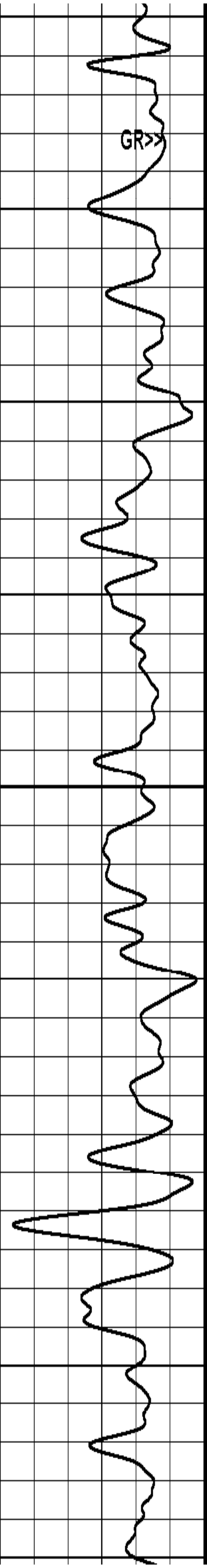


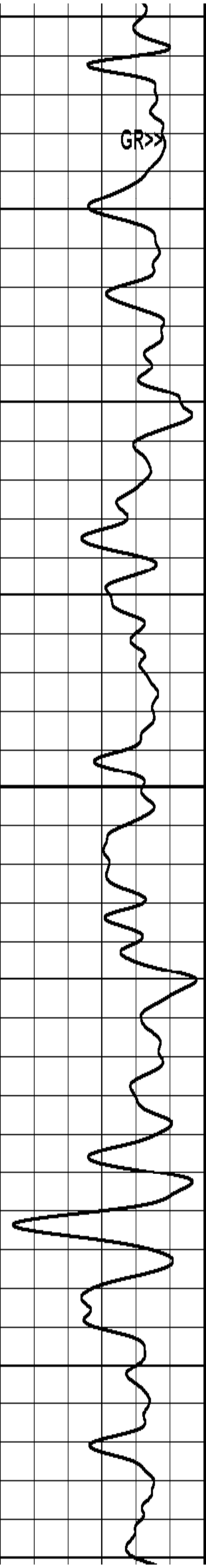
Keeping ISolation Simple

Keeping ISolation Simple

Don Getzlaf
President
Cemblend Systems Inc.

CEMBLEND SYSTEMS INC.
"Providing Cementing Solutions"

Ceramic cements are utilized to aid operators in meeting Environmental and Regulatory goals with step-change methodology, keeping up with the "*moving target*"



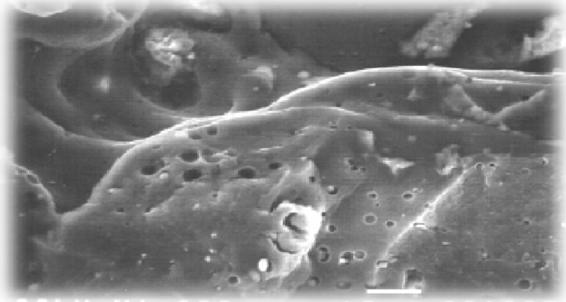
Today's Discussion

- **Why ceramics**
- **Progression of technology**
  - Reduce risk
- **Case Histories**
  - Remedial
  - Open Hole
- **Going forward**

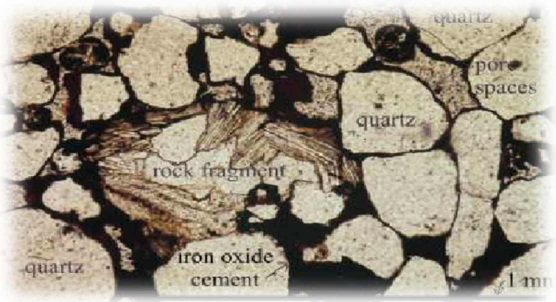
Definition

- **Structure**
  - Portland cement molecular bonds
    - Van der Waals forces
  - Ceramic cement molecular bonds
    - Ionic or covalent bonds
    - Much stronger and permanent

- **Traditional Definition**
  - Portland cements
    - Room temperature setting
  - Ceramics
    - High temperature setting



Ceramic Cement



Portland Cement

Why use Ceramics

Why Ceramics

- **Temp range**
  - Portland cement <110 C
  - Ceramics >400 C
- **Porosity**
  - Portland cement 5%
  - Ceramics < 0.5 %

Why Ceramics

- **Permeability**
  - Portland 0.1 md
  - Ceramic <1/10 th

- **Tensile Strength**
  - Equivalent or higher then Portland

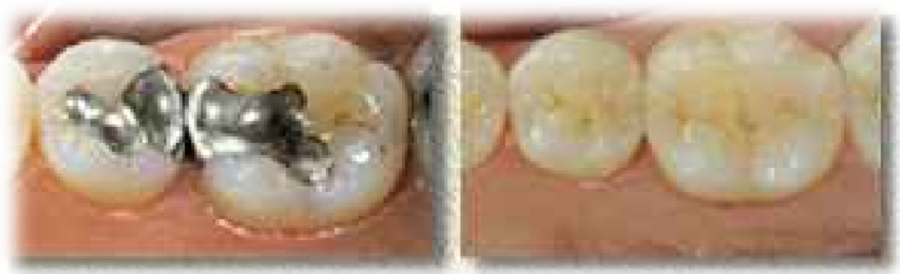
Why Ceramics

- **Environmental**
  - Portland high Ph
  - Ceramic neutral Ph
- **Bonding**
  - Portland bond is mechanical
  - Ceramic bond is direct chemical and mechanical
  - Typical bond is 3-5 times Portland

Uses

Other Industry Applications

- **Dental Fillings**
  - Permanent acid resistance and bonding
- **Runway repair**
  - Ultra high early strength, bonding and thermal
- **Nuclear waste encapsulation**
  - Leaching, permanence and bonding
- **Construction**
  - Temperature and endurance
- **Waste Management**
  - Same as Nuclear

