Surface – Subsurface Relationships

2007-08 Projects

Sagavanirktok River Area
East-central North Slope

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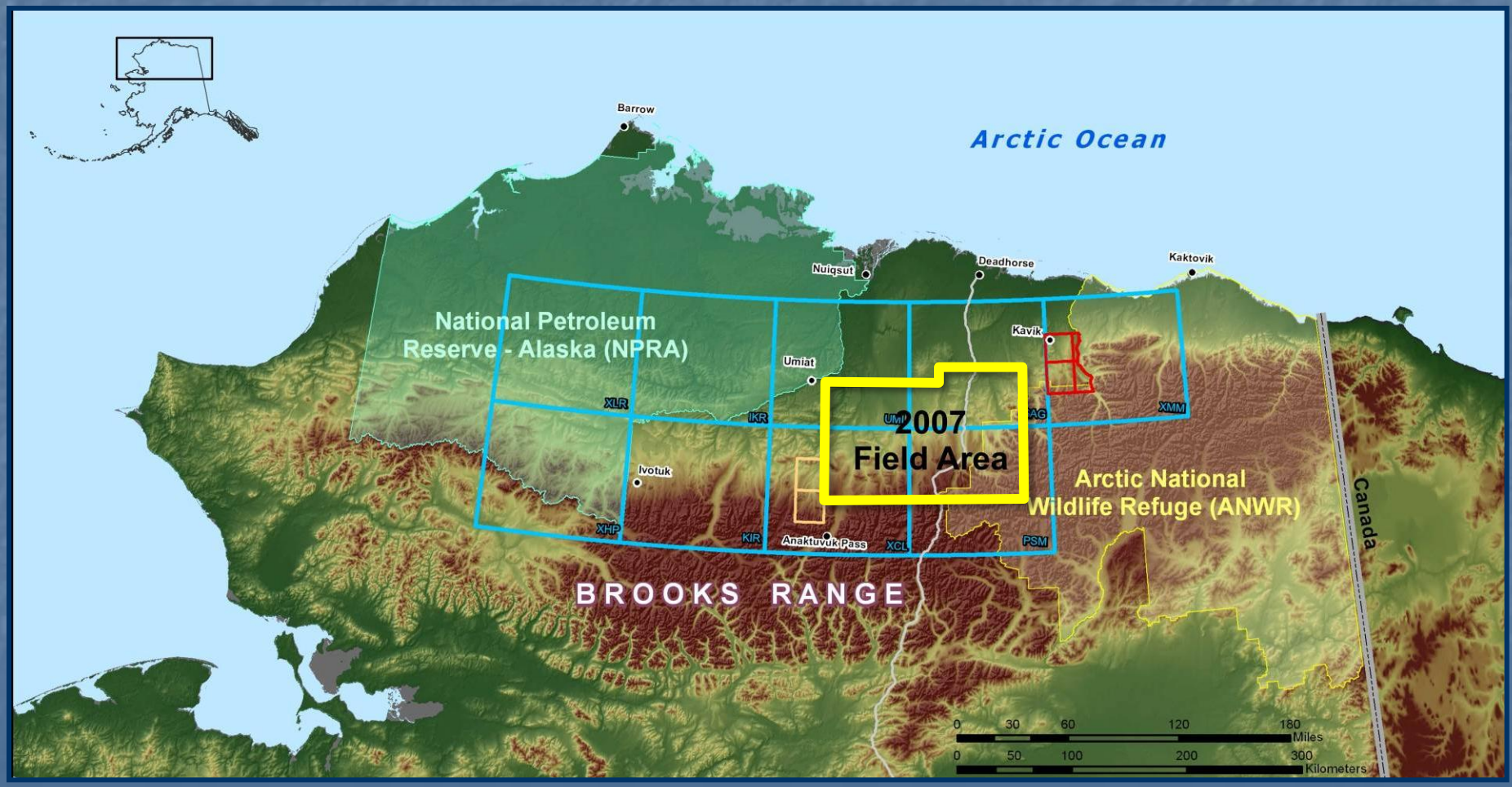
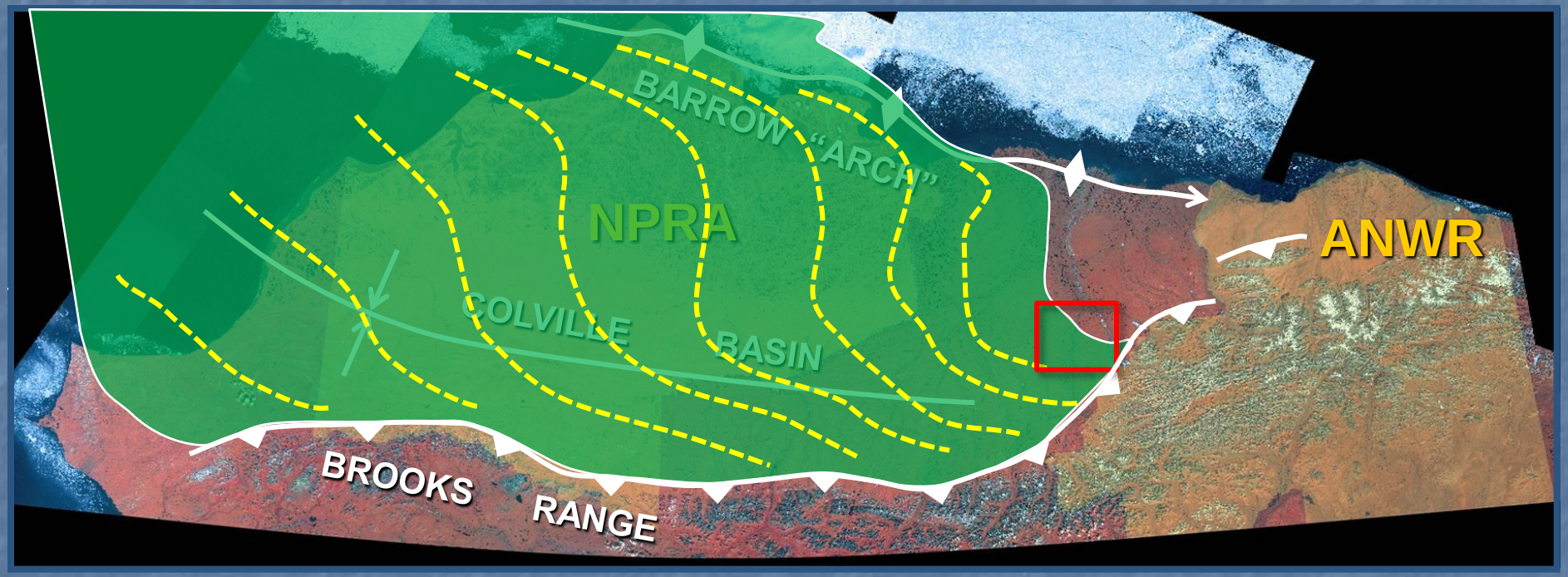
Sagavanirktok River Project Area



Colville Foreland Basin Tectonostratigraphic Setting

Sagavanirktok River Project Area

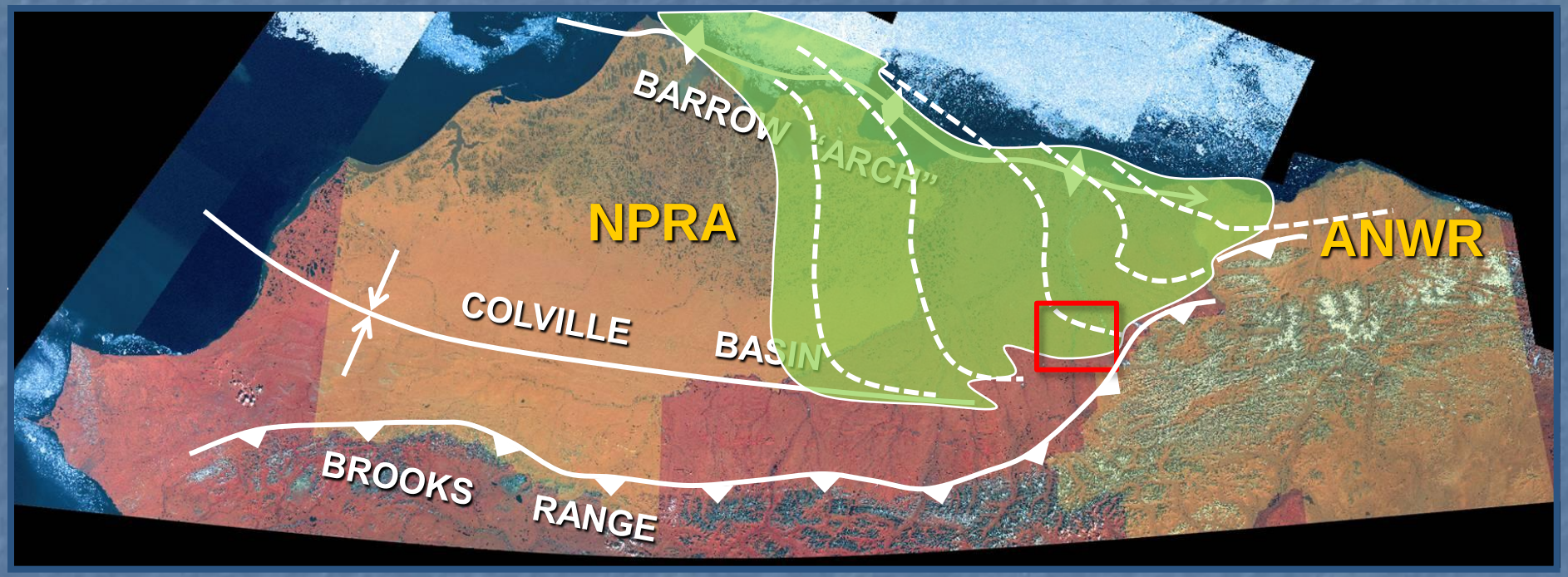


Lower Brookian basin fill: Early to middle Cretaceous

(Okpikruak-Fortress Mtn-Nanushuk-Torok)

