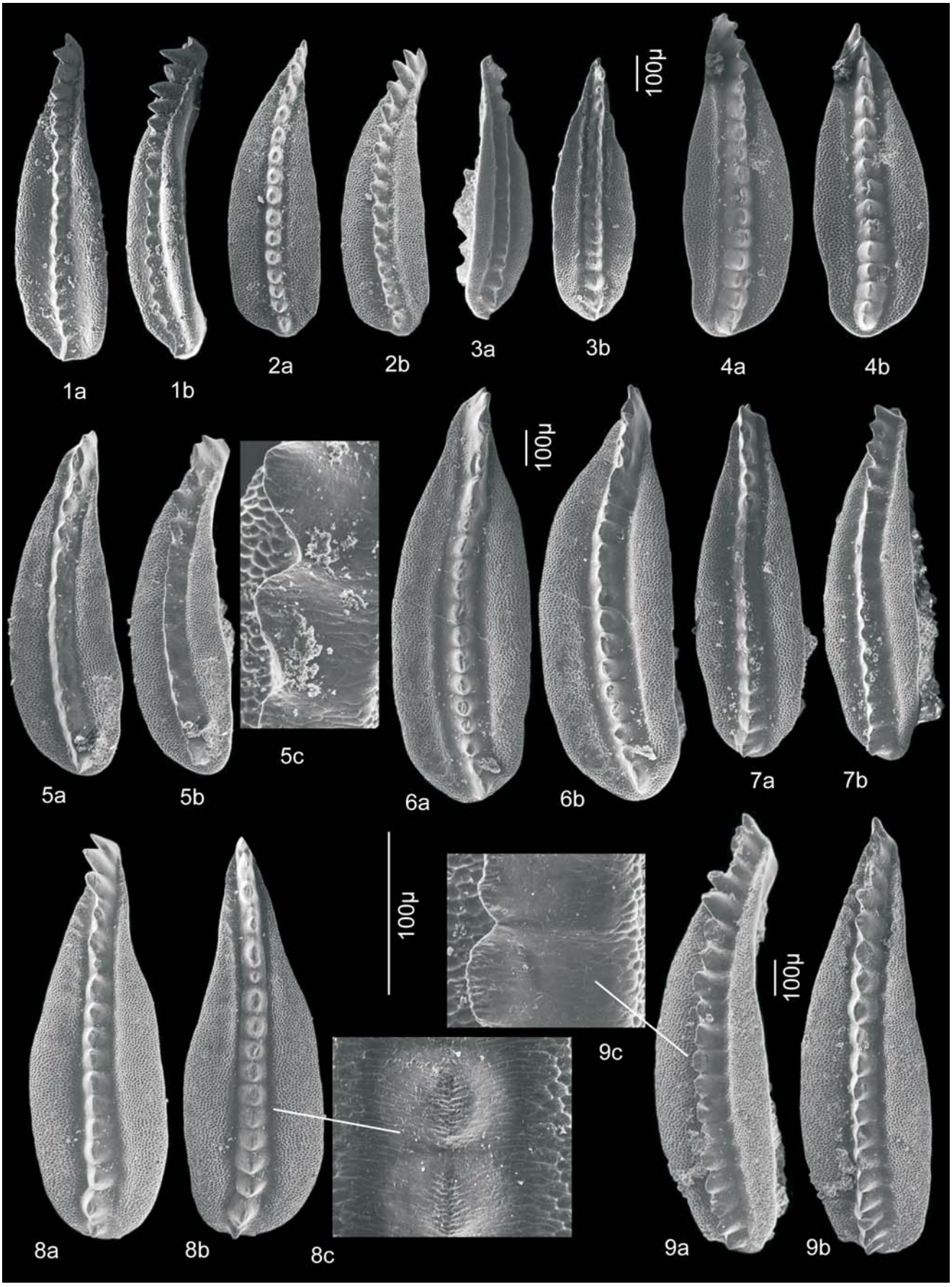
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PLATE 9

All specimens P1 elements ×65 except 8a ×500

1a,b *Jinogondolella aserrata*, upper and oblique upper views, scan 21-4

2a,b *Jinogondolella aserrata*, oblique upper and oblique lateral views, scan 21-2

3a,b *Jinogondolella palmata*, oblique upper and upper views, scan 21-6

4a,b *Jinogondolella palmata*, upper and oblique upper views, scan 21-5

5a,b *Jinogondolella aserrata*, oblique upper and upper views, scan 20-4

6a,b *Jinogondolella aserrata*, oblique upper and upper views, scan 20-5

7a,b *Jinogondolella aserrata*, upper and oblique upper views, scan 21-3

8a,b,c *Jinogondolella aserrata*, detail of mid-carinal ornamentation, upper view, oblique lateral and oblique upper views, scan 20-1

9a,b *Jinogondolella aserrata*, upper and oblique upper views, scan 20-3.

