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SUMMARY OF EXISTING DATA AND POTENTIAL FOR COMMERCIAL HYDROCARBON ACCUMULATIONS, BRISTOL BAY, ALASKA

compiled by

Alaska Division of
Geological and Geophysical Surveys
Oil and Gas Section

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794 University Avenue, Basement
Fairbanks, Alaska 99709

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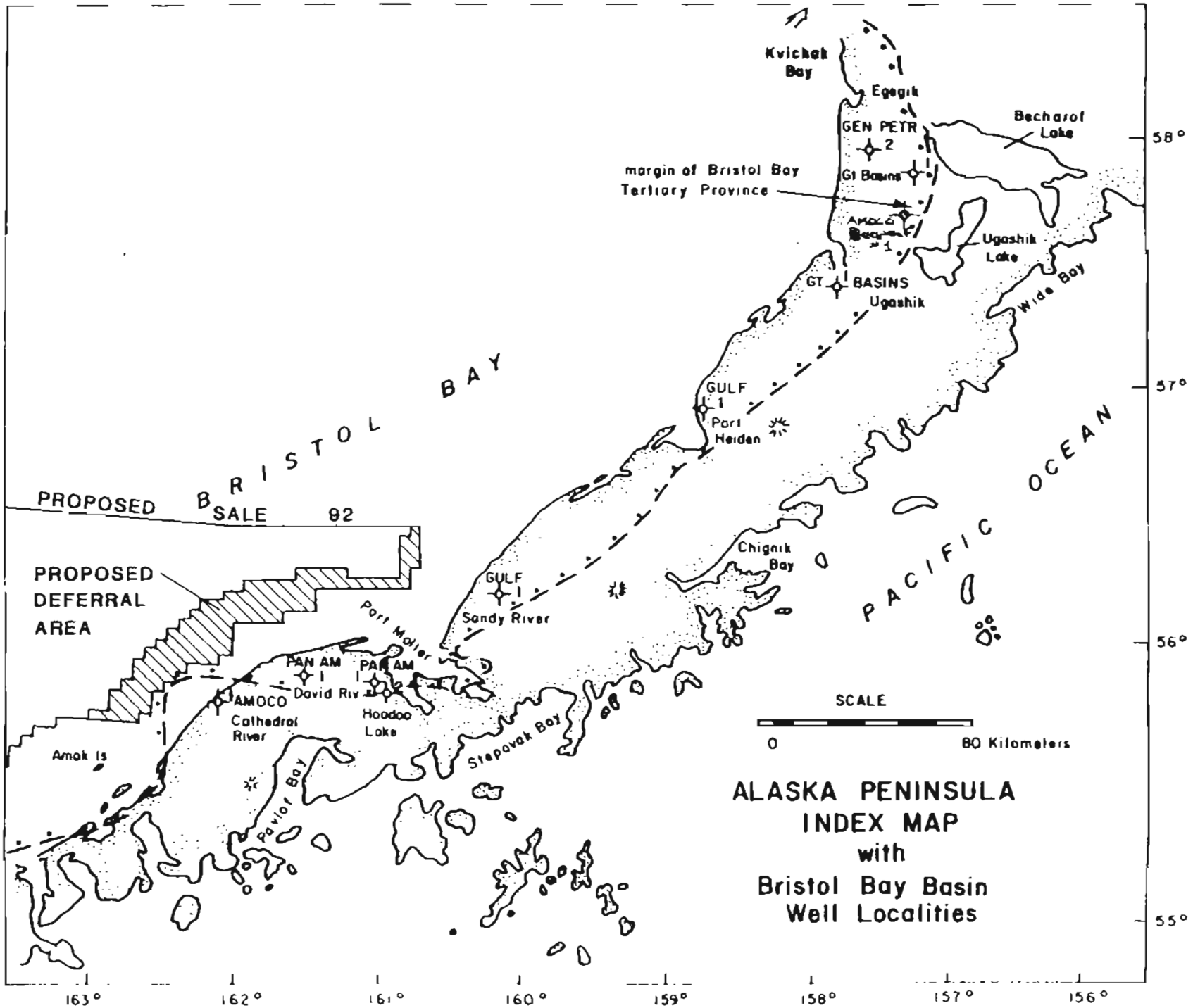

Figure 1 Index map of the Alaska Peninsula showing sites of wells drilled on the peninsula.

AVAILABLE DATA BASE

The data available to the State are limited almost entirely to the land area of the Alaska Peninsula. The State does not have access to proprietary seismic data beyond the 3 mile zone along the coast. Nor does the State have the data from the North Aleutian Shelf Cost -#1 well drilled by Arco et al to a depth of 17,155 feet. Some reconnaissance seismic data and the interpretation of these data are available in published form e.g., "A Preliminary Summary of Regional Geology, Petroleum Potential, Environmental Geology for Exploration and Development for Proposed lease Sale #75, Northern Aleutian Shelf, Bering Sea, Alaska" Marlow et al, 1980. The regional nature of these early surveys does not allow prospect generation. The most valid public resource estimates are those generated by the Federal Government reflecting the level of available data the Federal Agencies have in the offshore areas as compared to the State's data base.

The State has electric logs and well histories from ten exploratory onshore wells drilled in or near the eastern boundary of the Tertiary Province (Fig. 1). Data from these wells were used to develop cross-sections by Brockway et al, through the Alaska Geological Society. In addition geologic reports are available ranging from early geologic mapping by Burke, more recent mapping by the U.S.G.S. and specialized reports by Lyle, et al, which are joint State/Federal reports designed to examine the rock sections for reservoir parameters and for oil source determinations.

