

## ***Interactive comment on “Assessment of Halon-1301 as a groundwater age tracer” by M. Beyer et al.***

### **Anonymous Referee #1**

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Water age dating is of fundamental importance in hydrology and hydrogeology since it provides quantitative information on the time scales of water movement through catchments. This has implications for both water resources, fluxes and processing times of biogeochemically relevant ions and molecules. Despite the importance of water age dating, there are very few tools that can be used in a quantitative manner to measure water residence times. The paper presented by Beyer et al further investigates the use of Halon-1301 as a new tracer for dating of young water in groundwater systems. Thus the paper makes a potentially important contribution to the available methods for dating groundwater. Technically the paper is sound and in my opinion needs only minor revisions. My main concern is that this new tracer actually gives us no new information to the methods already available. SF6 for example is actually more sensitive and

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atmospheric concentrations are rapidly increasing, making it a more suitable gaseous tracer. Moreover, tritium is considered the most robust tracer, especially in the southern hemisphere. So I would ask the authors what Halon-1301 provides that tritium and SF6 don't. This may lie in finding a unique solution to model parameters, but if so this needs to be further explored in the paper.

Minor points:

The paper is rather difficult to read, and I found myself often being caught up in the grammar than concentrating on the ideas presented in the paper. This is mostly because the paper is written in present tense, which is quite strange, especially when referring to samples taken and measured in the past. I would highly recommend that the authors change the text to past tense, as this will help with many of the disconcerting sentences and allow the reader to better concentrate on the ideas and methods rather than constantly having the feeling that something is wrong with the grammar.

P1405 Line 15: the authors give first an approximate measured volume (10ml) and then the exact volume ( $9.97 \pm 0.02$ ml). This is redundancy, just give one or the other, I suggest that the exact volume is given, although this has also been discussed in the methods section. P1406 Line 10-15: The authors state that the data from Deeds 2008 cannot be considered robust because they come from a PhD thesis. In my experience some very good data is contained in PhD work that unfortunately never gets published. Thus while the authors may be correct as suggested later in the paper, the fact that the data come from a PhD thesis is in my opinion no grounds for the data to be considered in error.

P1406 Lines 20-25: How sure can the authors be that Halon-1301 is well mixed across the atmosphere of the southern hemisphere?

P1410 section 3.2: There is a fundamental difference between quantification limit and detection limit. Thus the authors cannot calculate a water age at the detection limit (since this statistic only determines if the gas can be detected or not), but need instead

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to do this at the limit of quantification. Other than this, the authors have provided a very robust estimation on error and error propagation. P1401: Solubility: there is a lot of noise in the data generated by the authors, much more than in Deeds 2008. Why is this and why didn't the authors do the solubility experiments in the classical way of exposing a known volume of water to a known concentration of Halon-1301? The noise in the data can also be seen in SF6. General: Halon-1301 vs other tracers: the authors state that the data agree very well with a few exceptions. Firstly, there is no Halon-1301 or SF6 plotted in Figure8 where ages are compared between 3H and CFCs. This makes it difficult for me as the reviewer to evaluate how well the ages agree. When looking at table 3 I found it hard to identify which MRTs correlated with which tracer. But if I understood the table properly, there are many dates that are quite different e.g. Lake Ferry MC, Seaview Wools, IBM2. If I am mistaken I would ask the authors to make the table clearer. There are also MRTs listed that are below the quantification limit of the tracers.

One of the assumptions in the models used to quantify the MRT is that the MRT and the distribution of residence times around the mean is stationary. Is this a reasonable assumption at the sites studied here? This may have implications for comparing data measured in the paper with previous measurements of 3H.

Plots: please indicate if the lines are 1:1 lines, which would be good, or simply lines of best fit. 'ff' is given in italics in all words.

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