AGENDA – ROSE meeting 25th-28th April 2016

Location: P1 in PTS1, S.P. Andersens veg 15, Trondheim.

Monday 25th April

09:00 Coffee and registration
09:30 Welcome

Session 1: Rock physics

09:40 Surface Controls on Storage, Stiffness, and Transport Properties of Rocks, *Manika Prasad, Colorado School of Mines*
10:00 Laboratory and in situ stress path dependence of wave velocities in shale, *Rune M Holt, NTNU*
10:20 Laboratory measured stress dependence at seismic and ultrasonic frequencies, *Dawid Szewczyk, NTNU*
10:40 Seismic to ultrasonic dispersion in shale: The role of saturation; *Andreas Bauer, SINTEF/NTNU*
11:00 Stress path evolution during fluid injection into geological formations, *Sohrab Gheibi, NTNU*
11:20 Laboratory measurements on pure THF-hydrates and hydrate-bearing porous media, *Mandy Schindler, Colorado School of Mines*

Session 2: Modeling, Processing and Anisotropy

11:40 The Gassmann-Burgers model to simulate seismic waves at the Earth crust and mantle, *Jose Carcione, OGS*

12:10 **LUNCH**

13:00 High-resolution complex time-frequency analysis, *Bjørn Ursin, NTNU*
13:20 Multigeophysical inversion for thermal properties, *Ketil Hokstad, NTNU/Statoil*
13:40 PP- and PS-wave reflections by a thin VTI layer, *Qi Hao, NTNU*
14:00 Zero- and infinite-frequency limits of P-wave traveltime parameters in tilted orthorhombic media, *Yuriy Ivanov, NTNU*
14:20 Anisotropy parameters from diving waves, *Shibo Xu, NTNU*
14:40 Orthorhombic medium – a new standard for seismic anisotropy, *Alexey Stovas, NTNU*

15:00 **Coffee break**

15:30 Use of diffraction wavefront attributes for tomographic model building with active and passive seismic data, *Dirk Gajewski, University of Hamburg*

Session 3: Seismic acquisition and broadband seismic

16:00 A comparison of broadband source strategies, *Kjetil Eik Haavik, NTNU*
16:20 AVO inversion in exploration – Key learnings from a Norwegian Sea Prospect, *Per Avseth, Tullow/NTNU*
16:40 Pressure dependencies of elastic and transport properties of rocks, *Serge Shapiro, Free University of Berlin*

19:00 Dinner, Palmehaven, hotel Britannia, Dronningens gt. 5

Tuesday 26th April

Session 3: Seismic acquisition and broadband seismic (continued)

08:30 Dual- and triple-source in simultaneous mode - a solution for higher density seismic? *Jan Langhammer, TGS*
09:00 Seismic apparition, *Lasse Amundsen, NTNU/Statoil*
09:20 Simultaneous sources and wave separation, *Dirk-Jan van der Manen, ETH Zurich*
09:40 Characterizing ghost cavitation noise generated by marine air gun arrays, *Babak Khodabandeloo, NTNU*
10:00 Modeling time-varying diffraction caused by ghost-cavitation, *Kjetil Eik Haavik, NTNU*

10:10 **Coffee break**

10:30 Maximizing seismic low frequencies, *Daniel Wehner, NTNU*

Session 4 Time lapse and reservoir characterization

10:50 Time lapse seismic analysis of the Tohoku-Oki earthquake, *Martin Landrø, NTNU*
11:10 Dilation factor as function of geological time, *Kenneth Duffaut, NTNU*
11:30 First Results on Reservoir Monitoring in Jubarte PRM - Offshore Brazil, *Filipe Borges, NTNU/Petrobras*
11:50 Optimal towing depth to minimize normal mode noise, *Toan Dao, NTNU*

12:10 **LUNCH**

Session 5: Imaging and inversion

13:00 True Amplitude Reverse-time Migration, *Børge Arntsen, NTNU*
13:20 Combination of surface and borehole seismic data for robust target-oriented imaging, *Yi Liu, NTNU*
13:40 Combining wave equation migration velocity analysis and full waveform inversion for improved 3D elastic parameter estimation *Espen B. Raknes, NTNU*
14:00 Computation of Hessian for Full Waveform Inversion, *Vegard Stenhjem Hagen, NTNU*

