Petroleum Potential of the Arctic Offshore of Alaska

Geophysical Society of Alaska

Anchorage, AK

Kirk Sherwood

Geologist, MMS

April 6, 2006

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Colleagues Sharing Blame

Beaufort Sea Assessment: Peter Johnson & Jim Scherr

Economic Assessment: Jim Craig, Larry Cooke, & Cameron Reitmeier

HQ Computer Model Guys: Barry Dickerson & John Buffington

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Outline

- Petroleum-rich Arctic Alaska offshore province
- MMS Assessment method
- Economic assessment results for Arctic offshore

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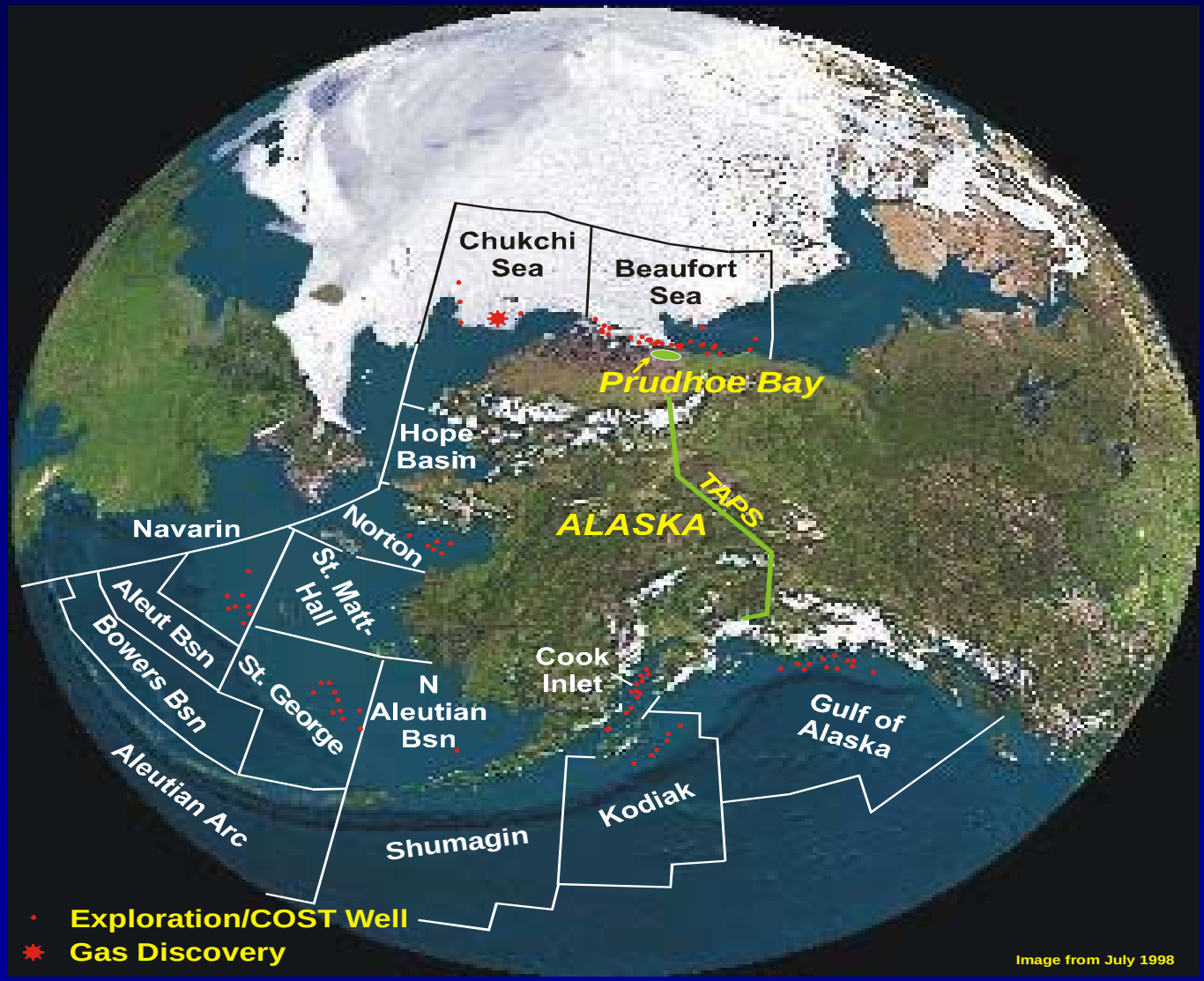
Arctic Offshore = Chukchi & Beaufort Sea Planning Areas

Arctic AK Petroleum Province = North Slope & Offshore Shelves



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Beaufort & Chukchi Seas

2006 Undiscovered Oil and Gas

Risked, Technically Recoverable

Commodity	>95 % chance	**MEAN**	> 5 % chance
Gas (Trillion Cubic Feet)	**11.0**	**104.4**	**281.7**
Oil (billion barrels)	**2.7**	**23.6**	**63.3**

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Yr 2000: 92.2 Tcfg + 22.4 Bbo

The Arctic Offshore Accounts For:

- **79% of Alaska Offshore Gas & 89% of Alaska Offshore Oil (2006-Undiscovered)**
- **Offshore has 39% of Total Arctic AK Endowment (117 Bboe)***

***Northern Alaska "Endowment", 46.6 Bbo + 139 Tcfg** = 71.3 Bboe**
Arctic Offshore "Endowment", 24.7 Bbo + 118 Tcfg = 45.7 Bboe
** Undiscovered + Discovered EUR, D.W. Houseknecht, 2006, pers. comm., State AK DOG, 2004

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Why is Arctic Offshore So Rich?

<u>Reason #1:</u> Geological continuity with highly successful northern Alaska petroleum province

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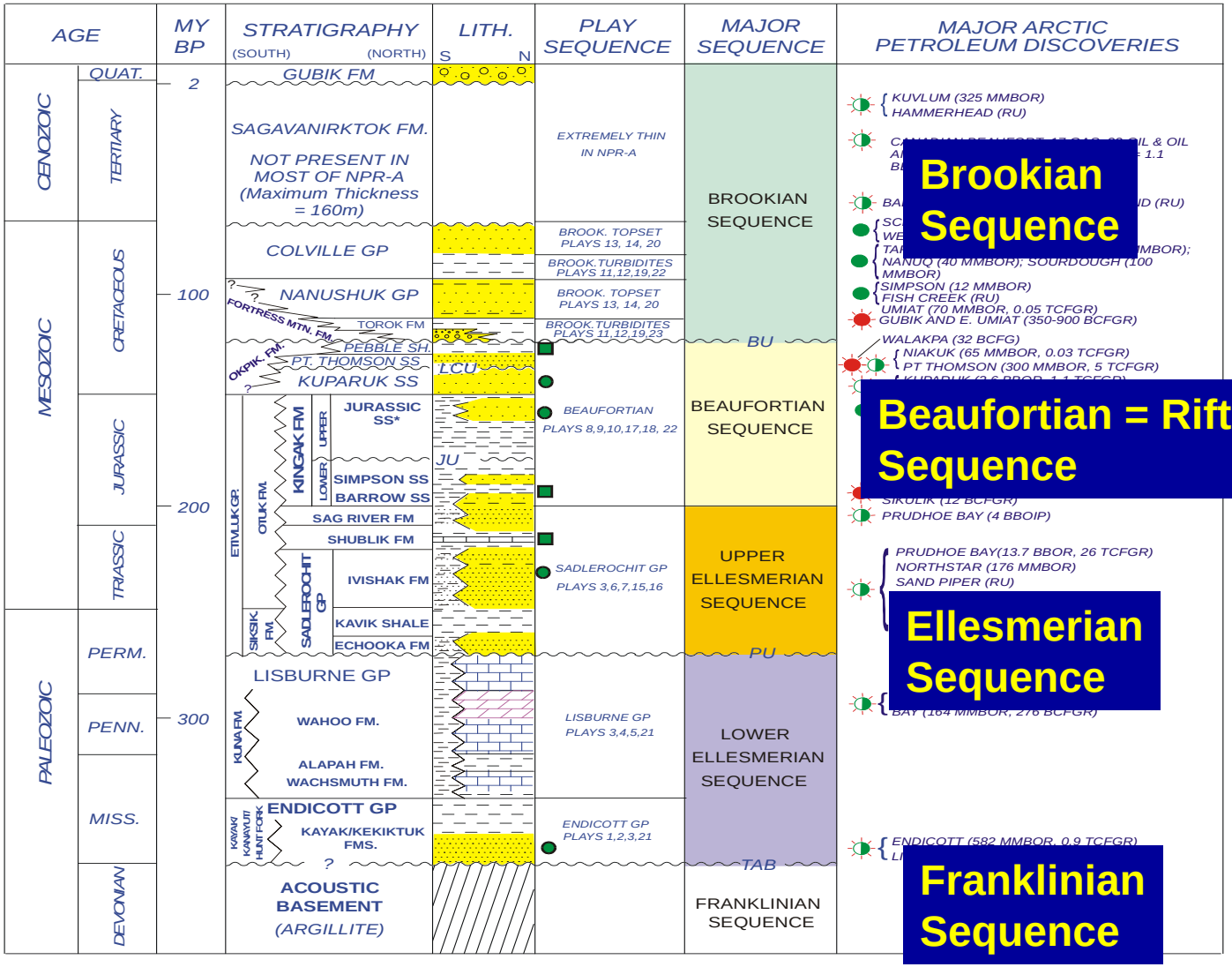
Stratigraphic Continuity Across Arctic Alaska & OCS

CHUKCHI SEA, BEAUFORT SEA, ARCTIC ALASKA

STRATIGRAPHIC COLUMN



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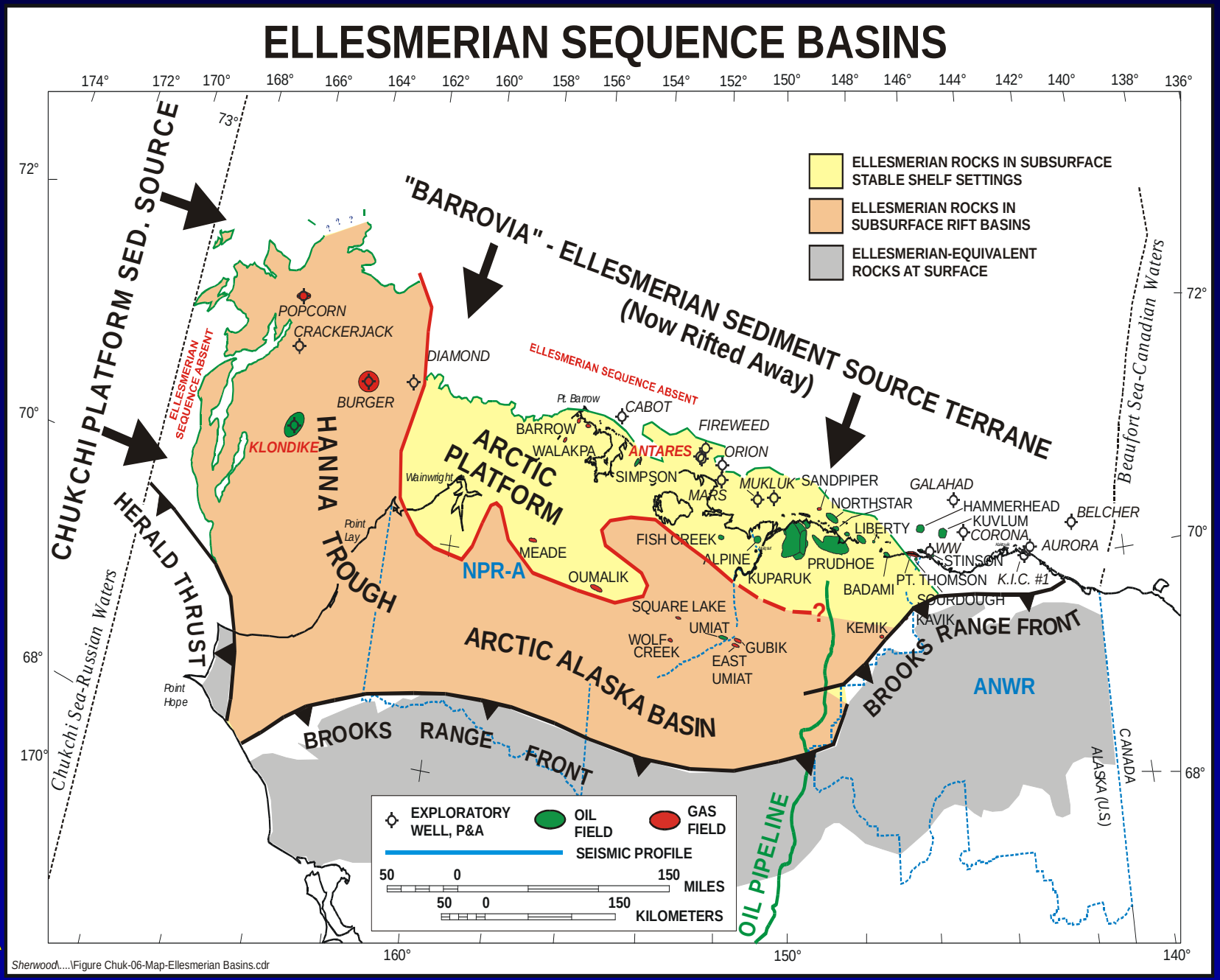
ELLESMERIAN SEQUENCE BASINS



