RESERVOIR CHARACTERIZATION OF THE SHANNON SANDSTONE, PINE TREE, HARTZOG, AND JEPSON-HOLLER FIELD AREAS, SOUTHWESTERN POWDER RIVER BASIN, WYOMING

Rebekah Parks
M.S. Geology

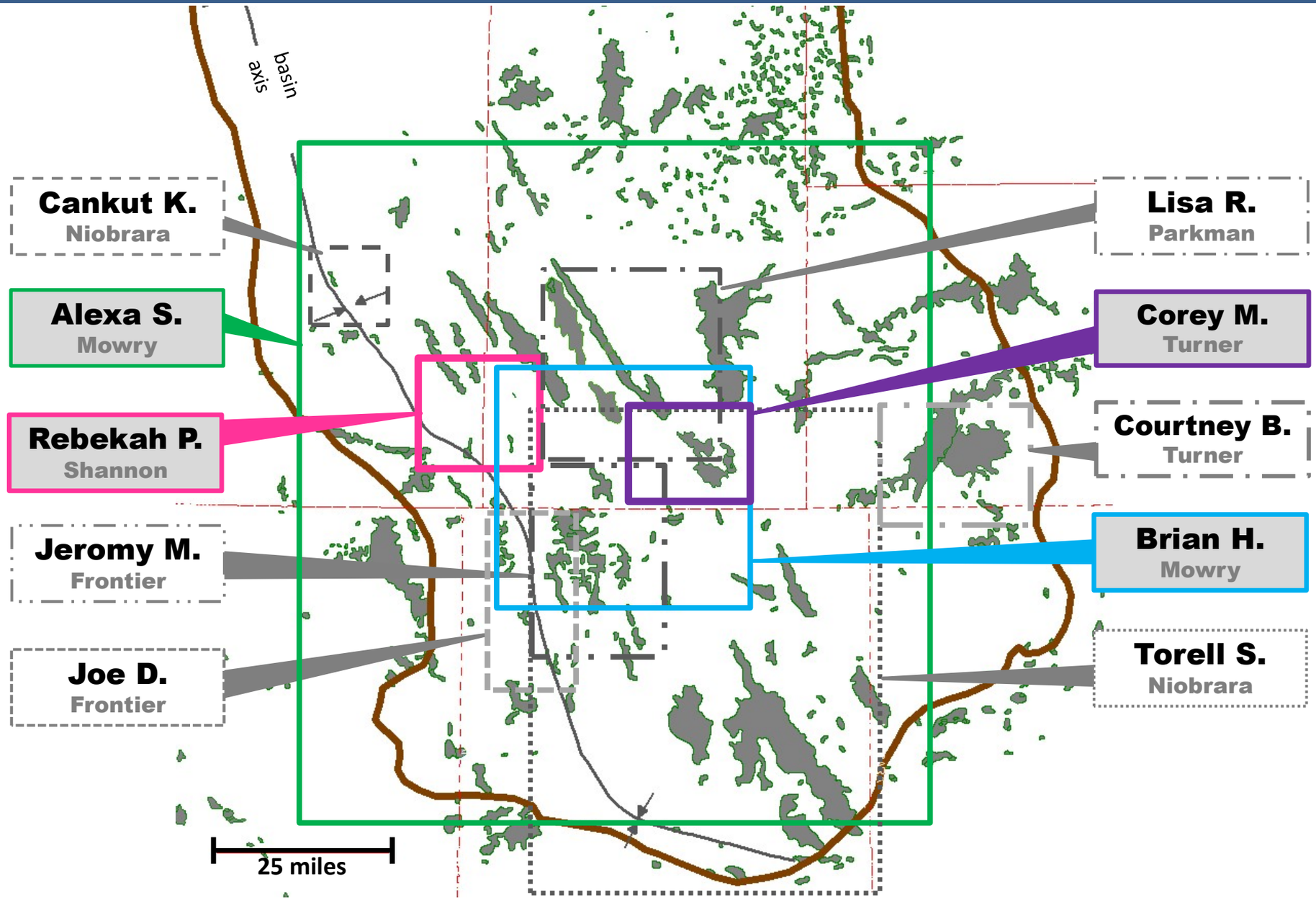
rparks@mymail.mines.edu

MUDTOC Fall 2020 Consortium Meeting

Presentation Outline

- Introduction and Regional Geology
- Activity & Production
- Updates to Study Area
- Continued Work

PRB Location Map of MUDTOC Study Areas



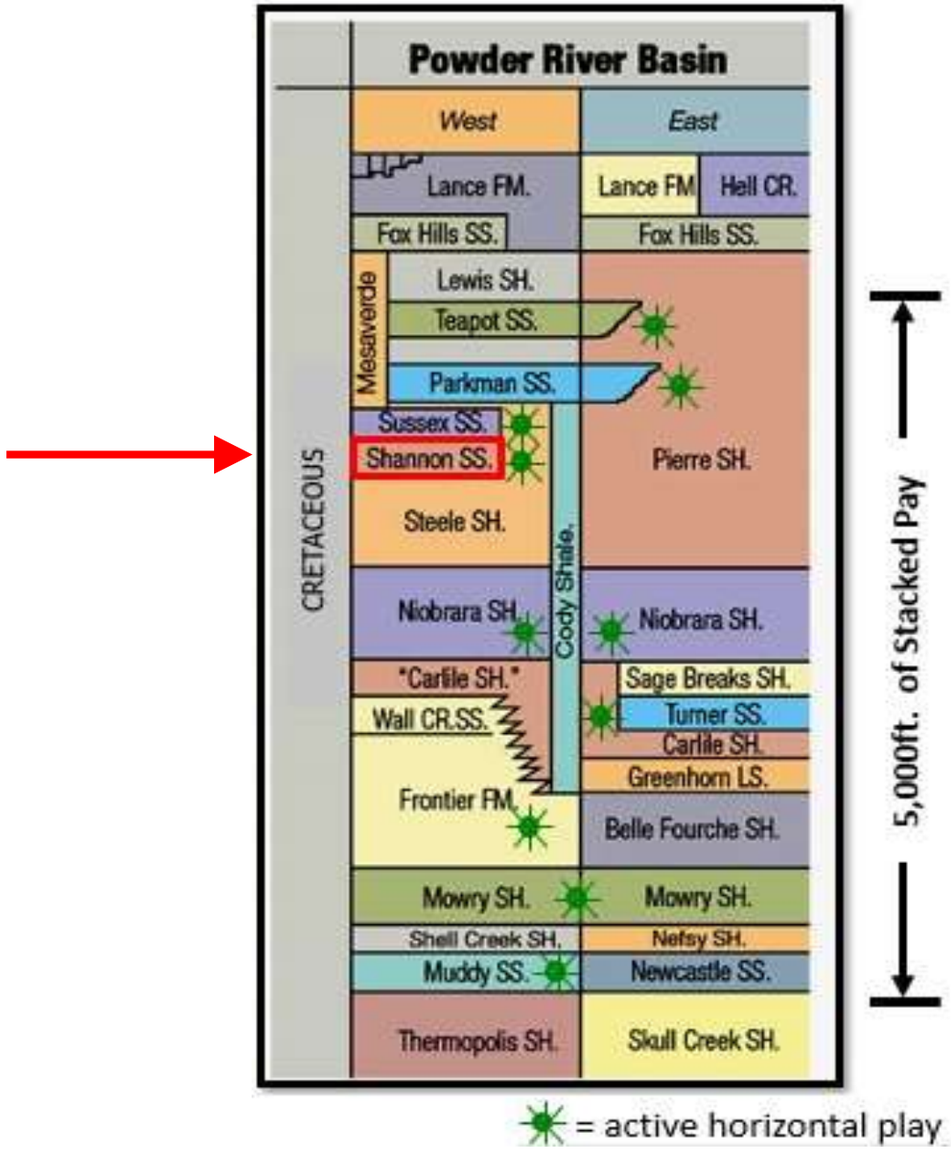
Purpose & Objectives

- Reservoir Characterization
  - Define Shannon Sandstone
    - Petrographic analysis
    - Petrophysics analysis
  - Geomechanical properties and stratigraphic interpretation
  - Characterization of lateral and vertical variability
  - Assess petroleum potential
    - Maximize efficiency & production

Regional Geology

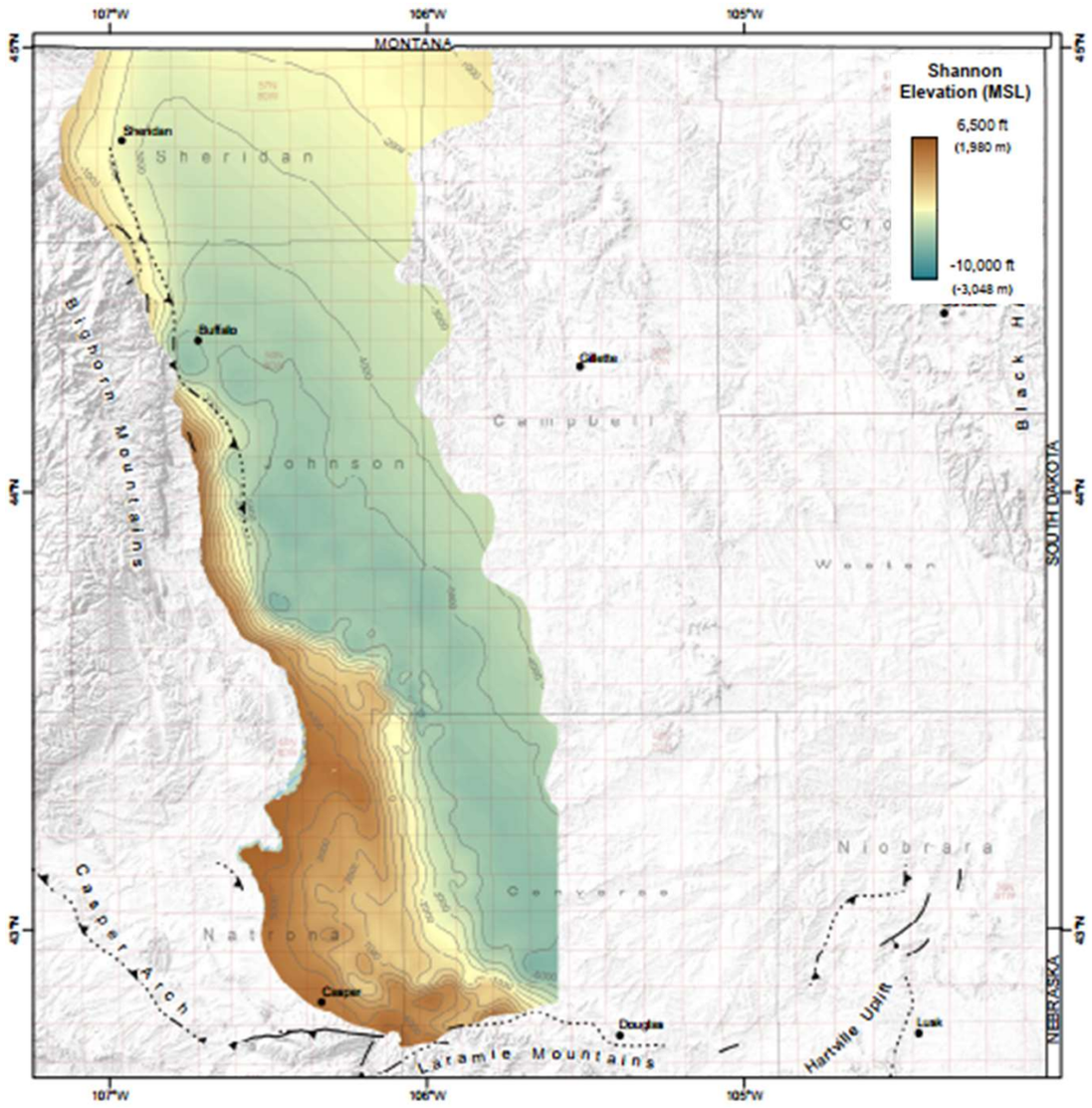
Paleogeographic setting of the Western Interior Seaway during the deposition of Cretaceous rocks in the PRB (Blakey, 2014).

