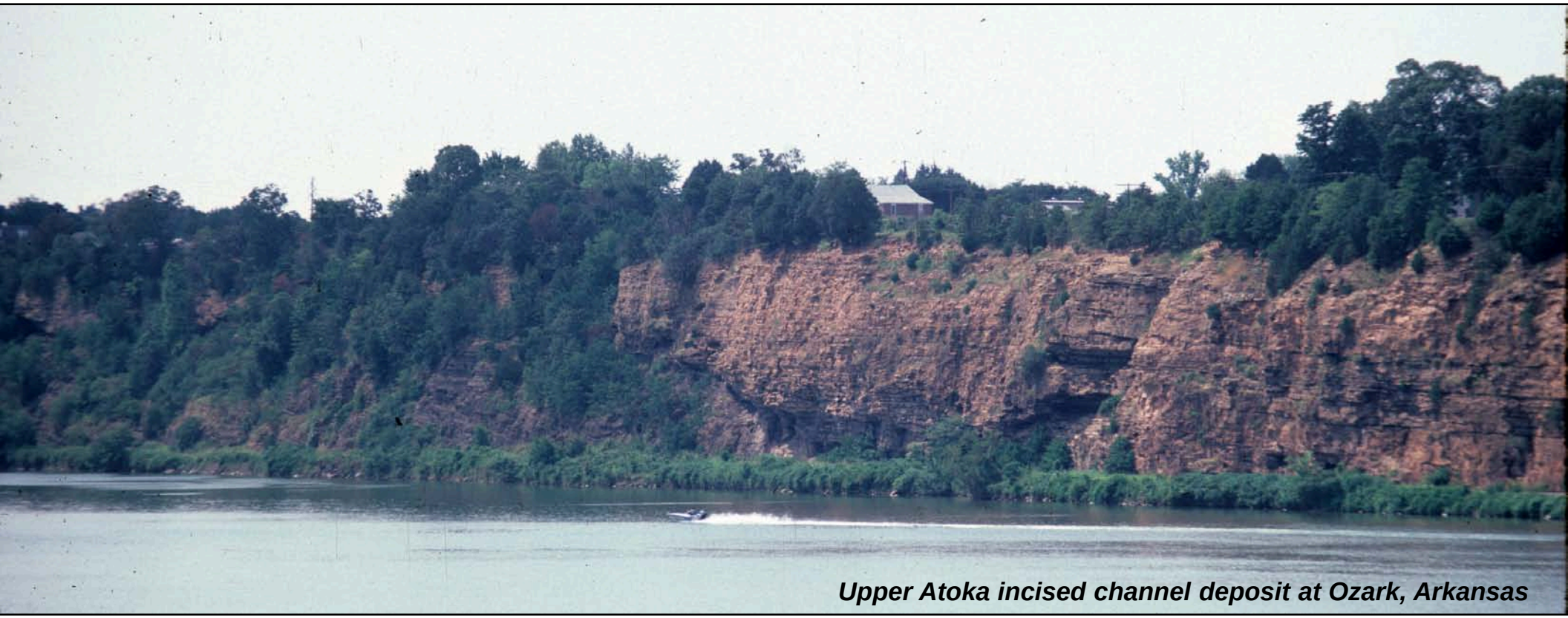
Natural Gas Assessment of the Arkoma Basin, Ouachita Thrust Belt, and Reelfoot Rift

Introduction & Methodology Overview



Upper Atoka incised channel deposit at Ozark, Arkansas

Dave Houseknecht

U.S. Department of the Interior
U.S. Geological Survey

Energy Policy and Conservation Act of 2000 (EPCA) *and* Energy Policy Act of 2005 (EPAct 2005)

Some Pertinent Directives Included in These Laws

- **These acts of Congress direct the Secretary of the Interior to conduct an inventory of oil and natural gas resources beneath onshore Federal lands.**

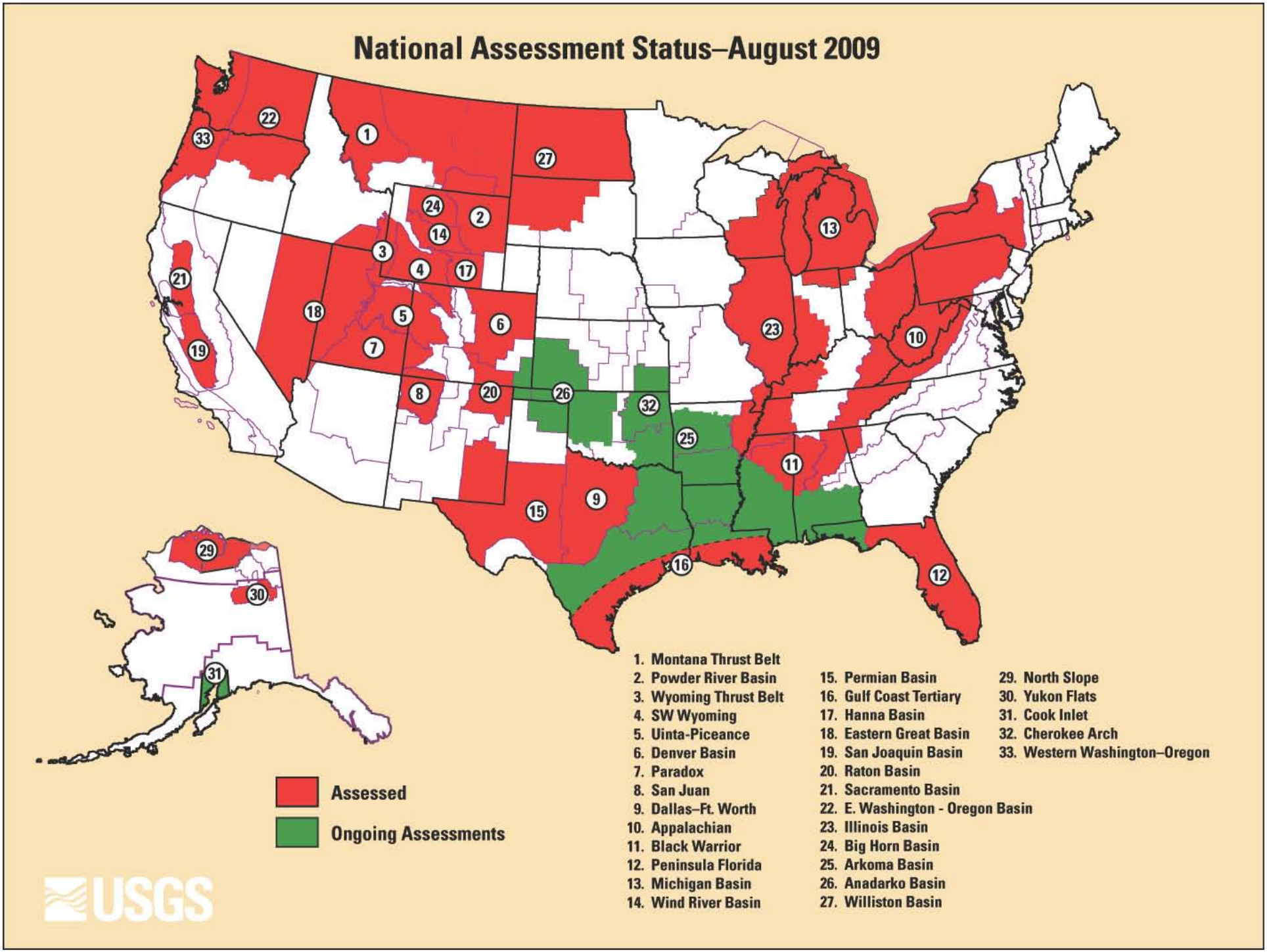
- **The EPCA Phase III inventory includes the entire onshore United States.**

- **USGS Responsibility: the inventory shall identify the USGS estimates of oil and gas resources underlying these lands.**