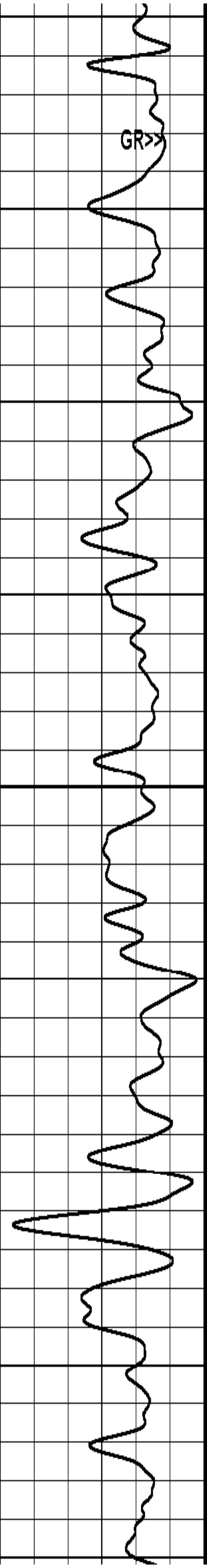


Oilfield use of Ceramics

- **Permafrost**
  - Low temperature setting properties
- **Thermal**
  - High temperature properties
- **Lost Circulation**
  - Quick setting properties

Oilfield use of Ceramics

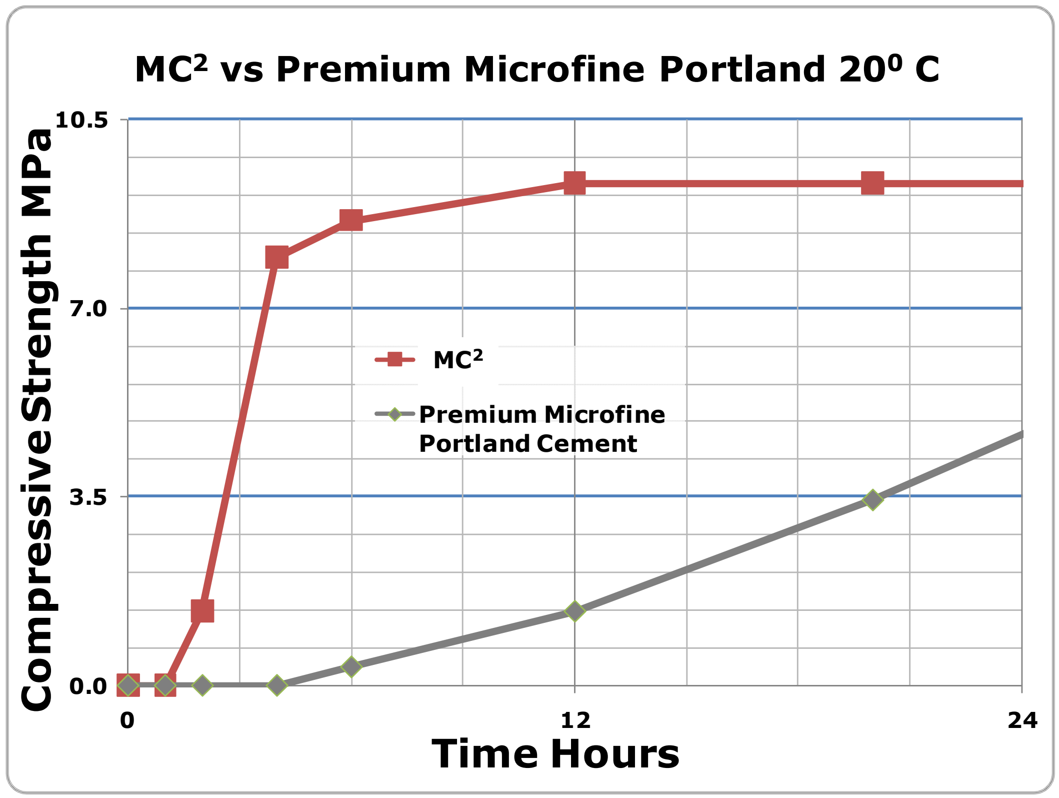
- **Environmental**
  - Permanent, impermeable, low porosity and neutral Ph
  - Conformance
- **CO_2 Sequestering**
  - Acid resistance
  - Low CO2 conversion
- **Remedial**
  - All of the above

