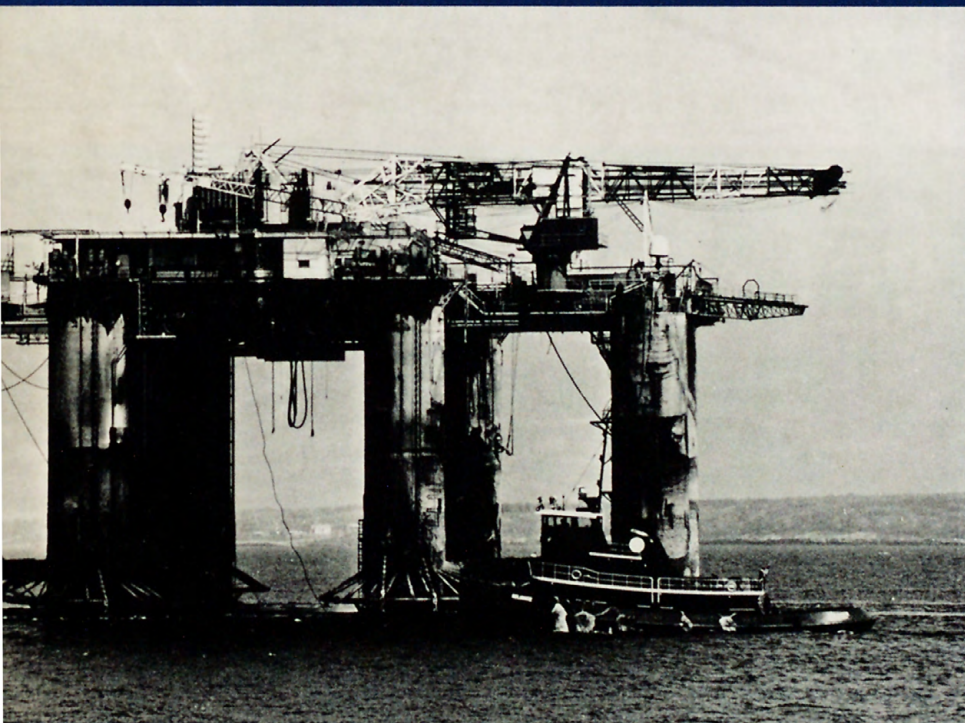


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no. 81-601

Outer Continental Shelf Oil and Gas Information Program

North Atlantic Summary Report



Prepared for the U.S. Department of the Interior, Geological Survey
in cooperation with the Bureau of Land Management

U.S. Geological Survey Open-File Report 81-601

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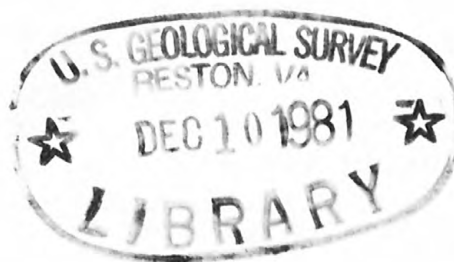
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PUBLICATION STATUS OF OCSIP DOCUMENTS						
Type of Document	Initial	Updates			Revisions	
		1	2	3	1	2
Summary Report:						
North Atlantic	9/81					
Mid-Atlantic	11/79	6/80	2/81	9/81		
South Atlantic	7/80	2/81	9/81			
Gulf of Alaska	9/80				8/81	
Gulf of Mexico	9/80				10/81	
Pacific (So. Cal.)	5/80					
Arctic	11/81*					
Indexes:						
Atlantic	5/79				5/81	10/81
Pacific	7/79				5/81	10/81
Alaska	7/79				5/81	3/82
Gulf of Mexico	9/79				5/81	7/82
*Indicates document in progress						

COVER—Davisville OCS support base piers (photo by Rhode Island Department of Economic Development, 1981); fishing boats at Galilee, Rhode Island, **Ocean Victory** being towed up Narragansett Bay, and fishing operations at Galilee, Rhode Island (photos by Richard Dorrier, 1981).

Outer Continental Shelf Oil and Gas Information Program



North Atlantic Summary Report

Outer Continental Shelf Oil and Gas Activities
in the North Atlantic and their Onshore Impacts:
A Summary Report, July 1981

Open-file report
United States
Geological Survey

By Richard T. Dorrier

Prepared for the U.S. Department of the Interior, Geological Survey,
in cooperation with the Bureau of Land Management
under Contract No. 14-08-0001-19719

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This report has not been edited for conformity with the
publication standards of the Geological Survey

U.S. Geological Survey Open-File Report 81-601

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English-Metric Conversion

(The following table gives the factors used to convert English units to metric units.)

Multiply English units	by	to obtain metric units
feet	0.3048	meters
miles	1.6090	kilometers
acres	0.4046	hectares
barrels	0.1589	m ³
cubic feet	0.0283	m ³

Acronyms and Abbreviations

APD	-	Application for Permit to Drill
BAST	-	Best Available and Safest Technology
bbl	-	barrel(s)
BLM	-	Bureau of Land Management, U.S. Department of the Interior
bpd	-	barrels per day
BTF	-	Biological Task Force
cfd	-	cubic feet per day
CFR	-	Code of Federal Regulations
CLF	-	Conservation Law Foundation of New England, Inc.
COST	-	Continental Offshore Stratigraphic Test
CZM	-	Coastal Zone Management
DEIS	-	Draft Environmental Impact Statement
DOI	-	Department of the Interior
EIS	-	Environmental Impact Statement
EPA	-	Environmental Protection Agency
FO	-	Field Office(s), BLM
IPP	-	Intergovernmental Planning Program for OCS Oil and Gas Leasing, Transportation, and Related Facilities, BLM
LNG	-	liquefied natural gas
m ²	-	square meters
m ³	-	cubic meters
NEPA	-	National Environmental Policy Act of 1969
NERBC	-	New England River Basins Commission
NOAA	-	National Oceanic and Atmospheric Administration
NPDES	-	National Pollutant Discharge Elimination System
OCS	-	Outer Continental Shelf (Federal jurisdiction)
OCSI	-	Office of Outer Continental Shelf Information, USGS
RTWG	-	Regional Technical Working Group, BLM
655 DM-1	-	Department Manual 655 Part 1 on Intradepartmental Coordination in the OCS Program
USGS	-	U.S. Geological Survey, Department of the Interior

Acknowledgments

A number of people have provided information and insights to the author. All of them deserve special thanks. Maire Murphy of the New England River Basins Commission; Kevin McDonough of the Massachusetts CZM Office; Ken Hoffman of the Conservation Law Foundation; Ted Spinard of the Rhode Island Department of Economic Development; John Dana of the Rhode Island Port Authority and Economic Development Corporation; Stephen Olsen of the University of Rhode Island's Coastal Resources Center; David Strouss of the Coalition of Coastal Communities; Charlie Colgan of Maine's State Planning Office; and Barry Clark and Joan Roberts of the U.S. Geological Survey (USGS) Office in Hyannis, Massachusetts, were especially generous.

The Field Draft Review Committee helped improve the report in a number of ways. Its members were: Louis G. Hecht, Jr., Doug Slitor, John Lees, Jim Hendrix, Roger Amato, Dan Palubniak, John Stone, Gil Wood, Bob Bickel, and Mary Davis from the USGS,

and Eileen Carlton and Charles Ham of the Bureau of Land Management (BLM). Louis G. Hecht, Jr., and Doug Slitor provided guidance and directed the project for the USGS. Robert Samuels, Charles Ham, and Richard Barnett from the BLM provided necessary data used in the preparation of chapters 2 and 3. Charles Browning of the Rhode Island Department of Economic Development provided the photographs of Davisville, Rhode Island, used in chapter 4. Mary Davis served as editorial coordinator for the USGS.

At Rogers, Golden & Halpern, Fritts Golden provided overall project direction. Mary Ann Collignon completed appendix D in its entirety. Richard Barrett edited the report and supervised its production. Sandy Dechert designed the report, and Mark Yankoski, Kim Tomlinson, and Gene Gilroy executed the graphics. Pamela Staubus, Valerie Smith, Sue McGuire, and Sam Karen Norgard provided editorial, graphics, and technical support.

Abstract

The leasing process for oil and gas exploration on the North Atlantic Outer Continental Shelf (OCS) began in June 1975. The first lease sale in the region (Lease Sale 42) was scheduled for January 31, 1978, by the Department of the Interior. However, the sale was delayed for 23 months by litigation before it was finally held on December 18, 1979. Of the 116 tracts offered, 63 tracts comprising 358,671 acres were leased as a result of the sale.

Eight exploration plans have been submitted by five oil companies since Lease Sale 42. The plans call for exploratory drilling on 11 separate tracts in the lease sale area. The plans and the required Federal drilling permits for two blocks, Exxon's block 133 and Shell's block 410, have been approved. Exploratory

drilling on these two blocks began on July 24, 1981. The review process to approve the other plans and the required OCS drilling permits is in progress.

Onshore impacts resulting from OCS exploration in the North Atlantic are expected to be minimal. The same support base at Davisville, Rhode Island, used for drilling operations in the Mid-Atlantic Region is servicing North Atlantic activities. This facility has more than enough capacity and berthing space to service the level of activity expected during exploratory drilling. Moreover, support requirements for the North Atlantic are expected to supplement the declining level of support activity that has occurred for the Mid-Atlantic Region.

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Introduction

The United States is currently engaged in an effort to develop the oil and gas resources of the Outer Continental Shelf (OCS). Offshore oil and gas activity must be supplied and supported from land, and the onshore support activities required may have significant effects on the communities in which they occur. For example, oil and gas production might require expansion of existing transportation facilities and construction of new ones, and it might trigger an influx of workers and change employment patterns. These effects, in turn, could influence regional income, demand on public services, tax revenues, and air and water quality.

The need for planning to accommodate the onshore impacts of offshore oil and gas development has long been recognized. State and local governments need current information to make these plans. In response to needs expressed by State and local governments for current information about offshore resources and related onshore activity, section 26 of the Outer Continental Shelf Lands Act Amendments of 1978 (43 U.S.C. 1352) created an Outer Continental Shelf Oil and Gas Information Program, which is now managed by the Office of Outer Continental Shelf Information (OCSI), U.S. Geological Survey (USGS), Conservation Division. Authorities and operating procedures are detailed in the Code of Federal Regulations (30 CFR 252), published in the Federal Register of August 7, 1979. Under this program, the Director of the U.S. Geological Survey, in conjunction with the Director of the Bureau of Land Management (BLM) (43 CFR 3300), has prepared indexes of information used by the Federal Government in its OCS decisionmaking process. The Atlantic,

In the North Atlantic, State jurisdiction extends 3 miles (4.8 km) seaward from the coastline. The OCS is under Federal jurisdiction and comprises those lands seaward of State boundaries.

Gulf of Mexico, Pacific, and Alaska Indexes have already been made available to the public. Revisions, which are made annually, are currently under way.

The Director of the USGS is also required to make available to affected States a regional summary report of data and information designed to assist State and local officials in planning for the offshore impacts of potential OCS oil and gas development and production.

This report, **Outer Continental Shelf Oil and Gas Activities in the North Atlantic and their Onshore Impacts**, is the sixth in a series of regional summary reports. It describes OCS activities off the coasts of Maine, New Hampshire, Connecticut, Massachusetts, Rhode Island, New York, and New Jersey. It is preceded by reports on the Mid-Atlantic, Pacific (Southern California), South Atlantic, Gulf of Alaska (including Lower Cook Inlet), and Gulf of Mexico. A summary report for the Arctic area of Alaska will be available in September 1981. Revised summary reports for the Gulf of Alaska and the Gulf of Mexico, which will include new information on recent lease sales in each of those areas, will be available in August and September 1981, respectively. Updates to the summary reports, which are generated approximately 6 months after publication of the initial reports,

have been prepared for the Mid-Atlantic, the South Atlantic, and the Pacific (Southern California) Regions. To receive updates and revisions, return the postcard attached to the back cover or write to the Office of OCS Oil and Gas Information, U.S. Geological Survey, 640 National Center, Reston, VA 22092. The Office of OCS Information staff is available to consult with State agencies if additional information or clarification is needed (telephone: (703) 860-7166).

Each summary report produced by the Office of OCS Information begins with a chapter presenting the most recent OCS oil and gas resource and reserve estimates. The magnitude and timing of OCS activity are discussed in chapter 2 of the report. Chapter 3 presents information on oil and gas transportation strategies, including those that are developed as part of the BLM's ongoing Intergovernmental Planning Program (IPP). Chapter 4 describes the nearshore and onshore activities that are either occurring or probably will occur as a result of current and projected offshore activity for each of the lease sales. Appendixes provide further detail, and a glossary presents definitions of geologic, industry-specific, and other special terms used in the report.

Resource and reserve estimates presented in the summary report reflect the most recent Federal Government information. The report is based in part on data collected by Federal agencies in the course of planning, leasing, and managing the North Atlantic OCS and in part on studies and reports of OCS activities that have been prepared outside the Federal Government.

Representatives of the Office of OCS Information have also discussed oil and gas activities directly with Federal officials, oil industry representatives, State and local officials, and others. In order to identify OCS-related issues and to explain the summary report process, the Office of OCS Information convened a public meeting in Boston, Massachusetts, on December 11 and 12, 1978. The meeting was attended by 48 people, including 17 representatives from State and local governments in Maine, New Hampshire, Massachusetts, Rhode Island, Connecticut, and New York. Concerns voiced at this meeting

and in subsequent interviews and through research identified issues to be addressed in this summary report. A data collection trip was also conducted during March 1981 to interview people involved in recent OCS activities and to identify additional concerns that should also be addressed in this report.

Protection of the Georges Bank fisheries has been the single most important issue in leasing activities in the North Atlantic area, primarily because Georges Bank is one of the most productive fishing grounds in the world (BLM, 1977; Olsen and others, 1977). The economy of local coastal areas in New England is dependent on this resource, and representatives from several coastal States and environmental groups have advocated the most stringent measures possible to protect the resource. Other concerns raised during pre-lease-sale activities for Lease Sale 42, the first oil and gas lease sale held in the North Atlantic Region, include the potential impacts on tourism in coastal areas of New England, notably Cape Cod and the offshore Massachusetts islands; consideration of a nomination to designate all or part of Georges Bank as a marine sanctuary; the mitigating effects of the OCS Lands Act Amendments of 1978; potential impacts of chronic low-level oil pollution on biological resources; and the potential effects of drilling mud discharges on the Georges Bank fisheries. All of these issues were addressed in the final and supplemental environmental impact statements for Lease Sale 42, as well as in other documents prepared in conjunction with the sale. These documents are cited and described in appendix D of this summary report.

Lease Sale 42, which had been scheduled for January 31, 1978, was held on December 18, 1979. The sale was postponed twice by a lawsuit that focused on the measures to be taken to protect the Georges Bank fisheries. The location of the 63 tracts leased during Sale 42 is shown in figure 1.

Two other lease sales planned for the region, Sales 52 and 82, are scheduled to be held in August 1982 and February 1984, respectively. The scheduled steps in the leasing process for each of these sales, according to the proposed 5-year OCS oil and gas leasing schedule (July 1981), are shown in table 1.

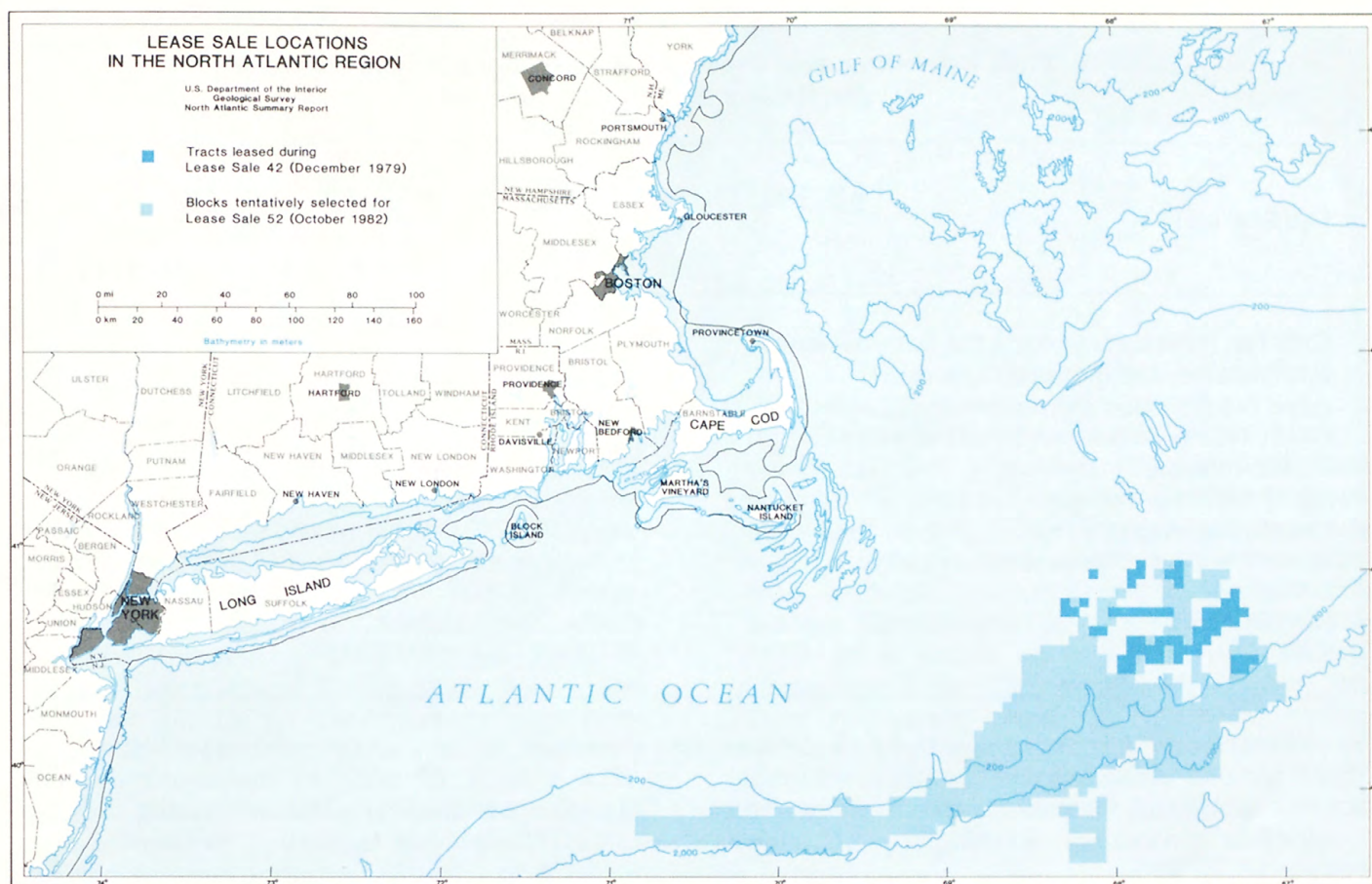


FIGURE 1.—Lease sale locations in the North Atlantic. (Adapted from BLM, 1980b, and BLM, 1977, by Rogers, Golden & Halpern, 1981.)

Tentative tract selection for Lease Sale 52 occurred on June 30, 1980, and a draft environmental impact statement is scheduled for publication in September 1981. A total of 540 blocks (3.1 million acres or 1.3 million hectares) were selected for environmental study for Lease Sale 52 and are shown in figure 1.

Pursuant to section 18 of the OCS Lands Act Amendments of 1978, the Secretary of the Interior will annually review and revise the OCS oil and gas leasing program. Revisions to the program are currently under way to streamline lease sale preparation procedures, to offer areas of high potential earlier, and to offer more acreage for leasing.

A proposed new 5-year leasing schedule was published in July 1981, and a final schedule is expected to be approved late this year or early in 1982. Until the final schedule is

approved, all sale dates noted in this report are based on the July 1981 proposed 5-year oil and gas leasing schedule or the June 1980 final schedule. However, pre-lease-sale steps for sales under way may be changed to reflect streamlining and may not match those shown on the July 1981 schedule.

As exploration of the Outer Continental Shelf in the North Atlantic continues, our knowledge of the region's resource potential will improve. In the event of either a discovery of oil or gas in commercial amounts or another lease sale, future editions of the summary report will include the most recent resource and reserve estimates, anticipated production, transportation strategies, and descriptions of existing and anticipated near-shore and onshore support activity and production facilities.

*TABLE 1.--Proposed 5-year OCS oil and gas leasing schedule
for the North Atlantic, July 1981*

Leasing steps	Sale 52	Sale 82
Call for information (call for nominations*)	12/79*	6/82
Information due (nominations due*)	2/80*	7/82
Area information (tentative tract selection*)	6/80*	9/82
Draft NEPA document (draft environmental statement*)	9/81*	5/83
Public hearing	11/81*	7/83
Final NEPA document	4/82	10/83
Proposed notice of sale	4/82	10/83
Governor's comments due	6/82	12/83
DOE review	6/82	12/83
Notice of sale	7/82	1/84
Sale	8/82	2/84

*Date and step is from the June 1980 leasing schedule.

SOURCE: U.S. Department of the Interior, 1981. Proposed 5-year offshore leasing schedule announced: Washington, D.C., news release July 15, 7p.

