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Estimated Oil and Gas Reserves, Southern California Outer Continental Shelf, December 31, 1980

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ABSTRACT

Remaining recoverable reserves of oil* and gas in the Outer Continental Shelf off Southern California are estimated at approximately 787 million barrels of oil and about 1,752 billion cubic feet of gas, as of December 31, 1980. Three of the 13 known fields were on production at this time. Original reserves of these fields are estimated at about 988 million barrels of oil and approximately 1,853 billion cubic feet of gas. The estimates for both the remaining and the original reserves are higher than the corresponding December 31, 1979, estimates for the same fields.

Reserve estimates for 11 fields were based on individual volumetric reservoir studies. Decline-curve and volumetric analyses were used to estimate the reserves in the remaining two fields.

INTRODUCTION

This report, which supersedes USGS Open-File Report 80-1042 (Kalil, 1980), presents estimates of original oil and gas reserves, cumulative production through 1980, and estimates of remaining reserves as of December 31, 1980, in the Outer Continental Shelf off Southern California. These estimates were completed in May 1981.

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*The term "oil" as used in this report includes crude oil, condensate and gas-plant liquids.

The annual update of this report is part of a USGS continuing program aimed at providing and maintaining a current inventory of oil and gas reserves on the Outer Continental Shelf.

Acknowledgments.--The estimates presented here represent the combined efforts of geologists, geophysicists, petroleum engineers, and other technical personnel within the U.S. Geological Survey's Los Angeles, California, office.

DEFINITION OF RESERVE AND RESOURCE TERMS

The reserve and resource terminology in this report conforms with that published by Miller and others (1975, p. 8-9). The quoted definitions of terms applicable to this report are:

"Resources.--Concentrations of naturally occurring solid, liquid, or gaseous materials in or on the Earth's crust in such form that economic extraction of a commodity is currently or potentially feasible."

"Reserves.--That portion of the identified resource which can be economically extracted."

"Measured reserves.--That part of the identified resource which can be economically extracted using existing technology, and whose amount is estimated from geologic evidence supported directly by engineering measurements."

"Indicated reserves.--Reserves that include additional recoveries in known reservoirs (in excess of the measured reserves) which engineering knowledge and judgment indicate will be economically available by application of fluid injection, whether or not such a program is currently installed (American Petroleum Institute, 1974). In this study indicated reserves are equivalent to API indicated additional reserves."

"Demonstrated reserves.--A collective term for the sum of measured and indicated reserves."

APPLICATION OF TERMS IN PRESENT REPORT

In fields with limited well control, "measured reserves" as used in this report refers to hydrocarbons within boundaries defined by the use of both seismic interpretation and well control.

Two producing oil fields in the Southern California Outer Continental Shelf--Dos Cuadras Offshore and Carpinteria Offshore (fig. 1) are undergoing fluid injection, and recovery beyond primary production is in progress or can be anticipated. For some remaining fields, where it was determined that "indicated reserves" could be anticipated by comparison with similar producing fields, "indicated reserves" were included with the "measured reserves" for a total estimate of "demonstrated reserves."

Pacific Region OCS Order No. 4, "Determination of Well Producibility" provides criteria for determining, through evaluation of borehole testing, whether a well is capable of producing in paying quantities (U.S. Geological Survey, 1976). The quality and quantity of the data vary from field to field. In some instances, these "paying quantities" as defined in the OCS Order may not prove to be "economically extractable" reserves, and these accumulations are generally omitted from reserve calculations. The accumulations are included here, however, because they may be necessary for effective planning and lease management.

METHODS USED FOR RESERVES ESTIMATION

Volumetric calculation.--The amount of original oil and gas in place is estimated from the bulk volume of the reservoir as mapped, using data from drill holes and seismic profiles. Maps of net oil-and gas-sand, thickness are made and planimetered, and the results are converted to bulk volume by use of pyramidal formulas. Porosity of the rock and the amount of water, oil, and gas in the pore space are interpreted from borehole logs and analyses of cores. The total amount of oil and gas in place is converted to standard conditions by analysis of pressure, volume, and temperature relationships and the use of standard correlation charts.

The amount of the original oil and gas in place that can be recovered is estimated from knowledge of the reservoir-drive mechanism, spacing of the wells, and API recovery-factor equations (Arps and others, 1967, p. 19-20).

