Not Your Father's Oilfield: How Technology is Changing Things*

Rod Nelson[1]

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Key Concepts

Technology development today is global and connected.

Four key drivers for technology needs

- Known reserves - Yet to be explored - Deep and harsh environments - Unconventional hydrocarbons

The value of technology integration

- Pre-drill – Prognosis - Data acquisition while drilling - Drilling operations support center - Integrated drilling - Update

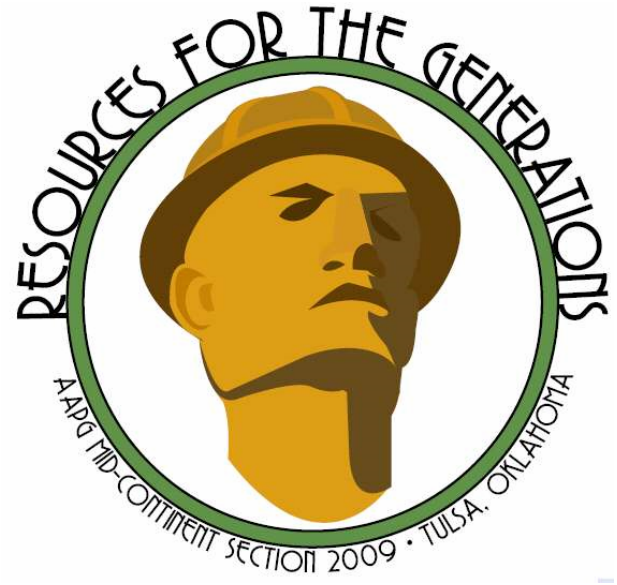
Integration of resources and data (e.g., maximizing reservoir contact – multi-stage frac with microseismic monitoring)

- Major enabler for unconventional gas - Greater understanding of frac treatments - Fracture length - Fracture orientation - Zonal differences – Asymmetry - Real-time interpretation and control

Smart materials that respond to their environments
Nano-composites
Wireless power
Complex multiphase flows…at all scales

Biomimetics: Architectures from nature

- Conventional tool and sensor architectures face hard limits in size, cost
- Nature achieves sensing and response through very "simple" designs



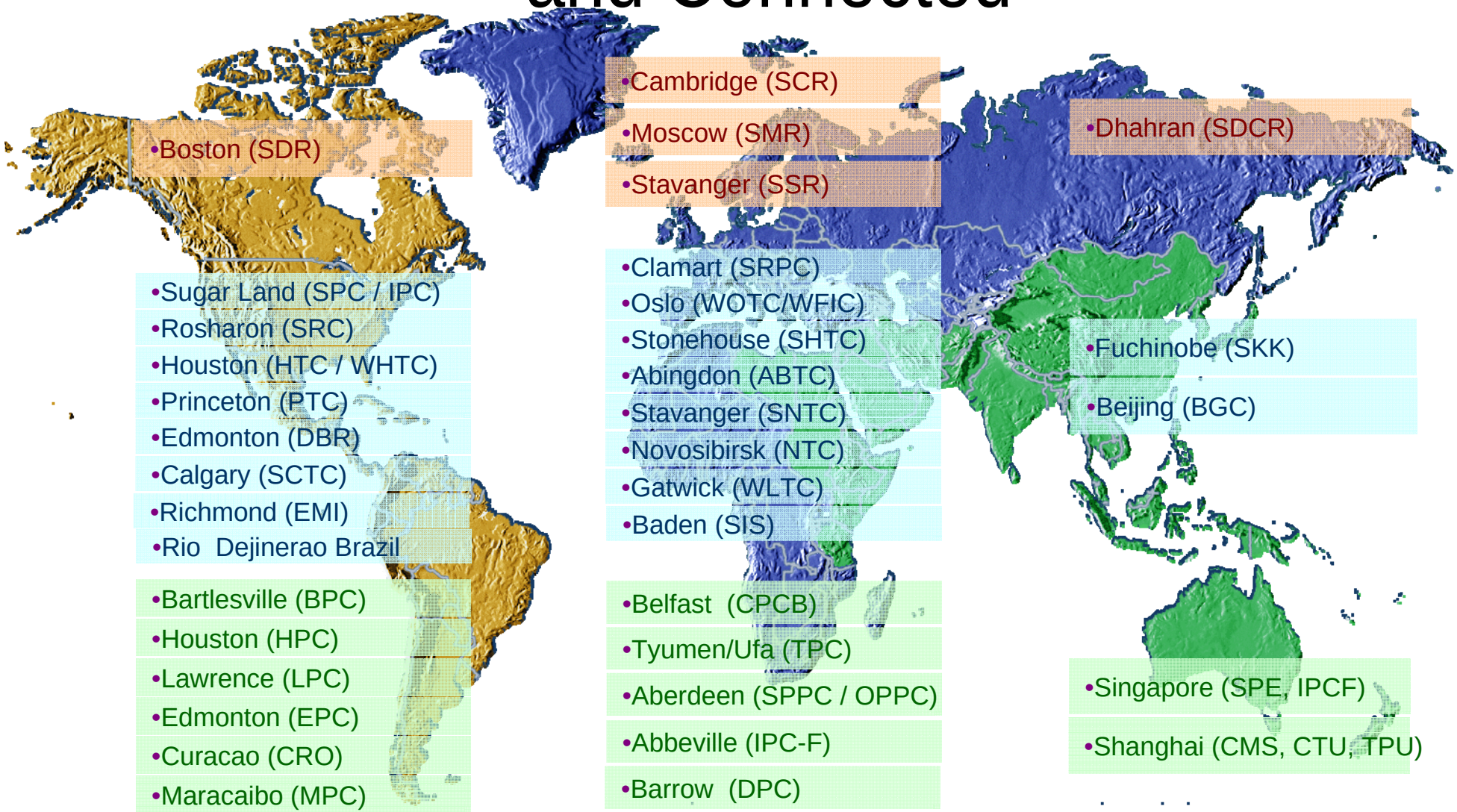
Not Your Father's Oilfield
How Technology is Changing Things

