UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

Assessment of undiscovered conventionally recoverable petroleum resources in offshore Tertiary sedimentary basins of The People's Republic of China

by

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Open-File Report 84-329

1984

[1]Denver, Colorado

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ASSESSMENT OF ENERGY RESOURCES

This report was prepared as part of the World Energy Resources Program of the U.S. Geological Survey (USGS). The objective of the study is to assess the undiscovered conventionally recoverable resources remaining within petroleum-producing provinces. The study utilizes geological and petroleum engineering data, in conjunction with statistical techniques, to estimate undiscovered resources by a process involving a team of geologists and statisticians. The geologic investigation leading to the assessment was conducted by Keith Robinson. The estimates represent the views of the U.S. Geological Survey estimation team and should not be regarded as an official position of the Department of the Interior.

Other U.S. Geological Survey publications relating to the assessment of undiscovered conventionally recoverable petroleum resources include the following:

Open-File Reports
- 81-0986 - Persian Gulf Basin and Zagros fold belt (Arabian-Iranian Basin)
- 81-1027 - Volga-Ural Basin
- 81-1142 - Indonesia
- 81-1143 - Northeastern Mexico
- 81-1144 - Southeastern Mexico, northern Guatemala, and Belize
- 81-1145 - Trinidad
- 81-1146 - Venezuela
- 81-1147 - West Siberia and Kara Sea Basins, USSR
- 82-0296 - Middle Caspian Basin, USSR
- 82-1027 - East Siberian Basin, USSR
- 82-1056 - North Africa
- 82-1057 - Timan-Pechora Basin, USSR, and Barents-northern Kara shelf
- 83-0598 - Northwestern, central, northeastern Africa
- 83-0801 - Onshore China
- 84-0094 - Northwest European region
- 84-0158 - New Zealand

ACKNOWLEDGMENTS

The resource assessment for this report was prepared in collaboration with the Resource Appraisal Group of the Branch of Oil and Gas Resources.

INTRODUCTION

The location of the major Tertiary offshore basins of The People's Republic of China is shown in figure 1. Figure 2 shows the two areas of assessment, northern and southern, which include, respectively, the North and South Yellow Sea, Subei, East China Sea, and Taiwan Basins; and the Pearl River, Beibu, Yinggehai, and Southeast Hainan - Qiong Basins. Figure 2 also shows the location of the natural gas producing region in Taiwan and crude oil discovery wells in the Beibu and Pearl River Basins, together with the unsubstantiated Longjing discovery well in the East China Sea Basin. The discovery wells are identified in table 1, as are the locations, discovery date, type of discovery and status. Table 2 lists estimates by the USGS appraisal group of oil and gas resources for Tertiary sedimentary basins in offshore areas of China, separated into northern and southern regions and aggregated. Figures 3 through 8 are computer generated graphs showing the probability of occurrence relative to specific amounts of oil and gas resources. Data supplementary to these estimates are given in table 3.

The assessment of undiscovered petroleum resources is confined to areas of Tertiary sedimentation underlying marine territorial waters claimed by The People's Republic of China and restricted to areas with water depths of less than 1,000 meters. This report is not authoritative with respect to the delineation of international maritime boundaries, and those shown are only approximate for the convenience of the assessment.

