



# CREWES 30<sup>th</sup> Annual Meeting Welcome and Introduction

CREWES Annual Sponsor's Meeting Nov 29 2018 Banff AB CA





- Banquet tonight (Thu) 6:30pm
- Checkout tomorrow prior to session; store luggage
- This year: all content is online



СССЕМ/ЕС

NSERC CRSNG

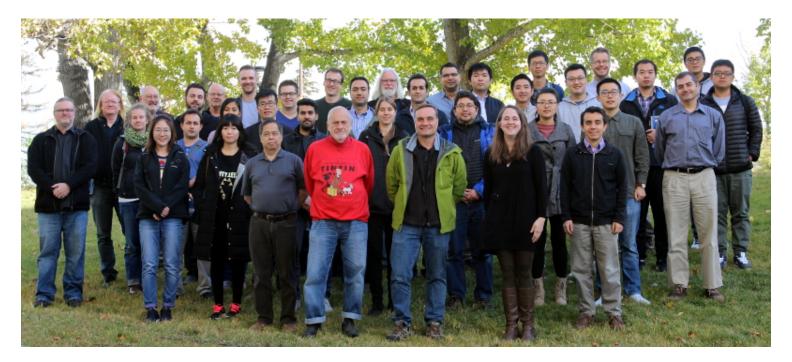
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rewes.org

Passwords	<b>Slide Shows</b>	for	2018
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Research Reports	Talk	Author(s)	Title	Availability
Research Reports	0 🥌	Kris Innanen	Welcome and Introduction	Document
Conf. Abstracts	6 📔	Don Lawton	A shear wave land streamer	Document
com. nostructs	92	Kevin Hall	CREWES 2018 simultaneous 3C/DAS WVSP field experiment	Document
Friday Talks	93	Kris Innanen	Design and deployment of a multicomponent DAS sensor	<b>Document</b>
Titung Tunic	6 📔	Nadine Igonin	Microseismic and SWD in the physical modelling lab	<b>Document</b>
CREWES Software	6 📔	Daniel Trad	Compressive sensing, de-blending and a new dataset	Document
	9 📔	Tyler Spackman	Monitoring with permanent source data	<b>Document</b>
CREWES News	97 🧯	Marie Macquet	Ambient noise monitoring at CaMI-FRS	Document
	9 🧯	Tim Cary	Monitoring methane gas migration in the near surface	Document
Overview Slides	9 🧯	Rachel Lauer	A proposal for and applications of a marine thermal probe	Document
	角 10	Heather Hardeman	Results from 2018 CaMI DAS VSP data acquisition	Document
Talks & Courses	角 11	Huaizhen Chen	Inversion for stress and fluids in randomly-oriented fractures	Document
	912 🖗	David Henley	Wrinkel reduction in 3D source ensembles	Document
Sponsors Meeting	6 🎾	Ron Weir	Integration of reflection and microseismic data	<b>Document</b>
		Adriana Gordon	Processing of walkaway DAS/geophone VSP data	Document
Sponsors Meeting	角 15	Andrew Iverson	Internal multiple prediction and generator spectra	Document
Talks	角 16	Sergio Romahn	Log-validated FWI with wavelet phase and amplitude updating	Document
Taiks	角 17	Scott Keating	Viscoelastic FWI: solving for Qp, Qs and Vp, Vs and density	Document
Sponsors Meeting	角 18	Matthew Eaid	Towards 4C FWI: DAS and 3C as complimentary datasets	<b>Document</b>
	61 🌔	Raul Cova	Practical multicomponent land FWI	Document
Posters	920 🥬	Scott Keating	Connectin FWI and LSRTM through variable restriction	Document
Sponsors Meeting		Jian Sun/Junxiao Li	i Deep learning and FWI	<b>Document</b>
Noncore Meeting	-			

5 Research Staff - 7 Postdoctoral Fellows - 3 Directors - 7 Collaborators & Investigators & 26 Graduate students



We do the basic and applied science behind the creation and extension of new seismic technology







