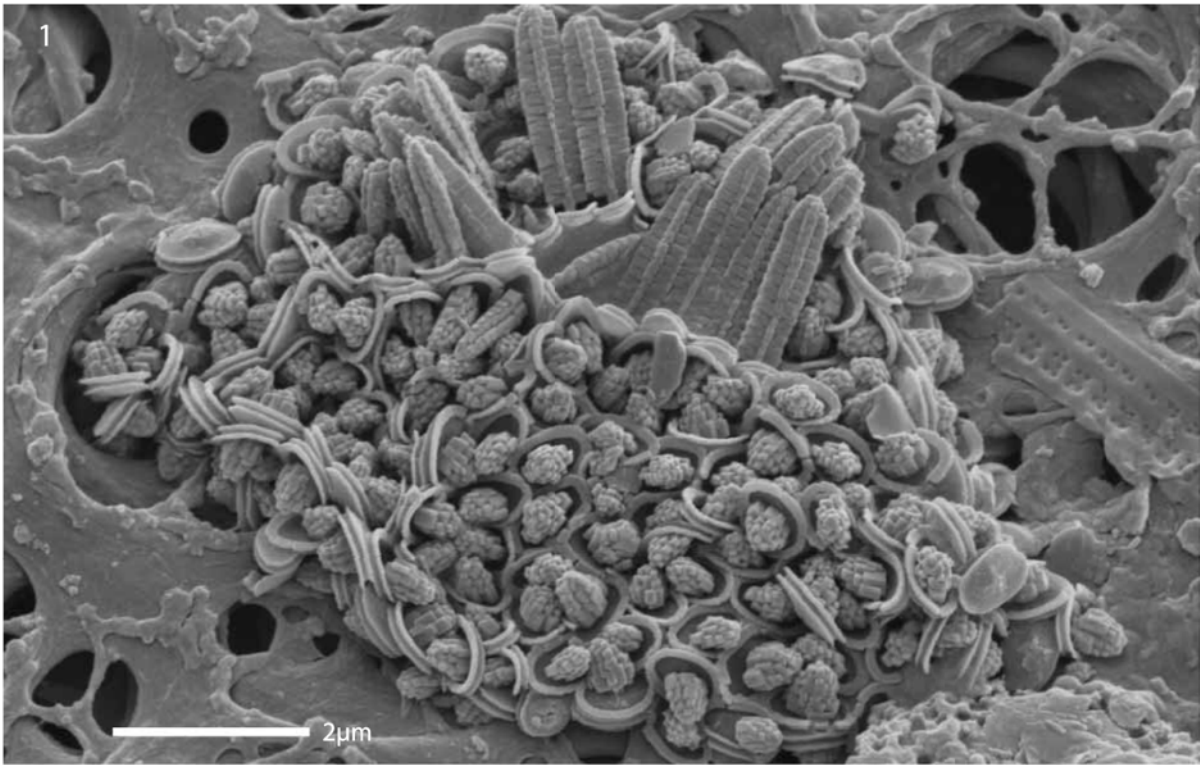
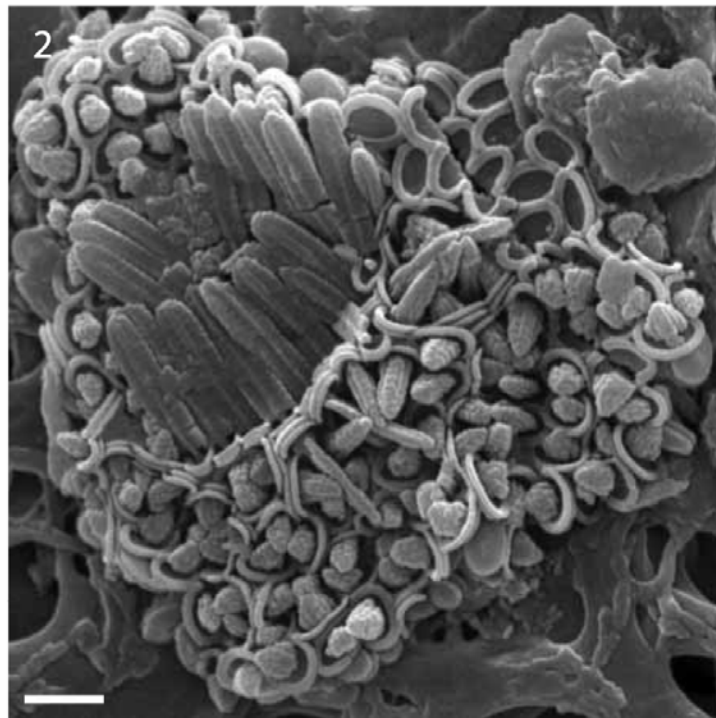
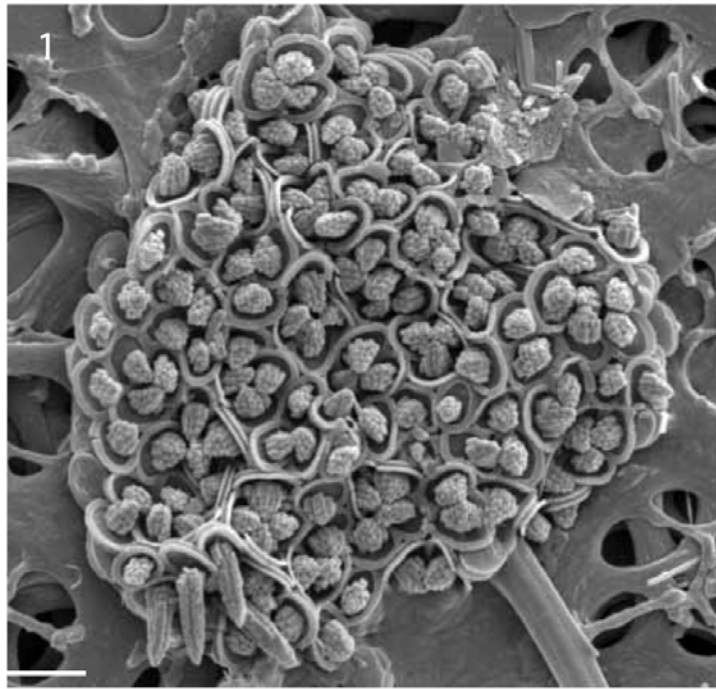


