

Interactive comment on “Quartz dissolution associated with magnesium silicate hydrate cement precipitation” by Lisa de Ruiter et al.

Anonymous Referee #1

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I enjoyed reading this manuscript, the authors present work around magnesium silicate hydrate 'cements' that form in glacial soils/sediments. The wider applicability to long-term nuclear storage seems warranted, and potentially to other forms of Mg-based anthropogenic cements.

I have a few main concerns with the work, 1) While I'm inclined to believe the mechanisms outlined in the ms from the evidence provided, have the authors considered that the source of Si may be from the parent rock rather than the dissolving quartz grains. Is there any possibility that some of the Si originates from there? 2) The chronology behind deriving the weathering rate seems speculative (i.e., the quartz only started dissolving following the closure of the mine. It's not clear how the rate was derived, was it calculated from a shrinking core model? 3) The overall evolution of the ground

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model is not well described. This can be improved in the 'geological setting' section. What is the source of the glacial till? When did the primary minerals weather (if they weathered post-glaciation, could they provide some of the Mg to the cements?). How does ground water flow into the till, and what is its chemical composition? 4) In similar environments, when Mg-OH ground waters contact the atmosphere, the formation of Mg-carbonates are typically observed (see mine tailings e.g., Turvey et al., 2018 International Journal of Greenhouse Gas Control V79, or the classic O'Neil and Barnes 1971 GCA). Is it not strange that Mg-carbonates were not observed here? Especially if evaporation was your primary mechanism for driving precipitation. 5) Section 5.5., regarding the applicability of the results need substantial expansion. How could M-S-H cements be used and how does this information in the ms held constrain this use? What is the long-term fate of M-S-H (e.g., potential for carbonation or weathering?).

I've attached a pdf with more specific comments.

Please also note the supplement to this comment:

<https://www.solid-earth-discuss.net/se-2020-34/se-2020-34-RC1-supplement.pdf>

Interactive comment on Solid Earth Discuss., <https://doi.org/10.5194/se-2020-34>, 2020.

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