

Fossilization processes of Pliocene tree fossils from the Yasu River, Shiga Prefecture, Japan: Organic geochemical approach

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The Pliocene fossil forest (ca. 2.7 Ma) is known to be distributed in the Yasu River, Shiga Prefecture, Japan. The tree fossils in the forest are characterized by blackish coal-like tissues in the surface but living tree-like fresh lignite in their inner part. In the present study, we investigate by organic geochemical analyses to identify the taxonomy and to examine fossilization, diagenesis, and taphonomy of the tree fossil.

The tree fossils used was separated to three parts; surface (outer), intermediate, and inner parts. The outer part is blackish coal-like tissue, but inner part is brownish lignite. The intermediate part is dark brownish lignite-like tissue. Lipids were extracted with dichloromethane/methanol, and separated to aliphatic, aromatic and polar fractions. Lipids were identified and quantified by GC-MS. The residues after extraction were used for pyrolysis and thermochemolysis by GC-MS equipped a Curie-point pyrolyzer. Thermochemolysis was performed with tetramethylammonium hydroxide (TMAH)

By the thermochemolysis, vanillic phenols are predominantly detected in all parts of the tree fossils. Phyllocladane and cuparane were identified as major plant-derived terpenoids in fee (extractable) components of the fossil samples. The phyllocladane is conifer-derived diterpenoid, and cuparane is a specific sesquiterpenoid produced by subfamily Cupressaceae. In addition, sugiol, which originated from family Taxodiaceae, were not detected in the fossil samples. Thus, the tree fossil can be presumably identified as subfamily Cupressaceae.

Polyaromatic hydrocarbon (PAH), which are generated by combustion at high temperature, were hardly detected in the blackish outer sample. Thus, the fossil did not experience burning by wild fire etc. The relative abundances of aldehyde-type lignin phenols are clearly lower in the outer sample, implying that degradation of woody tissues took place in the outer parts of fossil. Interestingly, aromatic and A-ring degraded (des-A) terpenoids were identified as free compounds in the outer sample. The aromatic and des-A terpenoids were reported to be compounds generated by microbial degradation during early diagenesis. The facts indicate that the woody tissues might be degraded by microbial activity in the outer part of the tree fossil. Moreover, the relative abundances of methoxy phenols decrease in the outer part, so that gelification of the degraded woody tissues occurred in the parts.

Keywords: tree fossil, fossilization processe, microbial degradation, plant terpenoid, lignin phenol