THE FIRST TERTIARY SCLEROSPONGE FROM THE AMERICAS

by EDWARD C. WILSON

ABSTRACT. *Diplochaetetes mexicanus* sp. nov. (Porifera: Sclerospongiae) is erected for specimens of fossil coralline sponges collected from the El Cien Formation of Late Oligocene and Early Miocene age in eastern Baja California Sur, Mexico. The genus was previously known only by its type species, *D. longitubus* Weissermel, 1913 from the Eocene of Namibia (South West Africa). This is the first record of sclerosponges in the Tertiary of the Americas.

IN 1940, J. W. Durham discovered a Tertiary marine section near Punta San Telmo, Baja California Sur, Mexico, from which he subsequently (Durham 1950) erected a new species of the bivalve *Anadara* and reported a few other marine mollusks. The same locality yielded the marine mammal *Cornwallius* (Vanderhoof 1942). In a correlative section 20 km south of this locality. I collected the fossils which form the basis of this report.

REGIONAL GEOLOGY AND STRATIGRAPHY

The geology of the isolated area east of the Sierra de la Giganta of Baja California Sur has been little studied. The sea cliffs that extend for 90 km north of Punta La Laguna (text-fig. 1) show beds that are arched in a broad, gentle anticline trending roughly east–west with northern and southern limbs that dip at about 5 degrees and are broken in places by normal faulting of minor displacement. Moderately metamorphosed sediments at the core of the anticline are exposed in places for 12 km between Punta San Telmo southward to Roca Moreno just off Punta del Cobre. They are known as the San Telmo Formation and considered to be of Mesozoic age.

The strata overlying the San Telmo Formation are unmetamorphosed. The lowest unit is about 100 m thick and composed of cross-bedded, red sandstones of uncertain age that may correlate with the Upper Oligocene Salto Formation which crops out further north (McFall 1968; Gastil *et al.* 1979; Hausback 1984). The marine Tepetate Formation of Cretaceous to Eocene age occupies this position in sections on both sides of the peninsula further south so there is also a possibility that the redbeds may, at least in part, be a terrestrial equivalent of this unit.

The superjacent unit is composed of a basal conglomerate and about 100 m of marine sandstones, shales, phosphorites, porcellanites, limestones, conglomerates, and tuffs of Late Oligocene and Early Miocene age. It has been named the San Gregorio Formation by various workers, including Durham (1950) and Hausback (1984). Others have referred to it as the Monterey, Monterrey, or Monte-Rey Formation because of a reputed similarity to the younger Monterey Formation of central and southern California. Its unique lithology, however, led Applegate (in press) to name it the El Cien Formation. It is the source of phosphates mined in large quantities at San Juan de la Costa on the coast 45 km north-west of La Paz and formerly mined near El Cien on the Transpeninsular Highway (Mexico 1) 75 km north-west of La Paz. This formation yielded the material described here.

Above this unit lie more than 1000 m of Miocene marine, terrestrial sedimentary, and volcanoclastic rocks of the San Isidro and Comondu Formations that form the bulk of the Sierra de la Giganta. Pliocene marine sedimentary rocks have not been recognized in the area, but there are marine terrace deposits of Pleistocene age.

