

# **Regional Stratigraphic Correlation Utilizing High-Density Digital Well-Log Displays\***

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## **Abstract**

The utilization of geophysical well-logs for stratigraphic correlation has proven to be a valuable tool in the understanding of regional geologic depositional frameworks. Recent advances in computer and database techniques now allow for the accumulation and display of large numbers of digital well-logs. It is now possible to utilize the digital geophysical well-logs from geologic basins containing tens of thousands of oil and gas wells to create three-dimensional earth models of the depositional framework.

Twelve thousand geophysical well-logs from the Fort Worth Basin, in Texas, were scanned and digitized. These digital well-logs were accumulated in a computer database system that allowed for their selection, display, and stratigraphic correlation. The process required that 100 to 300 well-logs be displayed on the screen simultaneously in order to generate cross-sectional views of the stratigraphic section.

Utilizing allostratigraphic correlating techniques that focus on the correlation of discontinuities apparent in the geophysical well-log character, digital correlations were captured for over 40 surfaces. These surfaces included erosional unconformities, major flooding surfaces, and various parasequence boundaries. The regional character of these events was readily apparent when viewed in high-density cross-sections that were created through the simultaneous display of geophysical well-logs for hundreds of wells.

From the stratigraphic correlations made in the cross-sections, it was possible to generate structure and gross isopach maps. Additional maps useful in identifying the presence of clean sand or limestone were created using calculations based on gamma-ray log readings. High-density geophysical well-log correlation represents a new methodology for regional stratigraphic analysis in mature oil and gas basins.

# Regional Stratigraphic Correlation Utilizing High-Density Digital Well-Log Displays

**AAPG Annual Convention 2008**

**Mark C. Robinson  
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# New Title: What do you do with 850,000 Digital Logs?

## **TGS Announces Major Expansion of Well Log Underwriter Program**

*Record Geological Products Contract Secured*

Houston, Texas (7 April, 2008) – TGS Geological Products and Services, a division of TGS-NOPEC Geophysical Company (TGS) announced today that it secured another multi-million dollar underwriting commitment to its U.S. LAS program on Friday, April 4th.. The underwriter will receive license to **approximately 400,000 LAS** and over four million smartRASTER well logs from TGS over a three and a half year period. Approximately one-third of this data is available for immediate delivery.

LAS (Log Ascii Standard) well logs are fully digitized well logs that are used in a variety of geological, geophysical and petrophysical applications and typically have a commercial value of approximately ten times the value of the standard well log images. smartRASTER is a format developed by TGS to depth calibrate rasterized well log images.

Robert Hobbs, Chief Operating Officer of TGS, said "This transaction is even larger than the record well log deal we announced in 2007. With this latest addition, the onshore U.S. LAS underwriter program now has six underwriters and includes commitments to **nearly 850,000 wells** covering much of the Rocky Mountains and the onshore Gulf Coast regions. In addition, we already have extensive LAS coverage in the offshore Gulf of Mexico region. We are excited by the industry's rapid acceptance of our vision to build a comprehensive inventory of higher value well log products and we look forward to expanding the program with additional sponsorship into other geographic areas."

# Build the Foundation for Excellence

- Utilize a data management system that integrates with an interpretation interface so that the digital logs are easily accessible.
- Provide interpretation and processing tools capable of working on large numbers of wells distributed over large areas.
- **Most important: Provide mentoring and training on the optimum geologic techniques for interpretation and analysis of digital well-logs.**

# Allostratigraphy

- Allostratigraphy is a methodology defined by the North American Stratigraphic Code that uses bounding discontinuities to subdivide the sedimentary section into mappable units. Bounding discontinuities include unconformities, disconformities, discontinuities, and omission surfaces. The bounding surfaces may relate back to sequence-stratigraphic boundaries such as Marine Flooding Surfaces (Bhattacharya and Walker, 1991).
- Important concept to remember: Parasequence sets are the building blocks of System Tracts. (J.B., per. comm., 2008)

