



Overview of the USGS Oil and Gas Assessment of the Williston Basin

Regina, Saskatchewan

April, 2007

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

USGS TEAM - DENVER

- Rich Pollastro - Lower Pz + Bakken Geology
- Stephanie Gaswirth – Madison Gp Geology
- Larry Anna - Above Madison Gp Geology
- Troy Cook - Petroleum Engineering
- Paul Lillis, Mike Lewan - Geochemistry
- Laura Roberts - Burial History Modeling

Industry/Agency Participation

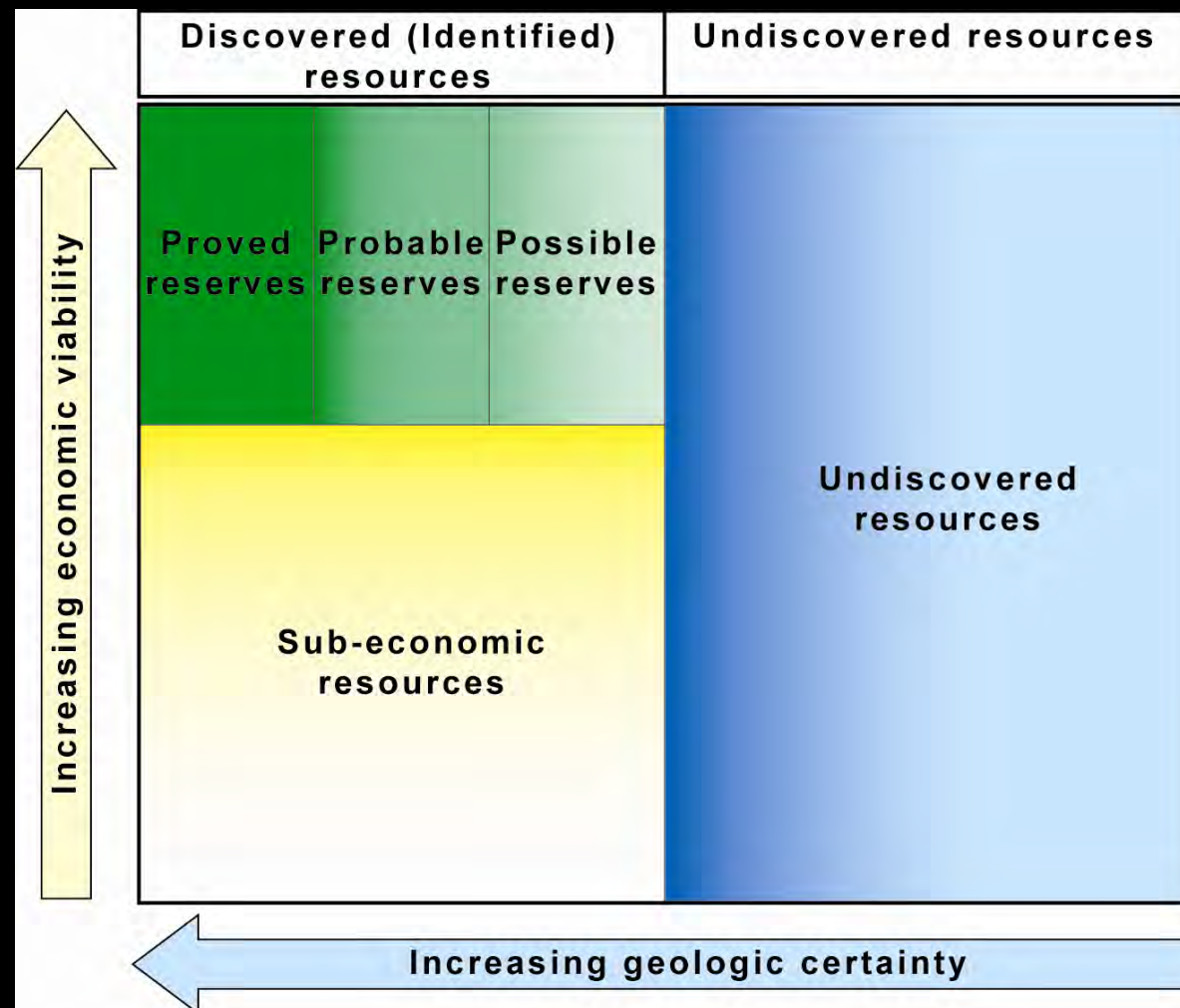
**“We are ready for
an unforeseen event
that may or may
not occur.”** *Al Gore*

**“Making predictions are
difficult, especially when it’s
about the future”.**

Casey Stengel

Resources vs. Reserves

USGS produces estimates of undiscovered, technically recoverable resources.



