

Extant coccolithophores: phylogeny, life-cycles, ecology and biogeography

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At the 14th International Nannoplankton Association Conference (INA 14) in Reston, Virginia in 2013, participants recognized that extant coccolithophore research had significantly advanced in the ten years since the “Coccolithophores 2003” workshop in Crete – which had included topics on taxonomy, methodology, and sediment trap and core-top studies. It was felt that a reunion of coccolithophore specialists within the framework of an INA Workshop would be useful to summarize our progress on extant coccolithophore research, identifying gaps in our knowledge and specifying targets for future collaborative research.

Thus, the National and Kapodistrian University of Athens (NKUA) and the Hellenic Centre for Marine Research (HCMR Crete) invited coccolithophore researchers to the INA “Coccolithophores 2014” Crete Workshop (5-10 Oct. 2014), which was held at the modern facilities of HCMR, Heraklion, Crete Island, Greece, (convenors: Maria Triantaphyllou, Stella Psarra, Jeremy Young), in a friendly atmosphere and in the vicinity of the deep-blue Aegean Sea.

About 50 delegates participated in the workshop in order to catch up with the state-of-the art research through fruitful discussion and oral and poster presentations. The broad focus was on exploring the diversity and taxonomy of modern coccolithophores including the following topics:

- Evolutionary biodiversity and functional morphology
- Coccolithophore ecology and biogeography: evidence of global warming?
- Coccolithophore biocalcification and ocean acidification: what we know
- Molecular genetics: unraveling coccolithophores
- Coccolithophore taxonomy: state of the art

Thanks to Micropaleontology Press, we are able to present contributions that reflect the current knowledge in these diverse topics in a single theme issue, with the appropriate title: “*Extant coccolithophores: phylogeny, life-cycles, ecology and biogeography*”.

The eight contributions that comprise this issue have been arranged according to the topics presented in the Workshop.

The first four papers deal with several taxonomic or biological aspects of coccolithophores.

Two papers by Thomsen et al. describe in detail the species *Papposphaera arctica* and *Papposphaera sarion* in polar waters, and carefully revise their taxonomy in both heterococcolithophore and holococcolithophore life-cycle stages.

The following paper by Jordan et al. investigates the morphological diversity of the siliceous haptophyte *Hyalolithus neolepis* and the enigmatic *Petasaria heterolepis* in scanning and transmission electron microscopes using materials from around the world. As a result, a new species, *Petasaria protuberans* Jordan, Malinverno, Šupraha, Thomsen et Young sp. nov. has been erected.

Triantaphyllou et al. present new evidence of coccolithophore combination coccospheres, with numerous specimens found in water samples collected from the north Aegean and Tyrrhenian Seas (Mediterranean), and photographed using the scanning electron microscope. As a consequence a series of taxonomic revisions are proposed, in which the names of the heterococcolithophores and holococcolithophores involved in the same life-cycle are synonymized. This has resulted in synonymizing the genus *Coronosphaera* with *Syracosphaera* and establishing one new combination; *Syracosphaera arethusae* (Kamptner 1941) comb. nov.

The next four papers present the distribution, composition, seasonal variation in coccolithophore standing crop and their biogeography in various marine environments.

Stolz et al. study living coccolithophores and coccoliths from surface sediments in the western equatorial Indian Ocean off Tanzania, from the coast and Pemba Channel to the open ocean. A rather good correlation exists between the occurrence of species in the plankton and those of the surface sediment assemblages, pointing to an excellent preservation potential in this area.



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TEXT-FIGURE 1

Participants in the International Nannoplankton Association “Coccolithophores 2014” Workshop, Crete (October 5–10, 2014). Convenors: Maria Triantaphyllou, Stella Psarra and Jeremy Young.

Malinverno et al. document surface coccolithophore species composition along a N-S transect from New Zealand to the Ross Sea, across the fronts of the Antarctic Circumpolar Current. Three *Emiliana huxleyi* morphotypes, A, B/C and O were recognized and show different biogeographic distributions along the investigated transect. Integration with previous data on the southern extent distribution of *E. huxleyi* showed no significant temporal shifts in the polar dynamic perspective of the species since early observations.

Along the same line, Saavedra et al. examined recent coccolith surface sediment assemblages across the Pacific sector of the Southern Ocean (from Punta Arenas, Chile to Wellington, New Zealand), in order to assess if and how the surface sediment assemblages reflect the present-day coccolithophore community and surface-water oceanographic conditions. They observe that numbers generally decrease southward to an almost a monospecific and sporadic record of *E. huxleyi* (types B/C and C) and *Calcidiscus leptoporus* south of the Polar Front.

Finally, Dimiza et al. present the species composition of living coccolithophore communities in various environmental condi-

tions from mesotrophic to ultra-oligotrophic regions of the Aegean Sea (northeastern Mediterranean). The assemblages are primarily controlled by surface water circulation and the associated water column stratification, with the sea temperature gradient affecting species composition. Particularly in the north Aegean, *E. huxleyi* dominates the winter-early spring upper photic zone and is affected by the Black Sea Water inflow; in contrast, *Syracosphaera* spp., Rhabdosphaeraceae and holococcolithophores characterize the late spring-early autumn low cell density and high diversity assemblages, mainly in the thermally-stratified south Aegean.

Thanks are due to all the speakers and all those who attended and helped to make the INA “Coccolithophores 2014” Crete Workshop an interesting and scientifically useful but also very enjoyable meeting. Special thanks go to the co-organizers of the meeting, Dr. Stella Psarra (HCMR) and Dr. Jeremy Young (UCL) for their enthusiastic and crucial support, and to all the colleagues who provided critical, though very constructive reviews of the papers included in this theme issue.