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Climate of the Past Discussions

Interactive comment on "Modern isotope hydrology and controls on δD of plant leaf waxes at Lake El'gygytgyn, NE Russia" *by* K. M. K. Wilkie et al.

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General comments: Wilkie et al., provide the results of a study of modern hydrogen isotope hydrology as measured and recorded by plant leaf wax hydrogen isotopic values in the Lake El'gygytgyn catchment in northeastern Russia, contributed as part of the special issue of CP on Lake El'gygytgyn. The goal of this work is to understand the hydrogen isotope systematics and signals recorded in plant leaf wax molecules, which are preserved within the lake core sediments of Lake El'gygytgyn, and offer the potential to reconstruct 2.8 million years of climate history (Melles et al., 2012), although the focus of the manuscript by Wilkie et al., (2012) is exclusively on understanding the

modern system.

The authors review the relevant literature and set their results in context of prior modern and paleoclimate leaf wax work, as well as the water isotope literature. Their sampling scheme includes waters from precipitation, stream water, lake waters, as well as organic molecules from coretop sediments and modern plant samples. In this way they calculate the hydrogen isotopic fractionation, between source water and plant lipids, needed to ultimately convert the downcore leaf wax δD values to yield precipitation δD reconstructions. From observations of environmental waters and plant waxes, the calculated fractionation between the C30 n-alkanoic acid and precipitation in modern plants is reported to be –105 $\pm$ 13‰ . A slightly smaller fractionation between the C30 n-alkanoic acid and precipitation is reported in the modern sedimentary samples from the lake floor –95 $\pm$ 5‰ . A similar fractionation was recently applied in a high latitude paleoclimate reconstruction (Feakins et al., 2012). These environmental samples contrast with earlier experimental work that reported very small fractionations (for n-alkanes) for certain species grown under continuous light (Yang et al., 2009) and expands upon other environmental samples (Yang et al., 2011). Thus this study is an important contribution to the plant leaf wax literature at high latitudes.

The authors investigate local, modern plant molecular abundance distributions and isotopic compositions and draw some conclusions about which species are driving the sedimentary signals. Bryophtes which produce abundant C28 n-alkanoic acids turn out not to be important, whereas lake proximal Artemisia and Salix are found to be important contributors to the sediments. These types of local considerations are useful in isolating hydrological from biological signals, as molecular abundance distribution differences can be observed in modern plants and then monitored in downcore studies. This will be a useful contribution to figuring out the paleoclimate record at this site.

Specific comments:

1) Page 3720 line 10 Text should specify which leaf wax compound throughout. Later

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text suggests this refers to C30 n-alkanoic acid/precipitation, but as several different fractionations are discussed (alkanes, alkanoic acids, stream water, precipitation) the meaning of δDwax and epsilon should be specified throughout for clarity.

2) Page 3720 line 12 The authors infer that the leaf wax proxy is recording close to an average annual precipitation isotopic composition, although also suggest a possible bias is towards winter precipitation. The reasoning could be elucidated further in the text of the discussion. Does this imply a mechanism related to water availability (in an arid Arctic context), rather than a bias towards the growing season of the plants suggested elsewhere (Feakins et al., 2012; Sachse et al., 2009)?

3) Page 3722, line 4-13. The discussion mixes values for alkanes and alkanoic acids which may have offsets (Chikaraishi and Naraoka, 2007), so the text should maintain the compound specific origins, so as not to oversimplify.

4) Page 3722, Line 18 For life form discussion of plant life forms please reference expanded dataset analyzed in (Sachse et al., 2012).

5) Page 3724, section 3.1.2 This is an intriguing use of herbarium samples – primarily for botanical and pollen studies – also being used for leaf wax studies. There has only been one prior such study Yang et al., (2011). As this is an approach that could more widely be used from existing and new herbarium specimens, it would be nice to see a few more details on the sampling approaches published in the leaf wax literature: how much leaf tissue is collected for herbarium specimens, how are they fixed onto paper, at what stage were leaf tissues for wax studies removed, how much material was removed for the leaf wax isotopic studies, any particular sampling considerations and protocols?

6) Page 3732, line 1 It is known that C20-C32 n-alkanoic acids are made by terrestrial plants (n=3) emergent plants (n=3) and submerged and floating plants (n=3) (Figure 1; Ficken et al., 2000). Part of the confusion has arisen because this early study has been mis-represented as showing mid chain leaf wax compounds are made by aquatic

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plants, whereas in fact it is only in mid chain n-alkanes that a distinction was observed. That study found mid chain n-alkanoic acids at in similar relative abundances in terrestrial plants (n=3), emergent plants (n=3) and submerged and floating plants (n=3) (Figure 1; Ficken et al., 2000). The finding of mid chain n-alkanoic acids in terrestrial plants is also corroborated here. The corresponding introduction should therefore not imply that mid chain alkanoic acids are markers for aquatic plants.

7) Page 3743, line 27 "Differences between samples are more likely due to randomly distributed net fractionations rather than a systematic offset between woody vs. grass samples (as predicted for high latitudes)." The meaning of this sentence is unclear, particularly the section in parentheses. An earlier statement said that there was no evidence for life form offsets in this survey, given that only 7 species are sampled perhaps this is inconclusive?

8) Page 3744, line 6 It is not clear why the sedimentary fractionation emphasized for paleoclimate work at the end of the conclusion is not also represented in the abstract; there the modern plant value is instead highlighted.

Technical corrections:

9) Page 3727, line 3 Report the δD values of the C15 and C38 n-alkanes used for normalization to the 2-point VSMOW-SLAP isotopic scale (Coplen, 2011).

10) Page 3733, line 15 Remove the definition of ACL, repeated from above.

11) Page 3738 The text could be rephrased to improve clarity on lines 7-21. Line 7 suggest to remove 'yet, despite... lake sediments'. Line 10: 'these 7 sampled species... we calculated an unweighted average (Fig. 11). This unweighted average was then...'. Line 18 'The average appears particularly sensitive to Bryophyta weighting.'

12) Page 3744, line 6 Recommend reporting the δD value to 0 decimal places throughout (consistency and appropriate precision).

13) Table 2 Epsilon terms need clearer definition within the table (e.g., which chain

length). Column 1 sample names are hard to read as formatted. Appropriate to report to 0 decimal places.

14) Figure 8 Specify the chain length of 'wax'?

15) Figure 11 Figure 7 and 8 have a color coded caption, but chain length information is missing from Figure 11.

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Interactive comment on Clim. Past Discuss., 8, 3719, 2012.