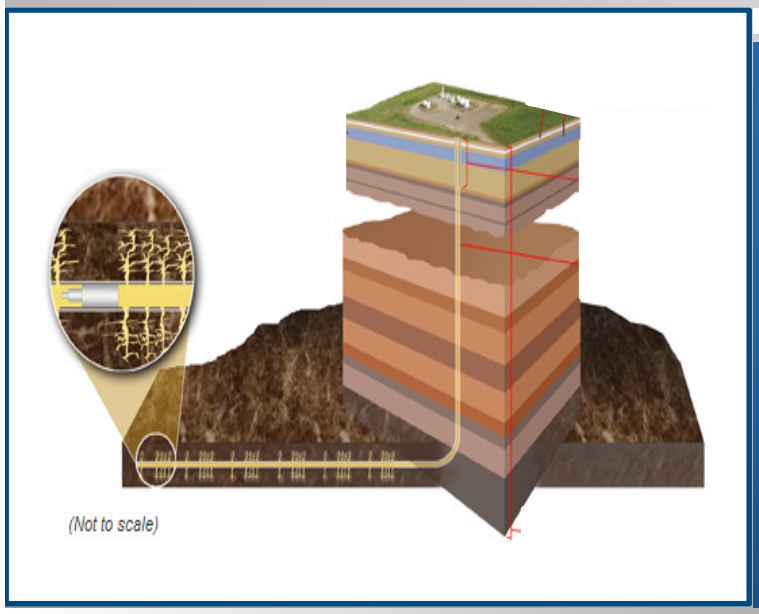

EPAct Complementary Program
Unconventional Resources
Technical Advisory Committee Meeting

Alexandra Hakala

Shale Gas Technical Coordinator, NETL-ORD

September 19, 2013

U.S. DEPARTMENT OF ENERGY | National Energy Technology Laboratory

Tech Transfer to Date:

www.edx.netl.doe.gov/ucr

31 Conference Presentations

7 Published Articles & Reports

- Additional manuscripts undergoing internal and external peer review

2 Datasets released via EDX

2 Data-driven tool/app via EDX

NOW UPDATED WITH Q3 PUBS, PRESENTATIONS, TOOLS, ETC

Complementary Program Portfolio – UCR

Fugitive Emission Factors and Air Emissions

- Fugitive Air Emissions Field Data *(2011 to present)*
- Greenhouse Gas Life Cycle Methane Emission Factor Assessment *(2011 to 2012 -- completed)*

Produced Water and Waste Management

- Predicting Compositions and Volumes of Produced Water *(2011 to present)*
- Evaluation of the Geochemical and Microbiological Composition of Shale Gas Produced Water and Solid Wastes *(2011 to present)*
- Biogeochemical Factors that Affect the Composition of Produced Waters and the Utility of Geochemical Tracer Tools *(2011 to present)*

Subsurface Fluid and Gas Migration

- Integrated Field Monitoring – *Gas/Fluid Migration* *(2011 to present)*
- Gas Flow from Shallow Gas Formations *(2012 to present)*
- Approach for Assessing Spatial Trends & Potential Risks with UCR Systems *(2011 to present)*
- Impacts of Shale Gas Development on Shallow Groundwater *(2012 to present)*
- Subsurface Gas and Fluid Migration Assessment *(2011 to 2012 -- completed)*
- Develop a Suite of Naturally Occurring Geochemical Tracer Tools that Verify the Sources of Fluids in Complex Geologic Systems *(2011 to 2012 -- completed)*

Predicting Fracture Growth and Ground Motion

- Fracture Propagation and Ground Motion Related to Unconventional Oil and Gas Development *(2011 to present)*
- Integrated Field Monitoring – *Microseismic* *(2011 to present)*
- Geophysical and Geomechanical Factors that Affect Subsurface Fluid and Gas Migration *(2011 to 2012 – completed)*

Complementary Program FY13 Portfolio
Unconventional Resources (UCR)

