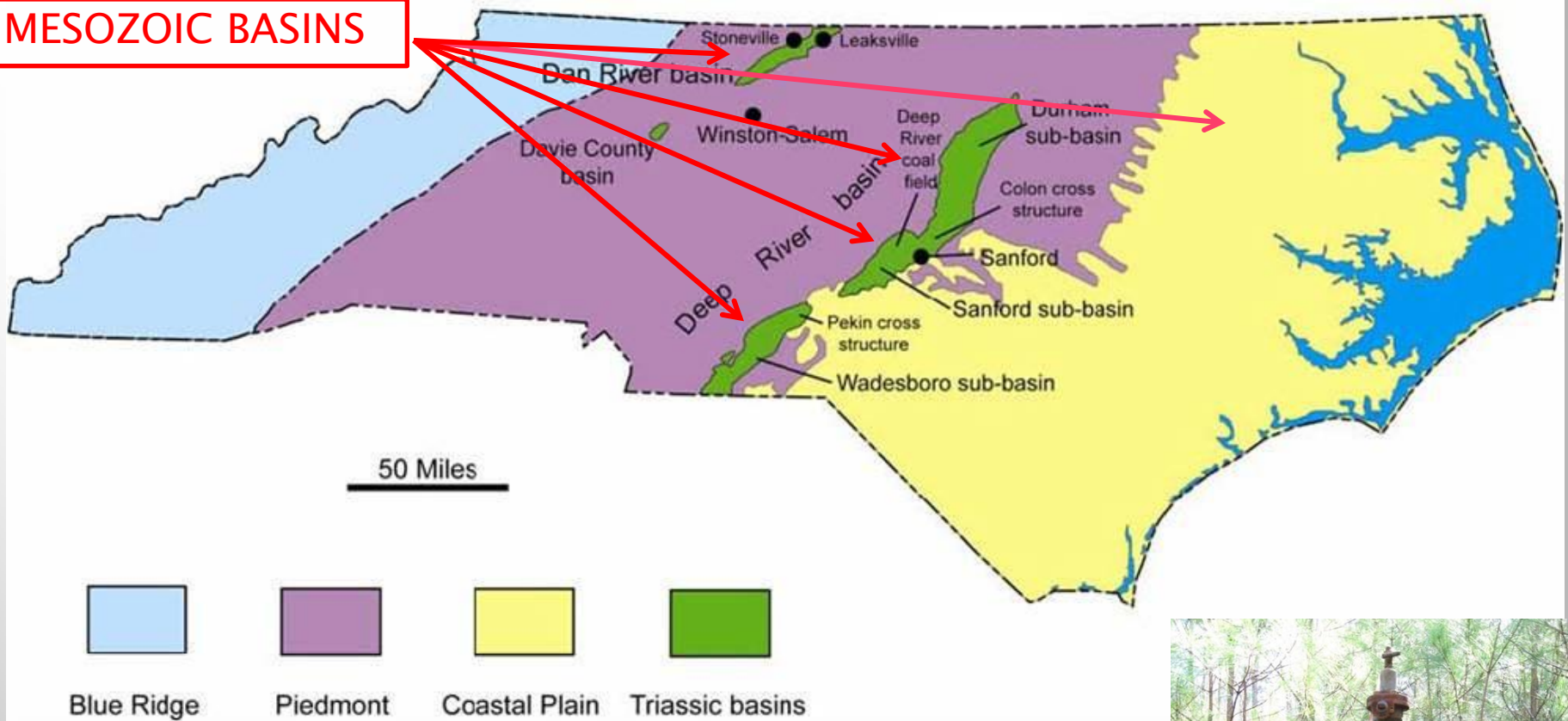


MESOZOIC BASINS



NORTH CAROLINA'S SHALE GAS POTENTIAL: WHO KNEW?

North Carolina Geological Survey



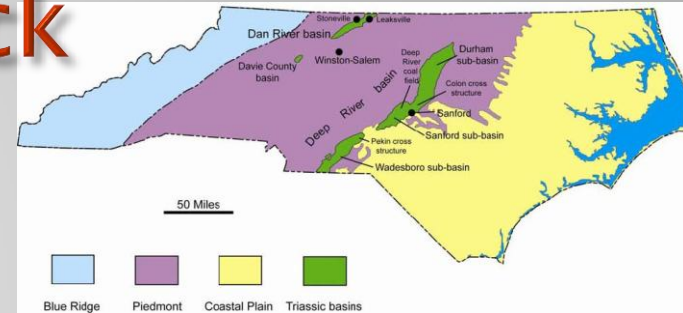
Role of N.C. Geological Survey

- ▣ The 1823 organic act which created the North Carolina Geological Survey (NCGS) tasked us to examine, describe and map the geology, geologic hazards, and mineral resources of North Carolina and publish these findings in NCGS reports and maps.
- ▣ Provide unbiased, impartial and relevant technical information to all parties.
- ▣ The NCGS is the custodian of rock cores, cuttings, geophysical logs, etc.



