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Rheology data overview for study sites

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Summary

A survey of existing rheological databases and scientific and industry literature and reports will yield a comprehensive database of the rheological behaviour of North Sea relevant lithologies with the aim to establish regional trends and correlations that maximise the quantification of rheology for CCS site-specific applications. This report details the availability (albeit rather limited) of geomechanical properties of the relevant lithologies determined both from rock deformation experiments (static properties) and derived from openhole wireline logging recordings of the p-wave and s-wave velocities as well as densities (dynamic properties).

Introduction

Many subsurface engineering operations and related risk assessments such as caprock integrity, reservoir compaction, hydraulic fracture management and containment, and induced seismicity, depend on a combination of rock mechanical deformation behaviour and in-situ stress state, not only of the reservoir itself but also of the surrounding rocks and lithologies in the under- and overburden. Though the rock mechanical deformation behaviour and characterisation can be quite complex, and the design of non-linear constitutive models is a specific research subject in itself for many subsurface applications and screening assessment, elastic deformation in combination with for instance Mohr Coulomb or critical state failure models works quite well.

Stress states

The deformation and failure of the poroelastic subsurface is controlled by the total stress state, σ , and the pore pressure, p_f. The total stress state σ, is a tensor, which can be described by three principal stresses. For subsurface purposes, in many cases we can approximate σ by assuming that one of the principal stresses is the vertical stress, σ_v ($\sigma_v = \sum \rho g z$), and the other two principal stresses are the minimum horizontal stress, σ_h, and the maximum horizontal stress, σ_H. The Anderson classification (Anderson, 1905) takes account of which of the principal stresses is largest and smallest; for a normal stress regime for instance, $\sigma_v > \sigma_H > \sigma_h$, whereas for a reverse faulting stress regime $\sigma_H > \sigma_h > \sigma_v$ and for a strike-slip stress regime $\sigma_H > \sigma_v > \sigma_h$.

Deformation of poroelastic materials is governed by effective stress changes as defined by the seminal works of Biot and Gassmann (Gassman, 1951; Biot, 1956; Thomsen, 1985), with effective stress σ' defined as,

$$\sigma' = \sigma - I\alpha p_f$$

and $\alpha = 1 - K_b/K_g$, the scalar Biot coefficient with K_b being the bulk modulus of the poroelastic material and K_g the grain modulus of the grains making up the framework of the poroelastic rock.

Here we have assumed the material to be isotropic. Elastic deformation for isotropic poroelastic materials is governed by the following linear relation between effective stress change and strain

$$\begin{bmatrix} \varepsilon_h \\ \varepsilon_H \\ \varepsilon_v \end{bmatrix} = \frac{1}{E} \begin{bmatrix} 1 & -\nu & -\nu \\ -\nu & 1 & -\nu \\ -\nu & -\nu & 1 \end{bmatrix} \begin{bmatrix} \Delta\sigma'_h \\ \Delta\sigma'_H \\ \Delta\sigma'_v \end{bmatrix}$$

In which *E* is Young's modulus, ν is Poisson's ratio, and ε_H, ε_h, ε_v are the strains along the direction of the initial σ_H, σ_h, and σ_v respectively. Any isotropic and elastic material is described by two elastic parameters; depending on the application, different combinations and expressions are used for the isotropic elastic parameters. Seismic wavefield propagation, characterised by the compressional wave-speed V_p, and the shear wave-speed V_s, in isotropic media, is directly related to these elastic properties as follows:

$$V_p, V_s = f\{E, \nu, \alpha, \varphi, pore\ fill\ properties, grain\ properties)$$

Where φ is porosity of the media. We leave this functional definition only for notification for now, but for a dry-frame poro-elastic medium (without any compliant pore-fill material) the expressions for compressional and shear sonic velocities simplify to,

$$G = V_s^2\rho = \frac{E}{2+2\nu} \qquad ,$$

$$K_b = \left(V_p^2 - \frac{4}{3}V_s^2\right)\rho = \frac{E}{3-6\nu} \qquad ,$$

Where Vp, Vs and ρ are the compressional velocity, shear velocity and density of rocks. This is also highlights that any pair of independent elastic parameters that characterize an isotropic material, eg. Bulk modulus K_b and Shear modulus G, can also be expressed in terms of two other independent elastic parameters, in this case Young's modulus E and Poisson's ratio ν.

Apart of elastic deformation, rock material can deform plastically as well or fail. Accumulated damage may introduce anisotropy and attenuation in the elastic framework, while partially dissipating further deviatoric stress changes. Assessment of onset of rock failure is governed by assessing the stress state against a failure criterion. The quite often used Mohr-Coulomb failure criterion (Heyman, 1997) for instance is defined by,

$$\frac{max\{\sigma_h,\sigma_v\} - min\{\sigma_h,\sigma_v\}}{2} = S_0 + \mu\left(\frac{max\{\sigma_h,\sigma_v\} + min\{\sigma_h,\sigma_v\}}{2} - p_f\right)$$

In which S_0 is the cohesion of the rock material, p_f is the pore fluid pressure and μ is the friction coefficient of the material.

In principle seismic wave propagation and scattering depend on the elastic parameters and amount of damage already present in the material. It is often assumed that seismic wave propagation is not dependent on the actual parameters that determine the onset and progression of material failures. However, numerous studies have shown that to some extent, elastic parameters derived from seismic wave propagation and plasticity/failure parameters do correlate and empirical constitutive material models prove to be effective. Then, given an applicable constitutive model, and a measure of elastic parameters from sonic measurement, a relation with the stress state can be made.

In-situ stress as a result of uniaxial equilibrium

Under assumption of a horizontally layered and elastically deforming earth, the stress state can be directly related to the elastic parameters, leading to the modified Eaton-equation (Eaton, 1972), which enables application of tectonic stain rates (ε_x and ε_y) to an elastic uniaxial equilibrium,

$$\sigma_x = \frac{\nu}{1-\nu}\left(\sigma_v - p_f\right) + \frac{E}{1-\nu^2}\left(\varepsilon_x + \nu\varepsilon_y\right)$$

In-situ stress as a result of failure equilibrium

Under the assumption that part of the subsurface is always at elevated equilibrium stress, the minimum stress is constrained by the failure criterion as defined by the constitutive plastic behaviour. For instance, determination of the Mohr-Coulomb failure criterion, formulated above and the related stress/strain behaviour at the appropriate conditions, can be used to estimate horizontal stress, given a vertical stress state and the rock mechanical parameters.

Value of rock mechanical properties and related seismic velocities to assess in-situ stress

The prevalent equilibrium assessment to be applied for an in-situ stress assessment, is subject to debate and potentially depends on geological setting, basin conditions and other proofpoints, but the opportunity is present to estimate stress conditions and stress changes from measured rock mechanical properties. Quantification of elastic parameters from literature and known databases for the North-Sea sequences, is a first step in achieving this. This will be the aim of this paper and serve as grounding work for future laboratory studies to quantify sonic characterisation of stress and failure states to define relations between elastic parameters and expected elastoplastic behaviour to calibrate applicable constitutive models. The elastic parameters (Young's modulus E, Bulk modulus Kb, Shear modulus G and Poisson's ratio v) can be determined from either rock deformation experiments (static moduli, Young's modulus and Poisson's ratio) and from analysis of openhole logging data (dynamic moduli, Bulk modulus and Shear modulus).

Overview of available data

A literature and online survey have been conducted to find all existing information on the mechanical properties of the relevant lithologies for the North Sea region. Both scientific literature as well as industry reports have been found that give some information on the mechanical properties of the lithologies in the North Sea. These are described and plotted in the following section. Several scientific papers exist detailing the mechanical properties of the relevant lithologies, but most papers list the same values from previous analyses (e.g. in Park et al., 2022). Therefore, although widely used and cited, relatively little information on the mechanical properties is available. All unique information is provided below.

Stress estimates can be obtained from log data, XLOT data and other data will be provided by our industry partners for the respective countries. This information will be gathered as part of WP1 and will/can be used extensively within WP3 as well. Publicly available data then can be integrated with the industry data (for NL, see e.g, Michielse et al., to be published report from the Dutch Window project).

All data available on mechanical parameters of the North Sea region are listed below, followed by a more comprehensive detailed list for each specific country. The mechanical data in the tables below originate mostly from experimental studies in the laboratory. Measurements are performed on representative samples for the respective lithologies/formations indicated. We have not made a distinction how extensive the dataset is in each source. Some values are determined from a single experiment, other values are derived from a more extensive set of experiments. In reality, mechanical properties can also vary with stress/depth. The experimental dataset summarized here is produced at varying stress conditions in the experiments. Values portrayed here are thus indicative for the behaviour. For use in e.g. modelling or risk assessment purposes the conditions at which the experiments have been performed need to be taken into account and checked in the respective papers.