Colville Foreland Basin Tectonostratigraphic Setting

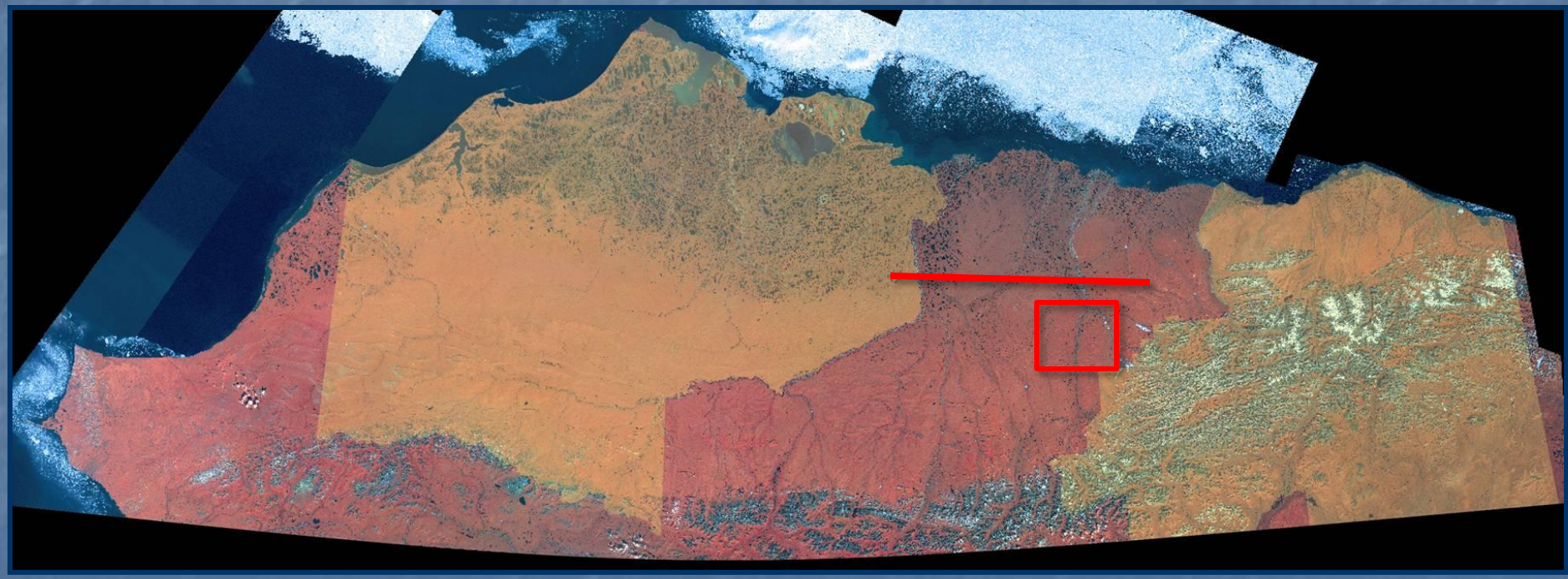
Sagavanirktok River Project Area



Middle & Upper Brookian basin fill: middle Cretaceous to Tertiary

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

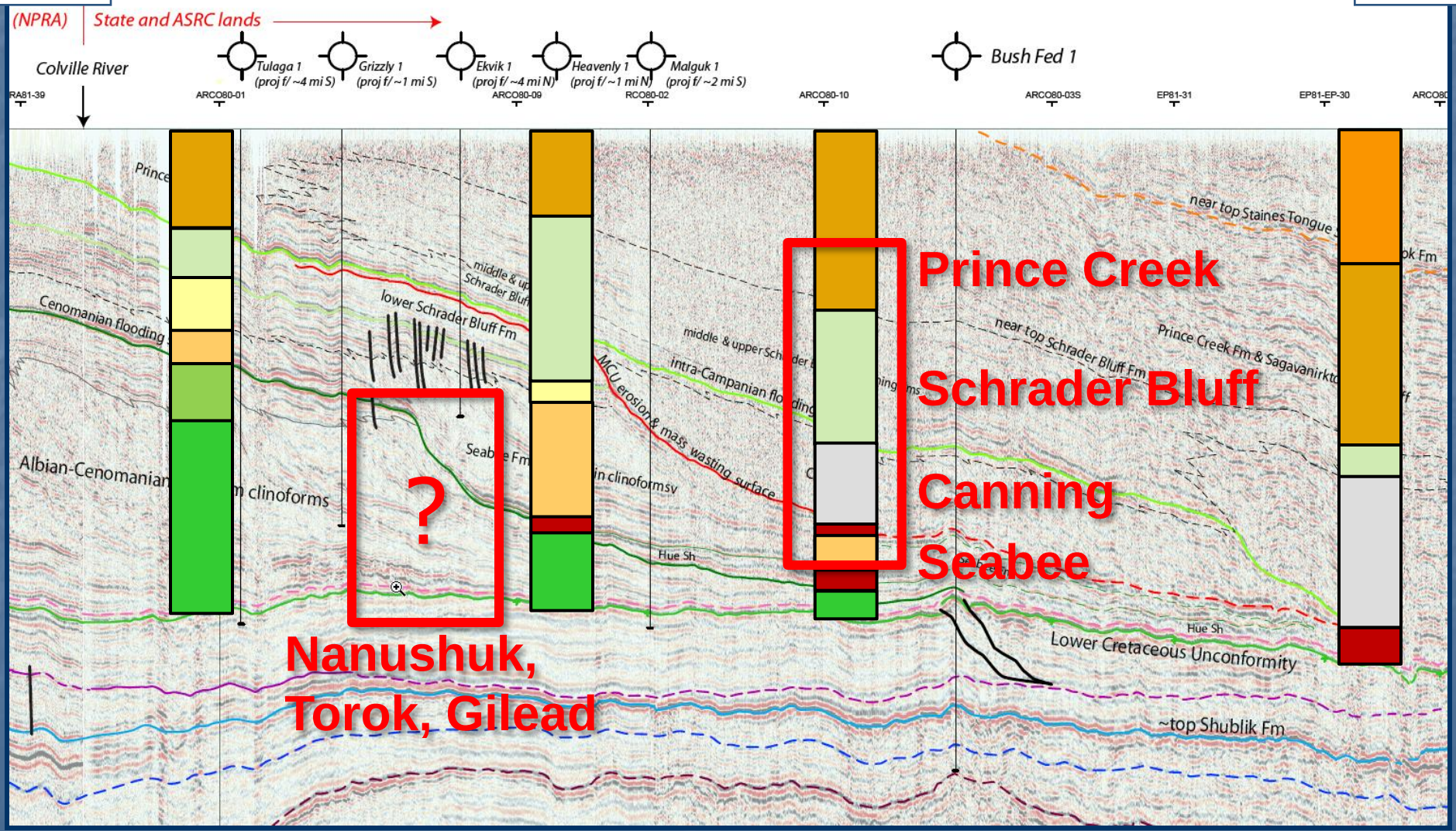
West-East Brookian Megasequence Stratigraphic Changes



