

Geology and Exploration of the Manteo Prospect off North Carolina

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Abstract

The Manteo Prospect is located about 45 miles northeast of Cape Hatteras, North Carolina. It is a high-risk prospect with world class potential. The 21-lease unit was approved by the Minerals Management Service (MMS) in May 1990. A suspension of operations (SOO) was issued in October 1992 by the MMS. Chevron was approved for an exploration permit for Block 510 while Mobil's plan for Block 467 was under appeal.

The Baltimore Canyon Trough and the Carolina Trough are the two large and deep sedimentary basins of the Atlantic Continental Margin. The Manteo unit is at the juncture of these two sedimentary basins.

The Manteo Prospect is interpreted as a reef with its overlying structural high on the seaward edge of a carbonate platform. The structure is approximately 30 miles long and 3 to 5 miles wide. The initial exploration well will be located at the highest point on the structure. Potential source rocks for the prospect are euxinic basinal shales and black micrite as well as interior lagonnal shales associated with the reef. The geothermal gradient projected from wells in the Baltimore Canyon trough indicates that thermally mature sediments would be encountered below 12,000 feet in the vicinity of the Manteo Prospect. Mobil estimated that the Manteo Prospect may contain as much as 5 trillion cubic feet of dry natural gas.

A meeting was held between the State of North Carolina, MMS, and Chevron in February 1997 to discuss the proposal for the Manteo Prospect. An additional meeting was held in September which concentrated on drilling technology. A well could be drilled on Block 467 or Block 510 during the year 2000. Chevron has not decided which type of drilling vessel will be employed. The potential shorebase for operations is Morehead City, North Carolina.

Introduction

The Manteo Prospect is located about 45 miles northeast of Cape Hatteras, North Carolina. It is a high risk prospect with world class potential. Unitization of 21 lease blocks was approved by the Minerals Management Service (MMS) in May 1990, and resulted in the Manteo exploration unit. Originally, eight oil companies were participating in this unit including Mobil, Chevron, Amerada Hess, Conoco, Marathon, Oxy USA, Union, and Shell. All but two of the 21 blocks were leased in Sale 56, which occurred in August 1981. The remaining two blocks were leased in Sale 78 held in 1983. Total bonuses for the unit were over \$300 million with Mobil bidding the highest value for a Sale 56 lease; over \$100 million for Block 467. The initial lease term was 10 years, but the leases were extended due to a suspension of operations (SOO) issued in October 1992 by the MMS pursuant to the regulations in 30 CFR 250.10.

Chevron received approval for an exploration permit in July, 1982, to drill Block 510. In July 1988, Mobil discussed with MMS a seven well exploration program in water depths ranging from 2,130 to 3,800 feet. The initial proposed wildcat was planned for mid-1993 on the crest of the prospect in Block 467. However, the plan of exploration was not approved and a decision on Mobil's appeal has not been made by the Secretary of Commerce. Additionally, on July 14, 1997, the Court of Federal Appeals determined that Mobil and Marathon were entitled to restitution of all their bonuses paid for five leases off North Carolina of which four are part of the Manteo Unit including Block 467. The Federal Government has appealed this decision. The appeal brief is due in early December 1997.

Regional Geology

The Baltimore Canyon Trough and the Carolina Trough are the two large and deep sedimentary basins of the Atlantic continental margin. The margin consists of a wedge of Mesozoic and Cenozoic sediments overlying a zone of deeply buried fault blocks and grabens. These sediments total over 40,000 feet thick in the deep basins and are separated by the breakup unconformity. The sedimentary wedge has been tested by 32 wildcats and two stratigraphic test (COST) wells in the Baltimore Canyon Trough. The Carolina Trough is untested. The Manteo exploration unit is at the juncture of these two sedimentary basins (Figure 1).