- **Methodology: the Secretary of the Interior shall use the same assessment methodology across all geological provinces, areas, and regions in preparing and issuing national geological assessments to ensure accurate comparisons of geological resources.**

- **Updates: the USGS estimates of oil and gas resources shall be regularly updated and made publicly available.**

Status of USGS National Oil and Gas Assessment



USGS

USGS National Oil and Gas Assessment – *Organization & Schedule*

Chris Schenk, Project Chief

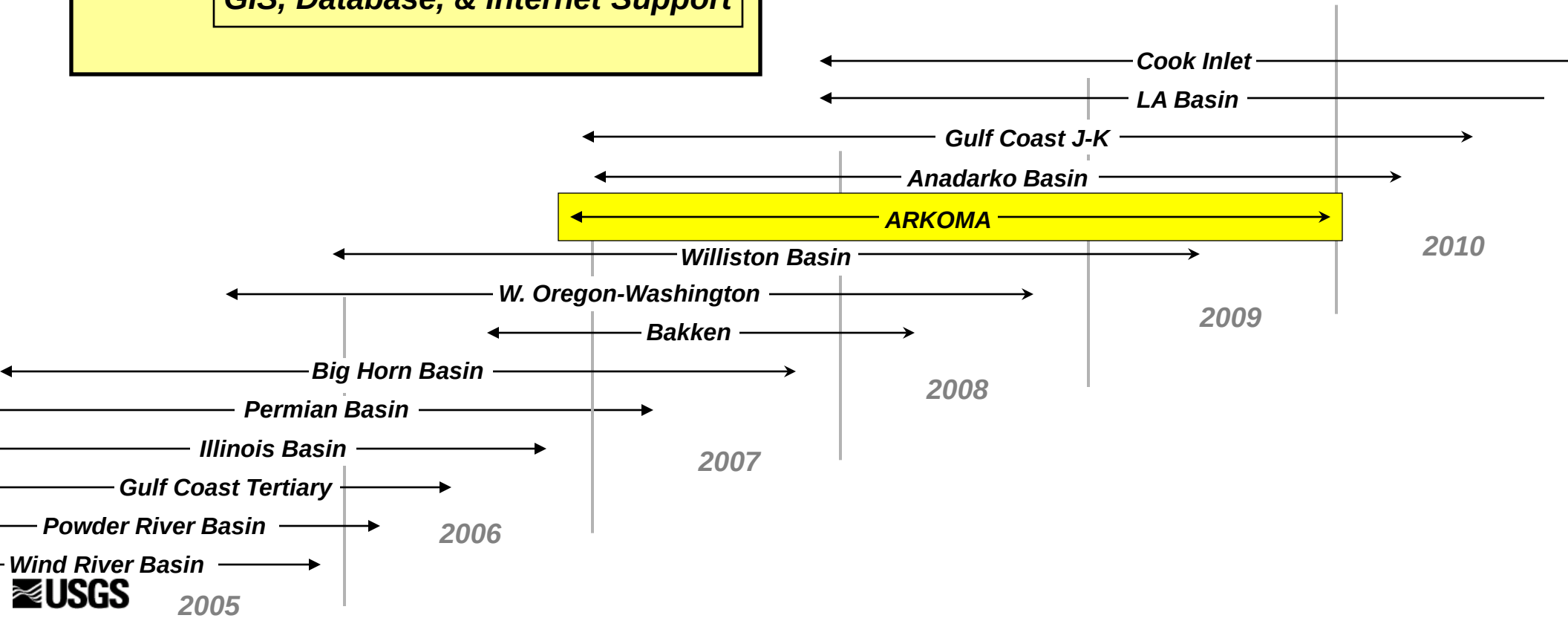
Standing Groups

- ***Methodology***
- ***Petroleum Engineering***
- ***Assessment Review***
- ***GIS, Database, & Internet Support***

Arkoma Basin Task

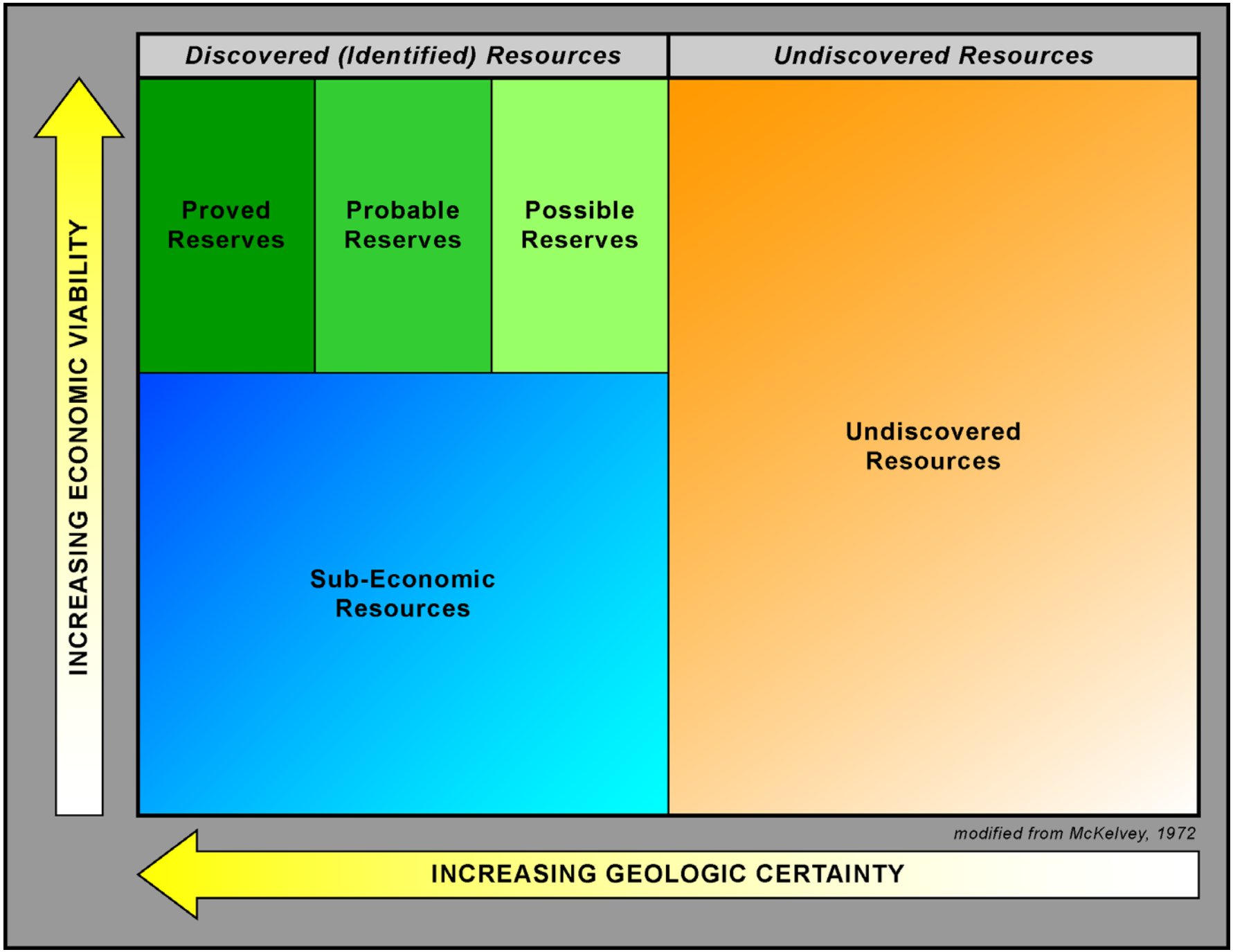
Dave Houseknecht, task chief
Jim Coleman, geologist
Bob Milici, geologist
Stan Paxton, geologist
Lyle Mars, geologist
Marvin Abbott, geologist
Chris Garrity, GIS cartographer
Bryant Fulk, summer geologist

