BIOMARKER STUDY OF COALS FROM THE BOULONNAIS AREA (FRANCE)

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Northern France coal basins are part of a large coal-producing belt which extends from Great Britain to Germany. These basins mainly developed during the Late Carboniferous at the front of the Variscan orogenic belt. The organic-rich deposits were afterwards deformed, buried in relation to the propagation of orogenic deformation, and eventually uplifted. In the most productive and most subsiding area, the Nord-Pas-De-Calais mining basin, coal bearing formations have a maximum thickness of 2000m. Burial in this area was relatively important and vitrinite reflectance values of coal seams range between 0.7 and 2%. In the Boulonnais area, located to the west, coal bearing formations are thinner (up to 300m) and were less buried, giving an opportunity to study organic material less affected by thermal evolution. Most of the coals from the Boulonnais area were exploited; nevertheless a few veins are still visible in a quarry where Visean limestones are mined. In addition to the coal veins, the quarry shows black lignitic material present in karstic cavities which affect the Visean limestones.

Samples of coal, of their enclosing rocks and of the lignitic material from the karstic cavities were studied for their biomarker content. The aims of this study were to 1) search for biomarkers of Carboniferous plants in order to compare with equivalent data from other carboniferous coals and 2) give information of the nature and origin of the karstic filling.

The extracts from the Carboniferous coals and enclosing rock are relatively similar and dominated by series of aliphatic and aromatic compounds (Fig. 1a). The aliphatic fraction is dominated by pristane and *n*-alkanes. The *n*-alkanes often show a marked contribution of even numbered short compounds, while long chain homologs only show a modest predominance of odd chain lengths (Fig. 1a). Hopanoids are relatively abundant and show a significant contribution of moretanes, indicating a relatively low thermal maturity of the organic matter in these coals. Steranes and diasteranes are present in low proportion and dominated by the C_{29} homologs. The aromatic fraction is dominated by naphthalenes and phenanthrenes. Plant biomarkers in the saturated fraction are represented by phyllocladane, *ent*-kaurane and norisopimarane. Aromatic biomarkers include cadalene, retene and MATH. A certain number of unknown compounds which mass spectrum suggests a bicyclic, tricyclic or more, terpenoid structure are observed in both the saturated and aromatic fractions. Their distribution could be specific to Carboniferous plants.

The extracts from the karstic filling are markedly different (Fig. 1b). Saturated compounds are present in minor proportion. *N*-alkanes are dominated by long chain homologs with a marked predominance of odd numbered compounds. Pristane and phytane are hardly observed. Unsaturated and functionalised compounds are abundant (Fig. 1b) and include hopenes, sterenes and diasterenes, fernenes, sterols and fatty acids. A large variety of bicyclic

and tricyclic terpenes is also observed, which distribution and mass spectra are different from those present in the coals extracts. The distribution of compounds nevertheless indicates that this lignitic material originates from terrestrial plants and did not suffer any thermal alteration.

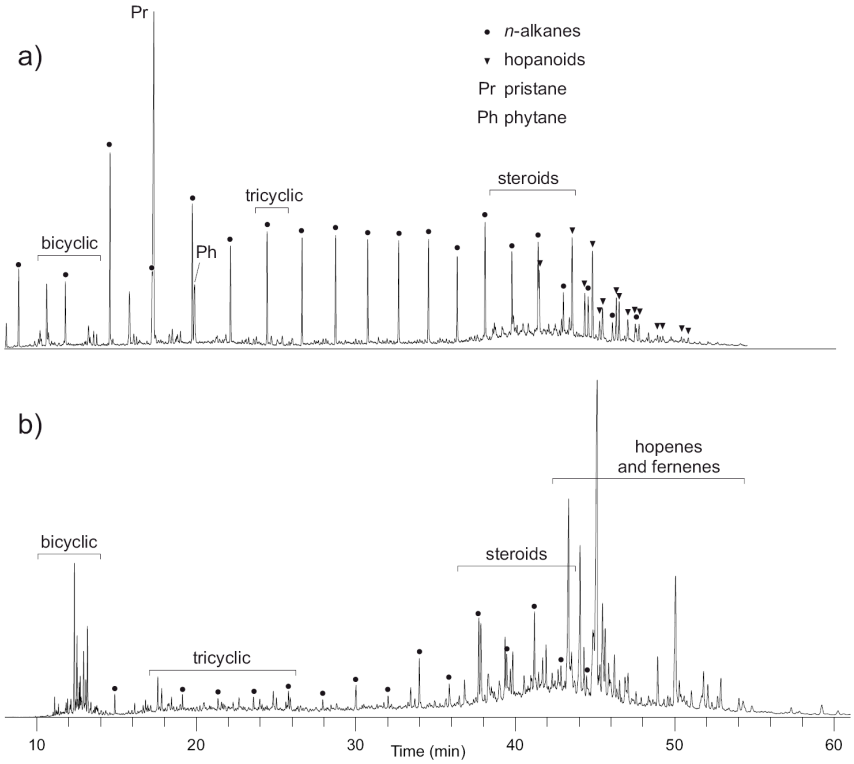

Figure 1 *Total ionic current of the aliphatic fractions extracted from a Carboniferous coal (a) and the filling of karstic cavities affecting the Carboniferous limestone (b) in the Boulonnais area (North of France).*

In conclusion, these data point to the low maturity of the organic matter in the Carboniferous coals, confirming that the burial in this region was less important than to the east. The lignitic material filling the karsts is different from the coals and, from its very low maturity, could be of Mesozoic age. Both coals and lignitic material yield a wide variety of terpenoids which could be used for a chemotaxonomic purpose in the future.