

Spectraseis



Measuring the reservoir fluid system

Brad Birkelo, Spectraseis

Presentation outline

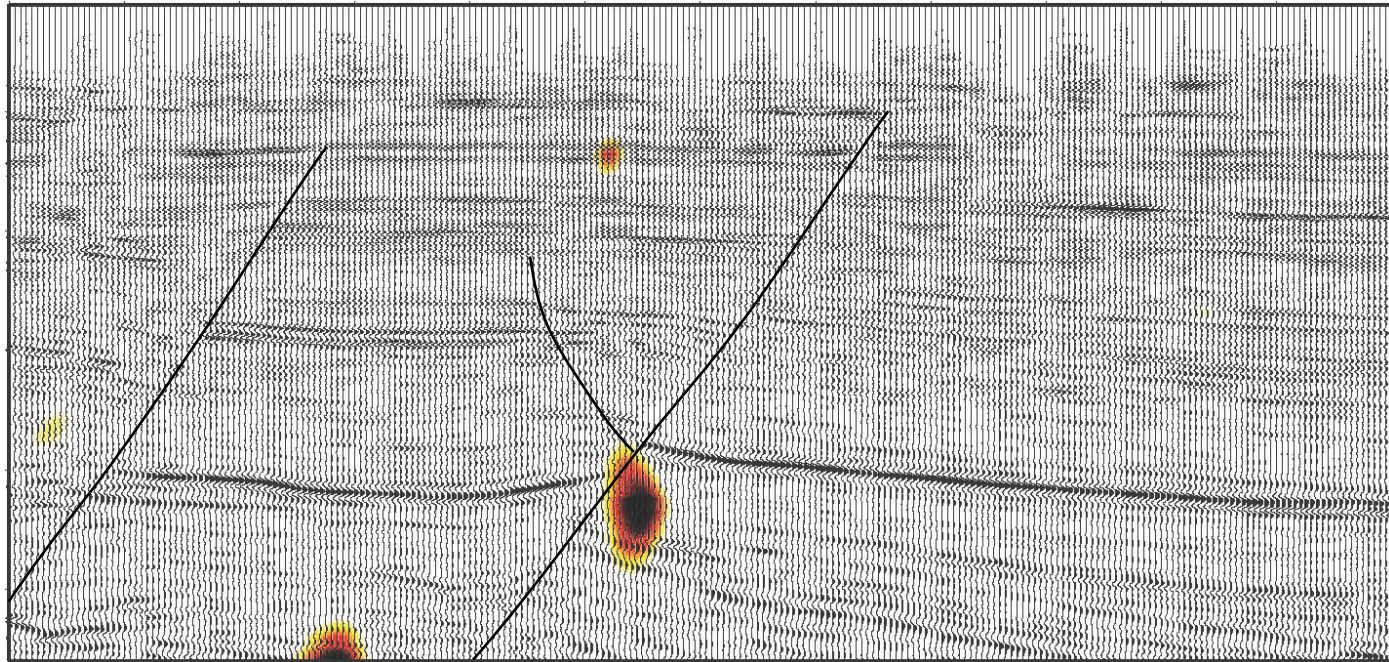
- What is LF seismic data?
- Locating tight gas sand sweet spots
- Other applications

Surface measurement of the reservoir fluid system

Valuable new information

Reflection seismic:
structural information

LF seismic: reservoir
fluid information



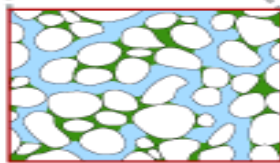
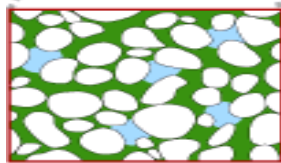
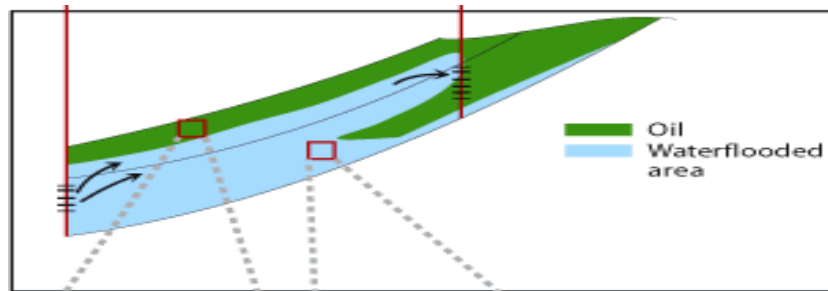
LF is a surface measurement of the reservoir fluid system. It adds **fluid information** to structural images from conventional seismic

What is LF seismic data measuring?

- Hydrocarbon reservoirs are unique
- Attenuation in reservoirs causes a secondary wave field
- LF measures weak secondary with strong surface wave fields