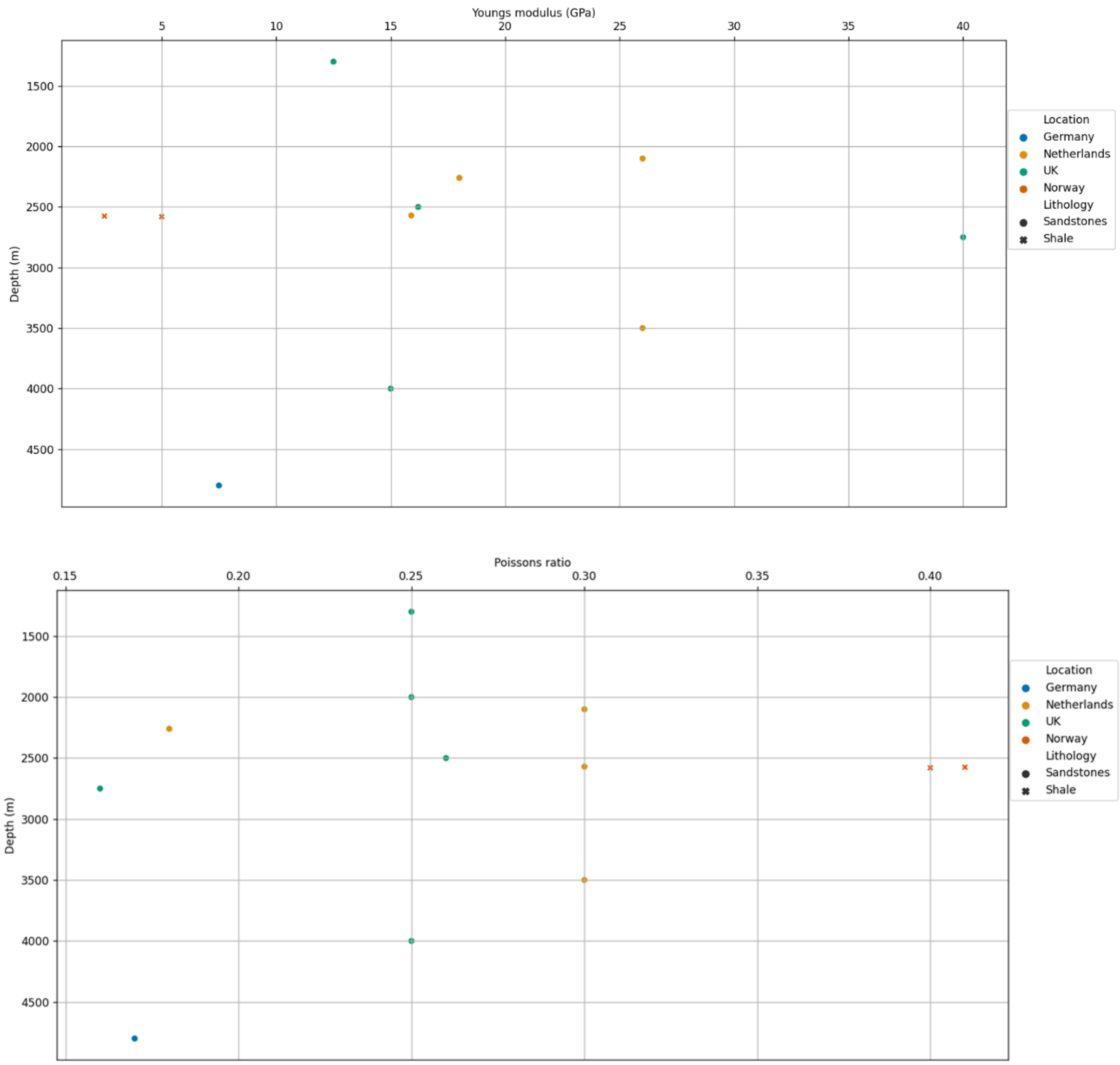


Figure 1: Young's modulus and Poisson's ratio values from experimental data of lithologies relevant for SHARP storage sites.

Mechanical data for relevant lithologies in Norway

CO2 storage sites currently and recently evaluated in Norway are Aurora and Smeaheia in the Horda platform area, Skade formation in central part of North Sea and Polaris in the Barents Sea. Available data from Horda platform are listed in the publications of Thomson et al. (2022), Michie et al., (2021), Mondol (2019), and Kozlowski et al. (2011). Released data from Aurora, Eos well data discloses relevant subsurface data including well log data, routine core data (porosity, permeability, and strength) and well test data (Equinor, 2019). EOS cores are currently tested at NGI for standard geomechanical parameters for Drake caprock and Cook and Johansen reservoir, see table below (NGI, 2022). Reference dataset for Smeaheia containing subsurface data, reports and geomodels for Draupne cap rock and Smeaheia reservoir is available (co2datashare.org). Skurtveit et al 2012 provides permeability and bulk moduli for Draupne Formation in Horda Platform area. Due to lack of suitable core data from Smeaheia, tests have been done on Sognefjorden formation from the Troll field and

Draupne from Ling depression (Park et. al, 2021, Grande et. al, 2020, Grande et. al., 2022). The same study includes test data of analogue formations representative of shallow reservoirs i.e., Sleipner CO2 storage in Utsira formation and shallow Skade formation storage candidate (Eleneius et. Al. 2018). Geomechanical properties of North Sea shales along with correlation equations for estimating strength and stiffness from P-wave velocity logs are commonly used (Horsrud, 2001). A detailed reference dataset for the Draupne shale from the Ling Depression southern North Sea is presented in Skurtveit et al (2015), Soldal (2021a and 2021b).

Authors	**Thompson**	**Michie**	**Mondol**	**Skurveit et al. 2012; 2015; Soldal et al. 2021**	**Elenius et al. 2018**
Location	Norway	Norway	Norway	Norway	Norway
Lithology	Shale	Sandstones	Shale	Shale	Shale
Field /Structure	Aurora storage complex	Smeaheia	Ling depresion		
Fm / Group		Sognefjord Fm			
Caprock	Drake Fm.	Draupne Fm.	Draupne Fm	Draupne Fm.	Nordland
Depth (m)	2580	1700	2575		
Youngs modulus (GPa)	5		2,5	~4	0.24
Bulk modulus (GPa)				~0.4	
Poissons ratio	0,4		0,41		0.29
Permeability (mD)	2,00E-07	2500			
Porosity (%)	8	34	7,8		
Stress ratio	1,41				
UCS (MPa)	14,3				
Tensile strength (MPa)	0,24			~4	
SV (MPa)	51,2	32			
sigmav (Mpa)	25,1	15	0		
Sh (MPa)	36,2	23			
sigmah (Mpa)	10,1	6	0		
Pp (MPa)	26,1	17			
Fault dip aver (degree)	60	50			
Friction coef.	0,6	0,45			
Cohesion (Mpa)	2		0,5		
Pp (MPa)	26,1	17			

Below is given the summary of the ongoing test program of mechanical experiments for the EOS well 31/5-7, Equinor (NGI, 2022). Now data portrayed.

Material	Test type	Drainage	Parameters
Johansen, Cook	Isotropically consolidated triaxial test	Drained	Loading/unload loop for elastic moduli, elastic moduli during main loading phase, stress at failure
Johansen, Cook	Hydrostatic	Drained	Bulk modulus during main loading phase, and during unload/reload from in situ
Johansen, Cook	UST	Drained	Grain stiffness, bulk compressibility, constrained modulus, stress ratio
Johansen, Cook	CO_2 flooding and "weakening"	Drained	Bulk modulus with scCO_2 saturation and time, geophysical response vs. saturation (velocity, resistivity)
Johansen, Cook	Thermal effects (Søreide, 2014)	Drained	Thermal expansion coefficient, horizontal stress response to cooling
Inter-Drake	Permeability	-	Permeability - vertical, horizontal (anisotropy)
Inter-Drake	Isotropically Consolidated Undrained (CIU) triaxial test	Undrained (+drained cycling from in situ stress)	Elastic properties during drained cycling, shear modulus during main loading phase and stresses at failure. Horizontal and vertical directions (anisotropy)
Inter-Drake	Uniaxial Strain Test (UST)	Drained	Constrained modulus, creep parameters, grain stiffness, stress ratio
Inter-Drake	CIU + temperature	Undrained	Shear modulus, stresses at failure at relevant temperature
Inter-Drake	Thermal expansion / integrity test (based on Søreide (2014))	Undrained - drained (depending on test duration)	Thermal expansion coefficient (undrained), horizontal stress response to cooling

<u>Mechanical data for relevant lithologies in Denmark</u>

The Lisa structure, situated offshore northern Jutland in the Norwegian-Danish Basin, is currently evaluated as a CO_2 storage site. The main reservoir is the sandstone-dominated Upper Triassic-Lower Jurassic Gassum Fm whereas the mudstone-dominated Lower Jurassic Fjerritslev Fm forms the main seal. The J-1 well penetrates the structure and reveals that the Gassum and Fjerritslev formations are present in the depth intervals (below mean sea level) 1769-1697 m and 1697-1074 m, respectively. Unfortunately, no existing information appears to be available on the mechanical properties of the relevant lithologies.

<u>Mechanical data for relevant lithologies in Germany</u>

Available data are listed in the publications of Haug et al. (2018).

Germany	
Authors	**Haug, C.**
Location	Germany
Lithology	Sandstones
Field /Structure	Pompeckj block
Fm / Group	Rotliegend G.
Caprock	Zechstein
Depth (m)	4800
Youngs modulus (GPa)	7,5
Bulk modulus (GPa)	4,54
Poissons ratio	0,17
Permeability (mD)	10
Porosity (%)	9
Stress ratio	
UCS (MPa)	
Tensile strength (MPa)	
SV (MPa)	138,6
sigmav (Mpa)	74
Sh (MPa)	85,6
sigmah (Mpa)	21
Pp (MPa)	64,6
Fault dip aver (degree)	60
Friction coef.	0,6
Cohesion (Mpa)	5

Mechanical data for relevant lithologies in the United Kingdom

Available data are listed in the publications of Collins (2002), Heineman et al. (2012), Miocic et al. (2014), Staples and 2 Shell reports from 2014 and 2016.

United Kingdom							
Authors	**Collins**	**Heinemann**	**Miocic**	**Allen**	**Shell 1**	**Shell 2**	**Staples**
Location	UK	UK	UK	UK	UK	UK	UK
Lithology	Sandstones	Sandstones	Sandstones	Sandstones	Sandstones	Sandstones	Sandstones
Field /Structure	P2-NE Field	UK quadrants (42-44, 47-49)	Fizzy Field	Acorn Site	Goldeyene F.	Endurance S.	Shearwater Field
Fm / Group	Rotliegend G.	Bunter Fm	Rotliegend G.	Captain Fm.	Captain Fm.	Bunter Fm	Fulmar Fm.
Caprock	Zechstein	Rot Fm	Zechstein	Rodby	Rodby	Rot Fm	Hod Chalk Fm
Depth (m)	2750	1500	2250	2000	2500	1300	4000
Youngs modulus (GPa)	40				16,2	12,5	15
Bulk modulus (GPa)							
Poissons ratio	0,16			0,25	0,26	0,25	0,25
Permeability (mD)		250	0,4	2114	1145	1150	
Porosity (%)		18	15	27,5	25	29	
Stress ratio							
UCS (MPa)	5,52				39,4	39	
Tensile strength (MPa)	0			0,16			
SV (MPa)	18,7	25	50,625	49	58,25		55,2
sigmav (Mpa)	9,625	10	50,625	22,4	33,25	0	55,2
Sh (MPa)	11,55		38,025	37,8	42,5		
sigmah (Mpa)	2,475	-15	38,025	11,2	17,5	0	0
Pp (MPa)	9,075	15		26,6	25		
Fault dip aver (degree)			80				
Friction coef.	0,8		0,45	0,6	0,5		
Cohesion (Mpa)	8,6388		0,5		6		

Mechanical data for relevant lithologies in the Netherlands

Available data are listed in the publications of Orlic (2013), Orlic et al. (2013), Orlic (2016) and Schutte (2019).