West-East Brookian Megasequence Stratigraphic Changes

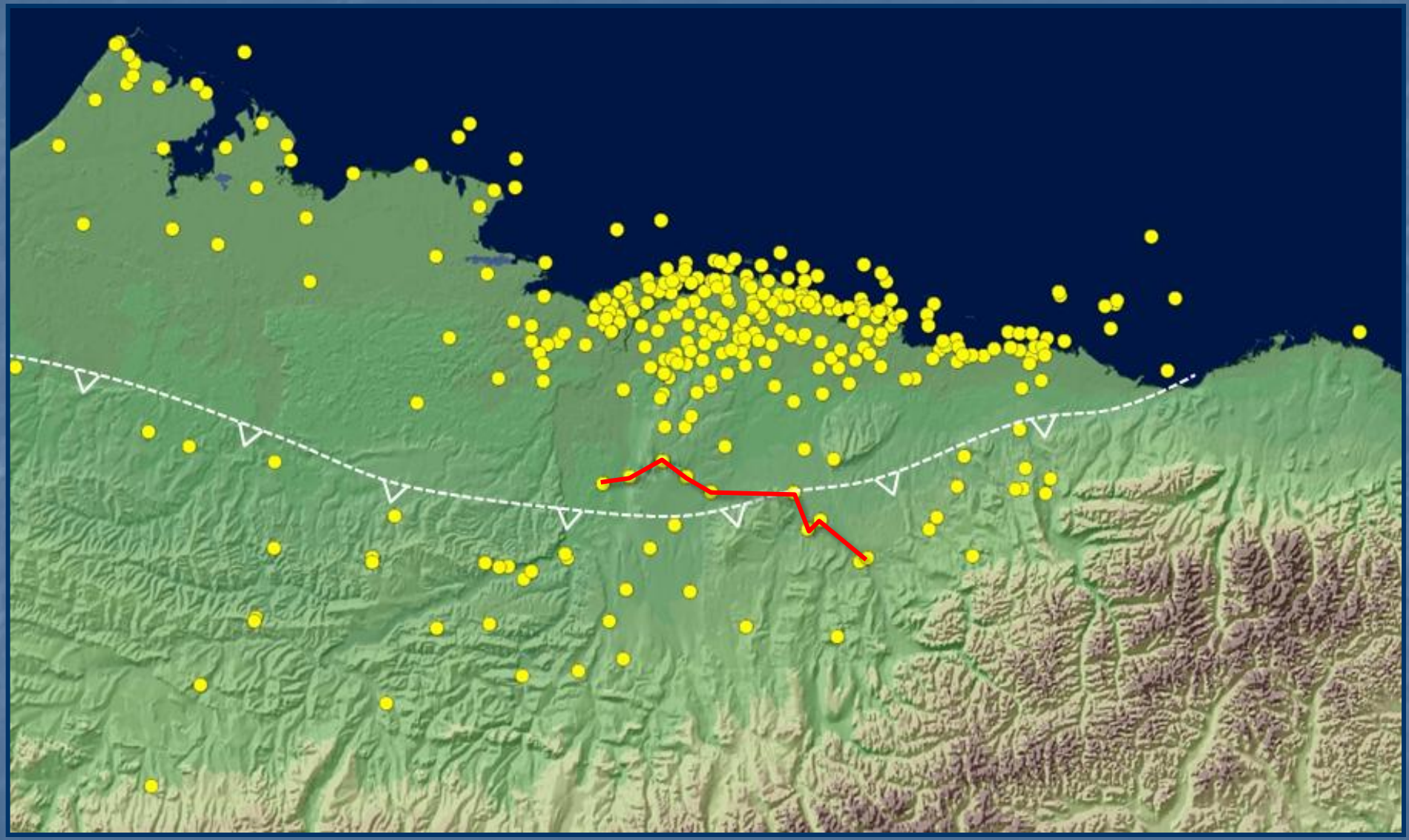
West

East



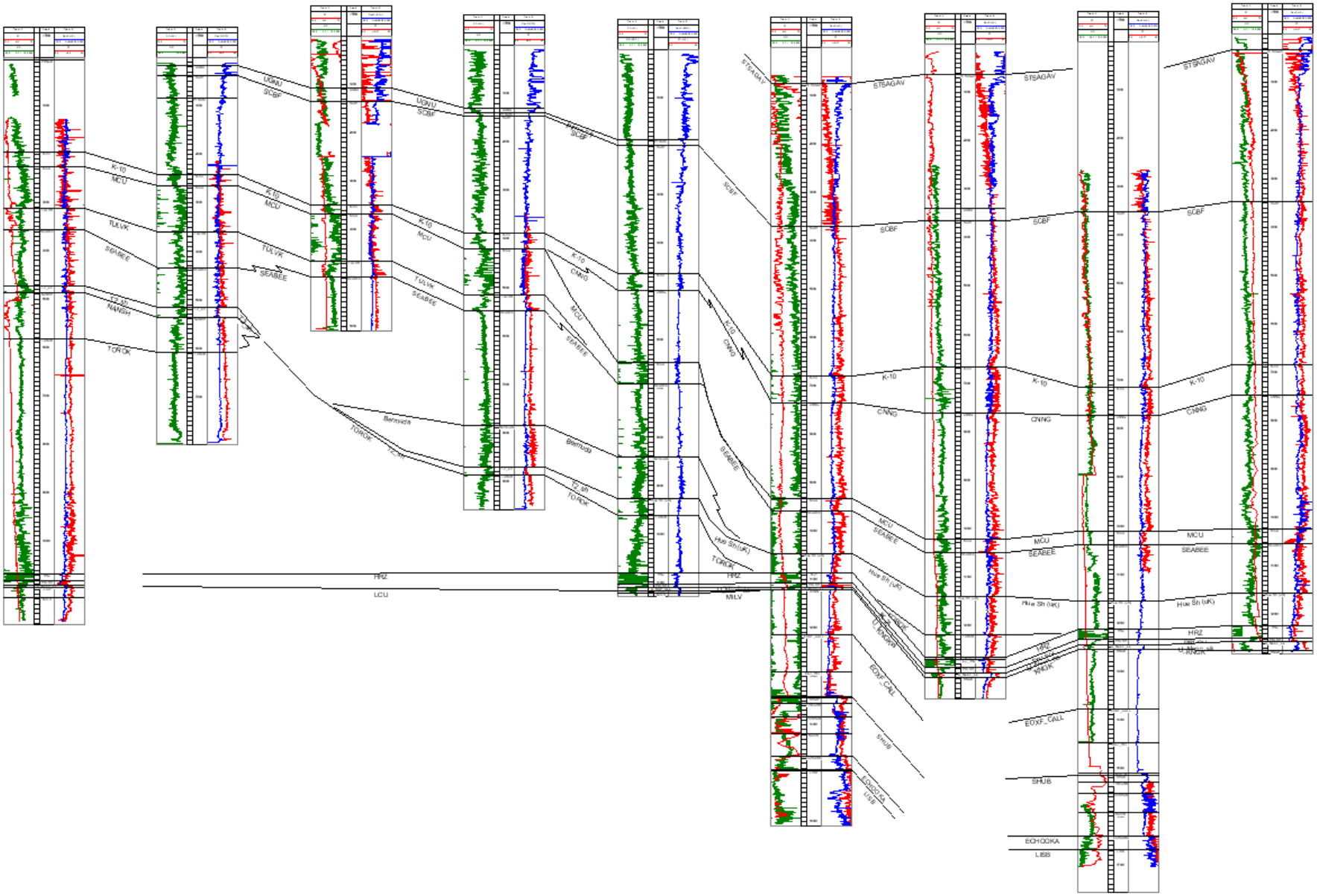
Brookian Correlations

ongoing effort

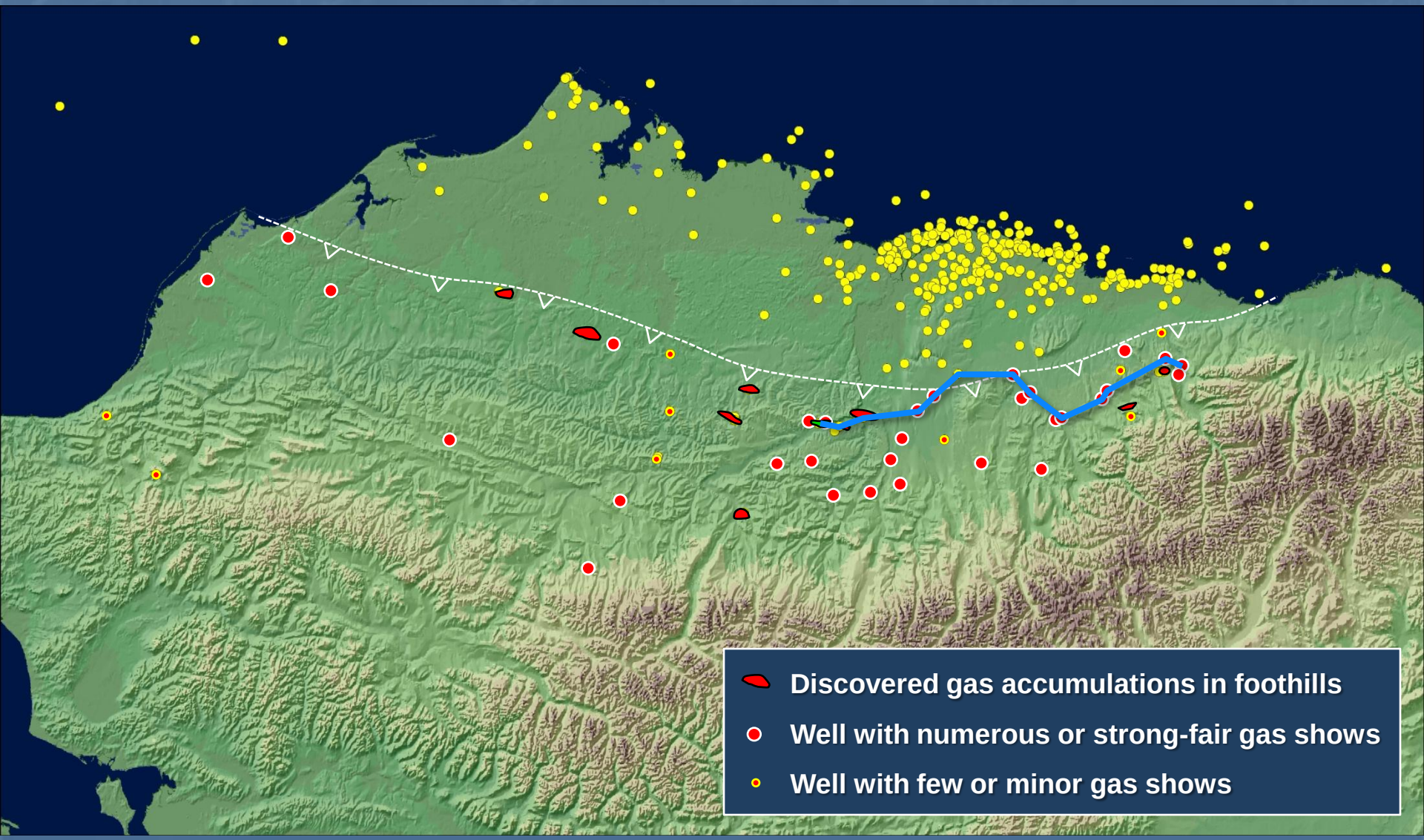


Brookian Correlations

ongoing effort



Foothills Drilling and Gas Occurrences

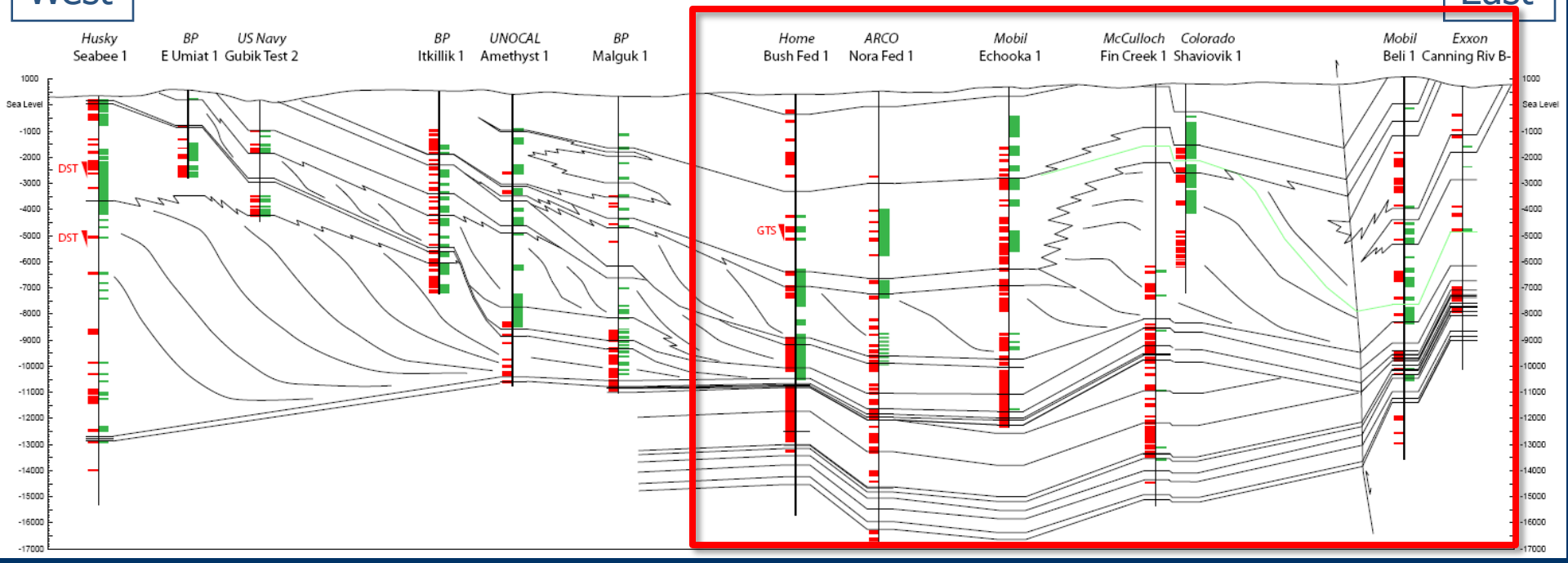


Foothills Cross Section

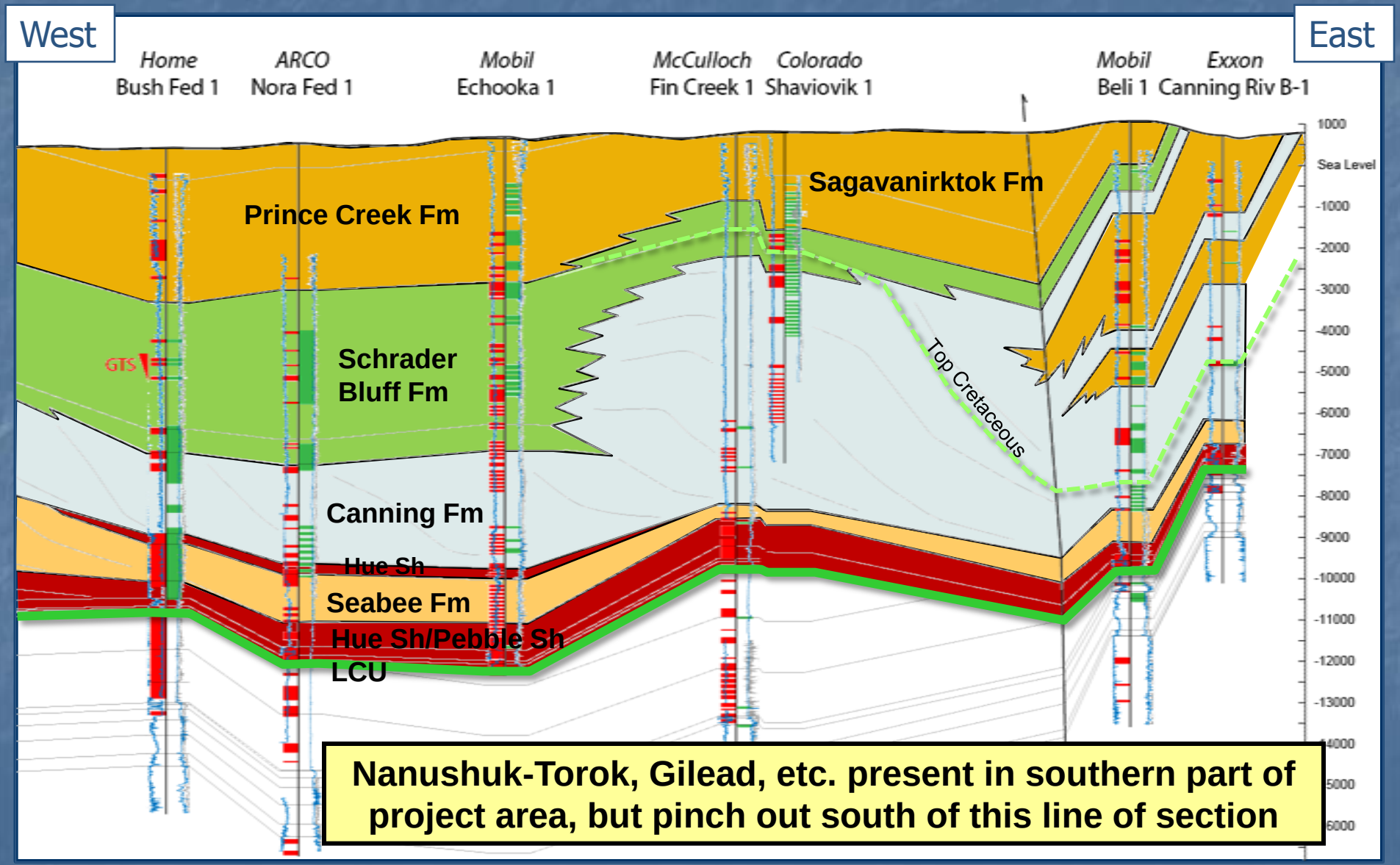
West-East Stratigraphic Changes, Oil & Gas Shows

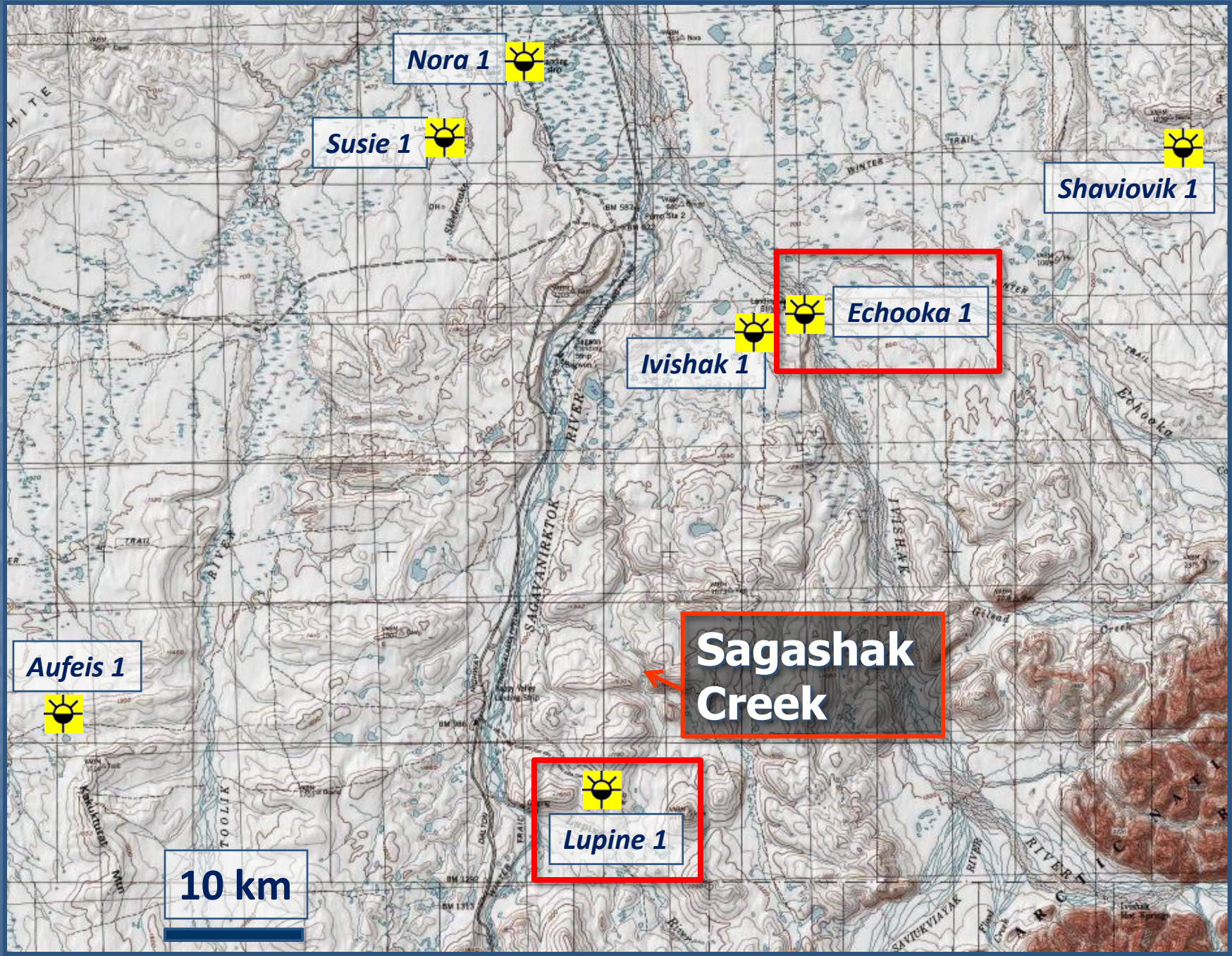
West

East



Brookian Subsurface Correlations
North of Sagavanirktok River Map Area




Nora 1
Susie 1
Shaviovik 1
Echooka 1
Ivishak 1
Aufeis 1
Sagashak Creek
Lupine 1
10 km