GEOLOGY

The eastern margin of the Bristol Bay Tertiary Province is shown on Figure 1. This basin is a sediment-filled structural depression that underlies a large portion of the continental shelf north of the Alaska Peninsula. The northeast end of Bristol Bay is bounded by exposures of highly deformed, locally intruded, metamorphosed Paleozoic and Mesozoic rocks. To the southwest, the basin is delineated by the offshore extension of the Black Hills. South of the basin, economic basement consists mainly of Mesozoic and Cenozoic volcanic and plutonic units that form the core of the Alaska Peninsula. Acoustic basement to the North is probably Mesozoic sedimentary, volcanic, metamorphic and crystalline rocks.

The basin probably formed in late Mesozoic time and is filled with Mesozoic and Cenozoic sediments. The Tertiary section thickens to the west and the North Aleutian Cost well may have penetrated mostly Tertiary (Cenozoic) sediments. Figure 2 is a composite columnar section of strata derived from Burk (1965) and Brockway et al in 1975. Figure 3 is a generalized stratigraphic section along the northern side of the Alaskan Peninsula.

STRUCTURE

Burk (1965) recorded extensive fault systems and many long broad folds in the Mesozoic strata in the southwest part of the basin. Schell and Hopkins (1969) mapped large scale faults along the margin of the continental shelf in the Tertiary strata.

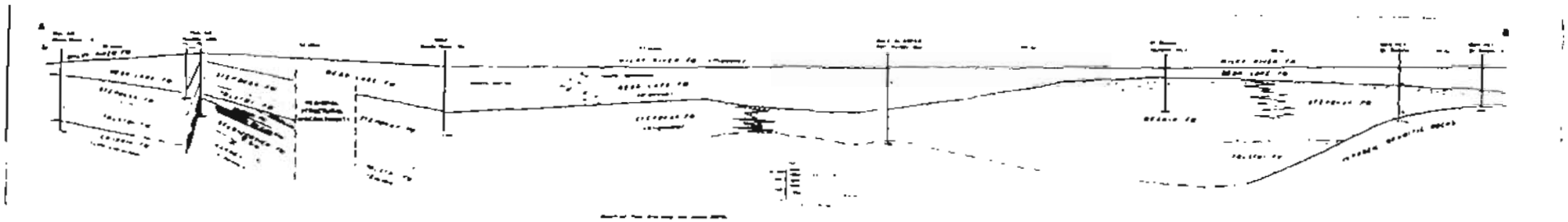

Figure 3 Generalized statigraphic cross section along the northern side of the Alaska Peninsula. Modified from Brockway and others (1975).

RESERVOIRS/TRAPS/OIL SOURCE

There are adequate sands that could form reservoirs in both the Cenozoic and Mesozoic parts of the section as known onshore. The Tertiary sediments, especially the Milky River and Bear Lake formations, contain sandstones and conglomerates that locally appear to have porosities and permeabilities sufficiently high to allow oil or gas production. Studies on the Alaska Peninsula completed by Lyle et al, however, indicate that much of the sandstone may have associated zeolites derived as a secondary product from volcanoclastics and pores may be zeolite filled.

All the drill stem tests in the nine wells examined are confined to Mesozoic sediments that range from a few hundred feet of rise to a flow of 548 barrels of water from the Chignik Formation in the Pan Am David River 1A well. This indicates poor to marginal reservoir characteristics in the tested wells.

HYDROCARBON TRAPS

Structural and stratigraphic traps associated with the faulted southeastern edge of Bristol Bay basin are possible targets for exploration. These traps are mainly anticlinal structures in the Cenozoic sequence that formed by draping and differential compaction of strata over erosional and block-faulted highs developed within the basin Complex stratagraphic pinch-outs may be developed within marine and non-marine transgression sequences in the central area of the North Aleutian Basin.

OIL SOURCE

Onshore studies completed by Lyle et al in 1979, in which samples were obtained from surface outcrops, were poor to marginal for organic content. Drill cuttings from eight of the nine wells drilled by 1977 and analyzed by McLean (1977) indicated that Paleogene strata are locally rich in organic matter but immature. The fine-grained Neogene sedimentary rocks have significantly lower carbon content than Paleogene strata and would appear to be poor source rocks for hydrocarbon generation. McLean (1977) states that the best source rocks in the Tertiary sequence appear to be block marine siltstone and shale beds in the Oligocene Stepovak formation. At least three Alaska Peninsula wells, Gulf, Sandy River, Pan American Hoodoo Lake # 1, and Pan Am. David River 1-A have encountered minor oil and gas flows in the Stepovak formation. Nevertheless, the overall section is deficient in good source beds and at least onshore the source rocks are immature.

BASIN SUMMARY

1) The thickness of the Tertiary section appears to be greatest in two sub-basins located near the shoreline at Port Moller and offshore from Ugashuk Bay.

2) Both Cenozoic and Mesozoic sediments may contain adequate reservoirs for commercial oil and gas production, however, secondary zeolites may have filled a large part of the primary porosites in these reservoirs.

3) There are poor to marginal source rocks known onshore although Mesozoic rocks and even so called Mesozoic basement rocks may have sufficient volume and organic material to generate commercial oil accumulations offshore. Gas generated from coal and organic material could be anticipated for the entire section.

4) The sediments onshore consist of non-marine and shallow water marine deposits. The general rule is that oil and gas are generated from marine sediments. Non-marine sediments are generally associated with methane gas.

5) Although onshore stratigraphic traps are mentioned in the literature, the most likely trapping mechanism offshore would probably be broad, open anticlines with associated faulting.

HISTORY OF PRODUCTION

There has been no commercial hydrocarbon production from wells drilled on the Alaska Peninsula. Live oil shows (oils with associated gas) were found in the Gulf Sandy River #1 corehole and 90 feet of mud cut oil (meaning natural oil mixed with drilling fluids) was recovered in a drill stem test of the Pan America Petroleum corp./Socal U.S.A, Hoodoo #1. Thin sands of the Mesozoic section near Port Moller omit a strong petroliferous odor.

