

26. TRIASSIC MARINE OSTRACODES OF THE AUSTRALIAN MARGIN (HOLES 759B, 760B, 761C, 764A, AND 764B)¹

Françoise Dépêche² and Sylvie Crasquin-Soleau³

ABSTRACT

Sixty-five species of benthic ostracodes have been discovered in the Triassic sediments of Ocean Drilling Program Leg 122, drilled on the northwestern margin of Australia. Known species were found in the samples studied from the upper Norian-Rhaetian at Holes 759B and 760B and from the Rhaetian at Holes 761C, 764A, and 764B. A large part of material of the recovered ostracodes belong to taxa that are related to ostracodes described in the Tethyan province. Seven species are known from northwestern Europe and five from Iran. *Ogmoconcha* and *Rhombocythere*, which are stratigraphically important genera in northern Europe, extend into the Tethyan province. Species of *Ogmoconcha* are present in Holes 760B, 764A, and 764B. The highly ornate bairdiids of the Alpine Tethyan province are dominant in Hole 761C. The affinities with the fauna of Iran noted by Kristan-Tollmann are corroborated by the presence of the genera *Moslerella*, *Hiatobairdia*, and other bairdiids.

INTRODUCTION

Leg 122 was drilled on the northwestern margin of Australia on the Exmouth Plateau, which is a rifted and subsided offshore fragment of a continental margin. More than 8 km of Phanerozoic sediments have been discovered that contain the history of vertical movements and sea-level fluctuations on this southern Tethyan margin. We recovered 3.5 km of Carnian to Holocene sediments at six sites. Drilling on Leg 122 had five main objectives:

1. To study the different phases of rifting and the sedimentary and paleoenvironmental developments from a young to mature ocean;
2. To test sequence stratigraphy models and eustatic curves;
3. To improve the chronostratigraphy of the Carnian to Cretaceous ages;
4. To analyze anoxic sediments from the Jurassic and Cretaceous; and
5. To retrieve sediments from the Cretaceous/Tertiary boundary.

Five holes extend into the Upper Triassic (Holes 759B, 760B, 761C, 764A, and 764B). These are the oldest sediments drilled since the beginning of the Deep Sea Drilling Project (DSDP) and Ocean Drilling Program (ODP). These sites are located on the Wombat Plateau on the northern part of the Exmouth Plateau, adjacent to the oceanic crust of the Argo Abyssal Plain (Fig. 1). One km of Triassic sediments were recovered. These sediments contain foraminifers, calcareous nannofossils, ostracodes, and palynoflora. Here, we pay particular attention to ostracodes found in the four sites. The first discovery of Triassic ostracodes in ODP cores is an important contribution to the knowledge of Triassic ostracodes in the eastern part of the Tethys sea.

METHODS AND PROCEDURES

Seventy-four samples have been studied (28 in Hole 759B, 17 in Hole 760A, 16 in Hole 760B, 7 in Hole 761C, 2 in Hole 764A, and 4 in Hole 764B). Sixty-one samples of unconsolidated sediments were washed under water and massive rocks were broken up by hot acetylase (Lethiers and Crasquin, 1988). More than 1,000 specimens were isolated from 14 fossiliferous samples.

Sixty-five species belonging to 27 genera have been studied under optical stereomicroscope and photographed by scanning electron microscopy.

Fossils are relatively scarce but well preserved, usually as carapaces. A few dissociated valves from collections in Sections 122-760B-8R-3 and 122-761C-31R-3 have preserved hinge structures and adductor muscle-attachment scars.

TRIASSIC OSTRACODES OF LEG 122

The ostracodes from Leg 122 resemble the Alpine Triassic fauna in Europe, Israel, Jordan, Iran, Pakistan, the Himalayas, China, Timor, Papua New Guinea, Australia, New Zealand, and North America, as shown in the references (see, for example, Urlichs, 1972; Bolz, 1969, 1970, 1971a, 1971b; von Kollman, 1960, 1963; Kozur, 1968, 1970a, 1970b, 1971a, 1971b, 1971c, 1972; Bunza and Kozur, 1971; and Kristan-Tollmann, 1970, 1971, 1972, 1973, 1978, 1979, 1980, 1982, 1986, 1988). We also compared Leg 122 specimens to the fauna of Great Britain (Anderson, 1964; Bate, 1978), Spain (Kozur et al., 1974), Israel (Sohn, 1968), Jordan (Basha, 1982), Iran (Kristan-Tollmann, 1980), Pakistan (Sohn, 1970), China (Kristan-Tollmann, 1982), the Himalayas (Kristan-Tollmann et al., 1987), Timor (Kristan-Tollmann et al., 1987), Alaska (Sohn, 1987; Kristan-Tollmann and Tollmann, 1983), Papua New Guinea, Australia, and New Zealand (Kristan-Tollmann, 1986).

Age determination is based on the following illustrated species:

Species described by Anderson (1964) as *Hungarella* are referred herein to *Ogmoconcha*.

Rhombocythere penarthensis Anderson (1964) (Pl. 4, Fig. 12): Norian-Rhaetian of Wales, Great Britain, and Germany (Bate, 1978).

Cytherella acuta Urlichs (1972) (Pl. 3, Figs. 4, 5, and 8): upper Norian-Rhaetian of Germany (Urlichs, 1972); Rhaetian of Iran and Australia (Kristan-Tollmann et al., 1979, 1986).

¹ von Rad, U., Haq, B. U., et al., 1992. *Proc. ODP, Sci. Results*, 122: College Station, TX (Ocean Drilling Program).

² Laboratoire de Micropaléontologie, Département de Géologie Sédimentaire, Université P. et M. Curie, U.R.A. CNRS 1315, Paris, France.

³ Département de Géologie Sédimentaire, Université P. et M. Curie, U.R.A. CNRS 1315, Paris, France.

