



Optical and Acoustic TelevIEWer Borehole Logging – Improved Oriented Core Logging Techniques

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GEOSCIENCE, INC.**

MYTHBUSTERS



THE PROBLEM:



- Highly fractured zones and soil filled joints – four episodes of folding and faulting
- Folded rock fabric within cut

THE PROBLEM:



- Maintaining core orientation difficult in highly fractured rock – soil seams up to 4” to 6” thick, significant core loss
- Local drillers not accustomed to double-or triple-tube coring methods

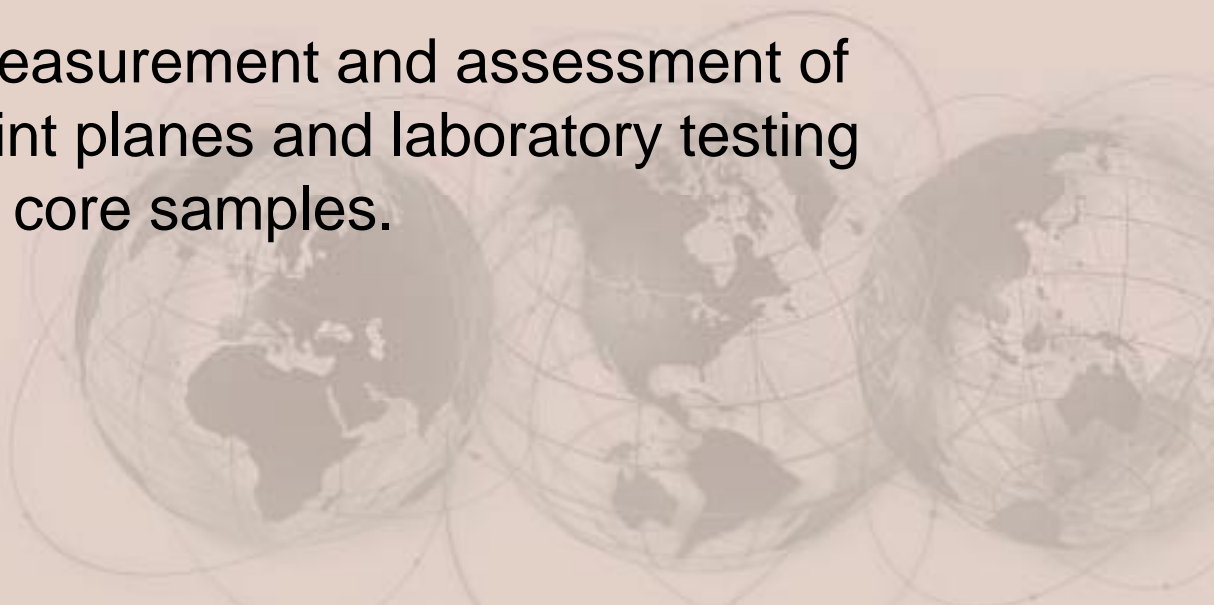
15-foot rockfall boulder in Route 9 ditch

LIMITED BEDROCK EXPOSURES:





PROJECT APPROACH:

- Collect joint and discontinuity data with a coordinated field mapping and coring program
 - Geophysical borehole logging using optical or acoustic methods
 - Measurement and assessment of joint planes and laboratory testing of core samples.
- 

OPTICAL AND ACOUSTIC LOGGING:

- Early logging developed in the 1960's in the oil patch – recent advances in data processing and field equipment have yielded highly mobile and practical applications.
- Good core drilling and sampling is still vital – for verification, lab samples and to assess joint planes



BOREHOLE TELEVIEWERS:

- Can replace Oriented Coring with an oriented image of the borehole wall
- Enhance geotechnical data with high-resolution *in situ* images
- Can be a cost effective investigation technique

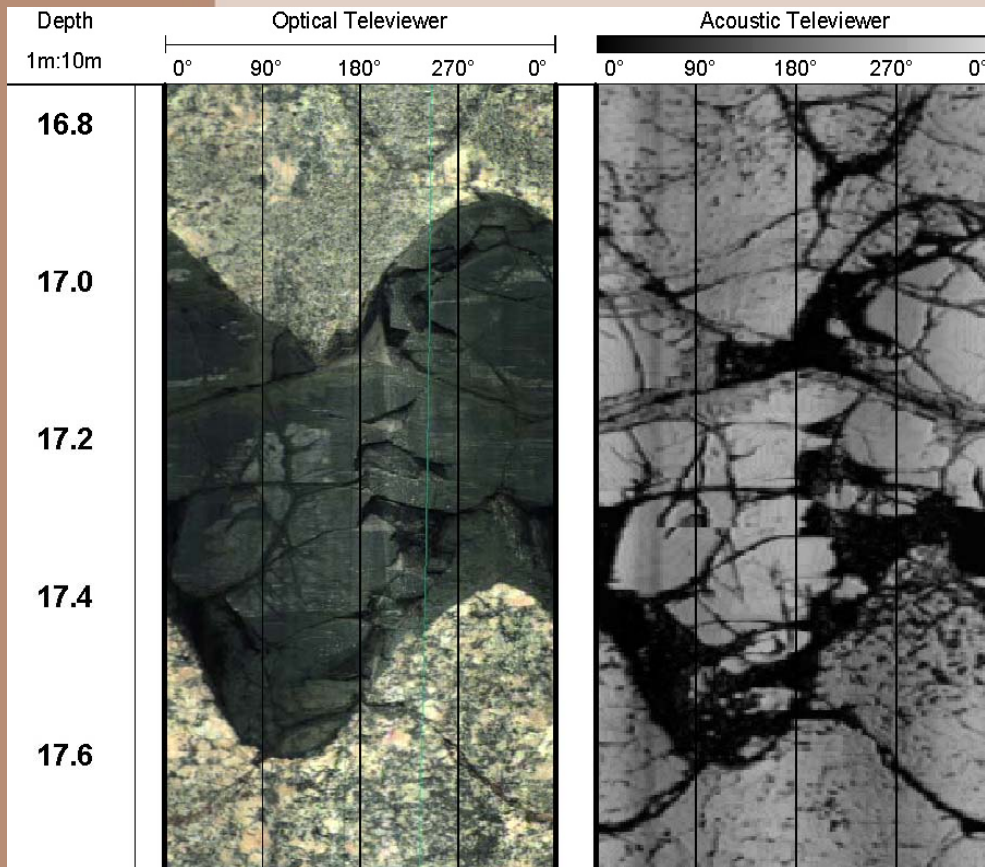


The Logging System

- Small, Portable
- Laptop controlled data collection - QC on site
- Operates independently of the drill rig



