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Brief on Reforma-Campeche's (Mexico) Petroleum Potential

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BRIEF ON REFORMA-CAMPECHE'S (MEXICO) PETROLEUM POTENTIAL

Opportunities and Challenges for the United States

For the past several months I have been endeavouring to gauge the petroleum prospects of southeastern Mexico on the basis of the published technical literature, newsmedia accounts, and critical examination of the data from a geologic point of view. The main results of this study are briefly summarized here, and will be reported in greater detail at a later date.

1) In May 1972 Petróleos Mexicanos (Pemex), the national oil company of Mexico, discovered a very important new petroleum province through two wildcat wells completed a day apart. These wells are about 50 km southwest of the City of Villahermosa, State of Chiapas. The well Sitio Grande-1, completed May 8, 1972, found at 4,120 m depth a Middle Cretaceous dolomitic pay zone, over 200 m thick. The well Cactus-1, completed May 9, 1972, found at 3,360 m depth an Upper Cretaceous to Lower Cretaceous calcarenite to dolomitic limestone pay, about 200 m thick. Cactus-1 tested initially 1,694 barrels of oil per day and 5.7 million cubic feet of gas per day through a 8 mm choke. These were the first finds of Cretaceous oil in southeastern Mexico.

2) From the information now on the public record, it is apparent that the magnitude of the petroleum resources of the new province may be second, in the sense of a single province, only to those in the Middle East province. The aggregate petroleum potential of the U.S.S.R. is of course substantial, but it is distributed in several petroleum provinces. For briefness, I will refer to the new Mexican find as the Reforma-Campeche Province. Moreover, the geologic conditions in other parts of Mexico's Gulf Coast are such that one can reasonably suspect that the ultimate potential of the country may turn out to be much larger than what can be projected now from the Reforma-Campeche Province as the main base of projection.

3) Until 1938 Mexico's petroleum industry was in private hands, consisting mainly of international corporations. In 1938 the government of President Lázaro Cárdenas expropriated the industry, establishing Pemex to carry out the country's petroleum development. A downward drift of Mexico's petroleum sector which occurred during the initial years of Pemex was arrested when in 1949 President Alemán appointed Senator Antonio Bermúdez to head Pemex. Bermúdez gave a very dynamic stance to Pemex that provided the base for its later successes.

4) The petroleum prospective sedimentary areas of Mexico consist of about 690,000 sq. km. onshore and about 440,000 sq. km. in the continental shelves down to the 200 m water depth line, (Grossling, 1976). The bulk of these prospective areas extend along the Gulf Coast plain, from Chihuahua

and Coahuila in the northeast to the Yucatán Península in the southeast. There is also a significant prospective area in the western part of Baja California. Also the continental slope, that is beyond the edge of the continental shelf, along Mexico's Gulf Coast appears to be of petroleum interest.

5) Mexico's oil production began in 1901 in the State of Tabasco, which is one of the States where about 70 years later the Reforma-Campeche discovery was to be made, Fig. 1. Mexico's annual production peaked at 193 million barrels in 1921, and then dropped in 1932 to a low of 33 million barrels. Production slowly recuperated, reaching in 1973 a level of 191 million barrels. Since 1973 Mexico's oil production has been rapidly expanding. The 1977 production of crude oil, condensate and absorption liquids was 396 million barrels, of which 75 million barrels were exported. For 1982 a production of 2.7 million barrels per day (equivalent to about 985 million barrels for the year) is being forecasted by Pemex, of which over one million barrels per day would be exported.

6) The productive trend--which may be called the Reforma-Campeche trend--appears to be controlled by a broad anticlinorium, about 120 km wide in the Reforma onshore area. In the neighborhood of Reforma it trends NW-SE. The trend extends northeastward, under a cover of Tertiary and Quarternary sediments, along the Campeche shelf. The distance from the southernmost wells drilled to the Ixchel well, the northernmost drilling undertaken so far, is about 500 km. Pemex has not disclosed officially yet the results of Ixchel production tests, but considers it to be an important discovery within a highly prospective area (Petroconsultants, S.A., report). The Macuspana Tertiary Basin lies roughly to the east of the anticlinorium and the Saline and Veracruz Basins to the west and northwest.

7) The productive trend is determined stratigraphically by a trend of Lower to Middle Cretaceous reefs, which in the Reforma area itself run NW-SE, and then curve northeastward following more or less the western edge of the Campeche Bank. The reef trend appears to extend eastward of the Cordoba Platform to just south of the Reforma area where it turns to the northwest. The above-mentioned anticlinorium, of the Reforma area, extends to the north under a cover of later sediments.

8) The initial Reforma discovery was in Upper to Lower Cretaceous rocks, but subsequently production has been found also in Eocene, Paleocene, and Jurassic formations. The Cretaceous carbonates are separated by a major unconformity from the overlying Tertiary clastics. The Tertiary formations provide the seal, and the source rocks are believed to be marine Jurassic shales.

9) The productive structures are anticlinal domes cut by normal and transverse faults, which subdivide each main structure in a number of blocks. Some of the onshore and offshore seismic structures are outlined in Fig. 2. The movement of the underlying Jurassic salt during the Laramide orogeny significantly affected the pattern of structural deformation of the Cretaceous carbonate section, and has contributed to the structural complexity.

The drilling depths to the pay tops in the onshore Reforma area have so far ranged from 3,646 m to 4,613 m, but the producing formations are shallower and in younger stratigraphic positions in the offshore continuation of the productive trend on the Campeche Bank. For instance, in the group of structures Abcatun, Akal, Bacab and Chac the depth to pay top has ranged from 1,300 to 3,545 m. Pemex expects that the Cretaceous rocks which are productive in the onshore Reforma area may be productive offshore, but apparently this has not been established yet.

10) The exceptional character of the Reforma-Campeche province is revealed by many factors--thicknesses of the oil columns, pay porosities and permeabilities, well productivities, success ratio of the exploratory drilling, areal extent of the individual fields and the apparent length of the productive trend as a whole.

According to Pemex (March, 1978), the fields presently under production in the onshore Reforma area range from 45 to 150 km^2 in areal extent, and have oil columns ranging from 300 to 1,000 m. In some blocks of the Bermúdez field the oil column has been stated to be more than 2,000 m thick; early in 1977 it was discovered that Samaria, Iride, and two smaller fields were in fact a single accumulation with four structural highs, which was then named Bermúdez. If the report of the 2,000 m plus oil column is correct, it may establish one of the thickest--if not the thickest--oil column found yet in the earth. Pemex has indicated that in the onshore area the oil columns in the various fields are generally over 500 m thick.

The pay porosities and permeabilities are stated to be very large. This is clearly due to the detrital character of the rocks, tectonic fracturing, subaqueous solution, and dolomitization.

The average well productivity, in the producing fields, is about 5,500 barrels per day.

The success ratio of the exploratory drilling appears to have been 35 percent and that of the development drilling over 80 percent. Moreover, Pemex has stated that as of now it has not entirely accepted that the structures with unsuccessful wells are definitely non-productive. Other step-out wells are to be drilled at the appropriate time. So the success ratio may turn out to be even higher.

11) Several factors further enhance the petroleum prospects of the Reforma-Campeche Province:

- Marine oil seeps have been found around the edges of the Campeche Bank.

- The Sigsbee Knolls, where cores saturated with oil retrieved from about 3,500 m of water, are located near the northwestern edge of the Yucatán escarpment.

- Giant reef trends (Fig. 3) have been mapped by seismic sparker or explosive sources methods and confirmed by drilling at the Reforma-Campeche area. They run through the Reforma-Campeche productive trend, and continue beyond the Ixchel location encircling the Yucatán Península.

- The giant Poza Rica field to the southwest of the Golden Lane, the production of which peaked in the 1960's, was formed in geologic conditions similar to those in the Cretaceous section of Chiapas and Tabasco.

12) Some of the fields appear to be undersaturated with gas (for example, Cunduacán, Bermúdez, Sunuapa, Artesa, Sabancuy, Sitio Grande, Cactus). Their gas/oil ratios range from 1,032 to 1,837 cu. ft. of gas per barrel of oil.

Other fields are more like condensate fields (for example, Paredón, Cacho López, Giraldas, Agave, Copanó, Mundo Nuevo). Their gas/oil ratios range from 2,000 to 9,000 cu. ft. of gas per barrel of liquid hydrocarbons.

The fact that there are oil fields undersaturated with gas, and others more like condensate fields richer in gas, bears on the prospects for enhancing gas production in the new province.

13) The API gravity of the oils in the various fields range from 20° to 41° API, and the API gravity in the condensate fields ranges from 33° to 51° API. The sulfur content of some of the oils is low, but in others values of around 1.5 and 3 percent, have been found.

14) The Reforma-Campeche discovery is a magnificent achievement. The discovery was not mere serendipity, but the result of a deliberate 20-year effort by Pemex to define petroleum prospects in southeastern Mexico. The area was surveyed by gravity and magnetic methods, by seismic refraction, by seismic reflection with analogue recording, and by modern seismic reflection using CDP techniques and digital recording. An earlier drilling campaign had discovered Tertiary production in small- to moderate-size fields. About two decades later many of these fields were found to be shallow expressions of deeper and larger Cretaceous fields.

15) Pemex reacted to the new discovery with great resolve. As soon as the first clues of a major discovery were apparent, Pemex rapidly increased the number of drilling rigs allocated to the Reforma-Campeche project. At present the number is 81 rigs onshore, and 93 drilling rigs are projected by early next year. In the Campeche Shelf Pemex has three drill ships, five jack-ups, and one semisubmersible rig.

Moreover, rather than settle on a full development strategy for the discoveries made, Pemex has spread its exploration effort trying to gauge as soon as possible the total dimensions of the new province.

16) Mexico's proven petroleum reserves have been increasing rapidly since the end of 1937, when they were 2.8 billion barrels of oil equivalent. Pemex customarily reports hydrocarbon proven reserves as the sum of the reserves of crude oil, condensate and adsorptive liquids, and the oil equivalent of the gas.

