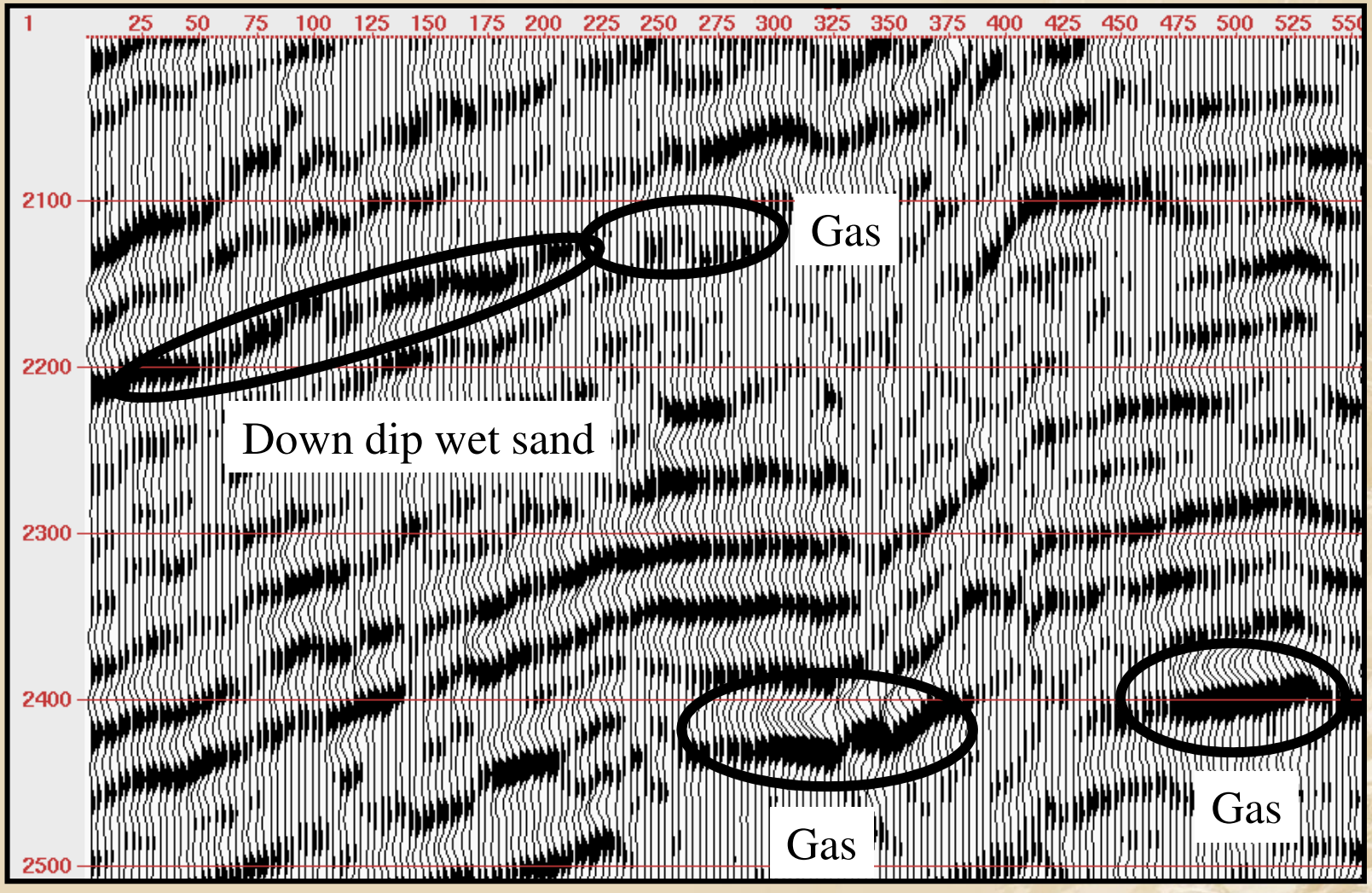
Rock Physics

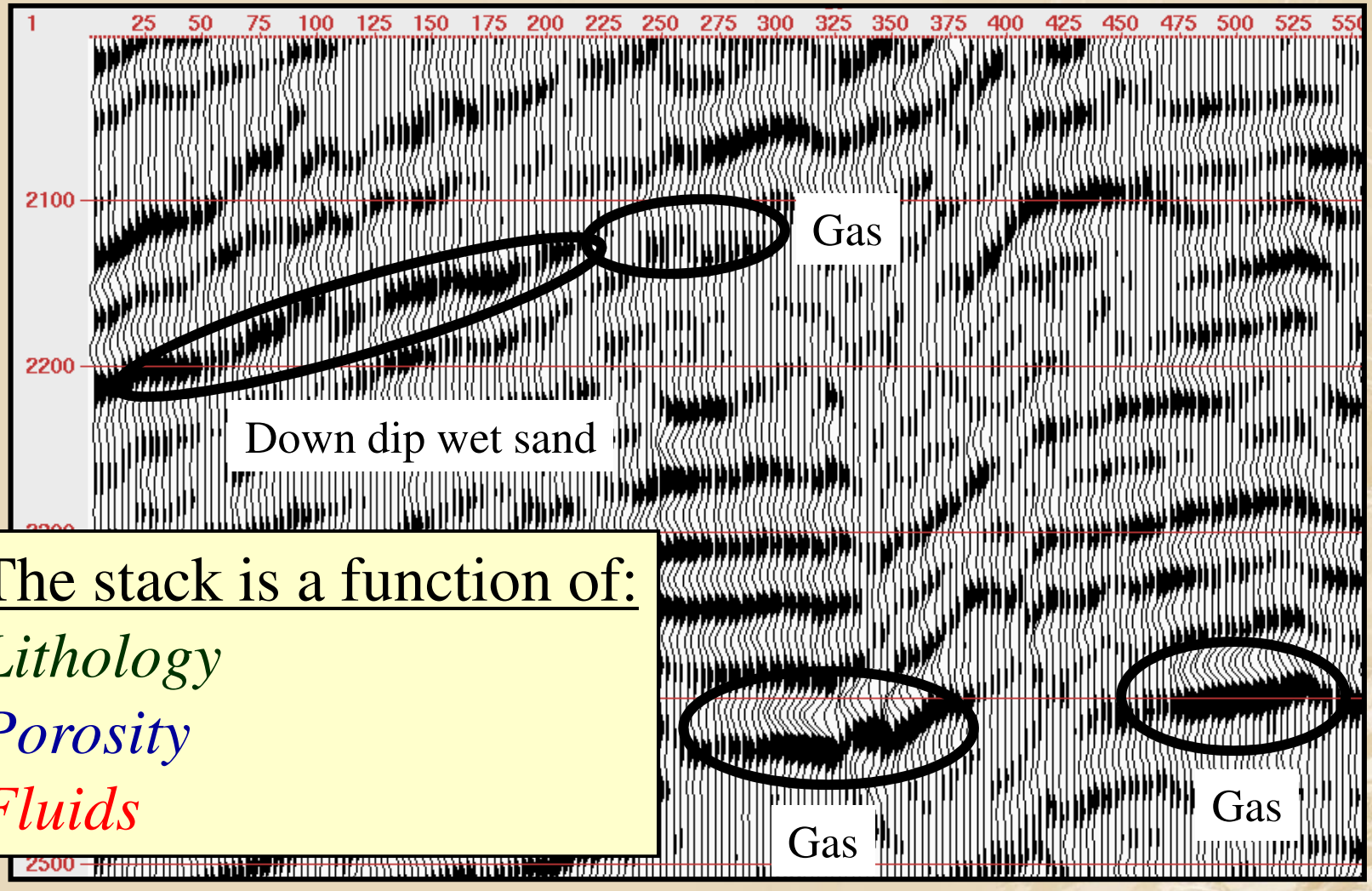
Where is the Gas?

Pre-stack Time Migrated Stack



Where is the Gas?

Pre-stack Time Migrated Stack



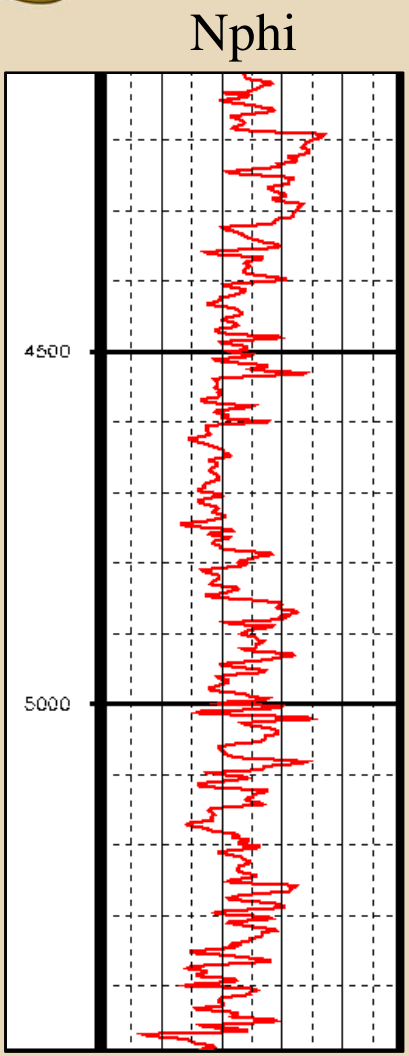
The stack is a function of:

Lithology

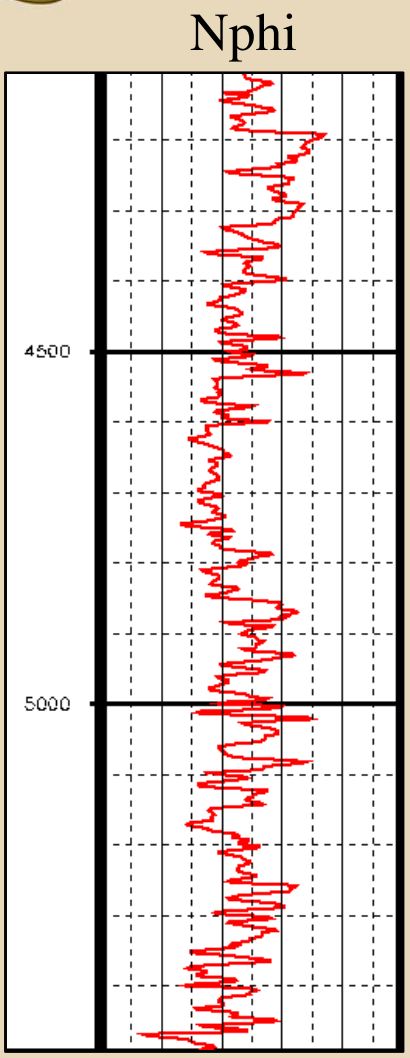
Porosity

Fluids

Petrophysics, Logs



Petrophysics, Logs



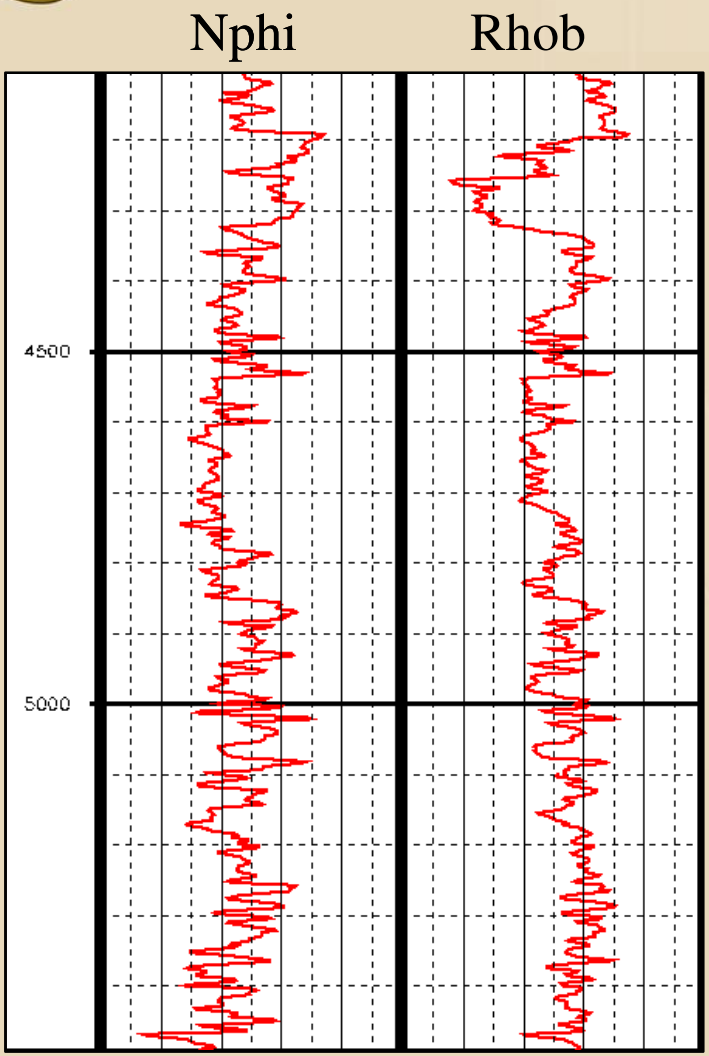
This log is a function of:

Lithology

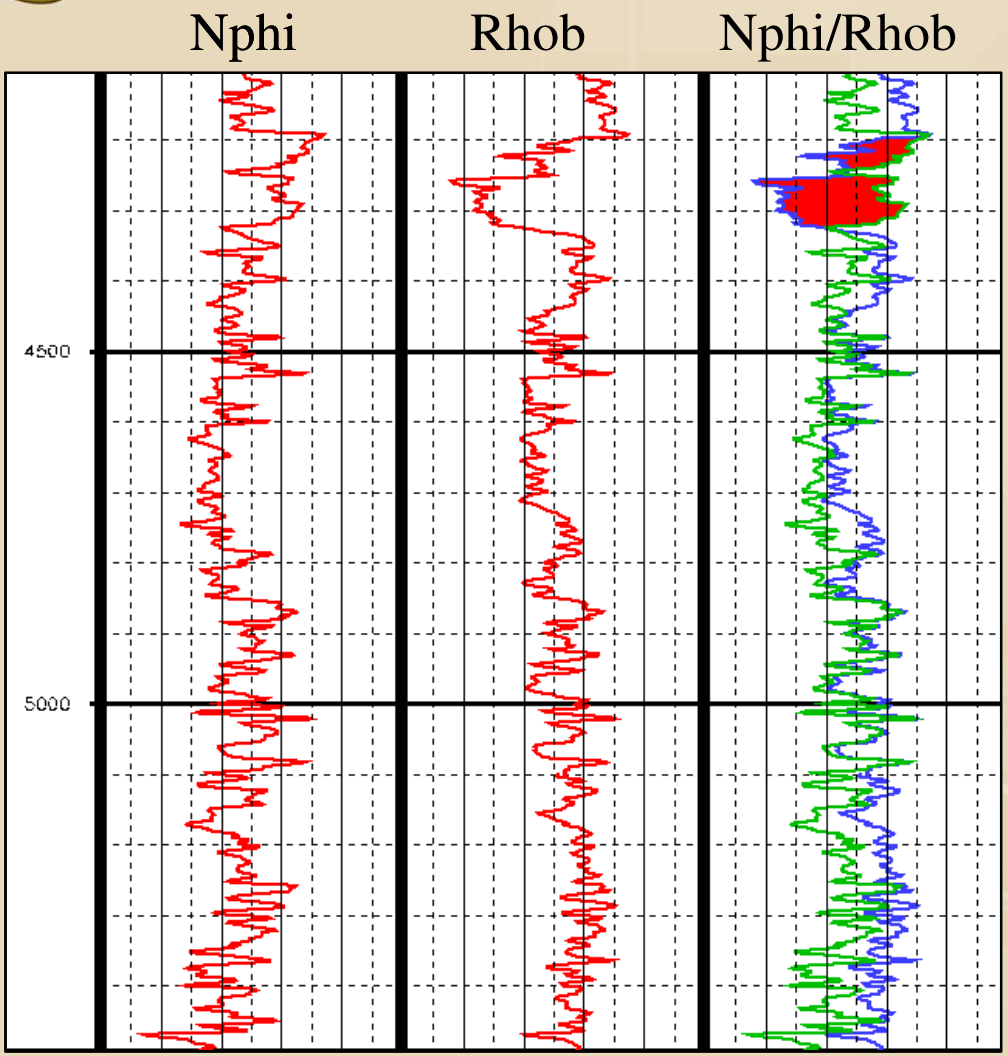
Porosity

Fluids

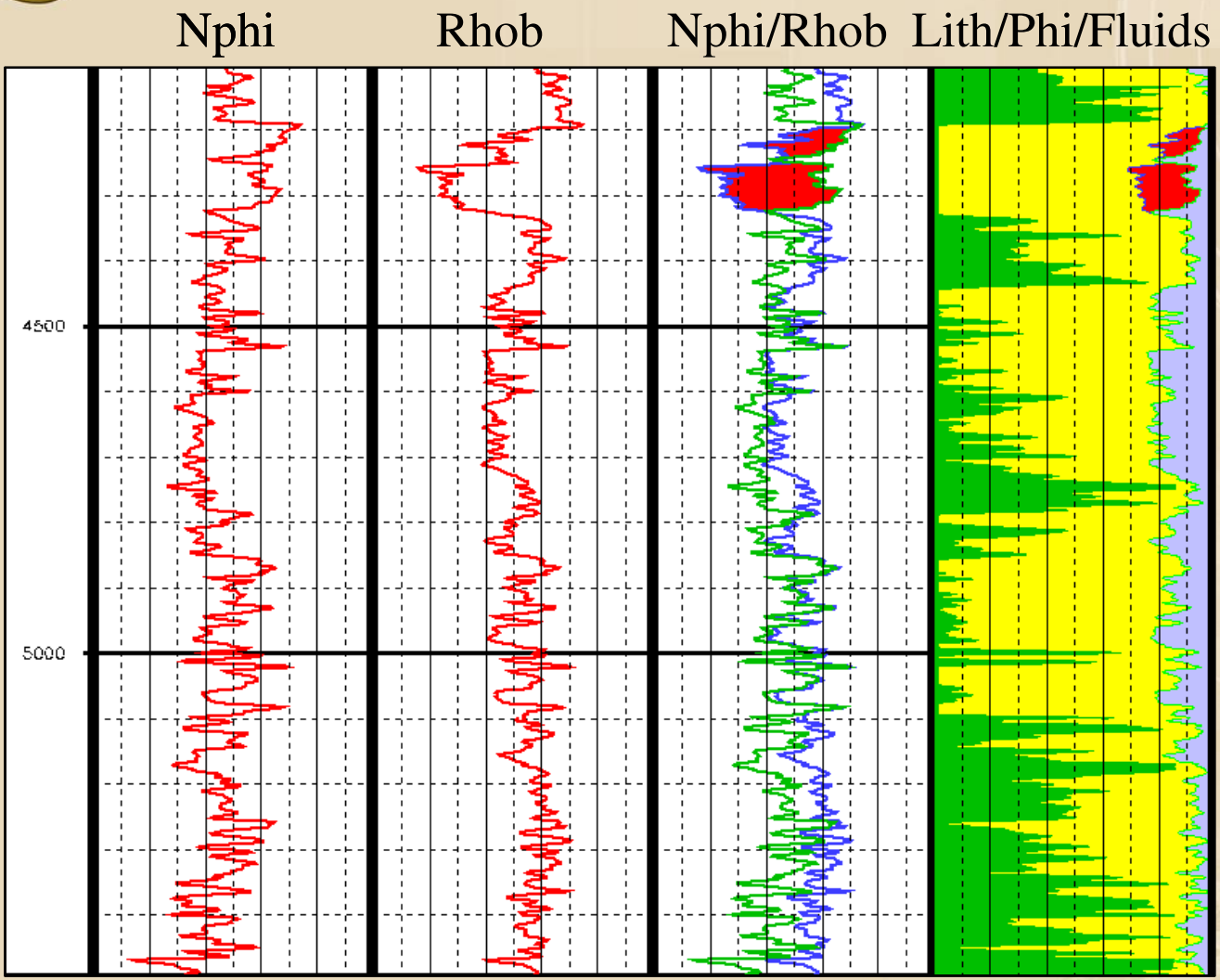
Petrophysics, Logs



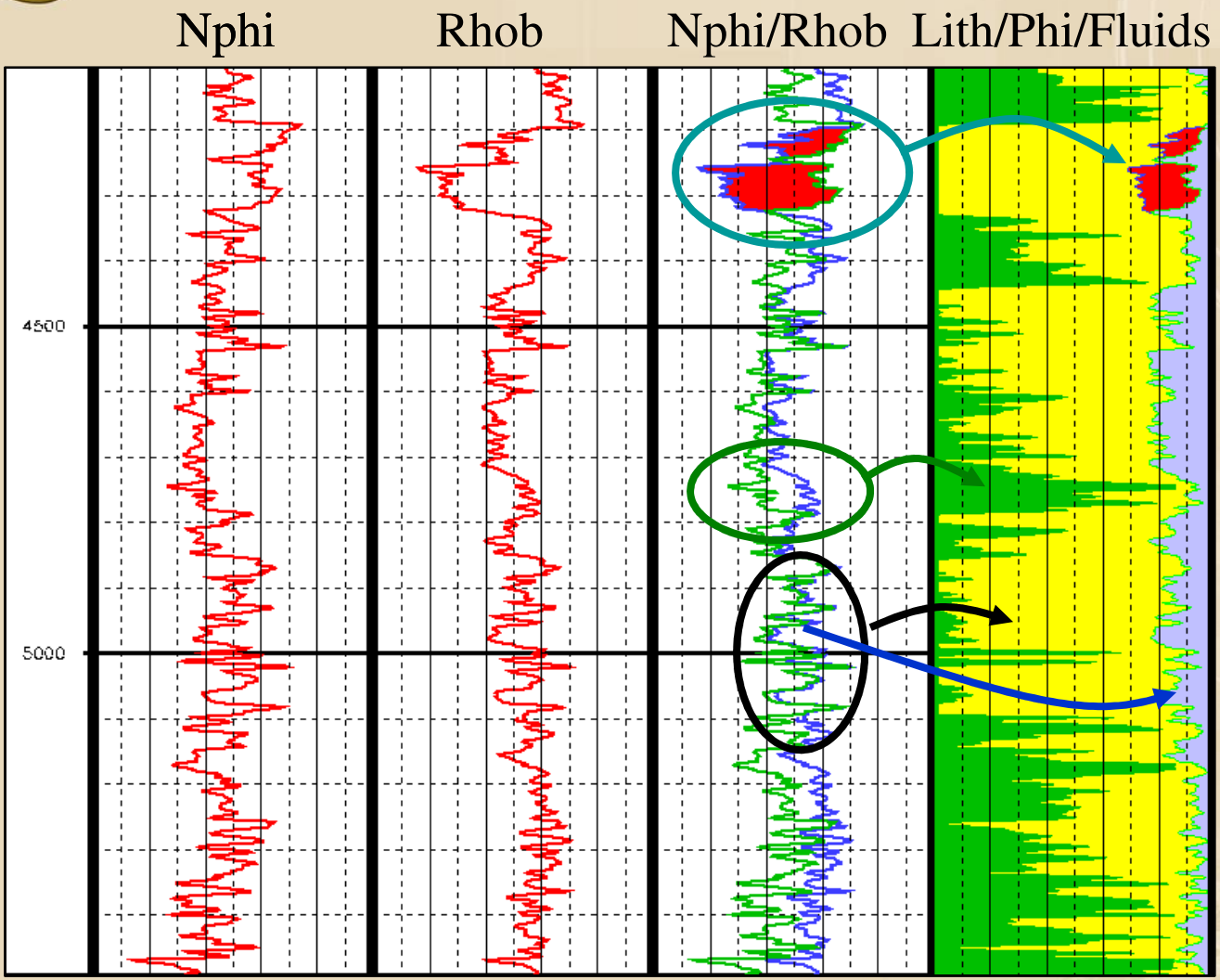
Petrophysics, Logs



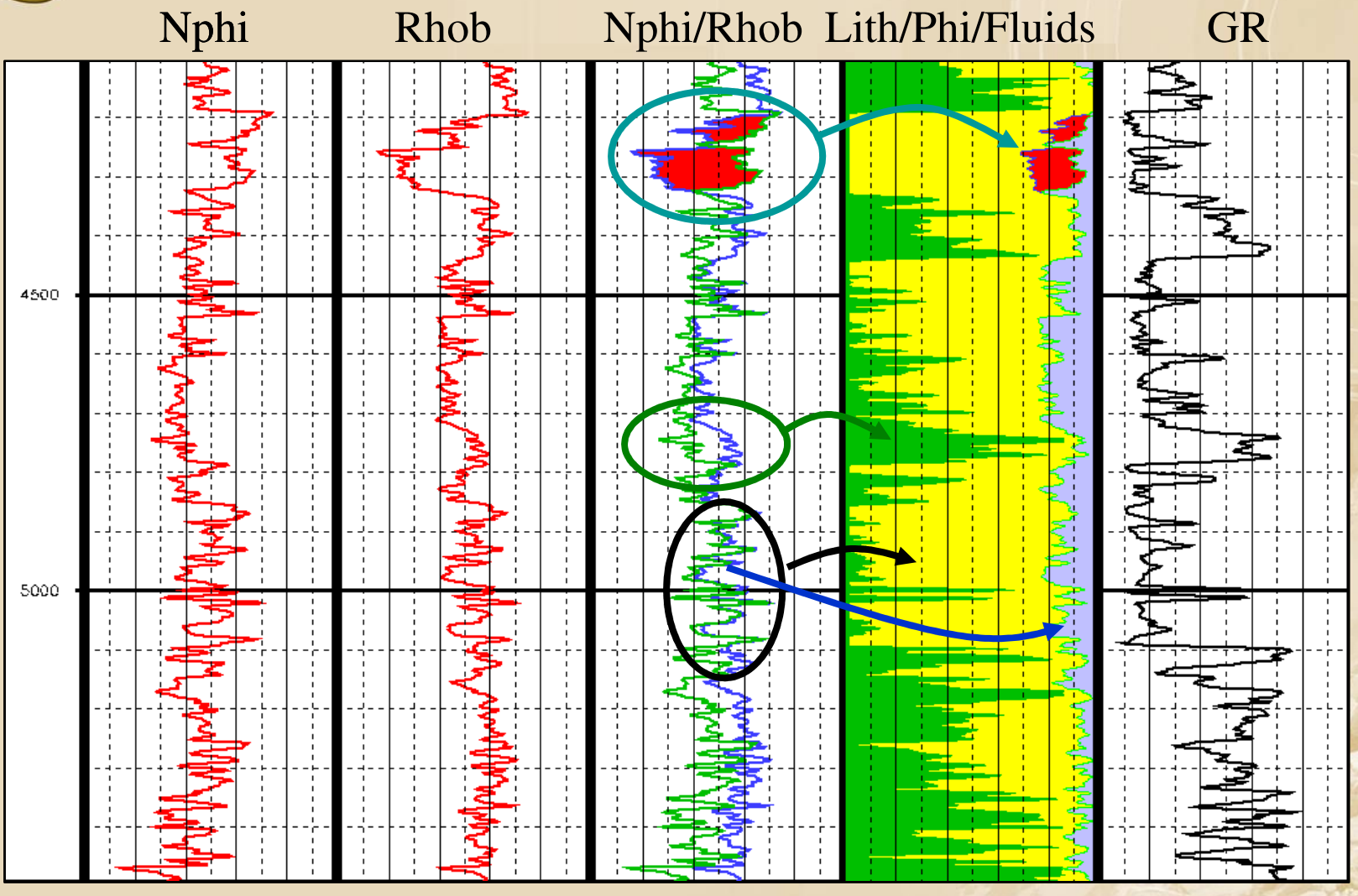
Petrophysics, Logs



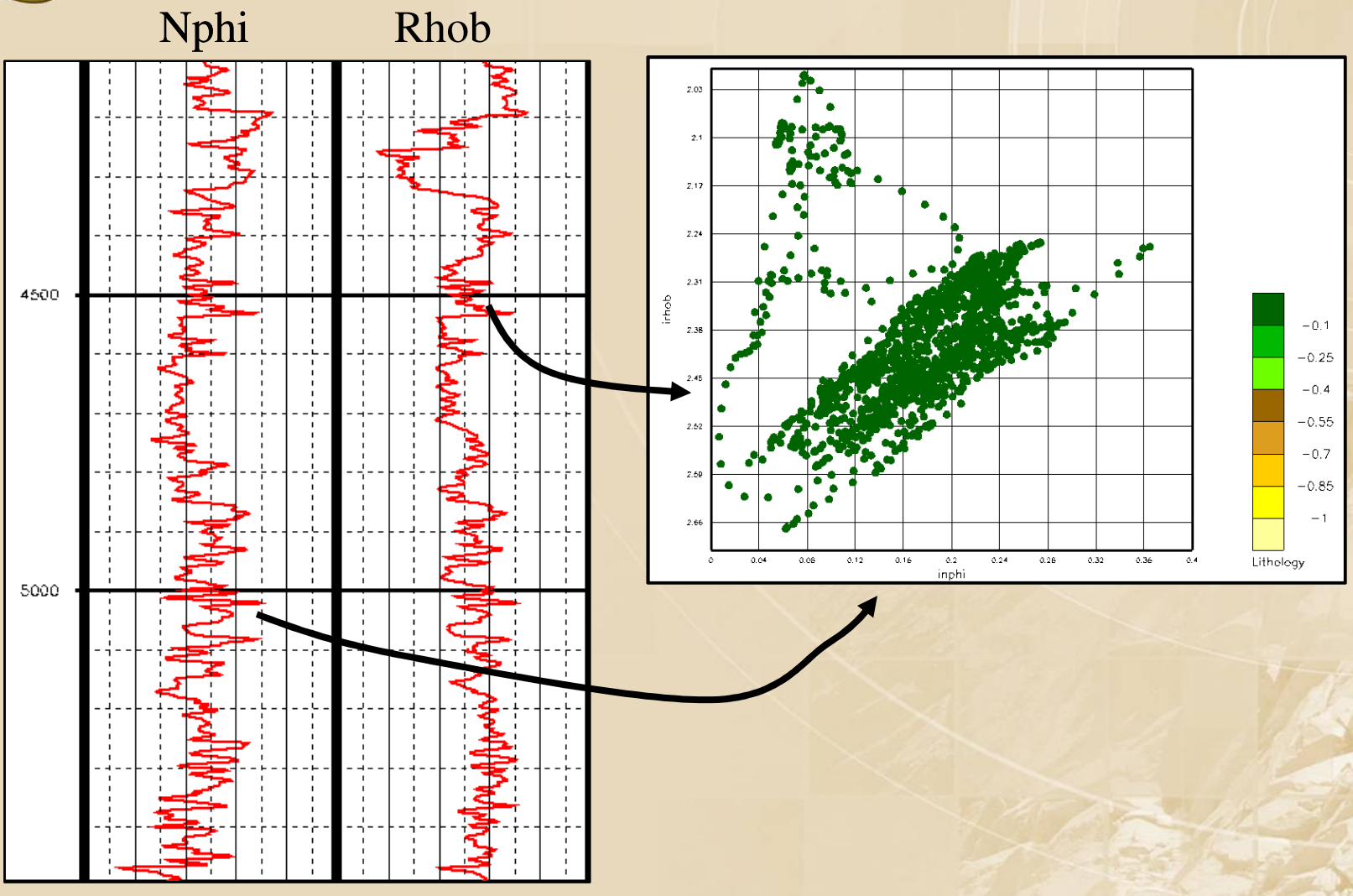
Petrophysics, Logs



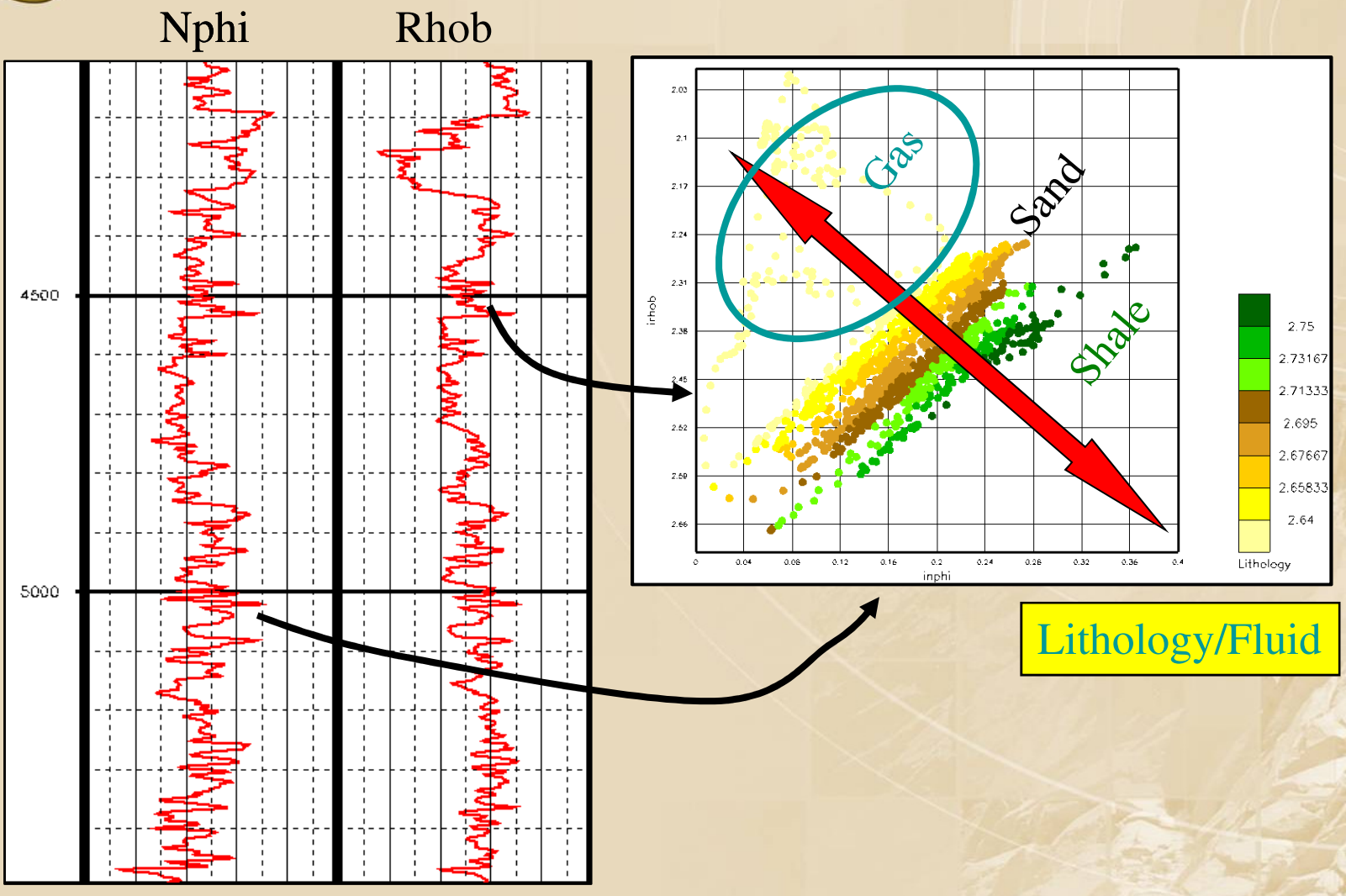
Petrophysics, Logs



Petrophysics, Logs

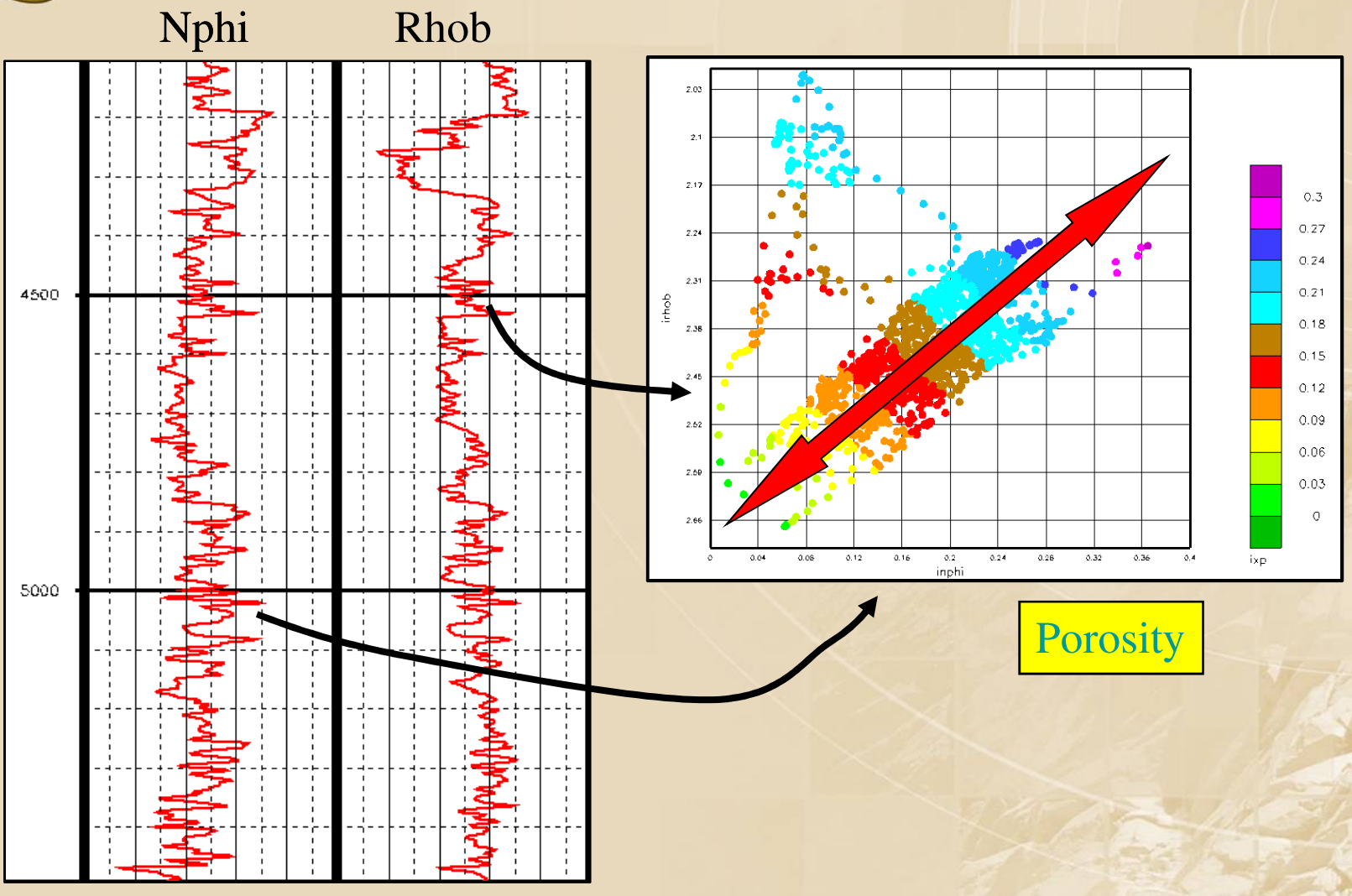


Petrophysics, Logs



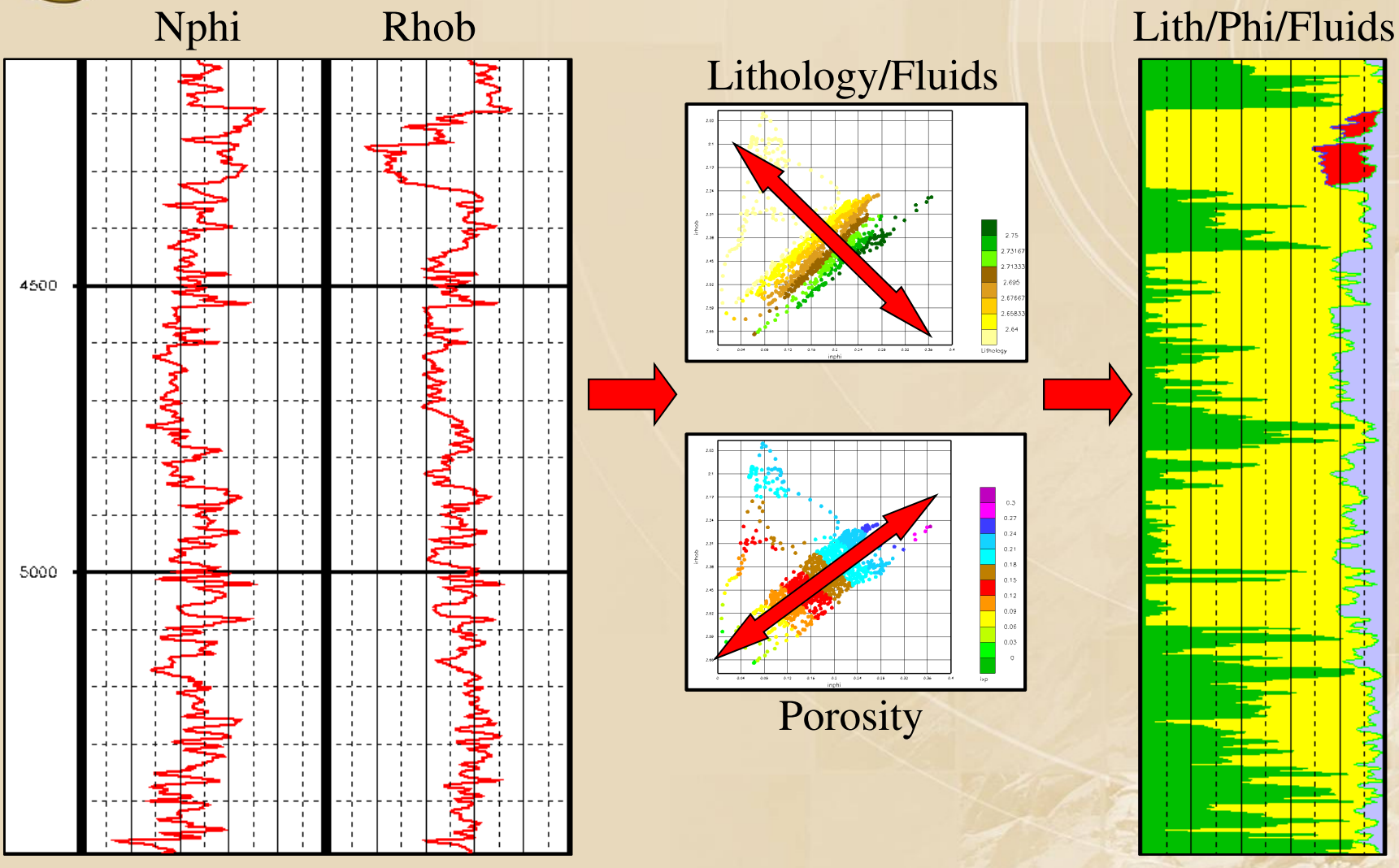
Lithology/Fluid

Petrophysics, Logs



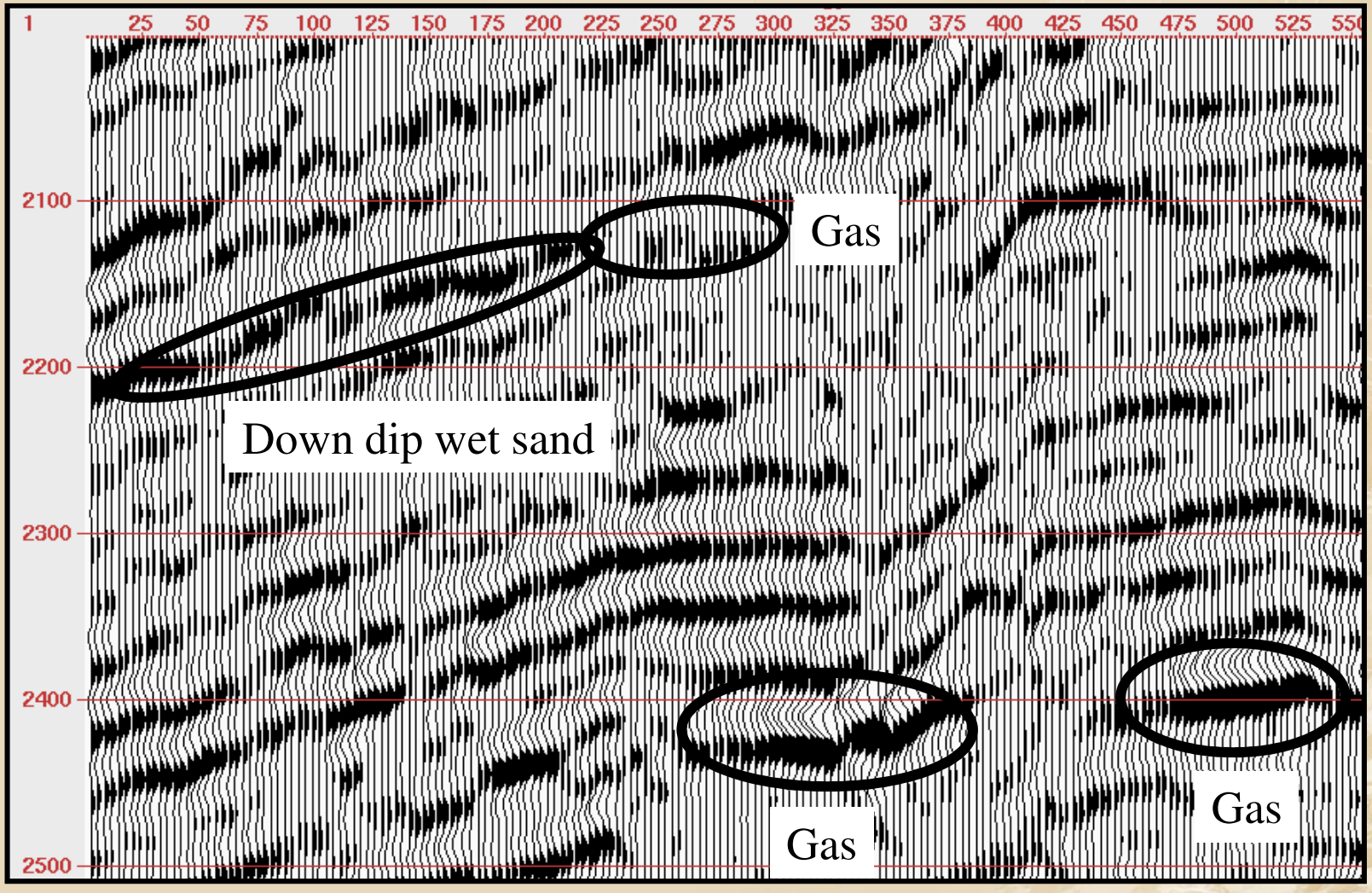
Porosity

Petrophysics, Logs



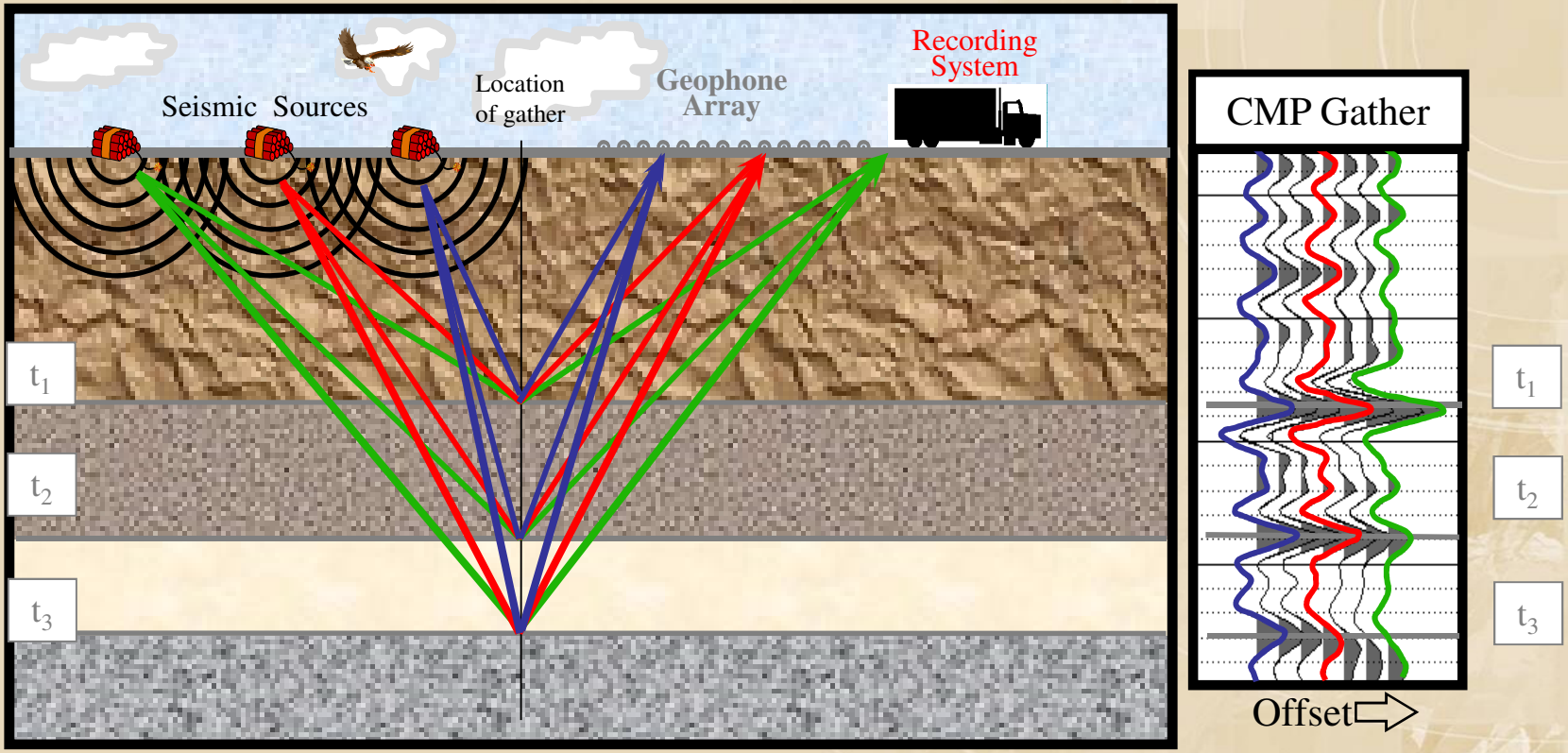
Where is the Gas?

Pre-stack Time Migrated Stack



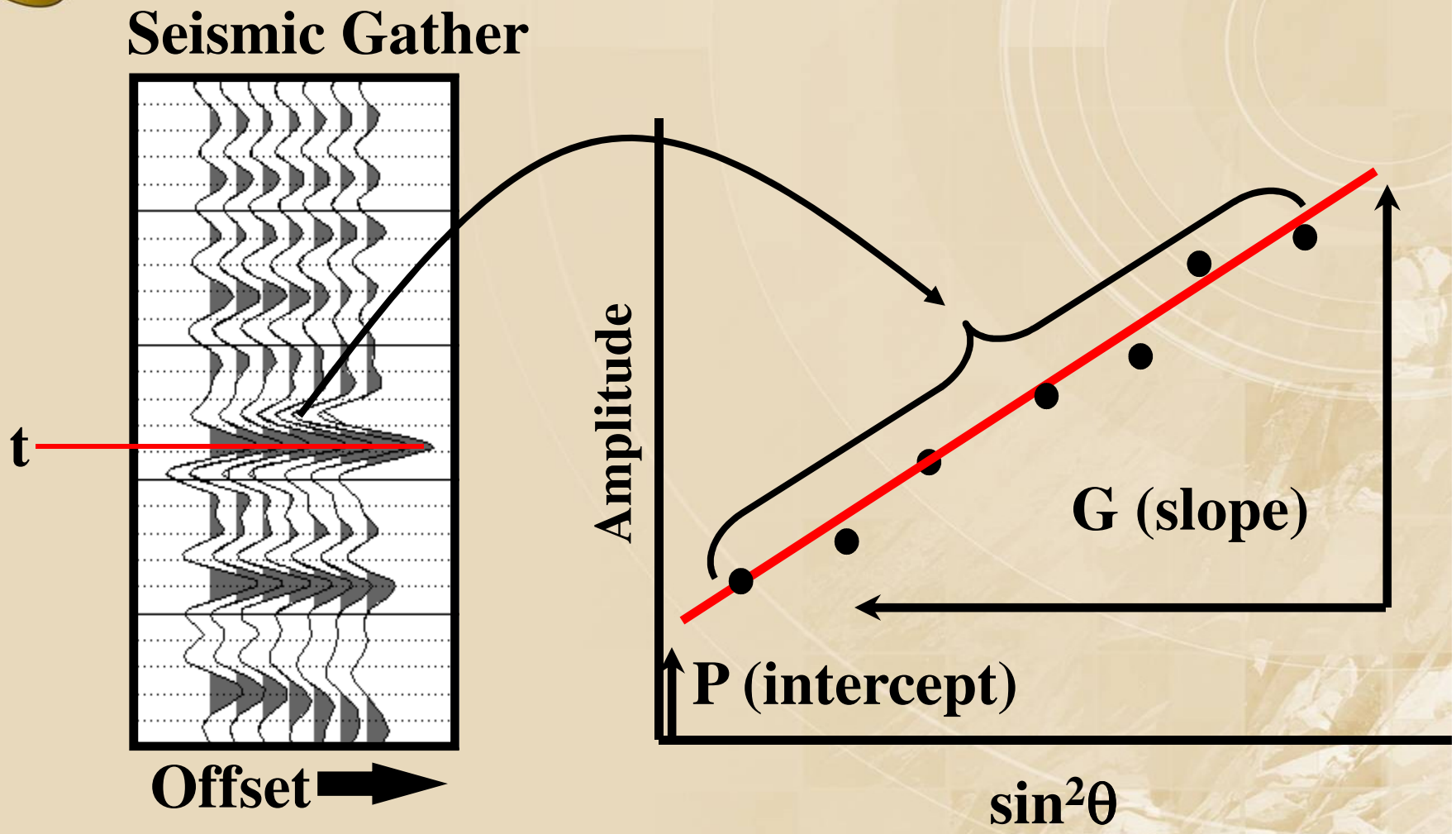
Amplitude Variations with Offset, AVO

The PSTM CDP Gather

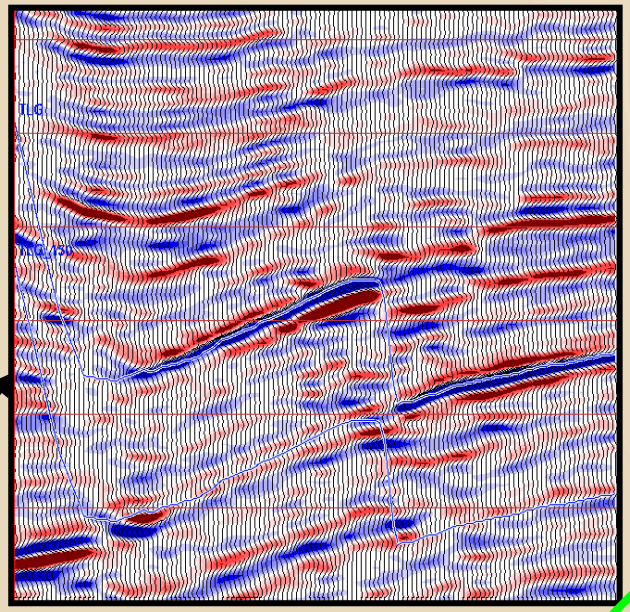


In the PSTM CDP gather, at any given time, each offset samples the same subsurface point but does so at different angles.

