
High Resolution Surface-Sourced Seismic Experiment to Image Wilcox Group Horizons in Northern Central Louisiana

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EXTENDED ABSTRACT

The petroleum reservoirs in the Wilcox Group strata, late Paleocene to Eocene in age in central and northern Louisiana, are generally small structural/stratigraphic traps in fluvial and paralic facies. Typical exploration seismic surveys have been little used in the discovery/delineation of these reservoirs because of the reservoirs' small sizes and shallow depths (typically less than 3500 ft [1060 m]) and the lack of resolution, both vertical and horizontal, of typical exploration seismic data.

We sought to determine whether a high resolution-surface sourced seismic survey could image to the depths of interest in the area of northern LaSalle Parish (Figs. 1 and 2). We formed a team of geophysicists and students from the School of Geosciences at the University of Louisiana at Lafayette (UL Lafayette) and from the Allied Geophysical Laboratories at the University of Houston (U. Houston). The idea originated at UL Lafayette, which managed the project, while U. Houston supplied the recording and location survey equipment, survey design, field survey management and most processing to date. The seismic source, an A200 Nitrogen Accelerated Impact Energy Source (Fig. 3), was provided (along with an operator) by United Service Alliance, Inc. The land and mineral rights were from Mark King of M. J. K. Oil Inc., as was the funding for the field exercise.

The field survey consisted of 144 phones spaced at 16.4 ft (5 m) in a line along a cleared right of way (Figs. 4 and 5). Phone locations were sourced with 5 vertically stacked impacts from the compressed nitrogen accelerated weight drop, truck mounted A-200 taking only a few minutes per shot point.

Imaging of the Carrizo Sand at a depth of about 1600 ft (500 m) was our initial minimum goal going into the project. This sand is a prolific oil producer in the area of LaSalle, Grant and Winn Parishes. For example, two, now depleted, aerially small (about 0.25 mi [0.25 km] diameter) fields have produced about 3 million barrels of oil—Salt Field production about 2 million barrels and Selma Field about 1 million barrels. These fields were discovered and produced without the benefit of seismic imaging by a technique that Mark King humorously describes as “closeology”—that is developing knowledge of the subsurface by drilling close to previous wells. In [Figure 6](#), an unprocessed shot-gather screen-shot (5 impacts), the continuous reflection whose far offset is at about 0.6400 sec is from the boundary between the overlying Cane River Shale and the Carrizo Sand. Clearly, our technique has imaged the sand in this single-fold gather even up to the maximum offset of nearly 0.6 mi (10 km). This clear single-fold image of the Carrizo reflection, and many other, not quite so clear, reflections that surround it, is a result way beyond our expectations going into the project.

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Minimum goal: Image the Carrizo Sand (Top of Wilcox Gp.) at 1600 ft.

TEAM:

University of Louisiana at Lafayette Idea, Coordination, Students, Processing

University of Houston Recording systems, Field operations, Students, Processing

United Service Alliance Source, Source operation

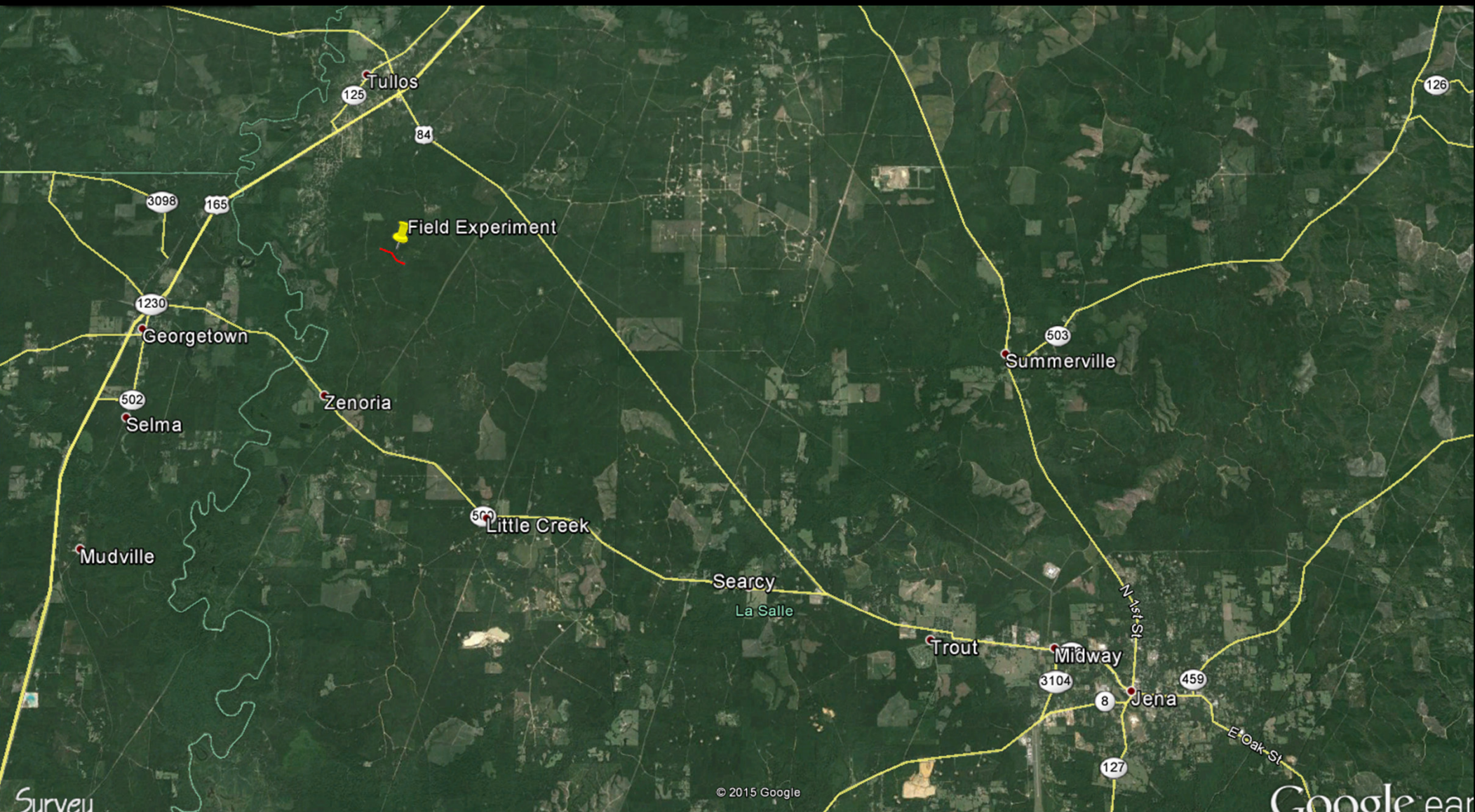
M. J. K. Oil Inc. Lease hold, Financial Support

