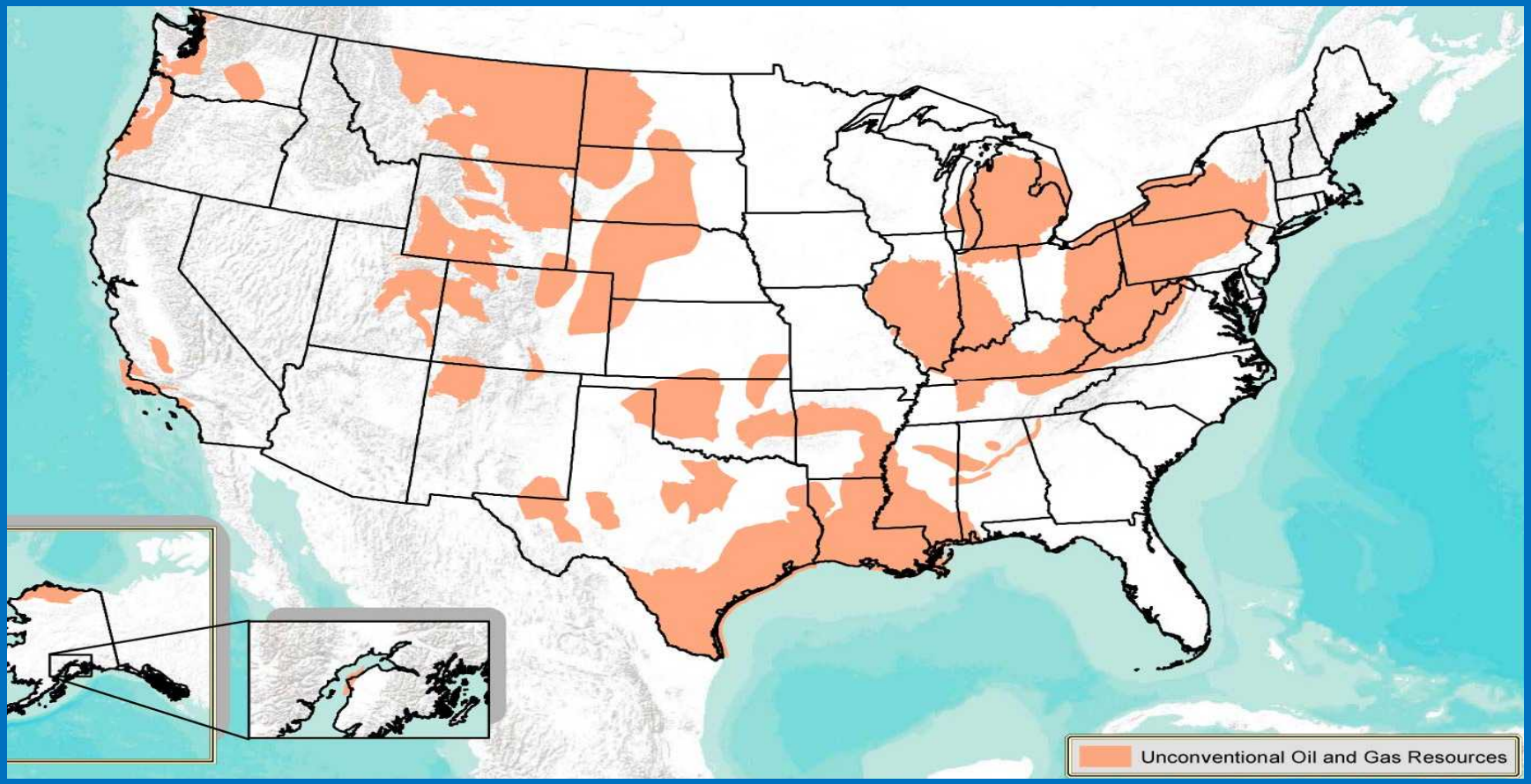
Unconventional Hydrocarbon Development and the Use of Hydraulic Fracturing --