~2.5 FTE Total



USGS

USGS Role in Assessing Petroleum Resources



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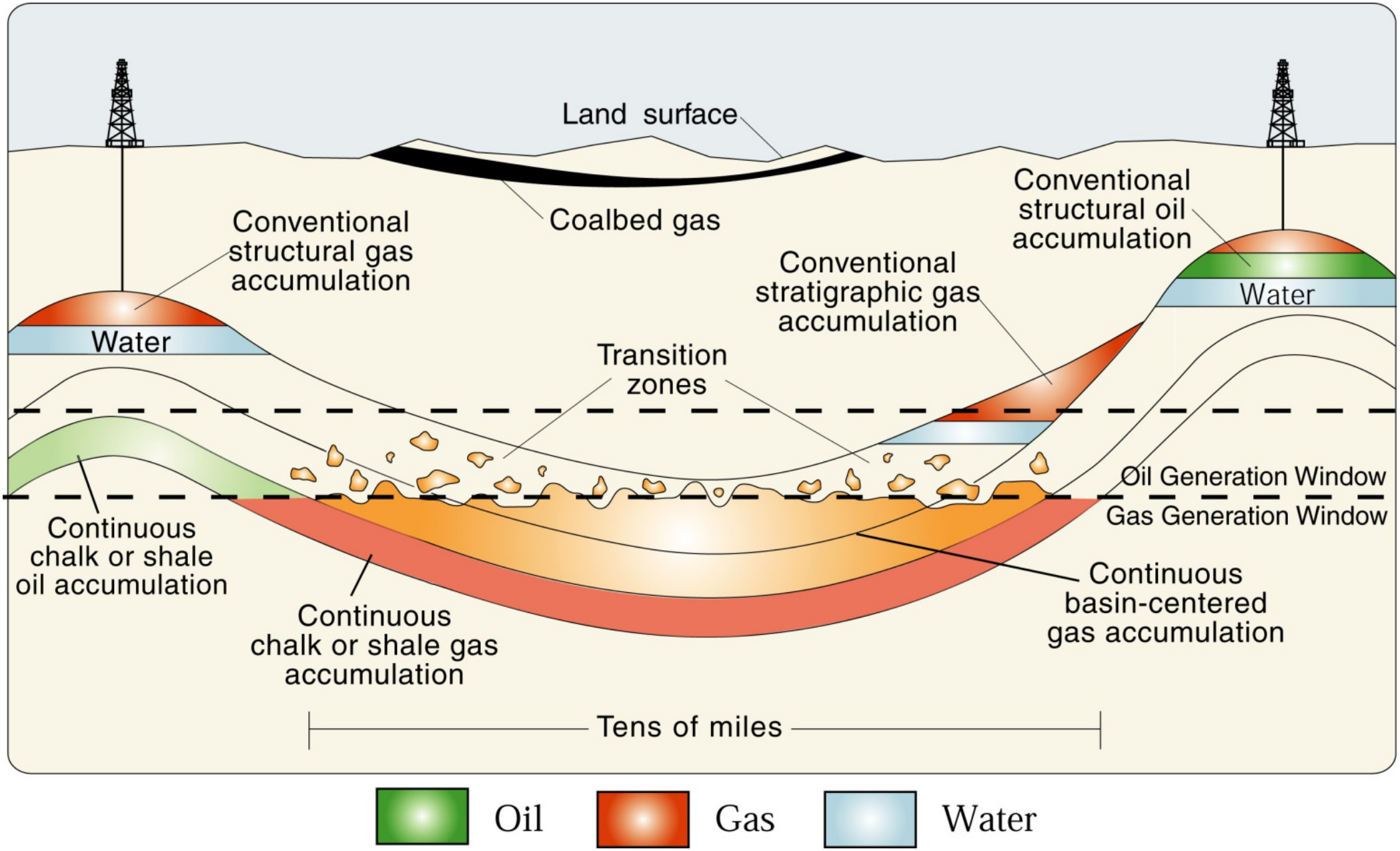
Conventional & Continuous Accumulations



USGS

Conventional Accumulations

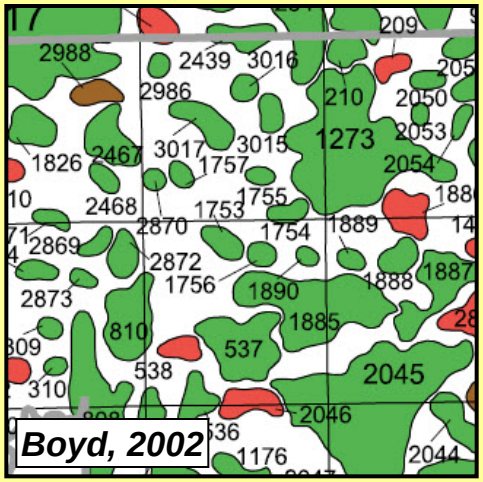
Fundamental Characteristics

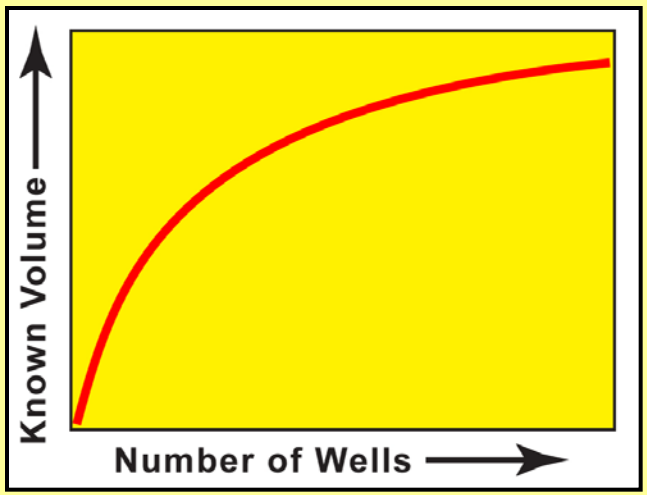
Conventional Accumulations

- Occupy limited, discrete volumes of rock defined by traps, seals, and down-dip water contacts.
- Depend on buoyancy of oil or gas in water for their existence.

Map View

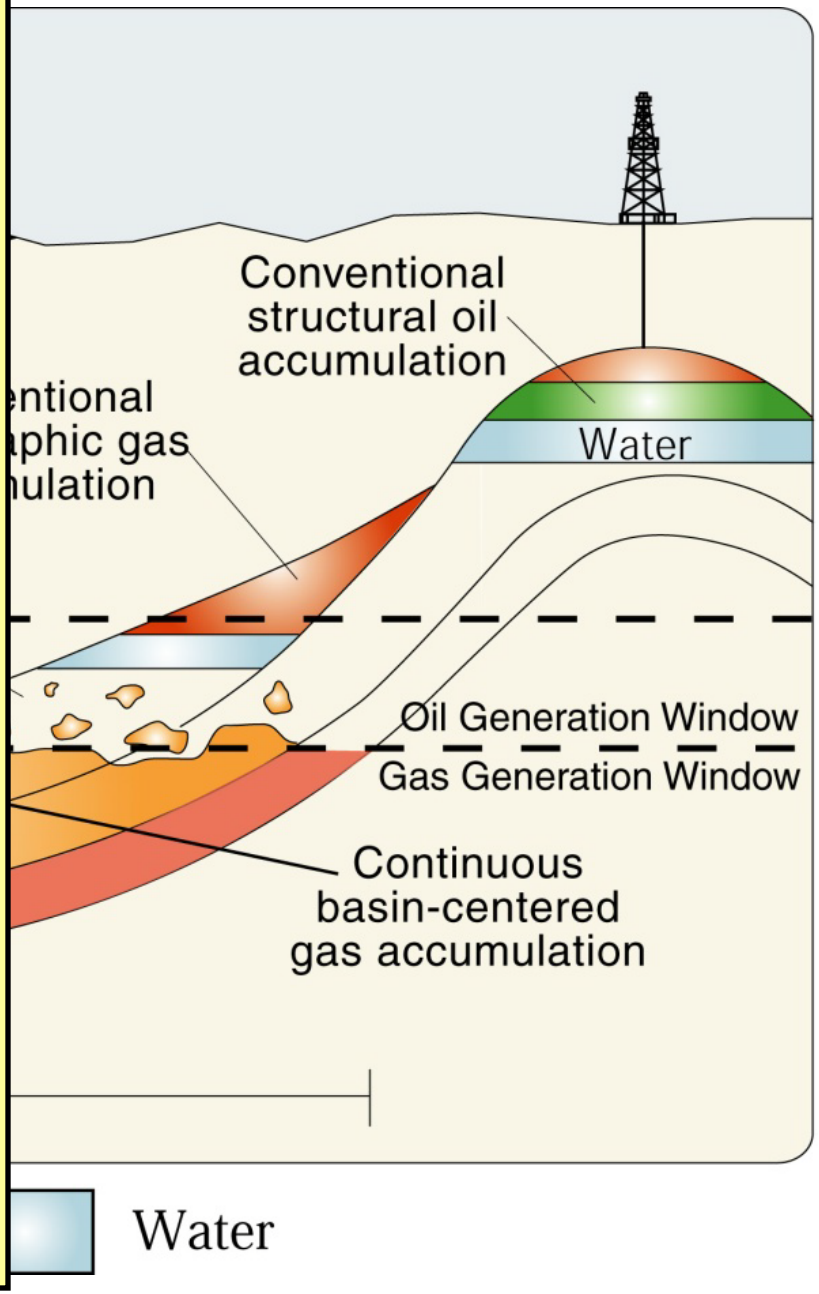
- Discrete
- Little or no expansion in area after initial development





