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Improvements of palaeochemotaxonomy as a palaeofloristic proxy using artificial maturation of extant conifers

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Numerous studies of the molecular composition of terrestrial plants show that many organic compounds have a chemotaxonomic value. This means that these biomolecules are synthesized by a restricted number of taxa and can be used as specific biomarkers. Some of these biomolecules, like terpenoids, are poorly altered and preserved in sediments where they are then transformed into geomolecules. Thus, the distribution of vascular plant biomarkers preserved in sedimentary rocks could serve as proxy for terrestrial palaeoflora assessment. Furthermore, as flora association may reflect climatic conditions, vascular plant biomarkers may also serve as palaeoclimatic proxies.
Botanical palaeochemotaxonomy presents some specific attributes compared to palaeobotany and palynology in the reconstruction of palaeofloristic and palaeoclimatic evolutions through geological time : 1) plant biomarkers are more widespread in the stratigraphic record than well preserved plant macrofossils, 2) on the contrary to palynomorphs they can be directly linked to specific plant taxa, 3) biomarkers are readily analyzed by usual organic geochemistry procedures. However, our knowledge in botanical palaeochemotaxonomy, allowing to link geomolecular markers to botanical taxa, is still incomplete. Difficulties are related to 1) extrapolation of information from extant plants to their fossil counterparts, 2) the scarcity of well preserved and identifiable fossils.
In order to help fill these gaps, we use an experimental method based on artificial maturation of extant plants by confined pyrolysis (*Hautevelle et al. 2006). This technique allows to simulate conversion of biomolecules into diagenetized compounds.
The objective of this study is to clarify the molecular signature of fossil conifer families. 69 species belonging to seven families of extant conifers (Araucariaceae, Cupressaceae, Pinaceae, Podocarpaceae, Sciadopityaceae, Taxaceae and Taxodiaceae) were pyrolyzed. Extractable organic matter is then analyzed by Gas Chromatography-Mass Spectrometry.
The results show that generally: 1) Araucariaceae are characterized by a high abundance of tetracyclic compounds; 2) Pinaceae are characterized by their richness in tricyclic but absence of tetracyclic compounds; 3) Taxaceae are distinguished from the other families by the unique presence of cadalanes and pimaranes as terpenoids; 4) the others show some similarities like the presence of bi-, tri-, tetra-cyclic compounds. Cupressaceae are also characterized by the presence of cuparene and totarane.
In addition, our study suggests specific tendencies of molecular association for each family. Further, these results can be used for palaeofloristic and palaeoclimatic reconstructions from the molecular analysis of sedimentary rocks.

*Hautevelle, Y., Michels, R., Lannuzel, F., Malartre, F., Trouiller, A., 2006. Confined pyrolysis of extant land plants: A contribution to palaeochemotaxonomy. Organic Geochemistry 37, 1546-1561.