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Coal Resources of the Triassic Deep River Basin, North Carolina

by

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ABSTRACT

The upper Triassic Deep River basin of central North Carolina is divided into three subbasins - the Durham, Sanford, and Wadesboro. It is bounded on the east by the major Jonesboro fault system, and on the west by a series of minor faults and nonconformities. The structure thus formed is a northeast-southwest trending half-graben with the nonmarine sedimentary beds dipping to the south-east. Numerous postdepositional normal faults and diabase intrusives affect the entire Deep River basin.

Although bituminous coal is known from the Durham and Sanford subbasins, only the Sanford has coal that has been commercially mined. The remaining coal resources in the subbasin can be calculated using the methods of Wood and others (1983).

Two coal beds, the Gulf and the Cumnock, are located near the base of the Cumnock Formation (Chatham Group, Newark Supergroup). They crop out and are best developed in the northern part of the Sanford subbasin. The Gulf coal has an areal extent of about 22 sq. mi., and the thicker Cumnock coal has an areal extent of 75 sq. mi.

The original coal resources were 141,870,000 short tons and were located in Chatham, Lee, and Moore counties. Commercial mining began in the 1850's. Mining was terminated in 1953 due to natural gas-induced explosions and nearly continual flooding of the mines, both causing hundreds of deaths. About 759,000 short tons were mined in Chatham County, 1,447,000 short tons from Lee County, and no tonnage from Moore County. The remaining resources are: Chatham County, 38,228,000 short tons; Lee County, 91,467,000 short tons; and Moore County, 9,969,000 short tons; thus giving the Sanford subbasin 139,664,000 short tons of remaining resources. The reserve base has been

calculated at 19,402,718 short tons, and the inferred reserve base at 15,610,179 short tons.

INTRODUCTION

This report was prepared under U.S. Geological Survey Grant No. 14-08-0001-G-970 to calculate coal resources for the Deep River basin of North Carolina. The following items were collected, analyzed, used in the University of North Carolina computer system, and are stored in the National Coal Resources Data System (NCRDS):

One set of 77 USALYT forms;

One set of 59 stratigraphic points on USTRAT forms;

One set of point location and coal bed maps of the Colon, Goldston, White Hill, Putman, and Sanford, N.C. 7 1/2-minute quadrangles.

The coal resources of central North Carolina were calculated for three counties: Chatham, Lee, and Moore. Those parts of the counties located within the Sanford subbasin of the Deep River basin originally contained about 141,870,000 short tons of bituminous coal. Since the end of commercial mining, in 1953, the counties have 139,664,000 short tons of coal resources remaining.

BASIN GEOLOGY

The Deep River basin trends northeast-southwest through the Piedmont of North Carolina, and consists of three subbasins: Durham, Sanford, and Wadesboro (fig. 1). The colon cross structure is a structural constricture that separates the Durham and Sanford subbasins, and Cretaceous Coastal Plain rocks separate the Sanford and Wadesboro subbasins. The basin is bounded on the east by the Jonesboro fault zone (fig. 2) which was active

primarily during Late Triassic basin filling, and on the west mainly by nonconformities and postdepositional faults. The sedimentary beds dip generally to the east and southeast toward the major border fault zone. Other faults and diabase intrusives affected the basin during the Late Triassic and Early Jurassic.

The only subbasin having substantial coal is the Sanford, although coal of minor thickness and extent is known from the southern part of the Durham subbasin (Reinemund 1955: Bain and Harvey, 1977; Bain and Brown, 1981). This minor coal, probably the middle bench of the more extensive Cumnock coal, is too thin for consideration under the Wood and others (1983) classification scheme.

STRATIGRAPHY OF THE SANFORD SUB-BASIN

The remainder of the report will concentrate on the coal resources of the Sanford subbasin.

The subbasin contains 5,000 to 6,000 ft of alluvial fan, river, lake, swamp, and floodplain sediments, preserved as conglomerates, sandstones, shales, coals, and mudstones, respectively (Gore, 1986). Some 5,000 ft of stratigraphic section has been eroded. The subbasin has numerous high angle normal faults and diabase instrusives (Reinemund, 1955).

