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Airborne volcanic ash trace metal release to the surface ocean and possible effects on marine primary production

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Marine primary production (MPP) is strongly influenced by trace metal concentrations in the surface ocean. Airborne volcanic ash has the potential to change surface ocean metal concentrations by either the release or scavenging of metals by the ash itself with implications for phytoplankton growth. Here we present new results from geochemical experiments with natural seawater and ash from volcanoes in different tectonic settings (e.g. subduction zones and hotspot areas). The concentrations of Fe and Zn, Cu, Cd, Pb were determined *in situ* in seawater as a function of time by means of Cathodic and Anodic Stripping Voltammetry. Our results demonstrate that most volcanic ash samples release significant amounts of Fe $^{(1)}$, Zn and Cu on the scale of minutes but that some samples scavenge more Zn and Cu than they release. In general volcanic ash from subduction zone volcanoes (e.g. encircling the Pacific) have a higher potential to release Fe $^{(1)}$, Zn and Cu than those from hotspot areas such as Hawaii and Iceland. Within the first hour of contact with seawater volcanic ash samples do not mobilise detectable levels of Pb or Cd. Deficiency of trace metals can be biolimiting in some areas of the open ocean, however, elevated concentrations of Zn and Cu can also have variable toxic effects on different phytoplankton species. While volcanic ash in general adds Fe to the surface ocean to stimulate phytoplankton growth, Zn and Cu concentrations in marine ash fall areas of subduction zone volcanic eruptions may reach toxicity levels even when organic ligands are present.

Toxic effects arising from marine hotspot volcanic ash deposition appear to be less likely. The interplay of limiting and toxic conditions partly depends on the tolerance and response of phytoplankton species to variable trace metal levels and therefore our data suggest that marine volcanic ash fall may locally and rapidly influence the MPP and the composition of the phytoplankton assemblage.

[1] Olgun N, Duggen S, Croot P, Dietze H, Schacht U, Óskarsson N, Siebe C, Auer A (2007) Volcanic ash as an iron-fertilizer in ocean surface water. In: AGU Fall Meeting, San Fransisco, USA, December 10–14, Eos Trans. AGU, 88(52), Fall Meet. Suppl., OS11B-0509.