GEOLOGY AND THERMAL REGIME

OF

BERT WINN #1 GEOTHERMAL TEST,

FRANKLIN COUNTY,

IDAHO

for

SUNOCO ENERGY DEVELOPMENT CO.

DALLAS, TEXAS

by

James R. McIntyre
James B. Koenig

GeothermEx, Inc.
Berkeley, California

December 1980
DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency Thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.
DISCLAIMER

Portions of this document may be illegible in electronic image products. Images are produced from the best available original document.
<table>
<thead>
<tr>
<th>CONTENTS</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>CONCLUSIONS</td>
<td>1</td>
</tr>
<tr>
<td>RECOMMENDATIONS</td>
<td>2</td>
</tr>
<tr>
<td>LOCATION</td>
<td>3</td>
</tr>
<tr>
<td>SUMMARY OF DRILLING OPERATIONS</td>
<td>4</td>
</tr>
<tr>
<td>LOGGING</td>
<td>5</td>
</tr>
<tr>
<td>GEOLOGIC SETTING</td>
<td>7</td>
</tr>
<tr>
<td>SUMMARY GEOLOGY OF BERT WINN #1 GEOTHERMAL TEAT</td>
<td>11</td>
</tr>
<tr>
<td>Stratigraphy</td>
<td>11</td>
</tr>
<tr>
<td>Structure</td>
<td>13</td>
</tr>
<tr>
<td>TEMPERATURE DATA</td>
<td>15</td>
</tr>
<tr>
<td>FORMATION FLUIDS AND GAS OCCURRENCES</td>
<td>17</td>
</tr>
<tr>
<td>RELATIONSHIP OF BERT WINN #1 TO THE ORIGINAL PROSPECT CONCEPT</td>
<td>19</td>
</tr>
<tr>
<td>REFERENCES</td>
<td>21</td>
</tr>
</tbody>
</table>

APPENDIX

A. Detailed Sample Descriptions, Bert Winn #1

B. Baroid Mud Log, Bert Winn #1  
(to be supplied by Sunedco)
ILLUSTRATIONS

Figure

1. Chloride content of the drilling mud, Bert Winn #1 ... 17

Table

1. Summary of temperature surveys, Bert Winn #1 ........ 5

2. Stratigraphy of the Precambrian and lowermost Cambrian formations, Bannock and Portneuf Ranges, southeastern Idaho .................. 8

3. Sunedco Bert Winn #1 geothermal test, stratigraphic summary .................. 11

4. Comparison of units, Bert Winn #1 and C. H. Stocks 1-A .................. 12

Plate

1. Geologic sketch map of the Little Mountain Prospect Modified from McIntyre and Koenig, 1980) ........ in pocket

2. Summary of temperature data, Bert Winn #1 ........ in pocket

3. Geologic cross-sections A-A', B-B' ........ in pocket

4. Correlation diagram, Bert Winn #1 and C. H. Stocks 1-A ........ in pocket
CONCLUSIONS

1. Bert Winn #1 did not encounter high-temperature zones of permeability, except possibly at 5,575 to 5,700 feet, where chloride conductivity indicates saline fluid entry, and where stabilized temperature may be 210°-215°F.

2. Structurally, Bert Winn #1 appears to have penetrated into the horst footwall block, penetrating progressively away from the horst-bounding faults believed to leak hot fluids.

3. Projections based on disequilibrium temperatures taken at 24 and 36 hours suggest a stabilized maximum temperature of about 260°-265°F at 7,450. Maximum observed temperature was 243°F.

4. Geochemically, temperatures at depth should be over 300°F. On the basis of observed temperatures and gradients, 400°F might not be encountered until 12,000 feet at this site.

5. C. H. Stocks 1-A, about one mile northwest, appears to be hotter at comparable depths, and to be better located to penetrate the range-front fault set at drillable depth.

6. Bert Winn #1 was sited principally on a geoelectrical anomaly in an area of high temperature gradients. With the remote exception of the saline interval at 5,575 to 5,700 feet, no evidence was seen in drilling and logging of any feature that could serve as the source of the geoelectrical anomaly.
RECOMMENDATIONS

1. Acreage on the Little Mountain horst may be released; acreage down-dip on the eastern and western horst-bounding faults may be kept, farmed out or pooled with those of any operator willing to test this flank-fault prospect.

2. Locations for such a deep test should be sufficiently down-dip along the horst-bounding fault to yield intersection at 8,000–10,000 foot depth. Alternatively C. H. Stock 1-A may be deepened to that depth.

3. No further geoelectrical or shallow gradient surveys are warranted. Detailed gravimetry may be useful in locating the frontal faults with greater precision.
LOCATION

The Sunedco Bert Winn #1 geothermal test is located at a site 888 feet north and 396 feet east of the SW corner of Sec. 8, T. 15 S., R. 35 E., Franklin County, Idaho. The ground elevation of the hole, estimated from the topographic map, is approximately 4,615 feet. The site is an ancient river terrace cut in Quaternary fluvial and lacustrine sediments covering the floor of Cache Valley. It is approximately one mile southeast of the nearest exposures of Precambrian rocks on Little Mountain, and approximately one mile southeast of the unsuccessful Sunedco C. H. Stocks No. 1-A geothermal test, drilled to a depth of 5,479 feet in July and August 1978 (plate 1). The site can be reached from the town of Preston by traveling west on the Dayton road about 2.5 miles to Hot Springs Road and the north about 2.2 miles to the drill site.
SUMMARY OF DRILLING OPERATIONS

The drilling contractor for this hole was Brinkerhoff-Signal, using rig 15. Drilling began on April 4, 1980. Thirty-inch pipe was set at 53 feet. Twenty-six-inch hole was drilled to 344 feet and 20-inch casing set at 330 feet. Seventeen and one-half-inch hole then was drilled to 1,739 feet and 13-3/8-inch casing was set at 1,733 feet. Thereupon, a 12-1/4-inch hole was drilled from 1,733 feet to 5,575 feet, where partial lost circulation was encountered. This was followed by a total loss at 5,580 to 5,585 feet. Lost circulation material was added to the mud and the hole was drilled ahead without returns to 5,666 feet. At this depth, two Kuster wireline temperature surveys were run, and a cement plug was set to shut off the lost circulation zone. Drilling was resumed in 12-1/4-inch hole with partial losses of drilling fluid varying from 20 to 35 barrels per hour, principally or totally in a zone at about 5,585 feet.

An additional fluid loss of about 100 barrels occurred at 7,203 feet. This was cured by addition of lost circulation material to the mud. Drilling continued to 7,444 feet, where 3 Kuster wireline temperature surveys were run. Drilling then resumed to a depth of 7,981 feet, at which depth Schlumberger surveys were run as indicated below. The well then was filled with light mud and suspended. The rig was released on June 15, 1980, the 72nd day of drilling operations.
The following logs were run:

1. **Geophysical Logs**

<table>
<thead>
<tr>
<th>CONTRACTOR</th>
<th>LOG TYPE</th>
<th>RUN NO.</th>
<th>DATE</th>
<th>INTERVAL (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Schlumberger</td>
<td>Dual Induction</td>
<td>1</td>
<td>6/14/80</td>
<td>1,733-7,967</td>
</tr>
<tr>
<td></td>
<td>Compensated Neutron-</td>
<td>1</td>
<td>6/14/80</td>
<td>1,733-7,967</td>
</tr>
<tr>
<td></td>
<td>Formation Density-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Gamma Ray-Caliper</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. **Temperature Surveys**

<table>
<thead>
<tr>
<th>CONTRACTOR</th>
<th>LOG TYPE</th>
<th>RUN NO.</th>
<th>DATE/TIME</th>
<th>TIME SINCE CIRCULATION</th>
<th>INTERVAL (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cable Well Servicing</td>
<td>Kuster</td>
<td>1</td>
<td>5/11/80; 1300-1540</td>
<td>11-13 1/2 hr.</td>
<td>500-5,650</td>
</tr>
<tr>
<td>Prueett*</td>
<td>Kuster</td>
<td>1</td>
<td>6/7/80; 0816-1111</td>
<td>9 hr. 41 min.</td>
<td>1,000-7,450</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>6/7/80; 2100-2350</td>
<td>22 hr. 25 min.</td>
<td>1,000-7,450</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
<td>6/8/80; 0853-1127</td>
<td>34 hr. 18 min.</td>
<td>1,000-7,450</td>
</tr>
<tr>
<td>Schlumberger</td>
<td>High resolution thermometer</td>
<td>1</td>
<td>6/13-14/80; 2230-0130</td>
<td>6 hr. 28 min.</td>
<td>200-7,922</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>6/14/80; 1400-1700</td>
<td>21 hr. 28 min.</td>
<td>200-7,970</td>
</tr>
</tbody>
</table>

*Wireline temperature survey data are compiled in table 1.
Table 1. Summary of temperature surveys, Bert Winn #1.

Surveys of 5/11/80: Kuster Wireline; Cable Company, contractor
Surveys of 6/7 and 6/8/80: Kuster Wireline; Pruett Company, contractor

<table>
<thead>
<tr>
<th>Depth, feet</th>
<th>5/11/80, RUN 1 (11 hrs. after circ.)</th>
<th>5/11/80, RUN 2 (14 hrs. 30 min. after circ.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>500</td>
<td>61.9</td>
<td>62.5</td>
</tr>
<tr>
<td>1,000</td>
<td>81.4</td>
<td>82.2</td>
</tr>
<tr>
<td>1,500</td>
<td>143.7</td>
<td>148.1</td>
</tr>
<tr>
<td>2,000</td>
<td>146.5</td>
<td>148.9</td>
</tr>
<tr>
<td>2,500</td>
<td>177.4</td>
<td>176.7</td>
</tr>
<tr>
<td>3,000</td>
<td>170.0</td>
<td>170.0</td>
</tr>
<tr>
<td>3,500</td>
<td>166.3</td>
<td>167.7</td>
</tr>
<tr>
<td>3,600</td>
<td>165.1</td>
<td>167.8</td>
</tr>
<tr>
<td>3,700</td>
<td>164.7</td>
<td>167.9</td>
</tr>
<tr>
<td>3,800</td>
<td>164.9</td>
<td>168.1</td>
</tr>
<tr>
<td>3,900</td>
<td>165.2</td>
<td>168.6</td>
</tr>
<tr>
<td>4,000</td>
<td>165.8</td>
<td>169.2</td>
</tr>
<tr>
<td>4,100</td>
<td>166.5</td>
<td>170.1</td>
</tr>
<tr>
<td>4,200</td>
<td>167.4</td>
<td>171.1</td>
</tr>
<tr>
<td>4,300</td>
<td>168.5</td>
<td>172.4</td>
</tr>
<tr>
<td>4,400</td>
<td>169.8</td>
<td>173.6</td>
</tr>
<tr>
<td>4,500</td>
<td>171.1</td>
<td>174.7</td>
</tr>
<tr>
<td>4,600</td>
<td>172.6</td>
<td>176.0</td>
</tr>
<tr>
<td>4,700</td>
<td>174.5</td>
<td>178.0</td>
</tr>
<tr>
<td>4,800</td>
<td>176.2</td>
<td>180.1</td>
</tr>
<tr>
<td>4,900</td>
<td>176.4</td>
<td>181.2</td>
</tr>
<tr>
<td>5,000</td>
<td>176.3</td>
<td>182.9</td>
</tr>
<tr>
<td>5,050</td>
<td>176.0</td>
<td>184.2</td>
</tr>
<tr>
<td>5,100</td>
<td>176.5</td>
<td>184.9</td>
</tr>
<tr>
<td>5,150</td>
<td>176.5</td>
<td>185.0</td>
</tr>
<tr>
<td>5,200</td>
<td>176.7</td>
<td>185.3</td>
</tr>
<tr>
<td>5,250</td>
<td>177.0</td>
<td>185.1</td>
</tr>
<tr>
<td>5,300</td>
<td>177.0</td>
<td>185.6</td>
</tr>
<tr>
<td>5,350</td>
<td>176.3</td>
<td>185.7</td>
</tr>
<tr>
<td>5,400</td>
<td>176.5</td>
<td>186.5</td>
</tr>
<tr>
<td>5,450</td>
<td>176.7</td>
<td>187.0</td>
</tr>
<tr>
<td>5,500</td>
<td>177.6</td>
<td>187.3</td>
</tr>
<tr>
<td>5,550</td>
<td>179.1</td>
<td>192.1</td>
</tr>
<tr>
<td>5,600</td>
<td>183.3</td>
<td>206.5</td>
</tr>
<tr>
<td>5,650</td>
<td>197.0 (after 28 min. on bottom)</td>
<td>209.1 (after 20 min. on bottom)</td>
</tr>
</tbody>
</table>

Time at each station was 3 minutes, except on bottom as noted.
<table>
<thead>
<tr>
<th>Depth, feet</th>
<th>T, °F</th>
<th>Time</th>
<th>T, °F</th>
<th>Time</th>
<th>T, °F</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,000</td>
<td>158.9</td>
<td>0828</td>
<td>169.03</td>
<td>2110</td>
<td>173.80</td>
<td>0853</td>
</tr>
<tr>
<td>2,000</td>
<td>173.95</td>
<td></td>
<td>176.83</td>
<td></td>
<td>176.61</td>
<td></td>
</tr>
<tr>
<td>3,000</td>
<td>166.0</td>
<td></td>
<td>172.06</td>
<td></td>
<td>174.66</td>
<td></td>
</tr>
<tr>
<td>4,000</td>
<td>170.6</td>
<td></td>
<td>179.43</td>
<td></td>
<td>183.33</td>
<td></td>
</tr>
<tr>
<td>4,500</td>
<td>174.78</td>
<td></td>
<td>185.50</td>
<td></td>
<td>189.40</td>
<td></td>
</tr>
<tr>
<td>5,000</td>
<td>179.59</td>
<td></td>
<td>190.48</td>
<td></td>
<td>195.68</td>
<td></td>
</tr>
<tr>
<td>5,250</td>
<td>182.1</td>
<td></td>
<td>193.08</td>
<td></td>
<td>199.36</td>
<td></td>
</tr>
<tr>
<td>5,400</td>
<td>183.15</td>
<td></td>
<td>193.95</td>
<td></td>
<td>200.88</td>
<td></td>
</tr>
<tr>
<td>5,500</td>
<td>184.62</td>
<td></td>
<td>194.81</td>
<td></td>
<td>203.91</td>
<td></td>
</tr>
<tr>
<td>5,700</td>
<td>185.24</td>
<td></td>
<td>195.68</td>
<td></td>
<td>205.0</td>
<td></td>
</tr>
<tr>
<td>5,800</td>
<td>185.87</td>
<td></td>
<td>197.85</td>
<td></td>
<td>206.73</td>
<td></td>
</tr>
<tr>
<td>5,900</td>
<td>188.38</td>
<td></td>
<td>201.10</td>
<td></td>
<td>207.92</td>
<td></td>
</tr>
<tr>
<td>6,500</td>
<td>195.91</td>
<td></td>
<td>210.41</td>
<td></td>
<td>217.92</td>
<td></td>
</tr>
<tr>
<td>7,000</td>
<td>197.79</td>
<td></td>
<td>215.37</td>
<td></td>
<td>223.23</td>
<td></td>
</tr>
<tr>
<td>7,205</td>
<td>200.31</td>
<td></td>
<td>218.98</td>
<td></td>
<td>226.20</td>
<td></td>
</tr>
<tr>
<td>7,300</td>
<td>204.07</td>
<td></td>
<td>222.16</td>
<td></td>
<td>230.87</td>
<td></td>
</tr>
<tr>
<td>7,400</td>
<td>211.76</td>
<td></td>
<td>229.60</td>
<td></td>
<td>236.81</td>
<td></td>
</tr>
<tr>
<td>7,450</td>
<td>211.95</td>
<td>1021</td>
<td>230.23</td>
<td>2257</td>
<td>238.51</td>
<td>1054</td>
</tr>
<tr>
<td>7,450</td>
<td>212.95</td>
<td>1036</td>
<td>233.84</td>
<td>2312</td>
<td>242.55</td>
<td>1109</td>
</tr>
<tr>
<td>7,450</td>
<td>214.33</td>
<td>1051</td>
<td>234.69</td>
<td>2327</td>
<td>242.97</td>
<td>1124</td>
</tr>
<tr>
<td>7,450</td>
<td>215.72</td>
<td>1106</td>
<td>235.54</td>
<td>2342</td>
<td>242.97</td>
<td>1127</td>
</tr>
<tr>
<td>7,450</td>
<td>216.32</td>
<td>1111</td>
<td>235.75</td>
<td>2350</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

1 12 hr. 36 min. after circulation broken.
2 24 hr. 22 min. after circulation broken.
3 36 hr. 52 min. after circulation broken.
3. Mud Logging

A Bariod mud logging unit was in operation from a depth of 530 feet to total depth of 7,981 feet. A copy of the mud log is included as Appendix B.
GEOLOGIC SETTING

An outline of the geologic history of the area appeared in the report covering the drilling of the Sunedco C. H. Stocks I-A well (McIntyre and Koenig, 1978). This summary is repeated here, including revisions that have been made in Precambrian stratigraphy since that report was written.

The Preston prospect is located in the northern end of Cache Valley, a major graben of Late Cenozoic age near the northeastern edge of the Basin and Range Province. The graben floor is covered by dissected Pleistocene lacustrine sediments, which overlay a thick Late Tertiary tuffaceous sequence of fluvial and lacustrine origin. Pre-Cenozoic rocks, ranging from Precambrian to Middle Paleozoic age, are well-exposed in the flanking Bear River Range to the east, the Bannock Range to the west, and in small intra-valley horsts, such as Little Mountain on which the prospect is located.

Three assemblages of Precambrian rocks are present in the region. The oldest of these consists of the Farmington "complex" of the northern Wasatch Mountains and Antelope Island, 50 to 150 miles south of the Preston area, and the Green Creek "complex" of the Raft River-Albion Ranges, 90 to 100 miles west of Cache Valley. The Farmington complex is about 90% granitic gneiss, with about 5% amphibolite and pegmatite. Near Ogden, Utah, the gneiss and migmatite contain quartz, microcline, sodic plagioclase, biotite and variable hornblende and almandite. The few available radiometric dates range from 1.6 to 1.8 billion years (Condie, 1969). On Antelope Island, Utah, rocks assigned to the Farmington complex consist of more than 20,000 feet of quartz-feldspathic schist, microcline schist, quartz schist and metaquartzite. No detailed descriptions of the sequences are available.

The Green Creek complex of the Albion Range consists of three main rock types: (1) porphyritic adamellite to quartz dioritic gneiss; (2) dark-colored biotite-quartz-oligoclase schist; and (3) hornblende-andesine-quartz amphibolite. They have been dated as 2.5 to 2.7 billion years old (Armstrong, 1968). Although the metamorphic history in each area is different, the oldest Precambrian rocks are characterized everywhere by their relatively high metamorphic grade.

The middle assemblage of Precambrian rocks consists of several thousand feet of sedimentary and local basic volcanic rocks, characteristically metamorphosed to the greenschist stage. These rocks are exposed extensively in the Bannock and Portneuf Ranges and in Little Mountain. They are assigned to the Pocatello Formation. Equivalent rocks also are present in the northern Wasatch Mountains and southern
Promontory Range in adjacent parts of Utah. The base of the Pocatello Formation is not exposed in southeastern Idaho, but it has been observed to rest unconformably on the Farmington "complex" at Fremont Island, Utah, and elsewhere. The Pocatello Formation stratigraphy has undergone revision since its redefinition by Trumble (1976). A summary of the units is given in table 2, derived from Crittenden (1971), Link et al. (1980) and Trumble (1976). Unfortunately, no detailed stratigraphic sections have been published to assist in defining the complex relationships between the various rock types in the Pocatello Formation, particularly lateral facies changes.

Late Precambrian rocks are also present in the Raft River-Albion Range area, unconformably overlying the Green Creek complex. The section there is complicated by local metamorphic facies and by intense deformation. The base of the section in the Albion Range consists of about 800 feet of the Elba Quartzite, a vitreous white quartzite with thin interbeds of quartz-muscovite schist. In the Raft River Range, some of this quartzite is colored bright green by chromium-bearing muscovite (fuchsite). The Elba Quartzite is overlain by quartz-mica schist, quartzite, quartz-amphibole schist, graphitic garnet-staurolite schist and marble. The stratigraphic relationship of this assemblage to the Pocatello Formation and overlying younger quartzite of southeastern Idaho is not known. The unusually high metamorphic grade found in the Albion-Raft River area rocks, compared to the greenschist stage found in the Pocatello Formation, reportedly is due to their association with the development of a mantled gneiss dome in Late Mesozoic time (Armstrong and Hansen, 1966).

The third and youngest sequence of Precambrian rocks in the project area consists of thick quartzite containing minor amounts of argillite and a single limestone unit. Quartzites of this age and type are widely distributed in the eastern Basin and Range Province. The character of the local section is summarized in table 2. Its distinguishing features are (1) low metamorphic grade, and (2) the predominance of pure quartzite units, compared to the abundance of argillaceous, silty and volcanic material found in the Pocatello Formation.

The depositional configuration of Late Precambrian rocks resembles that of the overlying Paleozoic rocks, with great thicknesses present in a belt extending from southern Nevada and southeastern California northeastward through western Utah, eastern Nevada and southeastern Idaho. To the east of this zone, in Wyoming and eastern Utah, except for the Unita Mountains, these rocks are thin or absent.

