

2-5-87

State's
Comments on
1002 REPORT
(ANWR) - TELE-
CONFERENCE W/KATZ

STATE OF ALASKA



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SENATE SPECIAL COMMITTEE ON OIL AND GAS

MEMORANDUM

TO: Members, Senate Special Committee on Oil and Gas
FROM: Committee Staff
RE: Committee Meeting, February 5, 1987
DATE: February 4, 1987

On Thursday, February 5, at 3:30 pm in the Beltz Room, the Senate Special Committee on Oil and Gas will receive a presentation from the administration on the U.S. Department of Interior's Draft Coastal Plain Resource Assessment for the Arctic National Wildlife Refuge, Alaska. It is also known as the 1002 report. The state will provide specific comments and recommendations to the Secretary of the Interior. The final report will include all public comments and should be presented to Congress sometime in March.

Participants at the hearing will include representatives from the Governor's office, OMB, the Departments of Natural Resources, Fish and Game, and Environmental Conservation. In addition, John Katz from the Governor's office in Washington, D.C. will be participating via the teleconference network. The hearing will be teleconferenced for listening only to sites across the state.

In addition, Jim Hansen, Division of Geological and Geophysical Surveys will present a brief assessment of the petroleum potential of the coastal plain area of ANWR.

After the presentation, there will be discussion of the three different legislative resolutions regarding ANWR (HJR 7, HJR 9, and SJR 7)

The Senate Judiciary Committee has invited members of the Senate Special Committee on Oil and Gas to attend overview of major oil and gas litigation. This hearing will be held on Thursday, February 5 at 1:30 in the Butrovich Room.

STATE OF ALASKA



SENATE JUDICIARY COMMITTEE

SEN. JAY KERTTULA
SEN. ARLISS STURGULEWSKI
SEN. RICK HALFORD
SEN. JOE JOSEPHSON
SEN. PAT RODEY

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Feb. 4, 1987

Senator Bettye Fahrenkamp
Chair, Senate Oil and Gas Committee
Box V
Juneau, Ak. 99811

A handwritten signature in cursive script, appearing to read "Bettye".

Dear Senator Fahrenkamp:

On Thursday, February 5, at 1:30 in the Butrovich Room, the Senate Judiciary Committee will be getting an overview on all major oil and gas litigation from the Department of Law.

You and all the members of your committee are cordially invited to attend.

Sincerely,

A handwritten signature in cursive script, appearing to read "Jay Kerttula".
Jay Kerttula

JK/bk

**SENATE SPECIAL COMMITTEE ON
OIL AND GAS
February 5, 1987
3:52 p.m.**

MEMBERS PRESENT

Senator Bettye Fahrenkamp, Chairman
Senator Jack Coghill
Senator Paul Fischer

COMMITTEE CALENDAR

Arctic National Wildlife Refuge - Resource Potential,
Department of Natural Resources and Teleconference with
John Katz, Washington, D.C.

WITNESS REGISTER

John Katz, Special Counsel
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Rod Swope
Special Staff Assistant
Office of the Governor
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James Hansen
Division of Oil and Gas
Department of Natural Resources
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Anchorage, Alaska 99510-0734

ACTION NARRATIVE

TAPE ONE SIDE ONE
February 5, 1987

Number 001

The Senate Special Committee on Oil and Gas meeting was called to order by Chairman Fahrenkamp at 3:52 p.m. She explained there were a lot of questions concerning what is happening with ANWR and conflicting information on the state's involvement, and she stated that John Katz of the Governor's staff in Washington, D.C. would be talking to

the committee via the teleconference network to clarify what is going on with ANWR and the state's participation.

Number 031

John Katz, speaking via the teleconference network, said there were literally five or six manifestations of ANWR policy, ranging from the introduction of legislation to the Congress, through the proposed land trades, to a caribou agreement between the U.S. and Canada.

Concerning the legislative process itself, he said, to his knowledge, only one bill has been introduced so far (HR 39) which would designate the coastal plain of the ANWR as wilderness. It is likely that additional bills will be introduced in the foreseeable future.

There are literally four committees of the Congress which will claim jurisdiction over the ANWR issue in one form or another. To date, there has been no action in the Congress, and he thought it was likely that any intense congressional consideration would be postponed pending the submission by the Secretary of the Interior of his final ANWR report (1002 Report).

Mr. Katz stated that to date, the state has not been particularly active on Capitol Hill. He felt it was necessary to crystallize a policy which would reflect the consensus of both the Legislature and the Governor, which he feels is evolving.

He thought it very important that the state put in place a self-contained, independent advocacy effort of its own which is capable of expressing our particular position on ANWR.

Referring to the 1002 Report, he said by virtue of the original lands legislation that was passed in 1980, the Secretary was obligated, as of last September, to submit a report on the coastal plain of ANWR to the Congress. Because of the filing of litigation, that report has been delayed. In the litigation, it was held that the Secretary was compelled to go through a public environmental impact statement process and that is what he is involved in now. He noted that February 6 would be the deadline for the submission of public comment to the Secretary, and he said the State Administration will be providing comments in that process.

Another area of activity has been the negotiation of land trades involving the Interior Department and several native corporations. Since last October, the state has been an active participant in those discussions. He said the last major series of meetings occurred in Washington early in

January and he said they would be meeting again that week. He then outlined three principal doctrines that the discussions would be devoted to. Mr. Katz said it was contemplated by all concerned that if any of any of the trades are consummated, they must be submitted to the Congress for approval, and in the case of any trades that might involve the State of Alaska, they would have to be submitted to the State Legislature for approval.

Outlining the position the state has been reflecting in those discussions, Mr. Katz said they have made it clear to both the native corporations and the Interior Department that they have not yet taken a position on the wisdom or lack of wisdom inherent in the trades themselves. That is a subject that is under active deliberation now within the Administration for the purpose of trying to come to a definitive conclusion as soon as possible. In the interim, they have been participating on what they feel is a constructive basis, both as sovereign and as land owner, trying to identify problems and also strengths in the various documents that are under consideration.

Another area that has been of great concern and interest to some legislators is the possibility of a caribou agreement between the U.S. and Canada. He thought the discussions which have occurred so far would lead to a bilateral agreement between the two governments. The last series of meetings, which occurred in Seattle, led ultimately to a draft agreement which was initialized by the parties but not finalized. The agreement has been circulated to all interested parties, including the State of Alaska, for comments. They have approximately 60 days to submit their comments. He said the caribou agreement does bear upon the ANWR issue because it does create a bilateral regime for the consideration of issues affecting the Porcupine Caribou herd, and it also deals with general mandates relating to habitat protection.

Number 217

Senator Coghill said he was concerned about the perception that was brought forth by the Governor's press conference wherein the state was not at the table and there were negotiations going on outside of the legislative authority. He asked Mr. Katz if he would address the question of revenue sharing and whether it could be negotiated along with the negotiation of the land swaps.

Number 235

Mr. Katz responded that negotiations were not going on outside of the authority of the State Legislature to approve them. They have made it clear that if they get to to the point of consummating a land trade with the Interior

Department, that trade must be submitted to the State Legislature for approval.

Concerning the 90/10 formula, they are contending that the 90/10 formulation is part of the solid compact between the people of Alaska and the Federal Government as embodied in the Statehood Act. They believe their best posture, both legally and strategically, is to argue strongly for the maintenance of the 90/10 formula, and if that changes by virtue of congressional action, then to examine what their options are at that point in time.

Number 302

Clarifying an earlier statement, Mr. Katz said he didn't think it was accurate to say that the state has been in the land trade discussions for the past two years. He thought the discussions began somewhere in that period with interest of the Kodiak Regional Corporation in exchanging their inholdings within the Kodiak Wildlife Refuge for lands and oil and gas interests within the coastal plain. The state's active involvement as a co-equal with the other parties at the table really began last October and was first manifested in concrete form in discussions that occurred in Washington in early December, 1986. Since then, they have been cognizant of what has been going on and have been permitted to represent themselves at the table.

Referring to when the Legislature should come involved, he said the AS 38.50 process affords that opportunity. He said they have been abiding by the Interior Department's rules in terms of how the discussions should be implemented and for that reason they have not been as forthcoming publicly as perhaps occurs on other issues. In that regard, they have kept confidential material that has been given to them by the Interior Department, but they have felt that under state law, any documents that they have submitted to the department are public record and they have made those letters available both to the press and to people who have requested them.

Number 340

Senator Fahrenkamp said she thought that was part of the confusion.

Mr. Katz explained there was a juncture in the process when the state felt that discussions were going on between the Interior and one or more native corporations that could clearly affect state sovereign interests. In addition, the state felt that in its own interest there might be some inholdings for the federal conservation system that it could put on the table in exchange for some possible rights

in ANWR. The amount they have on the table now is approximately 260,000 acres, almost exclusively located as state inholdings within federal wildlife refuges.

Senator Fahrenkamp asked, through lack of knowledge of what is happening, if we go in now with a resolution asking the Department of Interior, the Congress, etc. not to allow or to go ahead with land trades, and yet we have been working at the table offering a 260,000 acre exchange, doesn't that seem like a contradiction?

Mr. Katz responded that he didn't think so, but he agreed with the thrust of her question. If, for any reason, it is deemed that land trades involving native corporations are not in either the state interest or the federal interest, then those back there feel it would be hypocritical for the state to continue to pursue a land trade on its own with the federal government. It was his personal view that if for any reason the Legislature were to decide against native trades, then the state must walk away from the negotiating table with respect to that 260,000 acres as well.

Senator Fahrenkamp said it behooves the Legislature as they are looking at resolutions, to know a little more about the background than they have known to date.

Number 411

Senator Fahrenkamp noted that Senator Sturgulewski had joined the committee and would be participating in the meeting.

Number 418

Mr. Katz said he was in favor of a resolution and felt there would be therapeutic value in it in that it would reflect a consensus of the Governor and the Legislature early in the process about what policies to pursue.

Number 443

Senator Fahrenkamp inquired if he could be more specific on what he meant by "early."

Mr. Katz said, so far, what they have seen in the legislative area is just a little bit of preliminary skirmishing --- there really hasn't been any definitive action. He felt that the kind of guidance that would be embodied in that sort of resolution is needed relatively soon.

Number 455

Senator Coghill asked if Mr. Katz had a Memorandum of Understanding between the state and the Interior Department as to information pass-throughs on seismic work done in the area below the Kaktovik area.