Televiewers: Optical and Acoustic



Optical:

High-resolution
digital image of
borehole wall

Acoustic:

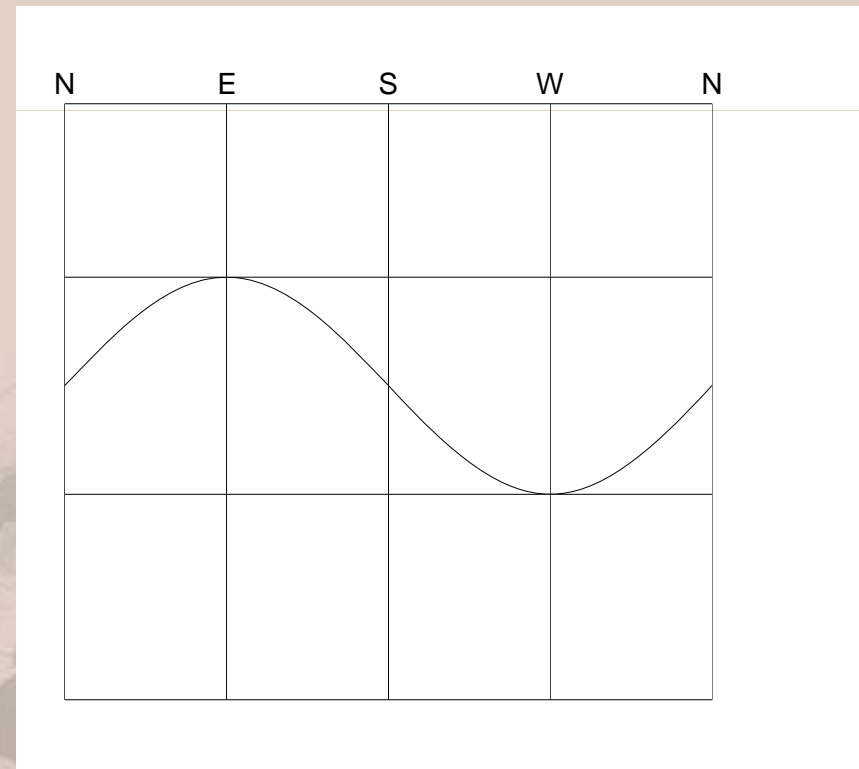
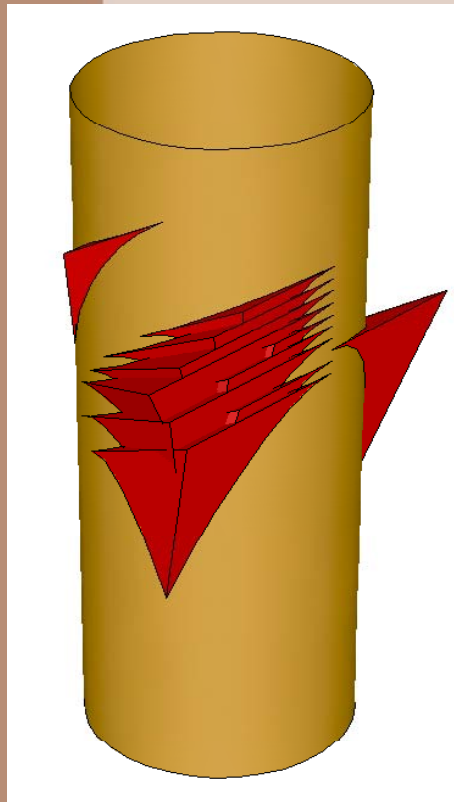
Sonar image of
borehole wall