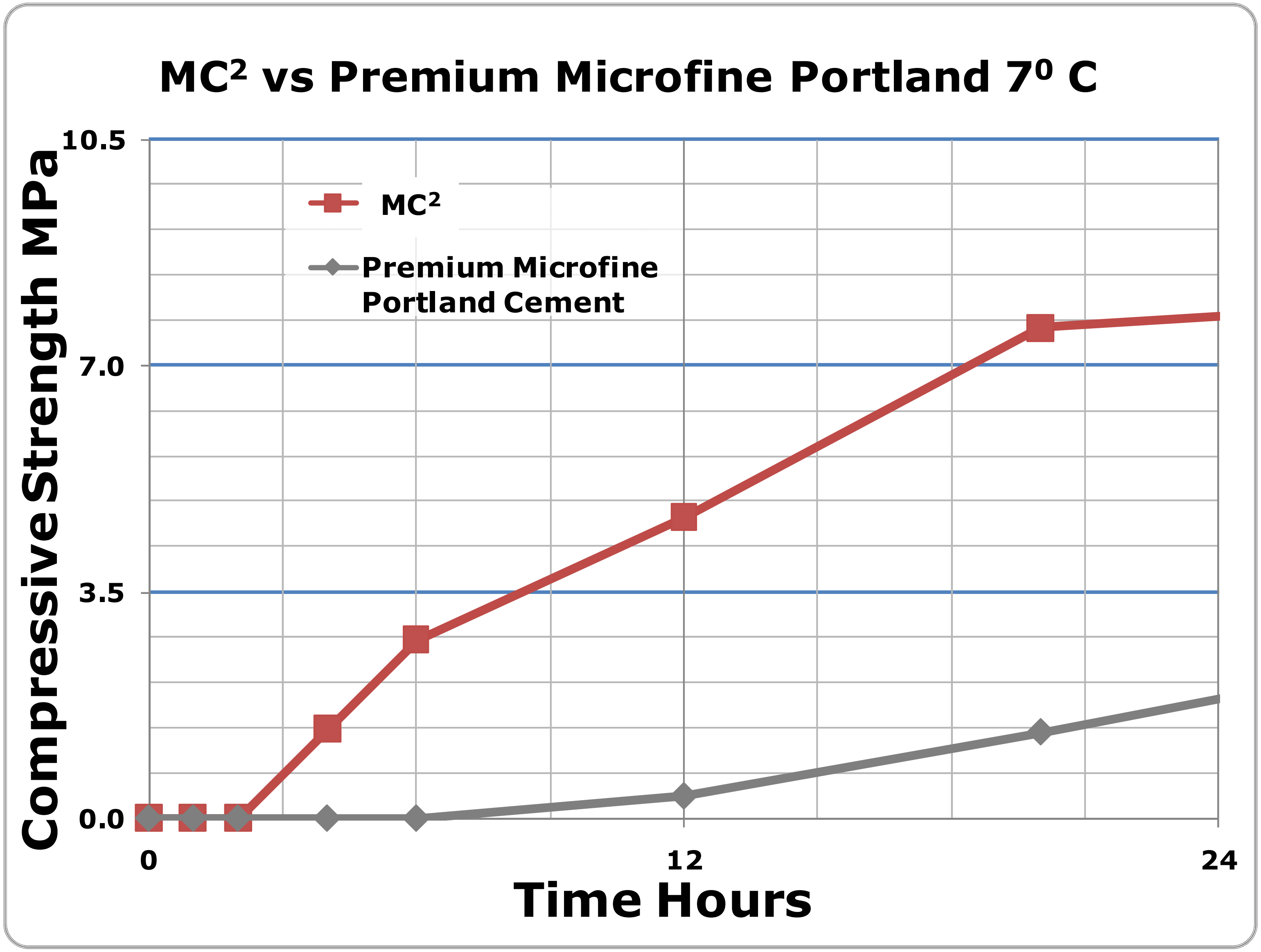


Properties

Properties

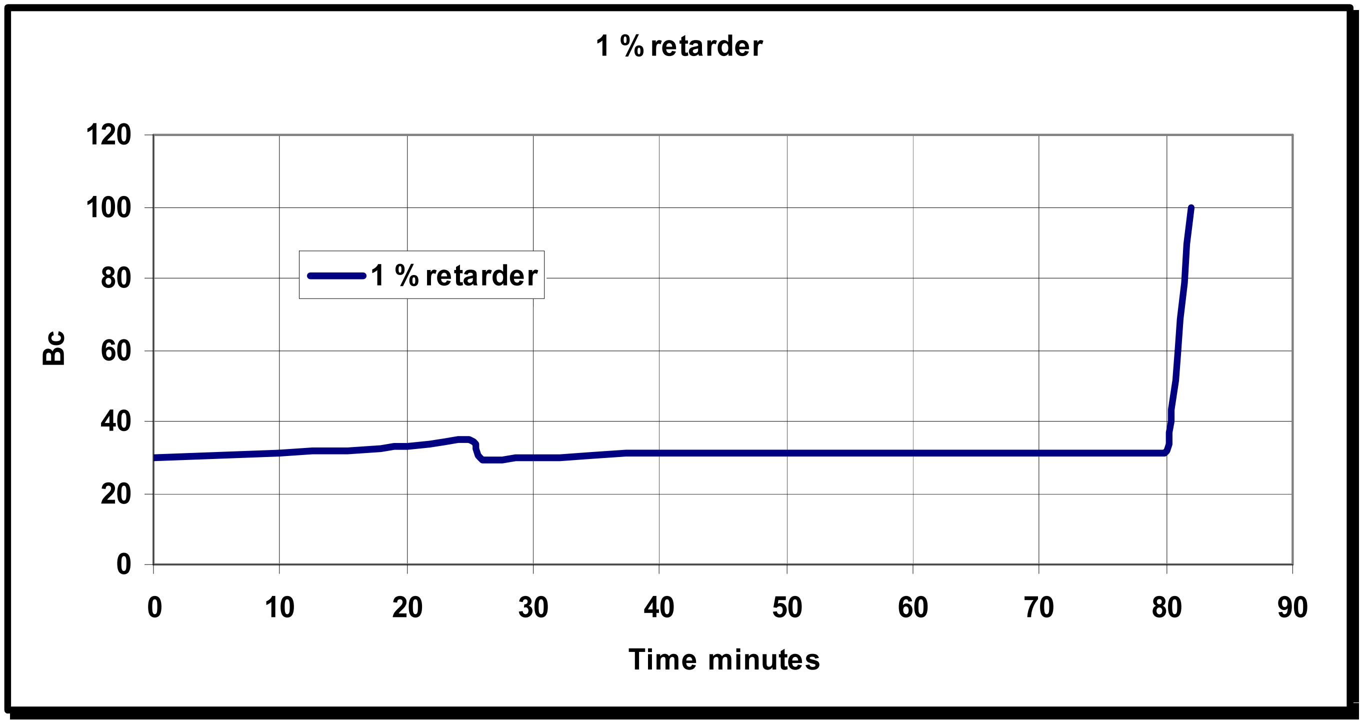
- Most of the strength is obtained in first few hours
- Slightly expanding
- High bond strength





MC² vs Premium Microfine Portland 7⁰ C
Compressive Strength MPa
10.5
7.0
3.5
0.0
0
12
24
Time Hours
MC²
Premium Microfine Portland Cement

Thickening time example



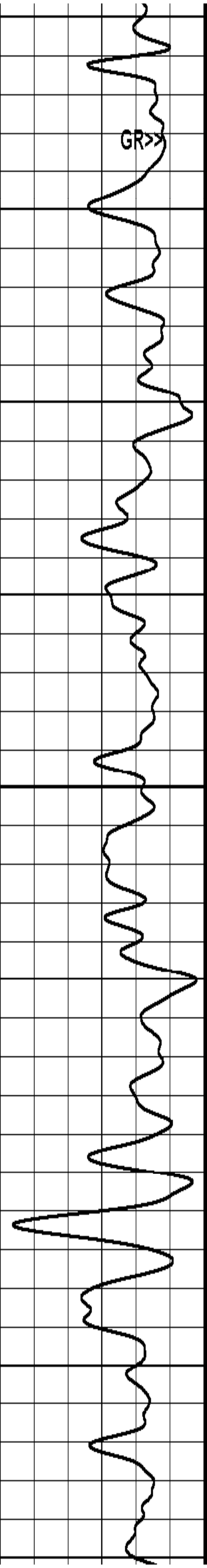
32 Bc to 100 Bc in 2 minutes
Bearden units of consistency

Bond Testing

Bond tests at surface temperature and 315 C
Typically 3-5 times higher then Portland.