Sherwood\....\Figure Chuk-06-Map-Ellesmerian Basins.cdr

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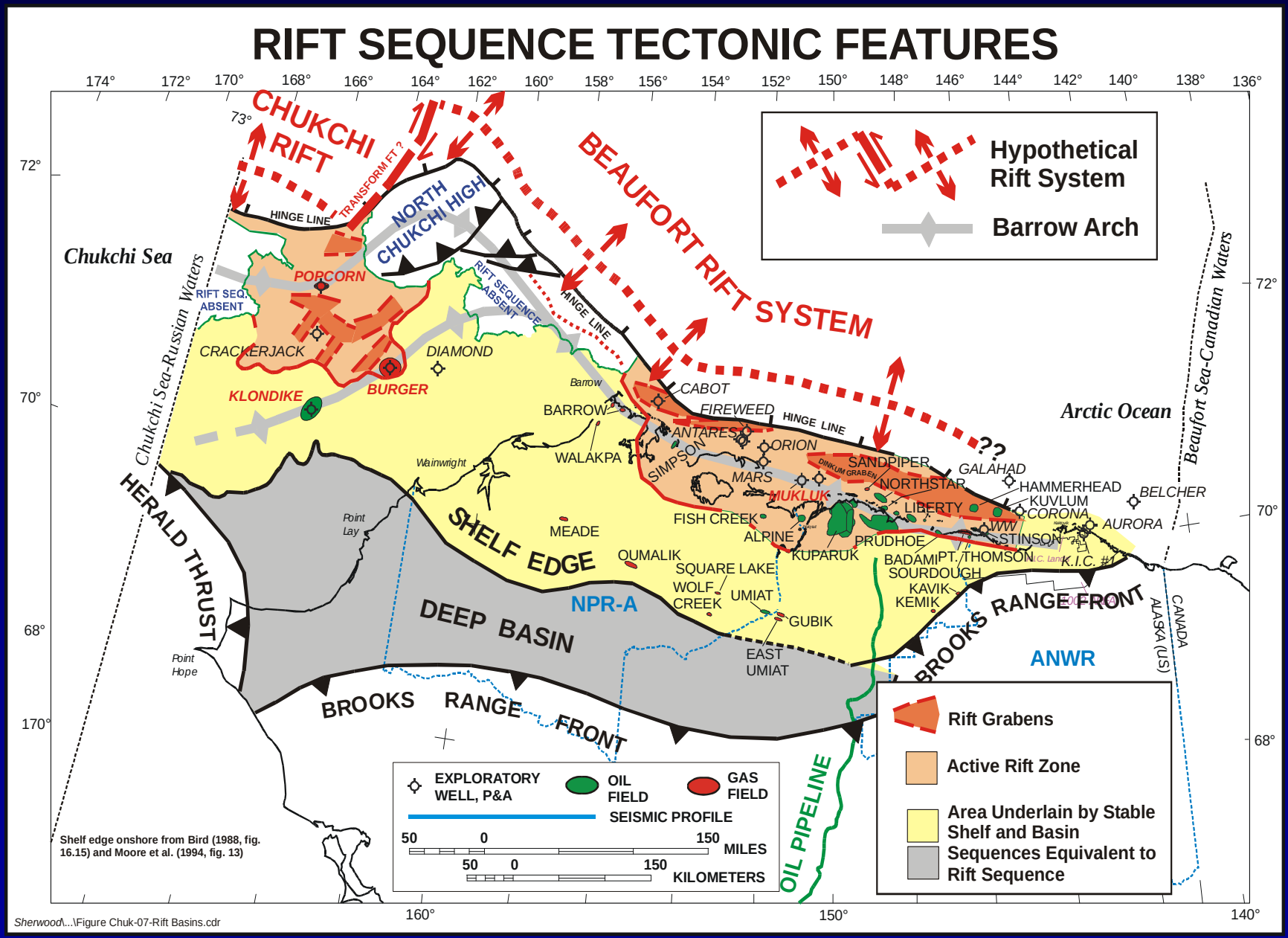
RIFT SEQUENCE TECTONIC FEATURES



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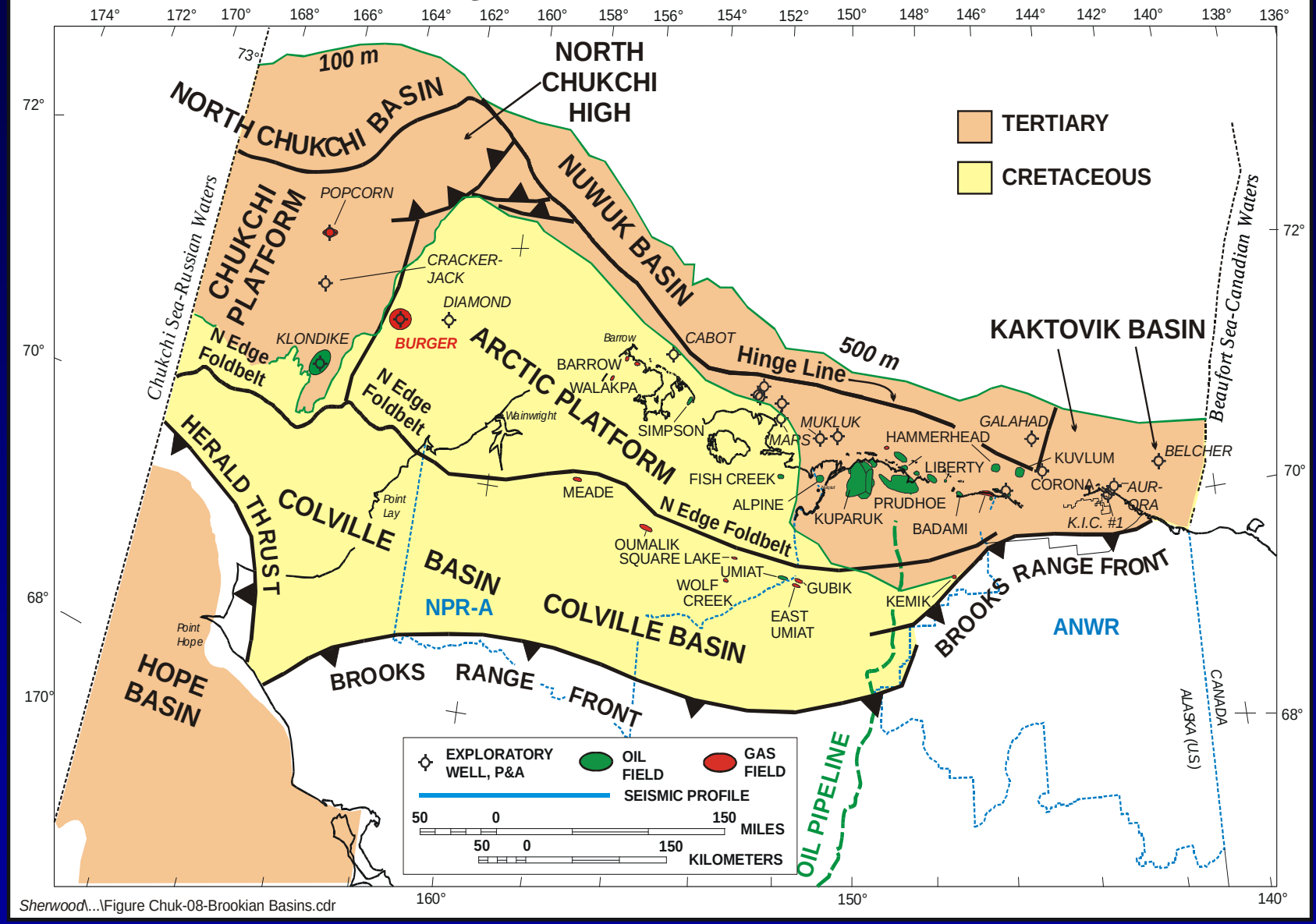
BROOKIAN SEQUENCE BASINS AND PLATFORMS



Sherwood\...\Figure Chuk-08-Brookian Basins.cdr

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Why So Rich?

<u>Reason #2:</u> Presence of many complex structures which created numerous potential traps