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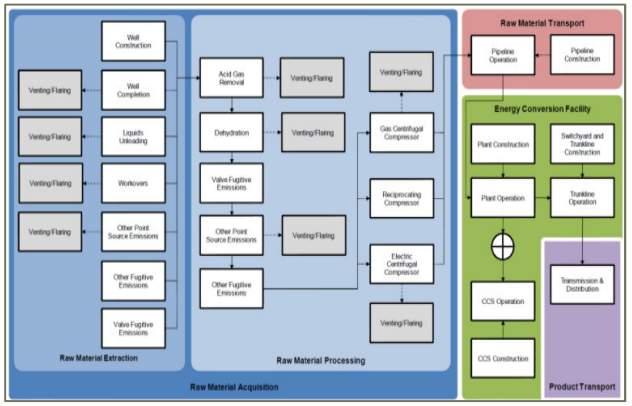
Fugitive Air Emissions Field Data

Ambient and point-source monitoring of methane and other emissions

Use of gas-phase isotope tracers and atmospheric dispersion modeling to pinpoint emissions source (*new)*

Inputs for emission factors used in greenhouse gas life cycle analyses

Field Measurements with the NETL ambient air quality trailer, and application of the acetylene tracer point source technique



Data processing to provide values in formats useful for LCA calculations

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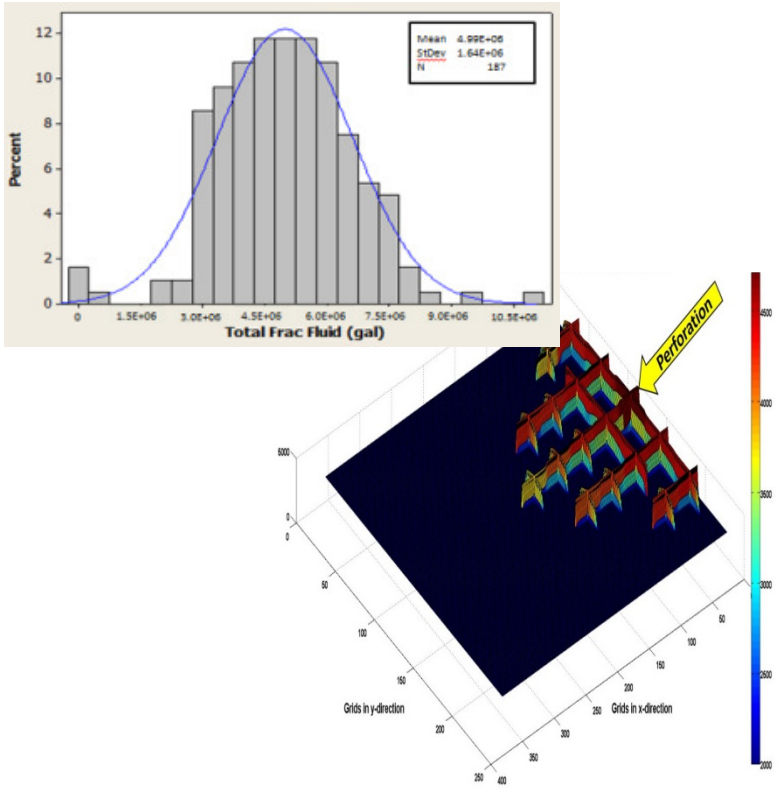
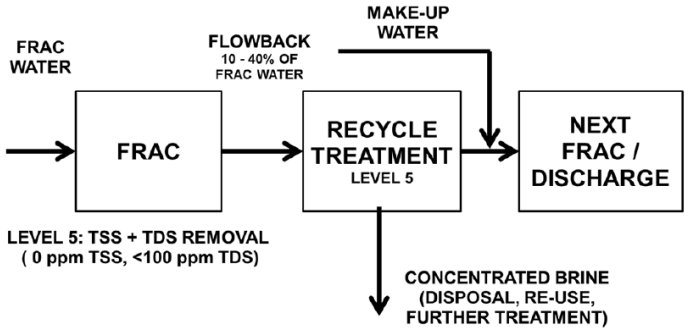
Predicting Compositions and Volumes of Produced Water

Couple existing data and simulations to predict **amount and salinity of fluid** produced during hydraulic fracturing