Senator Coghill said the compact that was made between the federal government on the 90/10 really disturbs him. If they have privied information on the seismic work and they can select before the state selects, what is going to be the process there and should that be done before the Secretary issues his 1002 Report, Senator Coghill asked.

Number 471

Mr. Katz replied that there was a Memorandum of Understanding that was negotiated by the prior administration by the Department of Natural Resources and the Interior Department. It provided some ground rules for the exchange of information between the federal government and the state. The memo provided some deadlines and a process for the state's dissemination of its analysis of ANWR. Recently, the Secretary of Interior granted his permission for the state to release its findings publicly.

In terms of the 90/10, Mr. Katz said it applies in any situation involving leasing by the federal government under the Mineral Leasing Act of 1920. The Attorney General has ruled that the 90/10 would not apply if land trades occur because the lands involved would then no longer be subject to the Act. From what he knows, state geologists have had pretty equal access to the information that is available. To his knowledge, nobody in the government has information relating to the results of the well that was drilled on the Kaktovik lands.

Number 498

Senator Sturgulewski said there seems to be some confusion among some in the Senate as to the potential role of the state in the land trades, and she wondered if the state does not participate in trading of land, what role, other than advisory, we have.

Number 540

Mr. Katz responded that they have sought to play two roles in the discussions. One is the role of state as land owner and the other is the state is sovereign. At the first level, the Interior Department has been much more interested and accommodating to them when they appear as land owner, a little less accommodating when they appear as a sovereign. He thought that the step of litigation could be viewed as being toward the end of the process, and he saw

the Legislature having a role in providing guidance to the executive by either a resolution or organic legislation.

Senator Sturgulewski asked Mr. Katz if the Udall bill was moving forward, and in addition to the 1002 Report, what might the Legislature anticipate the Congress to do.

Mr. Katz responded that the Udall bill has not yet begun to move and he didn't expect much substantive consideration until the 1002 Report was completed. He said he suspected that the Secretary will submit legislative recommendations to the Congress accompanying the 1002 Report, probably in the form of legislation. In addition, he thought it was likely that one or more members of our congressional delegation will be considering the introduction of legislation. He knows for a fact that a group of other congressmen are considering a separate bill which might, in addition to other things, involve an attempted alteration of the 90/10 revenue formula.

Number 552

Senator Fahrenkamp said, in talking to the Interior Department, they indicated that in their legal sense, it was not necessary for this to go before the Congress, but was being done to meet a promise, and she asked if that had any bearing.

Mr. Katz replied that the Interior Department has promised the appropriate committees of Congress that it will not consummate these lands trades as a matter of administrative discretion, even if it has that discretion, but rather it will, in fact, submit the land trades to Congress for approval at the appropriate time. They have chosen, at least as a policy matter, to do so irrespective of what the legal requirements might be.

Number 568

Senator Fahrenkamp asked Mr. Katz what he saw at this stage as the position of union representatives, environmental groups, etc.

Mr. Katz said there is a coalition which has formed in Washington of groups and organizations which are interested in seeing ANWR opened subject to some set of stipulations. On the other hand, the environmentalists have formed an effective coalition of their own. He thought there were two maritime unions involved in the coalition to open ANWR. Many other unions are still on the sidelines pending some possible resolution of the local hire issue.

Number 594

Responding to a question from Senator Fahrenkamp, Mr. Katz said there is one school of opinion that feels that native land trades are very important to the opening of ANWR. The natives have about a million acres of inholdings on the table and some people feel that that will be very attractive to congressmen who are looking for good environmental reasons to support the bill. Secondly, the native corporations are good advocates and are well respected in the Congress.

Another school of opinion is that the existence of some land trades complicates an already very difficult issue and that it injects the concept of private ownership, even if it's just ownership of oil and gas rights.

Number 618

Rod Swope, Special Staff Assistant on Resources, Office of the Governor, related that the Administration's position would be ready the following day and they would come back and discuss that position with the committee, if desired.

Number 635

Senator Coghill added that public comment would close the following day, but as he understood it, the Secretary would continue to hear further comment from the legislative branch.

TAPE ONE SIDE TWO
February 5, 1987

Number 655

Mr. Katz, referring to his statement that discussions had really begun in earnest in October, said he didn't mean to imply that there had been no interaction with the Interior Department before that. He felt that in October, the state's role in the process was respected and they began to be treated as co-equals in all the discussions that occurred. Prior to that period of time, they had been exchanging, mainly through the Department of Natural Resources, information with the Interior Department. Since October, they have been at the table with the corporations and the department. He noted there was a documentary record that goes back considerably further than that, and said the committee may want to review that at some point.

Number 702

Senator Fahrenkamp stated that the interpretations they're getting from the Interior Department is that the chances of a 90/10 holding up on federal leases are not good.

Mr. Katz said he thought it would be necessary to fight for the 90/10 and explain the legal and policy justification. For a number of very different reasons, a lot of congressmen are coming to this issue with a predisposition to alter the formula, and we've really got our job cut out for us, he said. From what he can tell, the Interior Department will not be supportive of the the 90/10 in the congressional discussion.

Number 750

Senator Fahrenkamp thanked Mr. Katz for his participation in the meeting, saying not only did he and the Administration have their work cut out for them, but the members of the Legislature did as well. She said, as they are working on their revenue projections, she would appreciate him sharing that information with her.

Mr. Katz confirmed that they have been trying to work up some revenue projections which haven't been completed yet. The Interior Department's projections are confidential information and they have not been shared with anybody, to his knowledge.

Number 774

Senator Coghill noted that he and Senator Bennett would be in Washington, D.C. the following week and would be in contact with Mr. Katz at that time in order to further discuss ANWR.

Number 792

Senator Fahrenkamp, speaking to Rod Swope, noted there were a number of resolutions the Legislature was looking at, and she thought it was important that the Legislature and Administration work closely together. She asked what his advice was as to what a resolution should look like, and how should they try to coordinate and negotiate their position.

Number 810

Mr. Swope said he could offer some advice in terms of the Administration's position on some of the major policy questions. They support local hire to the extent that it is possible. Their position is that the 90/10 revenue share should be maintained. They still don't have a definitive position on land exchanges, so they can't speak to that issue. In terms of their position on the 1002 Report, the Administration has said they clearly would like to see exploration and development of the coastal plain in ANWR, provided it is done with the intent and the express purpose of the refuge. A major discussion they have had is

how to best protect the Porcupine Caribou herd and still allow exploration and development.

Number 902

Jim Hansen, Chief Petroleum Geophysicist for the Department of Natural Resources, gave a brief and detailed slide presentation on why they say the ANWR has the high potential it does. He said the information he was giving was all taken from nonconfidential data.

He noted that committee members had just received a public data file, 87-1, which was released the previous day.

The slides shown pertained to the location of ANWR; the key elements necessary in order to have oil; and geologic features. He also pointed out on a map where they think the oil is located.

Number 058

Concluding, Mr. Hansen said what they firmly believe that the ANWR area has the highest potential of any onshore, unexplored area in the North American continent. All the key ingredients necessary for oil accumulation are there, he said.

Number 083

A brief discussion followed on the seismic information on the KIC land and the one well there. It was noted that that information was not available and is being shared only by the oil companies and the native corporations.

Mr. Hanson said the state Oil and Gas Conservation Commission receives data from all wells in the state. They have those logs, but they are kept in a vault and no one is allowed to look at them.

Number 107

Mr. Katz said the Arctic Slope Regional Corporation, which drilled the KIC well with its oil company partners, is not a party in the land exchange discussions in Washington, D.C. He explained that the other native corporations, which are parties, do not have access to ASRC's information. ASRC is in a unique position under ANILCA in that they don't need trades. If the Congress authorizes drilling in the coastal plain, then they can go forward with oil and gas development on their lands without the benefit of another trade, he stated.

There being no further questions or comments, Senator Fahrenkamp adjourned the meeting at 5:07 p.m.

STATE OF ALASKA

DEPARTMENT OF NATURAL RESOURCES

DIVISION OF GEOLOGICAL & GEOPHYSICAL SURVEYS

STEVE COWPER, GOVERNOR

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January 15, 1987

Representative Mike Davis
Pouch V
Juneau, Alaska 99801

Dear Representative Davis:

Per your request, I have enclosed three copies of U.S. Geological Survey map I-1791 that covers the Arctic National Wildlife Refuge. Your office said you would see that other members of the Interior delegation receive a copy. Unfortunately, the map is in short supply. I will be happy to forward additional copies when they become available.

I have also included 10 copies of DGGS Professional Report 90, 'Resource appraisal simulation for petroleum in the Arctic National Wildlife Refuge, Alaska.' Per our briefing last week, I thought it might be of interest to you and other members of the Interior delegation. The attached comments by Hansen and Kornbrath compare the results of the Department of Interior FAST study and DGGS RASP program.

