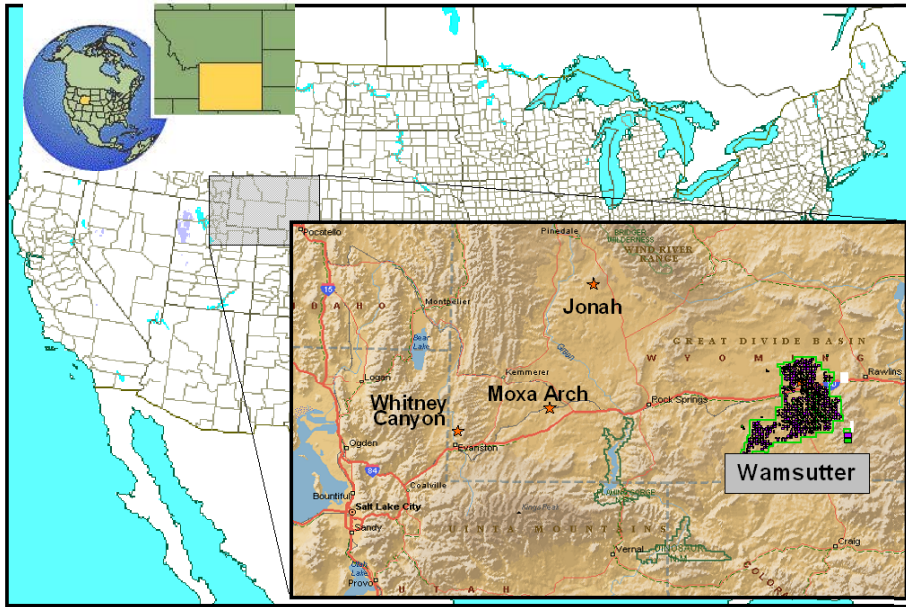


BP's World Record & World First Seismic Program - Wamsutter, Wyoming

Colin Bruce, Subsurface Manager, BP
Jim Hollis, COO, Input/Output, Inc.

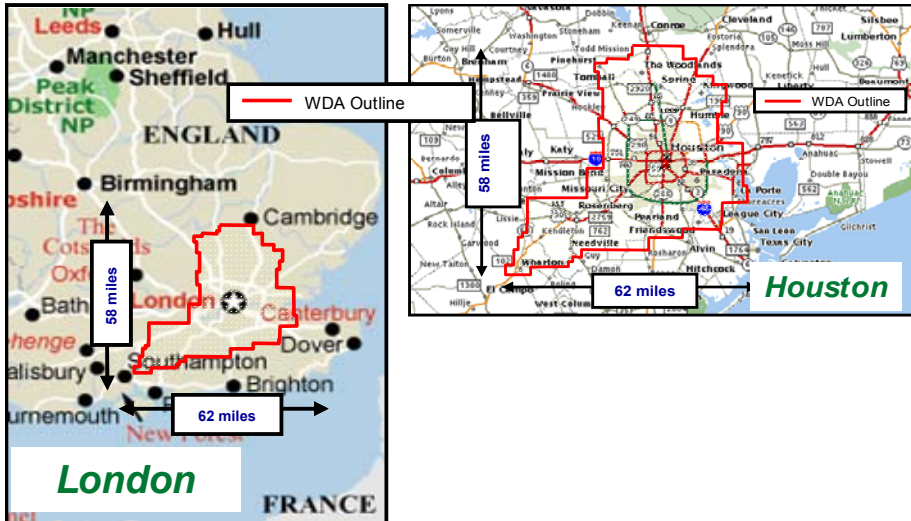


Wamsutter: Field Location



Key facts

- Tight gas field with >50Tscf GIIP discovered in '60s - Area covers 1600sq mls
- Over 2Tscf produced since first production in '77
- Checker board land ownership gives BP 40% equity of total area
- Reservoir is 500ft thick at depth of 10000ft with typically 100ft of reservoir sand
- Porosity of 9% and permeability of 0.01mD
- Developed with hydraulically frac'd vertical wells
- Wells IP at 1mmcf/d – with recoveries of 2Bscf/well
- In 2005 BP sanctioned a \$2bn 15 year 7-rig drilling campaign including \$113mm for technology
- Currently developed to 80 acres

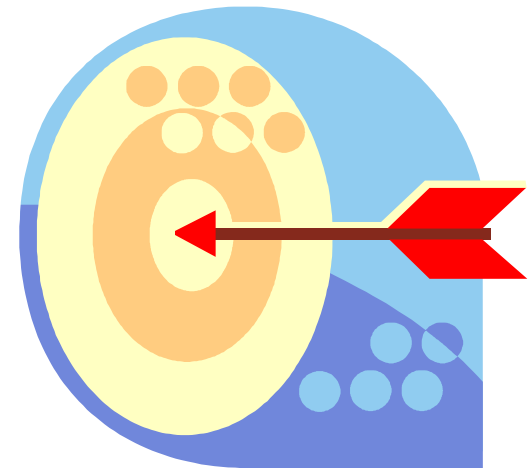


BP Objectives – Wamsutter ‘Major Project’

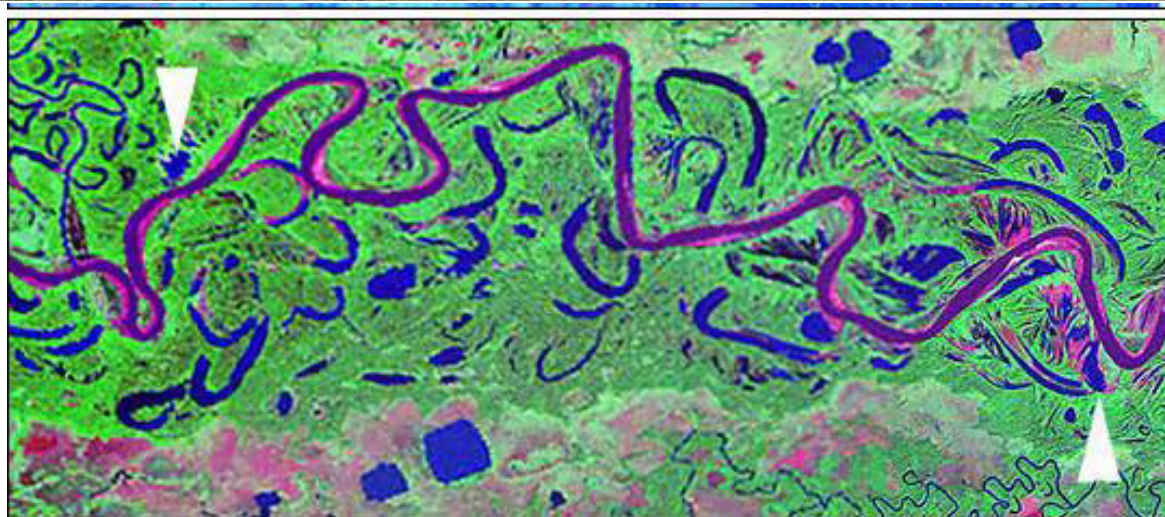
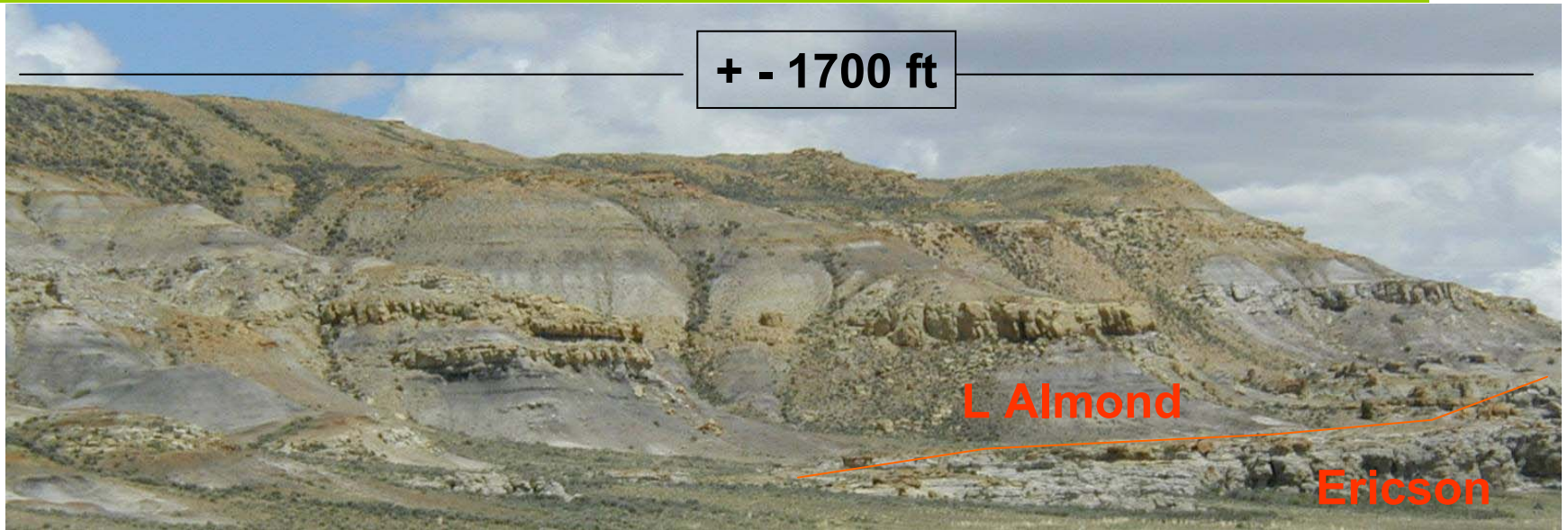