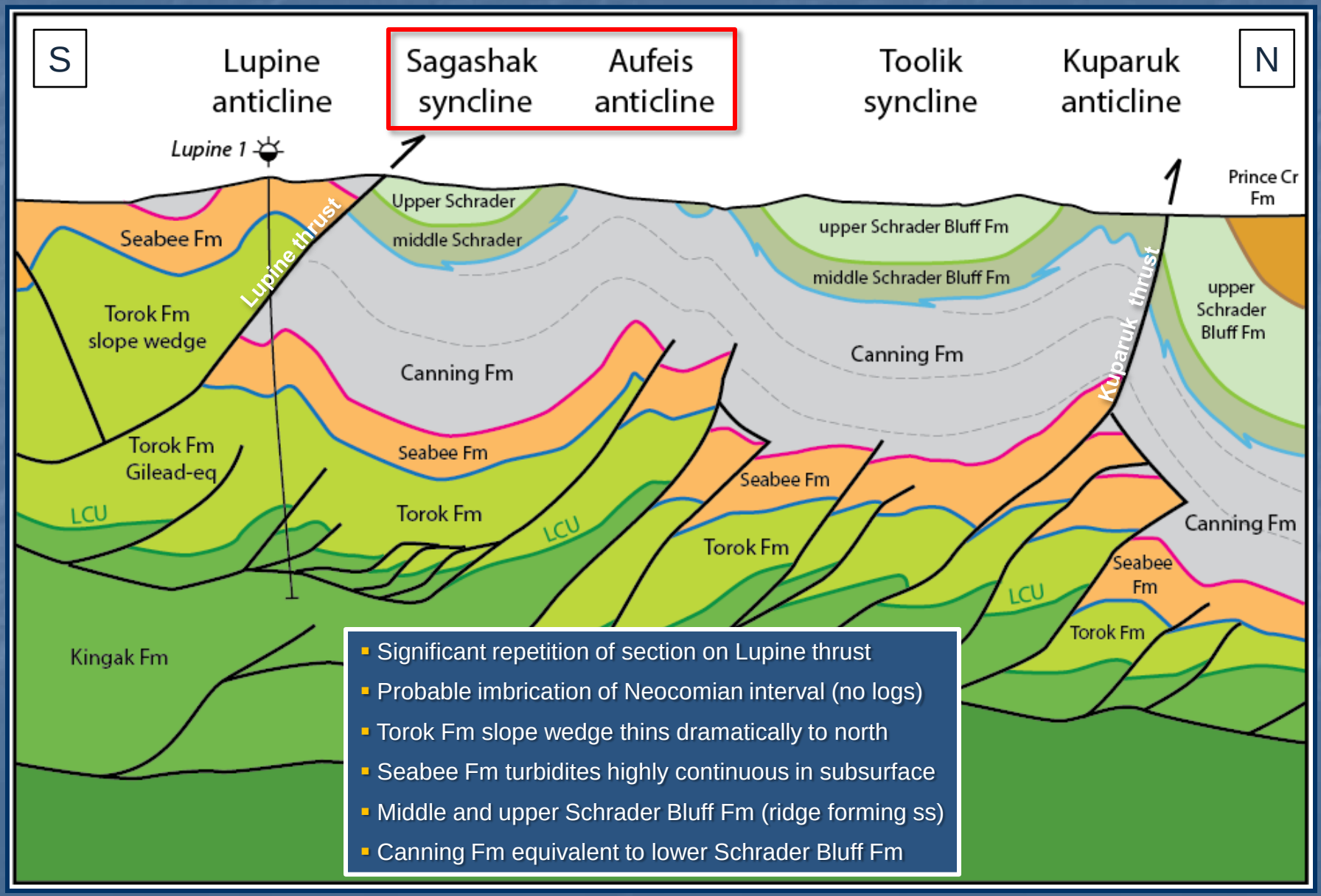
Lupine 1 well

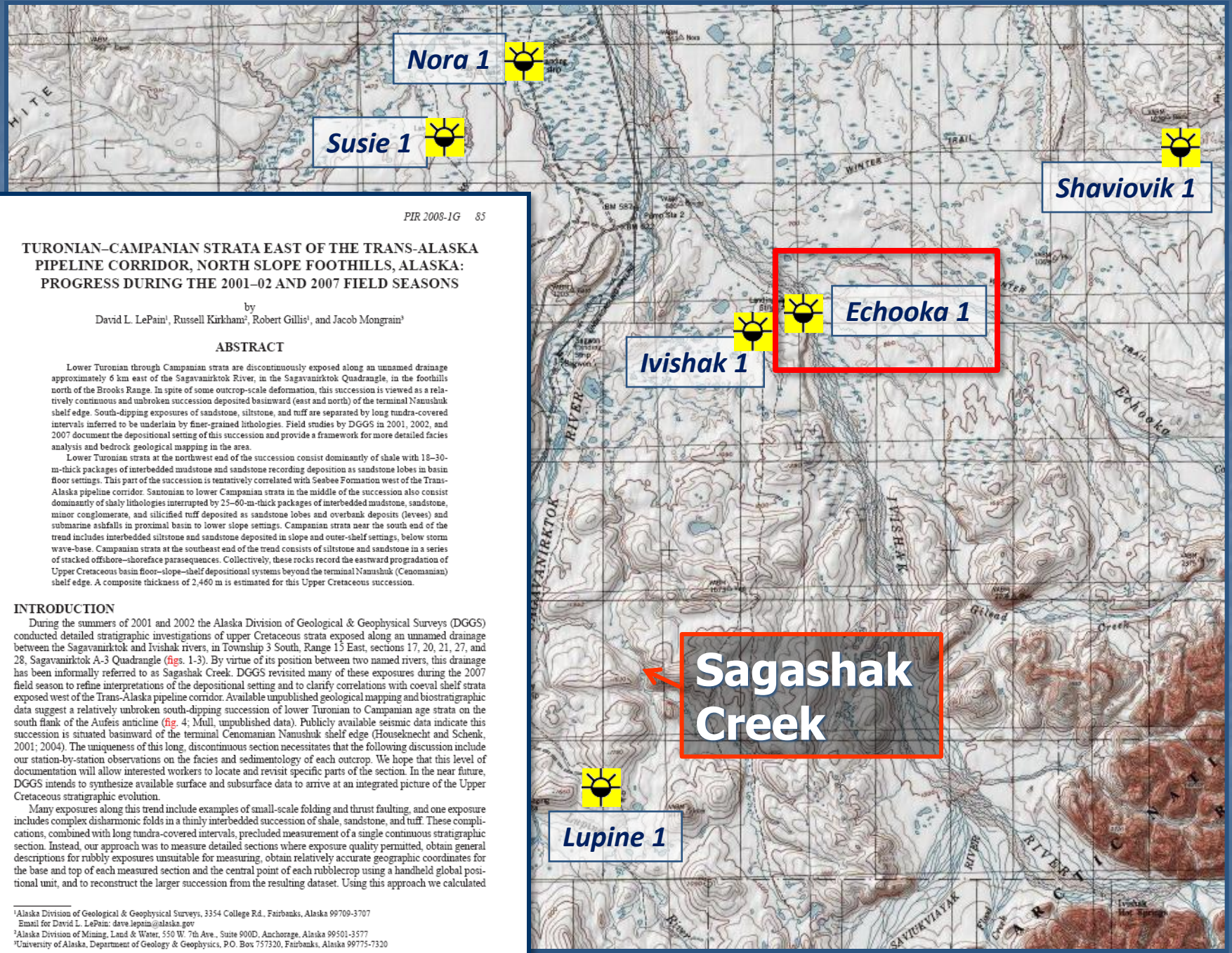
Challenge to determine formation tops

- Logs bear little relation to nearest offset wells
- Thrust complications (seismic, vitrinite, biostrat)
- Multiple & conflicting biostrat interpretations
- No wireline data above 500’ or below 10,700’ MD (overpressure)
- No checkshot to aid seismic tie
- Probable tie of near-surface interval to outcrops at river level (“Lupivanirktok”)

Preliminary Structural/Stratigraphic Interpretation

Lupine 1 well to Kuparuk anticline





TURONIAN–CAMPANIAN STRATA EAST OF THE TRANS-ALASKA PIPELINE CORRIDOR, NORTH SLOPE FOOTHILLS, ALASKA: PROGRESS DURING THE 2001–02 AND 2007 FIELD SEASONS

by
David L. LePain[1], Russell Kirkham[2], Robert Gillis[1], and Jacob Mongrain[3]

ABSTRACT

Lower Turonian through Campanian strata are discontinuously exposed along an unnamed drainage approximately 6 km east of the Sagavanirktok River, in the Sagavanirktok Quadrangle, in the foothills north of the Brooks Range. In spite of some outcrop-scale deformation, this succession is viewed as a relatively continuous and unbroken succession deposited basinward (east and north) of the terminal Nanushuk shelf edge. South-dipping exposures of sandstone, siltstone, and tuff are separated by long tundra-covered intervals inferred to be underlain by finer-grained lithologies. Field studies by DGGS in 2001, 2002, and 2007 document the depositional setting of this succession and provide a framework for more detailed facies analysis and bedrock geological mapping in the area.

Lower Turonian strata at the northwest end of the succession consist dominantly of shale with 18–30-m-thick packages of interbedded mudstone and sandstone recording deposition as sandstone lobes in basin floor settings. This part of the succession is tentatively correlated with Seabee Formation west of the Trans-Alaska pipeline corridor. Santonian to lower Campanian strata in the middle of the succession also consist dominantly of shaly lithologies interrupted by 25–60-m-thick packages of interbedded mudstone, sandstone, minor conglomerate, and silicified tuff deposited as sandstone lobes and overbank deposits (levees) and submarine ashfalls in proximal basin to lower slope settings. Campanian strata near the south end of the trend includes interbedded siltstone and sandstone deposited in slope and outer-shelf settings, below storm wave-base. Campanian strata at the southeast end of the trend consists of siltstone and sandstone in a series of stacked offshore–shoreface parasequences. Collectively, these rocks record the eastward progradation of Upper Cretaceous basin floor–slope–shelf depositional systems beyond the terminal Nanushuk (Cenomanian) shelf edge. A composite thickness of 2,460 m is estimated for this Upper Cretaceous succession.

INTRODUCTION

During the summers of 2001 and 2002 the Alaska Division of Geological & Geophysical Surveys (DGGS) conducted detailed stratigraphic investigations of upper Cretaceous strata exposed along an unnamed drainage between the Sagavanirktok and Ivishak rivers, in Township 3 South, Range 15 East, sections 17, 20, 21, 27, and 28, Sagavanirktok A-3 Quadrangle (figs. 1-3). By virtue of its position between two named rivers, this drainage has been informally referred to as Sagashak Creek. DGGS revisited many of these exposures during the 2007 field season to refine interpretations of the depositional setting and to clarify correlations with coeval shelf strata exposed west of the Trans-Alaska pipeline corridor. Available unpublished geological mapping and biostratigraphic data suggest a relatively unbroken south-dipping succession of lower Turonian to Campanian age strata on the south flank of the Aufeis anticline (fig. 4; Mull, unpublished data). Publicly available seismic data indicate this succession is situated basinward of the terminal Cenomanian Nanushuk shelf edge (Houseknecht and Schenk, 2001; 2004). The uniqueness of this long, discontinuous section necessitates that the following discussion include our station-by-station observations on the facies and sedimentology of each outcrop. We hope that this level of documentation will allow interested workers to locate and revisit specific parts of the section. In the near future, DGGS intends to synthesize available surface and subsurface data to arrive at an integrated picture of the Upper Cretaceous stratigraphic evolution.

Many exposures along this trend include examples of small-scale folding and thrust faulting, and one exposure includes complex disharmonic folds in a thinly interbedded succession of shale, sandstone, and tuff. These complications, combined with long tundra-covered intervals, precluded measurement of a single continuous stratigraphic section. Instead, our approach was to measure detailed sections where exposure quality permitted, obtain general descriptions for rubbly exposures unsuitable for measuring, obtain relatively accurate geographic coordinates for the base and top of each measured section and the central point of each rubblecrop using a handheld global positional unit, and to reconstruct the larger succession from the resulting dataset. Using this approach we calculated

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Sagashak Creek Traverse Stratigraphic Units

Schrader Bluff Fm

shoreface sandstones
shelf siltstones

Canning Fm

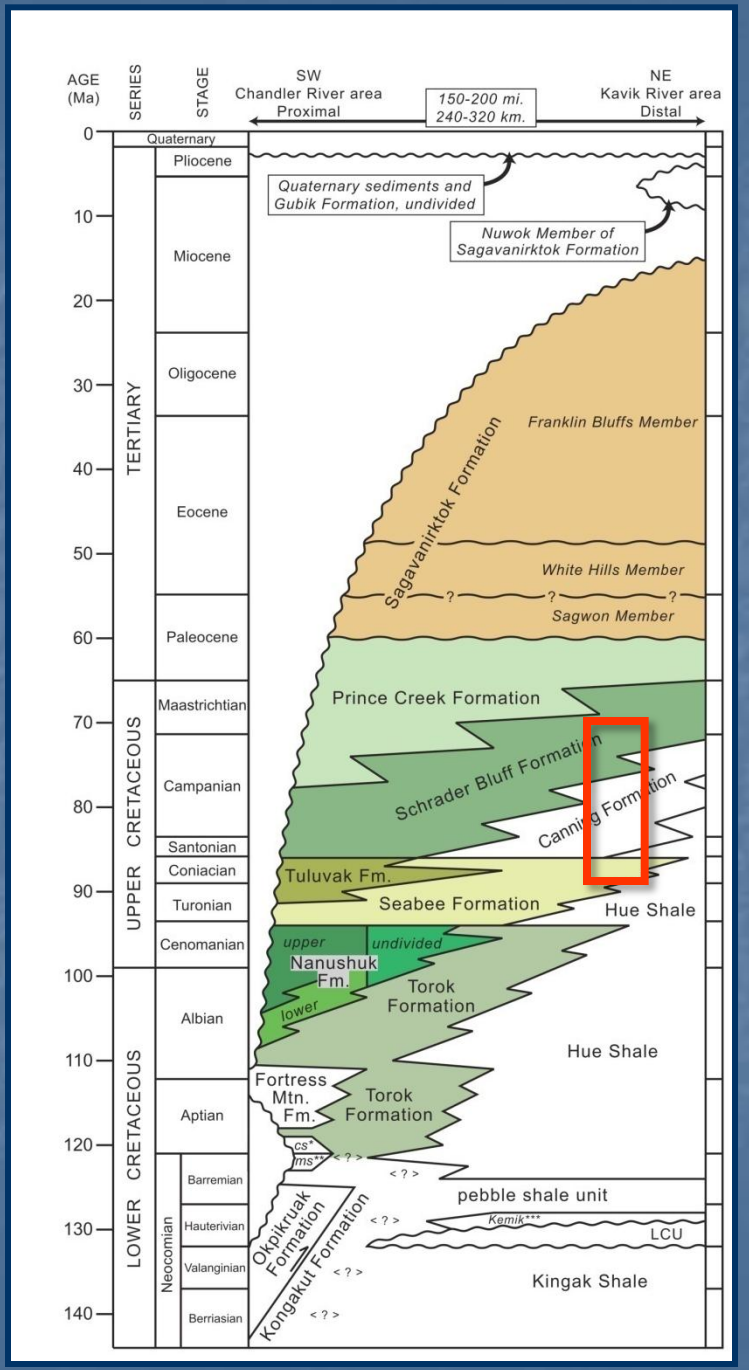
slope mudstones
toe-of-slope turbidite ss-cgl