Sincerely,



Cheri L. Daniels, Chief
Resource Information Section

CLD/ram

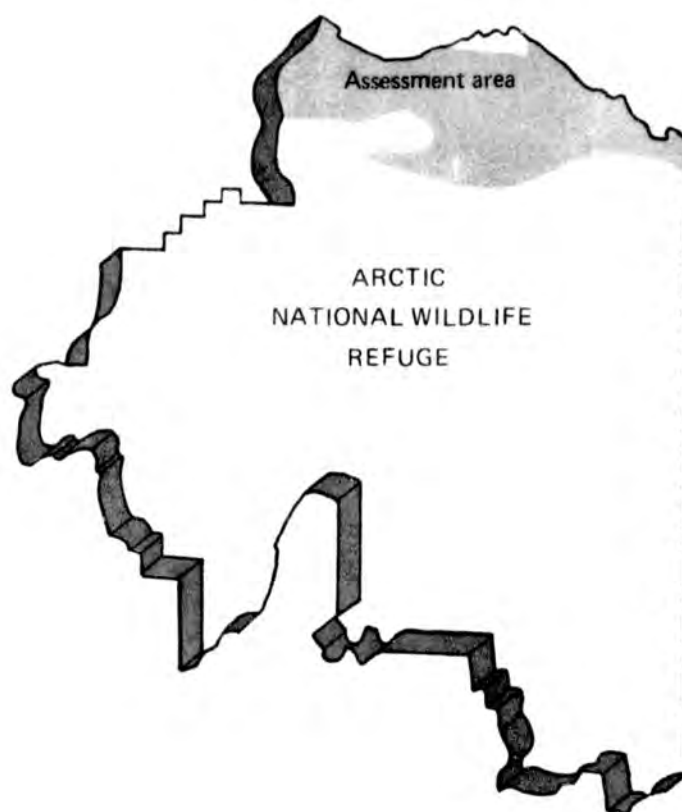
Enclosures

cc: Laurel Murphy
Dick Reger
Sally Wells

~~Fahrenkamp~~ Fahrenkamp

RESOURCE APPRAISAL SIMULATION FOR PETROLEUM IN THE ARCTIC NATIONAL WILDLIFE REFUGE, ALASKA

Compiled by J.J. Hansen and R.W. Kornbrath



PROFESSIONAL REPORT 90

Published by

State of Alaska
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1986

RESOURCE APPRAISAL SIMULATION FOR PETROLEUM IN THE ARCTIC NATIONAL WILDLIFE REFUGE, ALASKA

Compiled by J.J. Hansen and R.W. Kornbrath

Division of Geological & Geophysical Surveys
Professional Report 90

Fairbanks, Alaska
1986

STATE OF ALASKA

Bill Sheffield, Governor

**Esther C. Wunnicke, Commissioner,
Department of Natural Resources**

Ross G. Schaff, Director and State Geologist

This report was prepared at the request of the U.S. Department of the Interior by the State of Alaska Department of Natural Resources according to the Memorandum of Understanding signed by both agencies in 1985. DGGs publications are available at: Alaska National Bank of the North Bldg. (2nd floor), Geist Rd. and University Ave., Fairbanks; 3601 C St. (10th floor), Anchorage; 400 Willoughby Center (4th floor), Juneau; and the State Office Bldg., Ketchikan. Mail orders should be addressed to DGGs, 794 University Ave. (Basement), Fairbanks, AK 99709. Cost \$2.

FOREWORD

In 1985, the Secretary of the U.S. Department of the Interior and the Commissioner of the Alaska Department of Natural Resources signed an agreement to share geologic and geophysical data collected from the Arctic National Wildlife Refuge (ANWR). Scientists of the Department of Natural Resources analyzed these data and prepared estimates of the oil-and-gas potential of the coastal plain of ANWR, as stipulated in the agreement. These estimates are reported in this document.

*Ross G. Schaff
Director and State Geologist*

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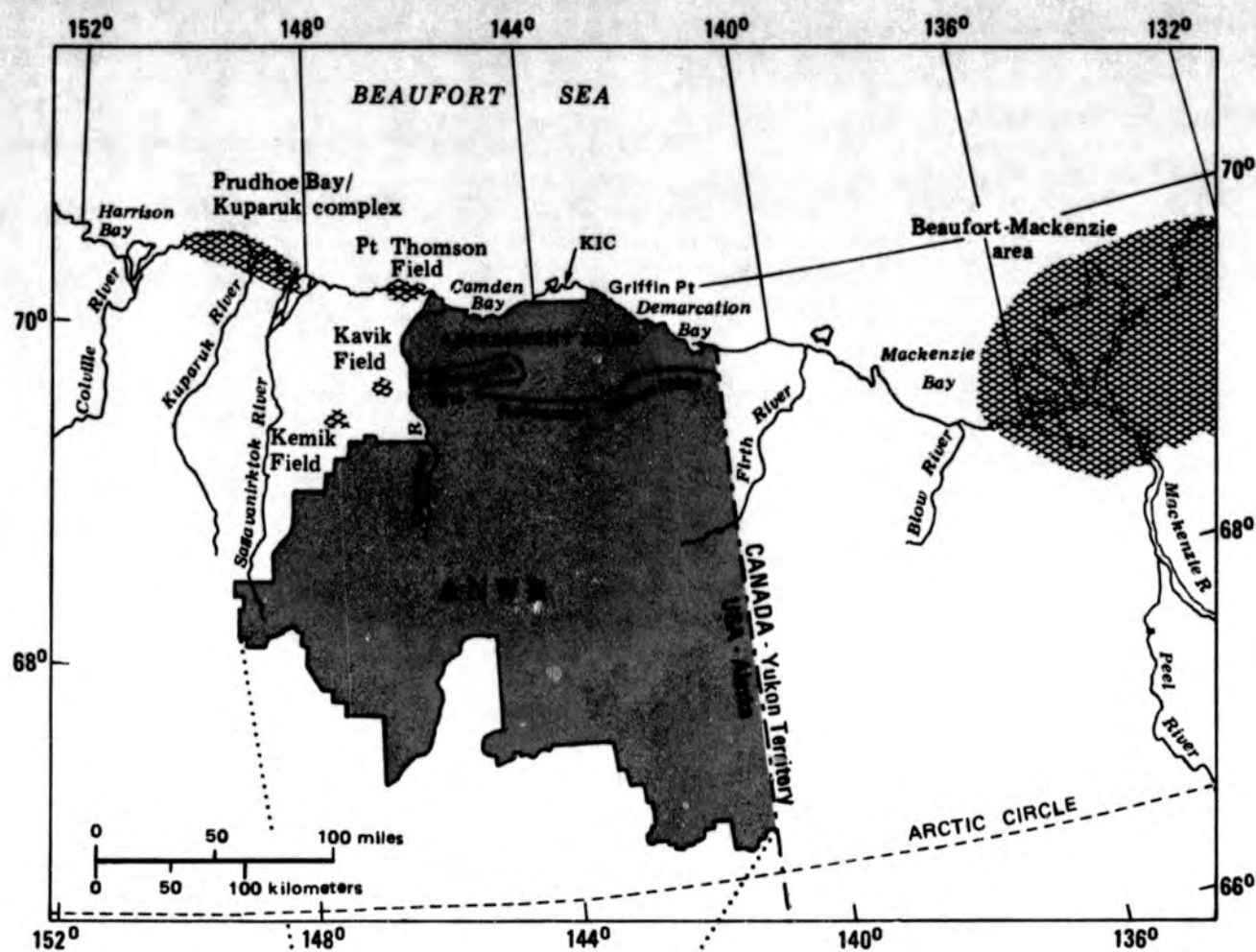
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PROFESSIONAL REPORT 90



Location map of the assessment area in the Arctic National Wildlife Refuge. The North Slope of Alaska contains nine known significant oil-and-gas fields with proven and inferred original recoverable reserves of about 15.4 billion barrels of oil and 32.0 trillion cubic feet of gas. The Beaufort-Mackenzie area of Canada contains 39 oil-and-gas fields with proven and inferred original recoverable reserves of about 8.5 billion barrels of oil and 65.0 trillion cubic feet of gas. KIC denotes land owned by the Kaktovik Inupiat Corporation.

RESOURCE APPRAISAL SIMULATION FOR PETROLEUM IN THE ARCTIC NATIONAL WILDLIFE REFUGE, ALASKA

Compiled by J.J. Hansen¹ and R.W. Kornbrath¹

INTRODUCTION

This report presents the results of the State's preliminary appraisal of the potential for undiscovered petroleum resources on the coastal plain of the Arctic National Wildlife Refuge (ANWR), Alaska. The assessment area is located north of the Sadlerochit and Romanzof Mountains between the Canning River and the Canadian border. The study area does not include that portion of the coastal plain from eastern Camden Bay to Griffin Point (owned by the Kaktovik Inupiat Corporation²) or state-submerged lands offshore from ANWR.

Members of the appraisal panel from the Alaska Department of Natural Resources include C. Arie, J.E. Decker, J.J. Hansen, R.W. Kornbrath, D.L. Krouskop, C.G. Mull, G.H. Pessel, M.S. Robinson, T.N. Smith, and S.M. Weum. B.H. White and R. Anderson (U.S. Bureau of Mines) and E.L. Phillips (Alaska Department of Natural Resources) assisted in the computer analysis of the data.

A resource appraisal of ANWR was completed in 1980 by the U.S. Geological Survey. At that time, the available data consisted of limited gravity and aeromagnetic surveys augmented by some geologic mapping. Since then, additional geologic studies, two proprietary gravity surveys, and two seismic surveys have been conducted. Interpretation of this new information has resulted in revised hypotheses about the geologic evolution of the coastal plain.

The methodology used to assess the resource potential of the coastal plain of ANWR is the Resource Appraisal Simulation for Petroleum (RASP), which was developed by the U.S. Department of Interior Office of Minerals Policy and Research Analysis. RASP is a simulation (or modeling) procedure that geoscientists use to assess the undiscovered oil-and-gas potential of frontier basins. The basic unit of analysis is the geologic

play, which is defined as a stratigraphic unit in a relatively homogeneous geologic setting. A basin will normally consist of one or more plays of interest; the geologic plays for this appraisal are presented in figures 1 through 7 (app.).

Resource estimates are presented as probability distributions that reflect the uncertainty inherent in appraising undiscovered resources. The resources estimated to exist in each play are combined to produce an estimate of the total 'undiscovered, conditional resources in place' as barrels of oil, cubic feet of gas, and barrels of oil equivalent for the study area. In addition, a probability distribution of the deposit size is generated for each play and for the total resources in place. Deposit size is important for economic considerations; for instance, less than 350 million barrels of recoverable oil in ANWR may not be commercially viable. A more detailed discussion of the RASP methodology is included on page 3.

ASSESSMENT RESULTS

The results of the petroleum-resource assessment are summarized in tables 1 through 4. Probability distributions for total oil, total gas, total barrels of oil equivalent, and oil-and-gas deposit sizes are presented at various fractiles that range from 0.99 to 0.01. The distribution values may be interpreted as follows. The 0.95 fractile means that there is a 95-percent chance that at least that amount of the associated resource is present. For oil, there is a 95-percent chance that ANWR contains at least 80 million barrels of oil. Similarly, there is a 1-percent chance that ANWR contains at least 45.78 billion barrels of oil. The 0.50 fractile is not the most likely case of occurrence. Rather, it is the median of the distribution and indicates a 50-percent chance that the quantity of resource present could be greater or less than its associated value.

The results in tables 1 and 2 show that in the range between the 95th and 5th fractiles, the resource potential of ANWR ranges from 0.08 to 26.52 billion barrels of oil (BBO) and from 0.71 to 43.62 trillion

¹Alaska Division of Geological and Geophysical Surveys, P.O. Box 7028, Anchorage, Alaska 99510.

²An additional assessment that includes the KIC lands was performed by the Alaska Department of Natural Resources.

