Influence of volcanic ash on growth and morphology of coccolithophore algae

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Deposition of airborne ash from volcanic eruptions has the potential to inject a significant amount of bioavailable metals into seawater, affecting marine primary productivity and increasing or decreasing phytoplankton biomass in the open ocean. These effects can be the result of the release of fertilizing trace elements e.g. iron in limited areas, like high nutrient low chlorophyll areas, like the Southern Ocean or potentially toxic elements like cadmium, copper or lead. In previous studies, the diatom *Thalassiosira pseudonana* has been shown to grow in contact with volcanic ash, whilst the growth of the coccolithophore *Emiliania huxleyi* came to a halt which was unclear why though and what the effects and thresholds could be [1]. Different trace metals have been shown to be vital for different processes in coccoliths [2].

Changes in coccolithophore productivity and coccolith numbers or sizes as a reaction to increased metal concentrations, could influence sinking rates and CO_2 uptake and could therefore alter the efficiency of organic carbon export to deep waters. For example, if volcanic material acts as a fertilizer in open ocean waters, it might stimulate phytoplankton growth, increasing the flux of CO_2 between the atmosphere and the surface ocean organic pool, and result in significant carbon sequestration.

To clarify the potential impacts of volcanic ash on coccolithophores, we performed culturing experiments with two coccolithophore strains and different volcanic ashes at a range of concentrations. Here we present results from these experiments, showing the release of an array of metals from the volcanic ashes in Antarctic seawater and the physiological (growth, Fv/Fm) and morphological responses of both coccolithophore strains (SEM).

Finally, from a broader perspective, we compare our results with paleo-data to increase the applicability of calcareous nannofossils (coccolithophore remains) as proxies for trace metal concentrations. In particular, the modeling of nannoplankton species-specific reactions/adaptations to excess volcanic trace metal released during different geological episodes is expected to open new scenarios on the characterization of critical past events.

References:

[1] Hoffmann, L. J., et al. (2012).

[2] Schulz, K. G., et al. (2004).