Determination of U-Th and Pb isotope ratios in crude oil, kerogen and asphaltenes: Potential application for dating age of expulsion of crude oil from the rock source

GEORGIA SANABRIA[1], CHRISTOPHE PECHEYRAN[1]*, SYLVAIN BERAIL[1], ALAIN PRIZHOFER[2] AND OLIVIER F.X. DONARD[1]

[1]LCABIE, IPREM UMR 5254, CNRS – Université de Pau es des Pays de l'Adour, 64053, Pau cedex 9, France
[2]IFP, Direction Géologie-Geochimie, 1 et 4, Av. de Bois Préau, 92852 Rueil Malmaison Cedex, France

The Pb-Pb, U-Pb and Th-Pb methods of dating have become in geochromometers widely used to determine ages of minerals and rocks. However, there is scarce information about their application for dating hydrocarbon samples.

A simplified concept for U-Th-Pb geochronometers is proposed to estimate the expulsion age of crude oil from the source rock. Elemental isotopic ratio U/Pb and Th/Pb were determined by Q-ICPMS after sample acid digestion. Due to the matrix composition, classical anion exchange procedures used for lead isolation in inorganic samples (like sediments, minerals or rocks) can not be applied directly in crude oil, kerogenes and asphaltenes samples. Therefore purification procedures were evaluated in-depth for experimental optimal conditions and the optimized method was compared with a new developed method which consists in a two purification steps: first Pb ethylation with $NaBEt_4$ and solvent extraction followed by second separation stage in a gas chromatograph coupled to the MC-ICPMS. This new approach providing limited sample preparation is an efficient alternative to conventional geochimical procedures, with a great potential for micro geochemical samples.

Isotopic ratios results were used for dating hydrocarbon accumulation of two petroleum basin. These results were in good agreement with the theoretical model, hence, representing a new potential tool in petroleum prospection.

Root litter decomposition and stabilisation in three different soil depths related to microbial community dynamics and enzyme activity

M. SANAULLAH[1], A. CHABBI[1,2], P.A. MARON[3], A. SARR[3], E. BLADOTSKAYA[4] AND C. RUMPEL[1]

[1]CNRS, BIOEMCO, Thiverval-Grignon, France (cornelia.rumpel@grignon.inra.fr)
[2]UEFE, INRA, Lusignan, France
[3]INRA, Dijon, France
[4]Uni Bayreuth, Bayreuth, Germany

Subsoil horizons located below the A horizon are known to store important amounts of organic carbon characterised by high mean residence times. Microbial biomass and activity in these horizons are most probably contrasting to those of topsoil horizons and thus influence root litter degradation in different soil depths [1]. The aim of this study was to follow ^{13}C labelled root litter degradation in three different soil depths during a three year field incubation experiment and to establish a relation to the dynamics of microbial communities analysed by DNA fingerprinting and enzyme activities.

Our results showed contrasting decomposition dynamics in top- and subsoil horizons despite similar stabilisation processes [2]. Subsoil horizons showed a lag phase during the first months of incubation, but this retard in decomposition was compensated at the end of incubation probably by slightly better abiotic conditions at depth [2].

Enzyme activities showed distinct dynamics in different soil depths. Chitinase was the only enzyme that showed similar activity in top-and subsoil horizons; all other enzyme activities were much higher in topsoil. Activity of the enzyme involved in the N-cycle was evident in subsoil only within a short period after plant litter addition.

Dynamics of microbial populations evolved with time especially in the first year of the experiment. Thereafter changes in community composition were less pronounced. Stucture of microbial communities showed a depth gradient with the lowest soil layer being most different from the other two. This was mainly related to the first six months, where fresh root litter input obviously caused drastic changes.

We conclude, that microbial biomass and activity at soil depth are more limited by lack of fresh plant litter than by physical conditions. Both parameters can rapidely be stimulated and reach topsoil level in the first few months after root litter addition. However, these changes were only transient at 90 cm depth.

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[1] Rumpel *et al*. (2011) *Plant & Soil*, **338**, 143–158.
[2] Sanaullah *et al*. (2011) *Plant & Soil,* **338**, 127–141.