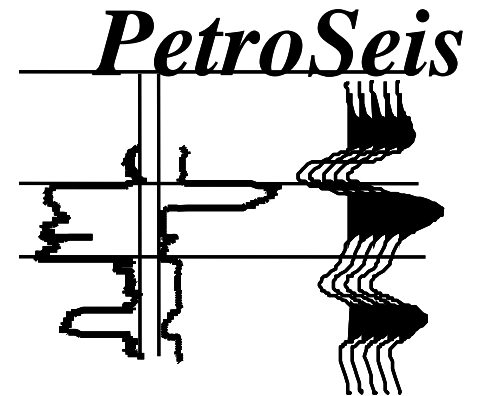


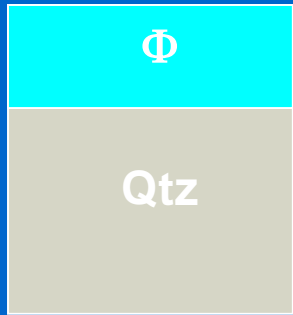
# PetroSEIS

## Shaly Sand Petrophysics and Fluid Replacement Modeling

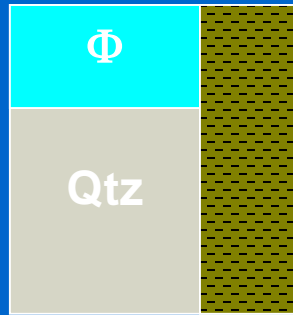
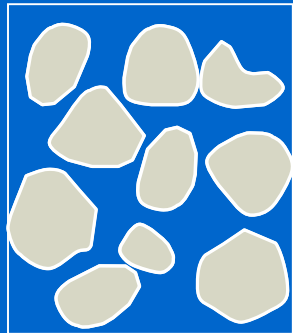


**Which Shaly  
sand model to  
use?**

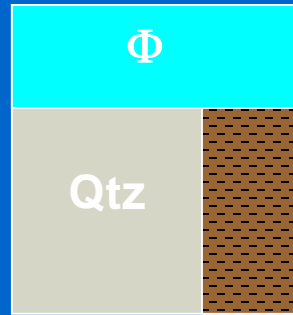
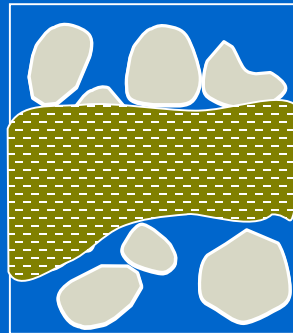
# **Thomas-Steiber- Haley Shale Characterization**



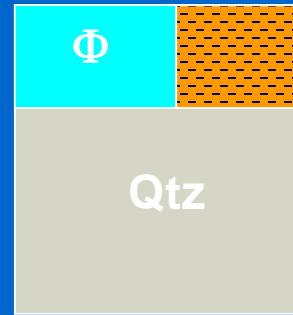
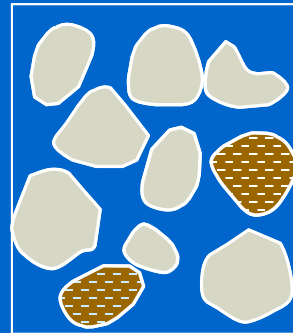
**Clean Sand**



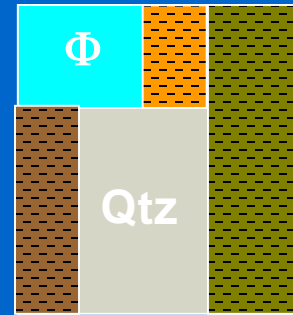
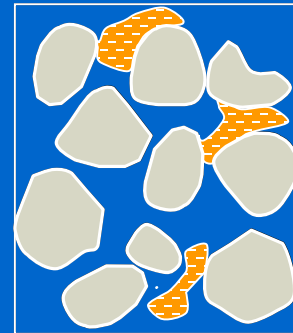
**Laminar Shale**



