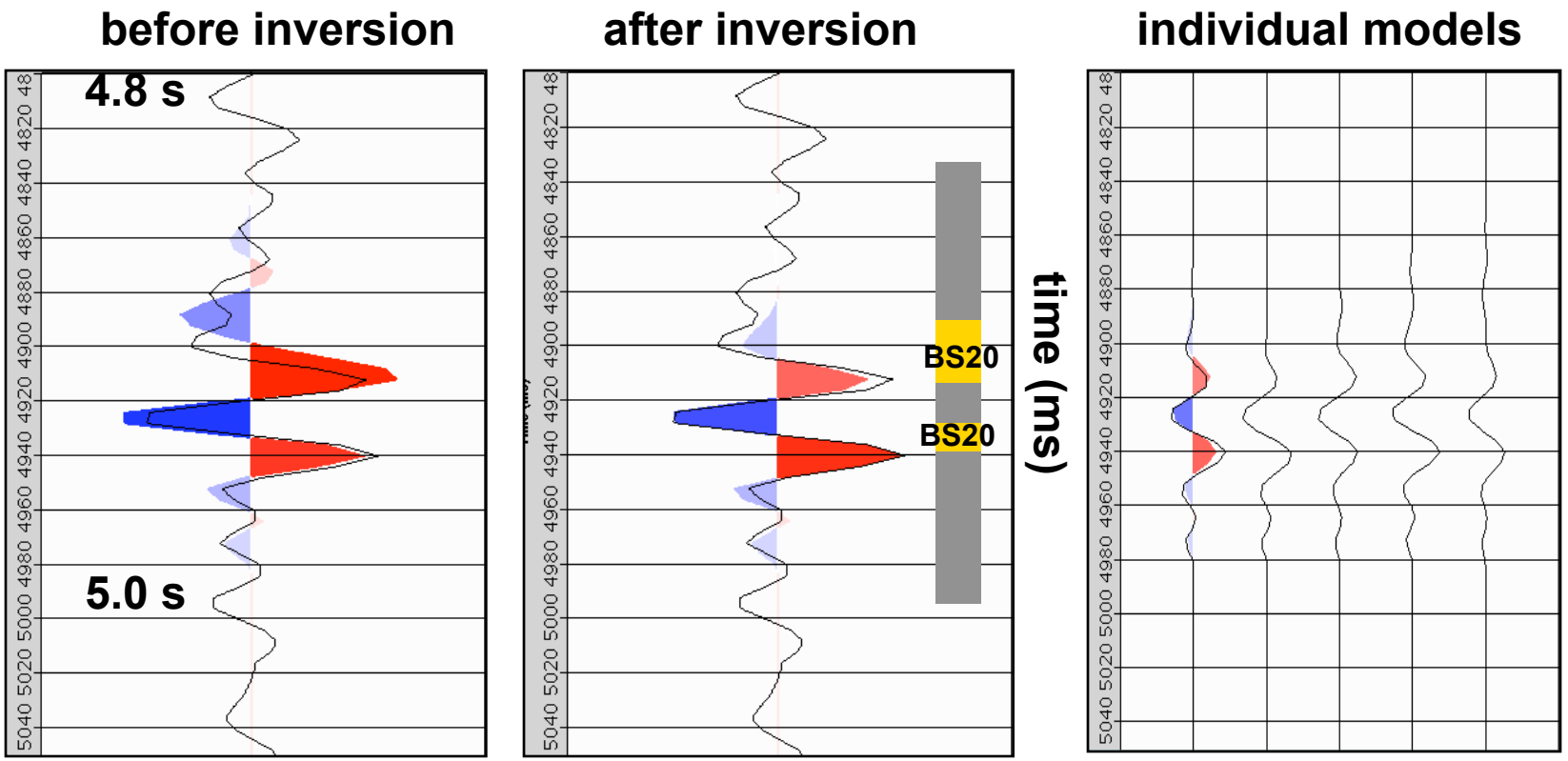
Fourier PROMISE results

Jennifer McGuire, Tim Barker and **Gino Birbiglia**
Shell Deepwater Development Inc.
Michael Glinsky and **Mark Barton**
Shell E&P Technology Co.

PROMISE inversion at the well (522-1)



note: rfc data

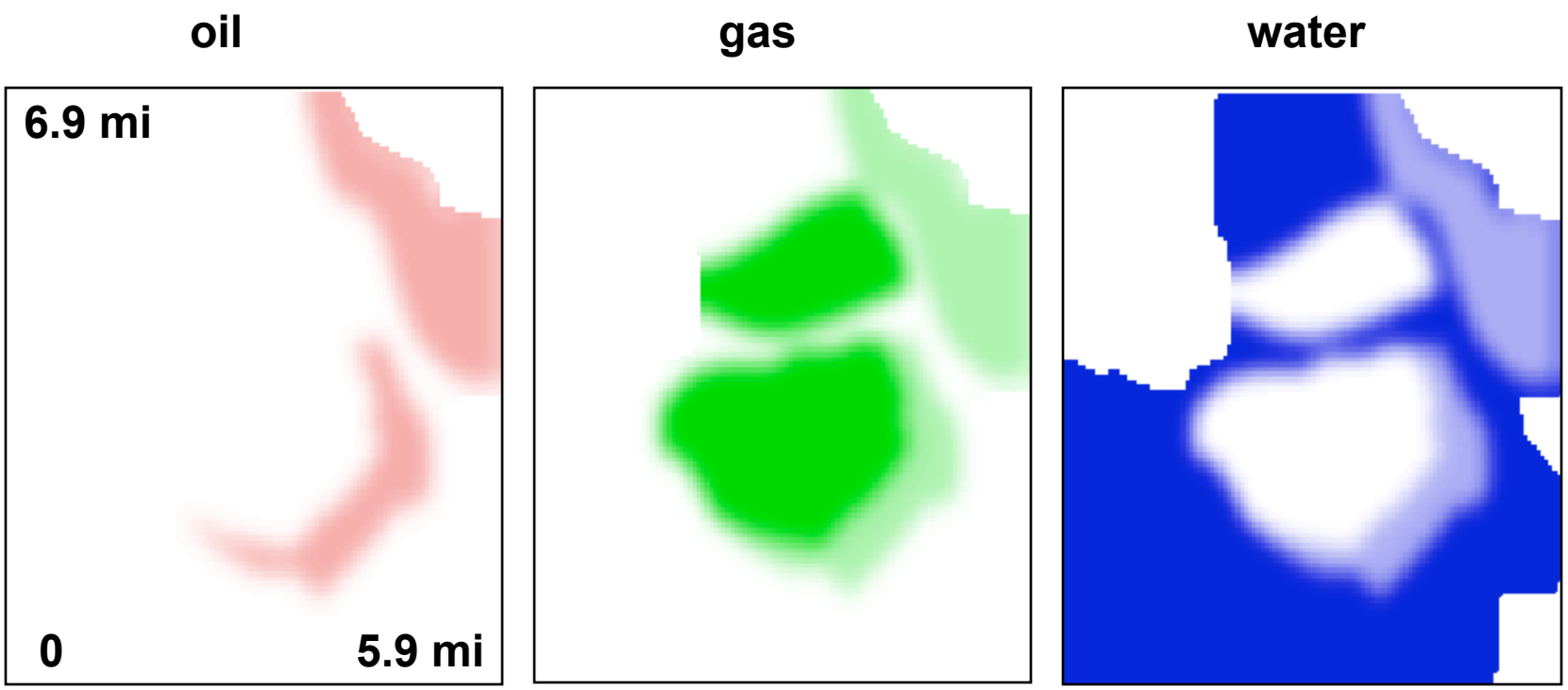
Some details of the inversion

top of BS20 sands and bottom of lower sand constrained to 12 ms

SDDI lithotypes and LIPOS fluids used (coefficients regressed from well information)