During Paleozoic and Early Mesozoic time, as much as 50,000 feet of limestone, dolomite, minor quartzite and shale was deposited
<table>
<thead>
<tr>
<th>Generalized Lithology</th>
<th>Thickness (Feet)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>GIBSON JACK FORMATION (Lower Cambrian)</td>
<td>1,000 +</td>
<td>Siltstone, argillaceous with argillite and minor sandstone or quartzite, brown, tan, olive to grey-green</td>
</tr>
<tr>
<td>CAMELBACK MOUNTAIN QUARTZITE (Lower Cambrian and Precambrian?)</td>
<td>3,500 +</td>
<td>Quartzite, white, weathers tan to brown; thick-bedded to massive</td>
</tr>
<tr>
<td>MUTUAL FORMATION (Precambrian)</td>
<td>3,000 +</td>
<td>Quartzite, light to dark grey-red and purple-black; coarse-grained to conglomeratic; interbedded with argillite members up to 200 feet thick, dark red and locally olive</td>
</tr>
<tr>
<td>INKOM FORMATION</td>
<td>800 - 2,300</td>
<td>Argillite grey-red to rust; phyllite or argillite, green; with minor fine-grained quartzite and micaceous quartzite</td>
</tr>
<tr>
<td>CADDY CANYON QUARTZITE</td>
<td>6,500 +</td>
<td>Argillite and siltite, greenish; interbedded with quartzite</td>
</tr>
<tr>
<td>Quartzite interbedded with argillite, pink, purple and maroon</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dolomite or limestone (501±)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quartzite, weathers white to tan, vitreous, locally thick-bedded; with minor interbedded green argillite</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PAPOOSE CREEK FORMATION</td>
<td>1,800 +</td>
<td>Siltite and very fine-grained quartzite, grey and brown mottled</td>
</tr>
<tr>
<td>BLACKROCK CANYON LIMESTONE</td>
<td>several hundred feet</td>
<td>Limestone, grey interbedded with minor quartzite and variegated argillite</td>
</tr>
<tr>
<td>Upper Member POCATELLO FORMATION</td>
<td>2,000 +</td>
<td>Argillite, black, phyllitic, graphitic; with interbedded quartzite in the upper part</td>
</tr>
<tr>
<td>Sandstone, siltstone, and marble, white (25')</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scout Mountain and Bannock Volcanic members</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scout Mountain and &quot;several thousand feet thick&quot;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SANDSTONE, LAMINATED; INTERBEDDED WITH LIMESTONE, LAMINATED; LOCALLY THICK DIAIMICTITE UNITS: INTERTONGUES WITH BASIC PORPHYRITIC AND AMYGDALOIDAL FLOWS AND PYROCLASTICS; LOCALLY INTRUDED BY DIABASE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Base not seen in SE Idaho; rests on Farmington Complex in Utah</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FARMINGTON COMPLEX</td>
<td>Gneiss and amphibolite</td>
<td></td>
</tr>
</tbody>
</table>
in the axial part of the Cordilleran geosyncline of eastern Nevada-western Utah-southeastern Idaho. In the same period, only about 6,000 to 10,000 feet of equivalent materials accumulated on the Wyoming-eastern Utah shelf area. The zone of thickening between the shelf and the miogeosyncline (hinge zone) appears to have exercised an important control on structures formed later, in the Laramide and Sevier orogenies (Armstrong and Oriel, 1965).

Commencing in Jurassic time, the depositional axis shifted eastward across the hingeline zone, probably as a response to uplift and deformation in the old basin area to the west. In Cretaceous time, this wave of compressional deformation and uplift passed eastward across the hingeline zone, while the depositional axis of the Cretaceous seas migrated into Wyoming and eastern Utah, in front of the deformational zone. The major structures of this episode are an arcuate series of subparallel anticlines and synclines cut by major low-angle thrust faults. The thrust fault closest to the Preston prospect lies along the east side of the Bear River Range, and dips to the west at a low angle. The location of the root zone of this thrust relative to the prospect area is uncertain. Widely differing alternatives suggest that the older Precambrian (Pocatello) rocks are in the footwall zone, or that the thrust may actually pass beneath them. The extensive exposures of Precambrian rocks in the Bannock Range, west of Cache Valley, show low-angle shear zones. However, overturning or major thrusts have not been detected there.

The Early Cenozoic history of the Cache Valley area is poorly known, as no deposits of this age have been identified. Probably it was an upland area subjected to extensive erosion. Later, perhaps as early as late Miocene time, the onset of Basin-and-Range faulting created an extensive basin in the region. Large amounts of tuffaceous fluvial and lacustrine clays, sands and gravels were deposited here. As much as 7,000 to 8,000 feet of these sediments, referred to the Salt Lake Formation, may be preserved in some parts of Cache Valley. The tuffaceous material in this section may be derived from volcanism in the Snake River Plain (S. Oriel, 1978, oral communication).

The climax of Basin-and-Range faulting appears to have occurred in late Pliocene time. No recent faulting has been reported in Cache Valley, although there has been historic seismicity in Malad Valley, to the west. The most important structures of this period are the north-trending normal faults separating the Cache Valley graben from the Bannock and Bear River Range horst bounding it on the west and east, respectively. The displacement on each of these fault systems may be 8,000 to 10,000 feet in areas of greatest movement. Both the horsts and grabens are cut by subsidiary faults. One of the most important secondary structures
is the Little Mountain horst complex, within the Cache Valley graben. The trend of faults associated with this feature is to the northwest, oblique to the main range-front faults (plate 1). In addition, a long, poorly defined lineament has been noted on ERTS imagery (Mitchell, 1976). This feature trends east-northeast along the Bear River near Preston. The structural significance of this feature is uncertain from the data now available.

Structural lowlands formed during Basin-and-Range faulting are either closed basins, or parts of larger closed basin complexes which were covered by lakes during parts of Quaternary time. At that time, Cache Valley was occupied by an arm of Lake Bonneville into which the Bear River built a delta of silts and gravels reaching a local thickness of several hundred feet. Changes in local base-level in the Lake Bonneville-Great Salt Lake drainage system have caused the Bear River to dissect this fill and cut prominent terraces in northern Cache Valley, near the well site.

The Quaternary history of the region includes the extrusion of basalt in Gem Valley and basalt flows and rhyolite domes in the Blackfoot lava field and the Snake River Plain, to the north of Cache Valley. However, Cenozoic volcanic rocks are absent from the prospect area, with the exception of small lamprophyric intrusions in the Salt Lake Formation south of Oneida narrows, and a lava flow or sill under Cache Valley, between Cornish and Lewiston, Utah (Mitchell, 1976). Small basalt dikes of unknown age occur south of Twin Lakes Reservoir in Little Mountain and in Five-Mile Canyon, near Dayton, Idaho.
SUMMARY GEOLOGY OF BERT WINN #1 GEOTHERMAL TEST

Stratigraphy

Detailed descriptions of cuttings appear as Appendix A to this report. The Baroid mud log is appendix B. A summary of this log can be found in table 3. Rock and mineral identifications are based on detailed study with a binocular microscope.

The well commenced drilling in non-lithified gravel, silt and sand deposited during the Provo stage of Quaternary Lake Bonneville (Oriel and Platt, 1968). Sampling did not begin until a depth of 350 feet. At this point, the well had already entered Precambrian rocks. Thus, the Quaternary sediments are less than 350 feet thick. It is probable that these sediments rest directly on Precambrian rocks and that the Tertiary Salt Lake Formation is absent at this site.

From some depth shallower than 350 feet, the well continued in Precambrian metamorphic rocks to the total depth of 7,981 feet. Four main assemblages are identified (table 3). The character of these units is summarized below, in the order in which they were penetrated. It should be noted that the intervals given are drilled thickness; the dip of the rocks is unknown and thus the true stratigraphic thickness cannot be determined.

Unit 1 (less than 350 feet to 4,390± feet). This interval consists of interbedded, weakly-foliated chlorite-albite-calcite green-schist, albite-actinolite metadiabase, quartzite and gray phyllite. The metadiabase and greenschist units have a similar gamma ray log character and are readily identified on this log. Intervals containing a high percentage of phyllite are characterized by rapid alternation from high to surprisingly low resistivity in both Units I and II. The greenschist is of uncertain origin. It may be an altered basic volcanic rock, or a metadiabase in which the characteristic texture has been destroyed. Those units with a distinctly diabasic relict texture are in the intervals 730-980, 1,020-1,050, 1,140-1,250, 1,500-1,640, 1,710-1,730 and 3,390-3,520 feet. The base of the interval has been picked on the gamma ray log as being the base of the lowest thick greenschist unit, at about 4,440 feet. Below this point, phyllite and quartzite are the dominant lithologic types, greenschist is present only in minor amounts and no metadiabase was recognized.

Unit II (4,390± to below 5,585 feet). The rocks in this interval consist of interbedded, well-foliated sericite-chlorite phyllite or schist, more-or-less-graphitic gray phyllite, light-gray phyllite or
<table>
<thead>
<tr>
<th>DEPTH (ft.)</th>
<th>LITHOLOGY</th>
<th>SUMMARY DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>No samples</td>
<td><strong>No data</strong></td>
<td>Greenschist, poorly-foliated to non-foliated (chlorite-albite-muscovite-biotite-quartz?) with minor phyllite and quartzite</td>
</tr>
<tr>
<td>500</td>
<td>330</td>
<td>Metadiabase(?) (albite-actinolite-chlorite-calcite)</td>
</tr>
<tr>
<td>1,000</td>
<td>440</td>
<td>Phyllite, greenschist and quartzite</td>
</tr>
<tr>
<td>1,500</td>
<td>460</td>
<td>Greenschist and phyllite</td>
</tr>
<tr>
<td>2,000</td>
<td>577</td>
<td>Phyllite and quartzite</td>
</tr>
<tr>
<td>2,500</td>
<td>4419</td>
<td>Greenschist, weakly foliated to non-foliated</td>
</tr>
<tr>
<td>3,000</td>
<td>4920</td>
<td>Phyllite and quartzite</td>
</tr>
<tr>
<td>3,500</td>
<td>4350</td>
<td>Greenschist, as above, very calcareous</td>
</tr>
<tr>
<td>4,000</td>
<td>4360</td>
<td>Greenschist, weakly foliated, granular, very calcareous</td>
</tr>
<tr>
<td>4,500</td>
<td>4340</td>
<td>Phyllite and quartzite</td>
</tr>
<tr>
<td>5,000</td>
<td>4320</td>
<td>Greenschist, as above</td>
</tr>
<tr>
<td>5,500</td>
<td>4560</td>
<td>Phyllite, greenschist, and quartzite</td>
</tr>
<tr>
<td>6,000</td>
<td>5660</td>
<td>Greenschist, chlorite-sericite, foliated</td>
</tr>
<tr>
<td>6,500</td>
<td>5670</td>
<td>Phyllite, graphitic</td>
</tr>
<tr>
<td>7,000</td>
<td>5690</td>
<td>Greenschist, as above</td>
</tr>
<tr>
<td>7,280</td>
<td>5730</td>
<td>Quartzite, fine to medium grained, white, trace of disseminated pyrite, occasional laminae of phyllite or fine grained sericite schist, light grey</td>
</tr>
</tbody>
</table>

**Quaternary-Precambrian contact above 330'**

---??-??---??-??---??

<table>
<thead>
<tr>
<th>AGE AND CORRELATION</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Quaternary-Precambrian</td>
<td></td>
</tr>
<tr>
<td>Subordinate phyllite and quartzite, with</td>
<td></td>
</tr>
<tr>
<td>several metadiabase intrusives. Scout</td>
<td></td>
</tr>
<tr>
<td>Mountain member(?) (6,060')*</td>
<td></td>
</tr>
<tr>
<td>Phyllite-quartzite</td>
<td></td>
</tr>
<tr>
<td>(includes graphitic phyllite-sericite</td>
<td></td>
</tr>
<tr>
<td>schist and chlorite-sericite greenschist)</td>
<td></td>
</tr>
<tr>
<td>Scout Mountain member? (1,210')*</td>
<td></td>
</tr>
<tr>
<td>Boundary uncertain</td>
<td></td>
</tr>
<tr>
<td>Unit III</td>
<td></td>
</tr>
<tr>
<td>Marble</td>
<td></td>
</tr>
<tr>
<td>phyllite-sericite schist and greenschist</td>
<td></td>
</tr>
<tr>
<td>with marble and dolomite marble</td>
<td></td>
</tr>
<tr>
<td>(270')*</td>
<td></td>
</tr>
<tr>
<td>Unit IV</td>
<td></td>
</tr>
<tr>
<td>Quartzite</td>
<td></td>
</tr>
<tr>
<td>quartzite, white, vitreous, with a</td>
<td></td>
</tr>
<tr>
<td>trace of phyllite/sericite schist</td>
<td></td>
</tr>
<tr>
<td>partings (2,110')*</td>
<td></td>
</tr>
</tbody>
</table>

#Penetrated thickness. Relationship to true stratigraphic thickness unknown
fine-grained schist, and quartzite. The graphitic phyllite samples appear to correspond to intervals of low resistivity on the Schlumberger log. Lost circulation was encountered from 5,585 feet to 5,700 feet covering the contact between units II and III.

Unit III (above 5,605(?) to 5,870 feet). Calcite and dolomite marble, interbedded with minor phyllite or fine sericite schist and quartzite occur in this unit. The marble is tan to gray and finely crystalline. The dolomitic intervals contain micro-vugs. Based on the compensated neutron-formation density log, the marble-bearing unit extends at least as high as 5,605 feet. Rapid drilling rates indicate that the most porous part of the section is in the intervals 5,575-5,580, 5,580-5,592, 5,598-5,661 and 5,615-5,619 feet. The fluid losses seem most likely to have occurred in fractures, but their relationship to the marble intervals of Unit III suggests that solution cavity porosity may also be present.

Unit IV (5,820± to 7,981 feet). The deepest unit penetrated is a remarkably homogeneous white quartzite, containing a small amount of light-gray phyllite or fine-grained sericite schist, which is present as thin partings. The quartzite itself is slightly calcareous and may contain a few calcite-filled microfractures. The bottom of the unit was not reached at TD. One thin zone of partial lost circulation occurred at 7,203 feet, probably in an open fracture.

Rock types characteristic of Units I, II and III are recognizable in Sunedco C. H. Stocks l-A, drilled in 1978, but it does not appear that Unit IV was reached in that hole. The differences in unit thickness between the holes may be due to differences in dip at the two sites. Some of the differences in lithologic detail result from the poor and unrepresentative quality of the cuttings from a large section of the Stocks well. Possible interval correlations between the two holes are shown in table 4 and plate 4, based on sample logs augmented by resistivity and gamma ray logs.

Correlations between the section seen in Bert Winn #1 and the regional Precambrian section are speculative and yield several radically different interpretations. There is a reasonable assurance that the greenschist-metadiabase sequence in Unit I is correlative with the Scout Mountain-Bannock Volcanic member of the Pocatello Formation. However, underlying Units II, III and IV do not correspond to rock types reported from the Scout Mountain member in the few areas where its basal part has been observed. Units II, III and IV also seem to be of a lower metamorphic grade and a somewhat different bulk composition than the older Precambrian of the Farmington and Green Creek complexes. They may be equivalent to quartzite and schists of the Elba Quartzite and overlying schists and marbles, seen in the Albion Range, but the relationship of
Table 4. Comparison of Precambrian Lithologic Units, Sunedco Bert Winn #1 and C. H. Stocks 1-A.

<table>
<thead>
<tr>
<th>Unit</th>
<th>Bert Winn #1 Interval, ft</th>
<th>apparent thickness, ft</th>
<th>C. H. Stocks 1-A Interval, ft</th>
<th>apparent thickness, ft</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>&lt;350 to 4,390±</td>
<td>&gt;4,040</td>
<td>2,150± to 3,740±</td>
<td>&gt;1,590</td>
</tr>
<tr>
<td>II</td>
<td>4,390± to &gt;5,585</td>
<td>&gt;1,195</td>
<td>3,740± to 5,120 or 5,260</td>
<td>1,380± or 1,520±</td>
</tr>
<tr>
<td>III</td>
<td>5,605(?) to 5,870</td>
<td>265±</td>
<td>5,120 or 5,260 to &gt;5,340</td>
<td>&gt;80± or &gt;220</td>
</tr>
<tr>
<td>IV</td>
<td>5,870 to &gt;7,981 (base not reached)</td>
<td>&gt;2,111</td>
<td>not reached</td>
<td>-</td>
</tr>
</tbody>
</table>
the Albion Range section to the Pocatello Group has not been established. Finally, in some respects, the sequence below Unit I resembles the upper member of the Pocatello Formation and the younger Precambrian limestone and quartzite overlying it (table 2). Correlation with this sequence would indicate that the well section is overturned or overthrust! At present there appears to be no means of determining which of the several interpretations is correct; and it appears to be relatively unimportant to the geothermal prospect to resolve the question. From the point of view of reservoir potential, all of the Precambrian rocks are likely to respond equally well to fracturing under tensional stress; only marble units may show appreciable solution porosity. Therefore, no specific lithologic objectives are identified by geologic mapping or drilling here.

Structure

Bert Winn #1 is located on a buried extension of the Little Mountain horst, within the Cache Valley graben. Several normal faults have been identified on the flanks and within the block on the basis of surface geology, drainage lineaments, gravity, and subsurface data (plates 1 and 3). Direct evidence of faulting encountered in the hole is limited to lost circulation in the interval from 5,575 to 5,700 feet and at 7,203 feet. The amount of offset in these zones is uncertain, and they do not appear to represent any of the faults known or projected from other data.

GeothermEx's report on C. H. Stocks 1-A (McIntyre and Koenig, 1978) interpreted structure from that deep hole, plus several shallower gradient holes and a regional gravity survey. A re-interpretation of structure in the area has been made on the basis of the additional data from Bert Winn #1. The new interpretation (plate 3) yields a more coherent picture.

A comparison of the section in Bert Winn #1 with that in the C. H. Stocks No. 1 deep gradient hole and the C. H. Stocks 1-A deep geothermal test confirms that C. H. Stocks 1-A is separated from the other two holes by a westward-dipping fault trending slightly west of north. The displacement on this fault at the top of the Precambrian-Cenozoic unconformity is about 1,800 feet.

Correlations between the wells in the Precambrian section are too poor to indicate conclusively the nature of the pre-fault structure. As indicated in the discussion of the stratigraphic section, there is some possibility that the section in both deep tests is overturned. Low-angle shear zones reported to occur in the Bannock Range to the west have not been identified in the wells.
Neither Bert Winn #1 nor C. H. Stocks 1-A was located to test for cells of convective geothermal fluids in the major fault zones present on the west or, particularly, on the east side of the Little Mountain horst. Of the interior faults, only one dips toward the Bert Winn site (plate 3). If a dip of 60° is assigned to that fault plane, Bert Winn #1 would have intercepted it at a depth of about 10,000 feet. With a steeper dip, the intersection would be significantly deeper. There is no evidence thus far that faults within the horst are as significant to geothermal prospecting as the boundary faults are likely to be.
TEMPERATURE DATA

All of the temperature data from Bert Winn #1 have been compiled on plate 2. It can be seen from the Schlumberger temperature run #2 that the temperature increased 93°F from the surface to 200 feet, giving a shallow gradient averaging about 46°F/100 feet. The gradient from 200 to 650 feet, where a temperature of 169°F was obtained, averaged about 6°F/100 feet. The temperature at the bottom of the hole on this log run was 220°F. This yielded an average gradient of only about 0.7°F/100 feet, but this clearly was a disequilibrium condition. However, there were no clearly-defined gradient changes in the areas of lost circulation at 5,575 to 5,700 feet, 7,203 feet, or elsewhere, which indicated that no fluids strongly out of temperature equilibrium with the mud had been encountered. The gradient at the bottom of the hole, excluding the bottom-hole effect, appears to be about 0.3°F/100 feet. Again this is a disequilibrium condition.

The maximum temperature recorded at the total depth of 7,981 feet, 24 hours and 28 minutes after breaking circulation, was 220°F. Thirty-six hours and 52 minutes after breaking circulation, temperature at 7,450 feet (deepest probe penetration) was 243°F and still rising at almost 1°F/hour. A maximum stabilized temperature, after about 100 hours, is projected to be 260°-265°F. The gradient in the zone from 5,900 to 7,450 feet is highly irregular, but may average just over 2°F/100 feet. From these temperature logs, a gradient of 0.3°F/100 feet correlates to a drilling depth greater than 20,000 feet to reach a temperature of 400°F! However, with a gradient of 2°F/100 feet, drilling would have to reach 15,000 feet to obtain 400°F; and using an anticipated maximum of 260°-265°F, a gradient of nearly 2.5°F/100 feet is calculated. This yields 400°F at perhaps 12,000 feet. This may be realistic for the Bert Winn #1 site. A lesser depth to 400°F is projected for C. H. Stocks 1-A, perhaps 10,000-12,000 feet.

The low gradients below about 650 feet (that is, within the Precambrian metamorphic rocks) reflect the high thermal conductivity of those rocks. More precisely, the lower calculated gradients of the deepest section (below about 6,000 feet) reflect the extremely high conductivity of quartzite (Unit IV) relative even to greenschist, phyllite and sericite-chlorite schist (Units I and II).

It is possible that lithology would change to rocks of lower conductivity with continued depth, and that the gradient would increase correspondingly. This is especially possible if (a) the section is overturned or (b) the section is cut by low-angle thrusts. However, there is no indication that this would come at a drillable depth. Even a projection of nearby normal faults (see Structure, above) suggests a depth in excess of 10,000 feet to a possible lithologic break.
The Bert Winn #1 data, compiled on plate 3, can be compared with the curves from C. H. Stocks 1-A (McIntyre and Koenig, 1978, plate 1). Although drilling procedures and the conditions under which logging was carried out were different in the two holes, the gradient profiles are similar. However, the temperatures in Stock 1-A are 20° to 60°F hotter at comparable depths in the Precambrian. Temperature in C. H. Stocks 1-A at the time the well was suspended was 252°F at 5,050 feet. This is much closer to the minimum reservoir temperatures predicted from the geochemistry of thermal waters at Battle Creek and Squaw Hot Springs (SiO₂ = 284°-302°F; Na-K-Ca = 266°-302°F) than temperatures obtained at 7,981 feet in the Bert Winn well.

