MET Survey Technology

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• The MET Process
The MET Process

- MET – Microbial Exploration Technology.
- Proprietary method used by EBT to identify hydrocarbon (HC) gas microseepages.
- Accurately measures levels of bacteria in soil that metabolize HC gas.
- Can identify extremely low levels of HC gases in soil.
- Quantifying the samples collected allows EBT to generate detailed maps that can identify geochemical anomalies within the survey area.
Principles of the MET Process

• Oil and gas accumulations leak hydrocarbons.

• Leakage (or microseepage) has a vertical migration to surface.

• Bacteria can utilize the hydrocarbon gas from a microseepage as a nutrient source.

• Identifying and measuring the bacterial population can identify subsurface hydrocarbon accumulations.

CHE-EBT MET TECHNOLOGY 2014
The MET Process

AIR

O₂ and hydrocarbon gases

HC gas migration

Oil Pool

microbes

soil sampling

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Examples of MET Survey Maps

**MET Survey Map**
MET values presented in a contour map format.

**Dot Matrix Map**
Highlights sample points of high values.

**Percent Probability of Success Map**
This map correlates MET survey results with drilling results from over 1,000 wells.

**Percentile Rank Map**
Contour format for ranking of all sample points in survey area.

**3D Survey Map**
MET values presented in 3D format.

**Relative Average Map**
Indicates strength of deviation from average MET value.

CHE-EBT MET TECHNOLOGY
Percent Probability of Drilling Success - %PS

- Exclusive technique developed by EBT.
- %PS is an average of three linear correlations.
- Correlates how MET values, % Rank, and Relative Averages relate to completion rates of pre and post survey wells.
- For exploration locations, EBT recommends a location when % PS is > 45; for development step-out locations EBT recommends a location when % PS is > 25.
- MET data is generally the average of four corners of an LSD.
- Thus, a well is judged based on four samples, 400 meters away.

CHE-EBT MET TECHNOLOGY
# World Wide Correlation of Oil and Gas Drilling With MET Data

## Correlation of Pre and Post Drilling Results with MET Survey Data

<table>
<thead>
<tr>
<th>Country</th>
<th>MET Acres</th>
<th>Total MET Wells</th>
<th>Dry Wells</th>
<th>% MET Correct</th>
<th>Total Post MET Wells</th>
<th>Completed %</th>
<th>Oil Industry</th>
<th>Industry % Completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>United States</td>
<td>343,072</td>
<td>285</td>
<td>16</td>
<td>94.4%</td>
<td>13</td>
<td>0</td>
<td>0</td>
<td>na</td>
</tr>
<tr>
<td>Manitoba</td>
<td>420,480</td>
<td>165</td>
<td>15</td>
<td>90.9%</td>
<td>57</td>
<td>11</td>
<td>9</td>
<td>81.8%</td>
</tr>
<tr>
<td>Saskatchewan</td>
<td>2,838,666</td>
<td>909</td>
<td>71</td>
<td>92.2%</td>
<td>629</td>
<td>221</td>
<td>174</td>
<td>78.7%</td>
</tr>
<tr>
<td>Alberta</td>
<td>329,780</td>
<td>253</td>
<td>17</td>
<td>93.3%</td>
<td>14</td>
<td>3</td>
<td>2</td>
<td>66.7%</td>
</tr>
<tr>
<td>BC, Ontario, Yukon,</td>
<td>78,860</td>
<td>5</td>
<td>0</td>
<td>100.0%</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.0%</td>
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<tr>
<td>Albania</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0.0%</td>
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<tr>
<td>Argentina</td>
<td>10,335</td>
<td>1</td>
<td>0</td>
<td>100.0%</td>
<td>8</td>
<td>5</td>
<td>4</td>
<td>80.0%</td>
</tr>
<tr>
<td>Brazil offshore</td>
<td>5,162,172</td>
<td>0</td>
<td>0</td>
<td>0.0%</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.0%</td>
</tr>
<tr>
<td>Columbia onshore</td>
<td>904,157</td>
<td>0</td>
<td>0</td>
<td>0.0%</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.0%</td>
</tr>
<tr>
<td>Columbia offshore</td>
<td>3,350,000</td>
<td>0</td>
<td>0</td>
<td>0.0%</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.0%</td>
</tr>
<tr>
<td>Ecuador</td>
<td>457,000</td>
<td>5</td>
<td>0</td>
<td>100.0%</td>
<td>44</td>
<td>19</td>
<td>19</td>
<td>100.0%</td>
</tr>
<tr>
<td>Greenland</td>
<td>1,000</td>
<td>0</td>
<td>0</td>
<td>0.0%</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.0%</td>
</tr>
<tr>
<td>Uruguay</td>
<td>1,927,421</td>
<td>0</td>
<td>0</td>
<td>0.0%</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.0%</td>
</tr>
<tr>
<td>Paraguay</td>
<td>50,000</td>
<td>0</td>
<td>0</td>
<td>0.0%</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.0%</td>
</tr>
<tr>
<td>Peru</td>
<td>1,074,060</td>
<td>69</td>
<td>3</td>
<td>95.7%</td>
<td>9</td>
<td>8</td>
<td>8</td>
<td>100.0%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>17,188,283</td>
<td>1,692</td>
<td>122</td>
<td>92.8%</td>
<td>774</td>
<td>267</td>
<td>216</td>
<td>80.9%</td>
</tr>
</tbody>
</table>