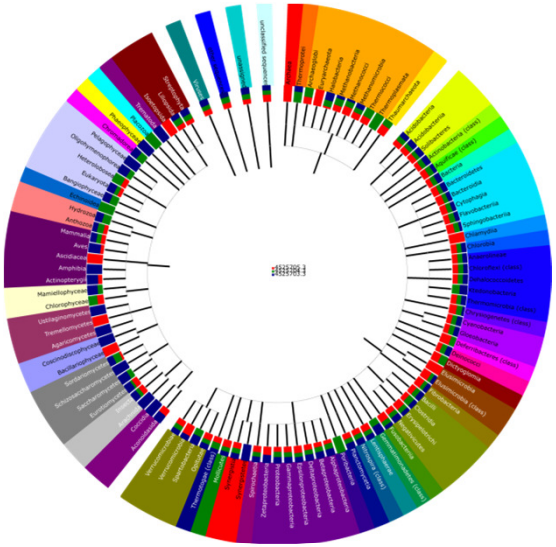
Use supply chain modeling to identify means for **optimizing the treatment, recycling, and disposal of produced water** with a focus on minimizing waste



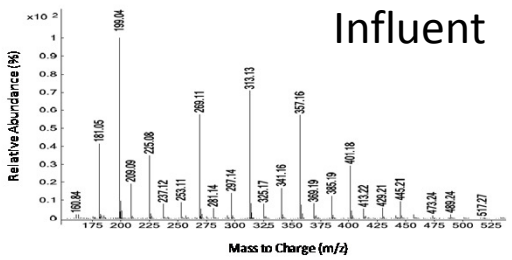
Schematic from Slutz et al, SPE 157532

Evaluation of the Geochemical and Microbiological Composition of Shale Gas Produced Water and Solid Wastes

Characterize chemistry and microbiology in produced waters (*new*: and solid residuals)
Focus on surface processes



Microbial ecology



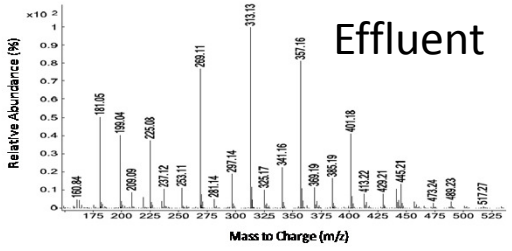


Figure 5. Mass spectrum of a) influent and b) effluent samples collected at a water treatment facility used specifically for the treatment of produced waters.

NORM, Organics, and Metals

Data from Carter (2013)

Biogeochemical Factors that Affect the Composition of Produced Waters and the Utility of Geochemical Tracer Tools

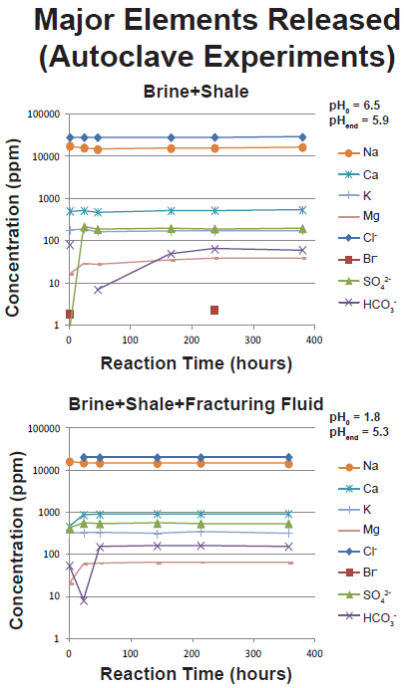
Focus on downhole processes and monitoring tools

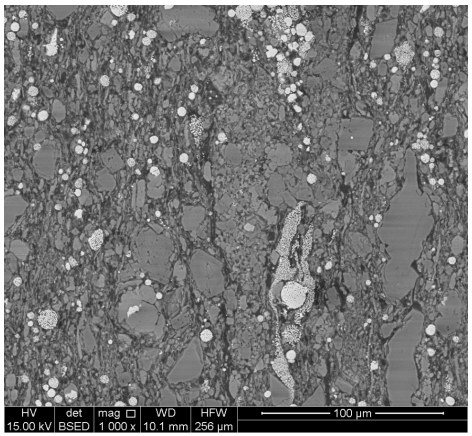
Sources and behavior of potential tracers and contaminants

