Preface

The increasing intensity of the subsurface usage for energy storage, energy "production", energy waste deposition, resource extraction, infrastructure and many others as part of the ongoing technical development of a growing world population requires a careful assessment of potential environmental consequences to maintain our base of living. The strategies and scenarios required for a sustainable development can be devised and tested with the help of numerical simulations using models of the underlying coupled physical, chemical and biological processes.

Here, subsurface storage of energy carriers is selected as an example technology in this context. In particular, this book presents an introduction to thermo-mechanical modelling of gas storage in salt caverns using the open-source software *OpenGeoSys* (*OGS*). The material is mainly based on work done in the framework of the ANGUS+[1] and NUMTHECHSTORE[2] projects, and is also the result of a close cooperation within the *OGS* community (www.opengeosys.org). These voluntary contributions are highly acknowledged.

In the context of subsurface usage in transforming energy systems, the book features a general introduction to gas storage in rock salt formations, the constitutive modelling of rock salt, and the coupling of heat transport with solid mechanical problems. It contains several step-by-step guides on how to set up models of both laboratory experiments and real-scale caverns with OGS.

This book is intended primarily for graduate students and applied scientists dealing with coupled problems in the subsurface, in particular those interested in applying a freely available and customizable open-source simulation framework in their research. As such, this book will be a valuable help in the training of geomechanical modelling and provides an entry point to a modelling tool which is expandable and highly flexible.

[1] http://angusplus.de/en.

[2] http://www.ufz.de/index.php?en=37528.

This tutorial is the fourth volume in the Springer series *Computational Modeling of Energy Systems*[3] that presents applications of computational modelling in energy sciences. Within this series, this volume opens up a sequel of contributions on applying the simulation platform OGS to geotechnical applications in the energy sector based on work performed in close cooperation with the Federal Institute for Geosciences and Natural Resources (BGR)[4]:

- Computational Geotechnics: Storage of Energy Carriers, this volume,
- Computational Geotechnics: Deep Geological Repositories, Nagel et al. (2018*).

It was proceeded by three tutorials in the series covering the topic geothermal energy

- Geoenergy Modeling I. Geothermal Processes in Fractured Porous Media[5] (Böttcher et al. 2016),
- Geoenergy Modeling II. Shallow Geothermal Systems[6] (Shao et al. 2016),
- Geoenergy Modeling III. Enhanced Geothermal Systems[7] (Watanabe et al. 2017).

and will also feature technical applications, such as

- Models of Thermochemical Heat Storage, Lehmann et al. (2017*).

These contributions are related to a similar publication series in the field of environmental sciences, namely:

- Computational Hydrology I: Groundwater Flow Modeling[8] (Sachse et al. 2015),
- Computational Hydrology II[9] (Sachse et al. 2017),
- OGS Data Explorer, Rink et al. (2017*),

(*approximate publication time)

Few books are without errors, and this book is likely no exception. Should you discover errors that should be corrected, we would be grateful if you let us know and help improve this book.

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[3] http://www.springer.com/series/15395.
[4] http://www.ufz.de/environmental-geotechnics.
[5] http://www.springer.com/de/book/9783319313337.
[6] http://www.springer.com/de/book/9783319450551.
[7] http://www.springer.com/de/book/9783319465791.
[8] http://www.springer.com/de/book/9783319133348.
[9] http://www.springer.com/de/book/9783319528083.

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