Gulf of Mexico Deepwater Trends

Regional Energy Seminar
Stephen Trammel
Sr.Product Manager—Activity Products
Topics

Activity Trends and Challenges
Leasing Summary
Delivering the goods
Plans of Exploration
You DO Know Jack!
Deepwater Future--Which Way doth the Wind Blow?
Gulf of Mexico – Deepwater Trends

Miocene Trend

Emerging Abyssal Plain Play

Lower Tertiary Trend

PLANNED EXPLORATION WELLS

17 ANADARKO
20 CHEVRON
29 DEVON
4 NORSK HYDRO
2 ENI
3 HESS
2 NEWFIELD
2 NOBLE
1 W & T
3 WOODSIDE
Gulf of Mexico – Deepwater Trends

• General Activity & Operator Trends
  • Super majors move in first --prior to 1999, deep pockets take 50% of leases
  • Large independents between 1999 and 2002—partnering and farm-ins
  • 2003 Parallel shift of smaller independents and foreign companies (e.g. Petrobras, Statoil, Norsk Hydro, Total)—currently hold 50% of leases
Cost & Technology Challenges

• **The Gulf is no exception to higher costs:**
  - Over the last year the MMS has posted a number of new NTL's
  - New regs are geared to safety but will increase costs
  - Many are geared to hurricanes safety and structural integrity
    - Interim Guidelines for Moored Drilling Rig Fitness Requirements for the 2007 Hurricane Season (NTL 2007-G19)
    - Interim Guidelines for Tie-downs on OCS Production Platforms for the 2007 Hurricane Season (NTL 2007-G18)
    - Hurricane and Tropical Storm Effects Reports (NTL 2007-G17)
    - High Pressure and High Temperature Completions and Workovers (NTL 2007-G07)
    - Deepwater Ocean Current Monitoring on Floating Facilities (NTL 2007-G17)
    - Pipeline Risers Subject to the Platform Verification Program (NTL 2007-G14)

• Day rates increasing dramatically—currently exceeding $500,000. Costs up almost 80% since 2000

• Rigs, crews, services and seismic still in tight supply—some improvement by 2009/10  Nearly half the deepwater-capable rigs are already in GOM

• Lower Tertiary wells may cost between $80 million and $120 million each, while producing facilities may cost between $600 million and $1.5 billion—even up to $3.0 billion.

• Record high bonuses being paid for Lower Tertiary Trend blocks
  - BP paid $21 million for Keathley Canyon 058
Lease – Awards

- Only two bid rounds with 449 leases in 2006
- BP won the most lease blocks in 2006, grabbing a total of 66 blocks.
  - Anadarko (48)
  - Petrobras (47)
  - Chevron (37)
  - Shell (35)
  - Hess (34)
  - Hunt Oil (28)
  - TOTAL (27)
  - Norsk Hydro Statoil (25)
  - Cobalt (24)
  - Nexen (20)
  - BHP Billiton (19)
  - Devon (15)
  - ConocoPhillips (11)
Lease – Awards

Leases Above 1 Million US
- OCS WGoM Sale 206 (52)
- OCS G50M Sale 198 (53)

- CHEVRON US
  G30848
  GB 763
  $2,267,950

- LLOG
  G28077
  GC 448
  $4,600,000

- HESS
  G28063
  GC 287
  $42,789,994

- HELIS
  G27691
  EW 1010
  $3,173,266

- NOBLE
  G28030
  MC 945
  $20,217,606

- SHELL OFF
  G30018
  KC 100
  $10,098,297

- PETROBRAS
  G30788
  GB 353
  $2,100,111

- PETROBRAS
  G30926
  KC 147
  $10,860,111

- CHEVRON US
  G30963
  KC 326
  $4,244,873

- COBALT
  G30876
  GB 959
  $8,257,880

- SHELL GOM
  G28170
  WR 265
  AND
  WR 309
  $4,584,400

- NOBLE
  G28131
  AT 445
  $1,008,165

- DOMINION
  G28129
  AT 426
  $21,353,333

- BP E&P
  G30850
  KC 058
  $21,011,812

- SHELL OFF
  G30956
  KC 059
  $12,800,111

- PETROBRAS
  G30926
  KC 147
  $10,860,111

- CHEVRON US
  G30963
  KC 326
  $4,244,873

- COBALT
  G30876
  GB 959
  $8,257,880

- SHELL GOM
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  WR 265
  AND
  WR 309
  $4,584,400