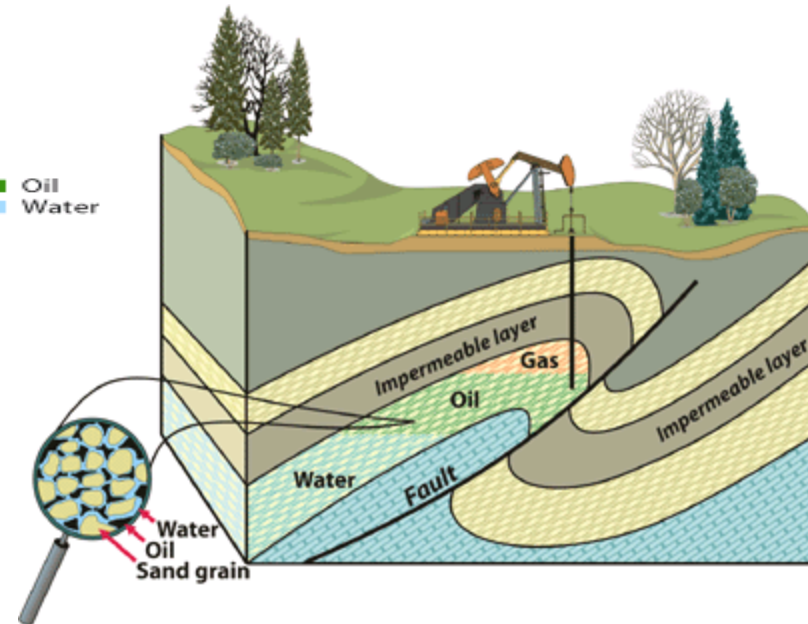
Reservoir fluid system measured via a secondary wave field

