Distribution of “minor” amino acids enantiomers in dissolved organic matter in marine vs. inland waters

YASUHIKO T. YAMAGUCHI[1]*, MATTHEW D. MCCARTHY[2], CHIKAGE YOSHIMIZU[3], ICHIRO TAYASU[3], KEISUKE KOBA[4], KAZUHIDE HAYAKAWA[1]

[1] Lake Biwa Environmental Research Institute, Otsu 520-0022, Japan (*correspondence: yamaguchi-y@lberi.jp)
[2] University of California, Santa Cruz, Santa Cruz, CA 95064, US
[3] Research Institute for Humanity and Nature, Kyoto 603-8047, Japan
[4] Center for Ecological Research, Kyoto University, Otsu 520-2113, Japan

Dissolved organic matter (DOM) plays crucial roles in the biogeochemical cycles in aquatic environments. One of key questions in this field is understanding the origin of recalcitrant DOM (RDOM).

High abundance of D-amino acid enantiomers (D-alanine, D-glutamic acids, D-aspartic acids, and D-serine) have suggested that bacterially-sourced organic matter is a major source of the ocean’s RDOM pool (e.g., McCarthy et al. 1998, Science; Kaiser & Benner 2008, LO). At the same time, recent GC-MS analysis of D-amino acids in DOM in the oligotrophic open ocean have identified ubitious occurrence of novel “minor” D-amino acids, such as D-leucine, D-valine, D-phenylalanine (Yamaguchi & McCarthy 2018, GCA; Broek et al. 2019, GCA). While these new D-AA have been propsed as detailed tracers for RDOM in the open ocean, the sources of these “minor” D-amino acids are not well understood.

In this study, we quantified the “minor” D-amino acids in DOM samples in a freshwater environment (Lake Biwa, Japan: a deep, large meso-oligotrophic lake) and a marine coastal upwelling reagion (California upwelling system, US: one of the hotspots of marine DOM production with small river influxes: e.g., Walker & McCarthy 2012, LO). To our knowledge, these are the first data from environments other than the oligotrophic open ocean. In the DOM from the California upwelling system, the “minor” D-amino acids were not significantly detected. On the other hand, the DOM from the Lake Biwa system contains significant contribution of the “minor” D-amino acids (D/L ratio was up to 0.1). These novel data suggest that the “minor” D-AA can potentially be environment-specific tracers for RDOM.