Wise, S. W., Jr., Schlich, R., et al., 1992
Proceedings of the Ocean Drilling Program, Scientific Results, Vol. 120

43. SILICEOUS SPONGE SPICULES FROM SITE 748[1]

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ABSTRACT

Siliceous sponge spicules are present and often diverse in sediments drilled by Ocean Drilling Program Leg 120. The sponge spicule assemblages are tabulated for Holes 748A and 748B. Neogene assemblages consist mostly of monaxons, whereas chelae, amphidiscs, discorhabds, polyaxons, and other spicule morphologies are often abundant in middle Eocene to upper Oligocene sediments.

INTRODUCTION

Diverse assemblages of siliceous sponge spicules were found in cores from Ocean Drilling Program (ODP) Sites 747A, 748A, 748B, 749B, and 751A on the Kerguelen Plateau (Fig. 1) while the sediment samples were being examined for silicoflagellates (McCartney and Harwood, this volume). The Neogene assemblages are dominated by monaxons, with other spicule morphologies representing only a minor fraction of the total abundance. Spicules are exceptionally diverse in Paleogene sediments at each site. The abundance and diversity of sponge spicules at Site 748 are representative of the sites examined for silicoflagellates and are tabulated in this study (Table 1).

Previous examinations of sponge spicules from Deep Sea Drilling Project (DSDP) Leg 93 and ODP Leg 113 (McCartney, 1987, 1990) allow for some general comparisons. There are many similarities among the spicules of the three studies, but those found in cores from Site 748 were more abundant and diverse. Non-monaxon spicules were especially abundant at Site 748, and absolute rather than relative counts are used in this study. Spicule morphologies that were rare or absent in earlier studies were found at Site 748; these include discorhabds and isochelae with spines or similar terminations.

Sponge spicules have received little attention in the paleontologic literature (see McCartney, 1990, for a list of previous studies associated with DSDP and ODP drilling). The scarcity of studies on sponge spicules is not because of a lack of spicules, as spicules are often abundant in marine sediments, but rather a result of our inability to make any biostratigraphic or paleoenvironmental interpretations. A single sponge can possess a wide variety of spicule morphologies so that taxonomic distinctions based upon isolated spicules are extremely difficult. Nevertheless, as we learn more about the environmental conditions under which sponges occur, their spicules may someday offer insight into bottom-water conditions such as water depth, clarity, or velocity. For this reason, the continued description of spicule assemblages is encouraged.

METHODS

Sediments examined in this study are from the same samples used in diatom investigations (Harwood and Maruyama, this volume). Raw samples were prepared as smear slides when diatoms represented more than 50% of the microfossils. Lower diatom abundances required chemical treatment with H_2O_2 and HCl to concentrate the siliceous fossils. Strewn slides with a 22 × 50 mm cover slip were then prepared.

In previous studies (McCartney, 1987, 1990), sponge spicules were scarce or were dominated by one or two morphologies. In these studies, the entire slide was examined, and spicule occurrences were shown as relative abundances. The exceptional abundance and diversity of sponge spicules in sediments of Leg 120, however, allowed us to make more accurate counts. Absolute counts were obtained from six traverses across the length of the cover slip, or approximately half the slide, using a magnification of 100×. The number of silicoflagellates counted over the six traverses varied from 0 to 346.

SITE SUMMARY

Site 748 (58°26.45′S, 78°58.89′E; water depth, 1290 m) was drilled on the Southern Kerguelen Plateau in the eastern part of the Raggatt Basin, east of Banzare Bank (see Fig. 1). The location of the site was chosen to provide an expanded section of Paleogene and Cretaceous sediments that would provide more knowledge about the geological history of this portion of the Kerguelen Plateau. Sponge spicules were most abundant in lithologic Subunit IIA (13.3–180.6 mbsf), which is an upper Miocene to middle Eocene nannofossil ooze with biosiliceous intervals. Sponge spicules are not particularly abundant and consist almost exclusively of monaxon morphologies in the Neogene, but abundance and diversity increase considerably in upper Oligocene to middle Eocene sediments. Paleogene sediments often include unusually abundant discorhabd, cheloid, and hexactinellid spicules.