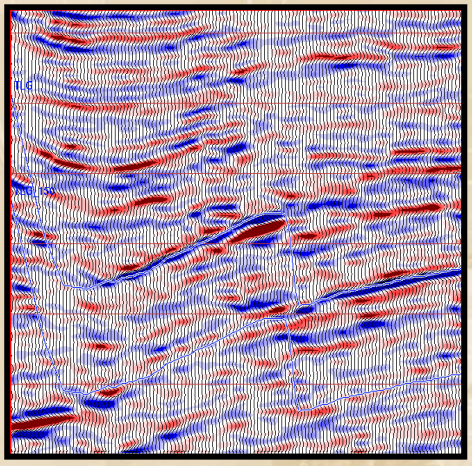
AVO Gradient Analysis



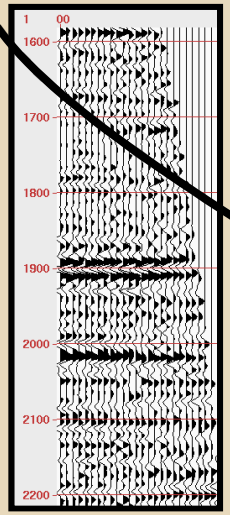
AVO Analysis

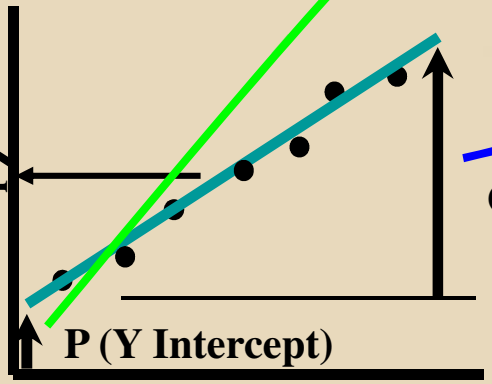


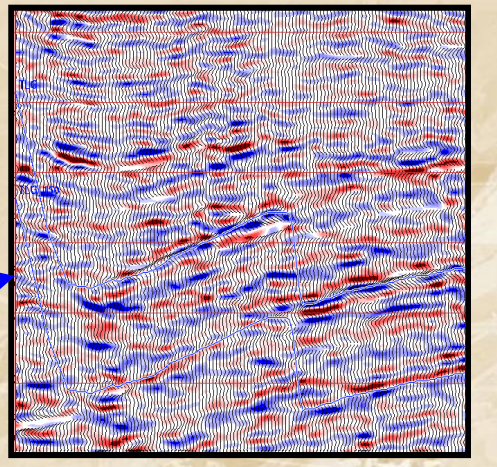
Full Stack



Normal Incidence Section



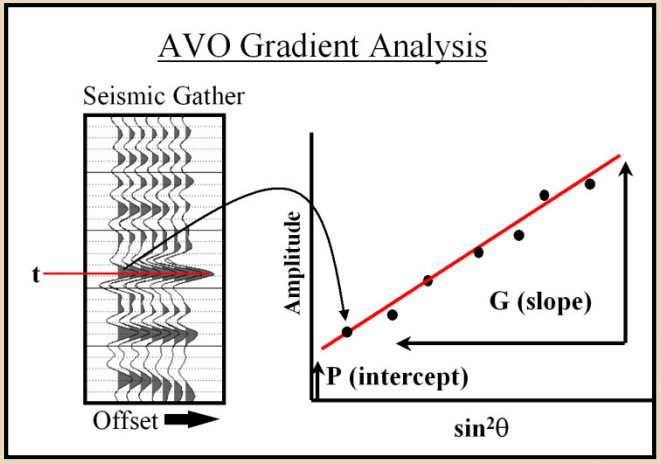


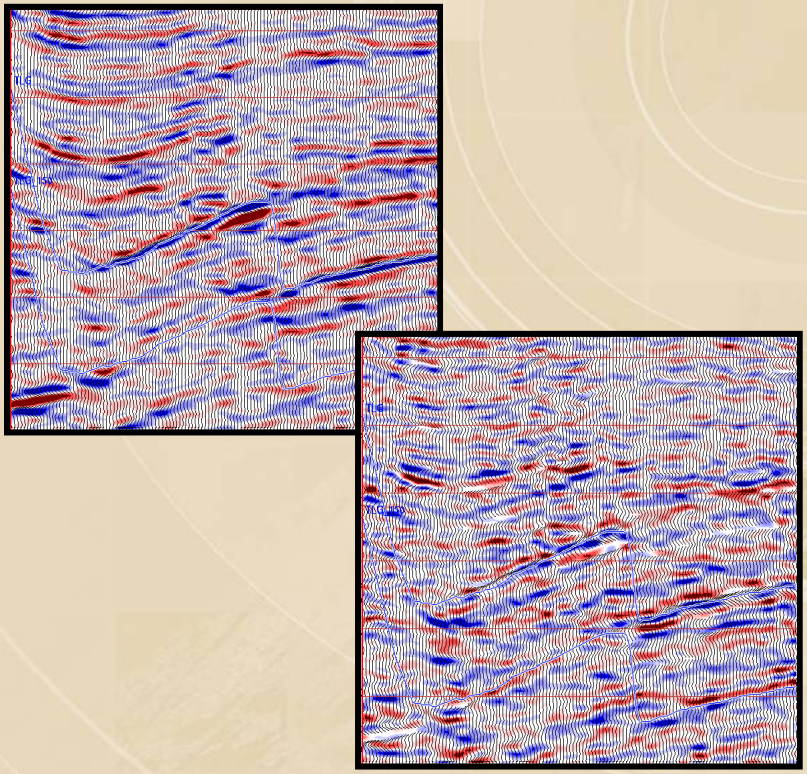


AVO Gradient Section

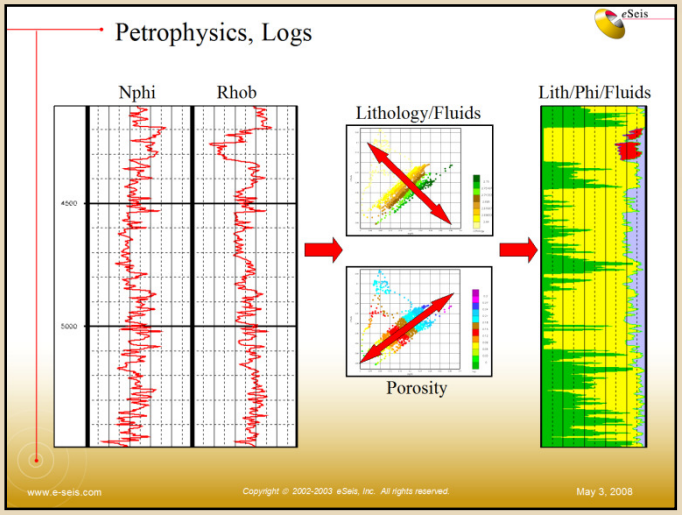
Seismic Petrophysics

Normal Incidence (P)



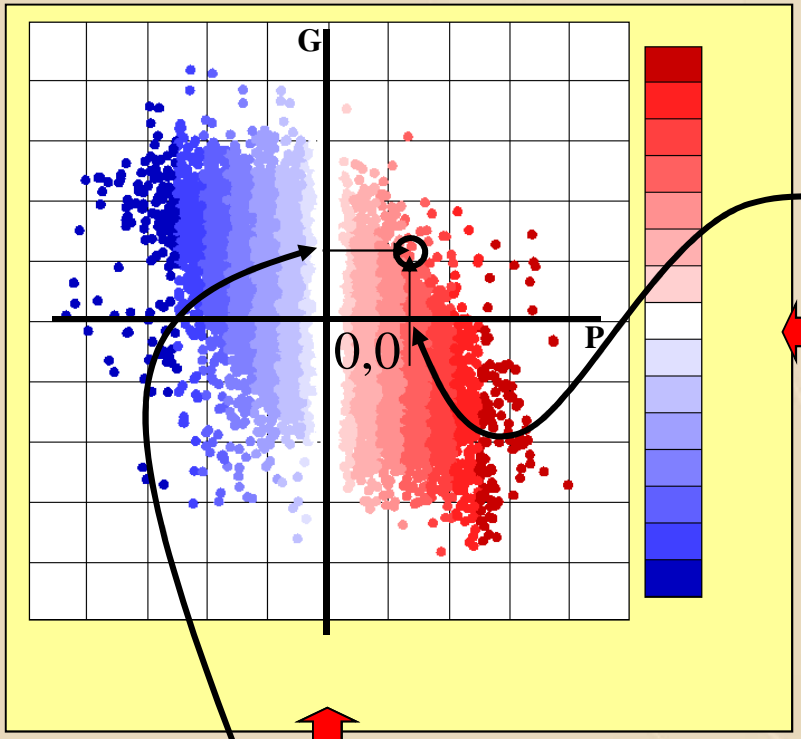


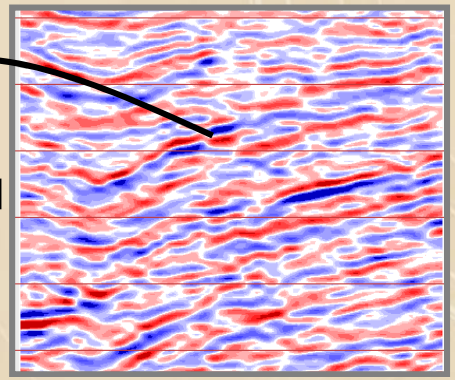
AVO Gradient (G)



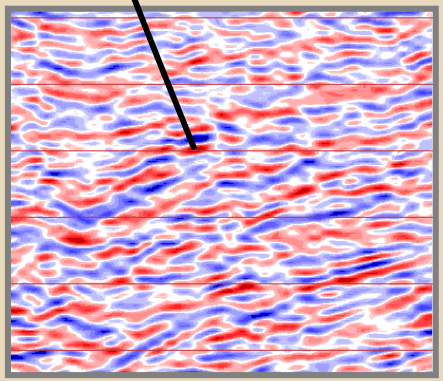
Where are the sands?
Gas?
Porosity?

Crossplot of P and G





P
Stack



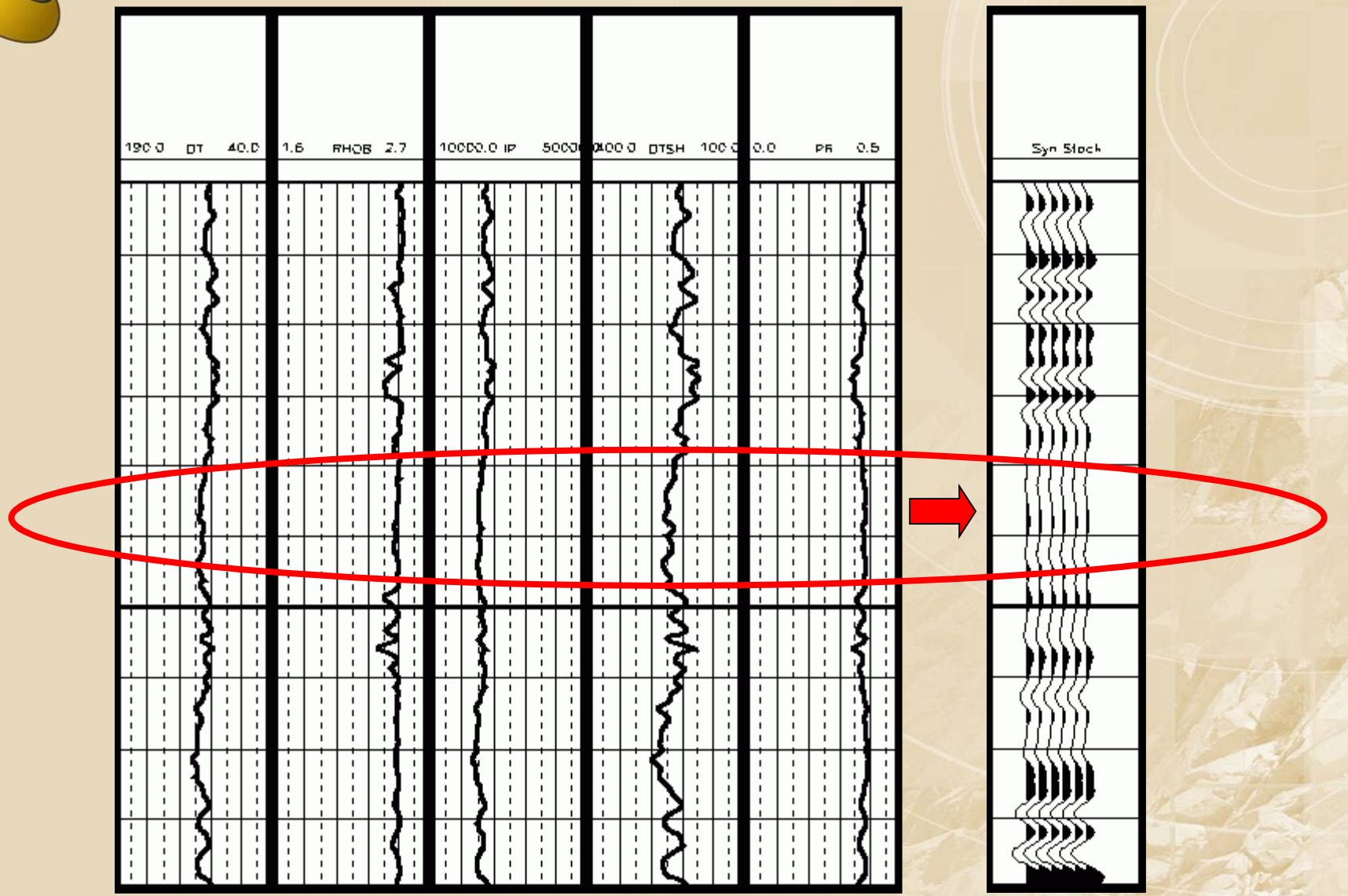
G
Stack

What does this crossplot mean
In terms of:
Lithology?
Porosity?
Fluids?

