

Review of manuscript “Geogenic organic carbon in terrestrial sediments and its contribution to total soil carbon” of Fabian Kalks et al.

I read the manuscript of Kalks et al. with great interest. It is a good study that brings the importance of geogenic derived organic C in (sub)soil carbon stocks to attention and increases our understanding of its (potential) role in soil C cycling. As such, it fits well the topic of the Soil journal.

However, despite the points addressed already by the previous reviewers, there are still some things to be cleared up. Especially the part on $\delta^{13}\text{C}$ is only very shortly mentioned in the introduction, without explanation or reference, and not at all used in the discussion section. These results have to be better integrated in the paper.

Furthermore, it is better to stick with geogenic organic carbon (GOC) as term and avoid using other terminologies like “sedimentary OC” or “Sedimentary contribution” as it causes some confusion. For example, it is not very clear if OC of section 3.1 was already corrected for GOC contribution. A better distinguish between OC and “corrected OC” has to be made, if this is the case.

Here below I gave more details on the issues encountered.

Major points to be addressed:

- Is there something known about the origin of GOC in the three different sites (i.e. buried organic matter / soot / coal / ...)? As it is not stated/hypothesized, it makes also difficult to evaluate the used temperatures (450 °C) for preheating samples to remove OC.
- Line 54: “GOC in most cases is devoid of ^{14}C and thus may lead to an overestimation of ancient OC sources although a number of studies showed the importance of root derived, young OC inputs to subsoils.” This is quite a fundamental point of your study and could be better stated here already. Suggested: “As ^{14}C has a half lifetime of 5730 years, carbon deposited from the Weichselian and older are depleted in ^{14}C , thereby diluting the overall ^{14}C concentration. Especially in C poor subsoil, where GOC forms a relative larger part of the overall C content, this leads to an age overestimation of relative fresh OM, like root derived components. “
- Line 80: “Thus, using both carbon isotopes can reveal if the OC is a mixture of GOC and OC”. It is not clear how $\delta^{13}\text{C}$ can be used (from the introduction) and more detail how these different isotopes can be used to disentangle the different C components should be added. Above this line it is only made clear why GOC and ^{14}C are important to study.
- Line 101-102: Restructure and rephrase questions, especially as question II is fundamental for the disentanglement of geogenic and more recent OC. It is suggested to start with “Is (G)OC free of ^{14}C ”, than “how much does GOC contribute to (sub)soil OC?” and “will ~~sedimentary~~ GOC be degraded and/or incorporated in recent OC”

- Line 261-266: This part of the results does not create confidence in your data. First it is stated all samples were within detection limit (to my opinion an understatement, as otherwise samples should not be included or represented by the value 0) and next there is speaking of “random noise”. Better to simply state what the mean relative standard deviation was (or overall measurement/methodological error) and the lowest measured value (0.04 **g C kg⁻¹ soil**). Note that mg C g⁻¹ soil and g C kg⁻¹ soil are both used in the text.
- You could consider to discuss first the “How much GOC contributes to soil organic carbon?” before going into the bioavailability of it. This would make the “flow” of the discussion more logical.

Minor suggestions for improvement:

Line 22: “this gap” -> this knowledge gap

Line 24: “sedimentary OC” -> GOC

Line 51: “an contribution” -> “a contribution”

Line 60: “have been investigated” Missing the results of these studies, probably rephrase.

Line 68-69: “more information about the amounts of OC in sediments is needed.” -> “GOC in sediments” or “contribution of GOC in sediments”

Line 74: “hydraulic conductivity” -> “Pore distribution” or “porosity” fits the context better.

Line 127-128: “This means e.g. for a sample increment from 1-2 m, the sample represents the 1.85-1.95 m depth” -> “This means that for example the increment 1-2m is represented by a sample from 1.85-1.95m depth.”

Line 148: “removing carbonates” Same as 14C?

Line 250: “*lm*” -> “the function *lm*”

Title 3.1: “...sedimentary and subsoil organic carbon” -> be consistent with terminology. Better to use GOC / geogenic organic C instead of “sedimentary”, especially as “subsoil organic carbon” can be all OC found in the subsoil

Line 296/277: Fig 1a. -> Fig 2a.

Line 284 “they all were in the range of C3 plant material. A value above -25 ‰ for the Red Sandstone in 4 m depth can be explained by corresponding high values of inorganic carbon (IC) in this depth” -> better for discussion

Line 308: “Fig. 2 a” -> “Fig. 3a”

Line 322: “Fig. 2 c” -> “Fig. 3c”

Line 424: “the same site assigned the different” -> “the same site **and** assigned the different”

Line 425: “sedimentary OC” -> “OC”

Line 426/427: "...extremely low concentrations of 426 OC is more prone for infiltration of biogenic OC" Not completely clear what is meant, but probably best to say: "... very low OC contents increases the relative importance of biogenic C input for the over OC"

Line 463: "sedimentary bedrock" Loess is no bedrock, but an (aeolian) deposit or sediment

Line 523: Not clear what is meant with "a resistant part"

Line 525: "distinguished" -> "Distinguish"

Line 526: "bedrock OC" -> "GOC"

Line 557: "despite differences between sediments" -> ", despite differing between sediments,"

Line 570-571: Combine sentences

Line 572: "high age" -> "high ^{14}C age"