

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

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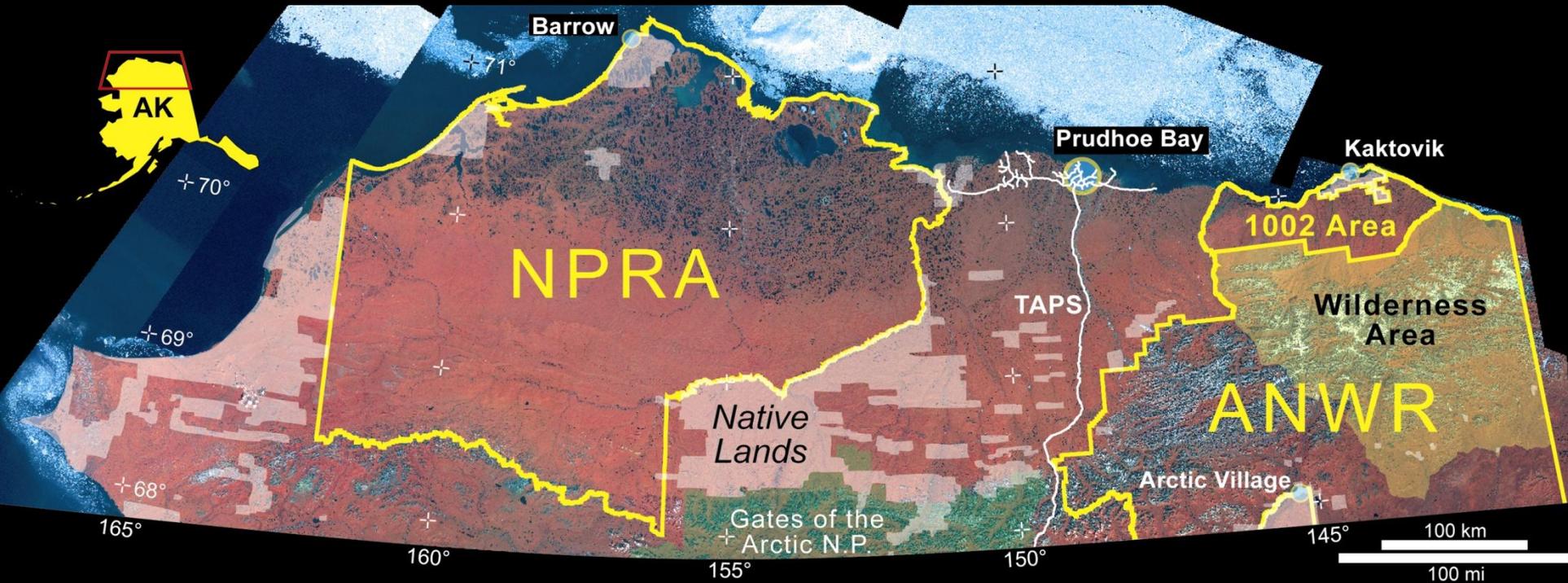
Summary

- 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

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.

Federal Lands of the Alaska North Slope



National Petroleum Reserve in Alaska (NPRA)

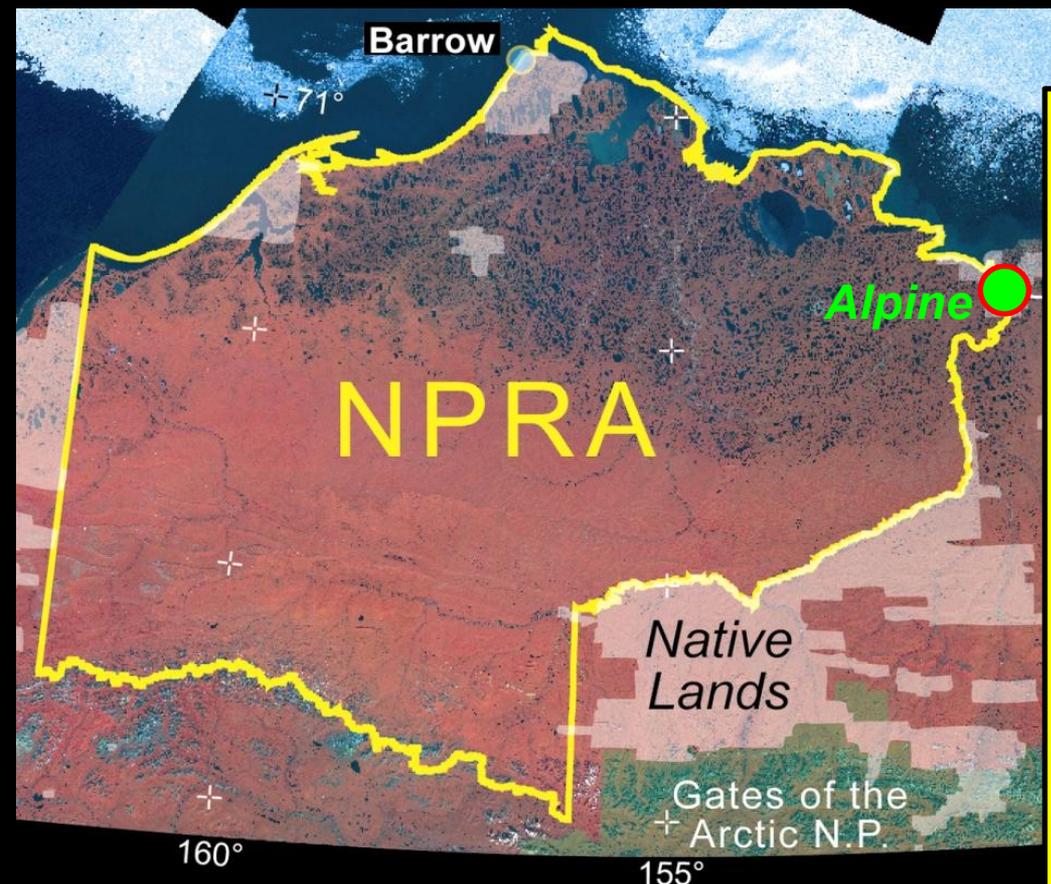
~23 million acres

~36,000 mi²

About the size of Indiana

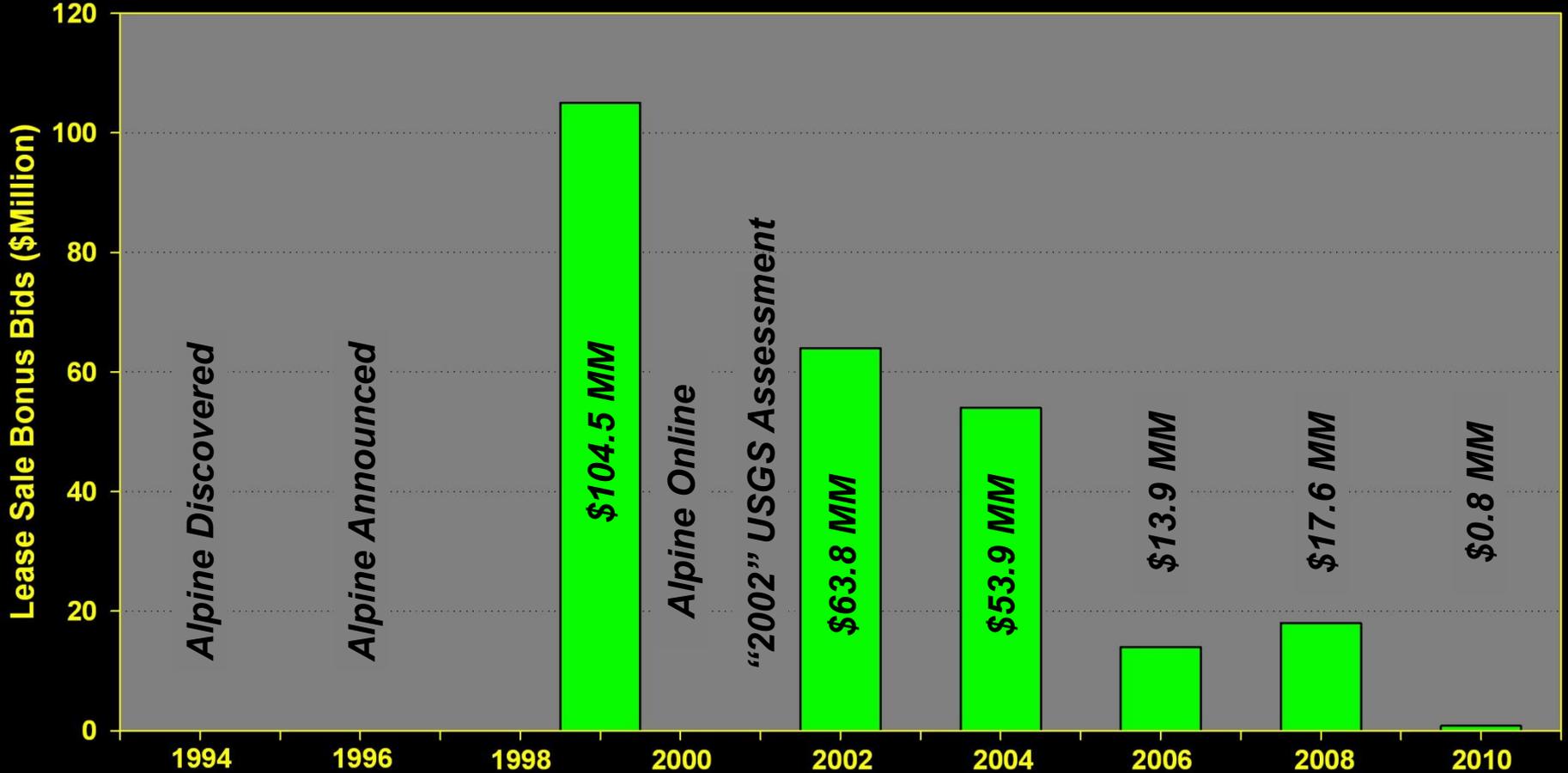
ANWR, Arctic National Wildlife Refuge
TAPS, Trans Alaska Pipeline System

