# The role of heterogeneity in controlling the geomechanical behaviour of sandstone reservoirs

*A Data Management Plan created using DMPonline*

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## Project abstract:

Fluid extraction from geological formations for purposes of subsurface utilization (e.g. hydrocarbon production, hydrogen storage, geothermal energy production) can result in reservoir compaction, which may induce seismicity and surface subsidence. Compaction of sandstone reservoirs is directly related to the petrography (composition and texture) of the rock, which also impacts the fluid flow within, and geochemical and geomechanical properties of the reservoir. To predict how a reservoir responds to fluid extraction, it is thus crucial to have a clear understanding of the reservoir petrography and the factors controlling its lateral variability. For the Groningen gas field and surrounding aquifers, where production-induced compaction is an issue of major socio-economic impact, no model for the reservoir petrography exists. I propose to identify and quantify the spatial compositional and textural variations within the Rotliegend sandstones of the Groningen gas field and aquifers in the vicinity, using optical and electron microscopy, x-ray diffraction and image analysis. The resulting dataset, which will include detailed information on detrital and authigenic mineralogy, will be used to develop a predictive petrographic model. This model will be combined with sedimentological, petrophysical and geophysical data in order to allow up-scaling of the petrographic properties to reservoir level. Samples with petrographic properties that are

representative for (parts of) the Groningen gas field will be subjected to deformation experiments to analyse the impact of petrographic variability on the geomechanical behaviour of the sandstone reservoir. The proposed integration of petrographic analysis, deformation experiments, and modelling will greatly improve our capability to predict petrographic properties, and thus the geomechanical behaviour, of Rotliegend sandstones. The project will thus provide a strong basis for evaluating reservoir response to fluid extraction, not only from the Groningen gas field, but from clastic reservoir rocks in general.

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**Copyright information:**

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## General Information

**Name applicant and project number**

Johannes M. Miocic
DEEP.NL.2019.003

**Name of data management support staff consulted during the preparation of this plan and date of consultation.**

Name: Prof. Harro Meijer
Date: 14.04.2021

## 1. What data will be collected or produced, and what existing data will be re-used?

**1.1 Will you re-use existing data for this research?**

**If yes: explain which existing data you will re-use and under which terms of use.**

- Yes

Subsurface data publicly available on nlog.nl will be reused. Additional subsurface data, such as the publicly available 3D model of the Groningen gas field will also be re-used.

**1.2 If new data will be produced: describe the data you expect your research will generate and the format and volumes to be collected or produced.**

New data will be produced by the project. This will include:

- results from thin section analyses (numeric data, as .xls/.csv; images, as .tiff/.png; mixed data, as .pdf)
- geological modelling (numeric data, as .csv; mixed data, as .pdf). Any modelling

data will be made available using the standards set by the open porous media initiative (https://opm-project.org/). This will allow reproducible models and simulations.
- triaxial deformation experiments (numeric data, as .csv; images, as .tiff/.png; mixed data, as .pdf)

**1.3. How much data storage will your project require in total?**

- 100 – 1000 GB

Images and geological modelling data quickly result in large storage needs, in total the data storage needed will be between 100 GB and 1 TB.

# 2. What metadata and documentation will accompany the data?

**2.1 Indicate what documentation will accompany the data.**

- For thin-section data: For each thin section a detailed description of how the data was obtained and analysed will be stored together with the results of the analysis in a linked-excel spreadsheet.
- Modelling data: Detailed documentation of the model set-up will be provided as code books
- Deformation experiments: Detailed documentation of the experimental setup and execution will be supplied for each experiment (as pdf)

**2.2 Indicate which metadata will be provided to help others identify and discover the data.**

By depositing the data on DataverseNL, information will be automatically be provided by a metadata standard scheme and thus the data will be searchable using common tools such as google scholar. Additionally, the data will be attributed with a DOI, which will make it easily identifyable and discoverable.

# 3. How will data and metadata be stored and backed up during the research?

**3.1 Describe where the data and metadata will be stored and backed up during the project.**

- Institution networked research storage

The data and metadata during the project will be stored and backed up on the server of the University of Groningen using iRODS.

**3.2 How will data security and protection of sensitive data be taken care of during the research?**

- Not applicable (no sensitive data)

## 4. How will you handle issues regarding the processing of personal information and intellectual property rights and ownership?

**4.1 Will you process and/or store personal data during your project?**

**If yes, how will compliance with legislation and (institutional) regulation on personal data be ensured?**

- No

**4.2 How will ownership of the data and intellectual property rights to the data be managed?**

Ownership rights of the created data will belong to RUG personified by either the PI or associated PhD students. No intellectual property rights are affected.

## 5. How and when will data be shared and preserved for the long term?

**5.1 How will data be selected for long-term preservation?**

- All data resulting from the project will be preserved for at least 10 years

Digital data created during the project will stored long-term on the server of the University of Groningen using iRODS.
Additionally, it will be archived on DataverseNL, an open access datastore, where third parties can access the data
Physical data, such as thin-sections, will be stored within the University of Groningen facilities and will be made available upon request.

**5.2 Are there any (legal, IP, privacy related, security related) reasons to restrict access to the data once made publicly available, to limit which data will be made publicly available, or to not make part of the data publicly available?**

**If yes, please explain.**

- No

**5.3 What data will be made available for re-use?**

- All data resulting from the project will be made available

All data will be made available, either as data-set accompanying relevant publications or as  digital archive after the project finishes.

**5.4 When will the data be available for re-use, and for how long will the data be available?**

- Data available as soon as article is published

Data will be made available as soon as an article is published or upon the completion of the project, whichever is earlier.

**5.5 In which repository will the data be archived and made available for re-use, and under which license?**

Data will be archived at on DataverseNL and be made availabe for re-use under CC BY-SA 4.0.

**5.6 Describe your strategy for publishing the analysis software that will be generated in this project.**

No analysis software will be generated in this project.

# 6. Data management costs

### 6.1 What resources (for example financial and time) will be dedicated to data management and ensuring that data will be FAIR (Findable, Accessible, Interoperable, Re-usable)?

Time for data storage and management has been accounted for in the research plan in the proposal, with both PI and PhD student(s) spending up to 0.05 FTE on data management. By depositing the data on DataverseNL it is ensured that the data is FAIR. Costs of storing data on DataverseNL are currently covered by RUG and not the individual researchers.