Wamsutter 2006 Integrated Seismic Program

- Address key challenges associated with the imaging of thin, tight gas-filled reservoirs in an environmentally sensitive area.
- Apply and accelerate technology to improve business and environmental performance
- Transformational ‘imaging’ outcome which affects all future BP Land Seismic Surveys on a global stage
- Incident and injury free program
- **Why – improve margins on the field by high grading drilling portfolio**



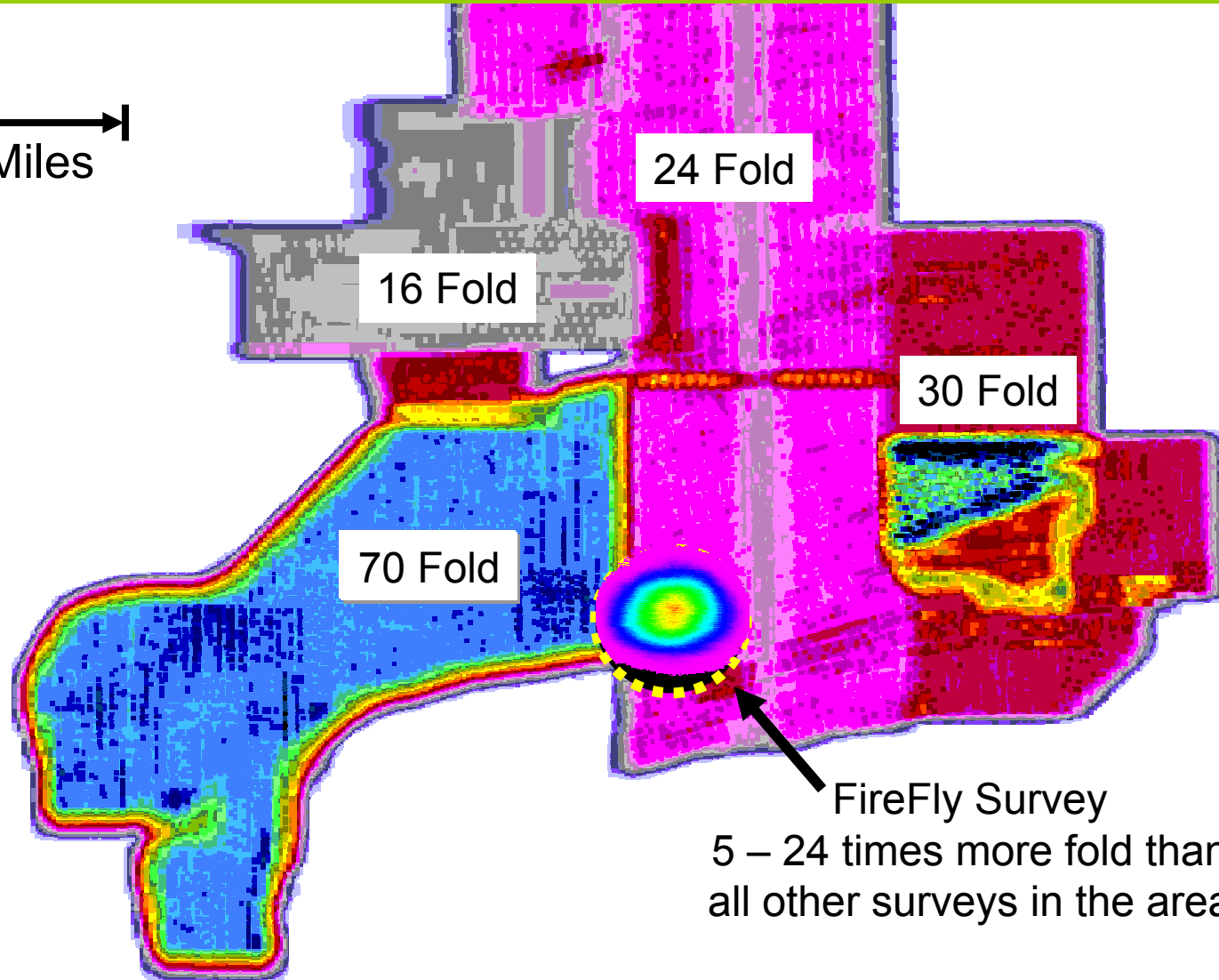