This higher temperature probably indicates that C. H. Stocks 1-A was closer to the upflow zone of a convecting thermal fluid, probably a normal fault of the Little Mountain horst (plate 3). This reinforces the suggestion that the horst-bounding faults are more attractive exploration targets than faults within the horst block. It also suggests that the fault separating C. H. Stocks 1-A from Bert Winn #1 dips westward, toward the former and away from the latter.
FORMATION FLUIDS AND GAS OCCURRENCES

No formation tests were made in this hole. Thus, no direct evidence was obtained concerning the composition of formation fluids in the lost circulation zones at 5,575 to 5,700 feet and at 7,203 feet. The daily analyses of the chloride content of the mud, made by the mud engineer, have been plotted on figure 1. These show that chloride concentration remained at less than 200 mg/l from 800 feet to about 5,500 feet. This is consistent with the low chloride concentration in the river water used to make up the mud. The concentration increased rapidly to about 1,200 mg/l across the lost circulation zone at 5,575 feet to 5,700 feet. This indicates that formation fluid with a higher chloride content than the drilling mud was entering the hole in this zone. In this regard, it should be noted that the chloride concentration in the thermal waters at Squaw and Battle Creek Hot Springs ranges from 5,048 to 7,398 mg/l, and that these concentrations are unusually high for any groundwater known in this area. Thus, it is likely that the fluids in the lost circulation zone communicate with the geothermal system feeding the springs.

Efforts were made to cement off the lost circulation zone but continued losses of 20 to 40 barrels per hour occurred while drilling the rest of the hole, indicating that the cement job was not completely successful. The continued presence of 400 to 700 mg/l of chloride ion in the mud below this zone also suggests that formation water continued to enter the hole from this zone, at least in small quantities.

A thin interval of partial lost circulation above the 20 to 40 barrel background occurred at a depth of 7,203 feet. This loss was accompanied by a slight increase of the chloride ion concentration from 500 to 700 mg/l.

Carbon dioxide gas was detected in measurable amounts in the following intervals:

<table>
<thead>
<tr>
<th>Depth</th>
<th>CO₂ Concentration</th>
</tr>
</thead>
<tbody>
<tr>
<td>7,183 feet</td>
<td>8,000 ppm trip gas</td>
</tr>
<tr>
<td>7,195-7,215 feet</td>
<td>2,000 ppm</td>
</tr>
<tr>
<td>7,277 feet</td>
<td>1,600 ppm trip gas</td>
</tr>
<tr>
<td>7,444 feet</td>
<td>35,000 ppm trip gas</td>
</tr>
<tr>
<td>7,590 feet</td>
<td>4,000 ppm trip gas</td>
</tr>
</tbody>
</table>

No gases were detected in the main zone of lost circulation at 5,575 to 5,700 feet, which corresponds to the marble and dolomite of Unit III. The CO₂ occurrences are much smaller and occur in a more restricted depth range than those encountered in the C. H. Stocks 1-A well. No H₂S was encountered in measurable concentrations while
Mud Chloride (ppm X 10^2)

Partial loss 5,575.
Total lost circ. 5,580.
Drilled w/o circ. to 5,666
Cement plug.

Partial circ. loss at 6,079.
Partial loss (20-30 bbls/hr.)
begins at 6,100. Adding
water to make up for loss.

- 8,000 ppm CO₂ trip gas
- 2,000 ppm CO₂ while drilling
- 1,600 ppm CO₂ trip gas
- 3,500 ppm CO₂ trip gas
- 4,500 ppm CO₂ trip gas

FIGURE 1. Chloride content of the drilling mud, Bert Winn #1.
drilling the Bert Winn #1 well. It is possible that the CO₂ comes from either (a) a deeper marble-dolomite horizon or (b) an open fault at some unknown depth beneath Bert Winn #1.
RELATIONSHIP OF BERT WINN #1 TO THE ORIGINAL PROSPECT CONCEPT

Originally, the Preston area was identified as a geothermal prospect on the basis of very hot, saline water issuing as springs along Battle Creek and Bear River. Later, the geothermal prospect at Little Mountain was defined by shallow and intermediate-depth temperature gradient holes and by an area of low resistivity from geoelectrical surveys. The selection of the C. H. Stocks 1-A well location was based on what was then considered to be an optimum overlap of the data from these sources. Review of the geophysical data after drilling that well resulted in the choice of the Bert Winn #1 wellsite as a better location for a test of the resistivity anomaly.

In retrospect, neither of the two deep wells appears to have tested the Preston anomaly satisfactorily. First, a reservoir of hot saline fluid with minimum temperatures above 300°F was predicted from the geochemistry of the nearby Wayland and Squaw Hot Springs waters. Second, neither well encountered conditions which could account for the low resistivity found in the surface surveys, at the depths penetrated. Additional review of the resistivity picture, using the log obtained from the Bert Winn #1, has indicated that the low resistivity feature may be present at 10,000 feet or deeper. The cause of the anomaly, whether hydrothermal clay, hot saline water or some rock character unrelated to geothermal activity, is still unknown. Third, no major range-bounding fault was intercepted in the deeper section, as indicated by the low temperature gradient, the absence of hydrothermal mineralization or H₂S gas occurrences, and the low incidence of CO₂ gas. If significant quantities of geothermal fluid are present in this area, their location has not been demonstrated by either Bert Winn #1 or C. H. Stocks 1-A.

An alternative prospect model for the Little Mountain area may have merit, analogous to the typical geothermal occurrences in the Basin and Range setting. In this model, the controlling factors are the major high-angle faults bounding the east and west sides of the Little Mountain horst. Fluids circulate upward from great depths along one or both of these faults. The fluids locally may spread laterally into fractures within the horst or into aquifers in Tertiary rocks on its lower flanks. In this way, a relatively shallow, high-gradient halo may occur around the fault conduits. The gradient and geoelectrical anomalies seen at the surface thus are offset up-dip from the fluid source at depth within the fault zones. Drilling into the shallow thermal or geoelectrical anomalies, therefore, will encounter shallow leakage phenomena, but not the higher-temperature deep source. True
depth to the anomaly is variable, depending upon fault angle and point of intersection. Wells drilled into the footwall (horst) block ultimately become low-gradient, reflecting the high conductivity of metamorphic rocks found there.

Neither C. H. Stocks 1-A nor Bert Winn #1 tested a range-front fault: Bert Winn #1 was not adequately located to accomplish this; and C. H. Stocks 1-A was terminated perhaps 2,000 to 3,000 feet short of the targeted fault intersection, for mechanical reasons (plates 2 and 3; also McIntyre and Koenig, 1978, plate 3). The higher temperatures and more-abundant CO2 at shallower depths in C. H. Stocks 1-A suggest that this hole was closer to the horst-bounding fault that communicates with the main geothermal convective system than was Bert Winn #1. Therefore, the original prospect objective remains untested.

Temperatures of convecting fluids down-dip on this fault (or on the eastern boundary fault) probably are well in excess of 300°F. No upper temperature boundary can be established with any confidence. It may be necessary to go to 10,000 or even 12,000 feet to encounter temperatures over 400°F. Permeability, if present, is likely to be confined to the major fault zones.
REFERENCES


APPENDIX A

Detailed Sample Descriptions,
Bert Winn #1
Notes: A number of contaminants have been introduced into the samples from mud additives and other sources.

1. Moscovite and biotite mica were added as lost circulation material below 5,670 feet. They are much larger grains than the muscovite and biotite occurring in the phyllites of this section.

2. Nickel chloride, a bright green anti-corrosion chemical, has been added throughout the hole. It appears to dye a few cuttings bright green. This might be confused with the green chromian mica sometimes present in Precambrian rock.

3. Traces of red-brown iron oxide stain occur on a few cuttings. Most if not all of this is due to rusting pipe shavings.

4. A white, granular, soft material, often containing fragments of metal, is a ubiquitous minor constituent of the samples. The fragments are often smooth on one side as if from adhering to a pipe surface. The identity of the material is uncertain but it does not appear to be a constituent of the rock. It is not a carbonate and does not decrepitate or fuse in a flame.
<table>
<thead>
<tr>
<th>DEPTH</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>(No samples above 350-370)</td>
<td></td>
</tr>
<tr>
<td>(Samples from 330-350 collected by drilling crew before mud loggers arrived)</td>
<td></td>
</tr>
<tr>
<td>330-350</td>
<td>100% Greenschist (?), light to medium green-gray, non-fissile (possibly a metamorphosed silty greywacke); trace of biotite and disseminated pyrite; calcareous.</td>
</tr>
<tr>
<td>350-370</td>
<td>100% Greenschist (?), as above; calcareous; trace of disseminated pyrite.</td>
</tr>
<tr>
<td>370-390</td>
<td>100% Greenschist (?), as above; calcareous; trace of biotite and pyrite.</td>
</tr>
<tr>
<td>390-400</td>
<td>100% Greenschist (?), as above; calcareous; trace of pyrite veinlets. Trace of quartz vein.</td>
</tr>
<tr>
<td>410-430</td>
<td>100% Greenschist, part similar to above and part weakly foliated; trace of biotite and pyrite; slightly calcareous.</td>
</tr>
<tr>
<td>430-450</td>
<td>100% Greenschist (?), as above; non-foliated; trace of biotite and pyrite. Pinpoint vugs.</td>
</tr>
<tr>
<td>450-470</td>
<td>100% Greenschist (?), as above; trace of biotite and pyrite; pinpoint vugs; slightly calcareous.</td>
</tr>
<tr>
<td>470-490</td>
<td>100% Greenschist (?), as above; trace of biotite and pyrite; slightly calcareous.</td>
</tr>
<tr>
<td>490-510</td>
<td>100% Greenschist (?), as above; trace of biotite, very calcareous.</td>
</tr>
<tr>
<td>510-530</td>
<td>50% Greenschist (?), as above; very calcareous; trace of biotite. 50% Phyllite, light gray.</td>
</tr>
<tr>
<td>530-550</td>
<td>90% Greenschist, light to medium green-gray, quartzitic, calcareous, very fine grained. (Minerals are chlorite, muscovite (?), quartz, calcite, albite(?), minor biotite). Trace of pyrite and calcite in veinlets. Weakly foliated due to abundance of quartz and calcite. 10% Phyllite, light gray, very fine grained. Much lost circulation material.</td>
</tr>
<tr>
<td>550-570</td>
<td>90% Greenschist, as above. 10% Phyllite, as above.</td>
</tr>
<tr>
<td>570-590</td>
<td>95% Greenschist, as above; minor vuggy porosity. 5% Phyllite, as above.</td>
</tr>
</tbody>
</table>
Greenschist, as above; minor vuggy porosity, with pyrite or magnetic iron sulfide disseminated and in veinlets.

Phyllite, as above.

Greenschist, as above; less calcareous; trace of pyrite in veinlets.

Phyllite, as above.

Greenschist, as above; trace of pyrite veinlets.

Quartzite, light gray, phyllitic, very fine grained; trace disseminated pyrite.

Schist, light gray, very fine grained, (quartz-biotite), vuggy.

Greenschist, as above; very slightly calcareous, weakly foliated, with increasing biotite.

Phyllite, light gray, as above.

Quartzite, light gray, very fine grained, as above.

Greenschist, non-calcareous, quartzite, weakly foliated, with magnetic FeS in veinlets and disseminated.

Phyllite, as above.

Quartzite, light gray, phyllitic, very fine grained.

Trace of quartz-vein.

Greenschist, medium green-gray, very fine grained (chlorite, quartz, albite (?), biotite) with pyrite disseminated and in veinlets with calcite.

*Metadiabase (?), mottled light gray and dark green, non-foliated to weakly foliated, very slightly calcareous; disseminated pyrite; trace biotite.

Quartzite, light gray, phyllitic, very fine grained.

Phyllite, light gray, as above.

*Metadiabase (?), as above; non-foliated.

Phyllite, as above.

*Metadiabase (?), as above; slightly calcareous.

Quartzite, light green-gray to gray, very fine to fine grained.

*Metadiabase (?), as above, with increasing pyrite in veinlets. (Fibrous texture may be due to actinolite(?))

This rock resembles basic meta-igneous rock such as "greenstone" or metadiabase.
100% *Metadiabase (?), as above.

100% *Metadiabase (?), as above, with minor disseminated pyrite.
Trace of vein quartz.

100% *Metadiabase (?), as above; slightly calcareous.

100% *Metadiabase (?), as above, slightly calcareous.
Trace of calcite vein material and soft crystalline white mineral (zeolite?).

100% *Metadiabase (?), as above; calcareous blebs and patches of limonite (after pyrite).

100% *Metadiabase (?), as above.

100% *Metadiabase (?), as above.

100% *Metadiabase, light green-gray and gray mottled; fibrous mineral (actinolite or tremolite), slightly calcareous; trace of oxidized pyrite.

100% *Metadiabase (?), as above; trace of pyrite. Trace of vein quartz and calcite.

100% *Metadiabase (?), as above; trace of oxidized pyrite.

100% *Metadiabase (?), as above; trace of limonite stain. Trace of calcite vein.

100% *Metadiabase (?), as above; trace of pyrite.

100% *Metadiabase (?), as above; trace of pyrite.

100% *Metadiabase (?), as above; trace of white unidentified mineral lining open cavities. Trace of vein quartz.

100% *Metadiabase (?), as above; trace of pyrite veinlets. Trace of vein quartz.

100% *Metadiabase (?), as above; slightly calcareous, white crystals lining open cavities. Trace of quartz-biotite quartzite (?).

100% *Metadiabase (?), as above; with quartz veins and cavities lined with quartz crystals.

100% *Metadiabase (?), as above; with trace of quartz and pyrite veinlets.

100% *Metadiabase (?), as above; with trace of quartz veinlets.
960-970 100% *Metadiabase (?), as above; with trace of quartz veinlets.

970-980 100% *Metadiabase (?), as above; with trace of quartz and pyrite veinlets.

980-990 40% *Metadiabase (?), as above.
30% Quartzite, medium gray, very fine grained with pyrite disseminated and in veinlets.
30% Quartzite (?), light tan-gray, very fine grained; abundant disseminated pyrite (possibly an altered tuff?).

990-1,000 50% Quartzite (?) or Meta-tuff (?) as above; with veinlets and disseminated pyrite.
30% Quartzite, medium gray, as above; pyritic.
20% *Metadiabase, as above; (caving).

1,000-1,010 Poor sample - mostly cavings (?).
70% *Metadiabase, as above (caving).
20% Quartzite, medium green, as above (Quartz-biotite), with disseminated pyrite and quartz and calcite veinlets.
10% Meta-tuff (?) or Quartzite, as above.

1,010-1,020 40% Quartzite, medium gray (with biotite), as above; pyritic.
30% *Metadiabase (?), as above (caving?).
30% Meta-tuff (?) or Quartzite, as above; pyritic.

1,020-1,030 70% *Metadiabase (?), as above; abundant biotite present, finer grained than above.
20% Quartzite, medium gray, pyritic, as above.
10% Phyllite, light gray.

1,030-1,040 90% *Metadiabase (?), fine grained, medium green-gray, (biotite-albite (?)-minor chlorite) or meta-tuff (?).
5% Quartzite, medium gray as above, with biotite and pyrite.
5% *Metadiabase, as above 990', green, medium grained. Trace of Meta-tuff (?), light tan, aphanitic, pyritic.

1,040-1,050 60% Greenschist, light green-gray, fine grained, poor to fair fissility, scattered biotite.
30% Quartzite, light green-gray, very fine grained; trace of biotite.
5% Phyllite, light gray, fine grained.
5% Meta-tuff (?), light tan, disseminated biotite and pyrite.
Trace of Quartzite or Meta-chert, light gray, very fine grained.

A-5
<table>
<thead>
<tr>
<th>Depth Range</th>
<th>Composition</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,050-1,060</td>
<td>60% *Metadiabase (?), fine to very fine grained, as above. 10% *Greenschist, as above. 10% *Quartzite, light grey, as above. 10% Phyllite, light grey, as above. 10% *Quartzite(?), biotitic.</td>
</tr>
<tr>
<td>1,060-1,070</td>
<td>80% *Quartzite, light gray and green-gray, very fine grained, scattered biotite, trace of pyrite. 10% *Greenschist, as above. 10% *Metadiabase (?), as above.</td>
</tr>
<tr>
<td>1,070-1,080</td>
<td>70% *Quartzite, light green-gray and gray, some with scattered biotite (may include meta-chert). 30% *Metadiabase (?), as above.</td>
</tr>
<tr>
<td>1,080-1,090</td>
<td>70% *Quartzite, medium-gray, very fine grained, disseminated biotite; trace of pyrite. 20% *Metadiabase (?), caving. 10% *Greenschist, as above.</td>
</tr>
<tr>
<td>1,090-1,100</td>
<td>50% Phyllite, medium gray, very fine grained, poor fissility. 30% *Greenschist, as above. 20% *Quartzite, gray, biotite-rich, as above.</td>
</tr>
<tr>
<td>1,100-1,110</td>
<td>50% Phyllite, as above. 30% *Greenschist, as above. 20% *Quartzite, light gray, green-gray, biotitic, as above.</td>
</tr>
<tr>
<td>1,120-1,130</td>
<td>60% Phyllite, gray, as above. 30% *Greenschist, as above. 10% *Quartzite, as above; with biotite.</td>
</tr>
<tr>
<td>1,130-1,140</td>
<td>90% Phyllite, as above. 10% *Greenschist, as above.</td>
</tr>
<tr>
<td>1,140-1,150</td>
<td>60% *Metadiabase, dark green-gray, very fine grained, calcareous. 40% Phyllite, gray, as above.</td>
</tr>
<tr>
<td>1,150-1,160</td>
<td>60% *Metadiabase, as above; calcareous. 30% Phyllite, as above. 10% *Quartzite, medium gray, medium grained, biotitic.</td>
</tr>
<tr>
<td>1,160-1,170</td>
<td>60% *Metadiabase (?), fine grained, as above; calcareous; trace of pyrite. 30% *Quartzite, light green, (quartz-biotite-muscovite(?)). 10% *Metadiabase, as above 1000' (caving?).</td>
</tr>
</tbody>
</table>
1,170-1,180
50% *Metadiabase(?), green, as above.
40% *Metadiabase(?), black, fine grained, as above.
10% Meta-chert(?), white speckled with black biotite grains.

1,180-1,190
50% *Metadiabase(?), green, as above.
30% *Metadiabase(?), black, as above.
20% Phyllite, light gray.

1,190-1,200
80% *Metadiabase(?), green, as above.
15% *Metadiabase(?), black, as above.
5% Meta-chert, gray, pyritic.

1,200-1,210
80% *Metadiabase(?), green, as above; calcareous.
15% *Metadiabase(?), black, as above.
5% Meta-chert or Quartzite, gray, speckled with biotite; trace of pyrite.
Trace of vein calcite and quartz crystals from open vugs.

1,210-1,220
60% *Metadiabase, green, as above; calcareous.
20% Phyllite, light gray.
20% Meta-chert or Quartzite, light gray, pyritic.
Trace of vein quartz.

1,220-1,230
Poor sample.
90% *Metadiabase(?), light green, more highly altered than above; traces of biotite; calcareous.
Change in Metadiabase(?) occurs about 1,220-1,230'.
*Metadiabase(?) may be Greenschist of a different origin. Appears to be mainly fibrous amphibole-like minerals (actinolite?).
10% Phyllite, light gray, pyritic (caving?).

1,230-1,240
90% *Metadiabase(?), light green, highly altered, traces of biotite, calcareous. Approaches greenschist appearance.
10% Phyllite, light gray, as above.

1,240-1,250
60% *Metadiabase(?), as in 1,230-1,240; very calcareous; increasing biotite.
40% Phyllite, light gray, fine grained, weak foliation, trace of microscopic white needle-like minerals; trace of pyrite.

1,250-1,260
80% Greenschist or Metadiabase(?) as in 1,240-1,250; calcareous, trace of pyrite.
20% Phyllite, gray, as above.

1,270-1,280
90% Greenschist (or Metadiabase) as above; calcareous, trace of pyrite, trace of biotite, weak foliation, vuggy.
10% Phyllite, as above.
<table>
<thead>
<tr>
<th>Interval</th>
<th>Phyllite</th>
<th>Greenschist or Metadiabase</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,280-1,290</td>
<td>50% Greenschist</td>
<td>40% Phyllite, less</td>
<td>calcareous</td>
</tr>
<tr>
<td></td>
<td>(or Metadiabase)</td>
<td>as above; pyritic.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>10% Metadiabase, black</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>as above. (caving?).</td>
<td></td>
</tr>
<tr>
<td>1,290-1,300</td>
<td>70% Phyllite,</td>
<td>30% Greenschist (or</td>
<td></td>
</tr>
<tr>
<td></td>
<td>light to medium</td>
<td>Metadiabase), as above.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>gray, with veinlets</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>of pyrite.</td>
<td>20% Greenschist (or</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Metadiabase), as above.</td>
<td></td>
</tr>
<tr>
<td>1,300-1,310</td>
<td>70% Phyllite,</td>
<td>10% Meta-chert (or</td>
<td></td>
</tr>
<tr>
<td></td>
<td>as above; slightly</td>
<td>Meta-tuff replaced by</td>
<td></td>
</tr>
<tr>
<td></td>
<td>calcareous.</td>
<td>silica?), trace of biotite.</td>
<td></td>
</tr>
<tr>
<td>1,310-1,320</td>
<td>50% Phyllite,</td>
<td>50% Greenschist,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>as above.</td>
<td>as above; microlaminated;</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>trace of biotite.</td>
<td></td>
</tr>
<tr>
<td>1,320-1,330</td>
<td>80% Phyllite,</td>
<td>20% Greenschist,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>as above; slightly</td>
<td>as above.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>calcareous;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1,330-1,340</td>
<td>60% Phyllite,</td>
<td>40% Greenschist with</td>
<td></td>
</tr>
<tr>
<td></td>
<td>as above; pyritic.</td>
<td>biotite, as above.</td>
<td></td>
</tr>
<tr>
<td>1,340-1,350</td>
<td>80% Phyllite,</td>
<td>20% Greenschist,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>as above; pyritic (veinlets),</td>
<td>calcareous.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>20% Greenschist,</td>
<td></td>
</tr>
<tr>
<td>1,350-1,360</td>
<td>90% Phyllite,</td>
<td>10% Greenschist,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>as above; calcareous,</td>
<td>trace of biotite</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>and pyrite.</td>
<td></td>
</tr>
<tr>
<td>1,360-1,370</td>
<td>95% Phyllite,</td>
<td>5% Quartzite, medium gray,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>as above; pyrite</td>
<td>very fine grained, trace</td>
<td></td>
</tr>
<tr>
<td></td>
<td>veinlets.</td>
<td>of biotite.</td>
<td></td>
</tr>
<tr>
<td>1,370-1,380</td>
<td>90% Phyllite,</td>
<td>10% Quartzite, as above.</td>
<td></td>
</tr>
<tr>
<td>1,380-1,390</td>
<td>85% Phyllite,</td>
<td>15% Quartzite, as above;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>as above; trace of pyrite.</td>
<td>minor biotite.</td>
<td></td>
</tr>
<tr>
<td>1,390-1,400</td>
<td>90% Phyllite,</td>
<td>10% Quartzite, as above.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>as above; trace of pyrite disseminated and</td>
<td>in veinlets.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Trace of quartz-calcite-pyrite veinlets.</td>
<td></td>
</tr>
<tr>
<td>1,400-1,410</td>
<td>60% Phyllite,</td>
<td>40% Quartzite, very fine</td>
<td></td>
</tr>
<tr>
<td></td>
<td>as above.</td>
<td>grained, as above.</td>
<td>Minor disseminated biotite and trace of pyrite.</td>
</tr>
<tr>
<td>1,410-1,420</td>
<td>90% Phyllite,</td>
<td>10% Quartzite, as above.</td>
<td></td>
</tr>
</tbody>
</table>
1,420-1,430  80% Phyllite, as above.
              20% Quartzite, as above; trace of disseminated pyrite.

