# HYDROGEN AND CARBON ISOTOPE COMPOSITIONS OF N-ALKANES FROM LEAF WAXES IN MODERN ANGIOSPERMS AND GYMNOSPERMS: HOW DO THEY COMPARE?

Nikolai PEDENTCHOUK[1], Brett TIPPLE[2], Mark PAGANI[2], Olubunmi ENIOLA[3] and Thomas WAGNER[3]

*1. Dep. of Geology and Geophysics, Univ. of Calgary, 2500 University Dr., Calgary, AB T2N 1N4, Canada*
*2. Dep. of Geology and Geophysics, Yale University, P.O. Box 208109, New Haven, CT 06520-8109, USA*
*3. School of Civil Engineering and Geosciences, Newcastle University, Newcastle upon Tyne, NE1 7RU, UK.*

Biomarker and stable isotopic signatures of higher plant leaf waxes are becoming increasingly popular in paleoclimate research (e.g., Schefuß et al., 2005; Pagani et al., 2006). Interpretation of results of this sort of studies, however, strongly depends on a thorough understanding of isotopic signatures from different plant types contributing to sedimentary organic matter. The purpose of this project is to investigate environmental factors that control stable isotopic composition of *n*-alkanes from modern angiosperms and gymnosperms growing under different climatic regimes. The project has two components. First, we sampled (approximately once a month) 3 angiosperm and 2 gymnosperm plants in one location in eastern Washington State, USA during the 2005 and 2006 growing seasons. Second, we are extending our work area by sampling (Fall 2006, Spring and Summer 2007) and analysing leaves from several angiosperm and gymnosperm species along a west-east climatic gradient in the Canadian Rocky Mountains. Data from the Fall 2006 campaign are not available yet but will be generated over the first half of 2007.

The initial 2005 $nC_{27}$-alkane data from WA State show a clear separation between 2 gymnosperms and 2 angiosperms (Fig.1). From May to October, δD and $\delta^{13}C$ values of common lilac and quaking aspen stayed within -166 and -182‰, and -31.6 to -32.7‰, respectively. However, δD and $\delta^{13}C$ values of Scots pine and blue spruce were within -190 to -208‰ and -28.8 to -30.6‰, also without a major trend throughout the growing season. Similar to the other angiosperm species, European white birch was D-enriched (δD from -160 to -173‰) relative to gymnosperms. However, $\delta^{13}C$ values of this species were more similar to those of Scots pine and blue spruce in May, but had a ca. 4‰ positive shift from May to October. Furthermore, birch underwent a significant increase in the proportion of $nC_{31}$- vs. $nC_{25}$-alkanes during the growing season. No other trees showed this trend.

Because all 5 plants experienced the same environmental conditions and were irrigated with the same water, we suggest that the observed isotopic variations derived from physiological differences among the species. Relative $^{13}C$-enrichment and D-depletion of

Scots pine and blue spruce may have resulted from their lower stomatal conductance and greater water use efficiency in comparison with common lilac and quaking aspen. A higher stomatal conductance of birch in comparison with the other species under investigation led to a greater water stress of this plant during June-August 2005. Hence, the observed shift in the production of *n*-alkanes and the greatest $\delta^{13}C$ response as well as its most D-enriched values.

Our first results already show that this study will have profound implications for interpreting δD and $\delta^{13}C$ values of terrestrial plant *n*-alkanes in the sedimentary record. The initial results from WA State indicate that large fluctuations in relative humidity and temperature during a single growing season do not cause significant shifts in δD and $\delta^{13}C$ values of *n*-alkanes. Second, large changes in δD (ca. 50‰) and $\delta^{13}C$ (ca. 3.5‰) values of sedimentary *n*-alkanes may result not only from shifts in paleoclimatic variables (a common assumption) but also from changes in paleovegetation. Further results from the WA State in conjunction with results from the Canadian Rocky Mountains study will show how well δD and $\delta^{13}C$ values of terrestrial plant *n*-alkanes reflect changes in environmental parameters, such as source water δD values, relative humidity, and soil moisture. This information will be crucial for investigating the levels and isotopic composition of atmospheric carbon dioxide as well as the state of paleohydrological cycle in the geologic past.

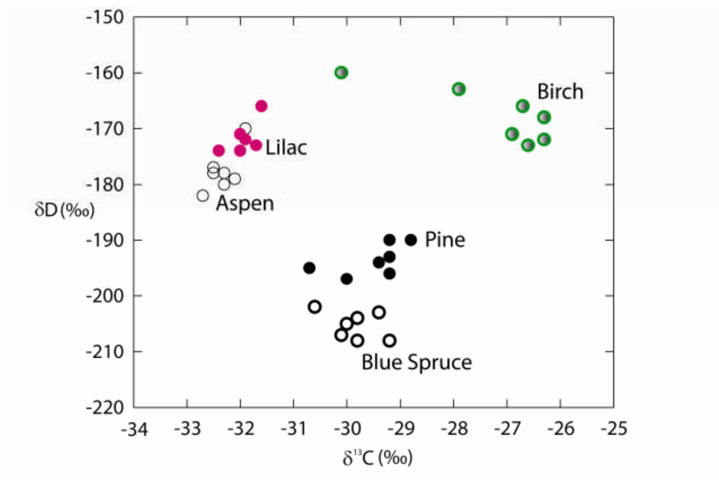


Figure 1. Carbon and hydrogen isotopic composition of leaf wax $nC_{27}$ alkanes from angiosperm and gymnosperm trees in eastern Washington State, USA.


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