TRANS-BOUNDARY OIL AND GAS FIELDS BETWEEN MEXICO AND THE USA

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The exploration and production of offshore petroleum resources in the Gulf of Mexico (GoM) have developed to a point where Mexico and the USA will soon have to solve issues related to reservoirs, already discovered, possibly extending along both sides of their territorial waters. The issues are complex since none of the two countries counts today with the agreements, legislation, regulations and technical norms to tackle these cases specifically.

Recent discoveries at Great White, Baha, Trident and Tobago fields have established the Perdido foldbelt in the GoM as a significant new petroleum province in the initial stages of evaluation. The drilling and discovery of hydrocarbons during 2001 at the Trident 1 wildcat proved the exploration viability of the Perdido foldbelt in the Alaminos Canyon. It is an area characterized by water depths reaching more than 10 thousand feet, difficult drilling conditions and risk of damages caused by hurricanes. Industry reports inform that the geologic insights gained so far include the discovery of high-quality light oil, the recognition of multiple hydrocarbon source rocks, the age of key seismic markers, and the presence of abundant and well-developed sandstone reservoirs.

PEMEX has also announced the existence of significant resources in the Mexican part of the Perdido foldbelt. The area shows interesting potentials to find extra-light crude oil. However, PEMEX considers that the challenges to explore for and to produce these resources will be better managed through cooperation, using state of the art technologies and existing infrastructure.
International experience shows that the technology exists to produce the oil and gas from any side of the border, though depending on the characteristics of the reservoirs and their structures, the optimal way to approach a field might indicate that operations should be carried out from sites belonging to one country or the other. Furthermore, the resources will have to be divided between both countries. The procedure to calculate the shares between them are usually dealt with through a procedure known as “unitization” which requires a deep knowledge of the reservoirs. Previous to that,

- The two Governments must agree that the petroleum filed is a trans-boundary reservoir which should be exploited.
- The reservoir shall be exploited as a single unit.
- The two Governments shall individually grant the authorizations required by their respective national law.
- In the event that a trans-boundary reservoir is to be exploited as a single unit by making use of a host facility, the two Governments shall agree the most appropriate procedures to exploit that trans-boundary reservoir.

In petroleum provinces where these situations have happened, as for example in the North Sea, in fields across Norway and Britain, the governments had to agree on a common framework to exploit these resources. There are many other examples of joint production agreements from other countries sharing common hydrocarbon resources: Austria and Czechoslovakia; Abu Dhabi and Qatar; France and Spain; Iceland and Norway; Malaysia and Thailand; the Federal Republic of Germany and the Netherlands; Japan and Korea;
Bahrain and Saudi Arabia; Kuwait and Saudi Arabia; Iran and Sharjah; Saudi Arabia and Sudan; Australia and Papua New Guinea; Australia and Indonesia.

The arrangements relating to the exploration and exploitation of hydrocarbon resources in joint development areas range from simple schemes of cooperation to highly complex and structured systems of jurisdiction and revenue sharing. However, at present, in the case of the USA and Mexico, neither the authorities nor the legislators have established the agenda for discussions leading to a common agreement for joint petroleum operations between both countries.

Independently from the potential resources contained in the fields that could extend across the borders of Mexico and the USA in the GoM, the issues involved in solving the cooperation to explore for and to exploit these fields represent different kinds of challenges for each country.

For Mexico, the solutions could entail divergences with the way the national hydrocarbons industry has been organized since 1938. The constitutional principles on the state ownership of the petroleum resources, as well as on the legal monopoly of PEMEX to carry out all the operations related to the exploration and production of the national petroleum resources poses serious limitations to joint investments and operations with third petroleum companies. An international agreement (Treaty) on this subject will require the approval of the Senate, as it would become part of the national legal system. This is established by article 133 of the Mexican Constitution:

“This Constitution, the laws of the Congress of the Union that emanate therefrom, and all treaties that have been made and shall be made in accordance therewith by the President of the Republic, with the approval of the Senate, shall be the supreme law of the whole Union. The judges of each State shall conform to the said Constitution, the laws, and treaties, in spite of any contradictory provisions that may appear in the constitutions or laws of the States”

In the case of the USA, the legal framework does not consider joint petroleum operations with Mexico in an explicit manner. It is also uncertain what the authorities directly responsible to propose the solutions have envisaged for solving this issue.

**Defining the border in territorial waters**

In the old “freedom of the seas” concept, dating from the 17th century, the national rights of the countries to their territorial waters were limited to three nautical miles extending from a nation's coastlines. In the first half of the 20th century many nations expressed varying claims of territorial waters. In 1967 the issue was raised in the UN and in 1973 the Third United Nations Conference on the Law of the Sea (UNCLOS) was convened to write a new Treaty covering the oceans. The convention came into force in 1994, introducing a number of provisions including one on the Exclusive Economic Zones (EEZ). The EEZ extends the territorial rights of the coastal nations to 200 nautical miles from the “baseline” or “internal waters” of the country. Within this additional area, the coastal nation has sole exploitation rights over all natural resources.

The United States strongly objected to Part XI of the Convention, although, from 1983 to 1990, it followed a policy of accepting the remaining provisions of the Convention as a
statement of customary international law. Today there is still a vigorous debate over the ratification of the UNCLOS Treaty in the USA. Some claim that it would impinge on US sovereignty. However, the Bush administration, a majority of the United States Senate, and the Pentagon favor the ratification of the Convention, as do representatives of scientific and international legal scholars, and mining and environmentalist groups.