Hue Sh facies

tongue of organic-rich shale

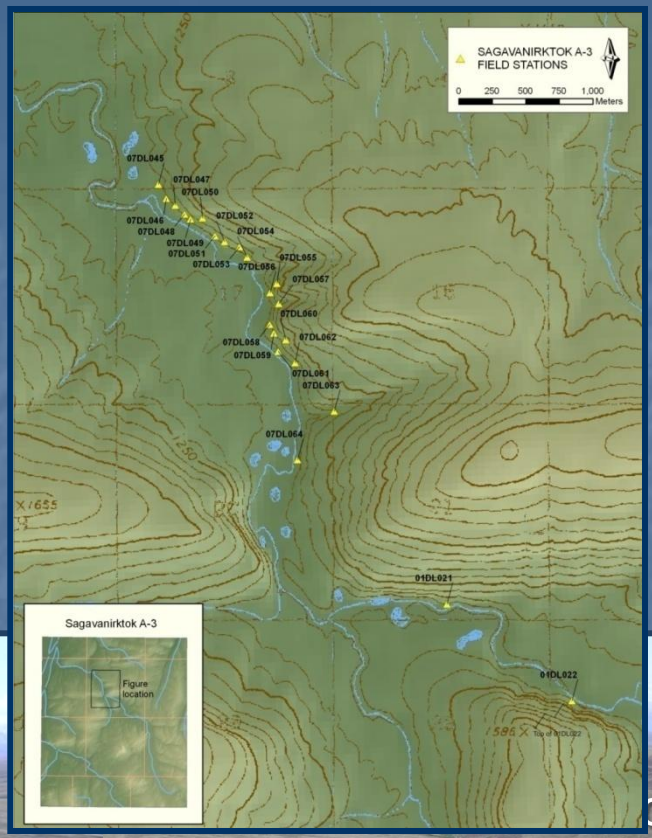
Seabee Fm

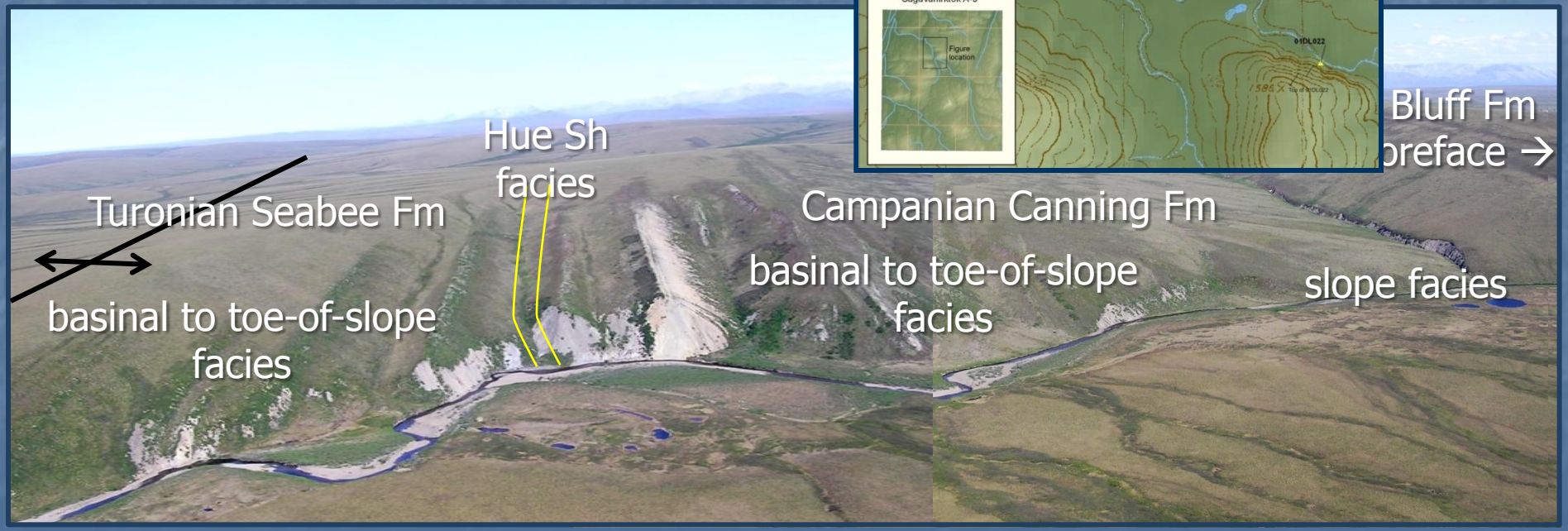
basinal(?) turbidite ss



Sagashak Creek Traverse

- South limb of Aufeis anticline





View to east

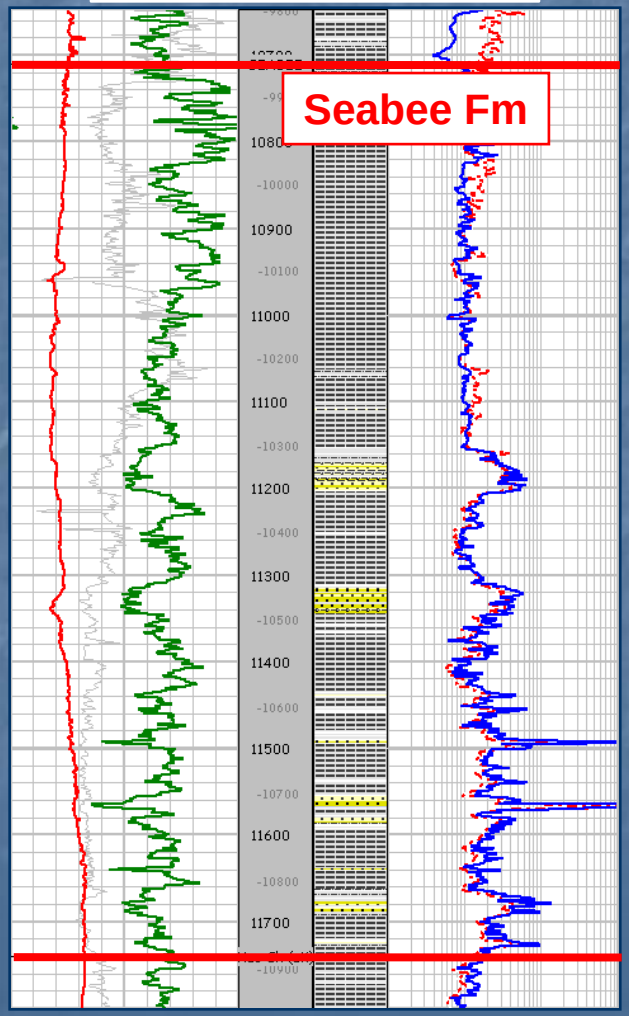
Echooka 1 well

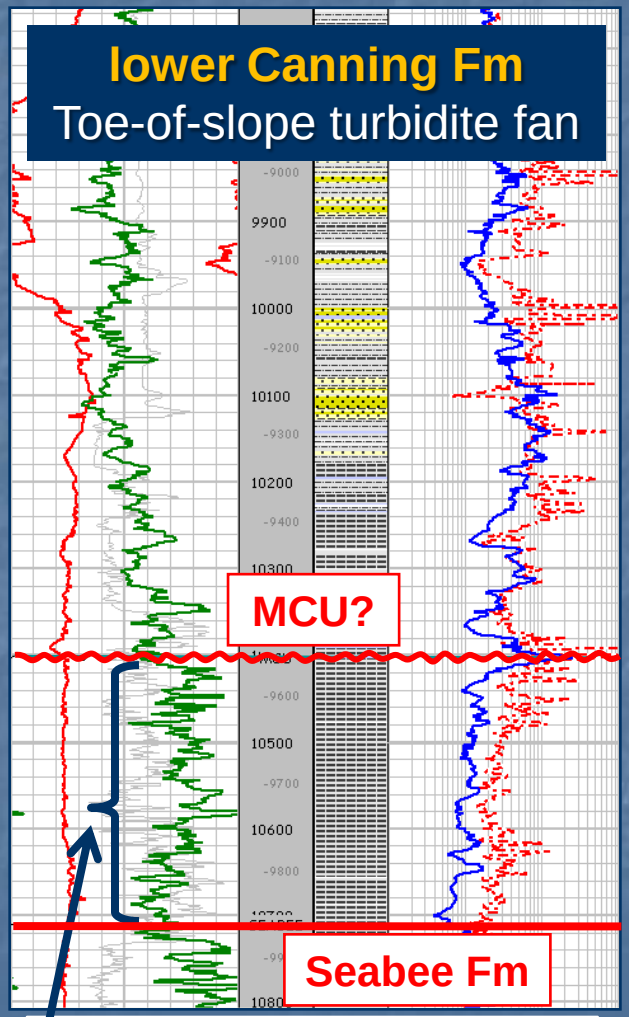
Correlation to Sagashak Creek outcrops

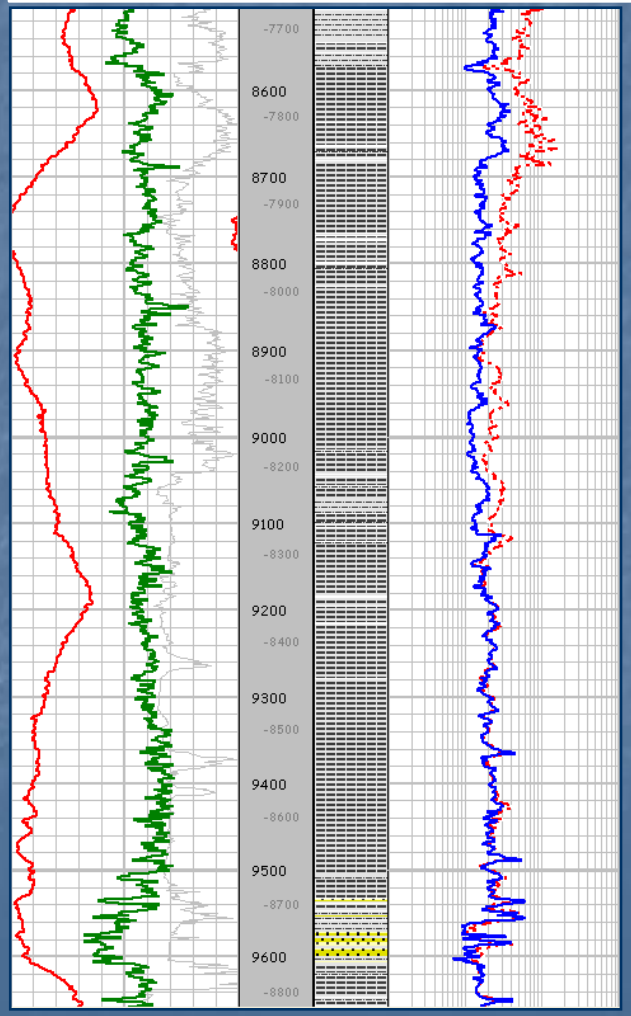
Seabee Fm
basinal(?) turbidite ss

lower Canning Fm
Toe-of-slope turbidite fan

middle-upper Canning Fm
monotonous, v fine slope facies





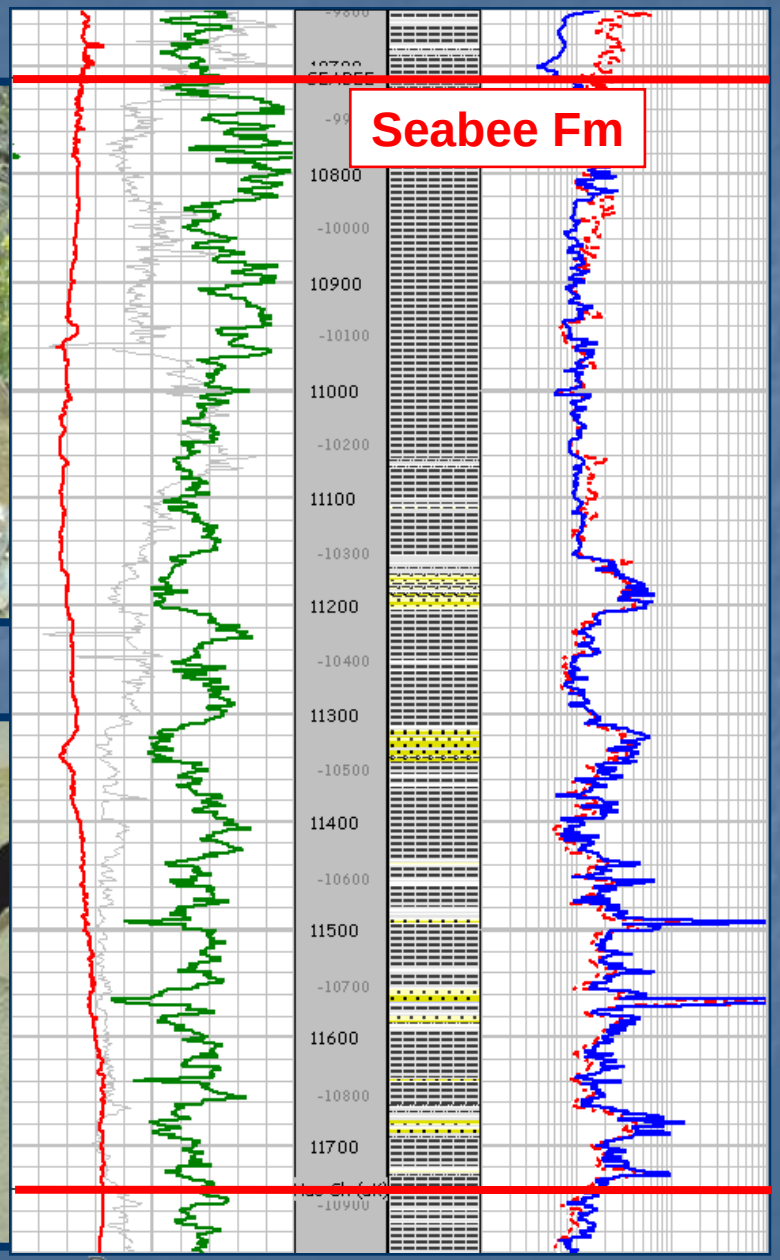


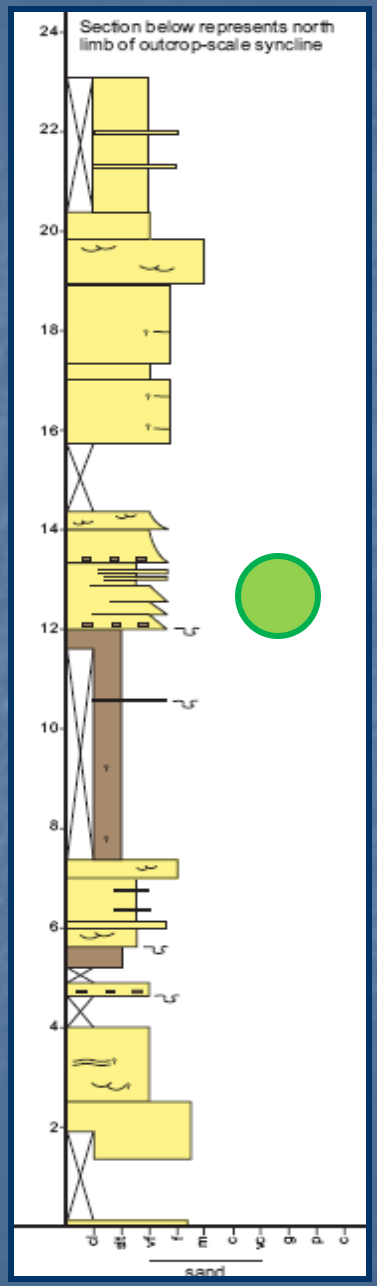
~ Hue Sh facies
tongue of organic-rich shale

Seabee Basin Floor (?) Turbidites

Station 07DL045

A.