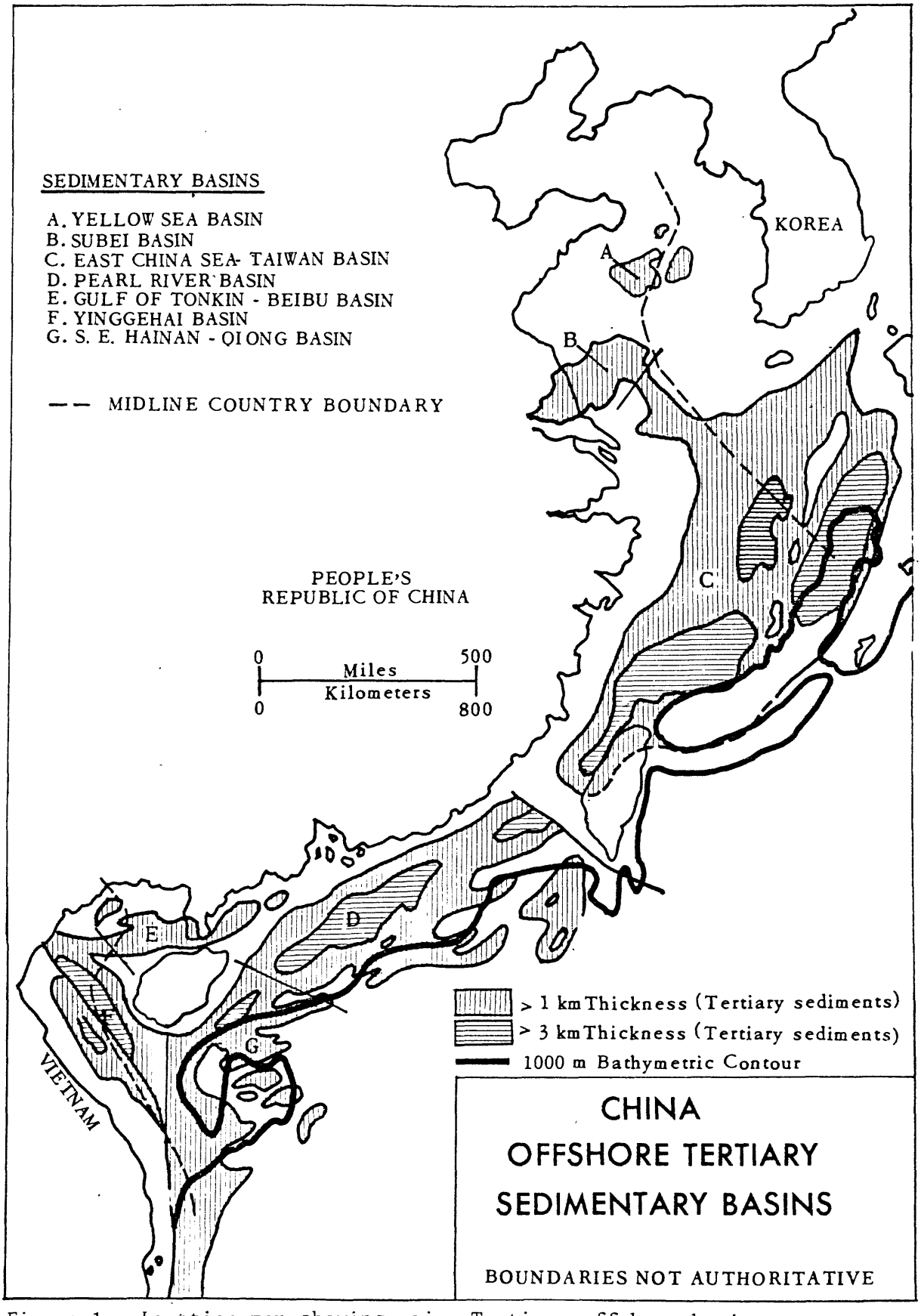

Figure 1.--Location map showing major Tertiary offshore basins.