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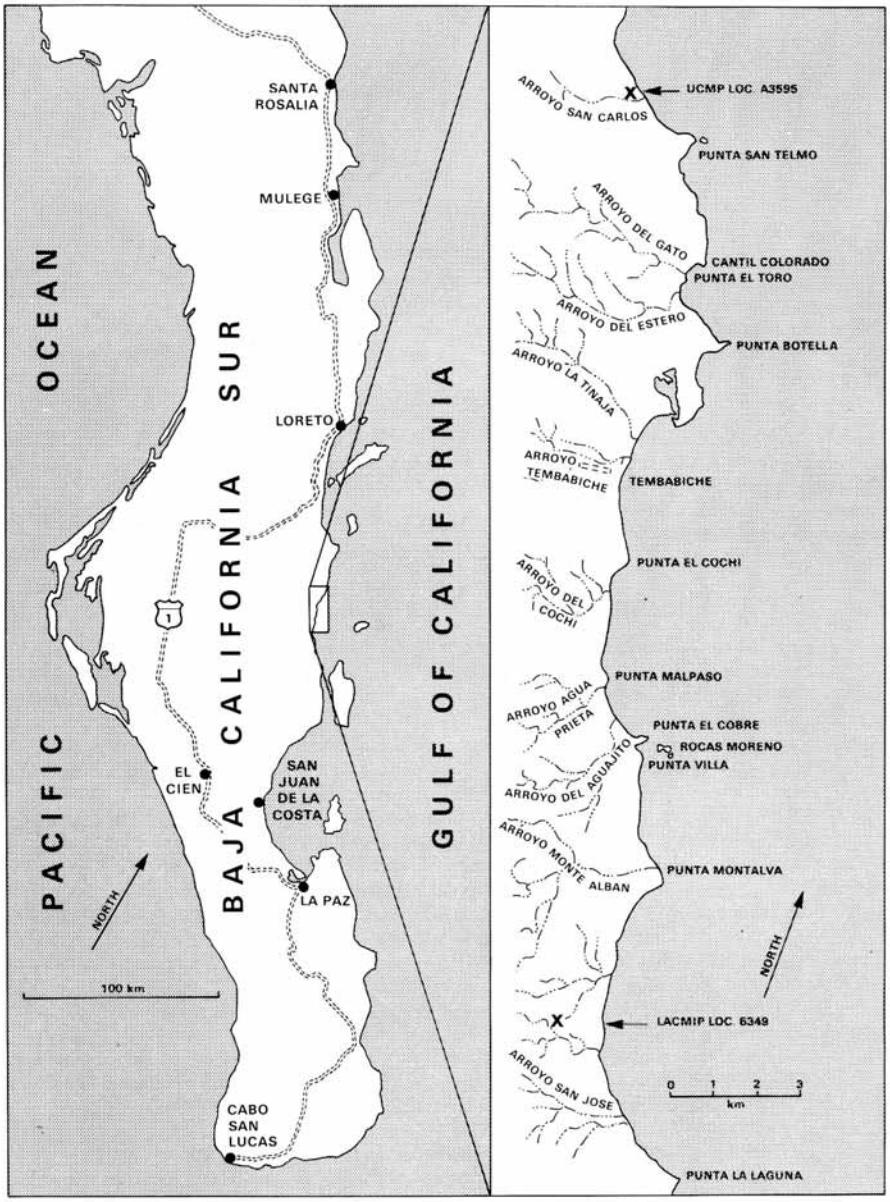


TEXT-FIG. 1. Index map (left) showing general location of study area (rectangle) in Baja California Sur, and more detailed map (right) indicating type localities of *Diplochaetetes mexicana* n. sp. (LACMIP loc. 6349) and of *Anadara vanderhoofi* Durham, 1950 (UCMP loc. A3595). Tembabiche (map, right) is the only settlement in the study area other than scattered ranches. Its small airfield is indicated by the dashed-line rectangle.

LOCALITIES

The locality (LACMIP loc. 6349) which yielded the paratypes is in the south-west quarter of section 09-82 as shown on the Estados Unidos Mexicanos, Direccion General de Geografia, Carta Topografica Los Burros G12D41, Baja California Sur (1978, 1:50000). It is 11·5 km south of Tembabiche and about 400 m inland from the sandy beach at the mouth of the first wash north of Arroyo San Jose on a low ridge forming its north boundary (text-fig. 1).

Cursory examination of this locality served to place the sponge bed in a regional stratigraphic framework. Two metres stratigraphically below it is a well-indurated limestone coquina of *Anadara vanderhoofi* Durham, 1950 (LACMIP loc. 6348). The type locality of this bivalve (UCMP loc. A3595) is in Durham's section near Punta San Telmo (text-fig. 1). Applegate and Wilson (1976) proposed a biostratigraphic correlation using occurrences of this species at El Cien and the type locality, which seems corroborated by subsequent field observations. It seems likely, therefore, that the occurrence of the species below the sponge bed represents the same stratigraphic position in the El Cien Formation. If so, the sponge bed lies between beds of known Late Oligocene and Early Miocene ages. An age refinement awaits more precise placement of the Oligocene–Miocene boundary within the formation.

