

EFFECTS OF EARLY DIAGENESIS ON THE ISOTOPIC SIGNATURE OF WOOD: INCUBATIONS IN AQUATIC MICROCOSM

Romain Tramoy, Thanh Thuy Nguyen Tu, Véronique Vaury, Mathieu Sebilo, L Millot Cornette, C Roose-Amsaleg, Johann Schnyder

► To cite this version:

Romain Tramoy, Thanh Thuy Nguyen Tu, Véronique Vaury, Mathieu Sebilo, L Millot Cornette, et al.. EFFECTS OF EARLY DIAGENESIS ON THE ISOTOPIC SIGNATURE OF WOOD: INCUBATIONS IN AQUATIC MICROCOSM. IMOG-2017, Sep 2017, Florence, Italy. insu-01624767

HAL Id: insu-01624767 https://insu.hal.science/insu-01624767

Submitted on 26 Oct 2017

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers. L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



EFFECTS OF EARLY DIAGENESIS ON THE ISOTOPIC SIGNATURE OF WOOD: INCUBATIONS IN AQUATIC MICROCOSM

R. Tramoy¹, T. T. Nguyen Tu², V. Vaury³, M. Sebilo³, L. Millot Cornette², C. Roose-Amsaleg², J. Schnyder¹

¹ Sorbonne universités, CNRS, UPMC, UMR 7193, ISTEP, France

² Sorbonne universités, CNRS, UPMC, EPHE, UMR 7619, METIS, France

³ Sorbonne universités, CNRS, UPMC, INRA, IRD-Paris Diderot-UPEC,

UMR7618, IEES, France

Introduction

The stable isotopes of organic matter (OM) of soils and sediments are often used to infer paleoenvironments and OM sources. Accurate paleoenvironmental reconstructions require to precisely constrain the effects of diagenesis on the isotopic composition of OM. However, the fate of carbon and, especially, nitrogen isotopic signature in OM is not well understood. Plants constitute major contributors to the terrestrial OM pool and plant debris generally undergo significant underwater degradation before burial in sediments. The present study thus aims at documenting changes in δ^{13} C and δ^{15} N values of plant OM through early diagenesis in aquatic environment reconstituted in laboratory. Wood samples were incubated in distilled water and river water for 73 weeks, and monitored for their bulk biogeochemical composition (%C, %N, δ^{13} C and δ^{15} N; (Tramoy et al., 2017). Sub-millimetric powder and centimetric pieces of wood were used to investigate the influence of sample size on degradation. As micro-organisms are the main degrading agent of OM, fungal development and bacterial activity were also monitored by macroscopic examination and ecoplates Biolog, respectively.

Degradation state

Mass loss of wood pieces in river water was three times greater than in distilled water (30% vs 10%; Figure 1). According to macroscopic observations, this difference was attributed to the development of white-rot fungi that colonized the pieces of wood incubated in river water, whereas soft-rot fungi developed in distilled water. The greater efficiency of white-rot fungi for degrading wood is probably responsible for the greatest mass loss of wood pieces in river water. Characterization of microcosms with Biolog ecoplates (Garland and Mills, 1991) showed that the potential metabolic activity of bacteria was two times higher in distilled water than river water, although the functional diversity of bacterial communities was similar in both types of water. These results confirm that fungi are the main agents of wood degradation, with an increased efficiency of white-rot fungi when compared to soft-rot fungi.

Geochemical effects

The carbon content of the wood pieces and their isotopic composition showed similar patterns in both types of water: (i) carbon content increased of ~2% during the first 20 weeks before it returned to initial values at the end of the experiment, whereas δ^{13} C values remained relatively constant. This might suggest that despite obvious wood degradation, its carbon isotopic composition is not significantly modified by diagenesis. Although difficult to interpret, the relative C- and ¹³C-enrichment (around +2.5 % and +0.3 ‰, respectively) of wood powder during the 73 week incubation may suggest small influence of microbial respiration (i.e.



degradation of C- and ¹³C-depleted plant components). Then, the higher influence of degradation in powder than in pieces of wood suggests that degradation is dependent on debris size. In contrast, nitrogen dynamics of wood pieces showed a variability \sim 5 times higher than that observed for carbon and opposite patterns in the different types of water (Figure 1): (i) N release associated with ¹⁵N-depletion in distilled water, attributed to uptake of ¹⁵N-enriched pool (i.e. proteins) by fungi, and (ii) N accumulation associated with ¹⁵N-enrichment in river water thanks to fungal development within the wood. Similar behaviors are recorded for wood pieces is due to initial variability than in wood pieces, suggesting that variability in wood pieces is due to initial variability along the wood.

Conclusions

Results confirm the strong impact of early diagenesis on nitrogen isotopes of organic matter (unlike carbon). However, most of the δ^{15} N changes could be attributed to fungal activity that imports or exports nitrogen from (in) the wood in response to variations in N-availability of their (micro-)environment. Thus, early diagenesis may average an environmental signal by integrating the δ^{15} N values of individual signals (woods, fungi, water) and microbial processes. Considering the non-linear behavior of early diagenesis, this integration is probably almost instantaneous on the geological time scale, which may not preclude paleoenvironmental reconstructions.

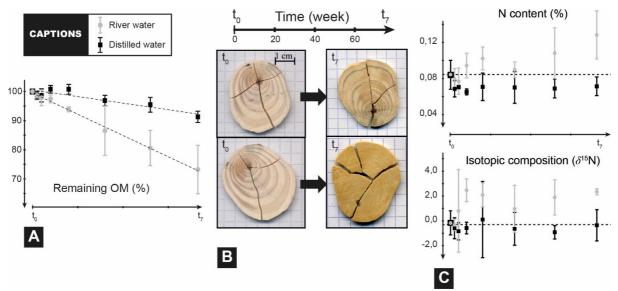


Figure 1: A, Mass loss of wood pieces relative to time in river (in grey) and distilled water (in black); B, their morphology at t_0 and t_7 (after 73 weeks of degradation in water) and C, the nitrogen dynamic relative to time. Vertical bars. Vertical bars correspond to the standard deviation (2σ) based on triplicates.

References

- Tramoy, R., Sebilo, M., Nguyen Tu, T.T., Schnyder, J., 2017. Carbon and nitrogen dynamics in decaying wood: paleoenvironmental implications. *Environ. Chem.* 14, 9–18.
- Garland, J.L., Mills, A.L., 1991. Classification and characterization of heterotrophic microbial communities on the basis of patterns of community-level-sole-carbon-source-utilization. *Appl. Environ. Microbiol.* 57, 2351–2359.