Rod Nelson, Schlumberger

AAPG Mid-Continent Section Meeting

October 13, 2009

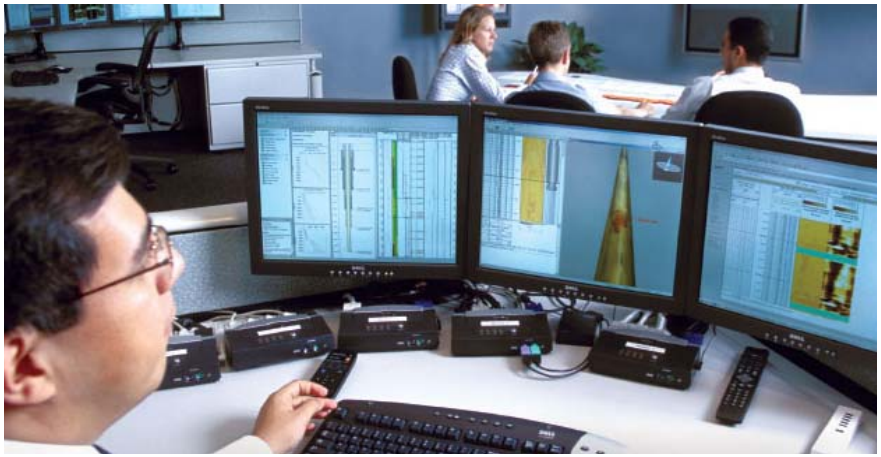
Technology Development Today is Global and Connected



