Geophysical Research Abstracts
Vol. 16, EGU2014-12162, 2014
EGU General Assembly 2014

Preserving drinking water quality in geotechnical operations: predicting the feedback between fluid injection, fluid flow, and contamination

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Not only in densely populated areas the preservation of drinking water quality is of vital interest. On the other side, our modern economies request for a sustained energy supply and a secure storage of waste materials. As energy sources with a high security of supply, oil, natural gas, and geothermal energy cover ca. 60% of Europe's energy demand; together with coal more than 75% (IEA 2011). Besides geothermal energy, all of the resources have a high greenhouse gas footprint. All these production activities are related to fluid injection and/or fluid production. The same holds true for gas storage operations in porous reservoirs, to store natural gases, oil, or greenhouse gases. Different concerns are discussed in the public and geoscientific community to influence the drinking water quality:

- wastewater discharges from field exploration, drilling, production, well treatment and completion

- wastewater sequestration

- gas storage

- tight gas and tight oil production (including hydraulic fracturing)

- Shale gas production (including hydraulic fracturing)

- mine drainage

This overview contribution focusses on strategies to systematically reduce the risk of water pollution in geotechnical operations of deep reservoirs. The principals will be exemplarily revealed for different geotechnical operations.

- How to control hydraulic fracturing operations to reduce the risk of enhanced seismic activity and avoiding the connection of originally separated aquifers. The presented approach to quantitatively predict the impact of stimulation activities is based on petrophysical models taking the feedback of geomechanical processes and fluid flow in porous media, fissures and faults into account. The specific flow patterns in various rock types lead to distinguished differences in operational risk.

- How can a proper planning of geotechnical operations reduce the involved risks. A systematic risk reduction strategy will be discussed. On selected samples the role of exploration, operation, monitoring, and proper abandonment will be presented.

- Which critical parameters can be monitored? The chances and limitation of different monitoring technologies will be discoursed for a storage site.

- How can public involvement reduce risks? This will be shown for hydraulic fracturing operations.

- How can geotechnical operation reduce the risk for the groundwater and environment? Some examples will be given to show, that geotechnical operations have the inherent capability to enhance the security of our drinking water.

The presentation will discuss how the use of underlying physical and chemical principles can significantly reduce geotechnical risks during fluid injection.