Shale reactivity under stimulation conditions

Fate of fracturing fluids

Changes to shale physical-chemical and mechanical properties





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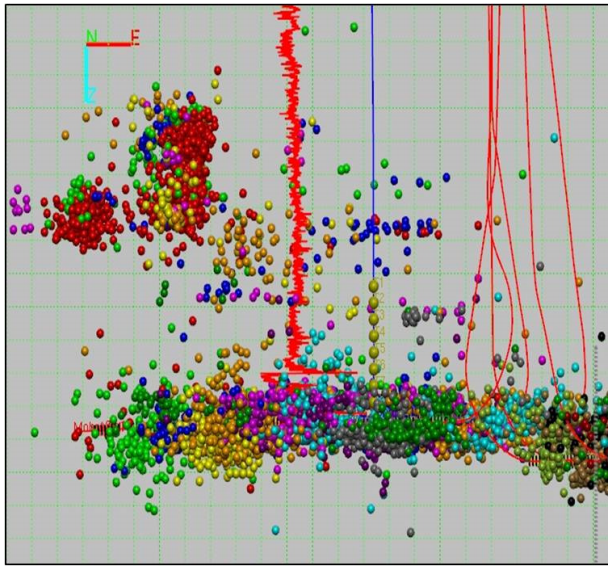
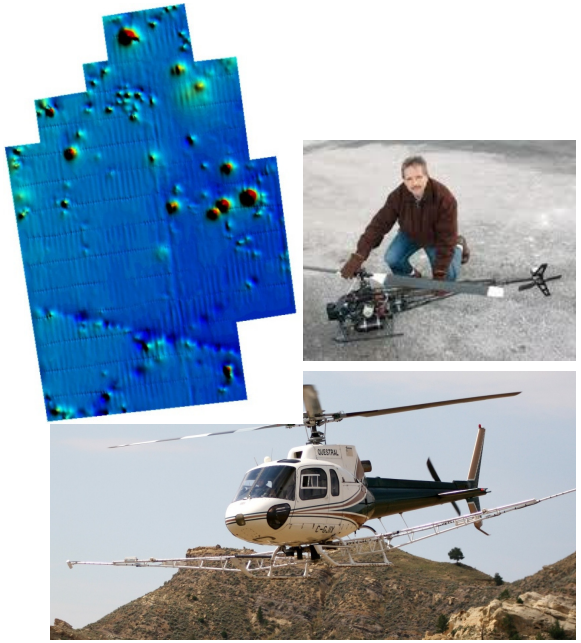
Integrated Field Monitoring – Fluid/Gas Migration

Evaluate fracture growth, ground motion, and potential pathways for gas/fluid migration



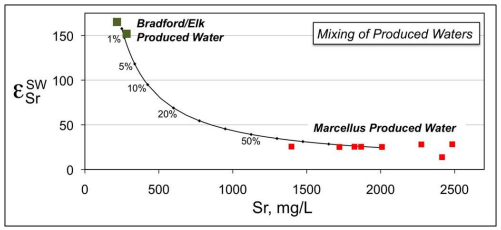
Field microseismic data to evaluate fracture behavior during stimulation

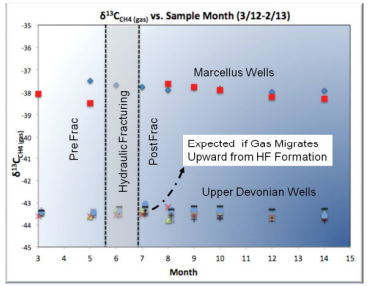
Identify wellbore locations and areas affected by surface spills.



Use airborne and ground surveys to locate existing wells and potential produced water spills

Identify sources of gases and fluids.

