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© Southern California Academy of Sciences, 1994**Middle Miocene Pholadid Borings at the Base of the
Isidro Formation, Arroyo Mezquital,
Baja California Sur, Mexico**Robert A. Demettrion¹ and Richard L. Squires²¹*Holmes International Middle School, 9351 Paso Robles Ave.,
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Abstract.—Abundant sediment-infilled clavate (club-shaped) borings, assignable to ichnogenus *Gastrochaenolites*, are reported from the base of the Miocene Isidro Formation, Baja California Sur, Mexico. The infilled borings were made by pholadid bivalves that lived in a nearshore-marine environment on a semi-consolidated substrate (“*Glossifungites*” ichnofacies). Some borings are connected by horizontal burrows that are sculptured (*Spongiomorpha*) or unsculptured (*Thalassinoides*). The localized pholadid community was short lived and abruptly terminated by an influx of sediment.

During the course of field investigations in Baja California Sur, Mexico, an assemblage of ichnofossils was found in the Isidro Formation at California State University, Northridge (CSUN) locality 1495 near the mouth of Arroyo Mezquital about 13.5 km south of the village of San Juanico on the Pacific coast (Fig. 1). The assemblage is at the erosional contact between the Eocene Bateque Formation and the overlying Miocene Isidro Formation. The ichnofossils are dominated by sediment-infilled clavate (club-shaped) borings that range in length from 5 to nearly 30 cm. The contact that contains these infilled borings is well exposed, at a height of some 40 m on the side of a mesa that borders the southeast margin of the arroyo. The infilled borings are confined to an approximate linear distance of 1 km along the mesa wall, which is deeply incised by a number of semi-circular re-entrants.

Fischer (1990), in a general review of the subject of boring bivalves, showed pictures of infilled borings from the Isidro Formation as examples of cylindrical-shaped burrows, but he did not give any locality data nor any ichnological details.

The purposes of this paper are to describe the ichnofossils and to consider their paleoenvironment. Abbreviations used are: CSUN, California State University, Northridge; LACMIP, Natural History Museum of Los Angeles County, Los Angeles, Invertebrate Paleontology Section.

Geologic Setting

The uppermost 30 m of the Bateque Formation at Arroyo Mezquital is a vertical exposure of bioturbated, yellow, very fine-grained sandstone that is moderately indurated. Rare lamination is preserved and it seems to be parallel or nearly so. Scattered shell fragments are present as are some oblique *Ophiomorpha*-like bur-



Fig. 1. Index map showing location of the study area and CSUN loc. 1495.

rows filled with the same type of sediment found in the Bateque Formation country rock. Squires and Demetrio (1992) interpreted the paleoenvironment of the Bateque Formation in this area to be "middle shelf" and equivalent to a depth range between normal-storm wave base and maximum-storm wave base. Microfossil evidence indicates a middle Eocene age equivalent to the Pacific coast molluscan "Tejon Stage." For a more complete discussion of the Bateque Formation at this locality, see Squires and Demetrio (1992).

Approximately 15 m of the overlying Isidro Formation is exposed in near-vertical to vertical cliffs. The outcrop consists of several horizontal shell-hash layers (coquinas), ranging in thickness from 10 cm to 2 m, in a white, coarse-grained sand matrix, separated by grayish-green mudstone and sandstone that are virtually barren of macrofossils. The shell-hash layers tend to be variable in terms of dominant genera. Barnacles and oysters, as well as pectinids and clypeasteroid echinoids (sand dollars), are the main components. Post-mortem transport of the fossils was minimal as some of the bivalves are articulated and delicate sculpture on the shells of most of the fossils has not been worn off. The stratigraphically lowermost layer is dominated by barnacles (as individuals up to 5 cm height, and

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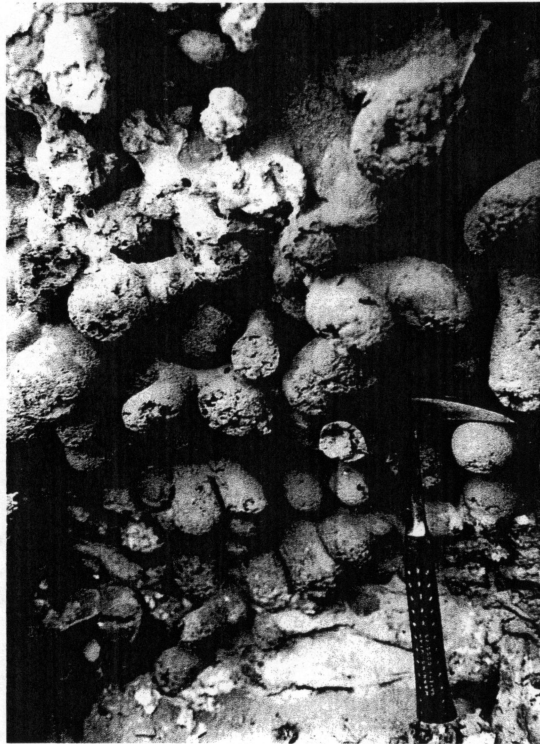


Fig. 2. Infilled clavate borings along basal contact of the Isidro Formation at CSUN loc. 1495 (where a large block of rock has fallen from the cliff face). Hammer is 30 cm in length.

in clusters) with significant numbers of small-sized (up to 3 cm height) and large-sized (up to 8 cm height) pectinids, internal molds of *Turritella* and unidentified bivalves, and rarer components of clypeasteroid echinoids, large-sized (up to 17 cm length) oysters, and bone fragments. A nearshore depositional environment is indicated by the fossil content and lack of significant post-mortem transport of the fossils. A late middle Miocene age for the Isidro Formation at this locality has been reported by Squires and Demetron (1993) on the basis of the presence of the sand dollar *Astrodapsis bajasurensis* Squires and Demetron, 1993.

The horizontal contact of the two formations at the study site is clearly delineated by a remarkable trace-fossil assemblage. The contact is accessible in two ways. A number of spurs have been created by erosion of prominences along the cliff face. They are rather steep and precarious. Safer, but more limited, access is possible at several places where huge blocks have fallen from the cliff face. Some of these fallen blocks provide excellent specimens of the trace fossils (Fig. 2). *In situ*, the contact presents a limited three-dimensional view due to differential weathering of less highly indurated Eocene substrate penetrated by Miocene borings.

Ichnofossils

Sediment-infilled clavate borings.—Infilled borings are predominantly smooth but rare individuals (Figs. 3A, B) display basal concentric, serrated tool marks

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