

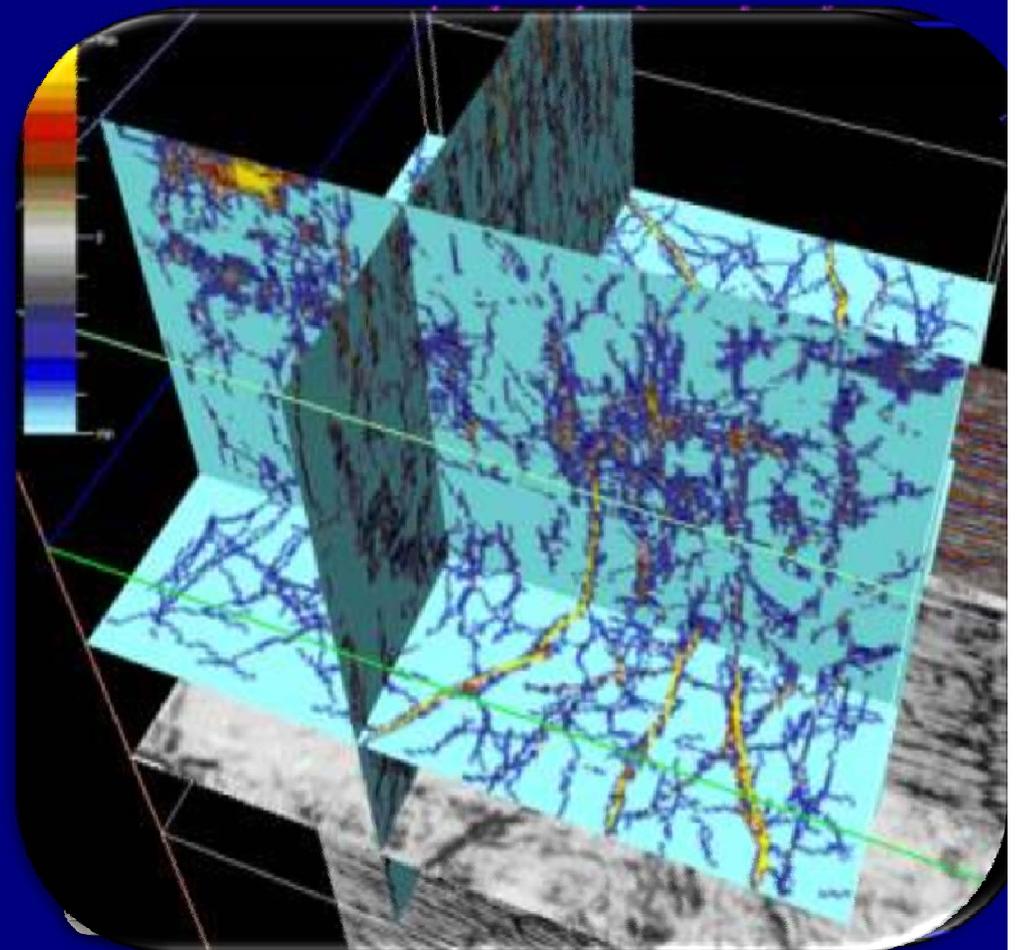
# Fracture Corridor Mapping

Fractured corridors cannot be generated by geostatistics.  
They must be identified and mapped.

High resolution seismic

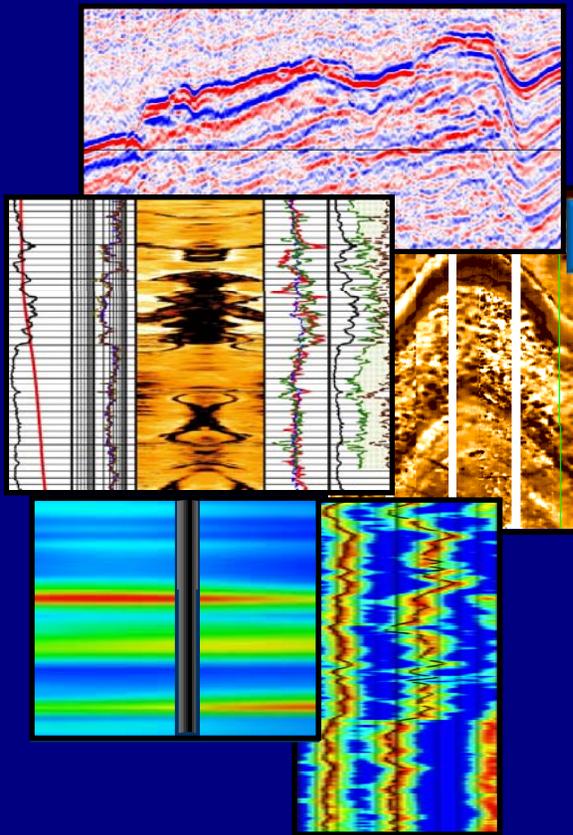
Structural interpretation in  
geological modeling  
software