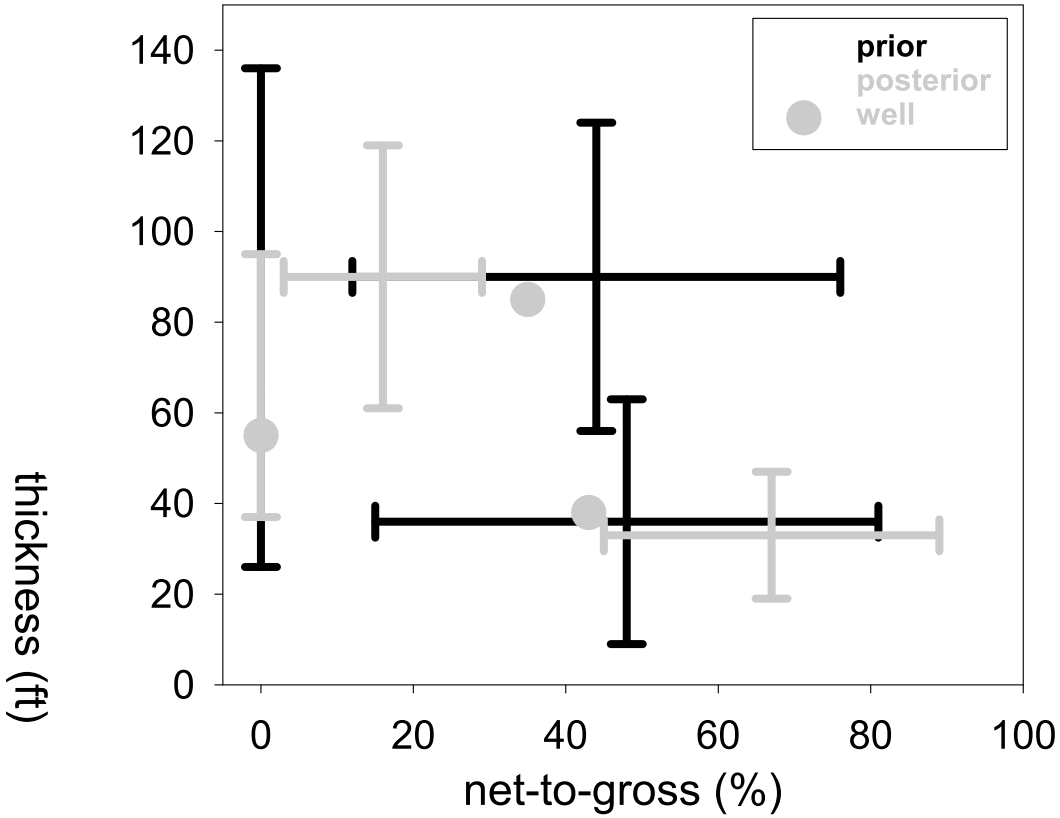
$\sigma_{thickness}$ = ~ 40 ft / layer (each layer allowed to go to 0 thickness)

Prior probabilities of fluids are assigned



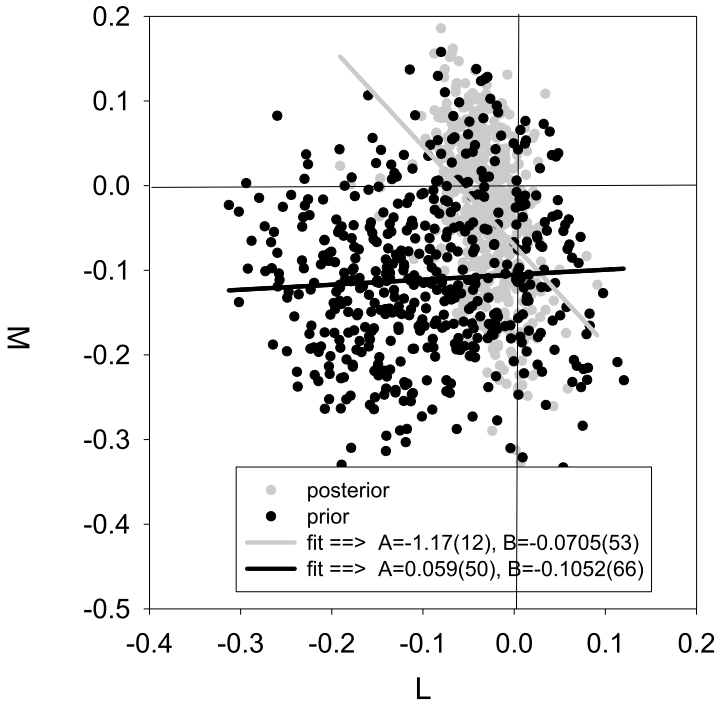
upper BS20

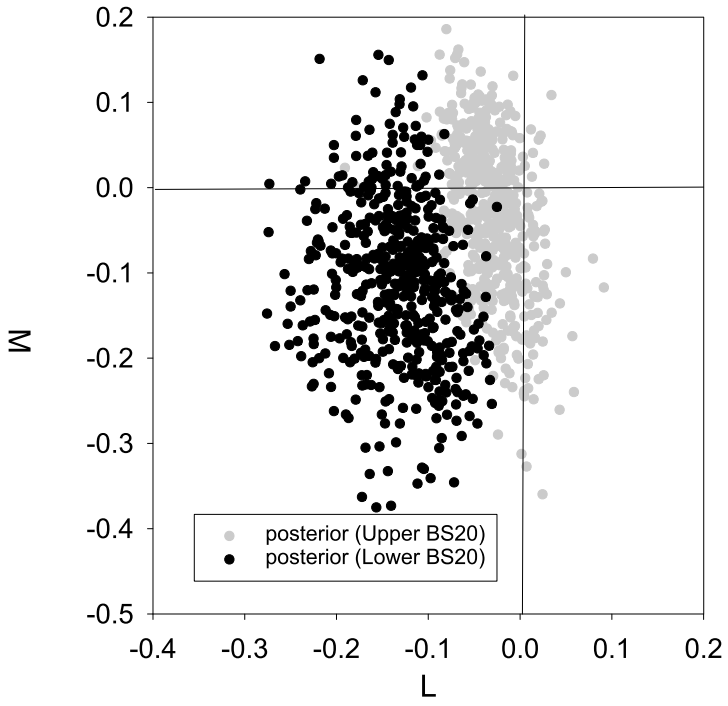
The prior and posterior distributions compared to the values at well 522-1



