GEOLOGIC MAP OF THE UMIAT–GUBIK AREA, CENTRAL NORTH SLOPE, ALASKA—INTEGRATION OF FIELDWORK AND SUBSURFACE DATA IN A REGION OF KNOWN OIL AND GAS ACCUMULATIONS

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ABSTRACT

The integration of recent fieldwork with available subsurface data has rendered a new geologic map (1:63,360) of the hydrocarbon-bearing Umiat–Gubik region of the central North Slope. The map spans ~2100 km² and lies at the northern extent of the Brooks Range foothills fold-and-thrust belt in the Colville foreland basin.

Cenomanian–Maastrichtian strata of the Nanushuk, Seabee, Tuluvak, Schrader Bluff, and Prince Creek Formations locally constitute an ~2-km-thick succession that crops out sparsely in the dominantly low-relief, tundra-mantled region; however, exceptional cutbank exposures occur locally. The stratigraphy comprises chiefly marine (Nanushuk, Tuluvak, Schrader Bluff) and nonmarine (Prince Creek) topsets and slope clinoforms (Seabee). This work benefits from and further elucidates recent sequence stratigraphic advances in understanding how this part of the Colville basin filled during Late Cretaceous time. As an example, the geologic map of this study is the first of the Umiat–Gubik area to distinguish that the three local Schrader Bluff Formation members underlie a regionally significant mid-Campanian unconformity and are entirely older than Schrader Bluff strata that crop out east of the formation's Anaktuvuk River type section.

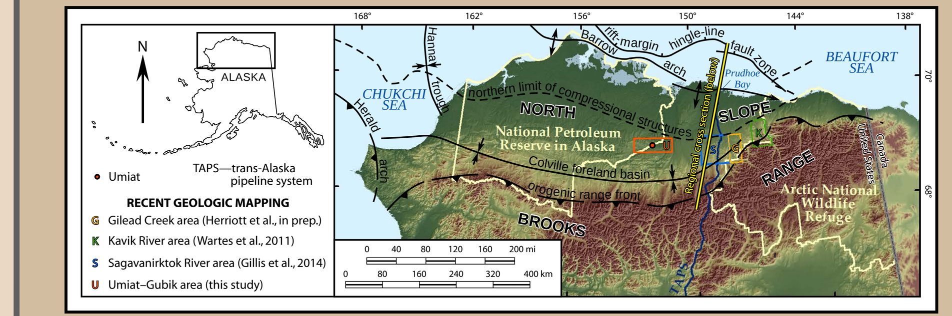
The map reveals a series of west- to northwest-trending gentle folds with km-scale wavelengths. Anticlines are locally thrusted and interpreted to be folded above structurally thickened and/or duplexed fine-grained successions of Torok Formation. Three culminations host known yet undeveloped petroleum accumulations at Umiat (mainly oil), East Umiat (gas), and Gubik (gas). These currently stranded discoveries occur along doubly plunging anticlinal traps and the main Umiat culmination is modified by what we interpret as south-dipping reverse faults.

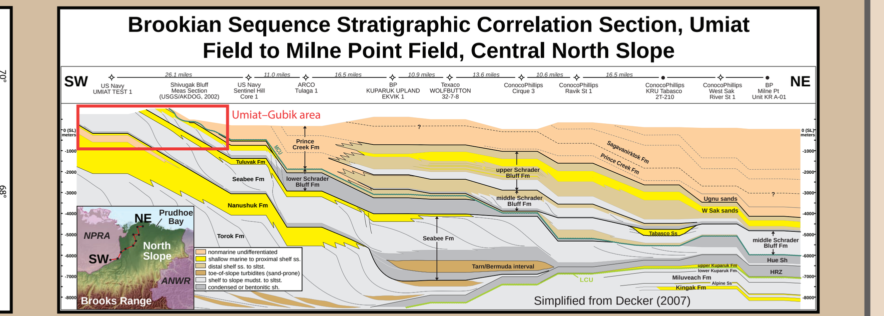
The geologic map was prepared through assimilation of our field data, aerial and satellite imagery, seismic data, and well logs. Near surface formation picks are available or derived for most of the area's 24 exploration wells and cross sections are constructed along lines of section approximately coincident with publicly available 2D seismic data. This integrative approach yields an improved understanding of the Umiat–Gubik area geology that is constrained by numerous and corroborating datasets.