Wellbore integrity testing

315 C pipe in pipe tests to test wellbore integrity

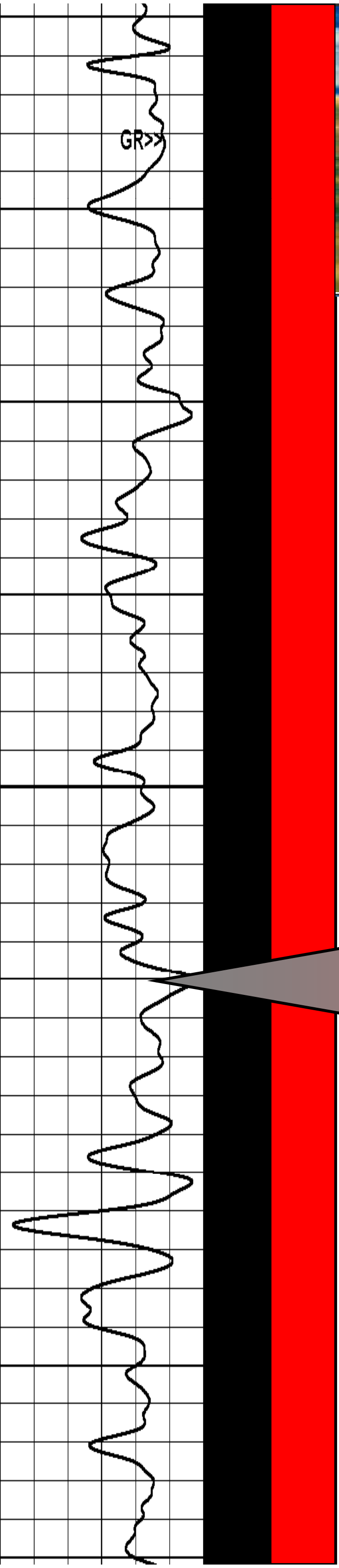


Risk Analysis

Risk Mitigation

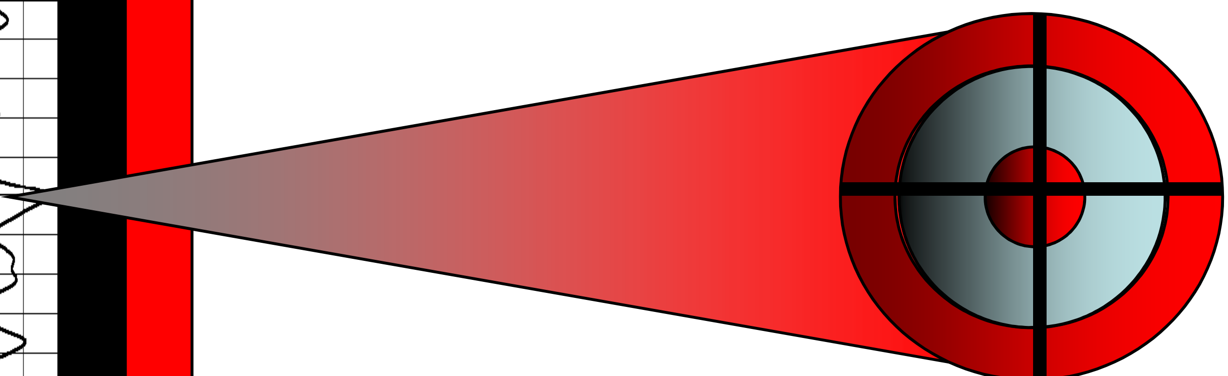
- **Start with low risk application**
  - Water conformance
  - Gas Migration
- **Medium risk**
  - Lost circulation
  - Zonal abandonment
    - Straddle tools
- **Highest risk**
  - Primary cementing

Case Histories



Pin Point Zonal Isolation

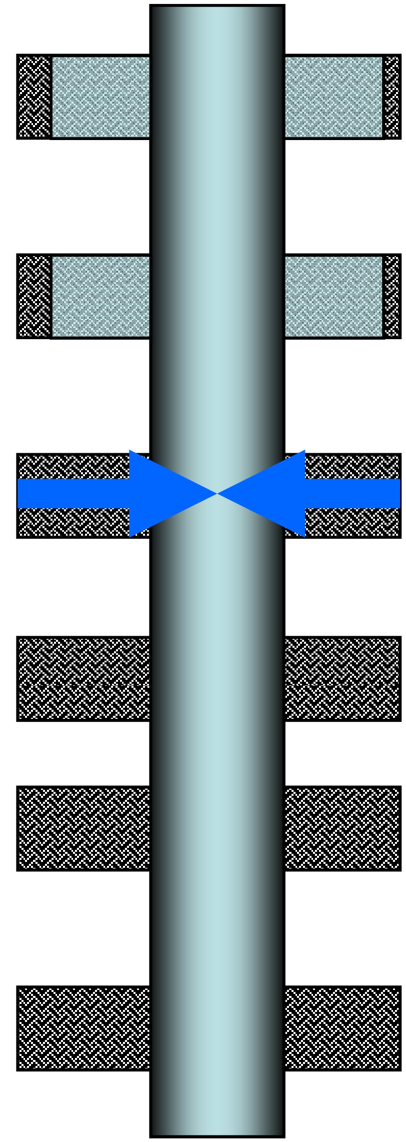
(a case history)



