OCS Report
MMS 2000-069

Outer Continental Shelf

Estimated Oil and Gas Reserves, Gulf of Mexico, December 31, 1998

T. Gerald Crawford
Barbara J. Bascle
Clark J. Kinler
Michael T. Prendergast
Katherine M. Ross

Resource Evaluation Office
Reserves Section

U.S. Department of the Interior
Minerals Management Service
Gulf of Mexico OCS Regional Office

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Abstract

Remaining proved reserves in the Gulf of Mexico Outer Continental Shelf (OCS) as of December 31, 1998, have been estimated to be 3.36 billion barrels of oil* and 30.0 trillion cubic feet of gas. These reserves are recoverable from 790 proved active fields. Unproved reserves as of December 31, 1998, have been estimated to be 1.00 billion barrels of oil and 5.1 trillion cubic feet of gas. These reserves are associated with 58 unproved active fields. There are 3 unproved active fields not studied. In total, there are 851 active fields located in Federal waters.

Proved reserves are estimated to have been 14.27 billion barrels of oil and 162.7 trillion cubic feet of gas from 984 proved fields in the same geographic area. Included in this number are 194 proved fields: not included are the 61 unproved active fields. Estimates were derived for individual reservoirs from geologic mapping and reserve evaluation.

The unproved reserves, associated with the 58 unproved active fields, are not added to proved reserves because of different levels of economic certainty and hydrocarbon assurance. For any field contained partly in State waters and partly in Federal waters, reserves are estimated for the Federal portion only.

*The term "oil" as used in this report includes crude oil and condensate.

Introduction

This report, which supersedes the Minerals Management Service (MMS) OCS Report MMS 2000-006 (Crawford and others, 2000), presents proved reserves, cumulative production, remaining proved reserves, and unproved reserves as of December 31, 1998, for the Gulf of Mexico (GOM). This report does not consider the reserves growth phenomena when addressing remaining proved reserves, nor does it report undiscovered or known resources. A discussion of reserves growth can be found in OCS Report MMS 99-0034 (Lore and others, 1999). The estimates of reserves for this report were completed in December 1998 and represent the combined efforts of engineers, geologists, geophysicists, paleontologists, and other personnel of the MMS Gulf of Mexico Region, Office of Resource Evaluation, in New Orleans, Louisiana.

As in previous reports, standard methods of estimating reserves were used, including volumetric calculation and performance analyses.

Definition of Resource and Reserve Terms

The MMS definitions and classification schema concerning reserves reflect those of the Society of Petroleum Engineers (SPE) and the World Petroleum Congress (WPC), 1996. SPE definitions have been used since 1988. The MMS definitions and classification schema concerning resources are modified as referenced by the U.S. Department of the Interior (DOI, 1989). The MMS petroleum resource and reserve classifications are presented in figures 1 and 2.

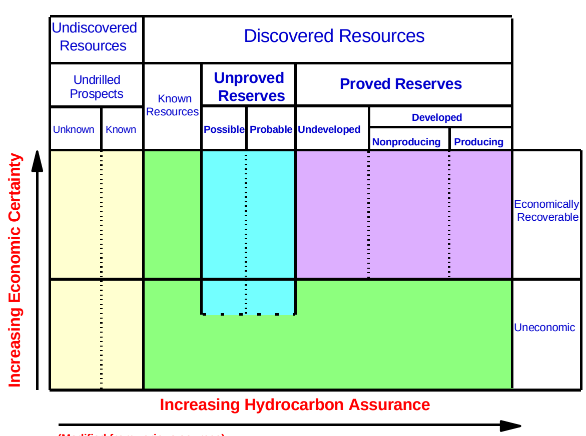

Figure 1.—MMS conventionally recoverable petroleum resource classifications.

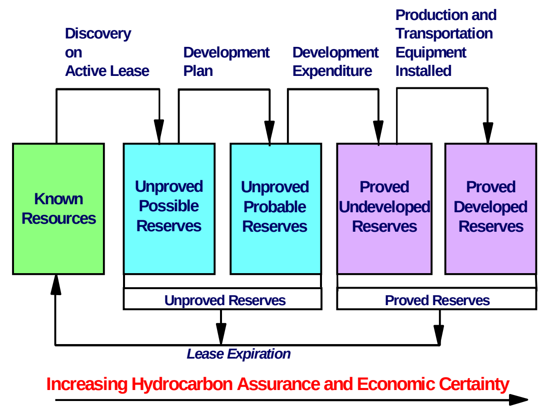

Figure 2.—Gulf of Mexico MMS reserve classifications.

Field

A field is an area consisting of a single reservoir or multiple reservoirs all grouped on, or related to, the same general geological structural feature and/or stratigraphic trapping condition. There may be two or more reservoirs in a field that are separated vertically by intervening impervious strata, or laterally by geological barriers, or both. The area may include one OCS lease, a portion of an OCS lease, or a group of OCS leases with one or more wells that have been approved as producible by the MMS pursuant to the requirements of Title 30 Code of Federal Regulations (CFR) 250.11, Determination of Well Producibility. A field is usually named after the area and block on which the discovery well is located. Field names or field boundaries may be changed when additional geologic and/or production data support such a change. Using geological criteria, the MMS designates a new producible lease as a new field or assigns it to a preexisting field. A further explanation of field naming convention can be found on page 5 and in the ***Field Naming Handbook*** available on the Gulf of Mexico Region's Internet homepage at http://www.gomr.mms.gov.

Undiscovered Resources

Hydrocarbons estimated on the basis of geologic knowledge and theory to exist outside of known accumulations are *undiscovered resources*. Undiscovered resources can exist in prospects (unleased acreage and undrilled leased acreage) or in known fields (undrilled reservoirs).

Discovered Resources

Hydrocarbons whose location and quantity are known or estimated from specific geologic evidence are *discovered* *resources*. Discovered resources include known resources, unproved reserves, and proved reserves depending upon economic, technical, contractual, or regulatory criteria.

Known Resources

Hydrocarbons associated with reservoirs penetrated by one or more wells that are not currently qualified under the MMS regulations as capable of producing in paying quantities pursuant to 30 CFR 250.11 are *known resources*. Known resources can exist on active, relinquished, or expired leases and fields.

Reserves

Those quantities of hydrocarbons which are anticipated to be recovered from known accumulations from a given date forward are *reserves*. All reserve estimates involve some degree of uncertainty. The uncertainty depends chiefly on the amount of reliable geologic and engineering data available at the time of the estimate and the interpretation of these data. The relative degree of uncertainty may be conveyed by placing reserves into one of two principal classifications, either unproved or proved.

Unproved Reserves

Those quantities of hydrocarbons which can be estimated with some certainty to be potentially recoverable from known reservoirs, assuming future economic conditions and technological developments, are *unproved reserves*. The MMS Gulf of Mexico Regional Field Names Committee designates a new producible lease as a new field or assigns it to a preexisting field. The reserves associated with new producible leases qualified pursuant to 30 CFR 250.11 are initially considered unproved reserves. Unproved reserves are less certain to be recovered than proved reserves and may be further subclassified as possible and probable reserves to denote progressively increasing certainty in their recoverability. This report does not present individual estimates for possible and probable reserves.

Unproved possible reserves are those unproved reserves which analysis of geological and engineering data suggests are less likely to be commercially recoverable than probable reserves. After a well on a lease qualifies, the reserves associated with the lease are initially classified as unproved possible because the only direct evidence of economic accumulations is a production test or electric log analysis.

Unproved probable reserves are those unproved reserves which analysis of geological and engineering data suggests are more likely than not to be commercially recoverable. Fields that have a Development Operations Coordination Document (DOCD) on file with the MMS would be classified as unproved probable.

Proved Reserves

Those quantities of hydrocarbons which can be estimated with reasonable certainty to be commercially recoverable from known reservoirs and under current economic conditions, operating methods, and government regulations are *proved reserves*. Establishment of current economic conditions includes consideration of relevant historical petroleum prices and associated costs and may involve an averaging period that is consistent with the purpose of the reserve estimate. Proved reserves must have either facilities operational at the time of the estimate to process and transport those reserves to market, or a commitment or reasonable expectation to install such facilities in the future. The application for a permit to install a platform is considered such a commitment. Proved reserves can be subdivided into undeveloped or developed.

Proved undeveloped reserves exist where there is a relatively large expenditure required to install production and/or transportation facilities and a commitment has been made by the operator to develop the field. Proved undeveloped reserves are reserves expected to be recovered from yet undrilled wells or from existing wells where a relatively large expenditure is required for field development.

Proved developed reserves are expected to be recovered from existing wells (including reserves behind pipe). Reserves are considered developed only after the necessary production and transportation equipment has been installed, or when the costs to do so are relatively minor. Proved developed reserves are subcategorized as producing or nonproducing. This distinction is made at the reservoir level.

PROVED DEVELOPED PRODUCING reserves are in reservoirs that have produced any time during the 12 months before the reporting date. Once the first reservoir in a field begins production, the reservoir and the field are considered proved developed producing.

PROVED DEVELOPED NONPRODUCING reserves are in reservoirs that have not produced during the 12 months prior to the reporting date. This category includes off-production reservoirs behind pipe and reservoirs awaiting workovers or transportation facilities. If all reservoirs in a field are off production, the field is considered proved developed nonproducing.

Remaining proved reserves are the quantities of proved reserves currently estimated to be recoverable. Estimates of remaining proved reserves equal proved reserves minus cumulative production.

Reference Standard Conditions for Production and Reserves

Production data are the metered volumes of raw liquids and gas reported to the MMS by Federal unit and lease operators. Oil volume measurements and reserves are corrected to reference standard conditions of 60 °F and one atmosphere (14.696 pounds per square inch absolute [psia]); gas measurements and reserves are corrected to 60 °F and 15.025 psia. To convert gas volumes to 14.696 psia, multiply by 1.022 (DOE, 1989). Continuously measured volumes from production platforms and/or leases are allocated to individual wells and reservoirs on the basis of periodic well test gauges. These procedures introduce approximations in both production and remaining reserves data.

MMS Reporting of Reserve and Resource Data

OCS reserve estimates have been published by the Gulf of Mexico Region annually since 1977, presenting end-of-year totals starting with 1975. From 1977 to 1981, the estimates were published as United States Geological Survey (USGS) Open-File reports. The 1982 report was a joint publication between the USGS and the newly formed MMS, which assumed the OCS mission responsibilities at that time. The MMS has continued the reporting since 1983. The first report provided by the MMS that also includes unproved reserve estimates was published in 1995.

Figure 3 shows the relationship of evaluated data to hydrocarbon assurance. The data are progressively aggregated on both a geologic and a geographic basis at each step of the evaluation process (the reservoir level through the region level). The most detailed studies of discovered resources are MMS individual field studies. These studies are based on analysis at the reservoir level (an example being a single fault trap in a single sand) and are used as the basis for the reporting of discovered and undiscovered resources. The geologic aggregation begins at the top of the figure at the reservoir level and progresses downward through the sand, pool, play, chronozone, series, and system to the regional level. Reservoirs correlated to a specific sand are aggregated to form the sand reporting level, which becomes the basis for further aggregations of data. A play is defined primarily (though not exclusively) by depositional style, geologic age at the chronozone level, and geographic area. Pools are based on the same characteristics of a play, but are specific to an individual field. Fields may contain one or more pools, with each pool representing a separate play. The geographic aggregation begins at the bottom of the figure, also at the reservoir level, and progresses upward through the field, area, and planning area to the regional level.

This report, ***Estimated Oil and Gas Reserves***, presents reserve data from the field level up to the series level.

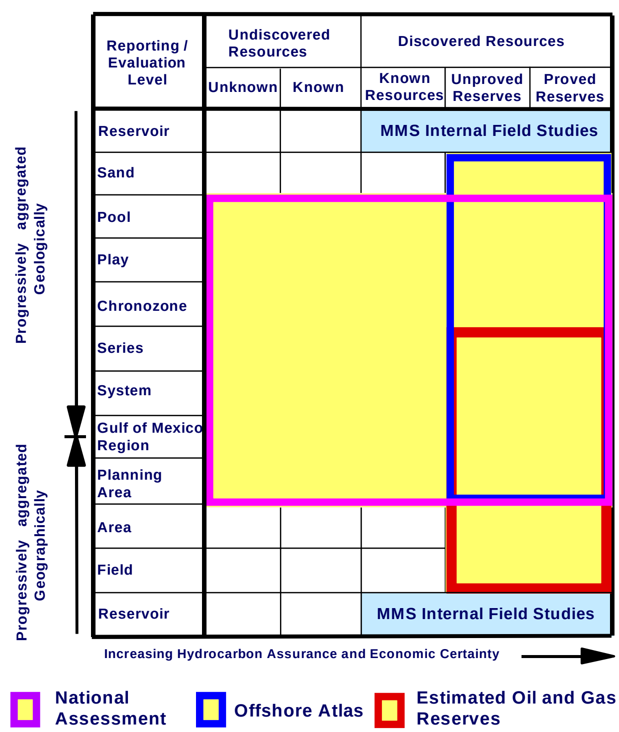

Figure 3.—MMS reporting of reserves and resources.

This report is based on aggregation of MMS internal field studies completed at the reservoir and sand levels. All of the reservoir level data have been linked to the sand, pool, play, chronozone, and series level to support the Offshore Atlas Project (OAP).

The ***Atlas of Northern Gulf of Mexico Gas and Oil Reservoirs, Volume 1: Miocene and Older Reservoirs*** and ***Volume 2: Plio-Pleistocene Reservoirs***, released in 1997, provide a detailed geologic reporting of oil and gas proved reserves. Reserve data on every productive sand, as of December 1994, have been placed into 72 proved geological plays in Federal waters. This was the first MMS release of such a comprehensive framework of geologic and reserve data and the associated attributes for each specific chronozone, play, pool, and sand. Series and system levels can also be evaluated with the data provided. An update of the Federal portion of this effort is in its final stages, and should be available in 2001.

The MMS OCS Report MMS 99-0034, ***Assessment of Conventionally Recoverable Hydrocarbon Resources of the Gulf of Mexico and Atlantic Outer Continental Shelf as of January 1, 1995***, also known as the National Assessment, addresses proved and unproved reserves, reserves appreciation, and undiscovered resources. To maintain credibility, an estimate of undiscovered resources must be based on discovered resources. The OAP supported this report by providing a framework of hydrocarbon plays that allowed for the logical extension of existing production rather than just a conceptual estimate. This report, made available in June 1999 on CD-ROM, contains reserves and resource estimates at the play, chronozone, series, system, province (era), and margin by planning area, water depth, and region.

For information on these reports, contact the Gulf of Mexico Region's Public Information Office at 1-800-200-GULF or 504-736-2519, or visit the GOM Region's Internet homepage at http://www.gomr.mms.gov.