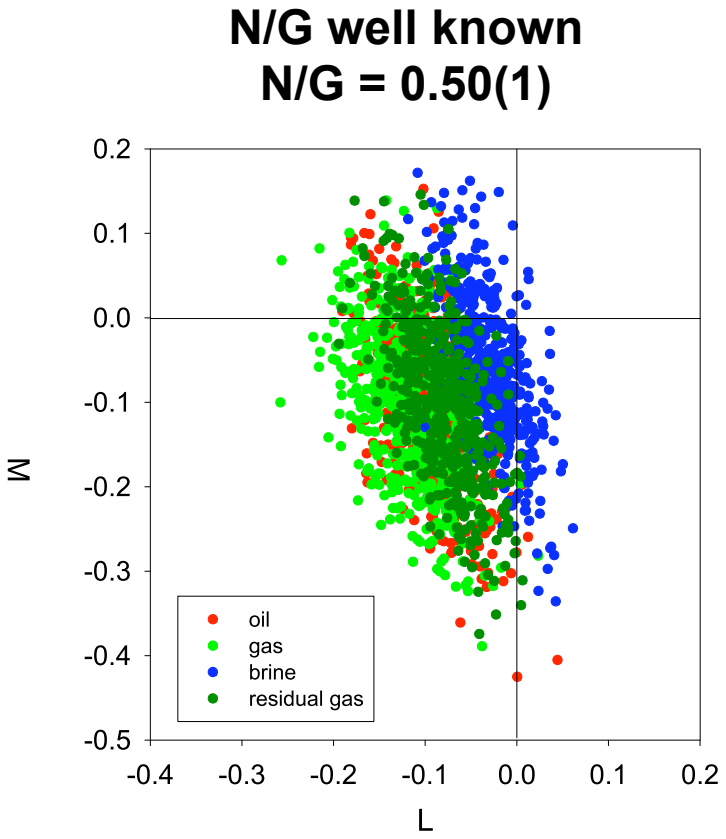
note: error bars show standard deviation

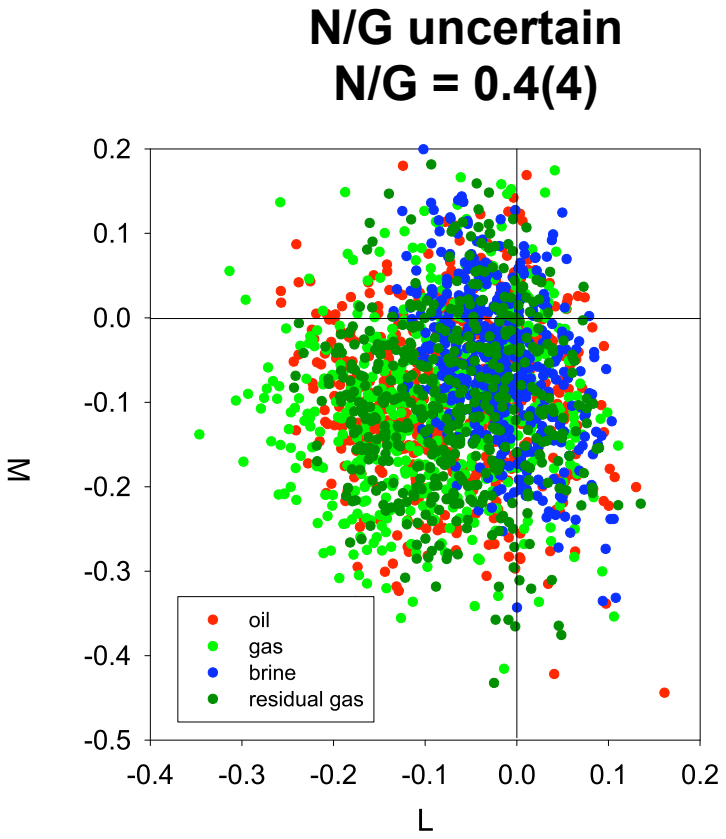
View of the inversion results in L-M space