Low risk model

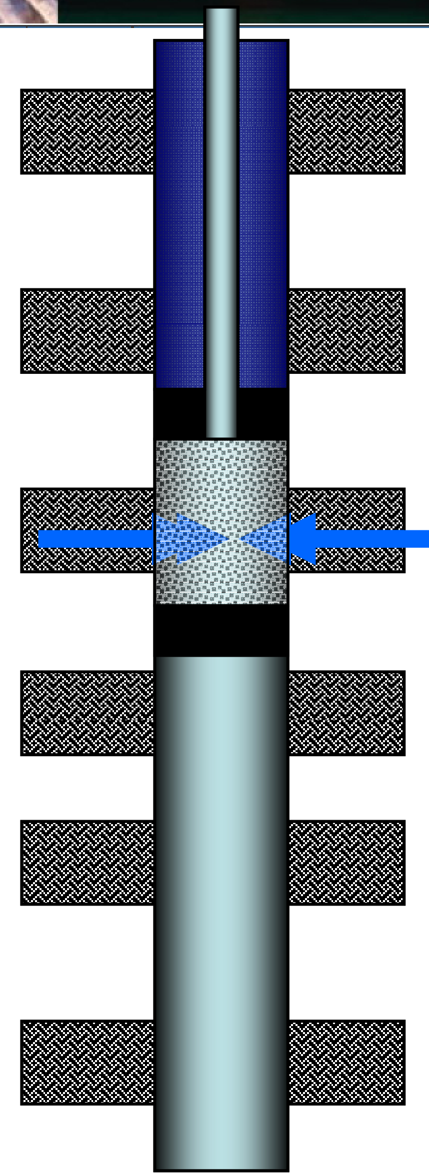
How do I …?

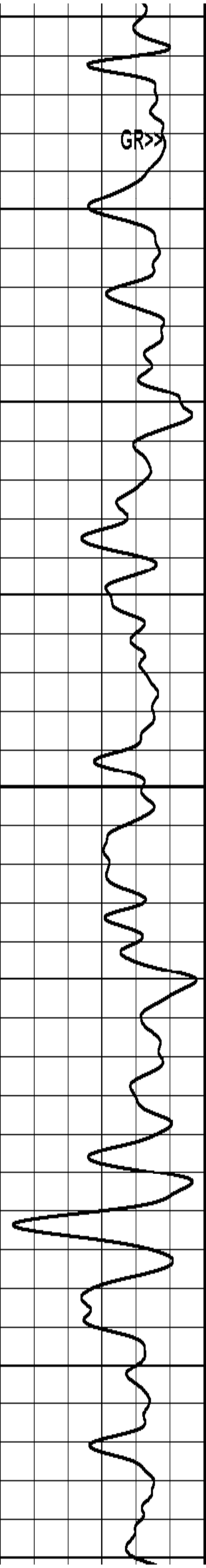
- Permanently shut the water production off
- Mitigate damage to the numerous other zones in the well
- Do this in a cost effective way



Answer #1

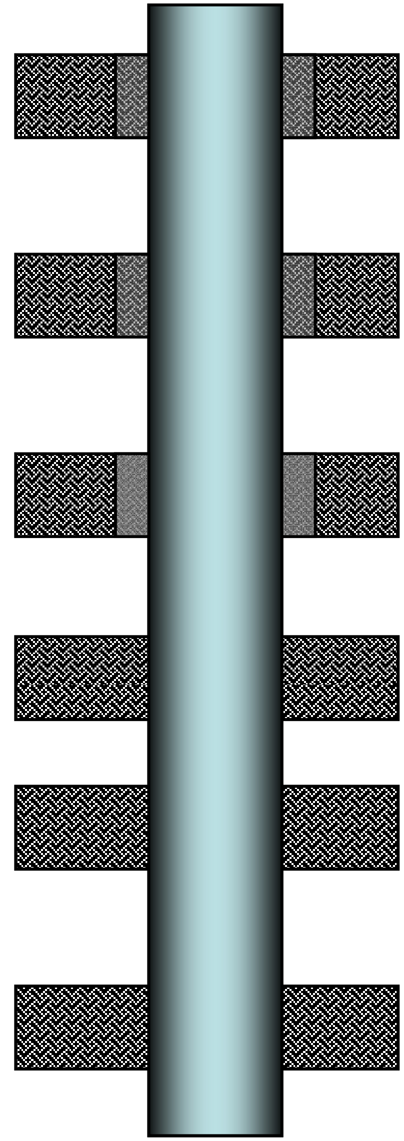
- Conventional cement squeeze technology requires rigs, retainers and subsequent drill outs

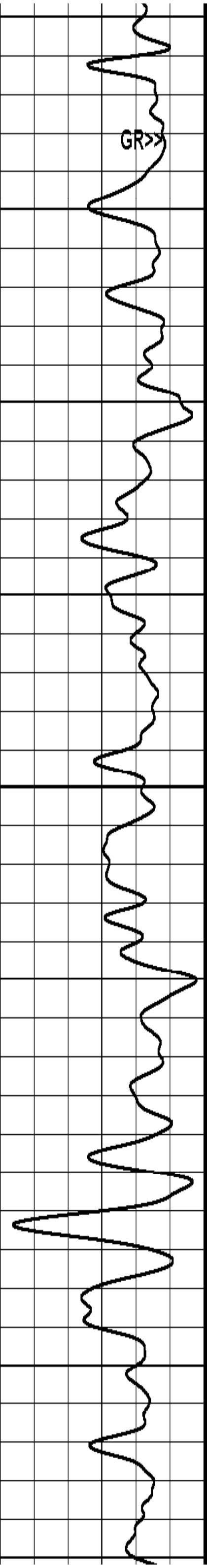




Answer #1

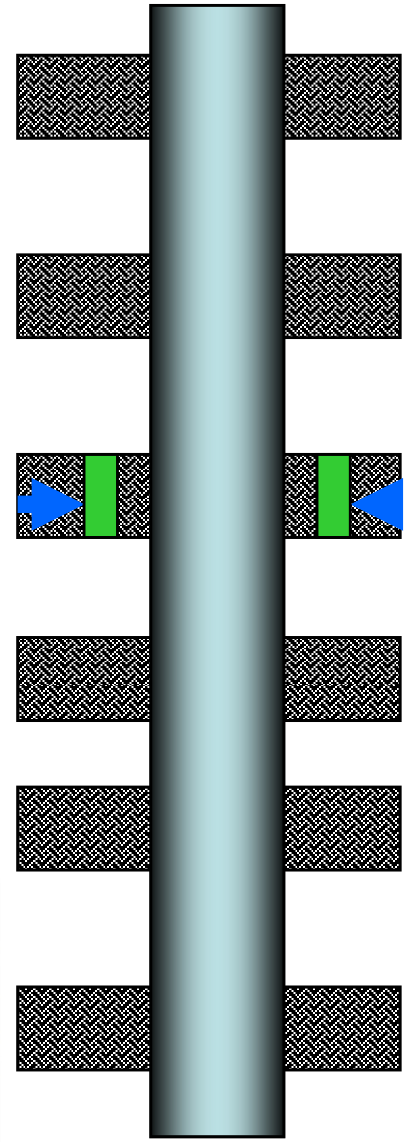
- Probably 3 days
- Damage to Upper Zones
- No guarantee of squeeze

