Geophysical Research Abstracts,
Vol. 11, EGU2009-10924, 2009
EGU General Assembly 2009

Carbon and Hydrogen Isotopic Composition of Plant Wax n-Alkanes: A Tool for Characterizing Soil Provenance in Forensic Science

N. Pedentchouk (1), T. Wagner (2), and M. Jones (2)

(1) University of East Anglia, School of Environmental Sciences, Norwich, United Kingdom (n.pedentchouk@uea.ac.uk, 44 01603 593395), (2) Newcastle University, Civil Engineering and Geosciences, Newcastle upon Tyne, NE1 7RU, UK

Forensic science is an integrative discipline that requires material evidence from diverse sources. Geochemical evidence derived from inorganic and organic substances is becoming increasingly popular among law enforcement agencies in industrialized countries. Previous investigations indicate that the relative distributions of individual plant-derived biomarkers found in soils are linked to the biomarker patterns found in the overlying vegetation. However, identification of soil provenance based on the distribution of plant-derived biomarkers for forensic purposes is inhibited by the fact that a significant number of terrestrial plant species have overlapping biomarker distributions. In order to enhance the resolving power of plant-derived biomarker signal, we propose to enhance the molecular approach by adding a stable isotope component, i.e. the delta13C/deltaD values of individual biomarkers.

The first objective of this project is to determine the delta13C/deltaD signatures of n-alkanes derived from various higher plant types commonly growing in the UK. The second objective is to investigate whether the same species/plant types differ isotopically between two locations affected by different weather patterns in the UK: a relatively warmer and drier Norwich, Norfolk and a cooler and wetter Newcastle-upon-Tyne in NE England.

The n-C29 alkane data from 14 tree species sampled during July 2007 and August 2008 in Newcastle show a clear negative trend between delta13C and deltaD values. When these data are plotted against each other, the six deciduous angiosperms (delta13C: c. -39 to -35 per mil; deltaD: c. -155 to -130 per mil) are completely separated from four evergreen angiosperms (delta13C: c. -33 to -28 per mil; deltaD: c. -195 to -165 per mil). The four gymnosperm species data plot between those of the deciduous and evergreen angiosperms.

Because all 14 species in Newcastle experience the same environmental conditions, we suggest that the observed isotopic patterns result from physiological differences among the plants. The relative differences in deltaD and delta13C values of various plant types could be explained by differences in stomatal diffusive conductance to H2O vapour and CO2 gas, so that species with higher stomatal conductance would have D-enriched and 13C-depleted values. We are currently investigating the stomatal conductance of leaves and needles taken from the same plants that were sampled for deltaD and delta13C measurements.

Comparison of the isotopic data from the deciduous angiosperm plants growing in Newcastle and Norwich shows that 6 species from Newcastle are more 13C-depleted (delta13C: c. -39 to -35 per mil) than 11 deciduous angiosperm species from Norwich (delta13C: c. -36 to -31 per mil). However, there is no significant difference in the deltaD values between the two locations since the Newcastle data (deltaD: c. -155 to -130 per mil) is within the range of the Norwich data (deltaD: c. -115 to -170 per mil).

Our n-alkane isotope data from Newcastle indicate that deciduous angiosperm species have a very different delta13C/dD signature in comparison with that of the evergreen angiosperm species. On the other hand, gymnosperms have deltaD values similar to those of deciduous angiosperms and delta13C values similar to those of evergreen angiosperms. Further results from our compound-specific work, will reveal whether these patterns also characterize the same plant groups in Norwich and whether different weather patterns in Newcastle and Norwich lead to isotopic differences in the same species/plant types. The results of this study will provide a valuable dataset that could be used for higher plant and soil characterization by forensics experts in the UK and elsewhere.