GEOLOGY AND COAL RESOURCES OF THE CANTARALO
SPRING 7½' QUADRANGLE, CIBOLA COUNTY, NEW MEXICO

NEW MEXICO BUREAU OF MINES AND MINERAL RESOURCES
OPEN-FILE REPORT 142

by
ORIN J. ANDERSON

(June, 1981)

Contents:
(1) Geologic map with cross sections and references
(2) Stratigraphic column
(3) Discussion of coal resources, 3 pages with measured sections at 8 localities
(4) Table of surface and mineral ownership
Coal Resources - Cantaralo Spring 7½'

Coal beds may be seen in outcrop in two formations within the Cantaralo Spring quadrangle - The Dakota Sandstone and the Moreno Hill Formation. The Dakota Sandstone exposures are in the W½ section 30, T 5N, R 20W, (Duran Canyon) and in the SE½, SE¼ section 25, T 5N, R 21W, and reveal thin lignitic and/or coaly beds generally less than 8" thick in paludal shale sequences. In Duran Canyon only one coaly zone, about 25' below the top of the formation, may be seen; in the section 25 exposure 2 carbonaceous zones may be seen, one in each of two paludal shale units separated by a 6-8 ft. sandstone bed. The Dakota Sandstone coals are of no economic importance.

The Moreno Hill Formation exposures are limited to the perimeter of the Zuni Plateau in the southeast quadrant of the quadrangle. The basal part of the formation does crop out in the east-west trending ridge in sections 16, 17, and 18 T 5N, R 20W, but no coal is present or exposed. The Moreno Hill has been removed by Tertiary erosion in the western one half of the quadrangle and there would be essentially no coal west of Cullen Tank. The accompanying measured sections, the localities of which are marked by an Ô on the geologic map, show coal seams or coaly beds up to 3.5 ft. thick. The "main coal bed", or the thickest, is within 10 to 20 ft. of the top of the Atarque Sandstone, and is characterized by a medial 2 inch thick white to light bluish gray hard clay (altered ash bed), the exception being in the SW¼ section 30, T 5N, R 19W where the clay is not present or not easily recognized.
Two test holes drilled on the Zuni Plateau in 1981 provide reserve data. One in the SE\(_\frac{1}{4}\) section 19, T 5N, R 19W was spudded at an elevation of 7190 and drilled to a T.D. of 500 ft. The other was in the SW\(_\frac{1}{4}\) section 13, T 5N, R 20W and was spudded at an elevation of 7140 and drilled to a T.D. of 380 ft.; both holes bottomed in the Rio Salado Shale. The logs indicate about 2 ft. of coal at a depth of 163 ft. in section 19. In section 13 no coal was intersected but a carbonaceous zone is present at 110 ft.; drill cuttings show additional carbonaceous zones between 130 and 165 ft.

These two drill holes plus coal sections measured in outcrop at the 8 localities indicated on the map provide the basis for the resource estimates shown in the table below. Only the "main" coal zone was used in the calculations because the lower one is not traceable to any extent in outcrop and generally does not meet the cut off thickness of 14 inches. The factor used is 1750 tons/acre foot (or 1.12 million tons/section foot). The area factor shown in the table is that portion of a square mile that is considered to be underlain by coal of the indicated thickness.

Analysis of grab samples of weathered coal yielded BTU values ranging from about 5000 up to 9350 and ash contents of about 14% up to 44%. BTU values of fresh samples could be expected to run up to 30% higher.
## Cantaralo Spring Quadrangle Coal Resources By Section