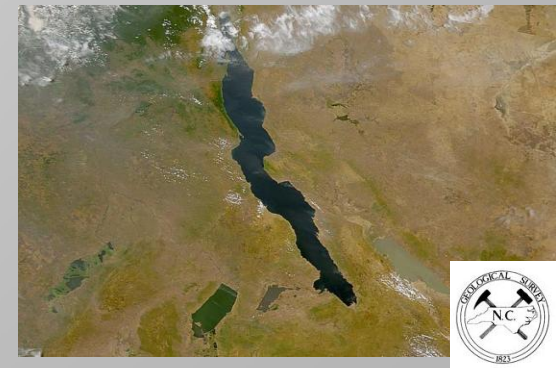


Basin and Source Rock Overview

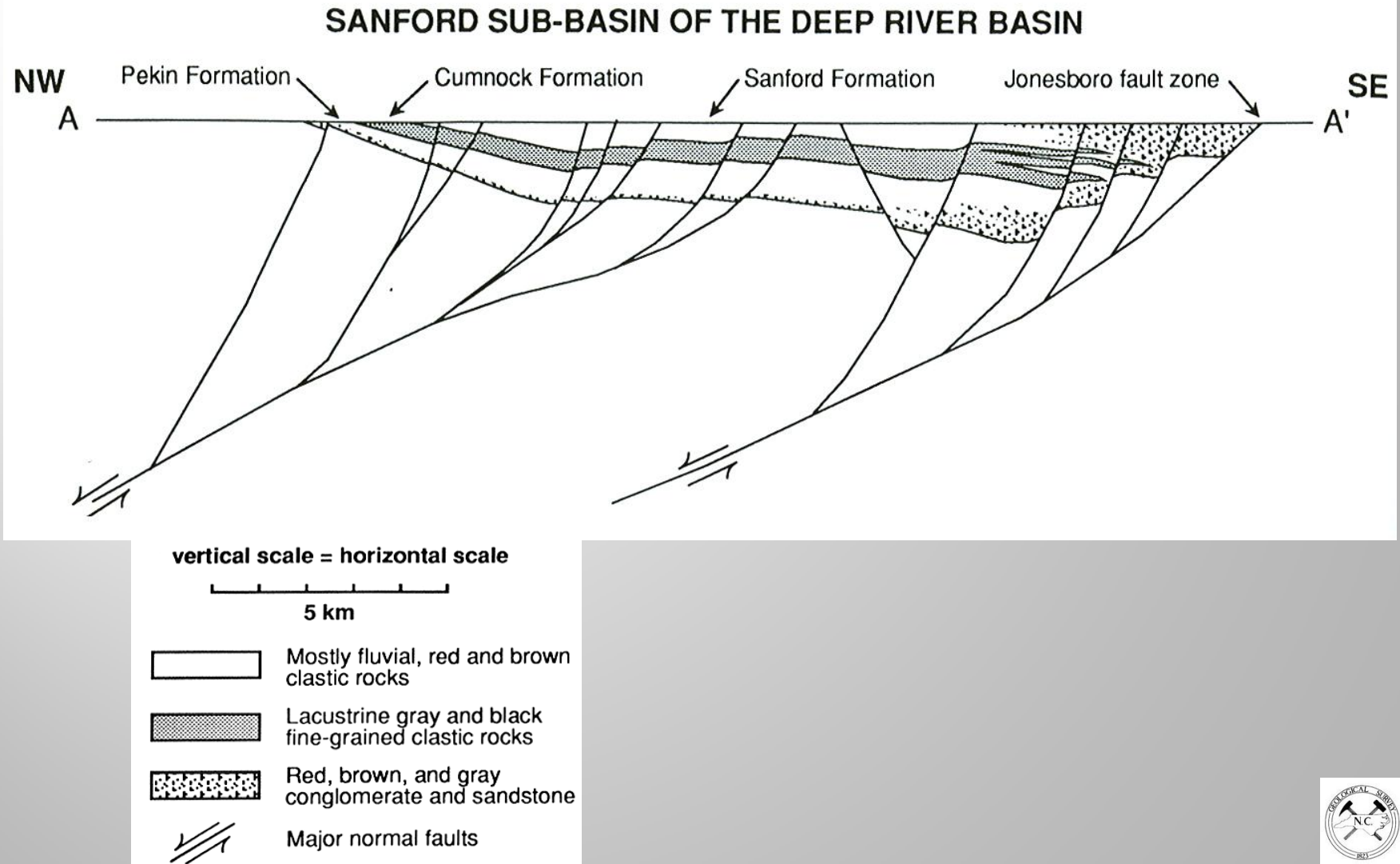


Map showing the distribution of Mesozoic basins in North Carolina (from Reid and Milici, 2008).