TELEVIEWER INTERPRETATION

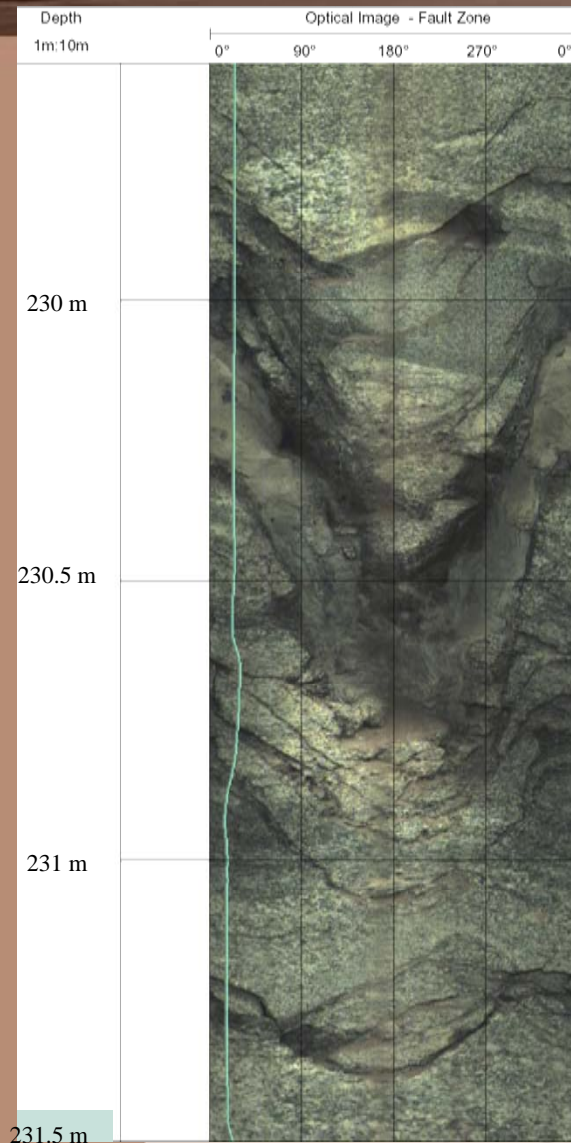
Plane Slice
Through a
Cylinder

Produces

Sinusoid in the
'Unwrapped' Televiewer
Image

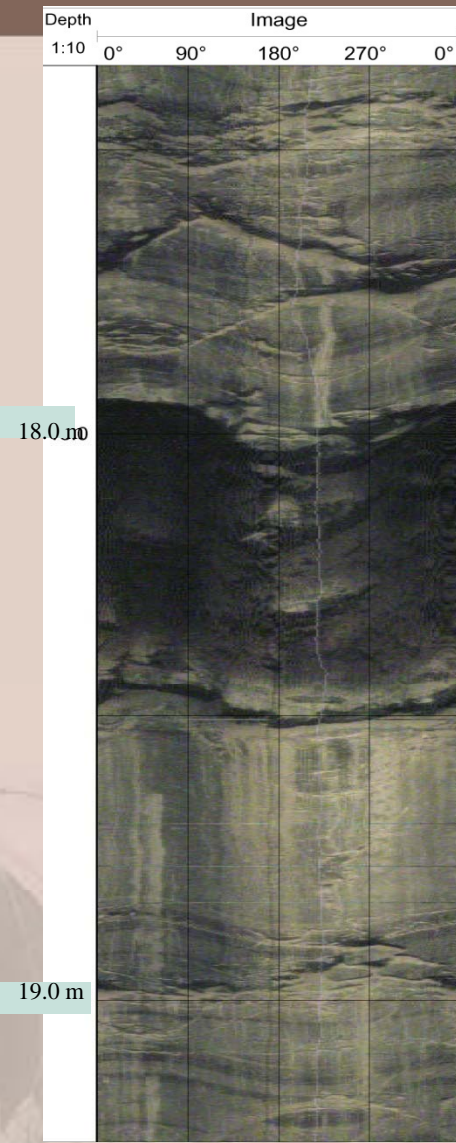


Optical Images in Fault Zones: Collecting Data in Poor Rock



Granite

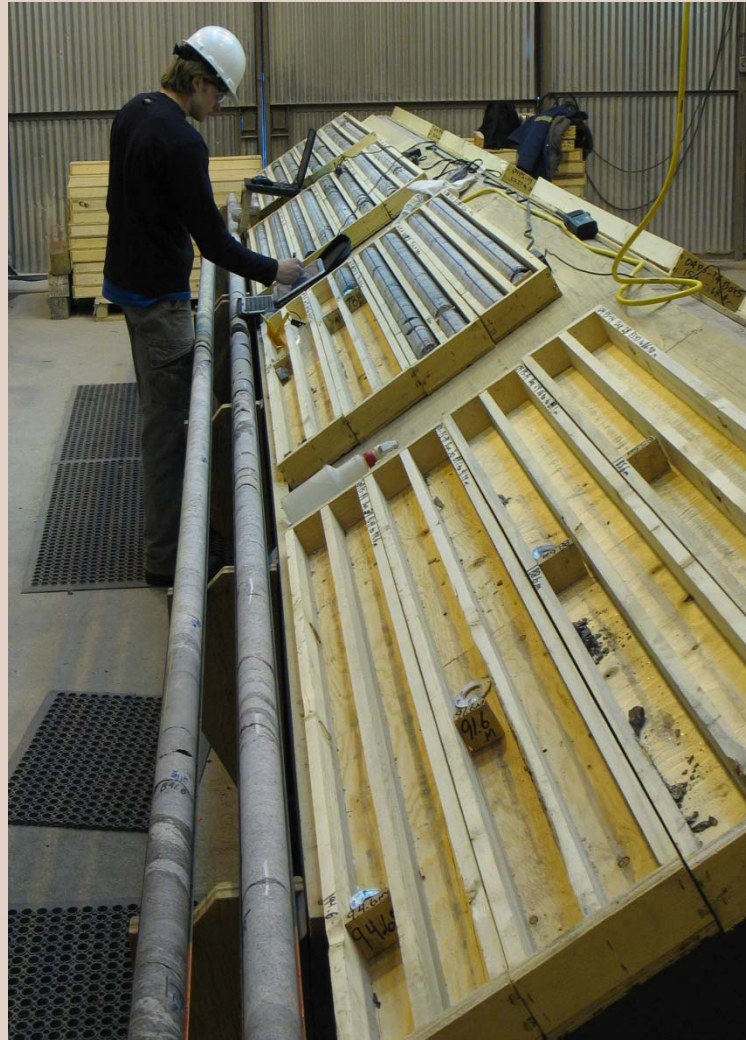
Broken Core



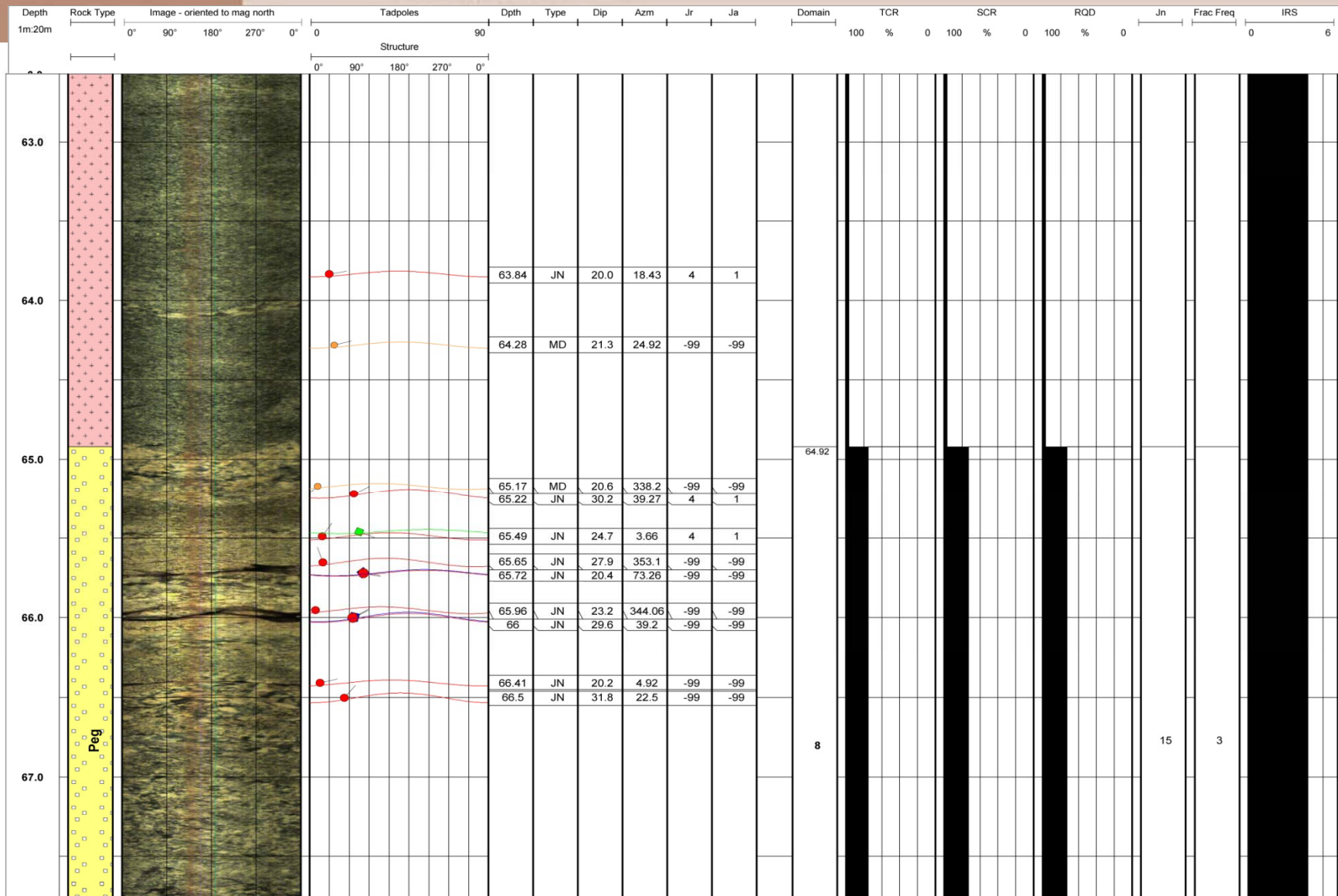