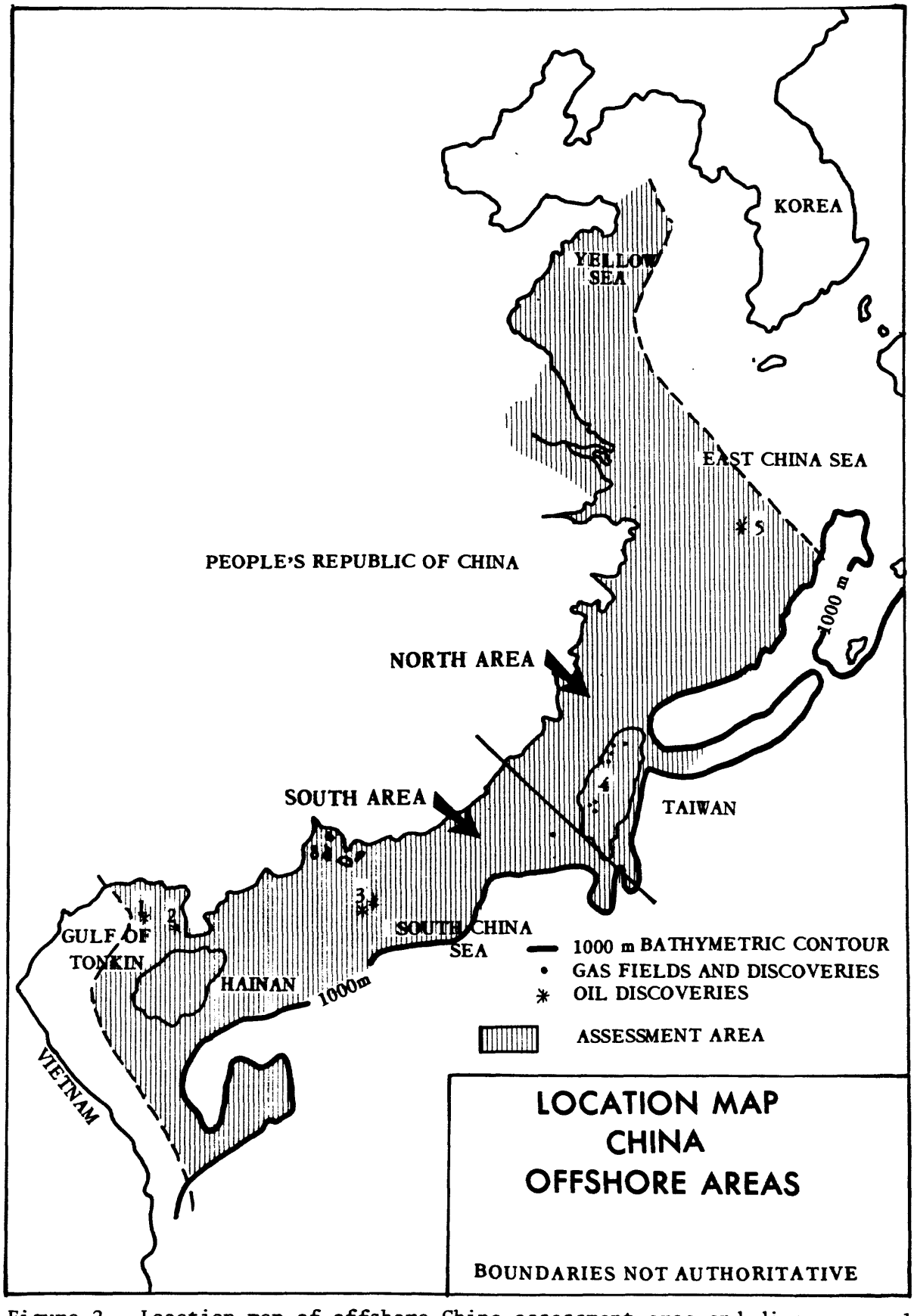

Figure 2.--Location map of offshore China assessment area and discovery wells.

Table 1.--Offshore China fields and discoveries

Number (see fig. 2)	Field name or discovery well	Location	Discovery date	Type field or discovery	Status
1	Wan	Beibu Gulf	1977	Oil	Shut in
2	Wushi	do	1981	do	Do
3	Zhu 5	Pearl River Basin	1979	do	Do
	Ying 9	Yinggehai Basin	1981?	do	Do
4	All Taiwan fields	Taiwan	1904-81	oil, gas and condensate	Producing
5	Longjing	East China Sea	1981	Oil?	?

Table 2.--Assessment of undiscovered conventionally recoverable petroleum resources in offshore Tertiary sedimentary basins of The People's Republic of China.

Resource assessment by USGS as of Feb. 17, 1983; see also figures 3 through 8.

Region	Crude oil in billions of barrels (BB)			Natural gas in trillions of cubic feet (Tcf) and billions of barrels of oil equivalent (BBOE) @ 6,000 cuft/bbl.		
	Low (F_{95})[1]	High (F_5)[1]	Mean	Low (F_{95})[1]	High (F_5)[1]	Mean
Northern Area						
North Yellow Sea, Subei-South Yellow Sea, East China Sea, and Taiwan Basin	0.33	5.00	2.05	Tcf 3.45	43.36	19.43
				BBOE 0.58	7.23	3.24
Southern Area						
Pearl River, Beibu Gulf, Yinggehai, and S.E. Hainan-Qiong Basins of South China Sea and Gulf of Tonkin	2.10	15.80	7.85	Tcf 10.73	83.27	40.99
				BBOE 1.79	13.88	6.83
Total of offshore China provinces:[2]						
	3.46	20.97	9.90	Tcf 21.25	127.64	60.42
				BBOE 3.54	21.27	10.07

[1] F_{95} denotes the 95th fractile; the probability of more than the amount F_{95} is 95 percent. F_5 is defined similarly.

[2] Totals are derived by statistical aggregation; only the mean total equals the sum of the component parts.

