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北海道北部，上部白亜系堆積層の高等植物バイオマーカー分析による古植生変動の復元

Paleovegetational changes revealed from plant biomarker analysis in the Late Cretaceous sediments of northern Hokkaido

中村 英人[1*], 沢田 健[1], 高嶋 礼詩[2]

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

[1]北海道大学大学院理学院・理学研究科, [2]北海道大学創成研究機構

[1]Grad. Sch. of Science, Hokkaido Univ., [2]CRIS, Hokkaido University

The divergence and early evolution of angiosperms are important for plant evolution and history of the terrestrial ecosystem. The first appearance and divergence of angiosperms are generally believed to be early Cretaceous period by paleontological investigations. However, the detailed history of diversification and expansion of angiosperm during the Cretaceous is still less understood. Systematic investigations for reconstructing paleovegetation have not been able to be performed due to incompleteness of fossil record. Meanwhile, organic compounds preserved in ancient sediments and plant fossils potentially have records for paleovegetation through their chemotaxonomic characteristics [1]. However, there are few biomarker studies focused on reconstruction of the early evolution of angiosperms and its floras. According to palynological studies [2], angiosperm pollen explosively advanced in diversity in the Late Cretaceous sedimentary sequences in Japan. Thus, we analyzed terrestrial higher-plant biomarkers from sediments of the Lower Cenomanian to the Lower Campanian of the Yezo group, northern Hokkaido, Japan. The high-resolution lithology, biostratigraphy, and carbon-isotope curve in this area have been reported by the previous study [3].

Mudstone, sandy siltstone and sandstone samples were collected from the Hikagenosawa, Saku, and Haborogawa Formations in the middle upper part of the Yezo Group, exposed along the Kotanbetsu River and its tributary in northern Hokkaido, Japan. 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_{30}beta-hopanes gradually decrease toward the bottom of the sequence (0.44 - 0.06), while C_{29}steranes (20S / (20S + 20R)) are consistently low values (less than 0.1). These results indicate that organic matters in the sediments from the Kotanbetsu River are notably immature and well preserved even in the Cretaceous sediments. C_{27}-C_{29}sterane compositions and microscopic observation of macerals indicate that terrestrial organic matter predominates in the Kotanbetsu River area. Angiosperm biomarkers such as oleanoids are identified in both aliphatic and aromatic fractions. The general trends of oleanane abundances during the Late Cretaceous sediments are concordant with the angiosperms diversification. Aromatic triterpenoids (oleanane, ursane, and lupane types) identified in this study are diagenetic derivatives originated from biosynthetic oleanoids (e.g. amyrin). Gymnosperm-specific aromatic sesquiterpenoid (cadalene)

and diterpenoids (retene, simonellite, dehydroabietane, norabietatriene, and dehydroabietine) are also identified. 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 ratio [4]. Changes in Ar-AGI values principally represent the vegetation in the hinterland. The Ar-AGI values roughly increase in the Late Cretaceous, which suggests that angiosperm-dominant vegetation expanded in paleo-Hokkaido area. As paleovegetation changes were driven not only by long-term evolution trend, but also by climatic affect (seasonality, temperature and humidity variations), Ar-AGI fluctuations were compared to the palynological data, and correspond the known global events in more detailed discussion.

References
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