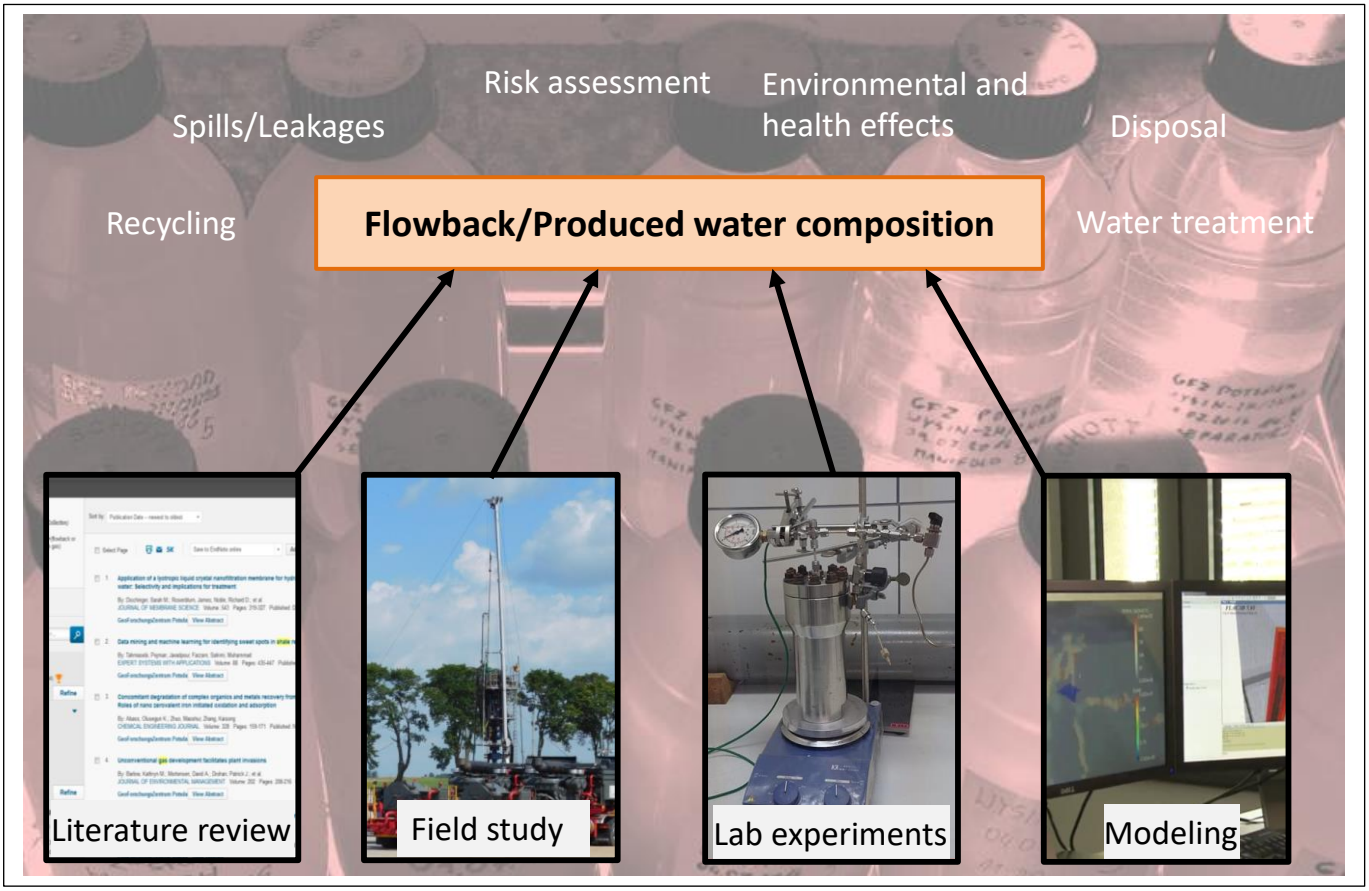
RECOMMENDATIONS ON FLOWBACK WATER COMPOSITION

A. VIETH-HILLEBRAND, F.D.H. WILKE, M. KÜHN, J. FRANCU



Background

Flowback and produced water contain not only residues of fracking additives but also chemical species that are dissolved from the target shales themselves. Shale is a heterogeneous mixture of minerals, organic matter, and formation water and little is actually understood about the main controls on the geochemical composition of flowback and produced water. The possibility that flowback water could be spilled during capture and transport or leak through the borehole casing during shale gas production or during injection in disposal pits, causes major public concerns about the environmental and social compatibility of shale gas exploration. Therefore, simulation of flowback water composition is necessary to provide scientific base for recommendations about possible risks for water systems as well as the environmental footprint of shale gas exploitation.