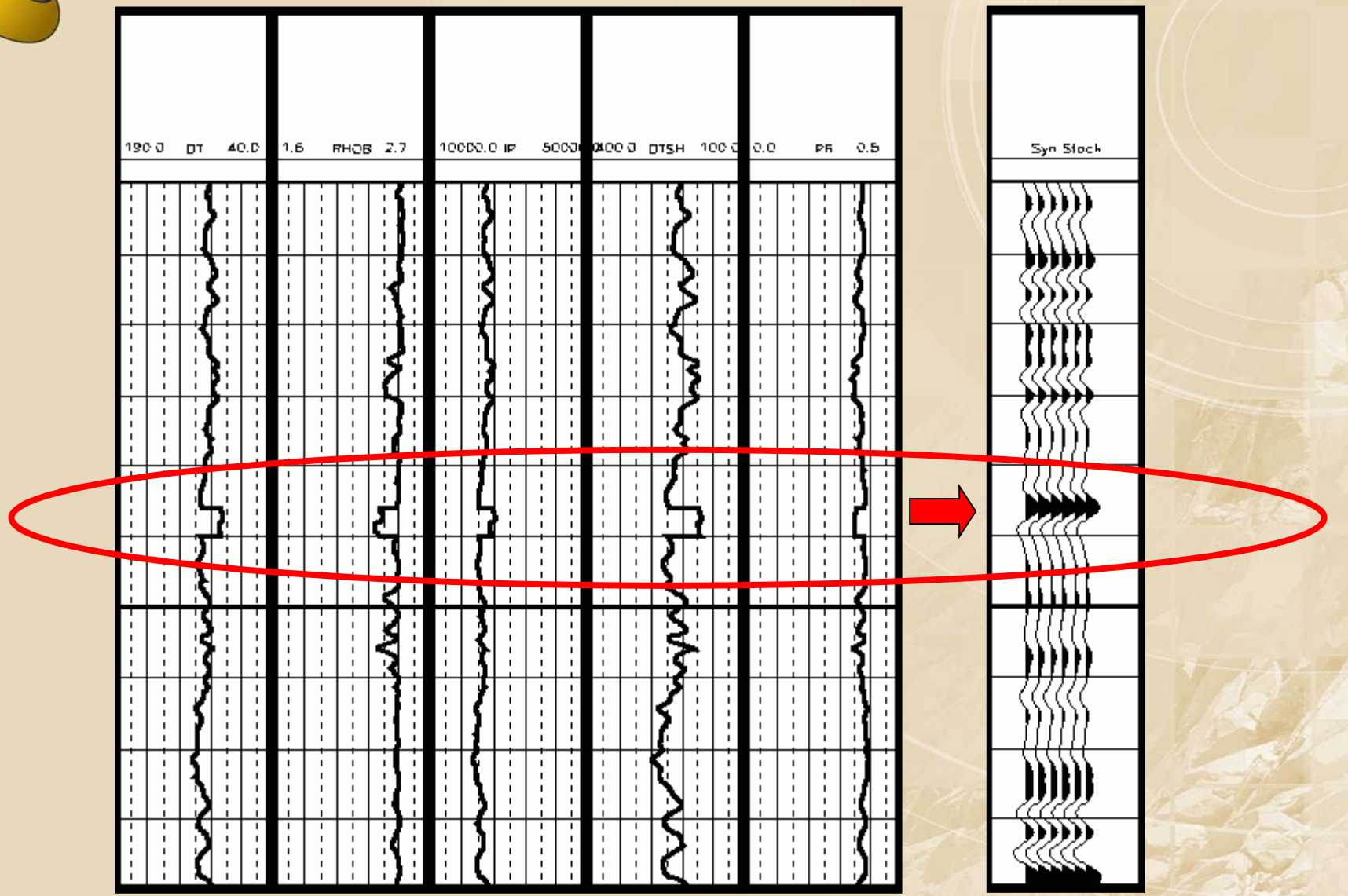
LithSeis®

Modeling Methodology

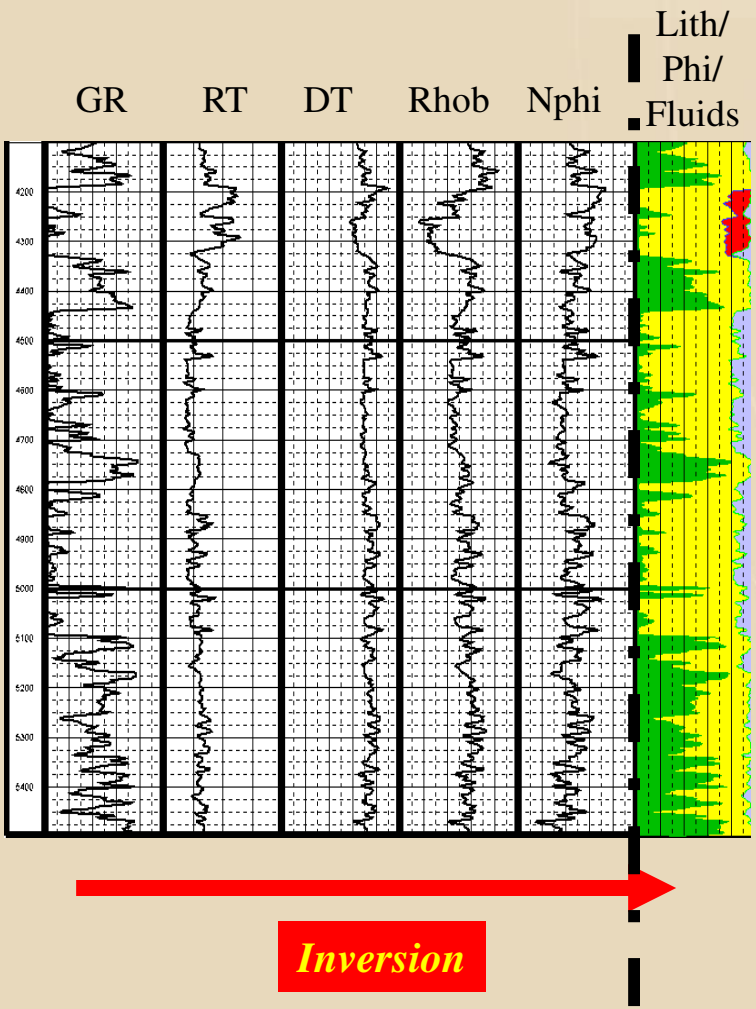
Conventional Seismic Modeling



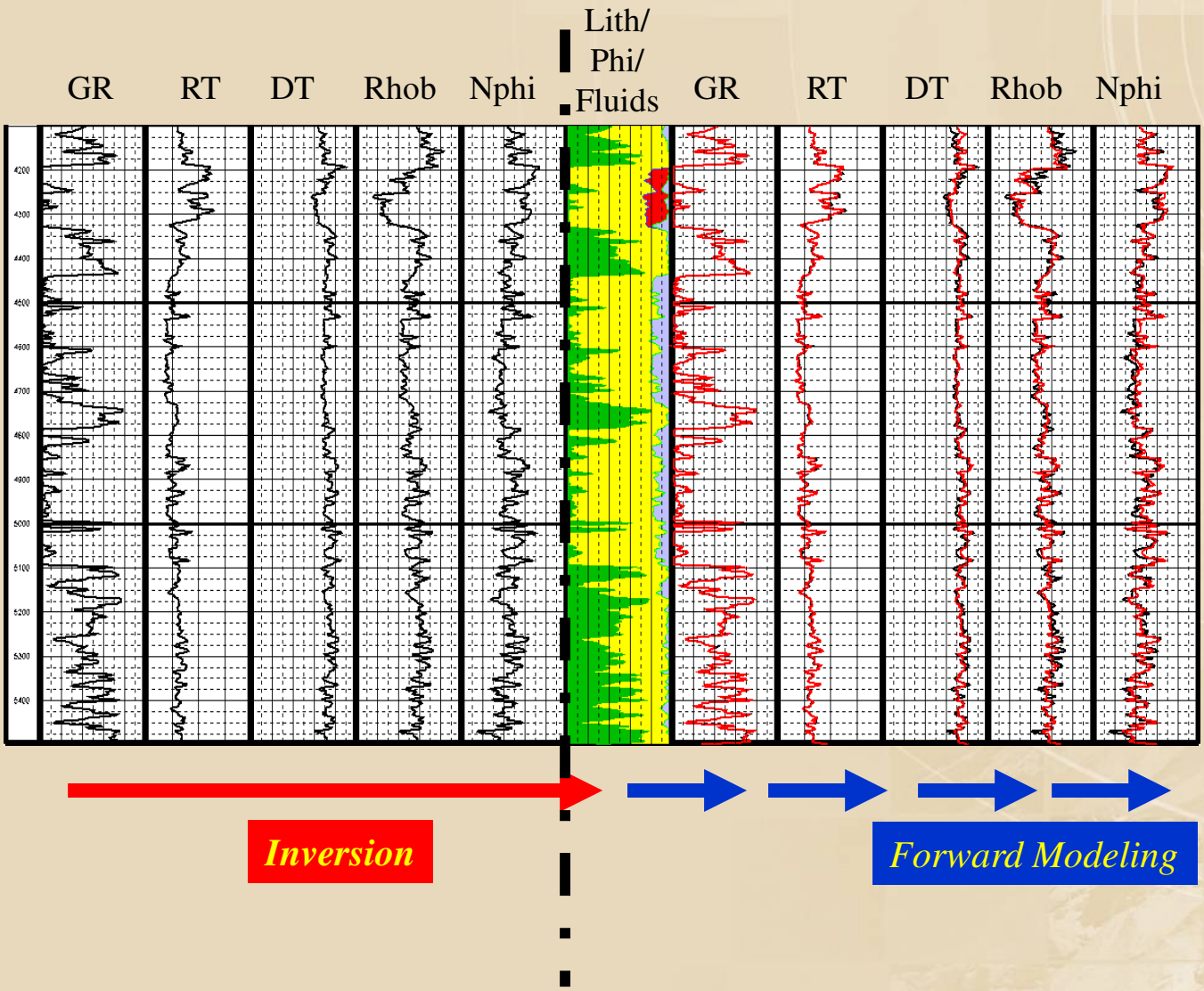
Conventional Seismic Modeling



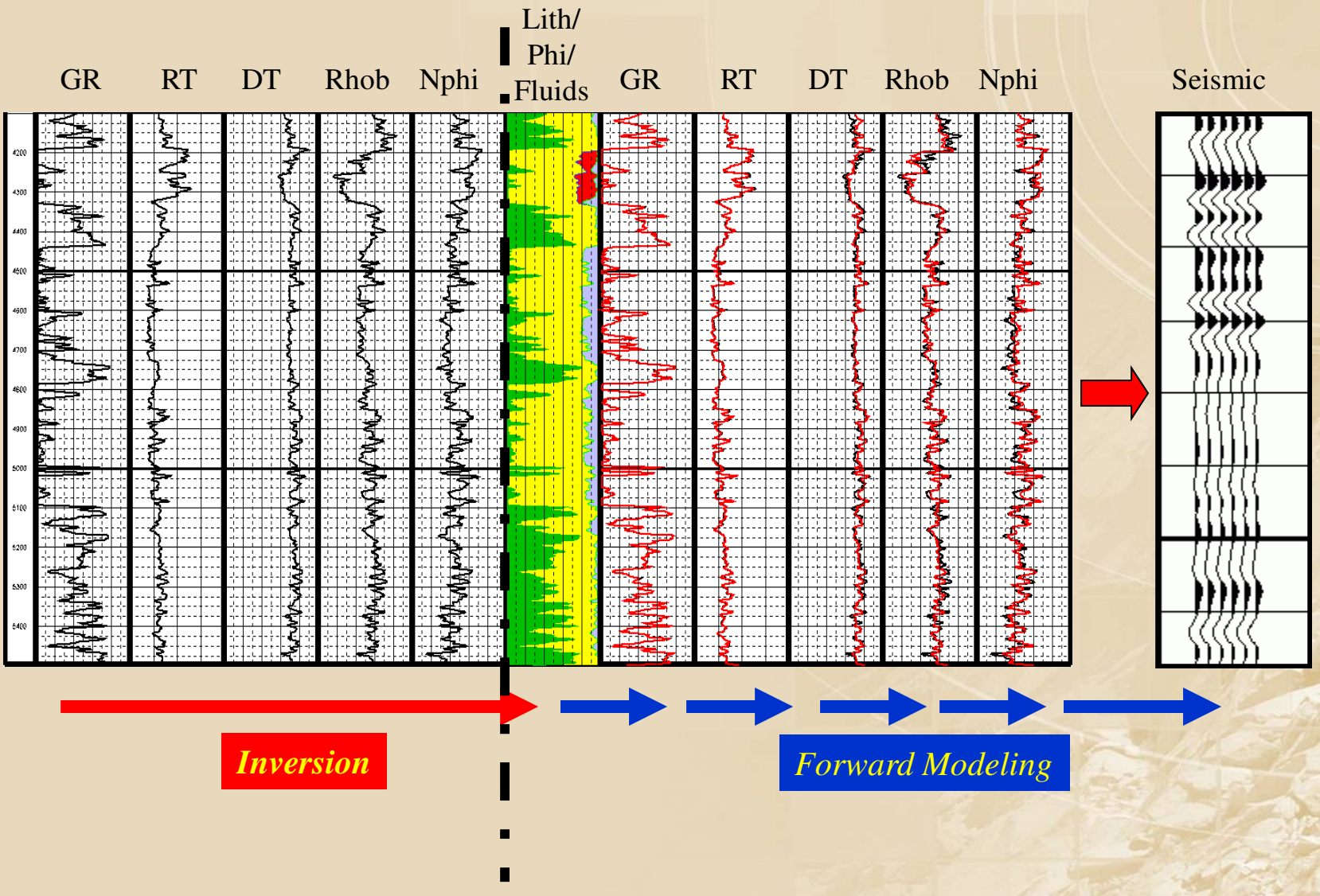
Seismic Petrophysics



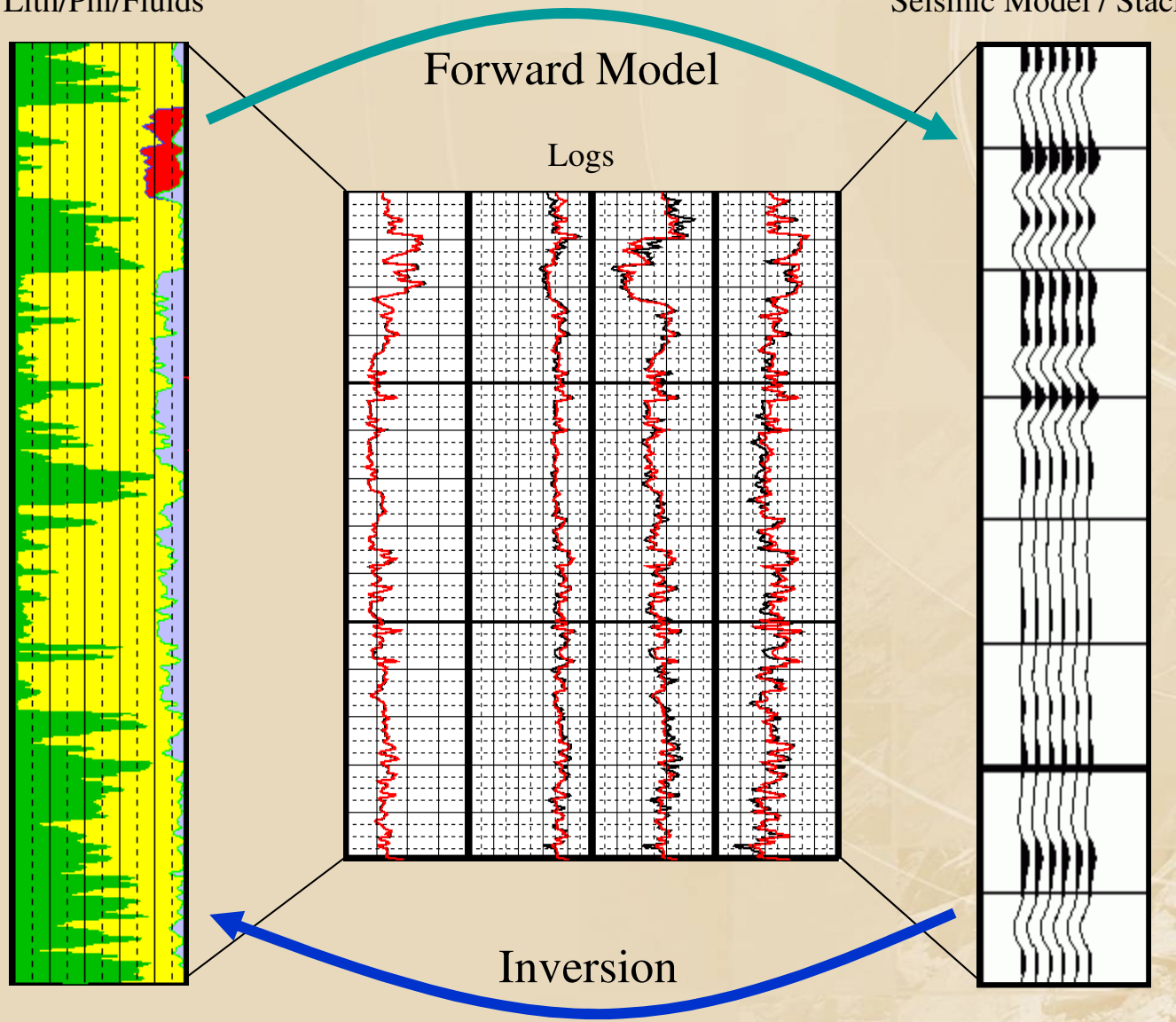
Seismic Petrophysics



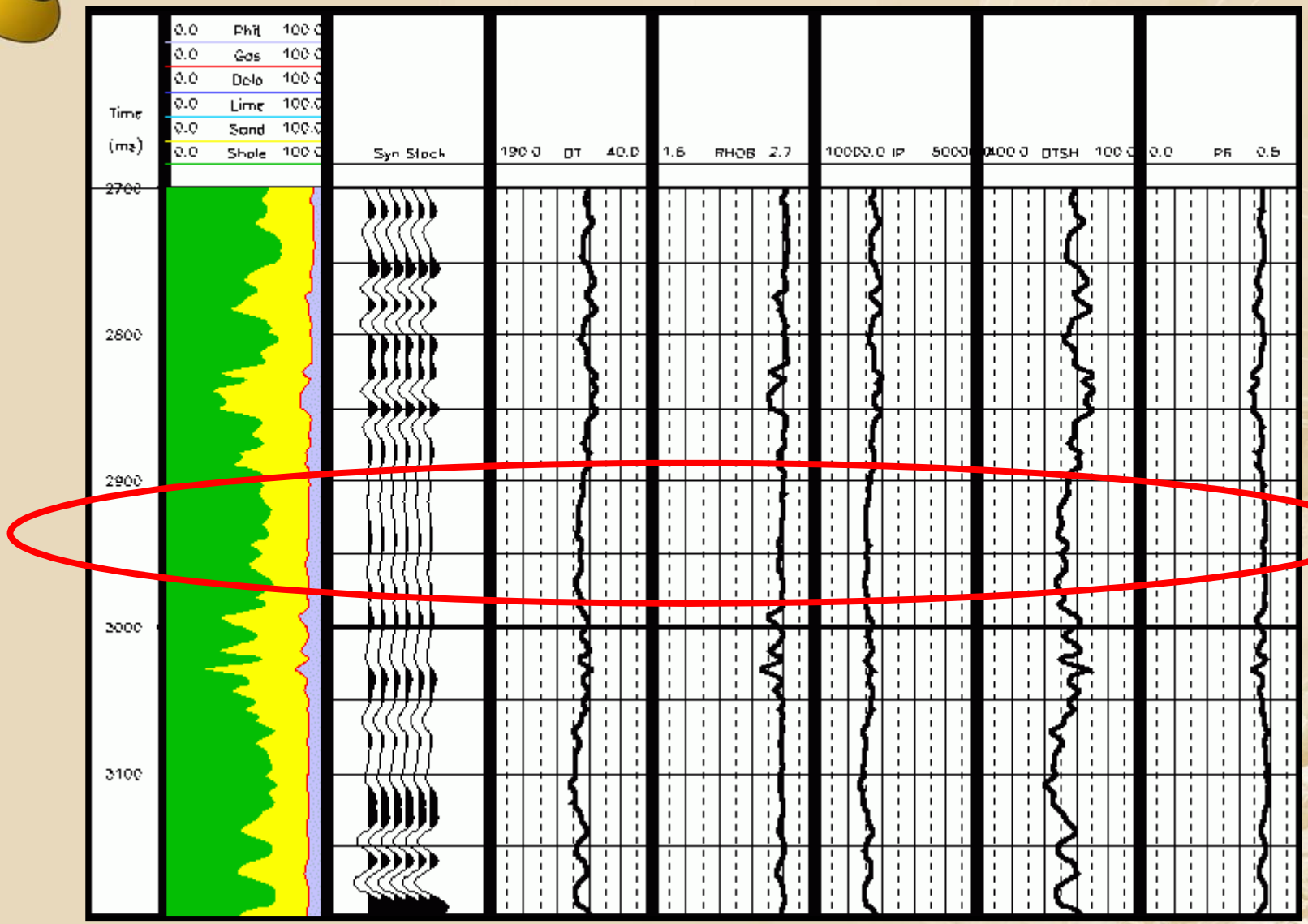
Seismic Petrophysics



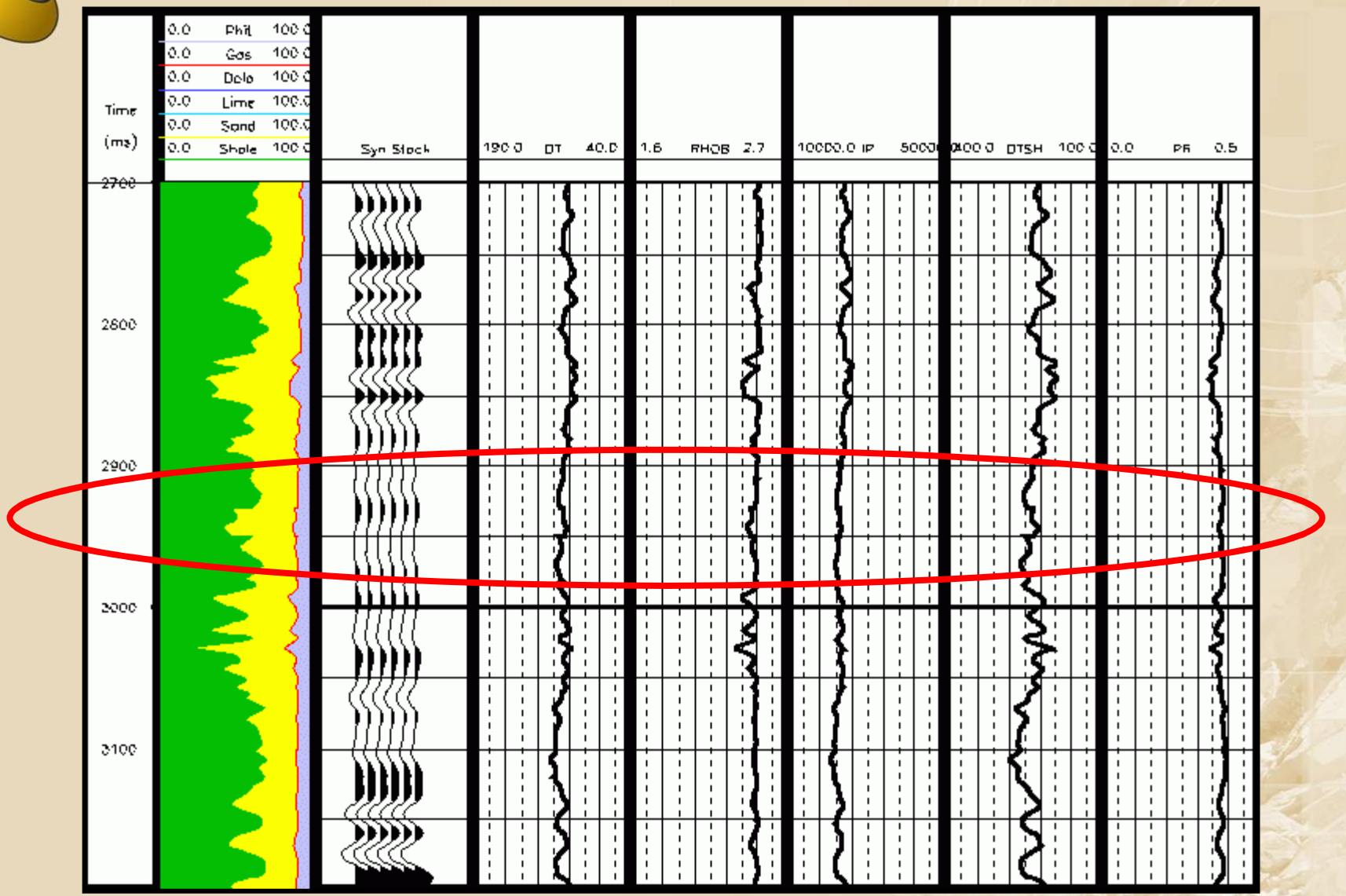
Seismic Petrophysics



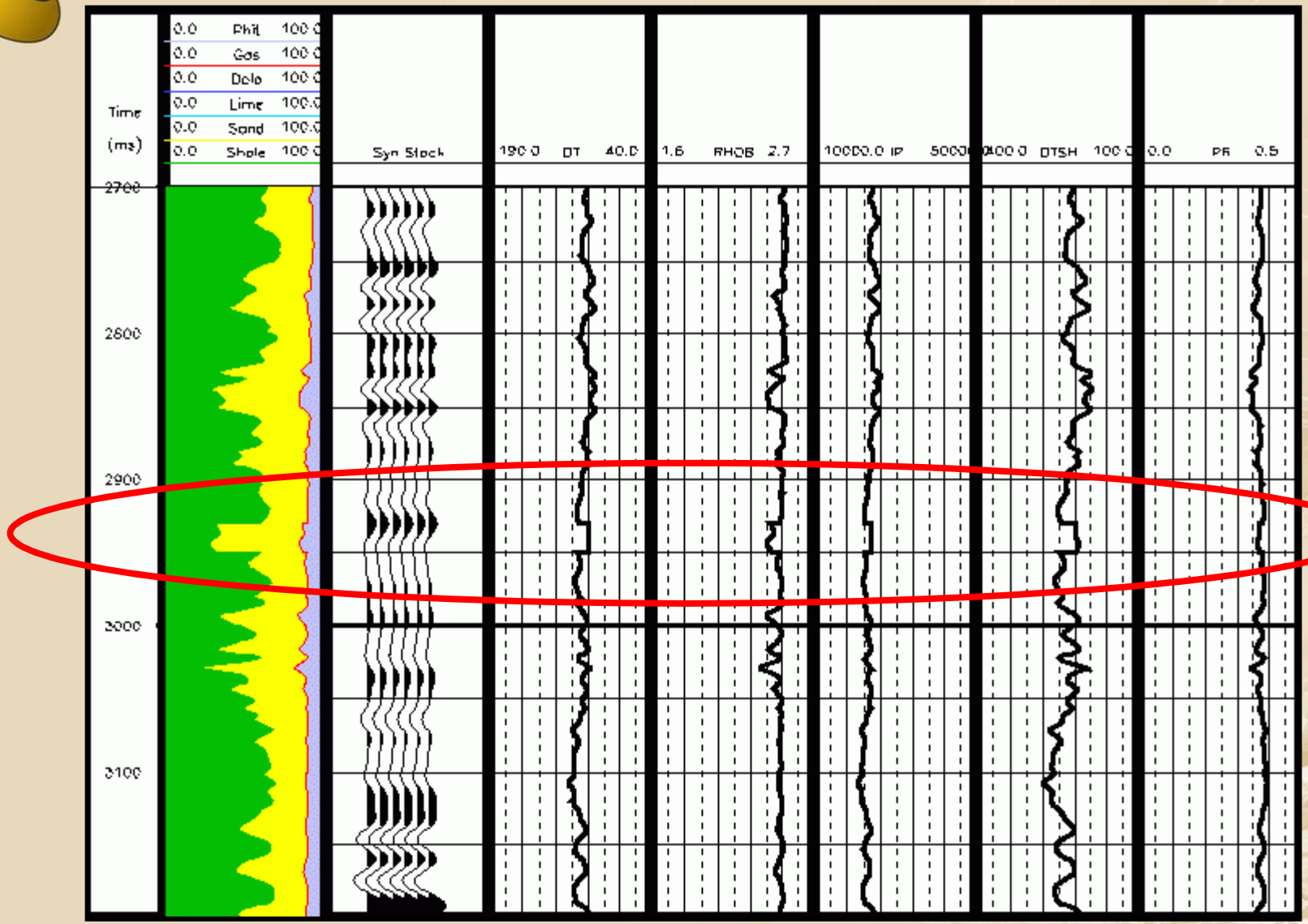
CDP 1



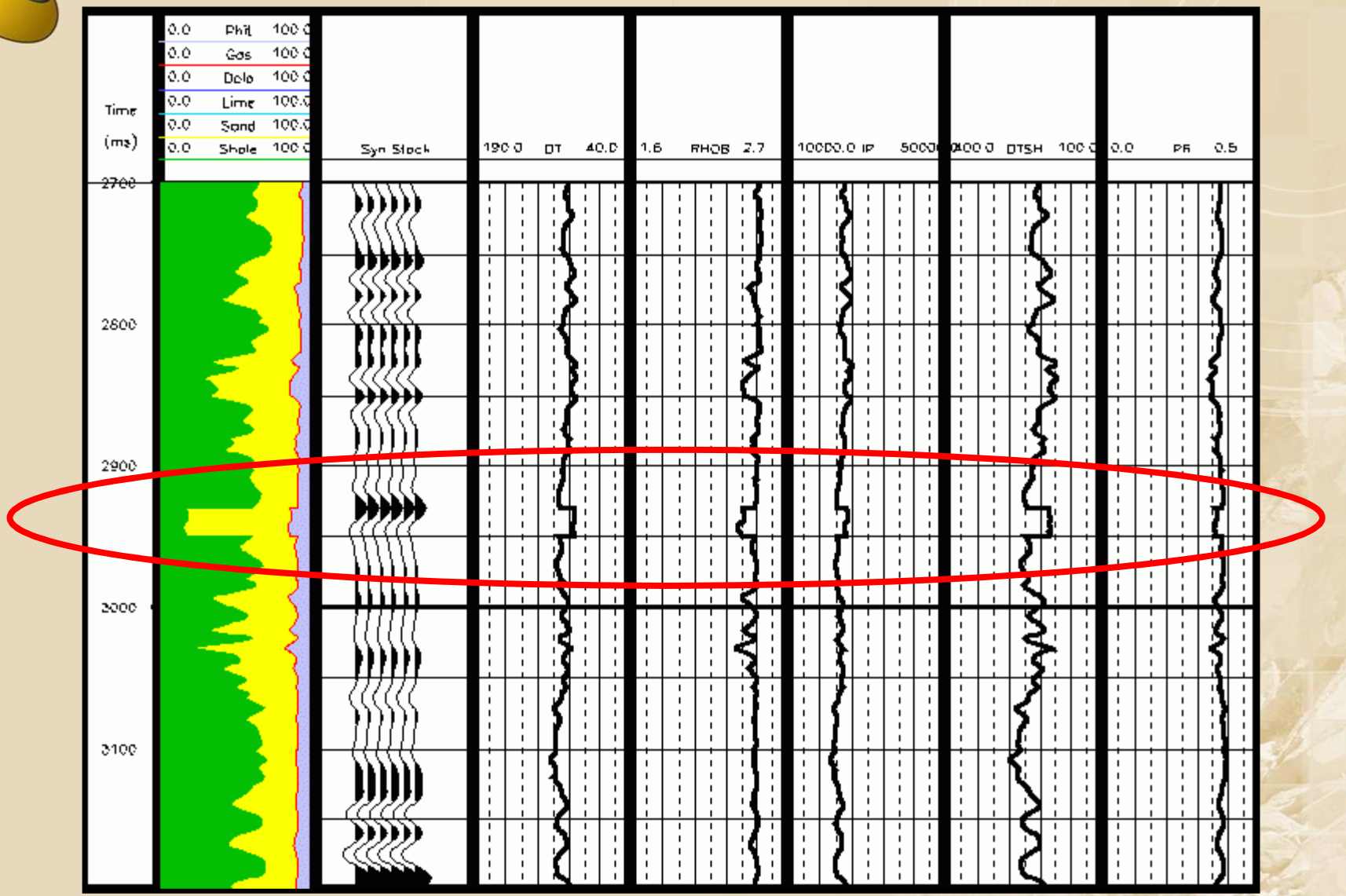
CDP 11



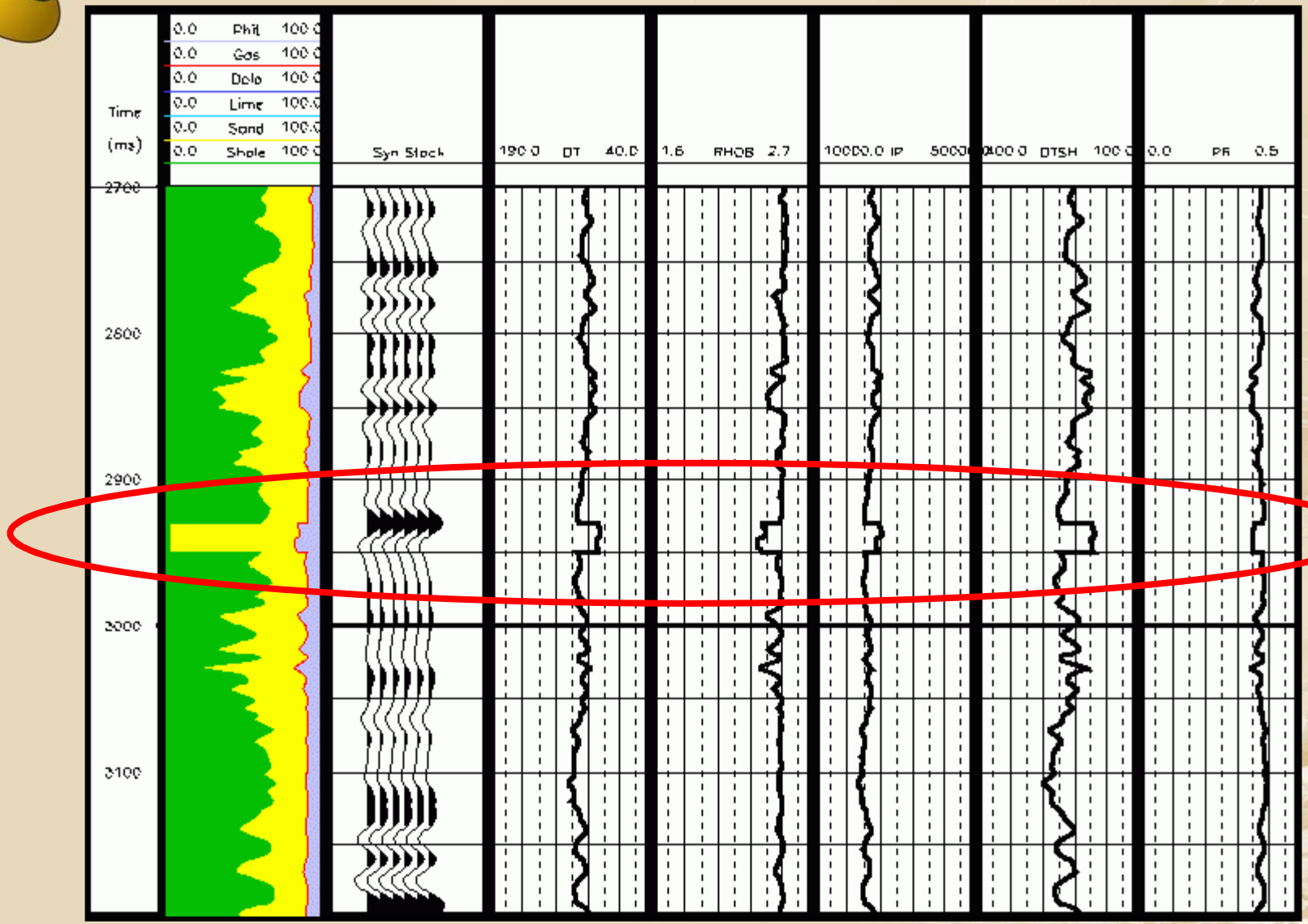
CDP 22



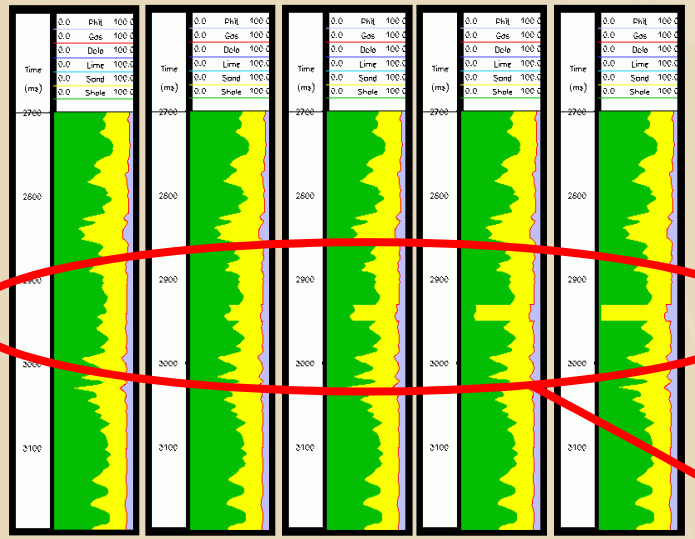
CDP 33

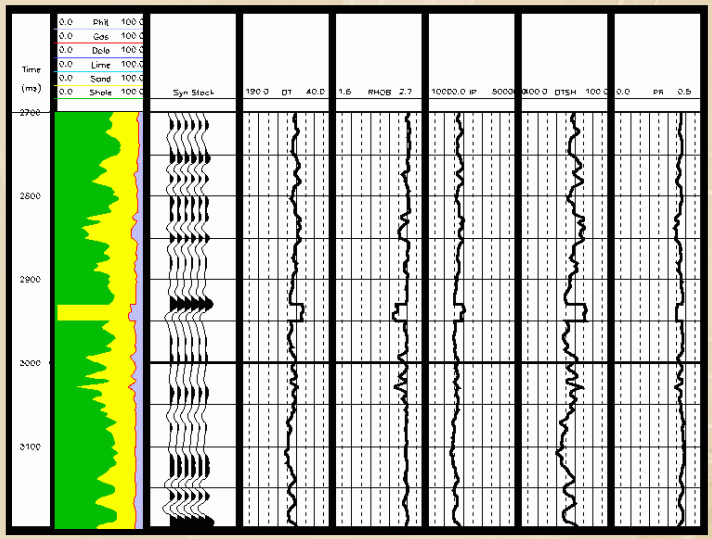


CDP 44

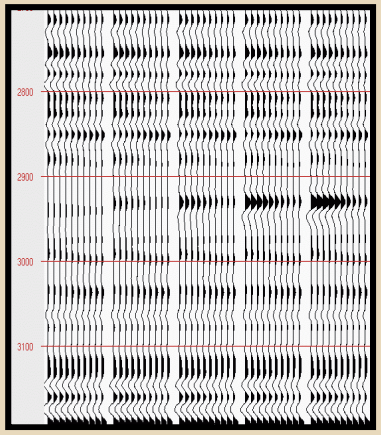


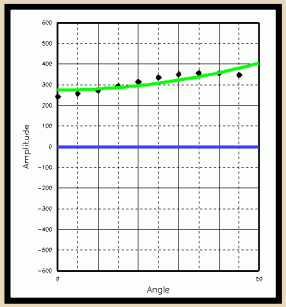
Rock Modeling Summary



