# Overview of Recent North Slope Energy Studies

## Part 1: North-Central Foothills, Sagavanirktok River Area

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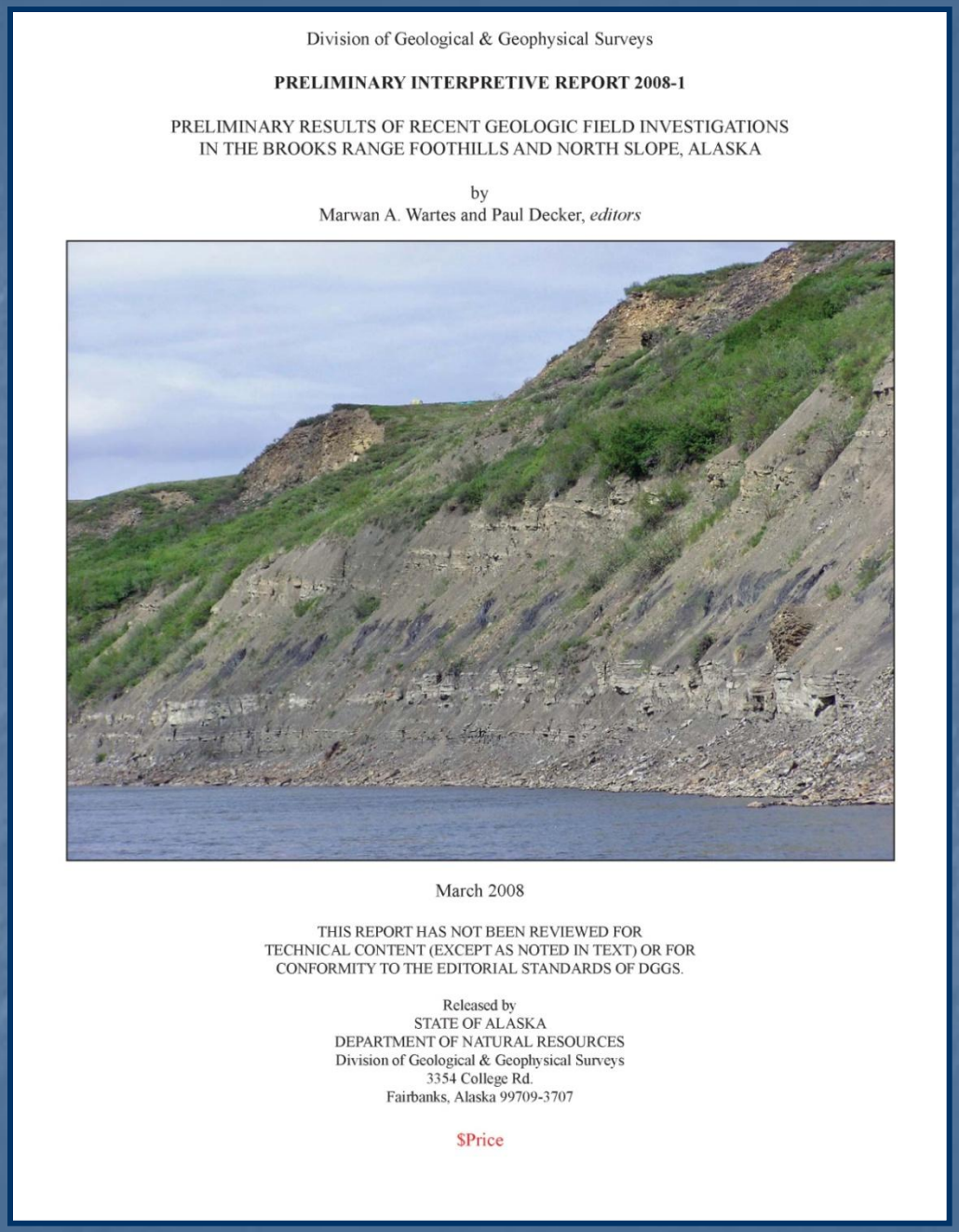
# Newly Published

## DGGS Volume PIR 2008-1

1. Introduction
2. Fortress Mtn – Atigun Syncline
3. Fortress Mtn – Nanushuk thermochronology
4. Nanushuk – Colville River
5. Aupuk Gas Seep
6. Gilead stratigraphy & structure
7. Seabee-Canning-Schrader Bluff – Sagashak Creek



Division of Geological & Geophysical Surveys

**PRELIMINARY INTERPRETIVE REPORT 2008-1**

PRELIMINARY RESULTS OF RECENT GEOLOGIC FIELD INVESTIGATIONS
IN THE BROOKS RANGE FOOTHILLS AND NORTH SLOPE, ALASKA

by
Marwan A. Wartes and Paul Decker, *editors*

March 2008

THIS REPORT HAS NOT BEEN REVIEWED FOR
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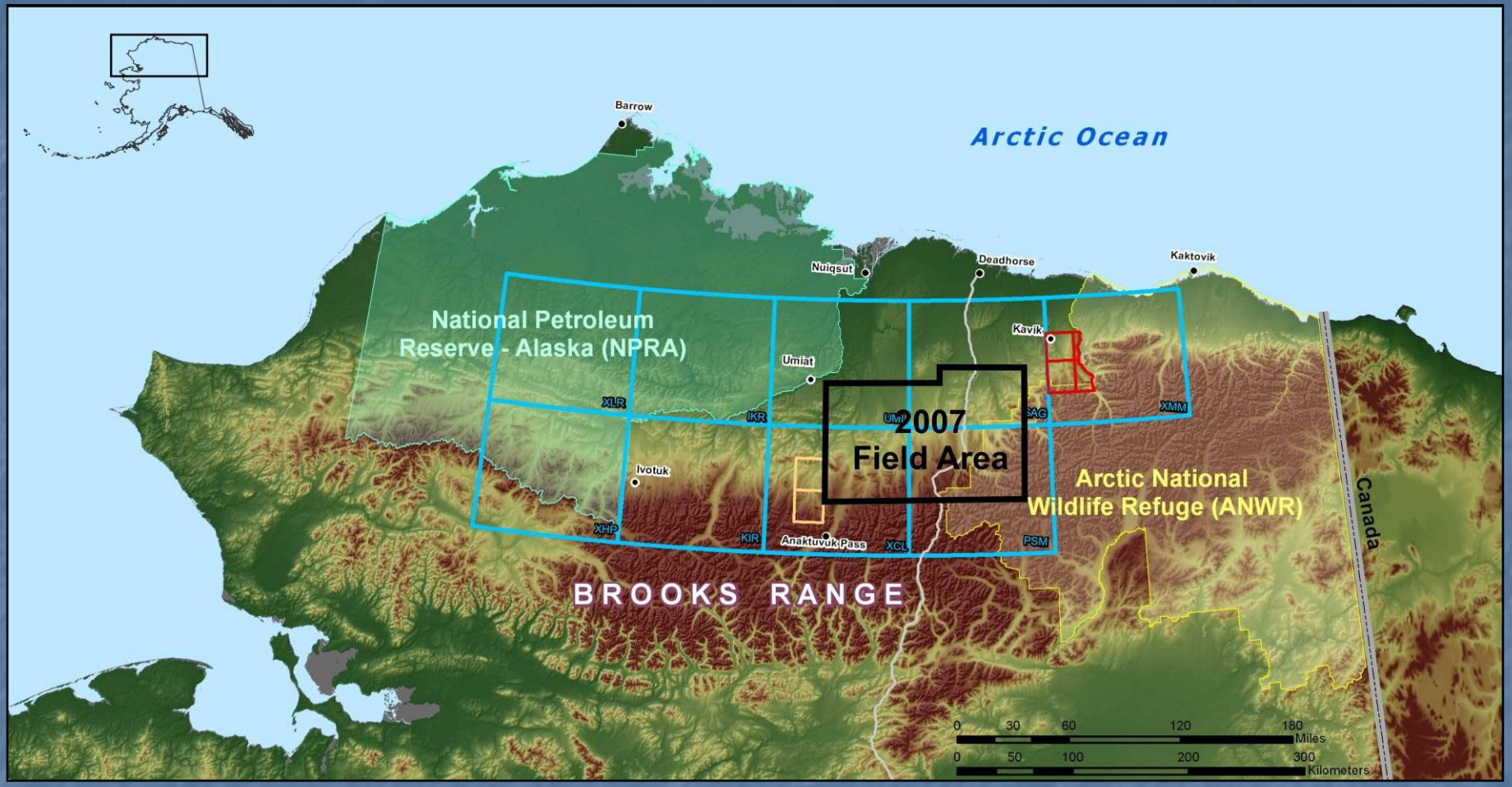
# Recent North Slope Energy Program Activity



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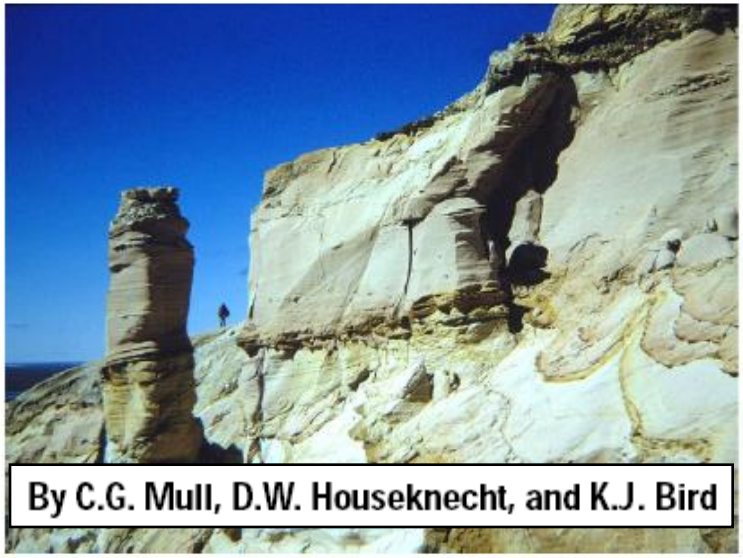
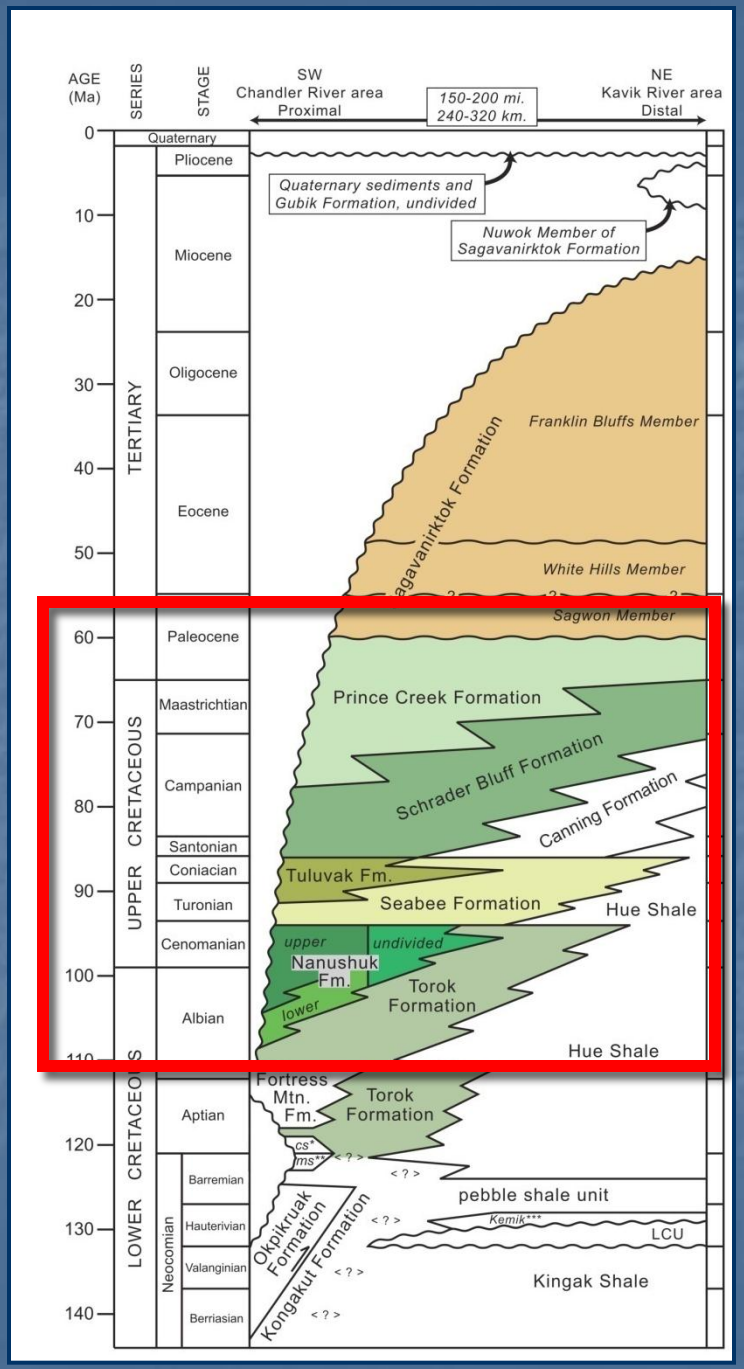
# Revised Cretaceous and Tertiary Stratigraphic Nomenclature in the Colville Basin, Northern Alaska

