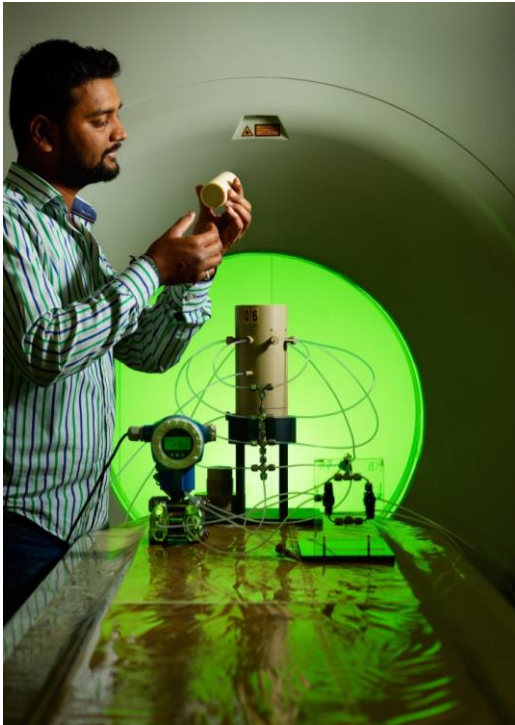


Appendix to the Introduction chapter Laboratory of Geoscience & Engineering

A. Selected set-ups



The CT scanner (**left**), here used for visualization (**below**) of multi-phase flow of oil, polymers, water and gases through porous samples under pore pressure at a given temperature. In this case for enhanced hydrocarbon recovery operations.

Photo: Dutch Polymer Institute / Bart van Overbeeke



Tri-axial cell with a thermo mechanical spalling experiment (**right**). It is also used for hydraulic fracture initiation and propagation in rock samples. The investigations are under in-situ tri-axial loading conditions. Acoustic techniques can also be used to monitor the fracture growth.





The shock tube generates variable-amplitude ramp-like pressure waves to study wave propagation in rock samples, its damping of bulk modes and borehole waves in (un)saturated rock samples, over a broad frequency spectrum.



Geotechnical centrifuge that underwent a total rebuild in 2009/10 (diameter ca. 1.8 meter).



Climate room with triaxial cells. In these rooms, long term temperature controlled experiments are performed.



Tri-axial soil experiments in the large climate chamber, where temperature and humidity controlled experiments are performed.

Foto: Annemiek van der Kuil



High pressure/high temperature (HP,T) plug flow experimental set-up (**left**). The blue pressure transducers measure the differential pressure over the entire sample. The coreholder is 1 m in length.

HP,T-EOR experiment (**below**).



Foam set-up. Here foam is created in a core at higher temperatures and pressures. The foam is used to improve flow-conditions in higher and lower permeable porous systems.

B. Development of facilities during the review period

- Acquisition of set-up various furnaces, density meters, high precision pumps and transducers for in-situ high pressure, high temperature (HP,T) set-ups (2007-2014).
- New climate rooms and a special soil laboratory (2008).
- Development of a new full field photo-elasticity set-up and a high speed electrical resistivity tomography set-up (2008-2011).
- Complete renovation of the geotechnical centrifuge (2009-2010).
- Continuous development of new types of flow cells, which can be placed in the CT-scanners (2009-2015).
- Improvements on (scaled) pressure vessel materials, high/low-pressure connections, micro-flow transducers, methods for process- and experimental imaging (2009-2014).
- Development of new test facilities to test fibrous materials at very low stress levels, including a special axial shear device for anisotropic consolidation prior to shearing are been developed (2010-2015).
- Upgrade of the Pendant-drop cell (2011).
- The high-pressure laboratory (in an annex of the building) was closed and, as a replacement, three smaller set-up boxes have been built in the main laboratory. Consequently, the maximum pressure-volume product has been reduced from 250 to 75 literbar-product (2011).
- Development of high precision diffusion set-up for shale- and coal-gas sorption/diffusion experiment (2007-2011). Equipment and set-ups were made more standardized and thus more exchangeable and faster to prepare. As a result, it is now possible for more (BSc/MSc/PhD) students to work in the laboratory (2011-2015).
- Renovation of the Terratek HP,T cell (2012).
- Purchase of a field vibrator source for accurate acoustic high energy production (2012-2013).
- A large slope liquefaction testing facility has been designed (2014) and is expected to be operational in 2015.

C. Staff during the review period

Name/Expertise	Set-up design	Deep HP,T Set-up construction	Shallow LP,T Set-up construction	Experimental activities	Chemical & biological analysis	Sample preparation	Sample characterization & quantification	Data-acquisition, IT, megatronics	Field work	First Aid, Emergency response team	Health Safety Environment	fte 2008	fte 2014	Remarks
H. van Asten	X									x		0.8	0.8	
D. Delforferie						X			X	x		0.8	0.8	s
J. Etienne	x											0.8	0.8	s
M. Friebel						x				x		1.0	1.0	
J. van Haagen				x	X						x	0.5	0.5	
K. Heller	X	x	x	x					x			1.0	1.0	MT-M
A. Hemstede	x		x					x	X	x		0.9	0.9	
G. Löhlefink							x	X				0.6	0.6	
A. Maljaars	X	X										1.0		
G. Mathu		x	x	x								0.8		
J. van Meel						x	X	X				0.9	0.9	
E. Meijvogel					X						x	0.6	0.6	
H. v.d. Meulen		x	x	x								0.9		
A. Mulder			X	X	x	x		x	x	x		0.9	0.9	
F. Riem Vis	X											0.8		
M. Slob	x	X		X		X		x					0.8	
G. Sigon		x	x						X			0.8		
W.Verwaal			x	x		x			x		X	0.8	0.8	MT-M
H. de Visser			x						x	x		1.0	1.0	
K.-H. Wolf				x							X	0.15	0.15	MT-C
Sum fte												15.1	11.6	

Legend

X	major occupation
x	minor occupation
s	soon to be retired
MT-M	Management Team member
MT-C	Management Team chair