Geophysical Research Abstracts
Vol. 19, EGU2017-6941, 2017
EGU General Assembly 2017

The challenges of a possible exploitation of shale gas in Denmark

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Extraction of shale gas has in recent years attracted increasing interest internationally and in Denmark. The potential areas for shale gas extraction from Alum shale in Denmark are defined as areas where Alum shale is at least 20 m thick, gas mature and buried at 1.5 to 7 km depth. Sweet Spots are areas where Alum shale potentially has a high utility value. Sweet Spots are identified and cover an area of approximately 6,800 km2 and are divided into two subareas; where the shale is at 1.5-5 km depth (2,400 km2) or at 5-7 km depth (4,400 km2). The shale in the upper depth interval has the greatest interest, as these areas are localized most accurate as the production from the deep interval is less costly. Many potential risks has been identified by exploitation of unconventional gas, of which groundwater contamination, waste management and radioactive substances are classified as the most important. The international literature reports a water demand with an average of about 18,000 m3 for older wells whereas newer fracking methods have less water usage. Based heron the estimated water consumption is between 20 million to 66 million m3 water in Danish shale gas production well and thus significantly in the total water budget. Consumption of water for shale gas will however be distributed over a number of years. The temporal development in water usage will depend on how quickly the gas wells are developed. The available groundwater resource in Denmark is estimated to about 1 billion m3 / year. Groundwater abstraction has been slightly falling the last decades and is now totally 700 million m3 / year. The use of surface water in Denmark is thus negligible. Although groundwater attraction is only 70 % of the available, the resource is overexploited in many areas due to water consumption is very unevenly distributed varying from region to region. The composition of potential hydraulic fracturing liquids in Denmark is at present unknown, but is expected to be selected from the same 14-40 different chemicals currently in use in Poland. In addition, the produced water may contain large amounts of formation brine expected to pose a significant problem for environmental safe discharge. Overall, this means that the fate of contaminants is very difficult to assess, but the infiltration of these substances into groundwater would likely result in a change of chemical conditions and an unacceptable deterioration of groundwater quality. Further, the average age of portable water in Denmark is high as the renewal time for groundwater is long. Hence, the spread and thus the dilution of contaminants will be very limited; these substances can be maintained in high concentrations in many areas. Consequently, a set of monitoring and remedial measures should be implemented to minimize possible environmental impacts, including baseline studies for the relevant inorganic and hazardous organic substances in surface water and groundwater known from previous studies to potentially have been affected by shale gas activities.