

CHAPTER 7

# *Summary and Conclusion*

## Chapter 7

### SUMMARY AND CONCLUSIONS

#### 7.1 Summary

The present investigation on coccolithophores was the first of its kind to carry out a comprehensive study from the Bay of Bengal based on sediment trap samples collected at two depths over a period of one year (January 1992 - December 1992), from three trap locations situated longitudinally at northern (NBBT), central (CBBT) and southern (SBBT) Bay of Bengal. The temporal and spatial distributions of total coccolithophore fluxes, their diversity and the abundance of various taxa were thoroughly discussed in relation to the physical processes.

The Bay of Bengal influenced by the Asian monsoons was highly diversified in its oceanographic setting from northern to southern Bay. For example, the northern Bay was largely impacted by enormous influx of freshwater resulting in sharp horizontal and vertical salinity gradients during the SW monsoon. Despite the fact that this is an upwelling free region due to stratification caused by fresh water influx, the productivity sustained by the supply of nutrients through the river plumes in the northern Bay of Bengal. Whereas, the southern Bay of Bengal despite being oligotrophic high biological productivity was discerned apparently triggered by the advection of nutrient rich upwelled waters from the southwest coast of India through the eastward flowing monsoon current. Similarly, the central Bay of Bengal was also different from the northern and southern Bay of Bengal wherein, conspicuous coastal and open ocean upwelling with deepened mixed layer facilitated the biological productivity.

This study has yielded a total of 25 species of coccolithophores from the Bay of Bengal which were largely comprised of *G. oceanica*, *U. sibogae*, *E. huxleyi*, *U. irregularis*, *U. tenuis*, *F. profunda*, *H. carteri*, *C. leptopora* etc. The total coccolithophore fluxes increased from northern to southern Bay of

Bengal. This study inferred that the factors governing the coccolithophore fluxes were the upwelling accompanied by deepening of mixed layer, riverine discharge and advection of nutrients from the upwelling regions elsewhere.

Besides, biologically mediated processes operating in the Bay of Bengal was responsible for dissolution and mechanical break which also led to variation in the abundance of fluxes at different water depths.

## 7.2 Conclusions

The major conclusions are as follows

- The total particulate and coccolithophore fluxes increased longitudinally from northern to southern Bay of Bengal.
- Coccolithophore fluxes were largely governed by the upwelling processes accompanied by deepening of mixed layer, riverine discharge and advection of nutrients from the upwelling regions elsewhere.
- This study yielded a maximum of 25 species of coccolithophores of which *G. oceanica*, *U. sibogae*, *F. profunda*, *U. irregularis*, *C. leptopora* and *E. huxleyi* were the most common to abundant species at all the trap sites.
- Increased fluxes during SW monsoon at NBBT were resulted by the productivity caused by supply of nutrients through the river plumes.
- At CBBT coccolithophore fluxes were largely due to coastal and oceanic upwelling processes.
- At SBBT higher fluxes were attributed to the lateral advection of nutrient rich upwelled waters from the southwest coast of India through SMC.

- Total particulate fluxes increased with depth from shallow to deep traps due to lateral advection, which was very conspicuous at the SBBT location
- Species like *G. oceanica*, *U. sibogae* and *E. huxleyi* were dominant species which displayed seasonality with peak fluxes occurring during SW and NE monsoons, reflecting their affinity to nutrient rich waters brought in by the river plumes and by divergence.
- *U. irregularis* an indicator of oligotrophic/warm water recorded peak fluxes only during NE-SW intermonsoon periods at all the three trap locations thus showing its preference for oligotrophic conditions caused by increased SST's, stratification and lack of supply of nutrients due to reduced wind velocities.
- *F. profunda* a deep dwelling species recorded peak fluxes during SW-NE intermonsoon (October/November) in the northern and the southern traps and during NE-SW intermonsoon (April/May) in the central and the southern trap indicating the prevalence of deep nutricline conditions. Furthermore, it was also observed that this species appears to be more dependent on temperatures rather than the specific depth of deep photic zone.
- *U. irregularis* showed positive correlation with temperature at SBBT and CBBT while, *U. sibogae* displayed fairly good correlation with opal at NBBT.
- Mechanical break down and dissolution observed throughout the sampling periods was due to a biologically mediated process.

