Combining short-lived radionuclides and an erosion model to understand present-day sediment transfer in a small mountain catchment (French Pyrenees)

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The objective of this study was to evaluate and simulate erosion and sedimentation processes in an average altitude catchment (French Pyrenees). A dam-reservoir with a storage capacity of 850 000 m^3 acts as a major sediment trap for this small catchment (2.8 km^2).

Two approaches were combined. The first approach, based on the WATEM/SEDEM model, predicts soil erosion and sediment deposition at the catchment scale. This model combines a physical description of the catchment (soil, topography, vegetation cover....) and climatic input data (mean annual precipitation).

The second approach is based on an approximately monthly sampling conducted in this watershed in 2007. Atmospheric fallouts were determined using a collector, suspended particulate matter and organic carbon concentrations were determined for the permanent streams and for the reservoir. Settling particles were collected using sediment trap. Activities of ^{7}Be ($T_{1/2}$ = 53 days) and ^{210}Pb ($T_{1/2}$ = 22.3 years) were determined for each sample using a low-background, well-shaped γ spectrometer. In addition, two sediment cores were collected to quantify sedimentation rate in the reservoir (X ray image, porosity, ^{137}Cs and ^{210}Pb).

Based on results from the model and stream survey, we highlight that the sediment feeding of the reservoir is mainly related to diffuse inputs from the whole catchment rather than spatially-delimited ones (streams). The ^{7}Be/^{210}Pb activity ratios of atmospheric fallouts, in suspended and trapped particles show marked spatio-temporal variations. Sediment ages were calculated using ^{7}Be/^{210}Pb activity ratios. Sediment budget and sediment ages will be discussed in order to demonstrate the interest of such a combined approach to investigate soil erosion, sediment delivery and sedimentation processes in a small mountain catchment.

High performance automated ion chromatography separation for Ca isotope measurements in geological and biological samples

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Natural mass-dependent fractionation of calcium isotopes is a promising tool for investigating Ca pathways and cycling in geological and biological materials. But since natural isotope fractionation of Ca appears to be extremely limited (~1.25‰/amu), excellent external precision and sensitivity are needed to make full use of its potential. Here, we describe a new Ca purification procedure, that consists in a high sensitivity automated ionic chromatography separation protocol (using ICS-3000, Dionex), suitable for Ca isotope measurements by mass spectrometry and applicable to multiple natural matrixes (waters, mineral and organic samples). The analytical advances in this automated technique are multiple: (1) gain of time with a minimum of handling, (2) complete separation of Ca from K, Mg and Sr, avoiding isobaric interferences which are critical during TIMS analysis and (3) Ca separation by peak recognition optimising the full recovery of Ca even if its retention time is shifted from one sample to the other. The two latter advantages ensure a Ca recovery yield close to 100%, leading to the absence of any fractionation of Ca isotopes during the chemical clean-up. Thus, this chemical separation will be of special interest for applications not compatible with the use of the double spike technique such as MCICP-MS and ^{40}Ca excesses measurements. Additionnally, this procedure leads to a twofold improvement of the long-term reproducibility of the Ca isotopes determination by TIMS (±0.11 for $\delta^{44/40}$Ca, 2SD) compared to the classical protocol using the Biorad AG50W-X8 resin chemistry and is similar to the best reproducibility published so far.