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## ***Interactive comment on “Soil organic matter dynamics under different land-use in grasslands in Inner Mongolia (northern China)” by L. Zhao et al.***

### **Anonymous Referee #3**

Received and published: 6 August 2014

This manuscript addresses an interesting topic, investigating how soil organic matter, varies between native, ground water sustaining, degraded and restored grassland. Bulk soil organic matter analysis, Stable carbon isotopes and biomarkers are used to infer the quantity, origins and molecular composition of soil organic carbon. The key finding, that ground water supply and restored grasslands enhances soil organic carbon sequestration has potentially important implications for the assessment of land management and restoration strategies.

Results and findings are generally well presented in the text, tables and figure. However, the manuscript would benefit from a careful proof read.

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Many of the key issues with this paper seem to have been addressed in response to previous reviews, but please see below for some specific comments, which I hope are useful.

## Comments

### Title and topic

As highlighted by a previous reviewer, this paper looks more at the quantity and composition of SOM at different sites rather than dynamics. No detail is provided about change over time or space, for example the quantity and composition of SOM, before/after restoration or how biomass inputs vary.

### Abstract

Page 1, line 10- Should this say 'a' rather 'the' total of sixteen soils?

Page 1, line 14 (and throughout results and discussion) -  $\delta^{13}\text{C}$  values are claimed to reflect level of degradation and water use efficiency. However, differences do not seem that great between sites and referring to Table 1, only GG is significantly different. Therefore, especially with the lack of detailed vegetation data, can this claim be justified? Could these values also reflect species differences such as different grasses or legacy species?

### Introduction

Generally a good introduction, outlining the significance of Mongolian grasslands and rationale for study.

Page 2, line 34- remove s in "changes".

### Materials and Methods

2.1. Study area and sampling Much of the focus of this paper is on the use of biomarkers and these are known to vary between species. Therefore more details of the spe-

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cific grass species present needs to be included.

Descriptions of cover quality are very qualitative i.e. page 3 line 89- “vegetation in GG is best developed” was any quantitative analysis of vegetation undertaken? I.e. species present or percentage cover.

## 2.2. – 2.5. Sections covering analysis

A major weakness of this study seems to be that, whilst much discussion of biomarker source is made in the results section, no analysis of vegetation species present appears to have been undertaken. Was any biogeochemical analysis of vegetation undertaken? This would seem particularly useful at the restored site, to look at whether soil organic matter is derived from new grass or legacy crops. If not, I still feel it would be valuable to increase the details regarding vegetation species present and if possible make greater reference to any previous studies that have carried out biogeochemical analysis on these species.

## Results

3.1. Page 6, line 181- insert ‘the’ so reads ‘by the same factors’. Additionally, suggestion that it is due to source or degradation stage is not backed up, so perhaps best to remove or address in the discussion.

3.2.-3.4. Again, main criticism is that the weakness of the arguments made is the lack of vegetation species analysis.

## Discussion

The discussion is well structured, logically split to examine changes in bulk SOM between land uses and change in molecular compositions between land uses. Nothing major to add following response to previous reviewer comments.

## Conclusion

Page 11, line 356- ‘investigate’ rather than ‘investigation for’

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Page 11, line 356- Would recommend removing or rewording the final sentence, as slightly confusing and detracting from your research. Isn't research to "understand the response of different soil organic matter to land-use changes" what this paper aims to do? Instead it may be more relevant to highlight other areas of research needed to address limitations in this study such as the quantification of biomass inputs under the different land uses studied.

Tables and figures

All tables- recommend add sample number (N) either to table or table caption.

Table 1- the header row could be made tidier.

Figure 1- Useful, but caption states 'Pictures from Inner Mongolia grasslands'. Are these photos from the study sites or just examples of different cover types? Figure 3- for bottom set of graphs, separate or make bolder the site abbreviations (DG, NG, GG, RG) to clarify that they apply to all graphs. Using different letters (a,b,c,d) to denote significant difference makes sense and are generally well used for the tables. However, slightly unintuitive as to how they are being used for figure 3 graphs. Would be clearer if always used sequentially for each graph (i.e. 'a' always used first) and for reader clarity could you clarify how double letters i.e. 'ab' are used?

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