ALASKA FEDERAL OFFSHORE
Descriptions of Geologic Plays
1995 National Resource Assessment
U.S. Minerals Management Service

BEAUFORT SHELF ASSESSMENT PROVINCE
(James Scherr and Peter Johnson)

Undeformed Pre-Mississippian Basement Play (UABS0101): The Undeformed Pre-Mississippian Basement Play consists of stratigraphic traps in carbonate or sandstone reservoirs in the pre-Mississippian basement complex (Dolton and others, 1987, p. 238). Leaching of carbonates or carbonate cements in the sandstones may have created some porosity and fractures may enhance permeability development. Potential source rock is the overlying Hue Shale and Canning Formation which also act as the seal. No OCS wells have tested this play. In State waters Alaska State F-1 tested 2.975 MMcf/day and 152 bbl/ day of 35.3° API gravity condensate.

Pre-Devonian Play (UABS0200 [1]): The Pre-Devonian Play includes platform carbonates and overlying shales of lower Paleozoic to Precambrian age in the western part of the Beaufort shelf assessment province. The source rock is either the carbonates or overlying shales. A source rock analog is the Silurian organic rich Cape Phillips shales in the Canadian Arctic Islands (Stuart Smith and Wennekers, 1977). The hydrocarbon traps are formed by anticlines, faulted anticlines, or faults. This play has not been tested nor is it seen in outcrop. It is only seen in CDP seismic profiles.

Endicott Play (UABS0401): Endicott Play includes the sandstone reservoirs of the Mississippian Endicott Group. The depositional environment is a pair of regressive and transgressive sequences consisting of swamp, braided stream, flood plain and shallow marine environments. Hydrocarbon traps are formed by anticlines, faulted anticlines, fault blocks, and unconformable truncations of Endicott reservoirs at younger unconformities. Two OCS wells, Y-0191 #1 and Y-0191 #2, unsuccessfully tested prospects in the play. Three OCS wells have penetrated the Tern Island oil field in this play. Onshore, the Endicott field with 480 million barrels of recoverable oil (Petzet, 1995) produces from this play.

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[1]*The "UA" Code is the "Unique Assessment Identifier" for each play, and is the principal guide to GRASP data files.*

Lisburne Play (UABS0501): The Lisburne Play includes the platform carbonate (limestone and dolomite) reservoirs of the Mississippian to Pennsylvanian Lisburne Group. Potential hydrocarbon traps of structural origins include anticlines, faulted anticlines, and fault block traps. Potential stratigraphic traps may be associated with porosity pinchouts, unconformity truncations or paleokarst topography at the Lower Cretaceous or other unconformities. Six OCS wells, Y-0191 #1, Y-0191 #2, Mukluk, Mars, Y-0181 (Seal Island), and Phoenix, tested prospects in the play without commercial success. The onshore Lisburne field with 200 million barrels of recoverable oil (Petzet, 1995) produces from the play.

Upper Ellesmerian Play (UABS0601): The Upper Ellesmerian Play includes the sandstone reservoirs of the Triassic Sag River Formation and Triassic to Permian Sadlerochit Group. The depositional environment is marine shelf for the Sag River Formation while the Sadlerochit Group has shallow marine, fluvial, floodplain, alluvial fan delta, and point bar sediments. Carbonates within the Shublik Formation are sometimes porous. Potential hydrocarbon traps are formed by anticlines, faulted anticlines, unconformity truncations, faults, or stratigraphic pinchouts. The play was the primary objective of 13 OCS wells including the well-known Mukluk well. Two OCS wells discovered and tested two oil fields, Sandpiper and Seal Island. There are three producing fields onshore, including Prudhoe Bay with 12 billion barrels recoverable oil (Petzet, 1995), Sag Delta North with 17.7 million barrels in place oil (AOGCC, 1991b), and North Prudhoe Bay State with 12 million barrels in place oil (AOGCC, 1994, p. 2).

Rift Play (UABS0701): The Rift Play contains locally derived clastics of the Beaufortian Sequence and Pebble Shale, mostly preserved in fault blocks (e.g., Dinkum graben) associated with an Early Jurassic to Early Cretaceous rifting event, but generally including correlative strata deposited beyond the rift zone. The reservoirs are marine and fluvial sandstones. The traps are anticlines, faulted anticlines, fault blocks, unconformity truncations, or stratigraphic terminations of reservoir beds. Potential source rocks may occur in the Shublik Formation, the Kingak Formation (especially in the lower Kingak), the Pebble Shale, and the overlying HRZ ("Highly Radioactive Zone"). The play had six dry OCS tests including Mars, Y-191, Fireweed, Antares, Mukluk, and Phoenix wells.

There are several onshore fields in the play, including Kuparuk field with 2.4 billion barrels of recoverable oil (Petzet, 1995), the Milne Point field with 220 million barrels of recoverable oil (Anchorage Daily News, 1995), the Point McIntyre field with 340 million barrels of recoverable oil (ARCO, 1993 and Petzet, 1995), and the Point Thomson field with 300 million barrels of condensate (Thomas and others, 1991). Three fields are in NPRA, the South Barrow field with 25 billion cubic feet of recoverable gas (Thomas and others, 1991), East Barrow field with 12 billion cubic feet of recoverable gas (Thomas and others, 1991), and Walakpa gas field with 30 billion cubic feet of recoverable gas (AOGCC, 1991a, p. 54).

Brookian Faulted Western Topset Play (UABS0800): This play includes Cretaceous deltaic topset facies of the Nanushuk and Colville Groups extending seaward from the hinge line fault zone to the province boundary. Reservoir quality is likely to be poor due to the distance from the sediment source and the high clay content associated with a mud-rich delta. Sands may thicken

abruptly in downthrown fault blocks. Source rocks are primarily gas-prone shales of the Torok Formation and Colville Group. Rotated blocks along listric growth faults are the chief trapping mechanisms. No prospects have been tested in the play area.

Brookian Unstructured Western Topset Play (UABS0902): This play occurs in the deltaic topset facies of the Brookian Sequence, primarily the Nanushuk Group, in the area between the Barrow Arch and the offshore hinge line fault zone. The Nanushuk Group in the play area is likely to be a poor reservoir due to the high clay content of the deltaic sandstones found in wells in the area. Potential source beds include the underlying Torok Formation, the Pebble Shale, the Kingak shale and the Shublik Formation. These sources may generate oil and/or gas. The play area is sparsely faulted and the sequence dips homoclinally to the north. Prospects are primarily stratigraphic traps related to the pinchout of reservoir beds. Prospects in this play have not been tested in the offshore. Sub-commercial oil pools onshore include the Simpson (12 MMBO recoverable) and Fish Creek (no resource estimate) fields in the National Petroleum Reserve-Alaska (Thomas and others, 1991 Table 2.2).

Brookian Faulted Western Turbidite Play (UABS1000): This play includes Cretaceous prodelta facies of the Torok Formation and lower Colville Group. Expected reservoirs include lowstand wedges or turbidite sands in submarine fan environments. Sandstone sequences may thicken abruptly in down thrown blocks in the hinge line fault zone. As in the Brookian Unstructured Western Turbidite Play (UABS1102), the reservoir sands are likely to be poor quality due to the fine grained nature of the Nanushuk deltaic system that delivered sand to the shelf break. Shales in the Torok Formation and Colville Group are primarily gas sources due to kerogen content and because many thousands of feet of the shales have passed through the oil window and into the gas window. Traps in the play are expected to be primarily stratigraphically controlled. There is also potential for fault traps against hinge line listric growth faults. No prospects have been tested in the play area.

Brookian Unstructured Western Turbidite Play (UABS1102): This play includes the Lower Cretaceous prodelta facies of the Torok Formation in the lower part of the Brookian sequence. It mostly underlies the Brookian Unstructured Western Topset Play (UABS0902). Expected reservoirs include turbidite sands deposited in submarine fan environments. Reservoir quality is expected to be poor due to the fine grained nature of the Nanushuk deltaic system that delivered sand to the shelf break. The Torok Formation, Pebble Shale, Kingak shale and Shublik Formation all form potential source rocks for charging reservoirs in this play. The Kingak shale in this area may be oil prone, but probably reaches sufficient thermal maturity only in rift grabens with expanded sedimentary thicknesses. Prospects are primarily stratigraphic traps formed by sand mounds within a shale sequence. The Phoenix well tested heavy oil in the Torok Formation and the Mukluk well had several Torok Formation oil shows.

Brookian Faulted Eastern Topset Play (UABS1201): This play includes deltaic topset facies of the Tertiary Sagavanirktok Formation and the Upper Cretaceous Colville Group. It is located seaward of the hinge line fault zone across the central part of the province. The

Sagavanirktok Formation sandstones offer excellent reservoir characteristics. Potential source rocks are organic- rich marine shales within the Canning Formation that reach thermal maturity north of the hinge line in the Nuwuk and Kaktovik basins. There is also potential for oil generation from Beaufortian sequence source rocks deeply buried within the Dinkum graben. The latter source rocks have passed completely through the oil generation window. Prospects in the play are likely to be fault traps along down-to-the-north listric growth faults. Seal continuity may be a risk factor for many prospects due to the high sand content of the Sagavanirktok Formation. One offshore well, Galahad, was drilled in the play area and encountered a gas sand that yielded frothy brown oil.

Brookian Unstructured Eastern Topset Play (UABS1302): This play includes deltaic topset facies of the Tertiary Sagavanirktok Formation and equivalent facies of the Upper Cretaceous Colville Group. It is located north of the Barrow Arch and south of the hinge line fault zone east of the eastern stratigraphic limit of the Nanushuk Group (generally east of Cape Halkett). Excellent reservoir quality sands occur within the Sagavanirktok Formation in most coastal wells and we expect quality reservoir sequences to continue offshore. The Canning Formation, Pebble Shale, Hue Shale, lower Kingak shale, and the Shublik Formation are variable to rich oil source rocks that lie within the projected oil window and underlie the play sequence across most of the play area. The play sequence is sparsely faulted. Most of the prospects are expected to be stratigraphic traps or small-offset fault traps. Seals are likely to be a risk factor for many of the prospects because of the abundant of sandstone within the play sequence. Oil was discovered offshore at Hammerhead prospect (reserves not released), and Kuvlum (reserves not released) and onshore at West Sak (15-25 BBO in place; Thomas and others, 1991 Table 2-5) and Ugnu (11-19 BBO in place reserves; Thomas and others, 1991 Table 2-5). In Harrison Bay, the Phoenix well tested oil from a sandstone in the Colville Group.

Brookian Faulted Eastern Turbidite Play (UABS1400): This play includes the Late Cretaceous and Tertiary prodelta shales and turbidites of the Canning Formation located between the hinge line fault zone and the northern province boundary, east of the eastern stratigraphic limit of the Torok Formation. Reservoirs are primarily turbidite sands in a submarine fan environment. The primary source rocks are expected to be gas-prone shales of the Canning Formation. There is also a potential for hydrocarbon generation from Beaufortian sequence source rocks that underlie the play sequence. These Beaufortian rocks are likely to be buried to below the base of the oil window and are most likely fully expended with respect to oil. Prospects in the play are both stratigraphic traps related to sand mounds within the marine shale sequences, and fault traps against listric growth faults. No wells have tested the play.

Brookian Unstructured Eastern Turbidite Play (UABS1502): This play includes Late Cretaceous and Tertiary prodelta shales and turbidites of the Canning Formation. It is located on the relatively unstructured part of the shelf between the Barrow Arch and the hinge line fault zone east of the eastern stratigraphic limit of the Torok Formation (east of the Colville River delta). It underlies much of the Brookian Unstructured Eastern Topset Play (UABS1302). Reservoirs include turbidite sands in submarine fan environments enclosed in prodelta shales.

Source rocks include relatively gas-prone shales of the Canning Formation, and rich oil-prone shales of the Hue Shale and Pebble Shale units. The base of the play sequence lies in direct contact with these source beds. Stratigraphic traps predominate, although small scale fault traps also occur. Marine shales provide a good seal for trapping hydrocarbons. The OCS Y-191 (Beechy Pt. #2) well, drilled in Steffanson Sound flowed oil and gas out of the Canning Formation. Onshore, oil has been tested in turbidite sands of the Canning Formation in the Badami field (estimated reserves, 100 MMbbl oil and 100 BCF gas; Alaska Report, 1994)) and at Flaxman Island.

Brookian Foldbelt Play (UABS1602): This play includes Tertiary Sagavanirktok Formation topset sequences and Cretaceous to Tertiary Canning Formation topset and pro-delta sequences complexly structured by both Brooks Range folding and coeval faulting along the hinge line fault system. The hinge line obliquely intersects the foldbelt within the area of the Brookian Foldbelt play. Major offshore structural features included in the play are the Herschel High, the Demarcation Subbasin, and the Camden anticline. Onshore, the play includes Marsh Creek anticline and other shallow structures in the Arctic National Wildlife Refuge (ANWR). Reservoir sands are very sparse in the three offshore wells (Belcher, Corona, and Aurora) that tested prospects in this play. However in the Natsek well at the southeast end of the Herschel High in Canada, reservoir quality sands were encountered in Upper Cretaceous and Paleocene rocks. Potential oil sources include the Hue Shale and Canning Formation, which probably underlie many offshore structures in the Brookian Foldbelt play. However, wells testing the play penetrated only Tertiary shales with gas-prone kerogen. The dominant recognized trap types include anticlines, faulted anticlines and fault closures. Also likely are stratigraphic traps occurring in syn- and post-tectonic sediments which fill basins developed between folded uplifts. Late stage structuring may have destroyed earlier formed seals and traps. Three offshore wells unsuccessfully tested the play. Belcher well was drilled on an anticline on the Herschel High and encountered neither sandstones nor hydrocarbon shows. Corona was drilled on the crest of Camden anticline, and encountered only sparse thin sandstones with no hydrocarbon shows. Aurora was drilled on an anticlinal feature adjacent to the Arctic National Wildlife Refuge. It primarily encountered shales and no hydrocarbon shows in the Brookian sequence.

Beaufort Shelf Plays That Overlap with Chukchi Shelf:

Endicott Portion Shared with Chukchi Shelf (UABS1800) *Chukchi Shelf Play 2 (UACS0200). Lower Ellesmerian—Endicott Clastics-Arctic Platform:* Reservoir objectives primarily include Late Devonian(?) to Mississippian sandstones deposited in marginal- to non-marine environments on the east side of Hanna trough during the early rift phase of subsidence. Early-formed horst and stratigraphic wedge traps have been buried to greater depths than their Chukchi platform counterparts and are associated with higher levels of thermal maturity and poorer reservoir properties. The play is charged by the Hanna trough play charging system (see Chukchi shelf play 1). Most identified prospects lie considerably deeper than the primary regional source rock (Shublik), and high thermal maturity of traps suggests the hydrocarbon endowment is largely dry gas. Chukchi shelf play 2 is therefore modeled with a higher gas content than other Chukchi shelf

plays charged by the Hanna trough play charging system. This play was not tested by any wells.

Lisburne Portion Shared with Chukchi Shelf (UABS1900) *Chukchi Play 3 (UACS0300). Lower Ellesmerian—Lisburne Carbonates:* Reservoir objectives include Mississippian to Permian carbonates that were deposited on a stable marine shelf, with deeper water facies in the southeast part of the province in axial parts of Hanna trough. Porosity in Lisburne carbonates is associated with sparse porous zones in limestones and thin dolomite beds. No reef facies have been documented within the Lisburne carbonate assemblage, which ranges in age from Mississippian to Permian. The play is primarily charged by the Hanna trough play charging system (see Chukchi shelf play 1), with minor contributions from interbedded organically-lean and gas-prone shales. Incomplete penetrations of the Lisburne carbonates occurred at Popcorn, Crackerjack, and Diamond wells, which encountered carbonates with porosities ranging from 0 to 14%. No hydrocarbons were encountered in Lisburne carbonates in these wells.

Ellesmerian Deep Gas Shared with Chukchi Shelf (UABS2000) *Chukchi Shelf Play 4 (UACS0400). Ellesmerian Sequence—Overmature "Deep Gas" (Lower and Upper Ellesmerian Sequences)***:** Reservoir objectives include all potential reservoirs in both Lower Ellesmerian and Upper Ellesmerian sequences (reservoir strata described in Chukchi shelf plays 1,2,3,5, and 6). Prospects in the "Deep Gas" play occur at subsurface depths beneath the oil floor (2.0% vitrinite reflectance) and would contain only gas. High thermal maturities have a detrimental effect on reservoir properties and multi-cycle tectonic history combined with extremely deep burial at present (to 38,000 ft) result in high exploration risks for Chukchi shelf play 4. This play was penetrated at Tunalik well in northwestern Alaska with no hydrocarbons present. At the level of Lower Ellesmerian rocks, Chukchi shelf play 4 extends from Chukchi shelf province into western parts of the Beaufort shelf assessment province.

Upper Ellesmerian - Portion Shared with Chukchi Shelf (UABS2100) *Chukchi Shelf Play 6 (UACS0600). Upper Ellesmerian—Sadlerochit Group-Arctic Platform***:** Reservoir objectives primarily include Late Permian to Triassic marginal to shallow marine sandstones of the Sadlerochit Group that were deposited on the south-facing shelf that then existed on the Arctic platform. Diamond well, offshore on the east flank of Hanna trough, encountered over 500 feet of potential reservoir strata that are correlative to the Permian Echooka Formation. Primary trap styles include stratigraphic wedges and fault traps, with hydrocarbons migrating northward into traps from the Hanna trough play charging system on the south. A prospect in this play was penetrated at Diamond well where it is barren of hydrocarbons. Several wells also penetrated the play sequence (with no pooled hydrocarbons) in northwestern Alaska.

Rift Portion Shared with Chukchi Shelf (UABS2200) *Chukchi Shelf Play 8 (UACS0800). Rift Sequence—Stable Marine Shelf***:** Reservoirs are primarily Late Jurassic to Early Cretaceous sandstones equivalent to the Kuparuk Formation of Arctic Alaska. Unlike the sandstones in the tectonically active rift zone (Chukchi shelf play 7) to the north, these rocks were instead deposited south of the rift zone on a tectonically stable shelf and slope that rimmed a deep water area in southernmost Hanna trough. Here, we anticipate fine-grained marine shelf sandstones that are

thinner at the extremes and probably less continuous laterally than their counterparts in Chukchi shelf play 7. This play is charged by the Hanna trough play charging system (described in Chukchi shelf play 1). A prospect within the play was incidentally tested by Klondike well, encountering pooled oil in a sandstone 80 feet thick. Diamond well encountered no sandstones (only the Pebble Shale was present) and was barren of hydrocarbons.

Sand Apron Shared with Chukchi Shelf (UABS2300) *Chukchi Shelf Play 14 (UACS1400). Sand Apron-North Chukchi High (Upper and Lower Brookian sequences)***:** Potential reservoirs are inferred to consist primarily of shallow marine to fluvial sandstones of Early Cretaceous to Tertiary age that are hypothesized to have been deposited in littoral systems that fringed North Chukchi high, an area of recurrent uplift throughout Albian-Aptian (post-Brookian unconformity) and later time (Johnson, 1992). This play therefore includes both Lower and Upper Brookian sequences. The play is probably charged primarily from the west by the North Chukchi basin play charging system (Lower Cretaceous to Tertiary Brookian shales generating gas and oil that rose along faults into shallow traps in North Chukchi basin and nearby structural uplifts). This play has not been tested by any well.

Turbidites (Torok) Shared with Chukchi Shelf (UABS2400) *Chukchi Shelf Play 17 (UACS1700). Lower Brookian Sequence—Torok Turbidites-Arctic Platform (Unstructured)***:**

This play addresses the unstructured area of the Arctic platform that lies south of Barrow arch, east of the wrench fault province of western Chukchi shelf (equivalent Chukchi shelf play 12), and north of the foldbelt (Chukchi shelf play 11). Potential reservoirs are turbidite sandstones within the Lower Cretaceous Torok Formation. Exploratory drilling has shown that sandstone is quite sparse within the Torok Formation in this play. Reservoir presence is therefore one important risk element for the play. Low-relief anticlines, possibly related to compaction, mounded fan complexes, and slope turbidites isolated within slope shales form the primary anticipated trap types, few of which are readily observable in seismic data. The play is modeled as predominately charged by the Hanna trough play charging system (described in Chukchi shelf play 1), although some contribution from the gas-rich Colville basin play charging system (described in Chukchi shelf play 11) is also possible. The play was tested by Burger and Diamond wells and several wells onshore. No pooled hydrocarbons were encountered in any well.

Topset (Nanushuk) Shared with Chukchi Shelf (UABS2500) *Chukchi Shelf Play 18 (UACS1800). Lower Brookian Sequence—Nanushuk Topset-Arctic Platform (Unstructured)***:**

This play addresses the unstructured area of the Arctic platform that lies south of Barrow arch, east of the wrench fault province of western Chukchi shelf (equivalent Chukchi shelf play 13), and north of the foldbelt (Chukchi shelf play 11). Reservoir objectives include delta-plain and nearshore sandstones of the Lower Cretaceous Nanushuk Group. Low-relief anticlines possibly related to differential compaction and stratigraphic terminations of homoclinally-dipping sandstones form the primary trap types. This play is modeled as predominately charged by the Hanna trough play charging system (described in Chukchi shelf play 1), although some contribution from the gas-rich Colville basin play charging system (described in Chukchi shelf play

OIL AND GAS ENDOWMENTS OF BEAUFORT SHELF PLAYS

Risked, Undiscovered, Conventionally Recoverable Oil and Gas

PLAY NO.	PLAY NAME (UAI * CODE)	OIL (BBO)			GAS (TCFG)		
		F95	MEAN	F05	F95	MEAN	F05
0101	Undeformed Pre-Miss. Bsmt (UABS0101)	0.000	0.006	0.027	0.000	0.028	0.109
0200	Pre-Devonian (UABS0200)	0.000	0.173	0.505	0.000	3.534	9.958
0401	Endicott w/o Portion Shared/Chukchi (UABS0401)	0.000	0.037	0.120	0.000	0.109	0.303
0501	Lisburne Play (Beaufort Only: UABS0501)	0.006	0.208	0.805	0.009	0.452	2.117
0601	Upper Ellesmerian (Beaufort Only: UABS0601)	0.135	0.763	2.200	0.273	1.834	8.057
0701	Rift (Beaufort Only: UABS0701)	0.564	0.910	1.570	1.302	2.559	5.512
0800	Brookian Faulted Western Topset (UABS0800)	0.000	0.082	0.254	0.000	1.570	5.372
0902	Brookian Unstructured Western Topset (UABS0902)	0.000	0.146	0.631	0.000	0.211	0.748
1000	Brookian Faulted Western Turbidites (UABS1000)	0.000	0.029	0.095	0.000	0.601	1.923
1102	Brookian Unstructured Western Turbidite (UABS1102)	0.000	0.057	0.214	0.000	0.133	0.468
1201	Brookian Faulted Eastern Topset (UABS1201)	0.518	1.046	2.042	7.323	16.074	35.665
1302	Brookian Unstructured Eastern Topset (UABS1302)	0.907	1.648	3.497	0.539	0.813	1.258
1400	Brookian Faulted Eastern Turbidites (UABS1400)	0.000	0.183	0.355	0.000	3.585	7.252
1502	Brookian Unstructured Eastern Turbidites (UABS1502)	0.000	0.042	0.169	0.000	0.090	0.349
1602	Brookian Foldbelt (UABS1602)	1.205	2.038	3.680	1.662	3.188	6.108
1800	Endicott-Overlaps Chukchi (UABS1800)	0.000	0.0006	0.002	0.000	0.012	0.034
1900	Lisburne-Overlaps Chukchi (UABS1900)	0.000	0.018	0.083	0.000	0.065	0.273
2000	Ellesmerian Deep Gas-Overlaps Chukchi (UABS2000)	0.000	0.004	0.014	0.000	0.150	0.583
2100	Upper Ellesmerian-Overlaps Chukchi (UABS2100)	0.000	0.497	1.407	0.000	1.391	4.075
2200	Rift-Overlaps Chukchi (UABS2200)	0.248	0.606	1.300	0.855	2.166	4.404
2300	Sand Apron-Overlaps Chukchi (UABS2300)	0.000	0.291	1.173	0.000	4.895	17.000
2400	Turbidites (Torok)-Overlaps Chukchi (UABS2400)	0.000	0.003	0.021	0.000	0.008	0.057
2500	Topset (Nanushuk)-Overlaps Chukchi (UABS2500)	0.000	0.044	0.167	0.000	0.034	0.127
	FASPAG AGGREGATION	***6.278***	***8.835***	***11.965***	***20.101***	***43.502***	***79.148***

* *Unique Assessment Identifier, code unique to play.*

11) is possible. The play was tested at Diamond and Burger wells. A gas-charged sandstone 36 feet thick was encountered at Burger well, which is located within several miles of the easternmost fault of a fault system that passes downward into the Burger gas pool. This fault may have formed a migration conduit for gas escaping upward from Kuparuk sandstones within the

underlying Burger gas pool.

