

Gulf of Mexico OCS Deep Shelf Gas Update: 2001-2002



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In 2001 MMS published a report, *The Promise of Deep Gas in the Gulf of Mexico* (OCS Report MMS 2001-037), on the potential for Deep Gas under Federal waters of the Shelf. This *Gulf of Mexico OCS Deep Shelf Gas Update: 2001-2002* report provides a review of Gulf of Mexico deep-gas drilling and completion activity in 2001 and 2002 on the Shelf in less than 200 meters (656 feet) of water. This report also presents the proposed incentives for deep-gas drilling and production on existing leases.

Shallow-water gas production from the shelf in the Gulf of Mexico has declined from 4.76 trillion cubic feet (Tcf) per year in 1997 to an estimated 3.36 Tcf per year in 2002, or approximately 29 percent (see figure below, GOM Shallow Water Gas Production). Additional

gas production from deepwater fields in the Gulf of Mexico and the Northern slope areas of Alaska and Canada are not expected to contribute significant new gas production until after 2008.

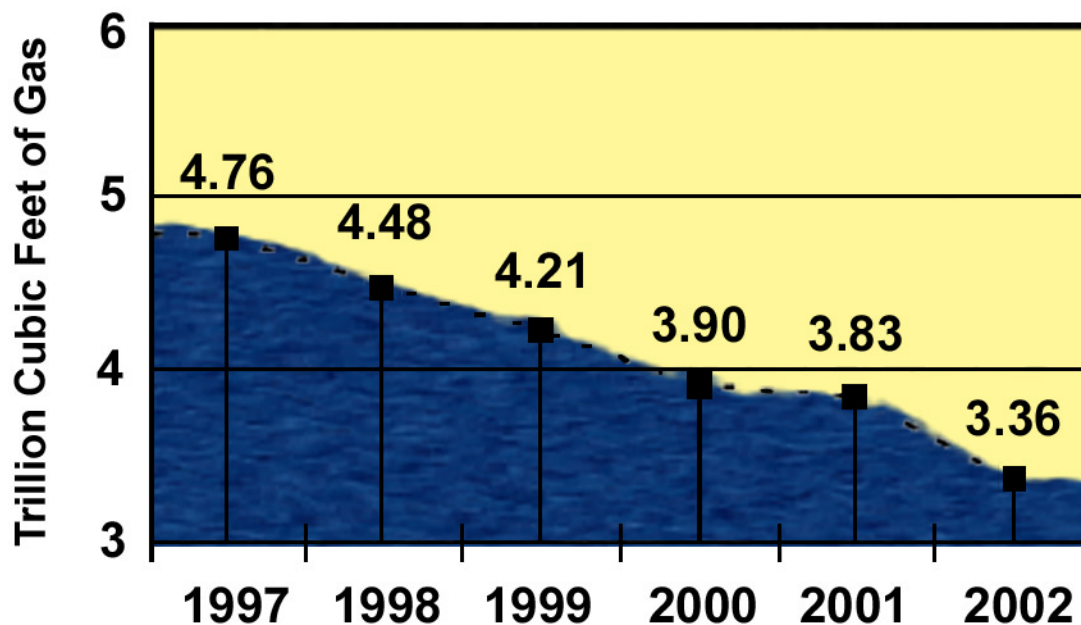
Production from deep wells on existing leases in the shallow-water Gulf is one of the most attractive sources of additional natural gas to help meet the near- and mid-term energy needs of the Nation. While the shallow waters of the Gulf have been actively explored, relatively few wells have penetrated depths below 15,000 feet because of the high cost and risk associated with such wells.

The discovery of deep gas in South Timbalier Block 204 (ST204) is an example of operators' ability to explore and develop quickly new sources of gas production on the Shelf. The ST204 deep-gas production was discovered in 2000

and established significant new gas production in 2001, with peak production of 350 million cubic feet per day (MMcfd) in 2002.

There were two significant Gulf of Mexico deep-gas discoveries announced in 2003, at JB Mountain and Mound Point, in close proximity to one another off the Louisiana coast in about 10 feet of water. The JB Mountain discovery is in Federal waters of the Shelf, and the Mound Point discovery is in State waters. The operator reported that the JB Mountain and Mound Point discoveries are separate prospects six miles apart, but they are related geologically. Each discovery is positioned below large shallow-gas reservoirs developed over the past half-century, and which have produced the oil and gas equivalent of 3.3 Tcf and 2.5 Tcf from the Tiger Shoal and Mound Point fields, respectively.

GOM Shallow Water Gas Production



Deep OCS Drilling

Drilling at depths greater than 15,000 feet below sea level in less than 200 meters (656 feet) water depth on the OCS declined from 86 wells drilled on the OCS in 2000, when natural gas prices on the spot market surged over \$8 per million British thermal units (MMBtu), to 75 wells drilled in 2001, and further declined to 64 wells drilled in 2002. Although deep drilling activity (see chart, Deep Shelf Wells Started) on the OCS declined, the realization of new high-rate gas well completions was good news to operators willing to drill deep wells.

