ShEER News

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Shale Gas Exploration and Exploitation Induced Risks

Issue 02, May 2016

In this Issue...

Welcome to the second SHEER newsletter. The aim of this Horizon 2020 project is to to develop best practices aimed at assessing the impacts and mitigating the environmental footprint of shale gas extraction and exploration.

Happy reading!

UK Environment Agency and Health and Safety Executive visit Keele University to learn about SHEER

Representatives from the Health and Safety Executive and the Environment Agency visited Keele University Sustainability Hub to learn about the SHEER project. Also in attendance were SHEER colleagues from Keele University, Glasgow University and RSKW.

Figure 1. Andrew Gunning, RSKW talking about groundwater monitoring at Wysin

An overview of the project was given by Prof Peter Styles, Keele University. This was followed by a presentation by Andrew Gunning, RSKW, on the monitoring which will be undertaken at the Wysin site in Poland (see next article for further details).

These two presentations led the way for an excellent discussion on all aspects of the SHEER project, especially on the monitoring techniques that will be used on site.

Figure 2. General discussion

The meeting ended with a lovely lunch and both agencies showing a very keen interest and asking to be kept informed of project developments

Latest Project Developments

- On-site monitoring at Wysin is ongoing
- High-level conceptual models of a selection of shale analogue sites have been developed. These were used to determine potential impacts on groundwater resources at the Wysin site.
- Geomechanical models of a shale play have been developed and are being used to investigate the effect changing various parameters have on the stress of the surrounding rock.
- Prof Paolo Gasparini, AMRA, introduced the SHEER project at the European Science and Technology Network on Unconventional Hydrocarbons Extraction - Annual Conference.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 640896

On-site Monitoring at Wysin

Atmospheric Monitoring

By Janusz Jaroslawski, Institute of Geophysics, Polish Academy of Sciences

The atmospheric constituents measured at Wysin, Poland include basic primary and secondary pollutants, greenhouse gases and radioactive gas.

IGF PAS undertake the air quality monitoring. Sensors are located in the vicinity of the water supply station in Stary Wiec village, about 1200m from the drilling area.

Figure 3. Air quality monitoring station

Continuous monitoring of air pollutants commenced on 10 July 2015. Air quality monitoring will cover a time period before, during and after hydraulic fracturing activities. In order to obtain the full extent of air quality baselines, additional data from the air pollution monitoring system in Pomerania province will be used. These data include air pollution and meteorological data collected for 2012 to 2014 by the five closest stations (located at distances from 8 to 30 km from the well). Integration of these data with the results from the on-site monitoring carried out during 2015-2016 will allow for the assessment of the background of the air quality in the area, as well as the assessment of the long range impact of drilling activities.

Seismic Monitoring

Dr Simone Cesca, GFZ Potsdam

The seismic monitoring network has been designed by GFZ and IGF PAS; taking into consideration site availability, safety, power supply and GSM coverage. The equipment has been provided by GFZ, IGF PAS and AMRA.

The induced seismicity monitoring plan includes monitoring by means of:

- a distributed network of broadband stations;
- three small-scale arrays of short period sensors;
- a shallow borehole installation.

The role of the small-scale arrays is to improve the detection and analysis of weak microseismic events. The arrays are located in the vicinity of the injection well. Better location and ray tracing are achieved because the arrays are not located directly above the injection, but at an offset, so that the seismic waves approach the array from one side. Three triangular-shaped arrays were deployed 3-4 km from the injection well. The geometry of each array was chosen to fit available sites after agreement with land owners, ensuring an array aperture of about 300-400 m, and smaller distributed inter-station distances. A sampling frequency of 500 Hz was chosen to resolve short time offsets between signals recorded at different stations. Three broadband stations are located at the sites of the small-scale arrays, to allow comparison of the signals from the different sensors. Three additional broadband stations were located to improve the azimuthal coverage around the injection site and to increase the epicentral distance (up to about 5-6 km from the injection well). If a felt earthquake occurs, broadband stations at further distance will help to constrain the location and improve the determination of source parameters. A sampling rate of 200Hz was chosen for the broadband stations to enable an overall a broad range of frequencies and to overlap with the frequency range of the short period stations. A total of 31 surface stations have been installed.

Figure 4. Borehole seismic station

Groundwater Monitoring

By Dr Nelly Montcoudiol, University of Glasgow & Dr Catherine Isherwood, RSKW

Following the completion of the drilling of the groundwater wells, the monitoring plan has begun to be carried out. Its objective is to provide insights into the potential impacts of shale gas exploitation by fracking on groundwater resources used as drinking water. The monitoring regime relies on the measurement of several indicators which, when interpreted together, will help to constrain the origin for any observed changes in the groundwater quality.