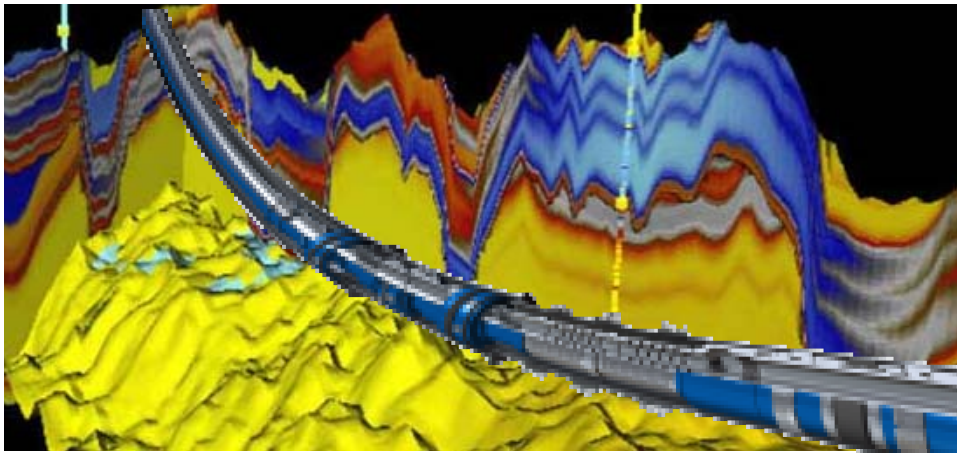
Schlumberger's R&D Organization

Four Key Drivers for Technology Needs

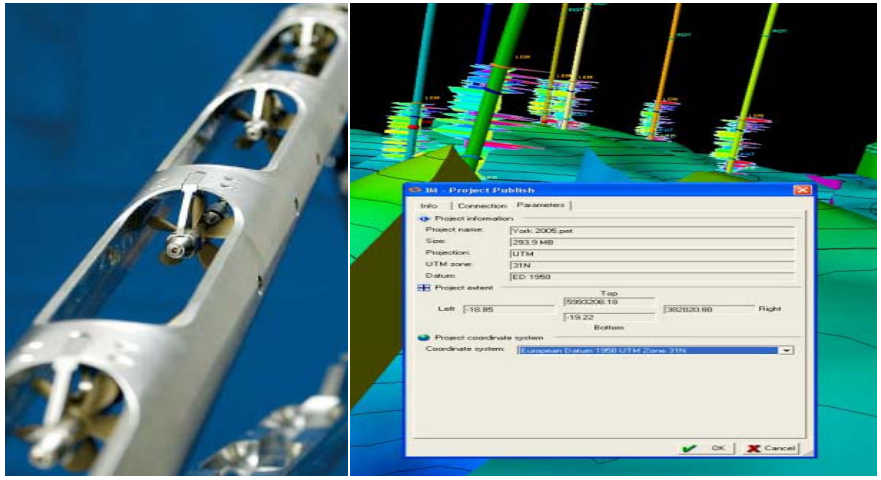
Known Reserves



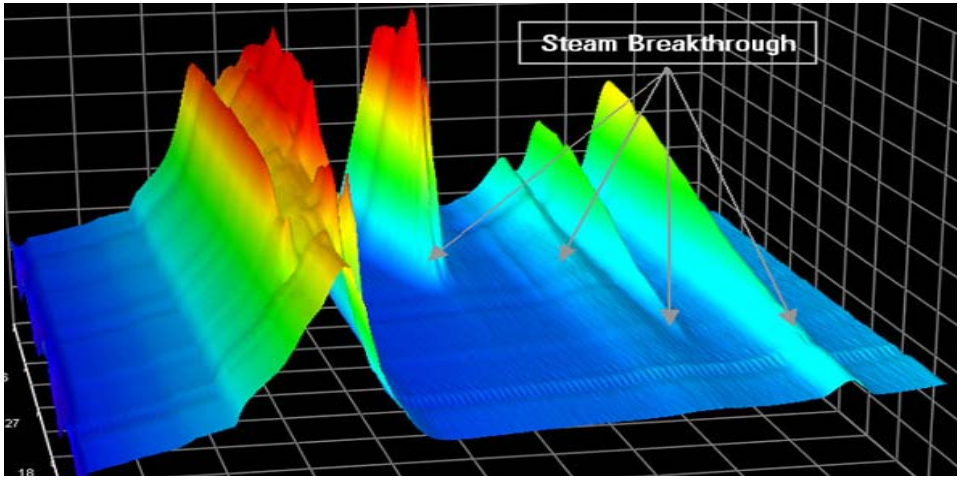
Yet to be Explored



Deep and Harsh Environments



Unconventional Hydrocarbons

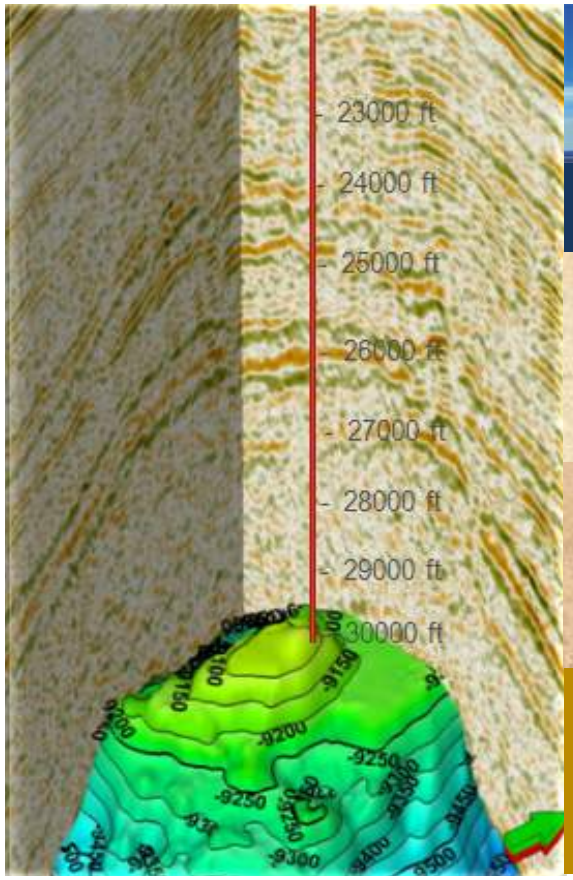


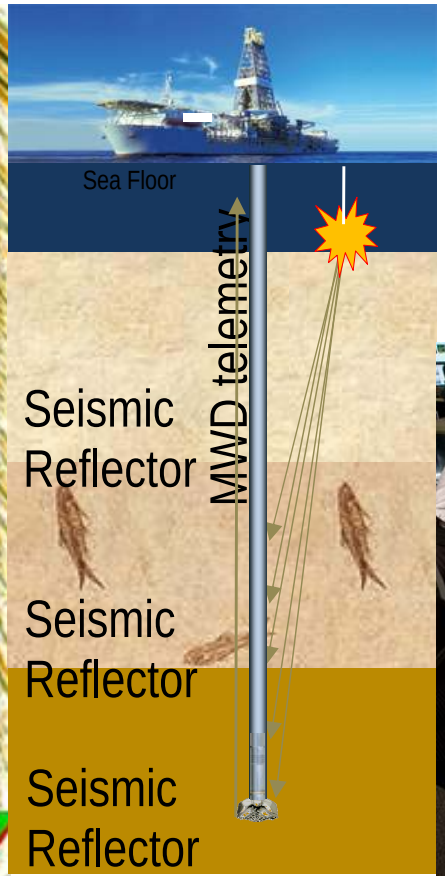
The Value of Technology Integration

