SOME GEOLOGICAL FACTORS AFFECTING THE UPPER FREEPORT COAL AND ITS QUALITY

By
Edwin F. Koppe
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ABSTRACT:

The Upper Freeport coal in the Freeport and New Kensington quadrangles, Pennsylvania, varies from a bony streak to a thick coal deposit often exceeding ninety inches, the "Double" or "Thick Freeport". Distinctive basal partings, a central bone layer, and a canneloid top bench may be present.

The appearance of a sandstone roof, sandstone rolls, and bony coal at the top of the main coal bench can be anticipated in thin Freeport areas when basal partings are absent. When the two basal partings are present, a shale roof is normal. These effects are correlated with the original topography upon which the coal was deposited. The original depositional high areas tend to coincide with present structural highs.

Preliminary data indicate that coal quality, in part, is affected by the depositional setting. In "high" areas, a tendency exists for the main coal bench to contain higher percentages of fusain and mineral matter. Within limits, somewhat higher ash fusion temperatures appear to correlate with paleotopographic highs.

As a result of these findings, critical examination of the paleotopography and related sediments is indicated in other areas and other coals.

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The Upper Freeport coal is quite variable both in thickness and composition in the Freeport and New Kensington quadrangles of Pennsylvania (Figure 1). The coal horizon in these quadrangles is marked either by a thin carbonaceous shale bed or by a single bed containing a variable number of partings (binders). The complex coal zone known locally as the "Double" or "Thick Freeport" contains the Upper Freeport Coal Bed at the base; but in addition, it has an overlying bone layer and an upper coal bed occasionally capped with a canneloid layer. The "Thick Freeport" often exceeds 90 inches in thickness, whereas the

normal Upper Freeport coal usually varies between 34 and 50 inches.


FIG. 1 Location of quadrangles.

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FIG. 2  Structure contours, Upper Freeport coal, New Kensington and Freeport quadrangles.
Shaded portion is thick Freeport area. A — Wildwood column; B — Springdale column;
C — Armstrong column; and * — data localities.

To determine the causes of variation, a preliminary study was made of the basal partings in the coal (Koppe, 1958). A characteristic distribution pattern was found to exist throughout the Freeport quadrangle which the author interpreted as a function of the depositional setting. Three related conclusions were drawn for the area. They are: 1) coals lacking persistent basal partings indicate topographically high areas at the time of peat accumulation; 2) the appearance of single basal partings suggests margins of depositional highs or equivalent elevations; and 3) two or more partings in the lower part of the bed are indicative of low areas of earliest peat accumulation. An extension of the studies into the "Thick Freeport" area was warranted to determine relations where the appearance of the coal is altered markedly by the addition of coal above the normal body (Rayburn, 1924).

Figure 2 is a structure contour map of the area under consideration. Present coal elevations were used to establish the structure in the two quadrangles (Hughes, 1933; Richardson, 1932). Structural features from northwest to southeast are: the Bradys Bend syncline, the Kellersburg anticline, the McMurray syncline, the Amity anticline, the shallow Freeport syncline as a limb of the major Duquesne-Fairmont syncline and separated from it by the local Leechburg anticline, and the Murrysville-Roaring Run anticline. All of the above structures plunge to the southwest; however, mild interruptions of the trend are located along the axes of the Kellersburg anticline, the McMurray syncline, and the Amity anticline in the southern portion of the New Kensington quadrangle. These interruptions are found in the area of the "Thick Freeport" coal (Figure 2). Rayburn (1924) best described the "Thick Freeport" coal area overall as having "— no well-defined anticlines or synclines and might well be described as lumpy, but with no excessively steep grades". Locations of data from published literature (Hughes, 1933; Richardson, 1932; Ashley et al., 1925; U. S. Bureau of Mines, 1939), mine records and field observations used in the course of this study are plotted as dots in Figure 2. In addition, some company information was examined which is not available for publication at this time.

The parting distribution map prepared from the above-mentioned data, reproduced as Figure 3, illustrates the regional changes in numbers of basal partings. In the previous report (Koppe, 1958) the writer postulated that the persistent partings in this area mark depositional events which took place at two
are further illustrated in a northwest-southeast cross-section of the Freeport quadrangle. The relations shown in Figure 4 may be of importance, especially in coal mining. Structure along the line of the cross-section is shown on the lowermost diagram in Figure 4. Coal profiles showing the relations of partings and bone layers are illustrated in the centrally located cross-section. The changes of cover sediments are shown at the top of Figure 4. Near paleotopographic high areas, shaly coal (or bone) is found at the top of the bed. Non-persistent knife-edge shale and fusain partings are abundant in the upper portion of the coal. These are observed less frequently as the depositional lows are approached. As shown in Figure 4, a shale roof is normal in areas between depositional highs. Massive Mahoning sandstone lies close to the coal and produces more roly conditions and cut-outs on and near the elevated areas. According to mine operators, sulfur content is generally objectionable when sandstone contacts the coal. In general, the lower part of the Mahoning sandstone grades laterally from a massive sandstone on the original depositional highs to an interbedded sandstone and sandy shale in areas where a thicker-shale unit forms the roof. The vertical scale of the covering sediments has been grossly exaggerated in Figure 4 to demonstrate these changes. In the field, transitions are very gradual - though sometimes interrupted by channel sandstones.

