Geophysical Research Abstracts, Vol. 9, 02106, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-02106

Distinct Differences between Modern Angiosperm and Gymnosperm Trees Based on Hydrogen and Carbon Isotope Values of Leaf Wax n-Alkanes

N. Pedentchouk (1), W. Sumner (2), B. Tipple (3), M. Pagani (3)

(1) Department of Geology and Geophysics, University of Calgary, Calgary, Canada, (2) Central Washington University, Ellensburg, USA, (3) Yale University, New Haven, USA

Biomarker and stable isotopic signatures of higher plant leaf waxes are becoming increasingly popular in paleoclimate research. Currently, very little is known about the effect of environmental conditions on the distribution and compound-specific isotopic composition of leaf wax n-alkanes from angiosperm and gymnosperm trees. This study investigates δD and δ^{13}C values of leaf wax n-alkanes from 3 angiosperm and 2 gymnosperm plants sampled during the 2005 and 2006 growing seasons. The study area is located in central Washington State, USA and characterized by near desert conditions. All 5 plants are 7 to 8 years old and grow in an open space, less than 10 m apart. Irrigation from a well was the main source of water for these plants.

The initial 2005 $n\mathrm{C}_{27}$-alkane data show a clear separation between 2 gymnosperm and 2 angiosperm species. From May to October, δD and δ^{13}C values of common lilac and quaking aspen stayed within -166 and -182 per mil, and -31.6 to -32.7 per mil, respectively. However, δD and δ^{13}C values of Scots pine and blue spruce were within -190 to -208 per mil and -28.8 to -30.6 per mil, 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 per mil) relative to gymnosperms. However, δ^{13}C values of this species were more similar to those of Scots pine and blue spruce in May, but had a ca. 4 per mil positive shift from May to October. Furthermore, birch underwent a significant increase in the proportion of $n\mathrm{C}_{31}$- vs. $n\mathrm{C}_{25}$-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. Hence, the observed shift in the production of n-alkanes and the greatest δ^{13}C response as well as the overall most D-enriched values in birch.

This study has profound implications for interpreting δD and δ^{13}C values of terrestrial plant n-alkanes in the sedimentary record. First, large fluctuations in relative humidity and temperature during a single growing season do not necessarily cause significant shifts in δD and δ^{13}C values of n-alkanes in leaf waxes. Second, large changes in δD (ca. 50 per mil) and δ^{13}C (ca. 3.5 per mil) values of sedimentary n-alkanes may result not only from shifts in paleoclimatic variables but also from changes in paleovegetational communities.