

2016 Annual Report:

Petroleum Research School of Norway

Nasjonal forskerskole i petroleumsfag (NFIP)

Introduction

Petroleum Research School of Norway (NFIP) includes PhD students from all of the five universities in Norway that provide PhD education within petroleum related disciplines. Education of petroleum researchers at Norwegian universities benefits from coordinated, interdisciplinary collaboration between the Norwegian universities graduating PhD's in petroleum related scientific disciplines.

The Petroleum Research School of Norway was established to provide a national tool to improve the PhD education within petroleum related sciences in Norway. This is achieved by coordinating lectures given by the different universities and providing intensive courses, seminars and conferences for all PhD students in Norway with research projects related to petroleum. The objective is also to establish discussion groups, collaborating opportunities and interdisciplinary meeting places for PhD students and their supervisors in Norway and internationally; for more information please see www.NFiPweb.org.

In 2016 NFIP obtained financial support from The Norwegian Research Council (RNC) amounting to NOK 23mill for the next 8 years. This support enabled NFIP to continue and expand the educational efforts.

A database of 123 PhD students related to upstream petroleum technology at the participating universities has been established by the Petroleum Research School of Norway; including University of Bergen, University of Stavanger, University of Oslo, Norwegian University of Science and Technology (NTNU), University of Tromsø and the University Center at Svalbard (UNIS).

More than 700 PhD and MSc students have participated in NFIP activities; in 2016 a total of 122 students participated.

2016 NFiP Activities.

Courses/seminars:

1) Geochemical Assessment of Subsea Engineering (Texas A&M U.)

At Texas A&M Corpus Christi campus a course titled: "Geochemical Assessment of Subsea Engineering", emphasizing environmental concerns during subsea operations was lectured by Richard B. Coffin, Ph.D. and Chair of the Department of Physical and Environmental Sciences. This course was a geochemical assessment of subsea engineering related to energy mining and carbon sequestration with a focus on environmental impact and platform and pipeline stability. Lectures included resource characterization.

A total of 28 participants (18% females), 14 PhD students and 14 Master students from academia attended the conference. International attendance: 9 PhD and Master students from the University of Bergen, from Rice (4), Texas A & M (1), University of Houston (6), and University of Austin + China University of Petroleum (6).

Link to the course: <http://nfipweb.org/NFiP-activities/courses/2016/geochemical%20assessment%20of%20subsea%20eng..html>

2) World Heritage Jurassic coast of Dorset; field techniques for sedimentary research

This course provided introduction to the stratigraphy and facies of the siliciclastic and carbonate sediments, and instruction in field logging and sampling techniques appropriate to the various sediment types present. The Jurassic coast provides spectacular exposures of Triassic-Cretaceous sediments, which include outcropping examples of source rocks and reservoirs of the Wytch Farm oilfield, including a number of fossil oil seeps. A total of 8 participants (63% females, 50% PhD) attended the course. Participants were from the University of Bergen (5) and University of Oslo (3).

Link to the course: <http://nfipweb.org/NFiP-activities/courses/2016/dorset2016.html>

3) Geological field trip to the Ainsa area in the Spanish Pyrenees

The course was primarily about clastic reservoir geology. The rocks studied are analogous to a number of important reservoir sections offshore Norway and other parts of the world and the use of analogues was discussed throughout the course. The course included a mixture of fieldwork and class work. A total of 13 participants (23% females, 1 PhD) attended the course. (all participants from UiB).

Link to the course: <http://nfipweb.org/NFiP-activities/courses/2016/pyrex%202016.html>

4) Practical Course in Rhetoric

The course is intended to help participants to be more precise and feel more confident in oral and written communication. The course lecturer was Siri Blindheim, who has been conducting rhetoric courses for 15 years. Among the clients are SINTEF, NTNU, The Research Council of Norway, NIBIO, the Ministry of Climate and Environment, GDF Suez (Engie), Petoro, and Statoil. A total of 10 participants (20% females, 1 PhD) attended the course; all from UiB.