The Netherlands				
Authors	**Orlic, B.**	**Orlic, Bo.**	**Orlic, Bog.**	**Schutte**
Location	Netherlands	Netherlands	Netherlands	Netherlands
Lithology	Sandstones	Sandstones	Sandstones	Sandstones
Field /Structure	Zuid-Friesland	P18	Unknown	Cranberry field
Fm / Group	Rotliegend G.	Bunter Fm	Rotliegend G.	Rotliegend G.
Caprock	Zechstein	Rot Fm	Zechstein	Zechstein
Depth (m)	2100	3500	2260	2570
Youngs modulus (GPa)	26	26	18	15,9
Bulk modulus (GPa)				
Poissons ratio	0,3	0,3	0,18	0,3
Permeability (mD)	300	150		1,33
Porosity (%)	20	10	25	10
Stress ratio			0,9	
UCS (MPa)				
Tensile strength (MPa)	9,5			
SV (MPa)	48,3	35	51,076	59,11
sigmav (Mpa)	25,2	35	28,276	59,11
Sh (MPa)	33,6		33,9	40
sigmah (Mpa)	10,5	0	11,1	40
Pp (MPa)	23,1		22,8	
Fault dip aver (degree)	60		60	
Friction coef.	0,6	0,6	0,6	
Cohesion (Mpa)		0	0	

In addition, in 2021 TNO published a report (Hunfeld et al., 2021) in which the mechanical data has been determined from numerous wireline logging data of wells both offshore and onshore in the Netherlands. Density logs combined with p-wave and s-wave sonic logs have been used to determine the mechanical parameters (dynamic moduli). This report states the reported moduli, no conversion from dynamic to static moduli or vice versa has been made.

- Young's Modulus (E) $E = 2G\ (1 + \nu)$

- Bulk Modulus (Kb) $K\text{b} = E/3(1 - 2\nu)$

- Shear Modulus (G) $G = \rho Vs^2$

- Poisson's Ratio (ν) $\nu = Vp^2 - 2Vs^2/2(Vp^2 - Vs^2)$

See Appendix B for all the data. The data has been summarised and portrayed in figures below. What can be observed is a significant spread in data with an average trend of an increase of the Young's modulus and a decrease in the Poisson's ratio with an increase in depth. As expected, trends are most absent for the Zechstein evaporite units. No significant difference can be observed regionally, most likely because of the still limited amount of data available. The dataset was constructed primarily for the onshore geothermal sector, data close to the Aramis field is absent so far. More detailed analyses of existing log data and the analysis of logs and samples within SHARP will add these datapoints.

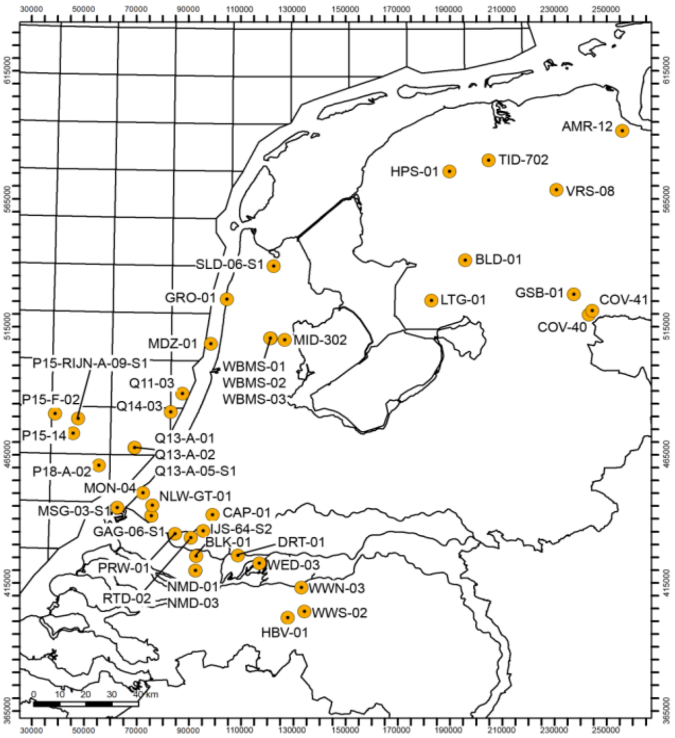
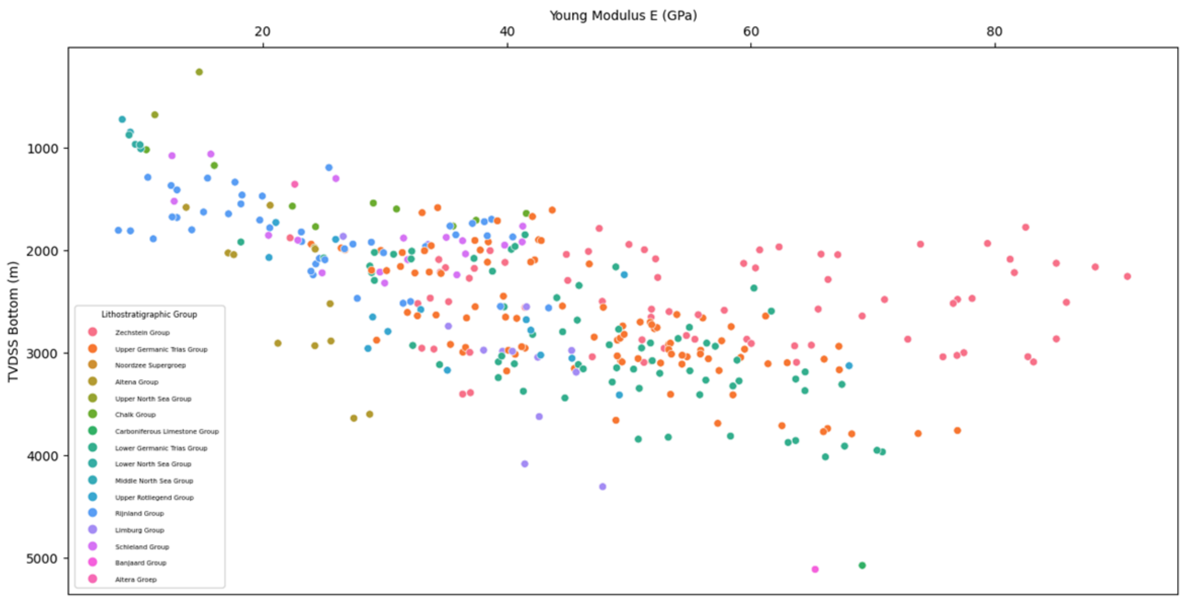


Figure 2: Well data used to calculate the dynamic mechanical properties of the Dutch subsurface



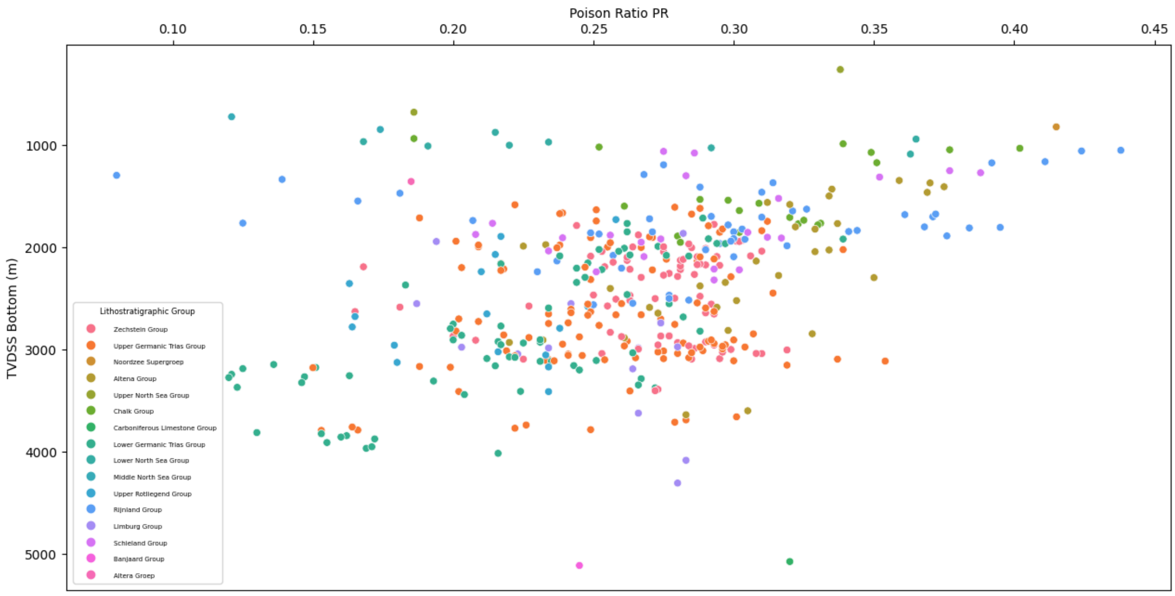
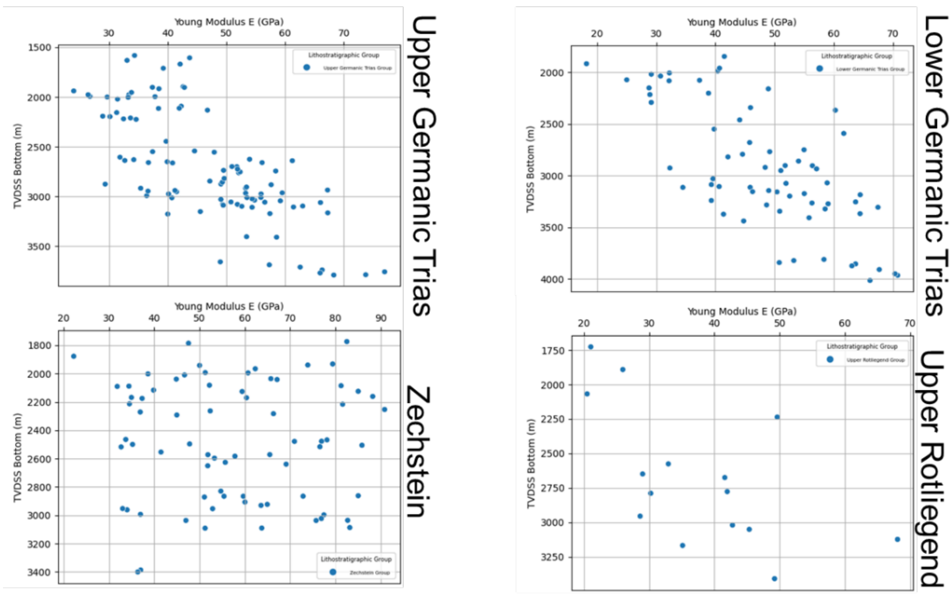


Figure 3: All Young's modulus and Poisson's ratio values for all the wells in the Dutch subsurface



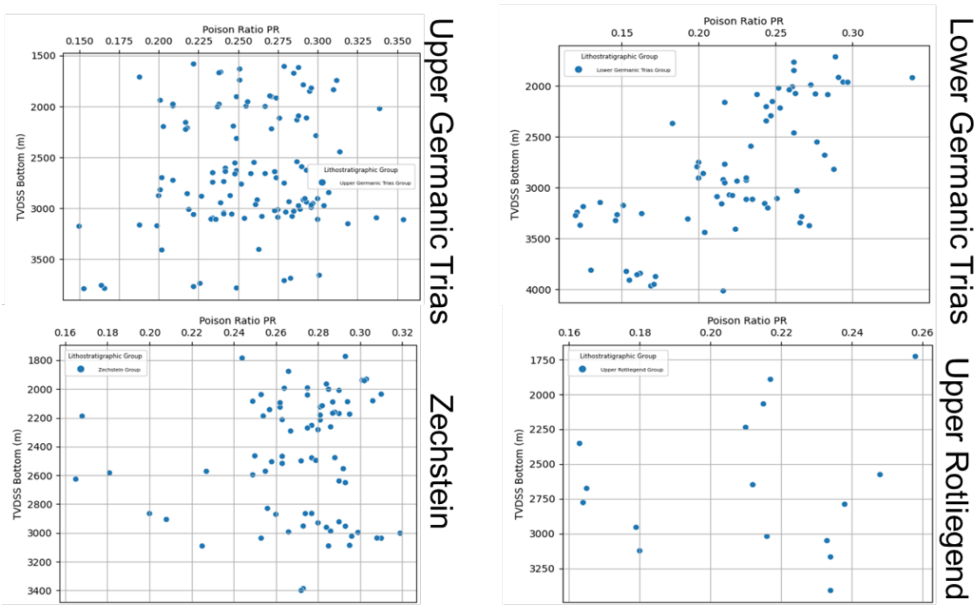


Figure 4: Mechanical data of the Dutch subsurface divided per formation.