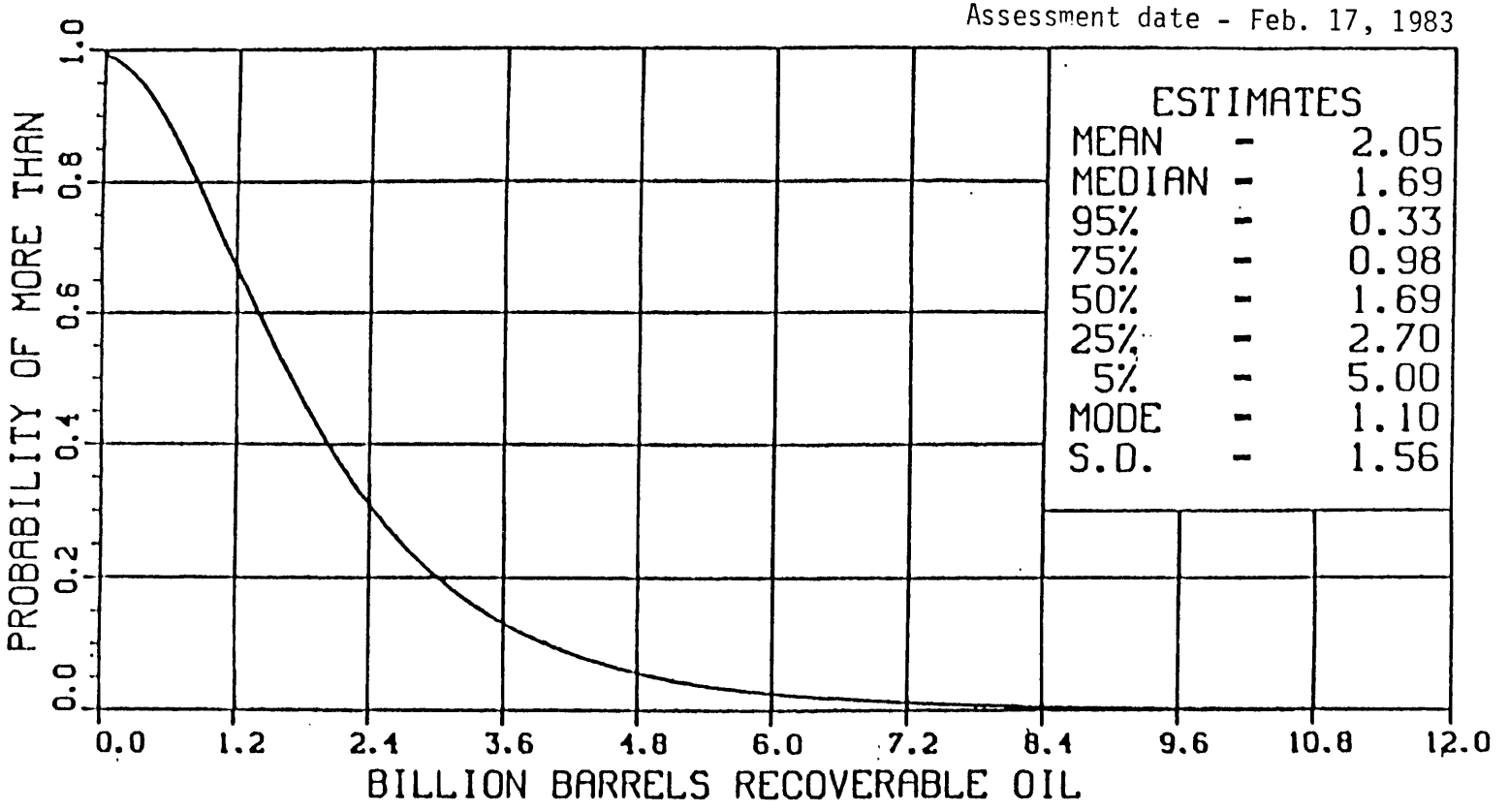

Figure 3.- Northern area, Offshore China, undiscovered recoverable oil, Yellow Sea, Subei, East China Sea, and Taiwan Basins.

