

**PETROLEUM EXPLORATION  
OF NPRA, 1974-1981  
Final Report**

**VOLUME 2**

PETROLEUM EXPLORATION

OF NPRA, 1974-1981

FINAL REPORT

VOLUME 2

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Area Geologist	E. C. Guldenzopf
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Tetra Tech Report No. 8200

March 31, 1982

Prepared for:  
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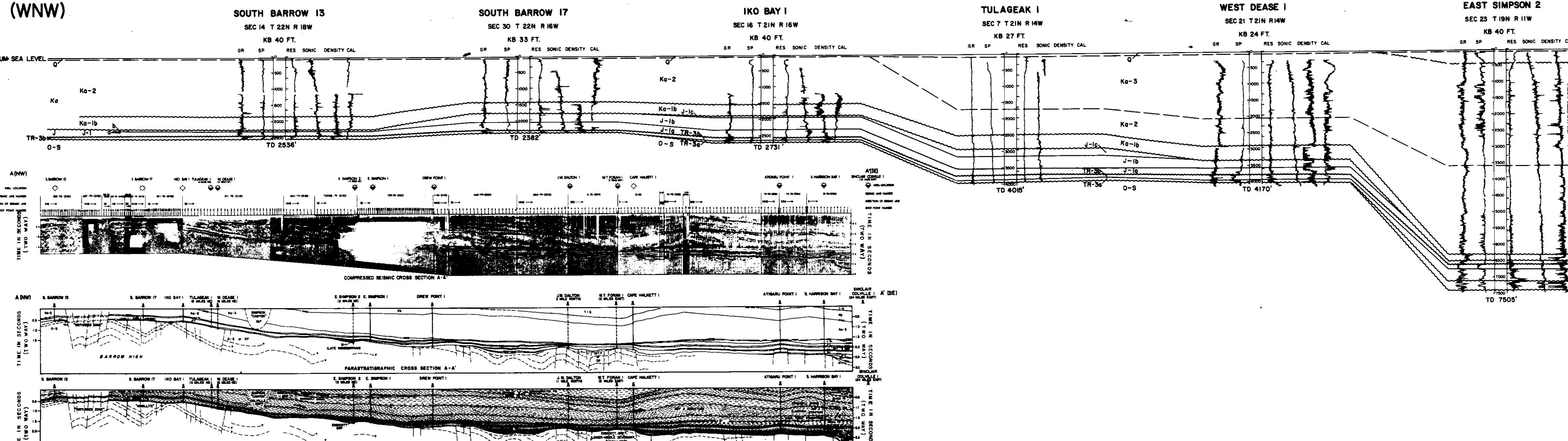
FIGURE 29

CORRELATION CROSS SECTION A-A', SOUTH  
BARROW 13 TO SINCLAIR COLVILLE 1

Cross section A-A' includes South Barrow 13, South Barrow 17, Iko Bay 1, Tulageak 1, West Dease 1, East Simpson 2, East Simpson 1, Drew Point 1, J. W. Dalton 1, W. T. Foran 1, Cape Halkett 1, Atigaru Point 1, and South Harrison Bay 1. Datum is sea level. The main geologic features shown are:

1. Unit M-1 (Endicott Group) overlies unit O-S ("Argillite") at East Simpson 2, W. T. Foran 1, Cape Halkett 1, Atigaru Point 1, and Sinclair Colville 1. M-1 is present questionably at J. W. Dalton 1, based on indeterminate fossils and Late Mississippian tectonics suggested by 18° to 35° dips recorded in basal clastics.
2. The Lisburne Group laps out to the northwest. M-2 (Alapah Limestone) laps out between Cape Halkett 1 and W. T. Foran 1, and P-1 (Wahoo Limestone) laps out between J. W. Dalton 1 and Drew Point 1. The basal Lisburne clastics at J. W. Dalton 1 are probably a part of P-1 and a lateral facies of the Wahoo.
3. P-1 is truncated and unconformably overlain by PR-2 at Sinclair Colville 1, South Harrison Bay 1, and Atigaru Point 1, and by TR-1 at Cape Halkett 1, W. T. Foran 1, and J. W. Dalton 1.
4. TR-2 ("Ivishak sandstone") is only 93 ft (28 m) below the basal "Pebble Shale" unconformity at W. T. Foran 1, and only 139 ft (41 m) below it at J. W. Dalton 1. The subcrop of TR-2 below the "Pebble Shale" is located under the Beaufort Sea, 4 to 6 mi (6 to 10 km) north of W. T. Foran 1 and J. W. Dalton 1.
5. Triassic rocks lap onto the Barrow High. TR-3a (Shublik Formation) laps out between Iko Bay 1 and South Barrow 17. TR-3b (Sag River Sandstone) is present at South Barrow 13, but grades into shale to the northwest between East Simpson 2 and West Dease 1.
6. Unit J-1 ("Lower Kingak") is present in all wells except J. W. Dalton 1 and W. T. Foran 1. J-1c is below the basal "Pebble Shale" unconformity at Sinclair Colville 1, South Harrison Bay 1, Atigaru Point 1, Tulageak 1, and Iko Bay 1. J-1 is truncated more deeply by the basal "Pebble Shale" unconformity toward the Barrow High; J-1b underlies it at Cape Halkett 1, East Simpson 1, West Dease 1, South Barrow 17, and South Barrow 13. At East Simpson 2, J-1a ("Barrow sandstone") is all that remains of J-1.
7. Unit J-3 is only in the wells farthest from the Barrow High: Atigaru Point 1, South Harrison Bay 1, and Sinclair Colville 1.
8. Ka-1b ("Pebble Shale") is present in all wells except South Harrison Bay 1 on the edge of the Fish Creek Platform.
9. Ka-2 and Ka-3 (Torok Formation and Nanushuk Group) are time-transgressive units that overlie unit Ka-1b. The rocks become younger from the southwest to the northeast, and have an initial regional dip to the northeast.
10. The Torok clinothem (foreset) beds in unit Ka-2 are immediately below the surface deposits in South Barrow 13 and South Barrow 17.
11. Progressively younger strata underlie the Quaternary surface materials to the southeast. The Torok undathem (topset) beds in unit Ka-2 are present at Iko Bay 1. At Tulageak 1 and West Dease 1, unit Ka-3 underlies unit Q and consists of mainly marine Nanushuk strata. Unit Kb (Colville Group) is present at East Simpson 2 and East Simpson 1. Unit T (Sagavanirktok Formation) underlies the surface beds in all other wells except Sinclair Colville 1 where unit Kb is on the surface.

A (WNW)



TETRA TECH, INC.  
ENERGY MANAGEMENT DIVISION  
PETROLEUM EXPLORATION OF SPRING 1974-1985 FINAL REPORT  
CORRELATION CROSS SECTION A-A'  
SOUTH BARROW 13-SINCLAIR COLVILLE I  
NPR  
ONTARIO  
ALASKA

HUSKY OIL NPF OPERATIONS INC

PROJECT NO. TC-774

INTERPRETATION BY V. SINGER, D. MORRIS

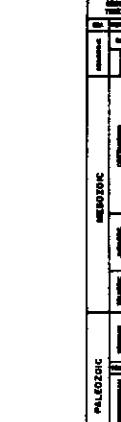
DATE: APRIL, 1986

DATUM: SEA LEVEL

FIGURE 29

NO HORIZONTAL SCALE

INDEX MAP

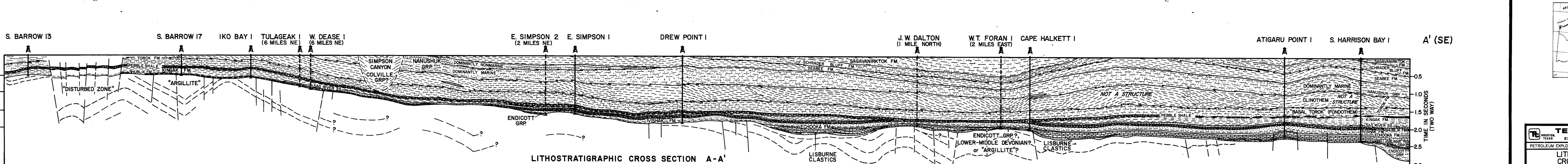


## FIGURE 30

LITHOSTRATIGRAPHIC CROSS SECTION A-A', SOUTH  
BARROW 13 TO SOUTH HARRISON BAY 1

Features of interest, from the bottom upward and from northwest (left) to southeast (right) of the section, are:

1. The "Acoustic basement" is composed of "Argillite" (phyllite and quartzite) in the Barrow area. Farther to the southeast, rocks lithologically comparable to the Endicott Group probably are downfaulted erosional remnants lodged in basement rocks.
2. The Endicott Group is time-transgressive onto the Barrow Arch. Pennsylvanian clastics below Lisburne Group carbonates at J. W. Dalton 1 are classed lithologically as Lisburne clastics (unit P-1).
3. Within the Lisburne Group, the Wahoo Limestone truncates the Alapah Limestone east of South Harrison Bay 1. The Wahoo laps out between J. W. Dalton 1 and Drew Point 1.
4. The Echooka Formation (Ikiakpaurak Member) and the upper part of the Wahoo Limestone are truncated and overlain by the Ivishak Formation just east of Drew Point 1.
5. The Shublik Formation and Sag River Sandstone lap out on the Barrow High. The Sag River is represented by an unnamed siltstone equivalent in the Barrow area.
6. The "Pebble Shale" truncates Paleozoic and early Mesozoic rocks over the Barrow Arch.
7. The source of the Torok Formation and the Nanushuk and Colville Groups seems to be to the west. The Torok-Manushuk sequence progrades toward the east. First, the Torok fonothem, clinothem, and undathem, and then the Nanushuk marine and nonmarine occur upward in the section. The great thickness of the sequence indicates very rapid deposition.
8. The Colville Group is a thinner replica of the underlying Torok-Manushuk sequence. The basin-slope sequence of the Seabee Formation, which is similar to the Torok, is succeeded by the shallow marine Schrader Bluff Formation, which is similar to the Nanushuk marine. The Colville progrades toward the east.
9. The Sagavanirktock Formation is a shallow marine Tertiary unit. The thickest Tertiary section on the Reserve occurs in the northeast corner between J. W. Dalton 1 and Atigaru Point 1.



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HOUSTON, TEXAS ENERGY MANAGEMENT DIVISION PASADENA, CALIFORNIA  
PETROLEUM EXPLORATION OF NPRA 1974-1981 (FINAL REPORT)

LITHOSTRATIGRAPHIC CROSS SECTION A-A'

SOUTH BARROW I3-S. HARRISON BAY I

NPR ALASKA

FOR  
ONPRA

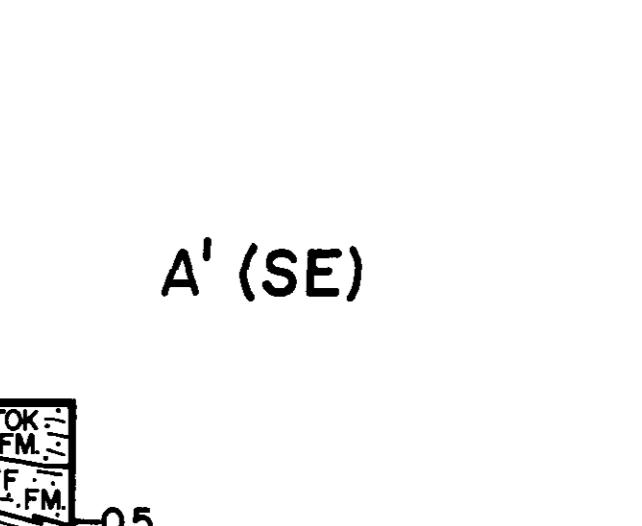
HUSKY OIL NPR OPERATIONS INC.

PROJECT MANAGER: J.W. BRUYNZEL PROJECT NO. TC-774  
INTERPRETATION BY: C. GULDENZOPF REVISED  
DATE: JUNE, 1981 DATUM: SEA LEVEL INITIAL  
CONTOUR INT: SCALE: DWG NO.

TETRA TECH REPORT NO. 8200

FIGURE 30

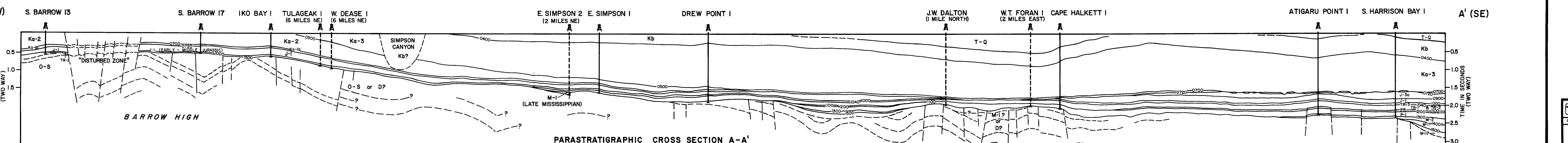
TG2-0170



**FIGURE 31****PARASTRATIGRAPHIC CROSS SECTION A-A', SOUTH  
BARROW 13 TO SOUTH HARRISON BAY 1**

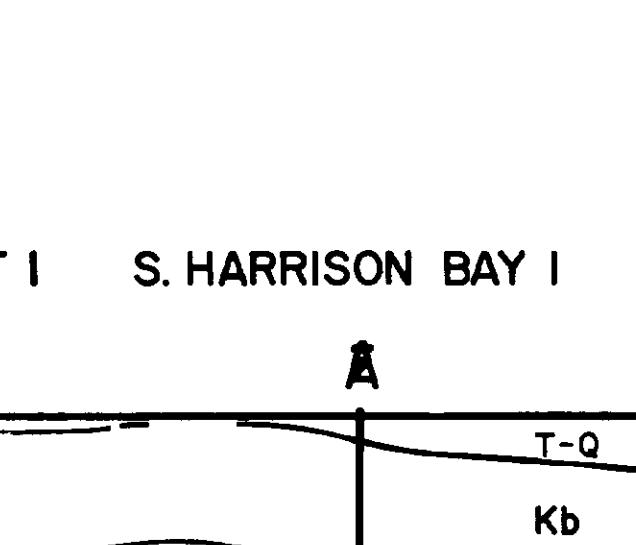
Features of interest, from the bottom upward and from northwest (left) of the section to the southeast (right), are:

1. Structures below horizon 1500 in the "Acoustic basement" are inferred. According to Carter and Laufeld (1975), the basement is Ordovician-Silurian in the Barrow area. Inferred bedding and dip changes indicate that, from J. W. Dalton 1 to Cape Halkett 1, some of the metasedimentary rocks comprising the "Acoustic basement" may be younger than Ordovician-Silurian.
2. Progressively younger rocks lap onto the Barrow Arch from the southeast toward the northwest. The M-1(?), M-2, P-1, PR, TR-1, TR-3, and J-1 units progressively overlap the "Acoustic basement."
3. Horizons 0700 and 0720 form a reflector doublet that is near the top and bottom, respectively, of unit Ka-1b (Late Neocomian). Ka-1b truncates progressively older rocks toward the north, and lies directly on TR-2 between J. W. Dalton 1 and Cape Halkett 1.
4. Horizon 0500 (mid-Aptian(?)) downlaps onto horizon 0700 (top of Ka-1b) and is near the top of unit Ka-2. East of Drew Point 1, unit Ka-3 (Late Aptian to early Cenomanian) directly overlies Ka-1b.
5. The Barrow High was uplifted in post-Cretaceous time. Progressively younger strata occur below surface deposits from the crest of the Barrow High toward the southeast. Ka-2 is near the surface on the Barrow High, and is overlain toward the southeast by units Ka-3, Kb, T, and Q.
6. The Simpson oil seeps emanate from the edge of the Simpson canyon. This sediment-filled trough is presumed to be a submarine canyon cut during mid-Cretaceous time. According to Robinson (1959), the sediments are Late Cretaceous.



TGZ-0170

FIGURE 3I



<b>TETRA TECH, INC</b>	PASADENA, CALIFORNIA
HOUSTON, TEXAS	ENERGY MANAGEMENT DIVISION
PETROLEUM EXPLORATION OF N.P.R.A. 1974-1981 (FINAL REPORT)	
PARASTRATIGRAPHIC CROSS SECTION A-A'	
SOUTH BARROW I3 - S. HARRISON BAY I	
N.P.R.	ALASKA
FOR ONPRA	
HUSKY OIL N.P.R. OPERATIONS INC.	
PROJECT MANAGER: J.W. BRUYNZEEL	PROJECT NO. TC-7174
INTERPRETATION BY: C.GULDENZOPF	REVISED
DATE: JUNE, 1981	DATUM: SEA LEVEL
CONTOUR INT:	SCALE:
DWG NO.	

TETRA TECH REPORT NO. 8200

FIGURE 32

COMPRESSED SEISMIC CROSS SECTION A-A', SOUTH  
BARROW 13 to SOUTH HARRISON BAY 1

Features of interest are:

1. Right-angle seismic line intersections are responsible for several "pseudostructures." For example, within the Torok clinothem, there are several apparent anticlines and synclines mostly caused by dip direction changes because of changes in the direction of the lines. This is also true for an apparent basin at the intersection of lines 665-79 and 684-79.
2. Below "Acoustic basement," there is an indication of structure in the O-S, D(?), or younger strata. Some of these features are refractions, probably from faults. Some apparent bedding is probably due to multiples from higher strata. Therefore, all interpreted structures below "Acoustic basement" are conjectural.
3. Mud-gun data are represented by "washed-out" zones over Dease Inlet and Smith Bay. These zones are found at the southeast end of seismic line B-11, and between East Simpson 1 and Drew Point 1 on line 75X-78. Although the data are poor, some of the continuous reflectors are more obvious on this compressed section than on the conventional seismic sections, especially in the deeper horizons.
4. The "Disturbed Zone" is crossed just east of South Barrow 13, beginning on line B10-78 and ending on line B11-78. Very few reflectors can be traced across this feature.
5. Basement tectonic elements are seen in the Barrow High to the northwest. The rest of this section is just to the south of and subparallel to the Barrow Arch. Minor flexures that are apparent in the basement are caused by line direction changes.

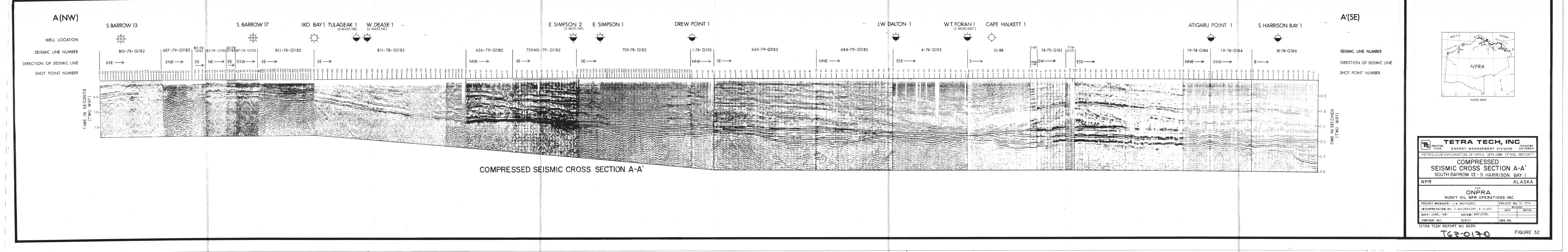
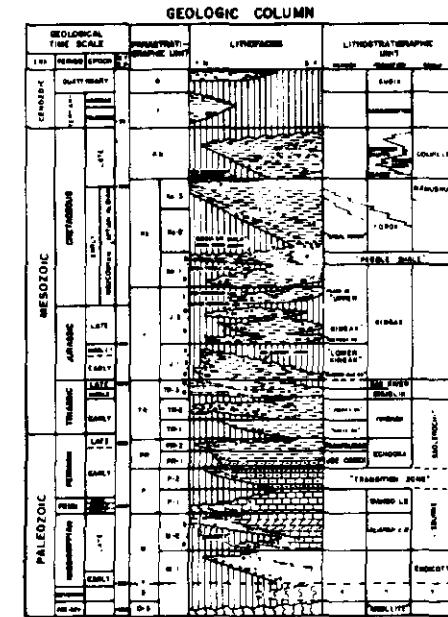
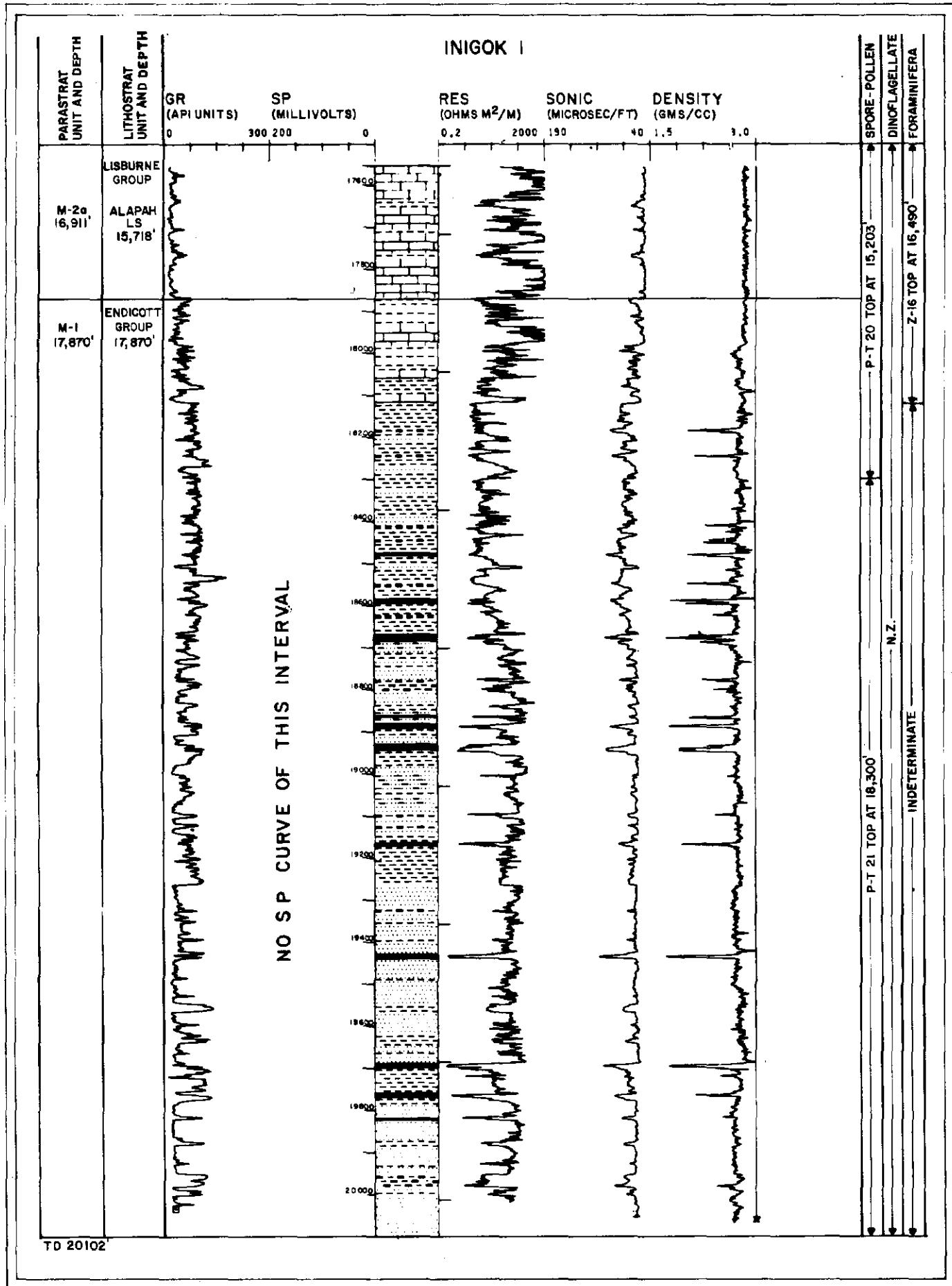


FIGURE 33

TYPE LOG OF M-1 PARASTRATIGRAPHIC  
UNIT, INIGOK I

At Inigok 1, the top of unit M-1 is picked at 17,870 ft (5,448 m). This depth coincides with the correlated lithostratigraphic top of the Endicott Group. Inigok 1 bottomed at a total depth of 20,102 ft (6,127 m) in the M-1 unit. The unit consists of interbedded fine- to medium-grained clastics and coal beds between 18,300 ft (5,578 m) and total depth. Between 17,870 and 18,300 ft (5,448 and 5,578 m), it consists of interbedded fine- to medium-grained clastics and carbonates. On electric logs, cyclical segments with a period of 20 to 60 ft (6 to 18 m) are typical in this unit. The log curves are characterized by numerous wide curve fluctuations producing a distinct "jagged" appearance.

FIGURE 33



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PETROLEUM EXPLORATION OF NPRA 1974-1981 (FINAL REPORT)

**TYPE LOG OF  
M-1 PARASTRATIGRAPHIC UNIT  
INIGOK I**

NPR	ALASKA
FOR <b>ONPRA</b> HUSKY OIL NPR OPERATIONS INC.	
PROJECT MANAGER: J. W. BRUYNZEEL	PROJECT NO. TC-7174
INTERPRETATION BY: STAFF	REVISED
DATE: SEPT., 1981	DATUM:
CONTOUR INT:	SCALE:
DWS NO.	

TETRA TECH REPORT NO.8200

TGZ-0130

FIGURE 33

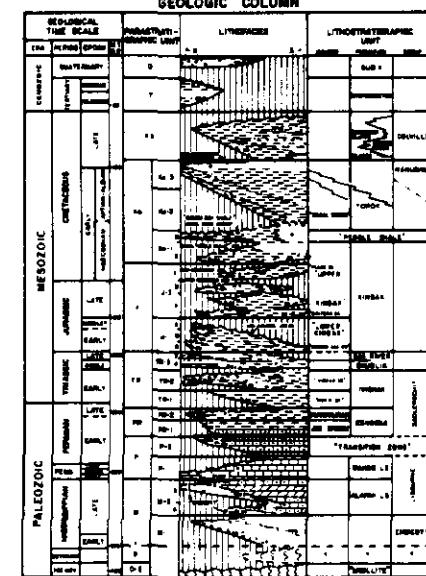
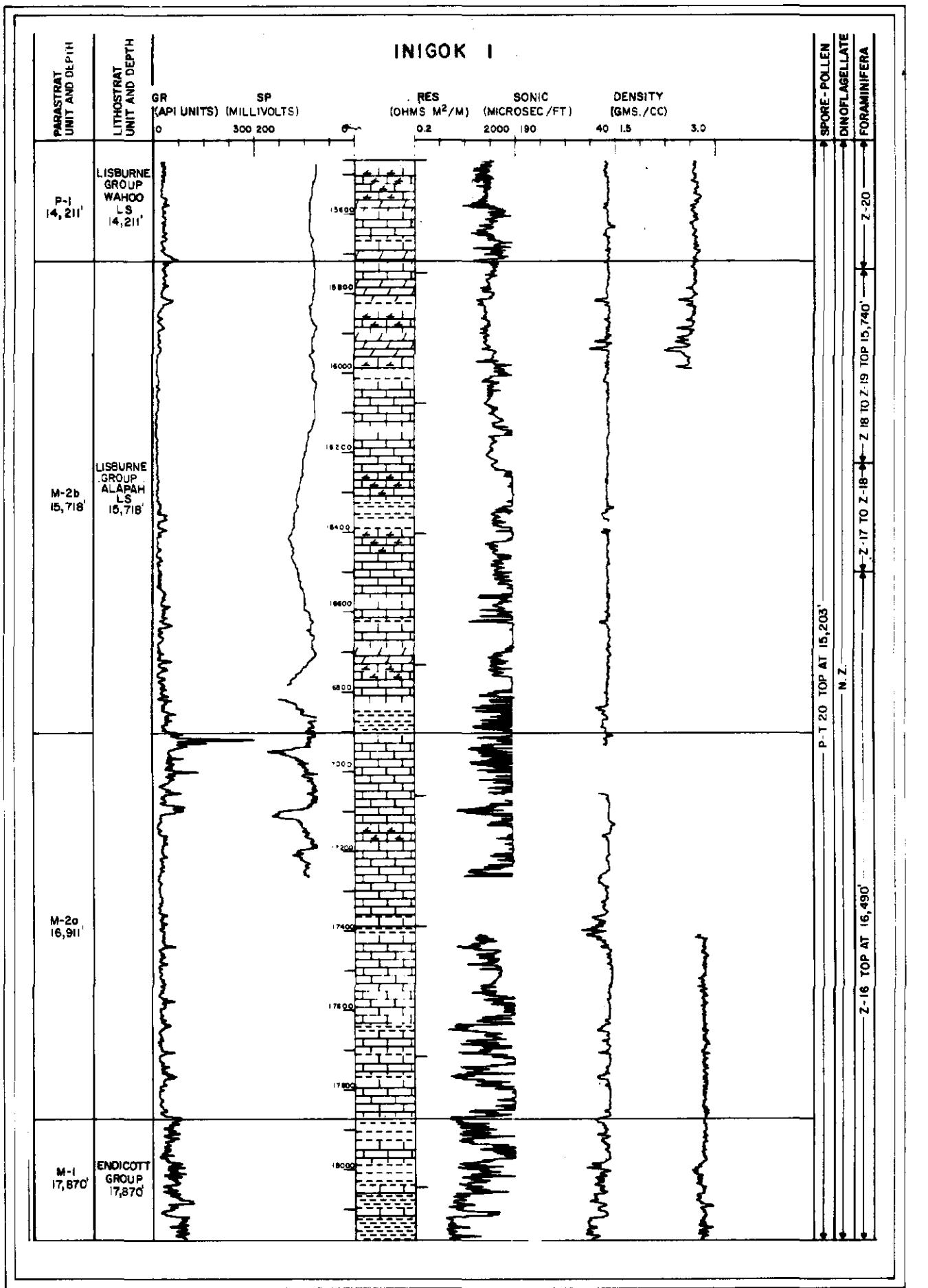
**FIGURE 34**

**TYPE LOG OF M-2 PARASTRATIGRAPHIC  
UNIT, INIGOK 1**

At Inigok 1, the top of M-2 is picked at 15,718 ft (4,791 m), which coincides with the lithostratigraphic top of the Alapah Formation. On electric logs, cyclical segments with a period of 50 to 150 ft (15 to 46 m) are typical of the M-2 unit. The cycles characteristically are funnel-shaped segments that probably represent "shoaling" or "shallowing-upward" carbonate depositional cycles (James, 1979, p. 110).

By contrast, a bell-shaped segment probably represents a "deepening-upward" carbonate depositional cycle during which eustatic sea-level rise or shelf subsidence outpaced carbonate sedimentation. Such a cycle is characterized by more numerous shale breaks and argillaceous carbonates.

The boundary between Mamet's foraminiferal zones 18, 19, and 20 is the marker selected to separate M-2 from the overlying P unit. This boundary occurs at 15,740 ft (4,799 m) at Inigok 1.



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PASADENA, CALIFORNIA		
PETROLEUM EXPLORATION OF NPRA 1974-1981 (FINAL REPORT)		
<p align="center"><b>TYPE LOG OF</b></p> <p align="center"><b>M-2 PARASTRATIGRAPHIC UNIT</b></p> <p align="center"><b>INIGOK I</b></p>		
NPR	ALASKA	
<p align="center">FOR</p> <p align="center"><b>ONPRA</b></p> <p align="center">HUSKY OIL NPR OPERATIONS INC.</p>		
PROJECT MANAGER:	J. W. BRUYNZEEL	PROJECT NO. TC-7174
INTERPRETATION BY:	STAFF	REVISED
DATE:	SEPT , 1981	INITIAL
CONTOUR INT:	DATUM:	
	SCALE:	DWS NO.

**FIGURE 34**

FIGURE 35

ISOPACH AND LITHOFACIES MAP, M-1

Well	Thickness		Clastic Ratio
	Feet	Meters	
Atigaru Point 1	187	57	<1/8
Cape Halkett 1	383	118	<1/8
J. W. Dalton 1	72	22	<1/8
W. T. Foran 1	188	57	<1/8
Ikpikpuk 1	200	61	1/6
Inigok 1	2,232+	680+	1/1.9
East Simpson 2	276	84	<1/12
Sinclair Colville 1	310	94	n.d.*
Arco Itkillik River	930	284	1/15

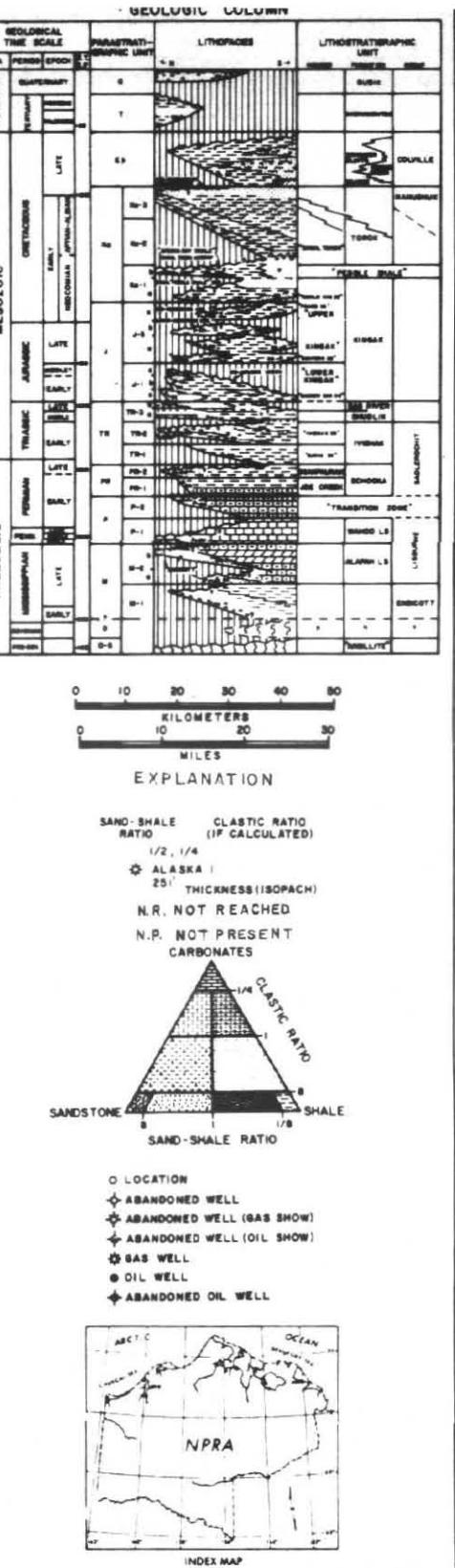
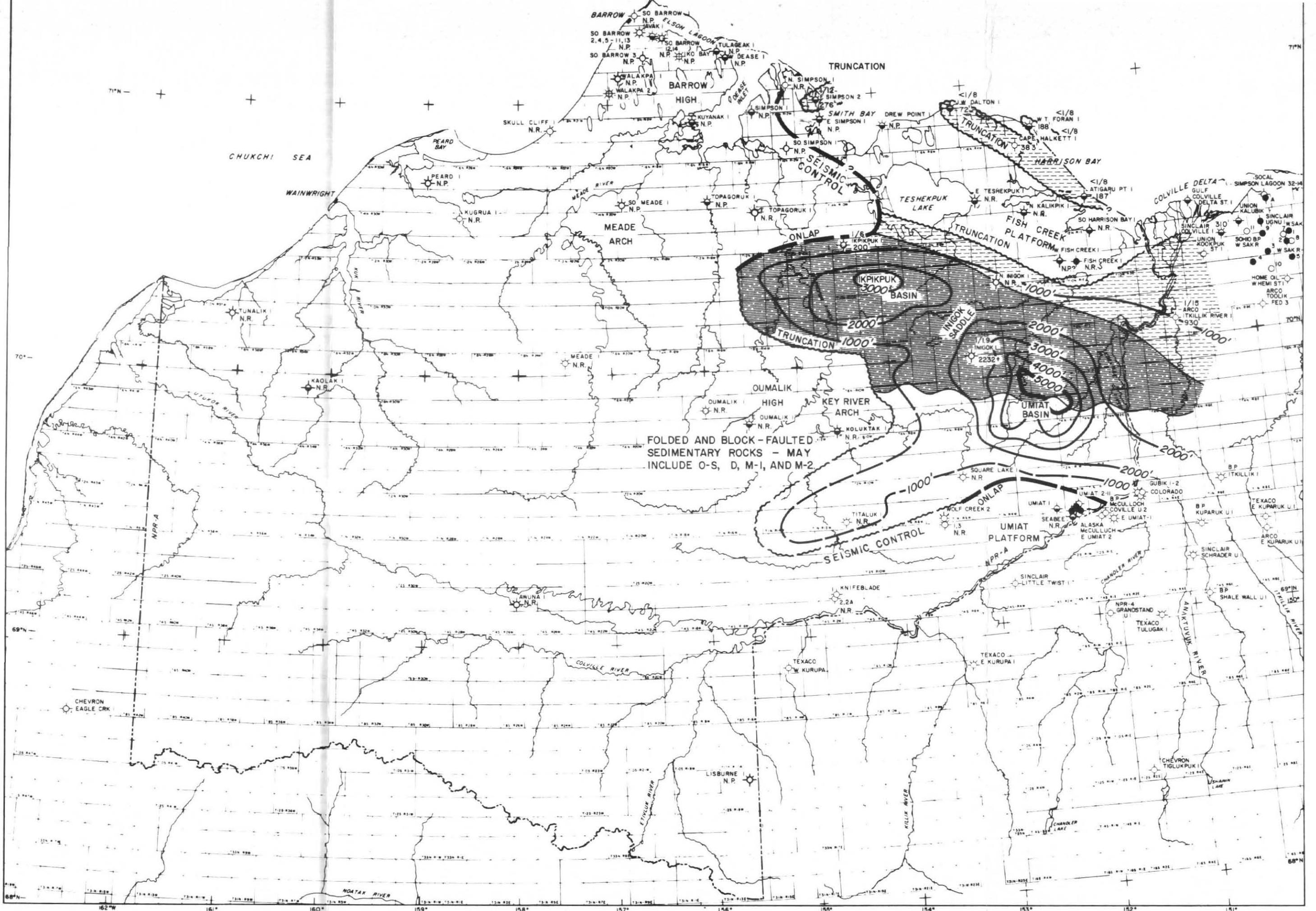
\*n.d., not determined

The M-1 unit is defined as pre-mid-Meramecian clastics containing foraminifera of Mamet's zone 12 or older. At Inigok 1, the top of M-1 coincides with the top of the clastic Endicott Group; in the northeastern part of the NPRA, M-1 is restricted to a northwest-trending trough. Steeply to gently dipping remnants of the M-1 overlie unit O-S ("Argillite") at East Simpson 2, and questionably at J. W. Dalton 1, Cape Halkett 1, W. T. Foran 1, and Atigaru Point 1. The unit probably extends farther north, below the Beaufort Sea.

Seismic interpretation delineated the layout of the western and southern boundaries of unit M-1 onto the Meade Arch and Umat platform, respectively. Elsewhere, the M-1 unit is truncated and overlain unconformably by younger rocks.

The mid-Meramecian tectonic event locally metamorphosed the clastics of unit M-1 and altered it to quartzite. The M-1 unit is composed mainly of clastics, although interbedded carbonates occur near the top of the unit at Inigok 1; shales and siltstones are more common than sandstones.

Oil shows were found in unit M-1 in a 20-ft (6-m) sandstone at East Simpson 2. However, this sandstone and others like it are probably thin and not extensive. The M-1 unit is mainly composed of shales along the Arctic coast.



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HUSTRON TEXAS	ENERGY MANAGEMENT DIVISION
PASADENA CALIFORNIA	
PETROLEUM EXPLORATION OF NPRA 1974-1981 (FINAL REPORT)	
ISOPACH & LITHOFACIES MAP	
M - I	
NPR	ALASKA
FOR	
NPRA	
HUSKY OIL NPR OPERATIONS INC.	
PROJECT MANAGER: J. W. BRUYNZEEL	PROJECT NO. TC-7174
INTERPRETATION BY: E. C. GULDENZOPF	REQUIRED
DATE: AUGUST 1980 DATUM:	INITIAL
CONTD. R. INT: 1000'	JUN 81 E.C.G.
SCALE:	DWS NO.
TETRA TECH REPORT NO. 8200	

FIGURE 36

ISOPACH AND LITHOFACIES MAP, M-2

Wells	Thickness		Sand-Shale Ratio	Clastic Ratio
	Feet	Meters		
Atigaru Point 1	531	162	1/3.3	1/3.9
Cape Halkett 1	165	50	1/3.5	1/2.1
West Fish Creek 1	309+	94+	1/2.3(?)	1/5.2
Ikpikpuk 1	1,632	497	<1/8	1/7.2
Inigok 1	2,152	656	1/8	1/7
Lisburne 1	1,198(?)	365	n.d.*	n.d.
East Teshekpuk 1	275	84+	1/3(?)	1/3(?)
Sinclair Colville 1	398(?)	121	n.d.	n.d.
Arco Itkillik River 1	1,250	381	n.d.	n.d.

\*n.d., not determined

The M-2 parastratigraphic unit coincides with the Alapah Limestone of the Lisburne Group at Inigok 1. Inigok 1 is used as the "type" well for the Lisburne in the NPRA because the thickest Lisburne section drilled was at Inigok 1.

Unit M-2 thins toward the north. Typically, it is less than 500 ft (152 m) thick over the Fish Creek Platform and laps out gradually near the present Arctic coastline. Seismic and well data show that this unit is not present in wells on the Simpson Peninsula.

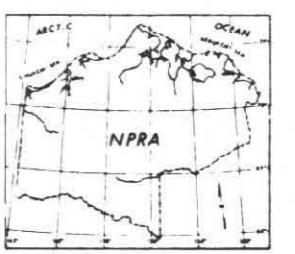
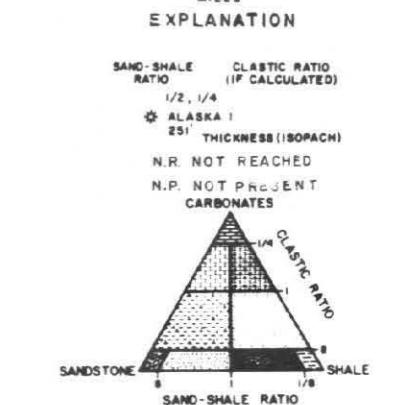
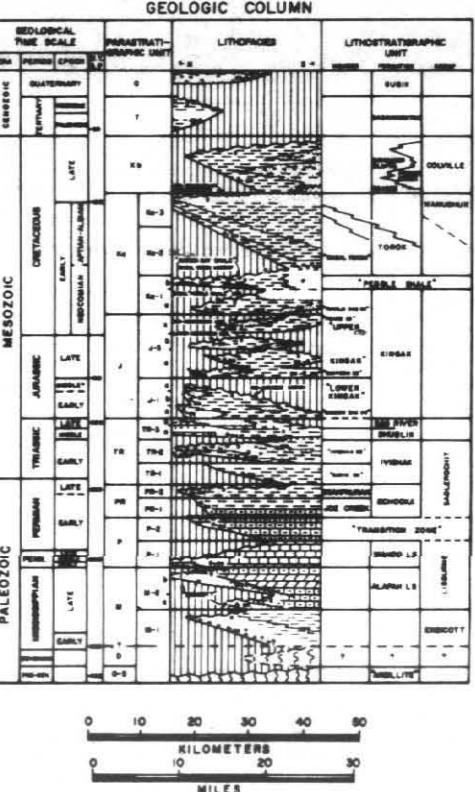
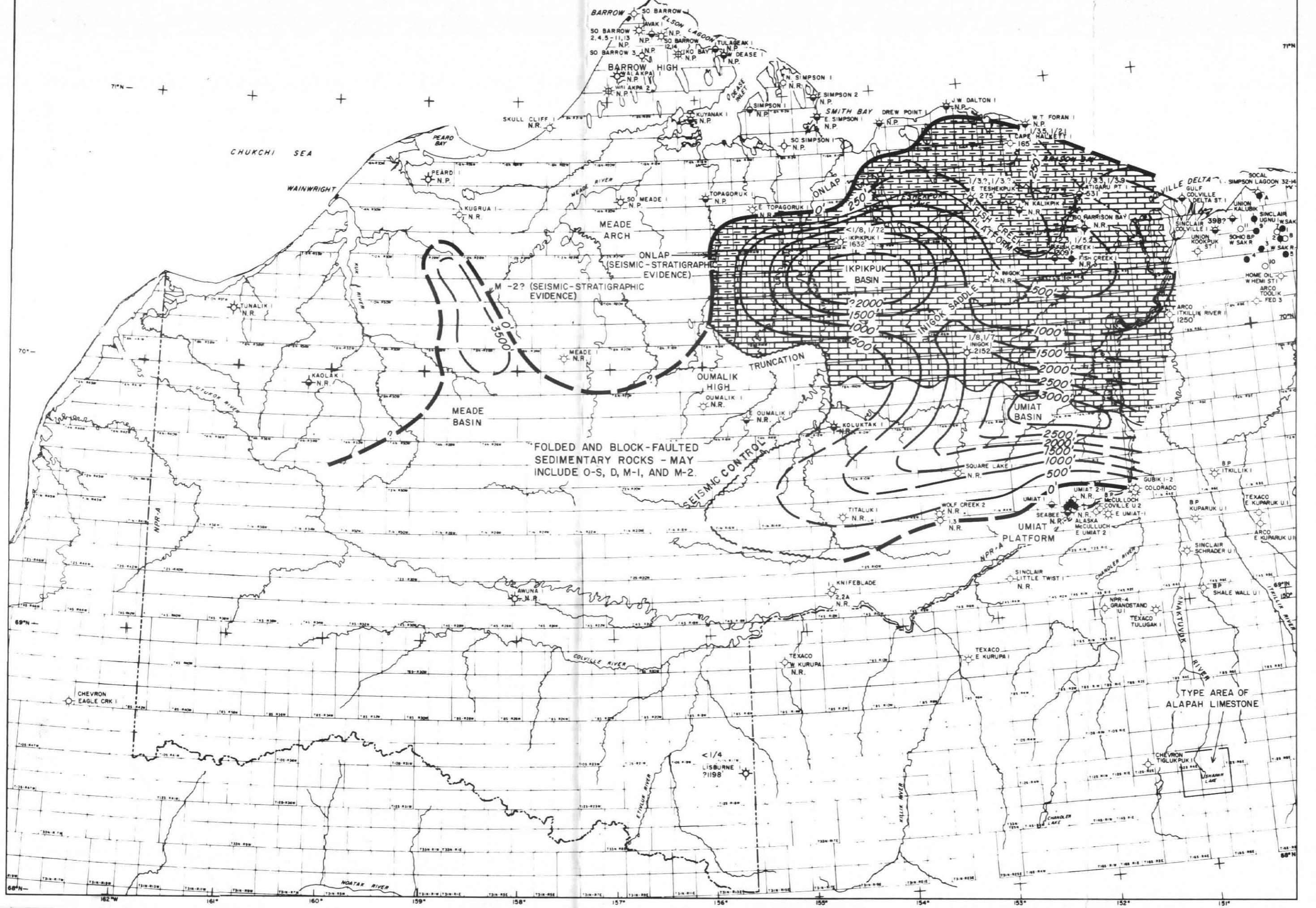
The depositional trend of M-2 in the coastal area departs markedly from that of M-1 (fig. 35). This probably indicates that the Barrow High and the Fish Creek Platform were uplifted at some time late in the deposition of M-1 to early in the deposition of M-2.