Integrate with log data to  
distinguish fracture  
corridors from other  
discontinuities

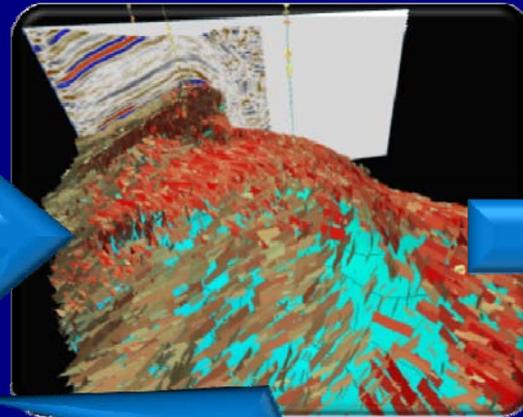


# Data Integration: The Key to Modeling Carbonates

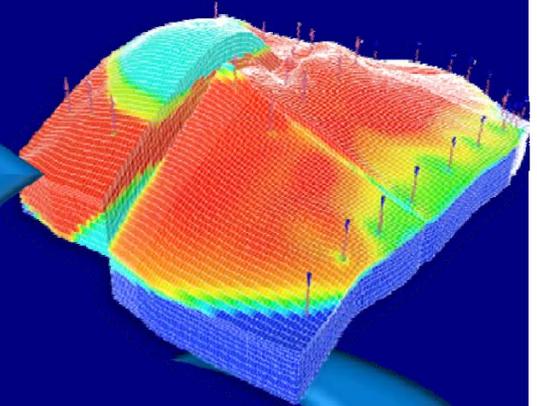
**Petrophysical  
& Geophysical  
Data**



