Spatiotemporal Transformation of Dissolved Organic Matter along an Alpine Stream Flowpath on the Qinghai-Tibetan Plateau: Importance of Source and Permafrost Degradation

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Introduction

As a climate sensitive region, accelerated climate warming has led to permafrost thaw on Qinghai-Tibetan Plateau (QTP). When permafrost derived organic carbon enters aquatic systems, it can be rapidly mineralized and transformed by microbes and light. The seasonal thawing-freezing cycle of permafrost soils leading to variability chemical composition of dissolved organic matter (DOM) in permafrost-impacted watersheds. The detailed chemical characterization of DOM is essential to illustrate the environmental behavior and the fate of seasonally exported permafrost organic carbon.

Experimental

We collected leachates from the active layer (AL), permafrost layer (PL) and stream waters on the northeast QTP. By coupling different analytical techniques (e.g., FT-ICR MS, NMR, radiocarbon age, UV-visible spectroscopy), we conducted detailed characterization of the organic matter composition of DOM and traced the persistence and degradation of permafrost-derived DOM in an alpine fluvial network.

Results and Discussion

FT-ICR MS identified 6409 molecular formulas specific to AL-leachates (i.e. not observed in the PL fig.1). Through various stream processes, some AL specific formulas were removed from the DOM pool (from 17% by Q-1 up to 59% by Q-17). Most PL-specific formulas were more biolabile components, e.g. aliphatics and peptide-like compounds assignments (73%), and 90% of these PL-specific molecular formulas were lost. Seasonal variation of the 14C age shows an increase in the relative contribution of deep soil carbon.

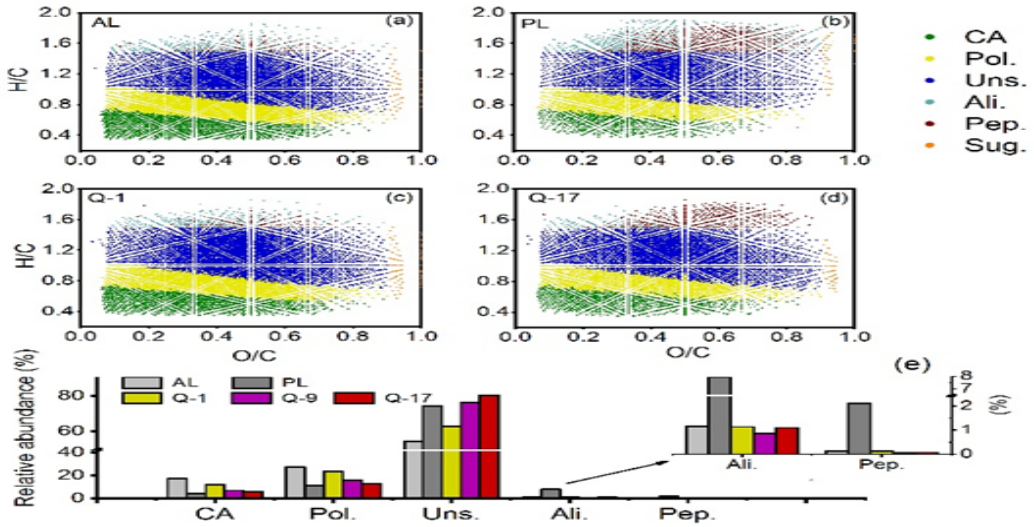

Fig. 1 van Krevelen diagrams of AL and PL leachate DOM (a,b), headstream DOM Q-1 (c), downstream DOM Q-17 (d), the relative abundance of defined compound class in different samples (e).

Conclusion

Our study thus demonstrates that hydrological conditions impact the mobilization of permafrost carbon in an alpine fluvial network, the signature of which is quickly lost through instream mineralization and transformation.

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References

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