U.S. GEOLOGICAL SURVEY PROFESSIONAL PAPER 1673

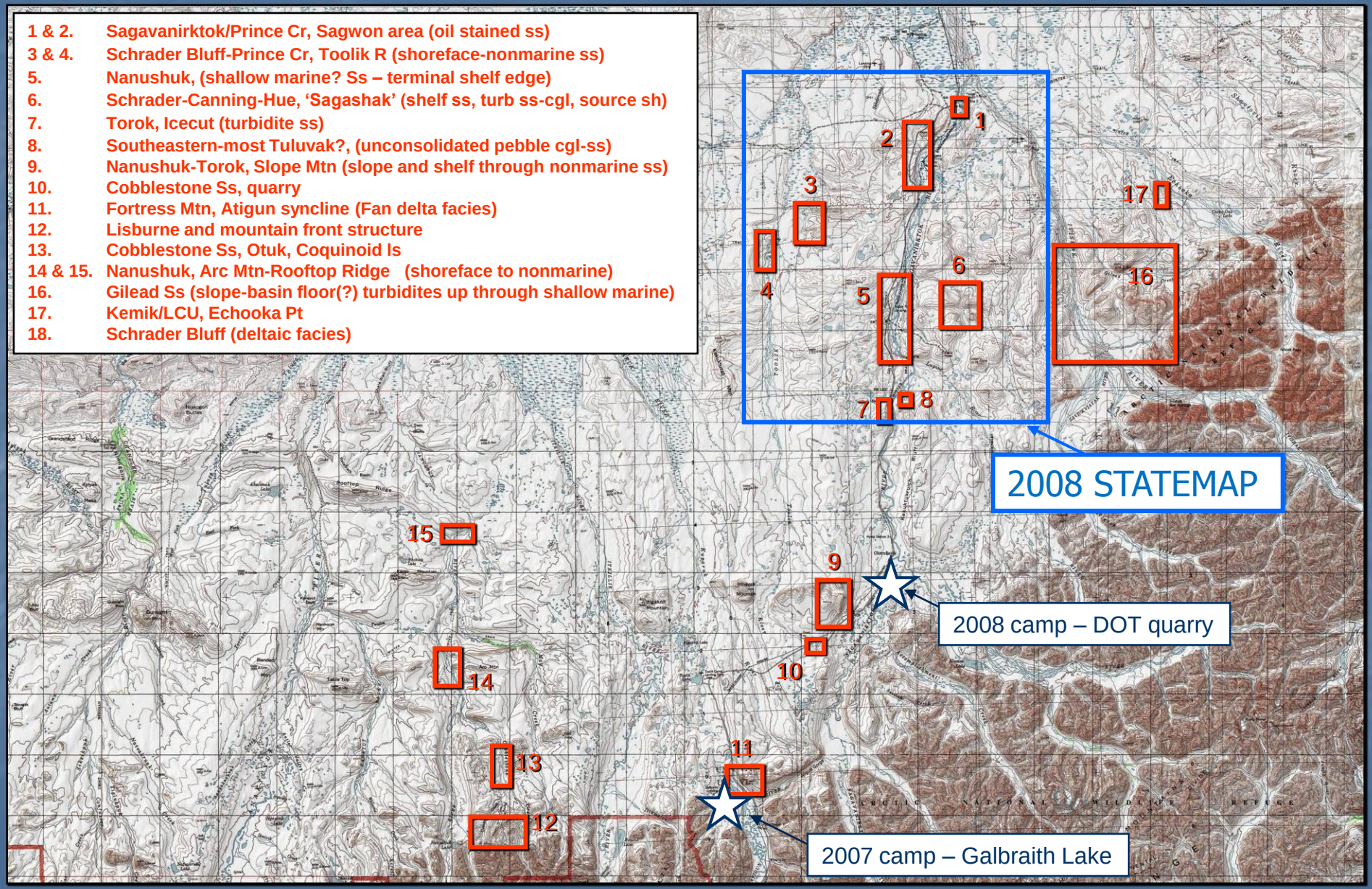


By C.G. Mull, D.W. Houseknecht, and K.J. Bird

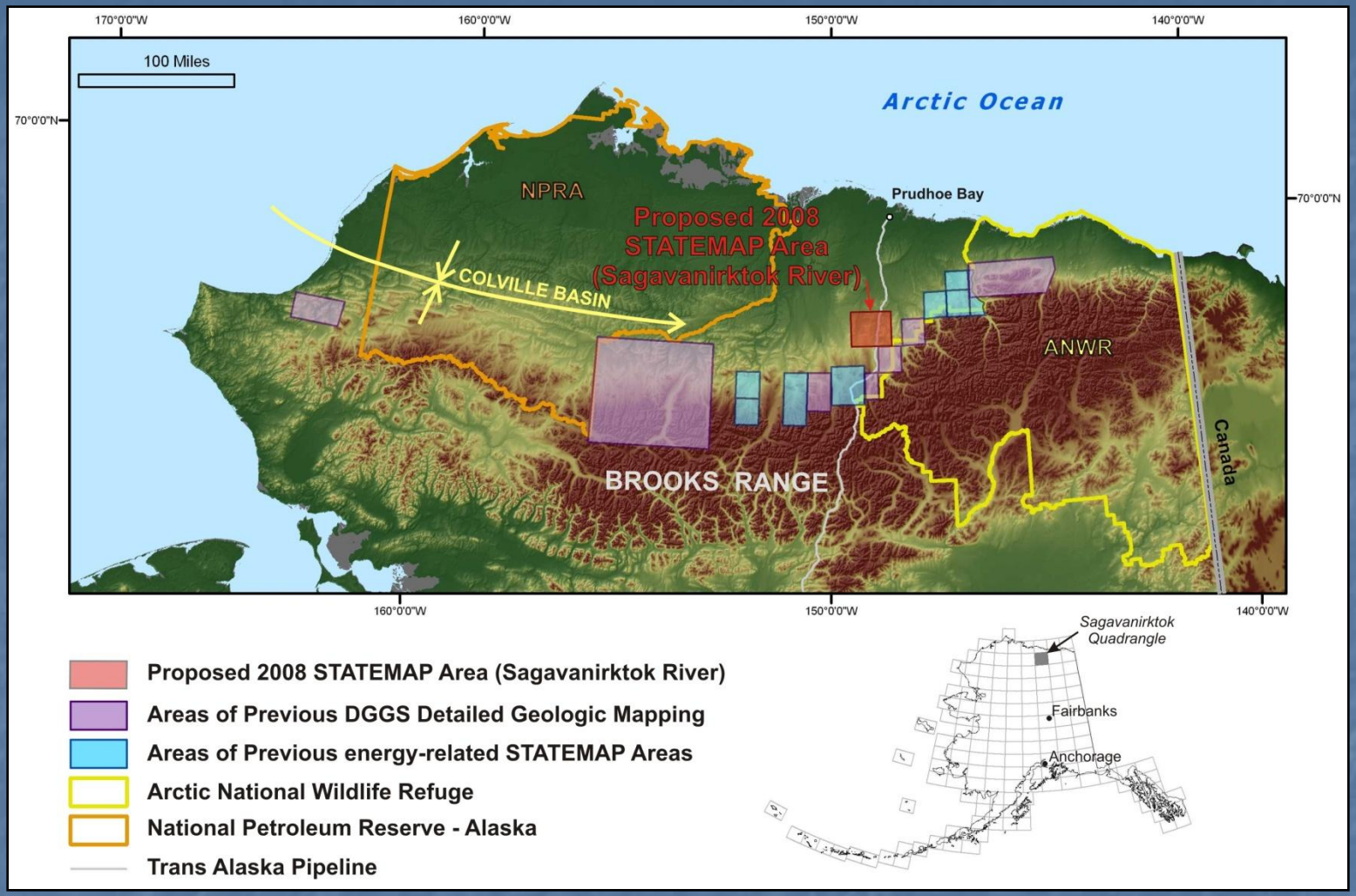



- 2007-08 Sagavanirktok River project area encompasses much of the Brookian stratigraphy revised by Mull and others, 2003

# 2007-08 Areas of Stratigraphic Interest

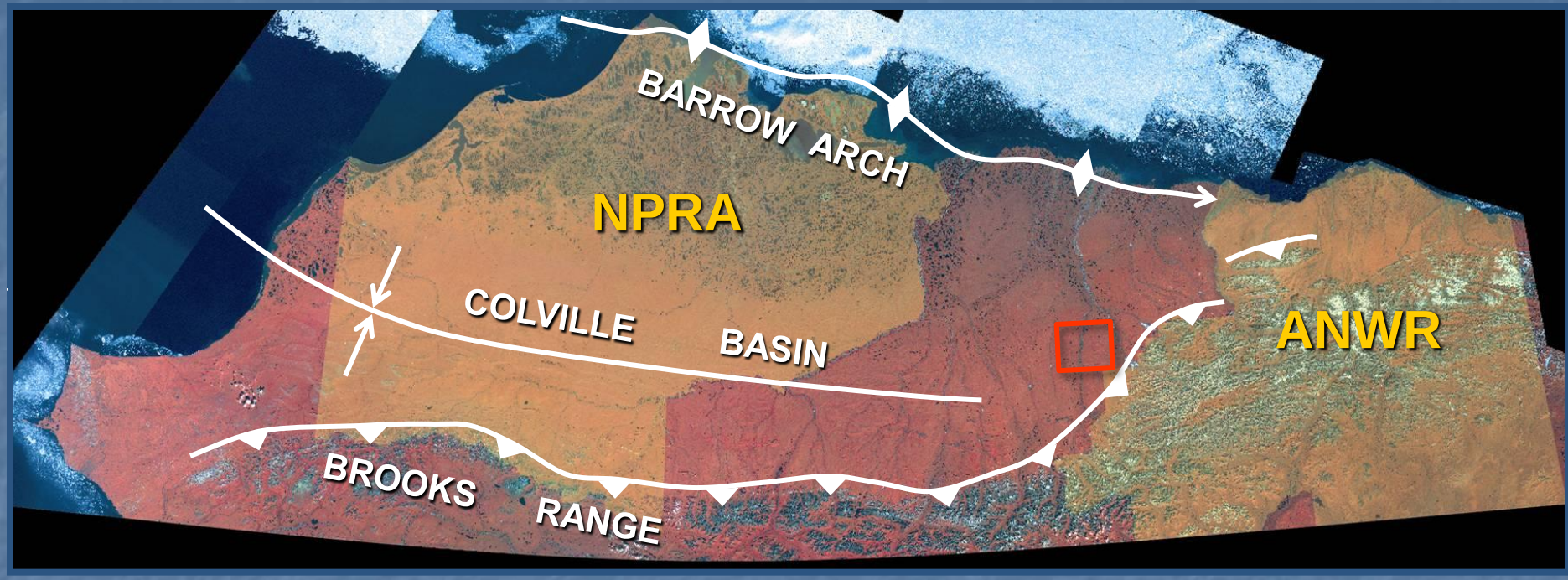


# 2008 STATEMAP and Previous DGGS Mapping




- Most Brookian units exposed within and near 2008 mapping area
- Proposed area situated in a key location for investigating fundamental genetic relationships within the upper parts of the Brookian megasequence

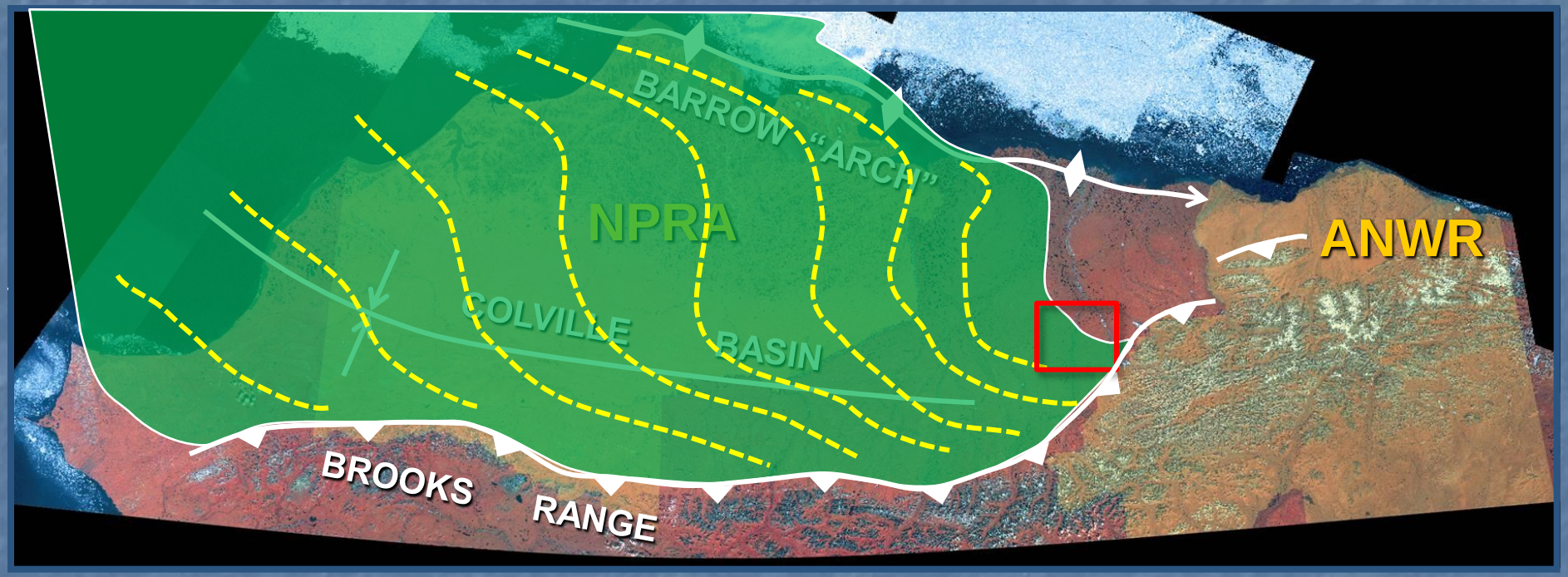
# Sagavanirktok River STATEMAP
# Project objectives




- **Define regionally mappable Brookian units using the new nomenclature of Mull and others, 2003 based on genetically related rocks** (may be different than Brookian to NW)
- **Link a growing subsurface dataset and body of interpretations with surface mapping, detailed sedimentology and stratigraphy** (map near well and seismic control)
- **Compare/contrast genetically related shallow to deep water Brookian facies exposed within a relatively compact area**
- **Develop a better understanding of structural style, deformation sequence, and mechanical stratigraphy in Brookian rocks**