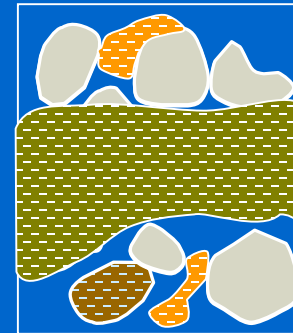
**Structural Shale**



**Dispersed Shale**

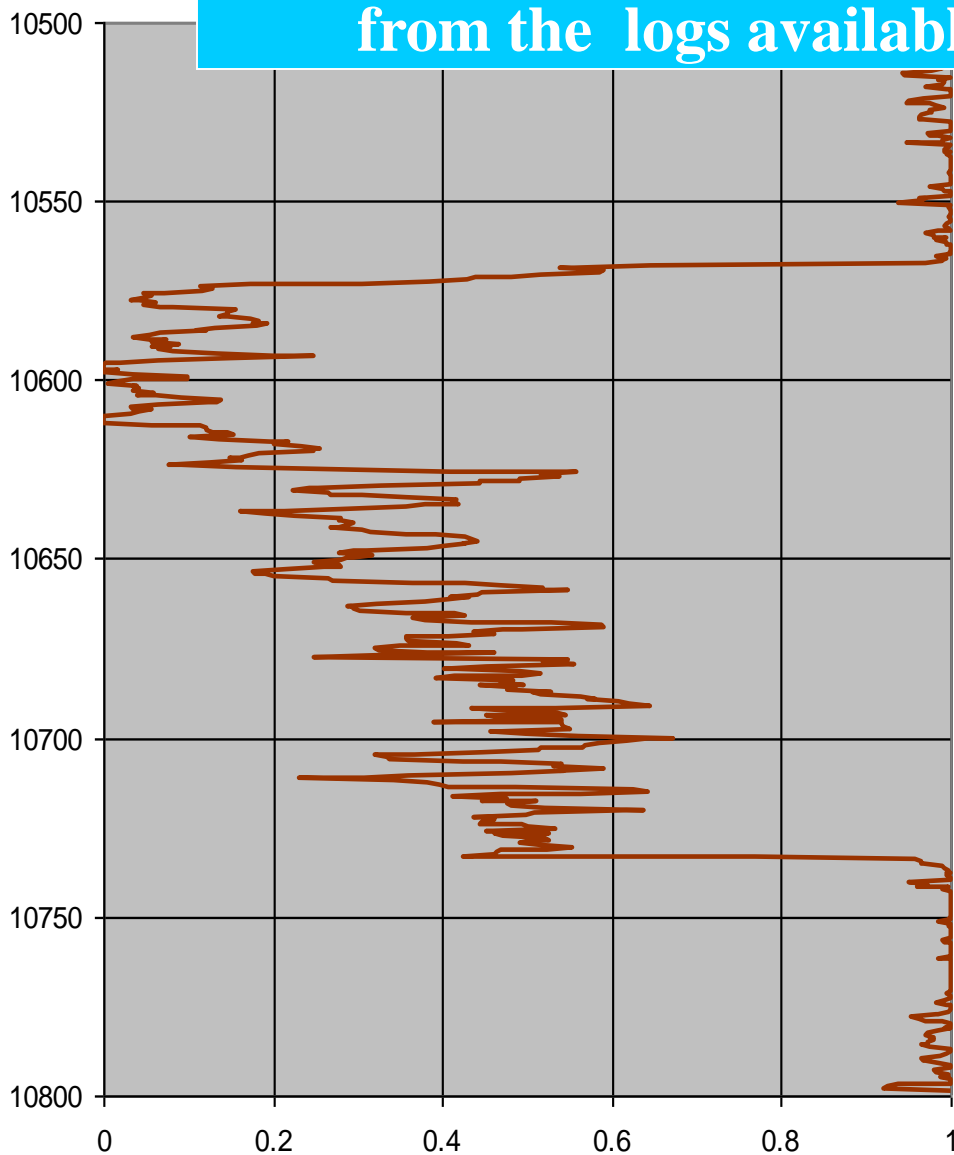


**Combined Shales**

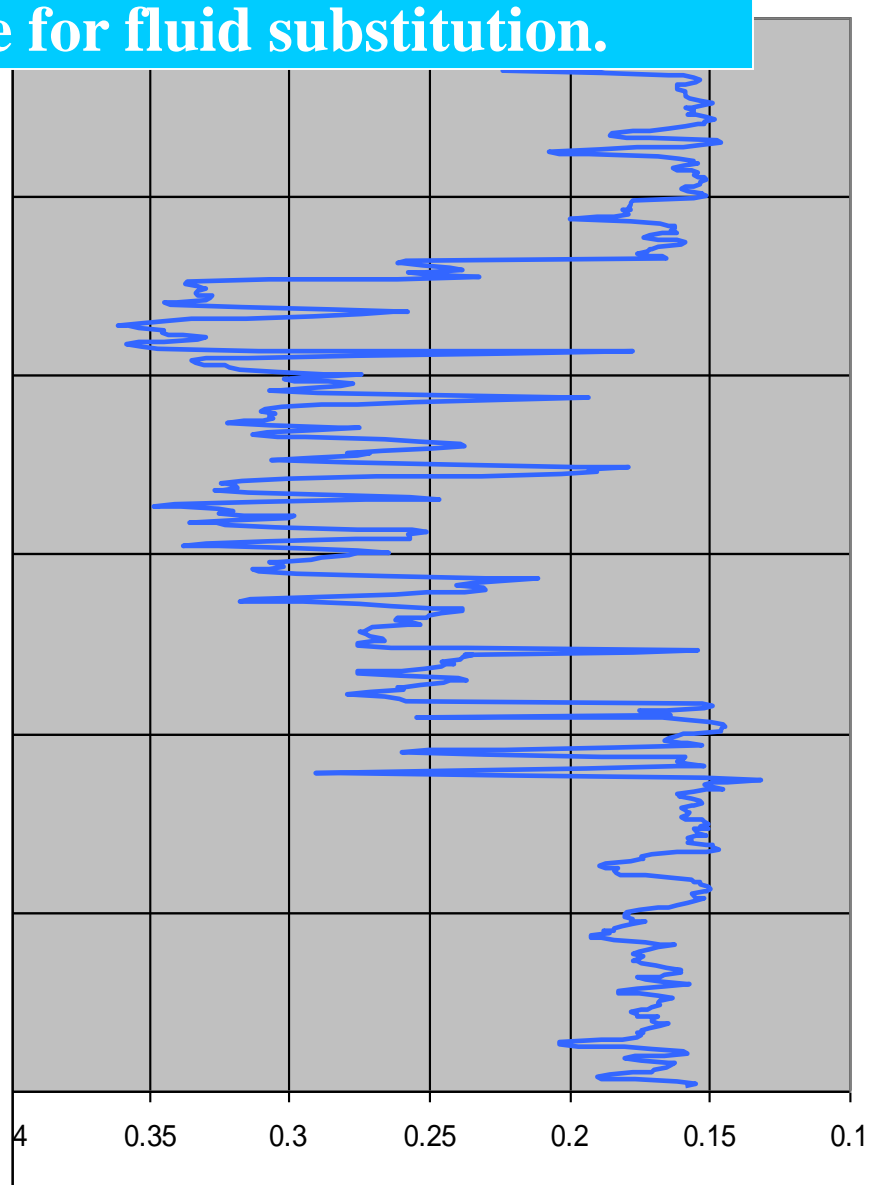


**How can the form of  
the shale be classified  
without extensive core?**

Shale volume and porosity can usually be determined from the logs available for fluid substitution.