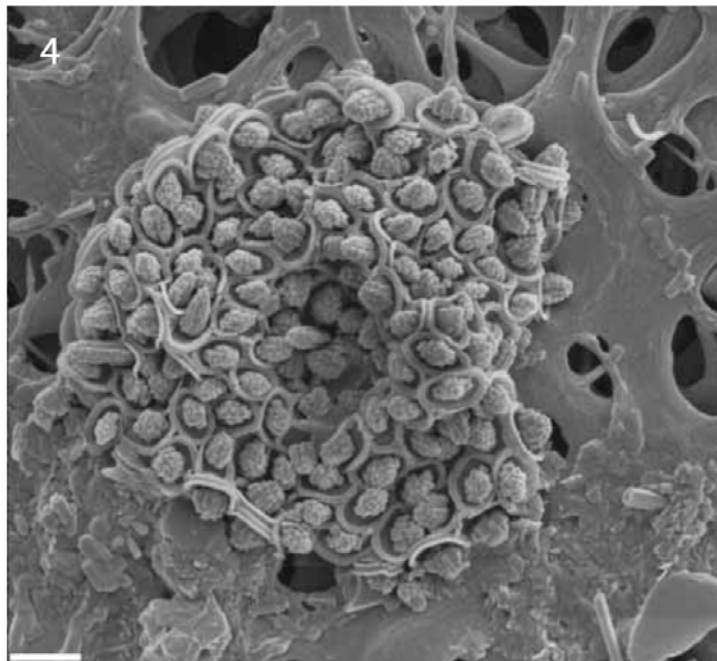
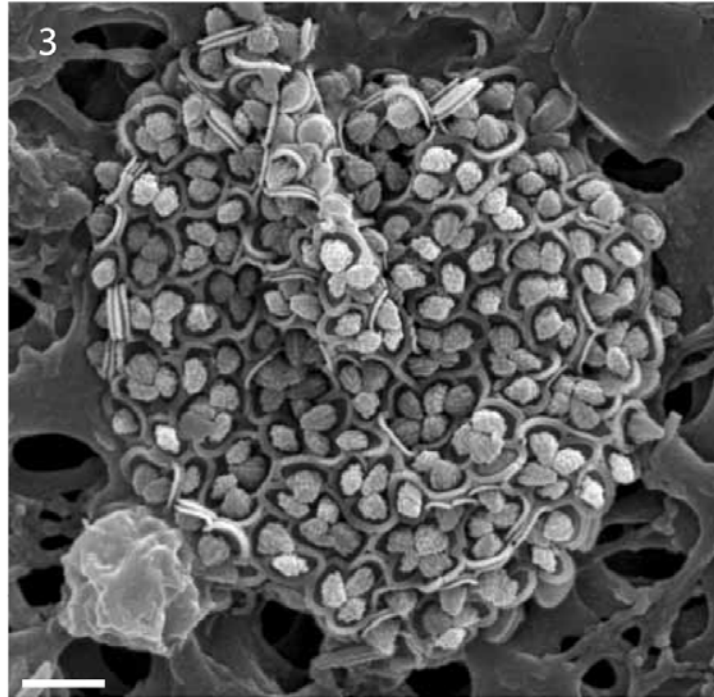
148. *Navilithus altivelum* Young & Andruleit (2006)