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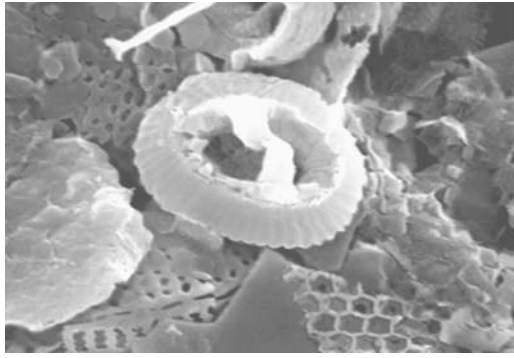
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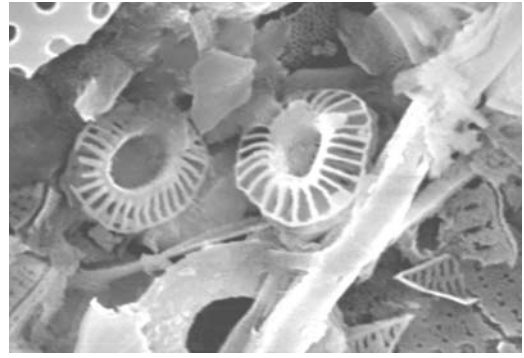
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Plate 1



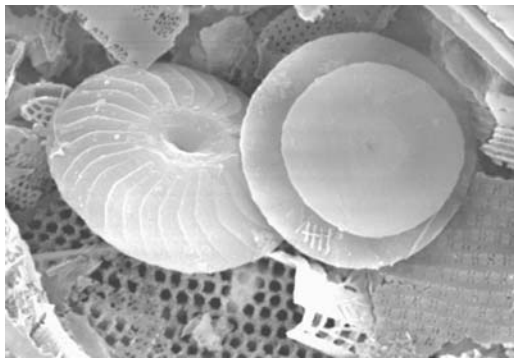
1

1 μm



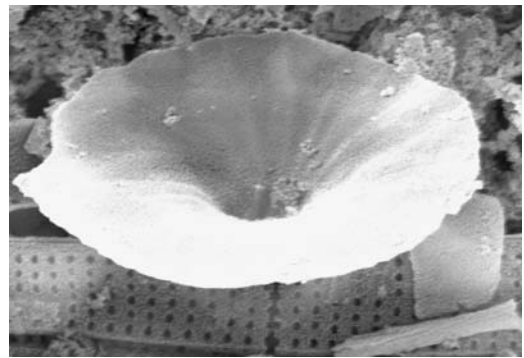
2

1 μm



3

2 μm



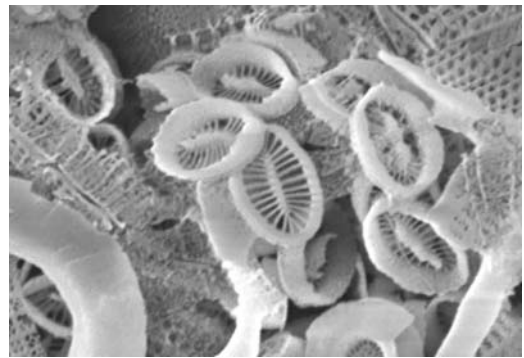
4

2 μm