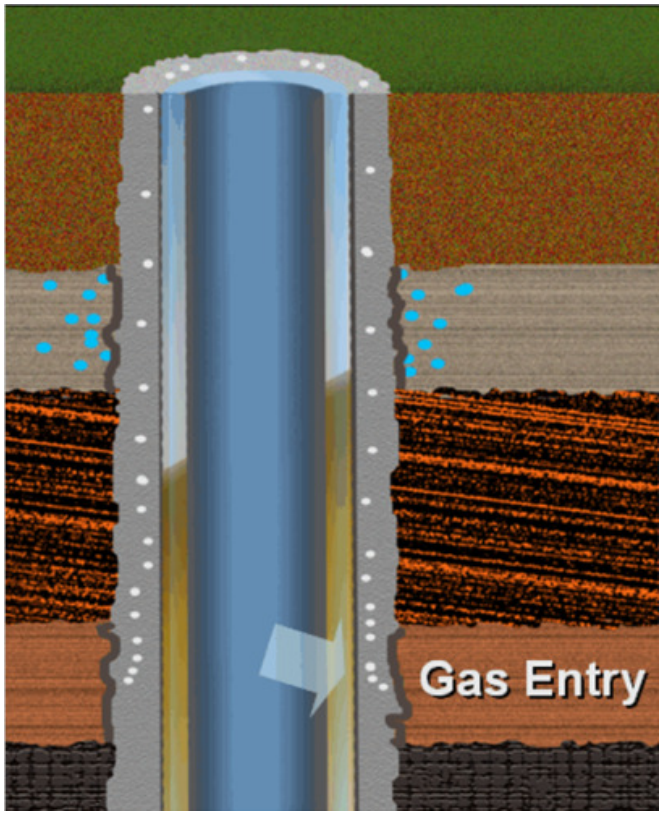




Use synthetic and natural geochemical tracers

Gas Flow from Shallow Gas Formations

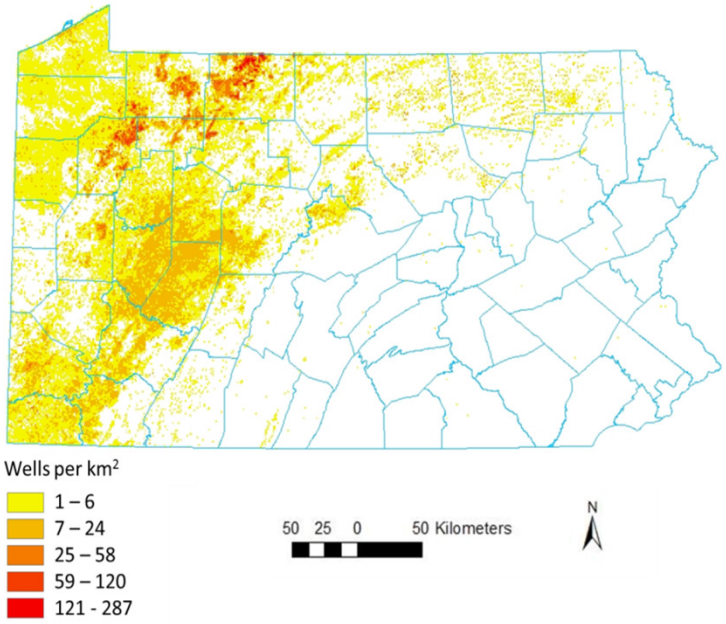
Evaluating wellbore risks requires knowledge about existing and newly-cemented wells