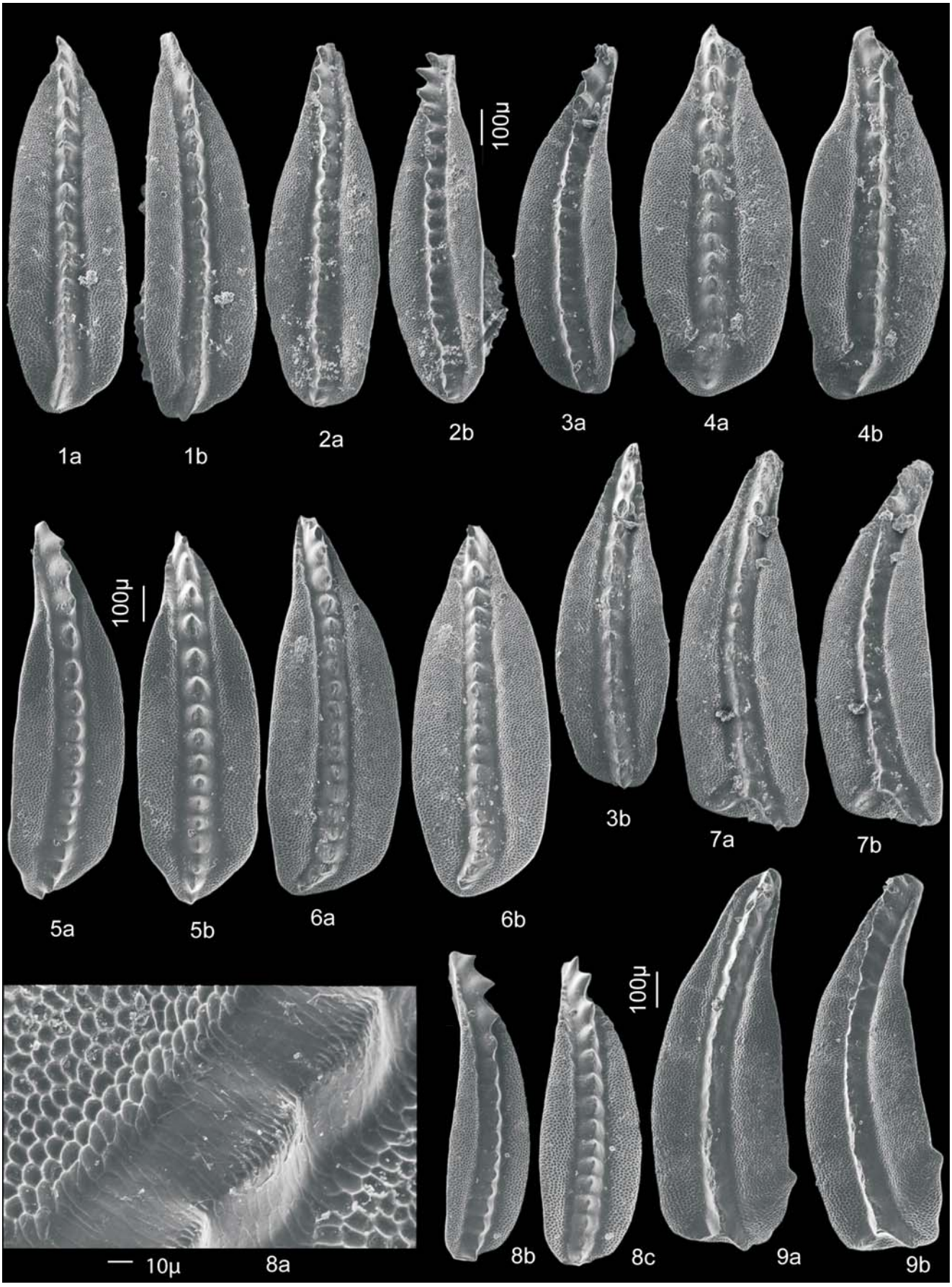
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PLATE 10

All specimens P1 elements ×65

1a,b *Jinogondolella aserrata*, upper and oblique upper views, scan 26-4

2a,b *Jinogondolella aserrata*, oblique upper and upper views, scan 26-6

3a,b *Jinogondolella aserrata*, oblique upper and upper views, scan 26-5

4 *Jinogondolella aserrata*, upper view, scan 23B-2

5 *Jinogondolella palmata*, upper view, scan 23A-1

6a,b *Jinogondolella aserrata*, upper and oblique upper views, scan 26-8

7a,b *Jinogondolella aserrata*, upper and oblique upper views, scan 23A-2

8a,b *Jinogondolella palmata*, oblique lateral and upper views, scan 23A-5

9a,b *Jinogondolella palmata*, upper and oblique lateral views, scan 26-3

10a,b *Jinogondolella palmata*, oblique upper and upper views, scan 23A-6

11a,b *Jinogondolella palmata*, upper and oblique upper views, scan 23B-3.