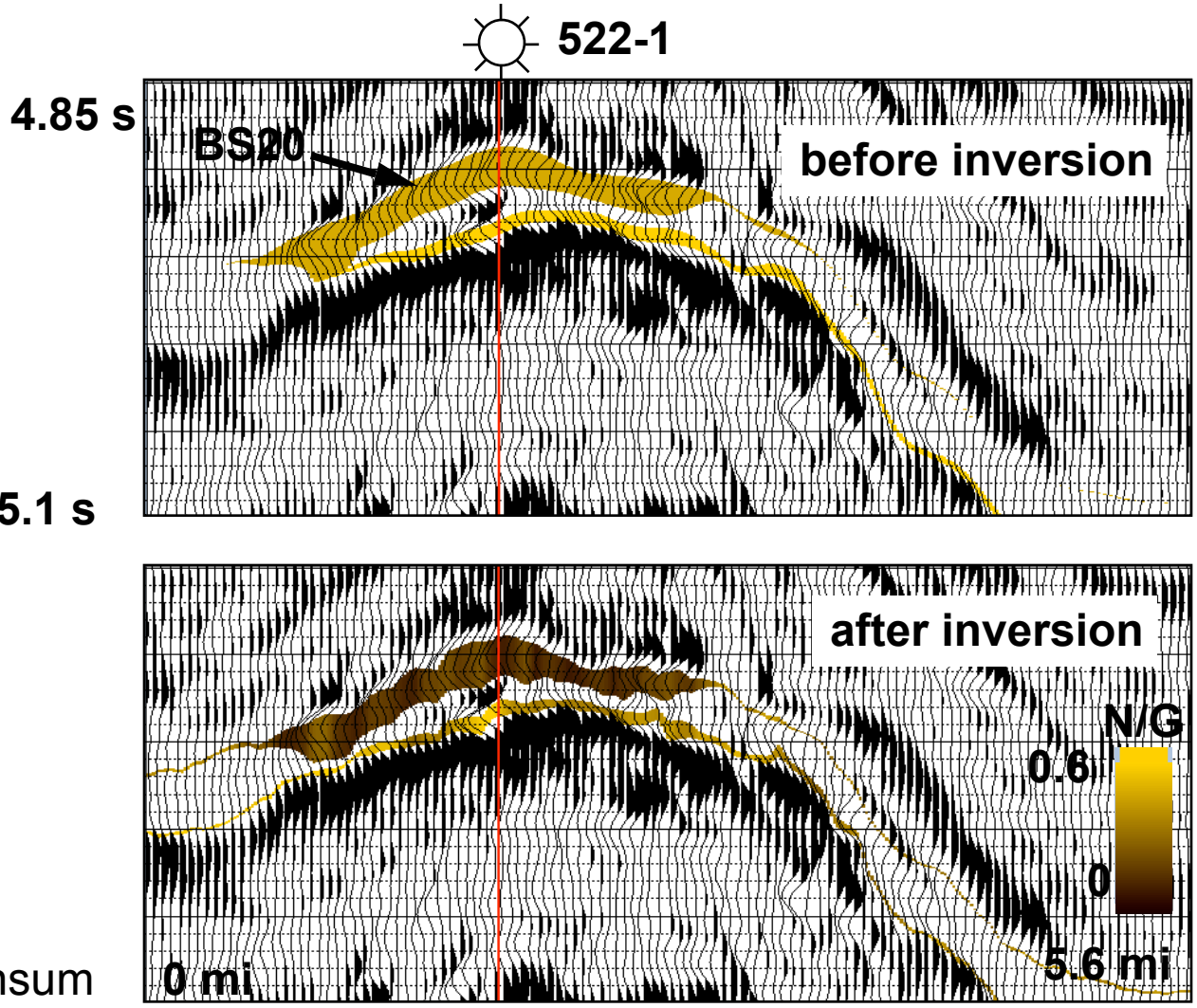


Lack of knowledge of N/G schemers clouds in L-M space



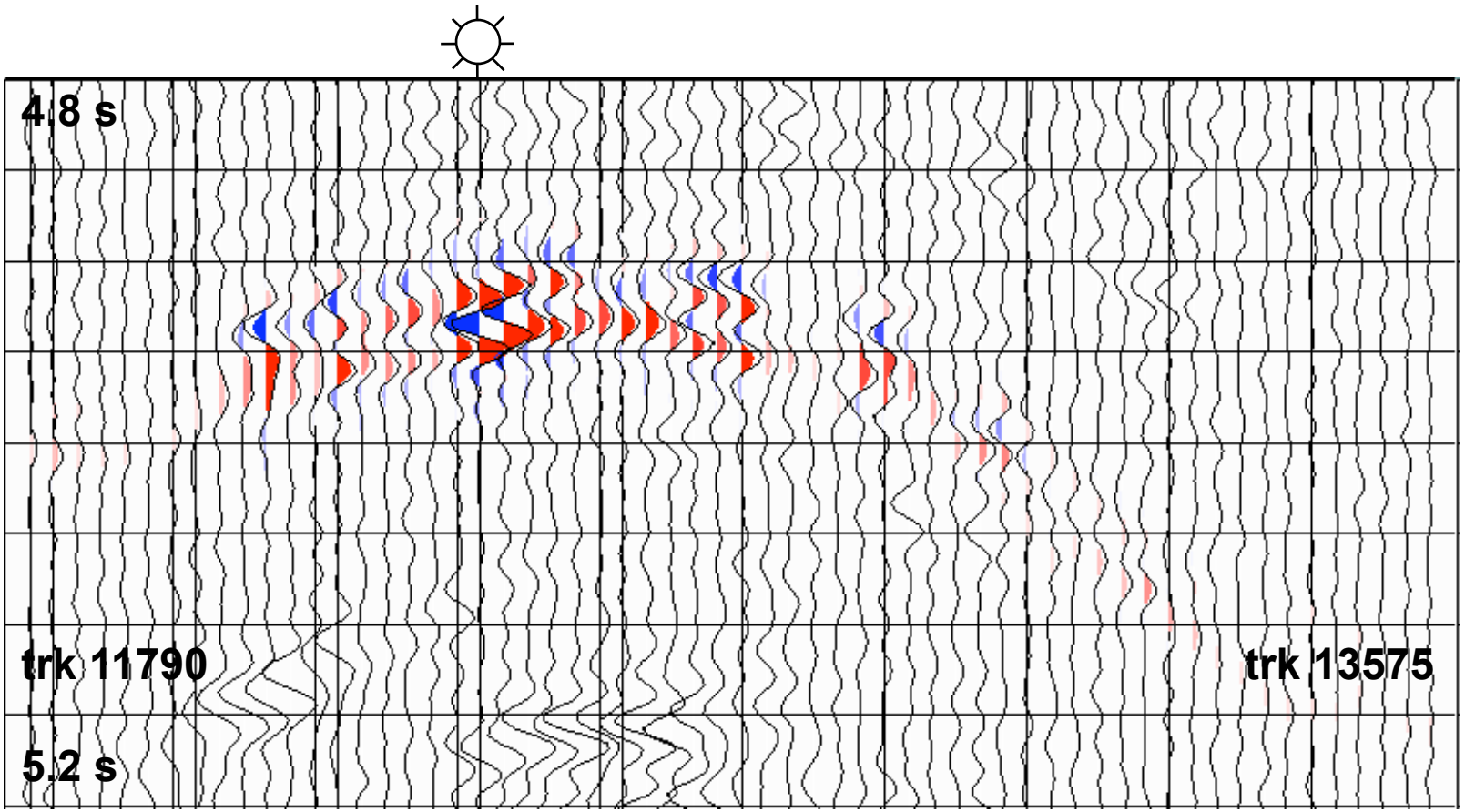


PROMISE inversion updates P50 model

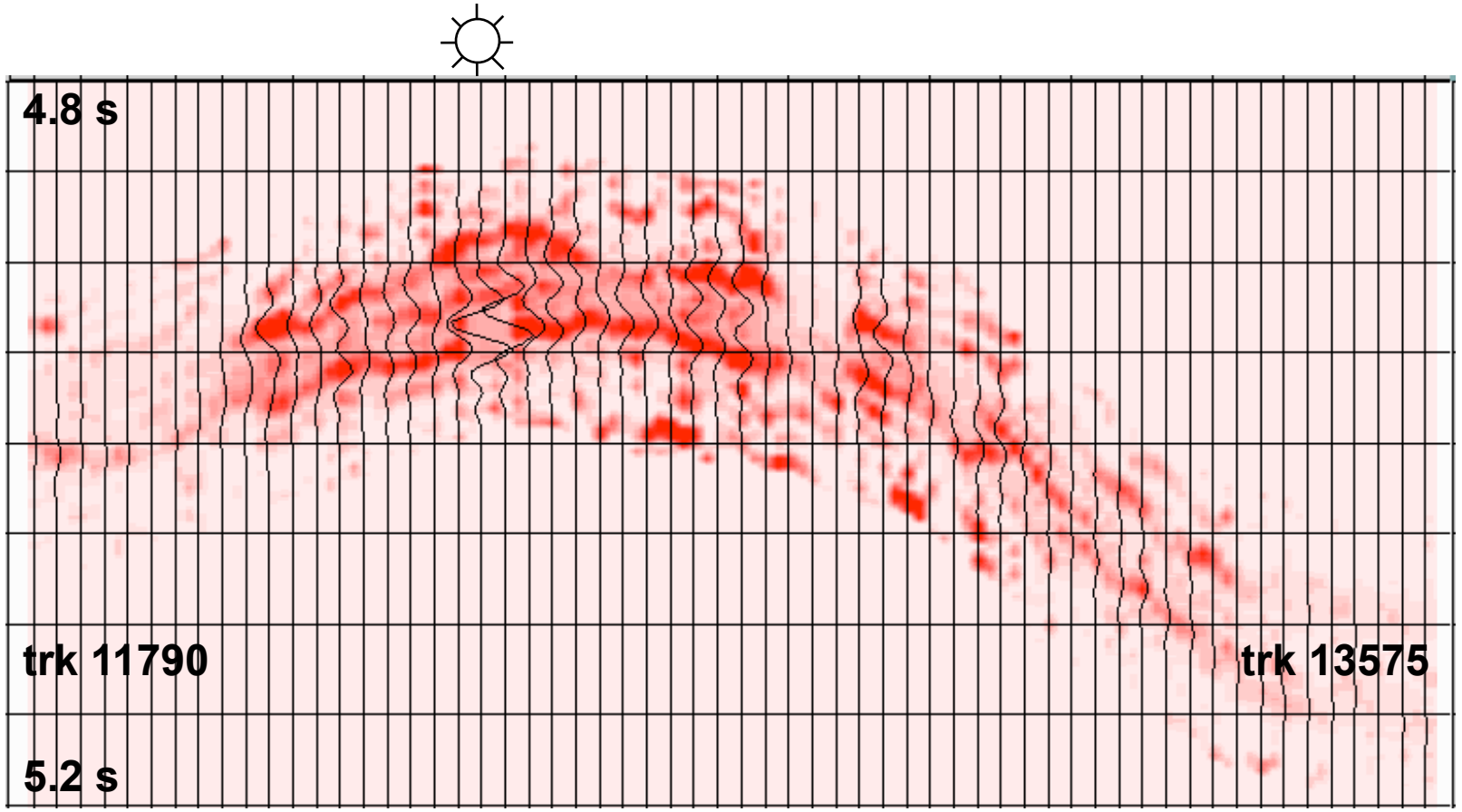


note: runsum