Production History

- Rapid identification of most known petroleum volume
- Modest additions with additional effort

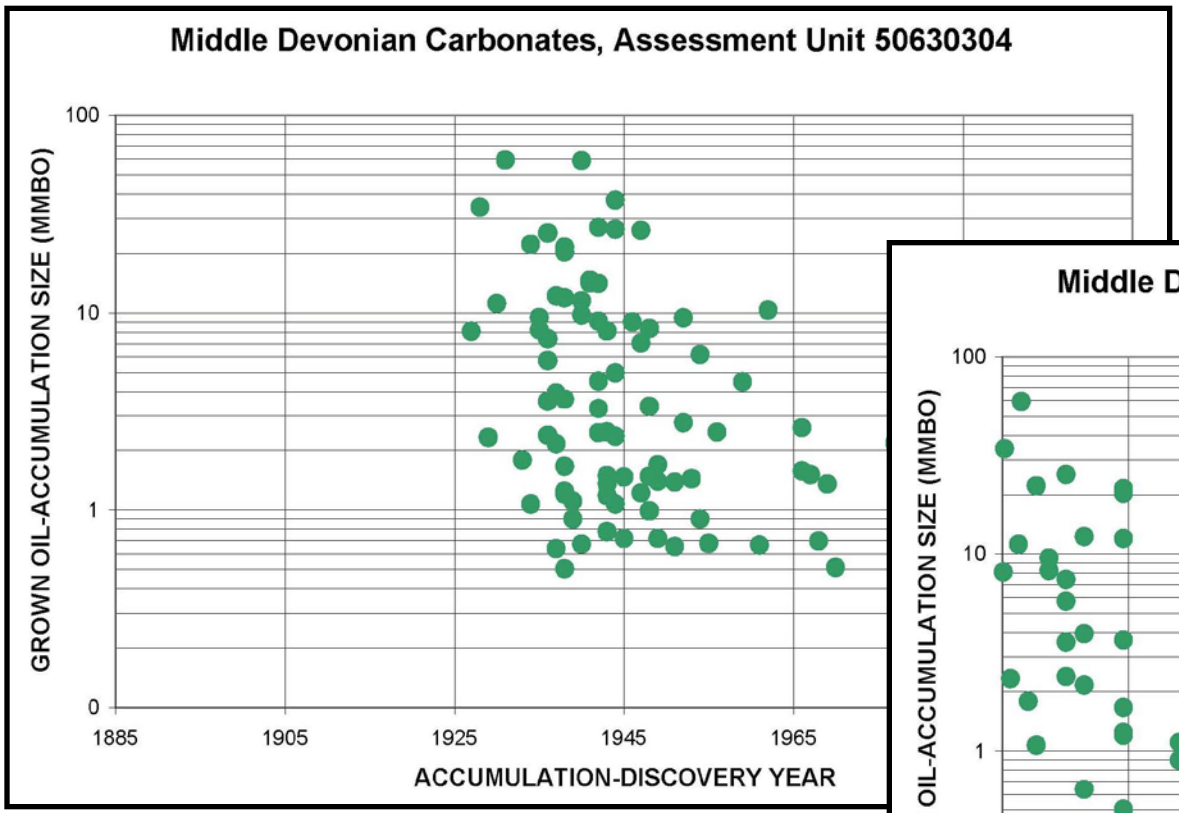


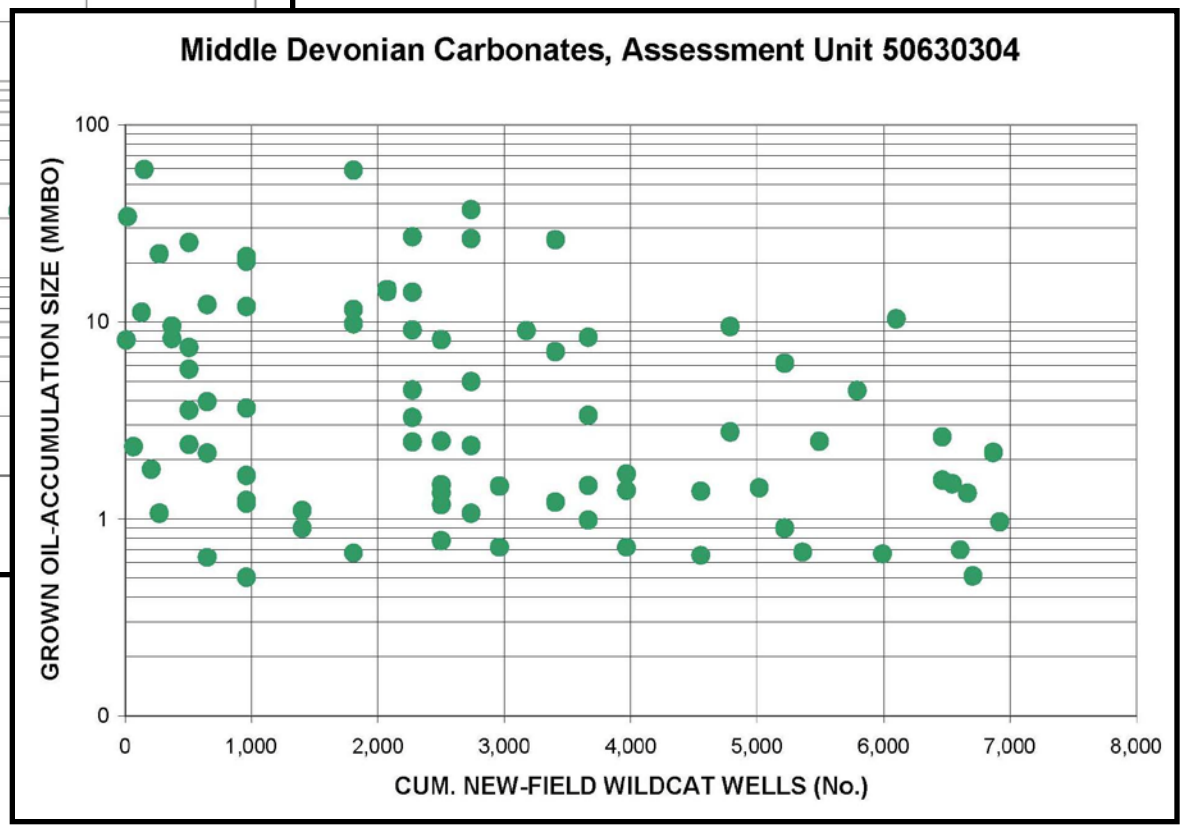
USGS

Conventional Accumulations – *Assessment Methodology*

USGS Methodology

- ***Estimates of SIZES and NUMBERS of undiscovered accumulations***
- ***Relies heavily on discovery history trends, including exploration maturity***
- ***Geologic analysis focuses on new reservoirs and new concepts***