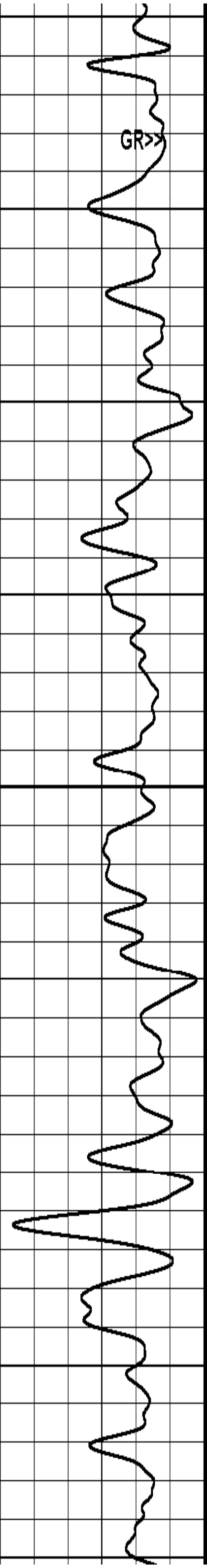




Answer #2

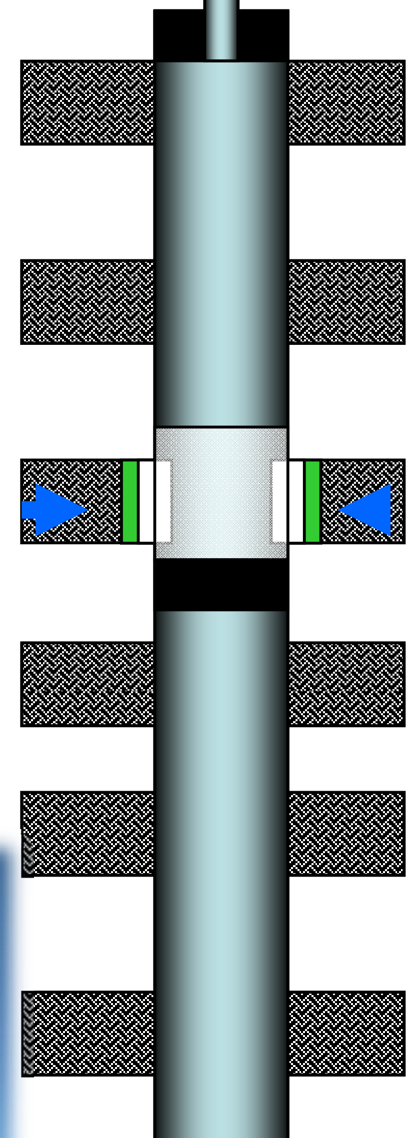
- Place a barrier within the porosity that permanently shuts off the water production and requires no drilling and/or damage to producing formations





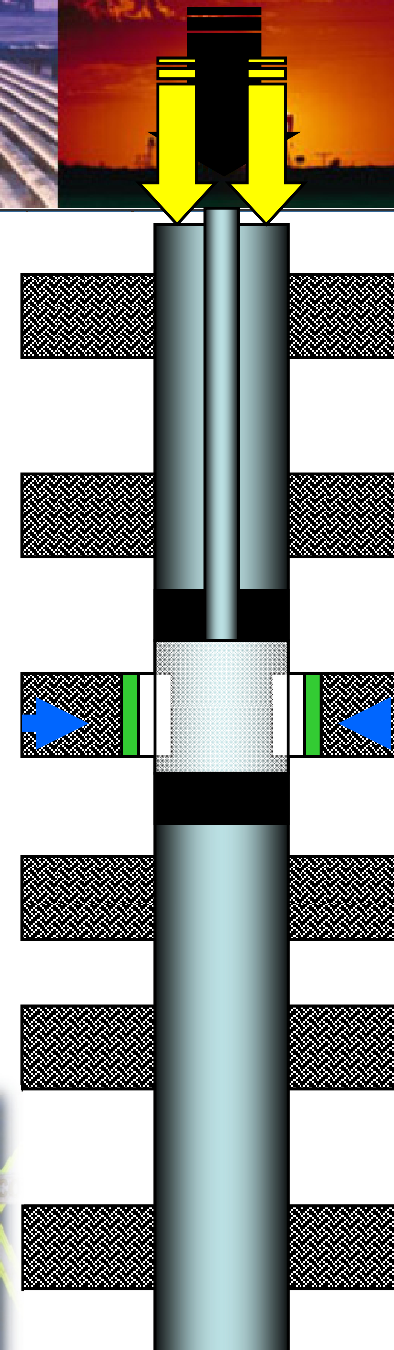
How do we do this?

