



# 3-D Seismic in the Glennpool Area

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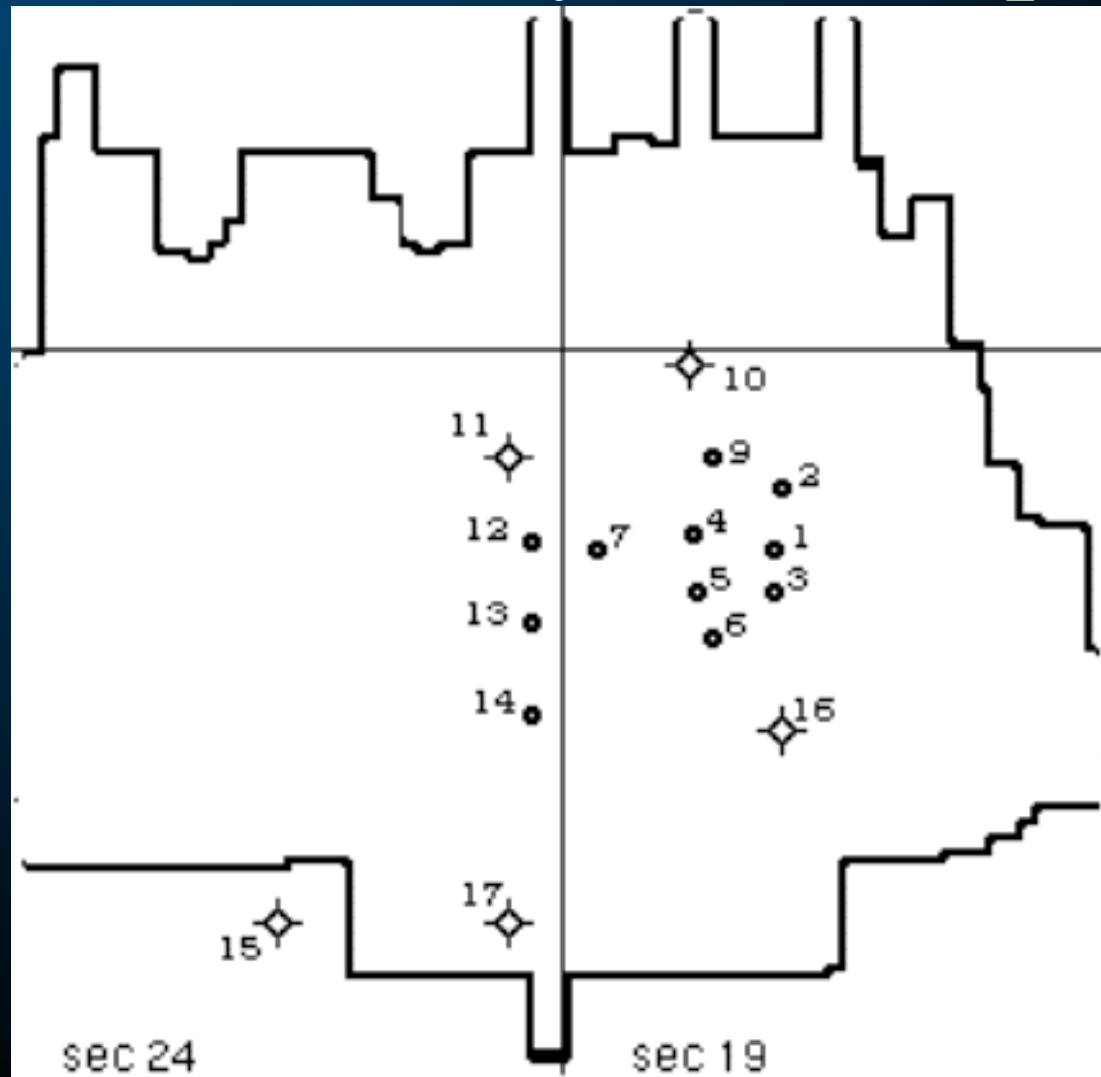
# Objectives

1. Leverage DOE project well information
2. Analog for Wilcox exploration
3. Get a view of the Glenn interval
  - Adjacent to Glenn Pool field
4. Test small-scale 3-D seismic in NE Okla

# Data inventory - Wells

- ▼ Sections 19/24 wells (17N 12E)
  - Total of 17 wells, 6/85 discovery
  - Wilcox production , ~ 2500 ft
  - Porosity up to 18%
  - Thickness up to 34 ft
  - Cumm: 950,000 BO (thru '96)
  - Approximately 120 acre 'bump' on SW flank of Glennpool field

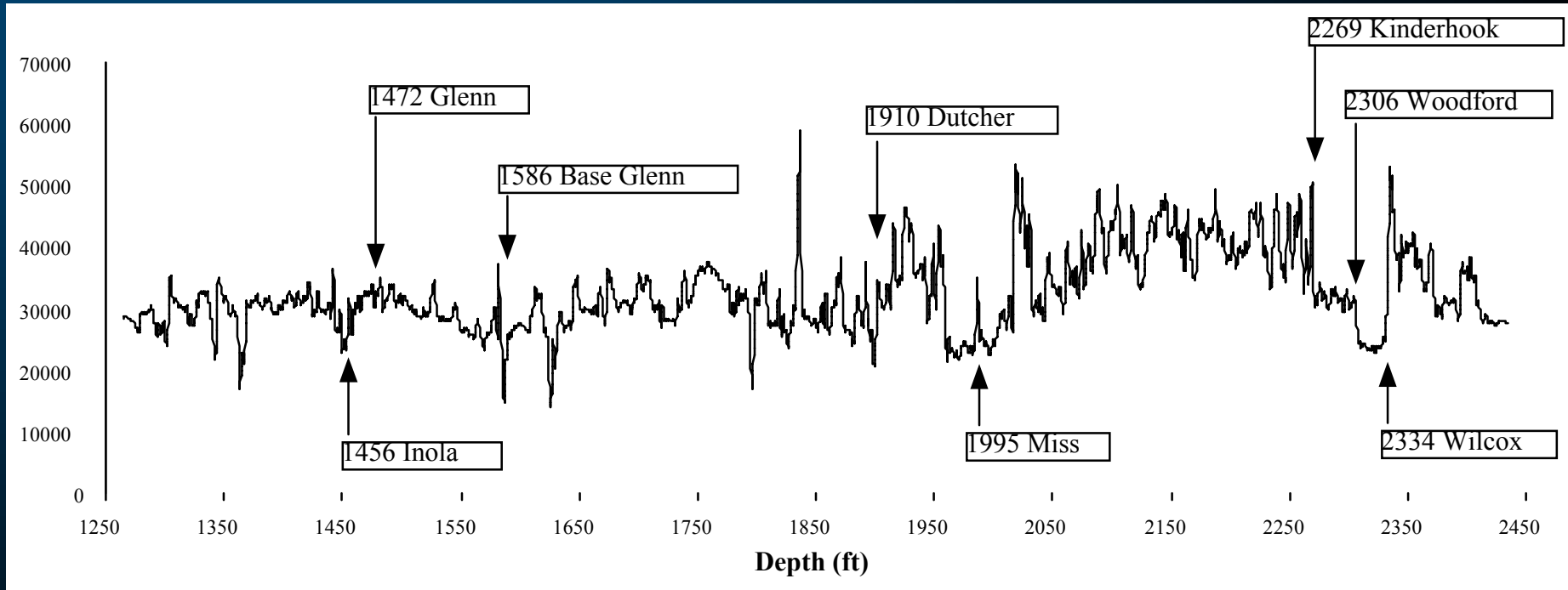
# Data inventory - Well spots



# Data inventory - Self #82

- ▼ Self unit #82 -- section 21 (17N 12E)
  - Approx 2 miles from 3-D area
  - DIL - LDL - BHC - CNL - GR - SP
  - Sonic+Density => velocity \* den = Impedance
  - Sonic => velocity => time/depth => event ID
    - Could do full synthetic
- ▼ Credits
  - Drilled for DOE project (D. Kerr, M. Kelkar)