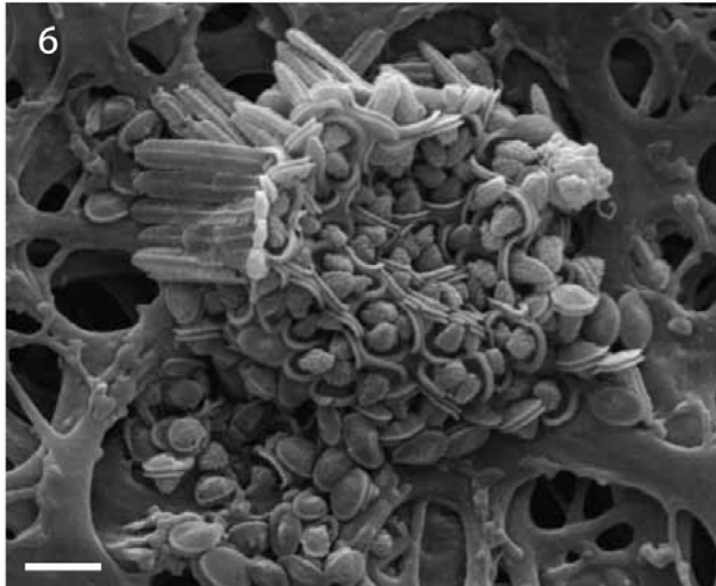
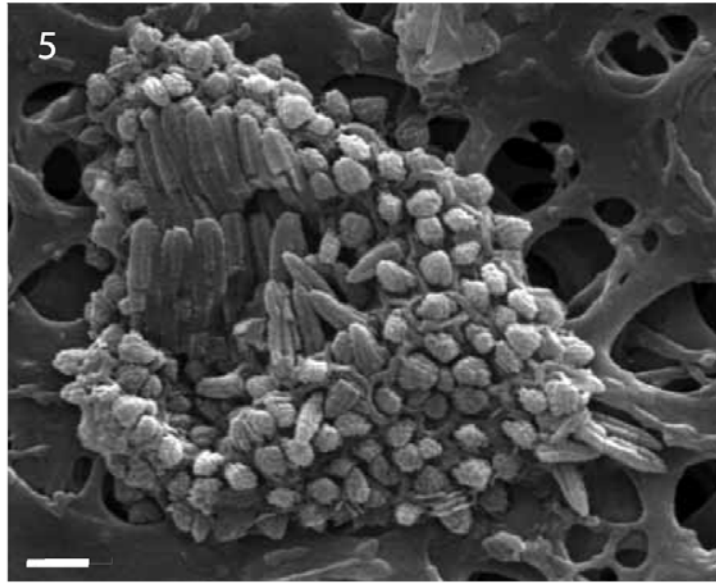


For Pl. 1, the original pictures are too large to be scaled to 1.25x original size, so they are scaled at 1.0x original size.

