Title: Global Trait-Based Chemogeography of Organic Matter Thermodynamics

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Project Abstract: *This study is part of an Early Career project focused on transforming our ability to understand and predict how the influences of biogeochemical hot spots and hot moments on surface–subsurface systems are altered by perturbation. New theory and models are being developed across a broad range of watersheds to ultimately inform next-generation Earth system models and help preserve long-term national clean water security.* River corridors are fundamental to global elemental cycles, and thermodynamic traits of organic matter (OM) underpin biogeochemical processes in these ecosystems. Theory allows use of OM thermodynamics in predictive models, but is limited by knowledge gaps associated with trait chemogeography and relationships among traits. We used globally crowdsourced samples to address this need. We reveal latitudinal and longitudinal trait gradients in both inland and coastal river corridors. Global relationships among traits indicate first-order constraints tied to a universal tradeoff based on thermodynamic controls over the efficiency of converting OM into biomass. River water and sediment OM diverge markedly in their position along this tradeoff axis. Large scale chemogeography and universal trait relationships enable inclusion of OM thermodynamics in predictive models across scales.