Monitoring for Water Quality Impact

USGS
science for a changing world

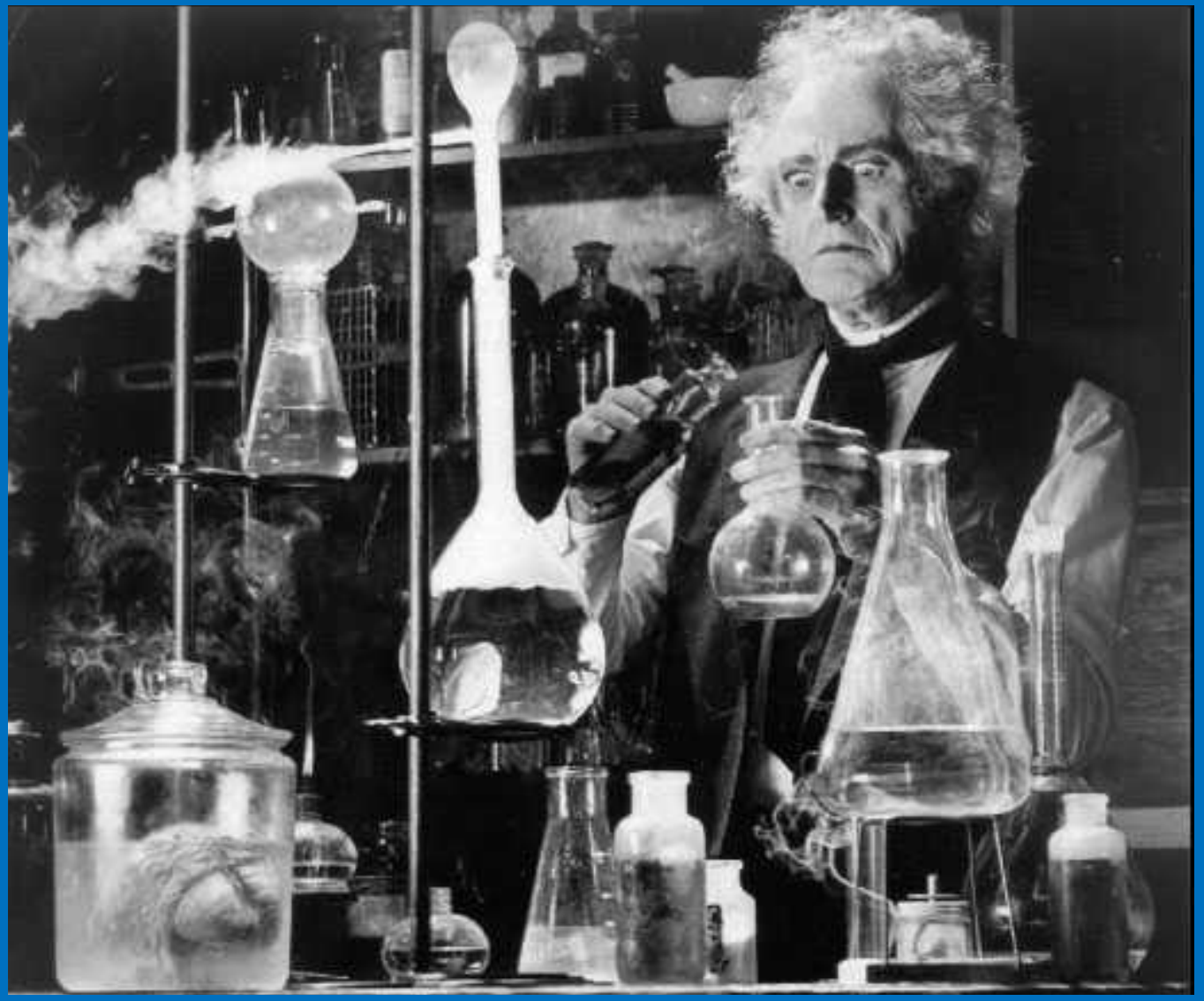
Principal Areas of Unconventional Hydrocarbon Resource Development

Oil, Gas, and Coalbed Methane



USGS
science for a changing world

What Parameters to Monitor?



USGS
science for a changing world

PARAMETERS TO MONITOR DEPEND ON:

1. **What parameters are important in relation to the local geology, hydrology, ecology?**
   Know and understand the parameters of interest/concern for your area – they vary by Play, and can vary within a Play.

2. **What do you sample for and when?**
   Collect specific baseline parameters each time, but if something is 'different' or 'out of range' from previous measurements, it might be time to increase the intensity and types of parameters monitored.

3. **What resource(s) are you interested in –**
   Surface water and[or] groundwater, stream and[or] forest ecology, other?

PARAMETERS TO MONITOR DEPEND ON: (continued)

4. **What has been measured to establish a 'baseline' for the area**?