Methods Used for Estimating Reserves

Reserve estimates from geological and engineering analyses have been completed for the 984 proved fields. Reserves accountability is dependent on the drilling and development phases of fields. When a field is in the unproved category, geophysical mapping and limited well data are the basis for defining reservoir limits. Once a field is moved into the proved category and more data become available, the reserve estimate is re-evaluated. Well logs, well file data, seismic data, and production data are continually analyzed to improve the accuracy of the reserve estimate. As a field is depleted and abandoned, the proved reserves of productive reservoirs are assigned a value equal to the amount produced and the reserve estimate of non-producing reservoirs are converted to known resources. Currently, there are 194 proved depleted fields.

Estimation of reserves is done under conditions of uncertainty. The method of estimation is called *deterministic* if the estimate is a single "best estimate" based on known geological, engineering, and economic data, and *probabilistic* when the known geologic, engineering, and economic data are analyzed probabilistically and the estimate determined from continuous probability distributions (SPE/WPC, 1996). Reserve estimates in this report are deterministic.

Methods used for estimating reserves can be categorized into three groups: analog, volumetric, and performance. The accuracy of the proved reserve estimate improves as more reservoir data become available to geoscientists and engineers. Resources are based on analogy with similar fields, reservoirs, or wells in the same area. Reserve estimates in this report are based primarily on volumetric and performance methods.

Analog

In the estimation of resources by analogy, geoscientists use seismic data to generate maps of the extent of subsurface formations. Before any wells have been drilled on a prospect, estimates of undiscovered resources are based on analogy with similar fields, reservoirs, or wells in the same area. The seismic data help geoscientists identify prospects and resources, but do not provide enough direct data to estimate reserves. The effective pore space, water saturation, net hydrocarbon thickness, pressure, volume, and temperature data, necessary to complete resource estimates for prospects, come from nearby field and reservoir well data. After one or more wells are drilled and found productive, a volumetric estimate is done. These estimates, while incorporating existing data, still rely on some information obtained from analogs.

Volumetric

In a volumetric reserve estimate, data from drilled wells and seismic surveys are used to develop geologic interpretations. The effective pore space (porosity), water saturation, and net hydrocarbon thickness of the subsurface formations are calculated through evaluation of well logs, core analysis, and formation test data.

Subsurface formations are mapped to determine area and net hydrocarbon thickness for each reservoir. Reservoir pressure, fluid volume, and temperature data from formation fluid samples are used to determine the change in volume of oil and gas that flow from higher pressure conditions deep underground to lower pressure conditions at the surface. All of these data are compiled, analyzed and applied to standard equations for the calculation of hydrocarbons in place within the reservoirs. Standard recovery factor equations are then applied to the hydrocarbon – in - place estimates to calculate proved and unproved reserves.

Performance Methods

In performance-technique methods, reserves are estimated using mathematical or graphical techniques of production decline curve analysis and material balance. These techniques are used throughout the oil industry in assessing individual well, reservoir, or field performance and in forecasting future reserves. In decline analysis, a plot of daily production rate against time is most frequently used. Once a well or reservoir can no longer produce at its maximum capacity, the production rate declines. This production rate plotted against time can be extrapolated into the future to predict the remaining reserves. Another type of decline analysis is daily production rate plotted against cumulative production, which can also be used to predict remaining reserves. The declining daily rate is extrapolated to predict remaining reserves.

Another performance method, material balance, is used to estimate the amount of hydrocarbons in place. Given the premise that the pressure-volume relationship of a reservoir remains constant as hydrocarbons are produced, it is possible to equate expansion of reservoir fluids with reservoir voidage caused by fluid withdrawal minus any water influx. For depletion-drive gas reservoirs, a plot of the pressure/gas compressibility factor (P/Z) versus cumulative gas production gives a good estimate of gas-in-place. Recoverable gas reserves are extrapolated to an abandonment reservoir pressure.

Reserves and Related Data Reported by Area

The Gulf of Mexico has been divided into three planning areas for administrative purposes; these planning areas (Western, Central, and Eastern) are shown in figures 4, 5, and 6, respectively. Each planning area is subdivided into smaller areas, which in turn are divided into numbered blocks. Fields in the Gulf of Mexico are identified by the smaller area name

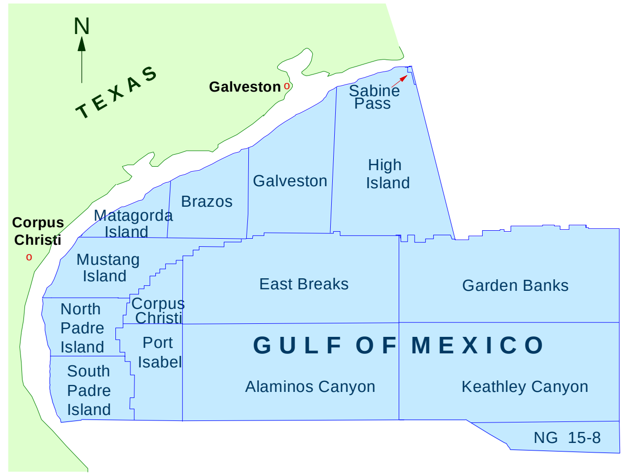

Figure 4.—Western Planning Area, Gulf of Mexico, Outer Continental Shelf.

Figure 5.—Central Planning Area, Gulf of Mexico, Outer Continental Shelf.

Figure 6.—Eastern Planning Area, Gulf of Mexico, Outer Continental Shelf.

and block number of discovery — for example, East Cameron Block 271 Field. As the field is developed, the limits often expand into adjacent blocks and areas. These adjacent blocks are then identified as part of the original field and are given that field name. Statistics in this report are presented as area totals compiled under each field name. All of the data associated with East Cameron Block 271 Field are therefore included in the East Cameron totals, although part of the field extends into the adjacent area of Vermilion. There are four exceptions to the above field-naming techniques: Tiger Shoal and Lighthouse Point, included in South Marsh Island; Coon Point, included in Ship Shoal; and Bay Marchand, included in South Timbalier.

There were 851 active fields in the federally regulated part of the Gulf of Mexico. An updated list of the active and expired fields can be found in the ***OCS Operations Field Directory, (June 2000)***, on the GOM Region's Internet homepage. For this report, 790 proved active producing and non-producing fields and 58 unproved active fields were studied. Also included were 194 proved depleted fields (abandoned with production) to give a complete record of cumulative oil and gas production. Not studied were 127 fields expired, relinquished, or terminated without production and 3 unproved active fields. In 1998, twenty-five proved fields were depleted and 9 unproved fields expired.

Reserves data and various classifications of fields, leases, boreholes, and completions are presented as area totals in tables 1 and 2, and the table 3 series. Dashes on these tables are used to preserve the proprietary nature of data. (The table 3 series will be discussed in the section "Reserves Reported by Geologic Age," beginning on page 8.) Figure 7 provides a geographical representation

Table 1.—Estimated oil and gas reserves for 984 proved and 58 unproved fields by area, Gulf of Mexico, Outer Continental Shelf, December 31, 1998.

(Reserves: oil expressed in millions of barrels at 60 °F and 1 atmosphere, gas in billions of cubic feet at 60 °F and 15.025 psia.)

Area(s) (Figs. 4, 5, and 6)	Number of fields						Proved reserves		Cumulative production through 1998		Remaining proved reserves		Unproved reserves	
	Proved active prod	Proved active nonprod	Proved expired depleted	Unproved active	Unproved studied	Expired nonprod	Oil	Gas	Oil	Gas	Oil	Gas	Oil	Gas
Western Planning Area														
Brazos	25	1	11	1	0	2	11	3,321	9	2,685	2	636	-	-
Galveston	21	0	23	0	0	4	52	1,943	38	1,550	14	393	-	-
High Island and Sabine Pass	84	2	31	3	3	16	373	14,580	305	12,371	68	2,209	-	-
Matagorda Island	27	0	2	0	0	3	25	5,473	18	4,067	7	1,406	-	-
Mustang Island	20	0	7	0	0	6	8	2,134	4	1,391	4	743	-	-
N. & S. Padre Island	4	0	4	0	0	2	0	490	0	415	0	75	-	-
Western Slope*	21	4	0	10	10	12	585	3,247	186	1,316	399	1,931	-	-
Western Planning Area Subtotal	***202***	***7***	***78***	***14***	***13***	***45***	***1,054***	***31,188***	***560***	***23,795***	***494***	***7,393***	***67***	***603***
Central Planning Area														
Chandeleur	7	0	3	0	0	0	0	395	0	317	0	78	-	-
East Cameron	44	1	15	0	0	5	339	11,022	283	9,408	56	1,614	-	-
Eugene Island	59	1	12	0	0	8	1,565	18,797	1,361	16,163	204	2,634	-	-
Grand Isle	15	1	0	2	2	2	937	4,396	882	3,983	55	413	-	-
Main Pass and Breton Sound	50	2	12	5	4	8	995	5,777	844	4,740	151	1,037	-	-
Mobile	23	1	1	0	0	3	0	2,578	0	955	0	1,623	-	-
Ship Shoal	48	3	10	2	1	5	1,308	11,581	1,181	10,482	127	1,099	-	-
South Marsh Island	39	2	6	0	0	3	805	13,751	753	12,481	52	1,270	-	-
South Pass	12	0	1	0	0	1	1,071	4,261	952	3,523	119	738	-	-
South Pelto	7	0	1	0	0	0	147	958	127	752	20	206	-	-
South Timbalier	39	2	7	3	3	4	1,484	9,333	1,281	7,230	203	2,103	-	-
Vermilion	62	2	14	0	0	6	502	15,468	446	14,300	56	1,168	-	-
Viosca Knoll	18	0	1	2	2	0	0	196	0	97	0	99	-	-
West Cameron and Sabine Pass	71	0	25	3	3	6	196	18,426	159	16,213	37	2,213	-	-
West Delta	20	0	4	0	0	2	1,356	5,175	1,238	4,622	118	553	-	-
Central Slope**	42	9	4	27	27	28	2,507	9,404	841	3,616	1,666	5,788	-	-
Central Planning Area Subtotal	***556***	***24***	***116***	***44***	***42***	***81***	***13,212***	***131,518***	***10,348***	***108,882***	***2,864***	***22,636***	***928***	***4,499***
Eastern Planning Area Subtotal*	***0***	***1***	***0***	***3***	***3***	***1***	-	***5***	-	-	-	***5***	-	-
GOM Total	***758***	***32***	***194***	***61***	***58***	***127***	***14,266***	***162,711***	***10,908***	***132,677***	***3,358***	***30,034***	***995***	***5,102***
	984													

*Western Slope includes Alaminos Canyon, Corpus Christi, East Breaks, Garden Banks, Keathley Canyon, and Port Isabel.
**Central Slope includes Atwater Valley, Ewing Bank, Green Canyon, Lund, Mississippi Canyon, Viosca Knoll (slope), and Walker Ridge.
***Eastern Planning Area includes Charlotte Harbor, Destin Dome, Pensacola and others. Unproved reserves data are included with Central Planning Area.

of locations for the 984 proved fields in the Gulf of Mexico. Estimates of proved reserves for these fields, both producing and non-producing, are presented as area totals in table 1. Figure 8 provides a geographical representation of the 61 unproved active fields in the Gulf of Mexico. Estimates of unproved reserves are presented as planning area subtotals.

The Eastern Planning Area totals for unproved reserves are included in the Central Planning Area subtotals. The status of Gulf of Mexico OCS Federal oil and gas leases as of December 31, 1998, is presented in table 2. There are 8,123 active leases (1,993 proved active, 109 unproved qualified, and 6,021 unproved active) and 9,218 relinquished leases (831 proved depleted and 8,387 expired).

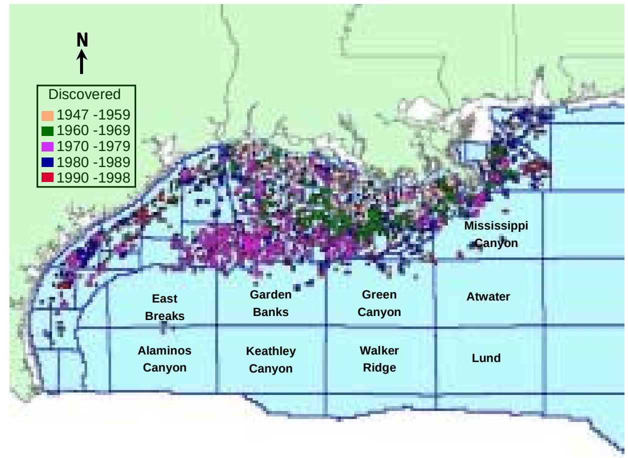

Figure 7.—Gulf of Mexico, 984 proved fields (790 active and 194 depleted).

Table 2.—Status of oil and gas leases, boreholes, and completions by area, Gulf of Mexico, Outer Continental Shelf, December 31, 1998.

(All statistics associated with fields are presented within area totals compiled under each field name.)

Area(s) (Figs. 4, 5, and 6)	Number of leases					Number of boreholes		Number of active completions
	Proved active	Proved depleted	Unproved qualified	Unproved active	Expired	Drilled	Abandoned	
Western Planning Area								
Brazos	48	24	1	74	259	490	330	180
Galveston	38	42	0	95	467	583	483	137
High Island and Sabine Pass	173	87	4	221	777	2,668	1,638	1,145
Matagorda Island	58	16	0	28	122	538	271	317
Mustang Island	35	12	0	70	331	356	229	148
N. & S. Padre Island	5	8	1	44	264	143	118	29
Western Slope*	53	3	11	1,613	940	572	350	159
Western Planning Area Subtotal	***410***	***192***	***17***	***2,145***	***3,160***	***5,350***	***3,419***	***2,115***
Central Planning Area								
Chandeleur	8	8	0	7	24	66	38	28
East Cameron	115	76	0	173	451	1,865	1,148	789
Eugene Island	200	70	0	141	364	4,213	2,388	1,891
Grand Isle	56	14	4	32	108	1,380	931	463
Main Pass and Breton Sound	134	50	6	103	313	2,149	1,023	1,401
Mobile	38	1	0	42	56	112	49	66
Ship Shoal	162	50	6	128	354	3,177	1,822	1,502
South Marsh Island	116	38	0	91	237	2,380	1,258	1,964
South Pass	44	12	0	22	76	1,995	1,036	974
South Pelto	17	4	1	6	28	349	205	145
South Timbalier	120	31	10	139	332	2,723	1,626	973
Vermilion	147	86	1	175	423	2,623	1,628	1,051
Viosca Knoll	48	4	11	160	212	106	60	107
West Cameron and Sabine Pass	196	156	5	329	635	3,135	2,078	1,172
West Delta	79	31	0	49	145	2,173	1,366	1,251
Central Slope**	102	8	42	2,138	1,133	1,751	1,076	522
Central Planning Area Subtotal	***1,582***	***639***	***86***	***3,735***	***4,891***	***30,197***	***17,732***	***14,299***
Eastern Planning Area Subtotal*	***1***	***0***	***6***	***141***	***336***	***50***	***43***	***1***
GOM Total	***1,993***	***831***	***109***	***6,021***	***8,387***	***35,597***	***21,194***	***16,415***

*Western Slope includes Alaminos Canyon, Corpus Christi, East Breaks, Garden Banks, Keathley Canyon, and Port Isabel.
**Central Slope includes Atwater Valley, Ewing Bank, Green Canyon, Lund, Mississippi Canyon, Viosca Knoll (slope), and Walker Ridge.
***Eastern Planning Area includes Charlotte Harbor, Destin Dome, Pensacola and others. Unproved reserves data are included with Central Planning Area.

