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Climate of the Past Discussions

Interactive comment on "A permafrost glacial hypothesis to explain atmospheric CO_2 and the ice ages during the Pleistocene" *by* R. Zech et al.

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General Comments: I think this is an excellent paper, bringing forward the importance of the huge amounts of organic carbon stored in soils in the permafrost region and its effect on climate. In addition, the authors argue against the accepted notion that the oceans control the carbon cycle, which has always been difficult to prove. Some of the arguments presented in this paper could be strengthened by giving supporting data, but I think that their concept is good. I recommend that the paper be published with minor revisions.

Detailed comments:

Abstract

Page 2200, lines 6-9: I think there have been previous studies in Siberia relating to carbon in perennially frozen loess deposits. Therefore, I suggest that the word 'first' in line 7 be removed and that the wording be changed to 'Here we present results from a permafrost loess sequence. . .. . .'

Introduction

Page 2201, lines 12-14: You might also want to include the information that the amount of carbon stored in permafrost-affected soils has been grossly underestimated because of the poor understanding of cryopedological processes in these soils. These processes move organic matter into the subsoil, where it has been preserved for thousands of years.

Page 2201, line 20: It is also crucial that cryoturbation moves organic materials from the surface into the subsoil, where it is then preserved for long periods of time.

Materials and methods

Page 2202, lines 10-12: The term 'total organic carbon' (TOC) content refers to the weight of carbon in a square metre (kg m-2) to a given depth. The percent (%) of carbon given on this page and in Figure 2 refers to the total carbon concentration, not to the total organic carbon content.

Results and discussion

Section 3.3.–Page 2207, line 5: Are you referring to unfrozen taiga or to forest-steppe soils in this sentence? Cryoturbated permafrost-affected soils in the Boreal region contain as much, or more, carbon than do the soils in the Tundra region.

Section 3.4.–Pages 2207-2208: Based on your suggestion, the estimated area of the Siberian permafrost during the glacial period was 10,000 x103 km2. You estimated that the amount of carbon stored in this area would be $\sim$300 Pg. Tarnocai et al. (2009) estimate that the current area of permafrost in Eurasia is 2,508 x 103 km2, and that it contains approximately 550 Pg of organic carbon in the 0-300 cm depth. Since the per-

mafrost area in Siberia during glacial periods was approximately 3 times greater than at the present time, your estimate of 300 Pg carbon is too low. In addition, I would like to mention what happened to the soil carbon in North America. In areas overridden by glacial ice, the soil organic carbon and the mineral materials were incorporated into the glacial ice. During the retreat of this glacial ice the carbon was deposited in the glacial till. I assume that the organic matter was quickly mineralized and subsequently released into the atmosphere since the till now contains no old organic material. I realise that the North American carbon is not part of your paper but, for future circumpolar carbon estimates, it should be considered.

Conclusions

Pages 2212-2213: I certainly agree with the comment that the unglaciated permafrost regions had different carbon dynamics than the formerly glaciated areas.

Figure 2. It is very difficult to differentiate the coloured lines in the dD diagram.

Supplementary Text. I think some of the figures and text presented here could be included in the paper.

References. References with multiple authors are cited with only the names of the first three authors followed by et al. I think that the references should include all authors' names.

Interactive comment on Clim. Past Discuss., 6, 2199, 2010.