Ocean acidification from explosive volcanism as a cause for mass mortality of pteropods

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Recently, it has been proposed that anthropogenic CO_2 emissions may affect marine ecosystems by causing ocean acidification. In particular, it is suggested that within acidified surface waters, calcifying organisms would be subject to malformation and enhanced dissolution. Here, we present evidence of this process occurring naturally where explosive volcanism leads to the deposition of volcanic ash into ocean surface waters. Sediment cores from around the island of Montserrat, Lesser Antilles, contain distinct horizons of planktic fauna associated with recently deposited volcanic ash layers from the Soufrière Hills volcano. Within these layers are abundant pteropod shells that display evidence of partial dissolution and etching of their aragonitic shells, and appear to have suffered mass mortality in response to ash deposition during an eruption. Laboratory studies show that the ~3 cm of ash resulting from the 2006 volcanic dome collapse event could have caused the upper 5 m of the water column to become undersaturated with respect to aragonite. Volcanogenic ocean acidification is proposed to be the most likely trigger of the observed pteropod mass mortality events associated with recent Montserrat volcanism. The difficulty of documenting pteropod mortality may have led to this process being overlooked as a by product of large explosive volcanic events, but the importance of pteropods in the marine food chain suggests that further investigation is warranted.

Surface warming and ice-rafting in North-Atlantic during MIS3, A possible link?

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Episodic delivery of freshwater to the North Atlantic by melting ice has been linked to abrupt climate changes during the last glacial period through its influence on the Atlantic meridional overturning circulation. The mechanism causing these ice-rafting events remains however unresolved; here we present data from sediment cores that show a possible link between (sub)surface warming and ice-rafting during marine isotope stage (MIS) 3.

Earlier work on these cores from Reykjanes Ridge showed a clear slowdown of the deep circulation in response to freshwater input [1, 2]. New methodological experiments as well as geochemical analyses of recent sediments have substantiated these inferences. We focus now on processes playing at the sea surface during the ice-rafting events.

During IRD events the calcite-content started to increase and peaked just after the main IRD input. The calcite signal cannot be attributed to dilution by IRD, thus reflecting primary production directly. The anti-correlation with the relative abundance of cold-water dwelling planktonic foraminifer *N. pachyderma* s. suggests that the $CaCO_3$-record predominantly reflects temperature variability at or near the sea surface. This is supported by the concurrent shift to lighter $\delta^{18}O$ values of *N. pachyderma* s. and few Mg/Ca paleotemperature reconstructions. The $\delta^{18}O$ thus dominantly reflects temperature. And remarkably no meltwater influence appears present in the $\delta^{18}O$ signal, possibly indicating sea-ice as an additional carrier of IRD. Thus (near) sea surface temperature started to increase during most ice-rafting events and consistently peaked afterwards. We hypothesize that this warming is related to the invigoration of the warm North Atlantic Current and might have caused the melting of the ice and weakening of the Iceland-Scotland Overflow.

[1] Moros *et al*. (2002) Mar. Geo. **192**, 393-417. [2] Prins *et al*. (2002) Geology **30**, 555-558.