The stratigraphic column is summarized in Figure 3, and shows the subdivisions of the Chatham Group into the Pekin, Cumnock, and Sanford Formations. Coal resources are calculated only for the Gulf coal and Cumnock coal beds, both near the base of the Cumnock Formation and associated with dark-gray to black, highly organic and fissile shale of lacustrine origin (Reinemund, 1955; Bain and Harvey, 1977; Bain and Brown, 1981). The shale may

be considered an oil shale in some parts of the subbasin (Robbins and Textoris, 1986).

The age of the coal and associated shale is late Middle Karnian according to fish studies by Olsen and others (1982). Palynomorph studies by Robbins and others (1988) also indicate a late Middle Karnian age.

DEPOSITION OF COAL

During Cumnock sedimentation, more moisture and less tectonic activity allowed accumulation of fine siliciclastics as gray and black muds in an anoxic shallow lake, while lake-fringe swamps formed and eventually extended from the west well into the lake (Robbins and Textoris, 1988). Reinemund (1955) suggested ponding took place in the sub-basin due to blockage in the Colon cross structure by greater accumulation of alluvial fan sediment, thus fitting the wet climate-closed drainage model of Ziegler (1983). As the lake became deeper, organic muds eventually covered the marginal swamps. Ultimately, alluvial sediment from the southeast became dominant and filled the sub-basin with siliciclastics represented by the Sanford Formation. This change may have coincided with a dry climate cycle allowing playas to form (Wheeler and Textoris, 1978).

Intra-basinal and syn-tectonic tensional faulting may have controlled major sedimentation patterns, as shown for Lake Malawi in Africa by Ebinger and others (1984). However, there is insufficient subsurface information at this time to support such detail in the Sanford subbasin.

COAL

The coal of interest is located stratigraphically near the base of the Cumnock Formation, and consists of two persistent beds from 28 to 39 ft apart

(fig. 3). The lower coal, the Gulf, is thin and usually confined to one bench which may rarely be up to 3 ft thick. It underlies an area of about 22 sq. mi. (fig. 4), being thickest and having the least ash in the northern part of the Sanford subbasin (Reinemund, 1955; Toenges and others, 1952).

The upper coal, the Cumnock, occurs over an area of nearly 75 sq. mi. (fig. 4). It is best developed in the northern part of the sub-basin where the middle bed may be nearly 9 ft thick. The middle bed is also the most extensive of the three.

Thermal maturation of these high volatile bituminous A coals has been shown by Robbins (1983) and Robbins and Textoris (1986) to be a maximum of 105°C by sheet-like algal kerogen, and 80°C by thin-walled bisaccate pollen. Semi-anthracite is present, but only in association with baked zones near diabase intrusives, as is some anthracite and coke.

COAL RESOURCES

Using the hierarchy of coal resources described in Wood and others (1983), it was determined that the total original coal resources within the Sanford subbasin were 141,870,000 short tons, and these were distributed in three counties: Chatham, Lee, and Moore (Table 1).

The Gulf and Cumnock coals were commercially mined since the 1850's, and the last mine was closed in 1953 due to nearly a century of natural gas-induced explosions and flooding of the mines, both of which caused the death of hundreds of miners (Reinemund, 1955). During that time, about 2,206,000 short tons were mined or lost to mining (Table 2).

The remaining resources, measured, indicated, and inferred, are 139,664,000 short tons with the major portion in Lee County (Table 3).

Hypothetical resources were not calculated because all coal more than 3 mi from data points is less than 14 in. thick.

Reinemund (p. 113, 1955) determined that the total of remaining resources (his reserves) as of January 1, 1950, were 110,337,000 short tons. About 1,621,000 short tons had been mined and lost in mining.

Table 4 shows the original resources for each county and for each coal bed. It is apparent that the middle Cumnock is the dominant bed, and that Lee County contained the most coal.

Table 5 shows the distribution of original coal resources by bed and by type of measurement. The indicated and the inferred resources, more susceptible to error than the measured resources, are higher in amount.