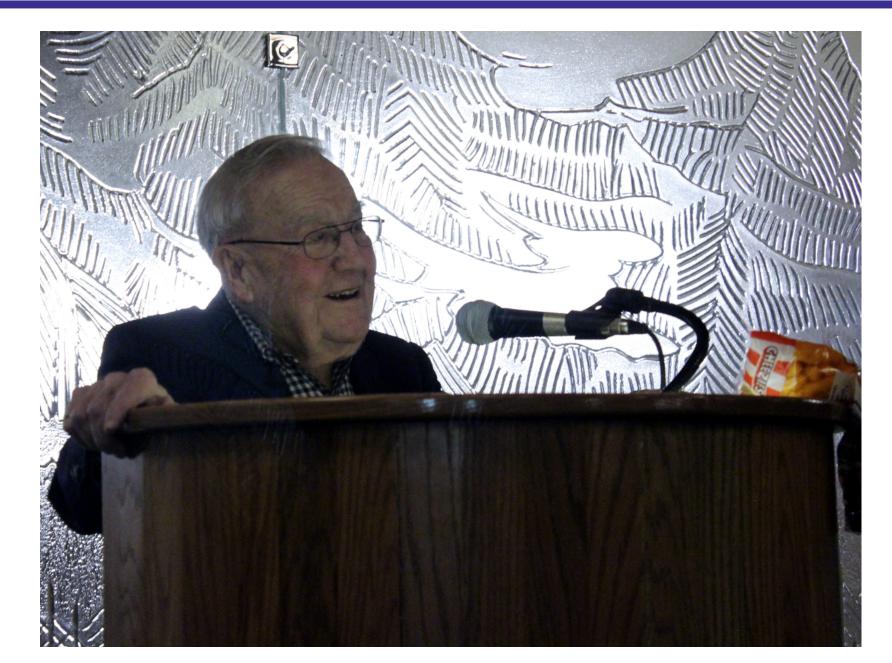




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### Martin Cordsen

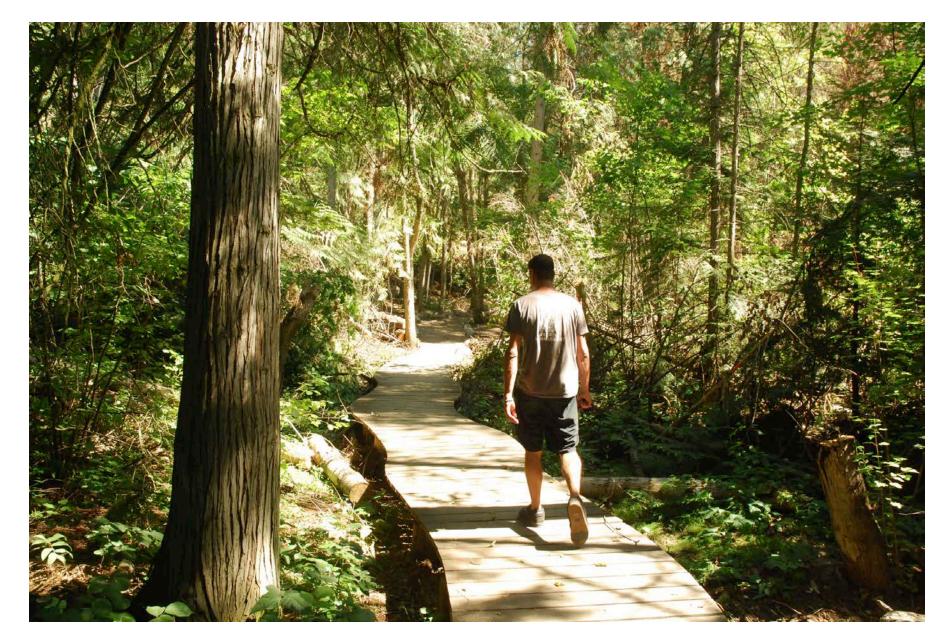


Photo courtesy of Andreas Cordsen

Central Okanagan Search and Rescue

www.cosar.ca





### 2018 Highlights

CREWES @ University of Calgary Geophysics Field Sc (see K. Bertram et al., CREWES 2018 Report)

Upgrades to the Physical Modeling Lab – new benchmark datasets (MS, SWD, time reversal: see Igonin et al., CREWES 2018 Report



Welcome back Joe!