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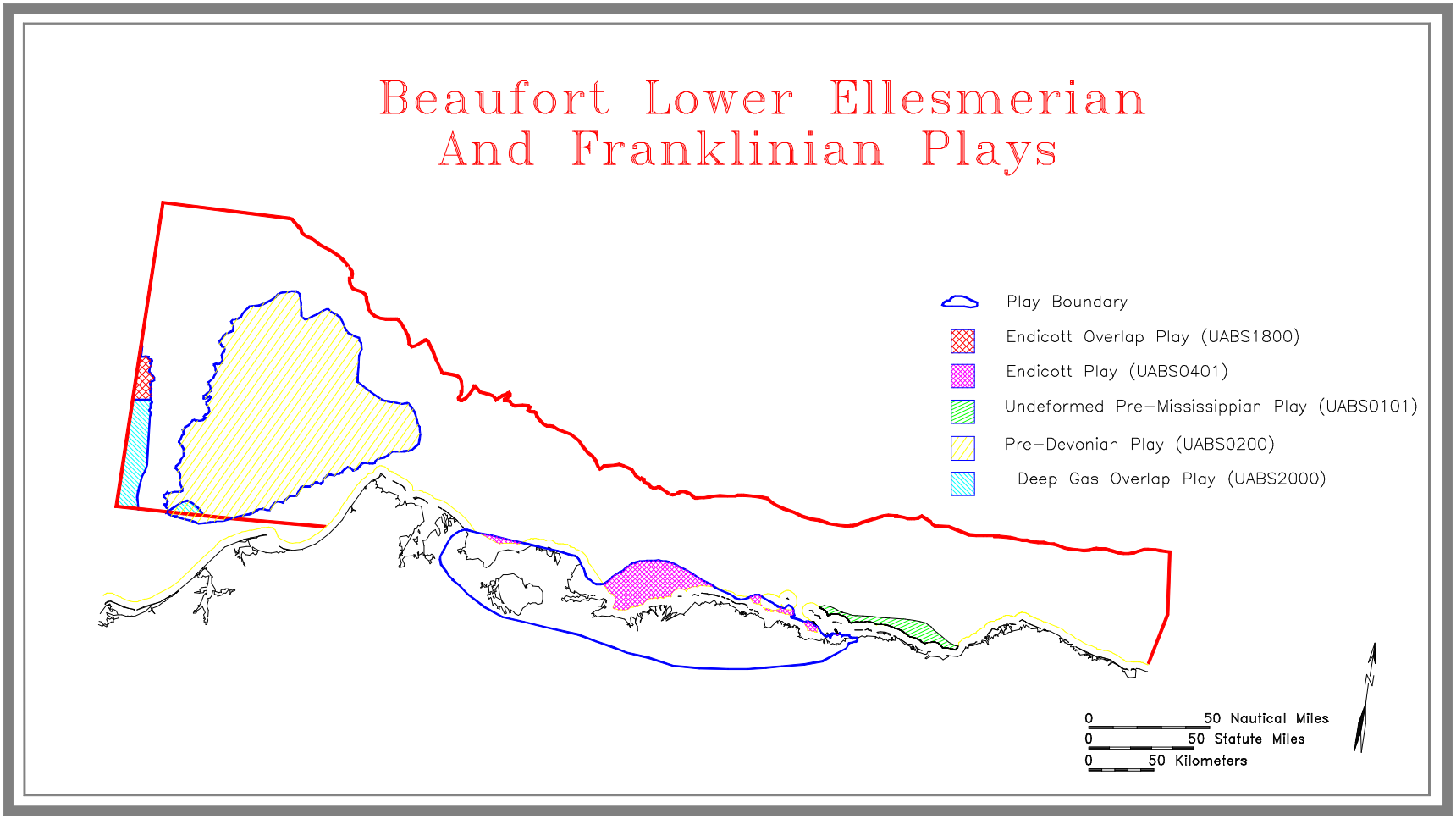
BEAUFORT SHELF - LOWER ELLESMERIAN AND FRANKLINIAN PLAYS



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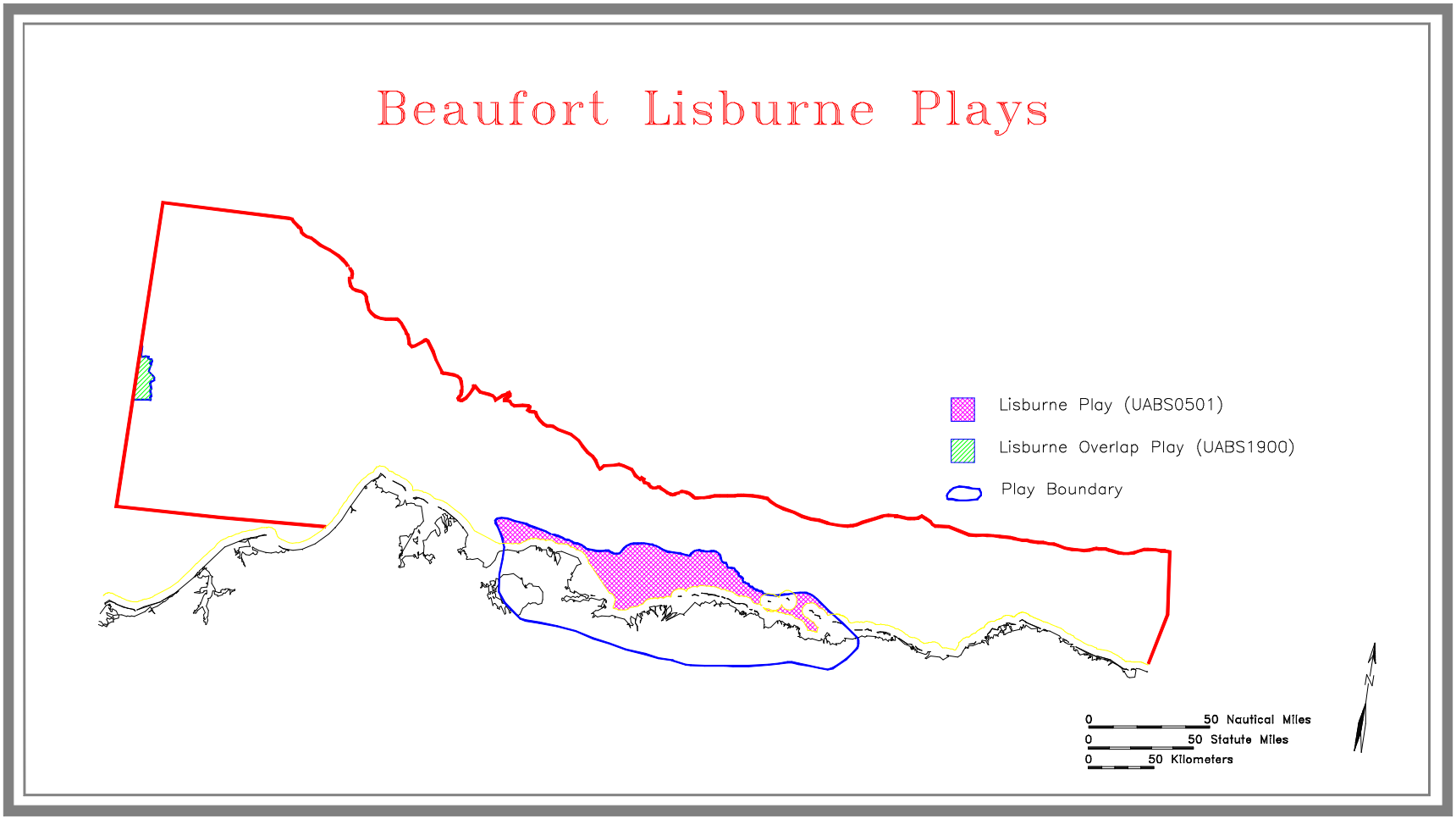

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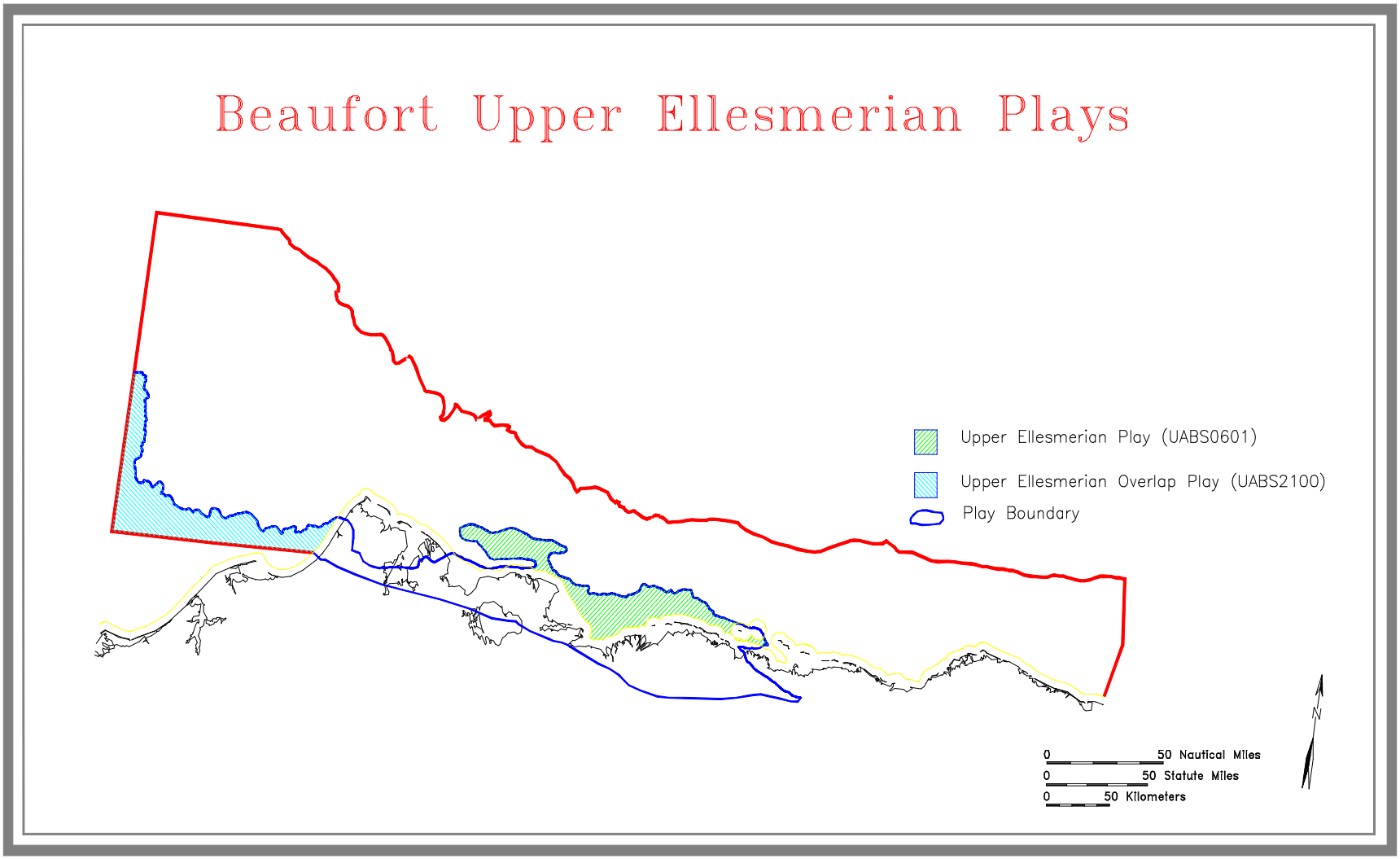
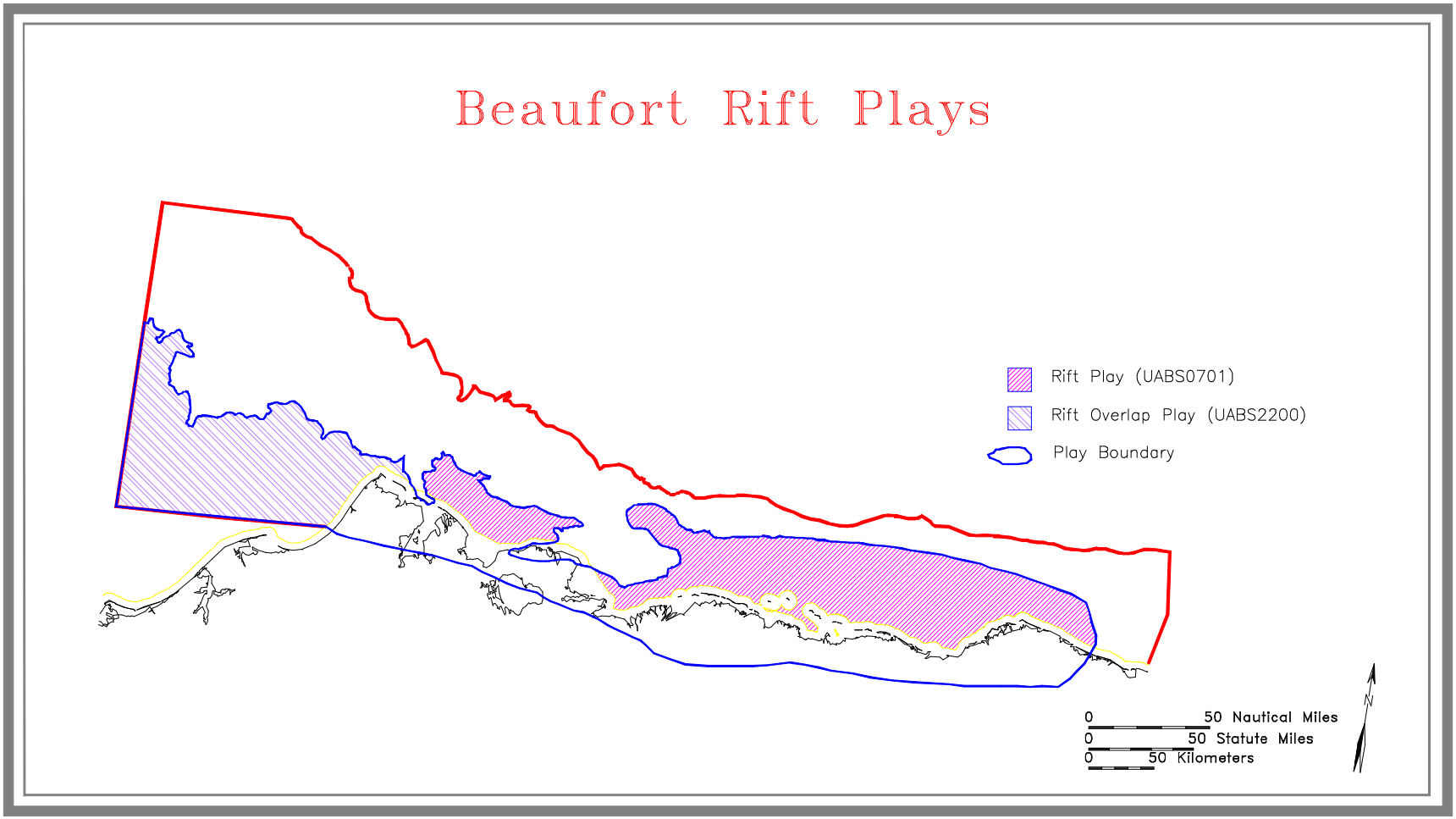
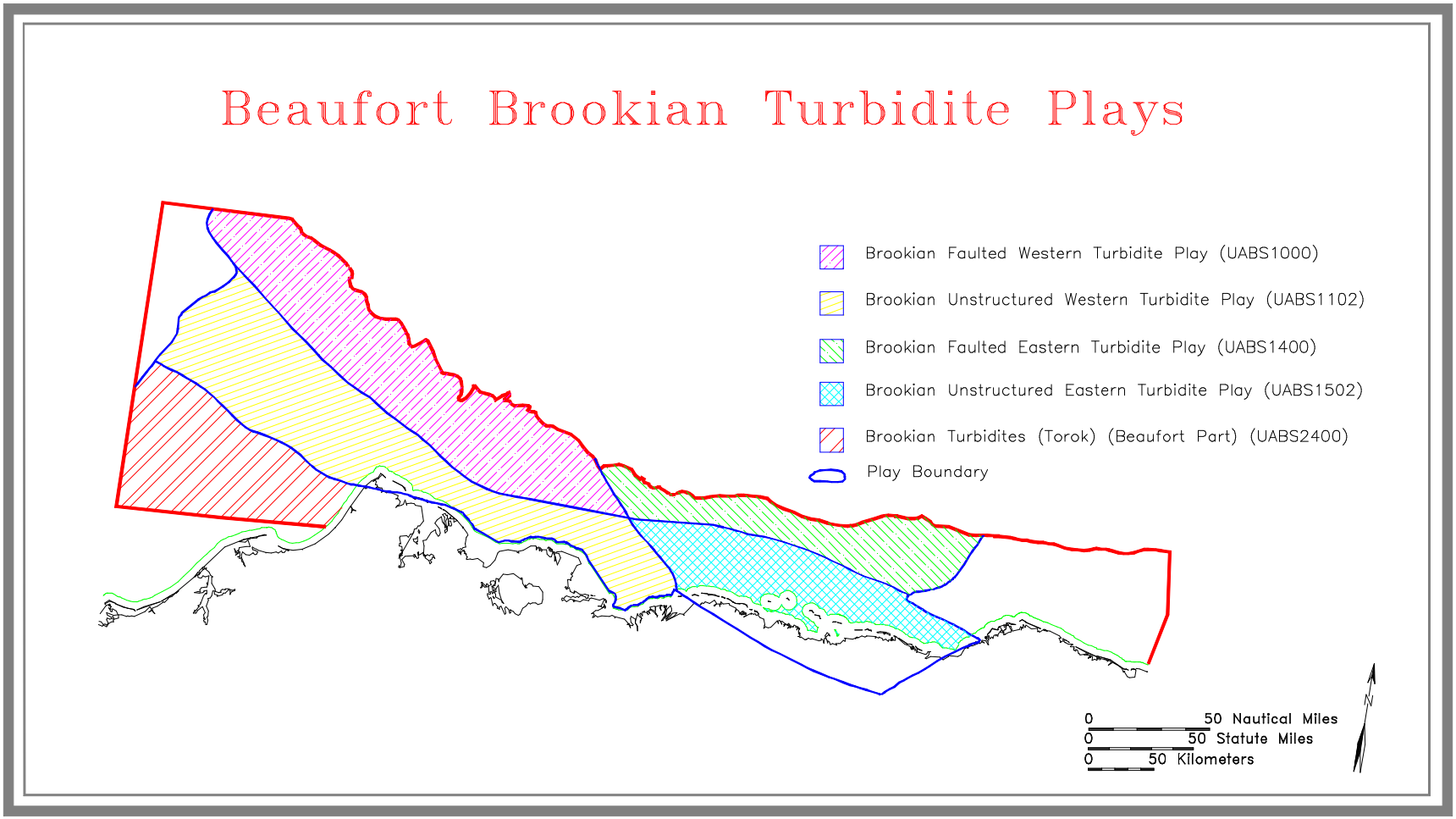


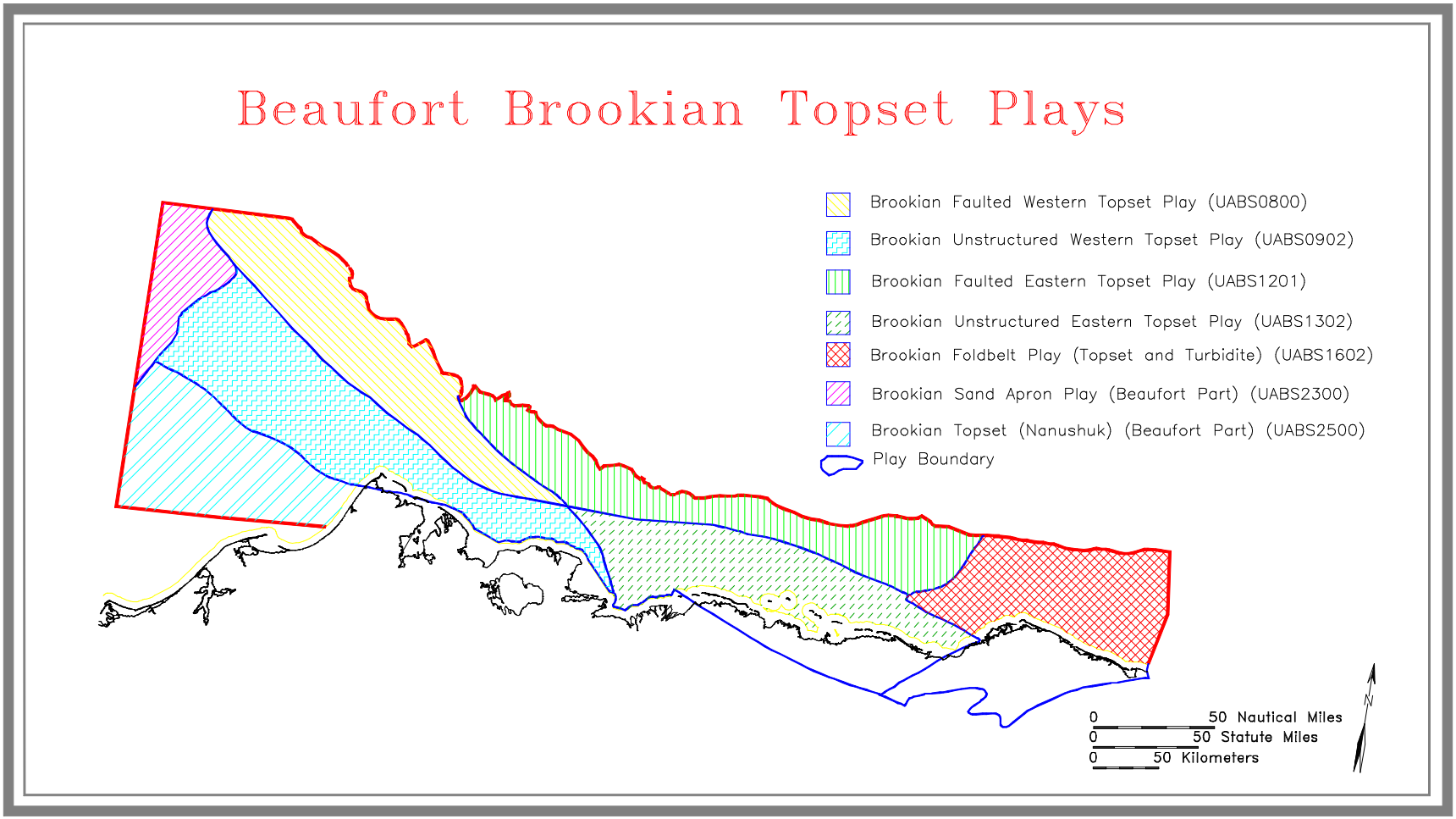
BEAUFORT SHELF - RIFT SEQUENCE PLAYS



BEAUFORT SHELF - BROOKIAN TURBIDITE PLAYS



BEAUFORT SHELF - BROOKIAN TOPSET PLAYS



EXPLANATION OF DATA TABLES FOR BEAUFORT SHELF ASSESSMENT PROVINCE

RESULTS

LOG-N PARAMS (PORE) — Key mathematic parameters that describe log-normal probability distributions for volume of hydrocarbon-bearing rock, in acre-feet, for each play as reported in the **PORE** module of **GRASP**.

- **mu** — Natural logarithm of F50 value of log-normal distribution for volume of hydrocarbon-bearing rock, or "μ", for the subject play. **mu** = ln F50. [Note: distribution **mean** = $e^{(mu + 0.5[sig. sq.])}$.]
- **sig. sq.** — The variance of the log-normal distribution for volume of hydrocarbon-bearing rock, or "σ^2", for the subject play. **sig. sq.** = $\{\ln [0.5((F50/F16)+(F84/F50))]\}^2$.

N (MPRO) — Number of hydrocarbon pools calculated for the plays by the **MPRO** module of **GRASP** from inputs for probability distributions of prospect numbers and geologic chances of success (approximately the product of play and prospect chances of success) . The maximum (**Max**) number of pools for each play was entered into the **MONTE1** module of **GRASP** to fix the number of pools aggregated to calculate play resources.

Reserves — Sums of recoverable oil and gas volumes for pools within the play, including both proven and inferred reserve categories. A "prop" entry indicates that the reserve data are proprietary.

- **BCF** — Billions of cubic feet of gas, recoverable, at standard (surface) conditions (here fixed at a temperature of 60° Fahrenheit or 520° Rankine, and 14.73 psi atmospheric pressure).
- **MMB** — Millions of barrels of oil, recoverable, at standard (surface) conditions.

Undiscovered Potential — Risked, undiscovered, conventionally recoverable oil and gas resources of the play, here reported at **Means** of probability distributions.

EXPLANATION OF DATA TABLES FOR BEAUFORT SHELF ASSESSMENT PROVINCE

Mean Pool Sizes of Ranks 1 to 3 Unrisked (or conditional) mean volumes of recoverable oil and gas in the three largest pools in the play.

PLAY INPUT DATA

F100.....F00 Fractiles for values within probability distributions entered to **GRASP** for calculations of play resources. Four-point distributions (F100, F50, F02, F00) generally indicate that calculations were conducted using log-normal mathematics. Eight-point distributions generally indicate that calculations were conducted using Monte Carlo mathematics. Choice of mathematic approach was in most cases the option of the assessor.

Prospect Area Maximum area of prospect closure, or area within spill contour, in acres. Probability distributions for prospect areas were generally based on distributions assembled independently for each play from large numbers of prospects mapped with seismic reflection data.

Trap Fill Trap fill fraction, or fraction of prospect area in which the reservoir is predicted to be saturated by hydrocarbons.

Pool Area Areal extent of hydrocarbon-saturated part of prospect, in acres. Calculated using **PRASS**, or **SAMPLER** module of **GRASP**, to integrate input probability distributions for prospect areas and trap fill fractions.

Pay Thickness Thickness of hydrocarbon-productive part of reservoir within pool areas, in feet. Probability distributions for prospect areas, trap fill fractions, and pay thicknesses are integrated in the **PORE** module of **GRASP**, to calculate a probability distribution for volume of hydrocarbon-bearing rock, in feet, within the play as reported above under **LOG-N PARAMS (PORE)** .

EXPLANATION OF DATA TABLES FOR BEAUFORT SHELF ASSESSMENT PROVINCE

Oil Yield (Recov. B/Acre-Feet) Oil, in barrels at standard (surface) conditions, recoverable from a volume of one acre-foot of oil-saturated reservoir in the subsurface. Oil yield probability distributions were generally calculated in a separate exercise using **PRASS** to integrate input probability distributions for porosities, oil saturations, oil shrinkage factors (or "Formation Volume Factors"), and oil recovery efficiencies.