SPONGE SPICULES

The sponge spicule systematics used in this study are descriptive rather than taxonomic, following the usage of McCartney (1990).

Monaxons

Diactinal (monaxons with similar ends)

Oxeas (pointed at both ends): Oxeas were very abundant throughout most of Hole 748B; in fact, they make up the majority of sponge spicules in most samples. The length and thickness of the oxeas are highly variable. Approximately one fourth of the oxeas have an

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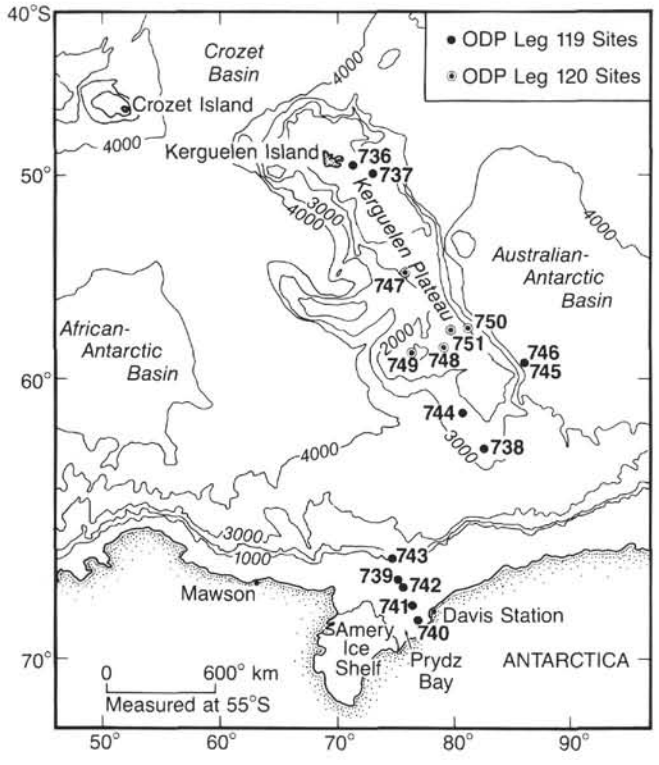

Figure 1. Location map of sites drilled during Leg 120.

observable axial canal. Acanthoxeas were very rare and are tabulated with the oxeas.

Toxons (bow-shaped; Plate 1, Fig. 5): Toxons occur with an abundance approximately one fourth of that of co-occurring oxeas.

Strongyles (rounded at both ends): Strongyles, when found, were few in number. Specimens show considerable variability in length and width.

Acanthostrongyles (strongyles with short spines radiating from the surface): Acanthostrongyles occur sparsely and are generally similar in size and appearance to the form illustrated by McCartney (1987, pl. 2, fig. 4).

Monactinal (monaxons rounded at one end and pointed at the other)

Styles (pointed at one end and no change in thickness at rounded end): Styles were less abundant than oxeas and acanthostyles.

Acanthostyles (styles with spinose surfaces): Acanthostyles were the second most abundant of the monaxon spicules, and variations in their abundance appear to fluctuate with that of oxeas. Acanthostyles and styles are of similar size.

Tylostyles (pointed at one end with a knob at the rounded end; Plate 1, Fig. 8): Tylostyles were uncommon in most samples. Acanthotylostyles were rare and are tabulated with the tylostyles.

Triaxons (Spicules with Three Axes)

Triacts (spicules with three rays): Triacts occurred frequently from the middle Eocene to upper Oligocene of Hole 748B.

Hexacts (six rays nearly perpendicular to each other): Hexactins are abundant in middle Eocene to upper Oligocene sediments.

Pentacts (spicules with four similar rays): Only eight pentacts were found.

Pinnules (pentacts with long spines on the dissimilar ray): Two specimens were found in Core 120-748B-18H.

Tetraxons (Spicules with Four Axes)

Calthrops (four tetrahedral rays of equal size radiating from a point): Calthrops are common in Eocene and lower Oligocene sediments from Hole 748B.