The breakdown among these may be judged by the December 31, 1976 proven reserves figures for Zona Sur, where the Reforma-Campeche lies, which are (Pemex, 1977):

crude oil	4,181,437,109 barrels
condensate	439,957,843 "
dry gas	7,866,476 million cu. ft.
	(1,573,293,000 barrels, oil equivalent)
	6,194,687,952 barrels, oil equivalent

Therefore about 25 percent of the hydrocarbon reserves correspond to dry gas.

17) The last disclosure of petroleum reserves was made September 1978 by President J. López Portillo in his annual message to the Mexican Congress. He stated that as of July 31, 1978, Mexico's proven reserves were 20 billion barrels, the probable reserves were 37 billion barrels, and the potential reserves were being estimated at 200 billion barrels. He moreover indicated at that time that the latter "will surely increase". About 1/4 of these barrels of oil equivalent may be considered to correspond to gas.

18) In Pemex's terminology, the proven reserves correspond to the economically recoverable amounts, by primary methods, of hydrocarbons in fields already discovered that can be estimated with great certainty and that can be put into production. The probable reserves are the additional amounts of recoverable hydrocarbons which are estimated for the fields already discovered, when considering their horizontal and vertical extent according to the geological and geophysical surveys. The potential reserves are the total amounts of recoverable hydrocarbons, which are projected for Mexico based on the regional geology and projections from past exploration and development outcomes; and consist mainly, therefore, of as yet undiscovered resources.

19) To gauge the potential magnitude of the Reforma-Campeche Province we make the following considerations, based on an interpretation of the published information:

a) In the onshore part about 127 seismic structures have been defined by geophysical methods--the structures are stated by Pemex (March, 1978) to be similar to those presently producing such as Cactus, Sitio Grande, Bermúdez.

b) In the offshore part, from the Campeche Bank to the Ixchel well location in the north, about 60 structures have been defined by geophysical methods, according to Pemex (March, 1978).

c) Already about 45 of the structures appear to have been tested onshore with one or a few exploratory wells each. About 35 structures have so far turned out to be productive; of the remaining 10 some are dry, but further exploratory drilling may still show some of them to be productive.

d) About 6 structures have been tested offshore with exploratory drilling, of which about 4 appear to have been shown to be productive.

e) The recoverable hydrocarbons in the new Reforma-Campeche fields can be estimated from Mexico's figures to be about 17 billion barrels of hydrocarbons in proven reserves, plus 31 billion barrels in probable reserves. For this we have assumed that the bulk of the increase in the proven reserves of Mexico since 1972 arises from the Reforma-Campeche discoveries.

(The application of secondary and tertiary recovery techniques would add 6.8 billion barrels to the proven reserves, according to estimates attributed to Pemex. However, we assume that the probable reserves, as reported by Pemex, already include secondary recovery.)

20) We are working on a statistical model to make quantitative estimates of the total recoverable resources of the Reforma-Campeche Province, but this is not complete yet.

At this point we want only to present a simple calculation which indicates the order of magnitude of what may be expected.

The petroleum already discovered in the Reforma-Campeche Province can be estimated to be 17 plus 31 billion barrels of oil equivalent, that is 48 billion barrels.

If the success ratio for the 187 structures already mapped is assumed to be the same as in those already tested by drilling, then the potential recoverable resources could be estimated to be

$$48 \times 10^9 \times \frac{187}{45} = 200 \times 10^9 \text{ barrels.}$$

Coincidentally, this figure is of the same value as that reported by President López Portillo in his September, 1978 statement. However, to our brief calculation above we would have to add some allowance for the recoverable petroleum resources of other parts of Mexico.

21) A thorough evaluation of this petroleum estimation problem requires careful examination of the various assumptions.

One needs to ascertain how accurate are the figures for the number of structures mapped and drilled, and the number of successful wildcats. One needs to examine if there is some kind of biases as to locations and directions of progress of the exploration. One needs to examine if there are well defined productive trends, which would influence the statistical inferences of potential resources, or if the Province can be segmented in regions of greatly different productivities.

In particular, it is crucial at this time whether one can make inferences based on the onshore Chiapas-Tabasco finds to the Campeche platform. Pemex (March, 1978) believes that the onshore geologic conditions in the Chiapas-Tabasco area do extend north into the Campeche platform. However, offshore production on the Campeche platform apparently has been obtained to date only from rocks of Paleocene age, and not from the underlying Cretaceous rocks.

Such questions will be considered in a more detailed report.

22) Of special significance are the Mexican gas discoveries. It appears that the potential gas reserves of Mexico are considerably greater than the absorptive capacity of the Mexican economy, even on a 50-year period. Mexico's proven crude oil reserves have increased since 1972 by a factor of about seven, and in fact may already amount to about 1/2 of those of the United States. However, Mexico's proven gas reserves now stand at only 1/6 those of the United States.

23) I interpret this lesser degree of increase of Mexico's gas reserves as not due to geologic conditions, but rather in large part the result of economic factors. Pemex's management has a great deal of discretion: whether to avoid discovering gas by aiming at oil, and in deciding the extent of the effort to prove gas reserves. At present there are greater economic incentives for Pemex to find oil rather than gas.

B.F. Grossling
December 3, 1978

References Cited

Grossling, B.F., 1976, Window on Oil, The Financial Times, London.

Pemex, 1977, Memoria de Labores.

Instituto Mexicano del Petróleo, March, 1978, Potencial Actual y Futuro de la Industria Petrolera de Mexico.

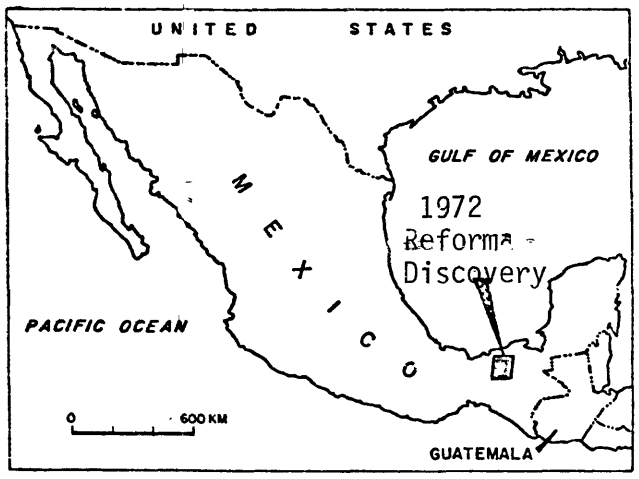
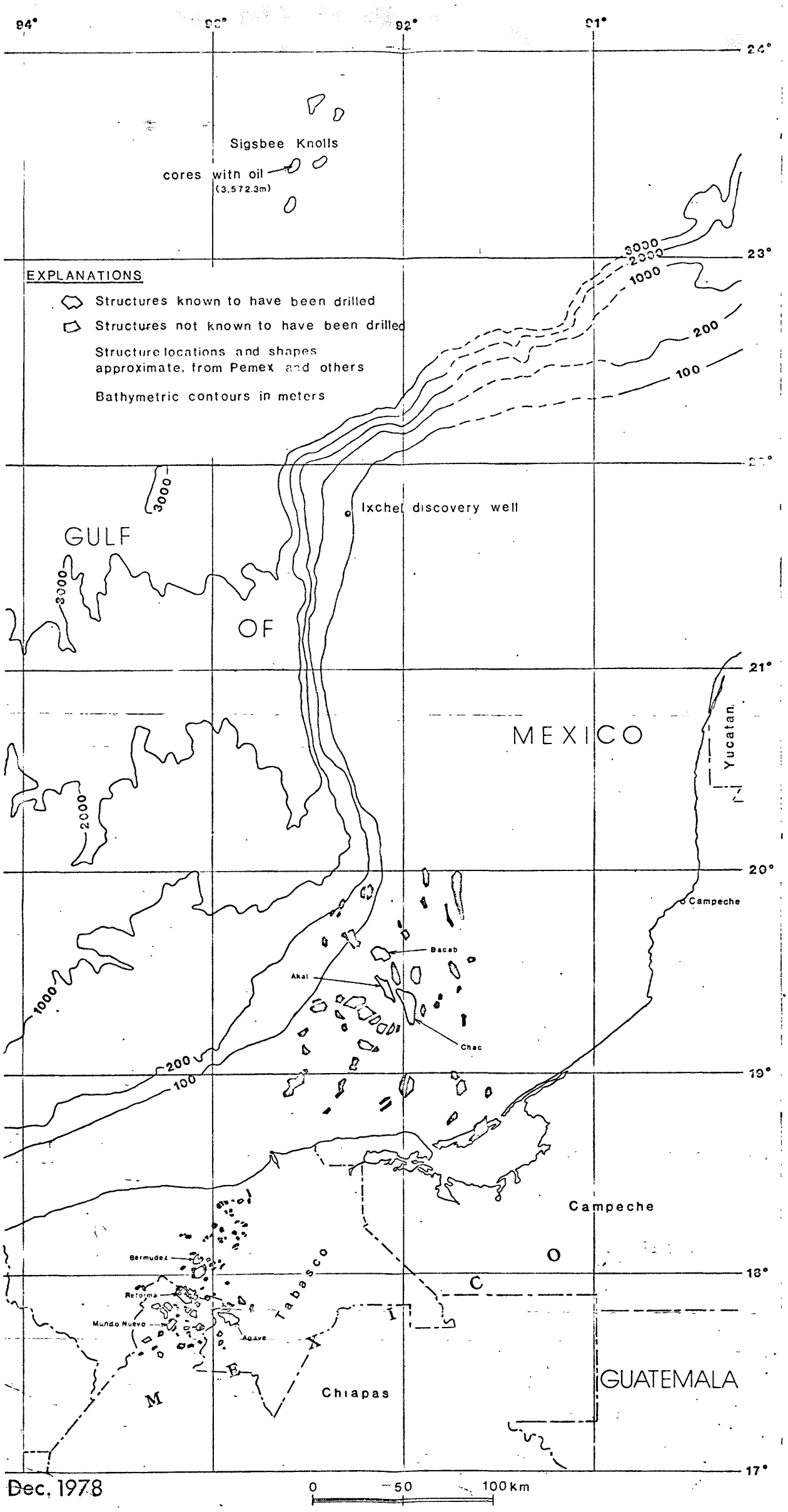


Fig. 1—Orientation map, Mexico.

