CHURKIN, MICHAEL, JR., U. S. Geol. Survey, Menlo Park, Calif.

Correlation of Fold Belts of Alaska, Canada, and Siberia[1]

Most of Alaska is part of the Cordilleran fold belt. The cordilleras arose from several geosynclines, some of which took form in late Precambrian and early Paleozoic time, and others as late as Mesozoic time. Early deformational features in the middle Paleozoic have been largely obscured by Mesozoic and local Cenozoic orogenic events, especially along the Pacific margin. Plutonic rocks and thick wedges of coarse clastic sedimentary rocks, derived from uplifts within the geosynclines, identify the older orogenic events.

Easternmost Siberia, opposite Alaska, contains a fold belt that is the extension of the Cordilleran fold belt across the shallow Bering Sea from Alaska. In northern Alaska there also is a belt composed of probably early Paleozoic geosynclinal rocks and late Paleozoic and Mesozoic successor basin deposits that seems to correlate with the Innuitian fold belt of Canada. The continuity of these fold belts around the rim of the northern Pacific and Arctic basins must be taken into account in evaluating continental drift and the age of the ocean basins in the Arctic.

CLACK, W. J. F., Dept. Geological Sciences, McGill Univ., Montreal, Que.

Transport and Deposition of Carbonate-Reef Sand, Windward Coast, Carriacou, West Indies

Different stages in the evolution of backreef sedimentologic regimes are represented in 2 bays behind a barrier reef 0.25–1 mi off the east coast of Carriacou.

In the largest bay, wave transport of reef-produced sediment has formed a shoreward prograding sand body at a depth in equilibrium with sediment grain sizes and prevailing wave conditions. Variations in grain-size distribution on top of and shoreward from the backreef sand flat reflect sorting and mixing, under oscillatory flow, of the mechanically distinguishable lag, rolling, saltating, and suspended sediment populations.

Decrease in the height of the water column, caused by partial filling of the backreef area in the smaller bay, has increased the rate of tidal flow. The sediment grain sizes, bottom depths, currents, and wave conditions are elements of a dynamic equilibrium which, given a steady relative sea level, results in the transport of all reef-produced sediment, up to pebble size, from the backreef area into adjacent deep water, and the maintenance of an equilibrium bottom profile.

The delineated processes and the resulting sediment properties and distribution patterns constitute a model of backreef clastic sedimentation which may be of wide applicability.

CLARK, D. A., Mobil Oil of Canada Ltd., Calgary, Alta.

Computer Applications in Geology at Industry Level

(No abstract submitted)

[1] Publication authorized by the Director, U.S. Geol. Survey.

CLARK, ROBEY H., and JOHN T. ROUSE, Mobil Oil Corp., Houston, Tex.

Closed System for Generation and Entrapment of Hydrocarbons in Cenozoic Deltas, Louisiana Gulf Coast

Deltas deposited during the Miocene, Pliocene, and Pleistocene in the vicinity of the present-day Mississippi River delta illustrate a closed system for the generation and entrapment of hydrocarbons. During those times various processes contributed to this closed system of deltas.

1. Vast quantities of sediments were derived from erosion of igneous, metamorphic, and sedimentary rocks of the high continental interior. These were transported gulfward and deposited in major deltaic masses by one or more large rivers ancestral to the Mississippi River.
2. Rapid burial in the deltas preserved stream-transported organic matter and related nutrients. The sediments also were enriched by abundant marine organic matter concentrated in the delta area by prevailing winds and ocean currents. Abundant raw materials and reducing conditions necessary for the generation and preservation of hydrocarbons were present.
3. Frequent shifting of distributaries resulted in the deposition of discontinuous lenticular bodies of sand and clay, a situation favorable for retention of locally generated hydrocarbons. In places, rapid deposition of large volumes of clay produced thick sections of under-compacted shales that are troublesome to drill.
4. Contemporaneous deformation, in the form of growth faults and folds, modified existing lenticular bodies and created structures which have trapped major quantities of oil and gas.
5. Differential distribution of the weight of the deltaic sediments, coupled with regional tilting, caused upward flowage of deeply buried Mesozoic salt beds. The resulting piercement salt domes or deep salt anticlines have contributed to the formation of other hydrocarbon traps.

In the closed system the hydrocarbons were formed almost *in situ* and impounded by early migration in structural and stratigraphic traps. Orogenic movements were not needed to form structural traps as these were formed by large-scale slippage, slumping, and salt movement within the deltaic masses. Thus, all the elements in this closed system worked together in a positive direction to form the giant oil and gas fields that are being exploited today. Many more remain to be found. Therefore future exploration for hydrocarbons in the Gulf Coast will be like its history—exciting, productive, and profitable.

CLEARY, W. J., and J. R. CONOLLY, Univ. South Carolina, Columbia, S.C.

Provenance Model Studies: Piedmont Rivers to Atlantic Deep-Sea Floor

Petrographic analyses of 500 impregnated sands from the piedmont rivers, coastal plain, beach, shelf, and deep sea off the southeastern United States indicate that they have differences in composition which reflect changes in depositional history.

Piedmont rivers transport mainly nonpolycrystalline quartz (20–80%), polycrystalline quartz (5–50%), microcline (2–15%), orthoclase (0–10%), plagioclase (0–4%), and minor amounts of reworked red sediments. Coastal-plain sands are more quartzose (more than 90%) and commonly show corrosion indicating postdepositional solution. Rock fragments in these sands consist mainly of reworked Tertiary limestone and sandstone.