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Appendices

Authors	Location	Lithology	Field /Structure	Fm / Group	Caprock	Depth m	Youngs modulus GPa	Bulk modulus GPa	Poissons ratio	Permeability mD	Porosity %	Stress ratio	UCS MPa	Tensile strength MPa	SV MPa	sigmav MPa	Sh MPa	sigmah MPa	Pp MPa	Fault dip average degree	Friction coef.	Cohesion MPa
Haug, C.	Germany	Sandstones	Pompeckj block	Rotliegend G.	Zechstein	4800	7,5	4,54	0,17	10	9				138,6	74	85,6	21	64,6	60	0,6	5
Orlic, B.	Netherlands	Sandstones	Zuid-Friesland	Rotliegend G.	Zechstein	2100	26		0,3	300	20			9,5	48,3	25,2	33,6	10,5	23,1	60	0,6	
Orlic, Bo.	Netherlands	Sandstones	P18	Bunter Fm	Rot Fm	3500	26		0,3	150	10				35	35		0			0,6	0
Orlic, Bog.	Netherlands	Sandstones	Unknown	Rotliegend G.	Zechstein	2260	18		0,18		25	0,9			51,08	28,276	33,9	11,1	22,8	60	0,6	0
Collins	UK	Sandstones	P2-NE Field	Rotliegend G.	Zechstein	2750	40		0,16				5,52	0	18,7	9,625	11,55	2,475	9,075		0,8	8,6388
Schutte	Netherlands	Sandstones	Cranberry field	Rotliegend G.	Zechstein	2570	15,9		0,3	1,33	10				59,11	59,11	40	40				
Thompson	Norway	Shale	Aurora storage complex		Drake Fm.	2580	5		0,4	2,00E-07	8	1,41	14,3	0,24	51,2	25,1	36,2	10,1	26,1	60	0,6	2
Heinemann	UK	Sandstones	UK quadrants (42-44, 47-49)	Bunter Fm	Rot Fm	1500				250	18				25	10		-15	15			
Michie	Norway	Sandstones	Smeaheia	Sognefjord Fm	Draupne Fm.	1700				2500	34				32	15	23	6	17	50	0,45	0,5
Miocic	UK	Sandstones	Fizzy Field	Rotliegend G.	Zechstein	2250				0,4	15				50,63	50,625	38,03	38,03		80	0,45	0,5
Allen	UK	Sandstones	Acorn Site	Captain Fm.	Rodby	2000			0,25	2114	27,5			0,16	49	22,4	37,8	11,2	26,6		0,6	
Shell 1	UK	Sandstones	Goldeyene F.	Captain Fm.	Rodby	2500	16,2		0,26	1145	25		39,4		58,25	33,25	42,5	17,5	25		0,5	6
Shell 2	UK	Sandstones	Endurance S.	Bunter Fm	Rot Fm	1300	12,5		0,25	1150	29		39			0		0				
Mondol	Norway	Shale	Ling depresion		Draupne Fm	2575	2,5		0,41		7,8					0		0				
Staples	UK	Sandstones	Shearwater Field	Fulmar Fm.	Hod Chalk Fm	4000	15		0,25						55,2	55,2		0				
Kozlowski	Norway	Shale	Eldfisk Field	Ekofisk Fm.		2700										0	3,795	3,795				

Well	Lithostratigraphic Group	Lithology type	TVDSS Bottom (m)	Young Modulus E (GPa)	Bulk Modulus Kb (GPa)	Shear Modulus G (GPa)	Poison Ratio v	Vp/Vs Ratio
BLD-01	Zechstein Group	Anhydrite	1772,94	82,5	67,1	31,9	0,29	1,851
CAP-01	Upper Germanic Trias Group	Anhydrite	2973,12	55,9	48,0	21,4	0,30	1,887
CAP-01	Upper Germanic Trias Group	Anhydrite	3009,18	55,9	44,3	21,7	0,29	1,836
COV-40	Zechstein Group	Anhydrite	2862,06	85,035	63,831	33,306	0,277	1,804

GRO-01	Zechstein Group	Anhydrite	2084,89	81,2	54,2	32,5	0,25	1,732
GSB-01	Zechstein Group	Anhydrite	2953,73	52,9	42,9	42,9	0,29	1,85
GSB-01	Zechstein Group	Anhydrite	2996,9	77,5	64,3	64,3	0,30	1,868
GSB-01	Zechstein Group	Anhydrite	3086,93	83,2	67,5	67,5	0,30	1,854
HBV-01	Upper Germanic Trias Group	Anhydrite	1850,29				0,30	1,864
HPS-01	Zechstein Group	Anhydrite	1931,13	79,4	67,1	30,5	0,30	1,881
MDZ-01	Zechstein Group	Anhydrite	1994,29	60,7	44,0	24,0	0,26	1,777
MDZ-01	Zechstein Group	Anhydrite	2041,21	67,1	50,6	26,3	0,28	1,802
MID-302	Zechstein Group	Anhydrite	2215,61	81,6	62,3	31,8	0,28	1,813
MID-302	Zechstein Group	Anhydrite	2282,54	66,3	50,9	25,9	0,28	1,82
TID-702	Zechstein Group	Anhydrite	2467,68	78,1	55,0	30,9	0,26	1,763
TID-702	Zechstein Group	Anhydrite	2505,47	85,9	59,1	34,1	0,26	1,751
VRS-08	Zechstein Group	Anhydrite	2987,76				0,29	1,832
VRS-08	Zechstein Group	Anhydrite	3023,35	76,9	63,0	29,7	0,30	1,862
WBMS-02	Zechstein Group	Anhydrite	2180,73				0,28	1,814
WBMS-03	Zechstein Group	Anhydrite	2477,23	76,9	60,7	29,9	0,29	1,835
WWS-02	Upper Germanic Trias Group	Anhydrite	2639,12	61,2	45,1	24,0	0,27	1,792
BLD-01	Zechstein Group	Anhydrite / Carbonate	1784,67	47,6	33,0	19,1	0,24	1,74
DRT-01	Noordzee Supergroep	Divers	819,65				0,42	2,667
DRT-01	Altena Group	Divers	2132,24				0,31	1,958
WWN-03	Upper North Sea Group	Divers	259,05	14,8	17,2	5,5	0,34	2,105
GAG-06-S1	Upper Germanic Trias Group	Dolomite	3685,94	57,3	44,1	22,3	0,28	1,82
HBV-01	Upper Germanic Trias Group	Dolomite	1835,04				0,31	1,918
MDZ-01	Zechstein Group	Dolomite	2169,87	60,4	48,1	23,4	0,29	1,841
MID-302	Zechstein Group	Dolomite	2252,66	90,9	68,6	35,6	0,28	1,804
P15-14	Upper Germanic Trias Group	Dolomite	3012,18	40,689	30,205	15,964	0,275	1,796

P18-A-02	Upper Germanic Trias Group	Dolomite	3107,53				0,3	1,885
P18-A-02	Upper Germanic Trias Group	Dolomite	3110,81				0,354	2,11
P18-A-02	Upper Germanic Trias Group	Dolomite	3150,58	45,538	45,062	17,3	0,319	1,981
Q11-03	Upper Germanic Trias Group	Dolomite	2285,99				0,299	1,871
Q14-03	Upper Germanic Trias Group	Dolomite	2445,21	39,721	35,829	15,127	0,314	1,926
Q14-03	Zechstein Group	Dolomite	2930,11	63,586	49,098	24,951	0,28	1,828
WBMS-02	Zechstein Group	Dolomite	2187,65				0,25	1,755
BLK-01	Upper Germanic Trias Group	Dolomite	2131,35	46,756	36,676	18,166	0,287	1,83
BLK-01	Upper Germanic Trias Group	Dolomite / Claystone	2113,86	38,416	29,492	15,054	0,276	1,814
NMD-01	Upper Germanic Trias Group	Dolomite / Claystone	1901,71	37,384	27,615	14,715	0,271	1,795
NMD-01	Upper Germanic Trias Group	Dolomite / Claystone	1916	38,484	28,468	15,111	0,274	1,795
BLD-01	Chalk Group	Limestone	1638,28	41,6	35,5	16,0	0,30	1,884
BLD-01	Chalk Group	Limestone	1705,31	37,5	34,8	14,2	0,32	1,948
COV-40	Zechstein Group	Limestone	2865,32	72,864	54,547	28,524	0,277	1,802
DRT-01	Chalk Group	Limestone	1029,35				0,40	2,519
DRT-01	Upper Germanic Trias Group	Limestone	2934,09	67,2	52,4	26,2	0,28	1,823
GAG-06-S1	Upper Germanic Trias Group	Limestone	3708,61	62,6	47,5	24,5	0,28	1,809
GRO-01	Zechstein Group	Limestone	2124,18	85,0	65,8	33,2	0,28	1,817
GSB-01	Zechstein Group	Limestone	3036,88	75,7	66,6	66,6	0,31	1,907
GSB-01	Zechstein Group	Limestone	3090,43	63,7	49,4	49,4	0,29	1,824
HBV-01	Chalk Group	Limestone	985,5				0,34	2,04
HBV-01	Chalk Group	Limestone	1069,53				0,35	2,09
HBV-01	Altena Group	Limestone	1368,15				0,37	2,24
HBV-01	Altena Group	Limestone	1428,64				0,34	2,017
HBV-01	Altena Group	Limestone	1495,79				0,33	2,026