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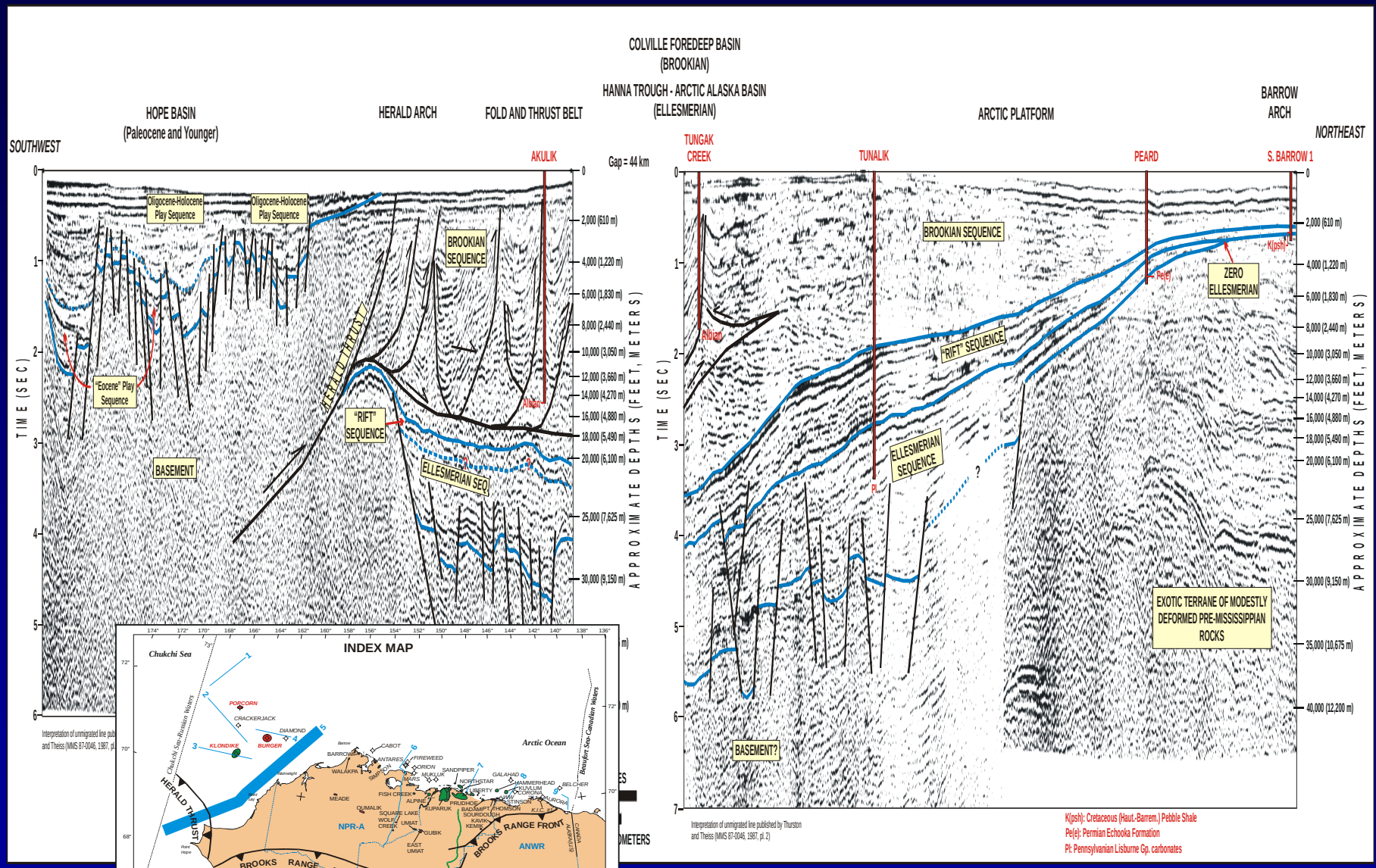
LINE 5


COLVILLE FOREDEEP BASIN
(BROOKIAN)
HANNA TROUGH - ARCTIC ALASKA BASIN
(ELLESMERIAN)
HOPE BASIN
(Paleocene and Younger)
HERALD ARCH
FOLD AND THRUST BELT
ARCTIC PLATFORM
BARROW ARCH
SOUTHWEST
NORTHEAST
AKULIK
Gap = 44 km
TUNGAK CREEK
TUNALIK
PEARD
S. BARROW 1
Oligocene-Holocene Play Sequence
Oligocene-Holocene Play Sequence
BROOKIAN SEQUENCE
"Eocene" Play Sequence
HERALD THRUST
"RIFT" SEQUENCE
BASEMENT
ELLESMERIAN SEQ
ELLESMERIAN SEQUENCE
ZERO ELLESMERIAN
EXOTIC TERRANE OF MODESTLY DEFORMED PRE-MISSISSIPPIAN ROCKS
BASEMENT?
TIME (SEC)
APPROXIMATE DEPTHS (FEET, METERS)
2,000 (610 m)
4,000 (1,220 m)
6,000 (1,830 m)
8,000 (2,440 m)
10,000 (3,050 m)
12,000 (3,660 m)
14,000 (4,270 m)
16,000 (4,880 m)
18,000 (5,490 m)
20,000 (6,100 m)
25,000 (7,625 m)
30,000 (9,150 m)
35,000 (10,675 m)
40,000 (12,200 m)
INDEX MAP
Chukchi Sea
Arctic Ocean
Beaufort Sea-Canadian Waters
PORCORN
CRACKERJACK
DIAMOND
KLONDIKE
BURGER
BARROW
CABOT
ANTARES
FIREWEED
ORION
WALAKPA
SANDPIPER
GALAHAD
MUKLUK
NORTHSTAR
HAMMERHEAD
KAUKLUM
CORONA
LIBERTY
BELCHER
MEADE
FISH CREEK
ALPINE
PRUDHOE
KUPARUK
BADAMI
SOURDOUGH
KAVIK
KEMIK
THOMSON
KUPARUK
AURORA
QUMALIK
SQUARE LAKE
WOLF CREEK
UMIAT
GUBIK
EAST UMIAT
NPR-A
ANWR
BROOKS RANGE FRONT
HERALD THRUST
OIL PIPELINE
CANADA
ALASKA
EXPLORATORY WELL, P&A
OIL FIELD
GAS FIELD
SEISMIC PROFILE
MILES
KILOMETERS
Interpretation of unmigrated line published by Thurston and Theiss (MMS 87-0046, 1987, pl. 2)
K(psh): Cretaceous (Haut.-Barrem.) Pebble Shale
Pe(e): Permian Echooka Formation
Pl: Pennsylvanian Lisburne Gp. carbonates

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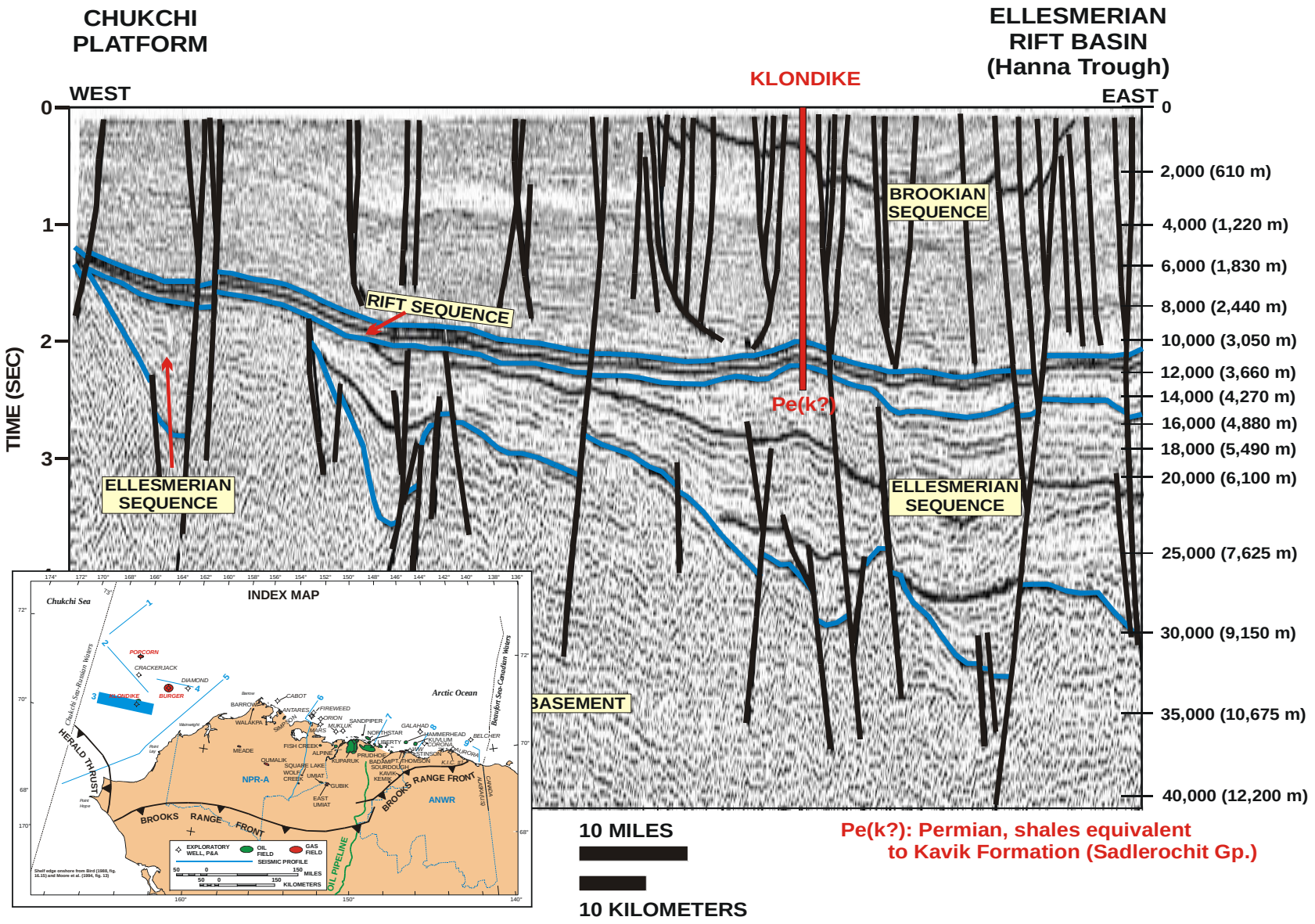
LINE 3


CHUKCHI PLATFORM
ELLESMERIAN RIFT BASIN (Hanna Trough)
KLONDIKE
WEST
EAST
TIME (SEC)
0
1
2
3
RIFT SEQUENCE
BROOKIAN SEQUENCE
ELLESMERIAN SEQUENCE
ELLESMERIAN SEQUENCE
Pe(k?)
BASEMENT
2,000 (610 m)
4,000 (1,220 m)
6,000 (1,830 m)
8,000 (2,440 m)
10,000 (3,050 m)
12,000 (3,660 m)
14,000 (4,270 m)
16,000 (4,880 m)
18,000 (5,490 m)
20,000 (6,100 m)
25,000 (7,625 m)
30,000 (9,150 m)
35,000 (10,675 m)
40,000 (12,200 m)
APPROXIMATE DEPTHS (FEET, METERS)
INDEX MAP
Chukchi Sea
Arctic Ocean
Beaufort Sea-Canadian Waters
Chukchi Sea-Russian Waters
HERALD THRUST
BROOKS RANGE FRONT
NPR-A
ANWR
OIL PIPELINE
EXPLORATORY WELL, P&A
OIL FIELD
GAS FIELD
SEISMIC PROFILE
10 MILES
10 KILOMETERS
Pe(k?): Permian, shales equivalent to Kavik Formation (Sadlerochit Gp.)