Triaenes (one ray different from three other similar rays). Triaenes (see Ivanik, 1983, pl. 5, fig. 3) occurred rarely in the lower Oligocene, lower Miocene, and middle and upper Eocene of Hole 748B.

Dichotriaenes (triradial symmetry with forked rays): Dichotriaenes were found in middle Eocene to lower Oligocene sediments. See McCartney (1990, pl. 2, figs. 5 and 7) for similar specimens.

Polyaxons (Many Equal-sized Rays)

Spherasters (spicules with many points radiating from a globular center): Spherasters were very rare except in Sample 120-748B-17H-2, 47–48 cm, in which there was considerable variation in size.

Oxyasters (spicules with many spines radiating from a center point; Plate 1, Fig. 10): Oxyasters occurred rarely.

Amphiasters: Amphiasters (similar to Locker and Martini, 1986, pl. 13, fig. 5) were sparse in the middle Eocene through the early Oligocene.

Sigmas (Spicules Shaped Like the Letters C or S)

Sigmas were found to occur mostly in middle Eocene sediments. Sigmas were exclusively of the C-shaped (see Bukry, 1978, pl. 11, fig. 5) and hooked (Plate 1, Fig. 8) type; these are tabulated together. No S-shaped sigmas were found.

Miscellaneous

Forceps (tong-shaped spicules): Forceps (similar to McCartney, 1987, pl. 8, figs. 6–7; see also Sollas, 1906, p. 222, fig. 109p) occur sparsely throughout Hole 748B.

Isochelae (C-shaped spicules with terminal elaborations; Plate 1, Fig. 1): Isochelae are abundant in middle Eocene to lower Oligocene sediments.

Asteroid isochelae (isochela with spines radiating from an expanded area in the center of the spicule; Plate 1, Fig. 2): These unusual isochelae occur sparsely in the middle Eocene of Hole 748B.

Anisochelae (isochela with dissimilar ends; Plate 1, Fig. 7): Three anisochelae were found in Sample 120-748B-18H-2, 47–48 cm.

Diancistrons (C-shaped spicules with an inner margin narrowing to a blade point): Diancistrons (similar to Hartman, 1982, figs. 16–19e) were sparse throughout Hole 748B. No more than four were observed in any sample. The two ends of some specimens were rotated with respect to one another (see Bukry, 1978, pl. 6, fig. 11).

Discorhabds (Plate 1, Figs. 3–4 and 8): This unusual spicule was abundant in Paleogene samples and showed considerable variability. Figure 8 (in Plate 1) illustrates an unusual discorhabd that was found only in Core 120-748B-18H. A discorhabd morphology common throughout the middle Eocene is illustrated in Figure 8 of Plate 1 (see also Bukry, 1979, pl. 6, figs. 12–15).

Gemmules: Three gemmules (similar to Hartman, 1982, figs. 16–19d) were found in Sample 120-748B-13H-2, 47–48 cm. Specimens were bar-shaped with two opposing rows of barb-shaped spines.

Frameworks (connected rods that form a netlike lattice): Frameworks were found in Samples 120-748B-14H-2, 47–48 cm, -15H-5, 47–48 cm, and -17H-2, 47–48 cm. See McCartney (1990, pl. 1, fig. 6) for an illustration.

Table 1. Abundances of siliceous sponge spicules from Holes 748A and 748B.