Gas Yield (MMCF/Ac.-Ft.) Gas, in millions of cubic feet at standard (surface) conditions, recoverable from a volume of one acre-foot of gas-saturated reservoir in the subsurface. Distributions were generally calculated in a separate exercise using **PRASS** to integrate input probability distributions for porosities, gas saturations, reservoir pressures, reservoir temperatures (in degrees Rankine), gas deviation ("Z") factors, combustible fractions (that exclude noncombustibles such as carbon dioxide, nitrogen, etc.), and gas recovery efficiencies.

Solution Gas-Oil Ratio (CF/B) Quantity of gas dissolved in oil in the reservoir that separates from the oil when brought to standard (surface) conditions, in cubic feet recovered per barrel of produced oil.

Gas Cond. (B/MMCF) Quantity of liquids or condensate dissolved in gas in the reservoir that separates from the gas when brought to standard (surface) conditions, in barrels recovered per million cubic feet of produced gas.

Number of Prospects..... Probability distributions for numbers of prospects in plays, generally ranging from minimum values (F99) representing the numbers of mapped prospects, to maximum values (F00) that include speculative estimates for the numbers of additional prospects that remain unidentified (generally stratigraphic prospects, geophysically indefinite prospects, or prospects expected in areas with no seismic coverage).

EXPLANATION OF DATA TABLES FOR BEAUFORT SHELF ASSESSMENT PROVINCE

Probabilities for Oil, Gas, or Mixed Pools

Oil (OPROB) Fraction of hydrocarbon pools that consist entirely of oil, with no free gas present. Typically, an undersaturated oil pool.

Gas (GPROB) Fraction of hydrocarbon pools consisting entirely of gas, with no free oil present.

Mixed (MXPROB) Fraction of hydrocarbon pools that contain both oil and gas as free phases, the gas usually present as a gas cap overlying the oil.

Fraction of Net Pay to Oil (OFRAC) When a hydrocarbon pool is modeled as a mixed case, with both oil and gas present, the fraction of pool volume that is saturated by oil in the subsurface.

Play Chance Success Probability that the play contains at least one pool of technically-recoverable hydrocarbons (that would flow into a conventional wellbore in a flow test or during production).

Prospect Chance Success The fraction of prospects within the play that are predicted to contain hydrocarbon pools, given the condition that at least one pool of technically-recoverable hydrocarbons occurs within the play.

Play Type (E-F-C) Play classification scheme.

E **Established** play, in which significant numbers of fields have been discovered, providing the assessor with data for pool size distributions and reservoirs sufficient to allow the assessor to model the play with confidence.

F **Frontier** play, where exploration activities are at an early stage. Some wells have already been drilled to test the play concept but no commercial fields have been established.

EXPLANATION OF DATA TABLES FOR BEAUFORT SHELF ASSESSMENT PROVINCE

C	**Conceptual** play, hypothesized by analysts based on the subsurface geologic knowledge of the area. Such plays remain hypothetical and the play concept has not been tested.

BEAUFORT SHELF

				Log-N Params.							
				PORE		N (MPRO)		Reserves		Undiscovered Potentia	
Play				Ac/Ft	Ac/Ft	No. Pools		Gas	Oil	Gas	Oil
No.	Area	UAI Code	Name	mu	sig. sq.	Mean	Max	(BCF)	(MMB)	(BCF)	(MMB)
101	Beaufort Shelf	UABS0101	Undeformed Pre-Mississippian Basement	10.312	2.9727	1	7	0	0	28	6
200	Beaufort Shelf	UABS0200	Pre-Devonian	14.061	1.4114	7	19	0	0	3534	173
401	Beaufort Shelf	UABS0401	Endicott w/o portion shared w/ Chukchi	11.652	2.1036	2	4	prop	prop	109	37
501	Beaufort Shelf	UABS0501	Lisburne w/o portion shared w/ Chukchi	11.742	3.4314	3	16	0	0	452	208
601	Beaufort Shelf	UABS0601	Upper Ellesmer. w/o portion shared w/ Chukchi	13.069	2.4728	5	15	prop	prop	1834	763
701	Beaufort Shelf	UABS0701	Rift w/o portion shared w/ Chukchi	12.461	2.5452	40	78	0	0	2559	910
800	Beaufort Shelf	UABS0800	Brookian Faulted Western Topset	11.662	2.6113	4	26	0	0	1570	82
902	Beaufort Shelf	UABS0902	Brookian Unstructured Western Topset	12.171	2.5478	1	6	0	0	211	146
1000	Beaufort Shelf	UABS1000	Brookian Faulted Western Turbidite	11.740	1.4290	2	13	0	0	601	29
1102	Beaufort Shelf	UABS1102	Brookian Unstructured Western Turbidite	11.803	1.5497	1	6	0	0	133	57
1201	Beaufort Shelf	UABS1201	Brookian Faulted Eastern Topset	12.230	2.4715	18	53	0	0	16074	1048
1302	Beaufort Shelf	UABS1302	Brookian Unstructured Eastern Topset	12.379	2.2277	3	9	prop	prop	813	1648
1400	Beaufort Shelf	UABS1400	Brookian Faulted Eastern Turbidite	11.562	1.8586	17	53	0	0	3585	183
1502	Beaufort Shelf	UABS1502	Brookian Unstructured Eastern Turbidite	11.249	2.4943	1	4	0	0	90	42
1602	Beaufort Shelf	UABS1602	Brookian Foldbelt	12.085	1.9114	20	45	0	0	3188	2038
1800	Beaufort Shelf	UABS1800	Endicott portion shared w/ Chukchi	12.174	2.0180	0	5	0	0	12	1
1900	Beaufort Shelf	UABS1900	Lisburne portion shared w/ Chukchi	12.724	1.3470	1	11	0	0	65	18
2000	Beaufort Shelf	UABS2000	Ellesmerian deep gas shared w/ Chukchi	12.836	0.9630	2	19	0	0	150	4
2100	Beaufort Shelf	UABS2100	Upper Ellsemerian portion shared w/ Chukchi	13.638	1.0550	5	22	0	0	1391	497
2200	Beaufort Shelf	UABS2200	Rift portion shared w/ Chukchi	13.081	1.6320	10	31	0	0	2166	606
2300	Beaufort Shelf	UABS2300	Sand Apron shared w/ Chukchi	13.971	2.3430	2	17	0	0	4895	291
2400	Beaufort Shelf	UABS2400	Turbidites (Torok) shared w/ Chukchi	12.669	0.3370	0	5	0	0	8	3
2500	Beaufort Shelf	UABS2500	Topset (Nanushuk) shared w/ Chukchi	12.232	0.6400	1	8	0	0	34	44

BEAUFORT SHELF

		MEAN POOL SIZES OF RANKS 1 TO 3						INPUT DATA					
		Pool #1		Pool #2		Pool #3							
PLAY		Gas	Oil	Gas	Oil	Gas	Oil	Prospect Area (Acres)					
No.	Name	(BCF)	(MMB)	(BCF)	(MMB)	(BCF)	(MMB)	F100	F95	F75	F50	F25	F05
101	Undeformed Pre-Mississippian Basement	84	21	24	6	11	3	1	39	197	609	1879	9505
200	Pre-Devonian	1891	39	876	21	554	12	1400	12000	40000	52000	100000	240000
401	Endicott w/o portion shared w/ Chukchi	disc. (Tern Is.)		94	34	44	16	100	800	2000	4000	8000	20000
501	Lisburne w/o portion shared w/ Chukchi	347	155	78	32	30	13	6	185	922	2812	8579	42692
601	Upper Ellesmer. w/o portion shared w/ Chukchi	1665	662	disc. (Seal Is.)		154	60	16	396	1732	4833	13484	58990
701	Rift w/o portion shared w/ Chukchi	not computed						Pool size dist. from fields in play.					
800	Brookian Faulted Western Topset	1304	57	370	17	174	8	18	315	1191	3000	7558	28556
902	Brookian Unstructured Western Topset	285	182	67	44	6	26	32	543	2012	5000	12429	46063
1000	Brookian Faulted Western Turbidite	508	22	191	9	108	5	163	1099	2683	4990	9280	22655
1102	Brookian Unstructured Western Turbidite	137	66	47	23	27	13	142	1072	2752	5200	10208	26211
1201	Brookian Faulted Eastern Topset	6908	305	2791	128	1701	76	38	597	2165	5300	12978	47067
1302	Brookian Unstructured Eastern Topset	201	905	disc. (Kuvlum)		229	182	60	800	2677	6200	14360	48079
1400	Brookian Faulted Eastern Turbidite	1393	62	649	30	427	19	69	676	1972	4150	8734	25477
1502	Brookian Unstructured Eastern Turbidite	100	47	23	11	11	5	22	343	1233	3000	7301	26246
1602	Brookian Foldbelt	1041	681	484	317	309	210	108	1107	3286	7000	14911	44259
1800	Endicott portion shared w/ Chukchi	98	5	32	2	18	1	42			6434		
1900	Lisburne portion shared w/ Chukchi	100	28	39	11	23	7	242			11148		
2000	Ellesmerian deep gas shared w/ Chukchi	143	4	67	2	44	1	472			12477		
2100	Upper Ellsemerian portion shared w/ Chukchi	939	315	472	158	306	106	277			9733		
2200	Rift portion shared w/ Chukchi	840	253	372	112	228	71	117			11153		
2300	Sand Apron shared w/ Chukchi	4598	114	1352	248	627	114	42			8519		
2400	Turbidites (Torok) shared w/ Chukchi	52	18	35	12	29	10	1370			7393		
2500	Topset (Nanushuk) shared w/ Chukchi	47	60	26	33	19	25	559			6819		

BEAUFORT SHELF

		INPUT DATA											
PLAY		Prospect Area (Acres)			Trap Fill (Dec. Frac.)								
No.	Name	F02	F01	F00	F100	F95	F75	F50	F25	F05	F02	F01	F00
101	Undeformed Pre-Mississippian Basement		18821	29677	0.10	0.14	0.29	0.50	0.76	0.95		0.99	1.00
200	Pre-Devonian		420000	860000	0.05	0.05	0.08	0.10	0.15	0.19		0.20	0.20
401	Endicott w/o portion shared w/ Chukchi		40000	50000	0.10	0.14	0.29	0.50	0.76	0.95		0.99	1.00
501	Lisburne w/o portion shared w/ Chukchi		131760	150000	0.10	0.14	0.29	0.50	0.76	0.95		0.99	1.00
601	Upper Ellesmer. w/o portion shared w/ Chukchi		109870	166320	0.10	0.14	0.29	0.50	0.76	0.95		0.99	1.00
701	Rift w/o portion shared w/ Chukchi	Pool size dist. from fields in play.											
800	Brookian Faulted Western Topset		72635	489440	0.10	0.14	0.29	0.50	0.76	0.95		0.99	1.00
902	Brookian Unstructured Western Topset		115590	757600	0.10	0.14	0.29	0.50	0.76	0.95		0.99	1.00
1000	Brookian Faulted Western Turbidite		42404	152670	0.10	0.14	0.29	0.50	0.76	0.95		0.99	1.00
1102	Brookian Unstructured Western Turbidite		50829	196740	0.10	0.14	0.29	0.50	0.76	0.95		0.99	1.00
1201	Brookian Faulted Eastern Topset		116320	739080	0.10	0.14	0.29	0.50	0.76	0.95		0.99	1.00
1302	Brookian Unstructured Eastern Topset		112340	636340	0.10	0.14	0.29	0.50	0.76	0.95		0.99	1.00
1400	Brookian Faulted Eastern Turbidite		54034	251150	0.10	0.14	0.29	0.50	0.76	0.95		0.99	1.00
1502	Brookian Unstructured Eastern Turbidite		64446	404420	0.10	0.14	0.29	0.50	0.76	0.95		0.99	1.00
1602	Brookian Foldbelt		95023	452840	0.10	0.14	0.29	0.50	0.76	0.95		0.99	1.00
1800	Endicott portion shared w/ Chukchi	103530		984920	0.08			0.43			0.68		1.00
1900	Lisburne portion shared w/ Chukchi	92425		513590	0.08			0.43			0.68		1.00
2000	Ellesmerian deep gas shared w/ Chukchi	76087		329600	0.08			0.43			0.68		1.00
2100	Upper Ellsemerian portion shared w/ Chukchi	69421		341470	0.08			0.43			0.68		1.00
2200	Rift portion shared w/ Chukchi	137970		1060600	0.08			0.43			0.68		1.00
2300	Sand Apron shared w/ Chukchi	190620		1896300	0.17			0.66			0.87		1.00
2400	Turbidites (Torok) shared w/ Chukchi	18756		39901	0.08			0.43			0.68		1.00
2500	Topset (Nanushuk) shared w/ Chukchi	27127		83112	0.08			0.43			0.68		1.00

BEAUFORT SHELF

PLAY		INPUT DATA													
		Pool Area (Acres)									Pay Thickness (Feet)				
No.	Name	F100	F95	F75	F50	F25	F05	F02	F01	F00	F100	F95	F75	F50	F25
101	Undeformed Pre-Mississippian Basement	1			301			8720		133640	14			100	
200	Pre-Devonian	170			6269			45900		230610	16			204	
401	Endicott w/o portion shared w/ Chukchi	30			1915			19032		122500	2			60	
501	Lisburne w/o portion shared w/ Chukchi	2			1397			48814		87088	8			90	
601	Upper Ellesmer. w/o portion shared w/ Chukchi	9			2371			52465		646250	38			200	
701	Rift w/o portion shared w/ Chukchi	50			6454			95000		840820	1			40	
800	Brookian Faulted Western Topset	6			1451			34229		371230	13			80	
902	Brookian Unstructured Western Topset	10			2413			54546		574970	13			80	
1000	Brookian Faulted Western Turbidite	33			2368			21209		117930	7			53	
1102	Brookian Unstructured Western Turbidite	30			2523			25305		151560	7			53	
1201	Brookian Faulted Eastern Topset	12			2561			54956		561290	13			80	
1302	Brookian Unstructured Eastern Topset	16			2973			53685		484580	13			80	
1400	Brookian Faulted Eastern Turbidite	17			1982			25933		192300	7			53	
1502	Brookian Unstructured Eastern Turbidite	7			1449			30584		307220	7			53	
1602	Brookian Foldbelt	26			3343			45715		346470	7			53	
1800	Endicott portion shared w/ Chukchi	17			2767			46221		453330	10			70	
1900	Lisburne portion shared w/ Chukchi	95			4794			41742		241380	23			70	
2000	Ellesmerian deep gas shared w/ Chukchi	183			5365			34643		157190	18			70	
2100	Upper Ellsemerian portion shared w/ Chukchi	108			4185			31468		161540	100			200	
2200	Rift portion shared w/ Chukchi	47			4795			61836		491560	34			100	
2300	Sand Apron shared w/ Chukchi	22			5844			127540		1553400	60			200	
2400	Turbidites (Torok) shared w/ Chukchi	485			3179			8973		20814	34			100	
2500	Topset (Nanushuk) shared w/ Chukchi	210			2932			12561		40867	18			70	

BEAUFORT SHELF

		INPUT DATA															
PLAY		Pay Thickness (Feet)				Oil Yield (Recov. B/ Acre-Foot)								Gas Yield (MMCF/Ac.-Ft)			
No.	Name	F05	F02	F01	F00	F100	F95	F75	F50	F25	F05	F01	F00	F100	F95	F75	F50
101	Undeformed Pre-Mississippian Basement		300		731	11	27	40	52	69	103	136	242	0.074	0.143	0.195	0.241
200	Pre-Devonian		836		2624	5	13	20	59	92	174	272	682	0.006	0.033	0.072	0.124
401	Endicott w/o portion shared w/ Chukchi		400		1862	34	94	149	207	286	458	636	1245	0.107	0.286	0.452	0.621
501	Lisburne w/o portion shared w/ Chukchi		350		1053	24	55	81	105	138	203	267	464	0.019	0.060	0.104	0.151
601	Upper Ellesmer. w/o portion shared w/ Chukchi		500		1051	28	74	117	162	223	355	491	953	0.081	0.224	0.361	0.503
701	Rift w/o portion shared w/ Chukchi		260		1186	32	81	125	169	228	351	476	884	0.048	0.173	0.317	0.483
800	Brookian Faulted Western Topset		220		500	115	220	298	367	453	613	758	1171	0.178	0.424	0.637	0.845
902	Brookian Unstructured Western Topset		220		500	59	118	163	204	255	352	442	702	0.173	0.414	0.623	0.828
1000	Brookian Faulted Western Turbidite		160		392	42	98	145	190	250	371	488	858	0.128	0.364	0.592	0.830
1102	Brookian Unstructured Western Turbidite		160		392	42	98	145	190	250	371	488	858	0.122	0.343	0.558	0.781
1201	Brookian Faulted Eastern Topset		220		500	133	249	333	408	500	669	821	1248	0.211	0.534	0.825	1.117
1302	Brookian Unstructured Eastern Topset		220		500	68	133	182	227	282	385	479	750	0.224	0.439	0.601	0.747
1400	Brookian Faulted Eastern Turbidite		160		392	29	73	111	149	200	306	412	756	0.128	0.331	0.517	0.704
1502	Brookian Unstructured Eastern Turbidite		160		392	29	73	111	149	200	306	412	756	0.118	0.305	0.476	0.648
1602	Brookian Foldbelt		160		392	61	133	192	248	320	462	598	1012	0.051	0.234	0.477	0.782
1800	Endicott portion shared w/ Chukchi		150		350	2	11	23	39	65	137	231	668	0.005	0.030	0.065	0.110
1900	Lisburne portion shared w/ Chukchi		190		427	2	7	14	23	37	73	118	314	0.006	0.029	0.059	0.098
2000	Ellesmerian deep gas shared w/ Chukchi		150		278	not used								0.001	0.011	0.030	0.058
2100	Upper Ellsemerian portion shared w/ Chukchi		370		609	6	25	47	73	114	215	335	833	0.017	0.081	0.170	0.285
2200	Rift portion shared w/ Chukchi		180		290	5	18	34	53	83	157	247	618	0.013	0.065	0.139	0.236
2300	Sand Apron shared w/ Chukchi		370		650	8	33	66	107	174	348	567	1535	0.007	0.049	0.125	0.239
2400	Turbidites (Torok) shared w/ Chukchi		180		290	6	19	33	48	70	122	179	392	0.031	0.097	0.165	0.238
2500	Topset (Nanushuk) shared w/ Chukchi		150		278	47	113	170	225	299	448	597	1069	0.006	0.028	0.057	0.094

BEAUFORT SHELF

		INPUT DATA															
PLAY		Gas Yield (MMCF/Ac.-Ft)				Solution Gas Oil Ratio (CF/B)								Gas Cond. (B/MMCF)			
No.	Name	F25	F05	F01	F00	F100	F95	F75	F50	F25	F05	F01	F00	F100	F95	F75	F50
101	Undeformed Pre-Mississippian Basement	0.298	0.405	0.502	0.779	19	165	449	900	1806	4917	9938	41850	14	42	70	100
200	Pre-Devonian	0.231	0.465	0.803	2.460	19	165	449	900	1806	4917	9938	41850	0	2	5	10
401	Endicott w/o portion shared w/ Chukchi	0.855	1.350	1.870	3.600	19	165	449	900	1806	4917	9938	41850	0	3	8	15
501	Lisburne w/o portion shared w/ Chukchi	0.220	0.379	0.555	1.210	19	164	449	900	1806	4917	9938	41850	0	2	5	10
601	Upper Ellesmer. w/o portion shared w/ Chukchi	0.699	1.130	1.570	3.110	19	165	449	900	1806	4917	9938	41850	0	2	5	10
701	Rift w/o portion shared w/ Chukchi	0.735	1.350	2.060	4.900	19	165	449	900	1806	4917	9938	41850	0	3	8	15
800	Brookian Faulted Western Topset	1.122	1.685	2.242	4.019	38	96	148	200	270	417	565	1051	8	19	30	40
902	Brookian Unstructured Western Topset	1.099	1.653	2.202	3.955	38	96	148	200	270	417	565	1051	8	19	30	40
1000	Brookian Faulted Western Turbidite	1.165	1.896	2.668	5.368	68	229	404	600	891	1573	2347	5309	8	19	30	40
1102	Brookian Unstructured Western Turbidite	1.095	1.778	2.500	5.014	68	229	404	600	891	1573	2347	5309	8	19	30	40
1201	Brookian Faulted Eastern Topset	1.511	2.335	3.169	5.918	38	96	148	200	270	417	565	1051	8	19	30	40
1302	Brookian Unstructured Eastern Topset	0.930	1.273	1.587	2.490	38	96	148	200	270	417	565	1051	8	19	30	40
1400	Brookian Faulted Eastern Turbidite	0.958	1.495	2.043	3.867	68	229	404	600	891	1573	2347	5309	8	19	30	40
1502	Brookian Unstructured Eastern Turbidite	0.883	1.379	1.885	3.570	68	229	404	600	891	1573	2347	5309	8	19	30	40
1602	Brookian Foldbelt	1.284	2.619	4.322	12.022	38	96	148	200	270	417	565	1051	8	19	30	40
1800	Endicott portion shared w/ Chukchi	0.189	0.408	0.703	2.127	170	520	800	1100	1500	2300	3100	7000	20	35	42	52
1900	Lisburne portion shared w/ Chukchi	0.162	0.336	0.560	1.594	230	750	1300	1700	2300	3800	5200	10000	20	35	42	52
2000	Ellesmerian deep gas shared w/ Chukchi	0.115	0.305	0.605	2.454	not used								10	17	22	25
2100	Upper Ellsemerian portion shared w/ Chukchi	0.477	1.000	1.684	4.879	220	600	900	1200	1600	2500	3100	6000	20	35	42	52
2200	Rift portion shared w/ Chukchi	0.400	0.856	1.181	4.361	250	680	1000	1300	1800	2700	3600	7000	20	35	42	52
2300	Sand Apron shared w/ Chukchi	0.458	1.166	2.248	8.595	800	1700	2200	2800	3300	4400	5500	9000	10	17	22	25
2400	Turbidites (Torok) shared w/ Chukchi	0.345	0.585	0.849	1.814	900	1020	1070	1100	1120	1140	1200	1300	20	35	42	52
2500	Topset (Nanushuk) shared w/ Chukchi	0.155	0.318	0.526	1.474	490	530	550	570	590	600	620	680	20	35	42	52

BEAUFORT SHELF

PLAY		INPUT DATA											
		Gas Cond. (B/MMCF)				Number of Prospects in Play							
No.	Name	F25	F05	F01	F00	F99	F95	F75	F50	F25	F05	F01	F00
101	Undeformed Pre-Mississippian Basement	143	241	347	731	7	9	14	21	28	34	35	36
200	Pre-Devonian	22	65	140	682	9	10	11	13	15	17	18	19
401	Endicott w/o portion shared w/ Chukchi	28	70	133	491	5	7	11	18	25	32	33	34
501	Lisburne w/o portion shared w/ Chukchi	22	65	140	682	23	27	33	39	43	53	61	62
601	Upper Ellesmer. w/o portion shared w/ Chukchi	22	65	140	682	31	34	41	44	50	56	62	63
701	Rift w/o portion shared w/ Chukchi	28	70	133	491	27	32	41	46	54	70	81	82
800	Brookian Faulted Western Topset	54	83	113	210	9	11	13	14	16	19	21	27
902	Brookian Unstructured Western Topset	54	83	113	210	2	2	3	3	4	5	5	7
1000	Brookian Faulted Western Turbidite	54	83	113	210	6	7	8	8	9	10	11	14
1102	Brookian Unstructured Western Turbidite	54	83	113	210	2	2	3	3	4	5	5	7
1201	Brookian Faulted Eastern Topset	54	83	113	210	33	37	40	43	46	51	55	62
1302	Brookian Unstructured Eastern Topset	54	83	113	210	3	5	5	6	6	7	8	10
1400	Brookian Faulted Eastern Turbidite	54	83	113	210	33	36	39	42	45	50	54	61
1502	Brookian Unstructured Eastern Turbidite	54	83	113	210	1	1	2	2	2	3	3	4
1602	Brookian Foldbelt	54	83	113	210	37	40	46	49	53	60	65	77
1800	Endicott portion shared w/ Chukchi	55	68	75	100	4	4.5	5	6	6.2	7	8	10
1900	Lisburne portion shared w/ Chukchi	55	68	75	100	17	18	20	22	23	27	28	35
2000	Ellesmerian deep gas shared w/ Chukchi	28	35	40	50	18	22	28	33	39	50	60	90
2100	Upper Ellsemerian portion shared w/ Chukchi	55	68	75	100	24	26	28	31	33	37	40	47
2200	Rift portion shared w/ Chukchi	55	68	75	100	9	10	13	15	17	22	25	36
2300	Sand Apron shared w/ Chukchi	28	35	40	50	20	22	26	30	33	39	44	57
2400	Turbidites (Torok) shared w/ Chukchi	55	68	75	100	3	3.6	5.6	5.7	6.6	9	10	15
2500	Topset (Nanushuk) shared w/ Chukchi	55	68	75	100	8	9	11	13	14	17	19	26

BEAUFORT SHELF

PLAY		INPUT DATA						
		Probabilities for Oil, Gas, or Mixed Pools			Fraction of Net	Play	Prospect	
		Oil	Gas	Mixed	Pay to Oil	Chance	Chance	Play Type
No.	Name	(OPROB)	(GPROB)	(MXPROB)	(OFRAC)	Success	Success	E - F - C
101	Undeformed Pre-Mississippian Basement	0.00	0.00	1.00	0.50	1.00	0.24	E
200	Pre-Devonian	0.00	0.67	0.33	0.76	0.75	0.66	F
401	Endicott w/o portion shared w/ Chukchi	0.00	0.00	1.00	0.75	1.00	0.75	E
501	Lisburne w/o portion shared w/ Chukchi	0.00	0.00	1.00	0.75	1.00	0.30	E
601	Upper Ellesmer. w/o portion shared w/ Chukchi	0.00	0.00	1.00	0.80	1.00	0.45	E
701	Rift w/o portion shared w/ Chukchi	0.45	0.45	0.10	0.75	1.00	0.81	E
800	Brookian Faulted Western Topset	0.00	0.80	0.20	0.75	0.80	0.32	F
902	Brookian Unstructured Western Topset	0.50	0.10	0.40	0.75	0.80	0.40	F
1000	Brookian Faulted Western Turbidite	0.00	0.90	0.10	0.75	0.80	0.32	F
1102	Brookian Unstructured Western Turbidite	0.00	0.00	1.00	0.75	1.00	0.32	F
1201	Brookian Faulted Eastern Topset	0.00	0.80	0.20	0.75	1.00	0.42	F
1302	Brookian Unstructured Eastern Topset	0.60	0.00	0.40	0.75	1.00	0.50	E
1400	Brookian Faulted Eastern Turbidite	0.00	0.90	0.10	0.75	0.90	0.43	F
1502	Brookian Unstructured Eastern Turbidite	0.00	0.00	1.00	0.75	1.00	0.49	E
1602	Brookian Foldbelt	0.00	0.00	1.00	0.75	1.00	0.32	F
1800	Endicott portion shared w/ Chukchi	0.00	0.90	0.10	0.70	0.40	0.05	C
1900	Lisburne portion shared w/ Chukchi	0.00	0.00	1.00	0.70	0.49	0.10	C
2000	Ellesmerian deep gas shared w/ Chukchi	0.00	1.00	0.00	0.00	0.54	0.10	C
2100	Upper Ellsemerian portion shared w/ Chukchi	0.00	0.00	1.00	0.70	0.60	0.24	C
2200	Rift portion shared w/ Chukchi	0.00	0.00	1.00	0.70	1.00	0.64	C
2300	Sand Apron shared w/ Chukchi	0.34	0.43	0.23	0.50	0.64	0.13	C
2400	Turbidites (Torok) shared w/ Chukchi	0.00	0.00	1.00	0.70	0.50	0.05	C
2500	Topset (Nanushuk) shared w/ Chukchi	0.00	0.00	1.00	0.70	1.00	0.06	C

EXPLANATION OF BEAUFORT SHELF PLAY SUMMARIES

This section consists of page-size compilations of graphics that summarize the results of ***GRASP*** modeling of the undiscovered, conventionally recoverable oil and gas endowments of each of the plays identified and assessed in the province. Each play summary features a plot for risked cumulative probability distributions for oil, gas, and BOE (gas in oil-equivalent barrels added to oil), a table of results, and a plot showing ranked sizes (oil and gas shown separately) of individual hypothetical pools. These three components of the play summaries are each described below.