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 . . .

NPRA Federal Lease Sales 1999-2010



Leases Acquired & Relinquished since 1999

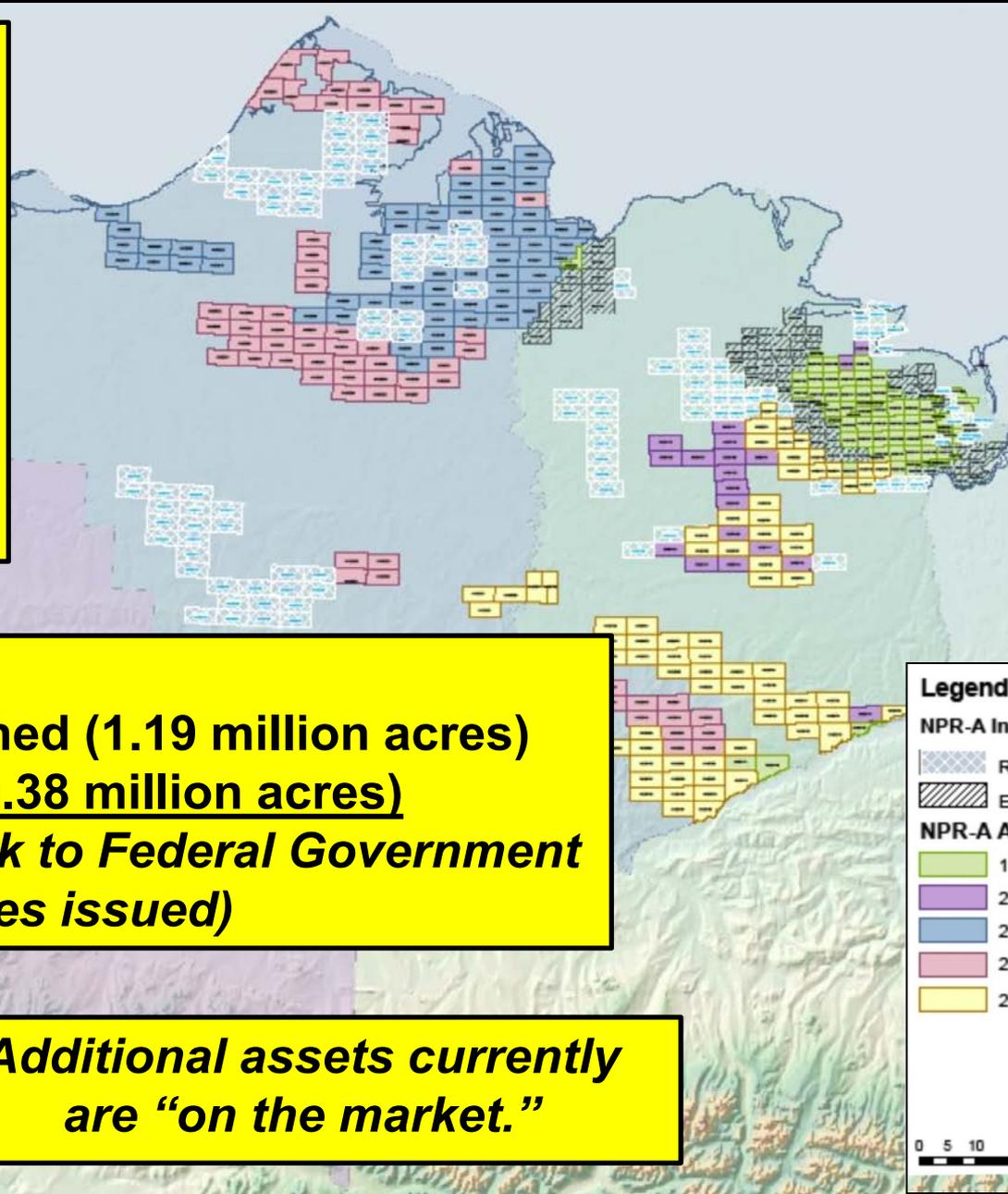
Sale 1999 \$104.5 MM
Sale 2002 \$ 63.8 MM
Sale 2004 \$ 53.9 MM
Sale 2006 \$ 13.9 MM
Sale 2008 \$ 17.6 MM
Sale 2010 \$ 0.8 MM

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)

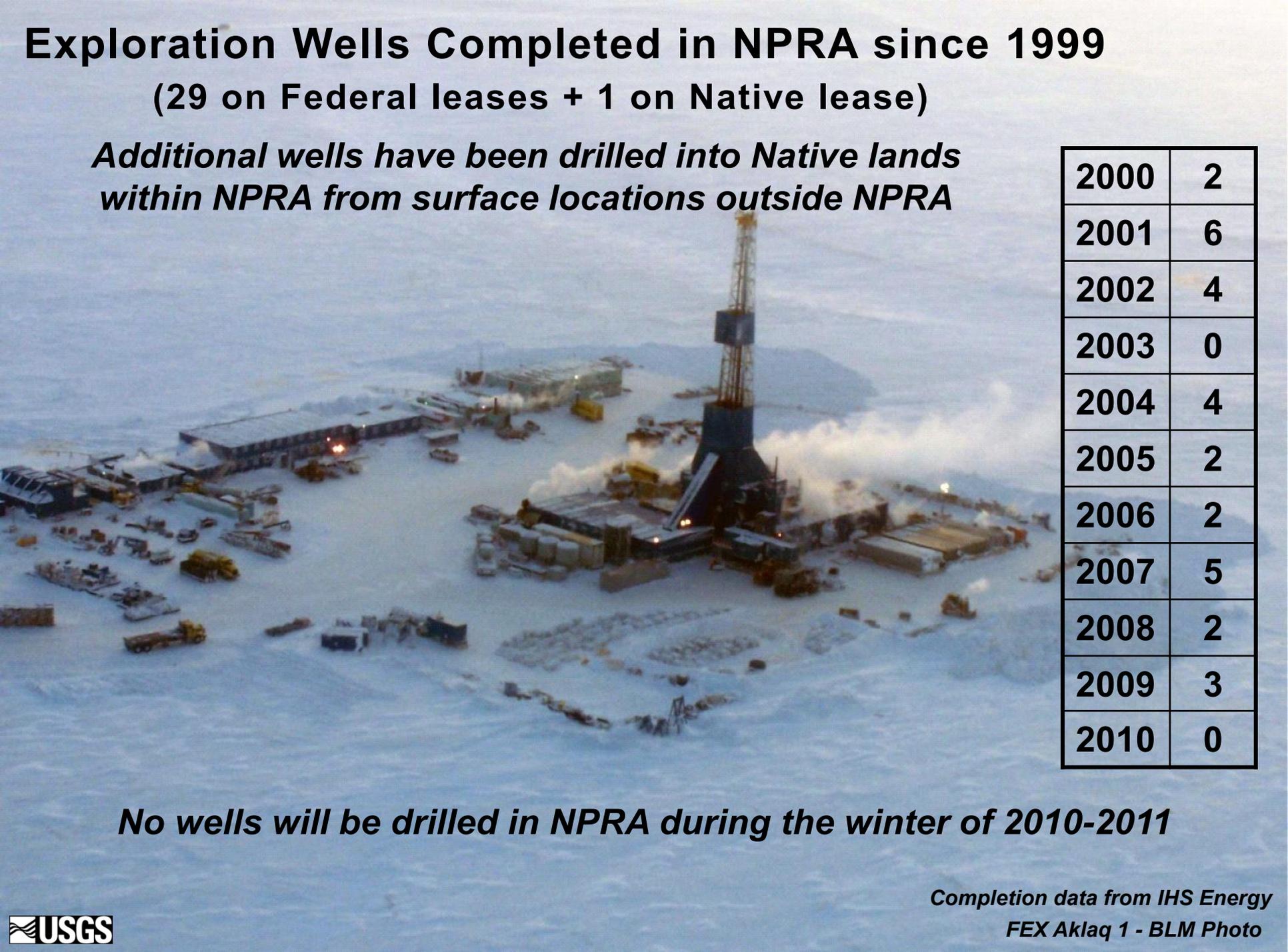
**Additional assets currently
are "on the market."**