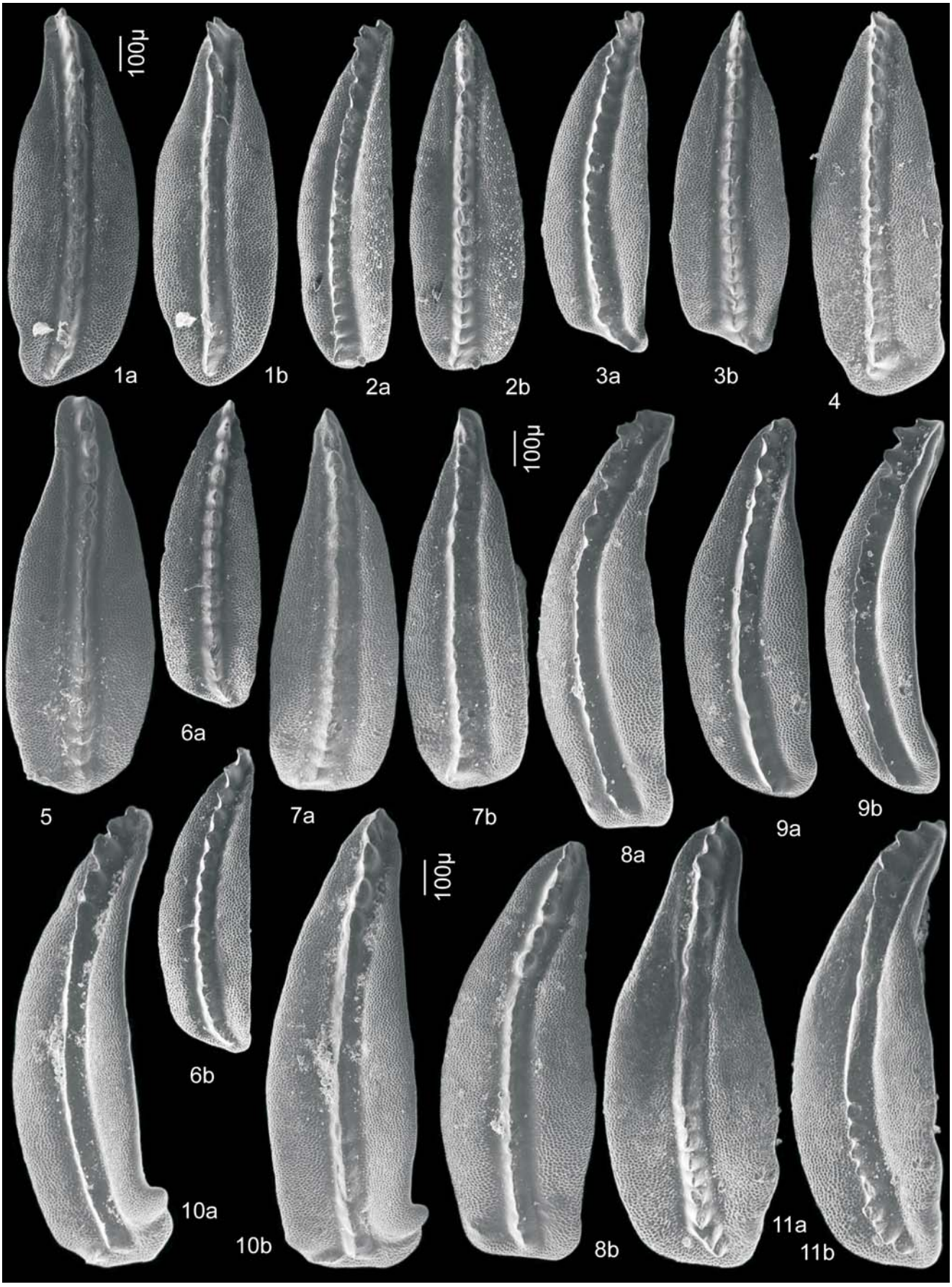
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PLATE 11

All specimens P1 element ×65 except 3c and 10b ×500

1a,b *Hindeodus capitanensis*, oblique upper and oblique lateral views, scan 31-1

2a,b *Jinogondolella postserrata*, upper and oblique lateral views, scan 31-11

3a,b,c *Jinogondolella postserrata*, oblique upper, upper, and detail of lateral serrations, scan 31-4

4a,b *Jinogondolella errata*, upper and oblique lateral views, scan 31-12

5a,b *Jinogondolella aserrata*, upper and oblique upper views, scan 31-3

6a,b *Jinogondolella aserrata*, upper and oblique lateral views, scan 31-7

7a,b *Jinogondolella aserrata*, oblique lateral and upper views, scan 31-10

8a,b *Jinogondolella aserrata*, upper and oblique upper views, scan 31-9

9a,b *Jinogondolella errata*, oblique upper and lateral views, scan 31-2

10a,b *Jinogondolella aserrata*, oblique upper view and detail of posterior carinal ridge, scan 10A-7.