# Self #82 Acoustic Impedance

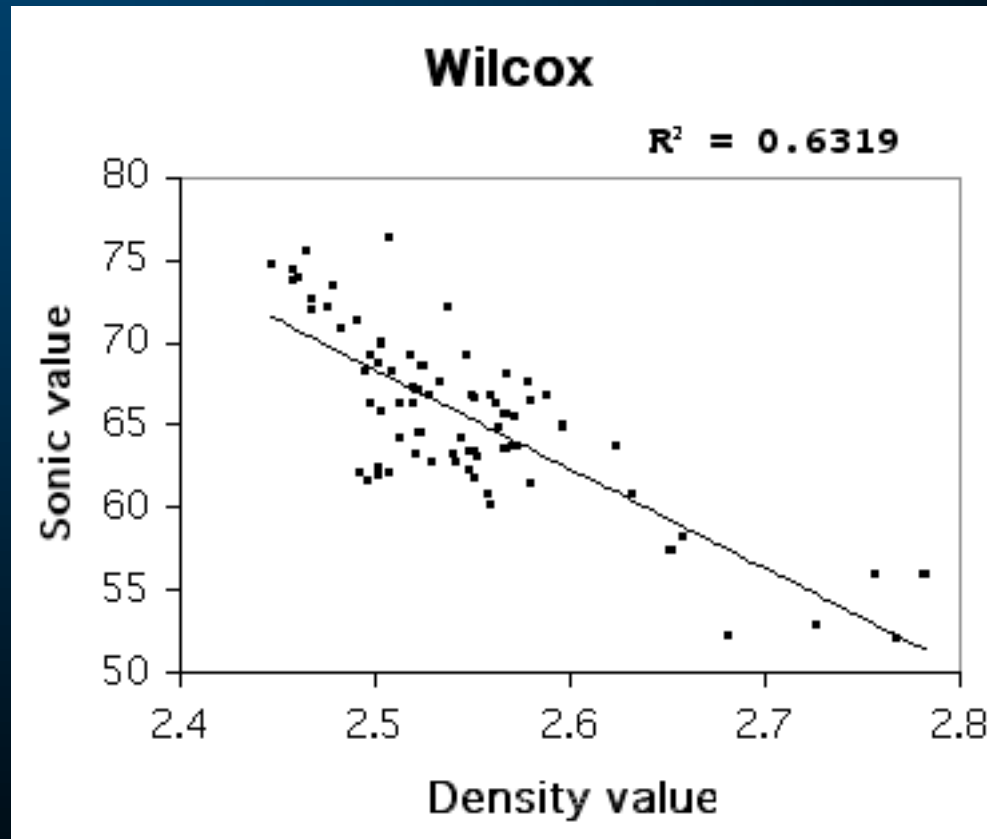


# Can we ignore sonic?

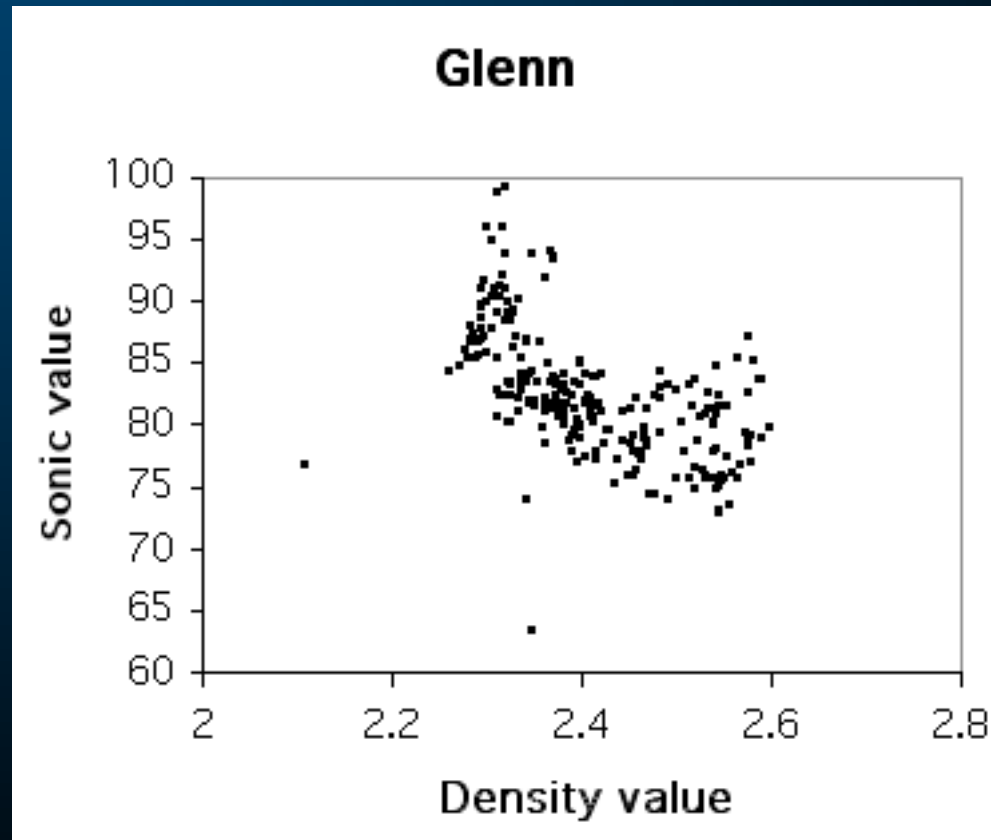
- ▼ Yes, if the sonic values are predictable from the (more common) density log



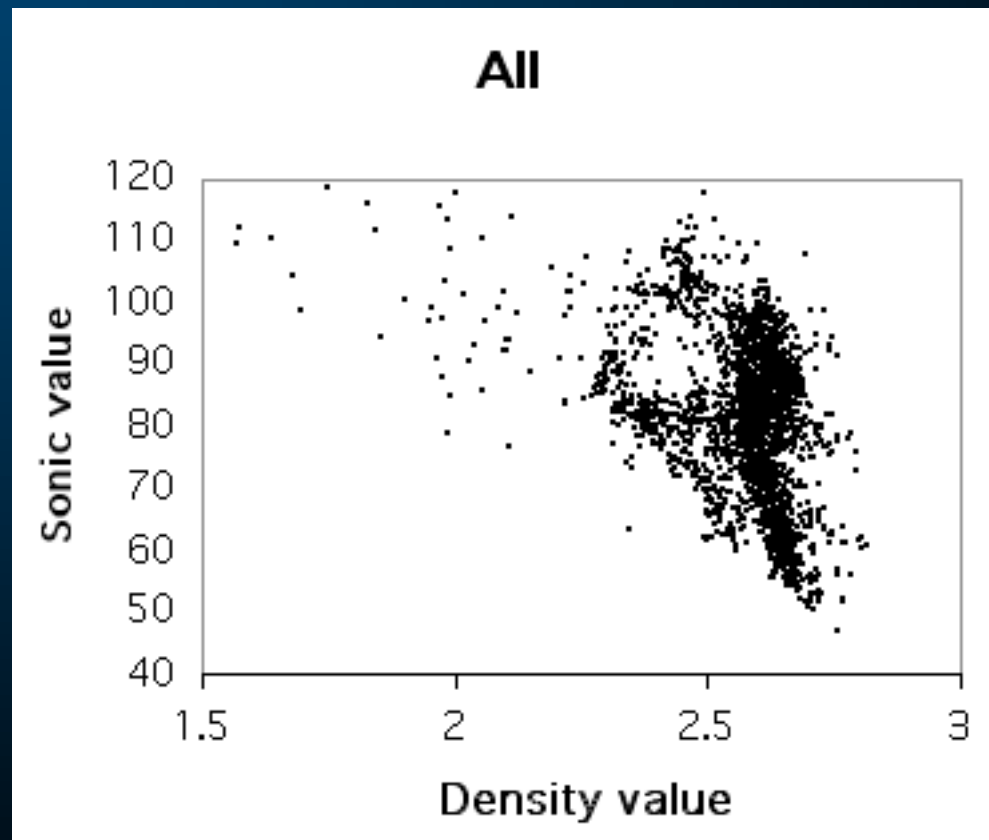
# Wilcox?



# Glenn?



# All?

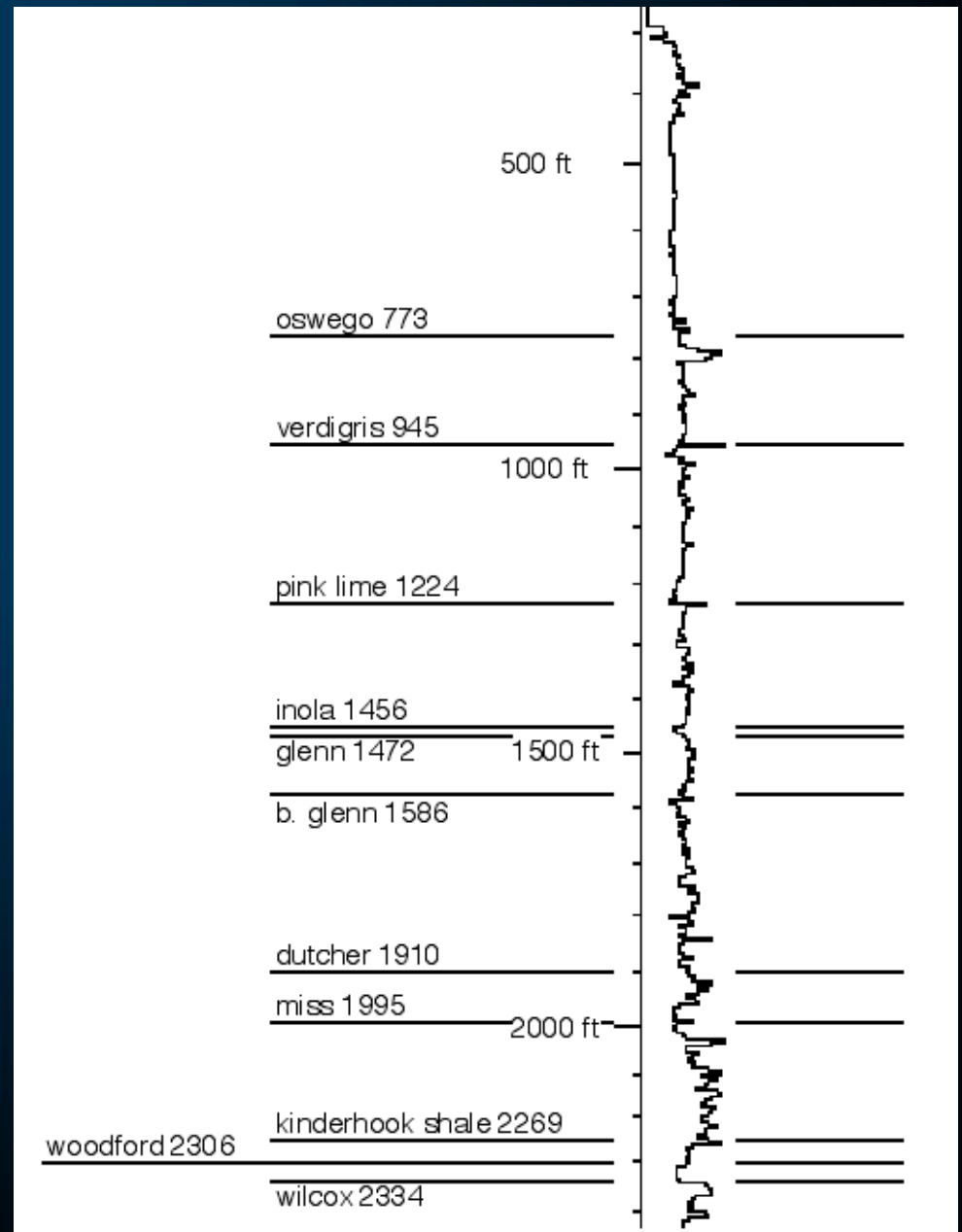


# Can we ignore sonic?

- ▼ Yes, if the sonic values are predictable from the (more common) density log
- ▼ Are they?
  - Wilcox? ... Maybe
  - Glenn? ... No
  - All? ... %\$#! No
- ▼ For synthetic generation we'd better have both

# Self #82

- Velocity from Sonic
  - more log (300-TD)
- Formation tops
- Time plot
  - (Non-linear Depth tics)



# Data inventory - Seismic

## ▼ 3-D seismic data

- Vibroseis, 55 x 55 ft bin
- 141 E-W lines x 145 N-S lines
- 1420 acres, 2.2 square miles
- 1 sec, 2 ms
- Frequency band 15-120 Hz

## ▼ Credits

- Producers Oil, Opseis, Merc. Intl. Tech

# Data inventory - Seismic

## ▼ Is 55 ft the correct bin size?

–  $\text{Bin} < V_{\text{int}} / (4 f_{\text{max}}) = 15\,000 / (4 * 120) = 31 \text{ ft}$

- 55 ft is a little too large
- Fault imaging degraded
- dips greater than  $34^\circ$  degraded

# Data inventory - Seismic

## ▼ What is the vertical resolution?

$$- VR = V_{int} / (4 f_{dom}) = 15\,000 / (4 * 60) = 62 \text{ ft}$$

- Wilcox is a 'thin bed'