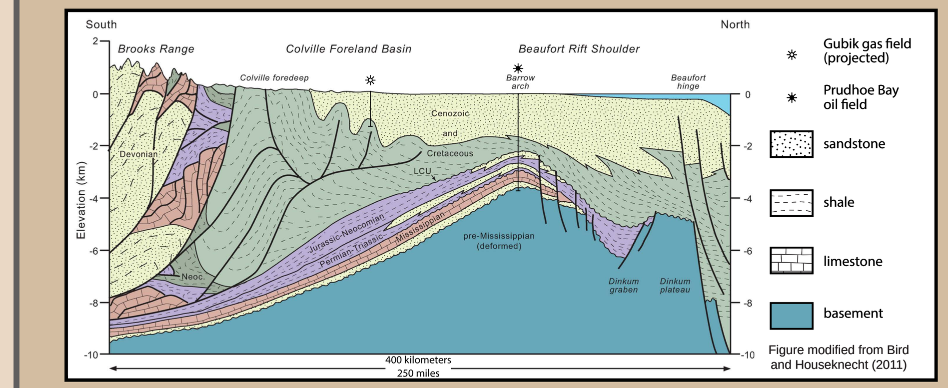
HIGHLIGHTS AND KEY OBSERVATIONS

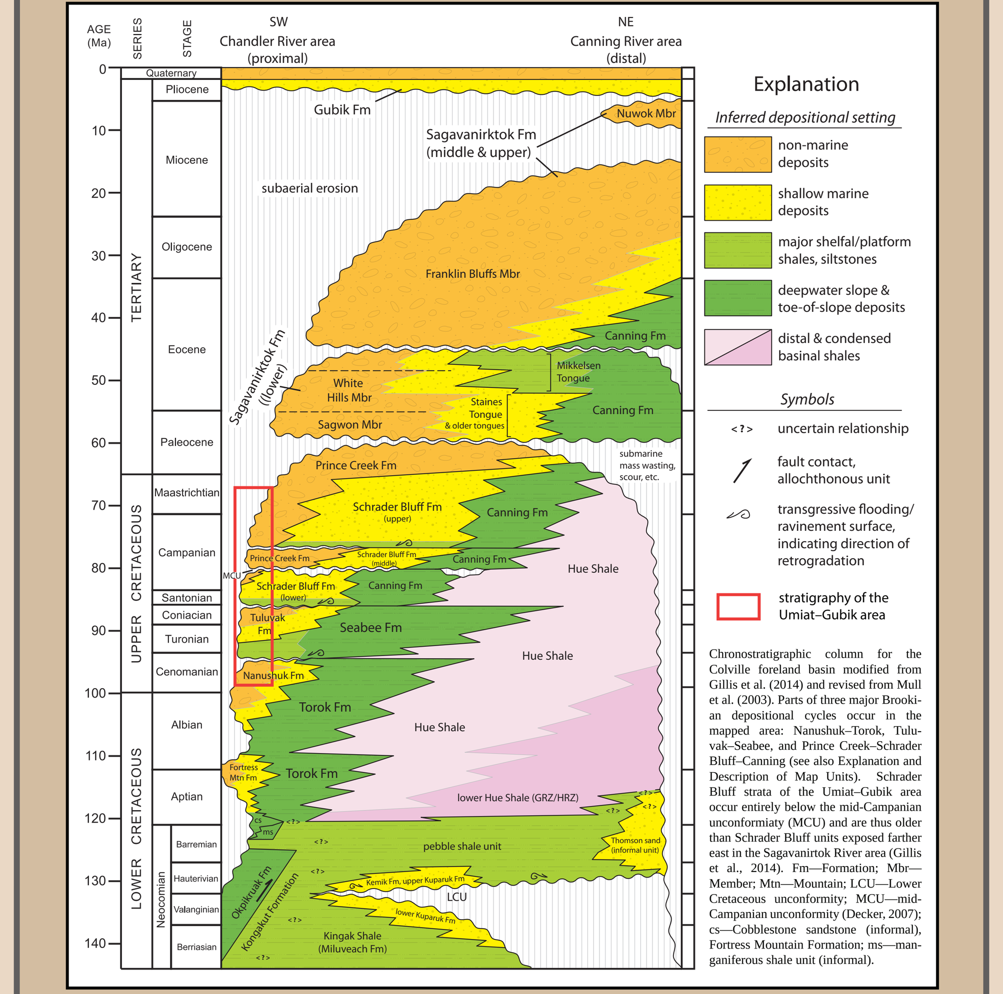
- The map area hosts dominantly topset strata that record continued filling of the Colville foreland basin during the Late Cretaceous (see Regional Context)
- This new geologic map of the Umiat–Gubik area is based on the integration of geologic and geophysical datasets, photogeologic mapping, and previously published data (see Geologic Mapping: An Integrated Approach)
- Three known, undeveloped petroleum accumulations occur in the map area along doubly plunging anticlinal traps at Umiat, East Umiat, and Gubik
  - Gubik gas field (see A–A')
  - Umiat trend oil and gas fields:
    - The East Umiat gas field occurs in the hangingwall of a north dipping thrust (see A–A')
    - The Umiat oil field lies farther west-northwest along the same trend, but is in the hangingwall of a south dipping thrust(s) (cf. Mull et al., 2004) (see B–B')
    - A transfer fault is locally interpreted in seismic data and mapped along the Colville River corridor between these two fields