Risked Cumulative Probability Distributions for Plays

Each play summary provides, at page top, cumulative probability distributions for risked, undiscovered endowments of conventionally recoverable oil, gas, and BOE. Oil and BOE quantities are shown in billions of barrels (B bbl). Gas quantities are reported in trillions of cubic feet (Tcf). Resource quantities are plotted against "Cumulative frequency greater than %." A cumulative frequency value represents the probability that the play resource endowment will exceed the quantity associated with the frequency value along one of the curves (fig. 0.1). Cumulative frequency values along the curves decrease as resource quantities increase. Accordingly, the cumulative frequencies, or "probabilities for exceedance," of small resource quantities are high, and conversely, the probabilities for exceedance of large resource quantities are low.

The cumulative probability distributions are risked and curves are truncated approximately at the output play chance. In most plays, the output play chance is equal to the input play chance for success. However, in plays with very small numbers of pools, the output play chance may be significantly **lower** than the input play chance for success.

The output play chance is derived from MPRO, a module within ***GRASP*** which uses inputs for geologic chance of success to convert probability distributions for numbers of ***prospects*** to probability distributions for numbers of ***pools***. The output play chance is obtained as a mathematic extrapolation to the probability at which the numbers of pools meets or exceeds zero. In plays with 5 or more pools at the mean, this probability usually equals the input play chance for success. In plays with less than 5 pools at the mean, the zero-pool probability (or output play chance) may be much less than the input play chance. Deviation between the output play chance and the input play chance is greatest in those plays with mean numbers of pools less than unity. Such highly risky plays contribute very little resources to overall province endowments.

Identification numbers beginning with "UA" in the graphics labels are codes unique to each of the plays in the ***GRASP*** data bases.

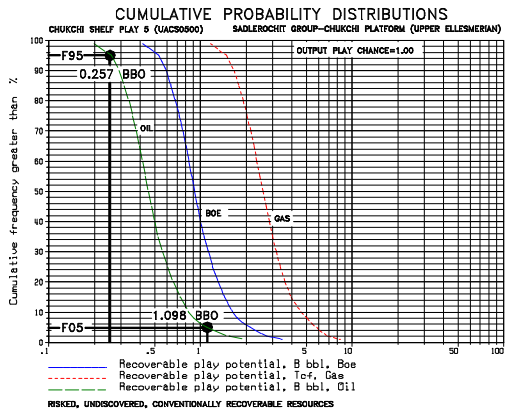
Table for Risked Play Resource Endowments

Each play summary provides, at page center, a table for risked, undiscovered play endowments of oil, gas, and BOE in billions of barrels of oil (BBO) or trillions of cubic feet of gas (TCFG). Quantities are reported at the **mean**, **F95** (a low estimate having a 95-percent frequency of exceedance), and **F05** (a high estimate having a 5-percent frequency of exceedance). Tabulated resource quantities are risked and therefore correspond to points on the cumulative probability distributions shown at page top. For plays with chances for success (play level) less than 0.95, the risked resource quantities reported at **F95** are zero.

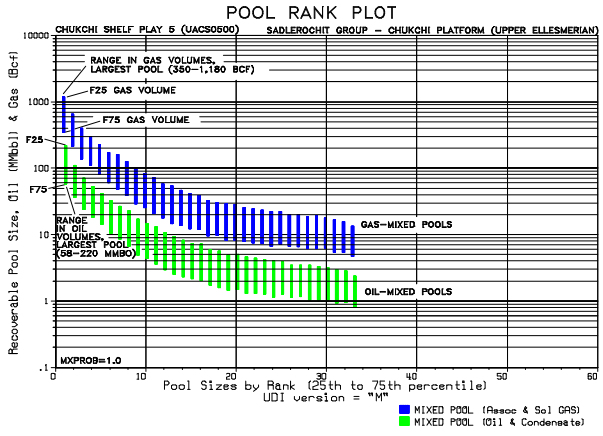
Ranked Pool Size Distributions for Plays

Each play summary provides, at page bottom, a plot showing pool sizes ranked according to size in BOE. The numbers of pools shown in the rank plots correspond to the maximum numbers of pools estimated to occur within the plays. Each pool in a pool rank plot is represented by a pair of adjoining vertical bars. The left bar of each pair represents the range (from **F75** to **F25** in the output probability distribution) of gas recoverable from the pool, and may include non-associated gas from an all-gas pool or associated gas from a gas cap and/or solution gas from oil, depending on pool type. The right bar of each pair represents the range (from **F75** to **F25**) of petroleum liquids recoverable from the same pool, and may include free oil, condensate from a gas cap, or condensate from a gas-only pool.

Volumes are shown in millions of barrels (MMbbl) of oil and billions of cubic feet (Bcf) of gas.



CHUKCHI SHELF PLAY 5 (UACS0500)			
FRACTILES	F95	MEAN	F05
GAS (TCFG)	1.478	2.993	5.823
OIL (BBO)	0.257	0.537	1.098
BOE (BBO)	0.530	1.069	2.125



The upper graph and the table report the volumes of risked, undiscovered, conventionally recoverable resources for the play. The graph, called a ***cumulative probability distribution***, shows three curves (oil, BOE, and gas) and reports the output play chance at upper right. The output play chance for Chukchi shelf play 5 is 1.0, meaning that there is a 100-percent chance that at least one hydrocarbon pool exists somewhere within the play. To illustrate how to read the graphs, dots have been placed on the ***oil*** curve at cumulative frequency values (vertical axis) of 95-percent and 5-percent. The corresponding oil quantities are 0.257 and 1.098 billions of barrels of oil. Thus, for Chukchi shelf play 5, there is a 95-percent chance that at least 0.257 billion barrels of oil are present and a 5-percent chance that more than 1.098 billion barrels are present. These same oil quantities are listed at F95 and F05 in the table.

The lower graph provides information about pool volumes and is called a ***pool rank plot***. This graph shows two sets of vertical bars, representing the quantities of oil and gas occurring ***together*** in 33 pools, the maximum number estimated to occur within this play. All pools in play 5 are modeled as mixed, that is, containing oil with a gas cap; other plays may also have all-gas or all-oil pools and show six separate commodities. Each pair of gas-oil bars in the play 5 pool rank plot shows the volume of oil in the pool and the volume of gas in the cap. The vertical bars extend across a range of possible volumes for each pool. The lower end of each bar represents the F75 resource quantity, meaning that the pool, if it exists, has a 75-percent chance of exceeding the corresponding resource quantity. Likewise, the upper end of each bar represents the F25 resource quantity. In Chukchi play 5, the largest pool offers oil volumes in the range from about 58 (F75) to 220 (F25) million barrels and gas volumes in the range from 350 (F75) to 1,180 (F25) billion cubic feet.

Figure 0.1: Sample play summary, Chukchi shelf play 5.

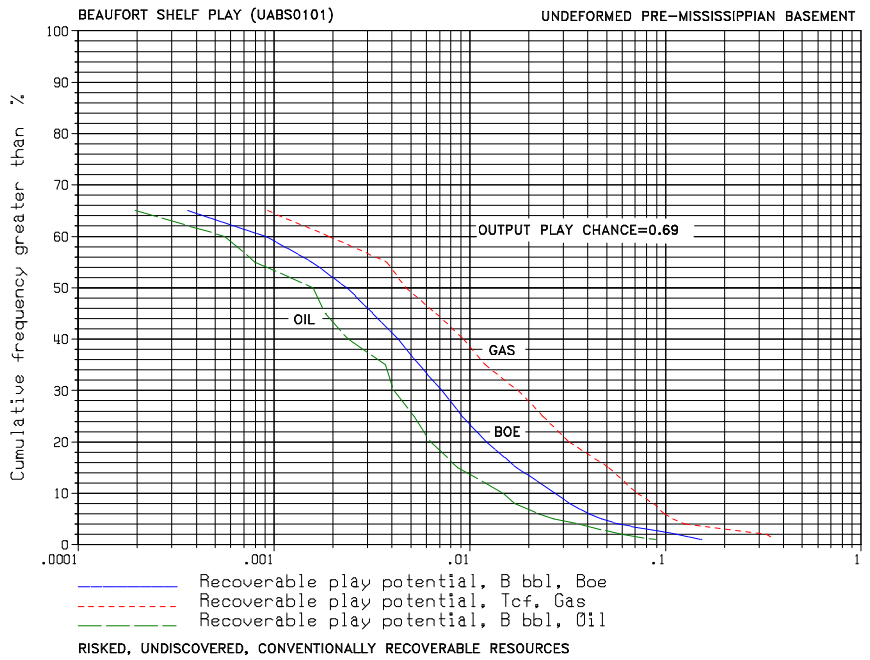
Extreme sizes outside the range between F75 and F25 volumes are not shown, but all pools offer (at low probabilities) high-side potential that may be several multiples of their median sizes (F50 or centers of vertical bars). For example, the largest pool in the pool rank plot in figure 0.1 shows F75-F25 ranges in oil volumes from 58 to 220 millions of barrels and gas volumes from 350 to 1,180 billions of cubic feet. But, these ranges do not capture the largest possible sizes of pool rank 1. This same pool has a 5-percent chance of containing over 600 million barrels of oil and 3,070 billion cubic feet of gas, or a 1-percent chance of containing over 1,140 million barrels of oil and 6,180 billion cubic feet of gas!

Although it might be interesting to portray the improbable yet extreme-high potential sizes of pools, choosing fractiles ranging up to F01 results in an uninformative plot where all pools nearly reach the top

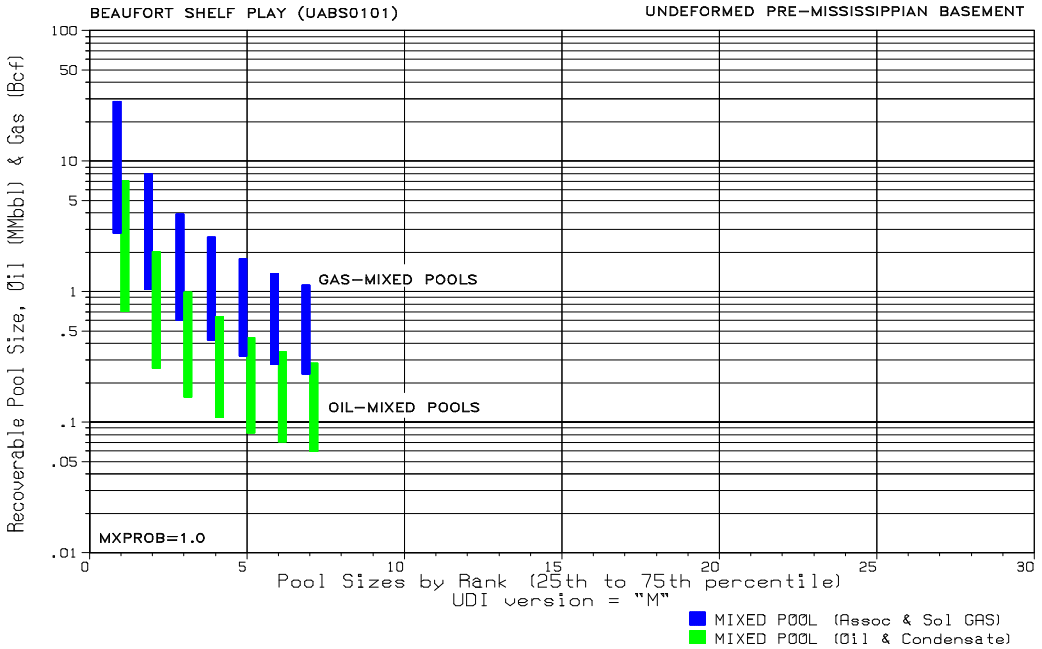
of the plot. For this presentation, a range based on F75-F25 values was chosen for visual clarity while still giving some impression of variance or spread.

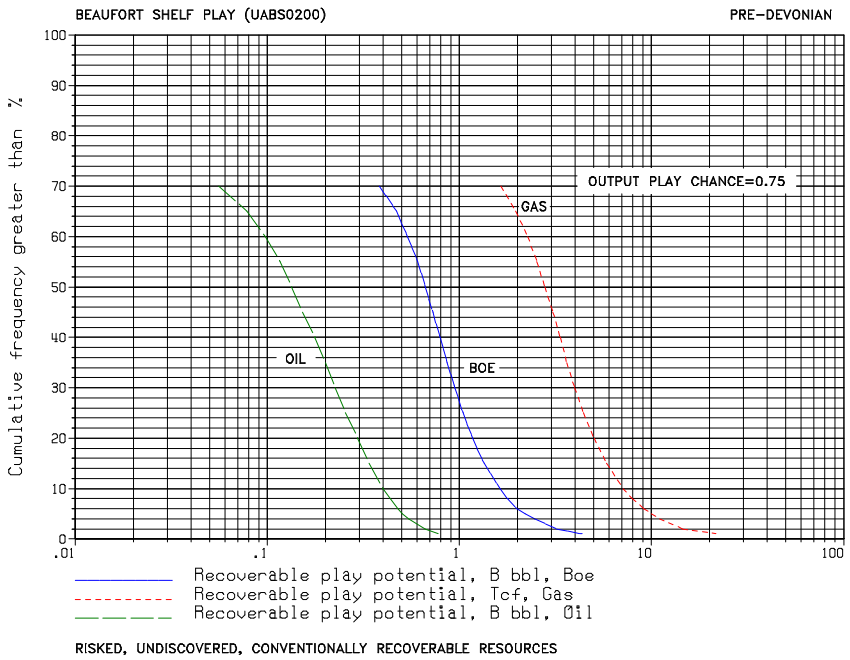
Pool volumes shown in the ranked plots are conditional upon success at the play level (i.e., a hydrocarbon pool existing ***somewhere*** within the play). The sizes of the pools posted in the rank plot have not been "risked", or multiplied against play chance of success. Therefore, except where the play chance of success equals 1.0, the sum of the mean sizes of the pools in the rank plot will exceed the risked mean play endowment that is reported in the table at page center. In fact, several of the largest pools, or even just the largest pool, may post conditional resources exceeding the risked play endowment.

Designation of pool types (oil-only, versus oil with gas cap, versus gas-only) within the play model was controlled by three data entries. Each play was assigned probabilities for (or frequencies of) occurrence of any of three pool types within the play—"OPROB" for oil-only pools, "GPROB" for gas-only pools, and "MXPROB" for mixed (oil and gas cap) pools. As the model recognizes only these three pool types, these three probability values always sum to 1.0. The three probability values control frequency of pool type sampling during ***GRASP*** runs, and, with a random number generator in ***GRASP***, ultimately dictate the sequence of pool types that appear in the play pool rank plots. The OPROB, GPROB, and/or MXPROB values that were used in the play models are posted, as appropriate, in the lower left corner of each pool rank plot.

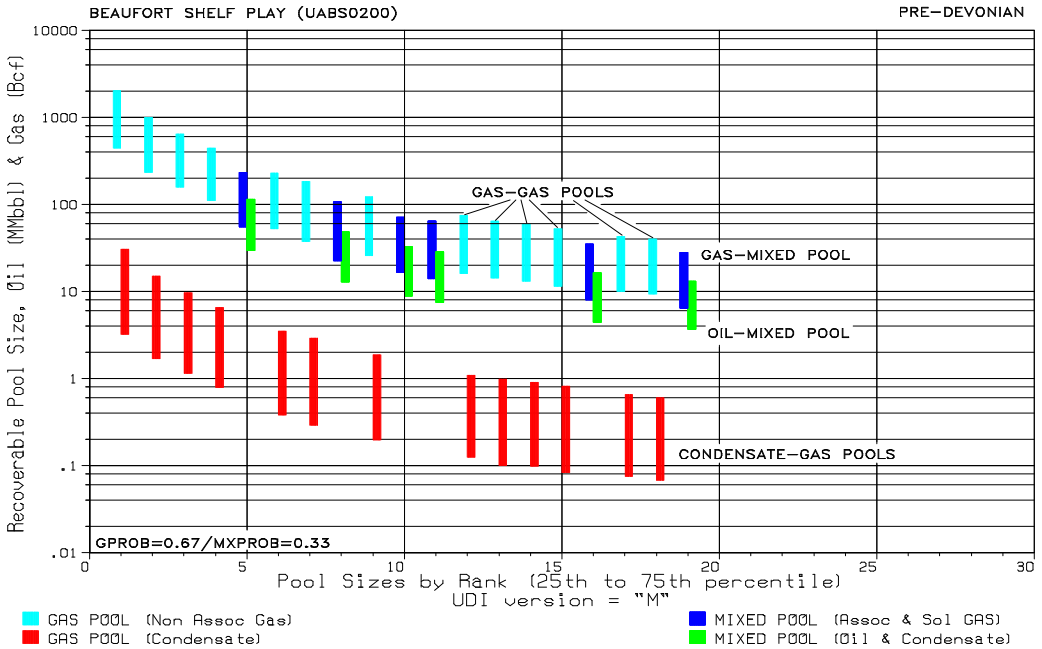


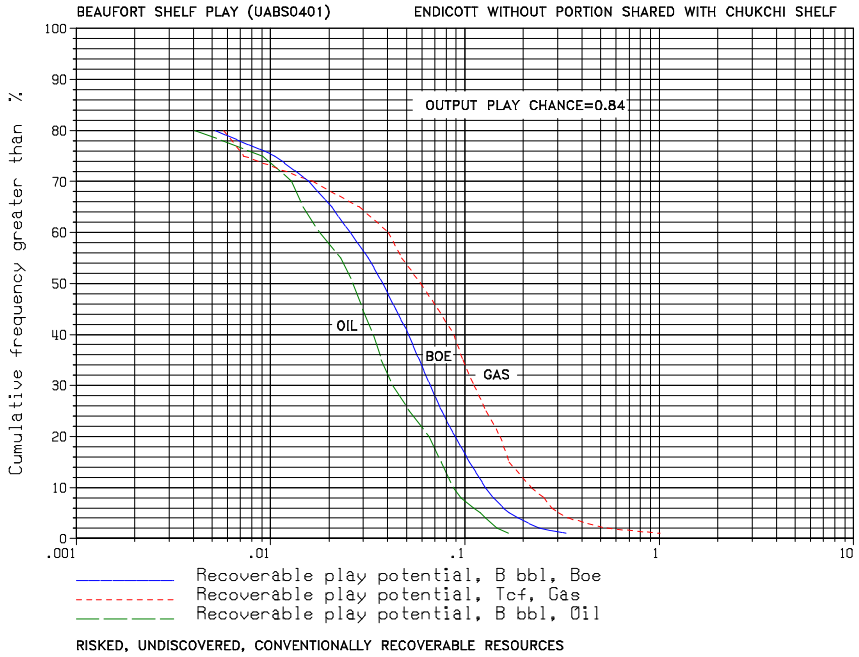
BEAUFORT SHELF PLAY (UABS0101)			
FRACTILES	**F95**	**MEAN**	**F05**
GAS (TCFG)	**0.000**	**0.028**	**0.109**
OIL (BBO)	**0.000**	**0.006**	**0.027**
BOE (BBO)	**0.000**	**0.011**	**0.047**



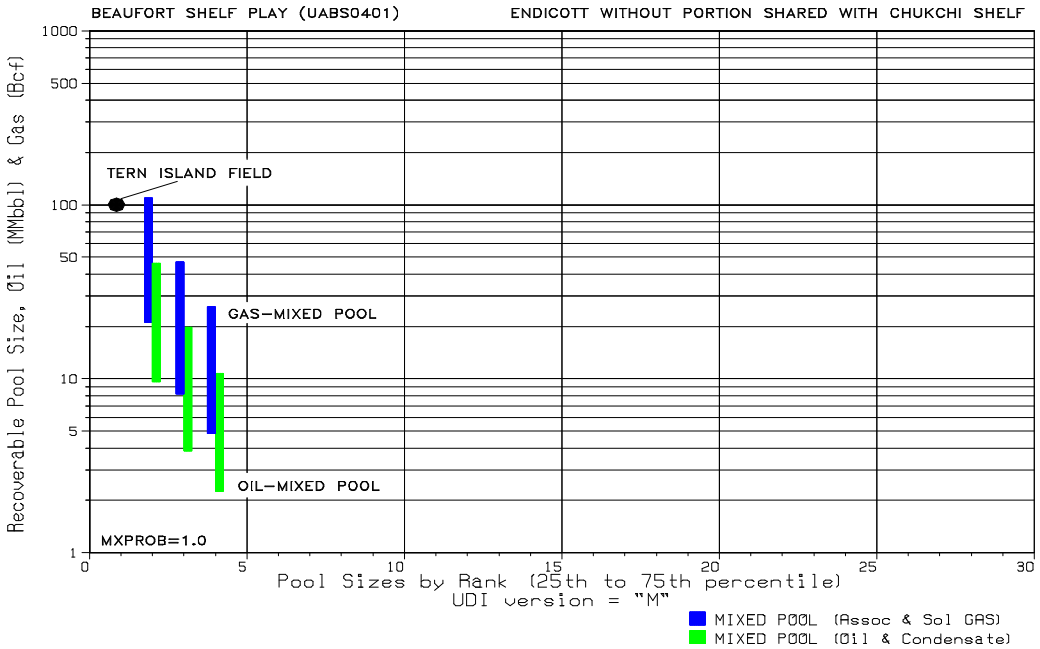


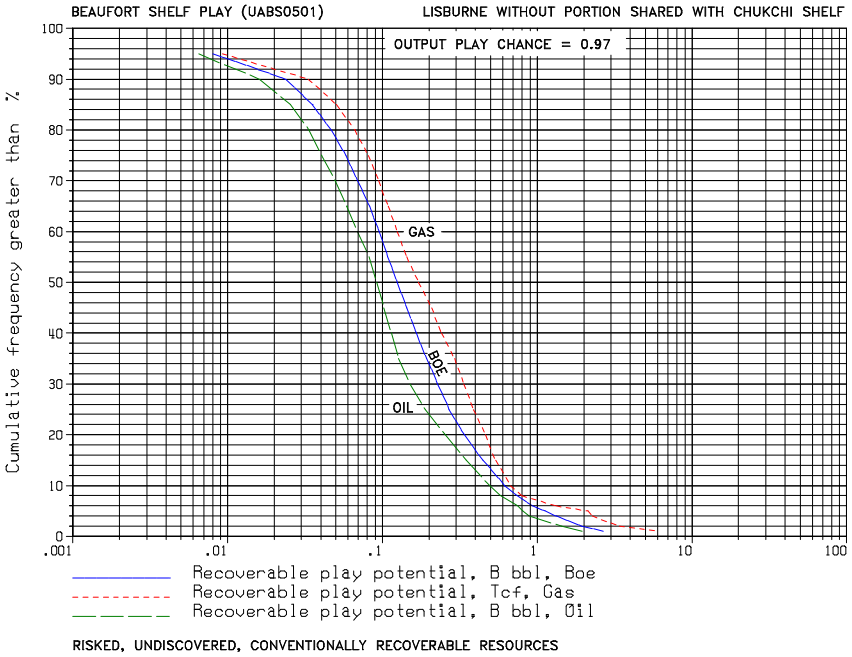
BEAUFORT SHELF PLAY (UABS0200)			
FRACTILES	**F95**	**MEAN**	**F05**
GAS (TCFG)	**0.000**	**3.534**	**9.958**
OIL (BBO)	**0.000**	**0.173**	**0.505**
BOE (BBO)	**0.000**	**0.802**	**2.191**



