Response Statement to Community's Comments (Giacomo Medici)

Wang and Jeng

January 24, 2026

The authors thank the reviewer for the valuable comments. The manuscript has been revised by carefully considering all the comments. The changes are highlighted in the marked copy, and detailed responses to the reviewer's comments are provided below.

General Comment:

Good research on contaminant transport in porous media that needs some improvement and further detail. See my specific comments, they will improve the potential new version of the manuscript.

Response (General Comment):

We thank the reviewer for the positive assessment of our work and for the constructive comments. All specific suggestions have been carefully considered and addressed in the revised manuscript, leading to improvements in clarity, technical detail, and overall presentation.

Comment #1-1:

Line 23. . . . "has been the most widely applied framework in the field". Last words not backed up by references. Add these papers that incorporate discussion on evidence of the Fick's law in the field:

- Agbotui, P.Y., Firouzbehi, F., Medici G. 2025. Review of effective porosity in sandstone aquifers: insights for representation of contaminant transport. Sustainability 17, no. 14 (2025): 6469.

- Parker, B.L., Cherry, J.A., Wanner, P. 2022. Determining effective diffusion coefficients of chlorohydrocarbons in natural clays: unique results from highly resolved controlled release field experiments. Journal of Contaminant Hydrology 250, 104075.

Response:

We thank the reviewer for this insightful comment. To address this concern, we have revised the statement to avoid an overly strong formulation and have clarified the applicability of the advection–dispersion equation by explicitly referencing field-scale evidence supporting Fickian diffusion in natural geological media. In particular, we have added recent field-based studies by Parker et al. (2022) and Agbotui et al. (2025) to support the revised statement.

[Deleted content:] ~~has been the most widely applied framework in the field.~~

[Added new content:] *remains one of the most widely applied frameworks for modelling contaminant transport in porous media, with its relevance supported by field-scale evidence of Fickian diffusion in natural geological formations (Parker et al., 2022; Agbotui et al., 2025).*

[Line 23–25]

Comment #1-2:

Line 30. This sentence does not work as it is. Before "purely physical transport" and then you involve geochemistry. Please, revise the structure.

Response:

We thank the reviewer for pointing out this issue. The sentence has been restructured to clearly distinguish between traditional contaminant transport formulations that focus on purely physical processes and the additional role of geochemical reactions. This revision resolves the logical inconsistency and improves the clarity of the statement.

[Deleted content:] ~~Beyond purely physical transport, geochemical reactions further affect the migration of dissolved species by altering concentration distributions and species mobility.~~

[Added new content:] *While many contaminant transport models focus primarily on purely physical processes, geochemical reactions can also significantly influence the migration of dissolved species by altering concentration distributions and species mobility.*

[Line 31–34]

Comment #1-3:

Line 76. You need to disclose the general aim of the research at the end of the introduction.

Response:

We thank the reviewer for this comment. A clear statement of the general aim of the study has now been added at the end of the Introduction.

[Added new content:] *The general aim of this study is to develop a three-dimensional hydro-mechanical–chemical (HMC) modelling framework that explicitly couples hydro-mechanical deformation with multicomponent geochemical reactive transport. The framework is used to investigate solute transport in near-saturated deformable porous media. Specifically, the objectives of this study are to: (i) analyse the coupled effects of mechanical deformation and multicomponent geochemical reactions on solute transport within the proposed HMC framework; (ii) explore the sensitivity of deformation-driven solute transport to loading conditions and limited deviations from full saturation through numerical simulations.*

[Line 75–76]

Comment #1-4:

Line 76. You need to describe the specific objectives of your research by using numbers (e.g., i, ii, and iii) at the end of the introduction.

Response:

We thank the reviewer for this comment. The specific objectives of the study have now been explicitly stated at the end of the Introduction using numbered points (i–iii).

[Added new content:] *Specifically, the objectives of this study are to: (i) represent deformation induced by mechanical loading under near-saturated conditions within a three-dimensional HMC framework and quantify its influence on solute transport; (ii) incorporate multicomponent and multi-mineral geochemical reactions into the HMC framework and examine their role in deformation-driven solute migration; (iii) investigate the effects of loading conditions and degrees of saturation on solute transport behaviour through numerical simulations.*

[Line 76–80]

Comment #1-5:

Line 199. Insert reference to Parkhurst for PHREEQC.

Response:

We thank the reviewer for this comment. In addition to the existing reference for PhreeqcRM, the standard reference for the PHREEQC geochemical engine by Parkhurst and Appelo has now been explicitly added in the

revised manuscript.

[Added new content:] which preserves the full thermodynamic and kinetic reaction capabilities of PHREEQC (Parkhurst and Appelo, 2013) while streamlining data exchange between the reactive-transport code and the geochemical engine.