Assessment Objectives

- **Assess Conventional and Continuous resources**
- **Define Total Petroleum Systems (fluids)**
- **Define Assessment Units (rocks)**

Energy Policy Act of 2005

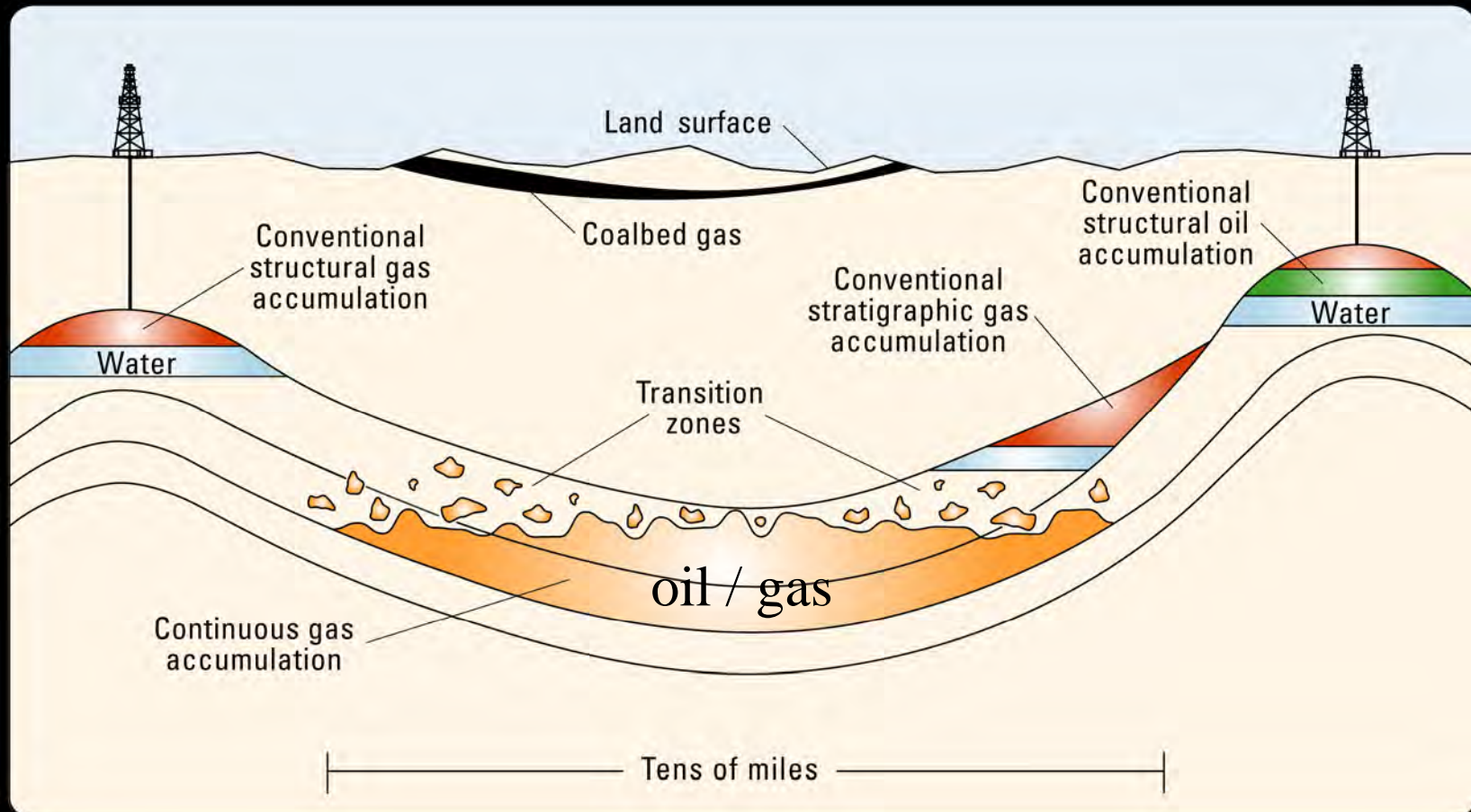
USGS assesses all lands in petroleum province

P.L. 109–58, SEC. 364.