Based on seismic stratigraphy, M-2 laps out against the Oumalik High. The unit thickens southward and may thin and lap out in the Umiat area. However, the seismic record quality in this area is poor, and there is no well control to support this conclusion.

At Lisburne 1, fossils indicate that the Lisburne Group is of late Meramecian to Chesterian age. Thus, these rocks are assigned to unit M-2. The Lisburne is repeated in five plates in Lisburne 1. Its original thickness in this area is not known; the thickness of 1,198 ft (365 m) shown on the map is from plate 1, which probably was deposited 100 mi (160 km) farther to the south.

In the northwestern NPRA, Mississippian rocks were not observed. Tunalik 1 and Kugrua 1 penetrated Pennsylvanian Lisburne carbonates, so the presence of unit M-2 at these locations is questionable. Seismic-stratigraphic interpretation shows that unit M-2 is present in the deeper part of the Meade Basin.

At Ikpikpuk, Inigok 1, and West Fish Creek 1, unit M-2 mainly consists of limestones and dolomites with shale partings. The noncarbonate to carbonate ratio increases with minor amounts of siltstone and sandstone patches at Cape Halkett 1, Atigaru Point 1, and East Teshekpuk 1.



**TETRA TECH, INC.**  
ENERGY MANAGEMENT DIVISION PASADENA CALIFORNIA  
PETROLEUM EXPLORATION OF NPRA 1974-1981 (FINAL REPORT)  
**ISOPACH & LITHOFACIES MAP M-2**  
NPR FOR ALASKA  
HUSKY OIL NPR OPERATIONS INC.  
PROJECT MANAGER: J.W. BRUNZEEL PROJECT NO. TC-7174  
INTERPRETATION BY: E.C. GULDENZOPF REVISED DATE: INITIAL  
DATE: 1980 DATUM: SEPT 30, 1980  
CONTOUR INT: 250', 500' SCALE: DWG. NO.  
TETRA TECH REPORT NO. 6200

FIGURE 37

CORRELATION CROSS SECTION G-G', W. T. FORAN 1  
TO ARCO ITKILLIK RIVER 1

Cross section G-G' includes W. T. Foran 1, Cape Halkett 1, Atigaru Point 1, South Harrison Bay 1, West Fish Creek 1, and Arco Itkillik River 1. Datum is sea level. The main geologic features shown are:

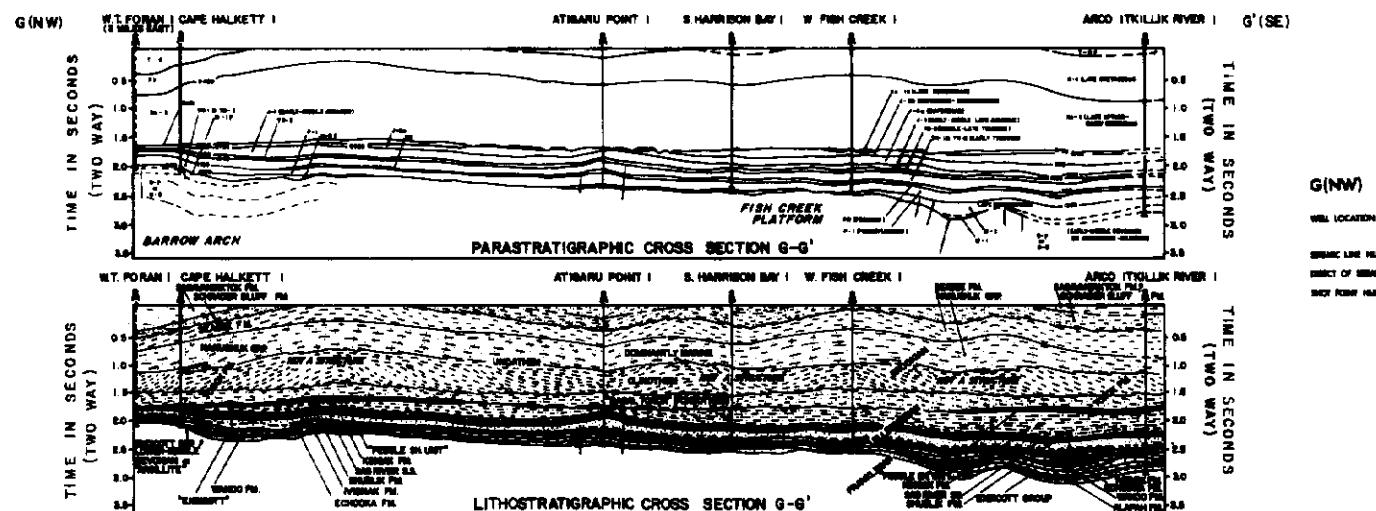
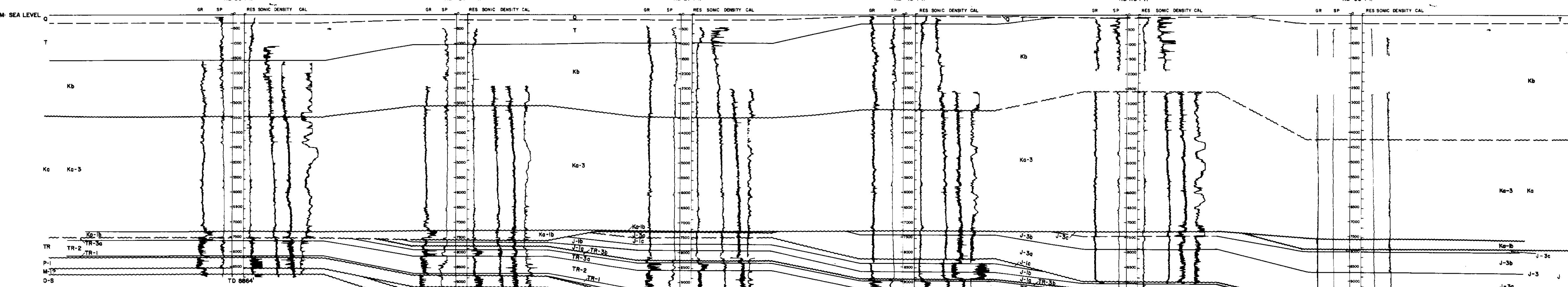
1. Unit M-1 (Endicott Group) overlies unit O-S ("Argillite") at W. T. Foran 1, Cape Halkett 1, Atigaru Point 1, and Arco Itkillik River 1. In W. T. Foran 1 and Cape Halkett 1, 18° to 35° dips were recorded in M-1, suggesting Late Mississippian tectonics.
2. Unit M-2b (Alapah Limestone) is overlapped and truncated by P-1 (Nahoo Limestone) toward the north.
3. Unit PR-2 (Ikiakpaurak Member of the Echooka Formation) laps out against the Barrow Arch between Atigaru Point 1 and Cape Halkett 1.
4. TR-2 ("Ivishak sandstone" member of the Ivishak Formation) probably is truncated by the basal "Pebble Shale" unconformity a few miles north of W. T. Foran 1, below the Beaufort Sea. Between Cape Halkett 1 and W. T. Foran 1, the unconformity truncates TR-3b (Sag River Sandstone). The Sag River grades into shale to the southeast between West Fish Creek 1 and Arco Itkillik River 1.
5. J-1 ("Lower Kingak") thins and is truncated by the mid-Jurassic unconformity toward the south.
6. Progressively older strata are truncated to the north by Early Cretaceous rocks. At Arco Itkillik River 1, Ka-1b ("Pebble Shale") unconformably overlies the J-3c (Berriasiyan-Valanginian) part of the "Upper Kingak." The Torok fondothem (bottomset) beds, within the time-transgressive Ka-3 (Torok-Manushuk) unit, unconformably overlie J-3c at West Fish Creek 1 and the J-3b (Oxfordian-Kimmeridgian) part of the "Upper Kingak" at South Harrison Bay 1. Unit Ka-1b unconformably overlies the J-3a (Oxfordian) part of the "Upper Kingak" at Atigaru Point 1, unit J-1 at Cape Halkett 1, and unit TR-3a (Shublik) at W. T. Foran 1.
7. Ka-1b is absent over the Fish Creek Platform at South Harrison Bay 1 and West Fish Creek 1, because either the Fish Creek Platform was a positive area where the "Pebble Shale" was never deposited, or the "Pebble Shale" was eroded subsequent to its deposition. Apparent channels through the "Pebble Shale" are evident on compressed seismic sections across the Fish Creek Platform.
8. The time-transgressive Ka-3 unit unconformably overlies Ka-1b at W. T. Foran 1, Cape Halkett 1, Atigaru Point 1, and Arco Itkillik River 1. At South Harrison Bay 1 and West Fish Creek 1, unit Ka-3 unconformably overlies unit J-3.
9. Unit Kb (Colville Group) unconformably overlies the marine Manushuk strata within Ka-3.
10. Tertiary (unit T) rocks overlie the Kb unit and underlie the Quaternary (unit Q) surface deposits in all wells except West Fish Creek 1 where Kb is below the Quaternary surface materials.

G (NNW)

W.T. FORAN I  
SEC 3 T 17N R 2W

KB 39 FT.

GR SP RES SONIC DENSITY CAL



CAPE HALKETT I  
SEC 5 T 16N R 2W

KB 37 FT.

GR SP RES SONIC DENSITY CAL

ATIGARU POINT I  
SEC 19 T 14N R 2E

KB 27 FT.

GR SP RES SONIC DENSITY CAL

SOUTH HARRISON BAY I  
SEC 6 T 12N R 2E

KB 45 FT.

GR SP RES SONIC DENSITY CAL

WEST FISH CREEK I  
SEC 11 T 11N R 1W

KB 113 FT.

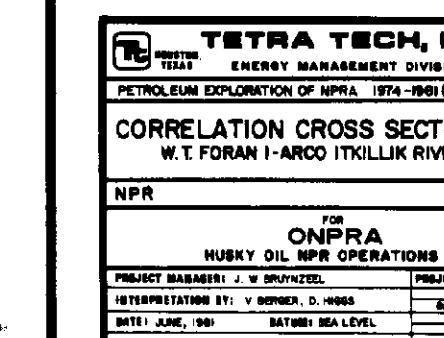
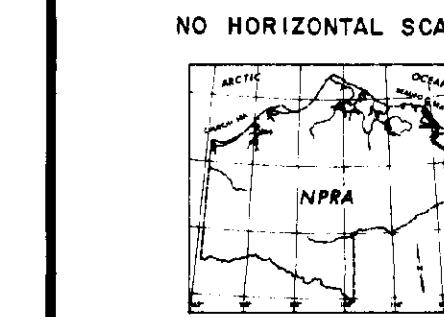
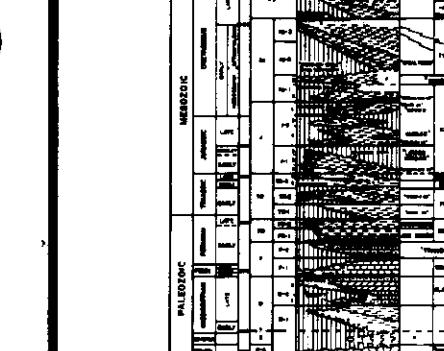
GR SP RES SONIC DENSITY CAL

ARCO ITKILLIK RIVER I  
SEC 10 T 8N R 5E

KB 60 FT.

GR SP RES SONIC DENSITY CAL

G' (SSE)

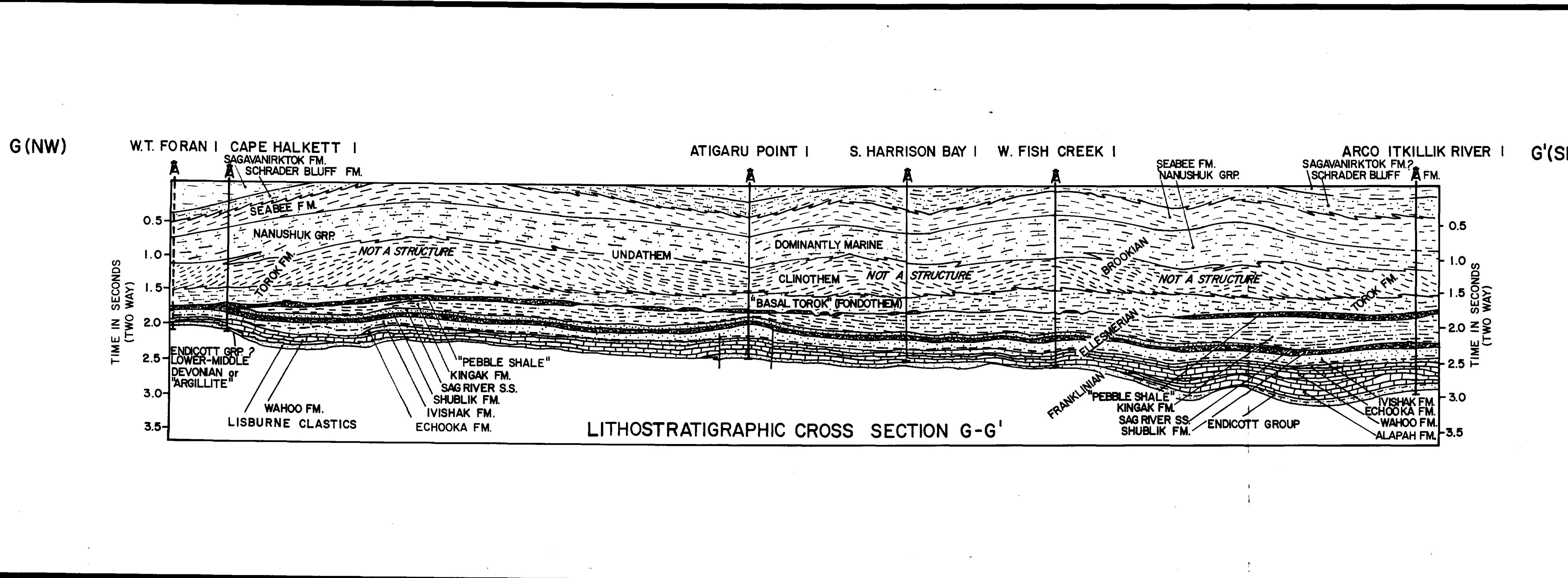


TGZ-070 FIGURE 37

**FIGURE 38****LITHOSTRATIGRAPHIC CROSS SECTION G-G'  
W. T. FORAN 1 TO ARCO ITKILLIK RIVER 1**

Features of interest, from the bottom upward and from northwest (left) to southeast (right), are:

1. The "Acoustic basement" in cross section G-G' is probably composed of "Argillite." "Argillite" was identified at the bottom of W. T. Foran 1, Cape Halkett 1, Atigaru Point 1, and Arco Itkillik River 1.
2. The Endicott Group overlies the basement at W. T. Foran 1, Cape Halkett 1, Atigaru Point 1, and Arco Itkillik River 1. The Endicott is probably a time-transgressive clastic magnafacies to the northwest.
3. The Sag River Sandstone is truncated by the "Pebble Shale" at Cape Halkett 1 and grades into shale between West Fish Creek 1 and Arco Itkillik River 1.
4. The Kingak Formation in this area is composed of siltstone and shale. No significant sandstone bodies were found in any of the wells in this section.
5. The "Pebble Shale," a distinctive seismic marker across the NPRA, is absent in the middle of cross section G-G', presumably removed by erosion. On the northwest (left) side of the section, the "Pebble Shale" truncates the Shublik and Ivishak Formations.
6. The Torok-Nanushuk sequence progrades toward the northeast. The Torok fondothem ("basal Torok"), clinothem, and undathem, and the Nanushuk marine beds succeed one another vertically. The Nanushuk nonmarine formations are absent in this section.
7. The Nanushuk marine Grandstand Formation is overlain by the Seabee Formation of the Colville Group, and the Seabee is succeeded by the Schrader Bluff Formation of the Colville Group. The Tertiary Sagavanirktock Formation overlies the Colville at W. T. Foran 1 and Cape Halkett 1, and is questionably present at Arco Itkillik River 1.



**TETRA TECH, INC**  
HOUSTON, TEXAS ENERGY MANAGEMENT DIVISION PASADENA, CALIFORNIA  
PETROLEUM EXPLORATION OF NPRA 1974-1981 (FINAL REPORT)

**LITHOSTRATIGRAPHIC CROSS SECTION G-G'**  
W.T. FORAN I - ARCO ITKILLIK RIVER I

NPR	ALASKA
FOR ONPRA	
HUSKY OIL NPR OPERATIONS INC.	
PROJECT MANAGER: J. W. BRUYNZEEL	PROJECT NO. TC-7174
INTERPRETATION BY: C. GULDENZOPF	REVISED
DATE: JUNE, 1981	DATUM: SEA LEVEL
CONTOUR INT:	SCALE:
DWG NO.	

TETRA TECH REPORT NO. 8200

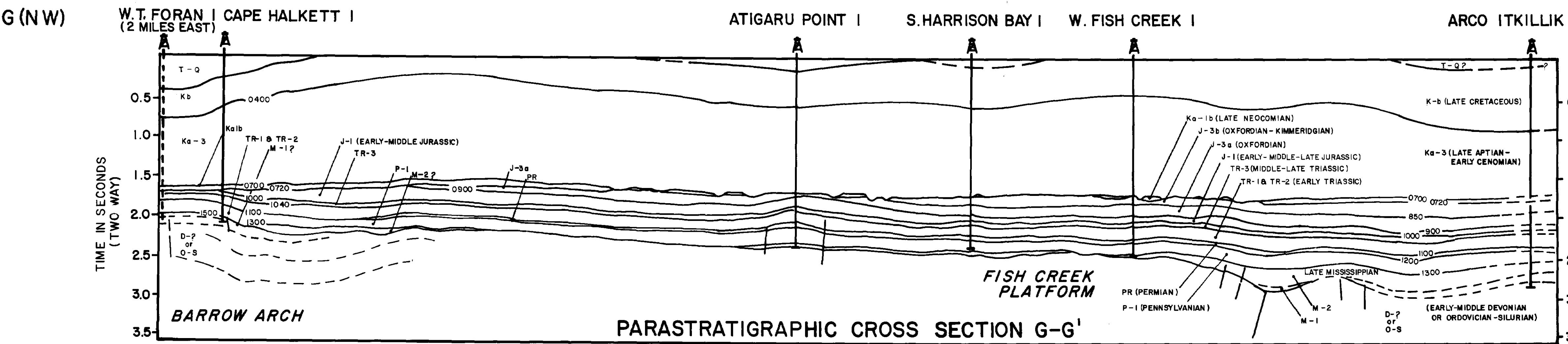
FIGURE 38

TG2-0170

**FIGURE 39****PARASTRATIGRAPHIC CROSS SECTION G-G',  
W. T. FORAN 1 TO ARCO ITKILLIK RIVER 1**

Features of interest from the bottom upward and from the northwest (left) to the southeast (right), are:

1. Few obvious structures can be seen below horizon 1500 ("Acoustic basement").
2. Unit M-1 overlies "Acoustic basement" at Arco Itkillik River 1, and laps out against the Fish Creek Platform to the northwest. M-1 may be present at W. T. Foran 1 and Cape Halkett 1; clastic rocks dipping 15° to 30° near the bottom of both wells may be erosional remnants of Mississippian rocks.
3. Unit M-2 laps out or is very thin on the crest of the Fish Creek Platform. P-1 truncates M-2 and overlies the Fish Creek Platform.
4. Horizon 1100 is near the top of unit P-1 at W. T. Foran 1 and Cape Halkett 1. To the southeast, horizon 1100 is near the top of unit PR, which is truncated by unit TR-1.
5. Horizons 1000 and 1040 are near the top and bottom, respectively, of unit TR-3. These seismic horizons form a reflector couplet that is traceable across the section.
6. Units J-1 and J-3 thin because of truncation by overlying Cretaceous units from the southeast toward the northwest. Horizon 0850 (late Oxfordian) is truncated by horizon 0700 between Atigaru Point 1 and South Harrison Bay 1. Horizon 0900 (mid-Jurassic unconformity) is truncated by horizon 0720 to the southeast of Cape Halkett 1. At W. T. Foran 1, Ka-1b directly overlies TR-3.
7. Horizons 0700 and 0720 form a reflector couplet near the top and bottom, respectively, of unit Ka-1b. Ka-1b and overlying Cretaceous units truncate progressively older rocks toward the northwest. In the middle part of the section, Ka-1b is absent, perhaps because of erosion.
8. Unit Ka-3 (probably late Aptian-early Cenomanian) directly overlies Ka-1b or older rocks. Unit Ka-2, which downlaps on Ka-1b to the southwest, is absent in cross section G-G'.
9. Horizon 0400 (mid-Cenomanian unconformity) is near the boundary between units Ka-3 and Kb. Units T and Q are thickest at W. T. Foran 1 and Cape Halkett 1, and questionably present at Arco Itkillik River 1.



**TETRA TECH, INC.**  
HOUSTON, TEXAS    ENERGY MANAGEMENT DIVISION    PASADENA, CALIFORNIA

PETROLEUM EXPLORATION OF NPRA 1974-1981 (FINAL REPORT)

**PARASTRATIGRAPHIC CROSS SECTION G-G'**  
W.T. FORAN I - ARCO ITKILLIK RIVER I

NPR    ALASKA

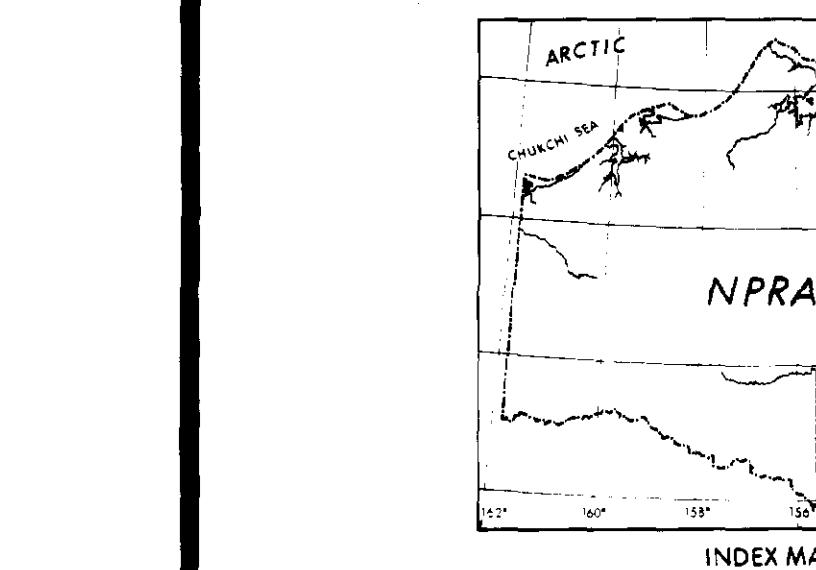
FOR  
**ONPRA**  
HUSKY OIL NPR OPERATIONS INC.

PROJECT MANAGER: J.W. BRUYNZEEL	PROJECT NO. TC-7174
INTERPRETATION BY: C. GULDENZOPF	REVISED
DATE: JUNE, 1981	INITIAL
DATE: JUNE, 1981	DATUM: SEA LEVEL
CONTOUR INT:	SCALE:
DWG NO.	

TETRA TECH REPORT NO. 8200

FIGURE 39

**TGZ-0170**



**FIGURE 40****COMPRESSED SEISMIC CROSS SECTION G-G',  
W. T. FORAN 1 TO ARCO ITKILLIK RIVER 1**

Compressed seismic cross section G-G' connects several of the wells in the northeastern part of the NPRA in the Harrison Bay area. The wells and years they were drilled include W. T. Foran 1, 1977; Cape Halkett 1, 1975; Atigaru Point 1, 1977; South Harrison Bay 1, 1976; and West Fish Creek 1, 1977. Cross section G-G' runs northwest to southeast, starting about 2 mi west of W. T. Foran 1 and ending on the Colville River about 3 mi west of Arco Itkillik River 1. (Segments G-88 through 18-74 of compressed seismic cross section G-G' are repeated in figure 32 on compressed seismic cross section A-A'.) The most direct route between Cape Halkett 1 and Atigaru Point 1 is over Harrison Bay; however, because the mud- or air-gun seismic data obtained in 1970-72 are unsuitable for this compressed seismic section, the section detours around Harrison Bay passing East Teshekpuk 1 at shotpoint 105 and North Kalikpik 1 at shotpoint 50 on line 75-75. Neither of these wells is shown on the section. The route from South Harrison Bay 1 to West Fish Creek 1 is by switchback, or reversal, of direction at line 20-74. Features of interest are:

1. Because of the circuitous nature of this section, a number of dip reversals occur at seismic line intersections 7-74 and 75-75, 19-74 and 18-74, 18-74 and 25X-75, 19-74 and 22-74, 22-74 and 27-74, and 27-74 and 24-74. In addition, line 19-74 is reversed and partly repeated at Atigaru Point 1. Shown between 0.5 and 2.0 seconds at these intersections are a series of "pseudostructures," or northeast-dipping clinoforms, in the Tork Formation.
2. There is little indication of structure below "Acoustic basement." Most of the features are probably refractions from faults or multiples from higher strata.
3. A number of sharp "pull-ups" on lines 19-74, 18-74, 20-74, and 22-74 are probably velocity anomalies related to nearsurface permafrost. Seismic interpretation eliminated these irregularities on figures 38 and 39.
4. Basement tectonic elements shown are the Barrow Arch to the northwest and the Fish Creek Platform in the middle of the section.

G(NW)

WELL LOCATION

W.T. FORAN 1  
(2 MILES EAST)  
CAPE HALKETT 1

SEISMIC LINE NUMBERS

DIRECT OF SEISMIC LINE

SHOT POINT NUMBER

G-88

S →

74-75-G182

SW →

G-87

W →

NW →

S →

ESE →

75-75-G182

20 →

105 →

100 →

80 →

75 →

65 →

60 →

55 →

50 →

45 →

40 →

35 →

30 →

25 →

20 →

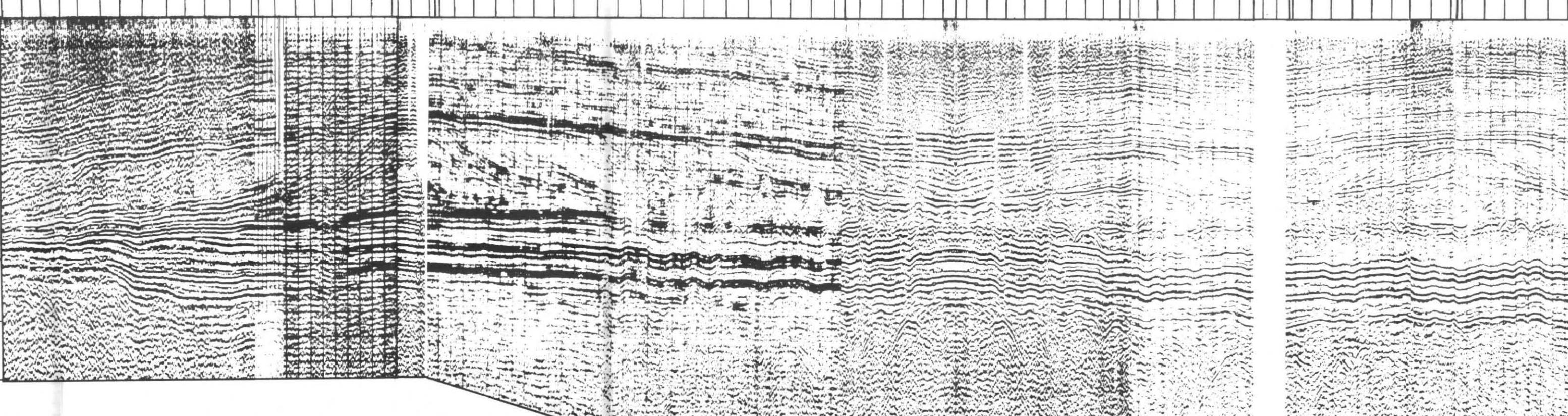
15 →

10 →

5 →

0 →

TIME IN SECONDS  
(TWO WAY)



COMPRESSED SEISMIC CROSS SECTION G-G'

ATIGARU POINT 1

S. HARRISON BAY 1

W. FISH CREEK 1

19-74-G184

NNE →

19-74-G184

NNW →

18-74-G186

E →

20-74-G184

W →

19-74-G184

S →

22-74-G184

E →

27-74-G184

SSW →

24-74-G184

ESE →

5 →

10 →

15 →

20 →

25 →

30 →

35 →

40 →

45 →

50 →

55 →

60 →

65 →

70 →

75 →

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FIGURE 41

ISOPACH AND LITHOFACIES MAP, P-1

Wells	Thickness Feet	Thickness Meters	Sand-Shale Ratio	Clastic Ratio
Atigaru Point 1	972	296	1/6	1/4
Cape Halkett 1	385	117	1/3.2	1/2.7
J. W. Dalton 1	879	268	1.2	1.3
West Fish Creek 1	622	190	1/2.1	1/4.2
W. T. Foran 1	377	115	1/8.8	1/2.1
South Harrison Bay 1	1,058	322	<1/8	1/4.4
Ikpikpuk 1	1,667	508	<1/8	1/3.7
Inigok 1	1,507	459	<1/8	1/5.6
Kugrua 1	1,053+	321	1/6	1/4.5
East Teshekpuk 1	740	226	1/8	1/4.3
Tunalik 1	1,240+	378+	1/8	1/4.4
Sinclair Colville 1	32	10	n.d.*	n.d.
Arco Itkillik River 1	1,295	395	n.d.	n.d.

\*n.d., not determined.

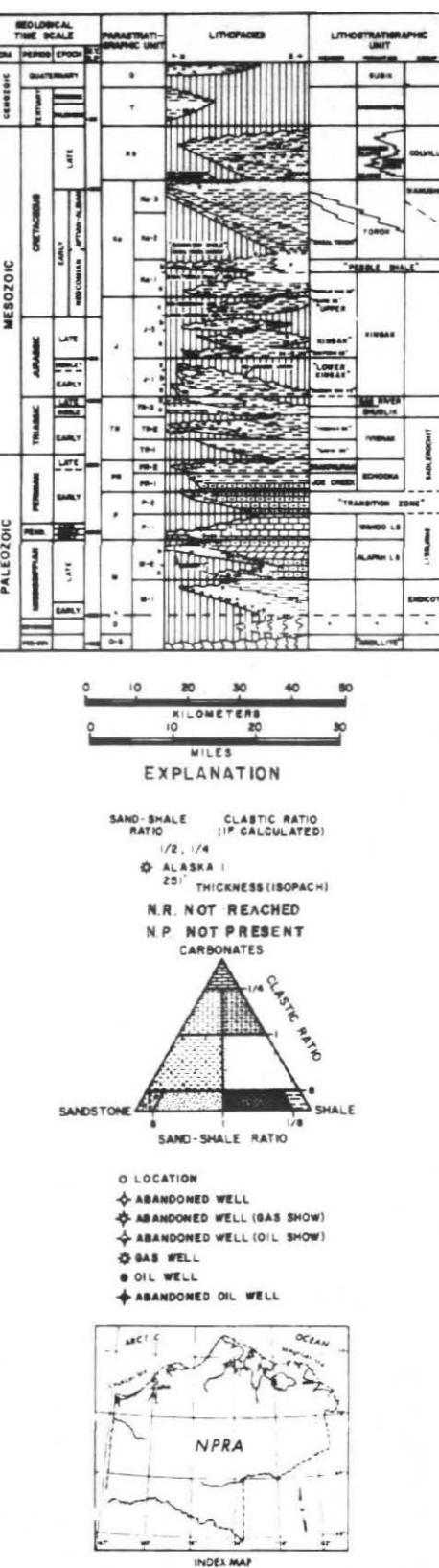
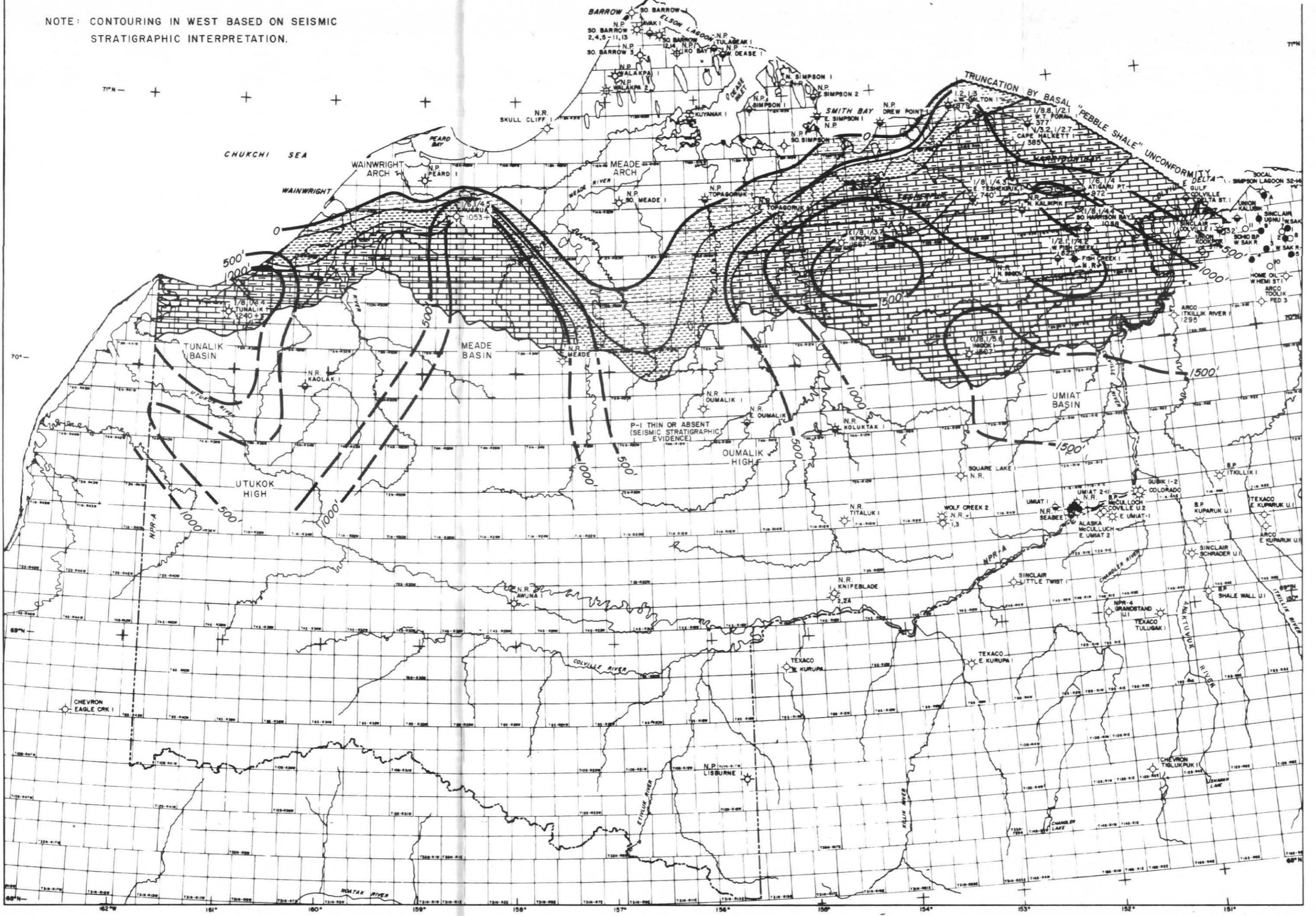
The tectonic elements shown are the Tunalik Basin, Wainwright Arch, Meade Basin, Meade Arch, Oumalik High, and Utukok High.

In the northeastern part of the NPRA, unit P-1 is nearly synonymous with the Wahoo Limestone. P-1 comprises massive Pennsylvanian carbonates containing Mamet's foraminiferal zones 20 through 24.

The P-1 unit is thickest in the vicinity of Ikpikpuk 1 in the Ikpikpuk Basin. It gradually thins to the northwest and laps out toward the Barrow High. East of the Meade Arch, P-1 is overlapped by the TR-1 interval. The unit is truncated beneath the Beaufort Sea by the basal "Pebble Shale" unconformity, and thins toward the south in the direction of the Umiat Platform. Correlation of equivalent foraminiferal zones and seismic stratigraphy show that, west of the Meade Arch-Oumalik High trend, P-1 thickens considerably in local basins, and thins or laps out completely over local highs.

The laterally correlative Pennsylvanian carbonates penetrated in both Kugrua 1 and Tunalik 1 probably are not present in the southern part of the Reserve. The P-1 unit becomes coarser as it onlaps the arches to the north. The unit contains sandy basal clastics at J. W. Dalton 1. These clastics are projected to the western side of the Meade Arch.

NOTE: CONTOURING IN WEST BASED ON SEISMIC STRATIGRAPHIC INTERPRETATION.



**TETRA TECH, INC**  
HOUSTON TEXAS ENERGY MANAGEMENT DIVISION PASADENA CALIFORNIA  
PETROLEUM EXPLORATION OF NPRA 1974-1981 (FINAL REPORT)  
**ISOPACH & LITHOFACIES MAP**  
P-1

NPR	ALASKA
FOR ONPR HUSKY OIL NPR OPERATIONS INC.	
PROJECT MANAGER: W. BRUYNZEEL	PROJECT NO. TEC 714
INTERPRETATION BY: E.C. GULDENZOPF	REVISED
DATE: AUG 1980	INITIAL
DATUM:	AUG 1981 V.E.B.
CONTOUR INT: 500'	SCALE:
TETRA TECH REPORT NO. 8200	
DWG NO.	

TG20170 FIGURE 41

FIGURE 42

ISOPACH AND LITHOFACIES MAP, P-2

Wells	Thickness		Sand-Shale Ratio	Clastic Ratio
	Feet	Meters		
Ikpikpuk 1	212	65	1/8	1/1.7
Inigok 1	185	56	1/8	1/3.2
Kugrua 1	357	109	1/8	1/2.9
Tunalik 1	1,997*	486	1/8	1/2.8
Arco Itkillik River 1	(?)	-	-	-

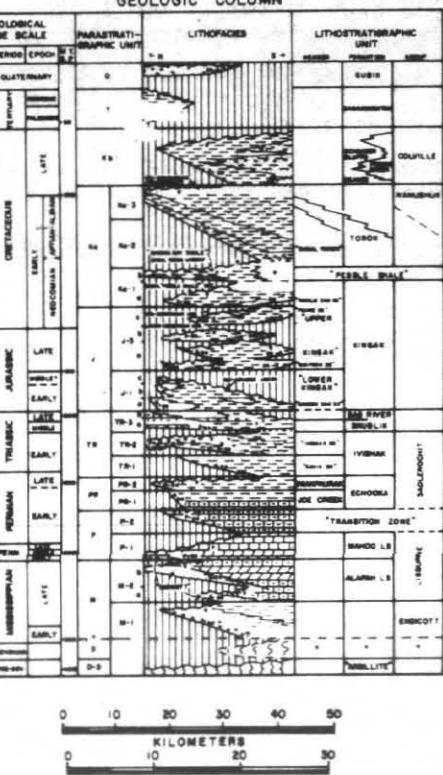
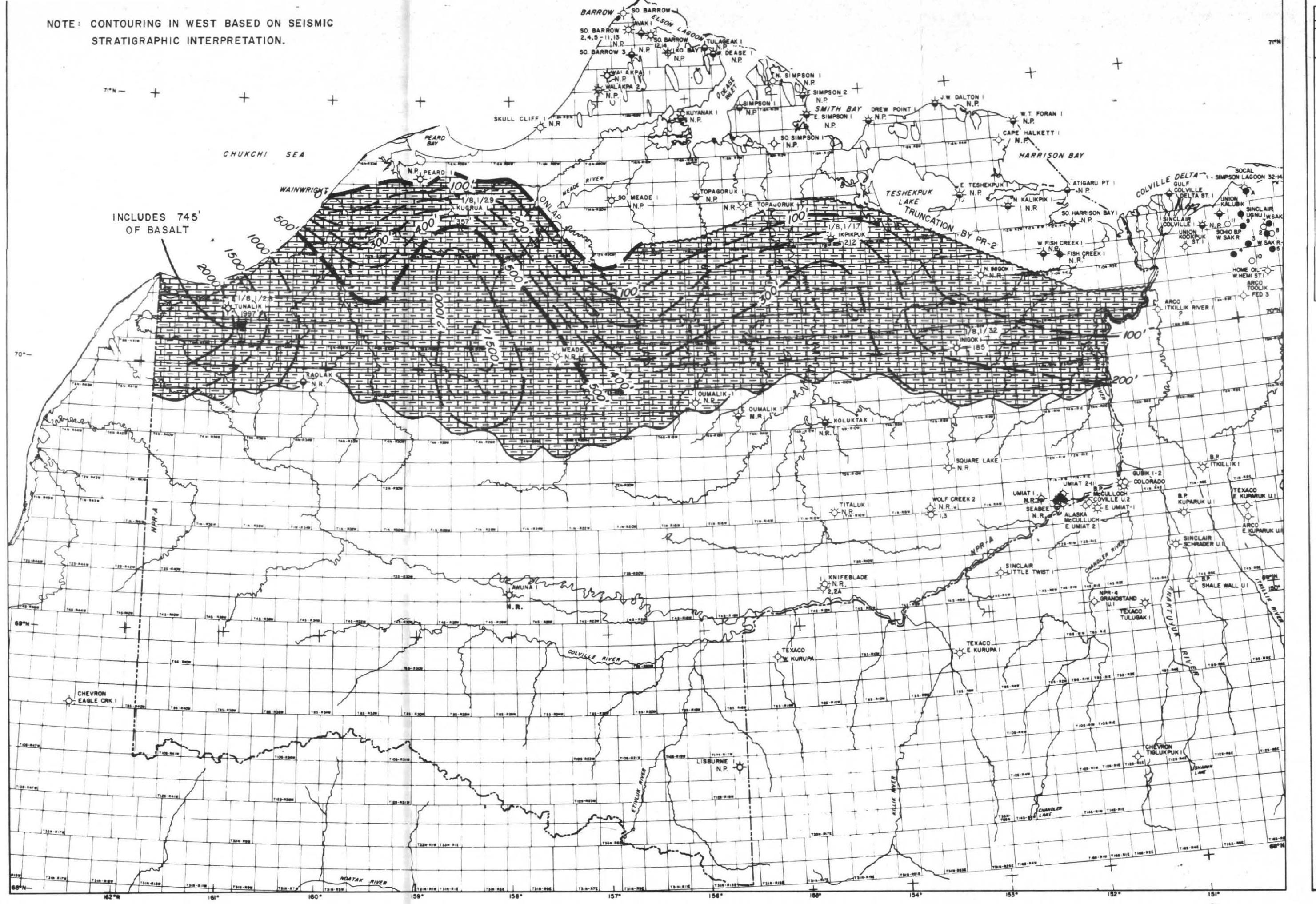
\*Includes 745 ft (227 m) of interbedded basalt.

The P-2 parastratigraphic unit mostly coincides with the "Transition Zone" between the Wahoo Limestone and the Joe Creek Member of the Echooka Formation.

The northern boundary of P-2 runs roughly east-west. West of the Meade Arch, and farther to the north, the unit unconformably overlaps the P-1 unit. East of the Meade Arch, P-2 is truncated by the PR-2 unit in the north. Unit P-2 is thickest in the Ikpikpuk Basin, and wedges out to the northeast.

At Tunalik 1, unit P-2 is 1,997 ft (609 m) thick and includes 745 ft (227 m) of interbedded basalt. In the Meade Basin, seismic-stratigraphic interpretation indicates P-2 is fairly thick. Relatively thin P-2 sediments are present over the positive tectonic elements in the northwestern NPRA.

NOTE: CONTOURING IN WEST BASED ON SEISMIC STRATIGRAPHIC INTERPRETATION.



