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

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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. The present-day riverine flux of carbon is estimated about 1 $GtC.y^{-1}$ (0.8 to 1.2 according to the estimates); DIC, PIC, DOC and POC fluxes 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, the flux of CO_2 consumed by carbonate dissolution on the continents is balanced by the CO_2 fluxes released to the atmosphere by carbonate precipitation in the oceans. Consequently, with regard to the CO_2 content in the atmosphere, it is only the fluxes of CO_2 consumed by silicate rock weathering which represent a non-negligible sink of CO_2. Consequently, future researches on weathering must be focussed on the CO_2 uptake by silicate rock weathering and on the subsequent riverine alkalinity transport.

As previously shown, the runoff is one of the main factors controlling rock weathering and atmospheric/soil CO_2 consumption. Consequently, if we want to simulate correctly the erosion and river transports of carbon during the Quaternary period or the geological past, we need first to improuve the runoff modelling. Moreover, it appears also clearly that, for similar runoff, the CO_2 flux consumed by silicate weathering is lower for lateritic drainage basins than for non-lateritic ones. It is important to consider such a difference for future researches because the lateritic covers occupy 33% of the whole continental areas.

To reconstruct the geological fluctuations of CO_2 consumed by silicate weathering, it is interesting to derive directly alkalinity produced by silicate weathering from riverine discharge of dissolved silica. But, there is no direct correlation between alkalinity and dissolved silica content in large rivers because lithologies and weathering types and rates are so different from one river basin to another. Nevertheless, it is possible to determine a good relationship between the silicate weathering types and the ratio $alkalinity_{silicate}$/silica in large river basins.

Concerning the chemical and physical erosion of soil organic matter, all the organic carbon released into the rivers originates from the atmospheric CO_2, via the photosynthesis and the litter fall. Nevertheless, part of this carbon (two thirds) can be oxydized and released to the atmosphere during the fluvial transport, but also in the estuarine and coastal zones and on the long term in the oceans. The contribution of the organic geological carbon erosion is not very well known for the moment. Our modelling show that DOC and POC fluxes are respectiveley dependent on the soil organic carbon contents and on the river sediment transports. The knowledgement of this two parameters must be improuved for the geological past.

Finally the role of river carbon loop (atmospheric CO_2 uptake by erosion-riverine transport of carbon-subsequent ocean transport of riverine carbon-loss of riverine carbon back to the atmosphere by air-sea gas exchange) in the global carbon cycle has been underestimated and even sometimes ignored. We could recently show for example that the river carbon loop can explain the discrepancy between data-based and model-based estimates of the ocean interhemispheric transport of carbon.

Several other questions need to be solved if we want to better evaluate the role of erosion during the Last Glacial Maximum: "What about chemical weathering under the ice sheets?", "What about the lithology and climatology of continental emerging shelves?", What is the fate of river carbon entering in the oceanic system?" ...

Key-words : Carbon cycle, River transport, Perspective.DOC , POC, DIC , PIC.

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