Part II, The Habitat of Some Oil

Recently, a detailed statistical study was made of 236 or all the free world's major oil fields (those with 100,000,000 barrels or more ultimate recovery). These fields account for 217 billion barrels or 82.5 per cent of the ultimate reserves discovered to date outside the Soviet orbit. According to the results obtained, the bulk of the oil occurs: (1) on the stable side of basins, (2) in anticlines, (3) in sandstone and carbonate reservoirs, (4) from formations of Mesozoic age or younger, (5) from a depth range of 2,000 to 8,000 feet.

Most of the discovered free world ultimate oil is 30° API gravity or lighter, with mixed asphaltic-base oils predominating. Both the number of fields and the volume of reserves have been cyclic with ten-year intervals starting in 1917.

9. Gregory K. Elias, Gulf Oil Corporation, Durango
Tectonics of Paradox Basin and Its Relation to Oil Occurrence

The Paradox basin is defined as the areal extent of the Pennsylvanian evaporitic Paradox formation in the Four Corners area.

Two areas of uplift, the Fort Defiance and San Luis, influenced sedimentation throughout the entire Paleozoic. The Uncompahgre uplift developed during early Pennsylvanian time and remained active through the Permian.

Possible stratigraphic traps are postulated for the Devonian and Mississippian sediments in the proximity of the Fort Defiance and San Luis uplifts. Tectonism during the Pennsylvanian has given rise to potential reef production in beds bordering the evaporite basin. Stratigraphic porosity trends within the Paradox evaporite basin have yielded oil and gas. The major duty of the stratigrapher will be to determined the porosity belts. Sand pinch-outs may be expected in proximity to the uplifted areas in both Pennsylvanian and Permian sediments.

10. Phil A. Mundt, Mobil Producing Company, Billings
Paleotectonic Control of Carboniferous Sedimentation in Central Montana

In central Montana the accumulation of oil in the so-called "Heath" and "Amsden" formations is controlled by complex stratigraphic relationships. These relationships, however, are clarified by an analysis of the effect of tectonic elements upon depositional patterns. A revision of stratigraphic units is necessary in the process; such a revision is here proposed.

The "Amsden" formation of the central Montana area consists of three lithologic divisions—an upper light-colored cherty carbonate member, a middle brown ostracodal limestone unit, and a lower sequence of red shale and sandstone beds. The upper dolomite unit is lithologically, stratigraphically, and paleontologically equivalent to the carbonate portion of the Amsden formation at its type locality in northern Wyoming. The Amsden dolomite overlaps the underlying two units which pinch out southward and are not laterally continuous with Amsden beds in Wyoming.

The Amsden dolomite of Atokan age is unconformable with the underlying brown limestone unit which is probably of Chester age but may be very early Pennsylvanian, in part or altogether. This brown limestone was named the Alaska Bench formation by Freeman and his terminology is recommended for future use.

Since the "Heath" formation includes two lithologically distinct units which are separated by an unconformity, the term Heath is herein restricted to beds below the unconformity. The term Tyler is revived to apply to beds above the unconformity. The Tyler formation includes a lower sequence of dark gray shales and channel sands, a tongue of marine limestone, and an upper "red shale member." The channel sands in the lower part of the Tyler formation form excellent oil reservoirs at the prolific Northwest Sumatra and other central Montana fields.

The unconformity at the top of the restricted Heath formation is the result of tectonic instability at the end of Heath time; this instability is reflected in the depositional types of the Tyler formation. Paleogeologic maps illustrate that the "ancestral Sweetgrass arch" and its un-named counterpart on the south side of the Big Snowy trough were the principal effective tectonic elements. Where the Amsden dolomite onlaps the southern un-named element, excellent oil possibilities exist, and several oil fields have been discovered along the trend.

11. Vincent C. Kelley, University of New Mexico, Albuquerque
Tectonics of Colorado Plateau

The Colorado Plateau structural province consists of seven principal basins, nine principal uplifts, and several intermediate tectonic divisions such as platforms, slopes, sags, and broad saddles. Long monoclinal flexes between uplifts and basins are the principal lines of deformation in and marginal to the Plateau.

The Plateau may be divided roughly into northeastern and southwestern parts which differ considerably as to the magnitude and form of the principal tectonic elements. The northeastern part includes the major basins (Uinta, Piceance, and San Juan), the Paradox fold and fault belt, and uplifts and monoclines that generally face southwesterly. The southwestern part includes the minor basins (Henry, Kaiparowits, Black Mesa, and Blanding), the broad Mogollon slope, and uplifts and monoclines that generally face eastward.