## ▼ Lateral resolution?

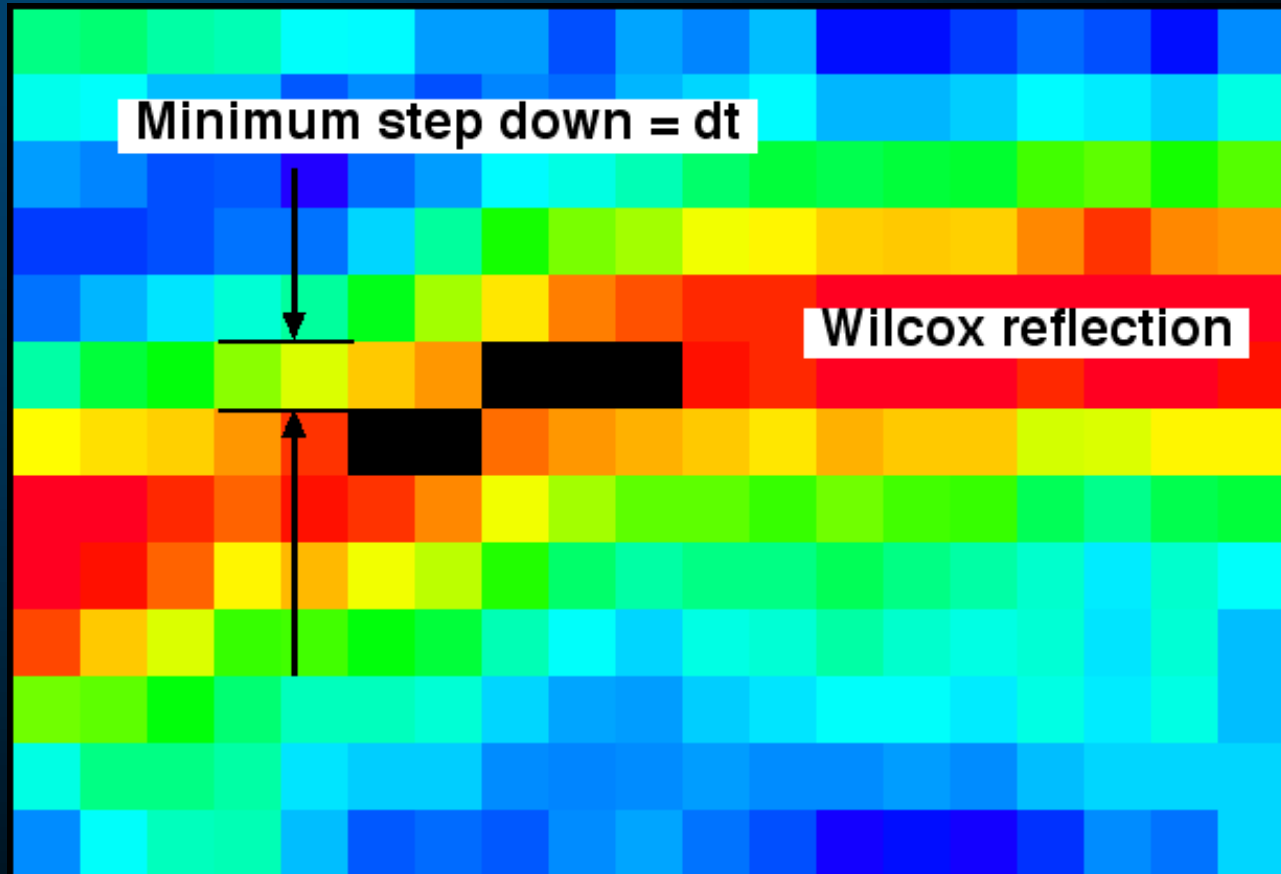
$$- LR = 2 * VR = 144 \text{ ft} \sim 2 \text{ bins}$$

## ▼ Structural resolution?

$$- dZ = (V_{avg} dT) / 2 = 11\,000 * .002 / 2 = 11 \text{ ft}$$

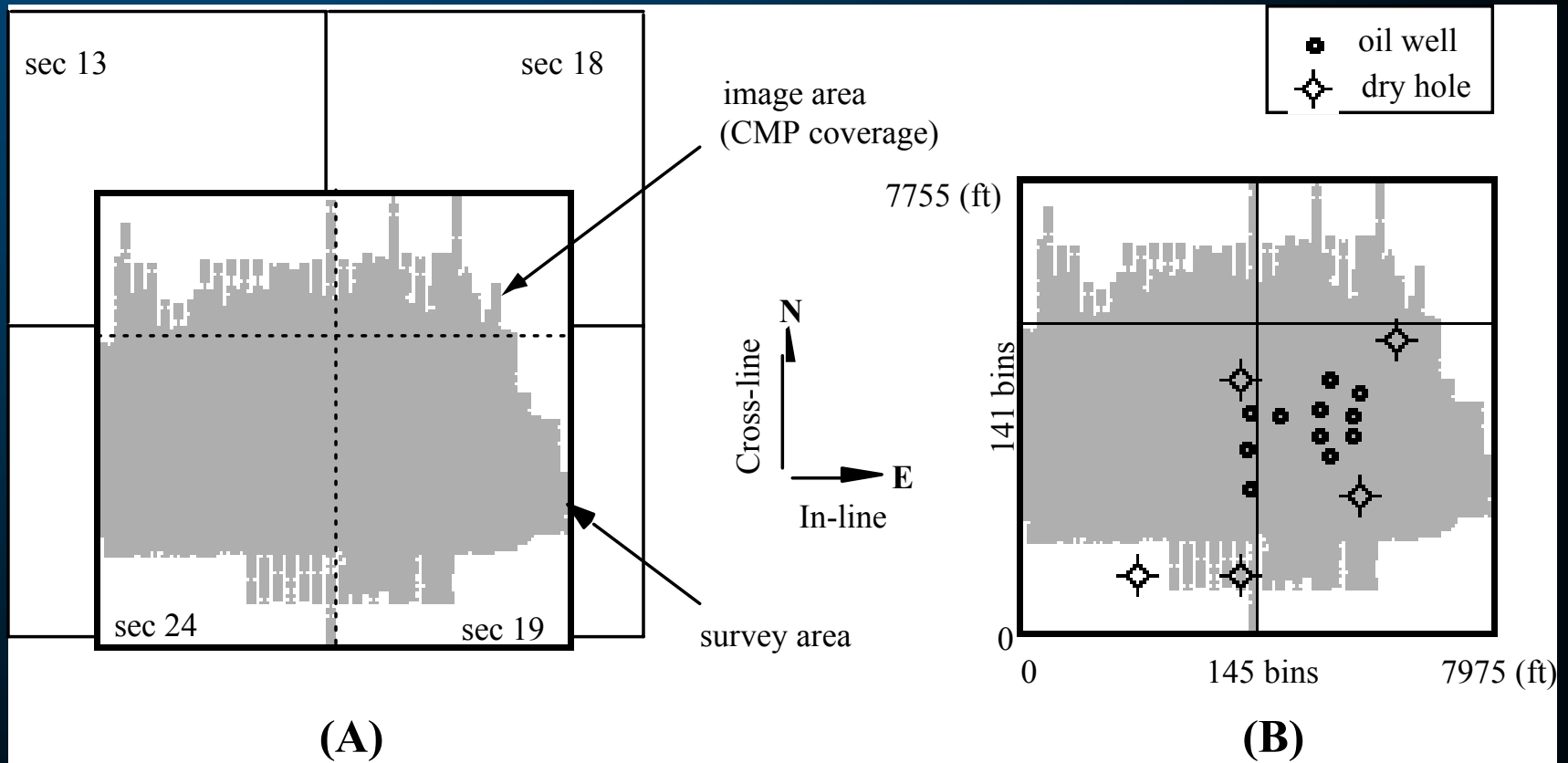


# Structural resolution



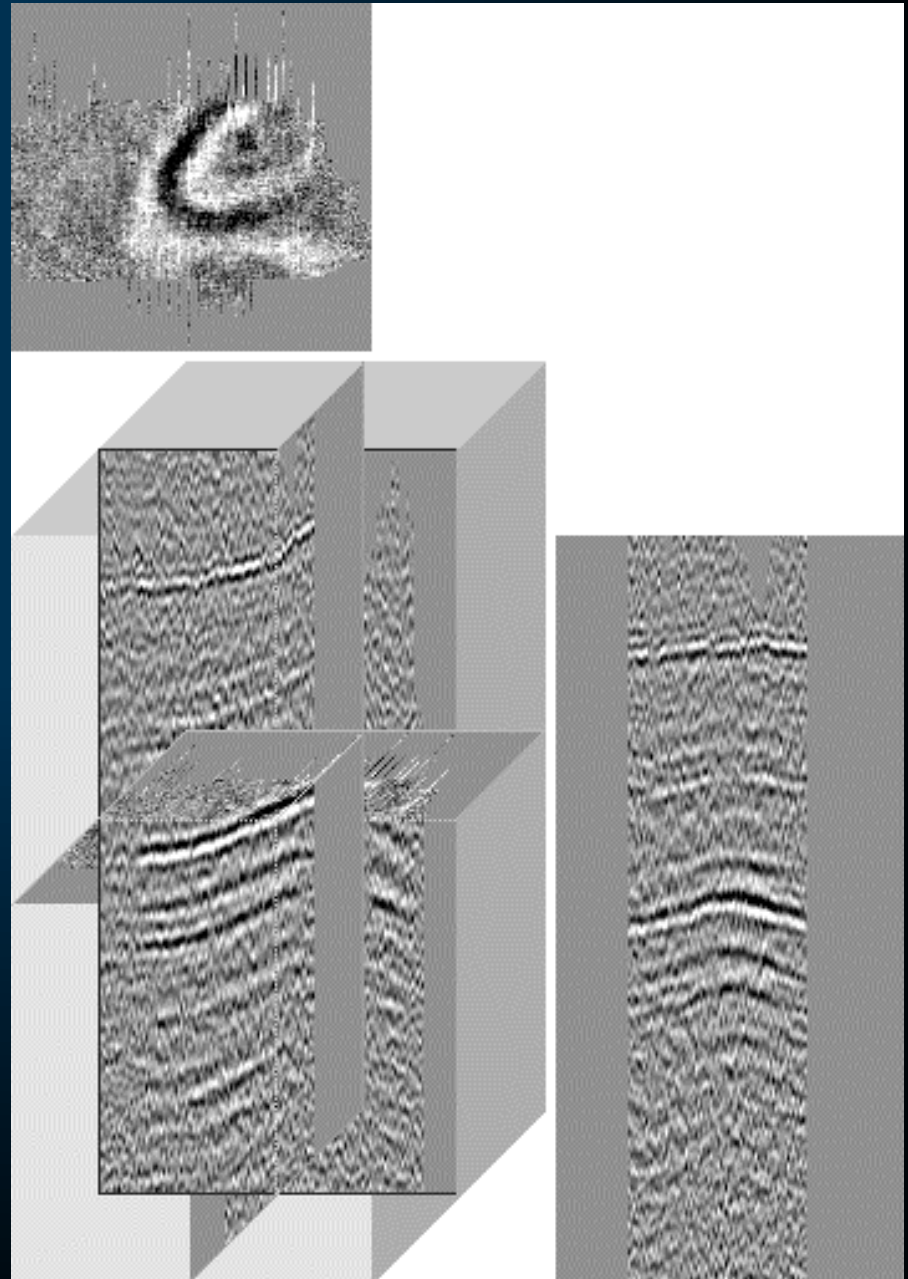
- Step down = 11 ft
- Assumes perfect removal of shallow effects