**EXPLANATION**

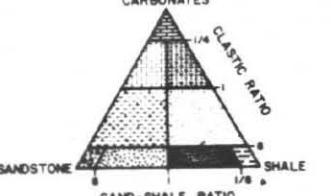
D-SHALE CLASTIC RATIO  
RATIO (IF CALCULATED)

1/2, 1/4

251' THICKNESS (ISOPACH)

N.R. NOT REACHED  
N.P. NOT PRESENT

N.P. NOT PRESENT  
CARBONATES



**LOCATION**

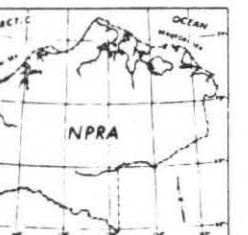
**ABANDONED WELL**

ABANDONED WELL (GAS SHOW)  
ABANDONED WELL (OIL SHOW)

ABANDONED WELL (OIL SHOW)  
GAS WELL

#### OIL WELL

**ABANDONED OIL WELL**



**ETRA TECH, INC.**

**ENERGY MANAGEMENT DIVISION CALIFORNIA  
EXPLORATION OF NIPRA 1974-1981 (FINAL REPORT)**

### **3. AUTHENTICATION MAP**

## LITHOFACIES MAP

P-2

ALASKA

**FOR  
ONPRA**

**KY OIL NPR OPERATIONS INC.**

J. W. BRUYNZEEL PROJECT NO. TC-7174  
 E. C. GULDENZOPF REVISED

DATUM: AUG 1981 VER

500 SCALE: QWB NO. REPORT NO. B200 FIGURE 43

REPORT NO. 8200 FIGURE 42

-0170

REPORT NO. 8200 FIGURE 42  
-0170

**FIGURE 42**

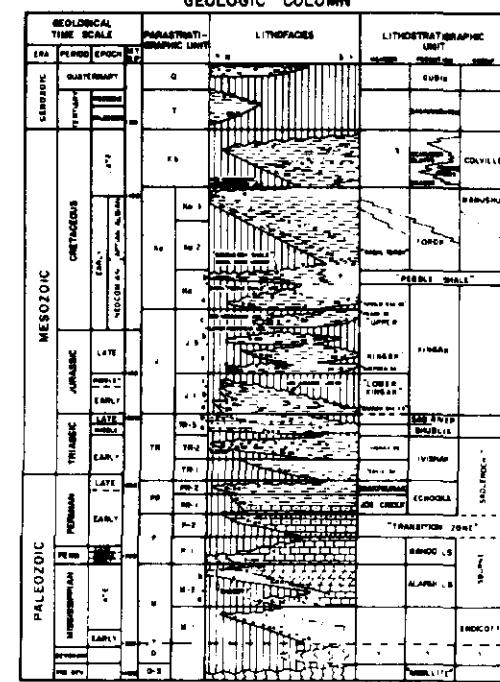
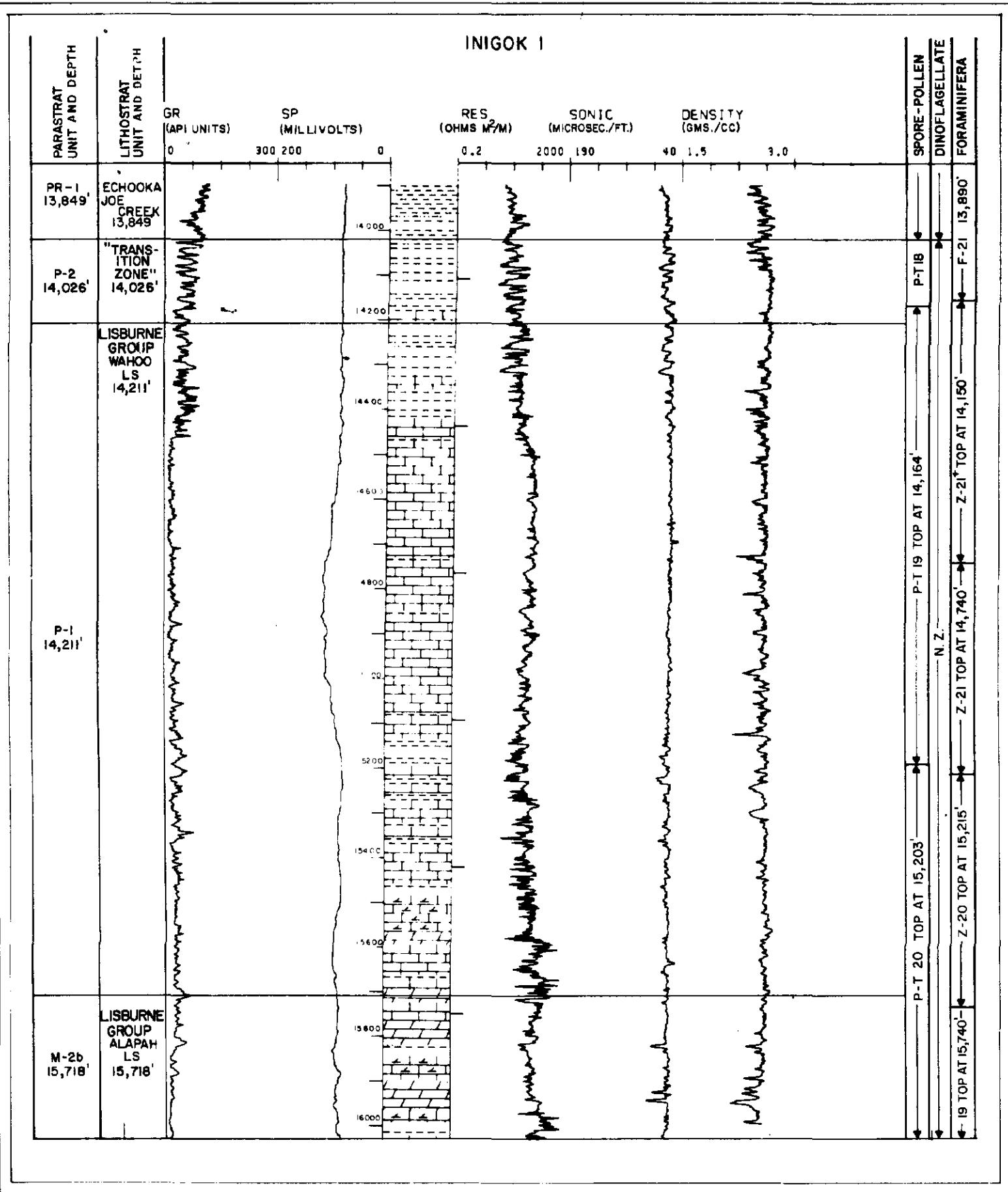
FIGURE 43

TYPE LOG OF P-1 PARASTRATIGRAPHIC  
UNIT, INIGOK I

At Inigok 1, the top of the P-1 unit is at 14,211 ft (4,332 m). On electrical logs, the unit is characterized mainly by funnel-shaped cyclical segments with a period of 30 to 100 ft (9 to 30 m). The gamma-ray curve indicates relatively fewer, thinner shale breaks in the P-1 unit than in underlying units. The P-2 unit consists mainly of funnel-shaped cyclical segments with a period of 20 to 40 ft (6 to 12 m).

In most wells, the lower two-thirds of P-1 consists of massive carbonates with relatively few shale breaks; on logs, the gamma-ray and sonic curves are relatively straight. The lithologic boundary between the more massive carbonates and the interbedded carbonates and shales occurs at different levels in different wells.

In the various NPRA wells, the boundary between Mamet's 20-21 or 22-24 (21+) foraminiferal zones and all younger foraminiferal assemblages is picked as the top of the P-1 unit.



<b>TETRA TECH, INC.</b>	<b>PASADENA, CALIFORNIA</b>
<b>HOUSTON, TEXAS</b>	<b>ENERGY MANAGEMENT DIVISION</b>
<b>PETROLEUM EXPLORATION OF NPRA 1974-1981 (FINAL REPORT)</b>	
<p style="text-align: center;"><b>TYPE LOG OF P-I PARASTRATIGRAPHIC UNIT INIGOK I</b></p>	
<b>NPR</b>	<b>ALASKA</b>
<p style="text-align: center;">FOR <b>ONPRA</b> <b>HUSKY OIL NPR OPERATIONS INC.</b></p>	
<b>PROJECT MANAGER:</b> J. W. BRUYNZEEL	<b>PROJECT NO. TC-7174</b>
<b>INTERPRETATION BY:</b> STAFF	<b>REVISED</b>
<b>DATE:</b> SEPT., 1981	<b>DATUM:</b>
<b>CONTOUR INT:</b>	<b>SCALE:</b>
<b>DWG NO.</b>	

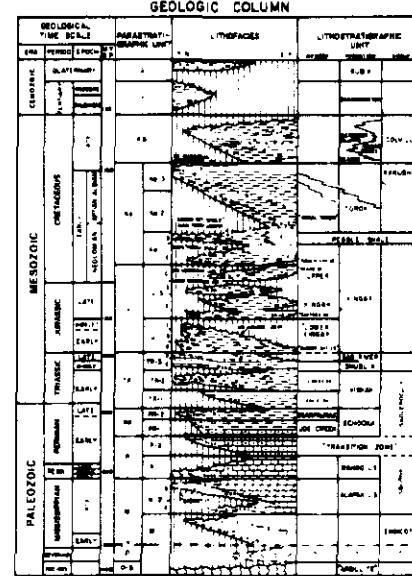
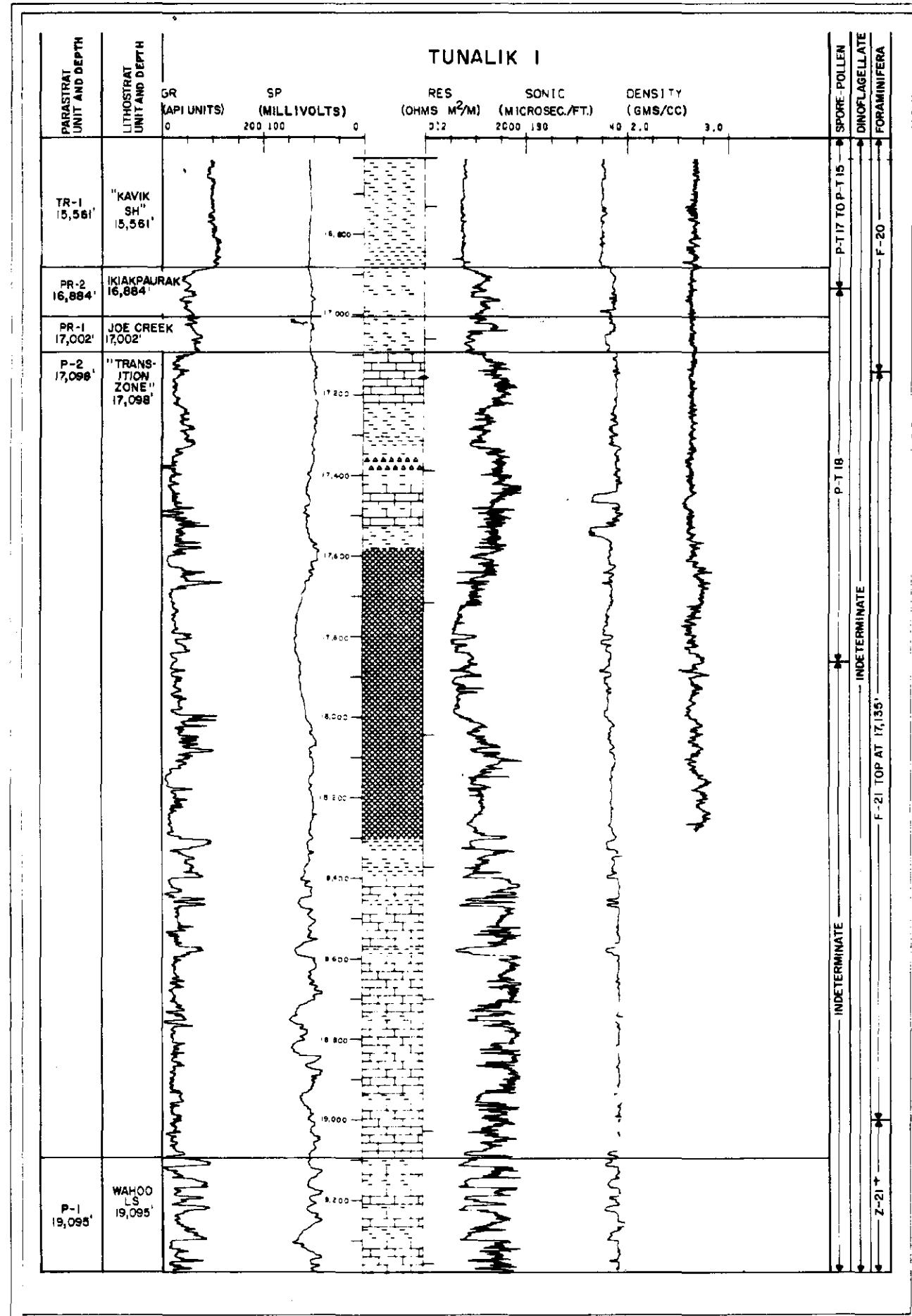
TECHNICAL REPORT NO. 8200  
T62-0170 FIGURE 43

## FIGURE 44

TYPE LOG OF P-2, PR-1, AND PR-2  
PARASTRATIGRAPHIC UNITS,  
TUNALIK 1

At Tunalik 1, the P-2 unit is 1,997 ft (609 m) thick. The top of the unit is at 17,098 ft (5,211 m) and the base is at 19,095 ft (5,820 m). This is the thickest occurrence of the unit that was drilled in the NPRA; hence, Tunalik 1 is the "type" well for definition of unit P-2. A 745-ft (227-m) basalt layer is contained in P-2 at Tunalik 1; core and cuttings descriptions define this layer as a volcanic flow.

The PR unit is recognizable from pronounced log deflections at the base of the relatively featureless TR-1 unit. PR is subdivided into a lower calcareous, fine clastic unit designated PR-1 and an upper coarse clastic unit designated PR-2. The lower unit appears shaly on the electric logs with several pronounced carbonate "spikes" near the base of the unit. The upper unit is characterized by pronounced deflections on all curves. PR is 300 to 400 ft (91 to 122 m) thick in most places.



**TETRA TECH, INC.**  
HOUSTON, TEXAS      ENERGY MANAGEMENT DIVISION      PASADENA, CALIFORNIA  
PETROLEUM EXPLORATION OF NPRA 1974 - 1981 (FINAL REPORT)

**TYPE LOG OF P-2, PR-1 AND PR-2 PARASTRATIGRAPHIC UNITS TUNALIK I**

NPR      ALASKA  
FOR  
ONPRA  
HUSKY OIL NPR OPERATIONS INC.

PROJECT MANAGER: J. W. BRUYNZEEL	PROJECT NO. TC-7 74
INTERPRETATION BY: STAFF	REVISED INITIAL
DATE: SEPT., 1981	DATUM:
CONTOUR INT: SCALE:	DWG NO.

TETRA TECH REPORT NO. 8200

FIGURE 44

TGZ-0170

FIGURE 45

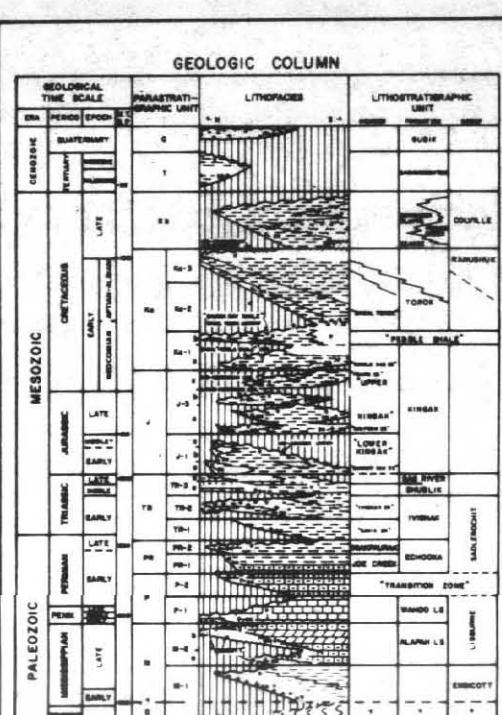
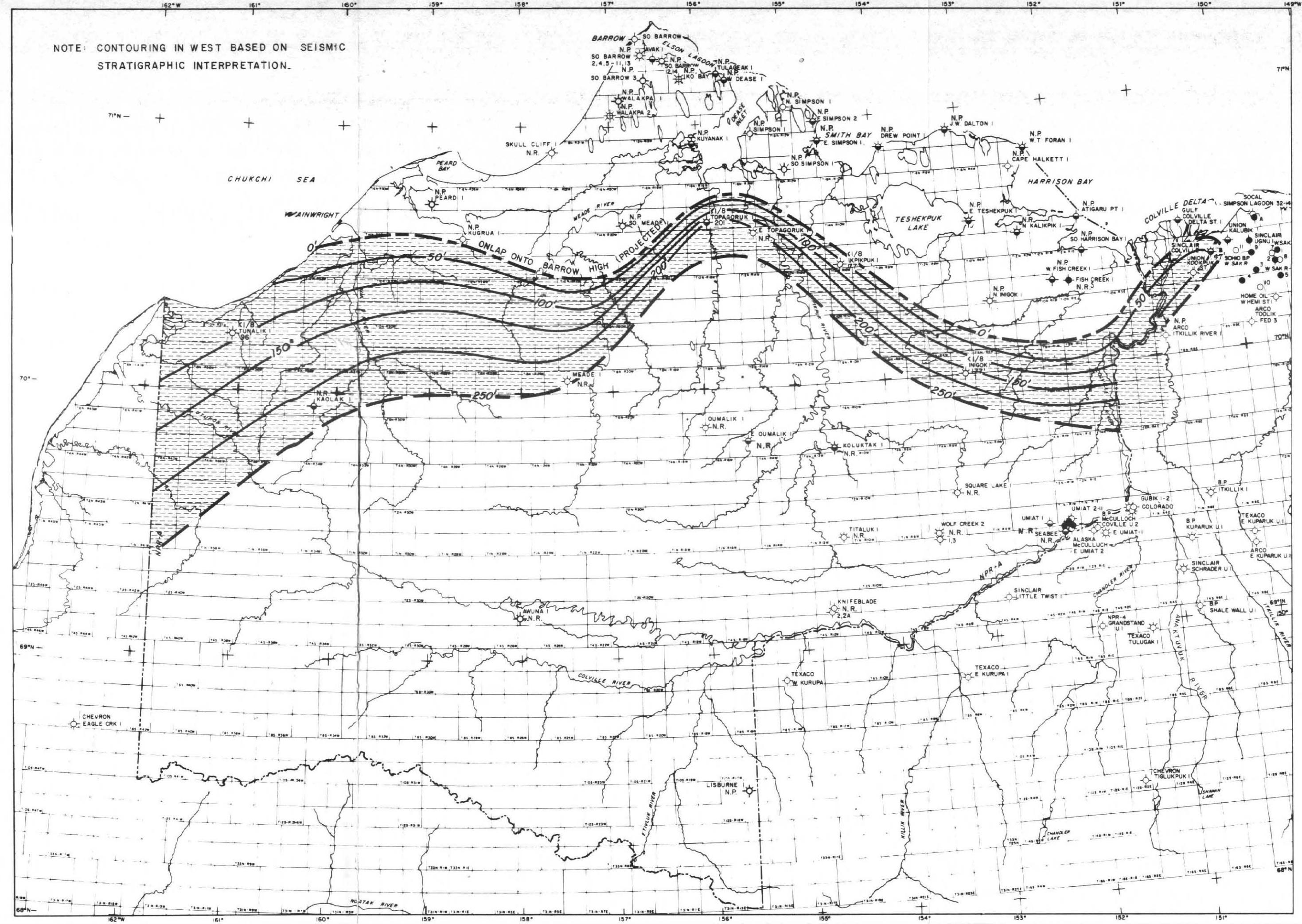
ISOPACH AND LITHOFACIES MAP, PR-1

Well	Thickness		Sand-Shale Ratio
	Feet	Meters	
Ikpikpuk 1	77	23	<1/8
Inigok 1	177	61	<1/8
Tunalik 1	96	29	<1/8
Topagoruk	201	62	<1/8
Sinclair Colville 1	47	14	n.d.*

\*n.d., not determined.

The PR-1 unit coincides with the Joe Creek Member of the Ehooka Formation and consists mainly of shale and siltstone with some interbedded limestone near the base. A relatively thin unit, PR-1 overlies the shaly P-2 and underlies the coarser clastics of the PR-2 unit.

The PR-1 unit onlaps the underlying P-2 interval toward the north. Unit PR-2 extends farther to the north than PR-1 before terminating by onlap onto the Barrow High.



0 10 20 30 40 50  
KILOMETERS  
0 10 20 30  
MILES

**EXPLANATION**

SAND-SHALE CLASTIC RATIO  
RATIO (IF CALCULATED)

1/2, 1/4

25' THICKNESS (ISOPACH)

N.R. NOT REACHED

N.P. NOT PRESENT

CARBONATES

CLASTIC RATIO

SANDSTONE SHALE

SAND-SHALE RATIO

1/2, 1/4

25' THICKNESS (ISOPACH)

N.R. NOT REACHED

N.P. NOT PRESENT

CARBONATES

CLASTIC RATIO

SANDSTONE SHALE

SAND-SHALE RATIO

1/2, 1/4

25' THICKNESS (ISOPACH)

N.R. NOT REACHED

N.P. NOT PRESENT

CARBONATES

CLASTIC RATIO

SANDSTONE SHALE

SAND-SHALE RATIO

1/2, 1/4

25' THICKNESS (ISOPACH)

N.R. NOT REACHED

N.P. NOT PRESENT

CARBONATES

CLASTIC RATIO

SANDSTONE SHALE

SAND-SHALE RATIO

1/2, 1/4

25' THICKNESS (ISOPACH)

N.R. NOT REACHED

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SANDSTONE SHALE

SAND-SHALE RATIO

1/2, 1/4

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SANDSTONE SHALE

SAND-SHALE RATIO

1/2, 1/4

25' THICKNESS (ISOPACH)

N.R. NOT REACHED

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SANDSTONE SHALE

SAND-SHALE RATIO

1/2, 1/4

25' THICKNESS (ISOPACH)

N.R. NOT REACHED

N.P. NOT PRESENT

CARBONATES

CLASTIC RATIO

SANDSTONE SHALE

SAND-SHALE RATIO

1/2, 1/4

25' THICKNESS (ISOPACH)

N.R. NOT REACHED

N.P. NOT PRESENT

CARBONATES

CLASTIC RATIO

SANDSTONE SHALE

SAND-SHALE RATIO

1/2, 1/4

25' THICKNESS (ISOPACH)

N.R. NOT REACHED

N.P. NOT PRESENT

CARBONATES

CLASTIC RATIO

SANDSTONE SHALE

SAND-SHALE RATIO

1/2, 1/4

25' THICKNESS (ISOPACH)

N.R. NOT REACHED

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CARBONATES

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SANDSTONE SHALE

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1/2, 1/4

25' THICKNESS (ISOPACH)

N.R. NOT REACHED

N.P. NOT PRESENT

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CLASTIC RATIO

SANDSTONE SHALE

SAND-SHALE RATIO

1/2, 1/4

25' THICKNESS (ISOPACH)

N.R. NOT REACHED

N.P. NOT PRESENT

CARBONATES

CLASTIC RATIO

SANDSTONE SHALE

SAND-SHALE RATIO

1/2, 1/4

25' THICKNESS (ISOPACH)

N.R. NOT REACHED

N.P. NOT PRESENT

CARBONATES

CLASTIC RATIO

SANDSTONE SHALE

SAND-SHALE RATIO

1/2, 1/4

25' THICKNESS (ISOPACH)

N.R. NOT REACHED

N.P. NOT PRESENT

CARBONATES

CLASTIC RATIO

SANDSTONE SHALE

SAND-SHALE RATIO

1/2, 1/4

25' THICKNESS (ISOPACH)

N.R. NOT REACHED

N.P. NOT PRESENT

CARBONATES

CLASTIC RATIO

SANDSTONE SHALE

SAND-SHALE RATIO

1/2, 1/4

25' THICKNESS (ISOPACH)

N.R. NOT REACHED

N.P. NOT PRESENT

CARBONATES

CLASTIC RATIO

SANDSTONE SHALE

SAND-SHALE RATIO

1/2, 1/4

25' THICKNESS (ISOPACH)

N.R. NOT REACHED

N.P. NOT PRESENT

CARBONATES

CLASTIC RATIO

SANDSTONE SHALE

SAND-SHALE RATIO

1/2, 1/4

25' THICKNESS (ISOPACH)

FIGURE 46

ISOPACH AND LITHOFACIES MAP, PR-2

Well	Thickness		Sand-Shale Ratio
	Feet	Meters	
Atigaru Point 1	111	39	1/1.3
West Fish Creek 1	55	17	1.8
South Harrison Bay 1	99	30	1.7
Ikpikpuk 1	241	73	1/2.3
Inigok 1	193	59	1/2.8
Kugrua 1	188	57	3.0
Peard 1	164	50	100
South Simpson 1	162	49	1.8
East Teshekpuk 1	38	12	1/1.2
Topagoruk 1	68	22	1/2.5
Tunalik 1	118	36	3.2
Sinclair Colville 1	78	24	n.d.*
Arco Itkillik River 1	105	32	1.3

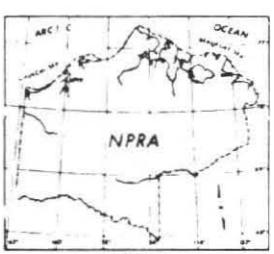
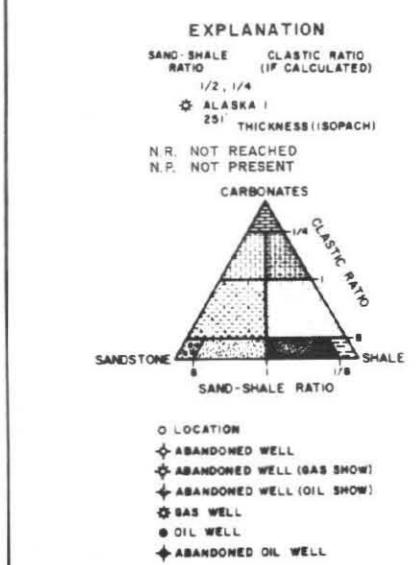
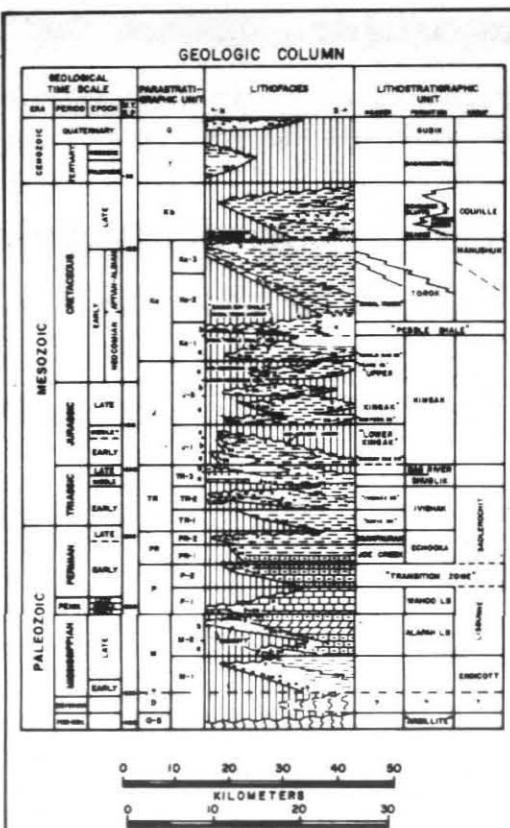
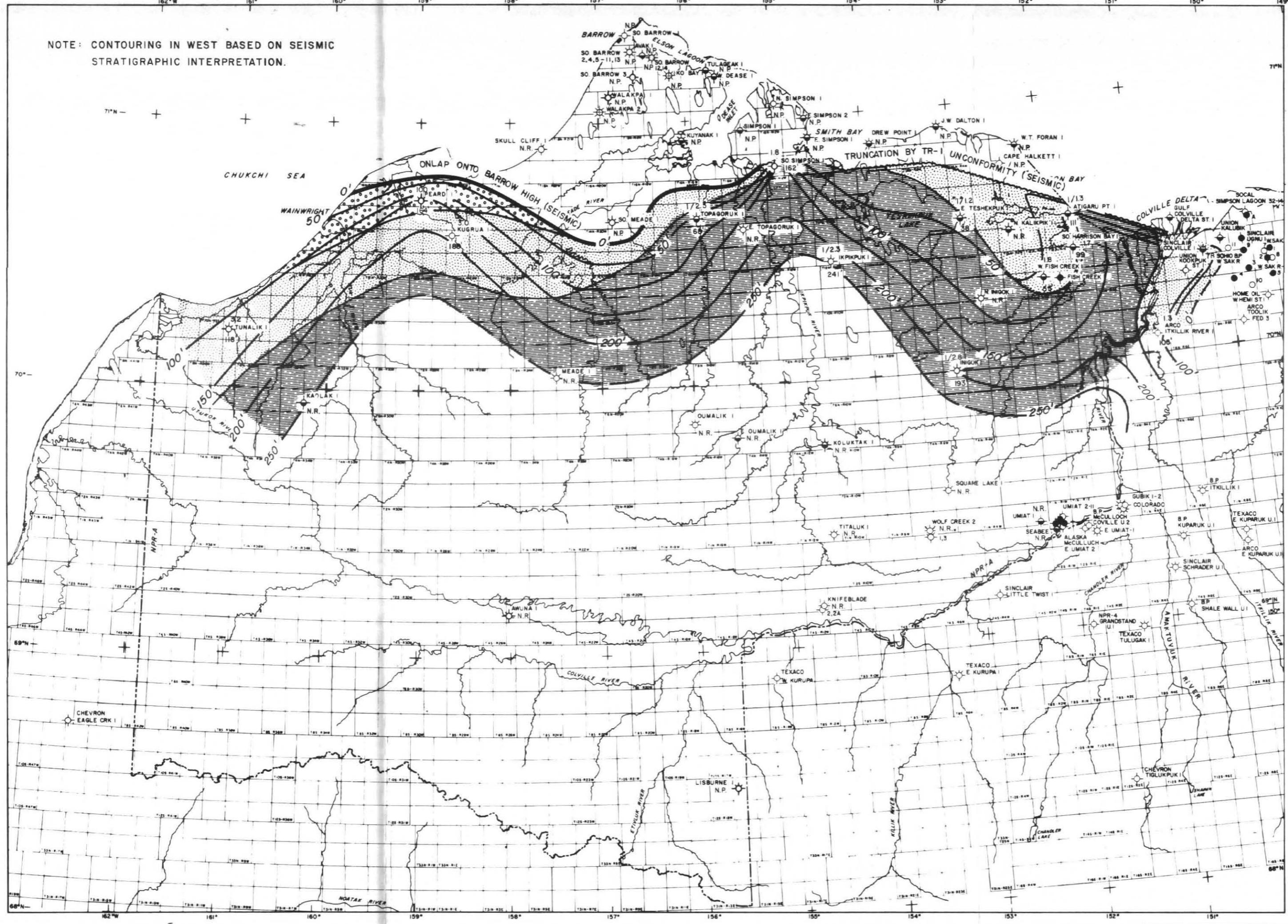
\*n.d., not determined.

The PR-2 parastratigraphic unit coincides with the Ikiakpaurak Member of the Echoaka Formation. PR-2 laps onto the tectonically positive Barrow High to the north. The unit thickens toward the south to a maximum of 241 ft (73 m) at Ikpikpuk 1.

In the west, the PR-2 unit laps onto the Wainwright and the Meade Arches. East of the Meade Arch, the unit is truncated by the overlying TR-1 unit.

PR-2 becomes increasingly sandy toward the north. The area of greatest sand development is at Peard 1 where the unit consists entirely of sandstone. PR-2 also is sandy over the Fish Creek Platform.

NOTE: CONTOURING IN WEST BASED ON SEISMIC STRATIGRAPHIC INTERPRETATION.



**TETRA TECH, INC**  
HOUSTON TEXAS ENERGY MANAGEMENT DIVISION PASCAGOULA, MISSISSIPPI  
PETROLEUM EXPLORATION OF NPR-A (974) (981) (FINAL REPORT)  
**ISOPACH & LITHOFACIES MAP PR-2**  
NPR ALASKA FOR ONPRA  
HUSKY OIL/NPR OPERATIONS INC.  
PROJECT MANAGER: J. W. BRUYNEEL PROJECT NO. T-714  
INTERPRETATION BY: D. H. HIGGS DATE: REVISED  
DATE: SEPT 1980 SATURN INITIAL  
CONTOUR INT: 50' SCALE: SWS NO.  
TETRA TECH REPORT NO. 8200

TG7-0170 FIGURE 46

FIGURE 47

ISOPACH MAP, TR-1

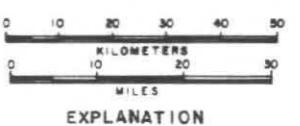
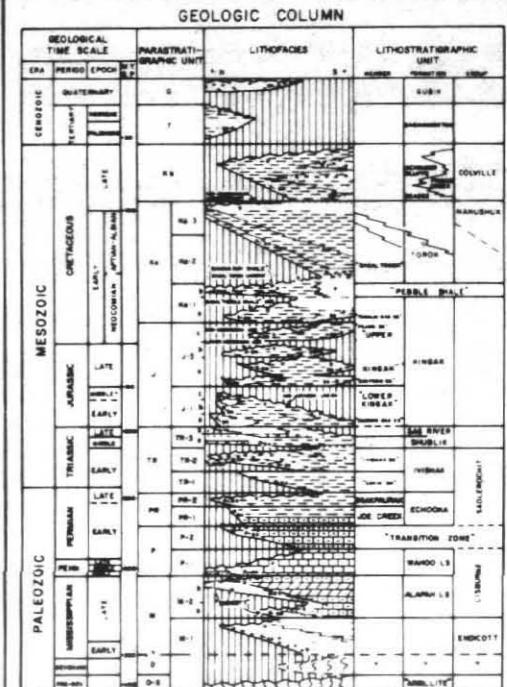
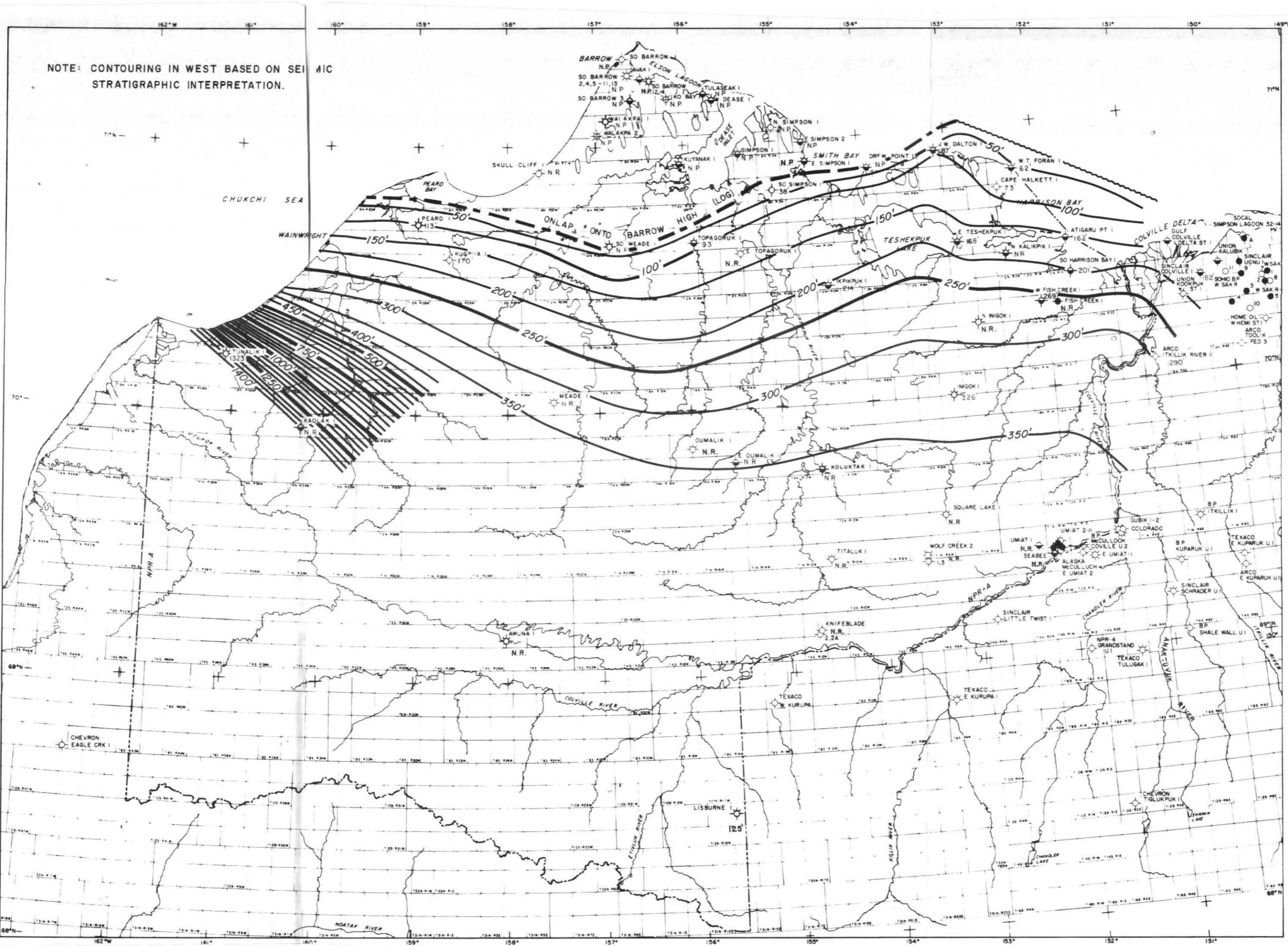
Well	Thickness	
	Feet	Meters
Atigaru Point 1	162	49
Cape Halkett 1	73	22
J. W. Dalton 1	87	27
West Fish Creek 1	269	82
W. T. Foran 1	62	19
South Harrison Bay 1	201	61
Ikpikpuk 1	214	61
Inigok 1	326	99
Kugrua 1	170	52
Listurne 1	125	38
Peard 1	113	34
South Simpson 1	38	12
East Teshekpuk 1	168	51
Topagoruk 1	93	28
Tunalik 1	1,323	407
Sinclair Colville 1	182	55
Arco Itkillik River 1	290	89

The TR-1 interval coincides with the "Kavik shale," and parts may be equivalent to parts of the overlying TR-2 unit.

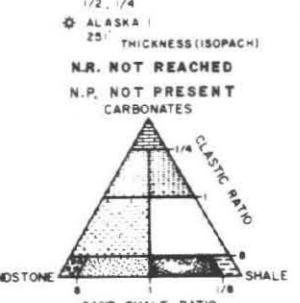
The TR-1 unit laps onto the Barrow High and probably is truncated to the north by the basal "Pebble Shale" unconformity. In the northeastern NPRA, TR-1 thickens gradually toward the south to a maximum thickness of 326 ft (99 m) at Inigok 1. In the northwestern NPRA, the unit thickens toward the Tunalik Basin. The thickest "Kavik shale" interval penetrated in the NPRA is at Tunalik 1 where TR-1 is 1,323 ft (403 m) thick.

The TR-1 unit consists of shale and siltstone. All sand-shale ratios are less than 1/8. No limestone was identified in this unit, so no clastic ratios were calculated. Lithofacies patterns were not plotted.

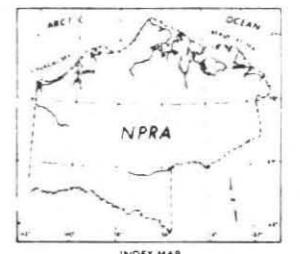
NOTE: CONTOURING IN WEST BASED ON SEI &  
STRATIGRAPHIC INTERPRETATION.



SAND-SHALE RATIO CLASTIC RATIO  
(IF CALCULATED)



- LOCATION
- ◆ ABANDONED WELL
- ◆ ABANDONED WELL (GAS SHOW)
- ◆ ABANDONED WELL (OIL SHOW)
- GAS WELL
- OIL WELL
- ▲ ABANDONED OIL WELL



	HUSTON TEXAS	TETRA TECH, INC.		PASADENA CALIFORNIA
ENERGY MANAGEMENT DIVISION				
PETROLEUM EXPLORATION OF NPRA 1974-1981 (FINAL REPORT)				
ISOPACH MAP				
TR-1				
NPR	ALASKA			
ONPRA				
PROJECT MANAGER: J. W. BRUYNZEEL			PROJECT NO. TC-7174	
INTERPRETATION BY: D. A. HIGGS			REVISED	
DATE: OCT. 1980			DATE: AUG 1981	
DATUM:			INITIAL	
CONTOUR INT: 50'			V.E.B.	
SCALE:			DWS NO.	

**FIGURE 47**

FIGURE 48

ISOPACH AND LITHOFACIES MAP, TR-2

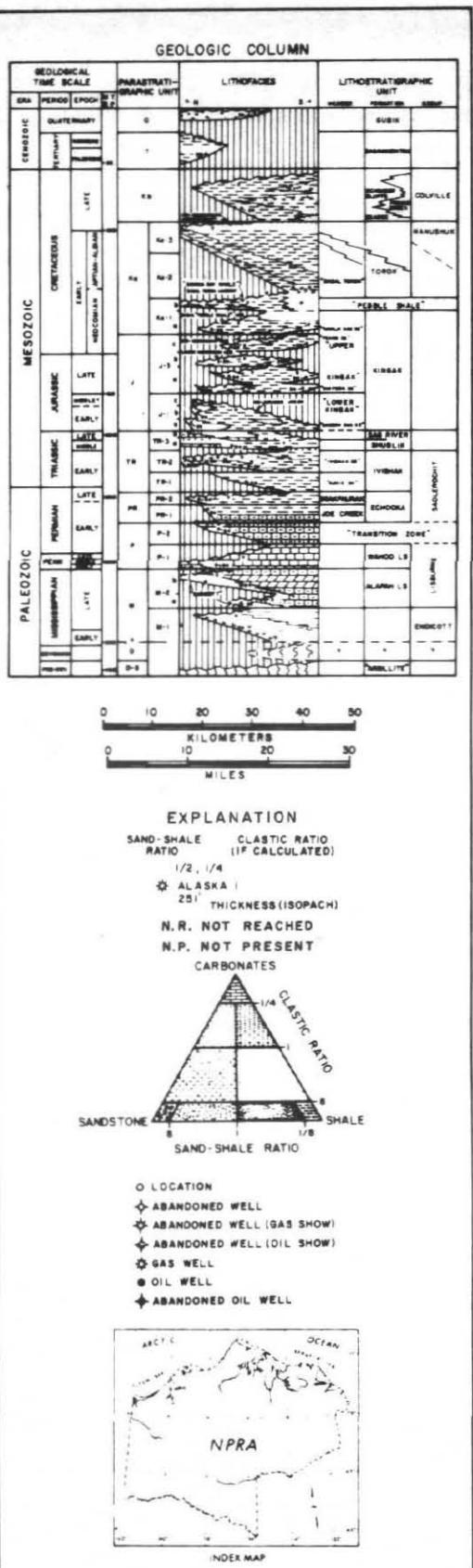
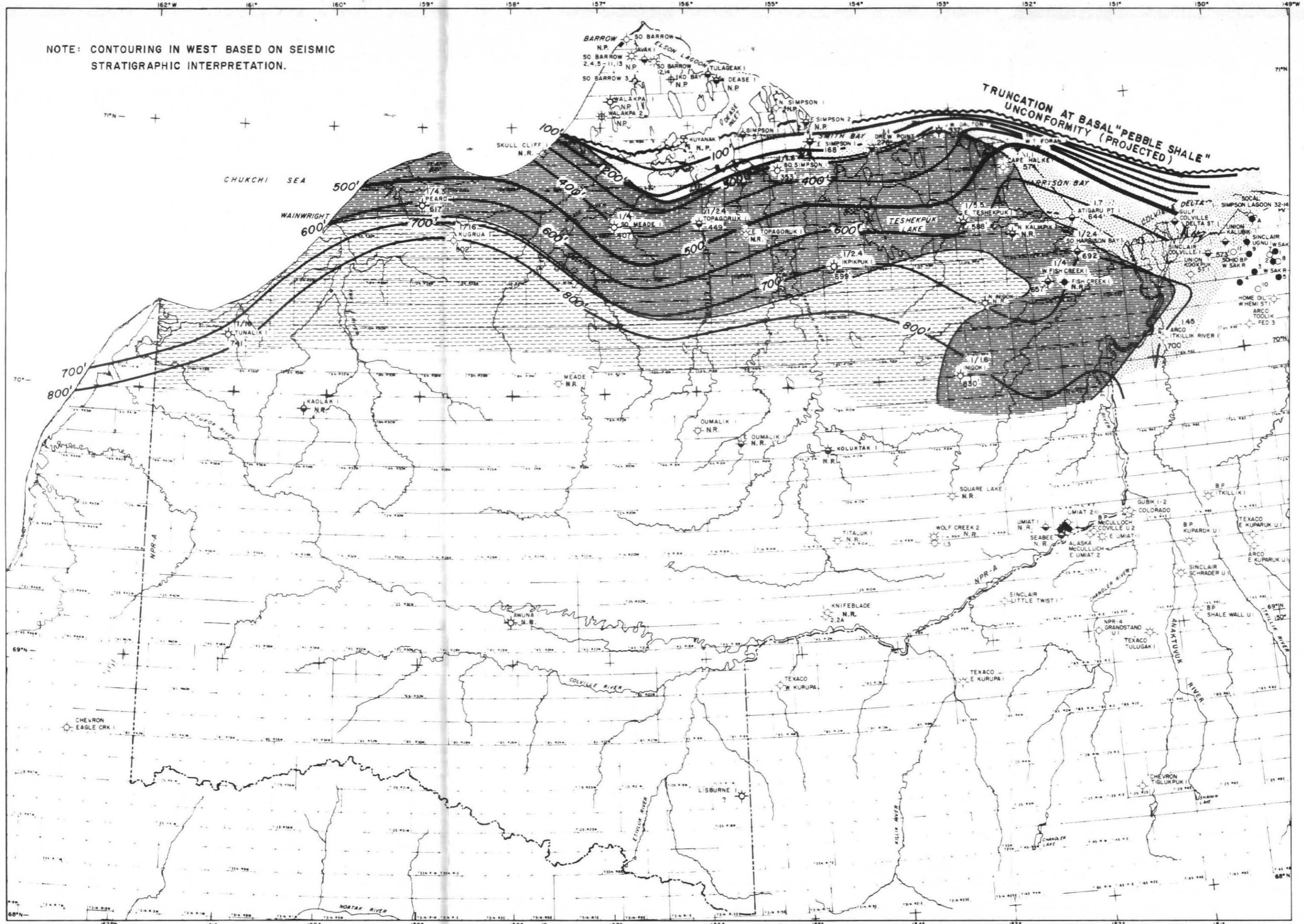
Well	Thickness		Sand-Shale Ratio
	Feet	Meters	
Atigaru Point 1	644	196	1.7
Cape Halkett 1	574	175	1.1
J. W. Dalton 1	337	103	1.1
Drew Point 1	278	88	1.1
West Fish Creek 1	657	200	1/4
W. T. Foran 1	498	152	1.6
South Harrison Bay 1	692	211	1/2.4
Ikpikpuk 1	699	211	1/2.4
Inigok 1	830	253	1/1.6
Kugrua 1	802	244	1/16
South Meade 1	407	124	1/4
Peard 1	617	188	1/4.3
Simpson 1	5	2	n.d.*
East Simpson 1	168	51	2.1
South Simpson 1	353	108	1/1.6
East Teshekpuk 1	588	179	1/5.5
Topagoruk 1	449	127	1/2.4
Tunalik 1	741	226	1/16
Sinclair Colville 1	573	175	n.d.
Arco Itkillik River 1	700	213	n.d.

\*n.d., not determined.

The TR-2 unit contains the "Ivishak sandstone," which is the main reservoir at Prudhoe Bay. TR-2 laps onto the Barrow High westward from J. W. Dalton 1. East of J. W. Dalton 1, TR-2 is truncated by the basal "Pebble Shale" unconformity.

The sand-shale ratios for this unit become progressively smaller toward the southwest. The highest sand counts occur along the Arctic coast and south of the Barrow High.

The TR-2 interval is very sandy in the northeastern part of the NPRA. West of the Meade Arch, TR-2 consists mainly of siltstones, shales, and thin silty sands.



**TETRA TECH, INC.** PASADENA CALIFORNIA  
TRUSTED TEXAS PETROLEUM EXPLORATION OF NPRA 1974-1981 (FINAL REPORT)  
**ISOPACH & LITHOFACIES MAP TR-2**

NPR FOR ALASKA  
ONPRA HUSKY OIL NPR OPERATIONS INC.  
PROJECT MANAGER: J. W. BRUYNZEEL PROJECT NO. T.T.C.7174  
INTERPRETATION BY: R. M. PRATT DATE: INITIAL  
DATE: OCT 1978 DATUM: SEPT 1974 / JUNE 1981  
CONTOUR INT: 100' SCALER: AUG 1981 V.E.B.

FIGURE 48

FIGURE 49

ISOPACH AND LITHOFACIES MAP, TR-3a

Wells	Thickness		Sand-Shale Ratio	Clastic Ratio
	Feet	Meters		
Atigaru Point 1	255	78	1/1.4	3.8
South Barrow 3	165	50	n.d.*	n.d.
Cape Halkett 1	215	66	1/1.4	3.1
J. W. Dalton 1	139	43	1/1.2	0
W. Dease 1	67	21	1/1.2	0
Drew Point 1	510	155	1.2	9
West Fish Creek 1	231	70	<1/8	1.8
W. T. Foran 1	93	28	1/2.5	14
South Harrison Bay 1	284	87	1/10	1/6
Iko Bay 1	58	18	2.4	13.5
Ikpikpuk 1	480	146	1/7	6.4
Inigok 1	343	105	1/6	18
North Inigok 1	152+	46+	n.d.	n.d.
Kugrua 1	372	113	<1/8	1.9
Kuyanak 1	184	56	1.1	0
Lisburne 1	250(?)	76	1.2	1/1.6
South Meade 1	238	73	1/9.5	0
Peard 1	300	91	5.1	18
Simpson 1	269	82	1/2.4	0
East Simpson 1	431	131	1/8.3	10
East Simpson 2	382	116	0	1/1.1
South Simpson 1	524	160	<1/8	23
East Teshekpuk 1	181	55	<1/8	1.6
Topagoruk 1	370	113	<1/8	0
Tulageak 1	67	20	1/1.3	0
Tunalik 1	470	143	1.1	5.6
Walakpa 1	284	87	2.3	8.5
Walakpa 2	313	95	2.1	7.9
Sinclair Colville 1	324	99	n.d.	n.d.
Arco Itkillik River 1	322	99	n.d.	n.d.