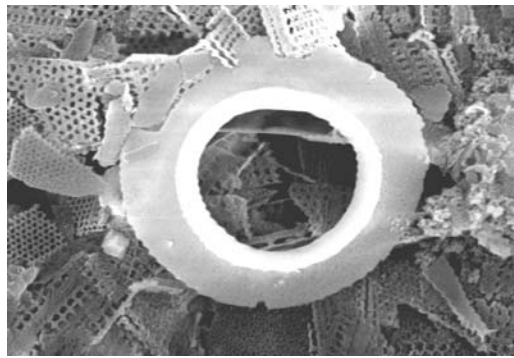
5

2 μm



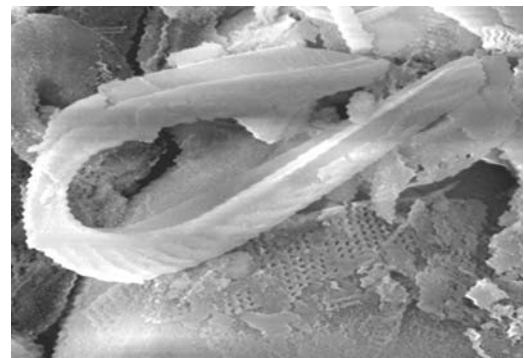
6

1 μm



7

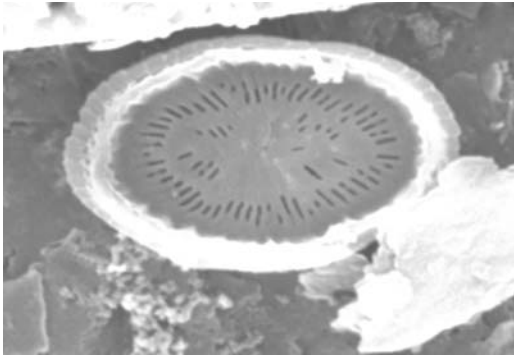
2 μm



8

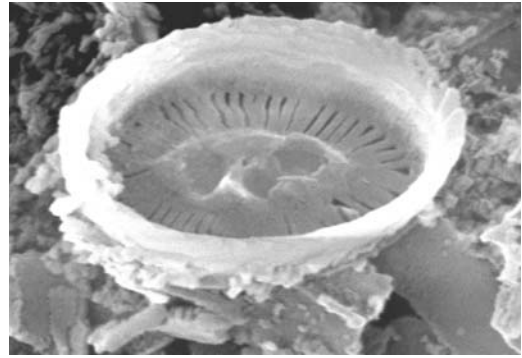
2 μm

Plate 2



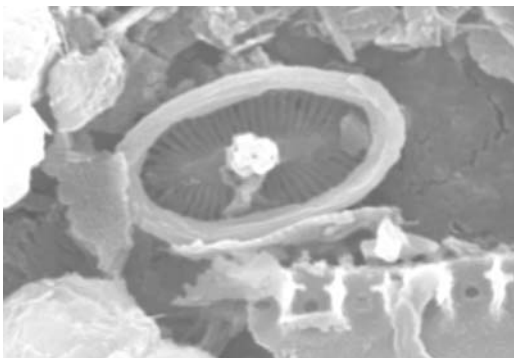
1

1 μm



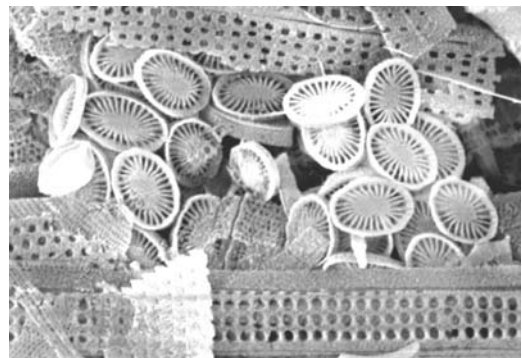
2

1 μm



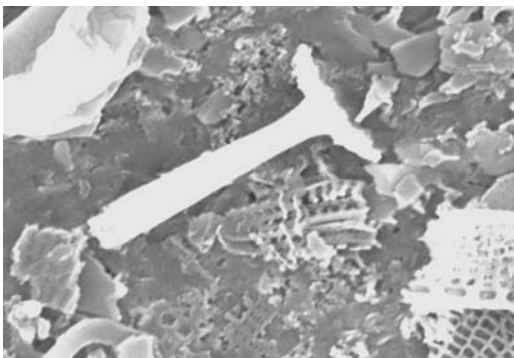
3

2 μm



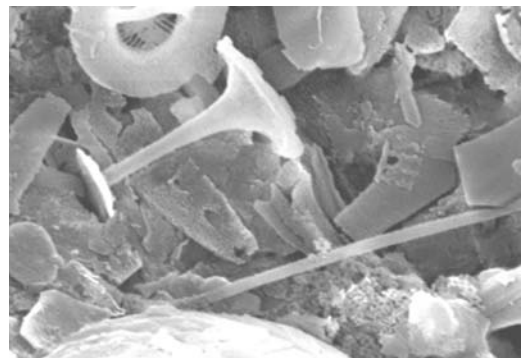
4

1 μm