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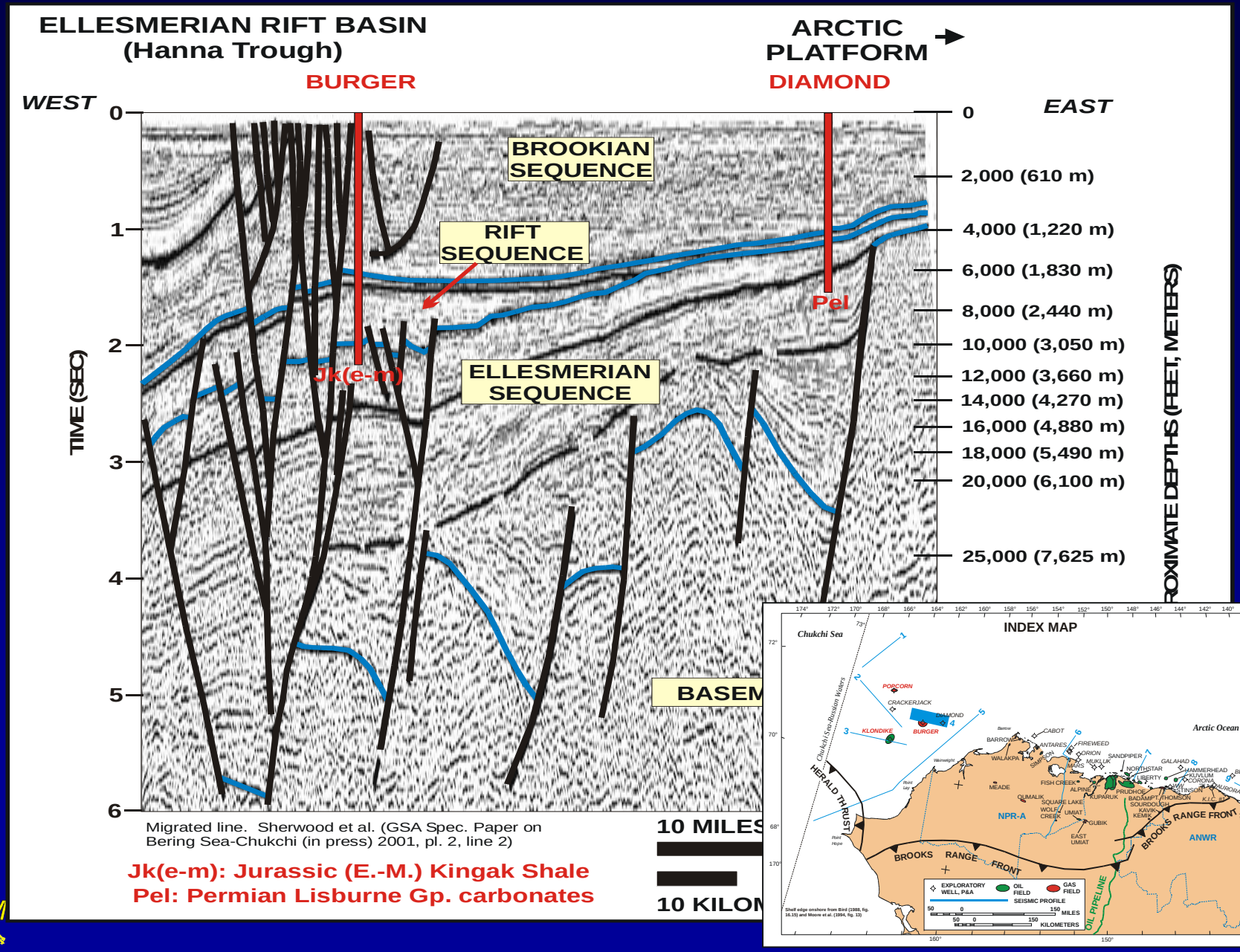
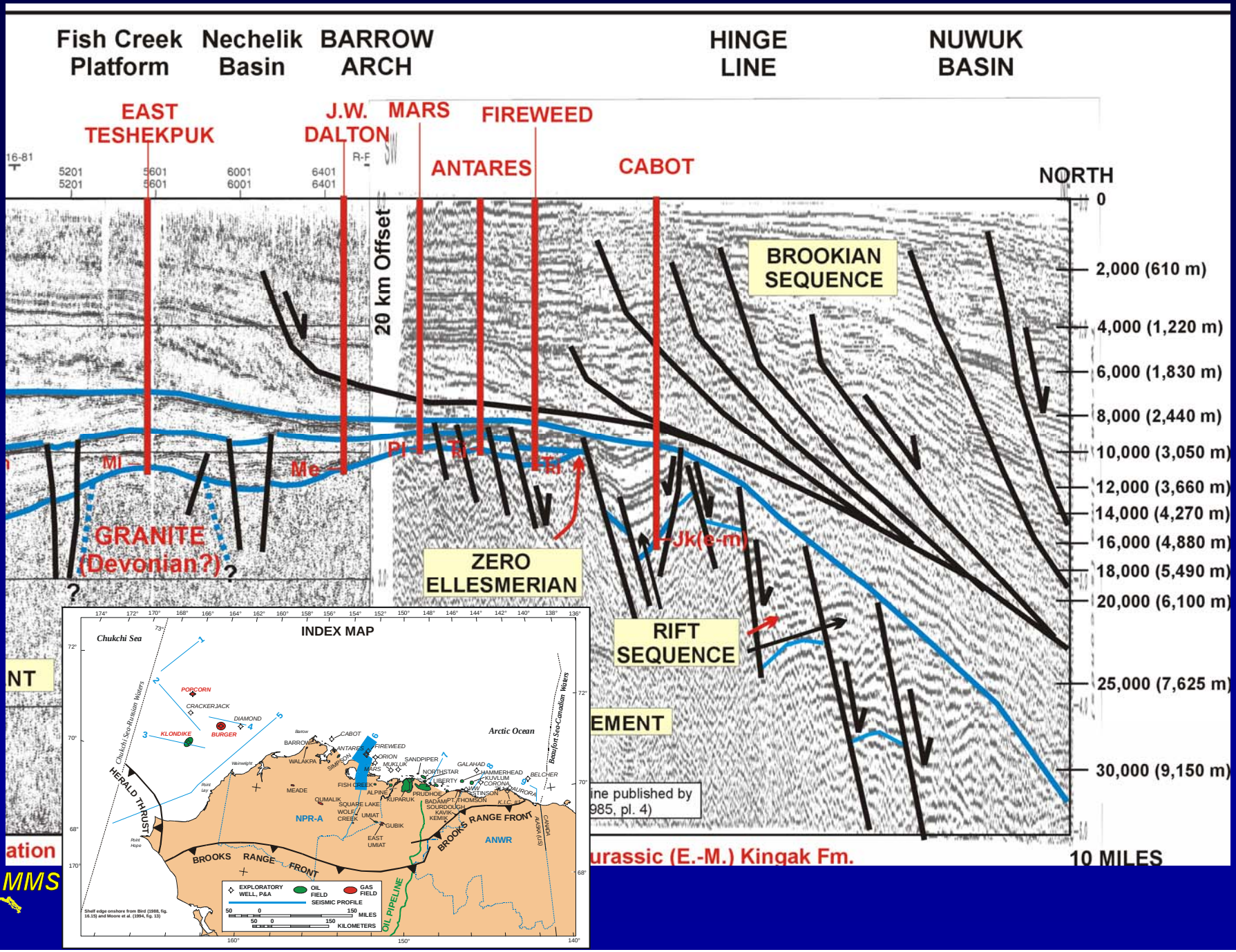
LINE 4



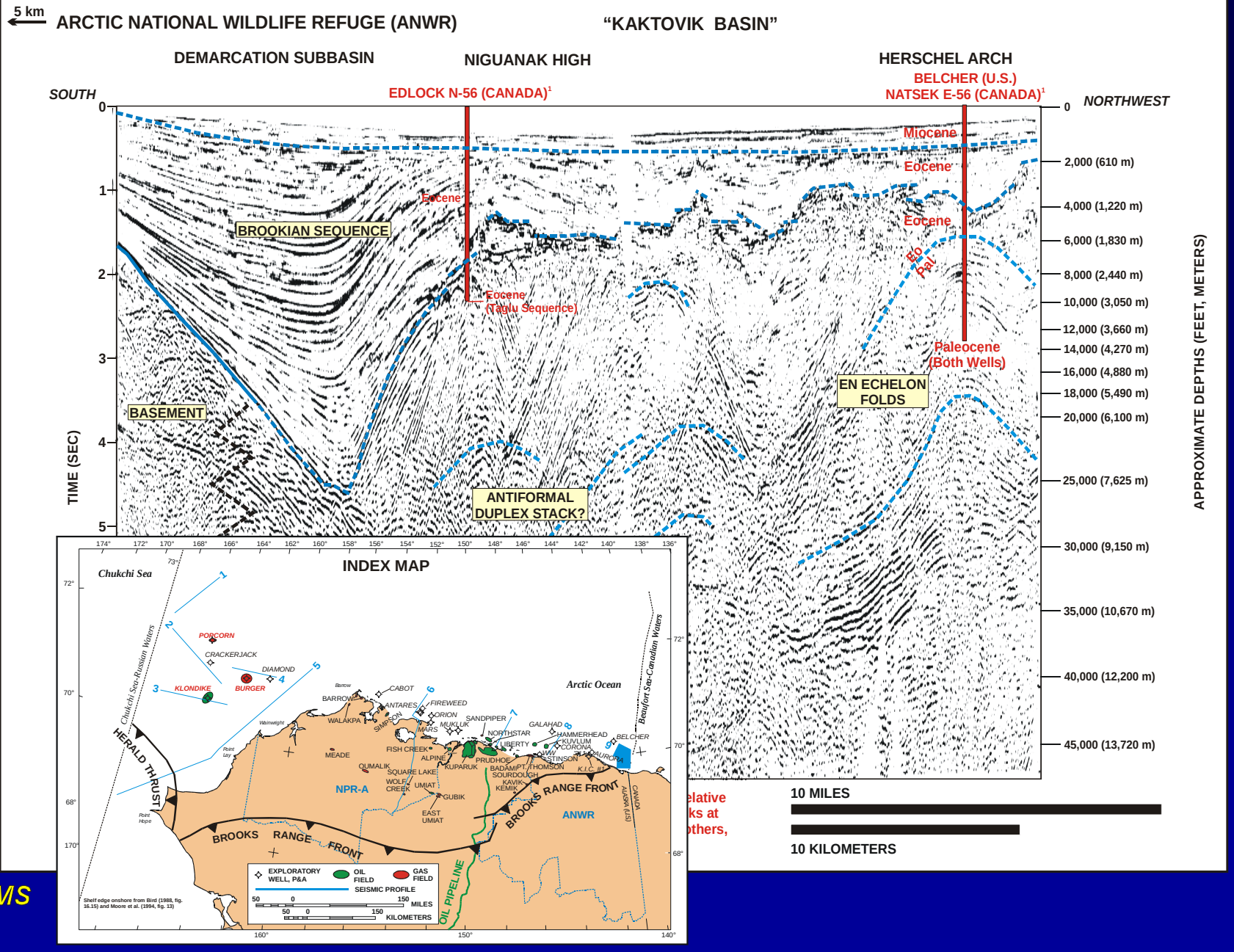
Migrated line. Sherwood et al. (GSA Spec. Paper on Bering Sea-Chukchi (in press) 2001, pl. 2, line 2)

Jk(e-m): Jurassic (E.-M.) Kingak Shale

Pel: Permian Lisburne Gp. carbonates


Fish Creek Platform
Nechelik Basin
BARROW ARCH
HINGE LINE
NUWUK BASIN
EAST TESHEKPUK
J.W. DALTON
MARS
FIREWEED
ANTARES
CABOT
NORTH
0
2,000 (610 m)
4,000 (1,220 m)
6,000 (1,830 m)
8,000 (2,440 m)
10,000 (3,050 m)
12,000 (3,660 m)
14,000 (4,270 m)
16,000 (4,880 m)
18,000 (5,490 m)
20,000 (6,100 m)
25,000 (7,625 m)
30,000 (9,150 m)
20 km Offset
BROOKIAN SEQUENCE
RIFT SEQUENCE
ZERO ELLESMERIAN
GRANITE (Devonian?)
MI
Me
Pl
Tl
Tb
J-Jk(e-m)
INDEX MAP
Chukchi Sea
Arctic Ocean
Chukchi Sea-Russian Waters
Beaufort Sea-Canadian Waters
PORCORN
CRACKERJACK
DIAMOND
KLONDIKE
BURGER
BARROW
WALAKPA
SIMPSON
MEADE
FISH CREEK
ALPINE
KUPARUK
PRUDHOE
NORTHSTAR
SANDPIPER
MUKLUK
ORION
GALAHAD
HAMMERHEAD
KUVLUM
CORONA
AURORA
BELCHER
LIBERTY
BADAMI
PT. THOMSON
SOURDOUGH
KAVIK
KEMIK
K.I.C. #1
QUMALIK
SQUARE LAKE
WOLF CREEK
UMIAT
GUBIK
EAST UMIAT
NPR-A
ANWR
HERALD THRUST
BROOKS RANGE FRONT
OIL PIPELINE
EXPLORATORY WELL, P&A
OIL FIELD
GAS FIELD
SEISMIC PROFILE
MILES
KILOMETERS
Shelf edge onshore from Bird (1988, fig. 16.15) and Moore et al. (1994, fig. 13)
ine published by
985, pl. 4)
urassic (E.-M.) Kingak Fm.
10 MILES
MMS

LINE 9


5 km
ARCTIC NATIONAL WILDLIFE REFUGE (ANWR)
"KAKTOVIK BASIN"
DEMARCATION SUBBASIN
NIGUANAK HIGH
HERSCHEL ARCH
SOUTH
NORTHWEST
EDLOCK N-56 (CANADA)1
BELCHER (U.S.)
NATSEK E-56 (CANADA)1
TIME (SEC)
APPROXIMATE DEPTHS (FEET, METERS)
Miocene
Eocene
Eocene
Eocene
Eocene
(Tuktu Sequence)
Paleocene
(Both Wells)
BROOKIAN SEQUENCE
BASEMENT
EN ECHELON
FOLDS
ANTIFORMAL
DUPLEX STACK?
0
1
2
3
4
5
2,000 (610 m)
4,000 (1,220 m)
6,000 (1,830 m)
8,000 (2,440 m)
10,000 (3,050 m)
12,000 (3,660 m)
14,000 (4,270 m)
16,000 (4,880 m)
18,000 (5,490 m)
20,000 (6,100 m)
25,000 (7,625 m)
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35,000 (10,670 m)
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45,000 (13,720 m)
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MEADE
FISH CREEK
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KUPARUK
PRUDHOE
BADAMI
PT. THOMSON
SOURDOUGH
STINSON
K.I.C. #1
OUMALIK
SQUARE LAKE
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UMIAT
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CANADA
ALASKA (U.S.)
EXPLORATORY WELL, P&A
OIL FIELD
GAS FIELD
SEISMIC PROFILE
MILES
KILOMETERS
10 MILES
10 KILOMETERS

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Why so Rich?