**Geological  
Modeling *Discrete  
Fracture Networks***



**Reservoir  
Simulation**

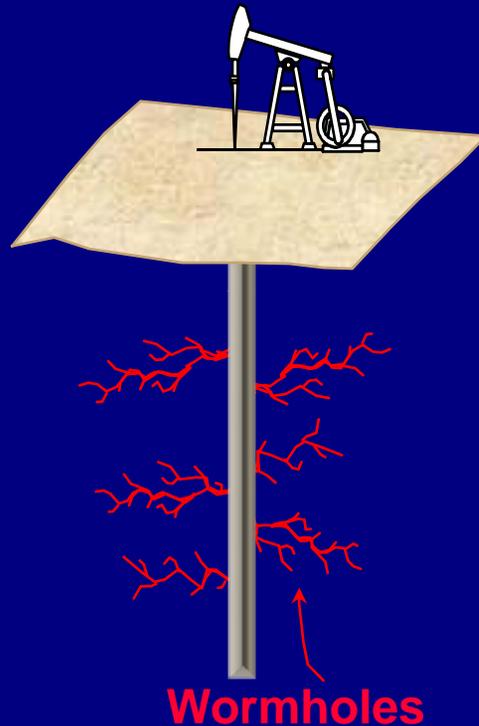


**Well Tests  
Interference Tests  
Production Analysis**

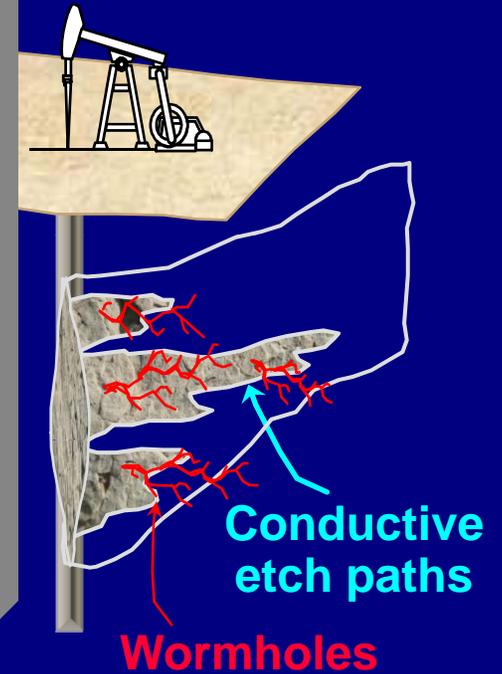
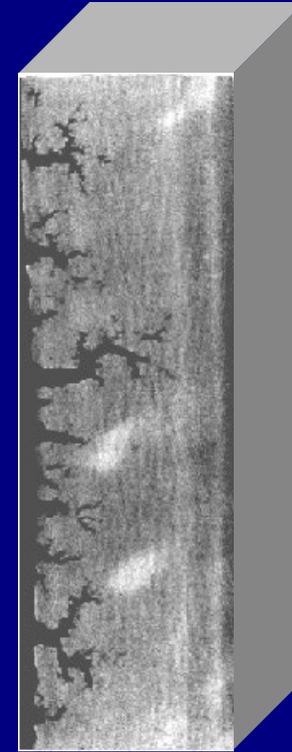
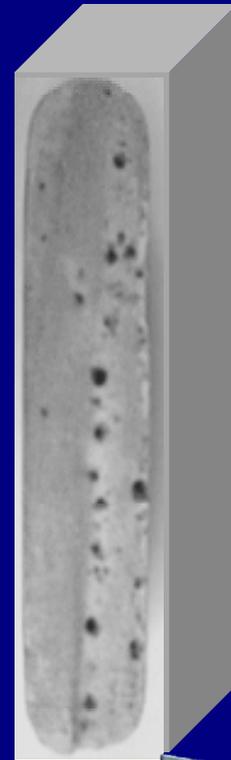
*Geophysics, Petrophysics, Geomechanics, Geology, Reservoir Engineering*