A single specimen of the sponge was collected by Applegate in 1978 from the main quarry of Roca Phosphorica Mexicana at San Juan de la Costa, on the coast 45 km north-west of La Paz (text-fig. 1). I have designated this specimen the holotype because of its superior preservation. Applegate reports that it came from the same stratigraphic position in the El Cien Formation as the specimens found by me further north. The locality has since been destroyed by the strip mining operation.

SYSTEMATIC PALAEONTOLOGY

It has been nearly 20 years since Hartman and Goreau (1966) reported that some living sponges secrete skeletons so similar to those of fossils then classified in the phylum Coelenterata that they should be reassigned to the Porifera. The history and significance of this and related reassignments recently has been summarized succinctly by Basile *et al.* (1984), Fagerstrom (1984), and others and need not be repeated here. Even recently, however (Hill 1981, p. 520), *Diplochaetetes* Weissermel, 1913 has been placed among the tabulate corals although Hartman and Goreau (1972, p. 138) have earlier recognized the relationship of the genus to the sclerosponges.

Morphological terminology follows de Laubenfels (1955), with modifications for coralline sponges by Stearn (1984).

Repositories of type specimens and locality numbers are denoted by the following institutional acronyms: IGM (Instituto de Geologia, Universidad Nacional Autonoma de Mexico), LACMIP (Invertebrate Paleontology Section, Natural History Museum of Los Angeles County), and UCMP (University of California Museum of Paleontology, Berkeley).

Phylum PORIFERA
Class SCLEROSPONGIAE Hartman and Goreau, 1970
Order TABULOSPONGIDA Hartman and Goreau, 1975
Family ACANTHOCHAETETIDAE Fisher, 1970 (= TABULOSPONGIDAE Mori, 1976)
Genus DIPLOCHAETETES Weissermel, 1913

Type species. Diplochaetetes longitubus Weissermel, 1913, from the Eocene of Namibia.

Diagnosis. Diplochaetetes is a coralline sponge of large domal growth form with polygonal to rounded tabulated calicles that lack septa and spinules, a completely aspicular skeleton, lamellar calicle walls that are fused where calicles touch and unfused where they do not, tabulae distally concave and complete and grouped and ungrouped but not zoned, an axial and bipartite increase, and a poorly known fine-wall microstructure.

Diplochaetetes mexicanus sp. nov.

Plate 50, figs. 1–4

Diagnosis. A species of *Diplochaetetes* characterized by great numbers of tabulae (as many as 15 per mm) clumped in the calicles of some specimens.

Etymology. The species is named after Mexico, country of origin.

Type material and Locality. IGM holotype 3948, IGM paratypes 3949–3955, LACMIP paratype 7195. Two thin sections and eighteen polished sections from the holotype and seven thin sections and sixty-six polished sections from the eight paratypes were studied. Upper Oligocene or Lower Miocene, El Cien Formation; San Juan de la Costa (holotype) and 11·5 km south of Tembabiche (paratypes), both Baja California Sur, Mexico.

External description. Growth form domal, large, diameter up to 60 cm; calicles polygonal giving cerioid appearance; external surfaces not well preserved.

Transverse section description. Calicles 1·5 to 2·0 mm in diameter, generally polygonal externally, circular internally, not everywhere in contact in all neighbouring calicles (sediment in 'corners'); septa and spinules not present; tabulae absent or represented by one or more circular shapes in some calicles; walls lamellar, fused where neighbouring calicles touch, separate elsewhere.

Longitudinal section description. Calicles long, straight to gently curved (rarely broadly vermiform), 1·5 to 2·0 mm in diameter; septa and spinules not present; tabulae generally complete, concave upward, not zoned in neighbouring calicles, generally grouped 1 to 3 per mm, with clumps 5 to 20 mm apart, densely grouped in some calicles, 4 to 15 per mm for vertical distances as much as 10 mm, with intervening distances between dense groups without tabulae or less densely grouped as in other calicles; wall lamellar, preservation poor.

