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What do we know about Fossil Organic Carbon stock and fluxes in supergene environments?

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CO_2 concentration is regulated by processes controlling the carbon fluxes occurring between different carbon pools such as atmosphere, ocean, hydrosphere, soil, biomass, and lithosphere. However, some controversies persist on the nature and quantification of carbon stocks and fluxes acting in supergene environment such as soils and rivers pools. For example, Meybeck (1993) considers that FOC released by weathering of sedimentary and metamorphic rocks can reflect up to 40-45% of POC annually carried by major rivers, instead of others numerous authors (Holland, 1978; Adams and Faure, 1996) that do not take into account this FOC yield. Up to now, at a global scale, we only know an initial estimation of the annual organic yield induced by carbonates and shales chemical weathering that reach 0.1 Gt C y^{-1} (Di-Giovanni et al., 2002). No FOC fluxes have been reported for chemical weathering of sands and sandstones, as well as those inherited from mechanical weathering of all sedimentary rocks, altought mechanical weathering is 4 to 11 higher than chemical one (Probst, 1992; Gaillardet, pers. com.). In addition to these gaps concerning FOC fluxes, the role of erosional processes on those of FOC in global carbon cycle (source or sink of CO2) and the FOC stock available in surficial layer of sedimentary rocks and rapidly reload in supergene carbon pools, remain unresolved.

The influence of weathering processes on the release and fate of FOC in supergene carbon cycle was approached through our recent results from a study carried out on 2 experimental watersheds (Draix; Copard et al. submitted). Input of FOM inherited from Jurassic marls in soils through alterites, where occur chemical weathering and bioerosion, experiences a significant, but not complete, mineralisation of its carbon. Input of FOM in streams, controlled by mechanical weathering, experiences no FOM mineralisation. Hence, for the global carbon cycle, FOM reload in supergene carbon cycle can act either as a maintaining of an ancient sink, when gully erosion is dominant, or as a source of carbon, when (bio)chemical erosion is preponderant.

At a global scale, we estimated FOC stock in the uppermost bedrock to a depth of 1m. That first estimate is of the same order of magnitude than soil OC (generally also calculated to a depth of 1 m), but obviously do not exhibit the same turnover of its OC.

We focus now to the preliminary estimate of FOC fluxes in world major watersheds that store about one half of the global FOC stock. For each of these watersheds, we attempt to calculate these fluxes by taking into account: their bedrock lithological composition, their mechanical and chemical rock denudation, their land cover type overlaps.

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