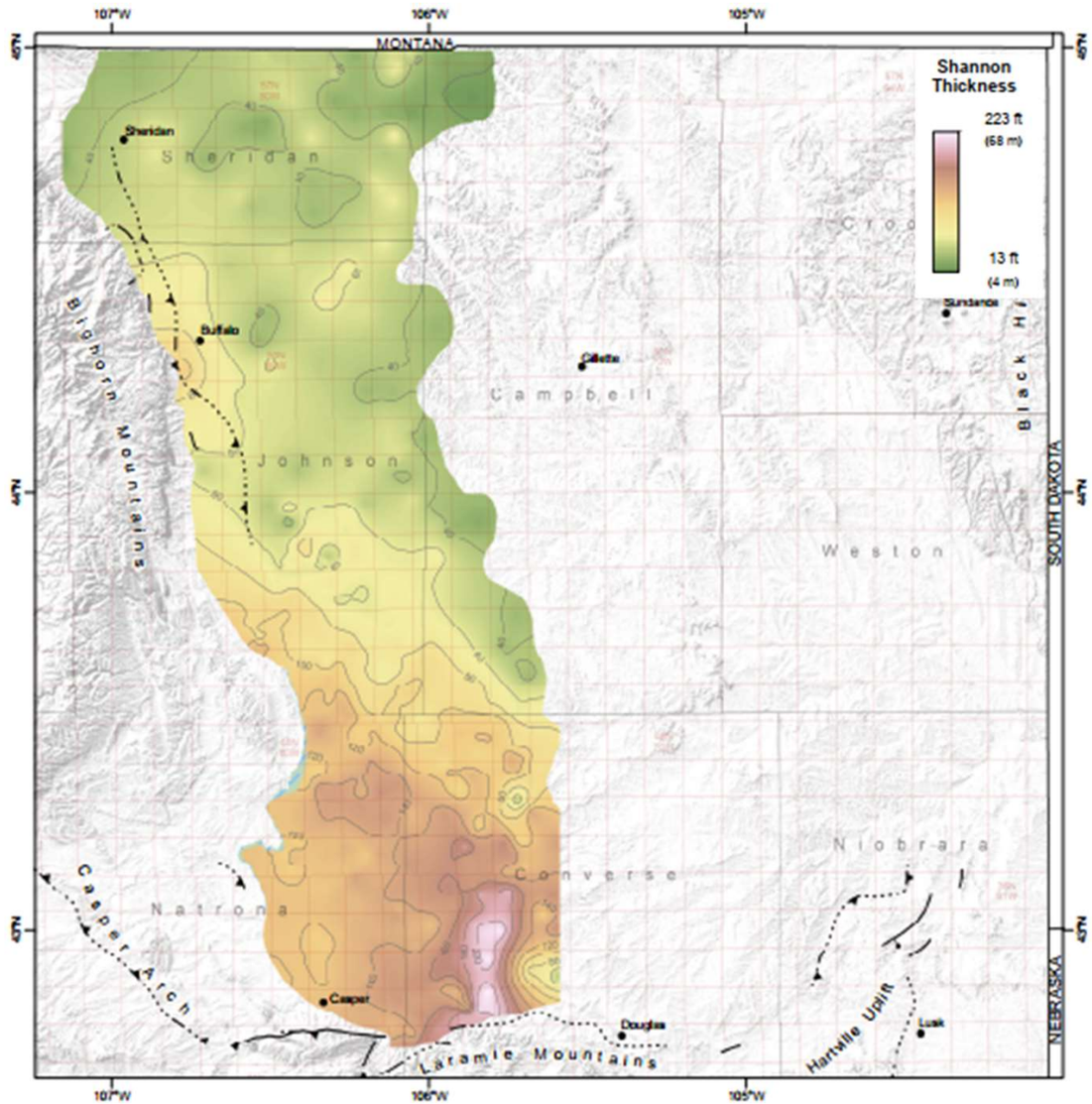
Shannon Sandstone



Cretaceous stratigraphic column of the PRB with the Shannon Sandstone and other pay highlighted (Modified from Toon, 2014).

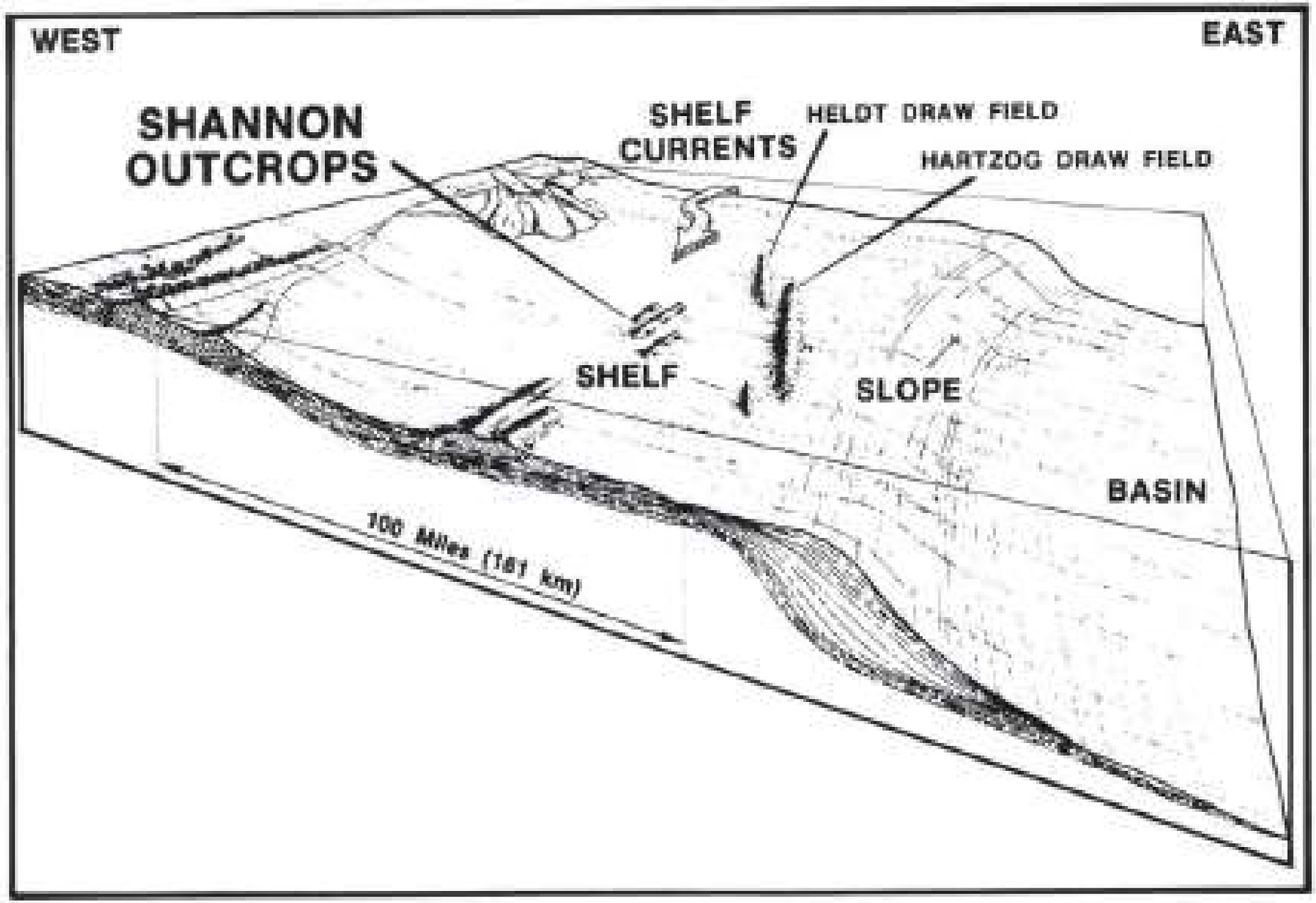
Shannon Sandstone





Structure and Isopach maps of the Shannon Sandstone in the Wyoming portion of the Powder River Basin (modified from WSGS - Lichtner et al, 2020)

Shannon Sandstone



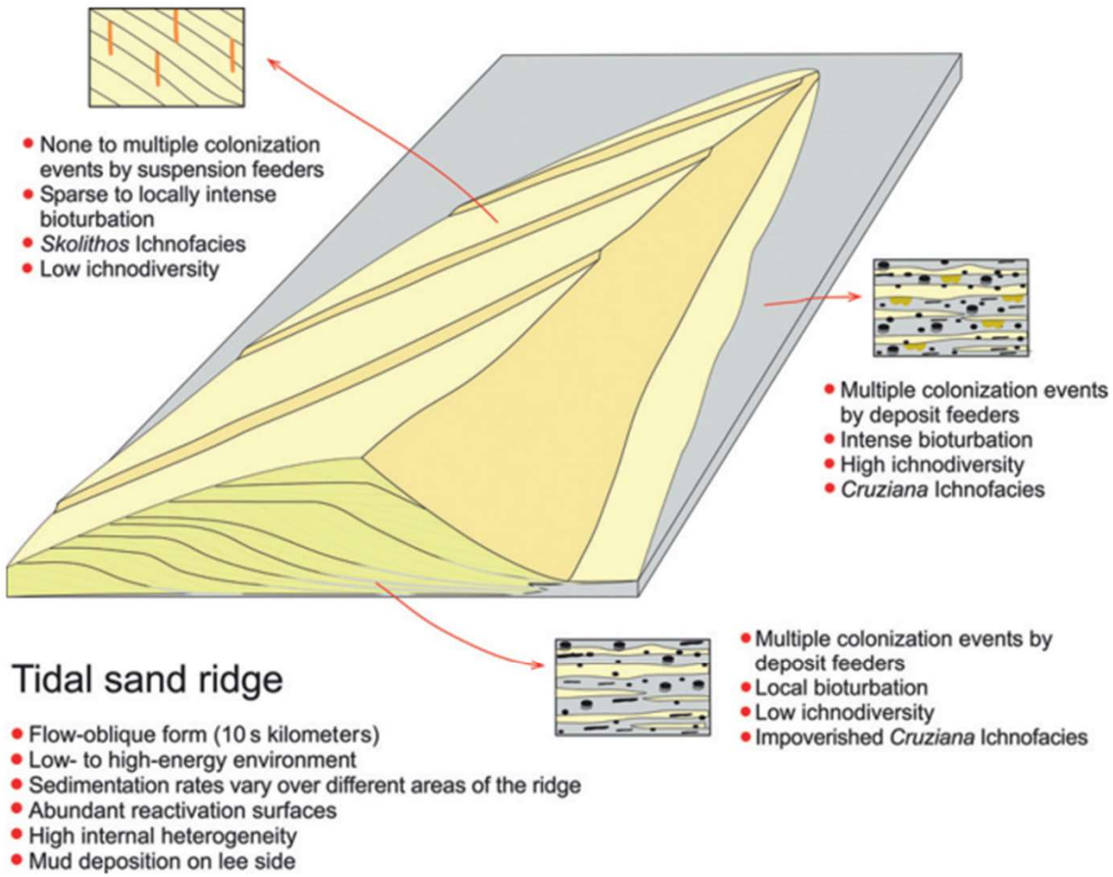
Schematic of shelf-slope to basin paleogeography during the deposition of the Shannon Sandstone (Tillman and Martinsen, 1986).

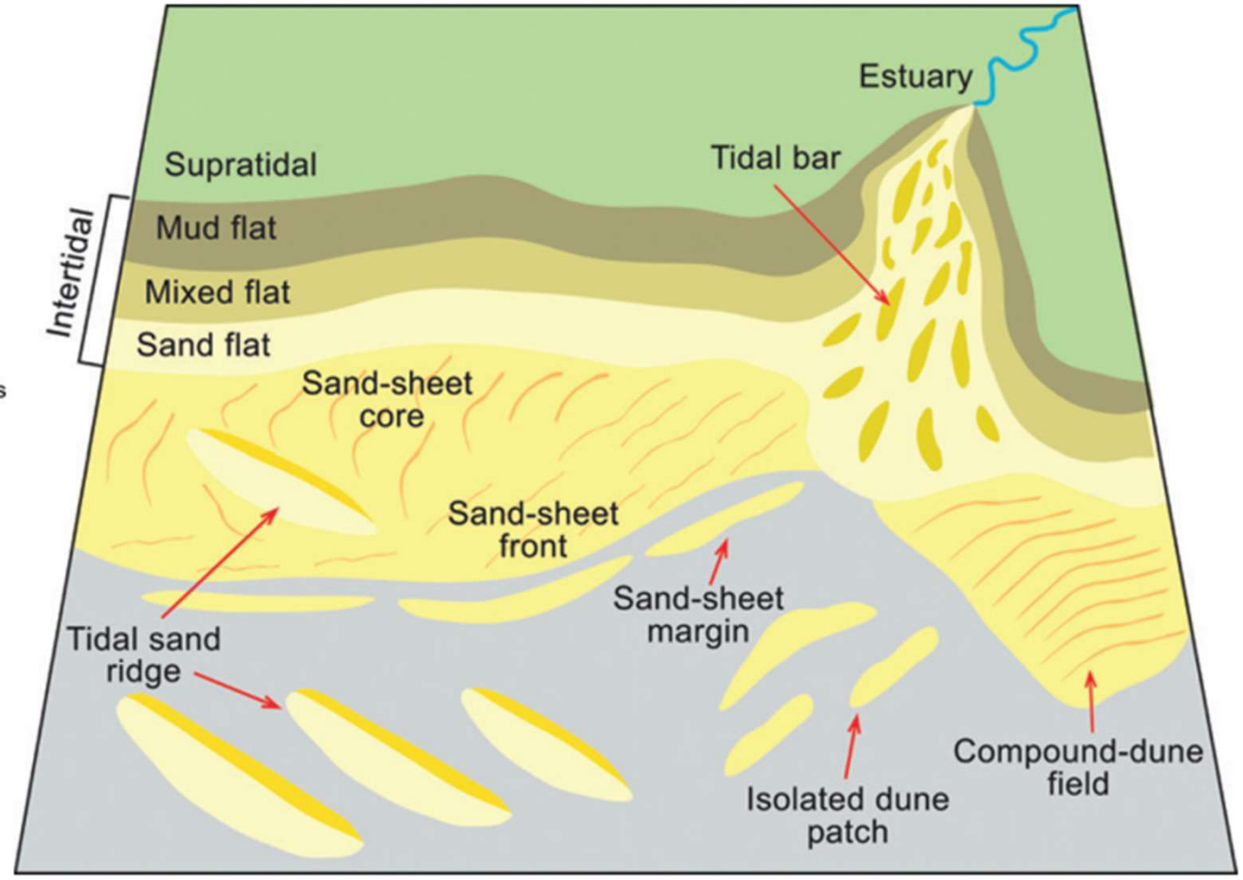
Shannon Deposition

Varied depositional interpretations

- Open bay (estuarine) model
- Shelf ridge model
- Incised valley fill model
- Lowstand shoreface model
- Reworked delta systems

