THE VELIGER

The Veliger 39(3):226-240 (July 1, 1996)

New Species of Small to Minute Gastropods of Early Eocene Age from the Crescent Formation, Black Hills, Southwest Washington

by

RICHARD L. SQUIRES

Department of Geological Sciences, California State University
Northridge, California 91330-8266, USA

AND

JAMES L. GOEDERT

15207 84th Ave. Ct. NW, Gig Harbor, Washington 98329, and
Museum Associate, Section of Vertebrate Paleontology, Natural History Museum of Los Angeles County,
900 Exposition Boulevard, Los Angeles, California 90007, USA

Abstract. Six new species of small to minute gastropods are part of a diverse shallow-water marine assemblage in the upper part of the Crescent Formation at Larch Mountain in the Black Hills west of Olympia, Washington.

The scissurellid *Scissurella* (*Scissurella*) ***malloryi*** is the earliest record of *Scissurella sensu stricto* and its first record from the Pacific coast of North America. The orbitestellid *Orbitestella* ***palaiopacifica*** and the omalogyrid *Ammonicera* ***benhami*** are the earliest records of these genera. In regards to the Pacific coast of North America, *O.* ***palaiopacifica*** is the first fossil record of this genus, and *A.* ***benhami*** is the first record of this genus. The fissurellid *Puncturella* (*Altrix*) ***pacifica*** is the first record of this subgenus from the Pacific coast of North America. The liotiid *Arene* ***olympiata*** is the second Paleogene record of this genus from the Pacific coast of North America. The volutomitrid *Conomitra* ***capitolina*** is the second record for this genus from the Pacific coast of North America.

New information on associated benthic foraminifera confirms a middle early Eocene age that was previously based only on molluscan data.

INTRODUCTION

This study is an outgrowth of our continuing investigation of little-studied molluscan faunas of the upper part of the Crescent Formation in southwestern Washington. The Crescent Formation ranges in age from late Paleocene to early middle Eocene (Snavely, 1987) and is the basement rock in this area. It consists predominantly of oceanic tholeiitic basalt flows, but the original tectonic setting of the Crescent Formation remains uncertain (Suczek et al., 1994). One hypothesis is that the basalts formed seamounts that later accreted to North America (Duncan, 1982), but an alternative hypothesis proposes that the basalts formed in a rift-basin environment along the continental margin (Wells et al., 1984; Babcock et al., 1992, 1994).

The upper third of the Crescent Formation contains mollusk-bearing, shallow-marine deposits and, locally, terrestrial deposits. Prior to 1992, studies of the mollusks (Weaver & Palmer, 1922) dealt with only a few new species from exposures along the north shore of the Olympic Peninsula. Although Weaver (1942) monographed Tertiary marine megafossils from Washington and Oregon, his coverage of species from the Crescent Formation was essentially a review of the species described by Weaver & Palmer (1922). The first detailed analysis of a megafossil assemblage in the Crescent Formation was made by Squires

et al. (1992) and dealt with the shallow-marine upper part of the formation at Pulali Point (Figure 1), west of Seattle. That study spawned two additional articles (Squires, 1992, 1993) on certain bivalves from the Pulali Point area. Squires & Goedert (1994a) made a detailed study of another megafossil assemblage in the upper part of the Crescent Formation in the Little River area in the southern Olympic Peninsula (Figure 1). Squires & Goedert (1994b) reported new species (some minute in size) of mollusks in the upper part of the Crescent Formation in the Black Hills, west of Olympia, at the same localities (CSUN locs. 1563 and 1564) that are the focus of this paper (Figure 1). Squires & Goedert (1995) also reported additional new species of gastropods in the transition zone between the upper part of the Crescent Formation and the overlying lower member of the McIntosh Formation in the northern Doty Hills, approximately 30 km to the southwest of the Black Hills.