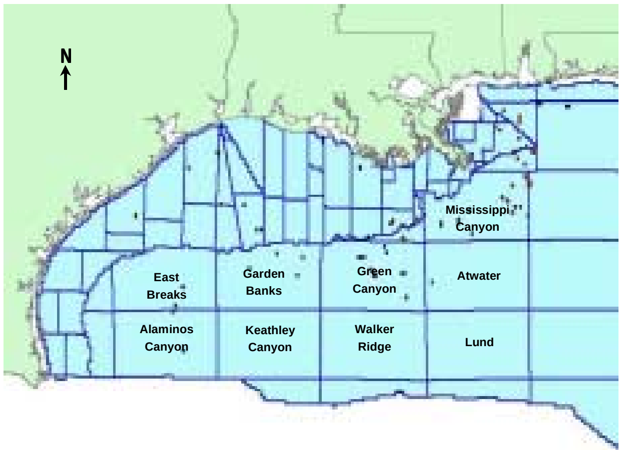

Figure 8.—Gulf of Mexico, 61 unproved active fields (58 studied and 3 not studied).

Definitions of the table 2 subgroups follow:

Proved Active **—** Leases within the designated 790 proved active fields presented in table 1.

Proved Depleted **—** Leases relinquished after oil and gas production. The leases associated with the 194 depleted fields are represented here along with other produced, relinquished leases that are part of currently active fields.

Unproved Qualified **—** Leases associated with the 61 unproved active fields. The leases have qualified as producible under 30 CFR 250.11, but the operators have not established a commitment to produce. These fields may be classified as unproved possible or unproved probable.

Unproved Active **—** Active exploratory leases not yet qualified as producible or associated with any field.

Expired **—** Leases relinquished by the operator without having produced any oil or gas, although some were once qualified as producible under 30 CFR 250.11. There are 127 expired fields with no production.

The total number of boreholes drilled and the number of boreholes plugged and abandoned are also shown in table 2. There were 1,098 boreholes spudded during 1998, compared with 1,258 during 1997, and 1,059 during 1996. The last column of table 2 presents the total number of active completions per area. Active completions are defined as those with perforations open to the formation and not isolated by permanent plugs; service wells (injection, disposal, or water source) are included. The presence or absence of production or injection is not considered. The number of boreholes and the number of active completions as of December 31, 1998 are based on reports received by the MMS at the time the count was made in 1999. These numbers may change when all data have been received, processed, and edited.

Reserves Reported by Geologic Age

In this report, the 984 proved and 58 unproved fields have been classified at the geologic series level. The different geologic age classifications in use by MMS are shown in figure 9. Paleontological examinations of borehole cuttings, along with regional analysis of geological and geophysical data, were used in determining the age classifications. Table 3 shows the distribution of reserves and production data by geologic age and planning area. Tables 3a through 3d also show the distribution of reserves and production data by geologic age, but further subdivide the planning areas as area totals. Unproved reserves are not reported as area totals to maintain the confidential nature of unproved fields.

Province	System	Series	Chronozone	
			Name	Biozone
Cenozoic	Quaternary	Pleistocene	UPL	Sangamon fauna Trimosina "A" 1st Trimosina "A" 2nd Hyalinea "B" / Trimosina "B"
			MPL	Angulogerina "B" 1st Angulogerina "B" 2nd
			LPL	Lenticulina 1 Valvulineria "H"
	Tertiary	Pliocene	UP	Buliminella 1
			LP	Textularia "X"
		Miocene	UM3	Robulus "E" / Bigenerina "A" Cristellaria "K"
			UM1	Discorbis 12
			MM9	Bigenerina 2 Textularia "W"
			MM7	Bigenerina humblei Cristellaria "I" Cibicides opima
			MM4	Amphistegina "B" Robulus 43 Cristellaria 54 / Eponides 14 Gyroidina "K"
			LM4	Discorbis "B" Marginulina "A"
			LM2	Siphonina davisi
			LM1	Lenticulina hanseni
		Oligocene	UO	Discorbis Zone / Robulus "A" Heterostegina texana
			MO	Camerina "A"
			LO	Textularia warreni
		Eocene	UE	Hantkenina alabamensis Camerina moodybranchensis
			ME	Discorbis yeguaensis
			LE	Globorotalia wilcoxensis
		Paleocene	UL	Globorotalia velascoensis Cristellaria longiforma
			LL	Globorotalia uncinata
Mesozoic	Cretaceous	Upper	UK5	Globotruncana mayaroensis Globotruncana fornicata Globotruncana concavata
			UK2	Planulina eaglefordensis Rotalipora cushmani
		Lower	LK8	Lenticulina washitaensis Cythereis fredericksburgensis
			LK6	Eocytheropteron trinitiensis Orbitolina texana Rehacythereis? aff. R. glabrella
			LK3	Choffatella decipiens Schuleridea acuminata
	Jurassic	Upper	UJ4	Epistomina uhligi Epistomina mosquensis Pseudocyclammina jaccardi
		Middle	MJ	
		Lower	LJ	
	Triassic	Upper	UTR	
		Middle	MTR	
		Lower	LTR	

* Lithostratigraphic nomenclature is often used informally to identify strata that are correlative to Gulf Coast chronostratigraphic reference sections (provincial stages). For example, subsurface beds containing diagnostic Upper Cretaceous faunas are frequently defined as "Navarro."

Figure 9.—Gulf of Mexico MMS geologic time scale.

Table 3.—Estimated oil and gas reserves for 984 proved and 58 unproved fields by geologic age, Gulf of Mexico, Outer Continental Shelf, December 31, 1998.

(Reserves: oil expressed in millions of barrels at 60 ºF and 1 atmosphere, gas in billions of cubic feet at 60 ºF and 15.025 psia.)

Geologic Age	Number of proved reservoirs	Proved reserves		Cumulative production through 1998		Remaining proved reserves		Number of unproved reservoirs	Unproved reserves	
		Oil	Gas	Oil	Gas	Oil	Gas		Oil	Gas
Western Planning Area										
Pleistocene	1,575	662	12,841	383	9,848	279	2,993	32	53	574
Pliocene	21	252	581	74	158	178	423	2	14	14
Miocene	2,252	139	17,721	103	13,779	36	3,942	4	0	10
Oligocene, Cretaceous, and Jurassic	12	1	45	0	10	1	35	3	0	5
Western Planning Area Subtotal	***3,860***	***1,054***	***31,188***	***560***	***23,795***	***494***	***7,393***	***41***	***67***	***603***
Central Planning Area										
Pleistocene	8,614	4,383	51,989	3,510	44,123	873	7,866	69	148	518
Pliocene	6,340	4,082	24,645	3,279	21,225	803	4,420	26	90	170
Miocene	6,377	4,747	51,625	3,559	42,804	1,188	8,821	78	690	3,187
Oligocene, Cretaceous, and Jurassic	22	0	2,259	0	730	0	1,529	6	0	624
Central Planning Area Subtotal	***21,353***	***13,212***	***131,518***	***10,348***	***108,882***	***2,864***	***22,636***	***179***	***928***	***4,499***
Eastern Planning Area Subtotal*	***1***	***0***	***5***	***0***	***0***	***0***	***5***	***4***	***0***	***0***
GOM Total	***25,214***	***14,266***	***162,711***	***10,908***	***132,677***	***3,358***	***30,034***	***224***	***995***	***5,102***

***Eastern Planning Area includes Charlotte Harbor, Destin Dome, Pensacola and others. Unproved reserves data are included with Central Planning Area.

Table 3a.—Estimated oil and gas reserves for Pleistocene reservoirs in 518 proved and 22 unproved fields by area, Gulf of Mexico, Outer Continental Shelf, December 31, 1998.

(Reserves: oil expressed in millions of barrels at 60 ºF and 1 atmosphere, gas in billions of cubic feet at 60 ºF and 15.025 psia.)

Area(s)	Number of proved reservoirs	Proved reserves		Cumulative production through 1998		Remaining proved reserves		Number of unproved reservoirs	Unproved reserves	
		Oil	Gas	Oil	Gas	Oil	Gas		Oil	Gas
Western Planning Area										
Galveston	21	1	88	1	76	0	12	0	-	-
High Island and Sabine Pass	1,365	328	10,083	270	8,610	58	1,473	1	-	-
Western Slope*	189	333	2,670	112	1,162	221	1,508	31	-	-
Western Planning Area Subtotal	***1,575***	***662***	***12,841***	***383***	***9,848***	***279***	***2,993***	***32***	***53***	***574***
Central Planning Area										
East Cameron	696	244	5,481	206	4,706	38	775	0	-	-
Eugene Island	1,819	983	12,137	848	10,539	135	1,598	0	-	-
Grand Isle	117	10	1,427	7	1,311	3	116	0	-	-
Main Pass and Breton Sound	24	48	133	39	105	9	28	2	-	-
Ship Shoal	1,461	782	6,876	725	6,357	57	519	0	-	-
South Marsh Island	822	482	3,420	450	3,096	32	324	1	-	-
South Pass	219	159	1,329	140	1,151	19	178	0	-	-
South Pelto	75	22	23	20	17	2	6	0	-	-
South Timbalier	1,028	380	5,339	301	4,261	79	1,078	5	-	-
Vermilion	853	173	3,332	140	2,874	33	458	0	-	-
Viosca Knoll	1	0	0	0	0	0	0	0	-	-
West Cameron and Sabine Pass	885	45	7,923	29	6,847	16	1,076	9	-	-
West Delta	174	200	786	183	668	17	118	0	-	-
Central Slope**	440	855	3,783	422	2,191	433	1,592	52	-	-
Central Planning Area Subtotal	***8,614***	***4,383***	***51,989***	***3,510***	***44,123***	***873***	***7,866***	***69***	***148***	***518***
Eastern Planning Area Subtotal*	-	-	-	-	-	-	-	-	-	-
GOM Total	***10,189***	***5,045***	***63,830***	***3,893***	***53,971***	***1,152***	***10,859***	***101***	***201***	***1,092***

*Western Slope includes Alaminos Canyon, Corpus Christi, East Breaks, Garden Banks, Keathley Canyon, and Port Isabel.
**Central Slope includes Atwater Valley, Ewing Bank, Green Canyon, Lund, Mississippi Canyon, Viosca Knoll (slope), and Walker Ridge.
***Eastern Planning Area includes Charlotte Harbor, Destin Dome, Pensacola and others. Unproved reserves data are included with Central Planning Area.

Table 3b.—Estimated oil and gas reserves for Pliocene reservoirs in 300 proved and 15 unproved fields by area, Gulf of Mexico, Outer Continental Shelf, December 31, 1998.

(Reserves: oil expressed in millions of barrels at 60 ºF and 1 atmosphere, gas in billions of cubic feet at 60 ºF and 15.025 psia.)

Area(s)	Number of proved reservoirs	Proved reserves		Cumulative production through 1998		Remaining proved reserves		Number of unproved reservoirs	Unproved reserves	
		Oil	Gas	Oil	Gas	Oil	Gas		Oil	Gas
Western Planning Area										
High Island and Sabine Pass	1	0	4	0	4	0	0	0	-	-
Western Slope*	20	252	577	74	154	178	423	2	-	-
Western Planning Area Subtotal	***21***	***252***	***581***	***74***	***158***	***178***	***423***	***2***	***14***	***14***
Central Planning Area										
Chandeleur	2	0	16	0	11	0	5	0	-	-
East Cameron	172	15	983	12	843	3	140	0	-	-
Eugene Island	1,142	433	3,120	385	2,554	48	566	0	-	-
Grand Isle	357	345	1,089	319	947	26	142	2	-	-
Main Pass and Breton Sound	369	226	1,234	189	1,093	37	141	0	-	-
Ship Shoal	708	370	2,550	319	2,242	51	308	0	-	-
South Marsh Island	603	139	4,546	129	4,090	10	456	0	-	-
South Pass	808	773	2,413	704	1,919	69	494	0	-	-
South Pelto	164	67	274	61	235	6	39	0	-	-
South Timbalier	526	287	2,088	226	1,454	61	634	0	-	-
Vermilion	579	182	3,103	166	2,848	16	255	0	-	-
Viosca Knoll	4	0	5	0	3	0	2	0	-	-
West Cameron and Sabine Pass	170	3	1,009	2	885	1	124	0	-	-
West Delta	581	503	1,193	460	1,036	43	157	0	-	-
Central Slope**	155	739	2,022	307	1,065	432	957	24	-	-
Central Planning Area Subtotal	***6,340***	***4,082***	***25,645***	***3,279***	***21,225***	***803***	***4,420***	***26***	***90***	***170***
Eastern Planning Area Subtotal* ***	-	-	-	-	-	-	-	-	-	-
GOM Total	***6,361***	***4,334***	***26,226***	***3,353***	***21,383***	***981***	***4,843***	***28***	***104***	***184***

*Western Slope includes Alaminos Canyon, Corpus Christi, East Breaks, Garden Banks, Keathley Canyon, and Port Isabel.
**Central Slope includes Atwater Valley, Ewing Bank, Green Canyon, Lund, Mississippi Canyon, Viosca Knoll (slope), and Walker Ridge.
***Eastern Planning Area includes Charlotte Harbor, Destin Dome, Pensacola and others. Unproved reserves data are included with Central Planning Area.

The Pleistocene reserves trend is presented in figure 10 and corresponds to the *Sangamon Fauna* through *Valvulineria* "H" biozones. Production within the Pleistocene extends from the Galveston area to east of the modern-day mouth of the Mississippi River. Pleistocene productive sands are limited to the east and west because of a lack of sediment influx at the edge of the depocenter. Downdip deepwater Pleistocene production occurs in the East Breaks through Mississippi Canyon areas, and well control suggests sands continue beyond the Sigsbee Escarpment. As of December 31, 1998, the Pleistocene produced from 518 fields. Proved reserves were 5.04 billion barrels (Bbbl) and 63.8 trillion cubic feet (Tcf). Remaining proved reserves were 1.15 Bbbl and 10.9 Tcf.