A well completion is the work conducted upon a well to establish production of the resource (gas and oil) or injection of fluids after the well has been drilled to the target depth.

In 2001, oil and gas operators drilled 75 wells deeper than 15,000 feet below sea level, 40 wells were drilled deeper than 16,000 feet, 27 were drilled deeper than 17,000 feet, and 16 were drilled deeper than 18,000 feet. Of the 75 deep wells drilled, 45 wells were completed at some depth in the well, 4 were temporarily abandoned, 21 were plugged and abandoned, and 5 were sidetracked.

In 2002, operators drilled 64 wells deeper than 15,000 feet below sea level, 39 wells were drilled deeper

than 16,000 feet, 27 were drilled deeper than 17,000 feet, and 18 were drilled deeper than 18,000 feet. Of the 64 deep wells drilled, 32 wells were completed at some depth in the well, 10 were temporarily abandoned, 13 were plugged and abandoned, and 9 were sidetracked. One of the deep wells drilled in 2002 was the announced JB Mountain deep-gas discovery in South Marsh Island.

High-Rate Wells

Completions in new deep-gas reservoirs on the OCS are showing signs of providing the best short-term opportunity for production increases to offset declining gas production from the OCS. Forty-five of the deep-gas completions in 2001 and 2002 were completed in new reservoirs (some completions were in reservoirs discovered prior to 2001). An analysis of the maximum well test* rates for these 45 deep-gas completions indicates the sum of the test rates to be about 1.24 billion cubic feet of gas per day (Bcfd) in well tests measured over a two-year period. The average maximum rate for these 45 deep-gas completions in 2001 and 2002 was approximately 27.7 million cubic feet per day (MMcfd). When the maximum test rates for these completions are analyzed by depth, the average rate tends to increase with depth, indicating reservoir quality does not necessarily decrease with depth across the Gulf of Mexico OCS (see chart, Gulf of Mexico OCS

Deep Shelf Gas, Maximum Test Rates of Completions in New Reservoirs).

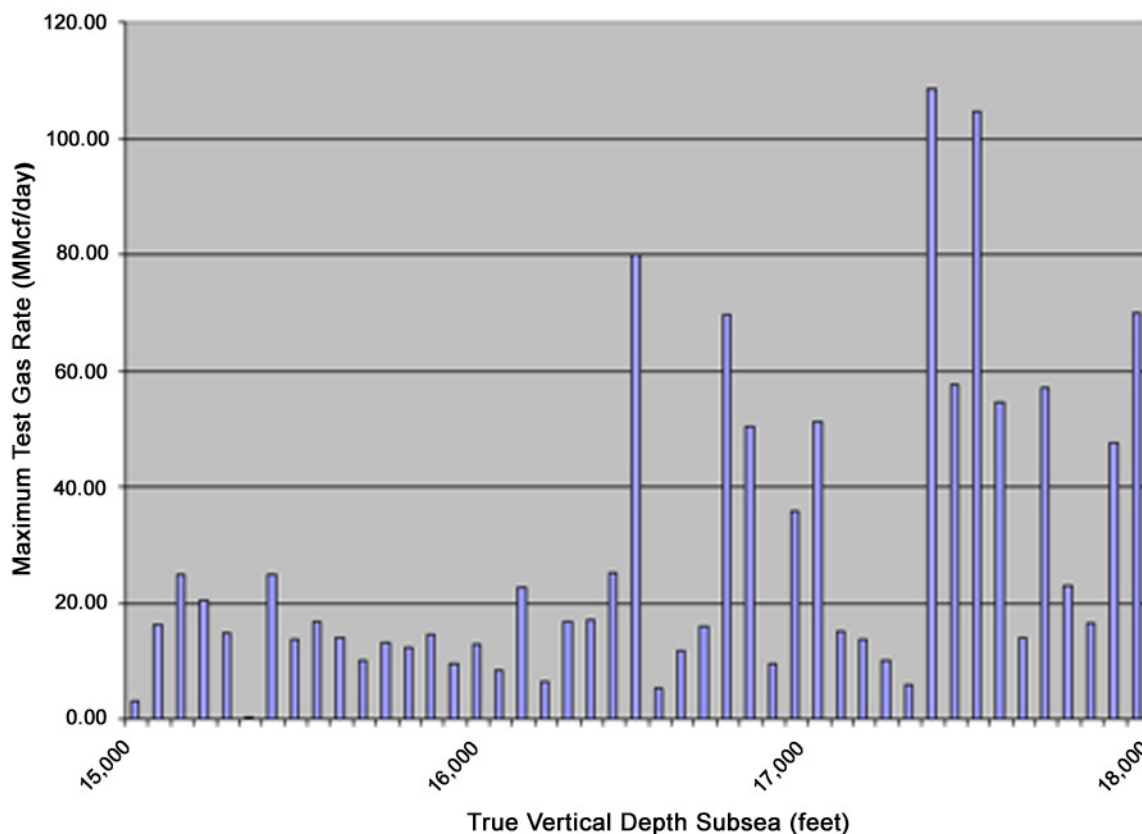
In the range of 15,000 to 16,000 feet true vertical depth subsea, the sum of the test rates from the 20 deep-gas completions in new reservoirs during 2001 and 2002 was about 275.5 MMcfd, or about 22 per cent of the 1.24 Bcfd from all 45 new reservoir completions. The average maximum rate for these 20 completions in 2001 and 2002 was approximately 13.8 MMcfd. None of these 20 completions exceeded a maximum test rate of 25 MMcfd.