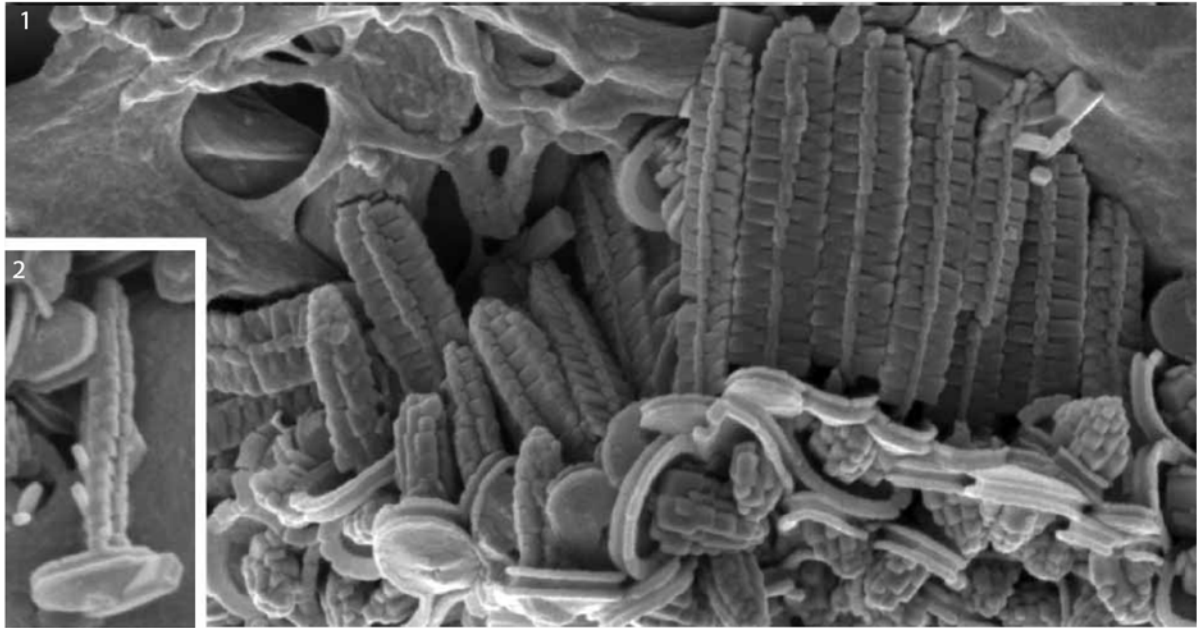
Pl. 1, figs 1, 2



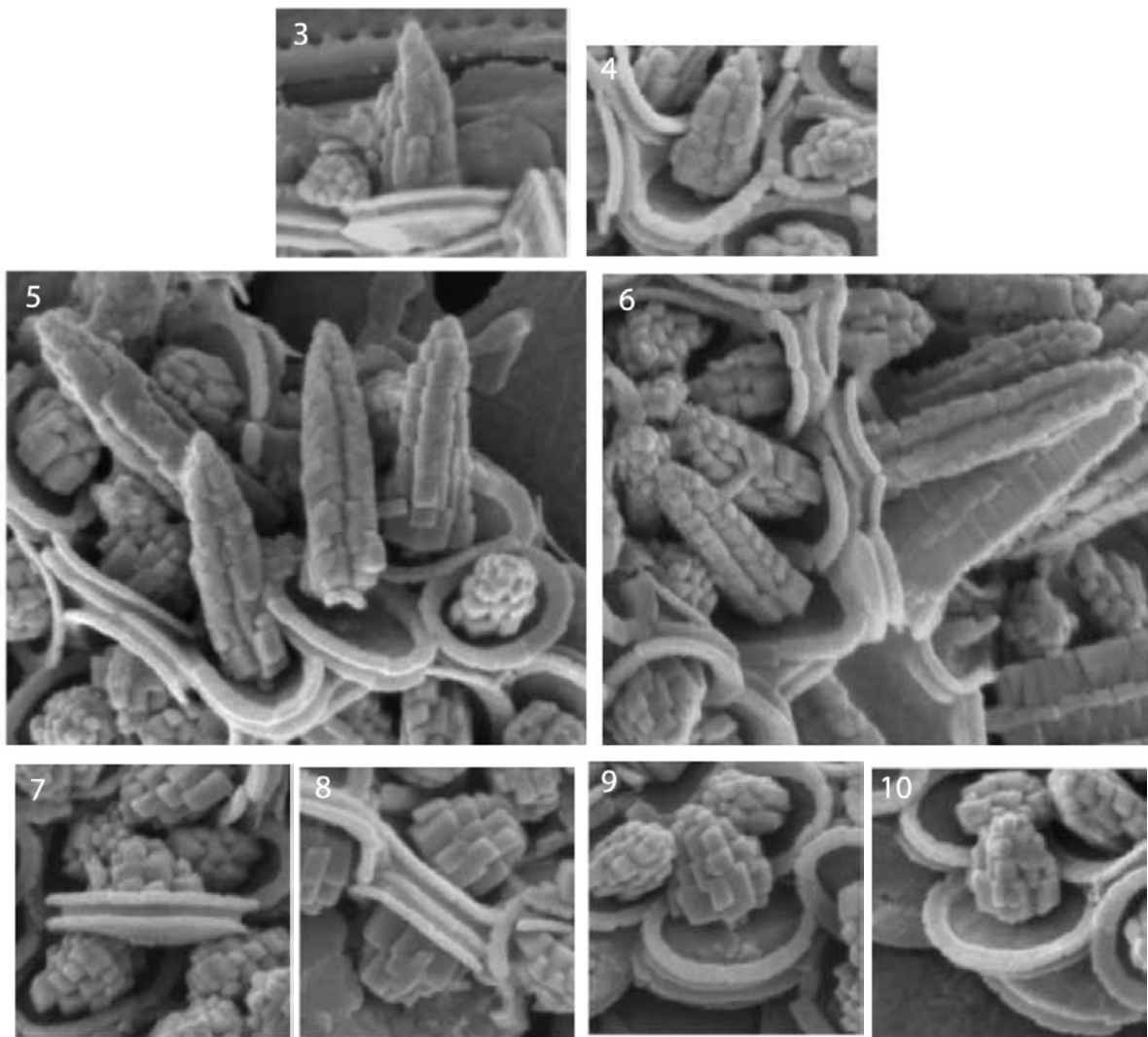


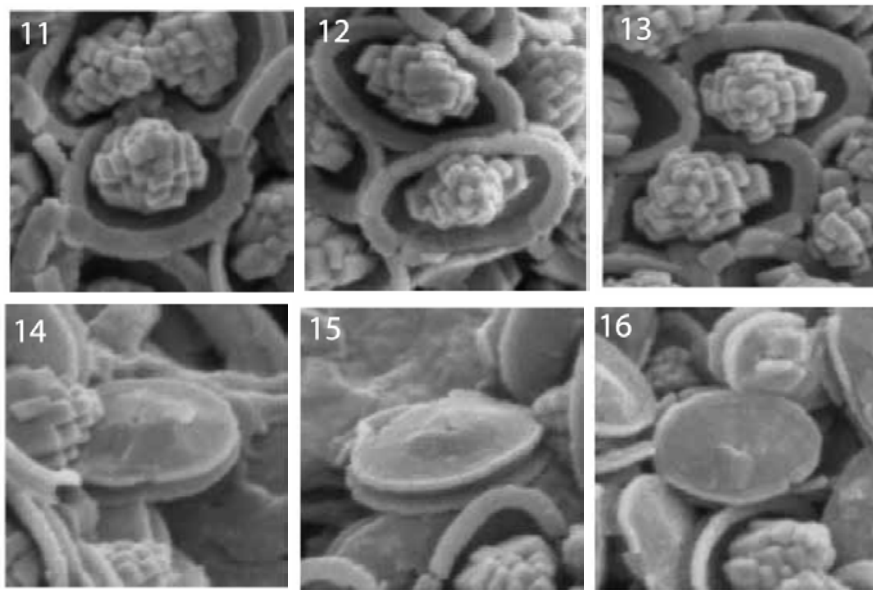


Pl. 2, figs 1-6



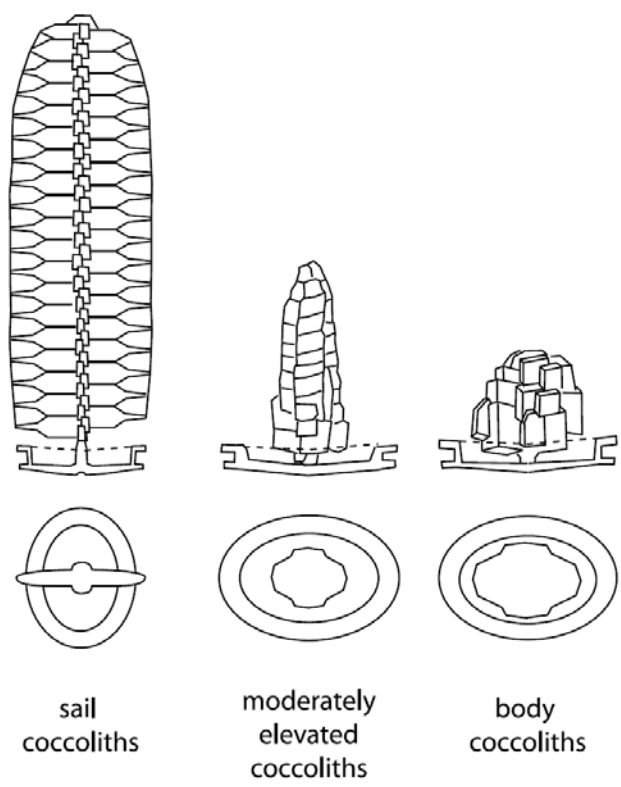
For Figs. 1 & 2, the original pictures are too large to be scaled to 1.25x original size, so they are scaled at 1.0x original size.





1 micron

Scale Bar applicable to figs 3-16 only  
Pl. 3, figs 1-16



**Fig. 3.** Summary drawings of the three *Navilithus altivelum* coccolith morphologies: circum-flagellar sail coccoliths, body coccoliths and moderately elevated coccoliths (plan and side views). The plan views and the side view of the sail coccolith are schematic, based on numerous observations, the other side views are tracings of SEMs.

fig. 3

**Derivatio nominis:** From the Latin *altus* (high) and *velum* (sail) reflecting the distinctive sail-like form of the spines of the circum-flagellar coccoliths. Note that since this a noun, not an adjective, its case should not be changed to agree with that of the genus.