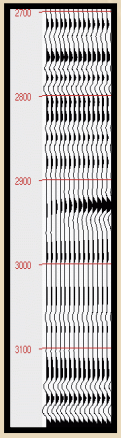


Gathers

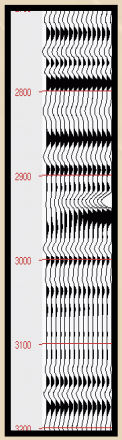


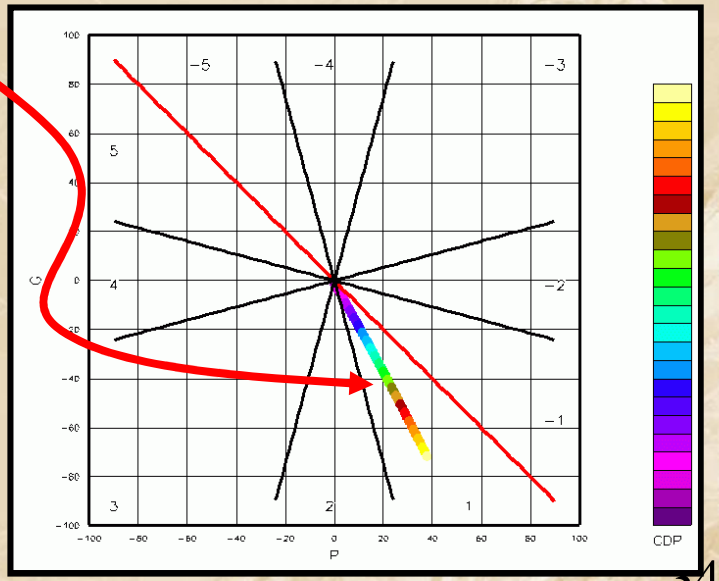


P



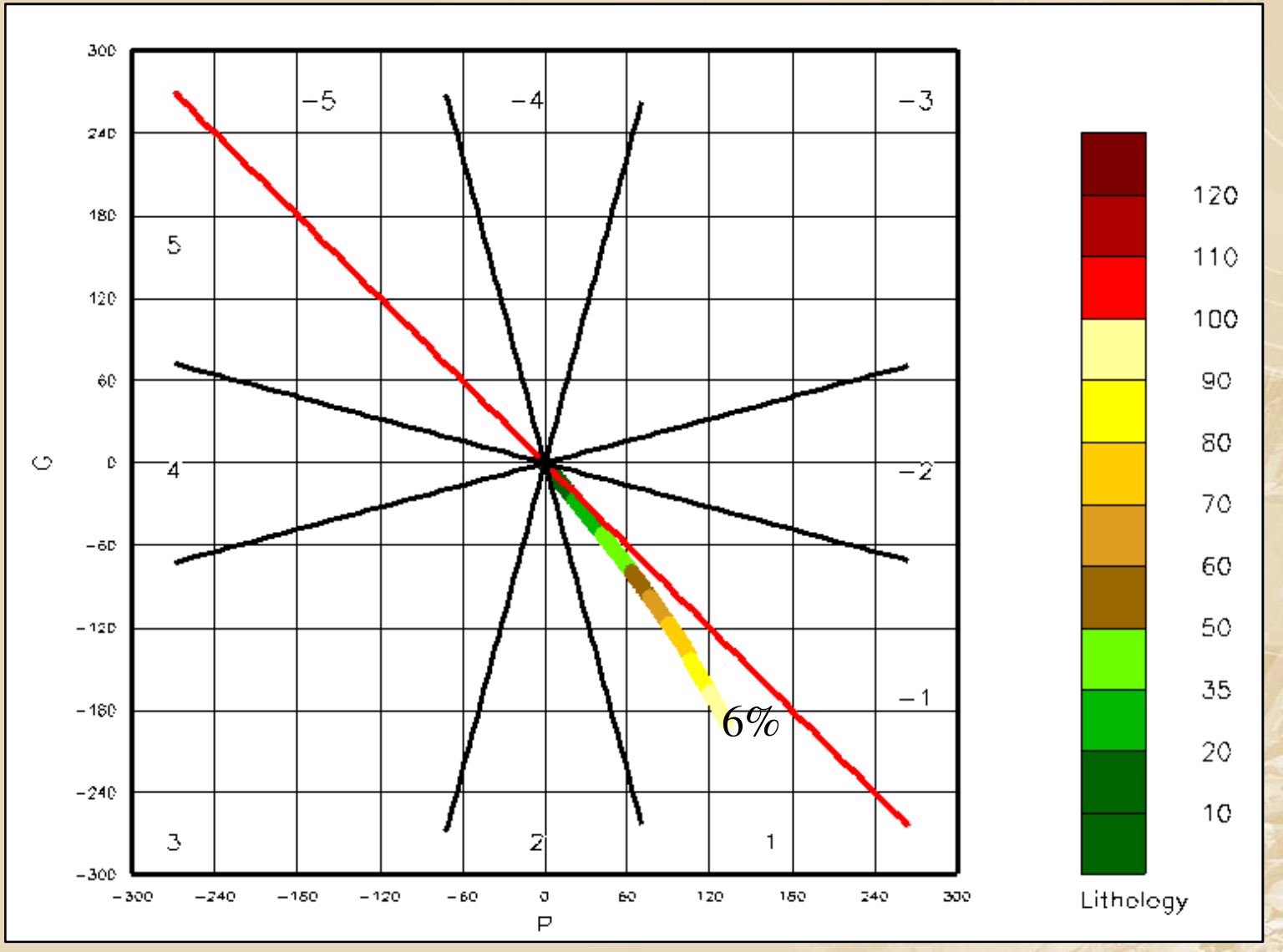
G



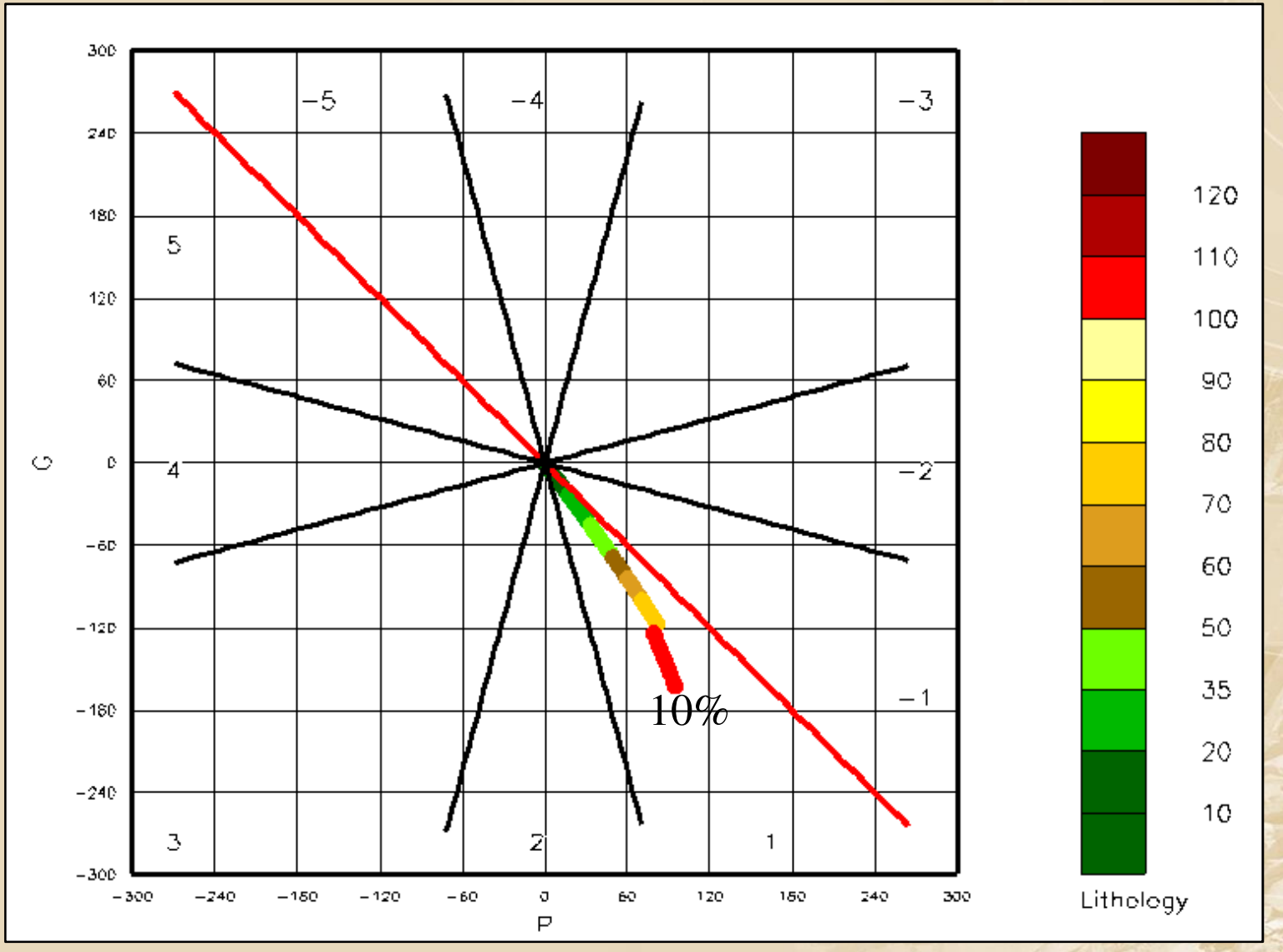


1000 Models

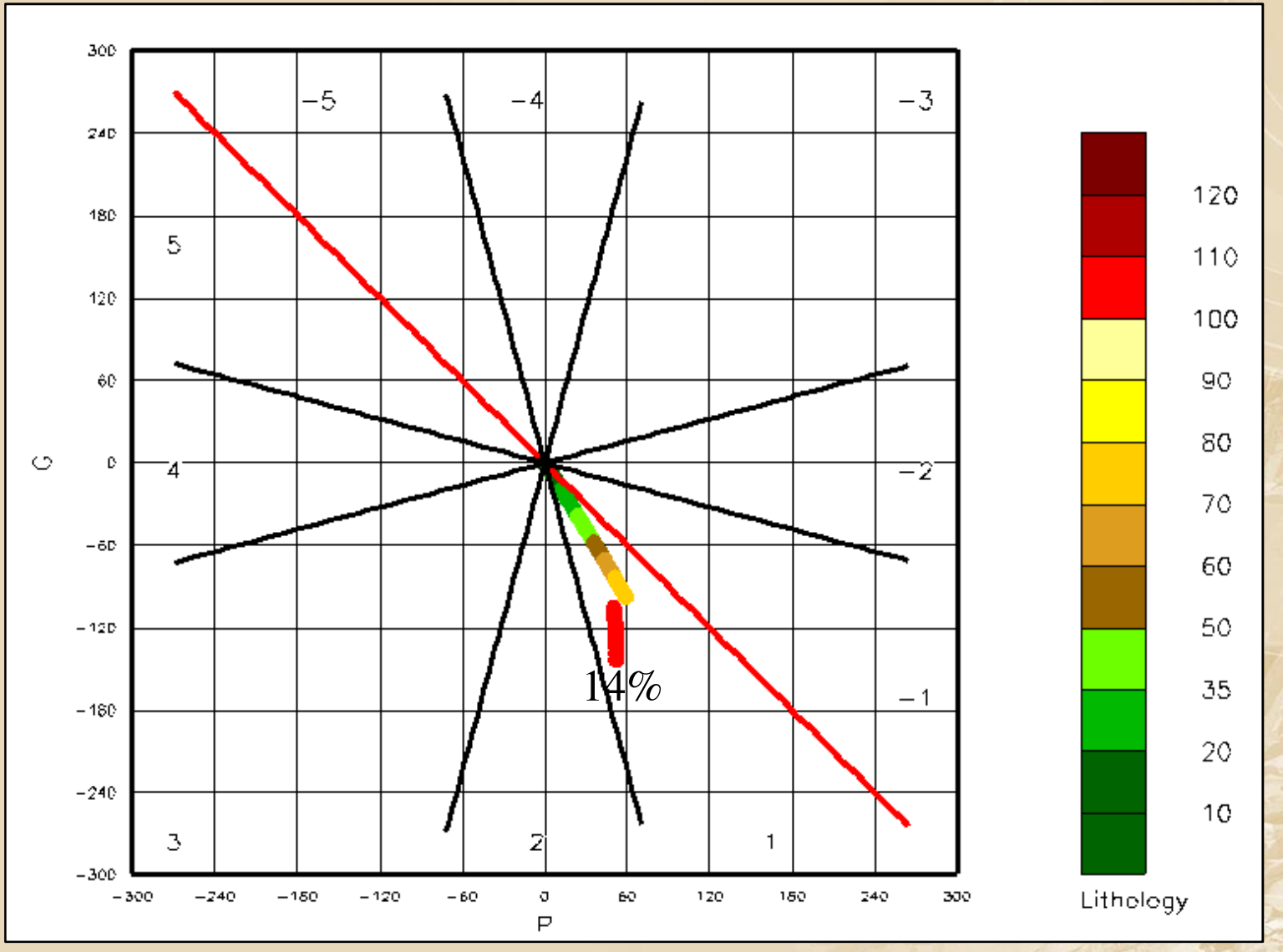
From Shale to a 6% Porosity Sand Wet, Gas



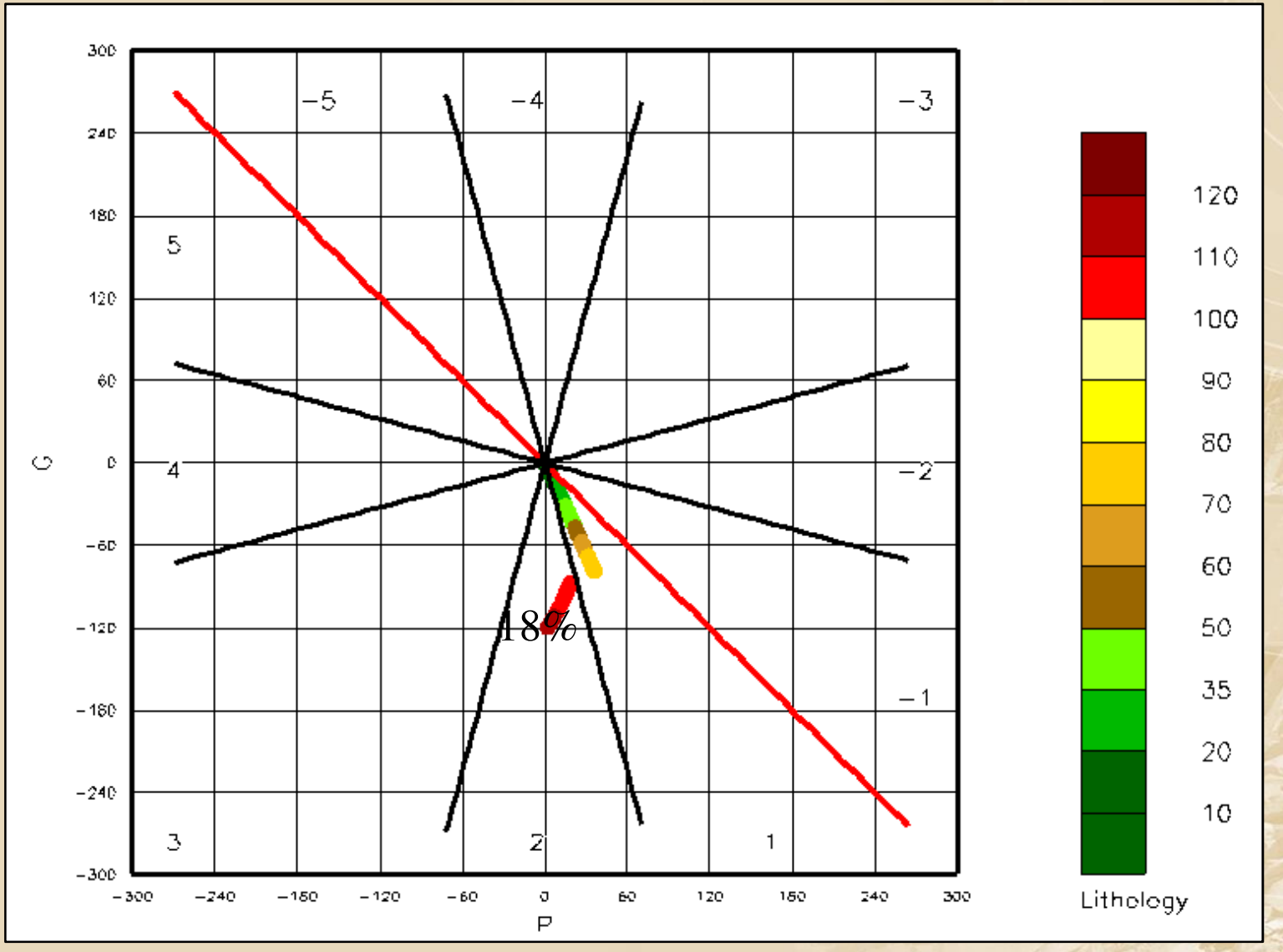
From Shale to a 10% Porosity Sand Wet, Gas



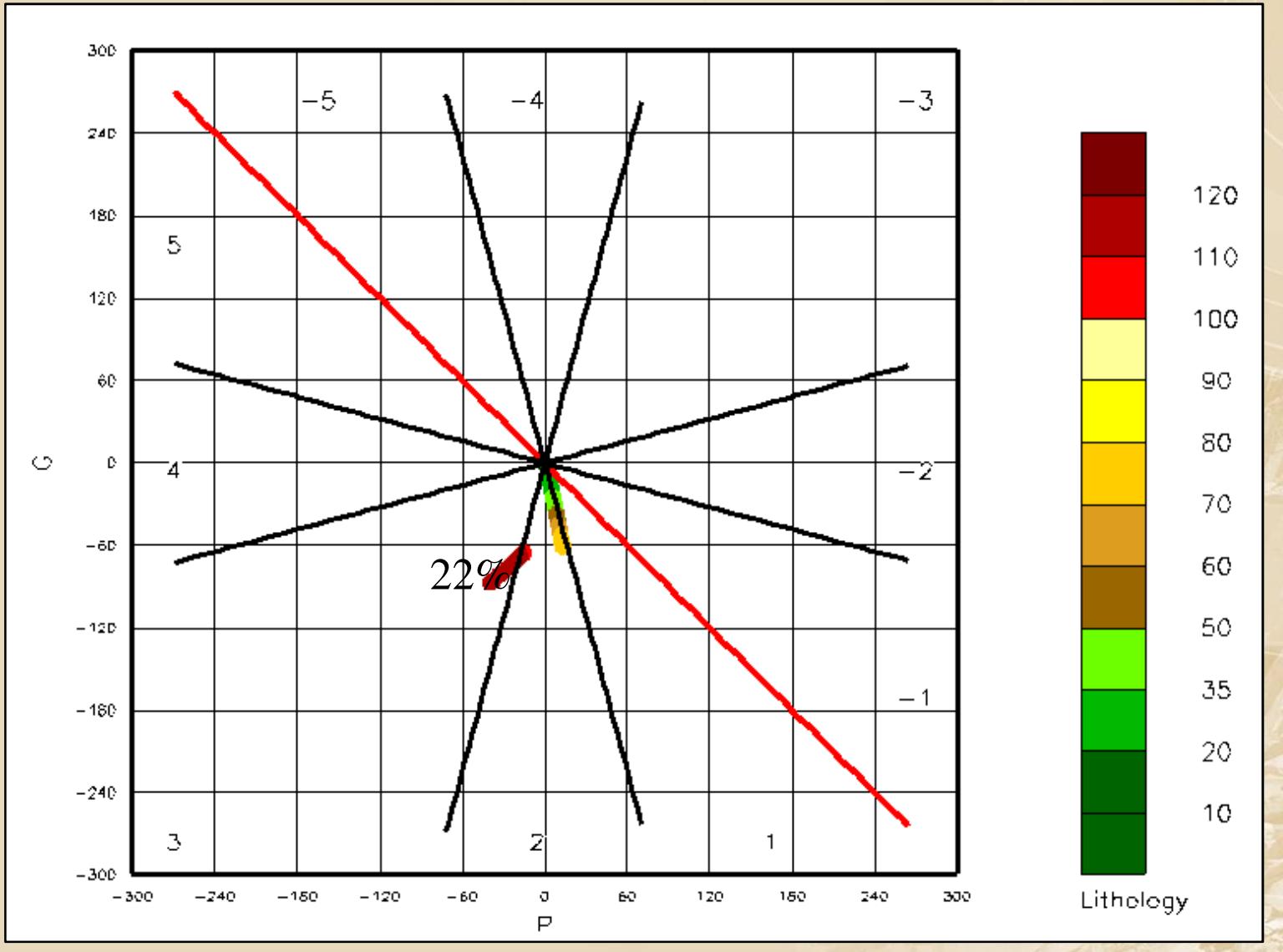
From Shale to a 14% Porosity Sand Wet, Gas



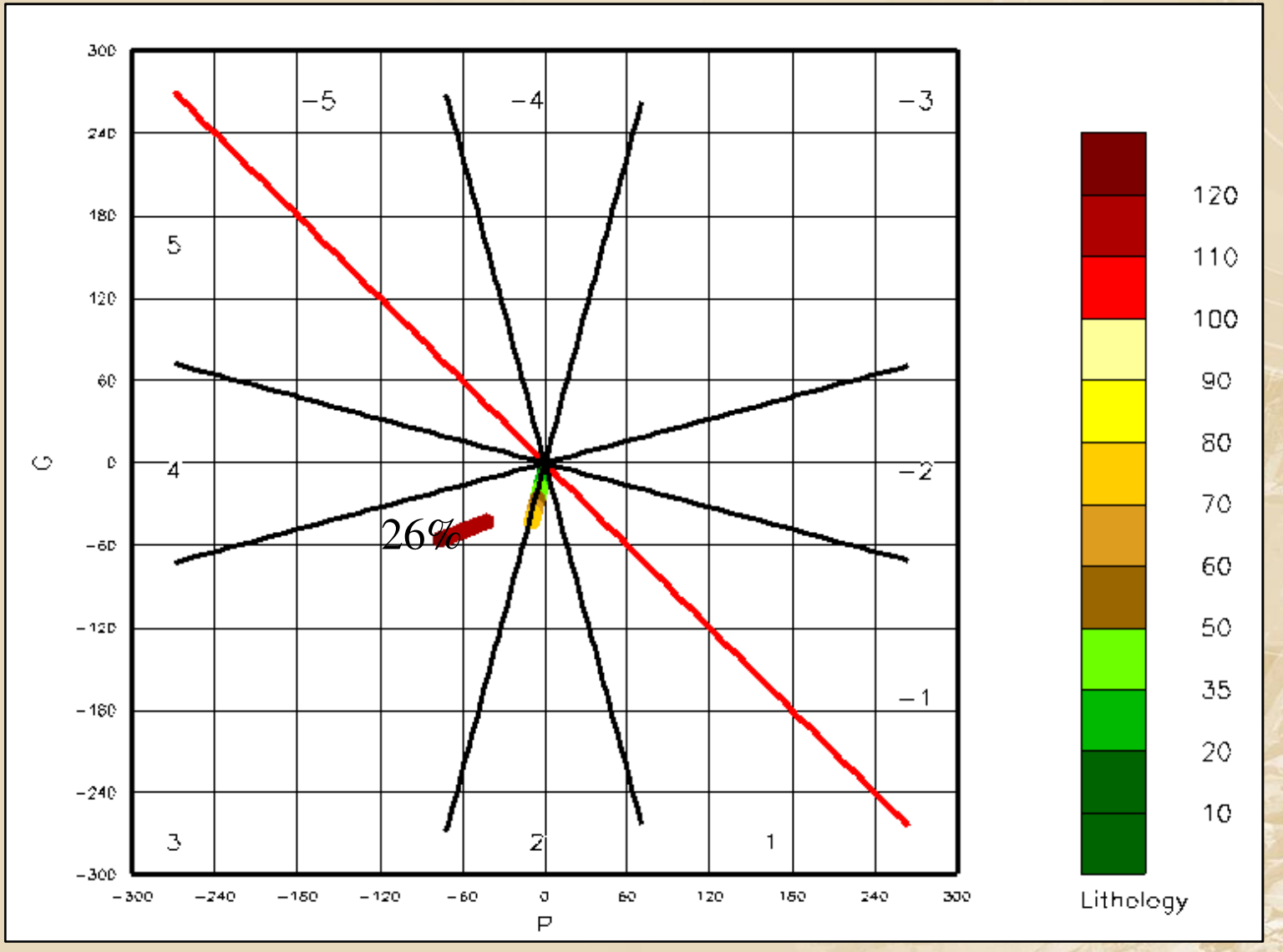
From Shale to a 18% Porosity Sand Wet, Gas



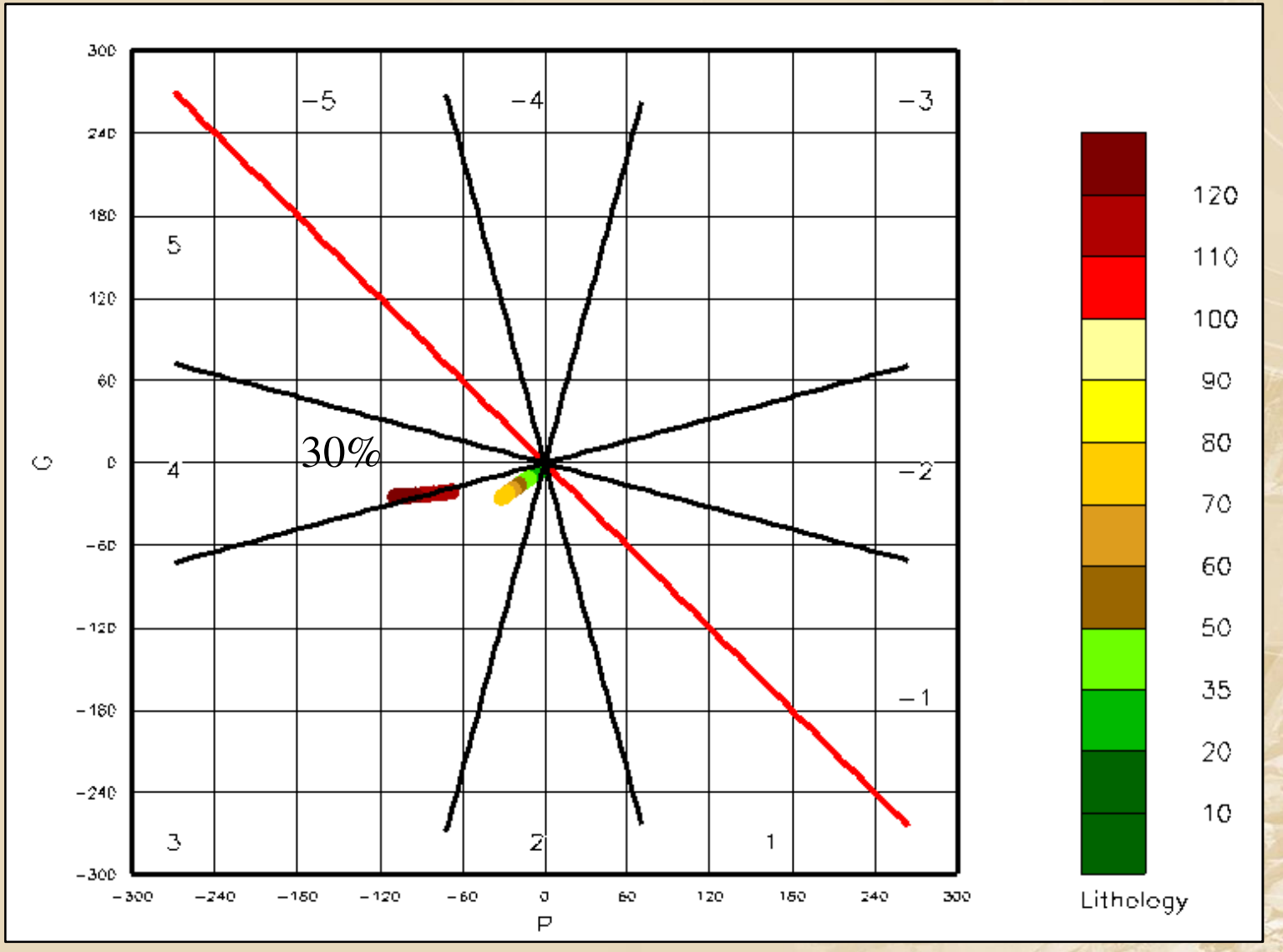
From Shale to a 22% Porosity Sand Wet, Gas



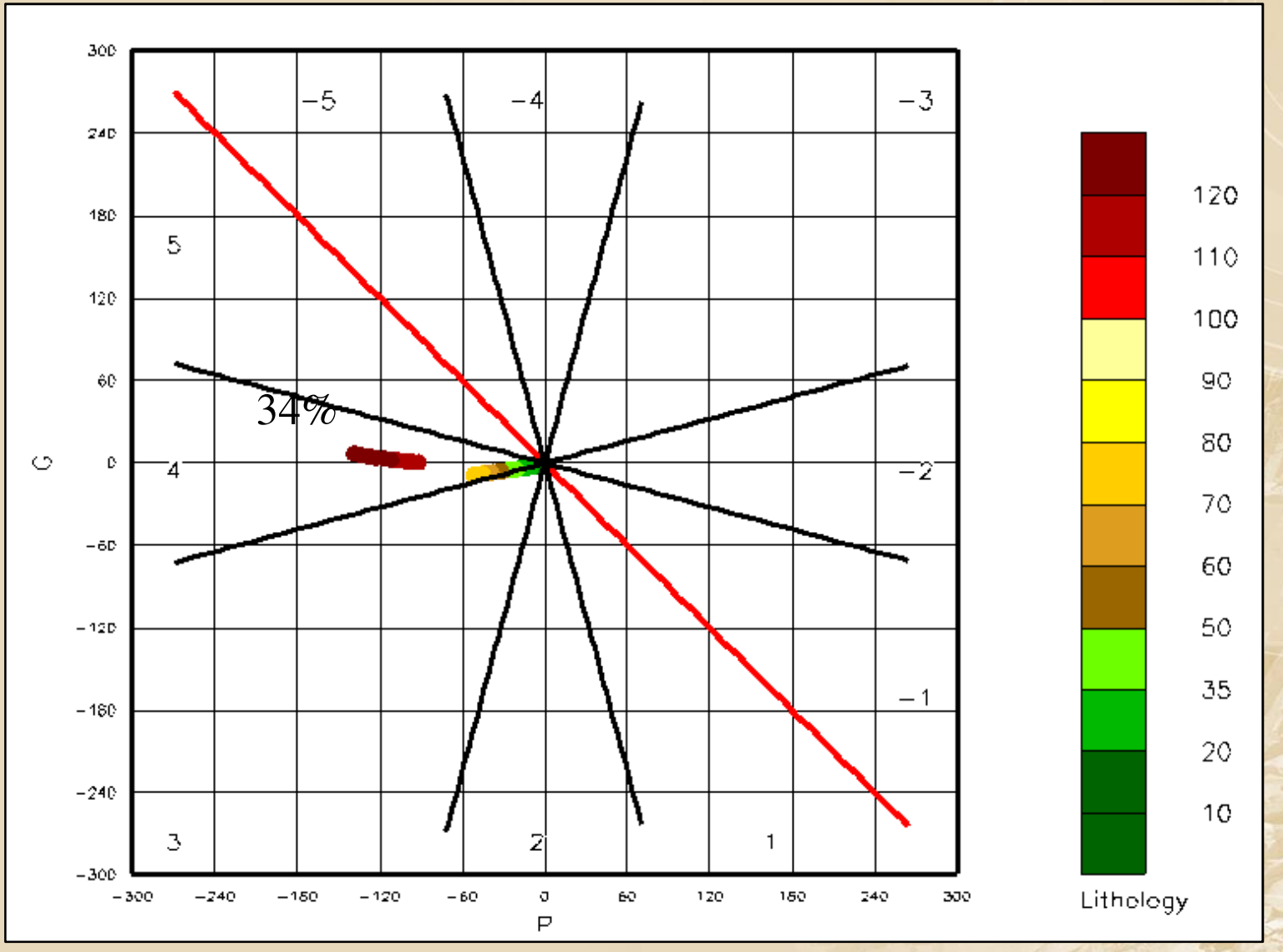
From Shale to a 26% Porosity Sand Wet, Gas



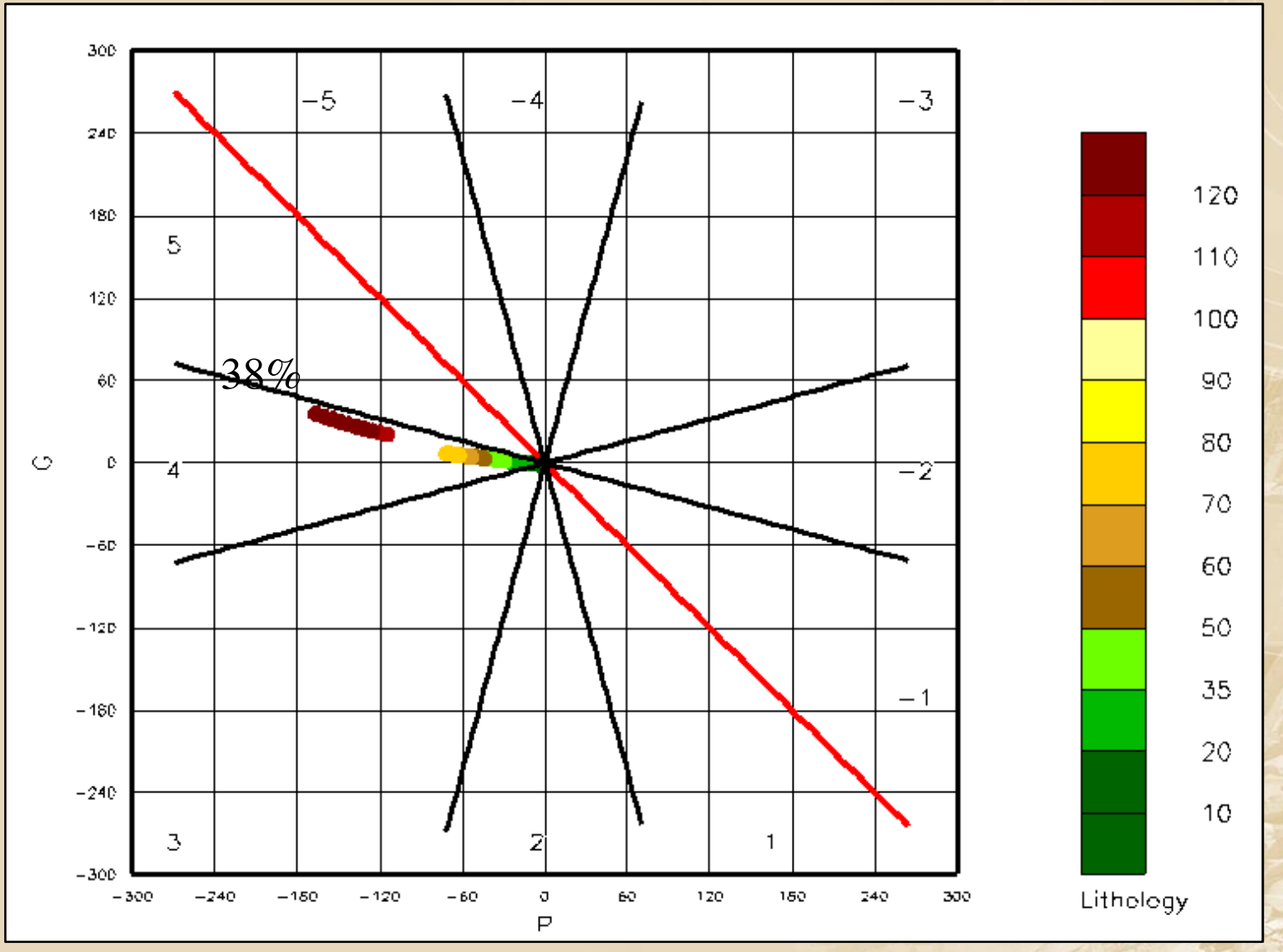
From Shale to a 30% Porosity Sand Wet, Gas



