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Plant wax biomarkers in fresh snow: Implications for ice core studies

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The leaves of terrestrial plants are covered with epicuticular waxes. Typical constituents of these protective waxes are long-chained n-alkanes, n-alkanols and n-alkanoic acids. When deposited into sediment or ice archives, plant wax molecules can remain unaltered for millions of years. Their distribution and isotopic composition retain information about the type of vegetation they originate from. Plant wax compounds can thus be utilized as geochemical biomarkers, yielding insights into past vegetation and climate conditions. Their distributions have been successfully studied in numerous marine sediment cores, but their analysis in ice cores is still a fairly novel field.

As a first step in a research project to analyze terrestrial plant waxes in a polar ice core, we are collecting fresh snow samples from a lowland forest site near Sapporo, Hokkaido, during winter 2009–2010. The snow samples are melted and extracted for plant wax molecules with dichloromethane / ethyl acetate mixture at pH=1. Both acid and neutral compounds are divided into further fractions of varying polarity by means of silica-gel chromatography. Finally the fractions are analyzed with gas chromatography, mass spectrometry and compound specific isotope ratio mass spectrometry. A similar set of snow samples is also currently obtained from a mountain forest site in Northern Hokkaido, and the two sets will be compared with each other.

In the lowland samples analyzed so far, n-alkanes from C_{20} to C_{42} are detected, C_{27} being the most abundant. Total concentrations of n-alkanes range from 1100 to 8100 ng/l. The n-alkane distributions show Carbon Preference Indices (CPI) typical for terrestrial vegetation, ranging from 18 to 30. Anthropogenic input from fossil fuel burning is low at the sampling site, as evidenced by the high CPI.

We report here for the first time hydrogen isotope ratios measured for plant-derived n-alkanes in fresh snow. Compound specific isotope analysis shows that n-alkanes in Sapporo snow samples are more depleted in deuterium than the local vegetation. δD values measured from the snow samples range from -210 to -230 ‰ whereas the local vegetation shows on average lower depletion values. This result indicates that n-alkanes in snow pack originated from higher latitudes, likely Siberia, which is consistent with the prevalent north-west winds that bring snowfall in Hokkaido. The finding implies that plant wax compounds in fresh snow do retain information on their remote source vegetation. Results from further hydrogen and carbon isotopic composition measurements will be presented in the poster, along with their implications for ice core analysis.