Recent Gulf exploration efforts in the Williston basin have resulted in the discovery of a major new field, Little Knife, with multiple reservoir potential in a relatively untested area of the basin. The 70 producing wells drilled have been completed in the Mission Canyon Formation, but potential Devonian Duperow production has also been established in restricted areas of the field.

The dominant factor in entrapment appears to be a north-plunging structural nose, though stratigraphic contribution to entrapment has not been fully evaluated.

The Mission Canyon can be divided into five zones (A to E) based on lithologic and sonic log data. Zone B is the principal producing zone and was deposited in a wide variety of shore and nearshore environments. The depositional environments and diagenetic settings associated with zone B are responsible for an intricate pattern of carbonate deposition and porosity development.

Little Knife, now 2 years old, has already produced 3,675,000 bbl of oil (January 1, 1979) even though during much of that time many wells capable of much higher production were restricted to 100 BOPD. Little Knife now vies for position as North Dakota's largest oil producer, as a gas treatment plant became operational in late 1978 and allowed daily field capacity to increase to approximately 15,000 BOPD.

## AAPG EASTERN SECTION MEETING
**October 15-17, 1978**
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### Abstracts of Papers

BIRCH, MICHAEL J., and WILLIAM C. MACQUOWN, Univ. Kentucky, Lexington, Ky.

Petroleum Production from Basal Greenbrier Formation in Hyden West Pool, Eastern Kentucky

The Hyden West pool of northeastern Leslie County in eastern Kentucky produces from the Mississippian "Big Lime" (Greenbrier or Newman Limestone). The pool includes approximately 7,000 acres (2,800 ha.), with more than 60 wells which range in depth from 1,900 to 2,400 ft (570 to 720 m). Production in the pool is primarily gas, with small amounts of oil, from the basal Greenbrier.

Drill cuttings from 10 wells within the pool and on its margins were studied using a binocular microscope. The thickness of the Greenbrier was determined throughout the pool from gamma-ray logs and samples. Drillers' logs have been used cautiously, and only if other sources of data were unavailable. These thicknesses, as well as intervals within the Greenbrier and structural data from the logs, were used to construct maps and cross sections of the pool.

The Greenbrier has a thickness of between 160 and 250 ft (48 and 75 m) in this pool, and consists of limestone and dolomite, with minor amounts of shale. Evidence suggests that the sequence was deposited in a shallow epicontinental sea that was transgressing across low-lying, exposed surfaces of the Maccrady siltstone.

The dolomite present in the basal part of the Greenbrier is mainly a secondary replacement of limestone. Porosity and permeability in the dolomite provide the pay zone of the Hyden West pool.

CEMEN, IBRAHIM, Pennsylvania State Univ., University Park, Pa.

Structure of San Cayetano and Oak Ridge Thrust Faults, East-Central Ventura Basin, California

The central Ventura basin, containing at least 20,000 ft (6,000 m) of Pliocene and Pleistocene sedimentary rocks, has been long recognized as bounded by thrust faults—the north-dipping San Cayetano fault (SCF) on the north and the south-dipping Oak Ridge fault (ORF) on the south. Field investigations and synthesis of available surface and subsurface data show that the three strands of the SCF, here named the Main, Goodenough, and Piru, join at depth to form a single fault plane. The SCF shows a 30,000-ft (9,000 m) maximum separation in the Fillmore area where a possible structural downstep is stepped to the left along the Goodenough strand. The SCF loses the separation progressively eastward and within about 14 mi (22 km) the fault apparently disappears in the north flank of the Santa Clara Valley syncline. The ORF, exposed within the southeastern part of the study area, also loses its separation eastward and disappears along the axis of the syncline. The Main strand of the SCF was initiated during the deposition of the "Pico." West of Hopper Canyon, the fault involves movement during and after the deposition of the Pleistocene Saugus Formation. The SCF cuts late Quaternary deposits and should be considered as potentially active. Most of the folds in the upper (north) block, and all the folds in the lower (south) block of the SCF, were contemporaneous with fault movement.

CORRE, PIERRE, and GILDAS OMNÈS, CGG, Houston, Tex., and Denver, Colo.

Shallow Seismic Reflection in Appalachian Basin with Mini-Sosie

The Mini-Sosie is a digital seismic system developed by Barbier and Viallix. The source is a 130- or 220-pound (59 or 99 Kg) tamper identical with those used for earth compaction. By acting on the throttle, the operator obtains a series of random impulses at an average rate of 10 per second. The digital recorder is connected to a normal 12- or 24-trace seismic reflection array and to a sensor set up on the tamper base plate. Each pulse from the sensor activates a register for each trace; thus, each repeatable seismic event corresponding to the impact which created the pulse is stored in the registers at a constant time interval after the activation of the register. Therefore, seismic events occurring at a constant time interval after the surface impulse will add up when the contents of a group of registers are stacked. Other events due to preceding or subsequent impulses behave as random noise and their sum decreases as more register contents are stacked. The operation amounts to a real-time correlation between the series of random pulses and the input from the geophones. The Mini-Sosie method is in fact a product of the microprocessor revolution. For two-way times of 1 second, decoding in

real time multiplies the stacking rate by more than 10 if the Mini-Sosie method is compared to an ordinary impulse-by-impulse stacking method such as weight dropping. The method resists moderate external noise well and the source can be used almost everywhere, and is particularly useful in populated areas.