HPS-01	Chalk Group	Limestone	1762,12	35,6	34,7	13,4	0,33	1,996
HPS-01	Zechstein Group	Limestone	1938,6	73,9	61,8	28,4	0,30	1,878
LTG-01	Chalk Group	Limestone	1529,45				0,29	1,898
LTG-01	Chalk Group	Limestone	1595,24	31,0	21,8	12,3	0,26	1,773
LTG-01	Carboniferous Limestone Group	Limestone	5071,43	69,1	64,3	26,2	0,32	1,949
MDZ-01	Zechstein Group	Limestone	2035,14	65,8	58,1	25,1	0,31	1,908
MDZ-01	Zechstein Group	Limestone	2160,43	88,2	69,7	34,2	0,29	1,835
NLW-GT-01	Lower Germanic Trias Group	Limestone	4013,03	66,1	38,8	27,2	0,22	1,663
NMD-03	Chalk Group	Limestone	1170,34	16,028	16,115	6,014	0,351	2,063
NMD-03	Chalk Group	Limestone	1768,02	24,328	23,031	9,202	0,323	1,962
P15-14	Chalk Group	Limestone	934				0,186	1,616
P15-14	Chalk Group	Limestone	1851,96				0,302	1,896
P15-14	Chalk Group	Limestone	1887,96				0,28	1,814
P15-14	Upper Germanic Trias Group	Limestone	3036,06	54,774	41,719	21,407	0,28	1,812
P15-14	Upper Germanic Trias Group	Limestone	3077,83	51,851	40,345	20,193	0,284	1,825
PRW-01	Chalk Group	Limestone	1537,25	29,1	23,9	11,2	0,30	1,864
Q11-03	Zechstein Group	Limestone	2571,37	65,519	47,21	26,059	0,255	1,766
Q11-03	Zechstein Group	Limestone	2639,16	69,124	55,4	26,835	0,29	1,846
Q11-03	Zechstein Group	Limestone	2650,5	51,822	41,894	20,046	0,293	1,851
Q14-03	Zechstein Group	Limestone	2829,61	54,717	37,8	21,793	0,256	1,75
Q14-03	Zechstein Group	Limestone	2923,18	64,958	53,882	25,143	0,29	1,857
TID-702	Chalk Group	Limestone	1732,97				0,33	1,976
TID-702	Chalk Group	Limestone	1778,42				0,33	1,995
TID-702	Zechstein Group	Limestone	2478,24	71,0	53,1	27,8	0,28	1,801
TID-702	Zechstein Group	Limestone	2515,78	76,6	53,9	30,3	0,26	1,765
VRS-08	Zechstein Group	Limestone	3001,98				0,32	1,947
VRS-08	Zechstein Group	Limestone	3035,82	82,7	72,3	31,6	0,31	1,9

WED-03	Upper Germanic Trias Group	Limestone	2699,23	51,8	38,5	20,3	0,27	1,798
WWN-03	Chalk Group	Limestone	1016,9	10,5	7,4	4,2	0,25	1,759
WWN-03	Altena Group	Limestone	1559,04	20,6	18,6	7,9	0,31	1,924
WWS-02	Upper Germanic Trias Group	Limestone	2658,19	56,1	38,9	22,3	0,26	1,756
BLD-01	Lower North Sea Group	Clay	1024,91				0,29	1,878
WWN-03	Middle North Sea Group	Clay	720,96	8,5	3,9	3,8	0,12	1,537
WWN-03	Middle North Sea Group	Clay	845,01	9,1	4,8	3,9	0,17	1,599
WWN-03	Lower North Sea Group	Clay	964,02	9,6	5,0	4,1	0,17	1,598
WWN-03	Lower North Sea Group	Clay	1006,99	10,0	5,6	4,2	0,19	1,635
BLD-01	Lower North Sea Group	Clay / Silt	999				0,22	1,72
WWN-03	Lower North Sea Group	Clay / Zand	968,9	9,9	7,0	4,0	0,23	1,739
AMR-12	Upper Rotliegend Group	Claystone	2789,37	30,3	19,7	12,2	0,24	1,717
BLD-01	Rijnland Group	Claystone	1761,06	35,3	20,1	15,1	0,13	1,551
BLD-01	Limburg Group	Claystone	1941,11	33,5	19,8	14,1	0,19	1,66
BLK-01	Upper Germanic Trias Group	Claystone	2155,83	31,289	19,306	12,818	0,217	1,675
BLK-01	Upper Germanic Trias Group	Claystone	2209,81	33,643	20,184	13,812	0,218	1,671
BLK-01	Upper Germanic Trias Group	Claystone	2218,8	32,467	23,637	12,79	0,271	1,787
CAP-01	Altena Group	Claystone	2904,72	21,2	15,3	8,5	0,23	1,749
CAP-01	Upper Germanic Trias Group	Claystone	2915,93	35,4	25,0	14,0	0,26	1,768
CAP-01	Upper Germanic Trias Group	Claystone	2951,53	41,5	34,2	16,0	0,30	1,863
CAP-01	Upper Germanic Trias Group	Claystone	3021,66	54,4	39,9	21,4	0,27	1,79
CAP-01	Upper Germanic Trias Group	Claystone	3078,17	49,3	35,4	19,5	0,27	1,772
CAP-01	Upper Germanic Trias Group	Claystone	3086,78	49,4	36,6	19,4	0,28	1,794
CAP-01	Lower Germanic Trias Group	Claystone	3105,03	40,6	27,1	16,2	0,25	1,734
CAP-01	Lower Germanic Trias Group	Claystone	3282,94	48,6	34,8	19,2	0,27	1,775
CAP-01	Lower Germanic Trias Group	Claystone	3372,46	41,4	30,2	16,3	0,27	1,787

CAP-01	Zechstein Group	Claystone	3386,96	37,0	27,5	14,6	0,27	1,798
CAP-01	Zechstein Group	Claystone	3400,44	36,4	26,8	14,3	0,27	1,794
CAP-01	Limburg Group	Claystone	3620,09	42,7	30,4	16,9	0,27	1,779
COV-40	Zechstein Group	Claystone	2865,66	55,409	40,914	21,741	0,274	1,793
COV-41	Limburg Group	Claystone	2549,03	39,512	26,005	15,986	0,242	1,732
COV-41	Limburg Group	Claystone	2982,12	39,653	28,825	15,716	0,266	1,79
DRT-01	Rijnland Group	Claystone	1055,3				0,42	2,814
DRT-01	Schieland Group	Claystone	1248,47				0,38	2,325
DRT-01	Altena Group	Claystone	2294,58				0,35	2,092
DRT-01	Altena Group	Claystone	2375,84				0,29	1,837
DRT-01	Altena Group	Claystone	2810,87				0,30	1,874
DRT-01	Altena Group	Claystone	2843,39				0,33	1,994
DRT-01	Upper Germanic Trias Group	Claystone	2915,88	53,3	42,8	20,6	0,29	1,846
DRT-01	Upper Germanic Trias Group	Claystone	2962,22	59,5	42,6	23,6	0,26	1,769
DRT-01	Upper Germanic Trias Group	Claystone	3042,51	59,2	38,8	23,8	0,24	1,719
DRT-01	Upper Germanic Trias Group	Claystone	3056,15	56,5	37,3	22,7	0,25	1,726
GAG-06-S1	Altena Group	Claystone	3596,85	28,8	24,7	11,1	0,31	1,898
GAG-06-S1	Altena Group	Claystone	3635,8	27,5	23,2	10,9	0,28	1,884
GAG-06-S1	Upper Germanic Trias Group	Claystone	3655,89	48,9	41,4	18,8	0,30	1,883
GAG-06-S1	Upper Germanic Trias Group	Claystone	3736,08	66,3	40,8	27,1	0,23	1,689
GAG-06-S1	Upper Germanic Trias Group	Claystone	3767,27	65,9	39,8	27,0	0,22	1,677
GRO-01	Upper Germanic Trias Group	Claystone	1661,28				0,24	1,721
GRO-01	Lower Germanic Trias Group	Claystone	1914,64				0,29	1,844
GRO-01	Lower Germanic Trias Group	Claystone	2076,98	37,3	30,5	14,4	0,28	1,801
GRO-01	Zechstein Group	Claystone	2081,4	52,2	43,6	20,1	0,31	1,894
GRO-01	Zechstein Group	Claystone	2125,54	59,4	42,0	23,5	0,26	1,765

GSB-01	Zechstein Group	Claystone	2961,63	34,0	26,4	26,4	0,28	1,825
HBV-01	Altena Group	Claystone	1405,74				0,38	2,245
HBV-01	Altena Group	Claystone	1460,52				0,37	2,22
HBV-01	Altena Group	Claystone	1765,25				0,34	2,034
HBV-01	Altena Group	Claystone	1797,61				0,32	1,957
HBV-01	Altena Group	Claystone	1819,78				0,33	1,992
HBV-01	Upper Germanic Trias Group	Claystone	1895,36	42,6	31,1	16,8	0,27	1,783
HBV-01	Upper Germanic Trias Group	Claystone	1903,03	42,8	28,5	17,1	0,25	1,731
HBV-01	Upper Germanic Trias Group	Claystone	1975,83	33,4	21,3	13,5	0,24	1,707
HBV-01	Upper Germanic Trias Group	Claystone	1995,71	37,8	25,7	15,1	0,26	1,744
HPS-01	Rijnland Group	Claystone	1803,12	8,2	13,0	2,9	0,40	2,424
HPS-01	Rijnland Group	Claystone	1886,18	11,0	14,8	4,0	0,38	2,251
HPS-01	Lower Germanic Trias Group	Claystone	1916,96	18,2	19,3	6,8	0,34	2,034
HPS-01	Zechstein Group	Claystone	1941,19	50,0	42,4	19,2	0,30	1,881
IJS-64-S2	Upper Germanic Trias Group	Claystone	3403,12	53,4	37,6	21,2	0,26	1,764
LTG-01	Lower North Sea Group	Claystone	1086,34				0,36	2,218
LTG-01	Rijnland Group	Claystone	1678,39	13,0	16,5	4,9	0,36	2,246
LTG-01	Limburg Group	Claystone	1861,73	26,6	20,9	10,6	0,28	1,888
LTG-01	Limburg Group	Claystone	2737,79	35,2	25,8	14,1	0,27	1,849
LTG-01	Limburg Group	Claystone	2971,71	38,1	29,0	15,0	0,28	1,826
LTG-01	Limburg Group	Claystone	4081,06	41,5	32,0	16,3	0,28	1,84
LTG-01	Banjaard Group	Claystone	5109,82	65,3	42,9	26,2	0,25	1,724
MDZ-01	Upper Germanic Trias Group	Claystone	1581,69	34,3	21,5	14,2	0,22	1,709
MDZ-01	Upper Germanic Trias Group	Claystone	1631,11	33,1	22,4	13,3	0,25	1,745
MDZ-01	Lower Germanic Trias Group	Claystone	1846,53	41,5	29,1	16,4	0,26	1,763
MDZ-01	Lower Germanic Trias Group	Claystone	1988,36	40,4	29,6	15,9	0,27	1,789