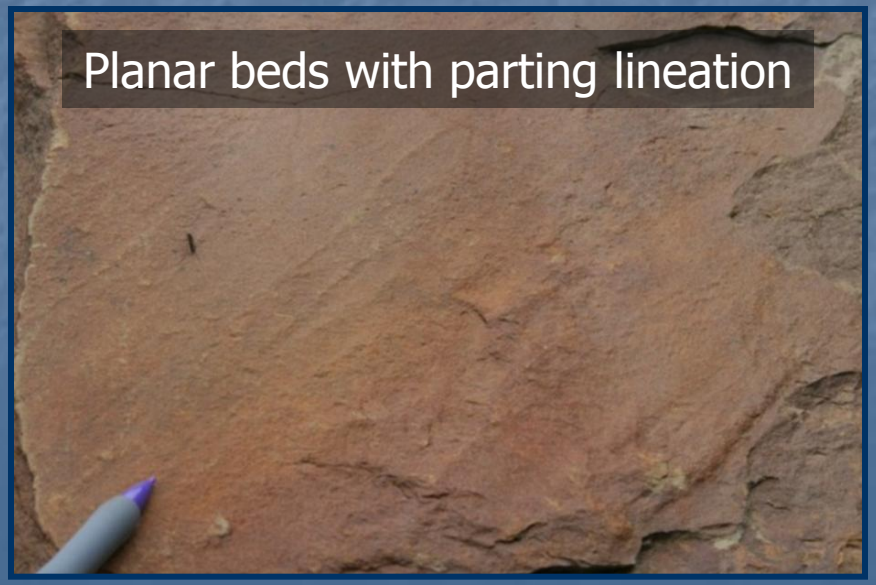
Seabee Basin Floor (?) Turbidites

Station 07DL051

Seabee Basin Floor (?) Turbidites

Station 07DL051

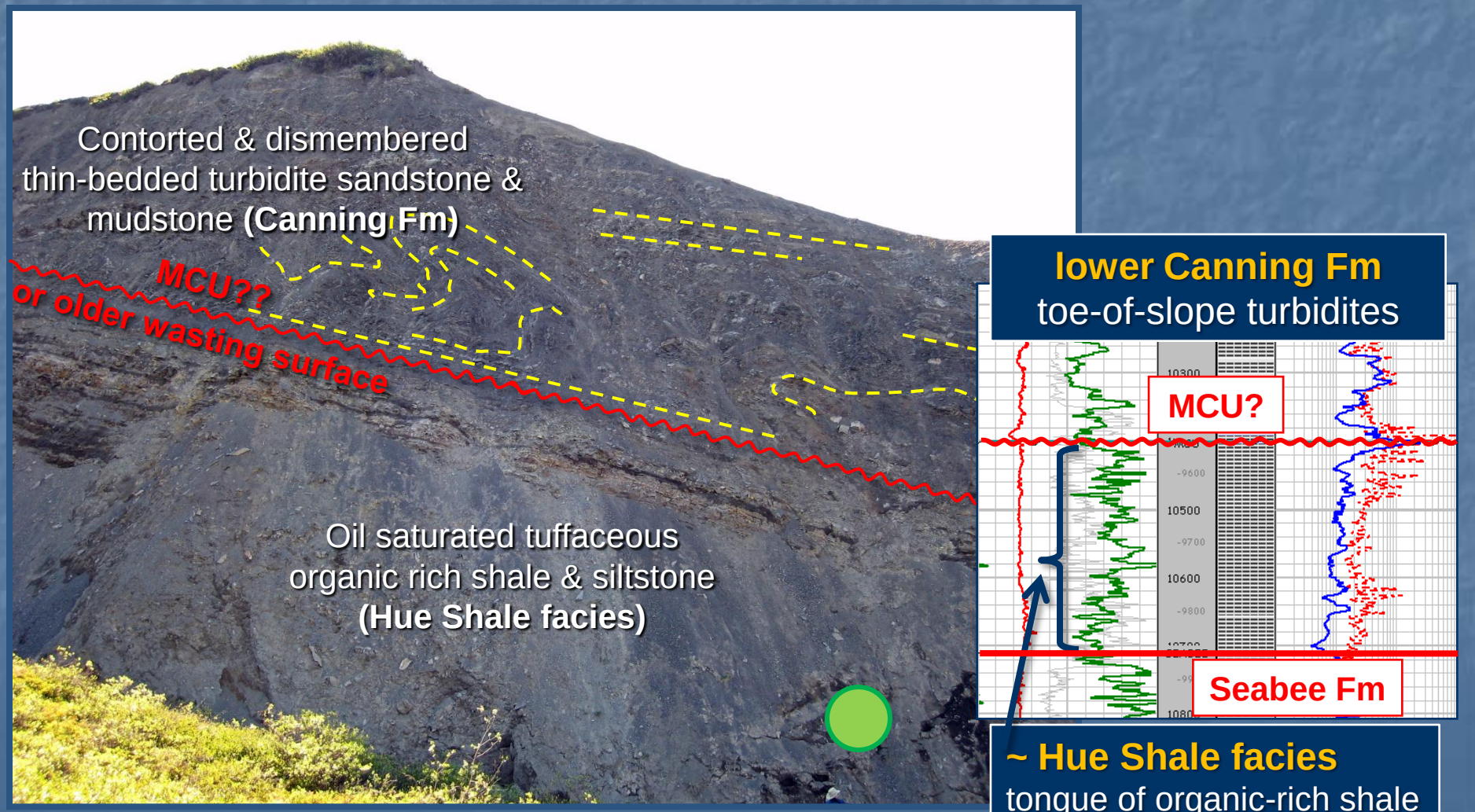
Irregular, thin bedded sandstone



Planar beds with parting lineation

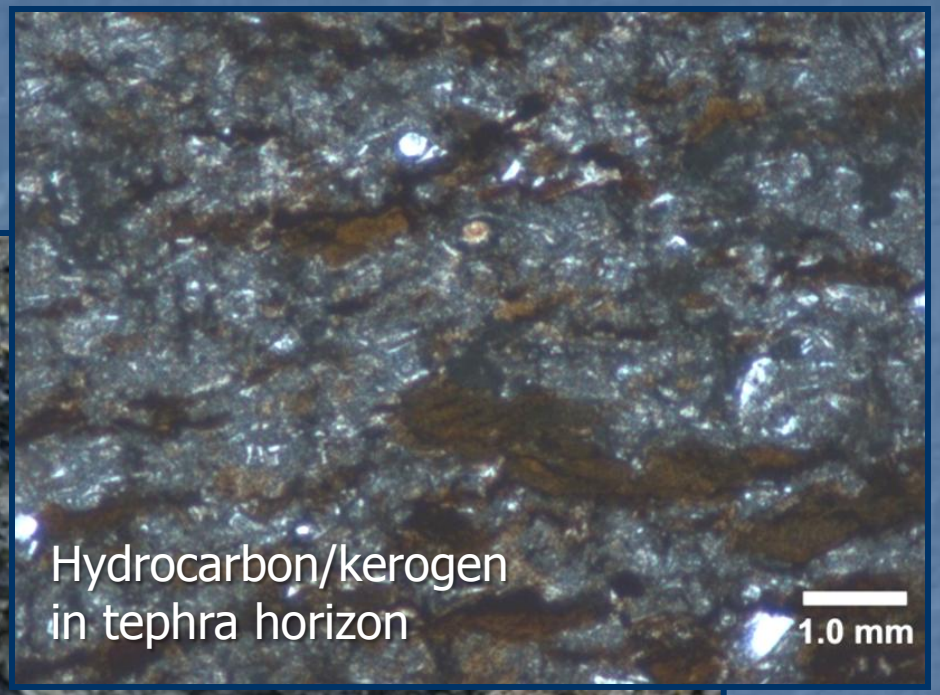
Hue Shale facies and lower Canning Fm slump

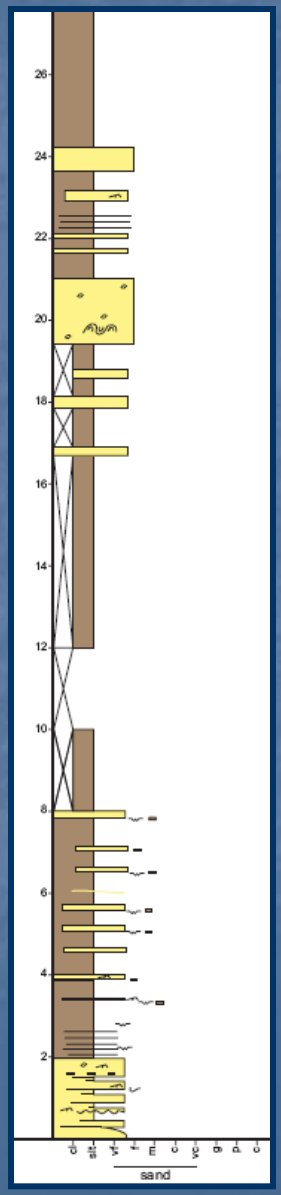
- **Turonian-Santonian to early Campanian(?) turbidites**
- **Tuffaceous, oil saturated interval (complex structure)**



Distal Seabee Fm (Hue Shale facies)