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

NPRA Geology and Recent Exploration

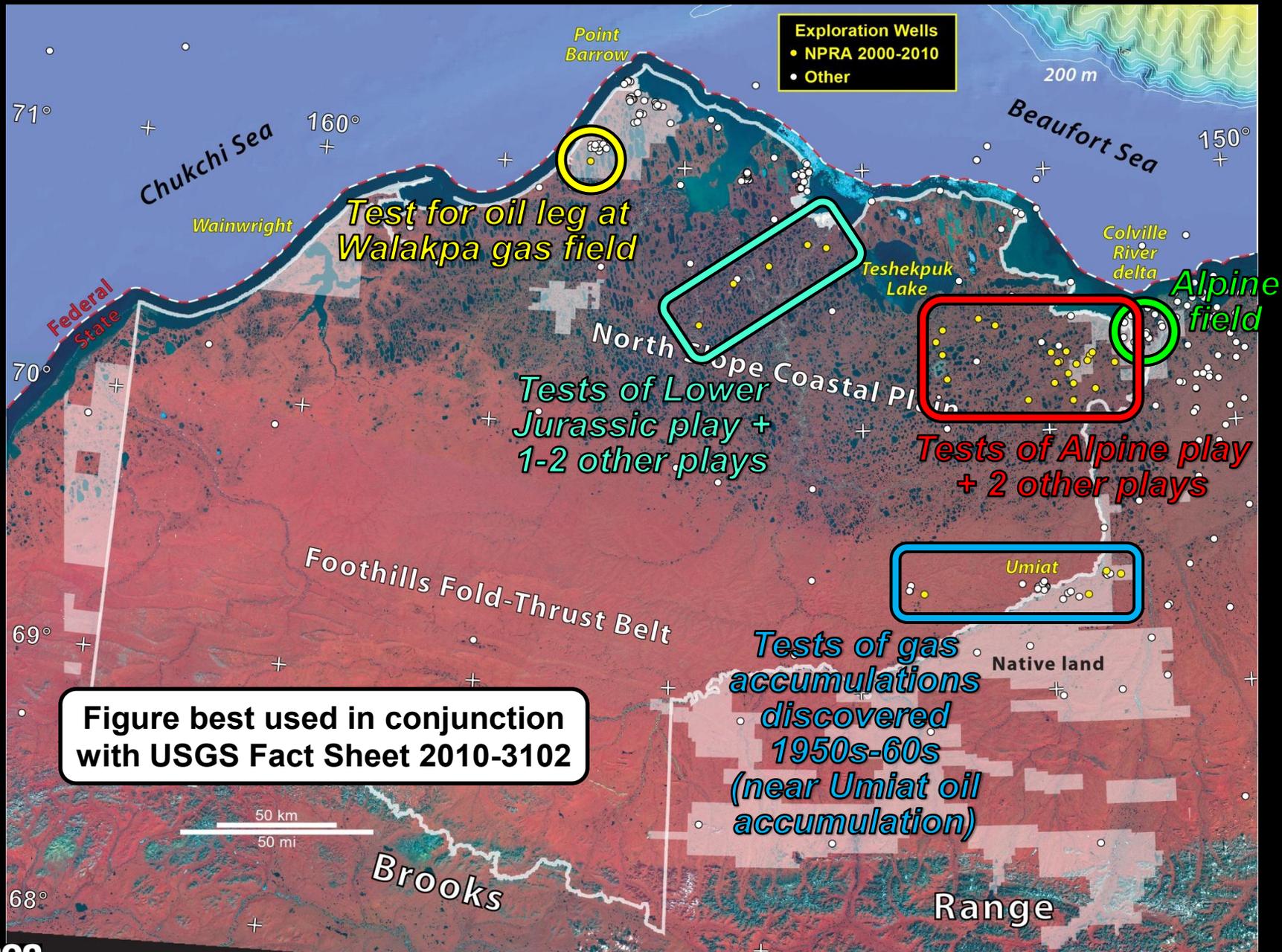
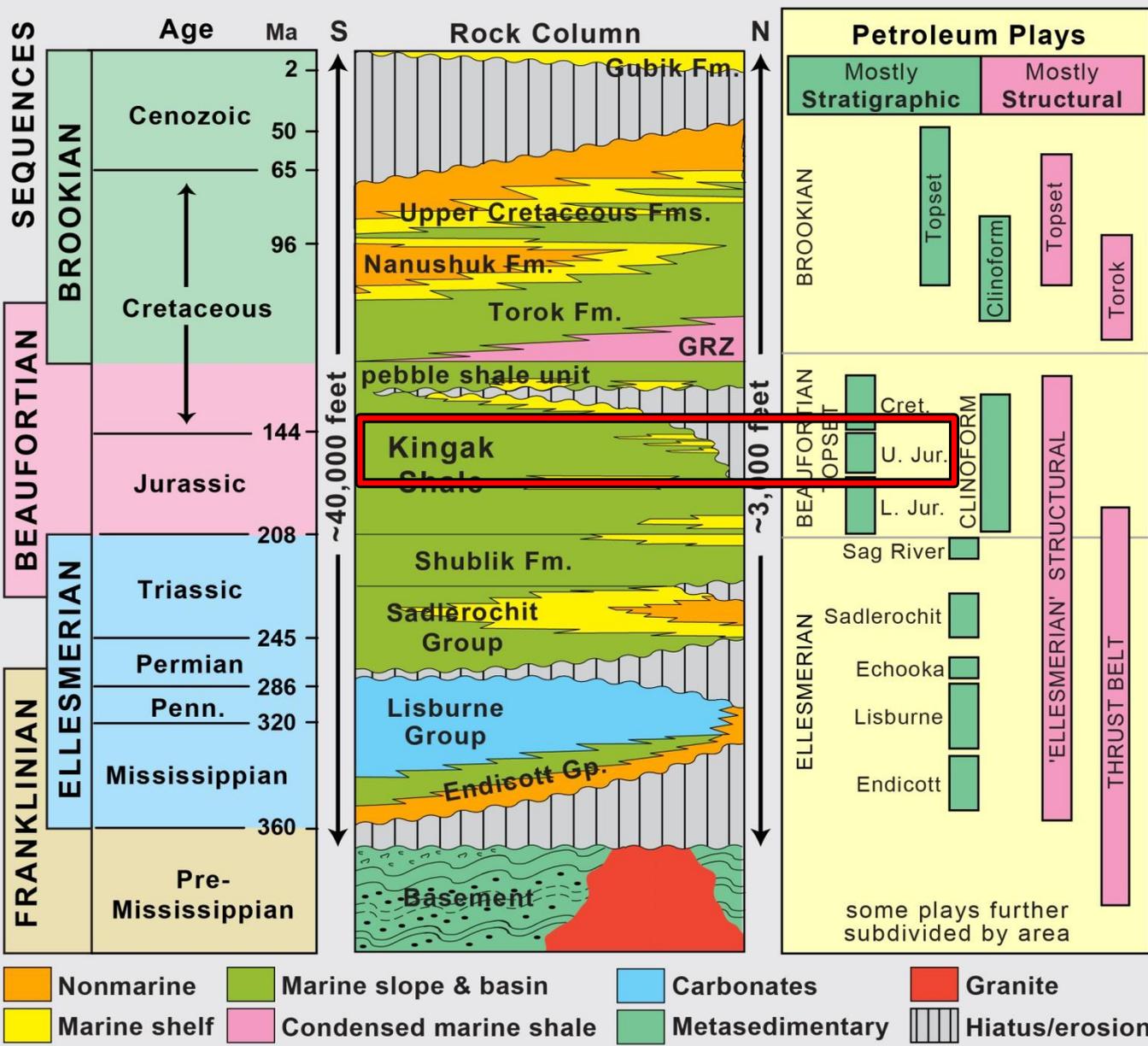