1. Offshore Oil and Gas Resources of the North Atlantic Region

This chapter summarizes the geologic factors affecting petroleum exploration and development in the North Atlantic Outer Continental Shelf (OCS) Region, an area extending from Maine to New Jersey. The discussion focuses on the geology of Georges Bank, where 63 tracts comprising 358,671 acres (145,152 hectares) were leased during Lease Sale 42 on December 18, 1979. Current knowledge concerning the petroleum potential of the area proposed for lease in Sale 52 is also summarized. Since the Federal Government must prepare resource estimates for many purposes and the estimation techniques used often differ, various estimation methods and their applicability to onshore planning are reviewed. The final section of the chapter provides the most recent estimates of the oil and gas resources in the North Atlantic Region.

GEOLOGIC ASPECTS OF THE NORTH ATLANTIC REGION

The OCS in the North Atlantic is a sloping subsea feature that varies in width from 25 to 200 miles (40-322 km) off the coast of New England. Water depths on the OCS reach a maximum of 328 to 656 feet (100-200 m) before dropping to approximately 6,560 to 9,840 feet (2,000-3,000 m) at the base of the Continental Slope. From the base of the Continental Slope, the Continental Rise extends gradually seaward to oceanic basin depths exceeding 16,405 feet (5,000 m).

The major physiographic features of the North Atlantic OCS are shown in figure 2. A significant portion of the shelf is Georges

Bank, which is a plateau 174 miles (280 km) long by 93 miles (150 km) wide on the easternmost part of the OCS. Georges Bank is one of a chain of banks, or vast undersea platforms of sand, gravel, and clay, found along the northeastern Continental Margin. It is separated from other banks on the Scotian Shelf off Nova Scotia by the Northeast Channel and from Nantucket Shoals to the west by the Great South Channel. The Gulf of Maine lies directly north of Georges Bank, and the Continental Slope lies to the east and south of this area.

The southern edge of Georges Bank is dissected by six major submarine canyons and several smaller, unnamed canyons. The major canyons are (from west to east) Hydrographer, Welker, Oceanographer, Gilbert, Lydonia, and Corsair. The canyons are several miles long and wide and several hundred feet deep. They were probably eroded by sediments in glacial meltwater rivers during the later periods of the Pleistocene ice age (Schlee and others, 1975). At that time, ice sheets covered New England as far south as Long Island and Nantucket, and the sea level was at the present shelf edge.

Underlying Georges Bank is a large, basin-shaped depression in the basement rock. This depression, or trough, contains over 10,000 feet (3,048 m) of post-Paleozoic sedimentary rock in the northern part of the bank, increasing to 33,000 feet (10,058 m) along the bank's southern edge (Schlee and others, 1975). Seismic surveys have revealed that sedimentary rocks in this basin appear to have good potential for the generation and entrapment of hydrocarbons (Schlee and others, 1975).

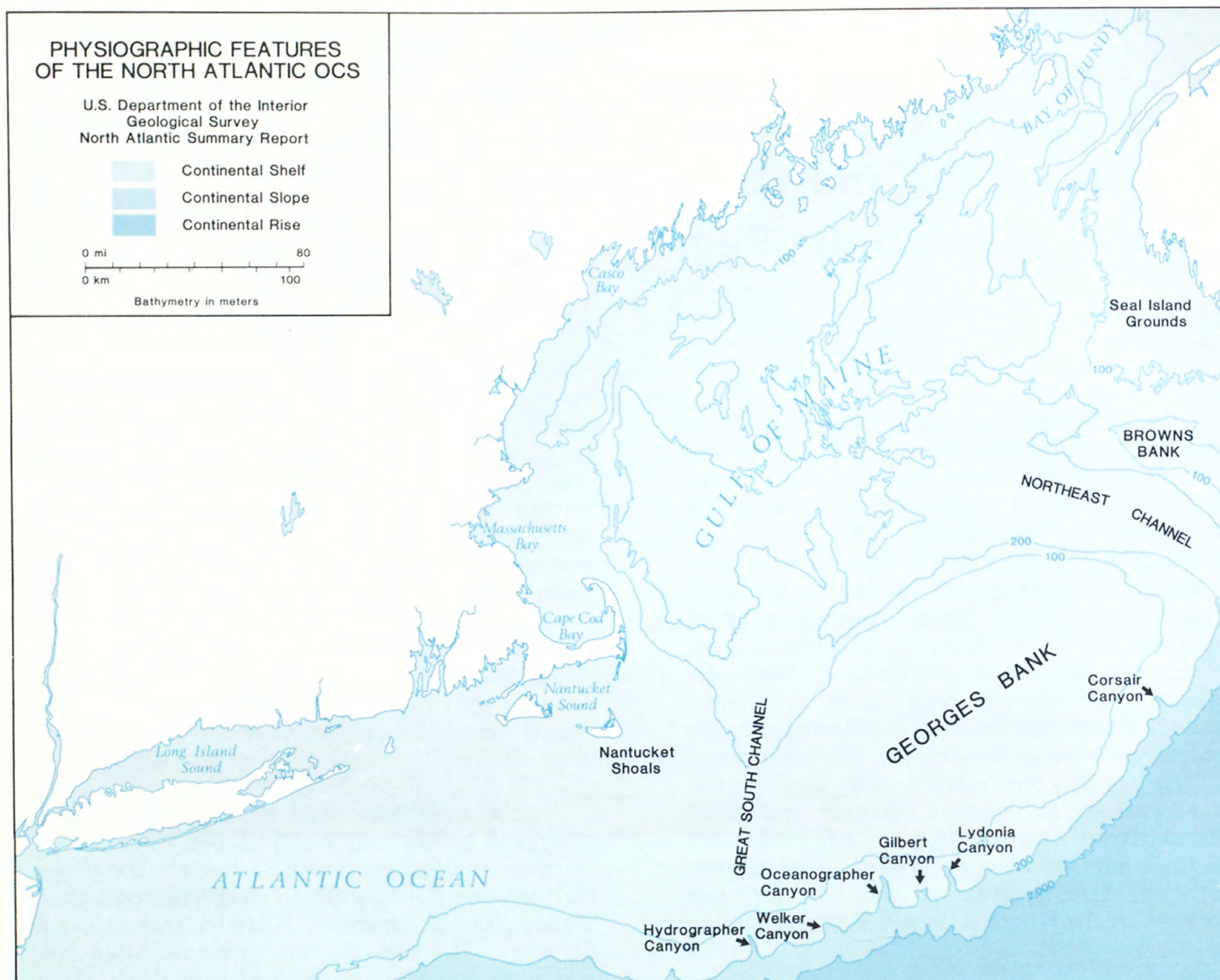


FIGURE 2.—Physiographic features of the North Atlantic OCS. (Adapted from BLM, 1977, by Rogers, Golden & Halpern, 1981.)

The most recent geologic data obtained on Georges Bank Basin are the results from two Continental Offshore Stratigraphic Test (COST) wells drilled in 1976 and 1977. These wells were drilled adjacent to the Lease Sale 42 area to provide the U.S. Geological Survey (USGS) and oil companies with data for evaluating the petroleum potential and possible drilling problems in the North Atlantic before Sale 42 was held. Data from both of the wells confirmed the presence of hydrocarbon source rocks at varying depths in the basin (Amato

and Bebout, 1980; Amato and Simonis, 1980). The best petroleum potential was reported to be middle and lower Jurassic rocks below approximately 14,000 feet (4,267 m) as these beds appear to contain the most favorable potential reservoir rocks and have sufficiently matured to generate hydrocarbons (Amato and Simonis, 1980). Data from the COST wells also revealed that the deeper part of the basin close to the shelf break appears to be the more prospective area for hydrocarbon deposits (Amato and Simonis, 1980).

Some initial research has been conducted concerning the geology of the Continental Slope seaward of Georges Bank. This area was selected during tentative tract selection for further study in the environmental impact statement for Lease Sale 52. No drilling has occurred on the Continental Slope to date; however, geophysical and stratigraphic interpretation has been possible through the use of seismic data collected by the USGS and the oil industry.

Interpretation of the data has led several scientists to believe that a Jurassic and Lower Cretaceous carbonate bank or reef trend is buried under the present Continental Slope (Amato and Simonis, 1980; Schlee and Grow, 1980). These researchers believe that the petroleum potential of this apparent reef area is favorable because of its thick sedimentary sections, possible structural and stratigraphic traps, and the presence of potential sealing beds (Schlee and Grow, 1980). The only well drilled in the vicinity of the apparent carbonate bank was COST B-3 well in the Mid-Atlantic Region. This well was deliberately drilled off-structure and therefore did not penetrate the main reef area; however, it showed the greatest hydrocarbon potential in the sedimentary section below a well depth of 14,100 feet (4,297 m) (Amato and Simonis, 1979). Further testing in the Mid-Atlantic and additional data collected from the proposed exploratory wells in the North Atlantic will help confirm the presence of this possible feature and the petroleum potential of the Continental Slope seaward of Georges Bank.

The USGS has conducted several studies to assess geologic and other potential hazards and constraints that could affect drilling in the Lease Sale 42 area. Hazards are geologic features that may jeopardize OCS oil and gas activities and, once identified, may require special mitigating measures to prevent accidents. The only potential hazards identified in the Lease Sale 42 area were a possible shallow gas deposit in one block and shallow faulting in those blocks located near the shelf edge (Hall, 1979). The faulting represents possible slump areas where mass movement of sediments has occurred in the past, although these areas have apparently not been active since the Tertiary period, over 2 million years ago (Hall, 1979).

As a result of these studies, three lease stipulations were included in the leases for Sale 42 for the one tract containing the potential shallow gas deposit and for seven tracts subject to mass movement of sediments. The stipulations required lessees to take proper engineering precautions when conducting drilling operations on tracts containing the potential geohazards (BLM, 1979).

Geologic constraints are factors that may have an impact on drilling operations but that can be mitigated through the use of existing standard design and engineering technology (Hall and Ensminger, 1979). Constraints that were identified for the Lease Sale 42 area include sand waves, filled channels, potentially unstable slopes, scour, and shipwrecks and other bottom objects (Hall, 1979).

Appendix A provides a more detailed discussion of the petroleum geology of Georges Bank and the Continental Slope of the North Atlantic Region. The appendix also identifies factors that are necessary for the occurrence of hydrocarbon accumulations.

ESTIMATING HYDROCARBON POTENTIAL

To appreciate the complexities of estimating hydrocarbon potential, one must understand the process by which hydrocarbons are discovered and developed. Until a well has been drilled, investigators derive all their knowledge of subsurface geology indirectly, from geologic and geophysical data collected at the surface. The existence of hydrocarbons can be confirmed only by physical evidence produced by drilling. At this early stage of exploration on the North Atlantic OCS, and as there are no proven reservoirs of oil or gas, the region's resource potential is discussed only in terms of **undiscovered resources**. Undiscovered resources are quantities of oil and gas that have been estimated to exist outside known fields. Estimates of undiscovered resources are made by identifying areas of resource potential on the basis of broad geologic knowledge and theory. Using available data as

a basis for further investigations, petroleum geologists then conduct a variety of geologic assessments of the region by exploratory drilling, which may or may not confirm the presence of hydrocarbons.

Information added to the geologic and geophysical data base enables geologists to refine resource estimates. However, estimates of undiscovered resources are always matters of interpretation. Only extensive further drilling will ascertain the existence, extent, and commercial attractiveness of a reservoir. Normally, several wells are drilled in an area where a wildcat strike has occurred before a commercial discovery is confirmed.

After the commercial potential of a reservoir has been established, it is possible to calculate **reserves**. Reserve estimates are estimates of the portion of the identified resource that can be economically extracted. A preliminary estimate of reserves might be based on a map of the subsurface geology and information obtained from several wells, or conceivably from a single well.

Once a commercial discovery has been made, site-specific planning for OCS development and production that a State and local government undertakes should be based on reserve estimates. However, in the absence of a reserve estimate, which is based on the actual measurement of hydrocarbons, the most appropriate figure to use is the estimate of **risked, economically recoverable resources**, based on assumptions or indirect measurements. This method is less accurate than the reserve estimate, but it is the most useful resource estimate for general--as opposed to site-specific--planning because it has been modified by the likelihood of finding hydrocarbons in an area, as well as by the likelihood of any discovery being commercially attractive. Estimates of reserves allow us to approximate more nearly the level of development activity that can be expected in an area than do risked estimates of economically recoverable resources.

For additional information on the process of resource estimation, the reader may refer to appendix B, which explains in greater detail how resource estimates are derived,

what they mean, what they should be used for, and how the process of estimating resources relates to the process of exploring for oil and gas.

RESOURCE AND RESERVE ESTIMATES FOR THE NORTH ATLANTIC

The USGS's most recent (April 1981) resource and reserve estimates for the North Atlantic Region and for the offshore area currently under lease are presented in table 2.

The undiscovered recoverable resource estimates for the North Atlantic Region are given in the first two lines of the table. These estimates are included in order to provide a measure of the petroleum potential of the entire North Atlantic Region. It is important to understand that the regionwide estimates are based on interpretation of broad-scale geological data and therefore provide only a preliminary approximation of the total hydrocarbon potential of the Region.

The risked estimates of economically recoverable resources are given next. They cover all tracts currently leased in the North Atlantic. These estimates are based on the following information:

- the results of drilling two COST wells, plus seismic data; and
- an assumption that the potential geologic traps that have been identified contain risked, economically recoverable quantities of hydrocarbons.

These risked, economically recoverable resource estimates provide a basis for study of and preliminary planning for onshore impacts.

Reserve estimates approximate the cumulative production that can be expected from a discovery. For this reason, they provide a foundation for site-specific onshore planning. The entry for reserves is zero at this time because no discovery of oil or gas has been made yet in the North Atlantic.

**TABLE 2.—North Atlantic OCS oil and gas
resource and reserve estimates**

	Oil (million barrels)	Gas (billion cu ft)
Undiscovered recoverable resources		
North Atlantic Region (including leased tracts)		
0 - 200 m water depth	400	2,500
200 - 2,500 m water depth	1,000	3,200
Risked, economically recoverable resources		
North Atlantic leased tracts	31.6	277.9
Reserves	0	0

SOURCES: Dolton and others, 1981 (undiscovered recoverable resource estimates); USGS, Conservation Division, internal memorandum, April 14, 1981, (risked, economically recoverable resource estimates and reserve estimates).

2. Magnitude and Timing of Offshore Exploration

The history of OCS activity in the North Atlantic Region covers a 6-year time period. The first request for information on tracts proposed for leasing in Lease Sale 42 was made when requests for resource reports were issued on April 14, 1975. This sale, scheduled for January 1978, was finally held on December 18, 1979, after several court-ordered delays. Lease Sale 42 has been the only sale held in the region to date. A second sale, Lease Sale 52, is scheduled for August 1982, according to the proposed July 1981 leasing schedule.

This chapter summarizes the events preceding Lease Sale 42 and describes the recently initiated exploratory activities. The steps in the leasing process that have been completed for Lease Sale 52 are also described.

TRACT SELECTION FOR LEASE SALE 42

The call for nominations and comments for Lease Sale 42 was published in the Federal Register on June 17, 1975. This call requested tract nominations from oil companies on 15.8 million acres (6.4 million hectares) off the coasts of Maine, New Hampshire, Massachusetts, and Rhode Island. Comments were received from government agencies (Federal, State, and local), the public, environmental groups, and other organizations interested in oil and gas leasing in the North Atlantic Region.

In response to this request, 18 oil companies nominated 1,927 blocks covering approximately 10.9 million acres (4.4 million hectares). Eleven comments were received,

most of which expressed concerns about negative impacts to commercial fisheries and to tourism in the coastal areas of affected States (BLM, 1979).

After an analysis was made of the nominated blocks, 206 blocks totaling 1,172,796 acres (474,624 hectares) were selected for study in a draft environmental impact statement on January 2, 1976. A number of Federal agency representatives and the Canadian government, as hereinafter will be discussed, as well as representatives of State governments, were involved in the tract selection process. The blocks selected had received multiple nominations from the petroleum industry and had been identified by the U.S. Geological Survey (USGS) as having high resource potential. The 206 selected blocks and those in the call area for Lease Sale 42 are shown in figure 3.

After the tentative tract selection and prior to the lease sale, 90 blocks and tracts

The words "block," "tract," and "lease" have discrete definitions and applications. The word **block** is used to refer to a geographical area as portrayed on an official BLM/OCS protraction diagram or leasing map, and it contains approximately 9 square miles. A **tract** is an administrative unit offered at a sale, and it may consist of a block or more than a single block. It is an administrative method of numbering blocks offered for sale so that there is a sequential process of offering. Therefore, block numbers and tract numbers may differ.

The term **lease** is an agreement between the lessee and the Federal Government that authorizes exploration for and development and production of minerals. Pursuant to Section 8(b) of the OCS Lands Act, an oil and gas lease shall be for a tract consisting of an area not exceeding 5,760 acres, unless the Secretary finds that a larger area is needed to comprise a reasonable economic production unit.

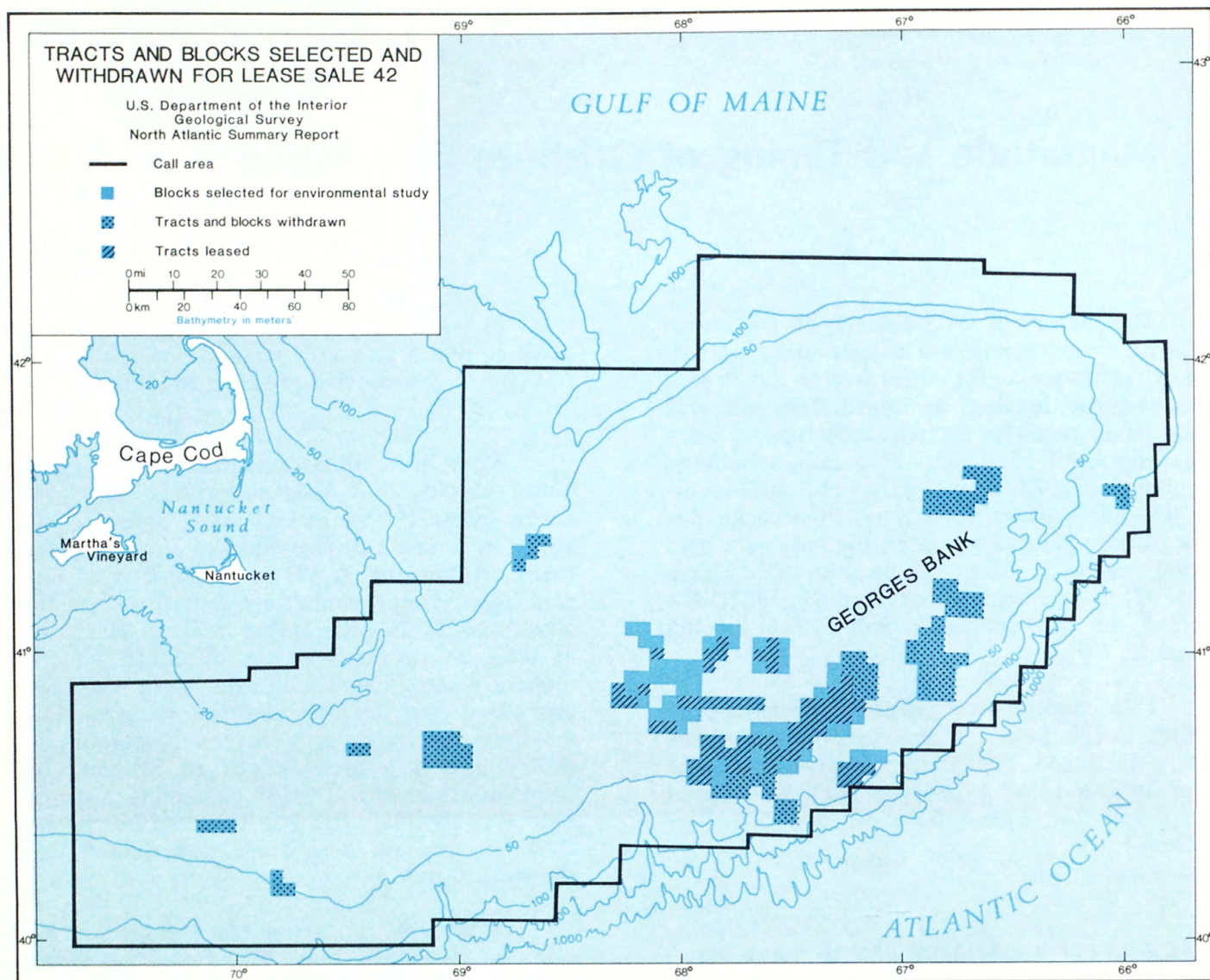


FIGURE 3.—Tracts and blocks selected and withdrawn for Lease Sale 42. (Adapted from BLM, 1977, and BLM, 1979, by Rogers, Golden & Halpern, 1981.)

were withdrawn from consideration in the proposed sale. These deletions occurred on five separate occasions for various reasons. The reasons given by former Secretary of the Interior Cecil D. Andrus for withdrawal of the blocks and tracts were as follows:

- On December 7, 1976, 28 blocks were withdrawn because of boundary negotiations with Canada over a disputed section of the U.S.-

Canadian border within the proposed lease sale area.

- On October 7, 1977, 12 blocks were withdrawn to reduce potential conflicts between commercial fishing and offshore structures.
- On December 23, 1977, 11 blocks were withdrawn in response to recommendations made by the

Governors of Maine, Massachusetts, and Rhode Island to reduce conflicts between oil and gas operators and commercial fishing.