# Data footprint

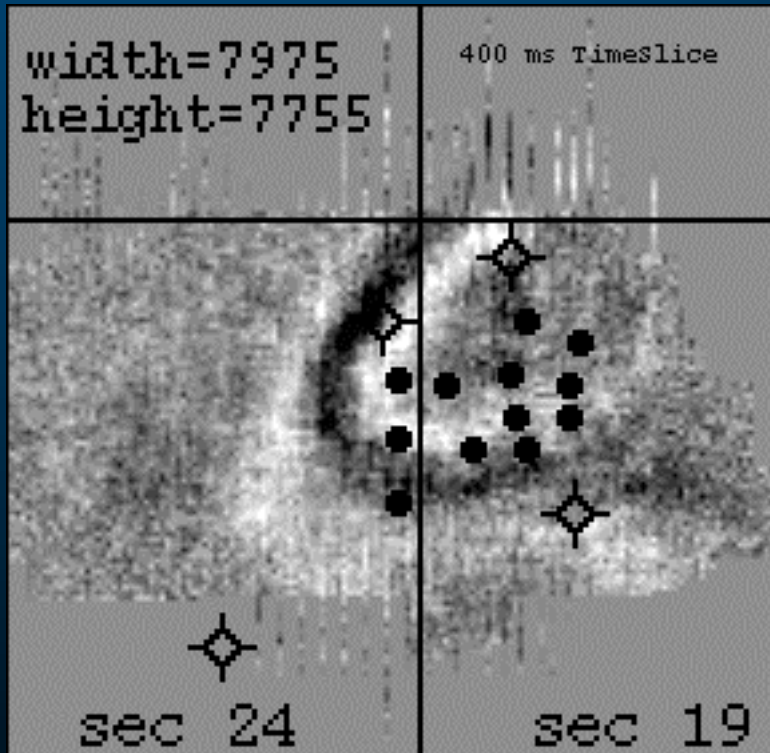


# Data cube

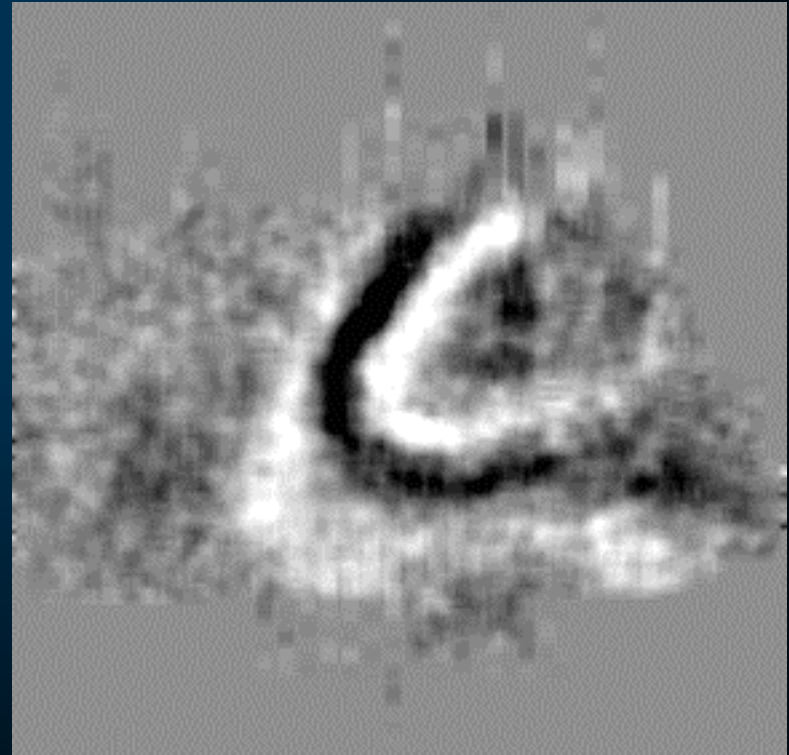
- ▼ Noisy data
  - Rough terrain
  - Near surface issues
- ▼ Good frequency
- ▼ How to improve?