CHE-EBT MET TECHNOLOGY 2014
Correlation of Drilling Results with MET Survey Data

• Over the past 14 years, industry has drilled over 1,000 post survey wells in our coverage area in Canada, a recent review in 2011 of 629 wells in the focus area has shown a strong correlation, 78.7%, with MET data and drilling success.

• EBT converts laboratory results into a Percent Probability of Drilling Success (%PS) value based on drilling correlation with our MET data, 2,500 wells and 12 million acres of survey data.

• For 468 exploration wells in Canada, we see a direct correlation of drilling success and increased production with the %PS ratings for those locations. The same is found for development wells.
Drilling Results for T1-2 R1-3 W2 Canada

Relationship of % PS Ratings to Well Completion

- EBT Recommendation Level > 42% PS
- Dry Wells
- Oil Wells

% PS Rating for Drill Site vs Individual Wells

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Completion Rate Versus the % PS Rating

Exploration wells (468 wells) in Canada. This graph indicates there is a direct correlation of higher %PS ratings and higher % completion rates.

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Cumulative Production Versus the %PS Rating

Exploration wells in Canada.
This graph indicates there is a direct correlation between a higher %PS rating and a higher accumulative production (cubic meters of oil).

CHE-EBT MET TECHNOLOGY 2014
# Summary of Drilling Correlation with MET Survey Data

<table>
<thead>
<tr>
<th>Completion Rates</th>
<th>Exploration Wells</th>
<th>Development Wells</th>
<th>Total Wells</th>
</tr>
</thead>
<tbody>
<tr>
<td>MET Recommended wells</td>
<td>70/95 = 73.6%</td>
<td>104/126 = 82.5%</td>
<td>174/221 = 78.7%</td>
</tr>
<tr>
<td>Non MET recommended</td>
<td>172/373 = 46.1%</td>
<td>22/35 = 62.8%</td>
<td>194/408 = 47.5%</td>
</tr>
<tr>
<td>Overall</td>
<td>242/468 = 51.7%</td>
<td>120/161 = 78%</td>
<td>368/629 = 58.5%</td>
</tr>
<tr>
<td>MET Improvement</td>
<td>59% greater</td>
<td>31% greater</td>
<td>65% greater</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Average Cumulative Production</th>
<th>Exploration Wells</th>
<th>Development Wells</th>
</tr>
</thead>
<tbody>
<tr>
<td>MET Recommended</td>
<td>28,480 BO</td>
<td>36,571 BO</td>
</tr>
<tr>
<td>Non MET Recommended</td>
<td>16,950 BO</td>
<td>21,366 BO</td>
</tr>
<tr>
<td>MET Recommended Versus Non Recommended</td>
<td>68% greater</td>
<td>71% greater</td>
</tr>
</tbody>
</table>
Applications of MET

• Oil and gas exploration using MET:
  – On-Shore
  – Off-Shore

• Hydrocarbon prospect / play confirmation.