1,430-1,440  90% Phyllite, gray and light green-gray, as above;
              slightly calcareous.
              5% Quartzite, as above.
              5% *Metadiabase (?), green (caving).

1,440-1,450  100% Phyllite, gray and green-gray, as above; slightly
              calcareous.

1,450-1,460  100% Phyllite, gray and green-gray, as above; non-
              calcareous; traces of biotite.

1,460-1,470  90% Phyllite, as above; with laminae of slightly
              coarser grained biotite.
              10% Phyllite, quartzose, dark gray, very fine grained,
              non-foliated; scattered biotite.

1,470-1,480  50% Phyllite, light green and medium gray, as above;
              slightly calcareous.
              50% Quartzite, medium gray, very fine grained, minor
              biotite and chlorite; trace of pyrite disseminated.

1,480-1,490  70% Quartzite, medium gray, fine to very fine grained;
              minor biotite, trace of pyrite, slightly calcareous.
              30% Phyllite, light green, calcareous.

1,490-1,500  80% Quartzite, as above; fine to very fine with
              scattered medium grains; minor biotite; slightly
              calcareous.
              20% Phyllite, light green and medium gray, slightly
              calcareous.
              Trace *Metadiabase (?), green and white mottled,
              slightly calcareous.

1,500-1,510  90% *Metadiabase (?), green and white mottled (mixture
              of chlorite, actinolite and albite?), calcareous,
              disseminated pyrite.
              10% Phyllite, as above.
              Trace of albite (?) and quartz veinlets.

1,510-1,520  90% *Metadiabase, as above.
              5% Quartzite, medium gray, with biotite, as above
              (caving?).
              5% Phyllite, light green, as above (caving?).

1,520-1,530  95% *Metadiabase, as above; good relic textures,
              slightly calcareous, with white veinlets of calcite
              and albite (?) with trace of pyrite.
              5% Quartzite, fine grained, as above (caving?).
1,530-1,540  95% *Metadiabase, as above; moderately calcareous.  
5% Quartzite, as above (caving?)  
Trace of vein quartz.

1,540-1,550  100% Metadiabase, as above.  
Trace of Quartzite, as above.

1,550-1,560  100% Metadiabase, as above; calcareous.  
Trace of quartz vein and slickensided metadiabase.

1,560-1,570  100% Metadiabase, medium green mottled with white  
(actinolite-albite), slightly calcareous; good  
relic diabasic texture.

1,570-1,580  100% Metadiabase, as above.  
Trace of slickensided metadiabase.

1,580-1,590  100% Metadiabase, as above.  
Trace of calcite from open fractures; quartz vein  
fragments.

1,590-1,600  100% Metadiabase, as above.  
Trace of quartz and calcite vein material with trace of  
pyrite.

1,600-1,610  100% Metadiabase, as above.  
Trace of slickensided metadiabase and vein calcite.

1,610-1,620  100% Metadiabase, as above.  
Trace of slickensided metadiabase; calcite veinlets with  
hematite stain.

1,620-1,630  100% Metadiabase, as above; slightly calcareous, trace  
of disseminated pyrite.  
Trace of slickensided metadiabase, as above.

1,630-1,640  100% Metadiabase, as above.  
Trace of slickensided metadiabase.

1,640-1,650  60% Metadiabase, as above.  
40% Quartzite, medium gray, phyllitic, very fine  
grained, non-foliated.

1,650-1,660  70% Quartzite, as above.  
30% Metadiabase, as above (caving).

1,660-1,670  40% Phyllite, medium gray, very fine grained, poorly  
foliated, phyllitic (?).  
30% Quartzite, phyllitic, very fine grained, as above.  
30% Metadiabase, as above (caving).

1,670-1,680  60% Quartzite, light to medium gray, fine to very fine  
grained, scattered biotite and pyrite.  
40% Phyllite, light to medium gray, weak foliation.
<table>
<thead>
<tr>
<th>Interval</th>
<th>Percentage</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,680-1,690</td>
<td>70%</td>
<td>*Greenschist, light gray-green, moderately foliated, soft, moderate-sized biotite crystals scattered; trace of pyrite. *This Greenschist may be a sheared zone.</td>
</tr>
<tr>
<td>30%</td>
<td>Quartzite, as above; with scattered biotite.</td>
<td></td>
</tr>
<tr>
<td>1,690-1,700</td>
<td>90%</td>
<td>Quartzite, medium gray, very fine grained, micaceous with scattered biotite.</td>
</tr>
<tr>
<td>10%</td>
<td>Greenschist, as above.</td>
<td></td>
</tr>
<tr>
<td>1,700-1,710</td>
<td>60%</td>
<td>Quartzite, as above; scattered biotite.</td>
</tr>
<tr>
<td>40%</td>
<td>Phyllite, medium gray, quartzitic.</td>
<td></td>
</tr>
<tr>
<td>Trace of slickensided Phyllite.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1,710-1,720</td>
<td>60%</td>
<td>Metadiabase (?), medium green, mottled with white and black (albite-chlorite-actinolite?-magnetite).</td>
</tr>
<tr>
<td>40%</td>
<td>Quartzite, medium gray, micaceous, as above.</td>
<td></td>
</tr>
<tr>
<td>Trace of slickensided metadiabase (?).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1,720-1,730</td>
<td>70%</td>
<td>Metadiabase (?), as above; fine grained with disseminated traces of magnetic FeS and magnetite ()?; moderately calcareous; biotite (?) may also be present.</td>
</tr>
<tr>
<td>20%</td>
<td>Phyllite, as above.</td>
<td></td>
</tr>
<tr>
<td>10%</td>
<td>Quartzite, as above.</td>
<td></td>
</tr>
<tr>
<td>1,730-1,740</td>
<td>70%</td>
<td>Quartzite, medium gray, very fine grained, micro-micaceous (biotite).</td>
</tr>
<tr>
<td>30%</td>
<td>Phyllite, medium gray, slightly calcareous.</td>
<td></td>
</tr>
<tr>
<td>1,740-1,750</td>
<td>80%</td>
<td>Quartzite, as above.</td>
</tr>
<tr>
<td>20%</td>
<td>Phyllite, as above.</td>
<td></td>
</tr>
<tr>
<td>1,750-1,760</td>
<td>60%</td>
<td>Quartzite, as above; slightly calcareous.</td>
</tr>
<tr>
<td>40%</td>
<td>Phyllite, as above.</td>
<td></td>
</tr>
<tr>
<td>1,760-1,770</td>
<td>60%</td>
<td>Phyllite, as above; slightly calcareous.</td>
</tr>
<tr>
<td>40%</td>
<td>Quartzite, as above.</td>
<td></td>
</tr>
<tr>
<td>1,770-1,780</td>
<td>70%</td>
<td>Quartzite, as above.</td>
</tr>
<tr>
<td>30%</td>
<td>Phyllite, as above.</td>
<td></td>
</tr>
<tr>
<td>1,780-1,790</td>
<td>50%</td>
<td>Quartzite, as above.</td>
</tr>
<tr>
<td>50%</td>
<td>Phyllite, as above, quartzitic and slightly calcareous.</td>
<td></td>
</tr>
<tr>
<td>1,790-1,800</td>
<td>60%</td>
<td>Phyllite, as above; dark gray with streaks of slightly coarser biotite; slightly calcareous.</td>
</tr>
<tr>
<td>40%</td>
<td>Quartzite, medium to dark gray, very fine grained, as above; with slightly coarser disseminated biotite.</td>
<td></td>
</tr>
<tr>
<td>1,800-1,810</td>
<td>80%</td>
<td>Quartzite, dark gray, fine to medium(?) grained, very micaceous, with small biotite blebs; slightly calcareous, trace of chlorite.</td>
</tr>
<tr>
<td>20%</td>
<td>Phyllite, light to medium gray, very fine grained.</td>
<td></td>
</tr>
</tbody>
</table>
1,810-1,820 90% Quartzite, fine to medium grained(?) as above; albite(?) biotite mica, trace of chlorite, moderate pyrite deposited between grains; quartz veinlets; trace of red-brown garnet(?) and pyrrhotite(?).
10% Phyllite, as above.
Trace of Chlorite Schist, moderately coarse, pyritic.

1,820-1,830 80% Quartzite, as above; trace of chlorite, pyrite and pyrrhotite(?).
20% Phyllite, as above.
Trace of slickensided quartzite.

1,830-1,840 70% Quartzite, as above. Quartzite in 1,800-1,840 contains more and coarser biotite and is coarser grained than above. Metamorphic grade appears to have increased slightly at this level.
30% Phyllite, as above.

1,840-1,850 70% Phyllite, medium gray, very fine grained, slightly calcareous.
30% Quartzite, medium gray, fine grained, moderate disseminated finely crystalline biotite.

1,850-1,860 80% Phyllite, as above.
20% Quartzite, medium gray, very fine grained with scattered fine biotite, as above.

1,860-1,870 70% Phyllite, as above.
30% Quartzite, as above.

1,870-1,880 70% Phyllite, as above; trace of pyrite veinlets.
30% Quartzite, as above.
Trace of calcite veinlets.

1,880-1,890 50% Phyllite, as above.
50% Quartzite, as above; trace of pyrite.

1,890-1,900 60% Phyllite, as above; trace of pyrite.
40% Quartzite, as above; trace of pyrite and calcite.

1,900-1,910 80% Phyllite, medium gray, quartzitic, very fine grained.
10% Phyllite, as above.
10% Quartzite, as above.

1,910-1,920 80% Phyllite, slightly quartzitic, as above.
20% Quartzite, as above.

1,920-1,930 60% Quartzite, medium to dark gray, fine grained, moderately abundant biotite; pyrite veinlets and films between quartz grains; calcite veinlets (similar to 1,800-1,810).
40% Phyllite, medium dark gray, very fine grained with microscopic white porphyroblasts ("spotted slate" texture).
1,930-1,940
60% Quartzite, medium gray, phyllitic, very fine grained.
40% Phyllite, as above; films of pyrite on foliation surfaces.

1,940-1,950
70% Phyllite, as above; pyrite veinlets.
30% Quartzite, fine grained, micaceous; trace of pyrite/pyrrhotite.

1,950-1,960
90% Phyllite, as above; pyrite/pyrrhotite disseminated and in veinlets.
10% Quartzite, very fine grained, as above.
Trace of quartz vein.

1,960-1,970
100% Phyllite, pyritic, as above.

1,970-1,980
80% Phyllite, dark gray, finely crystalline, coarser grained biotite than above; pyritic.
20% Phyllite, medium gray, very fine grained, as above.

1,980-1,990
90% Greenschist(?), fine grained, (chlorite-albite(?)-biotite-quartz?); trace of almandite garnet?; vuggy, pinpoint crystal-lined porous areas; pyritic/pyrrhotite weakly foliated to non-foliated.
10% Phyllite, as above.
Trace of quartz crystals(?) lining open fractures.

1,990-2,000
95% Greenschist(?), as above.
5% Phyllite, as above.

2,000-2,010
95% Greenschist, as above, with trace of pyrite and quartz veinlets.
5% Phyllite, as above.
Trace of slickensided Greenschist.

2,010-2,020
60% Greenschist, as above; trace of pyrite/pyrrhotite. This Greenschist (1,980-2,020+) is weakly foliated. It may be altered basic volcanic rock. Mineral identifications are tentative.
30% Quartzite, medium-dark gray, fine grained, with scattered biotite.
10% Phyllite, as above.
Trace of quartz and pyrite veinlets.

2,020-2,030
40% Phyllite, dark gray, very fine grained, pyritic.
40% Quartzite, as above; with fine to medium grains, phyllitic, pyritic.
20% Greenschist, as above (caving?). Trace of slickensided Phyllite.

2,030-2,040
60% Quartzite, as above; fine and medium grains, poorly sorted, scattered biotite mica, calcareous; slightly calcareous.
40% Phyllite, as above.

A-13
2,040-2,050  
60% Phyllite, as above; trace of pyrite veinlets.  
40% Quartzite, as above; fine and medium grained.

2,050-2,060  
80% Quartzite, as above; fine and medium grained.  
20% Phyllite, as above; with a trace of pyrite veinlets.  
Trace of Metadiabase, green and white mottled (albite-actinolite?).

2,060-2,070  
90% Quartzite, as above; trace of disseminated pyrite.  
10% Phyllite, as above.

2,070-2,080  
95% Quartzite, as above.  
5% Phyllite, as above.

2,080-2,090  
70% Quartzite, as above; with minor large fragments (?) of albite.  
30% Phyllite, as above; trace of pyrite veinlets.

2,090-2,100  
80% Phyllite, as above; trace of pyrite.  
20% Quartzite, as above.

2,100-2,110  
80% Phyllite, as above; trace of pyrite.  
20% Quartzite, as above.

2,110-2,120  
95% Phyllite, as above.  
5% Quartzite, as above.

2,120-2,130  
100% Phyllite, as above.  
Trace of Quartzite, as above.

2,130-2,140  
100% Phyllite, as above; trace of pyrite/pyrrhotite.

2,140-2,150  
100% Phyllite, as above; trace of pyrrhotite.

2,150-2,160  
70% Phyllite, as above; trace of pyrite.  
30% Quartzite, dark grey, very fine grained, micromicaceous; trace of disseminated pyrite and calcite.

2,160-2,170  
80% Phyllite, as above.  
20% Quartzite, very fine grained, as above; trace of pyrite/pyrrhotite.

2,170-2,180  
90% Phyllite, as above; trace of pyrite veinlets, calcareous.  
10% Quartzite, as above; slightly calcareous.

2,180-2,190  
100% Phyllite, as above; slightly calcareous; trace of pyrite veinlets and blebs.

2,190-2,200  
100% Phyllite, as above; trace of pyrite and quartz veinlets.  
Trace of Quartzite, medium grained.
2,200-2,210  80% Quartzite, medium and dark gray, very fine grained, scattered biotite and pyrite, slightly calcareous.  
   20% Phyllite, as above.

2,210-2,220  95% Quartzite, as above; slightly calcareous.  
   5% Phyllite, as above.

2,220-2,230  100% Quartzite, as above.  
   Trace of Phyllite, as above.

2,230-2,240  100% Quartzite, as above; very fine grained with scattered medium grains (quartz, albite, green fragments); biotite and pyrite in interstices; calcareous.

2,240-2,250  100% Quartzite, as above; trace of pyrrhotite.

2,250-2,260  60% Quartzite, as above; calcareous.  
   40% Phyllite, as above; calcareous.

2,260-2,270  60% Quartzite, as above; calcareous.  
   40% Phyllite, as above; pyritic.  
   Trace of albite-quartz(?)-biotite rock, very fine grained.

2,270-2,280  90% Phyllite, as above; calcareous; trace of pyrite/pyrrhotite.  
   10% Quartzite, as above.

2,280-2,290  90% Phyllite, medium to dark gray, slightly calcareous; veinlets of pyrite.  
   10% Quartzite, medium gray, very fine grained, slightly micaceous (biotite) and calcareous.  
   Trace of calcite veinlet.

2,290-2,300  70% Phyllite, as above.  
   30% Quartzite, as above.  
   Trace of calcite and pyrite veinlets.

2,300-2,310  80% Phyllite, as above.  
   20% Quartzite, as above.

2,310-2,320  80% Phyllite, as above.  
   15% Quartzite, as above.  
   5% Greenschist, light green (chlorite-actinolite).

2,320-2,330  80% Greenschist, light green to light gray, fine crystalline, very calcareous (actinolite-talc(?)—chlorite-albite(?)); trace of disseminated pyrite.  
   15% Quartzite, light gray, very fine grained, scattered biotite; pyrite/pyrrhotite veinlets; calcareous.  
   5% Phyllite, gray, as above (caving?).

2,330-2,340  100% Greenschist, as above; very calcareous.  
   Trace of Phyllite, as above; caving.

A-15
<table>
<thead>
<tr>
<th>Layer Range</th>
<th>Calcite Content</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2,340-2,350</td>
<td>90% Greenschist, as above; very calcareous. 10% Quartzite, light gray, scattered biotite.</td>
<td></td>
</tr>
<tr>
<td>2,350-2,360</td>
<td>70% Quartzite, medium gray, phyllitic, very fine grained (silt-sized); disseminated biotite, slightly calcareous; trace of pyrite. 30% Phyllite, medium-dark gray, quartzitic, slightly calcareous, trace of pyrite.</td>
<td></td>
</tr>
<tr>
<td>2,360-2,370</td>
<td>70% Phyllite, as above; trace of pyrite. 30% Quartzite, phyllitic; silt-sized, as above.</td>
<td></td>
</tr>
<tr>
<td>2,370-2,380</td>
<td>50% Phyllite, as above; pyrite veinlets. 50% Quartzite, medium gray, very fine grained, trace of biotite, pyritic; slightly calcareous.</td>
<td></td>
</tr>
<tr>
<td>2,380-2,390</td>
<td>50% Phyllite, as above; pyrite veinlets; slightly calcareous. 50% Quartzite, very fine grained, as above; trace of biotite, calcite, pyrite.</td>
<td></td>
</tr>
<tr>
<td>2,390-2,400</td>
<td>80% Quartzite, light to medium gray, very fine grained, scattered biotite and pyrite; slightly calcareous; pyrite veinlets. 20% Phyllite, as above.</td>
<td></td>
</tr>
<tr>
<td>2,400-2,410</td>
<td>60% Quartzite, light gray, calcareous, as above; pyritic. 40% Marble(?), white, medium crystalline.</td>
<td></td>
</tr>
<tr>
<td>2,410-2,420</td>
<td>80% Greenschist, light green, actinolitic, very calcareous (or actinolitic Marble?); trace of pyrite. 15% Quartzite as in 2,390-2,400. 5% Phyllite, as above.</td>
<td></td>
</tr>
<tr>
<td>2,420-2,430</td>
<td>90% Greenschist, very calcareous, as above; or actinolitic Marble. 5% Phyllite, as above (caving). 5% Quartzite, as above (caving).</td>
<td></td>
</tr>
<tr>
<td>2,430-2,440</td>
<td>95% Greenschist or actinolitic Marble, as above. 5% Quartzite, as above (caving).</td>
<td></td>
</tr>
<tr>
<td>2,440-2,450</td>
<td>100% Greenschist, as above; very calcareous.</td>
<td></td>
</tr>
<tr>
<td>2,450-2,460</td>
<td>100% Greenschist, as above; very calcareous.</td>
<td></td>
</tr>
<tr>
<td>2,460-2,470</td>
<td>100% Greenschist, as above; very calcareous.</td>
<td></td>
</tr>
<tr>
<td>2,470-2,480</td>
<td>100% Greenschist, as above; very calcareous.</td>
<td></td>
</tr>
<tr>
<td>2,480-2,490</td>
<td>90% Greenschist, as above; very calcareous. 10% Phyllite, dark gray, trace of pyrite.</td>
<td></td>
</tr>
<tr>
<td>2,490-2,500</td>
<td>90% Phyllite, dark gray; veinlets of pyrite/pyrrhotite. 10% Greenschist, as above (caving).</td>
<td></td>
</tr>
<tr>
<td>Layer Range</td>
<td>Composition</td>
<td></td>
</tr>
<tr>
<td>--------------</td>
<td>-----------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>2,500-2,510</td>
<td>80% Phyllite, as above.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>15% Greenschist, as above (caving).</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5% Quartzite, light gray, very fine grained; trace of disseminated pyrite.</td>
<td></td>
</tr>
<tr>
<td>2,510-2,520</td>
<td>85% Phyllite, as above.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>10% Greenschist, as above (caving).</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5% Quartzite, light gray, very fine grained, as above.</td>
<td></td>
</tr>
<tr>
<td>2,520-2,530</td>
<td>50% Phyllite, as above.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>50% Quartzite, as above; with disseminated biotite, pyrite; grains appear to be coarser, very calcareous. Trace of Greenschist (cavings), veinlets of pyrite and calcite.</td>
<td></td>
</tr>
<tr>
<td>2,530-2,540</td>
<td>90% Quartzite, as above, light to medium gray.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>10% Phyllite, as above.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Trace of pyrite and Greenschist.</td>
<td></td>
</tr>
<tr>
<td>2,540-2,550</td>
<td>55% Quartzite, as above.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>40% Quartzite, calcareous, white, fine to medium grained</td>
<td></td>
</tr>
<tr>
<td></td>
<td>with microcrystals of biotite and occasional pyrite coatings.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5% Greenschist, as above.</td>
<td></td>
</tr>
<tr>
<td>2,550-2,560</td>
<td>60% Quartzite, as above, with trace rose to bronze tint.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>35% Quartzite, calcareous, medium grained, as above.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5% Phyllite, as above.</td>
<td></td>
</tr>
<tr>
<td>2,560-2,570</td>
<td>90% Quartzite, as above, (salt and pepper-like) light gray to dark gray, abundant biotite, trace pyrite, very calcareous -- some has greenish color to it. 10% Calcite and quartz vein.</td>
<td></td>
</tr>
<tr>
<td>2,570-2,580</td>
<td>85% Quartzite, as above, some with salmon tint.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>15% Quartz and calcite (vein?), white, with minor pyrite cubes.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Trace of Phyllite.</td>
<td></td>
</tr>
<tr>
<td>2,580-2,590</td>
<td>85% Quartzite, calcareous, fine grained, medium gray to dark gray (salt and pepper-like), with abundant biotite. 10% Calcite or Marble, white, vein(?). 5% Quartz, white, vein(?).</td>
<td></td>
</tr>
<tr>
<td>2,590-2,600</td>
<td>85% Quartzite, as above.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>15% Calcite or Marble, white, as above.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Trace of Greenschist.</td>
<td></td>
</tr>
<tr>
<td>2,600-2,610</td>
<td>95% Quartzite, medium gray to dark gray, as above.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5% Calcite or Marble, white.</td>
<td></td>
</tr>
<tr>
<td>2,610-2,620</td>
<td>100% Quartzite, as above, increasing tan coloring.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Trace of calcite vein material, and trace pyrite.</td>
<td></td>
</tr>
</tbody>
</table>