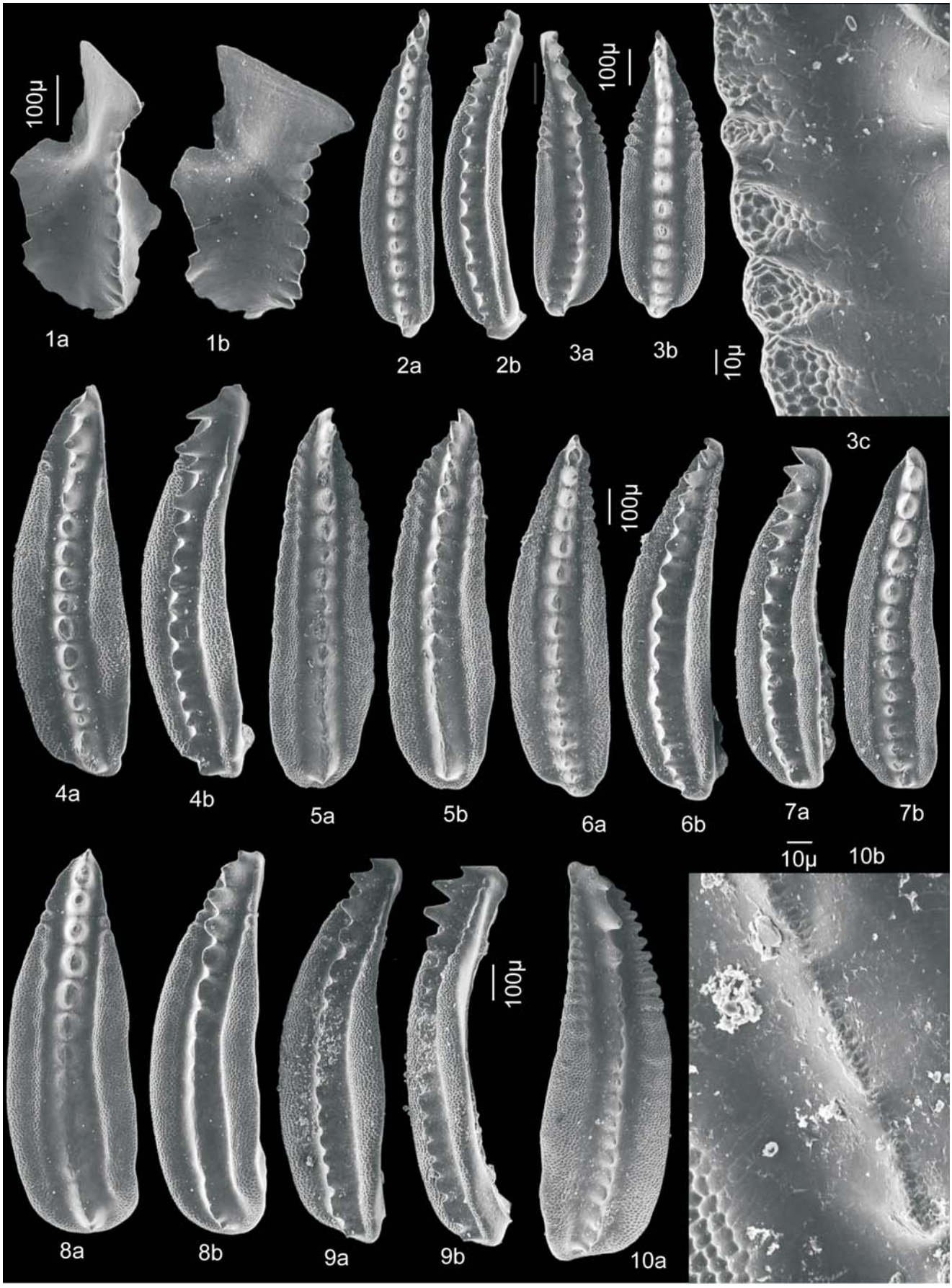
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PLATE 12
All specimens P1 elements ×65

1a,b *Jinogondolella postserrata*, upper and oblique upper views, scan 19-1

2a,b *Jinogondolella postserrata*, upper and oblique upper views, scan 19-5

3a,b *Jinogondolella postserrata*, oblique upper and upper views, scan 19-10

4a,b *Jinogondolella aserrata*, transitional to *J. postserrata*, upper and oblique upper views, scan 19-3

5a,b *Jinogondolella aserrata*, transitional to *J. postserrata*, oblique upper and upper views, scan 19-4

6a,b *Jinogondolella postserrata*, upper and oblique lateral views, scan 19-9

7a,b *Jinogondolella aserrata*, upper and oblique upper views, scan 19-12

8a,b *Jinogondolella aserrata*, oblique upper and upper views, scan 19-7

9a,b *Jinogondolella aserrata*, upper and oblique upper views, scan 19-13

10 *Jinogondolella aserrata*, upper view, scan 19-8

11a,b *Jinogondolella aserrata*, oblique upper and upper views, scan 19-11

12a,b *Jinogondolella aserrata*, oblique upper and upper views, scan 19-6.

