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Sponge spicules from the White Limestone Group of Jamaica

Roger W. Portell[1] & J. Keith Rigby[2]

[1]*Florida Museum of Natural History, P.O. Box 117800, University of Florida, Gainesville, Florida 32611-7800, U.S.A.; e-mail: portell@flmnh.ufl.edu*
[2]*Department of Geology, S389 Eyring Science Center, Brigham Young University, Provo, Utah 84604-4606, U.S.A.; e-mail: rigby-jkeith@qwest.net*

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Isolated siliceous sponge spicules recovered from deep-water chalk in the Lower Miocene Montpelier Formation (White Limestone Group) were collected from the lowest exposed beds at Duncans Quarry, parish of Trelawny, Jamaica. Megascleres include a variety of normal calthrops, a dichotriaene and a triaene, associated with an astrose sphaeraster microsclere. Because these spicules appear as common elements in the order Choristida of the class Demospongea, identification below order is not possible, and all the spicules may have come from one species of choristid sponge. A single pentactine also occurs in the collection. This spicule may be either from a demosponge or possibly a hexactinellid. The only other known reports of White Limestone sponge spicules (class Hexactinellida) are from the Pelleu Island Formation (formerly the Spring Garden Member of the Montpelier Formation).

KEY WORDS: Porifera, sponges, Miocene, Jamaica, White Limestone Group, Montpelier Formation.

Introduction

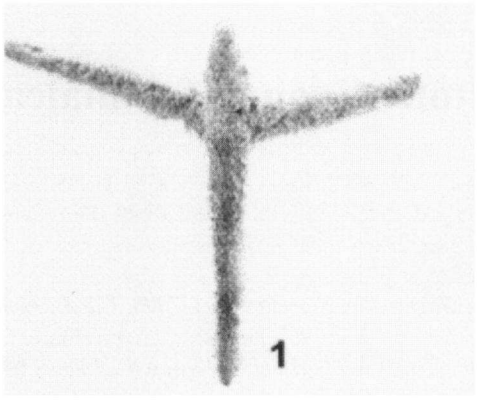
In recent years, living sponges of the West Indies have received considerable attention (Hartman, 1969, 1977; Hartman & Goreau, 1970; Hechtel, 1965, 1969; Kobluk & van Soest, 1989; Lang *et al.*, 1975; Pang, 1973; Pulitzer-Finali, 1986; van Soest, 1978, 1980, 1984; Wiedenmayer, 1977, 1978). However, Cainozoic sponges of the region are still very poorly known (Wiedenmayer, 1994; Pisera, 1999, 2000) with the only assemblage of intact siliceous sponges (lithistids and hexactinellids) thus far reported, but as yet still undescribed, occurring in the Upper Oligocene Antigua Formation, southeastern Antigua (Frost & Weiss, 1979; Wiedenmayer, 1994).

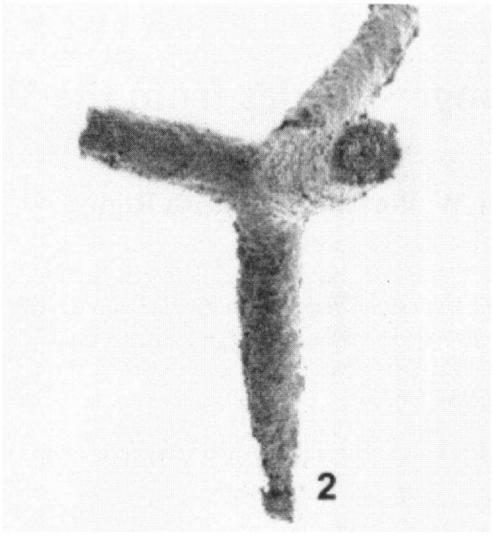
In Jamaica, only one formation from the whole of the White Limestone Group (which consists of six named formations ranging in age from Middle Eocene to Middle Miocene) is reported to contain fossil sponges. Robinson (1969, p. 3) first recognised abundant sponge spicules in the Spring Garden Member of the Montpelier Formation near Buff Bay, along the northeastern coast of the island, and commented that, '... most horizons contain sponge spicules in sufficient abundance to make prolonged handling of the rocks uncomfortable.' Maurrasse (1993), in his study of Radiolaria from the Spring Garden Member of the Montpelier Formation just east of the section studied by Robinson (1969) and stratigraphically lower, concluded that 60 to 99% of the biogenic siliceous component of that unit consisted of hexactinellid sponge spicules. Very tentatively, Maurrasse identified and figured several of the spicules belonging to the genera aff. *Sphaeraster*, aff. *Sterraster* and *Euplectella* spp., and figured numerous other spicules of indeterminate taxa. Recent refinement of the lithostratigraphy of the White Limestone Group (Mitchell, 2004) has relegated the Spring Garden Member of the Montpelier Formation to the Pelleu Island Formation, a unit stratigraphically above the Montpelier Formation and differentiated from that unit by an absence of chert layers. The Pelleu Island Formation is considered to be late Early to Middle Miocene. Therefore, previous reports by Robinson (1969) and Maurrasse (1993) of sponge spicules now are considered to be from the Pelleu Island Formation, not the Montpelier Formation.