Additional work by us in the Black Hills has revealed six more new species of gastropods. The purpose of this paper is to describe and name the new species, all of which were found in the upper part of the Crescent Formation in richly fossiliferous and conglomeratic silty mudstone interbedded with basalt. The extrusion of the basalt caused shoaling and the establishment of a rocky shoreline/shallow-water community where gastropods and bivalves lived alongside colonial corals and coralline algae. The mollusk shells were transported a short distance and deposited in muddy matrix coquina that filled cracks between boulders of basalt. Most of the shells in the coquina are small to minute, and their size prevented them from being pulverized during transport (Squires & Goedert, 1994b; Nesbitt et al., 1994). Extraction of the fossils is possible because the muddy matrix is only poorly indurated and, upon soaking in water, the rock can be broken apart with a strong needle. If care is exercised, intact small to minute fossils can be obtained. Our studies of the minute mollusks would have been impossible without the scanning electron microscopy work by Steven R. Benham (Pacific Lutheran University, Tacoma, Washington). Benham's work also enhanced our knowledge of protoconch morphology and shell microstructure on the small mollusks.

The molluscan stages used in this report stem mainly from Clark & Vokes (1936), who proposed five mollusk-based provincial Eocene stages, namely, "Meganos" (lowermost Eocene), "Capay" (middle lower Eocene), "Domengine" (upper lower to lower middle Eocene), "Transition" (lower middle Eocene), and "Tejon" (middle middle Eocene to upper Eocene). These stage names are in quotes because they are informal terms. Givens (1974) modified the use of the "Capay Stage," and it is in this modified sense that the "Capay Stage" is used herein. The upper Eocene to lower Oligocene Galvinian Stage of Armentrout (1975) is also used in this report. This stage is used in the Pacific Northwest and is correlative to the upper part of the "Tejon Stage" in California.

The classification systems used for taxonomic categories higher than the family level generally follow that of Haszprunar (1988) for the vetigastropods and that of Ponder & Warén (1988) for the caenogastropods and heterobranch gastropods.

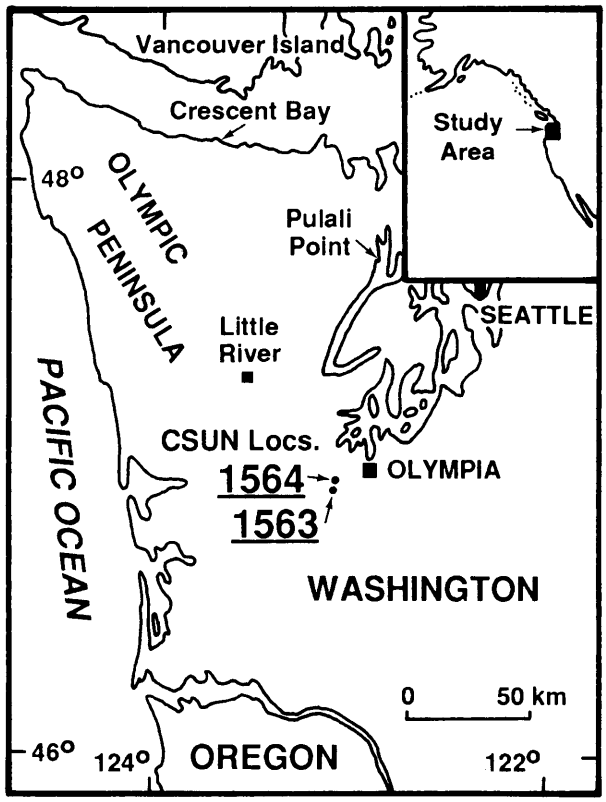


Figure 1

Index map to CSUN locs. 1563 and 1564, upper part of Crescent Formation, Larch Mountain, Black Hills, west of Olympia, Washington.

Abbreviations used for catalog and/or locality numbers are: CSUN, California State University, Northridge; LACMIP, Natural History Museum of Los Angeles County, Invertebrate Paleontology Section.

AGE

Squires & Goedert (1994b) assigned the upper part of the Crescent Formation at CSUN locs. 1563 and 1564 to the middle lower Eocene ("Capay Stage") based on molluscan fossil evidence. Benthic foraminiferal analyses done during the course of the present investigation confirm this age. Two microfossil samples from CSUN loc. 1563 contained a littoral to inner sublittoral fauna and the following key species diagnostic of Mallory's (1959) Penutian Stage: *Anomalina dorri aragonensis, Quinqueloculina yeguaensis, Alabamina wilcoxensis, Cibicides martinezensis, Cibicides whitei,* and *Nonion wilcoxensis* (S. Downs, personal communication). The Penutian Stage, as used in emended sense of Almgren et al. (1988) for shallow-marine strata, is indicative of the middle lower Eocene and correlative to

the molluscan "Capay Stage" (Squires et al., 1992). This corresponds well with the average age of 53.1 (± 2.0) Ma reported by Globerman et al. (1982) for basalts in the Black Hills.