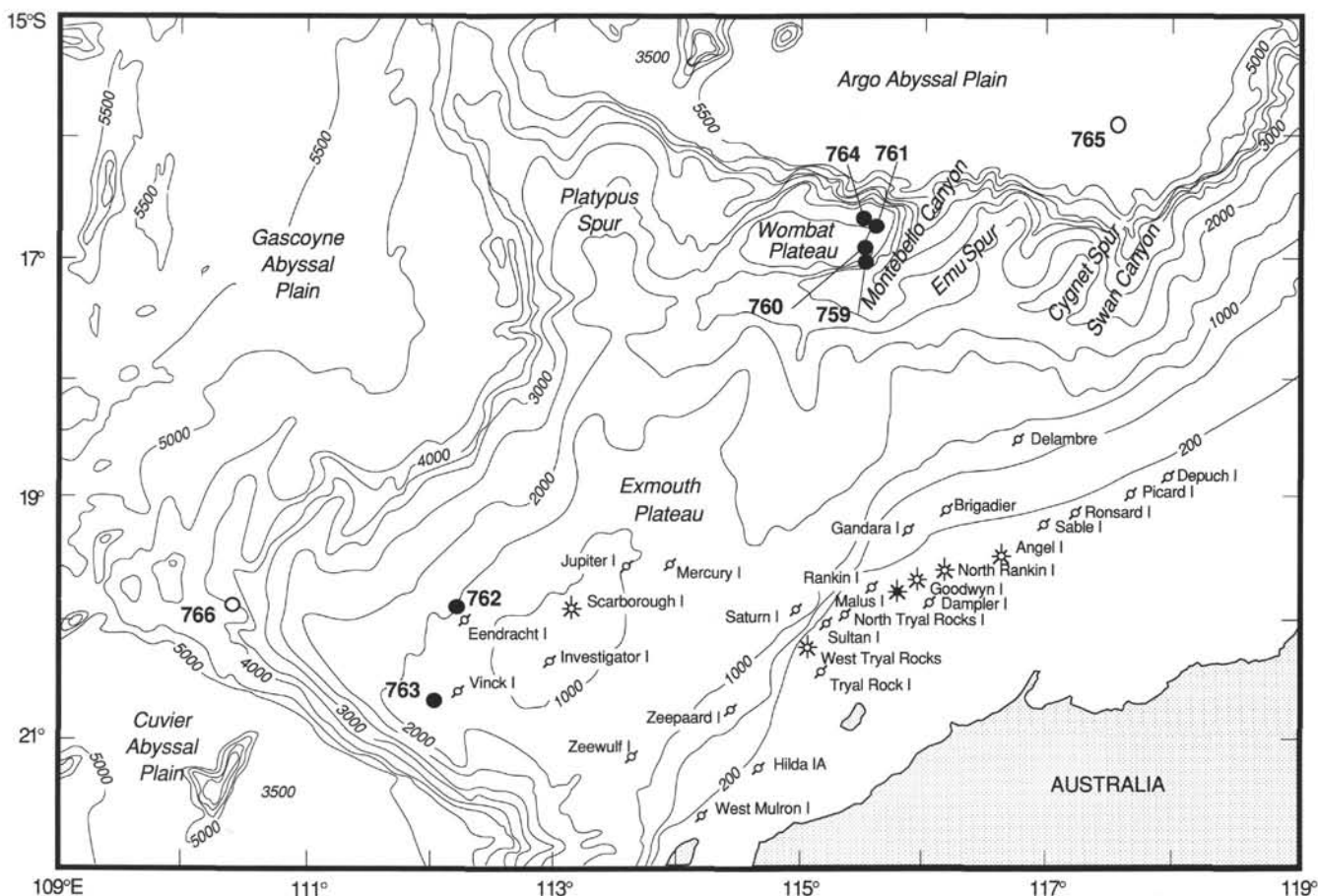


Figure 1. Location map of Leg 122 Sites 759, 760, 761, and 764.

Ogmoconcha martini (Anderson, 1964) (Pl. 4, Figs. 8–10, 15): upper Norian of England and Germany (Anderson, 1964; Will, 1969; Urlichs, 1972) and Rhaetian of Iran (Kristan-Tollmann, 1980).

Nodobairdia mammilata Kollmann (1963) (Pl. 2, Figs. 1–4): Ladinian-Rhaetian of the Alps, Austria (Kollmann, 1963; Bolz, 1971; Kristan-Tollmann, 1971, 1973, 1978) and Rhaetian of Iran and Australia (Kristan-Tollmann, 1980, 1986).

Cytherelloidea unicostata Bolz (1970) (Pl. 3, Figs. 1–2): Norian-Rhaetian of Alps, Austria (Bolz, 1970).

Hiatobairdia subsymmetrica subsymmetrica Kristan-Tollmann (1970) (Pl. 1, Fig. 1): Rhaetian of Alps, Austria, and Iran (Kristan-Tollmann, 1970, 1980).

Ogmoconcha cf. *reticulata* Kristan-Tollmann (1980) (Pl. 4, Figs. 4–6): Rhaetian of Iran (Kristan-Tollmann, 1980).

Ogmoconcha owthorpensis (Anderson, 1964): Rhaetian of Great Britain (Anderson, 1964).

Ogmoconcha bristolensis (Anderson, 1964) (Pl. 4, Fig. 3): Rhaetian of Great Britain (Anderson, 1964).

Judahella galli Kozur and Bolz (1971): upper Rhaetian of Mühlgraben (Austria).

Sixteen species compare to material described by previous authors. Most of the present material seems to be new. At least 17 species will be described in a later paper. At this time, several questions about the systematic descriptions of this new material remain unanswered.

HOLE SUMMARIES

All information on sites are from Haq, von Rad, O’Connell, et al. (1990).

Table 1. Ostracode distribution in Hole 759B.

Species	Sections 122-759B-			
	-23R-1	-16R-1	-13R-1	-11R-2
<i>Acratia</i> sp.	X			
<i>Gruendelicythere?</i> sp.		X		X
<i>Acratiidae</i> indet.		X		X
<i>Nodobairdia mammilata</i>			X	
<i>Triebelina</i> (<i>Ptychobairdia</i>) sp.1			X	
<i>Judahella</i> n.sp.1?			X	
<i>Kerocythere?</i> n.sp.2			X	
<i>Simeonella?</i> sp.1			X	
<i>Cytherella acuta</i>			X	X
<i>Kerocythere?</i> sp.3				X
Age	Carnian?	Norian	to	Rhaetian

Hole 759B (Table 1)

This is the southernmost site studied (16°57.27’S, 115°33.61’E, water depth 2091.9 m, 0–310 meters below sea floor, or mbsf). Twenty-eight samples were studied; four of them yielded ostracodes. Ten species belonging to ten genera were recorded. *Cytherella acuta* Urlichs (1972) indicates that Sections 122-759B-11R-2 and 122-759B-3R-1 are late Norian to Rhaetian in age. We lack specimens to confirm a Carnian age for Section 122-759B-23R-1. With the exception of *N. mammilata* Kollmann, all other listed species may be new.