Figure best used in conjunction with USGS Fact Sheet 2010-3102

NPRA and Nearby Stratigraphy and Petroleum Plays



Alpine Play

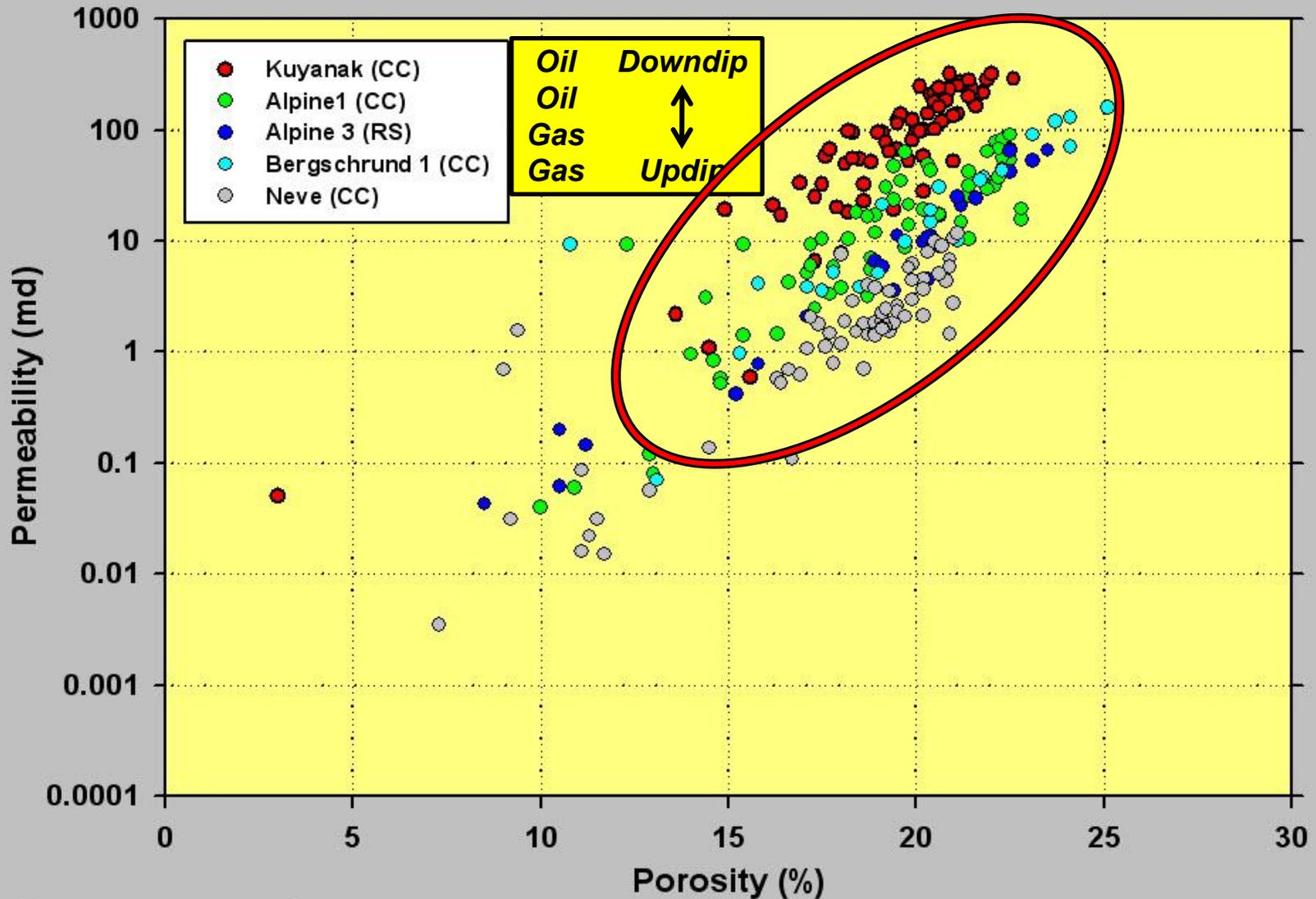
- Accounts for more than 93% of oil produced to date from Alpine field
- Accounted for 67% of undiscovered oil in 2002 USGS assessment
- Focus of most exploration in NPRA since 1999
- Accounts for 95+% of OIL discovered in NPRA since 1999

