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Spatial distributions of core and intact glycerol dialkyl glycerol tetraethers (GDGTs) in the Columbia River basin, Washington: Insights into origin and implications for the BIT index

David W. French (1,2), Carme Huguet (3), Stuart Wakeham (4), Courtney Turich (4), Laura T. Carlson (2), and Anitra E. Ingalls (2)

(1) School of Environmental and Forest Sciences, University of Washington, P.O. Box 352100, Seattle, Washington 98195-2100, (2) School of Oceanography, University of Washington, P.O. Box 357940, Seattle, Washington 98195-7940, (3) Departamento de Geociencias, Universidad de los Andes, A.A. 4976. Bogotá, Colombia (South-America). , (4) Skidaway Institute of Oceanography , 10 Ocean Science Circle , Savannah, Georgia 31411

Branched and isoprenoid glycerol dialkyl glycerol tetraethers (GDGTs) are used to reconstruct carbon flow from terrestrial landscapes to the ocean in a proxy called the branched vs isoprenoid tetraether index, or BIT Index. The index is based on analysis of core GDGTs from non-living material that originate from the cell membranes of bacteria living in soils and archaea living primarily in the marine environment. However, uncertainty in the identity and location of branched GDGTs (BrGDGTs) producing organisms and the likely production of isoprenoid GDGTs (IsoGDGTs) in terrestrial environments hinders interpretation of the BIT Index. Since BrGDGTs remain our only tool to study BrGDGT producing organisms, it is particularly important to use the intact form of BrGDGTs, present in living cells, to infer organism distributions. In situ production within riverine, lacustrine, and marine environments is currently thought to be possible, yet few measures of intact BrGDGTs (I-BrGDGTs) are available to confirm this. Here we assess the spatial distribution of both core and intact GDGTs throughout the Columbia River basin and nearby areas in Washington and Oregon in order to elucidate source environments for these lipids. The presence of I-BrGDGTs throughout the studied soils, rivers and estuaries suggests in situ production across the continuum from soil to marine environments. Likewise, intact crenarchaeol, the marine endmember isoprenoidal GDGT used in the BIT index, was present in all samples. Widespread production of each GDGT class along terrestrial carbon transport paths likely alters the BIT Index along this continuum. The core to intact GDGT ratios and the weak correlation between I-GDGT derived BIT values and carbon isotope signatures suggest a mixture of allocthonous and autochthonous sources of GDGTs in riverine and marine environments. Our findings highlight the need for further work into the provenance of GDGTs to improve the BIT index and other environmental proxies that rely on these compounds.