Manteo Geology and Hydrocarbon Potential

A thick Jurassic-Early Cretaceous carbonate trend exists as a buried ridge beneath the seaward margin of both the Baltimore Canyon and Carolina Troughs. This ridge is prominent below the Manteo unit and is interpreted as a reef on the seaward edge of a carbonate platform. This reef with its overlying structural high is the Manteo exploration target. The reef was tested further north in the Baltimore Canyon Trough in 1983-84. Shell Offshore Inc. found good reservoir facies but no significant oil or gas. A Near Top Jurassic horizon identified in the nearest deep well

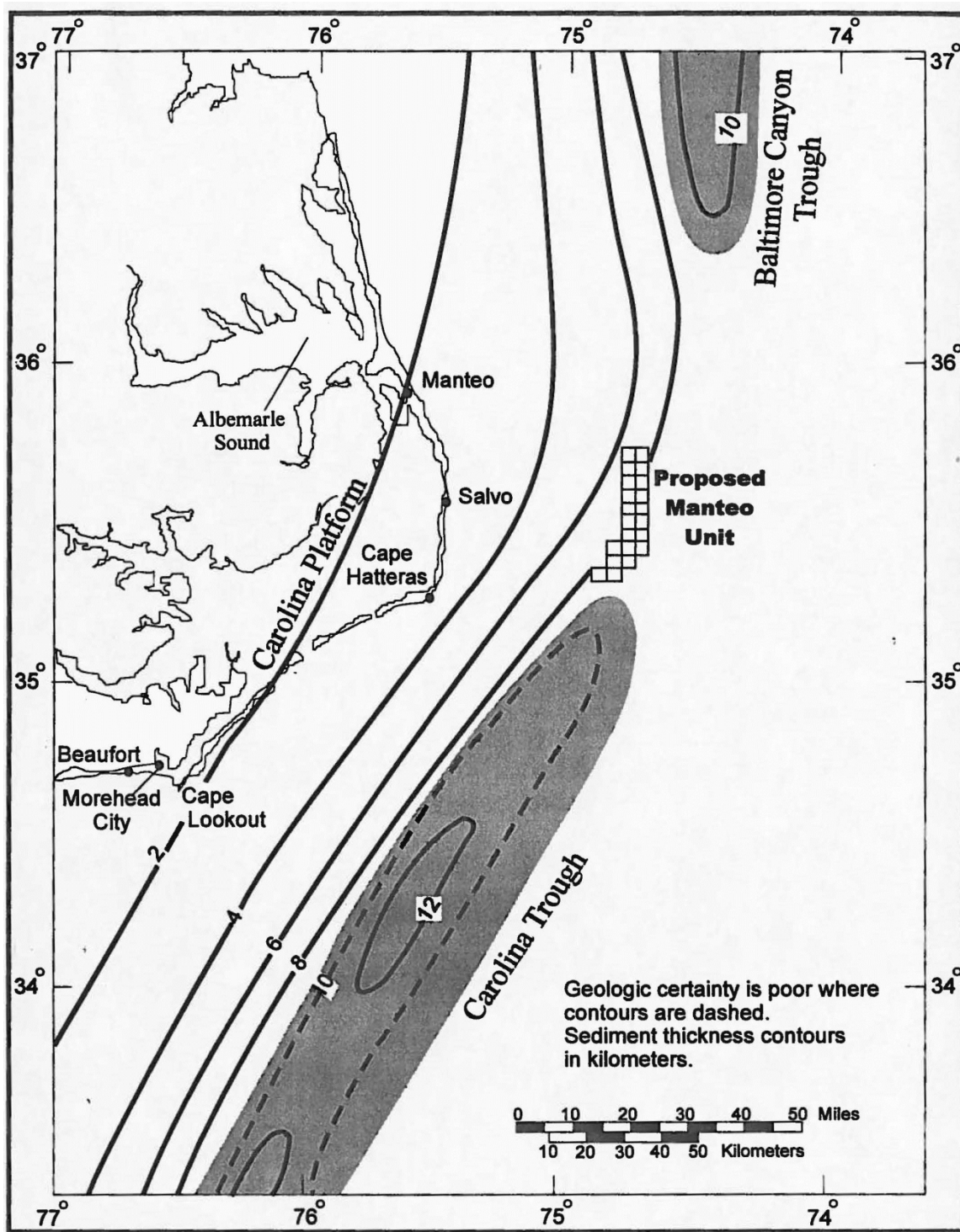


Figure 1. Location of the Manteo Unit on the arch between the Baltimore Canyon Trough to the north and the Carolina Trough to the south.