# Colville Foreland Basin Tectonostratigraphic Setting

## Sagavanirktok River Project Area

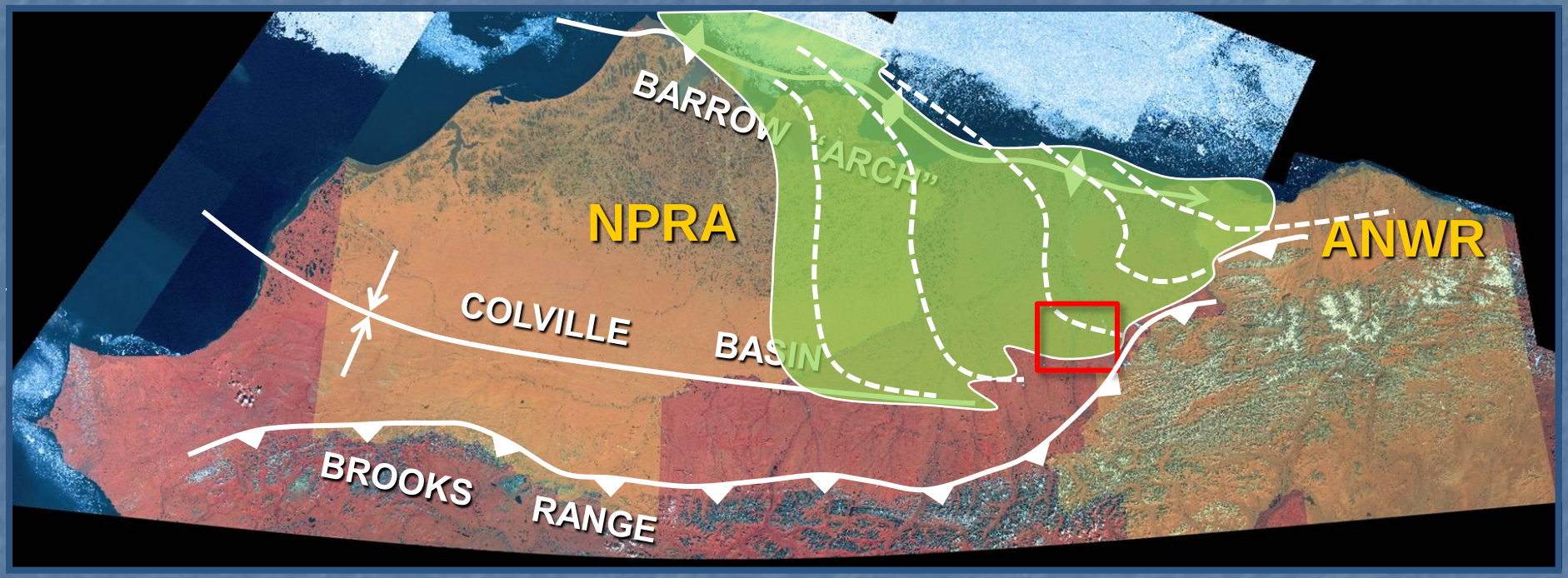



**Lower Brookian basin fill: Early to middle Cretaceous**

(Okpikruak-Fortress Mtn-Nanushuk-Torok)

# Colville Foreland Basin Tectonostratigraphic Setting

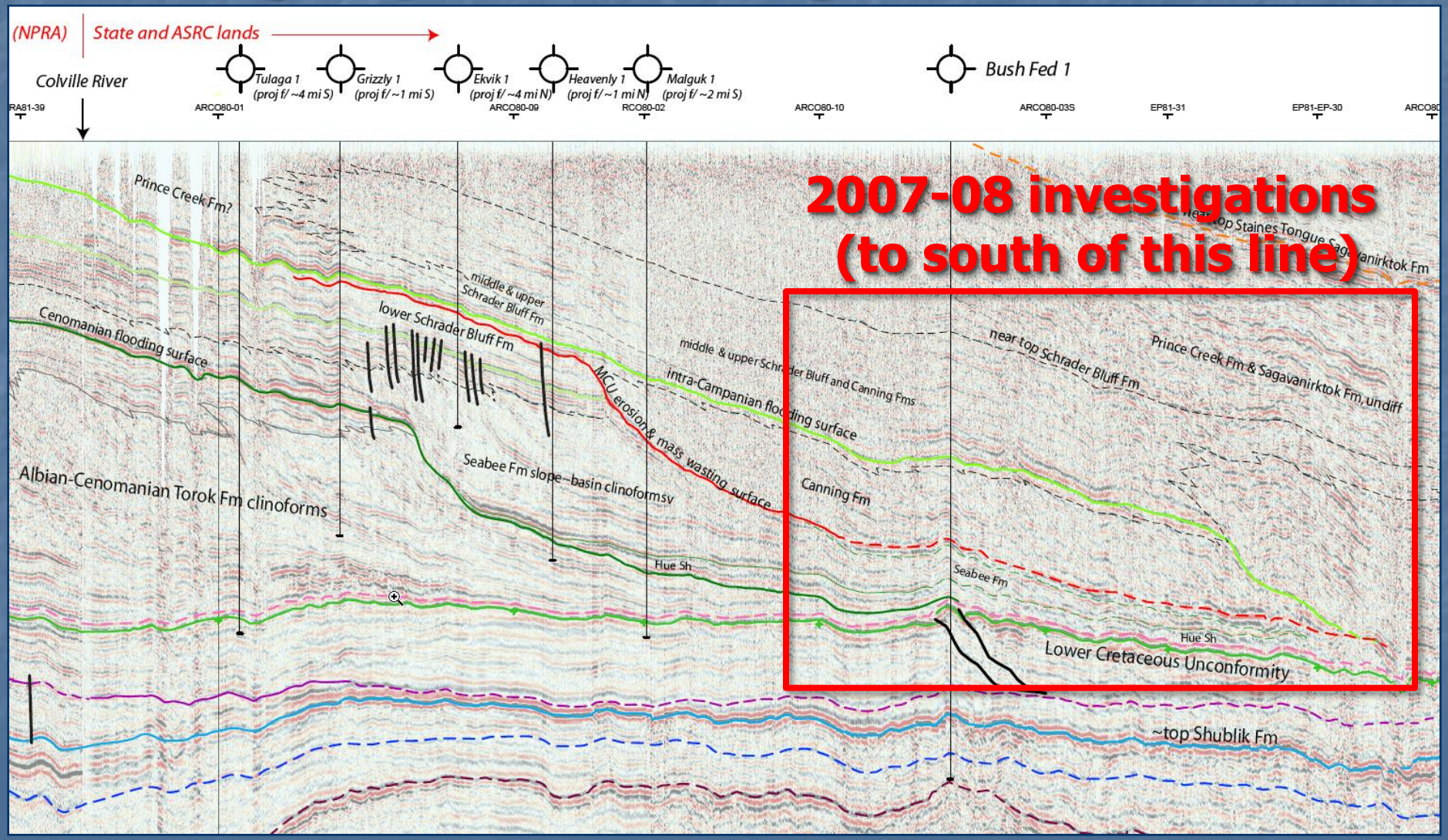
## Sagavanirktok River Project Area



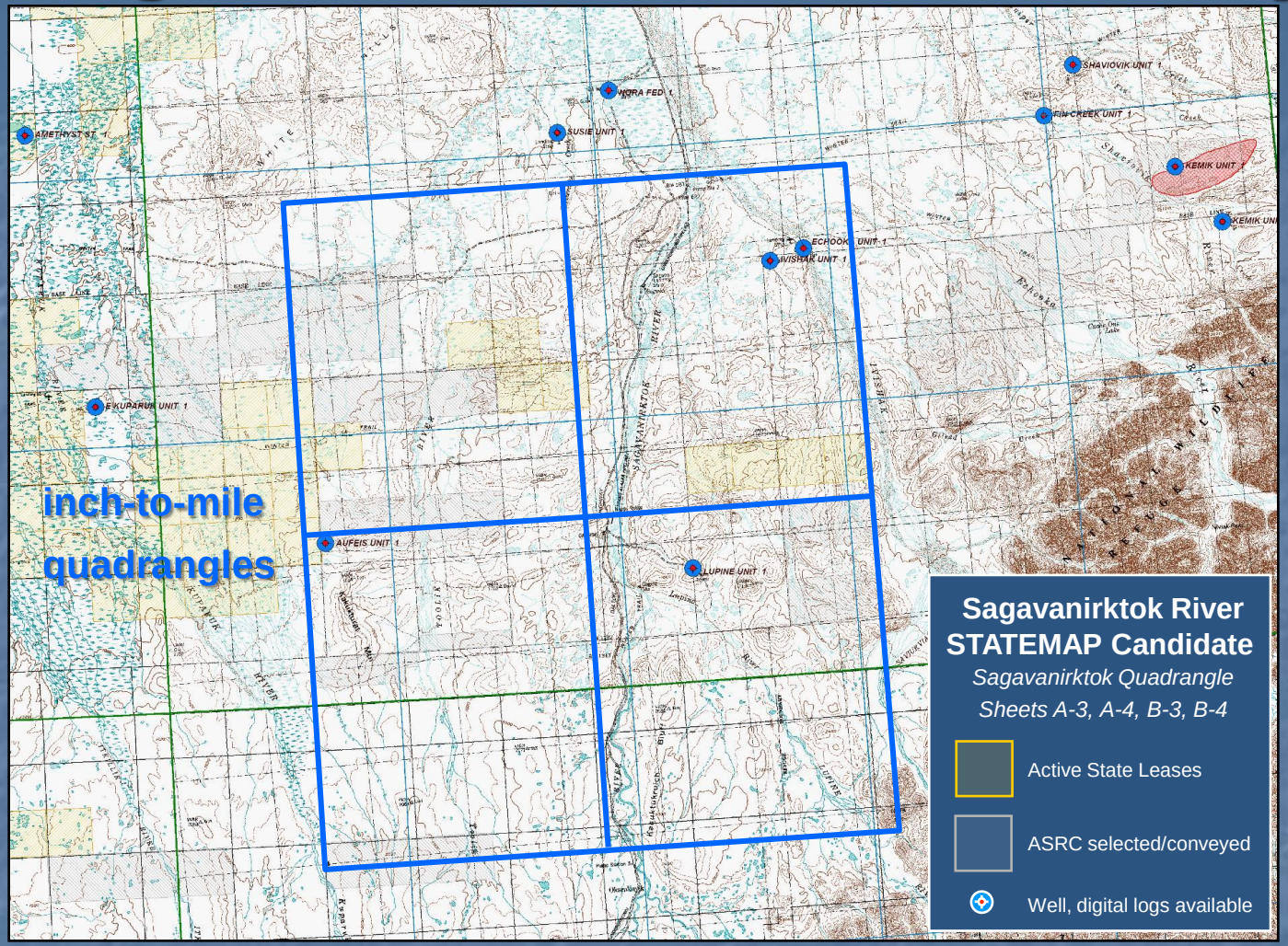

**Middle & Upper Brookian basin fill: middle Cretaceous to Tertiary**

(Tuluvak-Seabee → Prince Creek-Schrader Bluff-Canning → Sagavanirktok-Canning)

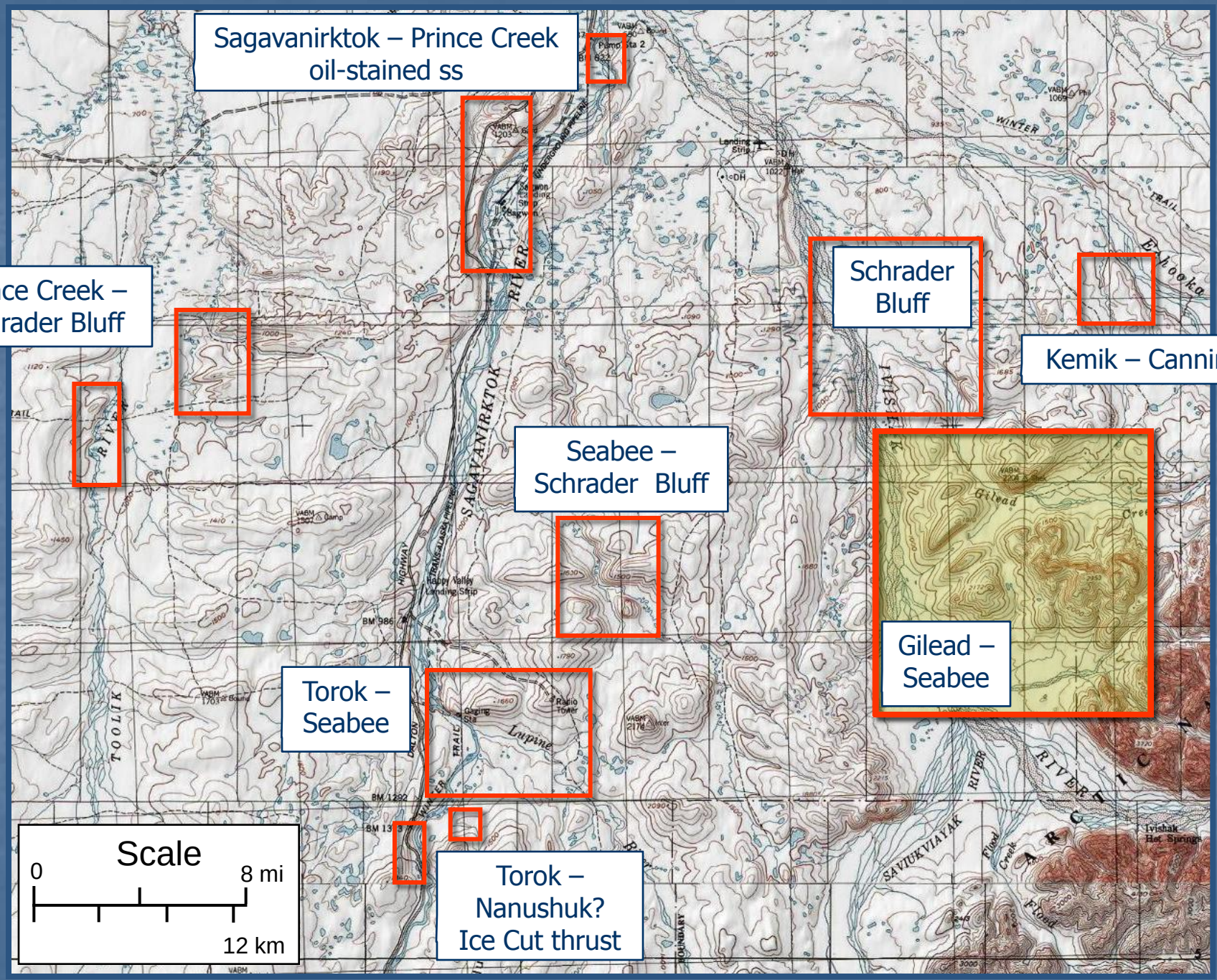
# West-East Brookian Stratigraphic Changes



