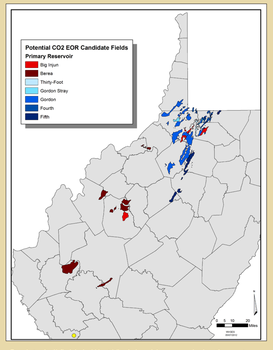
Assessing Suitability of Depleted Fields for Enhanced Oil Recovery in West Virginia

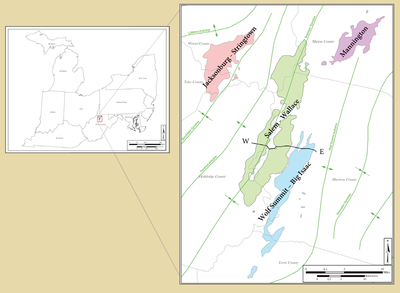
ABSTRACT

Oil production has been a part of West Virginia's economy since the 1860 discovery and subsequent development of the Volcano field, located near the axis of the Burning Springs anticline in the northwestern region of the state. Cumulative statewide oil production rates peaked at 16 million barrels in 1900 and began a steady decline that led to eventual abandonment of many early fields. Of the remaining active fields, several continue to be economically viable today due to secondary recovery water floods and are the focus of examination for potential tertiary recovery via CO_2 floods. As part of an effort led by the Midwestern Regional Carbon Sequestration Partnership (MRCSP) to identify potential carbon capture, utilization, and storage (CCUS) opportunities, the West Virginia Geological and Economic Survey is examining reservoir parameters in an attempt to establish a suitability ranking system for WV oil fields. Key characteristics were derived from existing sources (literature, completion reports, production data, and well logs) and include, but are not limited to, reservoir depth, pressure, temperature, porosity, permeability, oil viscosity or API oil gravity, estimated OOIP, and cumulative annual production. Only fields where a miscible flood would be possible were included in the assessment; these are generally the fields with a reservoir depth greater than 2500 ft. or a reservoir pressure that exceeds 1000 psi. From these broad screening criteria, several fields were identified as potential targets for more detailed characterization, with preliminary emphasis on the north-central region of the state. Potential targets in this area include the Jacksonburg-Stringtown, Wolf Summit, Mannington, and Salem-Wallace fields. In addition to the geological characterization of reservoir suitability, other factors were identified that would be critical to a successful CO_2 flood, including identification of areas with high probability of abandoned well locations, proximity to point-sources and available infrastructure. Many of West Virginia's coal-fired power plants are situated within 20 miles of EOR suitable fields and would be readily-available sources of CO_2 if the cost of retrofitting the plants became economically viable. In addition, significant investment of capital would be necessary to construct the network of pipelines to transmit the CO_2 from point-source to field.

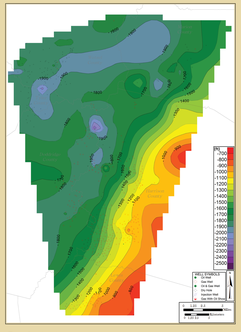


Depleted oil fields in West Virginia with reservoir depth greater than 2500ft (miscible flood) and/or reservoir pressure exceeding 1000psi. These fields would be targets for tertiary recovery via miscible CO_2 floods.

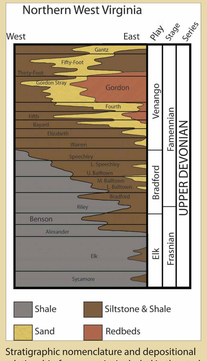
GEOLOGIC OVERVIEW



Study area with fields of interest and axes of regional anticlines and synclines.

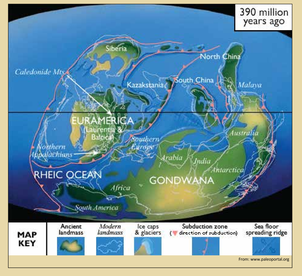


Detailed subsea structure contour map of the study area. Datum is base of the Gordon interval. C.I. = 100 ft.

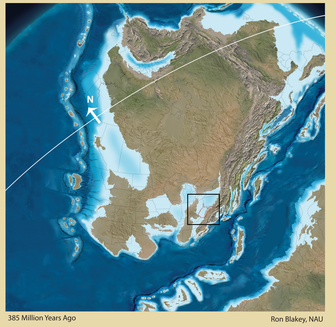


Stratigraphic nomenclature and depositional relationship for reservoirs included in the study. Modified from WVGES Vol. 25, 1996.

PALEOGEOGRAPHY



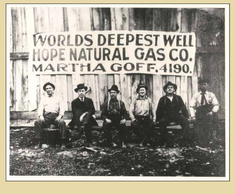
385 Million Years Ago

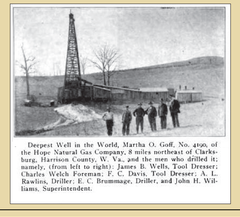


Ron Blakey, NAU

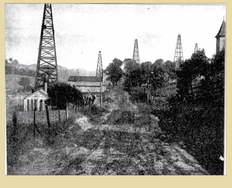
Paleogeographic reconstructions showing tectonics controlling Upper Devonian deposition. West Virginia was situated in a foreland basin setting south of the paleoequator.

