and retrieval, this approach has potential value for future planning of regional subsurface stratigraphic studies.

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MARINE GEOLOGY OF EASTERN CONTINENTAL MARGIN OF CANADA

The outer continental shelf of eastern Canada, from Georges Bank to Ellesmere Island, is mainly smooth compared with most of the land on the west. This submerged "prairie" ranges from 10 to 300 mi wide. It is the northern extension of the coastal plain of the United States that is partly exposed on land as far north as Long Island. North of Long Island there are no documented marine fragments of plain sediments on land. The depth of water on the banks south of 48°N lat. is about 200 ft. In contrast, north of the 48° parallel, the average water depth is about 450 ft. The shelf is partly covered with Pleistocene ground moraine. Cenozoic and Mesozoic rocks crop out or are close to *in-situ* positions along some of the submerged valleys.

It has been known for decades that most of the submerged coastal plain is underlain by fairly low-velocity sediments up to 25,000 or more ft thick. It can be speculated that these fairly soft strata (low velocity) are not older than Triassic because drifting and rifting probably started to make basins available to be filled at that time. The beds are mainly sandstone and shale. The source areas on the west are Precambrian and the folded Paleozoic rocks of the Appalachians. One speculation is that the Precambrian perhaps yielded a sandier section than the Paleozoic rocks because of the dominance of carbonates, volcanics, and shales in the Appalachian area.

Drilling on the Grand Banks and Sable Island has shown that hydrocarbons are present. It is known that almost all the stages are present from Pleistocene to Upper Jurassic. Salt is present but its age is still only assigned to the Jurassic or earlier. It is tempting to speculate that the salt is Permian and a western segment of the North Sea salt.

Salt dome structures are present as are "basement" features.

This large frontier area is an attractive place to look for large petroleum reserves.

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SEDIMENTOLOGIC MODELS FOR CARDIUM OF SOUTH-CENTRAL ALBERTA

The Cretaceous Cardium Formation, throughout 10,000 sq mi of the Alberta basin, is composed of almost contemporaneous, noncontiguous sandstone bodies which are present as far as 100 mi east of the maximum regression of fluvial and lagoonal lithofacies.

Individual bodies are separated by marine shale and consist of 1 or more linear bars, which abut abruptly against shale on the basinward flank. The sandstone is coarser and cleaner toward this flank, which is fringed by conglomerate in many places. The base of the sandstone is transitional with the underlying shale through a sequence that becomes coarser toward the top. These gross features of Cardium stratigraphy are unlike a normal cycle of shoreline regression.

Comparison is made with models based on 4 basic variables: vectors of sediment supply and dispersion, void space due to subsidence, and volume filled by sediment accumulation.

Models representing delta progradation and turbidity-current deposition are characterized by continuity of supply and dispersion and gradational relations between sandstones and basin shales. Models representing shoreline progradation have discontinuity between supply and dispersion resulting in abrupt basinward contacts, but require juxtaposition and diachroneity of continental, littoral, and basinal lithofacies. Reworking on transgression results in a regional disconformity of which there is no evidence in the Cardium.

A model representing vertical accretion (shoaling) on a shallow stable shelf with localized sand accumulation satisfies all critical observations.

Comparison with appropriate modern areas of sedimentation indicates that the post-Pleistocene rise of sea level has imposed limitations on uniformitarian analogies.

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BED THICKNESS IN EXPERIMENTAL TURBIDITES

Turbidity currents were produced by releasing suspensions of glass beads from a lock into a horizontal, water-filled channel. The channel was 15 cm wide and 6 m long. Two sizes of mixing chamber were used with lengths of 29 and 59 cm. Other variables were grain size, d; concentration by volume in the original suspension, C; depth of suspension and water in the channel, H; and sorting of the sediment. These variables were related to the thickness of the bed close to the release gate, t.

For nearly uniform grain sizes, the results may be summarized by a series of power equations: $t = k_1 d$; $t = k_2 C^{0.7}$; $t = k_3 H^{0.4}$; $t = k_4 L^{0.5}$ (L is the length of the mixing chamber). The relation between t and d differs from that in natural turbidites, where the exponent of d is generally less than unity. Preliminary results with sediment mixtures indicate that poor sorting changes the shape of the bed to a more tapering profile, and results in transport of coarse particles farther down the channel.

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INTEGRATED EXPLORATION ECONOMICS IN WYOMING: VIEWPOINT OF GEOLOGIST

Wyoming's general economy is dependent on its exploration geologists and the half-billion-dollar productivity of its minerals industry. Extraordinary uranium discoveries in sedimentary rocks, broad-scale leasing for coal, and an abnormally high, record-setting, wildcat success ratio of 10:1 in the petroleum industry have been contributing factors.

Integration of mining and petroleum activities in Wyoming have prompted modifications in exploration programs and resulted in improved evaluation techniques. Increased intercompany communication and improved industrial-related services have helped to broaden the economic perspective.