# 2008 Sagavanirktok River STATEMAP Project

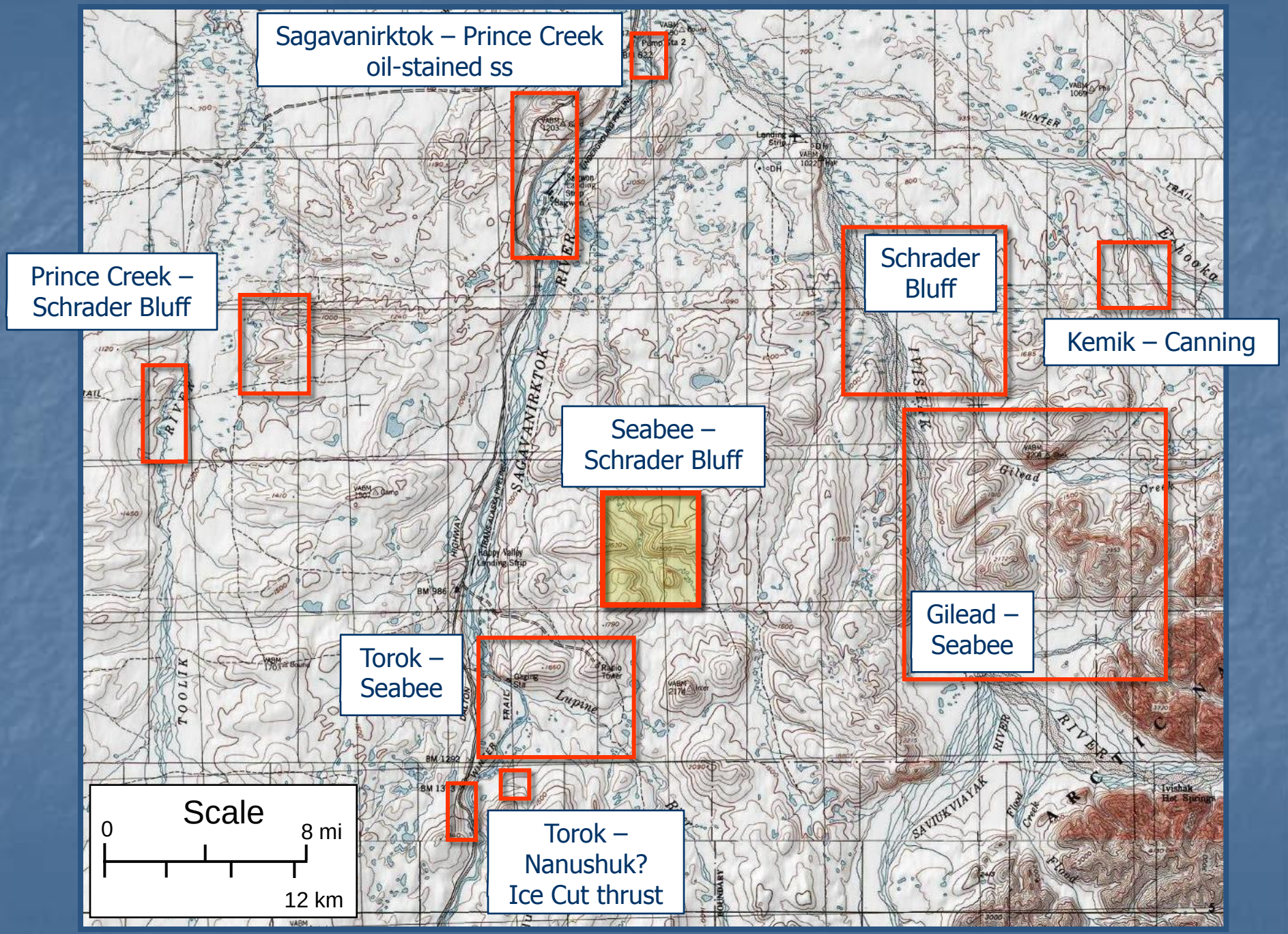



- Surface mapping based on drainage-cut exposures, traceable ridge-forming markers
- Mapping will integrate seismic & well interpretations to extend outcrop data into covered areas and ensure map patterns reflect genetic relationships, not simply lithology
- Build upon 2007 stratigraphic learnings and existing preliminary 1:250,000 mapping (Mull)


Sagavanirktok – Prince Creek oil-stained ss
Prince Creek – Schrader Bluff
Schrader Bluff
Kemik – Canning
Seabee – Schrader Bluff
Gilead – Seabee
Torok – Seabee
Torok – Nanushuk? Ice Cut thrust
Scale
0
8 mi
12 km

# 2007 Tour: Gilead Ss (~Torok eq) – Ivishak River

- Albian(?) sediment gravity flows – largely deepwater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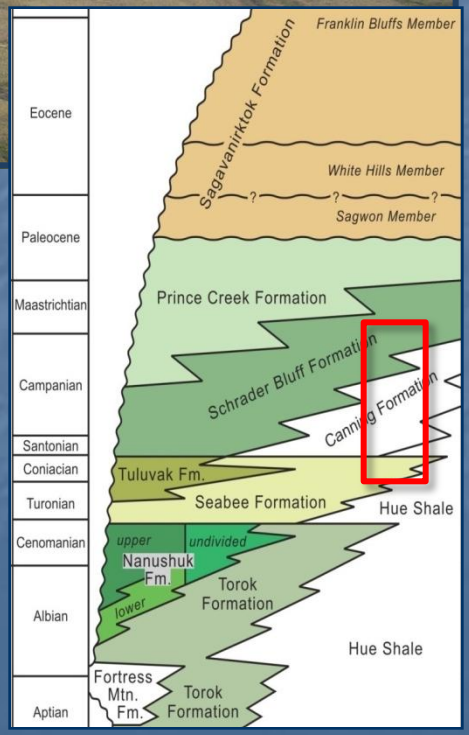
Torok – Seabee
Torok – Nanushuk? Ice Cut thrust
Scale
0
8 mi
12 km

# 2007 Tour: Seabee & Canning Fms --“Sagashak Ck”

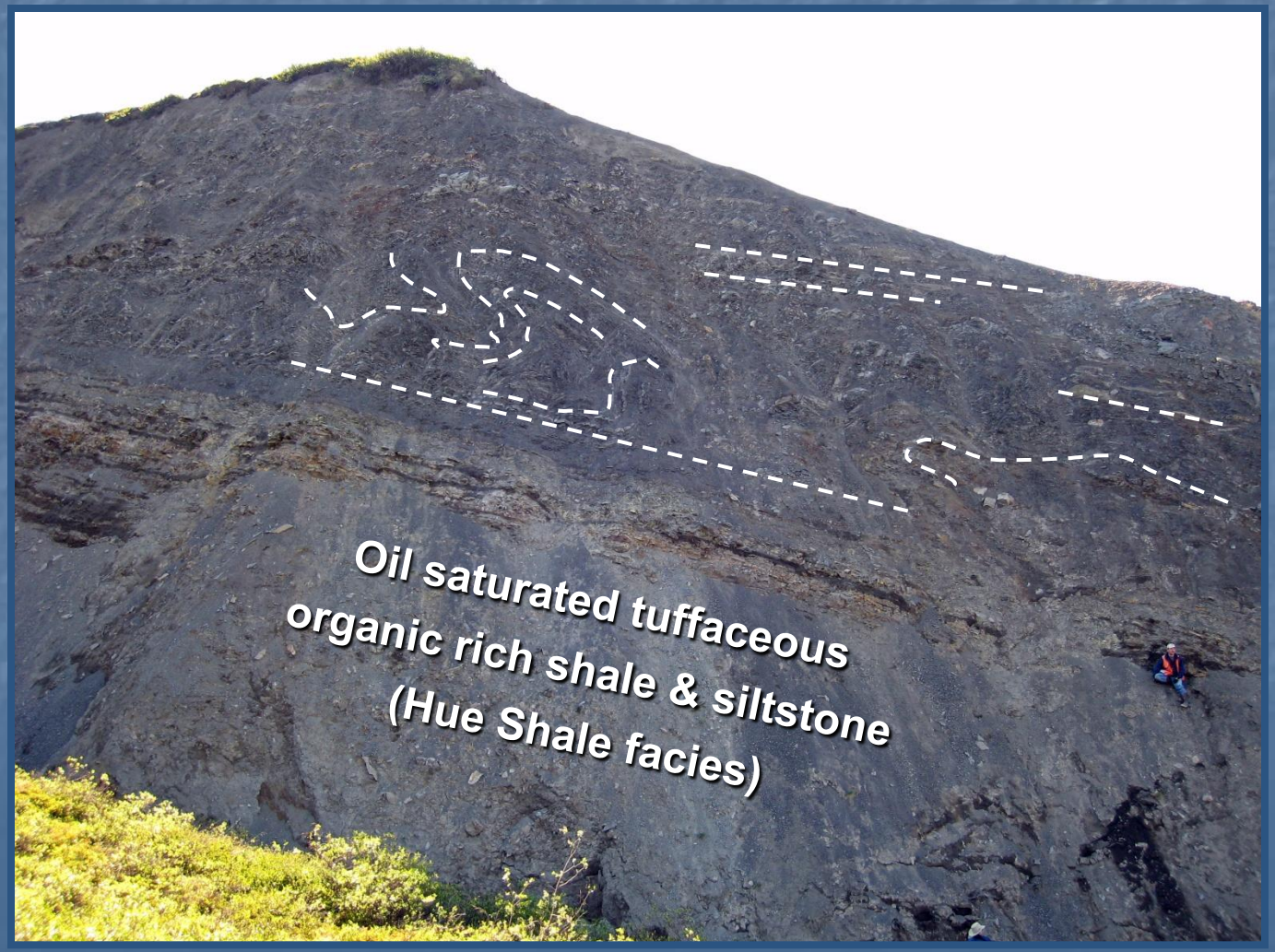
- South limb of Aufeis anticline (east of Sagavanirktok River)

# 2007 Tour: Seabee, Hue Shale facies, & Canning Fms

## "Sagashak Creek"

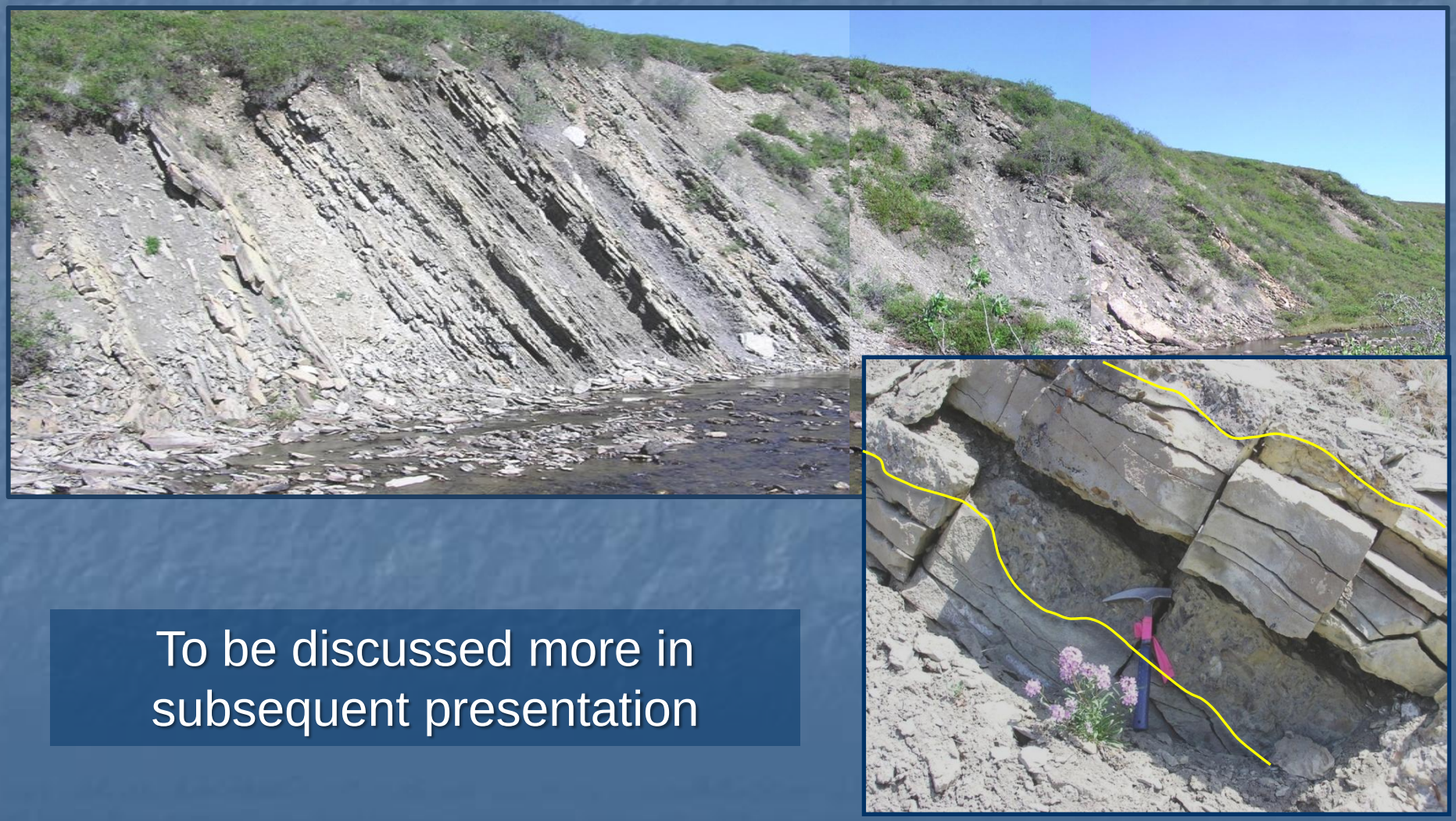
- Turonian-Santonian to early Campanian(?) turbidites
- Tuffaceous, oil saturated interval (complex structure)