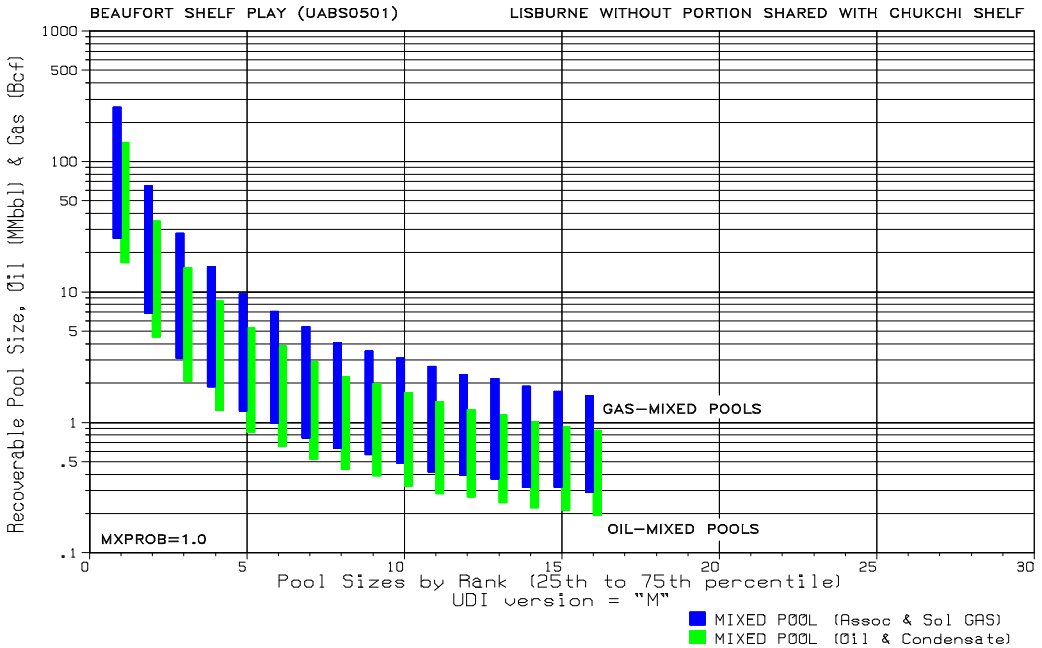


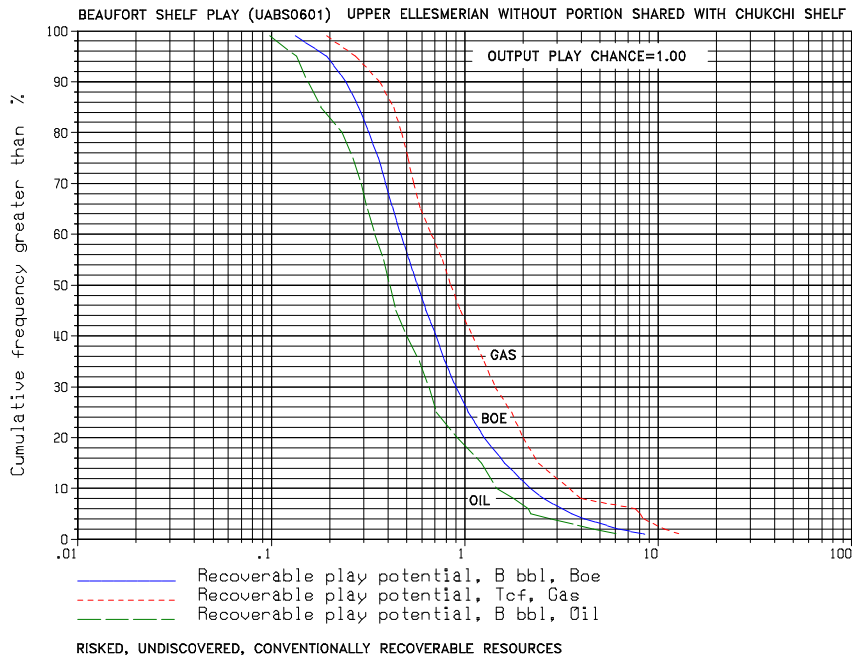
BEAUFORT SHELF PLAY (UABS0401)			
FRACTILES	**F95**	**MEAN**	**F05**
GAS (TCFG)	**0.000**	**0.109**	**0.303**
OIL (BBO)	**0.000**	**0.037**	**0.120**
BOE (BBO)	**0.000**	**0.056**	**0.169**



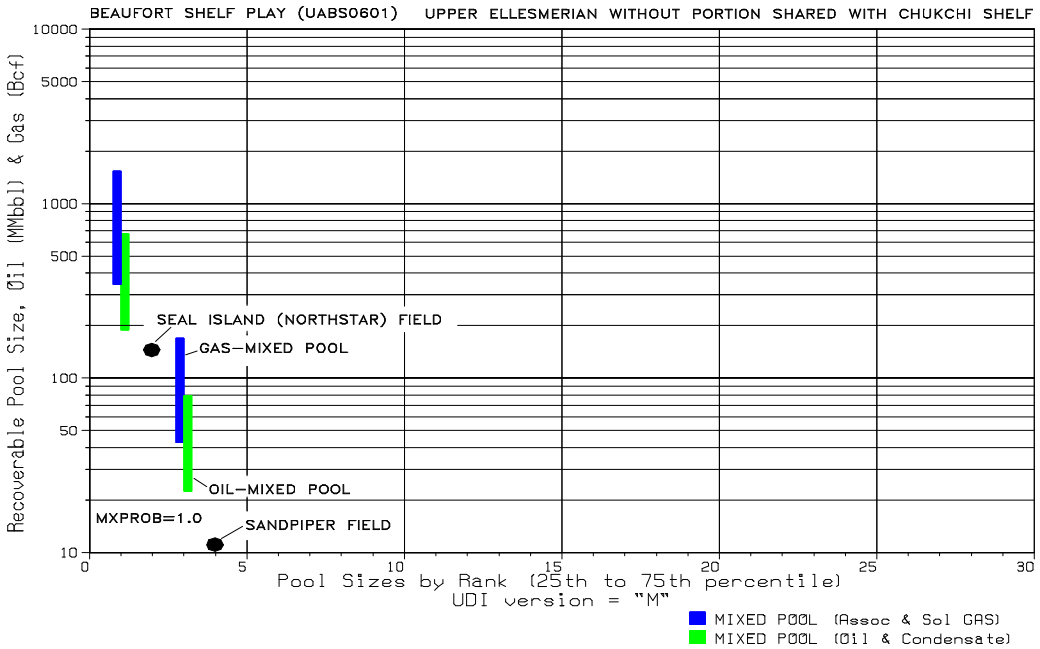


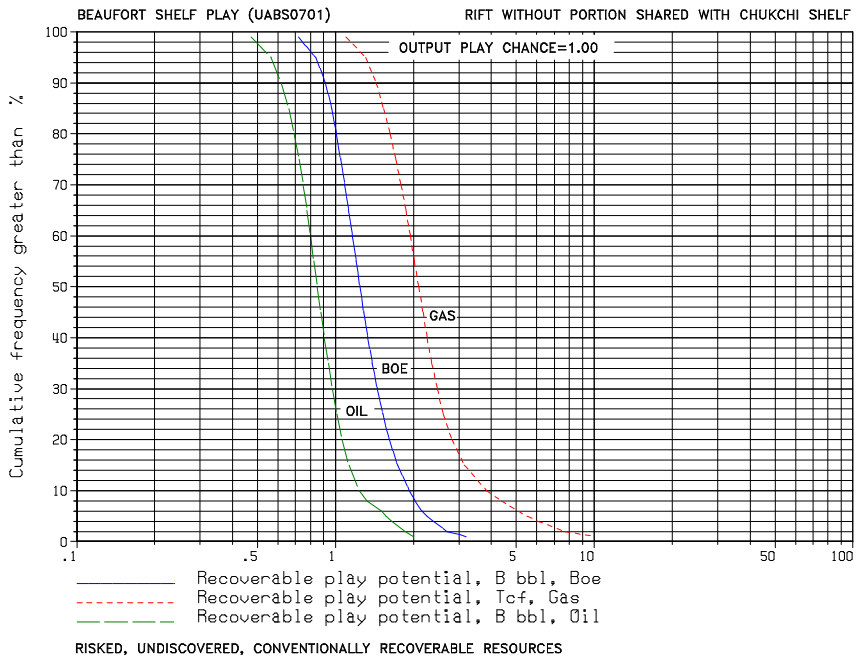
BEAUFORT SHELF PLAY (UABS0501)			
FRACTILES	**F95**	**MEAN**	**F05**
GAS (TCFG)	**0.009**	**0.452**	**2.117**
OIL (BBO)	**0.006**	**0.208**	**0.805**
BOE (BBO)	**0.008**	**0.288**	**1.122**





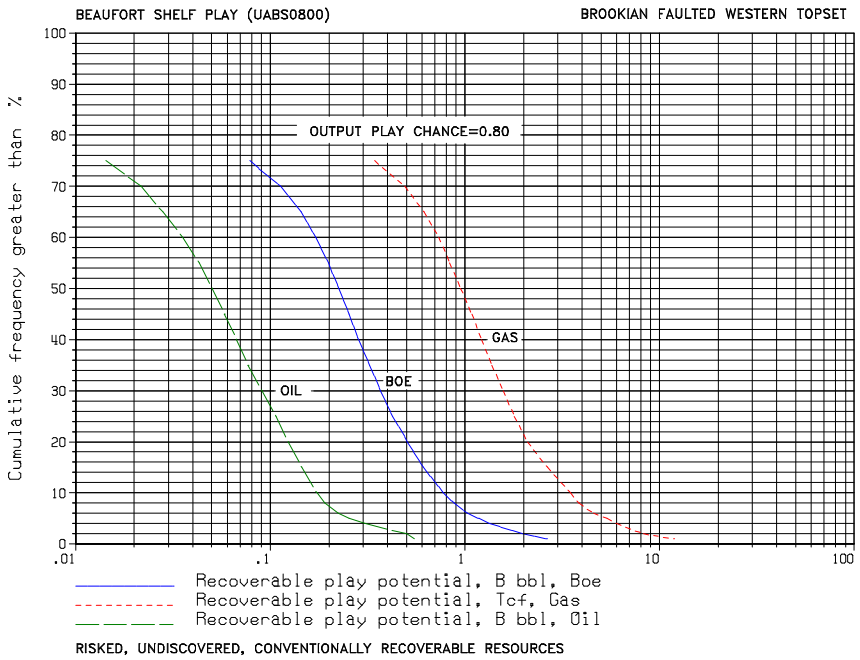
BEAUFORT SHELF PLAY (UABS0601)			
FRACTILES	**F95**	**MEAN**	**F05**
GAS (TCFG)	**0.273**	**1.834**	**8.057**
OIL (BBO)	**0.135**	**0.763**	**2.200**
BOE (BBO)	**0.193**	**1.090**	**3.581**



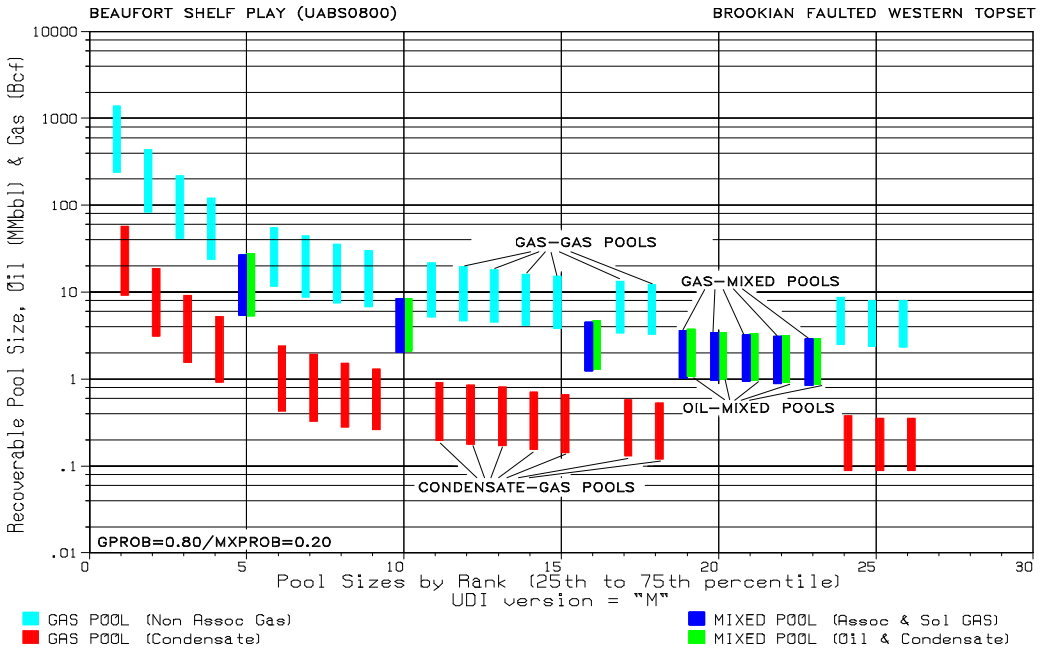


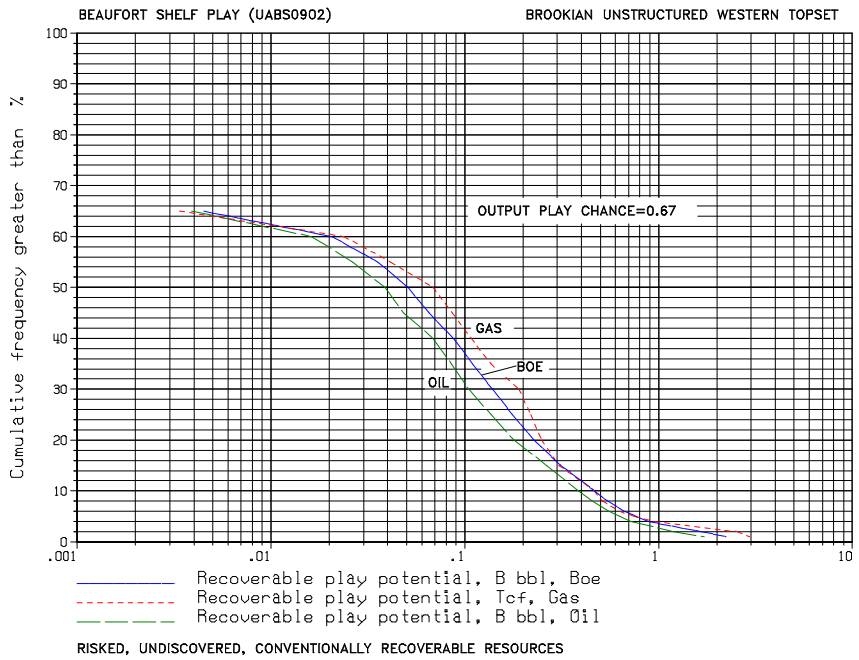
BEAUFORT SHELF PLAY (UABS0701)			
FRACTILES	**F95**	**MEAN**	**F05**
GAS (TCFG)	**1.302**	**2.559**	**5.512**
OIL (BBO)	**0.564**	**0.910**	**1.570**
BOE (BBO)	**0.837**	**1.365**	**2.256**

POOL RANK PLOT NOT AVAILABLE

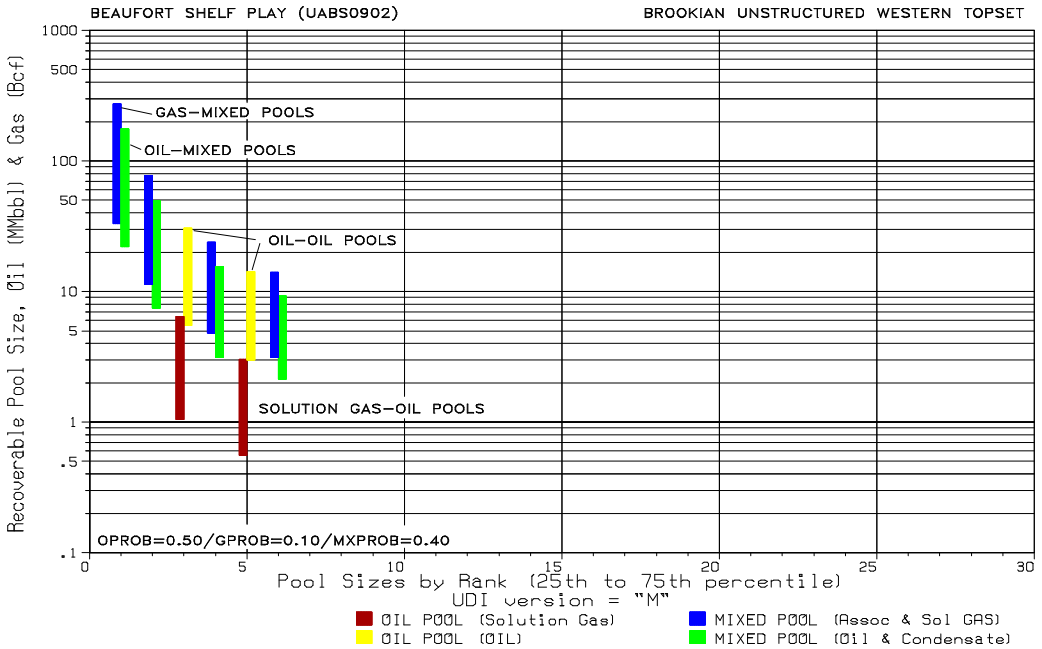


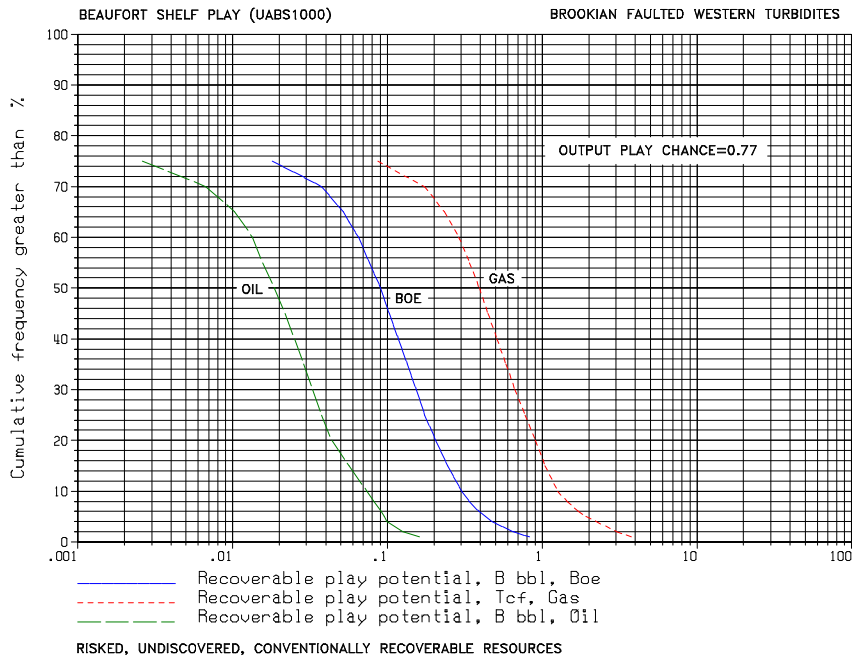
BEAUFORT SHELF PLAY (UABS0800)			
FRACTILES	**F95**	**MEAN**	**F05**
GAS (TCFG)	**0.000**	**1.570**	**5.372**
OIL (BBO)	**0.000**	**0.082**	**0.254**
BOE (BBO)	**0.000**	**0.361**	**1.176**



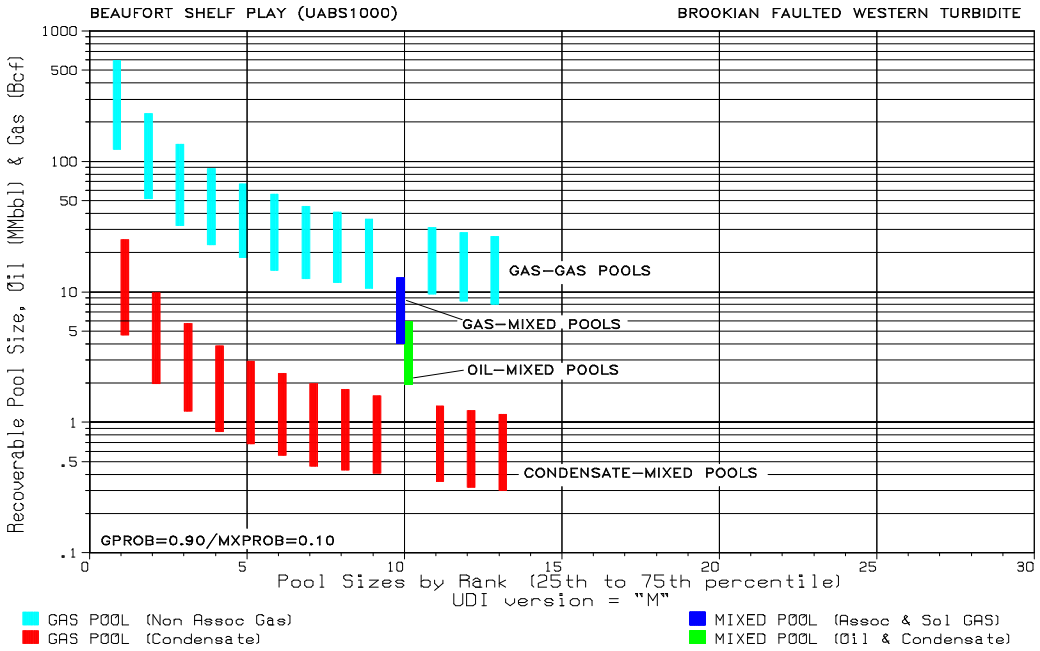


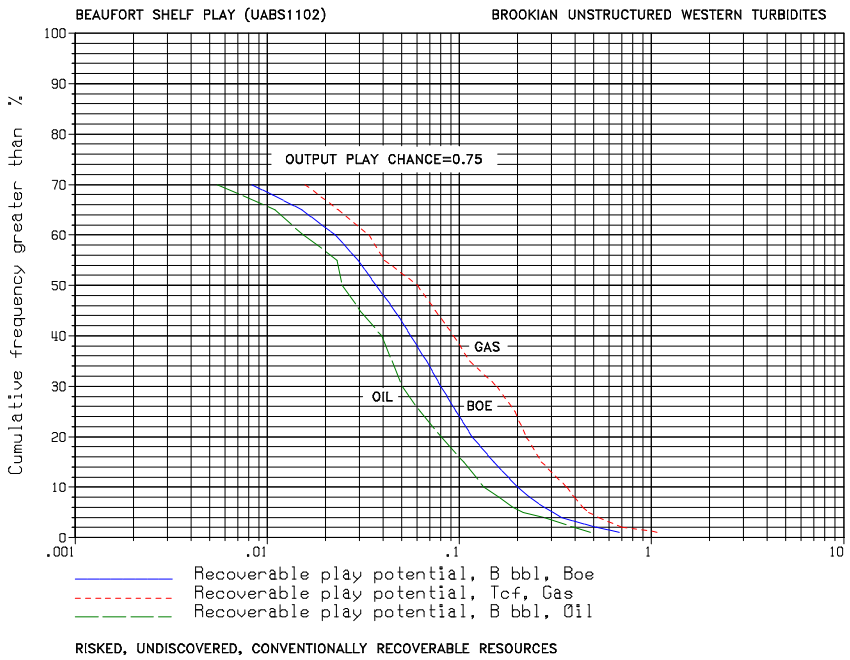
BEAUFORT SHELF PLAY (UABS0902)			
FRACTILES	**F95**	**MEAN**	**F05**
GAS (TCFG)	**0.000**	**0.211**	**0.748**
OIL (BBO)	**0.000**	**0.146**	**0.631**
BOE (BBO)	**0.000**	**0.184**	**0.763**



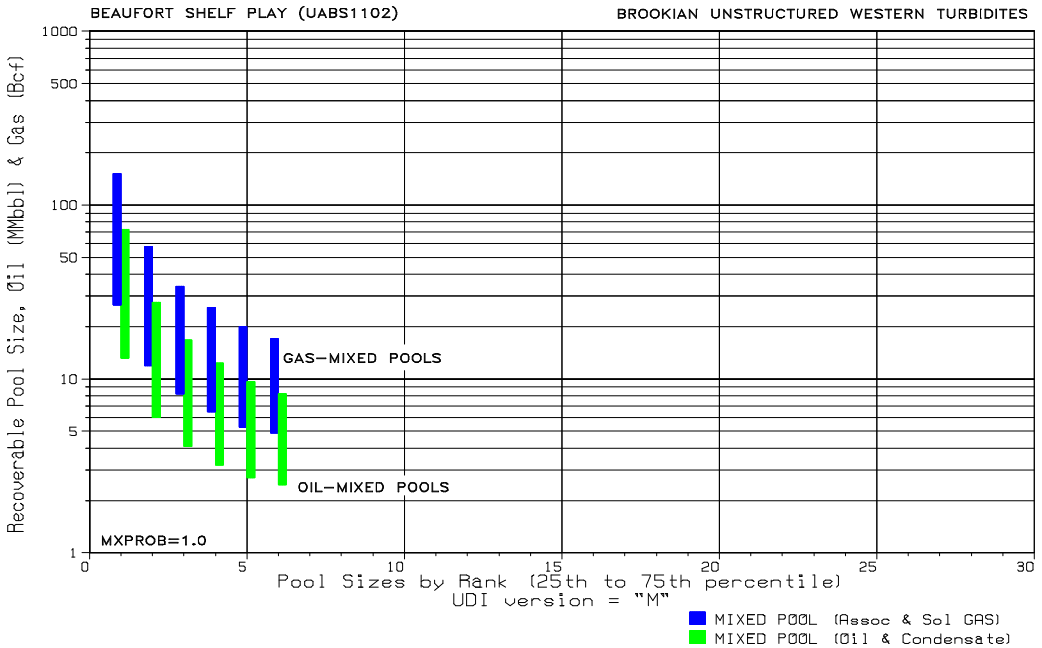


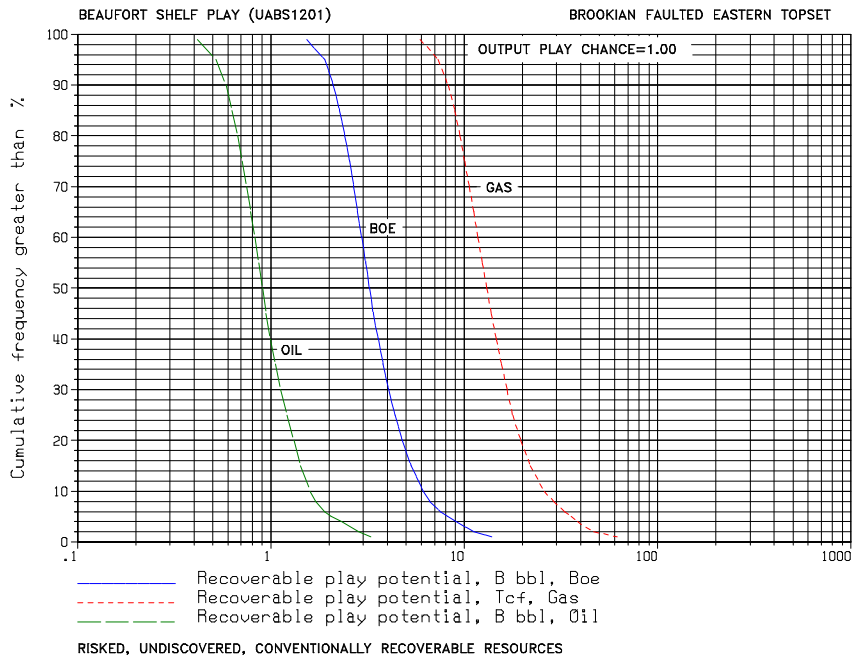
BEAUFORT SHELF PLAY (UABS1000)			
FRACTILES	**F95**	**MEAN**	**F05**
GAS (TCFG)	**0.000**	**0.601**	**1.923**
OIL (BBO)	**0.000**	**0.029**	**0.095**
BOE (BBO)	**0.000**	**0.136**	**0.428**