### 2018 Highlights

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Upgrades to the Physical (MS, SWD, time reversal:

CREWES 2018 3C/DAS WVSP (see Hall et al., 2018 CREWES Report)



Prototype multicomponent DAS sensor (see Innanen et al., 2018 CREWES Report)

> 18 3C/DAS WVSP I., 2018 CREWES Report)

(MS, SWD, time reversal:

### 2018 Highlights





#### CAMBRIDGE

#### 20% Discount on this title

Expires 31 December 2019

### Numerical Methods of Exploration Seismology

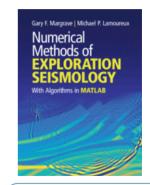
With Algorithms in MATLAB

Gary F. Margrave University of Calgary and Michael P. Lamoureux

University of Calgary

Exploration seismology uses seismic imaging to form detailed images of the Earth's interior, enabling the location of likely petroleum targets. Due to the size of seismic datasets, sophisticated numerical algorithms are required. This book provides a technical guide to the essential algorithms and computational aspects of data processing, covering the theory and methods of seismic imaging. The first part introduces an extensive online library of MATLAB seismic data processing codes maintained by the CREWES project at the University of Calgary. Later chapters then focus on digital signal theory and relevant aspects of wave propagation and seismic modelling, followed by deconvolution and seismic images, it provides readers with practical tools and codes to pursue research projects and analyses. It is ideal for advanced students and researchers in applied geophysics, and for practicing exploration geoscientists in the oil and gas industry.

Preface; 1. Introduction to MATLAB and seismic data; 2. Signal theory – continuous; 3. Signal theory – discrete; 4. Wave propagation and seismic modelling; 5. Deconvolution – the estimation of reflectivity; 6. Velocity measures and ray tracing; 7. Elementary migration methods; References; Index.



January 2019

246 x 189 mm 472pp 191 b/w illus.

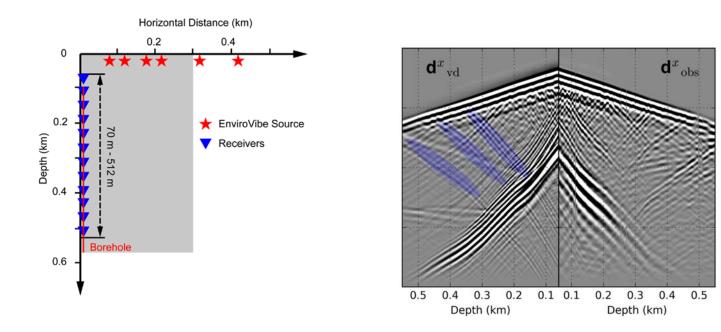
Hardback 978-1-107-17014-8 Original price Discount price £59.99 £47.99 \$79.99 \$63.99

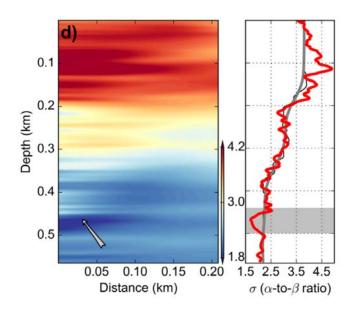
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**CAMBRIDGE** UNIVERSITY PRESS New Collaborative Research and Development Grant Proposal

"Full waveform sensing of reservoir structures, stresses, fluids, and fractures: integrating acquisition, imaging/inversion, and geocomputation" (2019-2024)

