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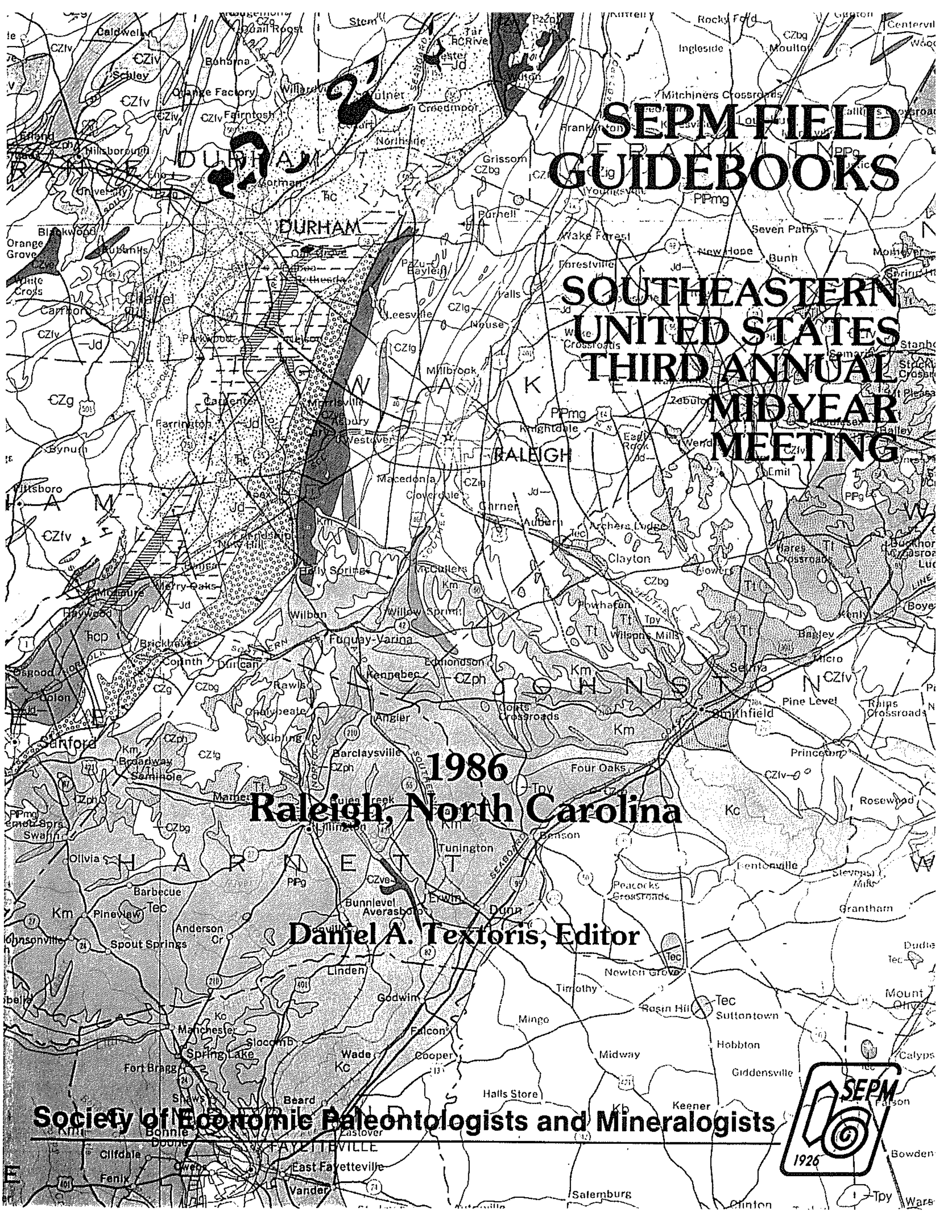

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ECOCENE CARBONATE FACIES OF THE NORTH CAROLINA COASTAL PLAIN

By

W. Burleigh Harris, Victor A. Zullo, and Lee J. Otte

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TRACE FOSSILS FROM THE ROCKY POINT MEMBER OF THE PEEDEE FORMATION (UPPER CRETACEOUS) AND THE CASTLE HAYNE LIMESTONE (EOCENE)

by

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INTRODUCTION

Trace fossils are the preserved tracks, trails, burrows, and borings formed by a wide variety of organisms. Such fossils are known to be formed at least to some extent in virtually all types of ancient marine depositional environments. Numerous studies, particularly in the past decade, have made effective use of trace fossils in the interpretation of depositional environments. Surprisingly, however, few studies of Atlantic Coastal Plain formations have made use of trace fossils. From North Carolina I know of only two such studies, by Curran and Frey (1977) and by Belt et al. (1983), in Pleistocene strata exposed at the Lee Creek mine near Aurora. Certainly there is no dearth of trace fossils in Atlantic Coastal Plain formations; they can be found in many units, in both outcrop and quarry exposures. Detailed studies of trace fossil assemblages can yield useful information to aid with the interpretation of depositional environments, the determination of sedimentation rates, and the relationships between formational and facies boundaries.