Synthetic data after inversion (red-blue) compared to seismic rfc data (bin 1846)

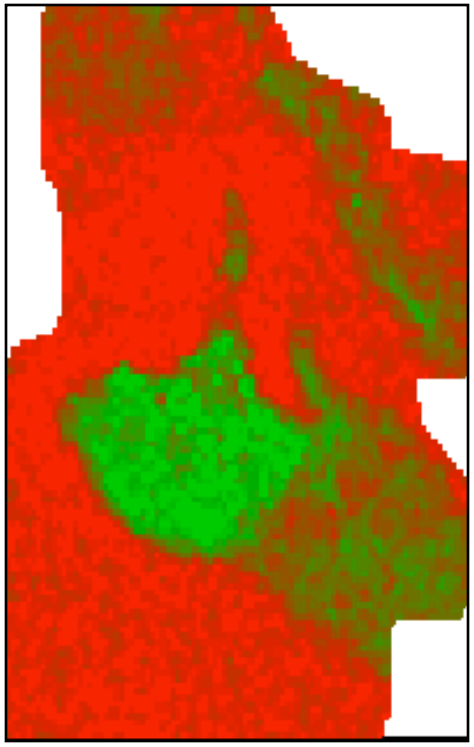


Chi-squared (0=white,1=red) shown in reference to synthetic rfc data after inversion



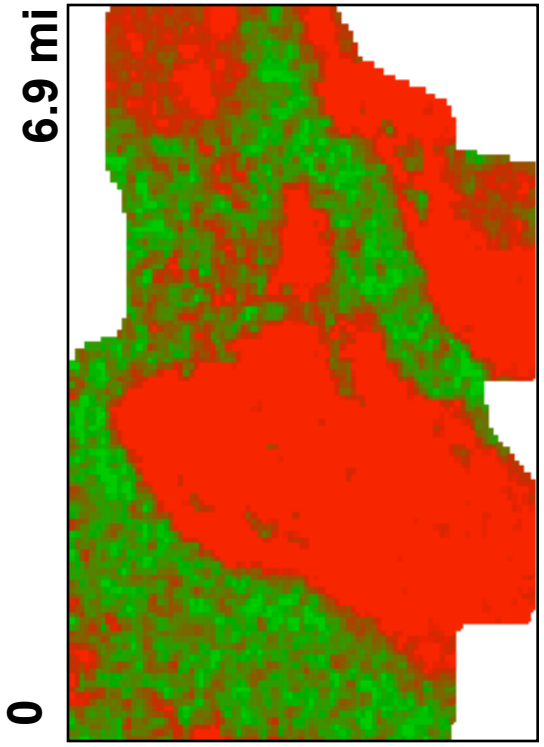
What properties are determined by seismic and where?