In 1970, Mexico and the USA signed a Treaty establishing the maritime boundaries of each country to 12 nautical miles. Few years later, the United States government stated its sovereignty and jurisdiction over its corresponding 200 nautical miles. In the case of Mexico, in 1974 President Echeverría also promoted the constitutional reforms incorporating Mexico's sovereign EEZ rights to 200 nautical miles. Mexico used its coastline as well as small Mexican islands north of the Yucatan Peninsula to calculate the new boundaries.

The extended jurisdictions of both countries overlapped in some areas of the GoM and it became necessary to accommodate each country's full claim. Thus, in November of 1976 a provisional recognition agreement of the Marine Frontiers between Mexico and the United States was signed. In 1977, both countries agreed to upgrade the provisional agreement to a Treaty, establishing the maritime boundaries at 200 nautical miles, which was approved by the Mexican Senate in December of 1978. The Treaty on Maritime Boundaries between the USA and the United Mexican States was ratified by the Mexican Government in 1979.

On January 23, 1979, the President of the USA transmitted the Treaty to the Senate for ratification. While the Senate’s Foreign Relations Committee favorably reported the Treaty to the full Senate for its advice and consent in 1980, the Senate declined to ratify it.

The Treaty on the EEZ settled down only seven points of delimitation, formalizing the provisional maritime boundaries between the two nations. However, when mapping the border lines it was shown that two portions of discontinuous line surpassed the 200 miles corresponding to each country. Later these two portions were called the “holes of the doughnuts”, representing more than 200 km of frontier pending for negotiations.

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The western doughnut hole (also called Western Gap or Western Polygon) represented an approximate surface of 17,000 km² and the eastern doughnut hole around 20,000 km². This last one is contiguous also to the EEZ of Cuba. The Eastern Polygon is right in front of the coast of Yucatan, the coast of New Orleans and Cuba.

In the year 2000, Mexico and the USA signed a territorial and marine delimitation Treaty solely for the western polygon or western doughnut hole. Both nations should begin negotiations regarding oil and gas developments in that area in order to implement the rules set forth in the last Treaty.

The Western Gap is considered part of the continental shelf of the GoM², and due to its location, two international laws may apply.

1. The 1958 Geneva Convention on the Continental Shelf, to which both the United States and Mexico are parties. Article 1 of the 1958 Convention provides that the continental shelf of a coastal state extends beyond the depth of two hundred meters where the depth of the superjacent waters admits the exploitation of the natural resources of the shelf.


² Jorge A. Vargas, *The GoM: A Bi-national Lake Shared by the United States and Mexico*, Transnatural Law. 459, 464-65 (1996) (arguing that, based on new scientific data, the Western Gap is actually part of the Continental Shelf rather than deep water that would require a separate international law involving the UN.
the Sea, to which Mexico is a party. The USA, however, refused to sign UNCLOS. Thus, while rejecting the Convention due to its stance on seabed mining, expressly recognized that the balance of interests achieved in the remaining parts of the Convention was in the interests of them and the international community as a whole. Therefore, the USA accepts that UNCLOS reflects customary international law in this respect and has acknowledged that UNCLOS provides a more scientifically based definition of a continental shelf.

Doughnut Holes or Gaps or Polygons

These issues were not given much attention because although the US government had signed the Treaty, the US Senate refused to ratify it. This lack of definition affected the whole Mexico-US border in the GoM. The US considered that geological studies were needed because the seven points already agreed left Mexico with an important sector with an enormous hydrocarbons and minerals potential.

In 1980 the US Senate decided to commend the United States Geological Survey (USGS) an evaluation on the mineral resources of the GoM. According to the USGS the resources in situ at the border and at central regions in the GoM could be from a minimum of 2,400 million barrels of oil equivalent (MMBoe) to a maximum of 22,000 MMBoe, and from a minimum of 5 billion cubic feet of gas (MMMCF) to a maximum of 44 MMMCF.³

The study included the whole border region and the “Gaps” beyond the 200 miles. However, the USGS extended the scope of the study to the parallel 23° and to the meridian 96 (Mexican coasts of Tamaulipas and Veracruz). The study showed the presence of hydrocarbons in Mexican territorial waters at the “Mexican Ridges.”

³ Barbosa Cano, Fabio “El petróleo en los Hoyos de Dona y otras áreas desconocidas del Golfo de México”. Editorial Porrúa. 2004
During the 1990s exploratory activities developed in the US part of the GoM: "Mickey" drilled by Exxon, "Gemini" by Texaco and "Crazy Horse" by British Petroleum. Drilling technology also evolved to engage in deeper waters and in 1996 the "Baha 1" well was drilled 35 km away from the Mexican border at the Perdido foldbelt in the Alaminos canyon, and in 1998, the same consortium drilled the "Baha 2". The results seemed to confirm the hypotheses of analogous geologic formations on both sides of the border at Keathley, Alaminos, Walker and Sigsbee areas.

In August 1998, PEMEX hired a Canadian company to evaluate the potential resources in the Western Polygon. The conclusions were that the Sigsbee Escarpments were only planes and that the overall hydrocarbon resources in the Western Polygon could be 2,500 MMBoe.

The political reactions in Mexico were important. It was mentioned that companies operating from the US could extract the Mexican resources using directional drilling. The Senate decided to start negotiations on the Mexican rights in the Western Polygon ("western doughnut hole"). However, the knowledge about the hydrocarbon and mineral resources in that region were diffuse. Moreover, few at the Senate knew that those negotiations had already begun in March 1998 (and concluded in June 2000). The final sharing of the Western Polygon was: 60% for Mexico, keeping the Abyssal Plain (3,700 meters water depth in some areas), and 40% for the USA, keeping the Sigsbee Escarpments (more than 4,000 meters water depths in some areas).

