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MISSISSIPPIAN GEOLOGY OF CANADA AND WILLISTON BASIN

(No abstract submitted)

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MISSISSIPPIAN AND PENNSYLVANIAN STRATIGRAPHY IN MIDDLE AND SOUTHERN ROCKY MOUNTAINS*

Kinderhook and Osage rocks record a marine advance from the northwest. The sea covered only part of Wyoming in Kinderhook time, but inundated nearly all of the region in Osage time. In Meramec time it retreated. Earlier deposited Mississippian rocks were widely eroded in late Meramec and early Chester times when the region was emergent. In the late Chester another advancing sea flooded a mature topography in Wyoming developed on the Madison Limestone.

Most Mississippian rocks in the region are carbonate, but traces of anhydrite in rocks of Meramec age in Wyoming suggest that evaporitic strata equivalent to the Charles Formation once were widespread. Sandstone and shale are present in the Humbug Formation (Meramec) and in the lower part (Chester) of the Manning Canyon Shale in northeastern Utah.

Pennsylvanian rocks display marked local diversity of extent, thickness, and lithology which contrasts with the high degree of lithologic homogeneity in Mississippian rocks. By Early Pennsylvanian time the marine waters which began their advance in the Chester covered most of Wyoming, but much of Colorado and eastern Utah was still emergent. In Des Moines time maximum marine transgression and maximum elevation of the Ancestral Rocky Mountains took place. Evaporites were deposited in basins adjacent to the mountains while coarse red clastic rocks accumulated near shorelines. On the Wyoming shelf widespread well-sorted Tensleep sands were deposited.

In Late Pennsylvanian time regression and shoaling of the sea limited the extent of marine deposition, and tectonic activity diminished.

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MIDDLE DEVONIAN FACIES RELATIONS, ZAMA AREA—ALBERTA, CANADA

(No abstract submitted)

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BANK-TO-BASIN TRANSITION IN PERMIAN (LEONARDIAN) CARBONATES, GUADALUPE MOUNTAINS, TEXAS

Light-colored, parallel-stratified, nonreef marine limestone and dolomite (Victorio Peak Formation) grade abruptly southeastward into dark cherty limestone (Bone Spring) along the northwestern margin of the Delaware basin (King, 1948). Study of the well-exposed transition zone in the Guadalupe Mountains suggests the presence of three major contemporaneous environments along a gentle basinward slope: bank; bank margin (½-1 mi wide), both Victorio Peak; and euxinic basin, Bone Spring. Basinward regression of transition facies was 2–3 mi during accumulation of 1,500 ft of section. Middle Permian erosion truncated the transition strata creating basin-sloping unconformities on which limestone, megabraccia, and sandstone (Cutoff and Brushy Canyon Formations) were deposited.

Principal lithologic facies of the transition zone are successively: lime grainstone and dolomite packstone (bank); dolomite wackestone and mudstone (bank margin); and lime mudstone (basin). Paucity of dessication or solution features, algal laminates, oölites, and coated or composite grains suggests prevalence of subtidal bank environments. Allochthonous channel-fills and sheet deposits of skeletal packstone and wackestone occur in bank margin and basin-edge facies. Sand-size skeletal grains and carbonate silt are dominant constituents in bank and bank margin rocks. Carbonate silt predominates in basin facies. Characteristics of bank relative to basin strata are: lighter colors; dominance of grain-supported rocks; coarser grain size; normal-marine fauna; more dolomitization; less chert, but larger, more rounded nodules; and thicker, more massive beds. Undulatory bedding and disturbed laminations characterize many basin strata adjacent to the bank margin.

Two major controls on sedimentation and subsequent diagenesis were diminished turbulence with depth, and an abrupt change along the depositional slope from normal-marine to euxinic water at inferred depths of a few hundred feet. Bank proximity and finer particle size favored dolomitization. Low permeability of organic-rich basin facies apparently inhibited downdip dolomitization. Cementation obliterated most depositional porosity.

ROBERT MCDONALD

TERTIARY WASATCH-GREEN RIVER FORMATIONS OF WESTERN WYOMING, UTAH, AND WESTERN COLORADO—OIL AND GAS

(No abstract submitted)

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COMPUTER AS AID TO GEOLOGIC COMMUNICATION

Machine-oriented information retrieval systems are becoming more widely appreciated in the scientific world. Having an awareness of a large percentage of a total literature provides a fund of information not previously obtainable. The volume of geologic literature, and the number of publications in allied fields with which explorationists must have an acquaintance, are of such dimension that computer processing is the only hope of remaining alert to all that is available.

A similar awareness of even greater significance to the geologist is the perception he must have to recognize that clue of exploration value within his data. Extensive and diverse computer retrievals and selected combinations of data can uncover associations and suggest new leads that were not previously apparent.

Encoding data to machine processing demands a definition and a consistency that requires a clear understanding of the project objective. Computer-sensibility checks will provide reliability and repeatability throughout an accumulation of facts, yet they also can accent variability in collection and point up anomalies in data gathering. The logic required in developing a computer program requires the anticipation of the unusual, and the geologist must know his subject in order to anticipate their existence or interpret their presence.