The purpose of this report is to bring to the attention of the field trip participants the occurrence of trace fossils in some of the units to be visited during the trip. The trace fossils described herein were discovered during several days of reconnaissance field work conducted in August, 1985. These trace fossils have not been interpreted in detail, and the full extent of the trace fossil assemblages present in these units is not yet known.

OPHIOMORPHA IN THE CRETACEOUS ROCKY POINT MEMBER, PEEDEE FORMATION

Location

The Rocky Point Member of the Peedee Formation is well exposed in the Martin-Marietta Ideal Cement Quarry. Burrows attributed to *Callianassa* sp. (=the trace fossil *Ophiomorpha*) first were reported from this quarry by Cunliffe (1968). The beds containing *Ophiomorpha nodosa* occur adjacent to the base of the ramp leading into the main part of the quarry. Looking down the ramp, a large sump pump is located on the right side. Behind the pump, a cave-like area has formed with the washout and collapse of layers of the Rocky Point Member. *O. nodosa* is common in the thin (10-70 cm thickness), rather poorly lithified, quartz arenite layers interbedded with considerably thicker beds of sandy pelecypod biosparrudite.

On the east side of the quarry road, diagonally across from the sump pump pond and drainage canal, is a west-facing exposure of Rocky Point Member beds of up to 9 m thickness. The basal unit of this exposure, bordered by a shallow drainage ditch, is a shelly, very fine to medium grained quartz sand layer in which *Ophiomorpha nodosa* also occurs commonly. Segments of *O. nodosa* tunnels that have been washed out of the sand can be found concentrated at the base of the outcrop along the edge of the drainage ditch. Several thinner sand layers occur above this basal sand unit, and at least one of these layers also contains some *O. nodosa* specimens, but, for the most part, these layers cannot be easily examined.

Description

Ophiomorpha nodosa is a branched burrow system consisting of straight to gently inclined or curved shafts (vertical segments) and horizontal to gently inclined tunnels. The burrows are lined and are smooth on the interior surface and mammillated on the exterior surface. *O. nodosa* is characterized by having a dominantly single pellet mode of wall construction. In this occurrence, tunnel segments are the dominantly preserved element of the burrow systems (Fig. 1A-C). Tunnel diameters range from 0.6 to 4.2 cm, with an average diameter of 2 cm. Shafts are relatively uncommon here and were noted to occur only in the quartz sand layer. The burrow segments often are well indurated as compared to the poorly lithified to unlithified nature of surrounding sediments. In the quartz arenite layers numerous small burrows about 1 to 2 mm in diameter are preserved in the O. nodosa walls and in the immediately adjacent sediment.

Discussion and Interpretation

The analog relationship between the modern burrows of callianassid shrimp, particularly burrows formed by the ghost shrimp Callianassa major Say, a species common today in the lower foreshore to offshore zone of beaches along the southeast Atlantic coast, and Ophiomorpha nodosa, has been well documented by Weimer and Hoyt (1964) and Frey et al. (1978). It seems virtually certain that the specimens observed here were formed by callianassid shrimp, and probably by a species with habits very similar to C. major. The small burrows associated with O. nodosa tunnels were probably formed by polychaetes that both infested the tunnel linings and used the tunnels as an anchor line from which to burrow outward. A similar occurrence has been reported by Curran (1985) in Cretaceous strata from Delaware.

The unusual aspects of this occurrence of Ophiomorpha nodosa are the dominance of the tunnel segments of the burrow systems, as opposed to shafts, and the close packing of these tunnels in the relatively thin quartz arenite and quartz sand layers. In the section behind the quarry sump pump, the O. nodosa tunnel segments are packed in a quartz arenite layer that thickens and thins, but is never more than 70 cm thick. Here the tunnels form an irregular maze pattern similar to that illustrated by Frey et al. (1978, Fig. 2F). The burrow systems do not show a stack configuration with closely packed shafts, as is typical of a lower foreshore - upper shoreface occurrence (for a Cretaceous example of the stack configuration, see Curran, 1985, Pl. 2C). Furthermore, the irregular maze pattern shows significantly less organization than the maze pattern often found preserved at the base of a set of closely packed shafts (see Pickett et al., 1971, Pl. 28, Fig. 7).