It did not take long before the Canadian company estimates were questioned by the facts. In August of 2001 Unocal started drilling the well called "Trident" at the Alaminos Canyon, only 6 km away from the Mexican border and not far from the Western Polygon. Geological interpretations made from the results obtained from the well indicated that the Sigsbee Escarpments could be the continuation of the large structures from fields already discovered by BP’s "Crazy Horse". No drilling activities have taken place at the Keathley Canyon or at the Walker Ridge, both bordering the Western Polygon, though four projects envisaging record depths seem to be in the drawing boards.

Producing hydrocarbons in the deep waters of the GoM is a complex matter. Pressures are high and seabed temperatures are low. In the United States 242 fields have been discovered in deep waters, of which 105 fields are at more than 1,000 meters water depth, some even at more than 2,000 meters. It can take 10 or 15 years to start production from these structures, even for giant fields as "Crazy Horse" in the Mississippi Canyon, 125 miles southeast of New Orleans.

In short, during the last years, prospecting works have been undertaken, in both areas, at the boundary limits and in the neighboring areas, because the possibilities to discover valuable hydrocarbon resources are highly favourable.

On the other hand, since the prospective works have signaled that some reservoirs are in the adjoining border areas, probably extending beyond the Mexican maritime boundaries, the Mexican authorities could apply procedures before the United Nations Organization (UNO) to claim title over the reservoir according to the 1982 Convention.

The matter is quite relevant to Mexico because, if activities are carried out from the US side, and considering the flow dynamics of the fields, the mexican resources could be affected due to the hydraulic communication of the structures, even if nobody used directional drilling to trespass the border.
As we have seen, in the US part of the GoM there has been an increased exploratory activity stimulated by advanced 3-D seismic, new drilling technologies, and deep-water production systems. Continued implementation of the deep-water royalty relief legislation, signed by President Clinton in November of 1995, is beginning to have an effect as well. Lease sales held by the Minerals Management Service (MMS) are reaching record totals. With moratoria on new leasing in effect for the Eastern GoM as well as the Atlantic and Pacific coasts, exploration has focused on the central and western GoM and on Alaska.

Meanwhile PEMEX is also preparing to approach these challenges. In 1999 the Mexican oil company concluded 3 exploratory studies and it is now preparing works for the first deep-water exploratory well in the Perdido foldbelt, not far from the Baha and Trident fields. These exploratory activities, as well as others in Campeche, Veracruz and Tamaulipas show that Mexico is highly interested in the hydrocarbon potentials of the GoM.

The Perdido Fold belt


GoM outlook

The USA requires increasing energy sources to meet its energy demand requirements, specifically oil and natural gas, and preferably should get them from domestic sources. US politicians have expressed a policy of reducing the country’s dependency on oil from the Middle East, despite the fact that the region remains an available and competitive petroleum source. Thus, the US is now focusing efforts to increase exploration and production within US borders.
Estimated Crude and Products Imports to the U.S. from Leading Supplier Countries

<table>
<thead>
<tr>
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<tbody>
<tr>
<td><strong>Imports</strong></td>
<td><strong>% of Total</strong></td>
</tr>
<tr>
<td><strong>(Thousand Barrels per Day)</strong></td>
<td></td>
</tr>
<tr>
<td>1 Canada</td>
<td>2,307</td>
</tr>
<tr>
<td>2 Saudi Arabia</td>
<td>1,613</td>
</tr>
<tr>
<td>3 Venezuela</td>
<td>1,490</td>
</tr>
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<td>4 Mexico</td>
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<td>5 Nigeria</td>
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<td>6 Algeria</td>
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<td>7 Angola</td>
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<td>8 Russia</td>
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<td>9 United Kingdom</td>
<td>382</td>
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<tr>
<td>10 Iraq</td>
<td>141</td>
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<tr>
<td>Other</td>
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<td><strong>Total</strong></td>
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<tr>
<td>OPEC Countries</td>
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</tr>
<tr>
<td>Persian Gulf Countries</td>
<td>2,148</td>
</tr>
</tbody>
</table>

**Source:** DOE. Petroleum Supply Monthly, July 2007

One possible area available to domestic producers is the deep-water areas of the GoM, which is believed to hold one of the largest oil reserves in the world. The GoM basin is a nearly circular structural basin, approximately 1,500 km in diameter, filled with sediments from the late Triassic to the Holocene. The GoM is approximately 4 million square miles and accounts for roughly ninety percent of US offshore oil and gas production. About 20% of the Gulf lay in more than 3,000 meters of water depth, with the deepest part, the Sigsbee Deep, at more than 4,000 meters water depth.

Although oil companies in both countries have long explored the shallower depths of the GoM, it had not been technologically or economically feasible to pursue oil and gas in the mineral-rich deep waters of the GoM until recently.

Small scale oil production in the US GoM started in 1938 and since then exploration and production has grown considerably. By the 1970s, more than 50% of the discoveries made in the Gulf Coast basins were offshore. By the 1980s exploratory drilling had reached water depths beyond 6,000 feet in the western part of the GoM and new research focused in sub-salt reservoirs.