The location of the initial (1972) Reforma discovery is within the small square.



REFORMA–CAMPECHE SEISMIC STRUCTURES

Compiled by B. F. Grossling

Figure 2

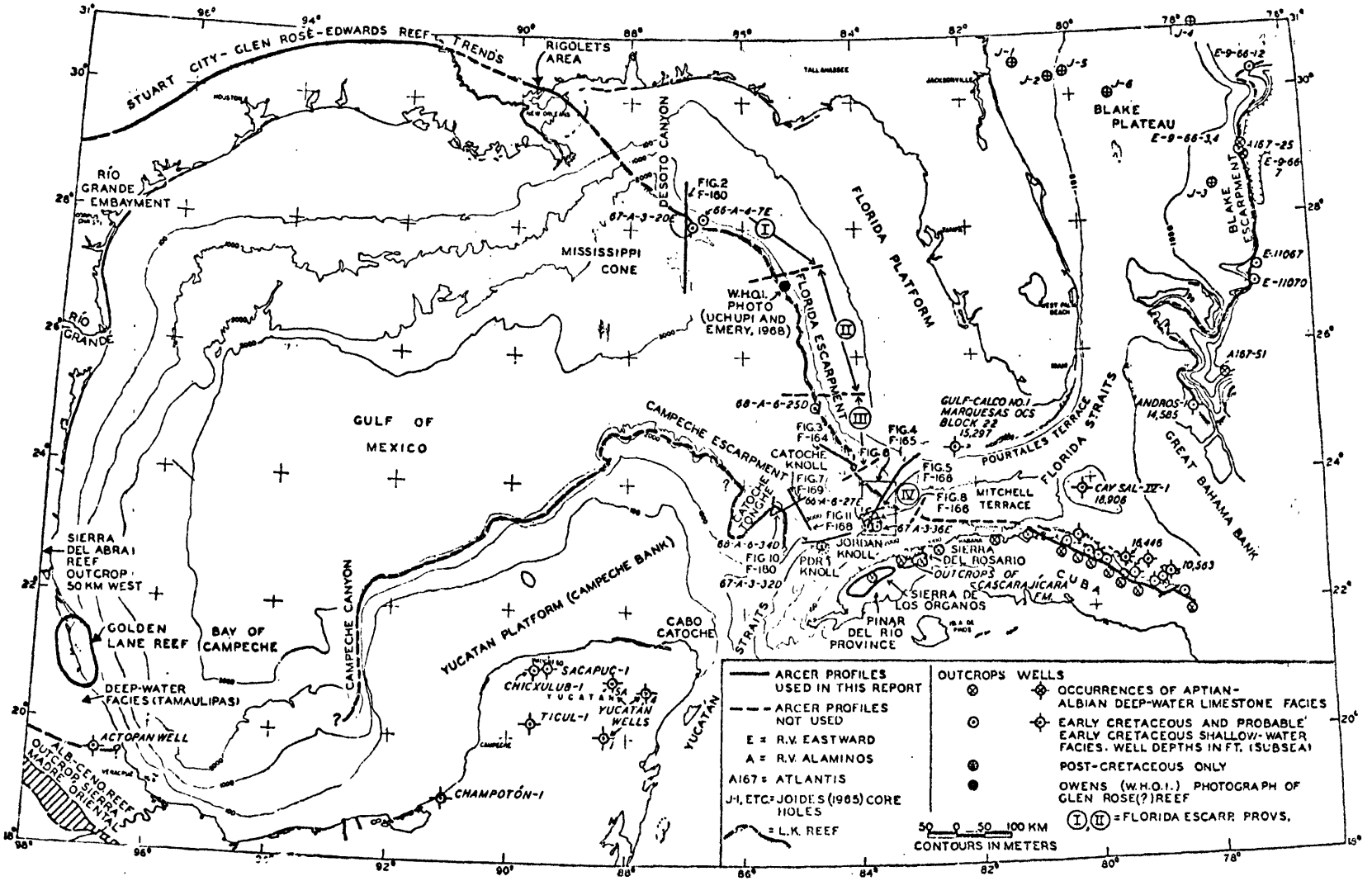


Fig. 1.—Index map, eastern Gulf of Mexico region. Shows localities mentioned in text, samples dredged or cored and described in Appendix I, and sites of arcer profiles used to illustrate text. Lower Cretaceous reef trends are shown, together with known Lower Cretaceous samples collected in deep water (by us and other workers), critical wells drilled by petroleum companies, and JOIDES (1965) drill holes east of Florida. Based on Jordan (1951), Ericson *et al.* (1952), Hatten (1957, 1967), Judoley *et al.* (1963), Furrazola *et al.* (1964, 1968), JOIDES (1965), Heezen and Sheridan (1966), Antoine *et al.* (1967), Meyerhoff (1967), Mina (1967), Spencer (1967), Sheridan *et al.* (1969), Uchupi (1967), Meyerhoff and Hatten (1968), Uchupi and Emery (1968), Viniegra and Castillo (in press), Viniegra (unpub. data, 1969), and Khudoley and Meyerhoff (in press).

Figure 3. Map of eastern Gulf of Mexico showing Lower Cretaceous reef trends (After W.R. Bryant et al, 1969, American Association of Petroleum Geologists Bulletin, vol. 53, no. 12, p. 2506-2542).

THE REFORMA-CAMPECHE NEWSMEDIA RECORD

In the United States there has been skepticism about the alleged magnitude of the petroleum discoveries in the Reforma-Campeche area in southeastern Mexico. Acceptance of their reality and magnitude has been guarded and slow. However, if one scans the record since 1972 in the various newsmedia and industry journals it becomes apparent that many independent and knowledgeable observers were becoming aware of the considerable magnitude of the petroleum discoveries in this new petroleum province.

To react properly to the opportunities which are offered by the new discovery, a certain degree of acceptance of their reality is essential. What may help on this is an overview of some of what has been learned by various observers, much like a Marco Polo account of Cathay to a skeptical Europe.

Appendix A, of the report on the Reforma-Campeche on which I am working, is intended to provide such kind of an account. It runs from the earliest reference I have found about the Reforma discovery to the latest statement by President J. López Portillo. All of the quotations are as nearly as possible verbatim versions. Many of the quotations were translated from Spanish.

B.F. Grossling
November 17, 1978

Appendix A

NEWS MEDIA EXCERPTS ABOUT THE SIGNIFICANCE OF THE REFORMA-CAMPECHE PETROLEUM DISCOVERY

Source	Item
King, R. E., April, 1973, WORLD OIL, vol. 176, no. 5 p. 75.	"Large oil discoveries on the Cactus and Sitio Grande structures in the southern part of the Tabasco salt basin give promise of additional fields in the Isthmian zone."
Anonymous, August 15, 1973, WORLD OIL, vol. 177, no. 3, p. 75.	"Particularly good discoveries have been made in the southern state of Chiapas, where wells have tested at rates to 3,500 barrels of oil per day."
	"Despite exploratory successes, Mexican crude reserves declined slightly last year to 2.8 billion barrels, while natural gas liquids reserves increased by 8 trillion barrels to 405 million barrels. Natural gas reserves also declined slightly to 10.75 trillion cubic feet."
Kliewer, Gene, November, 1973, WORLD OIL, v. 177, no. 6, p. 24.	"By the end of the year, Pemex expects to be producing 575,000 barrels of oil per day. Development drilling is particularly high in Tabasco and Chiapas states."
Montgomery, Jim, January, 1974, WORLD OIL, v. 178, no. 1, p. 19.	"New Cretaceous fields in Chiapas and Tabasco states are important sources of Mexico's increased output. Increased exploration and development will raise 1973 production to about 575,000 barrels of oil per day, an increase of 14 per cent over 1972."
King, R. E., April, 1974, WORLD OIL, v. 128, no. 5, p. 76.	"Discovery of prolific production in Lower Cretaceous limestone reservoirs in the southern part of the Tabasco salt basin of southern Mexico is leading to rapid development. Other prospects in the vicinity are likely to add further reserves."

Source	Item
(cont.)	"This important new producing area is likely to make Mexico self-sufficient in petroleum, despite growing internal demand. Production from the three present fields: Sitio Grande, Cactus, and Samaria is expected to reach 175,000 barrels daily by the end of this year."
Anonymous, August 15, 1974, WORLD OIL, vol. 179, no. 3, p. 75.	"Prolific wells in Chiapas contributed over 71,000 barrels of oil per day last year, while production from Tabasco wells contributed 34,400 barrels of oil per day."
	"The two areas combined have 25 wells which produced 105,400 barrels of oil per day, almost 25 percent of the nation's total."
	"31 rigs are working there, six of which are carrying out exploratory drilling."
	"As of March, 1974, total daily production of crude in Mexico had already jumped to about 500,000 barrels of oil per day."
	"At the end of 1973, crude reserves were placed at 2.847 billion barrels, while gas reserves were 10.813 trillion cubic feet. This compared to 1972 reserves figures of 2.833 billion barrels and 10.752 trillion cubic feet."
Anonymous, November, 1974, WORLD OIL, vol. 179, no. 6, p. 7.	"A newspaper story, indicating a recent oil strike in southern Mexico might be equal to a second Persian Gulf province, stirred the petroleum industry in mid-October."
	"Actually, discovery of production in the Mexican states of Tabasco and Chiapas was in 1972."
	"Pemex . . . reported at that time that a major strike had been made and that the fields were Mexico's most productive."

Source	Item
(cont.)	"Chances of a second Persian Gulf, or a discovery of even Prudhoe Bay proportions, are extremely unlikely."
	"Current crude reserves in Mexico have been put at 2.85 billion barrels by Pemex."

