RESERVOIR CHARACTERIZATION OF THE SHANNON SANDSTONE, SOUTHWESTERN POWDER RIVER BASIN, WYOMING

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MUDTOC Spring 2021 Consortium Meeting

Presentation Outline

- Purpose & Objectives
- Introduction & Regional Geology
- Updates to Study Area
- Continued Work

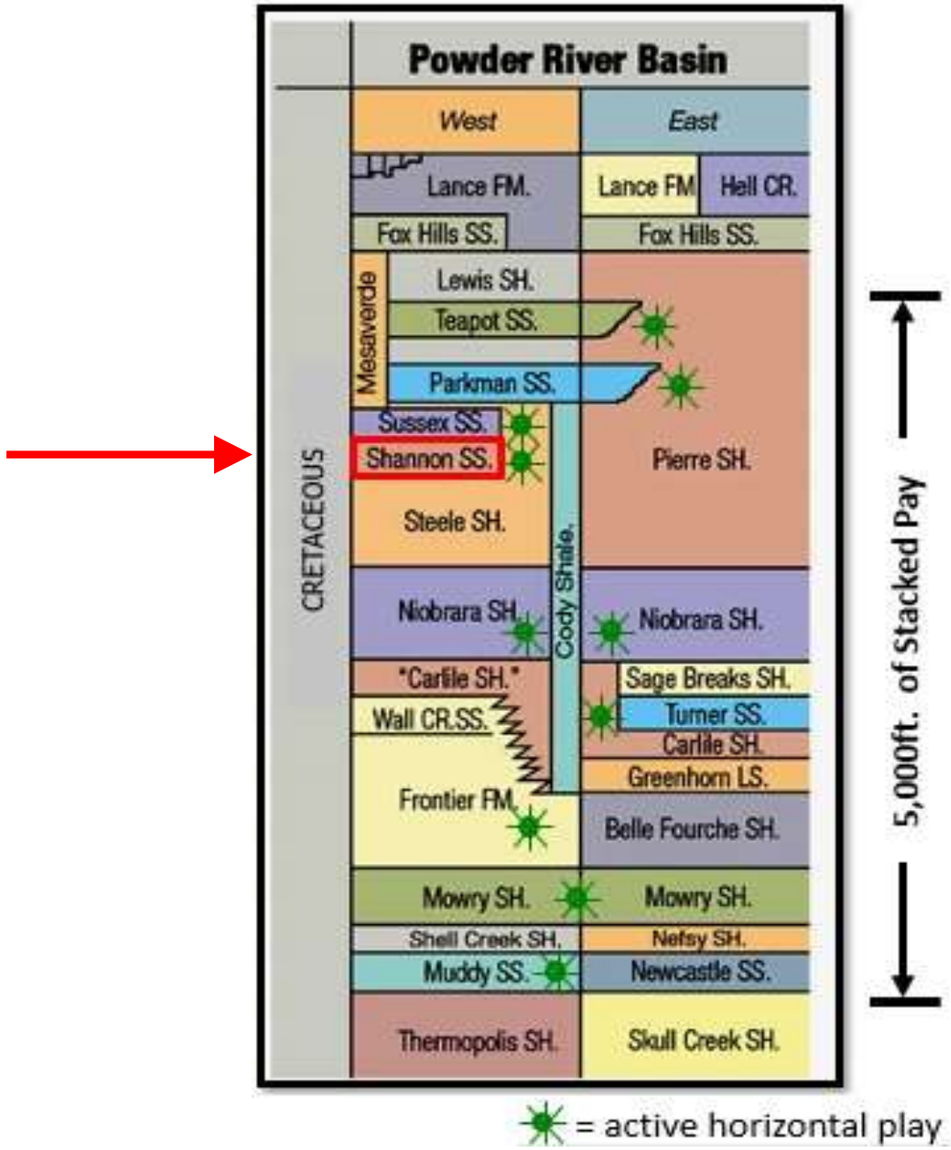
Purpose & Objectives

- 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

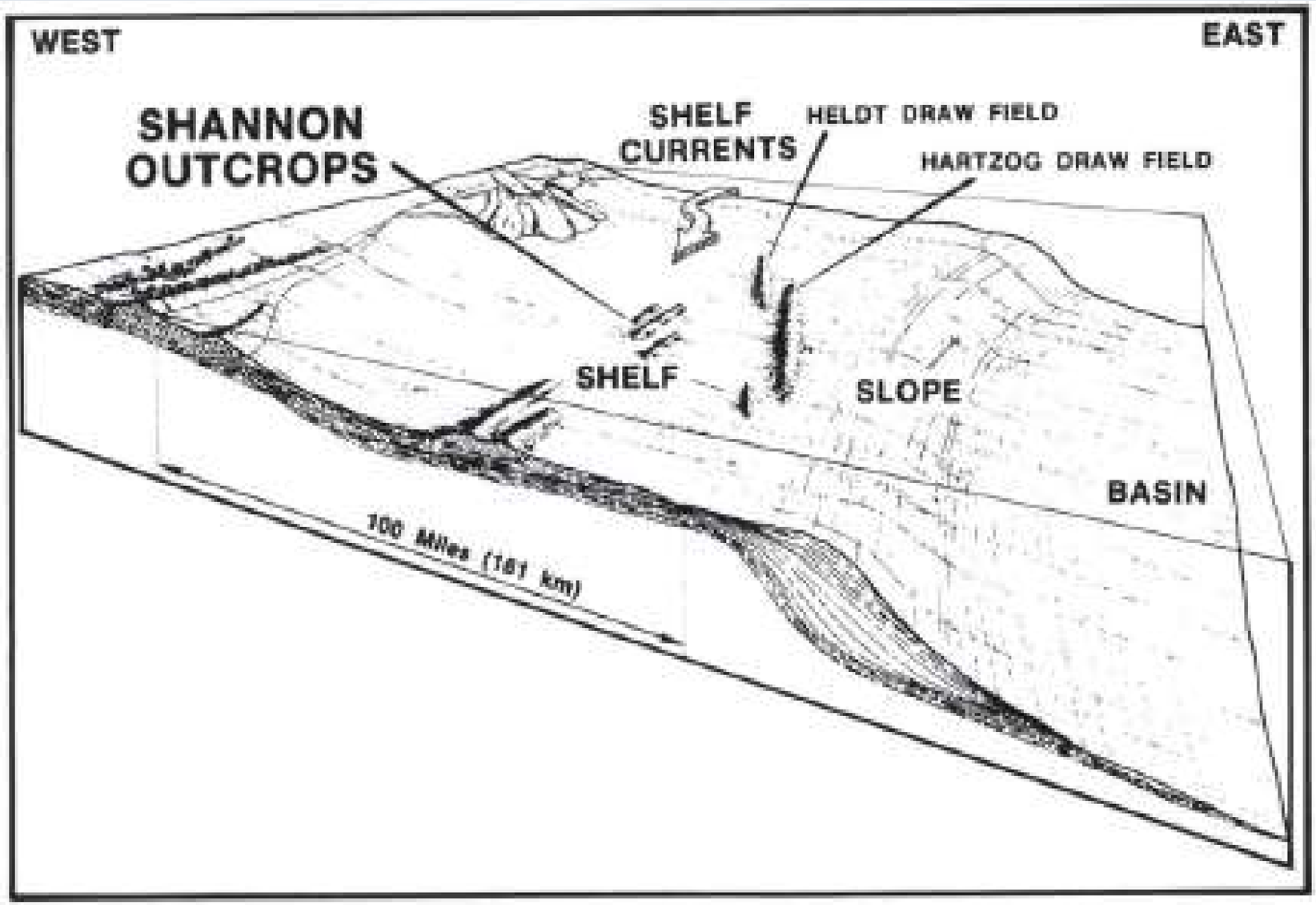
Paleogeographic setting of the Western Interior Seaway during the deposition of Cretaceous rocks in the PRB (Blakey, 2014).

Shannon Sandstone



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

Shannon Sandstone

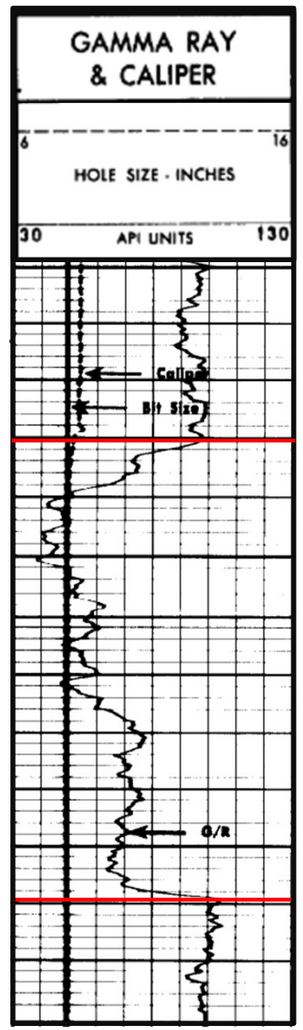


Schematic of shelf-slope to basin paleogeography during the deposition of the Shannon Sandstone (Tillman and Martinsen, 1986).

