

A new genus and species of crab from the bryozoan bioherms of the Eocene Santee Limestone; South Carolina, USA

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ABSTRACT

The fossil crab *Propinnotheroides orangeburgensis* is described from the Eocene Santee Limestone in Orangeburg County, South Carolina. The specimens, two nearly complete carapaces preserved in lithified coquina, add significant detail to our knowledge of the Eocene decapod faunas inhabiting the off-shore bryozoan bioherms on the southeastern coast of North America. The coquinoid limestone facies of the Santee Limestone and Ocala and Castle Hayne Limestone represent shallow offshore bioherms and patch reefs deposited on the upper shelf of the ancient continental shelf. The bryozoan bioherms and patch reefs provided a nutrient-rich environment in which fostered the development of a distinctive Eocene reef fauna, including a diverse decapod fauna.

Key words: Crustacea, Eocene, Santee Formation, bioherm, South Carolina.

RESUMEN

El cangrejo fósil *Propinnotheroides orangeburgensis* nuevo género, nueva especie, es descrito para el Eoceno de la Caliza Santee en el Condado de Orangeburg, Carolina del Sur. Los especímenes, dos caparazones casi completos preservados en coquina litificada, añaden detalles significativos a nuestro conocimiento de las faunas eocénicas de decápodos que habitaron los biohermas de briozoarios en plataforma interna del sureste de la costa norteamericana. Las facies de caliza coquinoide de la Caliza Santee y de la Caliza Ocala y Castle Hayne representan biohermas y parches arrecifales depositados en la parte superior de la antigua plataforma continental. Los biohermas de briozoarios y parches arrecifales proveían un ambiente rico en nutrientes en el que se desarrolló una fauna arrecifal peculiar, incluyendo una diversa fauna de decápodos.

Palabras clave: Crustacea, Eoceno, Formación Santee, bioherma, Carolina del Sur.

INTRODUCTION

The Santee Limestone of South Carolina and the stratigraphically equivalent Castle Hayne Limestone of North Carolina and Ocala Limestone of Georgia have produced an abundance of decapod specimens and taxa (Bishop and Whitmore, 1986; Blow and Manning, 1996; Feldmann *et al.*, 1998). The Santee Limestone is predominately a light yellowish-brown coquina limestone that contains abundant remains of shelled invertebrates, principally the remains of bryozoans, but also abundant steinkerns of bivalves and gastropod, echinoids, and other invertebrates (Toulmin, 1969; Zullo, 1984), as well as some vertebrates.

Typical of most nearby exposures, the Santee Limestone exposed in the Martin-Marietta Berkeley County Quarry (situated immediately across the road from the Martin Marietta Orangeburg Quarry) consists of approximately 14 m of fossiliferous limestone exhibiting various textures that include coquina, fossiliferous carbonate mudstones, and fossiliferous crystalline limestone. Porosity of the limestone is highly variable depending upon the amount of carbonate mud or calcite overgrowths filling inter-grain spaces.

The nearby Berkeley County Quarry has been studied extensively and consists of a series of trenches opened to mine the underlying limestone. Overburden is removed using a crane-mounted shovel and dumped to one side of the trench as a spoil pile. Excavation is done to the surface of the limestone (first hard beds). Rotary drills are then used to drill rectangularly-spaced vertical drill holes through the limestone across and along the working face of the trench. Holes are packed with explosive and detonated with electric blasting caps. The loosened rock is loaded from within the trench with front loaders into large dump trucks and hauled to a grizzly that sieves the rock fragments into different size fractions. Oversize rock is usually left behind in the pit as a series of blocks on the bottom of the trench. The limestone is produced for road metal and field-lime, and minor amounts are used in making cement at nearby plants. Similar mining techniques are used at other Martin Marietta quarries.

Spoil piles usually consist of overburden from above the uppermost layer of limestone that is often covered with a thin veneer of fossiliferous strata immediately underlying the Pleistocene Wicomico or Duplin sand deposits. These veneers offer excellent collecting opportunities for fossils from the Pliocene shell beds and from the underlying Eocene limestones.