MDZ-01	Zechstein Group	Claystone	1992,31	51,3	38,2	20,1	0,28	1,798
MDZ-01	Zechstein Group	Claystone	2001,27	38,6	30,2	15,0	0,29	1,827
MDZ-01	Zechstein Group	Claystone	2008,72	46,7	37,2	18,1	0,29	1,84
MDZ-01	Zechstein Group	Claystone	2038,17	44,9	30,3	18,0	0,25	1,744
MDZ-01	Zechstein Group	Claystone	2088	34,4	27,8	13,3	0,29	1,855
MDZ-01	Zechstein Group	Claystone	2089,98	31,8	24,9	12,4	0,29	1,83
MDZ-01	Zechstein Group	Claystone	2115,99	39,9	30,3	15,6	0,28	1,819
MDZ-01	Zechstein Group	Claystone	2174,43	37,3	30,5	14,4	0,30	1,858
MID-302	Lower Germanic Trias Group	Claystone	2159,91	48,9	29,0	20,2	0,22	1,673
MID-302	Zechstein Group	Claystone	2167,63	35,0	28,0	13,6	0,29	1,837
MID-302	Zechstein Group	Claystone	2262,87	52,4	41,4	20,4	0,29	1,836
MON-04	Rijnland Group	Claystone	1366,45	12,493	11,49	4,765	0,314	1,856
MSG-03-S1	Upper Germanic Trias Group	Claystone	2844,51	47,2	42,0	18,1	0,31	1,913
NLW-GT-01	Upper Germanic Trias Group	Claystone	3781,28				0,25	1,741
NLW-GT-01	Upper Germanic Trias Group	Claystone	3785,38	73,7	36,8	31,7	0,17	1,582
NLW-GT-01	Upper Germanic Trias Group	Claystone	3788,36	68,3	33,3	29,7	0,15	1,569
NMD-01	Upper Germanic Trias Group	Claystone	1938,16	23,971	14,084	9,939	0,201	1,646
NMD-01	Upper Germanic Trias Group	Claystone	1993,18	26,731	15,717	11,035	0,209	1,655
NMD-01	Upper Germanic Trias Group	Claystone	1999,11	29,678	20,938	11,772	0,267	1,778
NMD-03	Altena Group	Claystone	2023,93	17,164	17,349	6,434	0,334	2,006
NMD-03	Altena Group	Claystone	2040,63	17,624	17,103	6,647	0,329	1,988
NMD-03	Upper Germanic Trias Group	Claystone	2091,42	42,281	33,082	16,46	0,288	1,855
P15-14	Rijnland Group	Claystone	2130,95	24,348	16,13	9,857	0,237	1,724
P15-14	Rijnland Group	Claystone	2466,91	27,743	21,614	10,888	0,277	1,825
P15-14	Altena Group	Claystone	2882,66	25,587	18,87	10,172	0,261	1,789
P15-14	Altena Group	Claystone	2928,51	24,272	15,521	9,897	0,22	1,688

P15-14	Upper Germanic Trias Group	Claystone	2938,47	41,217	33,269	15,942	0,293	1,851
P15-14	Upper Germanic Trias Group	Claystone	2973,34	40,133	31,946	15,64	0,288	1,848
P15-14	Upper Germanic Trias Group	Claystone	2991,27	36,4	30,216	14,094	0,296	1,878
P15-14	Upper Germanic Trias Group	Claystone	3094,73	62,979	39,456	25,594	0,234	1,704
P15-14	Upper Germanic Trias Group	Claystone	3104,67	61,406	38,801	24,955	0,233	1,703
P15-14	Lower Germanic Trias Group	Claystone	3173,33	55,003	26,536	23,95	0,151	1,565
P15-F-02	Upper Germanic Trias Group	Claystone					0,293	1,855
P18-A-02	Upper Germanic Trias Group	Claystone	3091,9				0,337	2,037
P18-A-02	Upper Germanic Trias Group	Claystone	3163,14	67,248	36,722	28,317	0,188	1,621
P18-A-02	Upper Germanic Trias Group	Claystone	3170,65	57,393	32,259	23,913	0,199	1,636
P18-A-02	Lower Germanic Trias Group	Claystone	3264,02	56,308	26,694	24,552	0,147	1,556
PRW-01	Rijnland Group	Claystone	1642,2	17,2	16,1	6,5	0,32	1,95
PRW-01	Rijnland Group	Claystone	1961,04	33,3	27,2	12,9	0,30	1,858
PRW-01	Schieland Group	Claystone	2210,28	29,6	24,7	11,5	0,29	1,871
PRW-01	Schieland Group	Claystone	2317,07	30,0	25,0	11,6	0,29	1,873
PRW-01	Altena Group	Claystone	2518,96	25,5	21,4	9,8	0,30	1,876
Q11-03	Altena Group	Claystone	2273,06				0,316	1,929
Q11-03	Upper Germanic Trias Group	Claystone	2313,39				0,249	1,735
Q11-03	Lower Germanic Trias Group	Claystone	2341,42	45,917	30,053	18,484	0,244	1,724
Q11-03	Zechstein Group	Claystone	2553,53	41,499	33,205	16,068	0,292	1,845
Q11-03	Zechstein Group	Claystone	2572,14	51,859	31,731	21,15	0,227	1,685
Q11-03	Zechstein Group	Claystone	2596,45	53,301	35,479	21,387	0,249	1,735
Q13-12	Rijnland Group	Claystone	1698,91				0,371	2,216
Q13-12	Schieland Group	Claystone	1762,6	41,31	24,292	17,05	0,214	1,665
Q13-12	Schieland Group	Claystone	1871,68	35,039	21,324	14,636	0,208	1,692
Q13-12	Schieland Group	Claystone	1878,82	31,541	24,143	12,894	0,256	1,869

Q13-12	Schieland Group	Claystone	2088,3	31,891	23,641	12,701	0,268	1,818
Q13-A-02	Rijnland Group	Claystone	1847,04	35,822	26,066	14,108	0,271	1,786
Q13-A-02	Schieland Group	Claystone	1947,74	39,823	28,724	15,731	0,267	1,781
Q13-A-05-S1	Schieland Group	Claystone	1916,37	41,257	30,95	16,244	0,274	1,808
Q14-03	Upper Germanic Trias Group	Claystone	2541,66	44,557	34,939	17,328	0,287	1,832
Q14-03	Upper Germanic Trias Group	Claystone	2548,67	37,41	25,999	14,845	0,26	1,757
Q14-03	Lower Germanic Trias Group	Claystone	2818,18	42,113	33,155	16,348	0,288	1,835
Q14-03	Zechstein Group	Claystone	2871,14	51,085	35,48	20,277	0,26	1,757
RTD-02	Rijnland Group	Claystone	1293,9	15,478	6,206	7,176	0,08	1,484
SLD-06-S1	Zechstein Group	Claystone	1876,79	22,2	15,9	8,8	0,27	1,771
TID-702	Rijnland Group	Claystone	1843,17				0,34	2,084
TID-702	Lower Germanic Trias Group	Claystone	1960,17	40,7	32,9	15,7	0,29	1,857
TID-702	Zechstein Group	Claystone	1964,99	62,3	49,0	24,3	0,28	1,836
TID-702	Zechstein Group	Claystone	2517,1	32,7	23,2	12,9	0,26	1,765
TID-702	Upper Rotliegend Group	Claystone	2575,95	32,9	21,9	13,2	0,25	1,73
VRS-08	Zechstein Group	Claystone	3036,71	47,0	31,8	18,8	0,25	1,739
VRS-08	Upper Rotliegend Group	Claystone	3051,02	45,3	28,7	18,4	0,23	1,703
WBMS-01	Altera Groep	Claystone	1353,71	22,6	12,5	9,5	0,19	1,621
WBMS-01	Altena Group	Claystone	1972,45	24,2	15,9	9,8	0,23	1,712
WBMS-01	Altena Group	Claystone	1986,23	24,3	15,2	9,9	0,23	1,695
WBMS-01	Upper Germanic Trias Group	Claystone	2020,2	31,4	33,6	11,8	0,34	2,05
WBMS-02	Upper Germanic Trias Group	Claystone	1740,23				0,25	1,757
WBMS-02	Upper Germanic Trias Group	Claystone	1818,24				0,30	1,871
WBMS-02	Lower Germanic Trias Group	Claystone	1961,79				0,30	1,865
WBMS-02	Lower Germanic Trias Group	Claystone	2083,4				0,28	1,825

WBMS-02	Zechstein Group	Claystone	2095,3				0,26	1,774
WBMS-02	Zechstein Group	Claystone	2188,42				0,17	1,585
WBMS-03	Zechstein Group	Claystone	2499,23	35,2	25,7	13,9	0,27	1,789
WED-03	Upper Germanic Trias Group	Claystone	2604,14	31,9	21,5	12,8	0,24	1,731
WED-03	Upper Germanic Trias Group	Claystone	2628,86	34,2	24,5	13,7	0,25	1,77
WED-03	Upper Germanic Trias Group	Claystone	2636,85	32,7	21,8	13,2	0,24	1,731
WWN-03	Schieland Group	Claystone	1059,41	15,7	12,5	6,2	0,28	1,849
WWN-03	Altena Group	Claystone	1578,84	13,7	13,4	5,2	0,32	1,968
WWN-03	Altena Group	Claystone	2585,75				0,27	1,801
WWN-03	Altena Group	Claystone	2642,24				0,27	1,808
WWN-03	Upper Germanic Trias Group	Claystone	2761,19	52,1	35,1	20,8	0,25	1,738
WWN-03	Upper Germanic Trias Group	Claystone	2874,03	49,1	32,1	19,7	0,25	1,722
WWS-02	Altena Group	Claystone	2584,3				0,29	1,859
WWS-02	Upper Germanic Trias Group	Claystone	2736,06	49,5	31,9	20,0	0,24	1,714
P15-14	Lower Germanic Trias Group	Claystone	3344,23	50,856	36,223	20,091	0,266	1,771
Q11-03	Lower Germanic Trias Group	Claystone	2460,42	44,094	30,912	17,474	0,262	1,762
Q11-03	Lower Germanic Trias Group	Claystone	2549,63	39,778	29,713	15,582	0,277	1,8
Q14-03	Lower Germanic Trias Group	Claystone	2679,13	45,773	34,998	17,859	0,282	1,817
CAP-01	Upper Germanic Trias Group	Claystone / Anhydrite	2944,98	36,6	27,6	14,7	0,24	1,763
DRT-01	Upper Germanic Trias Group	Claystone / Anhydrite	2903,91				0,29	1,877
DRT-01	Upper Germanic Trias Group	Claystone / Anhydrite	2903,91	53,4	45,4	20,6	0,30	1,892
MDZ-01	Upper Germanic Trias Group	Claystone / Anhydrite	1605,58	43,7	33,3	17,1	0,28	1,813
WWN-03	Upper Germanic Trias Group	Claystone / Anhydrite	2751,74	52,3	39,8	20,5	0,28	1,811

