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Implications of a quantitative model for Cenozoic opal burial

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Alongside enhanced crustal activity and a warmer climate, the Eocene also saw prolonged periods of biogenic silica accumulation on the ocean floor. The peak of this accumulation occurred at approximately 50 Ma, creating Horizon Ac, a layer of silica-rich sediments spanning approximately 4 My. Horizon Ac is comparatively isolated in time from known silicic acid addition processes, leading McGowran (1989) to suggest a novel geohistorical mechanism (the ‘‘silica burp” hypothesis) that centres on the temporal decoupling of silicic acid supply and burial by climatic variation. Here we examine this hypothesis using a quantitative biogeochemical model of the silicon cycle (including the modern and pre-diatom cycles). Our results unequivocally show that McGowran’s hypothesis is unable to account for Horizon Ac. The residence time and ocean capacity for silicic acid are simply insufficient to permit the degree of temporal decoupling proposed by McGowran. Essentially, the model results suggest that outputs (opal burial) and inputs (primarily riverine silicic acid) cannot remain uncoupled for any longer than about 0.2 My. Inverting the model’s results suggests that, instead, the sediment record may be a useful proxy for silicic acid additions to the ocean.