**BLM - ESTIMATES OF OIL AND GAS RESOURCES
UNDERLYING ONSHORE FEDERAL LAND.**

Use same METHODOLOGY for all assessments

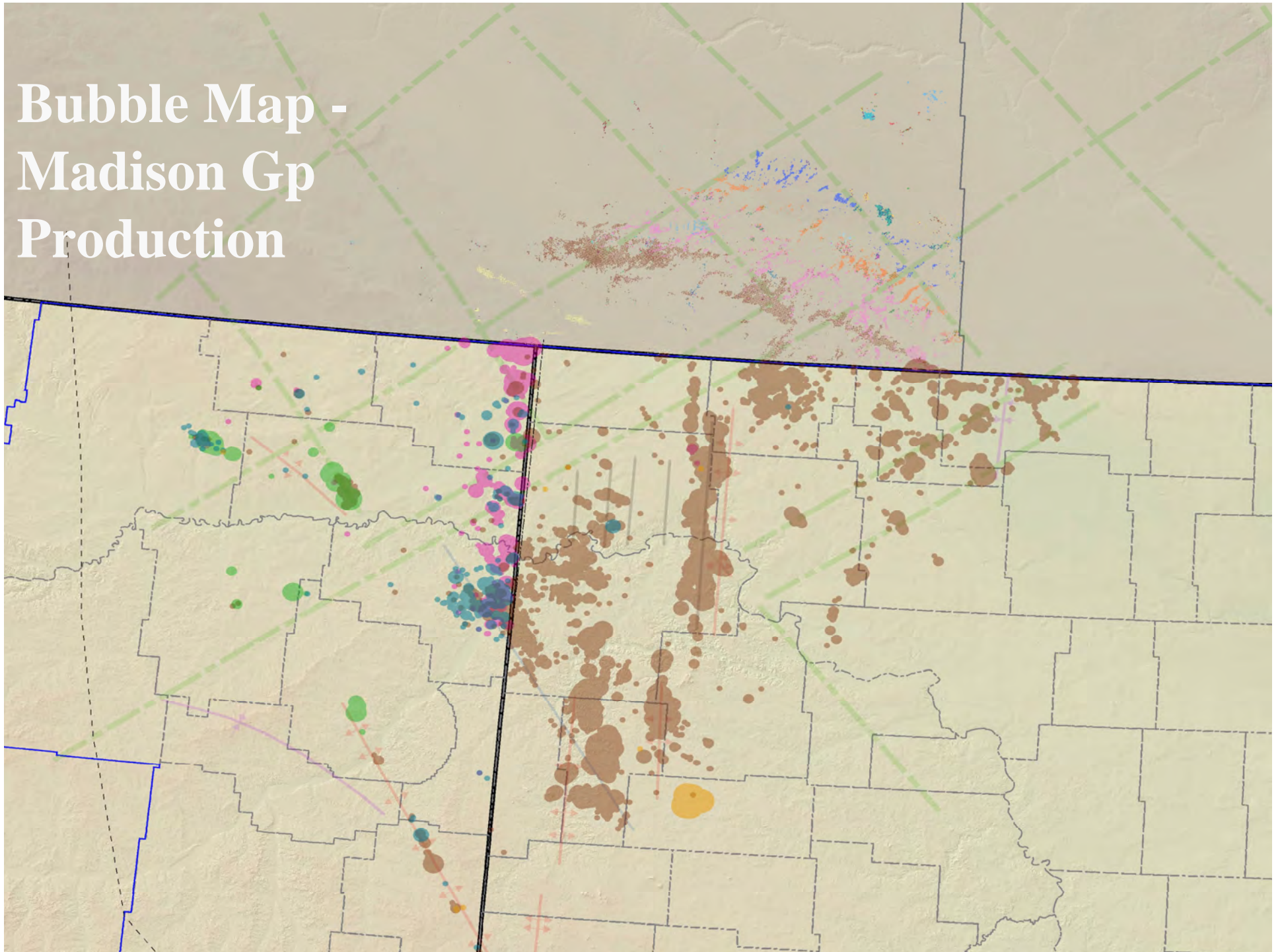
Conventional vs. Continuous Resources



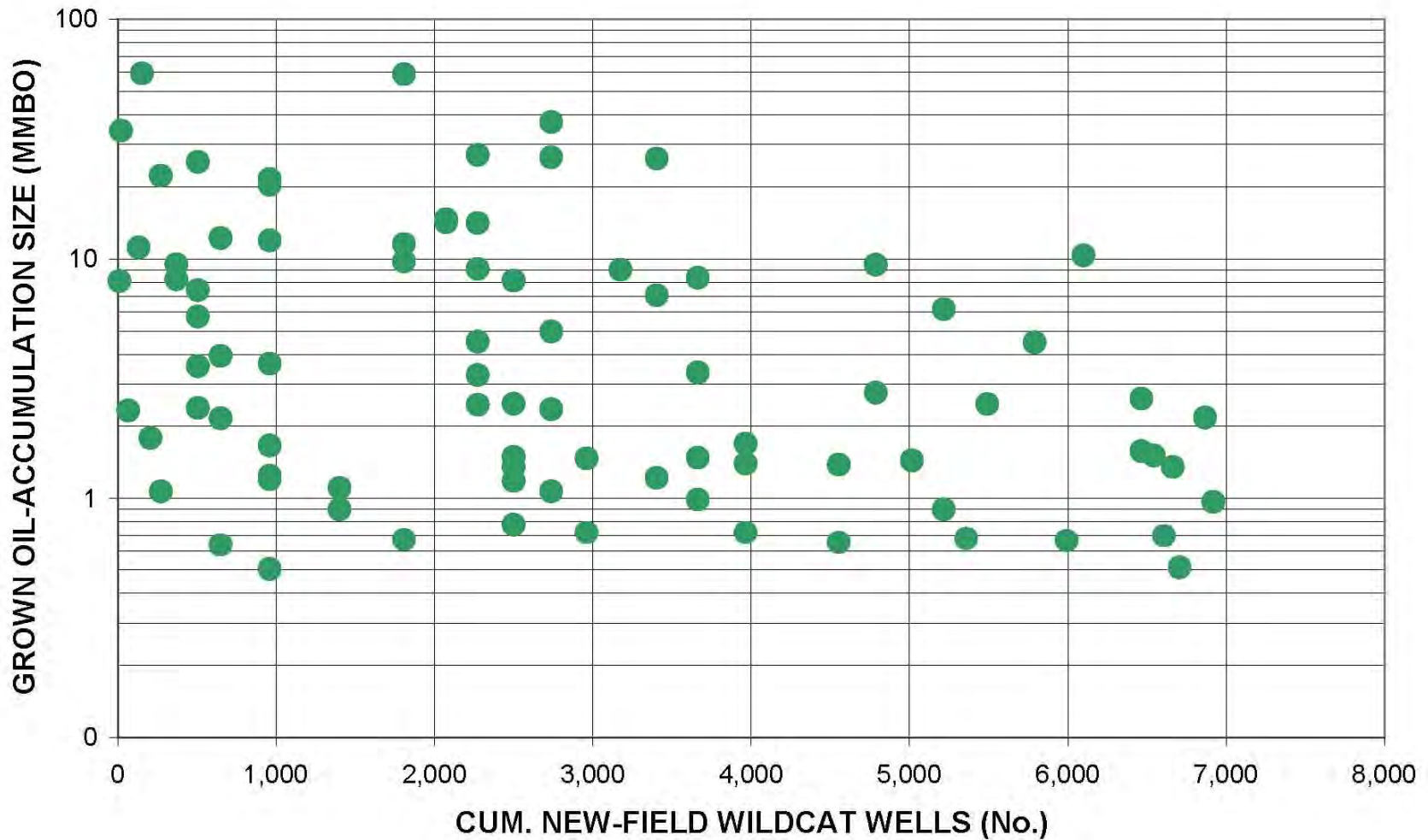
Conventional Methodology

- **Sizes and numbers of undiscovered fields**
- **Geologic analysis focuses upon new reservoirs and new concepts**
- **Past performance**

Bubble Map - Madison Gp Production