CURTIS, C. E., and R. R. HARTMAN, International Exploration, Ivyland, Pa.

Integration of Airborne Magnetic and Gamma-Ray Spectrometer Data for Uranium Exploration in Eastern Appalachians

Airborne gamma radiation surveys are very useful for surface geologic mapping, and aeromagnetic surveys are equally useful for basement geologic mapping. As the essence of airborne uranium exploration is the detection of the surface expression of a fundamentally subsurface phenomenon, the problem becomes one of resolving the vagaries of uranium migration in the subsurface or of "bridging the gap" between the basement and the surface. In the data-acquisition phase of the airborne survey, the three essentials are large crystal volume gamma-ray detectors, closely spaced magnetic data (recording interval of approximately every 100 ft or 30 m of ground distance traversed, or 0.5 sec), and digital data recording. With such a magnetic data-acquisition interval, small anomalies from sources within the section, such as mineralization in fault planes, erosional unconformities, etc, can be correlated upward with radiometric anomalies and downward with fundamental basement and structural anomalies.

GUSTAVSON, JOHN B., John B. Gustavson Associates, Memphis, Tex.

Geology and Production Potential of Monteagle Limestone (Upper Mississippian) of Morgan County, Tennessee

Monteagle (Upper Mississippian) gas production in Morgan County, Tennessee, is stratigraphically controlled by several porous limestone zones. These zones may be partially controlled by regional structure, as penecontemporaneous minor faulting may have caused localized shoaling during deposition with a resultant oolitic limestone development. In addition, after lithification, minor structural deformation appears to have created secondary fracture permeability which enhances production.

Detailed stratigraphic mapping of the oolitic zones offers the best exploration guide. Mapping may be coupled with a regional tectonic evaluation to derive joint and fracture directions. Operators would benefit from obtaining accurate subsurface material in drilling productive zones, followed by detailed examination of cuttings.

Most common completion techniques in these fields include application of raw acids and/or explosives, both of which leave undesirable completions with rapid decline of deliverability. Use of delayed acid treatment is strongly indicated as well as hydraulic fracing with sand-propping where economically justified. The Monteagle gas, despite its under-pressure characteristics, presents a good economic potential for small operators who follow basic geologic concepts and use modern completion techniques.

HARMON, DAVID E., JR., O'Neal Productions, Inc., New Concord, Ohio

Petroleum Geology of Whirlpool Member (Silurian) of McConnelsville Field, Morgan County, Ohio

With the drilling of the 1 Forrest Knox, Meigsville Township, Morgan County, Ohio, by O'Neal Productions, Inc., in July 1977, a new pay in the McConnelsville field was opened when production was obtained from the Whirlpool Member of the basal Silurian Albion Group. More than 20 wells have been drilled in this pool and sufficient production has been obtained to extrapolate production curves. These curve extensions indicate that an average well should produce 58,000 bbl of oil on 40-acre spacing over a 10-year life. This is believed to be a more accurate representation of expectations than the 9,000 bbl indicated by volumetric calculations, or the 120,000 bbl indicated by a previous paper on the Blue Rock field in Muskingum County, Ohio.

The Whirlpool Member is a very fine to medium-grained, white to light-gray sandstone that was deposited in meandering channels on a broad delta plain of the Ordovician Queenston Formation. Three deposition zones are present in the Whirlpool, with varying oil and water saturations in each zone. Production is directly related to log porosities indicated by correlation of compensated density readings. Such porosity trends are difficult to project.

Drilling has been restricted to the rotary method with air rotaries encountering fewer difficulties than mud rotaries. Completion techniques have been confined to fracture treatments using a relatively slow injection rate and appear to be quite successful in confining the treatment to the formation.

The relation of this pool to the older Blue Rock pool and to the scattered few test wells indicates that a substantial area of untested Whirlpool awaits exploration and should reward the explorer.

HECK, E. T., Consulting Geologist, Bradford, Pa.

Fossil Fluids in Post-Silurian Rocks of Appalachian Basin

More than 90% of the fluids in post-Silurian rocks of the Appalachian basin have been reported from three states—New York, Pennsylvania, and West Virginia. American Petroleum Institute estimates show 10,415 million bbl of oil in place with 2,124 million bbl as the total ultimate recoverable using known methods of production. The American Gas Association estimates 28, 039 Bcf as the total ultimate recoverable amount of natural gas. These figures are low by a multiple of 2 to 10. Connate water is present only in some of these rocks; many are nearly, or entirely, devoid of liquid water. All of the oil and gas and most of the salt water is considered to be of Paleozoic age.