The reserve base has been calculated as 19,402,718 short tons, and consists of coal less than three-quarter of a mile from a data point, more than 28 in. thick, and less than 1,000 ft deep. This coal still remains, and has the following county distribution: Chatham, 11,803,825 short tons; Lee, 5,532,271 short tons; and Moore, 2,066,622 short tons. Not included in these figures are 2,206,000 short tons which have been mined.

The inferred reserve base, based on the same criteria as the reserve base except that the information used is between three-quarter and three miles from data points, is 15,610,179 short tons. This coal still remains, and none has been mined. The county distribution is: Chatham, 1,854,722 short tons; Lee, 7,797,950 short tons; Moore, 5,957,507 short tons.

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Table 1. Original coal resources (in thousands of short tons).

County	1-Measur	2-Indica	3-Inferr	TOTAL
Chatham	14439	22674	1874	38987
Lee	14093	35379	43442	93914
Moore	862	2620	6487	9969
TOTAL	29394	60673	51803	141870

Table 2. Cumulative depletion of coal resources (in thousands of short tons).

County	1-Measur	2-Indica	3-Inferr	TOTAL
Chatham	704	55	0	759
Lee	1306	141	0	1447
Moore	0	0	0	0
TOTAL	2010	196	0	2206

Table 3. Remaining coal resources (in thousands of short tons).

County	1-Measur	2-Indica	3-Inferr	TOTAL
Chatham	13735	22619	1874	38228
Lee	12787	35238	43442	91467
Moore	862	2620	6487	9969
TOTAL	27384	60477	51803	139664

Table 4. Original coal resources (in thousands of short tons) by county and individual coal beds.

Coal Bed	Chatham	Lee	Moore	TOTAL
Mid Cumnock	32898	87335	8975	129208
Lwr Cumnock	608	2953	0	3561
Upr Cumnock	77	393	994	1464
Gulf	5404	2233	0	7637
TOTAL	38987	92914	9969	141870

Table 5. Original coal resources (in thousands of short tons) by type of measurement and individual coal beds.

Coal Bed	1-Measur	2-Indica	3-Inferr	TOTAL
Mid Cumnock	24578	53314	51316	129208
Lwr Cumnock	1122	2406	33	3561
Upr Cumnock	664	485	315	1464
Gulf	3030	4468	139	7637
TOTAL	92914	38987	9969	141870

