Response letter to Anonymous Referee #3

(Responses of authors are marked in yellow)

This paper presents a novel study using △17O to trace the atmospheric origin of nitrate in paleo groundwater. This study is well planned and the evidence to support the main conclusions is convincing. The paper is generally well written and I support its publication, but some clarifications are need.

1.Page 20091, line 5, 6, and figure 5: It is not clear how the δ15NNO3 and δ18ONO3 in desert deposition help explain your data here. All your data in this figure are close to the range of soil nitrogen rather than the nitrate in precipitation. I don't think you can
say the nitrate in groundwater is impacted by atmospheric deposition just based on this figure. Your strongest evidence for the atmospheric source is △17O. So I think you should bring up this evidence first, then talk about their relationship with desert nitrate deposition.

35. In this part of the ms the data are used to show that the NO_3 is not affected by denitrification and that a distinct but different trend can be followed in Fig. 5. The sentence is rewritten and shorten: "This trend cannot result from denitrification (dashed arrow; Böttcher et al., 1990; Kendall,1998; Granger et al., 2010), but might be explained by an impact of NO_3^- from atmospheric deposition (e.g. Böhlke et al., 1997)."

2.Page 20091, line 15-16 and Figure 7a: The green dashed line in Figure 7a is a regression for all nitrate data, not just the data of this study. The data of this study actually follow slightly below this line, which could be due to MDF as the authors pointed out. I think the authors should make it clear how their own data compares to this line and what that means.

36. Added text: "The isotope data of Hasouna groundwatwer are plotting slightly below the dashed line. This behaviour may be caused by minor variability of the isotopic composition of atmospheric photochemical NO_3^- and/or by a slight impact on secondary MDF effects e.g. induced by denitrification. For the present case the overall non-relevance of denitrification is shown in Fig. 5."

3.Page 20093, line 5-15: Like the other reviewers pointed out, the authors should discuss other possibility for the distribution of x[NO3-]atm.

37. See revision note 1 above (Comments on Review 1).

4.Page 20094, line 1,2: Not the best way to express this. Maybe you can just say "local distribution of x[NO3-]atm", but x[NO3-]atm needs to be clearly defined.

38. Revised text: "The local distribution of $x[NO_3^-]_{atm}$ (equation (6)) …"

5.Page 20094, line 23-24: The authors mentioned four possible sources of nitrate in groundwater (anthropogenic, evaporite dissolution, leaching from soils and atmospheric deposition). Here the authors conclude that the remaining nitrate relates to microbial sources. I think it should be made clear where the remaining nitrate is actually from. Is it synthesized by microbes within the groundwater or leached from the soils?

39. Revised text: "… is leached from the soils."

6.Figure 5: The references for the range of each box should probably be added to the figure caption (they are currently in the text).

40. References are given in the captions.

7.Another question: how mobile are these groundwater? How well are these atmospheric isotope anomalies preserved? Would the distribution of x[NO3-]atm be affected by influx and export to other areas?

41. Comment: This is one main result of our study: Our measured ^{17}O excess values in Fig.7a show that the atmospheric isotope anomalies are well preserved in the investigated paleo groundwater (see e.g. Abstract)! Influx and export from/to may change x[NO_3^-]atm, but also NO_3 concentration (Fig.7b). Thus within this large aquifer the relationship in Figs. 7a and b will be not changed.