



Earth Sciences

OpendTect: driving the open source model into the world of oil and gas

**Renee Bourque
& Yuancheng Liu**

June 2011

www.dgbes.com

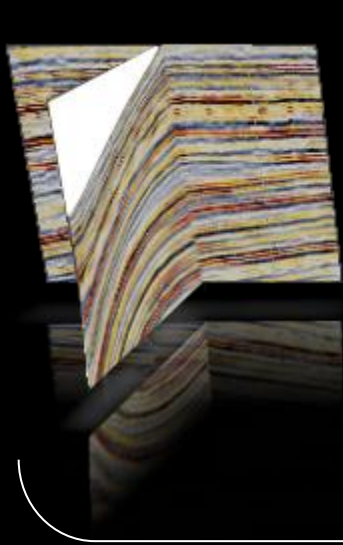


- What is OpendTect?
- Open Source Model Commercially viable?
- Academia
- *How to contribute*

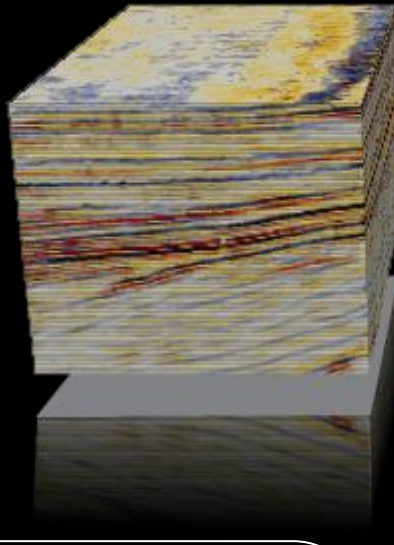


What is OpendTect?

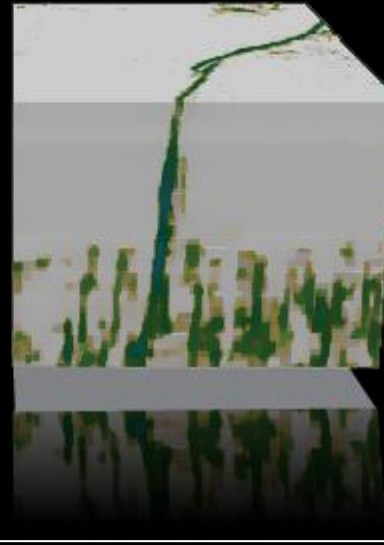
Processing



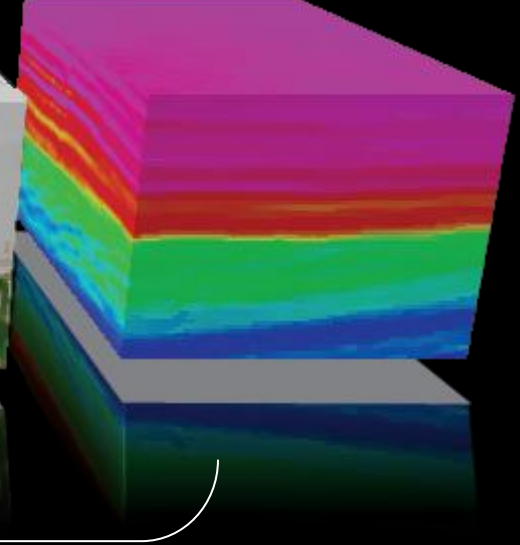
Interpretation



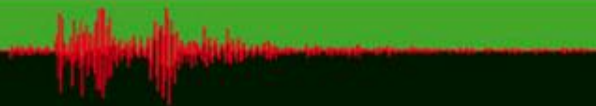
Attributes

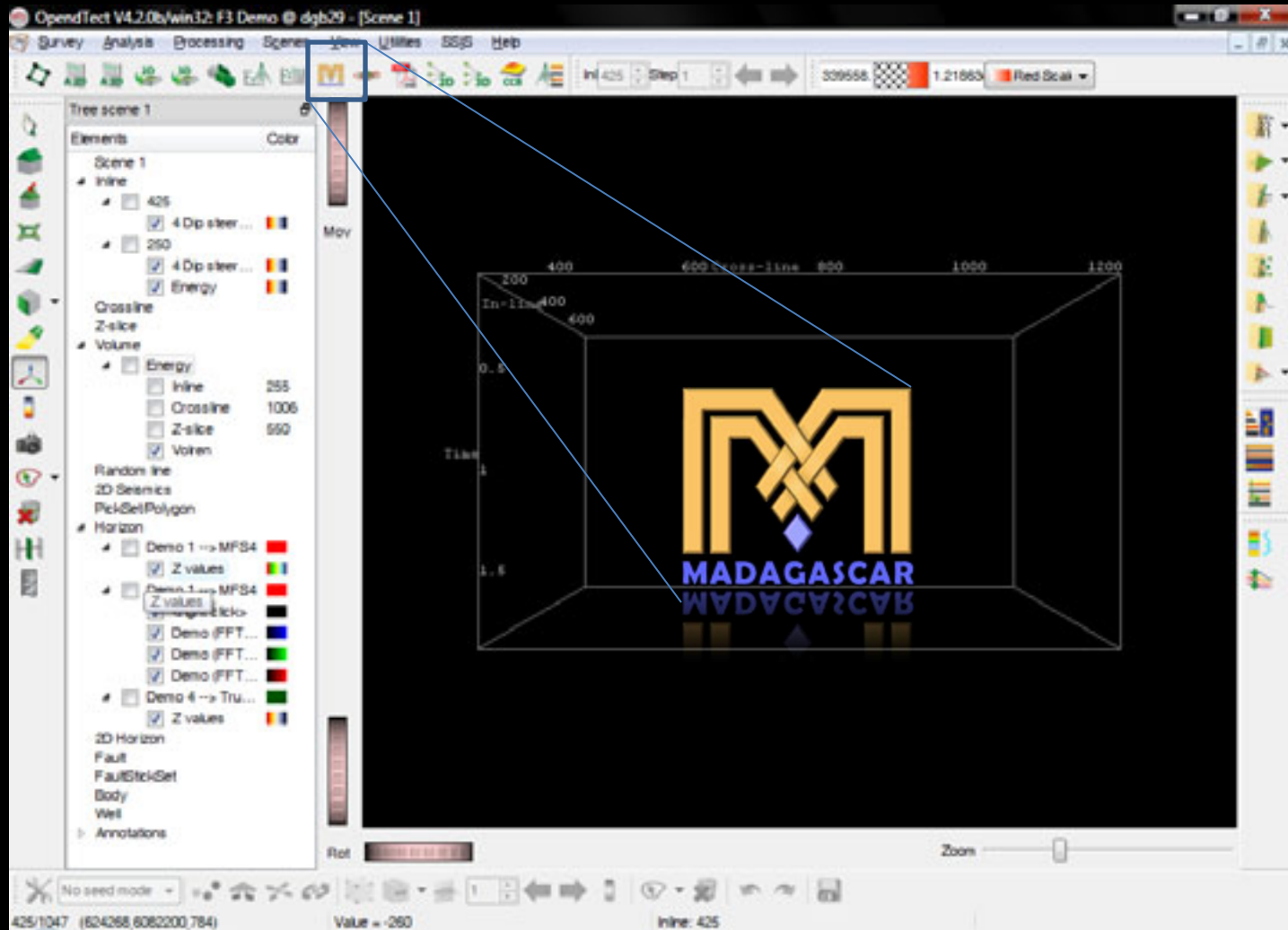


Rock Properties



+







Madagascar processing [New Flow]

INPUT Select ...

GROUP Search results

Programs

- vtUserCurl
- vtback
- vtbalance
- vtckl
- vtcl
- vtgc
- vtgmg
- vtidref
- vtimg01
- vtimg02
- vtimg
- vtimg2

Flowchart area (empty)

Synopsis

Command line

Add Plot Command

Plot Command Create ...

Output Select ...

Send to Single machine Multiple machines

Store processing specification as Select ...

Show options





The screenshot shows the 'Madagascar processing' window in the dGB Earth Sciences software. The interface includes a 'FLOW' workspace on the left, a 'Program' list in the center, and a 'Parameters' section on the right. The 'Program' list contains several items, with 'eSpectrum' selected. The 'Parameters' section lists various settings such as 'fLow', 'fHigh', 'cut', 'cutOff', 'low', 'high', and 'velocity', each with a corresponding value and a brief description. The 'Command line' field contains the command 'eSpectrum'. The 'File Command' field is empty. The 'Save processing type location as' field contains the path 'users/casem/CCOData/DEMOS_F3/Proc_Mad_Proc.par'. The 'Show options' checkbox is checked, and the 'Done' button is visible in the bottom right corner.

Madagascar processing (New Flow)

GROUP Search results

Program

- eSpectrum
- eSub
- eSubcor
- eSubcut
- eSubcut2
- eSubcut3
- eSubcut4
- eSpectrum**
- eSub
- eSub1
- eSubcut
- eSubcut2
- eSubcut3
- eSub

Parameters:

fLow	1 Hz	1	High frequency in band, default is Nyquist
fHigh	1 Hz	1	Low frequency in band, default is 0
cut	high	0	number of poles for high cutoff
cut	high	0	number of poles for low cutoff
low	phase	no	0: minimum phase, no zero phase
high	phase	no	velocity flag

Synopsis: eSpectrum - is not - cut off the the phase versus output signal

Command line: eSpectrum

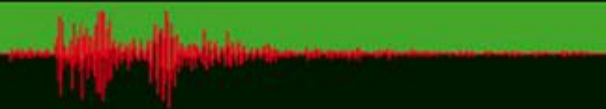
Add File Comment

File Command: [Empty]

Save processing type location as: users/casem/CCOData/DEMOS_F3/Proc_Mad_Proc.par

Show options

Done





Group: Search results

Program:

- staspread
- stattr
- stautocorr
- staweld2d
- staweld2dds
- staweld2dks2nd
- stbandpass**
- stbin
- stbin1
- stbooklist
- stbookmp
- stbox

Bandpass filtering.

Parameters:

float	fhi *		High frequency in band, default is Nyquist
float	flo =		Low frequency in band, default is 0
int	nphi =6		number of poles for high cutoff
int	nplo =6		number of poles for low cutoff
bool	phase =n	[y/n]	y: minimum phase, n: zero phase
bool	verb =n	[y/n]	verbosity flag

Synopsis: stbandpass < in rsf > out rsf flo fhi phase=n verb=n nplo=6 nphi=6

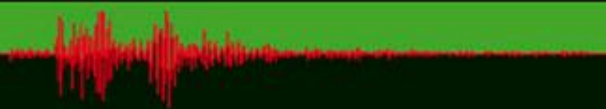
Command line: stbandpass

Add Plot Command

Plot Command:

Create ...

Add to flow Replace in flow





The screenshot shows the Madagascar processing software interface. The main window is titled "Madagascar processing [New Flow]". It features a central workflow editor with a "FLOW" pane on the left and a "PROGRAM" list on the right. The "PROGRAM" list includes items such as "chirpstack", "chirp", "chirp1", "chirpstack", "chirp", "chirp1", "chirpstack", "chirp", "chirp1", "chirpstack", "chirp", "chirp1", "chirpstack", "chirp", "chirp1", "chirpstack", "chirp", "chirp1", "chirpstack". Below the program list, there are fields for "Syntax", "Command line", and "File Command". The "Command line" field contains the text "chirpstack -s 100 -c 100 -f 100 -p 100 -q 100 -r 100 -t 100 -u 100 -v 100 -w 100 -x 100 -y 100 -z 100". The "File Command" field is empty. At the bottom of the interface, there are buttons for "Add to flow" and "Replace in flow".