Reservoirs are unique



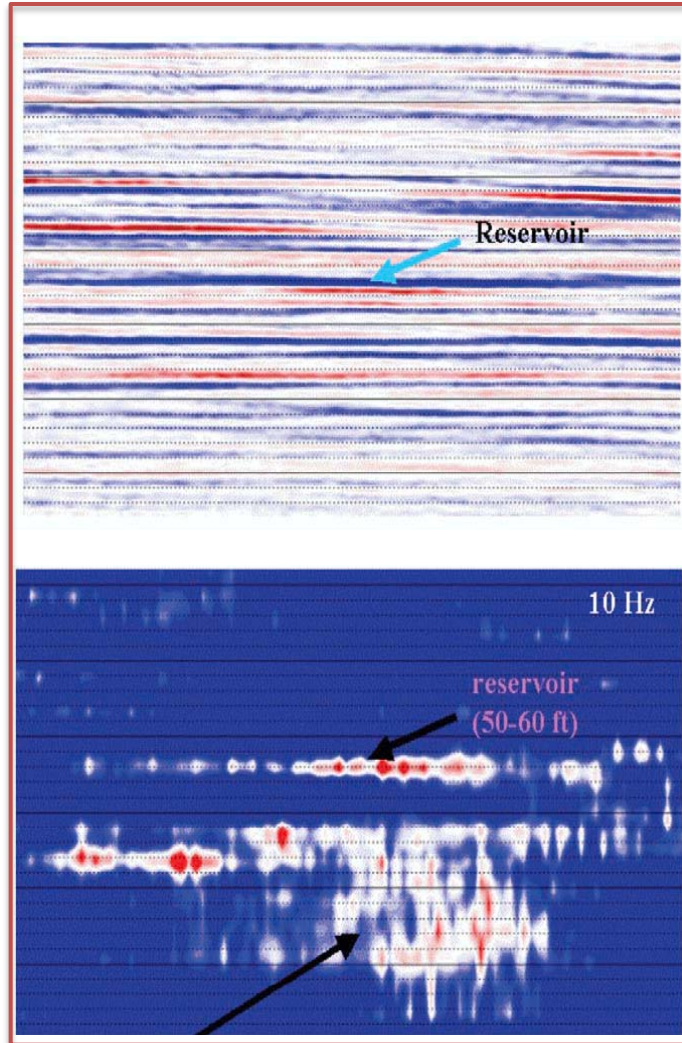
Oil
Water

100% water exists
100% oil/gas does not

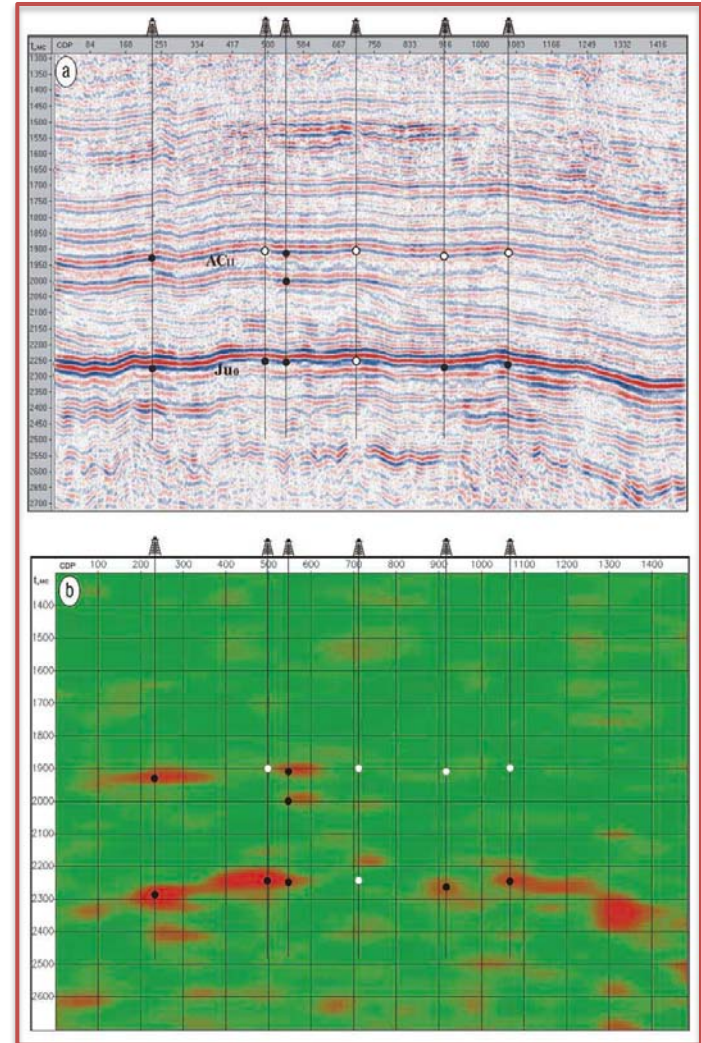


Reservoirs cause LF phenomena

Castagna, et al., *Leading Edge*, January 2003



Goloshubin, et al., *Leading Edge*, May 2006

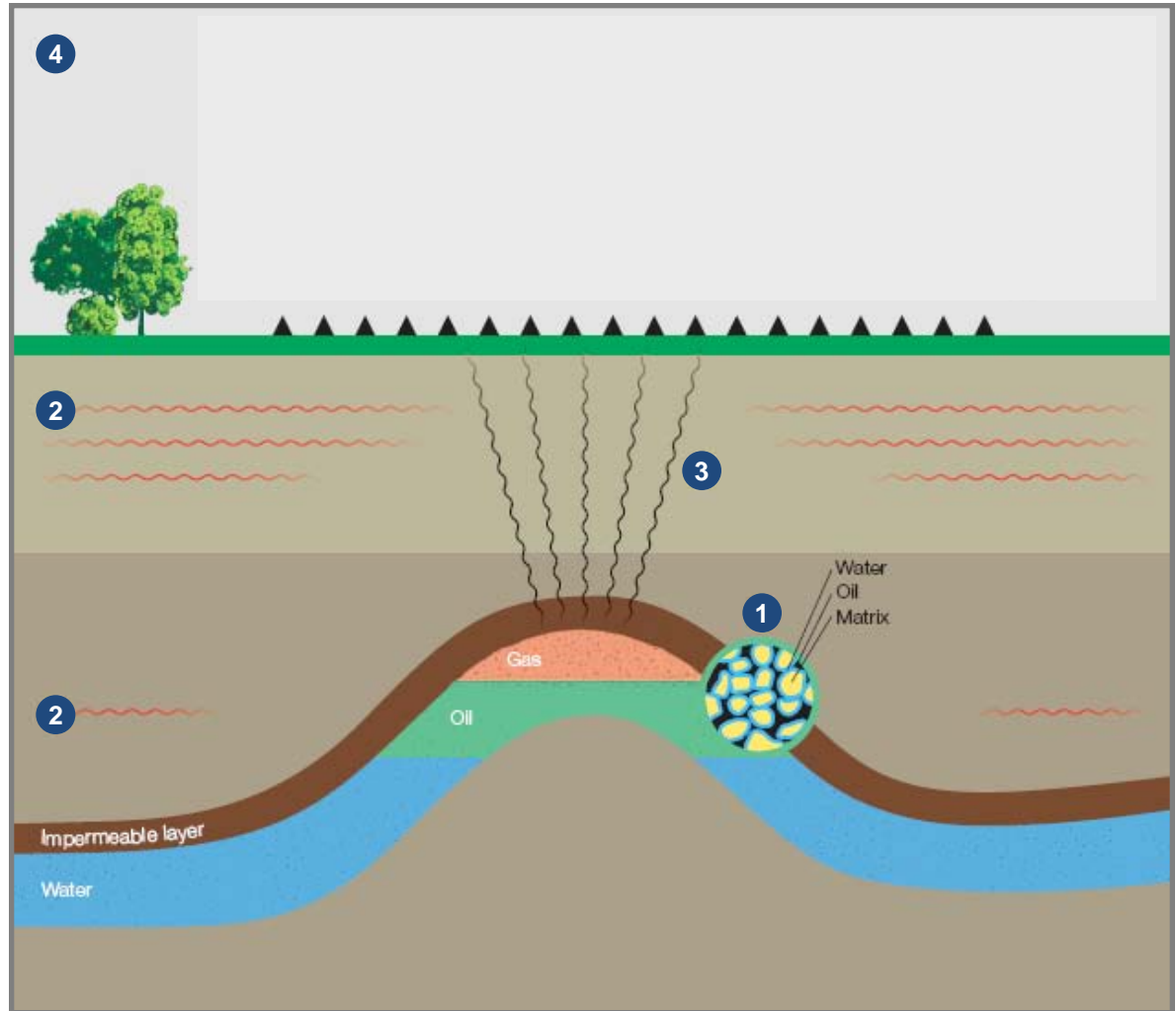


Full bandwidth
images:

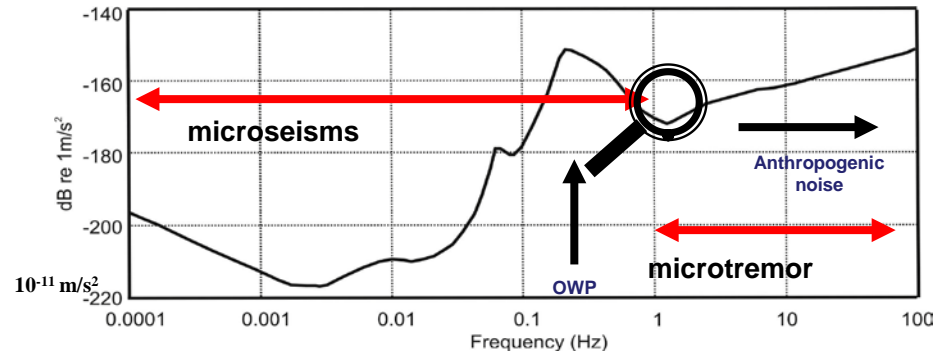
LF decompositions:

Scientific fundamentals

- 1 Multi-phase fluid-filled pore system
- 2 Rayleigh and Love waves, body waves
- 3 Scattering and/or absorption and re-emission
- 4 Wave field decomposition and LF attribute analysis



Measuring earth's background seismic energy

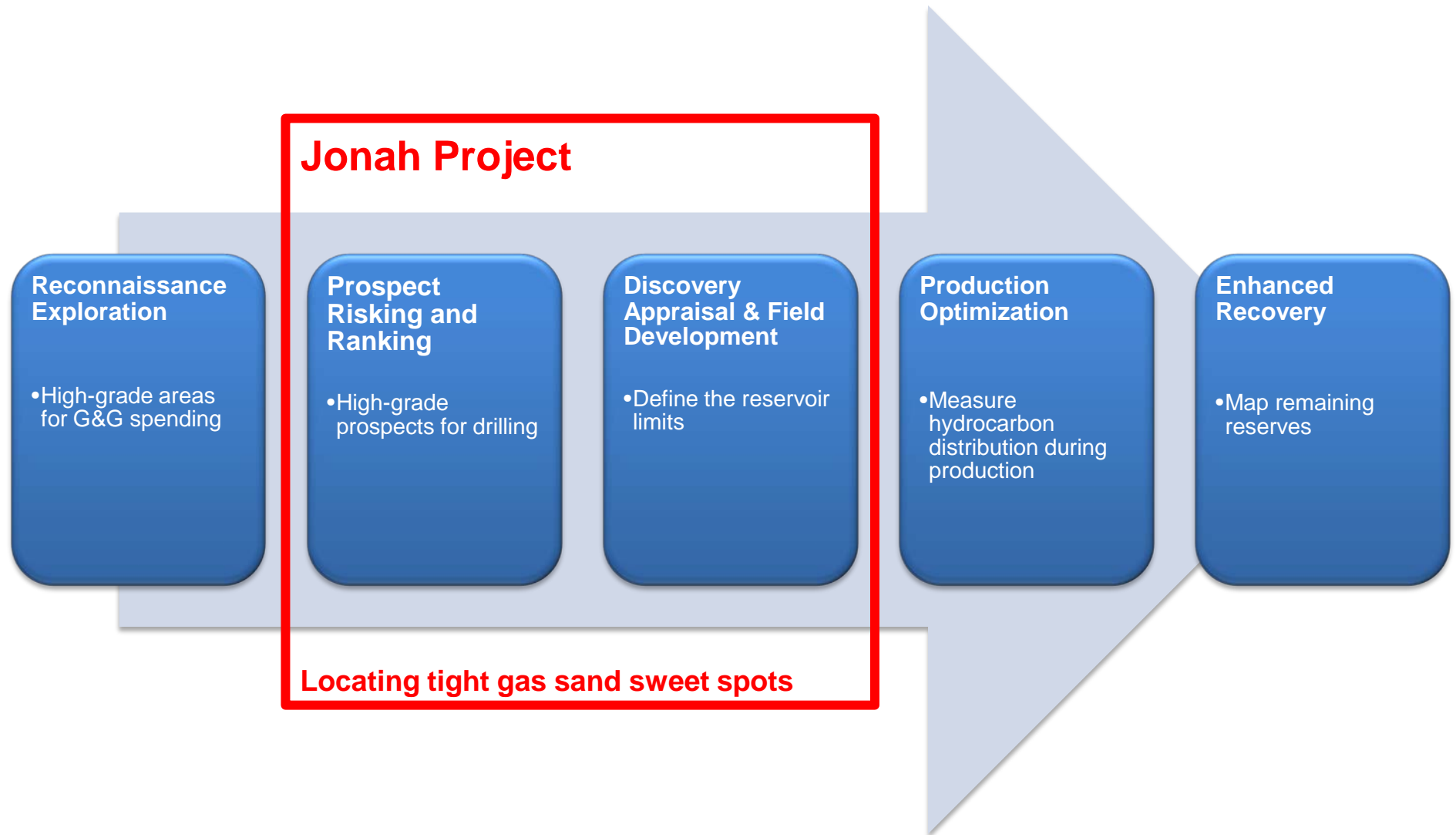


U.S. Geological Survey low noise model (Peterson 1993)