# Improved quality

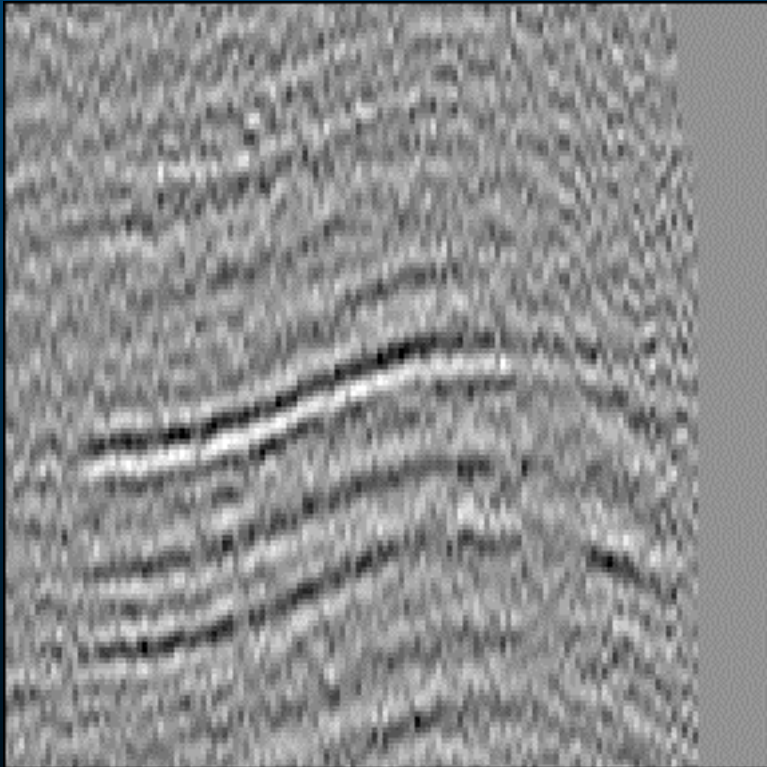


Original

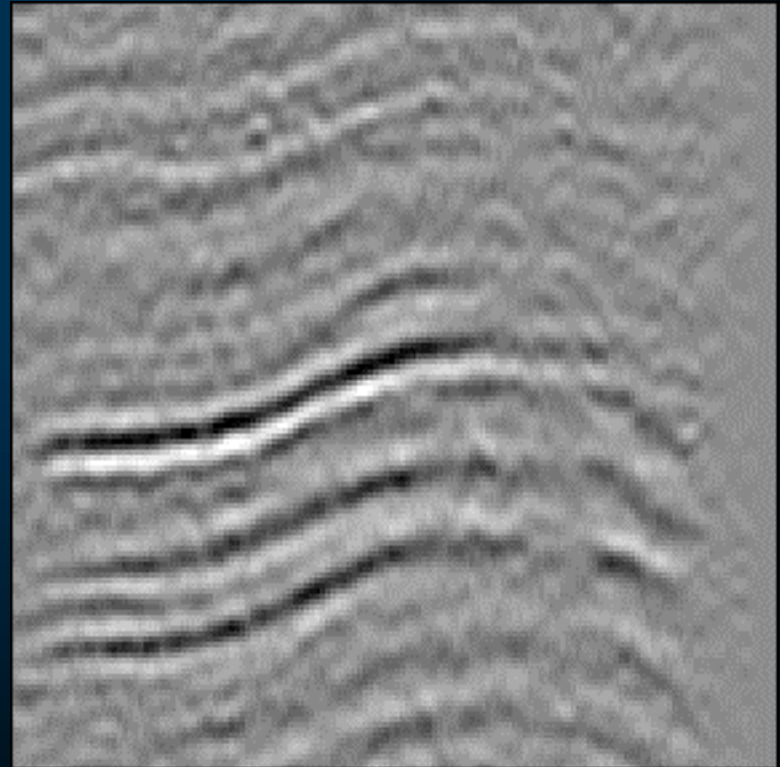


Time slice smoothing

# Improved quality

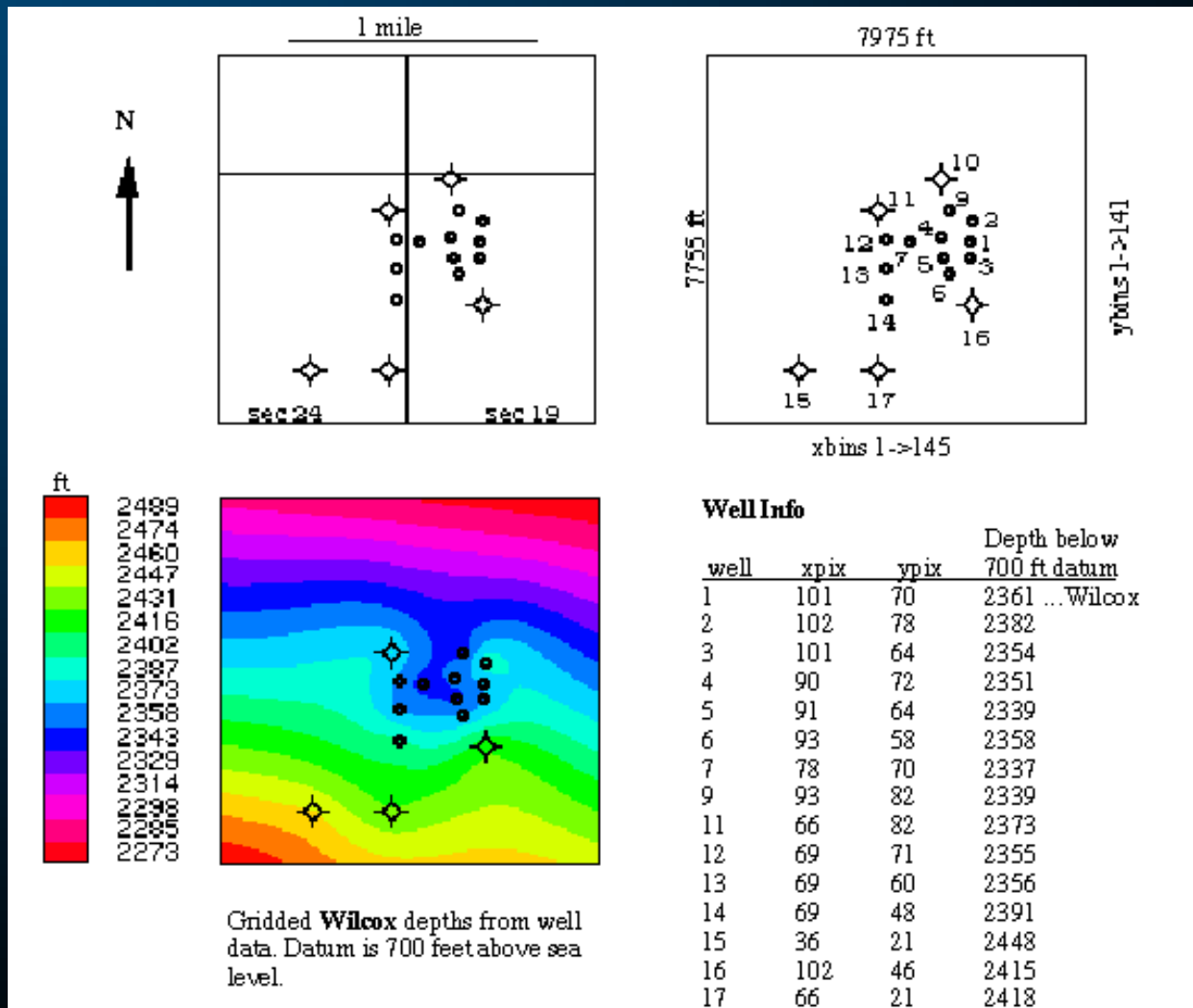


Original

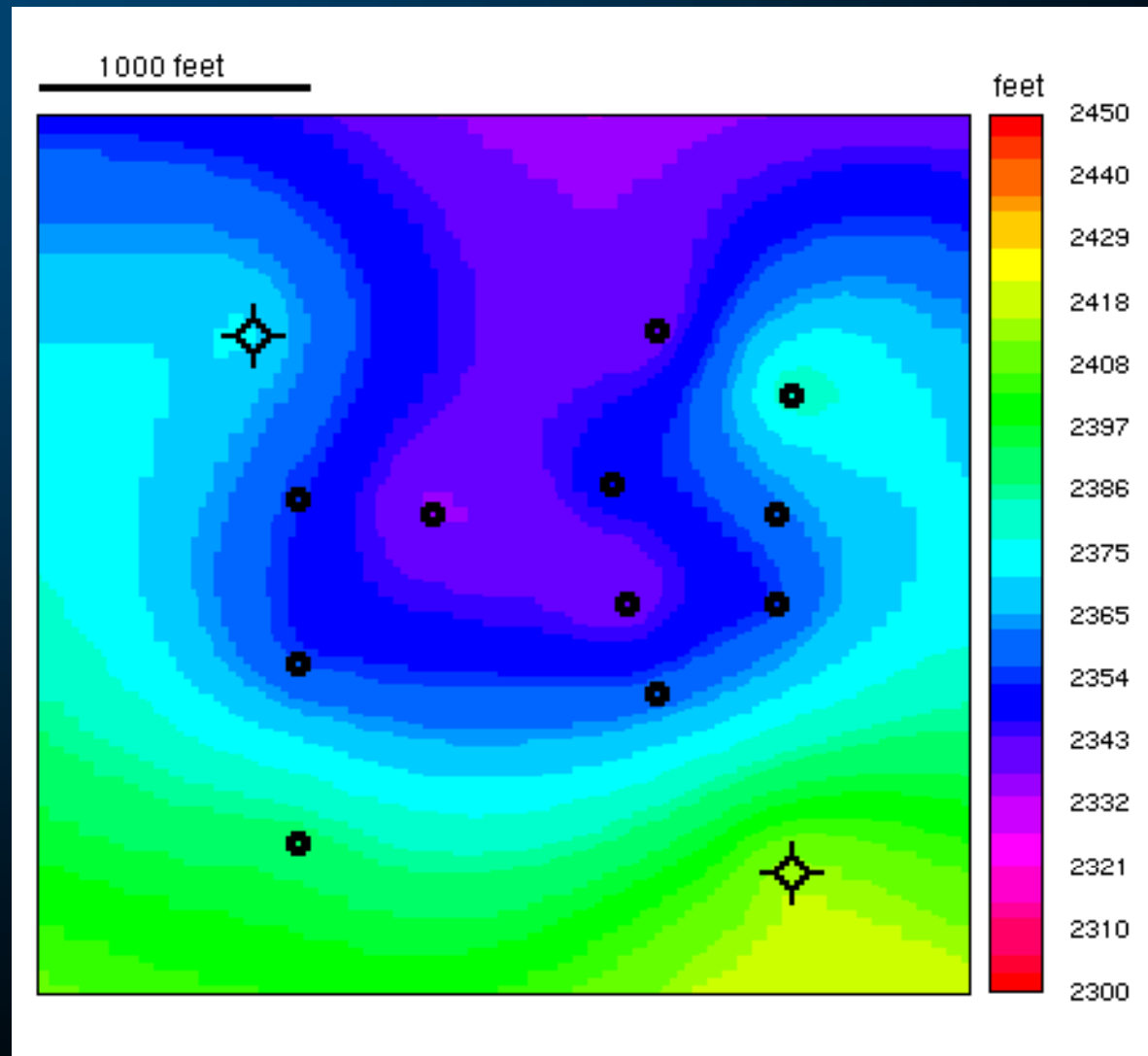


Time slice smoothing

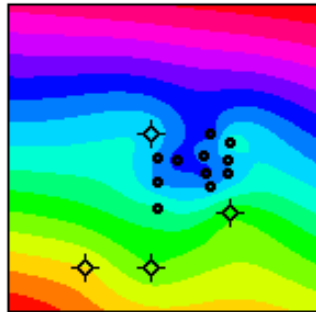
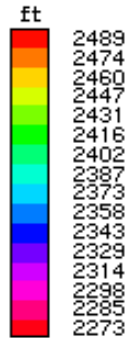
# Well depth maps - Wilcox



# Wilcox detail

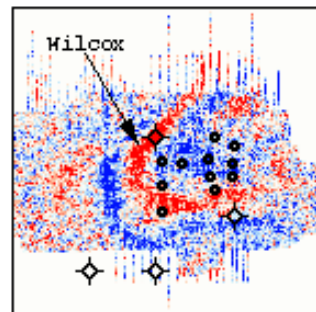


# Structure $\neq$ structure

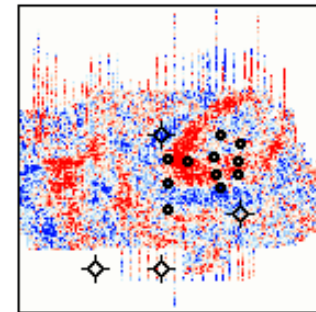


Gridded Wilcox depths from well data. Datum is 700 feet above sea level.

Well Info	depth below		
well	xpix	ypix	700 ft datum
1	101	70	2361 ...Wilcox
2	102	78	2382
3	101	64	2354
4	90	72	2351
5	91	64	2339
6	93	58	2358
7	78	70	2337
9	93	82	2339
11	66	82	2373
12	69	71	2355
13	69	60	2356
14	69	48	2391
15	36	21	2448
16	102	46	2415
17	66	21	2418



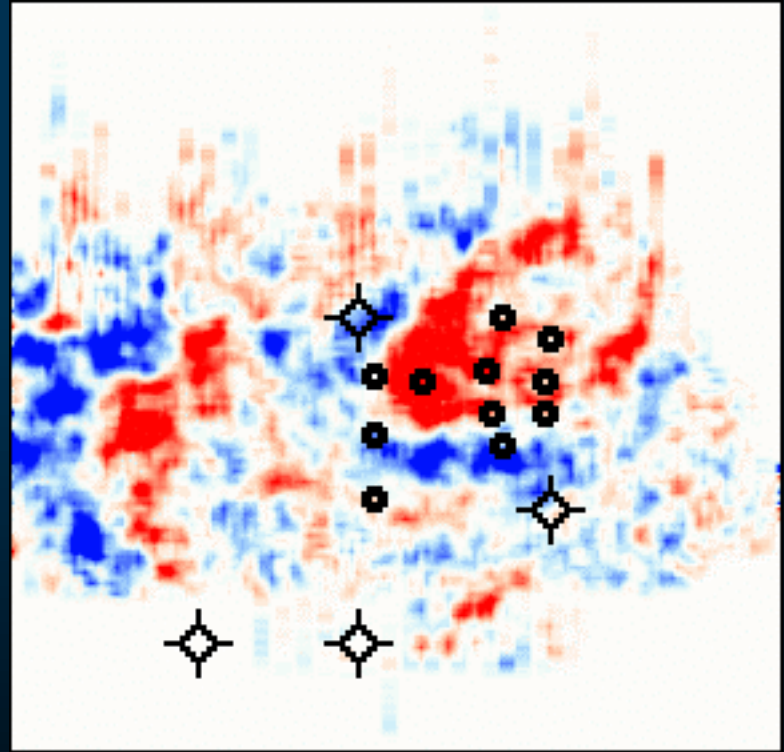
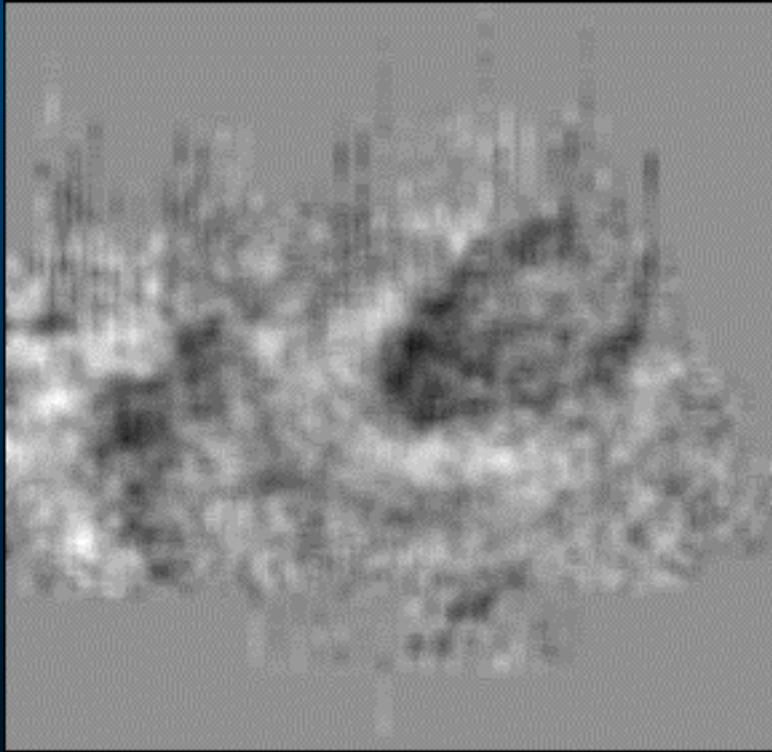
Time slice from 3D seismic data at 448 ms level, equivalent to about 2375 ft below datum. Average velocity 10,605 ft/sec.



