cally or kinetically[17]. Deforestation has not been considered in monitoring programmes in the Amazon, although fly-ash transport is now being investigated. It is clear that deforestation is a major source of mercury emission in a form more dangerous than that emitted by *garimpos*. Mercury emissions from any source must be stopped but all significant villains should be recognised.

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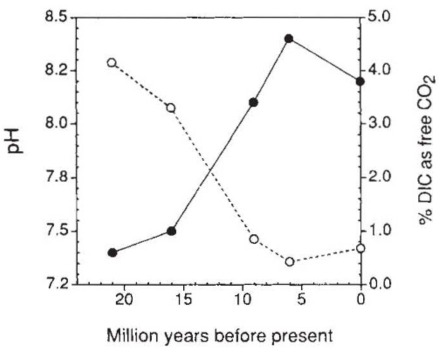
CO_2 and diatom mats

SIR — Levels of atmospheric CO_2 are thought to have been substantially higher during much of geological history than at present[1]. It has been suggested that the decrease in stromatolites in the Phanerozoic fossil record could partly be explained by declining levels of atmospheric CO_2, leading to CO_2 limitation[2,3]. Here I suggest that CO_2 limitation was also a contributing factor to the absence from the fossil record for the past 4.4 million years of the previously vast laminated diatom assemblages of the eastern equatorial Pacific[4].



Sea surface CO_2 (open circles) and pH (filled circles) changes during the past 21 million years. Values for pH from ref. 11; free CO_2 values calculated from the dissociation constants for dissolved inorganic carbon (DIC) given in ref. 12.

To enter the fossil record, biological material must be produced, exported and preserved. The export production of, for example, rhizosolenid diatom assemblages, is controlled by grazing, buoyancy, cell size and aggregation into mats[5]. The preservation of laminated sediments depends on low oxygen in the water to prevent a benthic community from causing sediment bioturbation, although in the case of the Neogene mats the amount of diatom material apparently overwhelmed the benthos[4]. Growth rates in phytoplankton are mainly controlled by primary production, and it is this factor that is influenced by levels of inorganic carbon. There must also be a link between growth rates and export production, because growth rates must be greater than loss if a mat is to form, algal concentration can affect grazing and aggregation, and growth rate can directly affect cell size.

Recent laboratory work on marine planktonic diatoms, at least one of which, *Rhizosolenia alata*, forms blooms[5], demonstrates that, given nutrient conditions typical of the onset of a high-latitude spring bloom, cell-doubling rates are correlated with concentrations of dissolved gaseous CO_2 (ref. 6). In this experiment, CO_2 concentrations were kept constant for 5–6 days. Cell doubling decreased dramatically at levels below ambient, but did not increase more than about 10% at free CO_2 concentrations over ambient. However, during intense growth in nature, such as in a bloom, free pCO_2 can become severely depleted[7]. Such depletion, caused by photosynthetic uptake and the resulting rise in pH of the surface water, is considered to be one cause for the collapse of spring diatom blooms[8]. Concentrations of CO_2 in sea water are dependent on dissolved inorganic carbon and pH, which controls the equilibrium concentrations of the species of inorganic carbon. Bulk inorganic carbon concentrations are a function of physical factors such as levels of atmospheric CO_2, temperature, surface mixing and salinity[9]. Biological factors such as the uptake and remineralization of inorganic carbon also affect oceanic inorganic carbon and pH (ref. 10).

Atmospheric concentrations of CO_2 21 million years ago are estimated to have been about 4.5 times their present levels, suggesting that levels of dissolved inorganic carbon were higher[10]. Surface sea water in the equatorial Pacific near Micronesia was pH 7.4, for example, in contrast to present-day values of about 8.2 (ref. 11). At 34 ‰ salinity, 18.5 °C and pH 7.4, about six times more dissolved inorganic carbon exists as free CO_2, than at pH 8.2, or roughly 4.2 versus 0.7% free CO_2 (see figure). Given sufficient quantities of other nutrients, diatoms would have shown elevated doubling rates at higher cell concentrations than would be possible today, resulting in more extensive populations. Conversely, as atmospheric levels of CO_2 decreased and the pH of surface sea water increased to near present-day levels, free CO_2 in surface waters decreased. As a result, diatom populations became CO_2-limited, leading to a decrease in diatom growth rates. The CO_2 limitation on diatom growth contributed to the disappearance from the fossil record of the Neogene diatom assemblages.

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Scientific Correspondence

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Mitochondrial DNA inheritance

SIR — Although the inheritance of mitochondrial DNA (mtDNA) was thought to be maternal, a low level of paternal transmission does occur in some animals[1,2] and plants[3]. In the marine mussel *Mytilus*, the results of laboratory crosses suggest extensive paternal transmission of mtDNA genotypes, as well as maternal inheritance[4]. This explains why many mussels from diverse geographic locations can possess two mtDNA genomes which show high nucleotide sequence divergence (10–20%)[5,6]. We have obtained evidence that whereas female mussels have only one mtDNA genome that is transmitted to eggs, male mussels have, in addition, a second genome that is transmitted preferentially to sperm.

Cloned DNA from the two genomes in *Mytilus edulis* (*F* and *M*[4,5]) has been used to probe genomic DNA prepared from somatic tissue and gametes (*a* in fig. 1). Males consistently give strong signals for both genomes in somatic tissue, but for only the *M* genome in sperm. Females consistently give a strong signal for the *F*, but not for the *M* genome, in both somatic tissue and eggs. These sex and tissue specific differences are mirrored when