ENAC – School of Architecture, Civil and Environmental Engineering
SGC – Civil Engineering Section
LMS – Soil Mechanics Laboratory
lms.epfl.ch

Pre-study and Master Project
Fall Semester 2023-2024

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Numerical study of the influence of geological heterogeneities during fluid injection in the subsurface

Supervisor: Prof. Lyesse Laloui
Assistant: Jose A. Bosch

Motivation of the project

Fluid injection operations are involved in many geo-energy applications such as CO2 carbon sequestration, deep geothermal energy and gas storage. The success of these operations might be compromised by eventual microseismic and seismic events caused by the fluid pressure buildup in the reservoir. In order to minimize seismic risks, proper site characterization and monitoring strategies are key. The aim of this project will be to investigate the effects of geological heterogeneities on the injection pressure buildup in order to verify the suitability of diagnostic plots for identifying reservoir geometries. For this, numerical simulations of fluid injection in different reservoir configurations will be performed and the results will be compared to ideally homogeneous cases. The results will be useful for enhancing current methodologies of reservoir characterization and injection strategies.

Keywords

Subsurface fluid injection, Reservoir geomechanics, CO2 geological storage, Flow in porous media.

References

Vilarrasa, V., Bustarret, G., Laloui, L., & Zeidouni, M. (2017). A methodology to detect and locate low-permeability faults to reduce the risk of inducing seismicity of fluid injection operations in deep saline formations. International Journal of Greenhouse Gas Control, 59, 110-122.

Renard, P., Glenz, D., & Mejias, M. (2009). Understanding diagnostic plots for well-test interpretation. Hydrogeology Journal, 17(3), 589-600.

Goal of the project

The goal of the project is to provide guidelines for the management of fluid injection strategies. The student will acquire an advanced knowledge in new technologies related to reservoir geomechanics.

Tasks and work to carry out

- Literature study of the site characterization and subsurface injection management methodologies
- Propose case studies of heterogeneous reservoirs
- Perform numerical simulations of the proposed cases
- Discuss and propose an advanced methodology of injection management based on the results

Deliverables

- Report

The student will have to prepare a technical report containing the introduction and motivation for the project, the description of the accomplished work and related results as well as conclusions. The technical report will have to be prepared in an electronic format and send to the supervisor and the responsible of the project by the end of the semester.

- Final Presentation

The student will have to present his work during a presentation at the end of the semester. The day and the place of the presentation will be communicated to the student.

Planning

- Meetings and presentations

A weekly meeting (on Friday pm) with the assistant is suggested to discuss the progress of the project. One meeting per month will be organized with Prof. Laloui (dates will be communicated to the student). During the meetings with the assistant, the student will have to present (i) the progress of the work, (ii) possible questions and remarks and (iii) a summary of the next steps for the project. During these meetings, the supervisors may vary the foreseen goals of the project, if necessary. The student will have to prepare all the possible questions before the meeting in written form and a summary of each meeting for the next fixed meeting.

- Report

The report will be written in English. Graphs will be built with the Python library Matplotlib. Particular attention will be given to the writing up of the report. In the document, the student will have to clearly introduce the topic, to highlight the hypotheses made, to present the considered methodology, to discuss the obtained results and to draw the related conclusions.

- **Electronic files**

At the end of the project, the student will have to send to the supervisors a folder containing a clear classification of all the electronic files developed during the project, including those related to the reports, obtained data, presentations, poster and graphs.

- Deadlines

The tasks of the pe-study should be accomplished during the Fall semester 2023, from September to December 2023. The report should be submitted to the supervisors by January 2023. The master project should be performed in the Spring semester 2024, from February to June 2024.

Grading

The final grade will be assigned considering the following proportions of contribution:

- Implication and initiative during the semester 30%
- Technical report 50%
- Oral presentation 20%

The evaluation will also consider the work methodology, discipline and resourcefulness of the student.

General rules of the project

The schedule of the project is defined by the EPFL Academic Calendar:
https://memento.epfl.ch/academic-calendar/?period=180

The student signature on the submitted report certifies that the work is original and developed by him/herself. This work is property of the EPFL and cannot be disseminated without the approval of the considered Institution.

Contacts

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