\*n.d., not determined.

The TR-3a unit coincides with the Shublik Formation. The variable thickness of the unit is associated with the principal tectonic features of the NPRA. In the eastern half of the Reserve, the maximum thickness of TR-3a occurs at

Ikpikpuk 1 (480 ft, or 146 m) and Inigok 1 (343 ft, or 15 m) in the Ikpikpuk Basin. East of the Dease Inlet, the basal "Pebble Shale" unconformity truncates TR-3a. The truncation zone runs roughly east-west and is just north of J. W. Dalton 1 and W. T. Foran 1. West of Dease Inlet, the unit onlaps the Barrow High.

Thicknesses of TR-3a at East Teshekpuk 1 and West Fish Creek 1 indicate thinning over the Fish Creek Platform. Thinning also is apparent on the flanks of the Meade Arch, as indicated at South Meade 1 and Kugrua 1. In the western half of the Reserve, the unit is thickest at Tunalik 1 and thins northeastward toward the Barrow High. Lithology and high gamma-ray curve deflections within TR-3a suggest that the thinning may be due to periodic nondeposition.

The TR-3a unit consists of calcareous carbonaceous shales and siltstones, silty limestones, and silty calcareous sandstones. Glauconite is a common accessory mineral in the sandstones, and thin shell beds occur throughout the interval. Sand-shale ratios and clastic ratios indicate that the best sand development is in the northwestern part of the Reserve.

High sand-shale ratios at Peard 1, Walakpa 1, Walakpa 2, and Iko Bay 1 indicate a source area northwest of the present shoreline. TR-3a is progressively more argillaceous toward the southeast and more calcareous toward the south. Over the Fish Creek Platform, the amount of limestone present increases significantly. At South Harrison Bay 1, the unit is mostly limestone. At Lisburne 1, with no nearby control, arenaceous limestone is indicated. Apparent lithologic anomalies occur at East Simpson 2 where the unit is interbedded siltstone and limestone and Drew Point 1 where the high sand count may be caused by statistical variations, or may indicate a small barlike body flanking the Barrow High.



FIGURE 50

ISOPACH AND LITHOFACIES MAP, TR-3b

Well	Thickness		Sand-Shale Ratio
	Feet	Meters	
Atigaru Point 1	94	29	3.4
South Barrow 3	47	14	1.8
South Barrow 13	50	15	>1/8
South Barrow 17	80	24	1.4
Cape Halkett 1	131	40	1.6
West Dease 1	151	46	1.8
Drew Point 1	104	32	3.9
West Fish Creek 1	36	11	>8
South Harrison Bay 1	54	17	1/1.2
Iko Bay 1	106	32	3.1
Ikpipluk 1	51	16	1.6
Inigok 1	44	13	<1/8
North Inigok 1	93	28	1/5.2
Kugrua 1	132	40	2
Kuyanak 1	132	40	4.8
Lisburne 1	(?)		-
South Meade 1	122	37	1.2
Pearl 1	216	66	1.8
Simpson 1	116	35	2.1
East Simpson 1	157	48	2.3
East Simpson 2	154	47	3.0
South Simpson 1	143	44	2.6
East Teshekpuk 1	129	39	1/1.3
Topagoruk 1	150	46	1.1
Tulageak 1	117	36	2.0
Tunalik 1	88	27	<1/8
Walakpa 1	126	38	2.86
Walakpa 2	147	45	2.3
Sinclair Colville	46	14	n.d.*
Arco Itkillik River 1	74	23	<1/8

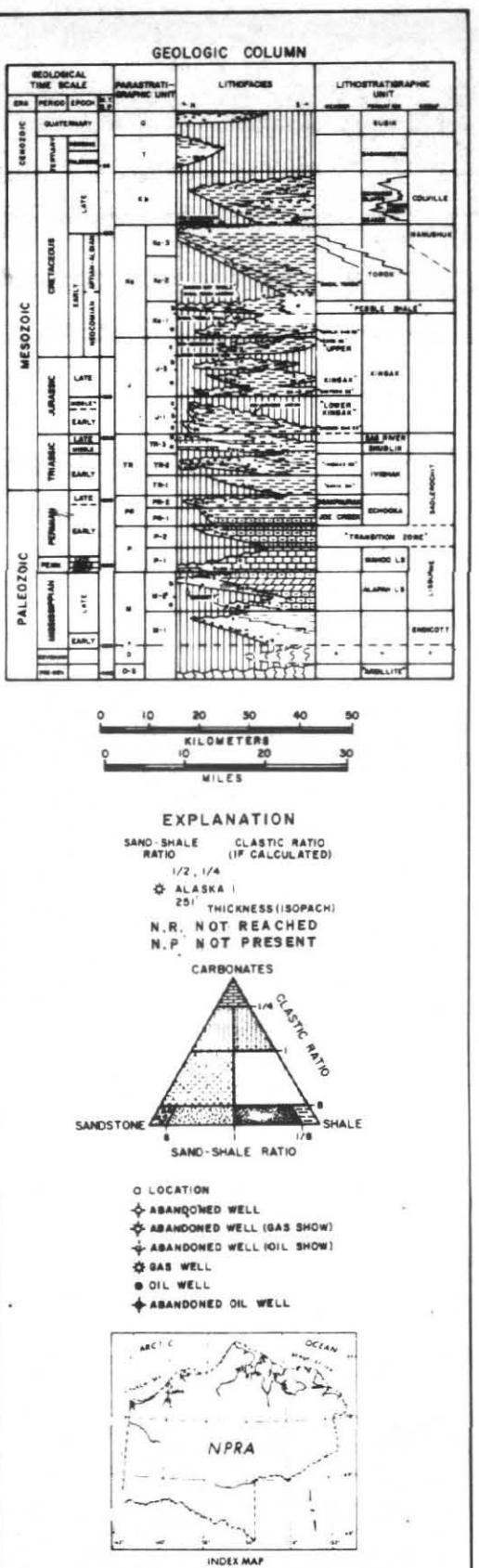
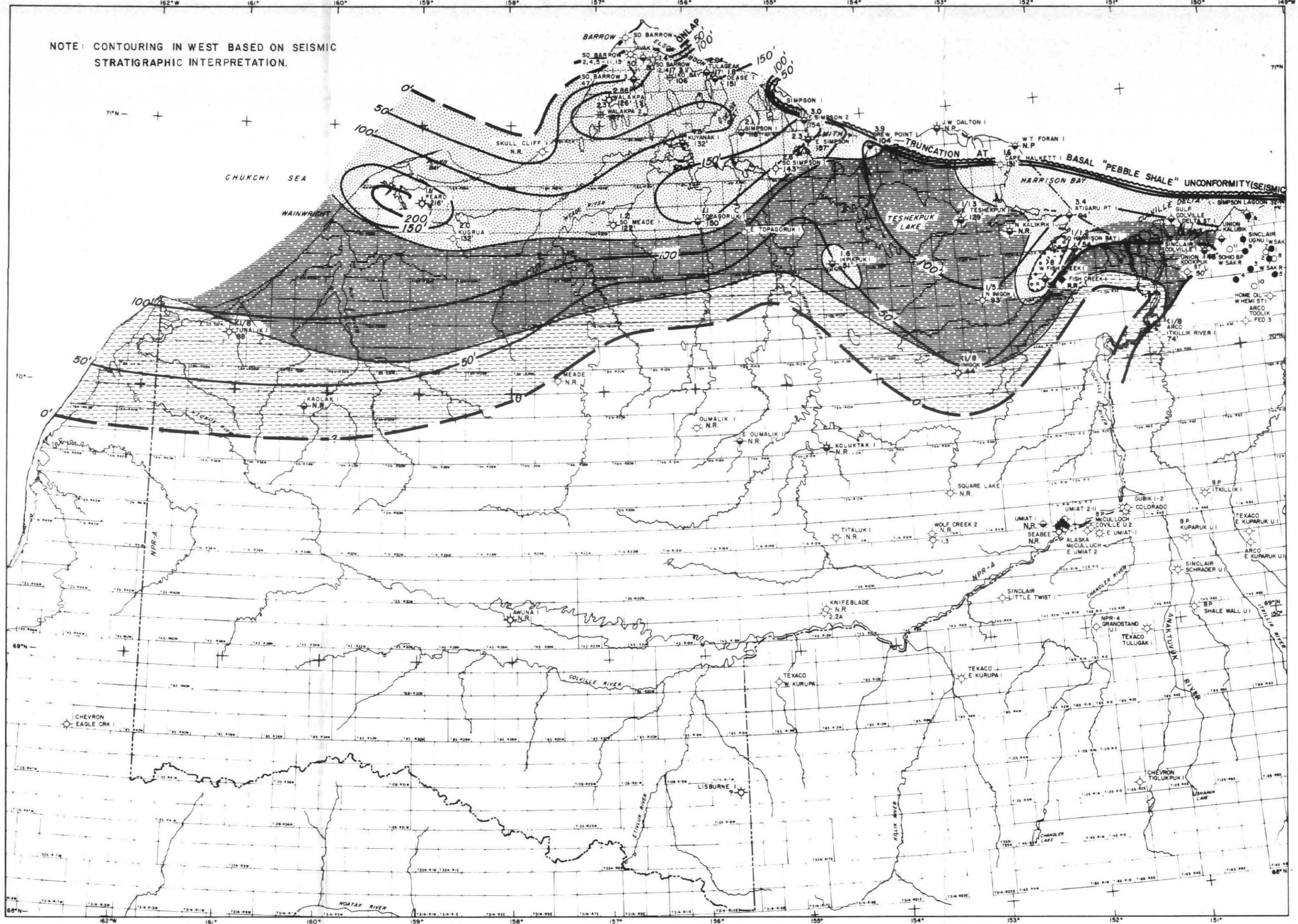
\*n.d., not determined.

In the northern part of the NPRA, Unit TR-3b contains the Sag River Sandstone. The unit ranges in thickness from 216 ft (66 m) at Pearl 1 to 36 ft (11 m) at West Fish Creek 1, with the thickest development just south of and parallel to the Barrow High. The unit thins toward the south across the Reserve and probably is present only in the northern half of the NPRA. In the Barrow area, TR-3b thins toward the north where it onlaps the Barrow High. East of Dease Inlet, the basal "Pebble Shale" unconformity truncates TR-3b. Near Dease Inlet, TR-3b appears to thicken toward the north-northeast, and it is uncertain whether truncation or onlap occurs.

Unit TR-3b is the "cleanest" stratigraphic unit drilled to date on the Reserve. The sandstone lithofacies of the Sag River is restricted to the northern part of the NPRA where it is a sheetlike sand probably consisting of a series of overlapping bars. The unit becomes increasingly silty toward the west and south. In the Barrow area, TR-3b consists of limestone and a shore facies of glauconitic, shelly sandstones, siltstones, and shales.

Sand-shale ratios indicate two areas of partly overlapping barlike complexes. The best developed area is in the northwestern NPRA, extending from South Barrow 17 in the north, to Pearl 1 and Kugrua 1 to the southwest, to Drew Point 1 to the northeast. The second area of good sand development is associated with the Fish Creek Platform. A third, smaller area of sand located at Ikpipluk 1 may be an extension of the Fish Creek Platform bar or may represent an isolated accumulation.

NOTE: CONTOURING IN WEST BASED ON SEISMIC STRATIGRAPHIC INTERPRETATION.



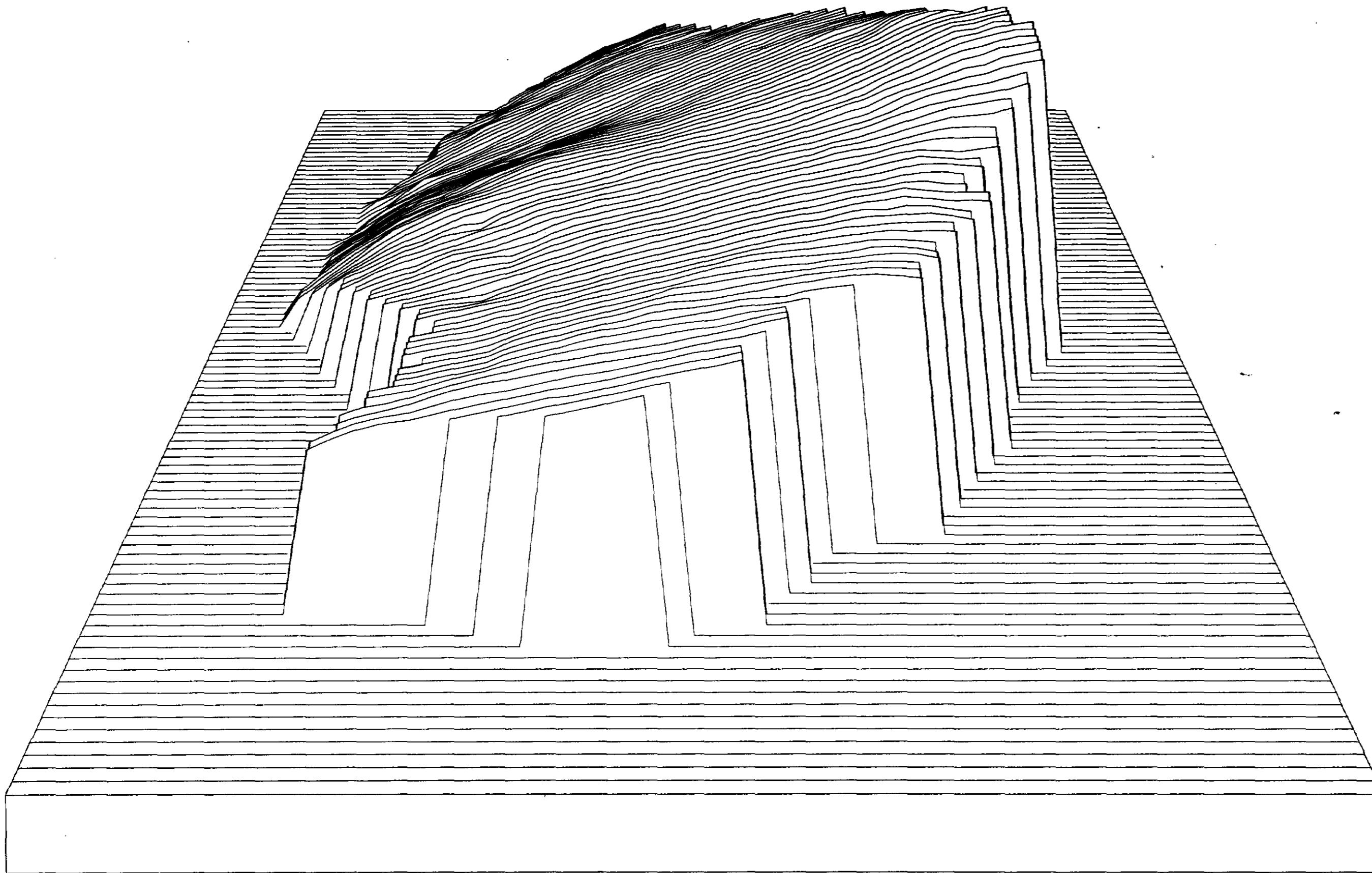
<b>TETRA TECH, INC.</b>		
PO BOX 11445	ENERGY MANAGEMENT DIVISION	PASADENA
PETROLEUM EXPLORATION OF NPRA 1974-1981 (FINAL REPORT)		
<b>ISOPACH &amp; LITHOFACIES MAP</b>		
<b>TR-3b</b>		
<b>NPR</b>	<b>ALASKA</b>	
<b>FOR</b>		
<b>ONPRA</b>		
<b>HUSKY OIL NPR OPERATIONS INC.</b>		
PROJECT MANAGER: J.W. BRUYNEL	PROJECT NO. T.C.7174	
INTERPRETATION BY: R.M. PRATT	REVISED	
DATE: OCT. 1978	DATUM:	DATE: DEC. 1981
CONTOUR INT: 50'	SCALE:	DATE: MAR 1982
TETRA TECH REPORT NO. 8200		

FIGURE 50

FIGURE 51

THREE-DIMENSIONAL PERSPECTIVE  
OF HORIZON 1000

This computer-plotted image of horizon 1000 as viewed from the east was generated from about 6,000 records in an NPRA geophysical data base. The illustration is a generalized configuration of the top of parastratigraphic unit TR-3 as represented by horizon 1000.



THREE - DIMENSIONAL  
PERSPECTIVE OF  
HORIZON 1000

— N —

TGZ-0170

**FIGURE 52****LINE B1-78-G-1182, SHOTPOINTS 8-270,  
SCALED FINAL STACK**

Line B1-78, a north-northeast seismic line subparallel to the northwest coastline of the Barrow area, shows the large structural feature known as the Barrow High. This broad anticline trends nearly east-west across the Barrow area, extending westward into the Chukchi Sea. Most of the pre-Cretaceous section terminates due to onlap onto the southern flank of the Barrow High or is truncated by the basal "Pebble Shale" unconformity. Line B1-78 shows the lapsouts of horizon 1000 and the Kingak Formation. Horizons 1040 and 1100 lap out farther to the south, demonstrating the extension of younger horizons northward beyond the terminations of older horizons. These onlap terminations provide possible stratigraphic traps.

B1-78 also shows the displacement of the Barrow High axis with depth. The axis, which trends generally east-west, migrates northward with increasing depth. Thinning of the Cretaceous portion of the section over the Barrow High is also evident.

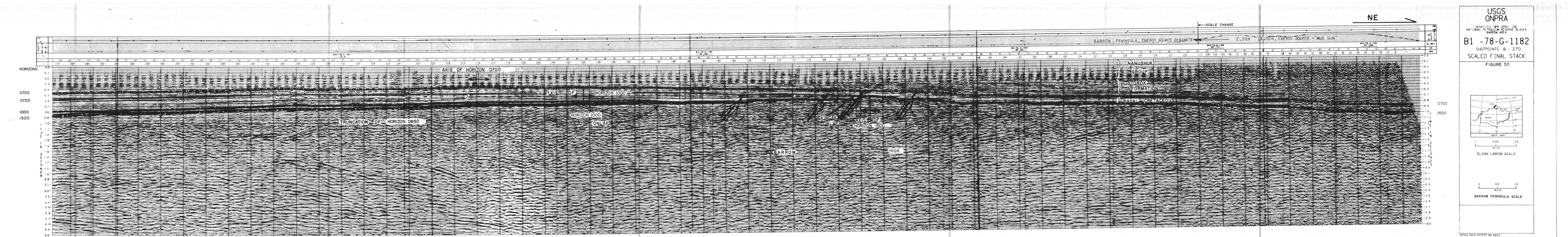


FIGURE 53

LINE B11-78-G-1182, SHOTPOINTS 1-305,  
SCALED FINAL STACK

Near the center of the Barrow High is an area of complex faulting and folding called the "Disturbed Zone." The boundaries of this subbound structure are defined by a series of high-angle faults, and its interior is structurally complex. The development of this zone may be due to an igneous piercement body which did not extend upward through the basement.

The South Barrow gas field lies on the western edge of this zone, and the East Barrow gas field is on the eastern edge. Both of these fields produce from the "Barrow gas sand" (horizon 0970), which may have been deposited as a channel sand. Line B11-78 is oriented northwesterly across part of the East Barrow gas field and the "Disturbed Zone," and lies just north of the South Barrow gas field.

High-angle faults along the margin of the "Disturbed Zone" are difficult to pinpoint on the seismic data because of strong diffractions.

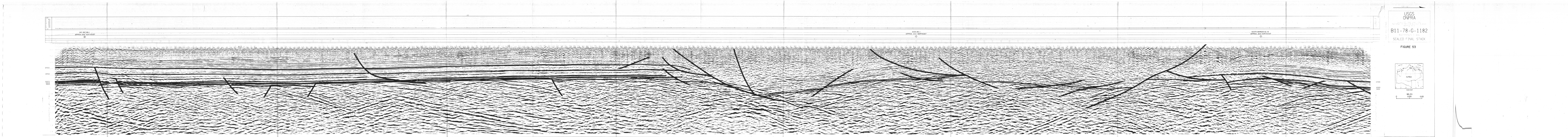


FIGURE 54

ISOPACH AND LITHOFACIES MAP, J-1

Well	Thickness		Sand-Shale Ratio
	Feet	Meters	
Atigaru Point 1	750	229	<1/16
South Barrow 3	748	228	n.d.*
South Barrow 13	187	57	1/8.4
South Barrow 17	503	153	1/3.2
Cape Halkett 1	178	54	<1/16
West Dease 1	431	131	1/8
Drew Point 1	71	22	1/16
West Fish Creek 1	252	77	<1/16
South Harrison Bay 1	667	203	<1/16
Iko Bay 1	643	196	1/3.9
Ikpiuk 1	580	177	1/16
Inigok 1	150	46	<1/16
North Inigok 1	136	41	1/11.4
Kugrua 1	616	188	<1/16
Kuyanak 1	587	179	1/11.2
Lisburne 1	(?)		-
South Meade 1	714	218	1/7
Peard 1	205	63	<1/16
Simpson 1	520	159	<1/16
East Simpson 1	282	86	1/16
East Simpson 2	87	27	1/8
South Simpson 1	814	248	<1/16
East Teshekpuk 1	1,038	316	<1/16
Topagoruk 1	782	238	1/16
Tulageak 1	812	248	1/9.1
Tunalik 1	140	43	<1/16
Walakpa 1	640	195	1/7.7
Walakpa 2	613	187	1/7.7

\*n.d., not determined.

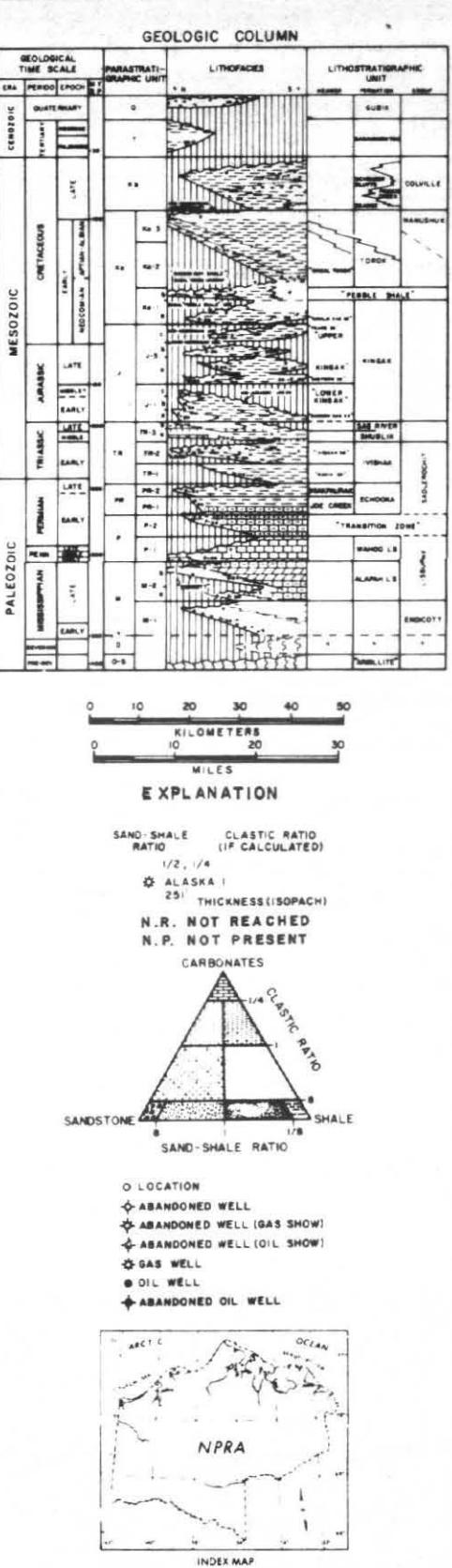
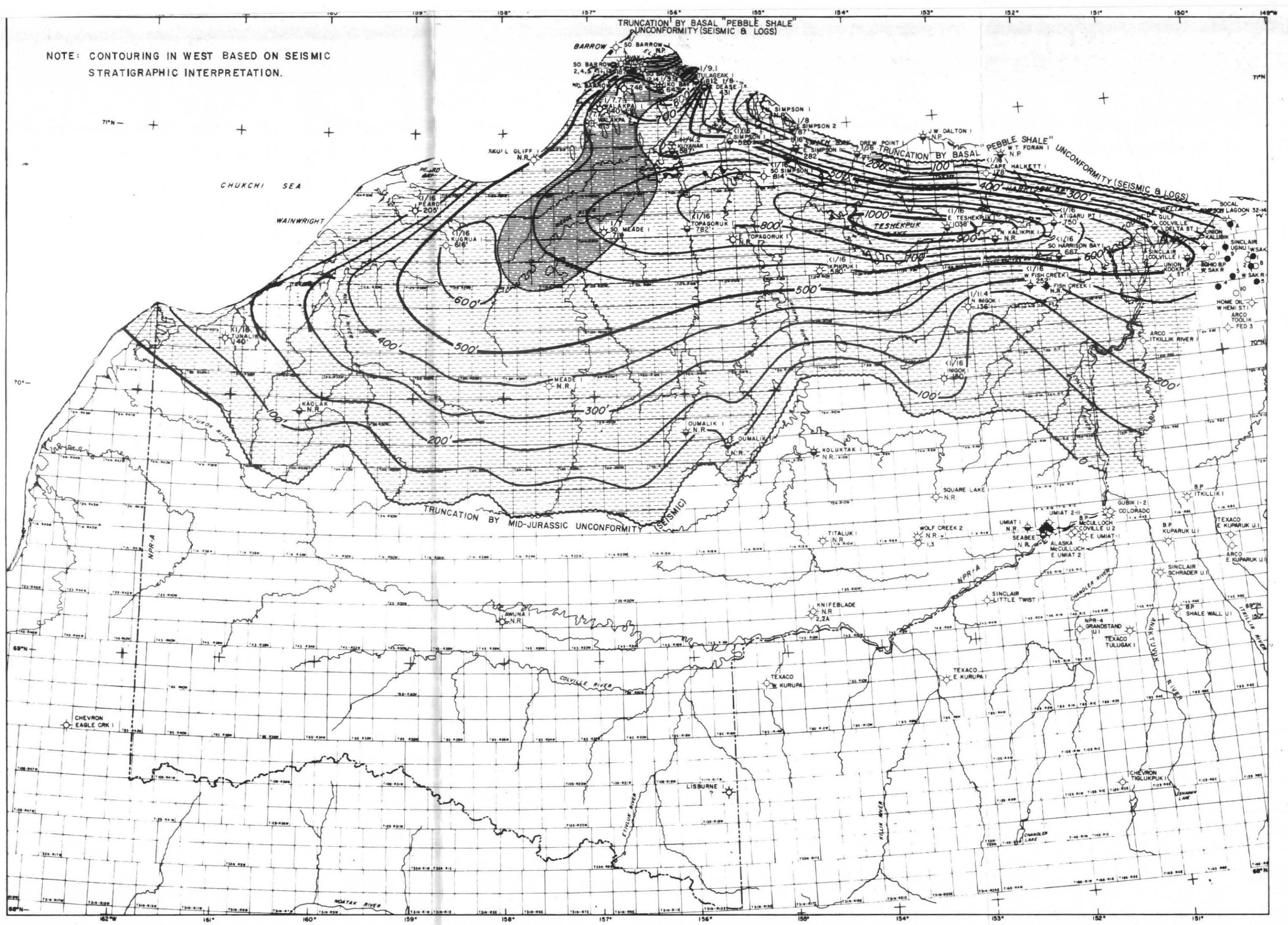
Unit J-1, which contains the reservoir "Barrow sandstone" in the Barrow area, lies unconformably on TR-3 and is restricted to the northern part of the NPRA. J-1 is Early-Middle(?) Jurassic and coincides with foraminiferal zones F-17 and F-18 (Anderson, Warren, and Associates, 1974-1979).

The thickness of J-1 is related to its truncation by the overlying mid-Jurassic and basal "Pebble Shale" unconformities. The thickest section penetrated is 1,038 ft (316 m) thick at East Teshekpuk 1; this section extends to the west and parallels the Barrow Arch. Northward, toward the Barrow High and the Barrow Arch, unit J-1 is progressively truncated by the basal "Pebble Shale" unconformity. In the eastern half of the NPRA, the mid-Jurassic unconformity deeply truncates J-1 toward the southeast; J-1 thickness ranges from 580 ft (177 m) at Ikpiuk 1 to 136 ft (42 m) at North Inigok 1.

In the western half of the Reserve, truncation by the basal "Pebble Shale" unconformity is more gradual, and 140 ft (43 m) of J-1 is present at Tunalik 1. The mid-Jurassic unconformity probably truncates J-1 completely in an east-west direction across the middle of the NPRA.

Unit J-1 consists of cyclically deposited shale units that coarsen upward into siltstone or sandstone. The only economically important sandstone in J-1 is the "Barrow sandstone." The unit becomes increasingly argillaceous toward the south, away from the Barrow area. At South Meade 1, a sand-shale ratio of 1 to 7 probably denotes the southern limit of any potential reservoir rock in J-1.

NOTE: CONTOURING IN WEST BASED ON SEISMIC STRATIGRAPHIC INTERPRETATION.



<b>TETRA TECH, INC.</b>	
HOUSTON TEXAS ENERGY MANAGEMENT DIVISION PASADENA CALIFORNIA	
PETROLEUM EXPLORATION OF NPRA 1974-1981 (FINAL REPORT)	
<b>ISOPACH &amp; LITHOFACIES MAP</b>	
<b>J-1</b>	
<b>NPR</b>	<b>ALASKA</b>
<b>FOR</b>	
<b>ON PRA</b>	
HUSKY OIL NPR OPERATIONS INC	
PROJECT MANAGER: J. W. BRUYNZEEL	PROJECT NO. TC-7174
INTERPRETATION BY: D. A. HIGGS	REVISED
DATE: SEPT 1980	DATE: AUG 1981
DATUM:	INITIAL
CONTOUR INT: 100'	A.G.
SCALE:	DWG NO.
TETRA TECH REPORT NO. 8200	
<b>GEOFIG FIGURE 54</b>	

FIGURE 55

ISOPACH MAP, Ka-la AND J-3

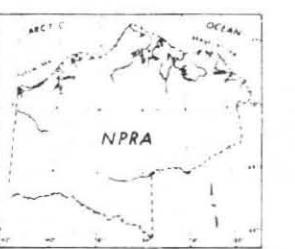
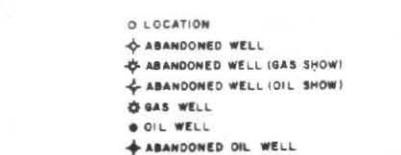
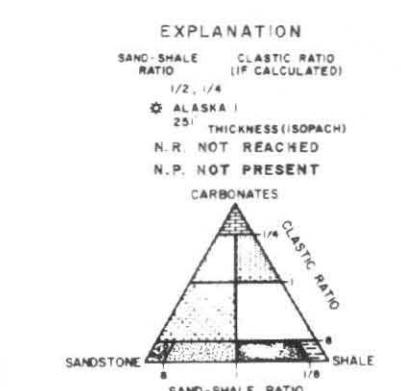
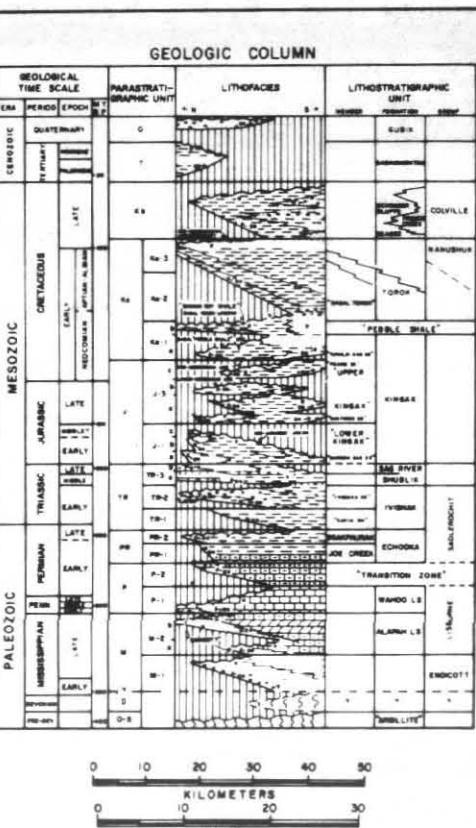
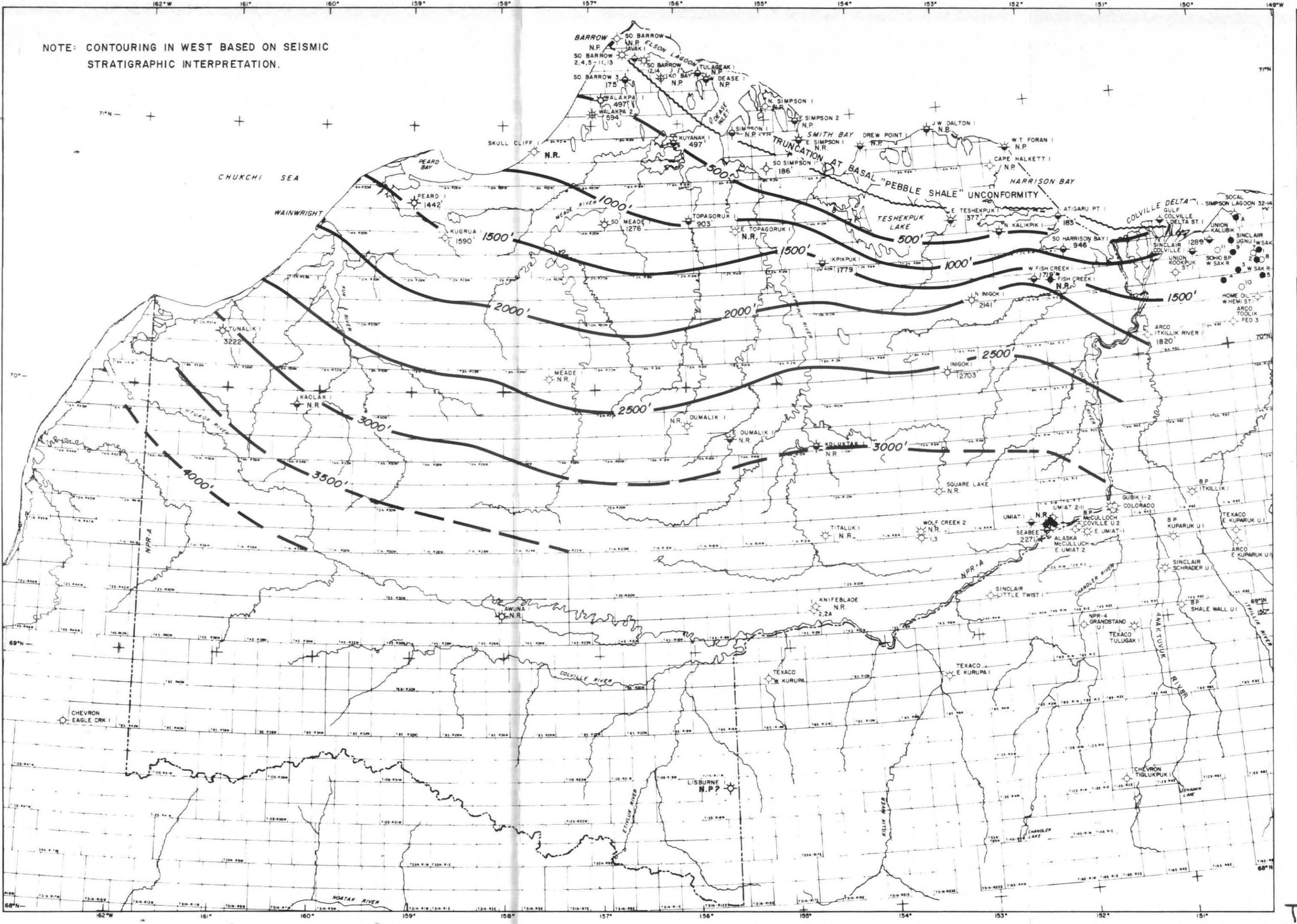
Well	Thickness	
	Feet	Meters
Atigaru Point 1	183	56
South Barrow 3	175	53
West Fish Creek 1	1,719	524
South Harrison Bay 1	946	288
Ikpikpuk 1	1,779	547
Inigok 1	2,703	824
North Inigok 1	2,141	663
Kugrua 1	1,590	485
Kuyanak 1	497	152
South Meade 1	1,276	389
Peard 1	1,442	440
Seabee 1	2,271+	692
South Simpson 1	186	57
East Teshekpuk 1	377	115
Topagoruk 1	903	275
Tunalik 1	3,222	982
Walakpa 1	497	151
Walakpa 2	594	181
Sinclair Colville 1	1,289	393
Arco Itkillik River 1	1,820	555

The base of the "Upper Kingak" (units Ka-la and J-3) is the mid-Jurassic unconformity; the upper boundary is the basal "Pebble Shale" unconformity. The "Upper Kingak" is Late Jurassic to Early Neocomian and coincides approximately with foraminiferal zones F-13 to F-16 (Anderson, Warren, and Associates, 1974-1979).

The "Upper Kingak" is a wedge-shaped body that thins northward toward the Barrow High and Barrow Arch because of progressive truncation by the basal "Pebble Shale" unconformity. In the eastern half of the Reserve, the unit thickens to the south, attaining a maximum thickness of 2,703 ft (824 m) at Inigok 1. South of Inigok 1, there is little data, and character of the "Upper Kingak" is uncertain.

The maximum thickness of the unit in the Reserve is 3,222 ft (982 m) at Tunalik 1. On seismic sections, the "Upper Kingak" thickens southwestward from Tunalik 1.

The "Upper Kingak" is mostly shale in the eastern half of the NPRA. In the western NPRA, it contains several sand bodies. The best developed of these sands is the "Simpson sandstone," which is shown on figure 57.



**TETRA TECH, INC**  
PRUDHOE BAY ENERGY MANAGEMENT DIVISION PASADENA CALIFORNIA  
PETROLEUM EXPLORATION OF NPR 1974-1981 (FINAL REPORT)

**ISOPACH MAP**  
Ka-1a and J-3

**NPR** FOR **ONPR**  
HUSKY OIL NPR OPERATIONS INC.

PROJECT MANAGER: J. W. BRUYNEEL	PROJECT NO. TC-774
INTERPRETATION BY D. A. HIGGS	DATE: APRIL 1980
DATUM: V.E.B.	SCALE: 1:250,000
CONTOUR INT: 500'	SW NO.:

TETRA TECH REPORT NO. 8200

TGZ0170 FIGURE 55

FIGURE 56

ISOPACH AND LITHOFACIES MAP, J-3a

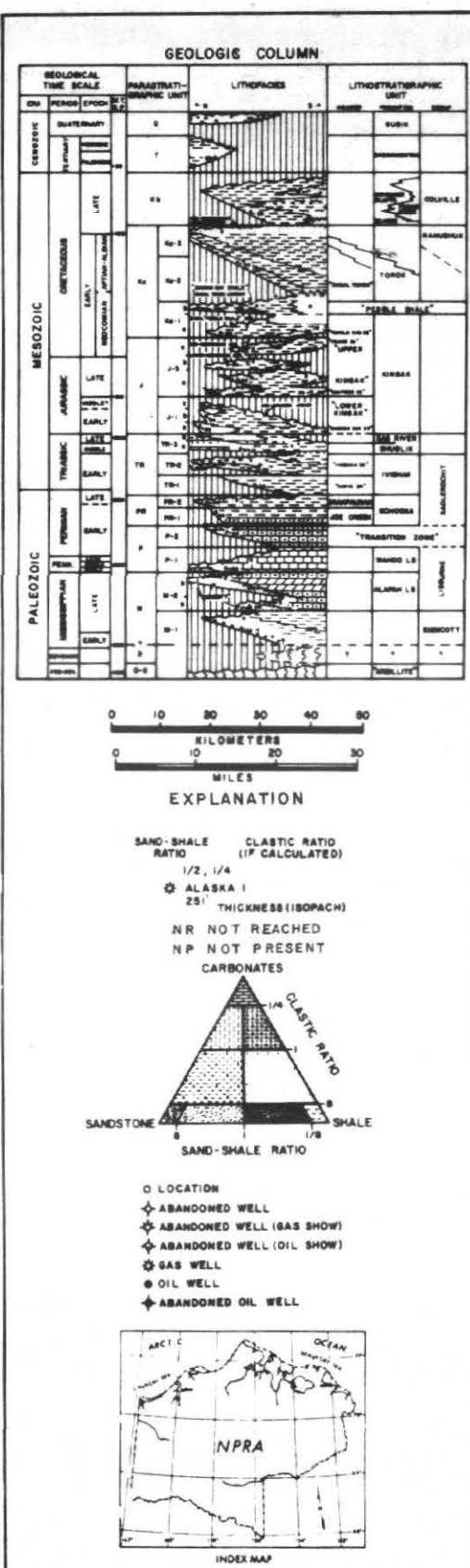
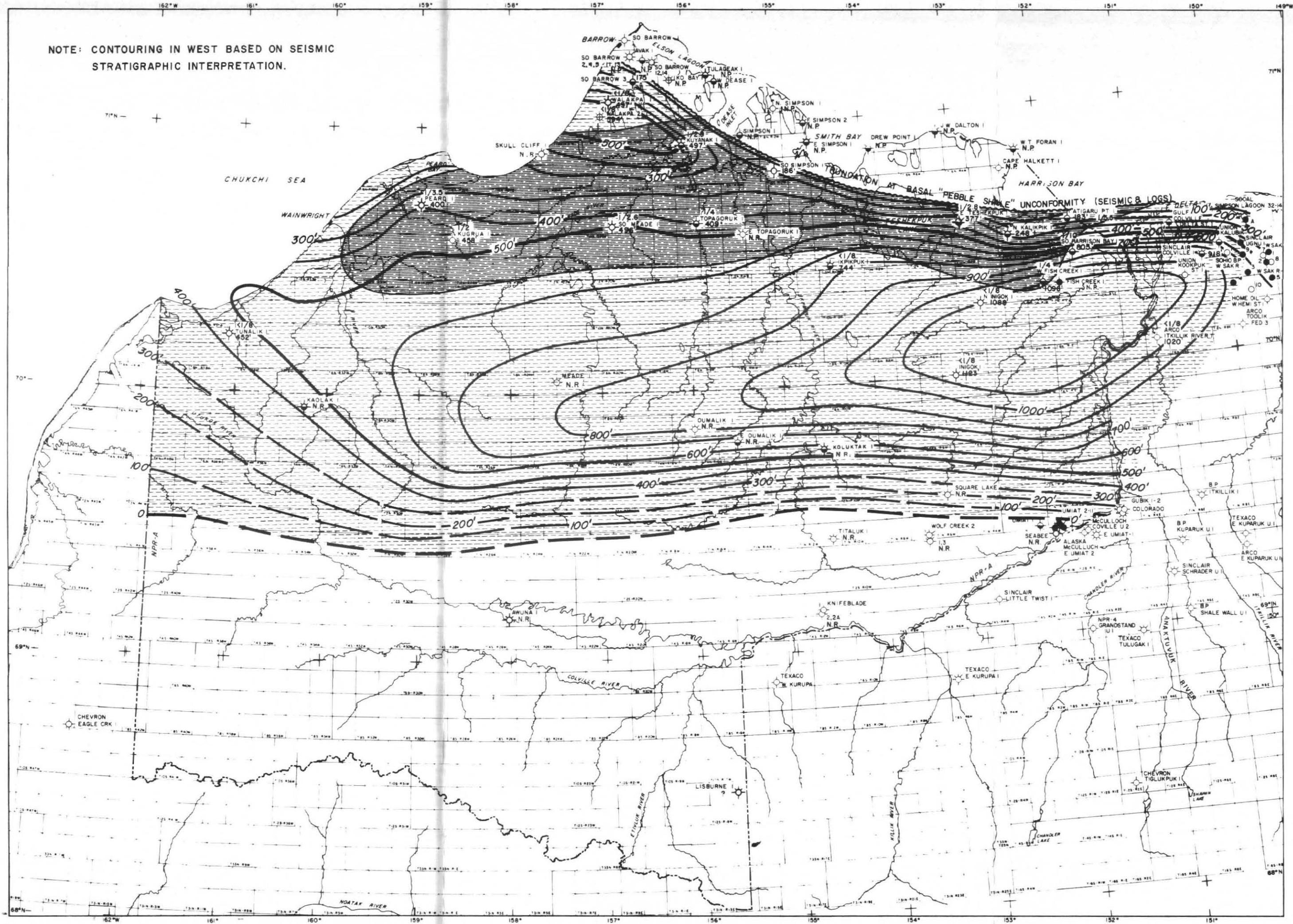
Well	Thickness		Sand-Shale Ratio
	Feet	Meters	
Atigaru Point 1	183	56	1/5.5
South Barrow 3	175	53	1/8
West Fish Creek 1	1,096	334	1/4
South Harrison Bay 1	805	245	1/10
Ikpikpuk 1	744	227	<1/8
Inigok 1	1,123	342	<1/8
North Inigok 1	1,088	332	<1/8
North Kalikpik 1	248+	76	n.d.*
Kugrua 1	458	140	1/2
Kuyanak 1	497	152	1/2.9
South Meade 1	496	151	1/2.6
Peard 1	400	122	1/3.5
South Simpson 1	186	57	n.d.
East Teshekruk 1	377	115	1/2.8
Topagoruk 1	409	126	1/4
Tunalik 1	452	138	<1/8
Walakpa 1	497	152	<1/8
Walakpa 2	594	181	<1/8
Sinclair Colville 1	918	280	n.d.
Arco Itkillik River 1	1,020	311	n.d.

\*n.d., not determined

Unit J-3a in the basal part of the "Upper Kingak" includes all the Oxfordian rocks. The unit coincides with foraminiferal zone F-16 (Anderson, Warren, and Associates, 1974-1979). Unit J-3aI, a subunit of J-3a shown in figure 57, contains the "Simpson sandstone."

The J-3a depositional pattern is similar to that of J-3aI. The major differences are the argillaceous Kimmeridgian strata (up to 860 ft, or 262 m) in J-3a, and truncation of J-3a by the basal "Pebble Shale" unconformity, which occurs to the north. In the east, the J-3a unit is truncated north of Atigaru Point 1 where 183 ft (56 m) of strata are present.

J-3a is silty in the north, near the truncation by the basal "Pebble Shale" unconformity; west of the Meade Arch, sand-shale ratios are highest to the north where J-3a is truncated by the unconformity. The sand-shale ratios shown above are statistical anomalies resulting from the absence of the siltstone interval overlying the "Simpson sandstone." The J-3a becomes increasingly argillaceous toward the south across the Reserve.



