RCP Phase XVIII: Chalk Bluff Development Optimization Project

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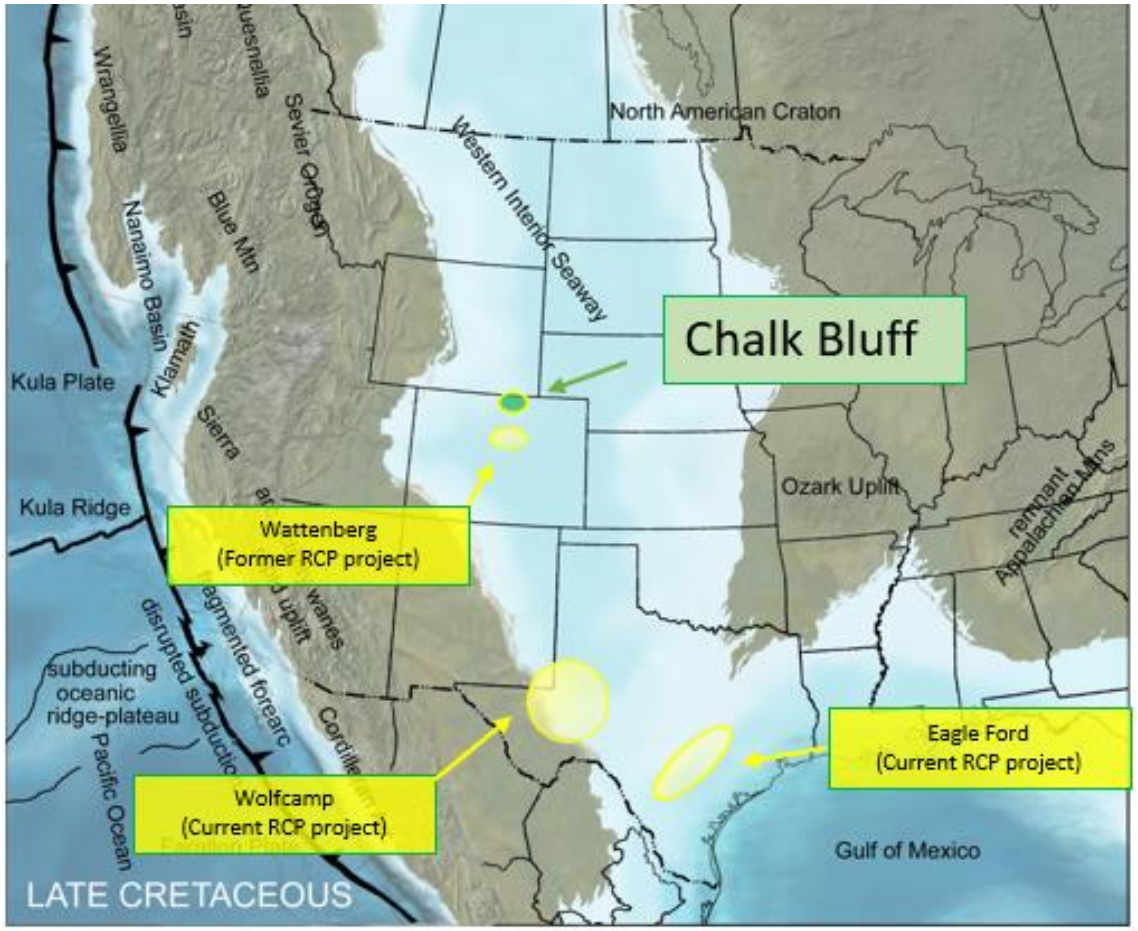
Project Overview