net/gross determined where sand is thick



upper BS20

thickness determined where sand is thin



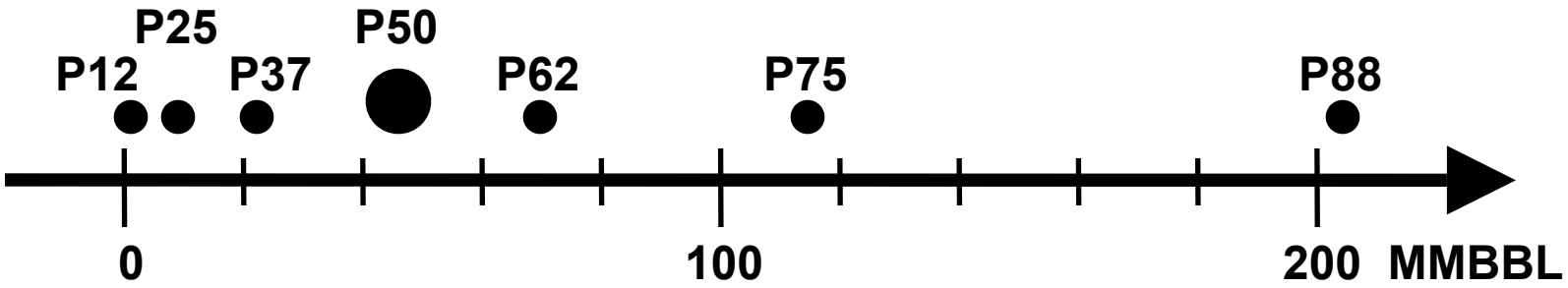
1.4 mi 5.9 mi

stddev post / stddev prior

determined by prior probability

determined by seismic

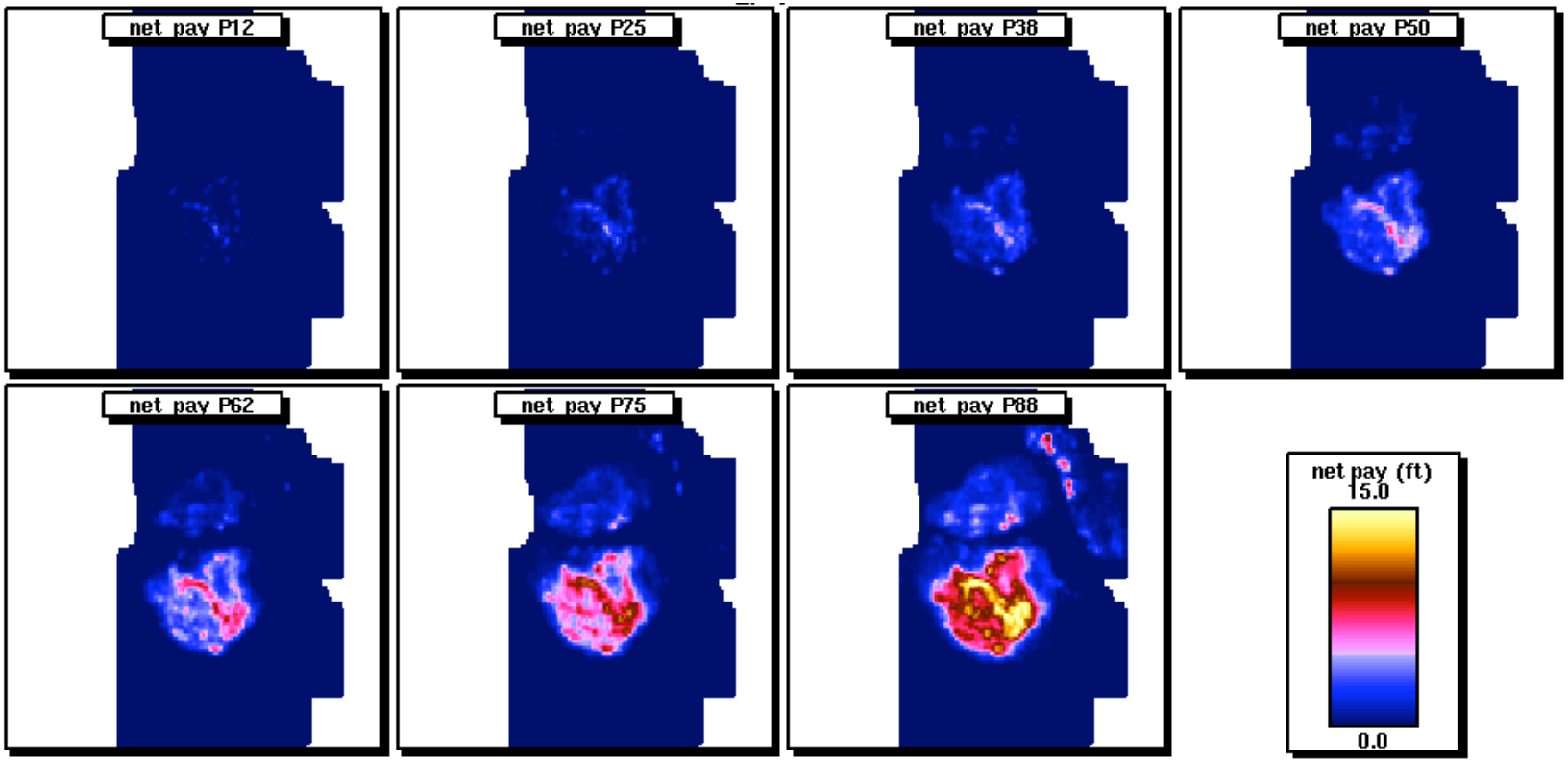
Probabilistic inversion gives distribution of net pay



net pay = sum over area of
(thickness x N/G x porosity x gas_probability x saturation)

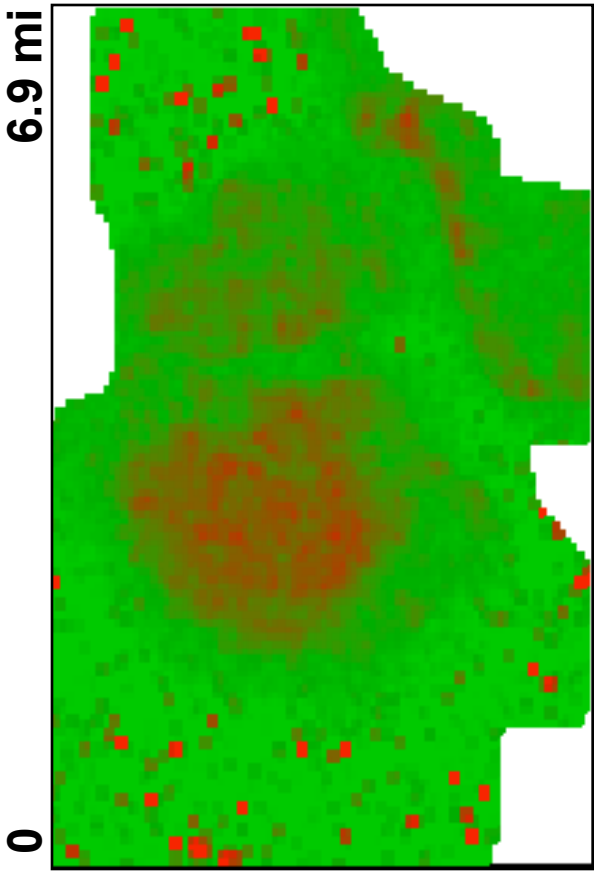
saturation = 85%= constant

Probabilistic inversion also gives distribution of net pay maps



note: assumes long correlation length

Where does seismic help determine net pay?



stddev post / stddev prior

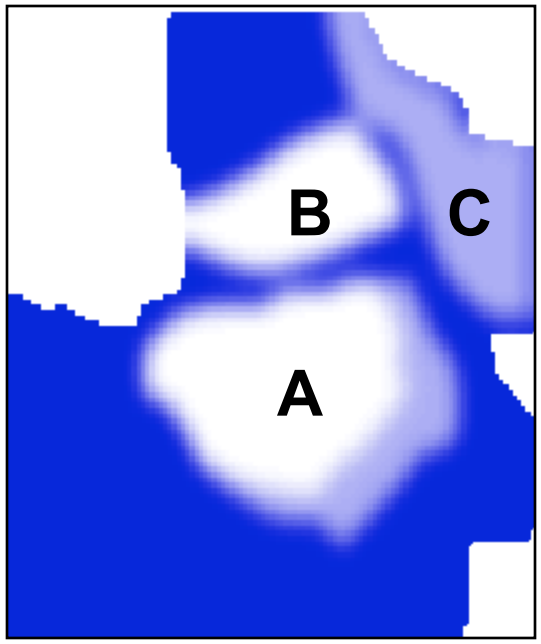
determined by prior probability

1

0

determined by seismic

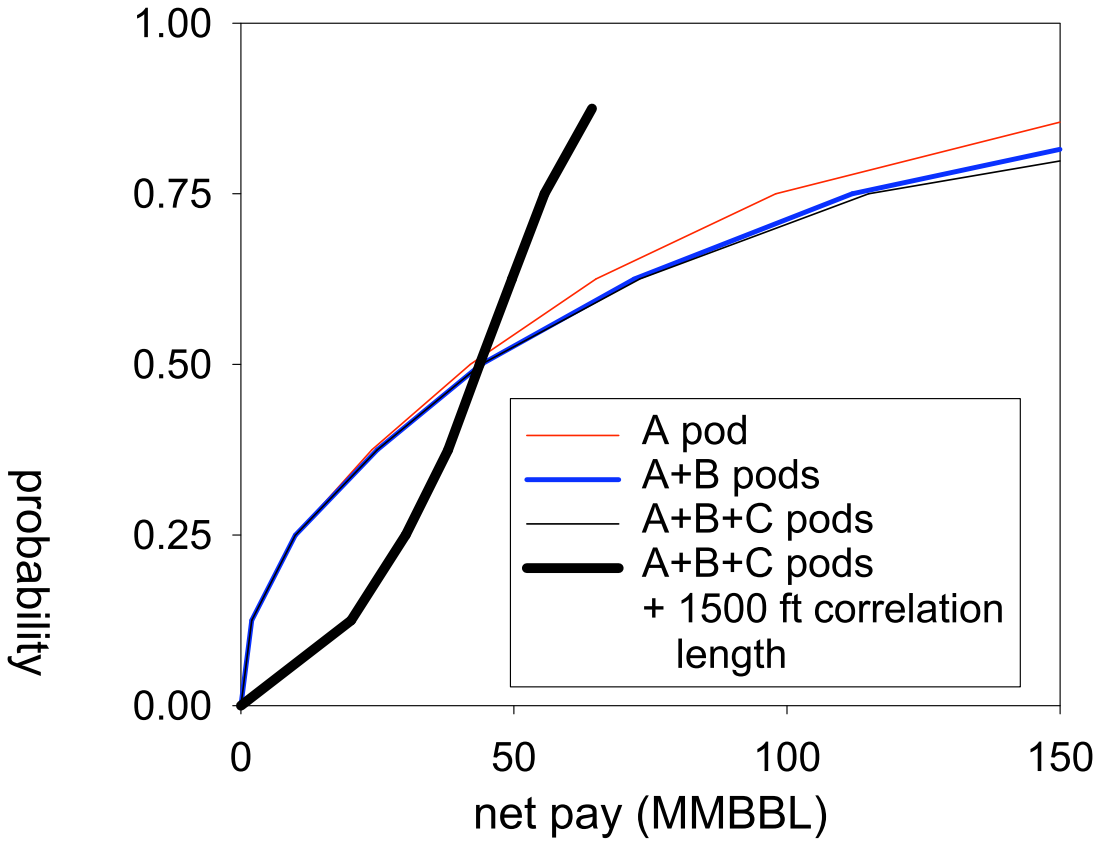
Different pods contribute to different parts of the distribution of net pay