Hole 760B (Table 2)

This hole was drilled just north of Hole 759B (16°55.32’S, 115°32.48’E, water depth 1969.7 m). It is subdivided into two parts: Hole 760A from 0 to 284.9 mbsf (17 samples studied) yielded no ostracodes and Hole 760B from 280 to 510 mbsf (16

Table 2. Ostracode distribution in Hole 760B.

Species	Sections 122-760B	
	-9R-2	-8R-3
Kerocythere? n.sp.2	X	
Ogmoconcha cf.blaket	X	
Reubenella n.sp.1	X	X
Judahella n.sp.1	X	X
Rhombocythere penarthensis		X
Judahella sp.		X
Kerocythere? n.sp.1		X
Bairdiacypris cf. triassica		X
Triebelina (Ptychobairdia) sp.1		X
Triebelina (Ptychobairdia) sp.2		X
Nodobairdia mammilata		X
Reubenella sp.		X
Liasina cf.lanceolata		X
Ogmoconcha martini		X
Reubenella n.sp.2		X
Reubenella sp.A		X
Ogmoconcha cf.reticulata		X
Ogmoconcha owthorpensis		X
Age	Upper	Norian
	Rhaetian	

Tabl.2

samples studied) contained ostracodes in two samples. Two hundred thirty-eight specimens were encountered in Sections 122-760B-9R-2 and 122-760B-8R-3. Eighteen taxa belonging to nine genera were recorded. *Ogmoconcha martini* (Anderson, 1964) and *Rhombocythere penarthensis* Anderson (1964) suggest a late Norian to Rhaetian age. Consequently, Sections 122-760B-8R-3 and 122-760B-9R-3 may be slightly younger than the Norian age attributed by Haq, von Rad, O'Connell, et al. (1990).

Hole 761C (Table 3)

This site is located north of Site 760 (16°44.28'S, 115°32.10'E, water depth 2167.9 m). The part of the hole we examined is from 260 to 436.7 mbsf. Seven samples have been

studied; five contain ostracodes. Numerous specimens were recovered from Sections 122-761C-31R-3, 122-761C-28R-CC, 122-761C-25R-CC, 122-761C-24R-3, and 122-761C-23R-1. We found 33 species belonging to 19 described genera, and one to a new genus. Section 122-761C-31R-3 contains *Ogmoconcha owthorpensis* (Anderson, 1964), which is found in sediments of the middle Rhaetian of Europe and *Cytherella acuta* Urlichs (1972) (upper Norian to middle Rhaetian). Section 122-761C-25R-CC contains *Ogmoconcha bristolensis* (Anderson, 1964) from the middle Rhaetian. *Nodobairdia mammilata* Kollmann (1963) is present in Section 122-761C-24R-3. *Hiatobairdia subsymmetrica subsymmetrica* Kristan-Tollmann (1980) is observed in Section 122-761C-35R-1 (Rhaetian). A Rhaetian age earlier attributed to those sediments seems to be confirmed for Sections 122-761C-31R-3 and 122-761C-25R-CC.

Holes 764A and 764B (Table 4)

This is the northernmost site of Leg 122 (19°53.23'S, 112°15.24'E, water depth 2698.6 m). This site is subdivided into two parts: Hole 764A from 0 to 70 mbsf (two samples, ostracodes in one of them) and Hole 764B from 40 to 294.5 mbsf (four samples, ostracodes in all of them). Ostracodes assemblages are dominated by the species *Ogmoconcha martini* (Anderson, 1964), *Cytherella acuta* Urlichs (1972), and *Cytherelloidea? unicostata* Bolz (1970a). Although *Judahella galli* Kozur and Bolz (1971) was described in the Carnian of Austria; this fauna indicates a Rhaetian age. *Ogmoconcha bristolensis* (Anderson, 1964) and *Ogmoconcha owthorpensis* (Anderson, 1964) in Sections 122-764B-31R-5 and 122-764B-6R-1 are characteristic species of the middle Rhaetian. This faunal assemblage still suggests a Rhaetian age, and more accurately a middle Rhaetian age. Except for the new genus sp. 1 (Table 4), the following taxa are closely related to species described from the Upper Triassic (Carnian to Rhaetian):

Table 3. Ostracode distribution in Hole 761C.

Species	Sections -122 -761C				
	31R-3	28R-CC	25R-CC	24R-3	23R-1
Cytherella acuta	X				
Lophocythere? sp.1	X				
Ogmoconcha owthorpensis	X				
Judahella n.sp.2	X			X	
Kerocythere? n.sp.1	X			X	
Bairdiacypris cf. triassica	X		X	X	X
Bairdia sp.C		X			
Ogmoconcha bristolensis			X		
Cytherelloidea? unicostata			X	X	
Cornutobairdia aff. trinodosa				X	
Triebelina (Nodobairdia) n.sp.				X	
Triebelina (T.) aff. T.(T.) longiforme				X	
Triebelina (T.) aff. T.(T.) sp.498				X	
Paracypris cf. redcarensis				X	
Bairdia sp.B				X	
Liasina cf. lanceolata				X	
Nodobairdia mammilata				X	
Iutkevichinella aff. keupera				X	
Polycope sp.				X	
Bythocypris sp.B				X	X
Lobobairdia cf. salinaria				X	X
Bairdia n.sp. cf. B. cassiana				X	X
Judahella sp.A					X
Praeschuleridea? n.sp.1					X
Bairdia n.sp.2					X
Bairdia cf. anisica					X
Bythocypris sp.A					X
Bairdiacypris sp.192					X
Paracypris sp.200					X
Kerocythere cf. hartmanni					X
Bairdia sp.A					X
n gen. n. sp. 2					X
Hiatobairdia subsymmetrica					X
Age	Rhaetian				

Table 4. Ostracode distribution in Holes 764A and 764B.