- Place a retrievable bridge plug on Wire Line
- Run in the well with a retrievable CT service packer
- Pump a Microceramic Activator
- Pump a Microceramic binder



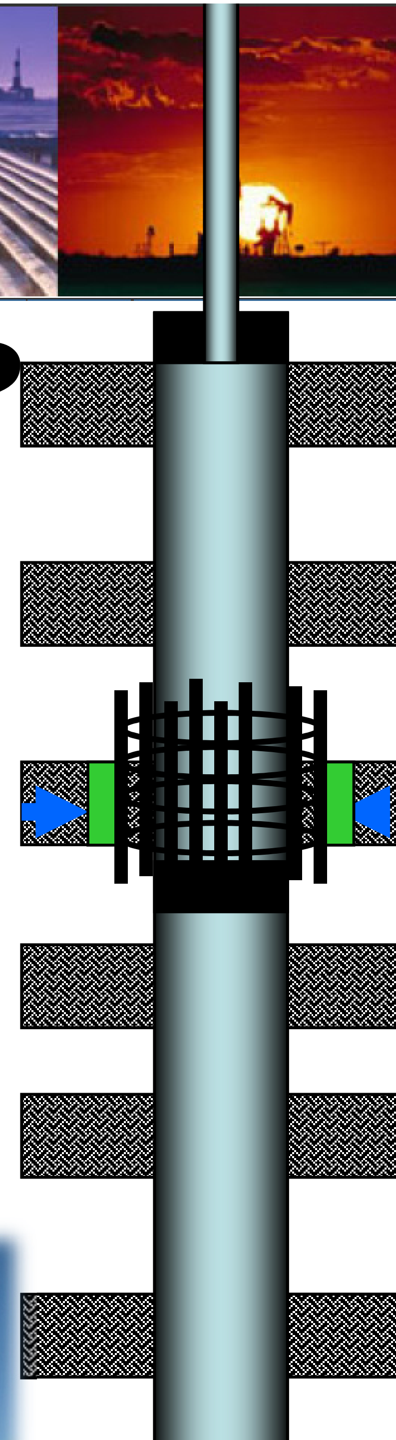
How do we do this?

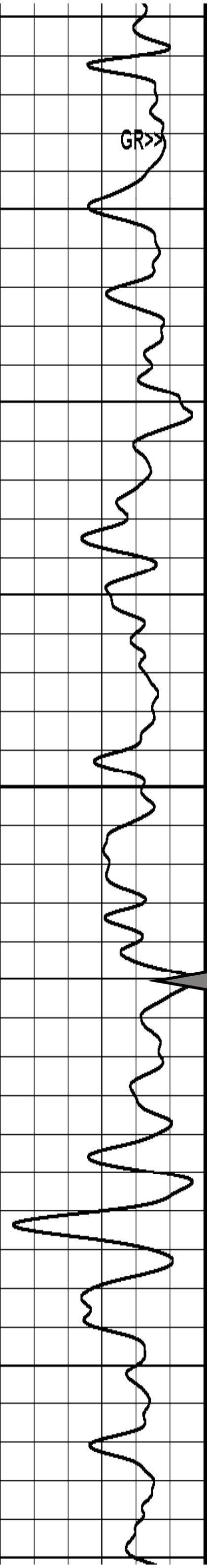
- Obtain a porosity squeeze
- Place N_2 pressure on the annulus
- Unset CT service packer
- Reverse out excess Microceramic binder



How do we do this?

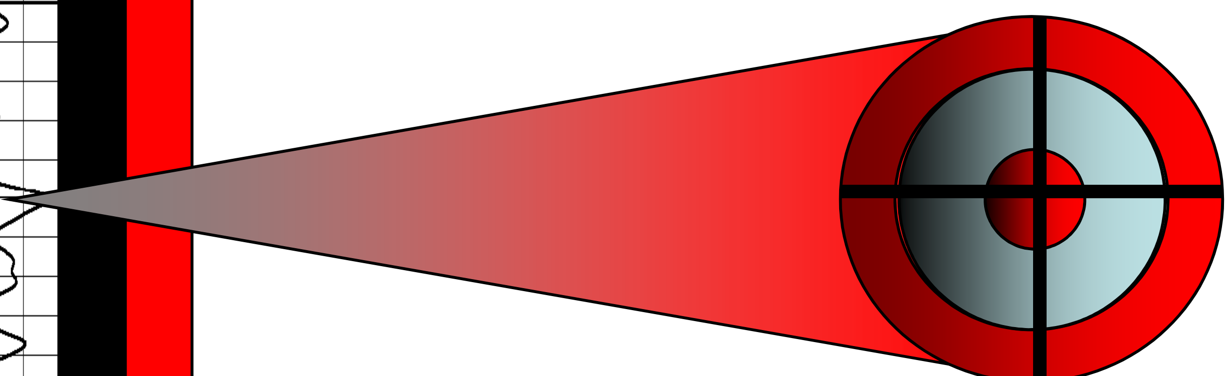
- Pull out CT service packer
- Pull out bridge plug
- Leaving behind impermeable permanent barrier





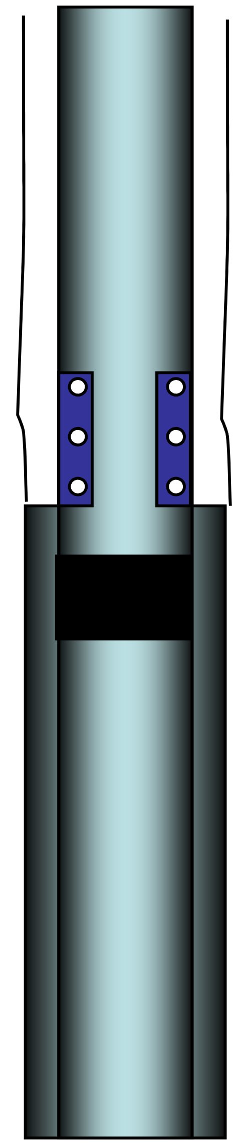
Lost Circulation

(a case history)