HISTORICAL PHOTOS

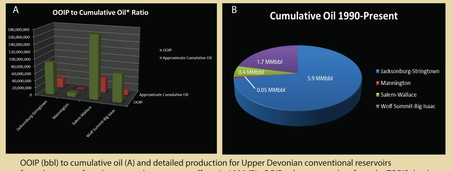




Deepest Well in the World, Martha O. Goff, No. 4190, of the Hope Natural Gas Company, 8 miles northeast of Clarksburg, Harrison County, W. Va., and the men who drilled it; namely, (from left to right): James B. Wells, Tool Dresser; Charles Welch Foreman; F. C. Davis, Tool Dresser; A. L. Rawlins, Driller; E. C. Brummage, Driller, and John H. Williams, Superintendent.

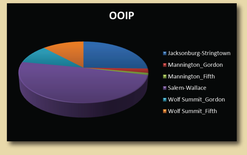


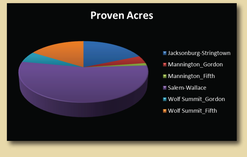
PRODUCTION STATISTICS

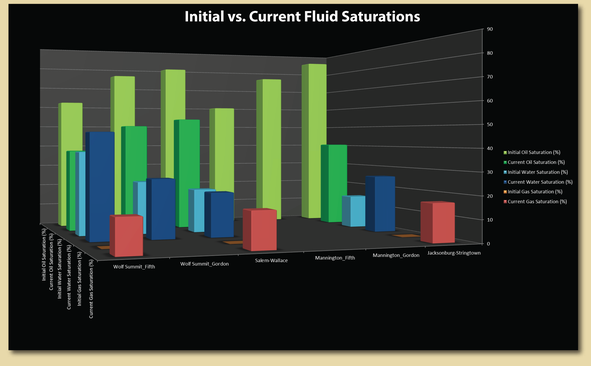


OOIP (bbl) to cumulative oil (A) and detailed production for Upper Devonian conventional reservoirs from the onset of modern secondary recovery efforts in 1990 (B). OOIP values were taken from the TORIS database and Whieldon, Jr. and Eckert (1963). See reference section for details.

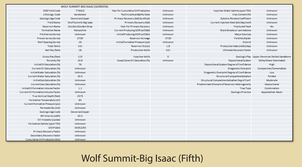
RESERVOIR PARAMETERS



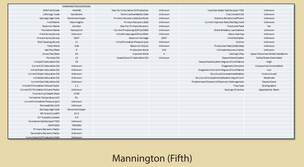




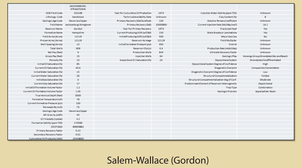
Wolf Summit-Big Isaac (Gordon)



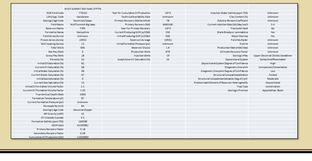
Mannington (Gordon)



Jacksonburg-Stringtown (Gordon)

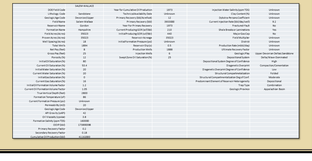


Wolf Summit-Big Isaac (Fifth)



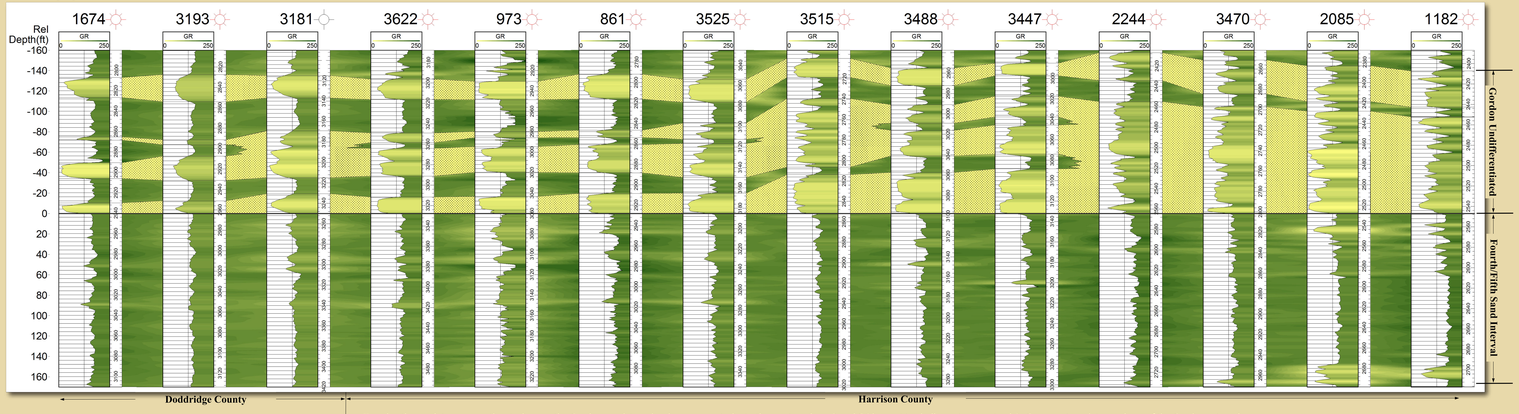
Mannington (Fifth)

Salem-Wallace (Gordon)



Summary data taken from TORIS and Whieldon, Jr. and Eckard (1963)

REGIONAL CROSS SECTION



To aid with correlation across the study area, the Gordon sandstone has been separated into three intervals: A, B and C (deepest to shallowest, respectively). Cross-section datum is base of the Gordon interval.
The Gordon 'C' interval becomes more isolated westward across the study area. It is commonly referred to as the "Gordon Stray" in the Jacksonburg-Stringtown field, where it is the main target for oil production.