

# Stratigraphy, geochemistry, and organic petrology data from the Esso Hatteras Light #1 and the Mobil State of North Carolina #3 and their effect on hydrocarbon prospectivity in coastal North Carolina

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The North Carolina (NC) Geological Survey undertook a two-pronged geochemical study to determine if (1) hydrocarbons present in two historic wells were *in situ* or migrated, and (2) provide new data on the petroleum potential of the U.S. OCS offshore NC. Drilling for oil/gas in coastal NC began in 1921. Oil and/or gas shows have been reported in wells, and oil occurrences were described in local, early 20th century newspapers. However, no reports of oil/gas have been found in wells in similar settings in Virginia, South Carolina, and Georgia.

The study focused on intervals where hydrocarbons had been reported. Hydrocarbons are reported in a fluid inclusion stratigraphic study of the Mobil State of North Carolina #3 well (NC#3), and oil shows reported in post-drilling examination of cuttings and cores in the Esso Hatteras Light #1 (HL#1) well. The NC#3 penetrated 7222 ft. (2,201 m) of Tertiary and Cretaceous strata overlying Precambrian granite. The down-dip HL#1, the deepest well drilled on the NC Atlantic Coastal Plain, encountered 9878 ft. (3011 m) of Tertiary and Cretaceous strata above granite.

Analyses for this current study included % TOC, % Ro, programmed pyrolysis, organic petrology, and biomarkers. Geological and geochemical data indicate sampled intervals are too thin, organically lean, and immature to source commercial conventional or unconventional hydrocarbons in the onshore or state waters of NC. Anomalously high % Ro values in HL#1 may be due to allochthonous kerogen from nearby exposed Triassic rift basins of the Piedmont. Analyses of these basins indicate ca. 3300–10 000 feet (ca. 1000–3000 m) of synrift strata were removed during their inversion, exhumation, and erosion.

The *in situ* or migrated nature of the hydrocarbons remains problematic, though biomarkers suggest an *in situ* origin. However, in HL#1, interpreted mobile hydrocarbons were detected at ~815 ft. (~249 m) in Tertiary strata, and solid bitumen and migrabitumen sporadically were identified in Cretaceous rocks. These, the lack of viable source rocks, and low level of thermal maturity, suggest their relation to a migration pathway(s) - the “*Carolina Ridge Complex*”. Both interpretations suggest a better hydrocarbon source rock potential and generation–expulsion–migration may have existed farther offshore in deep waters of the Atlantic OCS. Sea-surface hydrocarbon seepage slicks identified on satellite synthetic aperture radar images, and hydrocarbon-related diagenetic zones and “chimneys” interpreted on reflection seismic, data suggest vertical hydrocarbon migration in this area.