

altered into a gentle nose and sealed by a covering of Opeche shale.

The evidence for entrapment by regional truncation and facies change from sandstone into dolomite and anhydrite is not available for publication.

The recent approach to Minnelusa oil exploration is directed through seismic, magnetic, and subsurface structural mapping with Minnelusa age structures in mind. Isopaching the Opeche gives clues to buried topography. Detailed core and sample studies assist in locating facies changes and truncation as well as depositional character and trends of the reservoir rock. Holes based on little or no geology, drilled by independents and supported by majors, are effective in exploration. The discovery ratio of the eastern Powder River basin is 1:10.4 on wildcats and 1:3.49 for all wells. Average cost of a dry hole is \$44,000, and \$77,000 for a producer. Forty acres is the basic spacing and the average pay thickness is 25 feet. The gravity of the oil ranges from 12.5° to 37° API and is classed as a heavy, black, sour, intermediate base crude.

22. GEORGE DARROW, Consultant, Billings, Montana

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NEW FRONTIERS IN MONTANA EXPLORATION

Exploration and development in Montana during 1962 was particularly significant both in terms of successful wildcats which opened large new areas for future exploration, and field extensions which revealed unexpected economic potential in dormant field areas.

Two areas are discussed, the Williston basin in north-eastern Montana and the Sweetgrass Hills province in northwestern Montana. A sequence of prolific pre-Mississippian Paleozoic discoveries in northwestern Montana since 1960 had earlier revived interest in this area. During 1962, exploration of this area was further stimulated by three widely separated new-field discoveries: Spring Lake, Lone Tree, and East Benrud, as well as successful development wells in Dwyer and Southwest Richey. McAlester Fuel's Spring Lake discovery, dually completed in the Devonian Nisku and the Ordovician Red River for a combined flow of 742 BOPD on choke was the most significant.

A regional structure map, field maps, and cross sections illustrate how these 1962 discoveries have broadened the areas of active exploration interest and extended the reservoir objectives throughout the entire lower Paleozoic section, with multiple pay zones occurring in carbonate reservoirs at depths ranging from 7,500 feet to 12,000 feet. The significance of the existing production for future exploration includes: (1) location of the new discoveries off of known major structures, (2) distance from established production, (3) characteristic, subdued low-relief structural expression with regional dips averaging 30 feet to 60 feet per mile, and productive closures typically 50 feet to 75 feet, and (4) influence of facies, pore-size distribution and hydrodynamic factors in controlling oil accumulation.

In the Sweetgrass Hills province of northwestern Montana, 1962 extensions to existing production in the Flat Coulee and Whitlash field areas have revealed better quality reservoirs than were previously known and opened new pools. Cross sections illustrate the Jurassic Swift and Lower Cretaceous Sunburst sandstone reservoirs in which this production occurs at depths of 2,800-3,000 feet. Field maps show the accumulations to be combination stratigraphic-structural traps located down-flank on known structures.

Numerous structural domes uplifted by deeply buried

igneous intrusions, combined with rapid lateral variations in facies and porosity development in both Cretaceous and Jurassic reservoirs, holds forth the promise that many additional pools and fields will be found by future exploration in the Sweetgrass Hills province.

23. STANLEY D. CONRAD, Richfield Oil Corporation, Salt Lake City, Utah

EXPLORATION ACTIVITY AND OIL AND GAS DEVELOPMENT IN UTAH DURING 1962

Exploration activity continued at a moderate pace in Utah during 1962. The Paradox basin, which has been very active since the discovery of Aneth in 1956, had considerably less activity during the year. The Uinta basin, on the other hand, experienced a considerably accelerated rate of exploration, due largely to the completion of the Mountain Fuel Supply Company pipeline connecting many of the gas fields of the basin to the Wasatch Front markets.

Two rather insignificant new-field discoveries were made during the year in the southern end of the Paradox basin. Drilling of a few infield development wells and field extension wells continued in the greater Aneth area. The Ismay field received considerable drilling, extending the field south and southeast. The northern Paradox basin experienced some deep wildcat drilling in search of the Mississippian and deeper oil. All were unsuccessful. Three new discoveries were completed in the Paradox salt section in the general Big Flat area, indicating possible greater production from this stratigraphic interval. The Lisbon, Salt Wash, and Grassy Trail fields received some development drilling.

The Uinta Basin Uncompahgre area had at least ten discoveries or extensions of significance, five predominantly gas producers, and five oil. Two of these, the Phillips Flat Rock well No. 2 in sec. 30, T. 14 S., R. 20 E., and Pacific Natural Gas Exploration Moon Ridge No. 1, sec. 15, T. 16 S., R. 21 E., indicated possible important field discoveries. Formations from Tertiary Green River to Cretaceous Dakota shared in the discoveries. Development in the Red Wash, Chapata Wells, Ute Trail, and Rock House fields continued at a fair rate.

The emphasis of surface field work and geophysical work generally shifted west to the Wasatch Plateau, and Basin-and-Range areas, from the Paradox Basin, which has received most of the attention for the past few years. Considerable leasing took place in the Wasatch Plateau from the Clear Creek field south to the general Fish Lake area. Areas in the Basin-and-Range province, notably Box Elder and Iron Counties, experienced considerable leasing.

Oil production in 1962 was 31,104,169 barrels, a decline of approximately 813,000 barrels from 1961. Gas production totaled 72,516,409 MCF, an increase of nearly 14,000,000 MCF over 1961.

24. JOHN W. ROLD, California Oil Company, Denver, Colorado

HIGH-LIGHTS OF EXPLORATION AND DEVELOPMENT IN COLORADO AND WESTERN NEBRASKA, 1962

During 1962, 645 wells were drilled in western Nebraska, a 35 per cent decrease from the record year of 1961. The 381 exploratory wells resulted in 33 discoveries (success ratio of 8.7 per cent). Important developments in 1962 include the following: the expansion of the Cambridge arch productive area; the northward and north-eastward spread of the search for Paleozoic oil into sparsely drilled north-central Nebraska; the rapid ex-