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# 2010 Updated USGS Assessment of Undiscovered Oil and Gas Resources of the National Petroleum Reserve in Alaska (NPRA)

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# Summary

- USGS estimates that industry exploration in NPRA since 2000 has discovered:
  - 120 – 200 MMBO (oil & condensate) +
  - 1.9 – 3.0 TCFG
- Drilling has revealed an abrupt and unanticipated transition from oil to gas in Jurassic reservoirs just 15 – 20 miles west of the giant Alpine oil field
- Updated USGS estimates of fully risked,undiscovered, technically recoverable resources in conventional accumulations:
  - 896 MMBO
  - 52.8 TCFG (nonassociated only)
- Compared to the 2002 USGS assessment, these updated estimates represent:
  - a significant reduction in oil
  - a slight reduction in gas
- Greatest potential for undiscovered oil lies in northeastern NPRA, including the area of Teshekpuk Lake and adjacent coastal plain

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# Background on 2010 Updated Assessment of NPRA

- Why an updated assessment?
  - Drilling results released to the public indicated an abrupt and unanticipated transition from oil to gas in the Alpine play, just 15 - 20 miles west of the giant Alpine field.
  - The USGS updated assessment provides a current perspective of undiscovered oil and gas resources, which is significantly different than previously.

- Why now?
  - The USGS waited until sufficient well data had been released with which to conduct the updated assessment.
  - New USGS research has documented a significant Cenozoic uplift in northern NPRA inferred to significantly impact oil and gas resources.

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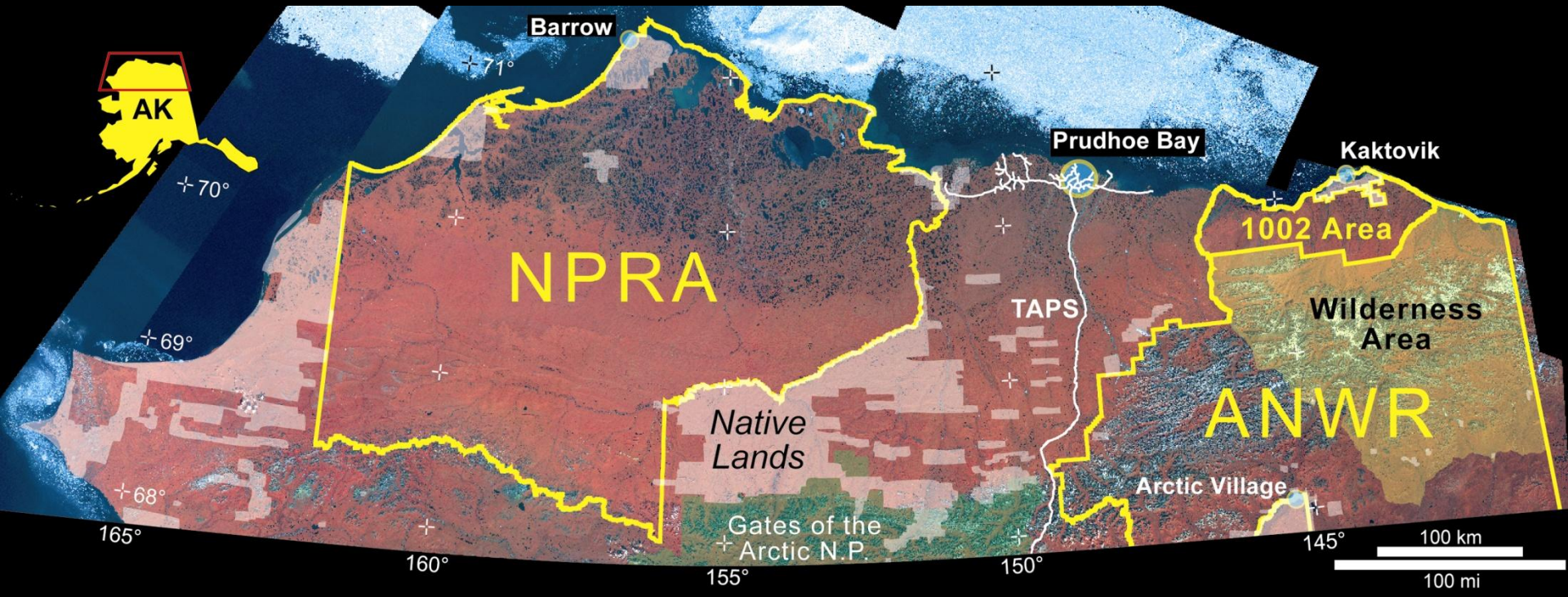
# Federal Lands of the Alaska North Slope




***National Petroleum Reserve in Alaska (NPRA)***

*~23 million acres*

*~36,000 mi²*

*About the size of Indiana*

ANWR, Arctic National Wildlife Refuge
TAPS, Trans Alaska Pipeline System

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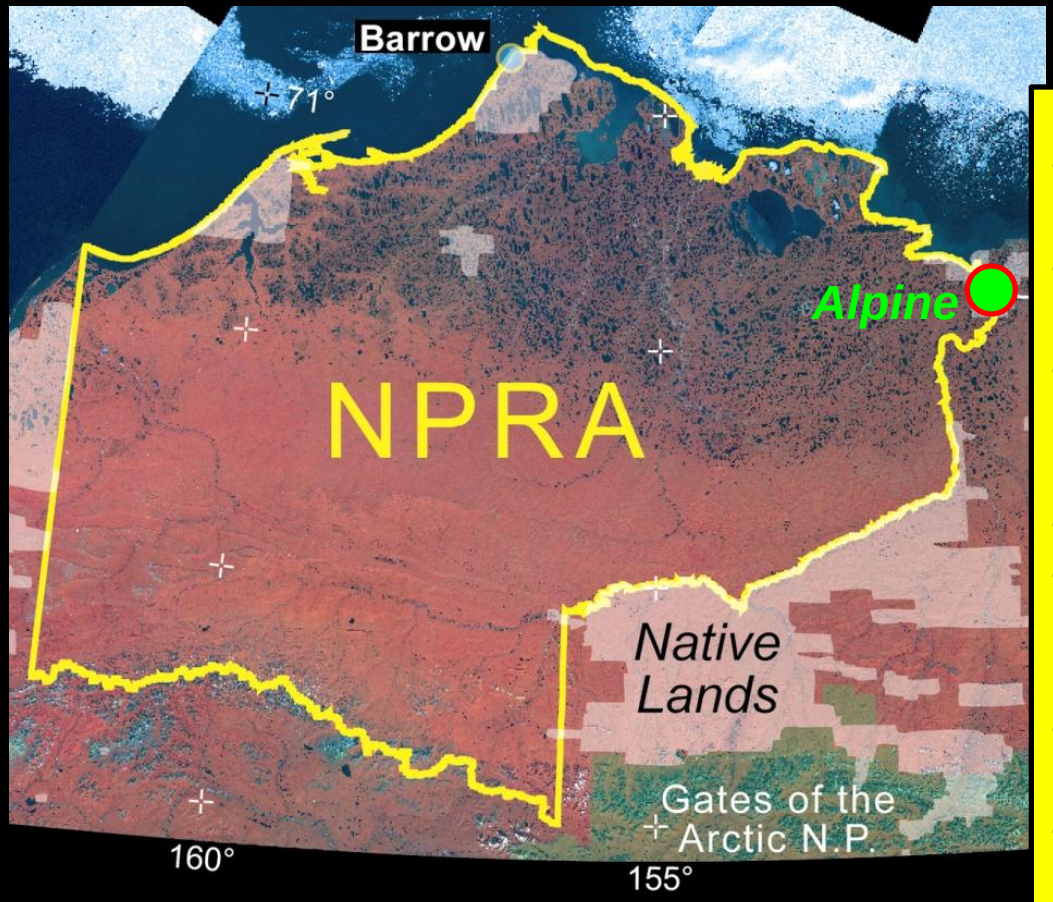
# Brief NPRA History




- Established in 1923 - Naval Petroleum Reserve No. 4
- Renamed National Petroleum Reserve in Alaska (NPRA) in 1976
- U.S. Government exploration during 1944-53 & 1974-82 resulted in a few sub-economic oil & gas discoveries
- Four lease sales held 1982-84
- Two industry wells drilled
  - 1982, Native land, still proprietary
  - 1985, Federal lease, dry hole
- Alpine field discovered in 1994 (announced in 1996) >750 MMBO!
- Federal lease sales held in NPRA in 1999, 2002, 2004, 2006, 2008, & 2010
- More than 30 wells drilled since 2000
- Discoveries announced, but . . .