**TETRA TECH, INC.**  
ENERGY MANAGEMENT DIVISION  
PARKER, CALIFORNIA  
PETROLEUM EXPLORATION OF N.P.R.A. 1974-1981 (FINAL REPORT)  
**ISOPACH & LITHOFACIES MAP**  
J-3a  
N.P.R.A.  
FOR  
ON P.R.A.  
HUSKY OIL N.P.R.O. OPERATIONS INC.  
PROJECT MANAGER: J. W. BRUYNZEEL  
INTERPRETATION BY: D. A. HIGGS  
DATE: SEPT 1980  
CONTOUR INT: 100'  
PROJECT NO. TC-7174  
REVISED  
DATE: INITIAL  
BATHY: INITIAL  
SATELLITE: V.E.R.  
SCALE: 1:250,000  
S.W.S. NO.  
TETRA TECH REPORT NO. 8200

TG-0170 FIGURE 56

FIGURE 57

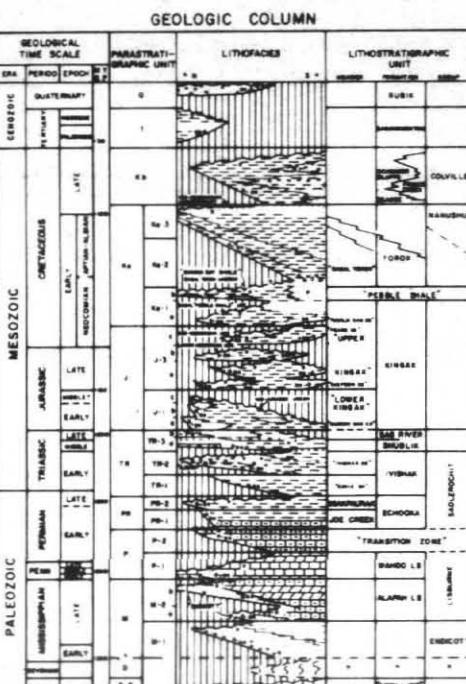
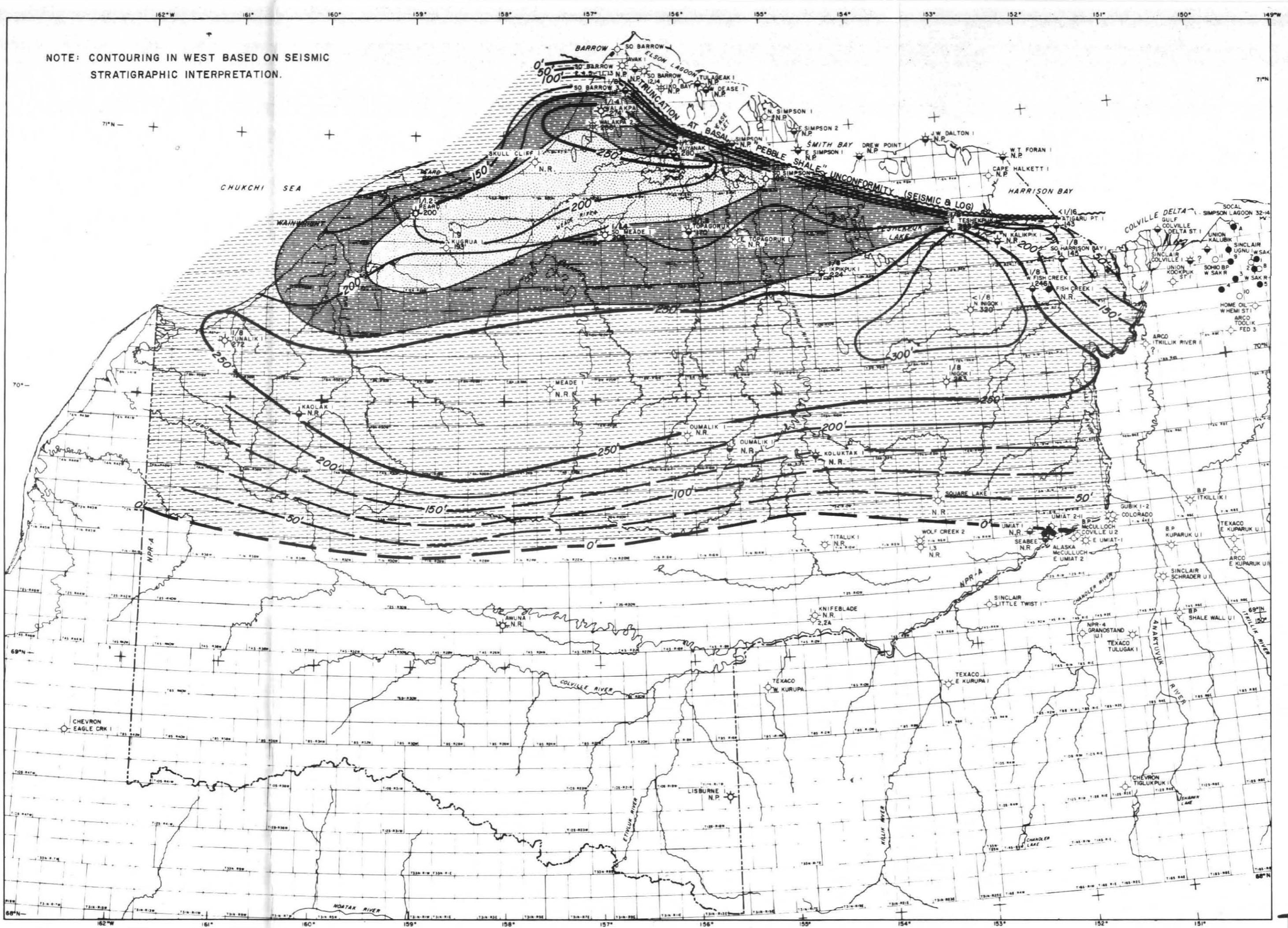
ISOPACH AND LITHOFACIES MAP, J-3aI

Well	Thickness		Sand-Shale Ratio
	Feet	Meters	
Atigaru Point 1	143	44	<1/16
South Barrow 3	117	36	1/8
West Fish Creek 1	246	75	1/8
South Harrison Bay 1	145	44	1/8
Ikpikpuk 1	224	68	1/8
Inigok 1	263	80	1/8
North Inigok 1	320	98	<1/8
Kugrua 1	193	59	1.9
Kuyanak 1	280	85	1/1.9
South Meade 1	206	63	1/1.4
Peard 1	200	61	1/1.2
South Simpson 1	186	57	1/1.2
East Teshekpu 1	293	89	1/8
Topagoruk 1	170	52	1/1.8
Tunalik 1	272	83	1/8
Walakpa 1	274	84	1/1.4
Walakpa 2	268	82	1/1.5
Sinclair Colville 1	{?}		n.d.*
Arco Itkillik River 1	{?}		n.d.

\*n.d., not determined

Unit J-3aI, the base of the "Upper Kingak," directly overlies the mid-Jurassic unconformity. In the northwestern NPRA, the unit contains the "Simpson sandstone." In the north, J-3aI is truncated by the basal "Pebble Shale" unconformity, just south of South Barrow 13 and Simpson 1, and just north of Atigaru Point 1. J-3aI thickens to the south-southwest from South Simpson 1; the thickest section of J-3aI is at East Teshekpu 1. The unit thins toward the south. In the eastern part of the Reserve, J-3aI consists of shales and siltstones.

The unit thickens to a maximum of 274 ft (84 m) at Walakpa 1 in the western half of the NPRA. South of Tunalik 1, lithology of the unit is uncertain because of a lack of data. The "Simpson sandstone" is a barlike sand body best developed at Kugrua 1. The source of the "Simpson sandstone" was most likely northwest of Kugrua 1; the sands probably were transported eastward and east-northeastward by longshore currents. The sand-shale ratio is 1 to 1.2 at Peard 1 and South Simpson 1, but the sandstone is increasingly silty toward the south and east.



0 10 20 30 40 50  
MILES

KILOMETERS

EXPLANATION

SAND-SHALE RATIO CLASTIC RATIO  
 $1/2, 1/4$

ALASKA I 25'

THICKNESS (ISOPACH)

N.R. NOT REACHED

N.P. NOT PRESENT

CARBONATES

CLASTIC RATIO  
 $1/4$

SAND-SHALE RATIO

O LOCATION

ABANDONED WELL

ABANDONED WELL (GAS SHOW)

ABANDONED WELL (OIL SHOW)

GAS WELL

OIL WELL

ABANDONED OIL WELL

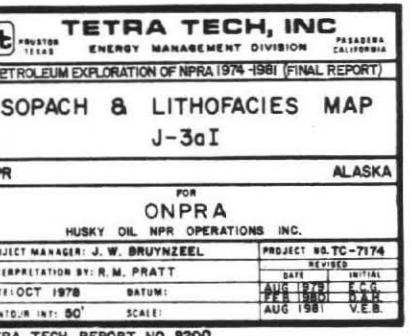


FIGURE 58

ISOPACH AND LITHOFACIES MAP, J-3b

Well	Thickness		Sand-Shale Ratio
	Feet	Meters	
West Fish Creek 1	440	134	1/1.1
South Harrison Bay 1	141	43	1/9
Ikpikpuk 1	850	259	1/1.2
Inigok 1	580	177	<1/8
North Inigok 1	557	170	1/2.6
Kugrua 1	435	133	1/1.3
South Meade 1	459	140	<1/8
Peard 1	400	122	<1/8
Sinclair Colville 1	365	111	n.d.*
Arco Itkillik River 1	685	209	1/8

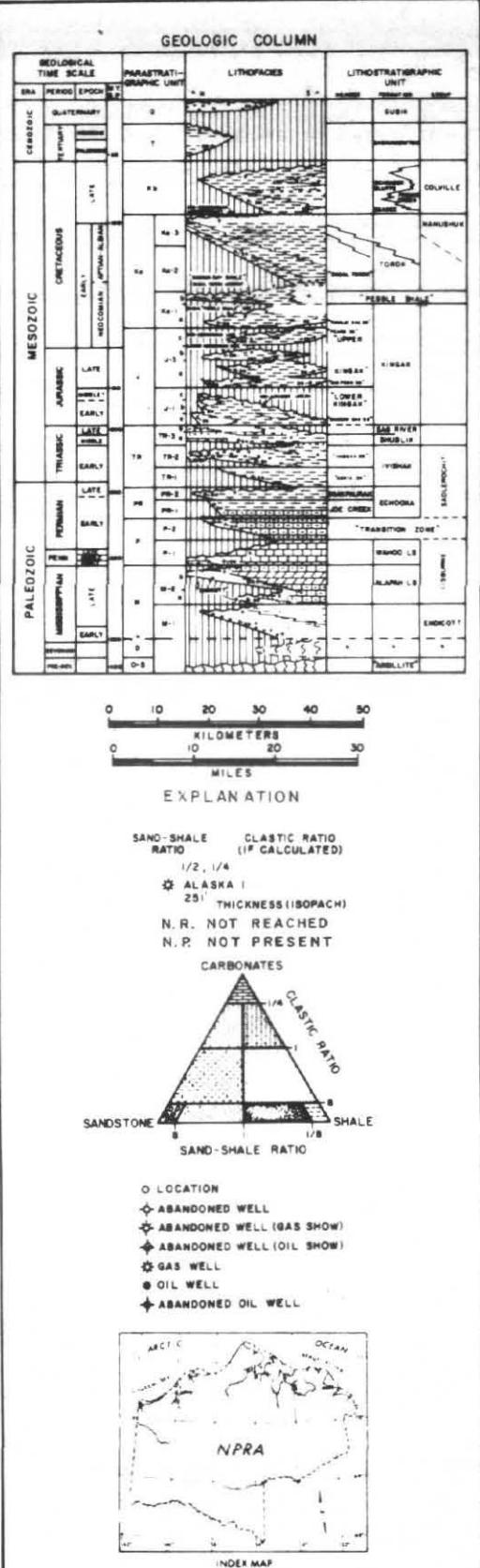
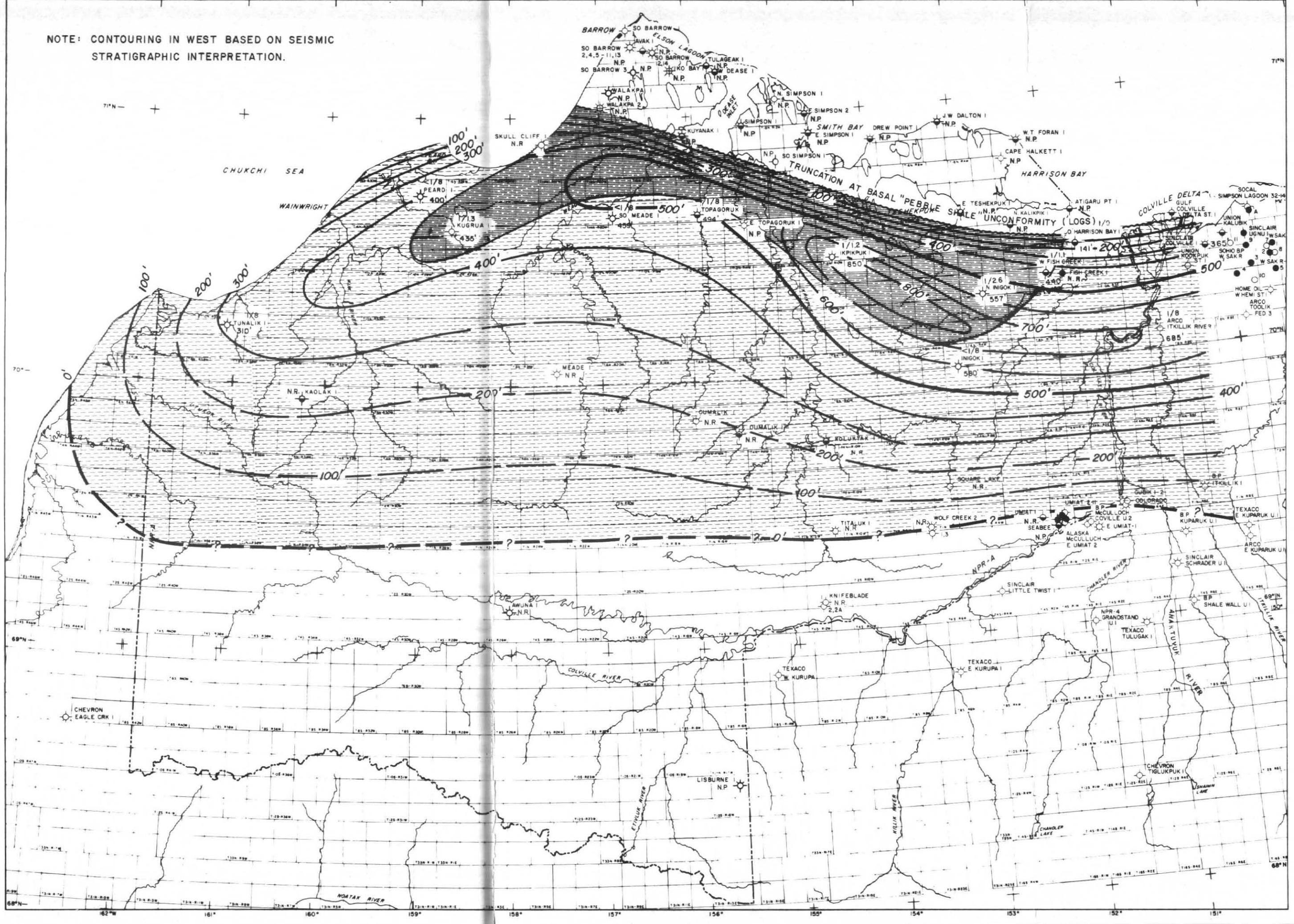
\*n.d., not determined.

Unit J-3b, the latest Jurassic part of the "Upper Kingak," overlies horizon 0850 and underlies the earliest Neocomian part (unit J-3c) of the "Upper Kingak." J-3b coincides approximately with foraminiferal zones F-15 and F-16 (Anderson, Warren, and Associates, 1974-1979).

J-3b is relatively thin west of the Meade Arch, but thickens to over 800 ft (244 m) in the Ikpikpuk Basin east of the Meade Arch. North of Ikpikpuk 1, J-3b is truncated by the basal "Pebble Shale" unconformity. Seismic stratigraphy indicates that the unit thins toward the south. No wells penetrated J-3b south of Inigok 1. It is not known whether the thinning is real and, if so, whether it is caused by erosional truncation or nondeposition.

J-3b contains many thin sandstone layers, particularly near the base of the unit.

NOTE: CONTOURING IN WEST BASED ON SEISMIC  
STRATIGRAPHIC INTERPRETATION.



<b>TETRA TECH, INC.</b>	
HOUSTON TEXAS ENERGY MANAGEMENT DIVISION PASADENA CALIFORNIA	
PETROLEUM EXPLORATION OF NPRA 1974-1981 (FINAL REPORT)	
<b>ISO PACH &amp; LITHOFACIES MAP</b>	
<b>J - 3b</b>	
<b>NPR</b>	<b>ALASKA</b>
<b>FOR</b>	
<b>ONPRA</b>	
<b>HUSKY OIL NPR OPERATIONS INC</b>	
PROJECT MANAGER: J. W. BRUYNZEEL	PROJECT NO. T.C.714
INTERPRETATION BY: D. A. HIGGS	REVISED
DATE: SEPT. 1980	DATE: INITIAL
BATUM:	ALICE (1981) A.G.
CONTOUR INT: 100'	DWG NO.
<b>TETRA TECH REPORT NO. B200</b>	
<b>FIGURE 58</b>	

TETRA TECH REPORT NO. 8200

## FIGURE 59

FIGURE 59

ISOPACH AND LITHOFACIES MAP, J-3c

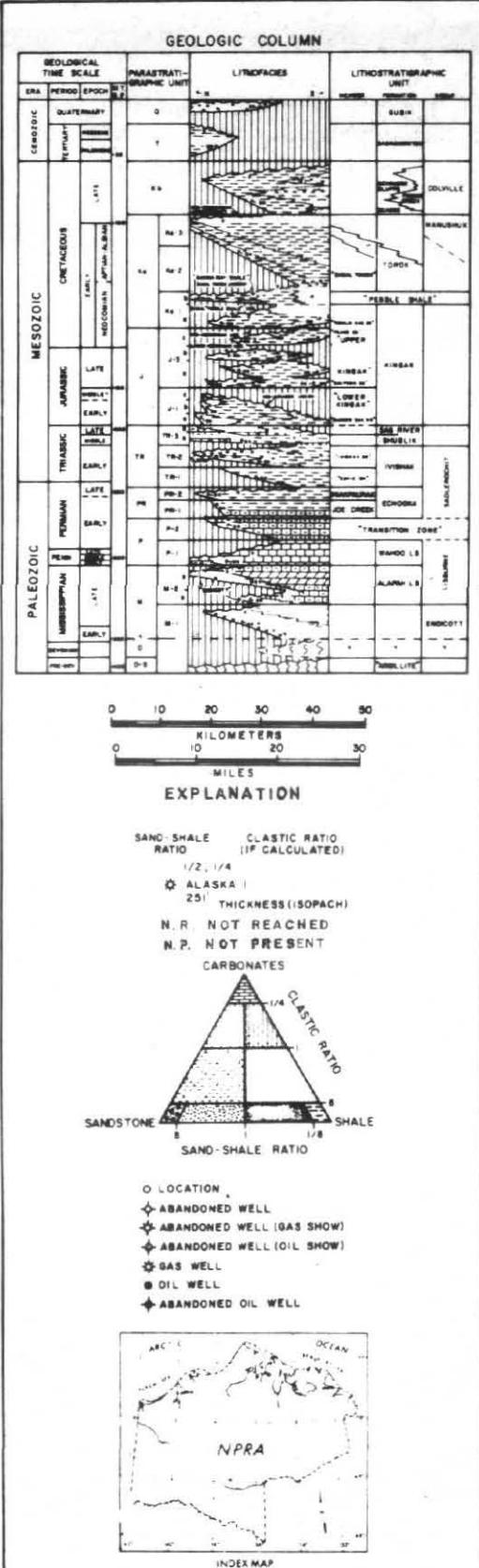
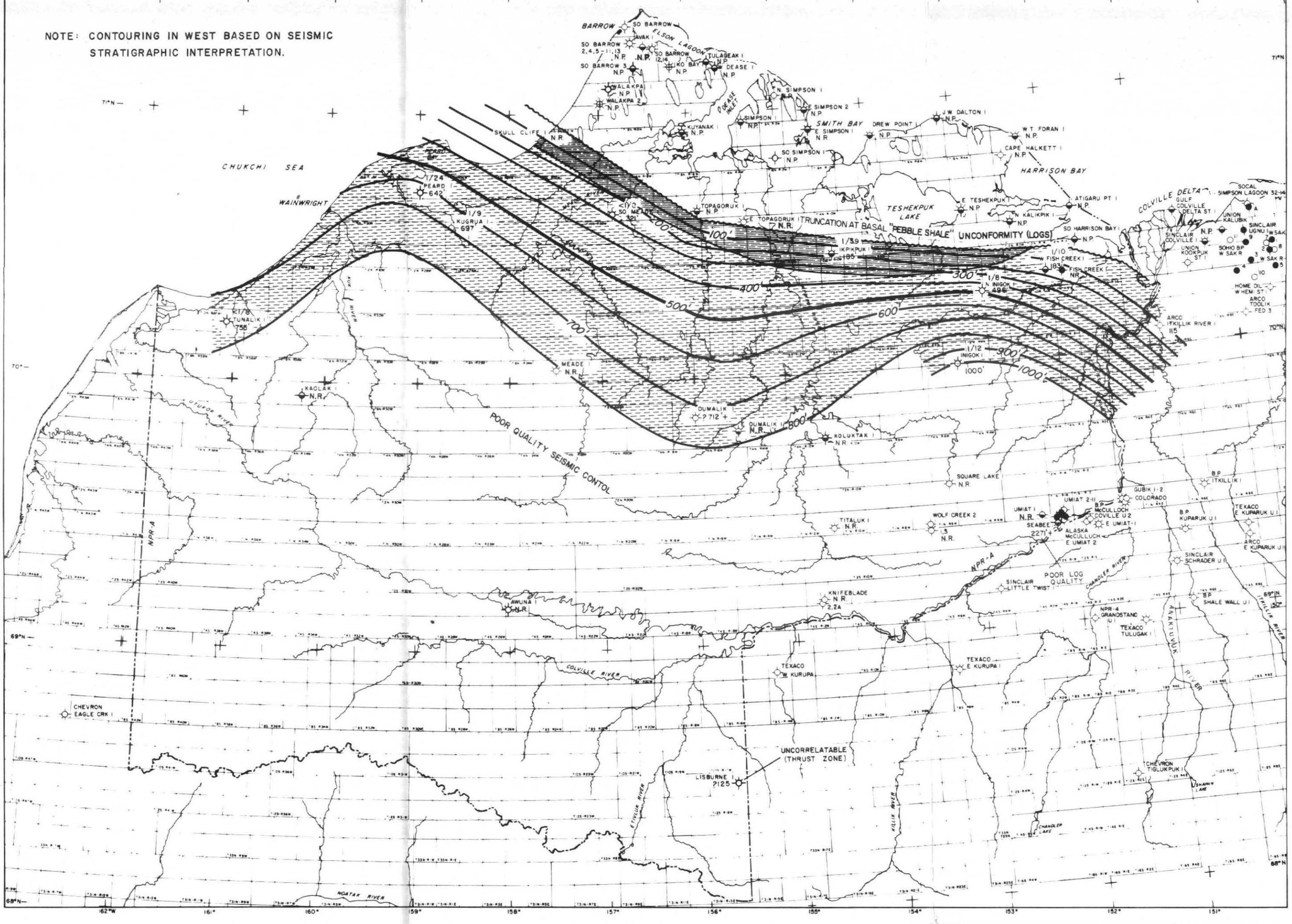
Well	Thickness		Sand-Shale Ratio
	Feet	Meters	
West Fish Creek 1	183	56	1/10
Ikpikpuk 1	185	56	1/3.9
Inigok 1	1,000	305	1/12
North Inigok 1	496	151	1/8
Kugrua 1	697	212	1/9
Lisburne 1	125(?)	38	n.d.*
South Meade 1	321	98	<1/8
Oumalik 1	712+	217+	n.d.
Peard 1	642	196	1/24
Seabee 1	2,271+	692+	n.d.
Tunalik 1	755	230	<1/8
Arco Itkillik River 1	115	35	n.d.

\*n.d., not determined.

The J-3c unit includes the earliest Neocomian "Upper Kingak" strata below the mid-Neocomian unconformity or the basal "Pebble Shale" unconformity.

J-3c is shown to be more sandy toward the north, near the truncation by the basal "Pebble Shale" unconformity; however, this effect is mainly statistical. The lower part of the unit, which contains more sand, occurs below the unconformity to the north where the finer clastic fractions are missing. The unit is composed mainly of siltstone and shale.

NOTE: CONTOURING IN WEST BASED ON SEISMIC STRATIGRAPHIC INTERPRETATION.



 <b>TETRA TECH, INC.</b> ENERGY MANAGEMENT DIVISION <small>PASADENA CALIFORNIA</small>	<b>PETROLEUM EXPLORATION OF NPRA 1974-1981 (FINAL REPORT)</b>	
<b>ISOPACH &amp; LITHOFACIES MAP</b> <b>J - 3C</b>		
<b>NPR</b>		<b>ALASKA</b>
<b>FOR</b> <b>ONPRA</b> <b>HUSKY ON NPR OPERATIONS INC.</b>		
<b>PROJECT MANAGER: J. W. BRUYNZEEL</b> <b>INTERPRETATION BY: D. A. HIGGS</b> <b>DATE: SEPT. 1980</b> <b>CONT'D. INT.: 100'</b>	<b>PROJECT NO. TC-7174</b> <b>REV. NO.</b> <b>DATE: AUG. 1981</b> <b>INITIAL: A.G.</b> <b>BWG. NO.</b>	
<b>TETRA TECH REPORT NO. 5300</b>		

SIERRA TECH REPORT NO. 8200

**FIGURE 59**

## FIGURE 60

TYPE LOG OF J-3c AND KA-1a PARASTRATIGRAPHIC UNITS, TUNALIK 1

Units J-3c and Ka-1a are best shown at Tunalik 1 between 10,900 ft (3,323 m) and 13,360 ft (4,072 m).

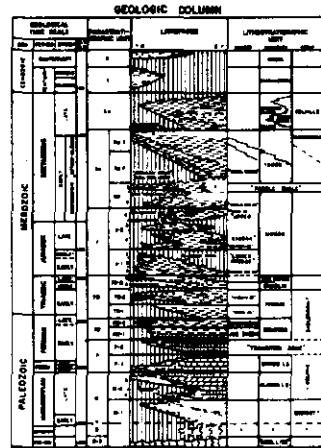
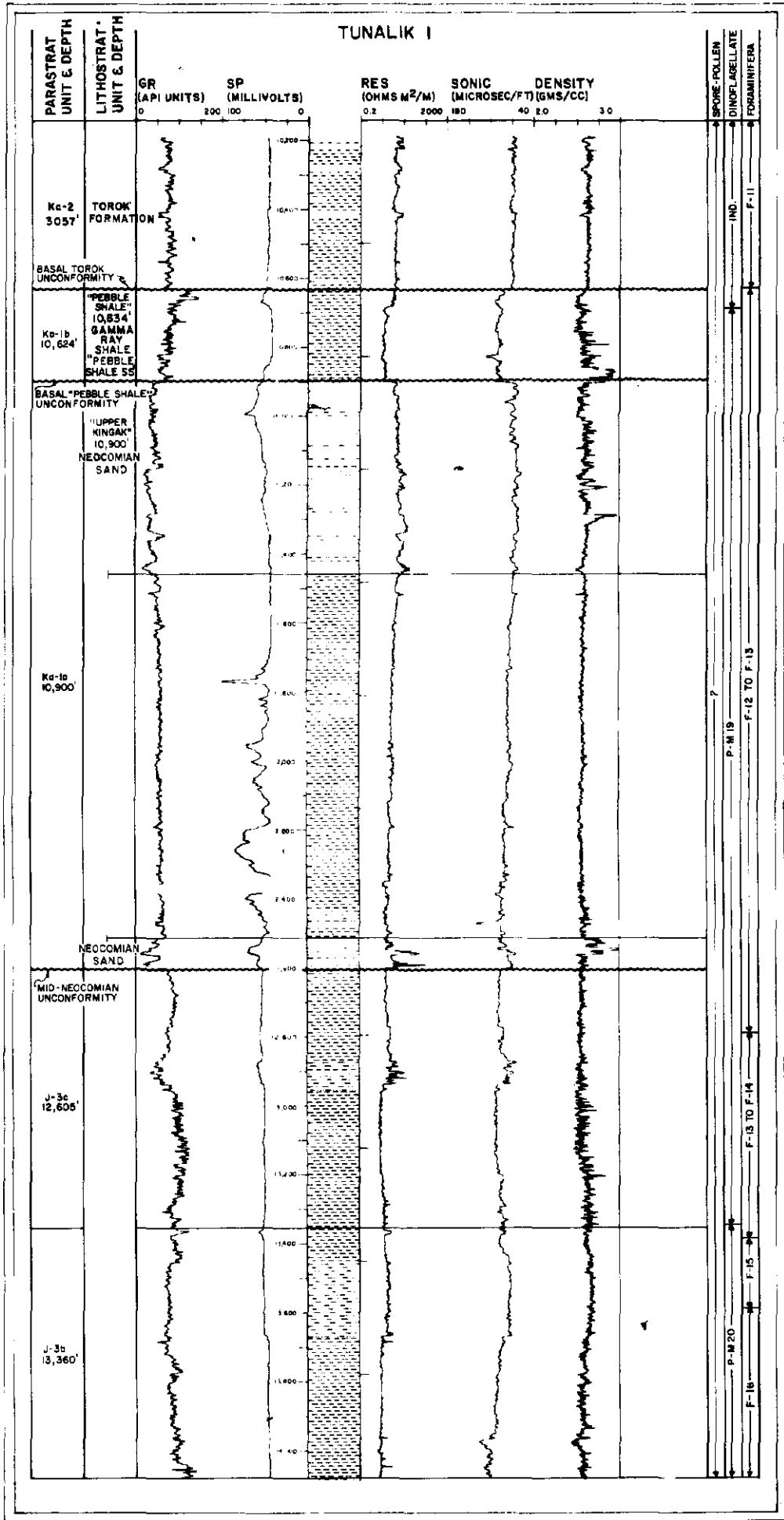
Unit J-3c is difficult to separate from the underlying J-3b. These units consist mainly of shale and lack many definitive log markers. In most places, the top of J-3b is located near a log "shoulder" caused by a rightward shift of the gamma-ray curve; a leftward shift of either the resistivity, sonic, or density curve; or both.

The top of J-3c is picked at the basal "Pebble Shale" unconformity in all wells except Tunalik 1. At Tunalik 1, the top of J-3c is under a Neocomian sand at 12,605 ft (3,842 m). The log shifts are leftward deflections in the gamma-ray and spontaneous potential curves and rightward deflections in the resistivity and sonic curves. The behavior of log curves at the basal "Pebble Shale" unconformity varies according to the presence or absence of the "Pebble Shale" sandstone above the unconformity.

The boundary between J-3b and J-3c is picked near the boundary between AWA foraminiferal zones F-15 to F-16 and F-13 to F-14 (Anderson, Warren, and Associates, 1974-1979), and between dinoflagellate zonules P-M20 and P-M19. The J-3b unit is entirely Late Jurassic, whereas J-3c is Late Jurassic to Early Neocomian.

The boundary between J-3c and overlying parastratigraphic units is picked near the top of AWA foraminiferal zone F-13 to F-14. The Ka-1a unit, which was recognized only at Tunalik 1, overlies the mid-Neocomian unconformity and is in AWA foraminiferal zone F-12 to F-13 and dinoflagellate zonule P-M19.

At Tunalik 1, the bottom of Ka-1a is picked at 12,605 ft (3,842 m), which is below the Neocomian sands, and the top is picked at the boundary between the Neocomian sands and the "Pebble Shale" at 10,900 ft (3,322 m). The sands are 570 ft (174 m) thick at the top of unit Ka-1b.



**TETRA TECH, INC.**  
HOUSTON, TEXAS ENERGY MANAGEMENT DIVISION PASADENA, CALIFORNIA  
PETROLEUM EXPLORATION OF NPRA 1974-1981 (FINAL REPORT)

**TYPE LOG OF J-3c AND KA-1a PARASTRATIGRAPHIC UNITS TUNALIK I**

NPR ALASKA  
FOR ONPRA  
HUSKY OIL/NPR OPERATIONS INC.

PROJECT MANAGER: J. W. BRUYNZEEL	PROJECT NO. TC-7174
INTERPRETATION BY: STAFF	REVIEWED BY:
DATE: SEPT. 1981	DATE: 1981
CONTOUR INT.: 100 FT	SCALES: 1:250,000
DOW NO. T62-0170	

TETRA TECH REPORT NO. 8200 FIGURE 60

FIGURE 61

ISOPACH AND LITHOFACIES MAP, Ka-1b

Well	Thickness		Sand-Shale Ratio
	Feet	Meters	
Atigaru Point 1	43	13	n.d.*
South Barrow 3	430	131	<1/8
South Barrow 13	396	121	1/4.8
South Barrow 17	362	110	<1/8
Cape Halkett 1	326	99	1/2.7
J. W. Dalton 1	271	83	<1/8
West Dease 1	464	141	<1/8
Drew Point 1	184	56	1/12
W. T. Foran 1	204	62	1/5.2
Iko Bay 1	381	116	<1/8
Ikpikpuk 1	248	76	1/3.3
Inigok 1	218	66	<1/8
North Inigok 1	264	66	<1/8
North Kalikpik 1	259	79	n.d.
Kugrua 1	416	127	1/5.2
Kuyanak 1	517	158	1/5.6
Lisburne 1	750(?)	229	1/5.1
South Meade 1	306	93	<1/8
Ounalik 1	280	85	n.d.
Peard 1	382	116	1/11
Seabee 1	272	83	1.1
Simpson 1	340	104	<1/8
East Simpson 1	211	64	<1/8
East Simpson 2	202	62	<1/8
South Simpson 1	255	78	1/2
East Teshekruk 1	279	85	1/2.9
Topagoruk 1	330	101	n.d.
Tulageak 1	447	136	<1/8
Tunalik 1	266	81	1/2.4
Walakpa 1	382	116	<1/8
Walakpa 2	434	132	<1/8
Sinclair Colville 1	350	107	1.0
Arco Itkillik River 1	325	99	1/2.3

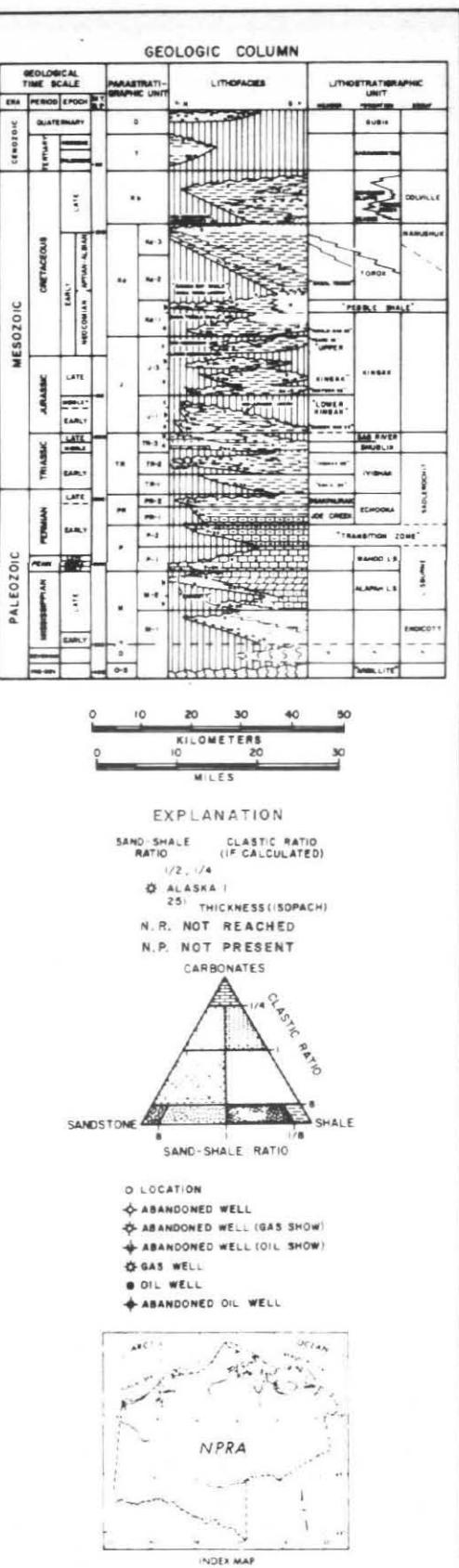
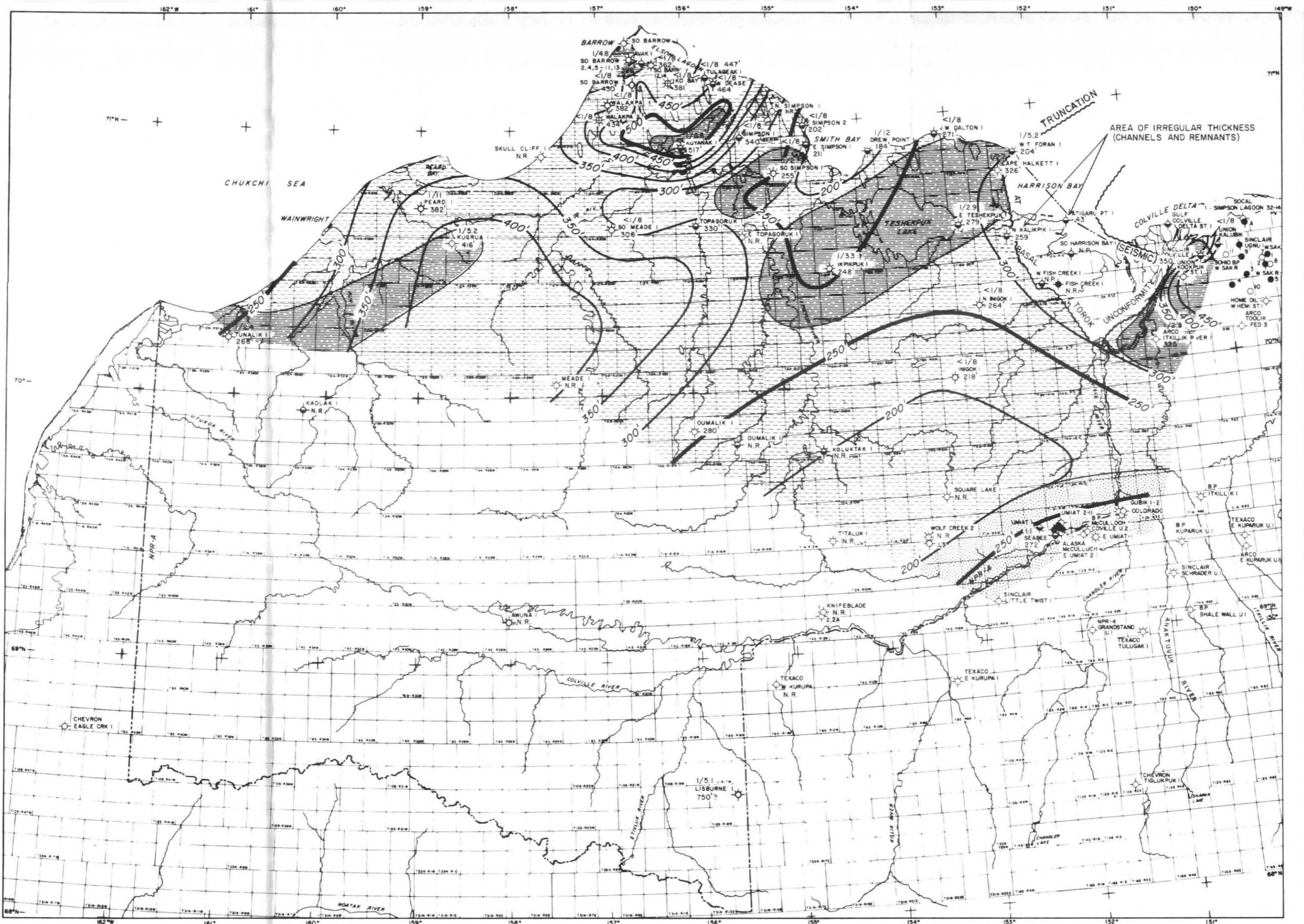
\*n.d., not determined.

Unit Ka-1b coincides with the "Pebble Shale" unit and is one of the most widespread and easily distinguished units in the northern NPRA subsurface. It is lithologically distinct and homogeneous, well defined on logs, and easily traced on seismic sections.

The Ka-1b unit is thinnest near the Fish Creek Platform and on the south and southeast flank of the Barrow High. On the Fish Creek Platform, the unit thins and is absent in South Harrison Bay 1 and West Fish Creek 1. There, the "basal Torok" lies directly on the J-3 ("Upper Kingak") unit. The Ka-1b unit may be absent from the Fish Creek Platform area because of either nondeposition or subaqueous erosion.

The Ka-1b unit is more difficult to identify south of 70° N. The distinctive "Gamma Ray Shale" zone that is the log "signature" of this unit is not as well marked in Seabee 1 and Lisburne 1. The unit also loses its seismic character to the south, where it is likely that the "Pebble Shale" unit merges with the Okpikruak Formation.

In the north, the Ka-1b unit is composed mainly of dark, organic shales. A series of northeast-trending sand bodies, informally named the "Pebble Shale" sandstone, are present under the Arctic coast in the Prudhoe Bay area, Smith Bay-Harrison Bay area, and southwestern flank of the Meade Arch. The "Pebble Shale" also contains a significant amount of sandstone toward the south, particularly in the Umiat area.



<b>TETRA TECH, INC.</b>		
FOUNDED 1947 TEXAS	ENERGY MANAGEMENT DIVISION	PASADENA, CALIFORNIA
PETROLEUM EXPLORATION OF NPRA 1974-1981 (FINAL REPORT)		
<h1>ISOPACH &amp; LITHOFACIES MAP</h1> <h2>Ka - Ib</h2>		
NPR	ALASKA	
FOR <b>ONPRA</b> HUSKY OIL-NPR OPERATIONS INC.		
PROJECT MANAGER: J.W. BRUYNZEEL	PROJECT NO. TC-7174	
INTERPRETATION BY: R.M. PRATT	REV. B (DATE 10-10-1978)	
DATE: OCT 1978	DATUM:	SEPT 1978 E.C.G./W.B. ALTA 1980 D.A./E.C.G.
CONTOUR INT: 50'	SCALE:	SEPT 1981 V.E.B./AG
<b>TETRA TECH REPORT NO. 8200</b>		

TG2-0170 FIGURE 61

FIGURE 62

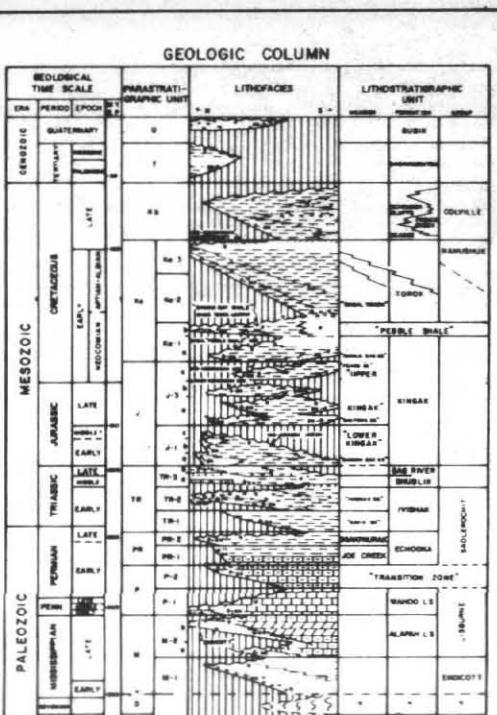
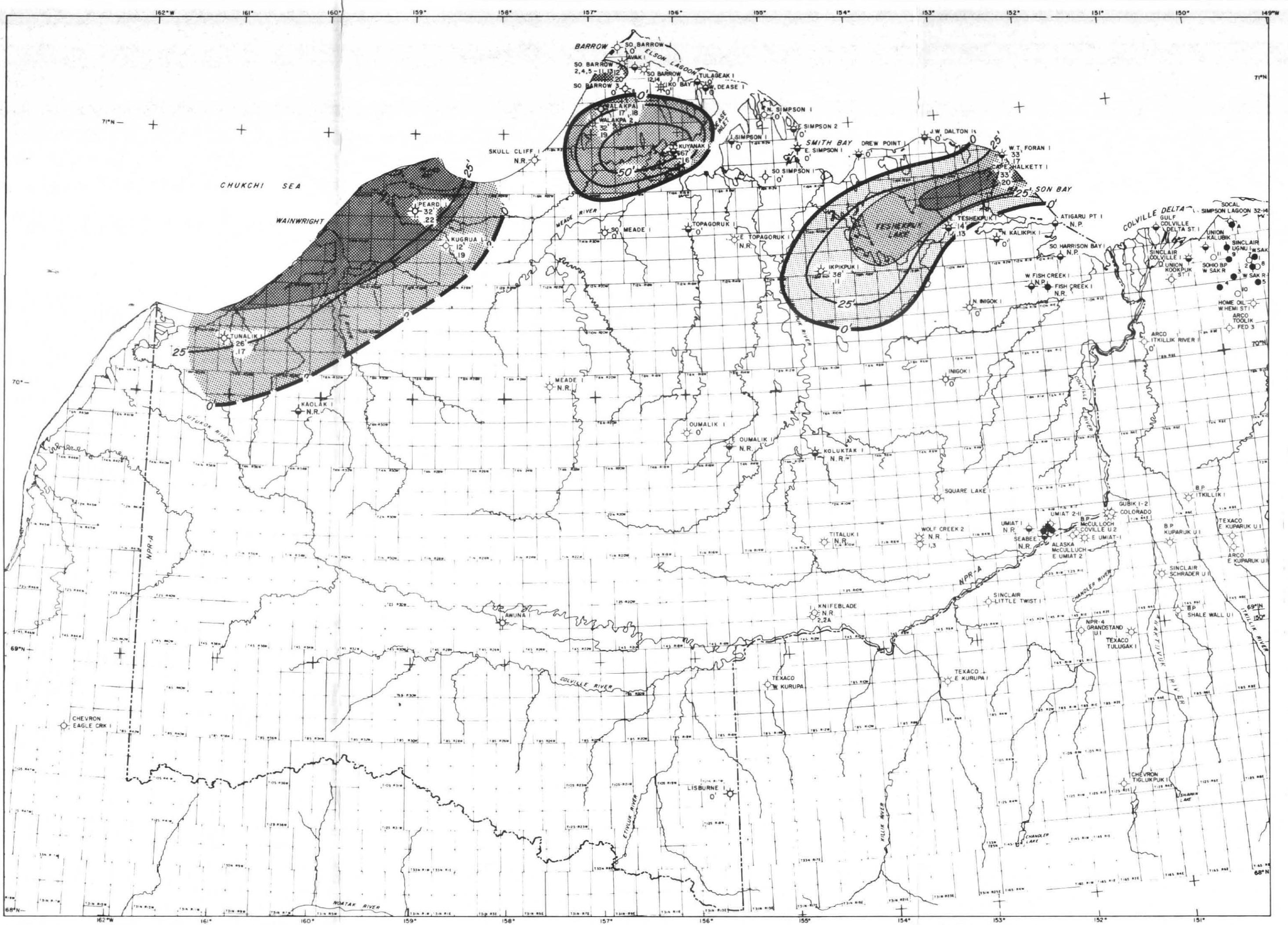
POTENTIAL RESERVOIR AND AVERAGE POROSITY  
MAP OF BASAL "PEBBLE SHALE" SANDSTONE

Well	Thickness		Average Porosity (Percent)
	Feet	Meters	
South Barrow 13	12	4	20
Cape Halkett 1	33	10	20
W. T. Foran 1	33	10	17
Ikpikpuk 1	38	12	11
Kugrua 1	12	4	19
Kuyanak 1	67	21	16
Peard 1	32	10	22
East Teshekpuk 1	14	4	13
Tunalik 1	26	8	17
Walakpa 1	17	5	18
Walakpa 2	32	10	19

The "Pebble Shale" sandstone reservoir includes several discontinuous sand bodies present in the basal part of Ka-1b in the northern NPRA. Biostratigraphic studies suggest a Berriasian to Valanginian age for these sands (Anderson, Warren, and Associates, 1974-1979).