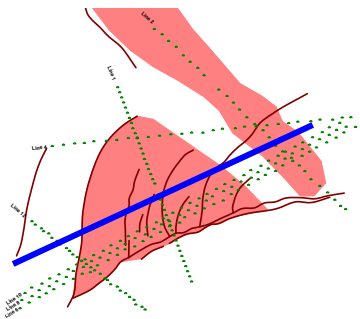
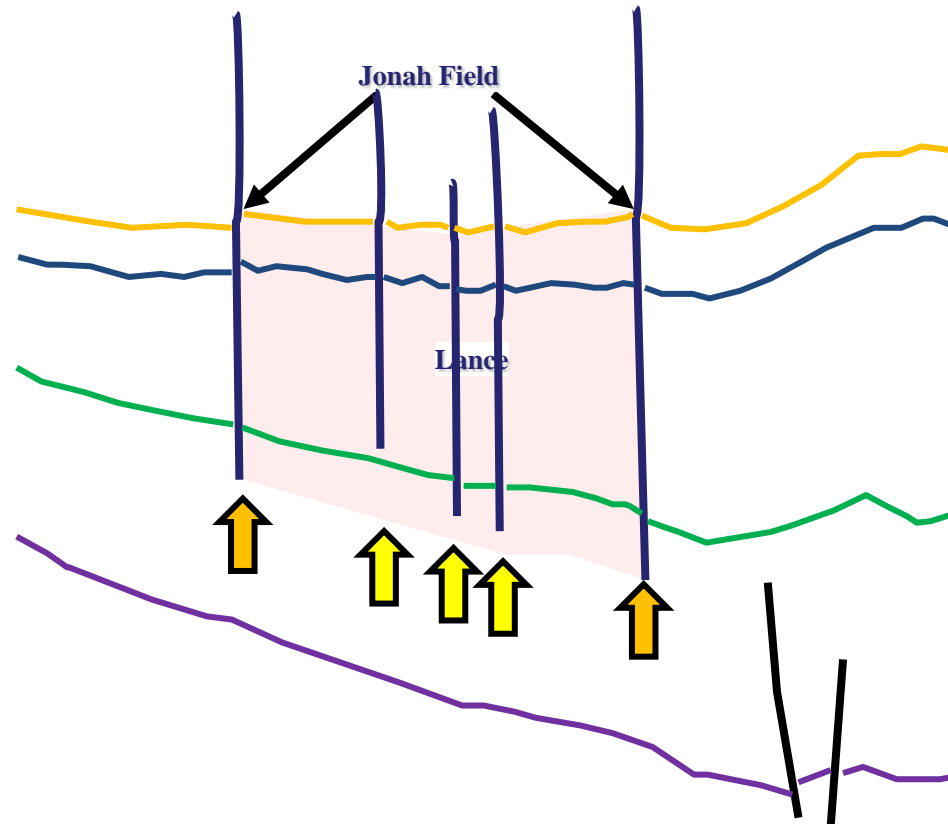


Window of opportunity to see the secondary wave field

Where do LF applications exist?