• Oil and gas field assessment for development.

• Uranium exploration.
MET Survey Example for Exploration
Exploration Example Maps

• The following maps demonstrate how a MET survey can identify exploration well locations.
• The Canadian township example had limited drilling at the time of the survey (1997).
• Please note that industry drilled these locations WITHOUT knowledge or use of MET data.
• Conversely, MET recommendations were based ONLY on MET data.
• In principle, MET data should be used in conjunction with other available survey data such as seismic, etc.

CHE-EBT MET TECHNOLOGY 2014
The following three maps show different views of the Canadian township, T1-R10-W2.

The First map is our original survey map produced in 1997. It shows our MET survey data and pre-survey wells.

The Second map shows our MET data and up-to-date drilling results as of 2012.

The Third map shows our MET data and up-to-date drilling with the production bubbled to scale. The map is color coded to show pre-drilling, MET recommended drilling and Non-MET recommended drilling.
Original %PS Survey Map

This map shows the results from the MET survey completed in 1997.

Areas in red have the highest MET values, and are considered areas of interest.

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Survey Area with Updated Wells

This map shows the survey area with updated drilling (2012).

Notice the drilling in the southeast corner is also where we have the highest %PS values.
Survey Area with Production Bubble

This map shows the survey area with production bubbled to scale.

This map is color coded to represent recommended and non-recommended locations. Blue wells are recommended.

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Summary of T1 R10 W2 Township Survey

- The areas of highest MET Values were in sections 1-3 and 10-12. These sections produced 65% of the oil from the township.
- IOP of MET recommended locations was 200 BOPD while IOP from non recommended locations was 131 BOPD (52% greater).
- Of the top 10 producing wells, 9 were at MET recommended locations.
- 8 of the 9 wells with IOP greater than 200 BOPD were MET recommended locations while only 2 of 6 wells with less than IOP of 100 BOPD were MET recommended.

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• MET Survey Example for Field Development

CHE-EBT MET TECHNOLOGY 2014
The following three maps show different views of the Canadian township T11-R6-W2.

The first map is our original survey map conducted in 1995. It shows our MET survey data and pre-survey wells.

The second map shows our MET survey data and up-to-date drilling, as of 2012.

The third map shows our MET survey data and up-to-date drilling with the production bubbled to scale. The map is color coded to show pre-drilling, MET recommended drilling and Non-MET recommended drilling.
Original %PS Survey Map

This map shows the results from the MET survey completed in 1995.

Areas in red have the highest MET values, and are considered areas of interest. There was significant drilling in the coverage area at time of survey.
Survey Area with Updated Wells

This map shows the survey area with updated drilling (2012).

Notice all the drilling in the survey area. In this developed field there is still a strong MET signal detected in the coverage area.
Survey Area with Production Bubble

This map shows the survey area with production bubbled to scale.

This map is color coded to represent recommended and non-recommended locations. Blue wells are recommended.
• MET Survey in Ecuador
Introduction

• This presentation is comparing 14 years of drilling data in Ecuador's Block 15 with EBT’s MET survey data that was generated in 1999.

• PetroAmazonas (PAM) now owns and operates Block 15. EBT completed 7 subsequent surveys for PAM in Ecuador.

• PAM after reviewing EBT’s Microbial Exploration Technology (MET) survey data from 1999 sent well data on 48 wells that were drilled in the MET coverage area.
Overall Results of Block 15

- There are 48 wells reviewed.
- Five of these wells were drilled pre-survey (1999) and all five were dry wells in non recommended locations.
- All 43 wells that were drilled post-survey were successfully completed and brought on production.
- EBT would have recommended 18 of these wells. The 18 recommended wells have an average cumulative production of 1,470,000 BO.
- 25 wells were in non-recommended locations and have an average cumulative production of 213,000 BO.
Recommended Locations Vs. Non Recommended Locations

• The Itaya field was the best field reviewed, which has an average %PS value of 64% and has an average IOP of 3,650 BOPD.