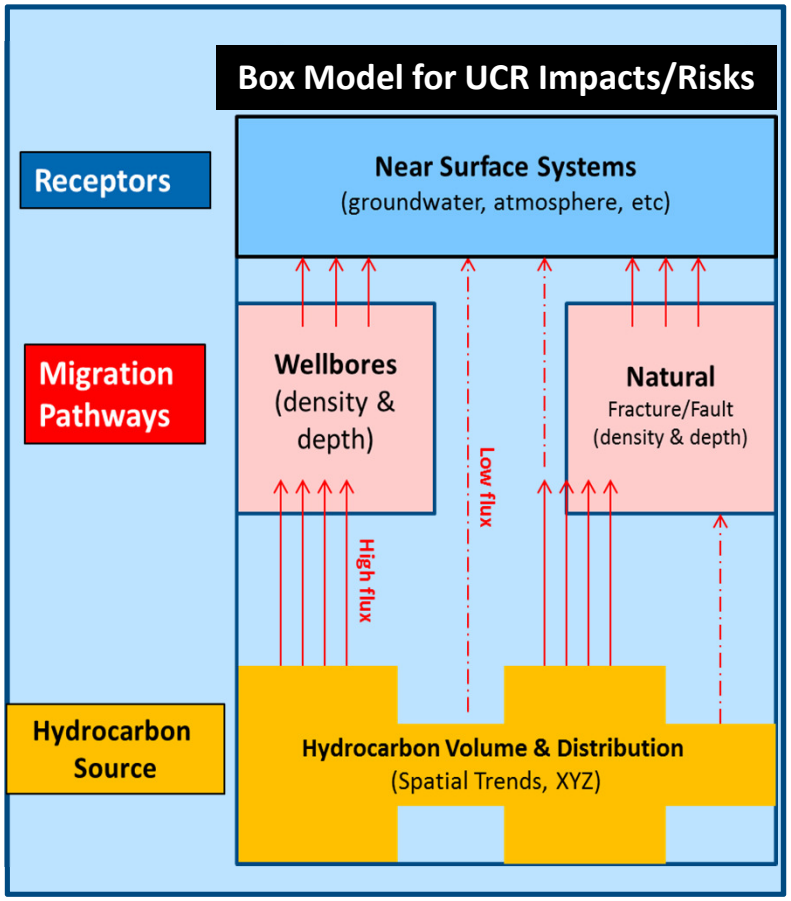
Develop laboratory and modeling techniques to evaluate shallow gas effects on well cement hydration

Approach for Assessing Spatial Trends & Potential Risks with UCR Systems

Use of spatial data sets to evaluate potential risks during shale gas development

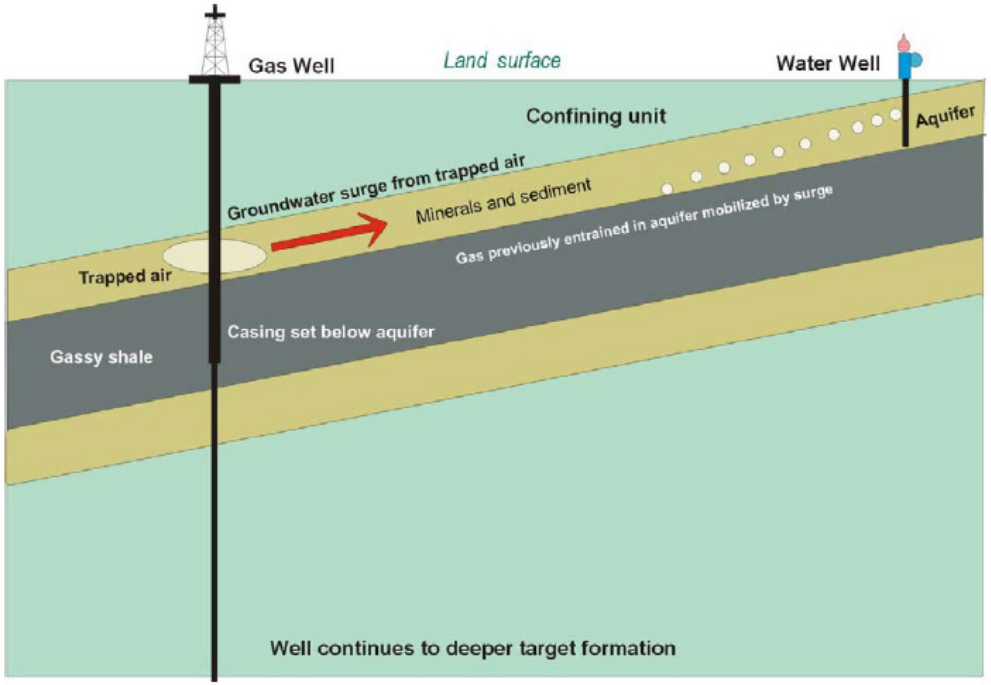


Existing wells in PA (PA IRIS database)



Impacts of Shale Gas Development on Shallow Groundwater

Potential for drilling to affect shallow groundwater hydrology



Schematic hypothesis of how shallow gas may migrate during drilling

Potential for natural processes to mitigate groundwater issues (*natural attenuation – new*)