- On January 28, 1978, 27 blocks were withdrawn because of a second border dispute with Canada during the boundary negotiations.
- On September 21, 1979, 12 tracts were withdrawn to protect coral, lobster, and fish at the head of Lydonia Canyon in the proposed sale area (BLM, 1979).

These deletions reduced the 206 blocks selected for sale to 116, which was the total number offered for lease on December 18, 1979. Figure 3 identifies the original area selected for environmental study and the tracts and blocks withdrawn from consideration by the former Secretary of the Interior.

LITIGATION CONCERNING LEASE SALE 42

Litigation surrounding the leasing of tracts for oil and gas exploration and development in the North Atlantic covered a 3-year time period from January 1978 to December 1980. The plaintiffs, Conservation Law Foundation (a public-interest, environmental law organization from Boston, Massachusetts) and the Commonwealth of Massachusetts, filed suit in the U.S. District Court in Boston against the former Secretary of the Interior and the former Secretary of Commerce. The case went to the Supreme Court level before a mutual agreement was reached by the parties on December 22, 1980. The sale was held during the litigation process, but it was delayed twice because of court proceedings. This section of the chapter summarizes the case and outlines the provisions of the final settlement.

Table 3 provides a summary of the pre-lease-sale history of Lease Sale 42. The key dates for the steps in the leasing process, as well as the legal activities that occurred at different court levels, are provided in the

table. Table 4 summarizes the major court decisions made during the 3-year case. The complete briefs filed by the parties involved in the lawsuit and the written opinions of the courts involved are available from the Bureau of Land Management, New York OCS Office, Jacob K. Javits Federal Building, Suite 32-120, New York, NY 10278.

Opposition to Lease Sale 42 was first made evident during the public hearing on the draft environmental impact statement for the sale. At the hearing, several environmental organizations and fishing groups challenged the document as inadequate, alleging it did not adequately assess the risk of oil spills associated with drilling and the effect a potential spill would have on fishing operations on Georges Bank (Christie, 1980). The final environmental impact statement (EIS) was still alleged to be inadequate in this regard, and on January 19, 1978, the Conservation Law Foundation and the Commonwealth of Massachusetts filed suit to enjoin (prohibit) the sale until they felt that adequate environmental safeguards were in place.

After 3 days of hearings, the district court issued a preliminary injunction prohibiting the former Secretary of the Interior from holding the sale. The court noted that the Secretary had committed several statutory violations because he did not take "all steps reasonably possible" to preserve the fishery resources of Georges Bank (Commonwealth of Massachusetts v. Cecil D. Andrus, et al., D. Mass. No. 78-184-G). The court further stated that the EIS for Lease Sale 42 was inadequate and passage of the pending legislation to amend the OCS Lands Act was necessary before the sale could be held. The OCS Lands Act Amendments contained several provisions that the court felt represented important safeguards to protect the Georges Bank fisheries.

A motion to stay (postpone) the injunction by the Department of the Interior was denied by the U.S. Court of Appeals. On January 31, 1978, the scheduled sale was cancelled until the appeal taken by the Department of the Interior could be resolved.

TABLE 3.—Key dates, leasing steps, and court activities for Lease Sale 42

Dates	Leasing steps	Court activities		
		U.S. District Court, Boston	U.S. Court of Appeals, Boston	U.S. Supreme Court, Washington
6/17/75	Call for nominations and comments			
8/29/75	Nominations and comments due			
1/2/76	Tract selection announced			
10/12/76	Draft EIS ^a announced			
12/7-10/76	Public hearings			
8/29/77	Final EIS published			
10/7/77	Proposed sale notice sent to Governors			
12/23/77	Sale announced for January 31, 1978			
1/19/78		Suit filed by Mass. and CLF ^b		
1/25-28/78		Hearing on injunction		
1/28/78		Injunction granted		
1/30/78			DOI ^c attempted to stay injunction. Hearing held. District Court decision upheld.	
1/31/78	Scheduled sale delayed by injunction			
3/7/78			Hearing of DOI's appeal	
2/20/79			Injunction lifted. Case remanded to District Court for trial on merits.	
4/18/79	Interior to publish supplement to final EIS			
5/22/79	Draft supplement EIS published			
6/20/79	Public hearing			
7/26/79	Proposed sale notice sent to Governors			
8/6/79	Final EIS supplement published			
9/20/79		DOI filed brief to dismiss case		
9/21/79	DOI announces management plan for Georges Bank. Oct. 30 sale date announced.			

TABLE 3.—Key dates, leasing steps, and court activities for Lease Sale 42 (Continued)

Dates	Leasing steps	Court activities		
		U.S. District Court, Boston	U.S. Court of Appeals, Boston	U.S. Supreme Court, Washington
10/2/79	Sale date changed to Nov. 6			
10/5/79		Mass. Attorney General and CLF file amended complaints and seek preliminary injunction to delay sale		
10/31-11/2/79	Hearing on case			
11/5/79		Injunction not granted	Expedited hearing held	
11/6/79	Sale delayed by stay order		Court denied injunction. Emergency stay order granted.	Justice Brennan extended stay order
11/9/79			Mass. Attorney General and CLF file motion for expedited hearing on the merits of appeal	Court vacated emergency stay
11/14/79	New sale date announced for Dec. 18			
12/6/79			Hearing on merits of preliminary injunction	
12/17/79			District Court's denial of injunction upheld	
12/18/79	Sale			Justice Brennan issued a brief oral stay. Stay was rescinded. Sale proceeded.
2/22/80			Court amended opinion, but denied previous holding was altered	
3/19/80			CLF filed petition for rehearing case	
4/4/80			Court denied rehearing of case	
7/17/80		Hearing held on merits of plaintiffs' complaints		
9/11/80		Additional hearings held on merits of plaintiffs' complaints		
12/22/80		Case dismissed		

^aEnvironmental impact statement^bConservation Law Foundation^cDepartment of the Interior

SOURCE: BLM, N.Y. OCS Office, 1981.

TABLE 4.—Summary of major court opinions for Lease Sale 42

Date	Court	Presiding judge(s)	Summary of opinion
1/28/78	U. S. District Court, Boston, Mass.	Judge W. Arthur Garrity, Jr.	Judge Garrity ordered a preliminary injunction against receipt of bids for Lease Sale 42. He found that the balance of harms, in both extent and irreparability, favored the plaintiff. He also held that the Department of the Interior would violate the Outer Continental Shelf Lands Act (OCSLA) and the National Environmental Policy Act if it held a sale before the OCSLA amendments were passed; or on the basis of an environmental impact statement (EIS) which gave insufficient consideration to delaying the sale and possible damage to beaches, and none to designating Georges Bank as a marine sanctuary.
1/30/78	U.S. Court of Appeals for the First Circuit, Boston, Mass.	Judge Levin H. Campbell	Judge Campbell denied a motion by DOI to stay the injunction granted by the district court on the grounds that Judge Garrity did not act arbitrarily or make an error of law. Judge Campbell reiterated that Georges Bank is so important that a few months delay for judicial review was appropriate.
2/20/79	U.S. Court of Appeals for the First Circuit, Boston, Mass.	Chief Judge Frank M. Coffin, Judge Levin H. Campbell, and Judge Frank Murray	The court vacated the preliminary injunction against Lease Sale 42. The opinion held that the issue of the Secretary of the Interior acting arbitrarily or capriciously had been mooted by passage of the OCS Lands Act Amendments; that the objections to the EIS were not strong enough to continue the injunction, but that the Secretary of the Interior should consider the designation of Georges Bank as a marine sanctuary; and that the Secretary should carefully exercise his responsibility to balance mineral development and fishery resources on Georges Bank.
11/5/79	U.S. District Court, Boston, Mass.	Judge John J. McNaught	Judge McNaught denied motions for a preliminary injunction against Lease Sale 42. He held that the plaintiffs would not suffer immediate and irreparable harm from the opening of bids; and that the plaintiffs did not have a reasonable prospect of success on the merits. He found that the EIS's were adequate; that the sale would not constitute an irretrievable commitment of resources contrary to the Endangered Species Act; and that best available and safest technology regulations might be issued after the sale.
11/6/79	U.S. Court of Appeals for the First Circuit, Boston, Mass.	Chief Judge Frank M. Coffin, Judge Levin H. Campbell	The court denied the plaintiff's motion for a stay of the sale pending appeal of the district court's denial of a preliminary injunction against the sale. The court found that the sale would not constitute an irretrievable commitment of resources prohibited by the Endangered Species Act; that best and safest technology regulations could be applied by the Secretary to pre-existing leases; and that the EIS and allied documents were sufficient for purposes of law.
12/17/79	U.S. Court of Appeals for the First Circuit, Boston, Mass.	Chief Judge Frank M. Coffin, Judge Levin H. Campbell	The court held that the district court, in denying the preliminary injunction against holding the sale, did not abuse its discretion or make a clear error of law. The sale does not constitute an irreversible or irretrievable commitment of resources by the Secretary of the Interior, who would still be bound by the Endangered Species Act, the OCS Lands Act, and the terms of the lease. The EIS's were sufficient to show good faith by DOI in considering the environmental consequences of the sale. Best and safest technology drilling regulations need not be issued prior to the sale.
12/22/80	U.S. District Court, Boston, Mass.	Judge John J. McNaught	The court ordered the case dismissed with prejudice. Besides the dismissal terms, the parties agreed to five provisions (discussed on p. 18).

SOURCE: Samuels, BLM, 1981; Commonwealth of Massachusetts and Conservation Law Foundation, Inc. v. Cecil D. Andrus, et al., D. Mass., No. 78-0184-MC and No. 78-0186-MC.

On February 20, 1979, the U.S. Circuit Court of Appeals vacated (lifted) the preliminary injunction against Lease Sale 42. The court opinion stated that the major grounds for the injunction were no longer applicable because of the passage of the OCS Lands Act Amendments. The court further stated that the objections to the EIS were not strong enough to continue the injunction. However, the court left open for future ruling a requirement that the EIS include a discussion of designating Georges Bank as a marine sanctuary (Commonwealth of Massachusetts, et al., and Conservation Law Foundation, Inc., et al., v. Cecil D. Andrus, et al., 1st Cir., No. 78-1036, no. 78-1037). The case was remanded (sent back) to the district court for trial on its merits.

A draft and final supplement to the environmental impact statement for Lease Sale 42 were published by the Department of the Interior during May and August, respectively, in 1979. These documents included a discussion of the marine sanctuary proposal, as well as a discussion of the responsibilities of the Secretary of the Interior under the OCS Lands Act Amendments of 1978. On May 10, 1979, the Attorney General for the Commonwealth of Massachusetts and the Conservation Law Foundation made a formal nomination to the Department of Commerce to designate Georges Bank as a marine sanctuary.

After studying this proposal, the Department of Commerce and the Department of the Interior agreed on a Georges Bank management plan as the vehicle for protecting the Bank's fisheries while allowing exploration and development of oil and gas. The plan deleted 12 blocks from the sale to protect known fish populations, established a biological task force (BTF) of government agency representatives to monitor the effects of drilling operations, and required on-site pollution control equipment as well as proper disposal of wastes from the drilling rigs operating on Georges Bank (Christie, 1980). After these measures had been adopted, the Department of Commerce

removed Georges Bank from an active list of marine sanctuary candidates.

The lease sale was rescheduled for November 6, 1979, and on October 5, 1979, the Conservation Law Foundation and the Commonwealth of Massachusetts filed suit to enjoin the sale a second time. The plaintiffs argued that the former Secretary of the Interior had still not satisfied his responsibilities under the OCS Lands Act to protect the Georges Bank fisheries, and that the final and supplemental impact statements for the sale were inadequate. On November 5, 1979, the U.S. District Court denied the injunction, and the plaintiffs immediately appealed to the U.S. Court of Appeals. The appeals court also denied an injunction but granted a stay of the sale to allow time for an appeal to the Supreme Court. Supreme Court Justice Brennan granted an emergency stay order on November 6, 1979, the day of the sale. His decision delayed the sale until the full Supreme Court could rule on the matter.

On November 9, 1979, the Supreme Court vacated the stay, which allowed the Department of the Interior to proceed with the sale. However, by law, the Department was required to give 30 days notice in the Federal Register of the rescheduling. The new lease sale date was announced for December 18, 1979.

During December 1979, a hearing was held in the appeals court on the merits of the district court's decision to deny the preliminary injunction. The district court's decision was upheld. On December 18, 1979, the plaintiffs again petitioned the Supreme Court to stop the sale. Justice Brennan issued a 3-hour delay to consider their proposal but decided against involving the Supreme Court in the matter, and his stay was lifted. The sale proceeded on the afternoon of December 18, 1979.

Following the sale, the plaintiffs petitioned for a rehearing of the case, which was

denied by the U.S. Court of Appeals. However, hearings were held in the district court on the merits of the complaints filed by the Commonwealth of Massachusetts and the Conservation Law Foundation. Further hearings on the merits of the case were scheduled during October 1980 but were then postponed. A settlement was finally reached on December 22, 1980, to dismiss the suit. Five major provisions were agreed upon in the settlement, as follows:

- The Federal Government agreed to provide all parties with information on the biological studies concerning Georges Bank. Copies of future reports would be made available to all parties involved in the legal dispute.
- The Department of the Interior agreed to issue Best Available and Safest Technology (BAST) standards to the extent that they were not already in existence or required by the OCS Lands Act.
- The Department of the Interior approved and agreed to fund certain studies recommended by the Biological Task Force. The Department of the Interior also agreed to consider for approval and funding future studies recommended by the task force.
- The National Oceanic and Atmospheric Administration (NOAA) agreed to consider whether all or part of Georges Bank should be nominated as an active candidate for marine sanctuary designation. A decision on this requirement will be made by December 1, 1981.
- The Department of the Interior agreed to prepare a development and production phase environmental impact statement after receipt of one or more development and production plans from any of

the lessees holding tracts in the Sale 42 area (Commonwealth of Massachusetts and Conservation Law Foundation, Inc. v. Cecil D. Andrus, et al., D. Mass., No. 78-0184-MC, no. 78-0186-MC).

OFFSHORE ACTIVITY IN THE NORTH ATLANTIC

Two Continental Offshore Stratigraphic Test (COST) wells have been drilled in the North Atlantic Region. These wells were drilled after the tract selection process to provide industry and the USGS with data for evaluating the petroleum potential of the area. The first well (G-1) was drilled between April 6 and July 26, 1976, on block 79 (NK 19-11) to a depth of 16,071 feet (4,898 m). The second COST well (G-2) was drilled on block 141 (NK 19-12) between January 6 and August 30, 1977, to a depth of 21,874 feet (6,667 m). The locations of the two wells are shown in figure 4.

The results of the two COST wells are described in two open-file reports published by the USGS during 1980. (See appendix D for information on the availability of these reports.) As stated in chapter 1, both wells revealed potential hydrocarbon source rocks at varying depths in the sedimentary basin (Amato and Simonis, 1980). However, these wells were deliberately drilled off-structure, and results do not confirm the presence of hydrocarbons beneath nearby leased tracts. Exploratory drilling by industry is required before this determination can be made.

A total bid of \$1,270,789,890 was submitted by 31 companies on 73 of the 116 tracts offered for lease at Sale 42. The Department of the Interior accepted high bids totaling \$816,516,546 on 63 tracts. Ten bids were rejected as insufficient. Figure 4 shows the tracts leased in Sale 42, tracts offered that did not receive bids, and tracts on which the bids were rejected.

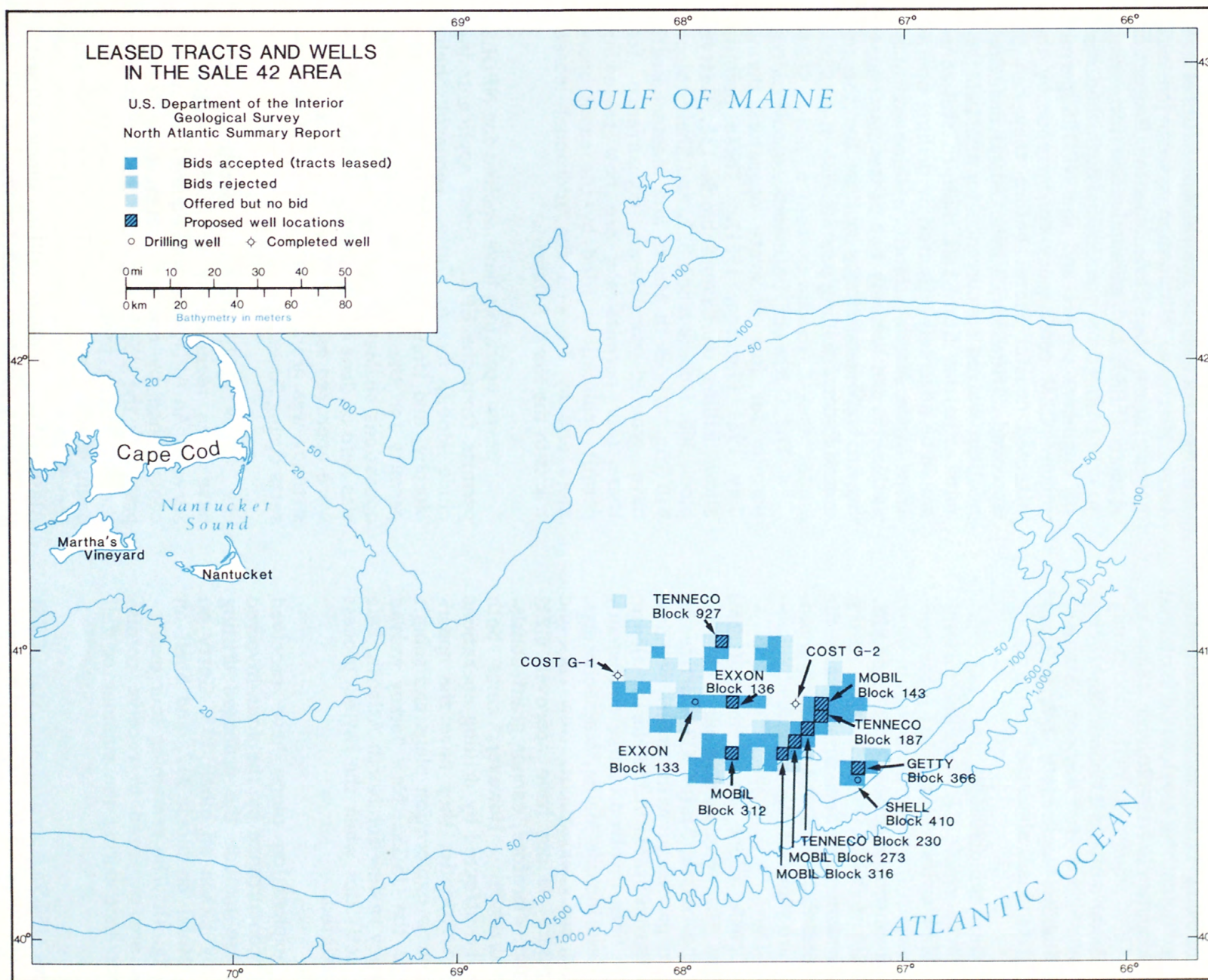


FIGURE 4.—Bidding results, leased tracts, and well locations in the Lease Sale 42 area. (Adapted from BLM, 1980a, and Oil and Gas Journal, 1981, by Rogers, Golden & Halpern, 1981.)

Eight exploration plans have been submitted by five oil companies to the U.S. Geological Survey. These plans call for drilling on the following 11 blocks, as identified by the U.S. Geological Survey, on OCS official protraction diagram NK 19-12:

- Exxon's blocks 133 and 136;
- Mobil's blocks 143, 273, 312, and 316;
- Getty's block 366;
- Shell's block 410; and
- Tenneco's blocks 187, 230, and 927.

All of these plans have been approved by the Geological Survey. The locations for the proposed wells are shown in figure 4.

The Coastal Zone Management (CZM) Act requires that exploration plans be reviewed by the coastal States' CZM offices to determine consistency with their policies. Four of the seven States in the North Atlantic Region have been involved in this consistency review. These include Maine, Massachusetts, Rhode Island, and Connecticut. New York and New Hampshire do not have approved CZM programs and, therefore, cannot grant consistency concurrence. However, since both States may be affected by drilling operations in the North Atlantic, they have the opportunity to review exploration plans and submit comments to the USGS. New Jersey waived its consistency review for North Atlantic Sale 42 drilling activities when the review process was first initiated.

Four exploration plans have received consistency concurrence by the four involved States. These include the proposed drilling operations by Exxon on block 133, Getty on block 366, Mobil on block 312, and Shell on block 410 (fig. 4). The remaining four exploration plans are expected to receive consistency concurrence during the summer or fall of 1981.

Besides USGS's approval and State CZM consistency concurrence for exploration plans, three Federal permits are required before an

operator can begin exploratory drilling. These include a permit from the U.S. Army Corps of Engineers allowing an operator to place a drilling structure on the OCS, a national pollutant discharge elimination system (NPDES) permit from the Environmental Protection Agency (EPA), and an application for permit to drill (APD) from the USGS. Both the Corps of Engineers permit and the NPDES permit require CZM consistency concurrence by the affected coastal States before they can be approved. However, Rhode Island and Connecticut waived concurrence for the two permits as neither State felt their coastal zones would be adversely affected by drilling operations in the North Atlantic. Maine and Massachusetts are the only two States participating in CZM consistency review for the required Federal drilling permits.