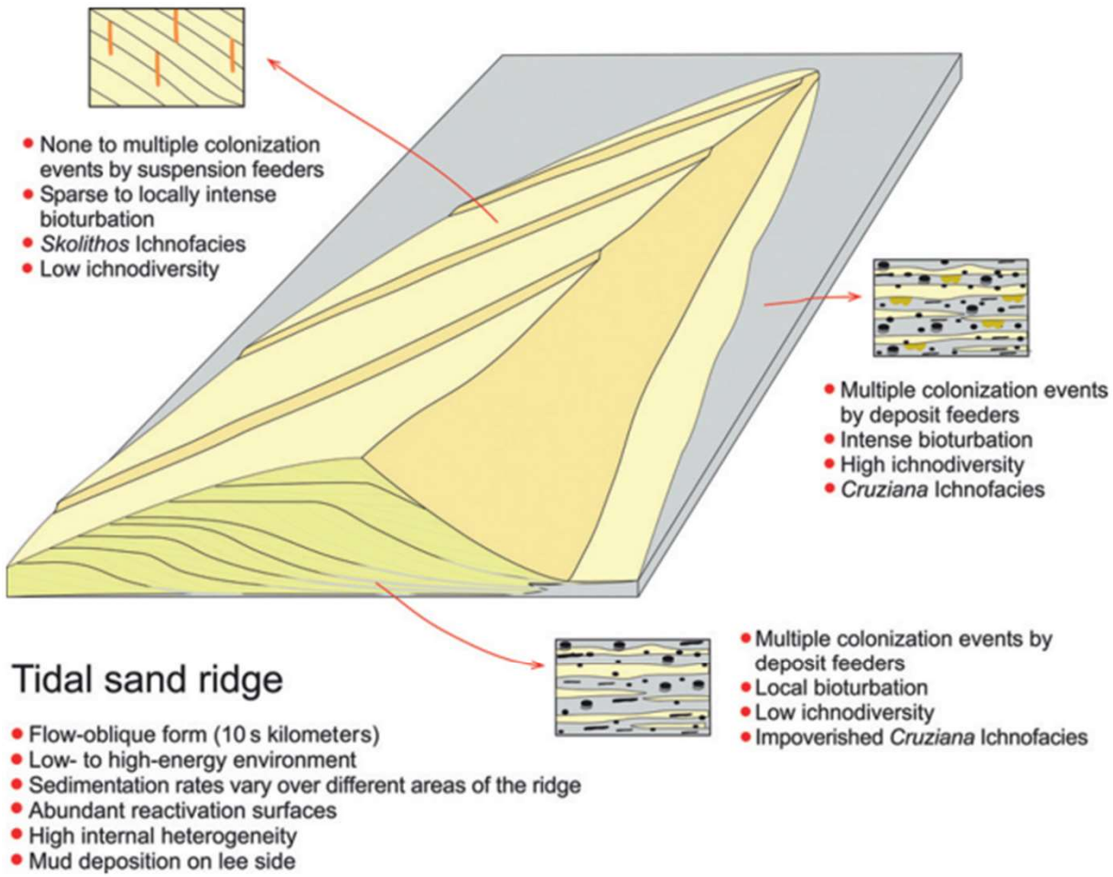
Shannon Deposition

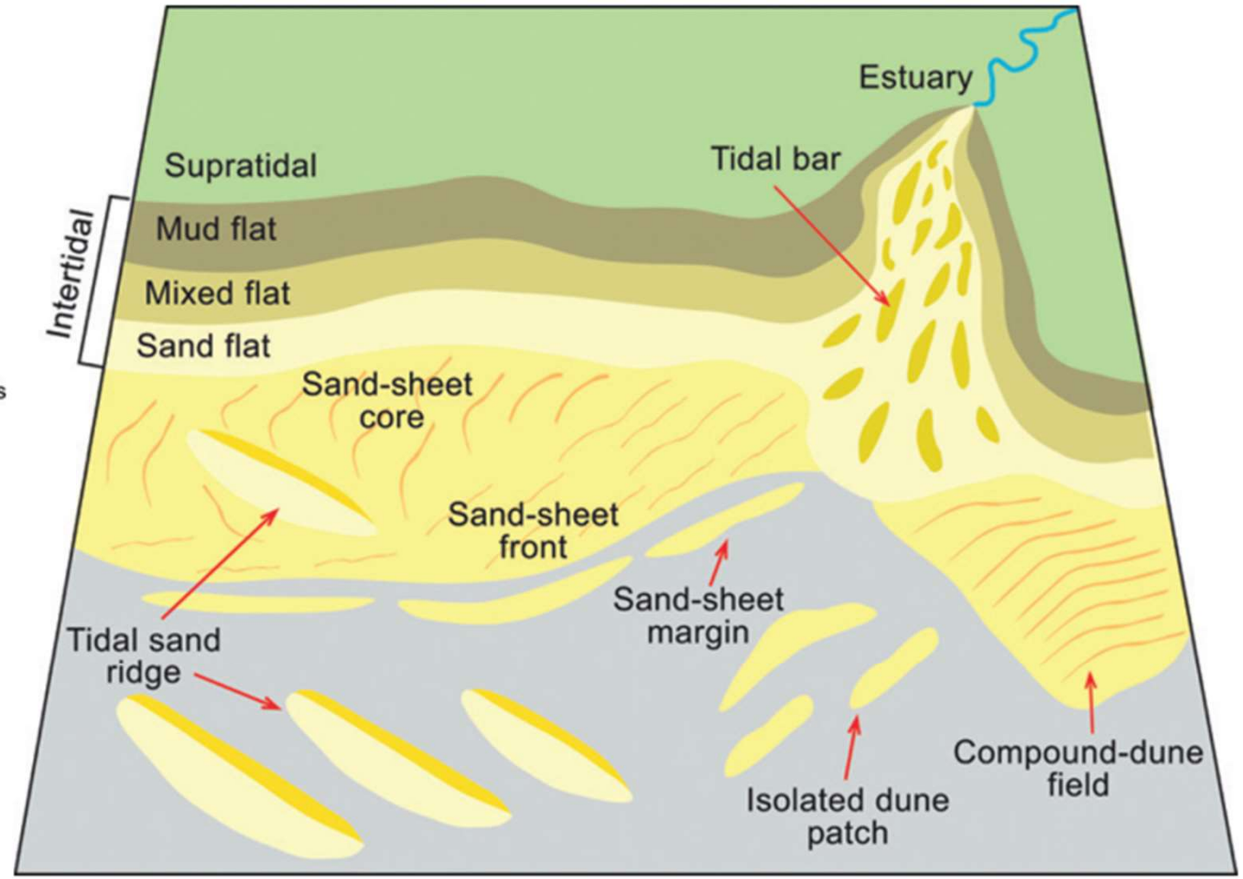
Varied depositional interpretations

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



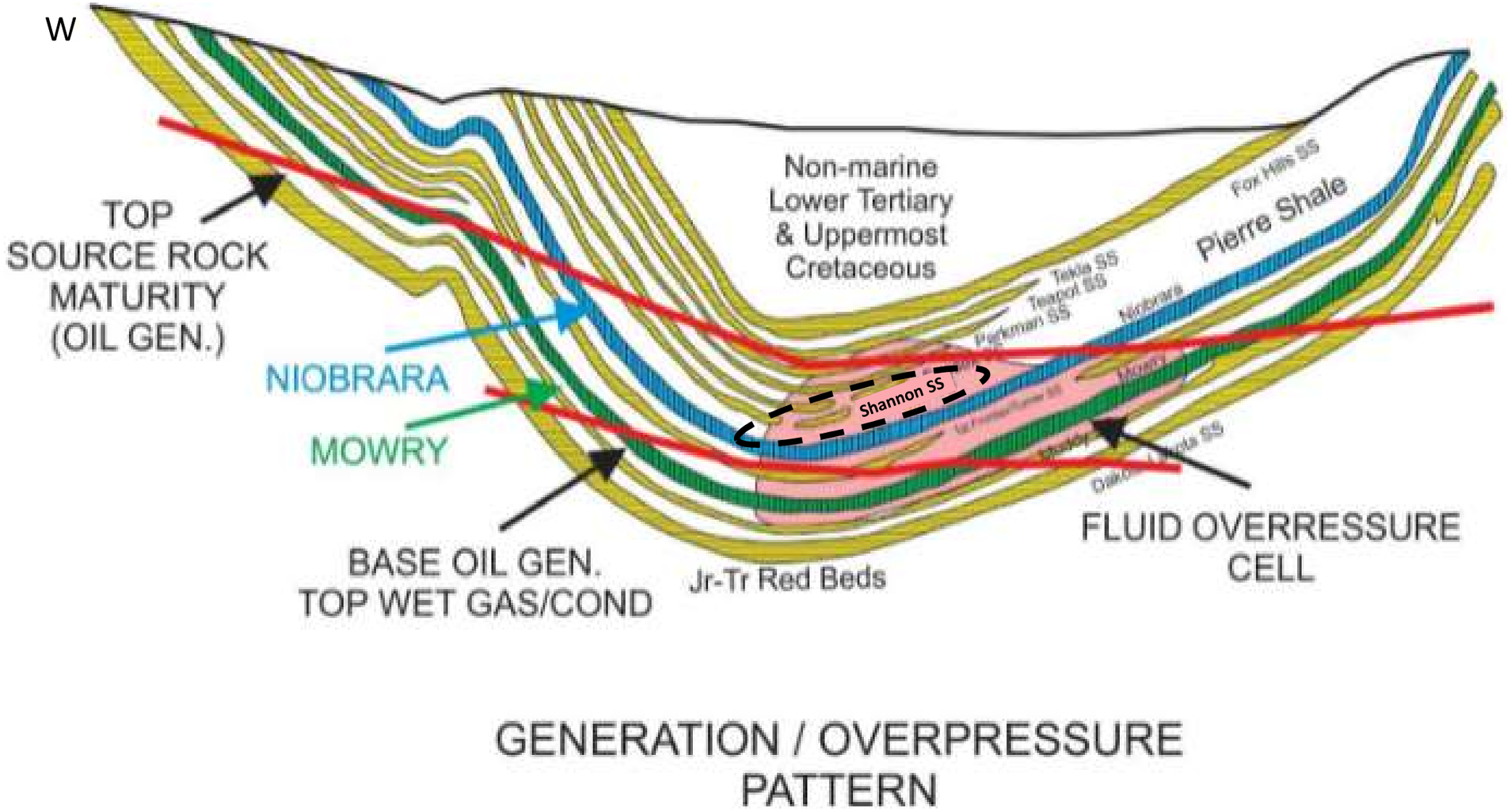
Tidal Sand Ridge Model





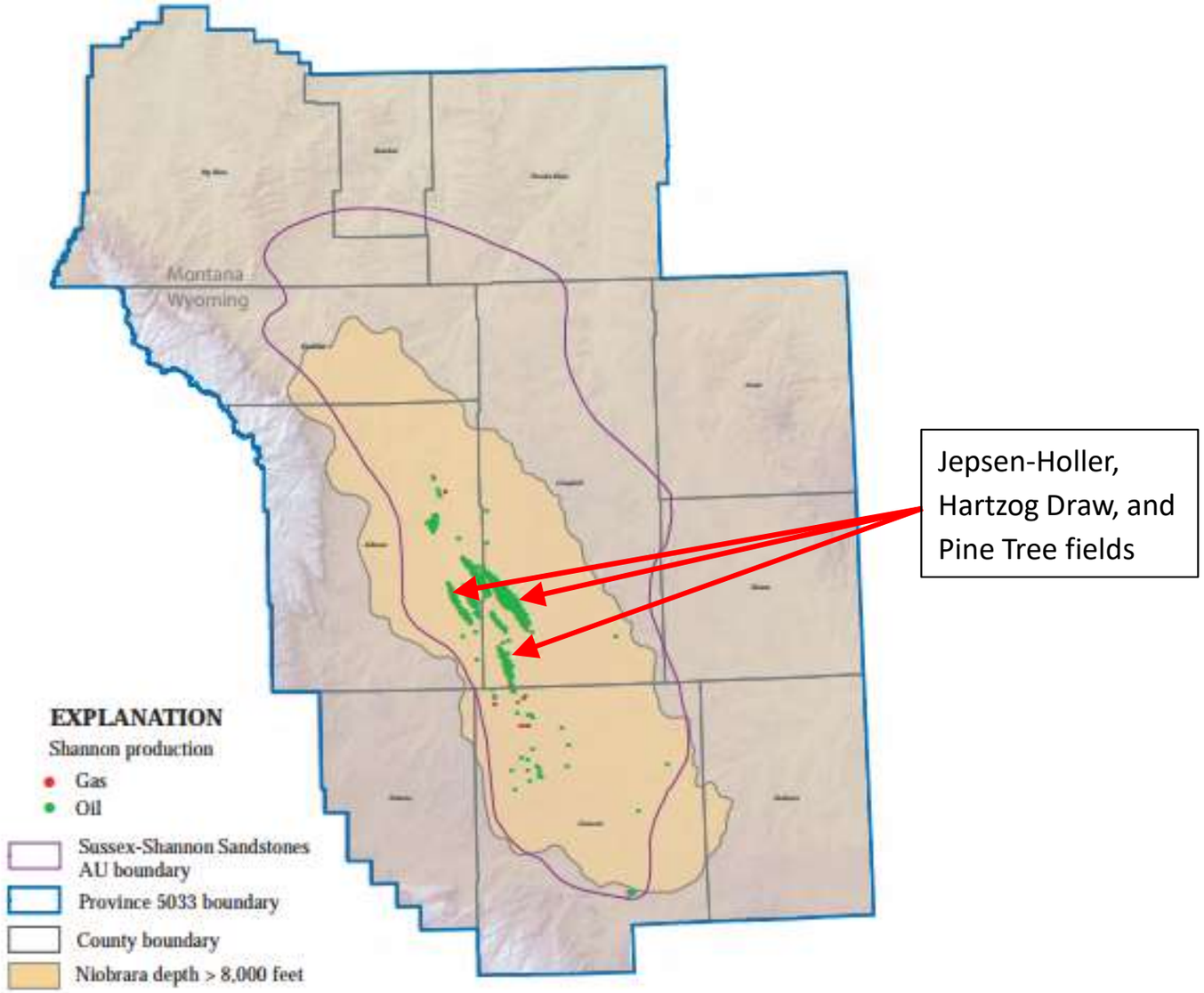
Tidal sand ridge depositional models (Desjardins, 2012)