GRZ, gamma-ray zone

Alpine Play Area

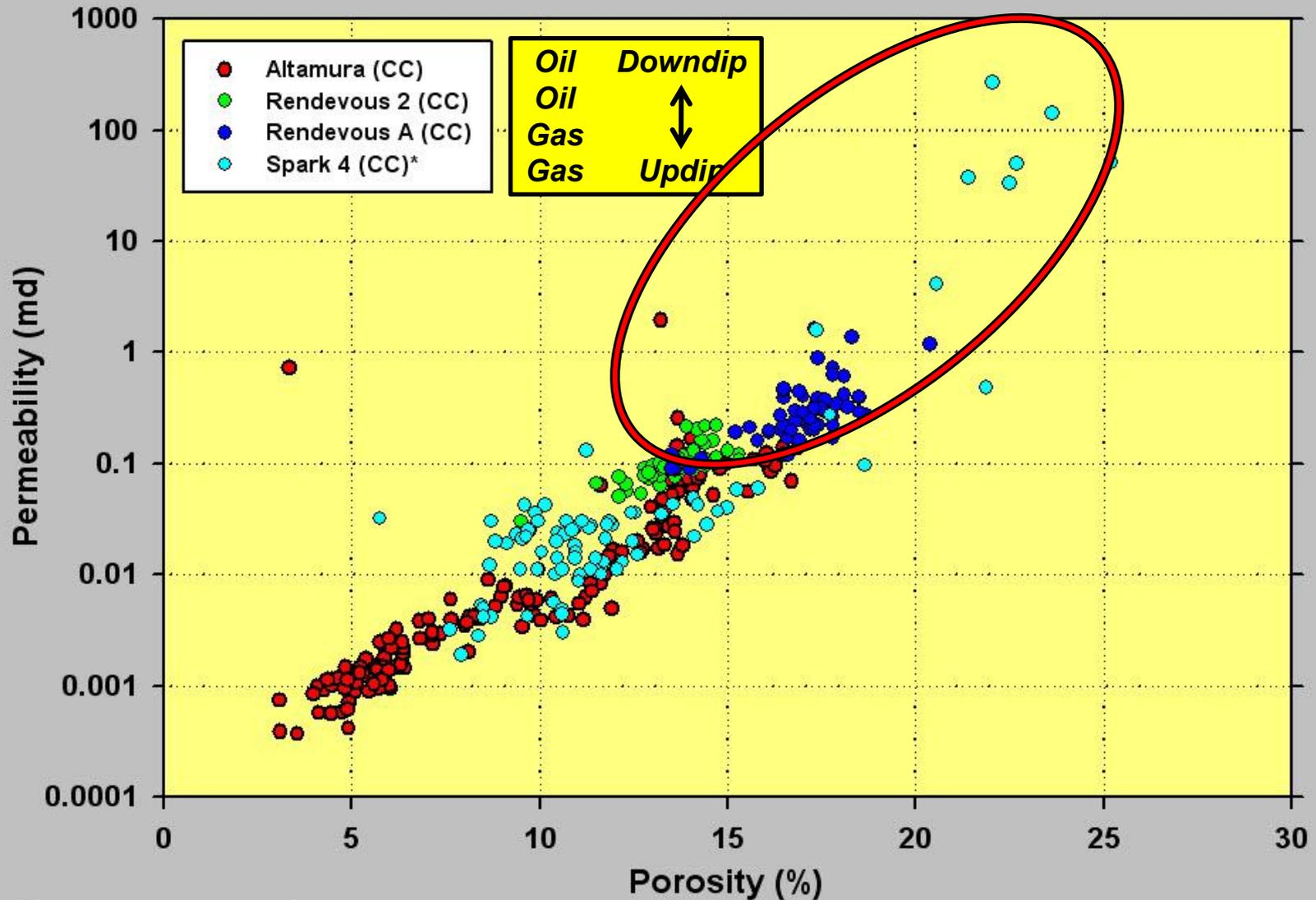


Challenge #1: Reservoir Quality



CC, conventional core; RS, rotary sidewall core

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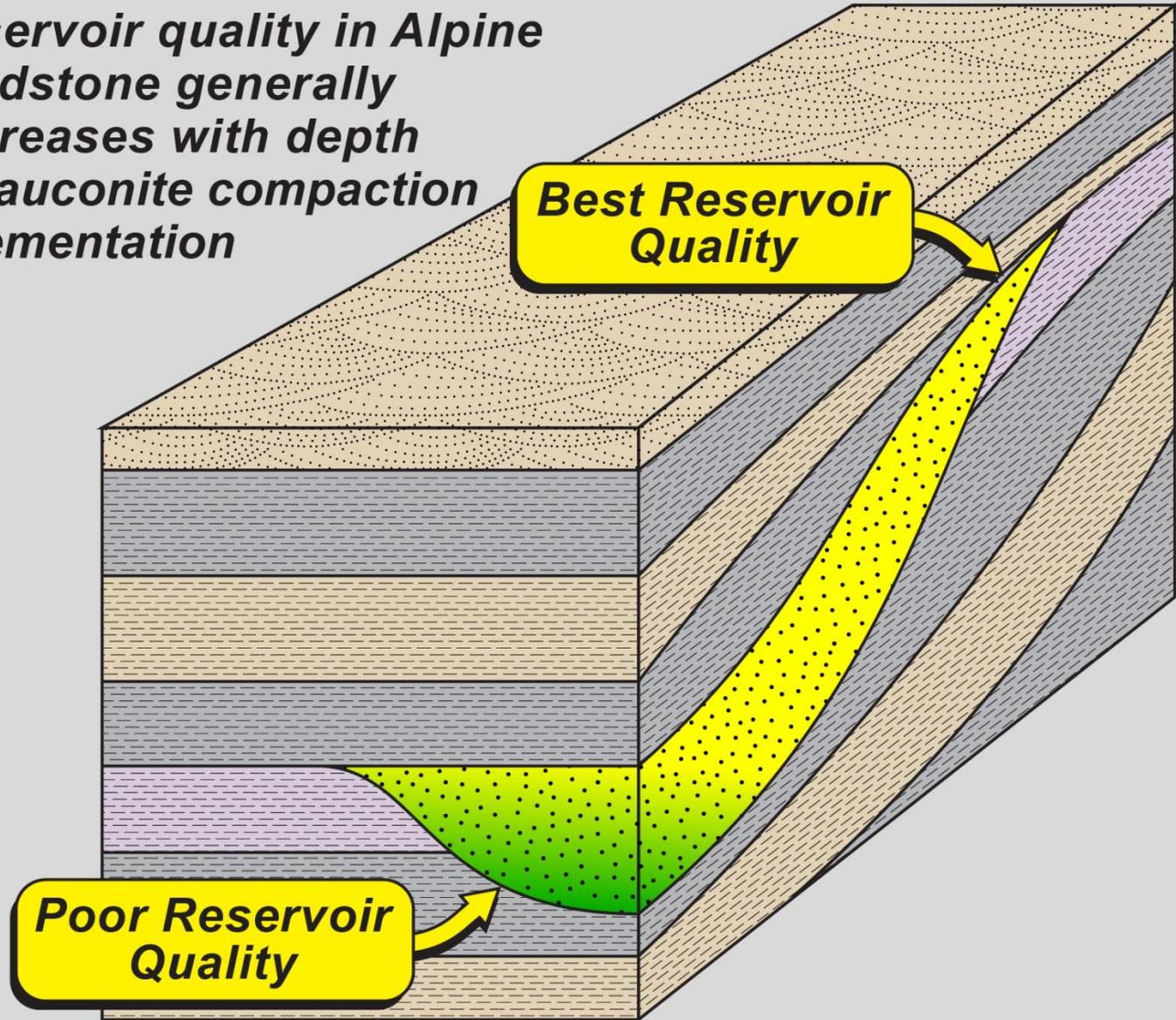


CC, conventional core; RS, rotary sidewall core

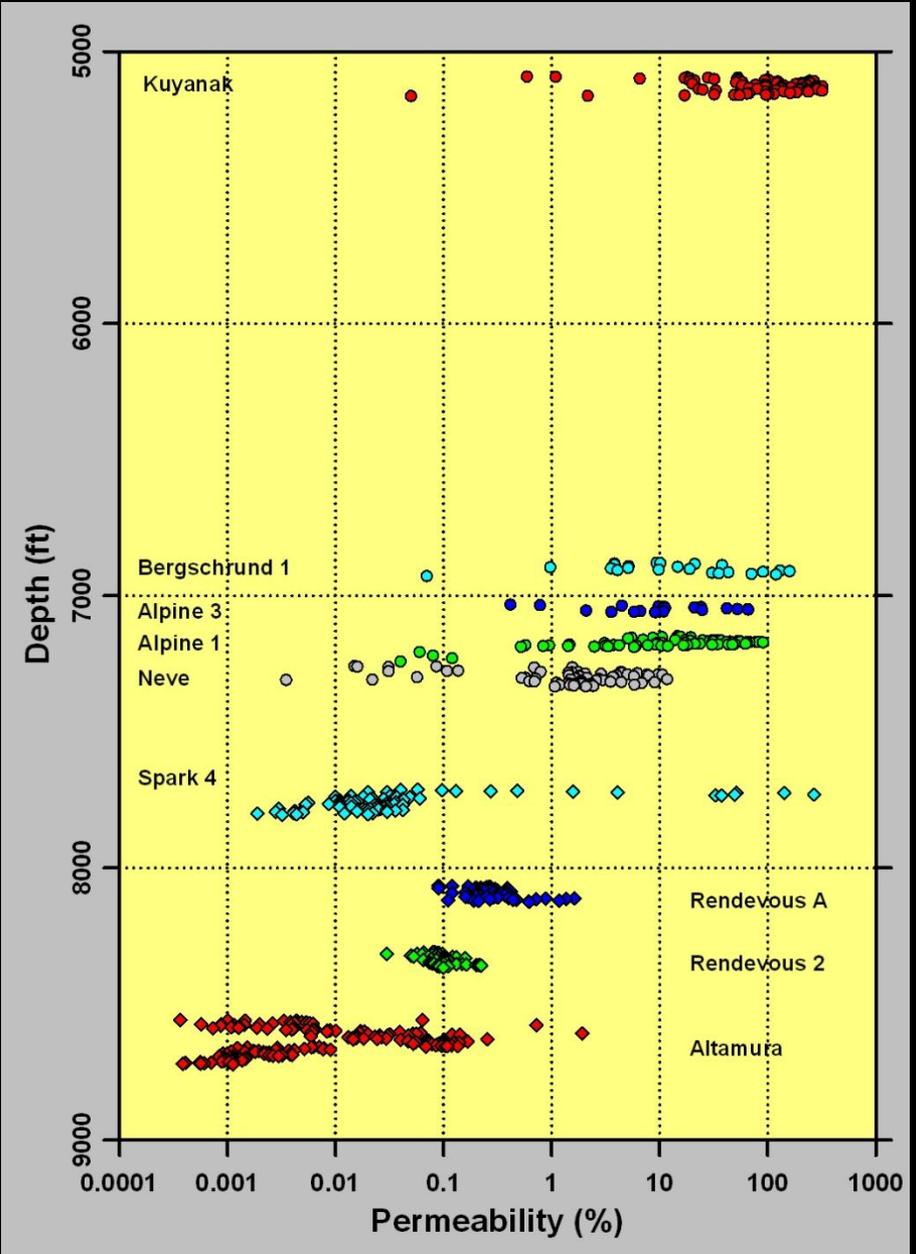
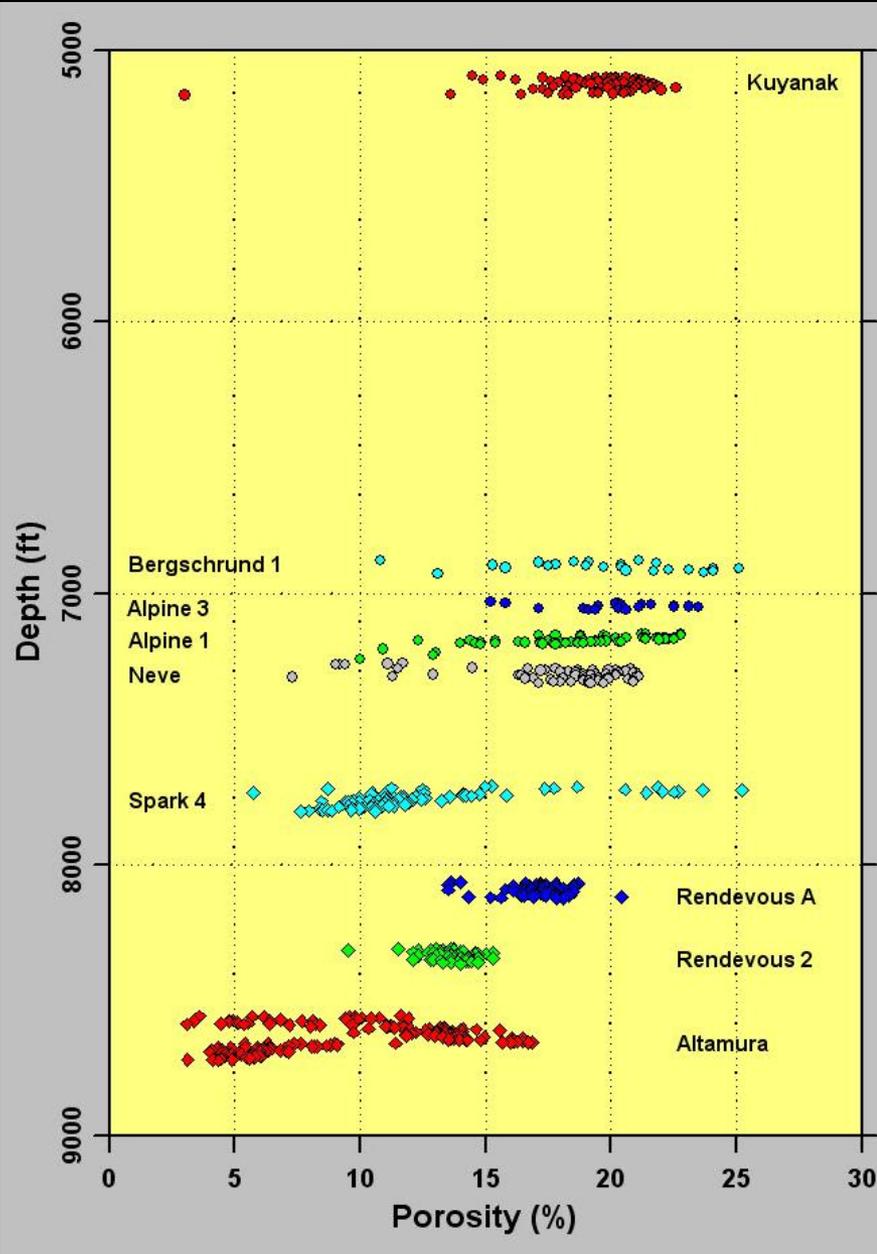
Challenge #1: Reservoir Quality