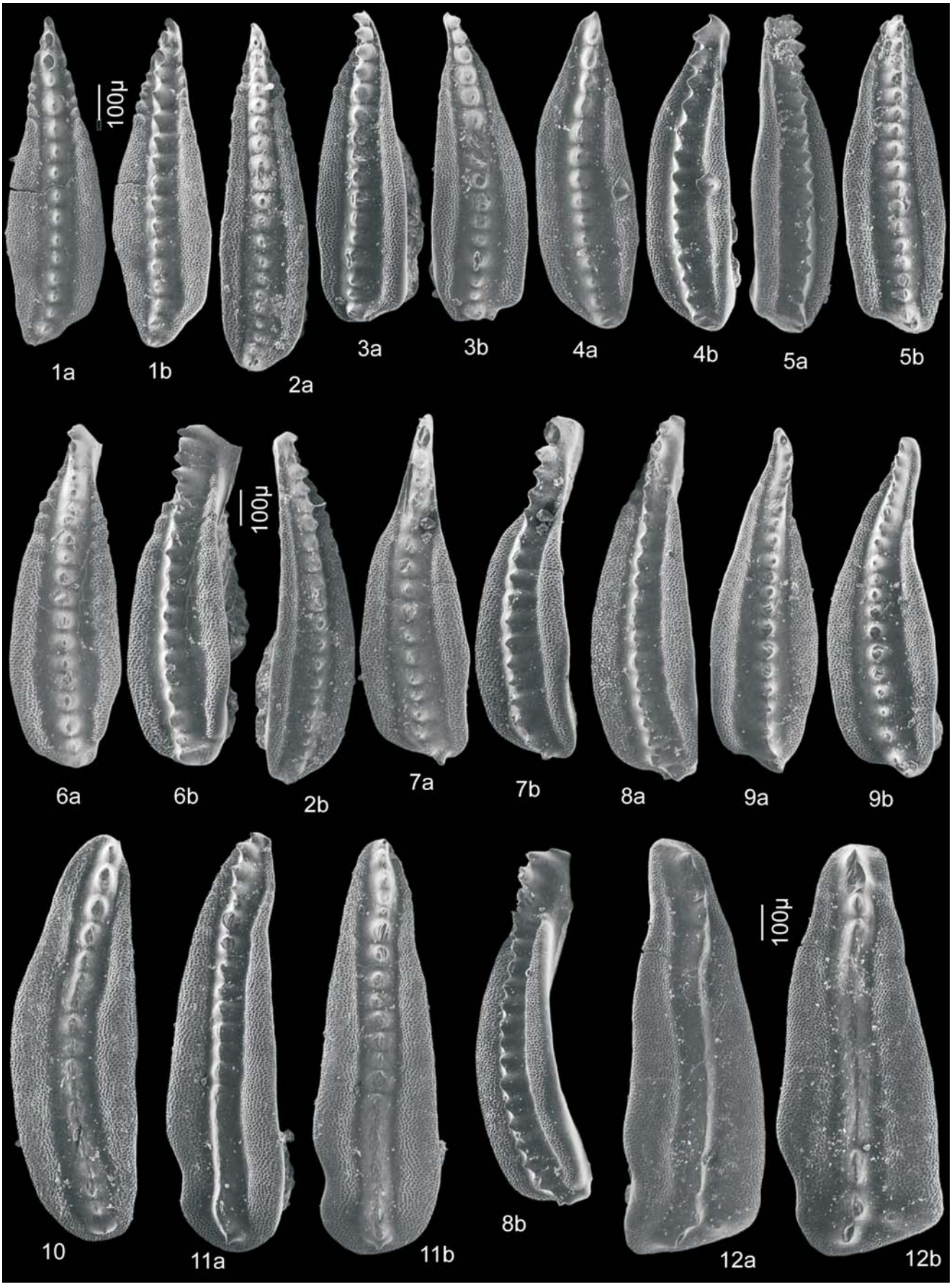
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PLATE 13
All specimens P1 elements ×75

1a,b *Jinogondolella aserrata*, upper and oblique upper views, scan 26-7

2a,b *Jinogondolella aserrata*, upper and oblique lateral views, scan 27-1

3a,b *Jinogondolella palmata*, upper and oblique upper views, scan 27-3

4a,b *Jinogondolella aserrata*, upper and oblique upper views, scan 27-4

5a,b *Jinogondolella palmata*, upper and oblique lateral views, scan 27-2

6a,b *Jinogondolella palmata*, upper and oblique upper views, scan 26-1

7a,b *Jinogondolella aserrata*, upper and oblique upper views, scan 28-1

8a,b *Jinogondolella palmata*, upper and oblique upper views, scan 28-2

9a,b *Jinogondolella palmata*, upper and oblique upper views, scan 26-2.