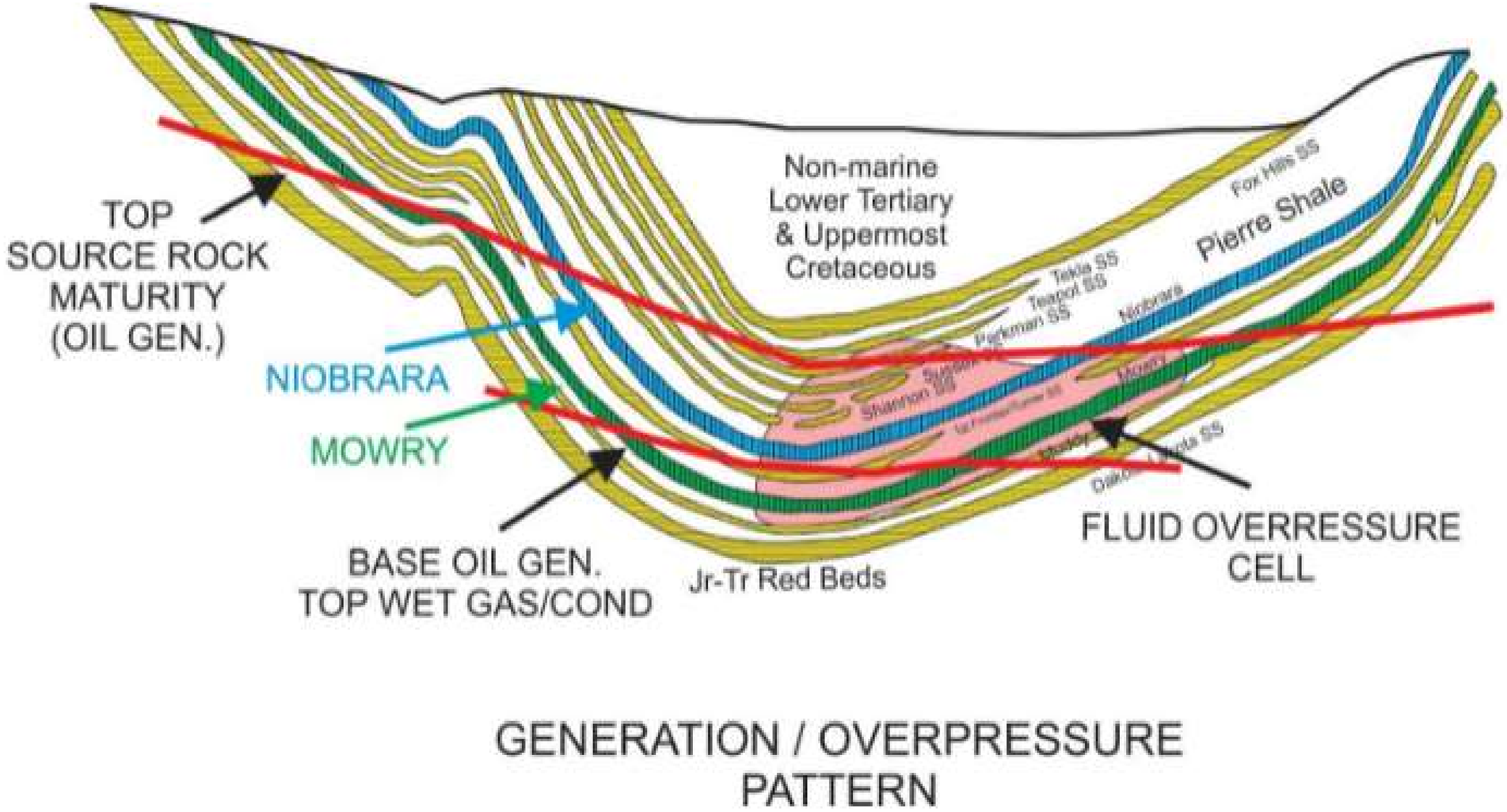
Tidal Sand Ridge Model





Tidal sand ridge depositional models (Desjardins, 2012)

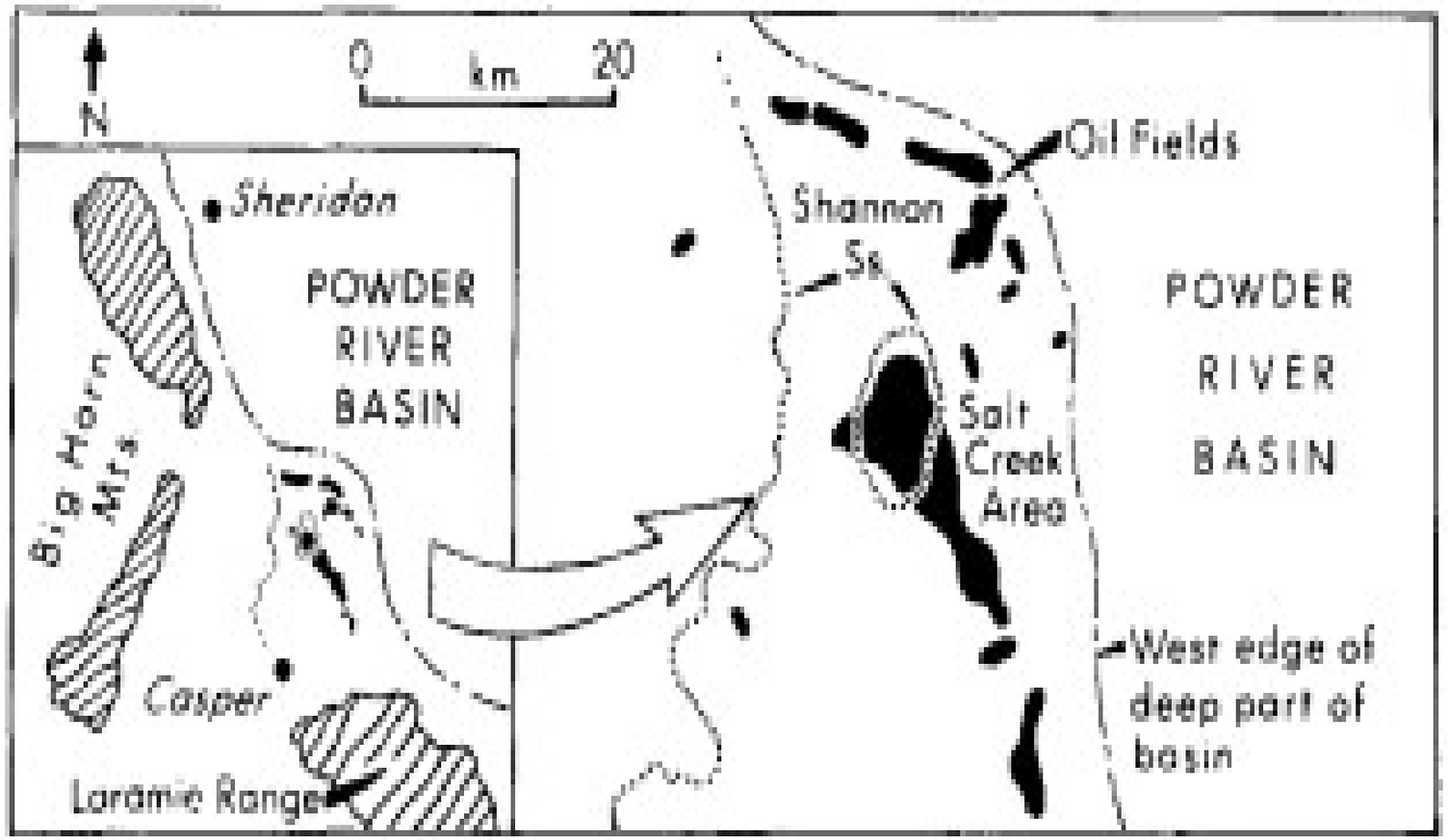
Halo Play



GENERATION / OVERPRESSURE
PATTERN

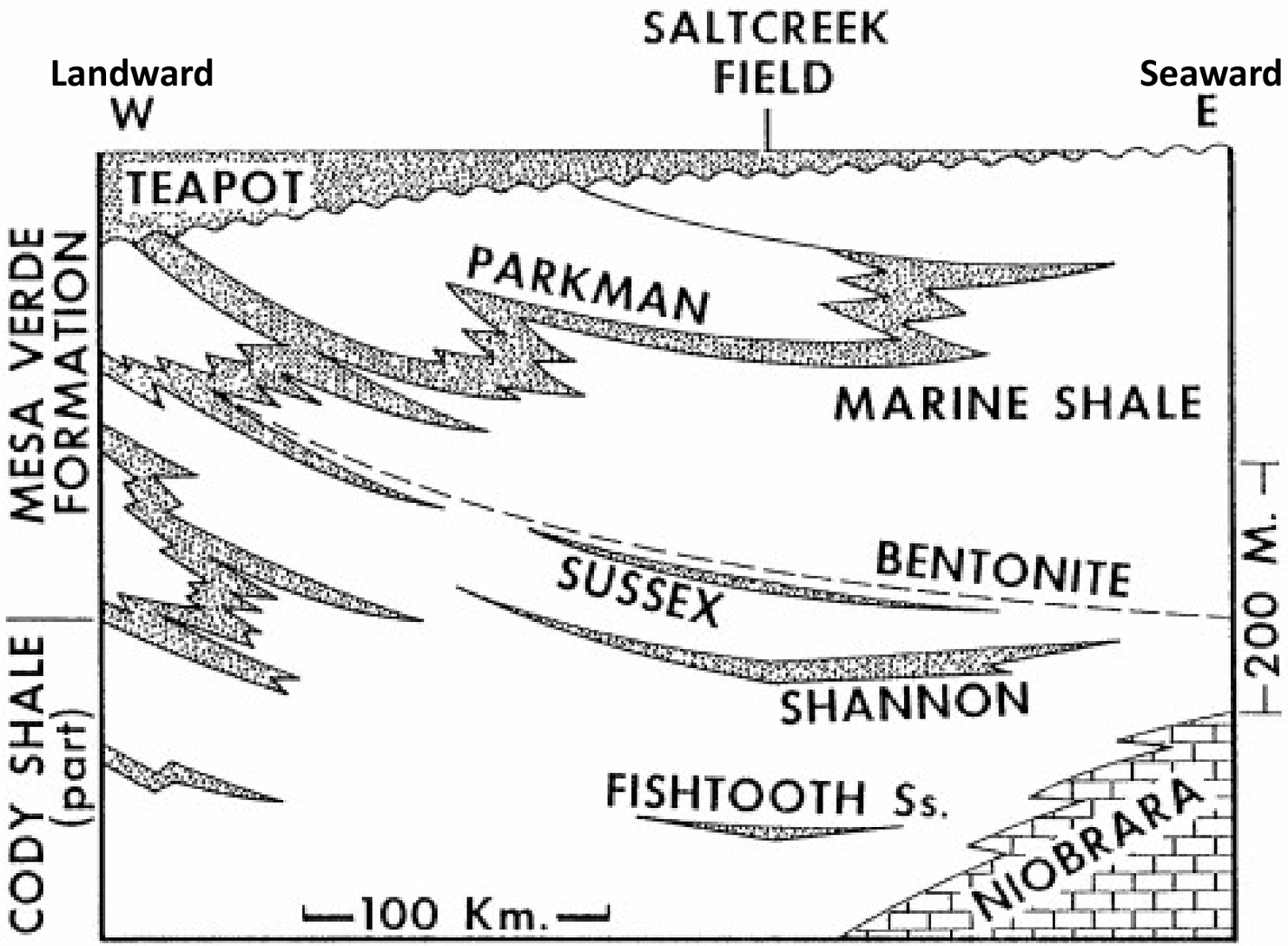
Schematic cross-section of the Cretaceous-Tertiary PRB (modified from Meissner, 2002).