Pre-Drill Prognosis

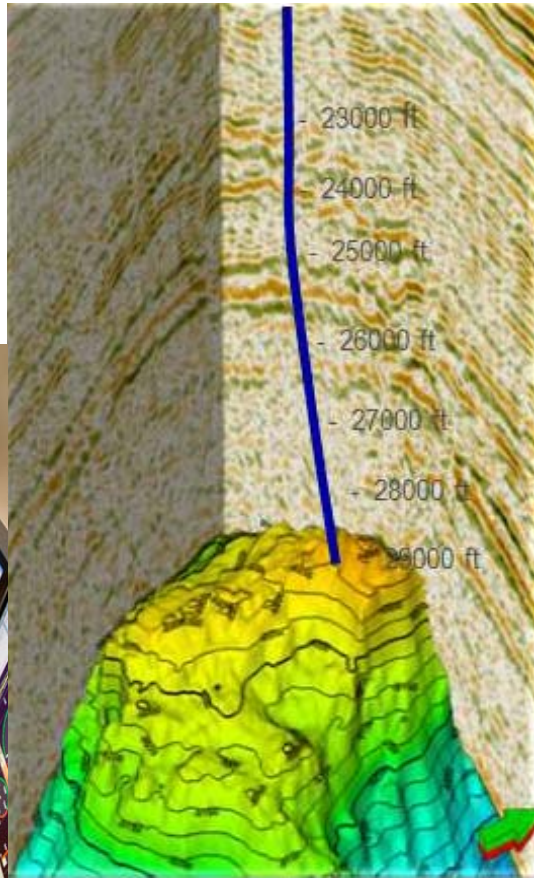
Data Acquisition While Drilling

Integrated Drilling Update



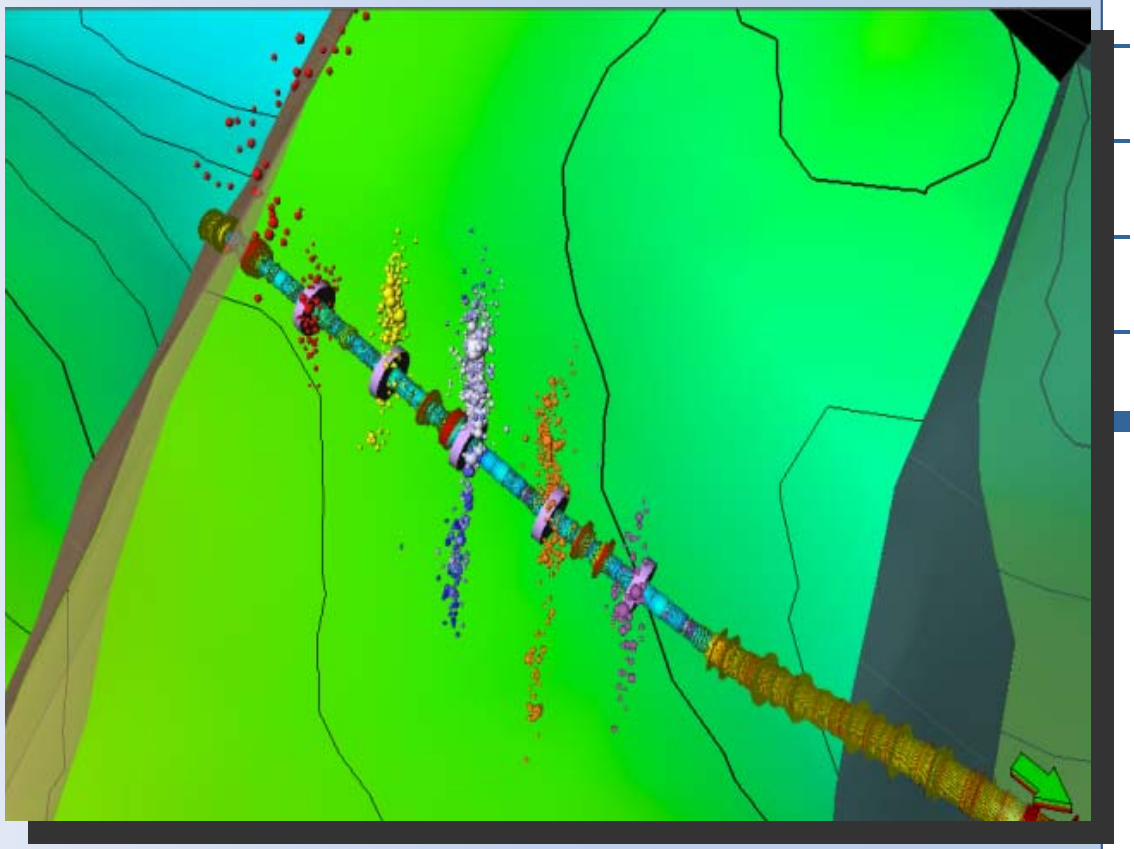


Drilling Operations Support Center

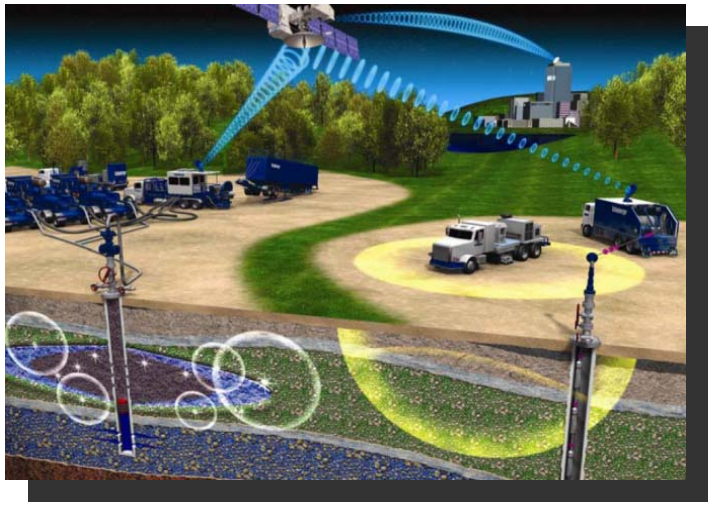


Integration of Resources & Data

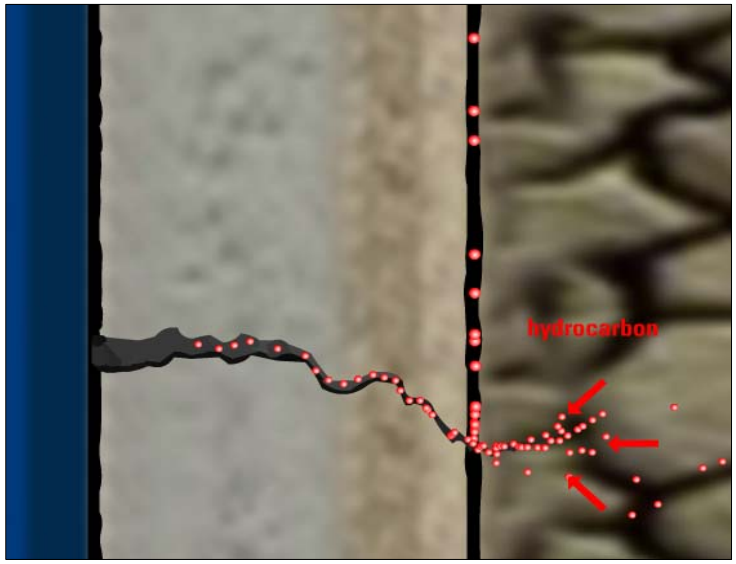
Maximizing Reservoir Contact –
Multi-Stage Frac with Microseismic Monitoring

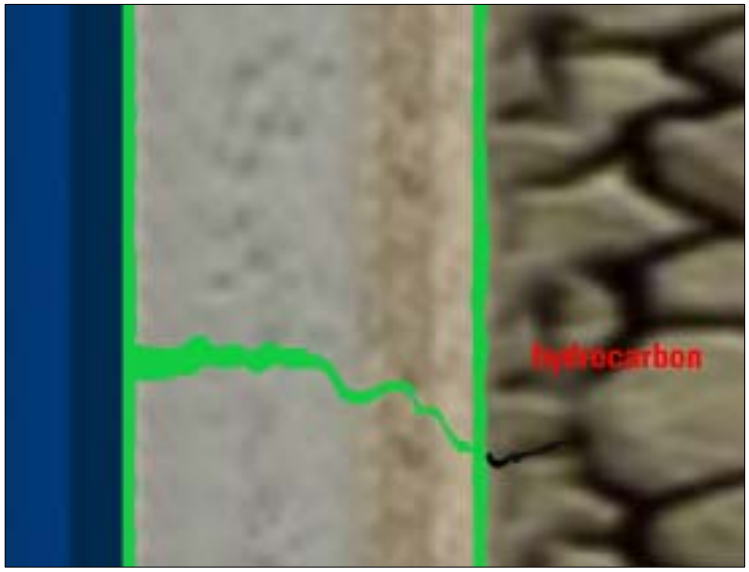