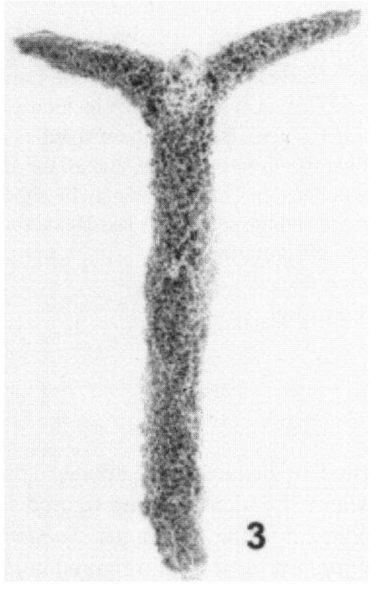
To the above meagre record of White Limestone Group fossil sponges, we add the occurrence of isolated siliceous sponge spicules discovered from the Lower Miocene Montpelier Formation on the north-central coast of Jamaica.

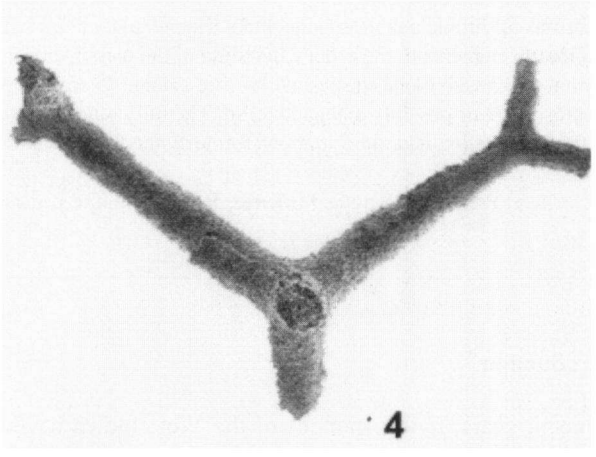
Material and methods

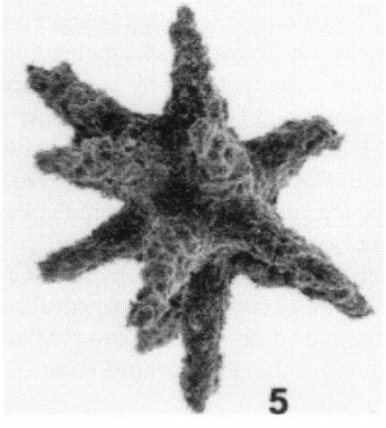
While prospecting for macrofossils between 1990 and 2000, R.W.P. and associates collected small bulk samples (10 kg in total) of deep-water chalk from the lowest exposed beds at the informally named Duncans Quarry (University of Florida locality XJ015).











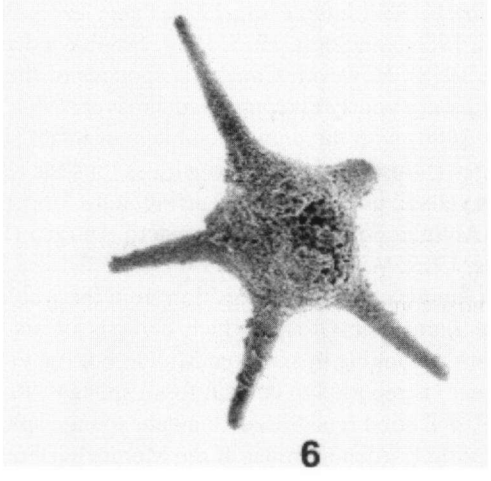


Figure 1.

1 - Calthrops megasclere of fossil choristid demosponge, UF 103357, longest ray 585 µm.
2 - Calthrops megasclere of fossil choristid demosponge, UF 108854, most complete ray length 750 µm.
3 - Triaene megasclere of fossil choristid demosponge, UF 108832, incomplete rhabdome length 640 µm.
4 - Dichotriaene spicule with forked clads of fossil choristid demosponge, UF 108853, the longest nearly complete ray 950 µm.
5 - Astrose sphaeraster microsclere of fossil tetractinomorph choristid demosponge, UF 108833, approximately 400 µm across.
6 - Fossil pentactine microsclere "pentaster"?, UF 108831, approximately 600 µm across.

