

BRADY, MICHAEL J. and RICHARD B. KOEPNICK,
Dept. Geology, Univ. Kansas, Lawrence, Kans.

TRANSITION FROM SHELF TO BASINAL CARBONATES IN MIDDLE CAMBRIAN MARJUM FORMATION OF HOUSE RANGE, WESTERN UTAH—PALEO-ENVIRONMENTAL ANALYSIS

Lithofacies of the Marjum Formation in the House Range of west-central Utah indicate that a rather abrupt transition from shallow-shelf to basinal depositional environments persisted in this locality during much of the Middle Cambrian. The beginning of Marjum deposition was marked by the accumulation of deep-water limestones and shales throughout the area, but this pattern soon was disrupted by shoaling and development of shelf conditions in the vicinity of the central and northern House Range. Supratidal to shallow subtidal carbonates formed on the shelf as deposition of slope and basinal sediments continued a few miles south for the remainder of Marjum time.

Algal-laminated and pelletal dolomitic mudstones accumulated in the extensive supratidal and intertidal areas that existed on the shelf. Some stromatolitic units are evenly laminated, whereas others have laminae that are irregular and discontinuous. The pelletal mudstones exhibit fenestral fabrics and contain intraformational conglomerate lenses, commonly including clasts reworked from the stromatolitic units. Wave ripples and desiccation features associated with these lithologies are further evidence of their shoal-water origin and periodic exposure.

Pelleted, intraclastic wackestones and packstones characterize the shallow subtidal environments of the shelf and shelf-slope. Interspersed with the slope sediments are units containing both algal-coated and uncoated intraclasts. The coated grains are on the upper part of the slope and were derived from the shelf edge, whereas the uncoated clasts were largely reworked from slope deposits. In addition, the coated grains have undergone little transport, but the uncoated clasts are well sorted and rounded, and are commonly graded.

Fossiliferous wackestones and laminated mudstones with interbedded shales represent the deeper water toe-of-slope and basinal sediments. The fossiliferous units have been moderately bioturbated, but the finely laminated mudstones, which were deposited well below wave base, are essentially undisturbed. The presence of sponge spicules and presence of small-scale cross laminations and microscopic cut-and-fill structures are typical of these dark, thin-bedded limestones. Depositional slopes in this part of the basin are indicated by penecontemporaneous slump structures and debris lenses deposited by submarine slides.

BRENNINKMEYER, BENNO M., S. J., Dept. Geology, Boston College, Boston, Mass.

SYNOPTIC SURF-ZONE SEDIMENTATION PATTERNS

A new device, the almometer, has been constructed which instantaneously measures the changing elevation of the bottom and distribution of bedload and suspended load in a water column. Three almometers were placed normal to shore in the surf zone at Point Mugu, California. Data for 20 tidal cycles show that mean grain size in the mid-swash zone is coarser on the ebb than on the flood. Except when the tidal inequality is small, skewness of the sand becomes negative on the ebb and positive on the flood. There are 6 episodes of profile change which increase seaward in magnitude per tidal cycle. Erosion increases from 6% of breaker height on the beachface to 14% on the shoreface. The frequency of motion of sand in the inner and outer surf zones is virtually independent of the deep-water wave period, but the relation improves somewhat in the breaker, transition, and swash zones. Outside the breaker zone, sand moves primarily as bedload, in pulses coincident with the prevailing swell period. Inside the breaker zone, sand moves more

rapidly, with frequencies equal to both seas and swell. Bottom elevation changes of more than 6 cm/wave are not uncommon. Sand seldom is thrown into suspension. In the outer surf zone, sand movement is rare, but in the inner surf zone sand suspension increases in frequency, elevation, and duration. At the still-water level, sand motion by suspension becomes dominant. In the swash zone, sand motion reverts to bedload. At Point Mugu, the amount of sand thrown into suspension 6 in. above the bottom per tidal cycle per foot of beach length is from 200 to 400 cu yd.

BRUCE, C. H., Mobil Oil Corp., Houston, Tex.