Near Cape Hatteras, sands of the shelf and upper slope consist mainly of quartz and are characteristically higher in feldspar (10–15%) than the shelf sands on the south. The feldspar is dominated by orthoclase with minor amounts of plagioclase and microcline. This content is in contrast to the high microcline content of the piedmont, coastal-plain rivers, and "southern" shelf sands but is similar to the mineralogy of the sands from the Hatteras abyssal plain. The relatively plentiful microcline and granitic rock fragments on the shelf between Cape Hatteras and Cape Romain suggest that these surficial sands are the result of reworking of older piedmont-coastal plain sands during late Pleistocene. Farther south of Cape Romain the terrigenous fractions have a piedmont signature but are much diluted with relict-residual carbonates and oolitic, algal, and micritic limestone debris.

COFFER, H. F., and B. G. BRAY, CER Geonuclear Corp., Las Vegas, Nev., and G. W. FRANK, Austral Oil Co., Houston, Tex.

Project Rulison and Economic Potential of Nuclear Gas Stimulation

Project Rulison was designed to determine the potential of underground nuclear stimulation for commercial development of the Mesaverde Formation of the Rulison field in Garfield County, Colorado. A method of stimulation far greater in magnitude and efficiency than conventional hydraulic fracturing is needed to recover the gas at economic rates.

Detailed testing of the Project Rulison exploratory well, R-EX, provided data on geology, hydrology, and reservoir characteristics. The data obtained from the testing have been used to determine the flow capacity of the Mesaverde reservoir. The reservoir characteristics were used as input data to make predictions of post-shot reservoir performance in the nuclear-stimulated well, using a radial, unsteady-state gas-flow computer model. The calculations show that rates of production will be sufficient if costs can be controlled. Costs of nuclear stimulation must be reduced drastically for commercial use. Project Rulison will cost approximately $3.7 million, excluding lease costs, preliminary tests, and well costs. At such a price, it can not possibly be commercial; however, these costs can be lowered in a logical stepwise fashion.

A nuclear explosive with a design yield of 40 kilotons was emplaced in a 10¾-in. hole at a depth of 8,426 ft below ground surface and detonated on September 10, 1969. A preliminary appraisal of the data taken at shot time indicates that the explosive behaved as predicted. The explosion was contained underground as predicted and no major seismic damage occurred. The post-shot reentry program, in the spring of 1970, will include reservoir testing to determine the degree of stimulation achieved.

COOK, H. E., Marathon Oil Co. Research Center, Littleton, Colo.

Miette Platform Evolution and Relation to Overlying Bank ("Reef") Localization, Upper Devonian, Alberta

The Flume Formation exposed in Jasper National Park, Alberta, is a widespread sheetlike carbonate body, 100–250 ft thick, which served as a platform for the overlying 1,200-ft thick, areally restricted Miette bank of the Cairn and Southesk Formations.

Platform deposition of the present Miette bank began on a pre-Devonian, topographically high erosin surface. During marine transgression across this surface, a broad shelf lagoon formed in which shallow subtidal to supratidal carbonates of the platform evolved. Shoaling conditions were maintained throughout platform evolution over this high by carbonate sedimentation buildup and perhaps gradual uplift. During relatively rapid inundation, most of the platform was covered with basinal carbonate mudstones of the Perdrix Formation. Stromatoporoids were able to survive only on the shallowest parts of the platform. In essence, the overlying Miette bank represents localized continuation of platform growth.

Bankward the lower platform member thins and the upper platform member thickens. As the upper platform member thickens, tidal flat and shallow subtidal deposits appear and thicken, and deeper subtidal deposits thin and disappear. These changes generally occur within 1–5 mi from the bank.

Widespread carbonate units which served as platforms for overlying banks can be important both in determining bank proximity, and in understanding relations between platform genesis, bank inception, and localization.

COX, G. L., Hudson's Bay Oil and Gas Co. Ltd., Calgary, Alta.

Pinnacle-Reef Model, Zama-Virgo Field, Northern Alberta

(No abstract submitted)

CROSS, AUREAL T., Dept. Geology, Michigan State Univ., East Lansing, Mich., and GARY G. THOMPSON, Shell Oil Co., Bakersfield, Calif.

Some Aspects of Paleoecology and Stratigraphy of Lower Mancos Shale (Upper Cretaceous) of Colorado and Utah, Based on Palynologic Analysis

Paleoecology of the deposits in the early Mancos Sea of western Colorado and eastern Utah is being studied by palynologic analysis. Seven sections, including 1 from the type area along the Mancos River, have been sampled at 15–20-ft intervals, from the top of the Dakota upward for 100–600 ft. These strata—the Graneros Shale, Greenhorn Limestone, lower Carlile, Juana Lopez, and upper Carlile Members—include most of the Cenomanian and Turonian stages.

The terrestrial microfossil flora includes more than 45 species of spores, about 15 species of gymnospermous pollen and more than 59 species of angiosperms. The microplankton differentiated include more than 30 species of acritarchs and about 40 species of dinoflagellates.

Much of the deposition took place relatively close to the shoreline but some sections were farther from the strand. Variations in the sections also indicate transgressive and regressive stages of the sea and some environmental control over the microplankton. Some stratigraphic zonation seems possible, principally on the terrestrial palynomorphs, and correlation and relative time of deposition of the several sections have been determined tentatively.