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Climate of the Past Discussions

Interactive comment on "The magnesium isotope record of cave carbonate archives" *by* S. Riechelmann et al.

J. Baldini (Referee)

james.baldini@durham.ac.uk

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This paper presents Mg-isotope data from several stalagmites from a variety of cave sites scattered across many different climate regions. As such, it is one of the broadest studies of Mg isotopes in stalagmites and should be of interest to a variety of researchers. The authors present a very fair assessment of the pros and cons of using this still novel isotopic system. Mg isotopes show potential because they appear to respond to climate variability; however, the authors identify a number of processes that could affect isotope ratios in different ways, and therefore lead to complicated and somewhat ambiguous interpretations. Particularly problematic were the different isotope time-series from stalagmites from Germany, from a similar climate and geology, but the authors provide a reasonable possible explanation for the differences. It must

be noted that more commonly used proxies such as carbon and oxygen isotopes from coeval stalagmites from nearby caves (and sometimes from the same cave) sometimes show different time-series trends. This is generally due to differing drip regimes; it is therefore not surprising to find that the same types of problems arise when investigating a novel isotope system like Mg isotopes. It is important that papers, such as this one, build the foundations for evaluating these systems, even if initially the results are ambiguous. The biggest obstacle to wide usage of Mg-isotopes is the poor resolution of the sample points due to the large amount of material required, but again this is something that may be resolved in the future with refinement of the technique.

The paper is well-written and comprehensive, and I see no major obstacle to publication. The only two substantial suggestions I have are to reorganize the text somewhat and to discuss the effects of detritus in more detail (both elaborated on below). I have also listed minor comments that I hope will help improve the manuscript.

Specific Comments: Section 4: The authors move on to the results a bit too early I think. It would benefit the reader to go through the systematics of Mg-isotopes in stalagmites before presenting the results, so that the reader may put the results into a better context. I therefore suggest that the text from section 5.1 is moved up to between Sections 3 and 4, or possibly even directly after Section 1. This may also require a slight rewording of the text in places.

P1846, L15: PCP does not actually lead to a higher Mg-content of the fluid, just a higher Mg/Ca of the fluid.

P1853: The authors are probably correct about the detrital material having an influence on Mg isotope ratios. However, the discussion is limited to areas of stalagmites with clear detrital layers, whereas there is probably detritus in the form of colloidal particles disseminated throughout the samples at variable concentrations. It might be worthwhile to add a few lines discussing colloids, and possible referencing Adam Hartland's work. I have made a suggestion on how to quantify detrital concentrations below.

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Section 5.5: Maybe I have missed this, but it might be worthwhile pointing out that Spannagel is developed in marble sandwiched between gneiss, and discuss what effect the gneiss might have on the Mg isotope signature.

Figure 3: Currently it's difficult to see the carbon and oxygen records in the figure. Could these be plotted on different axes so that the time-series could be compared better?

Figure 5: It might be useful to plot the AH-1 Mg isotope record alongside BU4 in order to facilitate direct comparison. It would be interesting to compare them directly in the figure, because they are compared in the text several times.

One possible way to add to the discussion on effects of detrital material on Mg isotopes is to plot Mg isotope ratios versus some proxy for detritus. Maybe 232Th concentrations could be used? These should be readily available for most of the stalagmites discussed, and then it would simply be a matter of either making a time series of 232Th versus d26Mg for some of the stalagmites, or perhaps just a scatterplot of mean 232Th concentrations for all stalagmites (where this known) versus mean d26Mg. This might not work, but is maybe worth trying?

Technical Corrections: P 1836, L1: "...of magnesium (d26Mg) isotope time-series data..." L19: "...which is consistent with the rather..." L21: "...suggest changes in outside air temperature was the principal driver rather than rainfall amount." P1838, L15-18: I wouldn't number this list unless there is a number 3. P1840, L24: "powdered" instead of "gounded". Elsewhere as well. L25: "...does not exceed the second decimal..." P1841, L6: "...is found that reverses at around..." L12: "The lowest measured values occurred at..." L22: "...(dated using one U-Pb age of 2.134...)" P1842, L13: "...between two age points:..." P1844, L16: "Rainwater becomes progressively 26Mg-enriched with increasing distance..." L29: "...weathering increases during..." P1846, L27: "...is observed (Fig. 8)." L29: "However, near the calcite-to-aragonite transition the presence of small amounts of aragonite within the calcite is possible."

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P1852, L15: “led” P1856, L15: “. . .are currently difficult.” P1857, L12: “. . .interact. . .” rather than “interfere”

Interactive comment on Clim. Past Discuss., 8, 1835, 2012.