# Identification of Allomembers

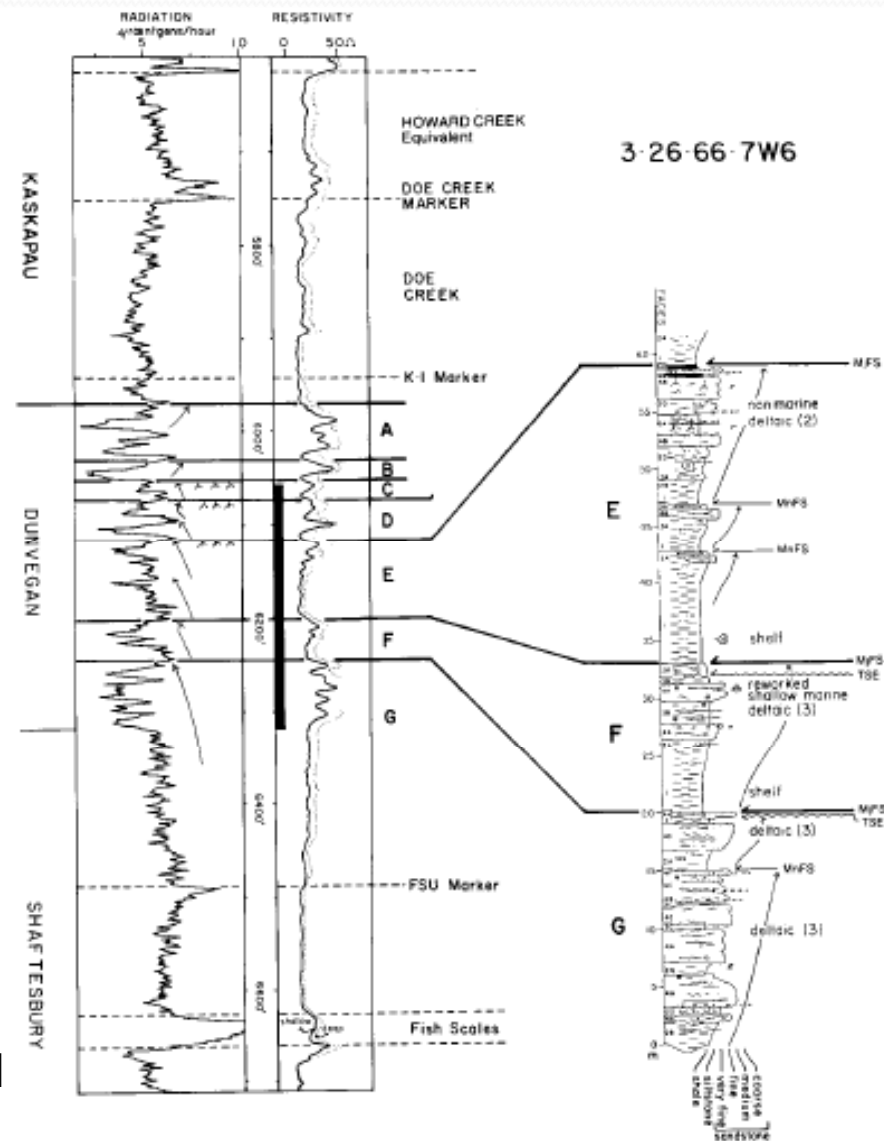
Allomember definition process may include:

- Well-logs
- Core description
- Outcrop analysis
- Paleontology
- Sample log/cuttings
- Geochemistry
- Petrophysics