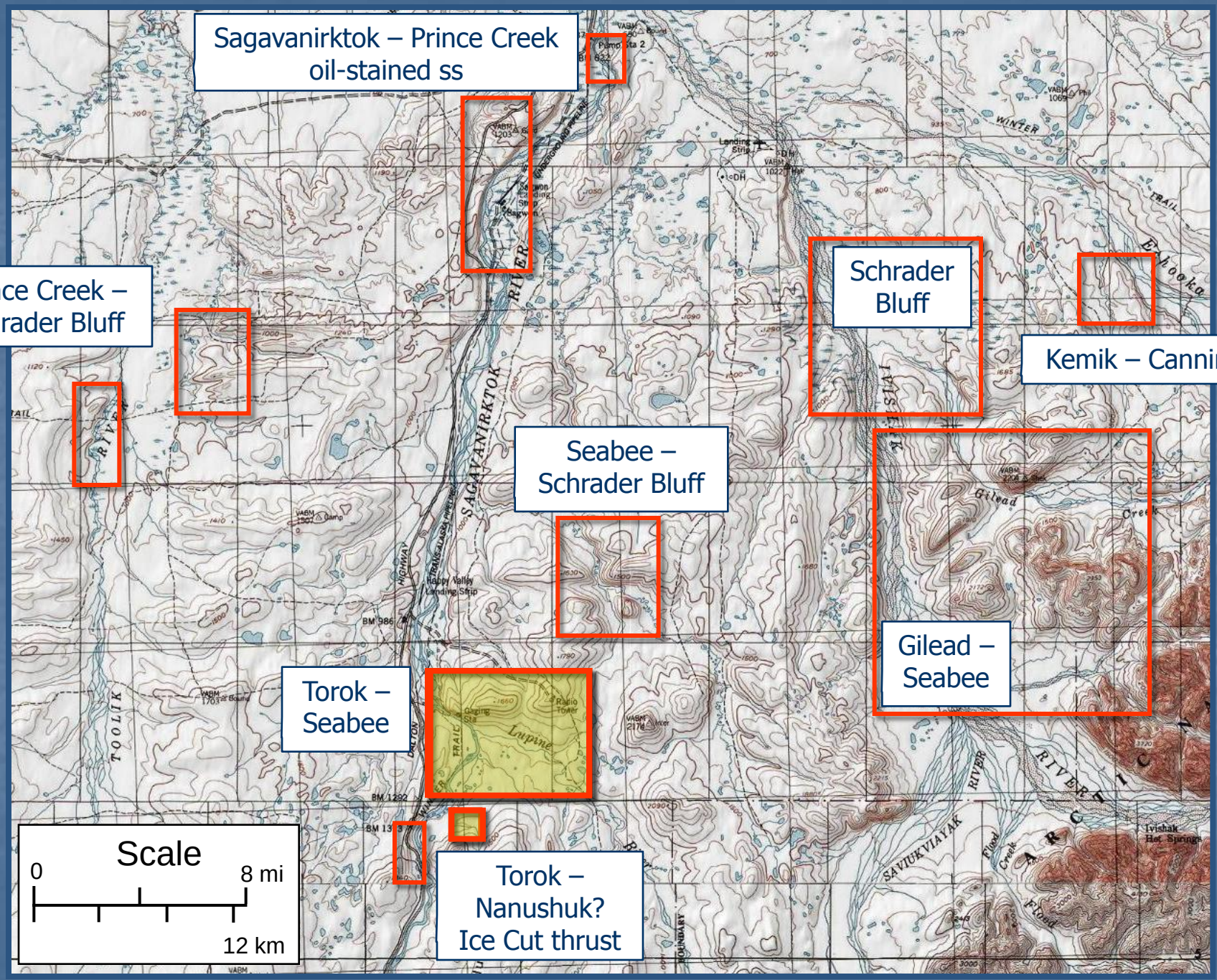

Probable deepwater slump failure deposit, "MCU" or slightly older mass wasting event

# 2007 Tour: Canning Formation -- “Sagashak Creek”

- Campanian turbidites: thin bedded and amalgamated facies
- Channelized pebble-cobble conglomerate sediment gravity flows



To be discussed more in subsequent presentation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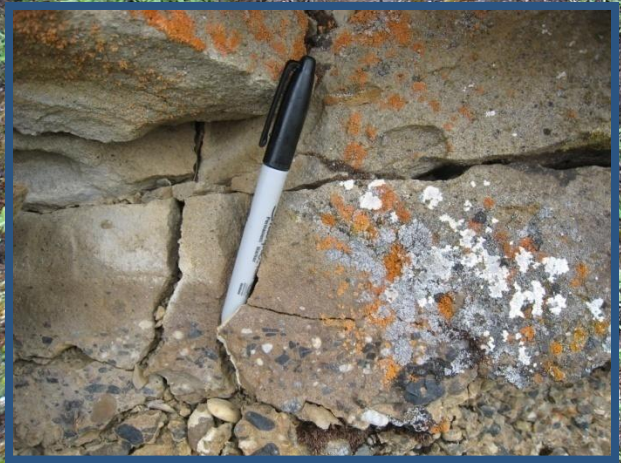
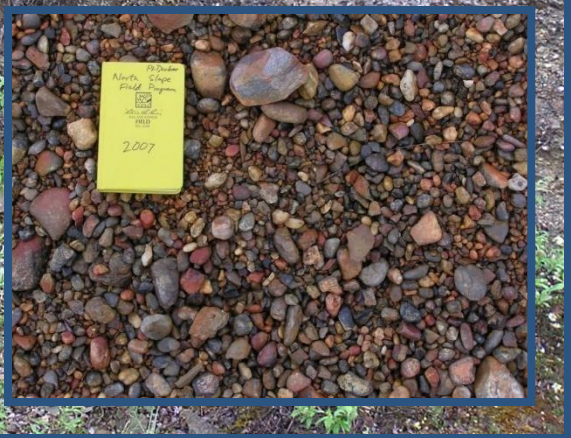
Torok – Nanushuk? Ice Cut thrust
Scale
0
8 mi
12 km

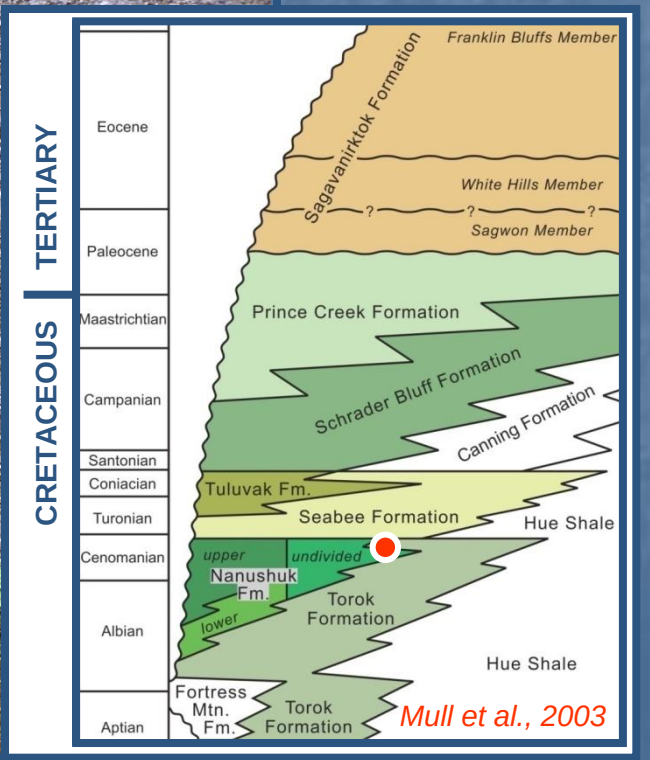
# 2007 Tour: Nanushuk(?) Fm – NE of Ice Cut

- **Is this really Nanushuk Fm? If so, would place the terminal Nanushuk shelf-edge much farther north than placed by recent USGS work***





* *D. Houseknecht, 2008, personal communication*



# 2007 Tour: Nanushuk(?) Fm – NE of Ice Cut

- Is this really Nanushuk Fm? If so, would place the terminal Nanushuk shelf-edge much farther north than placed by recent USGS work*

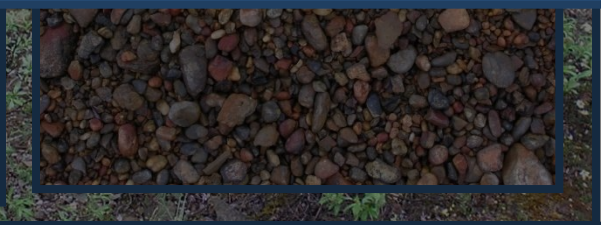
## Stratigraphic Alternatives:

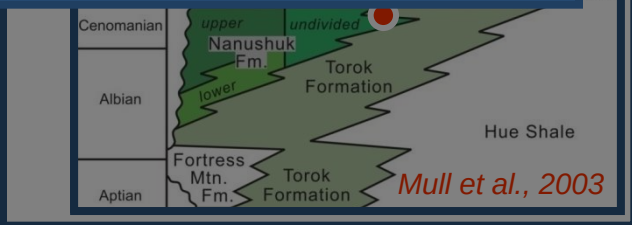
• Torok Fm deepwater? → Wow! Heaven…

• Tuluvak Fm fluvial? → SE-most; Why such different composition than Turonian conglomerates just to north?

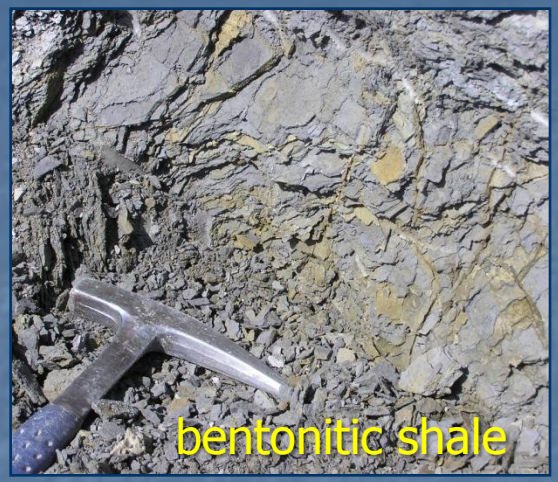
• Seabee Fm deepwater? → again, why so different?

• Canning Fm deepwater or equivalent proximal facies ? → along with Sagashak Creek deepwater conglomerates, more evidence of coarse southern facies – could also fit stratigraphically/structurally