Frequent and rapid display of data by computer maps and tabulations can provide continuous access to every part of the data file during the life of the project. The variety of computer output can pinpoint areas in need of greater effort. Judicious use of a computer program library can provide a geologist access to most of the standard treatments. Their use may provide him with answers, but can also suggest new approaches. In many cases he may consider output from a computer model as an "unbias view" of his data.

Mathematical analyses, engineering techniques, and economic evaluations used variously by geologists become standard tools on the computer. Although their use requires his appreciation of their capabilities, and their results demand an awareness of their exploration implications, their intricacies of solution no longer concern him. Their repeated use with multiple sets of data can communicate relationships not previously known.

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PERMIAN SYSTEM OF SOUTHERN ROCKY MOUNTAINS AND SURROUNDING PROVINCES

The Permian Period lasted approximately 50 m.y., beginning 275 m.y. ago. The sedimentary rocks of this system have been divided into four series in the western United States. Despite the scarcity of datable fossils, series correlations generally are reliable except in the piedmont and intermontane redbed facies.

The basal Wolfcamp Series is more extensive and thicker, on the average, than any of the other series. The Ochoa Series, the youngest, essentially is confined to the Permian basin, the Anadarko-Hugoton area and the Great Basin. The Guadalupe Series extends well beyond the erosional limits of the underlying Leonard Series in the northern Great Plains but is absent on much of the Colorado Plateau where the Leonard is well preserved.

A regional unconformity, usually of low angle, separates Permian rocks from the Pennsylvanian System, even where the Virgil Series of Late Pennsylvanian age underlies the Wolfcamp. It is believed that late Virgilian-early Wolfcampian time is not represented in most of the region. The Triassic System also is separated from the Permian by a regional low-angle unconformity. Rocks of Early Triassic age are missing by nondeposition or erosion in part or all of the southern structural provinces where the Ochoa is present.

Detailed studies also indicate the presence of interseries unconformities of regional extent. Lower Leonard, lower Guadalupe, and lower Ochoa rocks have limited areal distribution.

Permian depositional environments ranged from terrestrial-piedmont to deep-marine-basinal. Shelf-marine carbonates generally decrease in importance upward through the system whereas evaporite deposits, including halite, are more common and more widespread.

Permian rocks are the source of considerable mineral wealth including, in addition to petroleum, potash, phosphate, sulfur, and helium. Carbonate and sandstone reservoir rocks of Guadalupian, Leonardian, and Wolfcampian ages have yielded vast quantities of oil and gas, especially in the central Rockies, Great Plains, and Permian basin. Permian source shales in western Wyoming and in the Permian basin were major oil contributors.

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CAMBRIAN HISTORY OF WESTERN UNITED STATES

The Cambrian deposits of the western United States represent three major coexisting lithofacies, arranged more or less parallel with the western margin of the continental interior. The inner lithofacies is composed largely of terrigenous materials derived from the continental interior. The middle lithofacies consists largely of clean carbonate sediments of many kinds that represent relatively shallow, commonly high-energy deposits interpreted to be the products of a great series of coalescing banks. Seaward from the carbonate belt is an outer lithofacies represented by generally dark-colored, apparently deeper water sediments containing a moderate to high proportion of siliceous materials, some of apparent terrigenous origin. Region-wide expansion and contraction of the clean carbonate environment, and overall temporal transgression of all environments toward the continental axis, have produced the complex of formations and formational sequences presently observed in the western United States.

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REGIONAL ORDOVICIAN STRATIGRAPHY OF ROCKY MOUNTAIN REGION

The Ordovician formations of the Rocky Mountain region exhibit a remarkable unity in their stratigraphic development. A formational terminology in one area serves equally well in other areas, so that the most thoroughly documented stratigraphic relationships, such as those of the Bighorn and Winnipeg Formations, can be adopted as standards for the entire Rocky Mountain province. In explanation of this procedure, regional lithological similarities within formations and lithological contrasts between each formation are illustrated to show their relation to superpositionally significant unconformities. Existing zone and stage designations not based on adequate stratigraphic integration conflict with this scheme. The Bighorn cannot be entirely Richmondian, nor can the Winnipeg be Trentonian to Chazyan if the superpositional aspect of stratigraphy is admitted as evidence for their derivation.

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JURASSIC AND TRIASSIC OF WYOMING AND SOUTHERN ROCKIES

Correlations of continental Triassic and marine Jurassic rocks in Wyoming, northwestern Colorado, and northeastern Utah are based on 150 measured sections. In central Wyoming, these rocks are about 1,000 ft thick and consist, from bottom to top, of the following formations: Crow Mountain and Popo Agie (Triassic), Nugget (Triassic? and Jurassic?), and Gypsum Spring and Sundance (Jurassic). The lower part of the Nugget has been named. South and east of the Wind River basin, rocks equivalent to the Crow Mountain are called the Jelm Formation. In northwestern Colorado and northeastern Utah, Jurassic and Triassic rocks discussed here are about 1,500 ft thick and consist, from bottom to top, of the following formations: Chinle (Triassic), Glen Canyon (Triassic and Jurassic), and Carmel and Curtis (Jurassic). These formations thin southeast toward central Colorado. Near Boulder they are represented by