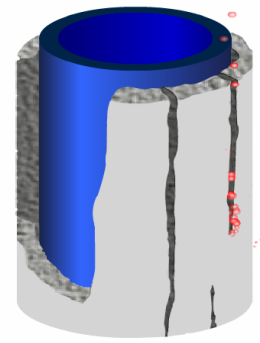
- Major enabler for Unconventional Gas
- Greater understanding of Frac Treatments
  - Fracture length
  - Fracture orientation
  - Zonal differences
  - Asymmetry
- Real-time interpretation and control



Smart Materials that Respond to their Environments

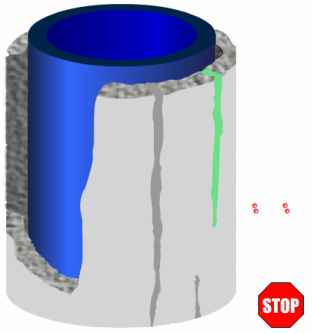




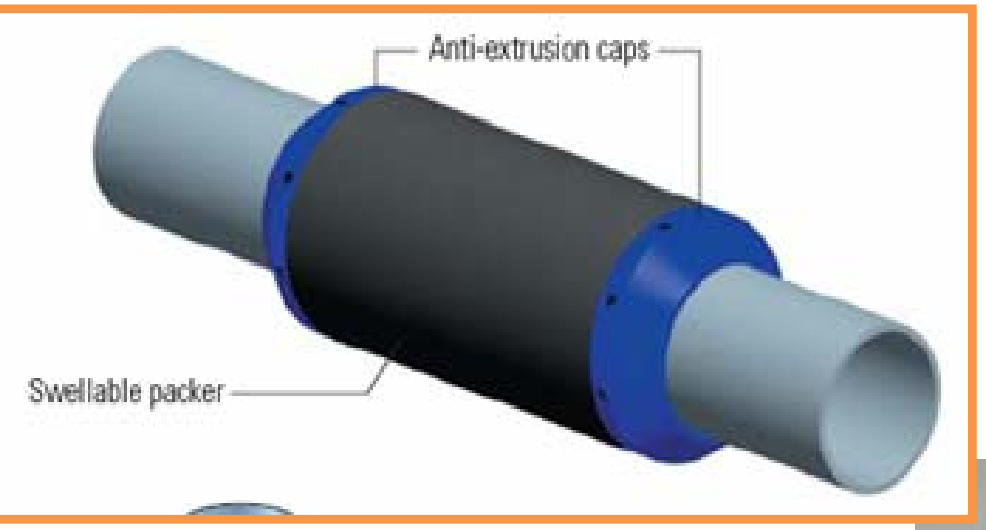


To go from a leaking well to….