The Corps of Engineers approved four permits for four separate operators during July 1981 (Jackson, 1981). These permits allow drilling on Exxon's block 133, Getty's block 366, Mobil's block 312, and Shell's block 410 (fig. 4). Both Maine and Massachusetts have granted consistency concurrence for these four permits and are now reviewing permit applications filed by the same operators and by Tenneco for additional leased tracts in the North Atlantic.

Seven operators have applied for NPDES permits from the EPA. These applicants include Mobil, Exxon, Getty, Tenneco, Shell, Murphy, and Union. The EPA released draft permits for the applicants' proposed drilling operations on May 8, 1981. A public hearing was held on June 9, 1981, and the final permits were approved on June 26, 1981. CZM consistency was granted by Maine and Massachusetts during June.

Three applications for permits to drill have been received by the U.S. Geological Survey. An APD does not require consistency concurrence by coastal States, and its approval by the USGS is usually the last step in the regulatory process before operators can begin drilling operations. The three APDs call for Exxon to drill on block 133 with the Alaskan Star, Shell to drill on block 410 with the Zapata Saratoga, and Tenneco to drill on block 187 (drilling rig not specified) (Roberts,

1981). Exxon's and Shell's APDs were approved on June 29, 1981, and exploratory drilling by these two operators began on July 24, 1981. Exploratory drilling by the other operators seeking approval of their exploration plans and the required Federal permits is dependent on the availability of drilling rigs for service in the North Atlantic Region.

LEASE SALE 52 PRE-LEASE-SALE ACTIVITY

Lease Sale 52 will be the second proposed sale scheduled for the North Atlantic Region. It was initially scheduled for October 1982, but this date was changed to August 1982 when a new proposed 5-year leasing schedule was released in July 1981.

In response to the call for nominations issued December 19, 1979, 10 companies nominated 1,261 blocks comprising 7.2 million acres (2.9 million hectares). Forty comments were received from Federal, State, and local agencies, environmental and conservation organizations, fishing groups, and a number of private individuals. Most of the comments indicated concern over the leasing of certain portions of Georges Bank and/or the timing of the proposed lease sale (Salzmann, 1981).

On June 30, 1980, the Secretary of the Interior selected 540 blocks covering 3.1 million acres (1.3 million hectares) for consideration in an environmental impact statement (fig. 1). The water depths for these blocks range from 171 to 9,285 feet (52 - 2,830 m). The draft environmental statement is now being prepared and is scheduled for publication during September 1981.

3. Oil and Gas Transportation Strategies

If commercially producible quantities of oil and gas are discovered on the North Atlantic OCS, they will have to be transported for processing, refining, and distribution. The process of planning for and constructing the necessary transportation facilities is complex and expensive. Because of the intricacy of this process, planning should begin as early as possible, even before oil and gas lease sales have occurred. The Bureau of Land Management (BLM) takes a lead role in transportation planning through its Intergovernmental Planning Program for OCS Oil and Gas Leasing, Transportation, and Related Facilities (IPP).

The IPP was officially initiated on September 20, 1979, when private-sector appointments were made to the Regional Technical Working Group (RTWG) Committees. These working group committees are composed of Federal and State officials, representatives of industry, and other special and private interests. The members of the North Atlantic RTWG Committee, as of July 1981, are listed in table 5.

The RTWG for the North Atlantic has met five times since the first meeting was held on November 8, 1979. During these meetings, the committee took action on two major items: recommendations on pre-lease-sale activities for the proposed Lease Sale 52, and recommendations on the proposed Georges Bank monitoring program. The committee's work on Lease Sale 52 included the development of eight specific recommendations on tract selection that were made to the Bureau of Land Management during April 1980. The recommendations were as follows:

- defer the leasing of any tracts within a 50-mile (80-km) buffer area;
- defer the leasing of any tracts within the 197-foot (60-m) isobath;
- defer the leasing of tracts in fish spawning and nursery areas;
- address deepwater technology in the Lease Sale 52 environmental impact statement (EIS) and consider mitigating measures or appropriate protective stipulation(s);
- give special emphasis to tracts selected on canyon areas and adjacent slopes in the EIS;
- give special attention in the EIS to tracts selected within U.S. Coast Guard delineated shipping lanes;
- give special attention in the EIS to tracts selected within major fishing grounds; and
- preface these recommendations with a statement that many comments received in response to the call for nominations requested that Lease Sale 52 be delayed until further information was obtained on the effects of Lease Sale 42 exploration (North Atlantic Regional Technical Working Group Committee, 1980).

The committee also made several recommendations on the implementation and

TABLE 5.—North Atlantic Regional Technical Working Group Committee

Member	Affiliation
Mr. Frank Basile	BLM-New York OCS Office
Mr. Elmer Danenberger	U.S. Geological Survey
Captain R. Barry Eldridge	U.S. Coast Guard
Ms. Carolyn Griswold	National Oceanic and Atmospheric Administration
Mr. James Mikolaities	Fish and Wildlife Service
Mr. Wallace Stickney	Environmental Protection Agency
Mr. Joseph Belanger	State of Connecticut
Mr. Mark Chittum	State of New Hampshire
Mr. Charles Colgan	State of Maine
Mr. John Harmon	State of New York
Ms. Patricia Hughes	State of Massachusetts
Dr. Norbert Psuty	State of New Jersey
Mr. Bruce Vild	State of Rhode Island
Ms. Brenda Boleyn	Association for the Preservation of Cape Cod
Mr. John D. Davis	Private consultant
Mr. Kevin Donohue	Interstate Natural Gas Association of America
Mr. Jay Lanzillo	Chatham Seafood Cooperative
Ms. Priscilla Newbury	Private citizen
Mr. Thomas Norris	New England Fishery Management Council
Mr. Richard Stauble	American Petroleum Institute
Dr. Donald Zinn	National Wildlife Federation

For further information concerning the North Atlantic Regional Technical Working Group Committee, contact Richard Barnett, Bureau of Land Management, New York OCS Office, Jacob K. Javits Federal Building, Suite 32-120, New York, NY 10278 (telephone: (212) 264-1061).

funding of the proposed Georges Bank monitoring program. The goal of the program is to provide Federal and State agencies with information on the following areas of concern:

- the physical and biological pathways through which drilling charges may affect fishery resources on Georges Bank;

- the extent to which potentially toxic components of the drilling discharges accumulate in near-field and far-field sites;
- whether these concentrations are sufficient to adversely affect biological resources; and
- the extent to which discharge practices affect the potential for biological impacts (North Atlantic Regional Technical Working Group Committee, 1981).

The committee recommended that overall responsibility for managing the program should be assigned to the U.S. Geological Survey's Office of Marine Geology in Woods Hole, Massachusetts. Funding for the program may come from the Department of the Interior, but other sources, including operators, are also being considered in case the Department's funding is not adequate. The committee recommended that the monitoring program be started as soon as possible (North Atlantic Regional Technical Working Group Committee, 1981).

Additional topics discussed in the committee's meetings included current environmental studies being conducted on Georges Bank and the development of transportation planning methodologies for the North Atlantic Region. On this latter subject, the New England River Basins Commission (NERBC) has an interagency agreement with the Bureau of Land Management to develop a set of procedures pertaining to regional transportation planning, using the Georges Bank area as a case study. This work will be used by the technical working group committee in choosing the preferred and alternative transportation corridors in the North Atlantic Region, once a commercial discovery of oil or gas is made. The committee is now in the process of reviewing NERBC's work to choose an appropriate methodological framework for its future transportation planning. NERBC's study and other studies related to transportation planning are described in appendix D of this summary report.

4. Nature and Location of Nearshore and Onshore Facilities

Because exploratory drilling has just begun in the North Atlantic, there have been few onshore effects of drilling activities in the region. Davisville, Rhode Island, which served as a support base for the two Continental Offshore Stratigraphic Test (COST) wells drilled on Georges Bank and for all the drilling operations conducted in the Mid-Atlantic Region, is now servicing the recently initiated exploratory activities in the North Atlantic. The only other area affected by OCS activities will be an airport in southeastern Massachusetts used as a refueling stop for helicopters servicing the rigs on Georges Bank.

This chapter focuses on the attitudes of the North Atlantic coastal States (fig. 5) toward OCS development, as well as the planning activities conducted by each State in anticipation of OCS exploration and development. The current level of activity at Davisville and its estimated capabilities of handling additional OCS-related activities as a support base are also described. The only onshore effects expected from North Atlantic drilling activities will be associated with the planned support base. These effects should remain minimal throughout the exploratory phase of drilling.

CONNECTICUT

The State of Connecticut did not take an active role in pre-lease-sale activity for Sale 42 on Georges Bank, mainly because of the distance from the Connecticut coastline to the lease sale area. The State is approximately

200 miles (322 km) from the major group of tracts leased during the sale. This distance, in relation to the other New England coastal States (especially Massachusetts and Rhode Island), does not make Connecticut a desirable location for onshore support facilities. Also, the distance buffers the State from the likelihood of spilled oil ever reaching its coast and from other physical impacts of drilling operations on the OCS. In fact, most of the waters off Connecticut are part of Long Island Sound (fig. 5), which is protected by Long Island.

Connecticut has a small fishing industry in comparison to the other New England coastal States. The total catch for the State in 1975 and 1976 was only 1 percent of the total value of the catch for the seven northeastern States from New Jersey to Maine (BLM, 1977). Most of Connecticut's fishing operations are limited to Long Island Sound and Block Island Sound, which are within 12 miles (19 km) of the shore. As Connecticut fishermen do not fish on Georges Bank, the State did not become involved in the litigation surrounding Lease Sale 42.

The State's Coastal Area Management Office of the Department of Environmental Protection granted consistency certificates for the four exploration plans submitted for tracts leased during Sale 42. The office waived its review of the required drilling permits because it felt drilling operations on Georges Bank would not affect the State's coastal zone (D'Eugenio, 1981, oral commun.). No plans for onshore support facilities for OCS operations are included in the State's coastal zone management program.



FIGURE 5.—The New England coastal area. (Adapted from USGS, 1976, by Rogers, Golden & Halpern, 1981.)

RHODE ISLAND

The State of Rhode Island has been a proponent of OCS development in the North Atlantic since Lease Sale 42 was first proposed. The State's economy has been relatively stagnant since World War II, and the development of onshore support facilities is envisioned as a means to alleviate this problem (Office of the Governor, State of Rhode Island, 1979). Rhode Island actively promoted the former Navy base at Davisville as an ideal support base for OCS operations in both the Mid-Atlantic and the North Atlantic. Davisville was subsequently chosen as a support area for both Mid-Atlantic and North Atlantic exploration efforts. Rhode Island therefore has taken the position of encouraging OCS development in the North Atlantic, especially

since activity in the Mid-Atlantic has subsided and available facilities at Davisville are underutilized.

Davisville and Quonset Point are two adjacent facilities that until 1974 served as bases for naval operations in the North Atlantic Region (University of Rhode Island, 1977). They are now in the process of being turned over to the State of Rhode Island. The Rhode Island Port Authority is the managing agency for the abandoned facilities. The Port Authority, with the assistance of the Rhode Island Department of Economic Development, is converting some of these facilities to new uses and demolishing the more outdated facilities to open up areas for industrial redevelopment.

Two piers and 156 acres (62.4 hectares) of the site (fig. 6) have been used as support facilities for Mid-Atlantic OCS operations



FIGURE 6.—Piers used for OCS support services at Davisville, Rhode Island. (Photo courtesy of Rhode Island Department of Economic Development, 1981.)

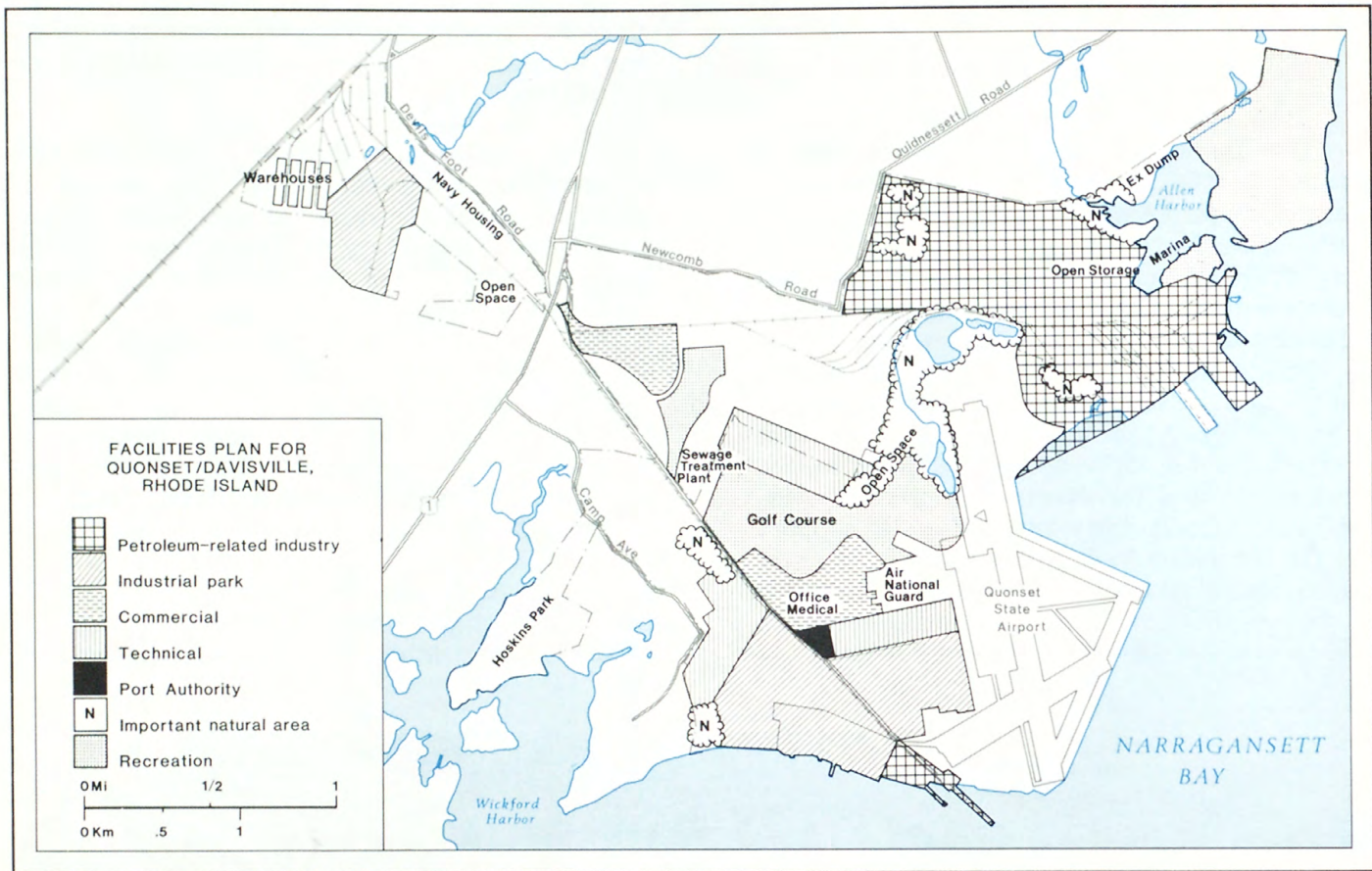


FIGURE 7.—Facilities plan for Quonset/Davisville, Rhode Island. (Adapted from Keyes Associates, 1977, by Rogers, Golden & Halpern, 1981.)

since 1976. Support activity at the base peaked in 1978, when 67 companies employing 670 persons were involved in OCS-related work at Davisville and Quonset Point (MacPherson and Bookman, 1980). Since that time, support activity has subsided as the level of drilling activity in the Mid-Atlantic declined from as many as nine rigs in January 1979 to the current level of one rig. Approximately 20 OCS-related companies are still active in Davisville, and the average number of employees involved in OCS support activities has been approximately 140 for the last 14 months (Deis, 1980; Dorrier, 1981).

The Rhode Island Department of Economic Development has prepared a redevelopment plan for Quonset/Davisville, which is shown in figure 7. This plan is a mixed-use

development scheme based on the assumption that a medium find of oil and gas will be made and developed from Georges Bank. The "medium find" used for planning purposes was defined as 900 million barrels (143 million m³) of oil, 4.2 trillion cubic feet (119 million m³) of natural gas, and 3.3 trillion cubic feet (93 million m³) of unassociated gas (Keyes Associates, 1977).

Of the 694 acres (281 hectares) of developable land at Quonset/Davisville, approximately 350 acres (142 hectares), including 4,000 linear feet (1,219 linear meters) of berth space, are planned for oil and gas support industries (Spinard, 1981, oral commun.). This is over twice as much land area as that currently used for support activities. Between 20 and 30 drilling rigs could be serviced with



FIGURE 8.—Quonset/Davisville Industrial Park, Rhode Island. (Photo courtesy of Rhode Island Department of Economic Development, 1981.)

this much land area and berthing space (Spinard, 1981, oral commun.). Proposed OCS-related facilities for Quonset/Davisville include pier space, storage buildings and lay-down space for service companies, a platform fabrication yard, and a pipe laydown and coating yard. The need for these facilities obviously depends on the commercially recoverable quantity of oil and/or gas discovered on Georges Bank. At this point, even if a significant discovery is made, it appears unlikely that a platform fabrication yard will be developed at Quonset/Davisville because of the lead-time required in constructing such a facility and the environmental constraints associated with dredging (Dana, 1981, oral commun.).

The planned facilities at Quonset/Davisville will provide more than enough space to service the number of rigs expected during the exploratory phase of drilling in the North Atlantic. The region is fortunate in having such an excellent facility already available as a support base, as the impacts associated with constructing such a base can be significant. However, in this case, OCS development is

helping to alleviate the difficult transition from the public sector to the private sector of 3,000 acres (1,200 hectares) of prime industrial real estate (fig. 8).

In addition to the Quonset/Davisville Facilities Plan, the Rhode Island Department of Economic Development has completed preliminary engineering and environmental assessments for a bulkhead expansion project at the Davisville piers, final engineering for a sewer line to the Davisville piers, and a traffic improvement system for the entire industrial park (Spinard, 1981, oral commun.). Once the new sewer line is constructed, utilities at the base will be adequate for the amount of industrial development planned in the Quonset/Davisville Facilities Plan.

The redevelopment plan for Quonset/Davisville is being incorporated as part of the master plan for the Kingston Township. The facilities plan is also part of the Rhode Island Coastal Zone Management Program, which was approved on May 12, 1978. The Coastal Zone Management Office for the State has concurred that the exploration plans are con-

sistent with its Coastal Zone Management (CZM) program and waived its consistency review for the required Federal drilling permits.

MASSACHUSETTS

The Commonwealth of Massachusetts was one of the major plaintiffs in the litigation surrounding Lease Sale 42, primarily because the State wanted the maximum protection possible for Georges Bank fisheries. The State's fisheries are larger than those of the other North Atlantic coastal States. The total value of landings (fish caught) for the State in 1975 and 1976 constituted 36 percent of the seven-State North Atlantic Region (BLM, 1977). Up to 50 percent of the total landings (by weight) for Massachusetts are taken from Georges Bank (Olsen and others, 1977). The State has therefore consistently pressed to protect this resource by recommending that mitigating measures be incorporated as part of the lease sale. These measures include a Fishermen's Contingency Fund, the Best Available and Safest Technology (BAST) standards, and marking of equipment on the drilling rigs. When these requirements were not fully implemented, the State challenged the legality of the lease sale in court. This suit continued for 23 months and was finally settled on December 22, 1980, as described in chapter 2. Most of the concerns the State had over OCS development were dispelled by the agreement reached in the final court settlement and by the OCS Lands Act Amendments of 1978. The State is now conducting its review of the exploration plans and drilling permits to determine their consistency with the State's coastal zone management program. Two plans and the accompanying permits (for Exxon's block 133 and Shell's block 410) were approved by the State during June 1981.

The Barnstable airport near Hyannis, Massachusetts, (fig. 5), served as a helicopter base for the two COST wells drilled on the North Atlantic OCS and as the location for the U.S. Geological Survey's North Atlantic District Office. This airport will also be used for refueling stops for helicopters operating out of Davisville, Rhode Island (Clark, 1981, oral commun.). Two other possible refueling stops are at Otis Air Force Base in Barnstable, Massachusetts, and the airport on Nantucket

Island. Refueling stops are required because of the distance from Davisville to the drilling rigs on Georges Bank. No impacts are expected from these activities.

Two other cities in Massachusetts, Fall River and New Bedford (fig. 5), have sought to support OCS development activity in the Mid-Atlantic and planned in the North Atlantic. Fall River recently completed a study identifying potential sites for development and predicting the associated environmental impacts. The study identified 159 acres (64 hectares) of waterfront area that could be developed for OCS support facilities (C.E. Maguire, Inc., 1981). However, neither Fall River nor New Bedford are expected to be used as support bases because of the good facilities existing at Quonset/Davisville, Rhode Island.

NEW HAMPSHIRE

New Hampshire has consistently supported OCS oil and gas exploration, provided that fishery, recreational, and environmental resources are afforded adequate protection (Gallen, 1979). The State has prepared several studies assessing the feasibility of siting OCS onshore facilities on its coast. However, as the State's coastline is approximately 150 miles (242 km) from the nearest leased tract on Georges Bank, such a facility would only be developed during development or production phases of drilling, assuming a significant commercial find were made. No onshore facilities will be located in New Hampshire to support exploratory drilling efforts because of the availability of closer sites in Rhode Island and Massachusetts.