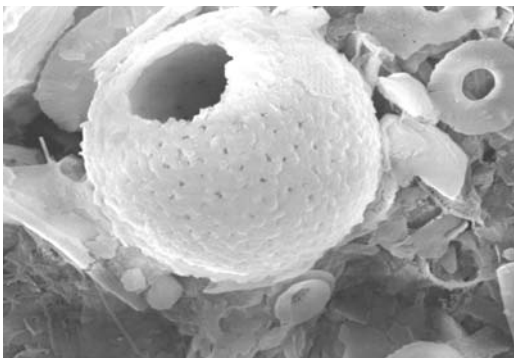
5

2 μm



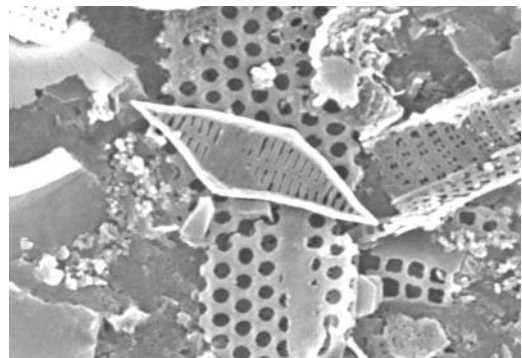
6

1 μm



7

2 μm

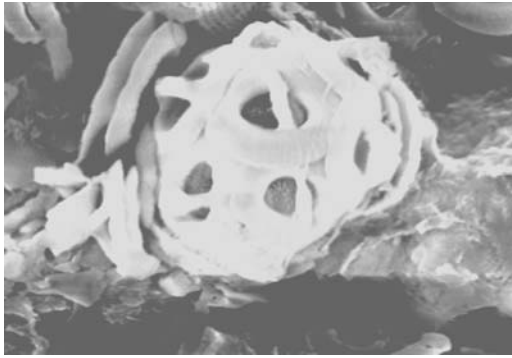


8

1 μm

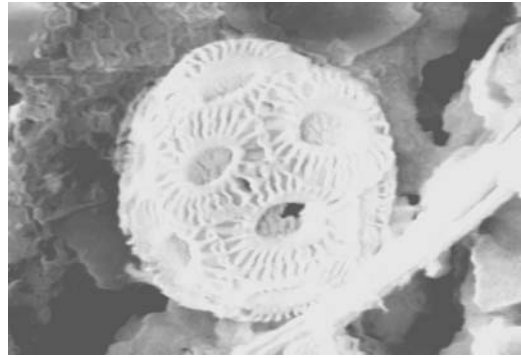


Plate 3



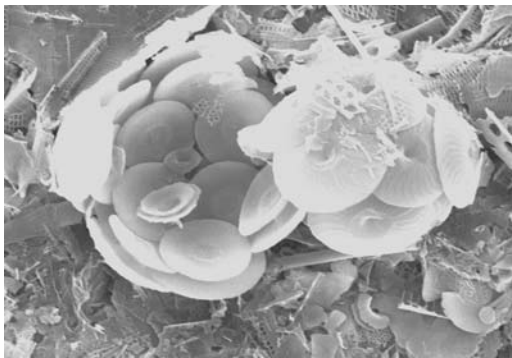
1

2μm



2

1μm



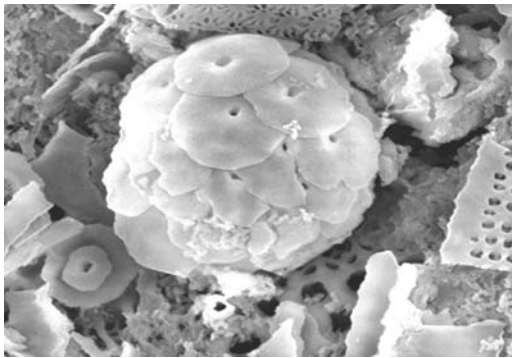
3

5μm



4

5μm



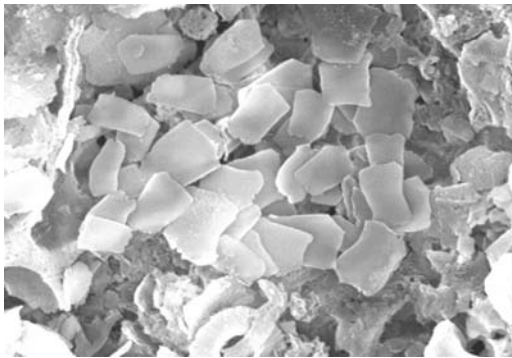
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2μm



