Gothic / Hovenweep
Shale Play Opportunity

UTE MOUNTAIN UTE RESERVATION

COLORADO
GOTHIC / HOVENWEEP SHALE PLAY OPPORTUNITY
ON THE UTE MOUNTAIN UTE INDIAN RESERVATION, COLORADO

Play Highlights and Terms

The Ute Mountain Ute Tribe is offering an opportunity to explore and develop Gothic Shale / Hovenweep Shale plays on Indian lands with demonstrated potential just north of the reservation.

PLAY HIGHLIGHTS

• ACREAGE: Thousands of contiguous acres under one land owner.
• 100% Tribal mineral and surface lands
• Close proximity to San Juan Basin pipeline infrastructure.
• Bill Barrett Corp. (BBC) reports rates in the Gothic Shale ranging from 1.5 to 4.9 MMCF/D and calculates 58 BCF gas-in-place per section in the Gothic Shale based on core. Significant associated light oil (condensate) and NGL production. The western portion of the Ute Mountain Ute Reservation may be in a more oil prone region.
• The northern border of the Ute Mountain Ute Reservation is less than fifteen miles south of Bill Barrett’s successful Gothic Koskie wells (Pedro Field), and less than ten miles south of their Hovenweep test, the Gray 13-15.
• Mapping of the Gothic and Hovenweep shale isopachs indicate thicknesses comparable to the Bill Barrett area (approximately 80 – 150 feet).
• Isopach and structure maps of the Gothic and Hovenweep shales have been completed and can be made available to interested parties.
• Geochemical analyses were conducted on cores obtained from the Bill Barrett Play area and the Ute Mountain Ute Reservation for both the Gothic Shale and Hovenweep Shale.

• Agreement will use the 1982 Indian Mineral Development Act. Refer to web site www.bia.gov/WhoWeAre/AS-IA/IEED/DEMD/WIL for sample IMDA agreements.

TERMS

• All terms, except for royalty, are subject to negotiation.
• The minimum royalty to the tribe will be 1/6 (16 2/3%).
• Exploration Blocks Size: 25,000 acres (negotiable)
• 5 year primary term

COVER PICTURE
Gothic Shale outcrop near Goosenecks of the San Juan River, Utah
The Ute Mountain Ute Reservation is located in southwestern Colorado/ northwestern New Mexico and lies within the hydrocarbon-bearing Paradox Basin (Figure 1). The Paradox Basin formed during Pennsylvanian time (Desmoinesian), approximately 330 to 310 million years ago. The basin is known for prolific oil fields, such as Aneth, which has produced over 440 million barrels of oil (Chidsey, et. al. SWII), and for natural gas production (Ute Dome cumulative gas: 6,930 MMCF and Barker Dome: cumulative gas: 4,741MMCF, IHS Energy).

These fields produce from the biogenic/bioclastic carbonate and algal mounds associated with the cycles of the Barker Creek, Akah, Desert Creek, and Ismay stages of the Pennsylvanian Paradox Formation. The organic-rich shales, including Chimney Rock, Gothic, and Hovenweep, that separate these carbonate reservoirs are thought to be the source of oil and gas (Figure 2 and 3).

Recent advances in technology and horizontal drilling now allow production from these low permeability shales, which were once thought to be too tight to produce. North of the Ute Mountain Ute Reservation, Bill Barrett Corporation (BBC) has claimed success in Gothic and Hovenweep shale-gas plays. Mapped shale thicknesses (up to 150’) and geochemical comparisons indicate these prospective shales extend southward from the BBC shale play area though the Ute Mountain Ute Reservation.
Geologic Comparisons between the Ute Mountain Ute Reservation and Bill Barrett Corp. Area

Nine horizontal Gothic wells and one horizontal Hovenweep well (which is currently shut-in) have been drilled by the BBC just north of the Ute Mountain Ute Reservation. The northern border of the Ute Mountain Ute Reservation is less than fifteen miles south of Barrett’s successful Gothic Koskie wells (designated the Pedro Field), and less than ten miles south of their Hovenweep test, the Gray 13-15.