- The regional lower part of Schrader Bluff Formation (Ksbl) thins northward across the study area (see A–A'), potentially reflecting reduced accomodation to the north during Santonian–mid-Campanian time
- The regionally recognized mid-Campanian unconformity (MCU *sensu* Decker, 2007) crops out locally

REGIONAL CONTEXT









GEOLOGIC MAPPING: AN INTEGRATED APPROACH

INPUTS

- Geologic Mapping
- Seismic Data (e.g., see A–A' and B–B')
- Stratigraphic Studies
- Photogeologic Mapping
- Well Logs
- Time and Depth Structure Maps

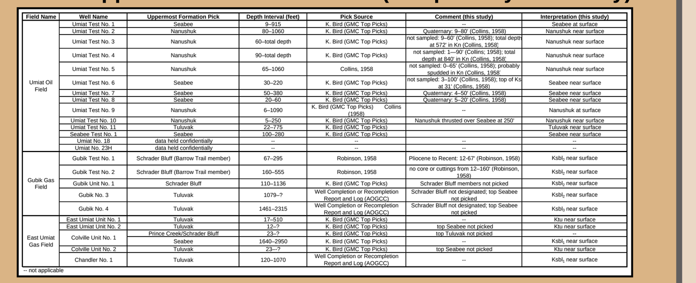
Previously Published Studies and Datasets

- Well Picks (Collins, 1958; Robinson, 1958; Geologic Materials Center (Top Picks spreadsheet); AOGCC)
- Geologic Maps (Detterman et al., 1963; Brosgé and Whittington, 1966; Mull et al., 2004)
- Recent Sequence Stratigraphic Advances (e.g., Houseknecht and Schenk, 2005; Decker, 2007; Flores et al., 2007a, b; LePain et al., 2009; Gillis et al., 2014; see also Regional Context)
- Stratigraphic Thicknesses (e.g., Collins, 1958; Robinson, 1958; Detterman et al., 1963; Brosgé and Whittington, 1966)
- Time and Depth Structure Maps (e.g., Kumar et al., 2002; Molenaar, 1982)