Lower Almond Analog



FireFly high density Surface Seismic

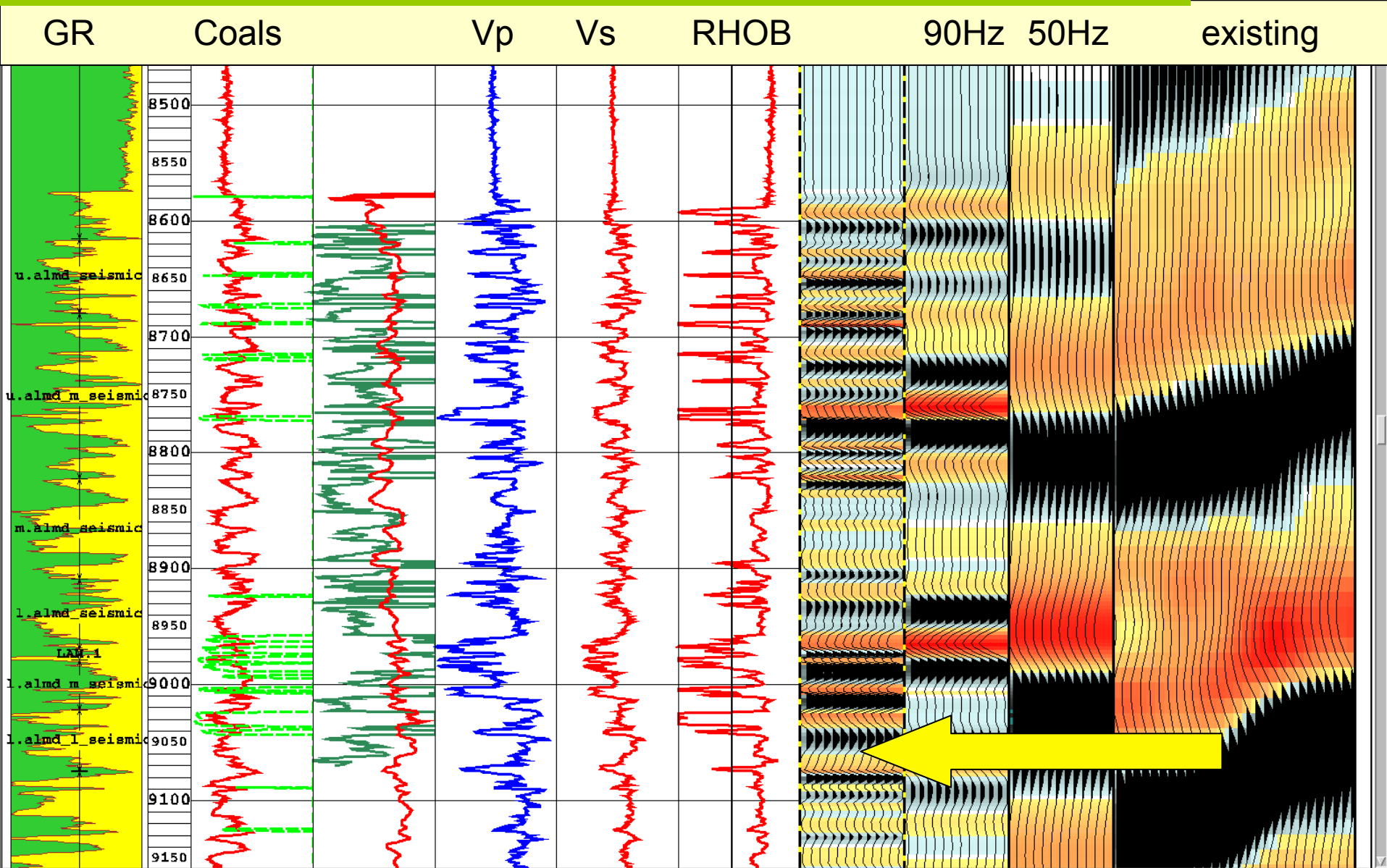


10 Miles

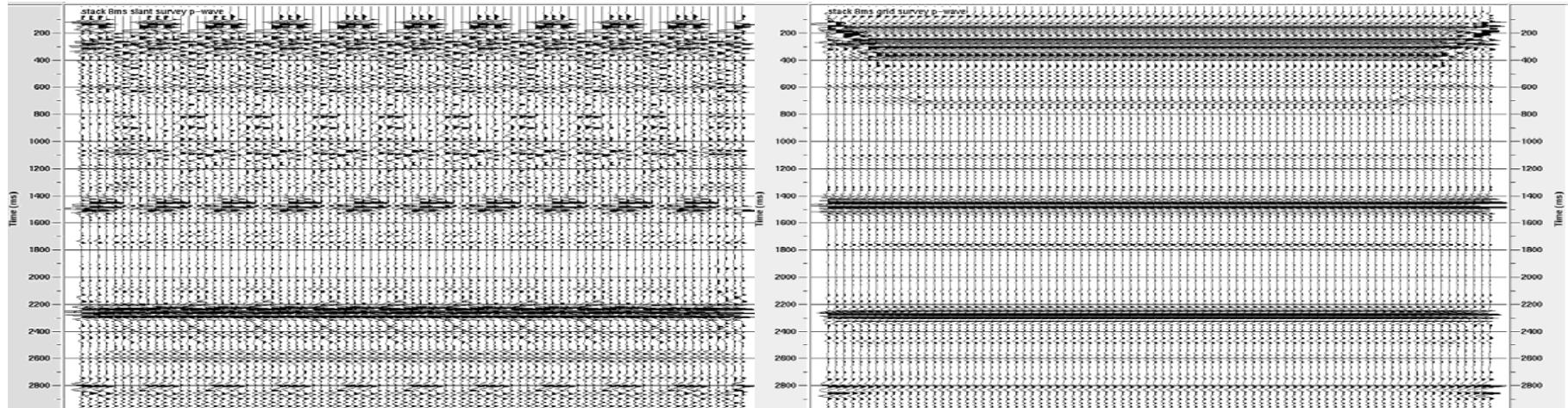


FireFly Survey
5 – 24 times more fold than
all other surveys in the area

The Seismic Challenge – Resolution!

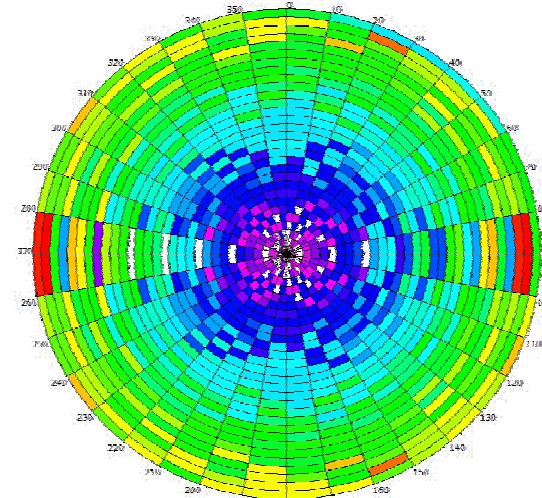
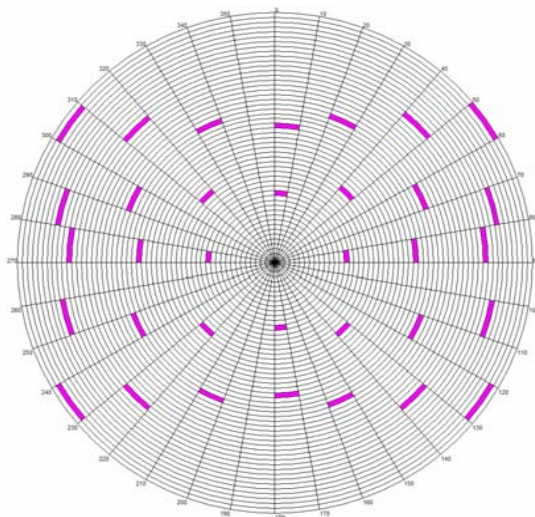


Improve the image with better sampling



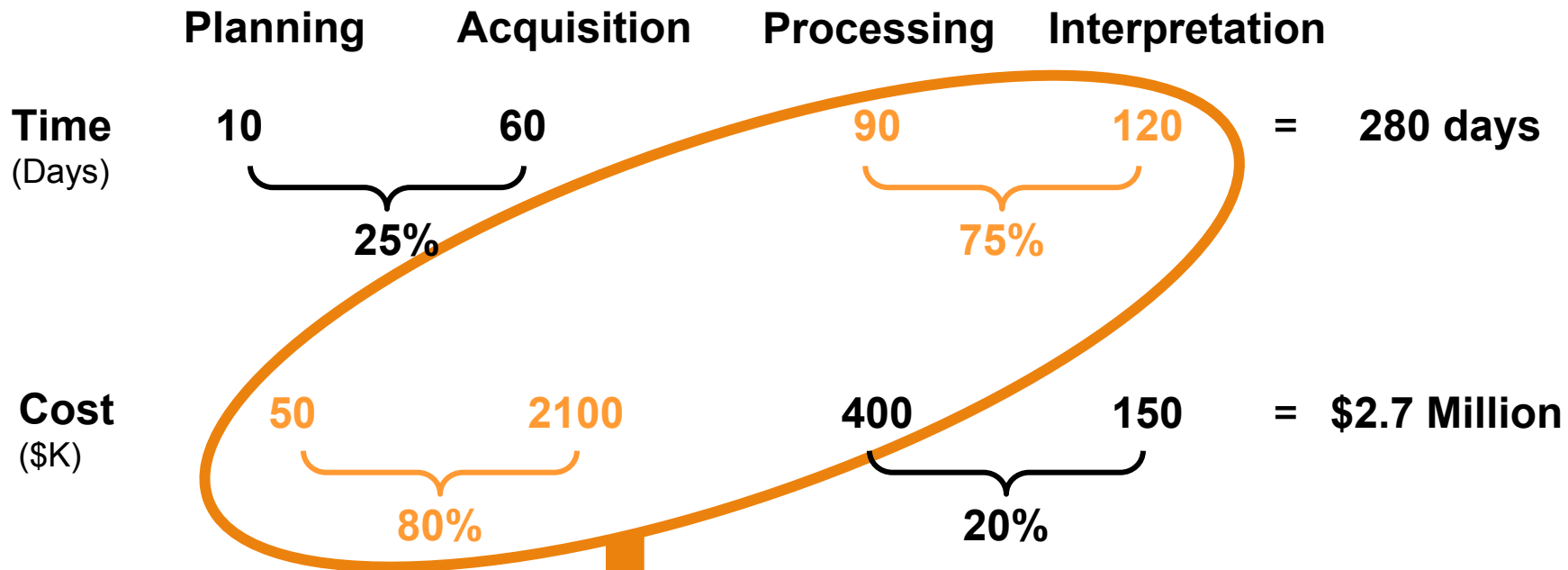
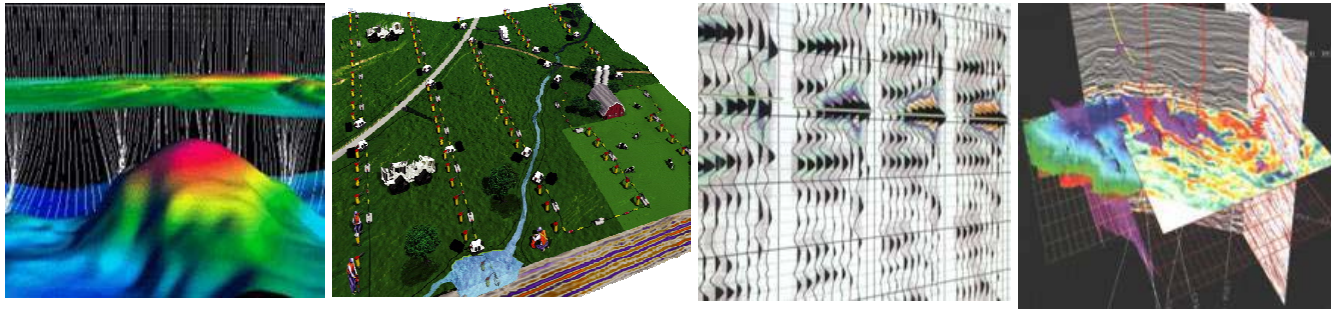
Legacy Data

