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Fossil organic carbon fluxes released by chemical and mechanical weathering. Jurassic marls of Draix experimental watersheds, France.

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Fate of Fossil Organic Carbon (FOC), originating from sedimentary rock weathering, is a major unknown into carbon cycle. Generally considered as degradable and as a CO2 source for the atmosphere, its occurrence was highlighted by numerous studies in various pools, such as rivers, soils and recent sediments, indicating a potential resistance to weathering.
This work focuses on annual FOC fluxes released by chemical and mechanical weathering of Jurassic marls occurring in the Draix experimental watersheds (Alpes de Haute Provence, France). Results of optical, geochemical, molecular and isotopical analyses allow to confirm the FOC occurrence and to its contribution, both in the studied soils and riverine particles. In detail, no FOC losses are observed for rock mechanical weathering process, and FOC losses do not exceed 30 % for rocks chemical weathering process. Annual export monitoring of solid and dissolved materials, obtained for twenty years at the watershed outlets, allowed FOC fluxes to be modelled. These fluxes mainly depend on watershed geomorphologic characteristics, such as vegetation rate, slope and annual precipitation heights. Results show that FOC fluxes released by rock mechanical erosion (FmFOC) and exported in rivers loads, range between 0.1 and 100 t km2 year-1, whereas those released by rocks chemical weathering (FcFOC) range between 1 and 7 t km2 year-1. Developed models permit to estimate the temporal evolutions of FOC fluxes: since the XIX th century, in order to limit mechanical weathering in this area, human reforestation brings an increase of chemical weathering, to the detriment of mechanical one. In the studied watersheds, since 1850, FcFOC average flux increased from 0.15 to 5 t km2 year-1 whereas FmFOC average flux dropped of 70 to 0.1 t km2 year-1. Models also permit to test FOC contribution from small watersheds to regional scale. In natural conditions, such geological formations can deliver 31050 t year-1 FOC to the Rhône river. Such FOC contribution can reach 15 % of the river's Particulate Organic Carbon flux. These results emphasize the importance of FOC delivery in modern carbon fluxes and in carbon cycle.