- NOBLE
  G28131
  AT 445
  $1,008,165

- DOMINION
  G28129
  AT 426
  $21,353,333

- BP E&P
  G30850
  KC 058
  $21,011,812
2007-2008 will see a significant number of leases being released

- Lease terms: 5 years for blocks in water depth < 400m; 8 years for blocks in water 400-799m; 10 years for blocks in water > 800m

- **Lease expirations 2006:**
  - BP (129)
  - Chevron (105)
  - Shell (101)
  - ExxonMobil (59)
  - ConocoPhillips (40)
  - Statoil Norsk Hydro (31)
  - Anadarko (25)
  - BHP (22)
  - Devon (16)
  - Nexen (11)
Deepwater-- Delivering the Goods

Pipelines and Plants

- Major deepwater midstream/downstream pipeline construction and marketing activity occurring to transport the expected large volumes of oil and gas to be produced from deepwater
  - Chevron approved the construction of the 55mi oil pipeline to connect with Tahiti project to the existing Amberjack pipeline
  - Enbridge Offshore Pipelines built a natural gas lateral for the Sheni field development project that will consist of 11mi of 12"-diameter pipe capable of delivering 100 MMcfd.
  - In February, FERC approved Chevron’s plan to build the 1.3 Bcfd-capable Casotte Landing regasification plant located at Jackson County, Mississippi

- Perdido Regional Development
  - Shell AC857
  - Support Great White Field, Tobago Field, Silvertip
  - The Perdido project is scheduled to come onstream by 2010 producing up to 130,000 boe/d.

- Independence Hub
Independence Hub Installed

• March 07, **Enterprise Products Partners** successfully installed **Independence Hub** production platform in unleased **Mississippi Canyon 920**, deepwater Central Gulf of Mexico.

• Control of the Independence Hub will transfer to platform operator Anadarko.

• Independence to have significant impact on natural gas production in the deepwater Gulf of Mexico.

• Produces gas from nine recent deepwater discoveries in 7,800-9,000ft water that have been made by Anadarko (Kerr-McGee), Dominion, Norsk Hydro (Spinnaker), Devon.

• Capable of producing 1,000 MMcfg/d (expanded from the original 850 MMcfg/d on 11 January 2006) and 4,250 bc/d.

• Excess capacity to tie-back as many as 10 additional fields to accommodate future discoveries in this area.

• First gas expected in August 2007
<table>
<thead>
<tr>
<th>Field</th>
<th>MC Blk 920</th>
<th>Mississippi Canyon</th>
<th>DeSoto Canyon</th>
<th>Atwater Valley</th>
<th>Lloyd Ridge</th>
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<tbody>
<tr>
<td>Independence</td>
<td></td>
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<tr>
<td>Hub Anchor</td>
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<tr>
<td>Anchor Fields</td>
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*Table with fields and their corresponding locations.*
# Independence Hub Anchor Fields