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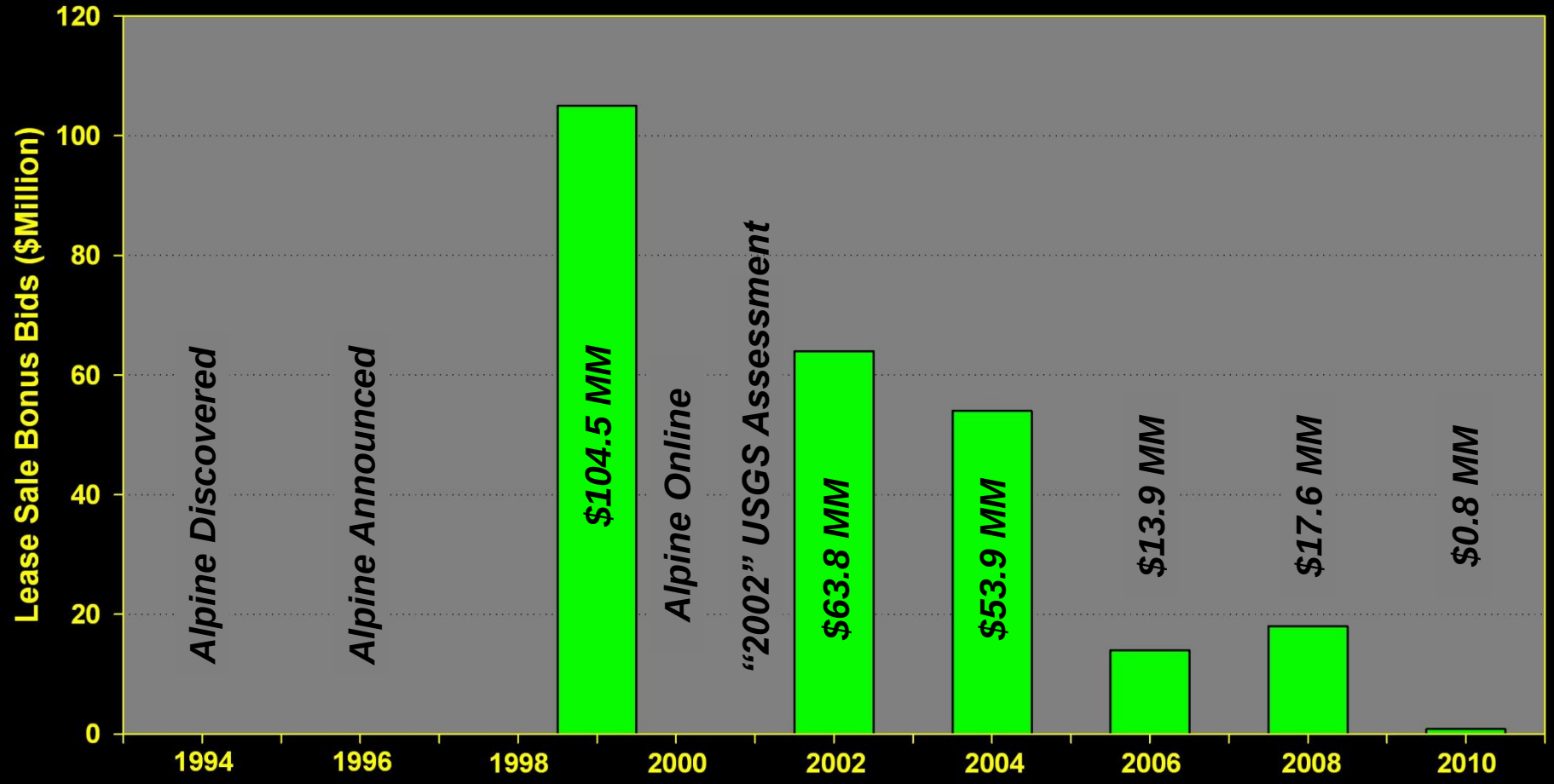
# NPRA Federal Lease Sales 1999-2010

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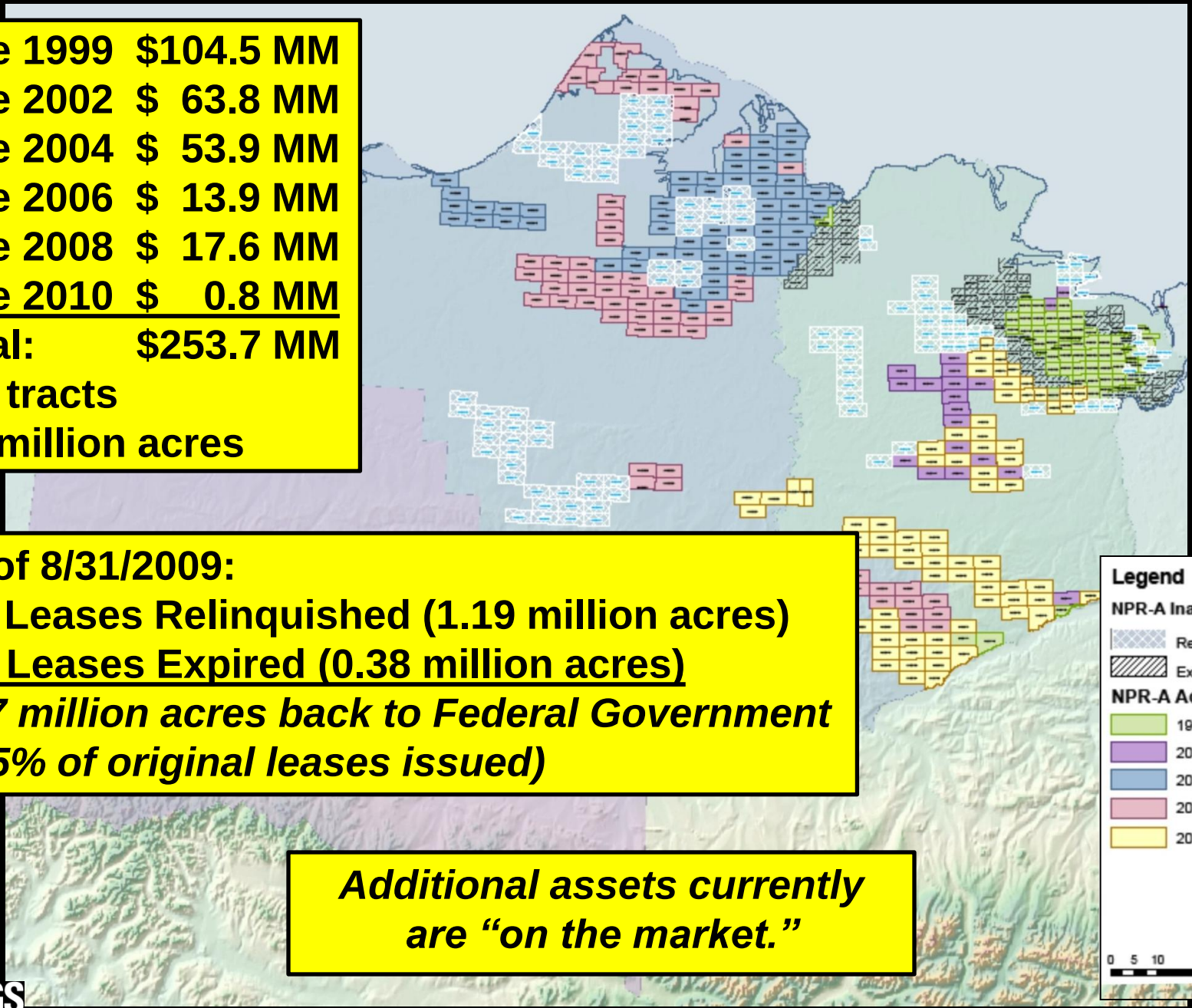
# Leases Acquired & Relinquished since 1999

| | |
|---|---|
| Sale 1999 | $104.5 MM |
| Sale 2002 | $ 63.8 MM |
| Sale 2004 | $ 53.9 MM |
| Sale 2006 | $ 13.9 MM |
| Sale 2008 | $ 17.6 MM |
| Sale 2010 | $ 0.8 MM |
| Total: | $253.7 MM |

474 tracts

4.6 million acres




As of 8/31/2009:

119 Leases Relinquished (1.19 million acres)

63 Leases Expired (0.38 million acres)

*1.57 million acres back to Federal Government*

*(~35% of original leases issued)*

***Additional assets currently are "on the market."***

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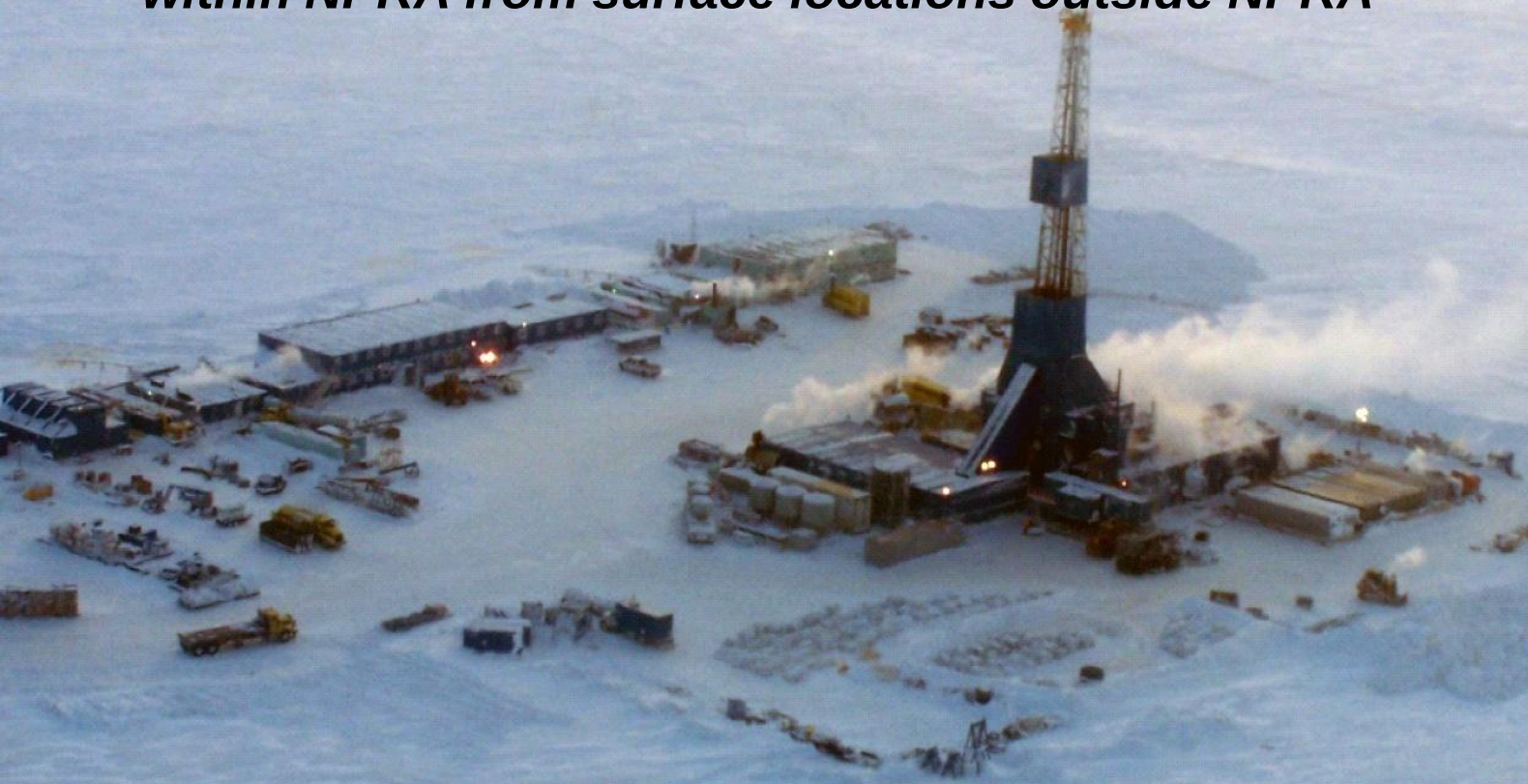
# Exploration Wells Completed in NPRA since 1999

## (29 on Federal leases + 1 on Native lease)

***Additional wells have been drilled into Native lands within NPRA from surface locations outside NPRA***



| | |
|---|---|
| 2000 | 2 |
| 2001 | 6 |
| 2002 | 4 |
| 2003 | 0 |
| 2004 | 4 |
| 2005 | 2 |
| 2006 | 2 |
| 2007 | 5 |
| 2008 | 2 |
| 2009 | 3 |
| 2010 | 0 |

***No wells will be drilled in NPRA during the winter of 2010-2011***

*Completion data from IHS Energy*

*FEX Aklaq 1 - BLM Photo*

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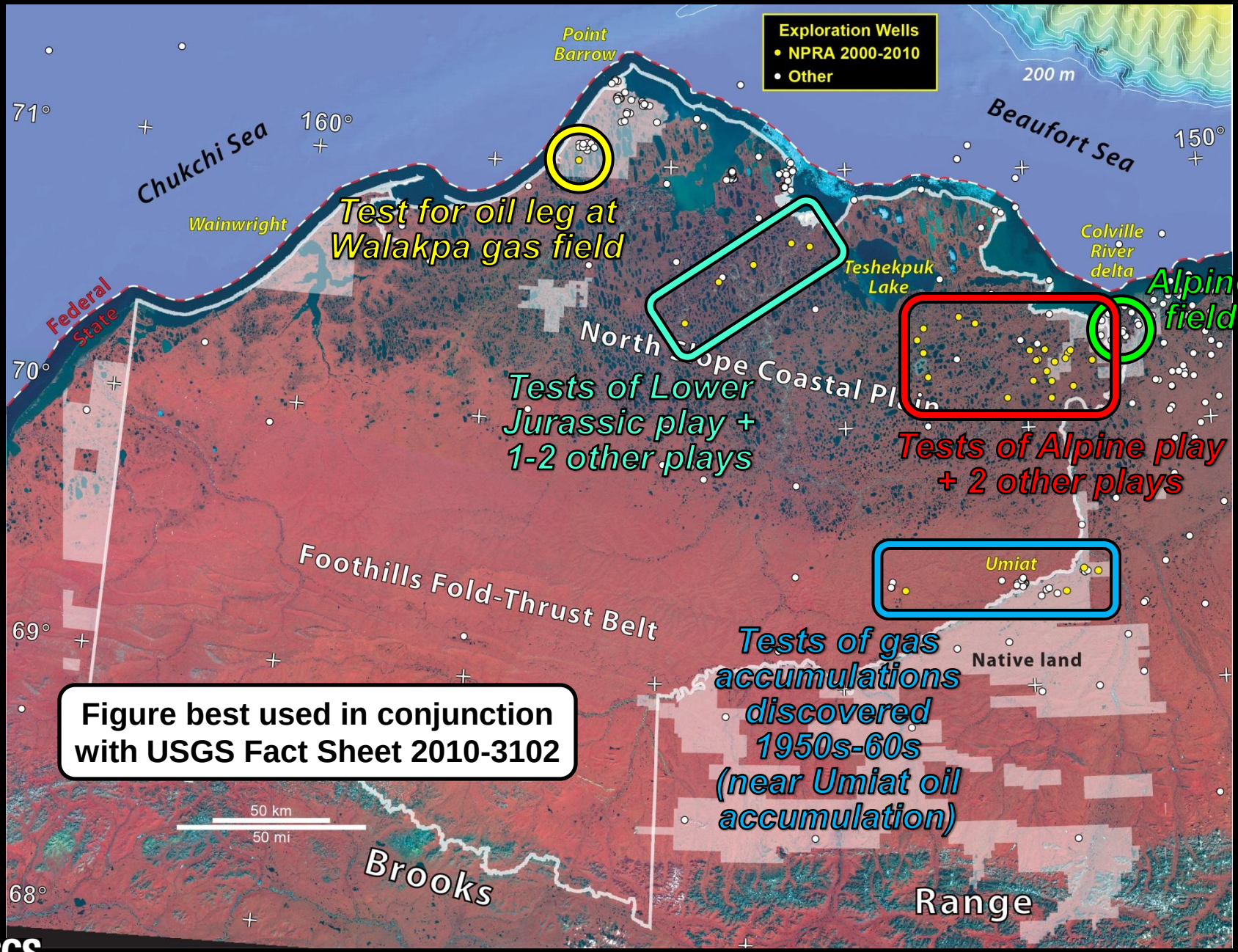
# NPRA Geology and Recent Exploration

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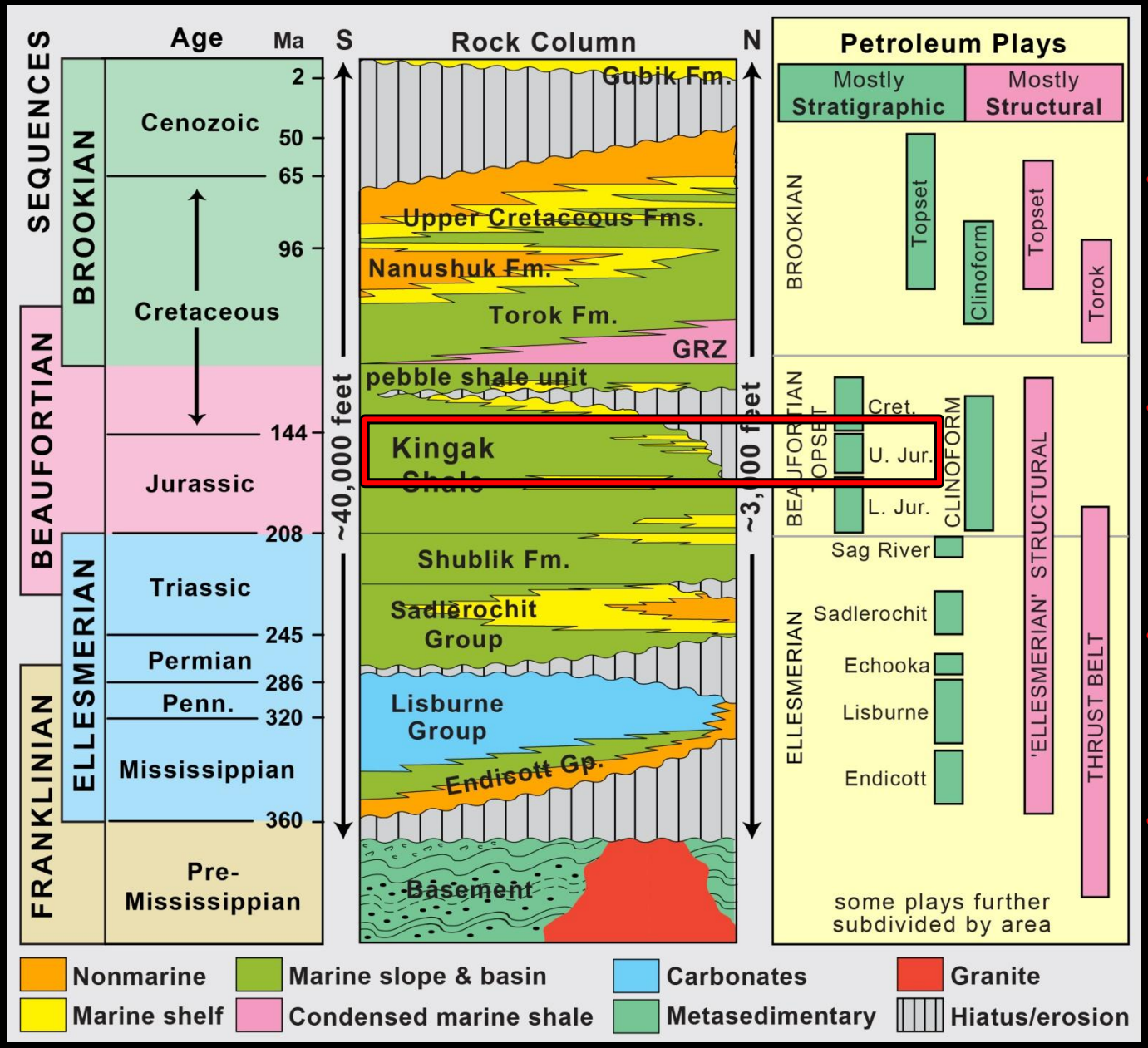
# NPRA and Nearby Stratigraphy and Petroleum Plays