Carbonate Reservoir example - Assessment Unit 50630304



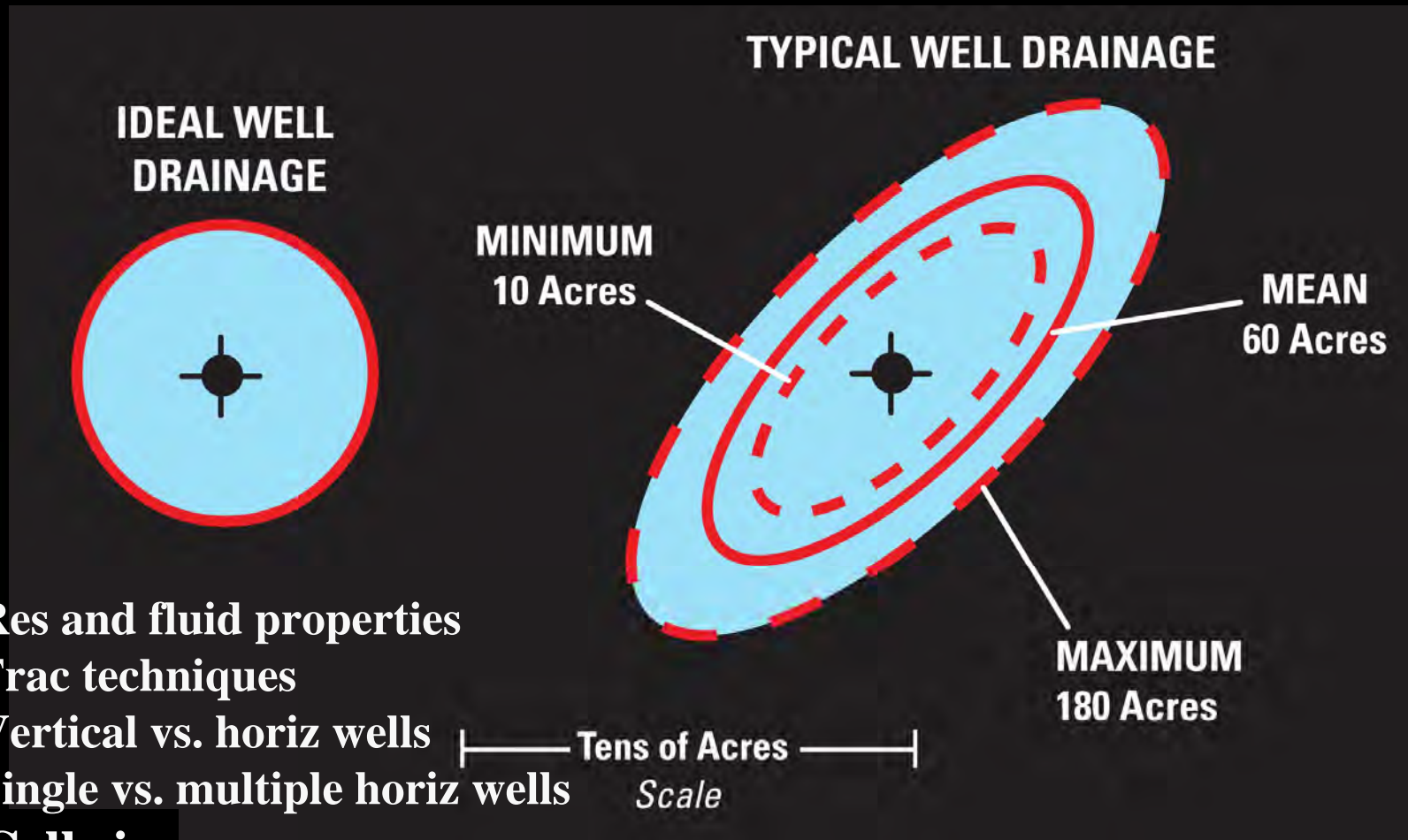
Continuous Assessment

- **Assessment based on geology, real production data, and petrophysical data**
- **Engineering Data**
- **Within TPS & AU framework**

Continuous Assessment Units

- May be divided or combined based upon reservoir performance
- EUR
 - Total production
 - “Production sweet spots”
 - Outside of sweet spots production