Species	Sections -122- 764A-B				
	-31R-5	-8R-1	-7R-1	-8R-CC	-6R-1
Kinkelina ? sp.1	X				
Judahella ? sp.1	X				
Cytherelloidea ? unicosata	X				
Norocythere n.sp.	X				
Pontocypris cf. richardsoni	X				
Cytherella acuta	X				
Ogmoconcha martini	X				
Bairdia n.sp.219	X				
Paracypris cf. redcarensis	X				
Judahella galli	X				
Judahella n.sp.2	X			X	
Ogmoconcha bristolensis	X				X
Kerocythere? n.sp.1	X				X
Ogmoconcha owithorpensis	X	X		X	X
Ogmoconcha cf. reticulata		X			
Luckevichinella sp.1		X			
n. gen. n.sp. 2		X		X	
Bairdia sp.2		X			
Bairdia n.sp. 1			X		
Paracypris sp.1			X		
Bairdiacypris cf. triassica				X	
Kerocythere? sp.3				X	
n. gen. n. sp. 1				X	
Praeschuleridea? sp.2				X	
Bairdia sp. A					X
Age	Rhaetian				

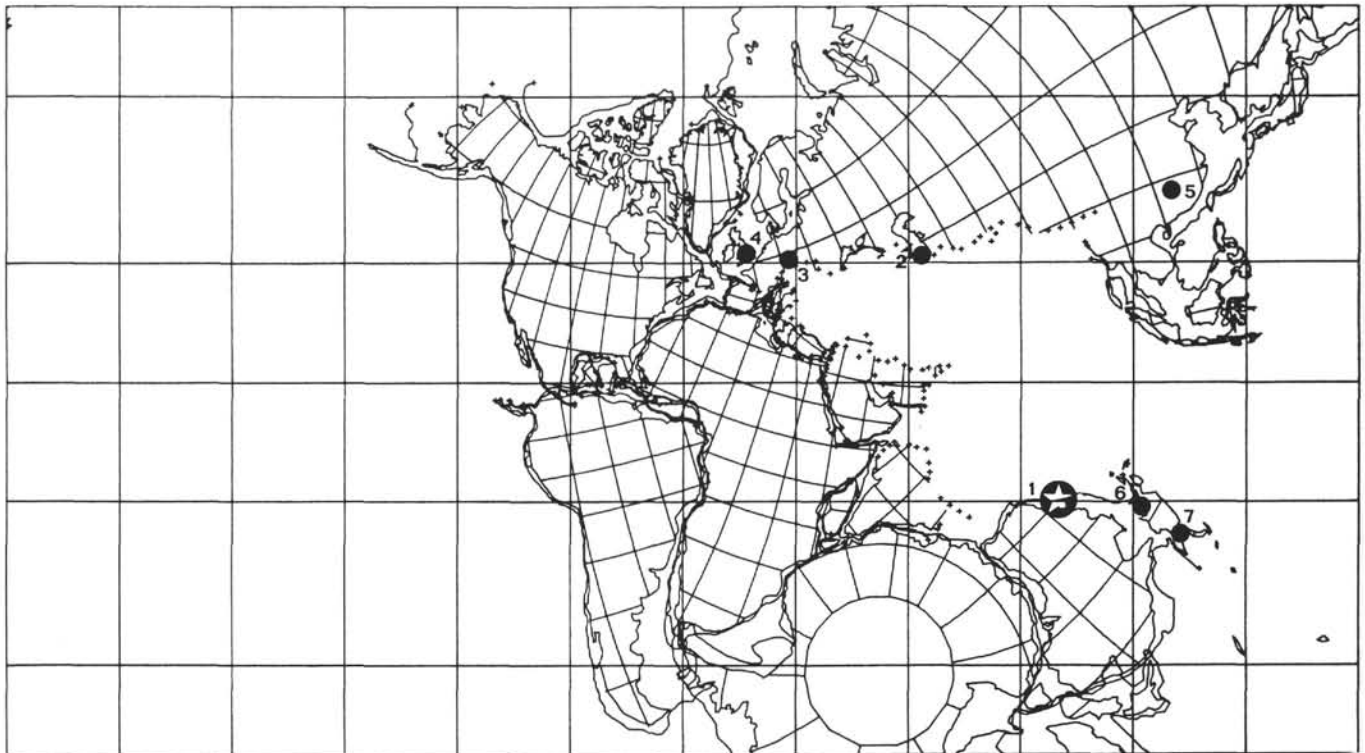


Figure 2. Paleogeographic map of the latest Triassic (Rhaetian) (Mercator, $N = 67$, $\alpha - 95 = 6^\circ 1'$), with location of ostracode sites (1 = Leg 122, 2 = Iran, 3 = Alps, 4 = Great Britain, 5 = China, 6 = Papua New Guinea, and 7 = New Zealand).

Paracypris cf. *richardsoni* Anderson (1964), *Paracypris* cf. *redcarensis* (Blake, 1876), *Ogmoconcha owithorpensis* (Anderson, 1964), *Bairdiacypris* cf. *triassica* Kozur (1971), and *Judahella galli* Kozur and Bolz (1971).

PALEOECOLOGY

Analysis of faunal composition allows us to identify paleoenvironment. The occurrence of the euryhaline ostracodes

Rhombocythere penarthensis and *Simeonella?* may indicate brackish hypersaline conditions. Species of typically marine genera, such as all forms shown in the figures, are found together with *Rhombocythere* in Sections 122-760B-9R-2 and 122-760B-8R-3 and suggest mixing with open ocean. These forms are present with sculptured bairdiids characteristic of shallow, warm water connected to coral reefs. Smooth bairdiids expand in the warm, calm water of the littoral zone,

while the dominance of *Ogmoconcha* in Holes 760B, 764A, and 764B indicates somewhat deeper water in open-marine conditions.

CONCLUSIONS

Sixty-five species of benthic ostracodes have been recognized in the studied samples of Leg 122 Triassic sediments. The majority of taxa are new and have to be described in another paper. Identified species indicate a late Norian-Rhaetian age for samples of Holes 759B and 760B and a Rhaetian age for Hole 761C, 764A, and 764B. Several species are common in the five holes. The ostracode assemblages are more diversified in Holes 761C, 764A, and 764B. Species of *Ogmoconcha* prevail in three holes (760B, 764A, and 764B); bairdiidae are dominant in Hole 761C. Species are consistent with those found in Australia (Kristan-Tollmann, 1986), Iran (Kristan-Tollmann, 1980), and Europe. The position of Leg 122 on a paleogeographical map (Fig. 2) shows that there are relations in ostracode communities of the southern and western margins of the Tethys during the Late Triassic. The presence of similar ostracodes assemblages along Triassic Tethyan margins are very likely due to climatic zonation and to current circulation (Kristan-Tollmann and Tollmann, 1983).