Halo Play



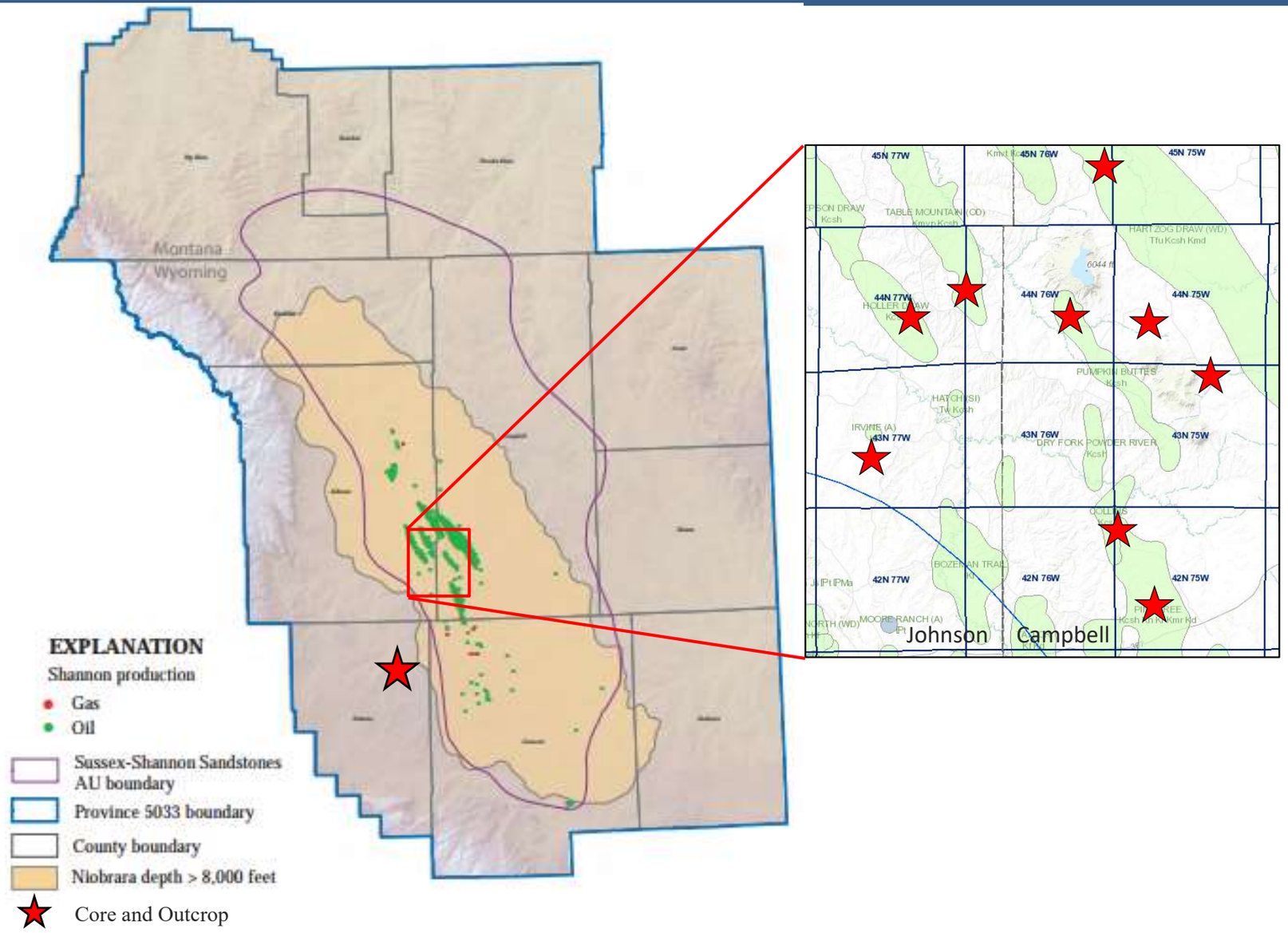
Schematic cross-section of the Cretaceous-Tertiary PRB (modified from Meissner, 2002).

Shannon Production



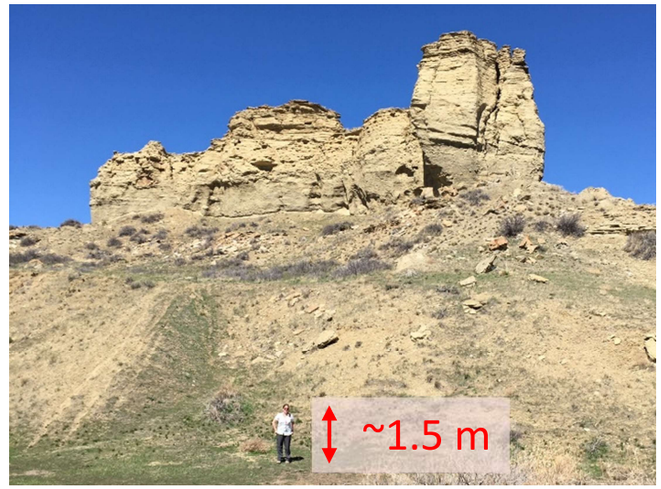
Powder River Basin Province showing oil and gas production in the Shannon Sandstone unit (Anna, 2009).