Link to the course: <http://nfipweb.org/NFiP-activities/courses/2016/rhetoric%20course.html>

5) Eclipse User Course

This course aims to let the participants discover the various solutions ECLIPSE offers over the entire spectrum of reservoir simulation. The training focuses on understanding ECLIPSE syntax rather than simulation methodology. 29 Master students participated in this course provided by Schlumberger at the University of Bergen.

6) Introduction to Petrophysics

Schlumberger provided an expert lecturer on Petrophysics and Well Logging: Tom Barber is semi-retired Technical Advisor at Schlumberger's Houston Formation Evaluation Center, and has worked on induction modeling, array design and environmental corrections since coming to Houston in 1978. He is author and co-author of over 50 papers and holder of 32 patents, he was awarded the SPWLA Distinguished Technical Achievement Award in 1993 for significant contributions in electromagnetic logging, and the SPWLA Gold Medal for Technical Achievement in 2011. Totally 37 Participants (4 UiT, 33 UiB).

7) Delft Summer School

2016 topic: Gas and Solvent Enhanced Oil Recovery.

2 Participants, UiB.

8) CSLF kurs for CCUS

1 Participant, UiB

Conferences:

1) Petroleum Research School of Norway Annual Seminar

Petroleum Research School of Norway (NFiP) provided in collaboration with NorTex Petroleum Cluster the conference: "*Oil and Gas Production in Perspective of the Green Energy Shift*", Nov. 1st, 2016, at Norwegian Petroleum Museum, Stavanger, Norway.

A total of 64 participants (45% females) from industry and academia attended the conference program, toured the Petroleum Museum and enjoyed networking during the conference dinner at the museum restaurant. A total of 42 PhD and 19 Master students from the following 5 universities in Norway participated: NTNU(20), UiB(14), UiS(28) and University Center at Svalbard(1).

Link to the conference: <http://nfipweb.org/NFiP-activities/annual-seminar/2016.html>

2) IOR NORWAY 2016: "Recover for the future"

The National IOR Centre of Norway and Petroleum Research School of Norway (NFiP) provided the 2-day conference IOR Norway 2016, April 26-27, 2016, at the U. of Stavanger, Norway. A total of 24 PhD students participated with a poster from the following 4 universities

in Norway: NTNU(3), UiB(3), UiS(16) and from IRIS (2). NFiP covered travel and living expenses for all PhD students attending.

2016 Courses and Conferences provided by NFiP and NorTex

Location	Course/Activity	No. of Participants	Expenses (NOK)
<i>Field trips</i>			
U. of Portsmouth	Geol. Field Trip to Devon and Dorset, UK External lecturer	8	45 760,-
U. of Barcelona	PYREX Geological Field Trip, Spain	13	339 762,-
<i>Courses</i>			
Corpus Christi	TAMUCC	28	130 172,-
Oslo	Retorikk	10	25 000,-
UiB	Petrophysics (Tom Barber, Schlumberger)	37	0,-
UiB	Eclipse User Course (Schlumberger)	29	28 000,-
Delft	Delft Summer School	2	26 500,-
U. of Birmingham	CCUS USA	1	8 000,-
<i>Seminars/conferences</i>			260
Norw. Petroleum Museum	Annual NFiP Seminar, 7th time in 2016	64	261 606,-
U. of Bergen	Interpore	15	10 000,-
U. of Stavanger	IOR Norway 2016	24	300 000,-

2016 Student/ Researcher Exchange.

During 2016 the following research exchanges and visits were funded by NorTex/NFiP:

PhD student Kun Guo, Univ. of Stavanger, Norway – visit at China University of Petroleum

Project Name: Nano Particles and Heavy Oil
Institution: University of Stavanger,
PhD student: Kun Guo
Project Supervisor: Prof. Zhixin Yu and Prof. Svein Skjæveland
Institution Visited: China University of Petroleum
Hosted By:
Period: December 1st, 2016 – January 15th, 2017

Project Summary:

The objective of this project is to perform a systematic study on the effect of metallic nanoparticles on enhanced heavy oil recovery. It aims at exploring the parameters of the nanoparticles (metal type, particle size, shape, content, etc.) and the effects of the thermophysical properties of nanoparticles containing fluids on the recovery efficiency. The characteristics of the heavy oil before and after the catalytic reactions together with the gas phase product will be studied. In this way, the actual chemical reactions could be elucidated and the main cause of viscosity reduction due to metallic nanoparticles could be clarified.