<table>
<thead>
<tr>
<th>Field</th>
<th>Block</th>
<th>Water depth (ft)</th>
<th>Field discovered in</th>
<th>Owner (op)</th>
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<td>Atlas, Atlas NW</td>
<td>Lloyd Ridge 5, 49, 50</td>
<td>8,810</td>
<td>June 2003, January 2004</td>
<td>Anadarko 100%</td>
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<tr>
<td></td>
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<td>9,180</td>
<td></td>
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<tr>
<td>Jubilee</td>
<td>Atwater Valley 305, 349</td>
<td>8,891</td>
<td>April 2003</td>
<td>Anadarko 100%</td>
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<tr>
<td>Merganser</td>
<td>Atwater Valley 36, 37</td>
<td>8,064</td>
<td>November 2003</td>
<td>Anadarko (Kerr-McGee) 45% (op)</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Dominion 36.67%</td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
<td>Norsk Hydro (Spinnaker) 18.33%</td>
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<tr>
<td>Spiderman</td>
<td>DeSoto Canyon 620, 621</td>
<td>8,100</td>
<td>November 2003</td>
<td>Anadarko 45% (op)</td>
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<tr>
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<td>Dominion 36.67%</td>
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<td></td>
<td>Norsk Hydro (Spinnaker) 18.33%</td>
</tr>
<tr>
<td>San Jacinto (jointly developed with Spiderman)</td>
<td>DeSoto Canyon 618, 619</td>
<td>7,850</td>
<td>2004</td>
<td>Dominion 53% (op)</td>
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<td>Norsk Hydro (Spinnaker) 27%</td>
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<td>Anadarko (Kerr-McGee) 20%</td>
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<tr>
<td>Vortex</td>
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<tr>
<td></td>
<td>Lloyd Ridge 177, 221</td>
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<tr>
<td>Mondo NW</td>
<td>Lloyd Ridge 1, 2</td>
<td>8,340</td>
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<td></td>
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<td>Murphy 50%</td>
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<tr>
<td>Cheyenne</td>
<td>Lloyd Ridge 399</td>
<td>8,987</td>
<td>January 2005</td>
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<td>Q</td>
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<td>7,925</td>
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<td>Dominion 50%</td>
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Gulf of Mexico – Deepwater Oil Production 2004-2006

Deepwater Oil Production 2004

Deepwater Oil Production 2005

Deepwater Oil Production 2006
Exploration Summary

2006 very successful in terms of exploration

- Drilling of 41 new-field wildcats led to a total of 13 discoveries (Table 4). More significant discoveries include:
  - Kaskida operated by BP, Pony by Hess, Mission Deep by Anadarko (Kerr-McGee), Big Foot by Chevron and Friesian by Shell.
  - These discoveries add estimated 1,140 MMboe of reserves to the deepwater reserve base
  - Replaced 228% of the 2006 total hydrocarbon production.
  - The success rate of these 41 new-field wildcats is around 32%--slightly below the most recent 5-year average of 38%.

2007 Six Reported Discoveries so far--highlights

- Marathon drilled a deepwater discovery in the Northern Gulf of Mexico on Green Canyon Block 244
  - Droshky prospect (formerly Troika Deep).
  - 2900 ft of water,
  - 21,190 ft TD
  - Marathon estimates that the well has about 250 ft of net oil pay.
- June, in the western Deepwater, Mariner announced a discovery in 2,789 ft of water
  - The EB 424 1SOBO in East Breaks block 424 encountered 42 ft of net TVD gas pay. Reserve potential set at 50-100 Bcfe
USA Deepwater Gulf of Mexico, Discovery Wells - Synopsis

Extract Date: 03 Jun 2007

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<th>Operator</th>
<th>Well</th>
<th>Geological Province</th>
<th>On/Off shore</th>
<th>Licence</th>
<th>Status</th>
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### USA Deepwater Gulf of Mexico, Discovery Wells - Current

**Extract Date:** 24 Jun 2007

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<th>Operator</th>
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<td>Plugged &amp; abandoned gas</td>
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</table>
You DO Know Jack!!!!