Reservoir quality in Alpine sandstone generally decreases with depth

- *Glauconite compaction*
- *Cementation*



Reservoir Quality – Alpine Sandstone (C Facies)



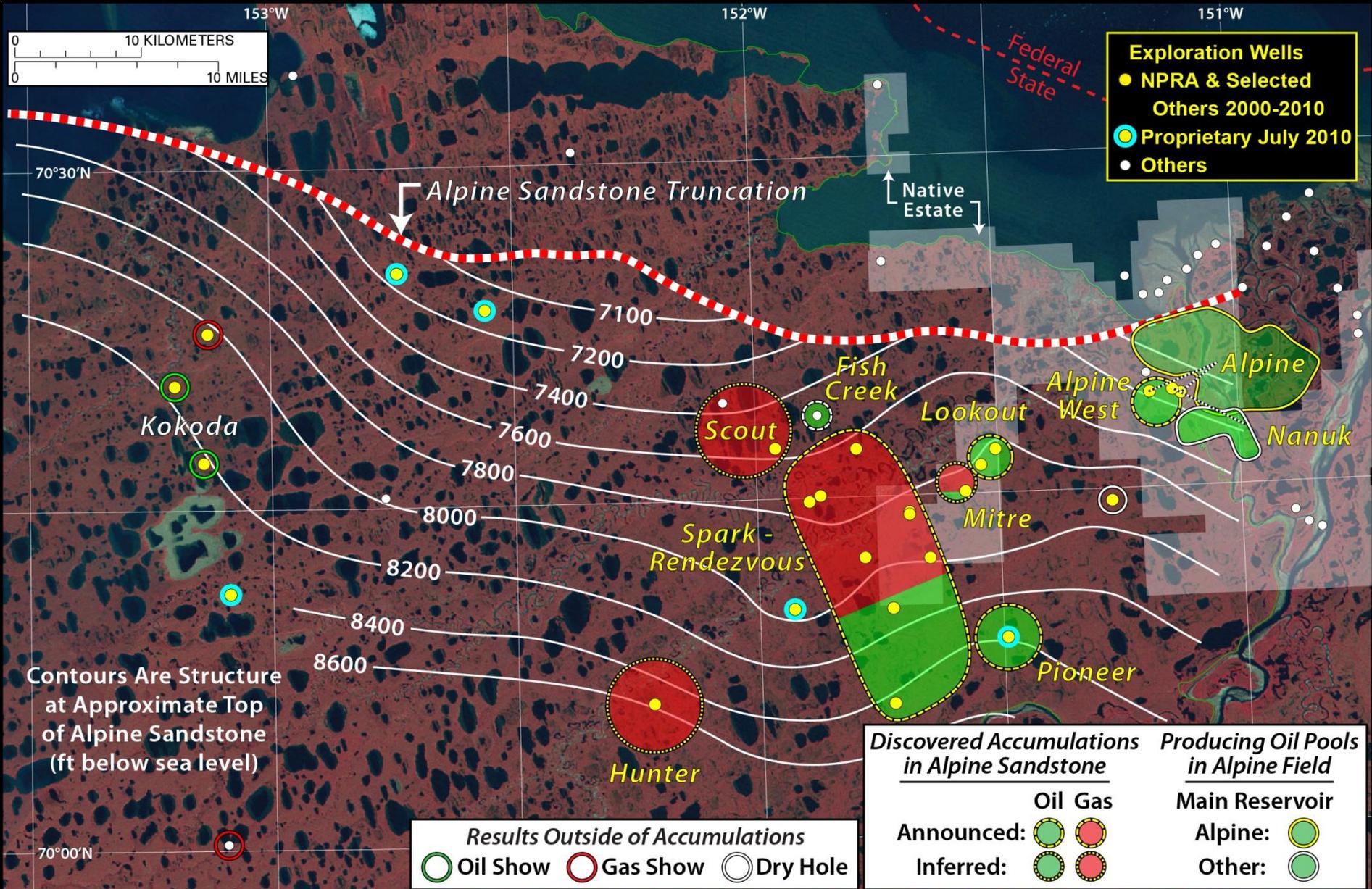
Challenge #2: Hydrocarbon Phase (Oil vs. Gas)



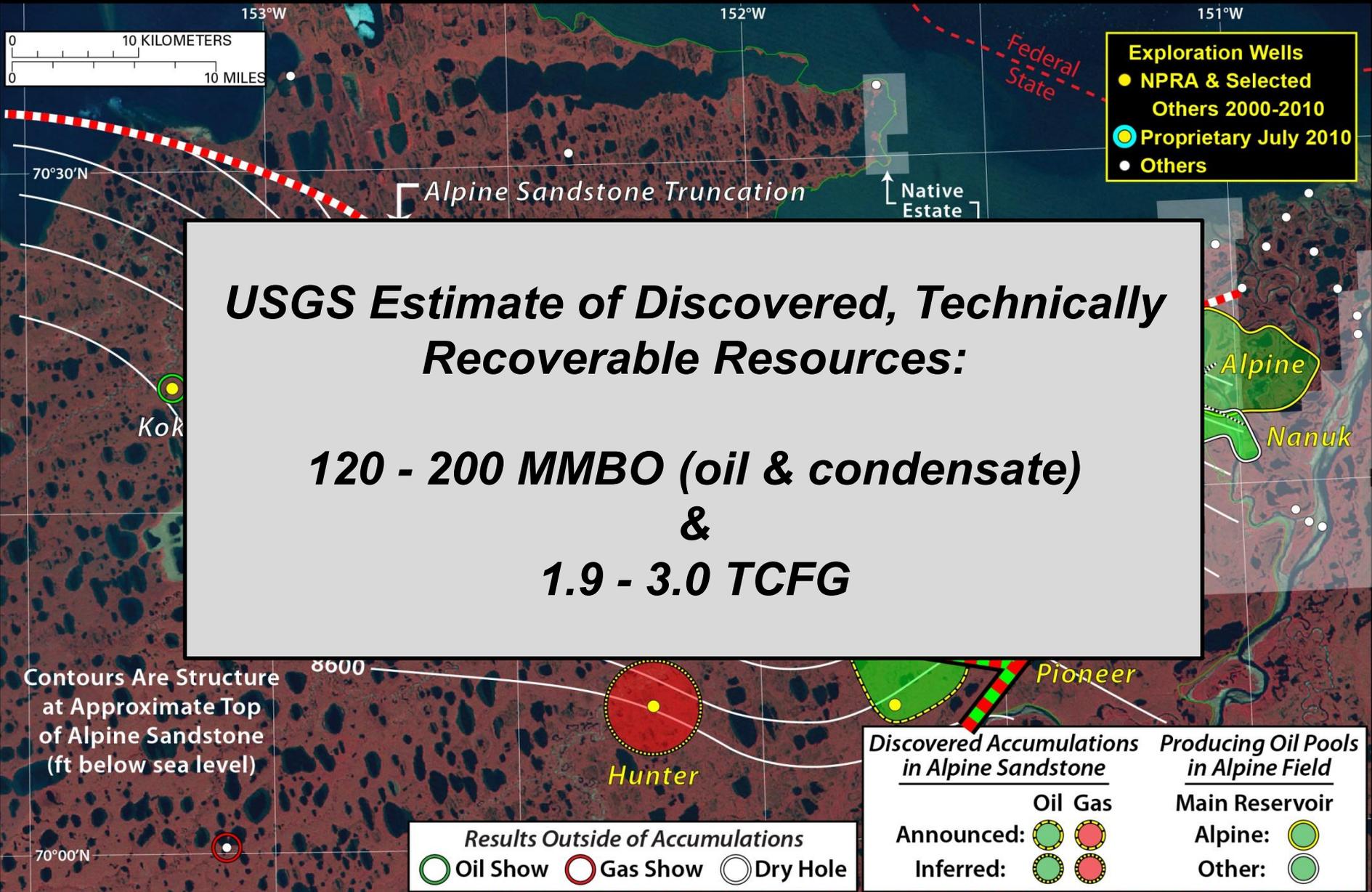
Challenge #2: Hydrocarbon Phase (Oil vs. Gas)



