Both sandstone bodies are elongate, channel-fill, belt-type deposits of fluvial origin. The Hockingport Sandstone is a north-south oriented deposit up to 90 feet thick, blanketing an area of 225 square miles. The longer axis of the Waynesburg Sandstone is oriented N 20° E, the maximum thickness is 75 feet, and the preserved deposit blankets an area of 880 square miles. The grand mean of dip directions of cross-stratification readings of the Hockingport Sandstone is N 19° W and of the Waynesburg Sandstone, N 10° E.

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UPHEAVAL DOME, SAN JUAN COUNTY, UTAH

Upheaval Dome is a dissected domal structure that lies in the rugged "Canyon Lands" of southeastern Utah. Extensive canyon development within the dome's immediate area has produced remarkable exposures of the feature. It is surrounded by a distinct rim syncline and piercement is much in evidence within the dome's central portion; the area of deformation is approximately three miles in diameter and a vertical displacement of at least 1,200 feet exists at the feature's center. Strata that crop out within the domal area range in age from Permian to Jurassic, and all exhibit deformation by the forces that produced the dome. The area is underlain by some 3,000 feet of Pennsylvanian saline strata. The origin of the dome has not been proven, but the following hypotheses have been advanced: (1) it is a cryptovolcanic feature; (2) it was formed by meteorite impact; and (3) it is a salt dome (but there are conflicting views concerning the reason for salt intrusion at this specific site). An additional hypothesis for salt intrusion is advanced: Upheaval Dome is the product of salt intrusion resulting from differential compaction of the sediments lying above and on the flanks of a low conical hill on the Precambrian surface.

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CRETACEOUS STRIKE-VALLEY SANDSTONES, NORTHWESTERN NEW MEXICO

Cretaceous sandstone bodies, which are the principal oil reservoirs in the San Juan Basin, have been interpreted as offshore bars related to deposition of the regressive Gallup Sandstone. A detailed outcrop and subsurface study in the northwestern San Juan Basin indicates that these sandstone bodies are strike-valley sandstones in the transgressive marine "basal Niobrara" unit which rests unconformably on the Gallup Sandstone and older units.

Paleotopography of the pre-Niobrara unconformity consisted of northwest-southeast trending cuestas and intervening strike valleys with local relief of over 100 feet. Cuestas and valleys are related to the subcrop of alternating resistant and non-resistant units in the truncated sequence. Elongate, lenticular sandstone bodies overlying the unconformity occur in strike valleys on the northeast side of cuesta scarps. Individual sandstone bodies, with a maximum thickness of about 50 feet, lap out to the southwest against the cuestas and thin to the northeast by facies change to shale. Younger sandstone bodies extend progressively farther to the southwest.

Basal Niobrara sandstones are fine to coarse grained and glauconitic, and contain marine macrofossils. Interbedded and laterally equivalent shales also contain marine fossils, including both benthonic and pelagic forms. The sandstones are characterized by broadly lenticular sets (up to 6 feet thick) of high-angle cross-stratification. Measurements of cross-stratification dip directions at 20 localities indicate transport by currents flowing generally southeastward.

These sandstones are best interpreted as nearshore marine sands deposited in strike valleys on the seaward side of cuesta scarps during a general transgression to the southwest. During the transgression, cuesta ridges acted to stabilize temporarily the position of the shoreline, permitting accumulation of sand nearshore while clays were deposited farther offshore to the northeast. Transport of sand was largely in the form of underwater dunes migrating alongshore to the southeast.

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AN APPLICATION OF ELECTRONIC DATA PROCESSING TECHNIQUES TO PALEONTOLOGY AND STRATIGRAPHY

A method for electronic data processing of paleontological/stratigraphic information has been devised and is in operation. Through use of a species accession reference number, paleontologic, stratigraphic, and ecological data (including synonymies of species) can be collated to reveal essential information on a given form. In addition, retrieval can be effected through use of the genus and species names as a retrieval code, although this is a slower process.

A bibliographic accession reference number allows complete treatments of bibliographic data, including abstracts, faunal lists, and other important collateral information. This bibliographic accession reference number is added to the species index cards to effect a cross-reference and corollary check of data.

This system is in operation for the McLean Card Catalogue of American Foraminifera, the Card Catalogue of Ostracoda, and the H. S. Puri Card Catalogue of Recent Ostracoda, all of which are completely cross-indexed by the system. With minor modifications, the index can be used for museum types and collections; it will be used for numerous other applications. The basic file will be available, through mechanical reproduction, to anyone desiring to use it.

Electronic data processing methods will partially replace, and greatly augment, manual methods; but for most operations, manual searches will still be the most efficient method of retrieval. Computers are advised only for extensive searches and, periodically, to correct and arrange the files. The interpreted, mechanically reproduced file cards are efficient for manual use.

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GENERAL GEOLOGY AND HYDROCARBONS OF THE NORTHERN AMADEUS BASIN, AUSTRALIA

The Amadeus basin is a structural depression extending easterly from the Canning basin in Western Australia to the Great Artesian basin in Queensland. It covers about 80,000 square miles and contains up to 30,000 feet of late Proterozoic and early Paleozoic marine and continental sediments.

The marine cycle of deposition started in late Proterozoic time and terminated in late Ordovician. No unconformity is present at the base of the Paleozoic sequence and both Proterozoic and Paleozoic beds are unaltered except along the northern margin of the basin where low grade metamorphic facies were developed in

the sediments during the Pertnjara orogeny in Devonian time.