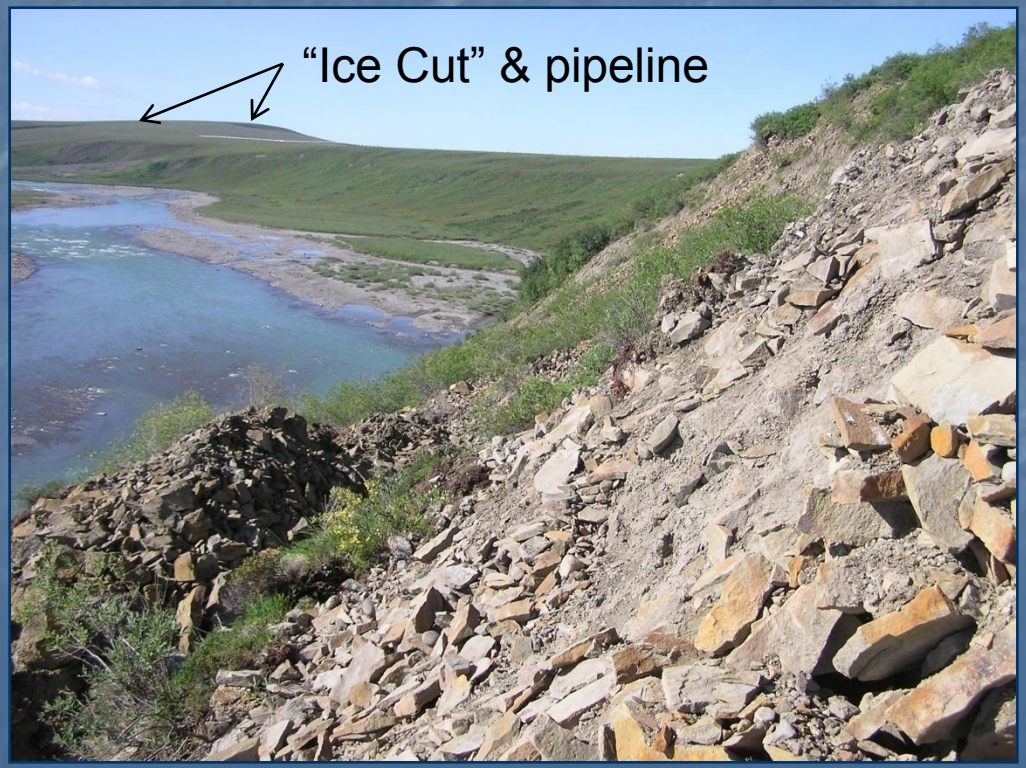


# **Ice Cut area landslide:** Seabee Fm

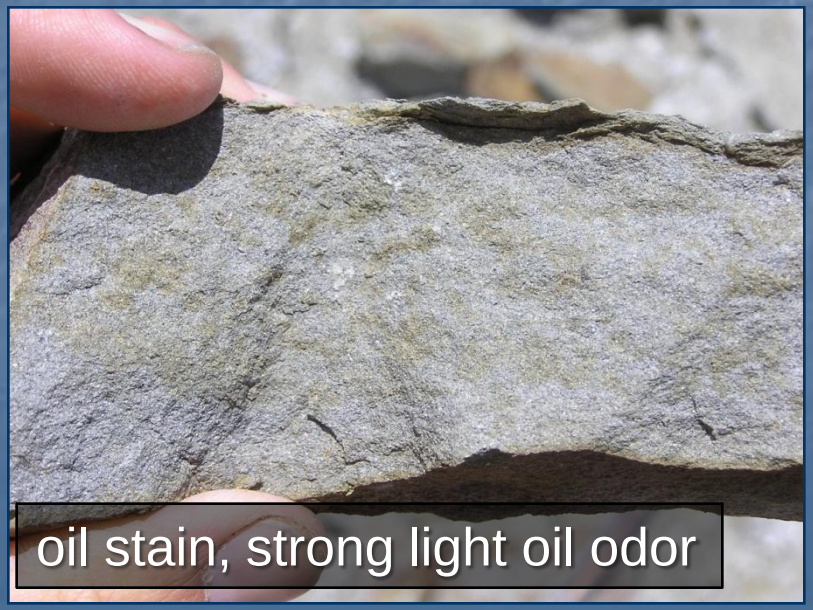

Ammonite


*Scaphites delicatulus* Warren
(uppermost Cenomanian – lower Turonian)




# **Ice Cut area landslide:** Seabee Fm



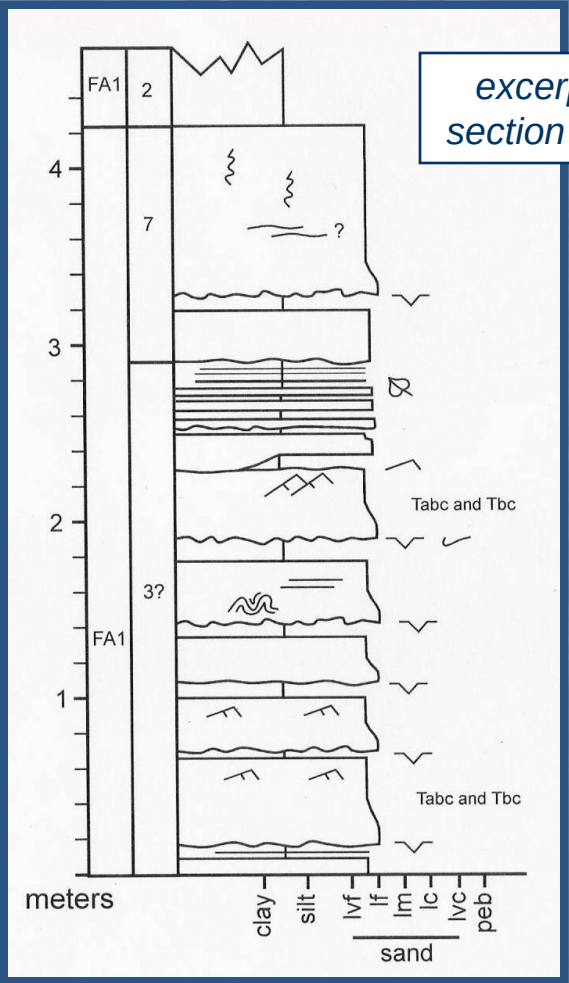



# **Ice Cut area landslide:** Seabee Fm

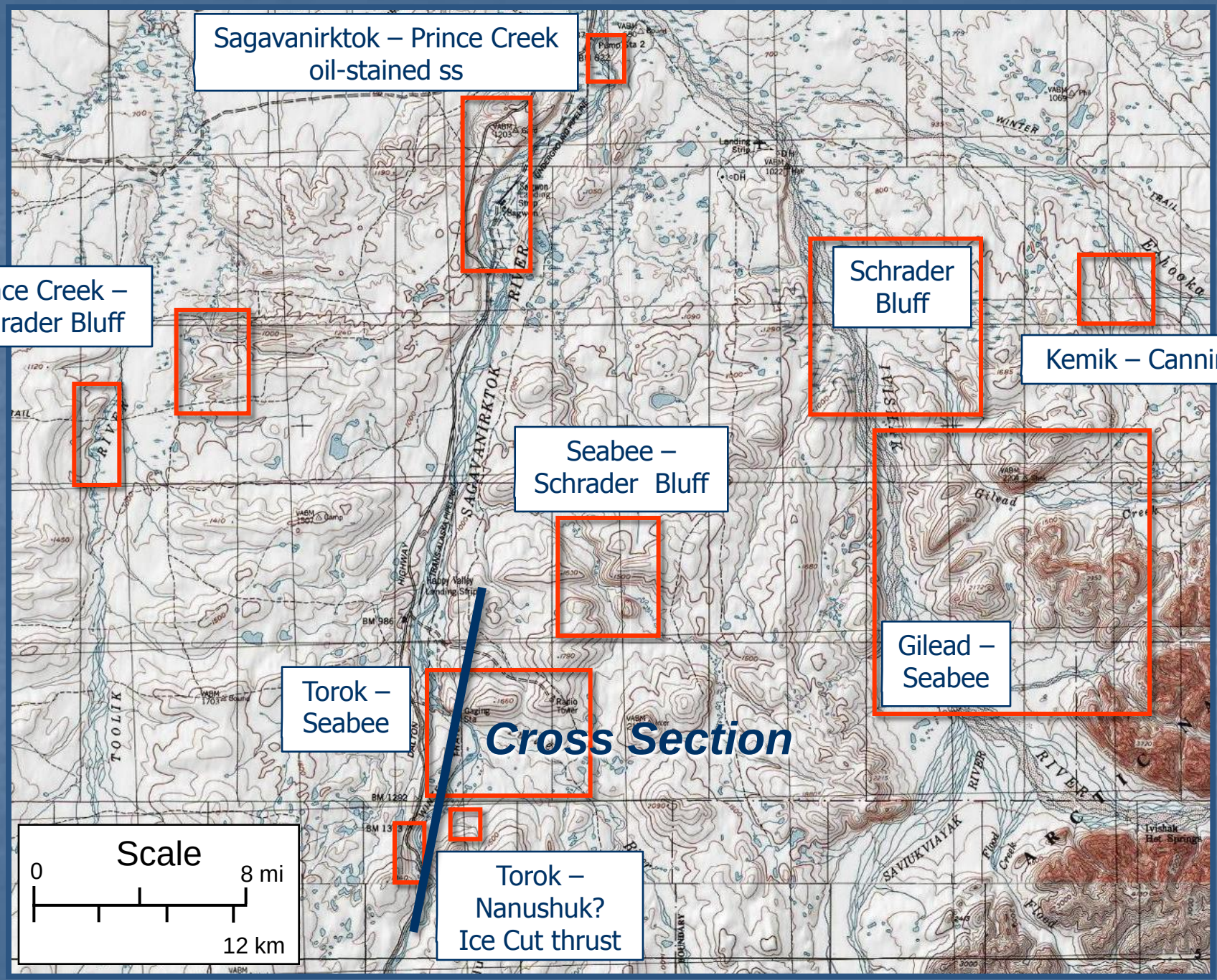
# 2007 Tour: Torok (+Seabee?) Fms

## Sagavanirktok River / Lupine River confluence ("Lupivanirktok")

- Sediment gravity flows (amalgamated) mostly below storm wave base
- Significant bentonitic mudstone package
- Correlation to Lupine well above ~1500' MD




*excerpt from 340 m measured section (LePain & Kirkham, 2001)*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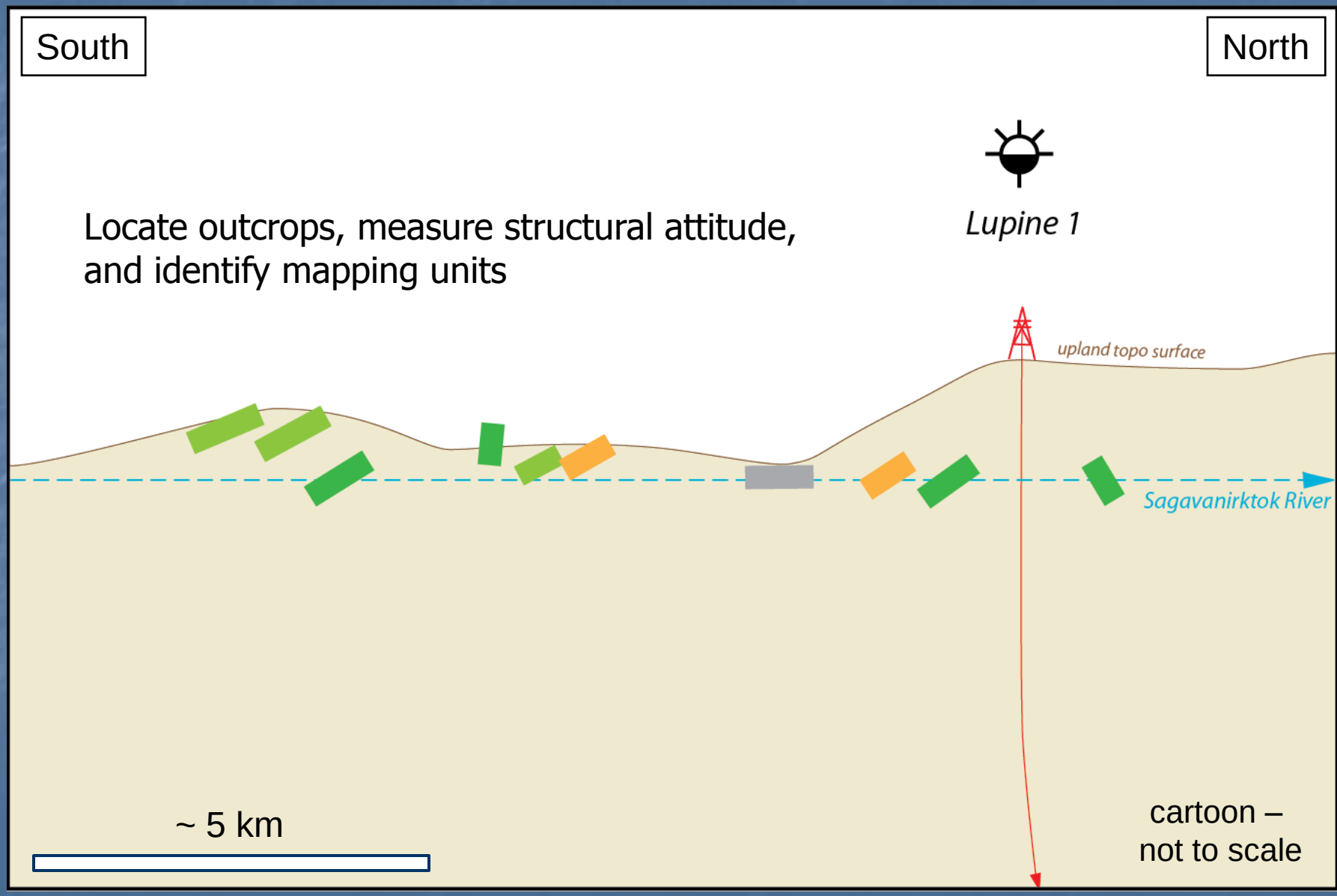
Torok – Seabee
Cross Section
Torok – Nanushuk? Ice Cut thrust
Scale
0
8 mi
12 km