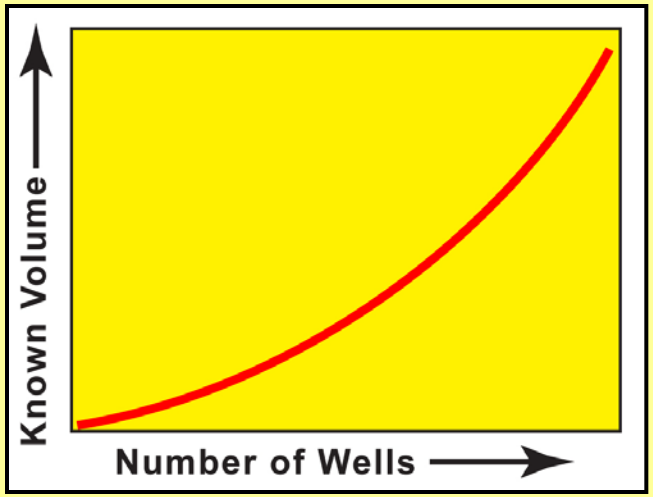
Example of discovery history trend:
Michigan Basin Middle Devonian Carbonates AU
(Klett, in press)

USGS

Continuous Accumulations - *Fundamental Characteristics*

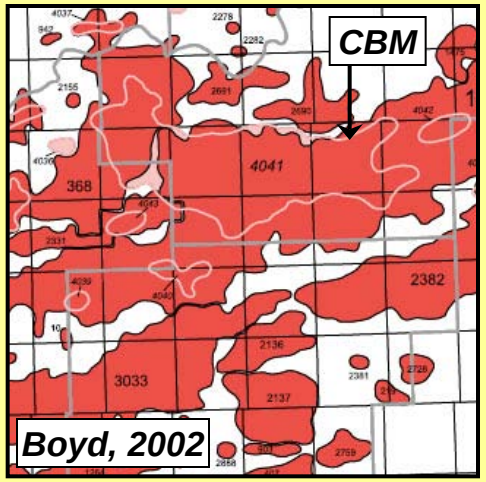
Continuous Accumulations

- **Consist of large volumes of rock pervasively charged with oil or gas.**
- **Do NOT depend on buoyancy of oil or gas in water for their existence.**



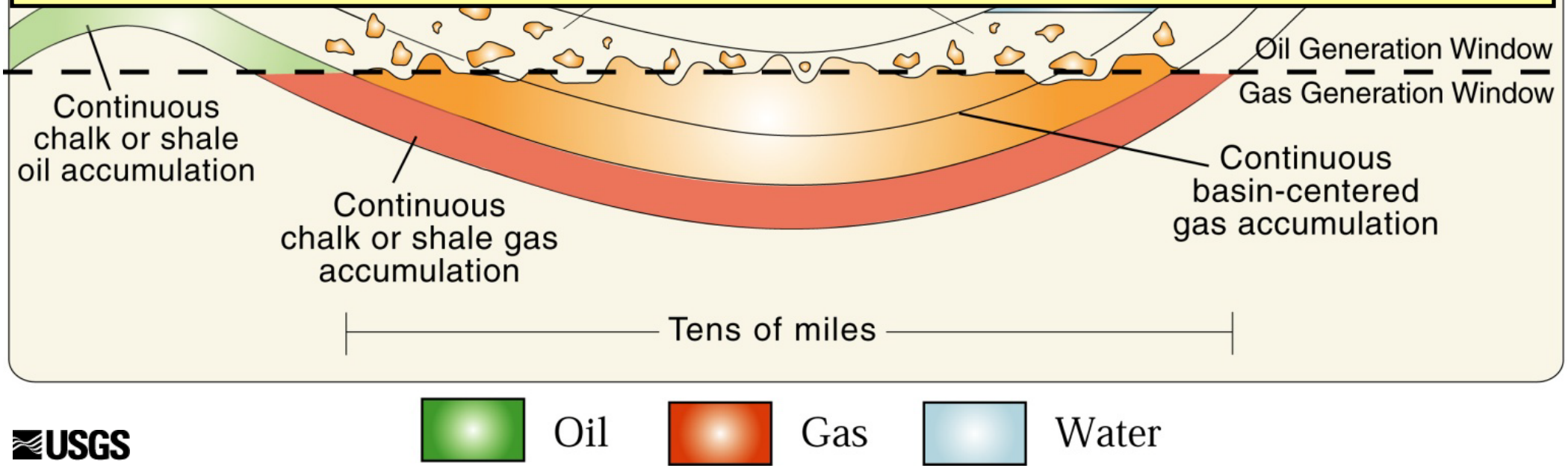
Map View

- **Extensive accumulations**
- **Expansion in area during development**



Production History

- **Known petroleum volume grows with effort (wells, knowledge,technology)**
- **Significant additions through time with additional effort**



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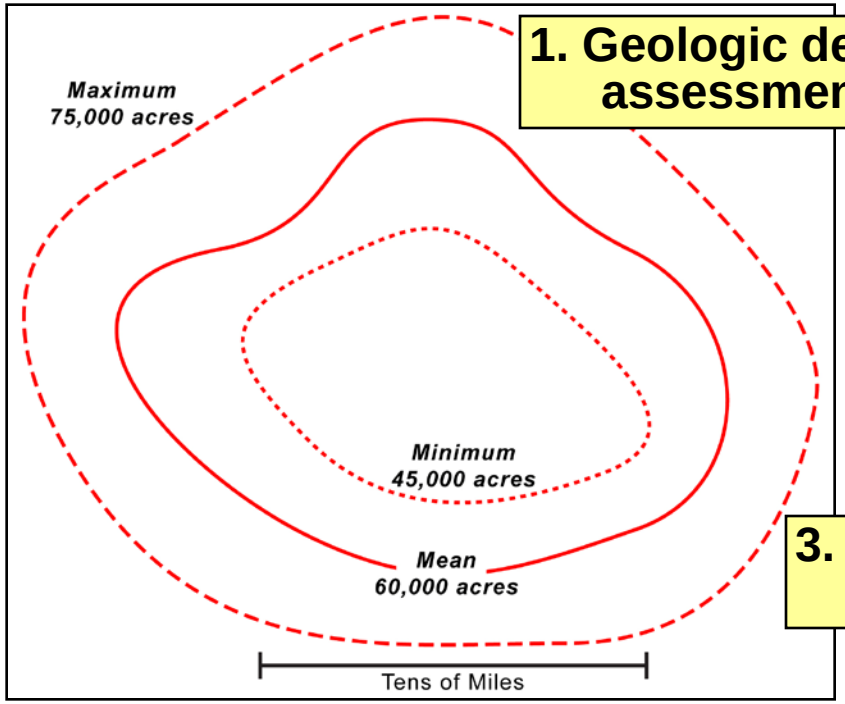
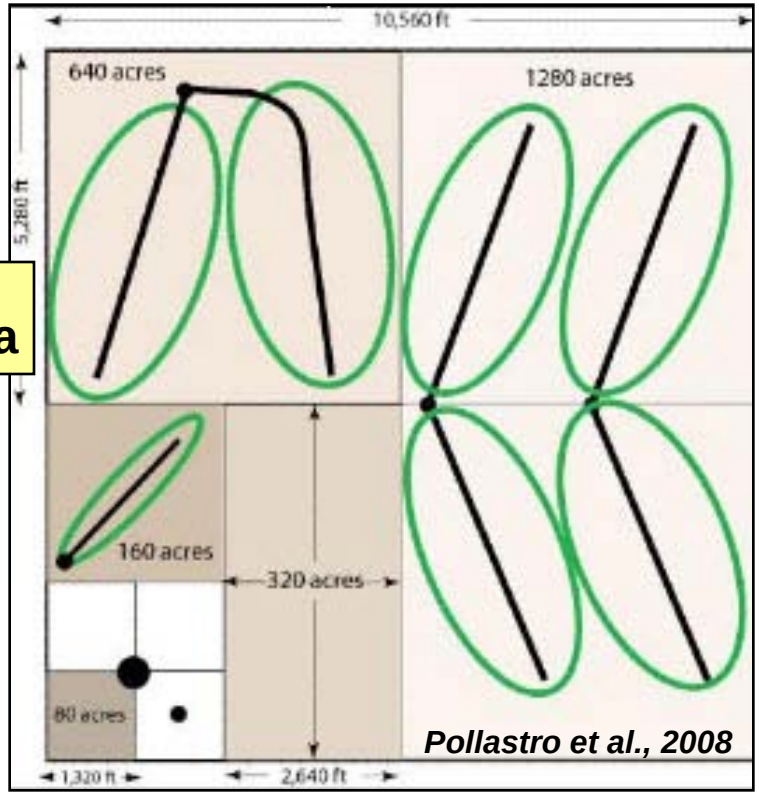
Continuous Accumulations – *Main Assessment Steps*