The marine sequence consists of clastics, carbonates, and evaporites. They were deposited in shallow water, shelf environments as is shown by algal growths, biohermal and biostromal carbonates, abundant ripple marks and abundant cross laminations in sandstones, and by widespread coquinoid facies in Ordovician shales. Silled or barred basins with restricted circulation of marine waters existed from time to time during the marine cycle as is shown by salt deposits in the upper Proterozoic and Cambrian sections and by thick accumulations of dark shales with abundant pyrite in late Proterozoic and Ordovician sediments.

The marine cycle of deposition was terminated by the Pertnjara orogeny. This orogenic episode created a welt north of the Amadeus basin and a bordering foredeep whose depoaxis follows the present northern margin of the basin. Marine sediments were stripped from the rising welt, transported southward, and dumped into the subsiding foredeep where they now form a thick apron of poorly sorted, coarse clastic deposits.

Salt tectonics has played an important role in the growth of structures in the northern Amadeus basin. Thick salt deposits in the Bitter Springs formation of late Proterozoic age constituted a semi-plastic layer near the base of the Proterozoic sequence. Sedimentary loading on this layer produced flowage and initiated salt anticlines and salt domes. These structures grew during late Proterozoic and early Paleozoic deposition as is shown by crestal stratigraphic convergence and local unconformities confined to one structure. The evaporite layer also provided a "lubricated zone" along which slippage was localized during the Pertnjara orogeny, and it may be responsible in part for the large nappes and overthrusts along the northern margin of the basin.

The anticlines and salt domes initiated by salt flowage were formed early in the history of deposition and thus constituted potential traps for hydrocarbons long before the Pertnjara orogeny. However, folding during the Pertnjara orogeny greatly increased structural relief on the anticlines and thereby created traps having large volumetric capacities.

Two of these large structures have been tested with encouraging results. The Exoil-Magellan-United Canso groups have discovered a large wet-gas accumulation, possibly with an appreciable oil leg, in Ordovician reservoirs on the Mereenie anticline in the western part of the Amadeus basin. They also discovered a non-commercial gas accumulation in Proterozoic sediments on the Ooraminna anticline in the eastern part of the Amadeus basin. A third test of a small structure near the Ooraminna anticline encountered non-commercial oil shows in Cambrian sediments. In addition, the Australian Bureau of Mineral Resources discovered oil-saturated sands in Ordovician sediments penetrated by a well being drilled as a test for phosphates. With the exception of shallow water bores, no other wells have been drilled to date in this basin.

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GROSS SEDIMENTARY FACIES IN UPPERMOST CRETACEOUS AND LOWER TERTIARY SEDIMENTS, WEST-CENTRAL ALBERTA

Uppermost Cretaceous and lower Tertiary rocks in central Alberta include a sequence of largely non-marine sediments which crop out between the eastern provincial boundary and the Foothills belt. On the basis of subtle to obvious differences in lithology, stratigraphic relations, inferred environments of origin, economically important mineral deposits, and the order in which areas were mapped, the rocks were long ago subdivided into several formations, but relationships among units and between areas never were determined satisfactorily. Problems associated with the sequence are of stratigraphic, historical, structural, tectonic, and economic importance.

The marine Bearpaw Formation separates the Belly River Formation (below) from the Edmonton Formation (above) along and east of the Red Deer River and on the North Saskatchewan River. Westward, the Bearpaw thins, tonguing out in the subsurface a short distance west of Red Deer and Leduc. Where the Bearpaw is absent, the Edmonton lies directly upon the Belly River; the entire section, Belly River, Edmonton, and Paskapoo, is non-marine.

Following the lead of Ower (1958) and Elliott (1958), the authors have attempted to trace the Belly River-Edmonton and Edmonton-Paskapoo contacts into the subsurface by means of electric and sample logs. No usefully persistent stratigraphic units that might mark the contacts have been identified. Gross electrical characteristics that have been used for this purpose are not atisfactory.

Portions of the sequence (Brazeau and Paskapoo) that crop out in the Foothills belt include much more sandstone than units that crop out along and east of the Red Deer River. The sandier character of the western sequence is also evident in well logs. The change from more sandy in the west to less so in the east occurs through reduction in number of sandstone bodies, reduction in thickness of sandstone units, and reduction in sandiness of the total section. However, in the eastern part of the subsurface section, distinctly more sandy intervals alternate with distinctly more shaly intervals; the change in character of the sequence is not uniform throughout.

At this stage, it is not possible to establish satisfactory criteria which would enable precise correlation of the subsurface units with the eastern outcrop belt; but it is probable that sandier units crop out and shalier units occupy covered intervals along major river systems.

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CUBAN EVAPORITE DIAPIRS[1]

At least five rock sequences occur in central Cuba: (1) an igneous-metamorphic basement of unknown age; (2) a Jurassic evaporite-redbed sequence; (3) a Portlandian-Turonian orthogeosynclinal suite; (4) a Turonian-Eocene series; and (5) a post-orogenic Eocene-Recent sedimentary cover.

The Portlandian-Turonian orthogeosynclinal suite includes, from south to north, four facies belts: a eugeosynclinal suite, a transitional suite associated with the median welt, miogeosynclinal carbonates, and platform carbonates. During mid-Cretaceous and Eocene orogenies, the eugeosyncline was thrust northward, overriding the median welt and, locally, the miogeosyncline. The latter is deformed much more severely than the other belts.

Only four evaporite diapirs are known in north Cuba. These lie north of the median welt in Matanzas and Camagüey Provinces, and are localized by deep faults. Two diapirs penetrate the eugeosynclinal rocks at or close to the surface. Exotic blocks in these two diapirs include fragments of eugeosynclinal, median welt, and miogeosynclinal facies.

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