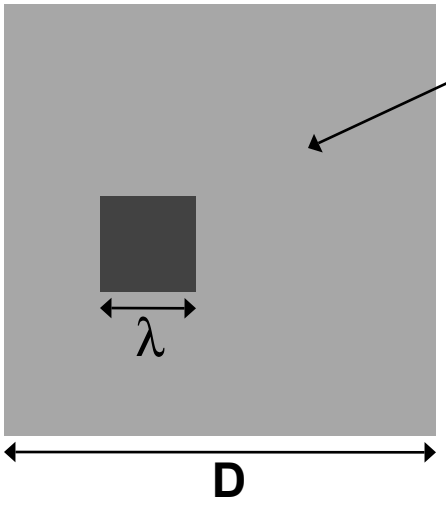
(MMBBL)	A	B	C	total	+ corr
P12	2	0	0	2	20
P25	10	0	0	10	30
P37	24	1	0	25	38
P50	42	2	0	44	44
P62	65	7	1	73	50
P75	98	14	2	115	56
P88	160	25	21	206	64

Note: the first total column assumes an infinite spacial correlation length, the second total column assumes a 1500 ft correlation length

Cumulative chart of net pay



"Back of the envelope" calculation of effect of spacial correlation on uncertainty estimates



λ = dominant spacial correlation length (can be obtained from variogram)

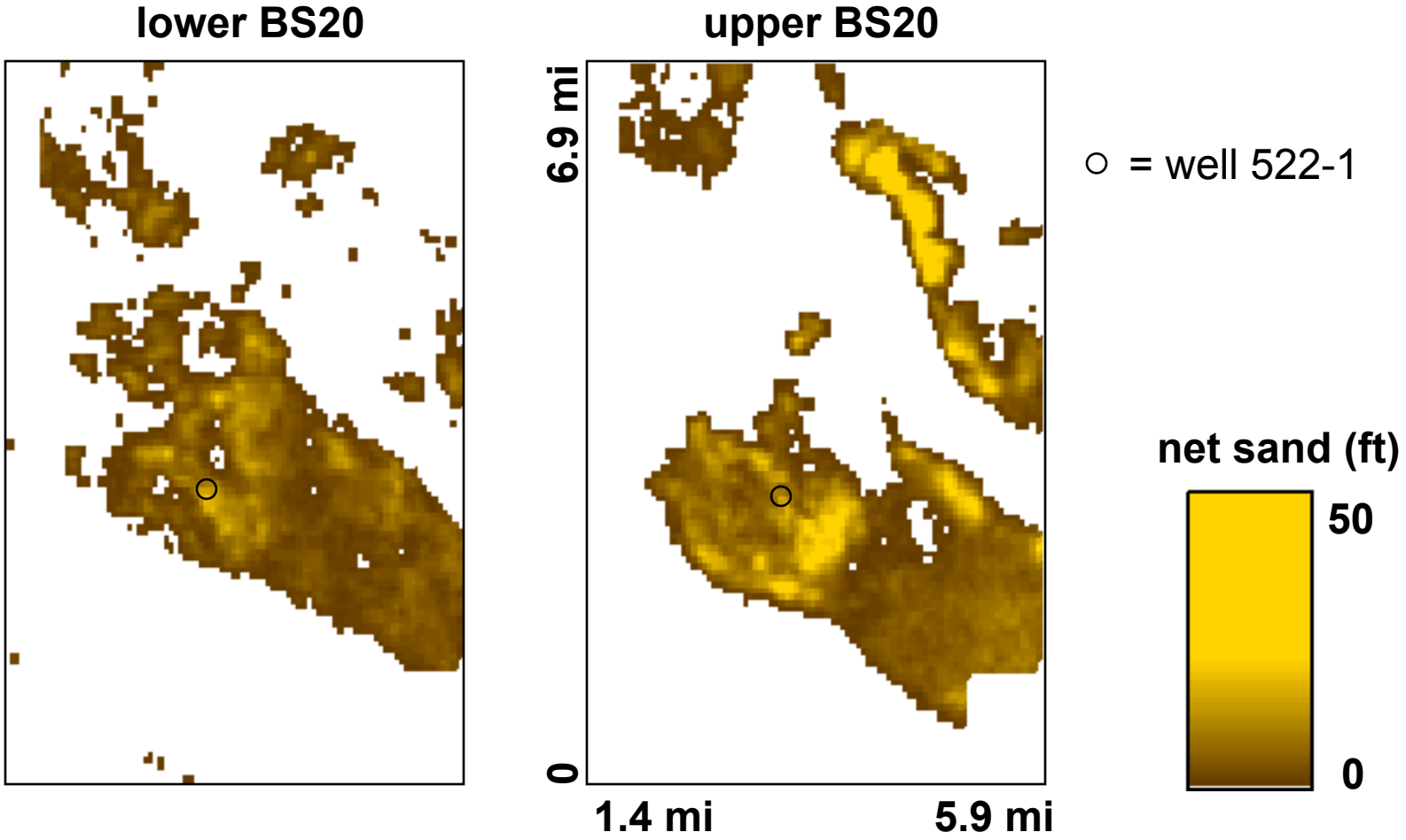
σ_λ = standard deviation with spacial correlation length of λ

f_λ(NS) = net sand distribution with correlation length of λ

it is assumed that f_λ is log normal and $\sigma_\lambda = (\lambda / D)\ \sigma_\infty$