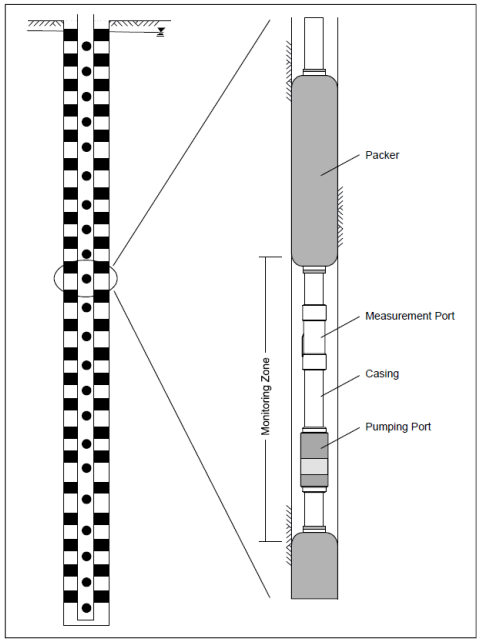


Figure 1. Westbay System with monitoring zones isolated by packers.

Schlumberger Water Services

Field monitoring, laboratory investigation, and modeling

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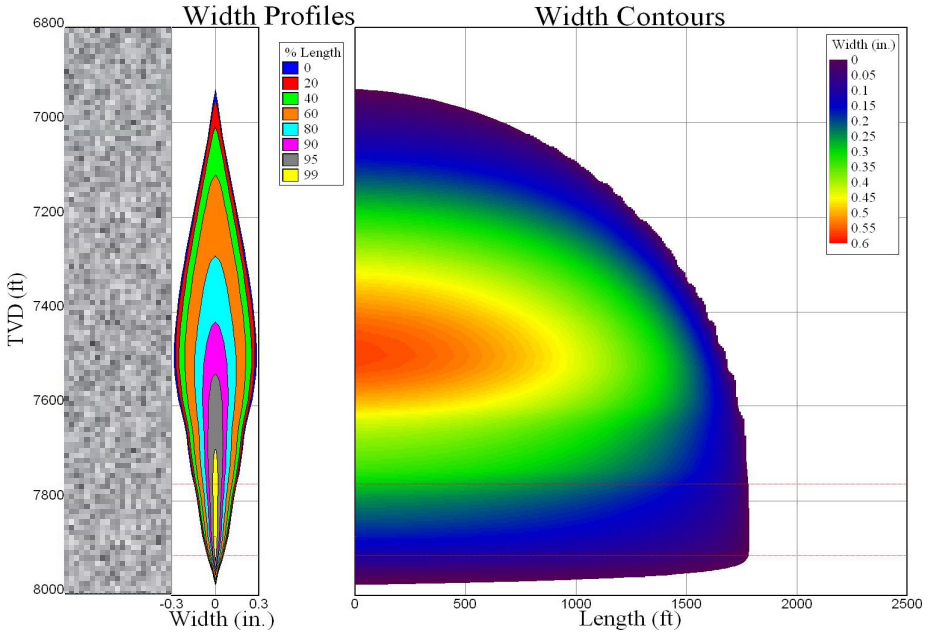
Fracture Propagation and Ground Motion Related to Unconventional Oil and Gas Development

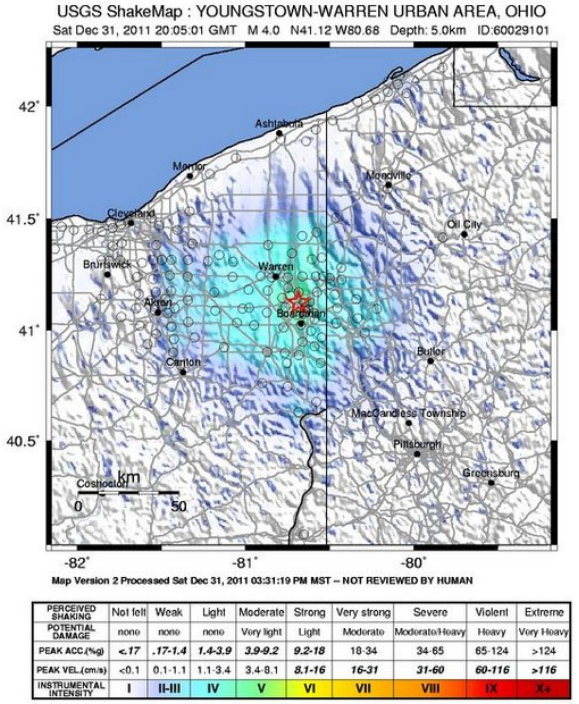
(Lead: Bromhal)