Ten exploratory tests have been drilled on the Southeast flanks of the Bristol Bay Basin. One of the wells (Amoco Becharof #1-1985) is still confidential. At least three of the others encountered oil shows and all had minor shows of dry gas (methane).

GEOLOGICAL EXPLORATION

Most of the major oil companies have completed field work in past years on the Alaska Peninsula. About 217 crew months had been completed by the end of the 1972 field season. Field work was less intense following 1972 with State, Federal, and private industry contributing in excess of 100 additional crew months.

GEOPHYSICAL

From 1957 through 1972 an average of seven crew months per year were completed onshore and offshore. This work includes seismic shoots and gravity and magnetic surveys. Geophysical activity continued after 1972 but was less active. The latest activity was a seismic shoot preceding the drilling of the Becharof #1 exploratory drill hole by Amoco in 1985.

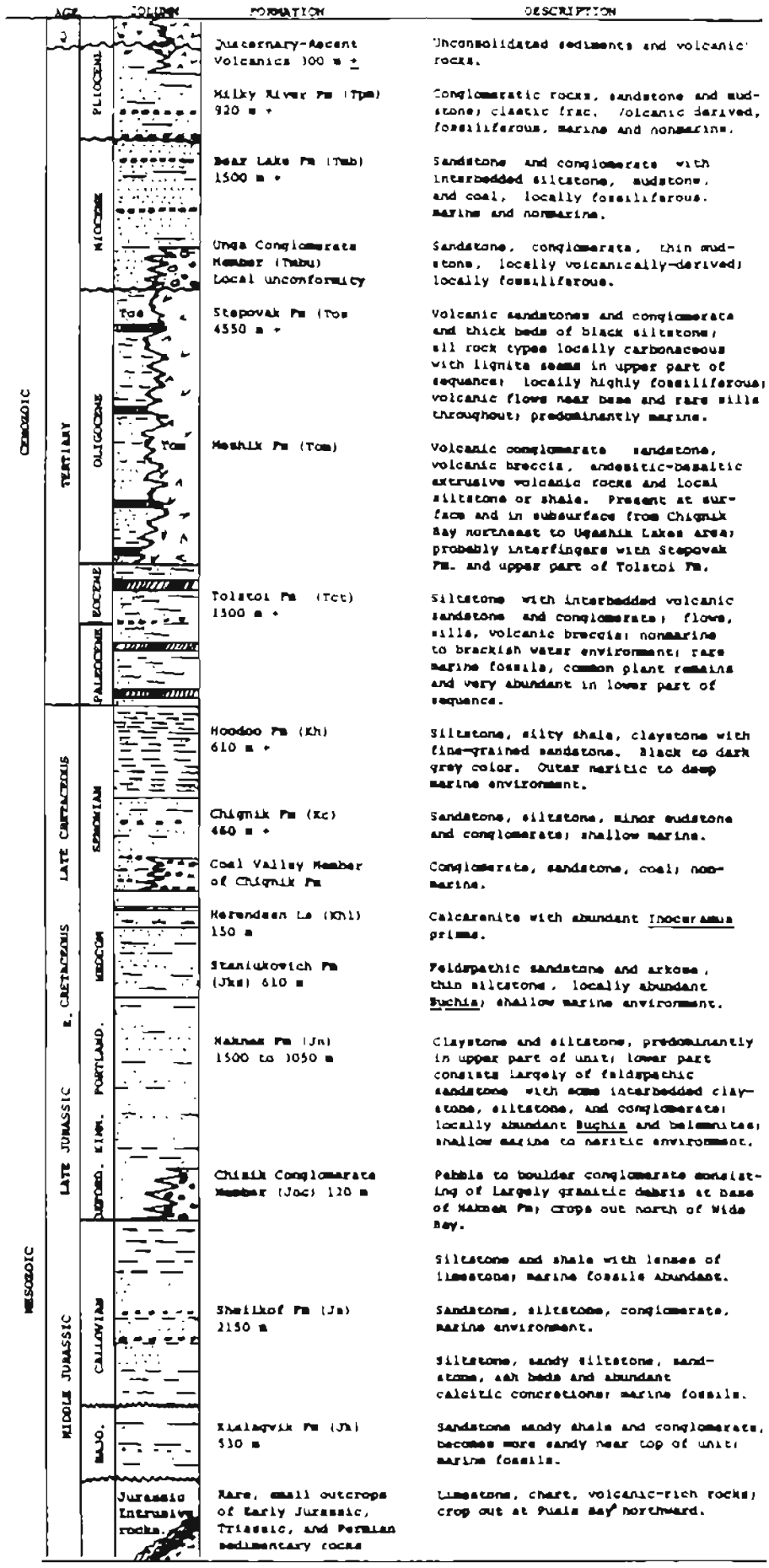

Figure 2 Composite columnar section of strata in the area of proposed lease sale #75 and the Alaska Peninsula. Derived from Burk (1965) and Brockway and others (1975).

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c) Dolton, G.L., and others, 1981, Estimates of undiscovered recoverable resources of conventionally producible oil and gas in the United States. U.S. Geological Survey, Open file Report 81-192.

d) Aries, C., Bolm, J.G., Lyle, W.M., McMullen, R.H., Mull, C.G., Nichols, C.P. and Wilson, R.H., 1982, Undiscovered oil and gas potential of the Bristol Bay region, Alaska, Alaska Department of Natural Resources, Division of Geological and Geophysical Surveys. (unpublished)

e) Bering Sea Summary Report, 1984, Outer continental shelf oil and gas information, U.S. Department of the Interior/Minerals Management Service MMS 84-0076 (Lists Bering Sea subregion oil and gas resource estimates, July 1984) source MMS