Shannon Discovery



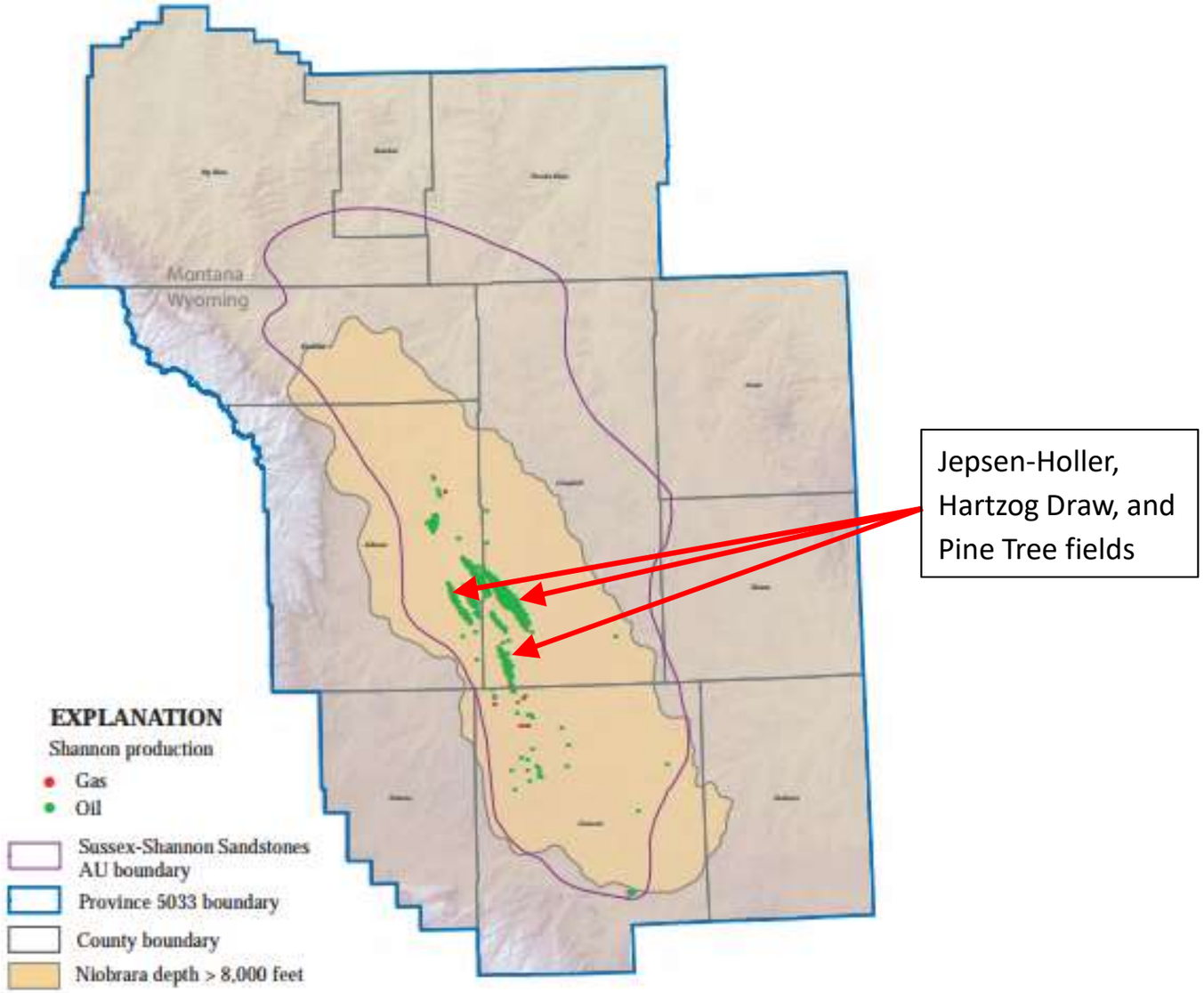
Shannon Sandstone outcrops and nearby oil field in the PRB (Spearing, 1976).

Shannon Discovery



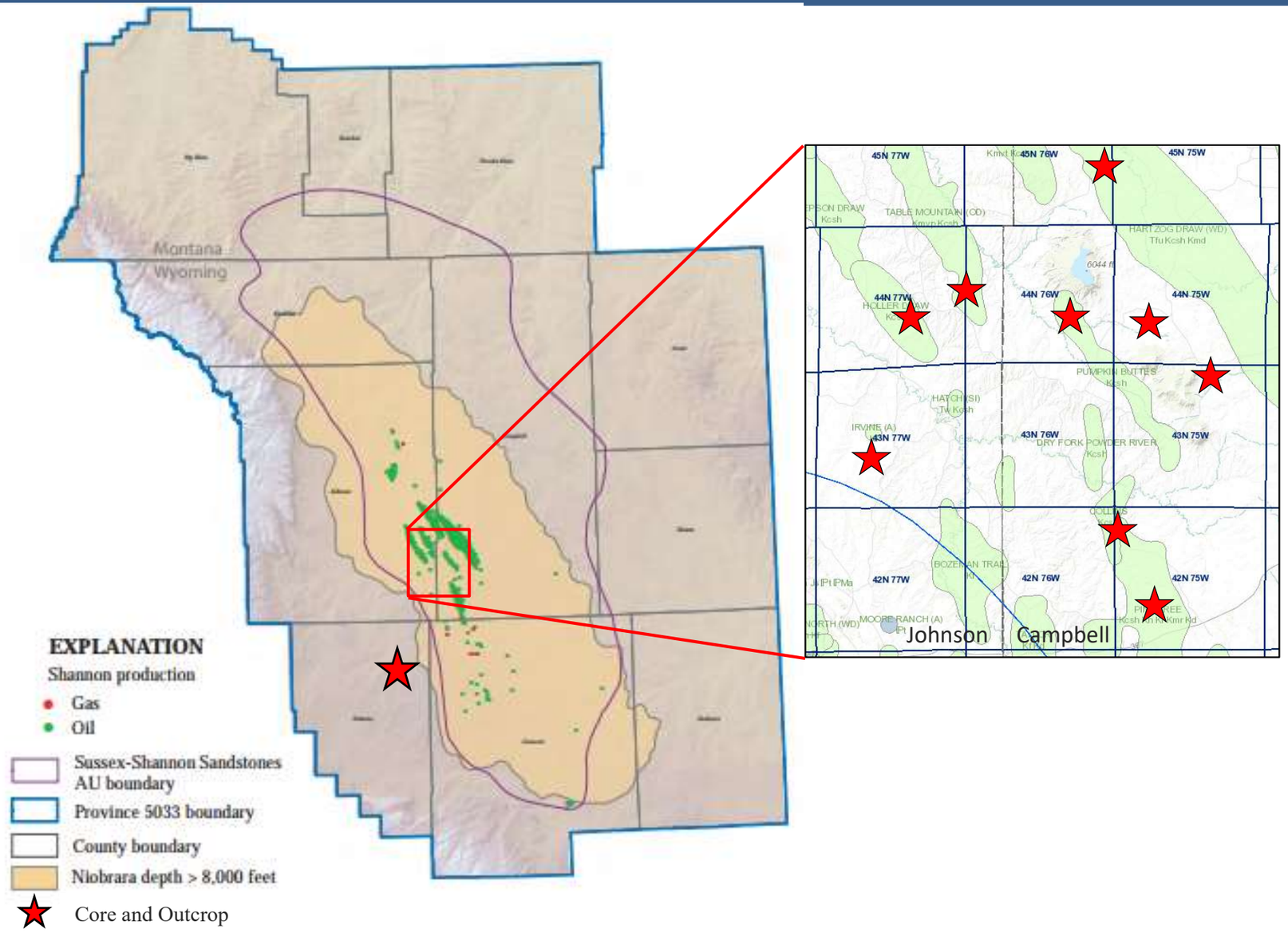
Stratigraphic reconstruction of the Upper Cretaceous in central Wyoming (Tillman, 1997).

Shannon Production



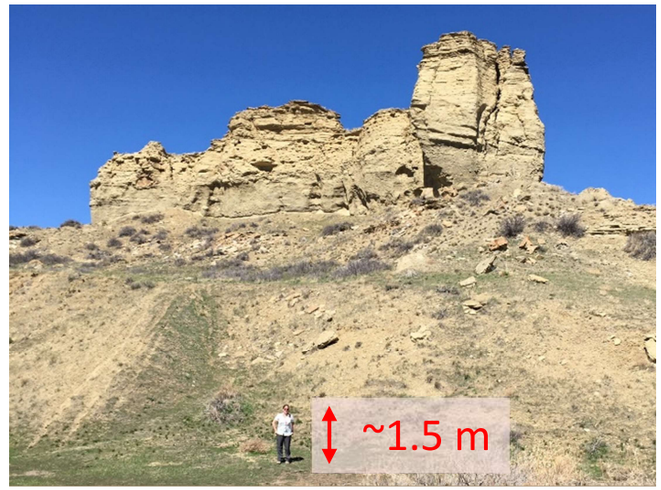
Powder River Basin Province showing oil and gas production in the Shannon Sandstone unit (Anna, 2009).

Study Area



Powder River Basin Province showing oil and gas production and proposed study area in the Shannon Sandstone unit (Modified from Anna, 2009).

Shannon Outcrop

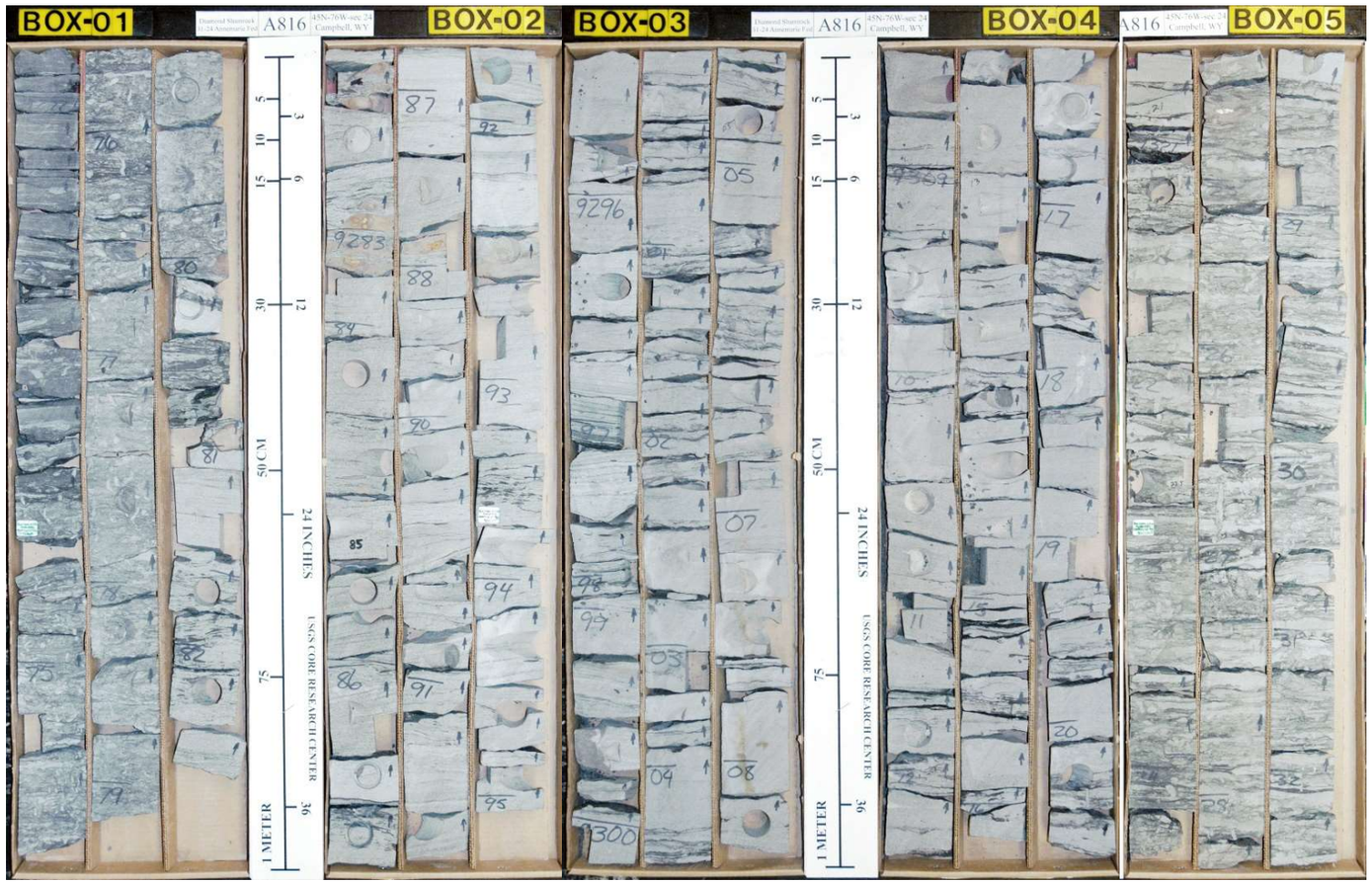


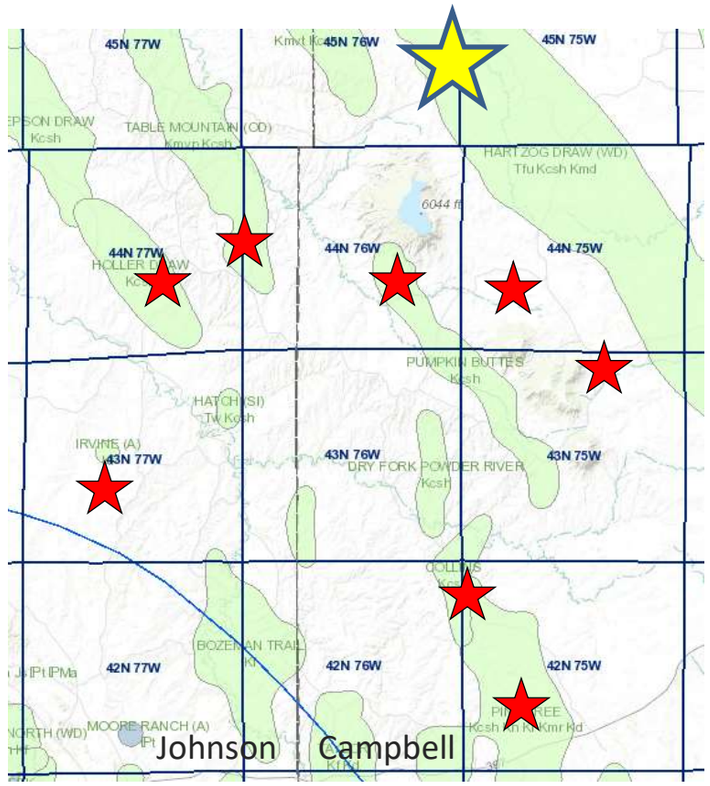
Shannon Outcrop

Tillman 1997	Bergman & Walker, 1995	Tillman & Martinsen, 1984	Ranganathan & Tye, 1986	Spearing 1976
CENTRAL-RIDGE SANDSTONE	F6, Cross-bedded Sandstone	Central Bar Facies	Facies A (and C)	Cross-bedded Sandstone Facies
PLANAR-LAMINATED SANDSTONE		Central Bar (Planar Laminated Facies)	Facies C	
HIGH-ENERGY RIDGE-MARGIN SANDSTONE	F4, Glauconitic Med. to Coarse SS	Bar Margin Facies (Type 1)	Facies B	
LOW-ENERGY RIDGE-MARGIN SANDSTONE		Bar Margin Facies (Type 2)	Facies C and A	
INTER-RIDGE FACIES	F5, Thin bedded SS	Interbar Facies	Facies D	Ripple-bedded Sandstone Facies
BIOTURBATED SANDSTONE	Coarse Bioturbated Sandy Mudstone	Bioturbated Shell-Sandstone	Facies E	