The small, seldom used quarry is located near the centre of the north coast, in the parish of Trelawny, approximately 5 km west of the Duncans Police Station on the south side of Highway A1 (GPS reading 18° 28.05' N, 77° 34.77' W) (see Mitchell, 2004, for locality map). Here, approximately 25 m of bedded and folded white carbonates and chert layers of the Montpelier Formation are exposed. The uppermost section along the east quarry wall (next to the access road) consists of large slump blocks (3-6 m thick) of indurated bioclastic limestone composed primarily of coral rubble, with interstitial echinoid tests and spines, mouldic molluscs and crabs. The lowermost exposed section east of the access road consists of chalk with abundant planktic foraminifera, with some brachiopods (Harper *et al.*, 1997; Harper & Portell, 2004), echinoderms (Donovan *et al.*, 1993; Donovan, 2004), fish remains (Underwood & Mitchell, 2004) and sponge spicules.

Fossil spicules were recovered by washing bulk samples through a series of U.S.A. Standard Testing Sieves down to 80 mesh (177 μm) and picking cleaned samples under a binocular microscope. All fossil spicules figured in this paper are reposited in collections of the Invertebrate Paleontology Division of the Florida Museum of Natural History (FLMNH), University of Florida (UF), Gainesville, Florida. Spicule terminology follows Wiedenmayer (1977 and references therein). Spicule measurements were taken from SEM micrographs.

Systematic palaeontology

Phylum Porifera Grant, 1836
Class Demospongea Sollas, 1885
Order Choristida Sollas. 1880 *sensu* Lévi, 1956

Megascleres (major support spicules)

Calthrops — Two examples of calthrops spicules occur in the collection. Spicule UF 103357 is a relatively slender-rayed form that is moderately complete, with four divergent rays of essentially the same proportions (Figure 1/1). The most complete rays taper distally from diameters of approximately 100 μm to more-or-less complete rounded tips of approximately 25 μm. These rays are up to 585 μm long and diverge from each other at angles of approximately 120-130°. Spicule UF 108854 is a somewhat more robust-rayed calthrops, but it is less complete (Figure 1/2). Its most complete rays have basal or proximal diameters of approximately 170 μm where they are moderately subcylindrical. They taper more abruptly in the outer half of their lengths, and their probably pointed tips are broken. The most nearly complete ray is essentially 750 μm long.

Triaene — A single plagiotriaene, spicule UF 108832 (Figure 1/3), has a relatively long, but broken, straight rhabdome that has a preserved length of about 640 μm and a basal diameter of 41-42 μm. Clads of the cladome are smaller, and flex upward and outward from their common junction with the rhabdome. They arch through approximately 30° from their common junction to their outer preserved ends. They thin from basal diameters of 30-35 μm to approximately half that thickness at their outer preserved tips.

Dichotriaene — A single fragmental dichotriaene, UF 108853, is a relatively thin-rayed form with forked distal rays (Figure 1/4). The most nearly complete of those straight main rays are 800-950 μm long and taper gently from basal or proximal diameters of 180-200 μm to distal diameters of 120-150 μm, where they divide into tapering outer clads. Those outer tips have basal diameters of 0.07 μm and are at least 0.24 μm long, though incomplete. These primary and outer rays diverge from each other at approximately 120-130°.

Microscleres (minor accessory spicules)

Sphaeraster — A single astrose sphaeraster microsclere, UF 108833, is in the collection (Figure 1/5). It consists of a more or less spherical centre from which radiate several abruptly tapering relatively robust rays. Thirteen such rays diverge from one side, so there may be as many as 20 rays on the complete spicule. The spicule is approximately 400 μm across, from tip to tip, and individual rays are approximately 125 μm long. They have basal ray diameters of approximately 60 μm and taper to irregularly preserved rounded tips 15-20 μm in diameter. Surfaces of the rays are micronodose, as preserved, but whether that was original sculpture or produced during diagenesis is unknown.

Other spicules?

A single pentactinal spicule 'pentaster,' UF 108831, was isolated in the collection (Figure 1/6). It consists of a globose centre 200 μm across, from which diverge five equally spaced, straight, tapering rays. The most complete of these rays is 200-220 μm long, so the 'spicule' is about 600 μm across. The rays taper abruptly from a basal diameter of approximately 60 μm at the margin of the globose centre, to 40 μm in diameter 20-30 μm out from that. The smooth rays taper less abruptly beyond that, so that they are only 20 μm across at their outer broken ends. Its taxonomic position is uncertain.

Conclusions

Occurrences of fossil sponges in the White Limestone

Group are restricted to the Lower Miocene Montpelier Formation and the stratigraphically higher, upper Lower Miocene to Middle Miocene Pelleu Island Formation. The sponge fauna of the Montpelier Formation consists of very rare spicules of the class Demospongea and that of the Pelleu Island Formation consists of abundant spicules of the class Hexactinellida. According to Mitchell (2004), both formations were deposited in deep-water troughs around a carbonate platform. This, coupled with the associated faunas of both units, indicates that the sponges represented are deep-water species.

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