PhD student Shaghayegh Javadi, Univ. of Stavanger, Norway – visit at University of California, Santa Barbara

Project Name: Experimental Investigation of fluid chemistry effect on adhesive properties of calcite crystals
Institution: University of Stavanger, Petroleum Technology Department.
PhD student: Shaghayegh Javadi
Project Supervisor: Dr. Anja Røyne, UiO, Physics Department & Prof. Aksel Hiorth, UiS, Petroleum Technology Department.
Institution Visited: University of California, Santa Barbara, Department of Chemical Engineering
Hosted By: Prof. Jacob Israelachvili, Professor of Chemical Engineering and Materials
Period: February 1st to mid-march 2017.

Project Summary:

It has been known for some time that rock fluid interactions can impact the mechanical stability of chalk, however the observations have mostly been made on chalk cores. We believe that it is the short range forces between individual grains in the chalk cores that are affected by the fluid chemistry. In this project the objective is to quantify the short range forces between calcite grains (as the main component of chalk) by the use of Atomic Force Microscopy (AFM) and Surface Force Apparatus (SFA). This project is financed by the National IOR center of Norway, and the main experimental work has been performing at the University of Oslo, physics department since January 2015.

PhD student Aojie Hong, Univ. of Stavanger, Norway – visit at University of Texas Austin

Project Name: CRM as a proxy model for production optimization and VOI assessment
Institution: University of Stavanger, Department of Petroleum Engineering
PhD student: Aojie Hong
Project Supervisor: Professor Reidar B. Bratvold, University of Stavanger
Institution Visited: University of Texas Austin, Petroleum and Geosystems Engineering
Hosted By: Larry W. Lake, Sharon and Shahid Ullah
Period: January 2nd 2017 to June 30th 2017.

Project Summary:

Over the past decades, numerical techniques for model-based optimization of subsurface hydrocarbon production have developed rapidly. However, many of these techniques come at significant computational time, as they require a very large number of reservoir simulations, especially for the case where multiple geological scenarios of a grid-based reservoir simulation model are used for geological uncertainty consideration.

Several methods have been proposed to reduce the computational time. One of them is to use a proxy model to supplement a grid-based model under the optimization process. The Capacitance-Resistance Model (CRM) has been shown to be quite accurate for waterflooding systems. Thus, it is a potential candidate to serve as a proxy model. Besides, the CRM for Enhance Oil Recovery (EOR) processes is under development.

A more advanced application of the CRM is to assess the Value of Information (VOI) from history matching. Because VOI assessment involves a large number of production optimization processes, the requirement of computational time reduction is more essential for VOI assessment.

The objectives of visiting the University of Texas at Austin are to collaborate with Prof. Larry Lake who leads a group of experts in CRM, to share the ideas about assessing the VOI from history matching and to search for the applicability of using the CRM as a proxy model for production optimization and for VOI assessment. Through this collaboration, I can learn more about the CRM and the counterpart can learn more about the concept of VOI.

During 2016 the following student exchange applications were additionally granted:

First Name	Surname	Affiliation	Destination	From	To
Nitya	Mohan	University of Houston	University of Bergen	02.01.2017	15.01.2017
Sharma	Mohan	University of Stavanger	Rice University	22.09.2016	21.09.2018
Chengling	Gong				
Anna	Kvashchuk	University of Stavanger	Geilo Winter School	15.01.2017	20.01.2017
Daniel	Csanadi	Montain U. of Leoben	University of Bergen	06.02.2017	20.02.2017
Mario	Silva	University of Stavanger	Oklahoma City	27.03.2017	31.03.2017
Zachary	Alcorn	University of Bergen	Rice U., Houston	01.01.2017	21.09.2018

2016 Board Meetings

Two Board Meetings were held in 2016; June 23rd and September 22nd.

