Shear Anisotropy Analysis with DT Compressional

Schlumberger

Sonic Scanner

Shear Anisotropy Analysis with DT Compressional

13400-14750
Trip 8

COMPANY:	DCP Midstream LP
WELL:	Zia AGI D2
FIELD:	AGI Devonian Exploration
COUNTY	Lea
STATE:	New Mexico
COUNTRY	USA

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API No: 30-025-42207 Job Number:

Location
Field: 1893' FSL & 950' FWL
Section: 19
Township: T19S
Range: R32S

Other Services:

Permanent Datum: Ground Level Elevation of Perm Datum: 3547 ft
Log Measured From: Kelly Bushing 27 ft above Perm. Datum
Drilling Measured from: Kelly Bushing

Elevations:
K.B. 3574 ft
D.F. 3573 ft
G.L. 3547 ft

Date	29-Nov-2016	
Run No.	Run 1A	
Depth Driller	13622 ft	
Depth Logger (Schl)	13637 ft	
Btm. Log Interval	13637 ft	
Top Log Interval	4702 ft	
Casing-Driller	9.625 in @ 4696 ft	
Casing-Logger	ft	
Bit Size	8.75 in	
Type Fluid in Hole		
Dens. | Visc.	10 lbm/gal | 41 s	
pH | Fluid loss		
Source of Sample	Active Tank	
Rm @ Meas.Temp.	0.08 ohm.m @ 72 degF	
Rmf @ Meas.Temp.	0.08 ohm.m @ 72 degF	
Rmc @ Meas.Temp.	-999.25 ohm.m @ 68 degF	
Source: Rmf | Rmc		
Rm @BHT	0.0347157 @ 174.75 degF	
Circulation Stopped	00:00:00	
Logger on Bottom	04:30:00	
Max Rec.Temp.	174.75 deg F	
Equipment | Location	9105 Midland, TX	
Recorded by:	Danielle Krebs	
Witnessed by:	Jared Smith	

The well name, location and borehole reference data were furnished by the customer

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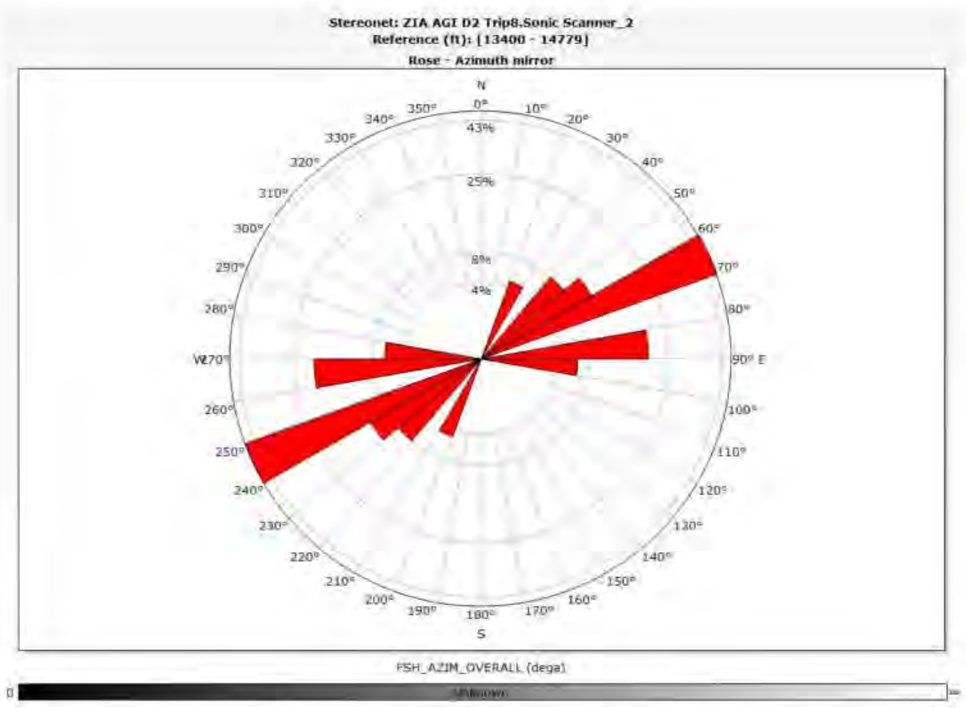
Ser. Order # CVDD-00139	TechLog 2003.4.0	Process Date: 1/13/2017	Center: Midland, Tx	Baseline: TechLog 20013.4.0	Log Analyst: Jermaine Packer

Sonic data depth matched to TNPH



Direction shown based off of following criteria: Fast Shear Azimuth Cutoffs for Anisotropy Flag: TIMANI > 2, SLOANI > 2, XENEDIF > 10, FSH_AZIM_ERR < 100,

TRACK

Track 1: Depth
Depth numbers - depth scale
MinEne - overall minimum cross energy
MaxEne - overall maximum cross energy
OffEne area shading - indicates the difference betwenn MinEne and MaxEne