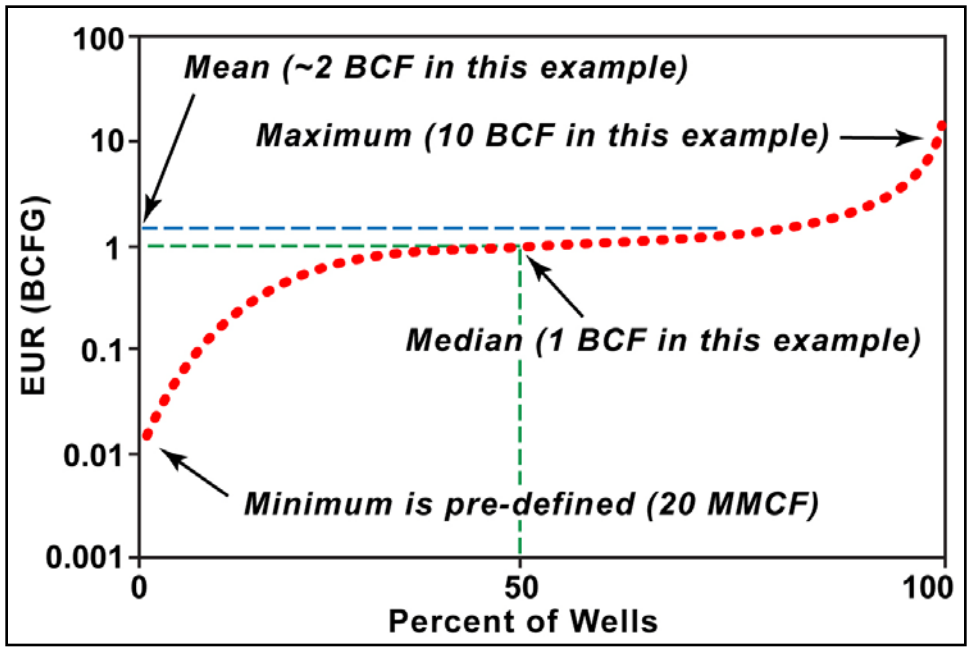
1. Geologic definition of assessment unit