New Hampshire is in the process of developing a formal coastal zone management program. Because legislation for this program has not been enacted yet, State CZM consistency review of exploration plans submitted for leased tracts in the Sale 42 area has not been performed. However, as an affected State for North Atlantic activities, New Hampshire has been afforded an opportunity to submit comments on the exploration plans to the USGS.

The State supported Lease Sale 42. New Hampshire's fishery is smaller than those of the other North Atlantic States (less than 1

percent of total landings for the seven-State area) and will not be affected by drilling operations on Georges Bank (BLM, 1977).

MAINE

The State of Maine's position on Lease Sale 42 was that the sale should be conducted only when all possible steps have been taken to ensure that oil and gas development would not harm the fisheries on Georges Bank (Colgan, 1979). The State has been actively involved in the leasing process to include these provisions as part of the lease sale requirements.

Maine has the second largest fishery, behind Massachusetts, in the North Atlantic Region. The fishery is a valuable economic resource for the State, whose economy has been depressed for at least a decade. However, only a fraction of the total catch landed at the State's ports is harvested from Georges Bank (Olsen and others, 1977). Maine fishermen primarily work close to shore, using small vessels or boats. Larger vessels fish farther offshore, but only 5 percent of their catch comes from Georges Bank, as most of their fishing is done in the Gulf of Maine and the smaller banks northeast of Georges Bank (Olsen and others, 1977). However, Maine contends that a large oil spill on Georges Bank could create a significant negative impact for the State because it would force Maine fishermen to fish State waters more actively, affecting in turn the State's regulation of its fisheries (Nautilus Press Inc., 1981). The State's Board of Environmental Protection addressed this issue and other potential impacts from OCS oil and gas operations in its review of the exploration plans from Exxon, Mobil, Getty, and Shell for drilling on Georges Bank. Following the review, the Board granted CZM consistency concurrence for the four plans during June 1981.

Maine has no onshore support facilities planned for OCS exploratory activities because of the availability of closer sites in southeastern New England. If multiple support bases were required in New England during development and production phases of drilling, Portland, Maine, would be a prime candidate for such a base (Colgan, 1981, oral commun.). Portland is already a large oil import harbor and has a marine terminal for an oil pipeline

to Canada. The State has recently completed a design for an oil spill debris-storage facility in Portland. Oil spill impact studies have also been conducted for Casco Bay and the southern coastline of Maine (fig. 5). Appendix D provides a description of these studies and their availability.

CONCLUSION

Although exploratory drilling has just begun in the North Atlantic, leasing activities in the region have covered a relatively long time period. This was due, in part, to court-ordered delays as a result of legal actions taken against Lease Sale 42. Twenty-three months elapsed between the originally-scheduled sale date for Lease Sale 42, during January 1978, and the actual sale date of December 18, 1979. The litigation continued for over a year after the lease sale before a final settlement was reached among the disputing parties.

Several results of the litigation surrounding Lease Sale 42 have relevance to leasing activities in other OCS Regions, especially frontier areas. These developments are highlighted in this section to show that measures can be taken to resolve conflicts concerning management of multiple-use resources.

One of the provisions made in the final settlement requires Federal Government agencies to provide all parties with information on studies being conducted in the North Atlantic Region. This requirement extends an effort on the part of the Federal Government to provide as much information for review as possible subject to Freedom of Information limitations on States and other parties. The summary report supplements this information need by providing State and local planners with summary data on leasing activities and the onshore impacts of OCS development.

In response to concerns raised during the lawsuit, a Biological Task Force (BTF) was created to monitor drilling activities in the North Atlantic. The BTF (table 6) has recommended that a sampling program be established in the vicinity of drilling rigs operating on Georges Bank to determine the effects of drilling mud discharges on marine communities. This program has been implemented

**TABLE 6.—North Atlantic
Biological Task Force**

Member	Affiliation
Mr. Piet deWitt, Chairman	Bureau of Land Management
Mr. William Beller	Environmental Protection Agency
Mr. James Mikolaities	Fish and Wildlife Service
Mr. Allen Peterson	National Marine Fisheries Service
Mr. Barry Clark	U.S. Geological Survey

For further information concerning the North Atlantic Biological Task Force, contact Piet deWitt, Bureau of Land Management, Branch of Offshore Studies, 18th and C Streets, NW., Washington, D.C. 20240 (telephone: (202) 343-7744).

through a joint memorandum of understanding between the U.S. Geological Survey and the Bureau of Land Management. The USGS provided \$200,000 for the first year of the program's operation to cover primarily the required field work. A minimum of four sampling cruises will be conducted between July 1, 1981, and August 31, 1982, to obtain field measurements and biological samples. This data will then be compared with control data to determine any changes in the ecosystem resulting from drilling mud discharges. Collecting data on the effects of drilling muds is especially important during exploration so that these impacts can be mitigated, if necessary, during the later development and production phases of drilling.

In the final court settlement, the Federal Government agreed to require Best Available and Safest Technology (BAST) standards to the extent that they are not already in existence or required by the OCS Lands Act. The OCS Lands Act Amendments of 1978 include BAST standards as part of the safety regulations required for OCS drilling operations. The regulations will be enforced in the North Atlantic Region by the Secretary of the Interior and the Commandant of the U.S. Coast Guard (BLM, 1979).

The OCS Lands Act Amendments of 1978 also include several other provisions that provide protection of the Georges Bank fisheries. These include, among others, the following measures:

- establishment of a Fishermen's Contingency Fund to provide compensation for damages to fishing gear as a result of oil and gas activities;
- authorization for the Secretary of the Interior to suspend or prohibit drilling operations that threaten marine life;
- authorization for the Secretary of the Interior to cancel any lease or permit if continued activity causes harm to marine life;
- a requirement that other uses of the sea, including fisheries, are considered by the Secretary of the Interior when determining the timing and location of leasing activities;
- a requirement that the Secretary of the Interior should disapprove any development and production plan that, when implemented, could cause harm to marine life (BLM, 1979).

Enactment of the OCS Lands Act Amendments in 1978 was a turning point in the lawsuit against Lease Sale 42 because of the mitigating measures included in the amendments. The same provisions are applicable to other areas where fishing operations must co-exist with oil and gas exploration and development activities (figs. 9 and 10).

Finally, as part of the final court settlement, the Department of the Interior agreed to prepare a development and production phase environmental impact statement (EIS) after receipt of a development and production plan. This requirement allows consideration of



FIGURE 9.—Fishing boats at Galilee, Rhode Island. (Photo by Richard Dorrier, Rogers, Golden & Halpern, 1981.)

the more extensive operations normally associated with development and production activities. Also, since exploration activities reveal considerable information about the effects of drilling in frontier areas, this information can be used to develop mitigating measures as part of the development and production phase EIS. The requirement for a development and production phase EIS is also in effect for other frontier areas (Lower Cook Inlet in Alaska, for example). It has particular relevance to areas where unique resources are

present that require different protective measures during each stage of OCS oil and gas operations.

For additional help in planning for coastal effects associated with OCS oil and gas development, limited technical assistance is available. All requests for technical assistance will be evaluated and approved on a case-by-case basis, and inquiries should be directed to the OCSI office at the address shown in the front of this publication.



FIGURE 10.--The Ocean Victory being towed up Narragansett Bay to Davisville, Rhode Island, after completing drilling operations in the Mid-Atlantic. (Photo by Richard Dorrier, Rogers, Golden, & Halpern, 1981.)

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Appendix A. The Geologic Setting

PETROLEUM GEOLOGY

Hydrocarbons are formed within the upper part of the earth's crust. Through heat and pressure, accumulations of organic matter are transformed into various mixtures of crude oil and natural gas. The time between deposition of organic material and the formation of hydrocarbons is on the order of millions of years (Tissot and Welte, 1978, p. 198).

The occurrence of hydrocarbon accumulations depends on many factors (Miller and others, 1975, p. 17):

- an adequate thickness of sedimentary rocks;
- the presence of source beds (rocks containing large amounts of organic matter);
- a suitable environment for maturation of the organic matter into oil and/or gas;
- the presence of porous and permeable reservoir rocks;
- hydrodynamic conditions permitting the migration of hydrocarbons and their ultimate entrapment in reservoir rocks;
- a thermal history of the area that favors production and preservation of hydrocarbons;
- formation of adequate geologic traps for accumulation of the hydrocarbons; and

- suitable timing of petroleum generation and migration to ensure the entrapment and preservation of the hydrocarbons.

In a prospective hydrocarbon province, geologists look for structural or stratigraphic traps in which oil and gas can accumulate. Structural traps include anticlines, sediments draped over salt diapirs and other dome-like intrusions, and fault traps. Examples of stratigraphic traps are reefs and the edges of porous strata truncated by impermeable strata. Traps may also be formed by a combination of structural and stratigraphic elements.

THE NORTH ATLANTIC OUTER CONTINENTAL SHELF

Underlying the North Atlantic Outer Continental Shelf (OCS) is a broad structural depression of sedimentary rocks termed the Georges Bank Basin. This is one of several deep sedimentary basins beneath the Atlantic Outer Continental Shelf off the United States and Canada. It encompasses an area of about 40,550 square miles (65,300 km²) underlying the topographic features of Georges Bank, the Great South Channel, Nantucket Shoals, and part of the Continental Slope (Schlee and others, 1975). Structurally, Georges Bank Basin is bounded to the northeast by the Yarmouth Arch and to the southwest by the Long Island Platform. This latter feature is a structural high that separates the basin from the Baltimore Canyon Trough off the Mid-Atlantic States. Figure 11 shows these structural features and the locations of the two sedimentary basins on the Atlantic OCS.

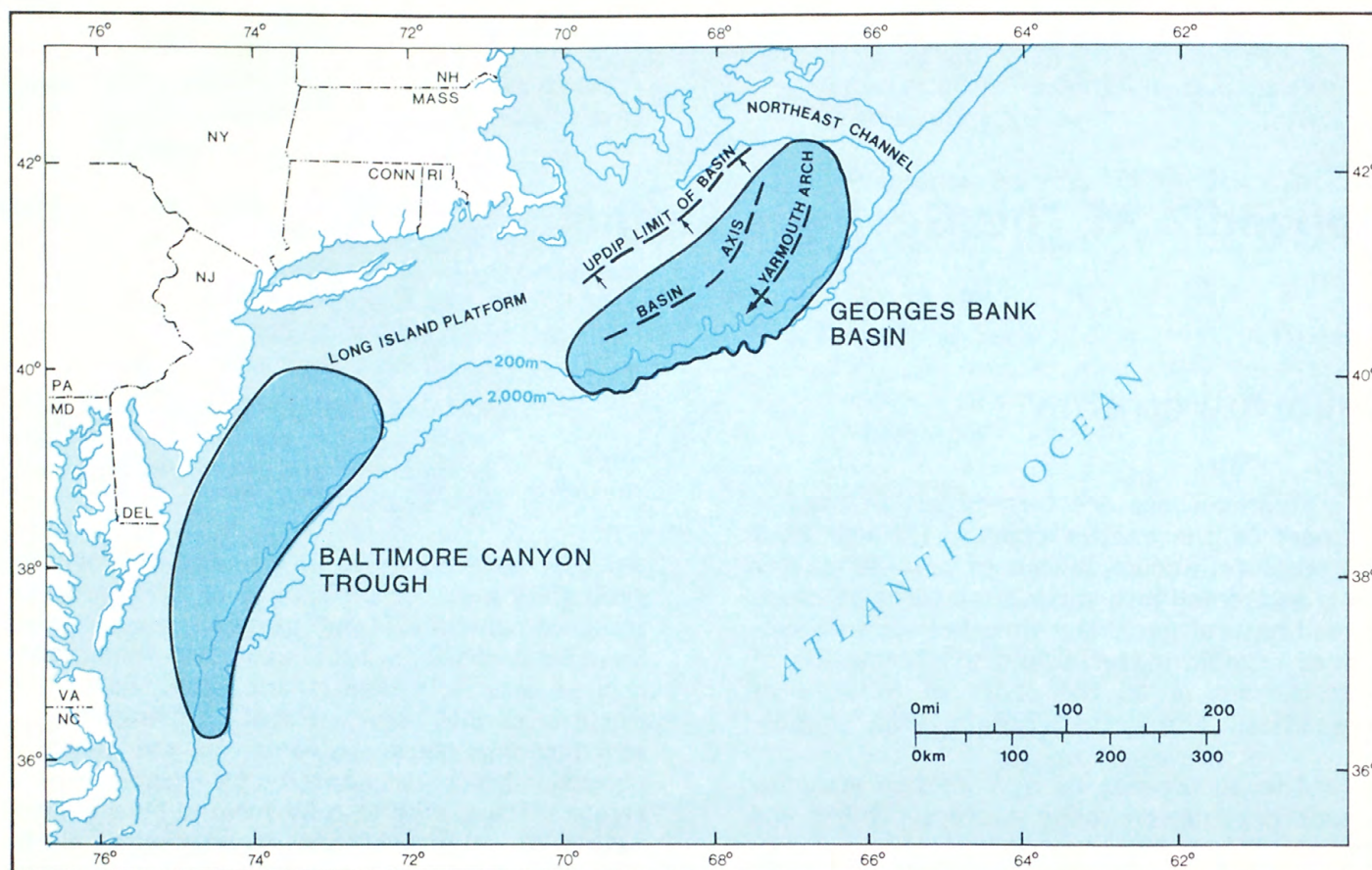


FIGURE 11.—Georges Bank Basin and Baltimore Canyon Trough. (Adapted from BLM, 1977, by Rogers, Golden & Halpern, 1981.)

A significant amount of geological and geophysical data has been collected for the Georges Bank Basin. These include seismic reflection data, magnetic profiles, gravity data, and well data from two Continental Offshore Stratigraphic Test (COST) wells. The two COST wells provide the most useful data for evaluating the petroleum potential of the basin. These wells, G-1 and G-2, drilled in 1976 and 1977, respectively, provided stratigraphic information for oil companies and the U.S. Geological Survey before Lease Sale 42 was held. COST well G-1 is located to the west of the leased tracts, and COST well G-2 is located 42 miles (68 km) east of G-1, near the center of the lease sale area (shown in figure 4 in chapter 2).

Analyses of geophysical data indicate that up to 33,000 feet (10,058 m) of sedi-

mentary rocks are present in the Georges Bank Basin (Schlee and others, 1979). These rocks were deposited during two stages, as described by Schlee and others (1979). First, during Triassic and early Jurassic time, sedimentation occurred as a result of active faulting in the area and was centered in rapidly subsiding grabens. Then, during Jurassic and younger time periods in which marine conditions prevailed, sedimentation occurred over the entire basin but at a slower rate. A carbonate platform predominately of Jurassic Age was created along the southern side of the basin during this second phase of sedimentation. During Early Cretaceous time shoreward of this platform, Early Cretaceous clastic sediments were deposited under deep sea and shelf conditions. Later in the Cretaceous and during the Tertiary and Quaternary periods, sedimentation was irregular because of the

changes in relative sea level, resulting in broad unconformities within the depositional sequence.

Figure 12 shows a cross-section of the sedimentary rocks present in the Georges Bank Basin. A distinguishing feature of the basin is the thickness of the Jurassic section. Well data from the COST wells revealed that the thickness of Jurassic strata range from 10,000 feet (3,048 m) to 16,000 feet (4,877 m) increasing seaward. The Jurassic rocks appear to have the best petroleum potential because favorable conditions for generating and trapping hydrocarbons occur in these beds (Amato and Simonis, 1980). Oil- and gas-prone source rocks that are thermally mature enough to produce hydrocarbons were interpreted to be present in the COST G-2 well below approximately 14,000 feet (4,267 m) (Smith, 1980). These source rocks could provide hydrocarbons to traps near the well and possibly to traps in the shallower parts of the basin by lateral migration.

Data from the COST G-1 well indicate that the organically richest rocks occurred in lower Cretaceous and upper Jurassic strata between 4,600 and 6,200 feet (1,402 - 1,890 m) (Smith and Shaw, 1980). However, these rocks are thermally immature, and the deeper, more mature Jurassic rocks do not have a high organic content. The petroleum potential in the vicinity of this well is therefore not as high as in the deeper parts of the basin, as

indicated by the G-2 well, where moderately organic-rich beds exist at sufficient depths and thermal gradients to allow hydrocarbon generation (Amato and Bebout, 1980).

In the vicinity of the COST wells, the best reservoir rock is restricted to sandstones above 10,000 feet (3,048 m) (Amato and Simonis, 1980). However, elsewhere the deeper rock overlying structural highs and included in reef structures may exhibit the best reservoir characteristics.

Potential traps in the Georges Bank Basin include possible patch reefs and barrier reefs, possible salt pillow structures, draping of sediments over basement highs, and various types of stratigraphic traps, such as lateral changes of porous to non-porous rocks, and pinchouts of porous beds.

Evidence of a possible carbonate bank or reef trend was found under the Continental Slope on seismic data collected by the U.S. Geological Survey (Schlee and Grow, 1980). This structure is thought to be a former shelf edge with the potential for providing either stratigraphic or structural traps for petroleum deposits. Upcoming lease sales in the Mid-Atlantic and North Atlantic (Lease Sales 59 and 52, respectively) will offer tracts coincident with the structure for exploratory drilling. Only actual drilling results can confirm the presence of hydrocarbons that may be trapped in the possible reef structure.

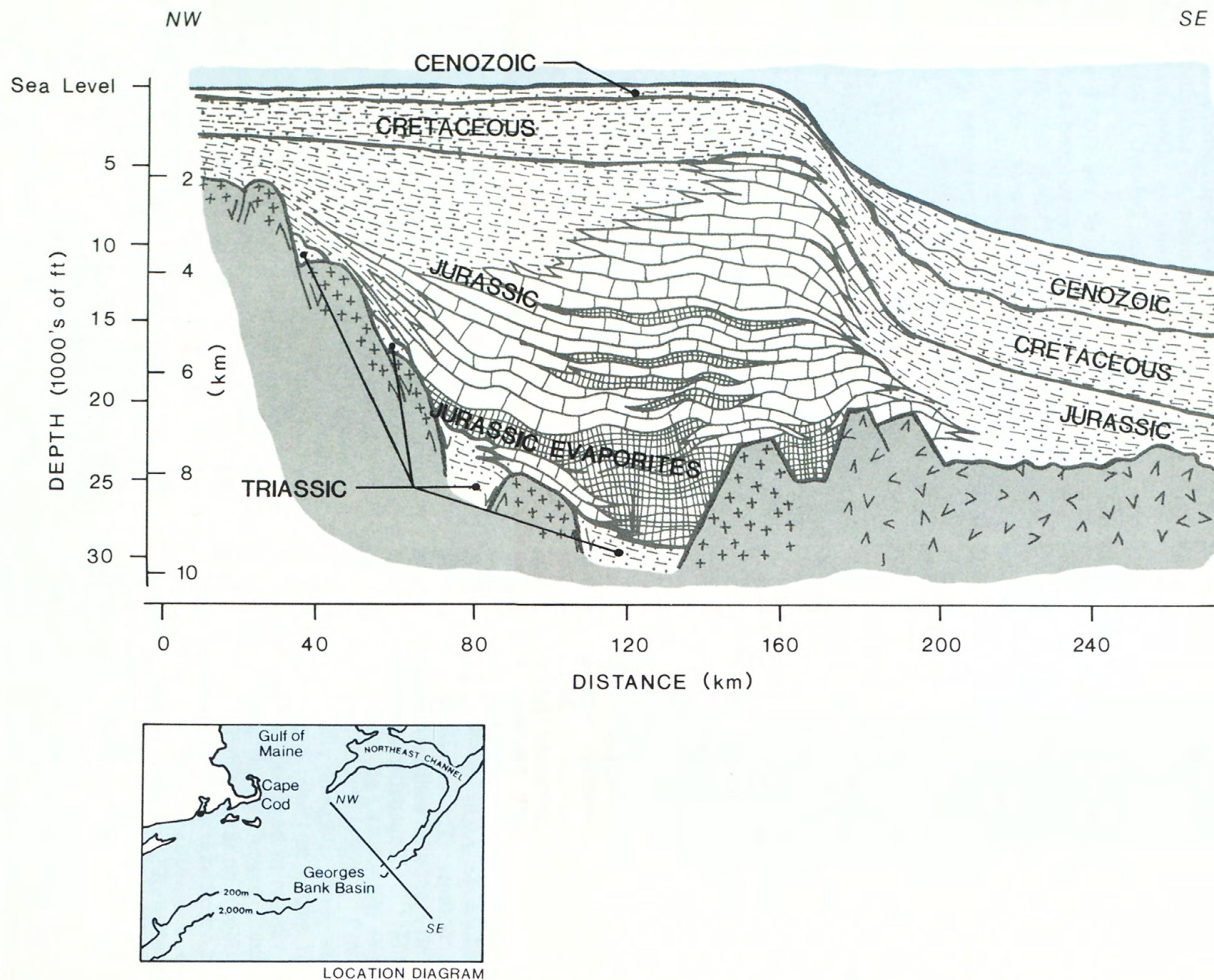


FIGURE 12.—Geologic cross section of Georges Bank Basin. (Redrafted from Edgar, 1981, by Rogers, Golden & Halpern, 1981.)