## *Alpine Play*

- *Accounts for more than 93% of oil produced to date from Alpine field*
- *Accounted for 67% of undiscovered oil in 2002 USGS assessment*
- *Focus of most exploration in NPRA since 1999*
- *Accounts for 95+% of OIL discovered in NPRA since 1999*

GRZ, gamma-ray zone

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# Alpine Play Area

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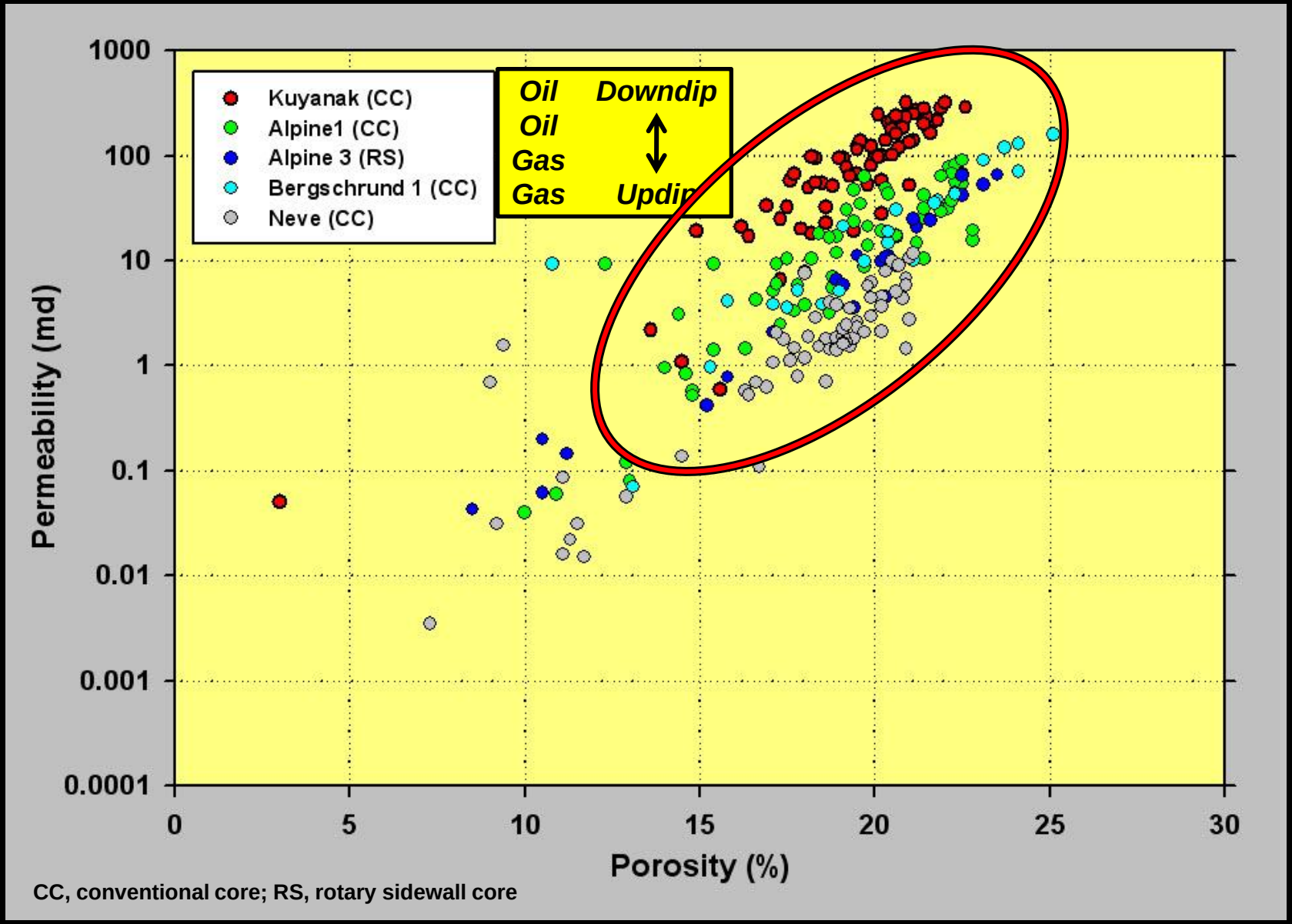
# Challenge #1: Reservoir Quality




CC, conventional core; RS, rotary sidewall core

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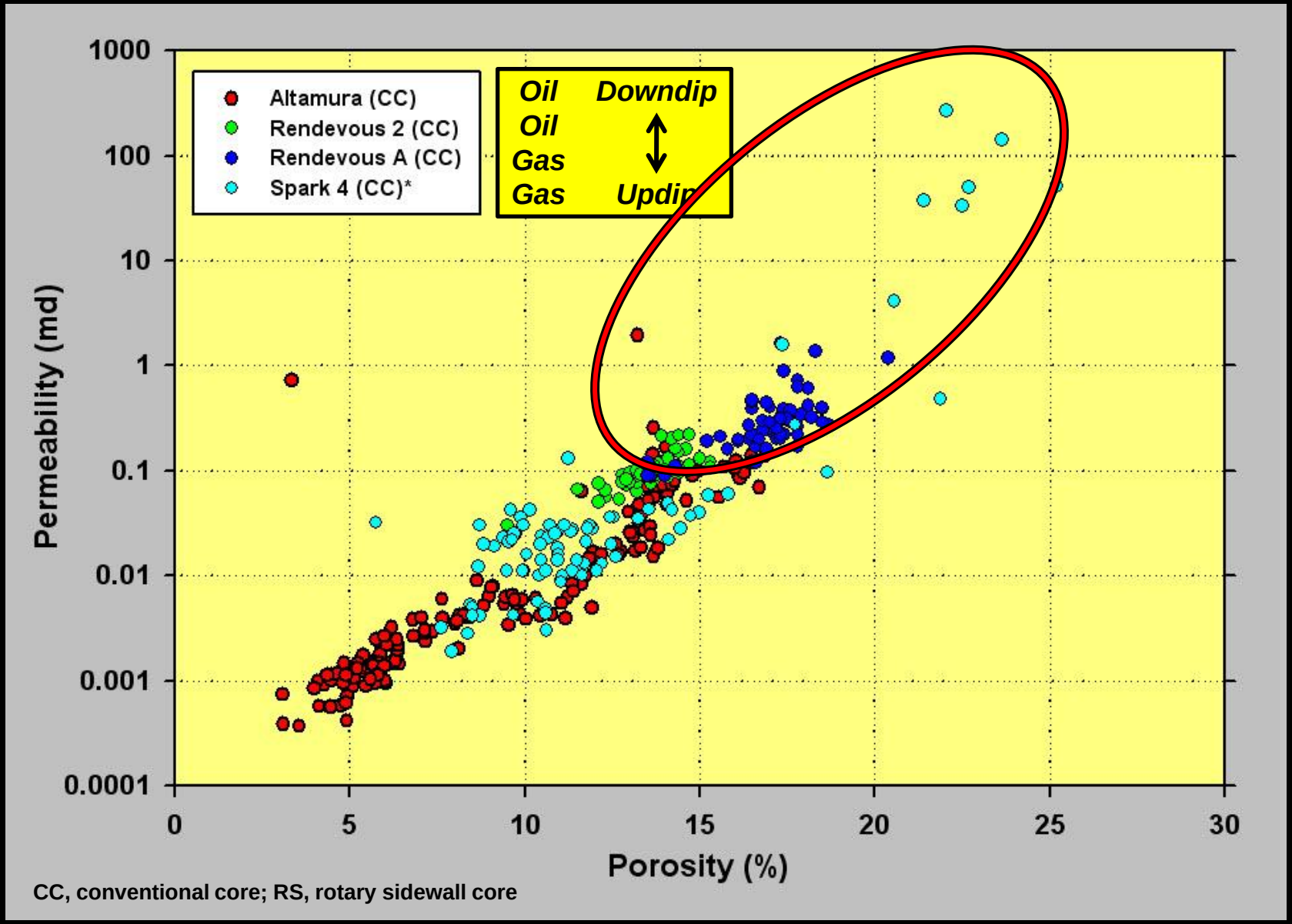


