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Palaeo cell size: A Novel Technique to Investigate the Coccosphere Fossil Record using Imaging Flow Cytometry

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Fossil coccospheres provide a wealth of information on cellular traits that can be compared directly to the living coccosphere such as cell size. Cell size is critical to ecosystem dynamics and particle sinking which has implications on the carbon cycle. However, cell size reconstruction is hindered by the poor preservation of coccospheres as coccospheres often disintegrate into individual coccoliths. Although palaeoecological information can be attained from individual coccoliths, assumptions must be made when correlating cell size to coccolith size. We demonstrate a novel technique using imaging flow cytometry to rapidly and reliably sort coccospheres from marine sediment by exploiting their unique optical and morphological properties. Imaging flow cytometry combines the functional insight of morphological information provided by microscopy with high sample numbers that are associated with flow cytometry. High throughput imaging overcomes the constraints of laborious manual microscopy enabling the analysis of sediments containing low concentrations of coccospheres that would simply not be feasible to manually hunt for coccospheres. By applying this technique to the fine fraction of sediments, hundreds of coccospheres can be isolated without the need for additional sample processing. Morphological information of individual coccospheres is obtained and graphical and statistical information can be extracted. This approach lends itself perfectly to rapid processing of down-core sediment samples or high spatial coverage from core-top samples and may prove valuable in investigating the interplay between a changing climate and coccolithophore response.