WBMS-03	Zechstein Group	Claystone / Dolomite	2496,23	47,8	36,2	18,7	0,28	1,809
P18-A-02	Lower Germanic Trias Group	Claystone / Limestone	3406,74	55,815	33,77	22,812	0,224	1,679
WWN-03	Upper Germanic Trias Group	Claystone / Limestone	2657,61	36,7	27,5	14,4	0,27	1,78
WWS-02	Upper Germanic Trias Group	Claystone / Limestone	2590,69				0,29	1,853
WWS-02	Upper Germanic Trias Group	Claystone / Limestone	2624,76	53,9	39,7	21,2	0,29	1,856
AMR-12	Limburg Group	Claystone / Siltstone	2974,87	45,3	25,5	18,8	0,20	1,639
GRO-01	Lower Germanic Trias Group	Claystone / Siltstone	1711,89				0,29	1,847
LTG-01	Limburg Group	Claystone / Siltstone	4303,72	47,9	36,5	18,8	0,28	1,832
HBV-01	Lower Germanic Trias Group	Claystone / Sandstone	2201,98	38,8	25,2	15,6	0,24	1,719
WWN-03	Upper Germanic Trias Group	Claystone / Sandstone	2854,99	49,3	29,3	20,2	0,22	1,667
WWS-02	Upper Germanic Trias Group	Claystone / Sandstone	2723,64	51,9	29,9	21,5	0,21	1,65
CAP-01	Upper Germanic Trias Group	Marl	2965,67	53,3	43,6	20,6	0,30	1,858
DRT-01	Rijnland Group	Marl	1048,8				0,44	3,308
DRT-01	Rijnland Group	Marl	1160,37				0,41	2,736
HBV-01	Altena Group	Marl	1343,9				0,36	2,142
HPS-01	Rijnland Group	Marl	1798,09	14,2	17,8	5,2	0,37	2,189
HPS-01	Rijnland Group	Marl	1808,14	9,2	13,2	3,3	0,38	2,328
LTG-01	Rijnland Group	Marl	1672,33	12,6	16,4	4,6	0,37	2,223
MON-04	Rijnland Group	Marl	1286,17	10,583	7,88	4,174	0,268	
MON-04	Rijnland Group	Marl	1459,05	18,303	16,147	6,991	0,31	1,911
P15-14	Rijnland Group	Marl	2076,96	24,643	17,235	9,793	0,257	1,755
P15-14	Rijnland Group	Marl	2236,94	24,123	16,413	9,915	0,23	1,744

P15-14	Upper Germanic Trias Group	Marl	3028,1	49,048	38,36	19,084	0,285	1,829
PRW-01	Rijnland Group	Marl	1624,42	15,1	14,5	5,7	0,33	1,97
RTD-02	Rijnland Group	Marl	1469,02	19,962	10,8	8,45	0,181	1,614
TID-702	Rijnland Group	Marl	1833,06				0,34	2,055
TID-702	Rijnland Group	Marl	1846,21				0,30	1,877
WED-03	Upper Germanic Trias Group	Marl	2649,68	39,9	26,2	16,3	0,23	1,726
DRT-01	Altena Group	Shale	2400,16				0,26	1,753
GSB-01	Zechstein Group	Shale	3091,35	51,2	31,8	31,8	0,23	1,685
WBMS-01	Schieland Group	Siltstone	1297,76	26,0	21,0	10,1	0,28	1,838
WWN-03	Lower North Sea Group	Silt	873,05	9,0	5,4	3,7	0,22	1,67
Q13-A-05-S1	Rijnland Group	Siltstone	1695,64	38,75	36,802	15,06	0,292	1,944
GSB-01	Zechstein Group	Salt (evaporite)	2952,66	33,0	24,2	24,2	0,27	1,79
GSB-01	Zechstein Group	Salt (evaporite)	2993,56	37,0	26,4	26,4	0,27	1,773
MID-302	Zechstein Group	Salt (evaporite)	2212,65	34,5	24,4	13,7	0,26	1,765
MID-302	Zechstein Group	Salt (evaporite)	2270,48	36,9	27,6	14,5	0,28	1,798
MID-302	Zechstein Group	Salt (evaporite)	2291,73	45,0	32,7	17,8	0,27	1,785
TID-702	Zechstein Group	Salt (evaporite)	2464,45	33,7	22,5	13,5	0,25	1,734
WBMS-02	Upper Germanic Trias Group	Salt (evaporite)	1616,62				0,29	1,835
WBMS-02	Upper Germanic Trias Group	Salt (evaporite)	1743,46				0,31	1,927
WBMS-02	Upper Germanic Trias Group	Salt (evaporite)	1787,16				0,29	1,845
WBMS-02	Zechstein Group	Salt (evaporite)	2143,28				0,26	1,754

WED-03	Upper Germanic Trias Group	Salt (evaporite) / Anhydrite	2661,6	40,8	27,5	16,4	0,25	1,739
HBV-01	Lower North Sea Group	Sand	939,45				0,37	2,184
WWN-03	Upper North Sea Group	Sand	676,46	11,2	7,9	4,7	0,19	1,689
AMR-12	Upper Rotliegend Group	Sandstone	2955,36	28,6	15,0	12,2	0,18	1,605
BLD-01	Upper Rotliegend Group	Sandstone	1891,14	26,0	16,2	10,7	0,22	1,689
BLK-01	Upper Germanic Trias Group	Sandstone	2196,31	30,149	17,358	12,509	0,203	1,645
BLK-01	Upper Germanic Trias Group	Sandstone	2223,8	34,604	20,471	14,23	0,217	1,666
BLK-01	Lower Germanic Trias Group	Sandstone	2291,28	29,148	19,302	11,708	0,247	1,73
CAP-01	Upper Germanic Trias Group	Sandstone	3054,12	50,8	32,9	20,4	0,24	1,715
CAP-01	Upper Germanic Trias Group	Sandstone	3097,29	52,6	35,7	21,0	0,25	1,743
CAP-01	Lower Germanic Trias Group	Sandstone	3112,77	45,9	28,9	18,6	0,24	1,701
CAP-01	Lower Germanic Trias Group	Sandstone	3154,25	46,3	30,0	18,6	0,24	1,717
CAP-01	Lower Germanic Trias Group	Sandstone	3197,74	52,5	34,5	21,1	0,25	1,722
CAP-01	Upper Rotliegend Group	Sandstone	3409,1	49,2	30,8	20,0	0,23	1,703
COV-40	Limburg Group	Sandstone	3041,08	42,54	26,051	17,438	0,223	1,687
COV-41	Limburg Group	Sandstone	2982,12	40,46	26,312	16,466	0,234	1,721
COV-41	Limburg Group	Sandstone	2549,03	41,617	22,713	17,359	0,187	1,622
DRT-01	Chalk Group	Sandstone	1043,73				0,38	2,333
DRT-01	Rijnland Group	Sandstone	1171,63				0,39	2,397
DRT-01	Schieland Group	Sandstone	1268,6				0,39	2,418
DRT-01	Schieland Group	Sandstone	1906,82				0,32	1,965
DRT-01	Altena Group	Sandstone	2341,33				0,30	1,876
DRT-01	Upper Germanic Trias Group	Sandstone	3010,29	53,5	32,4	21,9	0,22	1,674
DRT-01	Upper Germanic Trias Group	Sandstone	3059,63	66,0	40,3	27,0	0,22	1,679

DRT-01	Lower Germanic Trias Group	Sandstone	3069,52	58,9	35,3	24,2	0,22	1,675
DRT-01	Lower Germanic Trias Group	Sandstone	3074,55	51,9	31,5	21,2	0,22	1,678
DRT-01	Lower Germanic Trias Group	Sandstone	3085,98	39,3	23,0	16,2	0,21	1,66
DRT-01	Lower Germanic Trias Group	Sandstone	3113,25	34,5	21,6	14,0	0,23	1,695
DRT-01	Lower Germanic Trias Group	Sandstone	3157,07	50,4	29,7	20,8	0,22	1,664
GAG-06-S1	Upper Germanic Trias Group	Sandstone	3755,66	76,9	38,5	33,1	0,16	1,582
GAG-06-S1	Lower Germanic Trias Group	Sandstone	3810,06	58,3	26,4	25,8	0,13	1,536
GAG-06-S1	Lower Germanic Trias Group	Sandstone	3840,45	50,8	25,2	21,9	0,16	1,577
GAG-06-S1	Lower Germanic Trias Group	Sandstone	3853,57	63,7	31,5	27,5	0,16	1,577
GAG-06-S1	Lower Germanic Trias Group	Sandstone	3907,54	67,7	33,1	29,4	0,16	1,572
GAG-06-S1	Lower Germanic Trias Group	Sandstone	3963,94	70,8	36,2	30,4	0,17	1,594
GRO-01	Upper Germanic Trias Group	Sandstone	1672,84				0,29	1,842
GRO-01	Lower Germanic Trias Group	Sandstone	1764,26				0,26	1,77
GSB-01	Upper Rotliegend Group	Sandstone	3123,76	68,1	35,9	35,9	0,18	1,607
HBV-01	Schieland Group	Sandstone	1310,65				0,35	2,117
HBV-01	Upper Germanic Trias Group	Sandstone	1953,04	33,8	23,3	13,5	0,26	1,751
HBV-01	Lower Germanic Trias Group	Sandstone	2006,55	32,2	22,5	12,8	0,26	1,759
HBV-01	Lower Germanic Trias Group	Sandstone	2018,73	29,2	19,6	11,6	0,25	1,738
HBV-01	Lower Germanic Trias Group	Sandstone	2036,47	30,7	21,3	12,2	0,26	1,755
HBV-01	Lower Germanic Trias Group	Sandstone	2082,03	32,2	20,4	13,0	0,24	1,705
HBV-01	Lower Germanic Trias Group	Sandstone	2151,17	28,8	19,0	11,5	0,25	1,727
HPS-01	Rijnland Group	Sandstone	1912,39	23,2	19,3	8,9	0,30	1,875
IJS-64-S2	Upper Germanic Trias Group	Sandstone	3408,01	58,5	32,9	24,4	0,20	1,639
IJS-64-S2	Lower Germanic Trias Group	Sandstone	3438,19	44,8	25,2	18,6	0,20	1,641
LTG-01	Upper Rotliegend Group	Sandstone	1726,49	21,1	15,1	8,4	0,26	1,786