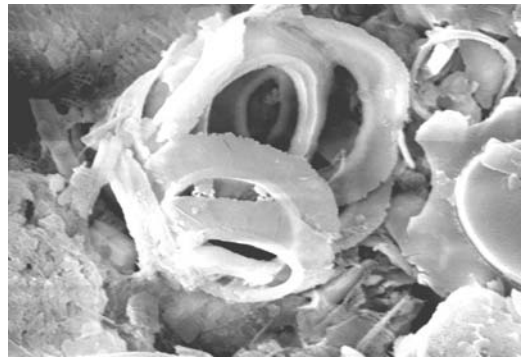
6

2μm



7

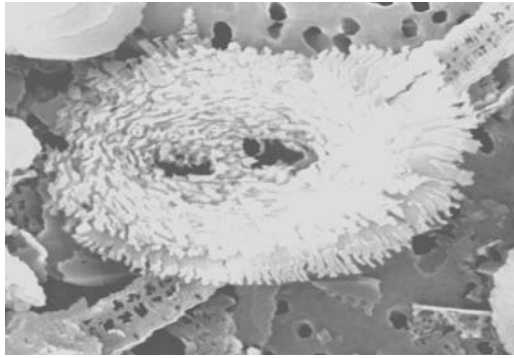
2μm



8

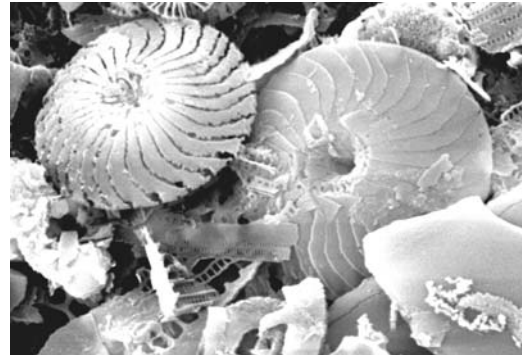
2μm

Plate 4



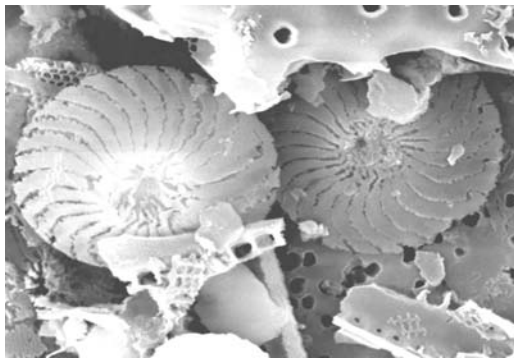
1

1µm



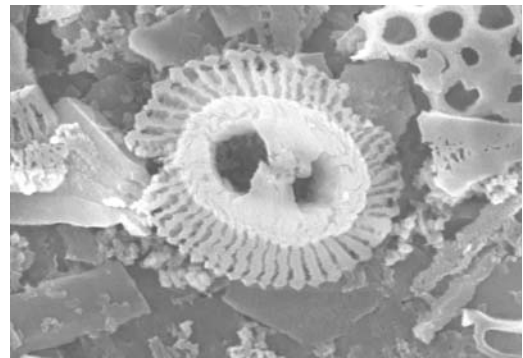
2

2µm



3

2µm



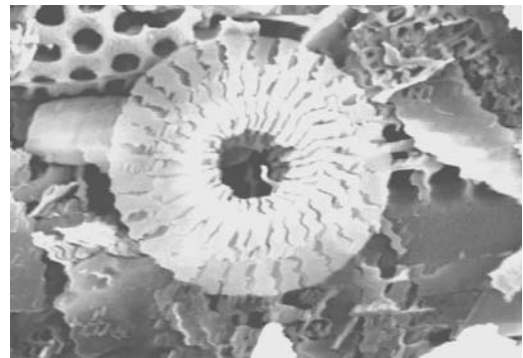
4

1µm



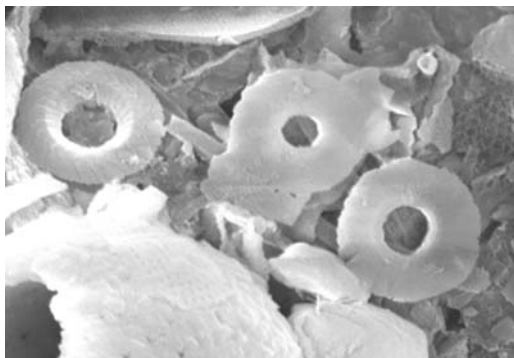
5

1µm



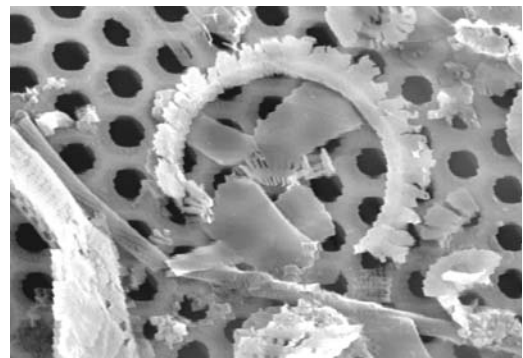
6

1µm



7

1µm



8

2µm

## Legend to plates

### Plate 1

1. *Gephyrocapsa oeanica*, distal view (x14,000; 8 February – 5 March 1992; CBBT shallow trap)
2. *Emiliana huxleyi*, distal view (x15,000; 8 February – 5 March 1992; CBBT shallow trap)
3. *Calcidiscus leptopora*, distal and proximal views (x8,000; 29 September – 25 October 1992; CBBT shallow trap)
4. *Umbellosphaera irregularis*, distal view (x13,000; 8 August – 3 September 1992; SBBT shallow trap)
5. *Helicosphaera carteri*, distal view (x7,500; 13 July – 8 August 1992; CBBT shallow trap)
6. *Syracosphaera lamina*, collapsed coccosphere (x13,000; 13 July – 8 August 1992; SBBT shallow trap)
7. *Neosphaera coccolithomorpha*, distal view (x8,500; 13 July – 8 August 1992; SBBT shallow trap)
8. *Ceratolithus cristatus*, isolated coccolith (x7,000; 26 April – 22 May 1992; CBBT shallow trap)

### Plate 2

1. *Syracosphaera pulchra*, distal view (x19,000; 17 June – 13 July 1992; SBBT shallow trap)
2. *Coronosphaera mediterranea*, distal view (x25,000; 31 March – 26 April 1992; SBBT shallow trap)
3. *Syracosphaera pirus*, distal view (x20,000; 17 June – 13 July 1992; SBBT shallow trap)
4. *Syracosphaera* sp., collapsed coccosphere (x10,000; 13 July – 8 August 1992; SBBT shallow trap)