Sandstone rolls and cutouts are erratic in the "Thick Freeport" area, although many are concentrated on local domes. One should recognize that
erosion and subsequent sandstone deposition in the "Thick Freeport" basin may have a later and different mode of origin than the equivalent features in a normal Upper Freeport area. Peat deposition continued in the restricted basin after cessation of peat accumulation elsewhere in the study area.

Coal quality is affected to some extent by the depositional environment. Excepting the local patch of impure coal and coaly shale detected in the southeastern corner of the Freeport quadrangle, the normal Upper Freeport coal tends to be uniform in quality. Petrographic data of widely separated samples were used in the preparation of Table 1 to illustrate this point. Because the "Thick Freeport" consists of the normal Upper Freeport coal plus a local overlying coal, only the main bed can be compared with the coal elsewhere. The Wildwood mine is located on the west side of the "Thick Freeport" deposit; Springdale, on the east side; and the Armstrong mine in "low coal" fairly close to an old topographic high. These areas are shown as sites A, B and C in Figure 2. The pronounced differences are in the amount of fusain at each locality. Thiessen and Sprunk (1935) reported that the lower bench at Wildwood consisted of 57 percent anthraxylon, 39 percent translucent attritus, three percent opaque attritus, and one percent fusain. On the other side of the "Thick Freeport" basin, fusain was found to be more abundant at Springdale (3.6 percent). Farther east, seven percent fusain was recorded in the Armstrong mine. The bulk of the fusain in the latter mine is confined to the uppermost seven inches of the coal in the form of lenticles and knife-edge partings mentioned earlier. As the fusain percentage is increased, the anthraxylon fraction is lowered somewhat.

Increased fusain in the upper part of the normal coal is often accompanied by an increase of detrital mineral matter. Over ancient highs, the combination gives rise to the capping bone layer found in the normal Upper Freeport coal. In the opinion of the writer, this layer is the product of local sub-aerial oxidation which gives rise to the fusain and reduces the percentage of organic matter relative to the mineral matter. Although the bony unit can be detrimental, petrographically determined coal quality is not affected below the layer. One exception was found during the investigation. The patch of shaly coal and carbonaceous shale found in the southeastern quarter of the Freeport quadrangle (Figure 3) was undoubtedly formed upon a local rise that was never covered sufficiently with peat to produce a good coal.

Ash softening temperatures reported by the U. S. Bureau of Mines (1939) were plotted upon a map to ascertain whether or not a correlation exists between

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**TABLE I**

**PETROGRAPHIC CONSTITUTION OF BEDS**

**UPPER FREEPORT COAL**

<table>
<thead>
<tr>
<th>MINE</th>
<th>COUNTY</th>
<th>PERCENT</th>
<th>Anthraxylon</th>
<th>Attritus</th>
<th>Fusain</th>
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<td>Allegheny</td>
<td>29</td>
<td>67</td>
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</tr>
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<td>Armstrong</td>
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<td>absent</td>
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**MAIN BED**

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<th>Attritus</th>
<th>Fusain</th>
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<td>38.9</td>
<td>3.6</td>
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</tr>
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<td>40.5</td>
<td>7.0</td>
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</table>

the original deposition and the character of the ash fraction. This map is reproduced as Figure 5. In the "Thick Freeport" area, no correlation can be established. However, a limited degree of correlation is suggested in the Freeport quadrangle. The ash softening temperatures along depositional highs are higher than those of the intervening depositional lows. Additional analyses will be needed to determine the extent of variations of ash fusion temperatures and the causes for those variations.


In summary, the Upper Freeport coal was deposited upon a surface whose topography was somewhat similar to present structure in the study area. High areas in the depositional floor were detected by changes in number of basal partings and are correlated with: 1) present coal structure, 2) the presence of uppermost coal layers rich in detrital mineral matter and fusain, and 3) a tendency for a sandstone roof and attendant rolls and cutouts. Ash softening temperature may correlate in normal coal development areas to a limited extent. The findings listed above suggest that a close relationship exists between the character of coal and the geology of the area. A better understanding of these relations might well aid in future exploration and beneficiation in other coals and other areas once the responses of individual coals to depositional features are known.

REFERENCES


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