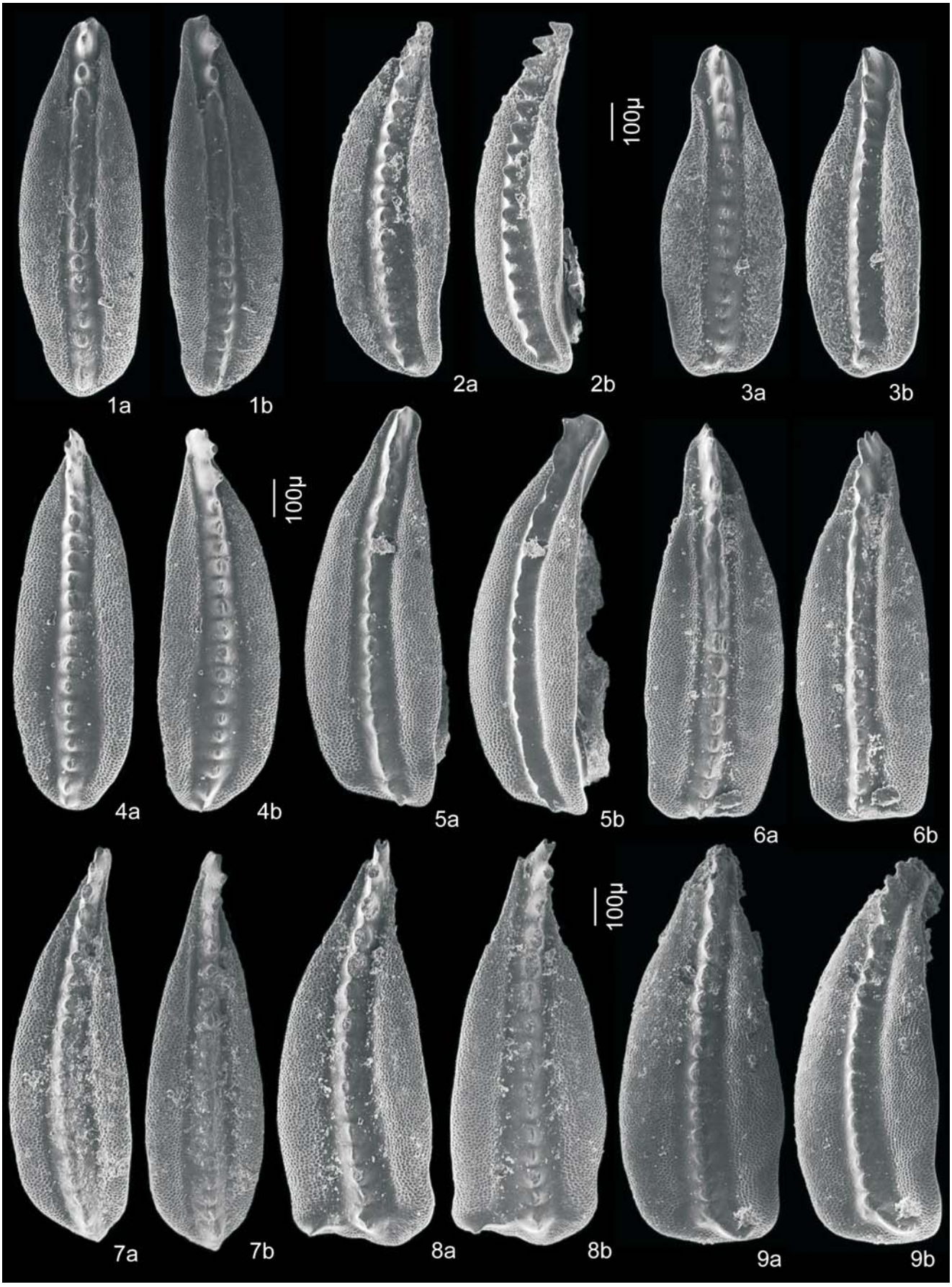
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PLATE 14
All specimens P1 elements ×120

1 *Pseudohindeodus brevis*, lateral view (scan 144044), Sample PI-7C

2 *Pseudohindeodus brevis*, lateral view of holotype (scan 152236), Sample PI-7B

3 *Pseudohindeodus brevis*, lateral view (scan 154018), Sample PI-7B

4 *Pseudohindeodus brevis*, lateral view (scan 151144), Sample PI-7A

5 *Hindeodus wordensis*, lateral view (scan 160844), Sample PI-7F

6 *Pseudohindeodus brevis*, lateral view (scan 132119), Sample PI-7G

7 *Pseudohindeodus brevis*, lateral view (scan 132314), Sample PI-7G

8 *Pseudohindeodus brevis*, lateral view (scan 133502), Sample PI-7G

9 *Hindeodus brevis*, lateral view (scan 172044), Sample PI-7G

10 *Hindeodus wordensis*, upper view (scan 160642), Sample PI-7F

11 *Pseudohindeodus brevis*, lateral view (scan 135600), Sample PI-7

12 *Pseudohindeodus brevis*, lateral view (scan 162859), Sample PI-7

13 *Pseudohindeodus brevis*, lateral view (scan 135100), Sample PI-9A

14 *Pseudohindeodus brevis*, lateral view (scan 140509), Sample PI-7E

15 *Pseudohindeodus brevis*, lateral view (scan 132015), Sample PI-10

16a,b *Hindeodus wordensis*, lateral view (scan 113119) and oblique upper view (scan 150329), Sample PI-21