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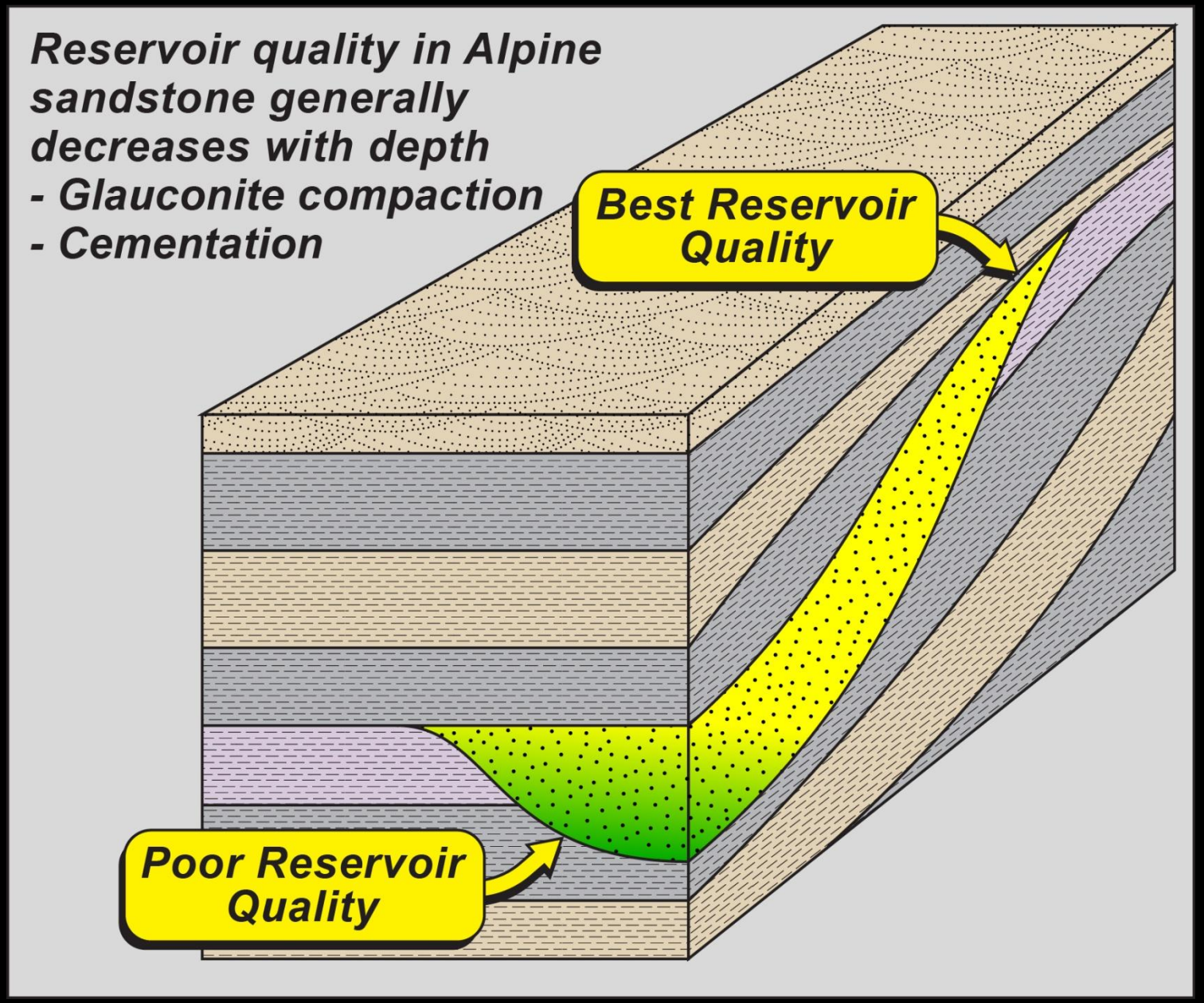


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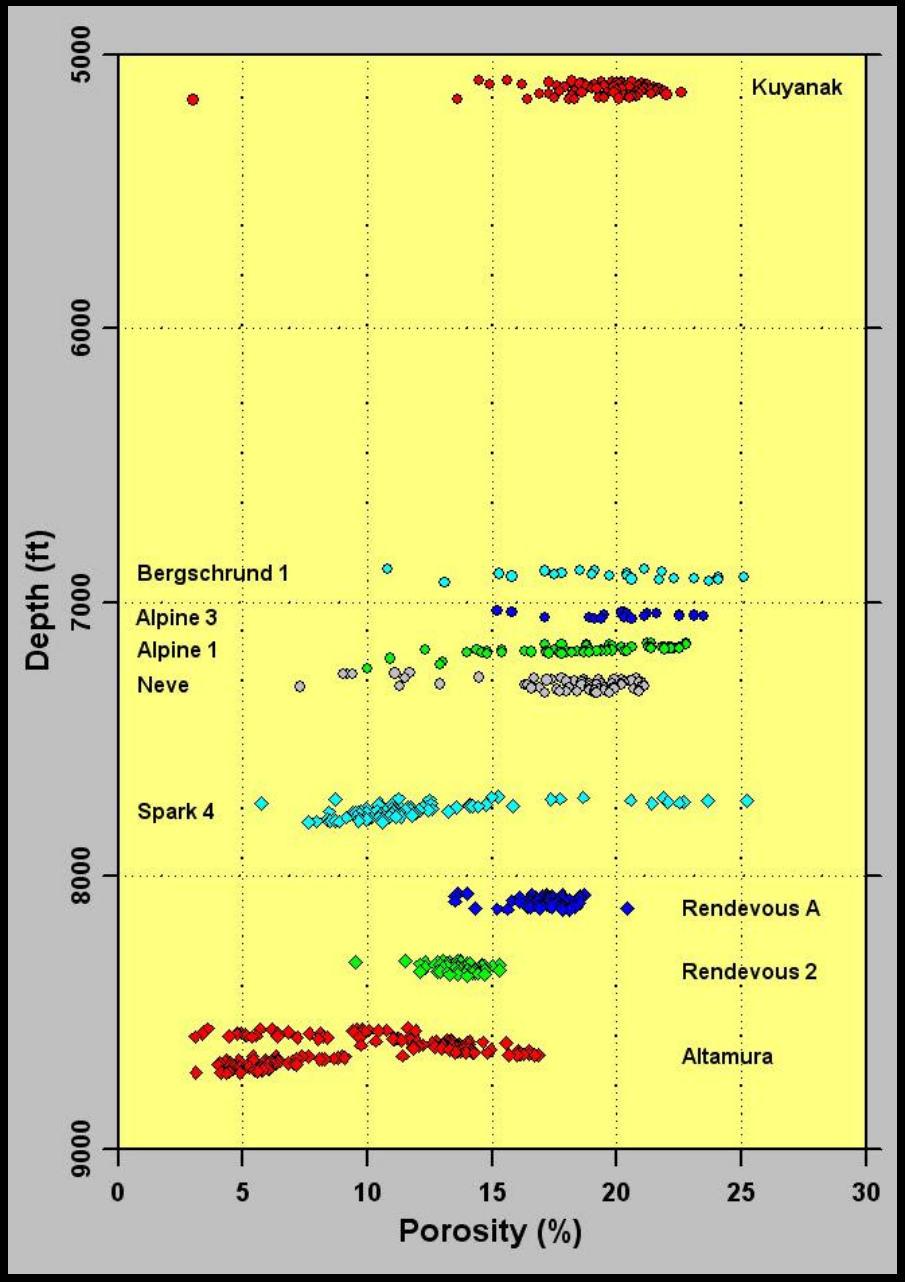
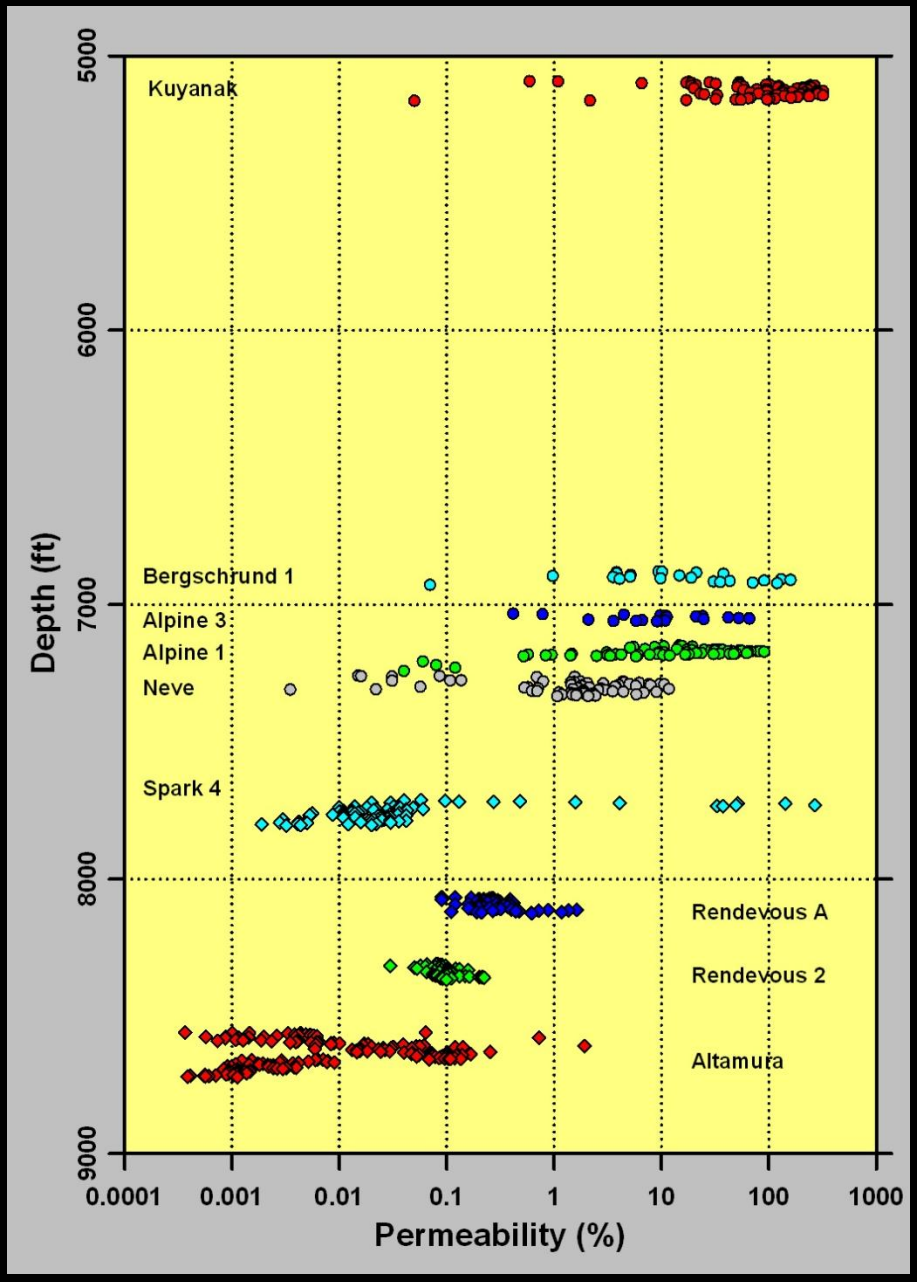
# Reservoir Quality – Alpine Sandstone (C Facies)