<table>
<thead>
<tr>
<th>Section</th>
<th>Township</th>
<th>Range</th>
<th>Seam Thickness (in ft.)</th>
<th>Area Factor</th>
<th>Coal Resource Estimate In Short Tons</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 (partial)*</td>
<td>5N</td>
<td>19W</td>
<td>- - - -</td>
<td>(.00)</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>5N</td>
<td>20W</td>
<td>3.0 m</td>
<td>(.33)</td>
<td>1,120,000</td>
</tr>
<tr>
<td>2</td>
<td>5N</td>
<td>20W</td>
<td>2.3 m</td>
<td>(.10)</td>
<td>258,000</td>
</tr>
<tr>
<td>3</td>
<td>5N</td>
<td>20W</td>
<td>2.2 m</td>
<td>(.30)</td>
<td>739,000</td>
</tr>
<tr>
<td>10</td>
<td>5N</td>
<td>20W</td>
<td>2.3 i</td>
<td>(.75)</td>
<td>1,930,000</td>
</tr>
<tr>
<td>11</td>
<td>5N</td>
<td>20W</td>
<td>2.4 i</td>
<td>(.80)</td>
<td>2,150,000</td>
</tr>
<tr>
<td>12</td>
<td>5N</td>
<td>20W</td>
<td>3.0 i</td>
<td>(.85)</td>
<td>2,856,000</td>
</tr>
<tr>
<td>7 (partial)*</td>
<td>5N</td>
<td>19W</td>
<td>1.5 m</td>
<td>(.10)</td>
<td>168,000</td>
</tr>
<tr>
<td>18 (partial)*</td>
<td>5N</td>
<td>19W</td>
<td>2.0 i</td>
<td>(.45)</td>
<td>1,008,000</td>
</tr>
<tr>
<td>13</td>
<td>5N</td>
<td>20W</td>
<td>0.0 †</td>
<td>( )</td>
<td>0</td>
</tr>
<tr>
<td>14</td>
<td>5N</td>
<td>20W</td>
<td>1.5 i</td>
<td>(1.00)</td>
<td>1,680,000</td>
</tr>
<tr>
<td>15</td>
<td>5N</td>
<td>20W</td>
<td>1.5 m</td>
<td>(.55)</td>
<td>924,000</td>
</tr>
<tr>
<td>22</td>
<td>5N</td>
<td>20W</td>
<td>1.4 i</td>
<td>(.20)</td>
<td>313,000</td>
</tr>
<tr>
<td>23</td>
<td>5N</td>
<td>20W</td>
<td>1.4 m</td>
<td>(.80)</td>
<td>1,254,000</td>
</tr>
<tr>
<td>24</td>
<td>5N</td>
<td>20W</td>
<td>2.0 i</td>
<td>(.95)</td>
<td>2,128,000</td>
</tr>
<tr>
<td>19 (partial)*</td>
<td>5N</td>
<td>19W</td>
<td>2.0 †</td>
<td>(.60)</td>
<td>1,344,000</td>
</tr>
<tr>
<td>30 (partial)*</td>
<td>5N</td>
<td>19W</td>
<td>3.5 m</td>
<td>(.35)</td>
<td>1,364,000</td>
</tr>
<tr>
<td>25</td>
<td>5N</td>
<td>20W</td>
<td>3.2 i</td>
<td>(.75)</td>
<td>2,688,000</td>
</tr>
<tr>
<td>26</td>
<td>5N</td>
<td>20W</td>
<td>- - - -</td>
<td>(.00)</td>
<td>0</td>
</tr>
</tbody>
</table>

**TOTAL** 21,924,000

* additional resources in this section will be shown in report on adjacent quadrangle.

† drill hole in section

m = measured

i = inferred
Measured coal bearing section in the NE\$ SE\$ sec. 1, T 5N R 20W

- Fluvial channel ss.; light reddish brn., low. med. gr., x-bed
- Paludal sh, some carb. sh and blk. clay; coal near middle
  - (main coal bed 3.2 ft.)
- Back barrier ss., fn to v fn grained, light gray to grayish brn., mottled
  (Covered interval)
- Regressive coastal barrier ss., white to light gray, up. fn. - low. med. gr., burrowed; (section below not measured)

EXPLANATION

- Burrowed
- Root tubes
- Calc. concretions
- Carbonaceous
- Coal bed

Increasing grain size
Locality: P  
NE 45 45  sec 1  SW 20w

- Light reddish brown, medium grained sandstone
- Gray to dark gray shale and carbonaceous shale
- Coal bed, with 1/2 to 2' thick white to bluish white melanic clay (coal)
- Gray to grayish brown shale and clay shale
- Skeletal debris, with tineground detrital mud (clay)
- Tinge rounded, lower grey to grayish ground or cross-bedded
Measured coal bearing section in the SW\% sec. 2, T 5N R 20W

Paludal sh

(section above here not measured)

Fluvial channel ss., light brn. - reddish brn. low. to up. med. gr., some x-bed

Paludal sh, carb. sh, and coaly intervals; thickest coal 10 ft. above base

- (main coal bed 2.5 ft.)