Source	Item
Editor, February 1975, IMIQ (Mexico), no. 2, p. 3.	(Translation from Spanish) "With the discovery of the Chiapas and Tabasco fields the crude oil imports have been completely cancelled since the middle of last year. The surpluses have been sold at international prices to various countries."
Inguanzo Suárez, Francisco, February 1975, IMIQ (Mexico), no. 2, p. 9, 10.	(Translation from Spanish) In Sabancuy, Sitio Grande, Cactus, Samaria and Cunduacan "there is a reef zone and post- and -pre reef sedimentary series"... and "in these structural highs there is either erosion of the reef or talus deposits." "We have known for some time of the existence of submarine oil seeps in the Campeche Shelf, where we have collected samples and we believe that in this area there were Jurassic rocks and that the oil migrated to Cretaceous rocks." "The Chac well is at present /September, 1974/ at a depth of 3,400 m, it just crossed the Tertiary and it is drilling in Paleocene, ... already we have obtained cores of limestone with marvellous porosity and permeability, and saturated with oil in the Paleocene." "At Sitio Grande the dolomitic section is being drilled, which extends to the lower Cretaceous." "The average drilling depth in this area ranges from 3,900 to 4,800 m." "Currently /September, 1974/ there are 38 drilling rigs operating" in the Chiapas-Tabasco area.

Source	Item
Nava, Martin et al, February 1975, IMIQ (Mexico), no. 2, p. 65, 69, 70, 73.	(Translation from Spanish) The discovery of the Cretaceous fields in the Tabasco-Chiapas area meant "that in about 18 months it was possible to define not just a few structures, but a real petroleum province." "In less than a year and a half about 55 wells (to December 31, 1974) had been drilled, reaching a production of 230,000 barrels per day (October 31, 1974), in the Chiapas-Tabasco Cretaceous area." In the Chiapas-Tabasco Cretaceous fields, "The average production per well are: 4,900 barrels per day in Sitio Grande, 2,600 barrels per day in Cactus, 8,000 barrels per day in Samaria. There are individual wells with productions of 200 barrels per day and others with production of about 13,000 barrels per day." "For the Cretaceous Area, the production to October 30, 1974 was of 230,000 barrels per day, to November 30, 1974 of 266,000 barrels per day and to January 31, 1975 of 284,546 barrels per day." "The number of wells drilled to October 30, 1974 ... was 25 in Sitio Grande, 17 in Cactus, 7 in Samaria, 1 in Cunduacan, 1 in Níspero, and 1 in Sabancuy."

Source	Item
Viniegra O., F., August 1975, American Association of Petroleum Geologists Bulletin, vol. 59, no. 8, p. 1277.	"New discoveries of great importance have been made in southeastern Mexico." "These new fields are accumulations in detrital calcareous middle Cretaceous rocks at depths ranging from 11,400 to 13,500 ft in angular and erosional discordance with clay and sand deposits of Eocene, Oligocene, and Miocene age." "The fields discovered make up two great parallel structural trends, Sabancuy-Sitio Grande-Cactus, and Samaria-Cunduacan, oriented northwest-southeast." "The [oil] column at Sabancuy and Sitio Grande is approximately 450 m above the water table; on the other hand, in Cactus, Samaria and Cunduacan the oil columns are respectively 800, 700 and 900 m." During the development of the Yucatan platform "clastic calcareous sediments from 100 to 500 m thick were formed and deposited near the gigantic reef escarpments."
Anonymous, August 15, 1975, WORLD OIL, vol. 181, no. 3, p. 56.	"At the end of 1974, official Pemex estimates totaled 3.086 billion barrels of crude oil reserves", without including condensate nor oil equivalent of the gas. "However, Reforma area reserves apparently are not included in this total and remain essentially unknown at this time."
Anonymous, September 1975, OCEAN INDUSTRY, vol. 10, no. 9, p. 328.	Pemex "announced the discovery of a new oil and gas strike at Chac-1, about 43 mi. north of Ciudad Carmen in the Gulf of Campeche.

Source	Item
(cont.)	"Oil was found at 11,595 ft. The well drilled to total depths of 14,760 ft."
Viniegra O. Francisco, 1975, Ninth World Petroleum Congress, Proceedings, vol. 3, p. 194.	"The producing zones were encountered at depths of 3,450 to 4,500 m."
	Producing rates in 1974 "averaged 6,750 barrels per day per well."
	"The oil column at Sabancuy and Sitio Grande is 150-200 m while at Cactus, Samaria and Cunduacan wells have penetrated 400 m of section without encountering salt water."
	"Tectonic fracturing increases permeability by about 50%."
Anonymous, 1975, World Petroleum Report 1975, p. 149.	"... major oil find ... reported in ... the Tabasco-Chiapas deposits west of Villahermosa."
	(Text reworded)
	Pemex proved reserves estimates as of December 31, 1974 of 3,087 million barrels of crude oil and if the crude oil equivalent of condensate and natural gas is added, of 5,773 million barrels compared with 2,847 million barrels at the end of 1973.
	"Some industry observers believe that the new find in the Reforma district is one of the largest in the Western Hemisphere."
	"To date, 67 holes have been drilled in the area of which only four are dusters."
	"Producing wells reportedly are averaging nearly 4,500 barrels per day each."

Source	Item
(cont.)	"35 rigs are drilling in the Reforma district."
	"In many wells, gross pay thicknesses of as much as 1,200 to 1,500 ft. are reported."
	The producing trends "appear to have five oil bearing structures in Cretaceous limestone."
	"In almost all cases, each well had found more than one reservoir, including some attractive gas in the Tertiary as well."

Source	Item
Secretaria de la Presidencia, March 18, 1976, no. 36, p. 1, 3, 4.	"The discovery of the deep [oil] deposits located at Reforma and Samaria, whose prolific wells, quickly developed, allowed cancellation, in the middle of 1974, of the onerous imports of crude oil." "The success of the offshore well Chac-1, located at the Campeche Sound, opens a very extensive area with possibilities of hydrocarbons [accumulation] in land [and offshore as well] . . ." "The yield per well in the area is presently 5,435 barrels [per day]." "Prospects for the discovery of huge volumes of hydrocarbons in this region are very firm, as a number of structures have been identified [in the neighborhood of] the ones already producing." "Proven reserves of crude, recoverable liquids and natural gas converted to crude, reached the amount of 6,338.3 million barrels at the end of last December [1975]."
King, R. E., June 1976, WORLD OIL, vol. 182, no. 7, p. 58.	"In 1975, an important oil discovery, Chac, was made 44 miles off the coast of Campeche state." "The field evidently lies on the seaward extension of the border of the Yucatan limestone platform, a buried Cretaceous reef escarpment." "The prolific fields of the Reforma area of Chiapas and Tabasco are related to the same feature."

Source	Item
Anonymous, June 1976, WORLD OIL, vol. 182, no. 7, p. 101.	A. A. Meyerhoff is quoted: "Wells in the Cretaceous carbonate trend have initial potentials of between 2,700-37,000 barrels of oil per day, with an average open hole completion rate of 5,277 barrels per day on a half inch choke." "The 10 fields so far discovered may be, in fact, one major accumulation of reserves which could ultimately exceed Prudhoe Bay in size." "The productive trend has been traced, geophysically, 297 miles north-northeast along the northwest edge of the Yucatan shelf. Favorable facies average 4.37 miles in width and range from a minimum of three miles to a maximum of 6.9 miles." "The late and Middle Cretaceous productive section is exceptionally thick and is continuous. Minimum pay thickness found to date is 3,000 ft. and the average thickness is 4,852 ft." "Last January, Pemex completed the most spectacular find in the area to date. The discovery indicated a productive column with more than 12,000 ft of closure." A. Dovali J., Director General of Pemex, is quoted: "The trend has proved reserves of five billion barrels and another 10-12 billion barrels of probable oil reserves." " . . . Mexico's production of crude and gas liquids will rise from the present 885,000 barrels per day to 1.1 million barrels per day by year end."

Source	Item
Beatty, Edward, June 20, 1976, OFFSHORE, vol. 36, no. 7, p. 143 and 146.	"A year ago Mexico made an electritrifying announcement that tremendous reserves had been discovered off the State of Campeche in the Gulf of Campeche." "The field was named Chac-1 and the reserves were found in Cretaceous sediments." "The Chac-1 well was begun in June 1974. At a depth of 12,600 ft the drill reached [calcareous] strata-richly impregnated with hydrocarbons." " . . . it is estimated that this oil bearing horizon extends for at least 2,000 ft in depth." "A high proportion of the associated gas from Poza Rica (State of Verucruz), Tabasco and Chiapas is sour and is being flared to the atmosphere."
Anderson, Jack and Whitten, Les June 29, 1976, THE WASHINGTON POST, p. B11.	"A top secret CIA report claims that impoverished Mexico is sitting on an astounding 75 billion barrels oil reserve." "Numerous government and industry sources have told us the huge figure is possible but improbable." "One [Mexican] embassy official told us that the CIA estimate is 'totally out of proportion'."
Anonymous, August 15, 1976 WORLD OIL, vol. 183, no. 3, p. 58, 60, 62.	Two additional structural trends paralleling the original [Sabancuy, Sitio Grande, Cactus, Nispero and Rio Nuevo] have been found. "Three new fields, Agave, Zarza and Lombarda lie to the east, and Nuevo Mundo, a discovery which tested a reported 90 million cubic feet of gas per day with 10,000 barrels of oil per day from a Cretaceous zone with 12,000 ft. of closure lies to the west" . . .

