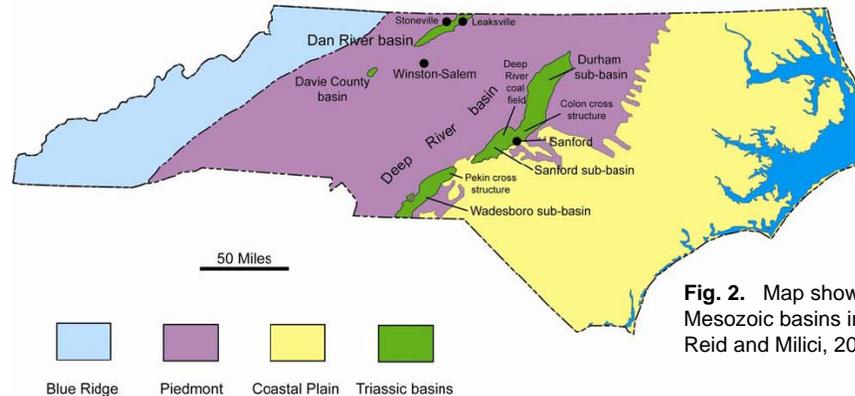




# Shale Gas Potential in Triassic Strata of the Deep River Basin, Lee and Chatham Counties, North Carolina with pipeline and infrastructure data



**Fig. 1.** Map showing the distribution of Mesozoic basins in the eastern United States (from Robinson and Froelich, 1985). Lee and Chatham counties are located inside the red box.



**Fig. 2.** Map showing the distribution of Mesozoic basins in North Carolina (from Reid and Milici, 2008).

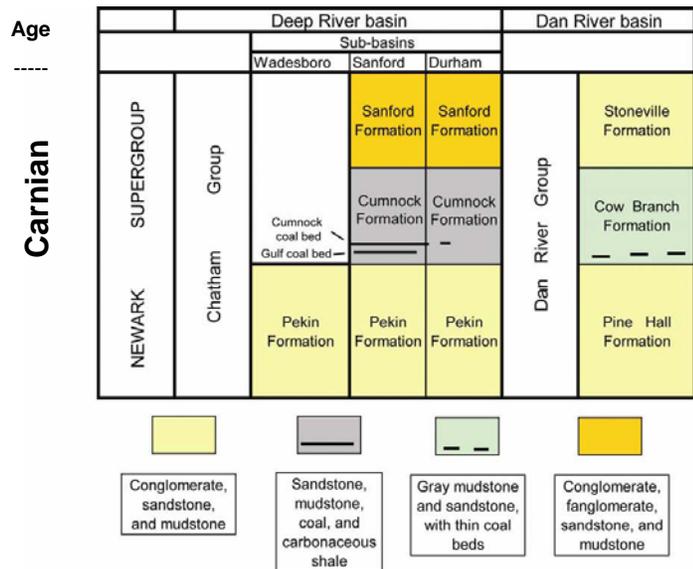
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The Deep River Basin is a 150-mile long northeast-trending half-graben with a steeply-dipping eastern border fault in central North Carolina (Fig. 1 and 2). The basin is divided into three sub-basins, which are named (from north to south) the Durham sub-basin, the Sanford sub-basin and the Wadesboro sub-basin. The three sub-basins are filled with ~7,000 feet of Triassic strata, which are divided into the following three formations in descending stratigraphic order (Figs. 3 and 4): (1) Sanford Formation (red and gray siltstone and shale); (2) Cumnock Formation (black shale, with some beds of gray shale, sandstone and coal); and (3) Pekin Formation (gray sandstone and shale). The Cumnock Formation includes a ~800 foot thick interval of Upper Triassic (Carnian) organic-rich black shale. This shale extends across ~25,000 acres, at depths of less than 3,000 feet in the Sanford sub-basin, Lee and Chatham counties. Organic geochemistry and thermal maturation analyses indicate that the black shale in the Cumnock Formation is gas-prone, and that values of total organic carbon (TOC) exceed 1.4 percent in places. The Cumnock Formation contains systematic fractures that are observable in outcrop, in drill cores and on 1:24,000-scale geologic maps superimposed on LiDAR data. The primary fractures trend northwest, whereas the conjugate fractures trend northeast. In some places along the west side of the basin, the primary fractures are filled with diabase dikes (that locally heated the Cumnock Formation), although mapping in underground coal mines (now closed) has shown that the diabase dikes do not extend far into the basin.

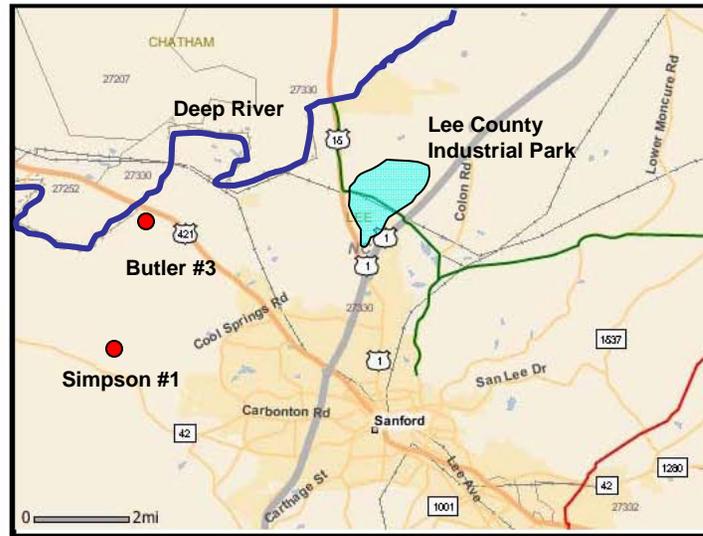
Six of the 28 wells (including old coal holes) that have been drilled in the Cumnock Formation have reported natural gas and oil shows, and two shut-in wells have reported pressures of 900 psi and 300 psi. One of these shut-in wells (Butler #3) is located within 3.5 miles of a six-inch natural gas distribution line to an industrial park with large volume gas users (Fig. 5). Well drilling preceded acquisition of ~75 miles of seismic lines that provide 3-D control in the Sanford sub-basin and parts of the Durham sub-basin. Deeper parts of the Sanford sub-basin are unexplored. Preliminary seismic interpretation suggests multiple stratigraphic and/or structural targets.