Shale

Missing Core

INTEGRATION WITH GEOTECHNICAL DATA



Geotechnical Data and Televiewer Images: One Log Sheet



Route 9 Improvements, Vermont:



All Terrain Vehicle w/ Gen-Set & Tools



Winch, Data Processor and Laptop



Caliper Tool



Optical Televiwer Tool

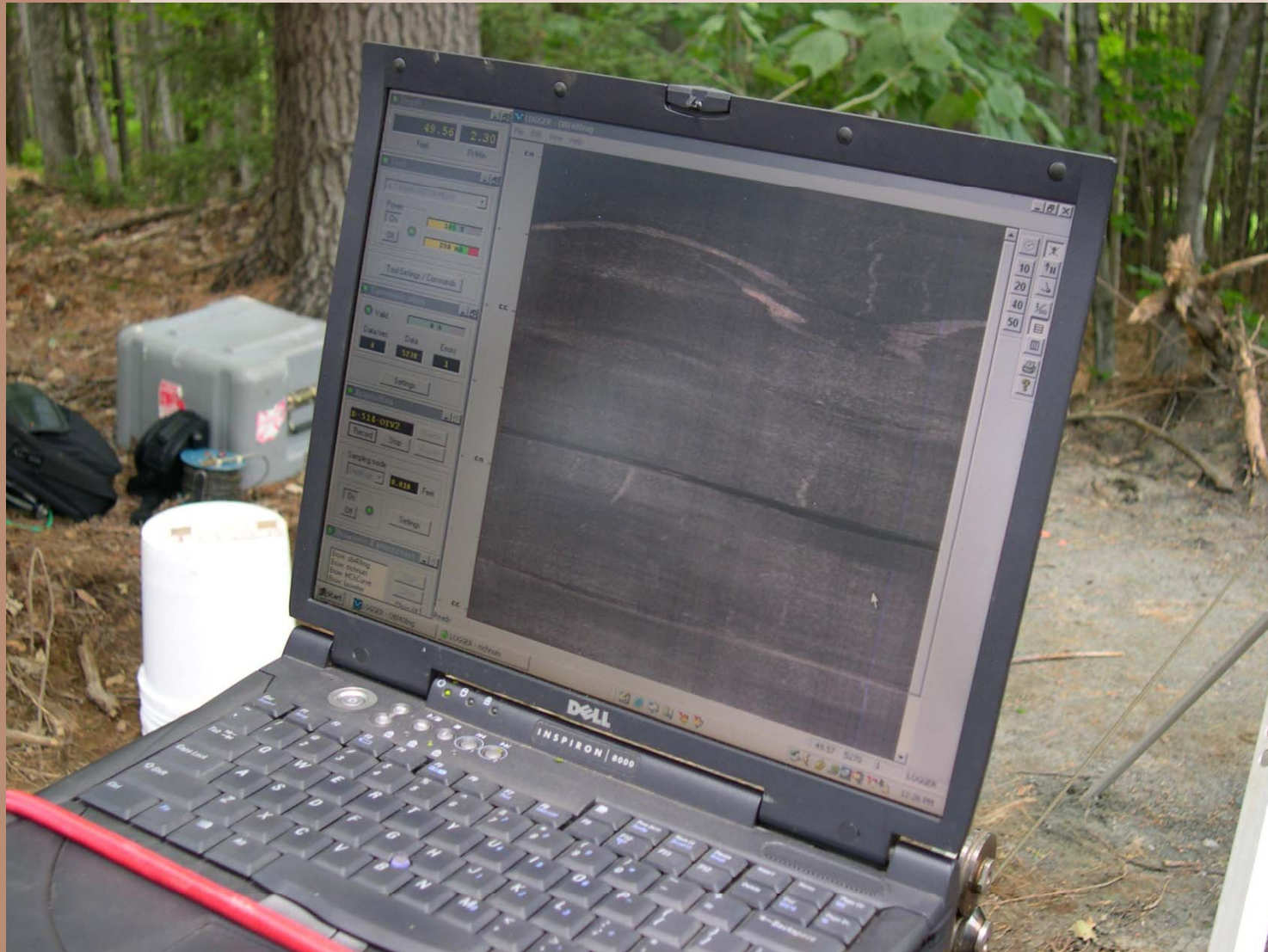


Acoustic Televiwer Tool

Route 9 Improvements, Vermont:



Route 9 Improvements, Vermont:



I-93 Improvements, New Hampshire:



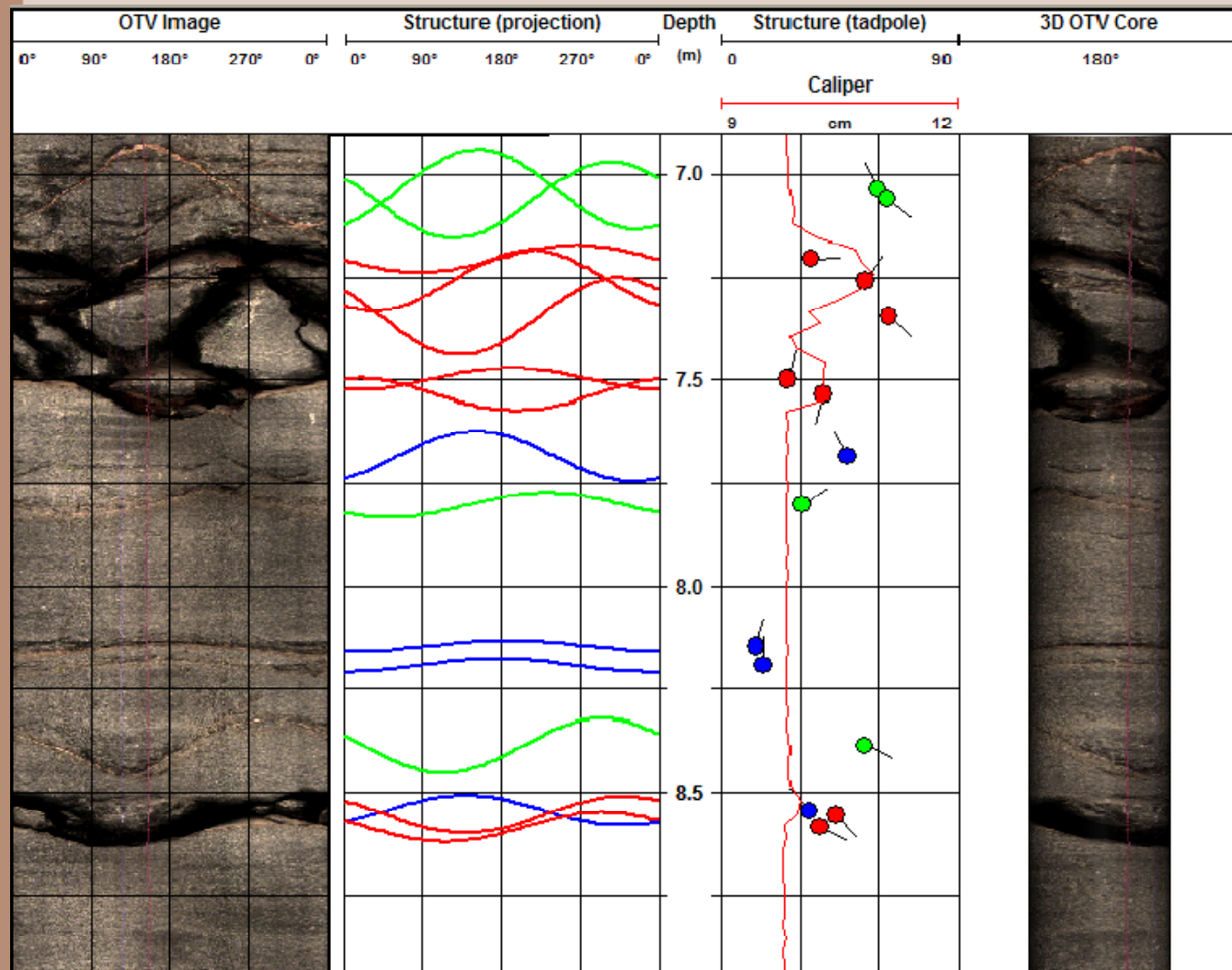
I-93 Improvements, New Hampshire:



I-93 Improvements, New Hampshire

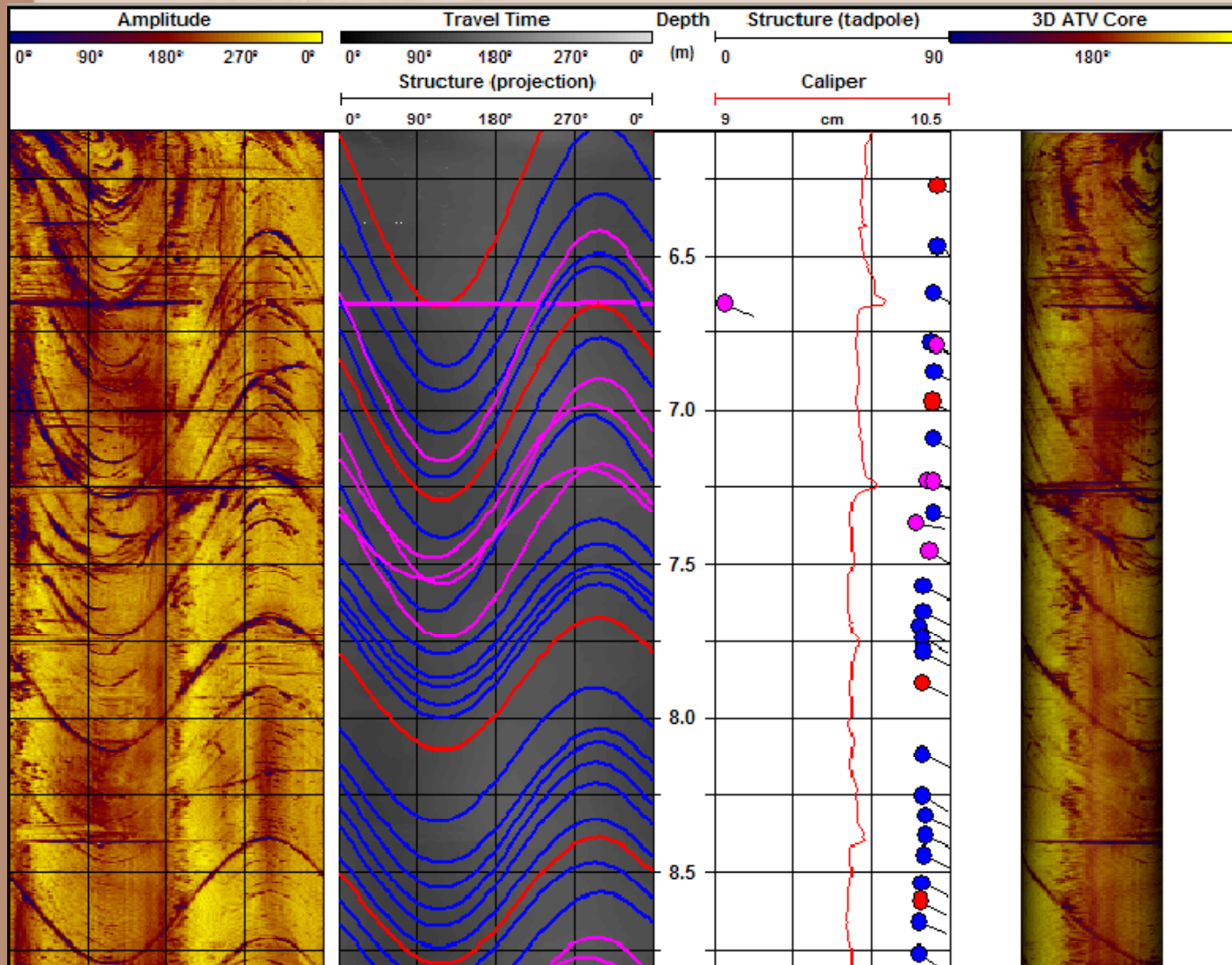


Route 9 Improvements, Vermont:



Optical Televiewer Log

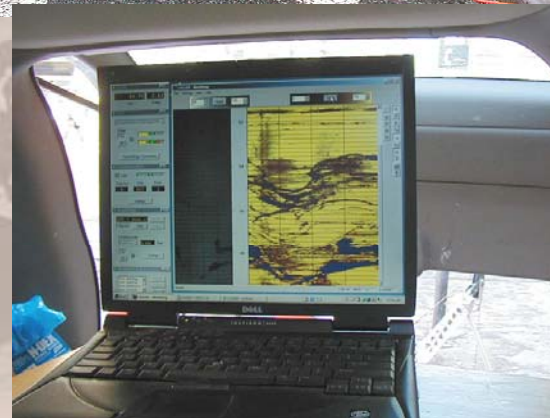
Route 9 Improvements, Vermont:



Acoustic Televiewer Log

TelevIEWER Logging in New York City:

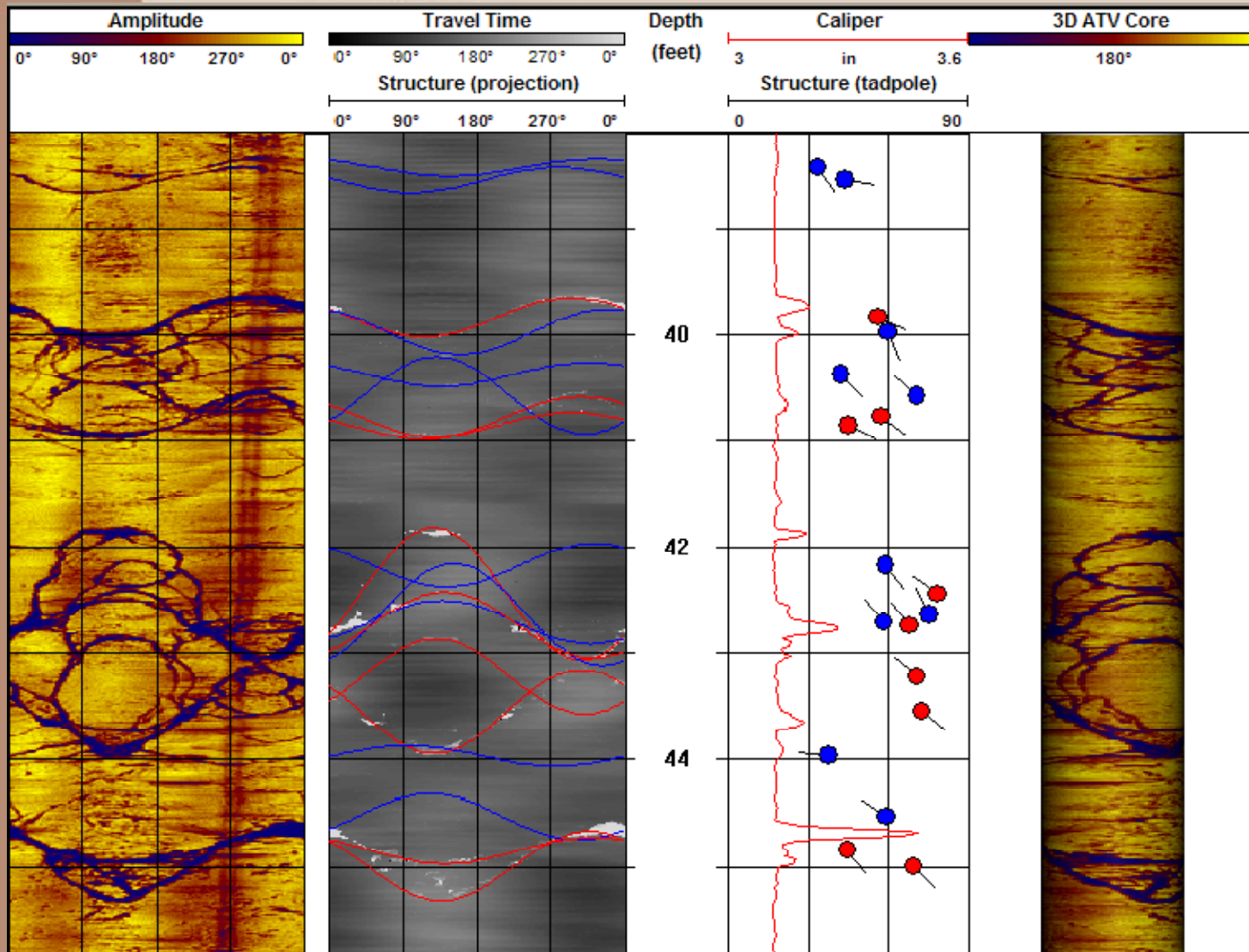
Getting there is half the battle....