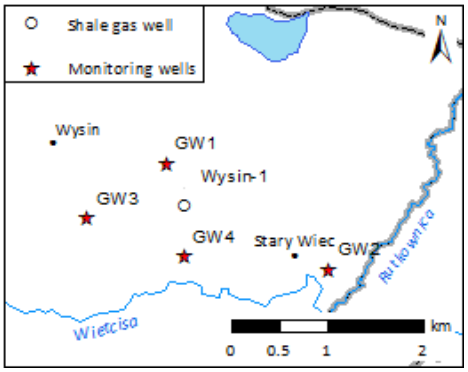

Figure 5. Location of the monitoring wells with regard to the vertical shale gas well

Figure 6. Downhole probe for continuous monitoring

The groundwater monitoring plan includes collection of both continuous and intermittent data. Downhole probes were installed in each borehole, at the level of the screened section. The probes take continuously records (every 15 minutes) of the absolute pressure (water column plus atmospheric pressure), the temperature and the specific electrical conductivity. In addition, a barometric probe records the atmospheric pressure.

Intermittent data are collected during regular site visits, in addition to downloading the data from the downhole probes. The frequency of planned site visits varies according to the phase of shale gas exploration activities:

- Before fracking: every month,
- During fracking (about two weeks): two rounds of sampling within a week, and
- After fracking: sampling every month for one year and quarterly thereafter.

Each of the four wells is sampled at each site visit. When arriving at the well, the groundwater level is measured using a dip meter. This measurement is then checked against the record from the corresponding downhole probe, to provide an independent check on the probe function.

The sampling procedure follows established best practice. Prior to sampling, the well is purged using a submersible pump. The purged volume is equivalent to at least three times the standing water contained in the borehole. The purging is necessary to ensure that groundwater samples are representative of the aquifer. During purging, the physico-chemical parameters (temperature, specific conductivity, pH, dissolved oxygen and oxido-reduction potential) are monitored using a multi-parameter probe. After purging and once they have stabilised, samples are collected for lab analyses. Alkalinity is measured directly on the field using a digital titrator. Samples are stored at 4°C until being shipped to the laboratory for analysis. In addition, duplicates and blanks are regularly taken for quality assurance purposes. The samples are analysed for the following constituents: cations & anions, a range of minor & trace elements, dissolved gas, and isotopes. Only isotopes are not systematically analysed after each sampling round.

Figure 7. Monitoring physico-chemical parameters during purging of GW4 (the River Wietcisa is located downhill, at the end of the field)

So far, site visits have been successfully completed in December 2015, February, March and April 2016. These four sampling rounds will help to define the baseline i.e. the prevailing conditions before fracking. Interpretation of the site visits is ongoing and will be presented in a future newsletter.

SHEER and EPOS-IP TCS AH

November 2015 saw the launch of the implementation phase of the European Horizon 2020 funded "European Plate Observing System" project (or EPOS-IP). A number of the SHEER team are partners under the "Anthropogenic Hazards" (AH) Technical Core Services (TCS) work package (WP14). EPOS-IP is one of the EU's flagship research programmes with over €28M of direct funding for the next four years.

The SHEER team are providing important data, services and information relating to the seismic and environmental hazards associated with shale gas exploitation. The WP14 kick-off meeting at the Central Mining Institute in Katowice brought together members of the Anthropogenic Hazards project for their first collaborative meeting. The EPOS-IP AH programme will initially provide "Episodes" (open access data sets of seismic event monitoring) that researchers can use to investigate the impact of shale gas and hydrocarbon related exploitation.

More information about the EPOS-IP Anthropogenic Hazards programme can be found at

https://goo.gl/Bff3vX

www.epos-ip.org

New Publications

Konstantinos Leptokaropoulos, Szymon Cielesta and Monika Staszek (2016). *Characteristics of Seismicity Related to Hydro-Fracturing: A Review and Case Studies.* IGF PAS

SHEER Key Facts

Project acronym: SHEER

Project full title: Shale Gas Exploration and Exploitation Induced Risks

*Project duration:*01.05.2015 – 30.04.2018

Funding Scheme: EU Horizon 2020

Project Partners:

8 partners from 6 countries

AMRA (Italy), IGF PAS (Poland), Keele University (UK), GFZ Potsdam (Germany), KNMI (Netherlands), RSKW Ltd (UK), University of Glasgow (UK), University of Wyoming (USA)

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