Comparison of Shannon Sandstone facies nomenclature from 1976 to 1997 (Tillman, 1997)

31-24 Anniemary Federal

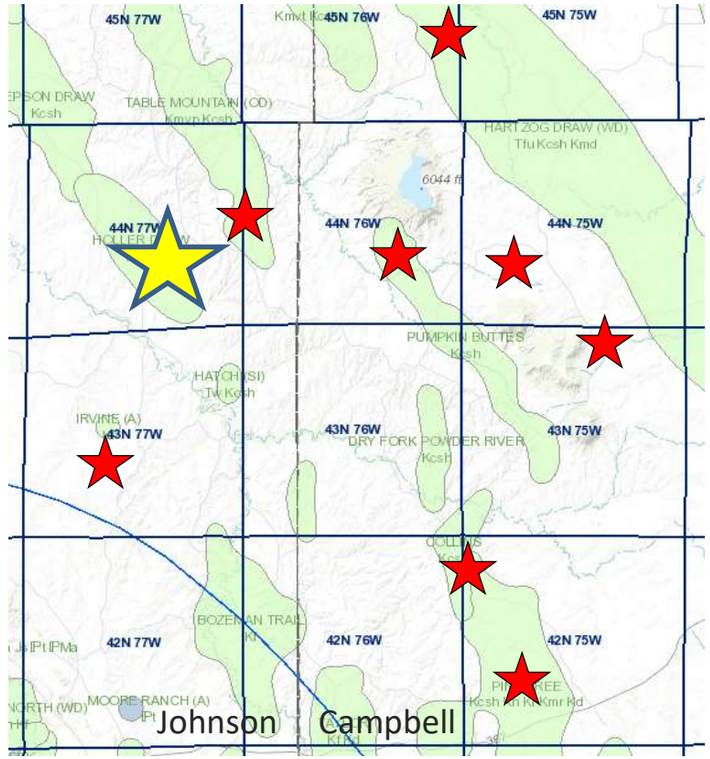




31-24 Anniemary Well

- Northernmost part of the study area
- T45N R76W, Johnson County, section 24
- Available data: XRD, 20 thin sections, and 60’ of core

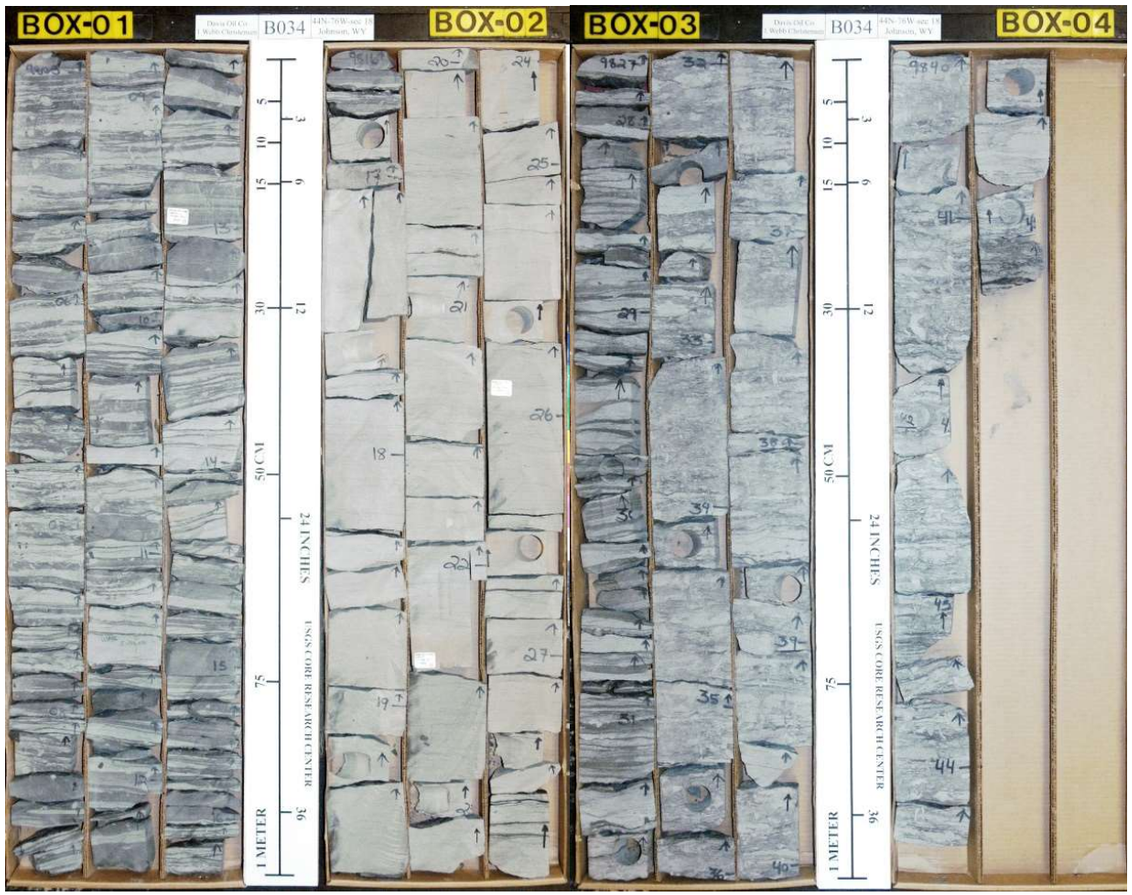
3 Van R Irvine Well

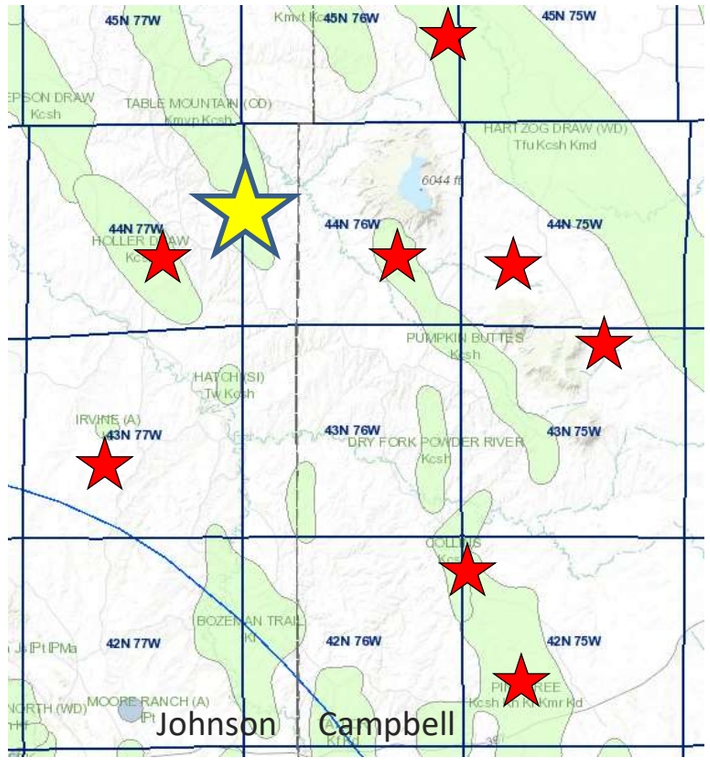


3 Van R Irvine Well

- Northwestern part of the study area
- T44N R77W, Johnson County, section 22
- Available data: XRD, 2 thin sections, and 62’ of core

1 Webb Christensen Well

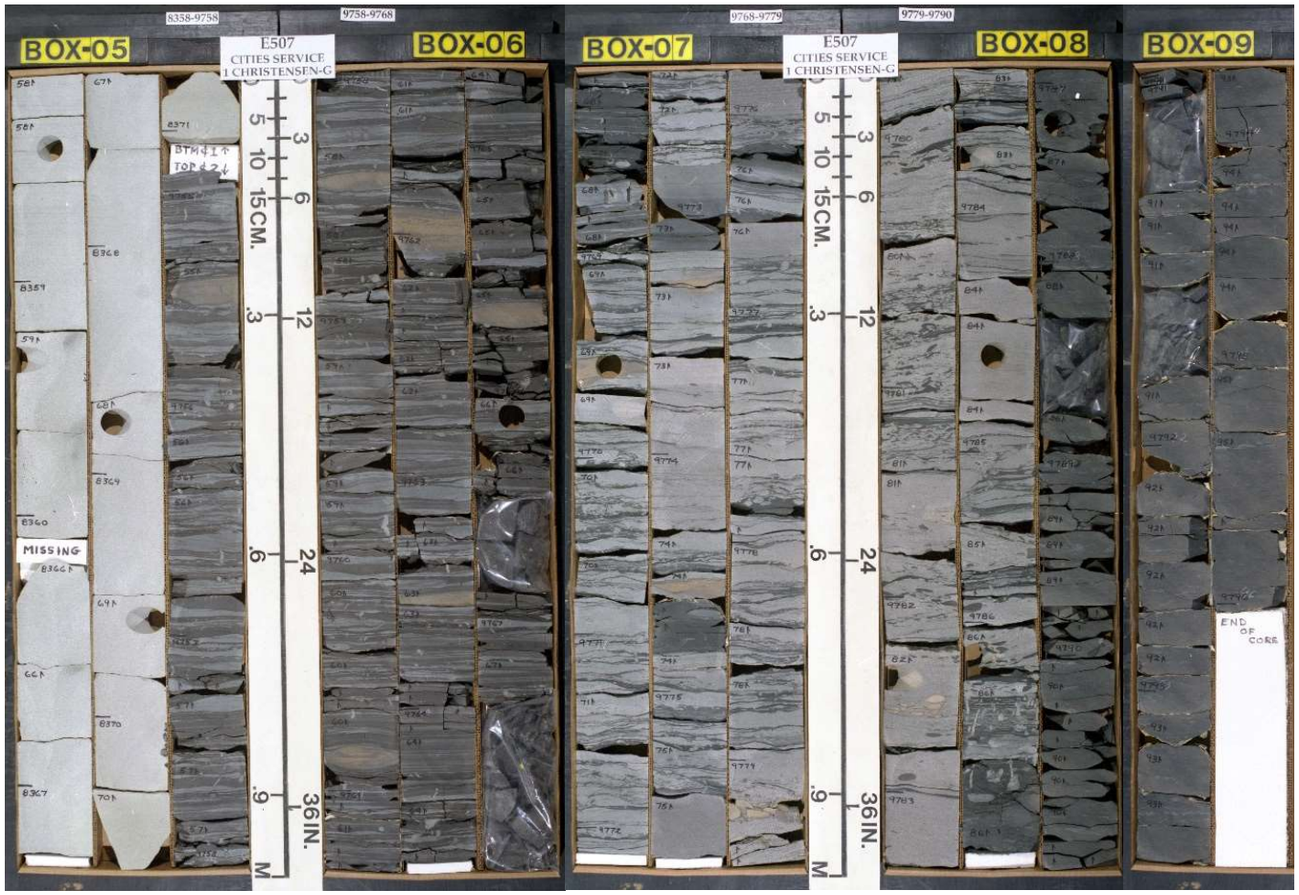


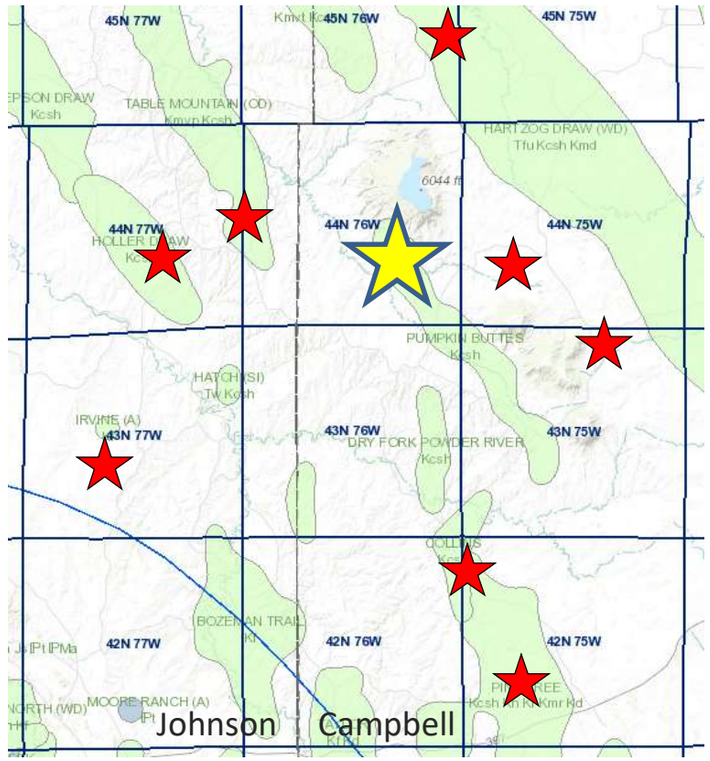


1 Webb Christensen Well

- Northwestern part of the study area
- T44N R76W, Johnson County, section 18
- Available data: Porosity and permeability data and 40’ of core