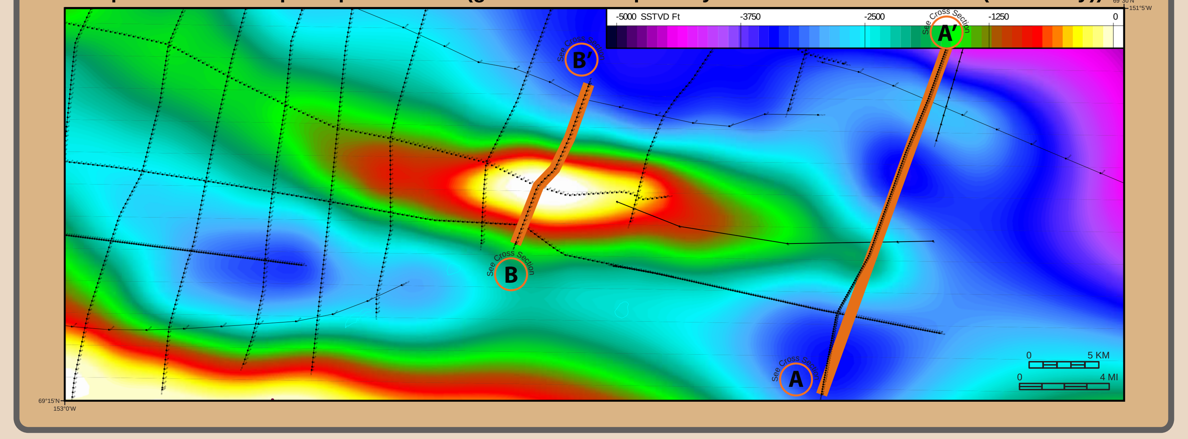
EXAMPLES OF INPUTS

Stratigraphic Studies: Schrader Bluff, Anaktuvuk River (this study)

Wells: Uppermost Formation Picks (compiled by this study)



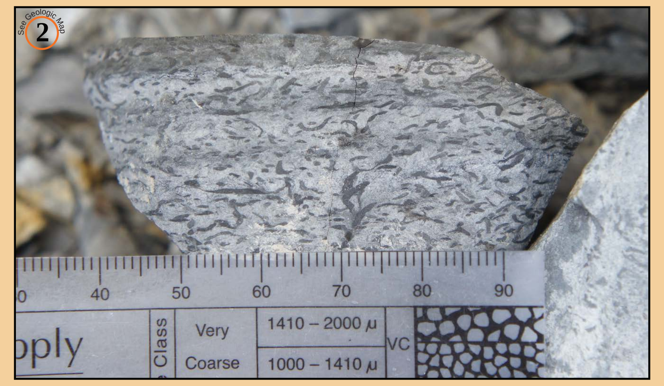
Depth Structure Map—Top Nanushuk (generated from publicly available 2D seismic data (this study))



FIELD PHOTOGRAPHS

View westward of Cenomanian-age Nanushuk Formation strata cropping out along the Colville River's north bank at a location informally referred to as the Colville incision (see LePain et al., 2009). Marine sandstones of the Nanushuk host the Umiat oil accumulation approximately 20 km northeast of this locality. Hammer is 31 cm long for scale.

View southeastward of rubble-crop and a laterally extensive traceable bed of the Schrader Bluff Formation within an area otherwise covered by tundra, which is characteristic of the mapped area. Tying this and similar traceable beds to locally excellent river bluff exposures (e.g., see Uluksrak and Shivugak Bluffs photographs below) is integral to mapping the area's geology beyond river corridors.