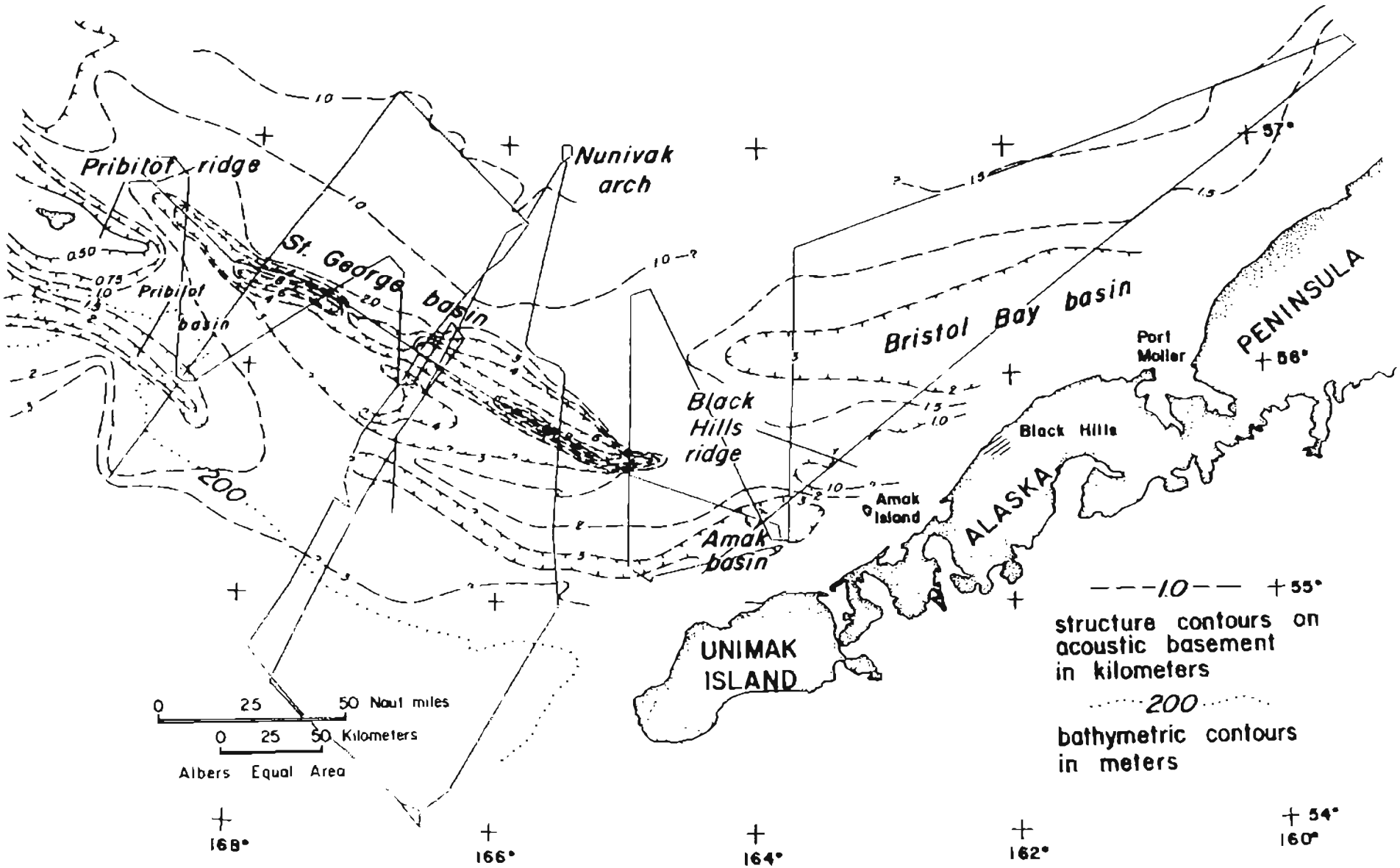

Pribilof ridge
Nunivak arch
St. George basin
Pribilof basin
Black Hills ridge
Amak basin
Bristol Bay basin
Port Moller
PENINSULA
Black Hills
Amak Island
ALASKA
UNIMAK ISLAND
200
0 25 50 Naut miles
0 25 50 Kilometers
Albers Equal Area
168°
166°
164°
162°
160°
57°
56°
55°
54°
structure contours on acoustic basement in kilometers
200
bathymetric contours in meters

Figure 4

COMPARISON OF FEDERAL AND STATE LEASING SCHEDULES IN ALASKA

	STATE			FEDERAL*				
				BLM OCS SALES			BLM UPLANDS OFFERINGS	
Year	Sale No.	Proposed Date	Area	Sale No.	Proposed Date	Area	Proposed Date	Area
1985	46A	2/85	Cook Inlet	88	Pending	Gulf of Alaska/Cook Inlet	9/85	Anvik/Bonsila
	47	5/85	Kuparuk Uplands	89	9/85	St. George Basin	9/85	Steese/White Mtn.
	45A	9/85	North Slope	92	12/85	N. Aleutian Basin	9/85	Central Yukon
				100	12/85	Norton Basin	9/85	Venetie
1986	48	1/86	Kuparuk Uplands	107	3/86	Navarin Basin		
	49	5/86	Cook Inlet	97	12/86	Diapir Field		
	52	9/86	Beaufort Sea					
1987	51	1/87	Prudhoe Bay Uplands	99	2/87	Kodiak		
	50	5/87	Camden Bay	109	2/87	Barrow Arch		
	53	9/87	Icy Cape	101	4/87	St. George Basin		
	46	9/87	Hollma Basin	86	6/87	Shumagin		
1988	54	1/88	Kuparuk Uplands					
	55	5/88	Demarcation Point					
	56	9/88	Alaska Peninsula					
1989	57	1/89	North Slope Foothills					
	45	5/89	Hope Basin					
	58	9/89	Offshore Icy Cape					

*Schedule based on Alaska Outer Continental Shelf Office Final 5-Year OCS Oil and Gas Leasing Schedule (OCS schedule amended before OCS advisory board 10-23-84). The BLM uplands schedule is for offerings which will be non-competitive unless individual aras are otherwise classified by the U.S. Geological Survey. Federal sale dates may change. They are presented here to indicated the full scope of planned oil and gas leasing activity in Alaska.