Track 2: Gamma Ray
SGR, CGR, TGR - spectral gamma ray
BS- bit size
HD1-PPC1- Hole diameter 1 from powered positioning caliper 1
HD1-PPC2-Hole diameter 1 from powered positioning caliper 2
Mudcake area shading - indicates caliper < bit size
Washout area shading - Indicates caliper > bit size
Hazim-hole azimuth from GPIT tool
Devim-hole deviation from GPIT tool
Sensor_Azim- sencor azimuth from sonic scanner tool

Track 3: Resitivity Track

Track 4: Porosity
TNPH - neutron porosity
SPHI - sonic porosity

Track 7: PR and VPVS
PR_fast-Poissons Ratio based off of fast shear
VPVS_Fast- VPVS ratio based off of fast shear

Track 8: Sonic Waveforms
TW-B- waveform time window start
TW-E- waveform time window stop
Window Size- Processing window
WF_Filt_Slow(blue)- Filtered slow shear waveform arrival time
WF_Filt_Fast(Red)-Filtered fast shear waveform arrival time

Track 9:Monopole Slowness-Time Coherence
SPR_MF: Monopole coherence projection
DTCO: Compressional slowness
DTSM_MONO: Monopole Shear
DTSM: Dipole XD Shear

Track 10: Fast shear sonic frequency analysis
SFA_Fast- Fast Shear frequency analysis projection
DTSM_Fast- Fast Shear Slowness

DPHI_LIM- density porosity

Track 5: Fast Shear Azimuth

Fast Shear Azimuth(Red)- Overall fast shear azimuth
Flagged Fast Shear Azimuth(Blue)- Fast shear azimuth over anisotropy flag intervals
Azimuth uncertainty area shading- Indicates uncertainty of fast shear azimuth

Track 6: Slowness Curves

DTSM_SLOW-Slow Shear Slowness
DTSM_FAST-Fast Shear Slowness
DTCO-Compressional Slowness
SLOANI- Slowness Anisotropy-Azimuthal
Timani-Time anisotropy

Track 11: Fast Shear Sonic Slowness-Time Coherence

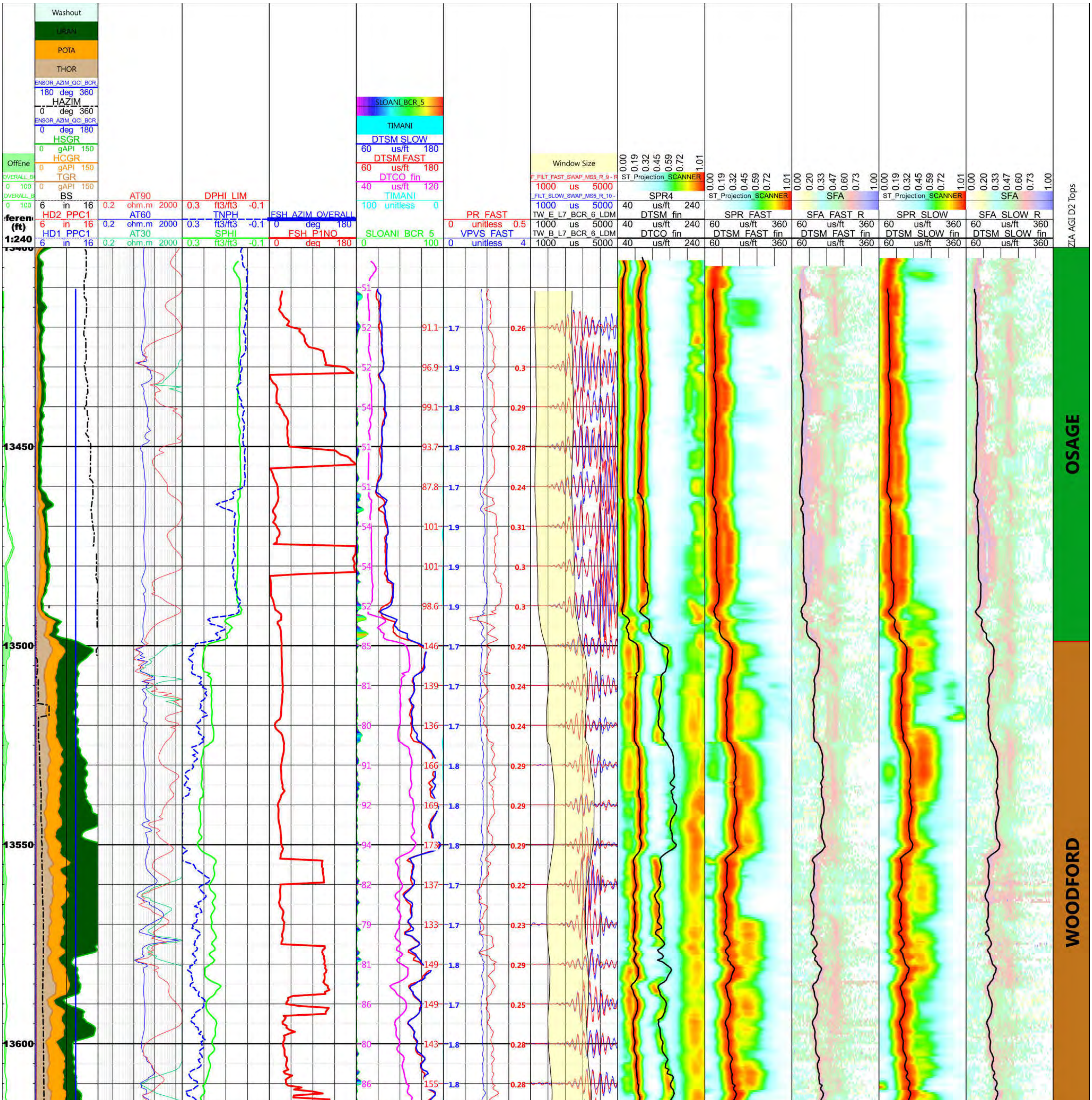
SPR_Fast- Fast Shear frequency analysis projection
DTSM_Fast-Fast Shear Slowness