The original depositional environment here was a shallow subtidal, shoaling bottom with accumulating shell layers. The underlying shell layers (later to be the sandy, pelecypod biosparrudite layers) formed an impenetrable barrier to downward burrowing. With environmental conditions otherwise favorable for callianassids, the deposition of thin layers of sand permitted their rapid colonization. The shrimp burrowed down a bit, were prohibited from further downward burrowing by a shell layer, and thus made extensive lateral systems.

The shell layers are likely to have been deposited during storm events, and some of the sand layers also may have been storm deposited, because they often contain thin horizons of oyster and Cardium sp. shells (Fig. 1D). It is quite possible that the top parts of sand layers and the contained upper parts of the burrow systems were eroded away immediately prior to the deposition of overlying shell layers. However, it does not seem likely that these sand layers ever were very thick. If that had been the case, the O. nodosa tunnel systems would have been less extensive and organized into more regular patterns.

Harris (1978) proposed several depositional models for the origin of the Rocky Point Member beds. He seemed to favor a cape-shoal model where shell layers accumulated in a shoaling environment adjacent to a Cretaceous cape, with the bulk of the sand-sized sediments being transported further offshore. The burrow patterns described here support this interpretation. The shell layers accumulated during storm events. Thin sand layers were deposited as storms waned or during fair weather conditions; these layers were quickly burrowed. Subsequent storm events then eroded off the tops of the sand layers and sealed the remaining sand with an overlying layer of shell.

TRACE FOSSILS IN THE EOCENE CASTLE HAYNE LIMESTONE

Fussell Quarry

The Santeelampas [Sequences 1 and 2] beds of the Castle Hayne Limestone are particularly well exposed in the walls of the Fussell Lime and Rock Company quarry. Trace fossils are present in at least some horizons of these beds, but they are difficult to study here because they tend not to be well displayed in the smooth, vertical quarry walls. Also, these walls often are covered with a thin veneer of silt and clay washed down from above. This veneer tends to obscure the texture of the rock, and further hampers the search for trace fossils.

In Sequence 1 beds (see the Harris et al. Road Log, this volume), I observed distinct burrow mottling in a number of places in the quarry. The burrows were found well exposed on the bedding planes of large blocks of rock lying on the floor of older parts of the quarry. These weathered surfaces revealed the lithified fill sediment of apparently unlined burrows (Fig. 1E, F). These are meandering burrows with Y-shaped branches and diameters of 0.8 to 2 cm, lying mostly in the horizontal plane and often quite closely spaced.

The burrows are tentatively assigned to the ichnogenus Thalassinoides on the basis of the Y-shaped branching and diameter of the burrows. A firm identification cannot be made at this time because vertical components of the burrow system were not observed. It is likely that upwardly directed Y-shaped branches and shafts are present here, but until this is confirmed, the Thalassinoides identification must remain tentative. These ?Thalassinoides burrow systems seem to be quite extensive in Sequence 1 beds here. With further study, the burrows could be useful in the paleodepositional environment interpretation of these beds.

Lying immediately below the Sequence 1 beds in this quarry is a well lithified hardground surface (Sequence 0). This surface is extensively bored and is characterized by the presence of shallow, spoon-shaped borings (Fig. 1G) between 3 to 5 cm in diameter. These borings have not been identified, and I have not studied this surface in any detail. I mention them here simply to point out another ichnologic element of these Eocene rocks that is well displayed and merits further study.

Martin-Marietta Rocky Point Quarry

Sequence 3a beds (see Harris et al. Road Log, this volume) of the Castle Hayne Limestone are well exposed in the upper part of the section of this quarry. These beds consist of poorly consolidated, tan biomicrite, and there is a moderate degree of burrow mottling throughout the unit. The mottling is intensified near and along the contact with overlying Sequence 3b beds, and the burrows are filled with biosparrudite from above. This concentration of burrowing near and along the contact indicates a diastemic break in sedimentation at this horizon. The burrows observed were not distinct enough to permit identification.

Hard, ledge-like layers of sequence 3b, a bryozoan biosparrudite, exposed at the top of the quarry sequence contain some vertical burrows. These burrows have lined shafts and are 2 to 3 cm in diameter. They are moderately common, but they could not be traced for any appreciable length. Also present is a larger-scale mottling pattern resembling the burrow galleries formed by large burrowing crustaceans. These galleries may be laterally continuous and widespread in this unit.

This preliminary view indicates that some potentially interesting trace fossils are present in the Castle Hayne beds of this quarry. More detailed investigations now are needed.