MDZ-01	Upper Germanic Trias Group	Sandstone	1710,33	39,2	21,9	16,4	0,19	1,62
MDZ-01	Upper Rotliegend Group	Sandstone	2236,23	49,6	28,6	20,5	0,21	1,652
MON-04	Rijnland Group	Sandstone	1408,73	12,971	10,322	5,057	0,288	1,847
MSG-03-S1	Upper Germanic Trias Group	Sandstone	2874,71	29,3	16,4	12,2	0,20	1,635
MSG-03-S1	Lower Germanic Trias Group	Sandstone	2925,73	32,3	20,1	13,1	0,23	1,696
MSG-03-S1	Lower Germanic Trias Group	Sandstone	3029,98	39,6	28,1	15,7	0,26	1,77
NLW-GT-01	Lower Germanic Trias Group	Sandstone	3821,06	53,2	25,6	23,1	0,15	1,564
NLW-GT-01	Lower Germanic Trias Group	Sandstone	3872,18	63,1	32,2	26,9	0,17	1,592
NLW-GT-01	Lower Germanic Trias Group	Sandstone	3948,92	70,3	35,8	30,1	0,17	1,59
NMD-01	Upper Germanic Trias Group	Sandstone	1975,97	26,427	15,895	10,891	0,209	1,66
NMD-01	Upper Germanic Trias Group	Sandstone	2002,48	33,251	23,922	13,453	0,237	1,753
NMD-01	Lower Germanic Trias Group	Sandstone	2072,45	25,006	17,621	9,906	0,263	1,766
NMD-03	Rijnland Group	Sandstone	1778,74	20,573	17,032	7,926	0,298	1,866
NMD-03	Lower Germanic Trias Group	Sandstone	2215,26	28,922	19,549	11,547	0,253	1,741
P15-14	Chalk Group	Sandstone	1948,96				0,281	1,823
P15-14	Rijnland Group	Sandstone	2201,94	23,953	17,612	9,525	0,26	1,784
P15-14	Rijnland Group	Sandstone	2497,91	32,111	24,172	12,583	0,277	1,807
P15-14	Rijnland Group	Sandstone	2514,41	31,503	24,41	12,301	0,284	1,83
P15-14	Rijnland Group	Sandstone	2559,91	43,428	28,951	17,396	0,25	1,734
P15-14	Upper Germanic Trias Group	Sandstone	3107,65	54,354	37,076	22,057	0,236	1,737
P15-14	Lower Germanic Trias Group	Sandstone	3143,96	49,002	23,071	21,629	0,136	1,551
P15-14	Lower Germanic Trias Group	Sandstone	3184,48	64,453	28,961	28,616	0,125	1,53
P15-14	Lower Germanic Trias Group	Sandstone	3253,52	63,679	31,911	27,381	0,163	1,581
P15-14	Lower Germanic Trias Group	Sandstone	3305,85	67,461	36,865	28,312	0,193	1,625
P15-F-02	Lower Germanic Trias Group	Sandstone		41,319	20,467	17,813	0,162	1,577
P15-F-02	Lower Germanic Trias Group	Sandstone		47,756	24,965	20,286	0,179	1,604

P15-F-02	Lower Germanic Trias Group	Sandstone		53,785	26,431	23,199	0,159	1,572
P15-F-02	Lower Germanic Trias Group	Sandstone		57,076	32,774	23,62	0,21	1,652
P15-F-02	Lower Germanic Trias Group	Sandstone		54,139	32,758	22,117	0,225	1,679
P15-RIJN-A-09-S1	Rijnland Group	Sandstone	1918,79	28,897	24,731	11,091	0,304	1,891
P15-RIJN-A-09-S1	Rijnland Group	Sandstone	2021,89	29,898	24,127	11,586	0,29	1,845
P18-A-02	Upper Germanic Trias Group	Sandstone	3175,24	39,992	19,217	17,369	0,15	1,56
P18-A-02	Lower Germanic Trias Group	Sandstone	3240,1	39,303	17,313	17,558	0,121	1,525
P18-A-02	Lower Germanic Trias Group	Sandstone	3271,9	59,034	25,947	26,367	0,12	1,523
P18-A-02	Lower Germanic Trias Group	Sandstone	3321,58	58,528	27,853	25,563	0,146	1,557
P18-A-02	Lower Germanic Trias Group	Sandstone	3367,38	64,431	28,946	28,679	0,123	1,53
PRW-01	Chalk Group	Sandstone	1567,33	22,4	19,5	8,6	0,31	1,904
PRW-01	Rijnland Group	Sandstone	1703,18	19,8	17,4	7,5	0,31	1,91
PRW-01	Rijnland Group	Sandstone	1819,26	23,2	19,7	8,9	0,30	1,886
PRW-01	Rijnland Group	Sandstone	1937,36	27,4	22,8	10,6	0,30	1,871
PRW-01	Rijnland Group	Sandstone	2089,87	25,1	21,0	9,7	0,30	1,875
PRW-01	Schieland Group	Sandstone	2217,85	24,9	20,9	9,6	0,30	1,881
Q11-03	Lower Germanic Trias Group	Sandstone	2366,81	60,258	32,092	25,449	0,183	1,609
Q11-03	Zechstein Group	Sandstone	2582,78	57,822	31,237	24,427	0,181	1,612
Q11-03	Zechstein Group	Sandstone	2626,27	55,688	28,845	23,945	0,165	1,594
Q11-03	Upper Rotliegend Group	Sandstone	2776,99	41,969	20,085	18,307	0,164	1,583
Q13-12	Rijnland Group	Sandstone	1718,77	38,16	24,939	15,501	0,27	1,846
Q13-12	Rijnland Group	Sandstone	1735,47	37,181	21,62	15,473	0,207	1,659
Q13-12	Schieland Group	Sandstone	1899,14	22,874	23,517	8,909	0,312	2,195
Q13-A-02	Schieland Group	Sandstone	1904,82	36,374	23,418	14,7	0,239	1,715

Q14-03	Upper Germanic Trias Group	Sandstone	2553,63	47,906	31,687	19,205	0,248	1,73
Q14-03	Lower Germanic Trias Group	Sandstone	2591,19	61,677	38,723	25,017	0,234	1,701
Q14-03	Zechstein Group	Sandstone	2865,65	59,667	33,271	24,919	0,2	1,637
Q14-03	Zechstein Group	Sandstone	2906,64	60,035	34,38	24,876	0,208	1,65
Q14-03	Upper Rotliegend Group	Sandstone	3020,08	42,777	25,026	17,614	0,216	1,663
RTD-02	Rijnland Group	Sandstone	1333,32	17,721	8,755	7,786	0,139	1,561
SLD-06-S1	Upper Rotliegend Group	Sandstone	2068,09	20,5	12,2	8,5	0,22	1,674
TID-702	Upper Rotliegend Group	Sandstone	2648,98	29,0	16,9	12,0	0,21	1,666
VRS-08	Upper Rotliegend Group	Sandstone	3167,82	35,1	22,0	14,3	0,23	1,7
WBMS-01	Rijnland Group	Sandstone	1190,63	25,4	19,1	10,0	0,28	1,802
WBMS-02	Upper Rotliegend Group	Sandstone	2351,95				0,16	1,577
WBMS-03	Upper Rotliegend Group	Sandstone	2675,12	41,6	20,9	17,9	0,17	1,582
WWN-03	Schieland Group	Sandstone	1075,4	12,6	10,2	4,9	0,29	1,859
WWN-03	Schieland Group	Sandstone	1519,2	12,7	12,0	4,9	0,32	1,955
WWN-03	Upper Germanic Trias Group	Sandstone	2817,07	49,6	27,9	20,6	0,20	1,637
WWN-03	Upper Germanic Trias Group	Sandstone	2880,39	57,6	35,3	23,5	0,23	1,685
WWN-03	Lower Germanic Trias Group	Sandstone	2902,16	51,8	32,3	21,0	0,23	1,693
WWN-03	Lower Germanic Trias Group	Sandstone	2919,91	48,4	28,6	19,9	0,22	1,663
WWN-03	Lower Germanic Trias Group	Sandstone	2950,68	51,0	30,2	21,0	0,22	1,665
WWS-02	Upper Germanic Trias Group	Sandstone	2697,78	50,9	28,7	21,2	0,20	1,64
WWS-02	Upper Germanic Trias Group	Sandstone	2742,66	58,4	36,8	23,7	0,23	1,702
WWS-02	Lower Germanic Trias Group	Sandstone	2749,3	55,0	30,6	22,9	0,20	1,634
WWS-02	Lower Germanic Trias Group	Sandstone	2768,02	49,2	29,1	20,2	0,22	1,665

WWS-02	Lower Germanic Trias Group	Sandstone	2792,65	44,6	24,7	18,6	0,20	1,633
WWS-02	Lower Germanic Trias Group	Sandstone	2858,93	54,0	30,4	22,5	0,20	1,639
WWS-02	Lower Germanic Trias Group	Sandstone	2903,45	56,4	31,4	23,5	0,20	1,634
LTG-01	Limburg Group	Sandstone / Claystone	3186,69	45,7	32,5	18,2	0,26	1,781
MDZ-01	Upper Germanic Trias Group	Sandstone / Claystone	1668,71	42,1	26,8	17,0	0,24	1,709
P15-14	Rijnland Group	Sandstone / Claystone	2544,91	39,48	27,769	15,648	0,264	1,769
P15-F-02	Upper Germanic Trias Group	Sandstone / Claystone		48,003	31,588	19,337	0,242	1,723
P15-RIJN-A-09-S1	Rijnland Group	Sandstone / Claystone	1982,78	26,699	24,653	10,125	0,319	1,943
Q13-A-02	Rijnland Group	Sandstone / Claystone	1867,88	40,489	27,37	16,171	0,252	1,739
Q13-A-02	Schieland Group	Sandstone / Claystone	2237,37	35,906	24,439	14,394	0,251	1,749
Q13-A-05-S1	Rijnland Group	Sandstone / Claystone	1856,47	38,4	26,131	15,419	0,249	1,745
Q13-A-05-S1	Schieland Group	Sandstone / Claystone	2033,1	36,616	23,459	14,906	0,234	1,714
RTD-02	Rijnland Group	Sandstone / Claystone	1545,13	18,211	9,388	7,821	0,166	1,593
WWS-02	Lower Germanic Trias Group	Sandstone / Claystone	2933,87	57,1	34,7	23,3	0,23	1,682
HBV-01			1765,25				0,33	2,001
MDZ-01			1631,11	31,1	20,8	12,4	0,25	1,734
NMD-03	Schieland Group		1851,86	20,471	17,597	7,848	0,305	1,894
NMD-03	Upper Germanic Trias Group		2111,98	41,958	34,276	16,206	0,293	1,852
NMD-03	Upper Germanic Trias Group		2191,96	28,915	4179,133	11,58	0,247	1,736
PRW-01			1537,25	51,7	42,3	19,9	0,30	1,86

WBMS -01	1353,7 1	19,5	8,9	8,6	0,14	1,54