# Stimulation of Carbonates

## Matrix Acidizing



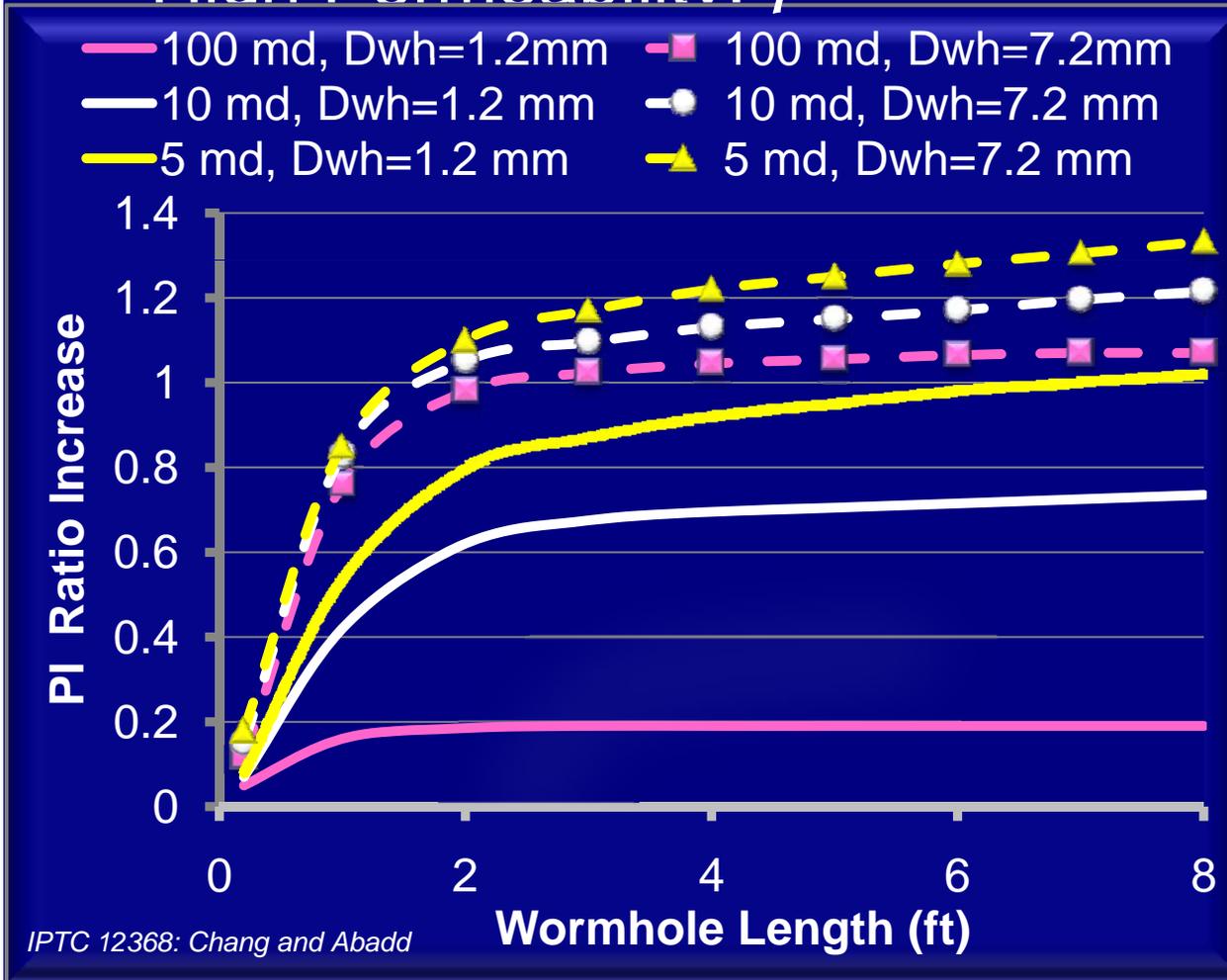
## Fracture Acidizing



The injection of acids into carbonate reservoirs leads to the formation of highly conductive flow channels.

# Productivity Impact of Wormhole Geometry

## High Permeability Example



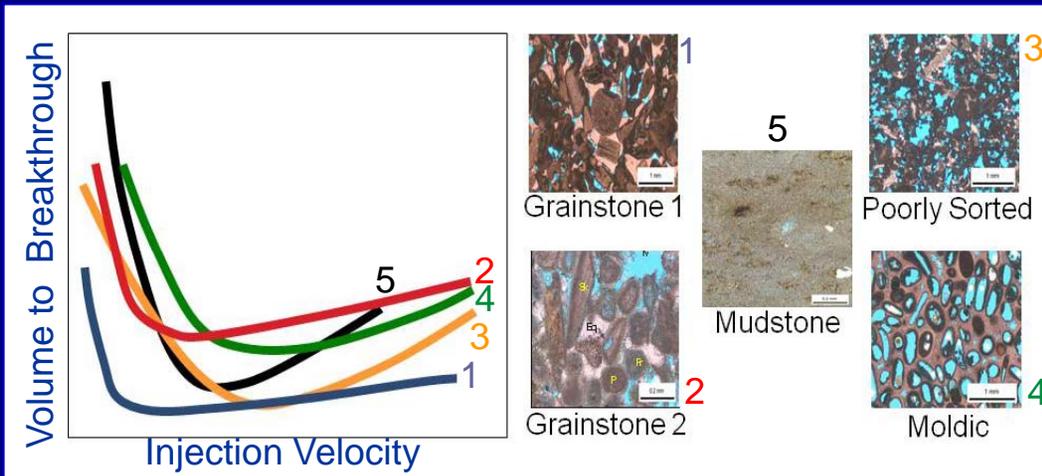
## High Permeability:

- Increasing wormhole diameter results in more significant PI increase.
- Increasing wormhole length provides no benefit beyond certain value.