[Line 208–209]

Comment #1-6:

Line 250. This one looks to me a figure, not a table or an equation. Am I correct?

Response:

We thank the reviewer for this comment. The item at Line 250 has now been presented and labelled as a figure, with the corresponding figure caption and in-text references revised accordingly.

[Added new content:]

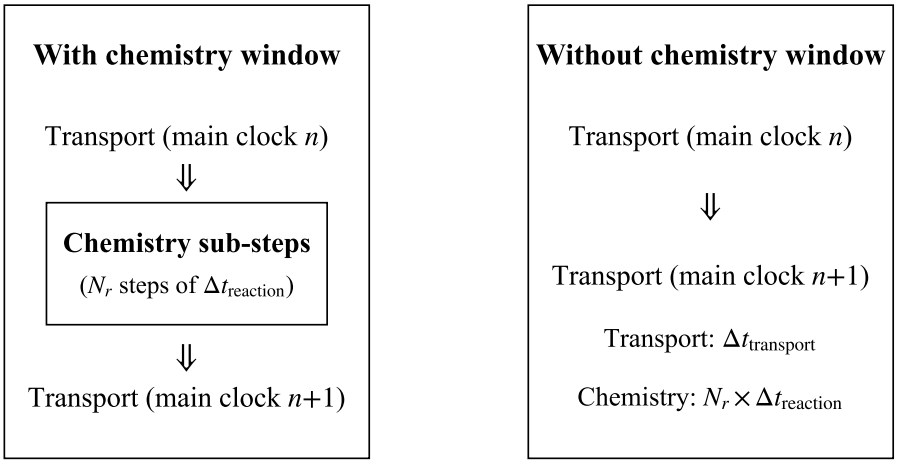


Figure 1: Schematic of reaction–transport time stepping with and without a chemistry window.

[Line 258–259]

Comment #1-7:

Line 700. More detail on the acknowledgement. Funding bodies are unclear.

Response:

We thank the reviewer for this comment. The Acknowledgements section has been revised to clarify the funding body and the nature of the support provided.

[Deleted content:] ~~The authors are grateful for the support from Shandong Provincial Overseas High-Level Talent Workstation (A2021-140).~~

[Added new content:] *The authors gratefully acknowledge the institutional support from the Shandong Provincial Overseas High-Level Talent Workstation (Grant No. A2021-140) for facilitating the research presented in this paper.*

[Line 707–709]

Comment #1-8:

Figure 3. Make the image larger.

Response:

Thank you for the suggestion. The size of Figure 3 has been increased to improve readability.

[Added new content:]

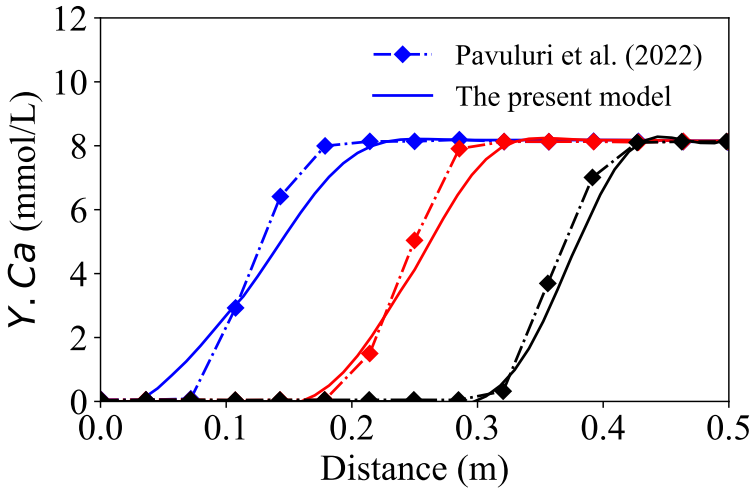


Figure 2: Comparison of the present model (solid line) with Benchmark 2 (Pavuluri et al. (2022), diamond markers). The blue line represents the result at 20 minutes, the red line at 40 minutes, and the black line at 60 minutes.

[Line 325–326]

Comment #1-9:

Figure 5. Same here, make the figure larger.

Response:

Thank you for the suggestion. The size of Figure 5 has been increased to improve readability.

