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Variations of palaeovegetation recorded by terrestrial plant biomarkers in the mid-Cretaceous sequence in Hokkaido

Hideto Nakamura[1*], Ken Sawada[1], Reishi Takashima[2]

[1]Faculty of Science, Hokkaido University, [2]Tohoku University Museum

The Early Cretaceous is an interval of exceptional interest for understanding the early evolution and expansion of angiosperm. The reconstruction and ecological interpretation of the Cretaceous flora, however, are far from complete because of some disadvantages of classical palaeobotanical and palynological studies (e.g. Rare occurrence of morphologically well-preserved fossils). Therefor, palaeovegetation and palaeoenvironment trend through the Early- to Mid-Cretaceous remain largely ambiguous. Several studies suggested that higher plant terpenoid in the marine sediments records palaeovegetational change involved with climatic variations [eg. 1]. In this study, biomarker analysis were carried out for the Aptian to Cenomanian sediments of the Oyubari area, central Hokkaido, Japan, in order to reconstruct uncharted vegetational history of early angiosperms in the Eastern margin of Eurasia.

The sediments studied comprised 24 mudstone and 2 tuffaceous sand stone sampled along the outcrop of exposed along the Tengu-sawa Valley in the Oyubari area, Hokkaido. The angiosperm fossils hitherto reported from Albian in the Yezo Group. Powdered samples were ultrasonically extracted by methanol (MeOH), MeOH/dichloromethane (DCM) and DCM. The lipid extract was separated by silica gel column to four fractions. Aliphatic lipid and Aromatic lipid fraction were analyzed by GC/MS.

The maturity indices of C_{29} steranes ($20S$ / ($20S$ + $20R$)) show almost constant value through the studied section, reaching the late diagenesis to catagenesis stage. The C_{27}/(C_{27}+C_{29}) sterane values (approx. 0.35), high Pristane/Phytane ratio (ca. 4.0) indicate that predominance of terrestrial organic matter, which is concordant to previous reports by macerals observation and elemental analysis. Aromatic triterpenoids (oleanane type, ursane type, and lupane type) identified in this study are diagenetic derivatives originated from biosynthetic angiospermous triterpenoids (e.g. amyrin). Gymnosperm-specific diterpenoids (retene, simonellite, dehydroabietane, norabietatriene, and dehydroabietine) are also identified. The Early Cretaceous sediments are characterized by very low concentrations of aromatic triterpenoids, yet continuously detected from the lowermost sample studied (ca. $>$115.5 Ma) that predates earliest report of angiosperm fossil in Japan. The aromatic angiosperm gymnosperm index (ar-AGI) was calculated by ratio of total aromatic angiosperm triterpenoids to the sum of total aromatic angiosperm triterpenoids and total gymnosperm diterpenoids, as molecular indicator of angiosperm / gymnosperm vegetation [2]. Higher plant parameter (HPP) were also calculated in formula [retene/(retene+cadalene)], which is proposed to reflect conifer vegetation, especially sensitive to Pinaceae contribution [1]. The Ar-AGI values generally increase during the Albian (0.01-0.38), which suggests that angiosperm vegetation expanded in the hinterland, while HPP values remain high (ca. 0.8) indicate that gymnosperms were dominant through Early Cretaceous. In addition, the biomarker vegetation indices suggests that the change of angiosperm/gymnosperm relative importance in vegetation was not uniform trend, but recording significant short-term variation. Because palaeobotanical and climatic information are only available in much lower temporal resolution, change in the palaeo aridity/humidity are inferred from the variation in $d^{13}C_{carbonate-wood}$ using previously reported carbon isotopic profiles[3]. From the result, significant variety recorded in ar-AGI and HPP are suggested to reflect change in environmental condition such as aridity/humidity.

Refferences
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