# Fertilization potential of natural and synthetic volcanic ash in marine phytoplankton

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Volcanic ash consists of silicate glass and crystalline minerals in various proportions. Both ash components contain ferrous (II) and ferric (III) iron in variable concentrations and ash has been shown to release Fe and other metals upon contact with seawater. Metals, including Fe, are vital elements for numerous processes in marine phytoplankton. However Fe is in limited supply in high-nutrient-low chlorophyll oceanic (HNLC) waters. The long range transport and subsequent deposition of ash to the open ocean surface has been linked to enhanced phytoplankton growth. Previous studies have attributed such fertilization effect primarily to rapid dissolution of iron sulfate and halide salt deposits present on ash surfaces, although such compounds have never been observed directly. In this study we performed new experiments aimed at confirming the ability of volcanic ash to act as a source of bioavailable Fe.

An unicellular microalgal strain (*Dunaliella tertiolecta*) commonly found in HNLC waters was cultivated in a Fe-depleted synthetic seawater medium. A known amount of Fe-containing ash was then added to the starved culture and the cell photosynthetic activity, number, size, and morphology were monitored with time. Nitrate consumption was also determined. All together, these measurements indicated a positive response of phytoplankton to ash addition. The same experiment was repeated but using a powdered silicate glass of known composition. Similar to the ash treatment, the algae responded positively to glass addition. Further, this effect could be sustained for up to 168 hours. This result strongly suggests that the glassy component of ash is a source of bioavailable Fe for phytoplankton and therefore, the presence of Fe salts on ash may not be necessary to trigger growth in HNLC areas.