North Carolina Shale Gas: Dan River Basin – Stokes and Rockingham Counties

Jeffrey C. Reid, Kenneth B. Taylor, and James D. Simons

N.C. Geological Survey, 1612 Mail Service Center, Raleigh, 27699-1612, jeff.reid@ncdenr.gov, kenneth.b.taylor@ncdenr.gov, jim.simons@ncdenr.gov

The Dan River Basin is a ~93-mile-long northeast-trending half-graben Triassic rift basin with a steeply dipping western border fault in north-central North Carolina (NC) and Virginia. The basin is filled with ~6,600 feet of Triassic strata that dip at about 30^{o} west toward the border fault. The Triassic are divided into the following three formations in descending stratigraphic order: (1) Stoneville Formation (red and gray siltstone and shale); (2) Cow Branch Formation (black shale, with some beds of gray shale, sandstone and very thin coal); and (3) Pine Hall Formation (gray sandstone and shale).

The Cow Branch Formation (CBF), the source rock in the Dan River Basin, is correlative to the Cumnock Formation in the Sanford sub-basin, and likely, to organic strata in the Wadesboro sub-basin, Deep River Basin, NC.

The CBF shale was deposited in fresh water, shallow lakes similar to African rift valley lakes in a paleo-equatorial geographic location. The formation extends across ~65,000 acres in Stokes and Rockingham counties, North Carolina, and then northeastward into Virginia.

The CBF has been informally divided into lower unnamed- and upper unnamed members. The lower member is late middle Carnian and is up to 540 feet thick. The upper member is early upper Carnian and is up to 1,050 feet thick near the state line in a quarry. Reconnaissance organic geochemistry and thermal maturation analyses indicate that the black shale in the lower member of the Cow Branch Formation is gas-prone, and that total organic carbon (TOC) average 3.68% from two core holes (n = 43, min. = 0.17, max. = 27.68; std. dev. = 5.15). Sparse vitrinite reflectance data from these same two drill holes averages 2.07%Ro (n = 4). Additional vitrinite reflectance and TOC analyses are pending. Sparse TOC data reported in the literature are higher in the southern part of the basin than in the northern part of the basin. Temperatures in the northern part have been interpreted in the literature to be higher from either deeper burial or a paleo hotspot.

The Dan River Basin contains systematic fractures that are observable in outcrop, and on regional geologic maps superimposed on LiDAR data. The primary fractures trend north-west, whereas the conjugate fractures trend northeast. The Dan River Basin is an untested basin with only three shallow core drill holes in the lower member of the Cow Branch Formation. No seismic lines are known. The gray shale of upper member of the Cow Branch Formation is mined for expanded- and lightweight aggregate where 1,500 feet of section are continuously exposed in a mine quarry. Additional organic geochemical sampling is in progress.

The Davie Basin, located in Davie and Yadkin counties, NC, was once connected to the Dan River Basin. Post depositional faulting and erosion account for the present configuration of the two basins. The Davie Basin has no known organic lake facies and is probably very shallow.

Staff have identified several aspects of the North Carolina Oil and Gas Law (adopted in 1945) that should be reviewed for updating, including horizontal drilling and hydraulic fracturing. Given the current interest in state shale gas exploration, the North Carolina General Assembly has indicated interest in reviewing the state statutes for possible legislation.