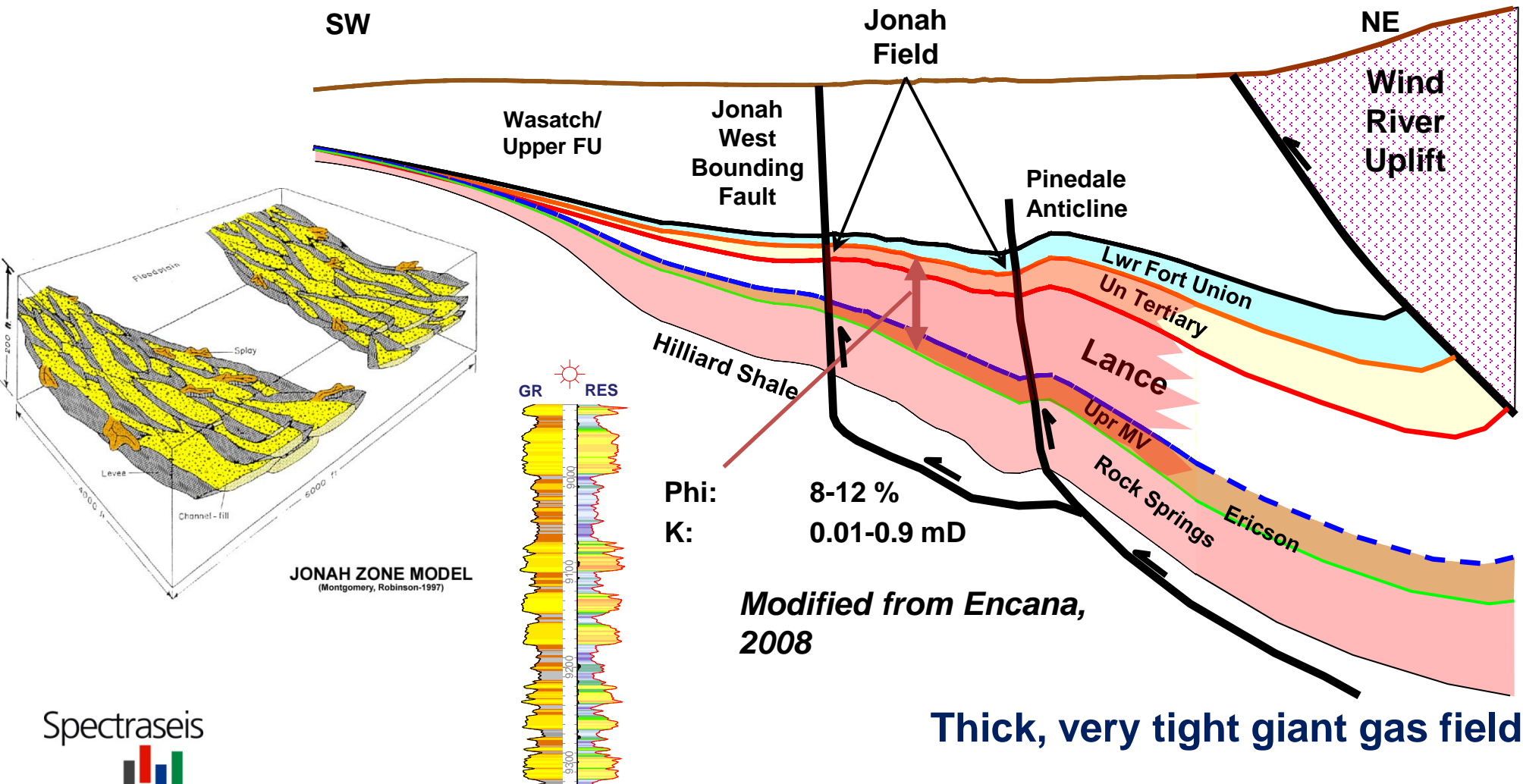


The Jonah Problem



Faults that control productivity are difficult to see

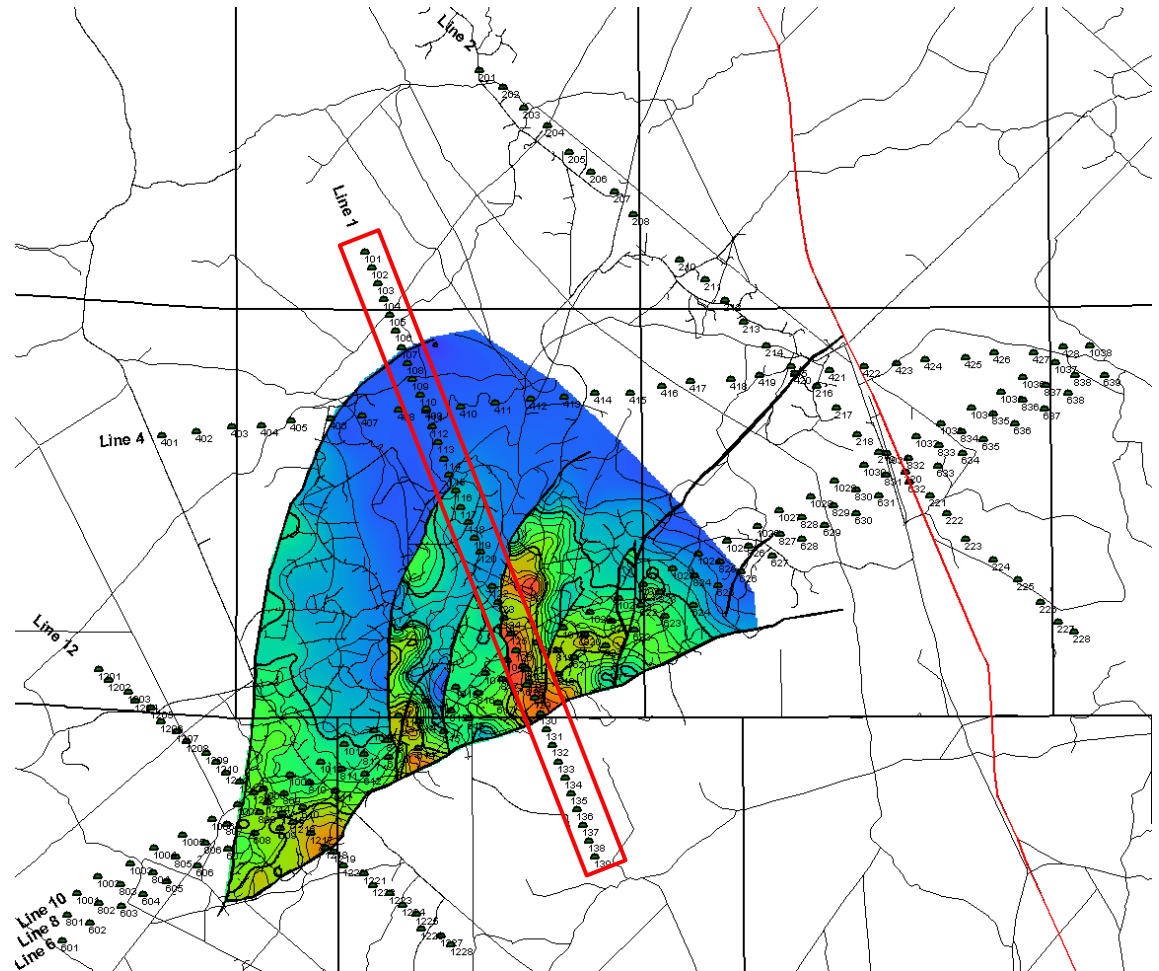
Jonah/Pinedale Geology



Jonah LF seismic survey on EUR map

Survey permitted in
two weeks under
BLM casual use
permits

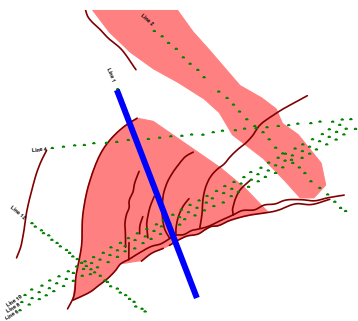