Study Area

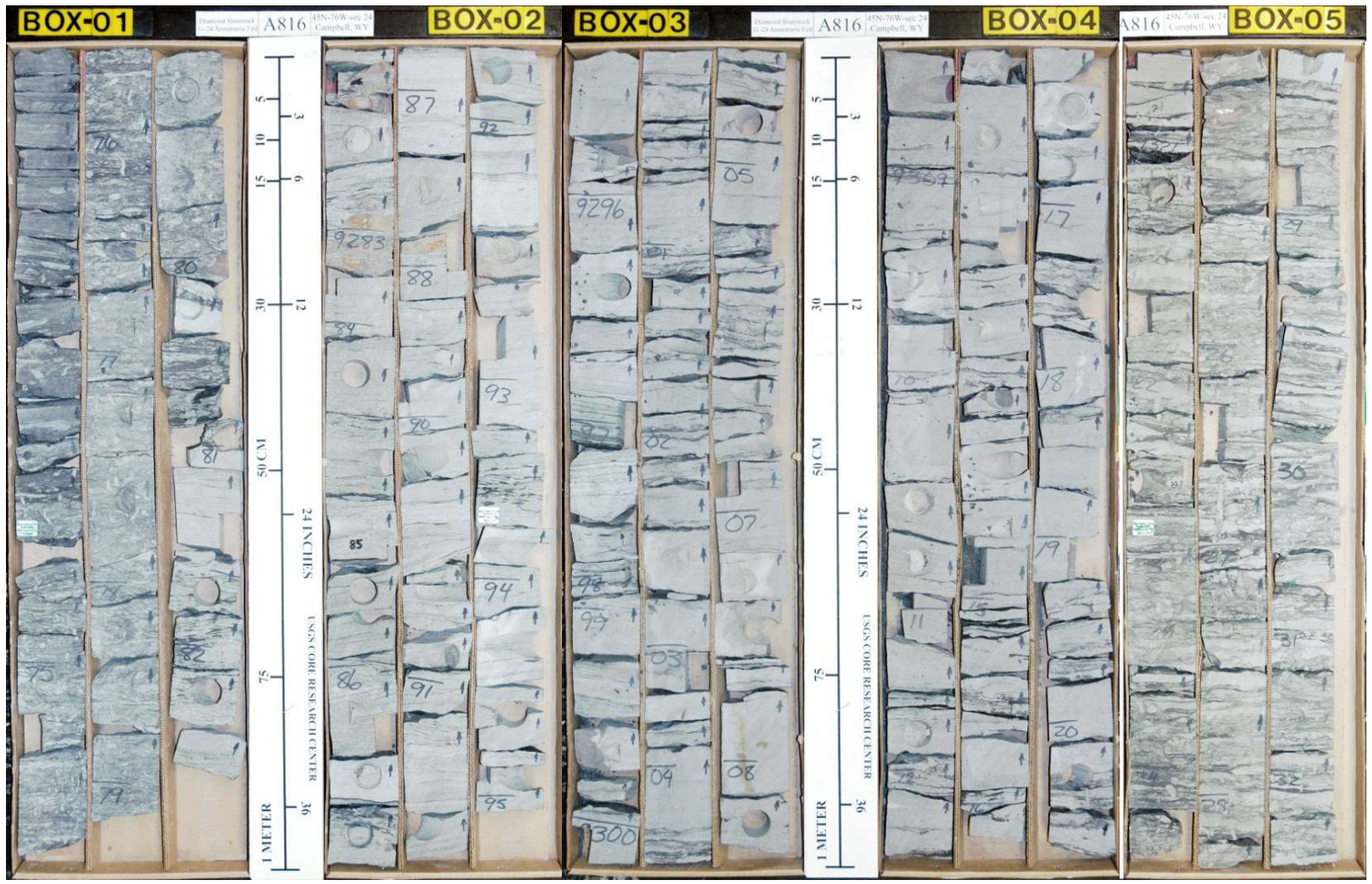


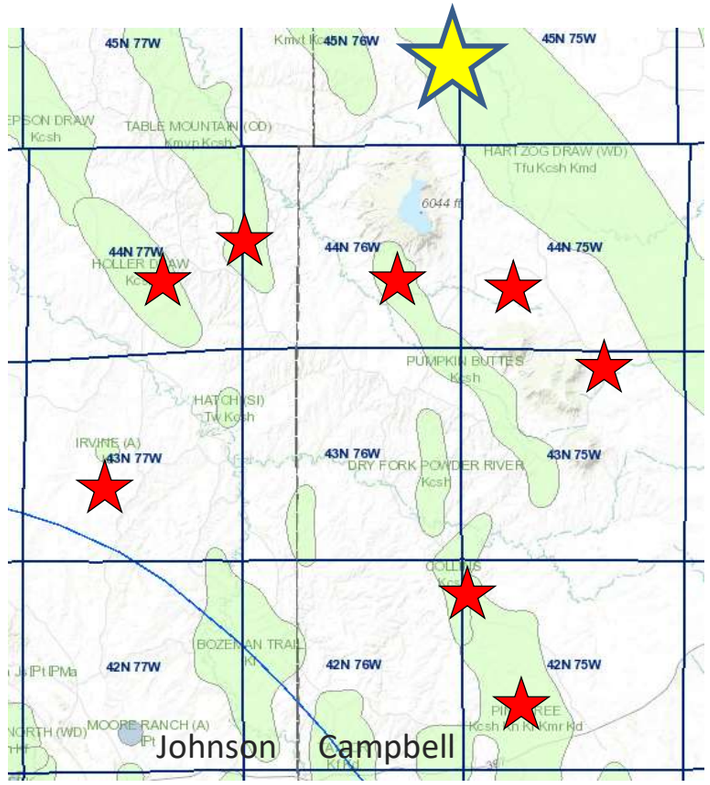
Powder River Basin Province showing oil and gas production and proposed study area in the Shannon Sandstone unit (Modified from Anna, 2009).