# Ice Cut – Lupine Unit 1 area

## Building a field-based structural-stratigraphic model



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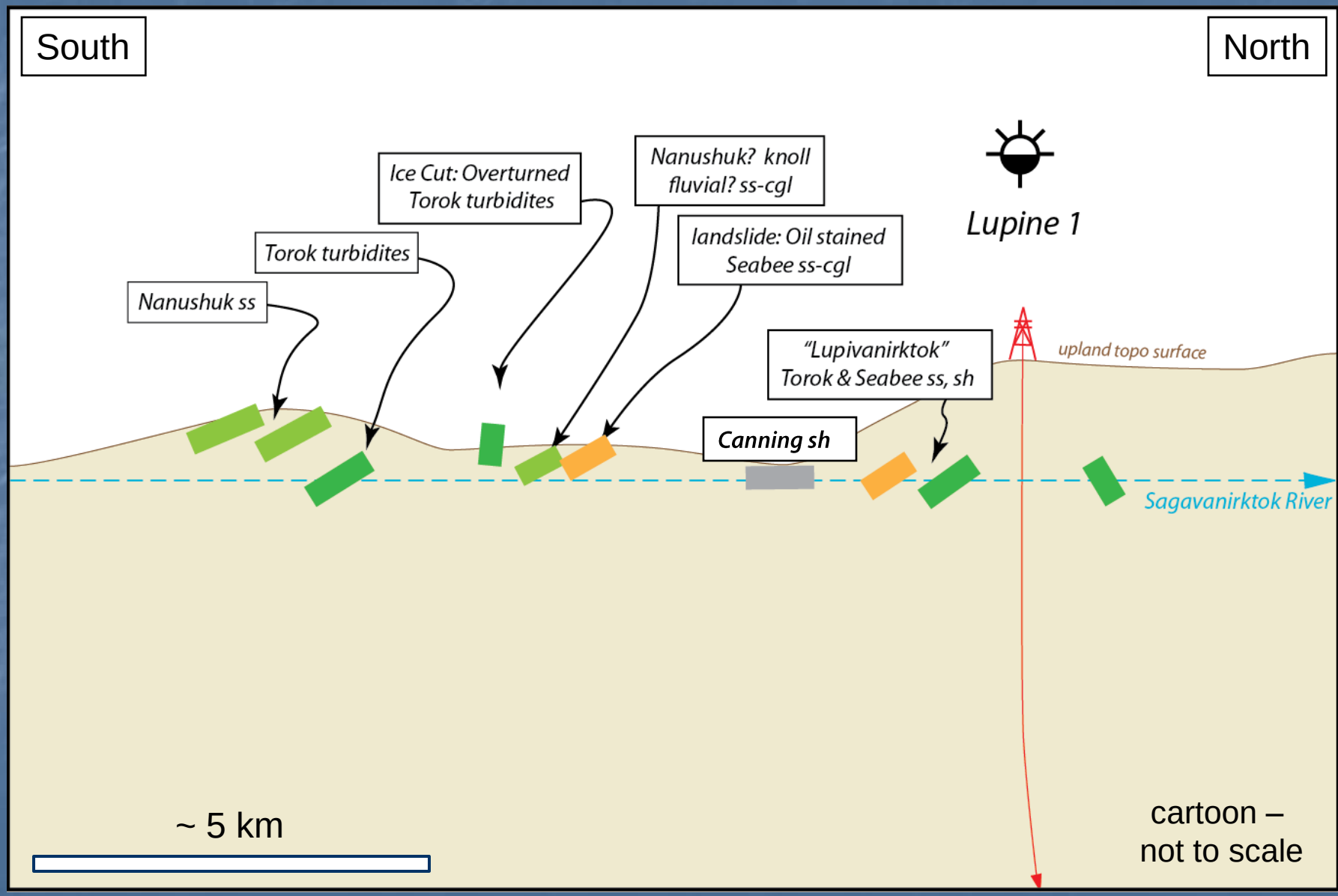

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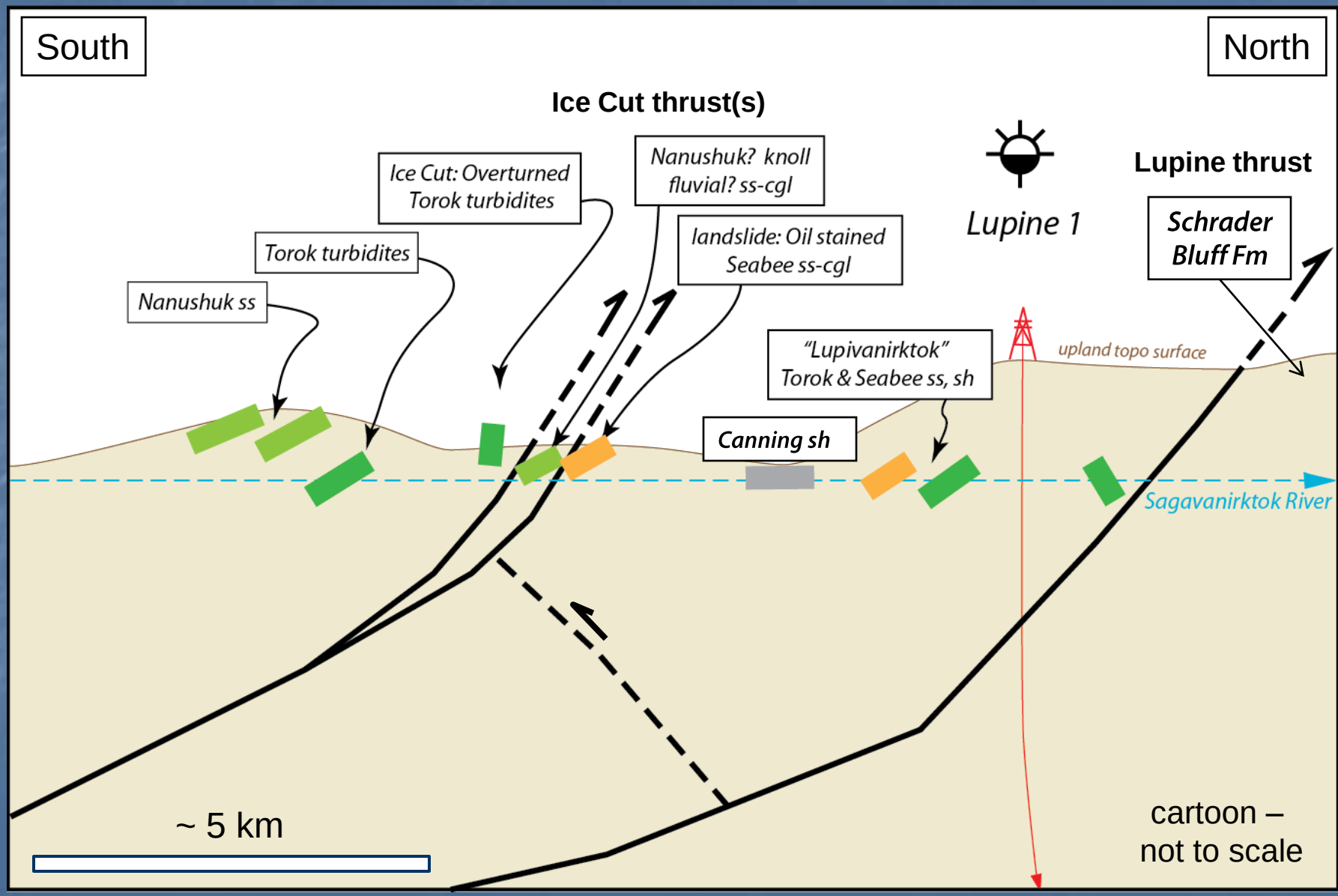

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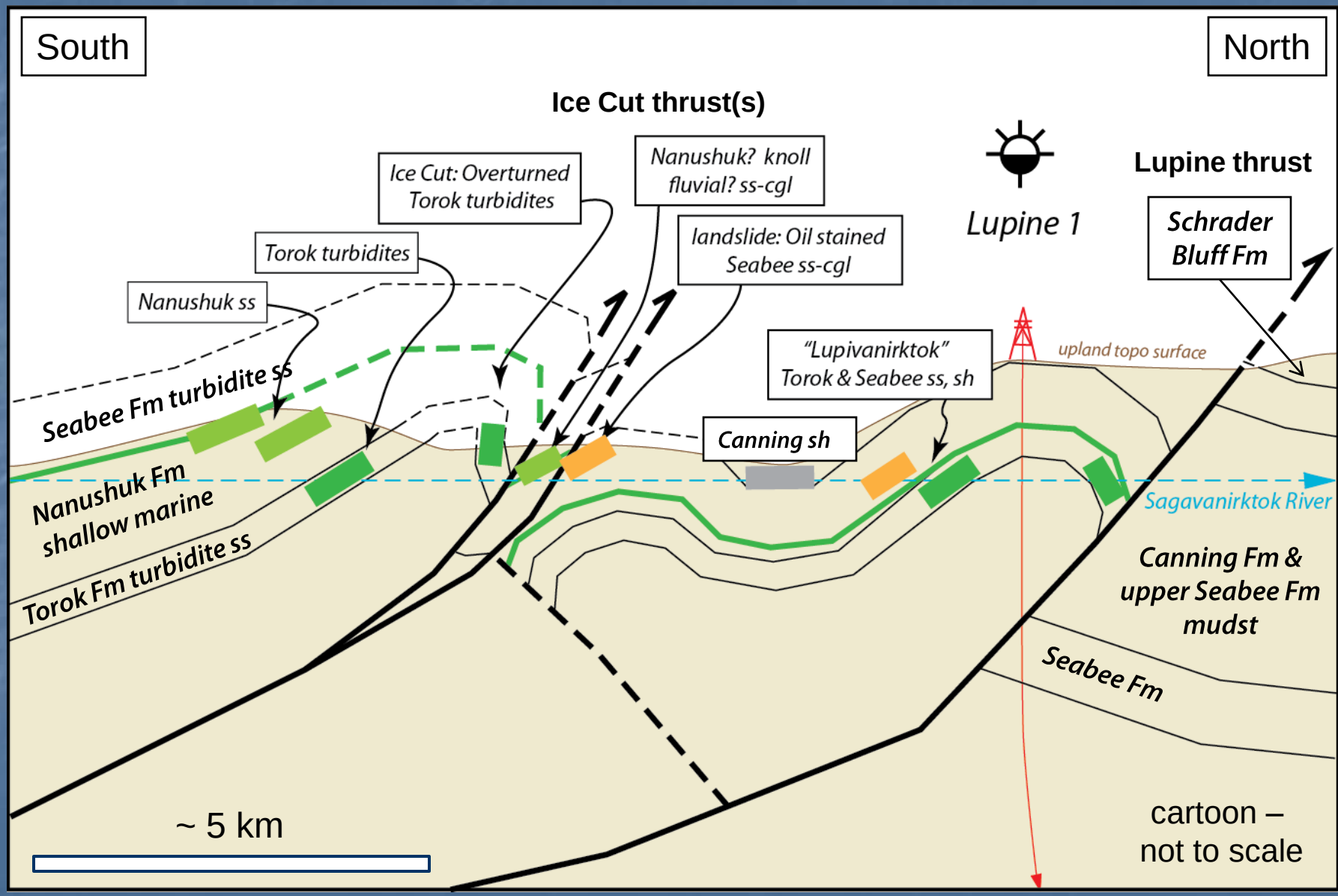

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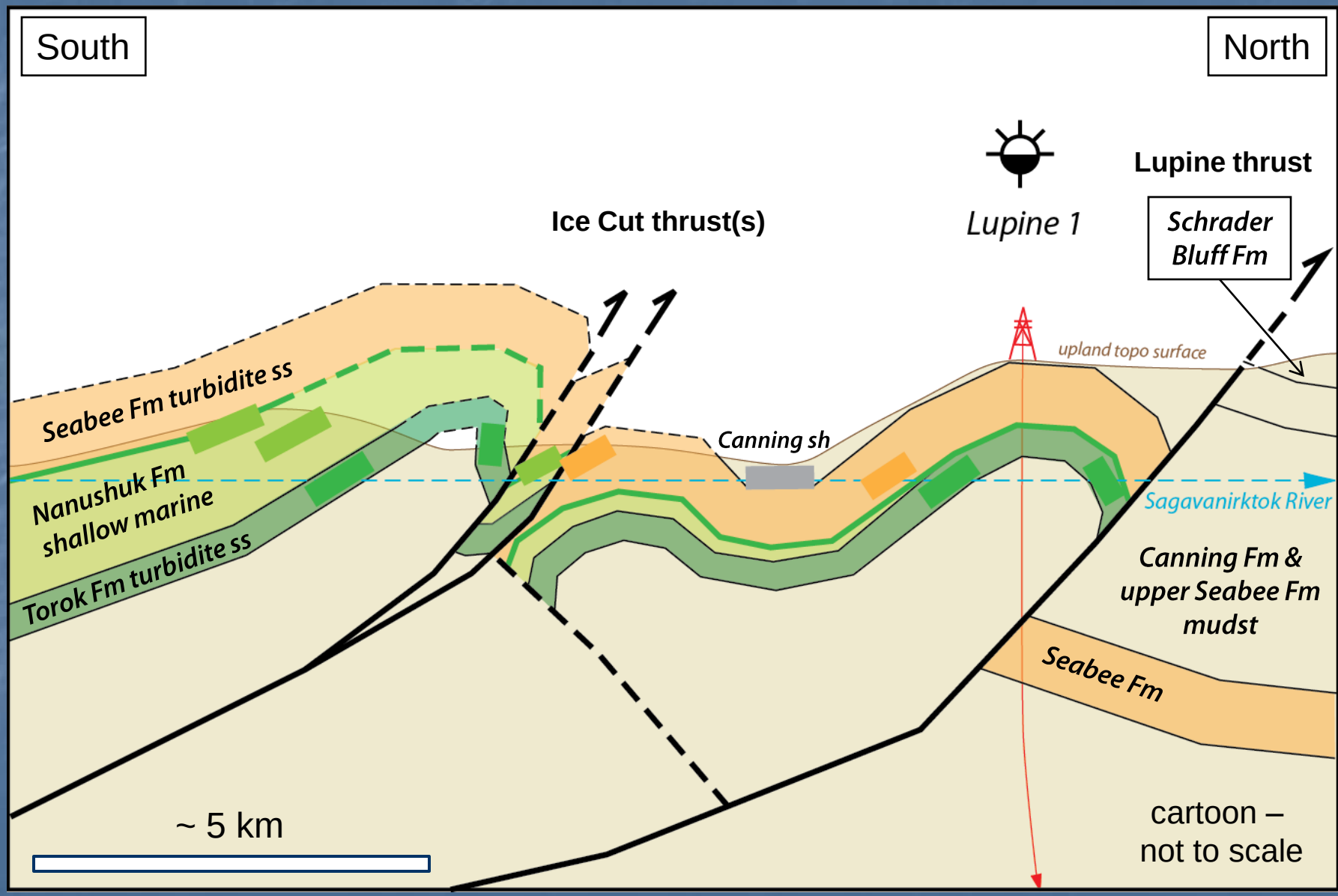
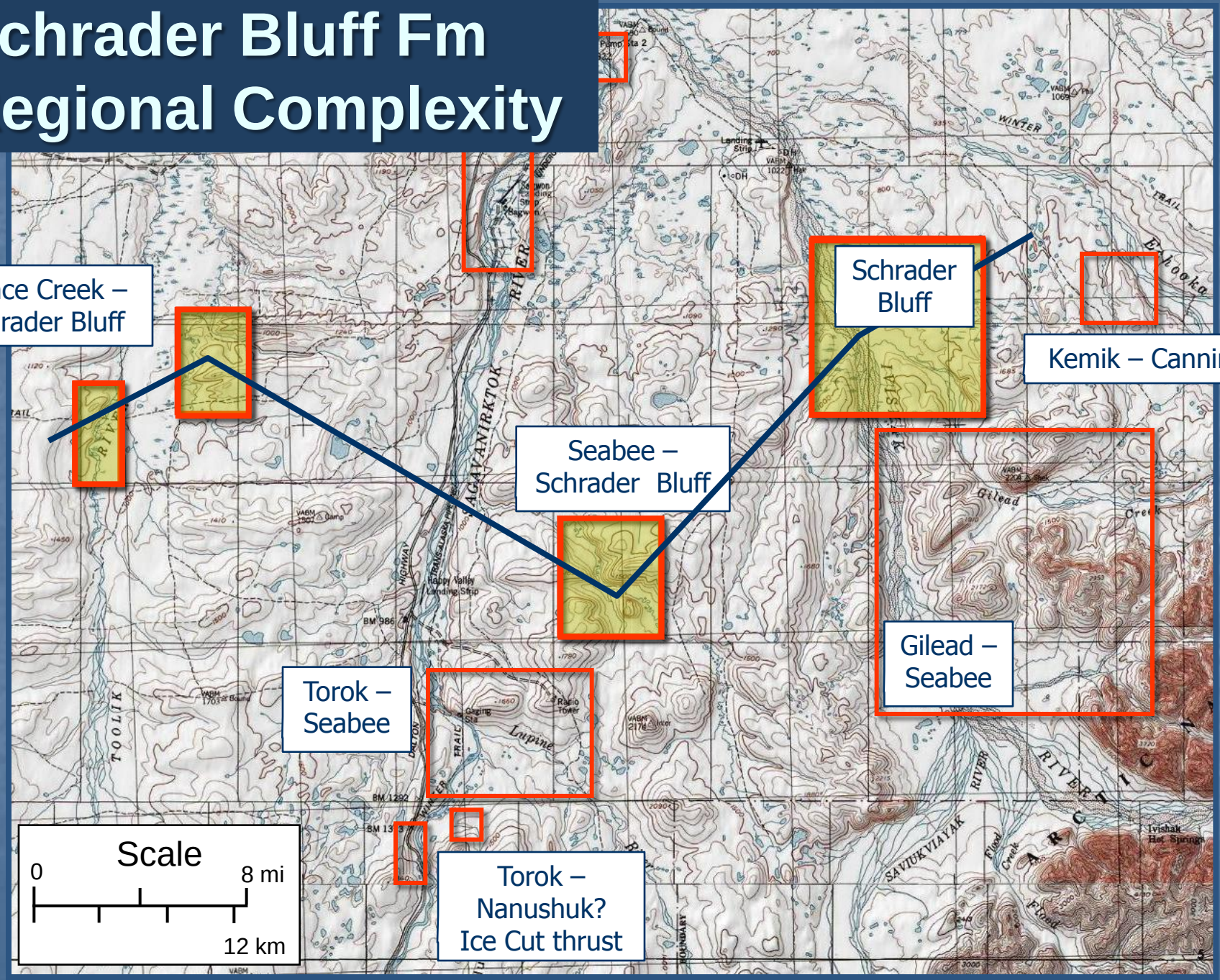