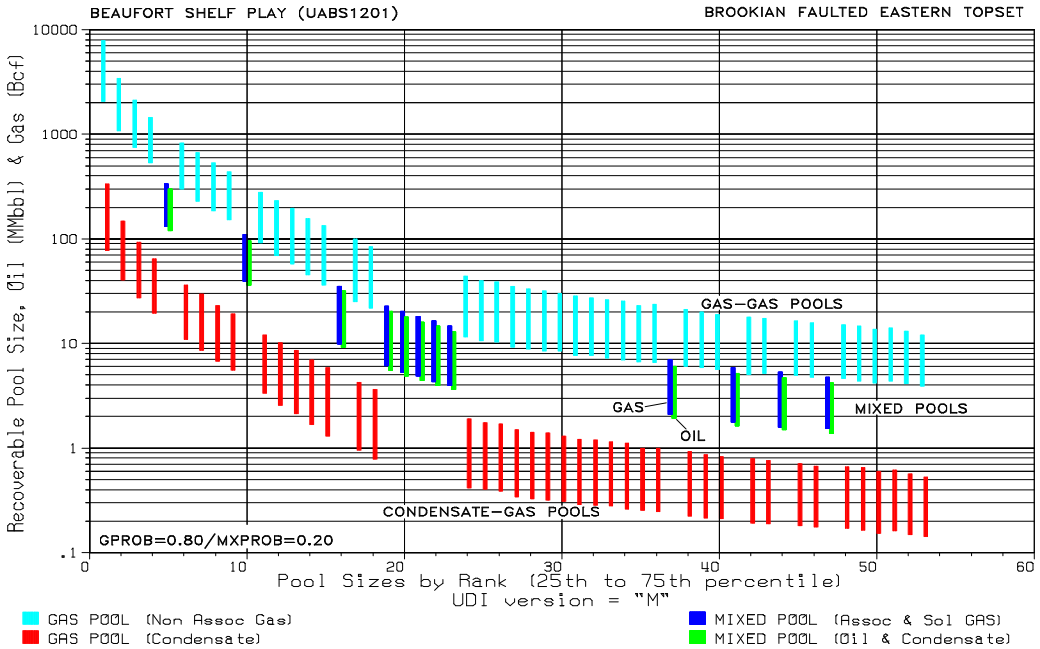


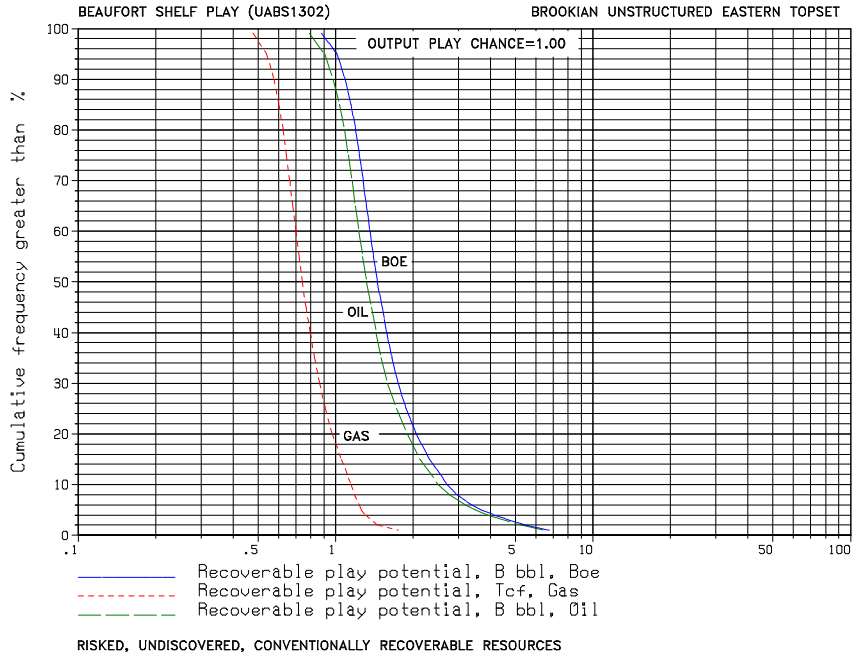
BEAUFORT SHELF PLAY (UABS1102)			
FRACTILES	**F95**	**MEAN**	**F05**
GAS (TCFG)	**0.000**	**0.133**	**0.468**
OIL (BBO)	**0.000**	**0.057**	**0.214**
BOE (BBO)	**0.000**	**0.081**	**0.307**



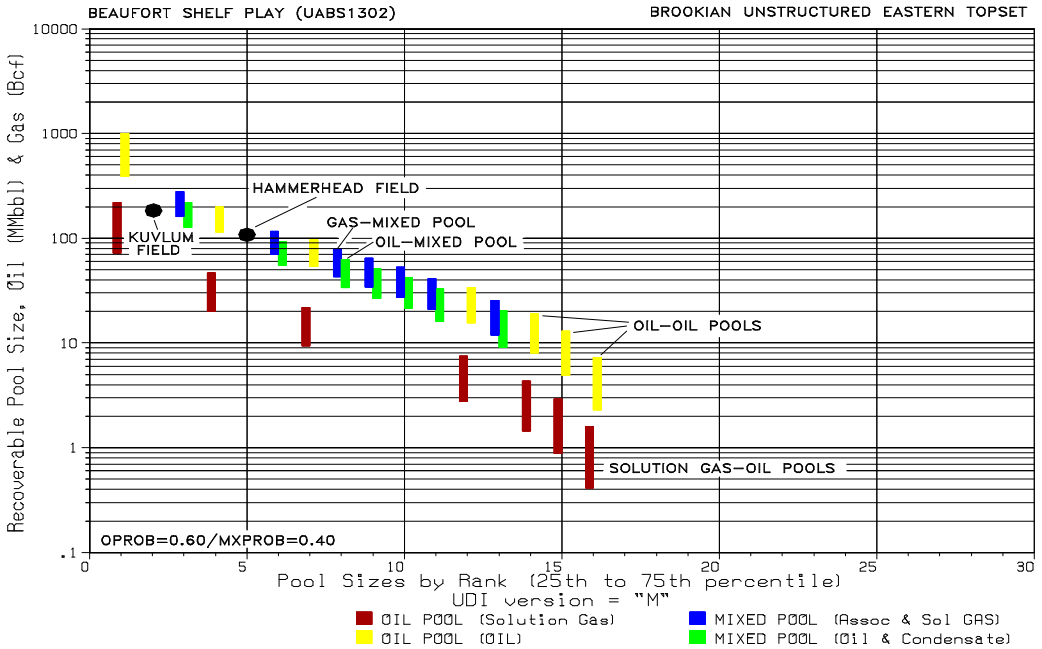


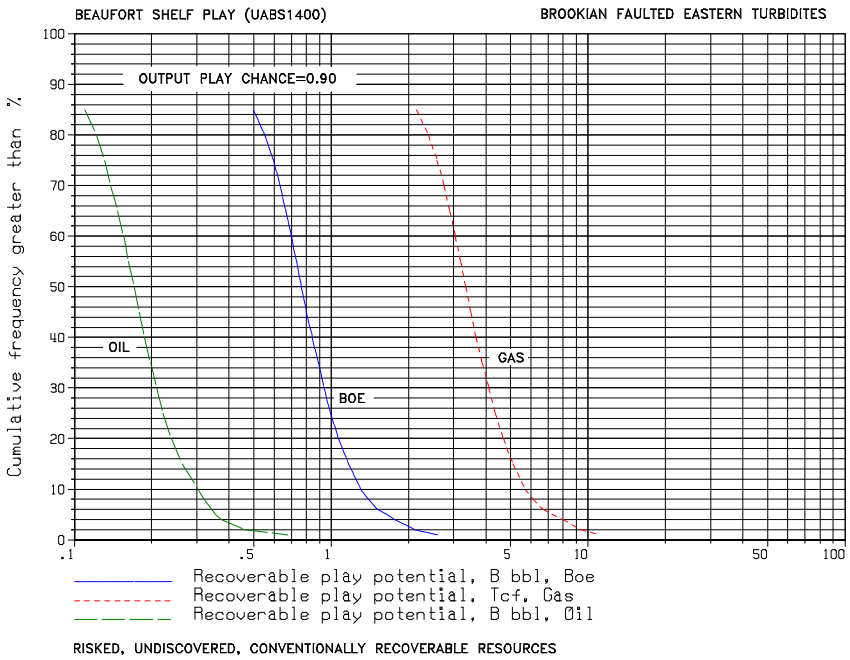
BEAUFORT SHELF PLAY (UABS1201)			
FRACTILES	**F95**	**MEAN**	**F05**
GAS (TCFG)	**7.323**	**16.074**	**35.665**
OIL (BBO)	**0.518**	**1.046**	**2.042**
BOE (BBO)	**1.890**	**3.908**	**8.187**



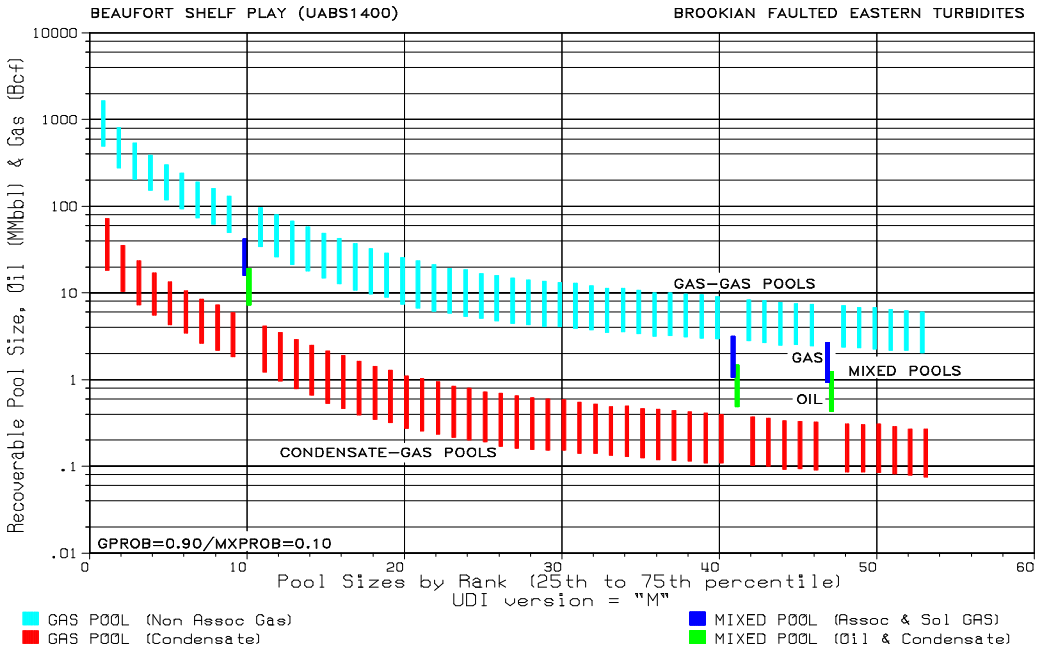


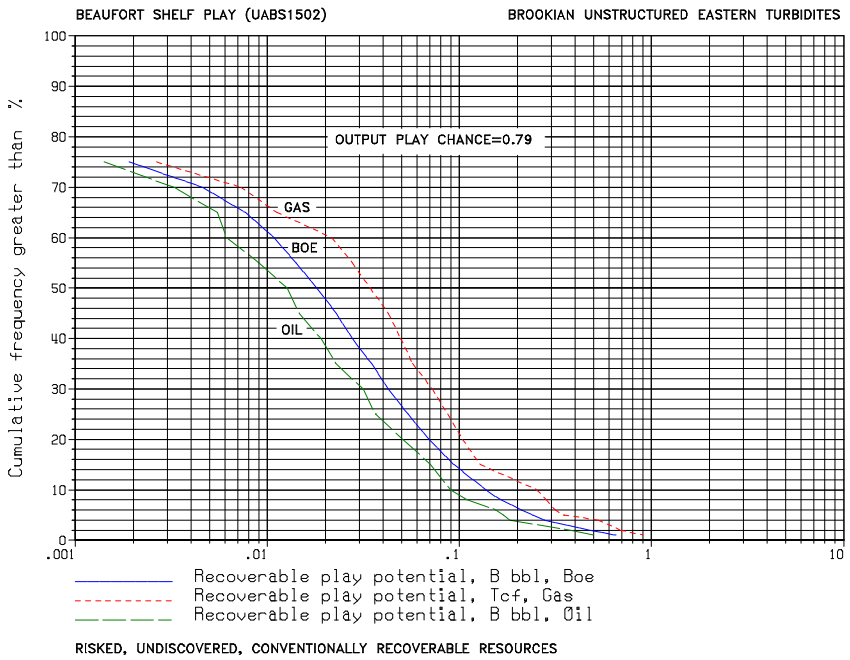
BEAUFORT SHELF PLAY (UABS1302)			
FRACTILES	**F95**	**MEAN**	**F05**
GAS (TCFG)	**0.539**	**0.813**	**1.258**
OIL (BBO)	**0.907**	**1.648**	**3.497**
BOE (BBO)	**1.011**	**1.793**	**3.695**



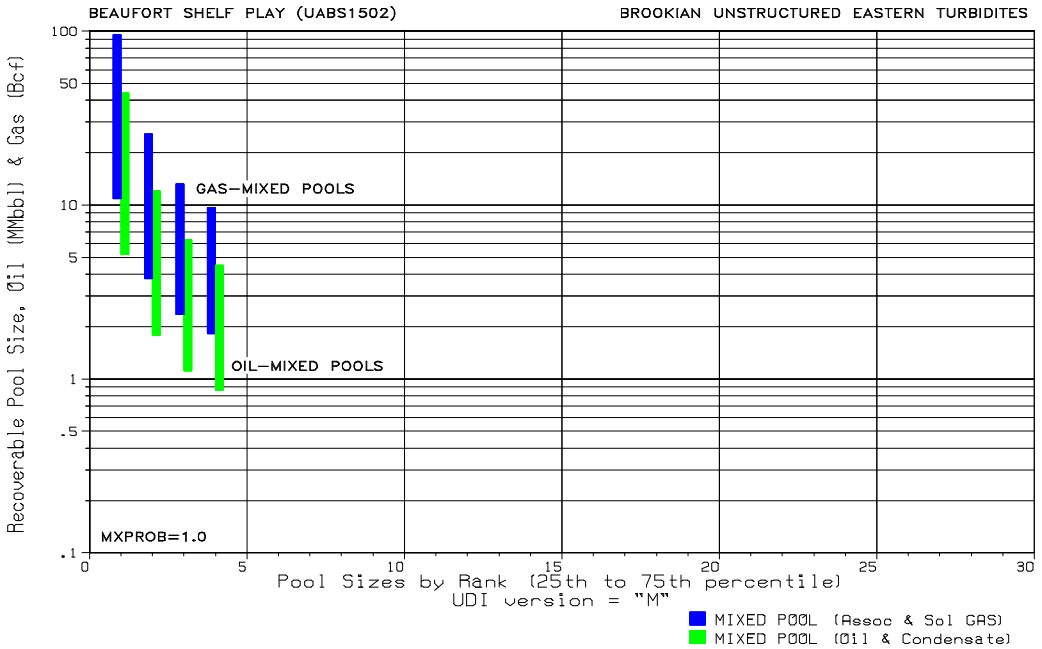


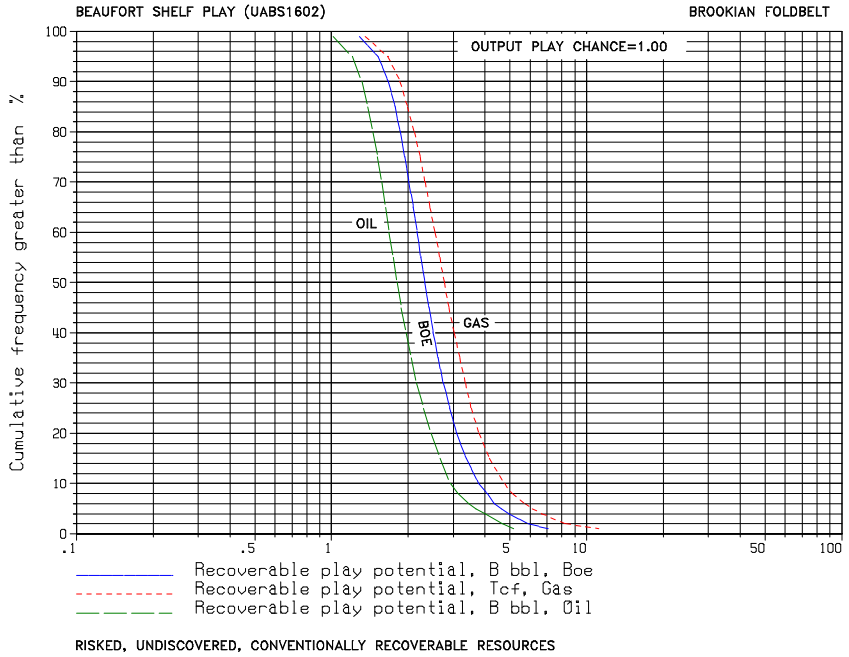
BEAUFORT SHELF PLAY (UABS1400)			
FRACTILES	**F95**	**MEAN**	**F05**
GAS (TCFG)	**0.000**	**3.585**	**7.252**
OIL (BBO)	**0.000**	**0.183**	**0.355**
BOE (BBO)	**0.000**	**0.821**	**1.643**



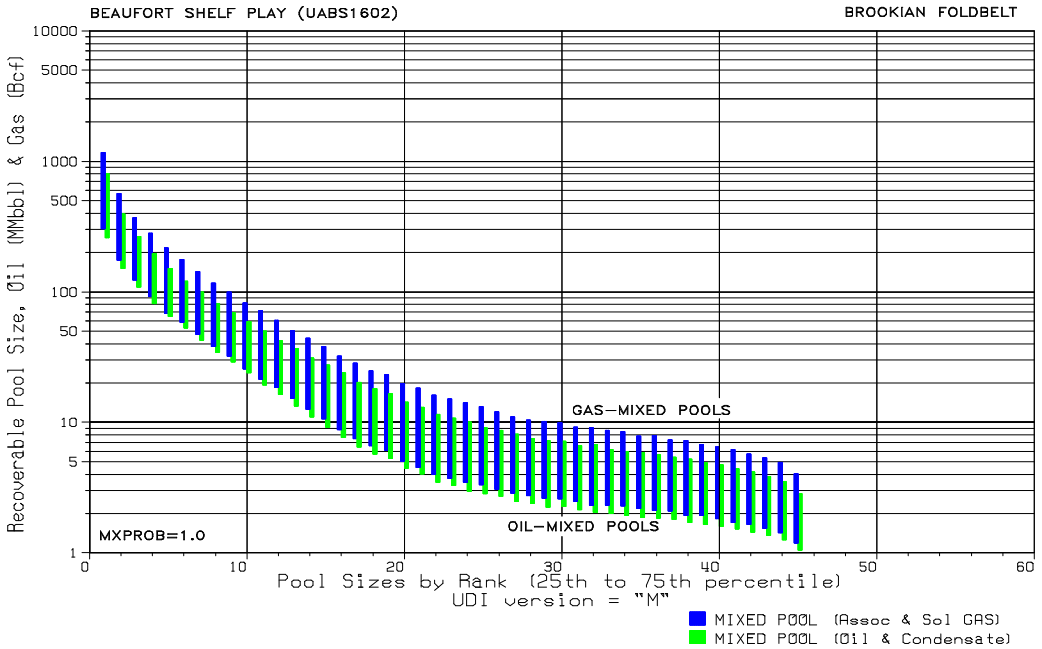


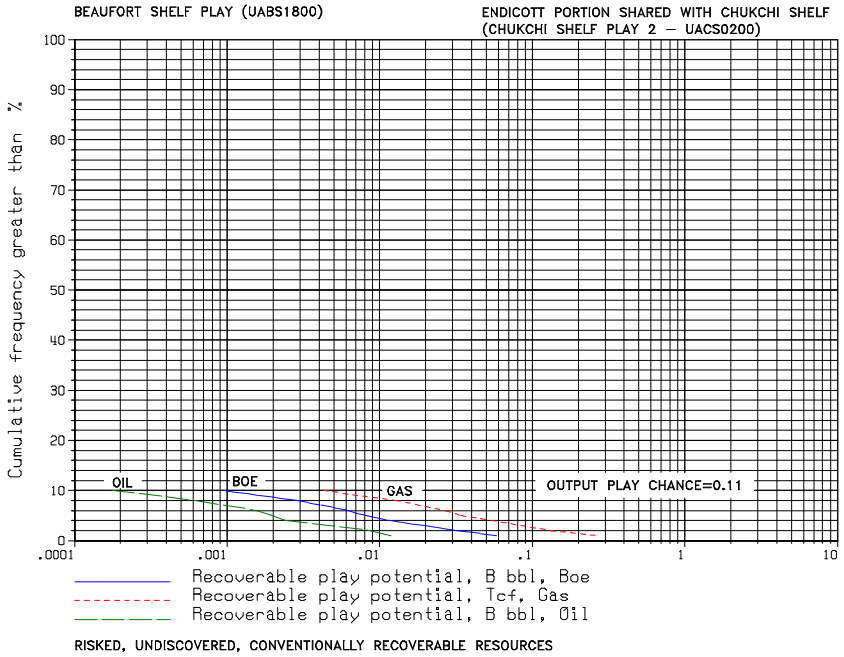
BEAUFORT SHELF PLAY (UABS1502)			
FRACTILES	**F95**	**MEAN**	**F05**
GAS (TCFG)	**0.000**	**0.090**	**0.349**
OIL (BBO)	**0.000**	**0.042**	**0.169**
BOE (BBO)	**0.000**	**0.059**	**0.241**



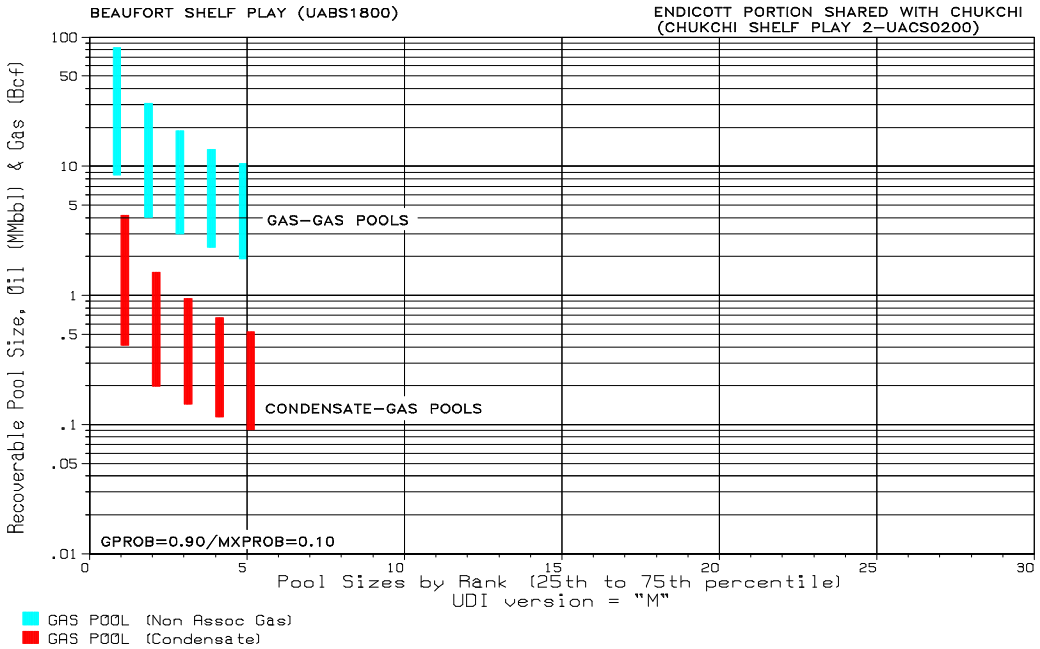


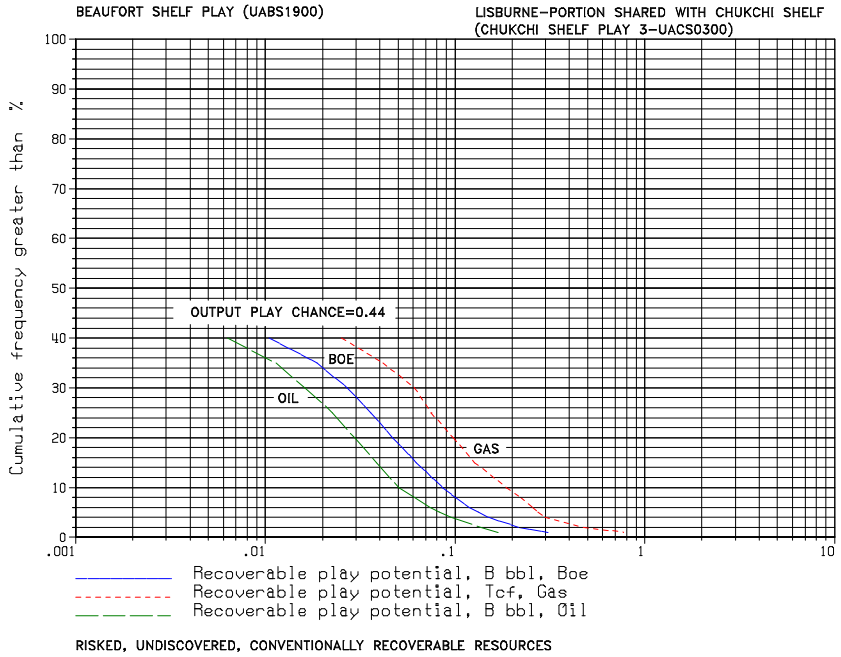
BEAUFORT SHELF PLAY (UABS1602)			
FRACTILES	**F95**	**MEAN**	**F05**
GAS (TCFG)	**1.662**	**3.188**	**6.108**
OIL (BBO)	**1.205**	**2.038**	**3.680**
BOE (BBO)	**1.521**	**2.606**	**4.644**