Reason #3: Numerous large prospects

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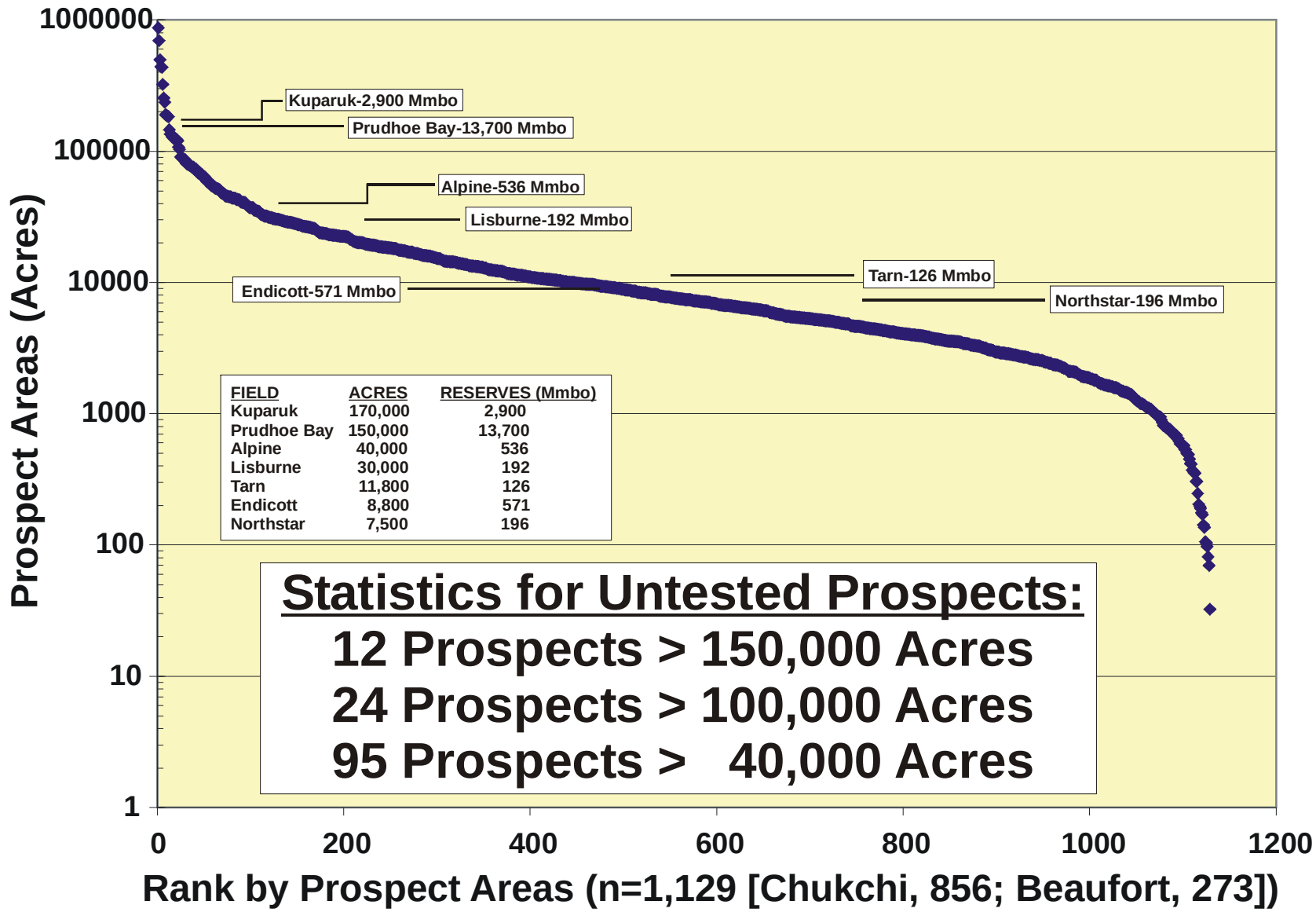
ARCTIC OFFSHORE PROSPECTS

Prospect Areas Compared to Pool Areas for Selected North Slope Fields



FIELD	ACRES	RESERVES (Mmbo)
Kuparuk	170,000	2,900
Prudhoe Bay	150,000	13,700
Alpine	40,000	536
Lisburne	30,000	192
Tarn	11,800	126
Endicott	8,800	571
Northstar	7,500	196

Statistics for Untested Prospects:

12 Prospects > 150,000 Acres

24 Prospects > 100,000 Acres

95 Prospects > 40,000 Acres

Sherwood\...\Beaufort & Chukchi-Ranked Prospect Areas.cdr

The MMS Assessment Method

Play Identification

("Play" = genetically-related group of pools, sharing hydrocarbon charge, reservoir, and trap styles)

MMS Arctic Plays

1. **Grouped by Stratigraphic Sequence**
2. **Structural Setting**
3. **Reservoir Thermal Maturity (All Gas?)**

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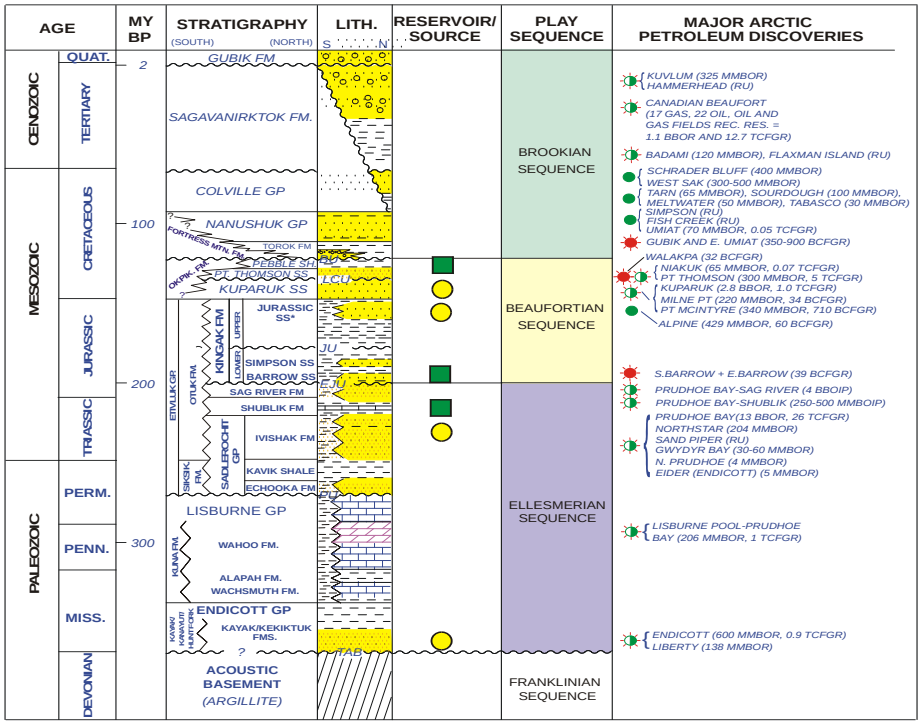
Stratigraphic Column

Chukchi Shelf, Beaufort Shelf, and Arctic Alaska



EXPLANATION

BU: BROOKIAN UNCONFORMITY
LCU: LOWER CRETACEOUS UNCONFORMITY
JU: JURASSIC UNCONFORMITY
PU: PERMIAN UNCONFORMITY
TAB: TOP OF ACOUSTIC BASEMENT

* INCLUDES ALPINE, NUIQSUT, AND NECHELIK SANDSTONES OF KORNBRATH AND OTHERS (1997)

KEY COMMERCIAL OIL RESERVOIRS

KEY OIL SOURCE ROCKS

SANDSTONE
CONGLOMERATE
SHALE
SILTSTONE
LIMESTONE
DOLOMITE
METAMORPHIC

OIL FIELD (RESERVE)
GAS FIELD (RESERVE)
OIL AND GAS FIELD (RESERVE)

MMBOR: MILLIONS OF BARRELS OF OIL, RECOVERABLE
MMBOIP: MILLIONS OF BARRELS OF OIL, IN PLACE
BBOR: BILLIONS OF BARRELS OF OIL, RECOVERABLE
BCFGR: BILLION CUBIC FEET OF GAS, RECOVERABLE
TCFGR: TRILLION CUBIC FEET OF GAS, RECOVERABLE
RU: RESERVES UNKNOWN

