Carbon cycle and climate evolution during the Earth history

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Long-term stability of climate of the Earth has been considered as a result of carbon cycle with a so-called Walker feedback which suppresses perturbations to the climate system in a dynamic equiriblium. However, the boundary conditions of the carbon cycle, such as an efficiency of CO2 recycling due to plate subduction, mantle degassing of CO2 via plume-related volcanisms, total area of continents, and an efficiency of carbonate precipitaion due to hydrothermal activity, should have changed significantlly with time.

In particlular, carbon cycle and climate during the early history of the Earth is largely uncertain. A large amount of impact ejecta generated by heavy bombardment of asteroids and/or comets should have enhanced global rates of chemical weathering, resulting in consuming CO2 to have caused global glaciations. On the other hand, subsurface magma ocean and intense mantle convection (including rise of hot plumes and mantle overturn) could have supplied significant amounts of CO2 to the atmosphere, resulting in very hot climate.

Characteristic features of the ancient carbon cycle system which may have been quite different from that of today should be clarified in order to understand the early evolution of climate of the Earth. Factors which may have controlled carbon cycle and surface environment during the early Earth will be disscussed.