A-17
| 2,620-2,630 | 100% Quartzite, as above, light to medium gray. Trace of calcite vein material. |
| 2,630-2,640 | 95% Quartzite, as above, mostly medium gray. 3% Marble(?), white with greenish tint. |
| 2,640-2,650 | 100% Quartzite, as above, medium gray. Trace of Marble(?) or calcite vein. |
| 2,650-2,660 | 100% Quartzite, as above, light to medium gray. Trace of calcite vein. |
| 2,660-2,670 | 100% Quartzite, as above. Trace of pyrite. |
| 2,670-2,680 | 100% Quartzite, as above; fine grained, medium gray, salt and pepper appearance, abundant biotite. Trace of pyrite. |
| 2,680-2,690 | 60% Quartzite, as above; with considerable reddish (hematite?) color. 30% Calcite and Quartz, white, vein material?, some with chlorite. 10% Quartzite, gray, very fine grained, grading to Phyllite. Trace of pyrite and Greenschist. |
| 2,690-2,700 | 80% Phyllite, dark gray. 10% Quartzite, as above; salt and pepper, fine grained with hematite(?) stain to very fine grained medium gray, grading into Phyllite. 10% Calcite, white, vein material. Trace of pyrite on Phyllite and Quartzite. |
| 2,700-2,710 | 90% Phyllite, dark gray, micaceous, with disseminated pyrite, almost a schist. 5% Quartzite, as above; brown-stain on quartz. 5% Calcite, white, vein? |
| 2,710-2,720 | 95% Phyllite, dark gray, as above; with disseminated pyrite. 5% Calcite, white. Trace of Quartzite (caving). |
| 2,720-2,730 | 100% Phyllite, dark gray, graphitic, with veinlets, spots and disseminated pyrite. Trace of white calcite. |
| 2,730-2,740 | 100% Phyllite, dark gray (gun metal), graphitic, with disseminated pyrite. Trace of white calcite. |
| 2,740-2,750 | 90% Phyllite, dark gray, as above; graphitic. 10% Calcite, white, vein(?). Trace of pyrite coatings, clusters and disseminated. |
2,750-2,760
100% Phyllite, as above; graphitic.
Trace of calcite, white.
Trace of pyrite, cubes, coatings, veinlets.

2,760-2,770
95% Phyllite, dark gray, graphitic, with disseminated pyrite.
5% Calcite, white.
Trace of pyrite cubes and coatings.

2,770-2,780
100% Phyllite, as above; graphitic.
Trace of white calcite.
Trace of pyrite.

2,780-2,790
95% Phyllite, as above, graphitic.
5% Calcite, white.
Trace of increasing pyrite coatings, veinlets, cubes and disseminated in Phyllite.

2,790-2,800
100% Phyllite, as above; slightly graphitic.
Trace of calcite, white.
Trace of pyrite, mostly disseminated.
Trace of Quartzite, fine grained, calcareous; light brownish gray.

2,800-2,810
100% Phyllite, dark gray, as above.
Trace of calcite, white.
Trace of pyrite, veinlets, coatings.

2,810-2,820
100% Phyllite, as above; trace of pyrrhotite.
Trace of calcite, white; pyrite and Quartzite.

2,820-2,830
95% Phyllite, as above.
5% Quartzite, fine grained with brownish-red stain.
Trace of calcite, white; pyrite.

2,830-2,840
95% Phyllite, as above.
5% Quartzite, fine grained, calcareous, brownish stain, pyritic.
Trace of calcite, white.

2,840-2,850
100% Phyllite, as above; graphitic.
Trace of Quartzite, calcareous, and white calcite.
Trace of pyrite.

2,850-2,860
100% Phyllite, as above.
Trace of pyrite, disseminated.

2,860-2,870
100% Phyllite, as above.
Trace of pyrite, calcite.

2,870-2,880
100% Phyllite, as above; graphitic, pyritic and with pyrrhotite veinlets.
2,880-2,890
70% Phyllite, as above; trace of pyrite.
30% Quartzite, medium gray, very fine grained, calcareous.

2,890-2,900
90% Phyllite, as above; graphitic.
10% Quartzite, calcareous, pyritic, greenish and brownish, very fine grained.
Trace of calcite, white.

2,900-2,910
60% Greenschist, light green, very calcareous, sugary texture.
30% Phyllite, dark gray, as above; with veinlets of pyrite.
10% Quartzite, calcareous, brownish, as above.

2,910-2,920
90% Greenschist, as above; calcareous.
10% Phyllite, as above.
Trace of pyrite.

2,920-2,930
90% Greenschist, as above.
10% Phyllite, as above; trace of pyrite.

2,930-2,940
90% Greenschist, as above.
5% Phyllite, as above.
5% Calcite, white.

2,940-2,950
50% Greenschist, as above; calcareous; textures vary from very fine grained to fine grained.
50% Phyllite, dark gray; trace of pyrite.
Trace of calcite, white.

2,950-2,960
50% Greenschist, as above.
45% Phyllite, gray, as above; with disseminated pyrite.
5% Quartzite, medium gray, very fine grained.

2,960-2,970
90% Phyllite, dark gray, as above.
10% Greenschist, as above.

2,970-2,980
80% Phyllite, gray, as above.
15% Calcite, white.
5% Quartzite, medium gray, as above.
Trace of Greenschist.

2,980-2,990
90% Phyllite, dark gray, as above.
5% Calcite, white.
5% Greenschist, as above.
Trace of Quartzite, medium gray, very fine grained.

2,990-3,000
60% Greenschist, as above.
40% Phyllite, dark gray, as above.
Trace of calcite, white and pyrite.
3,000-3,010  70% Phyllite, dark gray, as above.
            30% Greenschist, as above.
               Trace of pyrite.

3,010-3,020  95% Phyllite, dark gray, as above.
            5% Greenschist, as above.

3,020-3,030  75% Phyllite, dark gray, as above.
            10% Quartzite, very fine grained, medium grained.
            10% Calcite, white.
            5% Greenschist, as above.
               Trace of pyrite cubes and coatings.

3,030-3,040  95% Phyllite, dark gray, with disseminated pyrite.
            5% Calcite, white.
               Trace of Greenschist.

3,040-3,050  85% Phyllite, dark gray, as above.
            10% Quartzite, medium gray, very fine grained, grades
to Phyllite.
            5% Calcite, white.
               Trace of Greenschist.
               Trace of pyrite in crystals, coatings and disseminated.

3,050-3,060  80% Greenschist, as above; calcareous.
            15% Phyllite, as above.
            5% Quartzite, medium gray, as above.
               Trace of pyrite.

3,060-3,070  85% Greenschist, light green, calcareous, mottled green
            and white.
            10% Phyllite, dark gray, as above.
            5% Quartzite, medium gray, as above.
               Trace of pyrite.

3,070-3,080  70% Phyllite, as above.
            30% Greenschist, as above.
               Trace of Quartzite, as above.

3,080-3,090  95% Phyllite, as above.
            5% Greenschist, as above.
               Trace of calcite, white.

3,090-3,100  70% Phyllite, as above.
            25% Greenschist, as above (very light green).
            5% Calcite, white.

3,100-3,110  75% Phyllite, as above.
            15% Quartzite, as above.
            10% Greenschist, as above.
3,110-3,120  85% Phyllite, as above; dark gray.
5% Quartzite, as above; medium gray, very fine grained.
5% Greenschist, as above; light green and white mottled, calcareous.
5% Calcite, white.
Trace of pyrite.

3,120-3,130  60% Phyllite, as above.
40% Greenschist, as above.
Trace of pyrite and calcite, white.

3,130-3,140  60% Phyllite, as above.
35% Greenschist, as above.
5% Quartzite, as above.
Trace of calcite, white.

3,140-3,150  70% Phyllite, as above.
30% Greenschist, as above.
Trace of calcite, white; pyrite; Quartzite.

3,150-3,160  90% Phyllite, as above.
10% Greenschist, as above.

3,160-3,170  90% Phyllite, as above.
10% Quartzite, medium gray, very fine grained, as above.
Trace of Greenschist.

3,170-3,180  90% Phyllite, as above.
10% Quartzite, as above.
Trace of pyrite, Greenschist, calcite.

3,180-3,190  60% Phyllite, as above.
30% Greenschist, as above.
10% Quartzite, as above.
Trace of calcite, white; pyrite.

3,190-3,200  70% Greenschist, green and white, calcareous, as above.
30% Phyllite, dark gray, as above.

3,200-3,210  50% Phyllite, dark gray, as above.
45% Greenschist, green and white, calcareous, as above.
5% Quartzite, as above.

3,210-3,220  90% Phyllite, dark gray, as above.
5% Quartzite, as above.
5% Greenschist, as above.

3,220-3,230  80% Phyllite, as above.
10% Greenschist, as above.
10% Quartzite, medium gray, as above.

3,230-3,240  60% Greenschist, as above.
35% Phyllite, as above.
5% Quartzite, as above.
Trace of calcite, white; pyrite.
70% Greenschist, as above.
30% Phyllite, dark gray, as above.

80% Greenschist, as above, very light green to medium green.
20% Phyllite, as above.
Trace of pyrite.

90% Greenschist, as above.
10% Phyllite, as above.

90% Greenschist, as above; white to medium green.
10% Phyllite, as above.

100% Greenschist, white to medium green, very calcareous.

100% Greenschist, calcareous, as above; white to medium green, containing quartz, sericite, calcite, chlorite, albite(?), and trace of pyrite.
Trace of Phyllite.

100% Greenschist, calcareous, as above; white to medium green, some brownish hematite(?) stain.
Trace of Phyllite; seems to be contained in schist.

100% Greenschist, calcareous, as above; with increasing amount reddish to yellowish-brown iron (?) stain; some biotite plates.

100% Greenschist, calcareous, as above; lesser amount of brown stain; trace of pyrite cubes.

100% Greenschist, calcareous, as above.

100% Greenschist, calcareous, white to very light green, some medium green, silky texture, minor pyrite crystals.

100% Greenschist, calcareous, white to light green, trace of medium green, minor gray -- possibly a stage of phyllite becoming schist; pyrite veinlets and crystals.

100% Greenschist, calcareous, as above; trace of pyrite crystals.

100% Greenschist, calcareous, as above.
3,380-3,390  40% Greenschist or Metadiabase(?), sheared, light green and gray mottled, (chlorite, albite, actinolite(?), calcite, trace of pyrite).

30% Quartzite, light gray, fine to medium grained, sericite partings; trace of pyrite and chlorite.

30% Phyllite or very fine grained sericite schist, medium gray, well foliated; trace of pyrite porphyroblasts.

Trace of calcite vein or Marble, white, fine grained.

3,390-3,400  90% Metadiabase(?), medium green and white mottled, intergrowth of albite, chlorite and actinolite(?), non-foliated, slightly calcareous, trace of pyrite.

10% Phyllite-sericite Schist, as above.

3,400-3,410  95% Metadiabase, as above.

5% Phyllite-sericite Schist, as above.

3,410-3,420  100% Metadiabase, as above; slightly calcareous, trace of pyrite disseminated.

3,420-3,430  60% Metadiabase, as above.

40% Greenschist, light green to gray; very calcareous with chlorite and sericite; may be interlaminated Greenschist and Marble.

3,430-3,440  60% Greenschist, as above; very calcareous, possibly interlaminated with Marble.

40% Metadiabase, as above (caving?).

Trace of quartz-calcite veinlets.

3,440-3,450  95% Metadiabase(?), green and white mottled, (albite, chlorite, actinolite(?)), slightly calcareous, non-foliated.

5% Greenschist, as above.

3,450-3,460  95% Metadiabase, as above; calcareous, trace of magnetite and pyrite disseminated.

5% Calcite vein.

3,460-3,470  100% Metadiabase, as above; non-calcareous.

3,470-3,480  100% Metadiabase, as above; slightly calcareous.

Trace of calcite vein.

3,480-3,490  100% Metadiabase, as above; slightly calcareous.

3,490-3,500  100% Metadiabase, as above; non-calcareous.

Trace of Quartzite, glassy, medium grained.

Trace of calcite vein.

3,500-3,510  100% Metadiabase, as above; non-calcareous.

Trace of calcite and quartz vein material.
3,510-3,520  100% Metadiabase, as above; trace of disseminated pyrite. Trace of calcite vein.

3,520-3,530  60% Phyllite or Sericite Schist, light gray, thinly interlaminated with marble(?); foliated, crinkled. 40% Metadiabase, as above. Trace of calcite vein.

3,530-3,540  80% Phyllite/Sericite Schist, as above; trace of large pyrite porphyroblasts. 20% Metadiabase, as above (caving?). Trace of calcite vein.

3,540-3,550  70% Phyllite/Sericite Schist, as above; interlaminated with 20% Quartzite, white, very fine grained, calcareous. 10% Metadiabase, as above (caving).

3,550-3,560  70% Phyllite/Sericite Schist, as above; interlaminated with 30% Quartzite, as above; pyritic. Trace of Metadiabase (caving) and vein calcite.

3,560-3,570  90% Phyllite/Sericite Schist, as above; non-calcareous. 10% Quartzite, as above. Trace of Metadiabase (caving).

3,570-3,580  70% Phyllite/Sericite Schist, as above, interlaminated with 30% Quartzite, as above.

3,580-3,590  70% Quartzite, as above; slightly calcareous and micaceous; trace of pyrite. 30% Phyllite/Sericite Schist, as above.

3,590-3,600  80% Quartzite, light gray-white, fine to medium grained, glassy; disseminated pyrite and trace of sericite. 20% Phyllite/Sericite Schist, as above.

3,600-3,610  80% Phyllite/Sericite Schist, as above; pyritic. 20% Quartzite, as above. Trace of Quartz and calcite veins(?)

3,610-3,620  70% Quartzite, as above; pyritic. 30% Phyllite/Sericite Schist, as above. Trace of vein quartz and calcite.

3,620-3,630  60% Quartzite, as above; trace of disseminated pyrite. 40% Phyllite/Sericite Schist, as above. Trace of calcite vein.
3,630-3,640

60% Metadiabase(?) or Greenschist, green and white mottled, (albite, actinolite(?), chlorite), very calcareous.
20% Phyllite/Sericite Schist, as above.
20% Quartzite, white, glassy, trace of chlorite and pyrite.

3,640-3,650

80% Metadiabase(?) or Greenschist, as above; very calcareous.
10% Phyllite/Sericite Schist, as above.
10% Quartzite, as above.
Trace of calcite and quartz vein.

3,650-3,660

90% Greenschist, light to medium green, (chlorite, albite, actinolite(?)), very calcareous, trace of pyrite porphyroblasts.
10% Phyllite/Sericite Schist, as above.

3,660-3,670

70% Greenschist, as above; very calcareous.
30% Quartzite, white, vitreous, fine grained; slightly calcareous.

3,670-3,680

40% Quartzite, as above.
20% Greenschist, as above; calcareous.
20% Phyllite/Sericite Schist, as above.
20% Metadiabase(?), mottled green and white, as above.

3,680-3,690

60% Phyllite/Sericite Schist, as above.
30% Quartzite, as above; pyritic.
10% Greenschist, as above; calcareous.

3,690-3,700

60% Phyllite/Sericite Schist, fine grained, light to medium gray, interlaminated with Quartzite, white, glassy, very fine to fine grained; trace of pyrite.
Trace of vein quartz.
Trace of Greenschist (caving).

3,700-3,710

40% Quartzite, as above; with trace of pyrite and chlorite.
40% Greenschist or Metadiabase, green and white mottled, calcareous; non-foliated.
20% Phyllite/Sericite Schist, as above.

3,710-3,720

80% Greenschist or Metadiabase, as above (albite, chlorite), calcareous; trace of pyrite.
10% Phyllite/Sericite Schist, as above, with minor chlorite.
10% Quartzite, as above.

3,720-3,730

80% Greenschist(?), as above; calcareous, (albite, chlorite).
15% Quartzite, as above; trace of pyrite.
5% Phyllite/Sericite Schist (caving).
3,730-3,740  80% Greenschist, as above; very calcareous.
15% Quartzite, as above; with chlorite.
5% Phyllite/Sericite Schist, as above.

3,740-3,750  90% Greenschist, as above; weakly foliated, calcareous.
5% Quartzite, as above; chloritic.
5% Phyllite/Sericite Schist, as above (caving).

3,750-3,760  100% Greenschist, as above; very calcareous.
Trace of Phyllite/Sericite Schist, as above (caving).
Trace of Quartzite, as above.

3,760-3,770  40% Greenschist, as above; calcareous.
30% Quartzite, white, glassy, fine to medium (?) grained.
30% Phyllite/Sericite Schist, very fine grained, crumbly; trace of pyrite porphyroblasts.

3,770-3,780  40% Quartzite, as above; trace of sericite and chlorite.
30% Phyllite/Sericite Schist, as above; pyritic.
30% Greenschist, as above, calcareous.

3,780-3,790  40% Quartzite, as above.
40% Greenschist, as above.
20% Phyllite/Sericite Schist, as above.

3,790-3,800  60% Quartzite, as above.
30% Phyllite/Sericite Schist, as above.
10% Greenschist, as above.

3,800-3,810  80% Quartzite, as above; trace of pyrite.
15% Phyllite/Sericite Schist, as above.
5% Greenschist, as above.

3,810-3,820  90% Quartzite, as above; trace of sericite and pyrite.
5% Phyllite/Sericite Schist, as above.
5% Greenschist, as above.

3,820-3,830  85% Quartzite, as above; trace of sericite and pyrite.
10% Phyllite/Sericite Schist, as above.
5% Greenschist, as above (caving).

3,830-3,840  85% Quartzite, as above; trace of sericite, pyrite and bright green stain (not chlorite).
10% Greenschist, as above.
5% Phyllite/Sericite Schist, as above (caving).

3,840-3,850  100% Quartzite, as above; trace of sericite.
Trace of Phyllite/Sericite Schist, as above (caving).

3,850-3,860  100% Quartzite, as above; trace of sericite and pyrite.
Trace of Phyllite/Sericite Schist, as above (caving).

3,860-3,870  100% Quartzite, as above; trace of pyrite and sericite.
Trace of Phyllite/Sericite Schist, as above (caving).
3,870-3,880 100% Quartzite, as above; trace of sericite, chlorite and pyrite.
Trace of Phyllite/Sericite Schist, as above (caving).

3,880-3,890 60% Quartzite, as above; trace of sericite, pyrite and chlorite.
30% Greenschist, light green, (chlorite, quartz, albite(?)), pyritic, slightly calcareous.
10% Phyllite/Sericite Schist, light tan-gray, fine grained.

3,890-3,900 70% Greenschist, as above; calcareous
30% Quartzite, as above; chloritic.

3,900-3,910 80% Greenschist, as above; very calcareous.
20% Quartzite, as above.

3,910-3,920 85% Greenschist, as above; very calcareous, trace of pyrite.
10% Quartzite, as above.
5% Phyllite/Sericite Schist, medium gray, fine grained.

3,920-3,930 90% Greenschist, as above; very calcareous.
5% Quartzite, as above; trace of chlorite and pyrite.
5% Phyllite/Sericite Schist, as above.

3,930-3,940 95% Greenschist(?), green and white mottled, fine grained (albite, chlorite, actinolite(?)), calcareous, trace of pyrite; non-foliated; may be metadiabase of altered basic igneous rock.
5% Quartzite, as above.

3,940-3,950 90% Greenschist(?), as above; or Metadiabase/basic metavolcanic rock; calcareous; trace of pyrite.
10% Quartzite, as above; trace of chlorite.

3,950-3,960 85% Greenschist(?), as above; very calcareous.
15% Quartzite, as above.

3,960-3,970 80% Greenschist(?), as above; non-foliated, grading into greenschist, light green, (chlorite-sericite), well foliated.
20% Quartzite, as above.