Appendix B. Estimating Oil and Gas Resources

Before exploratory drilling, both the Federal Government and industry undertake analyses of geological basins to determine their oil and gas potential. The Government uses different methods of analysis, depending on the purpose of the estimate and the availability and level of detail of the data. The data base for resource estimation is regularly updated with new geologic and geophysical information, and as more data for a given area are gathered, processed, analyzed, and interpreted, the resource estimate is updated to reflect them.

Prior to a lease sale, the process of estimating the amount of oil and gas in a potential reservoir or a lease sale area involves a high degree of uncertainty. The U.S. Geological Survey makes these pre-lease-sale estimates for a variety of purposes. Regionwide estimates are used to aid in the preparation of proposed lease sale schedules. More specific resource estimates are made for the lands tentatively selected to be offered for lease. Later estimates are made on a tract-by-tract basis to establish an economic value for each tract offered. However, it should be reemphasized that estimates of undiscovered resources are extremely uncertain. The existence of resources cannot be confirmed until an area has been thoroughly explored by drilling.

REGIONWIDE RESOURCE ESTIMATES

In the early stages of exploration, when only broad interpretations of regional geology are possible, it is necessary to use expert judgment based on these minimal amounts of data to make resource estimates. As more data become available, the resource estimates

and the methods used become more refined. When data are abundant and detailed, the choice of method used depends on the purpose of the resource estimate. The quality of the estimate, however, depends on the quality of the geologic and geophysical data and other studies upon which it is based.

A number of estimation techniques are available for making regionwide or basin resource estimates. For an area that has not been extensively drilled, the most useful group of techniques may be classified as the **volumetric-yield methods**. In these methods, the volume of potentially hydrocarbon-producing rocks is calculated, and a yield of oil and/or gas based on known yields from geologically analogous basins or regions is derived. Other methods, more useful in regions that have experienced extensive exploratory drilling, are **performance** or **behavioristic extrapolation methods**. In these, various indices of past performance such as discovery rates, cumulative production, and productive capacity are fitted by various mathematical derivations into logistic or growth curves that are then projected into the future. In addition to these, more sophisticated methods involving geological, engineering, and statistical models may be used (Miller and others, 1975, p. 18).

TRACT-SPECIFIC RESOURCE ESTIMATES

Each tract selected for leasing for exploration and development of oil and gas resources must be evaluated prior to the lease sale. After the lease sale, resource estimates are periodically updated.

Resource evaluations of tracts consist of three parts: a geophysical and geological evaluation of potentially recoverable resources of possible hydrocarbon-bearing structures and stratigraphic traps underlying the tract; an assessment of the risk that, for whatever reason, hydrocarbons are not present in the quantities foreseen by the geologic evaluation; and an engineering and economic evaluation of those resources, taking the assessed risk into account.

Data used for resource estimation are seismic records, well data, other geologic data, and production histories from wells and fields in or near the lease sale area. In the case of frontier areas, the drilling and production histories of geologically analogous petroleum-producing basins and fields are substituted. Once an area has been leased and exploratory drilling has commenced, the result of drilling may allow updating of resource estimates. Changes in exploratory drilling and production techniques and costs may also necessitate reevaluation.

The tract-specific resource estimates are derived by using a **Monte Carlo-type computer program**. In this program, geologic, engineering, and economic information is used to calculate recoverable resources and an economic value of the resources for each tract. Some parameters, such as tract size, are entered as fixed values. Others, such as pay thickness and production rates, are given a range of values. Each variable is assigned a range and distribution of possible values. The program then randomly selects values for each variable from the specified distribution and combines them with the fixed parameters to calculate a resource estimate and economic value. The process is run many times, resulting in the determination of a mean resource estimate and economic value.

A **risk factor** is used to discount the mean resource estimate. The risk factor represents the probability that hydrocarbons may not be present in the quantities calculated by the geologic evaluation. The risk factor is a subjective appraisal by a geologist, geophysicist, and engineer based on the data available to them. It is determined through a knowledge of an area's (or an analogous area's) exploration history, together with an assessment of how strongly the data indicate the presence of a trap, of source rocks, and of other elements that make a good prospect.

RESERVE ESTIMATES

Reserves are the portion of identified resources that can be economically extracted (Miller and others, 1975, p.8). The techniques available for estimating reserves are similar to those used in making resource estimates, only in the case of reserves, they are more refined and are based on more information.

In **volumetric estimation** of reserves, the bulk volume of a reservoir can be calculated from interpretation of seismic data and information gained by drilling. Porosity and permeability of the rock and the relative amounts of oil, gas, and water in its pore spaces can be interpreted from borehole logs and analyses of cores.

For reservoirs in which some production has taken place, the **decline-curve method** may also be used. In this method, future production is estimated by extrapolating plots of actual production rates and fluid percentages into the future. By adding past production to predicted future production, an estimate of original reserves can be obtained (Bird, 1980, p. 3-4).

Appendix C. Intergovernmental Planning Program

The Intergovernmental Planning Program (IPP) for OCS Oil and Gas Leasing, Transportation, and Related Facilities was implemented to provide a formal coordination and planning mechanism for three major OCS program elements administered by the Bureau of Land Management (BLM). These elements are pre-lease-sale activities, the environmental studies program, and transportation planning. The transportation planning element was discussed in chapter 3. The other two elements will be addressed in this appendix.

In each of the six OCS leasing regions, a Regional Technical Working Group (RTWG) Committee is established and, if a commercial discovery of oil or gas is made, a State Technical Working Group subcommittee may be formed. One of three types of committees comprising the National OCS Advisory Board, the RTWG Committee is the nucleus of the IPP.

The National OCS Advisory Board provides advice to the Secretary of the Interior and to other offices in the Department of the Interior in the performance of discretionary functions of the OCS Lands Act, as amended (43 U.S.C. 1331 et. seq.), including all aspects of leasing, exploration, development, and production of the resources on the Outer Continental Shelf. The organization of the National OCS Advisory Board and its reporting structure are presented in figure 13.

Through the accumulation and evaluation of information, the RTWG provides guidance to the Bureau of Land Management and information to other bureaus within the Department of the Interior. Each RTWG is composed of representatives of the participating States, the Bureau of Land Management, the Fish and Wildlife Service, the U.S. Coast Guard, the U.S. Geological Survey, the Environmental Protection Agency, the National Oceanic and Atmospheric Administration, the petroleum industry, and other special and private inter-

ests, including private citizens, within a leasing region. Each RTWG is co-chaired by a State representative, who is elected by all the State representatives of the group, and by the BLM representative. The State representative's term of service as cochairperson is determined by all the State representatives of the group.

PRE-LEASE-SALE ACTIVITIES

The leasing of OCS lands sets in motion a process that can affect interests at local, State, regional, and national levels. Many decisions are made in this process that determine the manner in which development will take place. The IPP has been divided into four phases, which are discussed in this section and are shown in figure 14.

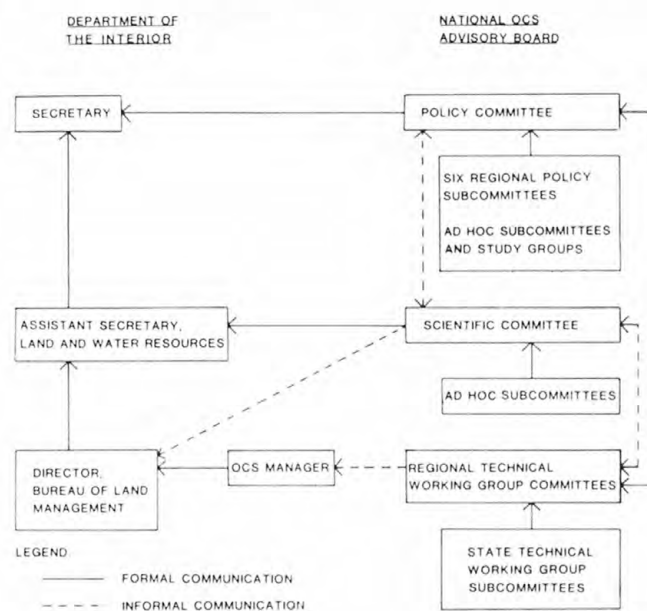
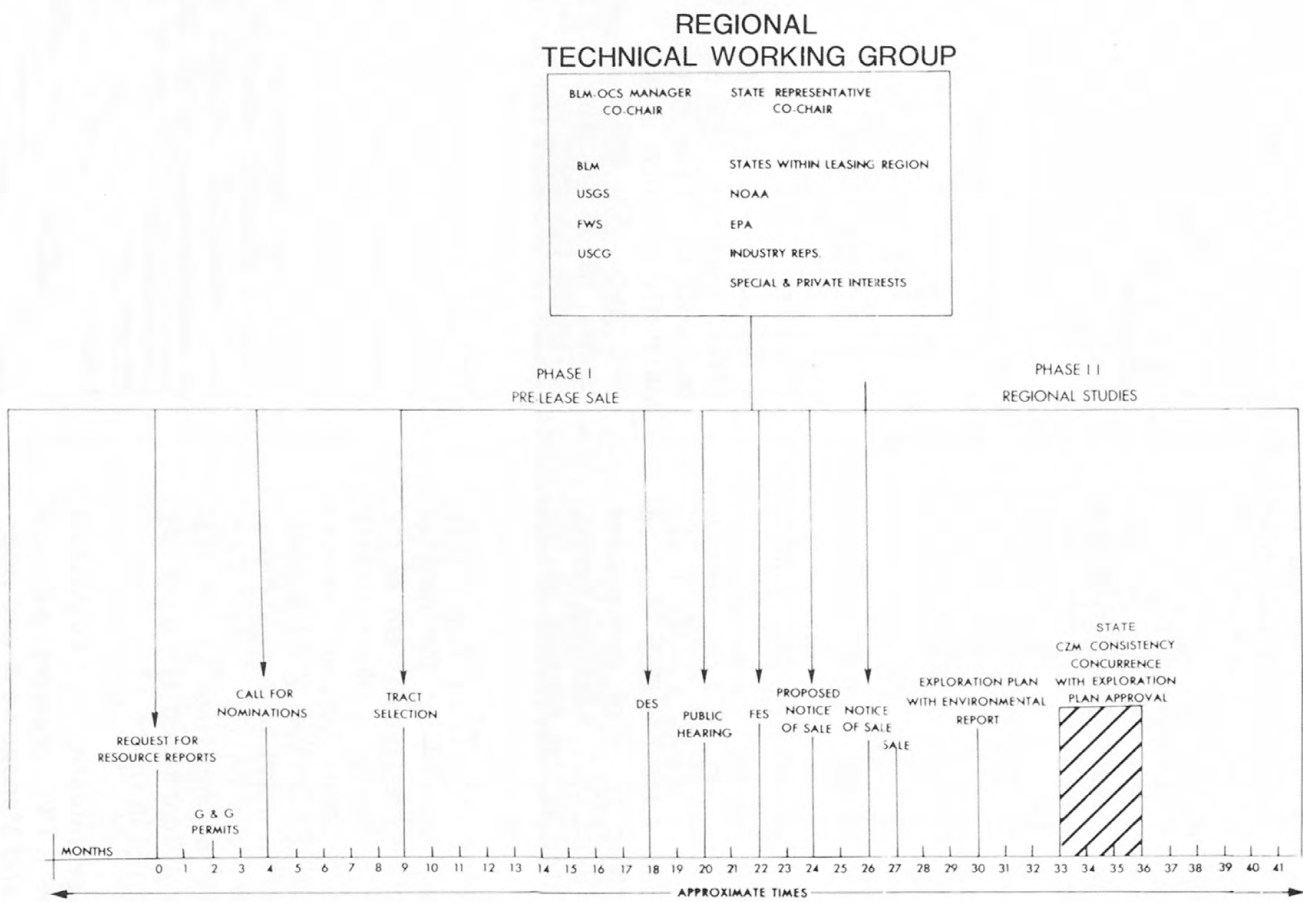


FIGURE 13.—Organization and reporting structure of the National OCS Advisory Board. (Adapted from Aronson, 1979, by Rogers, Golden & Halpern, 1981.)



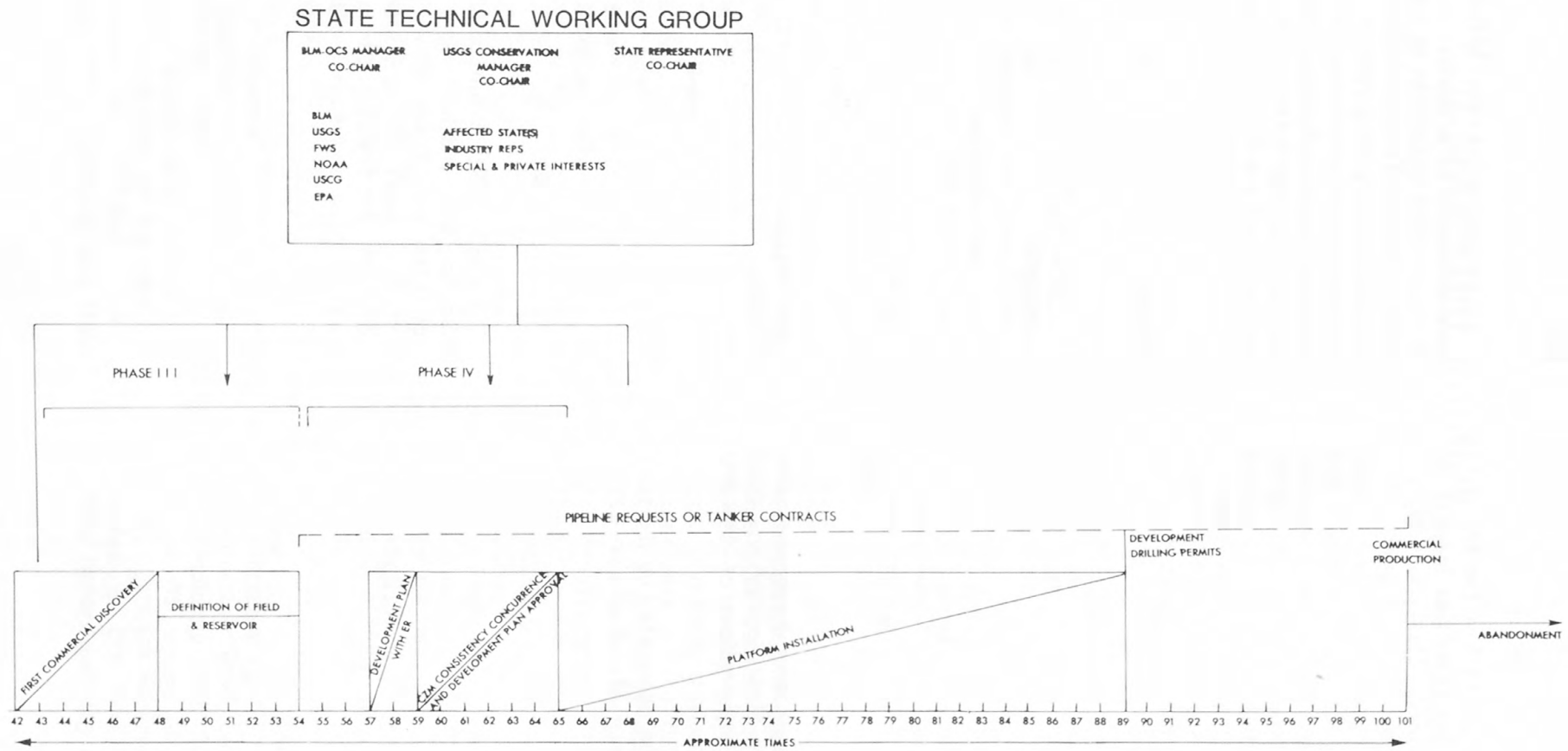


FIGURE 14.—Relationship of the IPP to the BLM's OCS program. (Adapted from Rodgers, 1979, by Rogers, Golden & Halpern, 1981.)

Phase I

The objective of phase I of the IPP is to assist in coordinating all activities leading up to a lease sale decision. This phase begins prior to the call for nominations and terminates with the lease sale decision. Most activities in phase I concern the exchange and assessment of information. Inventory and analysis of information related to the later preparation of regional studies plans and transportation management plans are also a part of this phase. Phase I can extend about 2 years, and it is completed by the time of a lease sale decision.

Phase II

Phase II of the IPP is formally implemented with the publication of the proposed notice of sale in the Federal Register. During this phase, each RTWG recommends site-specific and generic studies that should be included in a regional studies plan to be prepared during phase III. Other Federal, State, or local agencies may also identify and fund OCS-related studies independent of the IPP leasing process.

Phase II should be completed by the time a commercial discovery of oil and/or gas is made.

Phase III

Phase III of the IPP begins with the announcement of a discovery of hydrocarbons in marketable quantities in the region. At this time, a State Technical Working Group subcommittee may be formed to refine potential transportation corridors. The State Technical Working Group includes all Federal and private members of the RTWG as well as the representatives of the affected States.

Phase IV

During Phase IV of the IPP, a regional transportation management plan is developed. Phase IV begins as soon as transportation studies are completed and should either precede or coincide with the first development plan.

The IPP is a long-range planning effort. While its actual timing varies from region to region, the estimated minimum time for completion of the four phases of the process is approximately 4-1/2 to 5 years. However, the process could conceivably take as long as 9 years.

Appendix D. OCS-Related Studies

FEDERAL STUDIES

U.S. Department of the Interior:

Bureau of Land Management

The Bureau of Land Management (BLM) of the U.S. Department of the Interior (DOI) conducts an Environmental Studies Program. The BLM New York OCS Office administers studies approved by the BLM Washington Office for the North Atlantic Region. A number of studies have already been completed for the North Atlantic, and additional studies are planned for fiscal year 1982. Some of the studies were conducted by other agencies within the Department of the Interior as a part of the BLM's Environmental Studies Program. Completed studies may be reviewed at the New York OCS Office, Bureau of Land Management, Jacob K. Javits Federal Building, Suite 32-120, 26 Federal Plaza, New York, N.Y., or at the Offshore Studies Office of the Bureau of Land Management, 18th and C Streets, NW, Washington, D.C.

Bureau of Land Management, 1977, Proposed 1977 Outer Continental Shelf oil and gas lease sale offshore the North Atlantic States OCS Sale No. 42: final environmental statement: New York, N.Y., 5 vols. Available for review at the New York OCS Office.

This environmental impact statement is an analysis of 178 tracts of submerged lands in scattered sections of the Georges Bank basin, 50 to 170 miles (80 - 160 km) southeast of Nantucket Island, Massachusetts. Volume 1 describes the lease sale proposal and the

environment of the area. Volume 2 discusses potential environmental impacts. Volume 3 discusses mitigating measures, unavoidable adverse environmental impacts, and alternatives to the proposed action. Volume 4 includes appendixes, and volume 5 contains the graphics for the document.

Bureau of Land Management, 1979, Proposed 1979 Outer Continental Shelf oil and gas lease sale offshore the North Atlantic States OCS Sale No. 42: final supplemental environmental statement: New York, N.Y. Available for review at the New York OCS Office.

The purpose of this final supplemental environmental impact statement is to reflect the recent amendments to the OCS Lands Act promulgated subsequent to the preparation of the final environmental statement, and to address comments on the EIS by the reviewing court in prior proceedings concerning the Georges Bank sale proposal. In addition to evaluating the impacts anticipated from the sale, the supplement includes a discussion of the possibility of designating Georges Bank and other areas of New England as marine sanctuaries. Also contained is a discussion of the new authorities vested in the Secretary of the Interior as a result of the enactment of the OCS Lands Act Amendments of 1978.

Centaur Associates, Inc., An assessment of the space and use conflicts on the U.S. Outer Continental Shelf between the oil and gas industry and commercial recreational fishermen (draft): Washington, D.C. Interim reports are available for review in the New York OCS Office. Final report due May 1981.

This study examines port and harbor conflicts between offshore oil and gas operations and the commercial and recreational fishing industries. In addition, a quantitative analysis will be used to determine competition for labor and other inputs between the two industries. The study covers Northern California, Southern California, North Atlantic, Mid-Atlantic, South Atlantic, and Gulf of Mexico regions. Interim reports are available for review in the New York OCS Office.

E. G. & G. (Edgerton, Germeshausen and Grier) and Raytheon, 1980, *New England Outer Continental Shelf physical oceanography: Waltham, Mass., and Portsmouth, R.I. Quarterly reports are available for review in the New York OCS Office.*

The objective of this study is to identify and quantify the physical processes involved in the transport and dispersion of suspended or dissolved materials, so that the resulting information could be used in predictive models. Two years of field surveys were conducted. The first year surveyed the Georges Bank, developed working hypotheses of circulation patterns, and identified geographic areas that are possibly important in pollutant transport. The second year was a continuation of the first year and also refined data acquisition. The 13 quarterly reports are data compilations.

Lamont-Doherty Geological Observatory, 1980, *Epifaunal zonation and community structure in three North and Mid-Atlantic canyons: Palisades, N.Y. Final report of first phase of study available for review at New York OCS Office; National Technical Information Service number not yet assigned.*

This literature and specimen review and field effort provides information about the distribution and abundance of coral assemblages and epibenthic crustacean communities (lobster, crab, shrimp) within the slope and can-

yons of the North and Mid-Atlantic hydrocarbon development provinces. The study involves the analysis of photographic records from previous submersible dives and camera tows within canyon areas of interest and analysis of available samples from canyons held in institutional archives and from field surveys of Baltimore, Oceanographer, and Lydonia Canyons.