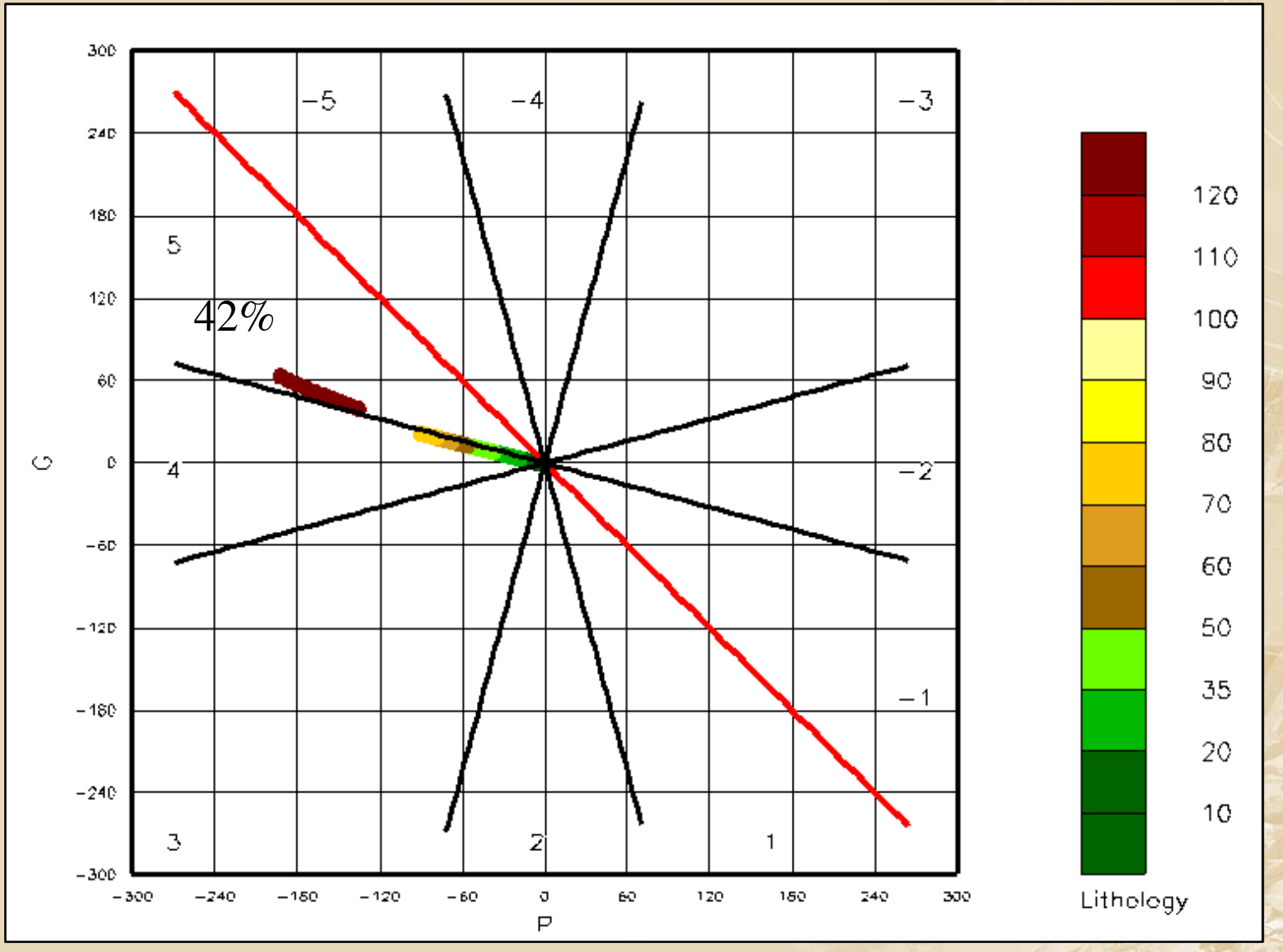
From Shale to a 34% Porosity Sand Wet, Gas



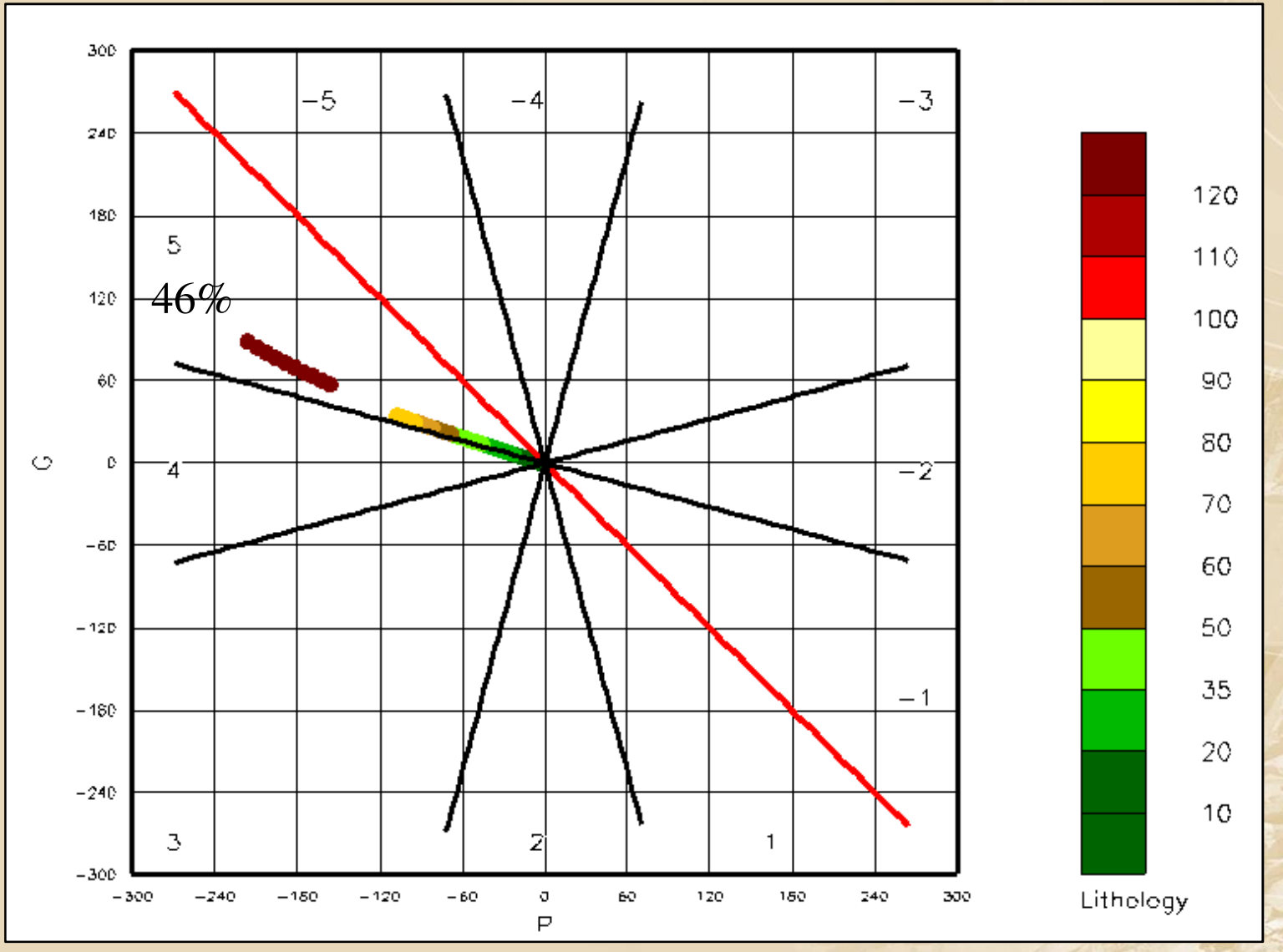
From Shale to a 38% Porosity Sand Wet, Gas



From Shale to a 42% Porosity Sand Wet, Gas

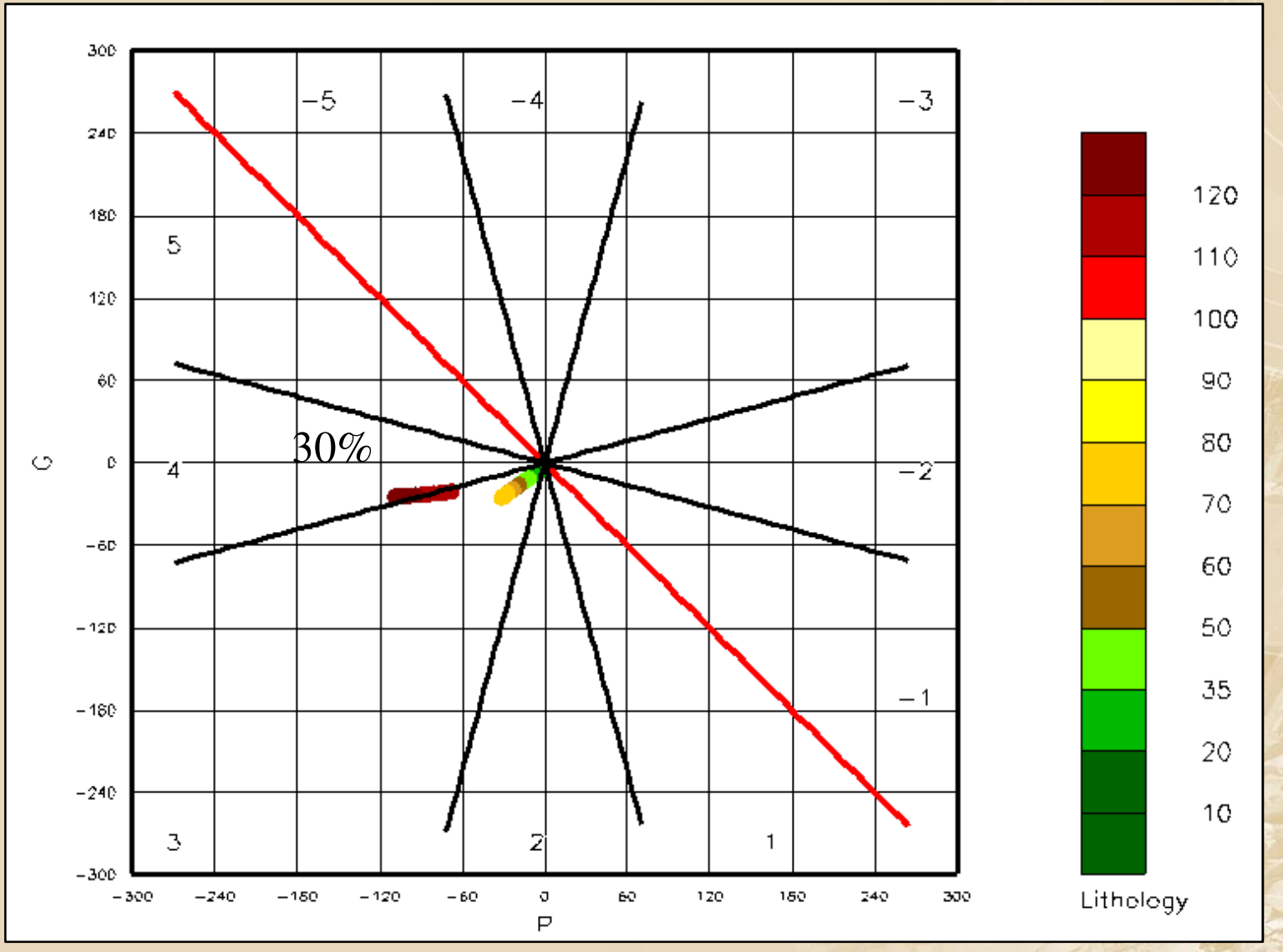


From Shale to a 46% Porosity Sand Wet, Gas

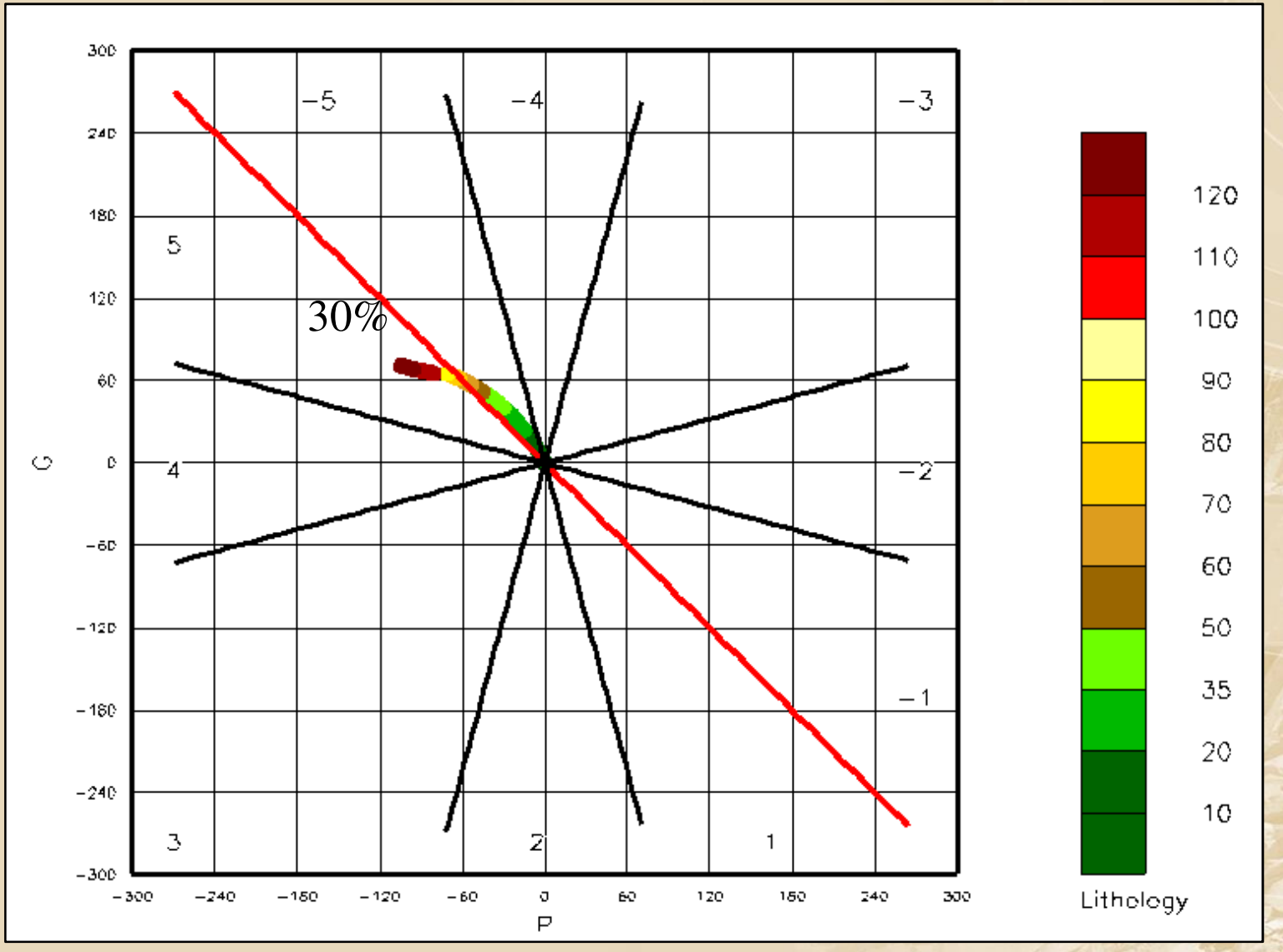


Laminated Sands

From Shale to a 30% Porosity Sand Wet, Gas

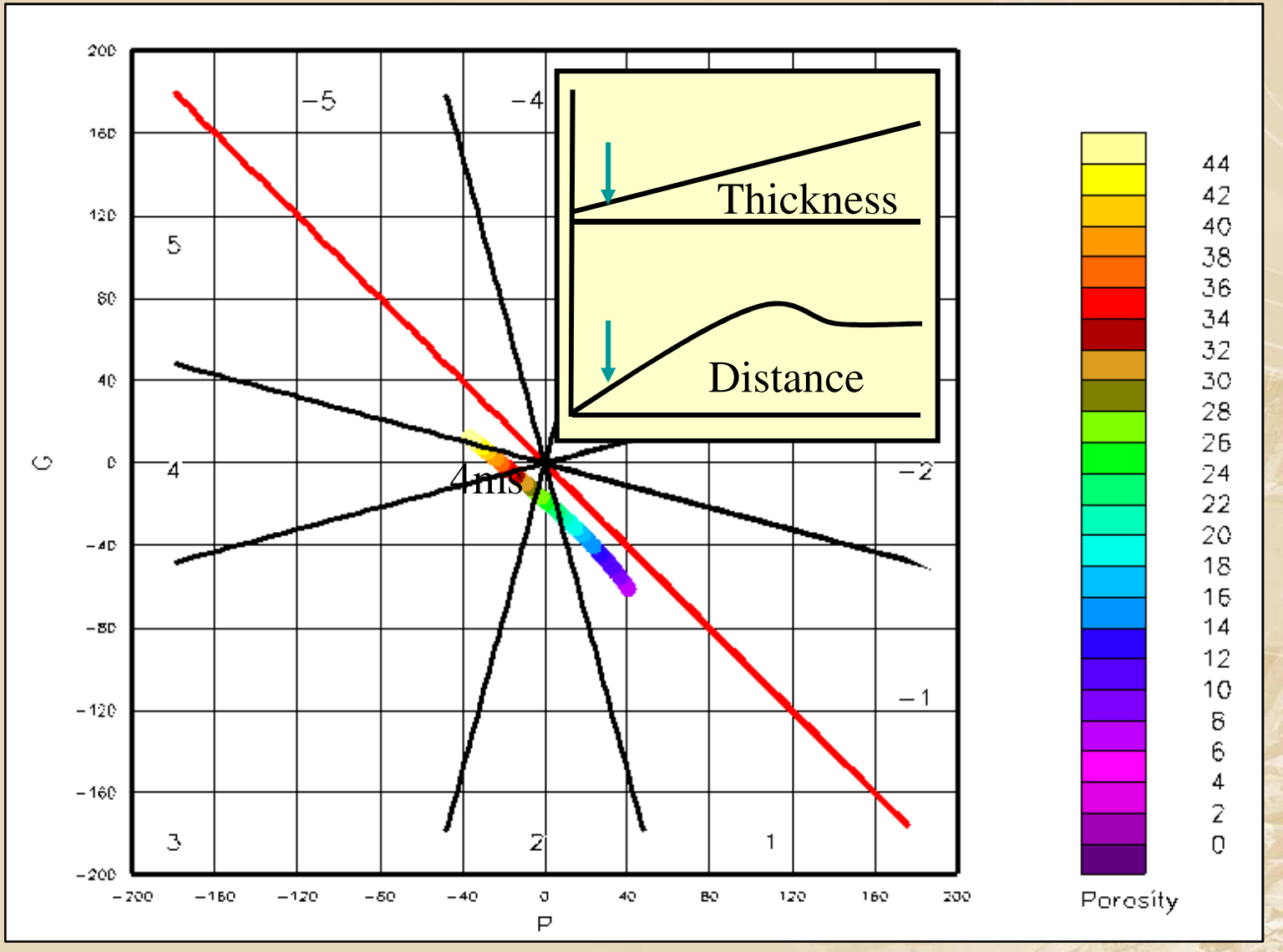


From Shale to a 30% Porosity,Laminated Sand Wet, Gas

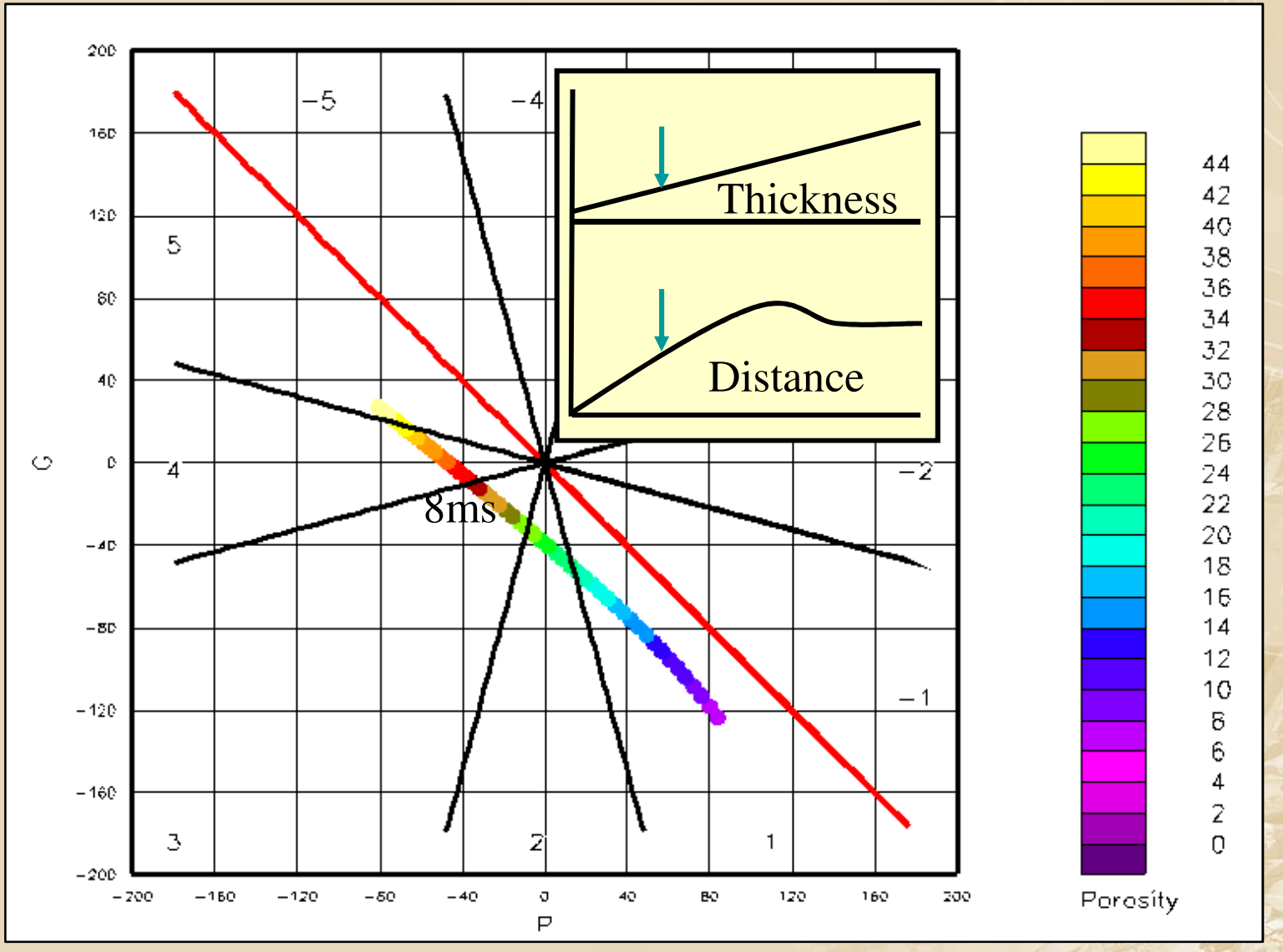


Thickness

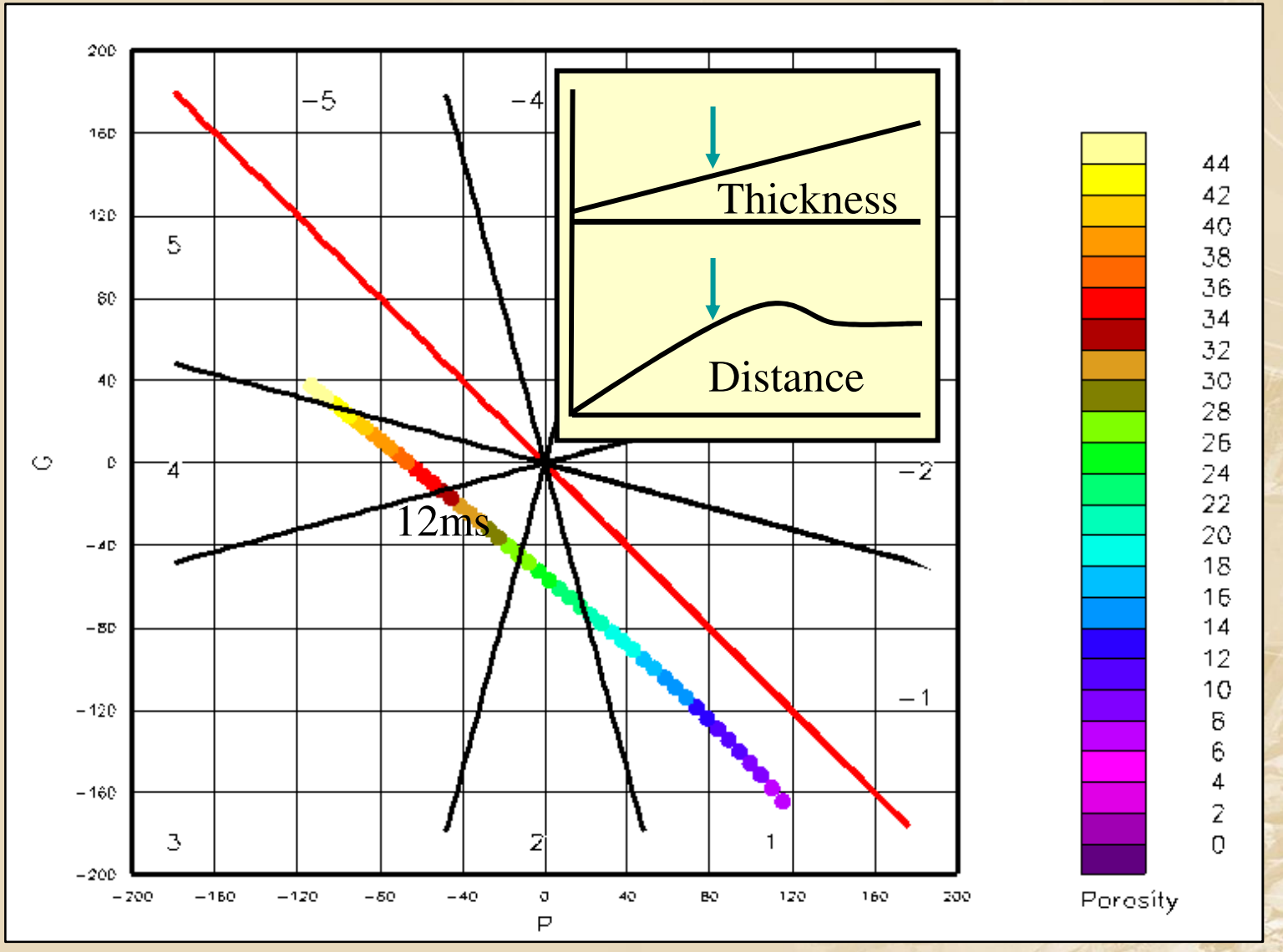
Sand with Porosity from 0 to 46% 4ms Thick



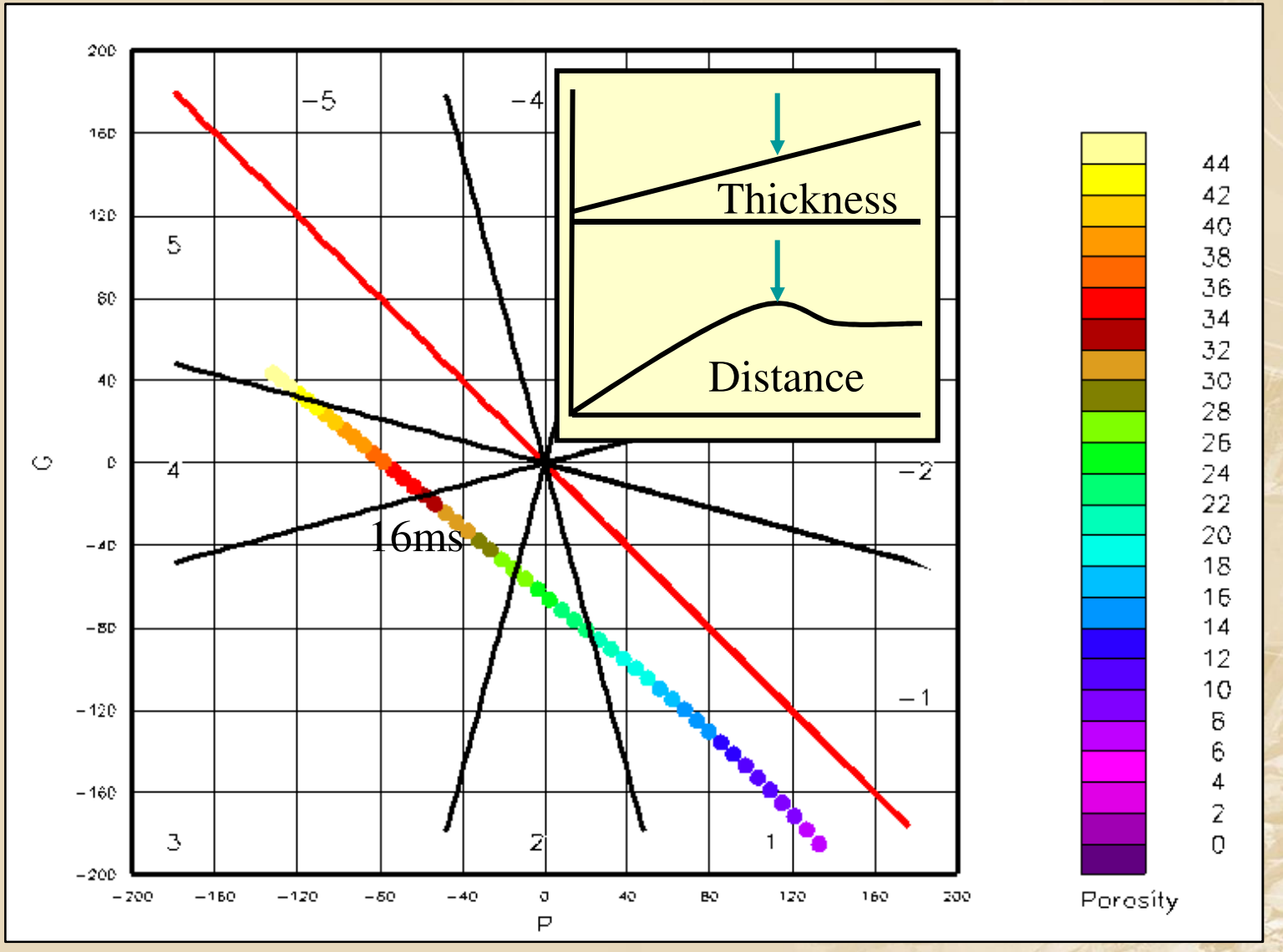
Sand with Porosity from 0 to 46% 8ms Thick