3,970-3,980 70% Greenschist, light green-gray, fine grained (chlorite, sericite), foliated; calcareous.
20% Greenschist(?), mottled medium green and white, non-foliated, as above; calcareous; trace of pyrite.
10% Quartzite, as above.

3,980-3,990 70% Greenschist, foliated as above; slightly calcareous; trace of pyrite.
20% Greenschist(?), as above; non-foliated.
10% Quartzite, white, glassy; fine to medium grained, chloritic; trace of acicular brown crystals (cf. rutile?).

A-28
3,990-4,000
90% Greenschist, foliated, as above; moderately calcareous.
10% Greenschist(?), non-foliated, as above.

4,000-4,010
100% Greenschist, foliated, as above; slightly calcareous.
Trace of Quartzite, as above.

4,010-4,020
80% Greenschist, foliated, as above.
10% Quartzite, as above; slightly calcareous.
10% Phyllite/Sericite-biotite Schist, very fine grained quartzitic.

4,020-4,030
50% Phyllite, dark gray, graphitic; crinkled; trace of pyrite.
40% Greenschist, as above.
10% Quartzite, as above, pyritic.

4,030-4,040
80% Phyllite, graphitic, as above; trace of pyrite porphyroblasts.
10% Quartzite, as above.
10% Greenschist, as above.

4,040-4,050
90% Phyllite, graphitic, as above; trace of pyrite.
5% Quartzite, as above.
5% Greenschist, as above.

4,050-4,060
85% Phyllite, dark gray, graphitic; trace of pyrite.
10% Quartzite, white, glassy, fine to medium grained.
5% Greenschist, as above.

4,060-4,070
95% Phyllite, as above, graphitic.
5% Quartzite, as above.
Trace of Greenschist, as above.

4,070-4,080
80% Phyllite, as above; graphitic.
10% Greenschist, as above.
10% Quartzite, as above; trace of pyrite.

4,080-4,090
60% Quartzite, light green-gray, fine grained, laminae of Phyllite and chlorite; slightly calcareous.
20% Phyllite, graphitic, as above.
20% Greenschist, as above.

4,090-4,100
60% Greenschist(?), green and white mottled, non-foliated, (chlorite, albite, actinolite(?)), calcareous; streaked with chlorite.
20% Phyllite, as above.
10% Greenschist, foliated.
10% Quartzite, as above; streaked with biotite-Phyllite.
90% Greenschist, light green, moderately foliated, streaked with gray sericite schist and quartzite laminae, very fine grained; calcareous; trace of pyrite.
10% Phyllite, dark gray, as above.

95% Greenschist, as above; slightly calcareous; trace of pyrite.
5% Phyllite, as above.

95% Greenschist, as above; (albite, chlorite, muscovite, quartz(?)), slightly calcareous; trace of pyrite.
5% Phyllite, as above.

70% Greenschist, as above; slightly calcareous, trace of pyrite.
30% Phyllite, dark gray.
Trace of vein quartz.

50% Greenschist, as above.
30% Phyllite, as above; slightly graphitic.
20% Quartzite, white, vitreous, fine grained.
Trace of vein quartz.

85% Phyllite, black, graphitic.
10% Quartzite, as above.
5% Greenschist, as above (caving).

100% Phyllite, as above; graphitic, trace of pyrite.
Trace of vein quartz.

100% Phyllite, as above; graphitic.
Trace of vein quartz.

95% Phyllite, as above; graphitic.
5% Quartzite, white, glassy, fine-grained.
Trace of vein quartz.

95% Phyllite, as above; graphitic; trace of pyrite.
5% Quartzite, as above.

95% Phyllite, as above; graphitic; trace of pyrite.
5% Quartzite, as above.
Trace of vein quartz.

95% Phyllite, as above; graphitic; trace of pyrite.
5% Quartzite, as above.
Trace of vein quartz.

50% Quartzite, light gray, very fine grained, slightly calcareous.
30% Phyllite, as above; graphitic.
20% Greenschist, medium green, weakly foliated (chlorite, albite).
4,230-4,240 80% Quartzite, gray, as above; slightly calcareous.  
10% Phyllite, as above; graphitic; trace of pyrite.  
10% Greenschist, as above.

4,240-4,250 60% Phyllite, as above; graphitic; trace of pyrite.  
40% Quartzite, gray, as above.

4,250-4,260 90% Phyllite, as above; graphitic.  
5% Greenschist, as above.  
5% Vein calcite.  
Trace of vein quartz.

4,260-4,270 85% Phyllite, as above; graphitic; trace of pyrite.  
5% Greenschist, as above; limonite stained.  
5% Quartzite, as above.  
5% Vein calcite.

4,270-4,280 100% Phyllite, as above; graphitic; trace of pyrite.  
Trace of Quartzite, as above.

4,280-4,290 100% Phyllite, as above, graphitic.  
Trace of Quartzite, as above.

4,290-4,300 100% Phyllite, as above; graphitic; trace of pyrite.  
Trace of Quartzite, as above.

4,300-4,310 100% Phyllite, as above; graphitic.

4,310-4,320 80% Phyllite, as above, medium to dark gray.  
20% Quartzite, light gray, very fine grained, trace of chlorite.

4,320-4,330 60% Phyllite, medium gray, as above.  
30% Quartzite, as above.  
10% Greenschist, light green and grey, fine grained, (chlorite and muscovite).

4,330-4,340 70% Phyllite, as above; trace of pyrite.  
20% Quartzite, as above.  
10% Greenschist, as above.

4,340-4,350 40% Phyllite, as above.  
40% Greenschist, light green, (chlorite and muscovite), as above; trace of pyrite.  
20% Quartzite, as above.

4,350-4,360 80% Greenschist, as above; trace of pyrite.  
20% Phyllite, as above.  
Trace of Quartzite, white, very fine grained; slightly calcareous.

4,360-4,370 60% Greenschist, as above; streaked with trace of biotite.  
40% Quartzite, light green, chloritic and sericitic, calcareous.
60% **Greenschist**, as above; (chlorite, albite, biotite),
moderately calcareous; trace of pyrite.
40% **Quartzite**, as above; and some glassy, fine grained
**Quartzite**.

90% **Greenschist**, as above.
10% **Quartzite**, as above.

90% **Greenschist**, as above; trace of pyrite.
10% **Quartzite**, as above.

90% **Greenschist**, as above.
10% **Quartzite**, as above.

60% **Greenschist**, as above.
20% **Quartzite**, as above.
20% **Phyllite**, dark gray.

70% **Greenschist**, as above.
20% **Quartzite**, as above.
10% **Phyllite**, as above.

70% **Quartzite**, light gray, fine to very fine grained,
with sericite partings.
20% **Phyllite/Sericite Schist**, light gray; trace of
pyrite.
10% **Phyllite**, dark gray, as above.
Trace of **Greenschist**, as above (caving).

70% **Quartzite**, as above; trace of pyrite.
30% **Phyllite/Sericite Schist**, light gray, as above.

90% **Quartzite**, as above; trace of red brown garnet(?)
and emerald green mica or chlorite(?); trace of
pyrite.
10% **Phyllite/Sericite Schist**, light gray, as above;
probably occurs as partings in quartzite.

70% **Quartzite**, as above; slightly calcareous.
20% **Phyllite**, dark gray.
10% **Phyllite/Sericite Schist**, light gray.
Trace of **Greenschist**.

60% **Quartzite**, as above; trace of orange-brown prism-
atic glassy mineral; trace of pyrite.
20% **Phyllite/Sericite Schist**; light gray; trace of
emerald green chlorite(?).
20% **Phyllite**, dark gray, as above.

70% **Quartzite**, as above; some with trace of chlorite.
20% **Phyllite**, dark gray, as above.
10% **Greenschist**, light green, chloritic.

60% **Phyllite**, dark gray; trace of pyrite.
40% **Quartzite**, green and gray, as above.
4,500-4,510  80% Phyllite, as above; trace of pyrite and graphite(?).
            20% Quartzite, green and white, fine grained; trace of pyrite.

4,510-4,520  90% Phyllite, as above; graphitic.
            10% Quartzite, as above; pyritic.

4,520-4,530  90% Phyllite, as above, trace of pyrite and graphite.
            10% Quartzite, as above.

4,530-4,540  80% Phyllite, as above; graphitic(?).
            20% Quartzite, as above; trace of pyrite.

4,540-4,550  70% Quartzite, light gray, fine to medium (?) grained;
            sericite partings; pyritic.
            30% Phyllite, as above.

4,550-4,560  60% Quartzite, as above.
            40% Phyllite, as above.

4,560-4,570  90% Quartzite, light gray, fine to medium grained; gray
            sericite partings; intergranular pyrite.
            10% Phyllite, dark gray; trace of pyrite porphyroblasts.

4,570-4,580  95% Quartzite, as above; trace of pyrite.
            5% Phyllite, as above.

4,580-4,590  95% Quartzite, as above; trace of pyrite; abundant
            sericite partings.
            5% Phyllite, as above.

4,590-4,600  90% Quartzite, as above; trace of pyrite; sericite partings.
            10% Phyllite, as above.

4,600-4,610  90% Quartzite, as above; sericite partings.
            10% Phyllite, as above.

4,610-4,620  90% Quartzite, as above; sericite partings.
            10% Phyllite, as above.

4,620-4,630  95% Quartzite, as above, thin sericite and Phyllite
            partings; trace of pyrite.
            5% Phyllite, as above.

4,630-4,640  70% Quartzite, light gray to white, glassy, fine to
            medium grained; slightly calcareous.
            30% Phyllite, dark gray, slightly graphitic(?).
            Trace of vein quartz(?) (may be vitreous quartzite).

4,640-4,650  60% Quartzite, as above; trace of sericite partings
            and pyrite.
            40% Phyllite, as above.
            Trace of vein quartz(?)

A-33
4,650-4,660
70% Quartzite, as above.
30% Phyllite, as above.
Trace of vein quartz(?).

4,660-4,670
60% Quartzite, as above; trace of phyllite partings and pyrite.
40% Phyllite, as above.
Trace of vein quartz(?).

4,670-4,680
80% Quartzite, as above; trace of pyrite.
20% Phyllite, as above.

4,680-4,690
50% Quartzite, as above.
50% Phyllite, as above.

4,690-4,700
50% Quartzite, as above.
50% Phyllite, as above.

4,700-4,710
80% Phyllite, as above; trace of pyrite.
20% Quartzite, as above.
Trace of Phyllite/Sericite Schist, light gray.

4,710-4,720
70% Phyllite, as above.
30% Quartzite, as above; trace of pyrite.
Trace of Greenschist, light green (chlorite, sericite) and Phyllite/Sericite Schist, as above.

4,720-4,730
70% Phyllite, as above.
20% Quartzite, as above.
10% Greenschist, as above; granular, possibly quartzitic or albite-rich.

4,730-4,740
70% Phyllite, as above; trace of pyrite.
20% Quartzite, as above.
10% Greenschist, as above; granular, fine grained.

4,740-4,750
70% Phyllite, as above.
20% Greenschist, as above.
10% Quartzite, as above.

4,750-4,760
60% Phyllite, as above.
20% Quartzite, as above.
20% Greenschist, as above.

4,760-4,770
70% Phyllite, as above.
20% Quartzite, as above.
10% Greenschist, as above.

4,770-4,780
70% Phyllite, as above.
20% Greenschist, as above.
10% Quartzite, as above.

A-34
4,780-4,790
60% Phyllite, dark gray, crinkled surfaces; trace of pyrite, as above.
30% Quartzite, white to light gray, fine to medium(?) grained; trace of pyrite; slightly calcareous; as above.
10% Greenschist, light green-gray; (chlorite-sericite).

4,790-4,800
40% Phyllite, as above; pyritic.
40% Quartzite, as above; pyritic.
20% Greenschist, as above.
Trace of vein quartz.

4,800-4,810
50% Quartzite, as above; trace of pyrite, slightly calcareous.
30% Phyllite, as above; trace of pyrite.
20% Greenschist, as above.

4,810-4,820
80% Quartzite, white to light gray, fine to medium grained, slightly calcareous; trace of pyrite; trace of interstitial chlorite.
10% Phyllite, as above.
10% Greenschist, as above.

4,820-4,830
80% Quartzite, as above; trace of pyrite.
15% Greenschist, as above.
5% Phyllite, as above.

4,830-4,840
90% Quartzite, as above; trace of pyrite; trace of red-pink stain (hematite?).
Greenschist, as above.

4,840-4,850
90% Quartzite, as above; sericite partings; trace of pyrite and pyrrhotite.
10% Greenschist, as above.
Trace of large flakes of muscovite.

4,850-4,860
50% Quartzite, as above; trace of pyrite.
50% Phyllite, black, very fine grained.

4,860-4,870
60% Phyllite, as above.
40% Quartzite, as above.
Trace of Greenschist, as above.

4,870-4,880
60% Phyllite, as above.
20% Greenschist, as above.
20% Quartzite, as above.

4,880-4,890
80% Phyllite, as above; trace of pyrite.
10% Quartzite, as above.
10% Greenschist, as above.

4,890-4,900
85% Phyllite, as above.
10% Quartzite, as above.
5% Greenschist, as above.
4,900-4,910  95% Quartzite, as above; trace of sericite partings.  
5% Greenschist, as above.

4,910-4,920  *Very fine cuttings. They may not be representative.  
70% *Quartzite, white to light gray, fine grained; trace of pyrite; slightly calcareous; partings of fine grained biotite and muscovite.  
30% Phyllite, black, very fine grained, probably in thin laminae in the quartzite.

4,920-4,930  60% *Quartzite, as above; micaceous partings.  
40% Phyllite, as above.

4,930-4,940  60% *Quartzite, as above; micaceous partings.  
40% Phyllite, as above.

4,940-4,950  70% *Quartzite, light gray, fine to medium grained, micaceous partings, as above.  
30% Phyllite, as above; trace of pyrite.

4,950-4,960  80% *Quartzite, as above; trace of sericite partings.  
20% Phyllite, as above.

4,960-4,970  80% *Quartzite, as above; trace of mica and albite.  
20% Phyllite, as above.

4,970-4,980  70% *Quartzite, as above.  
30% Phyllite, as above.

4,980-4,990  70% *Quartzite, as above.  
30% Phyllite, as above.

4,990-5,000  60% *Quartzite, as above.  
40% Phyllite, as above.

5,000-5,010  60% *Quartzite, as above; trace of pyrite.  
40% Phyllite, as above.

5,010-5,020  90% *Quartzite, as above; trace of pyrite.  
10% Phyllite, as above.  
Trace of Greenschist, as above.

5,020-5,030  95% *Quartzite, as above; trace of pyrite.  
5% Phyllite.

5,030-5,040  85% *Quartzite, as above; trace of limonite stain.  
15% Phyllite, as above.  
Trace of vein quartz.

5,040-5,050  80% *Quartzite, as above;  
20% Phyllite, as above.

5,050-5,060  90% *Quartzite, as above; trace of pyrite.  
10% Phyllite, as above.  
Trace of vein quartz.
5,060-5,070  90% *Quartzite, as above; trace of pyrite.
           10% Phyllite, as above.

5,070-5,080  80% *Quartzite, as above; trace of pyrite.
           20% Phyllite, as above.

5,080-5,090  50% *Quartzite, as above.
           50% Phyllite, as above.

5,090-5,100  70% *Quartzite, as above.
           30% Phyllite, as above.

5,100-5,110  70% *Quartzite, as above.
           30% Phyllite, as above.

5,110-5,120  60% *Quartzite, white, fine grained; trace of pyrite
           and Phyllite/sericite partings.
           40% Phyllite, dark gray to black.

5,120-5,130  60% *Phyllite, as above; trace of pyrite.
           40% Quartzite, as above.

5,130-5,140  60% *Phyllite, as above.
           40% Quartzite, as above.

Trace of vein quartz?

5,140-5,150  60% *Quartzite, as above.
           40% Phyllite, as above.

Trace of Greenschist, light green, chlorite-sericite,
           very fine grained.

Trace of vein quartz.

5,150-5,160  50% *Quartzite, as above.
           30% Phyllite, dark gray, as above.
           20% Phyllite/Sericite Schist, light gray, very fine
           grained.

5,160-5,170  90% *Quartzite, white, vitreous, original grain
           boundaries obscure; trace of pyrite.
           10% Phyllite, dark gray, as above.

Trace of Phyllite/Sericite Schist and Greenschist, as
           above.

5,170-5,180  85% *Quartzite, as above; trace of pyrite.
           10% Phyllite/Sericite Schist, as above.
           5% Phyllite, dark gray, as above.

Trace of Greenschist (chlorite-sericite-quartz).

5,180-5,190  85% *Quartzite, as above; trace of pyrite.
           10% Phyllite/Sericite Schist.
           5% Phyllite, dark gray.

Trace of Greenschist, as above.
<table>
<thead>
<tr>
<th>Interval</th>
<th>Composition</th>
</tr>
</thead>
</table>
| 5,190-5,200  | 75% *Quartzite, as above.  
10% **Phyllite/Sericite Schist**, as above.  
10% **Phyllite**, dark gray, as above.  
5% **Greenschist**, calcareous, quartzitic? |
| 5,200-5,210  | 70% *Quartzite, as above; trace of pyrite.  
10% **Phyllite/Sericite Schist**, as above; slightly calcareous.  
10% **Phyllite**, dark gray, as above.  
10% **Greenschist**, slightly calcareous. |
| 5,210-5,220  | 80% *Quartzite, as above; trace of pyrite.  
10% **Phyllite/Sericite Schist**, as above.  
10% **Phyllite**, dark gray, as above.  
Trace of **Greenschist**, as above. |
| 5,220-5,230  | 90% *Quartzite, as above; trace of pyrite; slightly calcareous.  
5% **Phyllite/Sericite Schist**, as above.  
5% **Phyllite**, dark gray, as above.  
Trace of calcite in Quartzite or veinlets. |
| 5,230-5,240  | 80% *Quartzite, as above; trace of pyrite; slightly calcareous.  
15% **Phyllite/Sericite Schist**, as above.  
5% **Phyllite**, dark gray, as above. |
| 5,240-5,250  | 85% *Quartzite, as above; slightly calcareous; trace of pyrite.  
5% **Phyllite/Sericite Schist**, as above.  
3% **Phyllite**, dark gray, as above.  
5% **Greenschist**, as above. |
| 5,250-5,260  | 90% *Quartzite, as above; slightly calcareous.  
5% **Phyllite/Sericite Schist**, as above.  
5% **Phyllite**, dark gray, as above. |
| 5,260-5,270  | 90% *Quartzite, as above; slightly calcareous.  
5% **Phyllite/Sericite Schist**, as above.  
5% **Phyllite**, dark gray, as above. |
| 5,270-5,280  | 80% Quartzite, as above; trace of pyrite; locally calcareous; trace of biotite.  
10% **Phyllite**, dark gray, as above; pyritic.  
5% **Phyllite/Sericite Schist**, as above.  
5% **Greenschist**, as above. |
| 5,280-5,290  | 80% Quartzite, as above; trace of pyrite.  
15% **Phyllite**, dark gray, as above.  
5% **Phyllite/Sericite Schist**, as above.  
Trace of **Greenschist**, as above. |
5,290-5,300

Very fine cuttings. Probably not representative.

80% Quartzite, as above.

10% Phyllite, dark gray, as above.

10% Phyllite/Sericite Schist, as above.

Trace of Greenschist, as above.

5,300-5,310

60% Quartzite, as above; with disseminated red-brown biotite(?); trace of limonite stain; trace of pyrite.

20% Phyllite, dark gray, as above.

20% Phyllite/Sericite Schist, as above.

5,310-5,320

80% Quartzite, as above; trace of limonite stain and pyrite.

10% Phyllite, dark gray, as above.

10% Phyllite/Sericite Schist, as above.

Trace of emerald green Sericite Schist and large muscovite flakes (green is probably corrosion inhibitor).

5,320-5,330

80% Quartzite, as above; slightly calcareous.

10% Phyllite, dark gray, as above.

10% Sericite Schist/Phyllite, as above.

Trace of emerald green Sericite Schist, as above (green is probably corrosion inhibitor).

5,330-5,340

90% Quartzite, as above; sericite partings; trace of pyrite.

5% Phyllite/Sericite Schist, as above.

5% Phyllite, dark gray, as above.

Trace of emerald green Sericite Schist, as above (green is probably corrosion inhibitor).

5,340-5,350

90% Quartzite, as above.

10% Phyllite/Sericite Schist, as above.

Trace of emerald green Sericite Schist, (green is probably corrosion inhibitor).

5,350-5,360

95% Quartzite, as above.

5% Phyllite/Sericite Schist, light gray mottled with light emerald green, as above (green is probably corrosion inhibitor).

5,360-5,370

80% Quartzite, white, vitreous, grain size difficult to determine; as above; trace of sericite partings and disseminated pyrite.

20% Phyllite/Sericite Schist, light gray, fine grained, as above.

Trace of emerald green mottled Sericite Schist, as above (green is probably corrosion inhibitor).
5,370-5,380
80% Quartzite, as above; slightly calcareous; trace of pyrite.
20% Phyllite/Sericite Schist, as above; muscovite and trace of chlorite.
Trace of increasing light emerald green coloration in schist (probably green corrosion inhibitor).

5,380-5,390
80% Quartzite, as above; slightly calcareous; trace of white feldspar(?).
20% Phyllite/Sericite Schist, as above; trace of chlorite.
Trace of emerald green spotted Sericite Schist.

5,390-5,400
80% Quartzite, as above; slightly calcareous.
10% Phyllite, dark gray, as above.
10% Phyllite/Sericite Schist, as above.
Trace of emerald green Sericite Schist (probably corrosion inhibitor).

5,400-5,410
80% Quartzite, as above; trace of pyrite.
10% Phyllite, dark gray, as above.
10% Phyllite/Sericite Schist, as above.
Trace of emerald green Sericite Schist (probably corrosion inhibitor).