**Diagnosis:** *Species Navilithus cum coccosphaera composita ex circa 200–300 corporis coccolithis cum spinis humilibus triangularibus, 10–20 coccolithis cum spinis altis ad instar veli navis et cum numero variabili coccolithorum cum spinis altis triangularibus.*

Species of *Navilithus* with coccosphere composed of *c.* 200– 300 body coccoliths with low triangular spines, 10–20 coccoliths with tall sail-like spines and a variable number of coccoliths with tall triangular spines.

**Type specimen:** Specimen illustrated in NHM SEMs JRY205-21, 22 (Pl. 1, figs 1–2; Pl. 3, figs 6, 7, 9, 13, 14, 15; Pl. 4, figs 3, 4). This specimen is located on NHM coccolithophore collection SEM stub 483.

**Type sample:** So139-95MS, 114 m, collected from NE Indian Ocean, Latitude 6.57°S 104.90°E, 25 February 1999 by BGR.

**Type depository:** Type images and stub are archived in the Natural History Museum, Micropalaeontology Division; topotype material is archived in the BGR (Bundesanstalt für Geowissenschaften und Rohstoffe) coccolithophore collection.

**Description – Coccospheres.** All observed coccospheres (Pls 1, 2) are collapsed so the original shape cannot be determined with certainty; however, these scatters have length to width ratios of 1.5 to 1.0, average 1.15 (30 measurements) so it is reasonable to infer that the original coccospheres were sub-spherical in shape. The collapsed coccospheres are 5 to 11  $\mu\text{m}$  across, average 7.8  $\mu\text{m}$ , suggesting an original coccosphere diameter of *c.* 5–8  $\mu\text{m}$ , assuming some of the variation is due to variable degree of scatter of coccoliths during collapse of the coccospheres. The coccospheres are trimorphic with body coccoliths, moderately elevated coccoliths and sail coccoliths (Pl. 3).