Initial production (IP) rates in the Gothic Shale range from 1.5 to 4.9 MMCF/D. Barrett calculates that there is 58 BCF gas-in-place per section in the Gothic Shale based on their core studies. Currently Barrett is working on frac design and evaluating the overall commerciality of the play (Bill Barrett Corp. conversation with P. Moreland).

Isopach maps for the Gothic and Hovenweep shales (Figures 4 and 5, respectively) indicate comparable thicknesses for the two areas. A structure map of the Gothic Shale (Figure 6) indicates the Gothic is structurally deeper in the Ute Mountain Ute area. The average measured depth for a horizontal well in the BBC area is 9,100’. Laterals range from 2,700’ to 4,100’ (Bill Barrett Corp., conversation with P. Moreland). Table 1 compares the Gothic and Hovenweep shale thicknesses and true vertical drilling depths of the Barrett area and the Ute Mountain Ute Reservation. The Gothic Shale trends southeast from the Bill Barrett Play area through the eastern portion of Ute Mountain Ute Reservation. A localized thickened section, up to 60 feet thick, is located along the western margin of Ute Mountain Ute Reservation. The Hovenweep thick lies west of that of the Gothic and trends through the central portion of the reservation.

<table>
<thead>
<tr>
<th></th>
<th>Thickness (ft)</th>
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<th>TVD Depth (ft)</th>
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<td>Barrett Area</td>
<td>Ute Mountain Ute Reservation</td>
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<td>GOTHIC</td>
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<td>80-140 ft</td>
<td>5,500-5900 FT</td>
<td>5,800-8,850</td>
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<td>HOVENweep</td>
<td>80-110 ft</td>
<td>80-110 ft</td>
<td>5,500-7,500</td>
<td>5,900-8,100</td>
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Table 1. Gothic and Hovenweep shale thicknesses and drilling depths for the Bill Barrett Corp. area and the Ute Mountain Ute Reservation.
Figure 4. Gothic shale isopach map showing the locations of the Bill Barrett Corp. Gothic/Hovenweep shale exploration area and Gothic shale isopach thicks in and around the Ute Mountain Ute Indian Reservation.
Figure 5. Hovenweep shale isopach map showing the locations of the Bill Barrett Corp. Gothic/Hovenweep shale exploration area and Hovenweep shale isopach thicks within the Ute Mountain Ute Indian Reservation.
Figure 6. Gothic shale structure map showing the locations of the Bill Barrett Corp. Gothic / Hovenweep shale exploration area and the Ute Mountain Ute Indian Reservation.
Geochemical Evaluation

Geochemical analyses were conducted on cores obtained from the Barrett Play area and the Ute Mountain Ute Reservation for both the Gothic Shale and Hovenweep Shale. For the Gothic Shale two core samples were selected from the Barrett area and three core samples were obtained from the Ute Mountain Ute Reservation. For the Hovenweep Shale, one core sample was selected from the Barrett area and two core chip samples were obtained on the Ute Mountain Ute Reservation.

Weatherford Laboratories performed the geochemical analyses, including programmed pyrolysis hydrocarbon yields (S1 and S2) by Rock-Eval, total organic carbon (TOC), and vitrinite reflectance. Table 2 (Gothic Shale) and Table 3 (Hovenweep Shale) are tabulations of the geochemical analysis of the cores from the Barrett area and Ute Mountain Ute Reservation. Log characteristics, geochemical data, and core photographs for a representative sample of the Gothic Shale (located in the eastern portion of the Ute Mountain Ute Reservation) are shown in Figure 7.

### TABLE 2. Gothic Shale Geochemistry, including Total Organic Carbon, Vitrinite Reflectance, and Programmed Pyrolysis Data, for wells from the Ute Mountain Ute Reservation and the Bill Barrett Corp. Shale-Gas Play area (analysis by Weatherford Laboratories).