Shale Volume



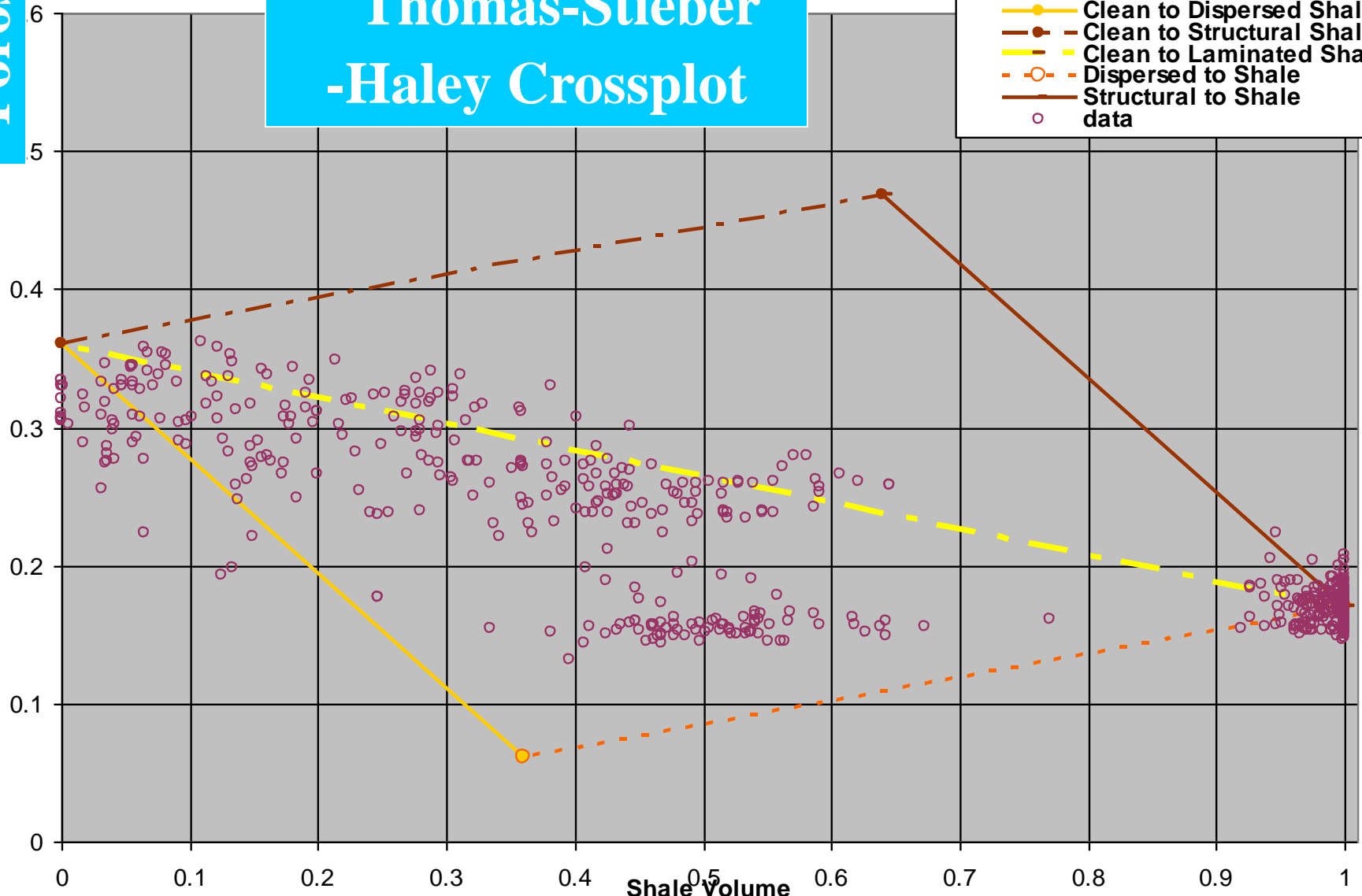
Porosity

Porosity

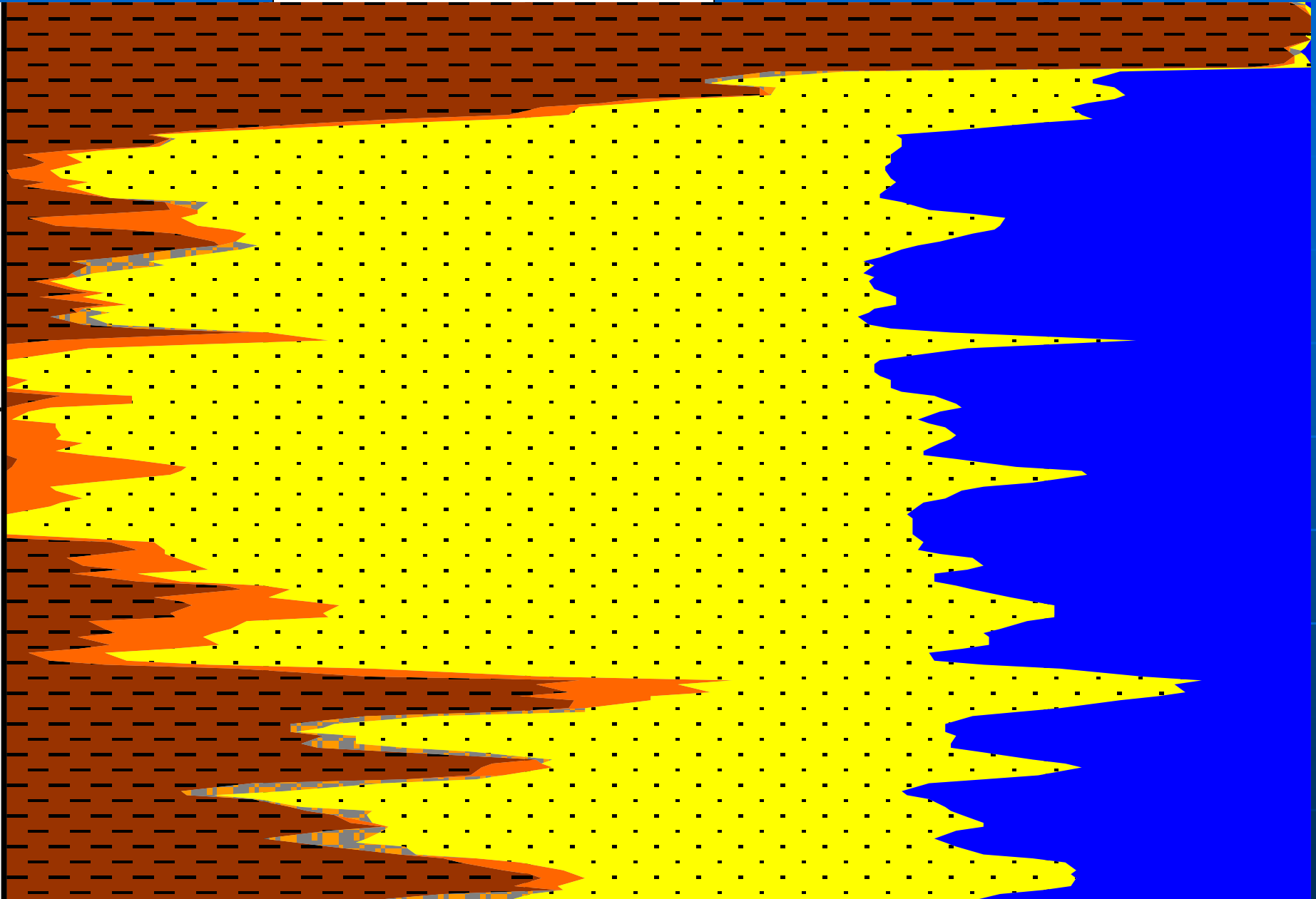
# Thomas-Stieber -Haley Crossplot

- Clean to Dispersed Shale
- Clean to Structural Shale
- Clean to Laminated Shale
- Dispersed to Shale
- Structural to Shale
- data