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# Challenge #2: Hydrocarbon Phase (Oil vs. Gas)

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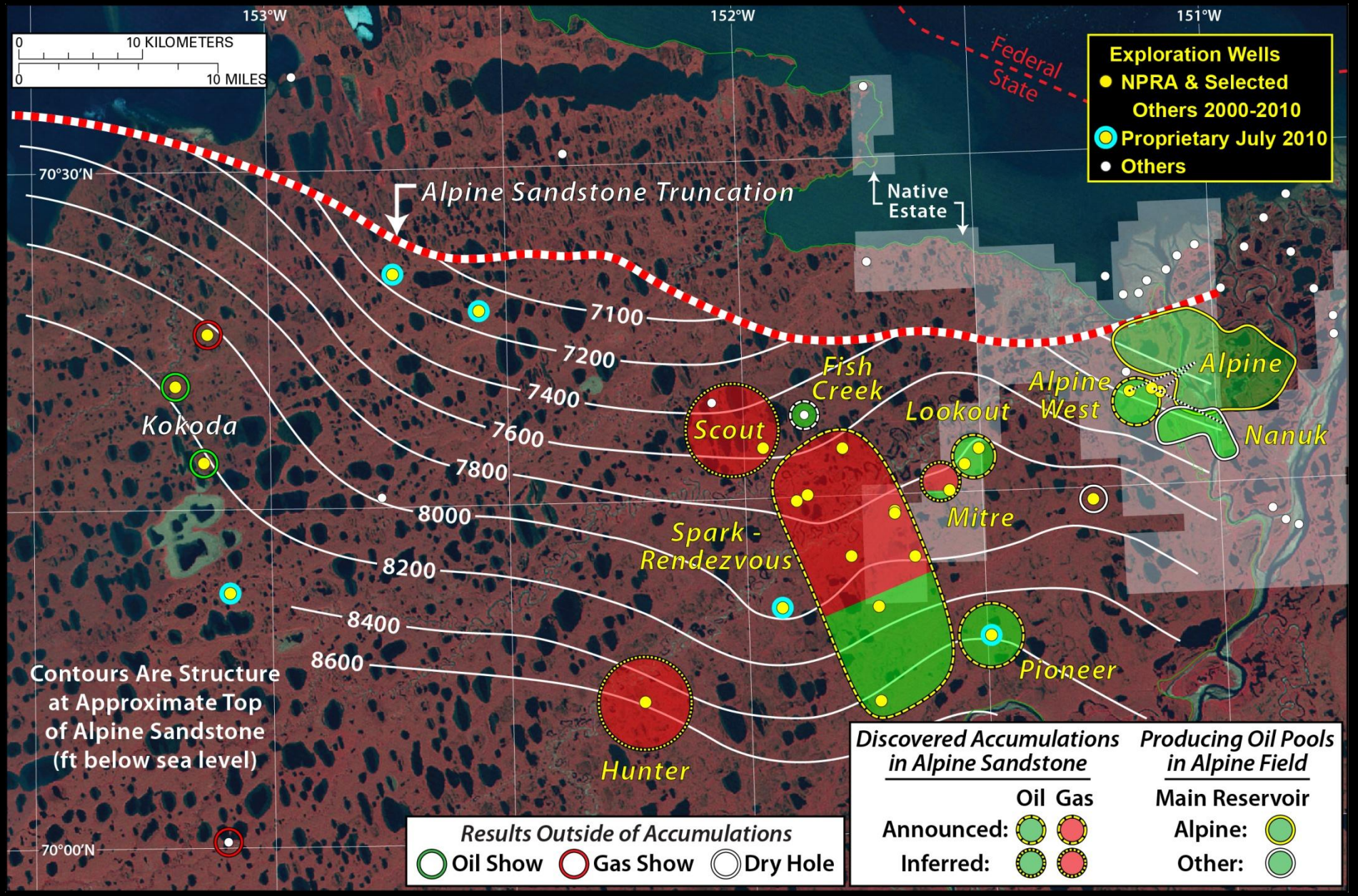
# Inferred Exploration Results – Northeastern NPRA

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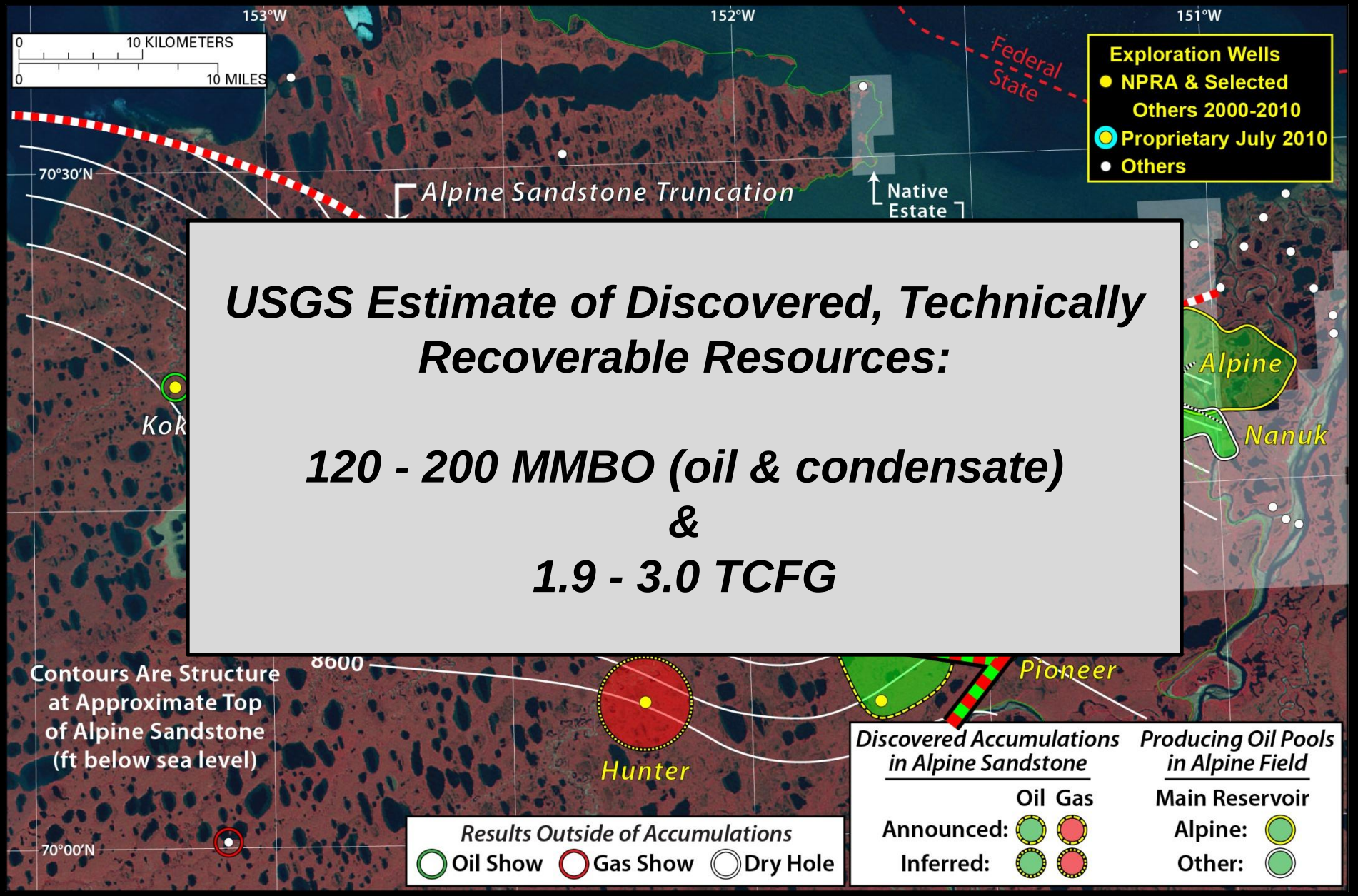