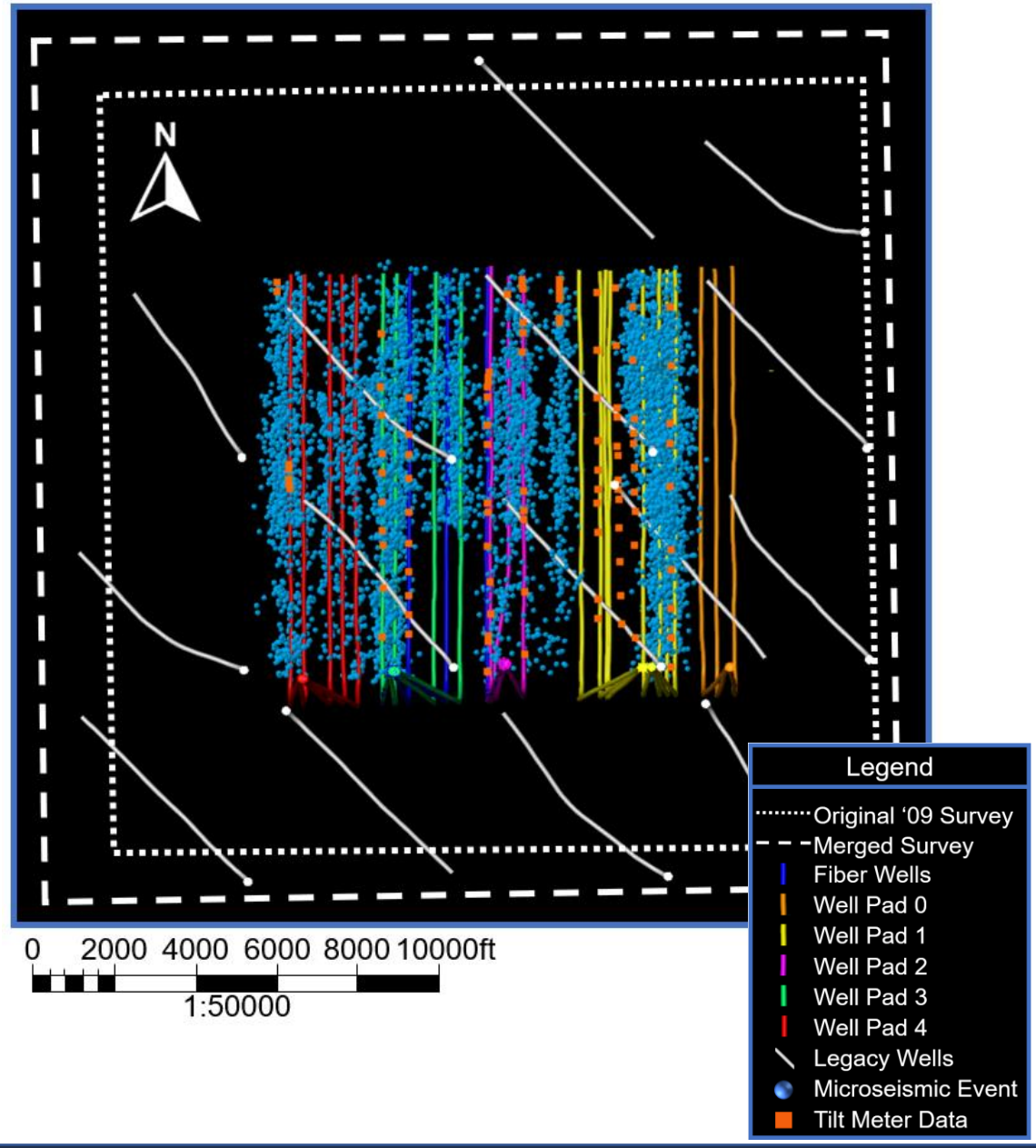


Modified from Blakey

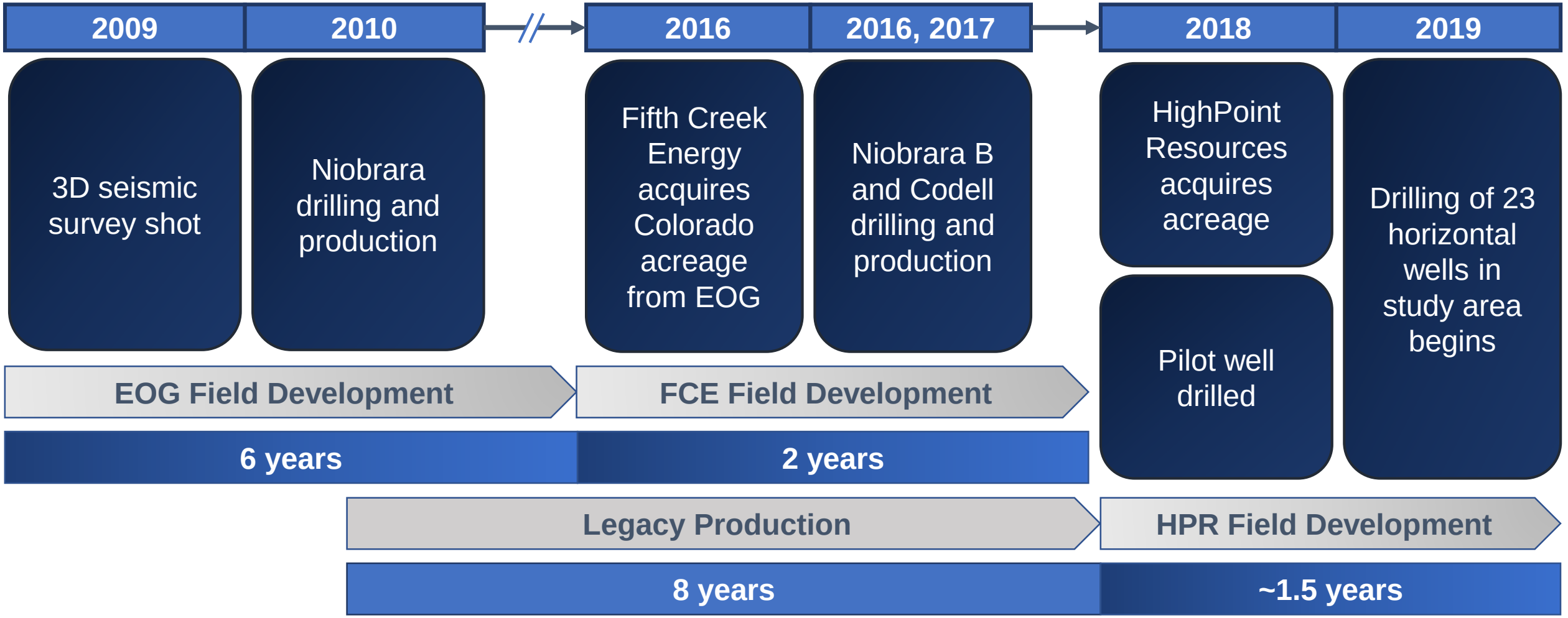
- Redevelopment of an existing field in the northern Denver-Julesburg Basin
  - Features legacy wells and newly drilled wells
- Two target reservoirs
  - Codell sandstone
  - Niobrara Chalk
- Goals:
  - Accelerate learnings in Chalk Bluff to determine optimal parameters for subsequent development of additional HighPoint Resources' acreage
  - Generalize learnings to be applied to other unconventional reservoirs (e.g., Permian, Eagle Ford)

Available Data

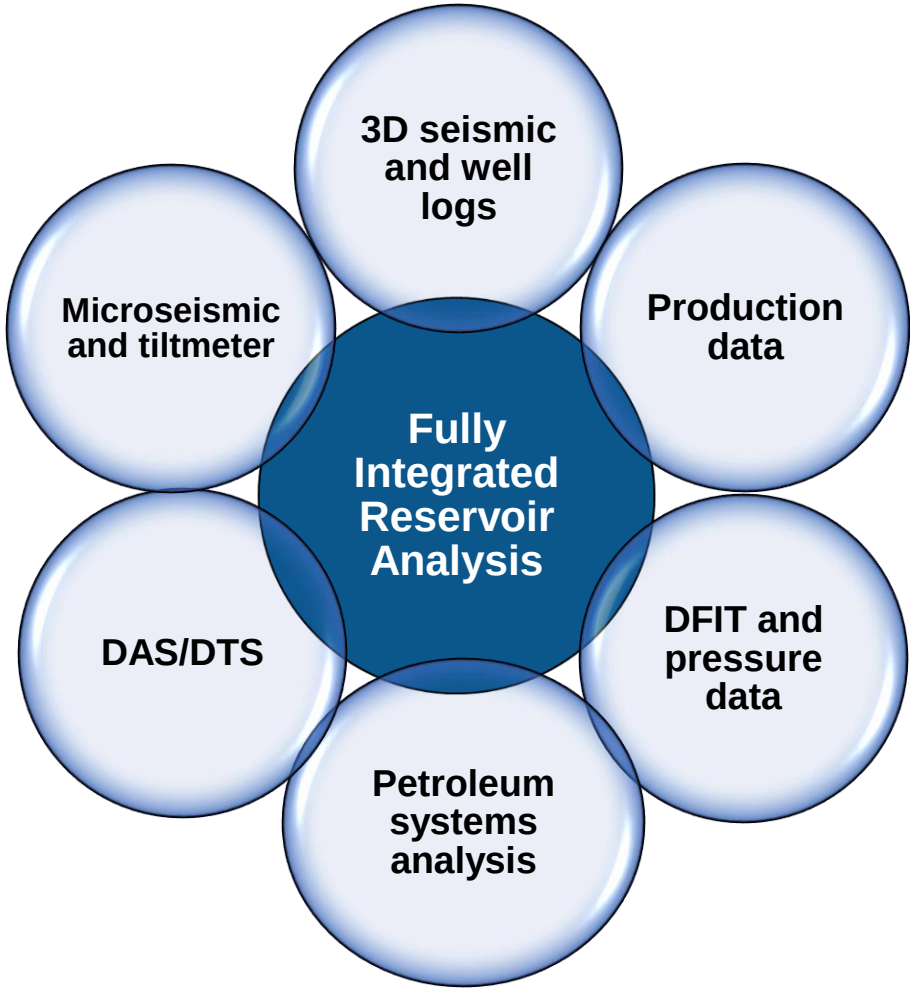
- Engineering Data:
  - Distributed temperature sensing (DTS) in two wells
  - Pressure (pressure gradient, ISIP)
  - Completion and treatment
  - DFIT
- Geophysical Data:
  - Distributed acoustic sensing (DAS) in two wells (including DAS microseismic)
  - Fiber VSP time-lapse monitoring
  - 3D seismic volumes (a 4 sq mi volume and a larger merged volume courtesy of Seitel)
  - Surface microseismic
  - Tiltmeter
- Geological Data:
  - Full quad combo and sonic scanner log suite in pilot well
  - XRD and XRF
  - Cuttings
  - Gas, mud gas, oil, and water composition
  - CMR (micro-resistivity image log)
  - LWD gamma
  - Core available from nearby wells