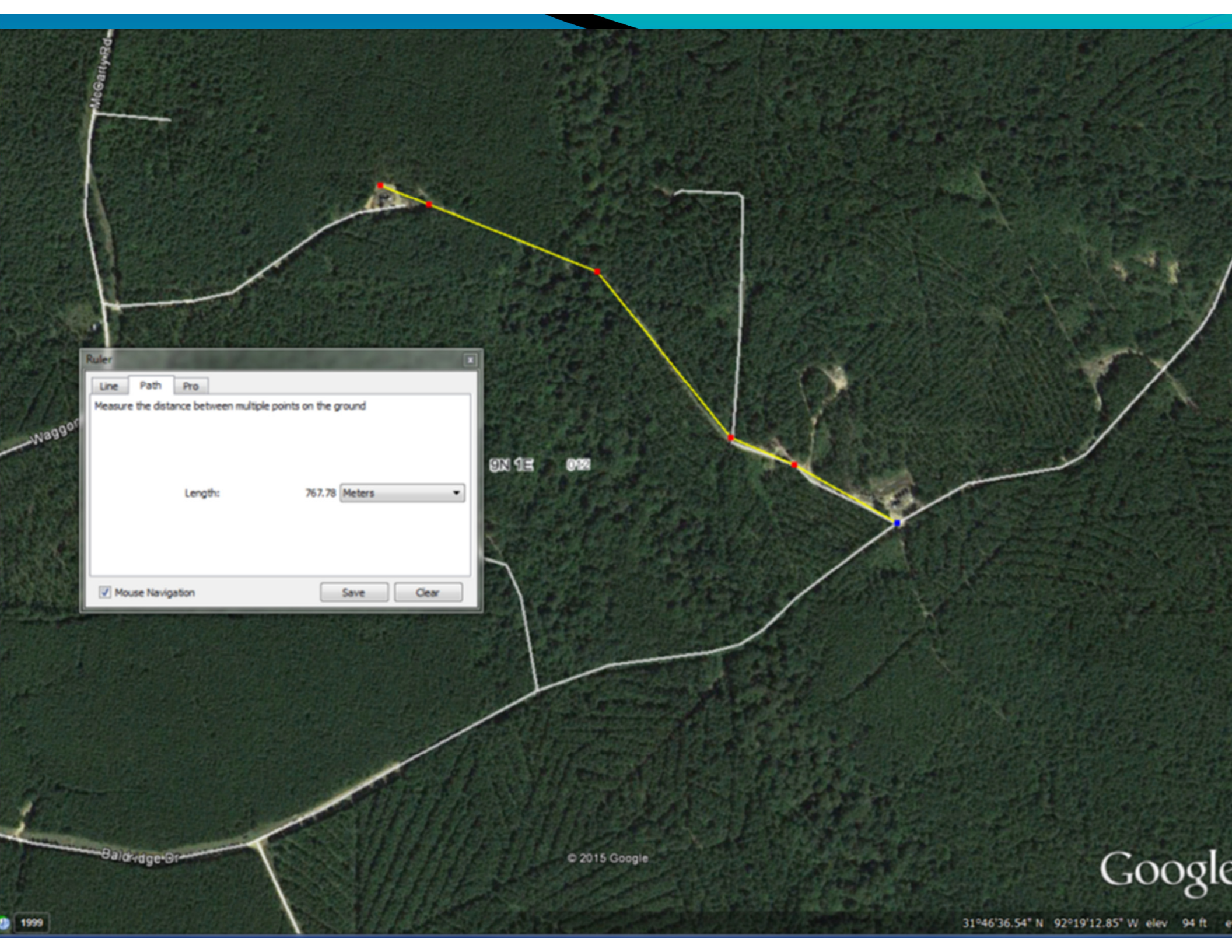


LOUISIANA

Tullos oil field:

<http://www.geoatlas.com>





Ruler

Line Path Pro

Measure the distance between multiple points on the ground

Length: 767.78 Meters

☒ Mouse Navigation

Save Clear

© 2015 Google

Google

31°46'36.54" N 92°19'12.85" W elev 94 ft

1999



Photo credit
Nathan Quick

144 receivers
one 715 m line
5 meter spacing
1 ms sample rate
4 sec records



Photo credit
Nathan Quick

United Service Alliance A-200 Nitrogen Accelerated Weight Drop

Base forced downward to support back weight of truck

Solid piston (inside) lifted upwards compressing nitrogen in cylinder

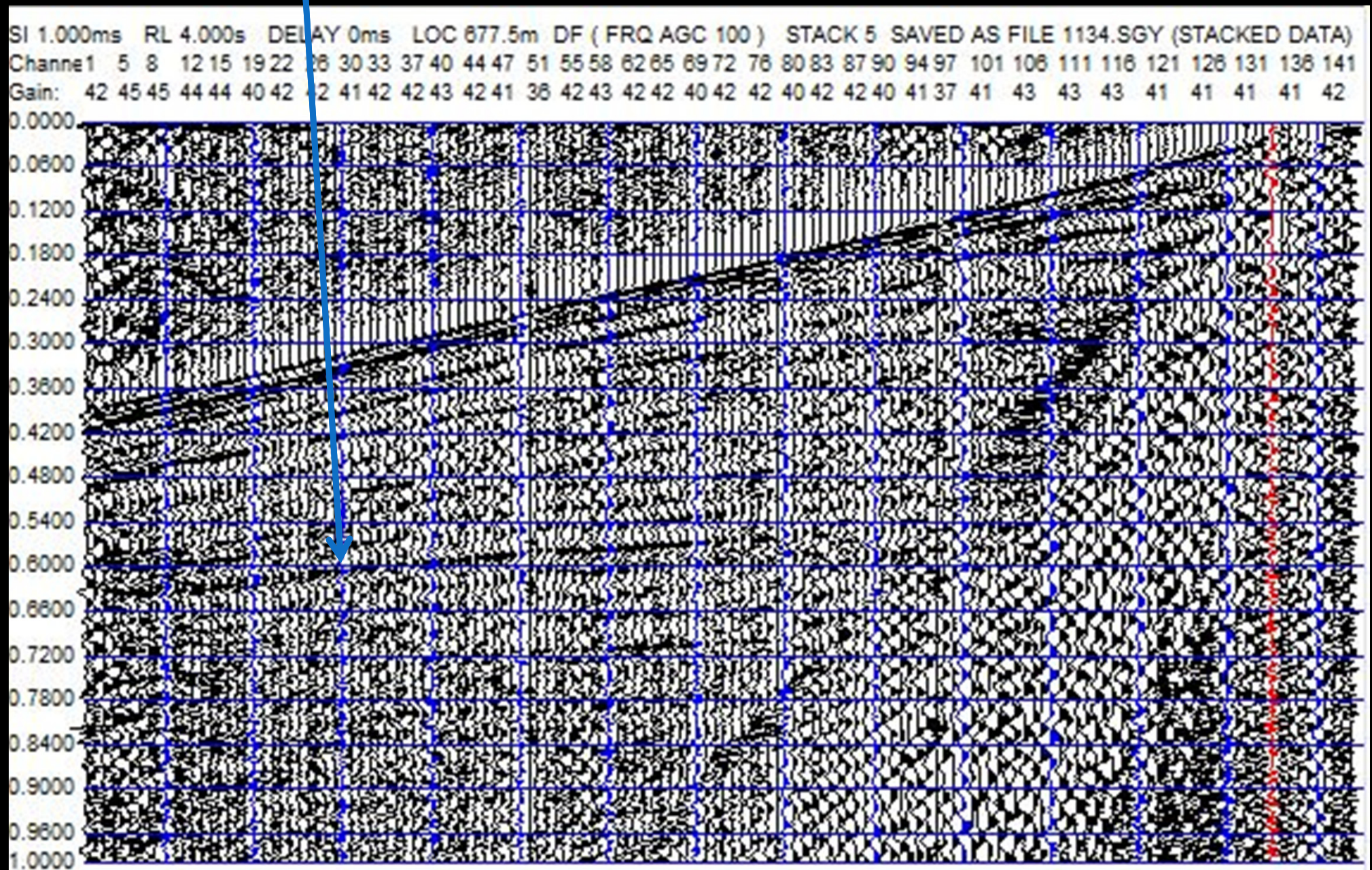
Piston released and accelerated downward to impact on base.