[Added new content:]

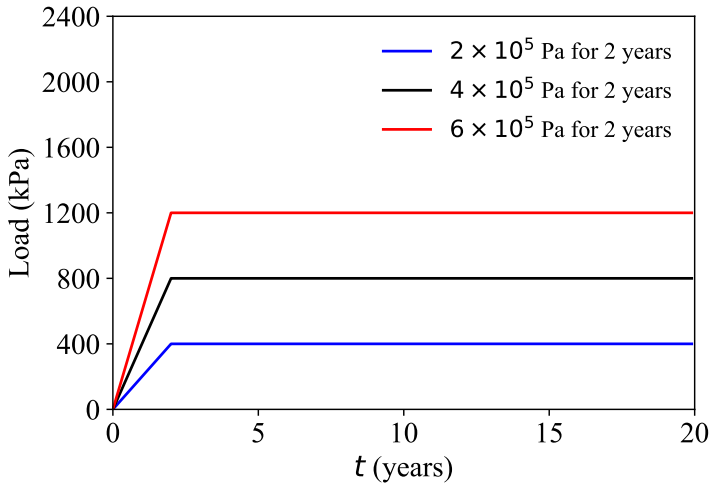


Figure 3: Load pattern under different models: the black line represents **Case A**, the red line represents **Case D**, and the blue line represents **Case E**.

[Line 421–422]

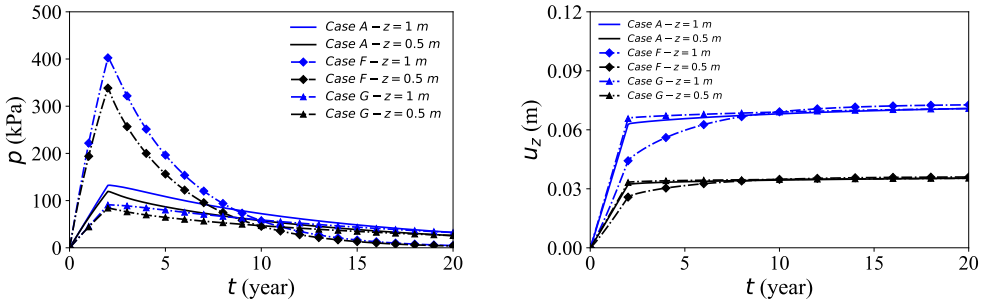
Comment #1-10:

Two figures 11. This is not ok.

Response:

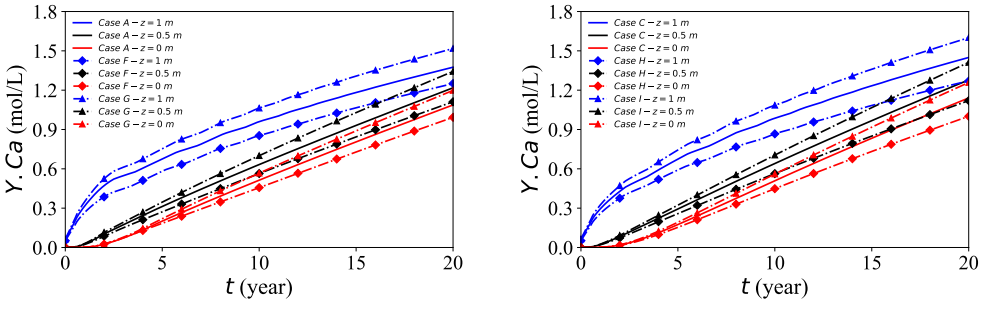
Thank you for pointing this out. The figure was originally split across two pages because the composite figure was too large to fit on a single page. In the revised manuscript, this issue has been resolved by separating the content into two figures: one showing pore pressure and vertical displacement, and the other showing concentration evolution.

[Added new content:]

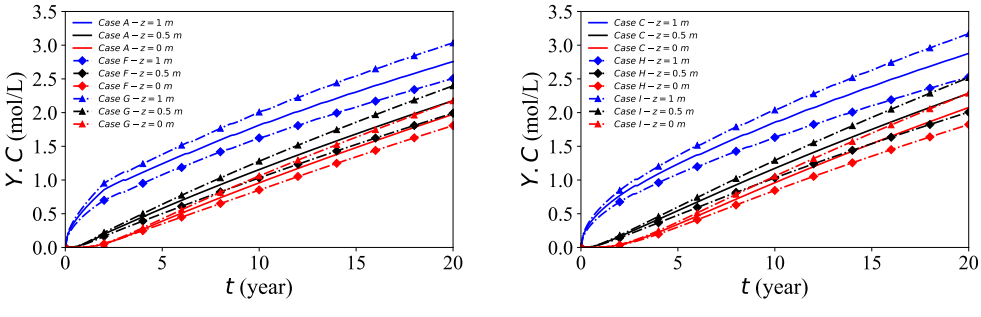


(a) p vs t of **Case A, F, G** (b) u_z vs t of **Case A, F, G**

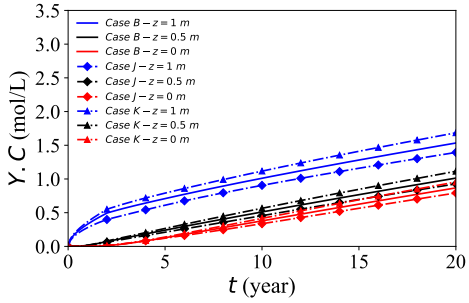
Figure 4: Time evolution of pressure and vertical displacement under different models (**Case A-C**, **Case F-K**) at the observation point located at $x = 17$ m.



