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Possible Predation Scars on *Rectithyris subdepressa* (Stoliczka, 1872), Late Cretaceous (Maastrichtian) Kallankurichi Fm., India.

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ABSTRACT

A single specimen of the terebratulid brachiopod, *Rectithyris subdepressa* (Stoliczka, 1872) from the Late Cretaceous (Maastrichtian) Kallankurichi Formation of southern India was found with durophagous predation traces. This occurrence is significant as it is possibly the first documentation of elasmobranch shark predation on brachiopods from the Mesozoic.

INTRODUCTION

Predator - prey relationships are difficult to document in the fossil record (Boucot, 1990), though numerous cases of predation scars on fossil brachiopod shells are known (Alexander, 1981;1986). Among numerous potential predators on invertebrates, shell piercing and crushing sharks are most notable for leaving well defined puncture holes (Hansen and Mapes, 1990). In a preliminary review of predation upon brachiopods throughout the Phanerozoic, Alexander (1985) found high frequencies of predation (up to 75% of shells per species) for Paleozoic brachiopods, but could document no single instance of predation on Mesozoic brachiopods. He hypothesized that the post-Paleozoic decline in predation might reflect several phenomena, including a shift in durophagy from brachiopods to molluscs, as the bivalves increasingly replaced the brachiopods in most shelf environments (Gould and Calloway, 1980; Walsh, 1996). Articulate brachiopods today have repellant, noxious-tasting flesh that insures that they are commonly not chosen as prey in modern marine environments (Thayer, 1981; 1985). Onset of this adaptation may be linked to the brachiopod/bivave replacement, or may have a Paleozoic history (cf. Thayer and Allmon, 1991).

RESULTS

The Late Cretaceous (Maastrichtian) Kallankurichi Formation crops out in the Tancem Mines area of the state of Tamil Nadu, India (Figure 1). A diverse fauna of bivalve oysters, echinoids, brachiopods, gastropods and ammonites has been described (Stoliczka, 1872; Radulovic and Ramamoorthy, 1992) from the arenaceous limestones (Sundram and Rao, 1986). These sediments may be interpreted as representing shallow-water, marine deposition in high-energy environments.

Trace fossils attributable to predation are termed Praedichnia, and in the case of shark predation upon brachiopods, are usually expressed as holes in the skeleton not located at the cardinal margins (Ruggiero, 1990). A single specimen of the large (up to 74 mm length) terebratulid brachiopod, *Rectithyris subdepressa* (Stoliczka, 1872) was collected from the Mines that has three holes on the pedicle valve (Figure 2) that are possibly Praedichnia traces.

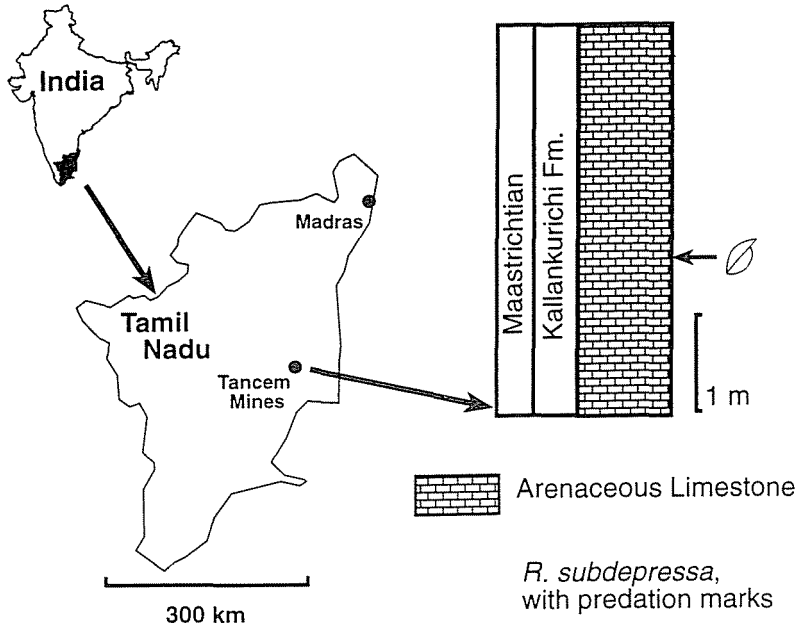

FIGURE 1. Geographic and stratigraphic location in state of Tamil Nadu, southern India.

