

Title: Low Soil Organic Carbon Storage in a Subarctic Alpine Permafrost Environment.

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General comments: According to the title of the paper, the authors planned to show the soil organic carbon storage in a subarctic alpine permafrost environment in the Tarfala Valley, which is situated in the Scandes mountains of northern Sweden. After the brief mention at the beginning of the paper, it was indicated that the soils in the study area are Leptosols, Regosols and Turbic Cryosols. However, no mention is made as to which of the 56 pedons sampled have these soil types. They also neglected to include the basic properties of these soils and which pedons have been included in which land cover types. Later, the permafrost was discussed in detail although none of the soils were associated with permafrost. It appears that the authors are trying to ‘stuff’ a number of non-soil related aspects into the paper. As a result, they lost the real objective of the paper, which is the soil carbon. In addition, they provided no clear pedological explanation as to why the organic carbon was low in these subarctic alpine soils.

Detailed comments:

Page 3493. I find that the title of this paper does not represent the content of the paper. First, the soil organic carbon is presented on a land cover basis (mainly vegetation), not on a soil map. Secondly, no permafrost was encountered in any of the soils that were sampled. Permafrost may occur at a deeper depth (>4-15 m) but, as far as the soils are concerned, the area is associated with a non-permafrost soil environment. Thirdly, there is no big surprise about the low soil organic carbon since none of the soils are affected by cryogenic processes. I would suggest that the title be changed to “Below-ground organic carbon storage in a subarctic alpine environment in northern Sweden.”

Page 3496, lines 23-26. The authors indicate that, in this section, the soils in the study area are classified as Leptosols and Regosols and that in areas affected by frost-thaw cycles, the soils are Turbic Cryosols. How can they be Turbic Cryosols if, in a number of places in the paper it is mentioned that none of the pedons sampled have permafrost or any cryoturbation (page 3503, lines 4-6).

Page 3497, line 10. Permafrost is currently not present in a 15 m depth borehole at an elevation of 1135 m. The active layer depth in the valley floor is 2.5-4 m. This is a clear indication that none of the soils in the study area are Cryosols. In addition, it is also stated on Page 3498, Line 2-3 that “permafrost was never encountered during coring, even at higher elevations.”

Page 3498, lines 24-26 and Page 1-3. Why has the organic carbon been determined for 199 samples using the loss on ignition (LOI) method and 96 samples using the CarloErba NC 2500

elemental analyzer? The LOI is not a recommended method for determining the percent of organic carbon, as is stated by D.W. Pribyl (Geoderma, 2010, 156:75-83). The conversion factor is not a universal physical constant. It may vary due to the types of vegetation, the amount and composition of the organic matter, and the depth of the sample in the soil profile. Pribyl further states that the LOI method provides only an estimate of the soil carbon content. He also points out that, for soil organic carbon studies, the amount of carbon should be determined directly rather than by relying on an estimate. Therefore, I would suggest that the LOI data not be used as an equivalent to the data determined by the CarloErba NC 2500 elemental analyzer.

Page 3503, lines 12-13. The organic carbon content of the organic-rich surface soil horizon(s) are almost always higher than the underlying mineral horizons in non-permafrost soils. You do not need a statistical analysis to find this out.

Page 3504, lines 5-13. This is the first time in the paper that soil development in relation to carbon was mentioned. Therefore, the 56 pedons sampled represent a variety of soils based on their development.

Page 3506, lines 15-22. It is unfortunate that the authors have not clearly pointed out the main pedological reasons for the low SOCC. The High Arctic soils are associated with a higher percentage of bare, stony ground and sparse vegetation cover than those used/studied in this paper in spite of the fact that these High Arctic soils contain many-fold higher SOCC than the Swedish soils. These High Arctic soils have the pedological processes (not only/just cryoturbation), so they can store organic matter for thousands of years. The soils studied in this paper behave just like their southern neighbours. They do not have the pedological processes that are able to concentrate and hold organic matter in the subsoil.

Table 1. The SOCC is presented in this table according to the cover classes. There is no information in the paper as to which pedons are included in these various cover classes. I assume that the column called "profile site" is the sampling depth of the pedon. According to this data, most of the pedons were only sampled to the 16-40 cm depth and only one pedon was sampled to the 53 cm depth. Since most of the pedons have been sampled only to a very shallow depth, the SOCC calculated for 100 cm is completely unreliable. Lastly, I am not sure how to interpret the data in the last column of this table relating to "sites in permafrost."

Figure 1. Maps A and B are so small that it is difficult to read them, even with a magnifying glass. I think that maps like these are especially important and should be able to be read easily with a "naked" eye. I would suggest including only maps A and B but make them at least twice the size presented here.

Figure 3. Why is there such a great variation ($0.3-3.0 \text{ g cm}^3$) in bulk density for the mineral samples, especially since the organic matter content is low? In these graphs it appears that data is available for some pedons to a depth of 80 cm. It would be very useful to see the properties of the individual pedons.

Figure 4. Showing the permafrost probability in relation to altitude has some usefulness but not for the soils sampled here since none of the 56 pedons sampled contain permafrost.