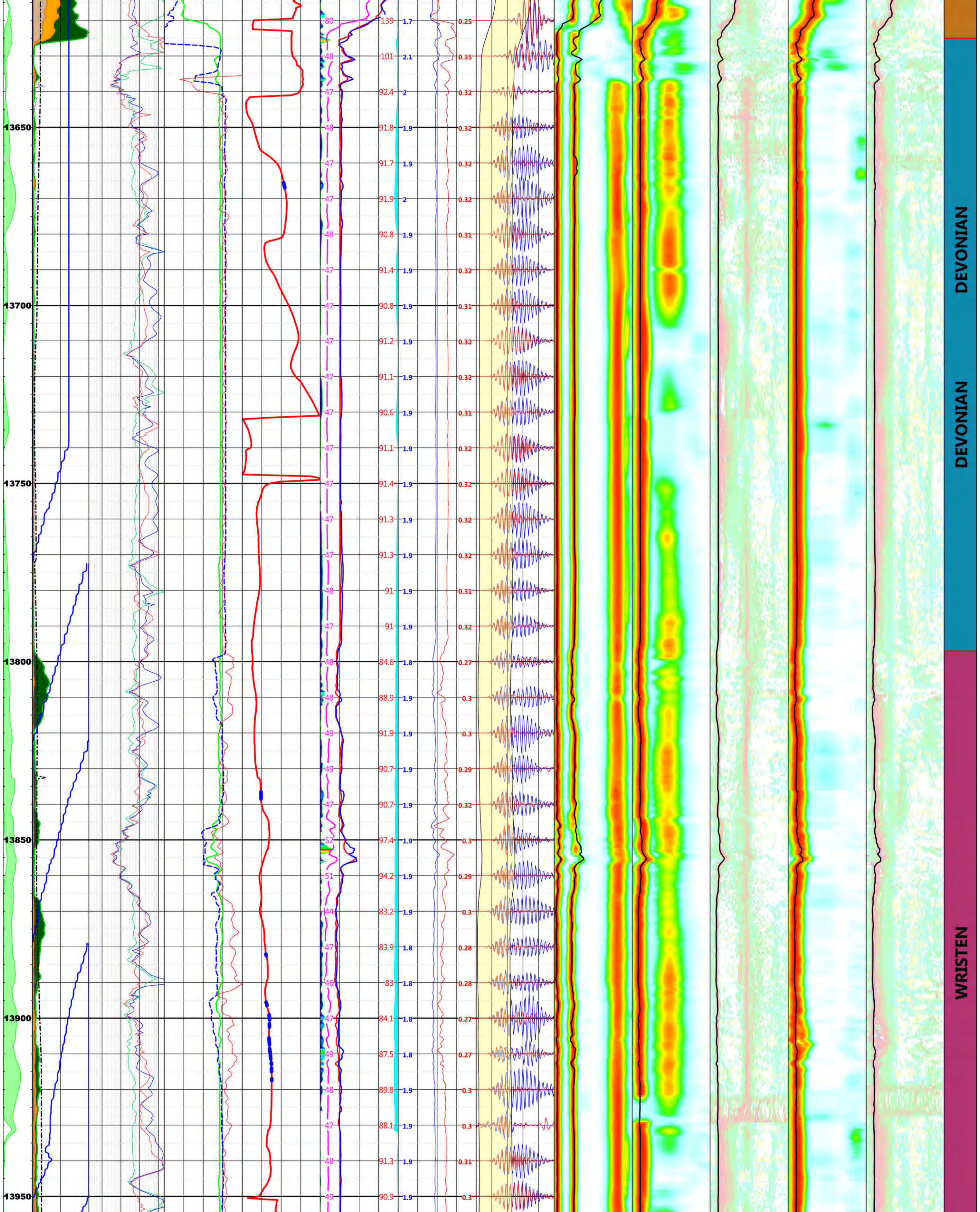
Track 12: Slow shear sonic frequency analysis