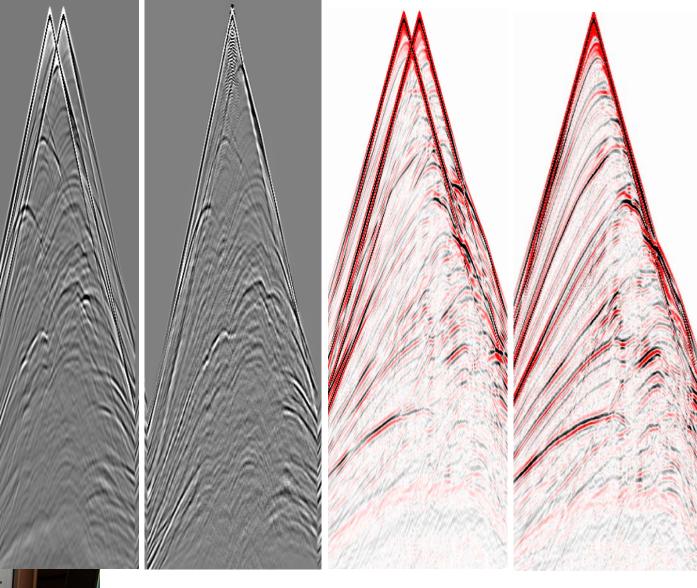






### Field experiment to support CS research – seeking input & partners!





#### **Thurs Nov 29**

Time	Session	Talk Title	Speaker
08:30	Acquisition	Welcome	K. Innanen
08:50		A shear wave land streamer	D. Lawton
09:10		CREWES 2018 3C+DAS WVSP experiment	K. Hall
09:30		Design and deployment of a prototype	
		6C DAS sensor	K. Innanen
09:50		MS + SWD lab experiments	N. Igonin
10:10		CS: processing and acquisition	D. Trad
10:30		COFFEE	
11:10	Monitoring	Seismic monitoring with permanent	
		sources	T. Spackmar
11:30		Ambient noise monitoring at CaMI	M. Macquet
11:50		Near surface methane monitoring	T. Cary
12:10		LUNCH	
01:30		Marine thermal probe applications	R. Lauer
01:50		New DAS data processing results	H. Hardemar
02:10		Inverting for stress and fluids in	
		randomly-oriented fractures	H. Chen
02:30	Processing	Wrinkle reduction in 3D source ensembles	D. Henley
02:50		COFFEE	
03:10		Integration of reflection & microseismic data	R. Weir
03:30		Processing of geophone vs DAS data	A. Gordon
03:50		Multiple prediction and generator spectra	A. Iverson

### Fri Nov 30

01:20The next generation in drillstring imaging LSRTM of a seismic-while-drilling datasetR. Shor N. Kazemi01:40LSRTM of a seismic-while-drilling datasetN. Kazemi02:00New ideas & O2:20COFFEEL. Lines02:20applicationsGeophysics and medicineL. Lines02:40Quantum computing in exploration and monitoring seismologyS. Moradi03:00New monitoring modes: time boundaries	Time	Session	Talk Title	Speaker
09:10FWI combining DAS and multicomponent data Practical steps for land FWI COFFEEM. Eaid R. Cova09:30Practical steps for land FWI COnnecting FWI and LSRTMR. Cova09:50COFFEES. Keating10:10Connecting FWI and LSRTMS. Keating10:30Machine LearningDeep learning and FWI Machine learning for facies classification and salt target identificationM. Guarido11:10Velocity model building with slope tomography Viscoacoustic RTM in TTI media LUNCHA. Fathalian11:50P- and S-wave elastic reverse time migration The next generation in drillstring imaging 01:40J. Monsegny R. Shor01:40New ideas & Quantum computing in exploration and monitoring seismologyS. Moradi03:00New monitoring modes: time boundariesS. Moradi	08:30	FWI on land	Land FWI with log validation	S. Romahn
09:10FWI combining DAS and multicomponent data Practical steps for land FWI COFFEEM. Eaid R. Cova09:50COFFEE10:10Connecting FWI and LSRTMS. Keating J. Sun10:30MachineDeep learning and FWI Machine learning for facies classification and salt target identificationJ. Sun10:50LearningMachine learning for facies classification and salt target identificationM. Guarido11:10Velocity model building with slope tomography Viscoacoustic RTM in TTI media LUNCHA. Fathalian11:50P- and S-wave elastic reverse time migration The next generation in drillstring imaging U1:40J. Monsegny R. Shor01:40New ideas & Quantum computing in exploration and monitoring seismologyL. Lines02:40New monitoring modes: time boundariesS. Moradi	08:50		Viscoelastic FWI: V <sub>P</sub> , V <sub>S</sub> , Q <sub>P</sub> , Q <sub>S</sub> , ρ	S. Keating
09:50COFFEE10:10Connecting FWI and LSRTMS. Keating10:30MachineDeep learning and FWIJ. Sun10:50LearningMachine learning for facies classification and salt target identificationM. Guarido11:10Velocity model building with slope tomographyB. Law11:30Viscoacoustic RTM in TTI media LUNCHA. Fathalian11:50P- and S-wave elastic reverse time migration The next generation in drillstring imaging US:200J. Monsegny R. Shor01:40New ideas & Quantum computing in exploration and monitoring seismologyL. Lines02:40New monitoring modes: time boundariesS. Moradi	09:10			M. Eaid
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03:20 Deep neural networks for prediction of	03:20		· · ·	
reservoir properties J. Downton			reservoir properties	J. Downton