Activities lowered down during the late 1980s and early 1990s. The GoM was believed to be a mature province. However, advances in platforms, drilling technology and 3D seismic made it possible to identify commercial fields in deeper waters. By the late 1990s the US GoM oil activities experienced a new boom, with additional interest in ultra-deep water areas. The Deep Water Royalty Relief Act provided incentives to develop fields in water depths greater than 600 feet, leading to expansion in all the segments of the petroleum value chain. During the following decade, oil production from deep waters grew by 840% and gas production by 1,600%. By 2004 exploration reached the 3,000 meters water depth record.

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4 www.api.org

Production in the deep waters has centered on the Mississippi delta in fields containing up to 500 million barrels of oil equivalent. Now the activities are moving towards the eastern part of the GoM where major discoveries like Neptune and Mad Dog are starting to produce. Other fields are in deeper waters (2,300 meters), as for example Spiderman and San Jacinto.

Only in the coast of Florida the offshore activities did not developed as in the rest of the US GoM. This is explained by an environmentally motivated moratorium passed in 1981, expiring in 2012. The area offshore Florida could contain 5 trillion cubic feet (TCF) of gas, though it is unknown whether the moratorium will be lifted.

Many continue to consider the US GoM as a mature hydrocarbon basin with production coming from 1,112 fields and accumulated production of more than 14.6 billion barrels (MMMB) of oil and 164 TCF of gas since 1938. On the other hand, the 2002 figures from the MMS show that proven reserves in the US GoM are 18.75 MMMB and 176.8 TCF of gas. Today offshore operations in the GoM represent about 12.5% of the total US oil production and some 25% of the gas produced.

Now that the main producing plays and hydrocarbon systems are well known, the GoM is regarded by oil companies as a region with interesting commercial hydrocarbon potentials, even though the projects to obtain them will require state of the art drilling technology and new approaches to exploration. Geologists consider that the area continues to present significant prospective resources in the deep and ultra-deep waters. New plays have been proved, including sub-salt reservoirs, while producing areas continue to be important. This could be explained by the fact that the average size of fields discovered in the deep waters of the GoM during the last decade are 67 million barrels of oil equivalent (MMboe) compared to 5 MMboe in shallow waters. Their productivity is also considerably higher, though the lifting costs are significant due to expensive exploration and production equipments. But this is not stopping the developments. Many of the new discoveries are at 7,000 feet water depths, adding 1.8 billion barrels of oil equivalents in new reserves. The deep and ultra-deep exploratory efforts have made possible to identify deep shelf gas plays and sub-salt reservoirs.
Reserves and water depths in the US GoM

Production estimates based on remaining oil reserves in the US GoM

Production estimates based on remaining natural gas reserves in the US GoM
These results have motivated some geologists to believe that it is possible to find prospects containing up to 1 billion barrels of oil equivalent each in the ultra-deep waters extending from the western part of the GoM to the Sigsbee Escarpments. Moreover, according to a report from the MMS in 2006⁶, the hydrocarbon potential of the deep and ultra-deep water in the GoM could be as high as 46 billion barrels of oil equivalent.

Geologists also consider that the Mexican part of the GoM contains significant resources, as for example in the Campeche salt province extending along the northwestern part of the Yucatan Peninsula. In the Campeche Basin the cretaceous carbonates have proved very prolific, with fields producing 100 thousand barrels per day in some wells. However, in general, the eastern part of the GoM is regarded as a frontier area, still to be fully explored, though with significant potentials.

Presently, 29.6 billion barrels of oil equivalent have been estimated in the Mexican part of the GoM, though, the size of the potential oil reserves at the Mexican GoM remains unknown, due to insufficient exploration.

PEMEX estimates of prospective hydrocarbon resources in Mexico
(Thousand million barrels of oil equivalent)

![PEMEX estimates of prospective hydrocarbon resources in Mexico](image)

Source: PEMEX, 2006

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Activities in the border areas: The US

The MMS of the USA Department of the Interior is responsible for Outer Continental Shelf leasing, production programs, and royalty management. The MMS was a strong promoter of the 200 miles and western polygon Treaties with Mexico in support of exploration and development in the deep waters of the GoM. The MMS has offered competitive conditions to attract investments for the development of the deep water resources. Examples of this are the royalty deduction relief to increase drilling in waters deeper than 800 meters\(^7\) and ten years duration of deepwater leases as compared to 5 years in shallow water leases. Foreign companies may participate in federal lease sales where reciprocal agreements allow USA nationals to lease in their countries.

Prospective resources in the GoM are likely to be found in Lower Tertiary sediments. However, their identification and exploration involves major challenges due to overlying salt and profound depths. Most of the Lower Tertiary trends are in water depths of 4,000 to over 7,500 feet (1,219 to over 2,286 meters) with significant potential for high pressure and high temperature. The salt layer has a very high velocity when compared with the surrounding rocks. Thus, to improve the images of the sediments and to draw the maps, it is necessary to make corrections to adjust the depths, to locate the wells, and to delineate the limits of a potential oil and gas field.

There are a number of challenges in drilling and testing these prospects and the sub-salt wells. Drilling depths greater than 32,000 feet (9,754 meters), high temperature, high pressures, and thousands of feet of overlying salt can drive well costs to US$ 80 to US$ 120 million. The availability of rigs capable of drilling these wells is limited, and with rig-on-location times of 3-6 months to drill each well, further delays in drilling additional prospects are created. This delay results in greater demands for rigs and is likely to lead to even higher well costs.
Drilling activity at the GoM has had its own peculiarities making the hydrocarbons production in this region very cyclical. It is a region that has to compete for investments with other parts of the world with more benign climate conditions. The damages caused by the hurricanes have led to new regulations and higher insurance costs. The cost of safety equipments and lifeboats has also increased.

