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Biomarkers and isotopic fingerprinting to track sediment origin and connectivity at Baldegg Lake (Switzerland)

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Slope destabilization and associated sediment transfer are among the major causes of aquatic ecosystems and surface water quality impairment. Through land uses and agricultural practices, human activities modify the soil erosive risk and the catchment connectivity, becoming a key factor of sediment dynamics. Hence, restoration and management plans of water bodies can only be efficient if the sediment sources and the proportion attributable to different land uses and agricultural practices are identified.

Several sediment fingerprinting methods, based on the geochemical (elemental composition), color, magnetic or isotopic (^{137}Cs) sediment properties, are currently in use. However, these tools are not suitable for a land-use based fingerprinting. New organic geochemical approaches are now developed to discriminate source-soil contributions under different land-uses:

1. The compound-specific stable isotopes (CSSI) technique, based on the biomarkers isotopic signature (here, fatty acids δ^{13}C) variability within the plant species,
2. The analysis of highly specific (i.e. source-family- or even source-species-specific) biomarkers assemblages, which use is until now mainly restricted to palaeoenvironmental reconstructions, and which offer also promising prospects for tracing current sediment origin.

The approach was applied to reconstruct the spatio-temporal variability of the main sediment sources of Baldegg Lake (Lucern Canton, Switzerland), which suffers from a substantial eutrophication, despite several restoration attempts during the last 40 years. The sediment supplying areas and the exported volumes were identified using CSSI technique and highly specific biomarkers, coupled to a sediment connectivity model. The sediment origin variability was defined through the analysis of suspended river sediments sampled at high flow conditions (short term), and by the analysis of a lake sediment core covering the last 130 years (long term).

The results show the utility of biomarkers and CSSI to track organic sources in contrasted land-use settings. Associated to other fingerprinting methods, this approach could in the future become a decision support tool for catchments management.