2. Estimation of drainage area

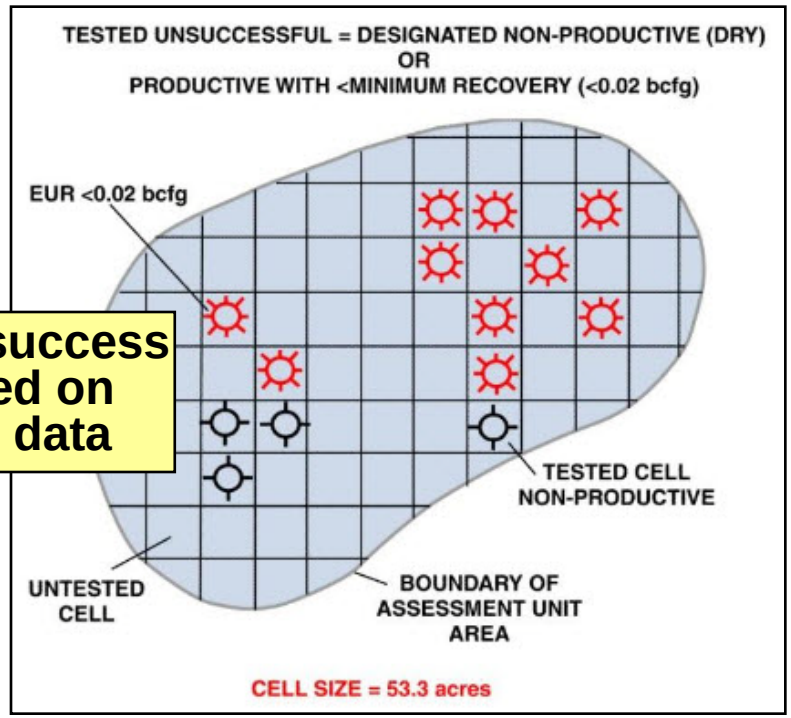
3. Number of potential cells in AU



4. EUR distribution based on historical production



5. Estimate success ratio based on historical data



USGS

Summary of USGS Assessment Methodology

Conventional Accumulations

- *SIZES and NUMBERS of undiscovered accumulations*

Continuous Accumulations

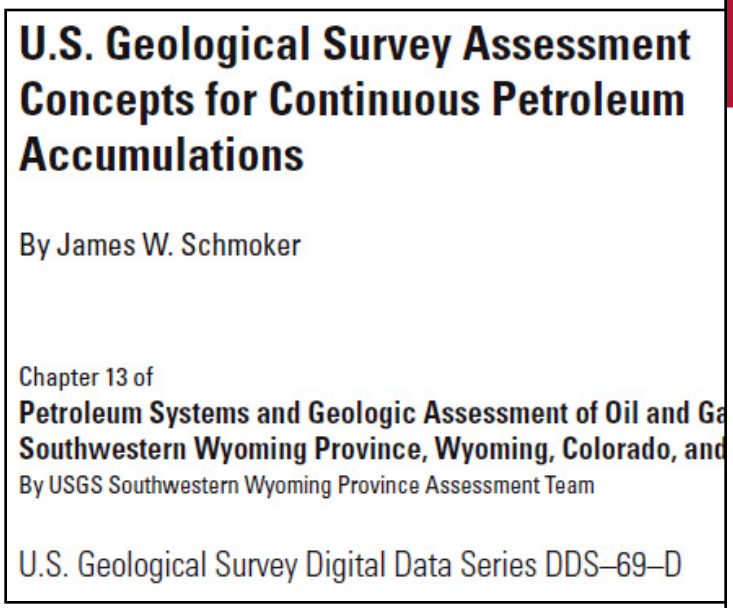
- *CELLS and EURs*

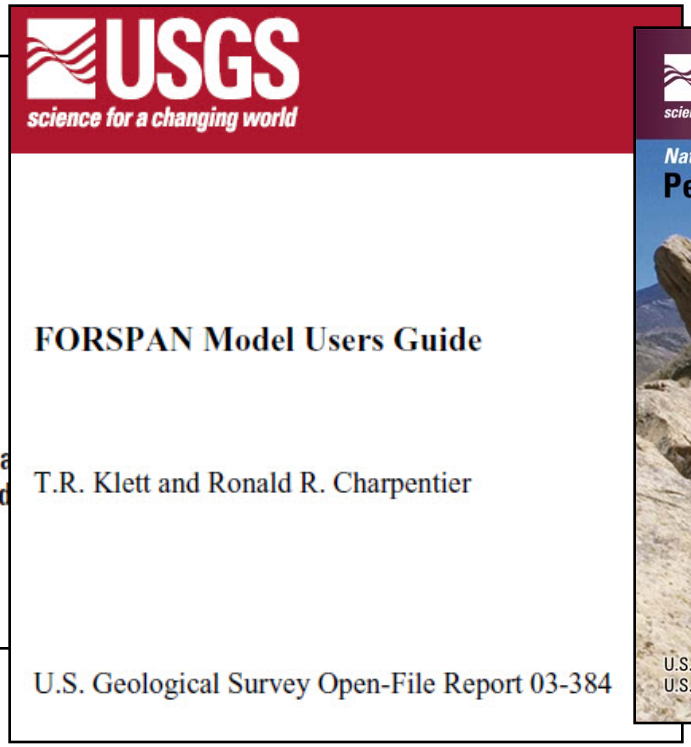
Documentation & AAPG Reviews of USGS Methodologies

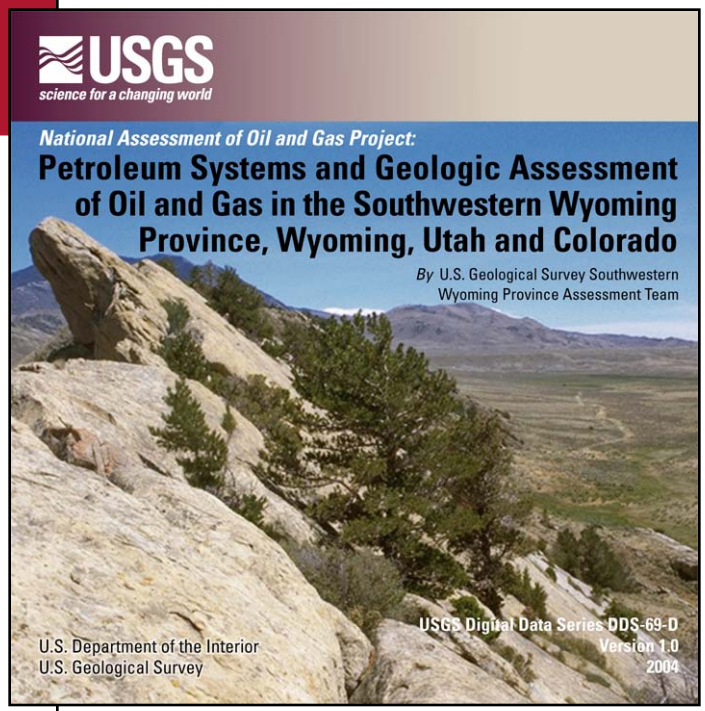
- *http://energy.cr.usgs.gov/oilgas/noga/methodology.html*

Numerous published examples of USGS assessments

- *Publication list: http://energy.cr.usgs.gov/oilgas/noga/products.html*







USGS

Assessment Schedule

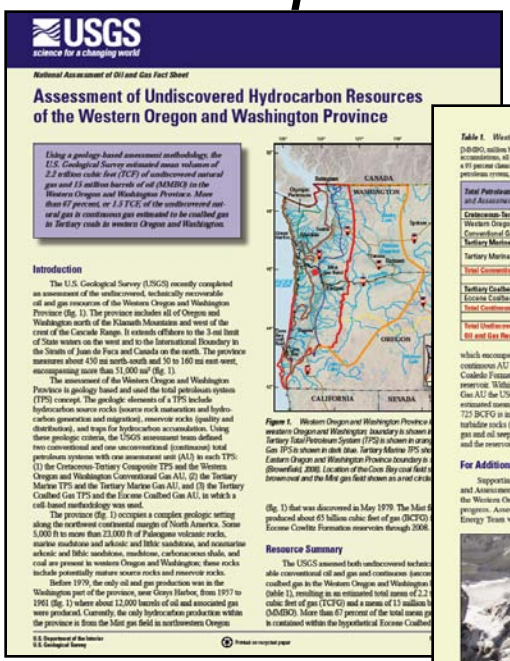
August 2009: USGS internal geology review meeting

November 2009: Public geology review meeting hosted by OGS

January 2010: USGS final assessment meeting

Release of products to follow as soon as possible:

- ***USGS Fact Sheet (spring 2010)***
- ***Results & GIS added to online National database (spring 2010)***
- ***USGS publications summarizing all aspects of the assessment will be released online and/or on cd-rom later in 2010***
- ***External papers summarizing certain aspects of the assessment will be published over the next few years***


USGS
science for a changing world
National Assessment of Oil and Gas Fact Sheet
Assessment of Undiscovered Hydrocarbon Resources of the Western Oregon and Washington Province
Introduction
Resource Summary

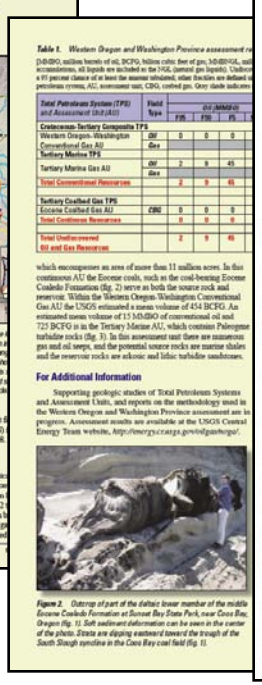
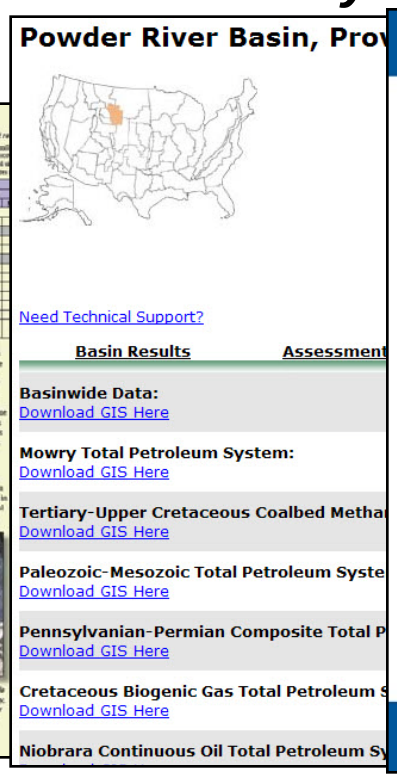


Table 1. Western Oregon and Western Washington Province assessment results.
Figure 2. Outcrop of part of the deltaic lower member of the middle Eocene Coaledo Formation at Sunset Bay State Park, near Coos Bay, Oregon (fig. 1). Soft sediment deformation can be seen in the center of the photo. Strata are dipping eastward toward the trough of the South Slough syncline in the Coos Bay coal field (fig. 1).


