Carbon dioxide emissions from sedimentary rock weathering: New insight from a paired catchment approach

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Carbon dioxide (CO_2) concentrations in the atmosphere regulate Earth's climate. Among the processes involved in the long term carbon cycle, oxidative weathering of sedimentary rocks is potentially an important source of CO_2 to the atmosphere. Two major weathering reactions must be considered: i) the oxidation of rock-derived organic carbon (OC); and ii) the oxidation of sulphides, production of sulphuric acid and the subsequent dissolution of carbonate minerals. The carbon fluxes from these two processes are thought to be high, but they are still poorly constrained in river catchments, hindering our knowledge of the rates and patterns of CO_2 emissions at a global scale.

We use trace element Rhenium (Re) to quantify the rock organic carbon weathering flux. The rates of sulphide oxidation and sulphuric acid production are assessed using isotope composition of riverine sulphide ($\delta^{34}S_{SO4}$ and $\delta^{18}O_{SO4}$), alongside with ion fluxes to quantify the associated dissolution of carbonates. We present new data from two marl dominated catchments located in Southern French Alps: i) Laval and ii) Brusquet rivers (Draix CRITEX Observatory). These catchments have very distinct physical erosion rates and vegetation cover. We use time series river water samples to investigate sessional variability in dissolved chemistry and oxidative weathering reactions. We find large seasonal variability of dissolved Re/SO_4 ratios and $\delta^{34}S_{SO4}$, indicating variable seasonal contributions of sulphide to rock carbon oxidation. This work will improve our understanding of CO_2 emissions associated with oxidation of sedimentary rocks at the river catchment scale.