PRESSURED SHALE AND RELATED SEDIMENT DEFORMATION—MECHANISM FOR DEVELOPMENT OF REGIONAL CONTEMPORANEOUS FAULTS

Regional contemporaneous faults of the Texas coastal area are formed on the seaward flanks of deeply buried linear shale masses characterized by low bulk density and high fluid pressure. From seismic data these masses, commonly tens of miles in length, have been observed to range in size up to 25 mi in width and 10,000 ft vertically. These features, aligned subparallel with the coast, represent residual masses of undercompacted sediment between sand-shale depoxes in which greater compaction has occurred. Most regional contemporaneous fault systems in the Texas coastal area were formed during times of shoreline regression, when periods of fault development were relatively short, and where comparatively simple down-to-the-basin fault patterns were formed. In cross-sectional view, faults in these systems flatten and converge at depth to planes related to fluid pressure, and form the seaward flanks of underlying shale masses. Data indicate that faults formed during shoreline regression were developed primarily through differential compaction of adjacent sedimentary masses. These faults die out at depth near the depoxes of the sand-shale section.

Where subsidence exceeded the rate of deposition, gravitational faults developed where basinward sea-floor inclination was established in the immediate area of deposition. Some of these faults became bedding-plane type, when the inclination of basinward dipping beds equaled the critical slope angle for gravitational slide. Fault patterns developed in this manner are comparatively complex and consist of many antithetic faults and related rotational blocks.

Conclusions derived from these observations support the concept of regional contemporaneous fault development through sedimentary processes, where thick masses of shale are present and where deep-seated tectonic effects are minimal.

BUCHER, SIEGFRIED, Phoenix Ventures Ltd., Calgary, Alta.

MINI-CREWS FOR SEISMIC OPERATIONS

It is common practice to use large crews and heavy equipment for seismic operations in remote and almost inaccessible country. The required camps are commonly very large and equipped with the most modern appliances providing for living habits expected in more civilized areas. Considerable supplies, fuel, and spare parts are required to operate the crew and maintain vehicles and machinery. This creates immense logistics problems, which in turn affect the economy of the seismic survey adversely.

Phoenix Ventures Ltd., a Calgary-based company, has introduced the MINI-CREW, a new concept in seismic operations. This crew was designed and built by Phoenix and used successfully to record 200 mi of seismic reflection data in the ice-covered waters of the Canadian Arctic Islands during the spring of 1972. This compact, lightweight, and highly mobile crew minimized operational and logistic problems, resulting in considerable cost savings over conventional methods used in the same areas.

The Arctic presents one of the world's most hostile environments, and any of man's enterprises in this area are subject to formidable logistical and operational problems. MINI-CREW proved to be very successful in this environment, and with modification lends itself to practical and efficient seismic operations in other parts of the world.

BURLINGAME, A. L., and BERND R. SIMONEIT, Univ. California, Space Sciences Lab., Berkeley, Calif.

COMPARATIVE COMPOSITIONAL STUDIES OF ORGANIC MATTER IN VARIOUS DEEP-SEA DRILLING PROJECT CORES

The Deep-Sea Drilling Project (JOIDES) is providing cored samples taken through the sedimentary layers of the deep ocean basins and continental rises. Preliminary organic geochemical studies on spot samples from cores in the Atlantic and Pacific Oceans have yielded data which suggest that planktonic versus terrigenous components in the total extractable organic matter may be distinguished. The biologic markers of terrestrial detritus used in this study are the high-weight paraffins (odd numbered $n-C_{27}-n-C_{33}$) with the corresponding high-weight fatty acids (even numbered $n-C_{22}-n-C_{30}$) and triterpenes. Some specific terrigenous markers found are a series of dehydroabietic acids, traceable to a conifer rosin derivation.

In addition, a remarkable degree of preservation of certain suites of organic compounds, such as monolefins and diolefins (phytadienes), has been found in anoxic recent marine cores, decreasing markedly with depth, for example, in a continuous calcareous clay and organic carbon-rich sediment from the Cariaco Trench. A concentration correlation of the phytadienes with the chlorin pigments is positive, indicating the source of these olefins is phytoplankton chlorophyll metabolized by zooplankton and thus preserved.

Recently available continuous cores from the Cariaco Trench and the Bengal fan promise to yield an excellent opportunity to analyze further and then compare planktonic, calcareous clay-rich anoxic sediments with oxic sandy-silt sequences having a high terrigenous component.

CAMERON, RUSSELL J., Cameron Engineers, Denver, Colo.

ECONOMIC VARIABLES IN PRODUCTION OF OIL FROM OIL SHALE

The oil-shale production cost estimates reported by the National Petroleum Council in December 1972, as part of an overall study of the U.S. energy situation are the most recent publicly available data on oil-shale economics. Using the basic NPC costs, this paper examines several important parameters affecting shale oil's economic viability. Other factors pertinent to consideration of oil shale as a domestic fuel source, such as the leasing of Federal oil shale lands, water availability, and environmental restraints are reviewed.