In addition to the sales shown here, BLM will manage the annual offering for lease of 2 million acres of National Petroleum Reserve Alaska lands, in August 1985.

Figure 5

STATE OF ALASKA
COMPETITIVE OIL AND GAS LEASE SALE 41
September 18, 1984

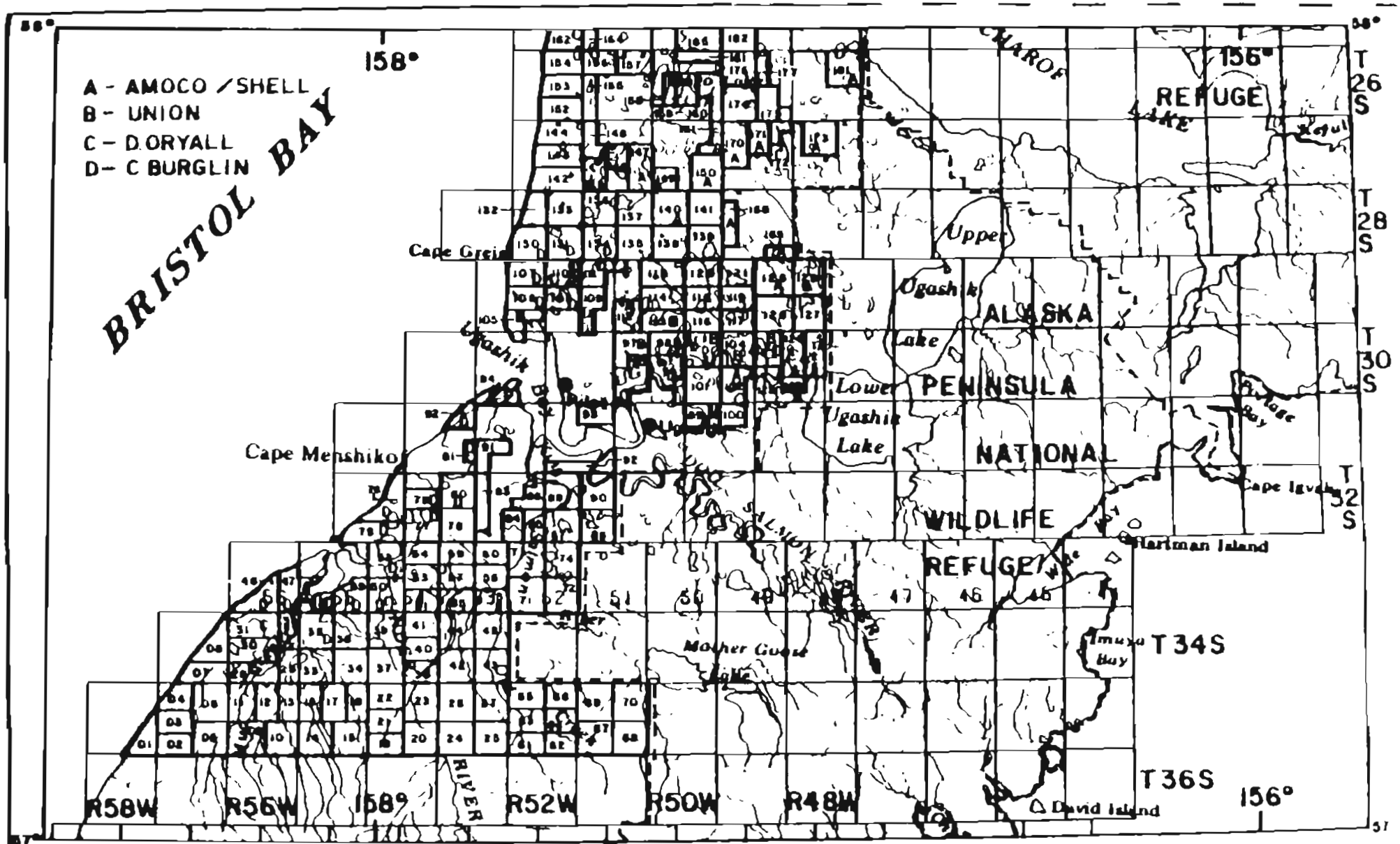
Tracts Offered:	308
Tracts Receiving Bids:	63
Acres Offered:	1,437,930.46
Acres Receiving Bids:	278,938.96
Bidding Method:	CASH BONUS
Leasing System:	Royalty 12.5%
Average High Bonus Bid:	$3.03/Acre
Total High Bonus Bids:	$843,964.92
Total of All Bids:	$913,775.72
Tracts with most Bids:	31, 32, 97, 98, 104, 113, 123, 215, 216, 217
Highest Total Bonus Bid:	$80,640.00 on Tract 215
Submitted By:	Union Oil of California

SALE RESULTS BY COMPANY

The following companies and individuals submitted bids in Sale 41. The parties listed below are either the bidder or the bidder's authorized representatives. All tracts that each company bid on are listed. The tracts on which that company was the apparent winner are marked with an asterisk (*). A complete bidder tally list including percentage interests in the groups is available by contacting OCS&G, Pouch 7-034, Anchorage, AK 99510.