Inferred Exploration Results – Northeastern NPRA



Inferred Exploration Results – Northeastern NPRA



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

Effects of Exhumation on Alpine Play in NPRA

West ← ————— Increased uplift and erosion ← ————— East

*Gas fills reservoir
± oil shows*

*e.g., most tests
west of*

Spark-Rendezvous

*Gas cap + condensate
High GOR*

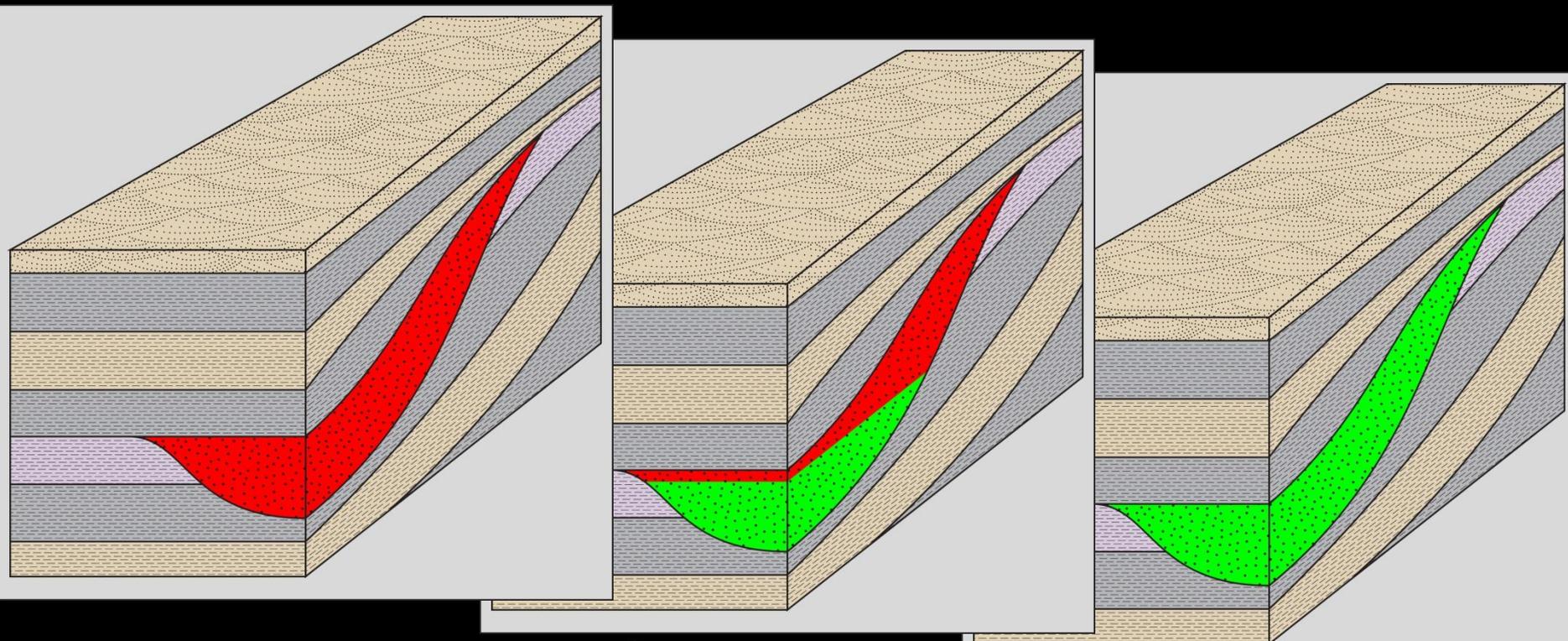
*Oil displaced downdip into
poor quality reservoir*