Table 1. Total oil, ANWR petroleum-resource assessment.

Fractile	Billion barrels
0.99	0.00
0.98	0.00
0.97	0.01
0.96	0.04
0.95	0.08
0.90	0.33
0.75	1.28
0.50	3.77
0.25	9.18
0.10	17.94
0.05	26.52
0.04	29.68
0.03	34.14
0.02	38.94
0.01	45.78
Minimum simulated oil	Maximum simulated oil
0.00	81.77
Average oil	Standard deviation
7.22	9.66

Table 2. Total gas, ANWR petroleum-resource assessment.

Fractile	Trillion ft ³
0.99	0.08
0.98	0.26
0.97	0.40
0.96	0.56
0.95	0.71
0.90	1.42
0.75	3.74
0.50	8.64
0.25	17.77
0.10	31.94
0.05	43.62
0.04	46.65
0.03	52.67
0.02	62.26
0.01	76.24
Minimum simulated gas	Maximum simulated gas
0.00	159.92
Average gas	Standard deviation
13.69	15.76

Table 3. Total deposit size, ANWR petroleum-resource assessment.

Fractile	Conditional, 100% oil (million barrels)	Conditional, 100% gas (billion ft ³)
0.99	3.202	5.797
0.98	6.115	10.252
0.97	8.766	14.854
0.96	11.154	19.368
0.95	14.556	23.382
0.90	30.865	45.115
0.75	102.155	143.645
0.50	354.131	509.171
0.25	1173.606	1721.490
0.10	3440.368	4846.398
0.05	6277.965	8912.465
0.04	7313.133	10861.937
0.03	8898.691	13492.098
0.02	11821.965	18052.875
0.01	18272.949	26867.359
Minimum simulated deposit	0.10	0.40
Average	1459.56	2143.70
Maximum simulated deposit	76941.38	125833.06
Standard deviation	3762.19	5768.84

Table 4. Total resources, ANWR petroleum-resource assessment.
(barrels of oil equivalent, BOE)

Fractile	Billion BOE
0.99	0.05
0.98	0.17
0.97	0.25
0.96	0.35
0.95	0.47
0.90	0.96
0.75	2.54
0.50	6.05
0.25	12.42
0.10	22.50
0.05	31.54
0.04	35.56
0.03	40.15
0.02	44.75
0.01	53.01
Minimum simulated BOE	Maximum simulated BOE
0.00	89.93
Average BOE	Standard deviation
9.64	11.06

cubic feet of gas (TCFG) in place, with an average value of 7.22 BBO and 13.69 TCFG. The median value (the 50th fractile) is 3.77 BBO and 8.64 TCFG (tables 1 and 2).

The resource distributions are strongly skewed toward the low-probability, high-resource values, as indicated by the difference between the average and median values (tables 1 and 2). This indicates that while only small quantities of resources are assured, there is a small chance that very large quantities of resources exist in ANWR.

Deposit-size estimates are equally important. For oil, the potential deposit sizes at the 1-percent confidence level range up to 18.27 BBO in place, with an average value of 1.46 BBO and a median value of 0.35 BBO. For gas, the potential deposit sizes at the 1-percent confidence level range up to 26.87 TCFG in place, with an average value of 2.14 TCFG and a median value of 0.51 TCFG (table 3).

In summary, the results of this evaluation indicate that the ANWR coastal plain may contain large petroleum deposits. On the basis of current data, large quantities of resources and large individual deposit sizes may occur within the coastal plain of ANWR. There is a 1-percent chance that the requisite parameters of source rock, timing, migration, reservoir rock, and trapping mechanisms have combined to generate up to 45.78 BBO and 76.24 TCFG in place in ANWR (tables 1 and 2). Assuming a recovery factor of 35 percent for oil, up to 16 billion barrels of recoverable oil may be present. This compares favorably with the original recoverable oil reserves of about 10 billion barrels in the Prudhoe Bay field.

GEOLOGIC PLAYS

The geologic play is the basic unit of analysis for resource assessment using the RASP methodology. Reservoir-quality rocks, known production, and trapping mechanisms are the most important parameters used to define specific plays in this assessment. Parameters such as thermal maturity, source-rock distribution, and timing are also requisite for a successful play. Specific plays used to assess the resource potential of ANWR include Kekiktuk (fig. 1), Lisburne North and South (figs. 2 and 3), Permian-Triassic Clastics North and South (figs. 4 and 5), Kemik-Thomson (fig. 6), and Post-Albian Clastics (fig. 7). A stratigraphic column and oil-and-gas summary for these plays are shown in figure 8 (app.).

The sandstone, conglomerate, and carbonate lithologies of these plays have produced large quantities of oil and gas on the North Slope and in the Mackenzie Delta area of Canada. The combination of generation and migration of hydrocarbons from source shales and timing of trap formation has produced large fields. On the basis of surface studies and geologic modeling, similar favorable conditions may be present in the subsurface of ANWR.

Geologic field studies conducted by DGGs indicate the existence of complex relationships between various rock groups that comprise the geologic plays in the subsurface of the ANWR coastal plain. Simple structural closures, thrust-fault repetitions of rock units, and complex folds could provide mechanisms to structurally trap hydrocarbons. Truncation of rock units and facies changes could also result in stratigraphic traps.

Plays of the Kekiktuk, Kemik-Thomson, and Post-Albian Clastics (figs. 1, 6, and 7) are broad in scope and are anticipated to be present throughout the study area. However, based on possible truncation of the rock units by a major unconformity, plays of the Lisburne North and Permian-Triassic Clastics North (figs. 2 and 4) are less likely to occur in the study area.

PROCEDURES FOR OIL-AND-GAS RESOURCE APPRAISALS

The procedure for the Resource Appraisal Simulation for Petroleum (RASP) incorporates a 'play' approach to petroleum-resource assessment. The methodology focuses on the concept of a geologic play as the basic unit of geologic analysis. The play is defined as a stratigraphic unit in a relatively homogeneous geologic setting.

A play approach to resource assessment of large basins or regions was chosen for the following reasons:

- The approach provides a direct assessment of the geologic characteristics—and their uncertainty—for the area of interest.
- The level of geologic detail provided by the play approach is sufficient to support a meaningful analysis.
- The approach does not require explicit identification and substantial detail for individual prospects.
- The approach recognizes regional trends within a play that enable prospects to be geologically correlated.

In essence, the play approach divides the traditional dry-hole risk factor into two components. The first component is the risk that is common to all prospects in the play because they share a common potential for source material, migration, timing, and reservoir rock. The second component is the risk that an individual prospect may have a geologic flaw specific to it and independent of other prospects in the play. Finally, the approach does not require actual discoveries in a play for assessment purposes. Judgments may be based on existing data and can explicitly reflect the uncertainty in those data.

Geoscientists familiar with the geology are asked to make three sets of probability judgments for each play.

The first set of judgments concerns the individual probabilities that each of four regional geologic characteristics common to the play area is favorable for the existence of petroleum accumulations. These regional characteristics are the existence of a petroleum source, favorable timing, potential migration paths, and reservoir rock. The product of these four probabilities is the marginal-play probability, that is, the joint probability that all regional geologic characteristics necessary for the accumulation of petroleum in the play area are simultaneously favorable. The existence of each geologic characteristic is necessary, but not sufficient to forecast the existence of oil or gas deposits in the play. If oil or gas have been found in a particular play, the marginal-play probability is 1.0. If none have been discovered in a play, additional probability judgments are necessary to determine the existence of hydrocarbon deposits.

The number of potentially drillable prospects in the play area, reservoir lithology (sandstone or carbonate), and petroleum mix (proportion of deposits within the play that are anticipated to be oil rather than non-associated gas) are also needed to evaluate each play. The RASP program assumes that petroleum accumulations exist only as gas deposits below 15,000 feet.

The second set of judgments is a set of probabilities that concerns the presence of three geologic characteristics that are common to the individual prospects within each play:

- Trapping mechanism. This defines the method that restricts hydrocarbon migration, which can be related to structure or stratigraphy, or both. A trap must have an areal extent of at least 600 acres with vertical closure of at least 5 feet.
- Effective porosity. The interconnected void space that may hold hydrocarbons must be equal to or greater than 3 percent.
- Hydrocarbon accumulation. Oil and gas must exist in at least 1 percent of a trap. This expresses the favorable relationships of source rock to reservoir rock and timing of hydrocarbon generation to trap formation.

The probability judgment is conditional on the existence of these three geologic characteristics. The product of the three attribute probabilities is the conditional-deposit probability, that is, the probability that a particular prospect is an actual accumulation of oil or gas, given that all play attributes are favorable. The familiar dry-hole risk factor is equal to one minus the product of the marginal-play probability and the conditional-deposit probability.

The third set of probability judgments involves the geologic parameters of the reservoir that determine the size of the potential deposits. These reservoir characteristics are area of closure, reservoir thickness, effective porosity, trap fill, reservoir depth, reservoir lithology, and hydrocarbon mix. Jointly, these parameters determine the potential reservoir volume for a deposit.

These three basic sets of judgments—geologic characteristics common to the play area, geologic characteristics common to the individual prospects within each play, and geologic parameters that determine the size of the potential deposits—are made for each identified play and comprise the basic geologic data necessary for a resource appraisal.

The probability distribution for each characteristic is randomly sampled to simulate one possible state of geologic nature. For example, the probability distribution for the number of potentially drillable prospects is sampled to determine the number of prospects that will be simulated for the play. The marginal-play probability is then sampled to determine whether the play will be simulated as unproductive or potentially productive. For each simulated prospect in a productive play, the conditional-deposit probability is sampled to determine whether that prospect will be treated as dry or as a deposit. The petroleum-mix probability is sampled for each deposit to simulate whether it contains oil or gas, but not both. All prospects in an unproductive play are automatically simulated to be dry. Each reservoir-parameter distribution is sampled for each deposit to simulate its volume and reservoir characteristics. This sampling procedure is repeated 3,000 times in a typical Monte Carlo method, and the results are combined to develop probability distributions for oil, gas, barrels of oil equivalent in place, and deposit size.