Group: chirpstack

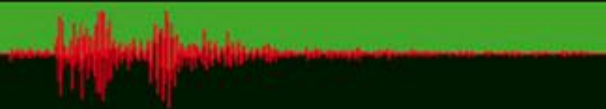
Program: chirpstack, chirp, chirp1, chirpstack, chirp, chirp1, chirpstack, chirp, chirp1, chirpstack, chirp, chirp1, chirpstack, chirp, chirp1, chirpstack, chirp, chirp1, chirpstack

Syntax: chirpstack -s 100 -c 100 -f 100 -p 100 -q 100 -r 100 -t 100 -u 100 -v 100 -w 100 -x 100 -y 100 -z 100

Command line: chirpstack -s 100 -c 100

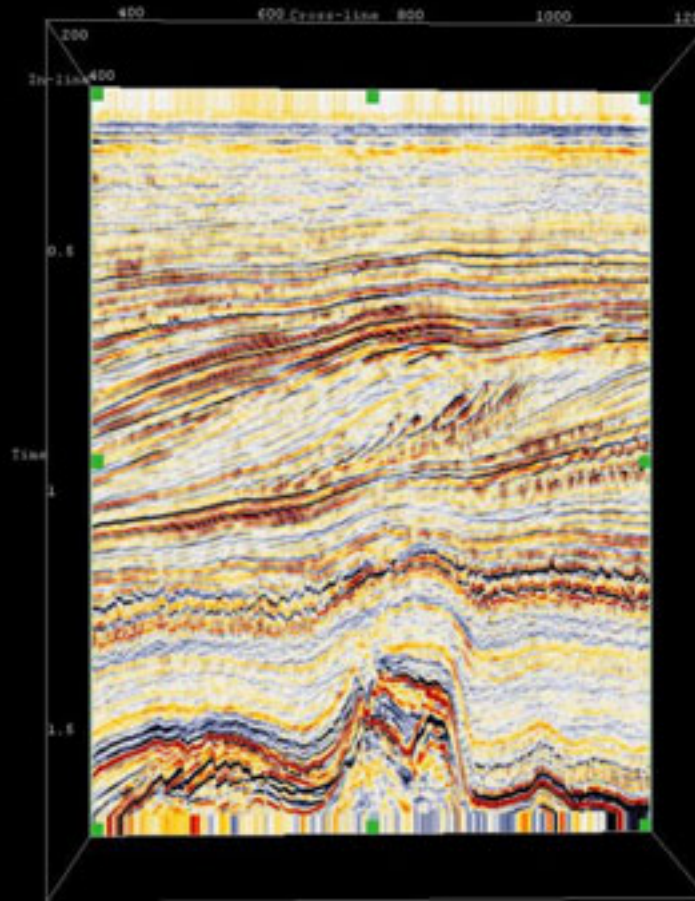
File Command: [Empty]

Buttons: Add to flow, Replace in flow

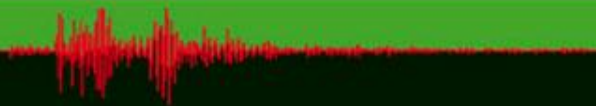
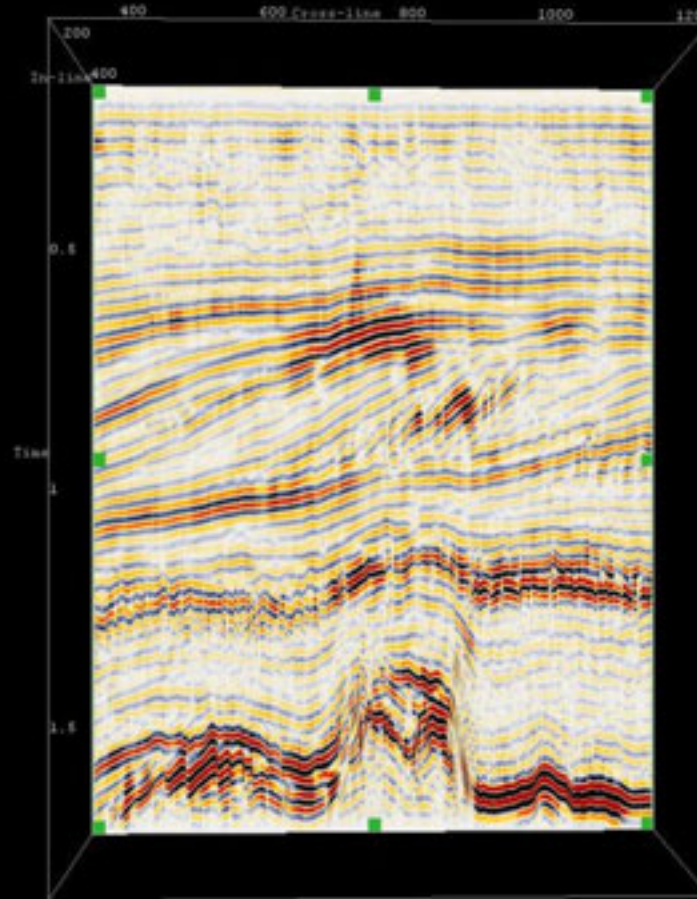




Original Seismic



Band Pass Filter





Madagascar processing [New Flow]

RPCT: 4 Dp clipped raster Map [Select...]

GROUP: esargpings

Program: afloat, clip, afloat, afloat, afloat, afloat, afloat

One or two-sided clipping

afloat is a generalization of afloat.

Clip values above or below afloat: afloat + in.ref + out.ref upper/lower

Clip values outside [in, out]: afloat + in.ref + out.ref upper/lower

afloat + in.ref + out.ref upper/lower

is equalized to

afloat + in.ref + out.ref clip

Synopsis: afloat + in.ref + out.ref upper/lower FLT_MAX lower FLT_MIN

Command line: afloat upper=2000 lower=0

Add Post Comment

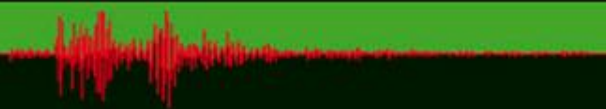
Post Comment: [] [Close...]

OUTPUT: Test2 [Select...]

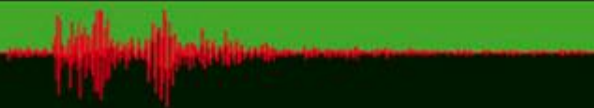
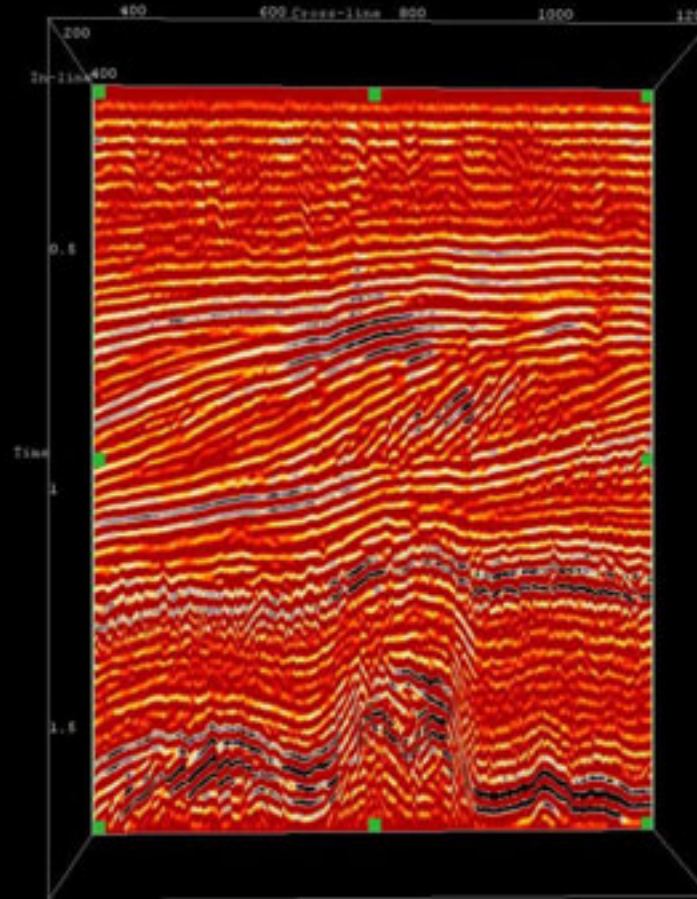
Send to: Single machine Multiple machines

Save processing type location as: users\csm\CGOData\Demo_F3\Proc_Mad_Proc.par [Save...]

Show options



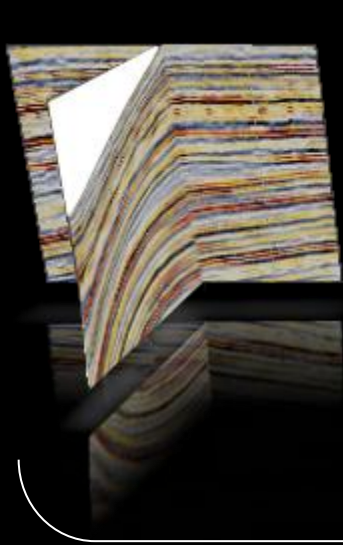
**Band Pass
Filter
+
Clipping**



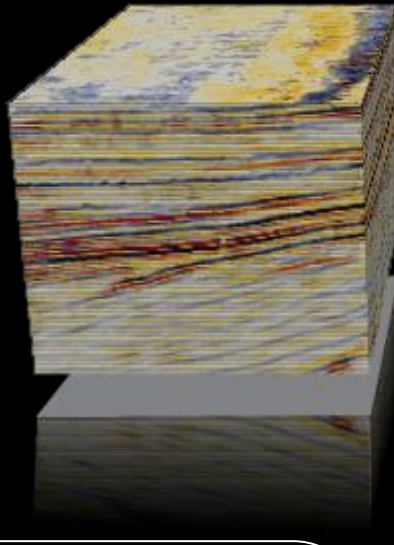


What is OpendTect?