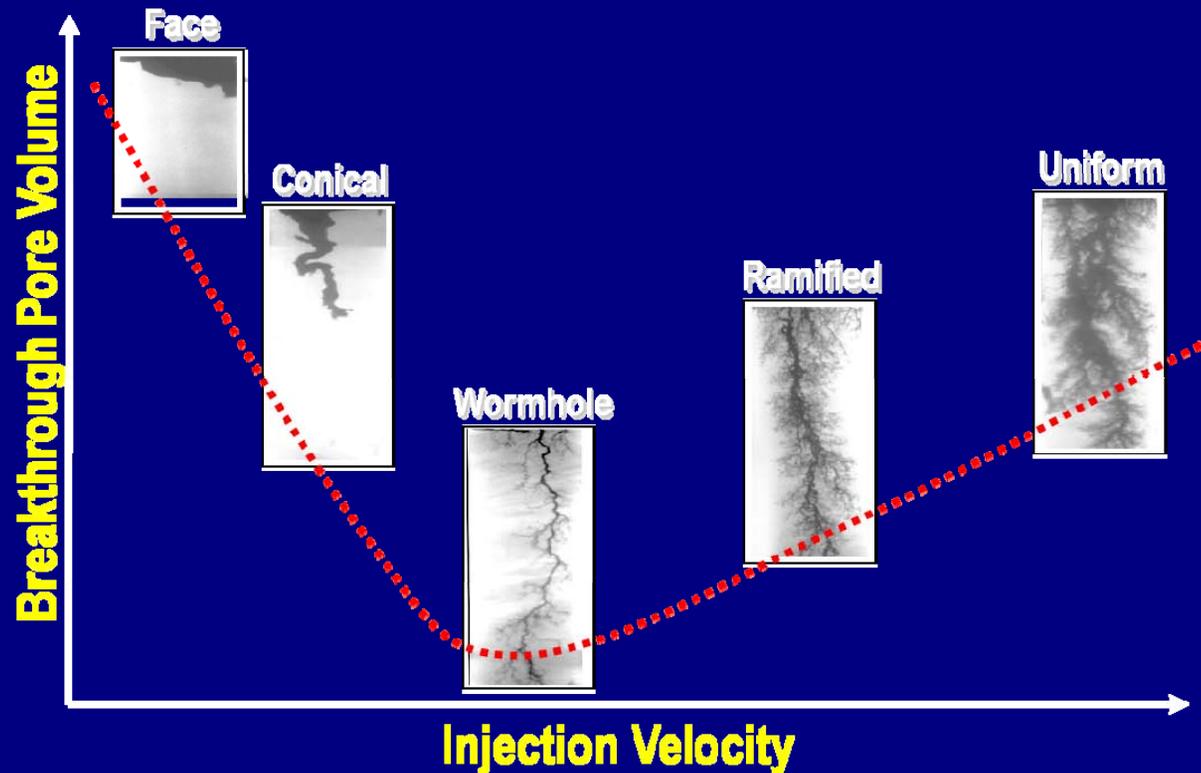
## Low Permeability:

- The diameter effect is less but still pronounced

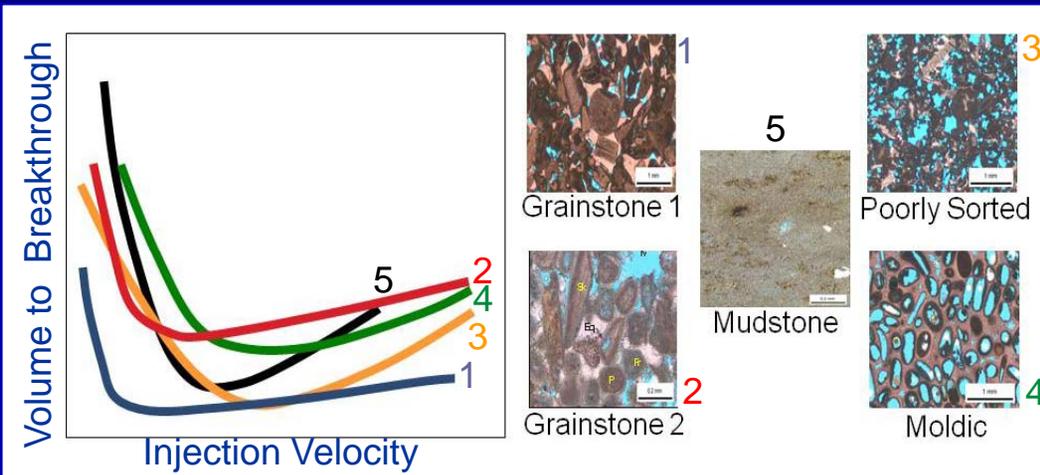
# Stimulation – Pore Scale Heterogeneity



**Matrix conditions –**  
pore distribution and  
connectivity dominate  
acid response



# Stimulation – Pore Scale Heterogeneity



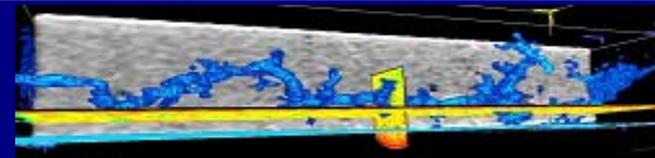
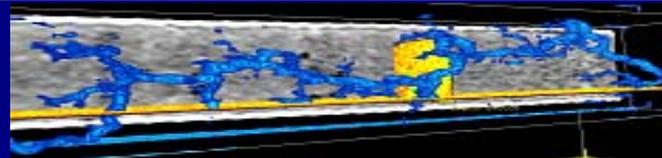
**Matrix conditions –**  
pore distribution and  
connectivity dominate  
acid response