APPENDIX

Areal distribution, input parameters, and
resources in place for geologic plays

Gas fraction = 0.40 Conditional resources in place			
Fractile	Oil (million barrels)	Gas (billion ft ³)	BOE (million)
0.99	0.00	0.00	0.00
0.95	0.00	0.00	0.00
0.90	0.00	0.00	0.00
0.75	0.00	0.00	0.00
0.50	0.00	0.00	0.00
0.25	0.00	0.00	0.00
0.10	0.00	0.00	0.00
0.05	0.00	75.28	48.54
0.01	234.23	670.64	325.42

Deposit size Conditional, 100% oil		Deposit size Conditional, 100% gas	
Fractile	(million barrels)	Fractile	(billion ft ³)
0.99	3.720	0.99	15.887
0.95	9.020	0.95	25.298
0.90	17.780	0.90	73.341
0.75	42.483	0.75	146.806
0.50	95.310	0.50	292.110
0.25	234.471	0.25	617.343
0.10	461.101	0.10	1723.089
0.05	536.209	0.05	1832.462
0.01	3207.997	0.01	4330.336

Attribute		Probability that attribute is favorable or present							
Play attributes	Hydrocarbon sources	1							
	Timing	1							
	Migration	0.8							
	Potential reservoir facies	0.5							
	Marginal-play probability	0.4							
Prospect attributes	Trapping mechanism	0.3							
	Effective porosity (>3%)	0.1							
	Hydrocarbon accumulation	0.4							
	Conditional-deposit probability	0.012							
Hydrocarbon-volume parameters	Reservoir lithology	Sand	0						
		Carbonate	1						
	Hydrocarbon mix	Gas	0.4						
		Oil	0.6						
	Fractiles Attribute		Probability of equal to or greater than						
			1.00	0.95	0.75	0.50	0.25	0.05	0
	Area of closure (x10 ³ acres)		0.6	3	10	12	15	30	100
	Reservoir thickness/vertical closure (ft)		5	50	125	200	350	500	750
	Effective porosity (%)		3	3	4	4	5	6	10
	Trap fill (%)		1	5	25	50	75	95	100
	Reservoir depth (x10 ³ ft)		6	9	11	13	19	23	29
	Number of drillable prospects (a play characteristic)		2	4	4	5	8	10	20

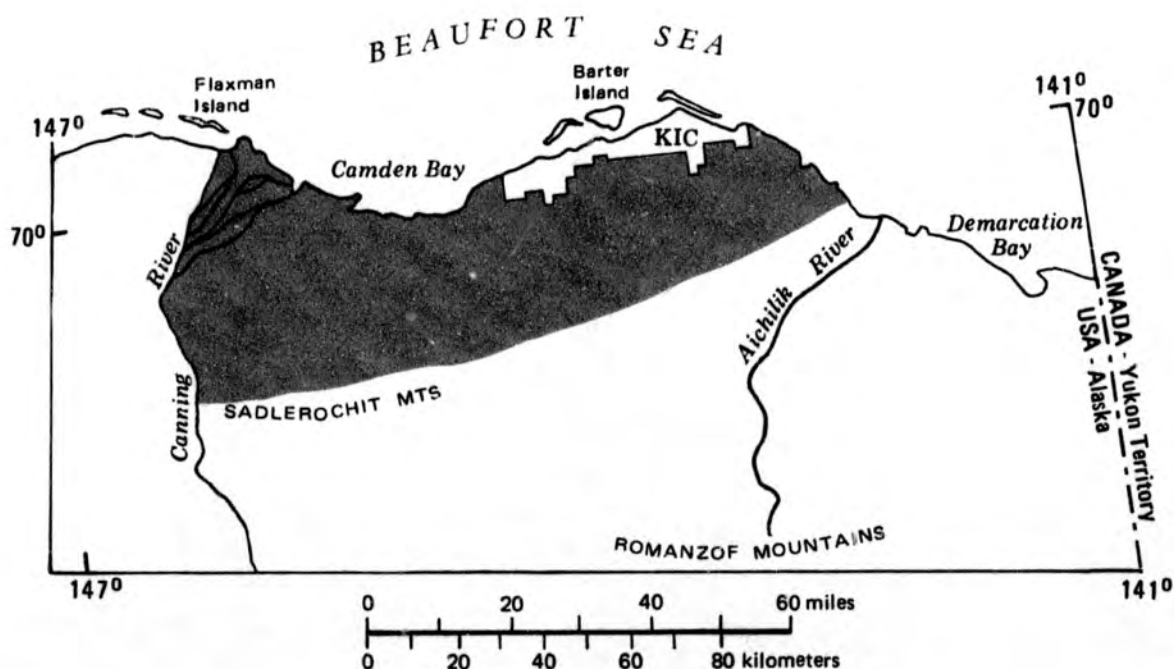


Figure 2. Areal distribution, input parameters, and resources in place for the Lisburne North Play, Arctic National Wildlife Refuge, Alaska.

Gas fraction = 0.40 Conditional resources in place			
Fractile	Oil (million barrels)	Gas (billion ft ³)	BOE (million)
0.95	0.00	0.00	0.00
0.90	0.00	0.00	0.00
0.75	0.00	0.00	0.00
0.50	0.00	0.00	0.00
0.25	0.00	0.00	0.00
0.10	0.00	13.85	10.04
0.05	64.03	170.30	129.34
0.01	624.02	1021.80	777.91

Fractile	Deposit size Conditional, 100% oil (million barrels)	Deposit size Conditional, 100% gas (billion ft ³)
0.99	3.812	2.779
0.95	11.388	9.681
0.90	19.488	17.355
0.75	54.967	56.067
0.50	163.679	172.416
0.25	406.565	454.902
0.10	796.095	1280.341
0.05	1536.064	2064.430
0.01	2277.339	5454.289

Attribute			Probability that attribute is favorable or present						
Play attributes	Hydrocarbon sources		1						
	Timing		1						
	Migration		1						
	Potential reservoir facies		1						
	Marginal-play probability		1						
Prospect attributes	Trapping mechanism		0.25						
	Effective porosity (>3%)		0.1						
	Hydrocarbon accumulation		0.4						
	Conditional-deposit probability		0.01						
Hydrocarbon-volume parameters	Reservoir lithology	Sand	0						
		Carbonate	1						
	Hydrocarbon mix	Gas	0.4						
		Oil	0.6						
	Fractiles Attribute		Probability of equal to or greater than						
			1.00	0.95	0.75	0.50	0.25	0.05	0
	Area of closure (x10 ³ acres)		0.6	1	3	5	10	30	100
	Reservoir thickness/vertical closure (ft)		5	100	225	350	425	600	1200
	Effective porosity (%)		3	3	4	4	5	6	10
	Trap fill (%)		1	5	25	50	75	95	100
	Reservoir depth (x10 ³ ft)		2	5	7	9	12	14	20
Number of drillable prospects (a play characteristic)			1	5	8	10	15	25	100

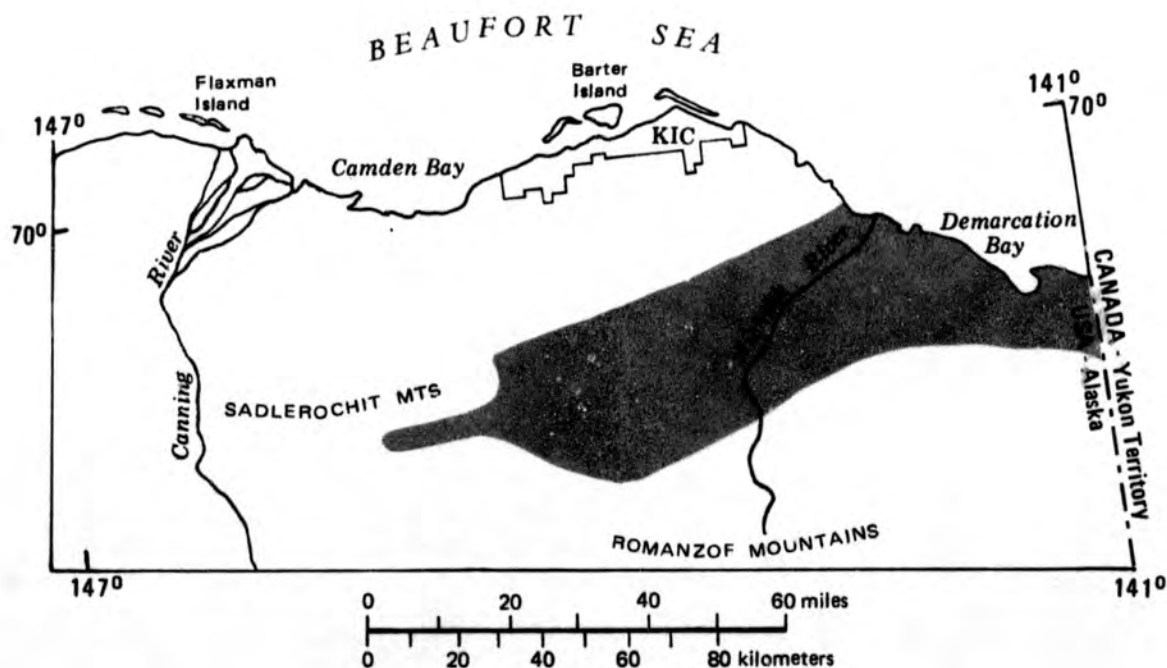


Figure 3. Areal distribution, input parameters, and resources in place for the Lisburne South Play, Arctic National Wildlife Refuge, Alaska.