Study

To get insights into the composition of fracking fluids, flowback and produced water, a literature review was performed with focus on available data from the USA, Canada and the Europe. Furthermore, compositions of fracking fluid and flowback samples from the Wysin-2H well (Poland) were analyzed. To provide information about the controls on flowback water composition, the fluid-rock interactions between an artificial fracking fluid (containing butyldiglycol and choline chloride) and four different shale samples (Posidonia (D), Alum (DK), Mikulov (CZ), and Marcellus (USA) shales) were studied in autoclave experiments. This data was then used for numerical process simulations to estimate the geochemical composition of flowback water. Finally, a model was developed enabling risk assessment without the necessity for field experiments.

Results

The results from autoclave experiments showed clearly that fluid-rock interactions change the chemical composition of the fluid over time. Depending on the shale composition, variable quality and quantity of inorganic elements will be released, the organic load of the fracking fluid will be retained probably by sorption and organic compounds are released that were not part of the artificial fracking fluid. Results from the Wysin sample confirmed the laboratory results with respect to inorganic constituents, but also showed that most organic compounds in flowback do not seem to be derived from the fracking fluid sample. They may originate from shale, fluid-shale interactions or transformation products of the injected chemicals. The lab-derived data have been used for calibration of the numerical model assuming kinetic dissolution of phyllosilicates as the process driver.

RECOMMENDATIONS ON FLOWBACK WATER COMPOSITION

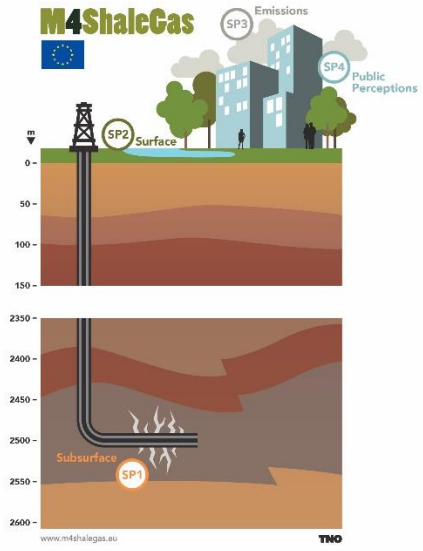
A. VIETH-HILLEBRAND, F.D.H. WILKE, M. KÜHN, J. FRANCU

Science-based Recommendations

- Full disclosure of the applied chemicals for hydraulic fracking is necessary for risk assessment. Only with knowledge of the compounds that are injected into the reservoir, it will be feasible to assess the possibility of subsurface reactions in the shale formation and make assumptions about flowback and produced water compositions.
- The composition of flowback and produced water needs to be known for application of optimized waste treatment, and/or decision about disposal or storage of water. This requires chemical monitoring of these different fluids over time.
- Determination of compound concentrations in fracking fluid and flowback samples is an analytical challenge due to high load of dissolved elements and organic compounds. Improvements in sample preparation are necessary. Consistent protocols for sampling and analytical methods need to be applied for a reliable chemical monitoring of fracking fluid and flowback/produced water samples.
- Both, returned fluids and solids (proppants, rock chips and tube scalings) need to be sampled and prepared for chemical analysis and monitoring as inorganic, organic and radioactive elements could be scavenged and sorbed on solid surfaces or newly precipitated.
- The complex composition of organic compounds needs an application of non-targeted analytical methods for screening and compound identification.
- The reliability of the analytical results as well as the proficiency of the laboratories can be enhanced by regular cross-checking and lab tests. By contract or legal regulation, sample providers and the laboratories have to agree that obtained data will be published and stored in a publically available data base.
- Simulation of flowback water composition using numerical modeling is only possible with (1) extended geochemical data bases, especially for organic constituents and (2) improved process understanding of geochemical mobilization from shales. With accordingly improved models other hypotheses need to be tested.
- On the short time frame it is recommended to deduce a purely data-driven model based on the existing experimental results. This would benefit input and output data of the system to find out specific patterns of the flowback and to be generalized for a broader range of data.

The Project

M4ShaleGas examines the potential environmental impacts and risks related to **shale gas** exploration and exploitation in Europe with the goal to build a technical and social knowledge base on best practices and innovative approaches for **m**easuring, **m**onitoring, **m**itigating, and **m**anaging these impacts.



4 sub-programs:

- SP1-subsurface
- SP2-surface
- SP3-air emissions
- SP4-public perceptions

Funding:
The project that has received funding by the European Union's Horizon 2020 research and innovation programme under grant agreement number 640715.

Horizon 2020 Topic LCE-16-2014:
Understanding, preventing and mitigating the potential environmental impacts and risks of shale gas exploration and exploitation.

Project duration:
1 June 2015 – 30 November 2017

Coordination:
TNO

Published December 2017 by M4ShaleGas Consortium