The Pliocene reserves trend is presented in figure 11 and corresponds to the *Buliminella* 1 through *Textularia X* biozones. Production within the Pliocene extends

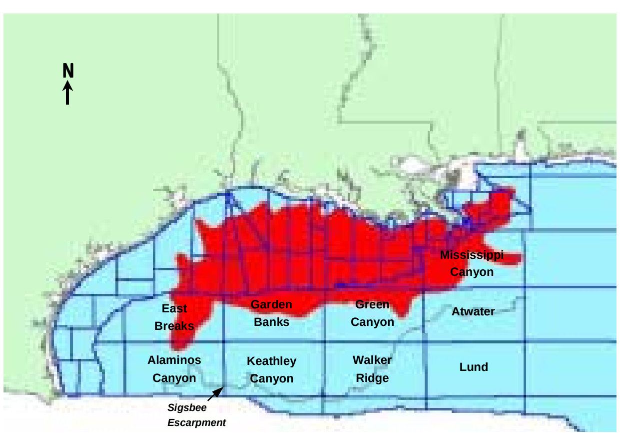

Figure 10.—Pleistocene reserves trend.

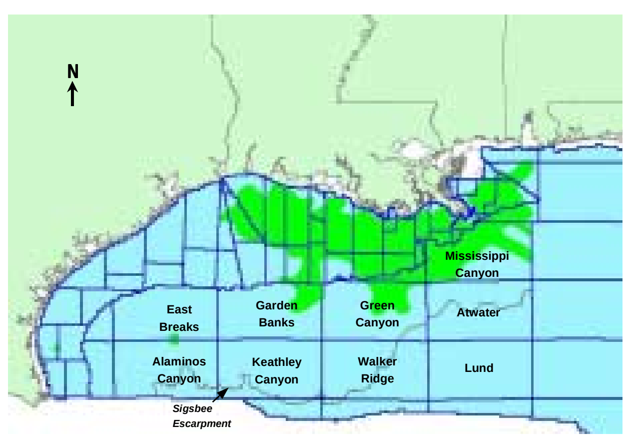

Figure 11.—Pliocene reserves trend.

Table 3c.—Estimated oil and gas reserves for Miocene reservoirs in 494 proved and 30 unproved fields by area, Gulf of Mexico, Outer Continental Shelf, December 31, 1998.

(Reserves: oil expressed in millions of barrels at 60 °F and 1 atmosphere, gas in billions of cubic feet at 60 °F and 15.025 psia.)

Area(s)	Number of proved reservoirs	Proved reserves		Cumulative production through 1998		Remaining proved reserves		Number of unproved reservoirs	Unproved reserves	
		Oil	Gas	Oil	Gas	Oil	Gas		Oil	Gas
Western Planning Area										
Brazos	429	12	3,321	9	2,685	3	635	0	-	-
Galveston	406	50	1,856	37	1,474	13	382	0	-	-
High Island and Sabine Pass	496	45	4,492	35	3,756	10	736	4	-	-
Matagorda Island	475	25	5,473	18	4,067	7	1,406	0	-	-
Mustang Island	357	7	2,090	4	1,382	3	708	0	-	-
N. & S. Padre Island	89	0	489	0	415	0	75	0	-	-
Western Slope*	0	0	0	0	0	0	0	0	-	-
Western Planning Area Subtotal	***2,252***	***139***	***17,721***	***103***	***13,779***	***36***	***3,942***	***4***	***0***	***10***
Central Planning Area										
Chandeleur	22	0	379	0	306	0	73	0	-	-
East Cameron	298	79	4,558	65	3,859	14	699	0	-	-
Eugene Island	468	149	3,541	127	3,070	22	471	0	-	-
Grand Isle	481	582	1,880	555	1,724	27	156	8	-	-
Main Pass and Breton Sound	913	721	4,404	616	3,540	105	864	7	-	-
Mobile	26	0	332	0	228	0	104	0	-	-
Ship Shoal	466	157	2,155	138	1,883	19	272	3	-	-
South Marsh Island	431	184	5,785	174	5,295	10	490	0	-	-
South Pass	219	140	518	109	454	31	64	0	-	-
South Pelto	207	58	661	46	501	12	160	0	-	-
South Timbalier	614	817	1,906	753	1,516	64	390	1	-	-
Vermilion	542	147	9,033	140	8,577	7	456	0	-	-
Viosca Knoll	26	0	183	0	92	0	91	0	-	-
West Cameron and Sabine Pass	999	148	9,494	128	8,481	20	1,013	0	-	-
West Delta	610	652	3,196	596	2,917	56	279	0	-	-
Central Slope**	55	913	3,600	112	361	801	3,239	59	-	-
Central Planning Area Subtotal	***6,377***	***4,747***	***51,625***	***3,559***	***42,804***	***1,188***	***8,821***	***78***	***690***	***3,187***
Eastern Planning Area Subtotal*	***1***	***-***	***5***	***-***	***-***	***-***	***5***	***3***	***-***	***-***
GOM Total	***8,630***	***4,886***	***69,351***	***3,662***	***56,583***	***1,224***	***12,768***	***85***	***690***	***3,197***

*Western Slope includes Alaminos Canyon, Corpus Christi, East Breaks, Garden Banks, Keathley Canyon, and Port Isabel.
**Central Slope includes Atwater Valley, Ewing Bank, Green Canyon, Lund, Mississippi Canyon, Viosca Knoll (slope), and Walker Ridge.
***Eastern Planning Area includes Charlotte Harbor, Destin Dome, Pensacola and others. Unproved reserves data are included with Central Planning Area.

Table 3d.—Estimated oil and gas reserves for Oligocene, Cretaceous, and Jurassic reservoirs in 18 proved and 4 unproved fields by area, Gulf of Mexico, Outer Continental Shelf, December 31, 1998.

(Reserves: oil expressed in millions of barrels at 60 ° F and 1 atmosphere, gas in billions of cubic feet at 60 °F and 15.025 psia.)

Area(s)	Number of proved reservoirs	Proved reserves		Cumulative production through 1998		Remaining proved reserves		Number of unproved reservoirs	Unproved reserves	
		Oil	Gas	Oil	Gas	Oil	Gas		Oil	Gas
Western Planning Area										
High Island and Sabine Pass	4	0	1	0	1	0	0	0	-	-
Mustang Island and N. & S. Padre	8	1	44	0	9	1	35	0	-	-
Western Slope*	0	0	0	0	0	0	0	3	-	-
Western Planning Area Subtotal	***12***	***1***	***45***	***0***	***10***	***1***	***35***	***3***	***0***	***5***
Central Planning Area										
Main Pass and Breton Sound	2	0	5	0	0	0	5	0	-	-
Mobile	19	0	2,245	0	727	0	1,518	0	-	-
Viosca Knoll	1	0	9	0	3	0	6	6	-	-
Central Planning Area Subtotal	***22***	***0***	***2,259***	***0***	***730***	***0***	***1,529***	***6***	***0***	***624***
Eastern Planning Area Subtotal*	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***1***	***0***	***0***
GOM Total	***34***	***1***	***2,304***	***0***	***740***	***1***	***1,564***	***10***	***0***	***629***

*Western Slope includes Alaminos Canyon, Corpus Christi, East Breaks, Garden Banks, Keathley Canyon, and Port Isabel.
***Eastern Planning Area includes Charlotte Harbor, Destin Dome, Pensacola and others. Unproved reserves data are included with Central Planning Area.

from south of Mobile Bay in the east to North Padre Island in the west. Upper Pliocene productive sands also extend into the deepwater areas of Garden Banks, Green Canyon, Ewing Bank, and Mississippi Canyon. Well control suggests Pliocene sands extend at least as far as the Sigsbee Escarpment. As of December 31, 1998, the Pliocene produced from 300 fields. Proved reserves were 4.33 Bbbl and 26.2 Tcf. Remaining proved reserves were 0.98 Bbbl and 4.8 Tcf.

The Miocene reserves trend is presented in figure 12 and corresponds to the *Robulus* "E" / *Bigenerina* "A" through *Cristellaria* "R" biozones. Production within the Miocene extends from east of the Mississippi River to as far west as North Padre Island. Miocene productive sands also extend into deep waters in Viosca Knoll and Mississippi Canyon. Well control suggests sands continue beyond the Sigsbee Escarpment. As of December 31, 1998, the Miocene produced from 494 fields. Proved reserves were 4.89 Bbbl and 69.4 Tcf. Remaining proved reserves were 1.22 Bbbl and 12.8 Tcf.

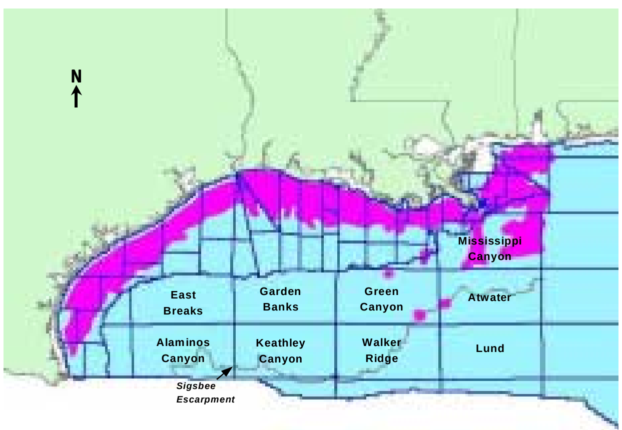

Figure 12.—Miocene reserves trend.

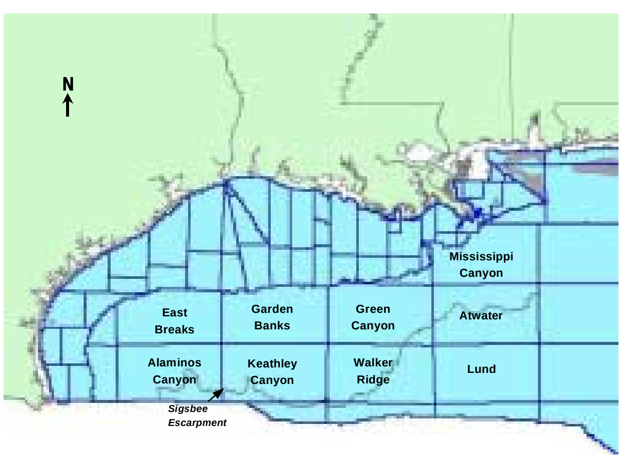

Figure 13.—Oligocene, Cretaceous, and Jurassic reserves trends.

The Oligocene, Cretaceous, and Jurassic reserves trends are presented in figure 13. These reservoirs are mainly Jurassic Norphlet sands, but also include Lower Cretaceous and Carbonates. Production within the Jurassic is limited to east of the Mississippi River in the Mobile area. Well control suggests reservoir sands continuing eastward into Destin Dome. As of December 31, 1998, these trends produced from 18 fields. Proved reserves were 1.00 Bbbl and 2.3 Tcf. Remaining proved reserves were 1.00 Bbbl and 1.6 Tcf.

Figure 14 shows the percentages of reserves and production data by geologic age. There is a fairly even distribution of oil reserves; however, the Pliocene has a significantly lower percentage of gas reserves than the Miocene and Pleistocene.

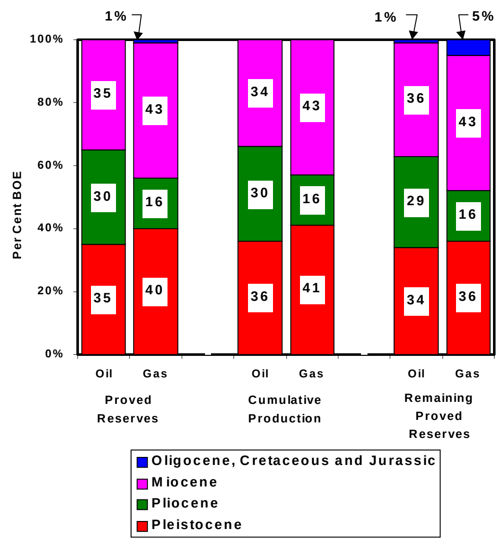

Figure 14.—Distribution of reserves and production data by geologic age.

Historical Exploration and Discovery Pattern and Trends

In large part, the following section was taken from ***An Exploration and Discovery Model: a Historic Perspective - Gulf of Mexico Outer Continental Shelf*** by Gary Lore. The information presented has been updated to reflect the current database.

It is informative to review the historic exploration and development activities that resulted in the world-class hydrocarbon-producing basin that is the Gulf of Mexico. Each of the four decades of activity will be examined by reviewing the status of exploration and development activity and the number of fields and quantities of proved reserves discovered during each decade. The discovery year is defined as the year in which the first well encountering significant hydrocarbons reached total depth. This date may differ from the year in which the field discovery was announced.

Figure 15 shows the locations of the proved fields discovered prior to December 31, 1959. As expected, initial development was in shallower, nearshore waters concentrated mainly in the areas off central and western Louisiana. This development primarily reflected the gradual extension of existing inland drilling and development technologies into the open-water marine environments, and the infancy of marine seismic acquisition activities. Early exploratory drilling in very shallow water on the shelf utilized barges and platforms. The mid-1950's witnessed the introduction of submersible and jack-up drilling rigs. During this period, 248 exploratory wells were drilled, culminating in the discovery of 67 proved fields. It was also during this period that 7 of the top 10 fields in the Gulf of Mexico, based on proved reserves, were discovered.

Figure 16 shows the location of the proved fields discovered in the 1960's. These discoveries were still concentrated offshore central and western Louisiana. Though still confined to the shelf (600 feet [ft] or less), field discoveries advanced seaward into deeper waters. During this decade, 2,020 exploratory wells were drilled and 145 proved fields discovered. The tenth largest field in the Gulf of Mexico, SS 208, was discovered in the sixties.

Figure 17 shows the location of the proved fields discovered in the 1970's. This period reflects continued drilling and development on the shelf, with an increase in field discoveries on the seaward portion of the shelf, predominantly in the Pleistocene depocenter. The introduction of dynamic positioning systems, used on drillships and semi-submersible drilling rigs, further opened up deepwater exploration. Frontier drilling on the shelf-slope margin led to discoveries of new fields that have been termed the *Flexure Trend*. During this decade, 2,934 exploratory wells were drilled, resulting in the discovery of 275 proved fields. The largest field in the Gulf of Mexico, EI 330, was discovered in 245 ft of water during this decade. Another significant field discovery was MC 194, the first field in over 1,000 ft of water.