Ideal Sampling



The Seismic Workflow

Cost & Cycle Time Inefficiencies at Different Stages

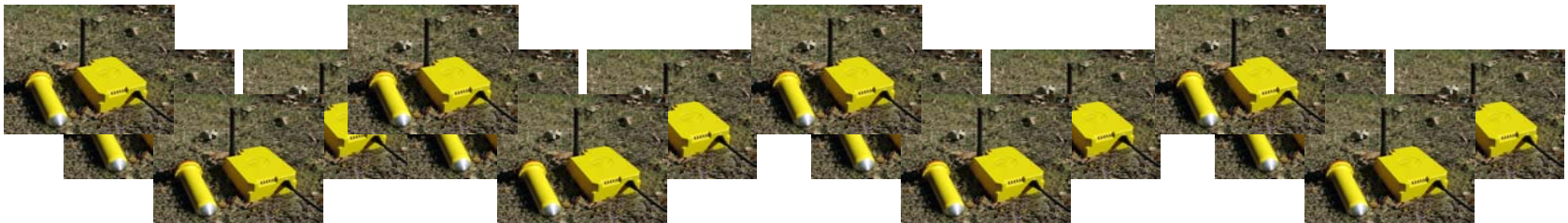


Attacking image quality, cost and cycle time requires a comprehensive 'systems' approach

FireFly Vision



- Improve the **image** using full-sampling and full-wave
- Eliminate cables & develop infrastructure to facilitate high **productivity**
- Reduce impact on the **environment** and improve **safety**

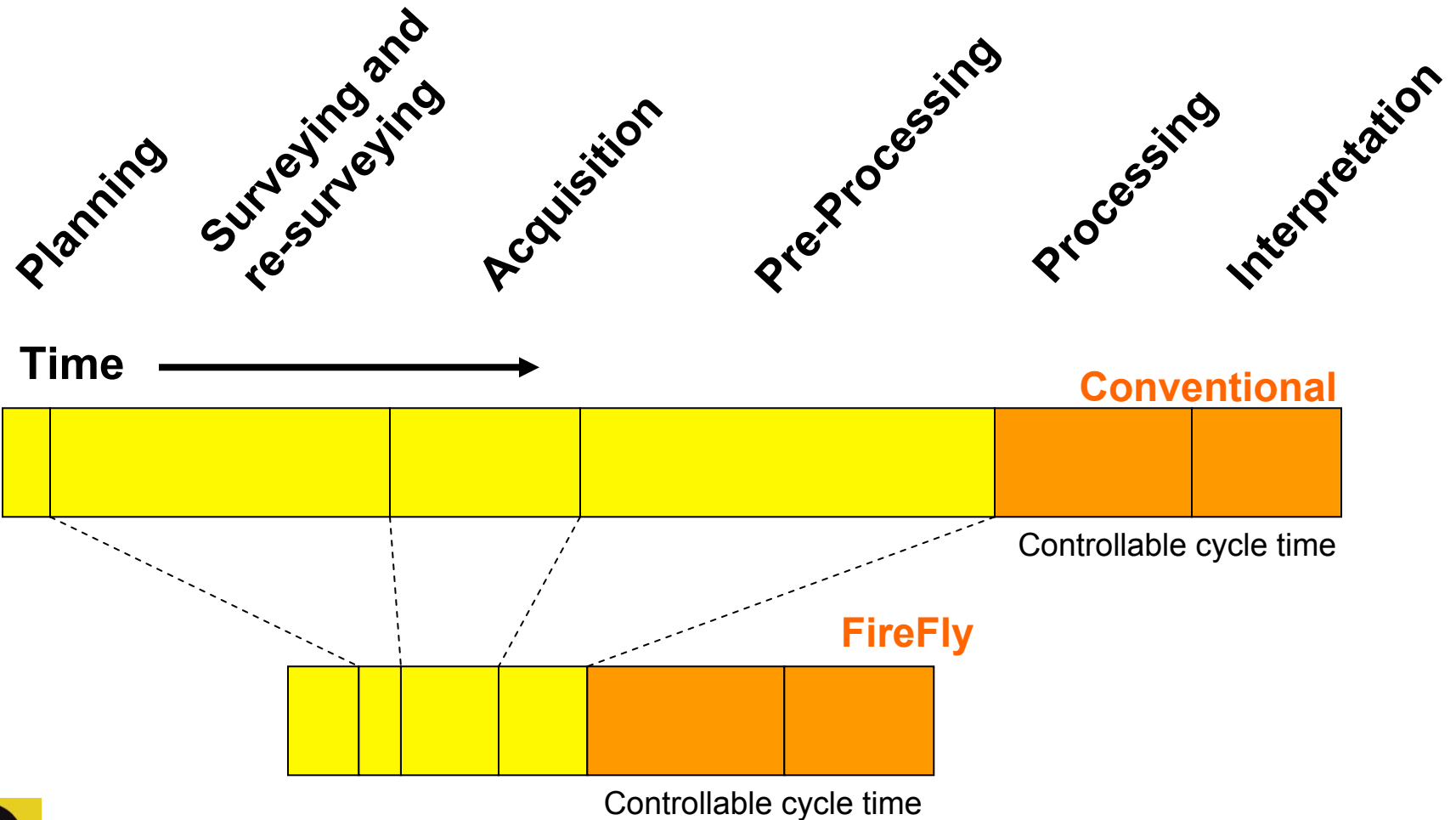


Scale station count without scaling people, cost
and environmental impact.

What's wrong with cable?



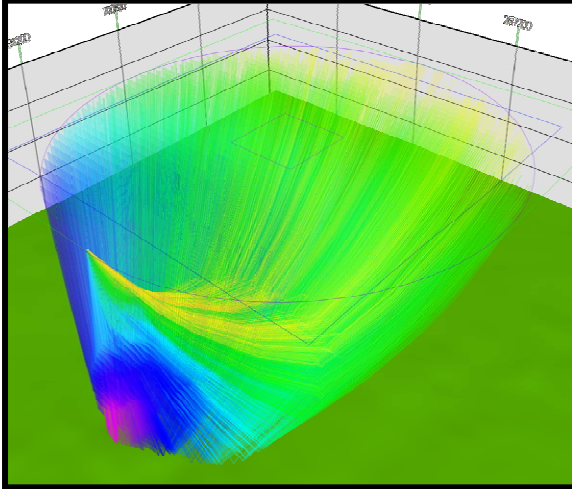
FireFly Ecosystem Vision applied to Wamsutter