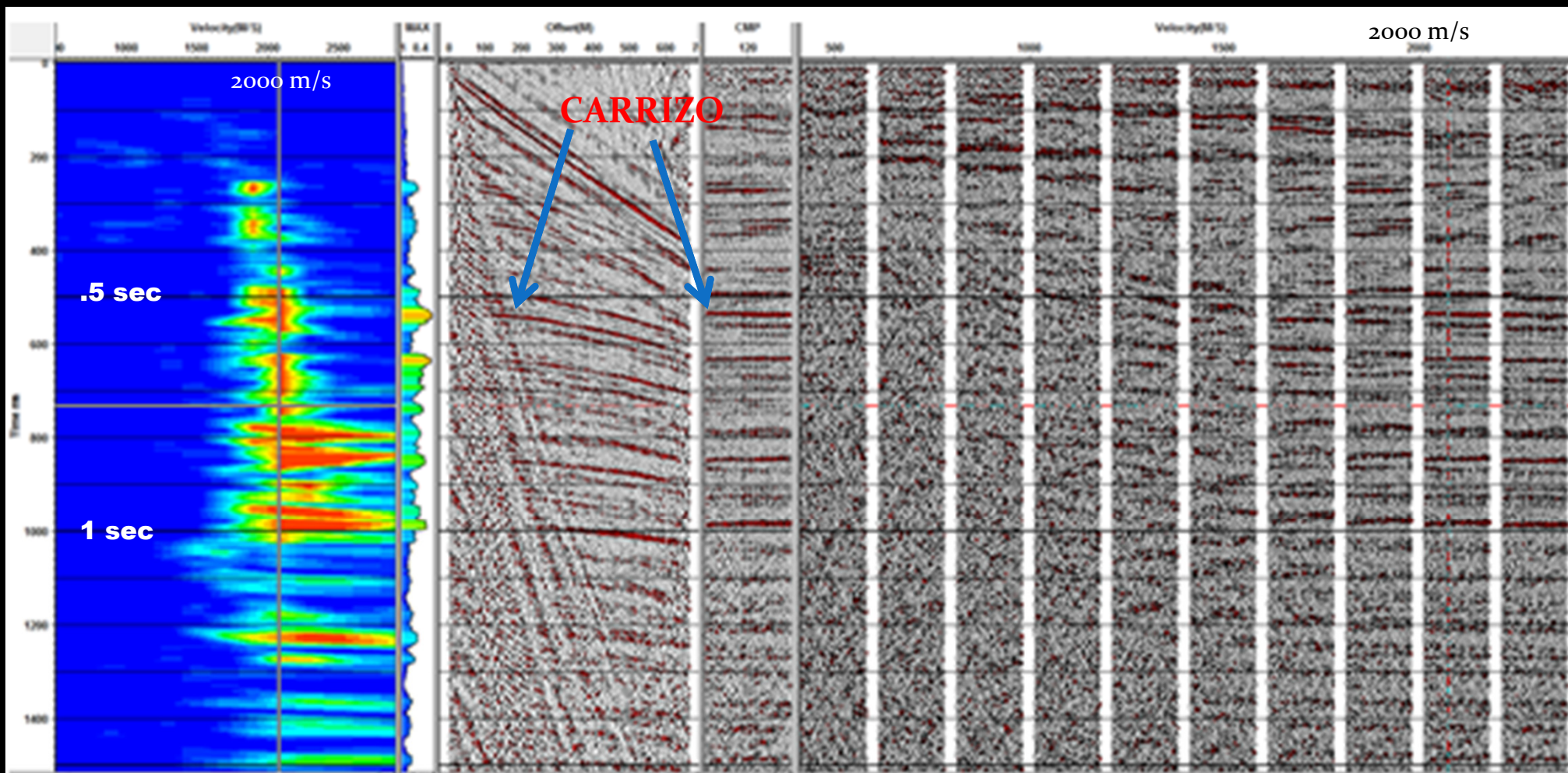
MAJOR ADVANTAGES:
mobility and low cost per SP