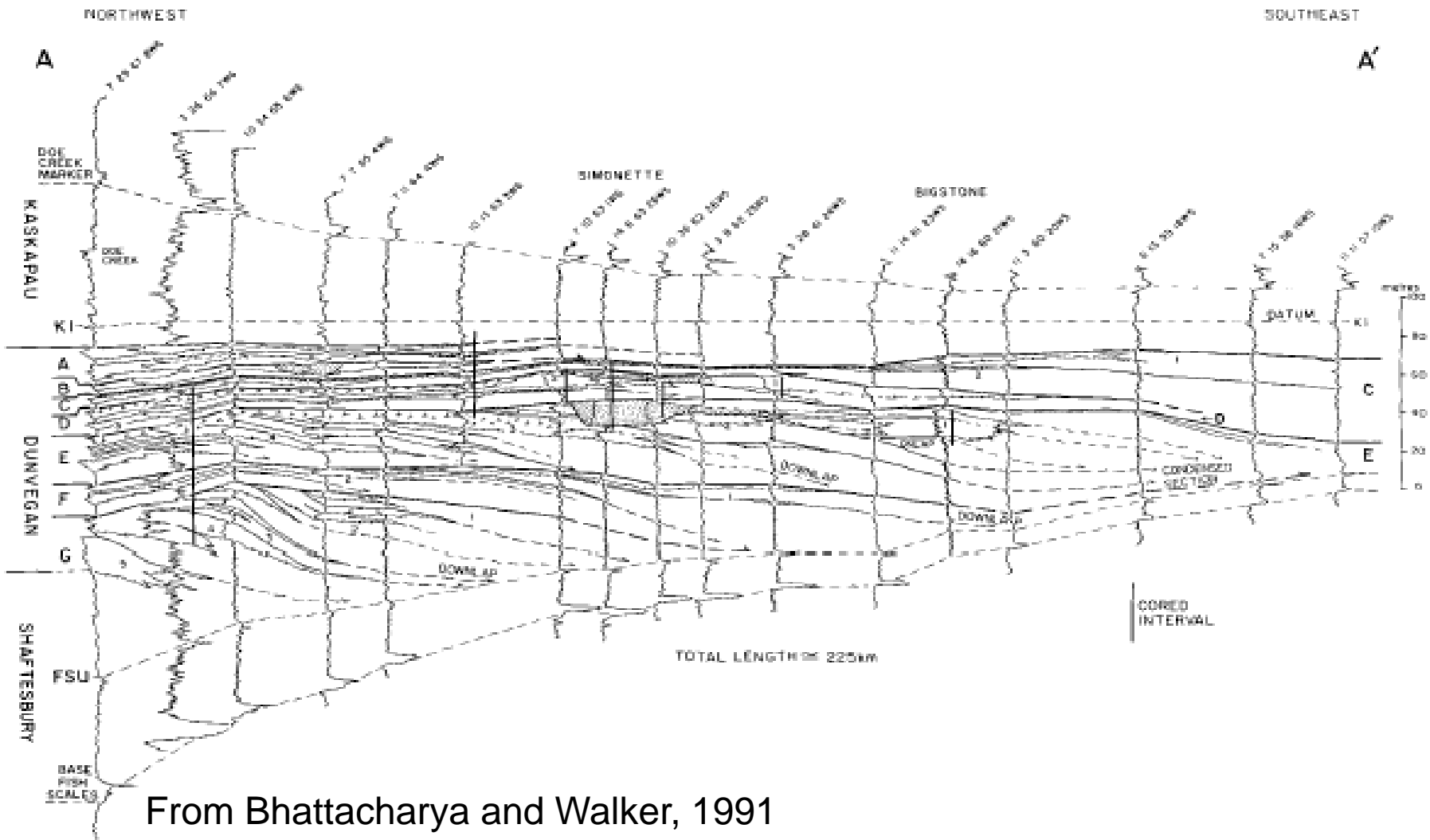
Ideally allomembers should be:

- Regionally correlative
- Have genetic significance

From Bhattacharya and Walker, 1991



# Detailed Cross-section



From Bhattacharya and Walker, 1991

# Examples

- Denver Basin – Washington Co., Colorado
- Black Warrior Basin - Mississippi

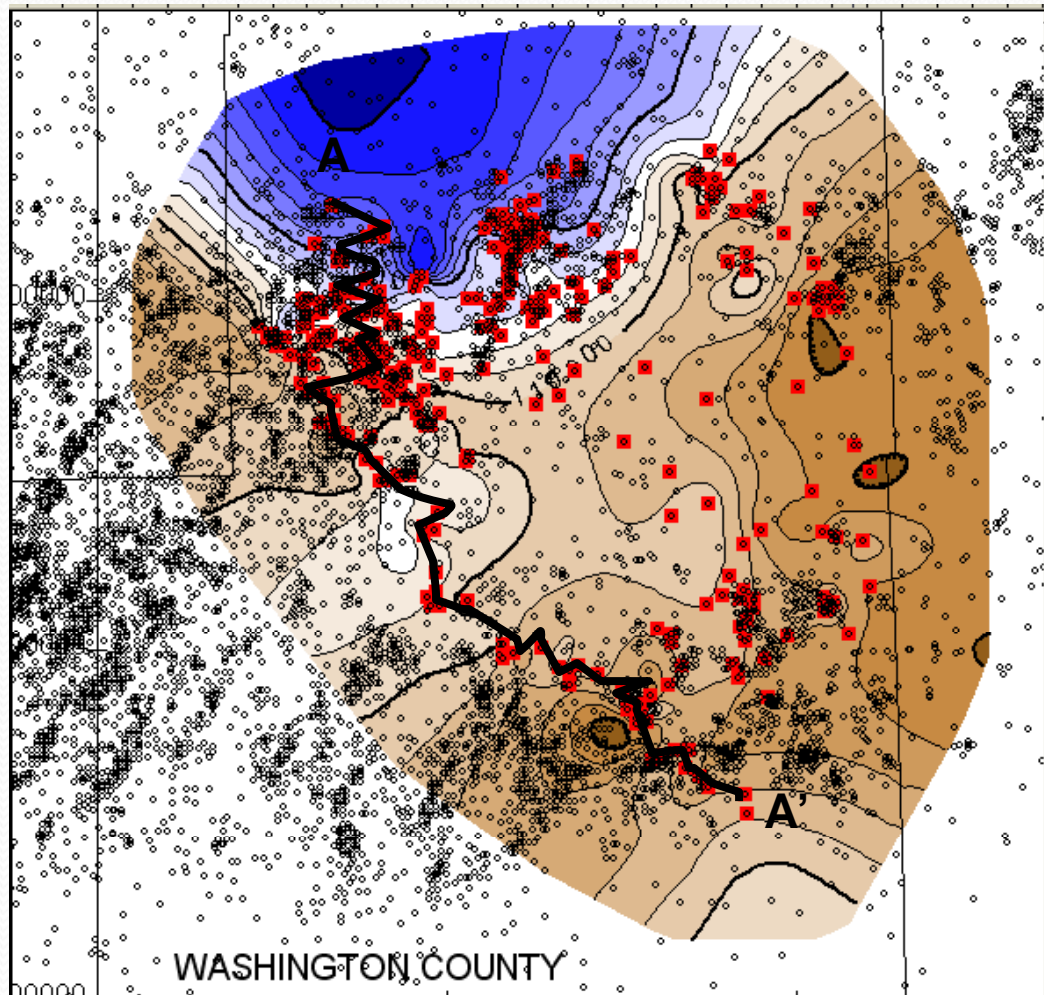


# Denver Basin : Washington Co., Colorado

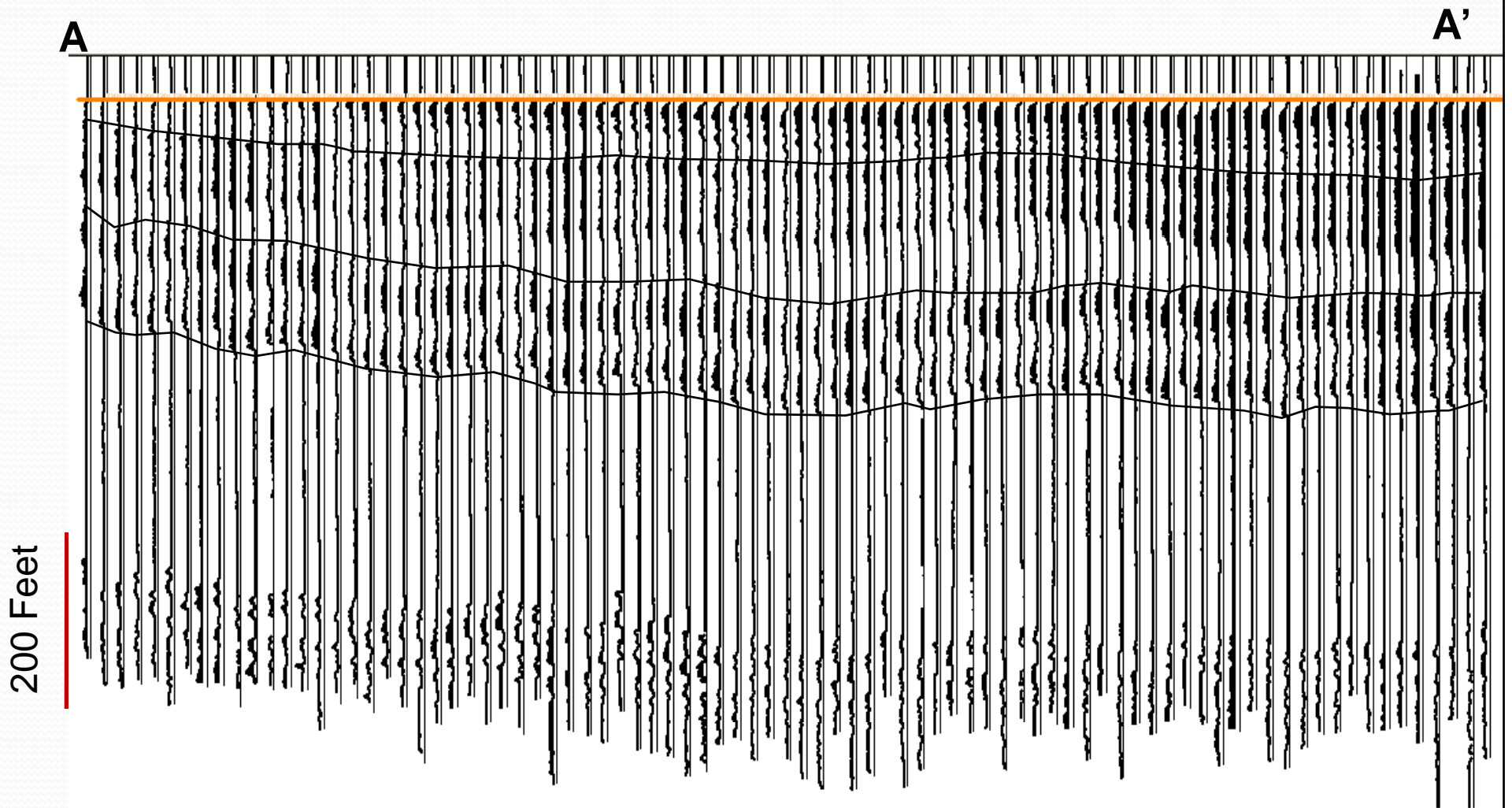
6000+ Wells Available  
322 Wells Used in Red

Contours are of gross  
isopach of upper  
Niobrara unit.

