Selective Leaching of Dissolved Organic Matter (DOM) from Alpine Permafrost Soils on the Qinghai-Tibetan Plateau

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Introduction

The Qinghai-Tibetan Plateau (QTP) is highly sensitive to climate change. Past studies of Arctic systems have suggested that DOM leached from the permafrost layer (PL) has a higher biolability and a lower photolability than DOM leached from the active layer (AL). Since the persistence of DOM is related to intrinsic chemical composition, detailed characterization of the chemical composition of PL and AL leachates on the QTP is needed.

Experimental

We collected soils and leachates from the AL and PL in a thermoerosion gully on the northeast QTP. By coupling different concentration (i.e., SPE, ultrafiltration) and analytical techniques (e.g., FT-ICR MS, NMR, radiocarbon age, fluorescence, UV-visible spectroscopy), we conducted detailed characterization of the organic matter composition of permafrost soils and different fractions of DOM from the AL and PL.

Results and Discussion

The FT-ICR MS data reveal the compositional difference between the DOM leached from the AL relative to the PL (Fig. 1). The PL SPE-DOM is more enriched in unsaturated compounds (74.2%) and has a higher proportion of biolabile components than that of the AL DOM including aliphatic compounds (7.9% versus 1.2%) and peptide-like compounds (2.1% versus 0.1%). An enrichment factor to express the degree of selected leaching of DOM is defined as: EC = ∑aromatic C in leachate DOM/aromatic C in source soil), which is 1.34 for AL leachate and 0.84 for PL leachate.

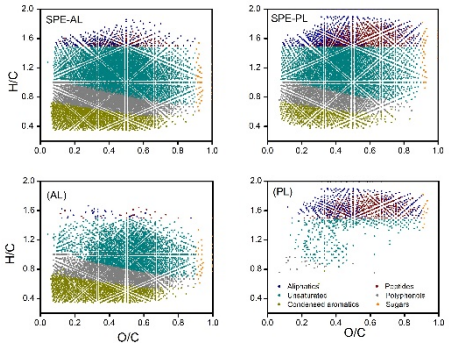

Fig. 1 Van Krevelen diagrams of DOM leachates and the unique molecular formulas found solely in AL and PL leachates.

Conclusion

We found preferential leaching of aromatic C from AL and proteins/carbohydrates from PL. Considering a seasonal thaw of entire AL but only a partial thaw of PL on the QTP, we postulate that photomineralization of aromatic C is currently an important pathway with respect to C fate. However, as the QTP is undergoing continued warming, the deeper permafrost soils will be thawed, leading to more biolabile material (e.g., carbohydrate and protein) to be mobilized.

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References

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