Station 07DL054 – tephra-rich, oil-saturated, organic shales



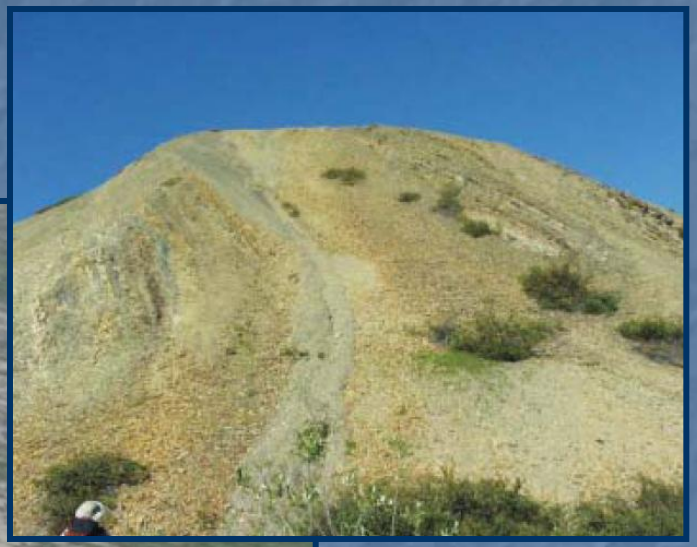


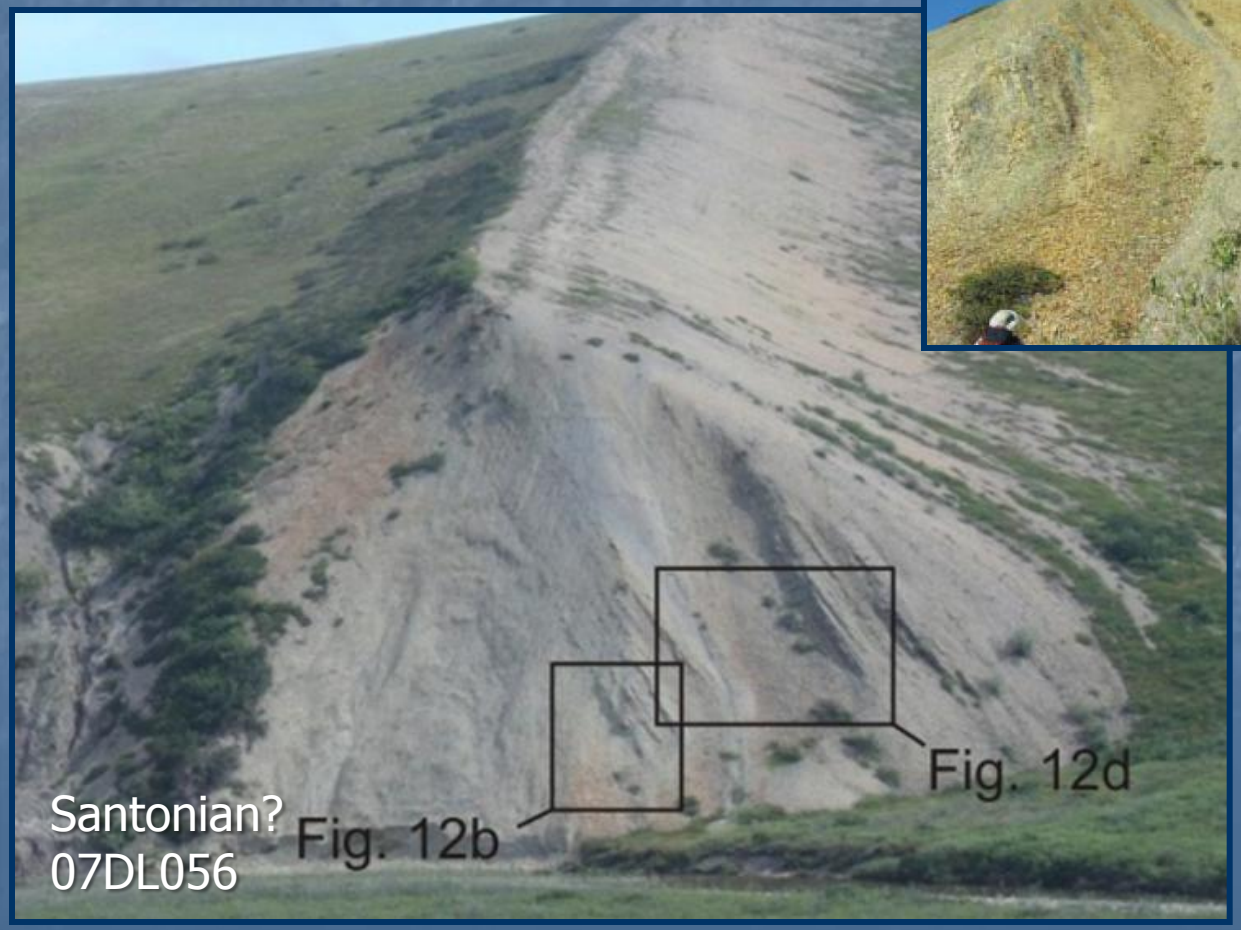
Lower Canning Fm

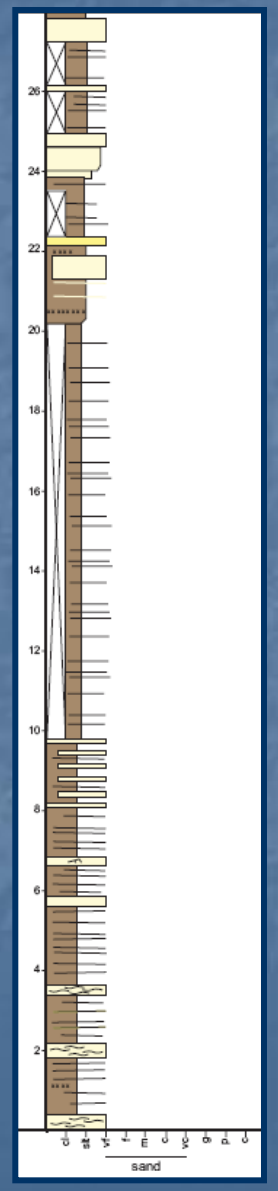
Santonian – early Campanian

tuffaceous deepwater sandstone-siltstone-shale

Stations 07DL056 – 059







Lower-middle Canning Fm

Campanian turbidite succession

Station 07DL061

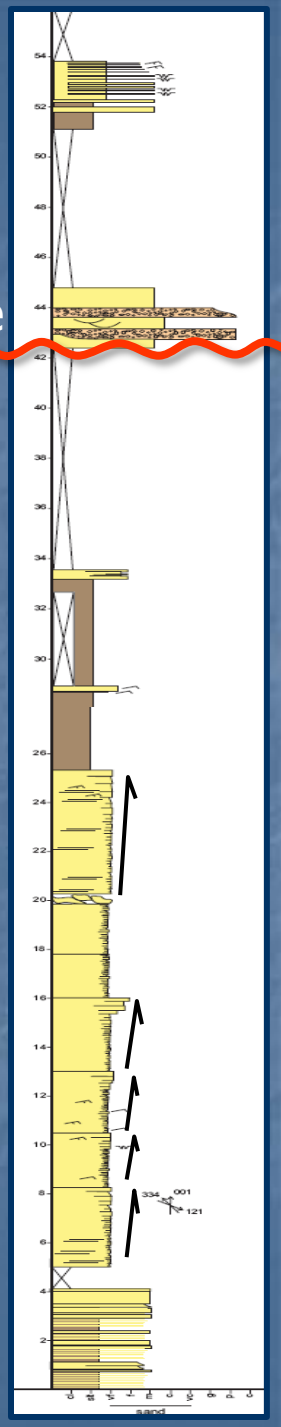
Lower-middle Canning Fm

Campanian turbidite succession
Station 07DL061

Lowstand channel/lobe

Gullied lower slope?

Leveed fan



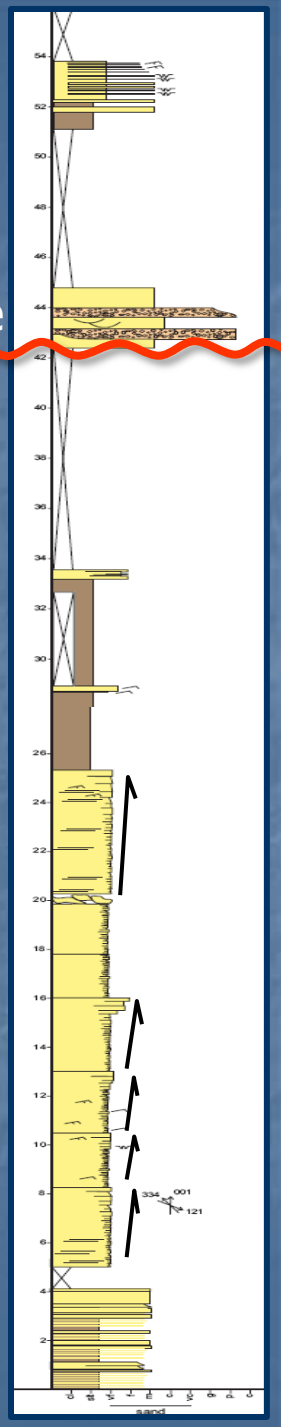
Lower-middle Canning Fm

Campanian turbidite succession

Station 07DL061

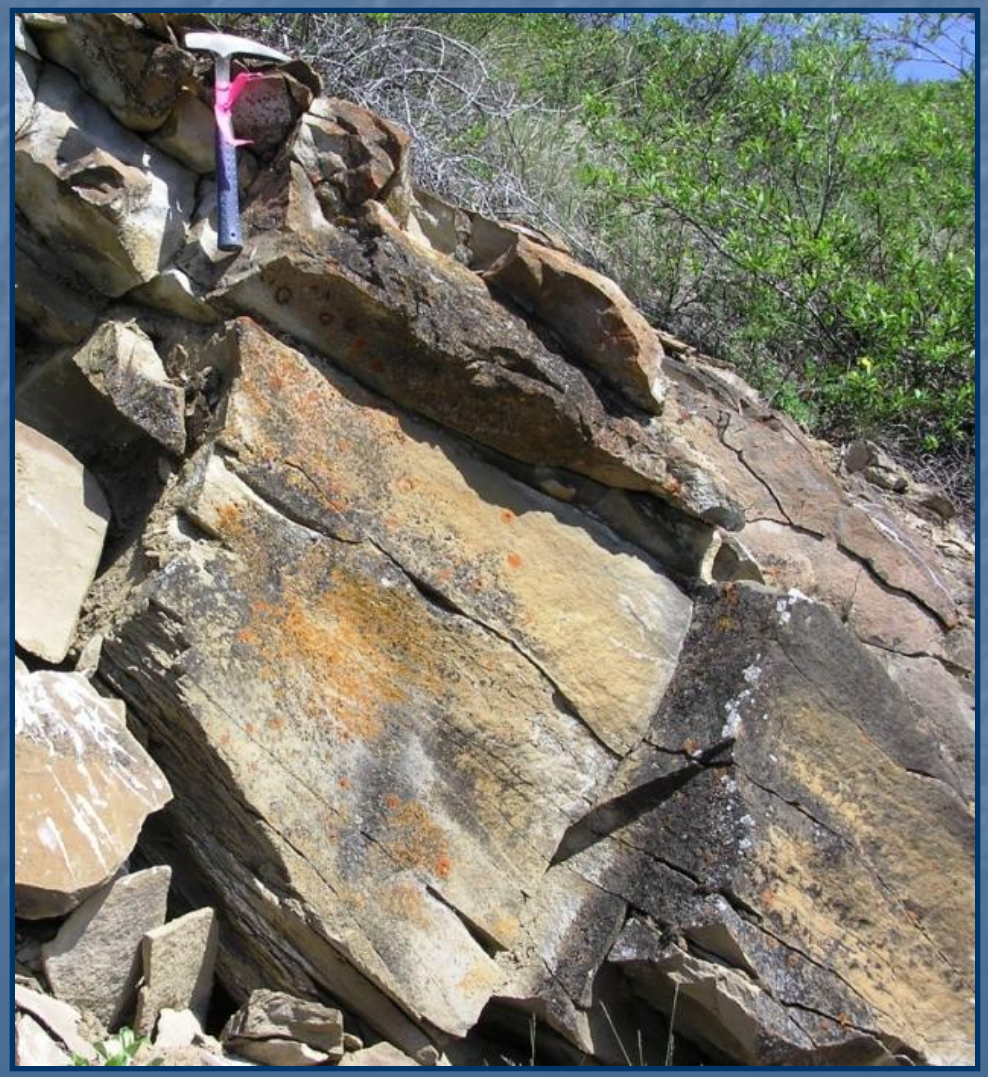
Lowstand channel/lobe

Leveed fan



Lower-middle Canning Fm

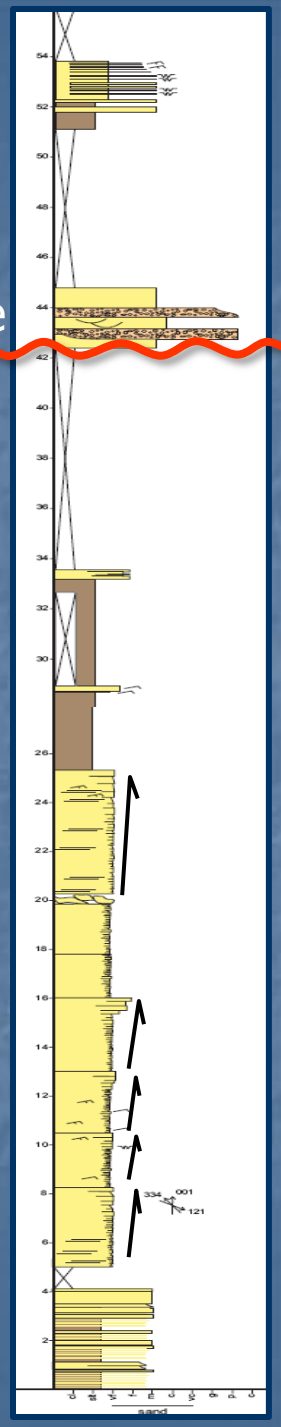
Campanian turbidite succession
Station 07DL061



Lowstand channel/lobe

Gullied lower slope?

Leveed fan



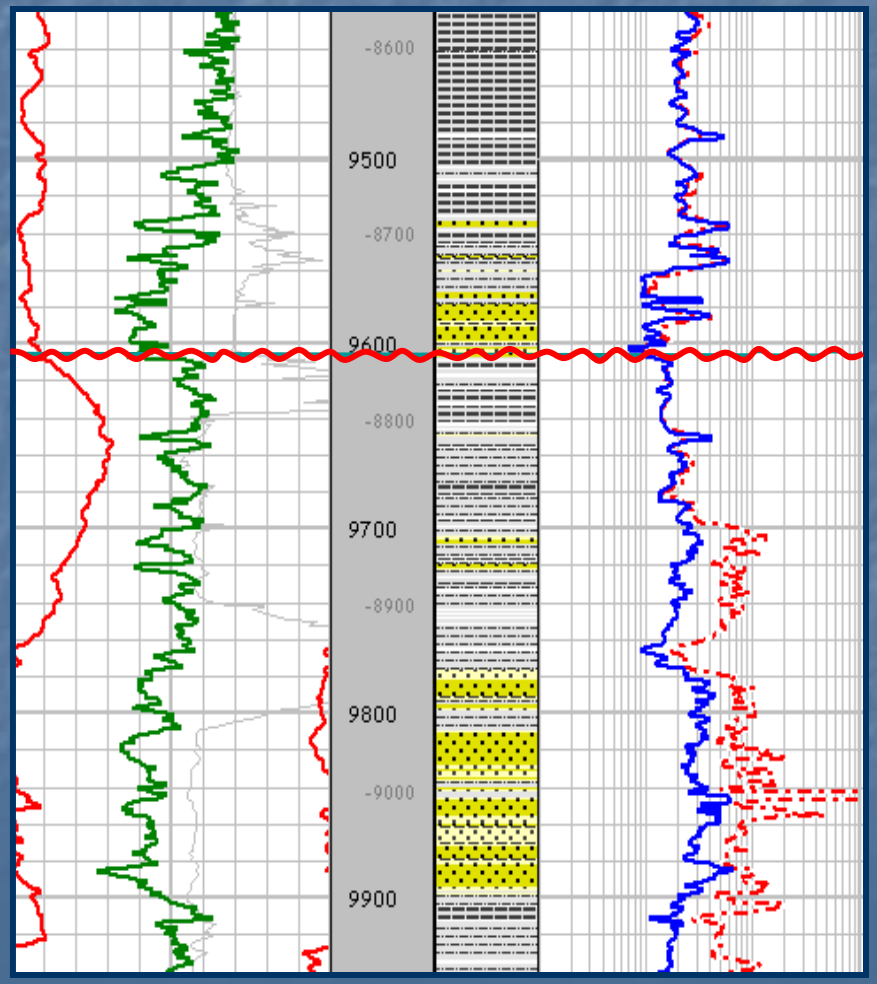
Lower-middle Canning Fm

Campanian turbidite succession

Station 07DL061

Similar motif, Canning Fm

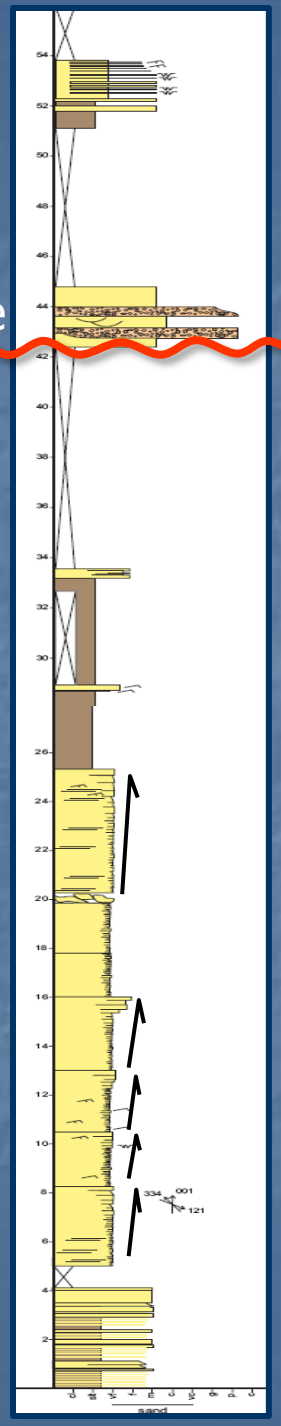
Echooka 1



Lowstand channel/lobe

Gullied lower slope?