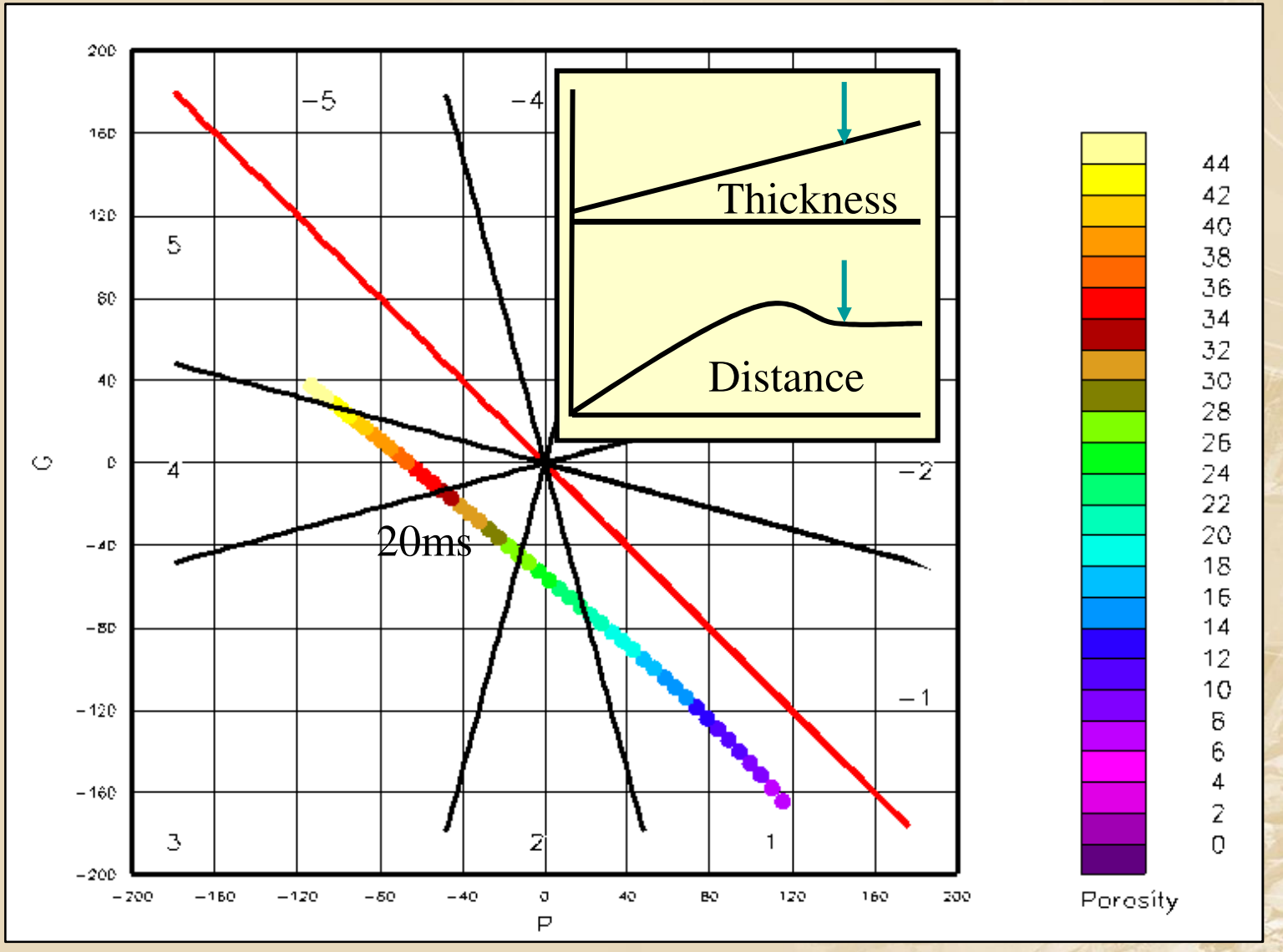
Sand with Porosity from 0 to 46% 12ms Thick



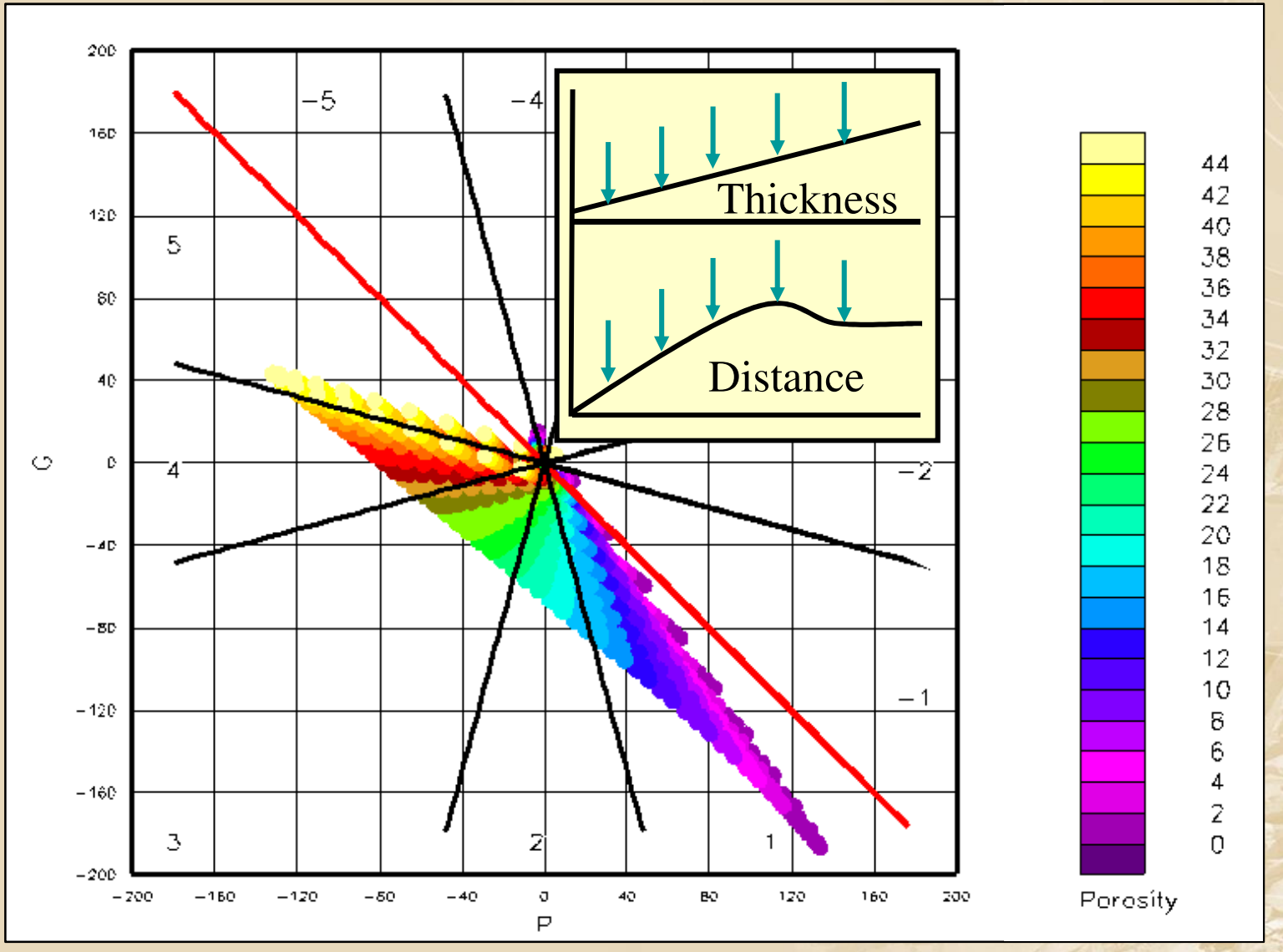
Sand with Porosity from 0 to 46% 16ms Thick



Sand with Porosity from 0 to 46% 20ms Thick



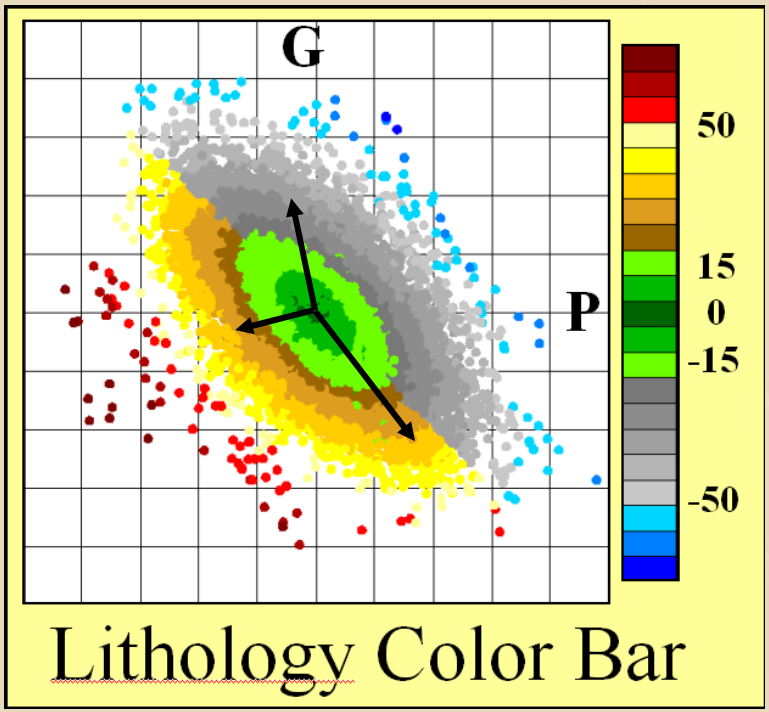
Sand with Porosity from 0 to 46% All Thicknesses



Results of:
1000's Models
100's data Sets

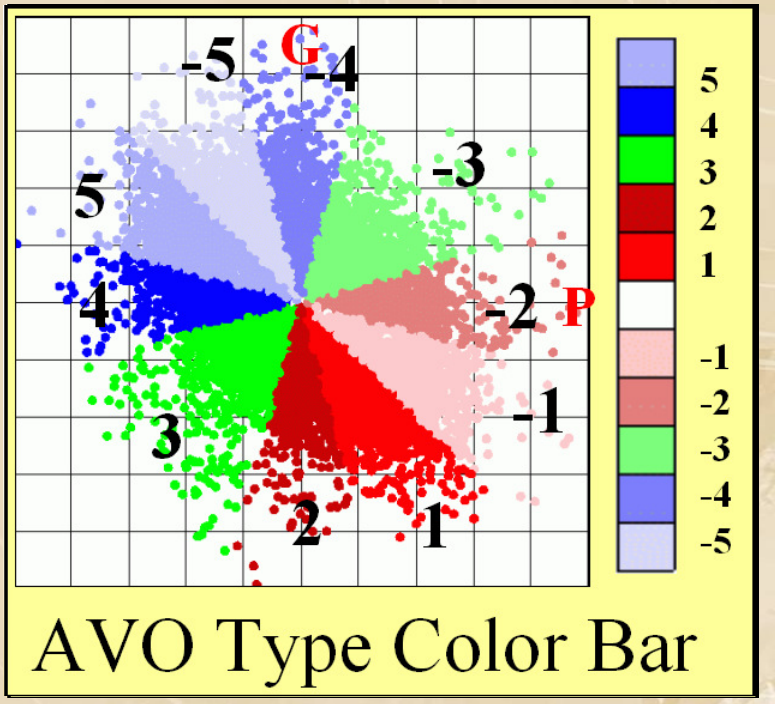
Rocks vs. Distance & Direction

Elliptical Distance

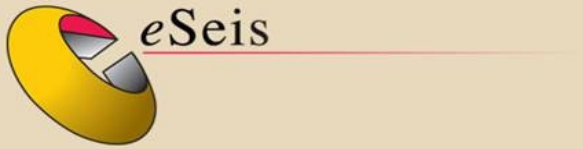


Function of?
Lithology
Fluids
Thickness

Direction

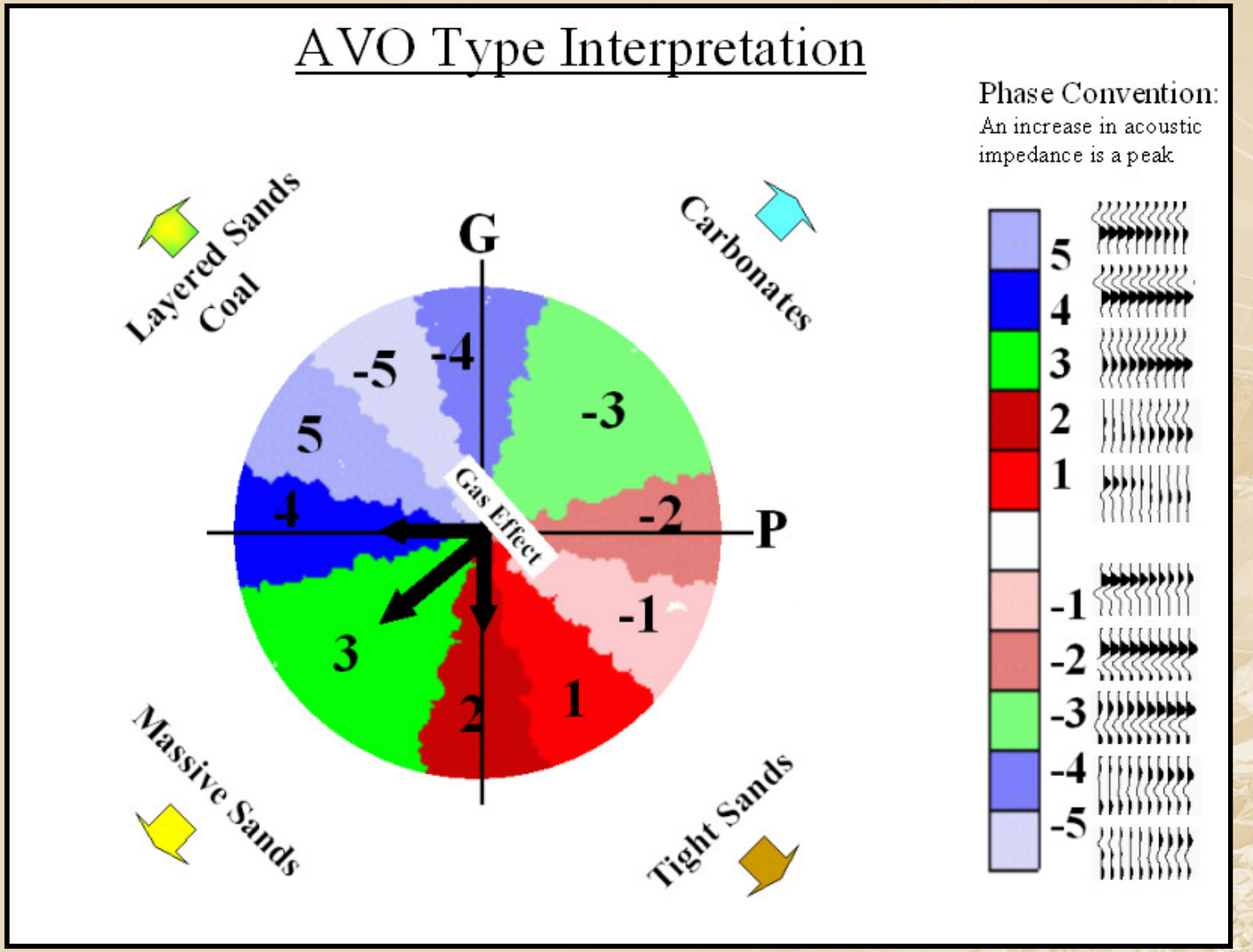


Function of?
Porosity
Blocky or Laminated
Infers Depositional Facies



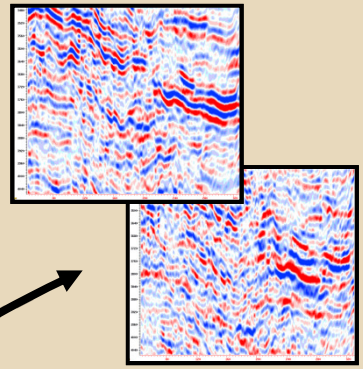
How does this fit with reality?

AVO Type Tendencies



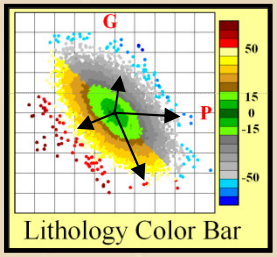
Seismic Petrophysical Workflow

P Section

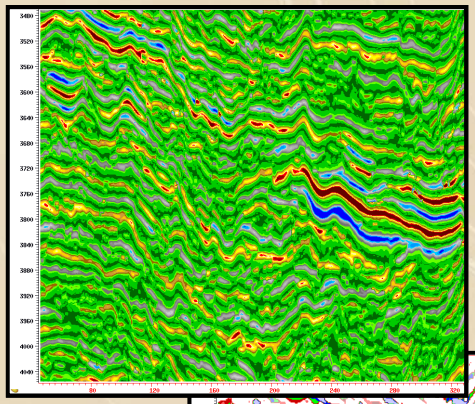


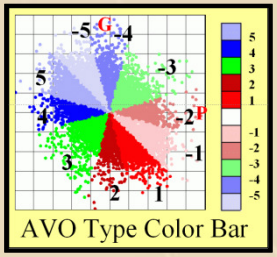
G Section

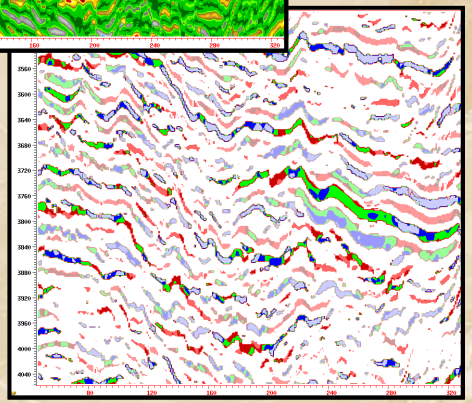
P vs. G



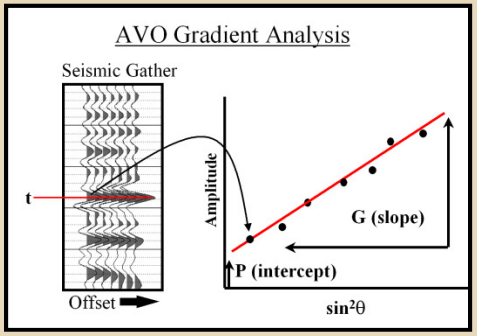
Lithology Section

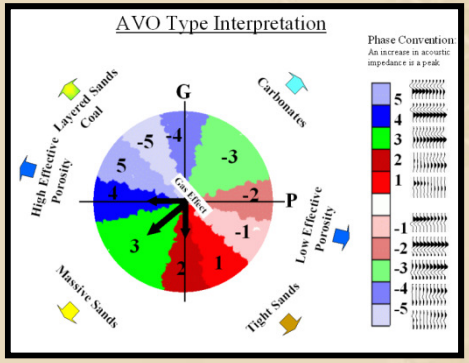






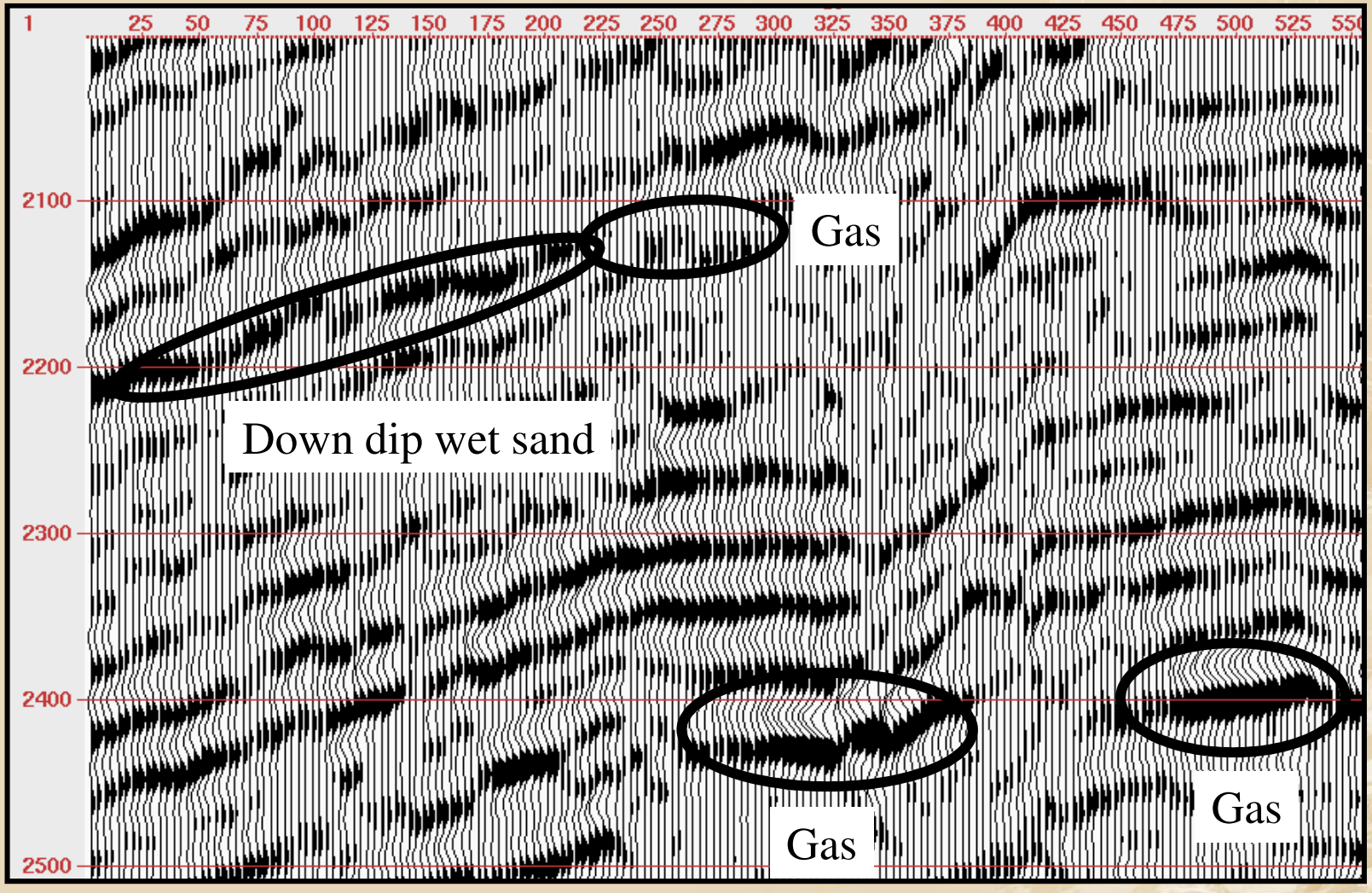
AVO Types Section





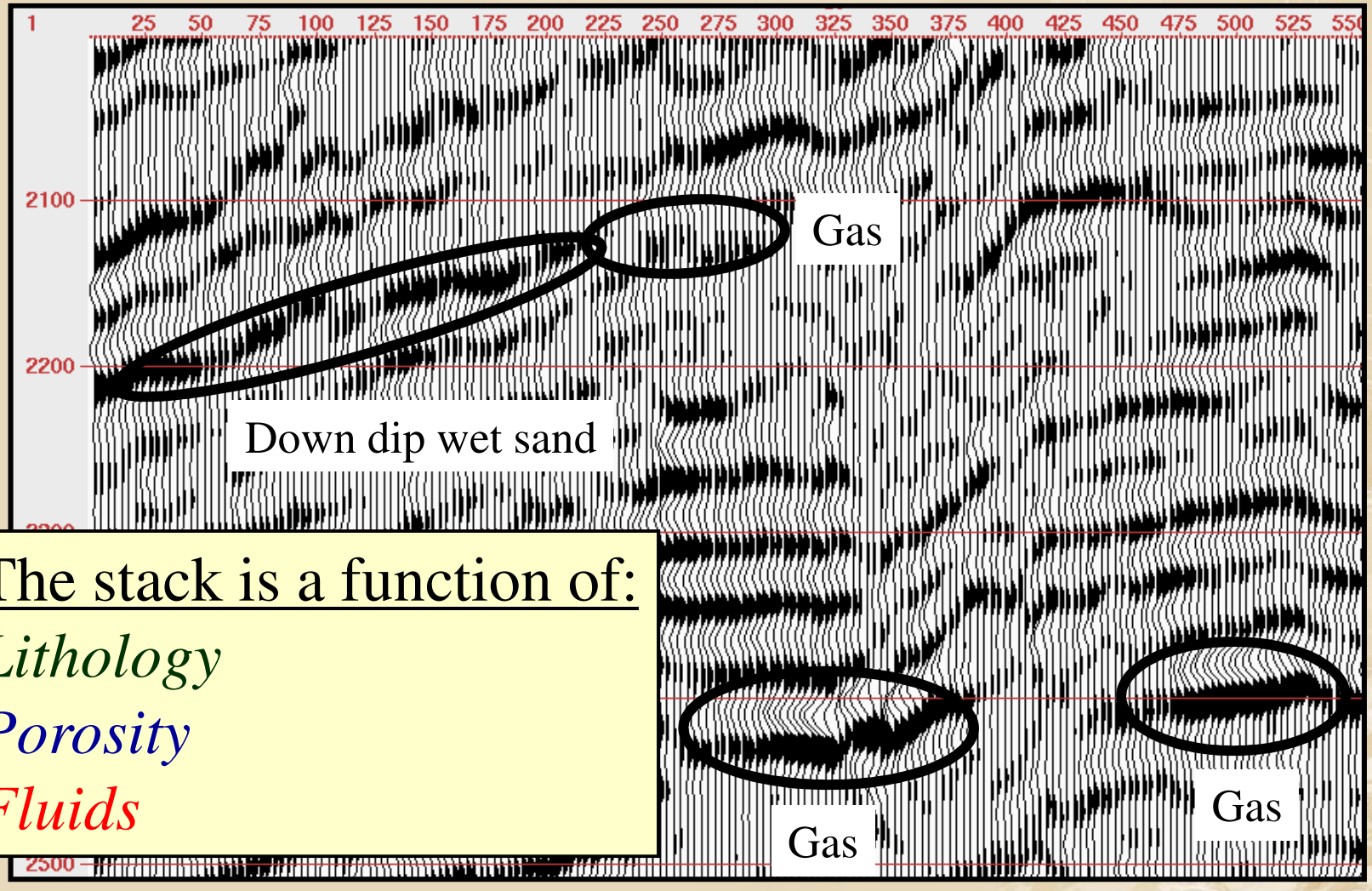
Where is the Gas?

Pre-stack Time Migrated Stack



Where is the Gas?