Discussion. The densely clumped tabulae of the new species distinguish it from *D. longitubus* Weissermel, 1913, the type and only other known species, from the Eocene (Siesser 1977) of Namibia. Weissermel (1913) had eleven specimens in the type lot and later received another thirteen which he described (Weissermel 1926), so it seems unlikely that his sample was too small to detect densely grouped tabulae if they had been present in his species. His type specimens are apparently lost and I have been unable to obtain topotypes.

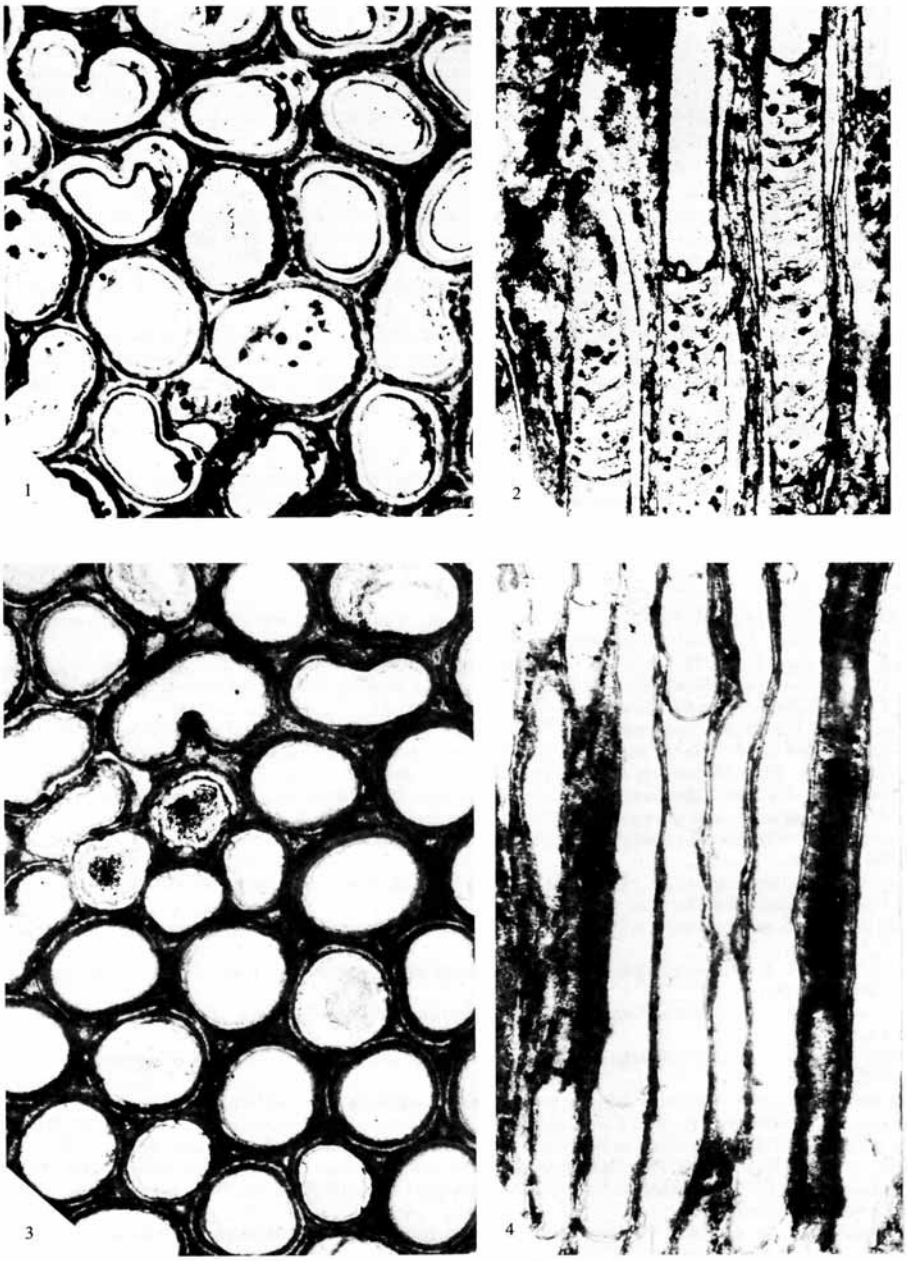
It is unfortunate that the wall microstructure of the type species was not described minutely but only mentioned as being lamellar. The Mexican specimens have SiO_2 intergrown between the wall lamellae as well as filling the calicles and the original microstructure cannot be observed with assurance. Abundant microfractures caused by the SiO_2 emplacement are widespread in most calicles.