Decline curves.--In the decline-curve method, future production is estimated by extrapolating plots of production rates and fluid percentage against time. The original recoverable reserves are determined by adding past production to predicted future production.

FIELDS REPORTED

As of December 31, 1980, thirteen fields in the Outer Continental Shelf off Southern California (fig. 1) are recognized as producing or capable of producing, on the basis of the "producible in paying quantities" criterion. Two of these fields are gas fields, five are oil fields, and six are combination oil and gas fields.

No new fields were discovered during 1980. Estimates for both the remaining and the original reserves are higher than the corresponding December 31, 1979, estimates, reflecting modified estimates of previous discoveries on the basis of additional data supplied by more drilling and testing done during 1980.

Reserves are estimated only for the Federal portions of those fields that lie partly in State and partly in Federal lands.

Estimates of the combined totals for 13 fields within the Southern California OCS are shown in table 1. Separate totals are given for oil and gas. These totals appear as composite numbers so as to protect the proprietary nature of the data used to determine the estimates.

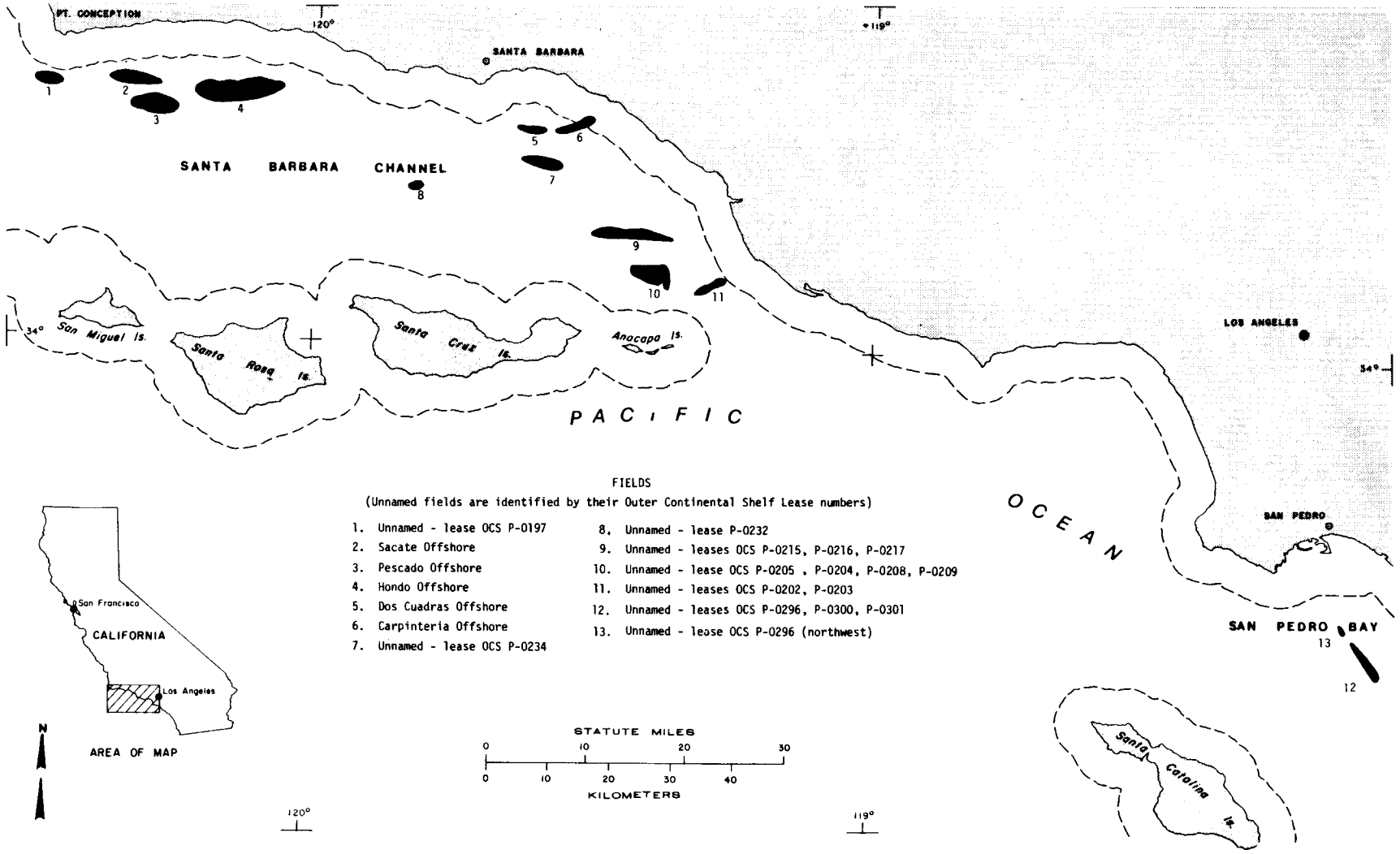

Figure 1. Recognized discoveries of federally controlled oil and gas fields in the Southern California Outer Continental Shelf. Dashed lines indicate 3-nautical-mile boundary between State and Federal waters.

STATUS OF DEVELOPMENT

As of December 31, 1980, none of the fields in the Southern California Outer Continental Shelf was fully developed. Of the 13 recognized fields, only three were producing at this time, namely Dos Cuadras, Carpinteria, and an unnamed field on Santa Clara Unit (fig. 1, fields 5, 6, and 9). Two fields, "Hondo" and "P-0300" (fig. 1, fields 4 and 12) are scheduled to start production in early 1981. Additional exploratory drilling is anticipated in many of the remaining fields so as to further define productive limits and aid in effective development.

TABLE 1.----Estimated demonstrated oil and gas reserves for 13 fields, Southern California Outer Continental Shelf, December 31, 1980