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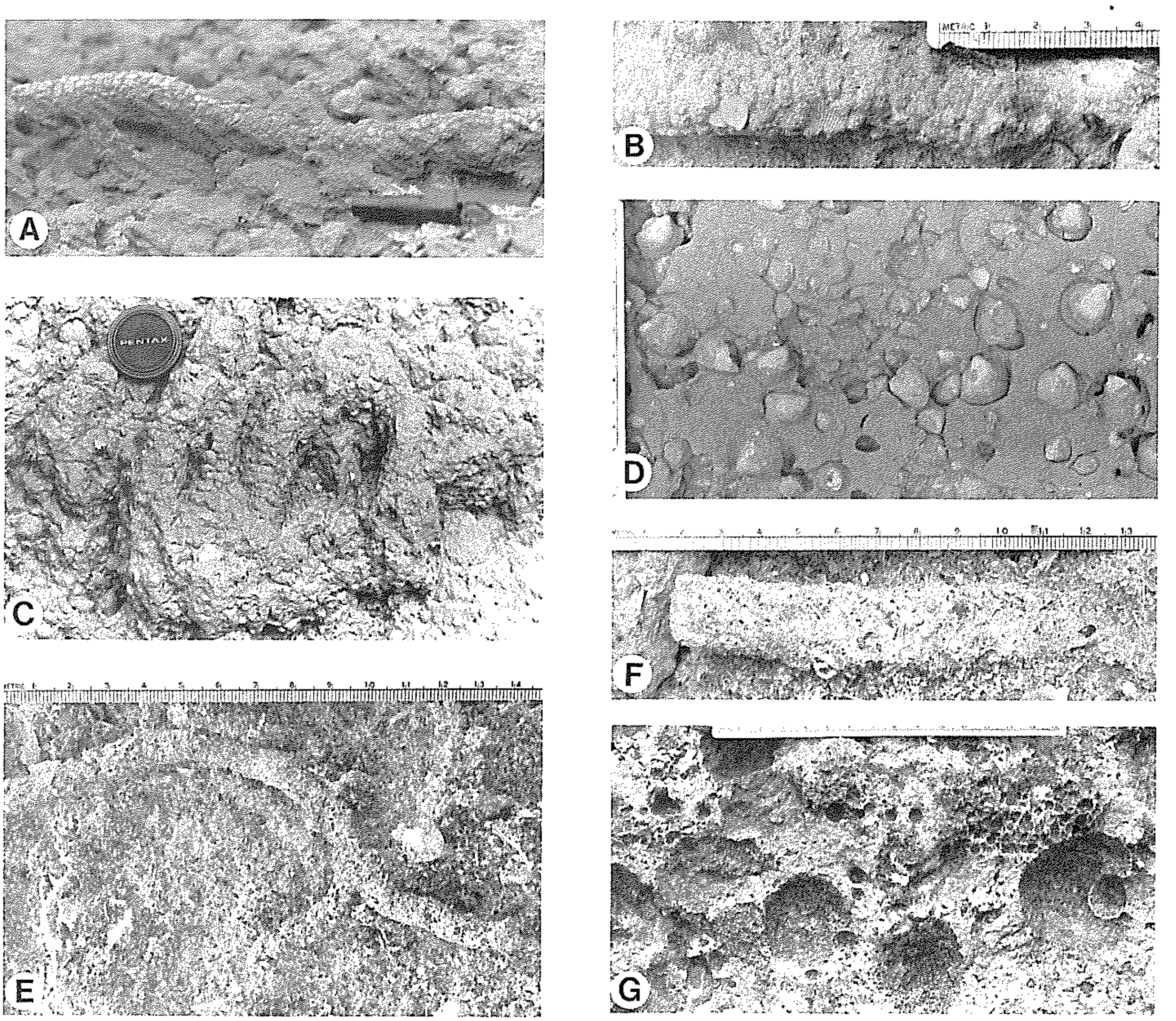

Figure 1. A) Segment of Ophiomorpha nodosa tunnel in side view, Rocky Point Member of Peedee Formation. Pen top = 6.5 cm. B) Top view of O. nodosa tunnel segment showing knobby character of burrow exterior surface, Rocky Point Member. C) Complex of O. nodosa tunnel segments in thin quartz arenite layer on underside of pelecypod biosparrudite bed, Rocky Point Member. Lens cap = 5.5 cm diameter. D) Bedding plane view of quartz arenite layer of the Rocky Point Member with numerous Cardium sp. specimens. Such layers also commonly contain O. nodosa tunnels. E) Branched segment of ?Thalassinoides on bedding plane exposure, Santeelampas beds of the Castle Hayne Limestone. F) Typical short segment of ?Thalassinoides tunnel, Santeelampas beds. The ?Thalassinoides burrows of these beds often give the unit a mottled appearance. G) Borings on the hardground surface immediately below the Santeelampas beds. The shallow, spoon-shaped borings are particularly noteable on this surface. A-D are from the Martin-Marietta Ideal Cement Quarry; E-G are from the Fussell Lime and Rock Company Quarry.

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