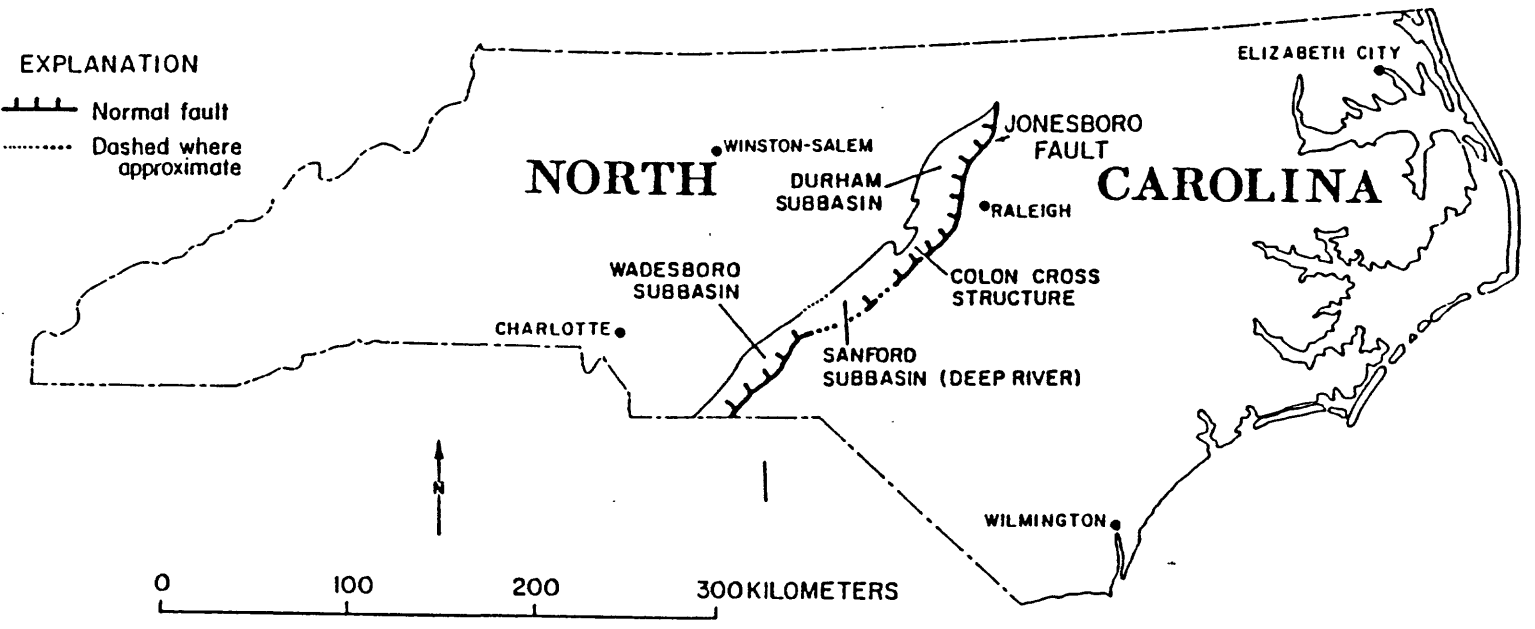

Figure 1. Deep River Triassic basin, with three subbasins and major Jonesboro border fault system on the east. Modified from Bain and Brown (1981)

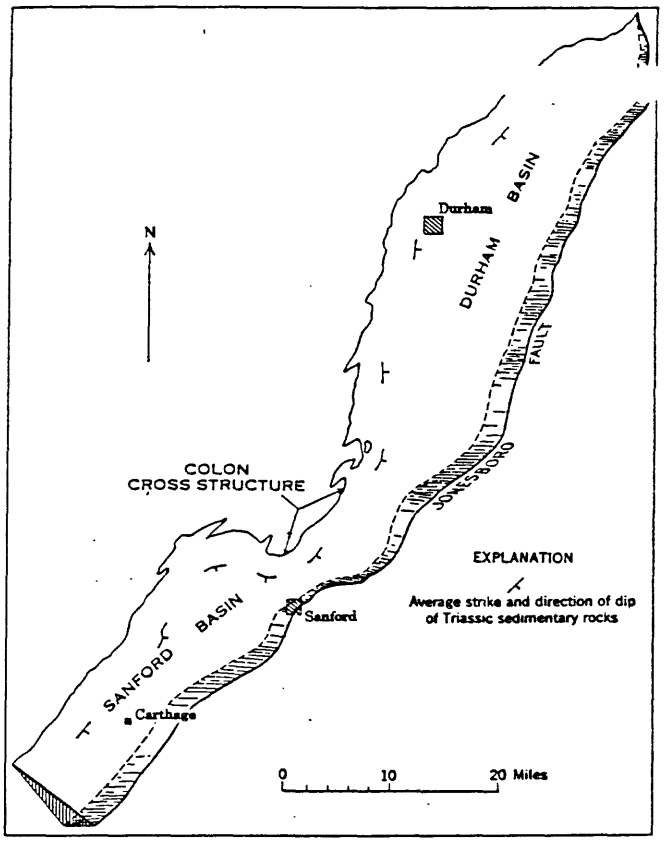

Figure 2. Major structural features of the Sanford and Durham subbasins showing the location of the Colon cross structure separating the two. (From Reinemund, 1955).