Although external surfaces of none of the specimens of *D. mexicanus* were preserved adequately to show the presence or absence of such features as astrorhizae, Weissermel (1926, pl. 35, figs. 1 and 2) illustrated specimens of *D. longitubus* with well-preserved external surfaces that show that these features are not present in the type species. In the LACMIP paratype of *D. mexicanus* there is an opening suggestive of an osculum, but it was the only one encountered and may represent growth around another organism.

The specimens seen by me at LACMIP locality 6349 appeared to have been in place and in growth position. They resembled coralla of *Chaetetes* that I have seen in Pennsylvanian formations of eastern Nevada. Large domal heads of *D. mexicanus* are abundant and upright, closely spaced, but not touching.

EXPLANATION OF PLATE 50

Figs. 1–4. *Diplochaetetes mexicanus* sp. nov., El Cien Formation, Oligocene–Miocene, Mexico, × 10. 1–2, IGM holotype 3948. 1, transverse section. 2, longitudinal section showing densely grouped tabulae. 3–4, LACMIP paratype 7195. 3, transverse section. 4, longitudinal section.



WILSON, *Diplochaetetes mexicanus* sp. nov.

Some specimens of *D. mexicanus* exhibit sinuous calicles in places either as the result of upward growth around the edges of the domes or as the result of reoriented upward growth after the specimen had been tilted. In this respect, they somewhat resembled *D. longitubus* var. *vermicularis* Weissermel, 1926, also from the Eocene of Namibia. I have no record of the field appearance of the holotype from the locality at San Juan de La Costa.

D. mexicanus occurs in a formation that has bone beds, including some articulated specimens, probable turbidites, and other indicators of at least moderately deep water. Its presence does not necessitate a shallow-water palaeoenvironmental interpretation, although most recent work on sclerosponges has emphasized their occurrences as part of the shallow cryptofauna of tropical reefs. Hartman and Goreau (1970) reported living sclerosponges to depths of 92 m on outer reef slopes off Jamaica. The holotype of the sclerosponge *Ceratoporella nicholsonii* (Hickson 1911) was dredged off Cuba at a depth of 100 fathoms (Hickson 1911).

Sheldon (1982) postulated that the phosphate deposits of Baja California Sur were deposited by extensive upwelling of phosphate-rich waters brought up to replace surface waters moved away by off-shore trade winds. Since *D. mexicanus* is associated intimately with these deposits, it follows that it inhabited cool water. The rarity of tropical corals and large tropical mollusks in the fauna further suggests cool temperatures.

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REFERENCES

APPLEGATE, S. P. In press. The El Cien Formation, strata of Late Oligocene and Early Miocene age in Baja California Sur. *Univ. Nal. Autón. México, Inst. Geol., Revista*, **6.**

——and WILSON, E. C. 1976. Correlation of Upper Oligocene or Lower Miocene sections at San Telmo Point and Arroyo Guadalupe, Baja California Sur, Mexico, and a possible new phosphate source. *Latinoamericano Congreso de Geologica III, Resumenes*, Mexico, p. 6.

BASILE, L. L., CUFFEY, R. J. and KOSICH, D. F. 1984. Sclerosponges, pharetronids, and sphinctozoans (relict cryptic hard-bodied Porifera) in the modern reefs of Enewetak Atoll. *J. Paleont.* **58,** 636–650.