…the *automatic* sealing of the well from leaks

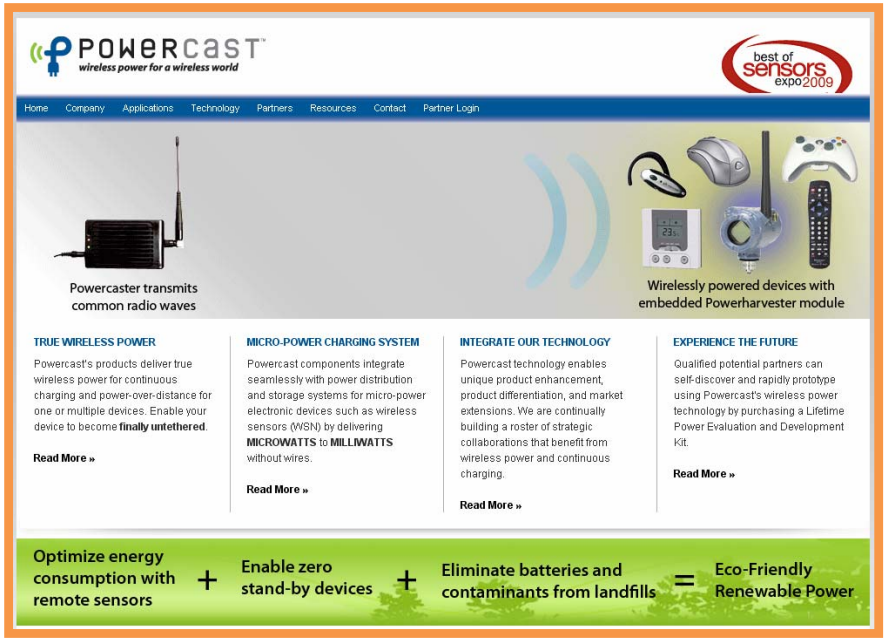


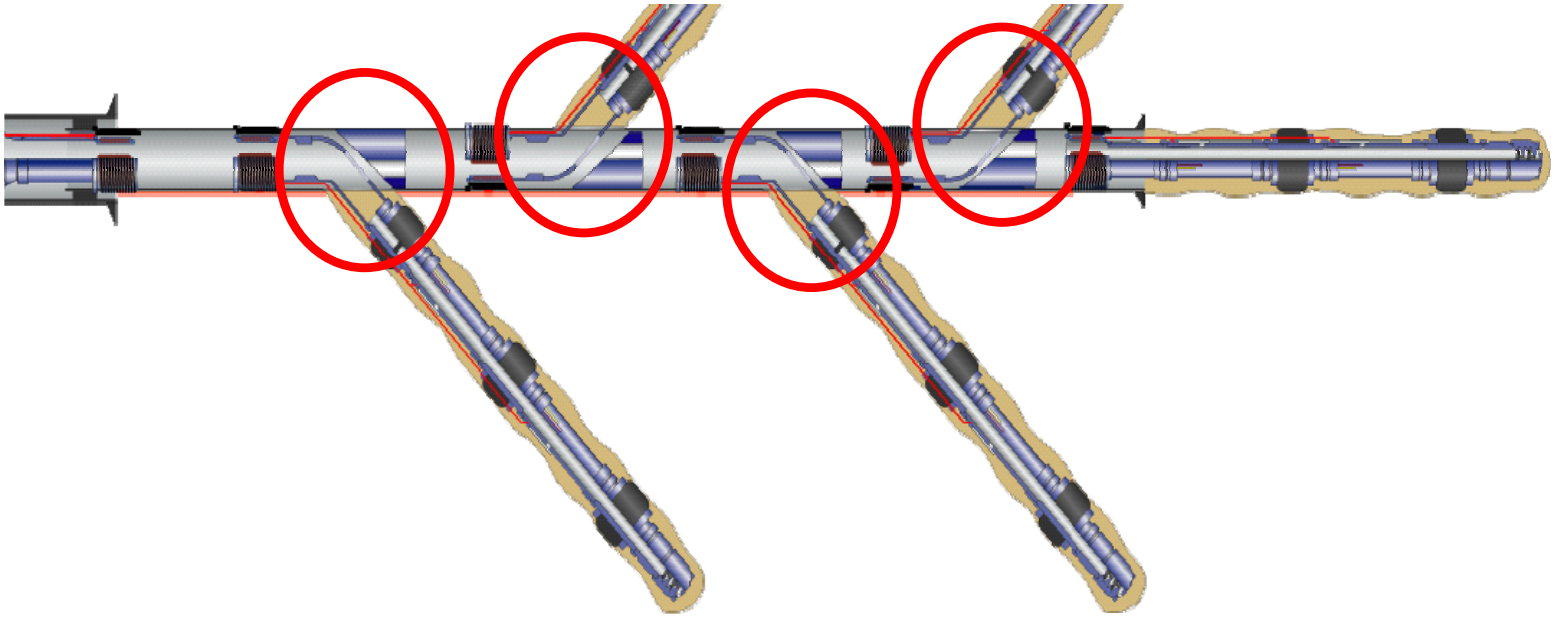
Nano-Composites



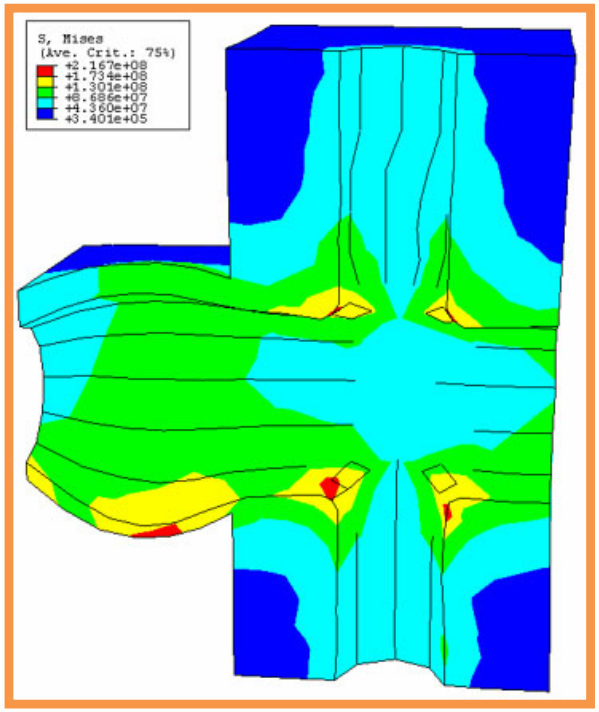
standard elastomer **with embedded CNT**