In the Deep River Basin, many families sold the mineral rights to their property to pay for taxes during the Great Depression, and significant underground coal mining occurred during the 1930s. Information on mineral rights and deed transfers may be found using online county land records. The North Carolina oil and gas law may be viewed online at the following Web site: <http://www.ncleg.net> (see short cut to General Statutes). Additional information on natural gas and oil, and permitting in North Carolina, may be found in N.C. Geological Survey Information Circular 36, available online at: [www.geology.enr.state.nc.us](http://www.geology.enr.state.nc.us) (see 'Publications' at that URL).

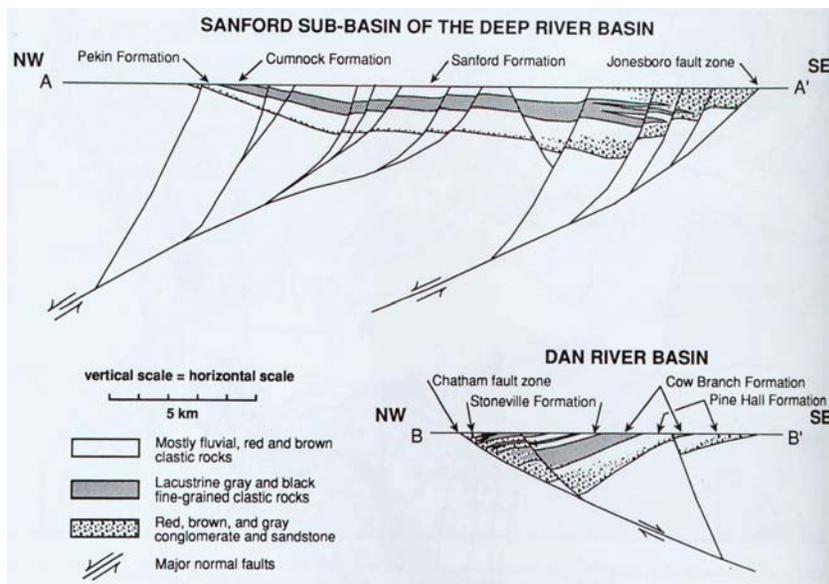
Seismic data, drill cores, cuttings, well logs and other data from the Deep River Basin may be examined at the facilities of the North Carolina Geological Survey in Raleigh, N.C. See contact information on the next page.



**Fig. 3.** Generalized stratigraphy of the Deep River and Dan River basins showing the stratigraphic position of the Triassic Cumnock Formation in the Deep River basin and the stratigraphically equivalent Cow Branch Formation in the Dan River basin (from Reid and Milici, 2008).



**Fig. 5.** Detailed map of part of Lee and Chatham counties, showing the city of Sanford and the locations of several brick kilns within about 4 miles of shut-in and previously drilled wells (map from National Pipeline System). Natural gas distribution line is shown as a green line and the regional transmission line is shown in red. The Butler #3 well is located within 3.5 miles of a six-inch natural gas distribution line (green) with a four-inch feeder line and multiple large gas users.



**Fig. 4.** Stratigraphic cross sections through the Sanford sub-basin of the Deep River Basin and Dan River Basin (adapted from Olson *et al.*, 1991).

**References and additional information**

Olson, P.E., A.J. Froelich, D.L. Daniels, J.P. Smoot and P.J.W. Gore (1991) Rift Basins of Early Mesozoic Age in Horton, Jr., J.W. and V.A. Zullo (ed.) (1991). *Geology of the Carolinas: Carolina Geological Society Fiftieth Anniversary Volume*, Univ. of Tennessee Press, Knoxville.

Robinson, G.R. and A.J. Froelich (1985). *Proceedings of the Second U.S. Geological Survey workshop on the early Mesozoic basins of the Eastern United States*, USGS Circular 946..

Reid, Jeffrey C. and Robert Milici (2008). *Hydrocarbon Source Rocks in the Deep River and Dan River Triassic Basins, North Carolina*, United States Geological Survey Open File Report 2008-1108 -- see URL: <http://pubs.usgs.gov/of/2008/1108/>

Reid, J.C. and K.B. Taylor (2008). *Tools to evaluate the hydrocarbon potential of the Mesozoic Basins, North Carolina, USA*, American Association of Petroleum Geologists Eastern Section Abstracts with Program – see URL: <http://www.searchanddiscovery.net/abstracts/html/2008/eastern-pittsburgh/abstracts/reid.htm>

Reid, Jeffrey C. (2009). *Natural Gas and Oil in North Carolina*, N.C. Geological Survey Information Circular 36 - Includes drilling regulations and permitting details – see URL: [http://www.geology.enr.state.nc.us/pubs/PDF/NCGS\\_IC\\_36\\_Oil\\_and\\_Gas.pdf](http://www.geology.enr.state.nc.us/pubs/PDF/NCGS_IC_36_Oil_and_Gas.pdf)

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