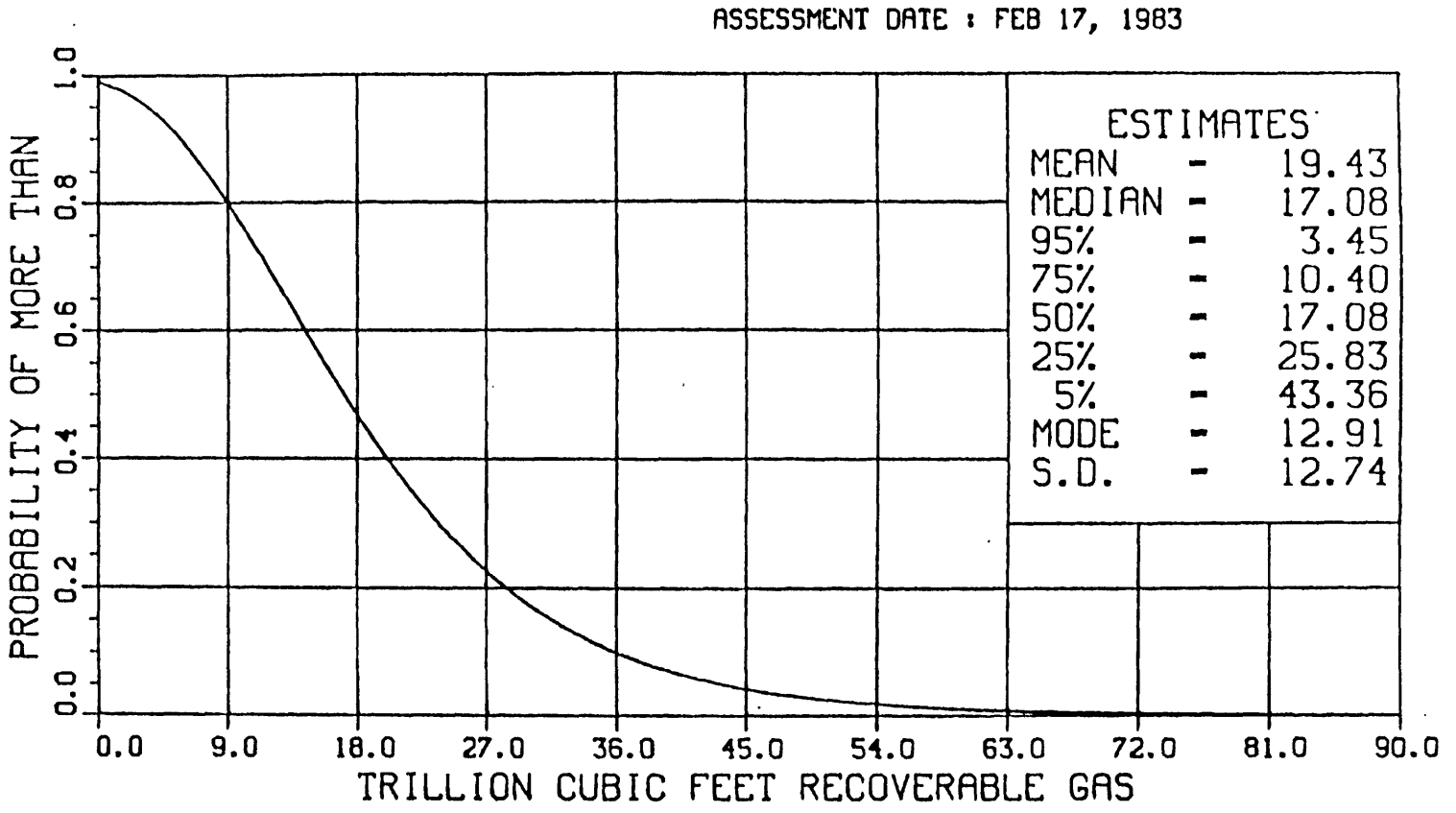

Figure 4.--Northern area, offshore China, undiscovered recoverable total gas, Yellow Sea, Subei, East China Sea, and Taiwan Basins.

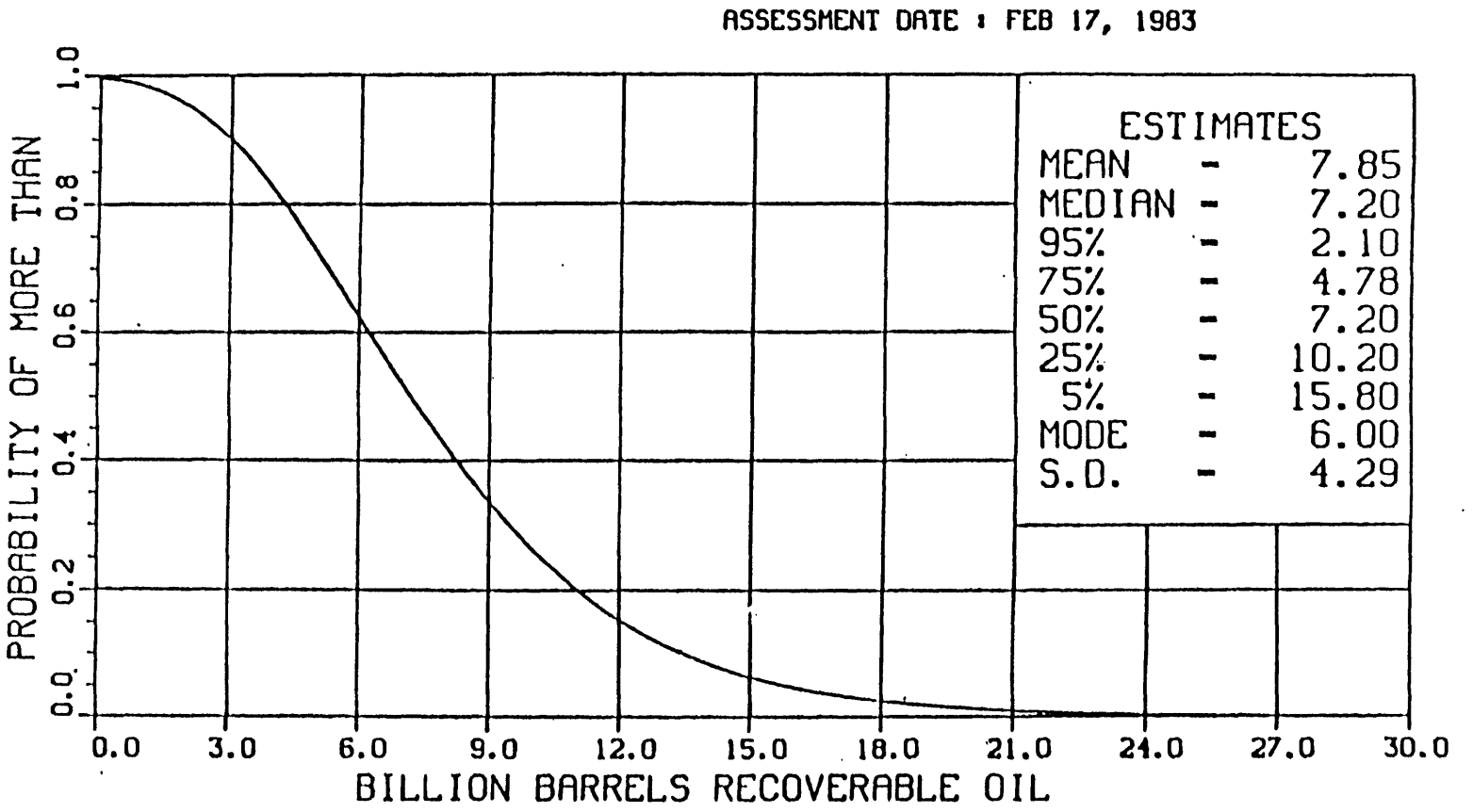

Figure 5.--Southern area, offshore China, undiscovered recoverable oil, Pearl River, Beibu Gulf, Yinggehai and southeast Hainon-Qiong Basin.

