Molecular isotopic insights into organic matter-mineral associations and their impact on carbon cycling within river drainage basins

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The mobilization and export of carbon within river basins forms an integral component of the global carbon cycle, linking processes that take place within terrestrial landscapes with those in aquatic systems. Organo-mineral interactions are considered to play an important role in both realms, but understanding the partnership between organic matter and minerals across these systems, and its influence on organic matter fate, is hindered by the complex inputs and myriad processes that characterize the terrestrial-aquatic continuum.

In an effort to better understand controls on carbon cycling on the scale of fluvial drainage basins, we trace the evolution of vascular plant biomolecular marker signals (esp. leaf wax lipids and lignin-derived phenols) as they move from plant to soil to river. In particular, ^{14}C measurements are used to place constraints on the dynamics of terrestrial organic matter mobilization and transport.

We find contrasting radiocarbon characteristics for different vascular plant tracer compounds, implying different modes of storage and transport. Moreover, these characteristics correlate with different drainage basin properties. We attribute this contrasting behavior to variations in the mode and extent of association of different organic matter components with mineral phases. Overall, our findings suggest that organic matter-mineral associations play a fundamental role in modulating overall residence times and transport pathways of terrestrial plant carbon in river basins.