The FireFly™ Ecosystem



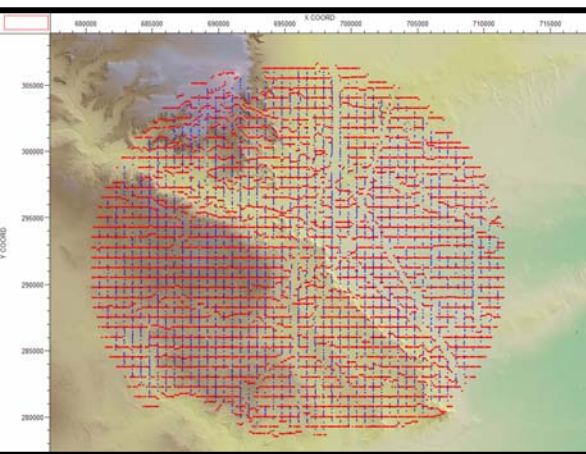
Survey design for optimum image



Navigation and positioning



Node based, full wave recording system



GIS planning and operations support



Comprehensive data management

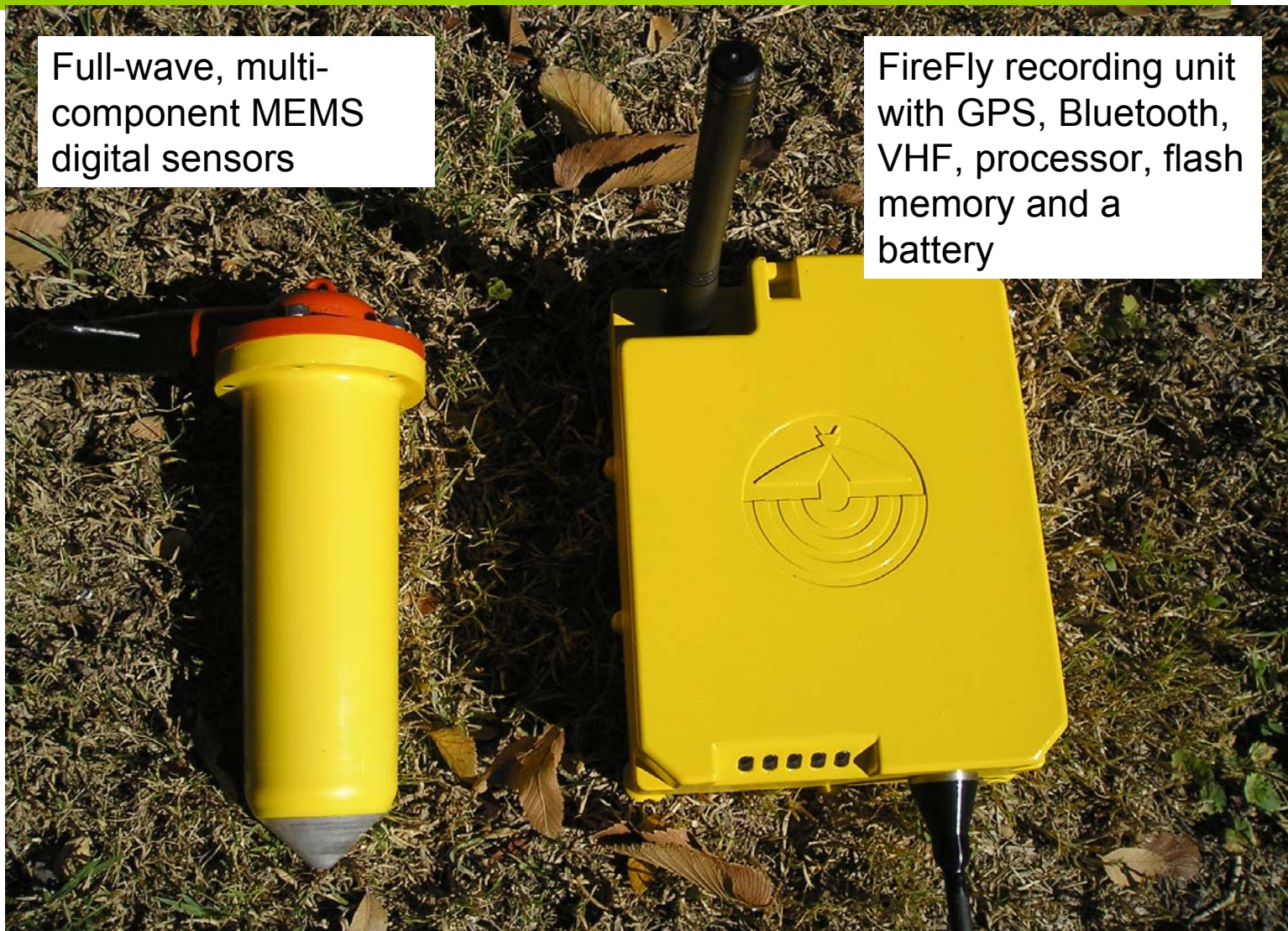


FireFly - FSU and SVSM



Full-wave, multi-component MEMS digital sensors

FireFly recording unit with GPS, Bluetooth, VHF, processor, flash memory and a battery



FireFly Connex™ Command & Control Software

Leveraging Concept Systems Expertise in Onshore Acquisition



Connex Software in the Doghouse

- Digitized 3-D database of all source and receiver points on the survey
- Datacom backbone cost-effectively connects to navigation and positioning tools of all field workers



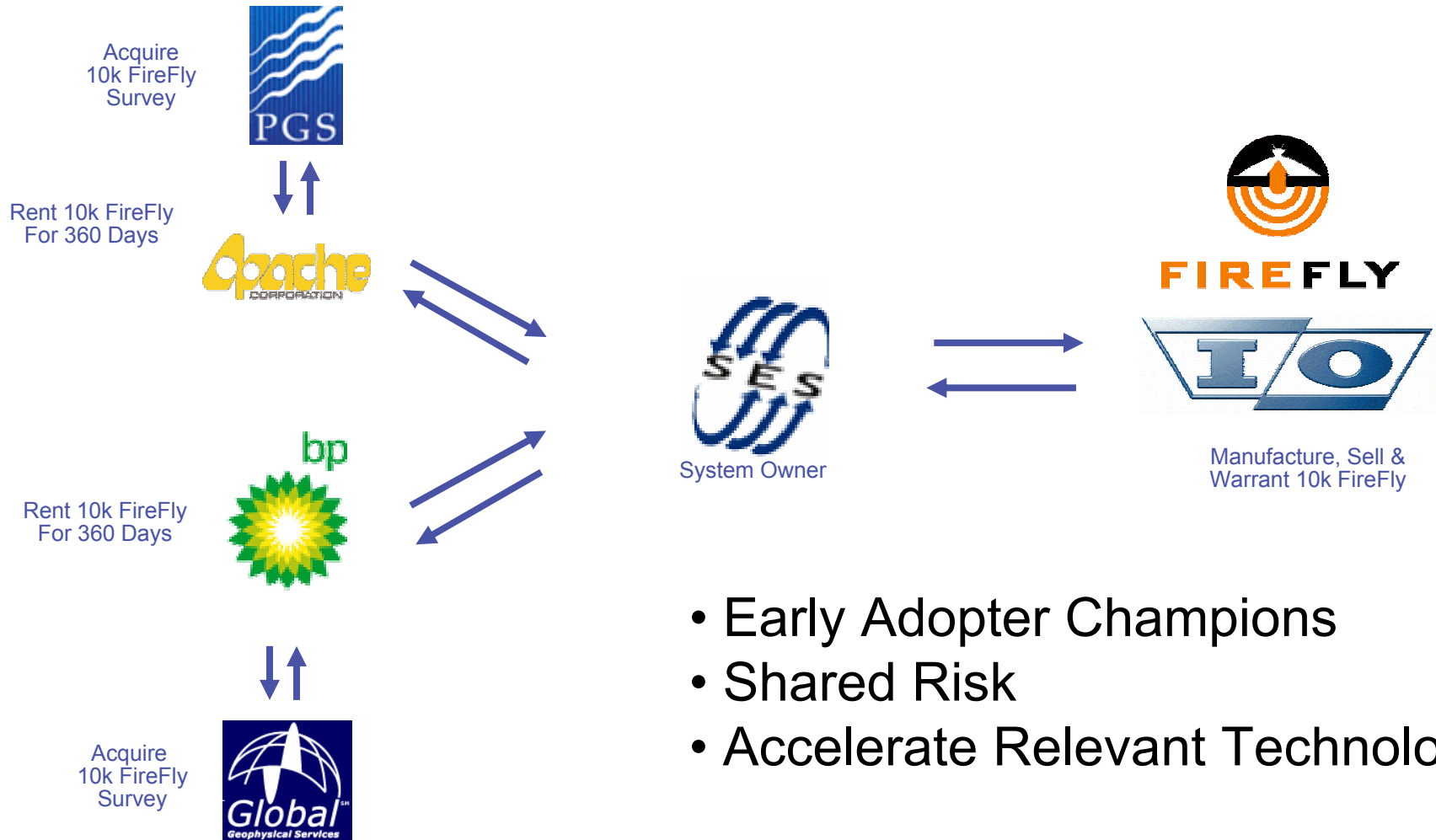
Connex Software in the Field

- Real-time navigation and positioning
- Accurate and efficient location of all source and receiver points

The Road to Wamsutter....



