P192-TU

DETERMINATION OF THE MOLECULAR SIGNATURE OF FOSSIL CONIFERS BY EXPERIMENTAL PALAEOCHEMOTAXONOMY : CONTRIBUTION TO PALAEOFLORISTIC AND PALAEOCLIMATIC RECONSTRUCTIONS

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Terrestrial vascular plants, and more especially conifers, synthesize a great variety of terpenoids which are major components of their essential oils and resins. The composition of these bioterpenoids differs significantly from a taxon to another and it is thus possible to distinguish the different conifer families by their molecular signature (Otto and Wilde, 2001). These bioterpenoids are then transported from palaeophytocenoses to sedimentary basins in which they are partially preserved within sediments. During diagenesis, bioterpenoids are transformed into geoterpenoids which can keep, partially or totally, their initial chemotaxonomic value. Therefore, plant biomarkers are excellent palaeofloristic, and thus palaeoclimatic, proxies (Otto and Simoneit, 2001; Hautevelle et al. 2006a).

Classically, palaeobotany and palynology are the most improved approaches for palaeofloristic and palaeoclimatic reconstructions but present some disadvantages. Indeed, recognizable plant macrofossils are very scarce in the sedimentary record and often concentrate within layers characterized by exceptional preservation. Spores and pollens, as for them, are common but not easily reliable to plant taxa, especially for pre-Cenozoic times. Conversely, plant biomarkers are very usual in the sedimentary record and can be directly linked to plant taxa. This makes botanical palaeochemotaxonomy a complementary, valuable and innovative approach for palaeofloristic and palaeoclimatic reconstructions. However, for now, available palaeochemotaxonomic data associating the biomarkers to their source plants are not sufficient to interpret biomarker assemblages in terms of palaeofloristic composition systematically. Currently, palaeochemotaxonomic data are derived from the extrapolation of chemotaxonomic data (Otto and Wilde, 2001) and the analysis of well identified fossils (Otto and Simoneit, 2001).

In order to fill this gap, we developed recently an original approach in order to gain access to new paleochemotaxonomic data based on artificial maturation of extant plants using confined pyrolysis (Hautevelle et al., 2006b). This method allows to determine the molecular signature of the fossil counterpart of each pyrolysed plant.

In this study, we investigated the palaeochemotaxonomy of the Coniferale order (i.e conifers) which are present in almost all types of vegetation and are major components of Meso- and Cenozoic floras. We pyrolysed nearly 70 conifer species which represent very well the diversity of the coniferale order. We studied 11 Araucariaceae representatives (8 Araucaria, 2 Agathis, 1 Wollemia), 17 Cupressaceae (1 Calocedrus, 4 Chamaecyparis, 2 Cupressus, 5 Juniperus, 1 Microbiota, 3 Thuja, 1 Thujopsis), 21 Pinaceae (4 Abies, 3 Cedrus, 4 Larix, 4 Picea, 4 Pinus, 1 Pseudotsuga, 1 Tsuga), 4 Podocarpaceae (Podocarpus), the unique Sciadopitaceae species, 5 Taxaceae (2 Cephalotaxus, 2 Taxus, 1 Torreya) and 8 Taxodiaceae (1 Cryptomeria, 2 Cunninghamia, 1 Metasequoia, 1 Sequoia, 1 Sequoiadendron, 2 Taxodium).

The data obtained highlights the molecular specificities and terpenoid association of each families as well as intra-family differences and inter-family resemblances. Our palaeochemotaxonomical data confirms that the different families can be distinguished from their respective molecular signatures. For instance, Araucariaceae are characterized by very high amount of tetracyclic diterpanes compared to tricyclic diterpanes and by the occurrence of not well identified bicyclic diterpanes (other than labdanes which are found in all conifer species). However, the nature of the tetracyclic diterpanes varies from a species to another (beyerane, phyllocladanes, *ent*-kauranes). Cupressaceae and Taxodiaceae show a very high diversity of molecular signatures which allows the distinction of many of their genus by means of their terpenoids compositions. Pinaceae are characterized by the abundance of hydrocarbon and acid abietanes coupled with the lack of tetracyclic diterpanes.

These data allow to fill the gap in our knowledge of botanical palaeochemotaxonmy and will improve the use of organic geochemistry as a competitive approach to palaeobotany and palynology in the field of palaeofloristic and palaeoclimatic reconstruction.

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