Source	Item
(cont.)	"There is also a highly prospective Jurassic section in the Reforma area which has yet to be fully explored although some wells in Cunduacan, Samaria, Cactus, Tres Pueblos and Tierra Colorada produce from the deeper formation." Chac-1, which "found a thick calcareous Cretaceous pay and tested about 1,000 barrels of oil per day", is being deepened to test Jurassic." "Near the Guatemalan/Mexican border, several possible salt domes have been identified which will be tested by wildcats Trinitaria-2, Honduras-1 and Jalisco-1." "In December, the Cretaceous trend produced 400,130 barrels of oil per day."
September 1976, Yearbook 1976, (Review of 1975), Int. Oil Scouts Ass., Part II, vol. XLVI, p. 513-514.	"The first discoveries were made in new areas in the State of Chiapas, indicating by the production and information of the first producing wells Cactus-1 and Sitio Grande-1, that it is the largest discovery of importance made in the last ten years, . . ." "(in) Cretaceous limestone formation from which no production had been obtained in the Southern Zone. Both wells produce 3,500 barrels of oil daily; the development wells drilled afterwards, confirm the potentiality of the oil field discoveries."

Source	Item
Riding, Alan, February 18, 1977, Mexico's Oil Reserves Put at 60 Billion Barrels Now, NEW YORK TIMES, p. D1 and D5.	"Despite conservative official estimates, Mexico's crude oil reserves are now believed to exceed 60 billion barrels . . ." "The new estimate . . . has been privately confirmed by Mexican officials who in the past were reticent to admit the enormity of the country's oil wealth."
Franco, Alvaro, February 28, 1977 OIL AND GAS JOURNAL, vol. 75, no. 9, p. 73-80.	"At the end of 1976, the new Director General of Petroleos Mexicanos, Jorge Diaz Serrano, said Mexican oil reserves were a 'conservative' 11 "billion barrels, . . . " "The naturally fractured, highly permeable and porous oolitic Cretaceous pays reach above-average thicknesses-from 150 m in the southern fringes of the play to a most unusual 700 m at Cunduacan field." "By the end of 1976, through fewer than 100 wells, four Reforma fields (Sitio Grande, Cactus, Samaria and Cunduacan) were producing nearly 500,000 barrels per day." " . . . Pemex expects to increase oil output to 2,200,000 barrels per day by 1982 . . ." "New offshore fields in the Campeche Sound are expected to contribute 118,500 barrels per day."
Anonymous, March 5, 1977, ABECOR Country Report, Barclays Bank, 2nd page.	"Pemex expects that total mineral oil deposits will reach 60 billion barrels." "By the end of 1982 daily output is scheduled to be doubled to reach 2.2 million barrels, and the export of crude oil is to be increased from the current 150,000 barrels to 1.1 million barrels per day."

Source	Item
Anonymous, May 2, 1977, OIL AND GAS JOURNAL, vol. 75, no. 18, p. 120.	The number of Chiapas-Tabasco onshore fields proved commercial so far has increased to 22. "The latest strikes at Artesa, Giraldas, Copano, and Sunuapa extend the producing trend southward by some 25 km." "In every case, according to Mexican sources, average thickness of the oil pays has been over 400 m." "Well capacities are similar to those already producing in other fields - some 5,500 barrels per day per well." "With the new discoveries, the proved producing area now stretches some 80 km from south to northeast and 55 km eastwest at the widest point." "The wildcat success ratio in Chiapas-Tabasco (is) at a remarkable 82 per cent." "The Director General of Pemex, Jorge Diaz Serrano, says some 70 top priority structures remain to be drilled onshore and believes at least 45 of them should prove productive." Offshore, discoveries were "made at Chac, Kukulcan, and Bacab some 70 km northeast of the northernmost onshore field (Tepotzingo) . . ., where an additional 60-plus structures have been mapped by seismic crews." " . . . De Golyer & Mac Naughton and the Mexican Petroleum Institute have certified Pemex's claim of 11 billion barrels of proved reserves of hydrocarbons (crude, gas liquids, and gas converted to liquids) in the Chiapas-Tabasco area."

Source	Item
Franco, Alvaro; June, 1977 PETROLEO INTERNATIONAL, vol. 35, no. 6, p. 25-27.	(Translated from Spanish) In the Chiapas-Tabasco area " . . . commercial production has been established in about 23 structures." "Only one of these structures (Sitio Grande) has been fully developed." "The proven recoverable reserve assigned to Samaria-Cunduacan and Cactus-Sitio Grande is 5,000 million barrels." "In some wells, oil columns of more than 1,000 m thickness have been crossed, potentially productive throughout." "Production comes from Cretaceous calcareous formations, of good permeability and excellent porosity." "Also Jurassic sandstone pays have been found in several fields." "The sulphur content of the onshore production is high." During 1977 "five new discoveries were announced: Paredon, Giraldas, Copano, Sunuapa; and Tepotzingo, north of Cunduacan-Tres Pueblos." Chac-1 "drilled to 3,545 m and found a thick calcareous section geologically equivalent to that productive in Chiapas-Tabasco, and also with good prospects in deeper Cretaceous and Jurassic formations." "Bacab-1 and Kukulcan-1 established conditions similar to those in Chac-1." "The cost of the Chiapas - Tabasco wells (more than 4,000 m deep) is about $3 million, and of those in the Campeche Shelf is about $6 million." In the proven Chiapas-Tabasco area "there are about 80 undrilled structures."

Source	Item
(Cont.)	"Seismic surveys have revealed more than 60 structures in a narrow belt which runs from the north coast of Tabasco to the Ixchel-1 location. This belt has an area of 8,000 km^2."
	"The belt runs along the Lower Tertiary, Cretaceous and Jurassic boundary of the Yucatan platform."
Anonymous, June 1977, PETROLEO INTERNACIONAL, vol. 35, no. 6, p. 35 and 36.	(Translation from Spanish)
	Ing. Jorge Diaz Serrano has stated that the total reserves of Mexico could surpass 60,000 million barrels."
	During the period 1977-1982 Pemex plans "to drill 24 exploratory and 120 development wells in the Campeche Shelf."
	"In the Chiapas-Tabasco area 477 development wells will be drilled."
	If adequate financial resources are available, the production at the end of 1982 could be 2,242,000 barrels of oil per day and 3,600 million cubic feet per day of gas."
	"The export surpluses would be 1,000,000 barrels per day of oil and refined products, and 1,000 million cubic feet per day of gas."
Anonymous June, 1977, OCEAN INDUSTRY, vol. 13, no.6, p. 113.	In the Bay of Campeche "Pemex has identified seismically 60 structures on 1.5 million acres."
	"Pemex will begin a 24-well two-year program to test 24 of the structures."
	"The Chac-1 flowed 3,000 barrels per day of oil last year on test."
	"The Bacab-1 was completed in May 1977 with a flow of 2,000 barrels per day of oil on test."

Source	Item
Anonymous, July 15, 1977 PETROLE INFORMATIONS, (Paris), no.1443, p. 29-301.	(Translation from French) The Director General of Pemex, Jorge Diaz Serrano, is quoted: "Mexico's oil exports, which at present are 155,000 barrels per day, will be six times larger in six years." "In the Chiapas-Tabasco fields it is estimated that the associated gas amounts to 34 m^3 per barrel of oil." The figure of 11 billion barrels of proved reserves is "based, in general, on drilling results up to 2,500 m, although never in more than 3,500 m depths, . . . and without allowance for secondary and tertiary recovery." He stated that "the Mexican petroleum reserves are certainly larger than officially estimated." "A general application of secondary recovery should increase the proven reserves by 40-50 percent, in particular in the Tabasco-Campeche Area." "He stated that Mexico could [was already capable] of producing a total of 60 billion barrels of oil including gas equivalent."

Source	Item
,August 15, 1977, WORLD OIL, vol. 185, no. 3, p. 61, 64, 65.	Present proved reserves are stated to be 14 billion barrels. "Pemex takes the cautious view that only reserves from fields which are in production are proved", that is included in the proved reserve estimates. "Recently, six new fields have been discovered-Artesa, Paredon, Giraldas, Copano, Sunuapa, and Tepotzingo--bringing to 23 the number of successfully tested structures in this region. (Chiapas-Tabasco). "There are still 70 to be tested." "Last year, Pemex revealed that the Reforma area contained three parallel producing trends." "There may be a fourth line of deep seated anticlines with oil in fractured, vuggy, Cretaceous carbonates." "Initially, pay thicknesses averaged 1,500 feet. However, a recent find had a 4,000 feet oil column and newer discoveries average 2,500 feet of pay." "The productive area . . . may, in fact, stretch across the continental shelf to the Yucatan Peninsula to the north, to the Guatemalan border in the east, and into the Veracruz area in the west." "Thus far, Pemex has identified no fewer than 60 features in the Gulf and has tested two - which may turn out to be one, even though the wells are 15 miles apart." "The Chac-1 well flowed about 3,000 barrels per day last year. Last Spring, Bacab-1 well produced 2,000 barrels per day of oil on test from the same interval."

Source	Item
Anonymous, September 5, 1977, OIL AND GAS JOURNAL, p.	Pemex announced discovery of Artesa, 7 1/2 miles southwest of Sitio Grande. It "flowed at rate of 5,000 barrels per day through 7/8-in. choke from more than 1,600 feet below 14,760 feet." Pemex announced that during the first 7 months of 1977 ten new fields had been found in the Chiapas-Tabasco area, and two in the Campeche Shelf. The new onshore fields are: Paredon, Cacho Lopez, Mundo Nuevo, Artesa, Giraldas, Copano, Sunuapa, Agave, Ojicaque, and Tepate. The new offshore fields are: Bacab and Akal.
Figueroa J., Santos, September 19, 1977 OIL AND GAS JOURNAL, September 19, vol. 75, no. 39, p. 242 and 244.	Current official Pemex proven reserve figure is 14 billion barrels. "The Mesozoic calcarenites and dolomitic carbonates that correspond to the producing horizons [in the Chiapas-Tabasco Province] are at more than 13,000 feet depth." "Horsts and grabens attributed to vertical tectonic uplift constitute the dominant type of structural features that correspond to the prolific fields of" the Chiapas-Tabasco Province. In the Campeche Shelf the "producing carbonates are lithologically similar and of equivalent geologic ages, and their depths vary from 8,200 to 13,000 feet," to those in Chiapas-Tabasco.
Franco, Alvaro; September 19, 1977, OIL AND GAS JOURNAL, vol. 75 no. 39, p. 81, 83, 84 and 85.	" . . . the Sound of Campeche is not a marine prolongation of the prolific Reforma producing area but part of a huge new structural trend." "The new oil province is believed to extend all the way from south of Ciudad Pemex to at least 345 km off Ciudad del Carmen Island."