The "salt" anticlines, piercements, and graben of the Paradox basin are the most special structures of the Plateau. Their folding and piercement began in Permian time, continued intermittently through Triassic and Jurassic time, and culminated in Laramide time. Subsequent collapse may be partly related to Cretaceous loading, partly to Laramide folding, and partly to solution of the salt.

In addition to the elongate, tangentially compressed uplifts such as San Rafael, Circle Cliffs, or Zuni, there are several domical uplifts due to the stock and laccolithic intrusions such as the La Sal, Abajo, or Ute centers. These centers fall on three nearly parallel, northwesterly trending lines.

The earliest tectonic events that appear to have influenced the present structure occurred during late Paleozoic time. Three northwesterly trending Permo-Pennsylvanian positives developed on and adjoining the Plateau. From northeast to southwest, these are the Front Range, Uncompahgre, and Zuni. All appear to have been asymmetrical toward the southwest where they were immediately adjoined in order by the Colorado, Paradox, and San Juan sags or basins. During Triassic and Jurassic time, local folding occurred in the Paradox fold belt and elsewhere and broad, slight epeirogenic sagging developed in a northwesterly direction between the Uncompahgre and Zuni positives. In late Jurassic time, the southern rim of the Plateau was generally tilted northward. During late Cretaceous time, the Plateau was markedly depressed and slowly tilted northward as it became a part of the Rocky Mountain geosyncline.

Despite the fact that the descriptive tectonics of the Plateau are fairly well known, there still remain several problems concerning the cause, nature, and history of deformation and the character, nature, and history of fluid movement. Among these problems are (1) influence of the Precambrian structures on later deformation, (2) Paleozoic and Mesozoic diastrophisms as interpreted from stratigraphy, (3) cause and nature of Laramide movements especially in relation to the formation of the adjoining Rockies belts, (4) significance of the fracture systems, (5) Cenozoic erosional history and basin sedimentation, and (6) paleodynamics of the rock fluids.

12. William Lee Stokes, University of Utah, Salt Lake City
Tectonics of Wasatch Plateau and Near-by Areas

The Wasatch Plateau of south-central Utah is a large table-like remnant of high ground not yet destroyed by the general erosion of the Colorado River system. The basic structure is monoclinal with a regional westward dip that is gentle on the east and steep on the west. Superimposed on the basic structure is a broad anticline, the Monument Peak uplift, consisting of two folds that plunge slightly east of north into the Uinta basin. These folds, in turn, are modified by a north-trending system of fault zones which fall into the North Gordon, Pleasant Valley, and Joes Valley zones. The Joes Valley zone is largest, having a total length of about 75 miles and an average width of 2 miles. It and the other zones are splintered by numerous small faults and the downward displacement reaches a maximum of 3,000 feet.

The regional westward dip of the Plateau is related to the origin of the San Rafael Swell. The greatest folding of the Swell must have been post-Cretaceous pre-Eocene by analogy with the Waterpocket fold on the south. Since the Monument Peak uplift shows structural alignment with the Swell, it probably originated at the same time.

The complex fault zones are obviously of later origin. They are tensional features and cut all surface rocks including Pleistocene moraines. They are related to the deep-seated Wasatch monocline and probably to subsidence and solution effects in the salt-bearing Jurassic rocks below. The western flank of the Wasatch Plateau is complex with numerous faults, unconformities, and landslides. This complexity may be due to growth and collapse of salt structures.

13. W. W. Mallory, Phillips Petroleum Company, Denver
Tectonic Development of Cordilleran Region

The Cordilleran region of Western United States is a segment of the Cordilleran geosyncline. Its western and eastern borders are the Pacific Coast Ranges and the Wasatch or Teton line. The Cordilleran geosyncline differs from its cratonic neighboring regions, the Colorado Plateau and the Rocky Mountains, by (1) containing extreme thicknesses of sedimentary and volcanic rocks and by (2) having experienced true orogeny. Like its counterpart, the Appalachian geosyncline, it has dual facies expression. An inner (cratonward or miogeosynclinal) belt has thick sediments lithologically similar to cratonic rocks; an outer (seaward or eugeosynclinal) belt has very thick graywackes, volcanics, and other lithotopes.

It is convenient to describe the tectonic development of the geosyncline in four stages, each of which exhibited a distinctive tectonic pattern. Stage I, comprising only the Cambrian period, was essentially simple failure of the continent margin by subsidence behind a progressively inward migrating hingeline. Sediment source was cratonic.

Stage II was a complex interplay of orogeny, volcanism, and deposition with long duration. It