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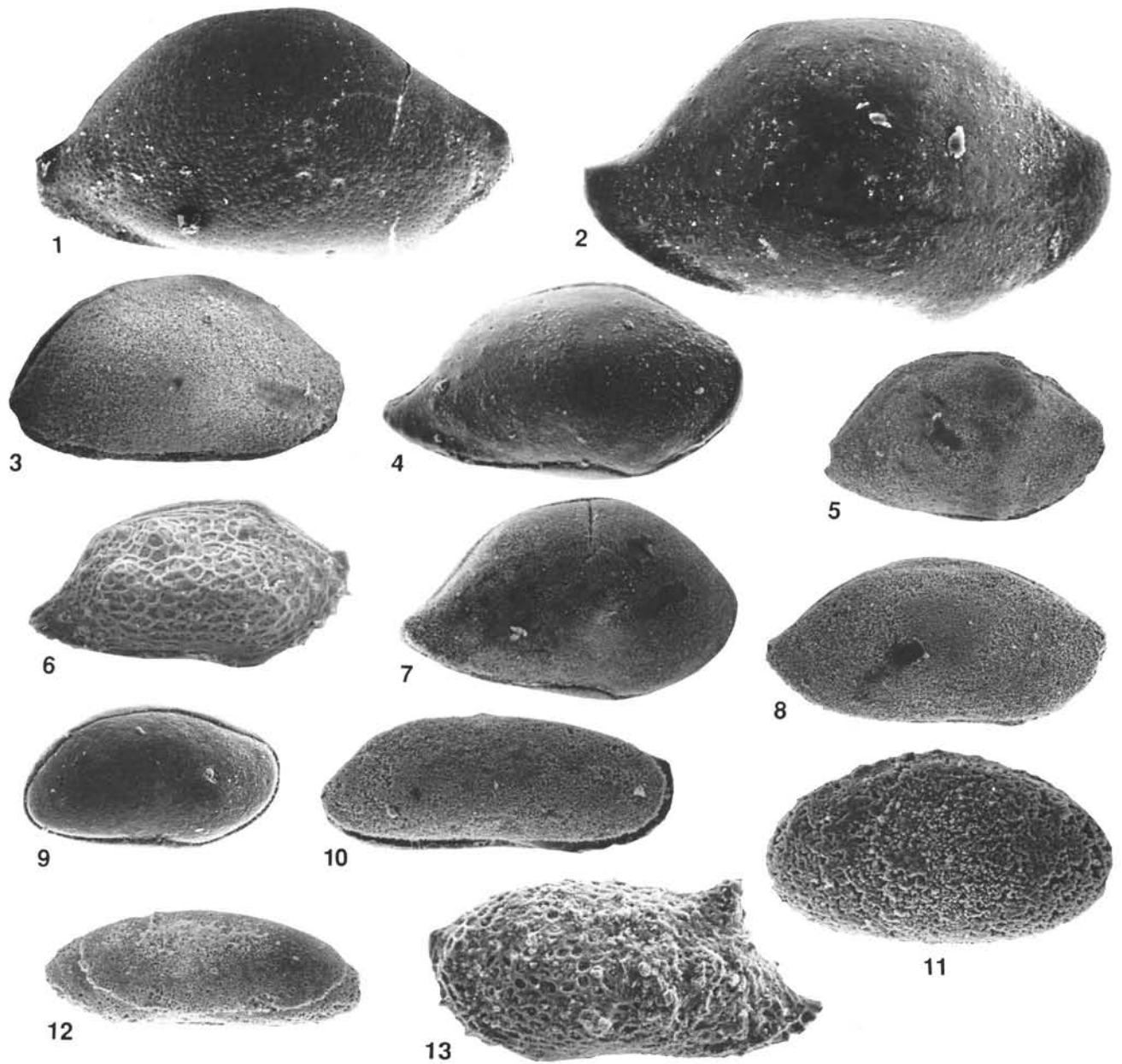


Plate 1. Magnification is 80× unless otherwise stated. 1. *Hiatobairdia subsymmetrica subsymmetrica* Kristan-Tollmann (1980), right view, Section 122-764C-23R-1. 2. *Bairdia* n. sp. cf. *B. cassiana* (Reuss, 1868), right view, 100×, Section 122-761C-24R-3. 3. *Bairdia* cf. *B. anisica* Kozur (1970), right view, 70×, Section 761C-23R-1. 4. *Bairdia* n. sp. cf. *B. cassiana* Reuss (1868), right valve, Section 122-761C-24R-1. 5. *Bairdia* n. sp. 2, right view, 50×, Section 122-761C-23R-1. 6. *Bairdia* n. sp. 219, right view, 110×, Section 122-764B-31R-5. 7. *Bairdia* sp. 2, right view, 100×, Section 122-764B-8R-1. 8. *Bairdia* sp. A, right view, 70×, Section 122-761C-23R-1. 9. *Bairdiacypris* cf. *triassica* Kozur (1971), right view, 50×, Section 122-761C-24R-3. 10. *Bairdiacypris* sp. 192, right view, 90×, Section 122-761C-23R-1. 11. *Bythocypris* sp. A, right view, 110×, Section 122-761C-23R-1. 12. *Bythocypris* sp. B, right view, 70×, Section 122-761C-23R-1. 13. *Cornutobairdia* aff. *trinodosa* Kristan-Tollmann (1971), left view, 90×, Section 122-761C-24R-3.