Field Development Timeline



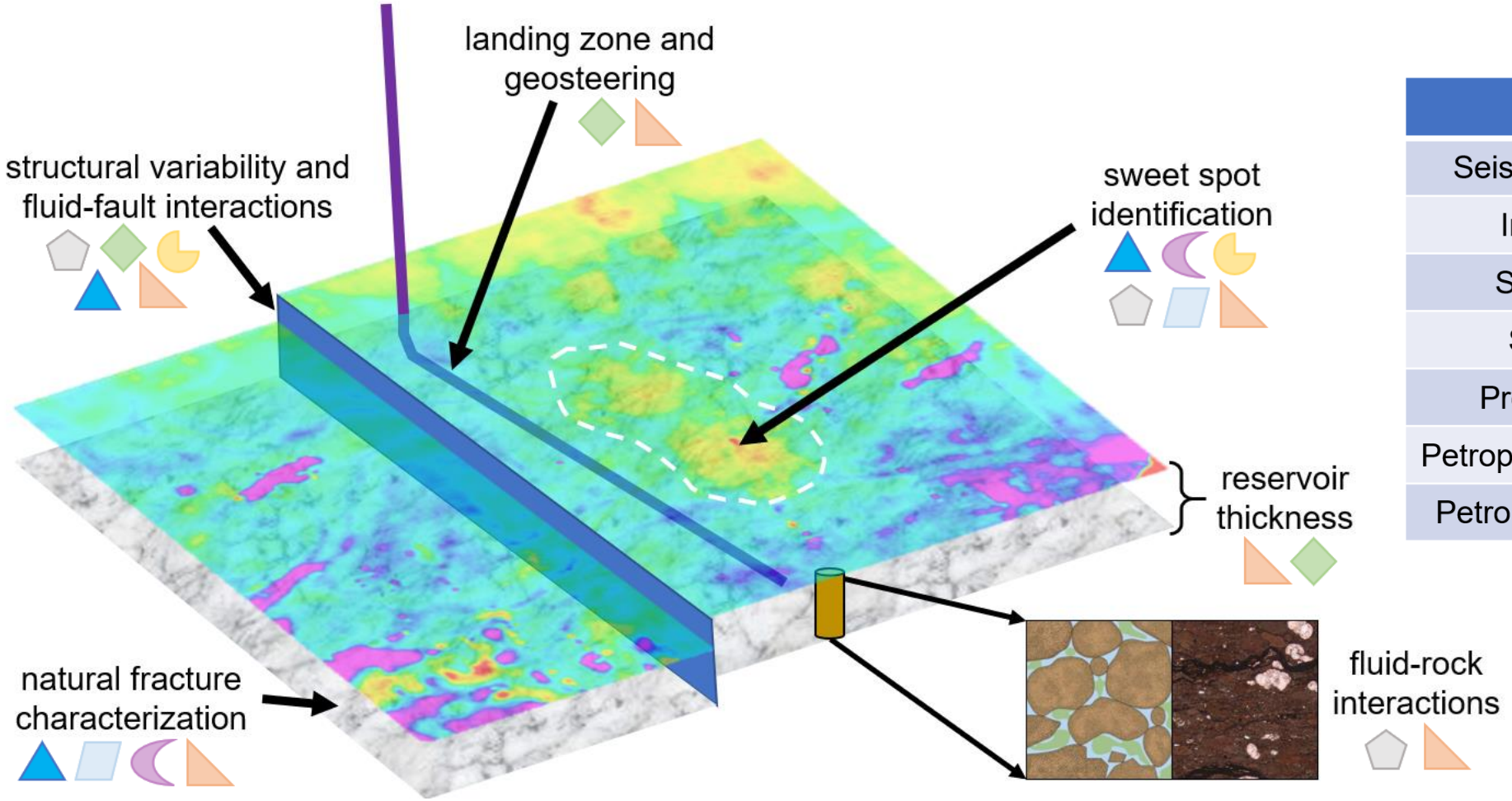
Project Approach



Optimize Niobrara and Codell development and production through evaluation of:

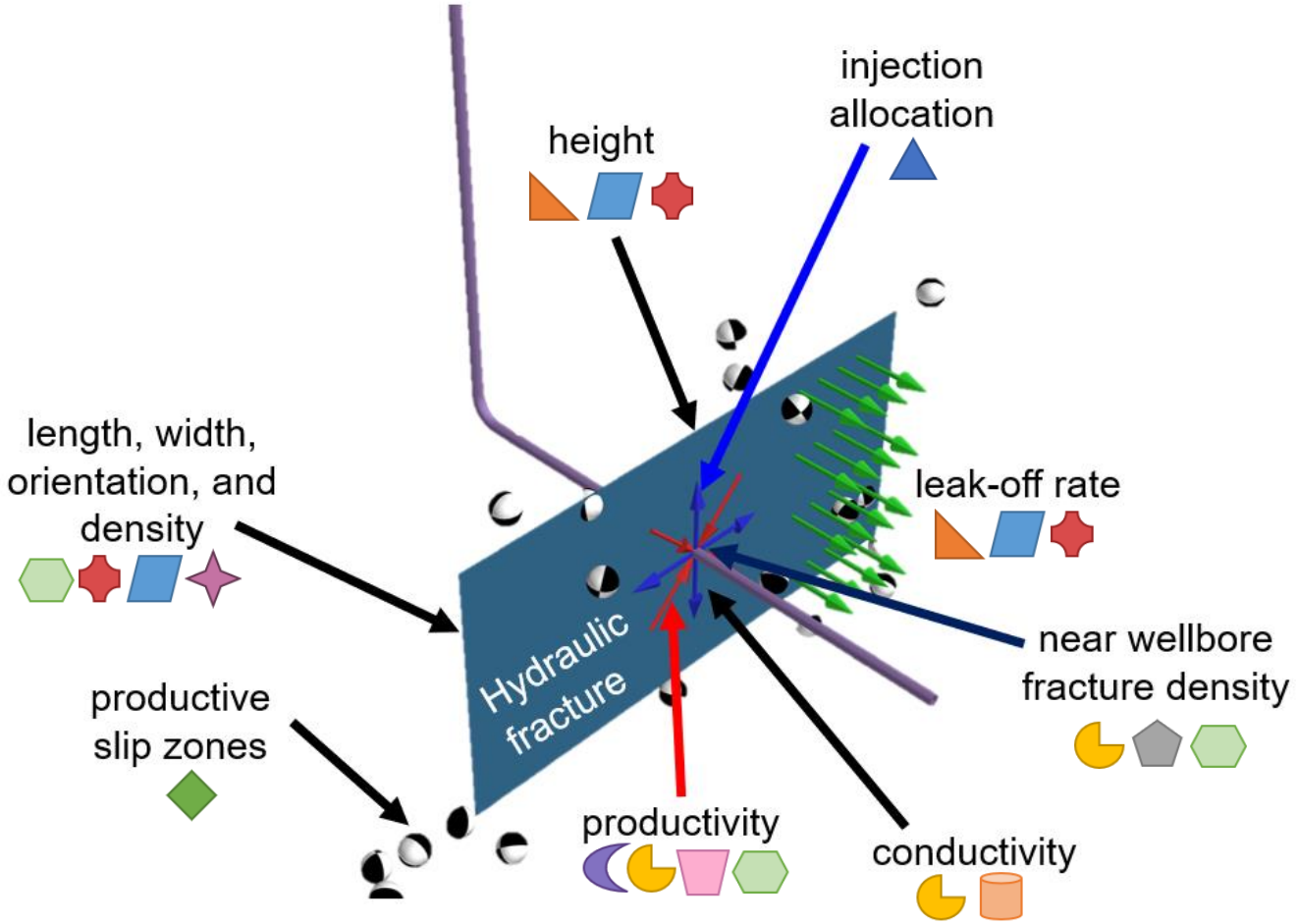
- Fracture Geometry
- Well Spacing
- Completion Parameters
- Frac Efficiency
- Reservoir Heterogeneity
- Legacy Well Effects