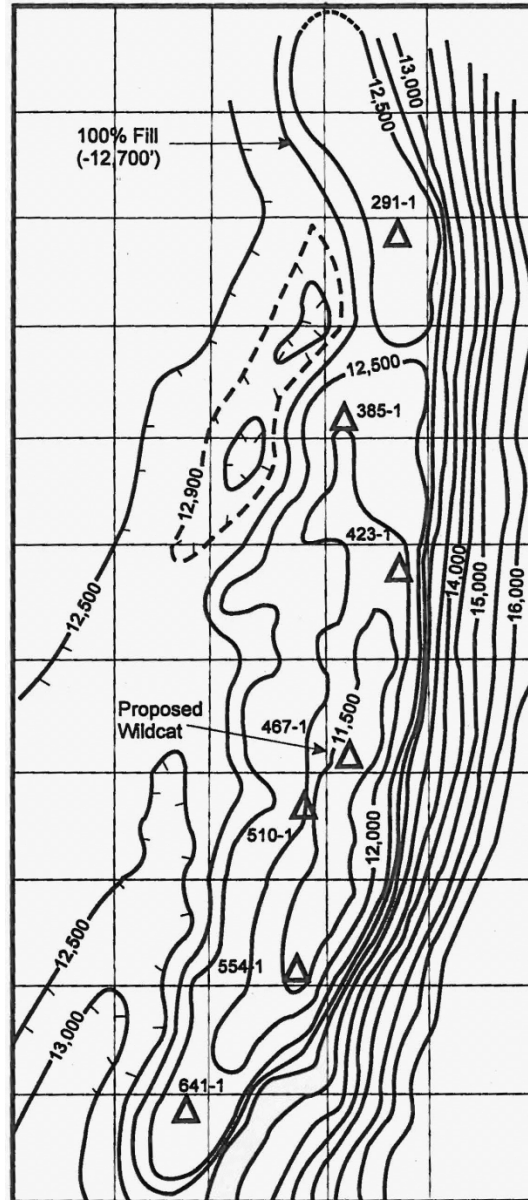


Figure 2. Manteo Prospect near top of Jurassic with Mobil's proposed wells. Chevron plans to drill either Block 467 or Block 510.

(Esso Hatteras Light #1, T.D. 10,054 feet) onshore at Cape Hatteras marks the top of the prospective interval and was tied to the Manteo Prospect seismic grid. No oil or gas shows were recorded in this well. Seismic surveys were conducted in the Manteo area in the late 1970's and early 1980's by Digicon and Petty Ray. The structure map on this horizon shows a large north-northeast trending structure approximately 30 miles long and 3 to 5 miles wide (Figure 2). The top of the reservoir is estimated at a depth of 11,300 feet and closes on the 12,700 foot contour, giving 1,400 feet vertical relief.