There have also been changes in the availability and prices of drilling equipments. The world drilling market is moving for rigs rated to 250 feet (76 meters) water depth or greater. The leasing rates are increasing and the contracts now require longer terms. Furthermore, the new regulations require increasing the air gap by 12 feet (4 meters), between the bottom of the rig’s deck and the water line.

In spite of the above, the MMS has offered deepwater GoM lease sales pursuant to the Outer Continental Shelf Lands Act, with positive results. The MMS informs that the deepwater GoM continues to increase in its importance to the US energy supply. The large quantity of active deepwater leases, important new discoveries, the growing deepwater infrastructure, and the increasing deepwater production are indicators of a booming region. Traditional deepwater mini-basins have not reached maturity and new deepwater plays near and even beyond the Sigsbee Escarpment, beneath thick salt canopies, and in lightly explored reservoirs show that the deepwater petroleum production in the US GoM can continue to grow. The 2000 Assessment indicated that more than 50 billion recoverable BOE remained to be discovered.

The MMS 2006 report points the following highlights:

- The deepwater frontier is expanding in water depths greater than 7,000 feet
- The deepest well in the GOM was drilled by Chevron/Unocal at the Knotty Head discovery to a True Vertical Depth of 34,157 feet (10,411 meters) and in a water depth of 3,557 feet (1,084 meters).
- Nine discoveries were found in over 7,000 feet water depths.
- The first cell spar was installed at Red Hawk.
- Four discoveries were made in the Eastern GoM.
- Four discoveries were made in Paleogene reservoirs in Walker Ridge and Alaminos Canyon.
- Newly collected loop-current data will promote technological developments to ensure safe, reliable drilling and production.
- Wells are moving into more high-temperature, high-pressure environments.
- Technologies such as high integrity pressure protection systems will enable development in deeper waters and harsher environments.

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• The number of completed subsea wells is down 15 percent.
• There was nearly a 190% increase in the number of pipelines less than or equal to 12 inches approved for installation.
• There was a 38% increase in the number of producing deepwater projects.
• Non-major companies have made more deepwater discoveries and hold more deepwater acreage than the major companies.
• Subsea gas production increased more than 110% between December 2000 and May 2004.
• Since the beginning of 2000, new deepwater drilling added over 6.2 billion BOE, a 50% increase over the total deepwater BOE discovered from 1974 to 1999.

In the border areas the region showing increasing activity is the Perdido foldbelt, an area that the USA Department of Energy considers as the most important one on the trans-boundary zone. Apparently México owns 80% of maritime zone where these structures are located.

Prospect Baha, drilled in 2001, established the presence of an active petroleum system. Prospect Trident, drilled in 2002, was the first Perdido discovery. Also in 2002, BP, Shell and ChevronTexaco jointly found an oil field which they named Great White, 250 miles from Houston. The discoveries at Great White and Trident have motivated six additional prospects likely to be drilled in the area.

The interest for exploratory activities in the Western Polygon is also increasing. In September 2004 Chevron and its partners (Devon Energy and Statoil), announced the discovery of the Jack prospect. The site is approximately 270 miles southwest of New Orleans and 175 miles offshore. The Jack 2 well reached a total depth of 28,175 feet (7,000 feet of water and more than 20,000 feet under the sea floor). The discovery represents a vast petroleum pool of 175 miles that could hold 3 billion to 15 billion barrels of oil and other natural gas liquids.

The results of the Jack 2 test re-intensified the industry’s interest on the Lower Tertiary trend. The USA has already started exploration works in the vicinity of the Western Polygon in order to be prepared for the coming year 2010. The required investment to locate these fields is about US$ 500 MM, and it takes 5 to 7 years to start production. Industry has responded not only by leasing new blocks but also by paying record bonuses.

Industry acquisition of new, high bonus leases is indicative of the potential many companies see in Shell’s plans to develop the Great White, Silver Tip, and Tobago discoveries. These fields are at about 8,000 feet of water depth and will be developed by using the deepest spar production facility in the world, capable of handling 130,000 boe/d. First production from Perdido is expected around 2010. “This geologic setting is different from what has previously been produced in the GoM and will establish the first production from the Lower Tertiary play in the GoM”

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10 Reuters, Sept 5, 2006

11 Shell, information, 2006.
Activities in the border areas: Mexico

Mexico is facing a major challenge in the production of oil and natural gas. Proven reserves have been declining and oil production has passed its peak level in 2005. The decline can be explained by low investment levels during the late 1980s and 1990s. The reason is that Mexican authorities were pleased with the high productivity levels from the giant Cantarell field. However, now that this field has begun to decline, the authorities have put additional pressure on PEMEX to find more reserves.

PEMEX is planning to maintain oil production above 3.1 MMBD and natural gas production above 6 MMMCFD. To do so it will be necessary to increase production from mature regions like Ku-Maloob-Zaap and Chicontepec, to increase exploration in shallow waters along the Mexican cost line and in the deep waters in the GoM.

Expected oil and natural gas production in Mexico

To reach these goals PEMEX activities will continue to concentrate onshore and in shallow water (less than 500 meters water depths). The plan for 2007-2009 envisages 4,358 wells and 31 new platforms in the GoM.