Shot point at each receiver, 5 impacts vertically stacked per shot.

SHOT GATHER

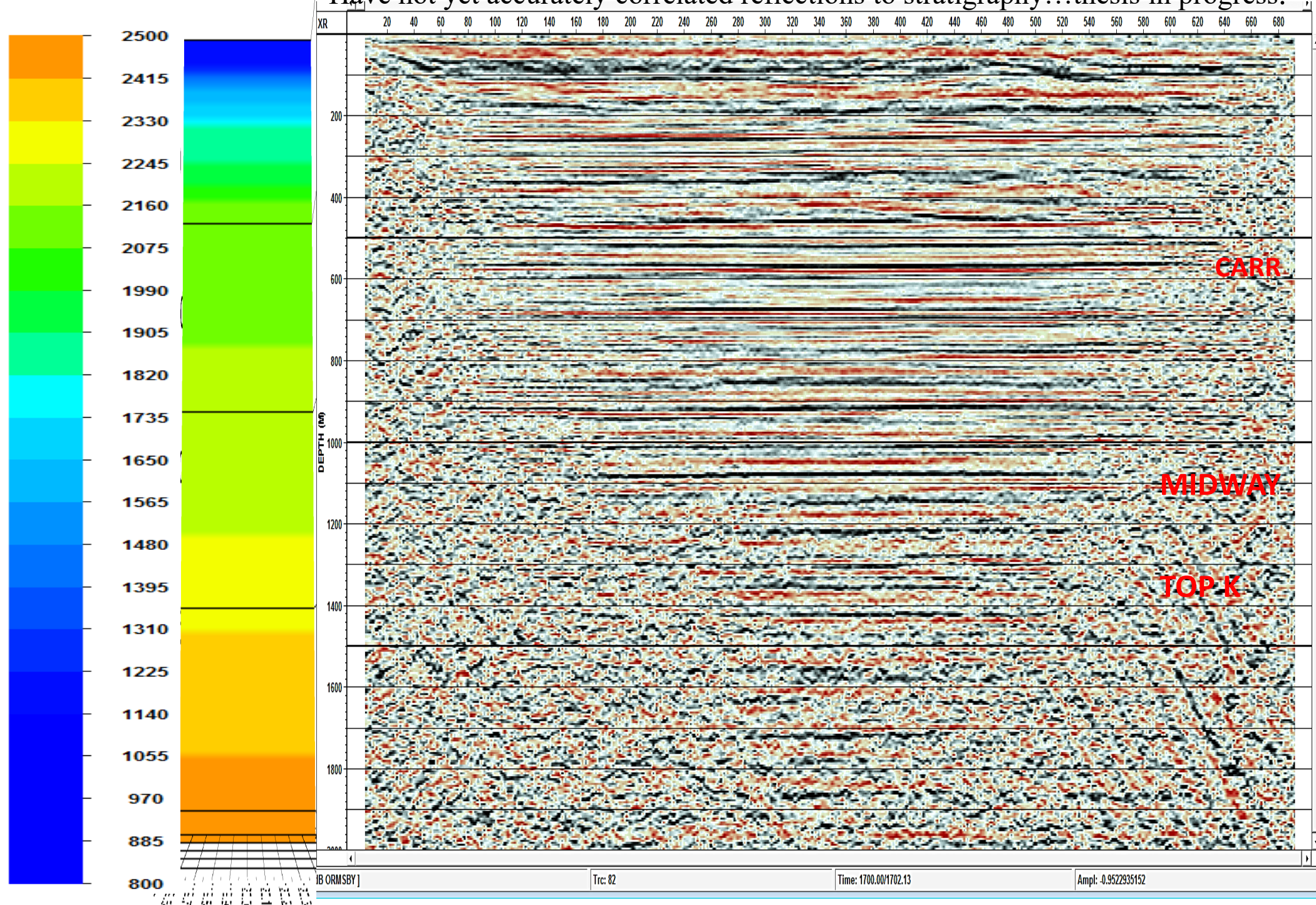
Carrizo Sand/Target Horizon T_0 about .5400 sec