["Demonstrated reserves" is the sum of measured and indicated reserves. "Oil" includes crude oil, condensate, and gas-plant products sold; "gas" includes both associated and nonassociated dry gas]

	Oil (million bbl)	Gas (billion ft^3)
Original reserves:		
Estimated as of 12/31/80 (this report)..	988	1,853
Estimated as of 12/31/79 (OF-80-1042)...	920	1,845
Change.....	+68	+8
Cumulative production:		
Through 1980.....	201	101
Through 1979.....	190	95
Remaining reserves:		
Estimated as of 12/31/80 (this report)..	787	1,752
Estimated as of 12/31/79 (OF-80-1042)...	730	1,750
Change.....	+57	+2

STUDIES CONDUCTED

Estimates of two of the producing fields, Dos Cuadras and Carpinteria (fig. 1, fields 5 and 6), were made on the basis of volumetric and decline-curve analyses. Individual reservoirs in each field were grouped for volumetric calculations. Decline-curve analyses were made on a lease-by-lease basis. The remaining fields were studied on a reservoir-by-reservoir basis and the reserve estimates were made by the volumetric method.

FIELD-SIZE DISTRIBUTION

Figure 2 shows the field-size distribution of the original recoverable reserves of eleven oil and gas fields, and two gas fields. For convenience of comparsion, gas reserves are expressed in terms of oil on the basis of equivalent heating values (6,000 cubic feet of gas is equivalent to 1 barrel of oil). This histogram exhibits a lognormal distribution, with a majority of the fields in the 0-100 million barrel category. About 80 percent of the combined reserves, however, are in the larger fields.

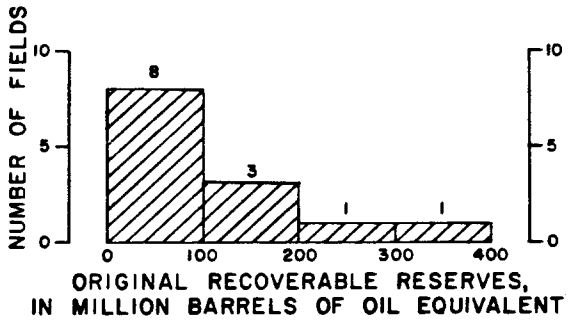

Figure 2. HISTOGRAM SHOWING FIELD-SIZE DISTRIBUTION OF OIL AND GAS FIELDS

CONCLUSIONS

As of December 31, 1980, the remaining recoverable reserves in 13 known oil and gas fields in the Southern California Outer Continental Shelf are estimated at 787 million barrels of oil and 1,752 billion cubic feet of gas. These figures represent an increase of about 57 million barrels of oil and about 2 billion cubic feet of gas more than the December 31, 1979, estimates. No new fields were discovered in the Outer Continental Shelf off Southern California during 1980. The increase in the reserves estimates is due to the modification of estimates of previous discoveries, on the basis of data supplied by additional drilling and testing during 1980.

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