During the 1980's, development activities occurred over practically the entire central and western Gulf of Mexico shelf, as well as on the upper slope, as can be

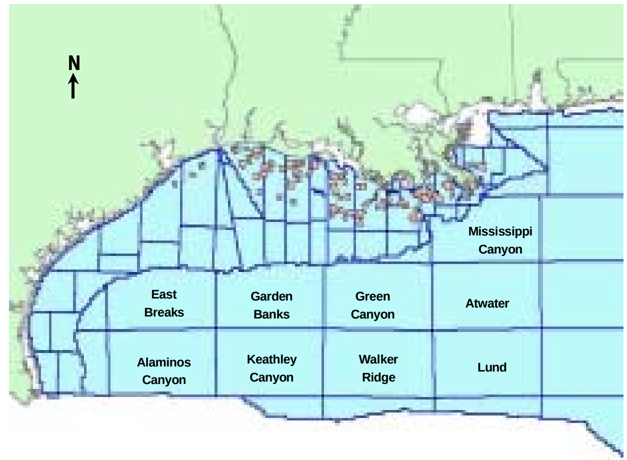

Figure 15.—Location of proved fields discovered 1947-1959, Gulf of Mexico OCS.

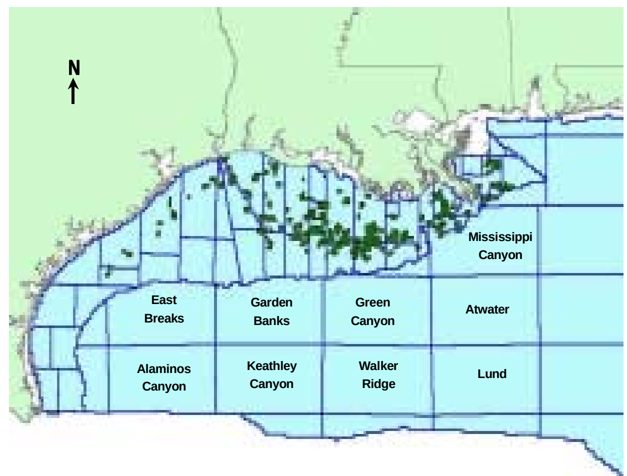

Figure 16.—Location of proved fields discovered 1960-1969, Gulf of Mexico OCS.

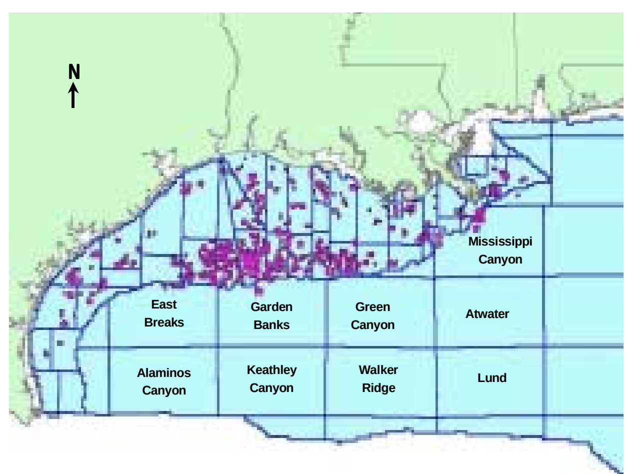

Figure 17.—Location of proved fields discovered 1970-1979, Gulf of Mexico OCS.

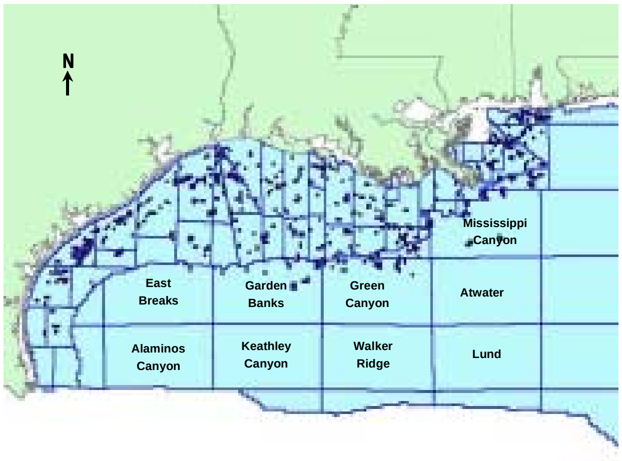

Figure 18.—Location of proved fields discovered 1980-1989, Gulf of Mexico OCS.

seen in figure 18. In addition, the first Norphlet fields and a Miocene shallow bright spot play were discovered in the eastern Central Gulf of Mexico planning area. Exploratory drilling had now reached water depths beyond 6,000 ft, putting the slope within reach. In this decade, 3,997 exploration wells were drilled, resulting in the discovery of 352 proved fields (20 were discovered in water depths greater than 1,000 ft).

From 1990 to 1998 (figure 19), 3,329 exploration wells were drilled, resulting in the discovery of 145 proved fields. The 1990's have seen the refinement and reduction in cost of tension leg platform design, and a much expanded use of subsea completions. Available production histories have documented high production rates for deepwater fields. The expanding use of horizontal drilling is also increasing productivity of specific reservoirs. Computer workstation technology using three-dimensional seismic data sets has allowed for reduced risk and greater geologic assurance in both

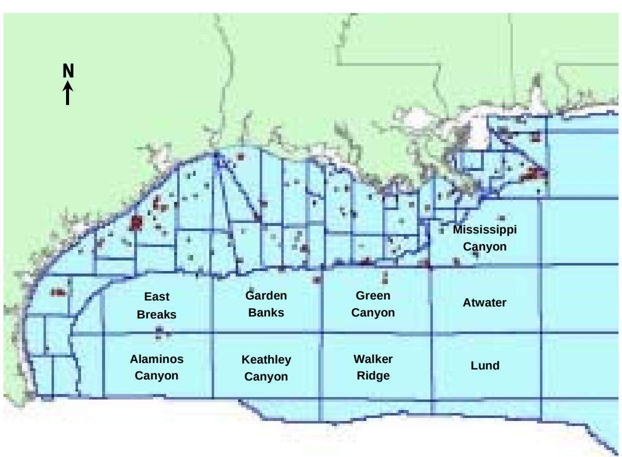

Figure 19.—Location of proved fields discovered 1990-1998, Gulf of Mexico OCS.

exploration and field development. This has also allowed for exploration of new plays, such as the *Subsalt Play*. Reserve estimates for individual fields discovered in the 1990's are generally conservative and will experience significant reserves appreciation.

Figure 20 shows annual field discoveries by geologic age for the 984 proved fields. Figure 21 shows annual field discoveries of proved reserves by geologic age for the 984 proved fields. These two figures show several trends over the last 50 years. From the mid-1940's through the 1960's, the largest number of fields discovered were of Miocene age and these fields contributed the largest reserves additions. This trend reflected a continuation of the nearshore operating environment. The decade of the 1970's saw a large peak in the discovery of Pleistocene fields and a correspondingly large addition of Pleistocene age reserves. Technological advances in seismic data and

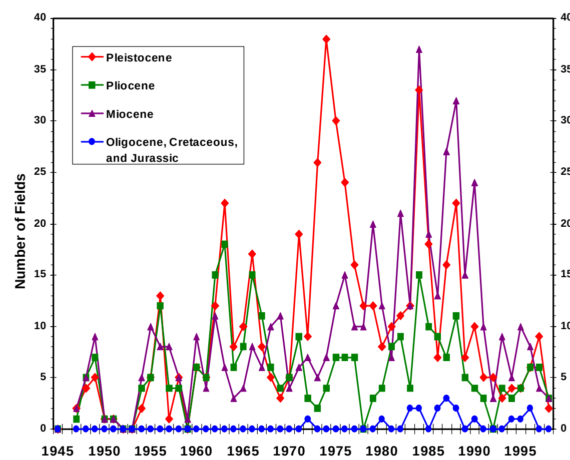

Figure 20.—Annual number of field discoveries by geologic age, 984 proved fields.

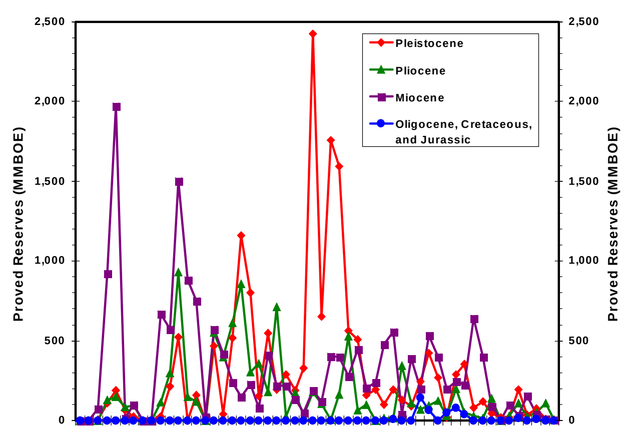

Figure 21.—Annual discoveries of proved reserves by geologic age, 984 proved fields.

deeper drilling accounted for the resurgence of Miocene field discoveries and reserve additions in the decade of the 1980's. This decade also saw the first Jurassic Norphlet discoveries. Completing an evaluation of the 1990's is premature, but the large discoveries in Pleistocene, Pliocene, and Miocene deepwater reservoirs will surely play a major role in future production. The MMS OCS Report MMS 2000-022, ***Deepwater Gulf of Mexico: America's Emerging Frontier***, available on the GOM Region's Internet homepage, provides a detailed report of deepwater activities.

Field-Size Distribution

Reserve sizes are expressed in terms of barrels of oil equivalent (BOE) and added to the liquid reserves. The conversion factor of 5,620 standard cubic feet of gas equals 1 BOE is based on the average heating values of domestic hydrocarbons. A geometric progression, developed by the USGS (Drew and others, 1982), was selected for field-size distribution ranges (figure 22).

Class	Deposit -size range *	Class	Deposit -size range *	Class	Deposit -size range *
1	0 to 0.006	8	0.380 to 0.760	14	24.3 to 48.6
2	0.006 to 0.012	9	0.760 to 1.52	15	48.6 to 97.2
3	0.012 to 0.024	10	1.52 to 3.04	16	97.2 to 194.3
4	0.024 to 0.047	11	3.04 to 6.07	17	194.3 to 388.6
5	0.047 to 0.095	12	6.07 to 12.14	18	388.6 to 777.2
6	0.095 to 0.190	13	12.14 to 24.3	19	777.2 to 1554.4
7	0.190 to 0.380	* Million barrels of oil equivalent (MMBOE)			

Figure 22.—Description of deposit-size classes.

In this report, fields are classified as either oil or gas; however, some fields do produce both products, making a field type determination difficult. Generally, fields with a gas/oil ratio (GOR) less than 9,700 standard cubic feet per stock tank barrel (SCF/STB) are classified as oil.

The field-size distribution based on proved reserves for 984 proved fields is shown in figure 23(a). Of the 984 proved oil and gas fields, there are 181 proved oil fields represented in figure 24(a) and 803 gas fields shown in figure 25(a). The Western Gulf of Mexico field-size distributions are displayed on figures 23(b), 24(b), and 25(b). Figures 23(c), 24(c), and 25(c) present the Central Gulf of Mexico field-size distributions of proved reserves. The field-size distribution, derived from unproved reserves for 58 unproved fields, is shown in figure 26(a). There are 28 unproved oil fields in figure 26(b) and 30 unproved gas fields in figure 26(c). Another 3 unproved active fields were not studied.

Analysis of the 984 proved oil and gas fields indicates that the Gulf of Mexico is currently a gas-prone basin. Figure 27 summarizes the total reserves, the median (exceeded by 50%), and the mean (arithmetic average) from the field-size distributions. This figure also provides information on the largest two field-size ranges of the proved fields. The GOR (gas divided by oil) of the 181 proved oil fields is 3,128 SCF/STB. The GOR of the 28 unproved oil fields is 2,858 SCF/STB. The average yield (condensate divided by gas) for the 803 proved gas fields is 20.0 barrels of condensate per million cubic feet (MMcf) of gas. The average yield of the 30 unproved gas fields is 18.9 barrels of condensate per MMcf.

Figure 28 shows the cumulative percent distribution of proved reserves in billion barrels of oil equivalent (BBOE), by field rank. All 984 proved fields in the Gulf of Mexico OCS are included in this figure. A characteristic often observed in hydrocarbon-producing basins is a rapid drop-off in size from that of largest known field to that of smaller ones. Twenty-five percent of the proved reserves are contained in the 24 largest fields. Fifty percent of the proved reserves are contained in the 77 largest fields. Ninety percent of the proved reserves are contained in the 364 largest fields.

Figure 29 shows the distribution of the number of fields and proved reserves by water depth. The water depth ranges used in this figure, 651-1,300 ft, 1,301-2,600 ft, and greater than 2,600 ft, closely approximate the 200-400 meter, 400-800 meter and greater than 800 meter water depths used in the OCS Deepwater Royalty Relief Act (DWRRA). Proved reserves, reported in million barrels of oil equivalent (MMBOE), are associated with the 984 proved fields. The 58 unproved active fields are presented to show current interest and development. Sixty-five percent of the proved reserves in the Gulf of Mexico are located in less than 200 ft of water. The shelf, generally considered as less than 650 ft of water, accounts for 89 percent of the proved reserves. Development of the slope, generally considered greater than 650 ft of water, reflects a sizable amount of proved reserves associated with a few fields. The mean

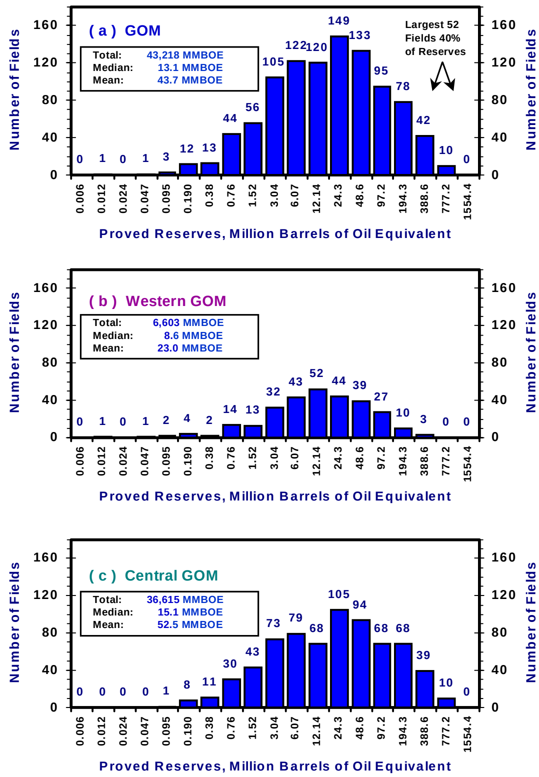

Figure 23.—Field-size distribution of proved fields: (a) 984 fields, GOM; (b) 287 fields, Western GOM; (c) 697 fields, Central and Eastern GOM.