Shannon Outcrop



31-24 Anniemary Federal

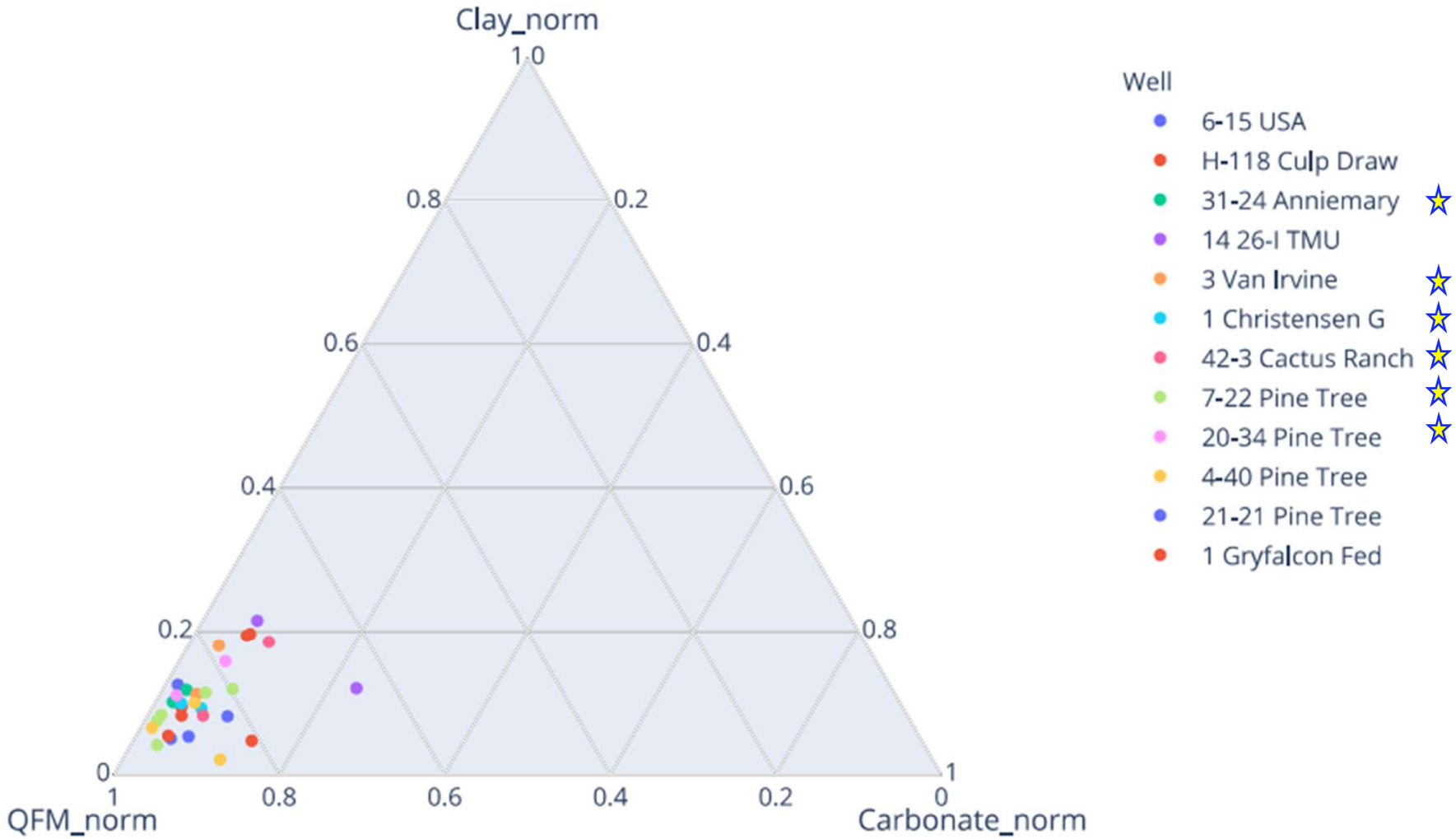




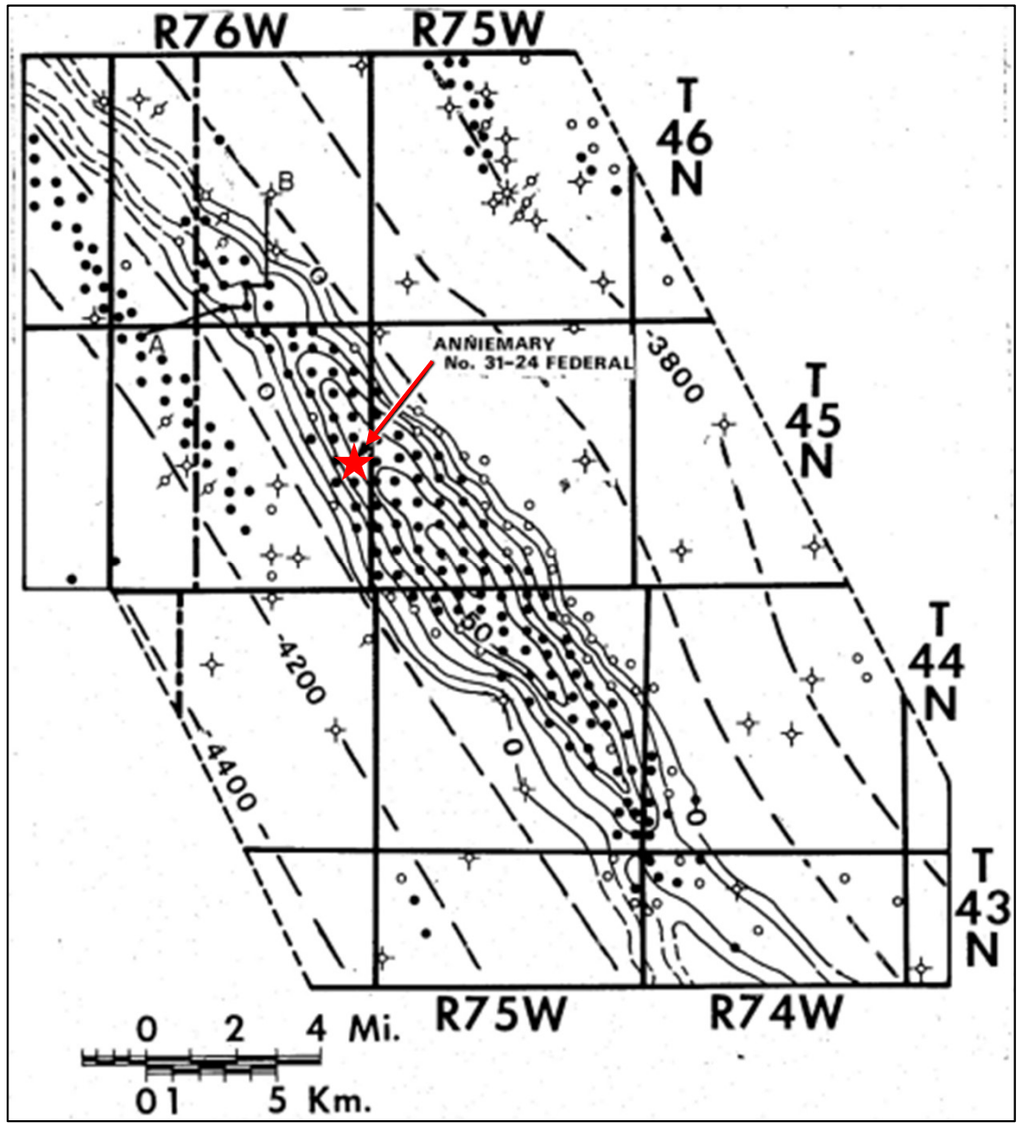
31-24 Anniemary Well

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

Ternary Plot of Shannon Wells in SW PRB

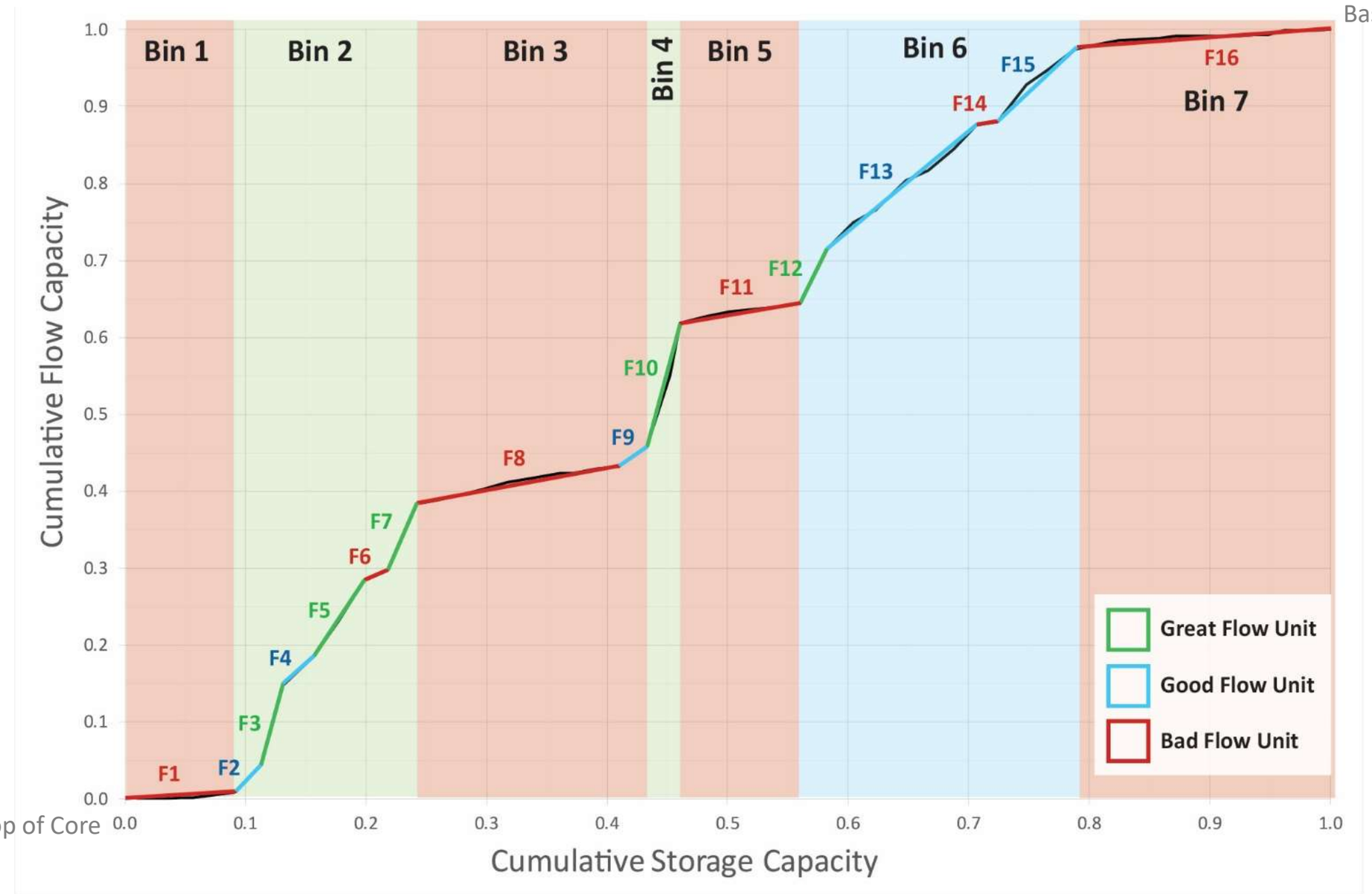


Diamond Shamrock Anniemary #31-24 Federal

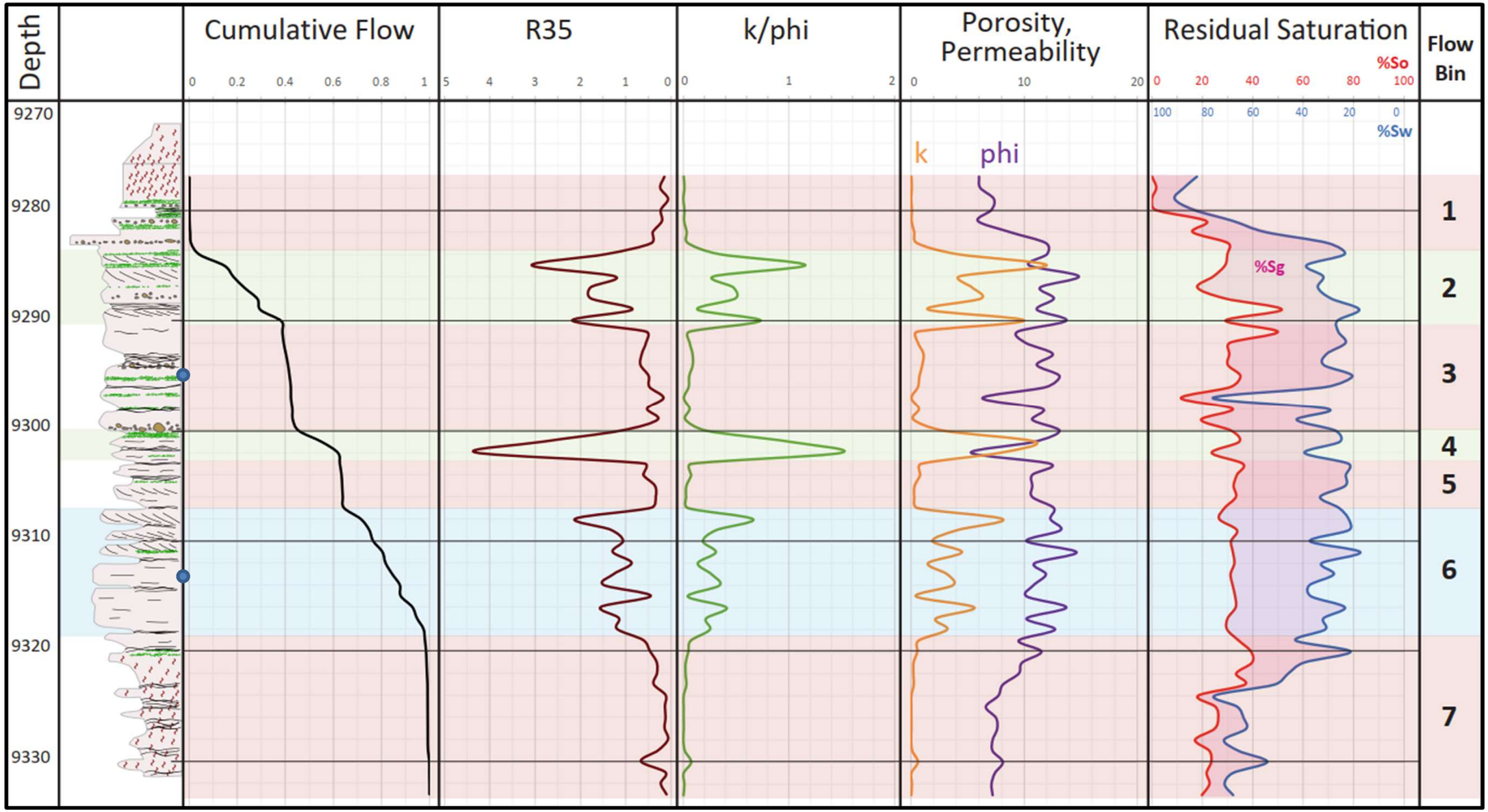


Net sand isopach map of the Shannon Sandstone in Hartzog Draw. Anniemary well is highlighted (From Weimer and Tillman, 1982).