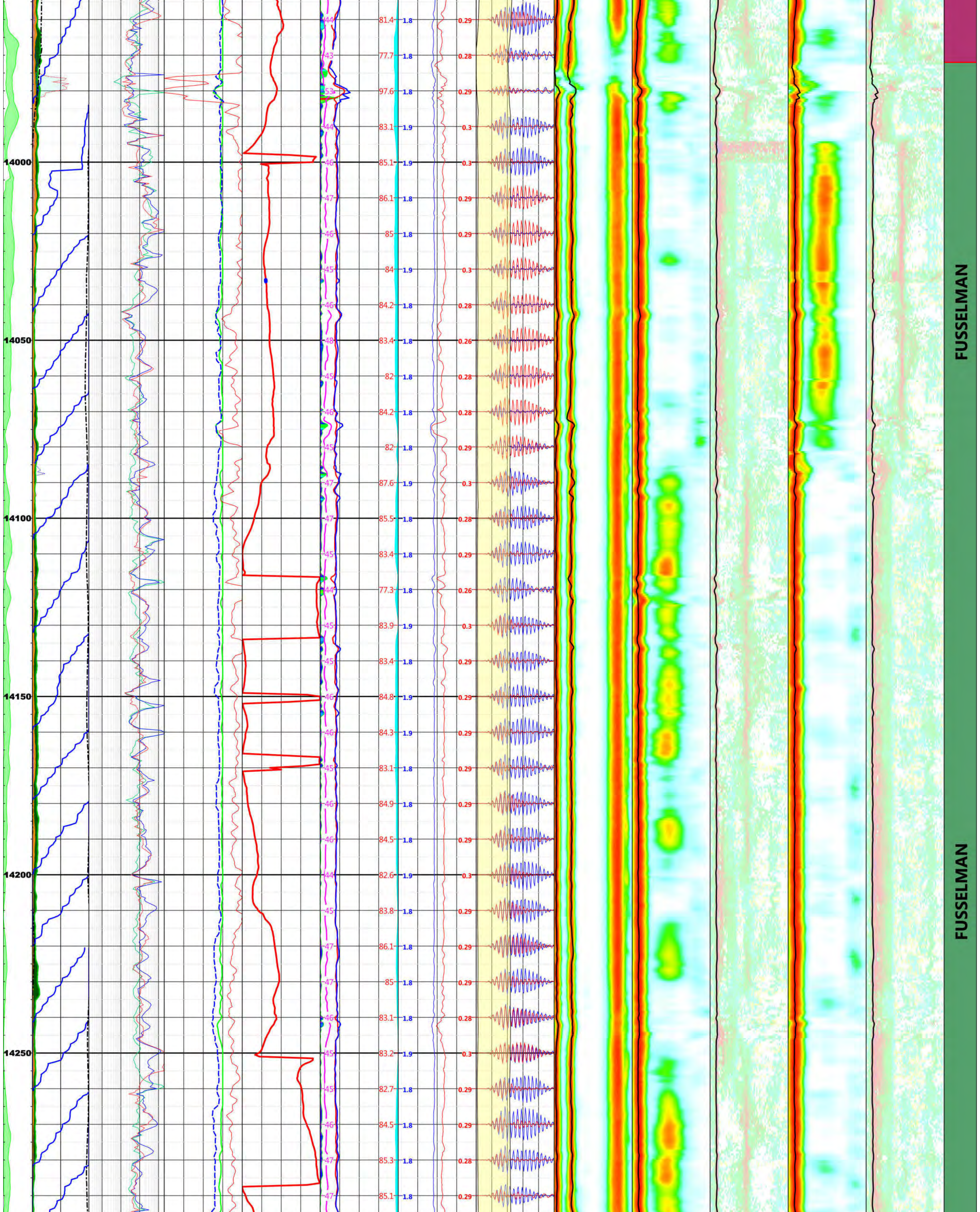
SFA_Slow- Slow Shear frequency analysis projection
DTSM_Slow- Slow Shear Slowness