17a,b *Hindeodus wordensis*, upper view (scan 160904) and oblique lateral view (scan 110628), Sample PI-14

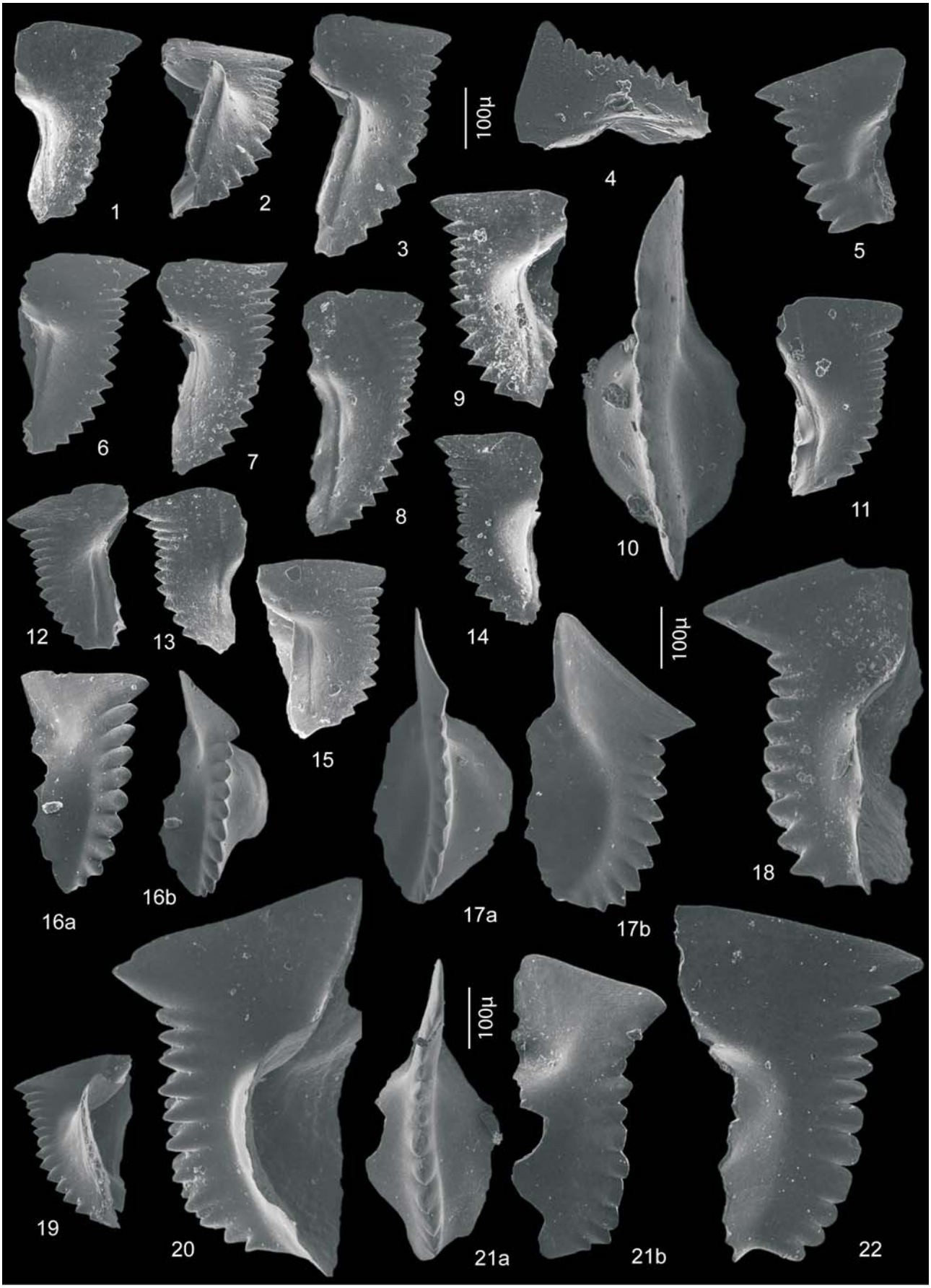
18 *Hindeodus wordensis*, lateral view (scan 150627), Sample PI-10C

19 *Hindeodus wordensis*, lateral view (scan 145417), Sample PI-23A (base)

20 *Hindeodus wordensis*, lateral view (scan 144918), Sample PI-23B (top), transitional to *H. capitanensis*

21a,b *Hindeodus capitanensis*, upper view (scan 141054) and lateral view (scan 114752), Sample PI-30