31-24 Anniemary – Modified Lorenz Plot



31-24 Anniemary – Core Analysis Plots



Anniemary Facies

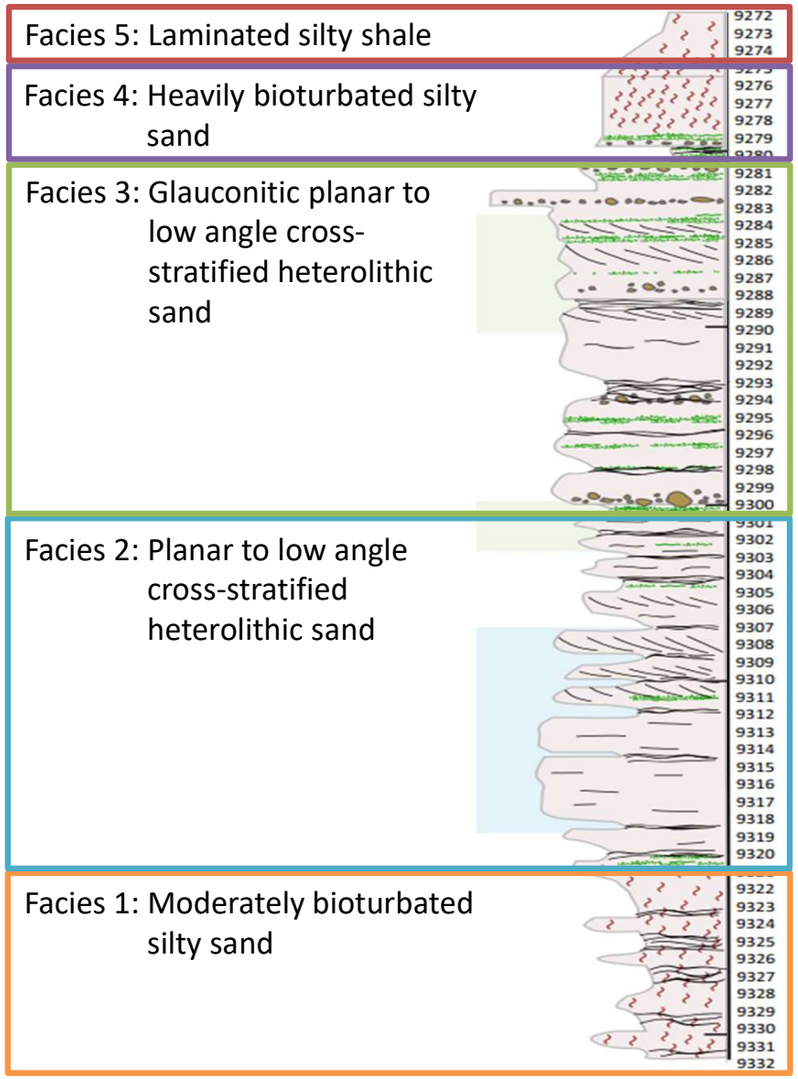
Facies 5: Laminated silty shale

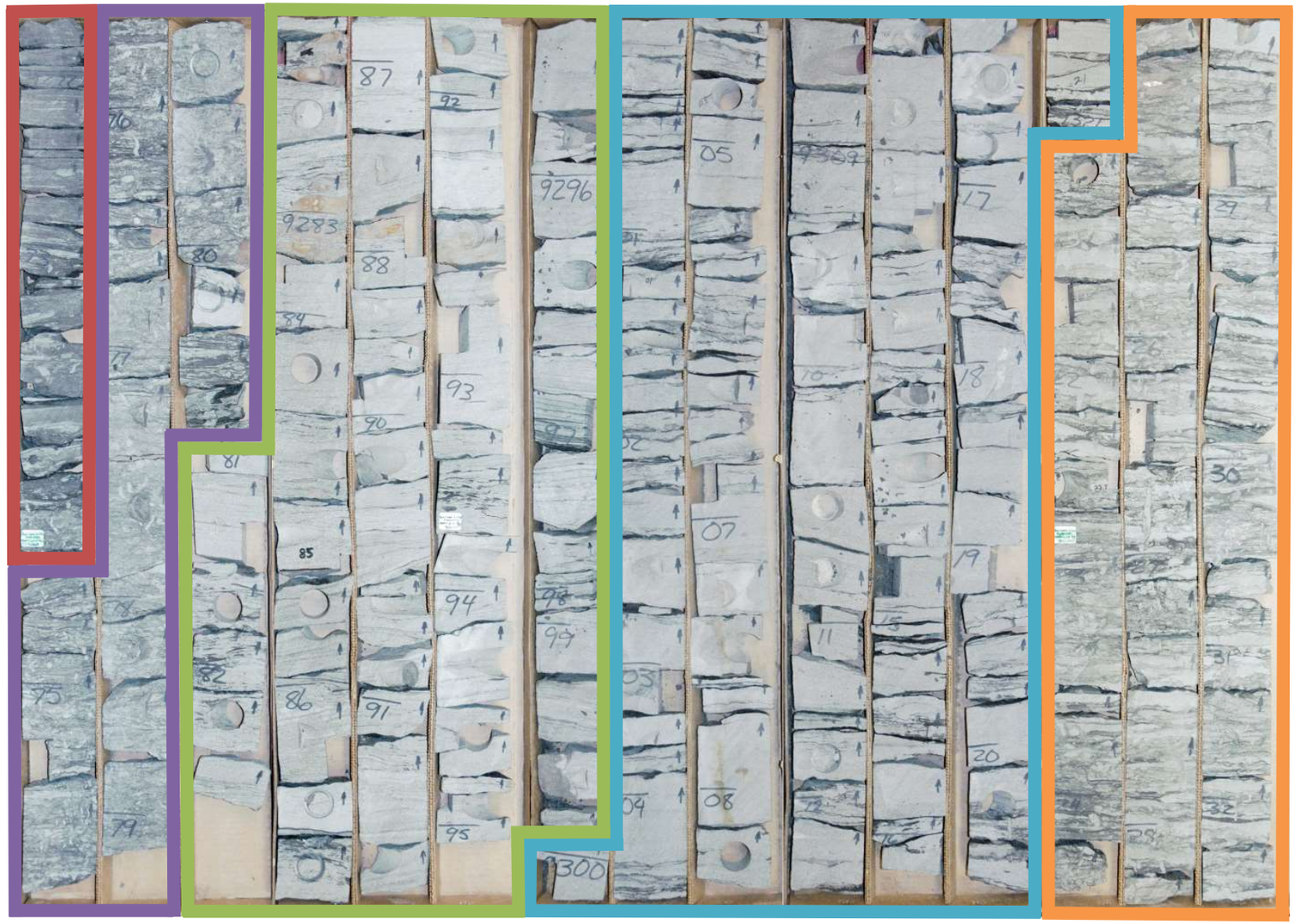
Facies 4: Heavily bioturbated silty sand

Facies 3: Glauconitic planar to low angle cross-stratified heterolithic sand

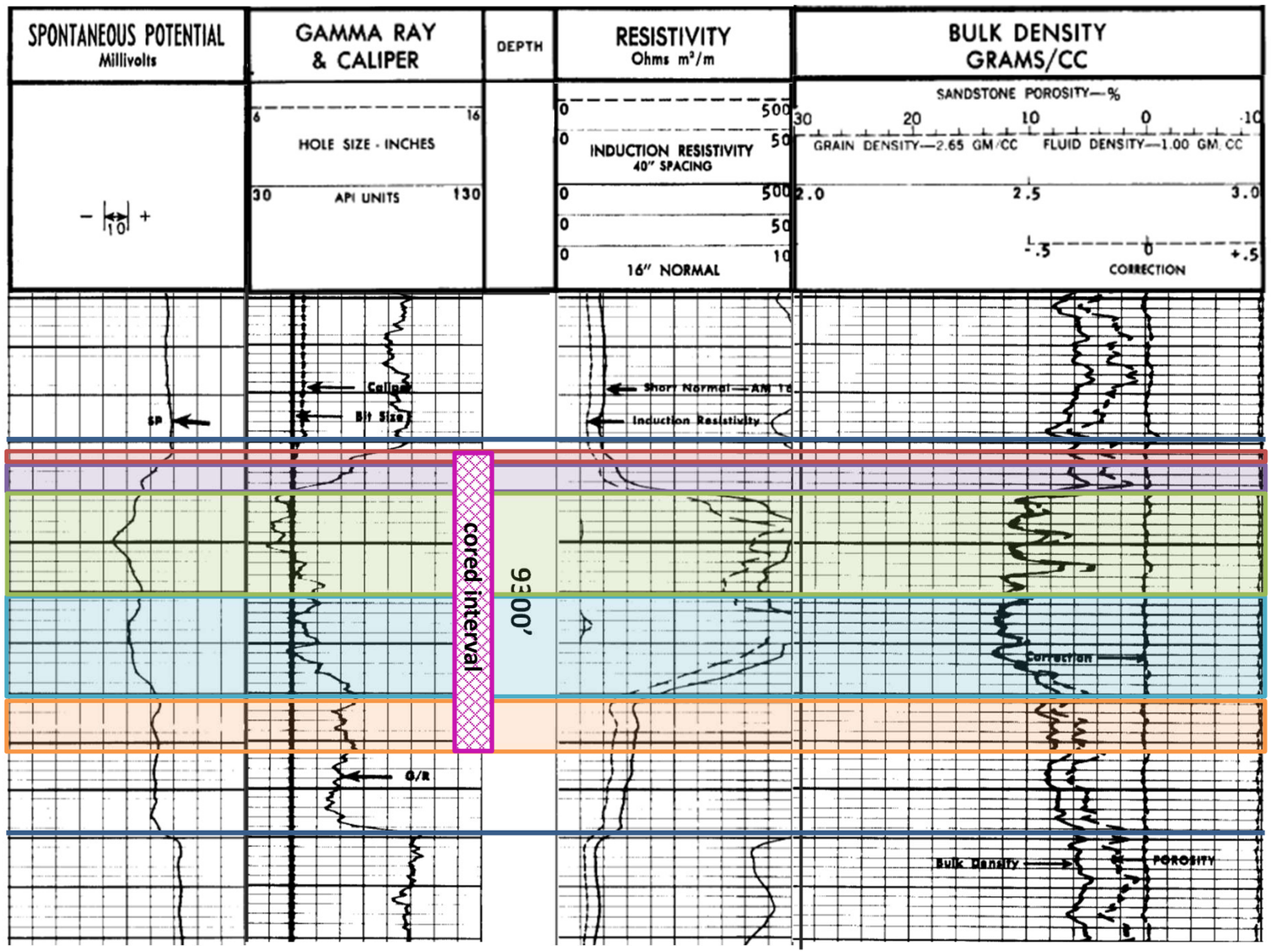
Facies 2: Planar to low angle cross-stratified heterolithic sand