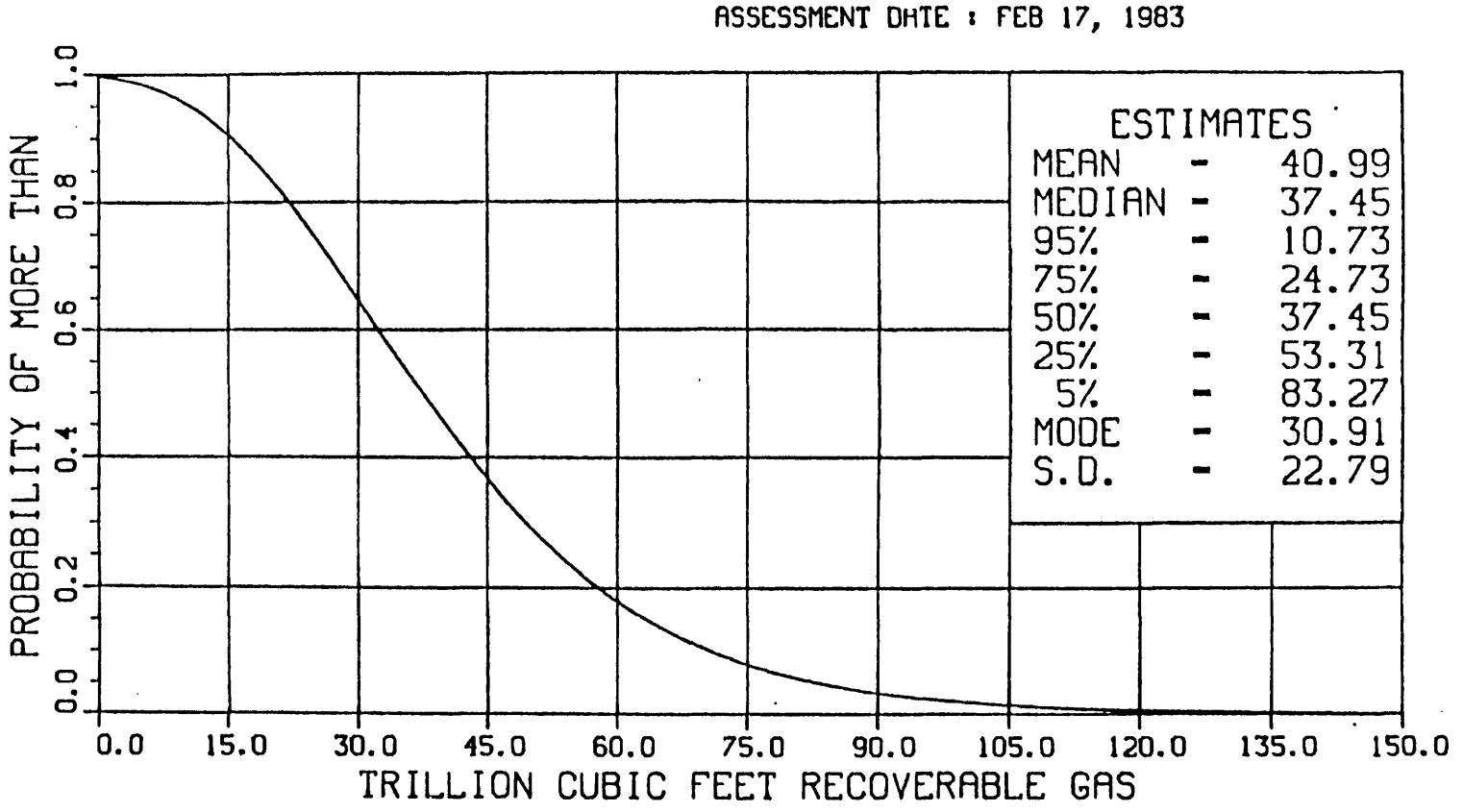

Figure 6.--Southern area, offshore China, undiscovered recoverable total gas, Pearl River, Beibu Gulf, Yinggehai and southeast Hainon-Qiong Basin.