14:20 **Coffee break**

14:50 Seismic data processing with the multidimensional Marchenko equation, *Joost van der Neut, TU Delft*
15:10 Acoustic Wavefields in the presence of boreholes, *Ivan Karpov, NTNU*
15:30 A Comparison of Different Parametrizations for Elastic Anisotropic (VTI) Full Waveform Inversion, *Tore Sivertsen Bergslid, NTNU*
15:50 Transmission Wave-Equation Envelope Tomography, *Jon Marius Venstad, NTNU*

27th -28th April: Course on rock physics and geomechanics of fluid-induced seismicity by *Serge Shapiro, Course ends at noon 28th April*

Rock physics and geomechanics of fluid-induced seismicity

Lecturer:Serge Shapiro: 27th-28th April 2016, aud. P1, S.P. Andersens veg 15A

Note that the course ends at lunch, Thursday 28th April

Title of the course:	**Rock physics and geomechanics of fluid-induced seismicity: hydraulic fracturing, stimulation of geothermal systems and hazard assessment**
Instructor:	**Dr. Serge A. Shapiro, Professor of Geophysics**
Duration:	8 lectures

Course Description:

Stimulations of rocks by fluid injections belong to a standard reservoir-development practice. Productions of shale oil, - shale gas, - heavy oil, - geothermal energy require broad applications of this technology. The fact that fluid injection causes seismicity has been well-established for several decades. Understanding and monitoring of fluid-induced seismicity is necessary for hydraulic characterization of reservoirs, for assessments of reservoir stimulations and for controlling the seismic risk. The course provides systematic quantitative rock-physical and geomechanical fundamentals of these aspects.

Course Objective(s):

1. To demonstrate the potential of microseismic monitoring for characterization of hydrocarbon and geothermal reservoirs.
2. To provide a systematic introduction into quantitative interpretation of microseismic monitoring and into assessment of the hazard of induced seismicity.

Approximate Course Outline:

Rock physics and geomechanics of induced seismicity (Lecture 1, 2):

- Poroelastic phenomena and seismic waves
- Stress, pore pressure and rock failure
- Geomechanics of earthquakes

The method of microseismic monitoring (Lecture 3):

- Observation systems, detection and location of events
- Microseismic wavefields and imaging

Seismicity, pressure diffusion and hydraulic fracturing (Lecture 4, 5 and 6)

- Modelling of fluid-induced seismicity
- Seismicity during a fluid injection
- Seismicity after a termination of a fluid injection
- Hydraulic properties of reservoirs and induced seismicity
- Hydraulic fracturing of hydrocarbon reservoirs
- Seismicity induced by hydraulc fracturing
- Non-linear diffusion and seismicity in unconventional reservoirs

Hazard of induced seismicity (Lecture 7, 8)

- Rates and magnitudes of fluid-induced earthquakes
- Seismogenic index
- Statistics of large magnitudes

About the lecturer :
Serge A. Shapiro is Professor of Geophysics at the Freie Universität Berlin, Germany, and since 2004, Director of the PHASE (PHysics and Application of Seismic Emission) university consortium project. From 2001 till 2008 he was one of Coordinator of the German Continental Deep Drilling Program. His research interests include seismogenic processes, wave phenomena, exploration seismology, and rock physics. He received the SEG Virgil Kauffman Gold Medal in 2013 for his work on fluid-induced seismicity and rock physics, and in 2004 was elected a Fellow of The Institute of Physics.
Who should attend?
Geophysicists, Geologists, Petrophysicits, Reservoir Engineers, Graduate and Postgraduate Students, Researchers, Interpreters.
The book for the course:
S.A. Shapiro, 2015, Fluid-Induced Seismicity, Cambridge (U.K.): Cambridge University Press, pp 289., ISBN: 9780521884570. http://www.cambridge.org/9780521884570

Time plan (day 1, Wednesday):

08:30	**Lecture**	**13:15**	**Lecture**
10:15	**Coffee**	**15:00**	**Coffee**
10:30	**Lecture**	**15:15**	**Lecture**
12:15	**Lunch**	**16:30**	**End**

Time plan (day 2, Thursday):

08:30	**Lecture**		
10:15	**Coffee**		
10:30	**Lecture**		
12:15	**Lunch**		