

Mesozoic C-cycle perturbations and climate: evidence for increased resilience of the Cretaceous biosphere to greenhouse pulses

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The Mesozoic C-isotope record traces the history of the global carbon cycle. Major perturbations of the carbon cycle triggered by extraordinary volcanic activity are recorded in negative spikes coupled with positive C-isotope excursions. Prominent examples are the extreme events at the Permo-Triassic and Triassic-Jurassic boundaries and in the Toarcian or in the Aptian. While major volcanic pulses at the P-T and T-J boundary are considered as the main trigger of mass-extinctions, extreme events in the Cretaceous were not accompanied by comparable extreme loss of marine or terrestrial biota. The data suggest that either changes in degassing of LIPs (SOBOLEV et al., 2011) and/or that the resilience of the Mesozoic biosphere to climate pulses changed through time. It is hypothesized that two factors contributed to increased resilience of the biosphere in the Cretaceous: (1) Starting in the Late Jurassic, pelagic carbonate developed into an important sink of carbon dioxide in the long-term carbon cycle, contributing to increased resilience of the carbon cycle to perturbations if compared with the Early Mesozoic dominated by shallow-water carbonate production. The Aptian C-isotope anomaly, for example, was accompanied by a shallowing of the CCD (THIERSTEIN, 1979). Shallowing of the CCD contributed to rapid lowering of elevated $p\text{CO}_{2\text{atm}}$ and to dampening of extreme acidification events associated with volcanic activity. (2) Increasing fragmentation of Pangea resulted in the establishment of a transequatorial current system coupled with equatorial upwelling and strong deep-water erosion. This circulation pattern was intensified during greenhouse pulses. Increased marine productivity and widespread basinal anoxia (Oceanic Anoxic Events) favoured the intensification of the biological carbon pump. Peculiar oceanography coupled with an intensified biological carbon pump contributed to the stabilisation of atmospheric CO_2 levels. Increased resilience of the Cretaceous biosphere to volcanic activity may explain why Deccan Trap volcanism was not sufficient anymore as a trigger of a mass-extinction at the K-Pg boundary, ultimately triggered by the Chicxulub asteroid impact.

SOBOLEV, S.V. et al., 2011. *Nature*, **477**/7364, 312–316.

THIERSTEIN, H.R., 1979. Deep drilling results in the Atlantic Ocean: continental margins and paleoenvironment, 249–274.