e.g., Spark-Rendezvous

*Oil fills reservoir
“Low” gravity oil*

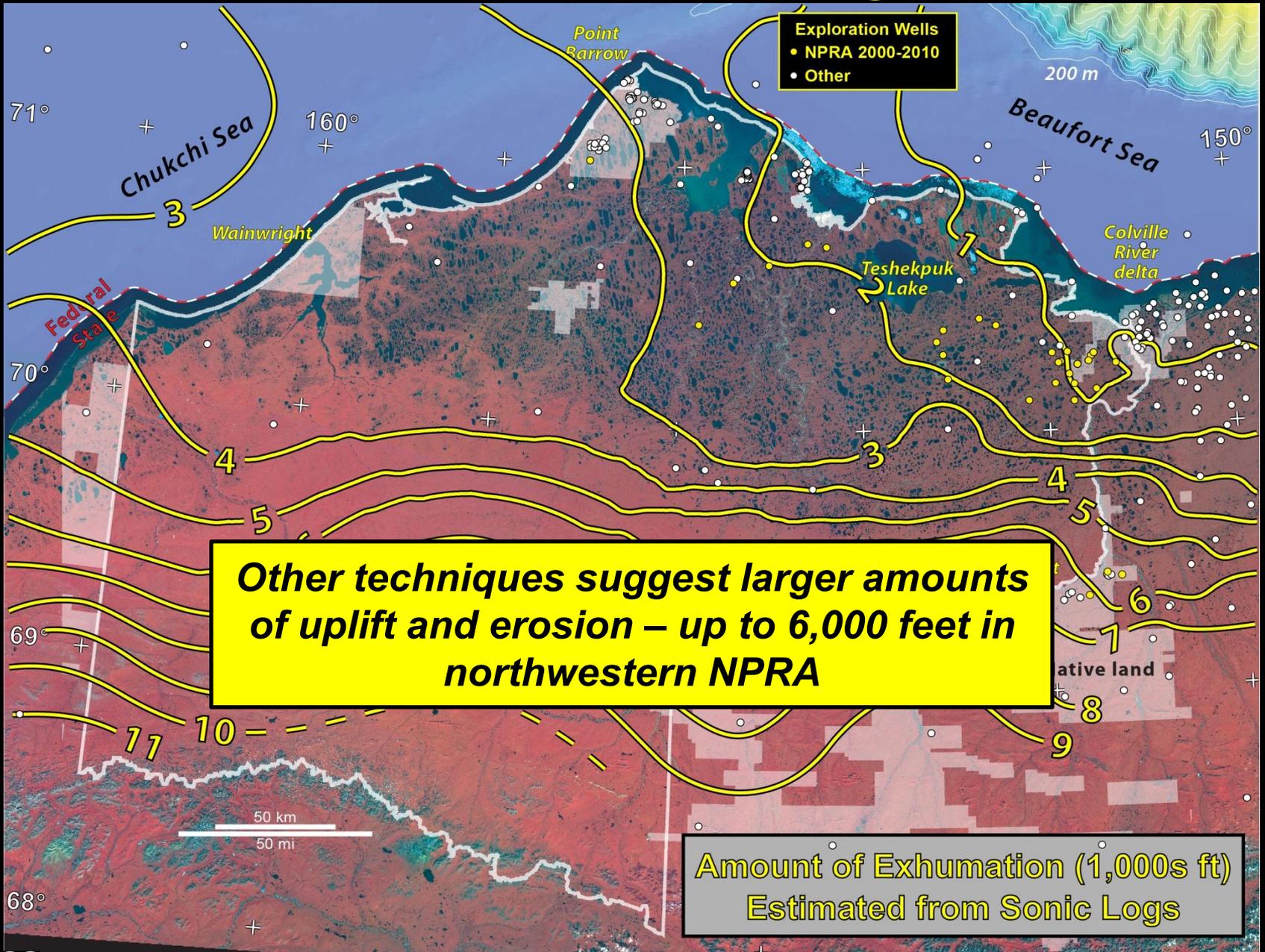
*No gas cap
Low GOR*

e.g., Alpine

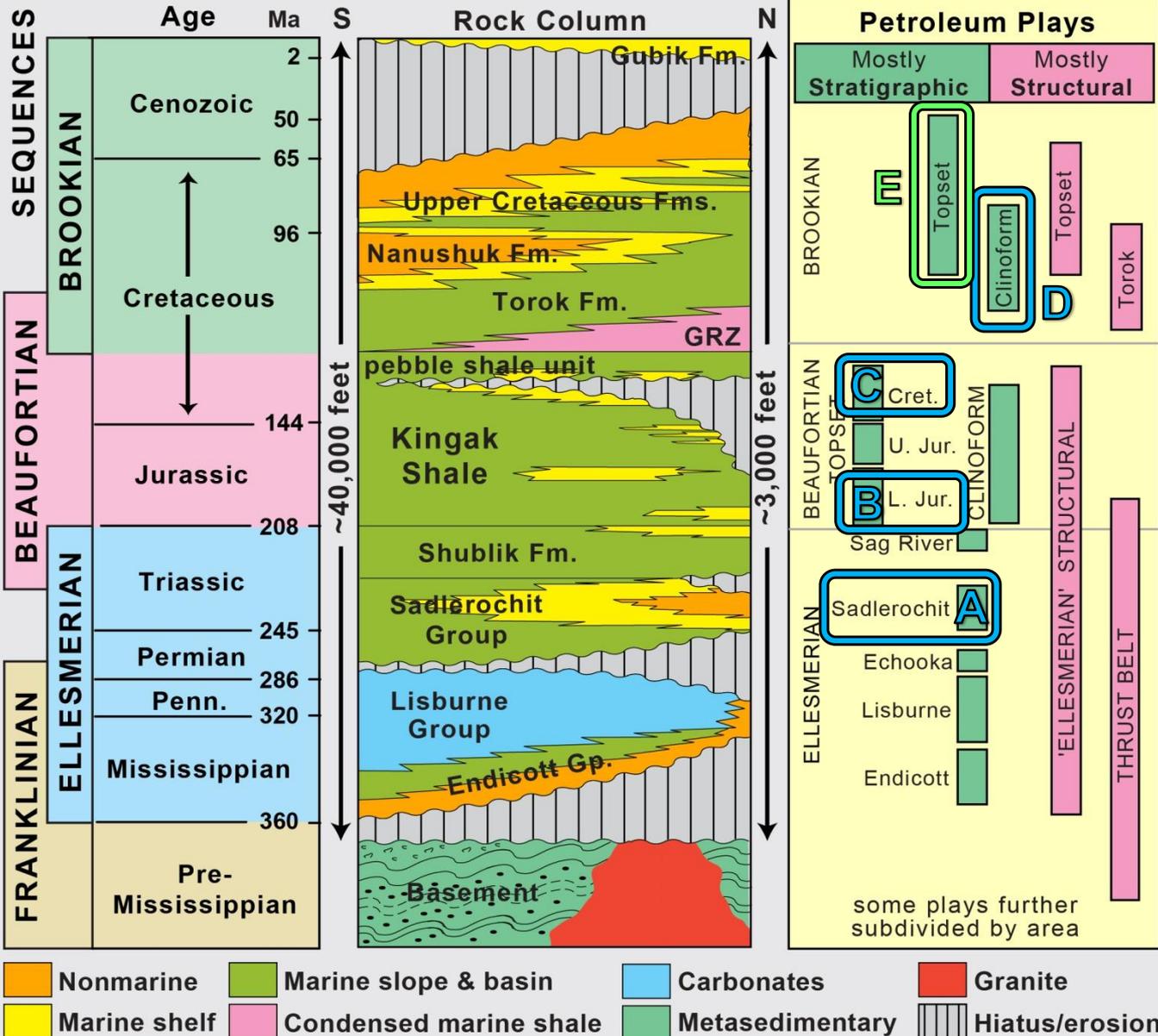


Green, oil; red, gas

Exhumation Estimated from Sonic Logs



NPRA and Nearby Stratigraphy and Petroleum Plays



Other Plays Tested

Primary objectives

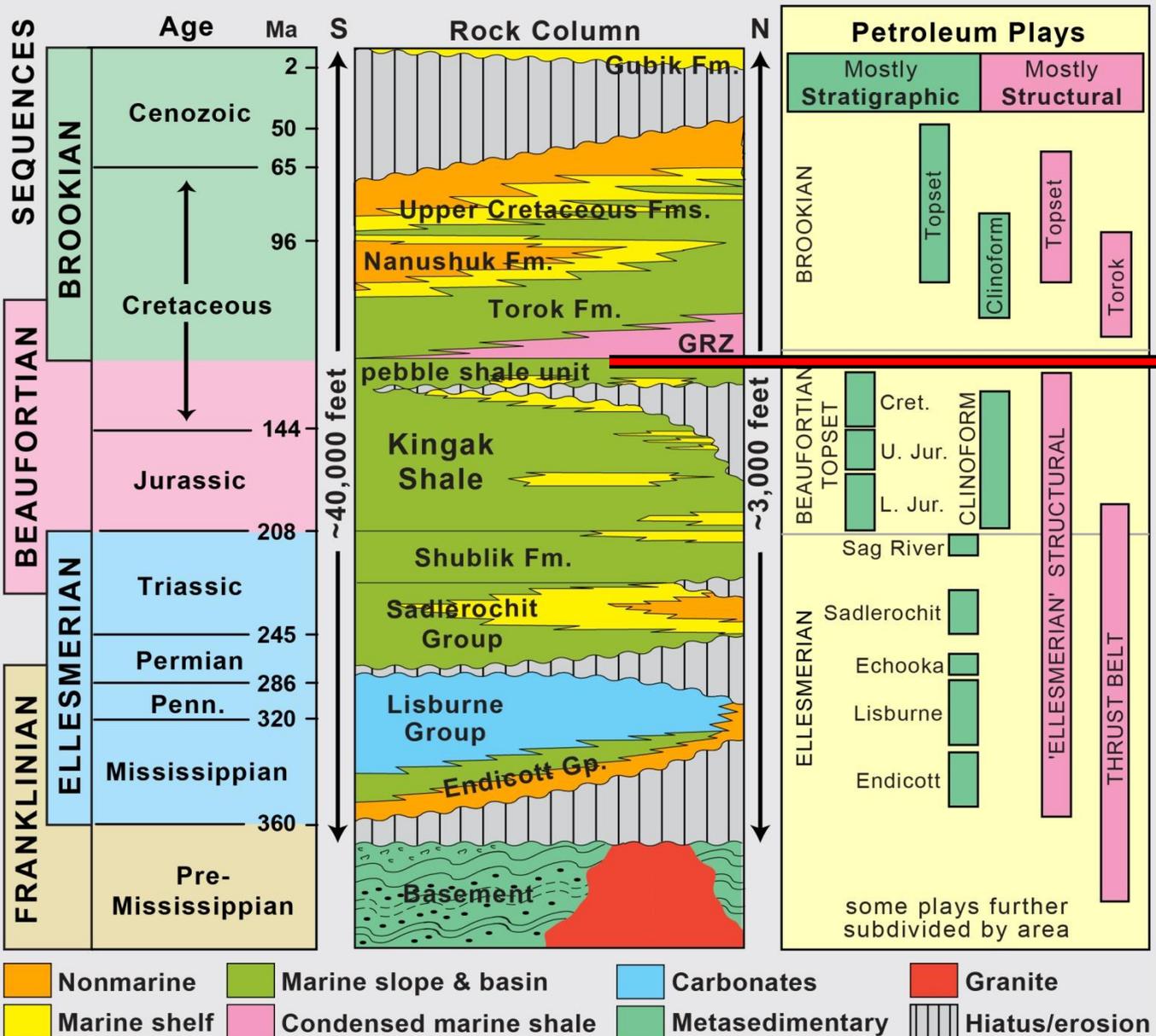
- A** – 1 dry hole
- B** – at least 4 wells; mostly gas
- C** – 2 dry holes
- D** – 2 wells; oil saturated & poor reservoir

Secondary objectives

- E** – at least 2 small oil accumulations

GRZ, gamma-ray zone

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

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

Additional Information

<http://energy.usgs.gov/>

- Fact Sheet
- Slide Presentation
- Other Information

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