Gas fraction = 0.40 Conditional resources in place			
Fractile	Oil (million barrels)	Gas (billion ft ³)	BOE (million)
0.99	0.00	0.00	0.00
0.95	0.00	0.00	0.00
0.90	0.00	0.00	0.00
0.75	0.00	0.00	0.00
0.50	0.00	0.00	0.00
0.25	0.00	689.02	292.14
0.10	948.85	2927.37	1339.20
0.05	1927.34	5123.80	2619.52
0.01	5981.70	11366.90	7005.12

Fractile	Deposit size Conditional, 100% oil (million barrels)	Deposit size Conditional, 100% gas (billion ft ³)
0.99	11.112	15.476
0.95	41.465	53.727
0.90	70.171	148.026
0.75	174.012	417.946
0.50	538.918	1163.055
0.25	1323.921	2905.923
0.10	2925.320	5803.098
0.05	4333.508	7478.438
0.01	9932.547	14709.691

Attribute		Probability that attribute is favorable or present							
Play attributes	Hydrocarbon sources	1							
	Timing	1							
	Migration	1							
	Potential reservoir facies	0.5							
	Marginal-play probability	0.5							
Prospect attributes	Trapping mechanism	0.3							
	Effective porosity (>3%)	0.8							
	Hydrocarbon accumulation	0.4							
	Conditional-deposit probability	0.096							
Hydrocarbon-volume parameters	Reservoir lithology	Sand	1						
		Carbonate	0						
	Hydrocarbon mix	Gas	0.4						
		Oil	0.6						
	Fractiles		Probability of equal to or greater than						
	Attribute	1.00	0.95	0.75	0.50	0.25	0.05	0	
	Area of closure (x10 ³ acres)	0.6	3	10	12	15	30	100	
	Reservoir thickness/ vertical closure (ft)	5	50	125	200	350	500	750	
	Effective porosity (%)	3	7	13	15	18	23	30	
	Trap fill (%)	1	5	25	50	75	95	100	
	Reservoir depth (x10 ³ ft)	5	8	10	12	18	22	28	
	Number of drillable prospects (a play characteristic)		2	4	4	5	8	10	20

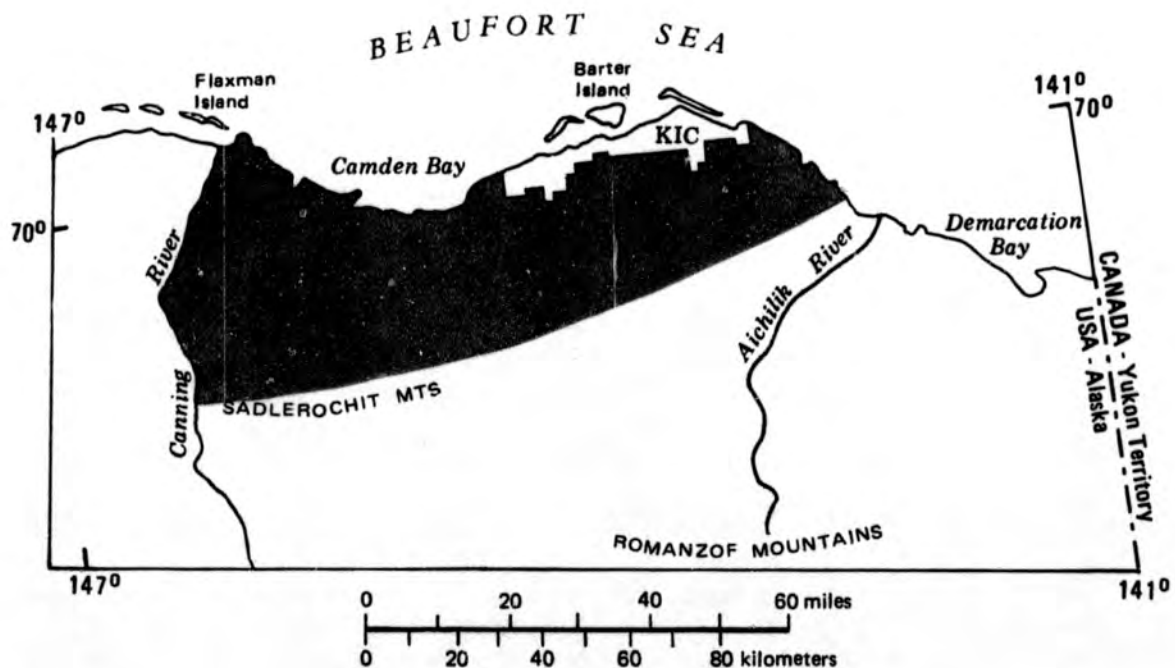


Figure 4. Areal distribution, input parameters, and resources in place for the Permian-Triassic Clastics North Play, Arctic National Wildlife Refuge, Alaska.

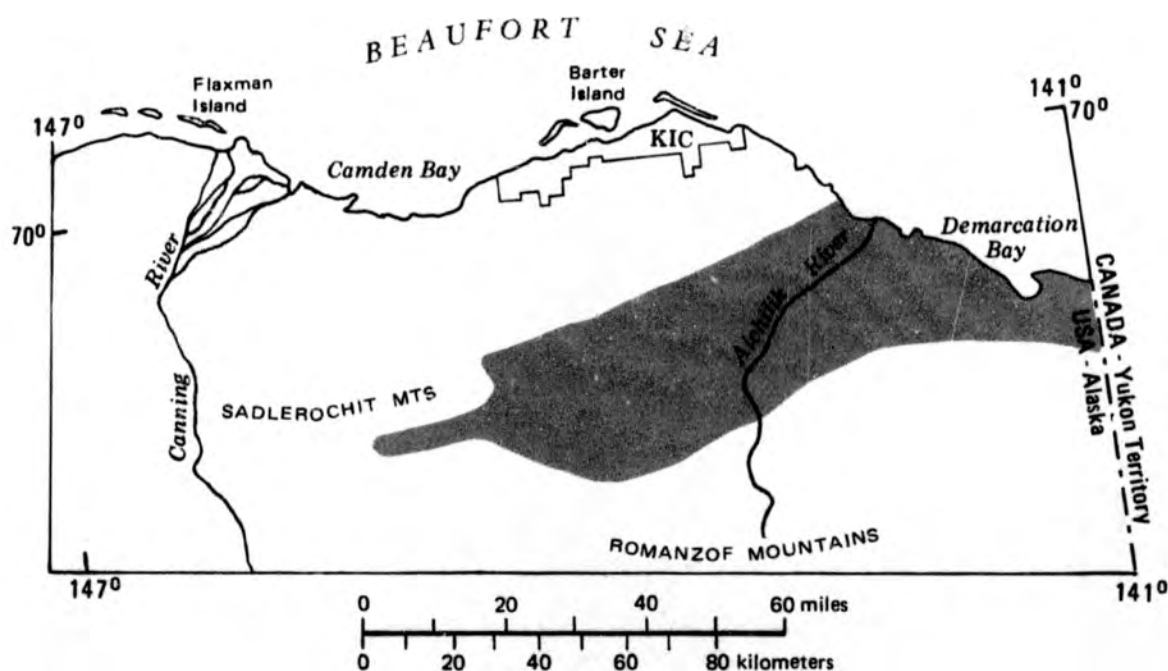
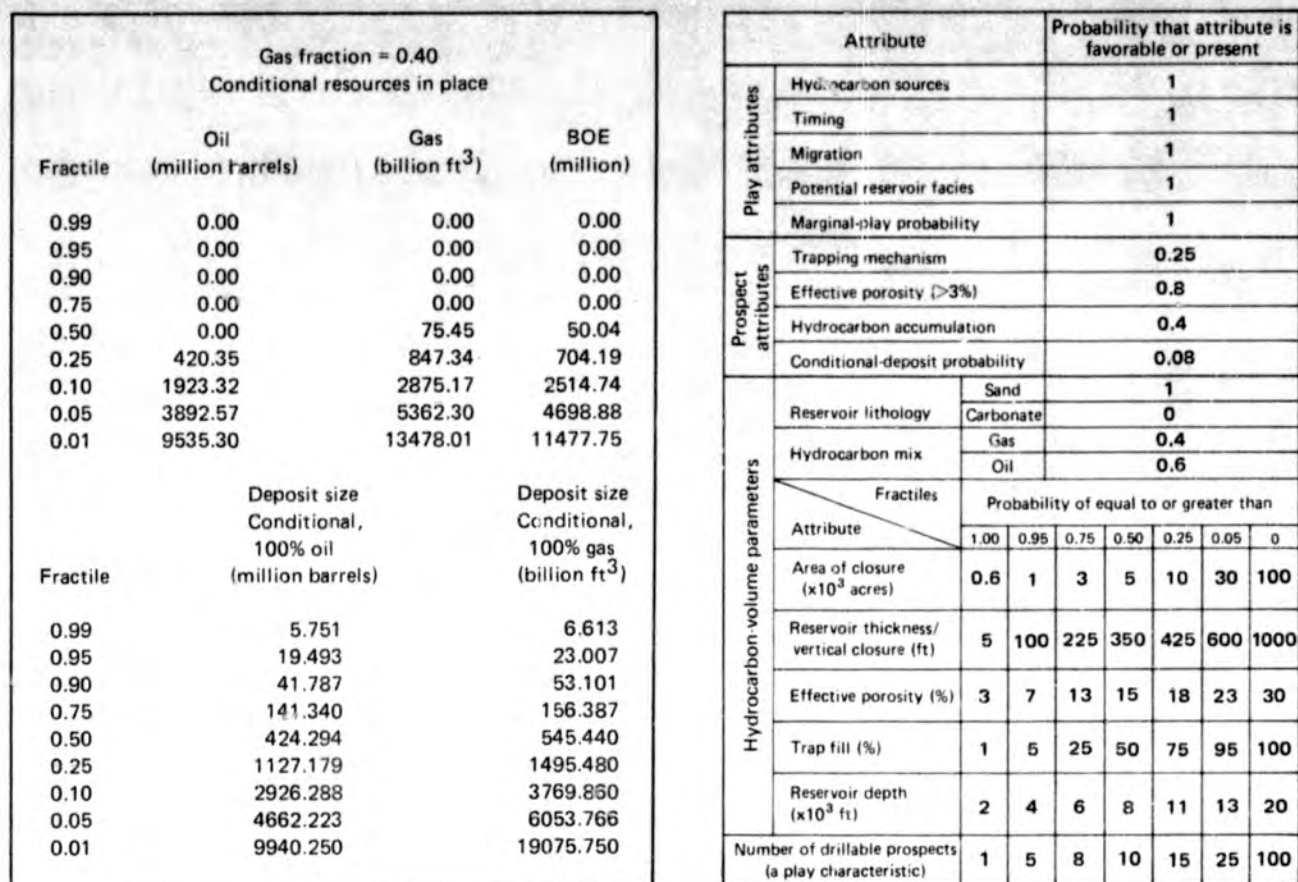


Figure 5. Areal distribution, input parameters, and resources in place for the Permian-Triassic Clastics South Play, Arctic National Wildlife Refuge, Alaska.