In the range of 16,000 to 17,000 feet true vertical depth subsea, the sum of the test rates from the 12 deep-gas completions in new reservoirs during 2001 and 2002 was about 386.6 MMcfd, or about 31 per cent of the 1.24 Bcfd from all 45 new reservoir completions. The average maximum rate for these 12 completions in 2001 and 2002 was approximately 32.2 million cubic feet per day (MMcfd). One of these 12 completions tested at a maximum rate of nearly 80 MMcfd, and three other completions exceeded maximum test rates of 50 MMcfd.

In greater than 17,000 feet true vertical depth subsea, the sum of the test rates from the 13 deep-gas completions in new reservoirs during 2001 and 2002 was about 582.8 MMcfd, or about 47 per

*A well test is conducted on a well completion over a specific period of time to determine its productivity or rate of flow and other engineering characteristics. Well tests are conducted by operators and reported to MMS upon initial well completion and semi-annually for gas completions. In well completion tests, the maximum well test rates are sometimes measured as potential tests upon initial completion, or may be measured in a semi-annual test, after the initial well potential test, as the production ramps up to a maximum rate.

**Gulf of Mexico OCS Deep Shelf Gas, Maximum Test Rates for Completions in New Reservoirs
2001-2002**



Subsea Depth Interval (feet)	Number of Completions in New Reservoirs	Average Maximum Well Test Rate (million cubic feet per day)
> 15,000	45	27.7
15,000 - 15,999	20	13.8
16,000 - 16,999	12	32.2
> 17,000	13	44.8

cent of the 1.24 Bcfd from all 45 new reservoir completions. The average maximum rate for these 13 completions in 2001 and 2002 was approximately 44.8 million cubic feet per day (MMcfd). Two of these 13 completions tested at maximum rates exceeding 100 MMcfd, and four other completions exceeded maximum test rates of 50 MMcfd.

Thus, well test information from deep gas completions in 2001 and 2002 in new reservoirs on the OCS suggests that higher production

rates can be expected on the OCS when drilling targets deeper than 16,000 feet true vertical depth subsea.

Recoverable Deep-Gas Resource Estimate

The MMS estimates that the potential of undiscovered conventionally recoverable resources for deep gas (at greater than 15,000 feet below sea level) on the Gulf of Mexico Shelf is approximately 5 to 20 trillion cubic feet (Tcf), with the mean estimated

at 10.5 Tcf. This estimate was done in 2000 and used data as of 1999. The Gulf of Mexico Region of MMS has not updated undiscovered resources for deep gas on the OCS since the publication of *The Promise of Deep Gas in the Gulf of Mexico* (OCS Report MMS 2001-037), but is currently working on an update of undiscovered oil and gas resources in the entire Gulf of Mexico.

Although MMS has not updated resource estimates for the Shelf,

some observations can be made regarding deep-gas production and resource potential for completions in new reservoirs for 2001 and 2002. A simple analysis of the well test rates and various decline rates of the 45 deep-gas completions determined by MMS to be in new reservoirs in 2001 and 2002 provides a range of potential recoverable gas resources attributed to the projected gas production from these deep-gas completions in new reservoirs. It is important to note that some of these new reservoirs were discovered prior to 2001, and were included in the MMS estimate of reserves that supported the undiscovered resource potential of 10.5 Tcf. The simple decline analysis uses the concept of production half-life to explain the decline in productive capacity of new completions and estimate recoverable gas for the 45 deep-gas completions. The production half-life is simply the amount of time it takes for a new completion to decline from the

initial maximum rate to one-half the maximum rate. For example, if a new gas completion produces an initial maximum rate of 100 MMcfpd and declines to 50 MMcfpd in the first 24 months of production, the production half-life of the completion is 24 months (or two years).