Time slice at 436 ms level, equivalent to about 2345 ft below datum.

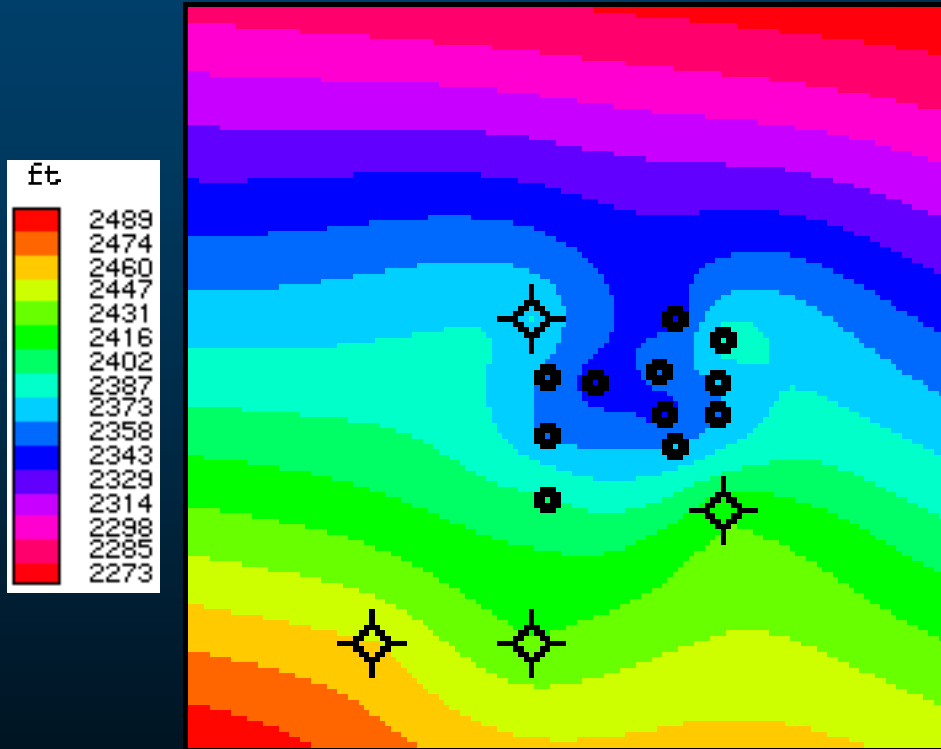


# Structure $\neq$ structure

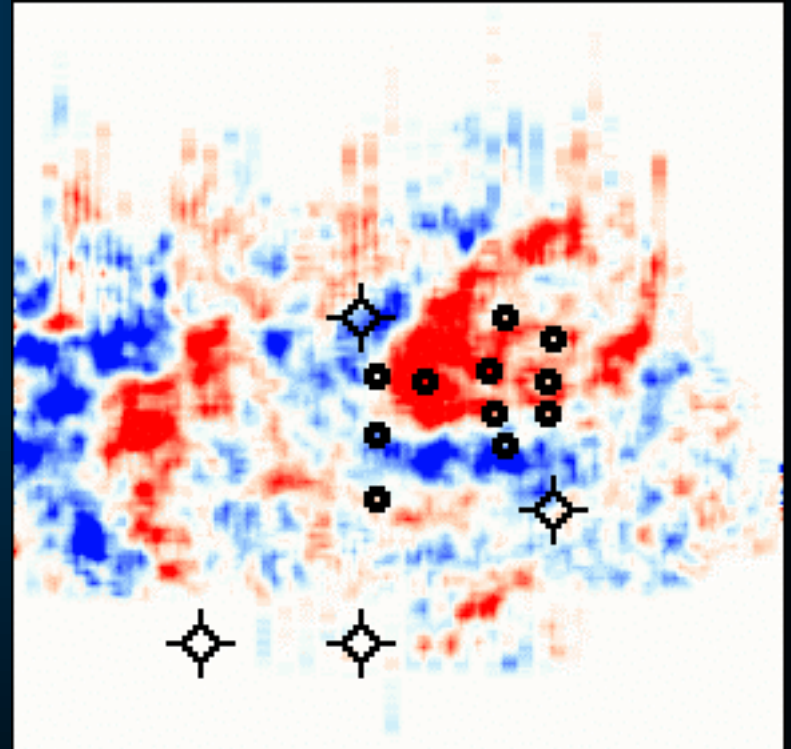


434 ms time slice

# Structure $\neq$ structure

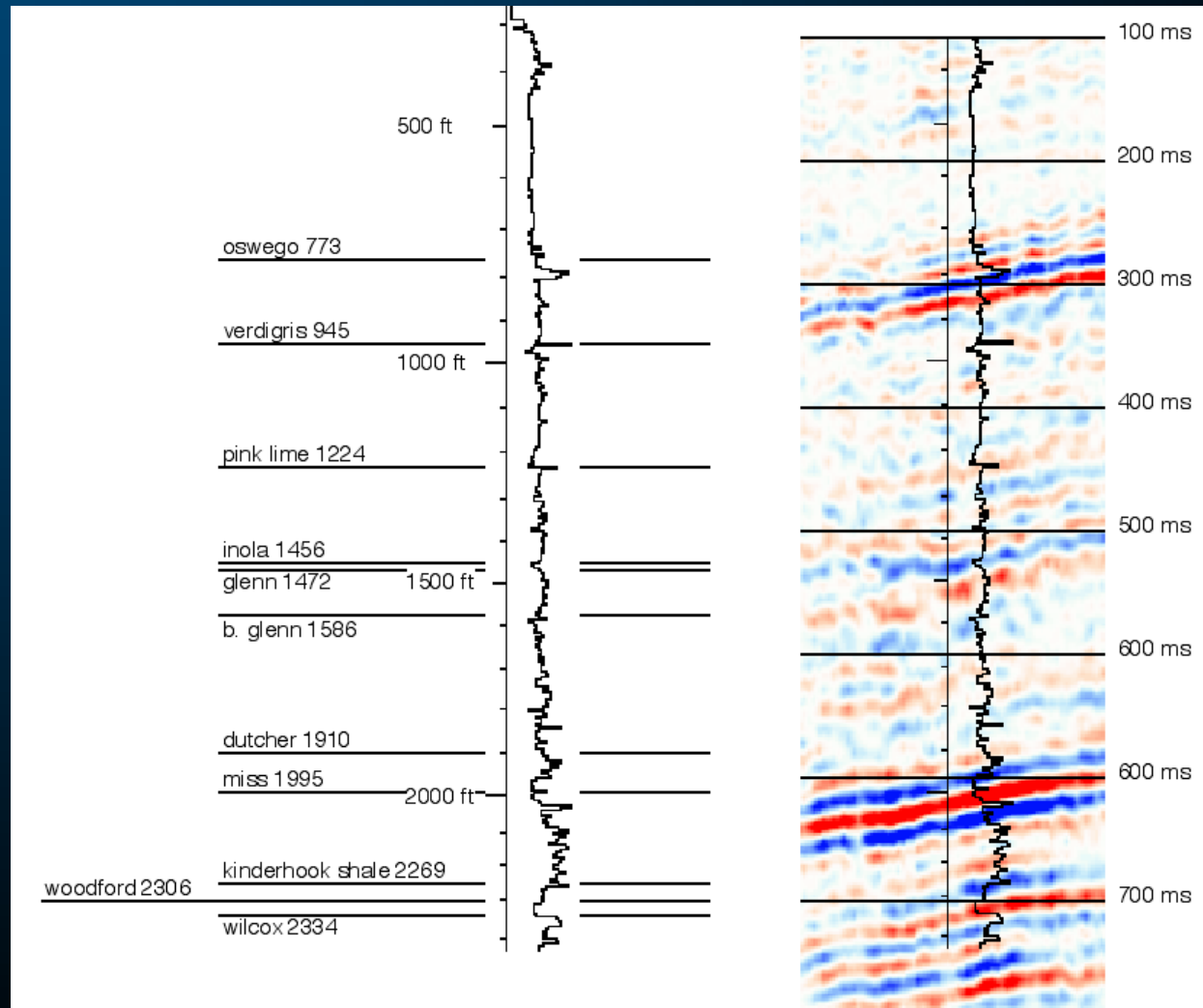


Well depths: crest?