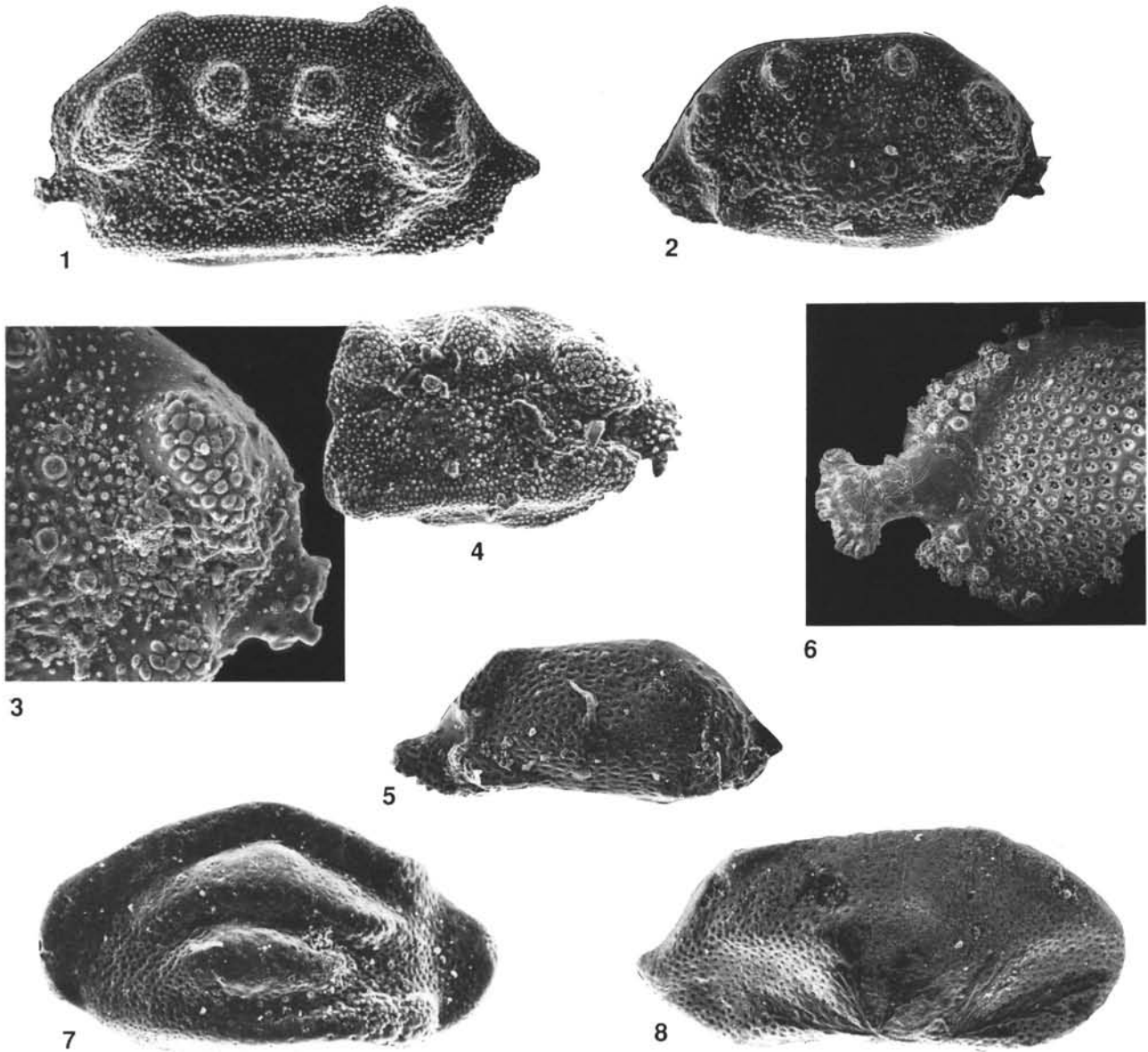


Plate 2. Magnification is 80× unless otherwise stated. 1-4. *Nodobairdia mammilata* Kollmann (1963); (1) left view, Section 122-760B-8R-3; (2) right view, Section 122-761C-24R-3; (3) right view (detail of Fig. 2, 150×); (4) right view, Section 122-760B-8R-3. 5. *Triebelina (Triebelina)* aff. *T. longiforma* Bolz (1971), right view, Section 122-760B-8R-3. 6. *Triebelina* sp. broken carapace, Section 122-760B-8R-3. 7. *Triebelina (Prychobairdia)* sp. 1, right view, Section 122-760B-8R-3. 8. *Triebelina (Triebelina)* aff. *Triebelina (Triebelina)* sp. 498 sensu Kollmann (1963), right view, Section 122-761C-8R-3.