**Injection**  
(cc / min)

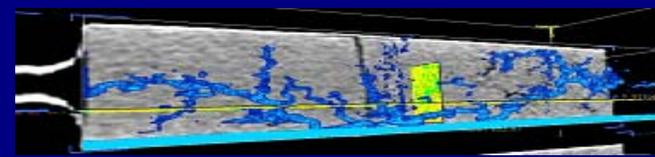
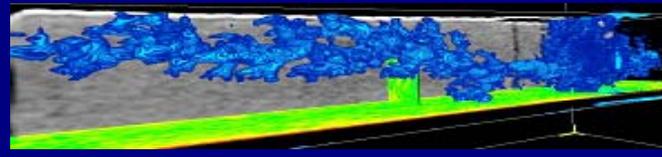
**Austin Chalk**

**Winterset Limestone**

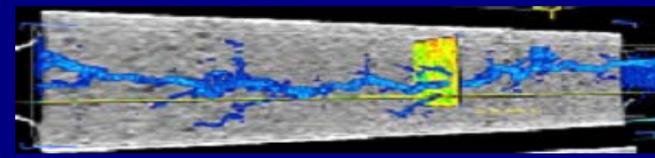
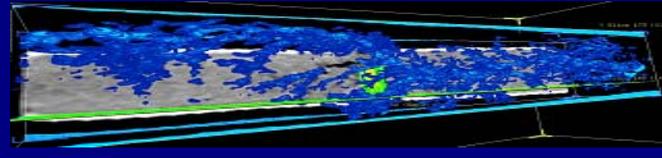
0.5



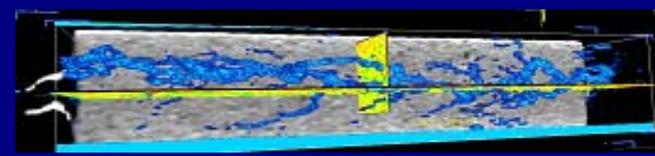
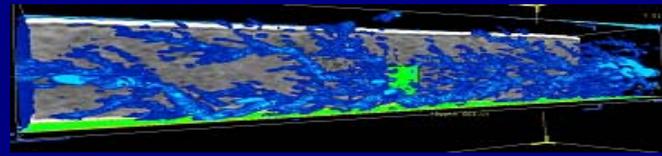
1



2.5

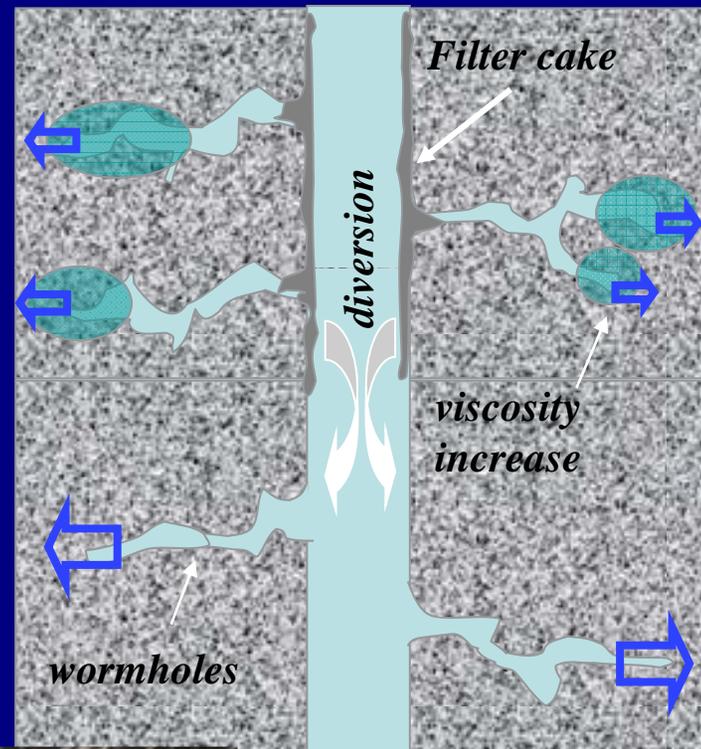


6.75



# Diversion from Wormholes and Fractures

- Materials and methods to divert away from dominant permeability wormholes and fractures