Medium- to dark-gray, hackly weathering, well-indurated, tuffaceous(?) very fine-sandstone and siltstone packages are abundant within $Ksbl_2$ (Schrader Bluff Foramtion, informal middle member) and are commonly intensely bioturbated by *Phycosiphon*.

View north-northeastward of the southern extent of Uluksrak Bluff, which exposes a thick section of Prince Creek Formation.

View northeastward of Shivugak Bluff, with prominent exposures of Schrader Bluff (regional lower part) and Prince Creek Formations. The mid-Campanian unconformity (MCU) crops out at this locality and is a sequence stratigraphically significant surface that farther to the east and northeast (i.e., basinward) separates the regional lower Schrader Bluff Formation from the regional middle Schrader Bluff Formation (Decker, 2007; see also Gillis et al., 2014).

ACKNOWLEDGEMENTS

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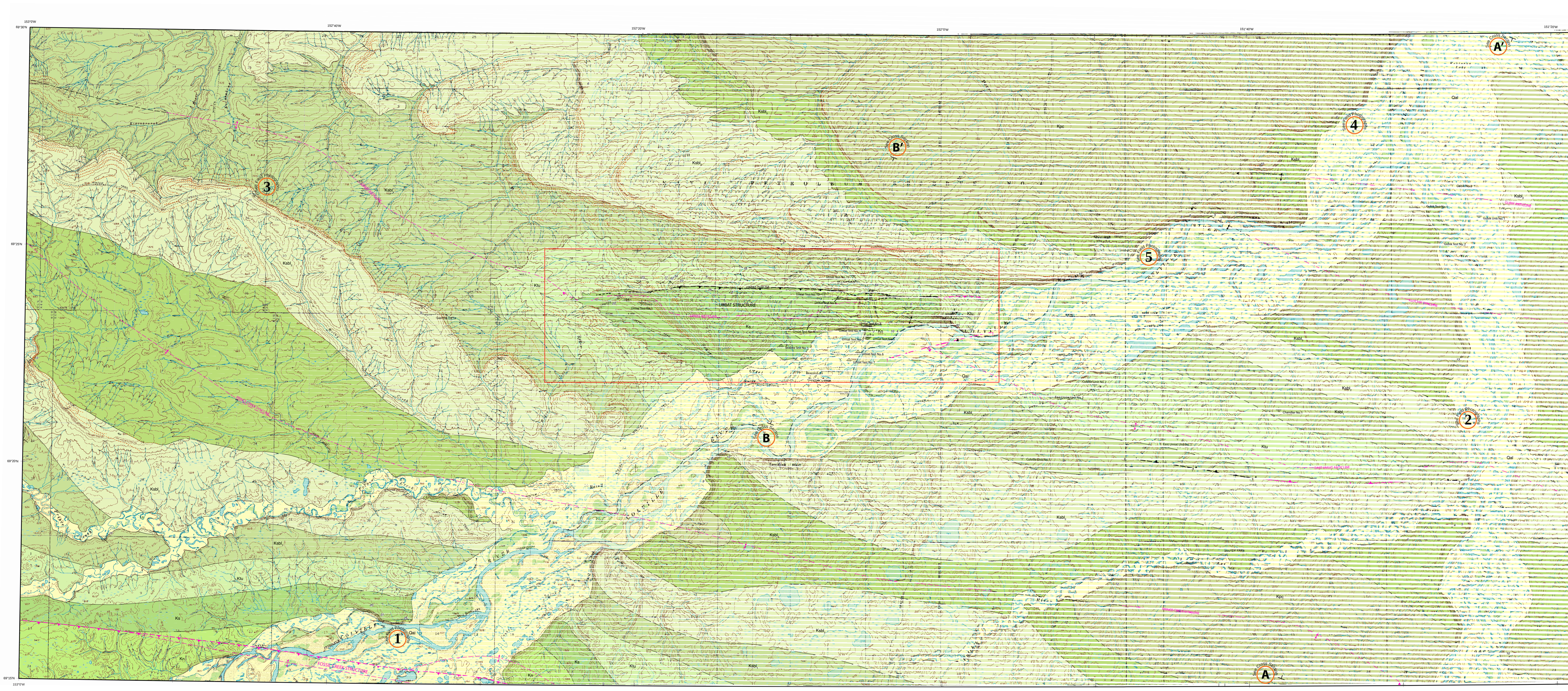
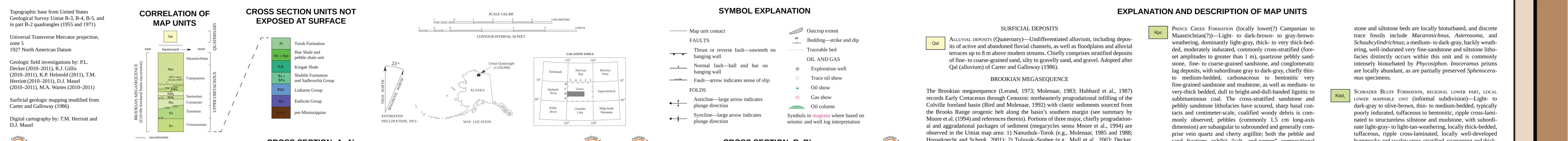
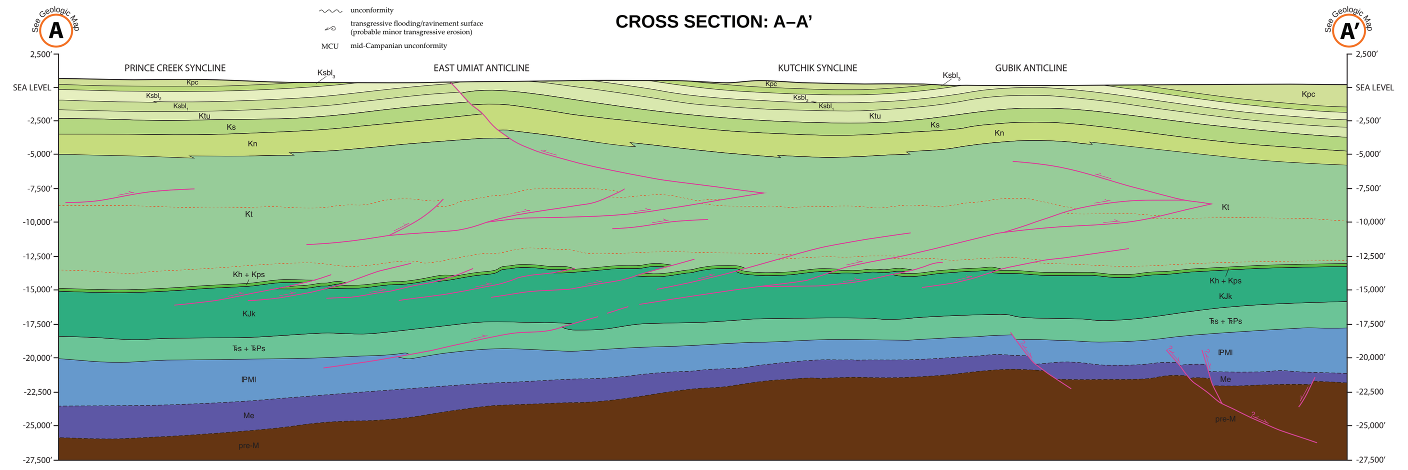
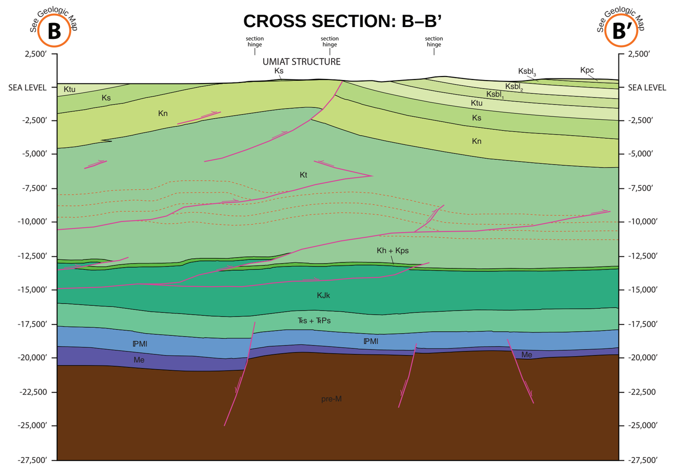