Gas fraction = 0.40 Conditional resources in place			
Fractile	Oil (million barrels)	Gas (billion ft ³)	BOE (million)
0.99	0.00	0.00	0.00
0.95	0.00	0.00	0.00
0.90	0.00	0.00	0.00
0.75	0.00	0.00	0.00
0.50	0.00	124.91	77.60
0.25	327.71	1075.43	654.49
0.10	1607.76	3468.63	2248.06
0.05	3122.80	5929.73	4097.80
0.01	7838.41	15008.58	9200.97

Fractile	Deposit size Conditional, 100% oil (million barrels)	Deposit size Conditional, 100% gas (billion ft ³)
0.99	1.902	3.359
0.95	7.342	14.279
0.90	14.607	28.752
0.75	47.014	88.333
0.50	163.259	283.541
0.25	523.658	891.588
0.10	1602.893	2668.084
0.05	2813.698	4705.582
0.01	7445.875	14078.285

Attribute		Probability that attribute is favorable or present							
Play attributes	Hydrocarbon sources	1							
	Timing	1							
	Migration	1							
	Potential reservoir facies	1							
	Marginal-play probability	1							
Prospect attributes	Trapping mechanism	0.25							
	Effective porosity (>3%)	0.9							
	Hydrocarbon accumulation	0.4							
	Conditional deposit probability	0.09							
Hydrocarbon-volume parameters	Reservoir lithology	Sand	1						
		Carbonate	0						
	Hydrocarbon mix	Gas	0.4						
		Oil	0.6						
	Fractiles		Probability of equal to or greater than						
	Attribute	1.00	0.95	0.75	0.50	0.25	0.05	0	
	Area of closure (x10 ³ acres)	0.6	2	3	5	15	40	100	
	Reservoir thickness/ vertical closure (ft)	5	25	50	100	200	350	600	
	Effective porosity (%)	3	5	10	15	20	25	30	
	Trap fill (%)	1	6	30	60	80	96	100	
	Reservoir depth (x10 ³ ft)	2	5	8	10	15	20	25	
	Number of drillable prospects (a play characteristic)		2	3	6	12	25	50	100

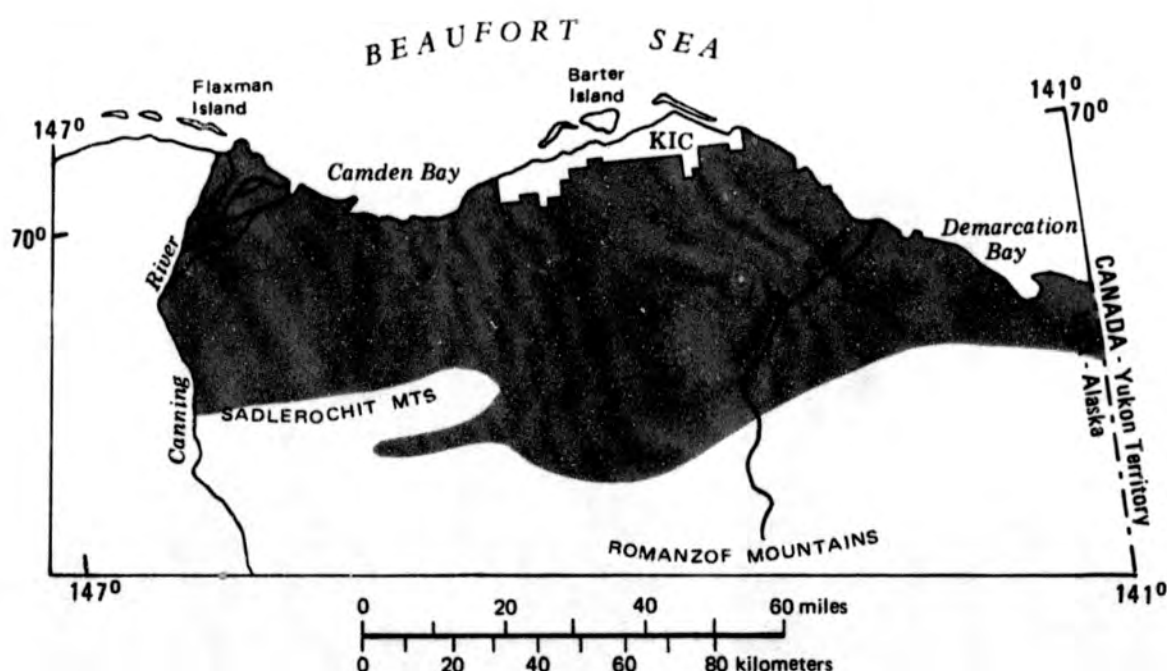


Figure 6. Areal distribution, input parameters, and resources in place for the Kemik-Thomson Play, Arctic National Wildlife Refuge, Alaska.

Gas fraction = 0.50 Conditional resources in place			
Fractile	Oil (million barrels)	Gas (billion ft ³)	BOE (million)
0.99	0.00	0.00	0.00
0.95	0.00	12.35	9.06
0.90	0.00	224.04	146.23
0.75	326.40	1498.50	1044.79
0.50	2097.78	5544.16	3785.89
0.25	6972.20	13623.56	9514.61
0.10	15625.20	28032.78	19546.79
0.05	24230.45	38904.07	29454.32
0.01	43382.48	74349.25	48926.22

Deposit size Conditional, 100% oil		Deposit size Conditional, 100% gas	
Fractile	(million barrels)	Fractile	(billion ft ³)
0.99	5.803	0.99	7.255
0.95	22.006	0.95	28.025
0.90	44.099	0.90	54.634
0.75	137.593	0.75	171.947
0.50	462.298	0.50	603.463
0.25	1542.427	0.25	2044.293
0.10	4489.004	0.10	5808.051
0.05	7927.445	0.05	10985.301
0.01	24037.582	0.01	32045.930

Attribute		Probability that attribute is favorable or present							
Play attributes	Hydrocarbon sources	1							
	Timing	1							
	Migration	1							
	Potential reservoir facies	1							
	Marginal-play probability	1							
Prospect attributes	Trapping mechanism	0.25							
	Effective porosity (>3%)	1							
	Hydrocarbon accumulation	0.5							
	Conditional-deposit probability	0.125							
Hydrocarbon-volume parameters	Reservoir lithology	Sand	1						
		Carbonate	0						
	Hydrocarbon mix	Gas	0.5						
		Oil	0.5						
	Fractiles		Probability of equal to or greater than						
	Attribute		1.00	0.95	0.75	0.50	0.25	0.05	0
	Area of closure (x10 ³ acres)	0.6	1	2	4	12	30	75	
	Reservoir thickness/ vertical closure (ft)	50	100	200	300	800	1200	2000	
	Effective porosity (%)	3	5	10	15	19	23	30	
	Trap fill (%)	1	6	30	60	80	96	100	
	Reservoir depth (x10 ³ ft)	2	3	4	6	9	12	20	
	Number of drillable prospects (a play characteristic)		5	10	25	40	70	100	200

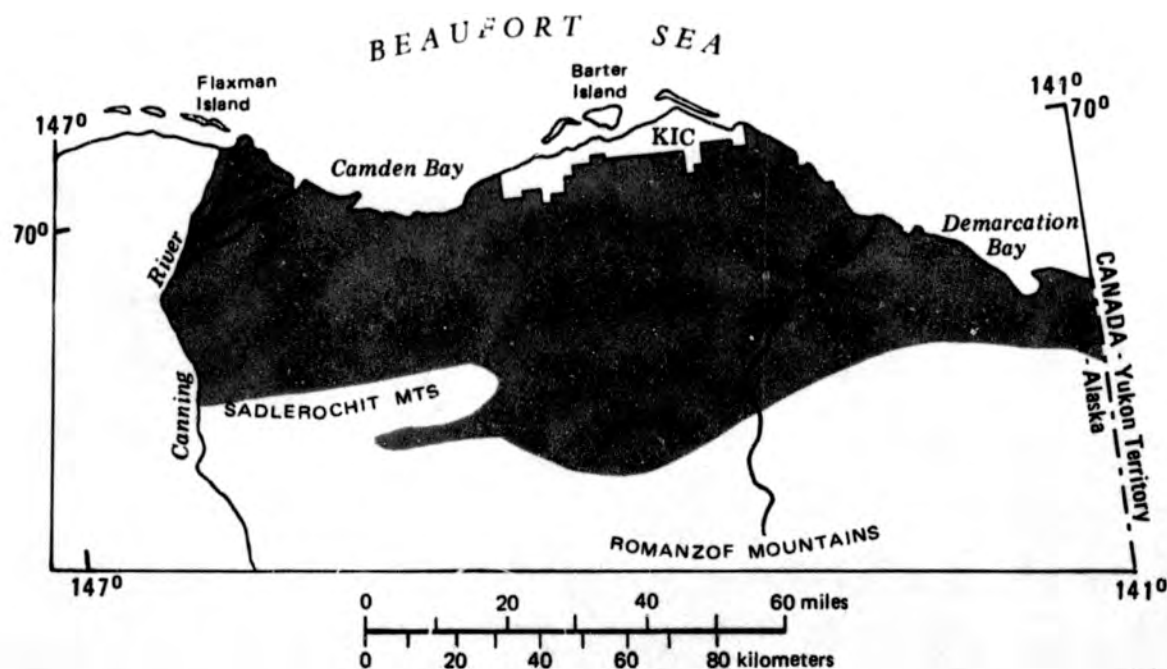


Figure 7. Areal distribution, input parameters, and resources in place for the Post-Albian Clastics Play, Arctic National Wildlife Refuge, Alaska.

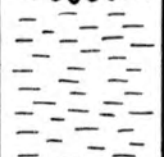
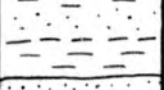
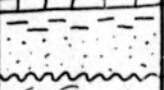
PLAY	AGE	LITHOLOGY	OIL SHOWS IN ANWR	KNOWN ACCUMULATIONS
		 Sandstone  Shale  Limestone  Dolomite	 Seeps  Oil staining	 Gas  Oil  Oil and gas
Post-Albian Clastics	Pliocene to Upper Cretaceous			Mackenzie Delta, Canada  West Sak  Ugnu  Umiat  Flaxman Island  Beaufort-Mackenzie area, Canada  Prudhoe Bay complex 
Kemik-Thomson	Lower Cretaceous			Kuparuk 
	Jurassic			Point Thomson  Milne Point 
Permian-Triassic Clastics (North & South)	Triassic			Prudhoe Bay complex  Kavik  Kemik  Gwydyr Bay  Seal Island 
	Permian			
Lisburne (North & South)	Pennsylvanian			Prudhoe Bay complex 
	Mississippian			
Kekiktuk				Endicott 
	pre-Mississippian			

Figure 8. Stratigraphic column and oil-and-gas summary for plays in the Arctic National Wildlife Refuge, Alaska.

