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The Mesozoic trends in climate and carbon cycle evolution

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The Mesozoic evolution of the carbon cycle and climate has been investigated with a variety of non-dimensional numerical models since the early 80's. The impact of fluctuations in the solid Earth degassing rate, the role of evolving vegetation (such as the rise of angiosperms) on continental weathering and hence on CO_2 consumption have been thoroughly quantified (1). However, the impact of continental drift on the carbon cycle and climate has never been considered in an explicit way. Here we present the impact of the most prominent tectonic event of the Mesozoic, the slow breakup of the Pangea super-continent, on the global carbon cycle and climate. The GEOCLIM model couples a 3D general circulation model with a model describing the global biogeochemical cycles, so that climate and CO2 are simultaneously calculated for a given continental configuration. We show that the breakup of Pangea is a first order climatic forcng. It forces atmospheric CO2 to decline by 2500 ppmv from the late Permian down to the latest Cretaceous, inducing a continental climatic cooling by about 10∞C mainly through an increase in continental runoff (2). The tectonic evolution of the Mesozoic thus appears as a strong climatic cooling force. We combine those results with the Earth degassing forcing function, and the general evolution of land plants and their impact on weathering, to estimate a new history of Mesozoic CO2, which is compared to other reconstructions (1).

(1) Berner, 2004. Oxford University Press, 150 pp (2) Donnadieu et al., 2006, Geochem. Geophys. Geosyst., 7, doi 10.1029/2006GC001278