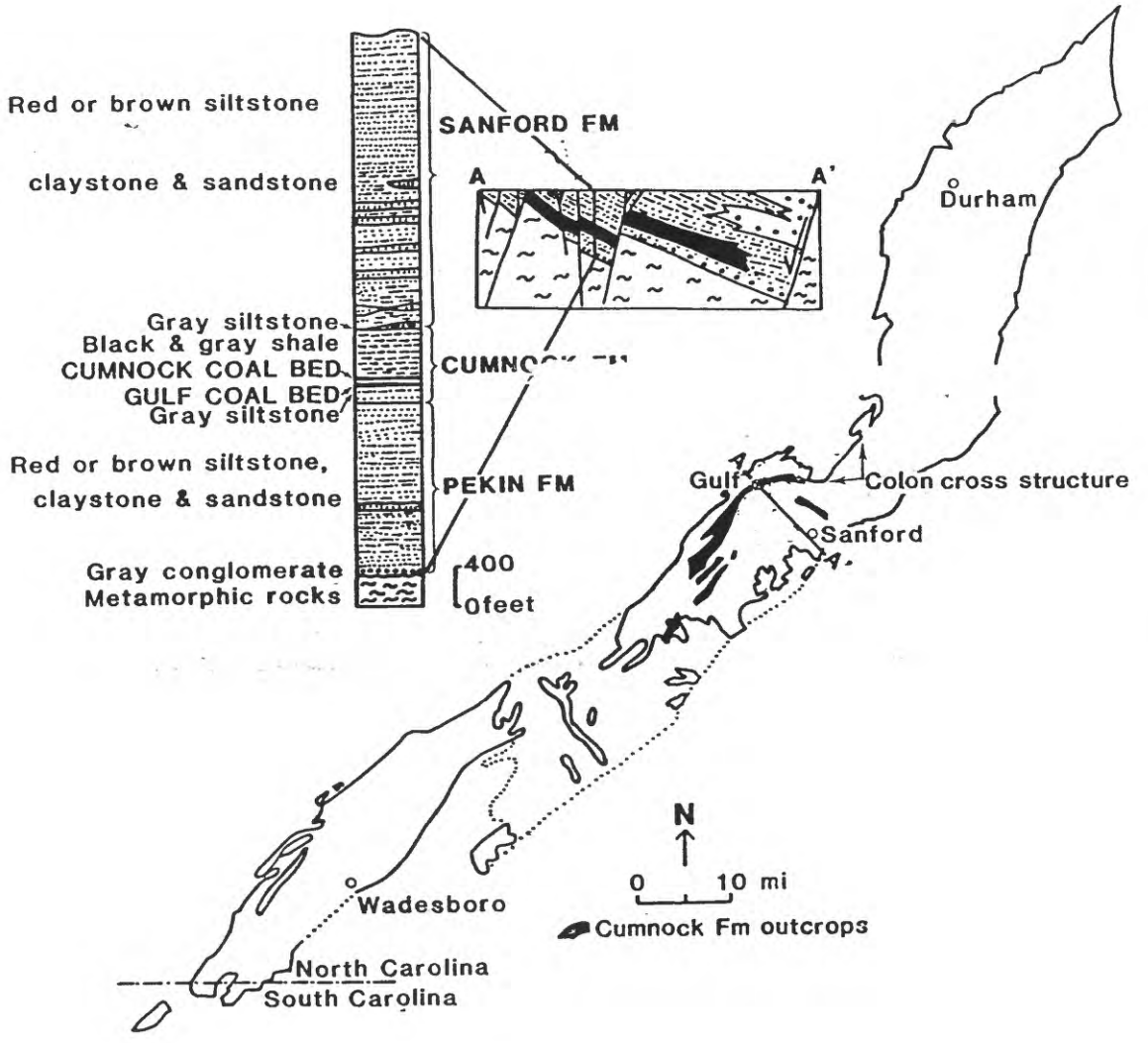

Figure 3. Stratigraphic section, map, and cross section of basin showing coal-bearing units. Note location of the Cumnock and Gulf coal near the base of the Cumnock Formation. Modified from Reinemund (1955) and Robbins and Textoris (1986).

