

must be answered for any prospective area, and answers will range from a few thousand barrels to a billion barrels. Wells in "oil country" may be economically successful where each produces less than 10 BOPD. In contrast, wells located in some inaccessible places must produce more than 1,000 BOPD to avoid economic failure.

HARRISON, STANLEY C., Department of Geology, Johns Hopkins University, Baltimore, Md., and **ALONZO D. JACKA**, Geosciences Department, Texas Technological College, Lubbock, Tex.

DEPOSITIONAL ENVIRONMENT OF CHERRY CANYON SANDSTONE TONGUE, LAST CHANCE CANYON, NEW MEXICO

In the area of Last Chance Canyon the sandstone tongue of the Permian Cherry Canyon Formation, the subjacent lower San Andres, and the superjacent upper San Andres formations accumulated in a submarine canyon that extended from the Delaware basin margin northwestward into the Northwestern shelf. The Cherry Canyon tongue thickens basinward from the outcrop area which is 3-5 miles northwest of the Cherry Canyon basin margin. Early during the time of San Andres deposition, axial water depth in the canyon may have been as much as 600-1,000 feet. The presence of intertidal deposits in the lower Grayburg, including northwest-southeast flood and ebb-current directions, indicates that the canyon had shoaled sufficiently to become a tidal inlet.

Submarine-canyon deposits consist predominantly of narrow, deeply incised channels which are filled with massive, laminated, and current-rippled flow units, and numerous beds of conglomeratic carbonate-mudstone. The conglomeratic carbonate-mudstone beds commonly have hummocky upper surfaces and represent mud flow, slump, and avalanche deposits. In the lower San Andres and Cherry Canyon tongue, channel axes are inclined 4° - 10° .

Orientation of channels, large and small current ripples, and aligned fusulines record a highly uniform southeasterly current flow pattern (*i.e.*, down the canyon axis).

The fauna of the canyon deposits is primarily a thanatocoenosis consisting of shallow-water marine invertebrates (fusulines, corals, bryozoans, brachiopods, mollusks, trilobites, crinoid columnals, and echinoid spines). Burrowing organisms have homogenized thick intervals. The sediments contain large amounts of plant material and other organic matter.

The canyon headed in a shelf lagoon on the broad Northwestern shelf of the Delaware basin. When the lagoon was constricted, clastics were prograded across it and intercepted by canyon heads. When the canyon was expanded little or no clastic sediment reached the canyon and carbonates accumulated on the shelf and in the canyon.

HAUN, JOHN D., Colorado School of Mines, Golden, Colo.

RELATION OF PETROLEUM TO TECTONIC DEVELOPMENT OF ROCKY MOUNTAIN AND WESTERN PLAINS REGION OF NORTH AMERICA

Structural and depositional history of miogeosynclinal and cratonic areas of the Rocky Mountain-Western Plains region controls petroleum origin and entrapment. Extensive source beds associated with timely traps have characterized exceptional periods of petroleum entrapment—Devonian, late Paleozoic, and Cretaceous.

Late Precambrian marine sedimentary rocks were deposited in the Cordilleran geosyncline, and eastward extensions of the sea occupied parts of the region. In the western part of the geosyncline, deposition was continuous into Cambrian time, but on the east a period of erosion was followed by a Middle Cambrian-to-Early Ordovician marine invasion. Major tectonic elements that developed early in Paleozoic time include the Peace River, Alberta, and Transcontinental arches. Middle Ordovician-to-Silurian depositional patterns indicate early development of the Williston basin. The Upper Ordovician-Silurian section is the oldest oil-producing interval; significant production is restricted to the Williston basin.

Middle Devonian-Mississippian carbonates and evaporites record another major marine invasion. Upper Devonian reefs, with associated evaporites and marine shale, contain more than half the oil reserves of the northern part of the region (largely in Alberta). Oil and gas in Mississippian rocks are found in bioclastic carbonates (associated with anhydrite), at or near unconformities, and in large anticlines. Southwest of the Williston basin, Devonian and Mississippian oil production is limited, but the potential has not been adequately evaluated.

Late Paleozoic rocks have limited distribution in the northern part of the region. Pennsylvanian and Permian tectonic activity (Ancestral Rockies) was most pronounced in the southern part of the region. Pennsylvanian-Permian petroleum is trapped in a wide variety of clastic and carbonate structural and stratigraphic traps in the middle and southern Rockies, and offers many opportunities for future exploration.

Triassic miogeosynclinal deposits are restricted to the western edge of the region. Jurassic marine invasions from the Arctic extended as far south as the southern Rockies. Continental deposits dominate the Triassic and Jurassic sequence and account for the relatively small percentage of petroleum reserves in these rocks.

During Early Cretaceous time the sea again invaded from the north and in late Early Cretaceous joined a Gulf of Mexico sea. Coastal-plain, deltaic, and shallow-marine clastics that were deposited in this vast seaway form the source and reservoir rocks for some of the largest petroleum accumulations of the region. The present tectonic framework of uplifts, intermontane basins, and thrust faults on the west was formed during Late Cretaceous and early Tertiary time (Laramide orogeny). Many petroleum accumulations that had been stratigraphically trapped before the Laramide orogeny remigrated to their present structural positions. Reconstruction of migration paths should lead to significant additional petroleum discoveries in Cretaceous rocks.

Important petroleum accumulations have been found in Tertiary lake deposits of the middle and southern Rockies. Despite their relative shallowness, Tertiary rocks have been very incompletely explored.

HAY, WILLIAM W., Department of Geology, University of Illinois, Urbana, Ill.

BIMINI LAGOON: MODEL CARBONATE EPEIRIC SEA

Bimini Lagoon contains a wide variety of marine environments, most of which have readily recognizable counterparts in the larger epeiric seas of the geologic past.

Located on the northwest margin of the Great Bahama Bank, Bimini Lagoon is a shallow area with