40 Miles



# “Seismic” Display of Well Logs



84 Denver Basin Well-Logs (SP Curves)

# “Seismic Like” View of Sequences

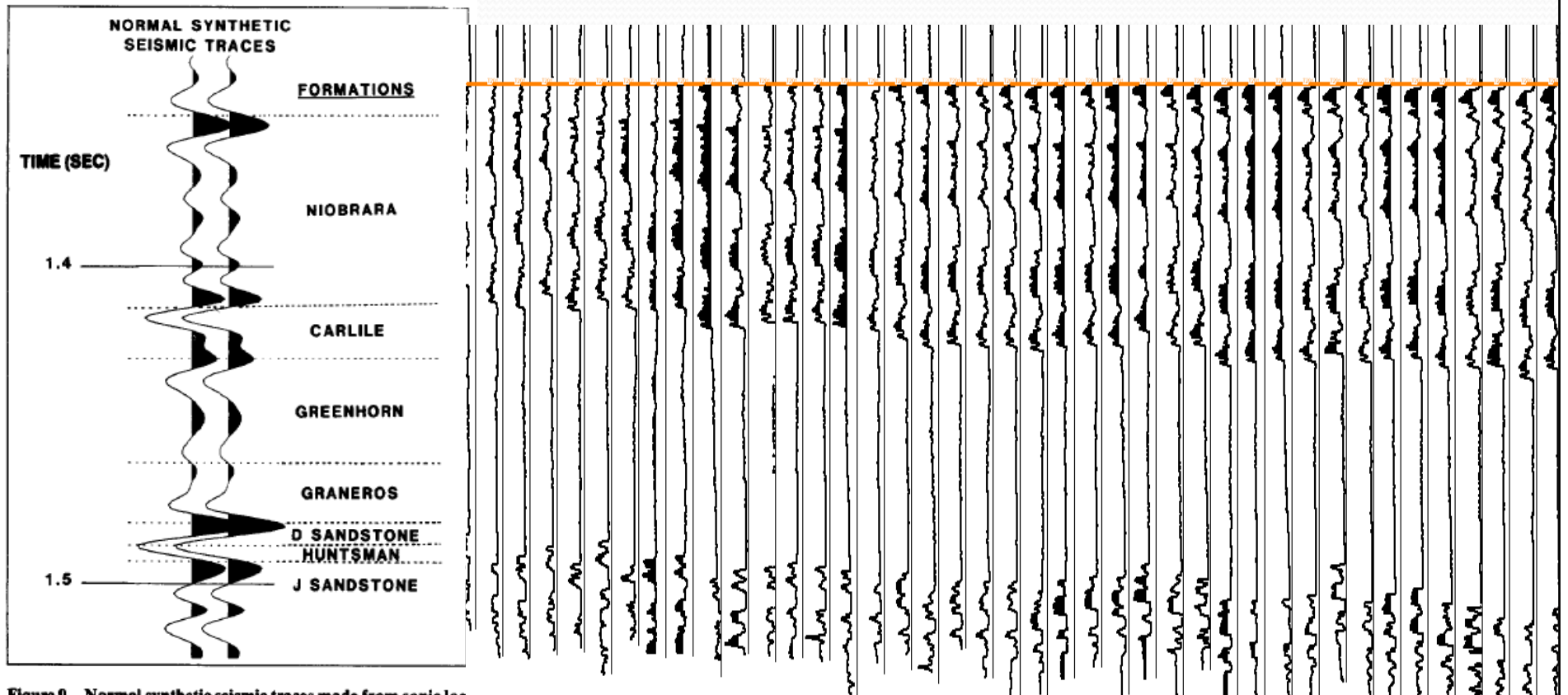


Figure 9—Normal synthetic seismic traces made from sonic log from Amoco 2 Champlin 287 (NW<sup>1</sup>/<sub>4</sub> SW<sup>1</sup>/<sub>4</sub> Sec. 17, T3S, R62W). Dashed lines denote formation boundaries.