***USGS Estimate of Discovered, Technically Recoverable Resources:***

***120 - 200 MMBO (oil & condensate)***

***&***

***1.9 - 3.0 TCFG***

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# Cenozoic Uplift & Erosion in Northern NPRA – *Possible Cause of Gas Predominance*

- Oil accumulation in traps in northern NPRA was mostly complete by about 90 million years ago

- Several types of geologic evidence indicate significant uplift in northern NPRA during the Cenozoic (60 – 15 million years ago)

- Uplift and erosion reduce confining pressure on subsurface fluids

- Oil in reservoirs will degas (solution gas)
- Gas in reservoirs will expand
- Formation water will degas (gas dissolved in formation water)

- Gas expansion may
  - Displace oil downdip into poorer quality reservoir rocks within the same trap
  - Displace oil completely from a trap, resulting in oil spilling to shallower formations or to the surface

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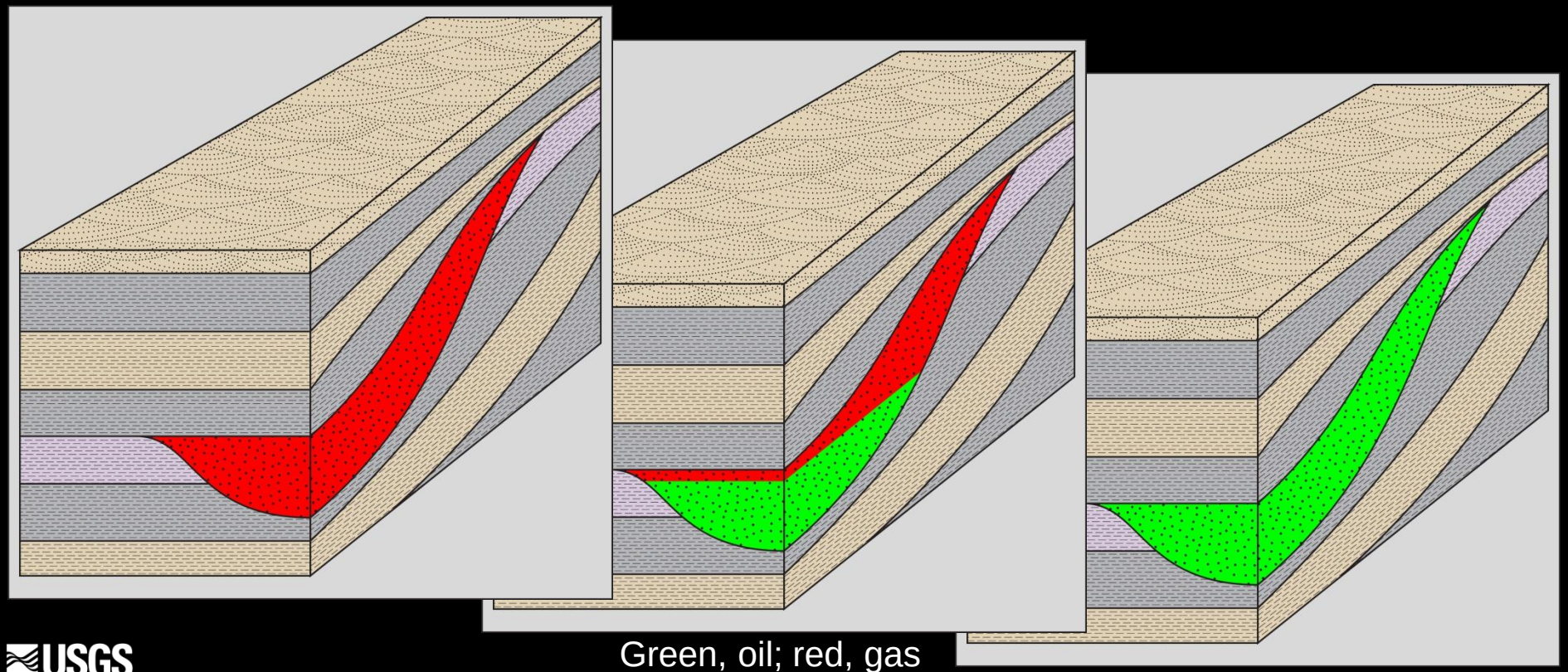
# Effects of Exhumation on Alpine Play in NPRA

***West*** ← ***Increased uplift and erosion*** → ***East***

| ***Gas fills reservoir ± oil shows*** | ***Gas cap + condensate High GOR Oil displaced downdip into poor quality reservoir*** | ***Oil fills reservoir “Low” gravity oil No gas cap Low GOR*** |
|---|---|---|
| ***e.g., most tests west of Spark-Rendezvous*** | ***e.g., Spark-Rendezvous*** | ***e.g., Alpine*** |



Green, oil; red, gas

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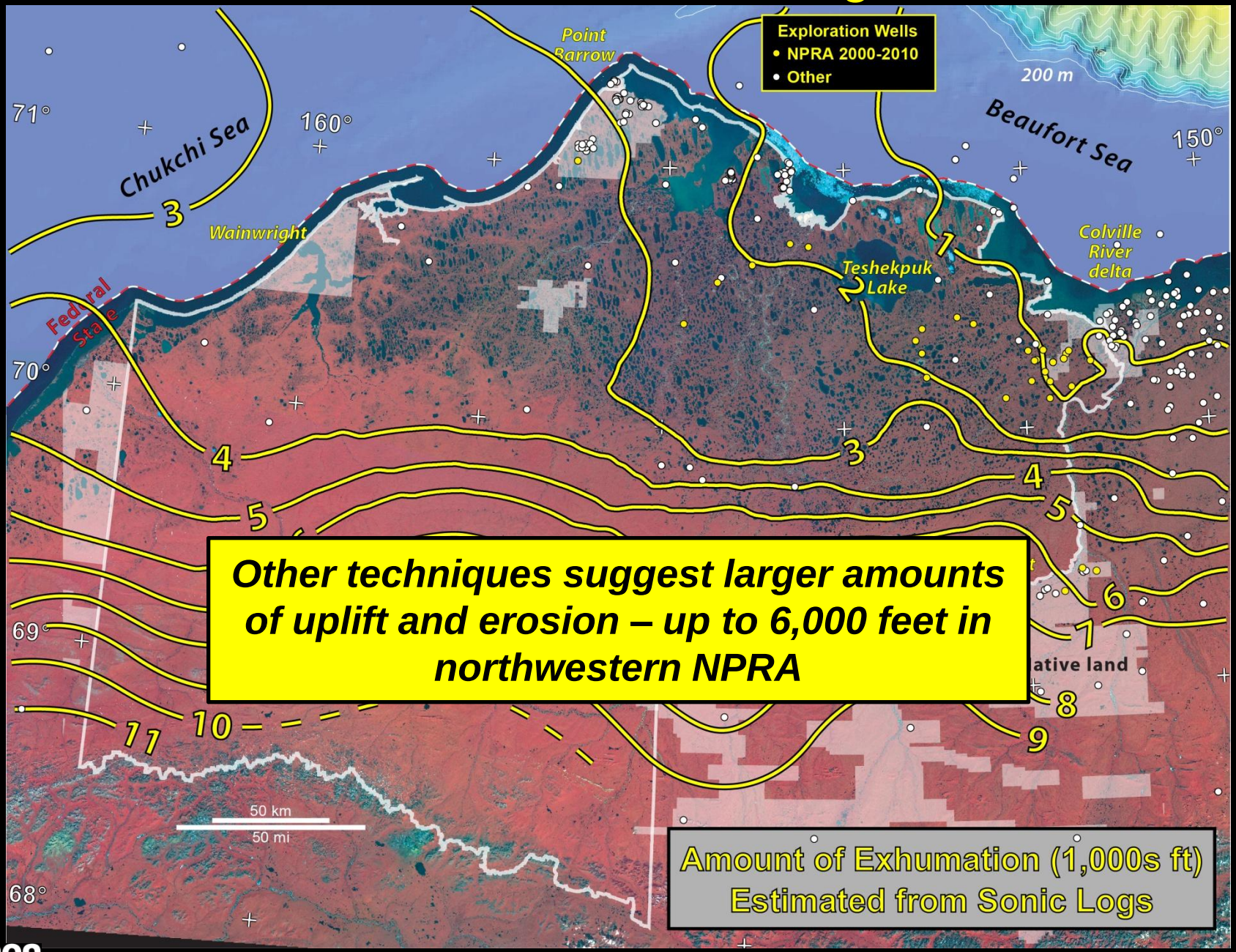
# Exhumation Estimated from Sonic Logs

