Solid phase extraction of dissolved organic matter from across the terrestrial to aquatic interface

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Understanding the chemical heterogeneity of dissolved organic matter (DOM) originating from different land positions along the terrestrial to aquatic interface can provide insights into a poorly constrained global carbon flux. By applying holistic analytical approaches, such as nuclear magnetic resonance (NMR), the location and extent of transformation of terrestrial DOM in response to direct and indirect climate effects can be ascertained and contribute to our understanding of C-climate feedbacks.

Solid phase extraction via a styrene-divinylbenzene copolymer (SPE-PPL) is a chemical isolation method that is commonly used to prepare dissolved organic matter (DOM) samples for solution-state NMR analysis. Despite its growing popularity, SPE-PPL has been hypothesized to select against some major components of DOM; however, this is likely dependent upon how the SPE procedure is carried out. This study investigates how the methodological parameters used in SPE-PPL may affect extraction yields and selectivity of DOM sourced from different land positions along the terrestrial to aquatic interface (stream, soil and ground water). Quantitative analysis of dissolved organic carbon and nitrogen (DOC/DON) was used to assess the relationship between SPE-PPL yields and flow rate, sample volume and sample type. Solution-state hydrogen (H) NMR was performed to investigate how chemical selectivity may relate to DOC and DON yield and the SPE-PPL parameters used (e.g. sample volume and application rate).

Average SPE-PPL DOC yields ranged from 50–80%, while DON yields ranged from 15–40%. SPE-PPL yields and selectivity were independent of sample application rates. However, higher sample loading volumes of soil water DOM exhibited selective loss of O-alkyl C relative to aliphatic C. However, this volume dependent selectivity was not observed with groundwater where O-alkyl C represented a smaller fraction of the total DOM. This source dependency of volume-induced selectivity represents an important caveat for applying the SPE-PPL technique to DOM across the terrestrial-to-aquatic interface.

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