Leveed fan

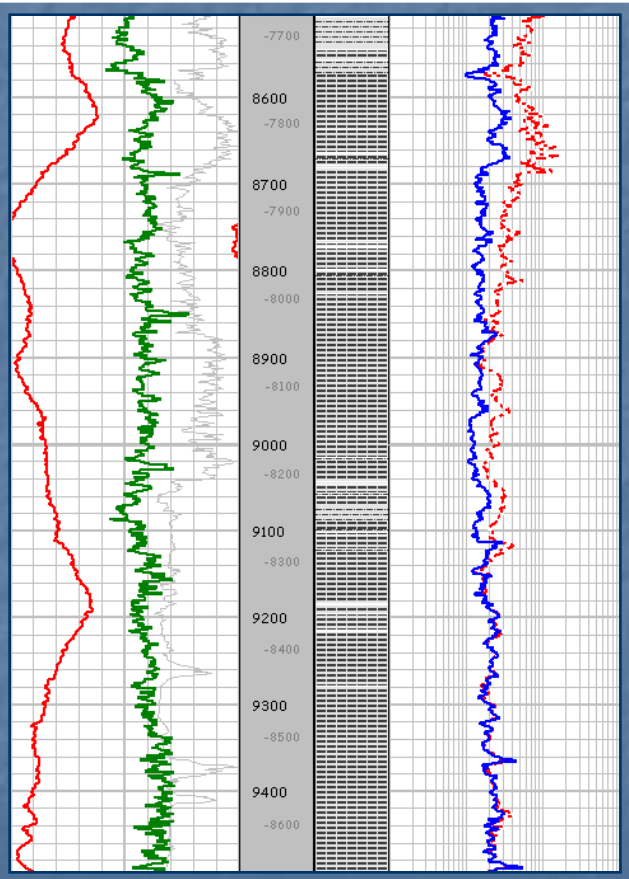


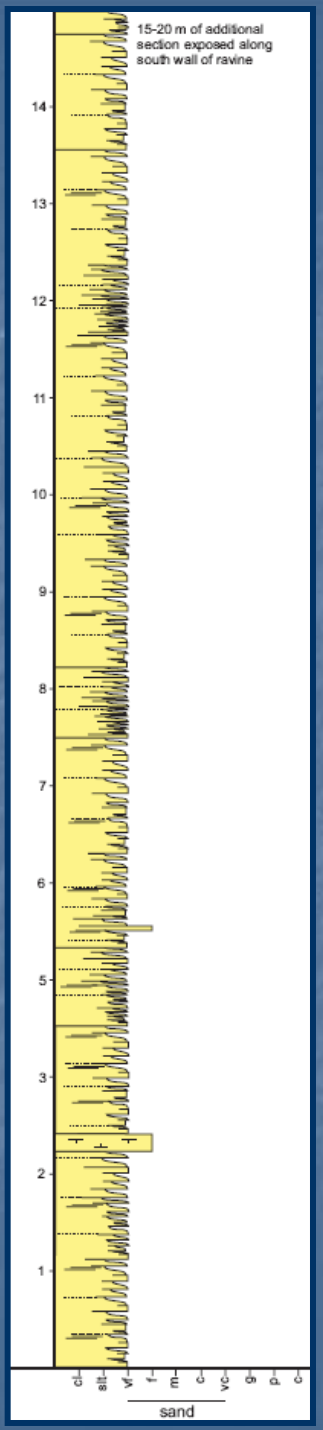
Middle-upper Canning Fm

Campanian slope to outer shelf facies

Station 07DL063

middle-upper Canning Fm
monotonous, v fine slope facies



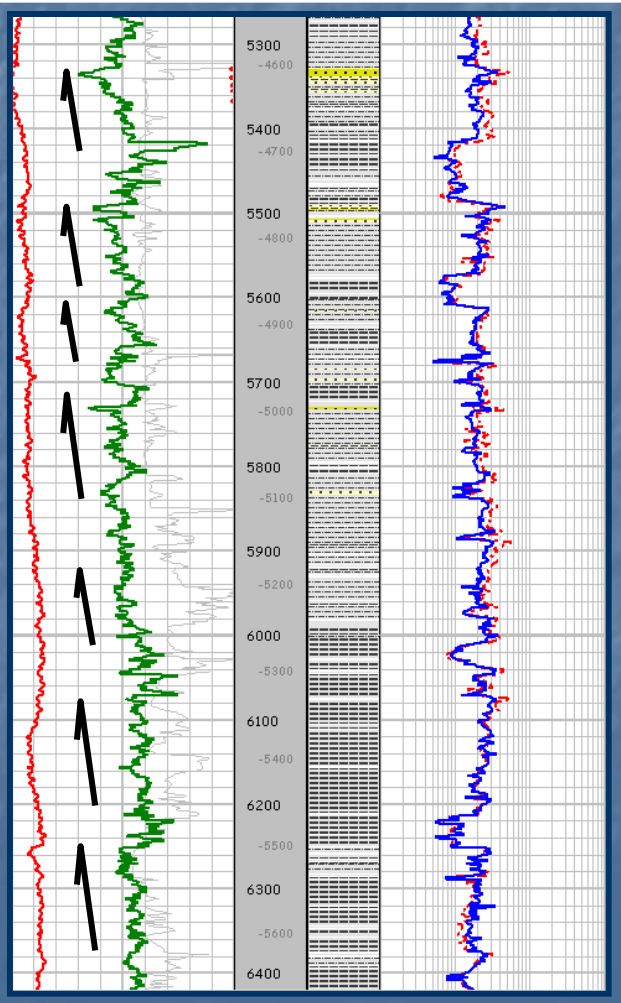


Highly continuous, monotonous, thin-bedded, planar-laminated very fine ss, planar clay drape partings

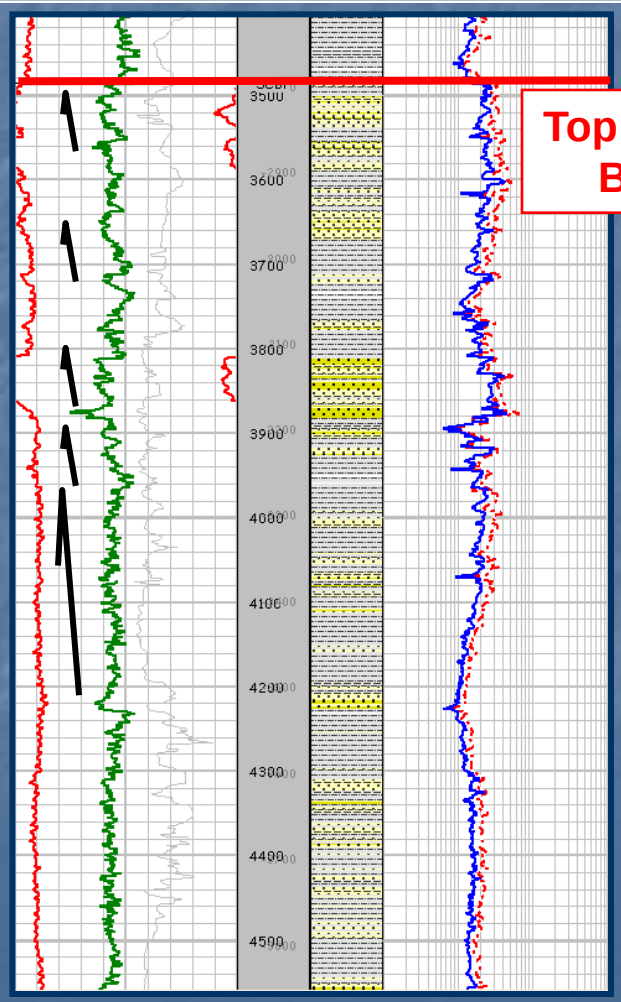
Echooka 1 well

Correlation to Sagashak Creek outcrops

Middle-upper Schrader Bluff Fm
shelf to offshore transition



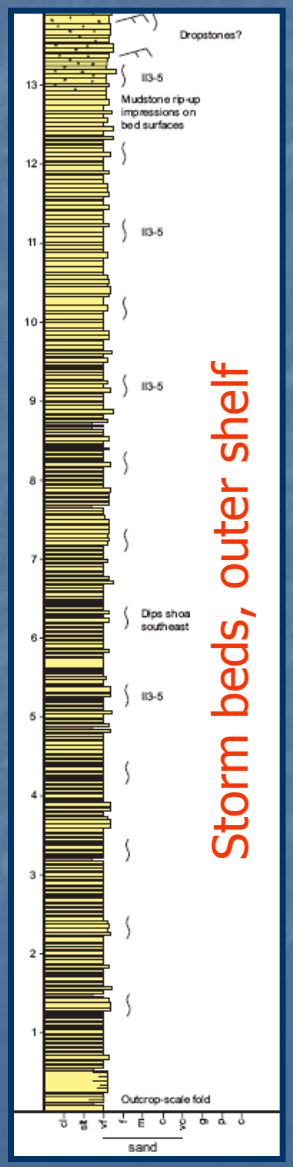
Top Schrader Bluff Fm
offshore transition to shoreface

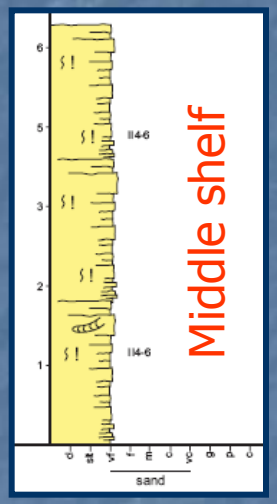


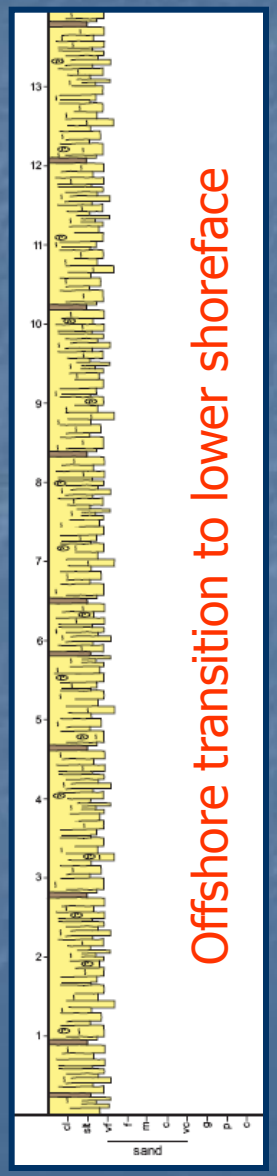
Top Schrader Bluff Fm

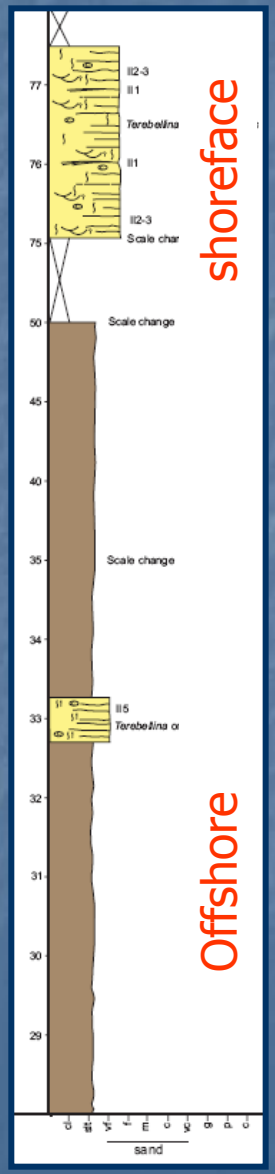
Schrader Bluff Fm

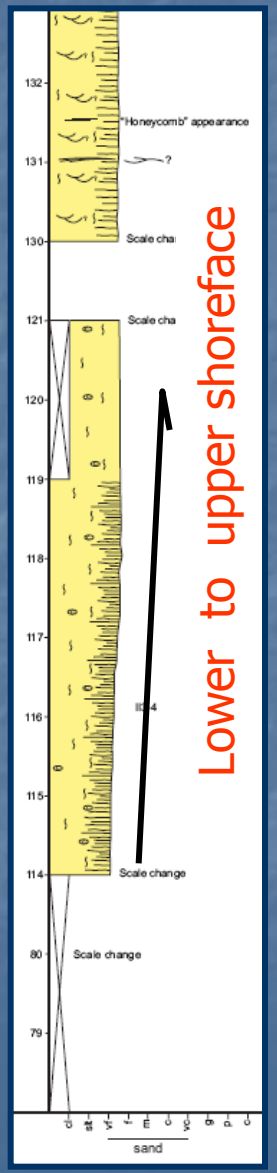
Late Campanian outer shelf to shoreface facies

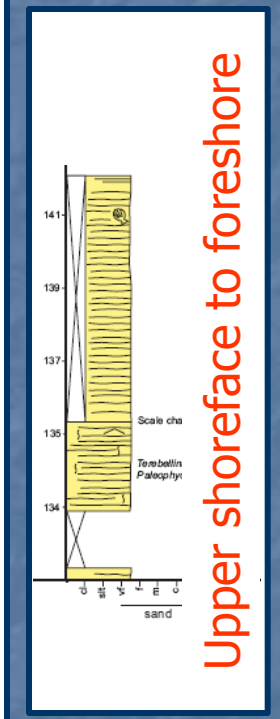












2007 Tour: Toolik River – Schrader Bluff Formation

Shallow marine topsets – shoreface parasequences

Chert-rich transgressive lag

Shell-rich transgressive lag

Conclusions

- **Sagashak Creek traverse:** provides the most continuous and least structurally complicated stratigraphic section in the project area that can be related to subsurface control

- **Echooka 1 well:** ~30 km to NNE; thinner but includes most of the section at Sagashak Creek

- **Lupine 1 well:** ~10 km to S; limited correlation to surface exposures (Seabee Fm)
  - greater uplift – mostly Seabee and older
  - structural repetition