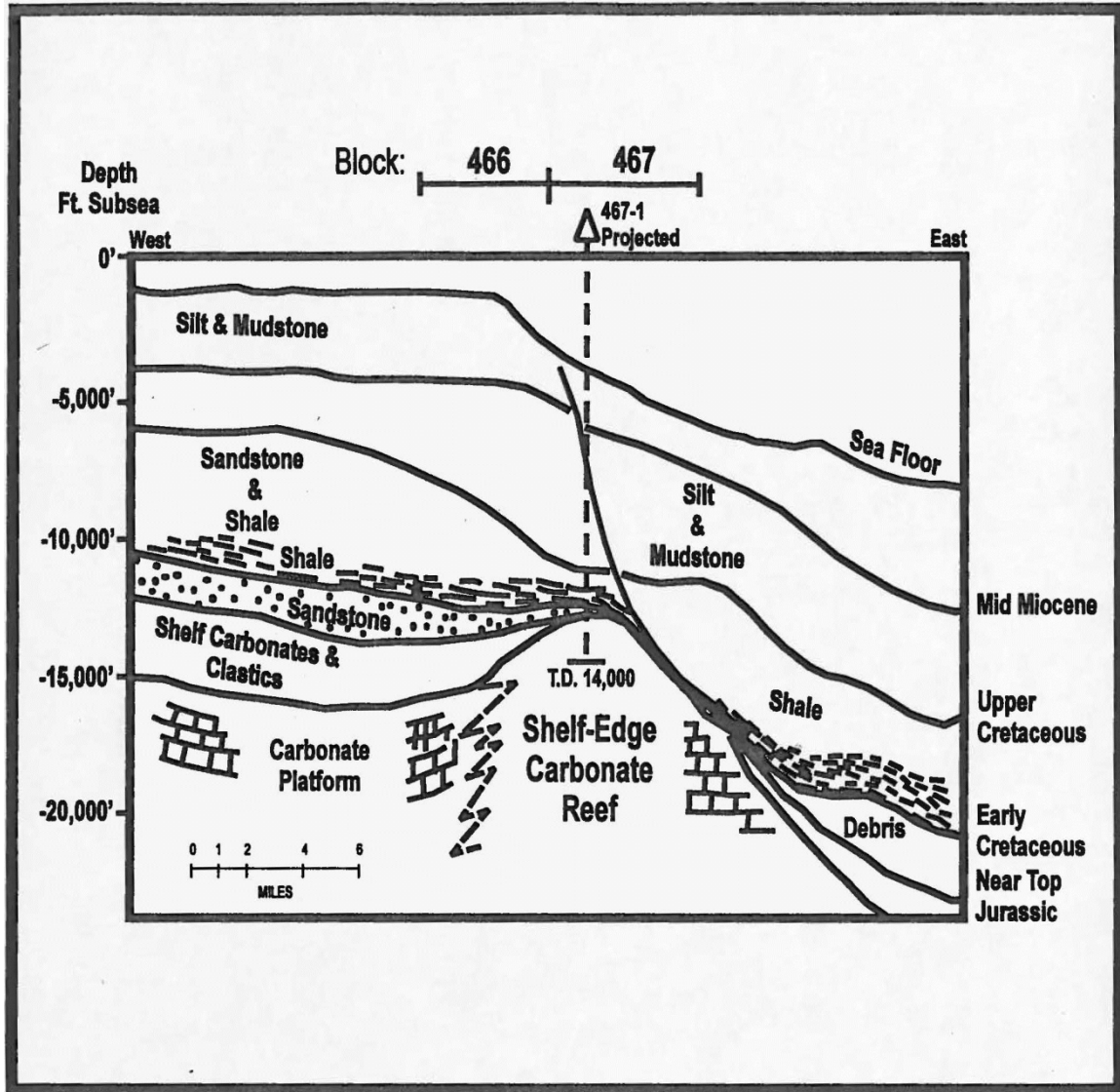


Figure 3. *Geologic cross section of the Manteo Prospect.*

A proposed exploration well on Block 467 will be located at the highest point on the structure and is expected to penetrate reservoir rocks composed of reefal boundstones and grainstones. Primary porosity is thought to have been enhanced by a period of subaerial weathering during the early Cretaceous. Following this period of exposure, the reef was buried by a thick wedge of Cretaceous and Recent fine-grained sediments which formed an effective seal over this combination structural/stratigraphic trap. The stratigraphic depth section of the Manteo Prospect is shown in Figure 3.

Potential source rocks for the Manteo Prospect are euxinic basal shales and black micrite as well as interior lagoonal shales associated with the shelf-edge reef. Early Cretaceous shale is thought to be widespread in the deep ocean basin and was

encountered in the Joides No. 105 research hole drilled about 300 miles to the east of the prospect. The geothermal gradient projected from wells in the Baltimore Canyon trough indicates that thermally mature sediments would be encountered below 12,000 feet in the vicinity of the Manteo Prospect. Geochemical analyses of the Early Cretaceous shale as well as lagoonal shales encountered in Atlantic OCS exploration wells indicate that any hydrocarbon source rock for this prospect would be far more likely to generate gas rather than oil. Faults and unconformities in the vicinity of the prospect would provide vertical and horizontal migration paths for the hydrocarbons.