COMPANY OR GROUP	TRACTS BID ON (* denotes high bidder on tract)
A - Amoco Production Co. Shell Western E & P Inc.	97, 98, *99, *100, *102, 104, 113, *122, 123, *124, *125, *128, *129, *140, *147, *149, *150, *151, *168, *169, *170, *171, *173, *181, *184, *191, *192, *193, *194, *214, 215, 216, 217, *218,
B - Union Oil Co. of Calif.	*97, *98, *103, *104, *113, *123, *215, *216, *217,
C - David J. Oryall	*31, *32,
D - C. Burglin, Kelley Everette, Jack Sexton	31, 32, *35, *46, *47, *48, *49, *50, *52, *75, *76, *77, *79, *80, *81, *82, *94, *105, *106, *107, *108, *109, *110, *111, *130, *131, *134

Figure 6



NOTE TRACTS 182, 184, AND 182 EXTEND INTO SHEET 2 OF 2 OF THE PRELIMINARY TRACT MAP

NOTE THIS MAP IS NOT TO BE CONSTRUED AS AN OFFICIAL TRACT MAP A SET OF (13) 1:63,360 SCALE TRACT MAPS IS AVAILABLE AT THE DEPT OF NATURAL RESOURCES, DIVISION OF OIL AND GAS, 550 CORDOVA ST, POUCH T-034, ANCHORAGE, ALASKA 99510 PHONE (907) 276-2653

STATE OF ALASKA
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF OIL & GAS

OIL AND GAS LEASE SALE 41
BRISTOL BAY UPLANDS TRACT MAP

SCALE 1:200,000 INCH = 3.1 MILES APPROX

Figure 6A

DIRECTOR, KAY BROWN
LEASING MANAGER, PAMELA ROGERS

DRAWN BY Q.D.S.
CHECKED BY KB

DATE APPROVED 8/8/84

SHEET 1 OF 2

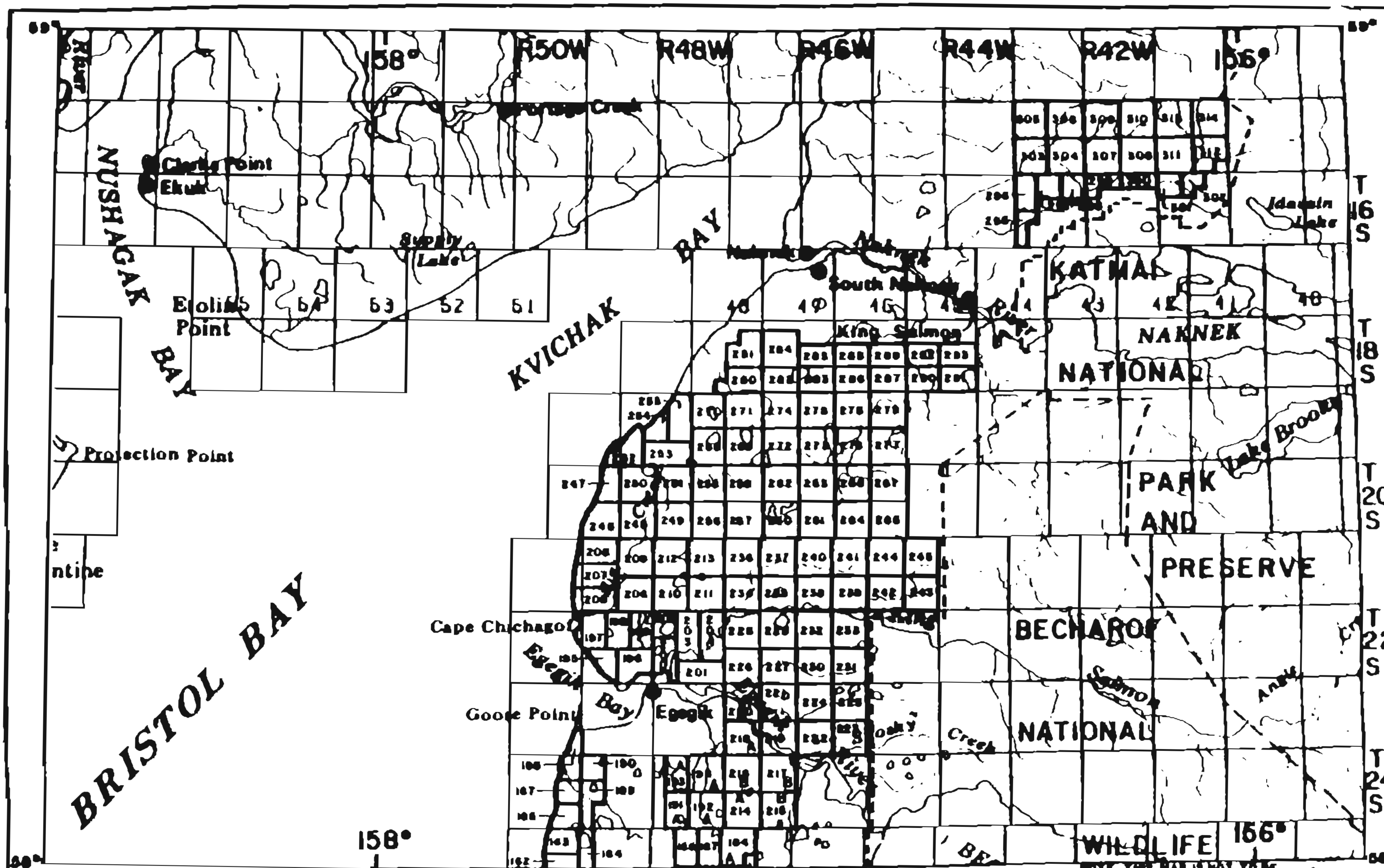


Figure 6b

STATE OF ALASKA
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF OIL & GAS
OIL AND GAS LEASE SALE 41
BRISTOL BAY UPLANDS TRACT MAP

DIRECTOR, DIV OF OIL & GAS KAY BROWN		DRAWN BY O.D.S.	DATE APPROVED 8/8/84
LEASING MANAGER		CHECKED BY	

NOTE: THIS MAP IS NOT TO BE CONSTRUED AS AN OFFICIAL TRACT MAP. A SET OF (13) 1:63,360 SCALE TRACT MAPS IS AVAILABLE AT THE DEPT OF NATURAL RESOURCES, DIVISION OF OIL AND GAS, 3601 C STREET, POUCH 7-034, ANCHORAGE, ALASKA

SHEET 2 OF 2

Date Scheduled: September, 1988.