At Walakpa 2, commercial quantities of gas are present in the 32-ft (10-m) thick "Walakpa gas sandstone," with 19 percent average porosity. Previously, the "Walakpa gas sandstone" was considered to be part of unit J-3, but based on paleontological information from Walakpa 2, it is now considered to be part of Ka-1b. The sand body observed in the Barrow area wells is probably separate from the "Walakpa gas sandstone."

In the western NPRA, minor oil and gas shows were observed at Kugrua 1, Peard 1, and Tunalik 1. In the northeastern NPRA, both reservoir thickness and average porosity increase northeasterly from Ikpikpuk 1 (38 ft (11 m) thick, 11 percent average porosity) to Cape Halkett 1 (33 ft (10 m) thick, 20 percent average porosity). At W. T. Foran 1, minor amounts of gas were present within the "Pebble Shale" sandstone.

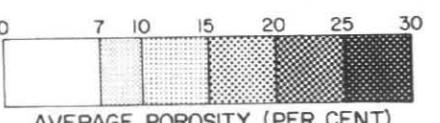


0 10 20 30 40 50  
MILES

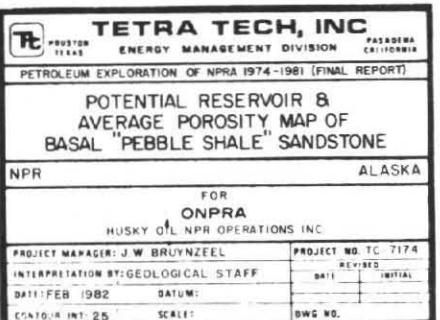
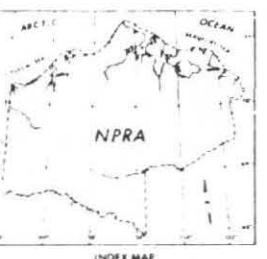
EXPLANATION

\* ALASKA I  
25' THICKNESS (POTENTIAL RESERVOIR)  
10% PERCENT POROSITY

N.R. NOT REACHED  
N.P. NOT PRESENT



- LOCATION
- ◊ ABANDONED WELL
- ◊ ABANDONED WELL (GAS SHOW)
- ◊ ABANDONED WELL (OIL SHOW)
- ★ GAS WELL
- OIL WELL
- ◆ ABANDONED OIL WELL



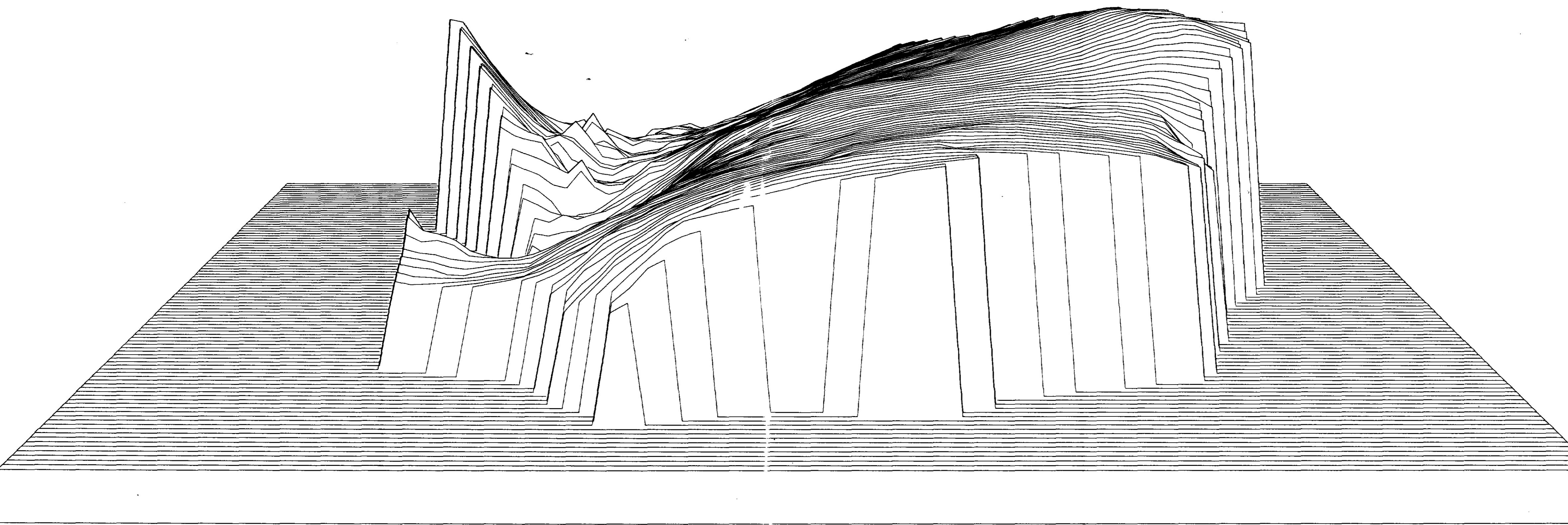
TG20170

FIGURE 62

**FIGURE 63**

**THREE-DIMENSIONAL PERSPECTIVE  
OF HORIZON 0700**

This computer-plotted image of horizon 0700 as viewed from the east was generated from about 6,000 records in an NPRA geophysical data base. The illustration is a generalized configuration of the top of unit Ka-1b ("Pebble Shale") as represented by horizon 0700.



THREE - DIMENSIONAL  
PERSPECTIVE OF  
HORIZON 700

N

TGZ-0170  
FIGURE 63

FIGURE 64

LINE B28-78-G-1182, SHOTPOINTS 4-300, AND  
LINE B28-77-G-1182, SHOTPOINTS 100-485,  
SCALED FINAL STACK

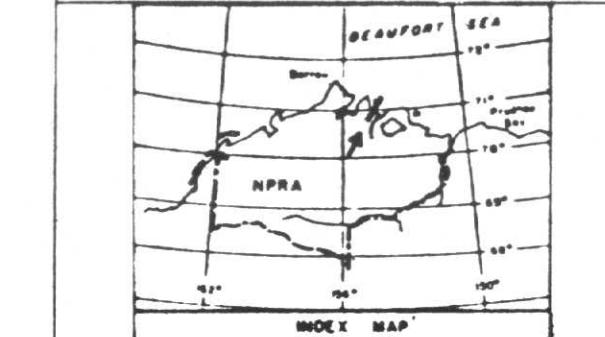
Lines B28-78 and B28-77 extend northeasterly offshore from the Teshekpuk Quadrangle into the Beaufort Sea. These lines cross the Barrow Arch, an east-southeast trending basement feature. The Barrow Arch is mostly just offshore of the NPRA in the Beaufort Sea, and is defined by the change of the regional dip of sediments in the northern NPRA from south to north-northeast. Potential traps in this area are stratigraphic, as much of the pre-Cretaceous section terminates because of truncation by the basal "Pebble Shale" unconformity (horizon 0720) or onlap onto the Arch.

USGS  
ONPRAHUSKY OIL NPR OPRS INC  
NATIONAL PETROLEUM RESERVE ALASKA  
BARROW AREA

B28-78-G-1182

SHOTPOINTS 4 - 300  
B28-77 SHOTPOINTS 100-485  
SCALED FINAL STACK

FIGURE 64



0 0.5 1.0  
MILES  
SCALE FOR LINE B28-78

0 0.5 1.0  
MILES  
SCALE FOR LINE B28-77

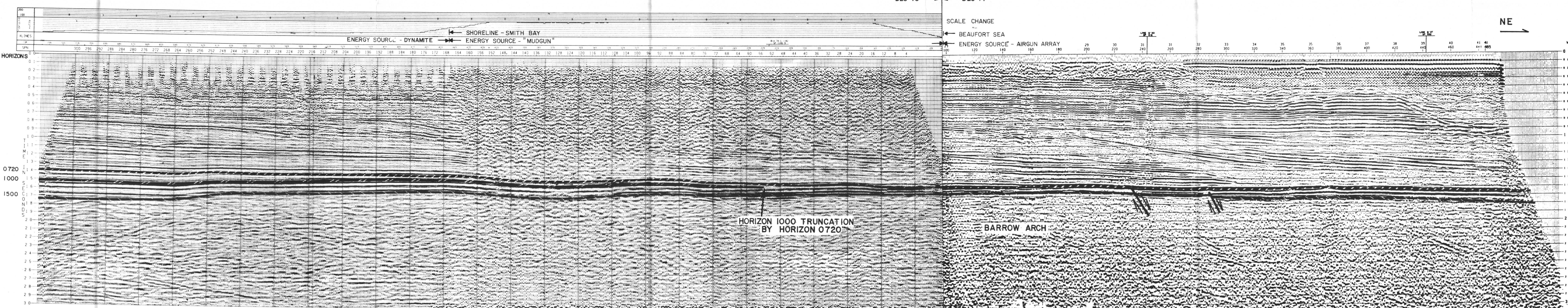
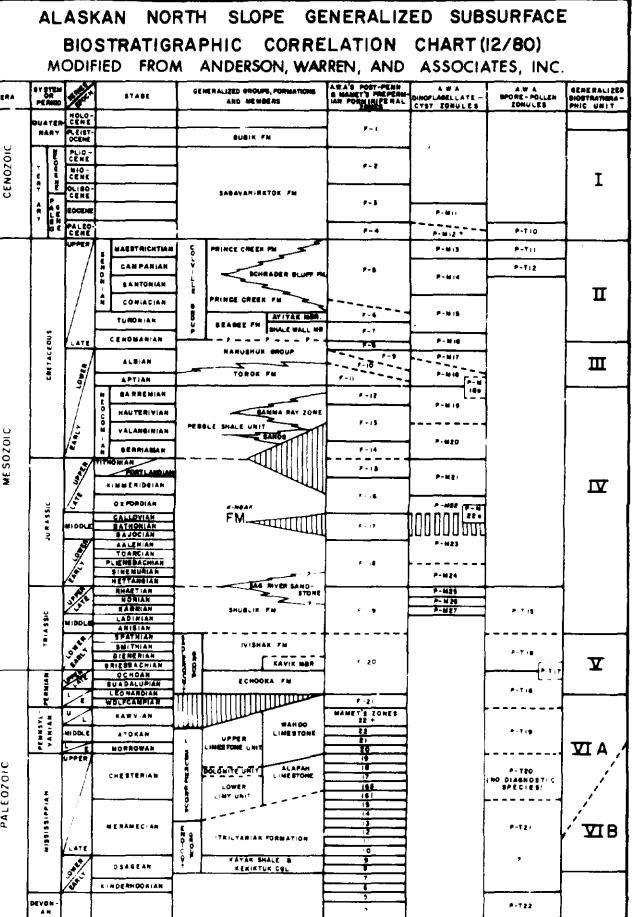


FIGURE 65

FORAMINIFERA CORRELATION CHART  
OF KEY NPRA WELLS

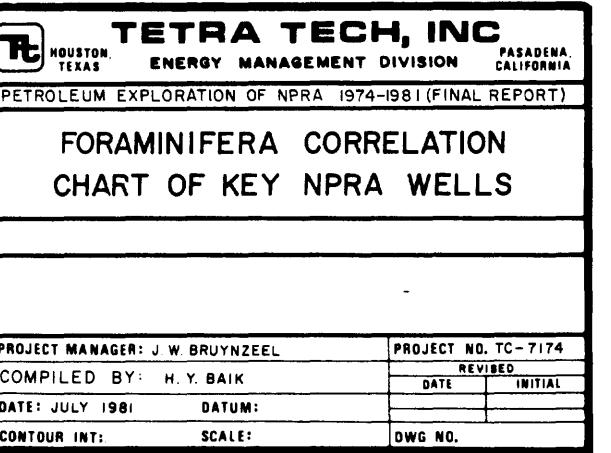
In figure 65, "F" designates foraminiferal zonules and "Z" denotes Mamet's carboniferous zones. The indeterminate intervals, which are barren of fossils, are bracketed by intervals where fossils were found.

Lisburne 1 was drilled in an area of complex thrust faults. The foraminiferal zones listed for Lisburne 1 are from plate 1 only. (See figure 69 for definition of plates 2-5.)



## **EXPLANATION**

?	NOT IDENTIFIED
100	ZONE QUESTIONABLE
00?	EXACT DEPTH QUESTIONABLE
N.P.	NOT PRESENT
N.R.	NOT REACHED
100	INDETERMINATE
↓	RANGE OF ZONES
*	BASED ON SCATTERED SAMPLES



## FIGURE 66

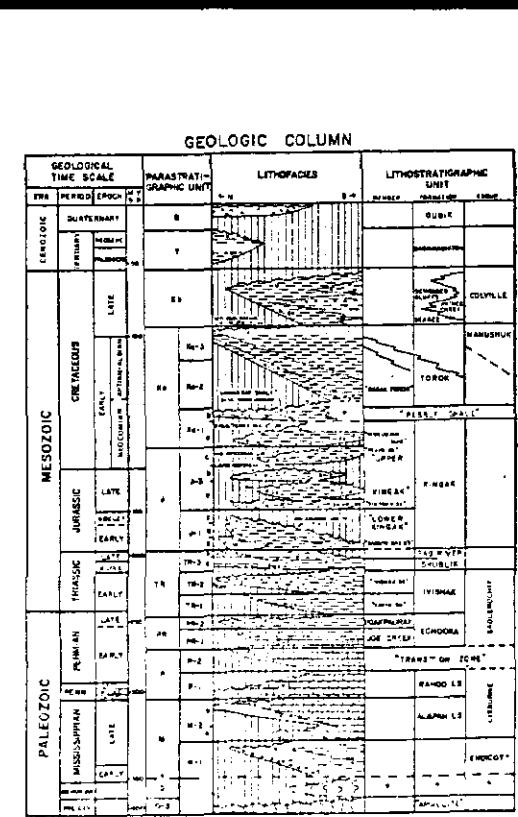
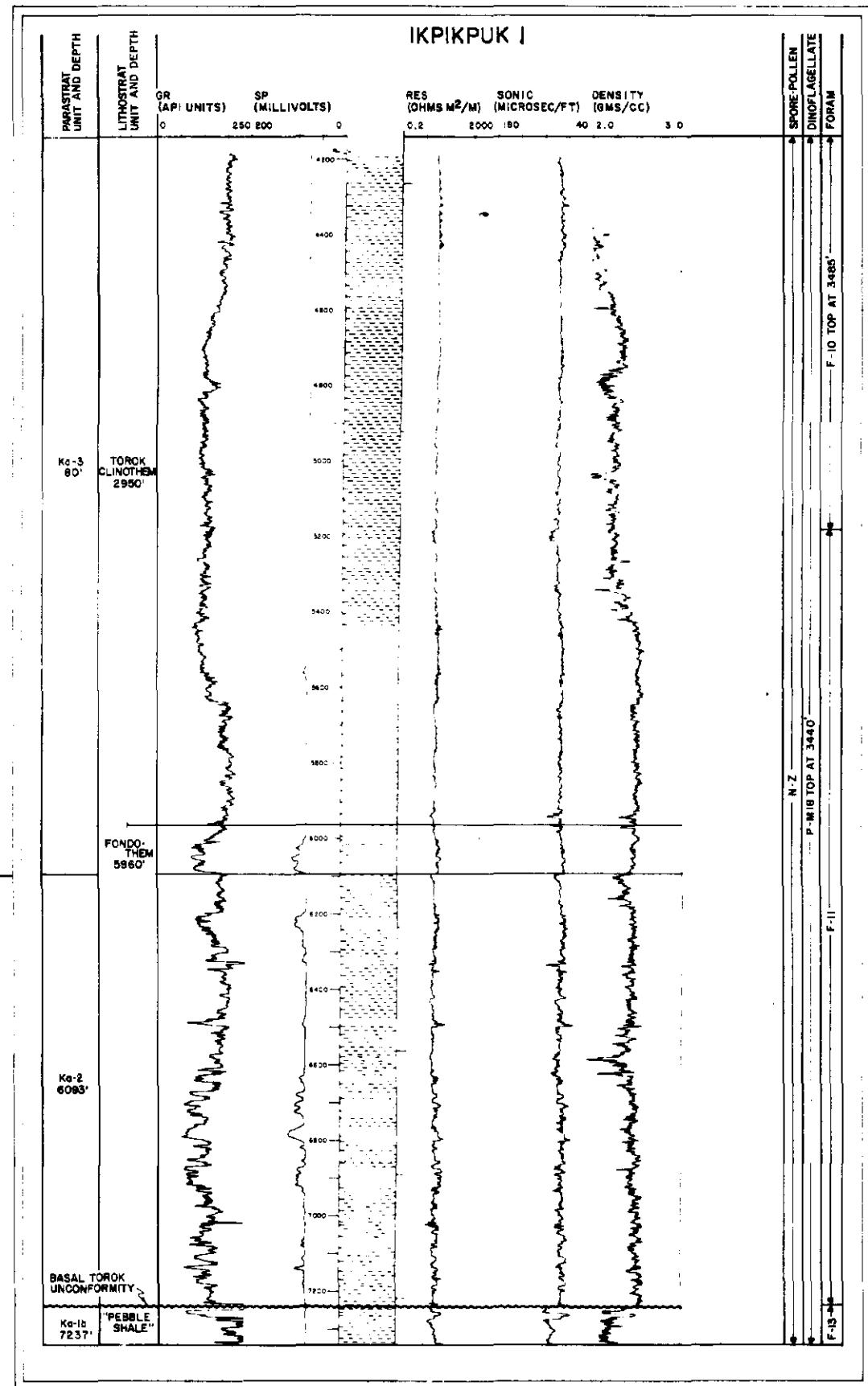
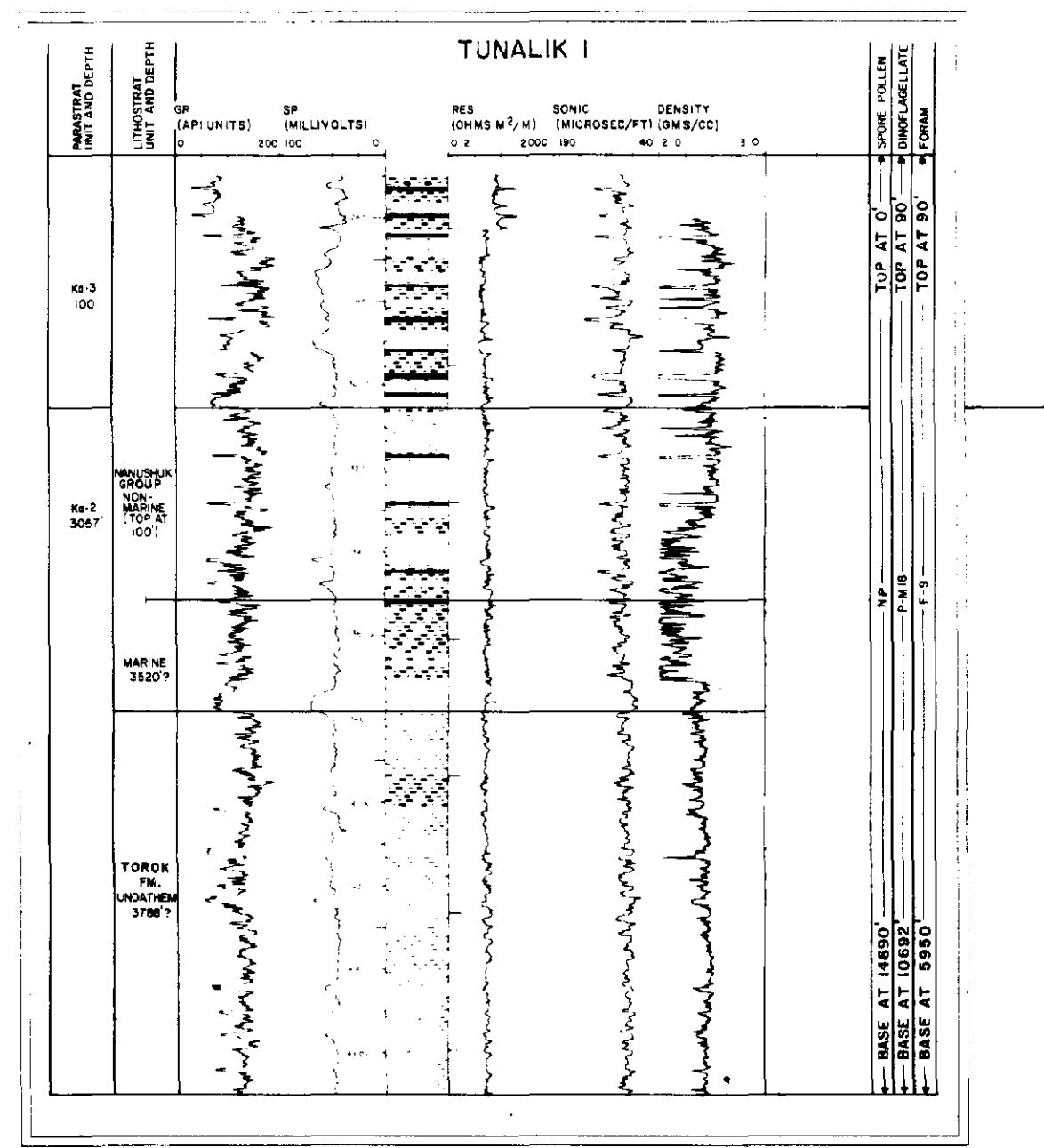
TYPE LOG OF KA-2/KA-3 PARASTRATIGRAPHIC UNITS, TUNALIK 1 AND IKPIKPUK 1

Ka-2 and Ka-3 are parastratigraphic units that are entirely in the Torok-Manushuk lithostratigraphic sequence. The boundary between the older underlying Ka-2 and the younger overlying Ka-3 cuts through lithofacies. Tunalik 1 and Ikpiakpuk 1 are typical wells showing the boundary in the Nanushuk nonmarine rocks and Torok fondothem, respectively.

These units are defined almost entirely on seismic character. Ka-2 corresponds to an early stage of the Torok-Manushuk sequence, including rocks deposited in basin, slope, marine shelf, and continental environments. In compressed seismic sections, Ka-2 contains more lower angle, less well defined clinoform beds than the overlying Ka-3 unit. This may indicate a more rapid and uniform deposition rate for the Ka-2 unit.

Ka-3 corresponds to the remainder of the time-transgressive Torok-Manushuk sequence. The Torok clinoform beds, as seen on seismic sections, are relatively steeper and more variable than those in the underlying Ka-2 unit, which may indicate a more sporadic depositional history of the Ka-3 unit.

Few consistent and obvious log characters are used to define the boundary between Ka-2 and Ka-3. At Tunalik 1, the Ka-2/Ka-3 boundary is in the Nanushuk nonmarine; at South Meade 1, the boundary is in the Nanushuk marine; at Topagoruk 1, it is in the Torok undathem; and at Ikpiakpuk 1, it is in the Torok fondothem. In all cases, the log boundary was picked where log curves indicate a change upward from shale to a more clastic rock. AWA foraminiferal zones F-9, F-10, and F-11 occur in both the Ka-2 and Ka-3 units. These facies-controlled zones are of little value for time-stratigraphic correlations.



 <b>HOUSTON</b> <b>TEXAS</b>	<b>TETRA TECH, INC.</b> <b>ENERGY MANAGEMENT DIVISION</b> <b>PASADENA</b> <b>CALIFORNIA</b>	
<b>PETROLEUM EXPLORATION OF NPRA 1974-1981 (FINAL REPORT)</b>		
<b>TYPE LOG OF Kg-2/Ka3</b> <b>PARASTRATIGRAPHIC UNITS</b> <b>TUNALIK I, IKPIKPLUK I</b>		
<b>NPR</b>		<b>ALASKA</b>
<b>FOR</b> <b>ONPRA</b> <b>HUSKY OIL NPR OPERATIONS INC.</b>		
<b>PROJECT MANAGER:</b> J. W. BRUYNZEEL		<b>PROJECT NO.:</b> TC-714
<b>INTERPRETATION BY:</b> STAFF		<b>REVISED</b>
<b>DATE:</b> SEPT., 1981		<b>INITIAL</b>
<b>CONTOUR INT'L</b>		<b>SCALE:</b>
		<b>DWG NO.:</b>
<b>TETRA TECH REPORT NO. 82D0</b>		

FIGURE 66

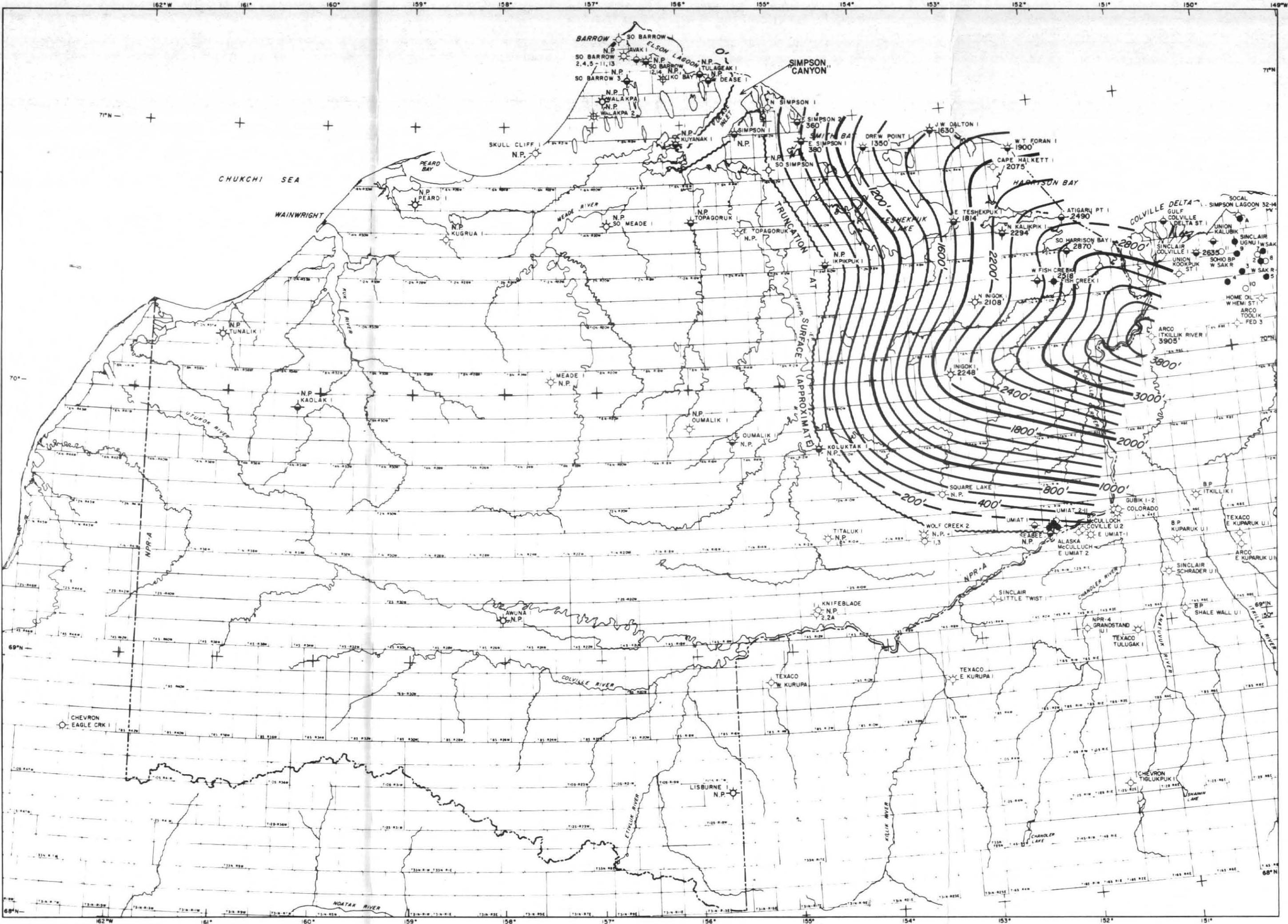
FIGURE 67

ISOPACH MAP, Kb

Well	Thickness	
	Feet	Meters
Atigaru Point 1	2,490	759
Cape Halkett 1	2,075	632
J. W. Dalton 1	1,630	497
Drew Point 1	1,350	412
West Fish Creek 1	2,518	767
W. T. Foran 1	1,900	579
South Harrison Bay 1	2,870	875
Inigok 1	2,248	685
North Inigok 1	2,108	643
North Kalikpik 1	2,294	699
East Simpson 1	380	116
East Simpson 2	360	110
East Teshekruk 1	1,814	553
Sinclair Colville 1	2,635	803
Arco Itkillik River 1	3,905	1,191

The Kb unit represents nearly all the late Cretaceous rocks in the NPRA. The base of Kb is marked by the mid-Cenomanian unconformity, which separates it from the underlying Ka-3 unit. The top of the Kb unit nearly coincides with the top of foraminiferal zone F-5 (Anderson, Warren, and Associates, 1974-1979).

Geographically, Kb is restricted to the northeastern part of the NPRA. The unit is thickest along the Barrow Arch from J. W. Dalton 1 in the northwest to Arco Itkillik River 1 in the southeast, outside of the Reserve. The unit thins by truncation southeast of the Barrow High. At West Fish Creek 1, North Kalikpik 1, East Simpson 1, East Simpson 2, and East Teshekruk 1, Kb is directly below Quaternary surface deposits. Kb is completely truncated at the surface just east of South Simpson 1, Ikpikpuk 1, and Koluktak 1.



**FIGURE 68****PALYNOLOGY CORRELATION CHART  
OF KEY NPRA WELLS**

In figure 68, "P-M" designates marine dinoflagellate-cyst zonules, "P-T" designates nonmarine spore-pollen zonules, and "N.Z." denotes that no zone or zonule is recognized for a given geologic time span. No dinoflagellate-cyst zonules are recognized for nonmarine rocks in the upper chart, because dinoflagellates and cysts are marine organisms. Conversely, no spore-pollen zonules are recognized for marine rocks in the lower chart because spores and pollen are used to subdivide nonmarine rocks. The indeterminate intervals are rocks barren of fossils and are bracketed by intervals where fossils were found.

Lisburne 1 was drilled in an area of complex thrust faults. The palynologic zonules listed in the chart are for plate 1 only. (See figure 69 for definition of plates 2-5).

For Drew Point 1, two depths are given for the P-M17 zonule on the dinoflagellate-cyst chart. The upper number indicates a questionable P-M17 zonule top, and the lower number is a definite P-M17 zonule top.



FIGURE 69

LITHOSTRATIGRAPHIC CORRELATION  
CHART OF KEY NPRA WELLS

The "Simpson sandstone" in NPRA wells was informally designated the "Simpson" by Bird (1979). The "Barrow sandstone" is one of several informal names used for many years to describe the production gas horizons in the South Barrow fields; the term collectively refers to the "Upper Barrow gas sand" and "Lower Barrow gas sand." The depths given in this chart for the "Barrow sandstone" refer to regional marker-defined units, not to production tops.

At Tunalik 1, the "Transition Zone" includes a 745-ft (229-m) basalt that should be subtracted from the Wahoo-to-Joe Creek thickness. The top of the Wahoo Limestone at Tunalik 1 is the top of the massive limestone. The overlying interbedded carbonates and shales are referred to here as the "Transition Zone."

The tops shown for the Lisburne clastics correlate lithologically with the Endicott Group, but are the lateral time-equivalents of the Alapah Limestone or the Wahoo Limestone.

The tops given in the chart for Lisburne 1 are for plate 1 only. The tops for the remaining plates at Lisburne 1 are as follows:

Stratigraphic unit or marker	Plate 2	Plate 3	Plate 4	Plate 5
Top of plate	8,599 ft (2,620 m)	10,898 ft (3,322 m)	13,370 ft (4,075 m)	15,318 ft (4,669 m)
"Pebble Shale" unit(?)	8,599 ft (2,620 m)	10,898 ft (3,322 m)	--	--
Shublik(?)	9,017 ft (2,748 m)	11,016 ft (3,358 m)	13,370 ft (4,075 m)	--
Ikiakpaurak(?)	9,440 ft (2,878 m)	11,340 ft (3,456 m)	13,540 ft (4,127 m)	15,318 ft (4,669 m)
Alapah Limestone (?)	9,670 ft (2,947 m)	11,549 ft (3,520 m)	13,735 ft (4,186 m)	15,405 ft (4,695 m)

Sinclair Colville 1 and Arco Itkillik River 1 are located east of the NPRA, but are included on the chart to tie the NPRA correlation units into Prudhoe Bay.

Oil and gas shows are indicated by the appropriate symbol shown above the unit top. Good shows, characterized by a good gas kick of heavy gases accompanied by a drilling break, a cut in mud weight, and significant fluorescence, are indicated by a "G" beside the show symbol.



FIGURE 70

POTENTIAL RESERVOIR AND AVERAGE POROSITY  
MAP OF IVISHAK FORMATION

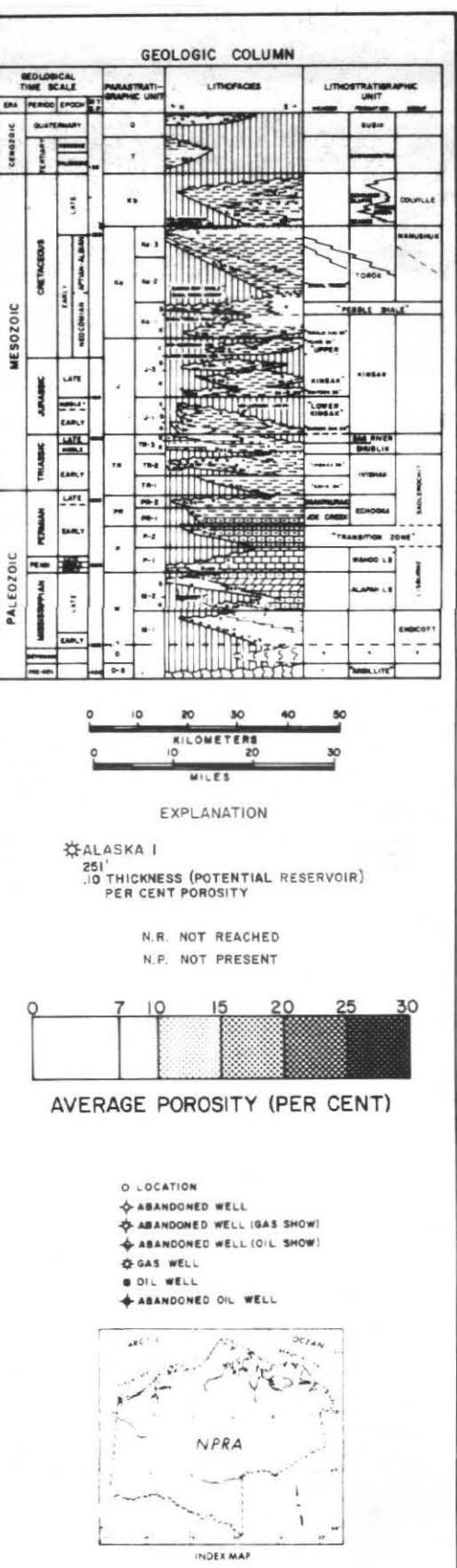
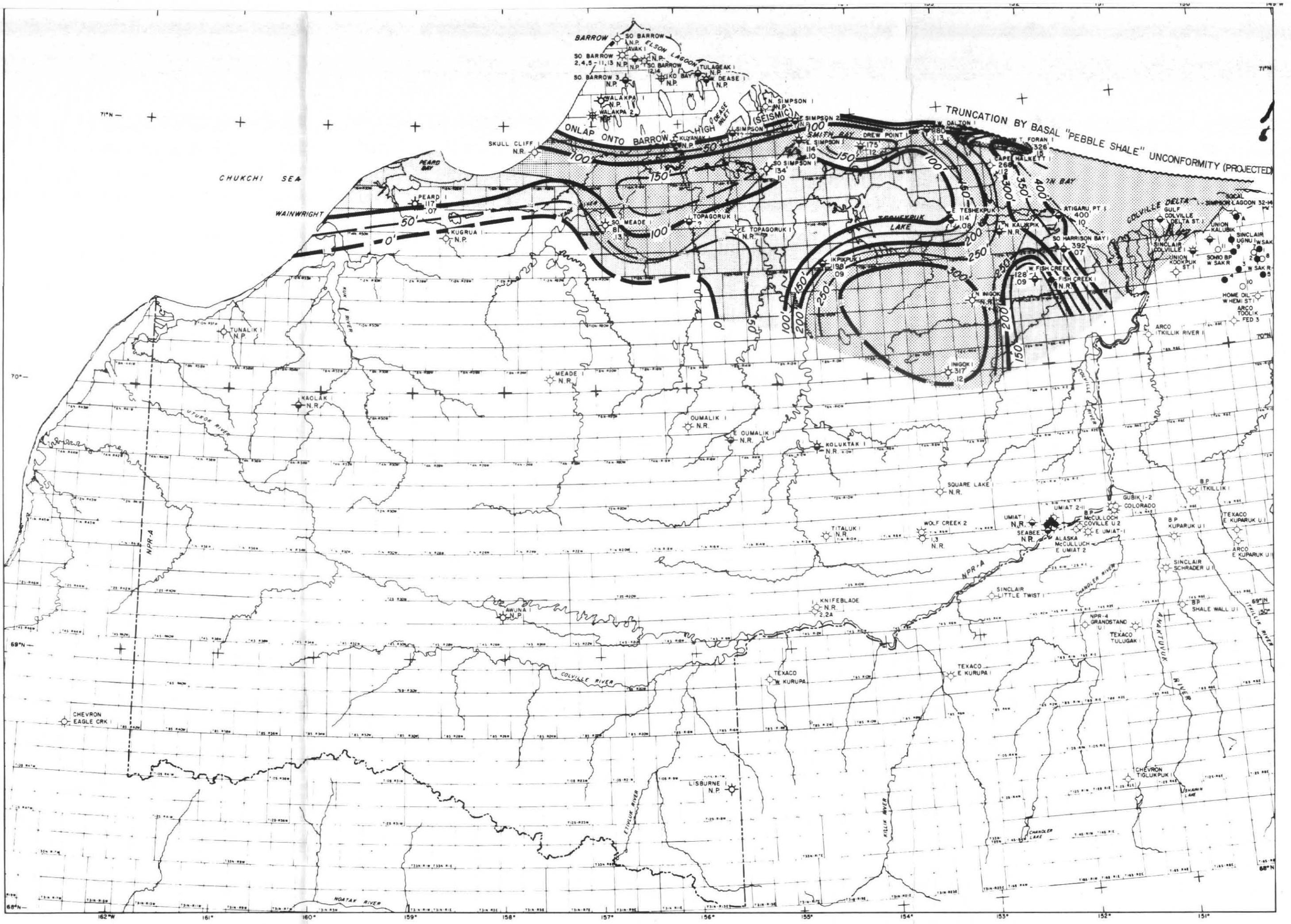
Well	Thickness		Average Porosity (Percent)
	Feet	Meters	
Atigaru Point 1	400	122	10
Cape Halkett 1	268	82	12
J. W. Dalton 1	180	55	13
Drew Point 1	175	53	12
West Fish Creek 1	128	39	9
W. T. Foran 1	326	99	15
South Harrison Bay 1	392	120	7
Ikpikpuk 1	198	60	9
Inigok 1	317	97	12
South Meade 1	81	25	13
Peard 1	117	36	7
East Simpson 1	114	46	10
South Simpson 1	134	41	10
East Teshekpuk 1	114	35	8

The sandstone lithofacies within the TR-2 parastratigraphic unit, commonly referred to as the "Ivishak sandstone," is the highly productive interval in the Prudhoe Bay field.

A thick sand trend just south of the Barrow High and the Barrow Arch runs approximately east-west. To the south, the sand lithofacies or "Ivishak sandstone" gradually thins out.

The "Ivishak sandstone" is composed of interbedded conglomerate, sandstone, and siltstone. Light-gray to white, very fine- to fine-grained sands with conglomeratic beds constitute the reservoir.

Only sands with porosities greater than 7 percent have been mapped as potential reservoirs within the Ivishak Formation. The porosity of the sands decreases southward due to secondary cementation. Along the northern limits, better quality reservoir sands are developed.



<b>T</b> TETRA TECH, INC	PRUSTON TEXAS	ENERGY MANAGEMENT DIVISION	PASADENA, CALIFORNIA
PETROLEUM EXPLORATION OF NPRA 1974-1981 (FINAL REPORT)			
<b>POTENTIAL RESERVOIR &amp; AVERAGE POROSITY MAP OF IVISHAK FORMATION</b>			
NPR	ALASKA		
FOR <b>ONPRA</b>			
HUSKY OIL NPR OPERATIONS INC			
PROJECT MANAGER: J W BRUYNZEEL	PROJECT NO. TC-7174		
INTERPRETATION BY:	REVISED		
DATE: OCT 1978	DATE: INITIAL		
DATUM:	SEPT 1978 E.C.G.		
LONG. R. INT: 50°	NOV 1980 C.G.F.		
SCALE:	SEPT 1981 A.G.		
TETRA TECH REPORT NO. 8200			

FIGURE 70

FIGURE 71

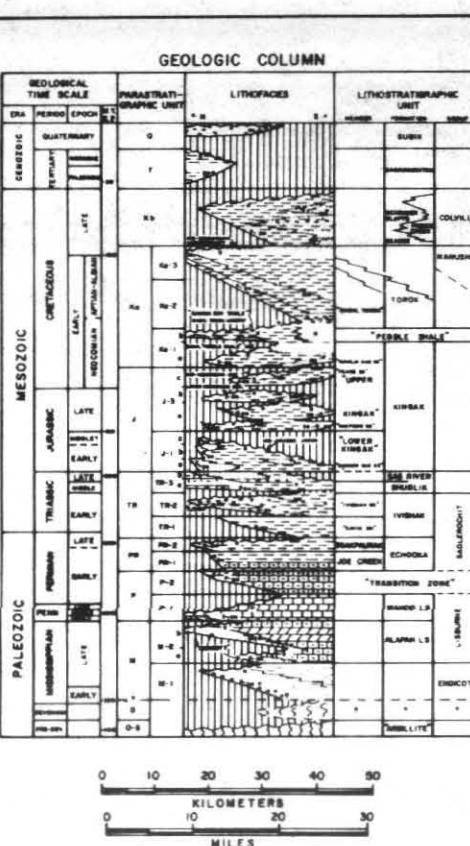
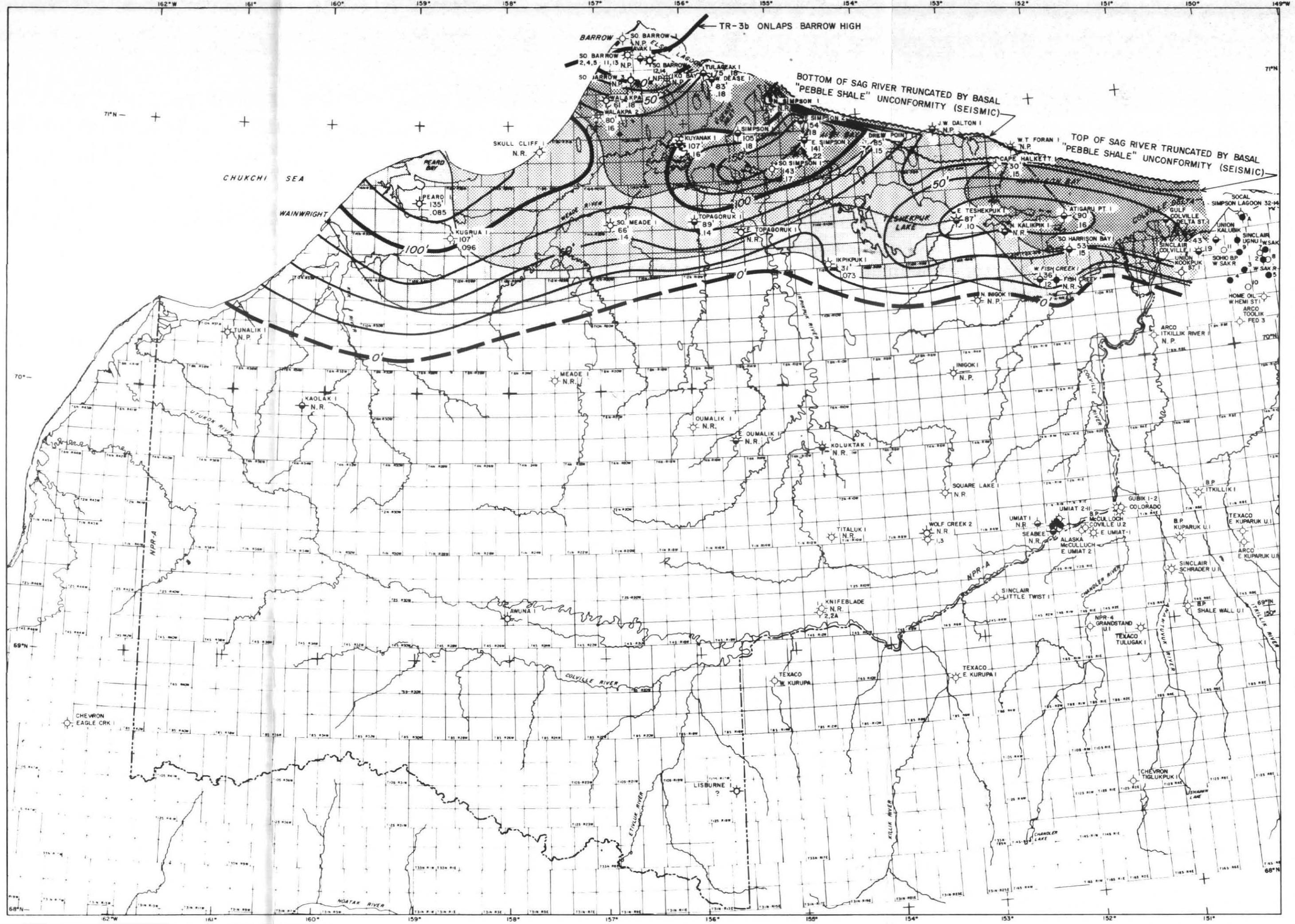
POTENTIAL RESERVOIR AND AVERAGE POROSITY  
MAP OF SAG RIVER SANDSTONE

Well	Thickness		Average Porosity (Percent)
	Feet	Meters	
Atigaru Point 1	90	27	16
Cape Halkett 1	30	9	15
West Dease 1	83	25	18
Drew Point 1	85	26	15
West Fish Creek 1	36	11	12
South Harrison Bay 1	53	16	15
Ikpikpuk 1	31	9	7.3
Kugrua 1	107	33	9.6
Kuyanak 1	107	33	16
South Meade 1	66	20	14
Peard 1	135	41	8.5
Simpson 1	105	32	18
East Simpson 1	141	43	22
East Simpson 2	154	47	18
South Simpson 1	143	44	17
East Teshekpuk 1	87	27	10
Topagoruk 1	89	27	14
Tulageak 1	75	23	18
Walakpa 1	61	19	18
Walakpa 2	80	24	16
Sinclair Colville 1	43	13	19

The Sag River Sandstone is the sandstone lithofacies of the TR-3b parastratigraphic unit. The rocks are Late Triassic to Early Jurassic and are restricted to the northern half of the Reserve.