Source	Item
(cont.)	" . . . (it) has far larger potential in calcareous Tertiary formations found productive for the first time in southeastern Mexico."
	"All three offshore discoveries (Akal, Bakab, and Chac) have been made in Paleocene limestone pays."
	Zapatero-1, some 45 km southwest of Ciudad Pemex, "tapped a highly promising oil interval above 2,000 m."
	Artesa-1, 12 km southwest of Sitio Grande, "penetrated net oil pay of 1,650 feet (500 m) in fractured Upper Cretaceous limestones and tested 5,000 barrels per day of 27° gravity oil through a 7/8-in. choke with a gas-oil ratio of 220:1." 1/
	"The fields--Giralda, Copano and Sunuapa--have extended the play at least another 19 miles (30 km) to the south" of Sabancuy.
	With the discovery of the Paredon field, the western boundary of the play has been extended "another 19 miles (30 km) to the west "of the Grijalva River."
	At Agave "the 3,310-feet thick (1,003 m) highly fractured pay has been estimated to contain 600-800 million barrels of recoverable oil."
	"Pays are always thick--ranging all the way from 660 feet (200 m) at Sitio Grande to 1,003 m at Agave, and over 6,600 feet (2,000 m) at some of the Samaria blocks. Average thickness is 1,320 feet (400 m)."
	"Wells drilled near the outer limits of the Samaria and Cunduacan fields have resulted in unexpected extensions giving yields of 9,000 barrels per day or larger."
	"GOR's in the the central Reforma fields (Sitio Grande, Cactus, Samaria, Rio Nuevo, Iride, Cunduacan, and Nispero) average just over 1,000: 1." 2/

1/ Apparently the G/O ratio is expressed here as the ratio of cubic meters of gas to cubic meters of oil.

2/ Apparently the G/O ratio is expressed here as the ratio of cubic feet of gas to barrels of oil

Source	Item
(cont.)	Jose Santiago of Pemex's is quoted: "We have set a limit of 446-feet (135 m) water depth for this initial stage of operations. But that doesn't mean the prospects end there. We have done seismic surveys in deeper waters and detected a large number of promising structures."
Meyerhoff, A. A. and Morris, A. E. L., October 17, 1977, OIL AND GAS JOURNAL, p. 107 and 109.	"The . . . Reforma trend produces from high-energy, bank edge carbonate facies of early Turonian through Oxfordian ages, and in some fields, from Late Jurassic sandstones."
	"In places the productive column exceeds 2,000 m. "
	"An April 1977 Pemex press release that proved, probable, and potential reserves are at leat 62 billion barrels [in the Reforma trend] is unlikely to be exaggerated.'
	"If Ixchel-1 wildcat is productive, the reserve potential of this trend could quadruple."
Franco, Alvaro, November 1977, PETROLEO INTERNACIONAL, p. 26-30.	(Translation from Spanish)
	In mid September, "Pemex reported that it appears that the petroleum potential of southeastern Mexico has doubled."
	"The Campeche Bench is not the offshore continuation of the Reforma producing trend, but part of a new and gigantic structural trend."
	"By the time this edition was going to press, Pemex had incremented the proven reserves by 2,800 million barrels of recoverable hydrocarbons, so that the country's total rose to 16,800 million barrels."
	A new discovery was made "at Artesa, a structure 12 km southwest of Sitio Grande. The drill penetrated an oil-saturated interval more than 500 m thick of Upper Cretaceous fractured limestone and tested 5,000 barrels per day of 27° API oil through a 7/8-in. choke, and with a 200:1 gas/oil ratio." 1/

1/ Apparently the G/O ratio is expressed here as the ratio of cubic meters of gas to cubic meters of oil.

Source	Item
(cont.)	"Additional seismic surveys detected several large structures [on the southern limits of the Reforma area] north of a large NE-SW regional fault which cuts across the area much south of Sabancuy."
	"In three of these structures - Giraldas, Copanó and Sunuapa - new fields have been discovered with a very high gas/oil ratio . . . These gas and condensate fields extend the proven area 30 km southward of the previously established limit."
	"The discovery of the Paredón field associated with a large salt dome, has extended the producing area another 30 km to the west."
	"In the Agave field the Cretaceous calcareous producing column has a net thickness of 1,003 m."
	"A preliminary evaluation indicated 600-800 million barrels of proven reserves in this field."
	"In the onshore Reforma area Pemex has 46 drilling rigs, of which 14 were on exploration by the end of September."
	"About the Reforma reservoirs the following has already been established:
	"The producing intervals appear to be completely saturated and are potentially productive from top to bottom."
	"The producing sections are of great thickness - they vary from 200 m in Sitio Grande, to 1,003 m in Agave, and surpass 2,000 m in Samaria."
	"The average thickness for all the Reforma area is more than 400 m."
	"Almost all the fields are undersaturated."

Source	Item
(cont.)	"In all the producing intervals there is ready communication both vertically and horizontally." A typical Reforma field is described by Ing. Benito Teran de la Garza, Manager of Reservoir Engineering, as follows: "Imagine a sealed and pressurized tank, full of gravel, with a thin water layer at the bottom and filled of oil to the top." "Because of being undersaturated, the Reforma fields would have a primary recovery factor of 20 per cent. With water injection during the initial period of production, however, the foreseen recovery factor is not less than 46 per cent." Many of the peripheral wells of Samaria and Cunduacán have productive potentials of 9,000 barrels per day or higher." "The gas/oil ratios in the fields of the central producing trend (Sitio Grande, Cactus, Samaria, Rio Nuevo, Iride, Cunduacán and Nispero) average a little over 1,000 : 1."1/
Anonymous, November, 1977, PETRÓLEO INTERNACIONAL, p.55,56.	(Translation from Spanish) "Development drilling indicates that Samaria, Iride and Cunduacan are not separate structures, but appear to form part of one field composed of faulted blocks." At Sitio Grande "the presence of an asphaltic layer separating the water zone from the oil saturated zone somewhat hindered water invasion."

1/ Apparently the G/O ratio is expressed here as the ratio of cubic feet gas to barrels ~~to~~ of oil.

Source	Item
(cont.)	"When the pressure differential between the producing interval and the water zone increased to a certain value, water invasion became appreciable and was estimated at 40,000 barrels per day. The field was then producing 129,000 barrels per day. Reducing the rate to 36,000 barrels per day was enough to stabilize the pressure at 323 kg/cm^2, which indicated that the volume extracted was equal to the water input." Pemex estimates that "Sitio Grande can produce for several years 75,000 barrels per day with small or negligible pressure drop if 150,000 barrels per day of water is injected." "The same results are foreseen for Samaria, where there are also indications of a strong water drive."
Anonymous, November, 1977, PETRÓLEO INTERNACIONAL, p. 98, 101, 102.	(Translation from Spanish) The gas/oil ratio in "Agave, Copanó, Sunuapa, Giraldas, Mundo Nuevo, Paredón and Cacho Lopez average 5,000 : 1." 1/ "Pemex had planned for 1982 a production of 3,800 million cubic feet per day of gas for all the country. With the discovery of the new Reforma fields [these with high gas/oil ratio] the rate will easily surpass 5,000 million cubic feet per day.
Calzada Tovar, Luis; November 1977, PETRÓLEO INTERNACIONAL p. 80, 85 and 86.	(Translation from Spanish) The Sitio Grande structure "was the first structure where Middle Cretaceous production was found, actually in May, 1972." It has "a NW-SE extension of 11 km and a NE-SW width of 7 km."

1/ Apparently the G/O ratio is expressed here as the ratio of cubic feet of gas to barrels of oil.

Source	Item
(cont.)	The Cactus structure "has a NW-SE extension of 16 km and 12 km across." "The Samaria field produces from several permeable zones. The first ones, discovered in 1960, correspond to Miocene sandy layers (800 to 2,000 m deep), and the last zone discovered in 1973 corresponds to a Middle Cretaceous dolomitic limestone." The Mundo Nuevo structure is "approximately 8 x 8 km in size."
Anonymous, November, 1977, PETROLEO INTERNACIONAL, p. 88, 89.	(Translation from Spanish) "The Agave field . . . in the Chiapas-Tabasco Mesozoic Basin . . . has recoverable reserves estimated at 600 to 800 million barrels and a potential production of 25,000 barrels per day of oil and 700 million cubic feet per day of gas." The producing interval "measures more than 1,000 m." "It is estimated that the area of the field is 40 km^2." Agave-1 produced crude of 0.843 gravity at 20°C. "Pemex expects to extract 25,000 barrels per day" [of oil per well in the Agave field].
Government of Mexico, 1977, Mexico-Oil and Gas Development 1973, Yearbook 1976, (Review of 1975), Int. Oil Scouts Ass., Part II vol. XLVI, p. 511.	"In the South Zone, the results of the exploratory wells Samaria-101, Sitio Grande-101 and Sabancuy, confirmed the large extension of oil possibilities in the Cactus and Sitio Grande fields, established in 1972, within sediments of Mid Cretaceous."

Source	Item
Anonymous, 1977, Mexico-Oil and Gas Development 1974, Yearbook 1976, (Review of 1975) Int. Oil. Scouts Ass., Part II, vol. XLVI, p. 509.	"In the South Zone, 38 exploratory wells were drilled, 3 of them discovered the new fields of Cunduacan, Níspero, and the Iride in the Reforma area, extending the production possibilities of the region in Cretaceous rocks." (Text as in original:) "In addition, 6 producing oil extensions were discovered, being the one in the Samaria and Iride area (Jobillo and Roatan) of major importance, that will increase the economical oil importance of the region."
Anonymous, 1977, Mexico-Oil and Gas Development 1975, Yearbook 1976, (Review of 1975), Int. Oil Scouts Ass., Part II, vol. XLVI, p. 507.	In the Reforma-Chiapas area, as well as parts of Veracruz, Oaxaca, Tabasco and Campeche, "new structures have been discovered, which appear to be the southern continuation of the fields Cactus and Sitio Grande, the most promising being Madero, Chibol and Mompuyil." "It has been determined the possibility of salt domes, in the vicinity of the border with Guatemala, these will be proven with the wells Trinitaria-2, Honduras-1, and Jalisco-1, of which the Trinitaria, is being drilled and the Honduras and Jalisco will start drilling in the near future; ..."