Description of Sale Area: The proposed sale area consists of approximately 1,774,080 acres of land on the Alaska Peninsula between Cape Kleko Cape and Port Heiden.

The area encompassed by Sale 56 is within the boundaries of the Bristol Bay Area Plan (BBAP), which was adopted by the state in September, 1984. All oil and gas activities will be subject to the provisions of the BBAP.

Petroleum Potential: Petroleum potential in the area is considered low to moderate.

Other Resources: The Alaska Peninsula supports diverse and abundant fish and wildlife species. There are three federally designated conservation units adjacent to the proposed sale area, and there are two legislatively designated state critical habitat areas and one state game refuge located within or near the proposed sale area.

Caribou, moose, and brown bear utilize various portions of the area for calving, denning, and wintering. Large numbers of harbor seals are found at the mouths of all major rivers and both walrus and seals have haulout areas in the sale vicinity.

The region is a major waterfowl nesting area and migration route. Millions of ducks, geese, whistling swans, and shorebirds nest or migrate along the coastal area annually. The world's entire population of brant and emperor geese may be found on the tidelands adjacent to the sale area in the spring and fall. A marine bird nesting colony is located in the Nelson Lagoon-Walrus Island vicinity.

The Bristol Bay salmon and herring fishery is the largest in the state, and crab fishing is substantial. Anadromous streams are found throughout the proposed sale area.

Because of the region's high biological productivity, fish and wildlife resources are extensively harvested by commercial, sport, and subsistence users. Fish and wildlife harvest activities in the Sale 56 vicinity contribute significantly to local economies, and in some instances, to the state economy.

Community Information: Dillingham serves as the regional center for the Bristol Bay area. Traditional subsistence activities, commercial salmon fishing, and government activities form the area's economic base.

The Bristol Bay Area Plan was adopted by the state in September, 1984. In addition, the sale area encompasses two coastal management districts. The Aleutians East Coastal Resource Service Area (CRSA) covers the southern half of the proposed sale area, and the Bristol Bay Coastal Resource Service Area covers the northern half of the proposed sale area. Both CRSAs are developing coastal plans which are scheduled to be completed and approved by the Coastal Policy Council in 1985.

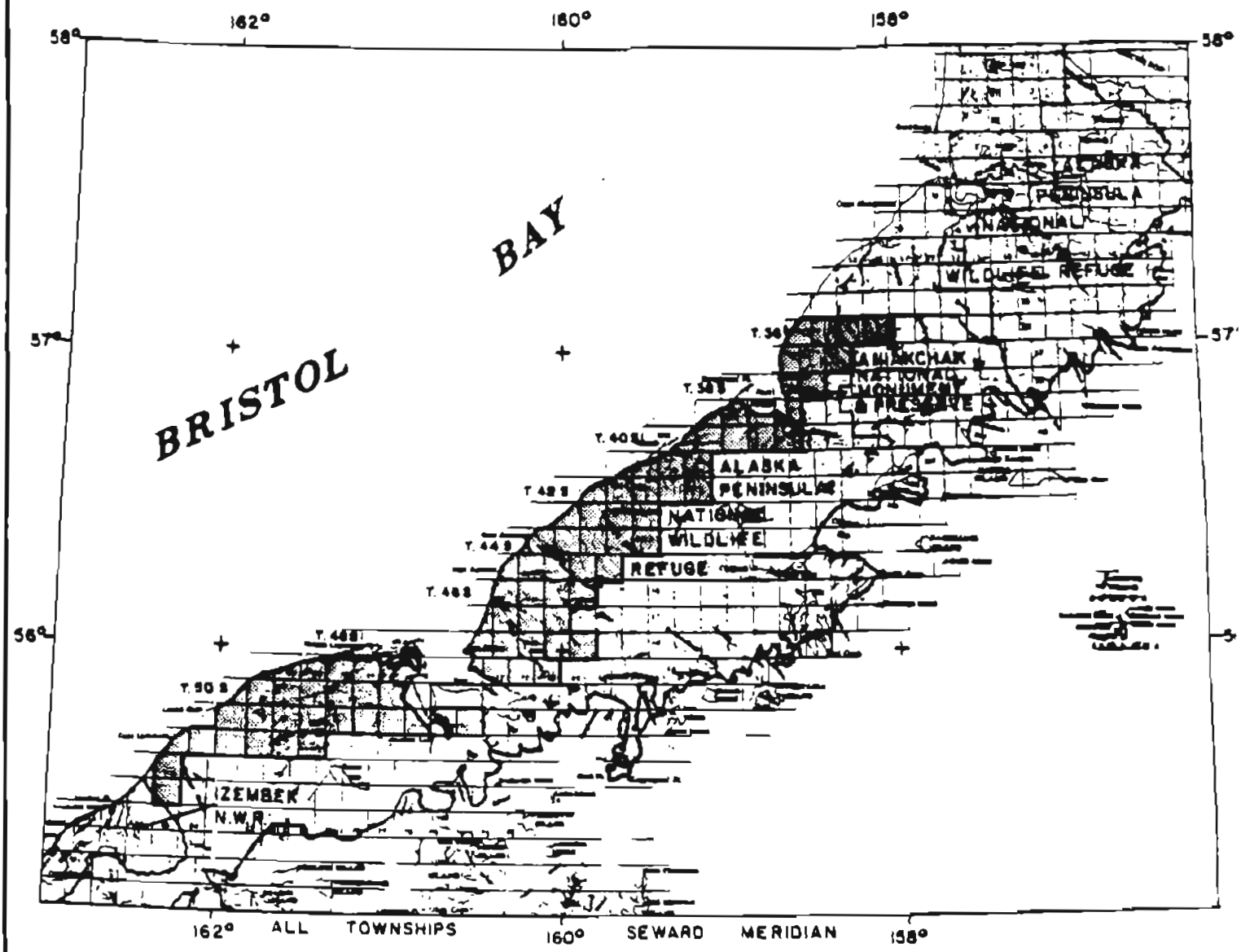
Local communities include:

Community	Municipal Classification	*Population
Port Moller	Unincorporated	--
Nelson Lagoon	Unincorporated	59
Port Heiden	Second Class City	92

*Population estimates based on 1980 Census Figures.