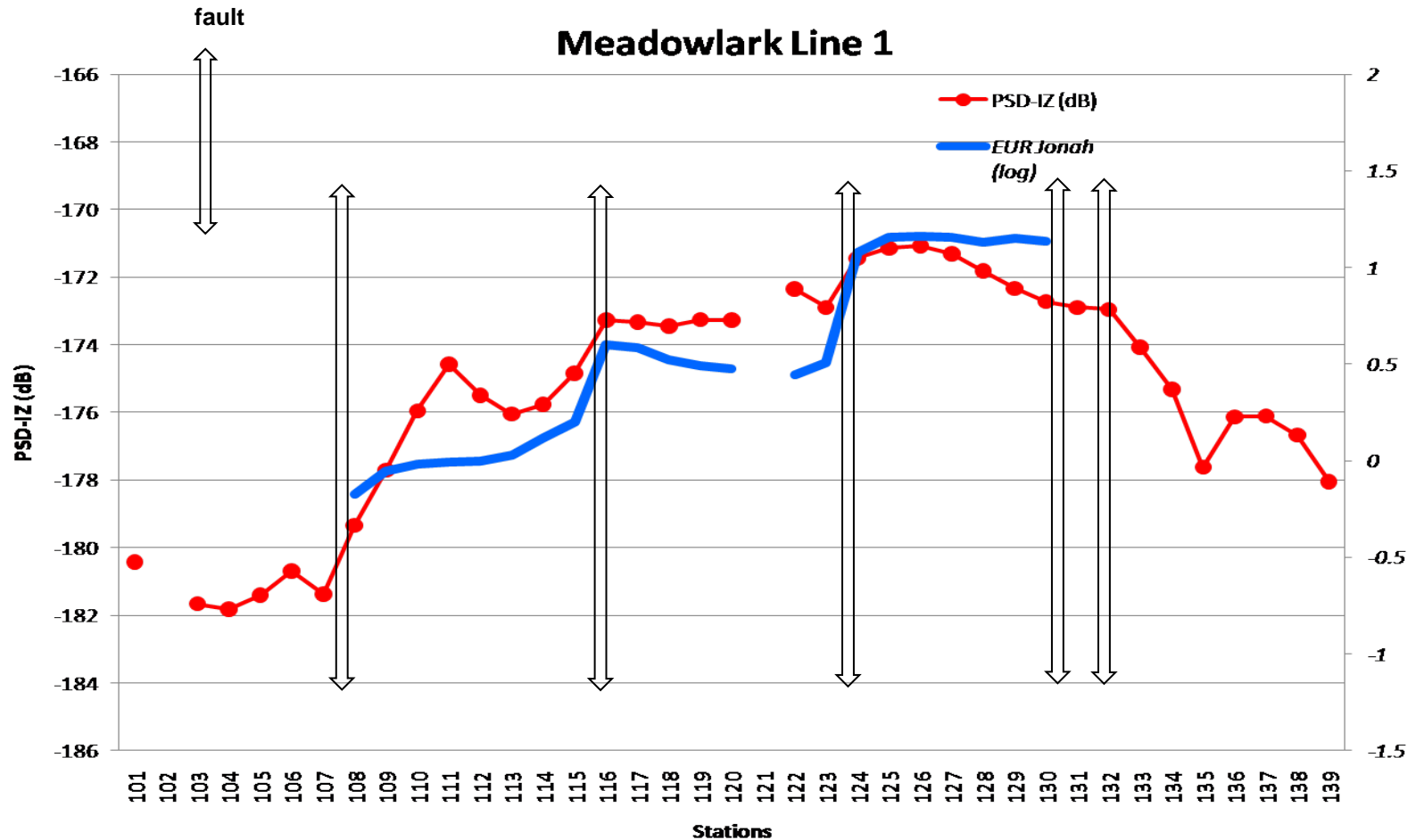
Data recorded in
December 2009



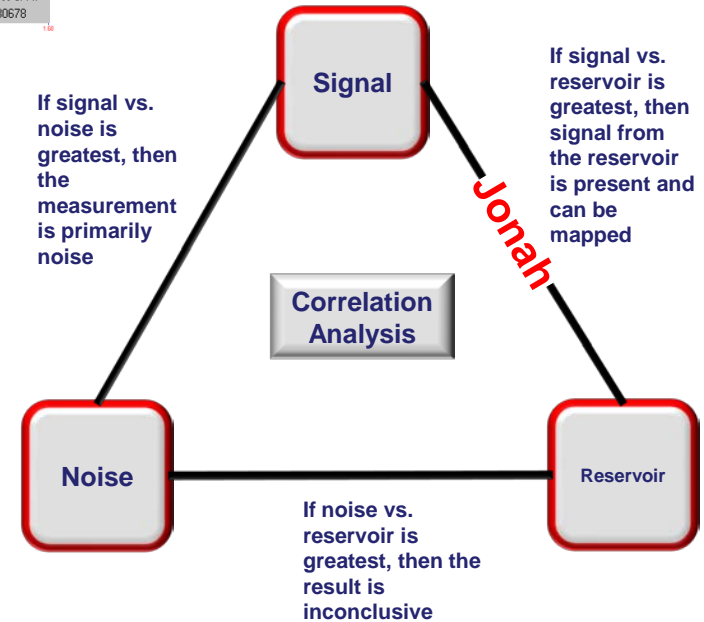
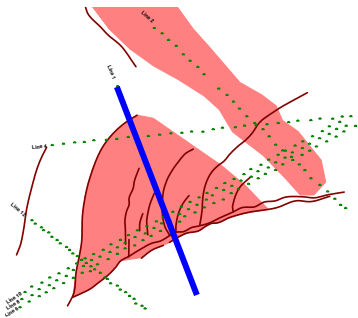
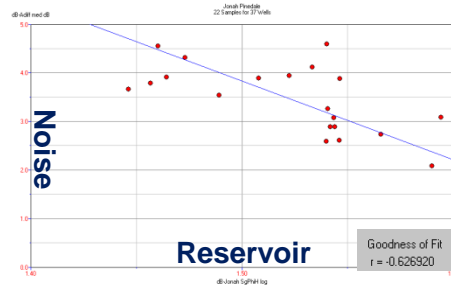
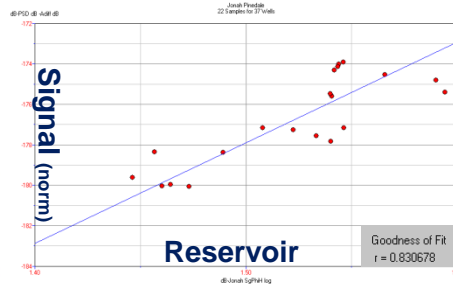
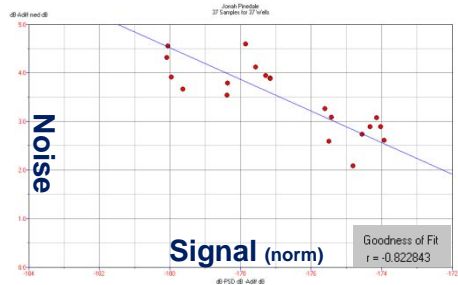
Line 1 profile - PSD-IZ vs. Jonah EUR

