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All fats are not equal: Considerations when using fatty acid biomarkers in compound-specific stable isotope soil and sediment tracing

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The development of cost-effective, convenient and reliable methods for tracing sediment movement will help establish water security. The use of compound-specific stable isotopes (CSSIs) has seen limited, small-scale applications, often in watersheds exhibiting exotic and highly diverse vegetation types.

The CSSI tracing technique relies on the detection and transport of naturally occurring organics of plant origin (biomarkers); the biomarkers of interest are produced by flora, deposited on the soil and potentially mobilized along with soil particles. In part, the uniqueness of a biomarker is dependent on its biological pathway. As a plant fixes CO_2–its primary source of carbon for building larger organic molecules–discrimination against the heavier 13C isotope leads to an enrichment of 12C. The more complex the biological pathway the biomarker has been subjected to, the more discrimination and unique isotopic signature the biomarker exhibits.

Successfully implementing CSSI tracing requires recognizing: (i) factors contributing to the natural variability of the isotopic signature (ii) the suitability of a biomarker and (iii) factors affecting sensitivity during analysis. Considering the relatively low input of suitable organic biomarkers into the soil and degree of signal dispersion, care must be taken to isolate and correctly identify biomarkers, particularly where vegetation types show low variability and where long-range transport occurs.

Research is currently being conducted in the Horsefly River (British Columbia, Canada) and South Tobacco Creek (Manitoba, Canada) watersheds; the research seeks to address some of these concerns, particularly in a temperate climate where exotic vegetation types are not common and variability is expected to be low.