ABSTRACT

Siliceous sponge spicules are present in sediments drilled during Leg 127. The sponge spicule abundances are tabulated for Hole 795A. Pliocene and Pleistocene sponge spicules consist mostly of monaxons, sporadically intermixed with isochelae, polyaxons, and other spicule morphologies.

INTRODUCTION

Siliceous sponge spicules are commonly found in sediments obtained through deep-sea drilling (see McCartney, 1990, for a list of previous studies). Diverse assemblages of siliceous sponge spicules were found in cores from Ocean Drilling Program (ODP) Sites 794 through 797 from the Japan Sea while the sediment samples were being examined for diatoms (White and Alexandrovich, this volume). Sponge spicules fluctuate in abundance between rare and common at all of the sites but appear to be most common in the Hole 795A in lithologic Subunit 1B (Cores 127-795A-9H through 127-795A-13H), which is a bioturbated silty clay (White and Alexandrovich, this volume). Our present examination of sponge spicules is restricted to Site 795; however, we plan to do further investigation of sponge spicules at the other Japan Sea sites. The Pliocene and Pleistocene sponge spicules are dominated by monaxons, with other spicule morphologies representing only a fraction of the total abundance. The abundance and diversity of sponge spicules at Hole 795A are tabulated in this study (Table 1).

Previous examination of sponge spicules from Deep Sea Drilling Project (DSDP) Leg 93 and ODP Legs 113 and 120 (McCartney, 1987, 1990; Ahlbach and McCartney, in press) allow for some general comparisons. There are many similarities among the spicules of the four studies. In each case monaxons were most abundant with other morphologies making up a minor portion of the total spicule counts. The abundance and diversity of the spicules in Hole 795A were higher than those found for Legs 93 and 113, and the spicules were sufficiently abundant to allow for absolute, rather than relative, counts to be used.

Sponge spicules have received little attention in the paleontologic literature. This general lack of spicule study is not due to the lack of spicules but rather to our inability to make biostatigraphic or paleoenvironmental interpretations with them. There are some biostatigraphic interpretations of sponge spicules, but they are rather limited (Palmer, 1988). Nevertheless, as we learn more about the environmental conditions at which sponges occur, their spicules may offer insight into bottom water conditions such as water depth, clarity, or velocity. This article is intended to show the diversity of sponge spicules found in the Japan Sea in order to offer some comparison with other sponge spicule studies made from deep-sea samples.

METHODS

The samples were disaggregated in water and a solution of 10% H2O2 over low heat for approximately 10–20 min. After cooling, the liquid was decanted and additional water was added to resuspend the residue. Material was then pipetted from the top 1 mL of residue and strewn onto a cover slip. The cover slip was then mounted to a glass slide with Hyrax.

In some previous studies (McCartney, 1987, 1990) the spicules were neither abundant nor diverse and only relative counts were presented. The exceptional abundance and diversity of the sponge spicules in sediments of Leg 127 meant that many spicules could be observed without examining the entire slide, and absolute counts could be presented, as previously done by Ahlbach and McCartney (in press). The slides were examined under the light microscope using 100× magnification and 10 traverses were made across the length of the cover slip. Some of the slides were examined under 400× magnification because of the high abundances or small size of the spicules. Because the magnification and the number of traverses can affect the spicule counts, these are shown in Table 1.

It should be noted that the absolute counts can be biased as a result of difficulties in assigning the spicule morphology. For example, the positive identification of styles and strongs requires that both terminations be intact; in this study incomplete specimens were identified using the experience of the microscopist (Ryszard Zolnik), but these identifications are not certain. Thus, the absolute counts should be viewed as approximate. The counts given for styles also include some radiolarian fragments that were misidentified until after the study was complete (see following discussion).

SITE SUMMARY

Site 795 is located in the northern Japan Sea at the northernmost edge of the Japan Basin (Fig. 1). It was drilled in a water depth of 3298 m in a bathymetric embayment bounded by a steep escarpment (Shipboard Scientific Party, 1990). Two important objectives of Site 795 were to determine the age and nature of the basement rocks and to characterize the basin and oceanographic history of the northern Japan Basin.

The approximately 365 m of Pleistocene through middle Miocene sediment penetrated in Hole 795A consists of fine-grained hemipelagic diatomaceous and terrigenous sediments. In general, Pleistocene sediments consist of silty clay with minor amounts of diatomaceous ooze and clay. Pliocene sediments generally have a larger proportion of diatomaceous ooze, although, the diatom component shows significant fluctuations in abundance throughout the Pliocene (White and Alexandrovich, this volume).
Table 1. Abundances of siliceous sponge spicules from Hole 795A.