2016 Chairman Activities

NFiP and NorTex was promoted by visits and presentations at: Univ. of Texas A&M, Corpus Christi, TX, USA, AGH U. in Krakow, Poland, ConocoPhillips, Bartlesville, OK, USA, Imperial College and CSLF in London, UK, DGH in New Delhi, India and OED, NPD and NRC in Norway.

Chairman of the Executive Board of NFiP and NorTex Petroleum Cluster has participated/presented at various occasions and events:

Selected invited scientific talks by the Chairman; where NFiP and NorTex were presented:

- Graue, A.: “Upscaling CO2 EOR as CCUS from Lab to Field Pilots - Research Challenges for 3 Ongoing CO2 Foam EOR Field Pilots in Texas”, presentation at Tekna’s CO2 conference, Trondheim, Norway, Jan. 6-7th, 2016.
- Graue, A.: “Ft. Stockton CO2 Foam EOR Field Pilot“, Ft. Stockton Work Group Meeting, American Resources, Houston, TX, USA.
- Graue, A.: “Petroleum Research School of Norway and NorTex Petroleum Cluster”, Presentation at Texas A&M University – Corpus Christi, TX, USA.

- Graue, A.: “CO2 Foam EOR Field Pilots in Texas “, ConocoPhillips, Bartlesville, OK, USA, March 14th, 2016.
- Graue, A.: “Petroleum as Energy Security in the New Energy Mix”, SPE Section, Bartlesville, OK, USA, April 20th, 2016.
- Graue, A.: “CO2 Foam EOR Field Pilots for Efficient and More Sustainable Petroleum Production”, IOR NORWAY 2016: University of Stavanger, April 26-27th, 2016.
- Graue, A.: “CO2 Foam EOR Field Pilots in Texas”, USDOE-MPE Bilateral meeting, Bergen, Norway, May 9th, 2016.
- Graue, A.: “CO2 Foam EOR Field Pilots in Texas”, GetEnergy, London, May 16th, 2016.
- Graue, A.: “CO2 Foam EOR Field Pilots in Texas”, CSLF, CCS Academic Council Meeting, London, June 27th, 2016.
- Graue, A.: “CO2 Foam EOR Field Pilots in Texas “, Repsol, Madrid, May 31st, 2016.
- Graue, A.: “Research for More Sustainable Oil and Gas Production”, GenNext Delegation to Univ. of Bergen; Delegation from California, June 28th, 2016.
- Presentations for the Ministry of Petroleum and Energy in Norway, July 1st, 2016.
- Graue, A.: “Applications of CO2 as CCUS Enabler for Efficient, Cost Saving and More Sustainable Petroleum Production”, AGH, Krakow, Poland, July 18th, 2016.
- Graue, A.: “CO2 Foam EOR Field Pilots in Texas”, CSLF, CCS Academic Council Meeting, London, July 28th, 2016.
- Graue, A.: “Nasjonal forskerskole i petroleumsfag – Petroleum Research School of Norway”, Annual Meeting for National Research Schools, 25.–26. October 2016, NRC, Oslo.
- Graue, A.: “Nasjonal forskerskole i petroleumsfag – Petroleum Research School of Norway”, NFiP Annual Seminar, Norwegian Petroleum Museum, Stavanger, Nov. 1st, 2016.
- Graue, A.: “Petroleum as Energy Security in the New Energy Mix Applications of CO2 as CCUS Enabler for Efficient, Cost Saving and More Sustainable Petroleum Production”, DGH, New Delhi, India, Dec. 1st, 2016.
- Graue, A.: “CO2 Foam EOR for Mobility Control – Preparations for Two Field Pilots in Texas “, 2016 CO2/ROZ Conference, Midland, TX, USA, Dec. 6-8th, 2016.

NFiP Web-site

The NFiP web-site is found at: <http://nfipweb.org/>

During 2016 the web-site has been improved, but will be further updated in 2017.

The NFiP secretariat, at Dept. of Physics and Technology, UiB, with Assoc. Prof. Martin Fernø as coordinator, has been of great value for the 2016 activities.

February 14th, 2017.

Arne Graue

Chairman of the Executive Board