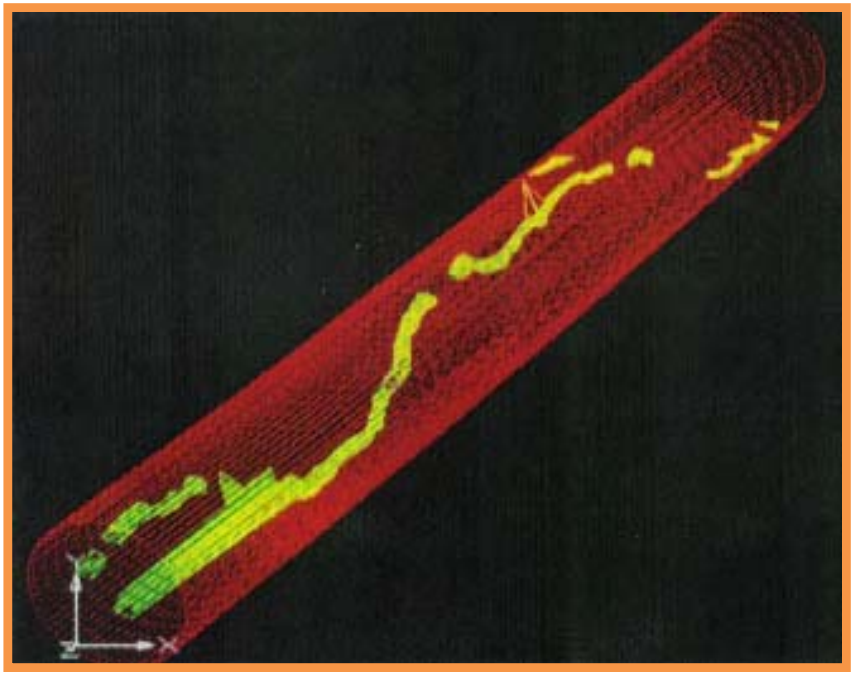
Wireless Power

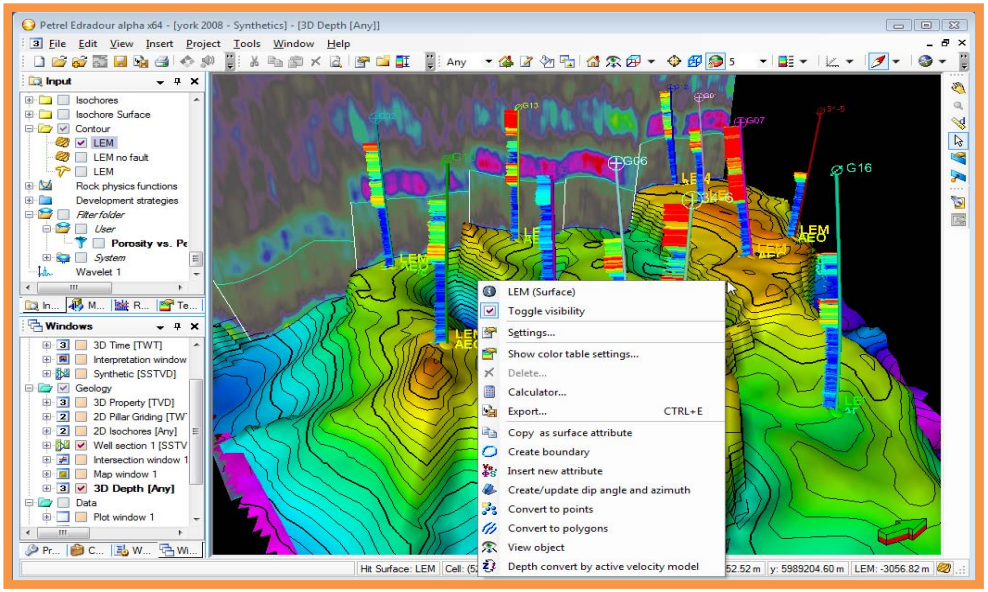


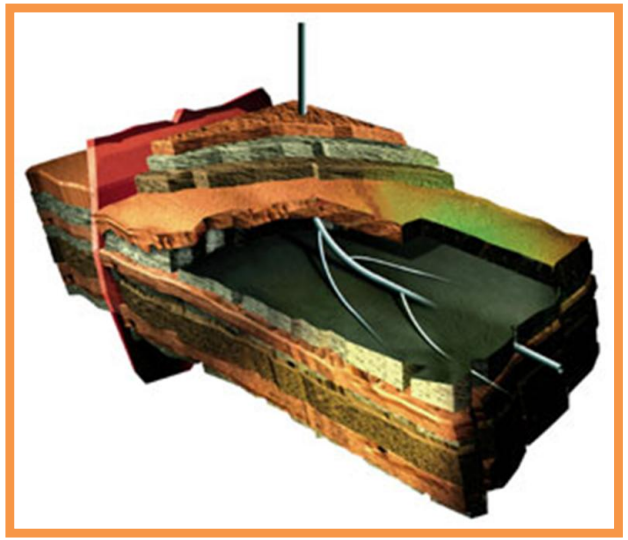


Complex Multiphase Flows…at all scales







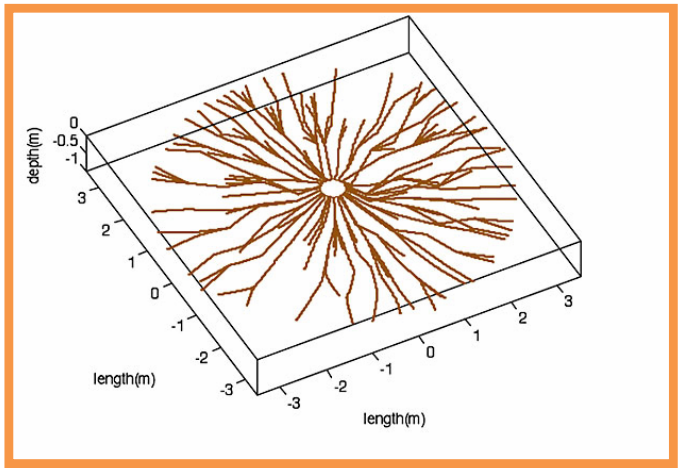


View Note for Slide 10 (page 11)

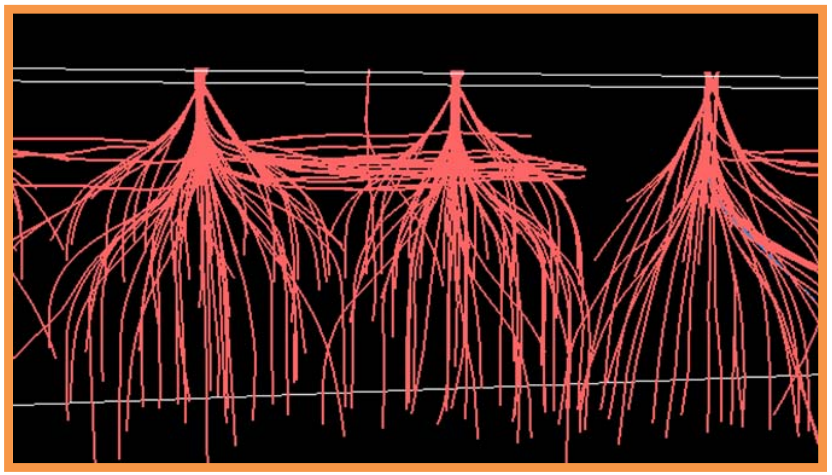
Biomimetics: Architectures from Nature

- Conventional tool and sensor architectures face hard limits in size, cost
- Nature achieves sensing and response through very “simple” designs

ex fleckeri, a type of box jelly, catches a meal. how this jelly's body is so transparent that it st invisible — the perfect camouflage when in the open water. (Photo courtesy of Paul land, Other World Images)



Radar Image of Tree roots…



…wells drilled offshore California

We Need the Best and the Brightest

America's Energy Future

Note Accompanying Slide 10

Biomimetics = " Mimicking Biology". Why would we want to do this?
We are already going the "miniaturization" route for the conventional "torpedo" geometry of wirieline and D&M tools.
But in other Segments, where we may have to deploy in difficult geometries (e.g. WS in fractures), or massive deployment (WG for land sesimic), a completely different paradigm may be better.
Nature is pretty smart about doing things with very little complexity; e.g., top right is the Venus Fly Trap, which has one of the fastest response times known (either man made or natural) with very little "general intelligence." Similarly, jellyfish stingers achieve the fastest response times known, with almost no neurones or brain.
One can imagine jellyfish-like sensors for fracturing which "feel or sense the frac."
How about steering a streamer with very elementary reflex-like responses, rather than lots of control and AI? Might be a lot more fault-tolerant. Having distributed, basic intelligence might be a lot better than very complicated centralized control.

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