Source	Item
Franco, Alvaro and Proubasta, Dolores, January 1978, PETROLEO INTERNACIONAL, p. 32.	"By the end of 1977, the Reforma fields were more than 20% the proven reserves of Mexico had increased to 16,800 million barrels, the oil production had surpassed 1.2 million barrels per day."
Franco, Alvaro, January 1978, OFFSHORE, p. 43, 44, 45.	"The oil producing column traversed in the Bay of Campeche had a striking similarity to that of Reforma."
	"It consisted of highly fractured limestones having high indexes of permeability and porosity both vertical and horizontal."
	"It assumed that the Reforma offshore prolongation had been found."
	Pemex announced "that more than 60 highly promising structures had been mapped around the initially discovered fields."
	"Jose Santiago, Pemex's Exploration Manager in Coatzacoalcos, indicate that the Bay of Campeche is not an offshore extension of the structural trend but part of a huge new structural trend."
	"A closer geological examination showed [that in the Bay of Campeche] the top of the pay to be of Paleocene age, absent in Reforma as a producing interval."
	"The new oil province is believed to extend all the way from south of Ciudad Pemex to at least 345 km off Ciudad del Carmen Island."
	"All three offshore discoveries (Akal, Bakab, and Chac) have been made in Paleocene limestone pays."

Source	Item
(cont.)	"In the Bay of Campeche, reports Jose Santiago, 'More than 100 structures have been detected.'"
	In the onshore portion of the play Zapatero-1 tapped a highly promising oil interval above 6,600 feet (2,000 m)."
	"Cores from the apparent discovery were called by Pemex's Director General Jorge Diaz Serrano, ' the most oily he had ever seen.' "
	"So far, no offshore well has found production in either Cretaceous or Jurassic formations. But the Chac-1 discovery, according to Santiago, found a thick Cretaceous-Jurassic interval, almost identical to that in the Reforma area. The Chac-1 was plugged due to water invasion, which Santiago attributed to its unfavorable structural position."
	"West of Chac, the Akal structure forms the southern tip of a giant horst, 7,590 feet (2,300m) higher than Chac where conditions for major Tertiary and Mesozoic accumulations are considered excellent. The block is 18 miles (29 km) long by 4 miles (6 km) at the widest point."
	In the Reforma-Campeche area:
	"Pays are totally saturated and productive from top to bottom."
	"Pays are always thick ranging all the way from 660 feet (200 m) at Sitio Grande to 1,003 m at Agave, and over 6,600 feet (2,000 m) at some of the Samaria blocks. Average thickness is 1,320 feet (400 m)."

Source	Item
(cont.)	"Most of the Reforma reservoirs are undersaturated."
	"Throughout the entire column there is total communication, both vertical and horizontal."
	"The presence of active aquifers . . . was confirmed only after the fields were pulled closer to their saturation points."
	"Being undersaturated the Reforma fields would have a low primary-recovery factor, of 20 per cent at best. Via early water flooding, however, a recovery factor of at least 46 per cent can be expected, Pemex feels."
	"The fact that the fields are gently sloping structures rather than cone shaped as originally believed means pay thicknesses are quite uniform and drastically thicker, than first thought, towards the flanks."
	"The proven areas swell north, south and west, as well as offshore. Field development reveals some of the fields to be larger than initially anticipated. East of the Reforma area we have found another monumental structural trend."
	"Proved Mexican hydrocarbon reserves (crude, gas liquids and gas converted to liquid equivalent) now stand at nearly 20 billion barrels.
Anonymous, January 1978 OFFSHORE p. 46, 48, 53.	"A Bay of Campeche well can cost $4 million or more. This compares with the average of $2 million per well in the adjacent onshore area."
	"For the initial phase of its exploratory program, Pemex is using six marine rigs---three drillships, two jackups and a semi-submersible."

Source	Item
(cont.)	Five of the rigs used in the Bay of Campeche "can drill down to 25,000 feet and the sixth to 20,000 feet."
	"At the Hol structure . . . the top of the Cretaceous is expected to be found at 1,500 m, while the predicted depth at Kin is 6,100 m. The shallowest wildcat to be drilled in the next few months is the Ek location (4,500 m). All the others have a programmed T.D of 5,000 m or more. Four of them will be drilled to 6,000 m and at least one (Kin) is planned to reach 6,500 m."
	"Pemex is expecting an oil output of 360,000 barrels per day by 1982 from the three best fields," that is Akal, Bacab, Chac.
	"Surrounding the three announced discoveries Pemex has mapped nearly 200 seismic structures A fourth completion (Kukulcan) remains suspended. But confidential sources say the well tested over 12,000 barrels per day.
	"The three discoveries [Akal, Bacab, Chac] are located within a giant horst block-- and Pemex suspects they are part of a highly fractured, single field, where some of the blocks could have thousands of feet of oil pay."
	"In Reforma, the average pay thickness is 1,200 feet, with at least one field having as much as 6,000 feet of net oil column."
	"Although no Bay of Campeche well has as yet found commercial production in Mesozoic formations, Chac-1 penetrated a thick, water-invaded Cretaceous-Jurassic interval 'extending more than 3,000 feet'. The water invasion is attributed to unfavorable structural positioning of the well."
	"The Ixchel location to be tested this year, is some 250 km from Ciudad del Carmen."
	"Structures have been already mapped in deeper waters [more than 135 m], up to 300-plus kilometers away from shore."

Source	Item
Reuters (Mexico City), March 29,1978, OIL DAILY, p. 5.	"Mexico's potential oil reserves amount to 120 billion barrels, Petroleos Mexicano Director General Jorge Diaz Serrano said." "This includes 16 billion barrels of proved reserves at December 1977 and 31 billon of probable reserves at that date." "Diaz Serrano forecast that by 1982 proved reserves would have risen to more than 30 billion barrels, and the production target for that year was 2.5 million barrels per day. He added that he expected this target to be reached by 1980." "Exports of crude should increase to more than 500,000 barrels per day by end year from the present 280,000 barrels per day, Diaz Serrano said."
Anonymous, May 1978, OCEAN INDUSTRY, p, 42-44.	The Director General of Pemex, Jorge Diaz Serrano, stated: "Our proven reserves of crude oil, natural gas and condensate rose to 16 billion barrels last year. Probable reserves are 31 billion barrels and potential reserves . . . are 120 billion barrels." "It is estimated that the probable consumption of hydrocarbons [of Mexico] up to the end of the century will be much less than the [current] proven and probable reserves." "We have already found the oil that Mexico will consume in the present century." "At the moment [March 18, 1978] we estimate that the proven reserves of the country in 1982 . . . will be more than 30 billion barrels." "In 1977, 26 new fields were discovered, 17 of oil and 9 of natural gas, as well as four extensions of fields already producing." "The high index of productivity per well" [in the Chiapas-Tabasco area as due to] "the potent section of . . . impregnated rock, up to 1,500 m thick."

Source	Item
(cont.)	During 1977 the Reforma area "produced an average of 647,000 barrels per day of crude and in December, 735,000 barrels per day." "The average production of natural gas during the year [1977] was 2,046 million cubic feet per day." "Pemex plans to export 16 per cent of its refined products by 1982 and 17 per cent of its basic petrochemicals." "Mexico already has natural gas in reserve for 40 years."
Anonymous, June 1978, NOROIL, vol. 6, June, p. 109,111, 112, 113.	In the "Chiapas and Tabasco regions onshore, more than 110 promising structures have been located, according to Pemex." "On the continental shelf off Campeche there are numerous structures with very similar characteristics which give this geological province a great potential economic value." "Seismic surveys indicate there are some 200 other structures to drill upon "[in the Campeche offshore area]. The Director General of Pemex, Jorge Diaz Serrano, is quoted: "Our proven reserves of crude oil, natural gas and gas liquids as of 31 December, 1977 amounted to 16 billion barrels. The probable reserves amount to 31 billion additional barrels and the potential reserves including these, reach 120 billion barrels." "At this moment, we estimate that proven reserves for the country in 1982 will amount to more than 30 billion barrels." "The Bermudez reservoir now is 150 sq. km. [with] average thickness of oil-bearing limeston of 425 meters; the Cactus reservoir 130 sq. km. [with] average thickness oil-bearing limestone 425 m; the Agave reservoir of unknown total extent but in places oil-bearing limestones are 1,200 meters thick."

Source	Item
(cont.)	"The increase [in oil production] in 1977 came mainly from the Reforma fields, producing an average 647,000 barrels per day [1977] and in December 1977, 735,000 barrels per day. "The target production of 2.25 million barrels per day envisaged for 1982 will be achieved instead in 1980." "The first stage, under construction, [of the Chiapas to Tamaulipas gas pipeline] . . . would not require compressors . . . would be enough to convey to domestic markets 800-million cubic feet per day." "If gas is to be sold to the United States . . . it would require also installation of 17 compressor stations in the gas pipeline." "Capacity of the system from Tabasco to Reynosa near the US border would become eventually 2.7 billion cubic feet per day." "Current Mexican gas production of 2.2 billion cubic feet per day included about 600,000 cubic feet per day exported to the US from fields in Reynosa area."
Anonymous, June 1978, NORTHERN OFFSHORE, vol. 7, no. 6, p. 6 and 7.	Pemex's Director General Jorge Diaz Serrano among other things, stated: The 2.2 million barrels per day of oil production target was moved from 1982 to 1980 because of "having found more highly productive wells." "Now we have wells producing around 20,000 barrels per day." "Today we are producing 65,000 barrels per day offshore." The article adds some information: In the Reforma area "the average production is 5,800 barrels per day per well, some wells producing 18,000 barrels per day."