Facies 1: Moderately bioturbated silty sand





Anniemary Logs

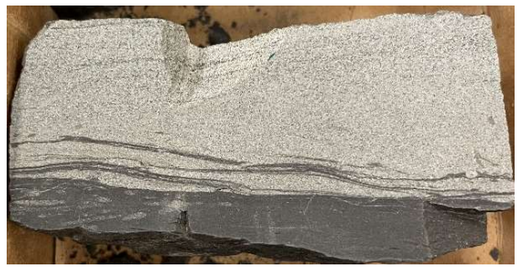


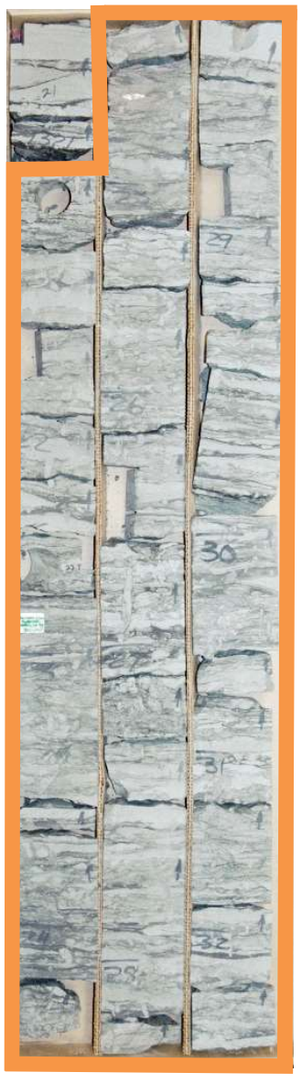
Top of Shannon

Base of Shannon

Anniemary Facies

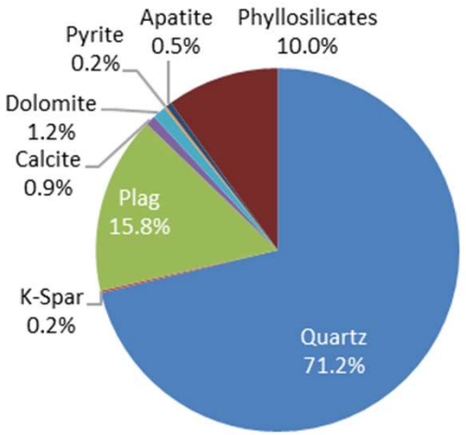
Facies 1: Moderately bioturbated silty sand