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Area</th>
<th>Well Name</th>
<th>Location</th>
<th>API #</th>
<th>Sample Type</th>
<th>Operator</th>
<th>Formation</th>
<th>Sample Prep</th>
<th>TOC</th>
<th>RE</th>
<th>S1</th>
<th>S2</th>
<th>S3</th>
<th>Tmax (°C)</th>
<th>Ro,%</th>
<th>HI</th>
<th>OI</th>
<th>S2/S3</th>
<th>S1/TOC</th>
<th>PI</th>
<th>Lab No</th>
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<tbody>
<tr>
<td>5988</td>
<td>Ute Mountain Ute</td>
<td>9-21 Alopecho</td>
<td>NW 9-T33 N-R20 W</td>
<td>S63</td>
<td>Core</td>
<td>Winterhawk Oil &amp; Gas</td>
<td>Gothic Shale</td>
<td>Core</td>
<td>2.05</td>
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<td>29</td>
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<td>9225</td>
<td>Bill Barre</td>
<td>1-4 Northcer Federal</td>
<td>NE 4-338 N-R22-BW</td>
<td>S909</td>
<td>Core</td>
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<td>Core</td>
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<td>4.68</td>
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<tr>
<td>5062</td>
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<td>Kieslingro Pet.</td>
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<td>S715</td>
<td>Core</td>
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<td>340</td>
<td>728394</td>
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</table>

Notes:
- "*" - not measured or invalid value for Tmax
- ** - low Tmax, Tmax is unreliable
- S1 - volatile hydrocarbon (HC) content, mg HC/g rock
- S2 - remaining HC generative potential, mg HC/g rock
- S3 - carbon dioxide content, mg CO₂/g rock
- S1/TOC - Programmed pyrolysis data by LECO
- S1/TOC - Programmed pyrolysis data by SRA
- HI - Hydrogen index = S2 x 100 / TOC, mg HC/g TOC
- OI - Oxygen index = S3 x 100 / TOC, mg CO₂/g TOC
- RE - Hydrogen index = S2 x 100 / TOC, mg HC/g TOC
- SRA - Programmed pyrolysis by SRA
- SRA - Programmed pyrolysis by SRA
- EXT - Extracted Rock
- NOPR - Normal Preparation

### TABLE 3. Hovenweep Shale Geochemistry, including Total Organic Carbon, Vitrinite Reflectance, and Programmed Pyrolysis Data, for wells from the Ute Mountain Ute Reservation and the Bill Barrett Corporation Shale-Gas Play area (analysis by Weatherford Laboratories).

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Area</th>
<th>Well Name</th>
<th>Location</th>
<th>API #</th>
<th>Sample Type</th>
<th>Operator</th>
<th>Formation</th>
<th>Sample Prep</th>
<th>TOC</th>
<th>RE</th>
<th>S1</th>
<th>S2</th>
<th>S3</th>
<th>Tmax (°C)</th>
<th>Ro,%</th>
<th>HI</th>
<th>OI</th>
<th>S2/S3</th>
<th>S1/TOC</th>
<th>PI</th>
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<td>8058</td>
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<td>1-3 F32 N-R17 W</td>
<td>#1 Mesa A</td>
<td>#1 Mesa A</td>
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<td>0.1</td>
<td>28</td>
<td>0.54</td>
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</tr>
</tbody>
</table>

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- "*" - not measured or invalid value for Tmax
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- OI - Oxygen index = S3 x 100 / TOC, mg CO₂/g TOC
- RE - Hydrogen index = S2 x 100 / TOC, mg HC/g TOC
- SRA - Programmed pyrolysis by SRA
- SRA - Programmed pyrolysis by SRA
- EXT - Extracted Rock
- NOPR - Normal Preparation

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TABLE 2. Gothic Shale Geochemistry, including Total Organic Carbon, Vitrinite Reflectance, and Programmed Pyrolysis Data, for wells from the Ute Mountain Ute Reservation and the Bill Barrett Corp. Shale-Gas Play area (analysis by Weatherford Laboratories).