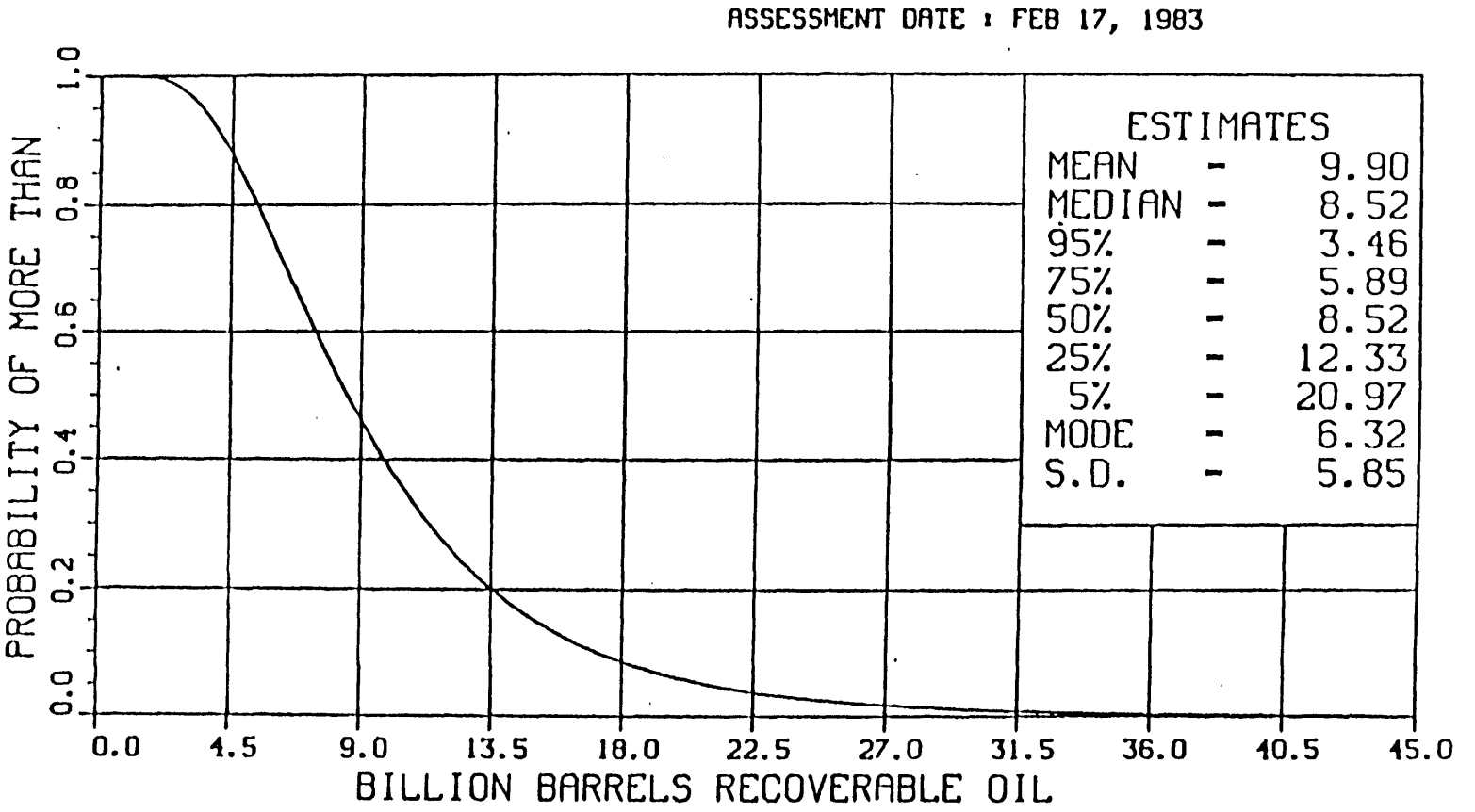

Figure 7.--Offshore China, aggregate undiscovered recoverable oil.

