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FOSSIL ORGANIC CARBON IN CONTINENTAL SURFACE: A MODELLING OF THE STOCK AND THE FLUX FROM THE WEATHERING OF SEDIMENTARY ROCKS

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It is well known that the biogeochemical carbon cycle plays a major role in climate change. Hence, it is also crucial to well constrain the different carbon species involved in such cycle, and answer to these following questions: what are the stocks of different carbon guises in carbon pools and what are the exchanges between them? As an example of a misunderstanding guise of carbon in continental surface is the fate of Fossil OC delivered to terrestrial geosystems through erosion and weathering processes of sedimentary rocks. FOC was frequently considered to balance the burial of OC through its total mineralization at outcrop. Though, FOC was characterised in various modern carbon pools and two studies, as Blair *et al.*, (2003) has revealed a significant estimate of FOC delivered to world's ocean (40-80 10^6t.yr^{-1}). Laslty, FOC release by weathering of shales and carbonates was estimated at 100 10^6t. yr^{-1} (Di-Giovanni *et al.*, 2002).

Here we focus on storage of FOC in the first meter of sedimentary rocks and the FOC yielded by the weathering of carbonates and shales in global continental surface. Two major results were expected: built some global maps of FOC storage and FOC fluxes (1°x1° grid resolution) and provide some modelled values for stock and fluxes both at global scale than at the catchment scales (40 major river basins). So, this study requires i) some world maps of river basin limits, continental rock lithology, and continental runoff, ii) average carbon content for sedimentary rocks, iii) average density of carbonates, shales, and sandstones/sands. Input of FOC to modern environments from rock weathering was estimated using GEM-CO_2, an approach that models CO_2 consumption by chemical weathering of rocks to calculate weathering rates (Amiotte-Suchet et al., 1995).

Global FOC storage in the first meter of sedimentary rocks for the studied major watersheds is about 448 10^9t, and 1100 10^9t at the global scale. The distribution is driven by the average TOC value of rock types, this is the reason why shales exert a strong control on the amount and distribution of the FOC stock (Fig. 1). Due to abundance of shales and surface, the Amazon drainage basin stores the largest amount of fossil carbon (>73 10^9t). The map of FOC yield resulting from the chemical weathering of shales and carbonates (Fig. 1), exhibits a heterogeneous distribution caused by that of TOC values, weathering index of sedimentary rocks and runoff. The total annual FOC yield for the 40 drainage basins combined is 20.04 10^6t, which corresponds to about half of the total global annual yield (42.90 10^6t), which is about twice that previously estimated. It is expected that a quarter of the FOC released to the Earth's surface is produced by the Amazon drainage basin (10.74 10^6t).

Our modelling demonstrates that both storage and chemical release of FOC are significant for the supergene carbon cycle. Results impacts and questions both on the origin of OC in soils and rivers and suggest that stock of Black Carbon, exhibiting the same ubiquity and physico-chemical properties of FOC, in soil should be re-estimate taking into account this fossil component.

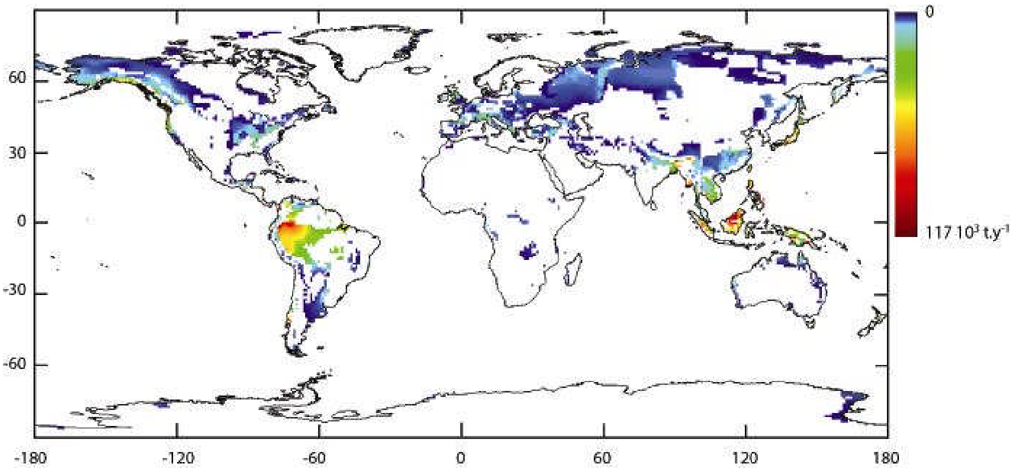

Figure 1. Annual FOC fluxes for each grid cell (10^3 t.yr^{-1}) delivered by chemical weathering of carbonate and shale for the entire continental surface. Values vary between 0 to 117 10^3t yr^{-1} and were calculated according to GEM-CO_2 model. Due to a high runoff, tropical climatic zones provide the main FOC amount yielded by rock weathering.

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