TABLE 3. Hovenweep Shale Geochemistry, including Total Organic Carbon, Vitrinite Reflectance, and Programmed Pyrolysis Data, for wells from the Ute Mountain Ute Reservation and the Bill Barrett Corporation Shale-Gas Play area (analysis by Weatherford Laboratories).
The vitrinite reflectance (Ro) values for the Hovenweep Shale from wells on the Ute Mountain Ute Reservation increase from 1.10% at a depth of 5500.5’ (western portion of the reservation) to 1.46% at 8058.5’ (central/eastern portion of the reservation). These data suggest thermal maturity increases from the late oil window – condensate-wet gas generation zone to the early dry gas window with increasing depth (Weatherford, 2010), and from the western portion of the reservation toward the central-eastern portion, where the Hovenweep Shale is the thickest (see Figure 8, Ro Geochemical Log 5). Thermal Alteration Indices (TAI), which range from 3-3+ (5500’) to 4+ (8058’), support this Ro interpretation. TOC values range from 0.75 – 1.06%, indicating “fair” organic richness.

The Hovenweep Shale is classified as Type III kerogen based on TOC weight % versus S2 (remaining hydrocarbon potential) and OI (oxygen index) versus HI (hydrogen index) plots - Figures 9 and 10, respectively. Figure 11 illustrates the relationship between maturity and kerogen conversion by plotting the measured vitrinite reflectance in oil (%Ro) versus the production index (PI). A high level of conversion from the condensate-wet gas zone (western reservation) to the dry gas window (eastern) is indicated.
The Gothic Shale is considered more prospective than the Hovenweep Shale in the area of Ute Mountain Ute Reservation. Similar to the vitrinite reflectance (Ro) and TAI trends interpreted for the Hovenweep Shale, the Gothic Shale values increase with depth (Figure 8, Ro Geochemical Log 5) and toward the eastern portion of the reservation from a condensate-wet gas maturity equivalent to a thermal maturity associated with dry gas (Ro: 1.17%, 1.32%, 1.49% at 5988.8', 6141.3', and 8771.5'). This is also illustrated in Figure 11 [measured vitrinite reflectance in oil (%Ro) versus the production index (PI)] where samples from wells on the western portion of the reservation plot in the condensate-wet gas zone, while the sample from the eastern portion falls into the dry gas window. TAI increases from 3+ to 4+ with increasing depth).

The Rock-Eval Tmax values for both the Gothic and Hovenweep in the Ute Mountain Ute area were deemed unreliable by Weatherford Labs. TOC values for the Gothic Shale in the Ute Mountain Ute area range from 1.63 to 2.05%, indicating relatively good organic richness (refer to Figure 8, Geochemical Log 1).

S2 values between 2.61 to 3.26 mg HC/g rock (refer to Figure 8, Geochemical Log 2) suggest the Gothic Shale is a fair to good quality source rock, and S1 data from shallow depths along the western portion of the reservation (1.49 – 2.05 mg/g rock) indicate “the rocks have good generative capacity for liquid hydrocarbons” (Weatherford, 2010).

Figure 8. Geochemical logs; Log 1, Organic Richness – TOC weight% versus depth; Log 2, Hydrocarbon Potential – HC Potential (S2) versus depth; Log 3, Organic Matter Type – Hydrogen Index versus depth; Log 4, Normalized Oil Content – S1/TOC*100 versus depth; Log 5, Maturity - %Ro versus depth (generated by Weatherford Laboratories).
The Kerogen Quality Plot (Figure 9) depicting total organic carbon (TOC weight %) versus remaining hydrocarbon potential (S2, mg HC/g rock) and Kerogen Type Plot showing hydrogen index (HI) versus oxygen index (OI) (Figure 10) indicate Type III-gas prone and Type IV-inert. However, based on organic petrology, the Gothic Shale original organic matter type varies “from oil-prone Type II to mixed Type II-III and gas prone Type III” (Weatherford, 2010). Figure 12 shows an example of vitrinite reflectance data from a well located on the western portion of the reservation (depth: 8,771.5 ft.). This sample is interpreted as Type III kerogen with good potential for gas generation.