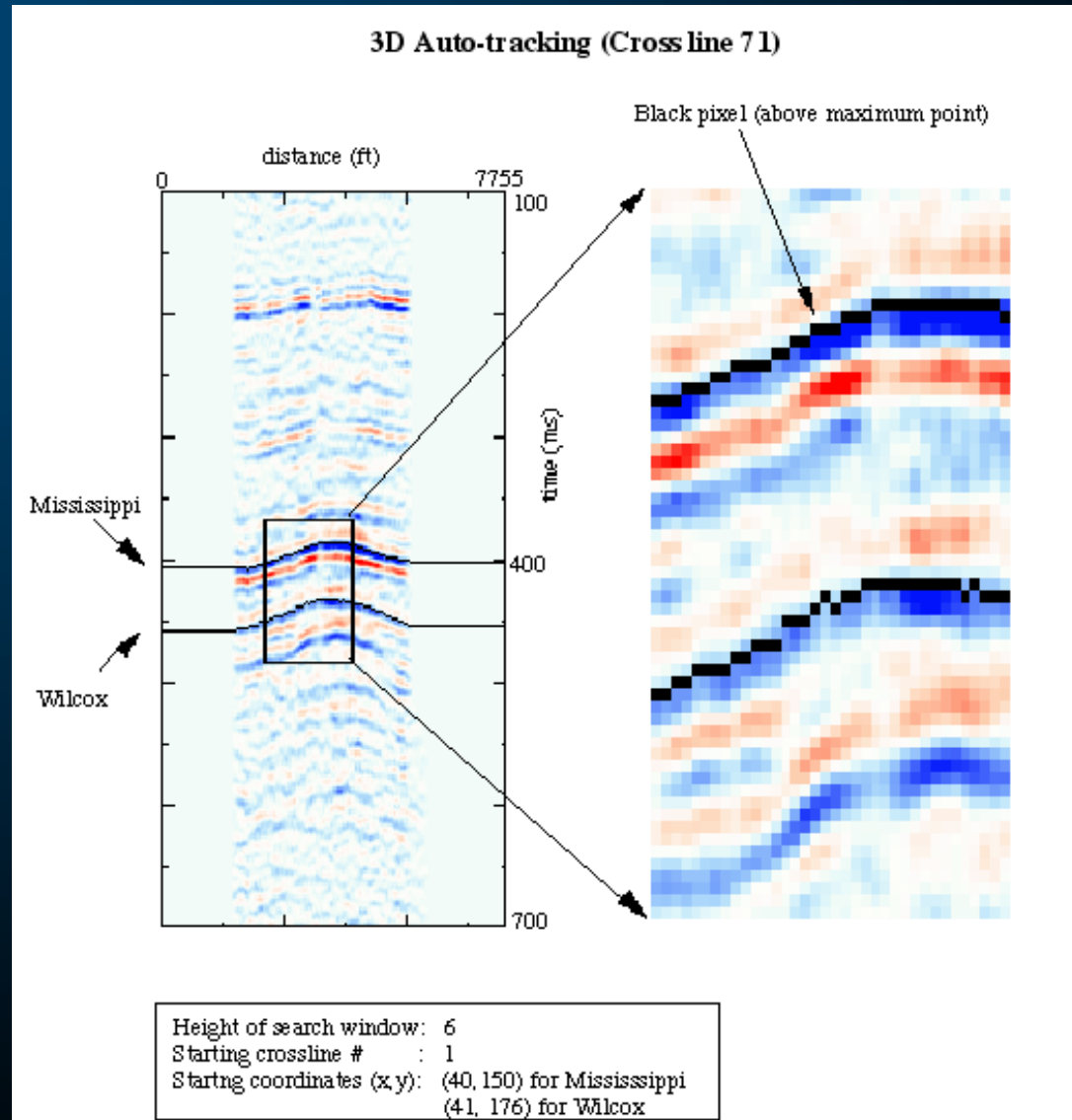


434 ms time slice

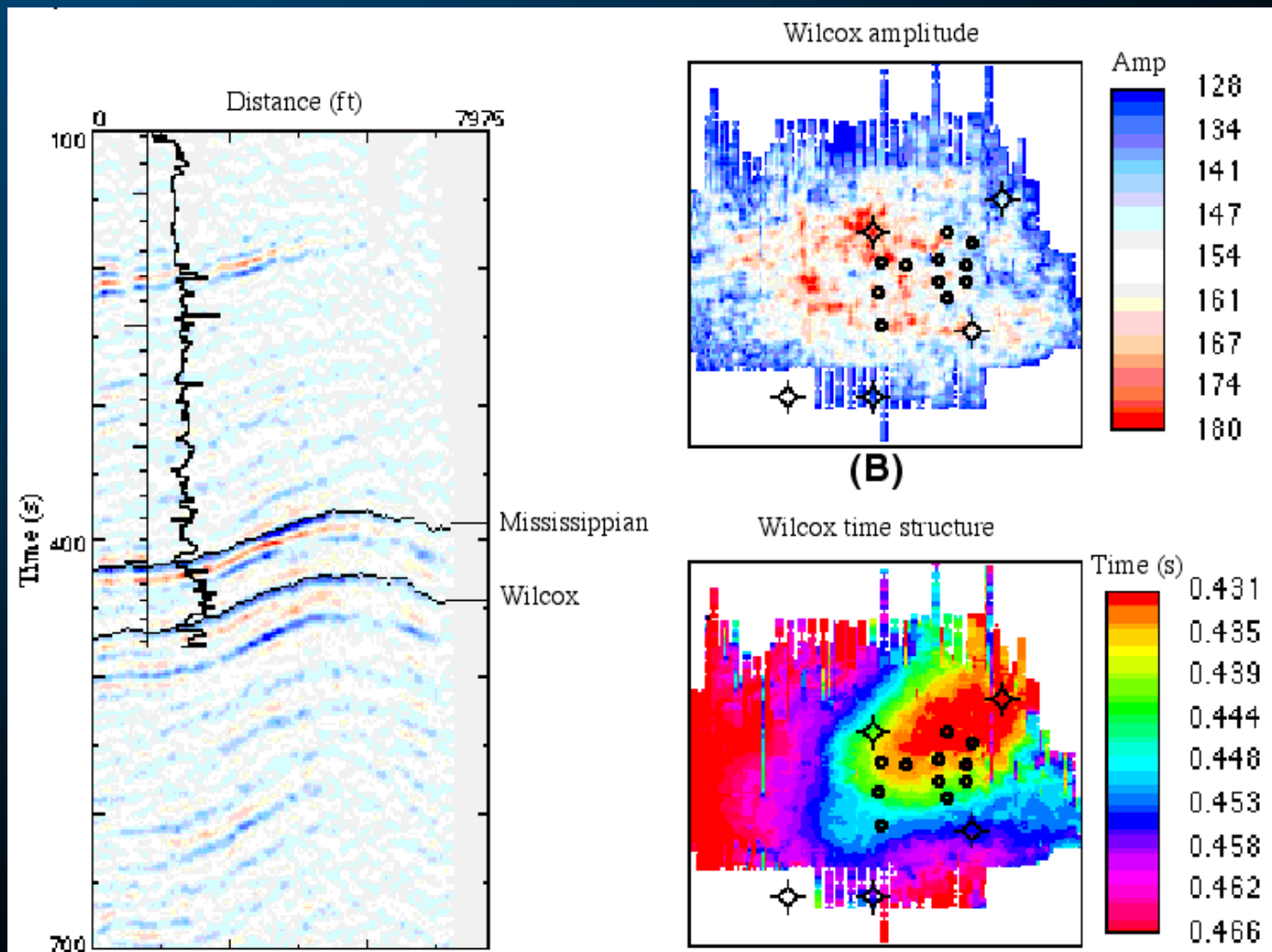
# Seismic tracking



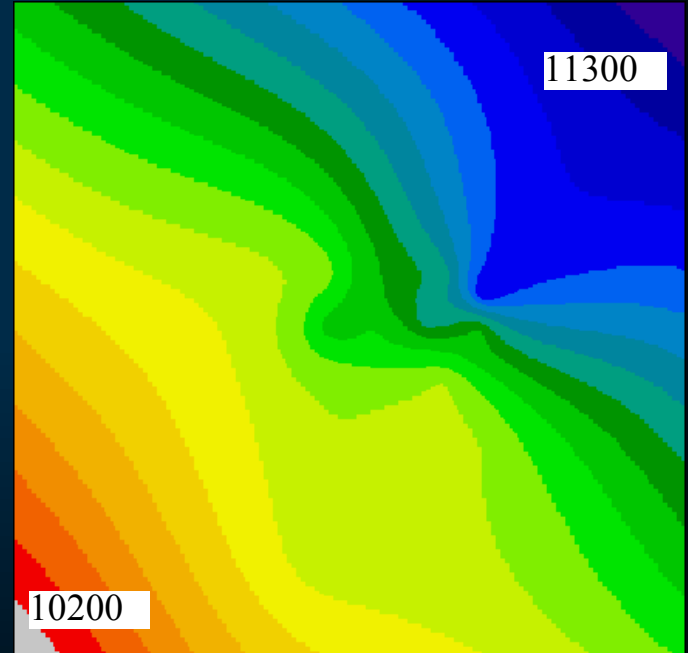
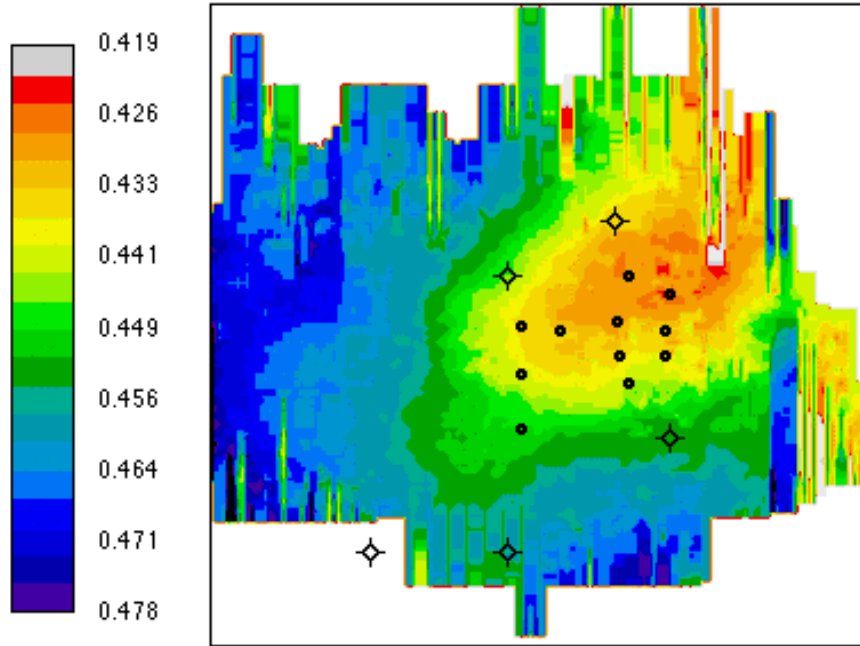
# Seismic tracking