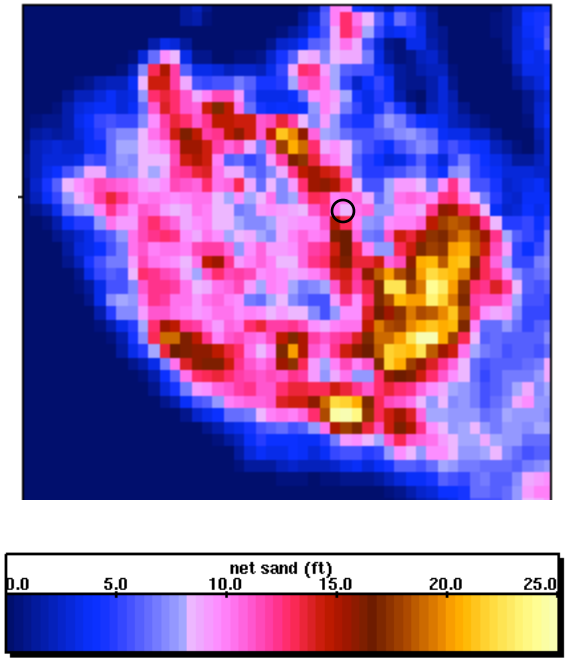
$$f_\lambda(NS) = f_\infty(10^{[(D/\lambda) [\log(NS)-\log(NS_{P50})] + \log(NS_{P50})]})$$

Net sand in each layer is determined by probabilistic inversion

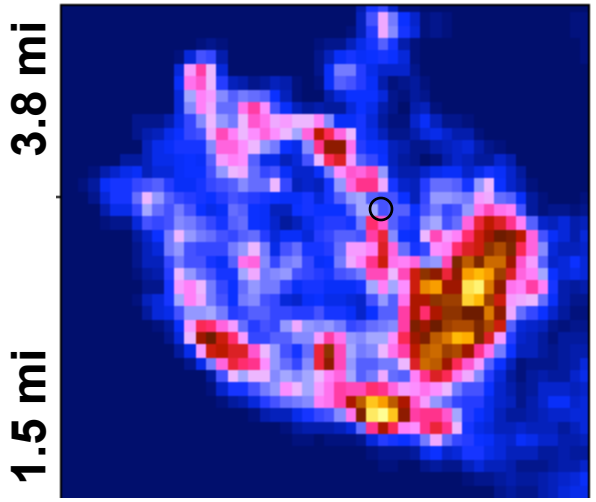


Seismic correlation of N/G and thickness reduces estimate of net sand by 60%

median N/G * median thickness (with no correlation)



median net sand (with correlation)



○ = well 522-1

$$< \text{net sand} > = < \text{N/G} > < \text{thickness} > + < (\delta \text{N/G}) (\delta \text{ thickness}) >$$

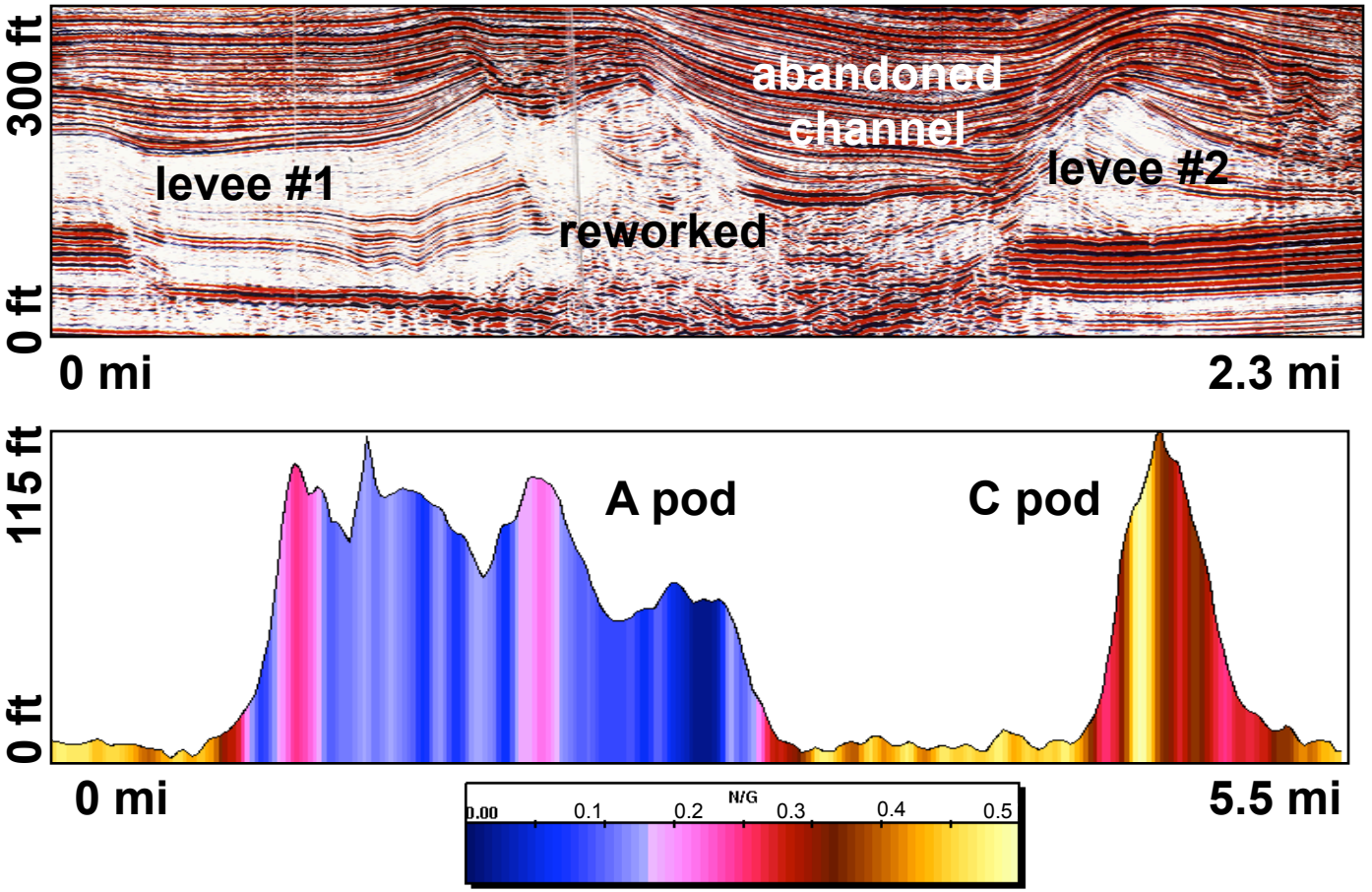
Probabilistic inversion changes volumetric uncertainties

- N/G of upper BS20 is reduced (factor of 2.1)
- correlation of N/G and thickness reduced net sand (factor of 1.7)
- high spacial variation in upper BS20 (net sand can change by a factor of 3 within 100 ft) -- maybe a reworked levee

gas pore volume in upper BS20 A pod (MMBBL)	estimate before inversion	probabilistic inversion estimate	with 1500 ft correlation length
P12	34	1	10
P50	79	22	22
P88	156	180	37

Upper BS20 as a levee

Einstien shallow seismic data (GOM turbidite)



Some things to expect in this depositional structure

- **Coriolis force could lead to**
  - more sediment in levee #1
  - more mud (effected more by Coriolis force) in levee #1
- **reworked levee would show high spacial variation**