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Estimated Oil and Gas Reserves,
Southern California Outer Continental Shelf,
December 31, 1979

By

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with U.S. Geological Survey editorial standards

CONTENTS

	Page
Abstract - - - - -	1
Introduction - - - - -	1
Definition of reserve and resource terms - - - - -	2
Application of terms in present report - - - - -	3
Methods used for reserves estimation - - - - -	3
Fields reported - - - - -	4
Status of development - - - - -	6
Studies conducted - - - - -	7
Field-size distribution - - - - -	7
Conclusions - - - - -	8
References cited - - - - -	8

ILLUSTRATIONS

Figure 1. Map showing location of oil and gas fields in the Southern California Outer Continental Shelf - - - -	5
2. Histogram showing field-size distribution of oil and gas fields - - - - -	7

TABLE

Table 1. Estimated demonstrated oil and gas reserves, December 31, 1979 - - - - -	6
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ABSTRACT

Remaining recoverable reserves of oil* and gas in the Outer Continental Shelf off Southern California are estimated at approximately 730 million barrels of oil and about 1,750 billion cubic feet of gas, as of December 31, 1979. Only two of the 13 known fields are on production at the present time and none is completely developed. Original recoverable reserves of these fields are estimated to have been about 920 million barrels of oil and approximately 1,845 billion cubic feet of gas. These estimates for both the remaining and the original recoverable reserves are higher than the corresponding December 31, 1978 estimates, which were for 14 then-known fields.

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

The estimates of original and remaining recoverable reserves are reported as one total for oil and one total for gas within the Southern California Outer Continental Shelf.

INTRODUCTION

This report, which supersedes USGS Open-File Report 80-477 (Bird, 1980), presents estimates of original recoverable oil and gas reserves, cumulative production through 1979, and estimates of remaining recoverable reserves as of December 31, 1979,

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

in the Outer Continental Shelf off Southern California. These estimates were completed in June 1980.

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 (API, 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

"Measured reserves" as used in this report comprises recoverable hydrocarbons within boundaries defined by the use of both seismic interpretation and well control in fields where well control was sparse.

Two producing oil fields in the Southern California Outer Continental Shelf--Dos Cuadras Offshore and Carpinteria Offshore--are undergoing fluid injection, and therefore 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 Area OCS Order No. 4, "Suspensions and 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. Net oil and gas sand thickness maps are made and planimetered, and the results are converted to bulk volume by use of pyramidal formulae. 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 American Petroleum Institute (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 percents against time. The original reserves are determined by adding past production to predicted future production.

FIELDS REPORTED

As of December 31, 1979, thirteen fields are recognized as producing or capable of producing in the Outer Continental Shelf off Southern California, based on the "producible in paying quantities" criterion (fig. 1). 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 1979. An unnamed field on lease OCS P-0176, included in the previous report, is deleted from this report because the lease was terminated in January 1979. Estimates for both the remaining and the original recoverable reserves are higher than the corresponding December 31, 1978, estimates, reflecting modified estimates of previous discoveries based on additional data supplied by more drilling and testing done during 1979.

Reserves are estimated for the Federal portions only of the 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 reported in table 1. Separate totals are given for oil and gas. The totals are reported as composite numbers to protect the proprietary nature of the data used to make the estimates.

