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Interactive comment on “Overview on radon measurements in Arctic glacier waters” by A. Kies et al.

Anonymous Referee #1

Received and published: 16 April 2015

This paper seeks to develop a “new” method for understanding subglacial hydrologic processes using radon as a tracer. With a half life of only ~4 days, radon-222 is continuously produced in sediments and rocks from the decay of uranium-238 series daughter product radium-226. Hence, melt water with any significant contact with basal sediments or fractured bedrock will acquire a radon signature. In theory, this tracer could be used to quantify the relative amount of distributed vs channelized system outflow in warm based glaciers since subglacial flow through open channels should have limited sediment-water interaction and therefore a relatively low radon content.

Overall the paper is not well written or organized (includes, among other issues, a repeating paragraph on p. 2031) and is more of a data report than original research article. Few of the discussion points are supported in any quantitative way, made more

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difficult by generally poor presentation of data (e.g. figures consisting of photos with pasted data tables for single point measurements). Measurements and discussion are quite heavily focused on artesian outflows. These are interesting on their own but I question how useful they are in providing insight on bigger picture ice dynamics (e.g. the question of relative importance of distributed vs channelized flow). In this way the title is misleading as it implies that the manuscript will provide a broad view not just on one aspect of subglacial hydrology (artesian springs). There is also the issue of the author's multiple claims to be the "first" to publish on the use of radon as a tracer of subglacial hydrology. Please see Bhatia et al. (2011) [Journal of Glaciology 57 (205), 929-941] for a systematic study on the use of radon tracing in such environments. Many of the benefits and caveats with the use of Rn in these environments have already been covered in this earlier publication, which is not to take away from this new data, but rather could serve as an example of how the data could be treated in a more quantitative manner. Note also that I have some concerns about the quality of the data: the solubility of Rn in freshwater at 0°C is about 50% (not 10% as reported here). Hence, the continuous Rn data may be off by a factor of ~5.

Though my recommendation is "reject", I will provide detailed comments below in case the Editor disagrees or with the hope that the authors might improve the quality of the manuscript for submission to another journal.

1. The title is too broad and doesn't adequately describe the focus of the study
2. typo in abstract line 6: 222Rnv
3. text on lines 18-23 of p. 2015 should be cut (not relevant for the manuscript)
4. line 27 p2015 spelling error Dulaiova
5. p. 2017 line 1: please remove all references to first attempt at use of radon in glaciology studies
6. p. 2017, line 7: what is "period T"?

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7. p. 2017 line 15: delete first sentence as it was already mentioned that radon comes from radium. Also line 20 here: again, repetitive.

8. p. 2018 lines 19 and 21: I think you mean to say channelized not canalized.

9. p. 2019 lines 12-15: speculation and not based on data (unless a reference can be provided).

10. p. 2020 line 1: how calibrated? What radon standard?

11. p. 2020 line 9: the other radionuclides should be listed along with the methods used. Alternatively they are not integral to the paper so this sentence and the corresponding data could be deleted.

12. p. 2020 line 15: what is the manufacturer and model # of the radon monitor used? How was it calibrated?

13. p. 2020 line 17: the partition coefficient for radon in water (water/air) is 0.5 at 0°C. Please recheck your calculation and correct all of the affected data.

14. p. 2020 line 19-21: The equilibration time for radon diffusion across a gas permeable membrane can be substantial-hours in some cases-and slow if circulation through the air loop is not continuous. Was the equilibration time under these conditions (pump on for only a few min per cycle) tested in the field? or in the laboratory? If there is a lag (Likely) how does this affect the data (correspondence between EC, radon and other parameters)? See Schubert et al. 2012: Kinetics of the water/air phase transition of radon and its implication on detection of radon-in-water concentrations: practical assessment of different on-site radon extraction methods, Environ. Sci. Technol., 46(16), 8945–8951.

15. p. 2020 line 23: what is TDGP really telling you? and how is it useful for this paper?

16. p. 2022 line 25: paragraph here needs to be rewritten to correct for problems with style and grammar.

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17. p. 2024: the U and Ra data are not discussed in sufficient detail to be included in the paper. Also, line 18: what is “scrap” sampling?

18. p. 2026: paragraph starting line 3: this point about freezing effects on EC vs Rn is an excellent one; what figure is this referring to? Fig. 4? Also, too much information is repeated between the first and second paragraphs here. Combine and condense.

19. p. 2027: the discussion here is generally good but the supporting figure is not clear.

20. p. 2028: the earlier point I made (#18 above) gives one example where Rn and EC are decoupled; discussion here at top of this page wrongly assumes that the two must always move in lock-step. Why the contradiction? Later on this page a comment is made that the radon should be constant from year to year (30 Bq/L). This cannot be assumed based on limited sampling reported here!

21. p. 2030 line 12: units of EC should be uS/cm not Bq/L

22. p. 2030 line 25: sediment surface area, contact time, and decay during transit all can control Rn in delayed flow waters.

23. p. 2031 line 18-23: this paragraph is repeated.

24. p. 2033 lines 2-3: not a complete sentence; line: 4: low radon cannot simply be attributed to decay during transit. Could be a sign of channelized flow. Also, many conclusions here (last paragraph) are difficult to draw without estimates of volumetric flow (from artesian springs or otherwise).

25. p. 2034: line 2: but Radon is increasing during 12-14 September, not decreasing. line 10 “no more any”.

26. p. 2035 line 13: contradictory statement: radon drops in lock step with EC here.

27. p. 2036 line 23: remove “first time” statement.

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Figures: there are some instances of water temperature and air temperature. Please be specific of what exactly is being measured. For example in Fig. 8: I think this is air temp but the previous figure shows water temp. Also what are the units for Rain?

TCD

9, C432–C436, 2015

Interactive comment on The Cryosphere Discuss., 9, 2013, 2015.

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