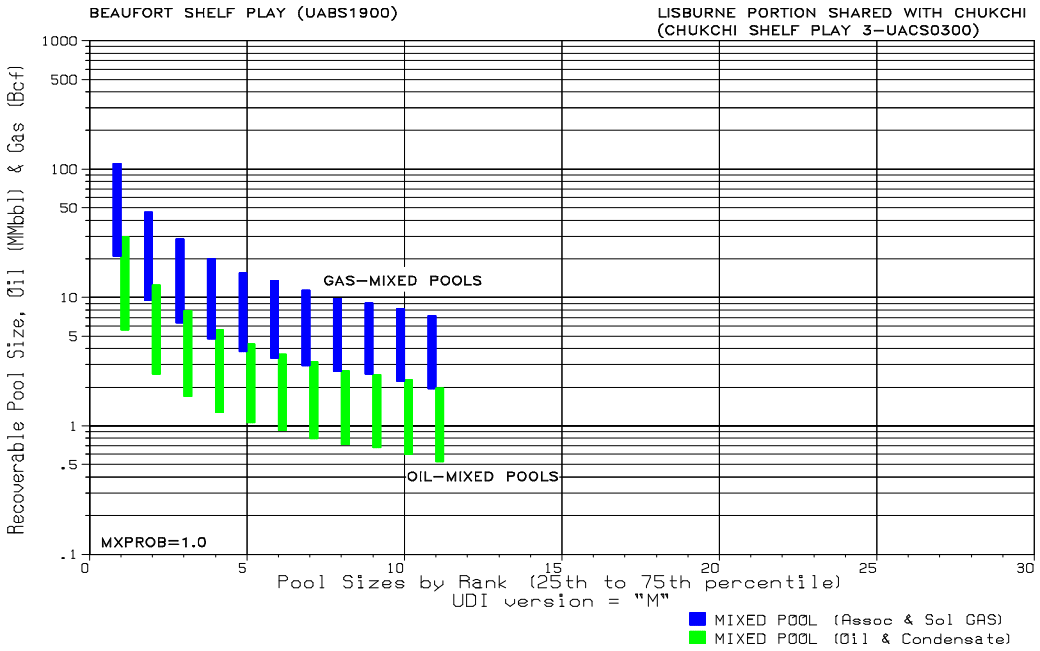


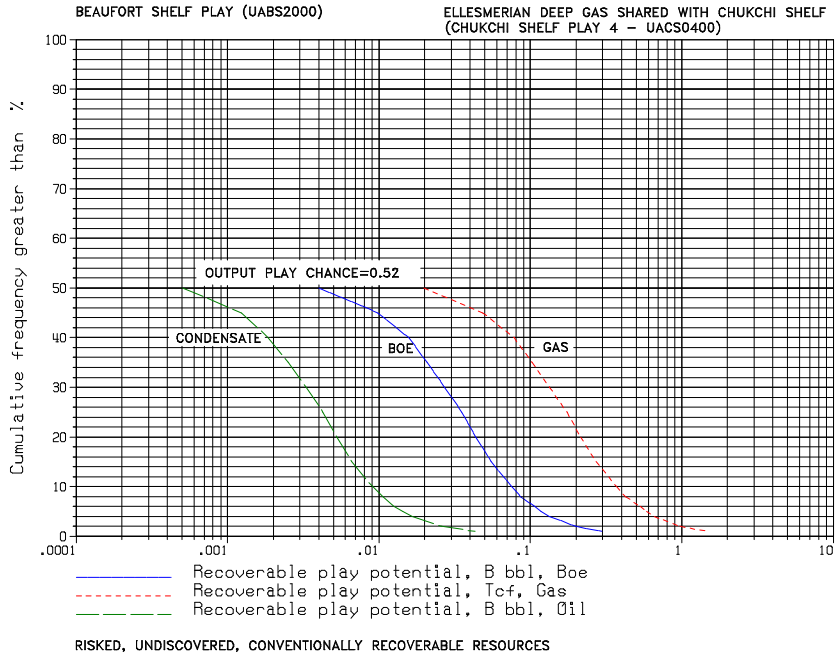
BEAUFORT SHELF PLAY (UABS1800)			
FRACTILES	**F95**	**MEAN**	**F05**
GAS (TCFG)	**0.000**	**0.012**	**0.034**
OIL (BBO)	**0.000**	**0.0006**	**0.002**
BOE (BBO)	**0.000**	**0.003**	**0.008**



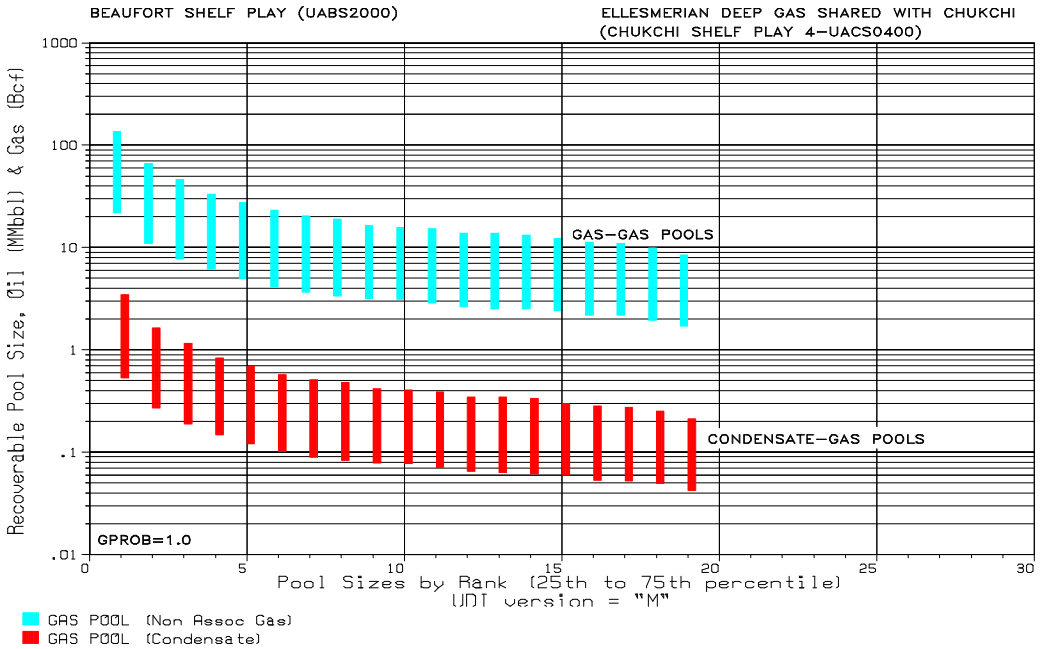


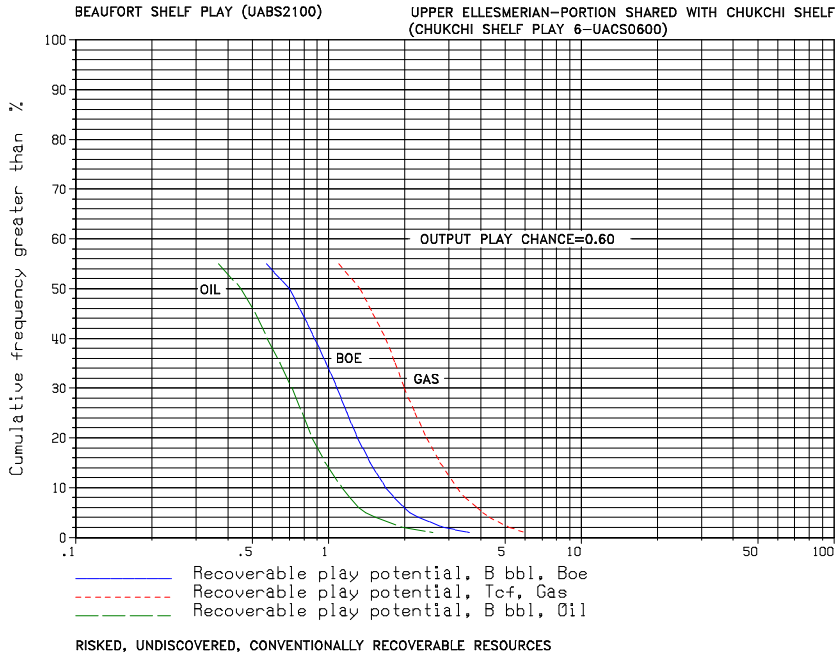
BEAUFORT SHELF PLAY (UABS1900)			
FRACTILES	**F95**	**MEAN**	**F05**
GAS (TCFG)	**0.000**	**0.065**	**0.273**
OIL (BBO)	**0.000**	**0.018**	**0.083**
BOE (BBO)	**0.000**	**0.030**	**0.132**



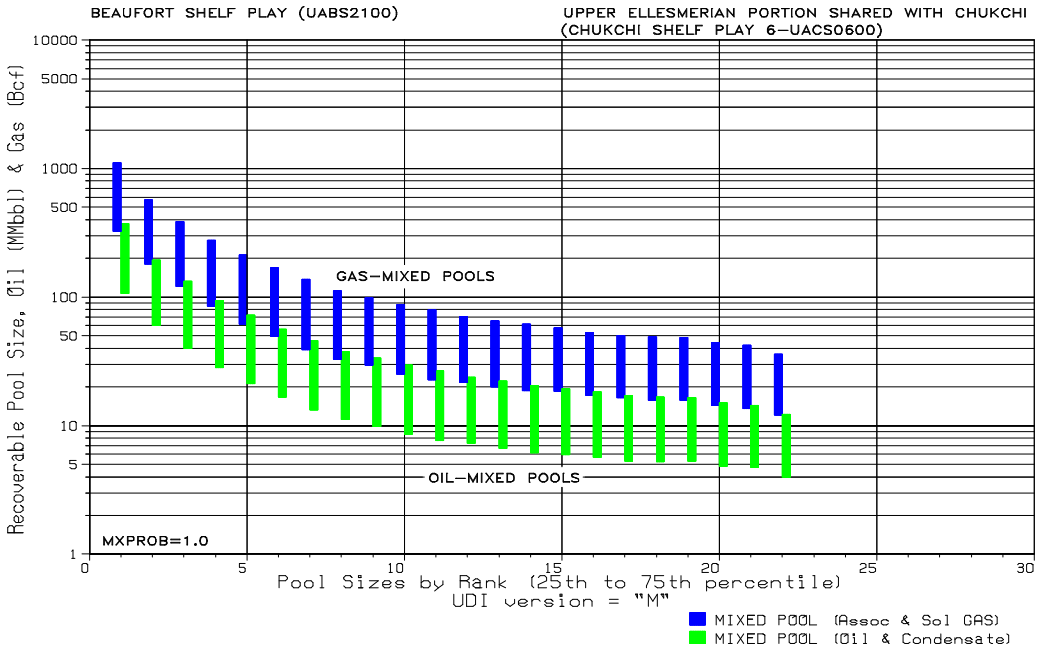


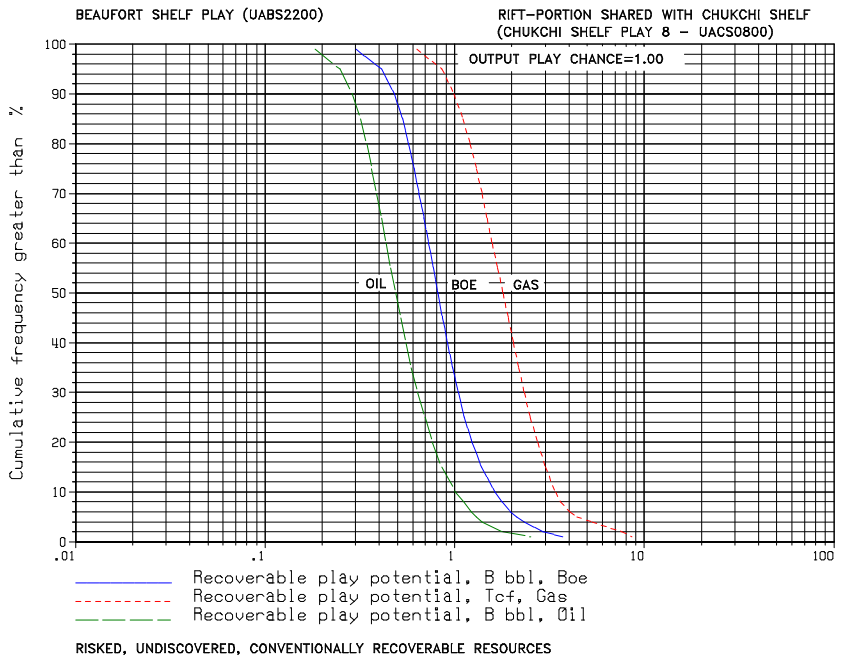
BEAUFORT SHELF PLAY (UABS2000)			
FRACTILES	**F95**	**MEAN**	**F05**
GAS (TCFG)	**0.000**	**0.150**	**0.583**
OIL (BBO)	**0.000**	**0.004**	**0.014**
BOE (BBO)	**0.000**	**0.031**	**0.118**



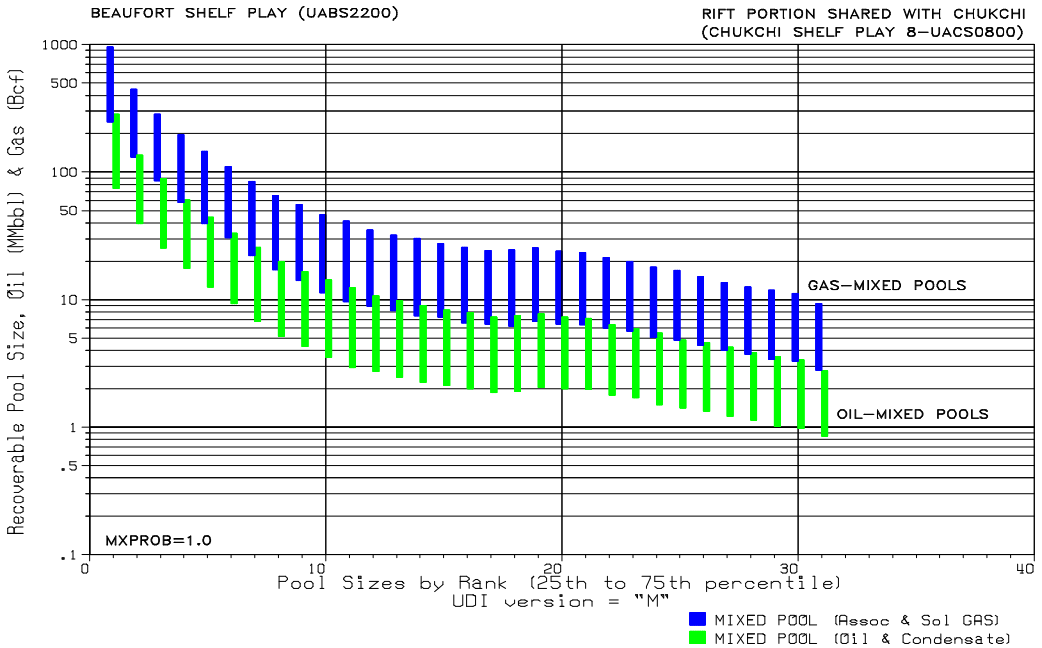


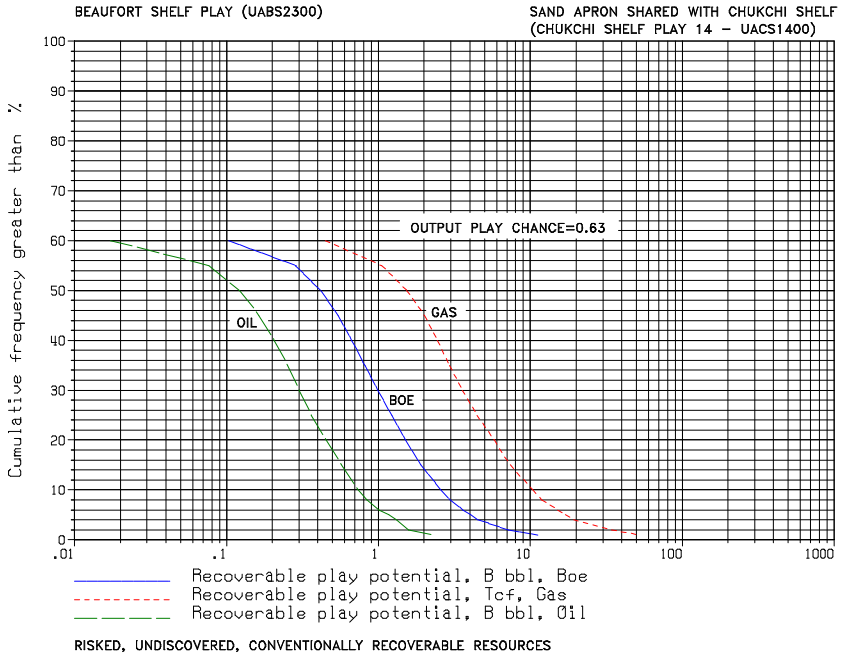
BEAUFORT SHELF PLAY (UABS2100)			
FRACTILES	**F95**	**MEAN**	**F05**
GAS (TCFG)	**0.000**	**1.391**	**4.075**
OIL (BBO)	**0.000**	**0.497**	**1.407**
BOE (BBO)	**0.000**	**0.744**	**2.093**



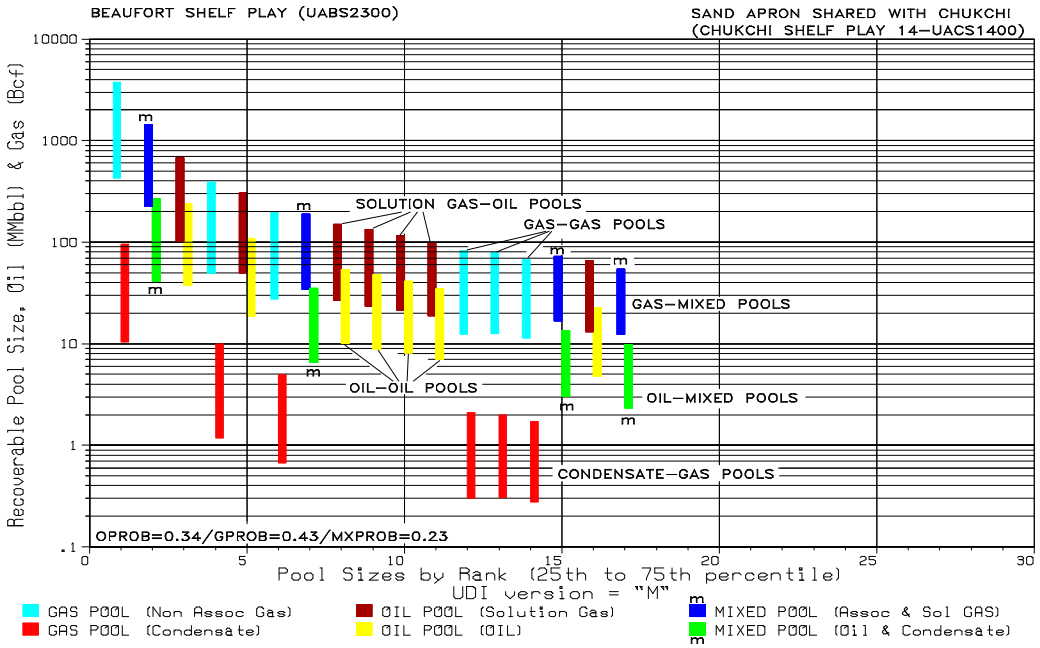


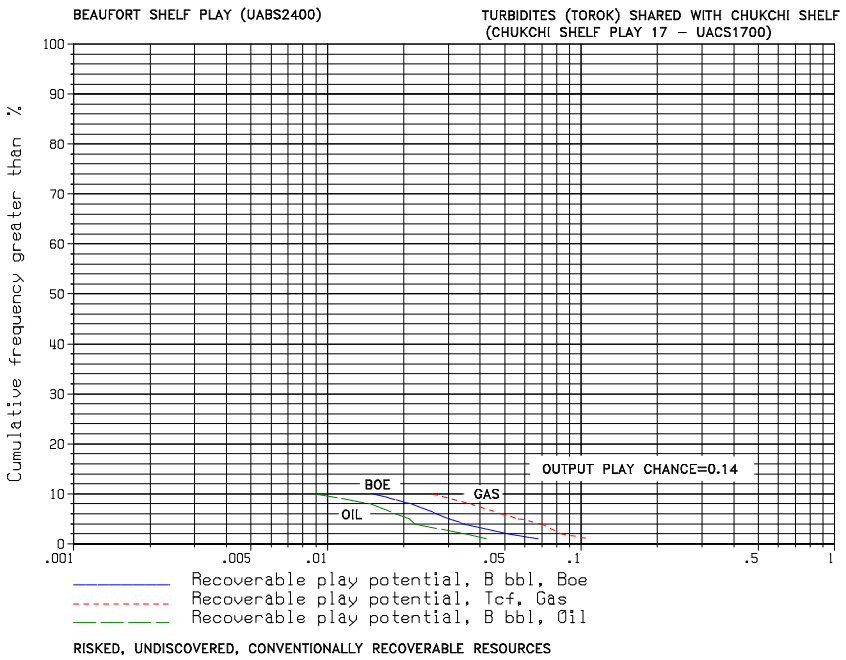
BEAUFORT SHELF PLAY (UABS2200)			
FRACTILES	**F95**	**MEAN**	**F05**
GAS (TCFG)	**0.855**	**2.166**	**4.404**
OIL (BBO)	**0.248**	**0.606**	**1.300**
BOE (BBO)	**0.410**	**0.991**	**2.121**



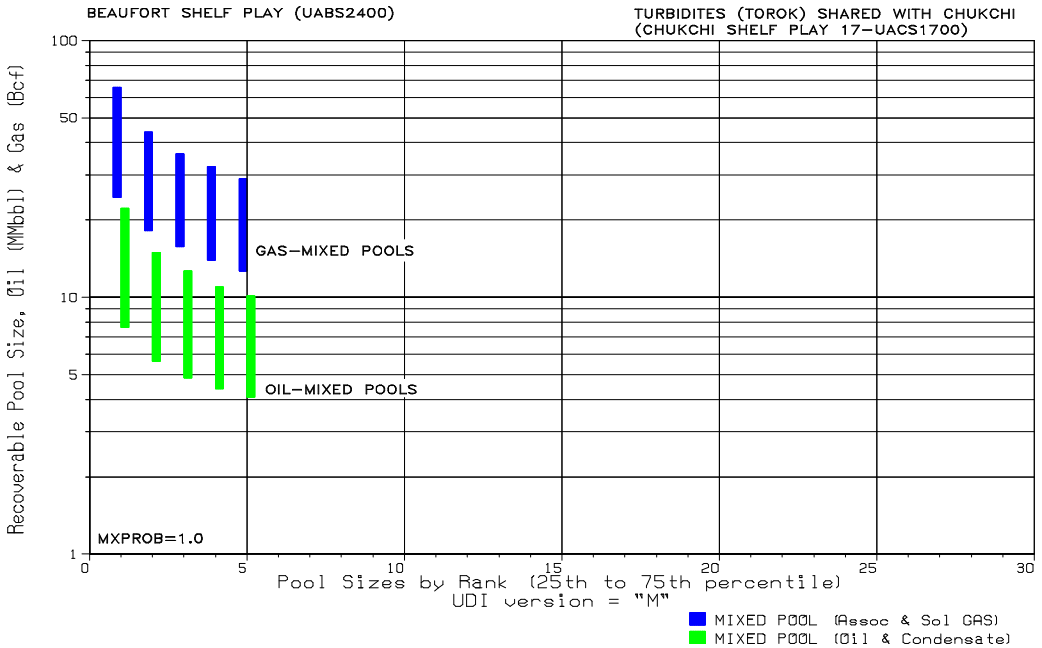


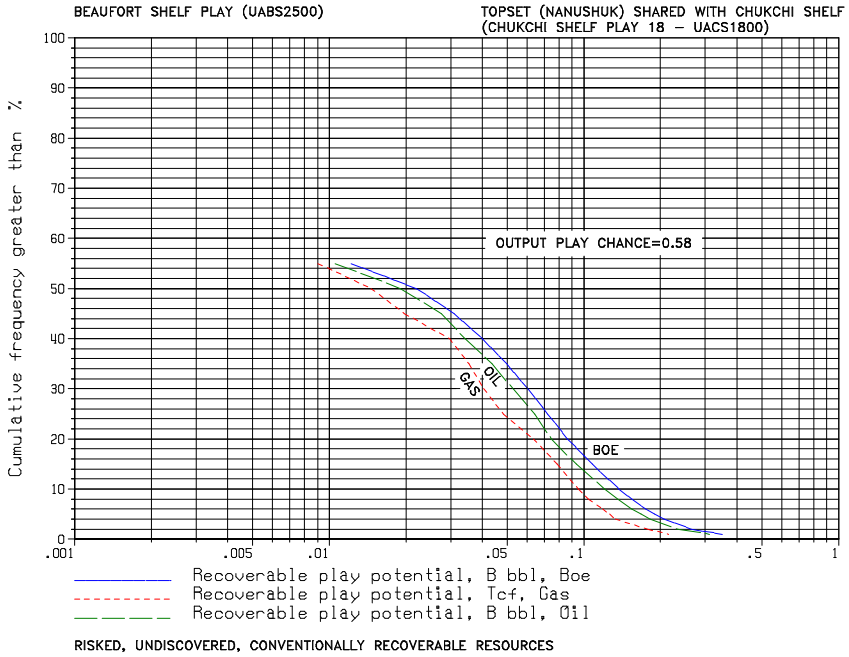
BEAUFORT SHELF PLAY (UABS2300)			
FRACTILES	**F95**	**MEAN**	**F05**
GAS (TCFG)	**0.000**	**4.895**	**17.000**
OIL (BBO)	**0.000**	**0.291**	**1.173**
BOE (BBO)	**0.000**	**1.162**	**4.029**