Track 13: Slow Shear Sonic Slowness-Time Coherence

SPR_Fast- Slow Shear frequency analysis projection
DTSM_Slow-Slow Shear Slowness




13650
13700
13750
13800
13850
13900
13950
DEVONIAN
DEVONIAN
WRISTEN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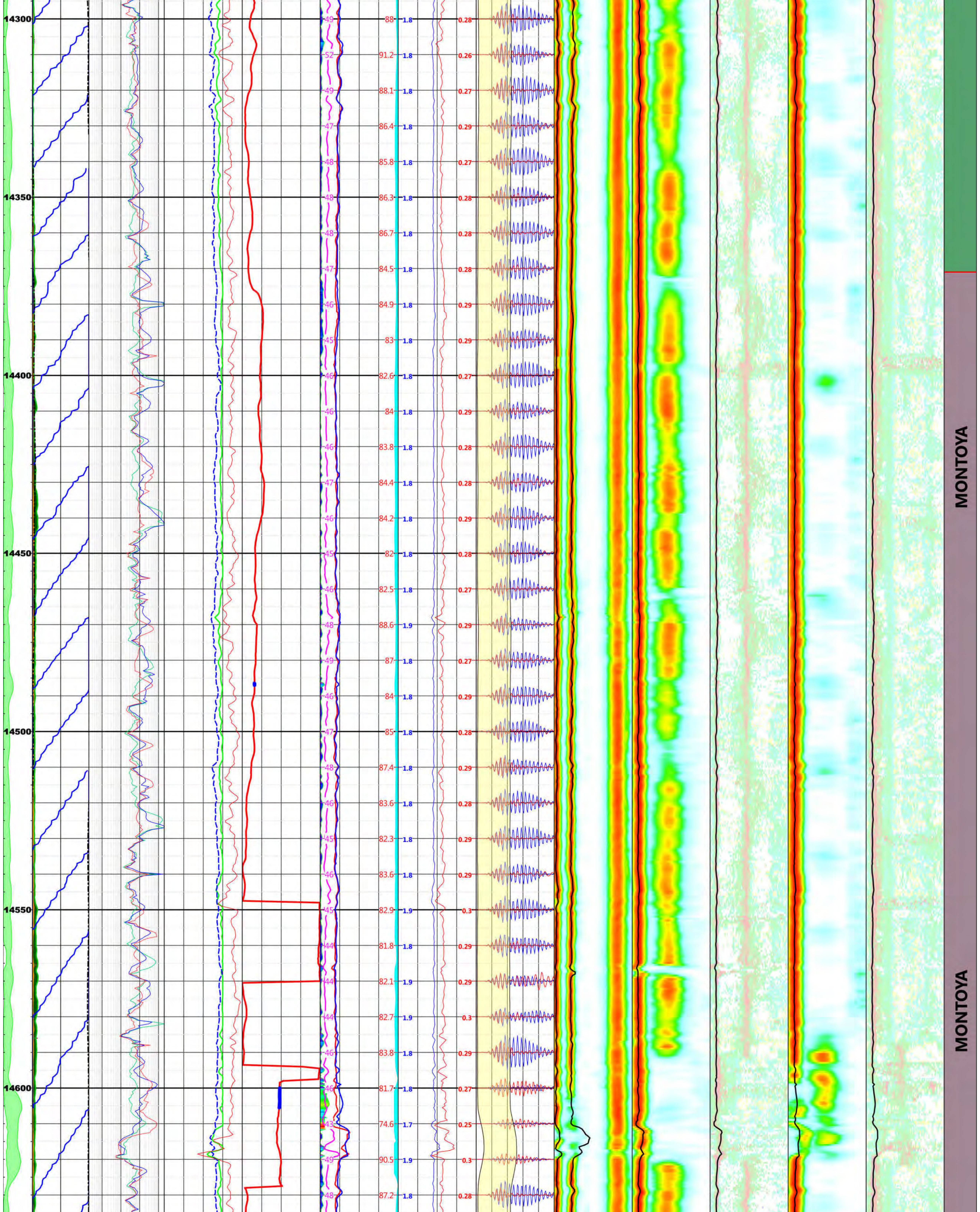
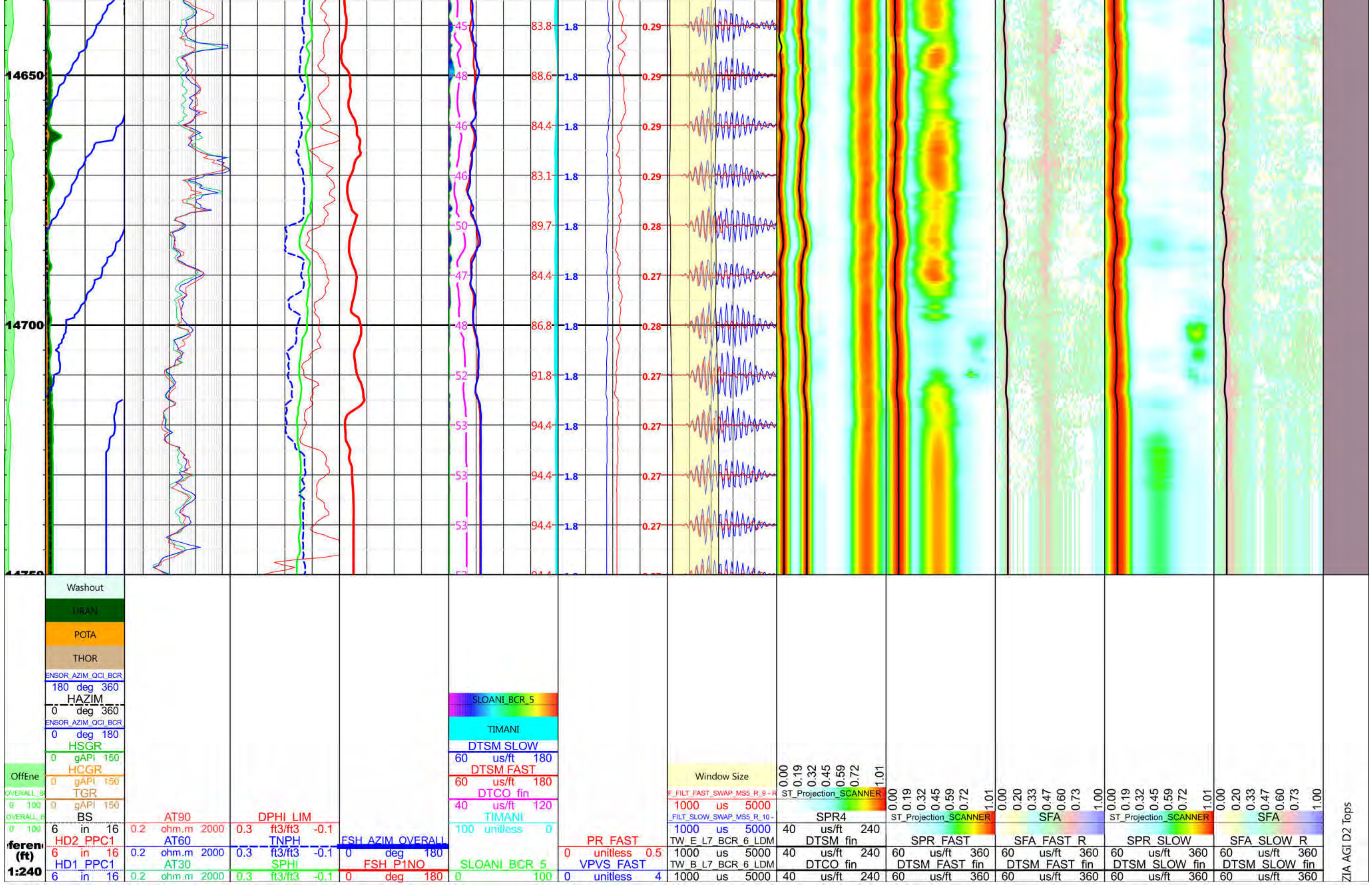
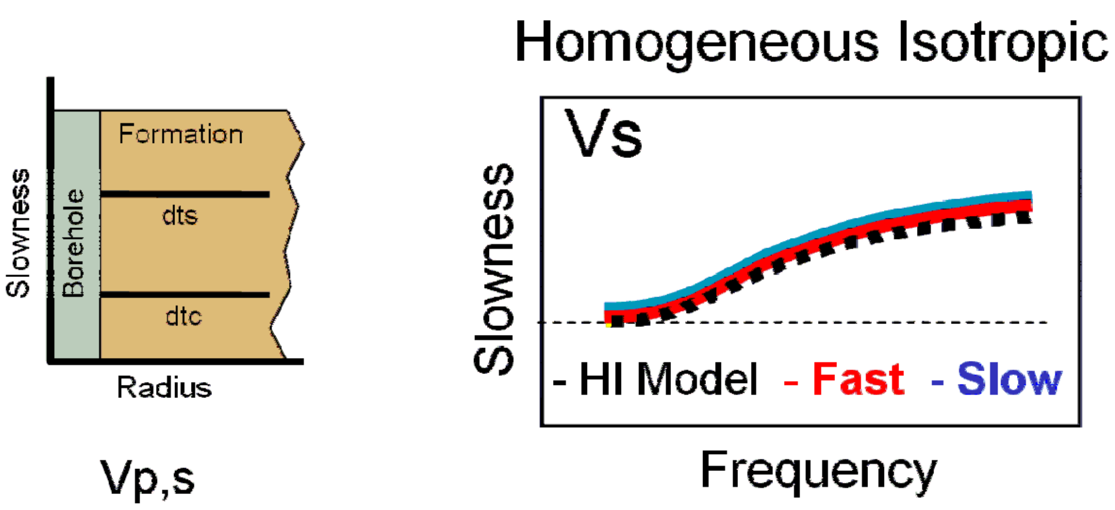
14050
14100
14150
14200
14250
FUSSELMAN
FUSSELMAN



