Geophysical Research Abstracts
Vol. 20, EGU2018-11541, 2018
EGU General Assembly 2018

Investigation of potential impact of hydraulic fracturing fluid and methane leakage at regional-scale

Alexandru Bogdan A.C. Tatomir (1), Christopher McDermott (1), and Martin Sauter (2)

(1) Dept. of Applied Geology, University of Göttingen, Göttingen, Germany (alexandru.tatomir@geo.u-goettingen.de), (2) School of Geosciences, University of Edinburgh, Edinburgh, UK

Hydraulic fracturing for natural gas extraction in shale formations not only has impacted the global energy landscape, but also has risen concerns over its potential environmental impact. The concept of "features, events and processes" (FEP) refers to identifying and selecting the most relevant factors for defining relevant scenarios for safety assessment studies. In the context of hydraulic fracturing we constructed, to the knowledge of the authors, the first of its kind FEPs database. FEP analysis is an established technique for (geo-)engineering projects such as radioactive waste management, or geological CO_2 storage (Yamaguchi et al. 2013).
The main objective of this work is the development of conceptual models for each key risk scenario from the FEP database and the ranked list of features, events and processes. The parameter ranges (e.g., porosity, permeability, formation depth, temperature, etc.) needed by the numerical simulators are determined from collecting data from seven shale gas basins (Baltic, Paris, North West German, Lublin, Bowland, Carpathian-Balkan, Pannonian-Transylvanian) and a chemical database. A number of six focused scenarios are then defined and parametrized. For each key scenario a number of sub-scenarios are constructed based on the ranked FEPs. Each sub-scenario contains the basic model assumptions, mathematical/ numerical model, definition of boundary and initial conditions, definition of the variable parameters and the ranges to be scanned in the sensitivity analysis, and the parameters of investigation (e.g., breakthrough curves, maximum values, such as pressure, concentration, etc.).
An example of gas and hydraulic fracturing leakage and fluid transport at regional-scale is constructed in the open-source numerical simulator DuMux. The equivalent continuum assumption is valid at the regional scale for the conductive overburden layer. Furthermore, a sensitivity analysis is conducted to understand the influence of reservoir properties (e.g., intrinsic permeability, porosity), operational factors determining the extent of the leakage rate (solved with a reservoir-scale model). The processes considered for investigations are the influence of the regional hydraulic groundwater flow, the buoyancy effects, effects of dissolved methane in the brine phase and the degassing leading to appearance of a two-phase flow system.