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Biogeosciences Discussions

Interactive comment on "Stable carbon isotopes as indicators for micro-geomorphic changes in palsa peats" *by* C. Alewell et al.

Anonymous Referee #2

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Review of "Stable carbon isotopes as indicators for micro-geomorphic changes in palsa peats" by Alewell et al.

General comments: This paper utilizes natural abundance 13C of soil organic matter (SOM) to investigate the possible millennial to century scale history of hummock and hollow peats in northern Sweden. The paper describes several possible mechanisms that could cause increasing, stable, or declining 13C values of SOM with depth including 1) anaerobic vs aerobic conditions 2) plant type 3) sues effect 4) methanogenesis and methane oxidation 5) stabilization of partially decomposed degradation products, 6) changes in hydrology, and 7) permafrost thaw. This is potentially a very interesting subject and could allow for analysis of the peatland diagenesis.

Specific comments: The large number of potential causes for trends in13C values of

SOM is one of the glaring difficulties with this paper. Although the author has done a fairly good job examining the literature, there is never a confident statistical analysis of the causes of the depth trends in 13C-SOM. Both the introduction and the results/discussion of the paper describe the potential causes of changes in 13C-SOM without a statistical analysis of the causes. This paper would be much improved if models were actually developed and curve fit the depth gradients in order to determine what the data are showing. There is some level of confusion by me regarding the differences expected by the authors between uniform depth trends in saturated peats in section 2.1 and declining depth trend of 13C in waterlogged anaerobic peats in section 2.2. In one section anaerobic conditions result in no change, and in the second section anaerobic conditions result in a negative change.

The figures (fig 3 and 4 especially) need to be much more comprehensively explained. What are the 4 sites? Why are they different? Are they showing replicates? If so, why are some shallow while some are deep? Why are there differences in some and not in others? Why are the depths different among graphs? I would suggest using more descriptive titles for cores besides 'HUSF11_June09', for example. One might also consider placing the 'zero depth' value at the same spot for both hummocks and hollows, such that one can see that the hummocks are above the zone of the hollows. This could also help to show similarity between the two zones belowground, and the aerobic 'frost heave affected soil' aboveground in the hummocks.

Conclusions: I largely disagree with the conclusions because I don't feel the authors have thoroughly explained the data. The patterns could be due to site disturbance due to climate change or differences in hydrology as they state. (It could also be due to changes in the succession of plant communities.) But this is very general and does little to explain the data.

I think there is a very strong story here, and if the authors are able to defend what is causing changes in the 13C of soil profiles and then apply those ideas through statistical analysis or modeling, it would be a much improved paper.

Finally, this paper began by discussing ice dynamics, frost heave, etc, but I saw no discussion of this soil property. If there was cryturbation in these soils, and I would think there is, I don't think it is seen in the isotopic data. If it is there, what should it look like? How would you know it when you saw it? Therefore the second conclusion really needs to be expanded upon and defended more reasonably.

Technical corrections: The grammar and writing style of the paper could be improved. Section 1 line 11: breaking instead of braking. Section 1 line 26/27: repetitive sentece Section 2, line 1: confusing sentence. Why bring up independent of vegetation and hydrology? Section 2, line 6 and line 17- Define what 'this' and 'these' are. Section 4 line 18: This could be natural plant community development. Section 5.2.1. line 1: Break up this sentence Section 5 line 11. I don't agree. High SOM produces lots of DOC too. Section 5.2.4, line 13: Methane production can increase without invoking thawing permafrost. Section 5.2.4 line 20. This line doesn't look uniform, it looks positive. Check. Section 6 line 1: permafrost thaws, it doesn't melt.

Interactive comment on Biogeosciences Discuss., 8, 527, 2011.