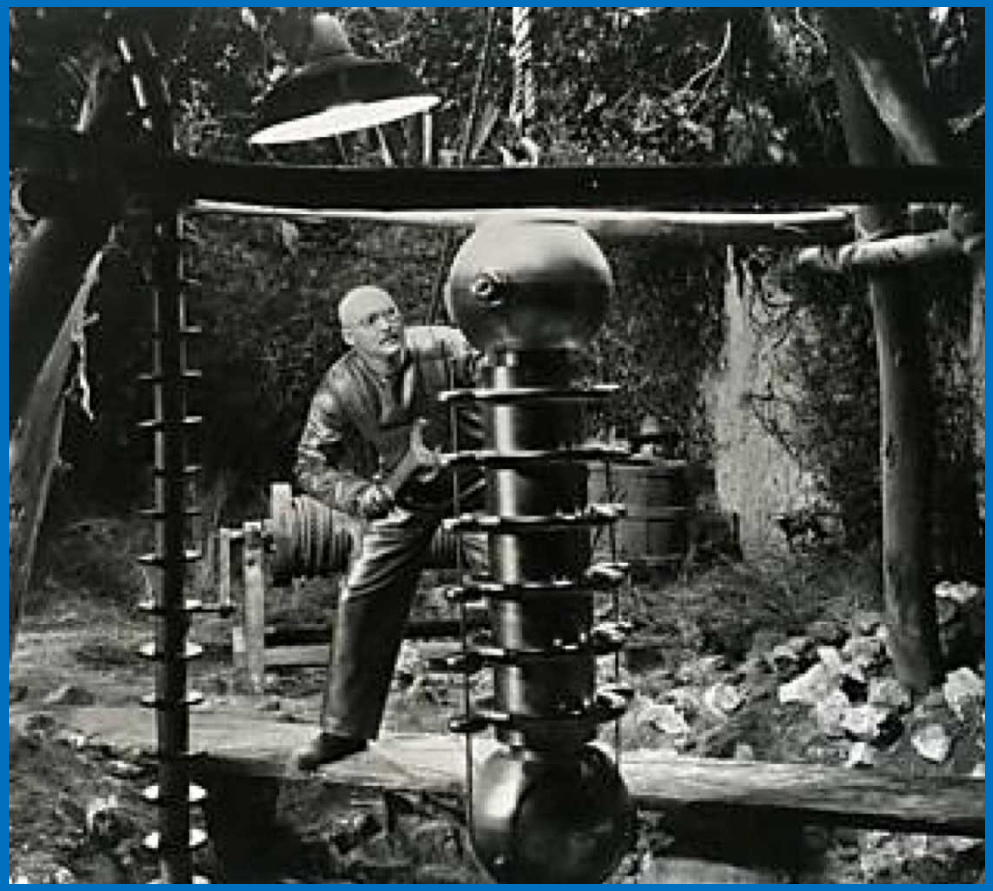
   a. What has been studied in the past by local, regional, state, federal agencies?

   b. Are these data available (electronically), and have they been summarized in cohesive document(s) to answer Question #1 (above)?

5. **What are the capabilities of the organization** to collect, analyze, and report the results?

   a. Personnel – Number, experienced, trained, dedicated?
   b. Funding – How much, how long can funding be sustained?
   c. Community - local, regional, or larger associations with similar interests across the Play?
   d. Data Quality is it 'good'? – QA/QC a 'must' to be accepted as part of a regional data base, and if needed, stand up in a court of law?

What are the "Best" Tools to Use?



USGS
science for a changing world

The best tools are those you can afford, use, and maintain to answer the previous set of questions for an extended period of time.

1. ***Simple tests*** – Test strips, colorimetric, titration – Plan and perform QA/QC.

2. ***Water-quality meters*** (conductivity, temperature, salinity, dissolved oxygen, specific ions, some organic constituents.) Plan and perform QA/QC.

3. ***Lab analyses*** of water quality samples – simple to complex, fairly inexpensive to expensive. Make sure that you do replicate, field blanks and spikes, and receive all field and lab QA/QC results in electronic spreadsheet format!

4. ***Think outside the 'chemical box'*** – macro-invertebrates can indicate the quality of a stream. They are not parameter specific, but act as an integrator of stream water-quality conditions over time.

5. ***Maintain a database*** of all information – field, sampling, lab results (including all QA/QC) and have adequate backup capabilities for data storage and analysis.

USGS science for a changing world

"Take note; Cronk say salinity unusually high."

For Groundwater – (For surface water, generally remove gas and volatile analyses)

"Simple List*"	***"Average List*"***	***"Full Monte List*"***
Barium	*Simple list* plus	*Simple & Average* plus
Bromide	Alkalinity	Radium 226/228
Chloride	TSS – (sediment)	Isotopic content of
TDS/ Specific	Sodium	methane, ethane, higher-
Conductance	Strontium	chain hydrocarbons
Iron	Sulfate	Full cations/anions
pH	TOC	with mass balance
Dissolved	Manganese	BTX scan
methane/ethane	Potassium	MBAS – detergents
	Gross alpha/beta	VOC's and…….
Can be field measurements except for gas analyses.	Some field measurements but most are laboratory.	All lab analyses.

*Suggestions only –
"Tune" them to your region, resources, and ability to do consistent monitoring.

USGS science for a changing world

Remember:

Choose your parameters carefully – understand what you want to monitor, what and how you can afford to monitor, and how long you can monitor your region and[or] Play!

Choose your sites carefully – safety first, keep your objectives and resources in mind, and remember - "You can't measure everything everywhere"!

Be consistent in how, where, when you collect samples and make measurements, no shortcuts! Seasonality can make a difference in water-quality results.

Provide good training, annual retraining, and use the buddy system. No hero's!

Provide a workable schedule - with trained personnel and "back-up" personnel. Document each sampling location (a map and GPS coordinates) , safety tips and equipment, emergency phone numbers , and make sure they carry this information as they travel!

Share and maintain all equipment - have back-up equipment if possible.

Calibration logs (in a book) for every piece of equipment with appropriate calibration schedules , dated results, and recalibration as per the manufacturer.

Document everything! Make copies, backup your computers, and save discs offsite. Provide a data archive and share with other groups –data, techniques, ideas.

Be prepared in case something goes wrong – expect the unexpected.

USGS
science for a changing world

Questions?