Freedom Tower, World Trade Center Site:



TelevIEWER Logging – New York City:



NYC TelevIEWER Log

Diavik Diamond Mine



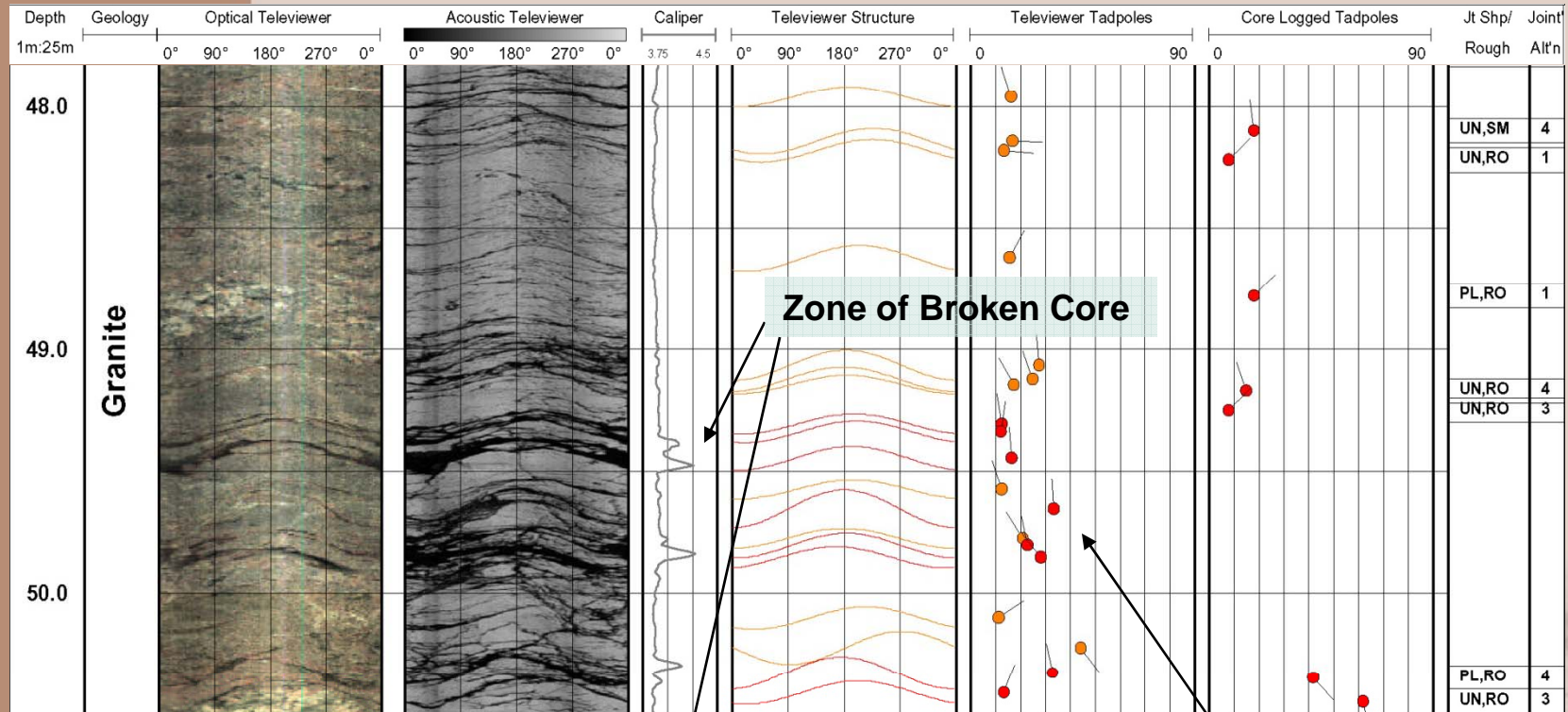
Diavik Diamond Mine

- Geotechnical drilling for pit slope stability investigation
- Televiewers introduced – oriented coring phased out