The same two microfossil samples studied for benthic foraminifera were also processed for planktonic foraminifera and calcareous nannofossils, but none were found (M. V. Filewicz & S. Downs, personal communication).

SYSTEMATIC PALEONTOLOGY

Class Gastropoda Cuvier, 1797

Subclass Prosobranchia Milne-Edwards, 1848

Order Vetigastropoda Salvini-Plawén, 1980

Family SCISSURELLIDAE Gray, 1847

Subfamily SCISSURELLINAE Gray, 1847

Genus *Scissurella* d'Orbigny, 1824

Type species: *Scissurella laevigata* d'Orbigny, 1824, by subsequent designation (Gray, 1847), Recent, Mediterranean Sea.

Subgenus *Scissurella sensu stricto*

Scissurella (*Scissurella*) ***malloryi*** Squires & Goedert, sp. nov.

(Figures 2–7)

Diagnosis: A *Scissurella sensu stricto* with a nearly flat spire, sculpture beyond the first teleoconch whorl and posterior to the selenizone comprised of about 28 axial ribs and three to five spiral ribs, and sculpture on body whorl anterior to the selenizone comprised of about 28 axial ribs and 15 weaker spiral ribs.

Description: Shell minute, diameter up to 1 mm, thin and fragile, consisting of slightly more than two post-protoconch whorls. Spire small, very slightly elevated (nearly flat), rapidly expanding. Suture incised. Protoconch just less than one whorl (about 70 microns in diameter), convex, with about 10 weak axial riblets; set off from post-protoconch whorls by a prominent varix. Selenizone on upper half of body whorl, starting after the first one-half whorl of teleoconch. Selenizone on shoulder of body whorl, keel-like and bordered by produced edges; slit long. Selenizone regularly lined with prominent, widely spaced axial ribs. First whorl of teleoconch with 17 axial ribs. Beyond first teleoconch whorl and posterior to the selenizone, about 28 arcuately prosocline axial ribs and three to five, less prominent spiral ribs. Body whorl anterior to selenizone with about 28 axial ribs and 15 less prominent spiral riblets, becoming closer spaced toward the umbilicus. Prominent and deep, smooth spiral sulcus present just anterior to selenizone. Base of body whorl rounded. Umbilicus open, deep, funnel-shaped, semilunar, set off from base by spiral cord; lined within by axial growth lines. Aperture circular. Outer lip incised with slit. Columella smooth.

Dimensions of holotype: Height 1 mm, width 1 mm.

Holotype: LACMIP 11354.

Type locality: CSUN loc. 1563, Larch Mountain, Washington, 47°59′03″N, 123°8′2″W.

Paratypes: LACMIP 11355–11357, CSUN loc. 1563.

Discussion: Fifteen specimens were found, all about 1 mm in height. Thirteen of the specimens were found at CSUN loc. 1563; two were found at locality 1564.

The new species is most similar to the living species *Scissurella* (*S.*) *rota* Yaron (1983:268–270, pl. 3; Herbert, 1986:622–623, figs. 25–27) from the Red Sea and Persian Gulf to eastern Cape Province, southern Africa (Herbert, 1986). The new species differs by having stronger and more (three to five rather than one to two) spiral ribs posterior to the selenizone, more axial ribs (28 rather than 20) on the body whorl anterior to the selenizone, sculpture that is not nodulose on the body whorl at the junction of the axial and spiral ribs, and spiral ribs that do not become coarser near the umbilicus.

The new species is also similar to *S.* (*S.*) *costata* d'Orbigny, 1824, from the Canary Islands, Bermuda, and the Mediterranean Sea (Yaron, 1983). Wenz (1938:173, fig. 269) and Batten (1975:figs. 4, 11, 12) also illustrated this species. The new species differs by having spiral ribbing, much weaker axial ribbing, and a deep spiral sulcus anterior to the selenizone.

The new species resembles *Scissurella parisiensis* Deshayes (1866:5, pl. 65, figs. 8–10; Cossmann & Pissarro, 1910–1913:pl. 2, fig. 12-2) from middle Eocene (Lutetian Stage) rocks of the Paris Basin, France, but the new species has a lower spire and a deep spiral sulcus just anterior to the selenizone.