Red: PSD-IZ result
 Blue: EUR data

Better correlation with
 EUR data than with
 noise proxy



Meadowlark Correlation Analysis



Jonah LF seismic project summary

- LF signal strength correlates to reservoir productivity (EUR, GIP, and HPV)
- LF data “see” important reservoir fault compartments
- Noise does not cause the LF signal

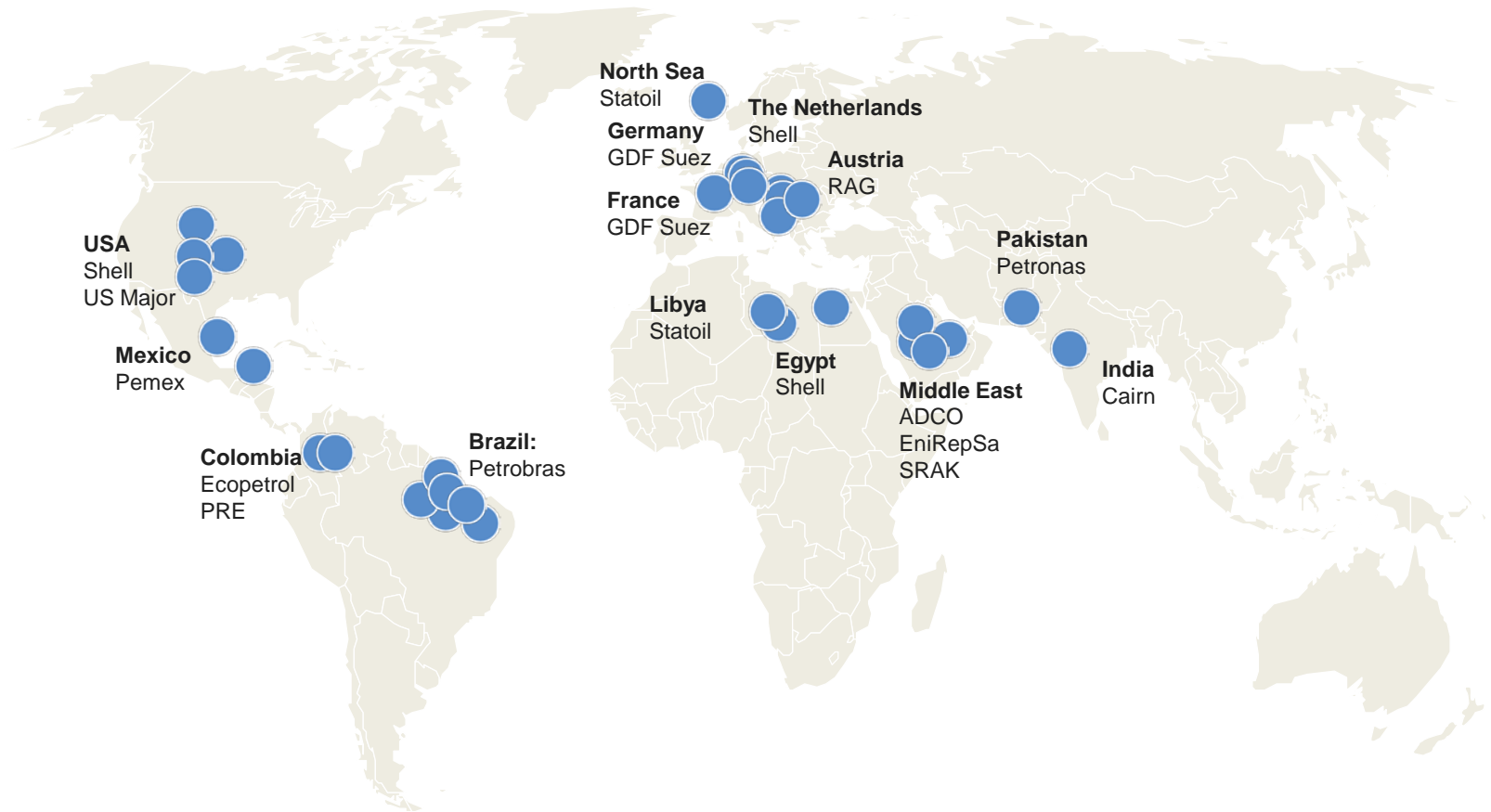
LF application developed at Jonah can help extend the field

Other applications to be published

- Mapping remaining reserves in a west Texas oil field
- LF seismic over a giant oil field in Abu Dhabi
- High-grading gas prospects in Pakistan
- Depth imaging a discovered, unproduced oil field in Egypt
- Replacing up-hole surveys for near-surface velocities

Worldwide track record

Spectraseis has safely and successfully delivered surveys for customers on five continents



Spectraseis



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