The Sag River Sandstone is a sheetlike sand body that probably consists of a series of overlapping bars. The lithology is typically light-greenish-gray glauconitic calcareous sandstone. The Sag River Sandstone becomes increasingly silty toward the south and west. At Inigok 1 and Tunalik 1, laterally equivalent siltstone and shales are present. The Sag River Sandstone also grades into equivalent calcareous and glauconitic siltstones, shales, and silty sandstones on the Barrow High.

Porosity within the unit is very good in wells drilled on the Reserve. The lowest porosity, 7.3 percent, was at Ikpikpuk 1; the highest porosity, 22 percent, was in East Simpson 1. Porosities above 16 percent were recorded in all wells in the northwestern NPRA. A second area of good porosity development is over the Fish Creek Platform northward to where the unit is truncated by the basal "Pebble Shale" unconformity. There were several minor oil shows in the Sag River Sandstone at East Simpson 1 and East Simpson 2.

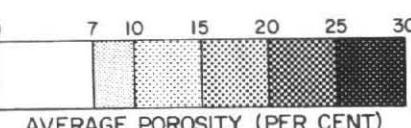


#### **EXPLANATION**

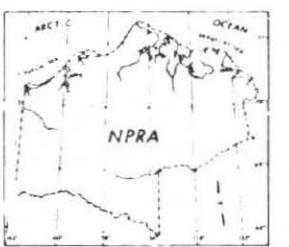
~~ALASKA~~ 1  
25' THICKNESS (POTENTIAL RESERVOIR)  
50% SALT DENSITY

N.R. NOT REACHED

N.P. NOT PRESENT



O LOCATION  
 ◊ ABANDONED WELL  
 ◊ ABANDONED WELL (GAS SHOW)  
 ◊ ABANDONED WELL (OIL SHOW)  
 ◊ GAS WELL  
 ◊ OIL WELL  
 ◊ ABANDONED OIL WELL



INDEX MAP

<b>TETRA TECH, INC.</b>	<b>PASADENA, CALIFORNIA</b>
<b>PROJECT NUMBER: TEXAS</b>	<b>ENERGY MANAGEMENT DIVISION</b>
<b>PETROLEUM EXPLORATION OF NPRA 1974-1981 (FINAL REPORT)</b>	
<p style="text-align: center;"><b>POTENTIAL RESERVOIR &amp; AVERAGE POROSITY MAP OF SAG RIVER SANDSTONE</b></p>	
<b>NPR</b>	<b>ALASKA</b>
<b>FOR</b> <b>ONPRA</b> <b>HUSKY OIL/NPR OPERATIONS INC</b>	
<b>PROJECT MANAGER: J.W. BRUYNZEEL</b>	<b>PROJECT NO. TC-7174</b>
<b>INTERPRETATION BY: GEOLOGICAL STAFF</b>	<b>REVISITED</b>
<b>DATE: FEB. 1982</b>	<b>DATE: (19)18</b>
<b>CONTINUOUS 25'</b>	<b>STATE:</b>
<b>DWS NO.</b>	

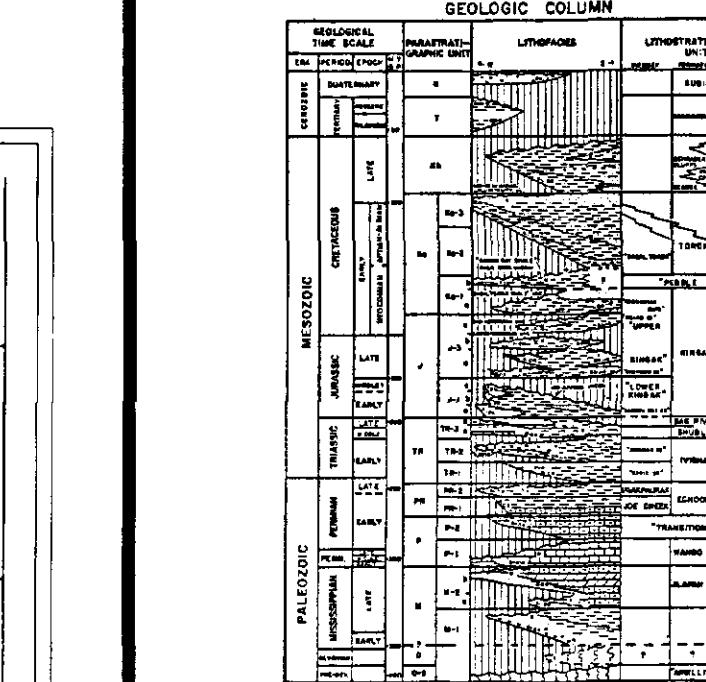
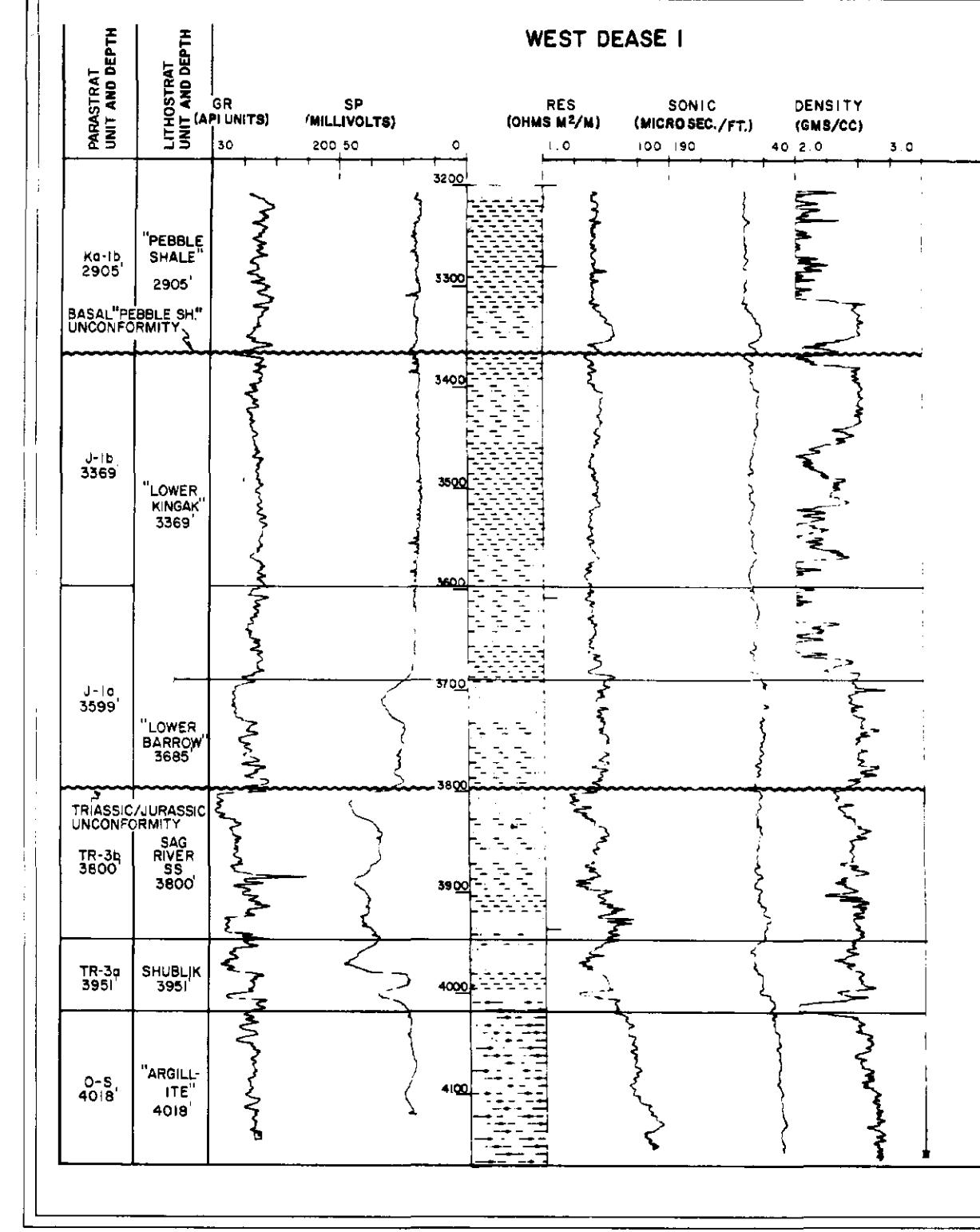
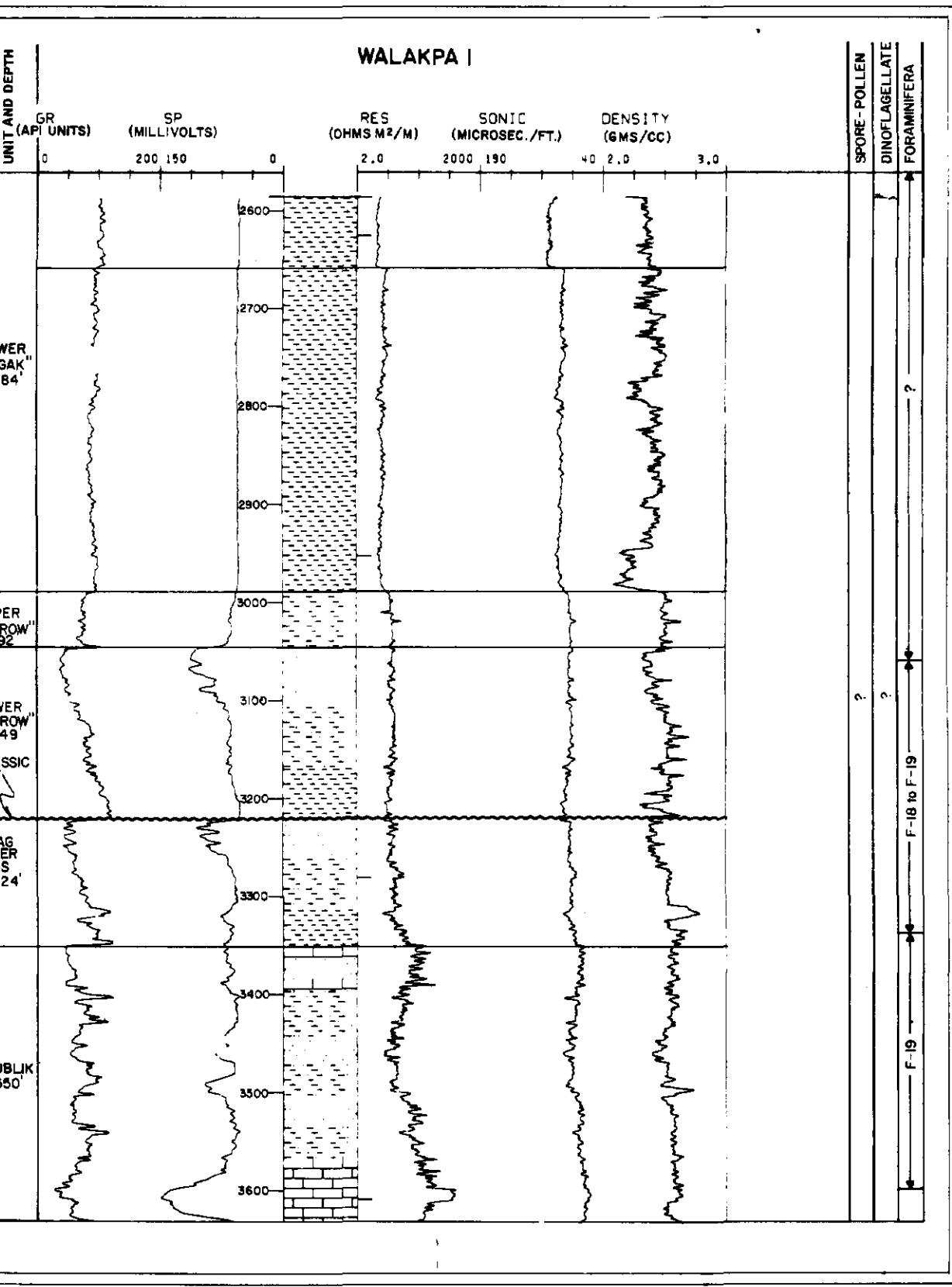
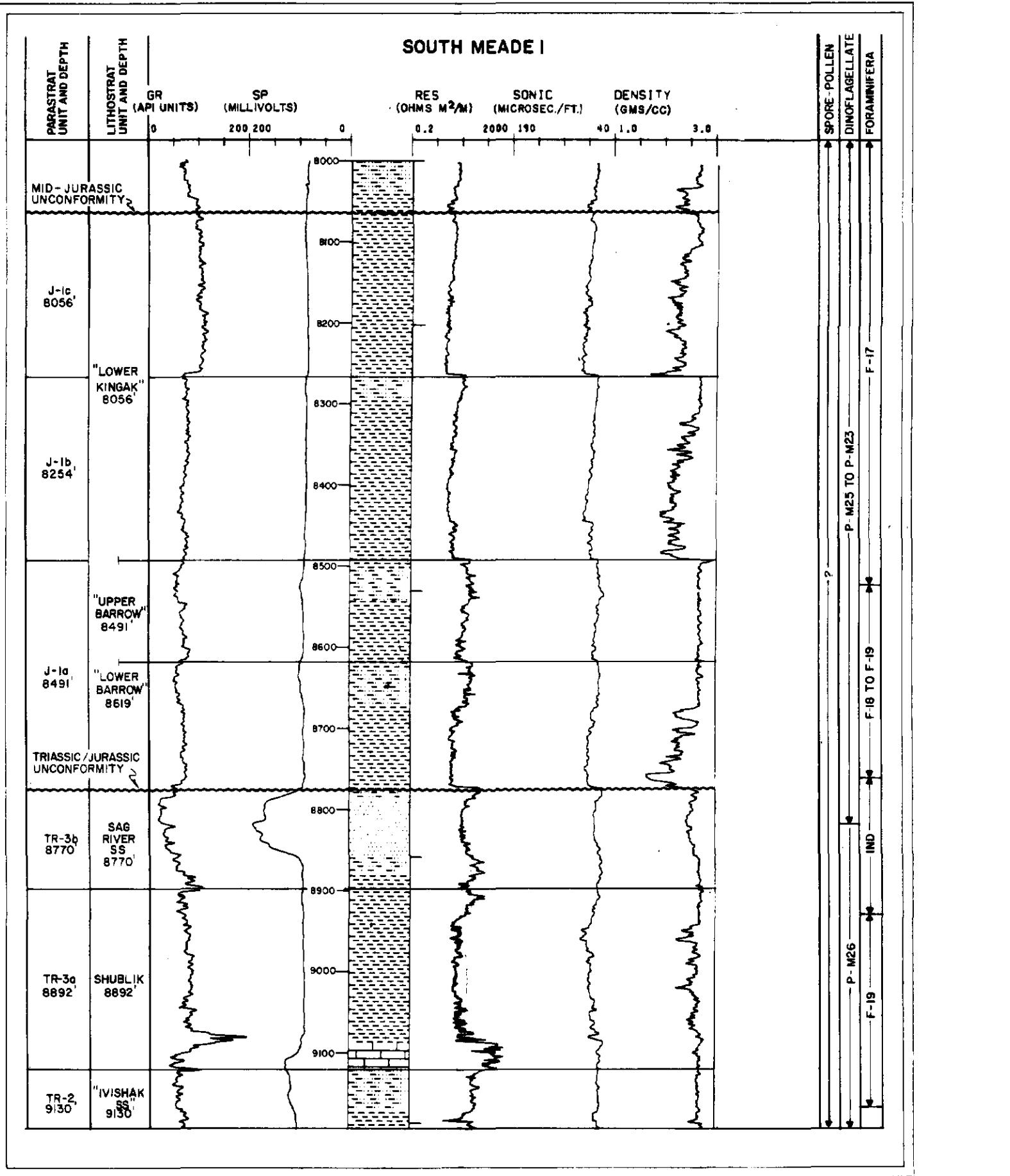
TETRA TECH REPORT NO. 8200  
TGZ0170

FIGURE 71

FIGURE 72

TYPE LOG OF UNCONFORMITY BETWEEN SAG RIVER  
SANDSTONE AND KINGAK FORMATION; SOUTH  
MEADE 1, WALAKPA 1, AND WEST DEASE 1

This figure shows representative sections of the Sag River Sandstone at South Meade 1, Walakpa 1, and West Dease 1. In this report, the top of the Sag River Sandstone is chosen at a prominent gamma-ray and resistivity deflection that can be recognized regionally. These sections show that the log character of the Sag River Sandstone is fairly consistent in the vicinity of the Meade Arch, while the overlying rocks are variable. The "Barrow sandstone" and Sag River Sandstone are separated by a shale and siltstone unit.



**TETRA TECH, INC.**  
HOUSTON, TEXAS ENERGY MANAGEMENT DIVISION PASADENA, CALIFORNIA  
PETROLEUM EXPLORATION OF NPRA 1974-1981 (FINAL REPORT)  
TYPE LOG OF UNCONFORMITY BETWEEN SAG RIVER SANDSTONE AND KINGAK FM.  
S. MEADE I, WALAKPA I, W. DEASE I  
NPR FOR ONPRA HUSKY OIL NPR OPERATIONS INC.  
PROJECT MANAGER: J. W. BRUNZEEL PROJECT NO. TC-774  
INTERPRETATION BY: STAFF, (V. E. BERGER) DATE: INITIAL  
DATE: SEPT., 1981 DATUM: TOP SAG RIVER  
CONTOUR INT: SCALE: DWG NO.  
TETRA TECH REPORT NO. 8200 FIGURE 72

TG2-0170

FIGURE 73

FIGURE 73

POTENTIAL RESERVOIR AND AVERAGE POROSITY MAP  
OF "BARROW SANDSTONE," BARROW AREA

Well	Thickness		Average Porosity* (Percent)
	Feet	Meters	
South Barrow 2	24	7	23
South Barrow 3	n.d.	-	n.d.
South Barrow 4	28	9	21
South Barrow 5	n.d.	-	n.d.
South Barrow 6	25	8	n.d.
South Barrow 7	n.d.	-	n.d.
South Barrow 8	24	7	n.d.
South Barrow 9	26	8	17.0
South Barrow 10	n.d.	-	n.d.
South Barrow 11	36	11	20.0
South Barrow 12	34	10	20.8
South Barrow 13	54	17	17.8
South Barrow 14	44	13	23.72
South Barrow 17	72	13	23.25
South Barrow 18	50	15	21.5
South Barrow 19	58	18	21.83
South Barrow 20	57	17	21.11
West Dease 1	29	9	16.95
Iko Bay 1	59	18	17.82
Kuyanak 1	34	10	11.8
Simpson 1	5	2	n.d.
East Simpson 1	34	10	15.5
East Simpson 2	15	5	12.06
Tulageak 1	57	17	17.4
Walakpa 1	77	23	19.65
Walakpa 2	62	19	16.30

\*Values combine the upper and lower "Barrow sandstone" units.

The "Barrow sandstone" is an argillaceous sandstone in the lower part of the Kingak Formation in the northern half of the NPRA. This rock unit, consisting of "Lower Barrow gas sand" and "Upper Barrow gas sand," is the gas-producing zone in the South Barrow and East Barrow gas fields. The "Barrow sandstone" is a series of isolated sandstone bodies that are barlike in map view (see "Jurassic Study"). The "Barrow sandstone" is a southeast-southwest transgressive facies deposited in early Jurassic time disconformably over the Sag River to the east of Simpson 1; are relatively lower than west and northwest of Simpson 1. Lower porosity and lesser thickness are attributed to lower wave energy, slower sedimentation rate, and lower rate of subsidence. The highest porosity and thickness occur within the South Barrow gas field where average porosities range as high as 23 percent and sands are as thick as 75 ft (23 m) at South Barrow 17. The thicker sands and higher porosities in this area indicate greater wave energy, rate of sedimentation, and rate of subsidence. Potential reservoir and average porosity are unknown in the "Disturbed Zone," an area between the South Barrow and East Barrow gas fields.

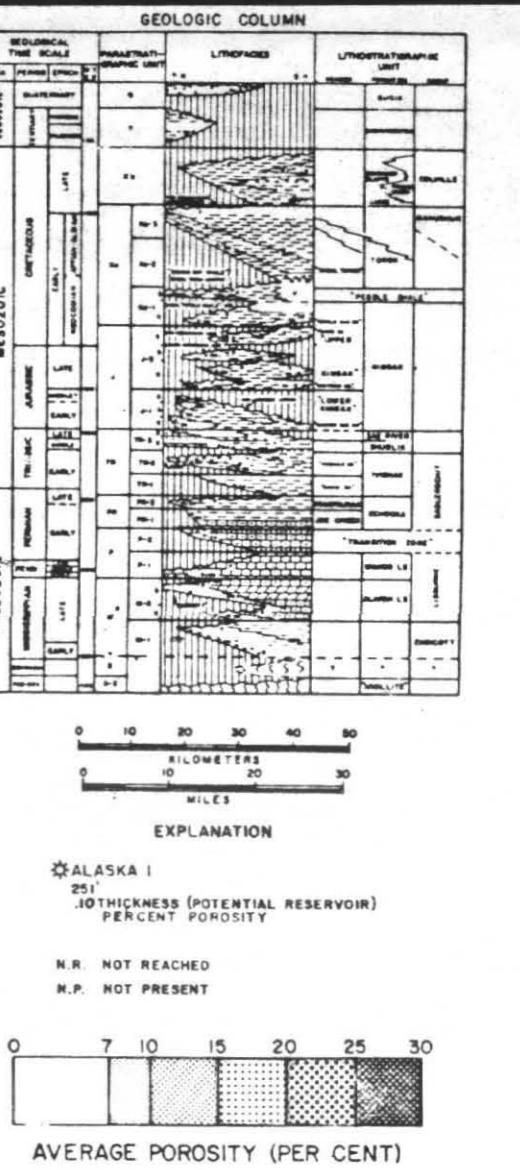
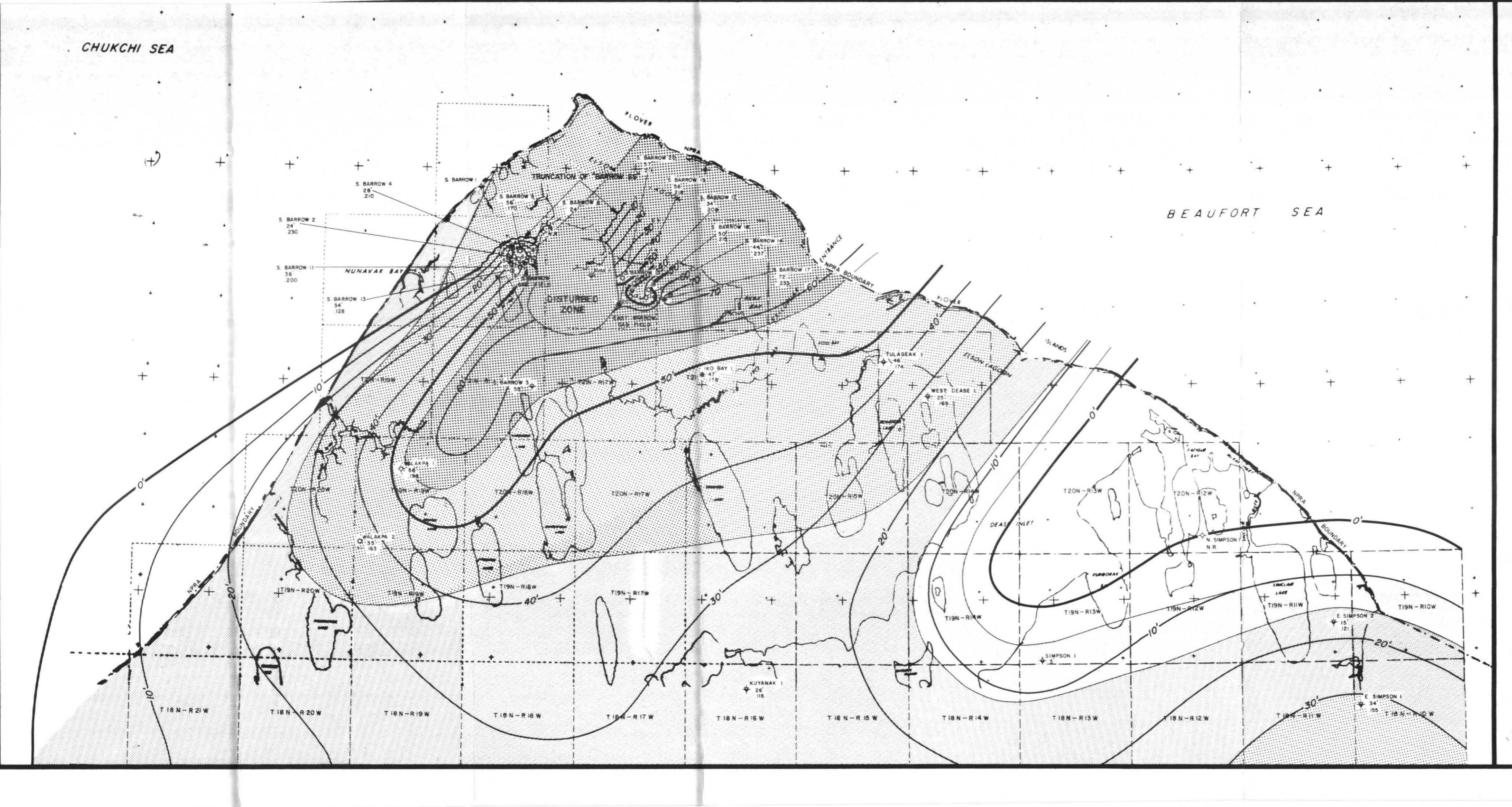


FIGURE 7.3

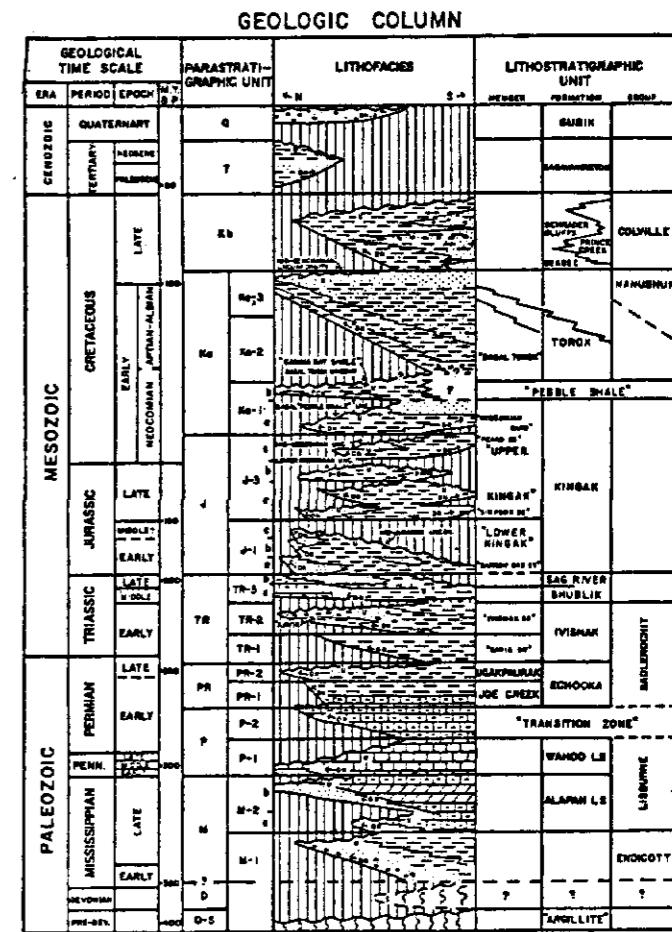
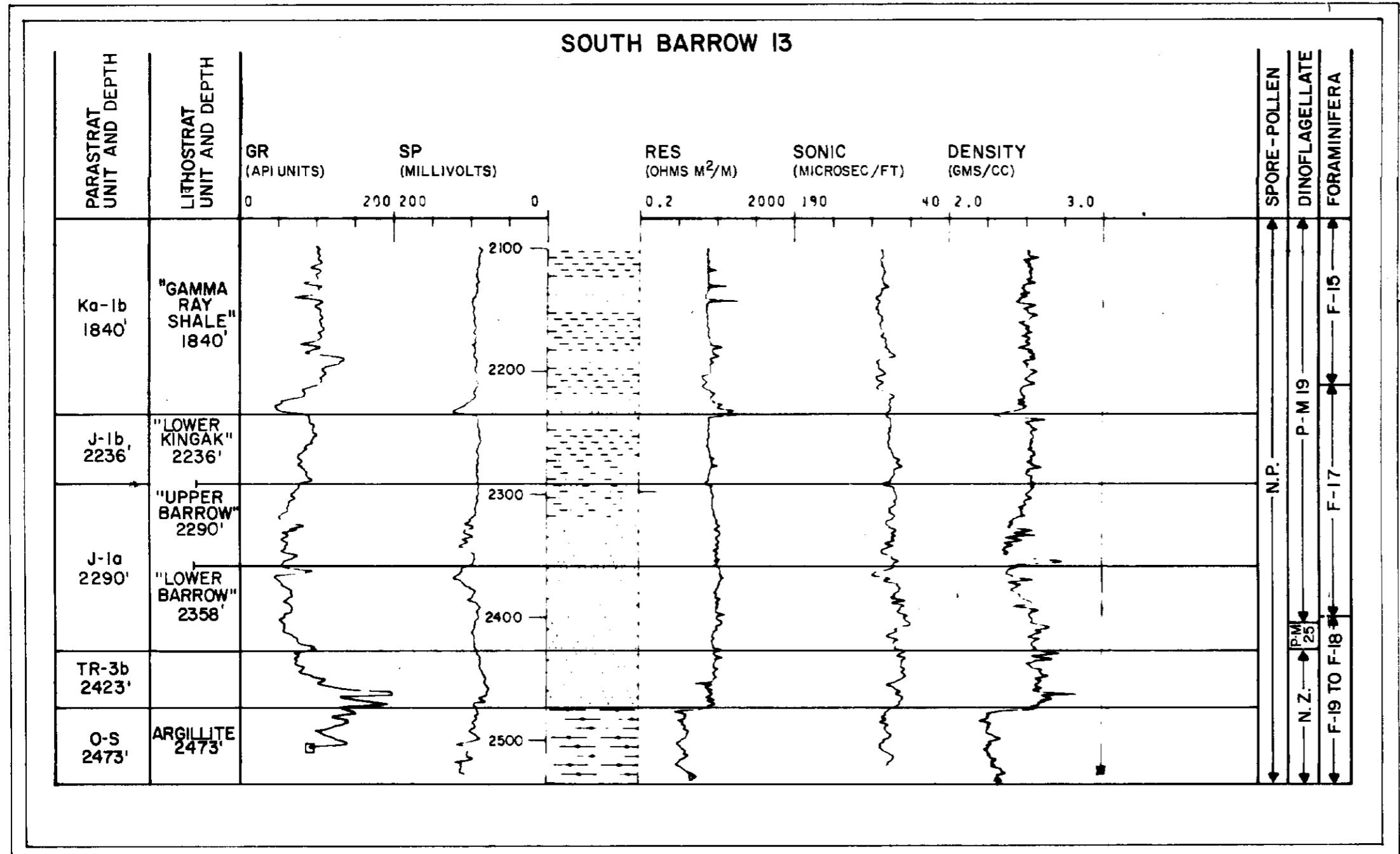
**FIGURE 74**

**FIGURE 74**

**TYPE LOG OF "BARROW SANDSTONE,"**  
**SOUTH BARROW 13**

This figure is a representative section showing the "Barrow sandstone" at South Barrow 13. Regional variation in the "Barrow sandstone" can be seen in figure 73.

The "Barrow sandstone" is the best known sandstone in the "Lower Kingak." This rock unit, consisting of "Lower Barrow gas sand" and "Upper Barrow gas sand," is the gas-producing zone in the South Barrow gas field. The "Barrow sandstone" is argillaceous in the Barrow area; a thin silty sandstone occurs at the same horizon at South Meade 1.



<b>TETRA TECH, INC</b>	<b>ENERGY MANAGEMENT DIVISION</b>	<b>PASADENA, CALIFORNIA</b>
<b>PETROLEUM EXPLORATION OF NPRA 1974-1981 (FINAL REPORT)</b>		
<p align="center"><b>TYPE LOG OF "BARROW SANDSTONE" SOUTH BARROW 13</b></p>		
<b>NPR</b>	<b>ALASKA</b>	
<p align="center">FOR</p> <p align="center"><b>ONPRA</b></p> <p align="center"><b>HUSKY OIL NPR OPERATIONS INC.</b></p>		
<b>PROJECT MANAGER:</b> J. W. BRUYNZEEL		<b>PROJECT NO.</b> TC-7174
<b>INTERPRETATION BY:</b> STAFF		<b>REVISED</b>
<b>DATE:</b> SEPT. 1981	<b>DATUM:</b>	<b>DATE</b>
<b>CONTOUR INT:</b>		<b>INITIAL</b>
<b>SCALE:</b>		<b>DWG NO.</b>

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TETRA TECH REPORT NO. B200

TGZ-0170

FIGURE 74

FIGURE 75

POTENTIAL RESERVOIR AND AVERAGE POROSITY  
MAP OF "SIMPSON SANDSTONE"

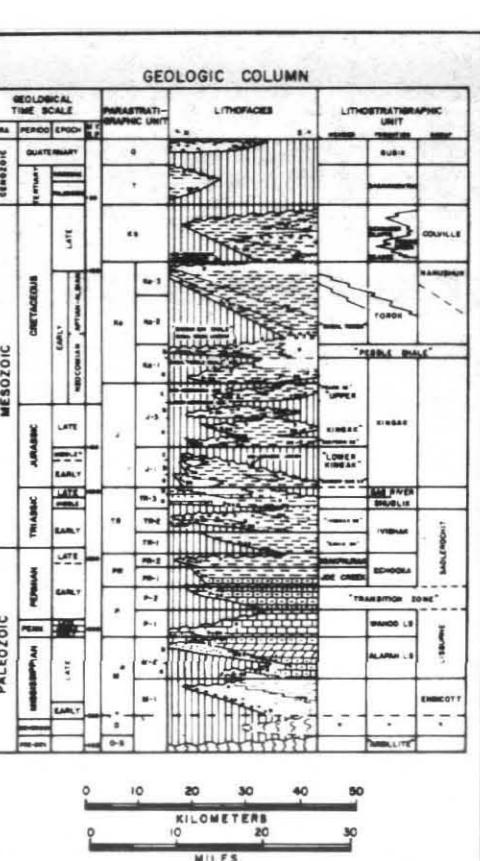
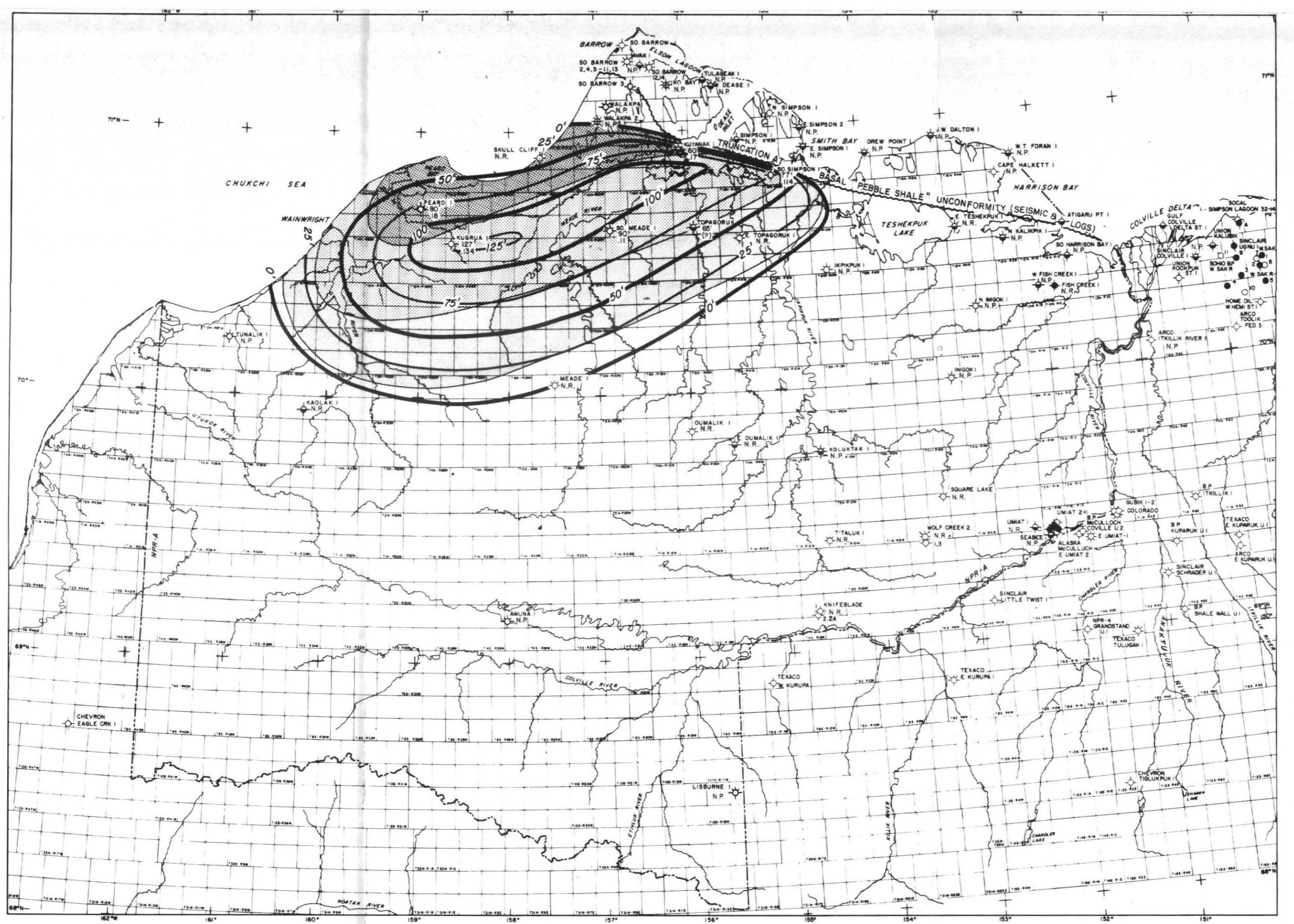
Well	Top of "Simpson sandstone" (Feet)	Thickness Feet	Thickness Meters	Average Porosity (Percent)
Kugrua 1	8,705	127	39	13.4
Kuyanak 1	5,376	60	18	17
South Meade 1	7,850	90	27	11
Peard 1	7,820	80	24	18
South Simpson 1	6,530	77	23	11.4
Topagoruk 1	7,748	65	20	(?)

The "Simpson sandstone," a sandstone unit within the J-3aI parastratigraphic unit, trends northeast; the thickest section penetrated was at Kugrua 1.

Thickness of the sandstone ranges from 60 to 127 ft (18 to 39 m) and average porosities range from 11 to 18 percent. Porosities increase to the northwest, which is the probable source direction. The configuration of the sand body suggests deposition as a marine bar. Well data indicate the sand body shales out to the south and southeast and is truncated to the northeast by the basal "Pebble Shale" unconformity. Walakpa 1 and Walakpa 2 well data indicate the unit shales out to the north. Thinning to the northwest is indicated at Peard 1.

The "Simpson sandstone" grades vertically from a silty, shaly sand to moderately sorted, clean sandstone. The lower part of the sand is light-gray to gray, very fine- to fine-grained, glauconitic, with calcareous cement. The upper part of the sand contains clear, frosted quartz with some rock fragments. The quartz grains vary from subround to subangular, and are very fine- to fine-grained. The upper part is generally noncalcareous and contains much less glauconite than the lower part. The abundance of glauconite increases rapidly to the southeast.

Kugrua 1 had dead oil shows in the "Simpson sandstone." Very good gas shows were recorded at South Simpson 1, and a drillstem test of the interval recorded flow rates of 75 MCFD. Lost circulation zones were encountered in Kugrua 1 and South Meade 1.