RESERVES FROM AKDO&G (2000) AND OTHER SOURCES AS OF MAY 2001

Brookian Sequence

Beaufortian = Rift Sequence

Ellesmerian Sequence

Franklinian Sequence

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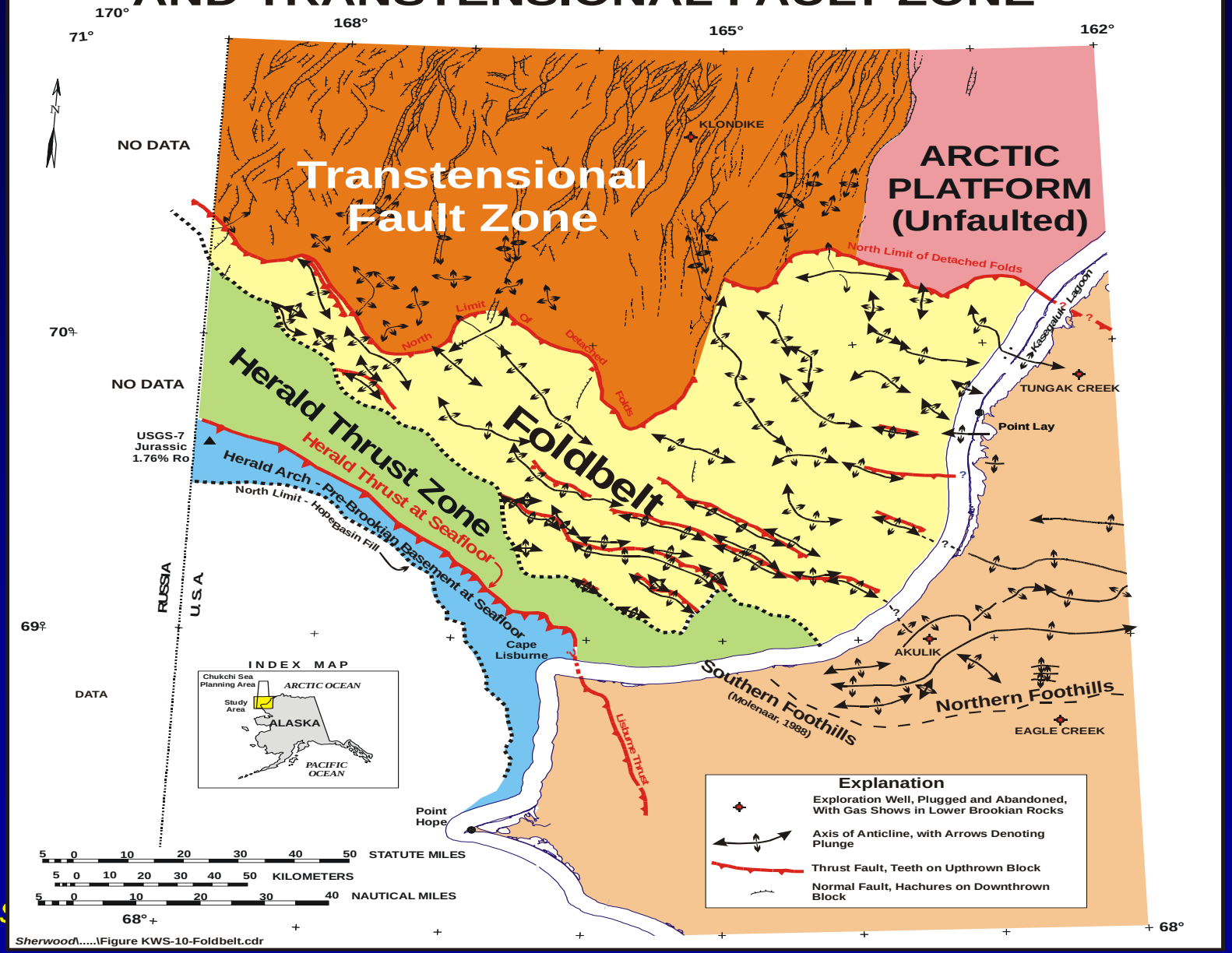
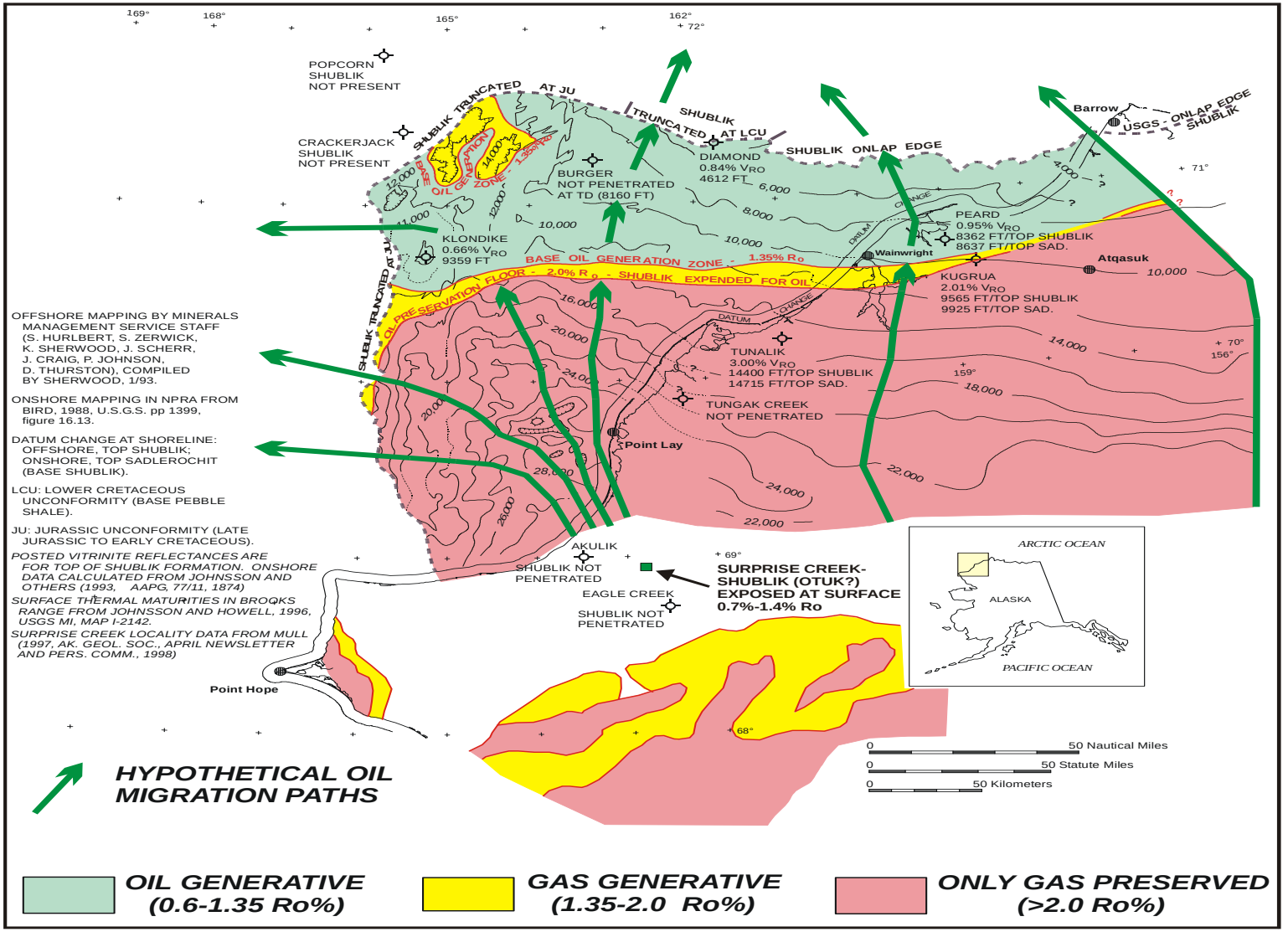
HERALD THRUST, FOLD AND THRUST BELT, AND TRANSTENSIONAL FAULT ZONE



STRUCTURE AND THERMAL MATURITY OF TRIASSIC OIL SOURCE ROCKS IN HANNA TROUGH

Estimated Potential Triassic Charge to Chukchi Shelf = 2.97 Trillion Barrels (Sherwood et al., 1998, p. 144)



OFFSHORE MAPPING BY MINERALS MANAGEMENT SERVICE STAFF (S. HURLBERT, S. ZERWICK, K. SHERWOOD, J. SCHERR, J. CRAIG, P. JOHNSON, D. THURSTON), COMPILED BY SHERWOOD, 1/93.

ONSHORE MAPPING IN NPRA FROM BIRD, 1988, U.S.G.S. pp 1399, figure 16.13.

DATUM CHANGE AT SHORELINE: OFFSHORE, TOP SHUBLIK; ONSHORE, TOP SADLEROCHIT (BASE SHUBLIK).

LCU: LOWER CRETACEOUS UNCONFORMITY (BASE PEBBLE SHALE).

JU: JURASSIC UNCONFORMITY (LATE JURASSIC TO EARLY CRETACEOUS).

POSTED VITRINITE REFLECTANCES ARE FOR TOP OF SHUBLIK FORMATION. ONSHORE DATA CALCULATED FROM JOHNSSON AND OTHERS (1993, AAPG, 77/11, 1874)

SURFACE THERMAL MATURITIES IN BROOKS RANGE FROM JOHNSSON AND HOWELL, 1996, USGS MI, MAP I-2142.

SURPRISE CREEK LOCALITY DATA FROM MULL (1997, AK. GEOL. SOC., APRIL NEWSLETTER AND PERS. COMM., 1998)

Sherwood\...\Figure Chuk-15-HannaTroughOilKitchen.cdr

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ARCTIC OFFSHORE PLAYS

2 Franklinian Sequence Plays (1 Chukchi, 1 Beaufort)

9 Ellesmerian Sequence Plays (6 Chukchi, 3 Beaufort)

4 Rift/Beaufortian Sequence Plays (3 Chukchi, 1 Beaufort)

24 Brookian Sequence Plays (16 Chukchi, 9 Beaufort)

39 Plays Total

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Basics of Assessment Method

- Determine Sizes and Numbers of Pools
- Summation of Pools
- Acknowledge Uncertainty (Reflected by Ranged Estimates or Probability Distributions)

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POOL VOLUMES
(Acre-Feet)

- **Prospect Areas from Seismic Mapping.**
- **Fill Fraction Estimates (Analogs; Seal**
- **Pay Thickness from Regional Data**

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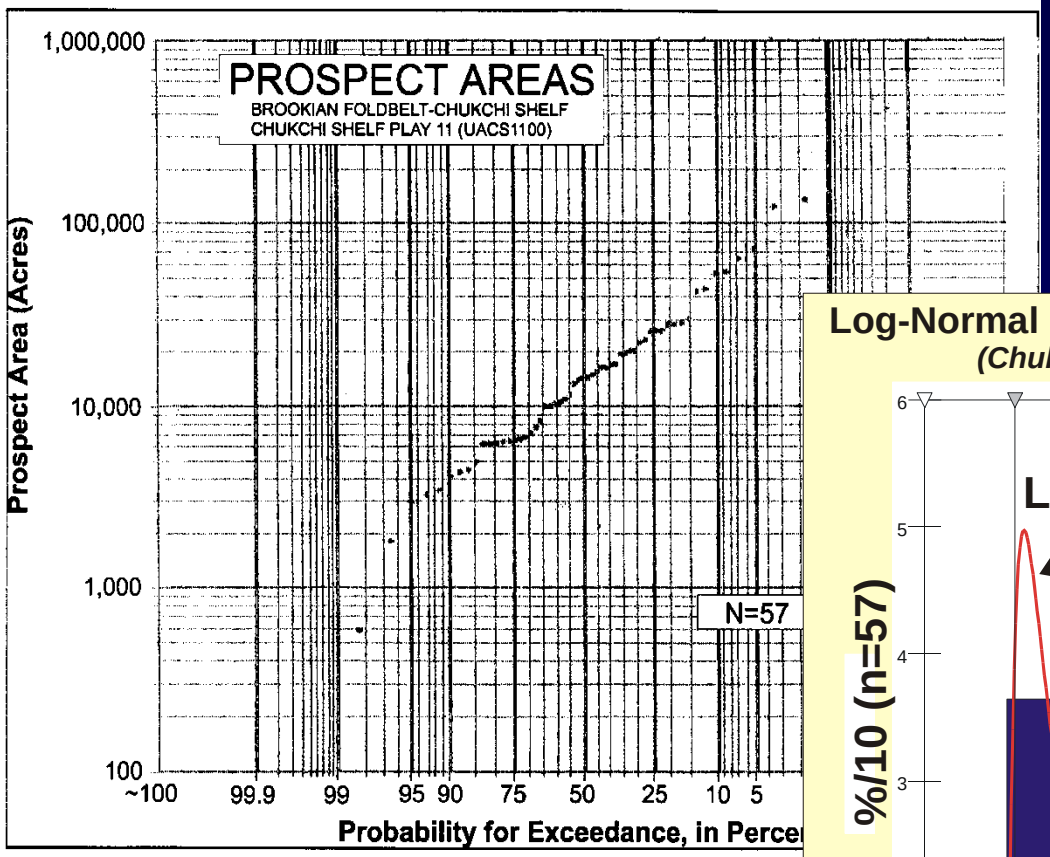
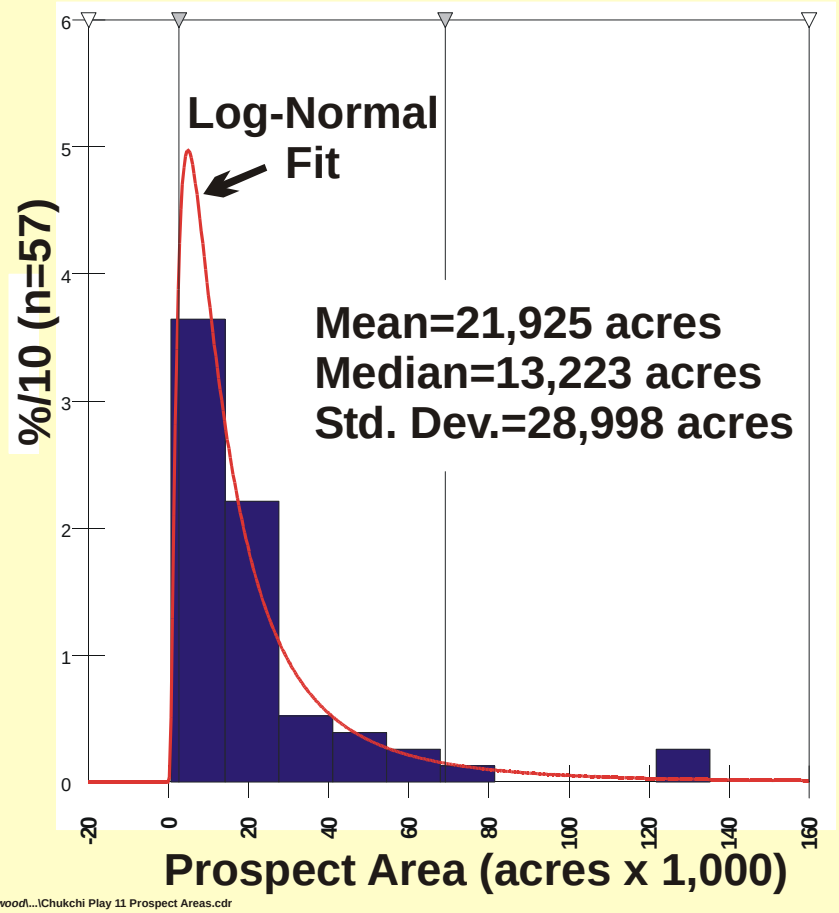