#### Sat Dec 01

9:00am-3:00pm

Short Course: Ideas, algorithms and applications of Machine Learning in geophysics

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Thurs	s Nov 29			Fri No	ov 30		
Time	Session	Talk Title	Speaker	Time	Session	Talk Title	Speaker
08:30 08:50 09:10 09:30 09:50 10:10 10:30 11:10 11:30 11:50 12:10 01:30 01:50 02:10 02:30 02:50 03:10 03:30 03:50	Acquisition Monitoring Processing	<ul> <li>Welcome</li> <li>A shear wave land streamer</li> <li>CREWES 2018 3C+DAS WVSP experiments</li> <li>Design and deployment of a prototype</li> <li>6 DAS sensor</li> <li>MS + SWD lab experiments</li> <li>CorFEE</li> <li>CorFEE</li> <li>Asismic monitoring with permanent sources</li> <li>Matient noise monitoring at CaMB hear surface methane monitoring</li> <li>LUNCH</li> <li>Matine thermal probe applications for State processing results in andomly-oriented fractures</li> <li>Minkle reduction in 3D source ensembles COFFEE</li> <li>Integration of reflection &amp; microseismic data processing of geophone vs DAS data processing descrites</li> </ul>	K. Innanen D. Lawton K. Hall K. Innanen N. Igonin D. Trad T. Spackman M. Macquet T. Cary R. Lauer H. Hardeman H. Chen D. Henley R. Weir A. Gordon A. Iverson	08:30 09:10 09:30 09:50 10:10 10:30 10:50 11:10 11:30 11:50 01:00 01:20 01:40 02:00 02:20 02:40 03:00 03:20	FWI on land Machine Learning New ideas & applications		S. Romahn S. Keating M. Eaid R. Cova S. Keating J. Sun M. Guarido B. Law A. Fathalian J. Monsegny R. Shor N. Kazemi L. Lines S. Moradi K. Innanen J. Downton
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08:50       A shear wave land streamer       D. Lawton       08:50       Viscoelastic FWI: V <sub>p</sub> , V <sub>S</sub> , Q <sub>p</sub> , Q <sub>S</sub> , ρ       S. Keating         09:10       CREWES 2018 3C+DAS WVSP experiment       D. Lawton       09:50       FWI combining DAS and multicomponent data       M. Eaid         09:50       MS + SWD lab experiments       N. Igonin       10:10       Correcting FWI end LSRTM       R. Cova         09:50       MS + SWD lab experiments       N. Igonin       10:10       Correcting FWI end LSRTM       S. Keating         10:30       COFFEE       N. Igonin       10:50       Learning       Machine learning for facies classification and salt target identification       M. Guarido         11:30       Ambient noise monitoring with permanent sources       T. Spackman       11:10       Viscoacoustic RTM in TI media       Laww         11:30       Ambient noise monitoring at OAMI       M. Macquet       11:30       Viscoacoustic RTM in TI media       Lawton         11:30       Marine thermal probe applications       R. Lauer       01:20       P- and S-wave elastic reverse time migration       J. Monsegny         11:30       Marine thermal probe applications       R. Lauer       01:20       The next generation in drillstring imaging       R. Shor         12:10       LUNCH       D. Henley       02:20       New idéas & and	08:50A shear wave land streamer CREWES 2018 3C+DAS WVSP experiment Design and deployment of a prototype 6C DAS sensorD. Lawton K. Hall08:50Viscoelastic FWI: V <sub>p</sub> , V <sub>S</sub> , Q <sub>p</sub> , Q <sub>S</sub> , ρS. Keating M. Eaid PWI combining DAS and multicomponent data Pactical steps for land FWI Design and deployment of a prototype 6C DAS sensorS. Keating M. Eaid PWI combining DAS and multicomponent data Pactical steps for land FWI Design and deployment of a prototype 6C DAS sensorS. Keating M. Eaid PWI combining DAS and multicomponent data Pactical steps for land FWI Design and deployment of a prototype 6C DAS sensorS. Keating M. Eaid PWI combining DAS and multicomponent data Pactical steps for land FWI Design and deployment of a prototype COFFEES. Keating M. Eaid M. Eaid09:50MS + SWD lab experiments COFFEEN. Igonin 10:30D. Trad 10:30Doep learning for facies classification and salt target identification Machine learning for facies classification and salt target identificationS. Keating M. Guarido11:10Monitoring SourcesSeismic monitoring at OAMI LUNCHM. Macquet T. Cary11:30Viscoacoustic RTM in TII media LUNCHA. Fathalian A. Fathalian11:30Marine thermal probe applications randomly-oriented fractures COFFEER. Lauer O1:20O1:20Processing results COFFEEJ. Monsegny The next generation in drillstring imaging and molitoring exploration and eastic reverse time migration The next generation in drillstring in exploration and eastic reverse time boundaries and molitoring exploration and molitoring exploration and a seismic-while-drilling dataset New indeast t	Time	Session	Talk Title	Speaker	Time	Session	Talk Title	Speaker
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		11:30 11:50 12:10 01:30 01:50 02:10 02:30 02:50 03:10 03:30	<	sources Ambient noise monitoring at CaMI Near surface methane monitoring <i>LUNCH</i> Marine thermal probe applications New DAS data processing results Inverting for stress and fluids in randomly-oriented fractures Wrinkle reduction in 3D source ensembles <i>COFFEE</i> Integration of reflection & microseismic data Processing of geophone vs DAS data	M. Macquet T. Cary R. Lauer H. Hardeman H. Chen D. Henley R. Weir A. Gordon	11:30 11:50 01:00 01:20 01:40 02:00 02:20 02:40 03:00		Viscoacoustic RTM in TTI media <i>LUNCH</i> P- and S-wave elastic reverse time migration The next generation in drillstring imaging LSRTM of a seismic-while-drilling dataset <i>COFFEE</i> Geophysics and medicine Quantum computing in exploration and monitoring seismology New monitoring modes: time boundaries and elastic bracing Deep neural networks for prediction of	<ul> <li>A. Fathalian</li> <li>J. Monsegny</li> <li>R. Shor</li> <li>N. Kazemi</li> <li>L. Lines</li> <li>S. Moradi</li> <li>K. Innanen</li> </ul>