Diavik Diamond Mine

Advantages: Structural data where it's most needed



Core Photograph

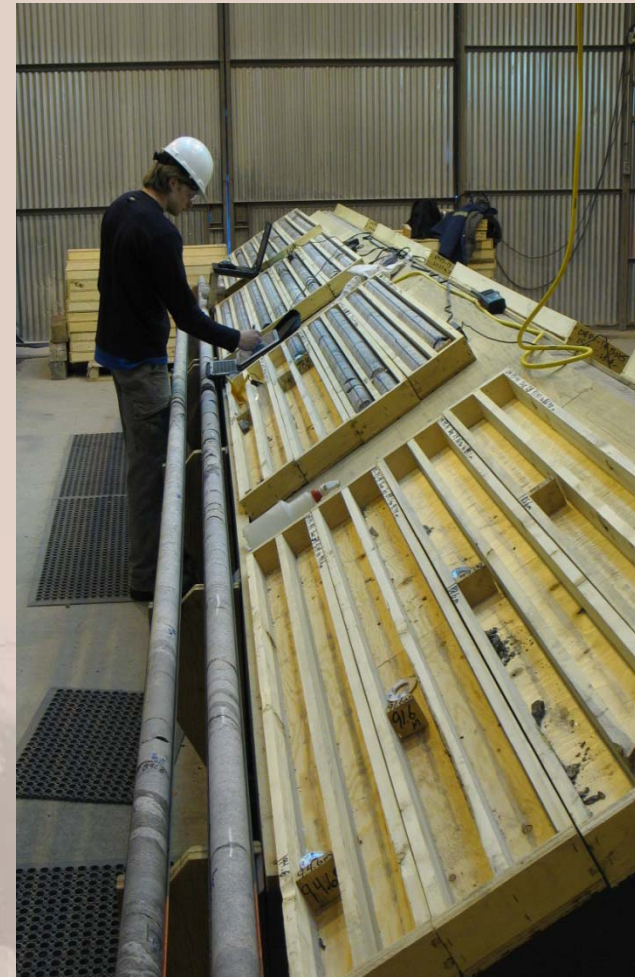


Televiwer interprets data reliably in fracture zone

Diavik Diamond Mine

Primary Benefits:

- **Costs reduced** – fewer staff, fewer hours on site, faster, more accurate core logging
- **Improved results** – greater confidence in structural orientations, *in situ* images, comprehensive log sheets



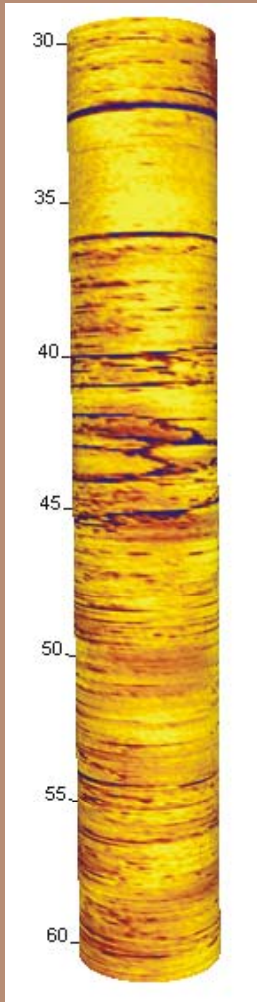
Tuen Mun Road - Hong Kong

- Acoustic and impression packer core orientation – foam coring
- Six major sheet joints in micro fractured granite
- 9000 vehicles/hr – Six Lanes

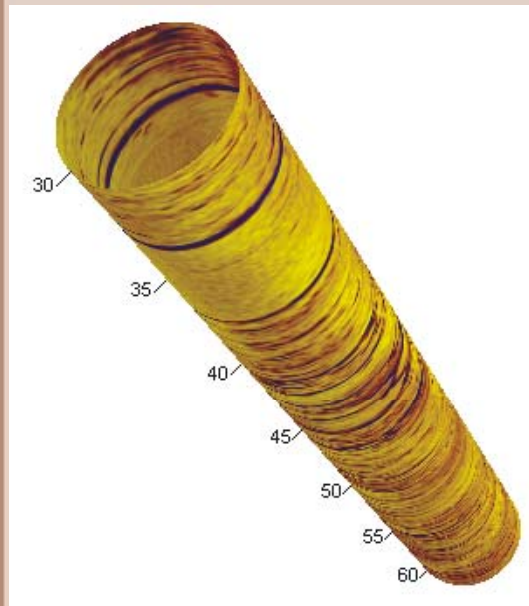


WellCad Televiewer Tools:

- Virtual cores can be developed from televiewer images and viewed from all angles



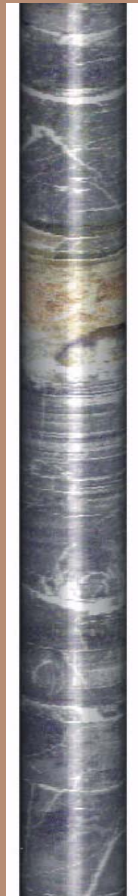
Virtual Acoustic Core - NYC



Virtual Optical Core - VT



Example “Virtual Core” plots from OPTICAL Televiewer

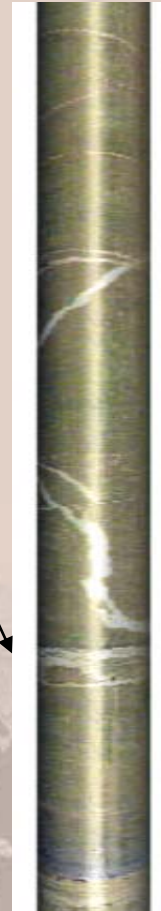


Soft Clay Interval
Within a Fault Zone

Calcite Veins in
Fault Zone



Fractures
with
Alteration



Calcite Veins
in Fault Zone

- Valuable for:
- Design Assessment
 - Data Interpretation
 - Contractor bidding

Televviewer Project Considerations:

OPTICAL TELEVIEWER

- Borehole diameter 3 – 12 inches
- Clean borehole – clear fluid or air filled
- Logging has produced excellent results in diamond drill and good results in air rotary boreholes

ACCOUSTIC TELEVIEWER

- borehole diameter 3 – 12 inches
- Fluid need not be clear but must be present in borehole
- Logging has produced excellent results in diamond drill and good - fair results in air rotary boreholes

Borehole Televiewers: What can be gained?

- **Accurate structural orientations of features in vertical and inclined boreholes**
- Image of rock conditions in situ leading to improved geotechnical information
- Significant cost savings when compared to traditional oriented core methods



Challenges Ahead

- Merge the Geotechnical and Televiewer Information; and
- Automate Stereonet Production and Joint Set Data Synthesis.



Questions?



The best part about trees in Vermont