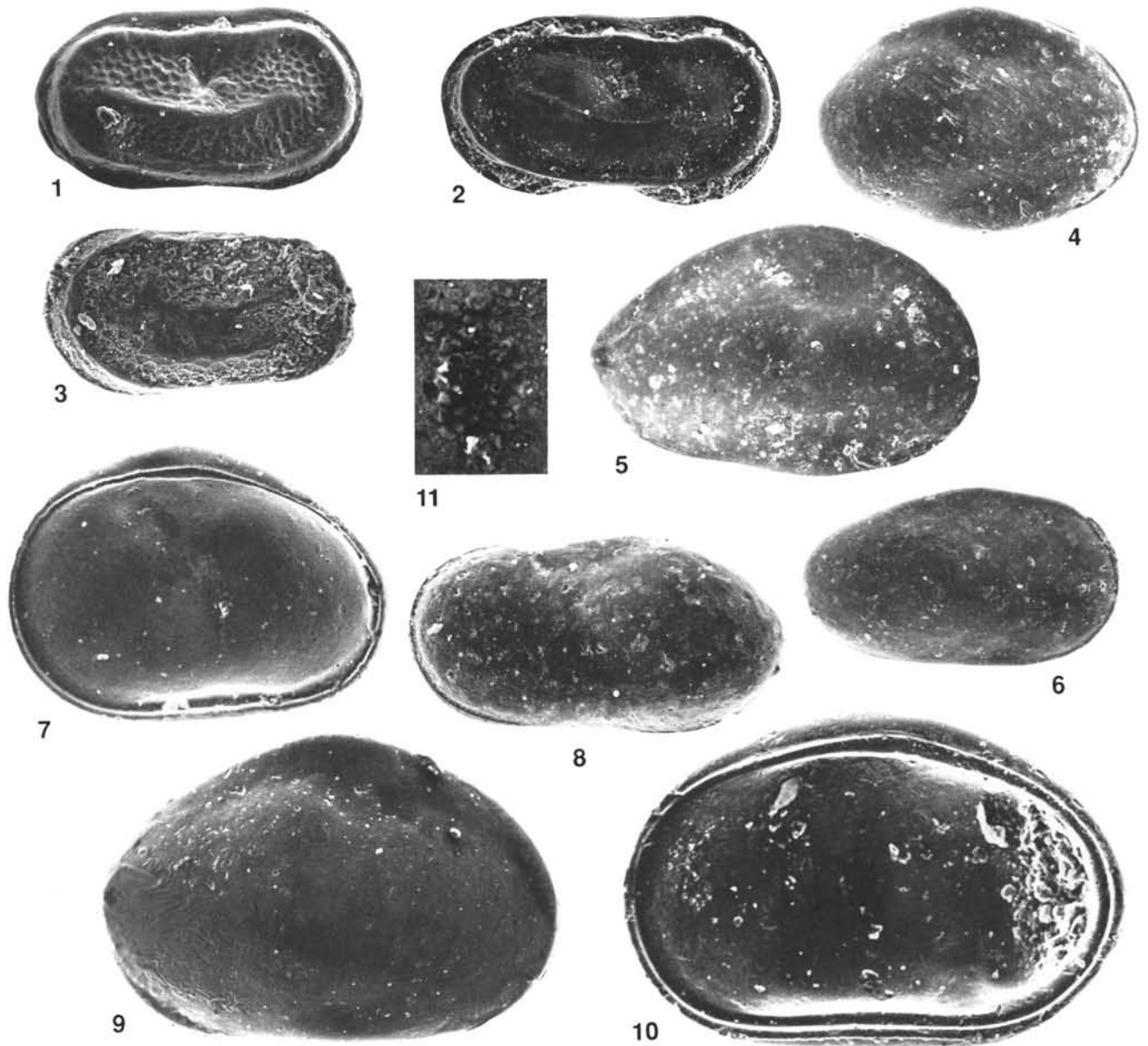


Plate 3. Magnification is 80× unless otherwise stated. 1, 2. *Cytherelloidea? unicostata* Bolz (1970); (1) right view, reticulate form, Section 122-764B-31R-5; (2) right view, smooth form, Section 122-761C-24R-3. 3. *Cytherelloidea* sp.?, left view, Section 122-761C-24R-3. 4, 5, (8?). *Cytherella acuta* Urlichs (1972), (4) right view, (5) left view, (8?) left view, Section 122-760B-8R-3. 6, 7, 9, 10. *Reubenella* n. sp. 1; (6) juvenile form, right view, (7) left view, (9) left view, (10) right internal view, Section 122-760B-8R-3. 11. *Reubenella* sp., adductor muscle scars, 300×, Section 122-760B-8R-3.

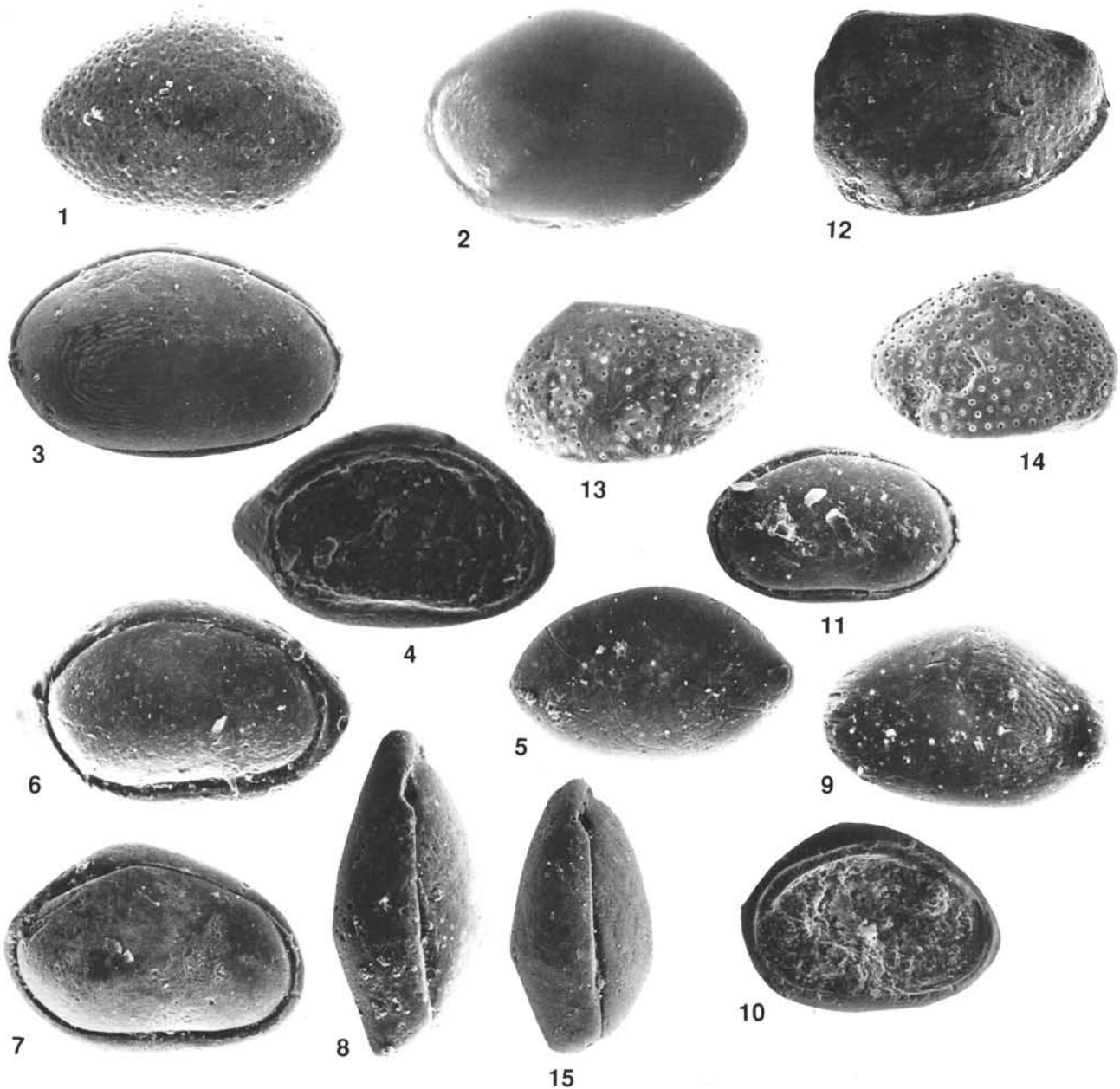


Plate 4. Magnification is 80× unless otherwise stated. 1. *Ogmoconcha* sp., left view, 95×, Section 122-760B-8R-3. 2. *Ogmoconcha* cf. *blakei* (Sohn, 1968), left view, Section 122-760B-9R-2. 3. *Ogmoconcha* *bristolensis* (Anderson, 1964), right view, Section 122-764B-31R-5. 4-6. *Ogmoconcha* cf. *reticulata* Kristan-Tollmann (1980); (4) left view, 95×; (5) left view; (6) right view, 95×, Section 122-760B-8R-3. 7. *Ogmoconcha* sp., right view, Section 122-760B-8R-3. 8-10, 15. *Ogmoconcha* *martini* (Anderson, 1964); (8) dorsal view, Section 122-760-8R-3; (9) left view, Section 122-764B-31R-5; (10) left valve, internal view, 90×, Section 122-760B-8R-3; (15) dorsal view, Section 122-760B-8R-3. 11. *Ogmoconcha* sp., right view, Section 122-760B-8R-3. 12. *Rhombocythere* *penarthensis* Anderson (1964), left view, 100×, Section 122-760B-8R-3. 13, 14. *Rhombocythere* *penarthensis*? Anderson (1961), (13) left view, Section 122-760B-9R-2; (14) right view, Section 122-760B-9R-2.