### Sat Dec 01

Fri Nov 30

9:00am-3:00pm

#### **Thurs Nov 29**

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08:30	Acquisition	Welcome	K. Innanen
08:50		A shear wave land streamer	D. Lawton
09:10		CREWES 2018 3C+DAS WVSP experiment	K. Hall
09:30		Design and deployment of a prototype	
		6C DAS sensor	K. Innanen
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10:10		CS: processing and acquisition	D. Trad
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11:50		Near surface methane monitoring	T. Cary
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03:30		Processing of geophone vs DAS data	A. Gordon
03:50		Multiple prediction and generator spectra	A. Iverson

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10:10		Connecting FWI and LSRTM	S. Keating
10:30	Machine	Deep learning and FWI	J. Sun
10:50	Learning	Machine learning for facies classification	
		and salt target identification	M. Guarido
11:10		Velocity model building with slope tomography	B. Law
11:30		Viscoacoustic RTM in TTI media	A. Fathalian
11:50		LUNCH	
01:00		P- and S-wave elastic reverse time migration	J. Monsegny
01:20		The next generation in drillstring imaging	R. Shor
01:40		LSRTM of a seismic-while-drilling dataset	N. Kazemi
02:00	New ideas &	COFFEE	
02:20	applications	Geophysics and medicine	L. Lines
02:40		Quantum computing in exploration	
		and monitoring seismology	S. Moradi
03:00		New monitoring modes: time boundaries	
		and elastic bracing	K. Innanen
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9:00am-3:00pm

Short Course: Ideas, algorithms and applications of Machine Learning in geophysics

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## Your support is critical!

Training (new academic and industry) New seismic data-sets acquired for purpose Creating and validating the next generation of technology Increasing the value and the profile of geophysics