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**A Comparison of State and Federal Appraisals of
the Arctic National Wildlife Refuge Coastal Plain**

by

James J. Hansen
Richard W. Kornbrath

The Alaska Department of Natural Resources Professional Report 90 presents the State's preliminary appraisal of the petroleum resource potential in the coastal plain of the Arctic National Wildlife Refuge (ANWR). The results of this study are compared with the resource estimates in the Department of Interior draft report titled "Arctic National Wildlife Refuge, Alaska, Coastal Plain Resource Assessment", which was issued for public review and comment on November 24, 1986.

To assess the potential for in-place oil and gas in this frontier area each study uses the geologic play as the basic unit of analysis. A geologic play is an area which can be viewed as an aggregate of prospects (areas of potential hydrocarbon accumulation) that have similar geologic characteristics and share common geologic elements. In analyzing the hydrocarbon potential of geologic plays, geoscientists familiar with the regional geology make three sets of probability judgments concerning the geological characteristics of these plays. These judgments comprise the basic geologic data necessary for a resource appraisal.

The first set of judgments concerns the individual probabilities that each geologic characteristic common to the play area is favorable for petroleum accumulation. These characteristics are: petroleum source, favorable timing of oil generation and migration, availability of potential migration paths, and reservoir rocks in which to retain the oil. These individual probabilities are multiplied together to arrive at the "marginal-play probability".

The second set of judgments involves probabilities that concern the presence of three geologic characteristics common to the individual prospects within each play area: trapping mechanism, effective porosity of the reservoir rock and hydrocarbon accumulation. The product of these probabilities is the "conditional-deposit probability".

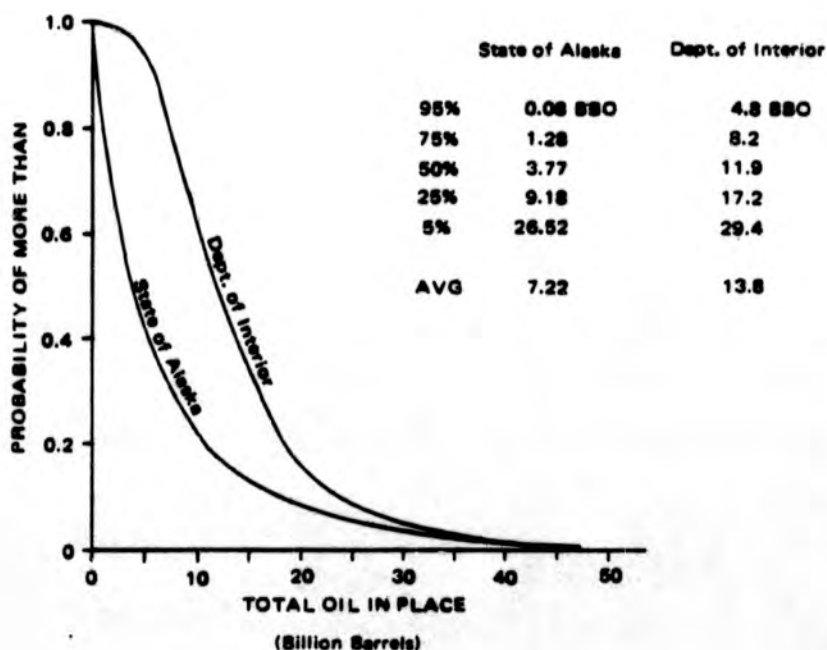
The "success factor", which gives the probability of a well encountering commercial accumulations of oil, is a product of the marginal-play probability and the conditional-deposit probability.

The third set of judgments involves the geologic parameters that determine the potential reservoir volume for a deposit. These reservoir characteristics include area of closure, trap fill, reservoir depth, reservoir lithology, and relative hydrocarbon mix (oil vs. gas).

Once a range of values for each of these characteristics is determined, computer simulation programs are used to analyze these characteristics and to arrive at a probability distribution for in-place oil and gas for each play, and for the frontier area as a whole. The State uses the Resource Appraisal Simulation for Petroleum (RASP) program, which employs a Monte Carlo method of randomly sampling probability distributions for each geological characteristic as many as 3,000 times. The Interior study uses Fast Appraisal Simulation for Petroleum (FASP), which utilizes a statistical approach to probability theory. The FASP method is based on a seven-point probability distribution for each geologic characteristic (i.e., a 95% probability of a given sandstone having 10 feet of net pay, a 90% probability of it having 15 feet of net pay, etc.). FASP computes a mean and the standard deviation from each distribution, then combines these figures to arrive at the oil in-place for each probability level.

Both RASP and FASP simulations yield lognormal distributions that show the probability of these being a given quantity of in-place oil or gas. The lognormal distribution, when plotted as a "bell type" curve, is skewed to the right. This means that the simulation processes result in the generation of many small values for oil in-place and relatively few large ones. Mathematically, the generation of a lognormal distribution is the result of a multiplicative relationship of the input parameters and of the random sampling that is conducted. The effect of the multiplicative relationship is that small variance in the input parameters can result in significant changes in the final numbers.

The following figure compares the probability distribution curves for in-place oil from the two appraisals:



The Department of Interior distribution curve is right-shifted relative to the State curve, meaning that for any given probability, Interior estimates that there is more oil in-place. Alternately, Interior estimates that there is a higher probability for a given amount of oil to be in-place, relative to the State estimate. Geoscientists make subjective judgments to select the geologic characteristics that are input into these two modeling programs. Because there are limited subsurface data in ANWR, there will understandably be differences in the geologic characteristics input into each modeling program. In comparing the two studies conducted, there are four main differences concerning the input data that can account for the divergence between these two distributions:

1. Difference in Geologic Plays

With the exception of the Kemik-Thomson Sand Play, the two studies analyzed different geologic plays. For example, the State's Post-Albian Play encompasses Interior's Topset, Turbidite, and Imbricate Fold Belt plays.

2. Appraisal of Ellesmerian sequence rocks

The Interior appraisal attributes approximately 50% of the oil to Ellesmerian rocks, with an average estimated oil in-place of 7.2 BBO. The State's appraisal only assigns a small probability of there being a significant quantity of this rock sequence in the subsurface; the average estimated oil in-place is 1.13 BBO. At probability levels above 25% the State appraisal exhibits little confidence of there being any Ellesmerian rocks; the federal report indicates that above this probability level there could exist Ellesmerian rocks capable of containing up to 9 BBO. However, the Interior report does state that if most of the Ellesmerian rocks are missing in most of the 1002 area, their assessment number would be reduced considerable (DOI Report, p. 54)

3. Success factors

The State's success factor varied from 8% to 1% for the Ellesmerian rocks, was 9% for the Kemik-Thomson Sand Play, and was the highest, at 12.5%, for the Post-Albian Clastics Play. Though the success factors are not presented in the Interior appraisal, it can be inferred that their percentages were considerably higher (on the order of 10 - 25%) for all plays, since assigning higher success factors will shift the distribution curves further to the right.

4. Appraisal of pre-Mississippian rocks

State geologists disagree with Interior geologists as to the contribution of pre-Mississippian rocks for oil accumulation. Though they have little effect on the distribution curve, Interior's appraisal includes these rocks, while the State appraisal does not.

Volumes of yet undiscovered petroleum resources in frontier areas are extremely difficult to estimate with a high degree of reliability. In the case of ANWR, the lack of sufficiently detailed subsurface geologic information results in a wide variance in the geologic characteristics that form the framework for the resource appraisal methods. In fact, geoscientists will differ in their opinion as to what should constitute a geologic play. It is not surprising (in fact, it should be expected) that these somewhat subjective scientific judgments, based on limited geologic data, will vary from group to group.

In addition to the variance in geologic input, inherent problems exist in the applied methodology and presentation of the resulting data. Lognormal distributions are the result of the multiplicative relationship of the input data; small variances in these input parameters can result in large differences in the resulting totals. It is important to note the fact that both probability distributions show the possibility for a wide range of resources. This is simply a reflection of the high uncertainty in the input data, and it should not be interpreted in a negative manner.

A comparison of the results of the two studies reveals the following:

1. Both reports conclude that the key elements requisite for petroleum accumulations have been demonstrated to be present beneath the coastal plain of ANWR.
2. Both reports conclude that there is a small possibility that significant and unusually large petroleum resources are present beneath the coastal plain.
3. Both reports conclude that there is a greater likelihood that the resources present are smaller in size. However, prior to its discovery, some industry officials had estimated that there was only a two percent probability that the Prudhoe Bay area contained two billion barrels of oil. They did not anticipate the twenty three and a half billion barrels of oil that are now calculated to have been initially in-place.
4. While the State study indicates smaller resources at the higher probability levels relative to the Interior study, there is close agreement between both studies at the lower probability levels.
5. Neither study can be labeled right or wrong. Both studies are valid professional estimates of resource potential under ANWR's coastal plain. Exploratory drilling will ultimately determine which estimate was more accurate.

3:50
2/5/87

BF
Coghill
Fischer.

O+G

BF

to Katz.

participation in land swaps -

1) HR 39 only bill -

not much presence on bill -

2) 1002 report -
delayed by Sinit

3) land trades. -

1) state as sovereign -
views should be considered

2) as land owner.

260,000 acres to trade.

4k at table w DOI & Natives

Threat selection. -

must be ~~sen~~ approved by Cong.

Not taken a position

4) Carbon Treaty w/ Canada
will lead to B. lateral agreement
creates regime for discussion of
habitat protection.

90-10 - is part of salmon compact
between State -

compensates for not participating in
fed reclamation.

The discussion for last 2 years?

began last October - ~~last~~ December.
promised to be at table.

→ 38.50

→ look at land exchange documents

260,000 acres.

Supports resolution -

reflect consensus of leg + gov.

no action until 1002 report to Congress

late March + Early April.

Cog
to Matt
get copy of
on seismic data?

10.10 - any leasing order - mineral leasing
not apply if we Act of 1920

Role of state in trades —

DOI has promised ~~an~~ sees it will
submit to Congress

COALITION ^{pro} < 30 members

ENVIRONMENTAL -

State separate -

Maintain unions support. - others on side.

1) Natives trades - give Congress reason to support
ANWR.

2) Native - effective lobbying

3) Premature to consider land trades until
after ANWR is open.

Legislative committee still open! (Cognill)

Danior dept has some revenue projections