<table>
<thead>
<tr>
<th>Project</th>
<th>Nr. of wells</th>
<th>New Platforms in the GoM</th>
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</thead>
<tbody>
<tr>
<td>Ku Mallob Zaap</td>
<td>65</td>
<td>8</td>
</tr>
<tr>
<td>Cantarell</td>
<td>35</td>
<td>3</td>
</tr>
<tr>
<td>Lankahuasa</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Crudo Ligero Marino (Offshore Light Crude Oil project)</td>
<td>24</td>
<td>3</td>
</tr>
<tr>
<td>Other offshore (less than 500 meters)</td>
<td>625</td>
<td>16</td>
</tr>
<tr>
<td>Burgos</td>
<td>791</td>
<td>-</td>
</tr>
<tr>
<td>Chicontepec</td>
<td>2,780</td>
<td>-</td>
</tr>
<tr>
<td>Bermúdez, Samaria and others</td>
<td>24</td>
<td>-</td>
</tr>
<tr>
<td>Jujo Tecominacán</td>
<td>10</td>
<td>-</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>4,358</strong></td>
<td><strong>31</strong></td>
</tr>
</tbody>
</table>

The deep Gulf of Mexico (more than 500 meters) has been under close evaluation since the year 2000. First steps in exploration of the Mexican GoM have made possible for PEMEX geologists and geophysicists to understand the complex nature of the deepwater petroleum systems and main associated risks. This has led PEMEX to conclude that the hydrocarbon potential of the deep waters in the Mexican GoM is quite promising due to its multiple plays and prospects. PEMEX deep water exploratory program has made significant progress allowing building a robust portfolio of drillable prospects with a wide range of opportunities. However, considering the widespread distribution and size of the opportunities, the progress made so far is still modest. Thus, PEMEX is working on plans to intensify exploratory activities and eventually to develop available hydrocarbon.

**Deep water activities (2002-2005)**

![Deep water activities map](image)

**Source:** Adán Oviedo. Deepwater Exploration in Mexico. Houston, Tx, March 6th, 2006

PEMEX Business plan for deep water exploration includes:
- To assess the Potential of the Deepwater Gulf of Mexico by 2007
- To implement new initiatives, business models and best technology practices to monetize the oil resources.
- To obtain the necessary subsurface information to properly assess the deepwater GoM potential and to estimate the availability of hydrocarbon resources

In the short term the objectives focus on the following:
- To assess the GoM hydrocarbon potential
- To develop core business skills
- To implement key best practices
- To monitor deep water oil activities
- To accelerate the deep water training program
- To obtain access to deep water data bases and intelligence reports
- To acquire 23,000 km$^2$ of 3D seismic
- To build a robust prospect inventory
- To drill 10 exploratory wells

**PEMEX seismic studies and drilling opportunities in the GoM**

Source: Heber Cinco Ley and Luis Ramirez Corso. PEMEX, 2006

**Prospect generation and further work**

So far, only three exploratory wells have been drilled at depths close to 1,000 meters. However, PEMEX also has plans for several deep water developments. According to recent press releases PEMEX soon will award drilling contracts for four deepwater drilling units. The company needs the following equipment:

1. A deepwater semi-submersible unit or drill-ship capable of drilling in 3,048 m (10,000 feet) water depth and,

2. Another with 2,134 meters (7,000 feet) water depth capability.

3. PEMEX also needs two deepwater semi-submersibles able to drill in 305 meters (1,000 feet) water depth.

It should be noted that PEMEX plans don’t mention specific works to be performed at the Perdido Foldbelt, though it has long been mentioned that additional studies and even some drilling works should be made in the area. On September 6, 2006, the director of PEMEX Exploration and Production announced a tender to lease drilling equipment to start working during the second half of 2008\(^\text{12}\). The reason why this had not been done earlier is that there were no available equipments in the market and some needed to be built, which can take a couple of additional years. The plan is to drill 30 deep water wells during a five years period at an assumed cost of US$100 to US$ 200 millions per well.

In order to speed the learning curve in deep water developments PEMEX has envisaged the possibility of establishing cooperation agreements with experiences international companies like Petrobras from Brazil and Statoil from Norway.

Towards a common solution

Mexico and the USA signed the Treaty on Maritime Boundaries in 1978\textsuperscript{13}. Mexico ratified the Treaty in 1979 while the US Senate signed the Treaty but failed to ratify it until October 23, 1997. The agreement defines the border line through most of the western and central GoM, though leaving an opening ("western gap") where the 200 mile claims of neither side reaches.

In 1995, the United States amended its federal laws governing the royalty payment system on offshore oil and gas production to encourage petroleum exploration in the GoM, through the Deep Water Royalty Relief Act. However, the increased exploration and leasing activity raised questions over the territorial boundary between the US and Mexico as well as the jurisdiction over the western gap. In 1997, the MMS announced that it would offer offshore leases in the Western Gap contingent upon a successful agreement between Mexico and the US on that area\textsuperscript{14}. The Government of Mexico indicated that no agreement on the Western Polygon could be considered until the US first ratified the boundary Treaty. The US Senate Foreign Relations Committee favorably reported the 1979 Treaty (not the Western Gap) to the Senate in September of 1997. The full Senate voted to ratify the Treaty on October 23, 1997.

As mentioned, a section of the Western part of the GoM was left without definition. Thus, the governments of Mexico and the USA signed the "Treaty between the Government of the United States of America and the Government of the United Mexican States on the Delimitation of the Continental Shelf in the Western Gulf of Mexico beyond 200 Nautical Miles". The Treaty was signed by the Mexican Senate on March 28, 2000 and took effect on March 21, 2001. The Treaty only covers the Western Polygon and it is the only Treaty where Mexico makes reference to the trans-boundary petroleum fields based on International Law.