Mobil estimated that the Manteo Prospect may contain as much as 5 trillion cubic feet (Tcf) of dry natural gas. This estimate would place the prospect on the border between a major (1-5 Tcf) and a giant (5-50 Tcf) field. The MMS geologists concluded that while optimistic, that amount of gas could be present given the size and reservoir characteristics of the prospect.

Chevron's Proposal

In February 1997, a meeting was held in North Carolina between the State, MMS, and Chevron to discuss the proposal for the Manteo Prospect. An additional presentation was made in September which concentrated on deep-water drilling technology.

Chevron plans to drill an exploratory well on Block 467, similar to the Mobil proposal or a well on Block 510. The two sites are about 9,000 feet apart. Because of the expense of drilling the Manteo Prospect, if it is a dry hole, the company will not drill any other wells. The well will be drilled to a depth of at least 14,000 feet and 2,500 feet of water using nonpollutant drilling muds composed of seawater and enhanced polymer muds. Fields in corresponding water depths have been explored and developed in the Gulf of Mexico (Table 1). Furthermore, Chevron has experience drilling in deep water and high current environments. The company hasn't decided which drilling vessel will be employed. Either a dynamically positioned drillship or moored semisubmersible will be used to drill the well. Chevron hopes to drill during the year 2000 depending on rig availability and permitting. It is estimated to take 100 to 115 days to complete the well. The potential shore base for operations is Morehead City, North Carolina. No decisions have been made about transportation, processing, or landfall for any hydrocarbons which might be discovered and produced. The company believes that the first well could test 600 million barrels of oil equivalent (about 3.36 billion cubic feet of gas). However, Chevron estimates that there is only a 7 percent chance of finding hydrocarbons and only a 2 percent chance of them being commercial.

In early November 1997 the Governor of North Carolina issued an executive order stating that Chevron must strive to avoid injuring environmentally sensitive areas and must repair any damage the company inflicts. A spokesman for Chevron said that he thought that's something they would want to do anyway.

Project Name	Area	Block	Depth (ft)/(m)	Operator
Coulomb	MC	657	7520/2292	Shell Offshore
King's Peak	DC	133	6530/1990	Amoco
(no prospect name)	AV	575	6220/1896	BP Exploration
Mensa(SS)	MC	731*	5376/1639	Shell Offshore
Diana	EB	945	4645/1416	Exxon Corporation
Fuji	GC	506	4243/1293	Texaco
Ursa	MC	854	4020/1225	Shell Offshore
Vancouver	GC	254	3780/1152	Shell Offshore
(no prospect name)	VK	688	3737/1139	Shell Offshore
Gemini	MC	292	3393/1034	Texaco
Allegheny	GC	254	3225/983	Enserch Exploration
Ram Powell	VK	956*	3218/981	Shell Offshore
Marlin	VK	915	3200/975	Amoco
Mars (TLP) (SS)	MC	807*	2940/967	Shell Offshore
Auger (TLP)	GB	426*	2861/872	Shell Offshore
Brutus (SS)	GC	158	2841/866	Shell Offshore
Troika	GC	244	2672/814	BP Exploration
Genesis (SPAR)	GC	205	2600/792	Chevron
Bison	GC	166	2518/767	Exxon Corporation
<p>FPS=Floating Platform System TLP=Tension Leg Platform SS=Subseas System SPAR=unit consisting of single point buoy tanker loading and mooring platform with storage tank</p> <p>AV=Atwater Valley DC=Desoto Canyon EB=East Breaks GB=Garden Banks GC=Green Canyon MC=Mississippi Canyon VK=Viosca Knoll</p> <p>* Producing discovery</p>				

Table 1. Deep-water fields in the Gulf of Mexico in water depths greater than 2,500 ft