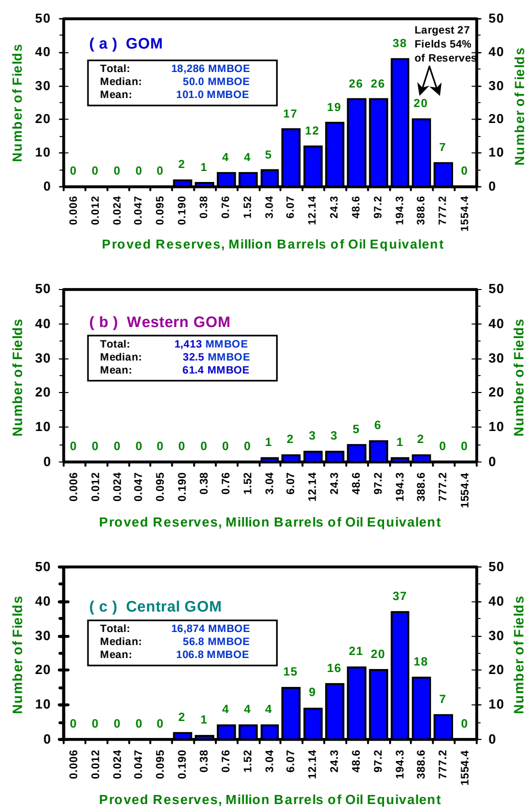

Figure 24.—Field-size distribution of proved oil fields: (a) 181 fields, GOM; (b) 23 fields, Western GOM; (c) 158 fields, Central GOM.

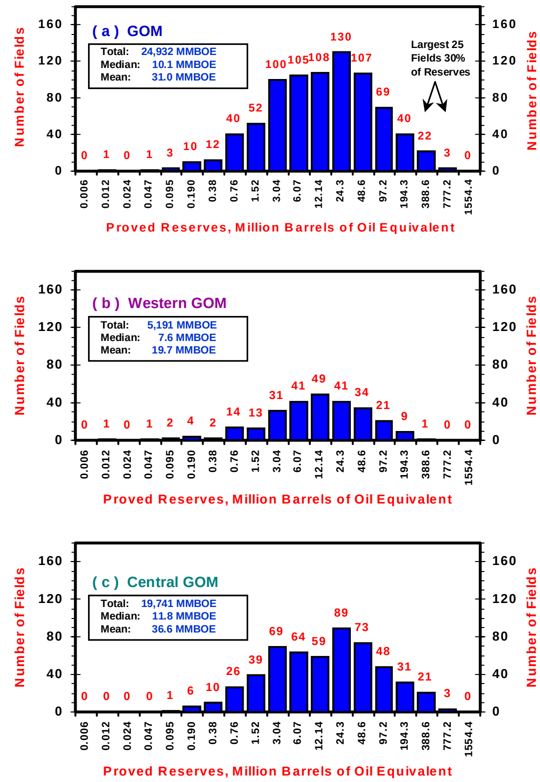

Figure 25.—Field-size distribution of proved gas fields: (a) 803 fields, GOM; (b) 264 fields, Western GOM; (c) 539 fields, Central and Eastern GOM.

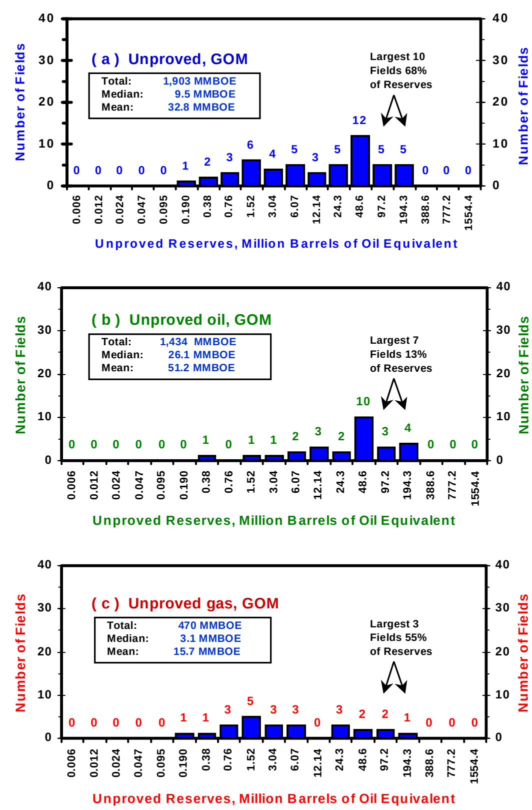

Figure 26.—Field-size distribution of unproved fields: (a) 58 fields, GOM; (b) 28 oil fields, GOM; (c) 30 gas fields, GOM.

Description of Fields	Figure Number	Median *	Mean *	Largest Fields	
				Number	Reserves
984 Proved	Fig. 23a	13.0	43.9	52	40 %
181 Proved Oil	Fig. 24a	50.0	101.0	27	54 %
803 Proved Gas	Fig. 25a	10.1	31.0	25	30 %
58 Unproved	Fig. 26a	9.5	32.8	10	68 %
28 Unproved Oil	Fig. 26b	26.1	51.2	7	13 %
30 Unproved Gas	Fig. 26c	3.1	15.7	3	55 %
* Million barrels of oil equivalent (MMBOE)					

Figure 27.—GOM field–size distribution.

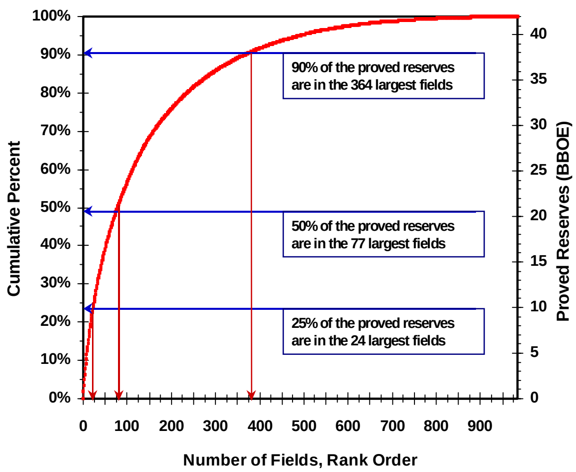

Figure 28.—Cumulative percent total reserves versus rank order of field size for 984 proved fields.

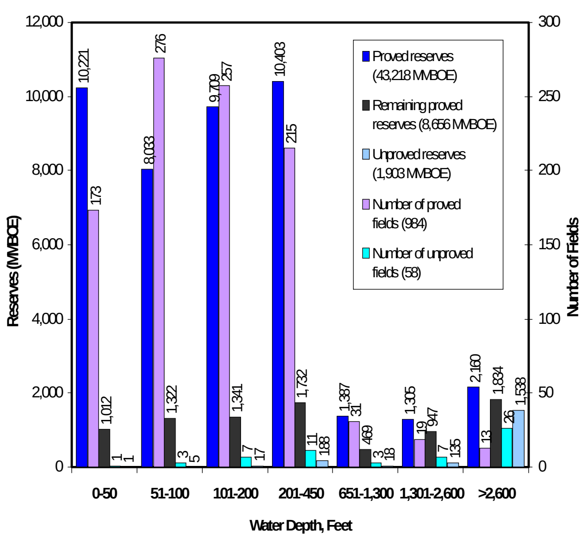

Figure 29.—Field and reserves distribution by water depth.

proved reserves per proved field in the Gulf of Mexico is 43.9 MMBOE. For fields in water depths between 651 and 1,300 ft, the mean proved reserves per proved field is 44.7 MMBOE. For fields in water depths greater than 1,300 ft, the mean proved reserves per proved field is 108.3 MMBOE. This is expected, given the economics associated with deepwater drilling and development.

Figure 30 shows the largest 20 fields ranked in order by remaining proved reserves. Nine of the ten top fields lie in water depths of greater than 1,300 ft and account for 21 percent of the remaining proved reserves in the Gulf of Mexico.

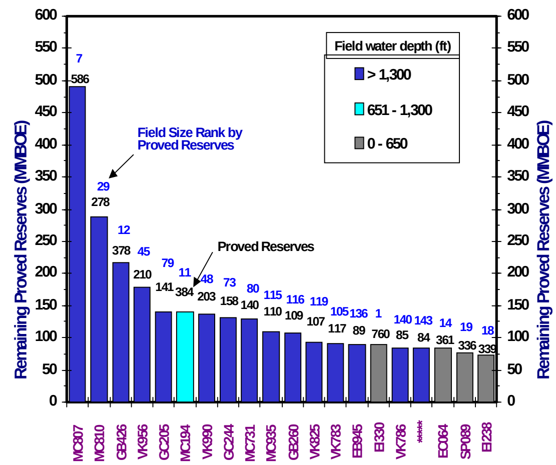

Figure 30.—Largest 20 fields ranked by remaining proved reserves.
(Note: ** - Proprietary)**

Estimates of proved reserves on the slope are increasing. This trend is expected to continue in the future due to additional exploration and development. Of the 63 proved fields in water depths greater than 650 ft, 47 are producing, 3 are depleted, and 13 are undeveloped. Included in these totals are 9 new proved fields containing proved reserves of 394 MMBOE. There are 36 unproved active fields in water depths greater than 650 feet. These fields contain 1,691 MMBOE of estimated unproved reserves representing 89 percent of the Gulf of Mexico total.

Planned deepwater development in the Gulf of Mexico will likely help slow the trend of declining domestic production and rising oil imports. Exploration and development is gradually increasing with technological advances, expansion of the infrastructure, and the enactment of the DWRRA. This act has given industry the incentive to explore and produce deepwater resources.

Table 4 lists the 50 largest proved fields ranked by proved reserves expressed in BOE. Rank, field name, new discoveries, discovery year, water depth, field type, field GOR, proved reserves, cumulative production through 1998, and remaining proved reserves are presented. If a new field was discovered in 1997 or 1998, the name is replaced with an asterisk to preserve the proprietary nature of the data. There were 31 new fields proved in 1998, and if there were any in the top 50, they would be identified with an asterisk in the column labeled “New Disc.” Unproved fields’ reserve data will not be listed. A complete listing of all 984 proved fields, ranked by proved reserves, is available on the Gulf of Mexico Region’s Internet homepage or by contacting the MMS at 1-800-200-GULF.

Reservoir-Size Distribution

The size distributions of the proved reservoirs are shown in figures 31, 32, and 33. The size ranges, which are based on proved reserves, are presented on a geometrically progressing, horizontal scale. These sizes also correspond with the USGS deposit-size ranges shown in figure 22; however, for figures 32 and 33, the proved reserves are presented in MMbbl and Bcf, respectively. The number of reservoirs in each size grouping, shown as percentages of the total, is presented on a linear vertical scale. For the combination reservoirs (saturated oil rims with associated gas caps), shown in figure 31, gas is converted to BOE and added to the liquid reserves. Proved uneconomic reservoirs are excluded from these distributions, but are included in the table 3 series.

Figure 31 shows the reservoir-size distribution, on the basis of proved BOE, for 1,610 proved combination reservoirs. The median is 1.2 MMBOE and the mean is 3.6 MMBOE. The GOR for the oil portion of the reservoirs is 1,459 SCF/STB, and the yield for the gas cap is 31.3 barrels of condensate per MMcf of gas.

Figure 32 shows the reservoir-size distribution, on the basis of proved oil, for 7,232 proved undersaturated oil reservoirs. The median is 0.3 MMbbl, the mean is 1.3 Mbbl, and the GOR is 1,445 SCF/STB.

Figure 33 shows the reservoir-size distribution, on the basis of proved gas, for 13,176 proved nonassociated gas reservoirs. The median is 3.0 billion cubic feet (Bcf) of gas, the mean is 10.3 Bcf, and the yield is 11.5 barrels of condensate per MMcf of gas.

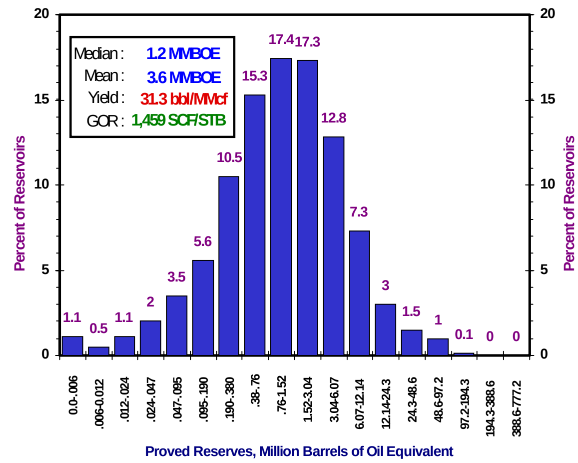

Figure 31.—Reservoir-size distribution, 1,610 proved combination reservoirs.

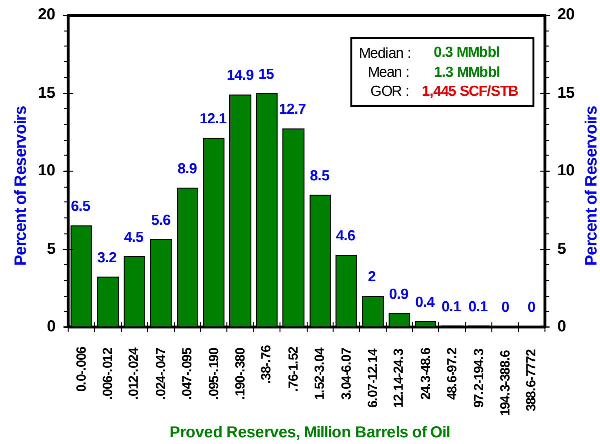

Figure 32.—Reservoir-size distribution, 7,232 proved oil reservoirs.

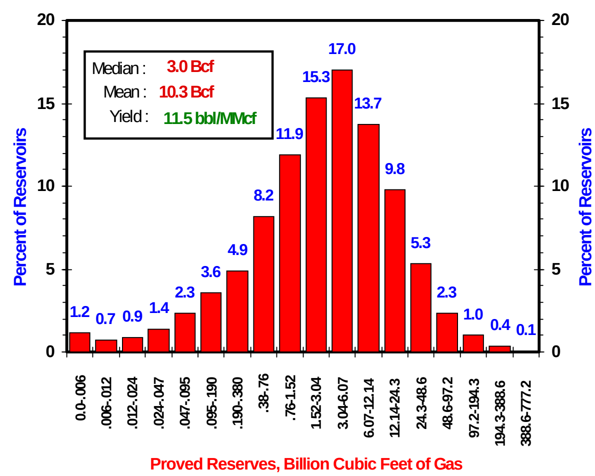

Figure 33.—Reservoir-size distribution, 13,176 proved gas reservoirs.

Table 4. —Gulf of Mexico fields by rank order, based on proved BOE reserves, top 50 fields.

