NEW MEXICO BUREAU OF MINES & MINERAL RESOURCES

A. G. Hill No. 1 Federal A Well

GeoChem Job Number 4414
August 14, 1998

NEW MEXICO BUREAU OF MINES
AND MINERALS
801 Leroy Place
Socorro, New Mexico 87801-4796

Attention: Mr. Ron Broadhead

Dear Ron:

Please find enclosed the results of the geochemical analyses, requested by you in your letter of July 30, 1998, made on one (1) sample of cuttings material collected at a depth of 4320-4450 feet in the A. G. Hill No. 1 Federal A Well, Guadalupe County, New Mexico at Sec. 27; T9N; R19E.

The sample was received August 3, 1998 and was logged in under GeoChem Job and sample number 4414-001.

The requested analyses involved measurement of total organic carbon content (TOC), Rock-Eval (R-E) pyrolysis and visual kerogen isolation and assessment of organic matter type (OMT) and determination of thermal alteration index (TAI).

The data for this sample is recorded in Tables I, II-A, II-B, III-A and III-B with the pyrogram diagram (Figure I-A) for your review. Based on this plot, one would consider that this sample represents at its current state a possibly fair oil and associated gas source based on the S, volatile and S, generatable hydrocarbon content. The Rock-Eval (R-E) data for the S2 generatable hydrocarbon yield would indicate a good remaining potential should this rock be buried deeper and have undergone a higher degree of thermal diagenesis elsewhere in this basin.

However, the organic carbon content is poor to marginally fair (0.57%; Table I), the contained organic matter is dominantly gas-prone terrestrially derived Herbaceous, Woody structured and Inertinitic (H;W;I) materials which have currently attained a Stage 2 to 2+ maturation rank (TAI=2.5) which is within the oil and associated gas generation window. The Rock-Eval (R-E) data also confirms a gas-prone character based on the S2/S3 ratio (0.37) and on the very low Hydrogen Index (51) and comparably high Oxygen Index (139).

It is my conclusion that this sample has a moderately mature to mature poor to very poor oil liquids source character with a fair gas source character.
The visual kerogen organic matter type (OMT) assessment indicated that well preserved herbaceous (H) and woody (W) structured plant remains were dominant with some inertinitic (I) content (which possibly could be reworked material). The particle size of these kerogens was very fine and it is likely this shale and contained organic material accumulated in greater water depths than would apply to an inner neritic environment which is usually characterized by this type of kerogen.

Should you have any questions about this work please call at your convenience.

Thank you for using GeoChem for this work.

Sincerely Yours,

Geoffrey S. Bayles
President
GEOCHEM LABORATORIES, INC.

GSB/kbm
Enclosures Data Report
Transmittal
Sample material

cc: Mr. Charles Reynolds, Ibis Petroleum
TABLE I
SAMPLE IDENTIFICATION AND
TOTAL ORGANIC CARBON RESULTS

<table>
<thead>
<tr>
<th>GeoChem Sample Number</th>
<th>Depth (feet)</th>
<th>Total Organic Carbon (% of Rock)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4414-001</td>
<td>4320-4450</td>
<td>0.57</td>
</tr>
</tbody>
</table>
TABLE II-A

RESULTS OF ROCK-EVAL PYROLYSIS (mg/g)

<table>
<thead>
<tr>
<th>GeoChem Sample No.</th>
<th>Client Identification</th>
<th>Qty.</th>
<th>Tmax (°C)</th>
<th>S1 (mg/g)</th>
<th>S2 (mg/g)</th>
<th>S3 (mg/g)</th>
<th>PI</th>
<th>PC*</th>
<th>T.O.C. (wt%)</th>
<th>Hydrogen Index</th>
<th>Oxygen Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>4414-001</td>
<td>4320-4450</td>
<td>99.6</td>
<td>387</td>
<td>0.19</td>
<td>0.29</td>
<td>0.79</td>
<td>0.40</td>
<td>0.04</td>
<td>0.57</td>
<td>51</td>
<td>139</td>
</tr>
</tbody>
</table>

T.O.C. = Total organic carbon, wt.%
S1 = Free Hydrocarbons, mg HC/g of rock
S2 = Residual hydrocarbon potential (mg HC/g of rock)

S3 = CO2 produced from kerogen pyrolysis (mg CO2/g of rock)
PC* = 0.083 (S1 + S2)
Hydrogen Index = mg HC/g organic carbon