The number of body coccoliths observed range from 100 to 170 (counts on seven specimens, including the largest and smallest observed coccospheres). This suggests that the coccospheres contain 200–300 body coccoliths, on the assumption that about half the coccoliths are visible on a collapsed coccosphere. Tall sail-coccoliths are always clustered together on the coccosphere but the number observed is highly variable, from 18 to 0 (average 7.6, 30 counts). This variation is interpreted as being largely due to variable orientation of collapse of the coccospheres, with minimum values when the sail-like coccoliths are on the concealed side of the coccosphere and maximum values when they are all visible. The typical number of sail coccoliths per coccosphere is thus likely to be about 15. The number of moderately elevated coccoliths observed is highly variable, from 0 to 22 (average 4.1, 30 counts). They mostly occur around the outside of the group of sail-coccoliths but there are also often a few of these coccoliths well-

separated from the circum-flagellar area and in at least some cases they appear to form a cluster of antapical coccoliths.

On the collapsed coccospheres, fields of coccoliths seen in proximal view are normally very obscured. This is probably a result of the cell membrane and other organics from the cell coating the coccoliths. No evidence of flagella was seen, but this is not necessarily significant, since they are only occasionally visible in SEMs of coccolithophores.

**Description – Body coccoliths (Pl. 3, figs 7–16).** These are elliptical in plan view with narrow placolith rim formed of sub-horizontal distal and proximal shields connected by a low tube. The coccolith is floored by a central area plate which supports a low robust spine. Length 0.7–1.0  $\mu\text{m}$  (average 0.86  $\mu\text{m}$ , from 55 measurements). Width 0.5–0.7  $\mu\text{m}$  (average 0.67  $\mu\text{m}$ , from 28 measurements).

The rim is narrow (0.08–0.12  $\mu\text{m}$ ). Elements in the distal shield are not usually imaged clearly but there seem to be 15–20. Sutures are sub-radial, with weak clockwise obliquity; the elements do not appear to be imbricated. The tube is narrow, height (0.09–0.15  $\mu\text{m}$ ) approximately equal to the distal shield width. The proximal shield is similar in width to the distal shield or slightly narrower. Both shields are essentially horizontal. The central area plate is not imaged clearly in any specimens, possibly because of an organic coating, but appears to be composed of numerous irregular elements, often with a small central pore. The proximal surface of the coccolith is convex, i.e. curves toward the cell. This morphology is unusual, as coccoliths normally have concave bases, but it occurs in too many specimens for it to be a result of deformation.

The spine is low (0.4–0.7  $\mu\text{m}$ ), triangular in profile. It is attached to the central area plate by a very narrow basal stem. Above this it immediately widens to its maximum width then tapers upward. It is formed of numerous rhombic, vertically elongated elements arranged in irregular tiers, the lowermost tier is higher than the others. The elements show flat rhombic faces and are probably modified calcite rhombohedra. In plan view the spine is approximately diamond-shaped, aligned parallel to the axes of the coccolith.

**Description – Moderately elevated coccoliths (Pl. 3, figs 3–6).** These are similar to the body coccoliths but have higher spines (0.7–1.4  $\mu\text{m}$ ). The spines have similar structure to those of the body coccoliths, including the presence of a basal cycle of relatively tall elements and attachment by a basal stem. They are diamond-shaped in plan view and elongated parallel to the long axis of the coccolith. The spine structure becomes more regular upwards and cross-shaped in plan view. The basal structure appears to be identical to that of the body coccoliths.

**Description – Circum-flagellar sail-coccoliths (Pl. 3, figs 1–2).** These have similar bases to the other coccoliths but the spine is much taller (1.3–2.2  $\mu\text{m}$ , average 1.84  $\mu\text{m}$ , from 15



measurements) and is flattened perpendicular to the long axis of the coccolith. The spine is cross-shaped in plan view but the arms extending parallel to the long axis are very short. The basal stem of the spine is rather higher than in the other coccolith types so that the base of the sail is elevated slightly above the rim. The spine structure is regular, with each blade of the sail being formed of two series of elements originating from either side of the blade and interfingering toward the outer margin of the sail (Fig. 3).

The basal structure is similar to that of the body coccoliths but perhaps slightly smaller, and the central pores are larger and more consistently developed.

Young, J.R. & Andruleit, H., 2006. *Navilithus altivelum*: a remarkable new genus and species of deep photic coccolithophores. *Journal of Micropalaeontology*, 25: 141-151.