5,410-5,420
70% Quartzite, as above; trace of pyrite and limonite pseudomorphs after pyrite; limonite stain.
20% Phyllite/Sericite Schist, limonite stain, as above.
10% Phyllite, dark gray, as above; trace of pyrite.

5,420-5,430
60% Phyllite/Sericite Schist, as above; trace of chlorite and pyrite.
40% Quartzite, as above; trace of pyrite.
Trace of Phyllite, dark gray, as above.

5,430-5,440
60% Phyllite/Sericite Schist, as above; trace of pyrite and chlorite.
40% Quartzite, as above; slightly calcareous.
Trace of Phyllite, dark gray.

5,440-5,450
60% Phyllite/Sericite Schist, as above; light tan-gray, fine grained, well foliated, crinkled; trace of pyrite.
40% Quartzite, white, vitreous, some is very fine to fine grained, other lacks visible grains; trace of mica partings and pyrite; slightly calcareous.
Trace of emerald green Sericite Schist.

5,450-5,460
85% Phyllite/Sericite Schist, as above; trace of pyrite.
15% Quartzite, as above.
Trace of emerald green Sericite Schist.
<table>
<thead>
<tr>
<th>Depth Range</th>
<th>Phyllite/Sericite Schist, as above; trace of pyrite.</th>
<th>Quartzite, as above; slightly calcareous.</th>
</tr>
</thead>
<tbody>
<tr>
<td>5,460-5,470</td>
<td>85%</td>
<td>15%</td>
</tr>
<tr>
<td>5,470-5,480</td>
<td>40%</td>
<td>20% Greenschist, dark green, fine grained, (chlorite-sericite(?)).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>20% Phyllite/Schist, medium gray (sericite-biotite).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>20% Quartzite, as above; slightly calcareous.</td>
</tr>
<tr>
<td>5,480-5,490</td>
<td>40% Greenschist, as above.</td>
<td>20% Phyllite/Sericite Schist, as above; trace of pyrite.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>20% Phyllite/Schist, medium gray, as above.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>20% Quartzite, as above.</td>
</tr>
<tr>
<td></td>
<td>Note that the three types of Phyllite-Sericite Schist-Greenschist appear to intergrade with each other.</td>
<td></td>
</tr>
<tr>
<td>5,490-5,500</td>
<td>60% Greenschist, as above.</td>
<td>20% Phyllite/Sericite Schist, as above.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10% Phyllite/Schist, medium gray, as above.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10% Quartzite, as above.</td>
</tr>
<tr>
<td>5,500-5,510</td>
<td>50% Greenschist, as above; trace of pyrite.</td>
<td>30% Quartzite, as above.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>20% Phyllite/Sericite Schist, as above; trace of pyrite.</td>
</tr>
<tr>
<td>5,510-5,520</td>
<td>40% Phyllite/Sericite Schist, as above.</td>
<td>30% Greenschist, as above.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>30% Quartzite, as above; trace of pyrite and chlorite.</td>
</tr>
<tr>
<td>5,520-5,530</td>
<td>40% Phyllite/Sericite Schist, as above.</td>
<td>30% Greenschist, as above.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>30% Quartzite, as above.</td>
</tr>
<tr>
<td>5,530-5,540</td>
<td>40% Greenschist, as above.</td>
<td>30% Phyllite/Sericite Schist, as above.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>30% Quartzite, as above; calcareous.</td>
</tr>
<tr>
<td>5,540-5,550</td>
<td>50% Phyllite/Sericite Schist, as above.</td>
<td>30% Greenschist, as above.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>20% Quartzite, as above.</td>
</tr>
<tr>
<td>5,550-5,560</td>
<td>50% Phyllite/Sericite Schist, as above.</td>
<td>30% Quartzite, as above.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>20% Greenschist, as above.</td>
</tr>
<tr>
<td>5,560-5,570</td>
<td>N.S. Lost circulation at 5,585. Added lost circulation material and drilled ahead with partial returns, bypassing shakers to 5,666.</td>
<td></td>
</tr>
<tr>
<td>5,570-5,580</td>
<td>N.S.</td>
<td></td>
</tr>
<tr>
<td>5,580-5,590</td>
<td>N.S.</td>
<td></td>
</tr>
<tr>
<td>5,590-5,600</td>
<td>N.S.</td>
<td></td>
</tr>
<tr>
<td>Depth Range</td>
<td>Note</td>
<td></td>
</tr>
<tr>
<td>-------------</td>
<td>------</td>
<td></td>
</tr>
<tr>
<td>5,600-5,610</td>
<td>N.S.</td>
<td></td>
</tr>
<tr>
<td>5,610-5,620</td>
<td>N.S.</td>
<td></td>
</tr>
<tr>
<td>5,620-5,630</td>
<td>N.S.</td>
<td></td>
</tr>
<tr>
<td>5,630-5,640</td>
<td>N.S.</td>
<td></td>
</tr>
<tr>
<td>5,640-5,650</td>
<td>N.S.</td>
<td></td>
</tr>
<tr>
<td>5,650-5,660</td>
<td>N.S.</td>
<td></td>
</tr>
<tr>
<td>5,660-5,670</td>
<td>Drilled to 5,666. Set cement plugs. Drilled out cement and drilled to 5,713 with partial returns. Poor quality sample. 30% Quartzite, white, fine grained, some with abundant calcite cement in patches; or some grains of marble(?). 30% Phyllite/Sericite Schist, light gray. 30% Calcite or Marble, white, fine grained, granular. 10% Cement. Trace of Phyllite, dark gray. Trace of Greenschist, light green (chlorite-sericite).</td>
<td></td>
</tr>
<tr>
<td>5,670-5,680</td>
<td>N.S. Drilling without returns.</td>
<td></td>
</tr>
<tr>
<td>5,680-5,690</td>
<td>N.S. Set cement plug. Drilled out cement but apparently drilled off the plug.</td>
<td></td>
</tr>
<tr>
<td>5,690-5,700</td>
<td>N.S.</td>
<td></td>
</tr>
<tr>
<td>5,700-5,710</td>
<td>40% Cement. 30% Marble(?), very fine crystalline, sugary, microvugs; calcite and dolomite(?); trace of pyrite. 20% Phyllite, medium to dark gray. 10% Quartzite, white, vitreous, or vein quartz. Trace of Greenschist (chlorite-sericite).</td>
<td></td>
</tr>
<tr>
<td>5,710-5,720</td>
<td>40% Cement. 30% Phyllite, dark gray, as above. 20% Marble(?), calcite/dolomite(?), as above. 10% Quartzite or Quartz, as above.</td>
<td></td>
</tr>
<tr>
<td>5,720-5,730</td>
<td>30% Marble(?), as above; dolomite(?)/calcite. 30% Phyllite, dark gray, as above. 20% Phyllite/Sericite Schist, light gray. 20% Quartzite or vein quartz, as above.</td>
<td></td>
</tr>
<tr>
<td>5,730-5,740</td>
<td>50% Marble(?), as above; (dolomite?/calcite), sandy(?). 20% Phyllite/Sericite Schist, as above. 20% Quartzite or Quartz, as above. 10% Phyllite, dark gray, microlaminated with Quartzite Siltstone. Trace of Greenschist, as above.</td>
<td></td>
</tr>
<tr>
<td>Range</td>
<td>Composition</td>
<td></td>
</tr>
<tr>
<td>------------</td>
<td>-----------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>5,740-5,750</td>
<td>40% Marble(?), as above; (dolomite(?)/calcite).</td>
<td></td>
</tr>
<tr>
<td></td>
<td>30% Quartzite or Quartz, as above.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>20% Phyllite, dark gray, as above.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>10% Phyllite/Sericite Schist, as above.</td>
<td></td>
</tr>
<tr>
<td>5,750-5,760</td>
<td>60% Marble(?), as above; (calcite/dolomite(?)).</td>
<td></td>
</tr>
<tr>
<td></td>
<td>20% Phyllite/Sericite Schist, as above.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>10% Quartzite, as above.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>10% Phyllite, dark gray, as above.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Trace of Greenschist, as above.</td>
<td></td>
</tr>
<tr>
<td>5,760-5,770</td>
<td>60% Marble(?), as above; (calcite/dolomite(?)).</td>
<td></td>
</tr>
<tr>
<td></td>
<td>20% Phyllite/Sericite Schist, as above.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>10% Phyllite, dark gray, as above.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>10% Greenschist, as above</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Trace of Quartzite, as above.</td>
<td></td>
</tr>
<tr>
<td>5,770-5,780</td>
<td>30% Phyllite/Sericite Schist, as above.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>30% Marble(?), as above; (calcite).</td>
<td></td>
</tr>
<tr>
<td></td>
<td>20% Greenschist, as above.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>20% Phyllite, dark gray.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Trace of cement.</td>
<td></td>
</tr>
<tr>
<td>5,780-5,790</td>
<td>40% Marble(?), as above; (calcite and minor sericite and chlorite).</td>
<td></td>
</tr>
<tr>
<td></td>
<td>30% Phyllite/Sericite Schist, as above.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>20% Greenschist, as above.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>10% Phyllite, dark gray, as above.</td>
<td></td>
</tr>
<tr>
<td>5,790-5,800</td>
<td>50% Greenschist, as above (chlorite-sericite) with calcareous laminations; trace of pyrite.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>40% Marble, as above; trace of pyrite.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>10% Phyllite/Sericite Schist, as above.</td>
<td></td>
</tr>
<tr>
<td>5,800-5,810</td>
<td>50% Marble, as above; mainly calcite.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>50% Greenschist, as above; interlaminated with marble.</td>
<td></td>
</tr>
<tr>
<td>5,810-5,820</td>
<td>50% Marble, as above.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>30% Greenschist, as above.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>20% Phyllite/Sericite Schist, as above.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Trace of vein quartz.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Trace of Phyllite, dark gray.</td>
<td></td>
</tr>
<tr>
<td>5,820-5,830</td>
<td>60% Marble, as above.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>20% Greenschist, as above.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>20% Phyllite/Sericite Schist, as above.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Trace of Marble, medium gray, fine crystalline, trace of gray mica, pyrite.</td>
<td></td>
</tr>
<tr>
<td>5,830-5,840</td>
<td>40% Marble, gray, fine crystalline, as above.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>30% Marble, white, as above.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>20% Phyllite/Sericite Schist, as above.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>10% Greenschist, as above.</td>
<td></td>
</tr>
</tbody>
</table>

A-43
<table>
<thead>
<tr>
<th>Interval</th>
<th>Percentage</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>5,840-5,850</td>
<td>40%</td>
<td>Marble, white, as above.</td>
</tr>
<tr>
<td></td>
<td>20%</td>
<td>Marble, gray, as above.</td>
</tr>
<tr>
<td></td>
<td>30%</td>
<td>Phyllite/Sericite Schist, as above.</td>
</tr>
<tr>
<td></td>
<td>10%</td>
<td>Greenschist, as above.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Trace of vein quartz.</td>
</tr>
<tr>
<td>5,850-5,860</td>
<td>60%</td>
<td>Marble, white, as above; dolomitic(?);</td>
</tr>
<tr>
<td></td>
<td></td>
<td>trace of pyrite.</td>
</tr>
<tr>
<td></td>
<td>40%</td>
<td>Phyllite/Sericite Schist, as above.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Trace of vein quartz.</td>
</tr>
<tr>
<td>5,860-5,870</td>
<td>40%</td>
<td>Marble, medium gray, calcitic, as above.</td>
</tr>
<tr>
<td></td>
<td>30%</td>
<td>Marble, white, dolomitic, as above.</td>
</tr>
<tr>
<td></td>
<td>30%</td>
<td>Phyllite/Sericite Schist, as above.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Trace of vein quartz.</td>
</tr>
<tr>
<td>5,870-5,880</td>
<td>30%</td>
<td>Marble, medium gray, as above.</td>
</tr>
<tr>
<td></td>
<td>20%</td>
<td>Marble, white, dolomitic, as above.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Minerals in the Marble(? 5,660+ to 5,880 are difficult to identify. Calcite is present in varying abundance. Quartz and dolomite are also probably present.</td>
</tr>
<tr>
<td></td>
<td>30%</td>
<td>Quartzite, white, vitreous, fine to medium grained.</td>
</tr>
<tr>
<td></td>
<td>15%</td>
<td>Phyllite/Sericite Schist, as above.</td>
</tr>
<tr>
<td></td>
<td>5%</td>
<td>Greenschist, light green (sericite-chlorite).</td>
</tr>
<tr>
<td>5,880-5,890</td>
<td>70%</td>
<td>Quartzite, as above; trace of interstitial pyrite.</td>
</tr>
<tr>
<td></td>
<td>20%</td>
<td>Marble, medium gray, as above.</td>
</tr>
<tr>
<td></td>
<td>10%</td>
<td>Phyllite/Sericite Schist, as above.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Trace of Greenschist, as above.</td>
</tr>
<tr>
<td>5,890-5,900</td>
<td>50%</td>
<td>Quartzite, as above.</td>
</tr>
<tr>
<td></td>
<td>30%</td>
<td>Marble, as above.</td>
</tr>
<tr>
<td></td>
<td>10%</td>
<td>Phyllite, dark gray.</td>
</tr>
<tr>
<td></td>
<td>10%</td>
<td>Phyllite/Sericite Schist, as above.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Trace of Greenschist, as above.</td>
</tr>
<tr>
<td>5,900-5,910</td>
<td>80%</td>
<td>Quartzite, as above; trace of pyrite.</td>
</tr>
<tr>
<td></td>
<td>10%</td>
<td>Marble, as above; dolomitic.</td>
</tr>
<tr>
<td></td>
<td>5%</td>
<td>Phyllite, dark gray, as above.</td>
</tr>
<tr>
<td></td>
<td>5%</td>
<td>Greenschist, as above.</td>
</tr>
<tr>
<td>5,910-5,920</td>
<td>60%</td>
<td>Quartzite, as above; trace of pyrite.</td>
</tr>
<tr>
<td></td>
<td>20%</td>
<td>Marble, as above.</td>
</tr>
<tr>
<td></td>
<td>10%</td>
<td>Phyllite, dark gray, as above.</td>
</tr>
<tr>
<td></td>
<td>10%</td>
<td>Greenschist, as above.</td>
</tr>
<tr>
<td>5,920-5,930</td>
<td>85%</td>
<td>Quartzite, as above.</td>
</tr>
<tr>
<td></td>
<td>10%</td>
<td>Phyllite/Sericite Schist, as above.</td>
</tr>
<tr>
<td></td>
<td>5%</td>
<td>Marble, as above.</td>
</tr>
<tr>
<td>5,930-5,940</td>
<td>90%</td>
<td>Quartzite, as above; trace of pyrite.</td>
</tr>
<tr>
<td></td>
<td>5%</td>
<td>Phyllite/Sericite Schist, as above.</td>
</tr>
<tr>
<td></td>
<td>5%</td>
<td>Marble, as above.</td>
</tr>
</tbody>
</table>
5,940-5,950
90% Quartzite, as above.
5% Marble, as above.
5% Phyllite/Sericite Schist, as above.
Trace of Greenschist, as above.

5,950-5,960
95% Quartzite, as above; trace of pyrite.
5% Phyllite, dark gray, as above.

5,960-5,970
95% Quartzite, as above.
5% Phyllite/Sericite Schist, as above.

5,970-5,980
90% Quartzite, as above.
10% Phyllite/Sericite Schist, as above.

5,980-5,990
95% Quartzite, as above; trace of pyrite.
5% Phyllite/Sericite Schist, as above.
Trace of Greenschist, as above.

5,990-6,000
95% Quartzite, as above.
5% Phyllite/Sericite Schist, as above.

6,000-6,010
95% Quartzite, as above.
5% Phyllite/Sericite Schist, as above.

6,010-6,020
90% Quartzite, as above.
10% Phyllite, dark gray, probably partings in quartzite.

6,020-6,030
85% Quartzite, as above; trace of pyrite.
15% Phyllite, dark gray, as above.

6,030-6,040
95% Quartzite, white, vitreous, fine to medium grained; trace of interstitial pyrite; slightly calcareous.
5% Phyllite/Sericite Schist, light to medium gray.
Trace of Marble, light to medium gray, fine grained.

6,040-6,050
95% Quartzite, as above.
5% Phyllite/Sericite Schist, as above.
Trace of Greenschist (chlorite-sericite), as above.

6,050-6,060
90% Quartzite, as above.
10% Phyllite/Sericite Schist, as above.

6,060-6,070
95% Quartzite, as above.
5% Phyllite/Sericite Schist, as above.
Trace of Marble, as above.

6,070-6,080
75% Quartzite, as above.
5% Cement (caving).
5% Greenschist, as above.
5% Phyllite/Sericite Schist, as above.
Trace of Marble, as above.
6,080-6,090  
80% Quartzite, as above.
10% Phyllite, dark gray, as above.
5% Phyllite/Sericite Schist, as above.
5% Marble, as above.

6,090-6,100  
90% Quartzite, as above.
5% Phyllite, dark gray, as above.
5% Phyllite/Sericite Schist, as above.

6,100-6,110  
85% Quartzite, as above.
10% Phyllite/Sericite Schist, as above.
5% Greenschist, light green (chlorite-sericite).

6,110-6,120  
85% Quartzite, as above.
5% Phyllite, dark gray, as above.
5% Phyllite/Sericite Schist, as above.
5% Greenschist, as above.
Trace of Marble, medium gray, as above.

6,120-6,130  
90% Quartzite, as above.
5% Phyllite, dark gray, as above.
5% Phyllite/Sericite Schist, as above.

6,130-6,140  
85% Quartzite, as above.
10% Phyllite, dark gray, as above.
5% Phyllite/Sericite Schist, as above.
Trace of Marble, gray and white.
Trace of Greenschist, as above.

6,140-6,150  
90% Quartzite, as above.
10% Phyllite, medium gray.
Trace of Greenschist, as above.

6,150-6,160  
90% Quartzite, white, vitreous, slightly calcareous, as above (but with some medium and coarse grained).
10% Phyllite, light and medium gray, as above.
Trace of Greenschist, as above.

6,160-6,170  
95% Quartzite, as above.
5% Phyllite, as above.

6,170-6,180  
95% Quartzite, as above.
5% Phyllite/Sericite Schist, light gray.
Trace of Greenschist, as above.

6,180-6,190  
100% Quartzite, as above; trace of pyrite.
Trace of Greenschist, as above.
Trace of Phyllite, dark grey.

6,190-6,200  
100% Quartzite, white, as above; with trace of pyrite.
Trace of Phyllite, Greenschist, and lost circulation material.
6,200-6,210 100% Quartzite, as above; trace of pyrite.
Trace of Phyllite, dark gray, as above.
Trace ofGreenschist, Sericite Schist.

6,210-6,220 100% Quartzite, as above; trace of pyrite cubes.
Trace ofSericite Schist, as above.
Trace of Phyllite andGreenschist; as above.

6,220-6,230 100% Quartzite, as above.
Trace ofSericite Schist, as above.
Trace ofGreenschist, as above.

6,230-6,240 100% Quartzite, as above.
Trace ofSericite Schist, as above.

6,240-6,250 100% Quartzite, as above.
Trace ofSericite Schist, as above.
Trace of calcite and pyrite.

6,250-6,260 100% Quartzite, as above; with trace of pyrite.
Trace ofSericite Schist, as above.
Trace ofPhyllite, as above.

6,260-6,270 100% Quartzite, as above.
Trace ofSericite Schist, as above.
Trace ofGreenschist, Phyllite, and pyrite.

6,270-6,280 100% Quartzite, as above.
Trace ofSericite Schist, as above.
Trace of pyrite, Phyllite, andGreenschist.

6,280-6,290 100% Quartzite, as above.
Trace ofSchist, Greenschist, andPhyllite.

6,290-6,300 100% Quartzite, as above; trace of pyrite.
Trace ofPhyllite, Sericite Schist, andGreenschist.

6,300-6,310 100% Quartzite, as above.
Trace ofPhyllite, dark gray, as above.
Trace ofGreenschist, Sericite Schist.

6,310-6,320 100% Quartzite, as above; trace of pyrite.
Trace ofSericite Schist andPhyllite, as above.

6,320-6,330 100% Quartzite, as above.
Trace ofSericite Schist/Phyllite andGreenschist, calcite.

6,330-6,340 100% Quartzite, white, as above.
Trace ofSericite Schist/Phyllite andGreenschist, as above.

6,340-6,350 100% Quartzite, as above.
Trace ofPhyllite/Sericite Schist andGreenschist, as above.
6,350-6,360 100% Quartzite, as above. 
Trace of Sericite Schist/Phyllite and Greenschist, as above.

6,360-6,370 100% Quartzite, as above. 
Trace of Phyllite/Sericite Schist, as above. 
Trace of pyrite, calcite and Greenschist.

6,370-6,380 100% Quartzite, as above. 
Trace of Phyllite, Sericite Schist and Greenschist; contaminated with lost circulation materials and trace of metal filings.

6,380-6,390 100% Quartzite, as above. 
Trace of Phyllite, Sericite Schist, as above; contaminated with lost circulation material and metal fragments, as above.

6,390-6,400 100% Quartzite, as above. 
Trace of Sericite Schist, Greenschist and Phyllite; contaminated with lost circulation material and metal fragments.

6,400-6,410 100% Quartzite, as above. 
Trace of Sericite Schist/Greenschist and Phyllite. 
Trace of white, very soft, granular, "slickensided", origin?

6,410-6,420 100% Quartzite, as above. 
Trace of Sericite Schist, white, as above. 
Trace of Phyllite and Greenschist, as above. 
Trace of white powdery, very soft mineral, origin(?)..

6,420-6,430 100% Quartzite, as above. 
Trace of Sericite Schist, white, as above. 
Trace of Phyllite/Greenschist, as above. 
Trace of white, powdery mineral, as above.

6,430-6,440 100% Quartzite, as above. 
Trace of Sericite Schist, as above. 
Trace of Greenschist, as above. 
Trace of soft, white mineral, as above. 
Trace of Phyllite. 
Contaminated with lost circulation material.