<table>
<thead>
<tr>
<th>Age</th>
<th>Core, section, interval (cm)</th>
<th>Depth (mbsf)</th>
<th>Magnification, traverses</th>
<th>Oxeas</th>
<th>Acanthostrongyles</th>
<th>Strongyles</th>
<th>Polystrongyles</th>
<th>Thoxeas</th>
<th>Triactinal</th>
<th>Cylindrical</th>
<th>Dihexal</th>
<th>Ambulacral</th>
<th>Forage</th>
<th>Cylindrical</th>
<th>Total</th>
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**TERMINOLOGY**

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

**Monaxons**

**Diactinal (Monaxons with Similar Ends)**

Oxeas (pointed at both ends): Oxeas were very abundant in Hole 795A and make up the majority of siliceous sponge spicules in most samples. The morphology of the oxeas was highly variable. No effort was made in this study to differentiate between various sizes and thicknesses, as was done by Ivanik (1983). Many of the oxeas have an observable axial canal.

Acanthoxeas (spine oxeas): Acanthoxeas are relatively common but not as morphologically diverse as co-occurring oxeas. The acanthoxeas generally have a straight rather than bow-shaped morphology with a readily visible axial canal (see McCartney, 1987, pl. 2, fig. 2).

Toxons (bow-shaped): Toxons varied considerably in size and shape. Observed specimens were generally similar to those illustrated by Hartman (1982, fig. 16-16, c, d, and f) and Ahlbach and McCartney (in press, pl. 1, fig. 5).

Strongyles (rounded at both ends): Strongyles were abundant and showed considerable variability in length and width. Specimens with slightly knobbed terminations were counted as strongyles. Broken specimens were classified as strongyles if the sides of the specimens were parallel with no evidence that they were converging.

Acanthostongyles (strongyles with short spines radiating from the surface): Acanthostongyles tended to be less abundant than other diactinal sponge spicules. A specimen typical of ones found in this study is illustrated by Bukry (1979, pl. 7, fig. 20).

**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 acanthostongyles; this was also found by Ahlbach and McCartney (in press). The counts listed here include some radiolarian fragments that were misidentified as sponge spicules (see "Serrated Spines," McCartney, 1987, p. 815). Acanthostongyles (styles with short spines radiating from the surface): Acanthostongyles tended to be more abundant than co-occurring acanthoxeas and showed considerable diversity in size. Similar specimens have been illustrated by McCartney (1987, Pl. 2, fig. 8) and Hartman (1982, fig. 16-14, c and f).
Tylostyles (pointed at one end and knobbed at the rounded end): Observed specimens were similar to those illustrated by McCartney (1987, pl. 2, fig. 7).

**Triaxons and Tetraxons**

Triacts (spicules with three rays): Triacts occurred infrequently but consistently throughout the observed samples. Calthrops (four tetrahedral rays of equal size radiating from a point): Calthrops were found infrequently. Hartman (1982, fig. 16-15, h) illustrated a specimen similar to those found in this study.

**Polyaxons (Many Equal-sized Rays)**

Spherasters (spicules with many spines radiating from a single point): Spherasters were uncommon in samples from Hole 795A. There was considerable variation in size. See McCartney (1987, pl. 4, fig. 9) for an illustrated specimen similar to the spherasters found in this study.

Spiraster (spicules with spines that radiate from the ends of a short axis, with other spines at the midpoint of the axis): A single specimen was found in Sample 127-795A-9H-1, 120-121 cm. See Bukry (1980, pl. 9, fig. 10) for a similar specimen.

**Sigmas (Spicules Shaped like the Letter “C”)**

Sigmas were exclusively of the C-shaped morphology; however, there was some variation in size and shape. The terminations were generally similar and pointed toward one another (see Bukry, 1978, pl. 11, fig. 5; McCartney, 1987, pl. 5, figs. 1 and 5). In some cases, the terminations were not in the same plane (see McCartney, 1987, pl. 5, fig. 2, for an example). Sigmas in which the terminations curved inward (see Bukry, 1980, pl. 9, fig. 7) were not found.

**Miscellaneous**

Forceps (tongs-shaped spicules): Forceps (similar to Bukry, 1979, pl. 8, figs. 13, 14) occur sparsely in Hole 795A, especially in the lower Pliocene. Their size was very small, and most observed forceps were found under 400× magnification.

Isochelae (C-shaped spicules with terminal elaborations): Isochelae were found infrequently in the Pliocene, with two specimens found in the Pleistocene. McCartney (1987, 1990) illustrated similar specimens.

Anisochela: A single specimen was found in Sample 127-795A-30X-1, 120-121 cm. A similar specimen was illustrated by Ahlbach and McCartney (in press, pl. 1, fig. 7). The specimens were tabulated together with other chelae.

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