14300
14350
14400
14450
14500
14550
14600
MONTOYA
MONTOYA

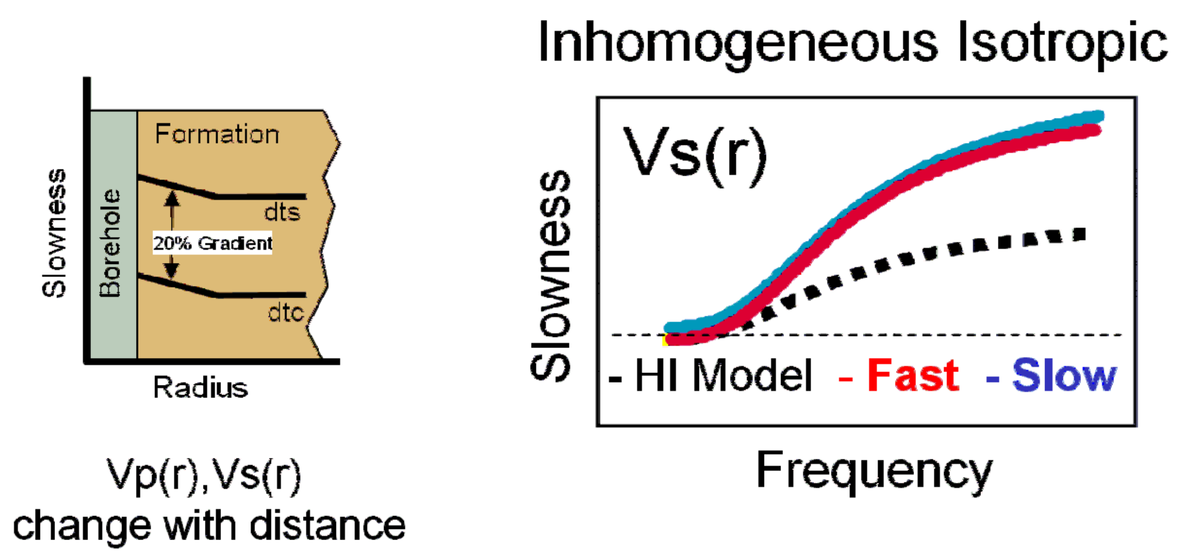


Homogeneous Isotropic Model



Shear slowness is the same in all directions, which is the basis of the Homogeneous Isotropic (HI) formation model.

Inhomogeneous Isotropic Model



Shear slowness changes with distance from the borehole. On dispersion plots, fast and slow shear curves will overlay and be higher than the HI model at higher frequencies.

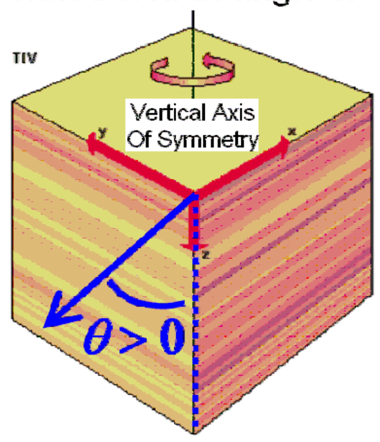
Homogeneous Anisotropic Formation Model

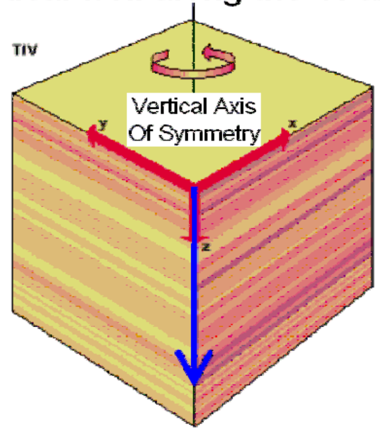
Transverse Isotropic Vertical – TIV
Shales & Bedding or Layering - $V_s(\theta)$

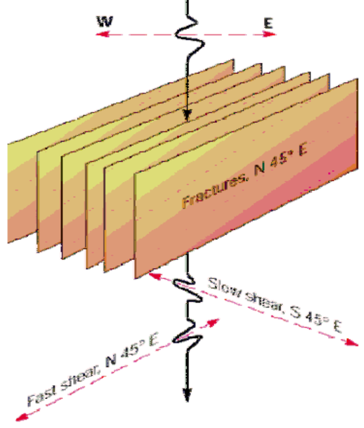
Deviated well at angle to TI axis

Vertical well along the TI axis

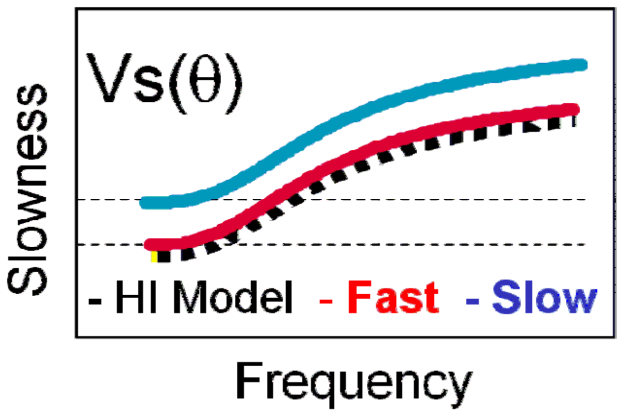
Transverse Isotropic Horizontal – TIH
Fractures - $V_s(\theta)$