Oxygen Index = mg CO2/g organic carbon

PI = S1/(S1+S2)

Tmax = Temperature Index, °C.
TABLE II-B

RESULTS OF ROCK-EVAL PYROLYSIS (ppm)

<table>
<thead>
<tr>
<th>GeoChem Sample No.</th>
<th>Client Identification</th>
<th>Qty.</th>
<th>Tmax (°C)</th>
<th>S1 (ppm)</th>
<th>S2 (ppm)</th>
<th>S3 (ppm)</th>
<th>PI</th>
<th>PC⁺</th>
<th>T.O.C. (wt%)</th>
<th>Hydrogen Index</th>
<th>Oxygen Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>4414-001</td>
<td>4320-4450</td>
<td>99.6</td>
<td>387</td>
<td>190</td>
<td>290</td>
<td>790</td>
<td>0.40</td>
<td>0.04</td>
<td>0.57</td>
<td>51</td>
<td>139</td>
</tr>
</tbody>
</table>

T.O.C. = Total organic carbon, wt.%
S1 = Free Hydrocarbons, mg HC/g of rock
S2 = Residual hydrocarbon potential (mg HC/g of rock)
S3 = CO₂ produced from kerogen pyrolysis (mg CO₂/g of rock)
PC⁺ = 0.083 (S1 + S2)
Hydrogen index = mg HC/g organic carbon
Oxygen index = mg CO₂/g organic carbon
PI = S1/(S1+S2)
Tmax = Temperature Index, °C.
### TABLE III - A

**SUMMARY OF ORGANIC CARBON AND VISUAL KEROGEN DATA**

<table>
<thead>
<tr>
<th>GEOCHEM SAMPLE NUMBER</th>
<th>DEPTH (FEET)</th>
<th>TOTAL ORGANIC CARBON</th>
<th>ORGANIC MATTER TYPE</th>
<th>VISUAL ABUNDANCE NORMALIZED PERCENT</th>
<th>ALTERATION STAGE</th>
<th>THERMAL ALTERATION INDEX</th>
</tr>
</thead>
<tbody>
<tr>
<td>4414-001</td>
<td>4320-4450</td>
<td>0.57</td>
<td>H2W:I</td>
<td>0 0 55 27 18 2 to 2+</td>
<td>2.5</td>
<td></td>
</tr>
</tbody>
</table>

**LEGEND:**

**KEROGEN KEY**

- Predominant: 60-100%
- Secondary: 20-40%
- Trace: 0-20%

- AI = Algal
- Am = Amorphous-Sapropel
- Am** = Relic Amorphous-Sapropel
- H = Herbaceous-Spore/Pollen
- H* = Degraded Herbaceous

- W = Woody-Structured
- U = Unidentified Material
- I = Inertinite
- C = Coaly
<table>
<thead>
<tr>
<th>GEOCHEM No.</th>
<th>DEPTH</th>
<th>INDIGENOUS POPULATION (INTERPRETED)</th>
<th>GENERAL CHARACTERISTICS</th>
<th>CAVED AND/OR REWORKED POPULATION(S)</th>
<th>SUMMARY ORGANIC MATTER TYPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>4414-001</td>
<td>4320-4450</td>
<td>TYPE OF ORGANIC MATTER</td>
<td>MATURATION INDEX</td>
<td>COLOR OF ORGANIC MATTER</td>
<td>STATE OF ORGANIC MATTER</td>
</tr>
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<td></td>
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<td>REMARKS</td>
<td></td>
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</tbody>
</table>

Remarks: H:W:T
APPENDIX I

Rock-Eval Pyrograms
DATE: 08-07-98    ANALYSIS    CYCLE: 4    SCALE = 1/32

INIT TEMP = 250    ISO TIME = 5    TEMP GRADIENT=25    TRAP STOP T = 390


1414-00: 99.5: 327: 0.19: 0.29: 0.79: 0.40: 0.36: 0.04: 0.57: 51: 139:

DATE: 08-07-98    ANALYSIS    CYCLE: 4    SCALE = 1/32

INIT TEMP = 250    ISO TIME = 5    TEMP GRADIENT=25    TRAP STOP T = 390


1111-100.0: 429: 0.44: 2.98: 1.62: 0.13: 1.79: 0.27: 2.89: 100: 56: