ing in synclines that were actively growing during deposition.

TWOMBLY, G., and J. H. SPANG, Univ. Calgary, Calgary, Alta.

Nature of Non-Recoverable Porosity Changes in Experimentally Deformed Indiana Limestone and Yule Marble

Cores of limestone and marble with porosities from 0.5% to 15% were experimentally deformed dry, at room temperature under confining pressures from 3.5 to 27.6 MPa. Deformations were documented by changes in porosity, permeability, and mercury-injection pressure measurements. Pore and fracture geometries and interrelations were preserved by epoxy impregnation. In Indiana limestone at axial loads to 95% of mean failure strength, no significant changes in porosity could be detected, although there was a significant increase in twinned grains around pores, and a slight increase in mercury-injection pressures. At loads to 90% of failure (1.2% axial strain of which 0.4% is non-recoverable), a slight change in recovery efficiency was produced. The significance of this change is uncertain. If real, it is probably the result of microcracking observed at grain boundaries. After failure, a direct relation seems to exist between bulk axial strain and porosity. The porosity increase seems to be entirely disseminated, as no major fracture was formed, though shear zones 1 to 2-mm wide characterized by twinning and grain rotation were noted. Failure was accompanied by widespread grain and pore-size reduction. Yule marble stressed at axial loads to 99% of mean failure strength showed no measurable change in porosity. Failure was accompanied by increase in porosity which showed a correlation to bulk axial strain. This increase in porosity is in the form of both major fractures and a general increase in intergranular pore widths from less than 1 μ (undeformed) to between 1 and 10 μ (deformed).

TYLER, NOEL, and FRANK G. ETHRIDGE, Colorado State Univ., Ft. Collins, CO

Reevaluation of Depositional Environments of Salt Wash Member of Morrison Formation, Uravan Mineral Belt, Southwest Colorado

The Uravan mineral belt of southwestern Colorado has proved to be a significant source of uranium and vanadium. Since 1948, 63 million lb of U_3O_8 and 332 million lb of vanadium have been produced. About 90% of the ore has come from the upper sandstone ledge of the Salt Wash Sandstone Member of the Morrison Formation.

It has long been recognized that the Salt Wash was the product of fluvial sedimentation. More recently most authors have concluded that the Salt Wash was deposited as a braided stream system and some have proposed that the system was part of a large alluvial fan complex because of the arcuate pattern of the belt. However, results of a detailed sedimentologic analysis of this sequence in the Slick Rock district suggests that the entire Salt Wash including the uraniferous upper ledge was deposited in a fine-grained meander belt system.

Evidence for this interpretation is based on the high percentage (up to 54%) of fine-grained bioturbated and/or rooted flood-plain sediments; associated coarsening-upward crevasse splay or overbank splay deposits; and the abundance of fining-upward point bar sequences. The fine to medium-grained sandstones of the point bar deposits crop out as a series of discontinuous ledges numbering between 3 and 6 throughout the district. Each ledge consists of a number of abbreviated and complete point bar sequences ranging in thickness from a few feet to over 25 ft. These point bar deposits grade laterally and vertically into levee, abandoned channel, and crevasse splay assemblages and are interbedded with thick sequences of overbank mudstones, siltstones, and thin sandstones.

USMANI, TARIQ U., and RICHARD T. BUFFLR, Univ. Texas Marine Science Inst., Galveston, TX

Post-Middle Cretaceous Seismic Stratigraphy of Abyssal Southwestern Gulf of Mexico Basin

The post-middle Cretaceous sedimentary section in the abyssal Gulf of Mexico (7 to 8 km thick) is divided into seven major depositional sequences. The sequence boundaries represent widespread unconformities which are best observed along the base of the Campeche Bank. These depositional sequences provide a framework for reconstructing the geologic history of the area.

The oldest sequence (middle Cretaceous-early Tertiary) displays strong to weak, discontinuous reflections, interpreted to represent fine-grained pelagites and hemipelagites. The overlying three sequences (early Tertiary–Middle Miocene) are characterized by strong, high-amplitude, continuous to distcontinuous reflections, and probably consist (predominantly) of sandy turbidites, as evidenced from cores recovered from the bottom of Deep Sea Drilling Project hole 90. Seismic facies analysis of these three sequences shows large convex-upward depositional buildups and numerous relict channels, suggesting deposition in large submarine fan complexes. The three youngest sequences consist of fine-grained turbidites and pelagites and display such features as prograding foreset beds deposited in the distal parts of submarine fans, and large-scale, dune-like features with wavelengths of 2 to 4 km. Westward thickening of most of the sequences indicates the source of the detrital sediments was to the west in eastern Mexico.

The southwestern Gulf of Mexico possesses excellent potential for hydrocarbon entrapment, especially in buried stratigraphic features such as the fan channel systems, and also in structural traps along the Mexican Ridges foldbelt.

VANINETTI, GERALD E., and SAMUEL R. JOHNSON, Utah Power and Light Co., Salt Lake City, UT

Multiple Barrier-Island and Deltaic Progradational Sequences in Upper Cretaceous Coal-Bearing Strata, Northern Kaiparowits Plateau, Utah

The Kaiparowits coalfield, Utah, contains reserves of 20 billion tons of coal which are confined to three major coal zones within the John Henry Member of the Straight Cliffs Formation (Upper Cretaceous). Mapping and subsurface work in the northern part of the coalfield indicates that the coal-bearing strata accumulated during seven minor progradations of the shoreline of the Cretaceous seaway.

The lower and middle coal zones consist of eight and six seams, respectively, and were deposited in a swamp 20 km wide on the landward side of a barrier-island complex. The upper coal zone consists of a single seam that accumulated in interdistributary swamps in a deltaic setting.

The three coal zones were deposited during the three of the seven progradations that are completely developed. The remainder are incompletely developed and do not contain significant coal seams.

Complete vertical sequences of barrier-island and deltaic progradation are present in the Straight Cliffs Formation. Incomplete progradational sequences are usually composed of transition, shoreface, and foreshore deposits.

The repetitious nature of the several progradations and transgressions of barrier-island deposits and the local incompleteness of their development suggest periodic fluctuations in the quantity of sediment supplied by longshore transport currents from deltas northwest of the study area. Delta-lobe abandonments probably resulted in the periodic interruption of sediment supplied to the barrier-island complex and allowed sufficient time for compactional subsidence in the barrier complex to cause minor transgressions.

VERRALL, P., Chevron Co., Madrid, Spain

Geologic and Structural History of Zagros Foldbelt, Iran

The earliest discernible event in the Zagros area, which is structurally the northern part of the Arabian continental block, was the deposition of the Infracambrian Hormuz salt, presumably in a rift basin with a north-south boundary on its west side. The overlying shallow-marine miogeoclinal shale-carbonate sequence through the Cambrian is overlian by deeper water Ordovician and Silurian shales, representing a progressive foundering of the rift margin. A second rift event, oriented along the present northern margin of the Zagros foldbelt, began in the pre-Permian, represented by a significant angular unconformity at the base of the shelfal, largely carbonate, Permian to Late Cretaceous sequence.

Sharp change from carbonate to marl deposition along this margin in the latest Cretaceous suggests rapid deepening associated with arrival at a north-dipping oceanic subduction zone, which almost immediately thrust melange and ophiolites up over the edge of the shelf. This entire ensemble has been colliding with the Central Iranian Block along a second north-dipping subduction zone since the Miocene, resulting in essentially concentric folding of the Infracambrian to Miocene shelf sequence, largely upon a basal detachment within the Infracambrian Hormuz salt but also involving the basement in north-dipping thrusts and in tear faulting, and involving the salt in numerous compressionally induced diapiric structures. The syntectonic, evaporitic, Miocene-Pliocene Fars Group rocks represent deposition in a basin restricted by the actual collision event. They are involved in the Zagros folding, and also in enormous, southward directed gravity glides down the regional topographic gradient resulting from the orogeny. The huge oil and gas traps of the area are within the concentric Zagros fold structures, in strata ranging from Permian to Miocene in age.

VOSS, JAMES D., 6750 W. Loop S., Bellaire, TX

Geology of Calvin Field—Deep Basinal Jurassic Play in North Louisiana Salt Basin

Calvin field is currently being developed by Getty Oil Co. but was discovered in 1941 with a Paluxy gas sand completion by Hunt Oil Co. In 1972-73 Texaco drilled two Cotton Valley wildcats which were plugged and abandoned but had interesting Cotton Valley gas shows. In 1976, Getty Oil Co. (Skelly) 1 Bodcaw blew out in a Cotton Valley sand section. Getty Oil and Bodcaw Oil and Gas have established and extended production, completing seven additional wells. To date, the productive limits of the field have not been defined but considerable information is at hand, including that concerning the generally poor porosity and permeability of reservoir rock. Presently six wells, and an extension to the northeast, appear potentially productive in one or more of eight Lower Cretaceous and Upper Jurassic formations. Greatest potential appears to be in Upper Jurassic (Cotton Valley) sand section. These reservoir sands interfinger with gray marine shales over the structure and are absent off the southern flanks.

Calvin structure was formed before the close of Jurassic time on an uplifted carbonate shelf when salt movement created trough-like depressions to the northwest and southeast. The resulting faulted anticlinal feature experienced local erosion and subsequent infilling with coarse clastics brought down from the Ouachita foothills to the north and deposited in a localized deltaic environment. Marine transgression from the south immediately followed with the accumulation of extensive regional sand bars and beach deposits. The Upper Jurassic section may have been buried several thousands of feet deeper in Tertiary time than the present 12,500 to 13,000 ft (3,810 to 3,962 m).

WAKEFIELD, W. W., Juniper Petroleum Corp., Denver, CO

Mason Lake Field, Musselshell County, Montana

In the Mason Lake field, the discovery of oil in the 1st Cat Creek sandstone, Lower Cretaceous in age, occurred in March 1978. Further ongoing development in the area is presently defining the limits of the field.

Discovery of the oil potential from the 1st Cat Creek sandstone occurred while development drilling to the 3rd Cat Creek sandstone was in progress. This potential had gone undetected for several wells because oil shows were absent in dry samples and rarely detectable in wet samples. The high-gravity oil (47°) may partly offer some explanation as to the unusual disappearing behavior of the oil in the dry drill cuttings. In 1964, electric-log analysis and drill-stem tests of this zone in the general area offered little evidence of potential oil production.