Figure 10.1: Log probability plot for maximum areas within closure, in acres, for 57 prospects iden play 11 in Chukchi shelf assessment province. Mapped prospects range from 588 to 135,278 acres in predicts larger prospects at very low probabilities. The linear arrangement of the plotted points is co probability distribution.

Log-Normal Fit (*@RISK-Bestfit*) to Prospect Areas

(Chukchi Shelf Play 11-Foreland Foldbelt)



Sherwood\...\Chukchi Play 11 Prospect Areas.cdr

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PROSPECT NUMBERS

(Probability Distribution)

1. **Numbers of Prospects from Seismic Mapping (“Identifieds”).**
2. **Numbers of Prospects Not Mapped Owing to Deficiencies in Mapping (“Unidentifieds”).**
3. **Create log-normal probability distribution between minimum and maximum.**

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CALCULATE NUMBERS OF POOLS

- **Construct Risk Model for Play to Estimate Exploration Chance**
- **Set Exploration Chance Against Prospect Numbers to Calculate Probability Distribution for Number of Pools**

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DEFINITIONS

1. Pool: hydrocarbons in sufficient concentration in a pore system to flow into a conventional wellbore (may establish minimum size if feasible)

2. Successful Play: any play known or believed to contain at least one pool (play chance = 1). All others <1.0.

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MORE DEFINITIONS

3. **Prospect Chance: Assuming a successful play, fraction of prospects that contain pooled petroleum**

4. **Play Exploration chance: [play level chance] X [prospect chance]**

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Play Risk Model

Risk Analysis Form - 2005 National Assessment

Assessment Province:	Chukchi Sea OCS Planning Area	**Play Number, Name:**	7. Rift Sequence-Active Margin
Assessor(s):	K.W. Sherwood	**Play UAI:**	AAAAA DAH
Date:	1-Jan-05		

For each component, a *quantitative* probability of success (i.e., between zero and one, where zero indicates no confidence and one indicates absolute certainty) based on consideration of the *qualitative* assessment of **ALL** elements within the component was assigned. This is the assessment of the probability that the minimum geologic parameter assumptions have been met or exceeded.

		Play Chance Factors	Averge Conditional Prospect Chance[1]
1. Hydrocarbon Fill component (1a * 1b * 1c)	**1**	***1.0000***	***1.0000***
a. Presence of a Quality, Effective, Mature Source Rock Probability of efficient source rock in terms of the existence of sufficient volume of mature source rock of adequate quality located in the drainage area of the reservoirs.	1a	1.00	1.00
b. Effective Expulsion and Migration Probability of effective expulsion and migration of hydrocarbons from the source rock to the reservoirs.	1b	1.00	1.00
c. Preservation Probability of effective retention of hydrocarbons in the prospects after accumulation.	1c	1.00	1.00
2. Reservoir component (2a * 2b)	**2**	***1.0000***	***0.4800***
a. Presence of reservoir facies Probability of presence of reservoir facies with a minimum net thickness and net/gross ratio (as specified in the resource assessment).	2a	1.00	0.80
b. Reservoir quality Probability of effectiveness of the reservoir, with respect to minimum effective porosity, and permeability (as specified in the resource assessment).	2b	1.00	0.60
3. Trap component (3a * 3b)	**3**	***1.0000***	***0.8000***
a. Presence of trap Probability of presence of the trap with a minimum rock volume (as specified in the resource assessment).	3a	1.00	0.80
b. Effective seal mechanism Probability of effective seal mechanism for the trap.	3b	1.00	1.00

Overall Play Chance (Marginal Probability of hydrocarbons, MPhc) (1 * 2 * 3) *Product of All Subjective Play Chance Factors*	***1.0000***	
Average Conditional Prospect Chance[1] (1 * 2 * 3) *Product of All Subjective Conditional Prospect Chance Factors*		***0.3840***
[1] Assumes that the Play exists (where all play chance factors = 1.0) ***Must be consistent with play chance and prospect distribution -- See discussion on Page 3 of Guide***		
Exploration Chance *(Product of Overall Play Chance and Average Conditional Prospect Chance)*	***0.3840***	

Comments: *See guidance document for explanation of the Risk Analysis Form*

2b: Chance That Porosity >10%, Based on Regional Model for Porosity vs Reservoir Thermal Maturity

Gas tested (RFT) from Rift sequence sandstones at Burger 1 and Popcorn 1 wells.

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RESERVOIR YIELD

1. **Recoverable Stock-Tank Barrels of Oil Per Acre-Foot.**
2. **Recoverable Gas at STP in Millions of Cubic Feet Per Acre-Foot.**
3. **Use Reservoir Equations In Monte Carlo Aggregation in @RISK**

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@RISK Data Model for Oil & Gas Recovery Factors

Table 8: DATA SHEET FOR *@RISK* MODELS FOR OIL AND GAS RECOVERY FACTORS FOR PLAY 1

Assessment Area: North Aleutian Basin — **Date: December 2003**

Play: 1 - Bear Lake-Stepovak (Oligocene-Miocene)

Assessors: K.W. Sherwood, D. Comer, J. Larson

Oil Recovery Factor (barrels recoverable per acre-foot)

Input Constant and @RISK Equation: "=7758.38*a2*(1-b2)*c2*d2"

		Mean	Standard Deviation	Minimum	Maximum	f(x) Type
a	Porosity	0.314705	0.053704	0.010	0.414	*T-Normal*
b	Water Saturation	0.343750	0.059615	0.030	0.700	*T-L-Normal*
c	Oil Recovery Efficiency	0.346810	0.057227	0.050	0.650	*T-L-Normal*
d	Oil Volume Factor [1/FVF]	0.793075	0.094369	0.500	1.000	*T-Normal*

Dependency or Correlation Matrix for Oil Yield Calculation

		Porosity	Water Saturation	Oil Recovery Efficiency	Oil Volume Factor [1/FVF]
a	Porosity	1	-0.9	0.9	0
b	Water Saturation	-0.9	1	-0.8	0
c	Oil Recovery Efficiency	0.9	-0.8	1	0
d	Oil Volume Factor [1/FVF]	0	0	0	1

Gas Recovery Factor (mcfg recoverable per acre-foot)

Input Constant and @RISK Equation: "=1537.8*a2*(1-b2)*c2*d2*e2*(1-f2)/g2"

		Mean	Standard Deviation	Minimum	Maximum	f(x) Type
a	Porosity	0.314705	0.053704	0.100	0.414	*T-Normal*
b	Water Saturation	0.343750	0.059615	0.030	0.700	*T-L-Normal*
c	Pressure (psi)	2609.400000	438.190000	878.000	4390.000	*T-Normal*
d	Gas FVF (1/Z)	1.079112	0.028545	0.960	1.200	*T-Normal*
e	Gas Recovery Efficiency	0.797408	0.038362	0.650	0.950	*T-Normal*
f	Gas Shrinkage Factor*	0.126230	0.161910	0.000	1.000	*T-L-Normal*
g	Temperature (°Rankine)	594.101000	18.089000	525.000	664.000	*T-Normal*

Dependency or Correlation Matrix for Gas Yield Calculation

		Porosity	Water Saturation	Pressure (psi)	Gas FVF (1/Z)	Gas Recovery Efficiency	Gas Shrinkage Factor*	Temperature (°Rankine)
a	Porosity	1	-0.9	0	0	0.8	0	0
b	Water Saturation	-0.9	1	0	0	-0.6	0	0
c	Pressure (psi)	0	0	1	0	0	0	0.95
d	Gas FVF (1/Z)	0	0	0	1	0	0	0
e	Gas Recovery Efficiency	0.8	-0.6	0	0	1	0	0
f	Gas Shrinkage Factor*	0	0	0	0	0	1	0
g	Temperature (°Rankine)	0	0	0.95	0	0	0	1

** Includes gas volume lost to condensate drop-out and content of inert gases (Nitrogen, Oxygen, Argon, Hydrogen Sulfide, Carbon Dioxide, and Helium)*

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10,000 Trials Calculate Conditional Oil & Gas Resources for 10's-100's of Thousands of "Simulation Pools"

Simulation Pools Are:

1. **Used to Construct Actual Pools Forecast for Play**
2. **Aggregated and Risked to Estimate "Geologic" Endowments of Plays**
3. **Individually Sampled and Tested for Economic Success**

