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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.

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Response to interactive comment of Referee 2:

Referee 2 states that one of the glaring difficulties with this paper is the large number of potential causes for trends in δ13C. I think the large number of potential causes is not a problem of this paper but the difficulties geochemists are confronted with when interpreting stable isotope data. However, we could clearly exclude most of the potential causes and remain with two: hydrological change due to permafrost uplifting, which is most likely amplified by a simultaneous change in vegetation due to the hydrological change. As described in our response to referee 1 in more detail, this might have not been totally clear in the manuscript. We will certainly revise this.

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Interactive Discussion

Discussion Paper

The main concern of referee 2 is the lack of a statistical analysis showing a tested difference between the profiles. We did a regression analysis for the hollows, which resulted in significant different slopes for the type 1 hollow Storflaket (very slight negative slope) and the type 2 hollows Stordalen (positive slopes):

Table 1 (Please note that for the regression the independent variable is depth, the dependent is δ13C, while in the figures it is vice versa to display depth profiles.)

We suggest to include the same type of analysis for the hummocks in a revised version of the manuscript: slopes and regression function for the upper horizon of each profile down to the turning point versus the lower horizons below the turning points.

Referee 2 was confused between the difference of type 1 and type 2 profiles. As we stated in paragraphs 2.1. and 2.2 and illustrated in Fig. 1 type 1 reflects soils with no or very low degradation mostly due to anoxic conditions (it could also be in very young soils with hardly any degradation). In contrary, type 2 is typical in soils with anoxic degradation where only easily degradable substances are mineralized leaving recalcitrant organic material depleted in 13C.

The differences in the geographic location of the four sites can be seen in Fig. 2. Depth differences are caused by differences in the active layer depth. We used archived samples from a previous study in September 2007 and combined this with additional samples where necessary. Because the palsa sites are highly sensitive we were very restricted with sample numbers.

We thought about more descriptive titles but think the one we used are descriptive and can not really think of a better suggestion (Hu= Hummocks, Ho= Hollows, SD = Stordadlen, SF = Storflaket). But of course we are open for good ideas. The suggestion to use the zero depth value for hummocks and hollows at the same spot is an interesting idea. Unfortunately we can not really scale figures accordingly because hummocks are up to three meters above the hollows. We would thus have an axis scale which would not allow to delineate patterns.

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Referee 2 asks about the influence of cryoturbation in these soils. Yes, of course, palsas are a form of cryoturbation. The uplifting of the hummocks due to permafrost heave is one form of cryoturbation. And this is seen in the stable isotope data with the “turning points”. We will be clearer in the manuscript and insert the term cryoturbation. If referee 2 is aiming at a mixing of the layering of different horizons due to frost processes we have to consider that the investigated soils are not mineral soils. Thus, we do not expect the ice wedges which will form in mineral soils and which might lead to mixing of horizons. If we assume that the turning points are caused by cryoturbation induced mixing of horizons, this would mean translocation of young material to the deepest investigated layers (because upper and lowest horizons turn to similar δ13C) without mixing the layers in-between. It would also imply that young peat is the dominant origin of carbon in the basal layers of all 6 profiles showing the turning points. We consider the latter very unlikely.

Referee 2 disagrees with our conclusions because he feels that we can not explain our data and that patterns could be due to site disturbance, climate change or differences in hydrology. We explicitly explained, why we are confident to exclude climate change as a triggering factor. And we state that it is very likely that changes in hydrology due to a permafrost up-heave/ cryoturbation explains our data. Of course we can not 100% rule out the possibilities of other disturbances we might have overlooked. However, this would be true for nearly every ecosystem study.

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

Table 1 Interactive comment to Referee 2 bg-2010-378: Regression functions, significance and correlation coefficients for the investigated hollows.

Type 1 Storflaket	p	R^2
SF8: y= -26.44 – 0.029x	= 0.019	0.57
Type 2 Stordalen		
SD1: y = -25.01 + 0.29x	< 0.001	0.62
SD2: y= -25.79 + 0.26x	= 0.012	0.56

Fig. 1. Table 1

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