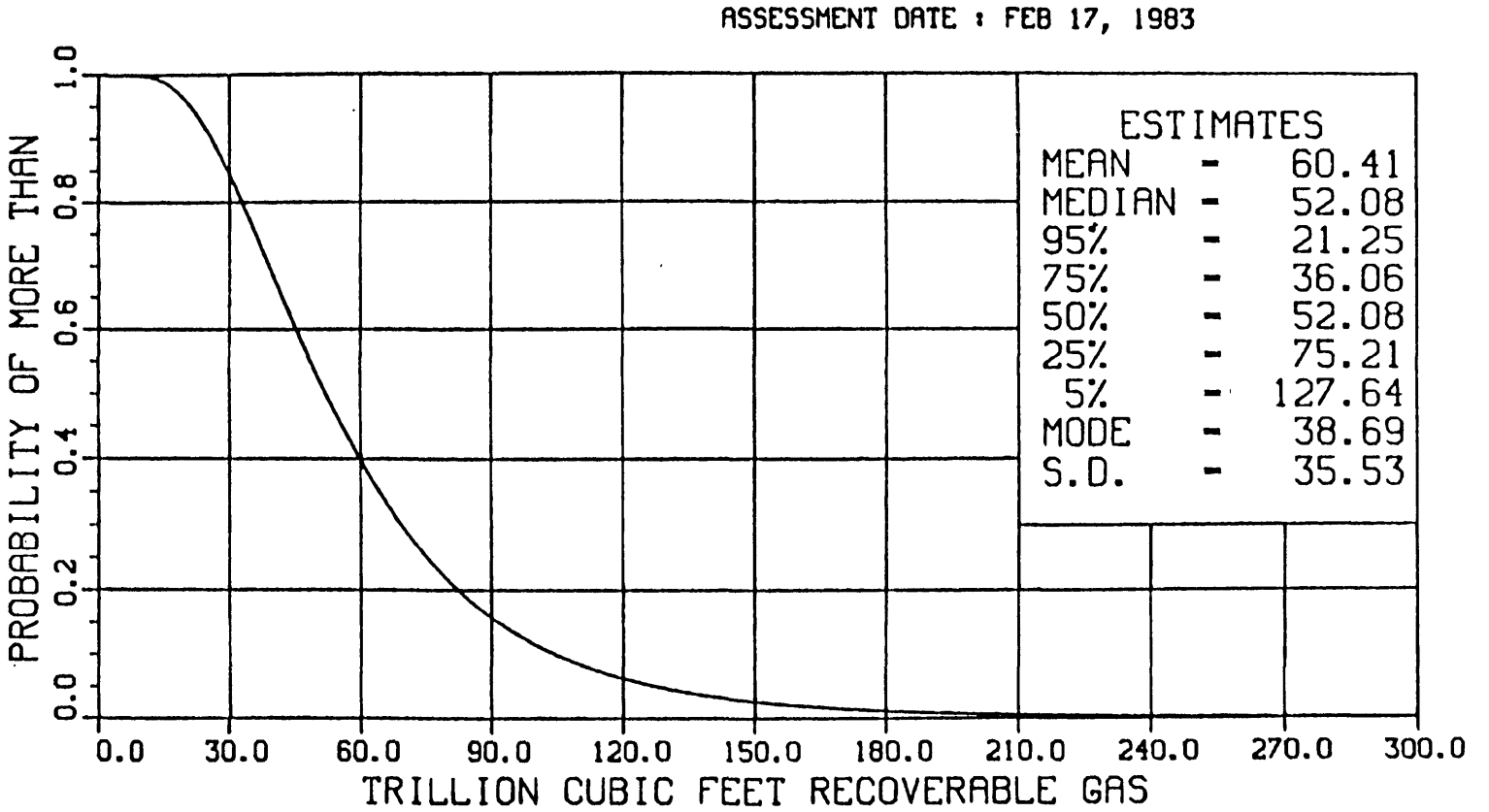

Figure 8.--Offshore China, aggregate undiscovered recoverable total gas.

Table 3.--Supplementary and comparative data supporting the resource assessment in offshore Tertiary sedimentary basins of China[1/]

	Crude oil (BB)	Natural gas (Tcf)
Cumulative production to 1/83		
Northern Area North Yellow Sea, Subei-South Yellow Sea, East China Sea, and Taiwan Basin	0.018 [2/]	+ [3/]
Southern Area Pearl River, Beibu Gulf, Yinggehai, and S.E. Hainan-Qiong Basins of South China Sea and Gulf of Tonkin	0	0
Subtotal	0.018	1.0+ (est.) [2/]
Measures reserves to 1/83		
Northern Area North Yellow Sea, Subei-South Yellow Sea, East China Sea, and Taiwan Basins	0.008 [2/]	0.7
Southern Area Pearl River, Beibu Gulf, Yinggehai, and S.E. Hainan-Qiong Basins of South China Sea and Gulf of Tonkin	+ [3/]	+ [3/]
Subtotal	0.008+	0.7+
Undiscovered Resources (mean)		
Northern Area	2.05	19.43
Southern Area	7.85	40.99
Original recoverable Resources (or Total)[4/]	10.00	62.00

[1/] Cumulative production and reserves are composited estimates from various sources.

[2/] Mostly condensate in Taiwan, minor Subei Basin crude oil.

[3/] Quantity positive, but data unavailable. Total estimate, this paper.

[4/] Does not include an estimate of inferred reserves.

COMMENTS

- Offshore Tertiary sedimentary basins of China can be classified as continental rifted basins. Fault block, horst and graben structures form the traps for most oil and gas fields. The fault blocks also controlled Paleogene sedimentation. Environments of deposition were mainly nonmarine, fluvio-deltaic to lacustrine, with occasional incursions of coastal plain and brackish marine sediments.

- Commercial discoveries of crude oil, natural gas, and condensate have been made in the Pearl River, Yinggehai, Beibu, Taiwan, and Subie-South Yellow Sea Basins. The Longjing discovery well drilled in the East China Sea has not been substantiated. Relatively very few exploratory wells have been drilled in any of the basins, and information is scant.

- Adequate maturation may be a problem in the Yellow Sea region; geothermal gradients appear to be low, generally less than 2 F/100'. Adequate source rock, reservoir rock, and maturation may be problems in the East China Sea.

- In the Beibu Gulf, northwest of Hainan Island, thick sequences of nonmarine Eocene-Oligocene sediments are restricted to the deeper grabens. In this region Neogene sediments are generally less than 1 kilometer thick.

- In the Pearl River Basin, the main source, reservoir, and sealing rocks are thought to be of Oligocene to early Miocene age. Lower Paleogene oil shales have been rated as having excellent source potential, but thermal maturity may be a problem. The top of the oil generating section has been put at 8,500 feet. Oil possibly migrated laterally from adjacent deep synclines.

- If future discoveries of petroleum are confined to the deeper graben areas, the assessed mean estimate of 7.1 billion barrels undiscovered recoverable crude oil for the South China Sea and Beibu Gulf may be too high. A resource assessment of the area, by the author, based on a play analysis approach and assuming oil restricted to the deeper grabens with more than 2 kilometers of Tertiary sedimentary section, suggests 4 billion barrels of undiscovered recoverable crude oil.