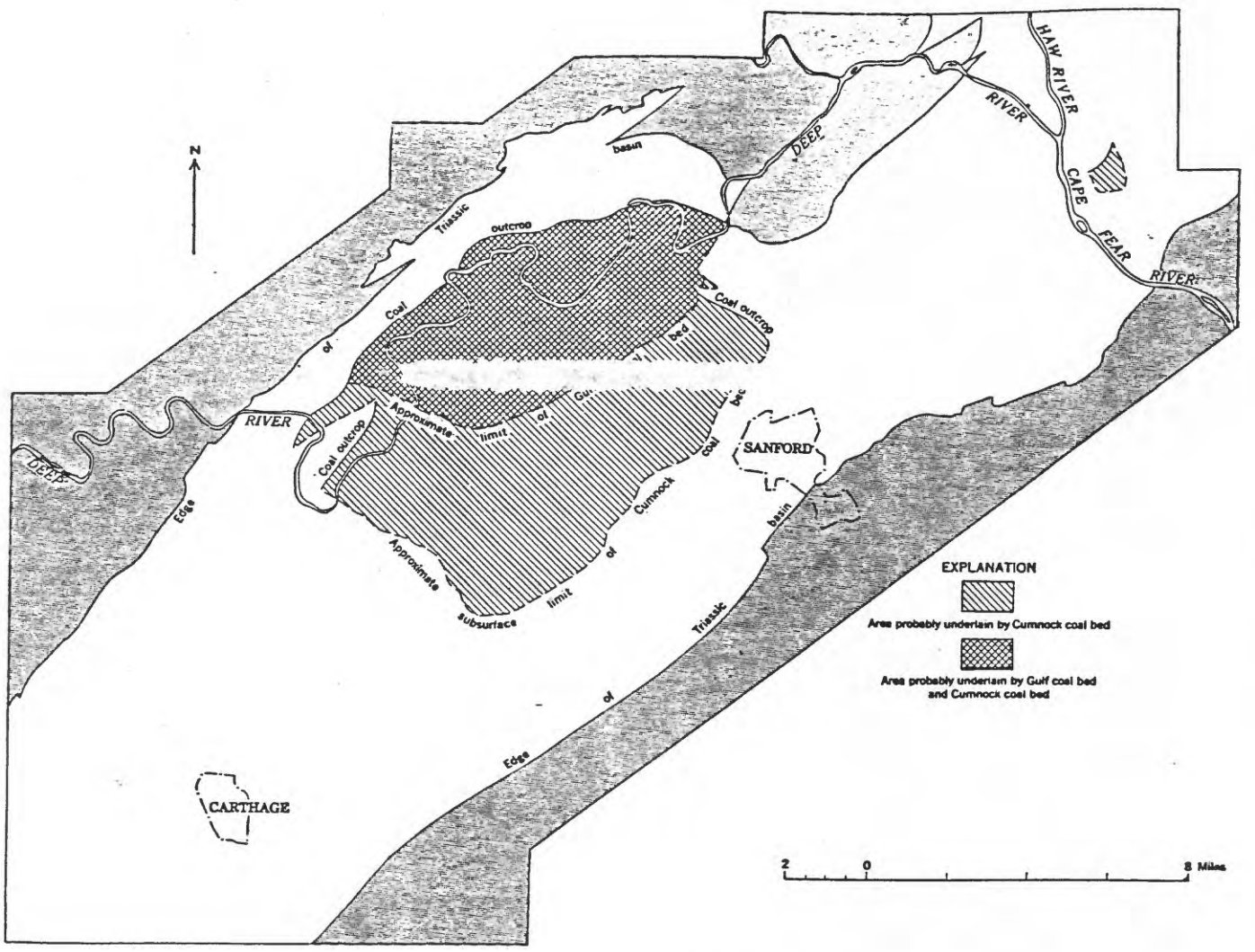

Figure 4. Surface and subsurface extent of the Gulf and Cumnock coals within the Sanford subbasin. Note outcrop and possible subsurface occurrence of Cumnock coal east of the Cape Fear River, at the border of the Colon cross structure and the Durham subbasin. This coal is too thin for consideration in this report. From Reinemund (1955).