Lagoonal-restricted bay; blk. clay, carb. sh, and sltstr; 1 ft. coal bed 2 ft. above base.

Regressive coastal barrier ss., pale yellowish brn, up. fn. to low. med. gr.

(section below here not measured)
Measured coal bearing section in
the SE1/4 SE1/4 sec. 3, T 5N R 20W

Fluvial channel ss., pale yellowish gray and
reddish brn. med. gr.; fining upward
(coversed interval)

Fluvial channel ss., light reddish brn. to
yellowish brn., med. gr.; x-bed dip dir. N65°W
Paludal sh, w/minor fn. ss. lenses

Fluvial channel ss., reddish brn. - light
reddish brn., med. gr. fining upward,
x-bed

Paludal sh, carb. sh, and coaly intervals;
thickest coal 6 ft. above base

- (main coal bed 2.4 ft.)

Back barrier-restricted bay ss., very fn.
gr., becoming better cemented toward top
Lagoonal, carb. sh w/ 6 in. coal bed
Regressive coastal barrier ss., low. med.
gr. (section below here not measured)
Measured coal bearing section in
the SE\(\frac{1}{4}\) sec. 7, T 5N R 19W

\[\begin{array}{c}
\text{Nonmarine} \\
\text{Moreno Hill Formation} \\
\text{Marginal marine} \\
\text{Atarque Sandstone} \\
\text{Marine}
\end{array}\]

\[\begin{array}{c}
0 \\
25 \\
50 \\
75 \\
100
\end{array}\]

- Fluvial channel ss. reddish brn., med. gr., x-bed
- Paludal sh, carb. sh and coaly beds
- (main coal bed 1½ ft.; w/coaly carb.sh 3 ft.)
- Back-barrier, restricted bay, very fn. ss, contains Crassostrea sp.
- Regressive coastal barrier ss., pale yellowish brn., low. med. gr.
Measured coal bearing section in
the SW¼ SW¼ sec. 23, T 5N R 20W

Nonmarine

Moreno Hill
Formation

50

Marginal marine

Atarque Sandstone

125

Fluvial channel ss., reddish brn., to reddish yellow, med. gr., x-bed.

Paludal sh

Fluvial channel ss., reddish brn., low. med. gr. x-bed in zones

Paludal sh, carb. sh and coaly beds, with thin, very fn., sandy zone above coal

- (main coal bed 1.4 ft.)

Back-barrier-restricted bay; fn. to very fn. ss.

Lagoonal carb. sh, sandy

Regressive coastal barrier ss., light grayish orange, low. med. gr. some lo angle x-bed (section below here not measured)
Locality Y  
5 W 5 S 4 sec 23  S 5 M 20 W

5 Divisions/Inch 5th Accent

Moore Hill Fm
Light reddish brown to grayish orange fine to medium grained sandstone.

Light gray to light grayish brown shale.

Reddish brown, medium grained sandstone, locally phosphatic. Grey to light grayish brown shale. Alter zone near.

Gray to light grayish brown shale. Alter zone near.

Calcite intergrown with (mashed coal zone).

Gray to light grayish brown shale. Altered shale. Fracture at base.

Measured coal bearing section in the SW ¼ NW ¼ sec. 15, T.5N R 20W

Fluvial channel ss., reddish brn. reddish yellow med. gr., x-bed.in zones

Fn.: silty ss., and sltst.; fining upward.

Fluvial channel ss., light reddish brn., med. gr., x-bed

Paludal sh, carb. sh, and coal beds
- (main coal bed 1.5 ft.)

Back barrier ss., fn. gr.
Lagoonal, fn. sand and sltst, carb. at top

Regressive coastal barrier ss., yellowish gray - grayish orange low. med. gr.
(section below here not measured)
- Measured coal bearing section in the SW\% SE\% sec. 30, T.5N R 19W

- Paludal sh, carb. sh and coal beds

- Moreno Hill Formation (main coal bed 3.2 ft.)