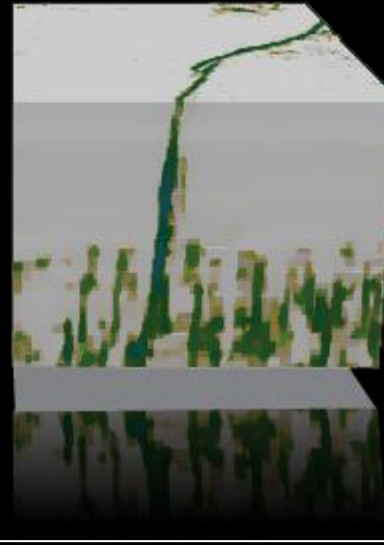
Processing



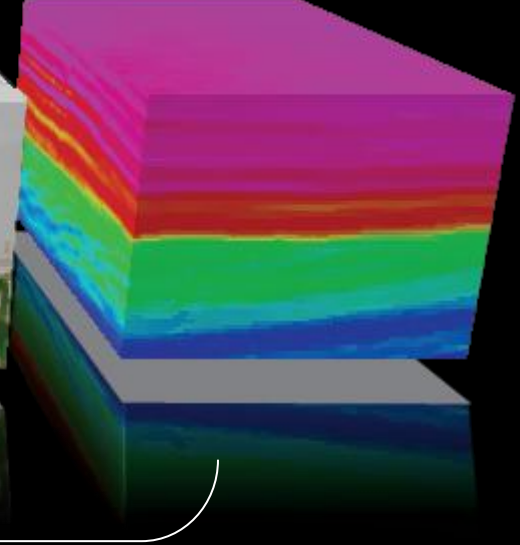
Interpretation



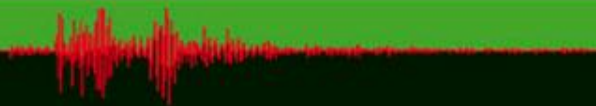
Attributes



Rock Properties

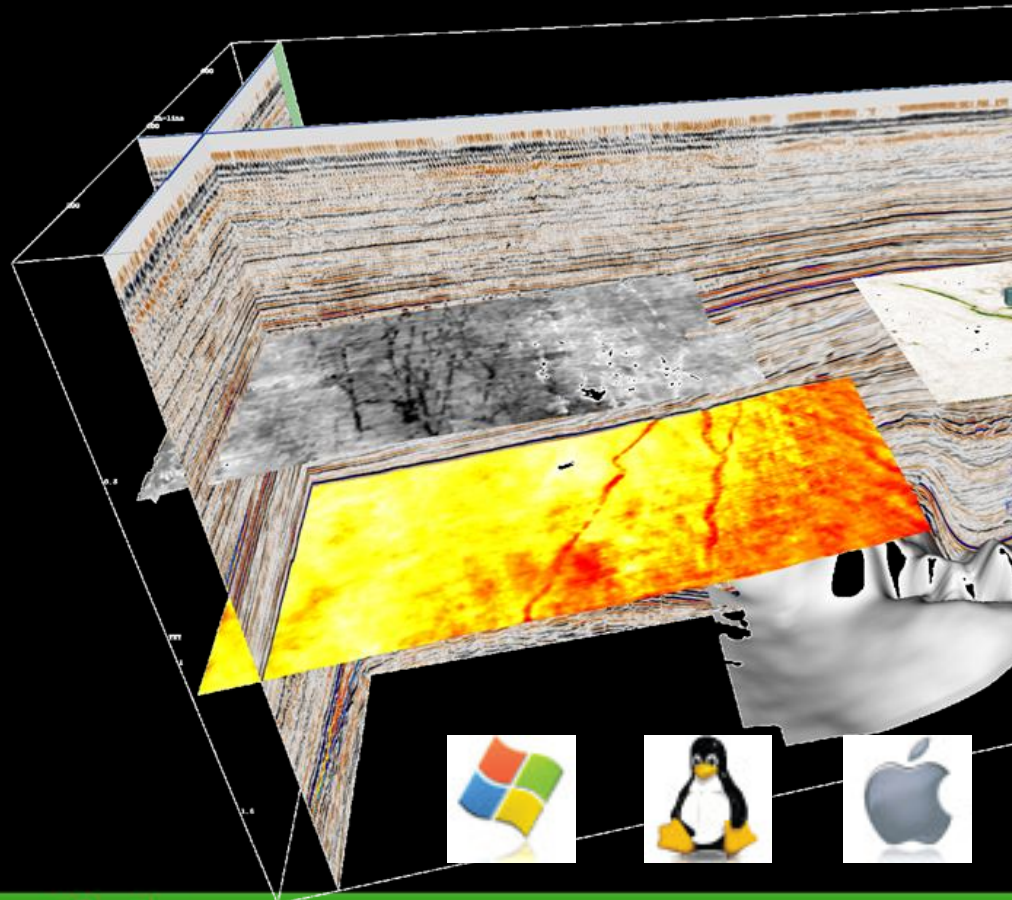


+





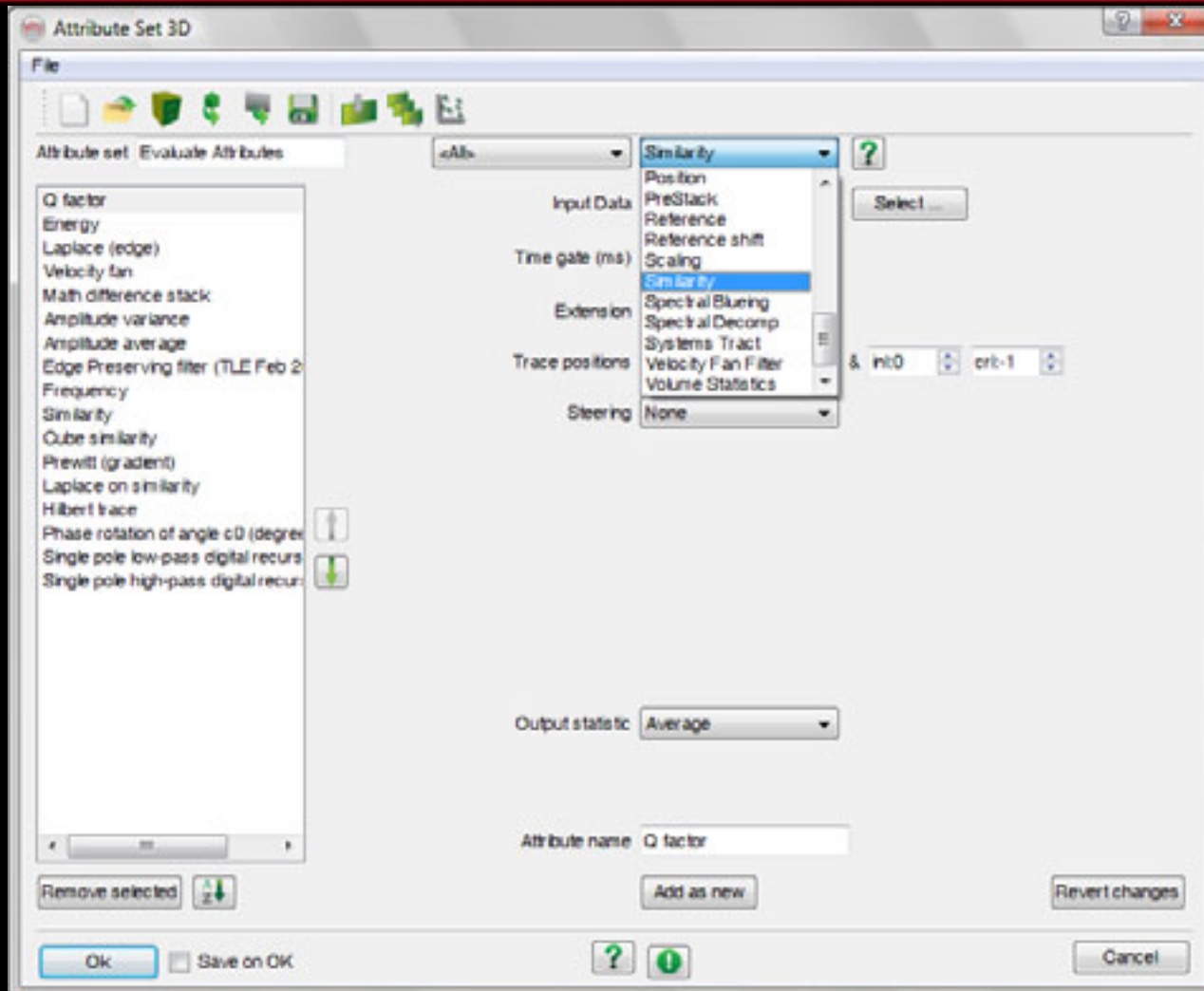
Completely Free Open Source Seismic Interpretation System



Key Features

- ✓ 2D, 3D & Prestack seismic
- ✓ 2D & 3D viewers
- ✓ Stereo viewing & Volume rendering
- ✓ Seismic Attributes & crossplots
- ✓ Spectral decomposition
- ✓ Movie-style parameter testing
- ✓ Distributed computing
- ✓ Horizon trackers
- ✓ Faults
- ✓ Well-tie
- ✓ Depth Conversion
- ✓ Geobodies
- ✓ Madagascar processing
- ✓ GMT Mapping
- ✓ ... a lot more







Attribute Set 3D

File

Attribute set: Evaluate Attributes «All» Mathematics ?

Formula (e.g. $\text{near} \times k + c0 * \text{far} \times k$): seismic-Laplace Set

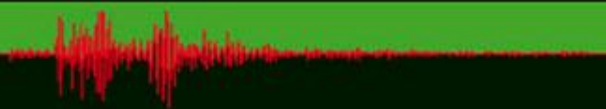
Select input for	
seismic	4 Dip steered median filter Select ...
Laplace	Laplace on similarity Select ...

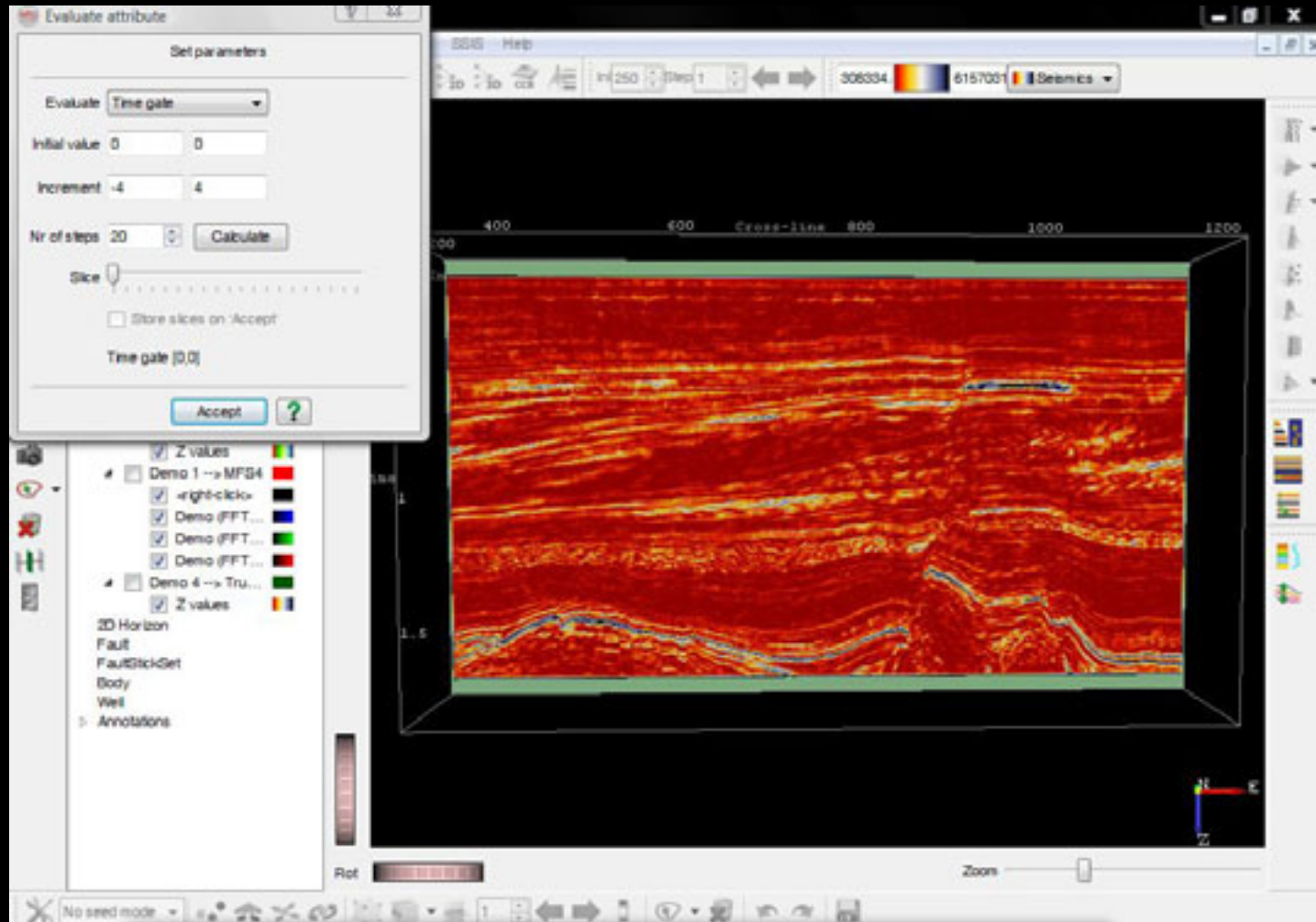
Math difference stack

Attribute name: Math difference stack

Remove selected Add as new Revert changes

OK Save on OK ? i Cancel







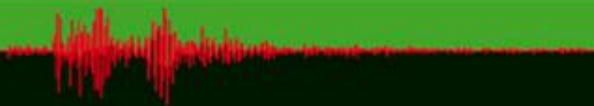
The screenshot displays a software interface for evaluating seismic attributes. On the left, a dialog box titled "Evaluate attribute" is open, showing the following settings:

- Set parameters**
- Evaluate:** Time gate
- Initial value:** 0
- Increment:** -4
- Nr of steps:** 20
- Calculate** button
- Slice:** A slider set to 10, with a "Store slices on 'Accept'" checkbox.
- Time gate:** [-12,12]
- Accept** and **?** buttons

The main window shows a seismic data visualization with a color scale from 306334 to 6157001. The visualization is a cross-section of seismic data, showing a complex geological structure with a prominent fault line. The x-axis is labeled "Cross-line" and ranges from 0 to 1200. The y-axis is labeled "Time" and ranges from 0 to 1.5. A legend on the left side of the main window lists various attributes and their corresponding colors:

- Z values
- Demo 1 -> MFS4
- <right-click>
- Demo (FFT...)
- Demo (FFT...)
- Demo (FFT...)
- Demo 4 -> Tru...
- Z values
- 3D Horizon
- Fault
- FaultStickGet
- Body
- Well
- Annotations

The bottom of the interface includes a "Rot" slider and a "Zoom" slider.



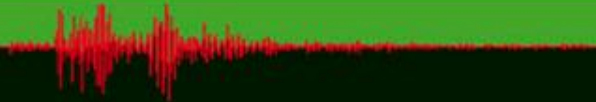


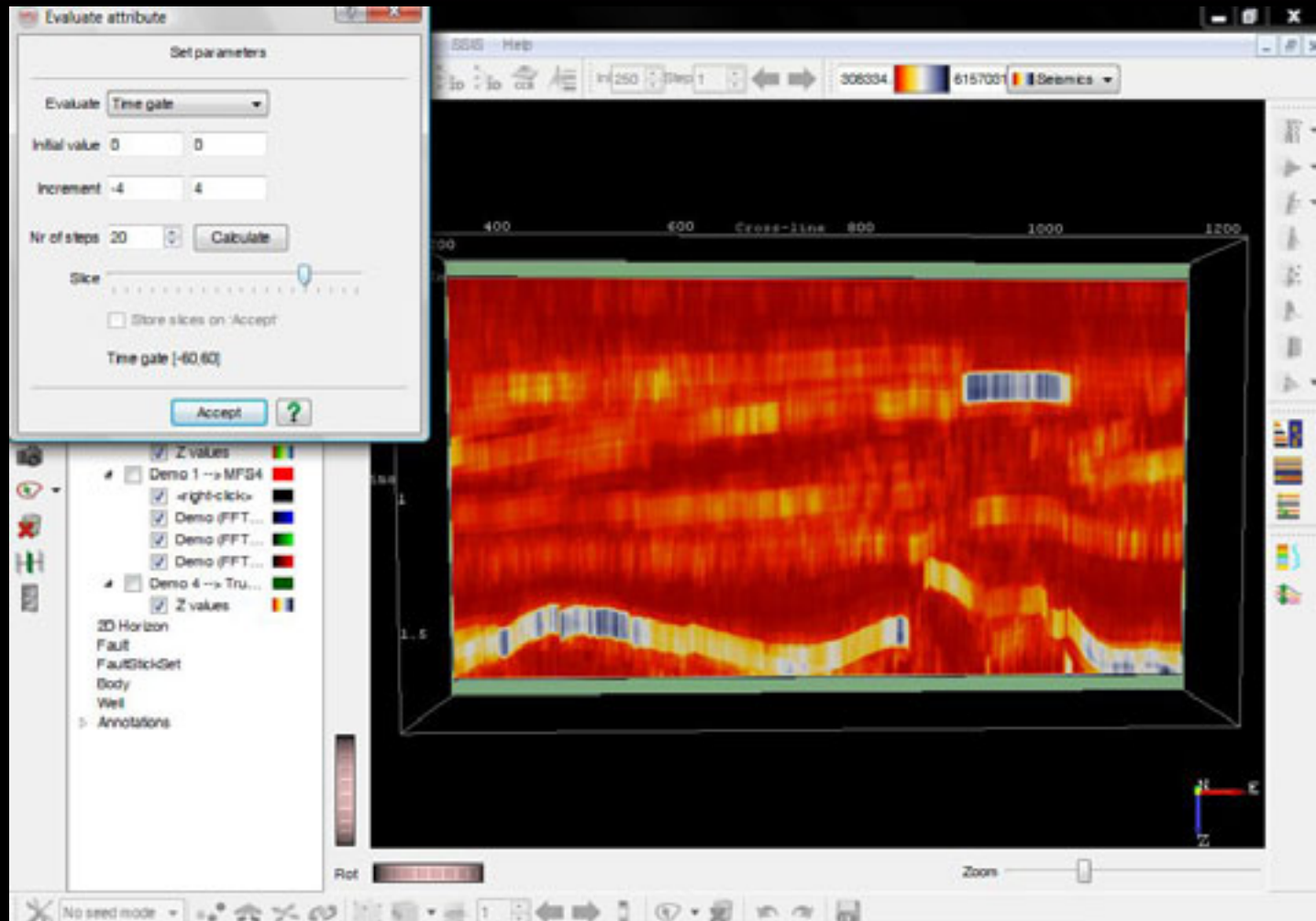
The screenshot displays a software interface for evaluating seismic attributes. On the left, a dialog box titled "Evaluate attribute" is open, showing the following settings:

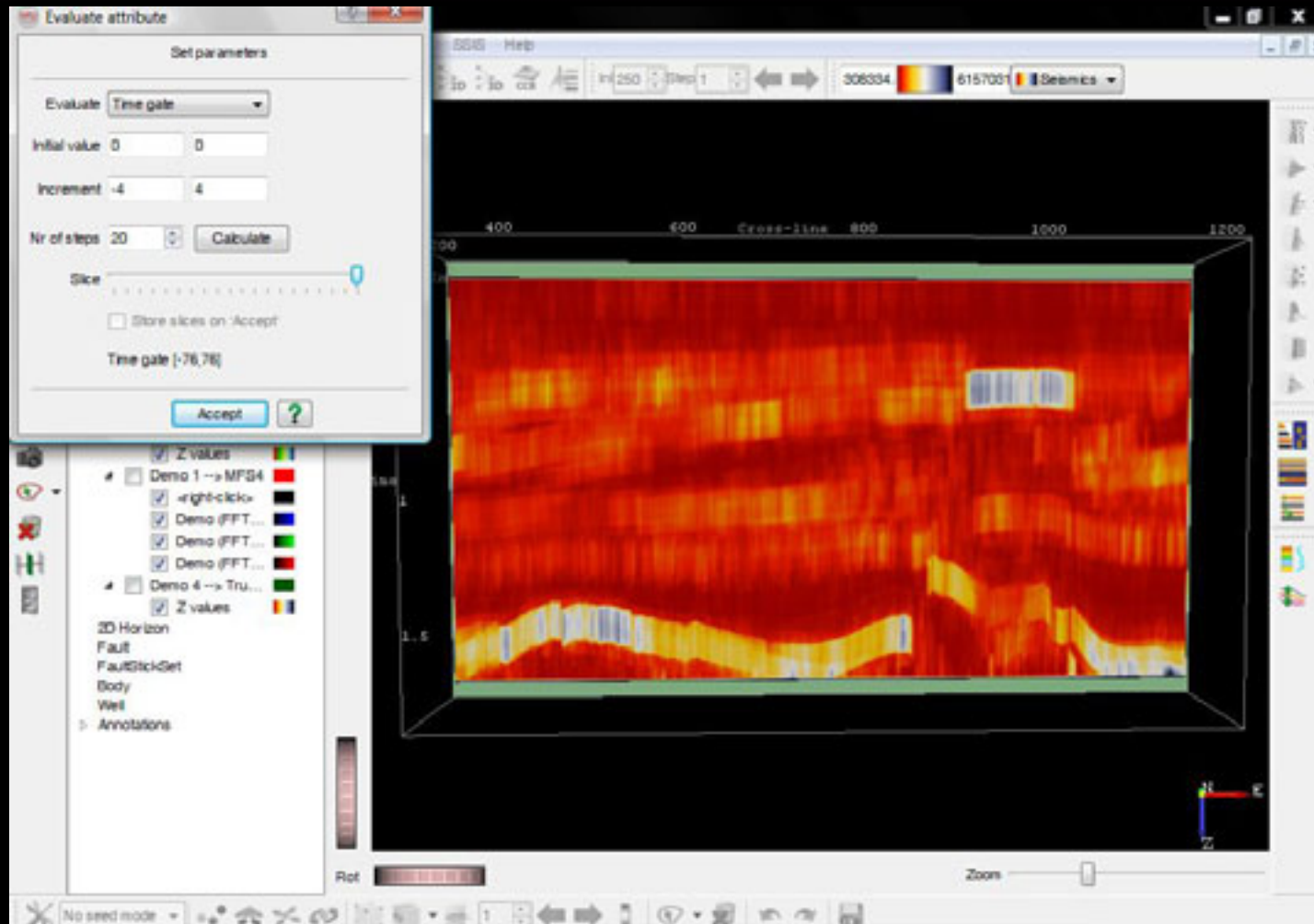
- Set parameters
- Evaluate: Time gate
- Initial value: 0
- Increment: -4
- Nr of steps: 20
- Calculate button
- Slide control
- Store slices on 'Accept' checkbox (unchecked)
- Time gate [-36,36]
- Accept button
- Help icon

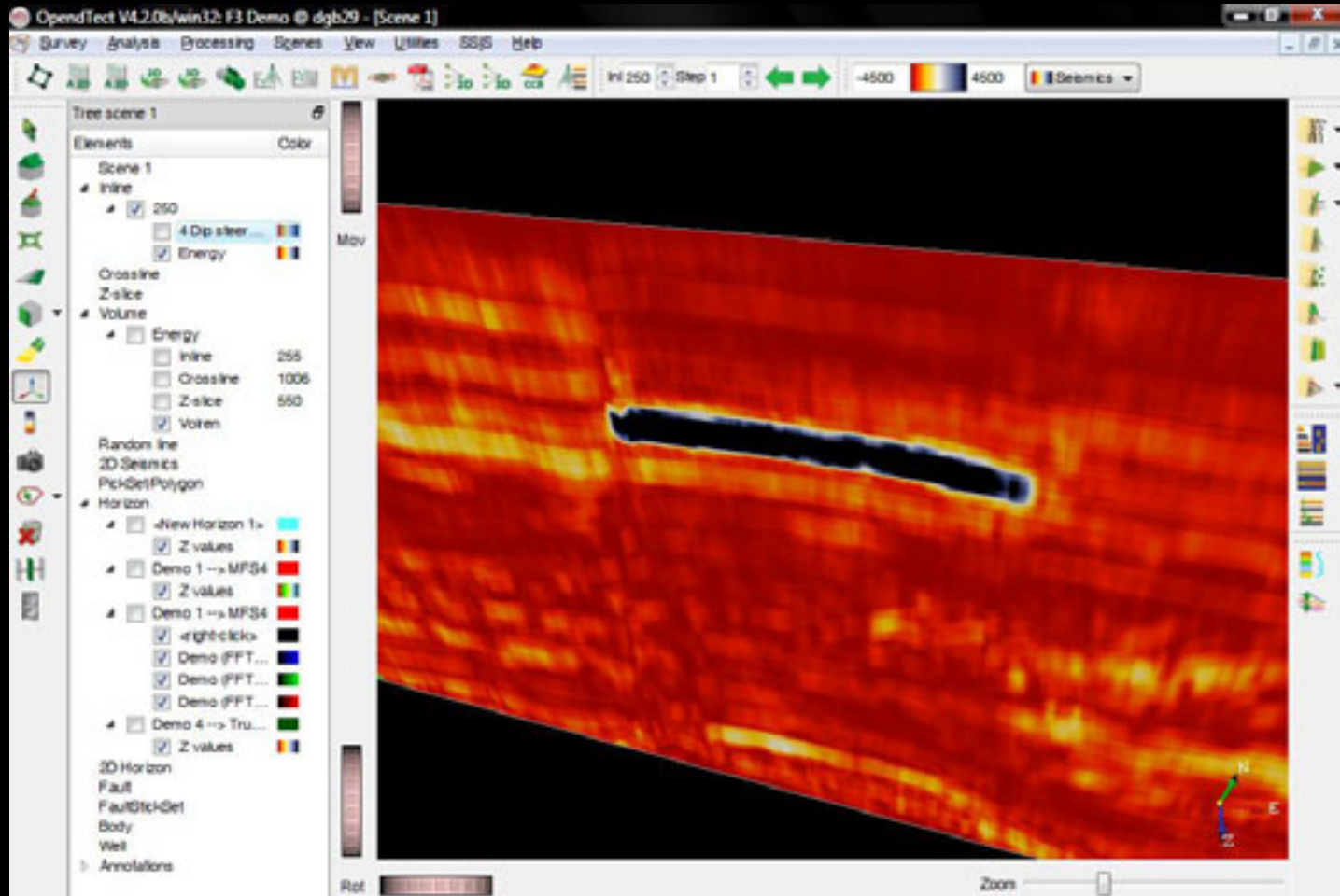
The main window shows a 3D visualization of a seismic cross-section. The horizontal axis is labeled "Cross-line" with values 0, 400, 600, 800, 1000, and 1200. The vertical axis is labeled "L.S" with values 1.5 and 1.0. The data is color-coded from red (low values) to blue (high values). A color scale at the top right indicates values from 306334 to 6157031. A toolbar at the bottom includes a "No seed mode" dropdown, a "Rot" slider, and a "Zoom" slider. A legend on the left side of the main window lists various data series:

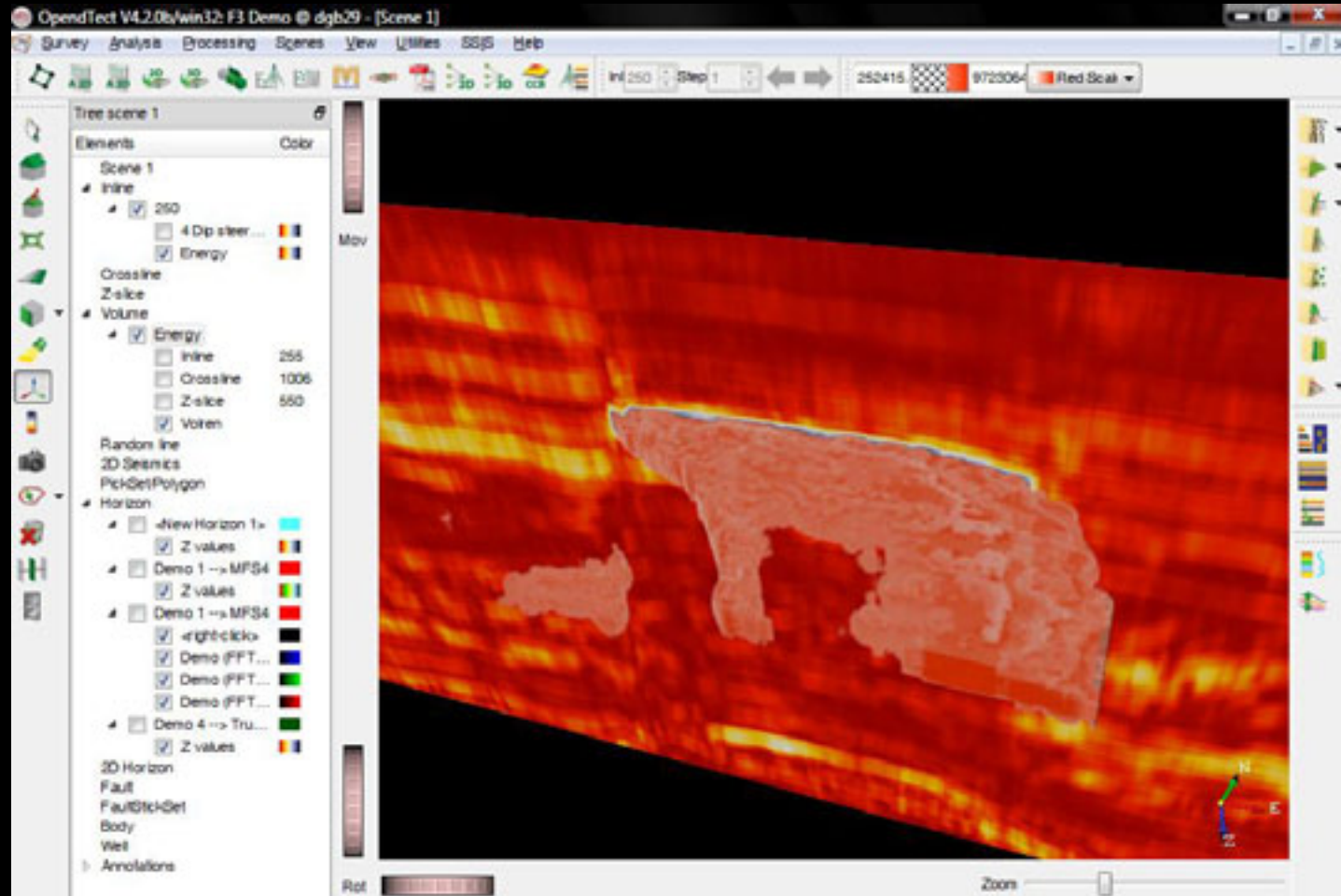
- Z values
- Demo 1 -> MFS4
- right-click
- Demo (FFT...)
- Demo (FFT...)
- Demo (FFT...)
- Demo 4 -> Tru...
- Z values
- 3D Horizon
- Fault
- FaultStickGet
- Body
- Well
- Annotations

