Hydrogen and carbon isotope fractionation during lipid biosynthesis of terrestrial plants

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Compound-specific δD is expected as a new proxy to study organic geochemistry. It is important to study isotopic compositions of various lipid biomolecules in terrestrial plants, which should be closely related to the biosynthetic pathway. The isotopic fractionations occur during enzymatic reactions due to the kinetic isotope effects on intermediate compounds.

The purpose of this study is application of dual stable isotope (carbon and hydrogen) techniques to study lipid biosynthesis of terrestrial plant. We determine compound-specific δD and $\delta^{13}C$ for various lipid biomolecules such as *n*-fatty acids, *n*-alkanols, *n*-alkanes, phytol, squalene and sterols consisting of seven terrestrial C3 plant leaves, and report different isotope fractionations associated with the various lipid biosyntheses.

Results and discussion

Hydrogen isotopic fractionation (ε_{water}) is calculated between δD values of lipid molecules and ambient water (Scheme 1). Carbon isotopic fractionation (ε_{bulk}) between $\delta^{13}C$ values of lipid molecules and bulk tissue is also calculated (Scheme 2).

$$\varepsilon_{water} = 1000[(\delta D_{lipid}+1000)/(\delta D_{water}+1000)-1] \quad (1)$$

$$\varepsilon_{bulk} = 1000[(\delta^{13}C_{lipid}+1000)/(\delta^{13}C_{bulk}+1000)-1] \quad (2)$$

The ε_{water}-ε_{bulk} cross polts (Fig.1) clearly indicate that various biosyntheses are isotopically distinguishable. Three acetogenic lipids have similar ε_{water} values, and have a wide variation in the ε_{bulk} values. On other hand, phytol and C_{30} isoprenoids such as squalene and sterols have quite different fractionations on both ε_{water} and ε_{bulk}, even though these isoprenoids are biosynthesized from isoprene.

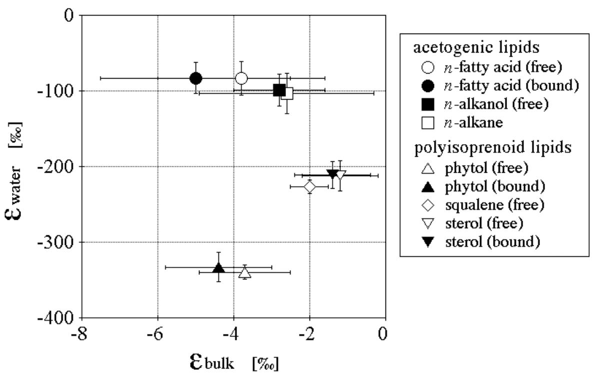

Fig.1 The ε_{water}-ε_{bulk} diagram during various lipid biosynthesis among terrestrial C3 plants. Each symbol and bars denote the mean and standard deviation in seven species, respectively.

Sr, Nd and Pb isotopic investigations of late Cenozoic alkali basalts and their ultramafic xenoliths in South Korea: A mixing zone in the source mantle beneath East Asia

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We obtained Sr, Nd and Pb isotope data of late Cenozoic basaltic rocks and clinopyroxene separates from their ultramafic xenoliths in Jeju Island, Baekryeong Island, Jogokri and Ganseong, South Korea in order to understand the geochemical nature of the source mantle.

Most xenoliths, including both the Group I and II, have isotopic compositions within the combined range of MORB-OIB data, with half of them possessing MORB-like compositions. Two Ganseong xenoliths (wherlite and clinopyroxenite) have highly enriched Sr and Nd isotopic ratios and old Nd model ages of 2.5-2.9 Ga, and plot far away from the MORB-OIB field in isotopic correlation diagrams. In general, the isotopic compositions of the xenoliths are different from those of the host basalts, suggesting that the lithospheric mantle represented by the xenoliths cannot be the source of the basalts.

The analyzed basalts have trace element and isotopic characteristics similar to oceanic island basalts, suggesting asthenospheric sources. The Jeju basalts possess EM2 signature in Sr-Nd-Pb isotopic correlation diagrams, whereas the basaltic rocks from Baekryeong Island and Ganseong, along with those from Ulreung and Dok Islands in the East Sea (Sea of Japan), display a mixing trend between DMM and EMm (an end member between EM1 and EM2). Available isotopic data for the Cenozoic basalts in East Asia, along with ours, show that the source mantle has a DMM-EM1 array for northeast China and a DMM-EM2 array for Southeast Asia. We note that the basalts with the DMM-EMm array are located between the two large-scale isotopic provinces, i.e., around the middle part of the Korean Peninsula. These observations suggest that there is a mixing zone between the two provinces in the source mantle (preferably the asthenospheric mantle) for the Cenozoic basalts.