If the half-life for the 45 deep-gas completions in new reservoirs completed in 2001 and 2002 is 24 months (or 2 years), the completions will produce approximately 1.2 Tcf of gas in about 8 years. The half-life of 24 months is reasonable, given new completion technology and declining discovery size on the Gulf of Mexico OCS. Rapid decline of productive capacity requires drilling more and more wells to maintain a given level of gas production.

If the half-life for the 45 deep-gas completions in new reservoirs completed in 2001 and 2002 is

48 months (or 4 years), the completions will produce approximately 2.4 Tcf of gas in about 16 years. For the half-life of 48 months to be reasonable, reservoir discovery size on the Gulf of Mexico OCS will have to increase after many years on a declining trend.

From the 24-month and 48-month half-life decline analyses, a simple estimate of the projected recoverable gas from these 45 completions is in the range of 1.2 to 2.4 Tcf produced over 8 to 16 years. Initial reservoir mapping and analyses of production and well test data by MMS indicate the half-life for these 45 deep-gas completions is closer to 24 months than 48 months. The shorter the half-life of production from new completions relative to lower discovery size of new reservoirs, the greater the need to maintain deep shelf drilling activity to meet increasing demand for natural gas and reduce the volatility in price.

Deep Shelf Wells Started

1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
56	68	58	62	68	57	59	86	75	64

Proposed New Incentive for Deep Shelf Gas Drilling and Production

With natural gas prices climbing sharply this winter and gas production in many areas of the Gulf of Mexico declining, MMS announced on March 26, 2003, proposed new incentives for energy companies to increase deep natural gas production in the Gulf. Under the proposal, the MMS would provide royalty suspension incentives when companies take the risk of exploring and developing deep-gas deposits in shallow-water areas they have already leased.

There are about 2,400 existing leases in the area targeted for relief in the proposed rule. Although natural gas from the Shelf currently provides about 25 percent of domestic production, the contribution from the shallow-water area has been declining precipitously over the past five years. Since infrastructure is already in place, in terms of platforms and pipelines, MMS anticipates that production could come on line relatively quickly.

Under the proposed rule, lessees would be eligible for royalty relief on their existing leases if they are willing to drill for new and deeper prospects at greater than 15,000 feet below sea level.

The proposed incentive program provides the following:

- A royalty suspension on the first 15 billion cubic feet (Bcf) of gas produced from a well drilled and completed from 15,000 feet to less than 18,000 feet below sea level or on the first 25 Bcf of gas from a well drilled and completed 18,000 feet or deeper below sea level. To encourage companies to drill early, authorized drilling could commence immediately. This deep production must start before five years after the effective date of the final rule. One royalty suspension volume is available per lease.
- A royalty suspension supplement of 5 Bcf, applied to future production of gas or oil from any drilling depth on that lease, is allowed for an unsuccessful well drilled to a target reservoir 18,000 feet or deeper below sea level. This dry hole incentive is aimed at helping to offset the high risk associated with drilling that deep. Two royalty suspension supplements are available per lease prior to production from a deep well.
- A well drilled after the date of the proposed rule and before five years after the effective date of the final rule may qualify for either incentive, if the lease has not had any deep-gas production from wells drilled prior to the proposed rule. Any royalty suspension volume or supplement earned must be applied only to production occurring after the effective date of the final rule, even if this production actually started between the proposed and final rule.

MMS has included a deep-gas royalty incentive for new leases since March 2001. In the new proposed rule, MMS proposes to allow lessees to exercise an option to replace their existing deep-gas royalty terms on leases acquired from sales held after January 1, 2001, with the terms in the final rule on this initiative.



The Department of the Interior Mission

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering sound use of our land and water resources; protecting our fish, wildlife, and biological diversity; preserving the environmental and cultural values of our national parks and historical places; and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The Department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.



The Minerals Management Service Mission

As a bureau of the Department of the Interior, the Minerals Management Service's (MMS) primary responsibilities are to manage the mineral resources located on the Nation's Outer Continental Shelf (OCS), collect revenue from the Federal OCS and onshore Federal and Indian lands, and distribute those revenues.

Moreover, in working to meet its responsibilities, the **Offshore Minerals Management Program** administers the OCS competitive leasing program and oversees the safe and environmentally sound exploration and production of our Nation's offshore natural gas, oil and other mineral resources. The MMS **Minerals Revenue Management** meets its responsibilities by ensuring the efficient, timely and accurate collection and disbursement of revenue from mineral leasing and production due to Indian tribes and allottees, States and the U.S. Treasury.

The MMS strives to fulfill its responsibilities through the general guiding principles of: (1) being responsive to the public's concerns and interests by maintaining a dialogue with all potentially affected parties and (2) carrying out its programs with an emphasis on working to enhance the quality of life for all Americans by lending MMS assistance and expertise to economic development and environmental protection.