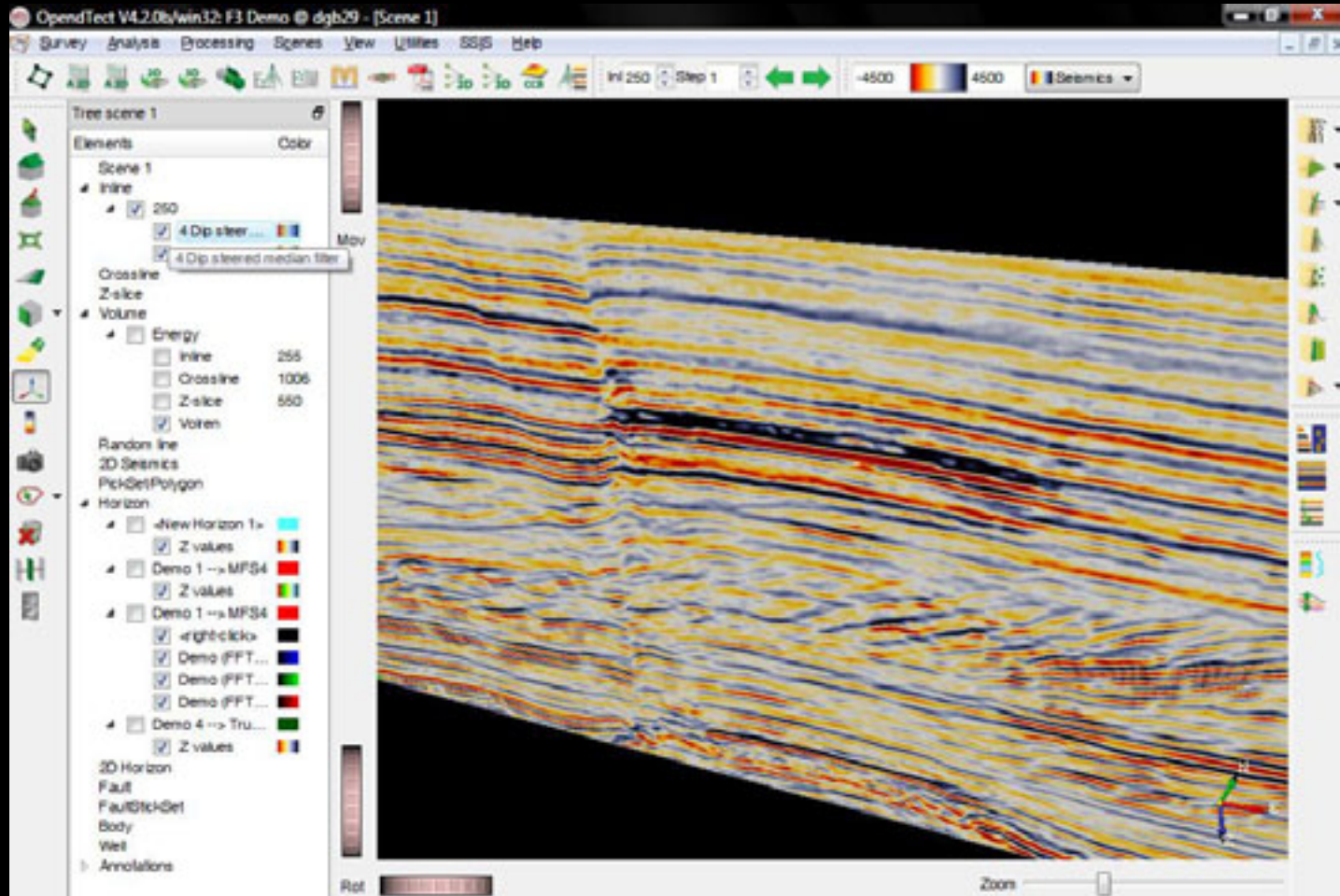


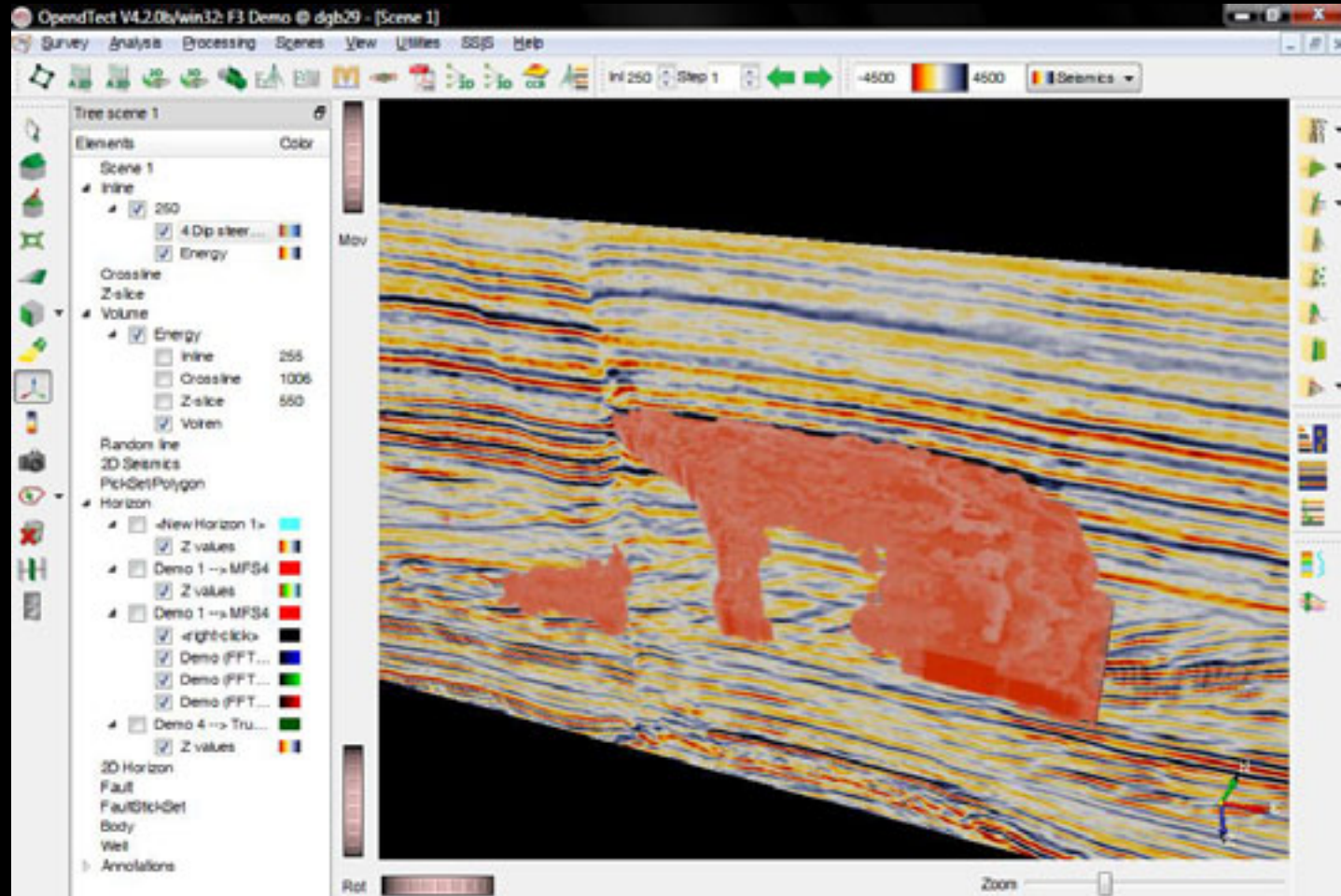














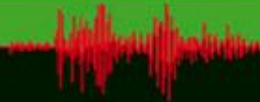
The screenshot displays the OpenTect V4.2.0b software interface. The main window shows a seismic section with a cyan highlighted horizon and green tracking points. A 'Tracking Setup' dialog is open in the foreground, and a '[70%] Autotrack' progress window is overlaid on the seismic data.

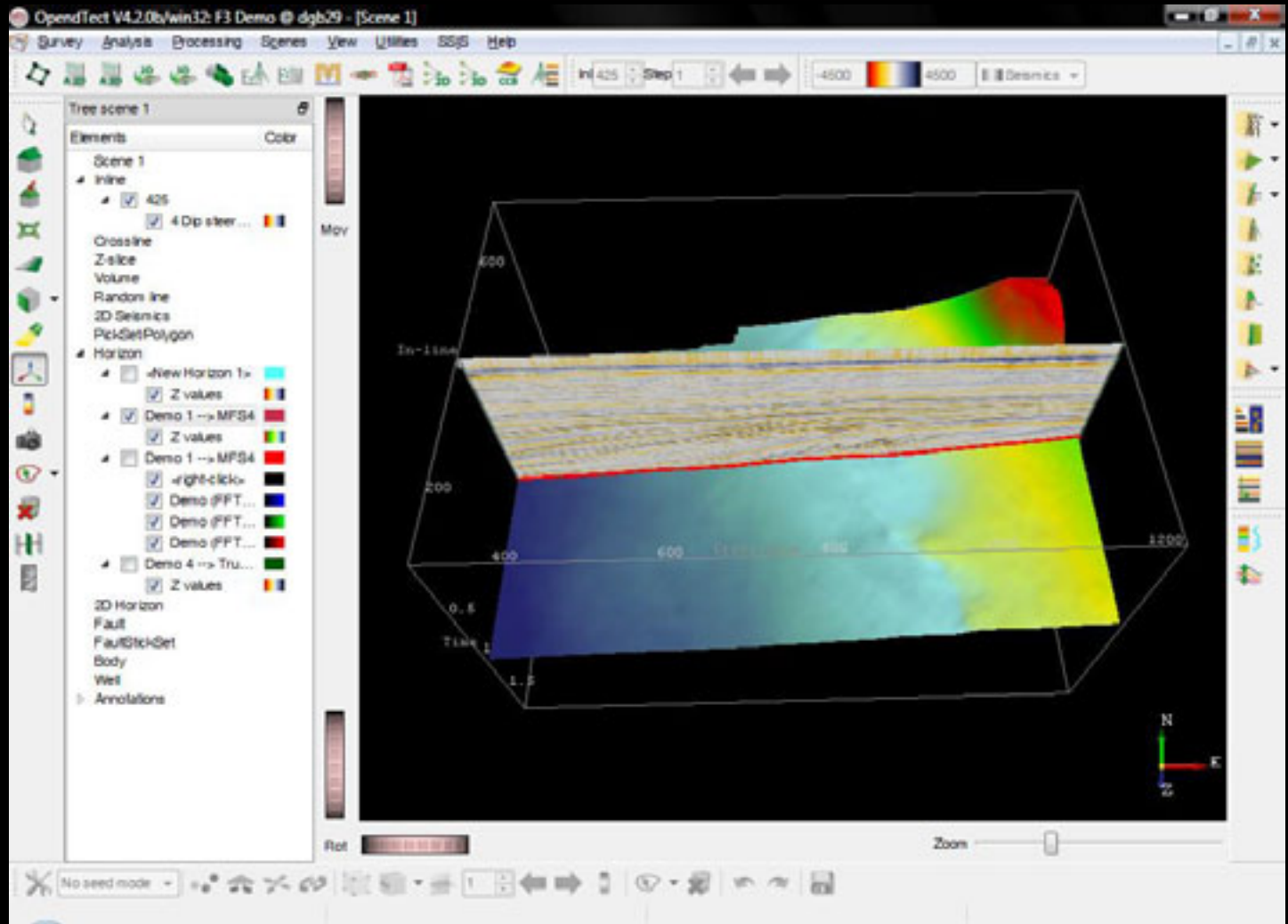
Tracking Setup Dialog:

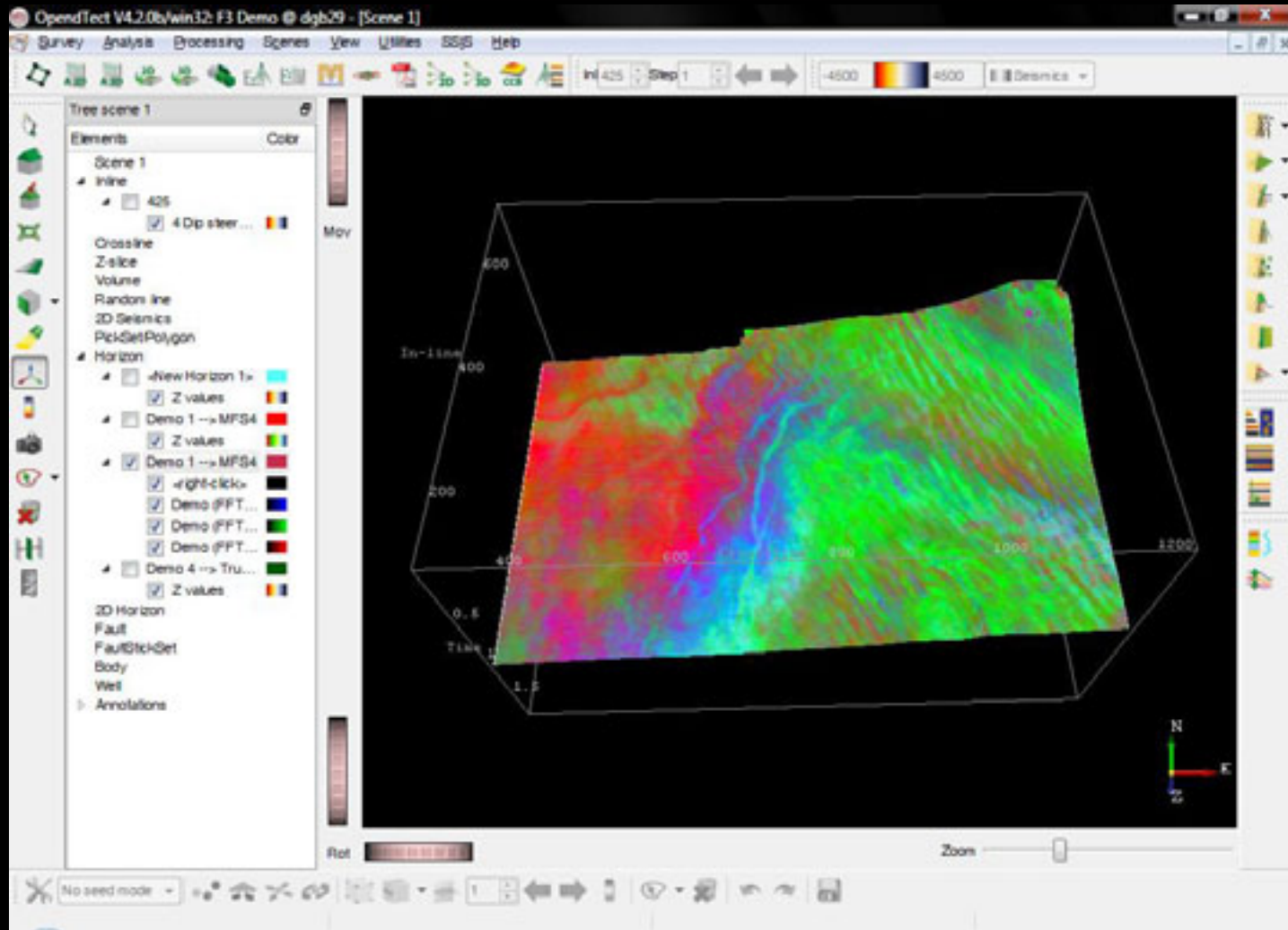
- Mode: Event
- Input data: steered median filter
- Event type: Max
- Search window (ms): -12 to 12
- Threshold type: Relative difference
- Allowed difference (%): 1,2,5,10,20
- If tracking fails: Stop

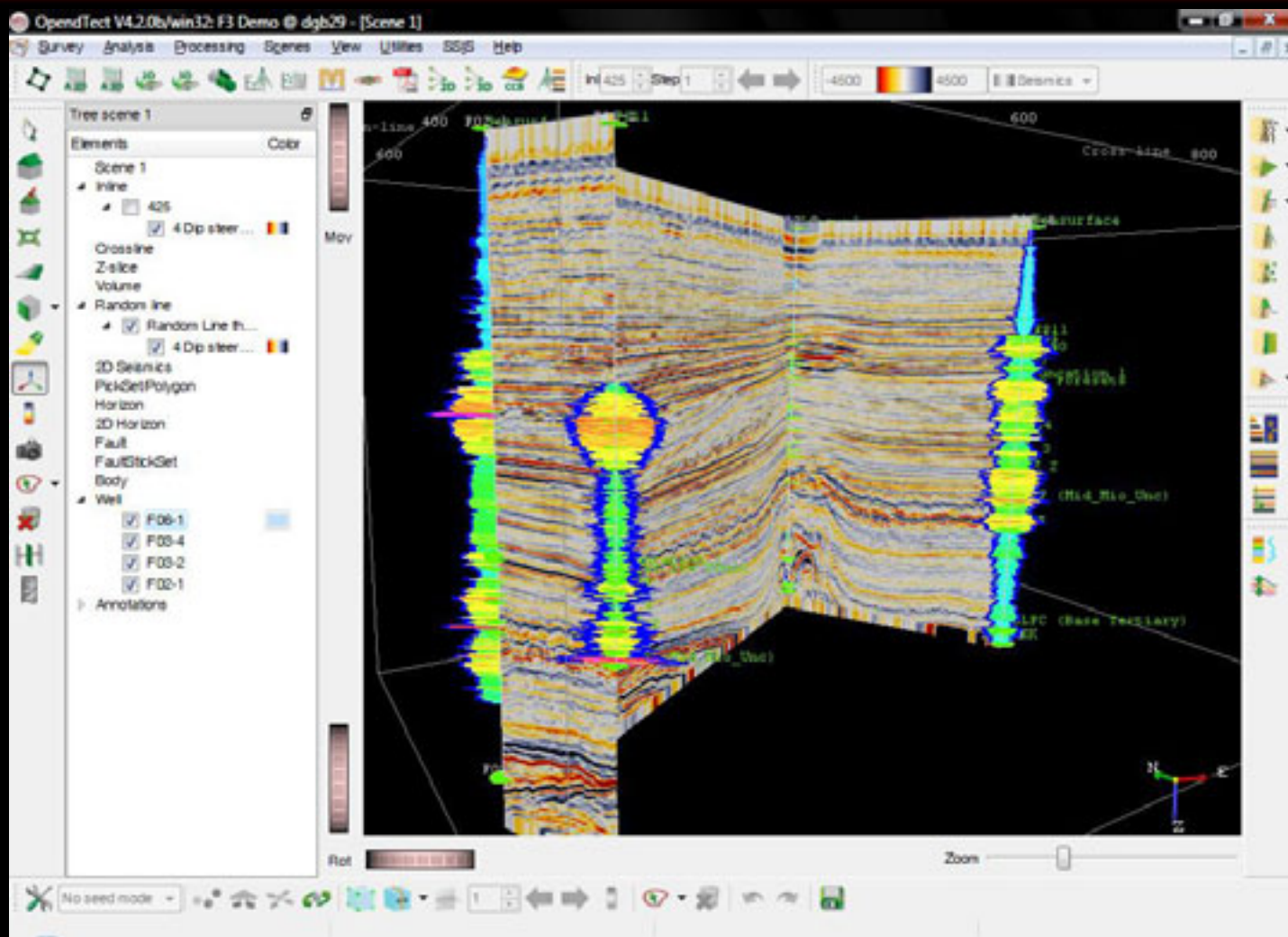
[70%] Autotrack Dialog:

- Progress: 70%
- Buttons: Pause, Abort
- Step: 1%
- seeds processed: 27496











Well file management

Manage wells

Filter *

- F02-1
- F03-2
- F03-4
- F06-1

Logs

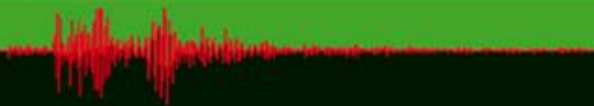
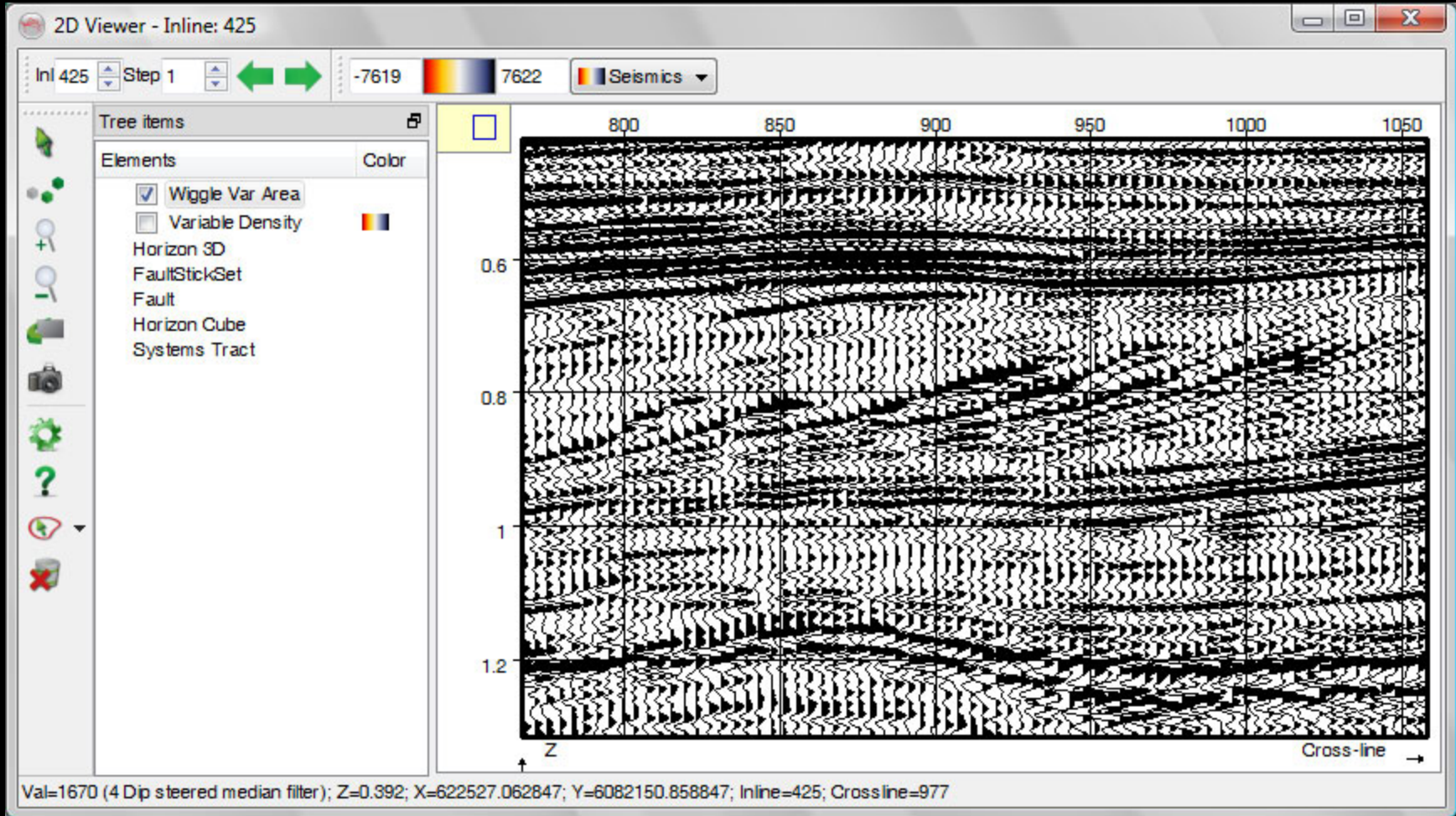
- Caliper
- Density
- Gamma Ray
- Sonic
- P-wave_corr
- Porosity

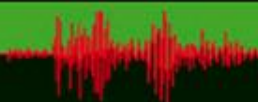
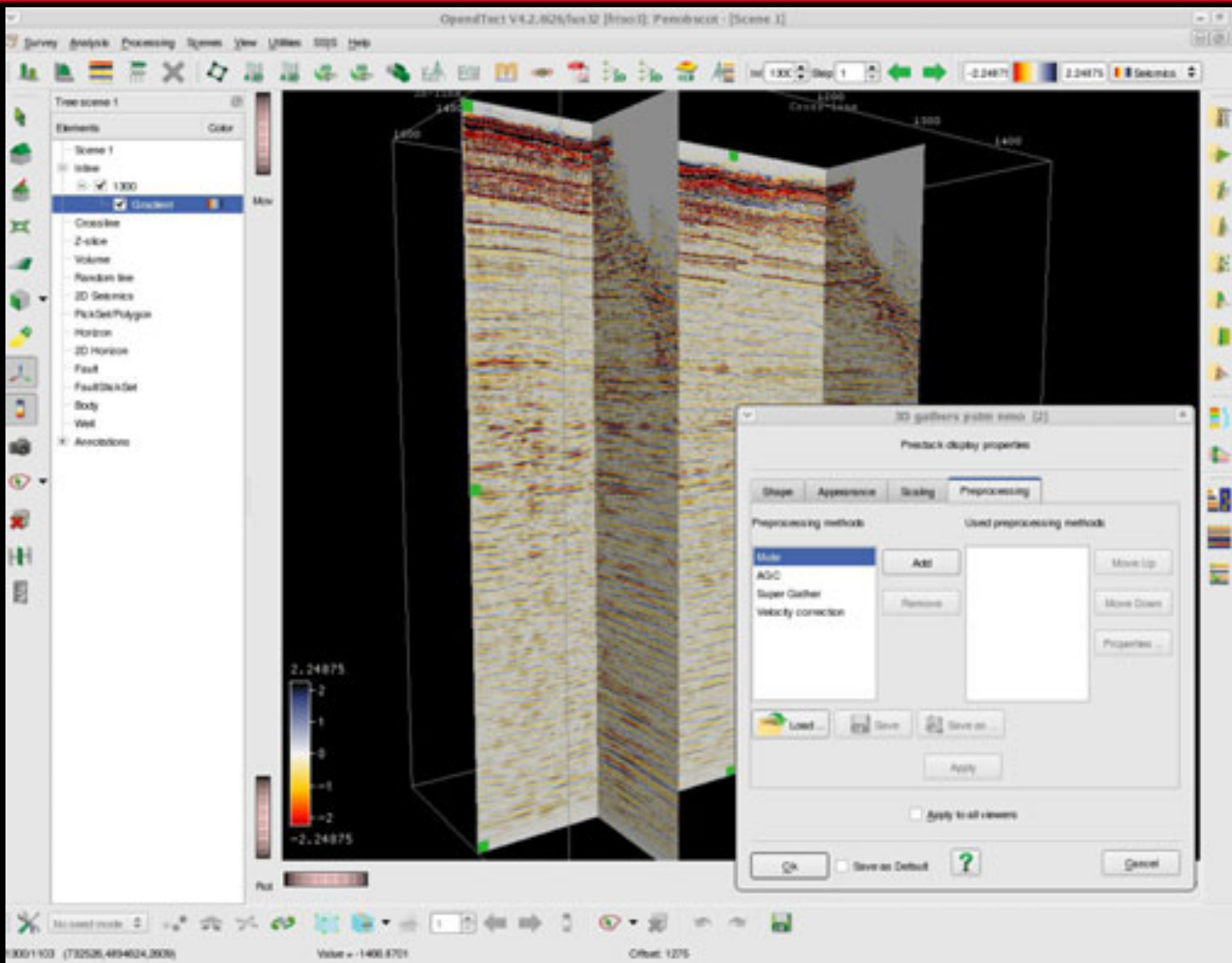
Import ... Create ...

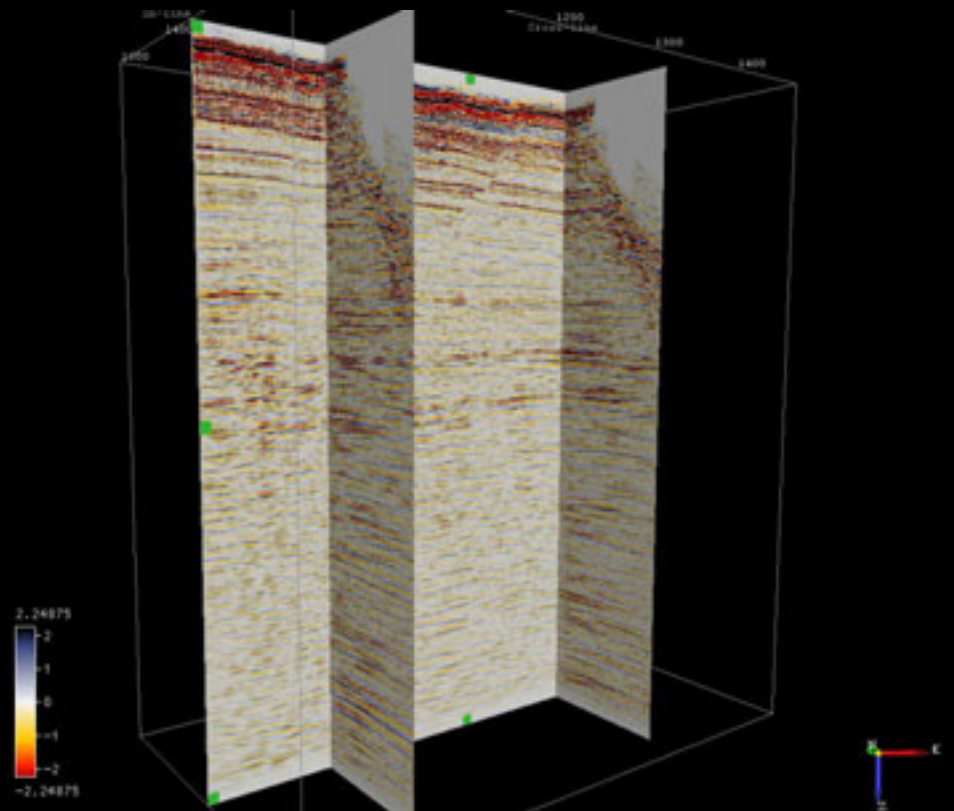
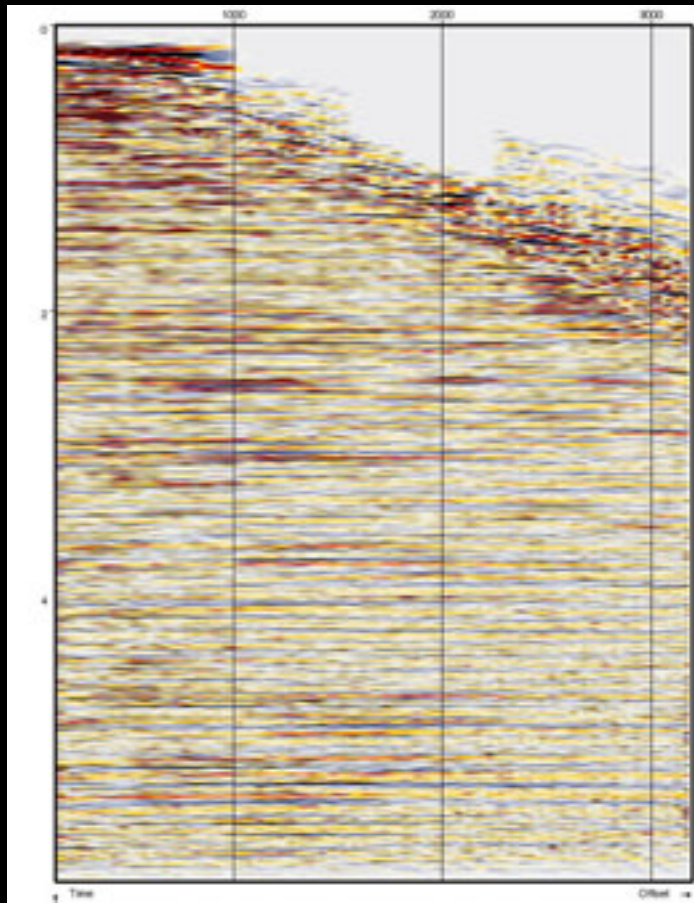
Surface coordinate: 362/336 (606554,6080126)
Reference Datum Elevation (KB): 30m
Surface Reference Datum: 1e30m
Location: C:\Work\surveys\F3_TrainingProject-Master\WellInfo
File name: F02-1.well
Size on disk: 753 kB
Number of files: 9
Last modified: Thu 14 May 2009, 07:29:02
Object ID: 100050.2

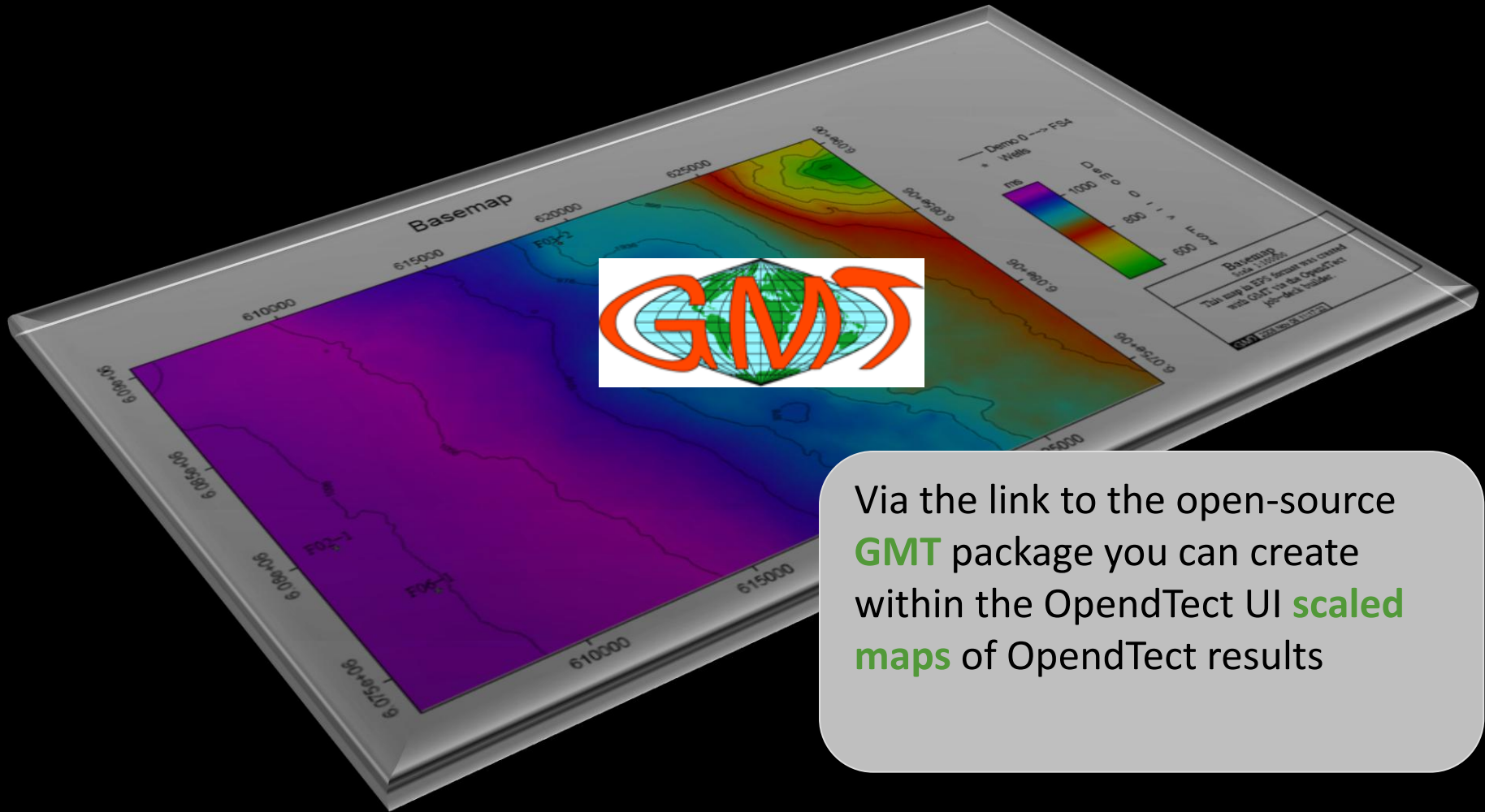
Dismiss ?

Free space on disk: 3.3 GB









Via the link to the open-source **GMT** package you can create within the OpenTect UI **scaled maps** of OpenTect results



Extract even more geology with advanced closed source plugins



- Neural Networks
- Dip-Steering

- PSDM Kirchhoff
- PSDM Tomography

- Deterministic Inversion
- MPSI Stochastic Inversion

- Spectral Blueing
- Coloured Inversion
- Workstation Access
- PDF3D
- **Petrel link**
(via Oceanstore)

- **HorizonCube**
- SSIS
- **Well Correlation Panel**
- Common Contour Binning

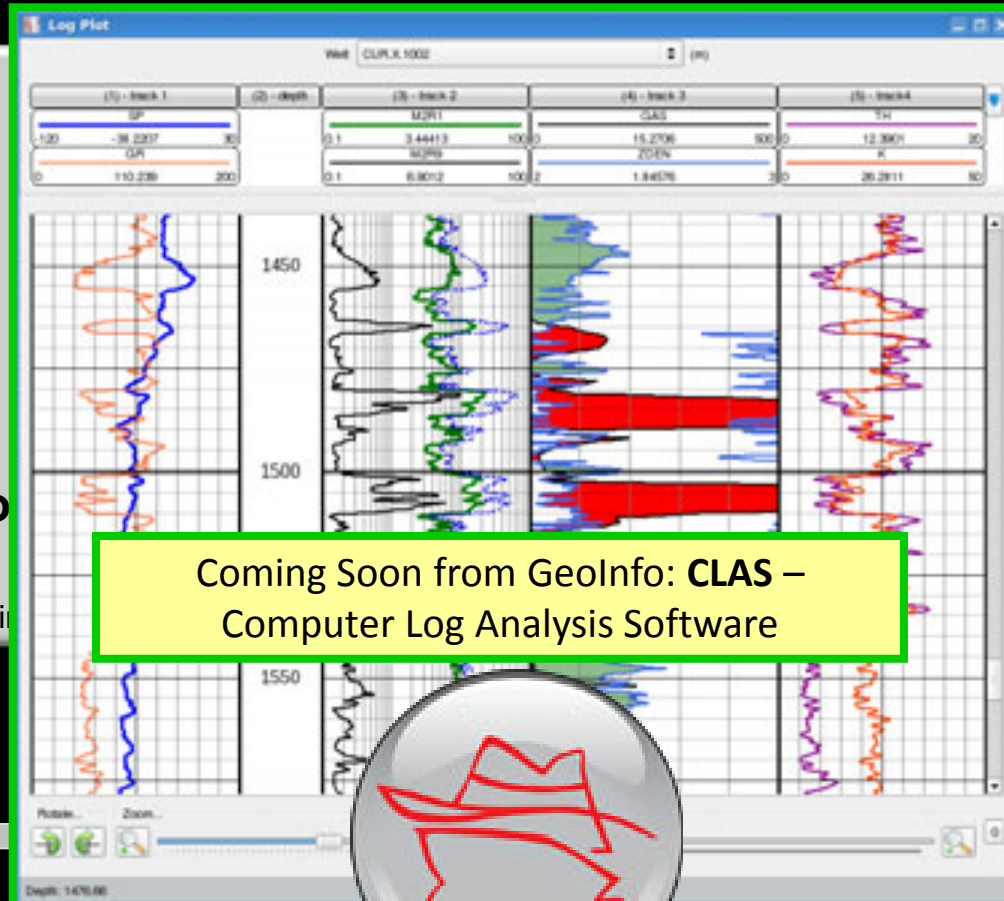




Extract even more geology with advanced closed source plugins



- Neural Networks
- Dip-Steering
- **HorizonCube**
- SSIS
- **Well Correlation Panel**
- Common Contour Binning



- Spectral Blueing
- Coloured Inversion
- Workstation Access
- PDF3D
- **Petrel link**
(via Oceanstore)

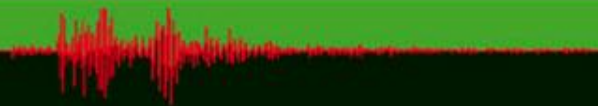
Coming Soon from GeoInfo: **CLAS** –
Computer Log Analysis Software





Is the Open Source model commercially viable?

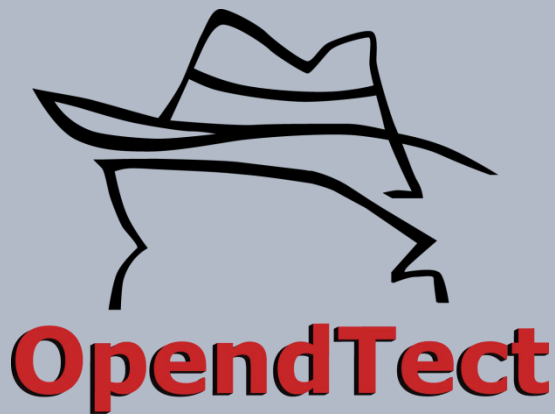
YES!





Free

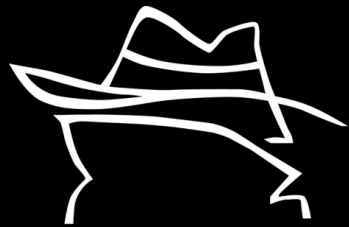
open source seismic interpretation
package



Premium

commercial products & services

- Plugins
- Maintenance & Support
- Paid Development
- Consultancy & Training
- Proprietary case studies



OpendTect



Open Source



Commercial



Academic

Run OpendTect



Links to Open S. systems*



Distribute Open S. plugins



Distribute Closed S. plugins



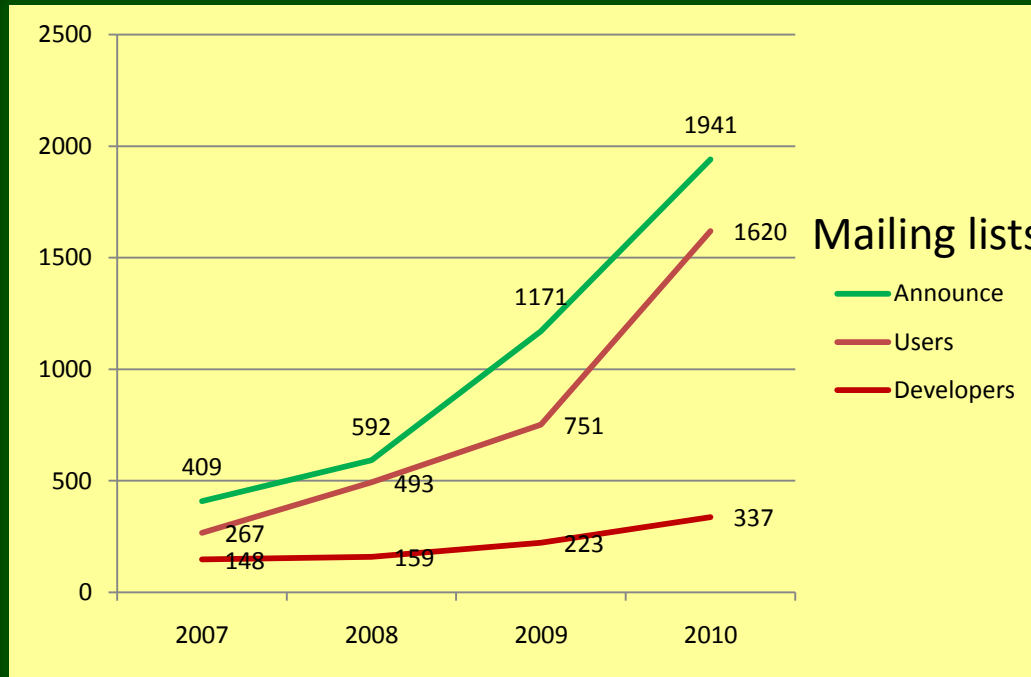
Run Closed Source plugins



Get priority support



* GMT and Madagascar



Estimated number of OpendTect users: 10000+?



Excluding Independent Consultants and Commercial Research Institutes

NOC's

ADA Oil (KNOC)
Saudi Aramco
CNOOC
Ecopetrol
KJO
MOL
NIOC
OMV
ONGC
Petronas
Petrobras
Petrochina
PTTEP
Sinopec
Statoil

Majors

Chevron
ENI – Agip

Independents

Anadarko
Addax
Apco
Abundant Resourc.
Aspect Energy
BG Group
Cathedral Energy
Cairn Energy
CNR
Detnor
DNO
Gaz de France
Geoproduction
Gran Tierra
Inpex
JGI
Maersk
Marathon
Maness Petroleum
MOL
Nettlecombe
Newfield
Noble Energy
Pan American
Premier (oilexco)
RAK Petroleum
Rocoil
Samson Resources
Wintershall
Woodside

Service Companies

AGR – Tracs
Ark CIS
ArkEx
Beicip
BGP
3D-Geo
Dakon
Degeconek Nigeria
Earthworks E&R
EOSYS
Fugro-Jason
Fugro-Robertson
GCT-GeoCruiser
Geofizyka Krakow
GeoInfo
Geokinetics
Geostan
IF Technologies
Ikon Science
Kerogen Resources
Norsar
Optim
Petroguard
Seabird Geophys
Predict Geocon
PGS
RPS
SIGSA
Spice Inc



OpendTect in Academia

OpendTect is being actively used by the Geophysicists of tomorrow in more than 200 universities world wide, including most of the leading Institutions

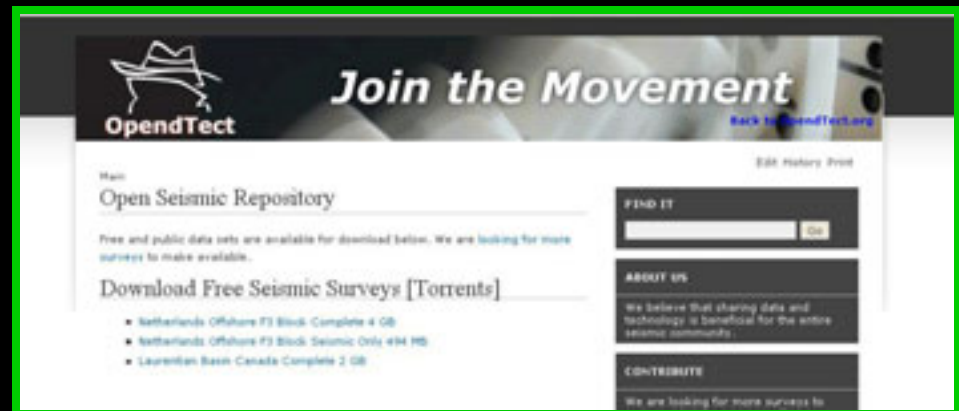




Open Seismic Repository

www.opendtect.org/osr

- Wiki site with free seismic surveys + interpretations in OpendTect format
- Download as bit-torrents
- Freely you receive, freely you give





How can you contribute?

- Open Source Functionality
- Open Source Plugins
- Closed Source Plugins





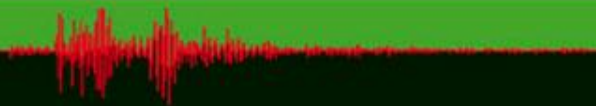
OpendTect is :

- Open source
- Available under **GPL & Commercial** licensing
- Easily extendable using its **plugin architecture**
- Natively **C++**
- Built using Agile Development strategy
- Using
 - Qt (Trolltech)
 - Coin3D (SIM)



Why Develop in OpenTect?

- Direct Access to Existing Framework:
 - base and advanced functionalities,
 - attributes and filters (for developer and end-user)
 - modern visualization techniques
- Develop in:
 - open source, cross-platform environment
 - safely and rapidly growing powerful toolkit
 - Structure designed for easy plugin development (reduce overhead!)
 - GPL or Commercial License
- Make your contribution!





- **Tutorial Plugins** available with Development Package
- Developers pages on OpendTect.org
- Development **webinars**
- developers@opentect.org mailing list
- Development **training course**
- Quick and automatic creation of your development environment
launchable from OpendTect menu



- BG Partners in Development project
 - Volume builder: parallelization, gridding algorithms, Time/Depth conversion
 - Horizons: 4D tracking, Horizon attribute engine, tracking
 - Processing tools: ray-tracer, pre-stack picks, gain correction
 - Various: pre-stack viewer, SEG-Y headers, screenshots to ODF, ...

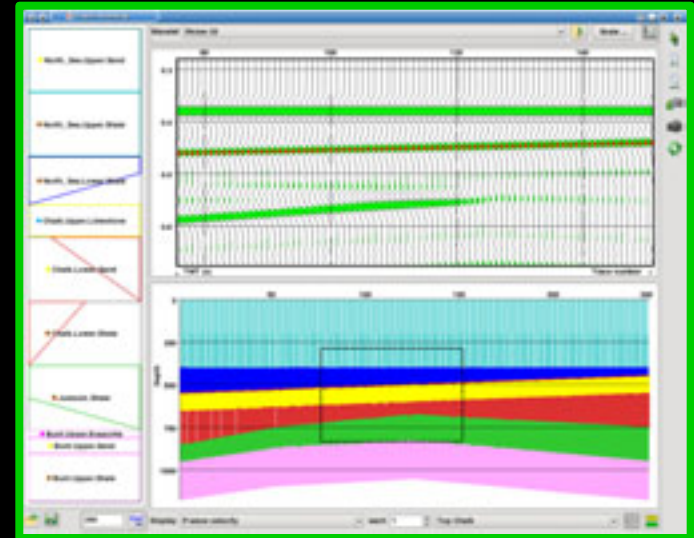
Sponsored by



- Open Source
 - Simple wedge models & synthetics

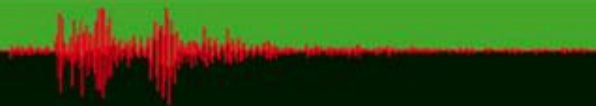
- Closed source plugin
 - Stochastic models
 - Pre-stack synthetics
 - Cross-plot analysis
 - Neural network & HIT cube inversion

- Under development





- Who will contribute?
 - Commercial
 - Individual/Academic
- Will other commercial companies join?





- OpendTect is...
- Extended open source workflows
- User collaboration
- Scientific accountability
- Open Source is commercially viable