# Seismic tracking

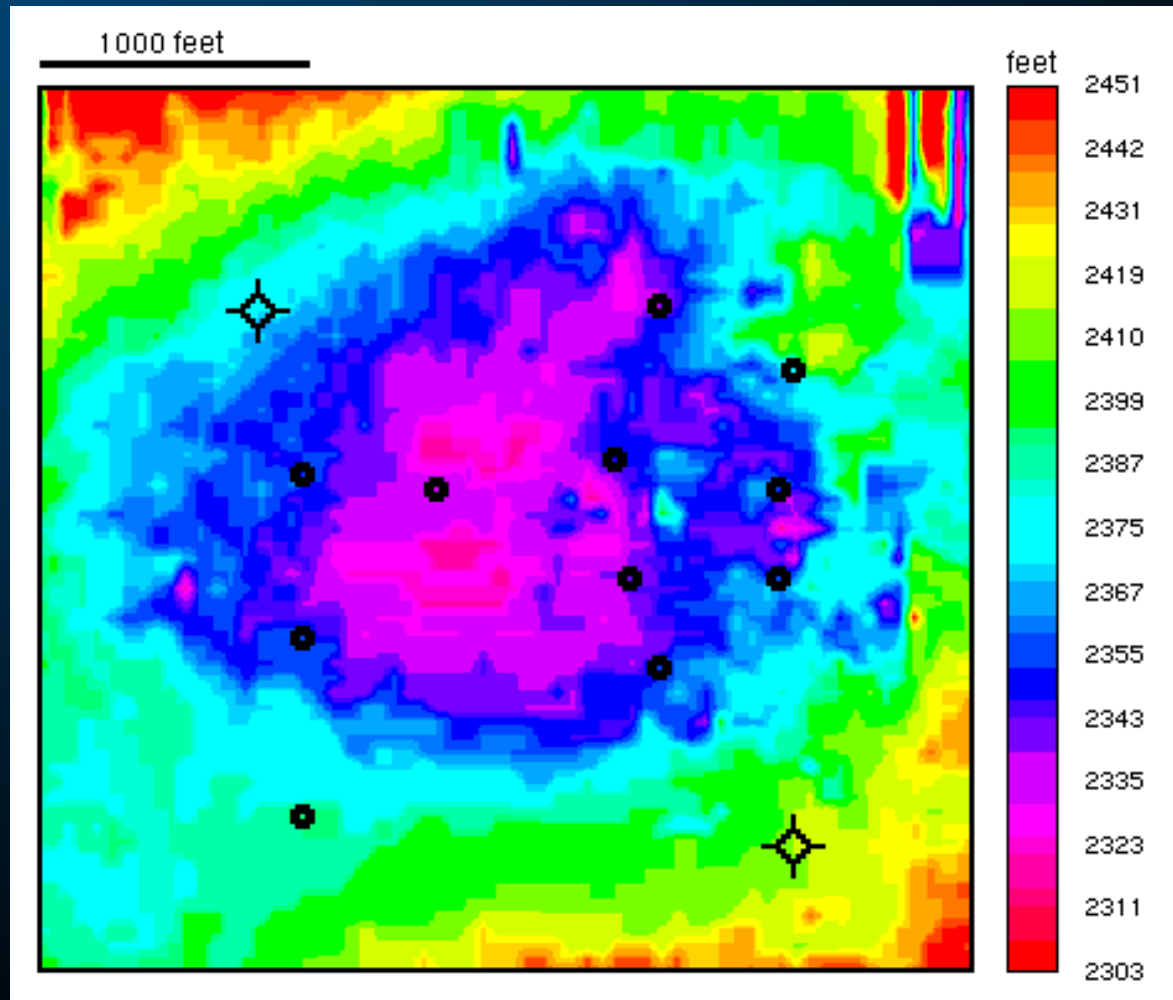


# Depth conversion

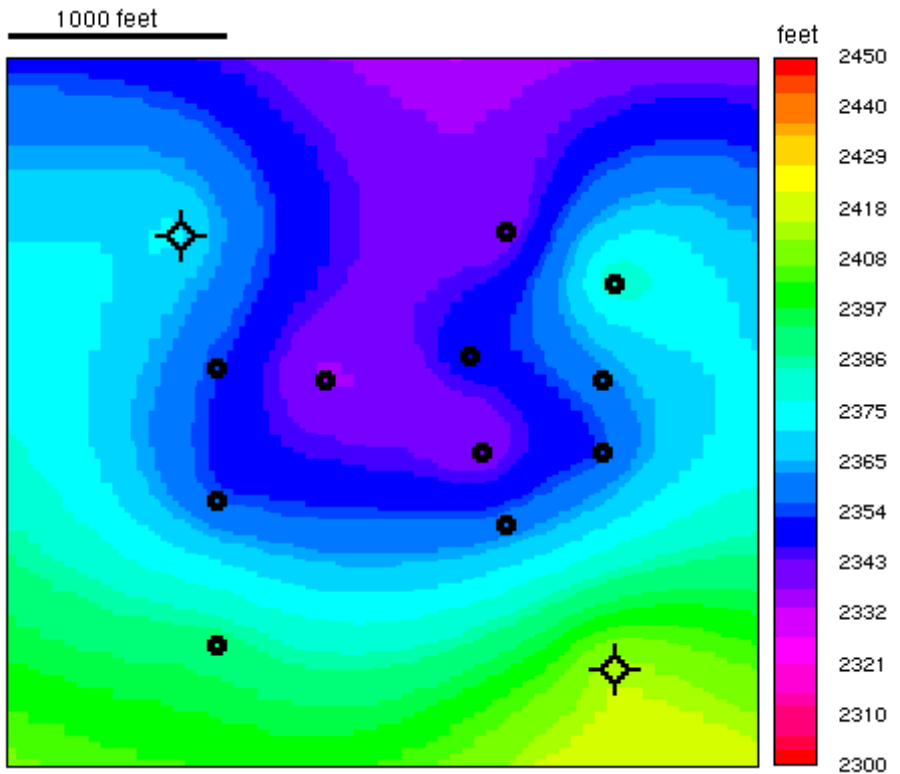


Average velocity (ft/s)

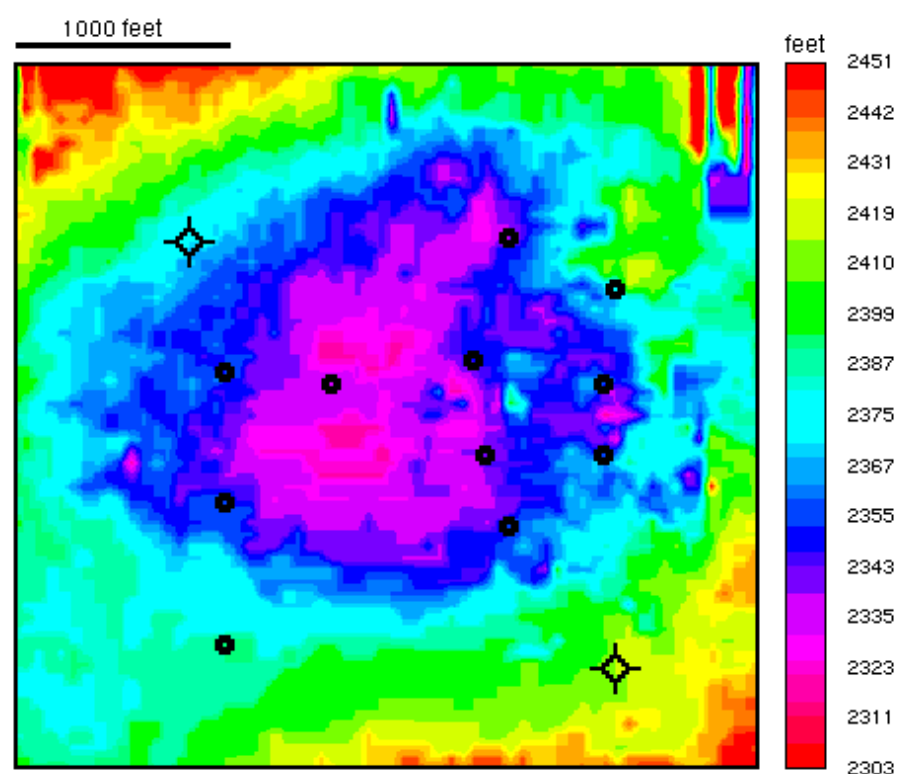
# Depth conversion



# Depth conversion



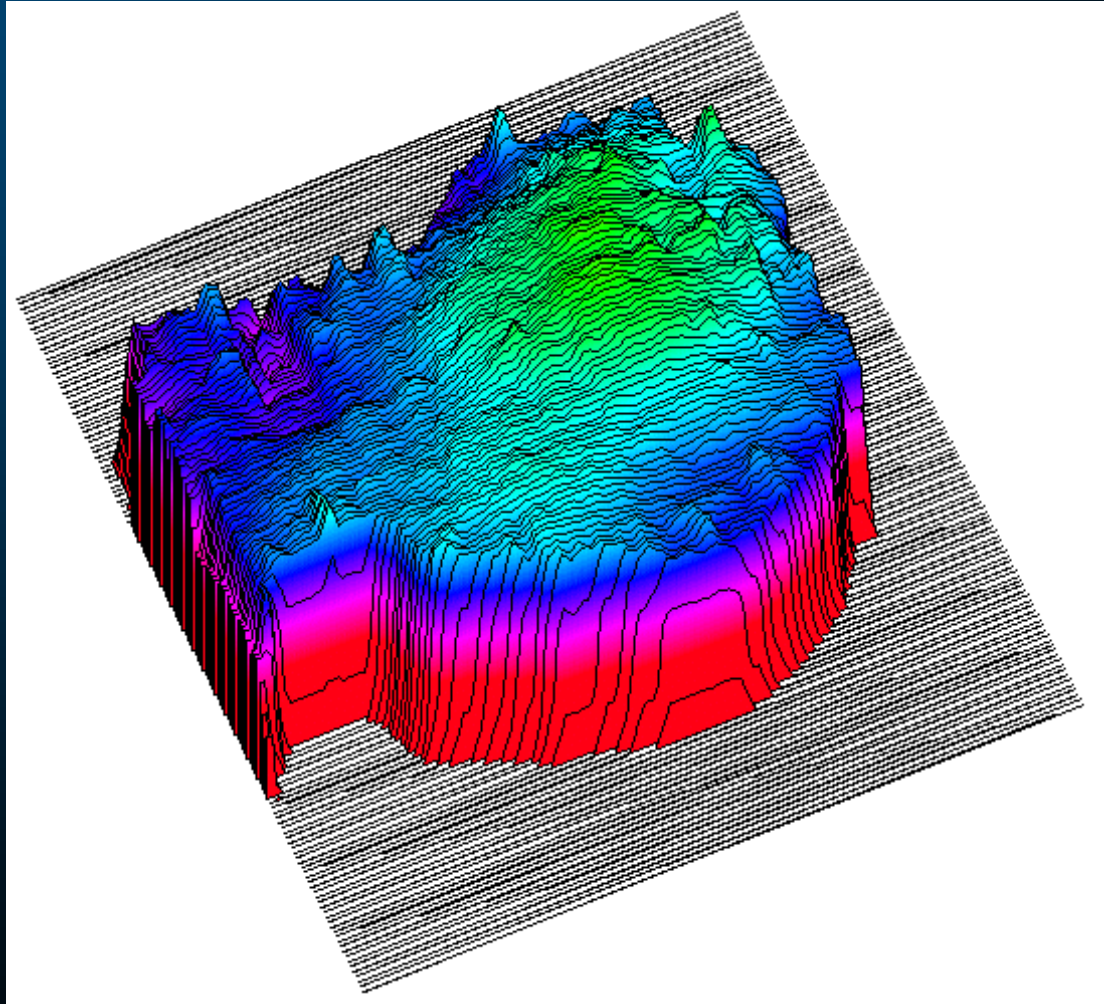
Wells Only



Wells + Seismic



# Wilcox depth structure



# Conclusions

- ▼ Data improvement through smoothing
  - Time slice (or FXY deconvolution)
- ▼ Time structure is not depth structure
  - Strong lateral velocity gradient
- ▼ Postage-stamp 3-D can add detail
  - Detail adds value