22 *Hindeodus capitanensis*, lateral view of holotype (scan 115158), Sample PI-31.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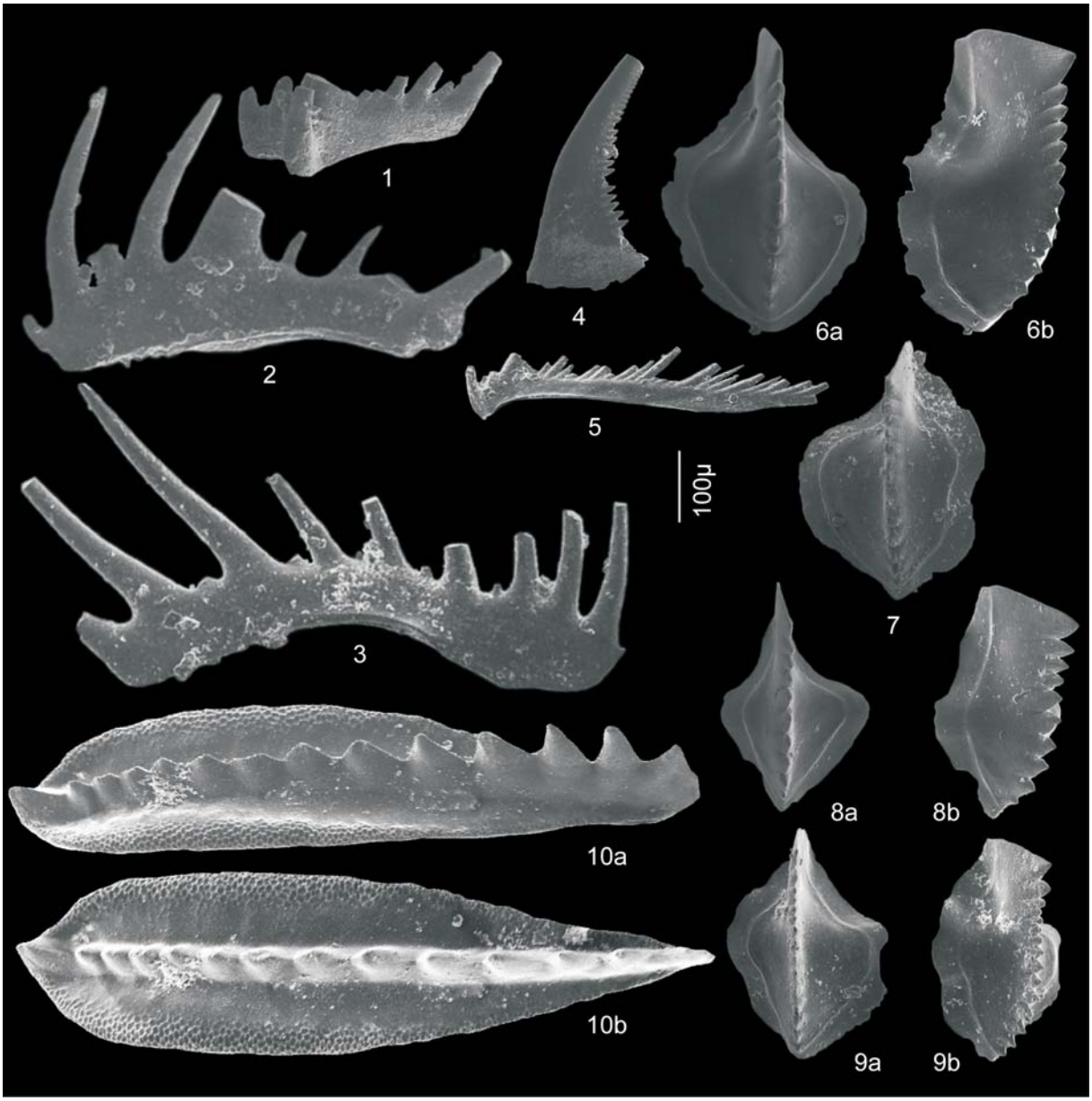

PLATE 15
All specimens ×120

1 *Sweetina triticum*, anterior lateral view (scan 142253) S0 element, Sample PI-7G

2 *Sweetina triticum*, lateral view (scan 142455) S3 element, Sample PI-7G

3 *Sweetina triticum*, lateral view (scan 135939) S4 element, Sample PI-7G

4 *Caenodontus serrulatus*, lateral view (scan 134225) P2 element, Sample PI-7G

5 *Pseudohindeodus ramovsi*, inner view (scan 133825) S4 element, Sample PI-9A

6a,b *Pseudohindeodus ramovsi*, upper view (scan 153318) and oblique lateral view (scan 111814) P1 element, Sample PI-1.

7 *Pseudohindeodus ramovsi*, upper view (scan 145634) P1 element, Sample PI-23A

8a,b *Pseudohindeodus ramovsi*, upper view (scan 161941) and lateral view (scan 105623) P1 element, Sample PI-10B

9a,b *Pseudohindeodus ramovsi*, upper view (scan 140312) and oblique lateral view (scan 165645) P1 element, Sample PI-7H

10a,b *Jinogondolella nankingensis tenuis*, oblique upper (scan QGal-3a) and upper view P1 element (scan QGal-3), Sample QGal-3, Williams Ranch Member, Cutoff Formation, Guadalupe Pass Quarry.