Pre-stack Time Migrated Stack



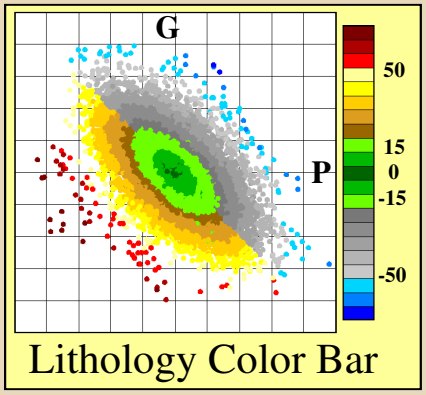
The stack is a function of:

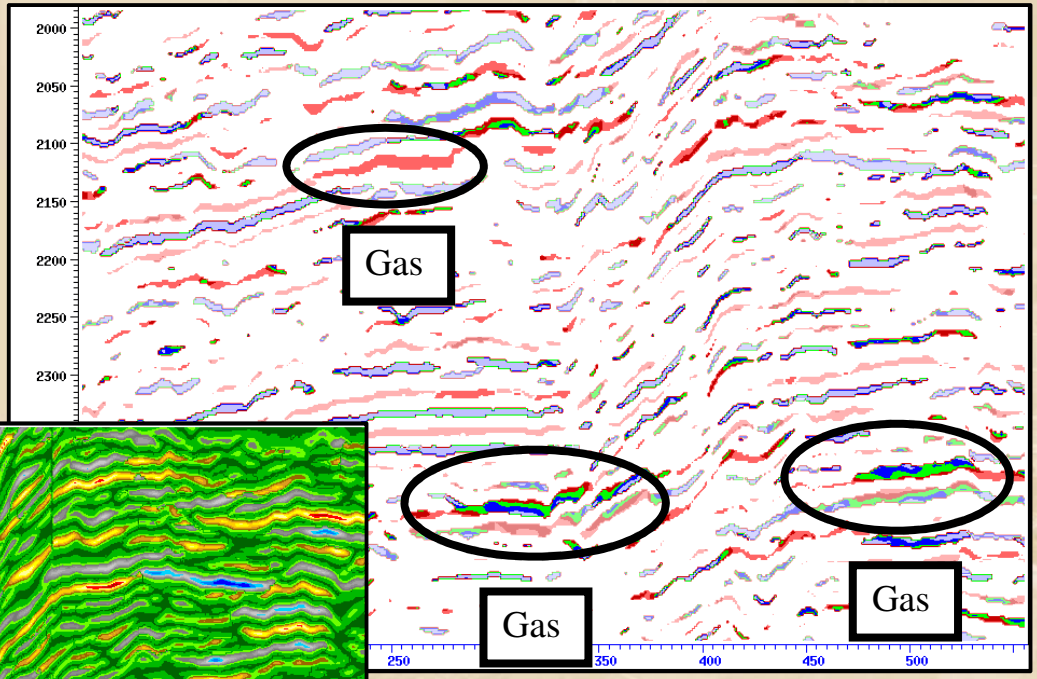
Lithology

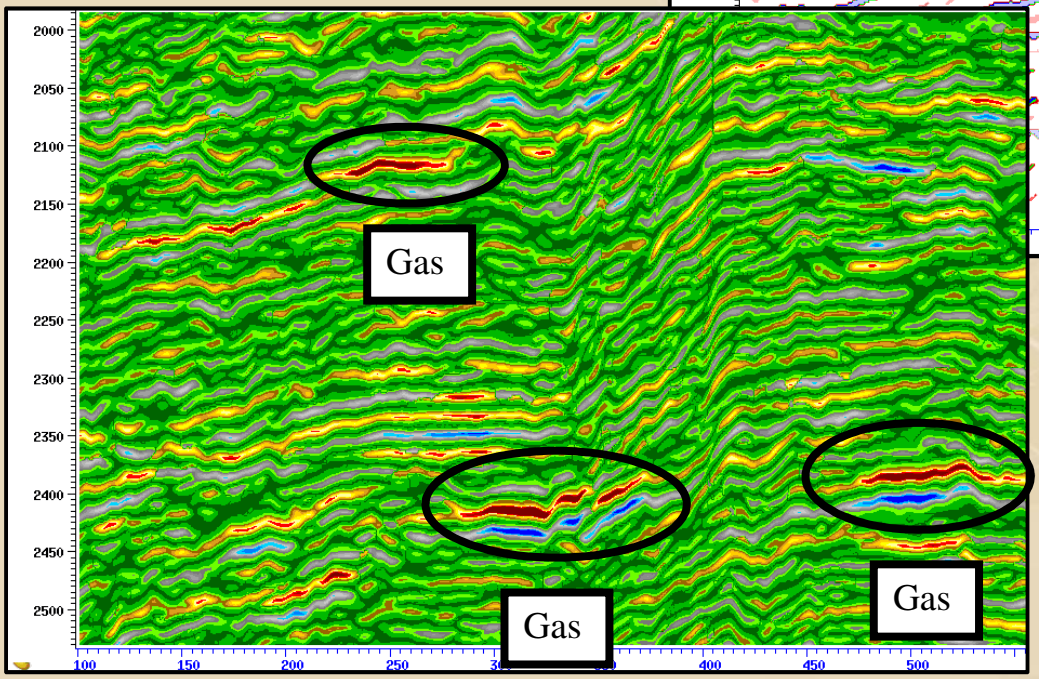
Porosity

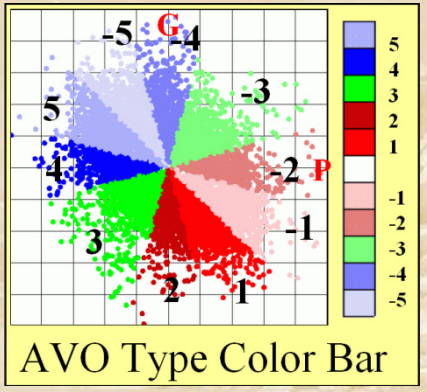
Fluids

Seismic Lithology/AVO Response





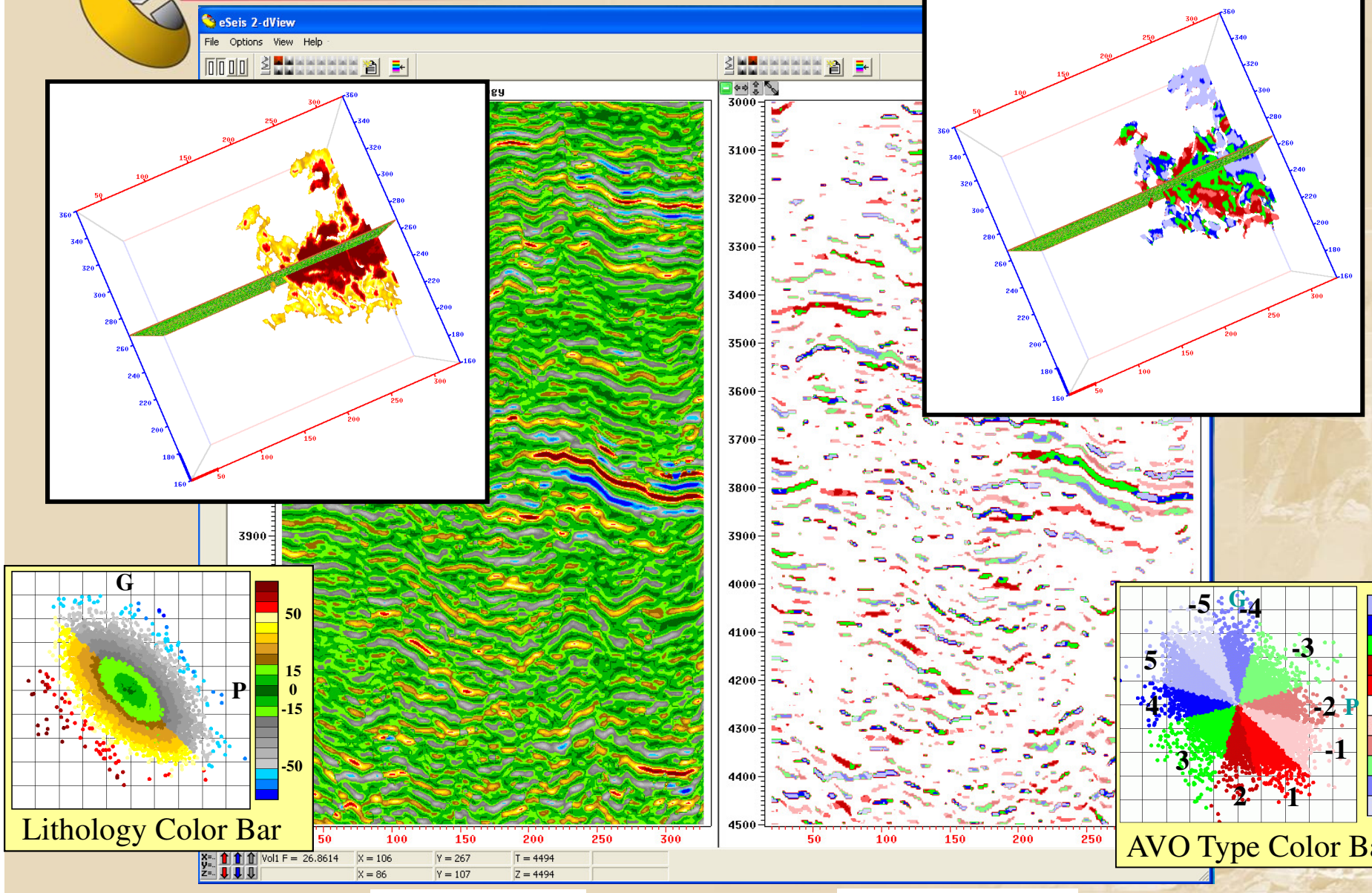




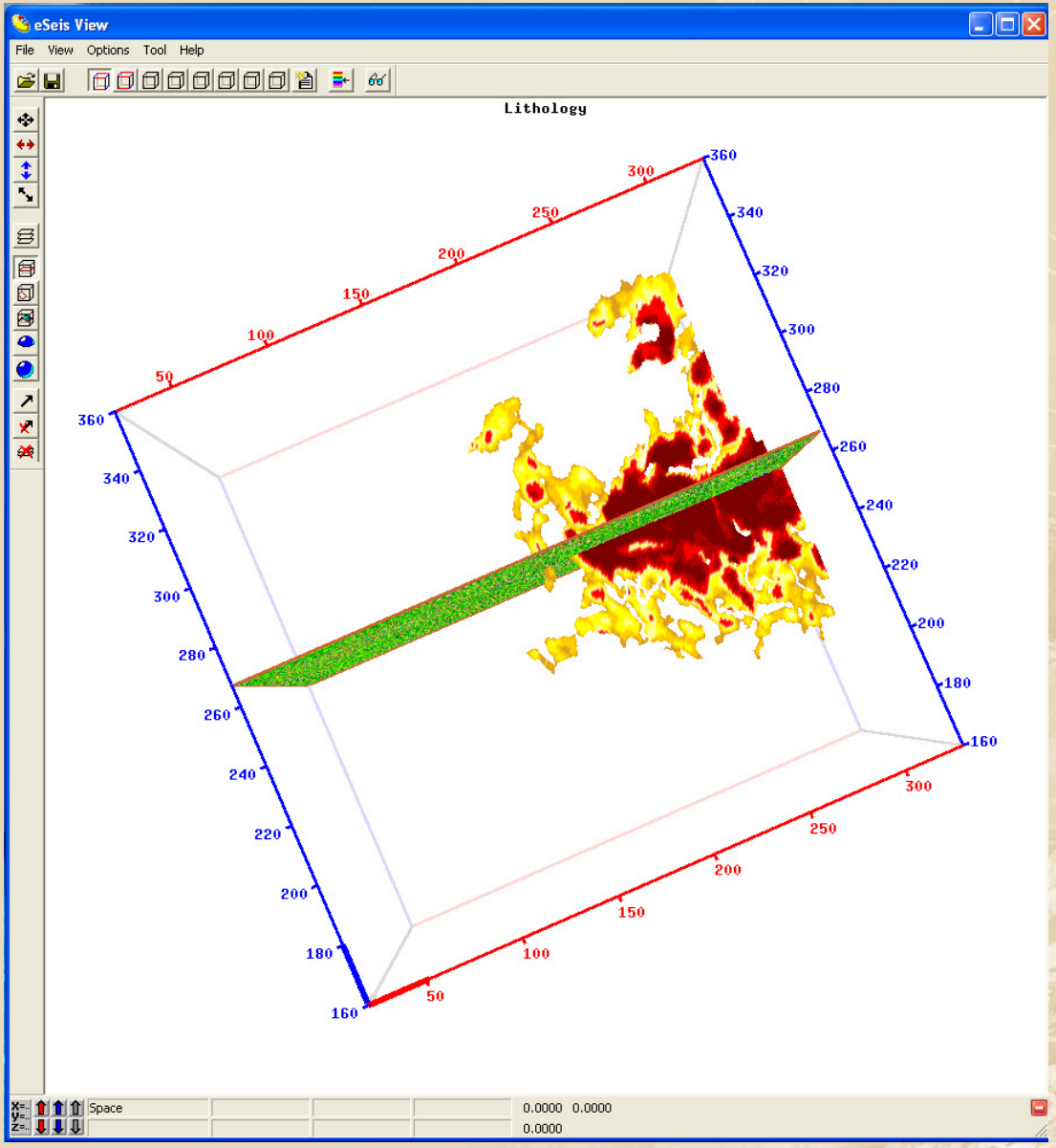
Examples

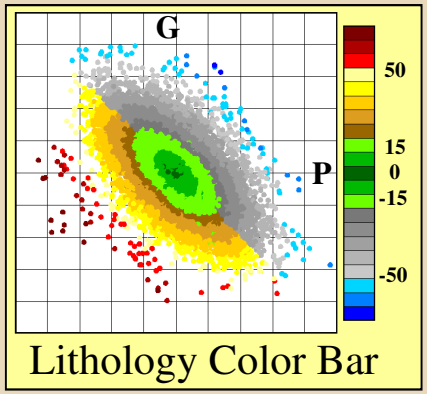
Depositional Facies

Lithology/Fluid and AVO Types

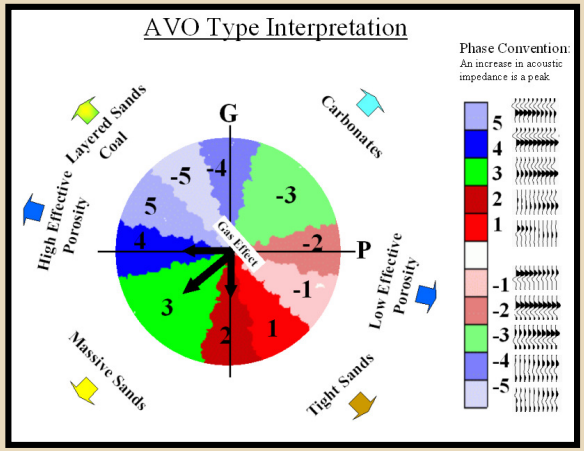


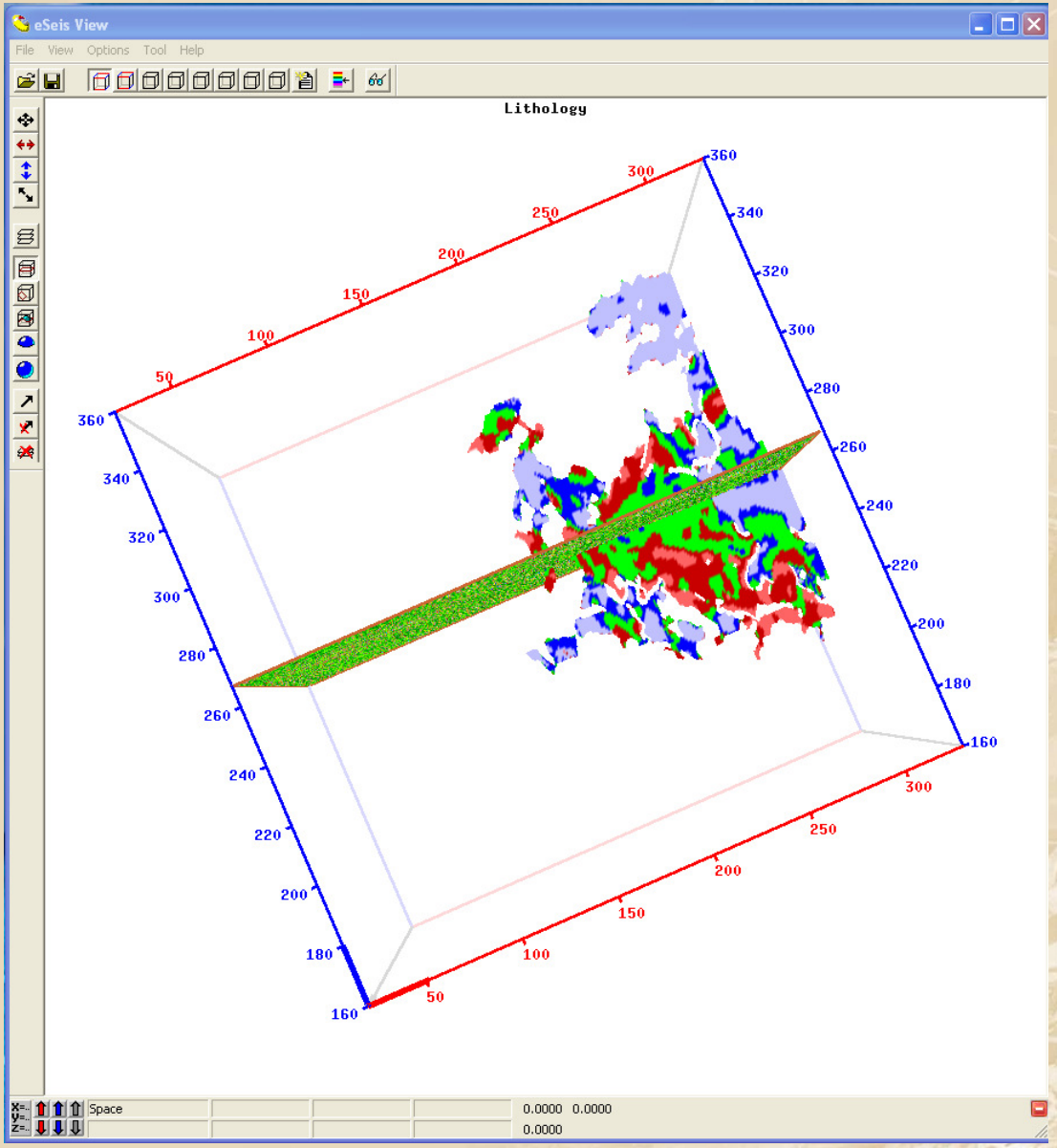
Lithology/Fluid Response, Surface



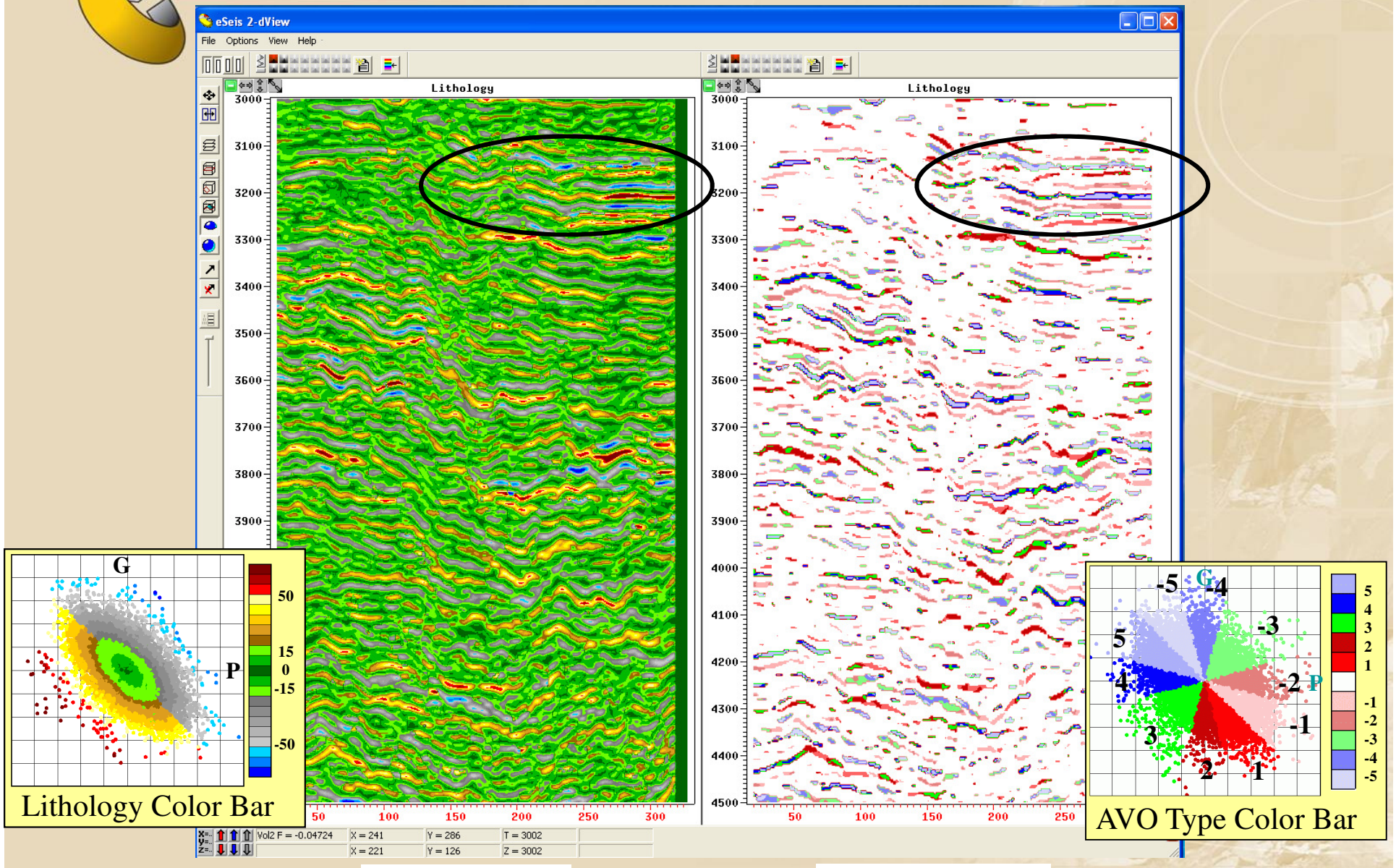


AVO Type Response, Surface





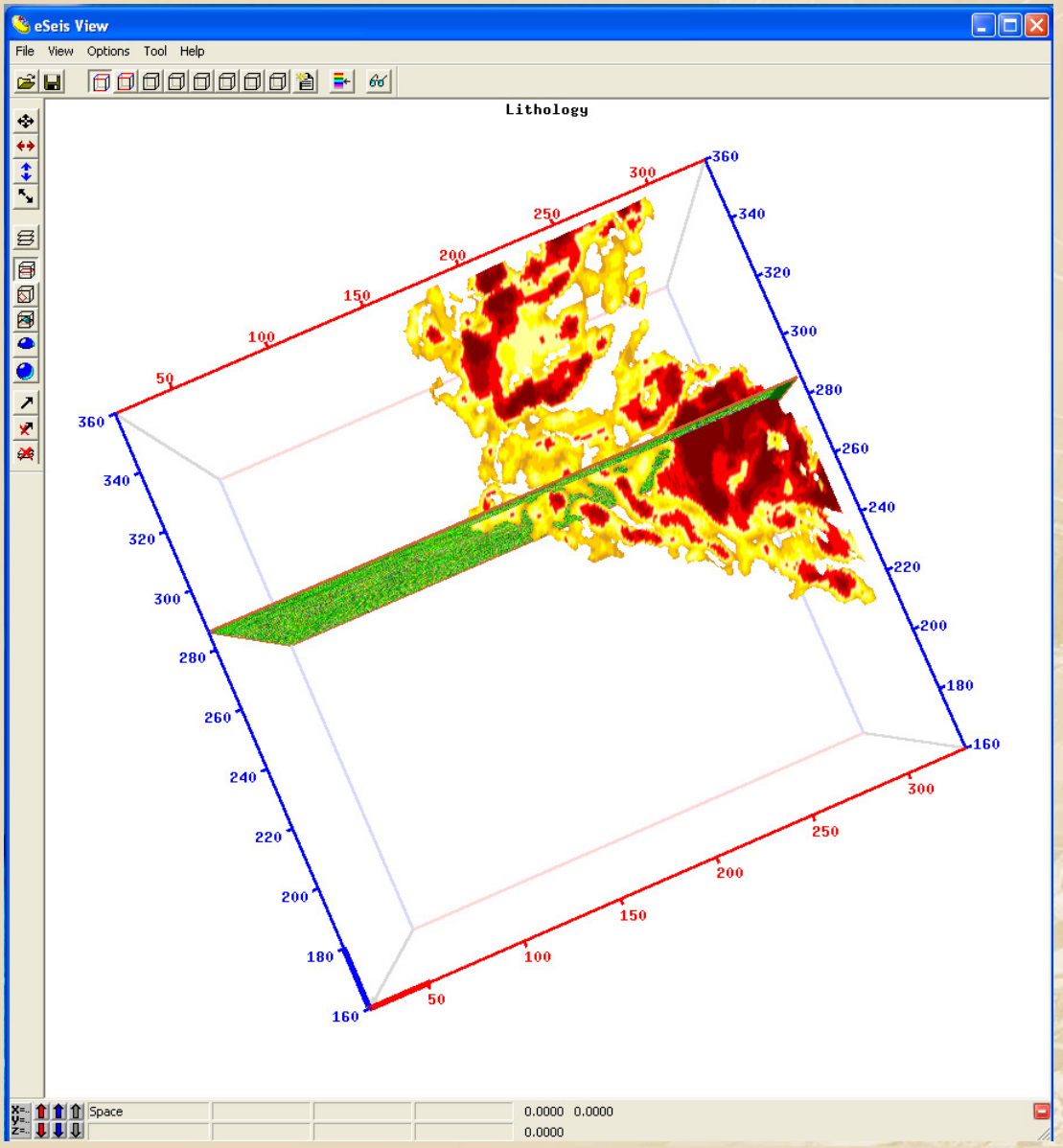
LithSeis Data, Section Views

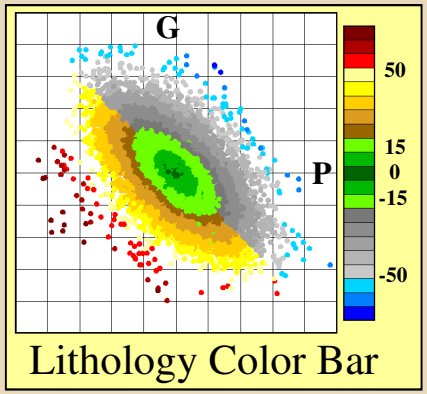


Lithology

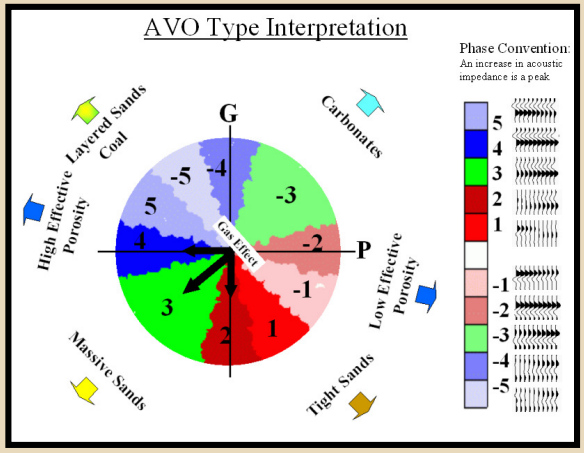
AVO Type

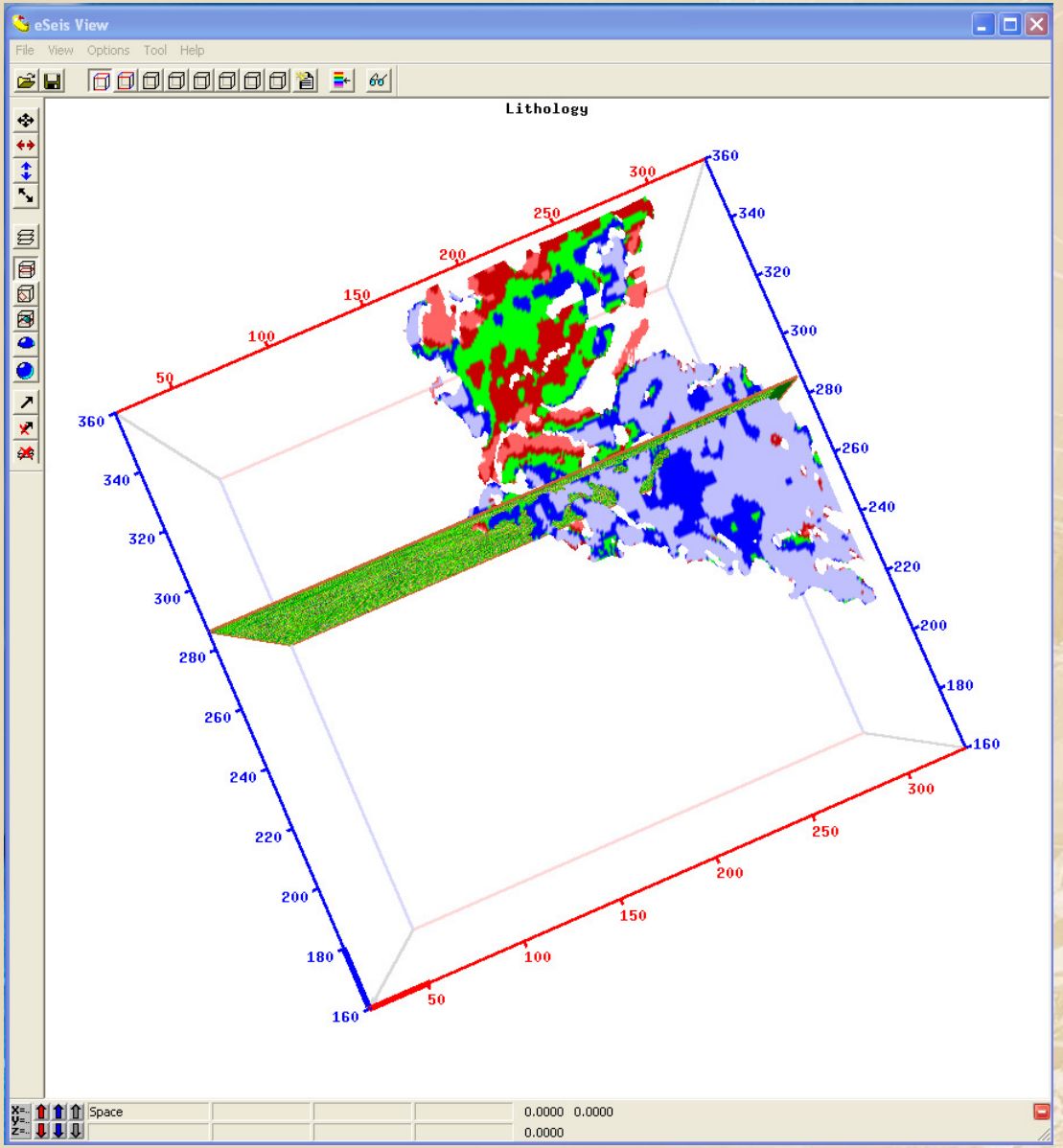
Lithology/Fluid Response, Surface





AVO Type Response, Surface





Conclusion

Think in terms of Lithology, Porosity and fluids not wiggles and impedances and instantaneous attributes.