南極湖沼溶存有機物の化学的多様性

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Chemodiversity of dissolved organic matter in Antarctic lakes

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Dissolved organic matter (DOM) exists ubiquitously in water and is involved in various biogeochemical processes. Primary producers in Antarctic lakes are the primary source of DOM as the surrounding landscape lacks terrestrial plants and organic rich soils. This unique feature of Antarctic lakes is interesting to evaluate the structural characteristics and functionality of DOM, which depend on source material and the environmental processing. Although the chemical distinctions between DOM from Antarctica and other regions are recognized, chemical diversity (chemodiversity) within Antarctic DOM is unknown. In this study, we report the diversity of DOM obtained from various lakes and streams (in Valleys Yukidori and Yatsude) of Soya Coast, East Dronning Maud Land, East Antarctica (n = 77). Water samples taken from the lake center (n = 35) or lake shore (n = 24) and streams (n = 18) were filtered through a glass fiber filter (pore size of 0.3 μm) and immediately measured for absorbance and excitation emission spectroscopy (3D-EEM), and the rest was stored in a glass bottle and transferred to Japan. In the laboratory, the samples were fractionated into humic substances (HS) and non-HS by DAX-8 resin batch adsorption technique (Tsuda et al., 2012), and %HS was determined. $SUVA_{254}$ (index of aromaticity) and S_R (index of molecular weight) were calculated from the carbon concentration and/or absorbance data to provide structural characteristics of DOM. %HS tended to be low (11–37%) in aquatic systems that are fed by glacier melt and high in lake bottom and pore water (29–56%). $SUVA_{254}$ exhibited a similar tendency with that of %HS, while S_R showed an opposite. These results suggest that Antarctic DOM increases molecular weight and aromaticity in the spectrum of glacier melt-lake water-pore water, and that these changes are driven by the activity of primary producers. We will also consider the results of 3D-EEM in the presentation.

溶存有機物（DOM）はあらゆる水の中に存在し、種々の生物地球化学的過程に関与する。南極大陸は DOM の起源となる有機物を産生する陸上植生が乏しく、従って DOM の起源はほぼ全てが湖内の一次生産者である。この南極湖沼のユニークな特徴は起源物質と生成場に依存する DOM の構造特性と機能性を評価するうえで興味深い。南極とその他の地域の湖沼 DOM の違いは認知されているものの、南極湖沼 DOM の化学的多様性に関しての知見は欠如している。本研究では宗谷海岸露岩域の大小さまざまな湖沼および沢（雪鳥沢とやつで沢）から得られた DOM（n = 77）の化学的多様性を報告する。湖心（n = 35、水深別あり）もしくは湖岸（n = 24）および沢（n = 18）から採取した水試料はガラス繊維ろ紙（孔径 0.3 μm）でろ過し、直ちに吸光度および三次元励起蛍光スペクトル（3D-EEM）を測定し、残りはガラス瓶に保存して日本に保冷移送した。持ち帰った試料は、バッチ式 DAX-8 樹脂吸着・炭素量測定法 (Tsuda et al., 2012) により DOM をフミン物質（HS）と非 HS に分画定量し、HS 割合を算出した。また、DOM の化学構造特性の指標として、吸光度と炭素濃度から $SUVA_{254}$（芳香族性の指標）および S_R（分子量の逆指標）を算出した。HS 割合は氷河に滋養される水系で低く（11~37%）、湖沼の底泥直上水や底泥間隙水で高い（29~56%）傾向にあった。$SUVA_{254}$ は HS 割合と同様の傾向を示し、S_R は逆の傾向を示した。これらの結果から、南極湖沼・河川の DOM は氷河融水―湖水―底泥間隙水のスペクトルの中で分子量および芳香族性を増加させ、かつその変化は一次生産者の活動により駆動されることが示唆される。発表では、3D-EEM の測定結果も併せて考察する。

Reference

Tsuda, K., Takata, A., Shirai, H., Kozaki, K., and Fujitake, N., A method for quantitative analysis of aquatic humic substances in clear water based on carbon concentration, Anal. Sci. 28, 1017–1020, 2012.