As discussed by Sohl (1992), current workers believe that family Scissurellidae may have originated during the

→

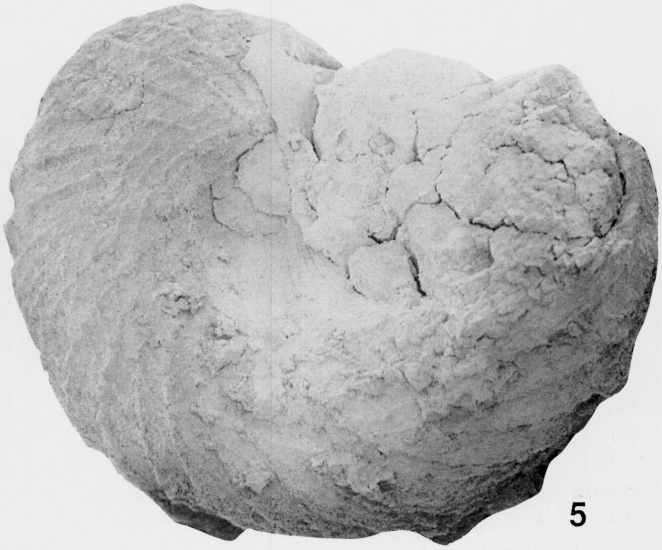
Explanation of Figures 2 to 7

All specimens from CSUN loc. 1563, and all figures = SEM micrographs. Figures 2–7. *Scissurella* (*Scissurella*) ***malloryi*** Squires & Goedert, sp. nov. Figures 2–3. Holotype LACMIP 11354. Figure 2. Apertural view, ×60, height 1.1 mm. Figure 3. Apical view, ×60, maximum diameter 1.45 mm. Figure 4. Paratype LACMIP 11355, abapertural view, ×60, height 1 mm. Figure 5. Paratype LACMIP 11356, umbilical view; ×60, maximum diameter 1.46 mm. Figures 6–7. Paratype LACMIP 11357. Figure 6. Oblique apical view, ×60, maximum diameter 1.2 mm. Figure 7. Apical view of protoconch shown in Figure 6, ×200, maximum length 0.475 mm.

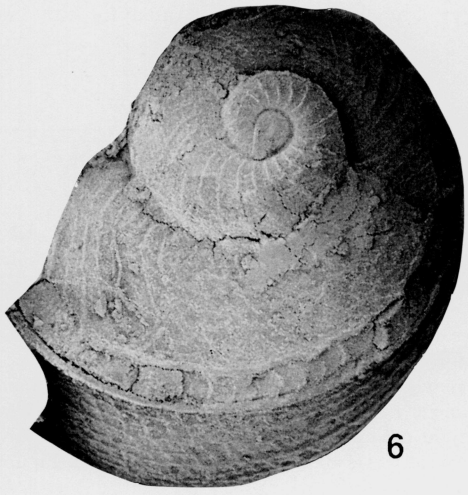
2

4

3



5



6

7

Triassic. Only a single Cretaceous species is known, *Scissurella marchmontensis* Sohl, 1992 from deposits of Late Cretaceous age (Maastrichtian Stage) in Puerto Rico and Jamaica (Sohl, 1992). Sohl's species is similar to *Scissurella sensu stricto,* a taxon that is characterized (McLean, 1967) by a flattened spire, with the selenizone on the upper half of the whorl. The genus is placed in subfamily Scissurellinae because it has a protoconch with distinct axial ribs (Marshall, 1993). The new species has the characteristics of *Scissurella sensu stricto* and, to our knowledge, is the earliest representative of *Scissurella sensu stricto* anywhere. The new species is the first record of *Scissurella sensu stricto* from the Pacific coast of North America. Today, only four cool- to cold-water species of *Scissurella (Anatoma)* are found in northeastern Pacific (McLean, 1967).

Etymology: The new species is named for V. Standish Mallory for his important contributions to the study of Pacific coast of North America benthic foraminiferal biostratigraphy.

Family FISSURELLIDAE Fleming, 1822

Genus *Puncturella* Lowe, 1827

Type species: *Patella noachina* Linnaeus, 1758, by original designation.

