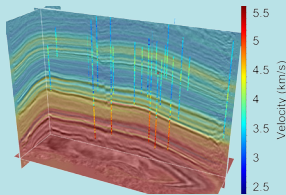
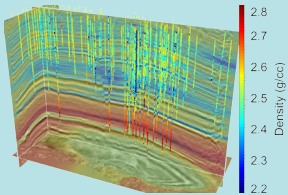


## C-Team (Leader: Dave Hale)

Dave Hale works with a group known informally within CWP as the C-Team. One goal shared among C-Team colleagues is good computing. We make good use of increasingly multicore computing systems.



When necessary, we exploit data structures beyond arrays and algorithms beyond array processing to solve a wide variety of problems related to seismic imaging and image processing. We implement our ideas in software that others find useful.



Recent applications include new, improved methods for:

- simultaneous multiple well-seismic ties
- simultaneous correlation of many well logs
- PP-PS wavelet processing with dynamic warping
- PP-PS image registration with dynamic warping
- handling velocity errors in least-squares migration
- computing horizon volumes with interpreted constraints
- extracting geologic unconformities from seismic images
- detecting geologic faults and estimating fault slips

## iTeam (Leader: Paul Sava)

The iTeam, or the Seismic Imaging Team, focuses on developing full wave-field methodology for imaging the interior of the Earth.

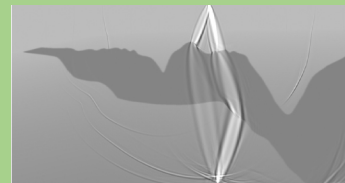
iTeam projects include:

- isotropic and anisotropic wave-equation migration
- wavefield tomography
- multi-component elastic modelling and migration
- wide-azimuth angle-domain imaging
- micro-earthquake monitoring

The iTeam pursues its goals by blending theoretical analysis, software development and data applications. The team emphasizes simple and efficient methods that take advantage of CWP's growing High

Performance Computing capabilities and those methods that can be adopted quickly by Consortium sponsor companies.

The iTeam promotes open-source software and reproducible research and is among the top contributors to the **Madagascar** open-source software package.



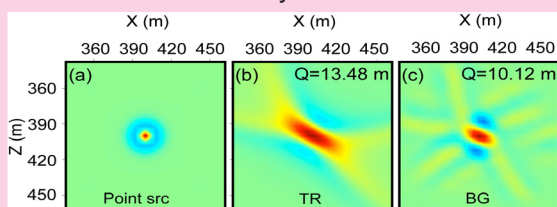
# CWP

## STeam (Leader: Roel Snieder)

"Steam" works on seismic interferometry, focusing and autofocusing, and controlled source electromagnetics (CSEM).

Recent work on autofocusing has led to the development of data-driven methods to image with internal multiples. As with seismic interferometry, this work consists of a combination of theory, numerical simulation, and application to data.

For focusing microseismic events, we developed a new Backus-Gilbert imaging method (right) that provides superior resolution in imaging microseismic events compared to traditional time-reversed imaging (center). The left panel shows the forward modeled wave field that is radiated by the microseismic event.



The Steam also investigates Controlled Source Electromagnetics (CSEM) by applying the concept of synthetic aperture sources to diffuse fields.

## A-Team (Leader: Ilya Tsvankin)

The A(nisotropy)-Team works on inversion and imaging of seismic reflection data from anisotropic media and on fracture characterization. The A-Team collaborates with the Reservoir Characterization Project at CSM on time-lapse monitoring of tight fractured reservoirs.

The current A-Team projects include:

- ray-based tomography of multicomponent reflection and VSP data for tilted transversely isotropic (TTI) media
- elastic full-waveform inversion (FWI) of transmitted and reflected waves for 2D TI models
- estimation of microseismic source parameters by anisotropic FWI of borehole data
- extension of diffraction-based imaging/parameter estimation to TI media
- anisotropic attenuation tomography of reflection data

Many A-Team research results over the past decade are summarized in the 2011 SEG book by I. Tsvankin and V. Grechka, *Seismology of Azimuthally Anisotropic Media and Seismic Fracture Characterization*.

# CWP

## Center for Wave Phenomena

Colorado School of Mines

924 16<sup>th</sup> Street

Golden, Colorado 80401

+1.303.384.2178

cwpinfo@mines.edu



- Academically current research relevant to our sponsors
- Excellence in all aspects of research
- Talented students and visitors from around the world
- Diversity in research directions and cultural backgrounds
- Growth, creativity and independence
- Nurturing, caring atmosphere

### Benefits of CWP sponsorship

Diverse and relevant research problems

First access to results and software

One-on-one consultations with faculty

Short courses for company employees

Hospitality for short- and long-term visitors

Interaction with talented students

Source of new employees

**Contact us for more information on Consortium sponsorship**

### Consortium Sponsors\*

Aramco Services Co.

BG Group

BGP Inc.

BHP Billiton Petroleum (Americas) Inc.

BP America Production Co.

CGG

Chevron Energy Technology Co.

China Petrochemical Technology Co.

Cimarex Energy

ConocoPhillips

Devon Energy Corp.

Drillinginfo, Inc.

Eni S.p.A.

ExxonMobil Upstream Research Co.

Halliburton/Landmark

Hess Corp.

Ikon Science Ltd.

Instituto Mexicano del Petróleo

ION Geophysical Corp.

Japan Oil, Gas and Metals National Corp.

Marathon Oil Co.

Nexen Petroleum USA Inc.

Paradigm Geophysical Corp.

Petrobras America Inc.

Petroleum Geo-Services

Repsol Services Co.

Shell International Exploration and Production

Statoil

TGS-NOPEC Geophysical Co.

Total E&P Recherche Développement

Tullow Oil Ltd.

WesternGeco/Schlumberger

\*Sponsors current at publication



[cwp.mines.edu](http://cwp.mines.edu)