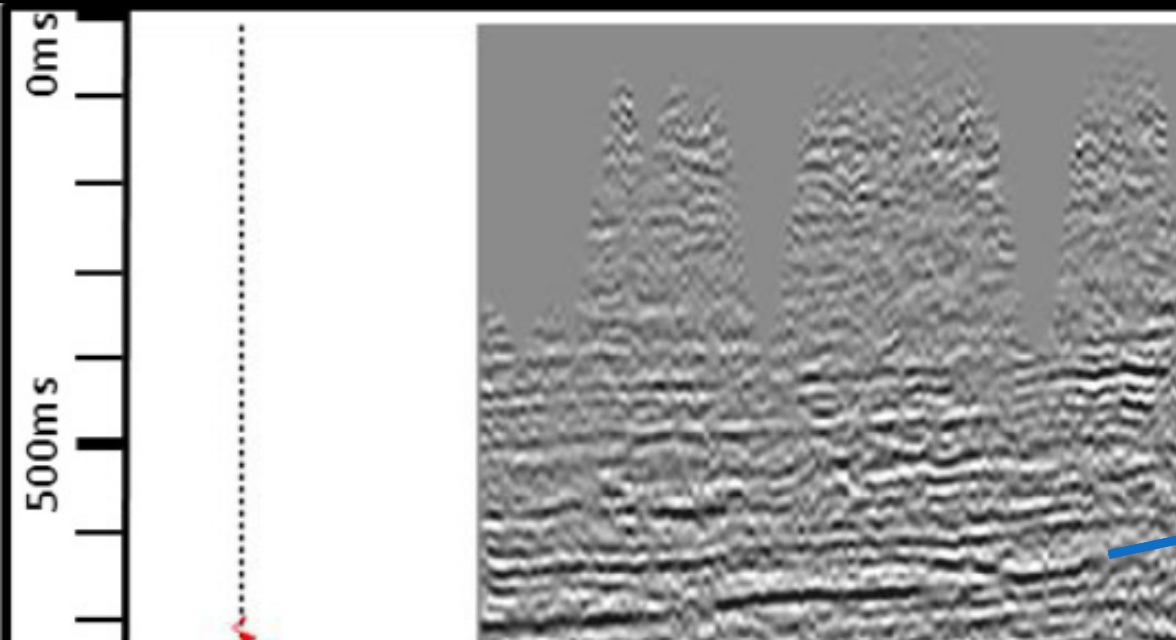
Reflections well into the Mesozoic. Bottom of image is 2000 m = 6560 ft

Have not yet accurately correlated reflections to stratigraphy...thesis in progress.