- Deep River Basin – 150-mile-long northeast trending half-graben (rift basin) with a steeply dipping eastern border fault.
- ~7,000 feet of Triassic strata.
- Lake deposits similar to African rift valley lakes.
- ~59,000+ acre prospective area.
- Total petroleum system containing:
 - Source rock
 - Seal
 - Traps / reservoir
- Relatively untested exploration area.



Generalized cross section



Time line – Deep River Basin

- ▣ 1775 – Revolutionary War era, coal exploration for iron and munitions.
- ▣ 1861 – 1873 – Civil war and post war coal production.
- ▣ 1920's – 1940's – Underground coal mining, exploration; 1925 coal mine explosion (killed 53 workers).
- ▣ 1980's – 1990's – Petroleum drilling (preceded seismic – vertical holes).
- ▣ 2008 – Organic geochemical data published (*Reid and Milici – USGS OFR 2008-1108*). NCGS recognizes thick section of organic shale as a potential gas resource.
- ▣ 2009 NCGS publishes 'Natural Gas and Oil in North Carolina' Information Circular 36.
- ▣ 2009 NCGS Open-File Report 2009-01 (Shale Gas Potential...).
- ▣ 2009 – 2010 Presentations made to interested industry, governmental and environmental groups.
- ▣ 2010 North Carolina Geological Survey / U.S. Geological Survey Resource assessment (currently in progress).



Why now? – 1

Compilation of data

- ▣ Years of scholarship locating and compiling data.
- ▣ Conversion of paper data to digital formats
- ▣ Organic geochemistry data collected and interpreted for first time.
- ▣ Interpreted seismic lines which were shot AFTER initial wells drilled.
- ▣ Natural gas focus was shallow coal bed methane, not shale gas.



Why now? – 2

New emphasis

- ▣ Exploration industry largely unaware of basins in North Carolina.
- ▣ USGS emphasis on Mesozoic basin energy systems.
- ▣ The thick organic-rich shale section previously not considered to be of interest.
- ▣ Similarity to other unconventional organic shale resources.

New techniques / interpretation

- ▣ New gas chemistry and gas quality data
- ▣ Use of LiDAR to delineate geologic structures.
- ▣ Recognition of a total petroleum system.



Current technology

- ▣ Current technology allows “shale gas = natural gas” to be recovered from shale formations with a high degree of organic content.
- ▣ Modern exploration and gas production technology, such as horizontal drilling and hydraulic-fracturing, has enabled the extraction of shale gas in similar formations in other states.
- ▣ Unconventional energy resource.



USGS/NCGS Resource Assessment

- ▣ *Current focus:* Rigorous, science-based assessment of technically recoverable natural gas.
- ▣ *Methodology:* Numerical, conservative approach to be computed by the U.S. Geological Survey.
- ▣ *Completion date:* Spring, 2011.
- ▣ *Publication date:* sometime in 2011.



Open Issues

- ▣ 1945 Oil and Gas Conservation Act
 - ▣ Article 27, G.S. 113–378 through 113–415

- ▣ Horizontal drilling: Not currently allowed
 - ▣ Based on the Oil and Gas Conservation Act

- ▣ Hydraulic–fracturing: Not currently allowed
 - ▣ 15A NCAC 02C. 0213



Permitting / Bond / Royalties

- ▣ Permit fees: Currently \$50/well.
- ▣ Bonding: Currently \$5,000/well.
- ▣ State royalties: \$0.005/mcf (1,000 ft³).

From: Oil and Gas Conservation Act of 1945



Environmental Issues

- ▣ Water resources for drilling and hydraulic-fracturing.
- ▣ Impacts on groundwater (quantity and quality).
- ▣ Solid and hazardous waste from drilling.
- ▣ Waste water from drilling and hydraulic-fracturing.
- ▣ Erosion and sedimentation control from construction of well pads, access roads and pipelines.



Summary

- ▣ 59,000+ prospective acres for exploration.
- ▣ Rift basin with depth of 7,000+ feet.
- ▣ 800-foot thick organic shale section with two coal beds.
- ▣ Gas prone section based on chemistry and maturation and two shut-in wells with pressure.
- ▣ Centrally located in state.
- ▣ Environmental and permitting issues.