5. *Discosphaera tubifera* (x13,000; 8 February – 5 March 1992; CBBT shallow trap)
6. *Rhabdosphaera clavigera* (x11,000; 17 June – 13 July 1992; SBBT shallow trap)
7. *Thoracosphaera heimii* (Dinoflagellate) (x7,000; 8 February – 5 March 1992; CBBT shallow trap)
8. *Anoplosolenia brachiensis* distal view (x14,000; 17 June – 13 July 1992; SBBT shallow trap)

### **Plate 3**

1. *Gephyrocapsa oceanica*, intact coccosphere (x8,500; 3 February – 8 February 1992; CBBT shallow trap)
2. *Emiliana huxleyi*, intact coccosphere (x13,000; 8 February – 5 March 1992; CBBT shallow trap)
3. *Calcidiscus leptopora*, collapsed coccosphere (x3,500; 3 September – 29 September 1992; SBBT shallow trap)
4. *Helicosphaera carteri*, intact coccosphere (x3,700; 22 May – 17 June 1992; SBBT Deep trap)
5. *Oolithotus antillarum*, intact coccosphere (x9,000; 25 October – 20 November 1992; SBBT shallow trap)
6. *Algirosphaera oryza*, intact coccosphere (x6,500; 29 September – 25 October 1992; SBBT shallow trap)
7. *Florisphaera profunda*, collapsed coccosphere (x8,500; 29 September – 25 October 1992; NBBT shallow trap)
8. *Neosphaera coccolithomorpha*, collapsed coccosphere (x6,000; 17 June – 13 July 1992; CBBT shallow trap)

#### **Plate 4**

1. *Helicosphaera carteri*, distal view showing intense dissolution (x13,000; 17 June – 13 July 1992; SBBT shallow trap)
2. *Calcidiscus leptopora*, coccolith well preserved and showing intense dissolution (x8,000; 8 August – 3 September 1992; SBBT shallow trap)
3. *Calcidiscus leptopora*, distal view of coccolith showing intense dissolution (x9,000; 8 August – 3 September 1992; SBBT shallow trap)
4. *Gephyrocapsa oceanica*, coccoliths showing intense dissolution (x16,000; 8 August – 3 September 1992; SBBT shallow trap)
5. *Umbilicosphaera sibogae*, coccosphere showing intense dissolution (x12,000; 5 March – 31 March 1992; SBBT shallow trap)
6. *Umbilicosphaera sibogae*, coccolith showing intense dissolution (x15,000; 8 August – 3 September 1992; SBBT shallow trap)
7. *Umbilicosphaera sibogae*, coccoliths showing intense dissolution (x10,000; 8 February – 5 March 1992; CBBT shallow trap)
8. *Neosphaera coccolithomorpha*, coccolith showing intense dissolution (x9,500; 13 July – 8 August 1992; CBBT shallow trap)

#### **Plate 5**

1. *Gephyrocapsa oceanica*, coccosphere showing signs of dissolution (x10,000; 29 September – 25 October 1992; CBBT shallow trap)
2. *Umbilicosphaera sibogae*, coccosphere showing signs of dissolution (x8,000; 25 October – 20 November 1992; SBBT shallow trap)
3. *Calcidiscus leptopora*, coccolith assemblage showing dissolution & mechanical breakdown (x4,300; 8 August – 3 September 1992; SBBT shallow trap)
4. *Emiliana huxleyi*, showing mechanical breakdown (x16,000; 8 August – 3 September 1992; SBBT shallow trap)
5. *Calcidiscus leptopora*, distal view showing mechanical breakdown (x11,000; 29 September – 25 October 1992; CBBT shallow trap)



6. *Thoracosphaera heimii* (dinoflagellate) showing mechanical breakdown  
(x2,700; 13 July – 8 August 1992; CBBT shallow trap)
7. *Umbellosphaera tenuis*, distal view showing mechanical breakdown (x17,000;  
20 November – 16 December 1992; CBBT shallow trap)
8. Diatom sp. (x2,500; 17 June – 13 July 1992; SBBT shallow trap)