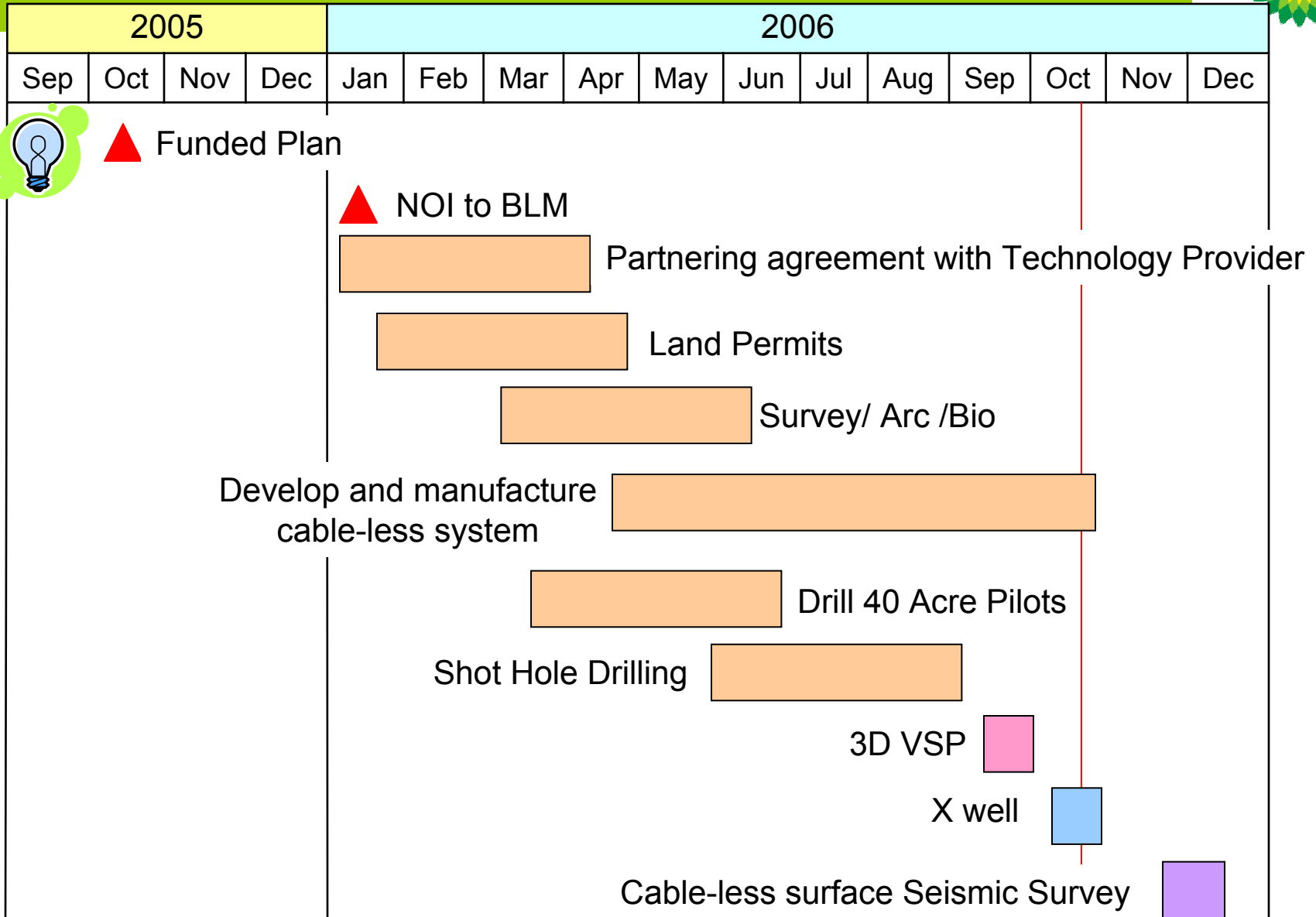
Innovative Business Model



- Early Adopter Champions
- Shared Risk
- Accelerate Relevant Technology



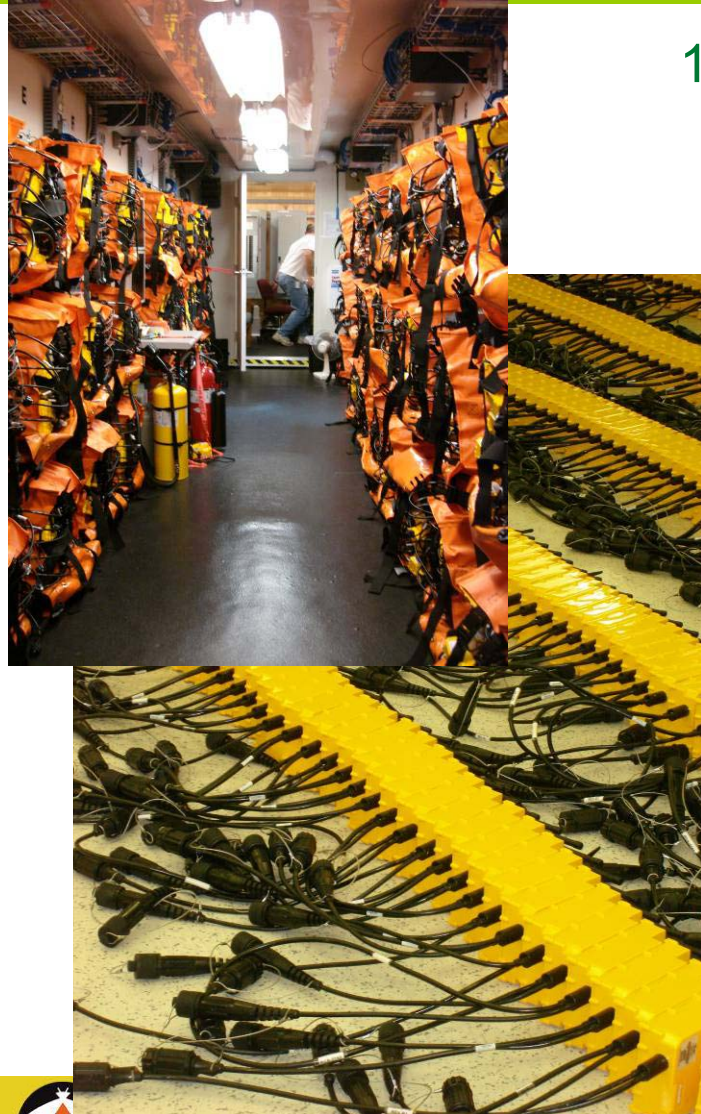
Remarkable Pace



Manufacturing and Commissioning



10,000 node system
Backpacks
Staging Trailer
Dog House
Azimuth Tools
Navigation Tools
etc, etc, etc

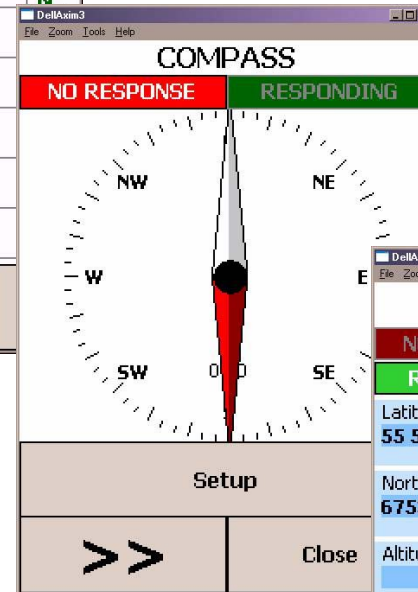
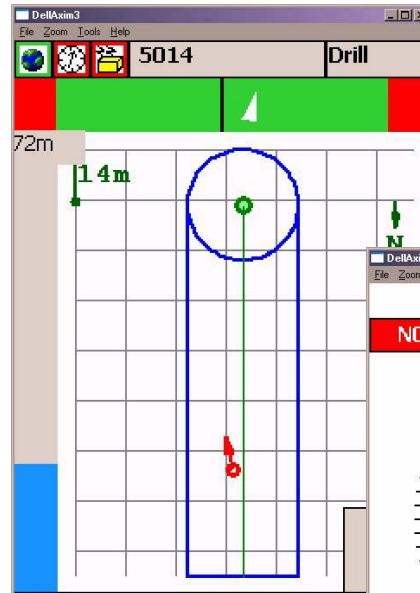