Lamont-Doherty Geological Observatory, *Study of physical and biological processes of canyons and the Continental Shelf in the North and Mid-Atlantic Outer Continental Shelf (draft): Palisades, N.Y. Final report due August 1983.*

This study examines the oceanographic processes of the Lydonia and Baltimore Canyons and nearby slopes in order to determine what their role might be in transmitting drilling pollutants to animal life on the ocean bottom.

Naval Ocean Systems Center, *The effects of sound on marine mammals (draft): San Diego, Calif. Interim reports available for review in the New York OCS Office. Final report due October 1981.*

The Naval Ocean Systems Center will conduct field studies in areas off the Alaska, California, Gulf of Mexico, and Atlantic coasts. The objectives of the studies are as follows: (1) to determine and characterize the various sounds emitted from OCS oil and gas operations (exploration, development, and production) and from related vessel traffic; (2) to characterize the sounds emitted and perceived by various species of cetaceans; (3) to evaluate the sound spectra created by human activities that could disrupt the behavior of cetaceans; (4) to determine the effects of a physical structure, such as a platform, on cetacean behavior; and (5) to propose a range of measures for eliminating or alleviating the impact(s) of sounds and physical structures from offshore oil and gas operations on cetaceans.

New England Natural Resources Center, 1975, Georges Bank Conference: marine environmental assessment needs on the Georges Bank related to petroleum exploration and development: Boston, Mass. Available for review at the New York OCS Office.

The report is the proceedings from the Georges Bank conference, which identified the marine environmental assessment needs related to petroleum exploration and development within the potential North Atlantic Outer Continental Shelf lease sale area. Proceedings of the meeting include identification of areas where information is needed, recommendations of sampling methods, prioritization of study needs, and suggestions for future programs.

Reinfeld, Kenneth D., and Callahan, Francis F., 1976, Economic study of the possible impacts of a Georges Bank sale: New York, N.Y., New York OCS Office Technical Paper no. 2. Available from the New York OCS Office.

This technical paper identifies the possible onshore economic and air or water quality impacts that leasing of the Georges Bank Outer Continental Shelf (Sale No. 42) could have on the New England coastal region. A multi-regional, multi-industry forecasting model (Harris' economic model) is used to characterize the existing economic structure of the region and to trace the impacts of offshore oil and gas leasing on the economy of the region.

Research Institute of the Gulf of Maine (TRIGOM), 1974, A socio-economic and environmental inventory of the North Atlantic Region from Sandy Hook, New Jersey, to the Bay of Fundy: South Portland, Maine. Out-of-print; review copy available at the New York OCS Office.

This study is a compilation of literature pertaining to the North Atlantic Region, between New Jersey and

Canada. Specific topics include the following: environmental issues; geological, physical, and chemical oceanography; meteorology; hydrology; systems ecology (phytoplankton, zooplankton, benthic invertebrates, macrophytes, fishes, birds, mammals); unique and endangered environments; environmental quality; and socio-economic topics including demography, recreation, transportation, fisheries, and canal and water use.

U.S. Geological Survey, 1981, Assessment of geohazards and geotechnical properties (draft): Woods Hole, Mass. Available for review in the New York OCS Office.

This study has the following objectives: (1) to estimate the extent and rate of sediment mobility over the seabed; (2) to identify major processes causing sediment movement; (3) to identify and study the effects of sediment instability in offshore lease areas; (4) to identify, date, and map areas of slumping and potential slump hazards in Lease Sale 49, 52, and 59 areas, and further offshore in future sale areas; (5) to determine the magnitude and potential of geologic hazards in Sale 59 and 52 lease areas; (6) to assess the geotechnical properties of sediments in Sale 49, 52, and 59 lease areas; (7) to obtain field measurements to document shelf-slope-canyon exchange processes; and (8) to define sub-bottom stratigraphy and potential geologic hazards for the near-shore environment in the Mid-Atlantic.

U.S. Geological Survey, 1980, Geological studies in the North Atlantic Region--first and second year: Woods Hole, Mass. Available from National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, VA 22161. Executive summary (Order No. PB80177520); report (Order No. PB80177512).

The U.S. Geological Survey conducted field studies in the North Atlantic (Georges Bank) from October

1976 to October 1978. The first-year study consisted of six major parts: (1) evaluation of transport of sediment over the sea bed; (2) determination of the concentration, distribution, and flux of suspended particulate matter in the water column across Georges Bank; (3) determination of the vertical distribution of selected trace metals (copper, chromium, and zinc) in sediments; (4) assessment of the texture and composition of sediments on Georges Bank; (5) identification of geologic hazards to oil and gas development; and (6) provision of preliminary physical oceanographic information. The second year emphasized the slope areas off Georges Bank.

University of Guelph, Study of the effects of oil on marine mammals (draft): Ontario, Canada. Interim reports are available for review in the New York OCS Office. Final report due March 1982.

This study has five objectives: (1) to determine the ability of cetaceans to detect and avoid an oil slick; (2) to determine the effects of oil on cetaceans; (3) to evaluate the long-term impacts of oil on cetacean survival and behavior; (4) to analyze the potential for bioaccumulation of petroleum hydrocarbons and metabolites in cetaceans; and (5) to identify a range of measures which would eliminate or alleviate the effects of oil pollution on marine mammals.

University of Rhode Island, Marine mammal and marine turtle characterization in the North Atlantic and Mid-Atlantic areas (draft): Providence, R.I. Quarterly reports are available for review in the New York OCS Office.

This study consists of five major parts: (1) determination of which species inhabit or migrate through the North and Mid-Atlantic Regions; (2) identification of and description of areas of importance (feeding, breeding, calving, etc.); (3) determination of temporal and spatial distribution and behavioral characteristics; (4) estimation of population size and extent; and (5) emphasis on those species classified as threatened or endangered for all of the preceding items.

University of Rhode Island, Study of the economic cost from oil spills to commercial fishing (North Atlantic OCS area) (draft): Narragansett, R.I. Final report due September 1982.

This study concerns the impacts of oil spills on commercial fishing in the North Atlantic OCS area. A mathematical model system incorporating a fishery model, an oil spill fates model, and an ocean transport model will be used to quantify the potential impacts. The objectives of this study are as follows: (1) to quantify the impacts of oil spills on selected candidate fish populations in the North Atlantic; (2) to evaluate the subsequent economic loss from oil spills; and (3) to evaluate the precision and sensitivity of the prediction method.

Woods Hole Oceanographic Institution, Study of crude oil effects on developmental stages of the American lobster (draft): Woods Hole, Mass. Final report due September 1981.

The study is a continuation of research begun by the Westinghouse Ocean Research Laboratory to determine the effects of crude oil on various developmental stages of the American lobster (*Homarus americanus*). The specific research tasks include evaluation of the growth and development of lobsters following exposure of the larval stages to crude oil; determination of changes in egg and embryonic development of lobsters following exposure to crude oil; and determination of the sub-lethal effects of oil exposure on larval and juvenile lobsters, including the effects of feeding and growth energetics.

Fish and Wildlife Service

Tippie, Virginia, and Robadue, Don, 1978, Environmental planning for offshore oil and gas, volume 5: regional status reports, part 1: New England: prepared by the Conservation Foundation for the U.S. Fish and Wildlife Service, Biological Services Program, FWS/OBS-77.16.1, 67 p. Available at cost from the National

Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, VA 22161. (Order No. PB281 450).

This report is one in a series conveying technical information and developing an impact assessment system relating to the recovery of OCS oil and gas resources. It is designed to aid Fish and Wildlife Service personnel, as well as other government agencies, the oil and gas industry, and the public, in decisions concerning OCS oil and gas development. The report describes the technological characteristics and planning strategy of OCS oil and gas development and assesses the effects on living resources and their habitats. Each regional report is presented in five sections: past and present OCS production, OCS development and future potential, effects on living resources, socioeconomic impacts, and regional information analysis. A bibliography is included.

U.S. Geological Survey

Amato, Roger V., and Bebout, John W., eds., 1980, Geologic and operational summary, COST No. G-1 well, Georges Bank area, North Atlantic OCS: Reston, Va., U.S. Geological Survey Open-File Report 80-268, 112 p. Available at cost from Open-File Services Section, Branch of Distribution, USGS, Box 25425, Federal Center, Denver, CO 80225.

This report summarizes geological and engineering data obtained from the first Continental Offshore Stratigraphic Test (COST) well drilled on the North Atlantic OCS. The report includes information on well operations, lithology, potential source rock porosity, temperature and pressure gradients, biostratigraphy, and paleoenvironment.

Amato, Roger V., and Simonis, Edvardas K., eds., 1980, Geologic and operational summary, COST No. G-2 well, Georges Bank area, North Atlantic OCS: Reston, Va., U.S. Geological Survey Open-File Report 80-269, 116 p. Available at cost from Open-File Services Section, Branch

of Distribution, USGS, Box 25425, Federal Center, Denver, CO 90225.

The Continental Offshore Stratigraphic Test (COST) No. G-2 well is the second deep well to be drilled in the Georges Bank Basin. This report summarizes geological and engineering data obtained from the well and includes information on well operations, lithology, potential source rock porosity, temperature and pressure gradients, biostratigraphy, and paleoenvironment.

Dolton, G. L., Carlson, K.H., Charpentier, R.R., Coury, A.B., and others, 1981, Estimates of undiscovered recoverable resources of conventionally producible oil and gas in the United States, a summary: Reston, Va., U.S. Geological Survey Open-File Report 81-192, 17 p. Available at cost from Open-File Services Section, Branch of Distribution, USGS, Box 25425, Federal Center, Denver, CO 80225.

In 1975 the U.S. Geological Survey (USGS) published estimates of the undiscovered recoverable oil and gas resources of the United States (Miller and others, 1975). A new appraisal was made in 1980 to incorporate new geologic information, new technology, economic changes, and new or refined methods of resource appraisal. This report represents the final resource estimates but does not include detailed discussions of geology and methodology. The report includes commodities assessed, areas of study, methods of assessment, and results.

Hall, Robert W., 1979, Potential geologic hazards and constraints for blocks in proposed North Atlantic OCS oil and gas Lease Sale 42: Reston, Va., U.S. Geological Survey Open-File Report 79-1285, 239 p. and plate. Available at cost from Open-File Services Section, Branch of Distribution, USGS, Box 25425, Federal Center, Denver, CO 80225.

Analysis of data for the 206 blocks originally selected for proposed Sale 42 disclosed potential hazards to oil and gas exploration and development as follows: a shallow gas deposit in one proposed

lease sale block and shallow faulting (or possible buried slumping) in 16 proposed blocks. Other features were considered to be developmental constraints that could be accommodated by existing standard design and engineering technology. These included sandwaves, scour, potentially unstable slopes (due to gradient or presence of possible slump-related features), filled channels, shipwrecks, and unidentified bottom objects. An appendix with a block-specific summary of potential hazards and constraints is included.

Schlee, John S., Mattick, R.E., Taylor, D.J., Girard, W.O., and others, 1975, *Sediments, structural framework, petroleum potential, environmental conditions, and operational considerations of the United States North Atlantic Outer Continental Shelf*: Reston, Va., U.S. Geological Survey Open-File Report 75-353, 126 p. Available at cost from Open-File Services Section, Branch of Distribution, USGS, Box 25425, Federal Center, Denver, CO 80225.

This report was compiled to provide the Bureau of Land Management with a summary of the geology, potential mineral resources, estimated oil and gas reserves, potential environmental hazards, and operational considerations of the United States North Atlantic area for the possibility of an oil and gas lease sale. The report brings together the geologic research done in this area over the past century, including the present studies using common depth point seismic reflection profiles.

Schlee, John S., Aaron, J.M., Ball, M.M., Klitgord, K.D., and others, 1979, *Summary report of the sediments, structural framework, petroleum potential, and environmental conditions of the United States Northeastern Atlantic Continental Margin*: Reston, Va., U.S. Geological Survey Open-File Report 79-674, 26 p. Available at cost from Open-File Services Section, Branch of Distribution, USGS, Box 25425, Federal Center, Denver, CO 80225.

This report was compiled to update and summarize geological information of

the Atlantic Continental Shelf off the northeastern United States. It includes a discussion of the regional geology and geophysics, a description of potential environmental hazards, and an estimation of the oil and gas potential of the area.

STATE STUDIES

Maine

Maine Department of Marine Resources with Bigelow Laboratory, *Ecological inventory and oil spill sensitivity analysis of the Casco Bay region*: Augusta, Maine. In progress.

A three-part study of the Casco Bay will be undertaken to increase the State's capabilities to predict and respond to oil spills in the Bay, which is currently the third most active oil port on the East Coast. The work will be coordinated with the State's Department of Environmental Protection, Division of Oil Conveyances, which has responsibility for spill response and cleanup under Maine law.

Rieser, Alison, and Spiller, Judith, 1981, *Regulating drilling effluents on Georges Bank and the Mid-Atlantic Outer Continental Shelf: a scientific and legal analysis*: submitted to the State of Maine, New Hampshire, Massachusetts, and New Jersey, 130 p. and tables. Limited distribution through the Maine State Planning Office, State House Station 38, 184 State Street, Augusta, ME 04333.

This study analyzes the issues surrounding the regulation of discharges from OCS oil and gas drilling operations with particular reference to the North and Mid-Atlantic Regions. Its objective was to assist the States in these regions in evaluating proposed drilling operations on Georges Bank and future drilling in the Mid-Atlantic. The report consists of a summary of the literature on the fate and effects of drilling mud discharges, a history of the permits that have been issued in four OCS Regions, and a dis-

cussion of issues concerning the monitoring of permit compliance. A separate section consisting of recommendations for NPDES permits in the North and Mid-Atlantic Regions will be released when the States funding the study have had an opportunity to consider and respond formally to the proposed permits.

Massachusetts

C.E. Maguire, Inc., 1981, *Waterfront study: City of Fall River, Massachusetts: prepared for the Massachusetts Coastal Zone Management Office*, 86 p. and appendixes. Limited distribution through the City of Fall River, Industrial Commission, Government Center, Room 641, Fall River, MA 02722.

As a result of its location in relation to present and future offshore oil and gas activities on Georges Bank and the Baltimore Canyon, the City of Fall River is a potential site for onshore support facilities. This study identifies impacts on environmental and recreational resources in Fall River due to offshore oil and gas activities and develops specific strategies to mitigate those impacts. Sections include information about a shoreline inventory, OCS development, OCS development scenarios, and potential development in Fall River. A bibliography is provided.

Massachusetts Institute of Technology, Offshore Oil Task Group, 1973, *The Georges Bank petroleum study summary: Cambridge, Mass., Massachusetts Institute of Technology Sea Grant 73-5, v. 3*, 83 p. Available at cost from Sea Grant Information Center, MIT Sea Grant College Program, Room E38-320, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Cambridge, MA 02139.

This study projects the region's future with respect to petroleum in general. It attempts to determine the implications of several hypothetical regional petroleum developments, ranging from essentially no changes in the present system to major changes in the

petroleum production source, crude transportation system, processing location, and products distribution system. It is intended to be an information source rather than an argument for or against development. Volume 1 deals with economic implications, and volume 2 addresses implications for the regional environment.

Massachusetts Office of State Planning, 1976, *Offshore oil development: implications for Massachusetts communities: Boston, Mass.*, 68 p. Limited distribution through Massachusetts Office of Coastal Zone Management, 100 Cambridge Street, Room 2006, Boston, MA 02202.

This manual for Massachusetts coastal communities provides basic information on potential oil development in Massachusetts, with emphasis on the siting of petroleum facilities and activities. The report intends to improve the decisionmaking effectiveness of local governments which have primary responsibility for planning for and handling oil development. Topics addressed include oil facilities related to offshore oil development; impacts of oil-related development on communities; management of community impacts and new growth; and oil spill controversy. A glossary and bibliography are provided.

Rhode Island

Coalition of Coastal Communities (CCC) and Regional Energy Project (REP), *Potential regional impacts of Outer Continental Shelf development (draft). Final report of project due January 1982.*

This study will examine the potential regional impacts of Outer Continental Shelf onshore development at Quonset Point and Davisville on the regions' municipal services (water and sewage), transportation, public lands, housing, energy characteristics, and historic features. Major problems that OCS activity could effect will be identified, and policies and management solutions will be developed.

Gladstone Associates, 1977, *Socio-economic assessment of the reuse alternatives of Quonset Point/Davisville: executive summary: prepared for the Rhode Island Department of Economic Development. Limited distribution through Rhode Island Department of Economic Development, 7 Jackson Walkway, Providence, RI 02903.*

This socio-economic assessment consists of three parts: (1) review of previous market and feasibility studies; (2) synthesization of development recommendations and alternatives; and (3) evaluation of the socio-economic impact arising from the alternative development schemes. The two major tables developed for discussion were "Preliminary Development Program Estimates", summarizing non-petroleum support activities that might be anticipated, and "OCS Related Onshore Support Facilities", identifying potential petroleum-related activities that might reasonably accrue relative to certain "find" levels.

Grigalunas, Thomas A., 1975, *Offshore petroleum and New England: a study of regional economic consequences of potential offshore oil and gas development: Kingston, R.I., University of Rhode Island Marine Technical Report no. 55, 114 p. Available at cost from Marine Advisory Service, Publications Unit, University of Rhode Island, Watkins Building, Narragansett, RI 02992.*

This study examines the direct and secondary impacts of alternative potential offshore oil and gas developments and possible petroleum refinery activity within the New England region. Several specific Georges Bank oil and gas and petroleum refinery scenarios are postulated, as well as estimates of their effects on various socioeconomic indicators and on broad industrial sectors of the regional economy. Appendixes provide estimates of offshore oil and gas pipeline transportation costs and estimates of possible Georges Bank production and royalties.

Keyes Associates, 1977, *Quonset Point Technical Park: executive summary: prepared for the Rhode Island Department of Eco-*

nomic Development. Limited distribution through Rhode Island Department of Economic Development, 7 Jackson Walkway, Providence, RI 02903.

This facilities study plans for the appropriate use of the Quonset Point-Davisville property within the comprehensive framework of economic development, natural resources conservation, historic preservation, and local communities' planning concerns. Three development scenarios were produced, ranging from a high offshore petroleum find to a medium find to a no petroleum offshore find.

Olsen, Stephen B., and Saulia, Saul B., 1976, *Fishing and petroleum interactions on Georges Bank, volume 1: areas of particular interest to the industries: prepared for the New England Regional Commission (NERCOM) by University of Rhode Island, Coastal Resources Center, NERCOM Energy Program Technical Report 76-3, 7 p. and plates. Available for public reference use at the New England Regional Commission Library, 141 Milk Street, Boston, MA 02109.*

At the request of five of New England's Governors, this preliminary report was prepared to summarize the potential interactions between the fishing and petroleum industries that might develop as a result of offshore oil and gas exploration. The report presents geographic and environmental information with a minimum of technical detail.

Olsen, Stephen B., Grigalunas, Thomas, Norton, Virgil, Saulia, Saul, and others, 1977, *Fishing and petroleum interactions on Georges Bank, volume 2: the characteristics of the two industries, potential future trends, and an assessment of foreseeable conflicts: prepared for NERCOM by University of Rhode Island, Coastal Resources Center, NERCOM Energy Program Technical Report 77-1, 323 p. Available for public reference use at the New England Regional Commission Library, 141 Milk Street, Boston, MA 02109.*

This report assesses available information on the Georges Bank and the

fisheries it supports. Data are presented on the characteristics and condition of major New England ports and the magnitude and characteristics of major commercial fisheries at the regional, State, and port level. Sport fisheries and foreign commercial fisheries are also discussed. Various scenarios are postulated for offshore oil and gas finds, and impacts resulting from development and production are discussed. The study suggests that potential conflicts between the two industries may be mitigated by proper advance planning and that the two industries may be compatible.

University of Rhode Island, Coastal Resources Center, 1977, The redevelopment of Quonset/Davisville: an environmental assessment: prepared for the Rhode Island Department of Economic Development, University of Rhode Island Marine Technical Report no. 55, 200 p. Available from Marine Advisory Service, Publications Unit, University of Rhode Island, Watkins Building, Narragansett, RI 02882.

Quonset/Davisville was once a major staging (support) area for American war efforts in Europe. This study concludes that the area, having already been extensively modified, can be redeveloped for industrial and commercial use by careful facility siting and construction that will have no significant impact on the environment. Three scenarios based on high and medium finds of oil and gas on Georges Bank, as well as no discovery, are presented along with recommendations for minimizing negative environmental impacts from site preparation and operation of facilities. A bibliography is included.

OTHER STUDIES

New England Regional Commission

Arthur D. Little, Inc., 1975, Petroleum development in New England: economic and environmental considerations, volume 1: executive summary: prepared for the

New England Regional Commission, Energy Program Technical Report 75-6, 32 p. Available for public reference use at New England Regional Commission Library, 141 Milk Street, Boston, MA 02109.

This four-volume report analyzes the economic and environmental impacts of diversifying New England's supply of petroleum products through the development of a petroleum industry. The industry could use either imported crude oil or oil produced from Georges Bank. The report assesses petroleum refining, petrochemical production, marine crude oil terminal handling and storage, and offshore oil and gas exploration and production on Georges Bank. The study is not a site-specific analysis, but it is designed to evaluate the desirability of petroleum-related facilities in New England and to offer detailed guidelines for analysis of future proposals for such facilities. The study concludes that there is no overwhelming reason to either oppose or support a refinery proposal in New England, and that each proposal must be evaluated on its individual merits.