Age	Core, section, interval (cm)	Depth (mbsf)	Oxeas	Toxons	Strongyles	Acanthostrongyles	Styles	Acanthostyles	Tylostyles	Triacts	Hexactines	Pentacts	Pinnules	Calthrops	Triaenes	Dichotriaenes	Spherasters	Oxyasters	Amphiasters	Sigmas	Forceps	Isochelae	Asteroid isochelae	Anisochelae	Discorhabds	Diancistrons	Gemmules	Frameworks	Total
	Hole 748A																												
late Pliocene	1H-2, 47-48	2.0	9					1	3											6									19
	1H-4, 47-48	5.0				B	A	R	R	E	N																		0
	1H-6, 47-48	9.5	2																										2
early Pliocene	2H-2, 47-48	11.5	3																										3
late	2H-4, 47-48	14.5	3																	1									4
Miocene	2H-6, 47-48	17.5						1	1																				2
	Hole 748B																												
late Pliocene	2H-4, 47-48	6.6				B	A	R	R	E	N																		0
late	3H-4, 47-48	14.6					5	4												8									17
Miocene	4H-4, 47-48	24.1				1		1																					2
middle Miocene	5H-4, 47-48	33.6	2					2																					4
early	7H-4, 47-48	52.6	12					5																					17
Miocene	8H-2, 47-48	59.1	10	4	2		2	10							1														29
	9H-4, 47-48	71.6	8		1			1			1														1				12
late Oligocene	10H-4, 47-48	81.1	32	7	2	1		11	1		1						2												57
	11H-4, 47-48	90.6	40	12	4		1	11	1			1								11		2			2				85
	12H-4, 47-48	100.1	56	13	7		11	18	8	10	17	4		4	6	1	2		2	11	2	15			8				195
early	13H-2, 47-48	106.6	48	15	5		10	10	2	4	7	1	1	3		1						1			1		3		112
Oligocene	**13H-5, 47-48**	111.1	69	33	6	1	2	8	4	1	7		1			2						4							138
	14H-2, 47-48	116.1	54	20	6		15	24	7	3	10			8		7				1		9			4			2	170
	14H-5, 47-48	120.6	41	1	2		6	31	5	2	6			16		12			1	1		6			12				142
	15H-2, 47-48	125.6	53	11	5		26	20	5	8	14			2	1	10			1	1		2			5				164
late	15H-5, 47-48	130.5	50	12	18	5	20	62	19	10	6			3			1			4		5			7			4	226
Eocene	16H-2, 47-48	135.1	1				3		1																				5
	16H-5, 47-48	139.6	17	4	9	1	15	32	7	8	5			4		4	2		2			2			14				126
	17H-2, 47-48	144.6	59	14	7	2	23	84	15	3	30			14		5	6		1	7	2	32			27			7	338
	17H-5, 47-48	149.1	46	18	6	6	15	30	2	6	8			16		3	3			1	2		1		12				175
	18H-2, 47-48	154.1	106	36	9		9	64	12	7	3			16		11	2		3	4		31	4	3	26	3			349
	18H-5, 47-48	158.6	507	32	20	2	29	153	29	7	30	3		36	1	14	9	1	12	13		65	21	8	40	11			1043
middle	19H-2, 47-48	163.6			11		20	65	16	8	7	1		17		5	3		2	11	1	27	2		20	6			222
Eocene	19H-5, 47-48	168.1			20		21	58	11	6	7			14		3	1		4	22	3	32	1		11	4			218
	20H-2, 47-48	173.1			15		16	43	2	2	13			5	6	8	2		3	1			2		22				140
	20H-5, 47-48	177.6															1												1
	22X-2, 47-48	182.6				B	A	R	R	E	N																		0
	22X-4, 47-48	185.6				B	A	R	R	E	N																		0

ACKNOWLEDGMENTS

We thank T. and D. Kellogg for encouragement and use of laboratory facilities and USSAC for grant support to Dave Harwood for sample preparations. K. Graham, M. Karrer, D. S. Higgins, and W. L. Duncan provided essential technical assistance. This study is partly supported by a grant for professional development by the University of Maine at Presque Isle.