System Testing and Training



- Sealy Texas Testing Site
- Component and Ecosystem Testing
- HSE Focused (mini-Wamsutter)

Field Navigation



GPS DEVICE		
NO RESPONSE		NO FIX
RESPONDING		GPS FIX
Latitude	Longitude	
55 57'56.23 N	3 11'45.07 W	
Northing	Easting	
675384.99	325451.97	
Altitude	Heading	Speed
	189.00	2.00 m/sec
HDOP	PDOP	VDOP
2.20 m	3.00 m	2.00 m
Setup		Satellites
>>		Close

Heliportable Operations Carrousel Layout & ATR Pickup



Deploying the Sensors



Two man “One Touch”
Operations & “Data Integrity”

Antenna and Remote Central Mesh Network

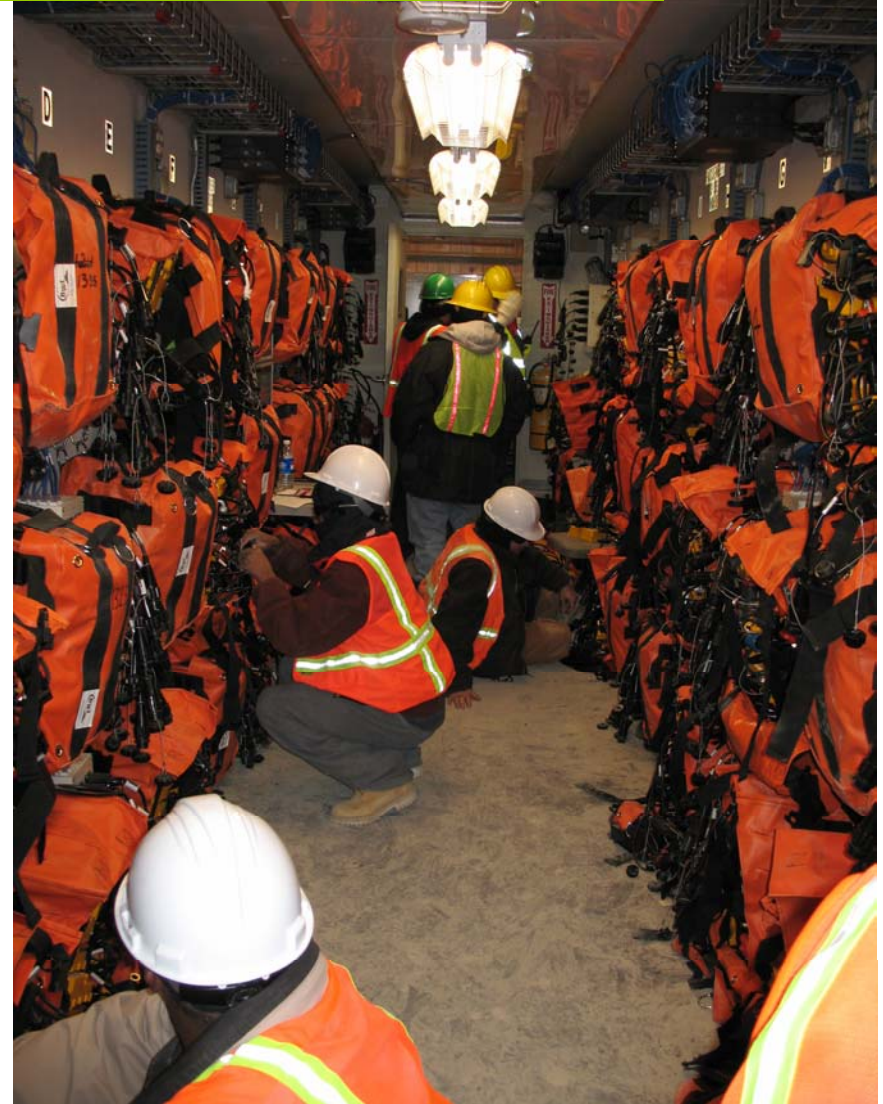


Shooting - Automated source control Digital Shot Queuing



Staging Trailer

Data download and battery recharge



Comparisons with Cable

Time (45 Man Crew vs 75 Man Crew)