Subgenus *Altrix* Palmer, 1942

Type species: *Fissurella altior* Meyer & Aldrich, 1886, by original designation, Eocene, Alabama.

Puncturella (*Altrix*) ***pacifica*** Squires & Goedert sp. nov.

(Figures 8–9)

Diagnosis: A conical *Puncturella* (*Altrix*) with a nearly circular apical perforation and 28 radial ribs crossed by equally strong concentric ribs.

Description: Shell small, up to 2.8 mm height, conical, slightly longer than high. Apex punctate, at summit and slightly forward of center of shell. Apical perforation nearly circular, with four, very minute constrictions. Posterior slope broadly convex, anterior slope very slightly concave and almost straight in profile. Sculpture of 28 strong, raised radial ribs approximately same width as interspaces. Concentric sculpture of equally strong raised ribs. Intersection of two sculpture components producing a rectangularly cancellate pattern. Aperture broadly circular.

Dimensions of holotype: Length 3 mm, width 3 mm, height 2.8.

Holotype: LACMIP 11358.

Type locality: CSUN loc. 1563, Larch Mountain, Washington, 47°59′03″N, 123°8′12″W.

Discussion: Only two specimens were found, both from CSUN loc. 1563. The holotype is moderately well preserved, but the other specimen is poorly preserved. The nomenclatural history of the name *Altrix* is discussed by Sohl (1992).

The new species is most similar to *Puncturella* (*Altrix*) *leesi* Sohl (1992:420, figs. 6.1–6.7), the earliest known species of this genus and known from Upper Cretaceous (Maastrichtian Stage) rocks of Puerto Rico. The new species differs in the following features: smaller shell, more conical shape, 28 rather than 16–17 radial ribs, and finer radial ribs.

The new species is similar to the type species of *Altrix, Puncturella* (*Altrix*) *altior* (Meyer & Aldrich, 1886:41, pl. 1, figs. 16a–16c; Palmer, 1937:30–31, pl. 3, figs. 1, 3, 6, 8) from middle Eocene rocks in Alabama. The new species differs in the following features: smaller, a more centrally located apex, perforation at summit, sculpture not as strong and there is no tendency for it to become nodular or scaly, and the radial ribs show much less tendency to alternate with any secondary radial ribs.

The geologic range of *Altrix* is Late Cretaceous to Recent, and only a few species are known (Sohl, 1992). The new species is the first record of the subgenus *Altrix* from the Pacific coast of North America.

Etymology: The new species is named for the Pacific Ocean.

→

Explanation of Figures 8–21

All specimens from CSUN loc. 1563, and SEM micrographs = Figures 17, 20, 21. Other figures done by the senior author. All non-SEM specimens coated with ammonium chloride. Figures 8–9. *Puncturella* (*Altrix*) ***pacifica*** Squires & Goedert, sp. nov., holotype LACMIP 11358. Figure 8. Left-lateral view, ×8.6, height 2.8 mm. Figure 9. Apical view, ×11, length 3 mm. Figures 10–17. *Arene* ***olympiata*** Squires & Goedert, sp. nov. Figures 10–12. Holotype LACMIP 11359, ×4.9. Figure 10. Apertural view, some shell missing, ×4.9, height 5.7 mm. Figure 11. Abapertural view, ×4.5, height 5.7 mm. Figure 12. Umbilical view, ×4.5, maximum diameter 7.5 mm. Figure 13. Paratype LACMIP 11360, abapertural view, ×2.9, height 8.5 mm. Figures 14–16. Paratype LACMIP 11361, ×11. Figure 14. Apertural view, height 2 mm. Figure 15. Abapertural view, height 2 mm. Figure 16. Umbilical view, maximum diameter 3.1 mm. Figure 17. Paratype LACMIP 11362, apical view, ×60, maximum diameter 1.5 mm. Figures 18–21. *Conomitra* ***capitolina*** Squires & Goedert, sp. nov. Figures 18–19. Holotype LACMIP 11363, ×6.5, height 6.8 mm. Figure 18. Apertural view. Figure 19. Abapertural view. Figures 20–21. Paratype LACMIP 11364, ×40. Figure 20. Apical view, maximum diameter 1.4 mm. Figure 21. Apertural view, height 2.6 mm.