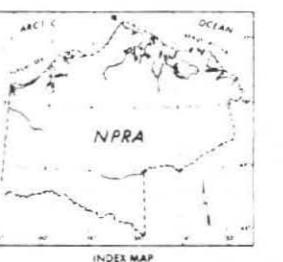


ALASKA I  
251'  
.10THICKNESS (POTENTIAL RESERVOIR)  
PERCENT POROSITY

N.R. NOT REACHED  
N.P. NOT PRESENT

AVERAGE POROSITY (PER CENT)

- LOCATION
- ABANDONED WELL
- ABANDONED WELL (GAS SHOW)
- ABANDONED WELL (OIL SHOW)
- GAS WELL
- OIL WELL
- ABANDONED OIL WELL



<b>TETRA TECH, INC.</b>		<b>PASADENA</b>
HOUSTON TEXAS ENERGY MANAGEMENT DIVISION CALIFORNIA		
PETROLEUM EXPLORATION OF NPRA 1974-1981 (FINAL REPORT)		
POTENTIAL RESERVOIR & AVERAGE POROSITY MAP OF "SIMPSON SS"		
NPR	ALASKA	
FOR		
<b>ONPRA</b>		
HUSKY OIL/NPRA OPERATIONS INC		
PROJECT MANAGER: J.W. BRUYNZEEL	PROJECT NO. TC-7174	
INTERPRETATION BY:	REVISED	
DATE: OCTOBER, 1978	INITIAL	
CONTINUED INTL: 25°	E.C.S.	
SCALE	NOV. 1980 C.G.F.	
SEPT. 1975		
SEPT. 1981 A.G.		
TETRA TECH REPORT NO. 6200		

FIGURE 7

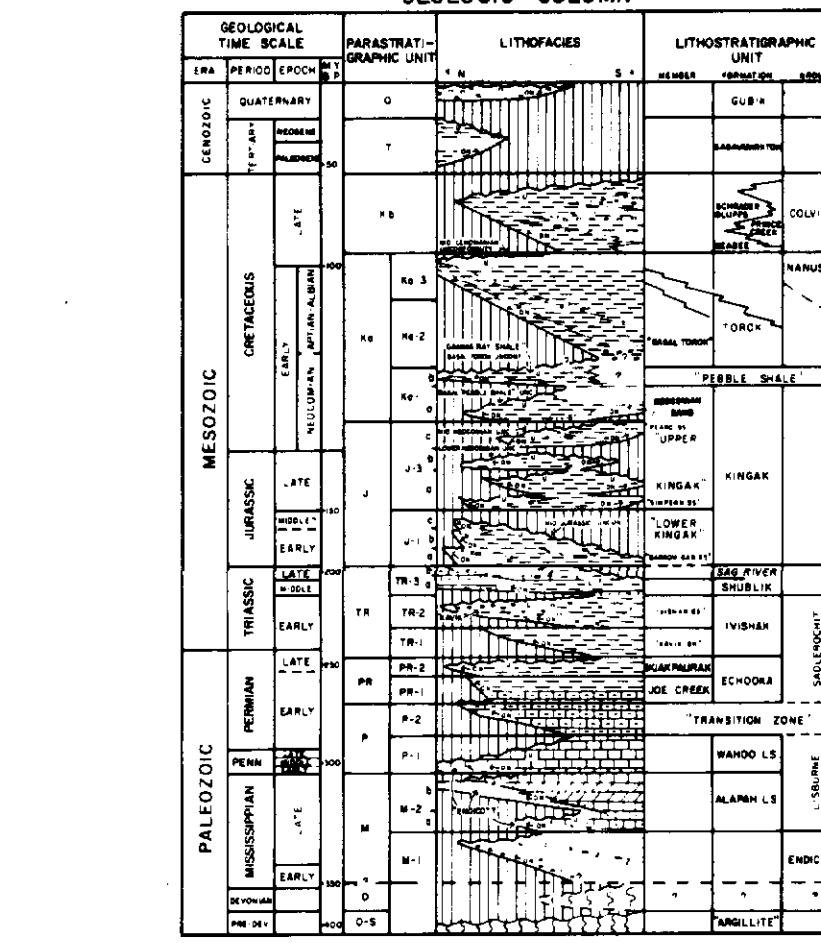
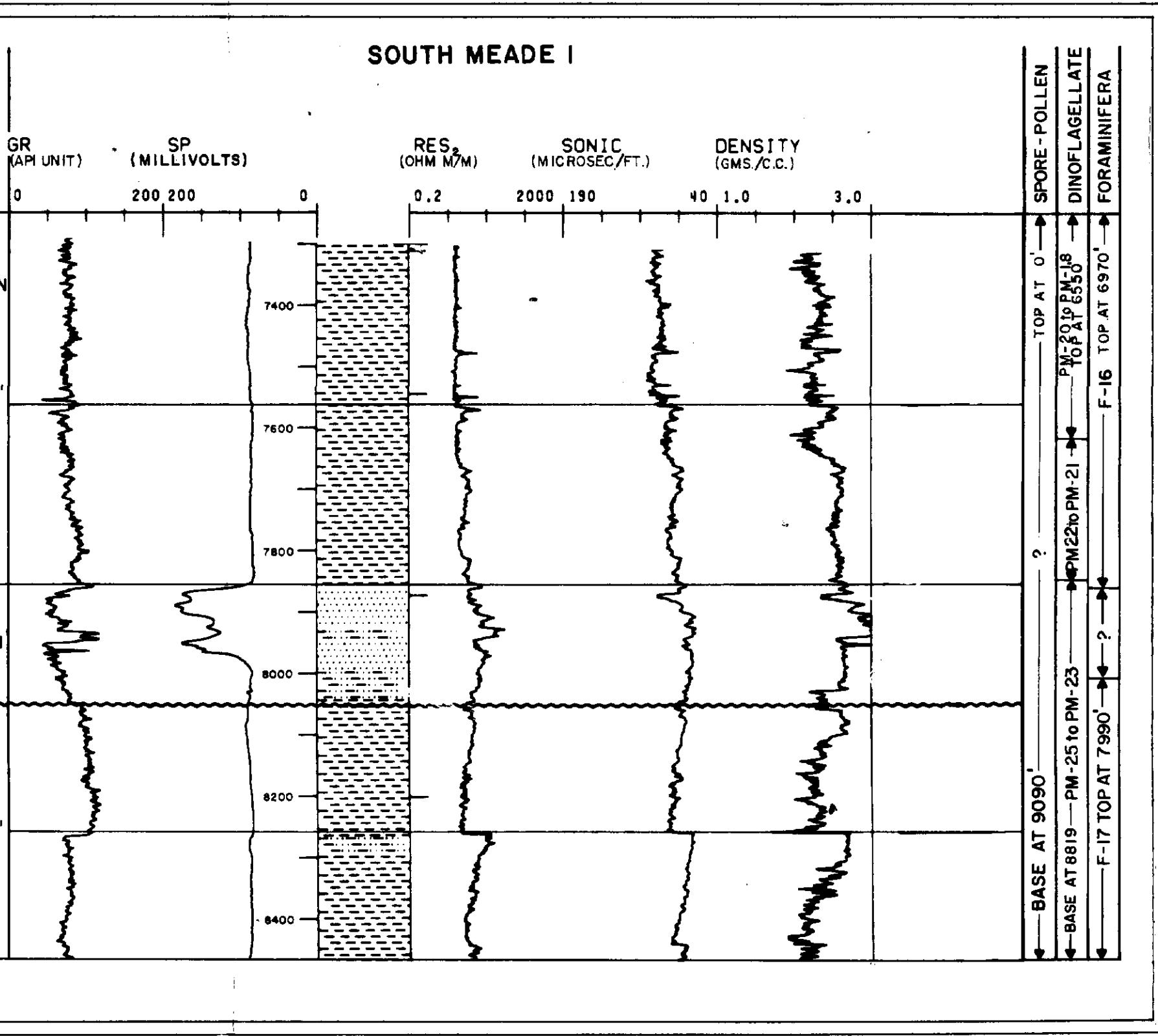
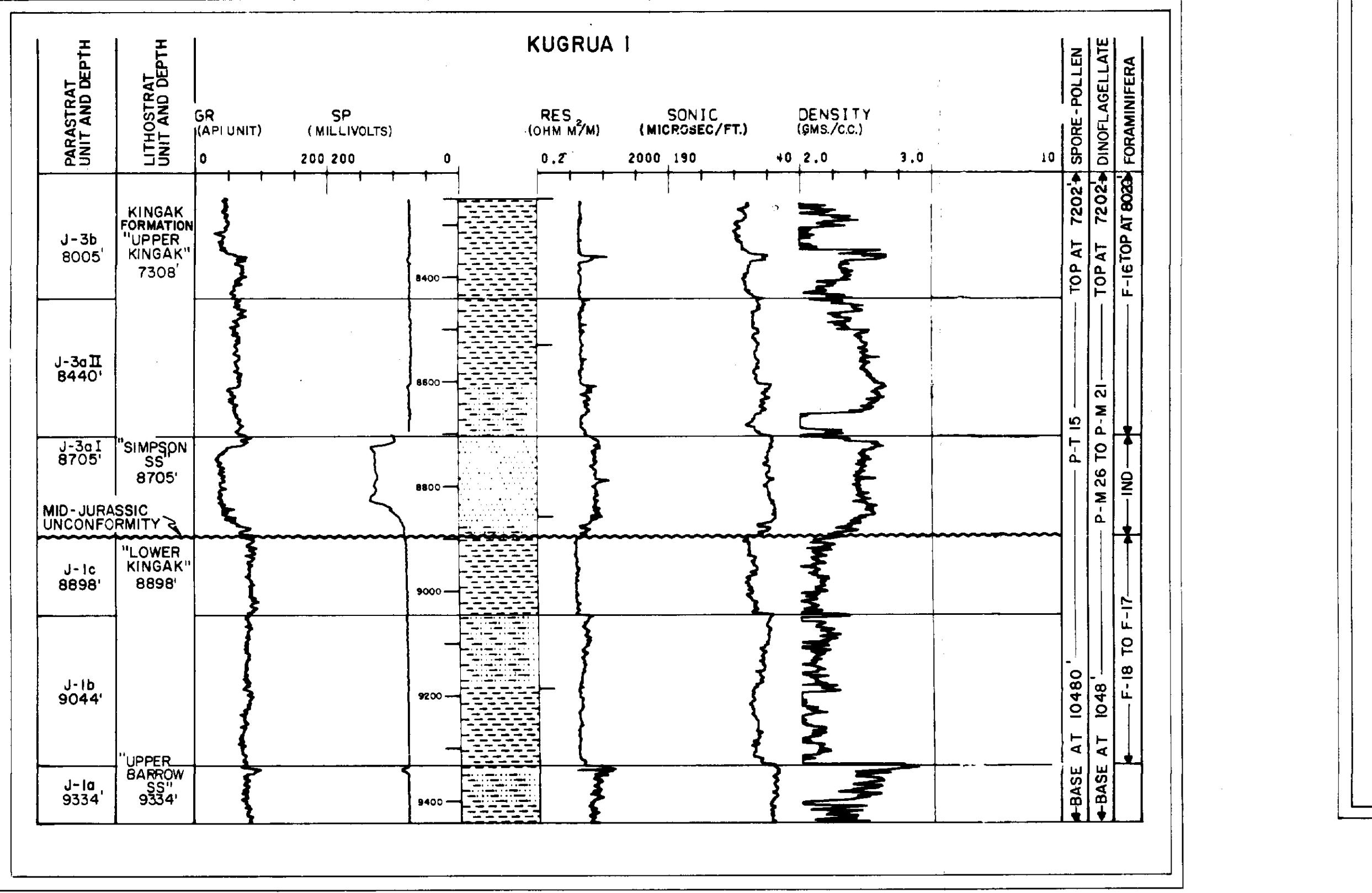
FIGURE 15

**FIGURE 76**

**TYPE LOG OF "SIMPSON SANDSTONE,"**  
**KUGRUA 1 AND SOUTH MEADE 1**

The "Simpson sandstone" was one of the targets at Kugrua 1, South Meade 1, Peard 1, Walakpa 1, and Kuyanak 1. It is a bar-like sandstone body restricted to the Meade Arch-Wainwright Arch area in the northwestern NPRA. The "Simpson" trends east-northeast, and is about 100 mi (161 km) long, 30 mi (48 km) wide, and 200 ft (61 m) thick.

Two representative sections of the "Simpson sandstone" are shown in this figure. The sandstone at Kugrua 1 is nearly a uniform sandstone with few shale breaks. At South Meade 1, the unit breaks into a relatively thin lower sandstone unit and a thicker upper sandstone unit. Regionally, the upper unit is more extensive than the lower unit.



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HOUSTON, TEXAS PASADENA, CALIFORNIA  
ENERGY MANAGEMENT DIVISION  
PETROLEUM EXPLORATION OF NPRA 1974-1981 (FINAL REPORT)

**TYPE LOG OF "SIMPSON SANDSTONE"**  
KUGRUA I AND S. MEADE I

**NPR** FOR **ONPRA**  
HUSKY OIL NPR OPERATIONS INC.

PROJECT MANAGER: J.W. BRUYNZEEL	PROJECT NO. TC-7174
INTERPRETATION BY: STAFF	REVISED
DATE: SEPT., 1981	DATE INITIAL
CONTOUR INT:	SCALE:
	DWG NO.

TETRA TECH REPORT NO.8200

TGZ-0170

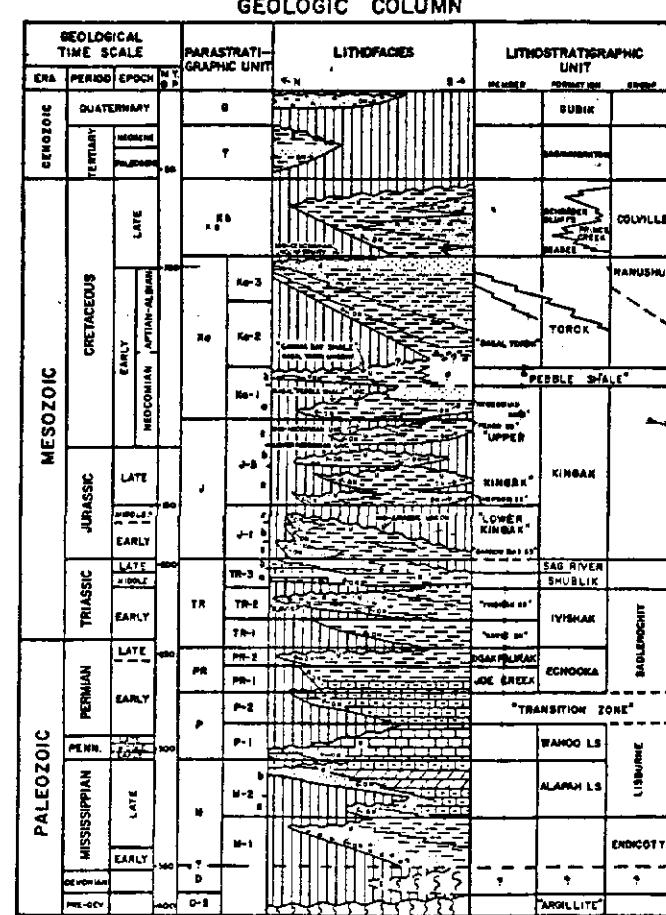
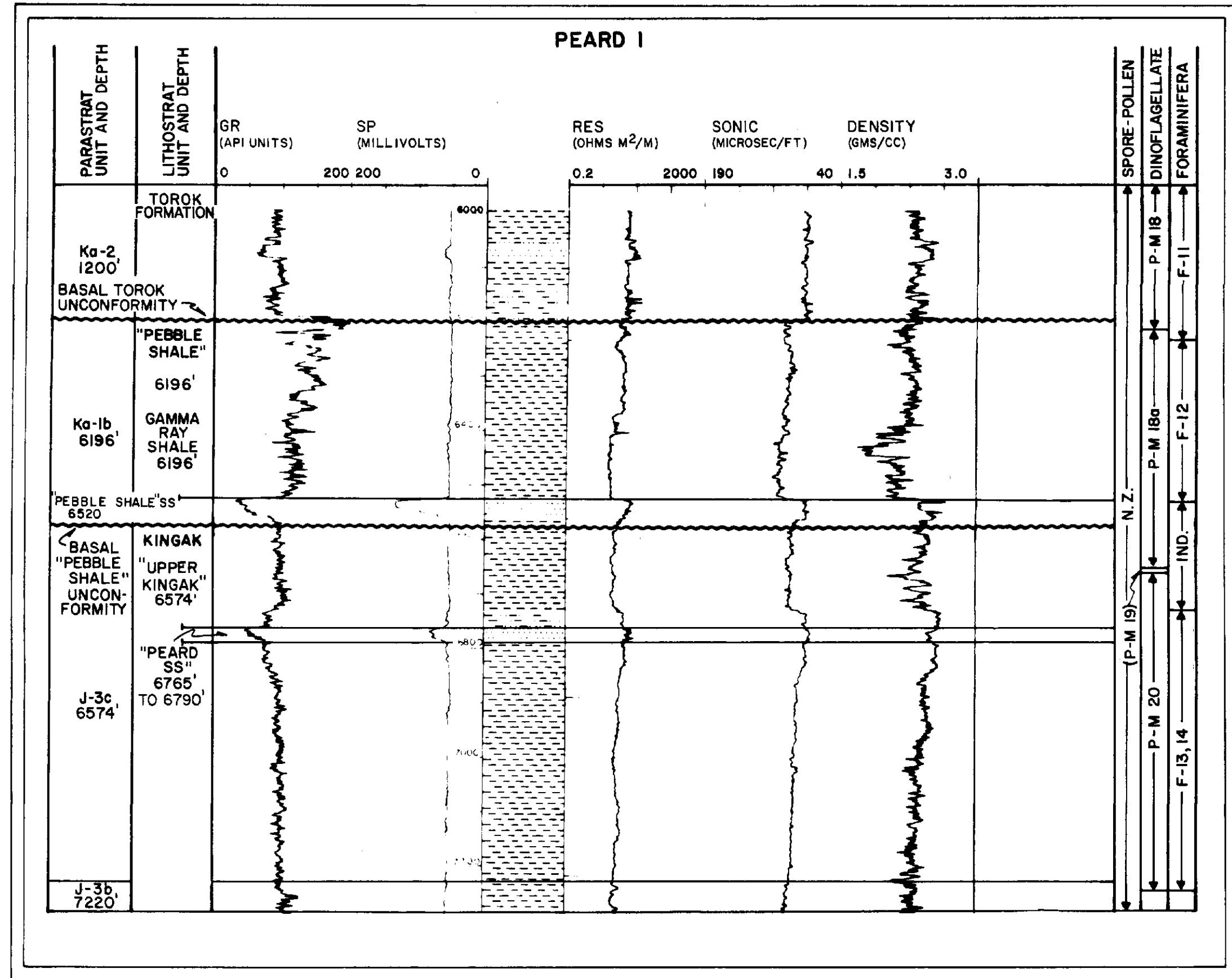
FIGURE 76

**FIGURE 77.**

**TYPE LOG OF "PEARD SANDSTONE,"**  
**PEARD 1**

This figure shows the thickest and most typical section of the "Peard sandstone" at Peard 1.

This thin (less than 100 ft, or 30 m) sandstone is present at both Peard 1 and Kugrua 1. The "Peard sandstone" may thicken toward the "Pebble Shale" truncation northward, below the Chukchi Sea.



**TETRA TECH, INC**  
HOUSTON, TEXAS ENERGY MANAGEMENT DIVISION PASADENA, CALIFORNIA

PETROLEUM EXPLORATION OF NPRA 1974-1981 (FINAL REPORT)

**TYPE LOG OF  
"PEARD SANDSTONE"  
PEARD I**

NPR	ALASKA
FOR	
<b>ONPRA</b> HUSKY OIL NPR OPERATIONS INC.	
PROJECT MANAGER: J. W. BRUYNZEEL	PROJECT NO. TC-7174
INTERPRETATION BY: STAFF	REVISED
DATE: SEPT., 1981	DATUM:
CONTOUR INT:	SCALE:
DWG NO.	

TETRA TECH REPORT NO. 8200

TGZ-0170

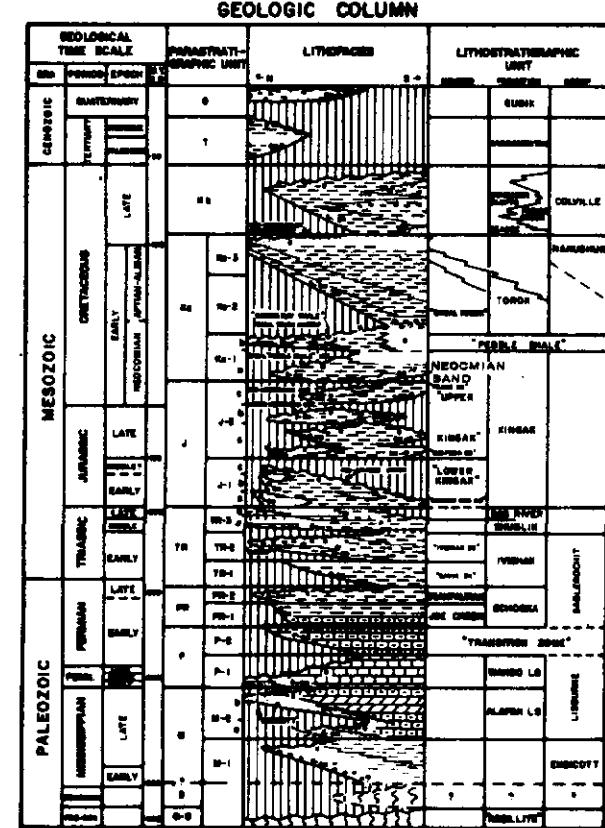
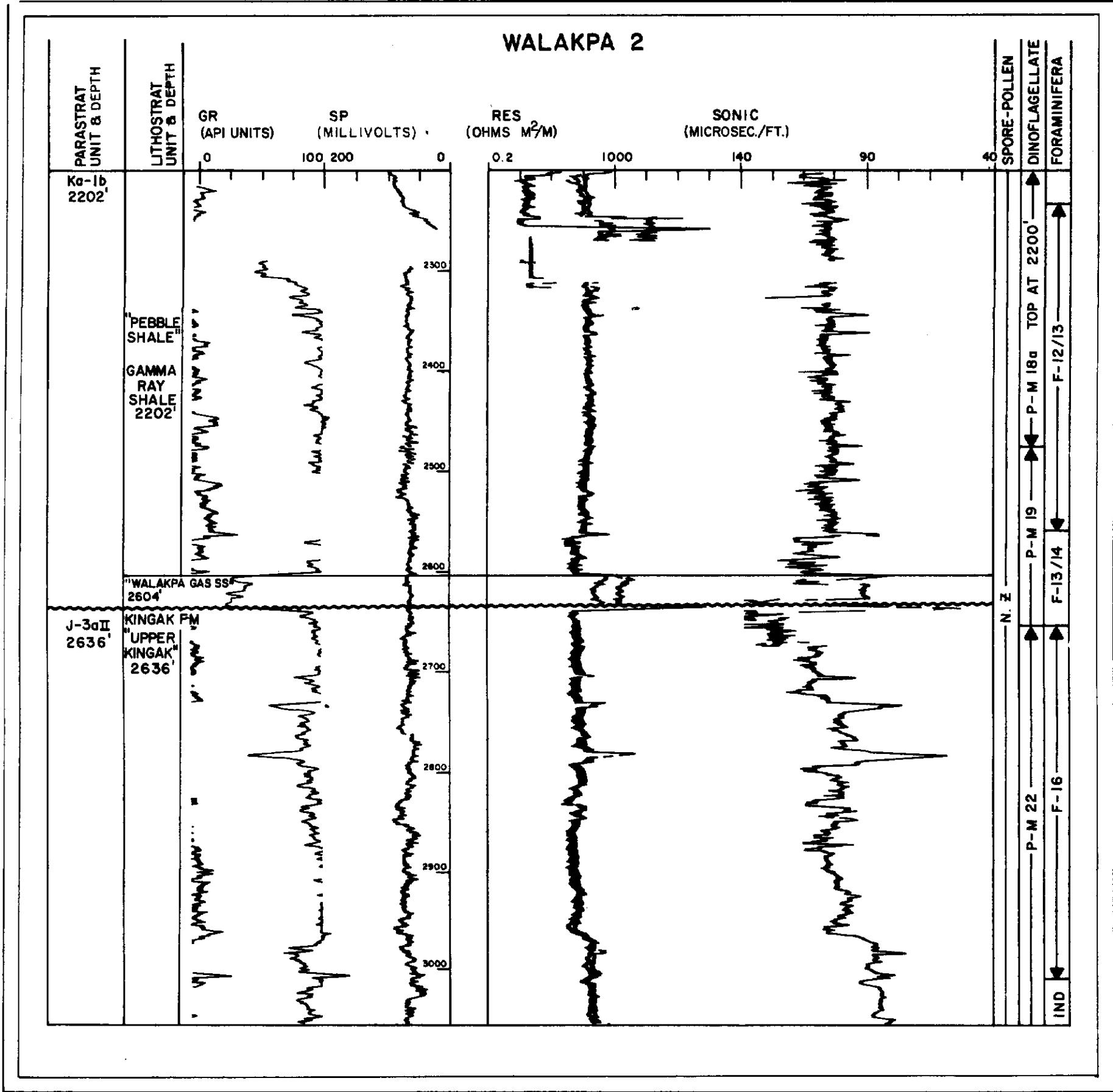
FIGURE 77

FIGURE 78

**TYPE LOG OF "WALAKPA GAS  
SANDSTONE," WALAKPA 2**

The "Walakpa gas sandstone," is present at Walakpa 1 and Walakpa 2 where it produces gas, and also at Kuyanak 1 where it was water-wet. This log segment is from Walakpa 2, which is typical of this gas-producing unit.

The "Walakpa gas sandstone" probably can be correlated to the "Pebble Shale" sandstone for two reasons. First, new section is added below, rather than above, the sandstone at Walakpa 2, which is a down-dip, step-out well. Second, biostratigraphic analysis indicates a Neocomian age, rather than an Oxfordian age, for rocks immediately on top of the sandstone.



**TETRA TECH, INC**  
HOUSTON, TEXAS      ENERGY MANAGEMENT DIVISION      PASADENA, CALIFORNIA

PETROLEUM EXPLORATION OF NPRA 1974-1981 (FINAL REPORT)

**TYPE LOG OF  
"WALAKPA GAS SANDSTONE"  
WALAKPA 2**

NPR	ALASKA
FOR <b>ONPRA</b> HUSKY OIL NPR OPERATIONS INC.	
PROJECT MANAGER: J. W. BRUYNZEEL	PROJECT NO. TC-7174
INTERPRETATION BY: STAFF	REVISED
DATE: SEPT, 1981	DATE INITIAL
CONTOUR INT:	SCALE:
DWG NO.	

TETRA TECH REPORT NO. 8200

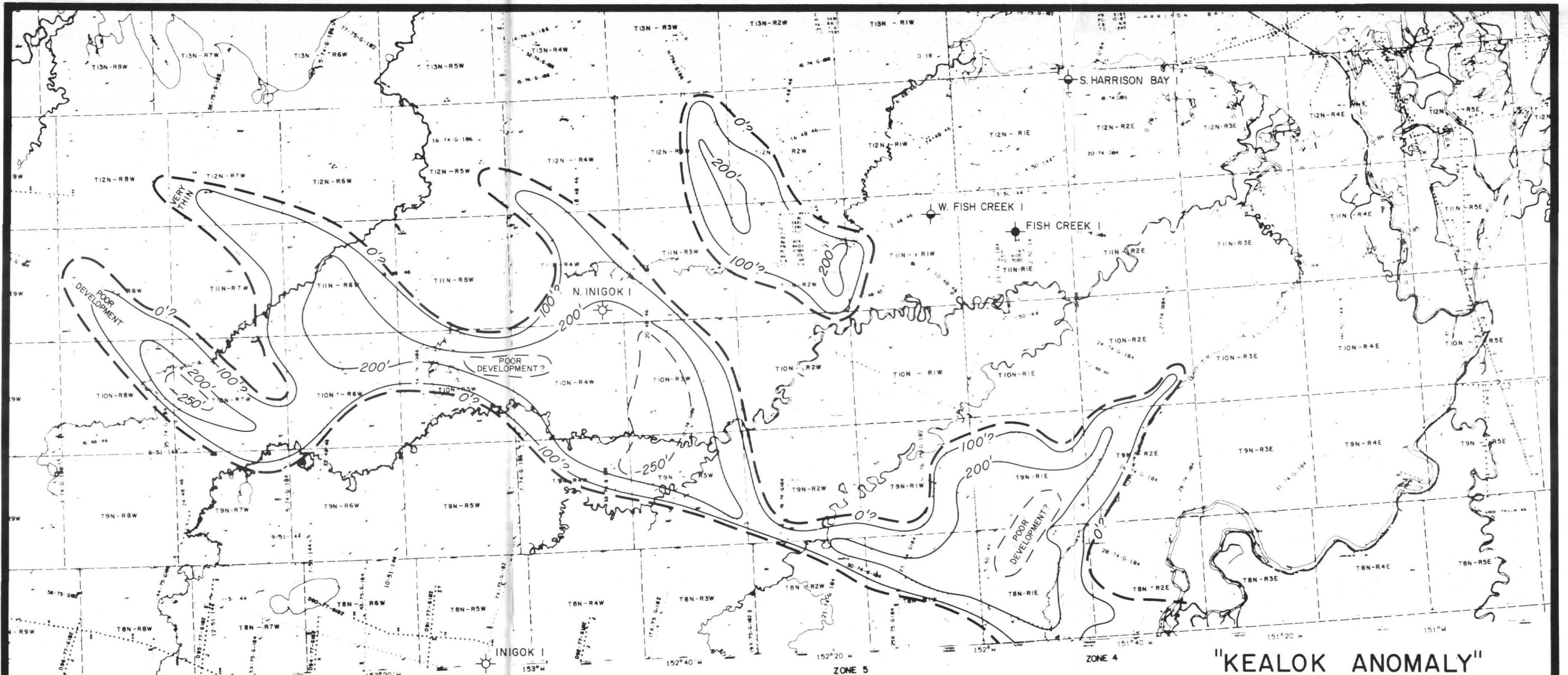
TGP-0170

FIGURE 78

**FIGURE 79**

**"KEALOK ANOMALY" ISOPACH WITHIN  
PARASTRATIGRAPHIC UNIT J-3B**

The "Kealok anomaly" isopach map resembles a map view of present sand islands off the Texas Gulf Coast, with relatively straight basinward (seaward) "strand lines" facing toward the southward and northward (lagoonward) projecting lobes. An "island" is shown in the vicinity of West Fish Creek 1.



"KEALOK ANOMALY"  
ISOPACH

WITHIN PARASTRATIGRAPHIC UNIT J-3b

C.I.: 100'

TGZ-0170 FIGURE 79

FIGURE 80

LINE 17-74-G-186, SHOTPOINTS 68-148

The Fish Creek Platform situated in the northeastern part of the NPRA is a large positive area trending southeasterly. Line 17-74, which extends northeasterly, shows this feature.

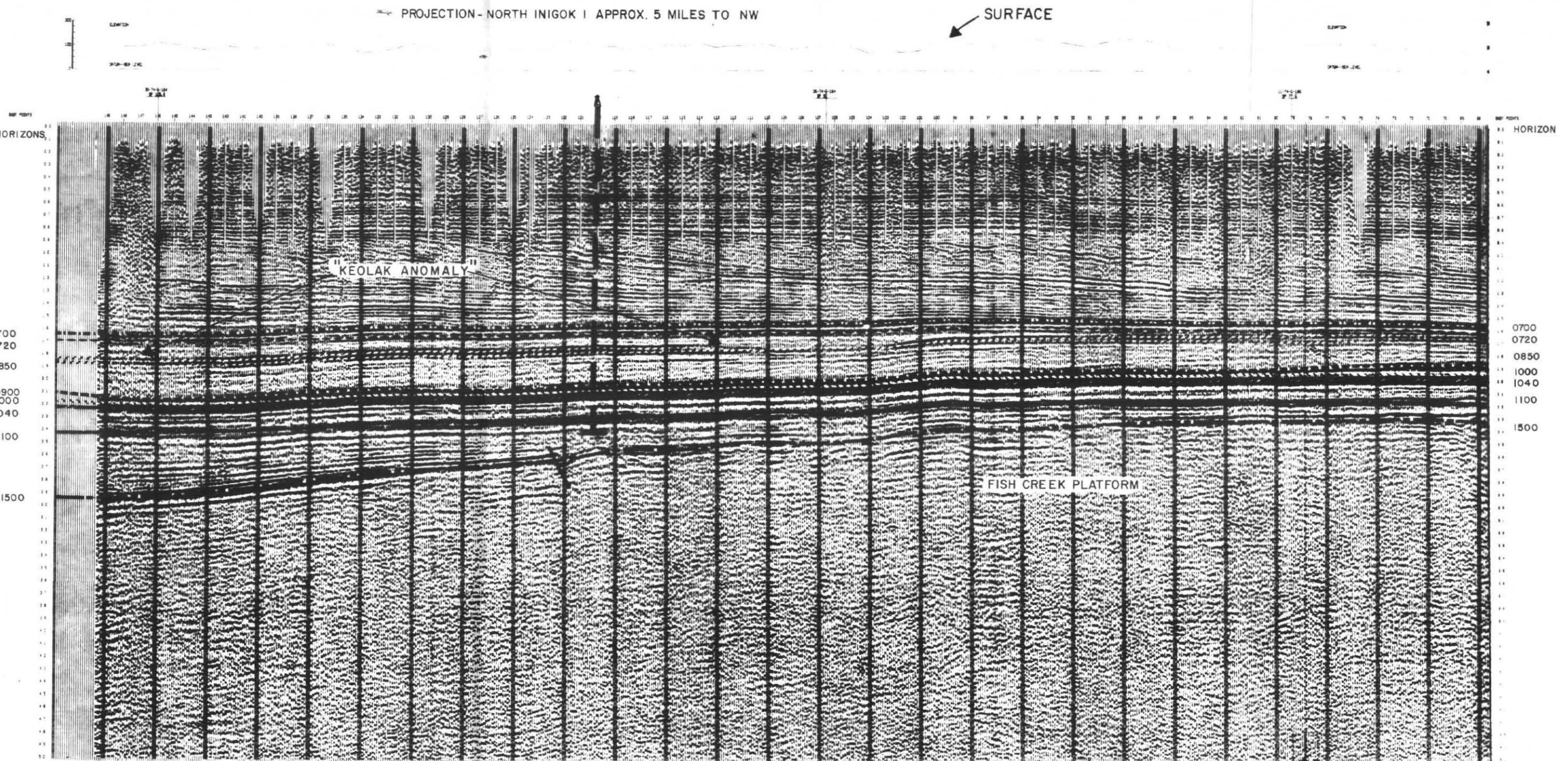
Horizon 0850 exhibits an east-west dip reversal off the southwest flank of the platform. Immediately overlying the southern portion of this reversal is a seismic event called the "Kealok anomaly." Seismic evidence for this is indicated by the development of a strong reflector immediately above horizon 0850 (shotpoints 113 to 149). This feature is composed of four lobes, totaling about 170 sq mi. North Inigok 1, drilled to test this anomaly, found a siltstone that produced a gas show.

NORTHEAST

LINE 17-74-G-186  
SHOTPOINTS 68 - 148  
AREA ZONE A  
LOCATION NAVAL PETROLEUM RESERVE NO. 4

DEPARTMENT OF THE NAVY

FIGURE 80



TETRA TECH REPORT NO 8200

TGZ-0170

FIGURE 81

LINE B20-78-G-1182, SHOTPOINTS 6-110,  
SCALED FINAL STACK

Line B20-78 is a northeasterly line on the Simpson Peninsula in the East Barrow and Teshekpuk Quadrangles. The Simpson canyon is the most prominent feature on this line. This submarine canyon was formed by erosion of the Nanushuk sediments with subsequent deposition of the younger Colville Group.

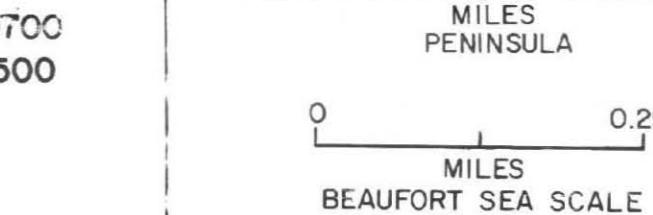
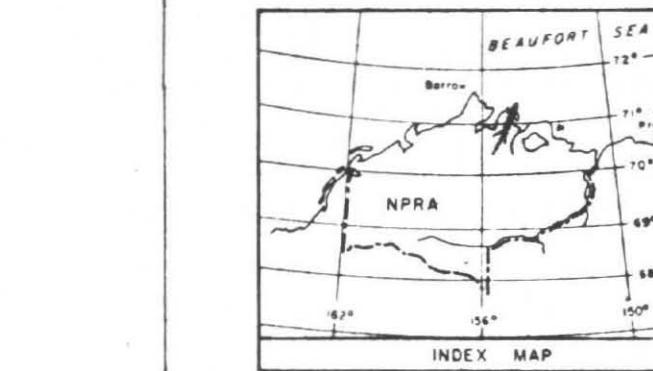
The Barrow Arch also is evident on this line. The relatively uniform regional southern dip that characterizes most horizons in the northern NPRA changes at the Barrow Arch to north-northeast regional dip. The Arch is an east-southeast trending structural feature lying mostly just offshore of the northeastern boundary of the Reserve. The northern limits of much of the pre-Cretaceous section are the result of either truncation by the basal "Pebble Shale" unconformity (horizon 0720) or onlap onto the Barrow Arch. Both are illustrated on this line.

B20-78-G-1182

SHOTPOINTS 6-110

SCALED FINAL STACK

FIGURE 81



TGZ-0170  
TETRA TECH REPORT NO. 8200

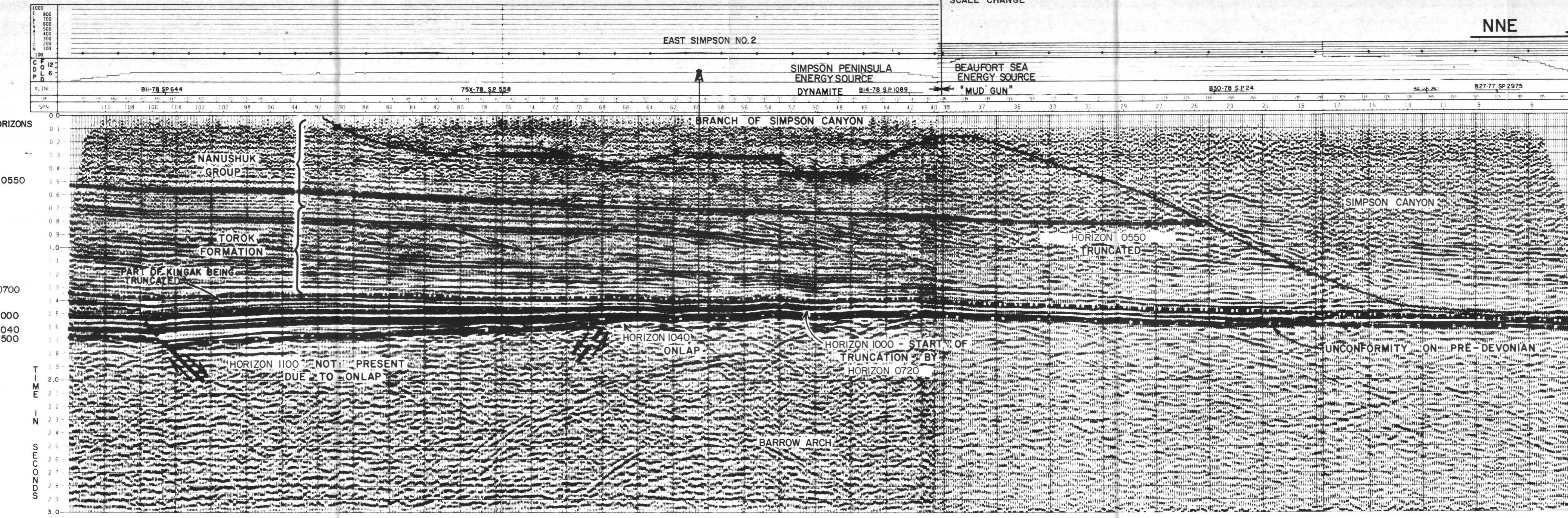
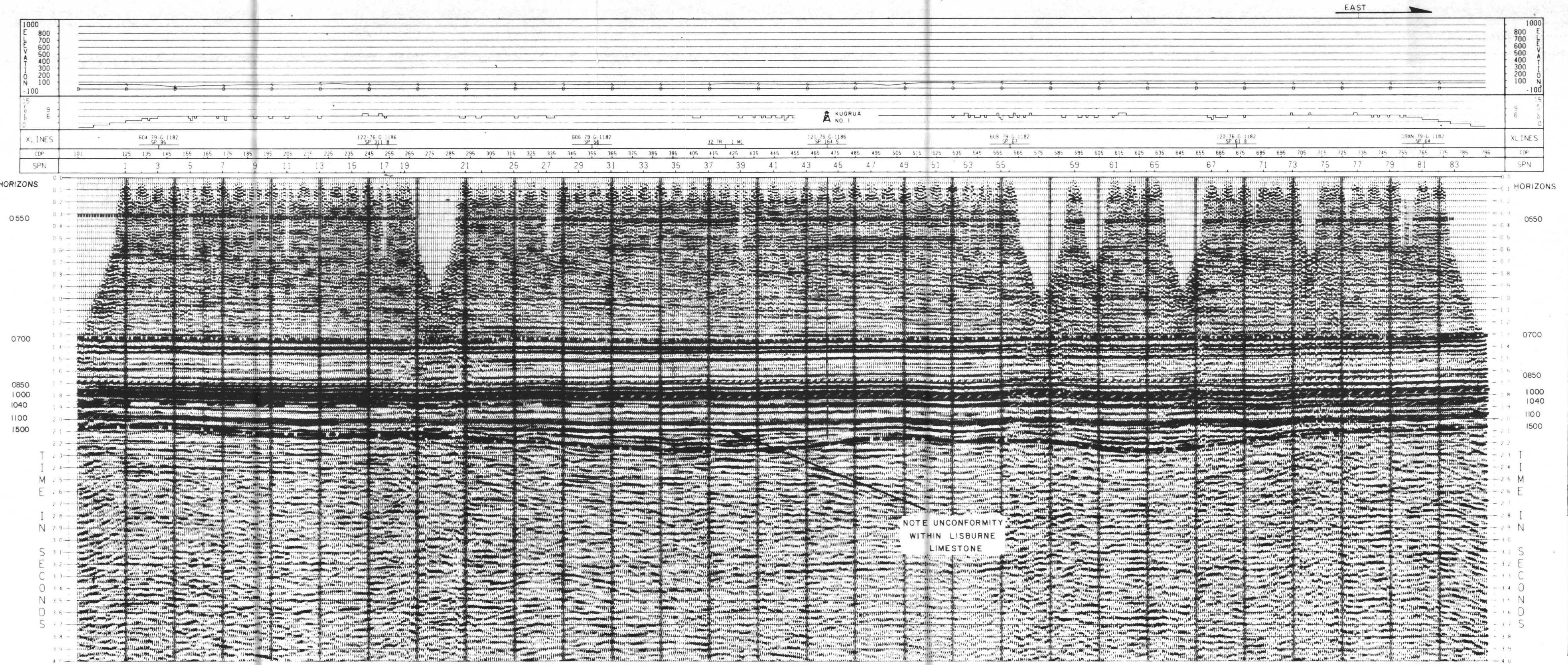


FIGURE 82

LINE 663-79-G-1182, SHOTPOINT 1-83,  
SCALED FINAL STACK

Seismic horizon 1100 approximates the top of the Paleozoic sediments in the NPRA. Line 663-79 in the northern part of the Meade and Wainwright Quadrangles is a good example of a potential stratigraphic trap at this level. This line, oriented east-west, extending from T14N-R25W to T14N-R28W, is just north of the Meade Basin and between the Wainwright and Meade Arches. A prominent unconformity is present at about 2.1 seconds (two-way time), and Paleozoic sediments are truncated between shotpoints 20 and 71.



USGS  
ONPRA

HUSKY OIL NPR OPRS . INC  
NATIONAL PETROLEUM RESERVE ALASKA  
NORTH COASTAL PLAINS AREA

663-79-G-1182

SHOTPOINTS 1-8

### -SCALED FINAL STACK

**FIGURE 8**

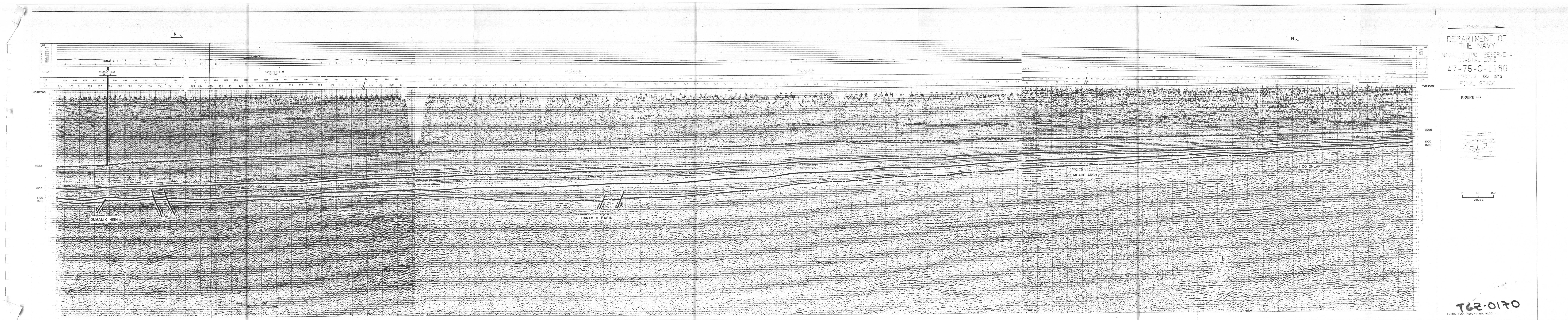


TG2-017

**FIGURE 83**

**LINE 47-75-G-1186, SHOTPOINTS**  
**105-375, FINAL STACK**

Line 47-75 is a long north-south line through the central NPRA. It crosses the Oumalik High in the south and the Meade Arch in the north. The Oumalik structure is a basement feature showing many faults in the deeper levels. No seismic horizons exhibit onlap onto this feature, but thinning over the high is seen, especially in the deeper intervals (horizons 1000 to 1500). Northward along this line from the Oumalik High, a small basin interrupts the continued northward shallowing and thinning of the section along the Meade Arch. As the line approaches the Barrow Area, the continued shallowing of horizon 1500 results in onlap terminations of shallower horizons.

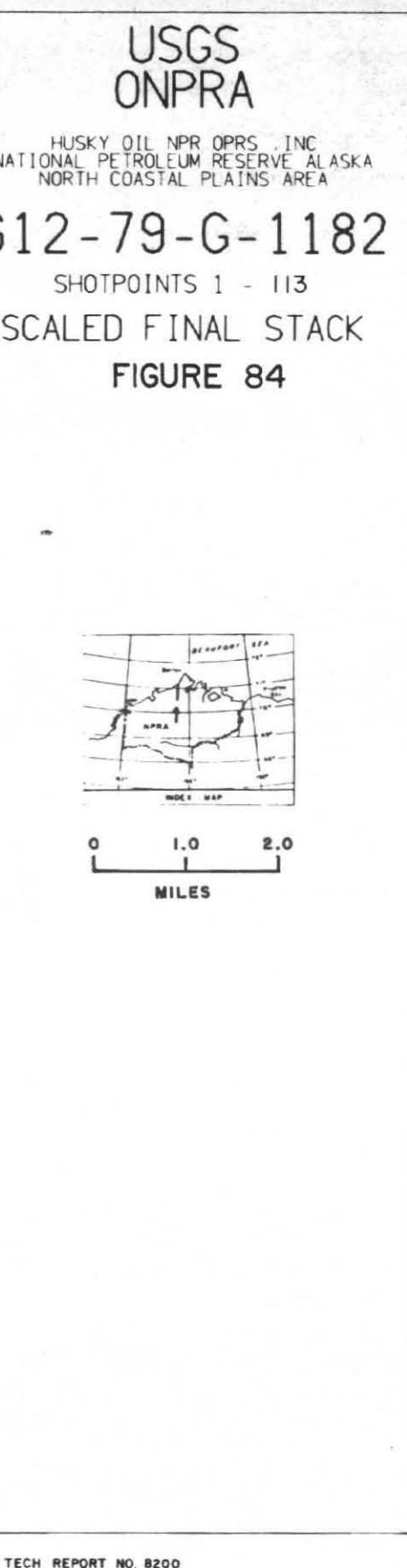
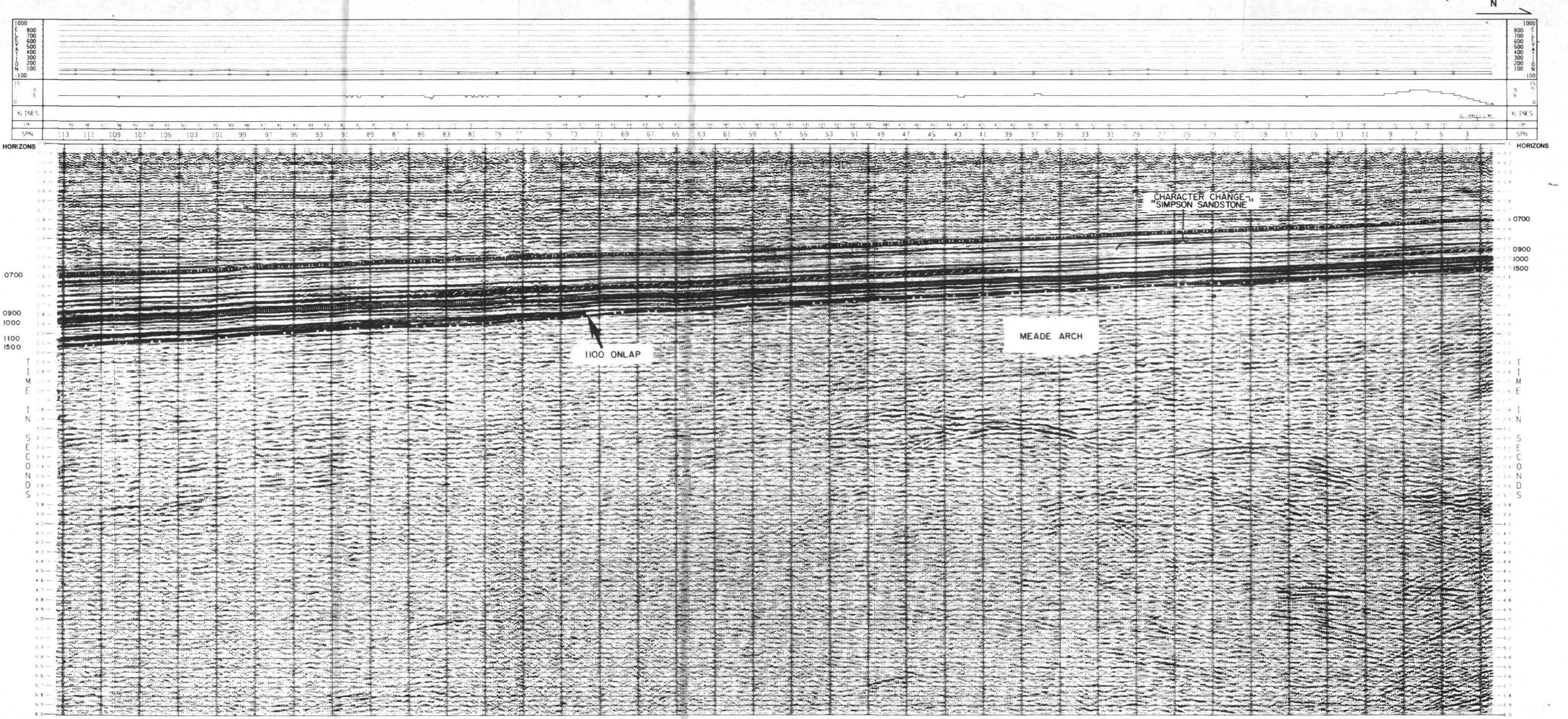


**FIGURE 84**

**LINE 612-79-G-1182, SHOTPOINTS 1-113,  
SCALED FINAL STACK**

The Jurassic Kingak Shale contains several interbedded sandstone units. Of these, the "Simpson sandstone" seems to be the thickest and most widespread. The regional south dip of this unit terminates to the north where it is truncated by the basal "Pebble Shale" unconformity near the Barrow High. Line 612-79, extending north-south in the center portion of the Meade River Quadrangle, shows a character change in the "Simpson sandstone" level near shotpoint 25. This is interpreted to be a facies change to the north from sandstone to shale or siltstone.

NORTH



TETRA TECH REPORT NO. 8200

T62-0170