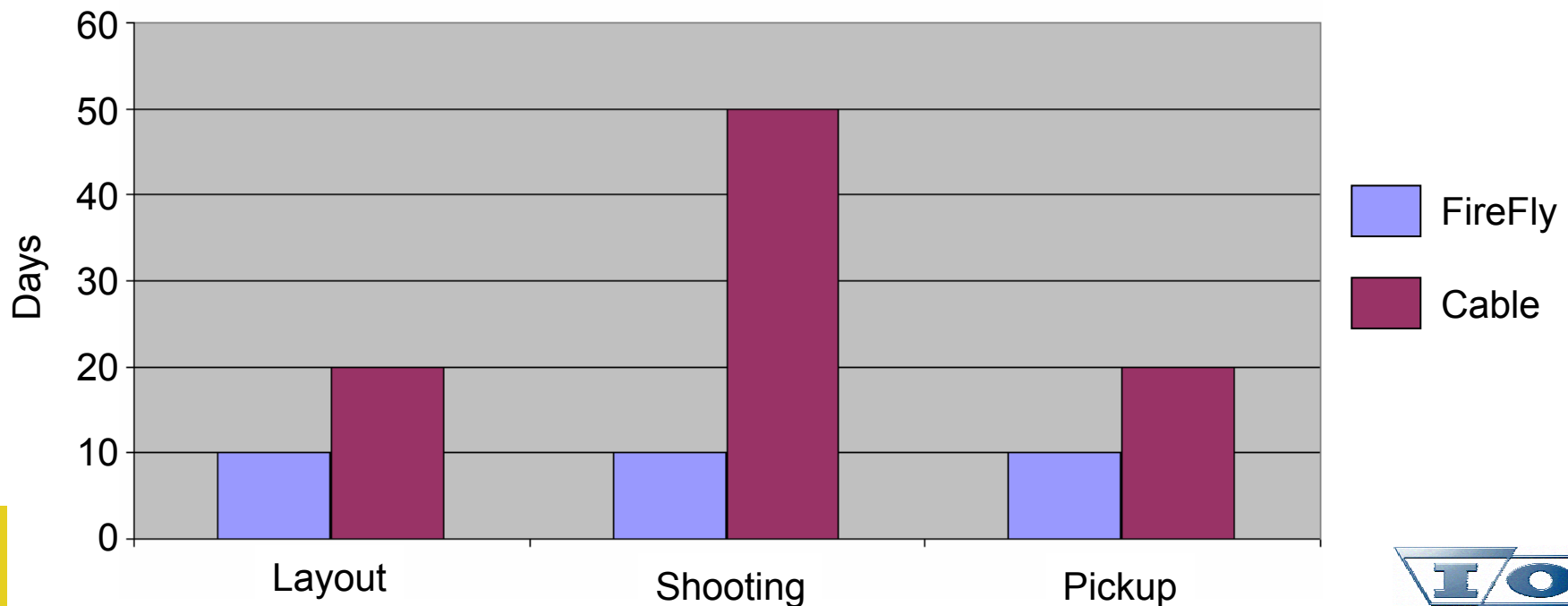


FireFly

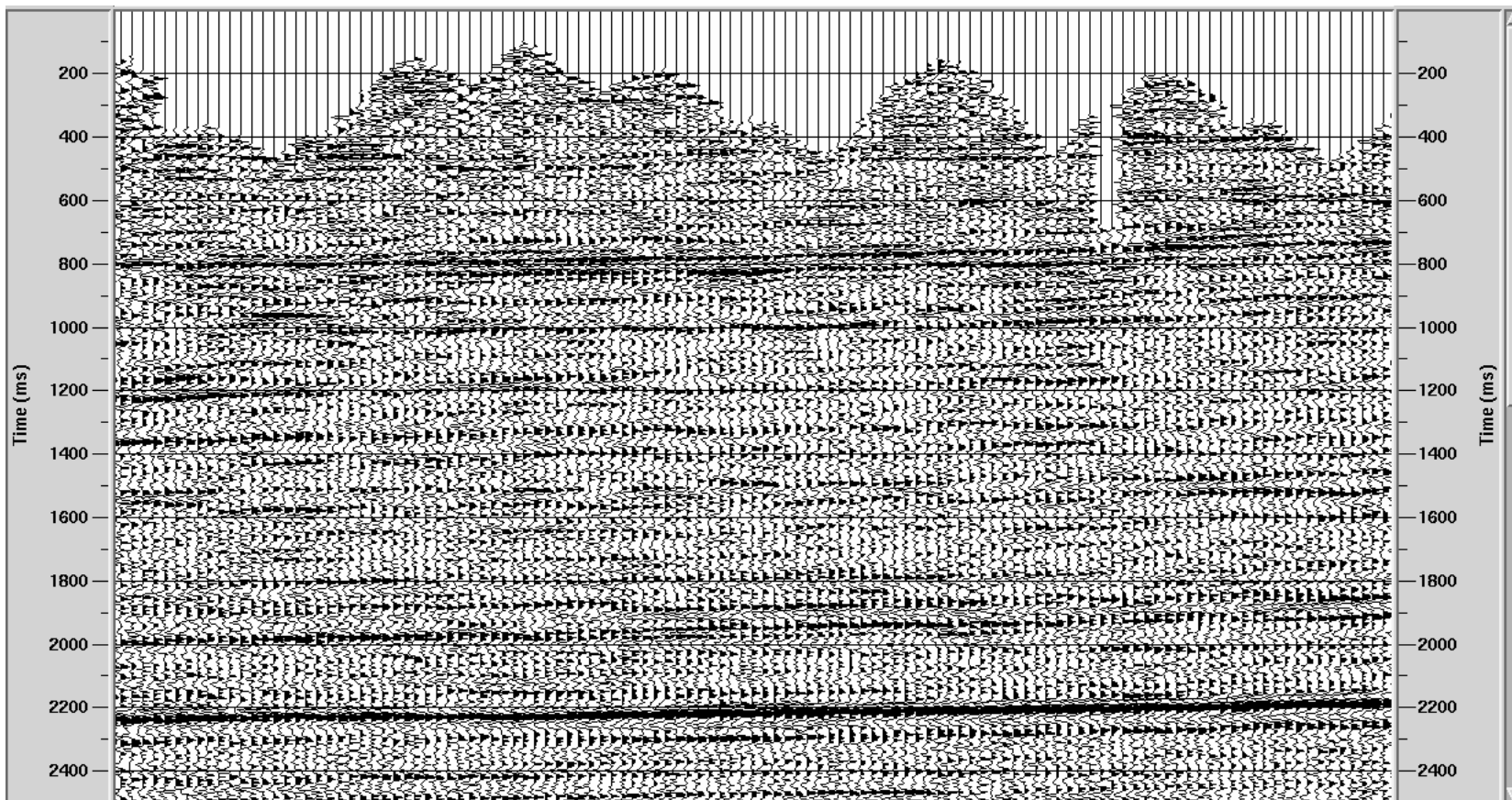
- Layout: 10 days
- Shooting: 10 days
- Pickup: 10 days

Cable

- Layout: 20 days
- Shooting: 50 days
- Pickup: 20 days



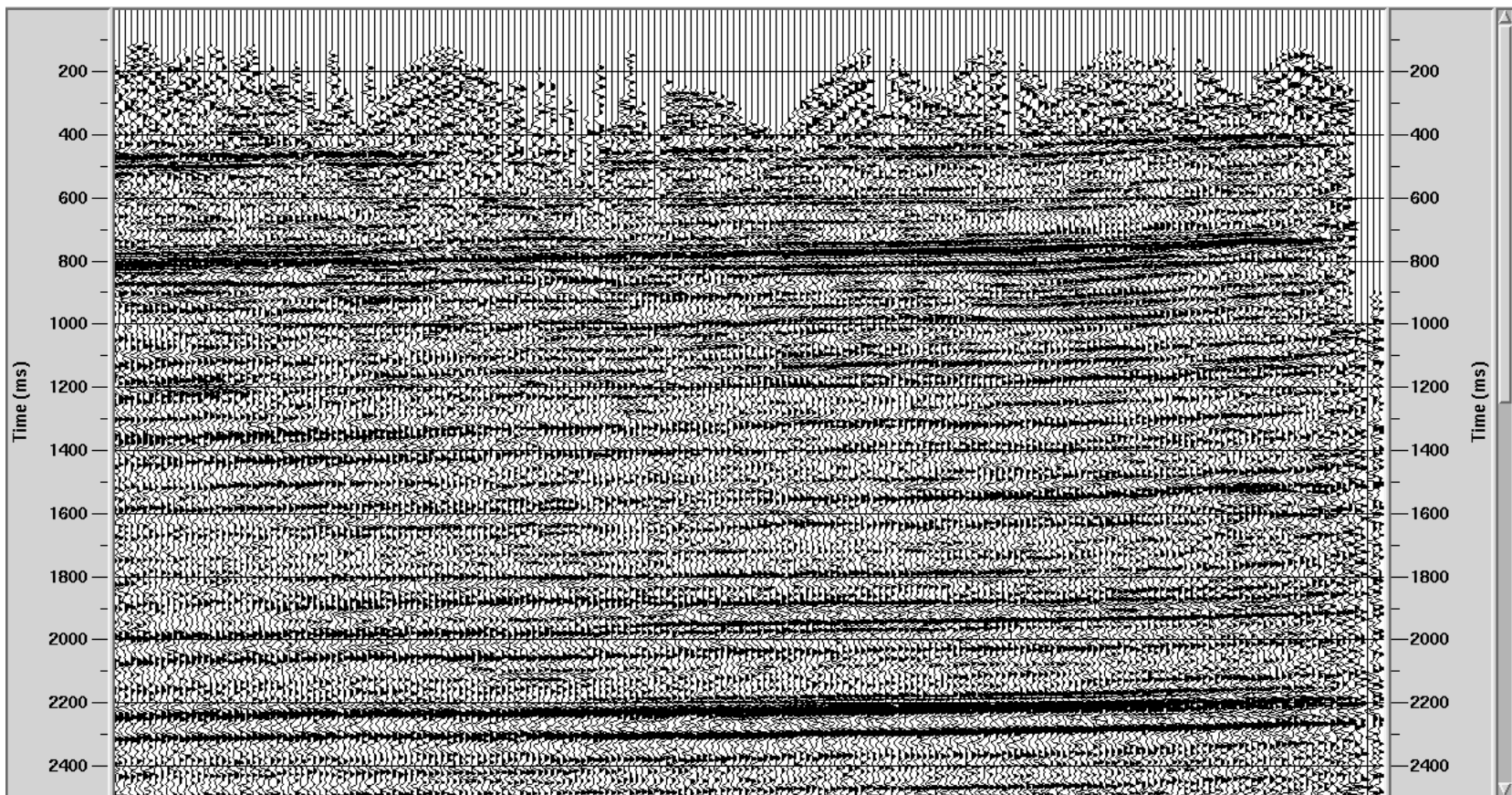
Vintage Preliminary Stack



After basic signal processing and two iterations of velocities and statics



FireFly Quick Look Stack



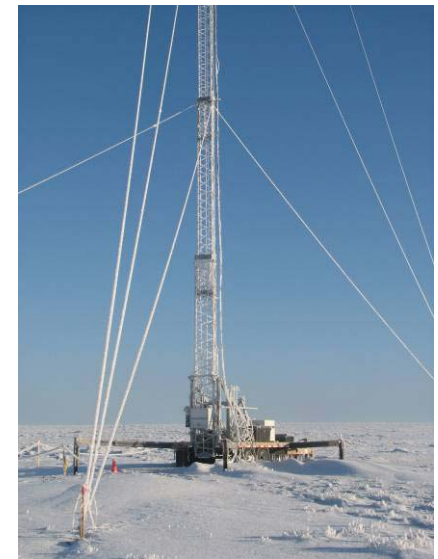
After basic signal processing and two iterations of velocities and statics



FireFly Accomplishments



- HSE – no incidents
- Acquired seismic data
- Data integrity
- Digitally managed shooting
- Deployment and shooting rates
- Timeline for completion
- Productivity predictions (mostly) matched reality
- Field navigation – happy and productive field crews
- Fasted-tracked technology
- Field aware design engineers



Thank you BP, Global, SES, & Apache!!

FireFly - Next Steps



- Imaging and Interpretation
- System improvements
- Apache (Texas)
- Vibroseis support
- Next BP field trial