- Complete dissolution for regained permeability



Chemistry, Chemical Engineering, Production Engineering, Stimulation

# Alternative Dissolution Chemistries



Solid and chemically inert at surface conditions

Mixed in conventional carrier fluids and pumped as a slurry

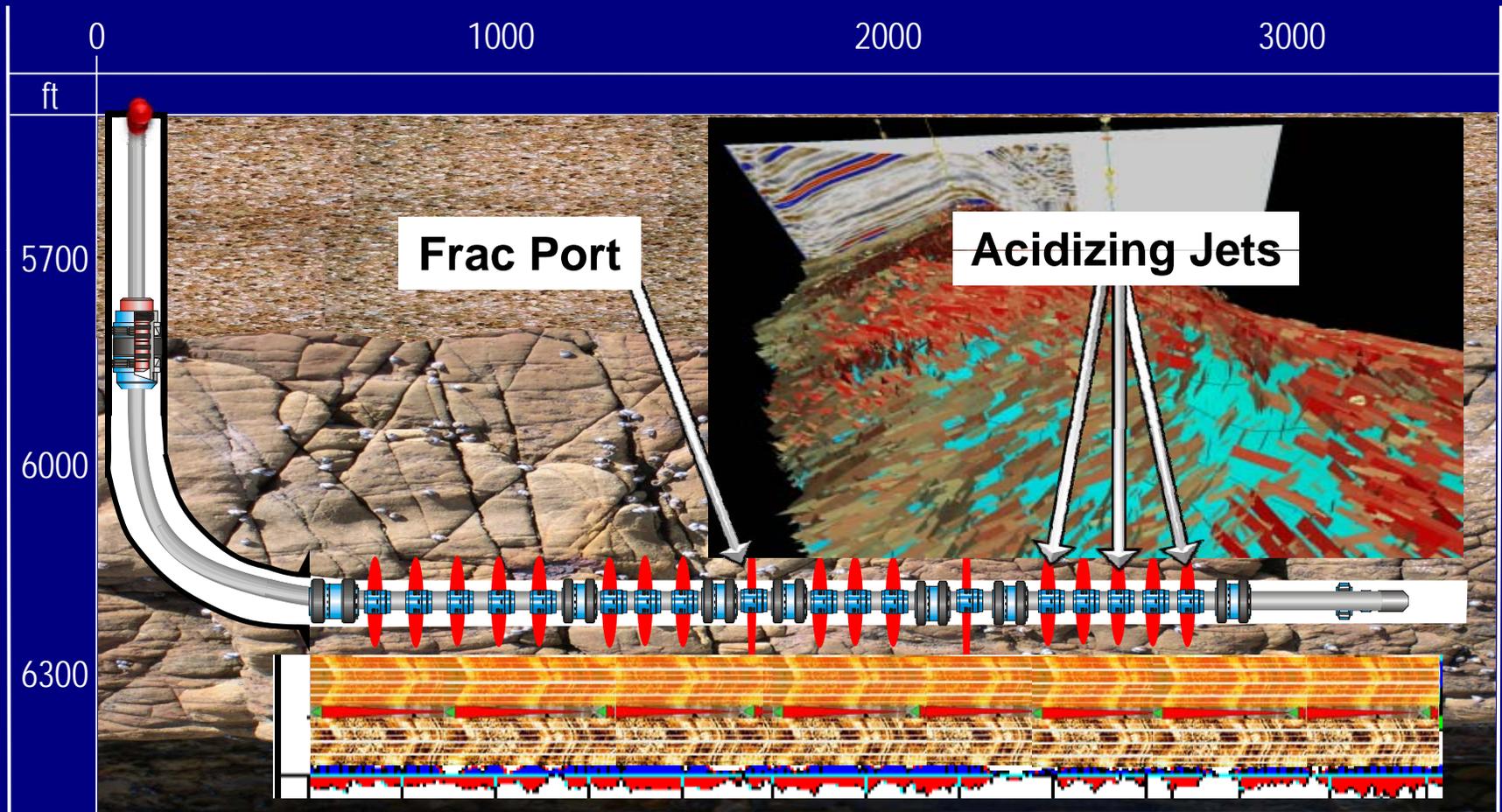
Generates acid downhole when exposed to water and heat