Status of Sale: No decision has been made on whether the state will hold this lease sale. The state is gathering social, environmental and economic information on which to base a decision. If it is determined this sale will best serve the interests of the state, a written decision and notice of sale including terms of sale, bidding methods, tract map and mitigating measures will be issued in July, 1988.

Figure 7



STATE OF ALASKA
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF OIL & GAS

PROPOSED OIL AND GAS LEASE SALE 56
ALASKA PENINSULA

SCALE 1:2,280,960 1 inch = 36 miles Approx.

MILES 18 9 0 9 18 27 36 54 72 90 MILES

DIRECTOR, DIV. OF OIL & GAS KAY BROWN	DRAWN BY: Q.D.S.	DATE APPROVED 12/21/84
LEASING MANAGER, PAMELA ROGERS	CHECKED BY: WRH	

NOTE: NO DECISION HAS YET BEEN MADE ON WHETHER THE STATE WILL HOLD THIS LEASE SALE. THE STATE IS GATHERING SOCIAL, ENVIRONMENTAL & ECONOMIC INFORMATION ON WHICH TO BASE A DECISION

PROPOSED SALE AREA

Figure 7a

RESOURCE ESTIMATES FOR THE BRISTOL BAY AND NORTH ALEUTIAN SHELF AREA

Reference	Specific Area	Estimates (Billion BBLS)			Estimates (TCF)			Comments
Alaska Open File Rept. No. 50 Div. of Geol. & Geophys. Surveys, June, 1974	Bristol Bay, Onshore		0.94			5.73		These estimates were calculated volumetrically; i.e., the estimates are based on the volume of sediment anticipated to be present in the basin area. Resources are termed "Speculative Recoverable Resources". Bristol Bay Onshore includes the entire onshore Tertiary and Mesozoic basinal area. The Bering Sea Province in this report is defined as the entire Bering Sea Shelf area from Nome to the Alaska Peninsula.
	Bering Sea Province		27.4			167.14		
		95%	Mean	5%	95%	Mean	5%	These estimates were derived from Monte Carlo methods for the entire regions indicated. Offshore estimates are made to 200 meter water depth. The estimates are defined as undiscovered and recoverable resources.
USGS Circular No. 725 1975 (reprinted in 1978)	Alaska, Onshore	6.0	12	19	16	32	57	
	Alaska, Offshore	3.0	15	31	8.0	44	80	
USGS Open File Rept. No. 81-192 1980 (replaced Circ. No. 725)	Bristol Bay, Offshore	0.0	0.2	1.2	0.0	1.0	5.6	These Monte Carlo estimates are for the specific regions indicated and are defined as undiscovered and recoverable.
	Bristol Bay, Onshore	0.0	0.1	0.6	0.0	0.5	2.3	
DGGS Preliminary Report Draft: Undiscovered Oil and Gas Potential of Bristol Bay Region, Ak. September 29, 1982	Bristol Bay Region (onshore and offshore)	0.0	0.99	3.79	0.44	5.14	15.01	These estimates are derived from the RASP methodology (Resource Appraisal Simulation for Petroleum). The estimates are defined as undiscovered in-place resources.
USGS Estimates of Undiscovered Oil and Gas Resources on the Bering Sea OCS Subregion, July, 1984	North Aleutian Basin	0.08	0.36	0.76	0.56	2.62	5.25	These estimates are derived from the PRESTO (Probabilistic Resource Estimates-OCS) methodology.
			0.08 (risked)			0.54 (risked)		These estimates are defined as undiscovered economically recoverable resources.

Figure 8

RESOURCE ESTIMATE DEFINITIONS

Undiscovered Recoverable Oil and Gas Resources:
resources estimated to exist outside known fields on the basis of broad geologic knowledge and theory that can be economically produced using existing technology, assuming current price/cost relationships and short-term technological development.

Conditional Resources:
resources expected to exist if at least one of the prospects in an area contained economically recoverable accumulations of hydrocarbons and if all the prospects modeled were drilled.

Note and Discussion

Due to the uncertainty involved in estimating undiscovered resources, estimates of their quantities include a range of values corresponding to different probability levels. These probabilities are subjective based on degree of certainty and geologic knowledge of the area. Common probabilities used in resource assessments include the 95%, 5% and modal ("most likely") levels:

1) a low resource estimate corresponds to a 95% probability of more than that amount.
2) a high resource estimate corresponds to a 5% probability of more than that amount.
3) a modal estimate corresponds to the quantity of resource associated with the greatest likelihood of occurrence.

Resources expressed in probabilities are conditional; ie, expected to exist if at least one of the prospects in an area contained economically recoverable resources. This constraint is due to the mechanics of the modelling program.

In frontier areas, however, where there has been little or no drilling, there is a risk that no recoverable petroleum exists.

Marginal Probability:
the subjective likelihood or probability that any economically

Risked Resources:
the product obtained by multiplying the conditional resource values by the marginal probability.

For frontier areas the risked resources provide a more realistic estimate because they take into account the possibility that recoverable resources may not exist in an area. The unrisked conditional resources indicate potential hydrocarbon resources for an area but do not take into account the marginal probability.