1 Christensen-G Well

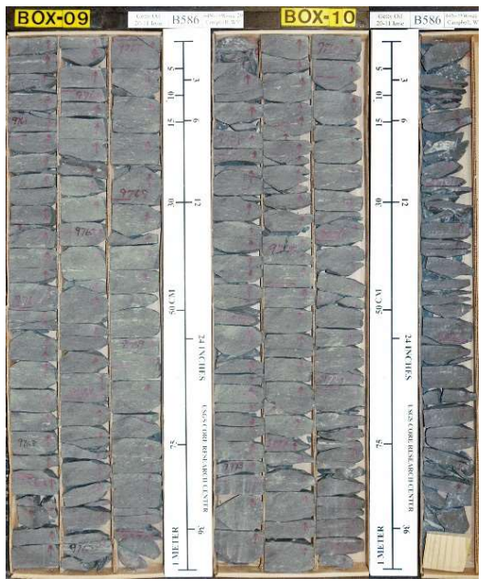


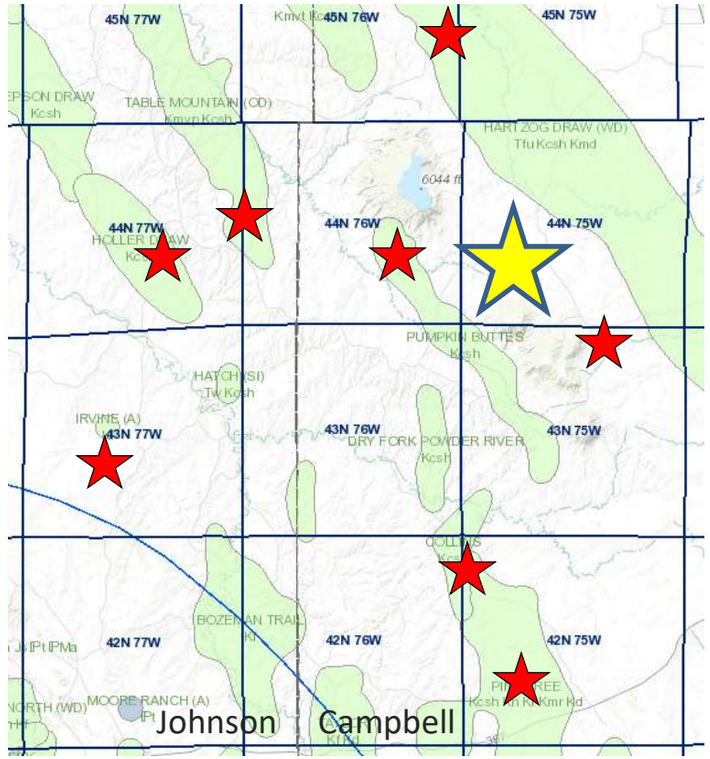


1 Christensen-G Well

- Northern part of the study area
- T44N R76W, Campbell County, section 22
- Available data: XRD, 2 thin sections, and 40’ of core

20-11 Ione Well

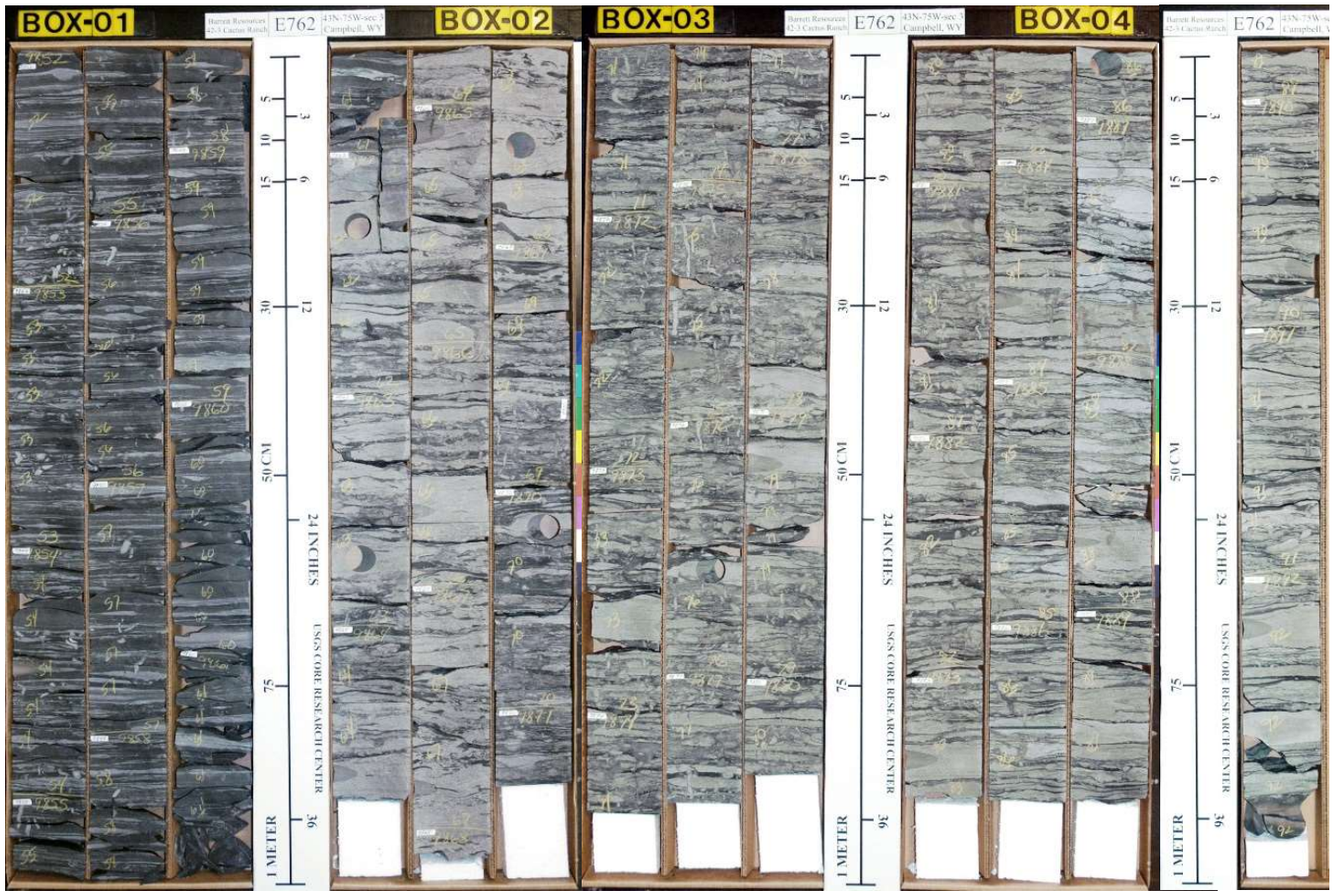


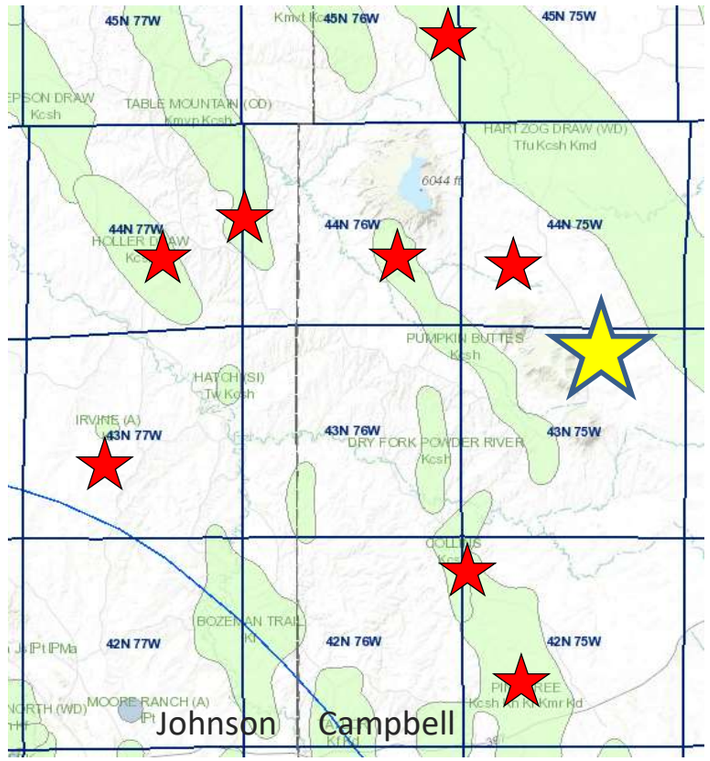


20-11 Ione Well

- Northeastern part of the study area
- T44N R75W, Campbell County, section 20
- Available data: 11 thin sections and 107’ of core