The Pliocene deposits at the Berkeley County Quarry are either incised into the Eocene limestone or constitute a thin overlapping deposit of sand and/or calcareous sandstone. A bored surface is often present on top of the calcareous substrates. This surface preserves abundant borings of pholad bivalve mollusks, some of which are lined with calcareous sheaths, and also by worm borings. This surface indicates that the limestone and calcareous sand was exposed as a submarine sea bottom and lithified prior to boring. Banks (1977) indicates that the bored surface is

developed on top of the Santee Limestone and is overlain by Pliocene Raysor Formation. Ward *et al.* (1979) recognized the Santee Limestone overlain by the Cross Member of the Tupelo Bay Formation that is in turn overlain by Pliocene (Goose Creek Limestone and Raysor Formation) and questionably by the Penholoway Formation. Geisler *et al.* (2005) have further refined the stratigraphy of these quarries. Field relationships remain unclear, but the bored surface appears to have been developed on top of Santee or the Moultrie Member of the Santee Formation. In any case, the bored surface represents a significant surface of unconformity, a disconformity, separating the bored Middle Eocene limestone from the overlying latest Eocene and Pliocene or Pleistocene sediment.

The Santee Limestone and its equivalents in Georgia (the Ocala Limestone) and North Carolina (the Castle Hayne Limestone) accumulated in warm, clean offshore Atlantic waters during the Middle Eocene, protected from the turbid, sediment-laden coastal zone further to the east by the ancient precursor of the Gulf Stream, a strong south to north current flowing out of the ancient Gulf of Mexico across the shoals formed by the Florida Peninsula resulting in the formation of the "Golden Trough". This through is an erosional and nondepositional feature that separates the clastic environments of the Atlantic nearshore from the non-clastic limestone deposited offshore across the ancient Gulf current that carried continental detritus northward (Popenoe, 1985; Popenoe *et al.*, 1987). This current (ancient Gulf Stream) protected the clear, shallow, and warm waters of the upper Blake Plateau (now the outer Coastal Plain of Georgia, South Carolina, and north Carolina) from deposition of continental detritus and allowed extensive development of bryozoan patch reefs and bioherms and provided a favorable ecosystem for evolving types of new organisms, including decapod crustaceans.

Abundant remains of decapod crustaceans occur as random allochems (carbonate grains) preserved as disassociation units (Bishop, 1986) in these coquinas with their exoskeleton usually intact, although reduced by groundwater leaching to a punky, chalk-like texture. This leaching and mobilization of calcium carbonate by ground water is indicated not only by the alteration of the decapod cuticles, but also by the selective dissolution of shells of bivalves and gastropods and the redeposition of the mobilized carbonate as a sparry cement within the coquina. The two specimens described herein were collected (BTP) in these rocks.

Invertebrate fossils from the Santee Limestone (Middle Eocene)

The fossils from the Eocene limestone are preserved as impressions if original shell was aragonitic and as original shell if the original shell was calcitic. The most common fossils are bryozoans and bivalves, but brachiopods, corals, and crabs are also common.

Bryozoans are represented by many growth forms, including encrusting, fenestellate fans, stick-like colonies, and cap-shaped colonies comprising over 60 species and constituting a great proportion of the grains forming the rock.

Oysters are common and, being originally calcitic, are preserved as original shell. The oysters often exhibit traces of borings of commensal or parasitic organisms that lived inside their shell. Large, saddle-shaped oysters (*Cubitostrea selliformis*), reclined or rested on the bottom of this ancient sea. Smaller oysters, *Cubitostrea lisbonensis*, are also present. Oysters have been used as biostratigraphic markers in Coastal Plain stratigraphy to determine the age of these rocks. Many other bivalves are represented by impressions, largely molds of the exterior or interior of articulated shells. Microfossil have more recently been used to establish a more precise biostratigraphy (Edwards *et al.*, 1997).

Decapods preserved in the limestone usually consist of fragmented exoskeletons, carapaces, cheliped or leg parts; all disassociation units of decapods (Bishop, 1986) attest to the high-energy regime of the bioherms. Sufficient energy was available to disarticulate the remains, but not so much as to destroy them. Fossil crabs, usually scarce as fossils, are relatively abundant and represent a diverse fauna of 25 described species in the Santee (Blow and Manning, 1996). As in the crabs from the reef facies of Italy, "The preservation of the carapace is generally good, so the original ornamentation is visible. The original shell is often preserved even if altered and it appears snow-white and dusty; sometimes it shows the presence of manganese dendrites; in other cases the surface is decorticated and can be taken for the matrix" (Beschlin *et al.*, 2000).

