

A look into coccolith sizes and shapes: the morphological responses of coccolithophore algae calcification to trace metal concentrations

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Coccoliths are formed through an intracellular growth process. This begins with nucleation of a proto-coccolith ring of simple crystals. It continues by upward and outward growth of these crystals into a complex unit that results in completed coccoliths. Coccolithophore algae frequently produce incomplete and malformed coccoliths: incomplete coccoliths occur if the growth process is arrested due to premature extrusion of the coccolith or death of the cell, while malformation is due to “irregular coccolith formation as a result of departure from the normal growth process” (Young & Westbroek, 1991), implying a malfunction of the coccolith-shaping machinery. When malformations are taken into account, most studies focused on the identification of changes in the shape of the individual elements. However, the main feature of malformed coccoliths is an altered symmetry of the shield. The latter is generally not investigated because it often is too inconspicuous to be unambiguously identified.

Here, we present a new method to quantitatively characterize coccolith shapes and discriminate between normal and malformed specimens and the degree of malformation.

Cultured algae of three different species, *Emiliana huxleyi*, *Gephyrocapsa oceanica*, and *Coccolithus pelagicus*, were typified using SEM pictures. First, we analyzed coccoliths grown under optimal conditions (control/ambient water) to assess the variability in size and morphology in the absence of ambient perturbations.

Subsequently, the method was applied to coccolithophore algae grown under excess trace metal concentrations to quantify the percentage and type of malformed coccoliths. Our results on living coccolithophore algae demonstrate that elevated trace metal concentrations do affect coccolith size and/or weight of the tested species. However, differences in species-specific responses were observed, which suggest that there were different sensitivities to trace metal content. Finally, an increased number of aberrant coccoliths points to an altered calcite content in the coccoliths and therefore a decrease in the cellular calcification rate.

References

Young, J.R. and Westbroek, P. 1991. Genotypic variation in the coccolithophorid species *Emiliana huxleyi*. *Marine Micropaleontology*, **18**(1–2): 5–23.