Characterizing Geologic Heterogeneity



Method	Symbol
Seismic attribute analysis	
Image log analysis	
Structural modeling	
Seismic inversion	
Production evaluation	
Petrophysical characterization	
Petroleum systems analysis	

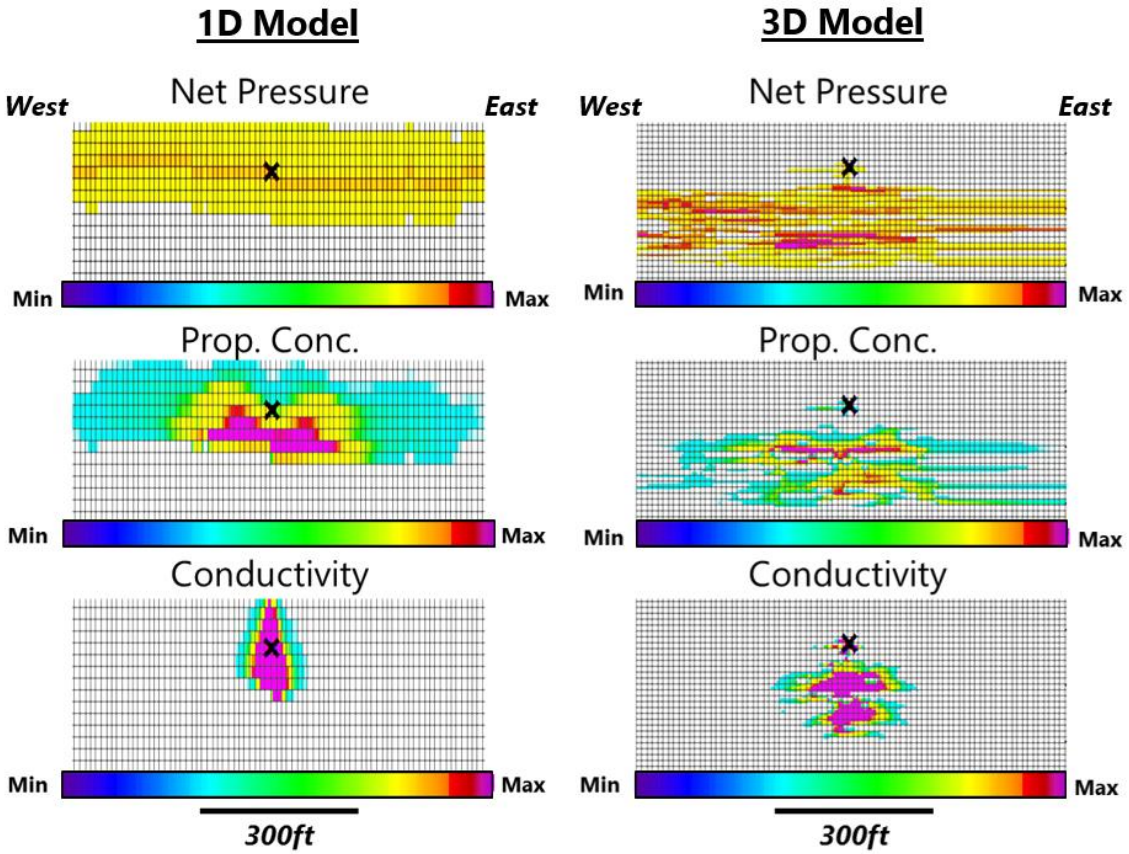
Characterizing Natural and Induced Fractures