- (slumped interval)

- Regressive coastal barrier ss., light reddish brn, low. med.gr. (section below here not measured—may be slumped)

- Nonmarine Sandstone

- Marine Atarque Sandstone
Locality W 5w 5e 5s 30 6n 18w

 Monsen Hill fm.
 Grey to light grayish brown shale

 3.2 ft
 (est. 30°)

 * Light reddish brown fine to medium grained sandstone,
   possibly slumped at this locality.

 * Lagoonal back barrier, marginal marine facies not exposed here, allowing
   for that the interval between Ka and "main coast" is normal.
Measured coal bearing section in SW1/4 SW1/4 sec. 30, T 5N R 19W showing underlying Atarque Sandstone and overlying Fence Lake Formation.

- **Fence Lake Formation**
  - 0 ft
  - 25 ft

- **Nonmarine**
  - 75 ft

- **Moreno Hill Formation**
  - 100 ft
  - 125 ft

- **Marginal marine**
  - 150 ft

- **Marine**
  - 175 ft
  - 200 ft

- **Rio Salado Tongue**

- **Braided river or braidplain deposits, horizontally bedded conglomerate and ss.; cgl. is both matrix and clast supported, but coarser material is matrix supported; similar to a proximal braided river facies.**

- **Fluvial channel ss., light reddish brn., low. med. gr., x-bed; grayish brn. calc. concretions at top**

- **Lagoonal-lacustrine, very fn. gr. ss. and sltst.**
  - Paludal sh
  - *(main coal bed: 4.5 ft coaly interval w/3.5 ft aggregate coal thickness)*

- **Back barrier or restricted bay, lower fine gr ss., flat-bedded, burrowed, root penetrated**
  - Lagoonal sltst and very fine ss

- **Regressive coastal barrier ss., upper shoreface unit; grayish orange to light yellowish gray, upper fine to lower med. grained, low angle cross bedded throughout; very few fossils except for scattered sharks teeth and isolated burrows**
  - lower shoreface unit; very fine to upper fine grained, coarsening upward, flat-bedded ss; unfossiliferous except for burrows in upper part
<table>
<thead>
<tr>
<th>Township and Range</th>
<th>Section</th>
<th>Patent</th>
<th>Patent or Holder’s Name</th>
<th>Inscribed or Other Names</th>
<th>Homestead or Other Patent</th>
<th>State of New holder</th>
<th>Rights reserved to U.S. Government</th>
</tr>
</thead>
<tbody>
<tr>
<td>06-11S-2W</td>
<td>18</td>
<td>all</td>
<td>1070427</td>
<td>X</td>
<td></td>
<td><em>none</em></td>
<td><em>none</em></td>
</tr>
<tr>
<td></td>
<td>19</td>
<td>all</td>
<td>670394</td>
<td>X</td>
<td></td>
<td></td>
<td><em>none</em></td>
</tr>
<tr>
<td></td>
<td>20</td>
<td>all</td>
<td>1067470</td>
<td>X</td>
<td></td>
<td></td>
<td><em>none</em></td>
</tr>
<tr>
<td></td>
<td>21</td>
<td>all</td>
<td>670296</td>
<td>X</td>
<td></td>
<td></td>
<td><em>none</em></td>
</tr>
<tr>
<td></td>
<td>22</td>
<td>all</td>
<td>111505</td>
<td>X</td>
<td></td>
<td></td>
<td><em>none</em></td>
</tr>
<tr>
<td></td>
<td>23</td>
<td>all</td>
<td>111505</td>
<td>X</td>
<td></td>
<td></td>
<td><em>none</em></td>
</tr>
<tr>
<td></td>
<td>24</td>
<td>all</td>
<td>111505</td>
<td>X</td>
<td></td>
<td></td>
<td><em>none</em></td>
</tr>
<tr>
<td></td>
<td>25</td>
<td>all</td>
<td>111505</td>
<td>X</td>
<td></td>
<td></td>
<td><em>none</em></td>
</tr>
<tr>
<td></td>
<td>26</td>
<td>all</td>
<td>111505</td>
<td>X</td>
<td></td>
<td></td>
<td><em>none</em></td>
</tr>
<tr>
<td></td>
<td>27</td>
<td>all</td>
<td>111505</td>
<td>X</td>
<td></td>
<td></td>
<td><em>none</em></td>
</tr>
<tr>
<td></td>
<td>28</td>
<td>all</td>
<td>30-63-0045</td>
<td></td>
<td></td>
<td><em>none</em></td>
<td></td>
</tr>
<tr>
<td></td>
<td>29</td>
<td>all</td>
<td>611945</td>
<td></td>
<td></td>
<td><em>none</em></td>
<td></td>
</tr>
<tr>
<td></td>
<td>30</td>
<td>all</td>
<td>611945</td>
<td></td>
<td></td>
<td><em>none</em></td>
<td></td>
</tr>
<tr>
<td></td>
<td>31</td>
<td>all</td>
<td>611945</td>
<td></td>
<td></td>
<td><em>none</em></td>
<td></td>
</tr>
<tr>
<td></td>
<td>32</td>
<td>all</td>
<td>611945</td>
<td></td>
<td></td>
<td><em>none</em></td>
<td></td>
</tr>
<tr>
<td></td>
<td>33</td>
<td>all</td>
<td>611945</td>
<td></td>
<td></td>
<td><em>none</em></td>
<td></td>
</tr>
<tr>
<td></td>
<td>34</td>
<td>all</td>
<td>611945</td>
<td></td>
<td></td>
<td><em>none</em></td>
<td></td>
</tr>
<tr>
<td></td>
<td>35</td>
<td>all</td>
<td>611945</td>
<td></td>
<td></td>
<td><em>none</em></td>
<td></td>
</tr>
<tr>
<td></td>
<td>36</td>
<td>all</td>
<td>611945</td>
<td></td>
<td></td>
<td><em>none</em></td>
<td></td>
</tr>
<tr>
<td></td>
<td>37</td>
<td>all</td>
<td>611945</td>
<td></td>
<td></td>
<td><em>none</em></td>
<td></td>
</tr>
<tr>
<td></td>
<td>38</td>
<td>all</td>
<td>611945</td>
<td></td>
<td></td>
<td><em>none</em></td>
<td></td>
</tr>
<tr>
<td></td>
<td>39</td>
<td>all</td>
<td>611945</td>
<td></td>
<td></td>
<td><em>none</em></td>
<td></td>
</tr>
<tr>
<td></td>
<td>40</td>
<td>all</td>
<td>611945</td>
<td></td>
<td></td>
<td><em>none</em></td>
<td></td>
</tr>
<tr>
<td></td>
<td>41</td>
<td>all</td>
<td>611945</td>
<td></td>
<td></td>
<td><em>none</em></td>
<td></td>
</tr>
<tr>
<td></td>
<td>42</td>
<td>all</td>
<td>611945</td>
<td></td>
<td></td>
<td><em>none</em></td>
<td></td>
</tr>
<tr>
<td></td>
<td>43</td>
<td>all</td>
<td>611945</td>
<td></td>
<td></td>
<td><em>none</em></td>
<td></td>
</tr>
<tr>
<td></td>
<td>44</td>
<td>all</td>
<td>611945</td>
<td></td>
<td></td>
<td><em>none</em></td>
<td></td>
</tr>
<tr>
<td></td>
<td>45</td>
<td>all</td>
<td>611945</td>
<td></td>
<td></td>
<td><em>none</em></td>
<td></td>
</tr>
<tr>
<td></td>
<td>46</td>
<td>all</td>
<td>611945</td>
<td></td>
<td></td>
<td><em>none</em></td>
<td></td>
</tr>
<tr>
<td></td>
<td>47</td>
<td>all</td>
<td>611945</td>
<td></td>
<td></td>
<td><em>none</em></td>
<td></td>
</tr>
<tr>
<td></td>
<td>48</td>
<td>all</td>
<td>611945</td>
<td></td>
<td></td>
<td><em>none</em></td>
<td></td>
</tr>
<tr>
<td></td>
<td>49</td>
<td>all</td>
<td>611945</td>
<td></td>
<td></td>
<td><em>none</em></td>
<td></td>
</tr>
<tr>
<td></td>
<td>50</td>
<td>all</td>
<td>611945</td>
<td></td>
<td></td>
<td><em>none</em></td>
<td></td>
</tr>
<tr>
<td></td>
<td>51</td>
<td>all</td>
<td>611945</td>
<td></td>
<td></td>
<td><em>none</em></td>
<td></td>
</tr>
<tr>
<td></td>
<td>52</td>
<td>all</td>
<td>611945</td>
<td></td>
<td></td>
<td><em>none</em></td>
<td></td>
</tr>
<tr>
<td></td>
<td>53</td>
<td>all</td>
<td>611945</td>
<td></td>
<td></td>
<td><em>none</em></td>
<td></td>
</tr>
<tr>
<td></td>
<td>54</td>
<td>all</td>
<td>611945</td>
<td></td>
<td></td>
<td><em>none</em></td>
<td></td>
</tr>
<tr>
<td></td>
<td>55</td>
<td>all</td>
<td>611945</td>
<td></td>
<td></td>
<td><em>none</em></td>
<td></td>
</tr>
<tr>
<td></td>
<td>56</td>
<td>all</td>
<td>611945</td>
<td></td>
<td></td>
<td><em>none</em></td>
<td></td>
</tr>
<tr>
<td></td>
<td>57</td>
<td>all</td>
<td>611945</td>
<td></td>
<td></td>
<td><em>none</em></td>
<td></td>
</tr>
<tr>
<td></td>
<td>58</td>
<td>all</td>
<td>611945</td>
<td></td>
<td></td>
<td><em>none</em></td>
<td></td>
</tr>
<tr>
<td></td>
<td>59</td>
<td>all</td>
<td>611945</td>
<td></td>
<td></td>
<td><em>none</em></td>
<td></td>
</tr>
<tr>
<td></td>
<td>60</td>
<td>all</td>
<td>611945</td>
<td></td>
<td></td>
<td><em>none</em></td>
<td></td>
</tr>
</tbody>
</table>