Results in heterogeneous etching and increased conductivity



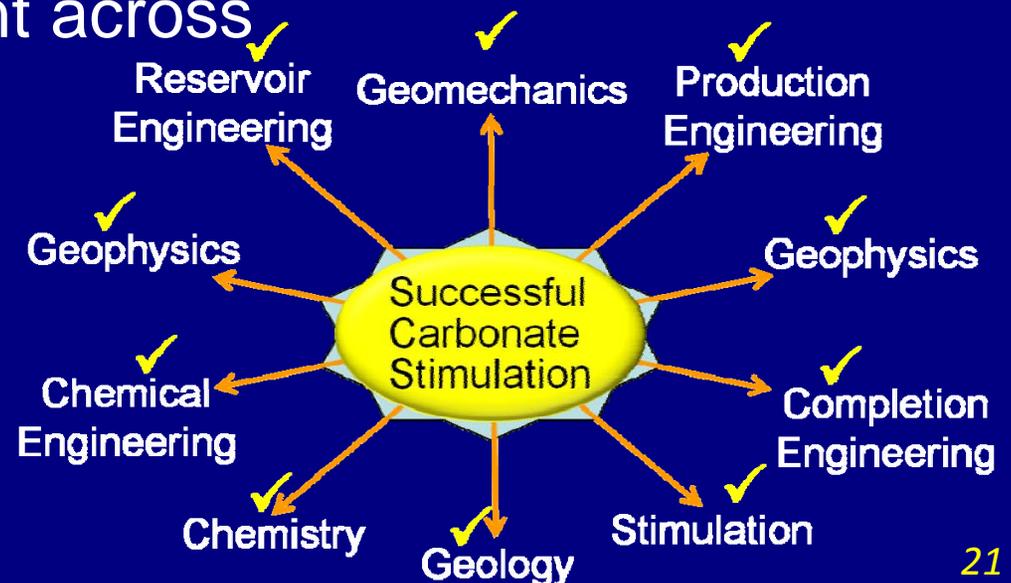
# Stimulation – Well Scale Heterogeneity

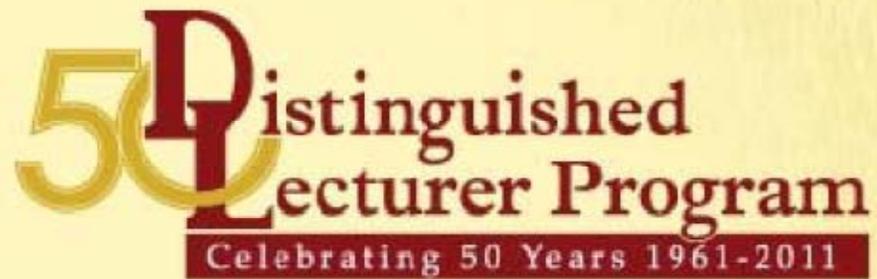
Natural Fractures – Dominate injection profile.  
Location and conductivity critical



# Conclusions

- Multidiscipline teams can improve production and recovery from carbonate reservoirs
- Tools and models are available to characterize carbonates across a wide range of physical scales
- New chemistries are improving stimulation results
- New strategies, techniques and completions are improving fluid placement across extended intervals



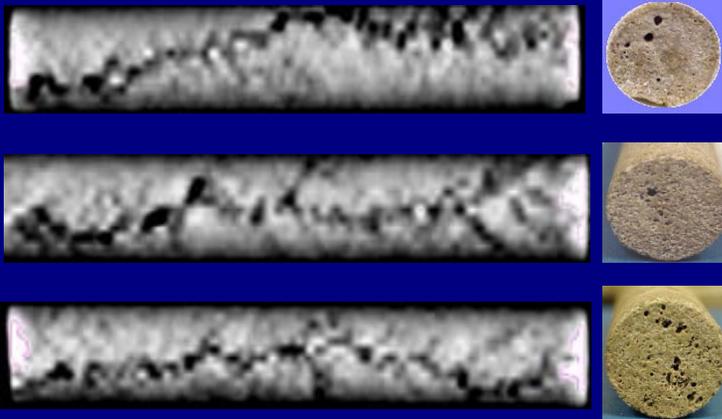


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