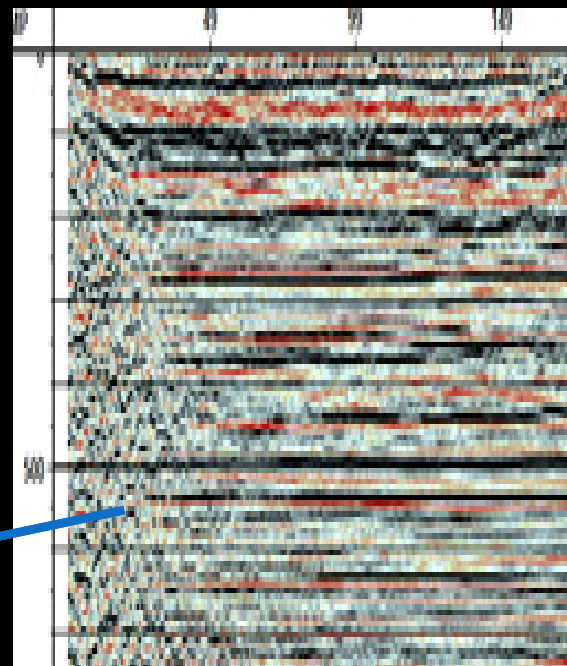


COMPARISON

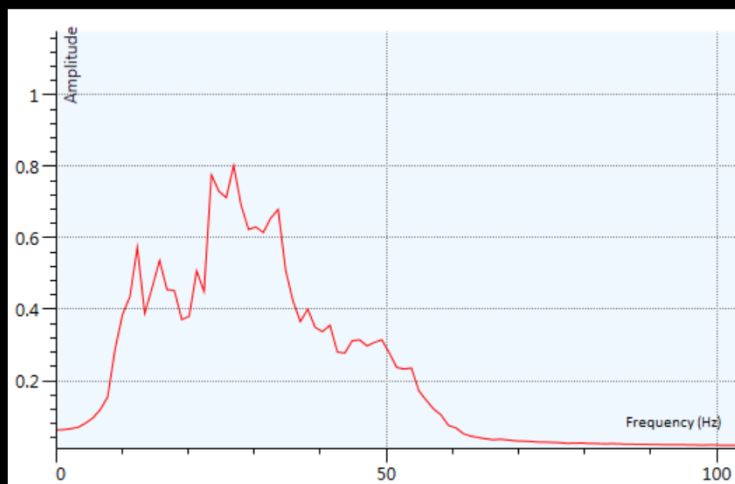
Data from Devon 3D about 25 miles WSW



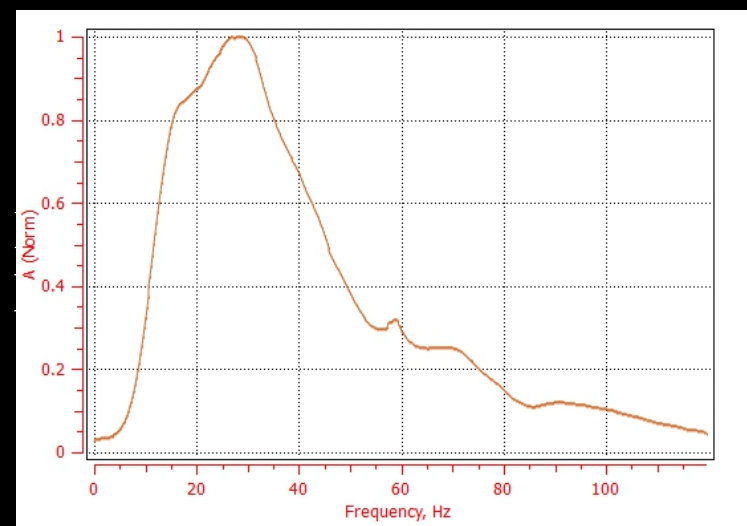
Data from constant velocity (2000 m/sec) brute stack w/ F-K filter



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Frequency Spectrum from stacked data from Feng Chen (2015)