Powder River Basin, Prov
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Basin Results
Assessment
Basinwide Data:
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Mowry Total Petroleum System:
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Tertiary-Upper Cretaceous Coalbed Methan
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Pennsylvanian-Permian Composite Total P
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Cretaceous Biogenic Gas Total Petroleum S
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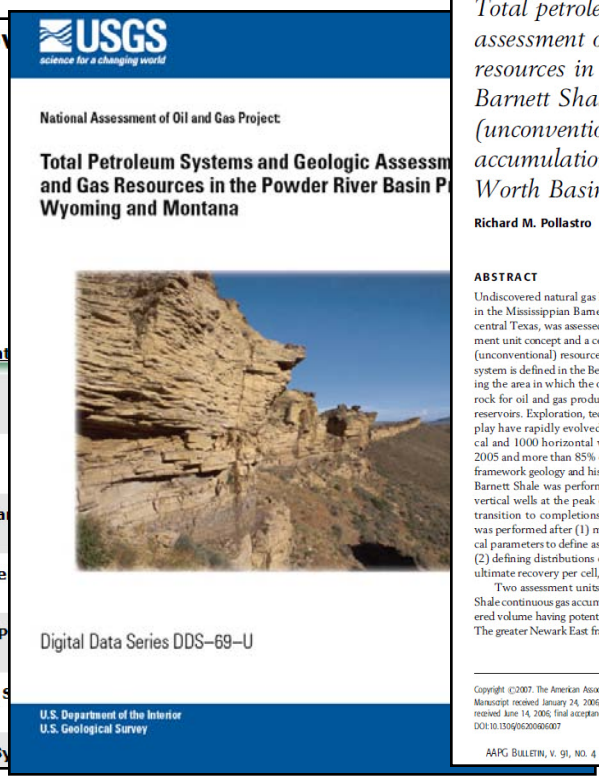
Niobrara Continuous Oil Total Petroleum Sy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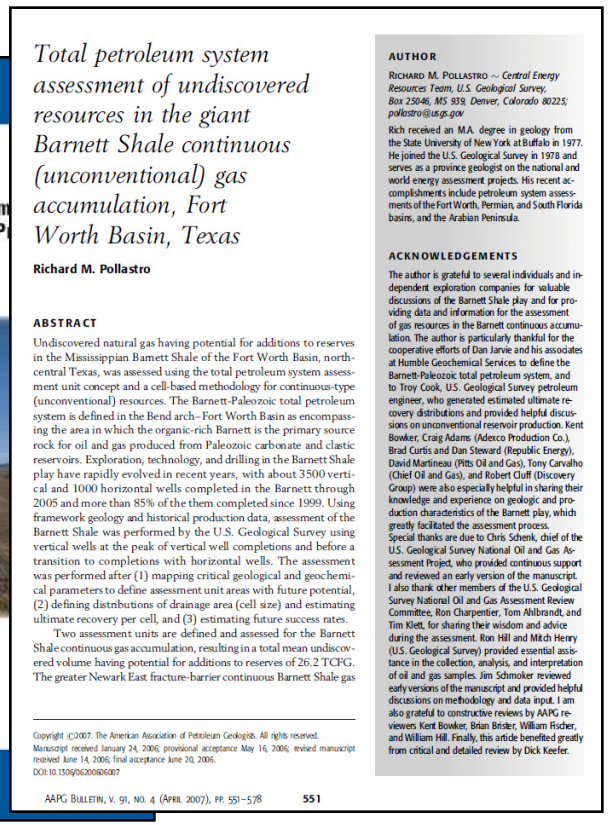
science for a changing world
National Assessment of Oil and Gas Project
Total Petroleum Systems and Geologic Assessm
and Gas Resources in the Powder River Basin P
Wyoming and Montana
Digital Data Series DDS–69–U
U.S. Department of the Interior
U.S. Geological Survey


Total petroleum system assessment of undiscovered resources in the giant Barnett Shale continuous (unconventional) gas accumulation, Fort Worth Basin, Texas
Richard M. Pollastro
ABSTRACT
Undiscovered natural gas having potential for additions to reserves in the Mississippian Barnett Shale of the Fort Worth Basin, north-central Texas, was assessed using the total petroleum system assessment unit concept and a cell-based methodology for continuous-type (unconventional) resources. The Barnett-Paleozoic total petroleum system is defined in the Bend arch–Fort Worth Basin as encompassing the area in which the organic-rich Barnett is the primary source rock for oil and gas produced from Paleozoic carbonate and clastic reservoirs. Exploration, technology, and drilling in the Barnett Shale play have rapidly evolved in recent years, with about 3500 vertical and 1000 horizontal wells completed in the Barnett through 2005 and more than 85% of the them completed since 1999. Using framework geology and historical production data, assessment of the Barnett Shale was performed by the U.S. Geological Survey using vertical wells at the peak of vertical well completions and before a transition to completions with horizontal wells. The assessment was performed after (1) mapping critical geological and geochemical parameters to define assessment unit areas with future potential, (2) defining distributions of drainage area (cell size) and estimating ultimate recovery per cell, and (3) estimating future success rates.
Two assessment units are defined and assessed for the Barnett Shale continuous gas accumulation, resulting in a total mean undiscovered volume having potential for additions to reserves of 26.2 TCFG. The greater Newark East fracture-barrier continuous Barnett Shale gas
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DOI:10.1306/06200606007
AAPG Bulletin, v. 91, no. 4 (April 2007), pp. 551–578
551
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Rich received an M.A. degree in geology from the State University of New York at Buffalo in 1977. He joined the U.S. Geological Survey in 1978 and serves as a province geologist on the national and world energy assessment projects. His recent accomplishments include petroleum system assessments of the Fort Worth, Permian, and South Florida basins, and the Arabian Peninsula.
ACKNOWLEDGEMENTS
The author is grateful to several individuals and independent exploration companies for valuable discussions of the Barnett Shale play and for providing data and information for the assessment of gas resources in the Barnett continuous accumulation. The author is particularly thankful for the cooperative efforts of Dan Jarvie and his associates at Humble Geochemical Services to define the Barnett-Paleozoic total petroleum system, and to Troy Cook, U.S. Geological Survey petroleum engineer, who generated estimated ultimate recovery distributions and provided helpful discussions on unconventional reservoir production. Kent Bowker, Craig Adams (Adesco Production Co.), Brad Curtis and Dan Steward (Republic Energy), David Martineau (Pitts Oil and Gas), Tony Carvalho (Chief Oil and Gas), and Robert Cluff (Discovery Group) were also especially helpful in sharing their knowledge and experience on geologic and production characteristics of the Barnett play, which greatly facilitated the assessment process. Special thanks are due to Chris Schenk, chief of the U.S. Geological Survey National Oil and Gas Assessment Project, who provided continuous support and reviewed an early version of the manuscript. I also thank other members of the U.S. Geological Survey National Oil and Gas Assessment Review Committee, Ron Charpentier, Tom Ahlbrandt, and Tim Klett, for sharing their wisdom and advice during the assessment. Ron Hill and Mitch Henry (U.S. Geological Survey) provided essential assistance in the collection, analysis, and interpretation of oil and gas samples. Jim Schmoker reviewed early versions of the manuscript and provided helpful discussions on methodology and data input. I am also grateful to constructive reviews by AAPG reviewers Kent Bowker, Brian Brister, William Fischer, and William Hill. Finally, this article benefited greatly from critical and detailed review by Dick Keefer.

USGS

Schedule for Arkoma – Ouachita – Reelfoot Workshop

1. **Introduction and Overview of USGS Assessment Methodology** ***(Houseknecht)***

2. **Regional Geologic Framework** ***(Houseknecht)***

3. **Arkoma "Fairway" Resources** ***(Houseknecht)***
   - **Arkoma Shelf AU**
   - **Arkoma Deep Basin Conventional AU**
   - **Arkoma-Ouachita Foredeep Continuous AU**

4. **Shale-Gas Resources** ***(Paxton, Milici, & Houseknecht)***
   - **Woodford Shale Gas AU**
   - **Chattanooga Shale Gas AU**
   - **Fayetteville Shale Gas AU**
   - **Caney Shale Gas AU**

5. **Arkoma Coalbed Gas Resources** ***(Milici)***
   - **Arkoma Coalbed Gas AU**

6. **Frontier Gas Resources** ***(Coleman)***
   - **Ouachita Thrust Belt AU**
   - **Arkansas Novaculite AU**
   - **Post-Ouachita Successor Basin AU**
   - **Reelfoot Rift Elvins Shale Gas AU**

6. **Poster Session** ***(USGS)***
   - **Spectrum of topics on geologic framework of the assessment**

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