Three holes are present at midvalve. They are crescent shapes with the concave sides directed posteriorly. Hole widths (posterior to anterior) are over twice as great as hole lengths. Widths range from 6.86 mm to 10.04 mm, while lengths range from 3.24 mm to 4.45 mm. Hole edges are sharp There is no evidence of major deflection of growth lines to indicate growth continued after the attack. The hypothesis of a post-mortem attack cannot be falsified. The brachial valve shows no punctures, but a single long crushing indentation of the valve. This indentation runs parallel to the holes in the pedicle valve and is also present at midvalve. Assymmetric hole number and/or shape on opposite sides of brachiopod prey fossils is common (Hansen and Mapes, 1990).

DISCUSSION

No shark teeth have ever been found in the Kallankurichi Fm., though presence of Praedichnia on *R. subdepressa* is implicit evidence that sharks were top level carnivores in the southern Indian basins as they were in most marine environments during the Cretaceous (Welton and Farish, 1993). Lack of shark fossils in the Kallankurichi Fm. is probably due to low collection effort - the formation has not been bulk-collected for paleoecological purposes.

Though the transition from brachiopod dominance to bivalve dominance in marine paleocommunities was abrupt (Gould and Calloway, 1980; Walsh, 1996), brachiopods were locally quite abundant in Mesozoic environments (Aberhan, 1994). The predation documented here is significant for evolutionary paleoecology as it is potentially the

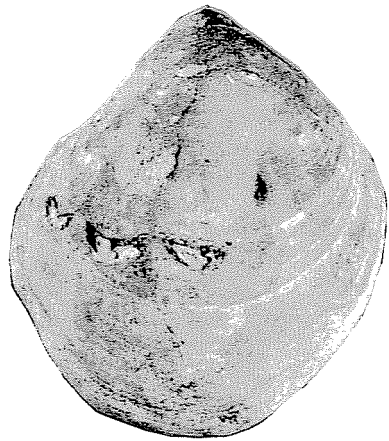

FIGURE 2. Praedichnia marks on Rectithyris subdepressa (Stoliczka, 1872). (X 1).

first evidence of Mesozoic predation by durophagous sharks on brachiopods. Brachiopods might not have been the first choice of prey for Mesozoic predators, but the food source was utilized if necessary, as brachiopods are today (Thayer, 1985).

Boucot (1990), in an extensive review of all behavior evidence among fossils, divided all case-studies into reliability categories. These range from category 1 in which the behavior is "frozen" in-place, with no doubts about its genesis, to category 7 in which the evidence is speculative, with "little to no reliability". Using this established scheme, the brachiopod specimen here would be placed within category 4. Boucot (1990) reserves this category for evidence in which the behavior is definitely known (in this case, puncture holes that penetrate through shell material), but the organism that produced the behavior is still inconclusive, though sharks remain the prime candidates.

Whatever the identity of the predation species, it is equally significant that *R subdepressa* is a terebratulid, as the Class shows the lowest levels of of predation damage throughout the Phanerozoic (Alexander, 1985). Perhaps the marked decrease in post-Paleozoic predation upon brachiopods does not reflect advent of noxious flesh late in brachiopod history as an adaptation to the Mesozoic marine revolution in predation (Vermeij, 1977; 1987), but instead reflects only the post-Paleozoic survival and dominance of a Class (Terebratulida) only rarely chosen as prey ever in the Phanerozoic brachiopod faunas.

Falsification of the initial hypothesis that this is indeed an example of shark Praedichnia requires enhanced sampling from the Kallankurichi Formation. Bulk samples supplemented by surface collection of large specimens (Dennison and Hay, 1967; Stanton and Evans, 1972) should be completed, with an eye toward potential predators - primarily sharks, but even for invertebrate predators, such as large lobsters. Globally, more data on predation upon brachiopods, especially fossil terebratulids, are needed to expand the seminal study of Alexander (1985).

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