Geophysical Research Abstracts
Vol. 21, EGU2019-6651, 2019
EGU General Assembly 2019

Lignin Dimers as Potential Markers for 14C-young Terrestrial Dissolved Organic Matter in the Critical Zone

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In the Critical Zone, the molecular composition of dissolved organic matter (DOM) integrates essential information that links surface and subsurface processes. New and specific marker compounds can improve our understanding of DOM dynamics and enhance our ability to trace surface signals into the subsurface. Here we used FT-ICR-MS and 14C-AMS in order to identify markers for fast transport of surface-derived DOM through the Critical Zone. We assessed the molecular composition and radiocarbon age of solid phase extracted DOM (SPE-DOM) from forest top soils. Solid phase extraction did not introduce a significant bias to the calibrated radiocarbon ages of SPE-DOM when compared to the corresponding bulk DOM. Rank correlation of the molecular composition and radiocarbon ages of SPE-DOM revealed that molecular entities with younger 14C ages had lower molecular weight, higher unsaturation and less oxygen and heteroatoms than those associated with older 14C ages. By compiling structure suggestions from the ChEBI database for molecular entities strongly associated to 14C age we could further identify molecules linking to inputs from decaying plant biomass. Among them, lignin dimers emerged as prominent surface-derived compounds that can potentially be used as markers for fast transport of water and DOM into the subsurface and groundwater.