# Question : Why Seismic?

In resource plays, all wells should (ideally) be productive. In practice, one good well (3 day payout) may be followed by a 3 year payout well in an adjacent offset location. Can seismic help discriminate between better and poorer wells?

# Question:

How can seismic help optimize production in Resource Plays?

- Fault Identification (Hazards?)

- Structure Issues

- "Shale" Characterization

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# Shale Characterization Projects in the EDGER Forum

**Student research project**

<u>Back-to-basics</u> studies to address how seismic responds to change is reservoir parameters. Use borehole data evaluate how the surface seismic response to changes in relevant reservoir properties.

# Required Information:

- "Reservoir" (or "Shale") Geology

- Completion Techniques

- Actual borehole data (Sonic, Dipole sonic, Density and other logs)

- Subsurface data in both good and bad wells. (Documented productivity associated with subsurface conditions)

## Back to Basics approach:

- Start with log data (including shear information) and 'reservoir' (or Shale) description

- Evaluate seismic response to 'reservoir' properties that can be seismically observed

- Predict surface seismic response to variations in reservoir properties (Sensitivity and Resolution Analyses)

# Results (Suggestions) to date:

| Seismic Property | Shale Property |
| --- | --- |
| Poisson's Ratio | 'Chertiness' Net/Gross |
| HTI | Fracturing |
| VTI | Clay content (Source or Seal) TOC |

# Results (Suggestions) to date:

| Seismic Property (More Speculative Hints) | Shale Property |
|---|---|
| ------------------ | ------------------ |
| Crack Aspect Ratio | Gas/Liquid effects |
| Crack Density | Fracturing Stress State |
| Density | 'Shale' Properties |

## To-do, with Producers:

**Subsurface information to relate:**
'Shale' Properties to Seismic Properties

**Rock Physics and Modeling to Bridge:**

| 'Chertiness' | to | Poisson's ratio |
|---|---|---|
| Fracturing and stress state | to | HTI parameters |
| Clay content, source richness and seal efficacy | to | VTI parameters |

# To-do, with Producers (2):

**Subsurface information to relate:**
'Shale' Properties to Seismic Properties

**Rock Physics and Modeling to Bridge:**

| | | |
|---|---|---|
| Gas/Liquid effects | to | Crack Aspect ratio |
| Fracturing stress state | to | Crack Density |
| Shale properties | to | Density |

# To-do, with Quantitative Seismologists:

**Subsurface information to relate:**
   Properties to'Shale' Properties Seismic

**Modeling and (full wave) Inversion to Bridge:**

| | | |
|---|---|---|
| Poisson's ratio | to | 'Chertiness' |
| HTI parameters stress state | to | Fracturing and |
| VTI parameters | to | Clay content, source richness & seal efficacy |

# To-do, with Quantitative Seismologists (2):

**Subsurface information to relate:**
   Seismic Properties to'Shale' Properties

**Modeling** and (full wave) **Inversion** to Bridge:

| | | |
|---|---|---|
| Crack Aspect ratio | to | Gas/Liquid effects |
| Crack Density | to | Fracturing and stress state |
| Density | to | Shale Properties |

# Status:

Considerable progress in three areas: Bakken, Woodford and Bossier. Preliminary results in the Marcellus.

Results suggest observable variations in seismic response for variations in

HTI, VTI and $\sigma$

To date—Seismic Sensitivity to changes in HTI, VTI and $\sigma$

No particular seismic technique has been isolated to actually interpret the variations.

# Project Areas

Working with sponsors to coordinate Rock Physics research on specific shales.

Bakken:    Project with Kerogen / Oasis
           MS and SEG Abstract-seismic response

To address:
       Rock Physics in an Oil Play

# Project Areas

**Working with sponsors to coordinate Rock Physics research on specific shales.**

**Woodford:**

   **Pecos Co., Texas**

      **1 MS and SEG abstract in West Texas Setting**

   **Anadarko Basin-Start of a project with**

      **Cimarex and Devon well data**

      **Incorporate 3D 3C surface seismic**

# Project Areas

Working with sponsors to coordinate Rock Physics research on specific shales.

Marcellus:  Seismic Model Building

Well data from Anadarko

# Project Areas

**Working with sponsors to coordinate Rock Physics research on specific shales.**

**Bossier:    Completed tight gas sand characterization with 3C data.**

**1 MS and SEG Abstract**

# Project Areas

**Working with sponsors to coordinate Rock Physics research on specific shales.**

**<u>Haynesville</u>: Characterization and Seismic Model Building**

# Project Areas

Working with sponsors to coordinate Rock Physics research on specific shales.

Other plays of interest:

**Eagle Ford, Barnett**

# <u>Summary</u>

**Log data for forward modeling and seismic response and sensitivity characterization**

**Rock Physics to understand log-seismic properties**

**Numerical methods for inversion of seismic to geological properties**