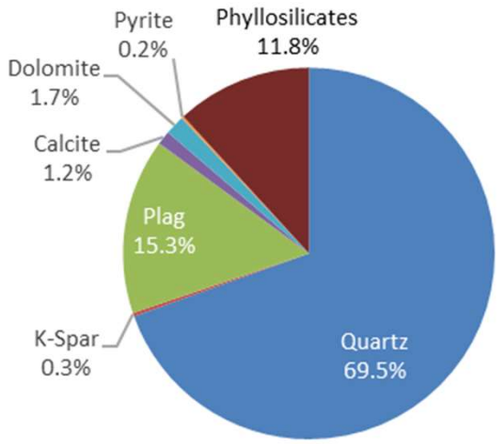
Anniemary Facies

Facies 2: Planar to low angle cross-stratified heterolithic sand



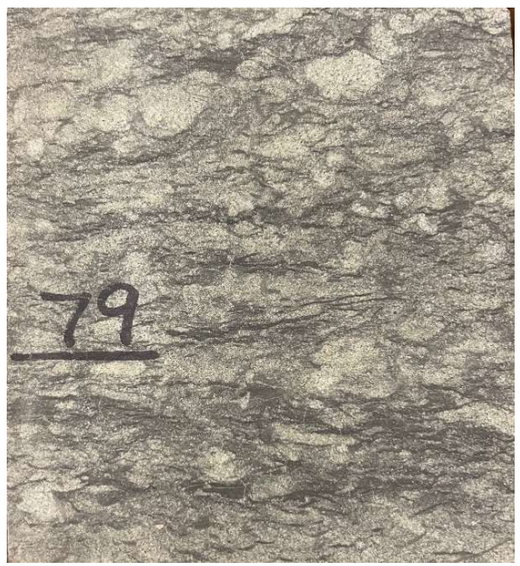
Anniemary Facies

Facies 3: Glauconitic planar to low angle cross-stratified heterolithic sand



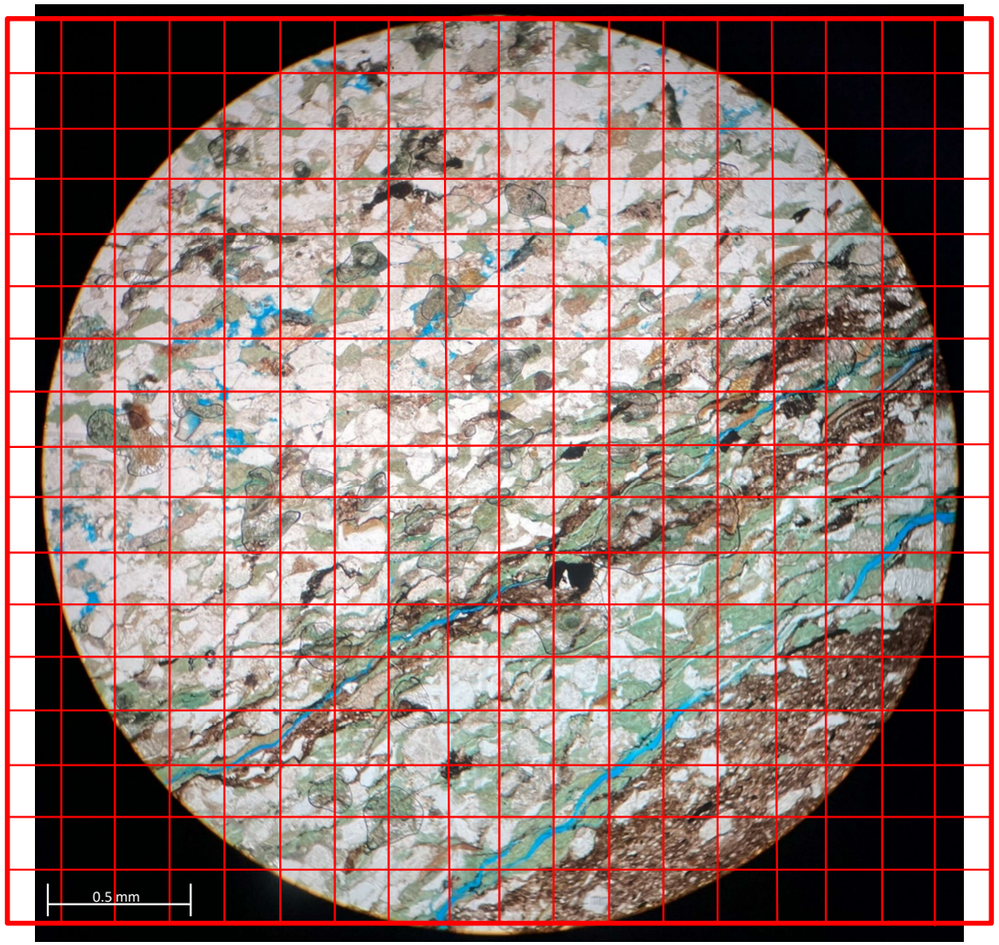
Anniemary Facies

F4: Heavily bioturbated silty sand

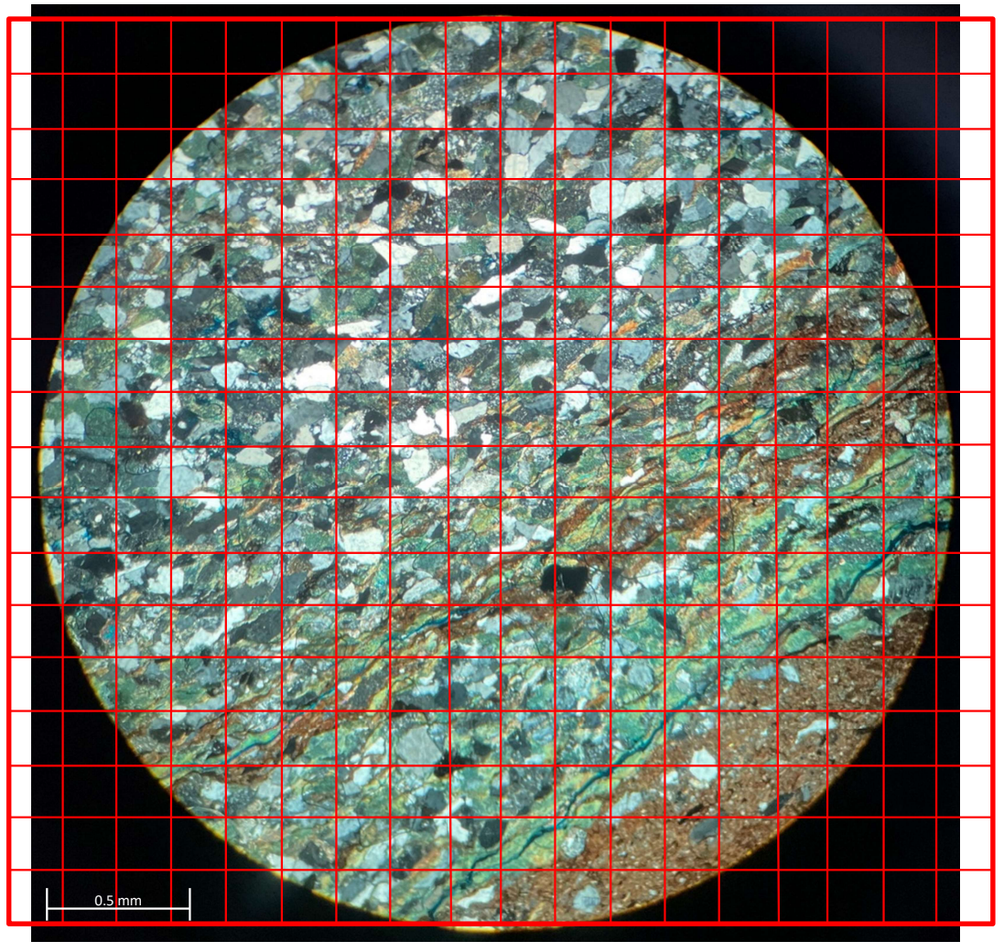


F5: Laminated silty shale

Point Counting

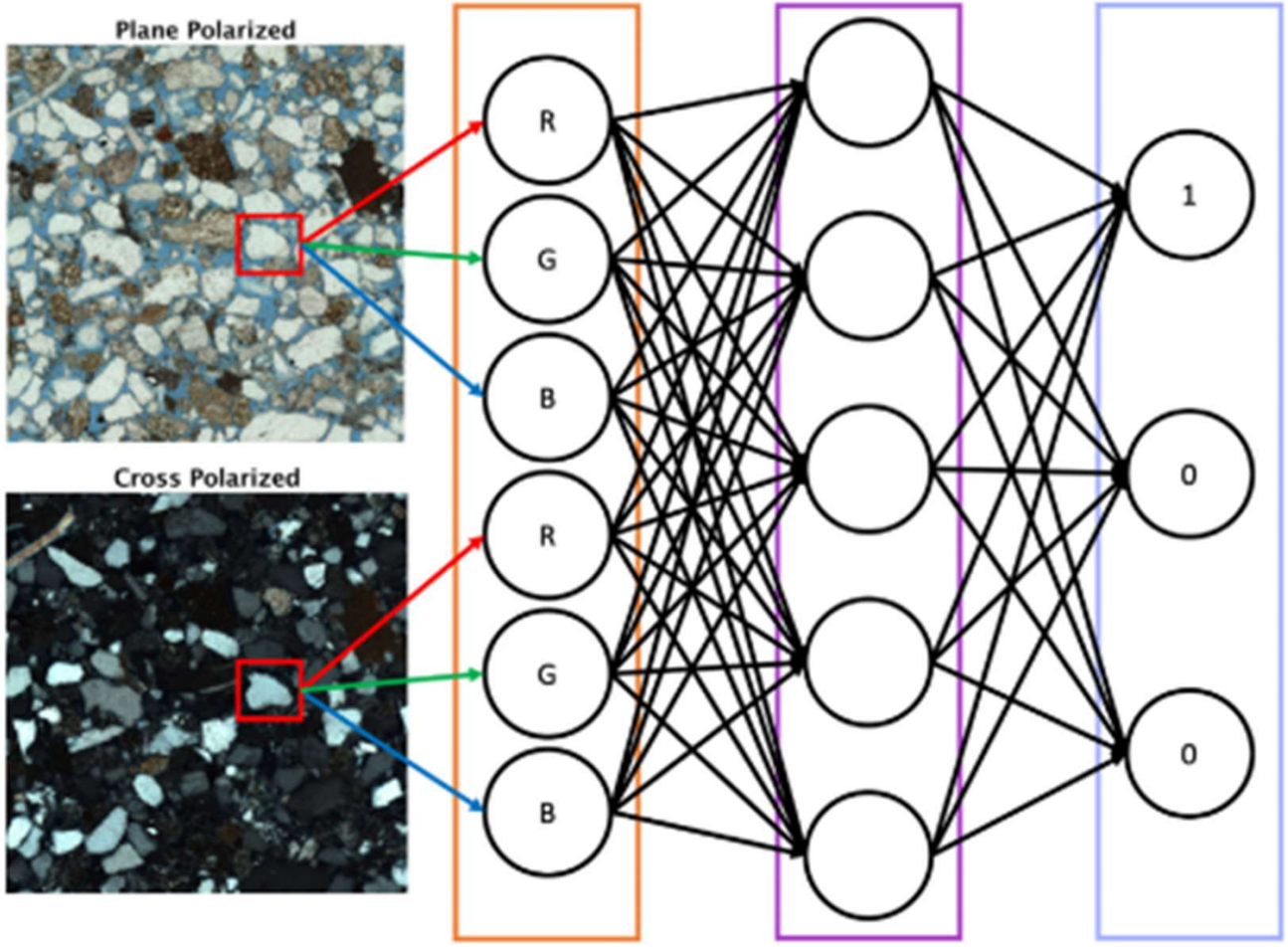


Plane polarized light

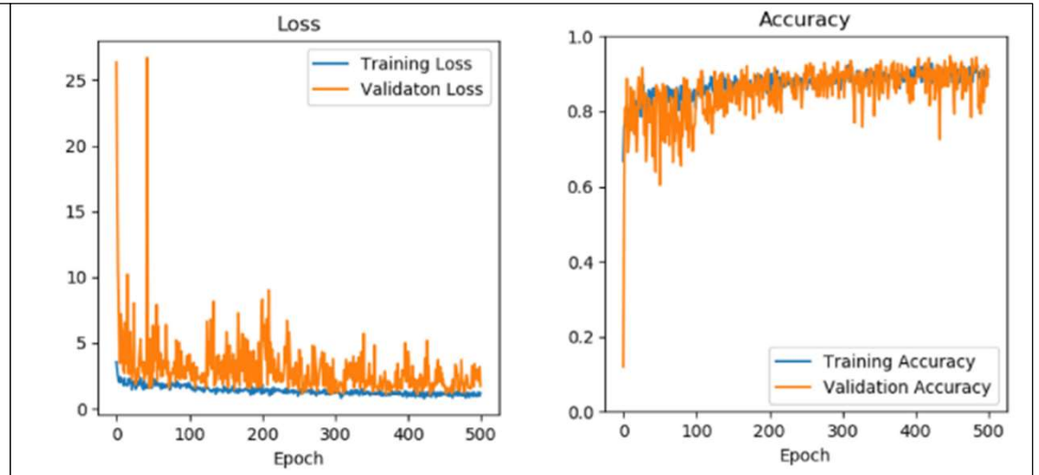


Cross polarized light

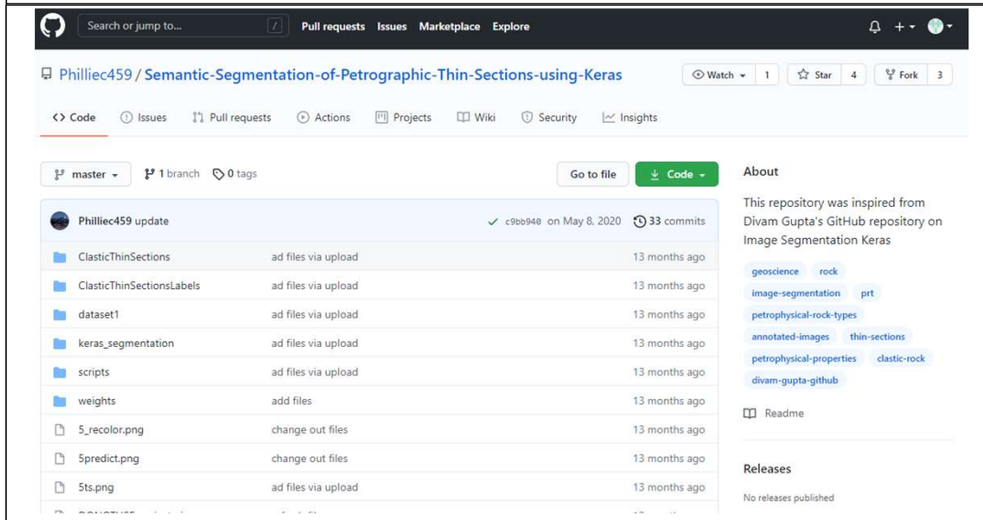
Machine Learning for Point Counting



Supervised machine-learning method used to automate the point counting process (Tang et al. 2020).



Model accuracy & loss (Tang et al. 2020).



Craig Phillips' Github Repository for Segmentation of Petrographic Thin Sections (2020).

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
  - Python machine learning neural network for point counting and segmentation
- XRF and XRD
  - Elemental data analysis and mineralogical composition
  - Terrestrial vs marine influence
  - Clay characterization
- Subsurface analysis
  - Log analysis
  - Subsurface Mapping and 3D seismic investigation
  - Pressure Systems Analysis
  - Trapping Mechanisms
- Characterization of lateral and vertical variability

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