Drainage area estimation



- Res and fluid properties
- Frac techniques
- Vertical vs. horiz wells
- Single vs. multiple horiz wells
- Cell size

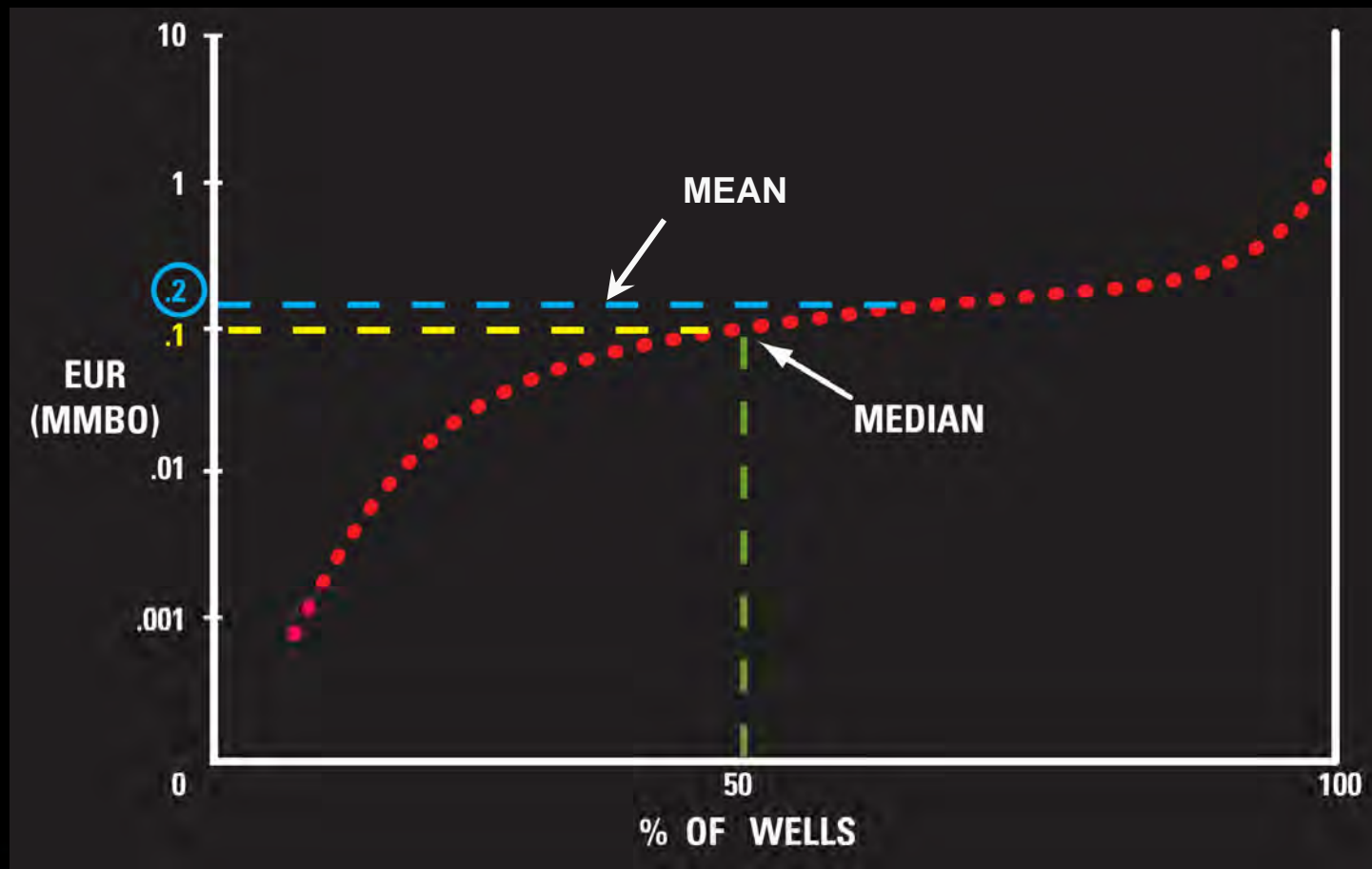
Numbers of potential cells (mean)

- 60,000 acres (mean) in AU
- 60 acres per cell (mean)
- $60,000 \text{ acres} / 60 \text{ acres per cell} = 1,000$ potential cells (mean)

Estimated Ultimate Recovery (EUR) distribution

- EUR used to determine recovery **per cell**,
(based on production data from wells)
within the assessment unit

EUR Distribution (Hypothetical) (well or field) in AU



Calculation of Resources (Mean)

- 1,000 potential cells (mean)
- 200,000 barrels per cell (mean)
- $1,000 \times 200,000 = 200,000,000$, barrels
- Range: 50,000,000 – 500,000,000 barrels
(encompasses geologic uncertainty)