The Treaty establishes that none of the two countries will for any purpose execute its sovereign rights or jurisdiction on the seabed or on the subsoil at the Western Polygon. The Treaty states that due to the possible existence of oil or natural gas fields that could extend through the established limits in the continental shelf, during a 10 years period after the Treaty took effect, the Parts will not authorize nor will allow the drilling or the exploration of oil and natural gas in the continental shelf within the established 1.4 miles (a total area of 2.8 miles).

Since then, the MMS has announced leases for the Outer Continental Shelf (OCS) in multi-sale processes covering the Central and Western GOM\textsuperscript{15}. The announcements properly inform the "Areas Excluded from this Call" by explaining that the Central GOM is bounded on the south to the continental shelf boundary with Mexico as established by the


\textsuperscript{14} Barbara Shook, MMS Offers Leases in "Doughnut Hole" Ahead of Senate OK, The Oil Daily, July 25, 1997, at 3.

\textsuperscript{15} DEPARTMENT OF THE INTERIOR. Minerals Management Service. Outer Continental Shelf (OCS), Central and Western Gulf of Mexico, Oil and Gas Lease Sales for Years 2002-2007
Mexico-US Treaty on the Delimitation of the Continental Shelf in the Western GoM beyond 200 Nautical Miles (January 2001), while the Western GOM is bounded on the south to the maritime boundary with Mexico as established by the same Treaty.

Although the Treaty doesn’t authorize or permit petroleum or natural gas drilling or exploitation in the Western Gap, both countries should allow each other conducting geological and geophysical studies, to determine the possible presence and distribution of trans-boundary reservoirs\(^\text{16}\). Furthermore, the USA and Mexico must have shared geological and geophysical information in their possession and notify one another of any possible trans-boundary resources.

Based on the above, since September 6, 2005, the Mexican Senate has announced the follow up of these issues, to know the progress on the studies on the trans-boundary fields, the progress in the negotiations between Mexico and the USA on the efficient and equitable exploitation of the trans-boundary fields in that area, and to know about other trans-boundary fields not included in the Treaty. So far, however, no new agreement has been announced by Mexico or the US on the possible cooperation between both countries concerning the trans-boundary reservoirs.

The question of competing sovereignty or jurisdictional claims or boundaries between countries has usually led to establishing joint development zones between them. When the boundaries exist the agreements help to avoid the potential infracion of rights of either party, as could be the exploitation of resources from the opposite side. The agreement can also help to define the boundary limits by separating the issue of underlying resources, which will be dealt with through a joint regime. Based on the solutions found to similar problems in other regions of the world, an agreement to solve the issue of trans-boundary petroleum reservoirs could include:

- Establishing common deposits of oil and natural gas, not referring to a particular geographical area but to a certain deposit, the extent of which would be determined by the States Parties through a mixed Technical Commission, empowered to calculate the resources \textit{in situ} (Austria-Czechoslovakia 1960)
- To define precise geographical areas in connection with the resources (Norway-UK, 1976)
- To establish a joint development zone, divided by a provisional line separating two sub-zones, one for each country (Federal Republic of Germany-The Netherlands, 1962) or as many sub-zones as needed (Japan-Korea, 1974)
- To establish a joint development area (Bahrain-Saudi Arabia, 1958) or a joint regime (Iran-Sharjah, 1971) or a Common Zone (Saudi Arabia-Sudan, 1974).
- To define a delimitation scheme setting up a protected zone (Australia-Papua New Guinea, 1978) or a Cooperation Zone, defined by geographical coordinates and divided into areas (Australia-Indonesia, 1989).

\(^{16}\) The oil and gas exploration and production 10 years moratorium in the buffer area allows each side to conduct its own seismic surveys and prepare for possible exploration. Following the moratorium, each side may permit drilling in its respective buffer zone, but must notify the other when any of the buffer area is made available for drilling. Under the current scheme, Mexico would merely be informed of drilling on the US side.
Any of this type of agreements can include simple or complex clauses depending on the
detail of activities that are allowed. A common but slightly complex approach is that which
provides for the "unitization" of the deposit which is to be exploited as a single unit. In the
Norway-UK agreement on the Frigg field, each government requires the acknowledgment
of the counterpart to establish a contract with the licensees of the neighbor country to
appoint a common operator. The agreement regulates the free movement of persons and
materials, safety issues, inspections, taxation, transfer of rights and other matters, but
does not affect the rights and jurisdiction of each country\textsuperscript{17}.

An alternative to the unitization is the joint-venture, as was the case between France and
Spain. Each country retains its sovereignty and jurisdiction of a common area where the
companies can operate together to obtain the products belonging to one country or the
other.

More complex schemes can also be envisaged as was the case between Australia and
Indonesia. Two countries establish a cooperation area divided by sectors within which
different rules can apply. In one sector the activities can be carried by a common
authority, while in another section they can be developed by joint venture companies. This
type of scheme requires of numerous rules on supervision, safety, environmental issues
and many more. Unitization is also needed when the reservoirs stretch along two or more
sectors.

In general, all the schemes require an institutional setup to administer the system. The
setup can be simple or complex depending on the trust of each others authorities and
institutions in matters related to border lines, permits, norms and arbitrage, to name a few.
Otherwise, the schemes must include a full regime of authorities and institutions to
manage the resulting issues.