• The second best field is the Dumbique field which has an average %PS value of 47% and an average IOP of 1,840 BOPD.

• The least productive field is the Palmeras Norte field, which has an average %PS value of 29% and an average IOP of 486 BOPD.
Ranking of Fields by % PS Values

Average %PS for Fields and Average IOP

- Eden Yuturi
- Tumali
- Panacocha
- Dumbique
- Palmeras Oeste
- Palmeras Norte

Average IOP (BOPD)

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Total Production and Recommendations

• Total cumulative oil production of the reviewed wells is **32.9 million BO**, to date.

• The 30 non recommended wells accounted for 19.4% of the total production, or **6.4 million BO**.

• That means that the 18 recommended post survey wells accounted for 80.6% of the total production, or **26.5 million BO**.
Total Production and Recommendations

Cumulative Production of Block 15 and %PS

% of Total Cumulative Production

% of Total Cumulative Production

%PS of Well Sites

CHE-EBT MET TECHNOLOGY 2014
Economics of MET Ecuador Survey

• Current pricing is $275,000 for the Block 15 MET survey, 4% of one well drilling costs.

• Individual wells costs $6-7 million to drilling.

• Total drilling program was $312 million.

• Recommended well sites (18) at $117 million have produced 26.5 million BO. Cost/BO produced is $4.42/BO.

• Non recommended well sites (30) at $195 million have produced 6.4 million BO. Cost/BO is $30.46/BO, 6.9 times higher.
• MET Surveys for Off-Shore Exploration
MET Survey Projects in S. America

- 4 lands surveys in Colombia for Ecopetrol
  - 1 offshore survey
- 8 surveys completed in Ecuador
  - 7 for PetroAmazonas/PetroEcuador
- 9 land surveys completed in Peru
  - 2 off-shore surveys completed in Peru
- 1 Paraguay survey
- 1 offshore survey for PetroBras
- 1 offshore survey for ANP
- 2014 planned project offshore Uruguay

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Offshore MET Survey Locations

- Offshore Peru – 1999, for Petrotech (now Savia)
- Offshore Brazil – 1999, for Petrobras
- Offshore Peru – 2004, for Petrotech (now Savia)
- Offshore Colombia – 2009, for Ecopetrol
- Offshore Brazil – 2013-2014, TDI Brooks and ANP
- Offshore Uruguay – 2014, TDI Brooks

CHE-EBT MET TECHNOLOGY 2014
The MET data supported the drilling from all 4 successful platforms located on this map.

The San Pedro platform spudded one well that had an IOP over 5,000 BOPD.
• EBTs’ Drilling Programs
Canadian Drilling Program

- Over past 14 years, industry has drilled 232 MET recommended locations and completed 79% of these wells (183).
- Approximately $1 billion of drilling costs have been spent by industry in drilling in our MET coverage areas which has helped confirm our MET survey data.
- EBT MET database of 3.4 million acres in Canada contains an additional 150 plus locations.
- These locations are for vertical wells with an ROI greater than 4, and initial payback within first year of production.
- EBT is seeking investors for this program, at $1 million per well for 10 to 150 well program.

CHE-EBT MET TECHNOLOGY 2014
EBT Investment in Second Party Drilling Programs

• EBT reviews investment opportunities in drilling programs marketed by other companies.
• If the economics and other details look excellent, EBT conducts a MET survey over prospect site.
• If MET data supports well location then we ask to invest in drilling prospect. If MET data is not supportive of site, we will not invest.

• Results to date:
   Has reviewed 20 prospects, conducted three MET surveys, and has not participated in any program.
General Conclusions

- **Experience** – Over 17 million acres of MET surveys around the world both on shore and offshore in 11 countries.

- **Accuracy** – MET recommended drilling results of 81% completion and were 65% greater than non-recommended locations.

- **Production** - MET supported wells have produced 71%-350% more oil than non recommended well locations.

- **Timely Results** – MET surveys typically have a turnaround time of two weeks once the soils have been received in our lab.

CHE-EBT MET TECHNOLOGY 2014
Let us know how we can best assist you
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– Website: www.christohoustonenergy.com
– Thank you for your time.