Original and present Hydrogen Index (HI) values, used to interpret the conversion of kerogen to petroleum, indicate that where the Ute Mountain Ute Gothic and Hovenweep shales are shallow (western portion) the rocks “still have a relatively high generative capacity, most likely for producing light oil/condensate-wet gas according to their maturity”. In areas where the Gothic Shale is the deepest (eastern portion), the Gothic is “a good source for gas production” (Weatherford, 2010).
Figure 11. Kerogen Conversion and Maturity (%Ro) - Measured Vitrinite reflectance in Oil (%Ro) versus the Production Index (PI) for samples from the Gothic Shale and Hovenweep Shale from wells located on Ute Mountain Ute Reservation (generated by Weatherford Laboratories).

Figure 12. Example of vitrinite reflectance data from a well located on the western portion of the reservation (depth: 8,771.5 ft.). This sample, Ute Mountain 44-34, is interpreted as Type III kerogen with good potential for gas generation.
Geochemical Comparisons and Gas/Oil Potential:
Ute Mountain Ute Reservation and Bill Barrett Corp. Shale-Gas Play Area

The TOC, Ro, and programmed pyrolysis data of the Gothic Shale (Table 2) and the Hovenweep Shale (Table 3) for wells on Ute Mountain Ute Reservation and Bill Barrett Corp. shale-gas exploration area are summarized in a series of five geochemical logs (Figure 13 – Gothic Shale and Figure 14 – Hovenweep Shale), which plot TOC, S2, HI, S1/TOC*100, and Ro versus depth.

Table 4 provides an independent interpretation by Weatherford Laboratories of the Gothic and Hovenweep shales’ capacity as source rock for both the BBC and Ute Mountain Ute areas. Their review of the data indicates that the Hovenweep may have better gas potential in the BBC area versus the Ute Mountain Ute Reservation. The Gothic appears marginally better for gas potential in Ute Mountain Ute area, but considerably better for liquid hydrocarbon potential when compared to the BBC area. This is especially true for the western portion of the reservation.

Figure 13. Geochemical Logs for Gothic Shale, Ute Mountain Ute Reservation and Bill Barrett Corporation Area - TOC, S2, HI, S1/TOC*100, and Ro versus Depth: (Log 1, Organic Richness – TOC weight% versus depth; Log 2, Hydrocarbon Potential – HC Potential (S2) versus depth; Log 3, Organic Matter Type – Hydrogen Index versus depth; Log 4, Normalized Oil Content – S1/TOC*100 versus depth; Log 5, Maturity - %Ro versus depth (generated by Weatherford Laboratories).
Table 4: Source Rock Evaluation of Hovenweep and Gothic Shales as interpreted by Weatherford Laboratories.

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<th>TOC (wt%)</th>
<th>Kerogen type</th>
<th>Source rock for liquid HC</th>
<th>Shale gas potential</th>
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Summary

Favorable comparisons in thicknesses, drilling depths, and geochemistry (TOC, Ro, and programmed pyrolysis data) between the Gothic and Hovenweep shales present in the area of Ute Mountain Ute Reservation with those to the north where Bill Barrett Corporation is currently drilling and completing successful, horizontal shale-gas wells indicate promising oil/gas exploration targets on the Ute Mountain Ute Reservation.

The data suggests that the Gothic Shale in the eastern portion of the reservation, which lies within the thickened section extending from the BBC area, is in the gas window. In the western portion of the reservation, the Gothic shale is more light oil/condensate-wet gas prone. The Hovenweep may be somewhat less prospective on the Ute Mountain Ute Reservation versus the BBC area. The reservation holds thousands of prospective contiguous acres. Although most of the reservation is open for exploration, there is sacred land (Sleeping Ute Mountain) where drilling is not allow (outlined in orange – Figures 4, 5, and 6) and park land where drilling restrictions may apply (outlined in purple – Figures 4, 5, and 6).

For more information on this play opportunity, please contact:

**Ute Mountain Ute Tribe**

Ute Mountain Ute Indian Reservation

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Lakewood, CO 80401