Rank	Field name		New disc	Disc year	Water depth (feet)	Field type	Field GOR (SCF/STB)	Proved reserves Oil (MMbbl)	Proved reserves Gas (Bcf)	Proved reserves BOE (MMbbl)	Cumulative production through 1998 Oil (MMbbl)	Cumulative production through 1998 Gas (Bcf)	Cumulative production through 1998 BOE (MMbbl)	Remaining proved reserves Oil (MMbbl)	Remaining proved reserves Gas (Bcf)	Remaining proved reserves BOE (MMbbl)
1	EI	330	-	1971	246	O	4,636	416.3	1,929.9	759.7	372.8	1,676.2	671.1	43.5	253.7	88.6
2	WD	030	-	1949	49	O	1,556	555.7	864.5	709.5	522.7	766.5	659.0	33.1	98.0	50.5
3	GI	043	-	1956	139	O	4,332	364.5	1,578.9	645.4	343.5	1,431.8	598.3	21.0	147.1	47.1
4	BM	002	-	1949	50	O	1,064	514.2	547.0	611.5	499.1	501.1	588.2	15.2	45.9	23.3
5	TS	000	-	1958	13	G	87,411	36.4	3,180.1	602.2	35.9	3,090.4	585.8	0.5	89.7	16.4
6	VR	014	-	1956	26	G	63,250	48.0	3,036.8	588.4	47.2	2,957.0	573.3	0.9	79.8	15.1
7	MC	807	-	1989	2,994	O	958	500.2	479.5	585.6	80.8	81.5	95.3	419.5	398.0	490.3
8	MP	041	-	1956	42	O	5,827	235.3	1,370.9	479.2	229.6	1,276.0	456.7	5.7	94.9	22.5
9	VR	039	-	1948	38	G	80,536	30.9	2,489.9	474.0	29.7	2,407.5	458.1	1.2	82.3	15.8
10	SS	208	-	1960	105	O	6,133	207.5	1,272.5	433.9	199.9	1,199.3	413.3	7.6	73.2	20.6
11	MC	194	-	1975	1,023	O	2,827	255.2	721.4	383.6	161.3	461.0	243.3	93.9	260.5	140.3
12	GB	426	-	1987	2,863	O	4,052	219.7	890.1	378.1	110.1	291.1	161.9	109.6	599.0	216.2
13	GI	016	-	1948	53	O	1,273	295.1	375.6	361.9	288.2	357.1	351.7	6.9	18.4	10.2
14	EC	064	-	1957	49	G	57,254	32.3	1,847.8	361.1	24.0	1,427.9	278.1	8.3	419.9	83.0
15	WD	073	-	1962	177	O	2,245	257.1	577.2	359.8	241.6	507.2	331.9	15.4	70.0	27.9
16	ST	172	-	1963	98	G	147,660	13.0	1,916.1	353.9	9.4	1,686.2	309.4	3.6	230.0	44.5
17	SP	061	-	1967	222	O	1,895	254.3	482.0	340.1	233.8	438.8	311.8	20.6	43.2	28.3
18	EI	238	-	1964	147	G	17,601	82.0	1,442.7	338.7	60.3	1,149.6	264.8	21.7	293.0	73.8
19	SP	089	-	1969	422	O	4,561	185.2	844.6	335.5	163.4	533.0	258.3	21.8	311.6	77.2
20	ST	021	-	1957	46	O	1,696	251.0	425.6	326.7	235.0	373.5	301.5	16.0	52.1	25.2
21	EI	292	-	1964	211	G	91,865	18.3	1,677.4	316.7	15.7	1,531.8	288.2	2.6	145.6	28.5
22	SP	027	-	1954	63	O	4,513	174.6	788.1	314.9	145.1	714.1	272.1	29.6	74.0	42.7
23	EC	271	-	1971	171	G	19,795	68.8	1,361.5	311.0	61.9	1,215.8	278.2	6.9	145.6	32.8
24	WC	180	-	1961	48	G	155,325	10.7	1,665.3	307.0	9.9	1,603.1	295.2	0.8	62.2	11.9
25	SM	048	-	1961	100	G	55,661	27.9	1,551.2	303.9	26.1	1,421.5	279.0	1.8	129.7	24.8
26	WC	587	-	1971	210	G	122,406	12.8	1,567.8	291.8	11.9	1,410.0	262.8	0.9	157.8	29.0
27	WD	079	-	1966	125	O	3,798	173.8	660.1	291.3	157.4	598.2	263.8	16.4	61.9	27.4
28	SS	176	-	1956	100	G	20,599	62.0	1,277.2	289.3	57.5	1,219.4	274.5	4.5	57.8	14.8
29	MC	810	-	1990	3,885	O	2,367	202.2	478.5	287.3	0.0	0.0	0.0	202.2	478.5	287.3
30	ST	176	-	1963	127	G	13,679	82.9	1,134.4	284.8	71.3	961.4	242.4	11.6	173.0	42.4
31	SS	169	-	1960	62	O	5,358	141.0	755.6	275.5	127.2	690.4	250.0	13.9	65.2	25.5
32	ST	135	-	1956	130	O	3,536	166.8	589.8	271.7	154.6	458.8	236.3	12.1	130.9	35.4
33	EI	296	-	1971	214	G	66,969	20.8	1,394.6	269.0	20.0	1,368.8	263.6	0.8	25.8	5.4
34	HI	573A	-	1973	340	O	8,274	103.0	851.9	254.5	92.1	730.9	222.1	10.9	121.0	32.4
35	MI	623	-	1980	82	G	92,959	13.9	1,296.0	244.5	9.8	908.3	171.4	4.2	387.7	73.2
36	SM	066	-	1963	124	G	243,132	5.2	1,254.1	228.3	4.7	1,194.7	217.3	0.4	59.4	11.0
37	SM	023	-	1960	82	G	38,708	28.9	1,117.4	227.7	27.6	1,031.0	211.0	1.3	86.3	16.6
38	WC	192	-	1954	57	G	59,627	19.4	1,154.6	224.8	17.5	1,084.3	210.5	1.8	70.3	14.3
39	GI	047	-	1955	88	O	3,508	137.8	483.4	223.8	131.2	466.3	214.1	6.7	17.2	9.7
40	SP	078	-	1972	206	G	12,051	71.1	857.0	223.6	56.3	750.5	189.9	14.8	106.4	33.7
41	SM	130	-	1973	215	O	1,375	177.6	244.2	221.1	171.9	222.1	211.4	5.7	22.2	9.7
42	PL	020	-	1951	31	O	5,640	109.2	616.0	218.8	97.4	532.9	192.2	11.8	83.1	26.6
43	SS	222	-	1966	142	G	12,774	65.3	833.6	213.6	61.2	797.2	203.0	4.1	36.4	10.6
44	VR	076	-	1949	32	G	209,242	5.6	1,163.6	212.6	4.7	1,075.2	196.0	0.9	88.4	16.6
45	VK	956	-	1985	3,244	O	10,106	75.0	757.6	209.8	17.4	81.2	31.9	57.6	676.4	177.9
46	ST	052	-	1948	58	O	5,449	105.0	571.9	206.7	79.3	391.5	148.9	25.7	180.4	57.8
47	WC	071	-	1955	40	G	55,360	18.7	1,037.2	203.3	17.2	967.1	189.3	1.5	70.0	14.0
48	VK	990	-	1981	1,445	O	1,501	159.9	239.9	202.5	54.9	63.8	66.3	104.9	176.1	136.3
49	SS	113	-	1955	41	O	4,027	115.3	464.1	197.8	108.5	428.0	184.7	6.7	36.1	13.1
50	EI	032	-	1949	12	G	17,745	47.3	839.8	196.8	41.4	791.3	182.2	5.9	48.5	14.5

There are no New Discoveries (New Disc) in the Top 50 Fields. A complete listing of all proved fields is available in digital format.

Production Rates and Discovery Trends

The mean daily production in the Gulf of Mexico OCS during 1998 was 1,009,000 bbl of crude oil, 157,000 bbl of gas condensate, 1.86 Bcf of casinghead gas, and 11.72 Bcf of gas-well gas. The mean GOR of oil wells was 1,841 SCF/STB, and the mean yield from gas wells was 13.37 barrels of condensate per MMcf of gas. Monthly production plots and data by field are also available on the Gulf of Mexico Region's Internet homepage or can be obtained on CD-ROM by contacting the MMS at 1-800-200-GULF.

Figures 34 and 35 show the frequency distribution of monthly production for completions active during 1998. Since the number of completions within a given range changes from month to month, the completion numbers presented are means of the 1998 monthly completion totals for each production range. The numbers shown in parentheses are also means of monthly counts for completions considered to be on continuous production. Completions off production for more than two days a month are not counted as continuously producing completions.

Figure 36 summarizes the data from monthly distributions of oil and gas production rates. The highest reported monthly oil production volume was from a Pleistocene reservoir with a subsea depth of 16,570 ft, during the month of December. The highest reported monthly gas production volume was from a Miocene reservoir with a subsea depth of 15,510 ft, during the month of May. The mean number of oil completions producing more than 1,000 bbl per day was 160, and the mean number of gas completions producing more than 10 MMcf per day was 312.

Annual production in the Gulf of Mexico OCS is shown in figure 37. The oil plot includes condensate, and the gas plot includes casinghead gas. Annual oil production is trimodal, reaching 376 MMbbl per year in 1971, and 350 to 356 MMbbl per year from 1984 through 1986. From 1986 through 1990, annual oil production declined 23 percent. From 1990 through 1998, annual oil production rose from 275 MMbbl to 444 MMbbl, a 61 percent increase. Annual gas production reached 4.9 Tcf per year in 1981 and 1990.

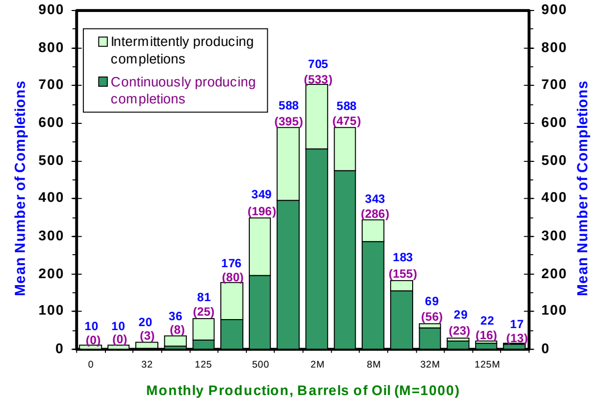

Figure 34.—Monthly distribution of oil production, 3,226 completions, (2,264) continuously producing completions.

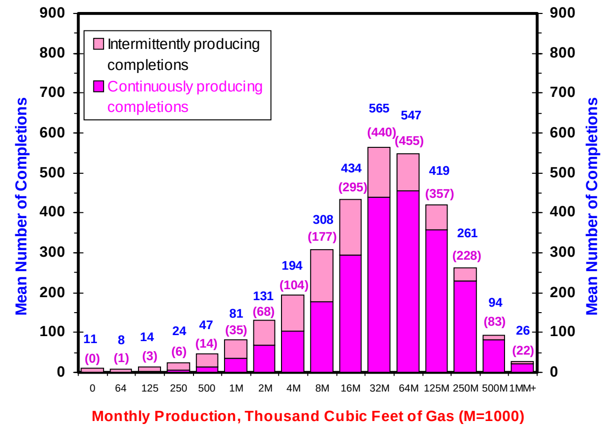

Figure 35.—Monthly distribution of gas production, 3,164 completions, (2,288) continuously producing completions.

1998	Oil	Gas
Mean Number of Producing Completions	3,226	3,164
Mean Number of Continuously Producing Completions	2,264	2,288
Highest Monthly Mean Number of Producing Completions	3,279 (January)	3,257 (May)
Lowest Monthly Mean Number of Producing Completions	3,141 (October)	3,021 (October)
Mean Production	9,515 bbl (313 bbl per day)	113 MMcf (3.7 MMcf per day)
Median Production	2,804 bbl (90 bbl per day)	48.7 MMcf (1.6 MMcf per day)
Highest Producing Rate for a Completion	959,958 bbl (30,966 bbl per day)	6,604 MMcf (195.6 MMcf per day)

Figure 36.—Monthly completion and production data.

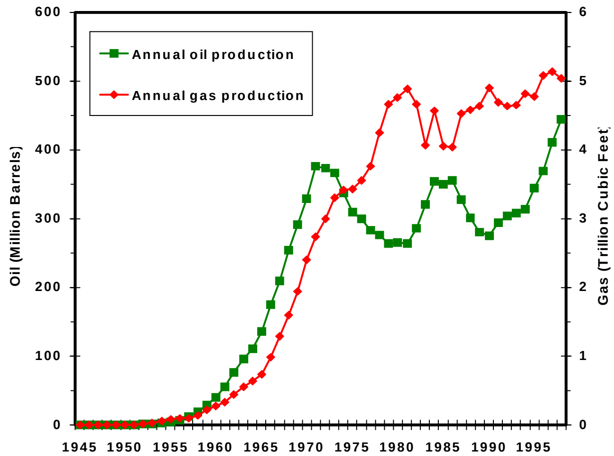

Figure 37.—Annual oil and gas production.

From 1990 through 1993, gas production declined 6 percent. From 1993 through 1998, annual gas production rose from 4.6 Tcf to a peak of 5.1 Tcf in 1997, an 11 percent increase.

Figure 38 presents proved reserves, cumulative production, and remaining proved reserves in BBOE as of December 31, 1998, summed according to field discovery year. Field depletion may be estimated by the relative positions of the cumulative production curve and the remaining proved reserves curve. For example, if the value of the remaining proved reserves is higher than the value of cumulative production for a given year, the aggregate depletion for fields discovered that year is less than 50 percent. The plot demonstrates that fields discovered after 1983, with the exception of 1988, are less than 50 percent depleted. The current trend is showing that overall field sizes are decreasing.

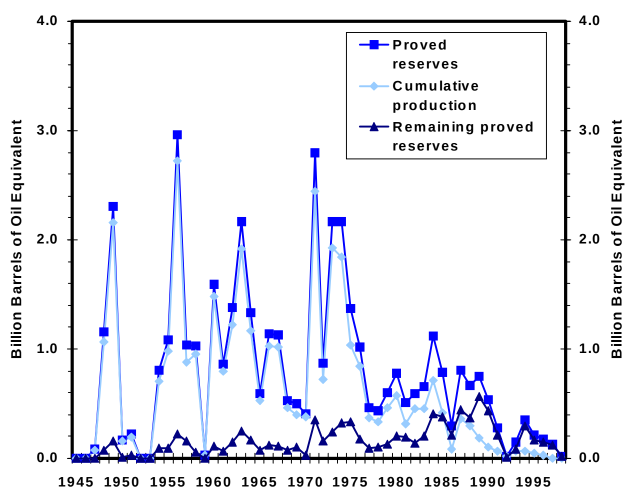

Figure 38.—Proved reserves and production by field discovery year.

Figure 39 is a plot of the number of proved gas and oil fields by discovery year. Linear regressions indicate the annual number of gas fields discovered has been steadily increasing, while the number of oil fields discovered has not varied much from year to year, never exceeding 11 and averaging only about 3.5 discoveries per year. Through 1959, 39 percent of all fields discovered were oil. This percentage declined steadily as more gas fields were discovered until only 13 percent of the fields discovered during the 1980's were oil fields. This reflects an industry change from oil production to gas production. The shift from oil to gas emphasis was fueled by several factors, including optimism concerning higher anticipated gas prices, realization of the inevitable decline in the size of oil fields being discovered, and the introduction of new seismic technologies that dramatically lowered the risk in identifying gas reservoirs (Lore, 1994).