Apparent Porosity

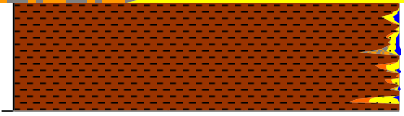


Shale Volume

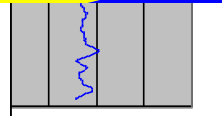
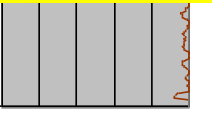


sity

10800



75  
10800





# Fluid substitutions:

- 1) Laminated
- 2) Dispersed
- 3) Structural

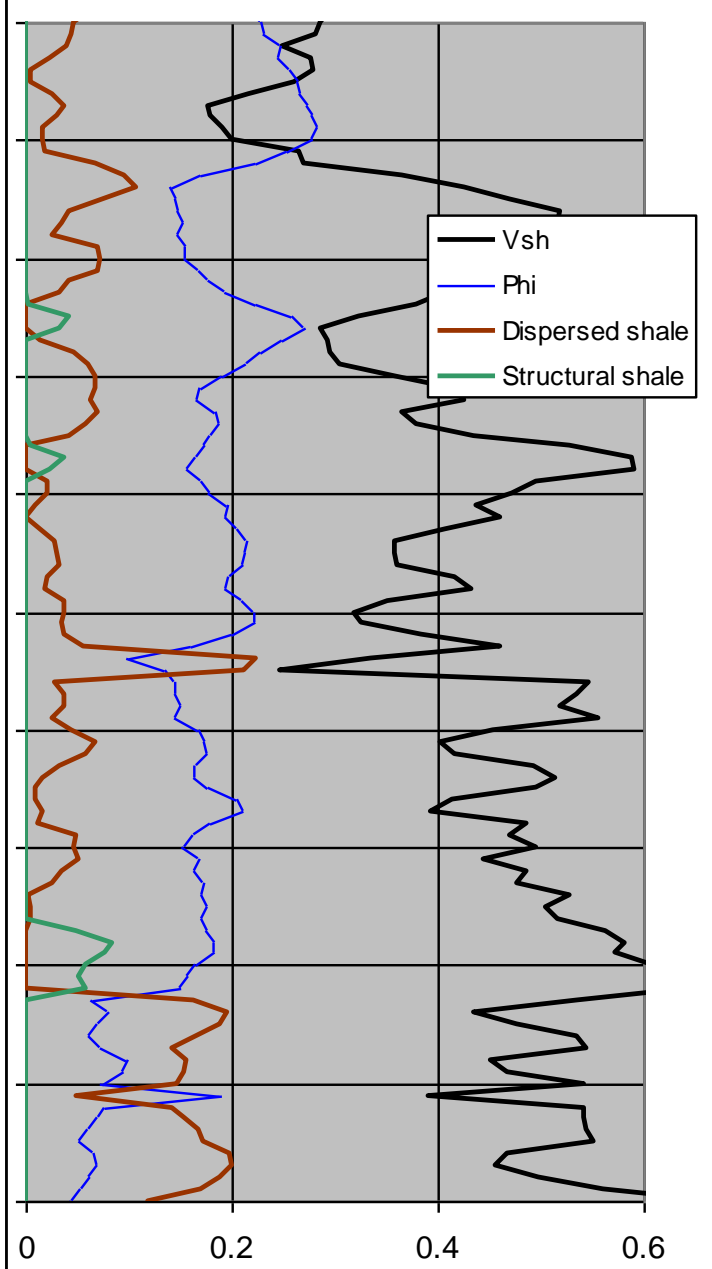
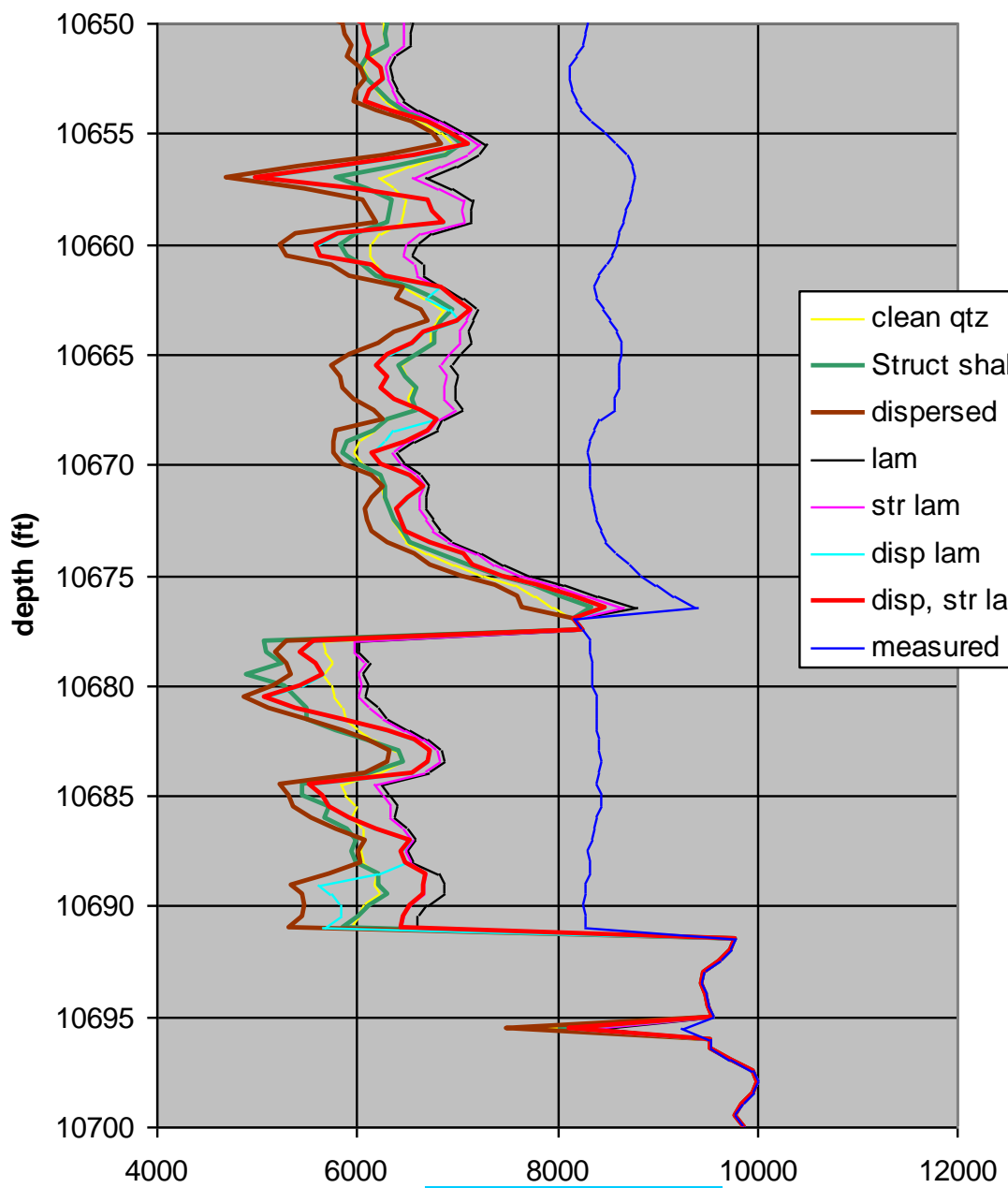
Shale mixed with fluid