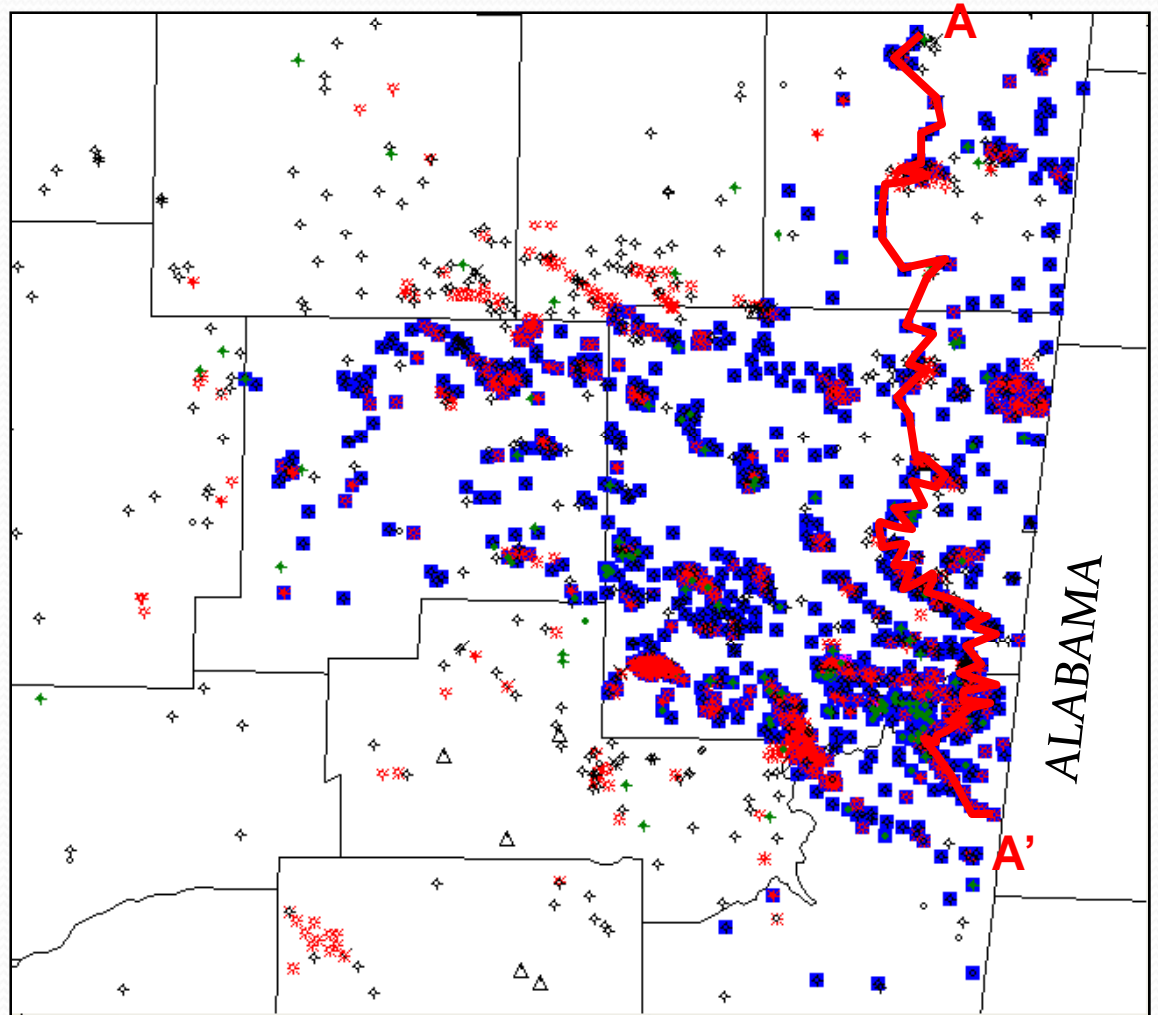
40 Black Warrior Well-Logs (SP Curves)  
From northern portion of Section A-A'