Complete evaluation of **vertical fracture extent based on heterogeneous rock properties** for the Appalachian Basin



Train models with field and laboratory-generated data to develop realistic predictions.

Identify the causes behind **induced seismic events caused by wastewater and frackwater disposal**



Evaluate case studies and develop models for predicting ground motion.

Integrated Field Monitoring – Microseismic

(*Lead: Hammack)*

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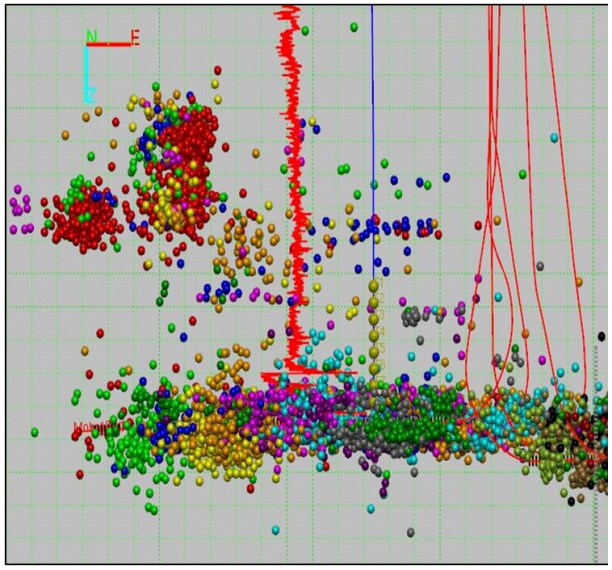

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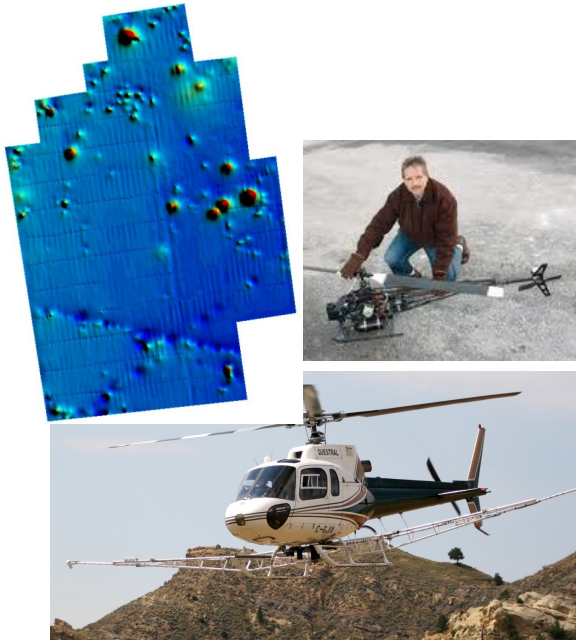

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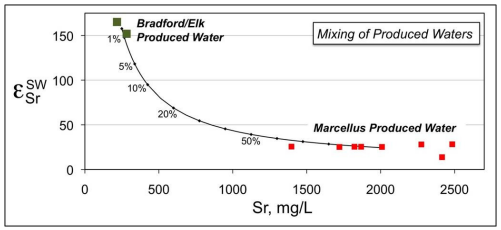

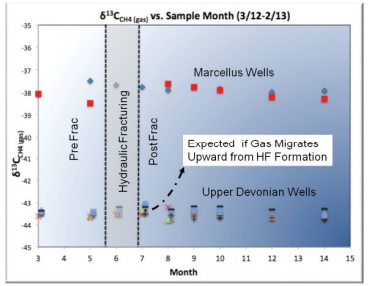

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