CANTU-CHAPA, ABELARDO, Inst. Mexicano Petroleo, Mexico 14, D.F.

HUASTECA SERIES (MIDDLE AND UPPER JURASSIC) AND ITS RELATION WITH POZA RICA RESERVOIR, MEXICO

Jurassic rocks, with a stratigraphic thickness close to 400 m, have been cored in 172 wells in an area of over 8,000 sq km. These rocks are quite important because they are the only rocks in Mexico of this age that produce petroleum. A lithostratigraphic study did not explain the nature of the reservoir, the time-stratigraphic method was used to comprehend the lithofacies changes, which occur at the stage level. Stratigraphic study based on analysis of cores from the western Sierra Madre Oriental established nine zones of ammonites: *Wagnericeras*, *Kepplerites*, *Reineckeia*, *Discosphinctes*, *Ataxioceras*, *Idoceras*, *Virgatioxoceras*, *Mazapilites*, and *Suarites* (Bathonian-Tithonian). Pelecypods also were present in the cores.

The common occurrence of the same fossils in other characteristic beds, which have been identified by radioactive well logs, permits their use as time-stratigraphic markers. These data were used to make subsurface structural and isopach maps.

In the northwestern Poza Rica area the Middle Jurassic transgression began during the Bathonian. Later it advanced to the central, east, and west parts, and the covered area is characterized by distinct transgressive lithofacies. The last phase of the transgression was in the early Tithonian in the southeast part of the trend, and calcarenites were formed which now produce hydrocarbons (San Andres). In northwestern Poza Rica, the San Andres calcarenitic member is within the uppermost part of the lower Kimeridgian stage.

The reservoirs are stratigraphic and structural traps. On the southeast the San Andres calcarenitic member can be subdivided at the stratigraphic level in the lower Tithonian; this fact is related to the occurrence of oil or salt water.

CARRASCO-V., BALDOMERO, Inst. Mexicano Petroleo, Mexico 14, D.F.

EXOTIC BLOCKS OF FOREREEF SLOPE, CRETACEOUS VALLES-SAN LUIS POTOSI PLATFORM (MEXICO)

The outcrops of the folded Sierra Madre Oriental in the Xilitla, San Luis Potosi area, allow the study of contemporaneous, shallow-water, rudistid-reef, forereef, and basinal carbonate sediments.

The "Tamabra" and Mendez Formations represent the forereef and basinal sediments and also the host rocks of the platform-derived exotic blocks. Parts of these formations are composed largely of lithoclastic fragments of rudistid reefs, or shallow-water, fossiliferous carbonates mixed with basinal, fossiliferous micrite containing planktonic foraminifers, radiolarians, calcispheres, and a few ammonites. These sediments show such sedimentary structures as graded bedding, and thin horizontal, and convolute laminations; many of these features are arranged in combinations analogous to Bouma's sequence of turbidite structures. The exotic blocks are formed mainly of rudistid biomicrite (biolithite?); their stratigraphic thicknesses range from 10 to 95 m.

Stratigraphic correlations between the reef and forereef or basinal sediments were made by using fossils to determine the probable displacement of the exotic blocks; by palinspastic reconstructions of Barremian, Albian, and Maestrichtian times, approximate displacement of 5.5, 3.5, and 1 km, respectively, were inferred.

Although the Valles-San Luis Potosi platform is the counterpart of the subsurface Cretaceous Golden Lane platform, it does not have comparable large displacements of sediments which were derived from the reefs of the latter. These sediments were transported 10-15 km or more from the Golden Lane and are now contained in the "Tamabra Formation." Perhaps this large displacement has not yet been discovered in the Valles-San Luis Potosi platform, or perhaps the patterns of sedimentation differed, because the tectonic settings of the platforms were different.

CASTANO, JOHN R., Shell Oil Co., Los Angeles, Calif.

APPLICATION OF COAL PETROGRAPHIC METHODS IN RELATING LEVEL OF ORGANIC METAMORPHISM TO GENERATION OF PETROLEUM

The generation of petroleum is a thermal process dependent on the maximum temperature and on the duration of the maximum heating phase attained by the source rock. The coalification process, which is governed by the same factors, offers a convenient means of determining the stage of thermal alteration of organic matter, because coals form a continuous metamorphic series ranging from peat to graphite.

The LOM scale (level of organic metamorphism) devised by Hood and Gutjarh is used to correlate a variety of measures of