*Notes:*
- All minerals, ditches and canals.
- None.
### Upper Member of Bidahochi Formation

- **Description:** fine to medium sand, brown, with occasional silt and clay. Lower part is coarser, up to 50 ft thick, with a well-bedded sandstone. Top is characterized by a distinct bentonite layer.

### Fence Lake Member of Bidahochi Formation

- **Description:** fine to medium sand, brown, with occasional silt and clay. Lower part is coarser, up to 50 ft thick, with a well-bedded sandstone. Top is characterized by a distinct bentonite layer.

### Moreno Hill Formation

- **Description:** fine to medium sand, brown, with occasional silt and clay. Lower part is coarser, up to 50 ft thick, with a well-bedded sandstone. Top is characterized by a distinct bentonite layer.

### Atarque Sandstone

- **Description:** fine to medium sand, brown, with occasional silt and clay. Lower part is coarser, up to 50 ft thick, with a well-bedded sandstone. Top is characterized by a distinct bentonite layer.

### Río Salado Tongue of Mancos Shale

- **Description:** fine to medium sand, brown, with occasional silt and clay. Lower part is coarser, up to 50 ft thick, with a well-bedded sandstone. Top is characterized by a distinct bentonite layer.

### Paguate Tongue of Dakota Sandstone

- **Description:** fine to medium sand, brown, with occasional silt and clay. Lower part is coarser, up to 50 ft thick, with a well-bedded sandstone. Top is characterized by a distinct bentonite layer.

### Dakota Sandstone

- **Description:** fine to medium sand, brown, with occasional silt and clay. Lower part is coarser, up to 50 ft thick, with a well-bedded sandstone. Top is characterized by a distinct bentonite layer.

### Whitewater Arroyo Tongue of Mancos Shale

- **Description:** fine to medium sand, brown, with occasional silt and clay. Lower part is coarser, up to 50 ft thick, with a well-bedded sandstone. Top is characterized by a distinct bentonite layer.

### Mogollon Rim formations

- **Description:** fine to medium sand, brown, with occasional silt and clay. Lower part is coarser, up to 50 ft thick, with a well-bedded sandstone. Top is characterized by a distinct bentonite layer.