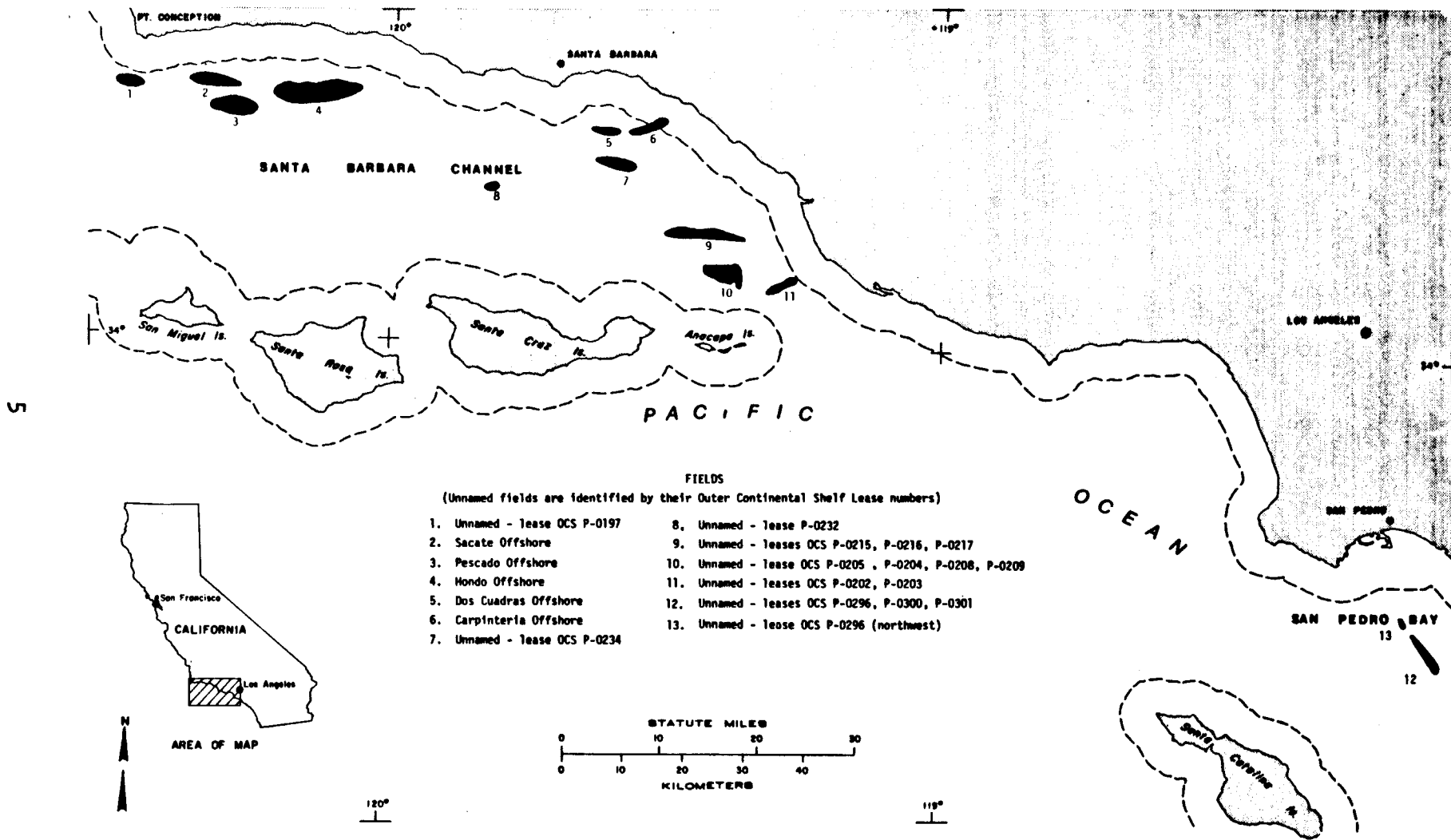


Figure 1. Recognized discoveries of federally controlled oil and gas fields in the Southern California Outer Continental Shelf. Dashed lines indicate 3-nautical-mile boundary between State and Federal waters.

STATUS OF DEVELOPMENT

As of December 31, 1979, none of the fields in the Southern California OCS was fully developed. Of the 13 recognized fields, only two--Dos Cuadras Offshore and Carpinteria Offshore--have platforms installed and are now producing. A platform was set on a third field, Hondo Offshore, and development drilling began in 1977, and by the end of 1979, a platform was set on lease P-0217, Santa Clara Unit and development drilling will start in early 1980. Additional exploratory drilling is anticipated in many of the remaining 10 fields to further define productive limits and aid in effective development.

TABLE 1.----Estimated recoverable (demonstrated) oil and gas reserves for 13 fields, Southern California Outer Continental Shelf, December 31, 1979

["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. 12/31/78 estimates were for 14 fields]

	Oil (million bbl)	Gas (billion ft ³)
Original recoverable reserves:		
Estimated as of 12/31/79 (this report)..	920	1,845
Estimated as of 12/31/78 (OF-80-477)....	875	1,665
Change.....	+45	+180
Cumulative production:		
Through 1979.....	190	95
Through 1978.....	180	90
Remaining recoverable reserves:		
Estimated as of 12/31/79 (this report)..	730	1,750
Estimated as of 12/31/78 (OF-80-477)....	695	1,575
Change.....	+35	+175

STUDIES CONDUCTED

Estimates of the two producing fields (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 11 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 comparison, gas reserves are expressed in terms of oil based on 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. More than 80 percent of the combined reserves, however, are in the larger fields.

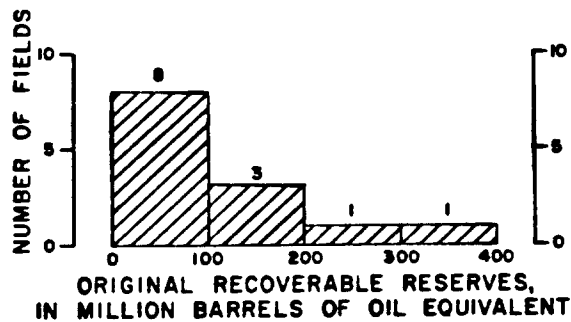


Figure 2. HISTOGRAM SHOWING FIELD-SIZE DISTRIBUTION OF OIL AND GAS FIELDS

CONCLUSIONS

As of December 31, 1979, the remaining recoverable reserves in the Southern California Outer Continental Shelf, are estimated at about 730 million barrels of oil and about 1,750 billion cubic feet of gas from 13 known oil and gas fields. These figures represent an increase of about 35 million barrels of oil and about 175 billion cubic feet of gas over the December 31, 1978 estimates. No new fields were discovered in the OCS off Southern California during 1979. The increase in the reserves estimates is due to modified estimates of previous discoveries, based on additional data supplied by more drilling and testing done during 1979.

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