6,440-6,450 100% Quartzite, as above. 
Trace of Sericite Schist/Phyllite and soft, white mineral, as above.

6,450-6,460 100% Quartzite, as above. 
Trace of Sericite Schist/Phyllite and Greenschist. 
Trace of soft, white material. 
Very dirty sample, with abundant lost circulation material. Mudloggers said it was collected after the trip. (6,454)
6,460-6,470 100% Quartzite, white, as above.
Trace of Sericite Schist/Phyllite.
Trace of soft, white mineral.

6,470-6,480 100% Quartzite, white, as above.
Trace of Sericite Schist/Phyllite.
Trace of soft, white mineral.

6,480-6,490 100% Quartzite, as above.
Trace of soft, white mineral.
Trace of Sericite Schist/Phyllite.

6,490-6,500 100% Quartzite, white, vitreous, fine grained, as above.
Trace of Phyllite/Sericite Schist, as above.
Trace of soft, white, granular mineral aggregate with microscopic veinlet of pyrite(?).
Trace of cement, soft.

6,500-6,510 95% Quartzite, as above; trace of pyrite.
5% Phyllite/Sericite Schist, as above.
Trace of cement and lost circulation material.

6,510-6,520 100% Quartzite, as above.
Trace of Phyllite/Sericite Schist, as above.
Trace of soft, white mineral, granular, slickensided, as above.

6,520-6,530 100% Quartzite, as above.
Trace of Phyllite/Sericite Schist, dark gray Phyllite and Marble; calcite.
Trace of white, granular, slickensided, as above (origin?).
Trace of cement.

6,530-6,540 100% Quartzite, as above.
Trace of Phyllite/Sericite Schist, gray Phyllite, as above.
Trace of white, granular mineral (origin?).

6,540-6,550 95% Quartzite, as above; trace of pyrite.
5% Phyllite/Sericite Schist, as above.
Trace of Greenschist and Phyllite, dark gray, as above.

6,550-6,560 100% Quartzite, as above.
Trace of Phyllite/Sericite Schist, Phyllite, gray; and Greenschist, as above.
Trace of cement.

6,560-6,570 100% Quartzite, as above; trace of pyrite.
Trace of Phyllite/Sericite Schist; Phyllite, dark gray; and Greenschist, as above.
Trace of white, granular, "mineral", as above; appears to be coating metal shavings.

6,570-6,580 95% Quartzite, as above; trace of pyrite.
5% Phyllite/Sericite Schist, as above.
Trace of Phyllite, dark gray; Greenschist; calcite.
6,580-6,590
95% Quartzite, as above.
5% Phyllite/Sericite Schist, as above.

6,590-6,600
95% Quartzite, as above.
5% Phyllite/Sericite Schist, as above.

6,600-6,610
100% Quartzite, as above.
Trace of Phyllite/Sericite Schist, as above.
Trace of white granular "mineral", as above.

6,610-6,620
100% Quartzite, as above; trace of pyrite.
Trace of Phyllite/Sericite Schist, as above.

6,620-6,630
100% Quartzite, as above.
Trace of Phyllite/Sericite Schist, as above.

6,630-6,640
100% Quartzite, as above; trace of pyrite.
Trace of Phyllite/Sericite Schist; Phyllite, dark gray, as above.

6,640-6,650
95% Quartzite, as above; trace of pyrite.
5% Phyllite/Sericite Schist, as above.
Trace of Phyllite, dark gray; Greenschist; calcite.

6,650-6,660
100% Quartzite, as above.
Trace of Phyllite/Sericite Schist, Greenschist.
Much lost circulation material (fiber, scrap mica).

6,660-6,670
100% Quartzite, as above.
Trace of Phyllite/Sericite Schist; Phyllite, gray; cement.

6,670-6,680
100% Quartzite, as above; trace of pyrite.
Trace of Phyllite/Sericite Schist, Greenschist, calcite.

6,680-6,690
100% Quartzite, as above.
Trace of Phyllite/Sericite Schist, Greenschist, calcite.

6,690-6,700
100% Quartzite, as above.
Trace of Phyllite/Sericite Schist; Phyllite, gray; calcite.

6,700-6,710
100% Quartzite, as above; trace of pyrite.
Trace of Phyllite/Sericite Schist; Phyllite, gray; calcite.

6,710-6,720
100% Quartzite, as above; trace of pyrite.
Trace of Phyllite/Sericite Schist; Phyllite, gray; calcite.

6,720-6,730
100% Quartzite, as above; trace of pyrite.
Trace of Phyllite/Sericite Schist; calcite.

6,730-6,740
100% Quartzite, as above.
Trace of Phyllite/Sericite Schist; Phyllite, gray; calcite.
6,740-6,750  100% Quartzite, as above.
Trace of **Phyllite/Sericite Schist**; Greenschist; Phyllite, dark gray.

6,750-6,760  100% Quartzite, as above.
Trace of **Phyllite/Sericite Schist**, as above.

6,760-6,770  100% Quartzite, as above.
Trace of **Greenschist** and **Phyllite/Sericite Schist**; calcite.

6,770-6,780  100% Quartzite, as above; trace of pyrite.
Trace of Quartzite, very fine, biotite rich; **Phyllite/Sericite Schist** and **Greenschist**; calcite.

6,780-6,790  100% Quartzite, as above; trace of pyrite.
Trace of **Phyllite/Sericite Schist**; calcite.

6,790-6,800  100% Quartzite, as above; trace of pyrite.
Trace of **Phyllite/Sericite Schist**; calcite.

6,800-6,810  100% Quartzite, as above.
Trace of **Phyllite**, gray; calcite.

6,810-6,820  100% Quartzite, as above.
Trace of **Phyllite/Sericite Schist**; **Greenschist**, as above.

6,820-6,830  100% Quartzite, as above.
Trace of **Phyllite/Sericite Schist**; Phyllite, gray; calcite.

6,830-6,840  100% Quartzite, as above; trace of pyrite.
Trace of **Phyllite/Sericite Schist**; calcite.

6,840-6,850  100% Quartzite, as above; trace of pyrite.
Trace of **Greenschist**; **Phyllite/Sericite Schist**; calcite.

6,850-6,860  100% Quartzite, as above.
Trace of **Phyllite/Sericite Schist**; calcite.

6,860-6,870  100% Quartzite, as above.
Trace of **Phyllite/Sericite Schist**; calcite.

6,870-6,880  Poor sample -- cuttings are sand size.
100% Quartzite, as above.
Trace of **Phyllite/Sericite Schist**; **Greenschist**; calcite.

A-51
6,880-6,890 100% Quartzite, as above. 
Trace of Phyllite, dark gray; calcite.

6,890-6,900 100% Quartzite, as above; trace of pyrite. 
Trace of Phyllite/Sericite Schist; Quartzite, very fine grained, biotite-rich; Marble, light gray; calcite.

6,900-6,910 100% Quartzite, as above; trace of pyrite. 
Trace of Greenschist; Phyllite/Sericite Schist; calcite.

6,910-6,920 100% Quartzite, as above. 
Trace of Phyllite, dark gray; Phyllite/Sericite Schist; calcite.

6,920-6,930 100% Quartzite, as above. 
Trace of Phyllite/Sericite Schist; Phyllite, dark gray; calcite.

6,930-6,940 100% Quartzite, as above. 
Trace of Phyllite/Sericite Schist; calcite.

6,940-6,950 100% Quartzite, as above. 
Trace of Phyllite/Sericite Schist; Phyllite, gray, pyritic.

6,950-6,960 100% Quartzite, as above. 
Trace of Quartzite with sericite partings.

6,960-6,970 100% Quartzite, as above; trace of pyrite; occasional clasts are pale milky-blue. 
Trace of Phyllite/Sericite Schist; Phyllite, dark gray; calcite.

6,970-6,980 100% Quartzite, as above. 
Trace of Phyllite/Sericite Schist; calcite.

6,980-6,990 100% Quartzite, as above. 
Trace of Phyllite/Sericite Schist; calcite.

6,990-7,000 100% Quartzite, as above; trace of pyrite. 
Trace of Phyllite/Sericite Schist; calcite.

7,000-7,010 100% Quartzite, as above; trace of pyrite. 
Trace of Phyllite/Sericite Schist; calcite.

7,010-7,020 100% Quartzite, as above; trace of pyrite. 
Trace of Phyllite/Sericite Schist, spotted with green (contamination from nickel chloride anti-corrosion chemical?).

7,020-7,030 100% Quartzite, as above. 
Trace of Phyllite/Sericite Schist, as above, with trace of emerald green contamination(?); Phyllite, dark gray; Greenschist.

A-52
7,030-7,040
100% Quartzite, as above.
Trace of Phyllite/Sericite Schist; calcite.

7,040-7,050
100% Quartzite, as above; trace of pyrite.
Trace of Phyllite/Sericite Schist; trace of pyrite; calcite.

7,050-7,060
100% Quartzite, as above.
Trace of Phyllite/Sericite Schist; Quartzite with biotite; Phyllite, dark gray; calcite.

7,060-7,070
100% Quartzite, as above.
Trace of Phyllite/Sericite Schist; calcite.

7,070-7,080
100% Quartzite, as above.
Trace of Phyllite/Sericite Schist; calcite.

7,080-7,090
100% Quartzite, as above; white, glassy, slightly milky; fine to medium and possibly coarse grains, fair to poor sorting(?); slightly calcareous.

7,090-7,100
100% Quartzite, as above; trace of pyrite.
Trace of Phyllite/Sericite Schist; calcite.

7,100-7,110
100% Quartzite, as above.
Trace of Phyllite/Sericite Schist; Greenschist; Metadiabase (caving).

7,110-7,120
100% Quartzite, as above.
Trace of Sericite Schist, white, very finely crystalline; probably laminations in quartzite.

7,120-7,130
95% Quartzite, as above.
5% Phyllite/Sericite Schist, white yellow-tan, as above.

7,130-7,140
100% Quartzite, as above.
Trace of Phyllite/Sericite Schist, as above.

7,140-7,150
100% Quartzite, as above; trace of pyrite.
Trace of Phyllite/Sericite Schist interlaminated in Quartzite; calcite.

7,150-7,160
100% Quartzite, as above; trace of pyrite.
Trace of Phyllite/Sericite Schist, as above.

7,160-7,170
100% Quartzite, as above.
Trace of Phyllite/Sericite Schist; calcite.

7,170-7,180
100% Quartzite, as above; trace of pyrite.
Trace of Phyllite/Sericite Schist; calcite.

7,180-7,190
100% Quartzite, as above.
Trace of Phyllite/Sericite Schist; calcite.
7,190-7,200 100% Quartzite, as above.
Trace of Phyllite/Sericite Schist; biotite-quartzite, very fine grained.

7,200-7,210 100% Quartzite, as above; trace of pyrite.
Trace of Phyllite/Sericite Schist; Greenschist; calcite.

7,210-7,220 100% Quartzite, as above.
Trace of Phyllite/Sericite Schist; Greenschist; calcite.

7,220-7,230 100% Quartzite, as above; trace of pyrite.
Trace of Phyllite/Sericite Schist; Greenschist; calcite.

7,230-7,240 100% Quartzite, as above.
Trace of Phyllite/Sericite Schist.
Trace of bright green stain (NiCl$_3$?).

7,240-7,250 100% Quartzite, as above; trace of pyrite
Trace of Phyllite/Sericite Schist, calcite.

7,250-7,260 95% Quartzite, as above.
5% Phyllite/Sericite Schist, as above.

7,260-7,270 95% Quartzite, as above.
5% Phyllite/Sericite Schist, as above.

7,270-7,280 95% Quartzite, as above.
5% Phyllite/Sericite Schist, as above.
Trace of Marble, gray; Phyllite, dark gray;
Greenschist (caving).

7,280-7,290 95% Quartzite, as above.
5% Phyllite, dark gray, probably as thin inter-
beds in Quartzite.
Trace of Phyllite/Sericite Schist; Greenschist;
calcite.

7,290-7,300 Poor, very fine cuttings.
100% Quartzite, as above.
Trace of Phyllite/Sericite Schist; Phyllite, dark
gray; calcite.

7,300-7,310 100% Quartzite, as above; trace of pyrite.
Trace of Phyllite/Sericite Schist; Phyllite, dark
gray; calcite.

7,310-7,320 100% Quartzite, as above; trace of pyrite.
Trace of Phyllite/Sericite Schist; Phyllite, dark
gray; Quartzite, fine grained with abundant
biotite; calcite.

7,320-7,330 100% Quartzite, as above.
Trace of Phyllite/Sericite Schist; calcite.
7,330-7,340 100% Quartzite, as above. 
Trace of Phyllite/Sericite Schist; Phyllite, dark gray; calcite.

7,340-7,350 100% Quartzite, as above. 
Trace of Phyllite/Sericite Schist; calcite.

7,350-7,360 95% Quartzite, as above. 
5% Phyllite/Sericite Schist, as above; trace of pyrite; calcite.

7,360-7,370 100% Quartzite, as above. 
Trace of Phyllite/Sericite Schist interlaminated in the Quartzite; calcite.

7,370-7,380 100% Quartzite, as above; trace of pyrite. 
Trace of Phyllite/Sericite Schist, as above.

7,380-7,390 95% Quartzite, as above. 
5% Phyllite/Sericite Schist, as above. 
Trace of Phyllite, gray; Greenschist; calcite.

7,390-7,400 100% Quartzite, as above. 
Trace of Phyllite/Sericite Schist; calcite.

7,400-7,410 100% Quartzite, as above; trace of pyrite. 
Trace of Phyllite/Sericite Schist; calcite.

7,410-7,420 95% Quartzite, as above. 
5% Phyllite/Sericite Schist; calcite.

7,420-7,430 100% Quartzite, as above. 
Trace of Phyllite/Sericite Schist, as above.

7,430-7,440 100% Quartzite, as above. 
Trace of Phyllite/Sericite Schist, as above; calcite.

7,440-7,450 100% Quartzite, as above. 
Trace of Phyllite/Sericite Schist; Phyllite, dark gray; Greenschist.

7,450-7,460 100% Quartzite, as above; trace of bright green stain (corrosion retardant?) 
Trace of Phyllite/Sericite Schist; Phyllite, dark gray; calcite.

7,460-7,470 100% Quartzite, as above.

7,470-7,480 100% Quartzite, as above. 
Trace of Phyllite, dark gray; calcite.

7,480-7,490 100% Quartzite, as above.
100% Quartzite, as above; trace of pyrite.  
Trace of Phyllite, dark gray; Phyllite/Sericite Schist; calcite.

7,510-7,520 100% Quartzite, as above.  
Trace of Phyllite/Sericite Schist; Greenschist; calcite.

7,520-7,530 100% Quartzite, as above; trace of pyrite.  
Trace of Phyllite/Sericite Schist; calcite.

7,530-7,540 100% Quartzite, as above; trace of pyrite, trace of emerald green stain (stain of NiCl3?).  
Trace of Phyllite, dark gray; Phyllite/Sericite Schist; calcite.

7,540-7,550 100% Quartzite, as above; trace of Sericite, pyrite and bright green stain.  
Trace of Phyllite/Sericite Schist; dark gray, fine grained Phyllite; Marble, gray; calcite.

7,550-7,560 100% Quartzite, as above; trace of pyrite, bright green stain.  
Trace of Phyllite/Sericite Schist; Greenschist; calcite.

7,560-7,570 100% Quartzite, as above; trace of green stain.  
Trace of Phyllite/Sericite Schist; Phyllite, dark gray; calcite.

7,570-7,580 100% Quartzite, as above; with trace of green stain (NiCl3?).  
Trace of Phyllite, dark gray; Phyllite/Sericite Schist; calcite.

7,580-7,590 100% Quartzite, as above.  
Trace of Phyllite/Sericite Schist; Phyllite, dark gray; Greenschist; calcite.

7,590-7,600 100% Quartzite, as above; trace of pyrite.  
Trace of Phyllite/Sericite Schist; Phyllite, dark gray; calcite.

7,600-7,610 100% Quartzite, as above.  
Trace of Phyllite, gray; Phyllite/Sericite Schist; calcite.

7,610-7,620 100% Quartzite, as above.  
Trace of Phyllite/Sericite Schist; Greenschist; calcite.
7,620-7,630 100% Quartzite, as above.
Trace of Phyllite/Sericite Schist; Phyllite, dark gray; calcite.

7,630-7,640 100% Quartzite, as above; trace of bright green stain.
Trace of Phyllite/Sericite Schist; Phyllite, dark gray; calcite.

7,640-7,650 100% Quartzite, as above.
Trace of Phyllite/Sericite Schist; calcite.

7,650-7,660 100% Quartzite, as above.
Trace of Phyllite/Sericite Schist; Phyllite, dark gray; calcite.

7,660-7,670 100% Quartzite, as above.
Trace of Phyllite/Sericite Schist; calcite.

7,670-7,680 100% Quartzite, as above.
Trace of Phyllite/Sericite Schist; calcite.

7,680-7,690 100% Quartzite, as above; trace of green stain.
Trace of calcite.

7,690-7,700 100% Quartzite, as above; trace of green stain.
Trace of Phyllite/Sericite Schist; calcite.

7,700-7,710 100% Quartzite, as above; trace of green stain.
Trace of Phyllite/Sericite Schist; calcite.

7,710-7,720 100% Quartzite, as above; trace of pyrite.
Trace of Phyllite/Sericite Schist; calcite.

7,720-7,730 100% Quartzite, as above; trace of pyrite.
Trace of Phyllite/Sericite Schist; calcite.

7,730-7,740 100% Quartzite, as above; trace of gray mica partings; pyrite.
Trace of Phyllite/Sericite Schist, bright green stain; calcite.

7,740-7,750 100% Quartzite, as above.
Trace of Phyllite/Sericite Schist; calcite.

7,750-7,760 100% Quartzite, as above; trace of pyrite.
Trace of Phyllite/Sericite Schist; Phyllite, dark gray; calcite.

7,760-7,770 100% Quartzite, as above; trace of pyrite.
Trace of Phyllite/Sericite Schist; calcite; bright green stain.

7,770-7,780 100% Quartzite, as above; trace of pyrite.
Trace of Phyllite/Sericite Schist; calcite.

7,780-7,790 100% Quartzite, as above.
Trace of Phyllite/Sericite Schist.
7,790-7,800 100% Quartzite, as above; trace of pyrite. Trace of Phyllite/Sericite Schist (as partings in quartzite).

7,800-7,810 100% Quartzite, as above. Trace of Phyllite/Sericite Schist; calcite.

7,810-7,820 100% Quartzite, as above. Trace of Phyllite/Sericite Schist.

7,820-7,830 100% Quartzite, as above. Trace of Phyllite/Sericite Schist.

7,830-7,840 100% Quartzite, as above; trace of pyrite. Trace of Phyllite/Sericite Schist.

7,840-7,850 100% Quartzite, as above. Trace of Phyllite/Sericite Schist.

7,850-7,860 100% Quartzite, as above. Trace of Phyllite/Sericite Schist; Phyllite, dark gray.

7,860-7,870 100% Quartzite, as above; trace of pyrite. Trace of Phyllite/Sericite Schist; Phyllite, dark gray; calcite.

7,870-7,880 100% Quartzite, as above; trace of green stain (NiCl₃?) Trace of Phyllite/Sericite Schist; calcite.

7,880-7,890 100% Quartzite, as above. Trace of Phyllite/Sericite Schist; calcite.

7,890-7,900 100% Quartzite, as above. Trace of Phyllite/Sericite Schist; Phyllite, dark gray; calcite.

7,900-7,910 100% Quartzite, as above. Trace of Phyllite/Sericite Schist; calcite.

7,910-7,920 100% Quartzite, as above. Trace of Phyllite/Sericite Schist; calcite.

7,920-7,930 100% Quartzite, as above. Trace of Phyllite/Sericite Schist; Greenschist; calcite.

7,930-7,940 100% Quartzite, as above. Trace of Phyllite/Sericite Schist; calcite.

7,940-7,950 95% Quartzite, as above. 5% Phyllite/Sericite Schist, light gray-white, as above; interlaminated with Quartzite.

7,950-7,960 100% Quartzite, as above. Trace of Phyllite/Sericite Schist; calcite.
APPENDIX B

Baroid Mud Log, Bert Winn #1
(to be supplied by Sunedco)
Temperature, °F

Depth in Feet

6,500
6,600
6,700
6,800
6,900
7,000
7,100
7,200
7,300
7,400
7,500
7,600
7,700
7,800
7,900
8,000
8,100
8,200
8,300
8,400
8,500
8,600
8,700
8,800
8,900
9,000
9,100
9,200
9,300
9,400
9,500
9,600
9,700
9,800
9,900
10,000
10,100
10,200
10,300
10,400
10,500
10,600
10,700
10,800
10,900
11,000
11,100
11,200
11,300
11,400
11,500
11,600
11,700
11,800
11,900
12,000

Sample coding note:
- Red: adding water
- Black: stop adding water
- Blue: water jet
- Purple: trip for pit
- Yellow: added to pit temperature compared to pit

Note: The diagram shows various temperature readings and corresponding events at different depths. The events include adding water, stopping the addition of water, and temperature comparisons with the pit temperature. The depth increments are marked along the vertical axis, and temperature values are distributed along the horizontal axis.
Temperature, °F

Maximum reading thermometer survey 5/4
G up 9 hrs, 30 min after circulation
6 min. on bottom

Maximum reading thermometer survey 5/4
G up 9 hrs, 30 min after circulation
6 min. on bottom

Cable stops
Cable stops at
Cable starts
Cable starts at

Max. temp.(o) 3 min. on bottom
Max. temp.(o) 3 min. on bottom

Decreasing
Decreasing

Softens up
Softens up

Water up
Water up

Bottom up
Bottom up
PLATE 2. Bert Winn summary of temperature data.
NOTE: See geologic map (Plate I) for explanation of geologic units.
PLATE 4. Correlation diagram, Bert Winn #1 and C. H. Stocks 1-A.