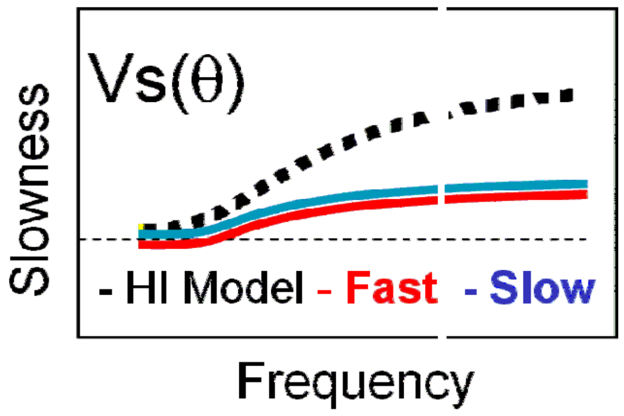




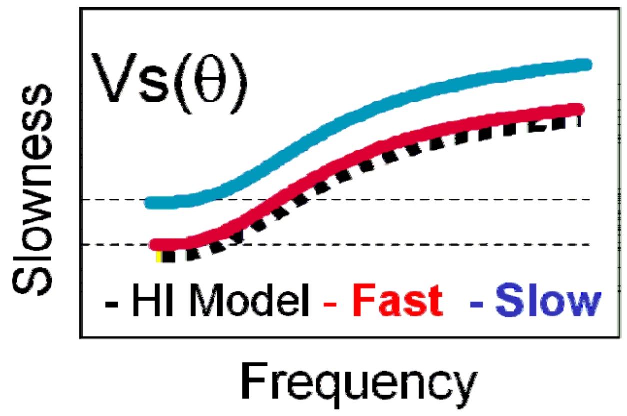
Intrinsic Anisotropy



Intrinsic Anisotropy



Intrinsic Anisotropy

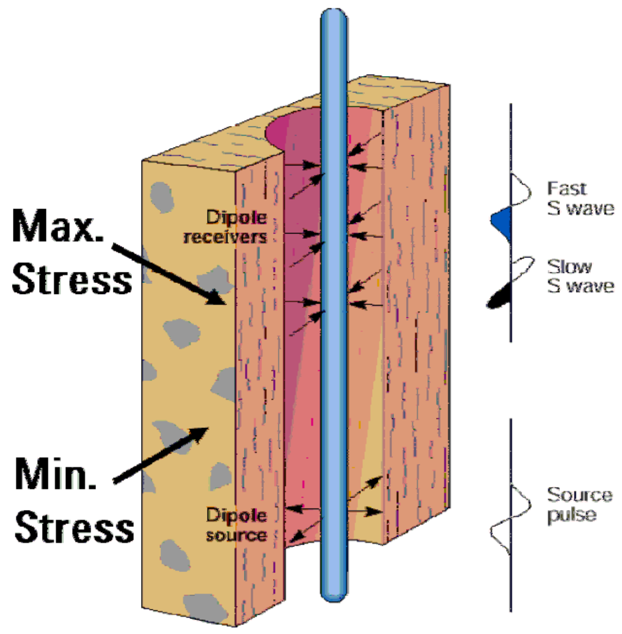


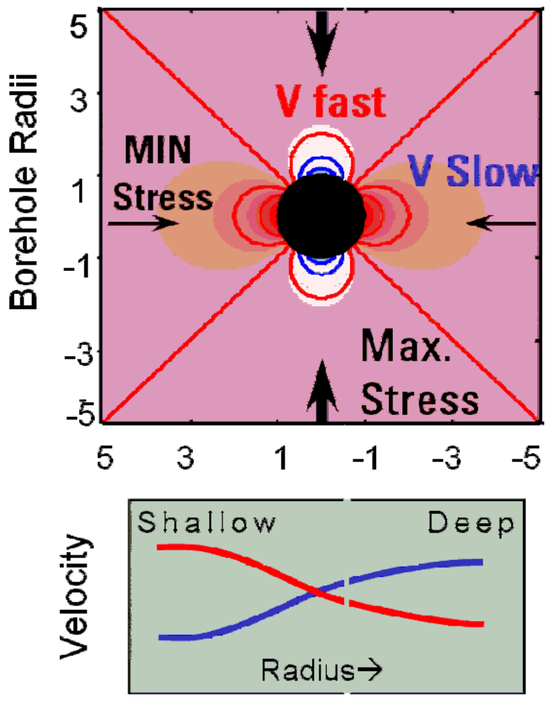
Shear velocity is function of angle in shales. On dispersion plots, the fast and slow shear are parallel to each other, and their relationship to the HI model is a function of angle.

Shear travels slower across fractures. On dispersion plots, the fast and slow shear are parallel to each other, with the slow shear shape close to that of the HI model.

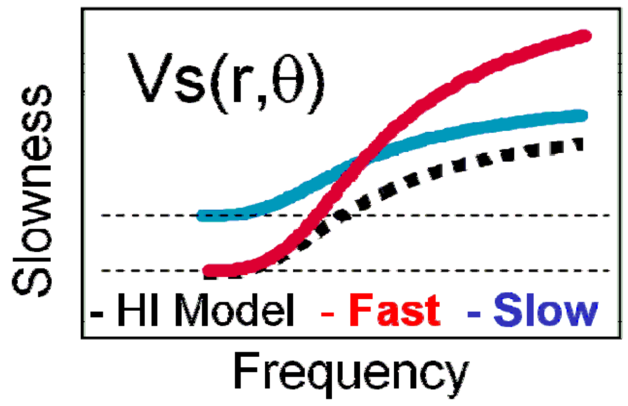
Inhomogeneous Anisotropic Formation Model

Intrinsic Anisotropy – Stress Induced – $V_s(r,\theta)$





Inhomogeneous Anisotropic (Stress) Induced



Shear velocity is a function of radius and angle, with the slowest shear velocity in the direction of minimum stress. On a dispersion plot, this is characterized as a crossover of the fast and slow shear as frequency increases.

FIELD:AGI Devonian Exploration
COUNTY:Lea
STATE:New Mexico
COUNTRY: USA

API No.: 30-025-42207

Date Processed: 1/13/2017