SYSTEMATIC PALEONTOLOGY

Family Pinnotheridae de Haan, 1833

Genus *Propinnotheroides* new genus

Type species. *Propinnotheroides orangeburgensis* n. sp. by present designation and monotypy.

Diagnosis. Carapace transversely oval, nearly straight anteriorly; circular posteriorly, smooth. Orbits wide divided, separated by strongly downturned broad rostrum.

Range. *Propinnotheroides* is Middle Eocene in age (Blow and Manning, 1996) and is thus far only known from its geographic type locality.

Etymology. *Pro* (to come before) + *pinnotheroides* (a genus of fossil decapod similar to pinnotherid decapods); masculine.

Remarks. *Propinnotheroides* superficially resembles one genus assigned to the Pinnotheridae, *Pinnotheres* Bosc,

1802, from which it significantly differs by being much more domed and inflated. Because of the lack of sculpture and the record limited at this time to two carapaces, it is possible that this genus will be reassigned when more complete material is collected and described. This new genus has well developed orbits, therefore, it is readily distinguished from *Pinnotheres*. The new genus resembles members of the subfamily Pinnothereliinae within the Pinnotheridae and/or *Palaeograpsus* s.l. (see Schweitzer and Karasawa, 2004).

Propinnotheroides orangeburgensis new species

Figure 1

Diagnosis. Carapace equant, quadrate-oval, wider than long, highly domed, unsculptured except for a pair of anterior cardiac pits and very subtle epibranchial flexures, carapace transversely and longitudinally convex, smooth.

Description. Carapace quadrate-oval, bilaterally symmetrical, wider than long ($L/W = 0.89$), moderately arched transversely and strongly arched longitudinally, smooth with no evidence of cervical and only shallow, indistinct branchio-cardiac grooves with no prominent bosses; anterior margin with smooth anterior-rostral trough, anterolateral margin being evenly rounded backward onto oval margins, with anterolateral marginal ridge visible at posterior of maximum width. Front broad, orbits wide with slightly differentiated orbits, rimmed by low ridge. Rostrum broad, downturned, with broad, indistinct medial trench. Two paired small pits situated transversely across very posterior of mesogastric. Cardiac area slightly differentiated, diamond-shaped, rela-

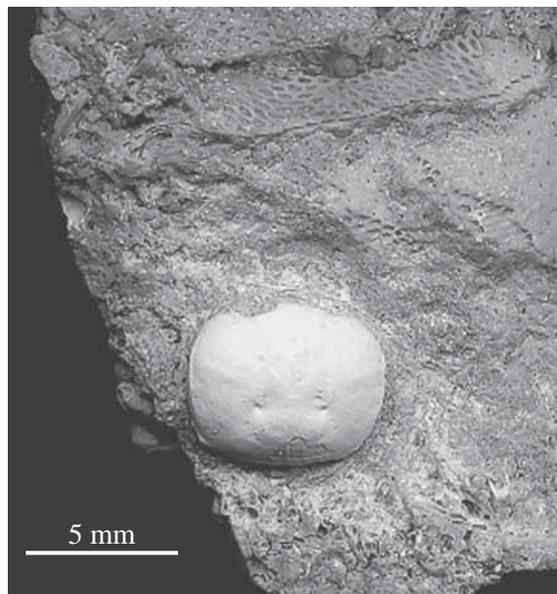


Figure 1. Holotype of *Propinnotheroides orangeburgensis* new genus, new species (ChM PI18337), showing highly domed carapace and almost total lack of ornamentation.

tively smooth, two pairs of small muscle attachment pits arranged on either side of the mid-line anteriorly, roughened posteriorly. Intestinal slightly expanded, smooth. Plastron, sternum, mouth frame, and appendages unknown, gender(s) unknown.

Types and occurrence. The holotype (ChM PI 18337) and paratype (ChM PI 18338) of *Propinnotheroides orangeburgensis* new genus, new species, are deposited at the Charleston Museum. They were collected from the Santee Formation, Orangeburg County, South Carolina, west side of County Road 59, 2.4 km (1.49 mi) south of South Carolina Routes 6 and 45; Billy Palmer, June 2001. USGS Chicora 15' quadrangle.

Measurements. Holotype: length 6.36 mm, width 7.14 mm; Paratype: length 5.95 mm, width 7.00 mm.

Etymology. *Propinnotheroides orangeburgensis* n. sp. is named in honor of its collection site, the Orangeburg Quarry of the Martin Marietta Corporation.

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