To our view the Framework Agreement between the Government of the United Kingdom of
Great Britain and Northern Ireland and the Government of the Kingdom of Norway
concerning Cross-Boundary Petroleum Co-operation, represents a good example that
Mexico and the US could emulate. This scheme reduces unnecessary administrative costs
but gives the Parties enough control to safeguard all aspects of the sovereignty, requiring
the Parties to seek agreement on the most effective manner to undertake exploitation and
the way in which the proceeds should be apportioned.

Closer to the US experience and considering prior treaties signed in North America,\textsuperscript{18} such
as those existing between Cuba-Bahamas, USA-British Virgin Islands and USA-Canada,
maybe the last one could provide elements for a joint solution offering quicker access to
the reserves, while giving Mexico the necessary resources to develop its own GoM
resources.

A royalty-sharing agreement. The agreement could be more beneficial and maybe more
equitable if it includes cooperation and scientific technology available to determine the
location of the reserves, including ownership percentages of trans-boundary resources.

\textsuperscript{17} Norway No. 1 (2006) \textit{Framework Agreement between the Government of the United Kingdom of Great
Britain and Northern Ireland and the Government of the Kingdom of Norway concerning Cross-
Boundary Petroleum Co-operation} Oslo, 4 April 2005.

\textsuperscript{18} John Holmes, J. D. Candidate, 2002, Vanderbilt University Law School; B.A., The University of the South.
Unitization. It is used worldwide in private joint development agreements\(^\text{19}\). Both countries have an equal number of representatives to govern the exploration and information to divide the trans-boundary reserves as agreed.

On the Mexican side, there is urgency to settle the dispute as an essentially defensive tactic. While the USA stands to benefit immediately from the delimitation of the Western Gap, Mexico is technologically behind the US petroleum industry and needs to protect its own reserves from private development.

Also, PEMEX is the only oil company allowed as investor and operator in the Mexican system, as the Constitution prohibits foreign control of energy production. PEMEX has the monopoly over exploration and production of all hydrocarbons, all of which are owned by the state.

This circumstance affects the ability of the USA and Mexico to create a joint development scheme in the Western Gap buffer zone or at the Perdido Foldbelt. Foreign investment in production of Mexico’s constitutional reserves will only be possible if the Mexican Congress allows a special treatment to these cases or accepts a mix of public ownership and private development in energy production.

Moreover, for Mexico, the solutions to the trans-boundary reservoirs could create an important precedent questioning the very monopolistic structure of the petroleum industry. Some would consider that the problems the Mexican oil sector is having are the direct consequence of the monopoly, while others believe that the failures have been caused by the lack of investment and the excessive fiscal dependency on the oil incomes. The fact is that the political parties are divided on whether the Mexican oil sector should open to private investors or not. By extension, they are also divided on the adequate solution to the trans-boundary petroleum resources. The debate centers on whether the constitutional article 27 paragraph has to be modified or not:

\begin{verbatim}
Article 27. Ownership of the lands and waters within the boundaries of the national territory is vested originally in the Nation, which has had, and has, the right to transmit title thereof to private persons, thereby constituting private property.

IV. Commercial stock companies may not acquire, hold, or administer rural properties. Companies of this kind that are organized to operate any manufacturing, mining, or petroleum industry or for any other purpose that is not agricultural, may acquire, hold, or administer lands only of an area that is strictly necessary for their buildings or services, and this area shall be fixed in each particular case by the Federal or State Executive.
\end{verbatim}

Conclusions

As we have seen the GoM can be considered as one the last most prolific remaining petroleum provinces in the world. So far the resources have been identified and produced

\(^\text{19}\) Almost every well drilled in the GoM has multiple investors to diversify the risk involved. Each agreement details the percentages owned by each party based on a variety of factors, but most noticeably capital investment. Single companies own very few exploration projects, most involve multiple parties as a way to diversify risk. Additionally, joint operating agreements make expensive explorations possible because few individual companies could attempt them alone.
in the shallow waters of Mexico and the USA. However, in the US the production has been extending southwards getting closer to the border areas with Mexico. At the same time the technology has evolved to the point where commercial production can take place at 3,000 meters water depths.

Mexico, the US and Cuba share the GoM, in which could lay transboundary reservoirs, including the western and eastern gaps. Thus, Mexico and the USA executed a bilateral Treaty in the year 2000, to define the area in which the Western Gap reservoir lies, with a 10 year moratorium during which neither country may permit oil or natural gas drilling or exploitation of the continental shelf within 1.4 nautical miles of the boundary.

Mexico and the US must reach oil sharing and unitization schemes pursuant to international practice. Mexico also faces a major challenge in implementing international practice due to its constitutional and legal hydrocarbons framework.

The legal amendments ought to be solved soon since the end of the moratorium is just around the corner and Mexican hydrocarbon reserves are declining faster than planned (7 years in proved reserves plus 2.5 years in recoveries), for this reason Mexico ought to develop shared hydrocarbon reserves soon.

The US should also be interested in a solution since the oil and gas resources in the GoM could help it to increase the energy security that has been at the hearth of many international conflicts with the Middle East.

An important benefit for Mexico is the free information it receives as part of the Western Gap Treaty. Although PEMEX has already carried out seismic studies in an effort to establish the geological characteristics of the Western Gap, it is unclear how detailed the research data actually is. Also, Mexico lacks any regulatory power over exploration efforts under the current Treaty.  

20 Even though there is a ten-year moratorium on oil and gas exploration and production in the buffer area, each side can conduct its own seismic surveys and prepare for possible exploration. Following the moratorium, each side may permit drilling in its respective buffer zone, but must notify the other when any of the buffer area is made available for drilling. Under the current scheme, Mexico would merely be informed of drilling on the US side.