DURHAM, J. W. 1950. Megascopic paleontology and marine stratigraphy. *Mem. Geol. Soc. Am.* **43,** 1–216.

FAGERSTROM, J. A. 1984. The paleobiology of sclerosponges, stromatoporoids, chaetetids, archaeocyathids and non-spicular calcareous sponges. Introduction. *Palaeontogr. Am.* **54,** 303–304.

FISCHER, J. C. 1970. Revision et essai de classification des Chaetetida (Cnidaria) post-Paleozoiques. *Ann. Paleont.* **56,** 151–220.

GASTIL, G., KRUMMENACHER, D. and MINCH, J. 1979. The record of Cenozoic volcanism around the Gulf of California. *Bull. Geol. Soc. Am.* **90,** 839–857.

HARTMAN, W. D. and GOREAU, T. F. 1966. *Ceratoporella*, a living sponge with stromatoporoid affinities. *Am. Zool.* **6,** 563–564.

——1970. Jamaican coralline sponges: their morphology, ecology and fossil relatives. *Symp. zool. Soc. Lond.* **25,** 205–243.

——1972. *Ceratoporella* (Porifera: Sclerospongiae) and the chaetetid 'corals'. *Trans. Conn. Acad. Arts Sci.* **44,** 133–148.

——1975. A Pacific tabulate sponge, living representative of a new order of sclerosponges. *Postilla*, **167,** 1–14.

HAUSBACK, B. P. 1984. Cenozoic volcanic and tectonic evolution of Baja California Sur, Mexico. *In* FRIZZELL, V. A. (ed.). Geology of the Baja California peninsula. *Pac. Sec., Soc. Econ. Paleont. Mineralog.* **39,** 219–236.

HICKSON, S. J. 1911. On *Ceratopora*, the type of a new family of Alcyonaria. *Proc. R. Soc.* **B84,** 195–200.

HILL, D. 1981. Rugosa and Tabulata. *In* MOORE, R. C. (ed.). *Treatise on Invertebrate Paleontology. Part F. Coelenterata*, F1–762. Geological Society of America and University of Kansas Press, Boulder, Colorado and Lawrence, Kansas.

LAUBENFELS, M. W. DE. 1955. Porifera. *In* MOORE, R. C. (ed.). *Treatise on Invertebrate Paleontology. Part E. Archaeocyatha and Porifera*, E21–122. Geological Society of America and University of Kansas Press, Boulder, Colorado and Lawrence, Kansas.

MCFALL, C. C. 1968. Reconnaissance geology of the Concepcion Bay area, Baja California, Mexico. *Stanford Univ. Pub. Geol. Sci.* **10,** 1–25.

MORI, K. 1976. A new recent sclerosponge from Ngargol, Palau Islands and its fossil relatives. *Sci. Rep. Tôhoku Univ.* 2 (Geol.), **46,** 1–9.

SHELDON, R. P. 1982. Phosphate rock. *Sci. Am.* **246,** 45–51.

SIESSER, W. G. 1977. Upper Eocene age of marine sediments at Bogenfels, South West Africa, based on calcareous nannofossils. *S. W. Afr. Geol. Surv. Bull.* **60,** 73–74.

STEARN, C. W. 1984. Growth forms and macrostructural elements of the coralline sponges. *Palaeontogr. Am.* **54,** 315–325.

VANDERHOOF, V. L. 1942. Occurrence of the Tertiary marine mammal *Cornwallius* in Lower California. *Am. J. Sci.* **240,** 298–301.

WEISSERMEL, W. 1913. Tabulaten und Hydrozoen. *Beit. geol. Erforsch. dt. Schutzgeb.* **5,** 84–111.

——1926. Neues uber Tabulaten, Hydrozoen und eine Hexakoralle aus dem Tertiar der Bogenfelser Diamantenfelder. *In* KAISER, H. *Die Diamantenwuste Sudwest-Afrikas*, **2,** 88–106. Berlin.

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