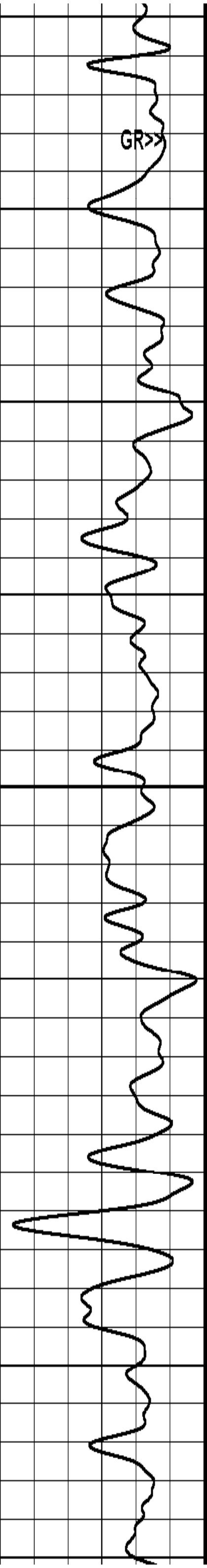


Medium risk model

Lost Circulation Squeeze

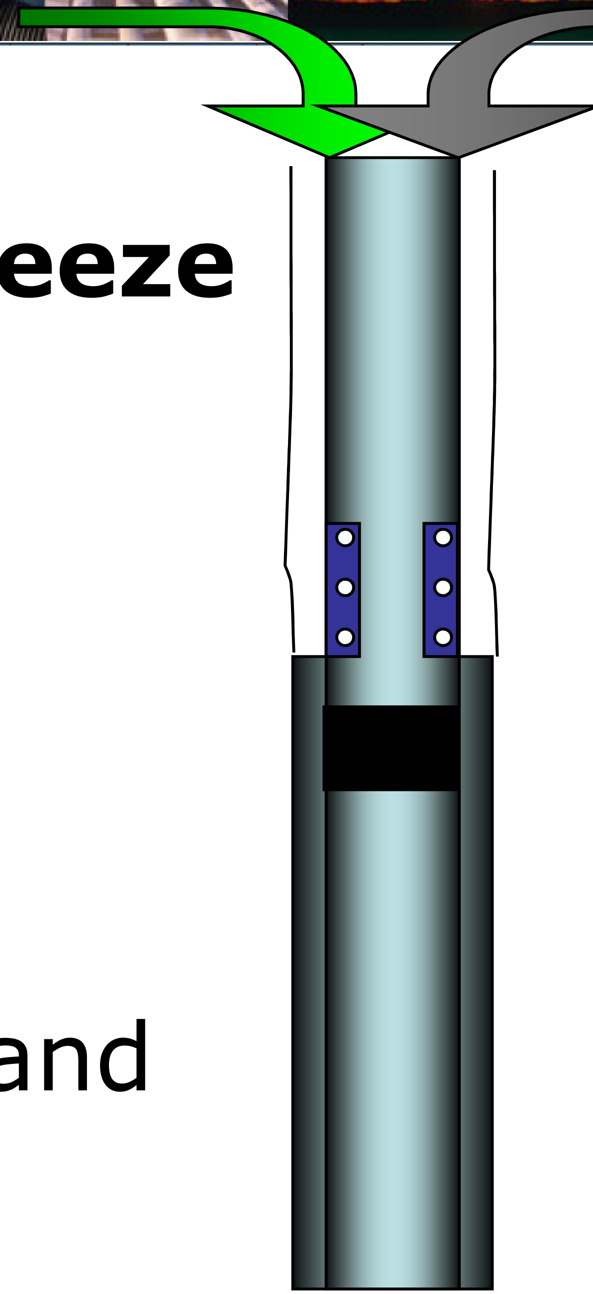


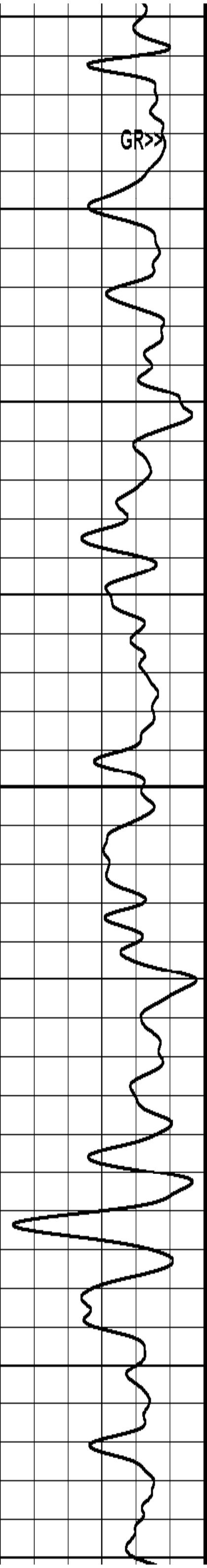
- Lost Circulation at 100 m
- Had attempted Large Thixo, Silicate squeeze
- Mix activator and Binder at surface



Lost Circulation Squeeze

- Time based on fluid level
- At 0.5 m^3 in zone gained pressure
- Drilled out next day and had minor leak





Going forward

- **Thermal Production casing**
  - Tail in slurry
    - Utilizes Ceramics best properties across zone
    - Compatible with Portland
    - Pump times and strength in place
    - Bond tests performed
- **Thermal injection casing**
  - Tail in slurry
- **CO_2 injection wells**
  - Tail in slurry

KISS Principle

- **Slurry set is largely independent of**
  - temperature
  - Particle size
  - pressure
  - organic contamination
- **Can adjust properties based on what is required not on product restrictions**

Keeping ISolation Simple

Thanks My Co-Authors

David Colborne Encana
Marty Stromquist Cemblend

Argonne NATIONAL LABORATORY

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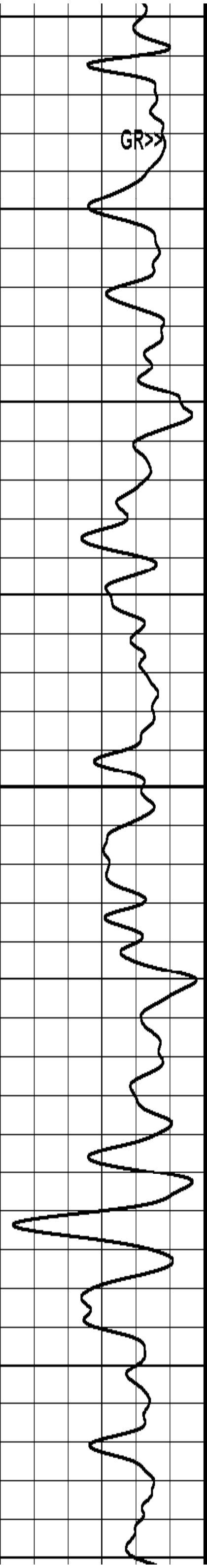

Do “YOU” have a question?