Source	Item
Franco, Alvaro; June 5, 1978, OIL AND GAS JOURNAL, p. 68, 69, 70.	"The number of seismic structures mapped in the prolific onshore Reforma area has climbed to 150."
	"Pemex estimates at least 100 of these structures will be proved productive."
	"Furthermore, 200 attractive structures have been mapped offshore in the Gulf of Campeche."
	"The Reforma area is producing over 900,000 barrels per day of total hydrocarbons - and essentially all of it from only three fields: Bermudez, Cactus, and Sitio Grande."
	"The Bermudez complex now comprises Samaria, Cunduacan, Oxiacaque, Iride, and Platanal initially announced as separate finds."
	"Bermudez's proved area at this point exceeds 150 sq. km. (58 sq. mi.) and the average thickness of the continous Cretaceous-Jurassic pay is well over 1,000 m (3,280 ft)."
	"The Mundo Nuevo structure . . . heralded in 1976 as a gas and condensate field, appears to be a very large oil field. Pemex penetrated over 1,000 m (3,280 ft) of wet gas pay in the discovery well."
	"The first Mundo Nuevo outpost drilled through the gas and condensate interval and found several hundred meters of oil pay underneath."
	"No structure drilled to date in Reforma has been condemned as non-producing."
	Diaz Serrano stated: "The Reforma area will be able to sustain production of as much as 3,500,000 barrels per day when fully developed. Productivity per well averages over 5,000 barrels per day. We have several 18,000 barrels per day wells, and we are ready to handle 25,000 barrels per day wells."

Source	Item
(cont.)	"At the end of March, 54 rigs were active in the area ... By the end of 1978, Pemex expects to have 92 working."
	In the Gulf of Campeche Pemex has nine marine rigs.
	"In the Gulf of Campeche" ... "we have mapped over 200 seismic structures ... larger than those in Reforma. Should they be oil-bearing, they would dwarf the potential of Chiapas-Tabasco."
	"Pemex has found oil in the Chac, Bacab, Akal, and Abkatun structures."
Anonymous, June 5, 1978, OIL AND GAS JOURNAL, vol. 76, no. 23, p. 96.	"At the giant Bermúdez field complex, Pemex is installing facilities to inject at rate of 1 million barrels of water per day."
	"Reforma fields are undersaturated but have highly active aquifers."
	"In the Samaria block /part of the Bermúdez field/ ... pay thicknesses range from 600 m (1,968 ft) to 2,000 m (6,560 ft), and no water cut has been observed."
	"With water flooding during the early stages of the producing lives /of the Reforma fields/ ... the recovery factor can be increased to at least 46 percent, Pemex believes."
	"Bermúdez requires 1 million barrels of water per day if the field is to continue the 500,000 barrels per day of oil it is currently producing."
Díaz Serrano, Jorge; July, 1978, PETROLEO INTERNACIONAL, vol. 36, no. 7, p. 18, 19.	(Translation from Spanish)
	"Mexico's proven reserves (crude, natural gas, and gas liquids) to December 31, 1977 amounted to 16,000 million barrels."
	"In addition, the probable reserves are 31,000 million barrels, and the potential, including both previous items, reaches 120,000 million barrels."

Source	Item
(cont.)	"At this moment we estimate that the proven reserves [of Mexico] by 1982 will be larger than 30,000 million barrels."
	"Mexico's proven reserves have been calculated without allowing completely for secondary, and without tertiary recovery."
	"It has been established that the area of the Bermudez field (Samaria-Cunduacan-Iride-Oxiacaque-Platanal) is already 150 km^2, and that the average thickness of impregnated limestone, is 450 m."
	"Its total area is not completely defined yet."
	"The proven area of the Cactus field is until now 130 km^2, . . . and the average thickness of the impregnated limestone is 425 m."
	"In the Agave field, the total extension of which is not known yet, . . . the impregnated limestones attain a thickness of more than 1,200 m in places."
	"We already have proven seven other similar structures, of similar dimensions, whose proven reserves are included only to a small extent in the overall published reserve figures."
	"During [1977] 26 new fields were discovered, of which 17 were of oil and 9 of gas, and also 4 producing fields were extended."
	In the Chiapas-Tabasco area: "The wells, which are not only being produced rationally but most carefully, produce an average of 5,500 barrels per day."
	"There are wells with capacities of 18,000 barrels per day, and in Agave installations are being completed for wells of 25,000 barrels per day capacity."
	The Reforma area " is producing mainly from three fields: Bermudez, Cactus, Sitio Grande, [a total of] 900,000 barrels per day of crude oil, gas liquids and natural gas equivalent."

Source	Item
(cont.)	"In the Reforma area a total of 150 structures have been identified seismically up to now."
	"It is estimated that of these 150 structures, at least 100 will be as productive as those proven already."
	"Until now not a single one of the structures drilled has been definitely abandoned."
	"It is reasonable to expect, from the 150 seismic structures already defined, that the production rate may increase to several times that at present, that is more than 3.5 million barrels per day.
	The Golfo de Campeche area "seems to be of greater productivity than the Reforma (Chiapa-Tabasco)."
	In the Golfo de Campeche "more than 200 seismic structures have been defined."
	"The seismic cross-sections indicate that these [structures] are more gently deformed than those in Tabasco and Chiapas—which means that if they have hydrocarbons, the fields would be of larger size than those found productive onshore."
	"Of these 200 [offshore] structures four have been drilled already, and in all four considerable amounts of hydrocarbons have been found."
	"It is now believed that the [Golfo de Campeche] area could be of greater scope than Europe's North Sea."
	"The Chac, Bacab, Akal and Abaktún fields . . . are of great magnitude and their [reservoir] rocks have not only a large porosity but are highly fractured as well, which permit a greater rate of production."
	"Water-depth in the already productive part of the Golfo de Campeche is about 60 m on the average."

Source	Item
(cont.)	"It should be noted that not even the entire Bermudez field is included in the proven reserve figures. With respect to the Golfo de Campeche, only a tiny fraction of its reserves, that is the area immediately surrounding 2 wells, has been included in the 16,000 million barrel figure."
Anonymous, July 1978, PETROLEO INTERNACIONAL, vol. 36, no. 7, p. 5.	(Translation from Spanish) Ignacio de Leon, of Pemex, stated that "it is very probable that by 1980 the [oil] production reaches 2.2 to 2.7 million barrels per day and that by that time gas production reaches 4,000 to 5,000 million cubic feet per day compared with 2,300 million cubic feet per day at present." "It seems quite feasible that in 1980 Mexico would have a surplus of about 1,000,000 barrels per day (Text contains probably a misprint: '1,000 million barrels per day.') and 2,000 million cubic feet of gas."
Anonymous, July 1978, PETROLEO INTERNACIONAL, vol. 36, no. 7 p. 21.	(Translation from Spanish) "Pemex is building at full speed the construction of the largest gas pipeline ever built in the Western Hemisphere." "The 48 in. pipeline runs from Cactus, in the Reforma area to the Monterrey industrial center. "The Chiapas-Monterrey gas pipeline without compressor stations [in its initial phase] . . . will cost 500 million dollars." "Initially, it will be able to transport, using the energy of the reservoirs themselves, up to 800 million cubic feet per day of gas." "In its final stage [with compressor stations] it will be able to transport up to 2,500 million cubic feet per day of gas." "The pipeline [first stage] will be completed March 1979."

Source	Item
Anonymous, July 1978, PETROLEO INTERNACIONAL, p. 21, 22, 24, 25, 26, 27.	"Aside of the fields already in production in the Reforma area similar [gas] productive capacity has been confirmed in another 9 structures not developed yet."
	"Of these structures, Artesa, Oxiacaque and Sunuapa produce light oils similar to those in production in the Chiapas and Tabasco area with a gas/oil ratio of 1,250 cubic feet of gas per barrel of oil; whereas Agave, Cacho Lopez and Paredon produce very light oils, with a gas/oil ratio of 2,300 cubic feet of gas per barrel of oil; and the other structures-Copano, Giraldas and Mundo Nuevo-which produce gas and condensate, have a ratio of 7,700 cubic feet of gas per barrel of condensate."
	"The gas reserves in the nine structures [mentioned above] are greater than 6.2 trillion cubic feet." [Spanish original reads: "6.2 billions", which probably refers to the 'billion' = million x million, as used in Latin America]
	"Mexico's [gas] reserves amount to 30 Tcf." [same note on 'billion' as before.]
	"Based on these reserves, gas production could be increased up to 5,400 million cubic feet per day by 1982."
	"The associated gas of the Mesozoic fields of the Southern Zone carries important quantities of recoverable valuable liquids. They also contain H^2S which must be eliminated before recovering the liquifiable fraction."
	"By the end of the present year there will be [at Cactus] a total installed capacity of 2,200 million cubic feet per day to remove sulphur."
	"The sweetening capacity . . . for treating associated gas for 1982 is 3,500 million cubic feet per day."
	The total current capacity to recover liquifiable fractions from the gas in the Chiapas-Tabasco area is 1,150 million cubic feet per day, and for 1982 the planned capacity is 3,950 million cubic feet per day.

Source	Item
(cont.)	"It can be foreseen, that the availability of dry gas in 1982 will be 4,326 million cubic feet per day."
López Portillo, President José, September 1978, THE NEWS, p. 2B-16B.	"A few months ago, proven reserves had already reached 16 billion barrels. As of last July 31, they rose to 20 billion barrels, while our probable reserves stood at 37 billion barrels and our potential reserves at 200 billion barrels."
	"The latter will surely increase in areas bordering what once, when the Earth was young, were the shores of long vanished seas".
	"Daily production of crude oil and by-products now stands at 1.4 million barrels per day, which is more than 50 percent our estimates of only six months ago".
	"If we have a surplus /of gas/, we can sell, consume or keep it in reserve; but we will never undersell it, which would be equivalent to flaming it".