# Schrader Bluff Fm Regional Complexity



# 2007 Tour: Toolik River – Schrader Bluff Formation

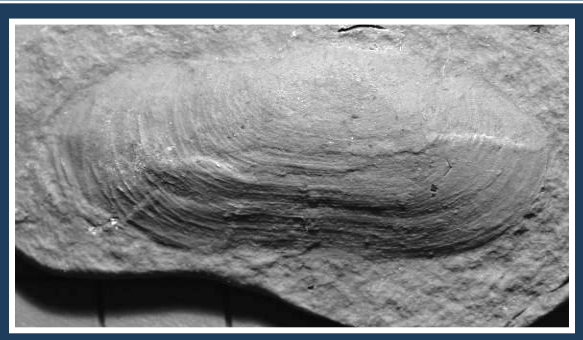
## Shallow marine topsets – shoreface parasequences

Bivalve shell & chert pebble lag

Transgressive lag – black chert

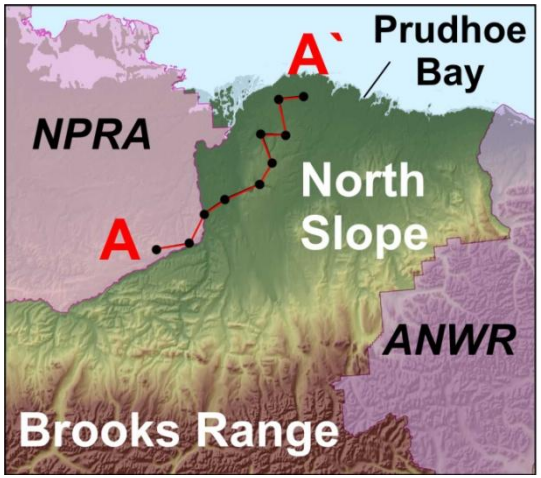
# 2007 Tour: Toolik River – Schrader Bluff Formation

## Shallow marine topsets – shoreface parasequences



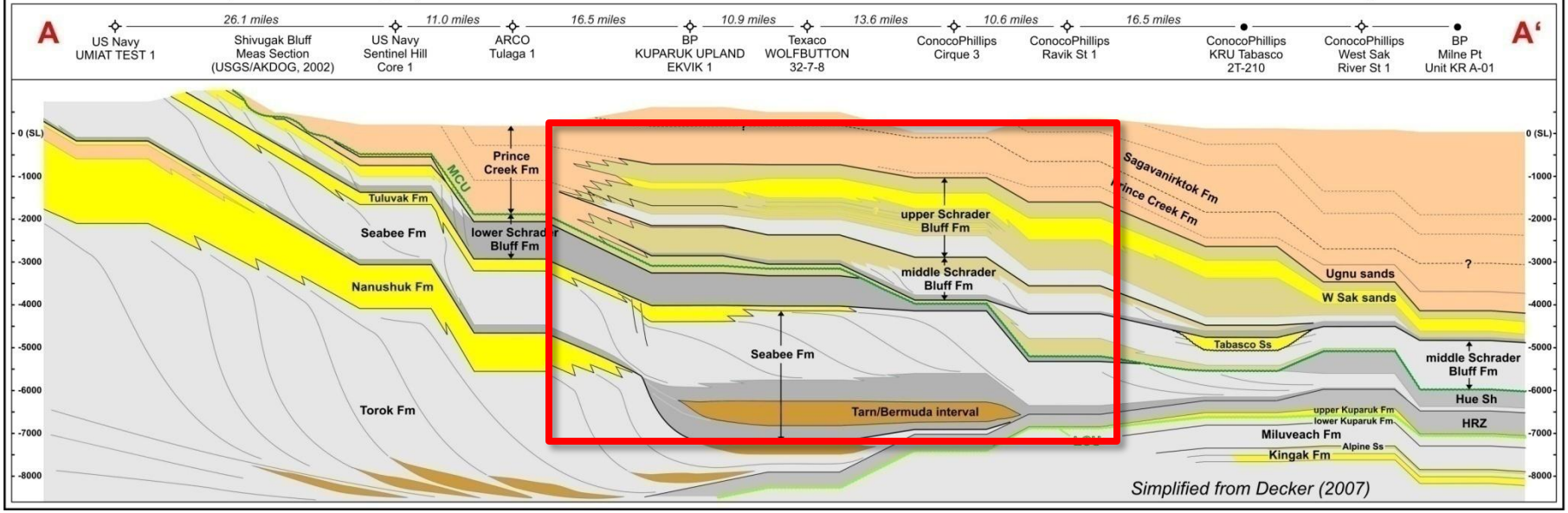
Bivalve fauna rich, diverse, but poorly known

# Brookian Sequence Stratigraphy and Correlations (Decker, 2007)

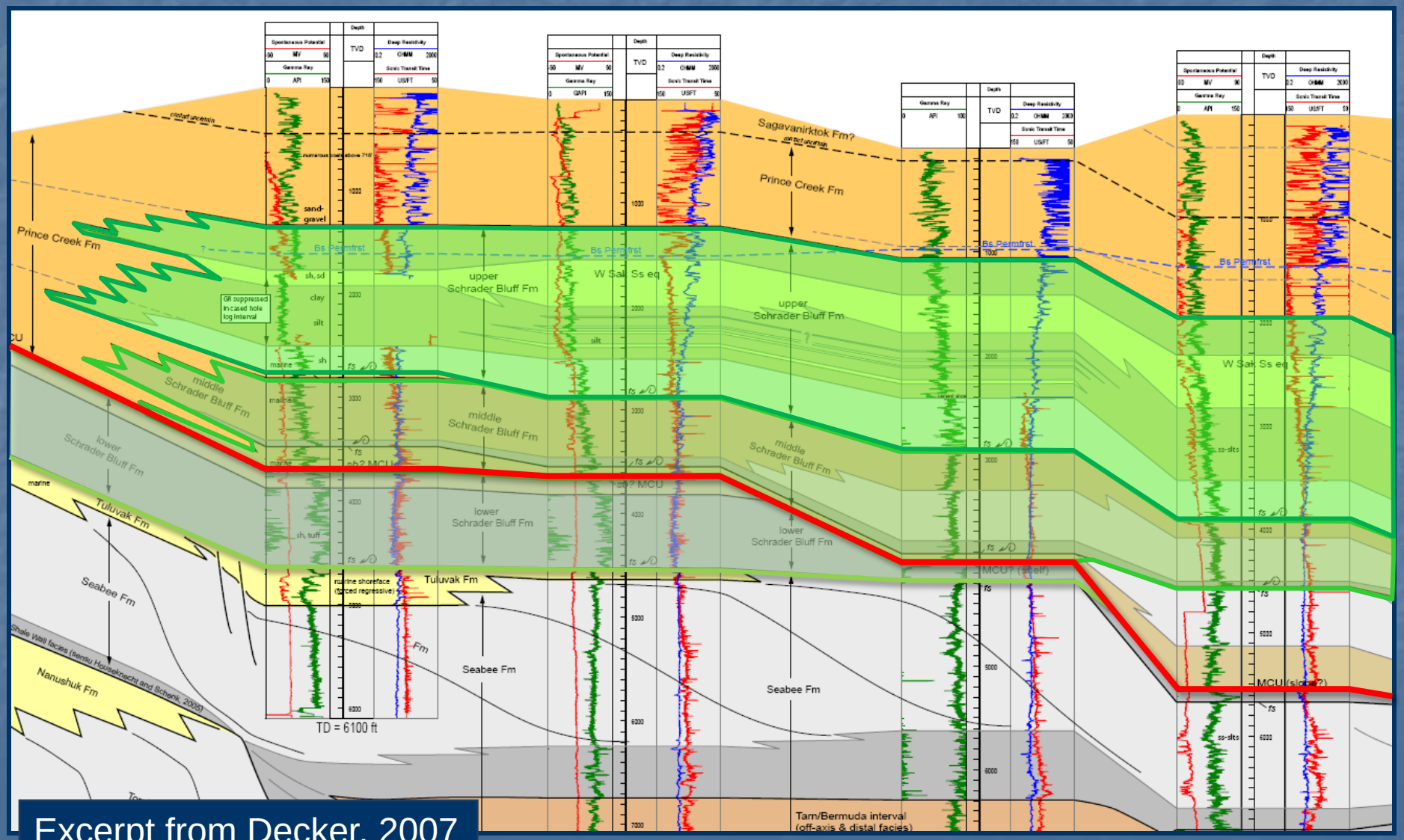



- nonmarine undifferentiated
- shallow marine to proximal shelf ss.
- distal shelf ss. to sltst.
- toe-of-slope turbidites (sand-prone)
- shelf to slope mudst. to sltst.
- condensed or bentonitic sh.

**Brookian Sequence Stratigraphic Correlation Section, Umiat Field to Milne Point Field, West-central North Slope, Alaska**



# Schrader Bluff Formation – Regional Complexity




Excerpt from Decker, 2007

# Schrader Bluff & Prince Ck. Formations

## New Professional Papers - USGS and Division of Oil & Gas

**Sentinel Hill Core Test 1: Facies Descriptions and Stratigraphic Reinterpretations of the Prince Creek and Schrader Bluff Formations, North Slope, Alaska**

By Romeo M. Flores, Gary D. Stricker, Paul L. Decker, and Mark D. Myers

Professional Paper 1747

U.S. Department of the Interior
U.S. Geological Survey

**Stratigraphy and Facies of Cretaceous Schrader Bluff and Prince Creek Formations in Colville River Bluffs, North Slope, Alaska**

By Romeo M. Flores, Mark D. Myers, David W. Houseknecht, Gary D. Stricker, Donald W. Brizzolara, Timothy J. Ryherd, and Kenneth I. Takahashi

Professional Paper 1748

U.S. Department of the Interior
U.S. Geological Survey

# Summary

## Sagavanirktok River Area 2007-2008 Project Goals

- **Needs new geologic mapping:**
  - Consistency with genetic nomenclature
  - Brookian subsurface data and interpretations
- **Stratigraphy of southern Colville Basin:**
  - Torok-Nanushuk and Gilead paleogeography
  - Seabee-Hue-Canning deepwater system
  - Prince Creek-Schrader Bluff topset sequence strat
  - Prince Creek-Sagavanirktok contact (Sagwon Bluffs)
- **Additional structural studies:**
  - Lupine and Ice Cut thrust relationships
  - Aufeis and Kuparuk anticlines (plunge)
  - Ivishak River – Gilead syncline (partitioning)