42-3 Cactus Ranch Well

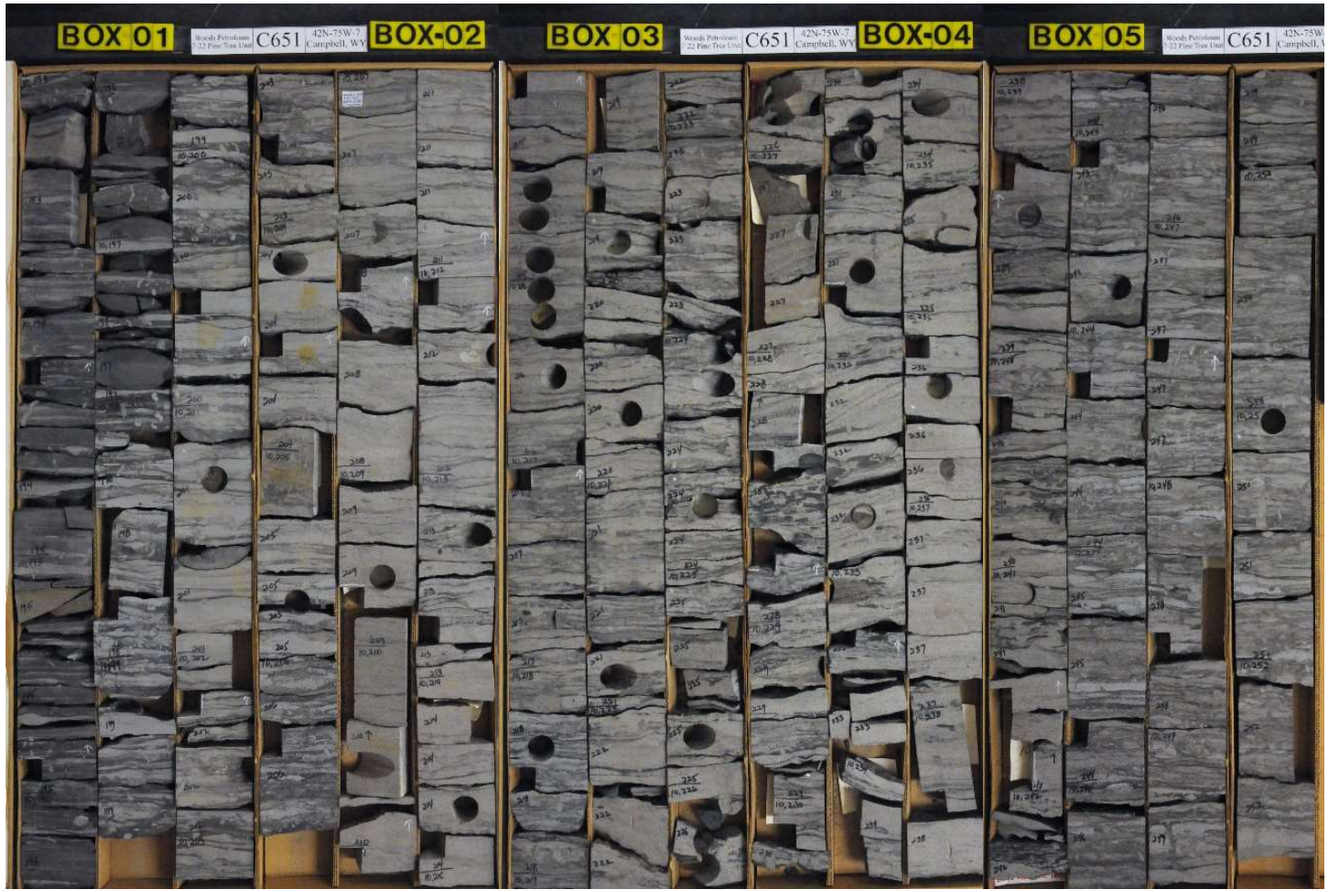


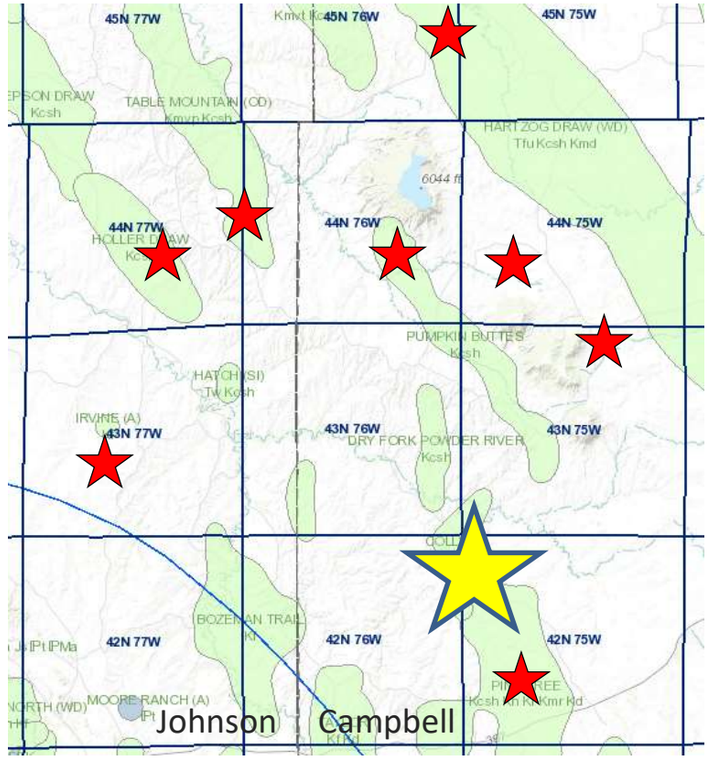


42-3 Cactus Ranch Well

- Eastern part of the study area
- T43N R75W, Campbell County, section 3
- Available data: XRD, 4 thin sections, and 40’ of core

7-22 Pine Tree Unit Well

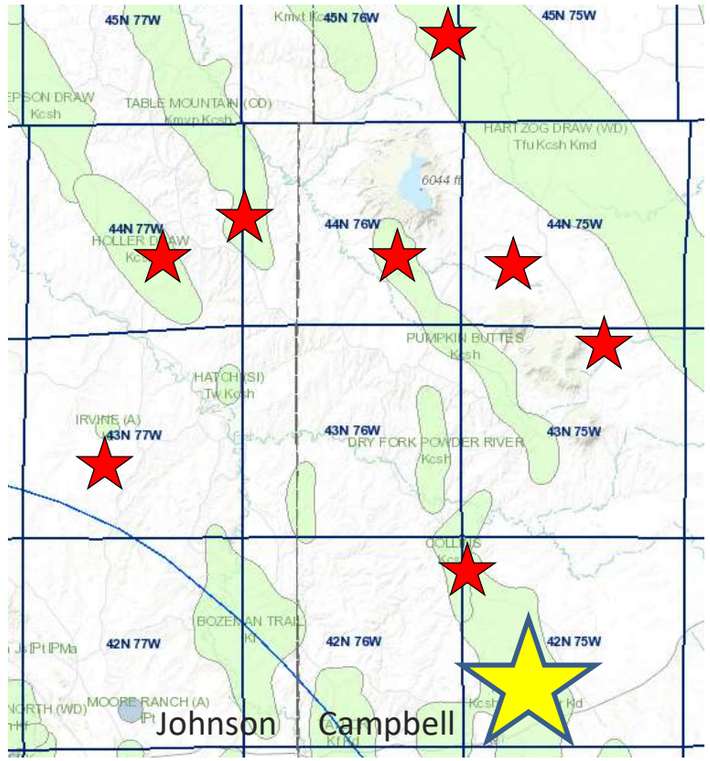




7-22 Pine Tree Unit Well

- Southeastern part of the study area
- T42N R75W, Campbell County, section 7
- Available data: XRD, 5 thin sections, and 59’ of core

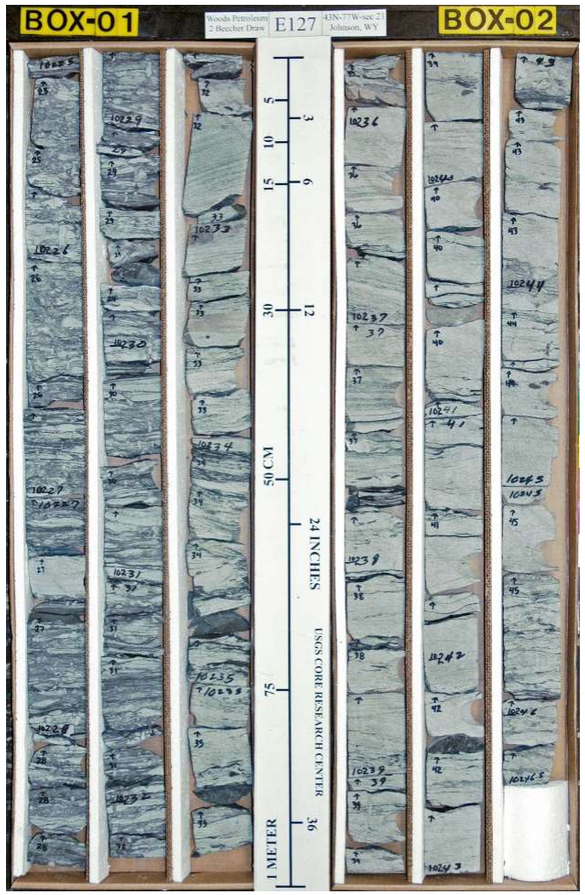
20-34 Pine Tree Unit Well

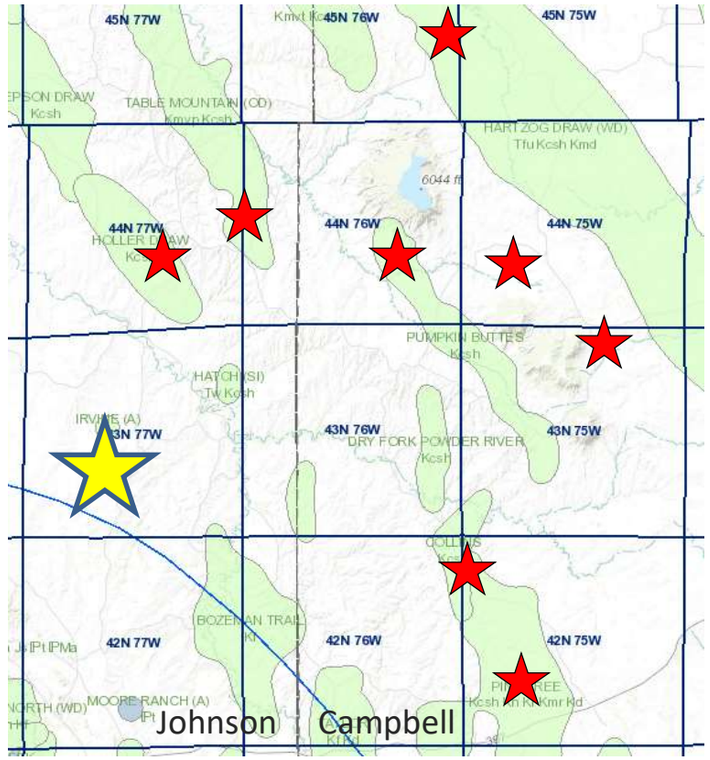


20-34 Pine Tree Unit Well

- Southeastern part of the study area
- T42N R75W, Campbell County, section 20
- Available data: XRD, 2 thin sections, and 59’ of core