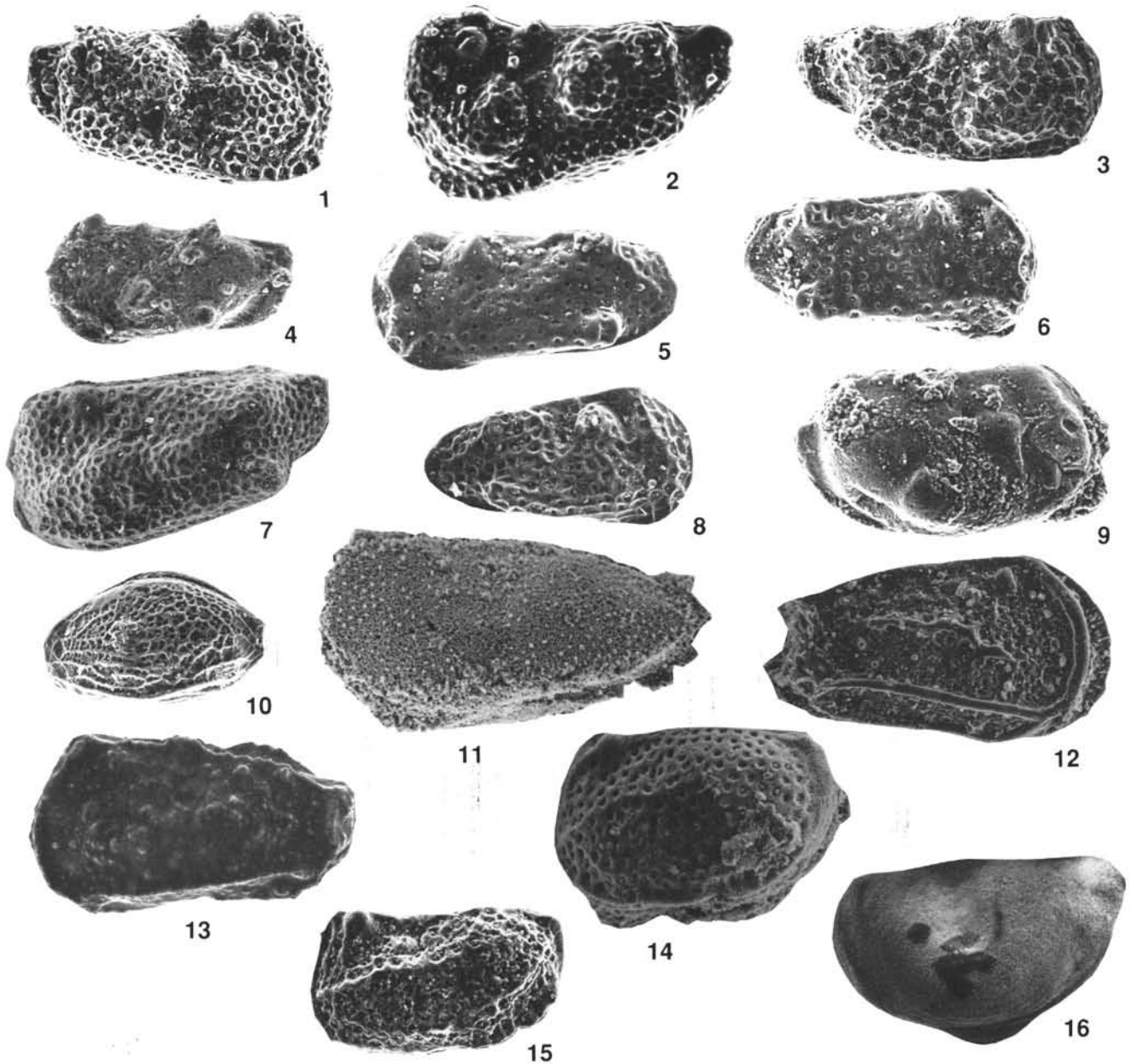


Plate 5. Magnification is 80× unless otherwise stated. 1, 2. *Mostlerella* n. sp. 11, right view, 100×; (2) left view, 100×, Section 122-760B-8R-3. 3. *Mostlerella* sp., right view, Section 122-764B-31R-5. 4. *Judahella galli* Kozur and Bolz (1971), left valve, 100×, Section 122-764B-31R-5. 5, 6. *Judahella* cf. *andrusovi* Kozur and Bolz (1971); (5) right view, 100×, Section 122-761C-24R-3; (6) left view, 90×, Section 122-761C-24R-3. 7. *Judahella* n. sp. 1, left view, Section 122-759B-13R-1. 8. *Judahella*? sp. 1, right view, 100×, Section 122-764B-11R-2. 9. Indet. gen.? sp., right view, Section 122-759B-11R-2. 10. *Kinkelinella*? sp. 1, left view, 100×, Section 122-764B-31R-5. 11. *Kerocythere* cf. *norica* Bolz and Kozur (1971), left view, Section 122-761C-23R-1. 12. *Noricythere* n. sp. aff. *mosstleri* Bolz and Kozur (1971), right view, Section 122-761C-31R-3. 13. *Kerocythere* sp. A, left view, 70×, Section 122-761C-23R-1. 14. *Simeonella*? sp. 1, left view, Section 122-759B-13R-1. 15. *Mockella* cf. *muelleri* Bunza and Kozur (1971), left view, 100×, Section 122-761C-24R-3. 16. Indet. gen., carapace in left view, 90×, Section 122-764B-8R-1.