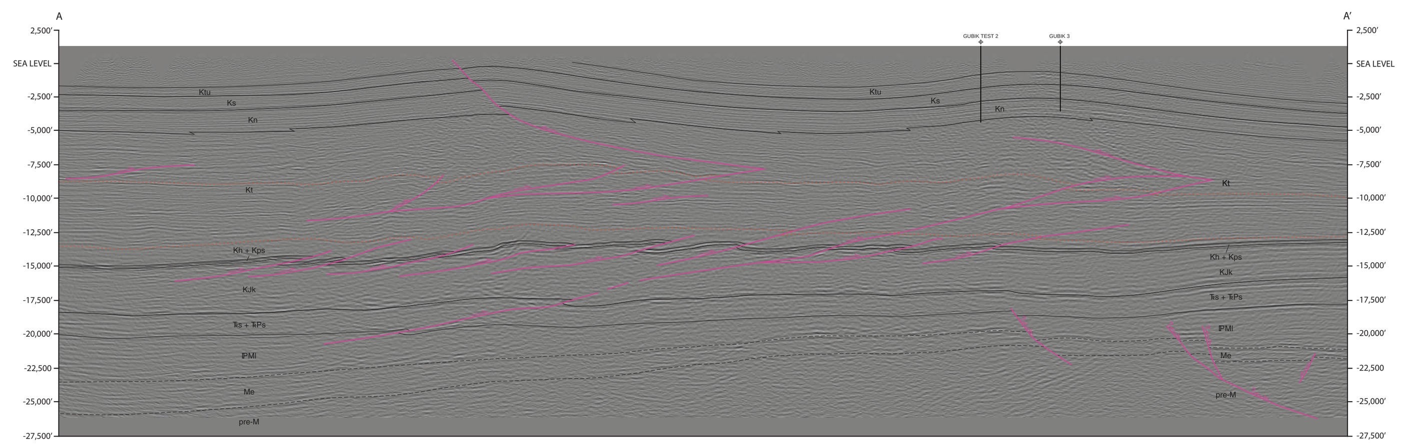


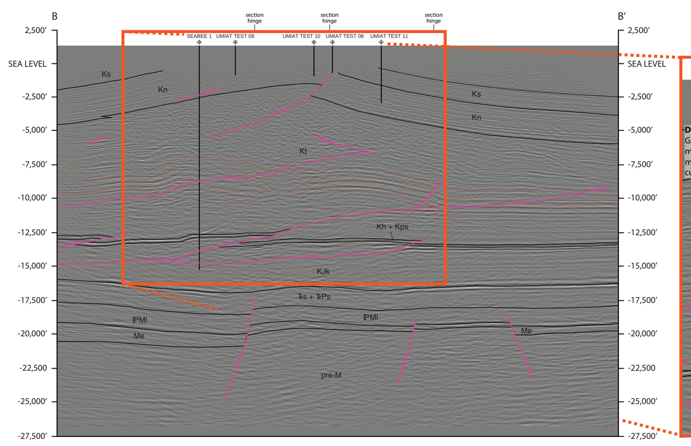
CROSS SECTION: A–A'



CROSS SECTION: B–B'







UMIAT OIL FIELD AT 150% MAP SCALE