- **Lower Tertiary Deepwater Play is among the leading exploration plays in the world**
  - Large recent discoveries in Alaminos Canyon, Keathley Canyon and Walker Ridge
  - Jack-2 well in Walker Ridge recently tested at 6,000 bbls/d
  - Key Players: Anadarko, BP, BHP Billiton, Chevron, Devon, Norsk Hydro, Petrobras, Shell, Total
- **Thick, high quality, sand reservoirs-- 20 wells drilled with 12 announced discoveries**
  - Source Rocks--Upper Jurassic and Middle Cretaceous organic-rich marls brought to maturity by post-Late Oligocene burial (Fiduk 1999)
  - Reservoirs -- Paleocene to Oligocene sandstones with the thickest—the Whopper—at the base of the sequence
    - Average porosity is 18% with permabilities in the range of 10-30 md (Durham 2006)
  - Limited information but traps are salt-cored anticlinal closures with tectonic styles ranging from thrusted symmetrical box-folds in the Perdido Fold Belt (Alaminos Canyon) to salt pillow structures in Walker Ridge
  - Over 12 billion bbls of oil have already been discovered in the trend (Meyer et al, 2005)
  - Recoverable reserves per discovery vary from 30-400 million BOE
  - Reserve estimates for the deepwater Wilcox trend range from 3-15 billion BOE
It’s a Whopper!

• The Whopper Sand—inconsistent with the existing paradigm for Tertiary deposition
• Where did it come from?

• The New Frontiers
  • Cuba—meet Florida
  • Section is characterized by sheet sands and is interpreted to be a regionally extensive basin floor system
  • Whopper Sand originally found in the Baha-II well in Alaminos Canyon and is almost 1100-ft thick
  • In Keathley Canyon (Sardinia-1 well) and in Walker Ridge (Jack-2 well) thicknesses range from 1200-ft to over 1900-ft (Chinook and Cascade-2 wells)
Stratigraphic Column for Wilcox Group, Texas Gulf Coast

Modified from Xue (1997)
Onshore Wilcox Isopach Map and Deep Gulf of Mexico Wilcox Well Penetrations
Wilcox Stratigraphic Cross Section, Alaminos Canyon to Walker Ridge
Wilcox section in Trident well, Alaminos Canyon 903
Facies interpretation of Whopper (Wilcox sand) in Hadrian well
Erosional Canyon Features Recognized Within Wilcox Strata

Paleogeographic Map at Maximum Wilcox Drawdown
Wilcox Depositional Model

Progressive Basinward Erosion & Bypass During Drawdown

- Lower Wilcox & Midway
- Cretaceous Slope Basin
- Alamos Canyon
- Walker Ridge
- Terminal Drawdown
- Lowstand Basin Floor Submarine Fan Complexes

Wilcox strata shown below are younger than Lower Wilcox shown in Wilcox Slope Basin and older than Big Shale

Continued bypass & erosion removed more of the forced regression packages than is shown

Figure 12a. Lower and Middle Wilcox Diagrammatic Cross Section.
The Deepwater Future

Existing Trends

- Flexure trend;
- Mini-basins;
- Sub-salt;
- Fold belts (Perdido fold belt, Subsalt fold belt, Mississippi fan fold belt);
- Paleogene (Lower Tertiary)

- There are still large areas of GOM yet to be explored and more light to be shed on emerging plays by these opportunities
  - Offshore Florida, Yucatan platform, Sierra de Chiapas, & Mexican and Cuban sectors of the deepwater.

- And in the more explored areas, new plays may emerge in a variety of areas and age intervals. These potentially include:
  - The Triassic-Mid-Jurassic syn-rift section;
  - The Oxfordian (Upper Jurassic) age on the US and Mexican sides;
  - Upper Cretaceous;
  - Mid-Upper Eocene and Oligocene submarine fans in the western deepwater;
  - K/T boundary mass-transport breccias throughout the Gulf;
  - Unconventional resource plays such as gas hydrates and shale gas trends.
An Ill Wind Blows No Good

Excepting Ivan (shut down 25% monthly production) and Katrina/Rita (70% monthly production), most disruptions have been temporary with near-normal production restored in a month.

Skewed by Katrina/Rita, average seasonal shut-in production from storms from 1960-2005 is still only 1.4% for oil and 1.3% for gas.

Better planning, better structures will reduce damage and shut-ins even more.
Gulf of Mexico Deepwater Trends

Regional Energy Seminar
Stephen Trammel
Sr. Product Manager—Activity Products