From: Sonnenberg, 1987

# Black Warrior Basin: Mississippi

1500+ Wells Available  
1041 Wells Used in Blue

30 Miles



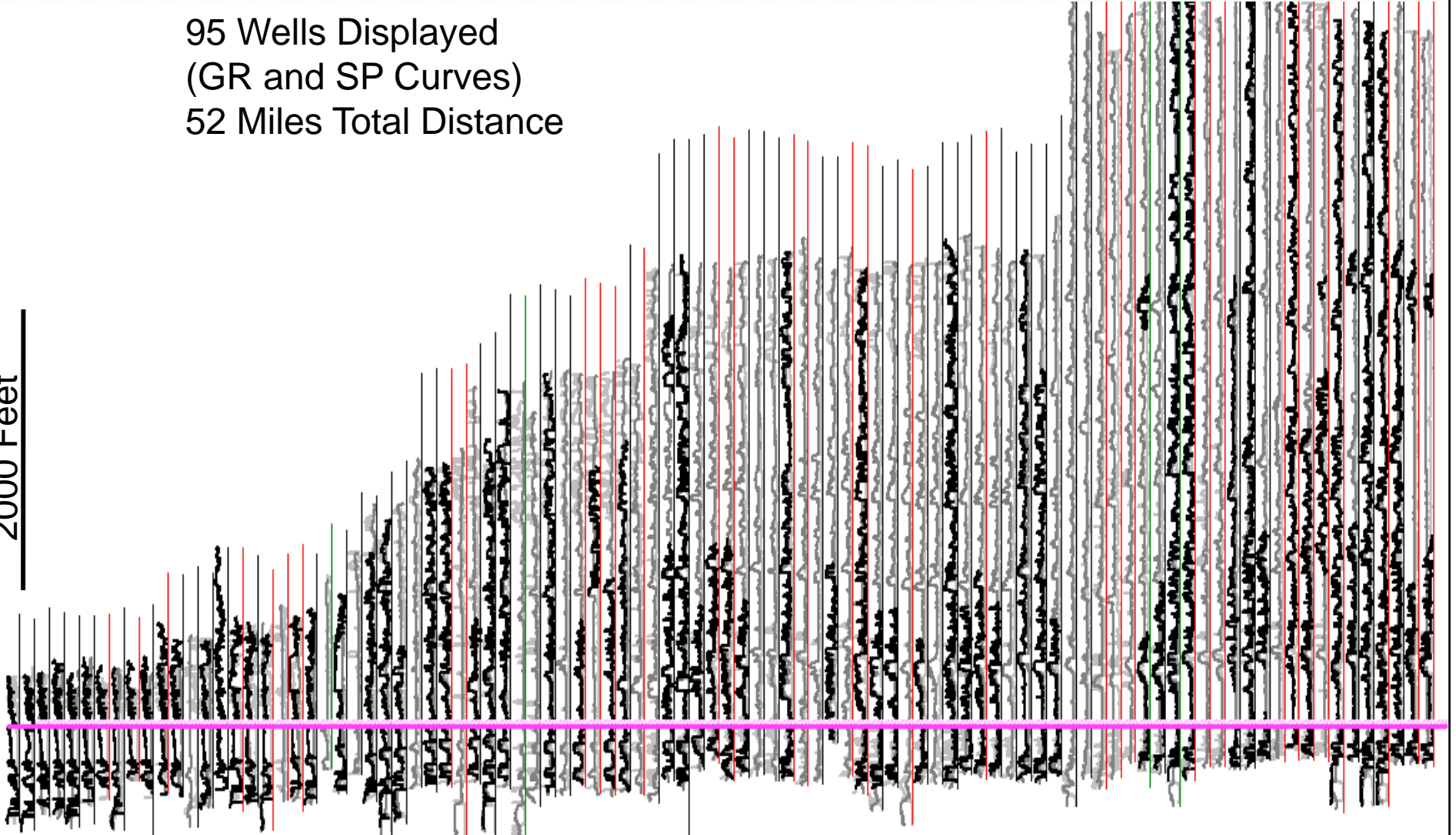
# Stratigraphic Section – BW Basin

A

A'

95 Wells Displayed  
(GR and SP Curves)  
52 Miles Total Distance

2000 Feet





# Summary

- Companies have begun investing millions of dollars in acquiring hundreds of thousands of digitized paper logs.
- Allostratigraphic correlating techniques can be used to interpret the regional geology and shed light on the sequence stratigraphy.
- Resulting data volume will lower exploration and development risks through enhanced understanding of the geology.

# References

- **Bhattacharya, J. and Walker, R.G. 1991**, Allostratigraphic subdivision of the Upper Cretaceous Dunvegan, Shaftesbury, and Kaskapau formations in the subsurface of northwestern Alberta. *Bulletin of Canadian Petroleum Geology*, v. 39, p. 145-164.
- **Sonnenberg, S. 1987**, Tectonic, Sedimentary and Seismic Models for D Sandstone, Zenith Field Area, Denver Basin, Colorado. *AAPG Bulletin*, v. 71, p. 1366-1377.