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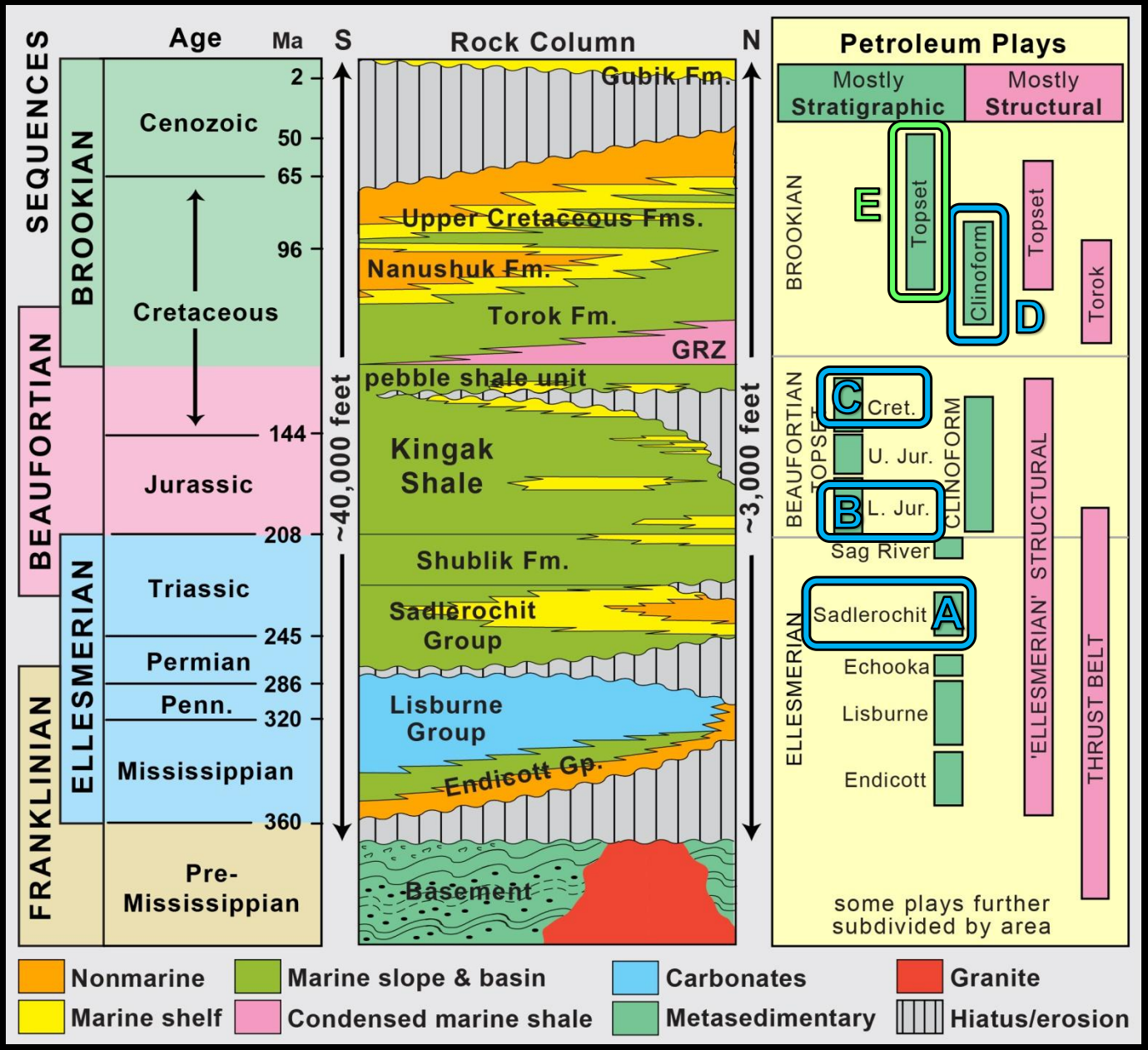
*Modified from Burns et al., 2007: http://pubs.usgs.gov/pp/pp1732/pp1732d/pp1732d.pdf*

# NPRA and Nearby Stratigraphy and Petroleum Plays




## *Other Plays Tested*

***Primary objectives***

- **A – 1 dry hole**
- **B – at least 4 wells; mostly gas**
- **C – 2 dry holes**
- **D – 2 wells; oil saturated & poor reservoir**

***Secondary objectives***

- **E – at least 2 small oil accumulations**

GRZ, gamma-ray zone

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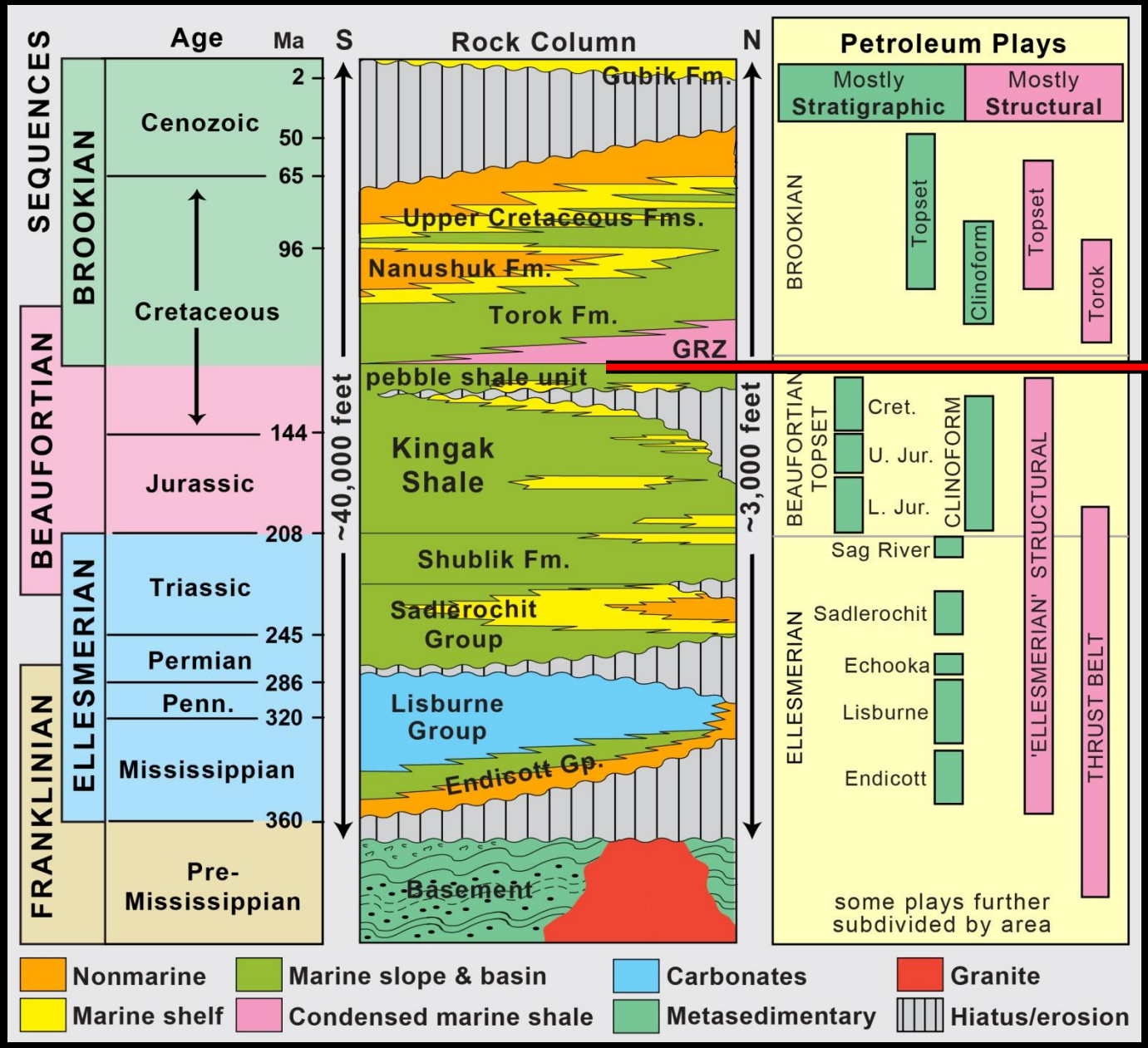
# NPRA and Nearby Stratigraphy and Petroleum Plays




***Drilling results indicate that Brookian strata retain oil saturation west of the oil-gas transition in the Alpine play.***

***This suggests that gas expansion was less effective in displacing oil in Brookian strata.***

***Likely indicates a regional "seal" formed by PSU-GRZ.***

PSU, pebble shale unit
GRZ, gamma-ray zone

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# Results of 2010 Updated Assessment of NPRA

- All results are fully risked, undiscovered, technically recoverable resources in conventional accumulations

- Total Oil: 896 MMBO (million barrels of oil)
  - Most in Brookian stratigraphic plays, *widely distributed*
  - Some in older stratigraphic plays in *northeastern NPRA*

- Total Gas (nonassociated only): 52.8 TCF (trillion cubic feet)
  - Most in structural plays in *southern NPRA*
  - Significant potential in stratigraphic plays in *northern NPRA (previously considered oil-prone)*

- Greatest potential for undiscovered oil resources in locations that likely are economically viable exists in northeastern NPRA, which has been inaccessible (Teshekpuk Lake and adjacent coastal plain)

- Gas resources remain stranded in the absence of a gas pipeline

- Analysis of economically recoverable resources is in progress

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# Additional Information

http://energy.usgs.gov/

- Fact Sheet
- Slide Presentation
- Other Information

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