Shale mixed with  
matrix

Fluid substituted only  
into sand laminations

# **Gassmann Fluid Substitution subsequently performed:**

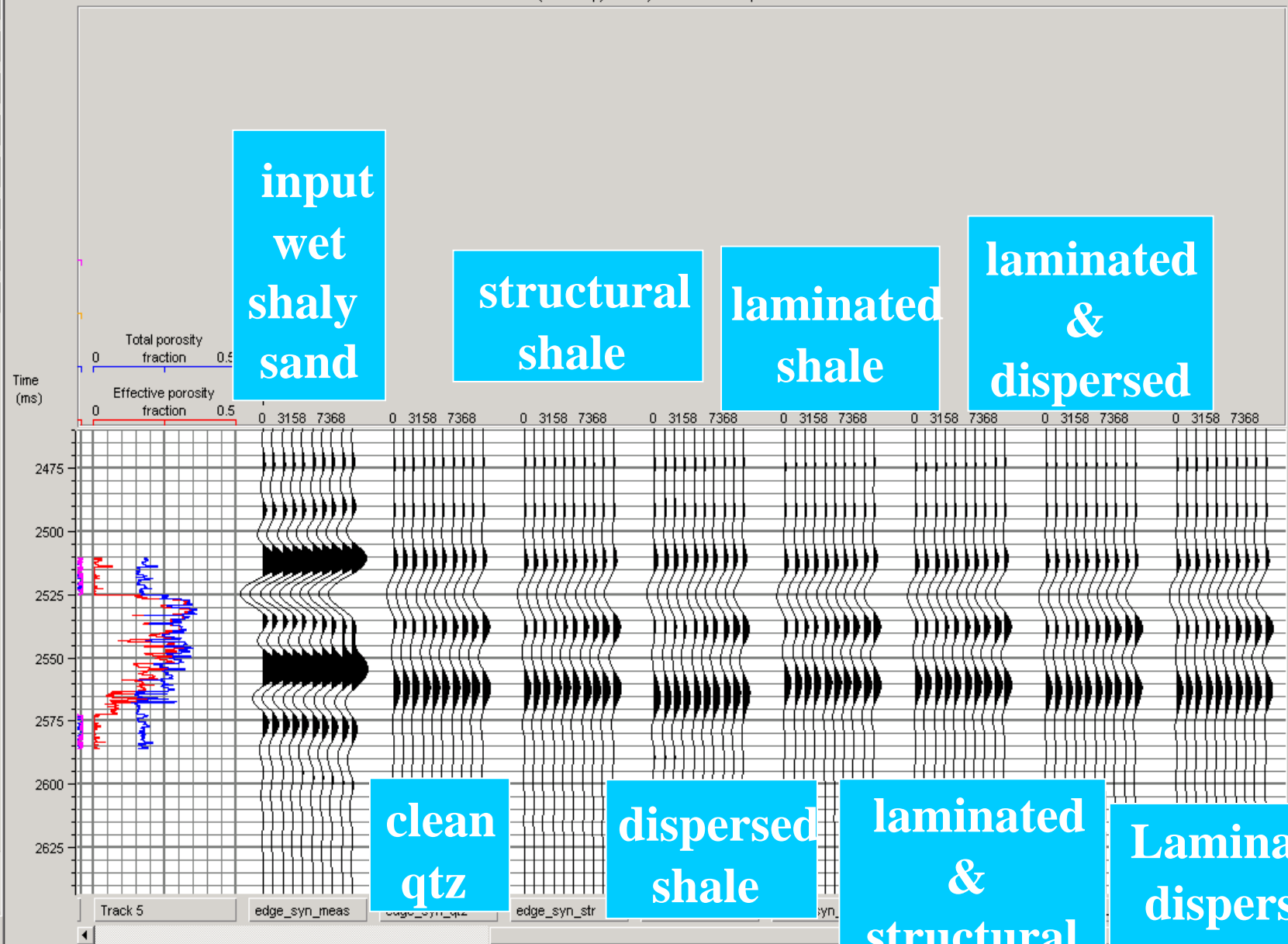
- 1) Clean quartz sand assumption (total porosity method)**
- 2) Laminated**
- 3) Dispersed**
- 4) Structural**
- 5) Laminated & Dispersed**
- 6) Laminated & Structural**
- 7) Laminated, Structural & Dispersed**





Edge  
(x=0.00m, y=0.00m) Elevation: kb=0ft, surface=0ft

- Wells ▾
- Logs ▾
- FRM ...
- Synthetic ▾
- Seismic ▾
- Crossplot ...
- Wavelet ▾
- Display ▾



**Laminated,  
dispersed,  
& structural**

# Conclusions:

- 1) The form of shale has little effect on fluid substitution of density and shear velocity.
- 2) Shale form has greatest impact on the fluid substitution of compressional velocity.
- 3) Impact on AVO was subtle in this example, but has the potential to be significant particularly in time lapse seismic modeling.