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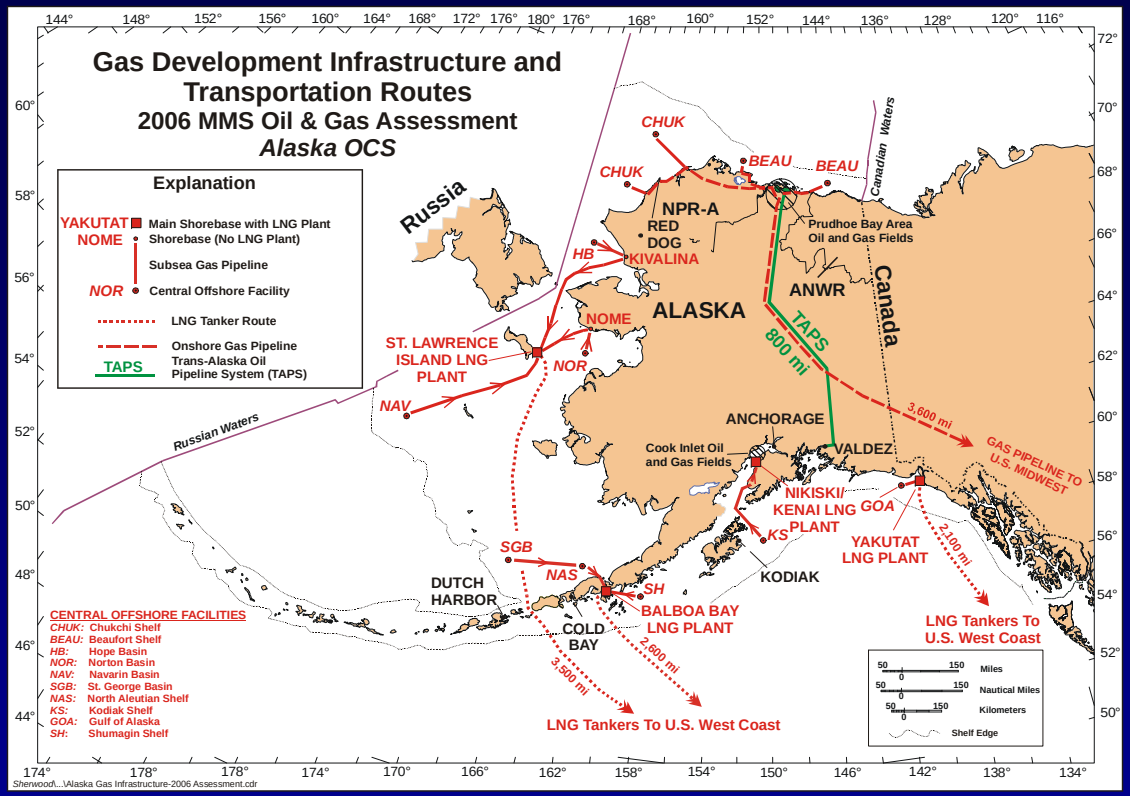
Development & Economic Models



Hypothetical Gas Development Infrastructure Model

>100 model parameters (engineering, costs, scheduling, and financial) are entered as ranged distributions

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ECONOMIC ASSESSMENT

- Hypothetical “simulation pools” as modeled by geological model
- Engineering simulation based on sizes and locations of hypothetical “simulation pools”
- Cost schedule and production & revenue stream based on engineering simulation
- Economic outcome based on discounted-cash-flow (DCF) model

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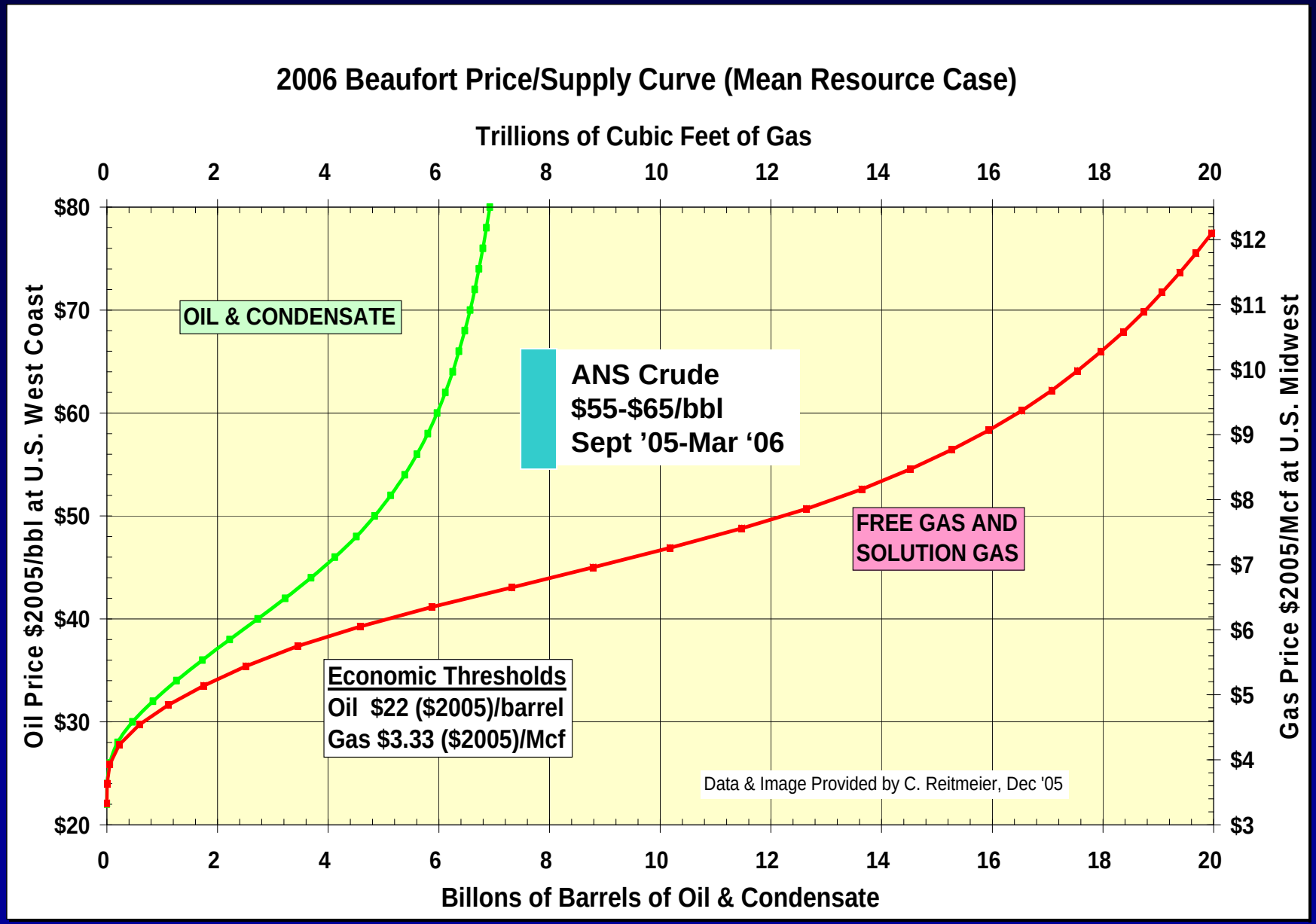
2006 Beaufort Price/Supply Curve (Mean Resource Case)
Trillions of Cubic Feet of Gas
0
2
4
6
8
10
12
14
16
18
20
$80
$70
$60
$50
$40
$30
$20
$12
$11
$10
$9
$8
$7
$6
$5
$4
$3
Oil Price $2005/bbl at U.S. West Coast
Gas Price $2005/Mcf at U.S. Midwest
OIL & CONDENSATE
ANS Crude
$55-$65/bbl
Sept '05-Mar '06
FREE GAS AND
SOLUTION GAS
Economic Thresholds
Oil $22 ($2005)/barrel
Gas $3.33 ($2005)/Mcf
Data & Image Provided by C. Reitmeier, Dec '05
Billons of Barrels of Oil & Condensate

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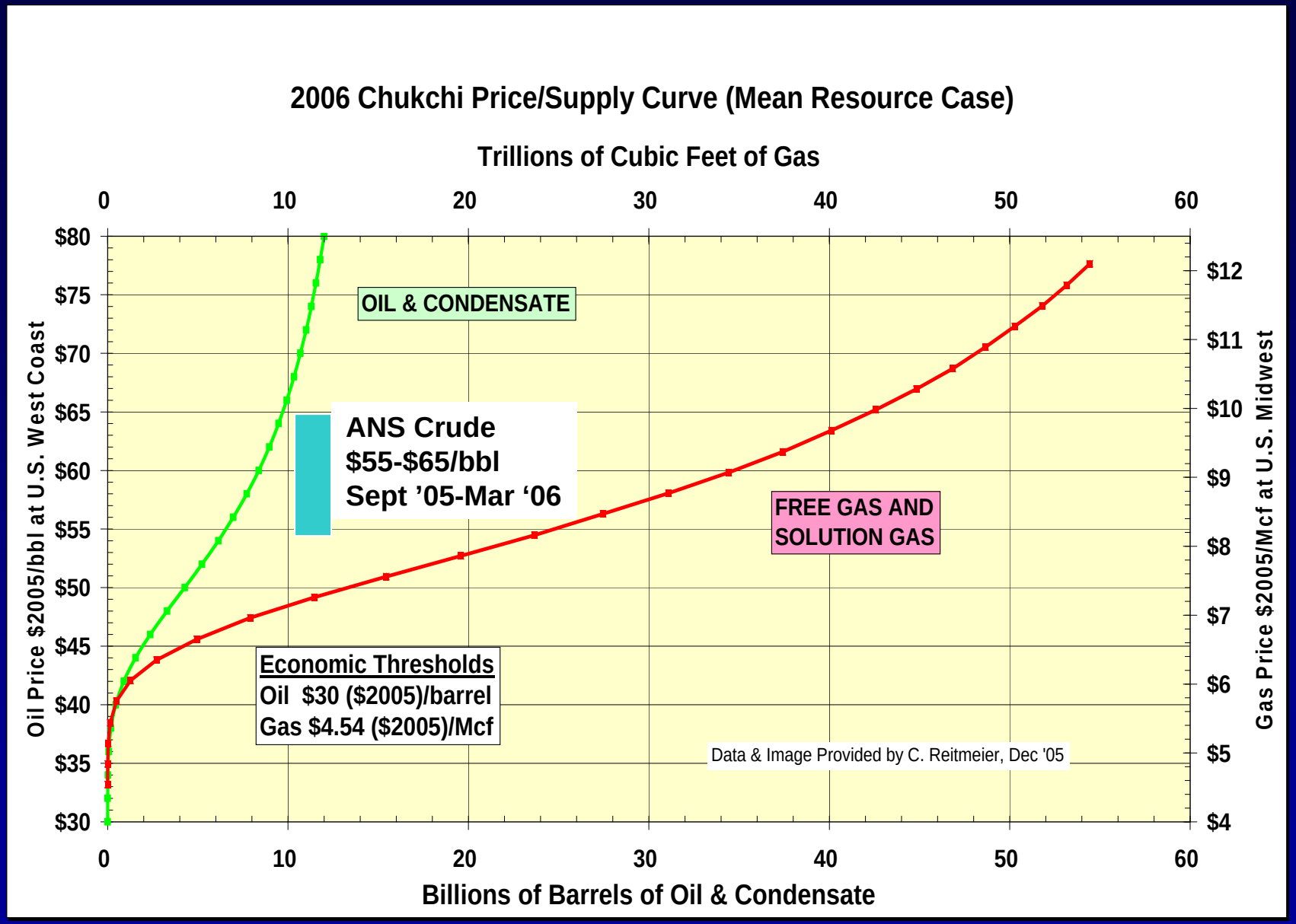
2006 Chukchi Price/Supply Curve (Mean Resource Case)
Trillions of Cubic Feet of Gas
0
10
20
30
40
50
60
$80
$75
$70
$65
$60
$55
$50
$45
$40
$35
$30
$12
$11
$10
$9
$8
$7
$6
$5
$4
Oil Price $2005/bbl at U.S. West Coast
Gas Price $2005/Mcf at U.S. Midwest
OIL & CONDENSATE
ANS Crude
$55-$65/bbl
Sept '05-Mar '06
FREE GAS AND
SOLUTION GAS
Economic Thresholds
Oil $30 ($2005)/barrel
Gas $4.54 ($2005)/Mcf
Data & Image Provided by C. Reitmeier, Dec '05
Billions of Barrels of Oil & Condensate

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6 Lease Sales for Arctic Offshore

Sale No.	Area	Year
202	Beaufort Sea	Mar 2007
193	Chukchi Sea	2007?
209	Beaufort Sea	2009
211	Cook Inlet	2009
212	Chukchi Sea	2010
217	Beaufort Sea	2011
219	Cook Inlet	2011
221	Chukchi Sea	2012

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