Method	Symbol
High-frequency DAS	
DAS time-lapse VSP	
Low-frequency DAS	
DAS/surface array	
DTS warmback	
DAS/DTS	
DAS tube wave analysis	
DFIT	
Rate transient analysis	
HF Injection analysis	
Petroleum systems analysis	
Image log analysis	

Learnings from RCP Phases XV & XVI: Wattenberg

- Using seismic methods to characterize hydraulic fracture efficiency is essential for proper fracture modeling
- Incorporating hydraulic fracture simulation results into the reservoir model significantly improved history matches
- 1D models are not sufficient for characterizing hydraulic fracture geometry along horizontal wells in the field – 3D modeling required

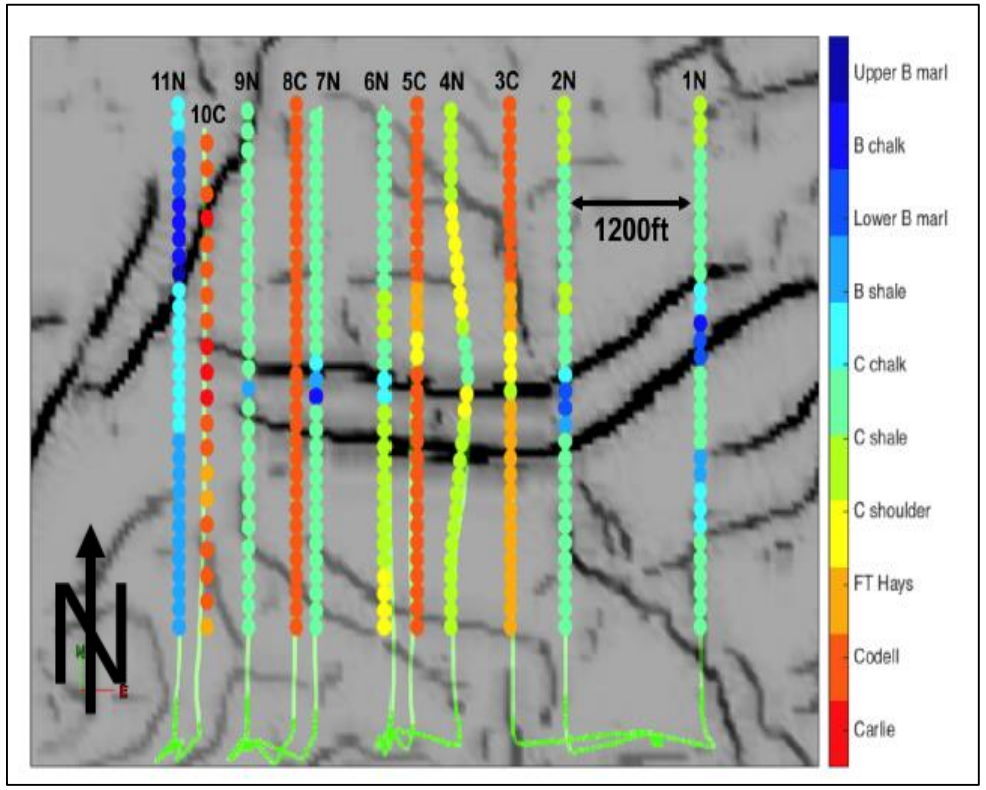


HF Modeling: Wattenberg

Modified from Alfataierge, 2017

Learnings from RCP Phases XV & XVI: Wattenberg

Well Landing Zones: Wattenberg



Modified from Alfataierge, 2017

- Geological heterogeneity is complex
  - Variable thicknesses of chalks and marls
  - Chalky intervals are correlated to better producers
  - Structural heterogeneity from faulting
- Structural complexity resulted in wells being steered out of zone
  - Landing position and well spacing is critical
- Reservoir response varies from stage to stage due to varying geomechanical properties

Thank you to Phase XVIII Consortium Members

And our RCP Contributors