Systems	Rock Units			
Quaternary	Pleistocene		Permian	Minnekahta
	White River			Onoche
	Golden Valley		Pennsylvanian	Broom Creek
				Amsden
				Tyler
Tertiary	Fort Union Group			Otter
				Kibbey
			Mississippian	Charles
				Mission Canyon
				Lodgepole
	Hell Creek			Bakken
	Fox Hills			Three Forks
	Pierre			Birdbear
	Judith River			Duperow
	Eagle			Souris River
	Niobrara		Devonian	Dawson Bay
	Carlile			Prairie
	Greenhorn			Winnipegosis
	Belle Fourche			Ashern
	Mowry		Silurian	Interlake
	Newcastle			Stonewall
	Skull Creek			Stony Mountain
	Inyan Kara		Ordovician	Red River
				Winnipeg Group
Jurassic	Swift			Deadwood
	Riardon		Cambrian	
	Piper			
Triassic	Spearfish		Precambrian	
Permian				

Larry

Stephanie

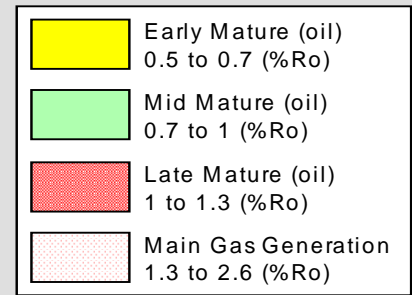
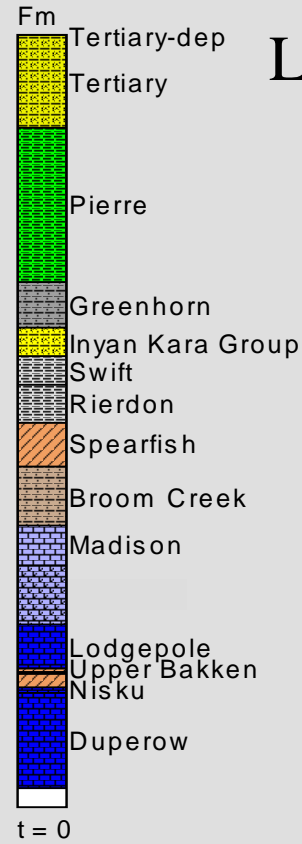
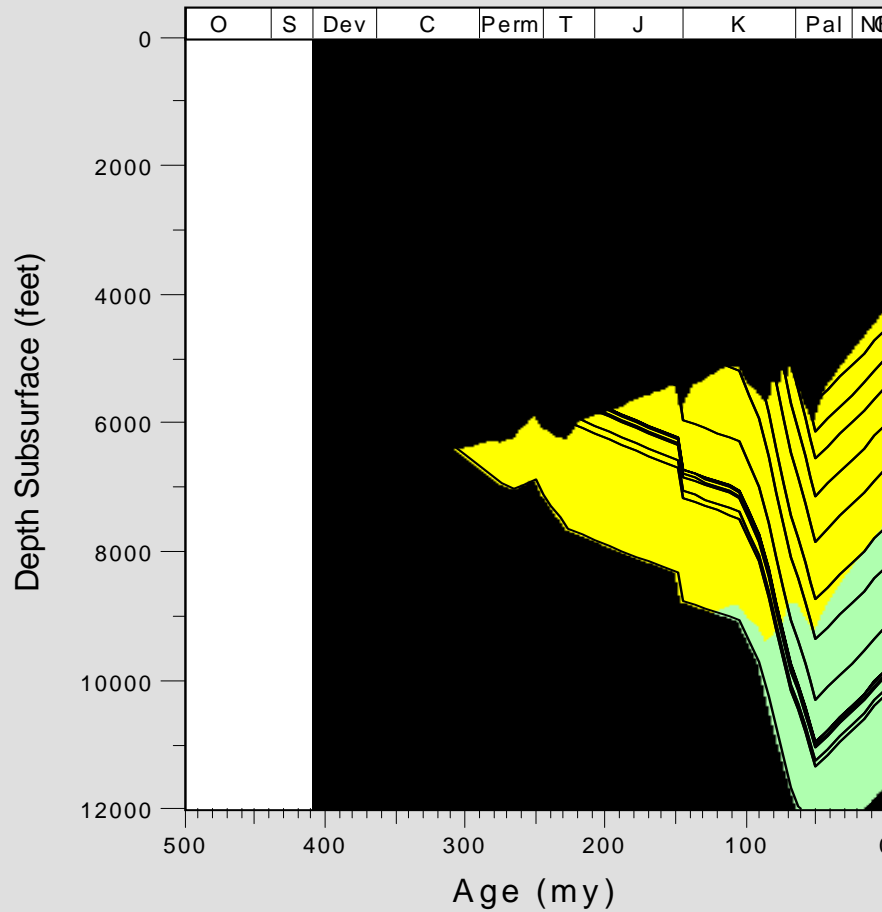
Rich