(a) *Y.Ca* vs t of **Case A, F, G** (b) *Y.Ca* vs t of **Case C, H, I**



(c) *Y.C* vs t of **Case A, F, G** (d) *Y.C* vs t of **Case C, H, I**



(e) *Y.C* vs t of **Case B, J, K**

Figure 5: Time evolution of concentrations under different models (**Case A-C**, **Case F-K**) at the observation point located at $x = 17$ m.

[Line 429–437]

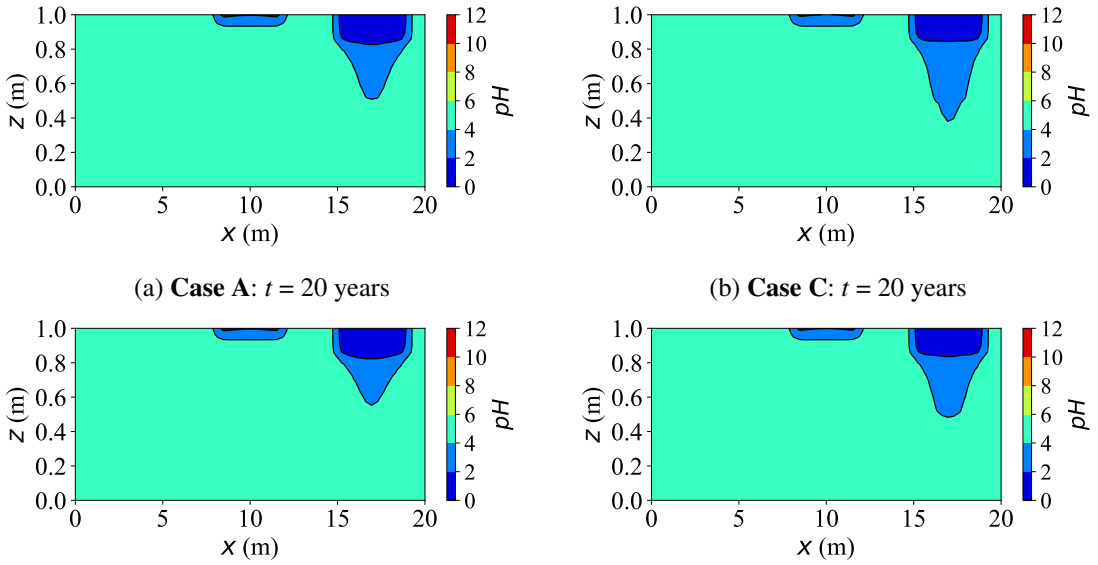
Comment #1-11:

Figure 9. Make the figure larger also here.

Response:

Thank you for the suggestion. The size of Figure 9 has been increased to improve readability.

[Added new content:]



(a) **Case A**: t = 20 years

(b) **Case C**: t = 20 years

(c) **Case D**: t = 20 years

(d) **Case E**: t = 20 years

Figure 6: Contour plots of *pH* for the different models (**Case A-E**).

[Line 438–447]

References

Agbotui, P.Y., Firouzbehi, F., Medici, G., 2025. Review of effective porosity in sandstone aquifers: insights for representation of contaminant transport. Sustainability 17, 6469. doi:https://doi.org/10.3390/su17146469.

Parker, B.L., Cherry, J.A., Wanner, P., 2022. Determining effective diffusion coefficients of chlorohydrocarbons in natural clays: unique results from highly resolved controlled release field experiments. Journal of Contaminant Hydrology 250, 104075. doi:https://doi.org/10.1016/j.jconhyd.2022.104075.

Parkhurst, D.L., Appelo, C.A.J., 2013. Description of Input and Examples for PHREEQC Version 3: A Computer Program for Speciation, Batch-Reaction, One-Dimensional Transport, and Inverse Geochemical Calculations. Technical Report Techniques and Methods, Book 6, Chapter A43. U.S. Geological Survey. Reston, VA, USA.

Pavuluri, S., Tournassat, C., Claret, F., Soulaine, C., 2022. Reactive transport modeling with a coupled openfoam®-phreeqc platform. Transport in Porous Media 145, 475–504. doi:https://doi.org/10.1007/s11242-022-01860-x.