Although economics continues to influence the ebb and flow of exploration at the individual company level, it plays only a subordinate role in the overall statewide picture. Geologic prospects rejected by 1 company as not economic are quickly absorbed by another. Marginal prospects have become successful ven-

tures because of flexibility and concessions on the part of management. Companies with stereotyped exploration policies regarding fixed ROI formulas, minimum size of land holdings, exploration procedures, and partnership arrangements, find it difficult to compete.

Examples of exploration geologists' influence on corporate decisions show how the merits of a prospect can change. They illustrate the disadvantages of restricting the geologist prematurely with economic limitations and suggest that the premonitions and innermost thoughts of the explorer should be included in geologic reports. There seems to be no substitute for exploration experience in dealing with important but intangible parameters.

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REEF FACIES AND STRATIFIED MINERALIZATION

The rhythmic reef-type sedimentation of the Givetian synclinorium of Dianant (Belgium) has been the subject of a detailed facies study including faunal and physical chemical characteristics.

The more recent reefal phenomena dating from the upper Aptian in the vicinity of Reocin (west of Santander, Spain) have been compared lithologically and paleontologically.

The stratified mineralization is related closely to the Reocin reef facies. This is not an isolated case; other examples throughout the world illustrate such associations.

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RECENT INTERTIDAL CEMENTS—THEIR MINERALOGY, TEXTURE, AND SIGNIFICANCE, GRAND CAYMAN, BRITISH WEST INDIES

Recent intertidal rocks of Grand Cayman are cemented by metastable carbonates. Both aragonite and high magnesium calcite are present in various morphologic forms, as shown by X-ray, stains, and chemical analysis. Aragonite is present either as clear acicular crusts or as a fine-grained ($<5\mu$) "micrite" crust. These 2 modes of aragonite are present in the same specimen and within the same pore as alternating layers. High magnesium calcite cement is present only as a fine-grained ($<5\mu$) "micrite" crust. Both the acicular and "micrite" aragonite cements appear to be a chemical precipitate from normal-marine water. Chemical analysis of a sample of the "micrite" aragonite cement shows a high sodium content (4,580 ppm) which would support the hypothesis of marine origin of this cement. The magnesium calcite cement data are incomplete and its origin is more uncertain. Both the aragonite and magnesium calcite "micrite" cements contain trapped detritus such as tiny foraminifers and silt-size shell debris and many areas appear to be distinctly pelleted. Once the pore is completely filled, the "micrite" cement mimics the fine-grained carbonate-mud matrix characteristic of quiet water conditions. The presence of significant amounts of fine-grained metastable cements as described from Holocene high-energy environments raises the question of whether these cements can survive in ancient rock sequences, and be confused with carbonate-mud matrix material characteristic of much lower energy situations. The presence of high magnesium "micrite" cement in this situation and its known propensity for stabilization without significant change in form leads me to believe that such cements can be preserved and incorporated into the rock record, and could be confused with true micrite matrix.

[1] Paper will be presented by G. P. BROGNON, Canadian Fina Oil Ltd., Calgary, Alta.

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CONSOLIDATION OF MARINE CARBONATE MUD

Although there has been considerable interest in the consolidation of marine carbonate sediments, there has been little actual testing of carbonates. For our study, 34 sediment samples from the Gulf of Mexico, Florida Bay, and the Bahama Banks were tested in an Anteus back-pressure consolidometer to determine their consolidation characteristics. Eleven of the sediment samples were less than 50% calcium carbonate. Of the samples containing more than 70% carbonate, 12 samples were of Holocene age, deposited since Wisconsin glaciation, and 11 samples from the continental slope west of Florida were of Pleistocene-Pliocene age.

The samples were overconsolidated; that is, there was more structural strength than would be expected from the effect of the present overburden. There was a definite relation between the percentage of fine material present and the resulting consolidation.

In general, the results of consolidation tests were similar to those found by testing noncarbonate silty clay. The main differences observed were between the older carbonate sediments and the noncarbonate or partly carbonate sediments. Under a similar final load, the carbonate sediments did not compact to as low a porosity as the noncarbonates. This could be caused by differences in particle shape and strength of the individual particles. Age and incipient cementation must play a part because the Holocene carbonate sediments did not show this characteristic. This conclusion is supported by the results reported by several other workers —that the strength of carbonate sediments increases with age.

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ARCHITECTURE OF WESTERN PART OF ALBERTA BASIN AND UPPER DEVONIAN REEF TRENDS

A paleogeology map with datum below the Devonian unconformity based on data from previous investigations, a revised Devonian palinspastic map, and maps of Devonian units in the Main Ranges west of the Banff-Jasper highway between 51°30′ and 52°00′, provide new data for assessing structural control of reef-bank margins and the western edge of the Fairholme carbonate shelf.

Although recent erosion has removed most of the Devonian strata of the Main Ranges, sufficient outcrops are preserved to indicate definite trends. Two distinct NW-SE trends are evident in the underlying Ordovician and Cambrian strata: (1) a prominent broad positive ridge paralleling the eastern Front Ranges and adjoining Foothills (Alberta ridge), and (2) a prominent negative trough or depression (North Saskatchewan trough) paralleling the eastern Main Ranges and marked by the thickest and youngest Ordovician sediments preserved.

The margins of the Southesk complex and the north margin of the Fairholme complex trend NNE or NE