Example

CMP=2D;TH=THF
 TI=10;KEXP=Sat;PRM=PL
 DI=1000

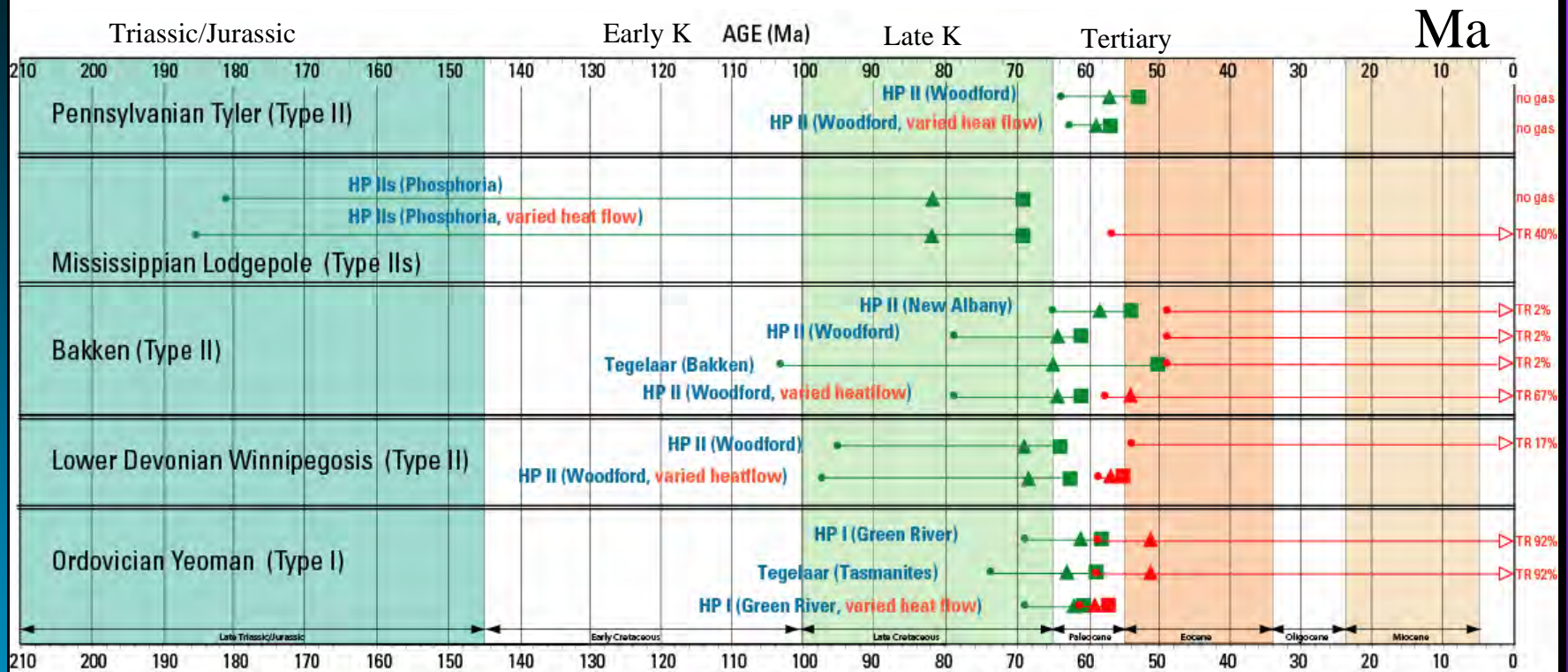
Laura Roberts

PedroMod
 1D, 2D



t = 0

Petroleum Generation – Preliminary

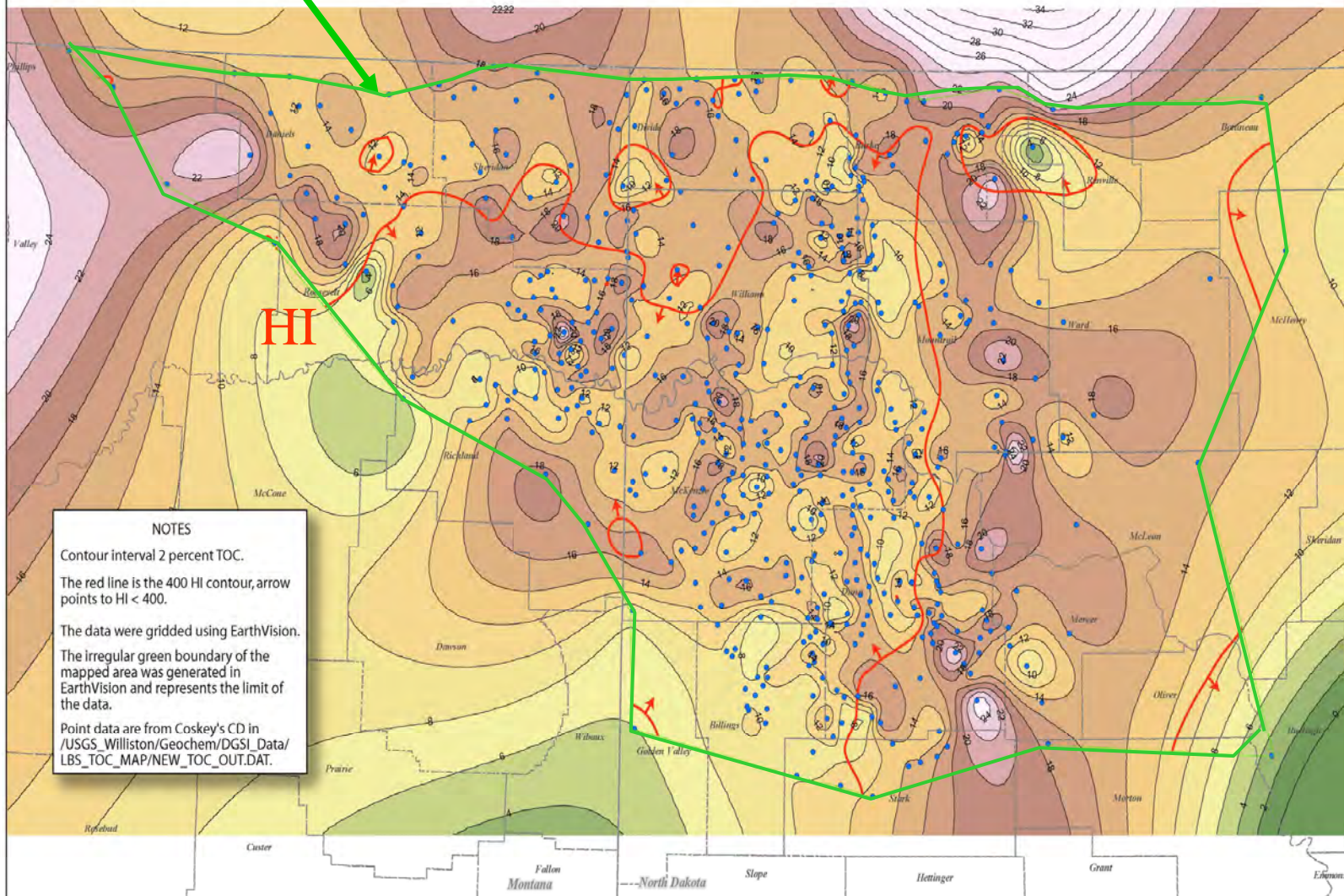


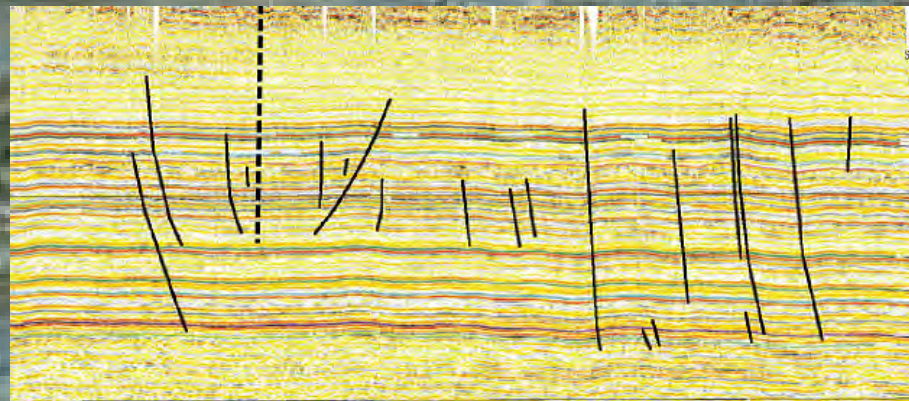
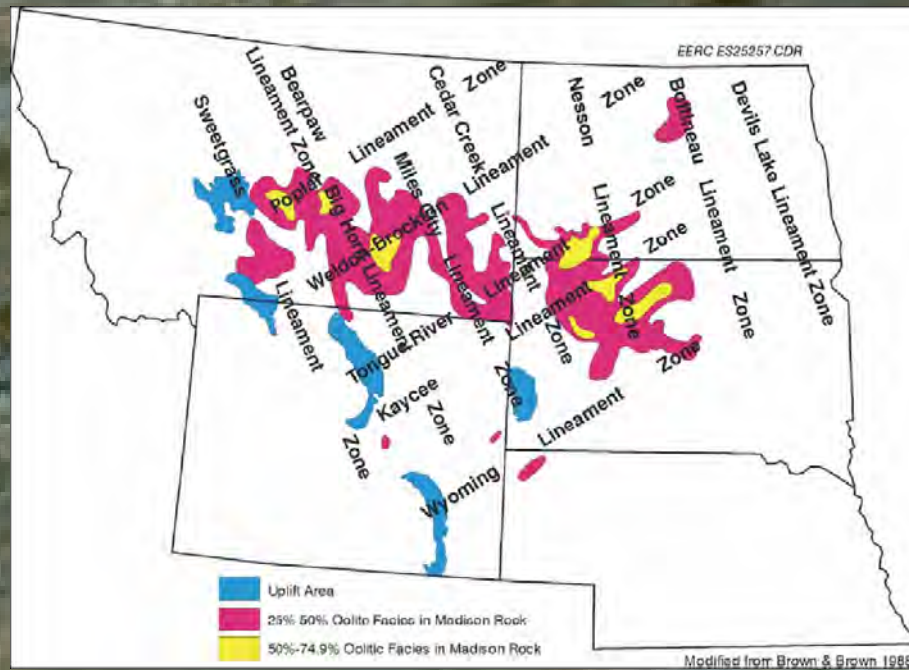
- Timing of oil generation**
- Start of oil
 - ▲ Peak oil
 - End of oil
 - ▷ Minor generation may continue
- Timing of oil cracking to gas (Tsuzuki and others, '99 kinetics)**
- Start of gas
 - ▲ Peak gas
 - End of gas
 - ▷ Minor generation may continue

Kinetics
Heat Flow

Data Limit

TOC, HI – Lower Bakken - Preliminary





Summary

- **Assessment schedule (4 parts)**
- **Technically recoverable undiscovered resources only**
- **Industry/Agency as Participants**
- **energy.cr.usgs.gov/oilgas/noga**