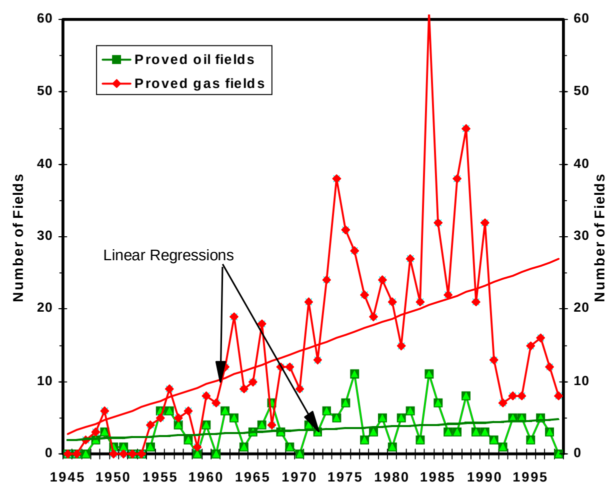

Figure 39.—Annual number of proved oil and gas field discoveries.

Figure 40 presents the number of proved fields and the mean field size by field discovery year. This plot shows that, though the number of discovered fields has typically been increasing from year to year, the mean size of the fields has been getting smaller. The mean field size discovered for the last few years is expected to increase because of reserves growth in proved fields and reserves additions in unproved fields discovered in recent years.

Figure 41 presents the number of proved and unproved fields and the average water depth of the fields discovered in each year. Clearly, exploration and resulting production are moving into deeper water, and this trend is expected to continue.

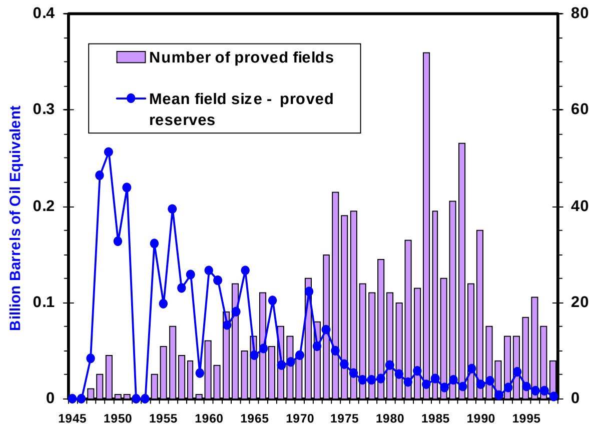

Figure 40.—Number of proved fields and mean field size by field discovery year.

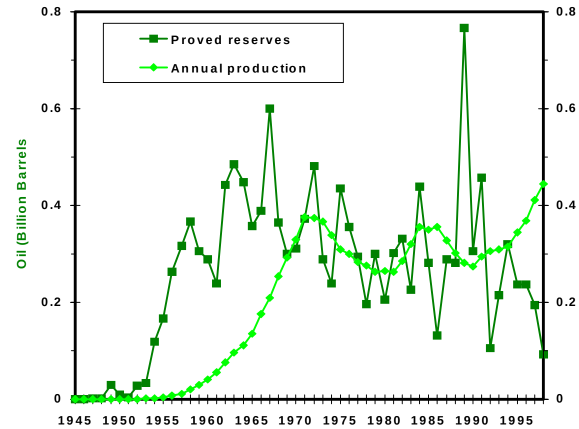

Figure 42.—Proved oil reserves by reservoir discovery year and annual oil production.

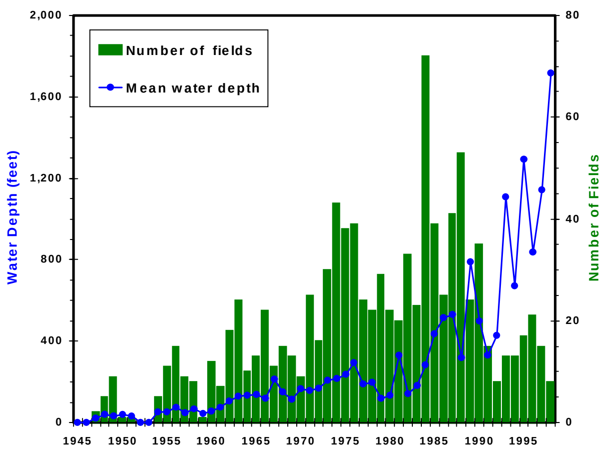

Figure 41.—Number of fields and mean water depth by field discovery year.

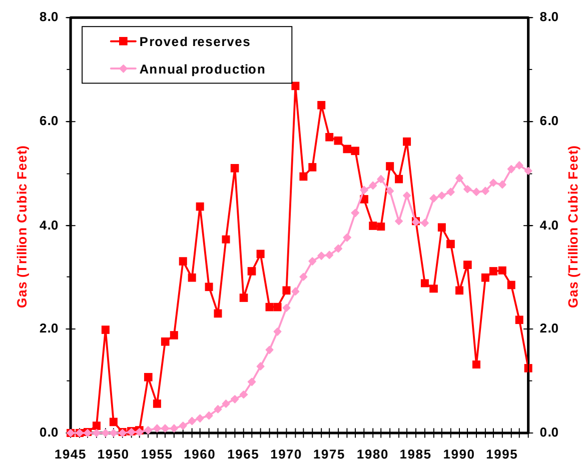

Figure 43.—Proved gas reserves by reservoir discovery year and annual gas production.

Figures 42 and 43 show proved oil and gas reserves and annual production by reservoir discovery year. All data presented in figure 42 include crude oil and condensate, and all data presented in figure 43 include associated and nonassociated gas. The year of discovery assigned to a reservoir is the year in which the first well encountering hydrocarbons penetrated the reservoir. For comparison with the rate of discoveries, the annual production of oil and gas is also shown. Since 1984, new proved reservoir discoveries, except for 1989 oil discoveries, are no longer offsetting annual production, indicating a decreasing trend in remaining proved reserves. Because of reserves growth, the proved reserves curve in both figures is expected to increase over what is shown.

Figure 44 presents the total footage drilled, the total number of wells drilled, and the number of exploratory and development wells drilled in the Gulf of Mexico OCS each year. All curves show a decline after the 1986 collapse in oil prices. A second decline occurred in 1991-92. Drilling increased from 1992-97, reflecting stable energy prices and improvements in exploration and production technology. The decline from 1997-98 is indicative of a decrease in energy prices.

Figure 45 presents the number of exploratory wells drilled each year by water depth. The plot shows the move toward drilling in deeper water, but also illustrates continued drilling on the shelf.

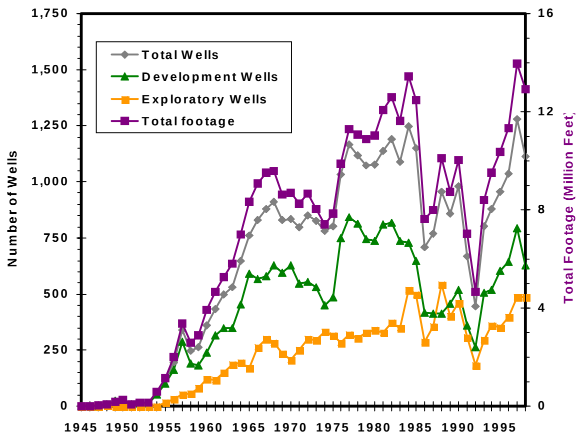

Figure 44.—Wells and footage drilled.

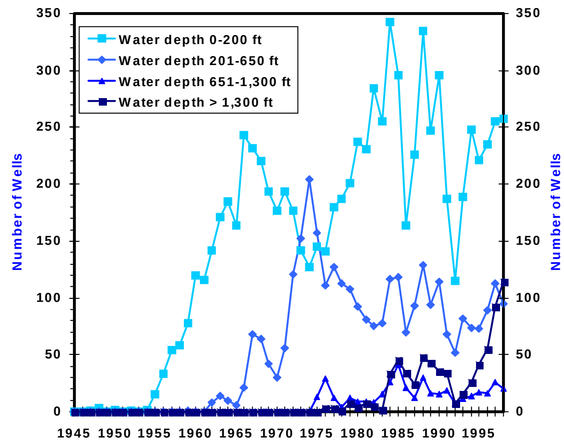

Figure 45.—Number of exploratory wells drilled by water depth.

Summary and Comparison of Proved Reserves

A summary of proved reserve estimates during the year and a comparison with estimates from last year's report (December 31, 1997) are shown in table 5. Recent proved field discoveries (9 oil fields and 22 gas fields) are summarized and tabulated as increases to proved reserves. For further clarification, recent field discoveries are identified as new fields added in the last year, even though some were discovered before 1998. Proved reserve estimates are revised as needed, resulting in increases as additional wells are drilled and new leases are added to existing fields, and decreases as reservoirs are depleted and leases relinquished. Complete reevaluations of existing field studies are conducted on the basis of changes in field development and/or production history. Increases and decreases of proved reserves are summarized and presented as changes because of revisions. Based on periodic reviews and revisions of field studies conducted since

Table 5.—Summary and comparison of proved oil and gas reserves as of December 31, 1997, and December 31, 1998.

	Oil (billion bbl)			Gas (trillion cu ft)		
Proved reserves:						
Previous estimates, as of 12/31/97*	13.67			158.4		
Discoveries		+0.32			+0.9	
Revisions		+0.28			+3.4	
Adjustments		0.00			0.0	
Net change		**+0.60**			**+4.3**	
Estimate, as of 12/31/98 (this report)			**14.27**			**162.7**
Cumulative production:						
Previous estimates, as of 12/31/97*	10.46			127.6		
Adjustments		+0.01			+0.1	
Production during 1998		+0.44			+5.0	
Net change		**+0.45**			**+5.1**	
Estimate, as of 12/31/98 (this report)			**10.91**			**132.7**
Remaining proved reserves:						
Previous estimates, as of 12/31/97*	3.21			30.8		
Discoveries		+0.32			+0.9	
Revisions		+0.28			+3.4	
Adjustments		-0.01			-0.1	
Production during 1998		-0.44			-5.0	
Net change		**+0.15**			**-0.8**	
Estimate, as of 12/31/98 (this report)			**3.36**			**30.0**

*Crawford and others, 1998

the 1997 report, the revisions for proved oil and gas reserves have resulted in a net increase. A net change in the proved oil and gas reserves is a result of combining both the discoveries and the revisions.

Table 5 demonstrates that the 1998 proved oil and gas discoveries, adjustments, and field revisions did exceed production. The remaining proved oil and gas reserves have increased since 1997.

Table 6.—Proved oil and gas reserves and cumulative production at end of year, Gulf of Mexico, Outer Continental Shelf and Slope.

Oil expressed in billions of barrels; gas in trillions of cubic feet. "Oil" includes crude oil and condensate; "gas" includes associated and nonassociated gas. Remaining proved reserves estimated as of December 31 each year.

Year	Number of fields included	Proved reserves		Historical cumulative production		Remaining proved reserves	
		Oil	Gas	Oil	Gas	Oil	Gas
1975	255	6.61	59.9	3.82	27.2	2.79	32.7
1976	306	6.86	65.5	4.12	30.8	2.74	34.7
1977	334	7.18	69.2	4.47	35.0	2.71	34.2
1978	385	7.52	76.2	4.76	39.0	2.76	37.2
1979*	417	7.71	82.2	4.83	44.2	2.88	38.0
1980	435	8.04	88.9	4.99	48.7	3.05	40.2
1981	461	8.17	93.4	5.27	53.6	2.90	39.8
1982	484	8.56	98.1	5.58	58.3	2.98	39.8
1983	521	9.31	106.2	5.90	62.5	3.41	43.7
1984	551	9.91	111.6	6.24	67.1	3.67	44.5
1985	575	10.63	116.7	6.58	71.1	4.05	45.6
1986	645	10.81	121.0	6.93	75.2	3.88	45.8
1987	704	10.76	122.1	7.26	79.7	3.50	42.4
1988†	678	10.95	126.7	7.56	84.3	3.39	42.4
1989	739	10.87	129.1	7.84	88.9	3.03	40.2
1990	782	10.64	129.9	8.11	93.8	2.53	36.1
1991	819	10.74	130.5	8.41	98.5	2.33	32.0
1992	835	11.08	132.7	8.71	103.2	2.37	29.5
1993	849	11.15	136.8	9.01	107.7	2.14	29.1
1994	876	11.86	141.9	9.34	112.6	2.52	29.3
1995	899	12.01	144.9	9.68	117.4	2.33	27.5
1996	920	12.79	151.9	10.05	122.5	2.74	29.4
1997	957	13.67	158.4	10.46	127.6	3.21	30.8
1998	984	14.27	162.7	10.91	132.7	3.36	30.0

*Gas plant liquids dropped from reporting system.
†Basis of reserves changed from API demonstrated to SPE proved.

Table 6 presents all previous reserve estimates by year. Because of adjustments and corrections to production data submitted by Gulf of Mexico OCS operators, the difference between historical cumulative production for successive years does not always equal the annual production for the latter year. No comparisons will be made for unproved reserves.

Conclusions

The 984 proved oil and gas fields in the federally regulated part of the Gulf of Mexico OCS contained proved reserves estimated to be 14.27 billion barrels of oil and 162.7 trillion cubic feet of gas. Remaining proved reserves, as of December 31, 1998, are estimated to be 3.36 billion barrels of oil and 30.0 trillion cubic feet of gas. Estimated remaining proved oil reserves have increased 10 percent and estimated remaining proved gas reserves have decreased 1 percent from last year's report.

The 58 unproved oil and gas fields studied in the federally regulated part of the Gulf of Mexico OCS contained unproved reserves estimated to be 1.00 billion barrels of oil and 5.1 trillion cubic feet of gas. There are an additional 3 unproved active fields not included in this estimate. Included are unproved reserves of 0.96 billion barrels of oil and 4.1 trillion cubic feet of gas from 38 fields in water depths greater than 1,000 feet. Estimated unproved oil reserves are 2.2 times annual oil production, and estimated unproved gas reserves are 1 percent greater than annual gas production. Estimated remaining proved reserves are expected to increase in future years because of significant moves of unproved reserves into the proved category.

Contributing Personnel

This report includes contributions from the following Gulf of Mexico Region, Office of Resource Evaluation, personnel.

Carol W. Crawford
Eric G. Kazanis
Michael L. LaFleur
Steve J. Patkowski
Chee W. Yu

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Notice

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1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123-2394
(504) 736-2519 or 1-800-200-GULF
http://www.gomr.mms.gov

Gary L. Lore
Regional Supervisor
Resource Evaluation