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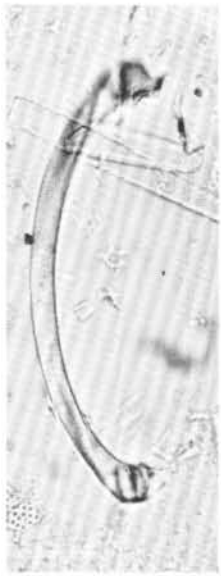
Date of initial receipt: 31 January 1990
Date of acceptance: 4 May 1990
Ms 120B-156



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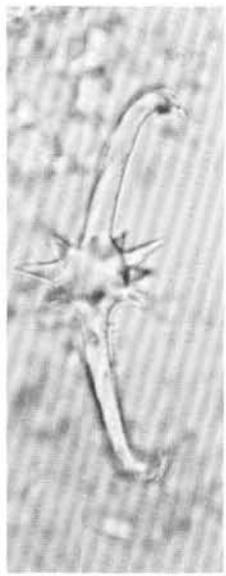

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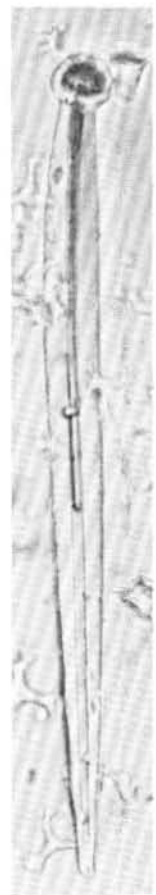

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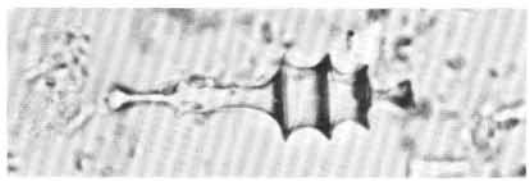

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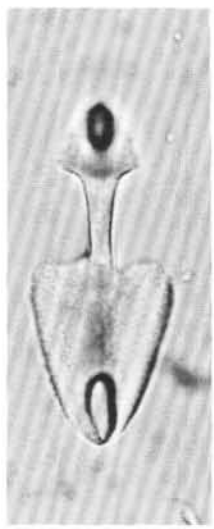

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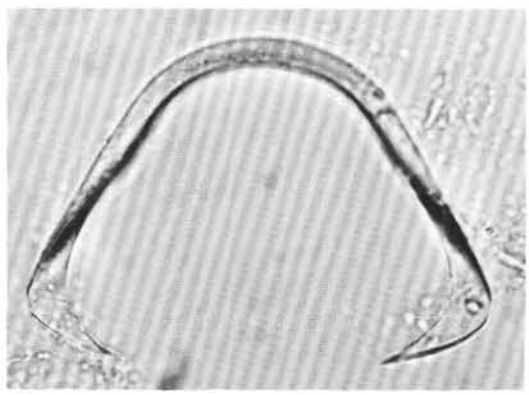

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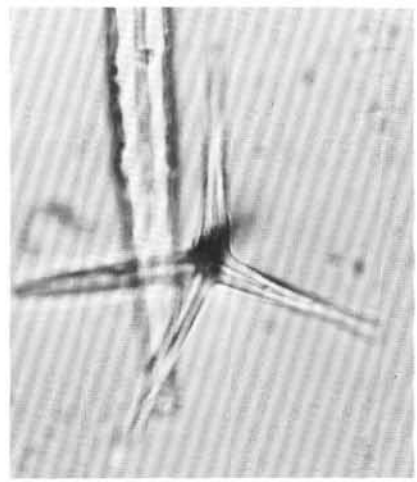

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Plate 1. Siliceous sponge spicules from Leg 120 (magnification 630×). **1.** Isochela; Sample 120-748B-12H-2, 47–48 cm. **2.** Asteroid isochela; Sample 120-748B-19H-2, 47–48 cm. **3–4.** Discorhabds; (3) Sample 120-748B-19H-2, 47–48 cm; (4) Sample 120-748B-18H-2, 47–48 cm. **5.** Toxon; Sample 120-748B-18H-2, 47–48 cm. **6.** Tylostyle; Sample 120-748B-19H-5, 47–48 cm. **7.** Anisochela; Sample 120-748B-18H-2, 47–48 cm. **8.** Discorhabd; Sample 120-748B-18H-2, 47–48 cm. **9.** Sigma; Sample 120-748B-20H-2, 47–48 cm. **10.** Oxyaster; Sample 120-748B-19H-2, 47–48 cm.