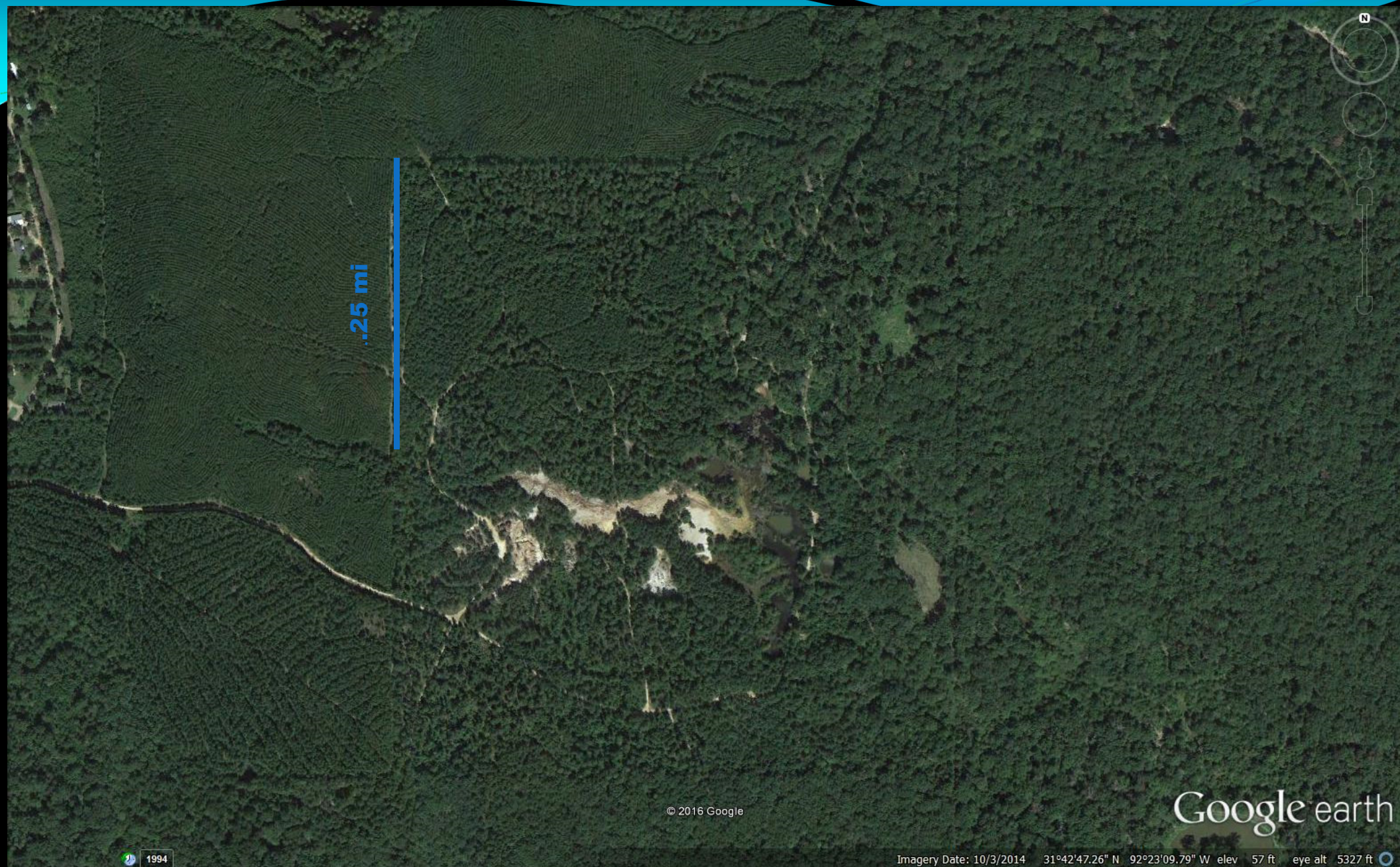


Frequency plot of the raw shot gather...including ground roll
Zach Ghalayini thesis in progress

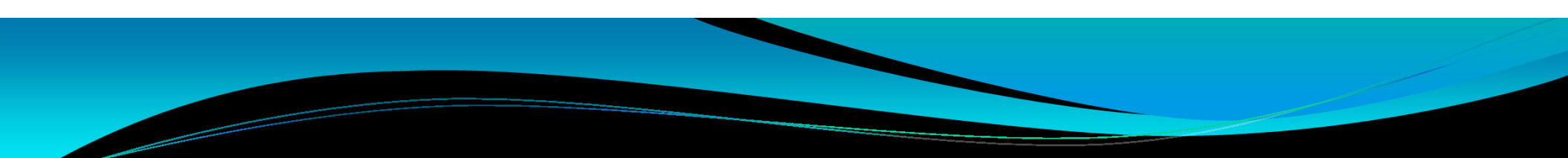
WE DID IT! WE IMAGED WAY DEEPER THAN OUR MINIMUM TARGET!
THE TECHNIQUE IS VIABLE FOR EXPLORATION IN CENTRAL LOUISIANA



WHAT NEXT?



Selma Oil Field 7 mi SW of field area , about $\frac{1}{4}$ square mile, less than 20 feet of structural closure, approximately 1 million bbls oil from the Carrizo Sand. Is there some left? Has it refilled? Would a 3D with our source tell us?



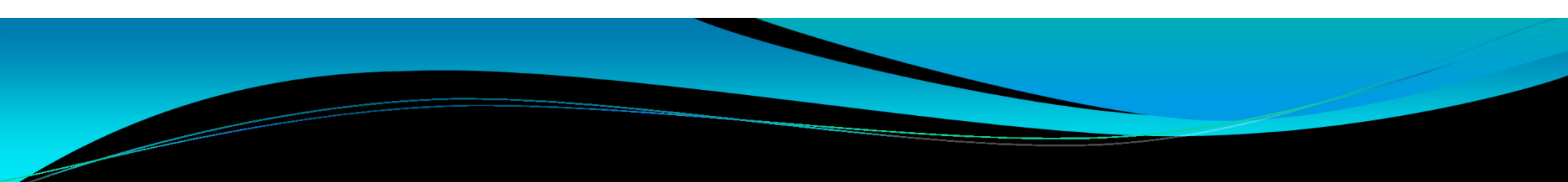
Can we design a high-density, “optimal offset,” low, or single, fold 3D survey to image the structure of Selma Field?

Might this define by-passed structural drilling targets?

Might we be able to detect hydrocarbons in place...by passed or refilled?

Can this be accomplished economically?

The major advantages of our system are the high frequency and the very low cost per shot point.



About the same time that we completed our surface sourced survey with the nitrogen accelerated weight drop Justiss Oil Company, Inc. contracted a 1.5 square mile 3D in northern Grant Parish. They also utilized a similar nitrogen accelerated weight drop surface source and achieved “good data.”

ACKNOWLEDGMENTS

M. J. K. Oil Co. for funding this field experiment
United Service Alliance, Inc. for the the source
Staff/students from U. Houston - Anoop William,
Jiannan Wang, Christopher Lovely, Andrea Paris,
Eliene Silva and Lingfei Mao
Students from UL Lafayette - Nathan Quick and
Zach Ghalayini
Source operator from United Service Alliance –
Dave Newman.
Melba King for her continued good humor