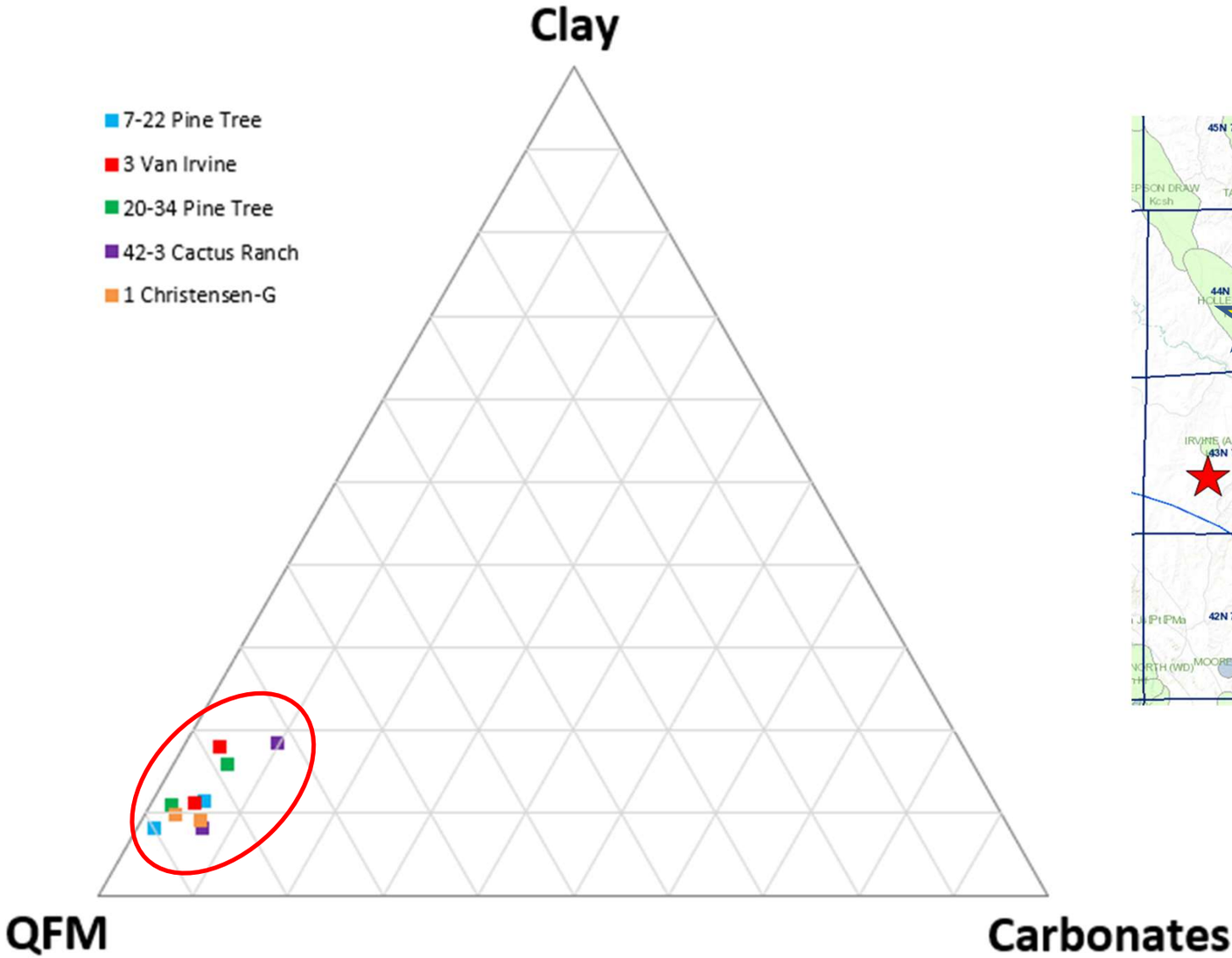
2 Beecher Draw Well

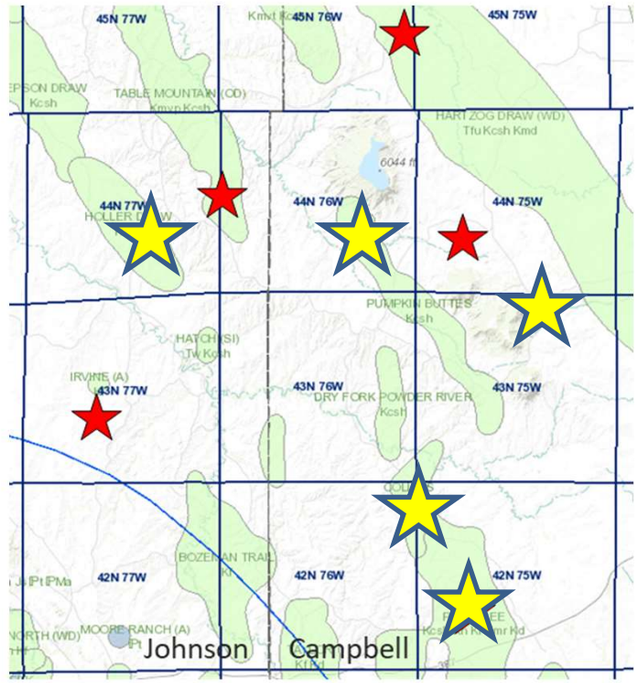




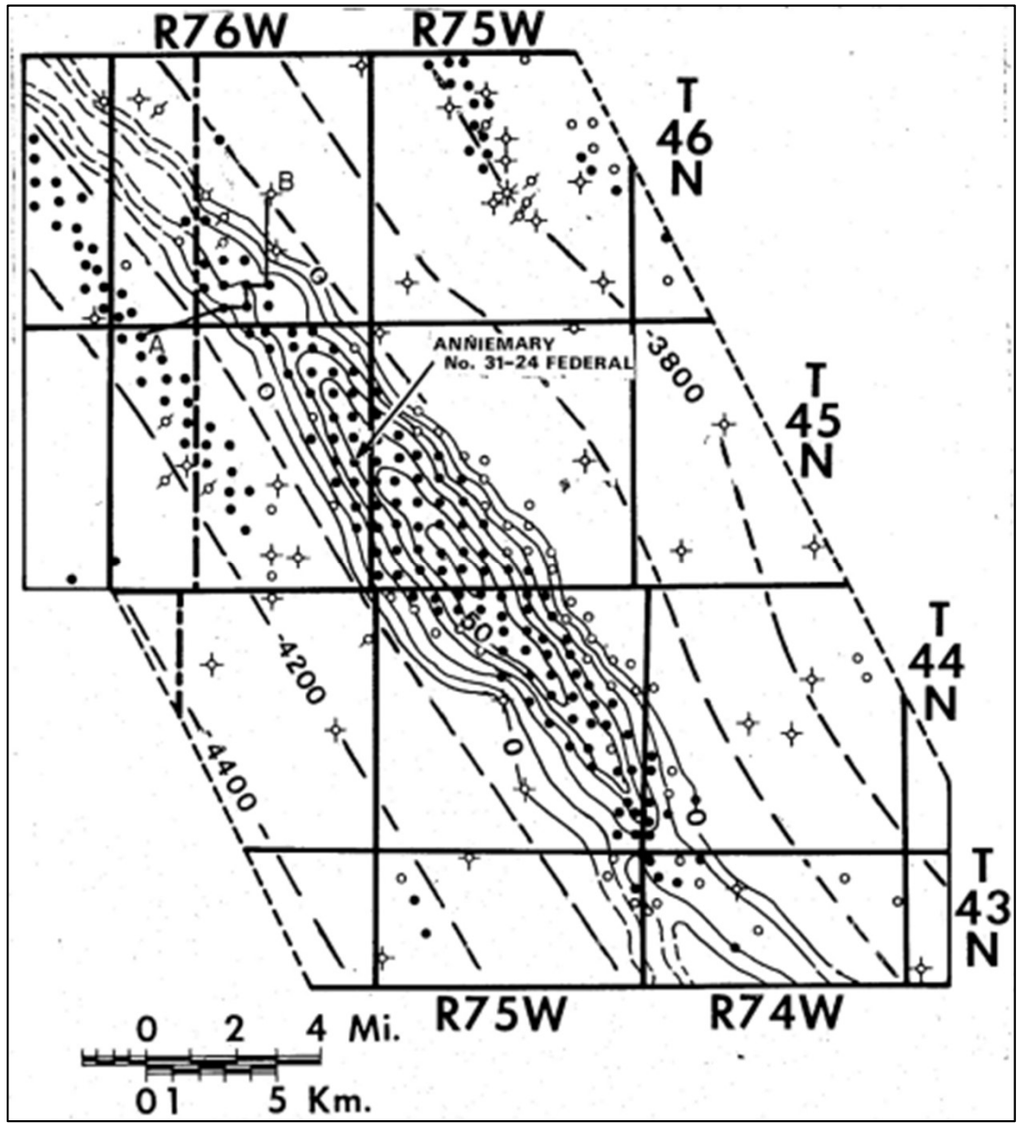
2 Beecher Draw Well

- Western part of the study area
- T43N R77W, Johnson County, section 21
- Available data: XRF and 21’ of core


Clay
7-22 Pine Tree
3 Van Irvine
20-34 Pine Tree
42-3 Cactus Ranch
1 Christensen-G
QFM
Carbonates

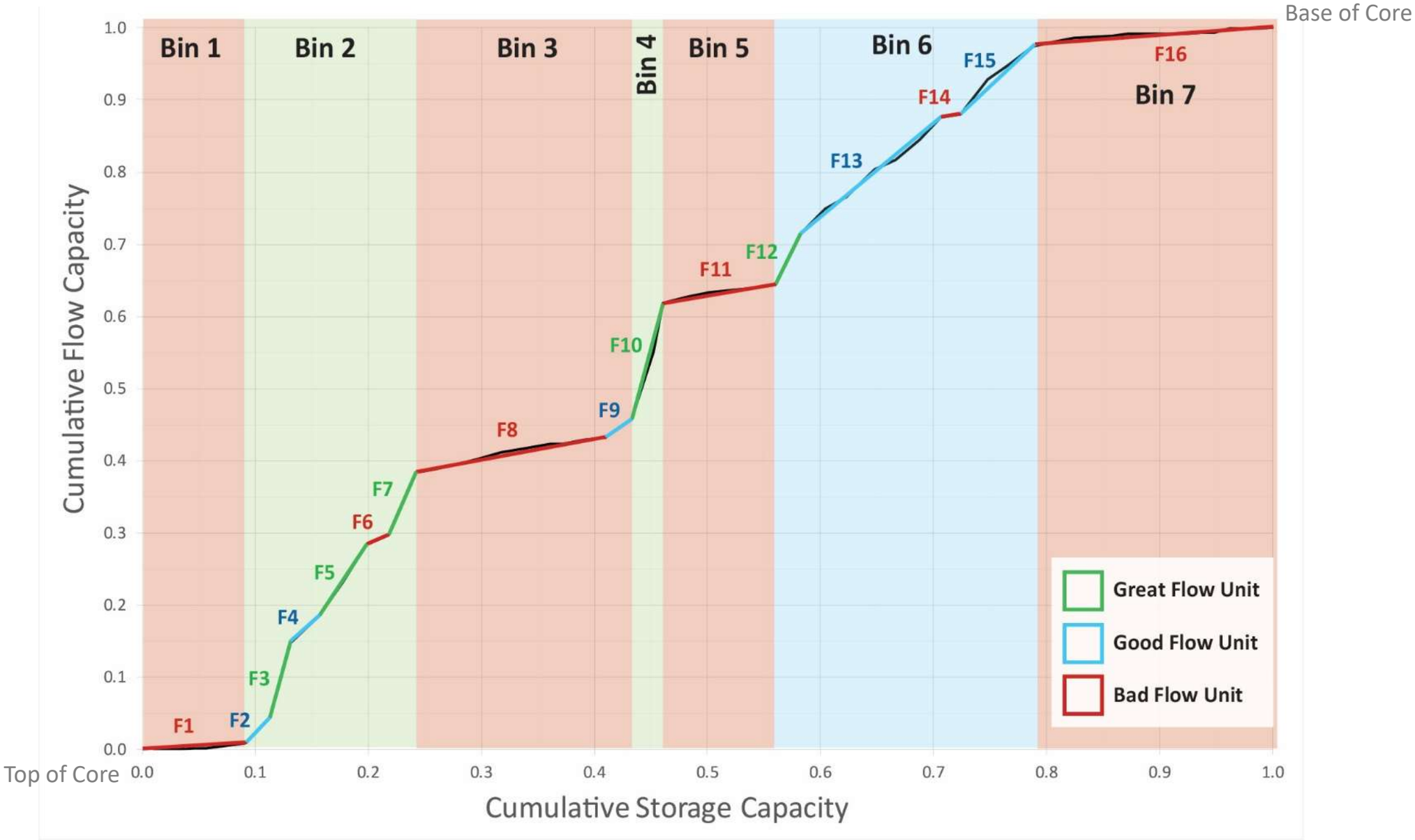

45N 77W
45N 76W
45N 75W
44N 77W
44N 76W
44N 75W
43N 77W
43N 76W
43N 75W
42N 77W
42N 76W
42N 75W
Johnson
Campbell

Diamond Shamrock Anniemary #31-24 Federal

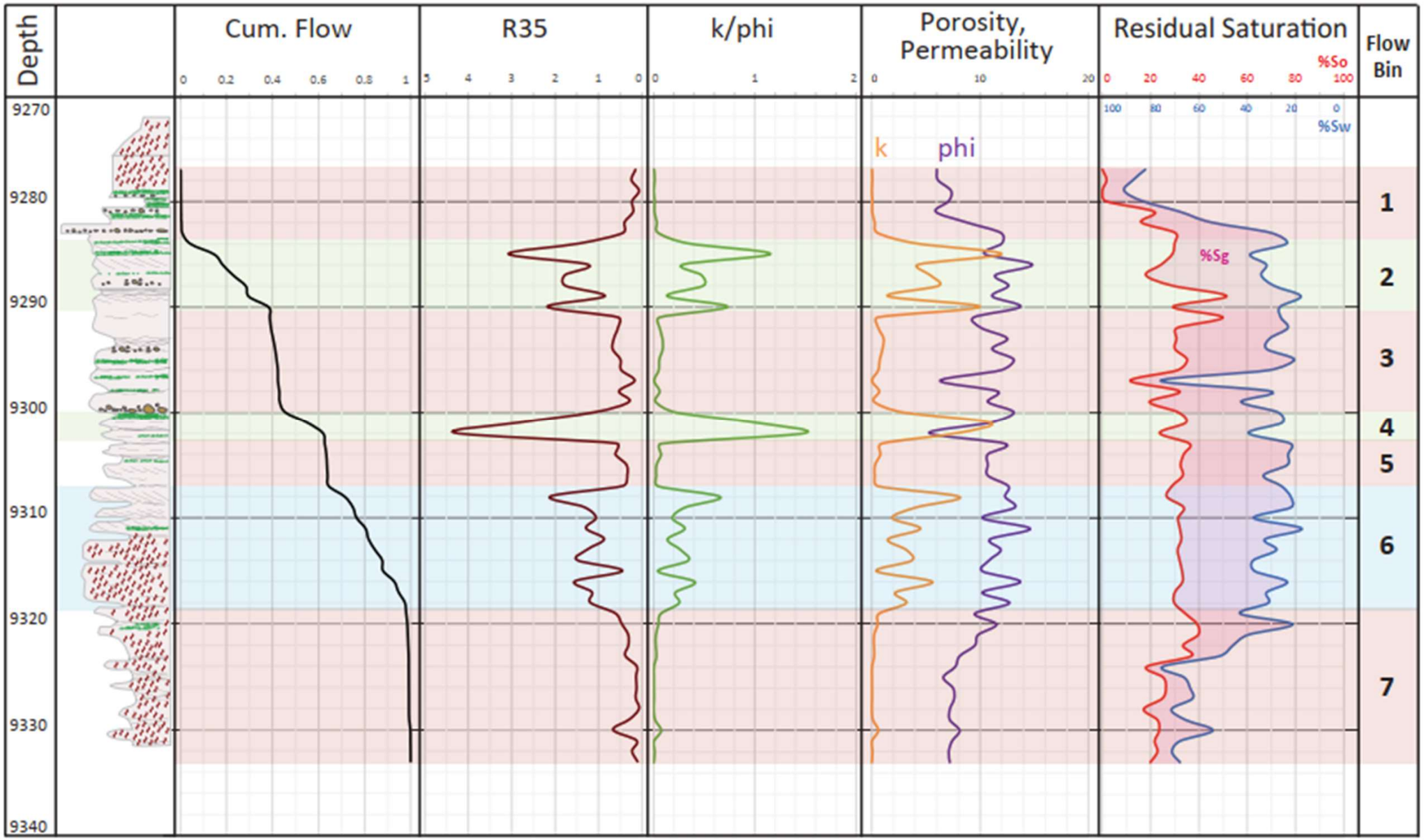


Net sand isopach map of the Shannon Sandstone in Hartzog Draw. Anniemary well is highlighted (From Weimer and Tillman, 1982).

31-24 Anniemary – Modified Lorenz Plot



31-24 Anniemary – Core Analysis Plots



Continued Work

- Core and outcrop analysis
  - Facies identification, lithology, trace fossils, depositional energy, flow units, ichnofacies, texture, grain size, color, and structure
- Thin section analysis
  - mineralogy, stratigraphy, and petrographic characteristics
  - FESEM, detrital characteristics, diagenesis, porosity, organic matter, and mineralogical features
- XRF and XRD
  - Elemental data analysis and mineralogical composition
  - Terrestrial vs marine influence
  - Clay characterization
- Subsurface analysis
  - Log analysis
  - Subsurface Mapping
  - Pressure Systems Analysis
  - Trapping Mechanisms
- Characterization of lateral and vertical variability

Thank You

MUDTOC Consortium Sponsors
Fall 2020

Sponsoring Member Companies

Anschutz Exploration Corporation

Red Willow Production Company

Antero Resources

Shell

Crestone Peak Resources

TGS

EOG Resources

Chevron

White Eagle Exploration

2M

HighPoint Resources

Stratum Reservoir

Cimarex

devon

Enverus

GMT Exploration Company LLC

Whiting

Supporting Companies

GeoMark

Mike Johnson & Associates

IHS

Schlumberger

MJ Systems

The Energy of Enerplus

PlatteRiver Associates Inc.