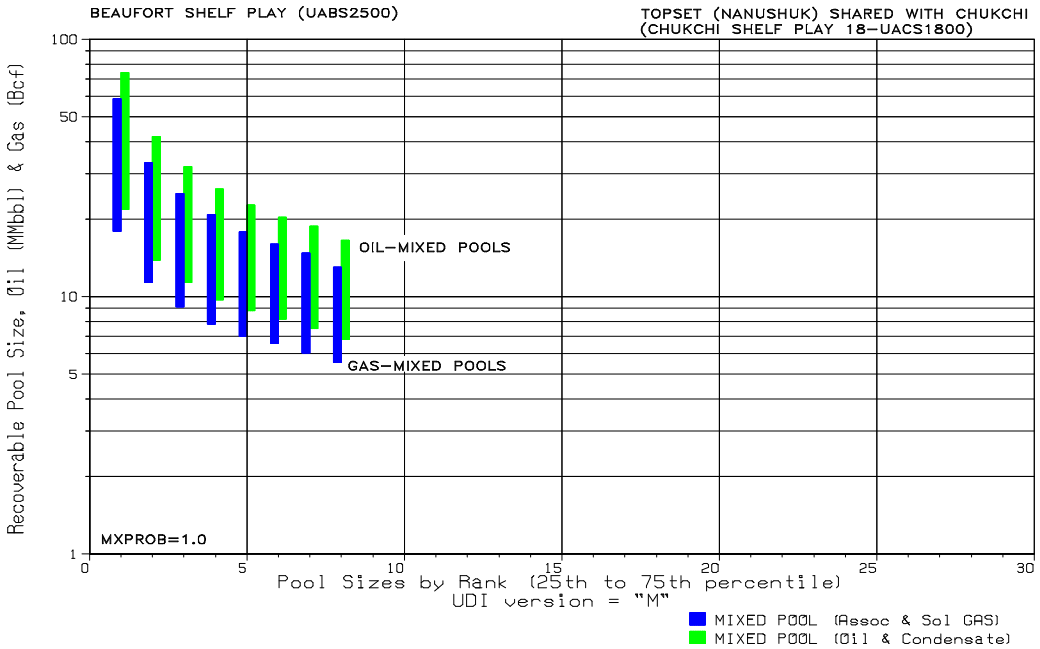


BEAUFORT SHELF PLAY (UABS2400)			
FRACTILES	**F95**	**MEAN**	**F05**
GAS (TCFG)	**0.000**	**0.008**	**0.057**
OIL (BBO)	**0.000**	**0.003**	**0.021**
BOE (BBO)	**0.000**	**0.004**	**0.030**





BEAUFORT SHELF PLAY (UABS2500)			
FRACTILES	**F95**	**MEAN**	**F05**
GAS (TCFG)	**0.000**	**0.034**	**0.127**
OIL (BBO)	**0.000**	**0.044**	**0.167**
BOE (BBO)	**0.000**	**0.050**	**0.189**



ECONOMIC RESULTS, BEAUFORT SHELF PROVINCE

(James D. Craig)

INTRODUCTION

This section summarizes the results of economic modeling using the *PRESTO-5* (*P*robabilistic *R*esource *EST*imates-*O*ffshore, version 5) computer program. The economic assessment results are influenced, to a large degree, by the undiscovered, conventionally recoverable oil and gas resources assessed using the *GRASP (G*eologic *R*esource *AS*sessment *P*rogram) computer model. The conventionally recoverable results are discussed in separate .pdf files (*Summaries of Play Results, with Cumulative Probability and Ranked Pool Plots*).

Each province summary page includes three illustrations: (1) cumulative probability plots for risked, conventionally recoverable resource distributions (oil, gas, and BOE); (2) a table comparing risked, mean, conventionally recoverable resources with the risked, mean, economically recoverable resources at current commodity prices; and (3) a price-supply graph displaying economically recoverable resource curves.

The province summary page is followed by a table reporting play-specific, economically recoverable resource estimates for two representative price scenarios: a Base Price scenario ($18/bbl-oil, $2.11/MCF-gas) representing current market conditions; and a High Price scenario ($30/bbl-oil, $3.52/MCF-gas).

PROVINCE SUMMARY PAGE

Risked Cumulative Probability Distributions

The province summary page provides, at page top, cumulative probability distributions for risked, undiscovered endowments of conventionally recoverable oil, gas, and BOE, where resource quantities are plotted against "cumulative frequency greater than %." A cumulative frequency represents the probability that the resource endowment is equal or greater than the volume associated with that frequency value along one of the curves. For example, a 95% probability represents a 19 in 20 chance that the resource will equal, or be higher than, the volume indicated. Cumulative frequency values typically decrease as resource quantities increase. An expanded description of cumulative probability plots is given in "*Summaries of Play Results, with Cumulative Probabilities and Ranked Pool Plots* " provided as a separate .pdf file.

Table of Risked Play Resources

The province summary page provides, at page center, a table comparing the total conventionally recoverable endowment and the smaller quantity of economically recoverable resources that could be profitably extracted under current economic and engineering conditions. Current prices are represented as $18 per barrel of oil and $2.11 per MCF of gas, where gas price is linked to oil price by energy equivalency and discount-value factors (5.62 MCF per barrel; 0.66 value discount). Conventional resource volumes correspond to points on the cumulative probability distributions (at page top). Economic resource volumes correspond to points along the mean price-supply curve (at page bottom). Resources listed as negligible (negl) have volumes lower than the significant figures shown. Not Available (N/A) means that these resources are unlikely to be produced in the foreseeable future because of reservoir conditions or the lack of a viable transportation infrastructure.

The ratio of economic to conventional resources indicates the proportion of the total undiscovered endowment that is profitable to produce under current commodity prices with proven engineering technology. However, for production to occur, commercial discoveries must be made, and the analysis does not imply discovery rates. Given the size and geologic complexity of the offshore provinces, exploration will require extensive drilling, and considering the relatively low chance of commercial success and the high cost of exploration wells, many of these frontier provinces are not likely to be thoroughly tested in the foreseeable future. The ratio of economic to conventional resources should be regarded as an opportunity indicator, rather than as a direct scaling factor for readily available hydrocarbon reserves.

Price-Supply Curves

The province summary page includes, at page bottom, a graph showing price-supply curves representing Low, Mean , and High resource production scenarios. Price-supply curves illustrate how volumes of economically recoverable resources increase as a function of commodity price. Characteristically, increases in commodity price result

in corresponding increases in economically recoverable resource volumes. The economic resource volumes represent oil and gas, as yet undiscovered, that could be recovered profitably given the modeled economic and engineering parameters. At very high prices, the mean curve approaches the mean total resource endowment estimated by *GRASP*. The price-supply curves do not imply that these resources will be discovered or produced within a specific time frame, only that the opportunity exists for commercial production at levels controlled by commodity prices.

The price-supply curves were generated by the *PRESTO-5* computer program, which simulates the exploration, development, production, and transportation of pooled hydrocarbons in geologic plays within a petroleum province. Economic viability depends on the interaction of many factors defining the size and location of the hydrocarbon pools, the reservoir engineering characteristics, and economic variables relating expenditures to income from future production streams. The economic simulation is quite complex, owing to the complexities in the state of nature, and requires a sophisticated analytical model.

The following is a brief overview of the *PRESTO-5* modeling process. Geologic parameters (for example, reservoir thickness, pool area, risk) used by the *GRASP* computer model to determine conventionally recoverable resources are transferred into the *PRESTO-5* model through an interface program. Economic viability is determined by performing a discounted cash flow analysis on the expenses and modeled production stream for each pool simulated in a given trial. A Monte Carlo (random sampling) process selects engineering parameters (for example, production rate profiles, well spacing, platform installation scheduling), and cost variables (for example, platforms, wells, pipelines) from ranged distributions. Each simulation trial models the expenses, scheduling, and production for pools "discovered" within a particular play. The sampling process is repeated for productive pools in all geologic plays, and the economic resources are aggregated to the province level. The development simulation process is repeated, typically for 1000 trials, at given set of prices (oil and gas prices are linked). After the specified number of trials are completed for the first set of oil and gas prices, a new set of prices is selected and another round of simulation trials is run. This process continues for approximately 30 iterations, yielding a range of economic resource volumes tied to commodity prices. The results for all runs are given as probability distributions, where selected probability levels can be displayed as continuous price-supply curves.

These analyses determine the resource volumes that are commercially viable under a specific set of current economic and engineering assumptions. No attempt was made to upgrade engineering technology or development strategies that might be implemented in response to higher commodity prices.

The price-supply curves provided in this report are based on the most likely development scenario tailored for each particular province. All provinces were modeled on a stand-alone basis, with engineering assumptions designed for the primary hydrocarbon substance (oil or gas) identified by the *GRASP* analysis. Generally, the secondary hydrocarbon is less economically viable and places an extra burden on the primary hydrocarbon substance. For provinces without existing oil and gas infrastructure, the modeling scenarios were designed assuming that the primary substance would drive initial development in a particular province. Oil-prone provinces were modeled as "oil-only" production, with gas reinjected for reservoir pressure maintenance to maximize oil recovery. Gas-prone provinces were modeled with both gas and oil production because natural gas-liquids (or condensates) are not reinjected. Often the volume of condensates in gas-prone provinces exceeds any volume of non-associated crude oil. All hydrocarbon liquids are commingled in production and transportation systems.

This economic analysis assumes 1995 as the base year. Higher nominal commodity prices in the future (price increases only at the rate of inflation) do not result in higher estimated volumes of economically recoverable resources, whereas higher real commodity prices (increases above the rate of inflation) do increase the economically recoverable resources. The economic model assumes that commodity price and infrastructure costs were inflated equally at an assumed 3% annual inflation rate (flat real price and cost paths). The price-supply curves can be used to project economic resource volumes relative to future price if appropriate discounting back to the 1995 base year is made to account for real price and real costs changes in the intervening years.

The price-supply graph usually contains three curves, corresponding to Low, Mean, and High resource production levels. The Low resource case represents a 95% probability (19 in 20 chance) that the resources are equal to, or exceed, the volumes derived from the price-supply curves. The High resource case represents the 5% exceedance level (1 in 20 chance). The Mean resource case represents the average. In high-cost and high-risk provinces, where there are no economically recoverable resources at the 95% probability level, no "Low" curve is displayed. An apparent anomaly is observed in some cases where the lower tail of the "Mean" price-supply curve indicates

economic resources greater than the "High" (5% probability) curve. This situation occurs at low prices where the probability of economic success drops below 5%, and the Mean curve is obtained from the few productive trials occurring at probabilities below 5%.

A few additional observations concerning price-supply curves are noteworthy. Following established convention for price-supply curves, these graphs are rotated from the usual mathematical display of X-Y plots. Although shown along the vertical (Y) axis, price is the independent variable and resource is the dependent variable. In many of the gas-prone basins, price-supply curves will display an abrupt step below which no risked economically recoverable resources are modeled. This step corresponds to the minimum resource value required to overcome the cost of production and transportation infrastructure. Because of the distances to Asian markets, the assumed destination for Alaska gas production, natural gas must be converted to liquid form for transportation by ships. The infrastructure associated with conversion into liquefied natural gas (or LNG) does not lend itself to incremental additions for grassroots projects; therefore, an abrupt "cost-hurdle" created by large LNG and marine terminal installations must be overcome by significant resource volumes.

Finally, the reader must be aware that these price-supply curves are models of risked hydrocarbon resources. Both the geologic risk that the resources are pooled and recoverable as well as the economic risk that development is profitable under the assumed economic and technologic conditions are factored into the reported results. This means that although very low resource volumes are reported as "economically recoverable", these low volumes, in fact, do not correspond to actual quantities of oil or gas. At low prices, risk is dominated by economic factors associated with engineering cost and reservoir performance variables. At high prices, risk is dominated by geologic factors related to volumetric variables. **Risked price-supply curves are most appropriately used to define the comparative potential of petroleum provinces under changing price and probability conditions.** They do not predict the timing of resource discovery or rate of conversion of undiscovered resources to future production. As previously stated, future production of the modeled economically recoverable resources will require extensive exploration programs. In the Alaska offshore, future leasing and exploration activities are likely to be driven by "high-side potential", combining perceptions of greater rewards at higher risk, higher future commodity prices, and innovative technology to reduce costs.

TABLE FOR PLAY RESOURCE DISTRIBUTIONS

The risked mean contribution for each geologic play in the province is tabulated under two hypothetical price conditions. The Base Price ($18 per barrel-oil; $2.11 per MCF-gas) represents current economic conditions. The High Price ($30 per barrel-oil; $3.52 per MCF-gas) represents a situation where real price has increased significantly from current levels. Other economic parameters (for example, discount rate and corporate tax rate) were equal in both scenarios, as were engineering technology and cost assumptions. The play number, name, and *UAI* (*U*nique *A*ssessment *I*dentifier code) provide a link to the data presented in other sections of this report. Hydrocarbon substances are distinguished as oil (includes crude oil and gas-condensate liquids), gas (includes non-associated, associated, and dissolved gas), and BOE (gas volume is converted to barrel of oil equivalent and added to oil volume).

BEAUFORT SHELF MODELING RESULTS

The Beaufort shelf province was modeled for the production of oil, and the scenario relies on existing infrastructure on the North Slope and the Trans-Alaska Pipeline System (TAPS). Oil production from offshore fields is assumed to be transported by TAPS and delivered by tankers to a U.S. West Coast (Los Angeles) market.

No Beaufort Sea gas resources are reported as economic The decision not to report offshore gas resources is based on two considerations. First, the huge known gas reserves (25-35 TCFG) on the North Slope remain undeveloped, and no gas transportation infrastructure is present to carry gas to outside markets. Second, if a future liquefied natural gas (LNG) market warrants the large investment (approaching $15 billion) required for development, the proven onshore gas reserves are likely to fill the new gas transportation system for decades. The economic assessment assumed that solution gas recovered from oil fields will be used as fuel for facilities or reinjected to maximize oil recovery. Non-associated gas pools will not be developed until there is excess capacity in the future gas transportation system. At present, a gas pipeline and LNG plant for North Slope gas production is being considered in the year 2005-2010 time frame.

Under present economic conditions ($18 per barrel), 2.27 BBO of risked mean economically recoverable oil is estimated for the Beaufort shelf province, placing it first among all Alaska offshore assessment provinces. This volume represents 26% of the total conventionally recoverable oil resources (8.82

BBO). None of the conventionally recoverable gas resources (43.50 TCFG) are economically viable at current prices. At oil prices of $30.00 per barrel (1995$) , the Beaufort shelf province could hold economic resources ranging from 3.3 BBO (Mean resource case) to 5.6 BBO (High resource case).

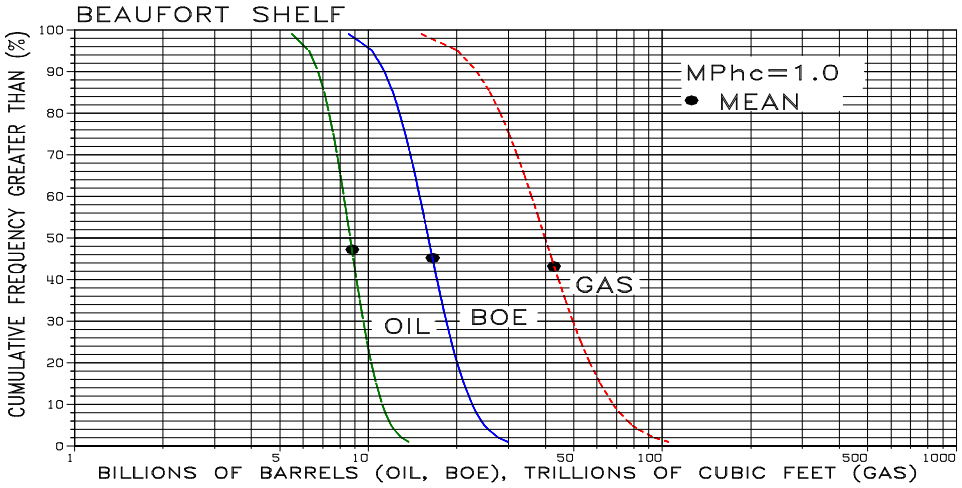
The economic oil resources are contained in few of the 23 geologic plays identified on the Beaufort shelf. For the Base Price ($18), 4 plays (Plays 0701, 1000, 1400, and 1602) contain 94% of the economic oil resources. At the High Price ($30), these same 4 plays contain 87% of the economic oil resources. Several of these Beaufort shelf plays (Plays 0401, 0501, 0601, 0701, 1302) are currently producing from fields on the adjacent North Slope. However, with the exception of the Rift play (0701) the offshore economic potential is estimated to be minimal for these productive onshore plays. The Brookian plays in deepwater areas of the outer shelf remain largely untested (plays 1000, 1400 and 1602), although oil and gas shows have been encountered in the few exploration wells drilled.

The multi-billion barrel, high-side potential and availability of existing infrastructure on the North Slope are two important factors which will attract future exploration efforts to the Beaufort Shelf province.

Economic Results for Beaufort shelf assessment province. (A) Cumulative frequency distributions for **risked, undiscovered conventionally recoverable resources** ; (B) Table comparing results for conventionally and economically recoverable oil and gas; (C) Price-supply curves for **risked, economic oil** at low (F95), mean, and high (F05) resource cases.

BOE, total oil and gas in energy-equivalent barrels; MPhc, marginal probability for occurrence of pooled hydrocarbons in basin; BBO, billions of barrels; TCFG, trillions of cubic feet.

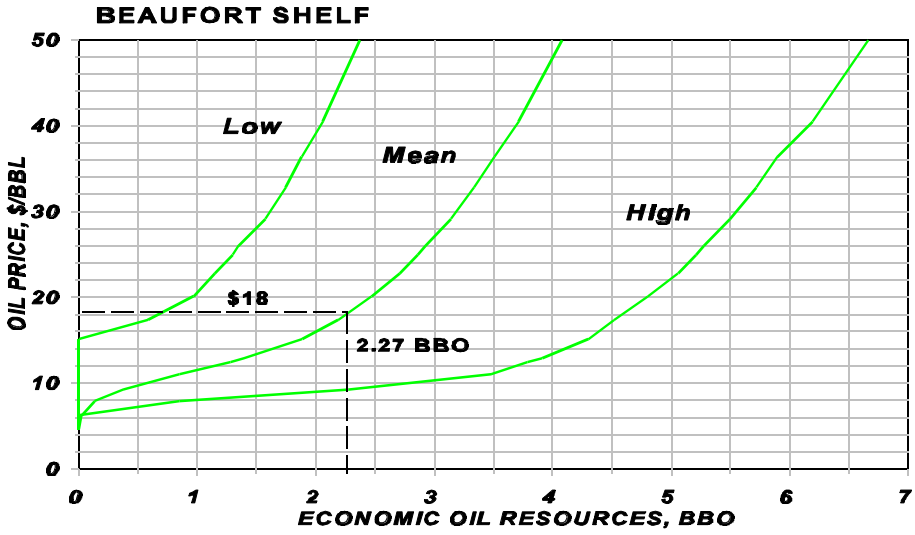
A.



B.

BEAUFORT SHELF PROVINCE		
RESOURCE TYPE	**MEAN OIL (BBO)**	**MEAN GAS (TCFG)**
CONVENTIONALLY RECOVERABLE	**8.84**	**43.50**
ECONOMICALLY RECOVERABLE ($18)	**2.27**	**N/A**
RATIO ECONOMIC/CONVENTIONAL	**0.26**	**N/A**

C.



OIL AND GAS RESOURCES OF BEAUFORT SHELF PLAYS*

Risked, Undiscovered, Economically Recoverable Oil and Gas

PLAY NO.	PLAY NAME (UAI ** CODE)	BASE PRICE			HIGH PRICE		
		OIL	GAS	BOE	OIL	GAS	BOE
0101	Undeformed Pre-Miss. Bsmt (UABS0101)	0.000	n/a	0.000	0.000	n/a	0.000
0200	Pre-Devonian (UABS0200)	0.002	n/a	0.002	0.006	n/a	0.006
0401	Endicott w/o Portion Shared/Chukchi (UABS0401)	0.000	n/a	0.000	0.001	n/a	0.001
0501	Lisburne Play (Beaufort Only: UABS0501)	0.010	n/a	0.010	0.040	n/a	0.040
0601	Upper Ellesmerian (Beaufort Only: UABS0601)	0.466	n/a	0.466	0.544	n/a	0.544
0701	Rift (Beaufort Only: UABS0701)	0.256	n/a	0.256	0.391	n/a	0.391
0800	Brookian Faulted Western Topset (UABS0800)	0.000	n/a	0.000	0.000	n/a	0.000
0902	Brookian Unstructured Western Topset (UABS0902)	0.001	n/a	0.001	0.018	n/a	0.018
1000	Brookian Faulted Western Turbidites (UABS1000)	0.000	n/a	0.000	0.000	n/a	0.000
1102	Brookian Unstructured Western Turbidite (UABS1102)	0.000	n/a	0.000	0.002	n/a	0.002
1201	Brookian Faulted Eastern Topset (UABS1201)	0.023	n/a	0.023	0.097	n/a	0.097
1302	Brookian Unstructured Eastern Topset (UABS1302)	0.840	n/a	0.840	1.001	n/a	1.001
1400	Brookian Faulted Eastern Turbidites (UABS1400)	0.000	n/a	0.000	0.000	n/a	0.000
1502	Brookian Unstructured Eastern Turbidites (UABS1502)	0.000	n/a	0.000	negl.	n/a	negl.
1602	Brookian Foldbelt (UABS1602)	0.578	n/a	0.578	0.882	n/a	0.882
1800	Endicott-Overlaps Chukchi (UABS1800)	0.000	n/a	0.000	0.000	n/a	0.000
1900	Lisburne-Overlaps Chukchi (UABS1900)	0.000	n/a	0.000	0.000	n/a	0.000
2000	Ellesmerian Deep Gas-Overlaps Chukchi (UABS2000)	0.000	n/a	0.000	0.000	n/a	0.000
2100	Upper Ellesmerian-Overlaps Chukchi (UABS2100)	0.055	n/a	0.055	0.124	n/a	0.124
2200	Rift-Overlaps Chukchi (UABS2200)	0.032	n/a	0.032	0.087	n/a	0.087
2300	Sand Apron-Overlaps Chukchi (UABS2300)	0.011	n/a	0.011	0.028	n/a	0.028
2400	Turbidites (Torok)-Overlaps Chukchi (UABS2400)	0.000	n/a	0.000	0.000	n/a	0.000
2500	Topset (Nanushuk)-Overlaps Chukchi (UABS2500)	0.000	n/a	0.000	0.002	n/a	0.002
	TOTAL	***2.274***	***n/a***	***2.274***	***3.223***	***n/a***	***3.223***

* *Revised table replacing incorrect table posted at this site from 20august to 22october 1996.*

** *Unique Assessment Identifier, code unique to play.*

OIL is in billions of barrels (BBO). **GAS** is in trillion cubic feet (TCF).
BOE is barrel of oil equivalent barrels, where 5,260 cubic feet of gas = 1 equivalent barrel-oil

For direct comparisons among provinces, two prices are selected from a continuum of possible price/resource relationships illustrated on price-supply curves. **BASE PRICE** is defined as $18.00 per barrel for oil and $2.11 per thousand cubic feet for gas. **HIGH PRICE** is defined as $30.00 per barrel for oil and $3.52 per thousand cubic feet for gas. Both economic scenarios assume a 1995 base year, flat real prices and development costs, 3% inflation, 12% discount rate, 35% Federal corporate tax, and 0.66 gas price discount.

Shaded columns indicate the most likely substances to be developed in this province. Economic viability is indicated on price-supply curves which aggregate the play resources in each province.

N/A refers to “not available”. Associated gas will be reinjected for pressure maintenance to maximize oil recovery or as fuel for production facilities. Coproduction of gas resources is not economically feasible because of the lack of a gas transportation system and over 25 TCF of proven and undeveloped gas reserves on the North Slope.