Cenozoic carbon cycling and climate change

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A new box model for carbon cycling over the Cenozoic is presented showing that the evolution of pCO_2 values closely follows the trends in Cenozoic climate change. According to the model, the partial pressure of CO_2 in the atmosphere (pCO_2) is high (up to 1000 µatm) during the early Eocene climate optimum and strongly decrease towards the late Eocene/early Oligocene boundary. Oligocene to Pleistocene pCO_2 values are rather constant ranging in between 200 and 300 µatm. Simulated pCO_2 changes are mainly driven by rates of volcanic and metamorphic degassing, silicate weathering and organic carbon burial. The rather good correspondence between Cenozoic pCO_2 and climate suggests that carbon cycling processes had a strong effect on Cenozoic climate change.

The role of continental erosion and river transports in the global carbon cycle

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The chemical and physical erosion of land materials released into the rivers organic (dissolved (DOC) and particulate (POC)), and inorganic (dissolved (DIC) and particulate (PIC)) carbon which is subsequently discharged into the oceans: about 1 $GtC.y^{-1}$ (DIC, PIC, DOC and POC represent respectively 38%, 17%, 25% and 20%). Most of the carbon transported by the rivers originates from the atmospheric CO_2, except PIC and half of the DIC which are supplied respectively by the physical and chemical erosion of carbonates.

The chemical erosion of inorganic materials which consists in dissolving or hydrolyzing primary minerals of rocks and soils requires CO_2 and releases DIC. The flux of CO_2 consumed by weathering processes is mainly produced by soil organic matter oxydation. Nevertheless, on a geological time scale, it is only the fluxes of CO_2 consumed by silicate rock weathering which represent a non-negligible sink of CO_2. Runoff and lithology are the major factors controlling rock weathering and atmospheric/soil CO_2 consumption. Among all silicate rocks, shales and basalts appear to have a significant influence on the amount of CO_2 uptake by chemical weathering. Moreover, soil cover plays an important role: the CO_2 flux is lower for lateritic river basins than for non-lateritic ones.

DOC and POC riverine fluxes are respectiveley dependent on the soil organic carbon contents and on the river sediment transports.

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