New England Regional Commission, 1980, Resource directory: Boston, Mass., 110 p. and appendixes. Available from the New England Regional Commission, 141 Milk Street, Boston, MA 02109.

The New England Regional Commission (NERCOM) was created in 1967, and it promotes regional cooperation among Federal, State, and local governments as well as between the public and private sectors in the New England States. This directory represents studies and reports completed for or by NERCOM from 1967 to 1979. Four major areas of studies are included: (1) commercial and industrial development; (2) energy; (3) government services; and (4) transportation. An appendix of conference materials is included, as well as an index to the directory. All studies are available for public reference use at the above address, and publications in print may be obtained at the same address.

New England River Basins Commission

Gowen, Ann Wessel, Gowen, Max, Lewis, Jennifer, and Northdurft, William, 1978, *Onshore facilities related to offshore oil and gas development, case studies in OCS planning: an evaluation of the use of NERBC-RALI Project information and methodologies in four States: Boston, Mass., 80 p. Limited distribution through the New England River Basins Commission (NERBC), 141 Milk Street, 3rd Floor, Boston, MA 02109.*

This report is one in the series for the joint NERBC and U.S. Geological Survey's Resource and Land Investigations (RALI) Program project, "Development and Application of a Methodology for Siting Onshore Facilities Associated with OCS Development." Information presented includes the following: testing the application of portions of methodologies developed by the project; examining how several States have used NERBC-RALI Project technical information; and evaluating the utility of the methodologies and information developed during the project; and providing conclusions and recommendations. The four States examined are Massachusetts, Maine, Rhode Island, and New York. A broad range of conditions and needs with respect to OCS planning are presented.

New England River Basins Commission, 1976, *Estimates for New England: onshore facilities related to offshore oil and gas development: prepared under agreement with the U.S. Geological Survey's Resource and Land Investigations (RALI) Program. Limited distribution through the New England River Basins Commission, 141 Milk Street, 3rd Floor, Boston, MA 02109.*

This document is one in a series produced during a 2-year project with RALI entitled "Development and Application of a Methodology for Siting Onshore Facilities Associated with OCS Development." The study develops and tests a methodology to help State and local officials plan for the siting of onshore facilities associated with offshore oil and gas development. Although

focused on New England, the methodology is national in scope. The report presents three hypothetical levels of Georges Bank oil and gas development with their estimated direct impacts.

Other documents in this series of reports are Factbook, an encyclopedic reference work on the principal onshore facilities related to offshore oil and gas development, and Planning Methodologies, a suggested systematic approach to policy and site planning for onshore development associated with offshore oil and gas development.

New England River Basins Commission, 1980, *Choosing offshore pipeline routes; problems and solutions: prepared for the U.S. Environmental Protection Agency, EPA-600/7-80-114, 91 p. Limited distribution through U.S. Environmental Protection Agency, Oil and Hazardous Materials Spills Branch, Industrial and Environmental Research Laboratory, Edison, NJ 08837.*

This report is the second in a series for the EPA project, "OCS Pipeline Construction and Operation: Potential Problems and Recommendations for Mitigation of Impacts", begun in 1978. It is designed for scientists or engineers involved in offshore petroleum pipeline planning, including pipeline corridors and landfalls. Environmental concerns associated with offshore pipelines are discussed and include oil spills and potential damage to sensitive environmental areas near the pipeline route. Geologic hazards related to pipeline failure are addressed, as well as fisheries problems associated with the effects of installation of offshore pipelines and obstructions which may result. Topics discussed in analyzing a proposed pipeline route include general industry siting criteria, geologic and environmental areas to avoid in pipeline siting, and methods for minimizing unavoidable impacts.

New England River Basins Commission, 1980, *Pipeline landfalls: a handbook of impact management techniques (draft): prepared for the U.S. Environmental Protection Agency (EPA). Final report anticipated before October 1981.*

This will be the final report in the series for the EPA project, "OCS Pipeline Construction and Operation: Potential Environmental Problems and Recommendations for Mitigation of Impacts." Designed for scientists or engineers involved in offshore petroleum pipeline planning (including pipeline corridors and landfalls), this report presents methods available for managing environmental effects of pipeline installation at the landfall. Site-specific methods of installation and restoration designed to minimize the potential negative effects of pipeline installation in coastal systems are presented. Specific examples of North Sea and Gulf Coast installations are used to illustrate technical methods that have been applied successfully to minimize pipeline effects in several coastal ecosystems.

New England River Basins Commission, 1980, Strategies for State participation in OCS exploration decisions: Boston, Mass., 115 p. and appendixes. Limited distribution through the New England River Basins Commission, 141 Milk Street, 3rd Floor, Boston, MA 02109.

This report is part of the joint project, "OCS Information and Planning Program", conducted with the U.S. Geological Survey's Resource and Land Investigations Program. It discusses the many consultation documents States will receive in the course of the OCS exploration decisionmaking process. It outlines planning needs, strategies for promoting State policies, and institutional and organizational options for effective participation in decisionmaking. The information will continue in reports of the joint NERBC-RALI project "Development and Application of a Methodology for Siting Onshore Facilities Associated with OCS Development."

Northdurft, William E., 1980, North Sea pipelines: a survey of technology regulations and use conflicts in oil and gas pipeline operation: prepared by the New England River Basins Commission for the U.S. Environmental Protection Agency, EPA-600/7-80-023, 68 p. Limited distribution through U.S. Environmental Protection

Agency, Oil and Hazardous Materials Spills Branch, Industrial Environmental Research Laboratory, Edison, NJ 08837.

This report is the first in a series for the EPA project, "OCS Pipeline Construction and Operation: Potential Environmental Problems and Recommendations for Mitigation of Impacts", begun in 1978. The report is designed for offshore oil and gas pipeline planners, and it focuses on pipeline corridors and landfalls. A brief overview of offshore activity in the United Kingdom and Norwegian sections of the North Sea is presented, with emphasis on the transportation systems established or proposed for the major commercial fields. Specific issues arising from the installation and operation of these systems are discussed, including regulations affecting pipeline placement, criteria for route selection, pipeline trenching and burial, and conflicts with the fishing industry in the North Sea. An annotated bibliography is included.

Woods Hole Oceanographic Institution

Allen, David W., Allen, Richard B., Black, Robert E., Friedman, James M., and others, 1976, Effects on commercial fishing of petroleum development off the northeastern United States: Woods Hole, Mass., Woods Hole Oceanographic Institution Ref. 76-66, 80 p. Available on interlibrary loan from Woods Hole Oceanographic Institution, Document Library, Smith 206, Woods Hole, MA 02543.

This report analyzes the effects on fisheries in three general categories: offshore interactions, onshore interactions, and pollution effects. Estimates are made of the probable magnitude of these effects on commercial fishermen. Recommendations are made as to steps that should be taken by the industries and by government to minimize undesired consequences. General descriptions are included for the physical environment, Atlantic Coast commercial fishing, and the offshore petroleum industry.

Glossary

Definitions presented in the glossary describe terms as they have been used in this summary report. The glossary is intended for general reference only: for detailed descriptions of technical or specialized terms, the reader should seek a reference in the field of particular interest. Abbreviations and acronyms are presented in tabular form on p. ii.

Sources used in compiling this glossary were the Gulf of Alaska, Gulf of Mexico, Mid-Atlantic, South Atlantic, and Pacific Summary Reports, the OCSI (formerly OCSIP) Atlantic, Pacific, Gulf of Mexico, and Alaska Indexes; Webster's Third New International Dictionary; the American Geological Institute's Dictionary of Geological Terms; and Langenkamp's Handbook of Oil Industry Terms and Phrases (2d ed.).

Anticline - An upfold or arch of stratified rock in which the beds or layers bend downward in opposite directions from the crest or axis of the fold.

Application for permit to drill (APD) - A document submitted by lease operators for review and approval by the USGS. This application, submitted in conjunction with exploration plans and prior to development and production plans, includes an operational plan for a detailed casing, mud, and cementing program for a specific drilling operation.

Arch - An regional upward flexing anticline.

Basement rock - Rock in the earth's crust beneath all sedimentary rocks.

Basin - A depression of the earth in which sedimentary materials accumulate or have accumulated, usually characterized

by continuous deposition over a long period of time; a broad area of the earth beneath which the strata dip, usually from the sides toward the center.

Block - A geographical area, as portrayed on an official BLM OCS protraction diagram or leasing map, that contains approximately 9 square miles (5,693 acres or 2,304 hectares in the North Atlantic Region).

Cash bonus tract - A tract on which the bidder places a cash bid in addition to a fixed or sliding-scale royalty on production.

Closure - In a fold, dome, or other structural trap, the vertical distance between the structure's highest point and its lowest contour that encloses itself. It is used in the estimation of petroleum resources and reserves.

Conservation Law Foundation of New England, Inc. (CLF) - a public interest, environmental law organization dedicated to the conservation and preservation of New England's natural resources. CLF is a charitable corporation supported by members, contributors, and foundations.

Continental Margin - A zone separating the emergent continents from the deep sea bottom.

Continental Shelf - A broad, gently sloping, shallow feature extending from the shore to the Continental Slope.

Continental Slope - A relatively steep, narrow feature paralleling the Continental Shelf; the region in which the steepest descent to the ocean bottom occurs.

Continental Offshore Stratigraphic Test (COST) well - A well drilled to gather information about the stratigraphic formation present, the general character of the rocks, their porosity, and their permeability.

Development - Activities that take place following discovery of minerals in commercially attractive quantities, including but not limited to geophysical activity, drilling, platform construction, and operation of all directly related onshore support facilities; and that are for the purpose of ultimately producing the minerals discovered.

Development and production plan - A plan describing the specific work to be performed, including all development and production activities that the lessee(s) propose(s) to undertake during the time period covered by the plan and all actions to be undertaken up to and including the commencement of sustained production. The plan also includes descriptions of facilities and operations to be used; well locations; current geological and geophysical information; environmental safeguards; safety standards and features; time schedules; and other relevant information. Under 30 CFR 250.34-2, all lease operators are required to formulate and obtain approval of such plans by the Director of the U.S. Geological Survey before development and production activities may commence.

Diapir - A piercing fold; an anticlinal fold in which a mobile core, such as salt, has broken through the more brittle overlying rocks.

Discovery - A find of significant quantities of hydrocarbons on a given lease.

Dome - A roughly symmetrical upfold, the beds dipping in all directions, more or less equally, from a point; any structural deformation characterized by local uplift approximately circular in outline, e.g., the salt domes of Louisiana and Texas.

Economically recoverable resource estimate - An assessment of the hydrocarbon potential that takes into account (1) physical

action significantly affecting the environment.

Evaporite - One of the sediments that are deposited from aqueous solution as a result of extensive or total evaporation of the solvent.

Exploration - The process of searching for minerals. Exploration activities include (1) geophysical surveys where magnetic, gravity, seismic, or other systems are used to detect or infer the geologic conditions conducive to the accumulation of such minerals and (2) any drilling, whether on or off known geological structures. Exploration also includes the drilling of a well in which a discovery of oil or natural gas in paying quantities is made and the drilling of any additional well(s) after such a discovery that is needed to delineate a reservoir and to enable the lessee to determine whether to proceed with development and production.

Exploration plan - A plan based on all available relevant information about a leased area that identifies, to the maximum extent possible, all the potential hydrocarbon accumulations and wells that the lessee(s) propose(s) to drill to evaluate the accumulations within the entire area and technological constraints on production and (2) the influence of costs of exploration and development and market price on industry investment in OCS exploration and production.

Environmental impact statement (EIS) - A document required by the National Environmental Policy Act of 1969 (NEPA) or similar State law in relation to any of the lease(s) covered by the plan. Under 30 CFR 250.34-1, all lease operators are required to formulate and obtain approval of such plans by the Director of the U.S. Geological Survey before exploration activities may commence.

Fault - A fracture in the earth's crust accompanied by a displacement of one side of the fracture with respect to the other.

Field - An area underlain by one or more geologically related hydrocarbon reservoirs.

Formation - The primary unit in lithostratigraphy, consisting of a succession of strata useful for mapping or description.

Geologic constraint - A feature or condition posing difficulties for OCS operations that can be mitigated by design and engineering technology.

Geologic hazard - A feature or condition that, if undetected, may seriously jeopardize offshore oil and gas exploration and development activities and, once identified, may necessitate special engineering procedures or relocation of a well.

Geologic trap - An arrangement of rock strata, involving their structural relations or varied lithology and texture, that favors the accumulation of oil and gas.

Glacial meltwater - Water resulting from the melting of glacial ice.

Graben - A block, generally long compared to its width, that has been downthrown along faults relative to the rocks on either side.

Hydrocarbon - Any of a large class of organic compounds containing only carbon and hydrogen, comprising paraffins, olefins, members of the acetylene series, alicyclic hydrocarbons, and aromatic hydrocarbons, and occurring in many cases in petroleum, natural gas, coal, and bitumens.

Lay-down space - A storage area for drill pipe.

Lease - A contract authorizing exploration for and development and production of minerals; the land covered by such a contract.

Lease sale - The public opening of sealed bids made after competitive auction for leases granting companies or individuals the right to explore for and develop certain minerals within a defined period of time.

Line mile - The linear distance of one mile by which geophysical surveys are measured. Such surveys are usually conducted in a grid pattern, and the total mileage

covered in crossing and recrossing the grid is expressed in terms of line miles.

Mass movement - Unit movement of a portion of the land surface, as in creep, landslide, or slip. Mass movement, or slumping, can occur where unconsolidated sediments are distributed over a steep gradient.

Migration - The movement of oil, gas, or water through porous and permeable rock.

National Marine Fisheries Service - A branch of the National Oceanic and Atmospheric Administration whose purpose is to research the development and maintenance of fish resources.

Nautical mile - A unit equal to 6,080.2 feet or 1,853.2 m.

New England River Basins Commission (NERBC) - A Federal-State planning partnership composed of representatives of the 6 New England States and New York, 10 Federal agencies, and 6 interstate agencies. NERBC was created at the request of the governors of the member States in 1968 under the provisions of Title II of the Water Resources Planning Act of 1965 (PL 89-80).

Organic matter - Material derived from living organisms.

Outer Continental Shelf (OCS) - All submerged lands that comprise the Continental Margin adjacent to the U.S. The OCS remains subject to Federal jurisdiction and control after enactment of the Submerged Lands Act (43 U.S.C. 1301 and 1302).

Permeability - The capacity to be penetrated or diffused through; the ability to transmit fluids.

Permeable - Capable of being penetrated or diffused through.

Petroleum - An oily, flammable bituminous liquid that occurs in many places in the upper strata of the earth, either in seepages or in reservoir formations; essentially a complex mixture of hydrocarbons

of different types with small amounts of other substances; any of various substances (as natural gas or shale oil) similar in composition to petroleum.

Platform - A steel or concrete structure from which offshore wells are drilled.

Porosity - The capability to contain fluids within void spaces; the percent of open space in a rock.

Porous - Capable of containing fluids within void spaces.

Proprietary information - Geologic and geophysical data and immediate derivatives thereof that cannot be released to the general public because of Federal law, regulations, or statutes, or because of contractual requirements.

Recoverable resource estimate - An assessment of oil and gas resources that takes into account the fact that physical and technological constraints dictate that only a portion of resources or reserves can be brought to the surface.

Reef - A type of reservoir trap composed of rocks, usually limestone, made up of the skeletal remains of marine animals. Reef reservoirs are often characterized by high initial production that falls off rapidly, requiring pressure maintenance techniques to sustain production.

Reserve estimate - An assessment of the portion of the identified oil or gas resource that can be economically extracted.

Reserves - Portion of the identified oil or gas resource that can be economically extracted.

Reservoir - An accumulation of hydrocarbons that is separated from any other such accumulation.

Resource - Concentration of naturally occurring solid, liquid, or gaseous materials in or on the earth's crust.

Rig - Apparatus used for drilling an oil or gas well.

Riskd resource estimate - An assessment of oil or gas resources that has been modified

to take into account the estimator's confidence in the estimate (i.e., "riskd" to account for the probability that economically recoverable resources will actually be found within the area of interest).

Riskd, economically recoverable resource estimate - An assessment of oil or gas resources that has been modified to take into account (1) physical and technological constraints on production; (2) the influence of the costs of exploration and development and market price on industry investment in OCS exploration and production; and (3) the estimator's confidence in the estimate.

Royalty tract - A leased tract for which the bidder offers a minimal cash payment but instead proposes to pay the Federal Government a significant royalty on any oil and/or gas produced.

Sandstone - A sedimentary rock made up of sand that usually consists of quartz more or less firmly united by some cement (as silica, iron oxide, or calcium carbonate).

Sand wave - A large ripplelike structure of sediments formed by water currents of high velocity.

Scouring - The erosion or washing away of sand/clay sediments on the ocean floor.

Sediment - Material or a mass of material deposited (as by water, wind, or glaciers).

Sedimentary rocks - Rock formed of mechanical, chemical, or organic sediment.

Seismic - Pertaining to, characteristic of, or produced by earthquakes or earth vibration; having to do with elastic waves in the earth.

Seismic reflection survey - A program for mapping geologic structures by creating seismic waves and observing their arrival times as they are reflected from discontinuities. The energy source for creating the waves is usually delivered to the earth for very short periods of time.

Shale - A fissile rock that is formed by the consolidation of clay, mud, or silt; it has

a finely stratified or laminated structure parallel to the bedding and is composed of minerals that have been essentially unaltered since deposition.

Slumping - (See **mass movement**).

Source bed - Rocks containing large amounts of organic matter that is transformed into hydrocarbons.

Spud - To begin drilling a well.

Stratum (pl., strata) - A tabular mass or thin sheet of sedimentary rock or earth of one kind formed by natural causes and made up usually of a series of layers lying between beds of other kinds.

Stratigraphic trap - A reservoir, capable of holding oil or gas, that is formed from a change in the character of the reservoir rock. Such a trap is harder to locate than a structural trap because it is not readily revealed by geological or geophysical surveys.

Structural trap - A reservoir, capable of holding oil or gas, that is formed from crustal movements in the earth that fold or fracture rock strata in such a manner that oil or gas accumulating in the strata are sealed off and cannot escape. In some cases "structure" may be synonymous with structural trap.

Subsurface geology - The study of structure, thickness, facies, correlation, etc. of rock formations beneath land or sea-floor surfaces by means of drilling for oil or water, core drilling, and geophysical prospecting.

Summary Report - Document prepared by the Department of the Interior pursuant to 30 CFR 252.4 that is intended to inform affected State and local governments as to current OCS reserve estimates, projections of magnitude and timing of development, transportation planning, and general location and nature of near-shore and onshore facilities.

Supply boat - Vessel that ferries food, water, fuel, and drilling supplies and equipment to a rig and returns to land with refuse that cannot be disposed of at sea.

Tract - A tract is an administrative unit offered at a sale that may consist of a block or more than a single block. It is an administrative method of numbering blocks offered for sale so that there is a sequential process of offering. Therefore, block numbers and tract numbers may differ.

Trap - A geologic feature that forms a reservoir enclosing and preventing the escape of accumulated fluids (hydrocarbons or water).

Truncated - Terminated abruptly as if cut or broken off.

Undiscovered resources - Quantities of oil and gas estimated to exist outside known fields.

Uplift - Elevation of any extensive part of the earth's surface relative to other parts.

Outer Continental Shelf Oil and Gas Information Program:
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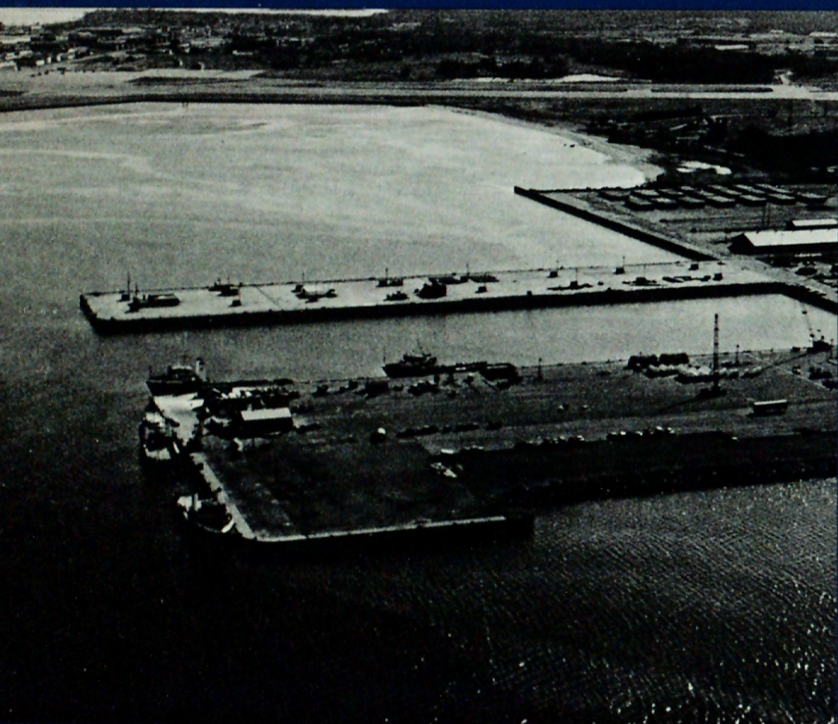
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