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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.

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The aim of this manuscript is to understand human impacts on grassland soils situated in Inner Mongolia, China. In order to evidence and describe these impacts, the authors follow the changes in the composition of molecular markers in soils. The chosen markers are either specific for vegetation (lignin and cutin/suberin markers, known to contribute to stable OM), or more ubiquitous (aliphatic lipids). This study nicely shows the effect of land management on the distribution of suberin, cutin and lignin markers in soils. Four sites were chosen for soil sampling, from a native undisturbed grassland, an irrigated grassland, a highly degraded grassland and a grassland restored from

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a cropland. Before analysis, the sequential release of biomarkers starts with free lipid extraction, followed by esterified lipid base hydrolysis, and finally CuO attack on lignins.

Results are generally well presented in Tables and Figures, with appropriate statistics. The identification of cutin/suberin biomarkers seems incomplete. There is no reference for example to tri-OH alkanoic acids or diOH alkanoic acids other than α,ω-ones, both types of compounds being generally observed in grassland soils (Otto et al., 2006; Hamer et al., EJSS 2012). Furthermore, the attribution of aliphatic biomarkers to a specific above- or belowground source necessitates the analysis of the vegetation growing on the studied sites (Mendez-Millan et al., SBB 2010), since their specificity can vary with the plant species. These data are lacking in the study.

In terms of grassland management strategies and their effects on soil organic matter, this study shows that irrigation increases OM concentration, both C and N., in this region where water is a main limiting factor. Restoration from cropland to grassland also increased OM contents. Decrease of OM in degraded grassland soils was attributed to the decrease in plant and nutrient inputs due to over grazing, and consequent soil erosion, with a preferential loss of clay fraction.

The authors tentatively explain the differences in the composition of free and esterified lipids and of lignins in the different grassland soils by 1) the preferential degradation of lipids and lignins, in accordance with recent results that dissociate the chemical composition of OM and its long-term fate in soils or 2) the loss of clay minerals in soils affected by erosion due to low OM contents. The authors show that suberins markers are the most affected compounds, with a high increase in the soils of the irrigated and restored grasslands. This study nicely confirms the higher stabilization of root C already suggested by Rasse et al. (Plant and Soil, 2005) and Mendez-Millan et al. (SBB 2010).

A weakness of this study is that the authors do not show any estimate of plant litter inputs to soil, which might greatly vary between the different sites. Thus, the conclusion

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based on the enrichment factor for the different molecular markers should be removed. The lack of data on the plant inputs and on the plant biomarker content and composition in roots and shoots makes it impossible to conclude on the dynamics of the markers. The authors should at least comment on the possible implications of the changes in content and molecular composition of plant biomass inputs at the different sites.

Specific comments:

- Page 6, line 180: “strong linear correlation”. Is a r^2 of 0.595 that strong? On Figure 4, it would be useful, first to precise that these are the values for each of the four soil samples taken at each site. And also to use different colors for the four different sites and indicate the means calculated for the different sites.

- Page 7, line 208-209: “These compounds were abundant in suberin of root and bark of higher plants”. This is probably not the correct origin for the w-OH acids in the free-lipid fraction, since suberin constituents are not recovered in the free lipid extract, but in the products of the base hydrolysis.

- Page 7, line 218: “and steroids”. No steroids are indicated in Figures 5B and 6B. By contrast, a,w diOH acids are indicated in the figures and not mentioned in the text.

- Page 7, lines 225-227: “Branched alkanoic acids [. . .] reflect inputs from soil microbes”. Microbial lipids are generally recovered in the free-lipid fraction. Why would they be present in the saponified extract here?

- Page 8, lines 241-242: “The ratios C:V and S:V were calculated to estimate the source of lignins”. These ratios can also vary with the degradation degree of lignins.

- Page 10, lines 304-305: “aliphatic and lignin biomarkers are preferentially degraded during the grassland degradation process. This explanation is consistent. . .”. This is more an hypothesis than an explanation. An explanation would require to explain how and why these compounds can be preferentially degraded, or more rapidly degraded, and necessitate some some information on the plant inputs and on the dynamics of the

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microbial communities in these soils.

- Page 10, line 315: “long-term decomposition in soils”. More probably “long-term stabilization”, since the decomposition of plant residues in soil is generally not considered as a long-term process.

- Page 10, lines 335-338: The meaning of this enrichment factor is not clear, since the inputs of the different markers might strongly vary in the different sites, depending on the vegetation type, plant species, primary productivity, environmental conditions.

- Page 11, lines 341: “changing allocation pattern of above and below-ground biomass of vegetation”. Since no estimate of plant biomass input is proposed in this manuscript, the validity of this hypothesis on plant C allocation is difficult to evaluate. This last paragraph drastically indicates that plant input measurement would strengthen this study.

- Page 11, line 349: “dynamics of responses of soil organic matter”. The composition was studied here, but not the dynamics, which would require the use of an isotopic marker, or a mass balance taking into account the plant inputs to soil.

Minor comments: - Page 9, line 279-283: this sentence is not clear

- Page 9, line 286: “became more positive”. If this is a general trend described in the literature, a more explicit expression such as “generally becomes” should be used.

- Page 10, line 307: replace “newly soil fungi. . .” by “newly formed soil fungi. . .”

- Page 10, line 324: replace “thereby reduced” with “thereby reduce”

- Page 11, line 343 and line 364: replace “resident time” with “residence time”

Interactive comment on Biogeosciences Discuss., 11, 5613, 2014.