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Jurassic Paleobiogeography of Western Canada Basin

Abundant microfossils are present in the Jurassic sediments of the south half of the Western Canada basin. These can be used to correlate north toward the Peace River area and south into the northern United States. Previously published Paleobiogeographic maps illustrating the Lias, Bajocian-Bathonian, Callovian-Oxfordian, and Kimmeridgian-Portlandian stages are now revised to include additional well and outcrop data. Some fossil information is presented concerning the Lower Cretaceous/Jurassic contact.

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History of Development and Economic Aspect of Jurassic of Northern United States

Petroleum was found in Jurassic strata early in the history of Montana. Part of the oil in the Kevin-Sunburst field reportedly came from the basal Ellis (Sawtooth) sand, the Ellis-Madison contact. This field was discovered in 1921.

Sandstones of the Sundance formations in Wyoming were found to be productive even earlier (1917). No production from Jurassic strata has been found to date in North or South Dakota. A tabulation chart showing present fields producing from Jurassic formations and date of discovery is given. A penetration chart showing depth to Jurassic formations across Montana is included.

Jurassic formations have proved to be productive where suitable reservoir characteristics exist. Changes in facies as well as rapid variance in porosity and permeability should play an important part in pointing future areas to prospect the strata of Jurassic age.

A discussion of the Jurassic of the Sweetgrass area of Montana is reviewed.

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Jurassic Subsurface of Peace River Area

Marine Jurassic sediments of this area can be tentatively correlated with those in the Central Plains of Alberta and in the Foothills to the west. The Fernie group consists of dark marine shales and sandstones with minor amounts of limestone and chert. Southeast of Sturgeon Lake limestones and cherts become prominent in the lowermost part of the group. The constant lithology permits well defined correlations except where there is a lateral facies change. The distribution of these beds was influenced by late Jurassic or early Cretaceous erosion. The strata are truncated to the north and northeast. They overlie with erosional unconformity either Triassic or Paleozoic sediments.

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Jurassic Subsurface in Southern Alberta

Jurassic rocks underlie all of southern Alberta from its eastern and southern boundaries to the Rocky Mountain front on the west. The northern boundary is roughly crescent shape, approximately coinciding with the South Saskatchewan River and its tributary, the Oldman River, to within a few miles of Lethbridge. From that point the boundary trends northwest, passing a few miles east of Calgary. On Alberta plains, Jurassic strata are readily divisible into three formations, which were originally described and named in Montana, and which are, in ascending order, Sawtooth, Rierdon, and Swift. In Alberta Foothills, Jurassic strata are called the Fernie formation, which is roughly the equivalent of the three formations of the Plains.

Jurassic strata in southern Alberta rest unconformably on the Rundle formation of Mississippian age. On the Plains they are overlain unconformably by the basal sandstones of the Blairmore formation which have been correlated with the Cutbank and Sunburst sands of Montana. The unconformity at the top of the Jurassic truncates the formations so that they wedge out northward; consequently, the Swift, being the uppermost, has a very limited distribution in Alberta having been eroded completely from the crest of the Sweetgrass arch and remaining only in the extreme southeastern corner of Alberta and in a narrow belt paralleling the Foothills. The Rierdon and Sawtooth formations extend northward approximately to the limits of the Jurassic as defined. In the Foothills the Fernie is overlain by Kootenay sandstone and shale.

The Sawtooth formation consists of two sandstone members, separated by green, pyritic, noncalcareous shale. The upper sand is a reservoir for oil and gas in several small fields in Alberta. The formation has a maximum thickness of about 235 feet. The Rierdon formation is made up of an alternation of gray calcareous shale and greenish gray limestone with some pyrite, glauconite, and ironstone, and has a maximum thickness of 200 feet. The Swift formation lies unconformably on the Rierdon and has a maximum thickness of 150 feet. It consists of glauconitic sandstone, siltstones, concretions, dark gray shale, and usually has chert pebbles at the base.

Facies changes take place from west to east in the Sawtooth, Rierdon, and Swift formations so that at the eastern boundary of Alberta they may be readily correlated with the Gravelbourg,

Shaunavon, and Vanguard formations of Saskatchewan. However, they are not the exact equivalents of these formations since some overlapping occurs.

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Jurassic of Southwestern Saskatchewan

The Jurassic in this area consists of four formations, the Vanguard, Shaunavon, and Gravelbourg of essentially marine nature, and an underlying Watrous formation composed of redbeds and evaporites. These formations were originally described by Milner and Thomas in 1952, and the subdivisions of these formations used here are essentially the same except for some slight modifications in the subdivision of the Vanguard formation.

The Watrous formation is considered to be of Jurassic age but the formation is largely unfossiliferous and many workers believe that at least the basal part of the formation may be Triassic in age. The Gravelbourg, Shaunavon, and most of the Vanguard formation are unquestionably Jurassic and extend from the Bajocian into at least the Oxfordian. In much of the area the top of the Jurassic is placed at a marked unconformity between obvious Jurassic and an unfossiliferous sequence of shale and sandstone thought to be of Lower Cretaceous age. In many wells, however, part of this unfossiliferous section may also be Jurassic in age and the top of the Jurassic is difficult to locate.

Correlations with adjacent areas are possible and the Saskatchewan section is most easily correlated with the Ellis group of Montana. The Saskatchewan section is considerably thicker than that found in the outcrop areas along the southwestern edge of the Jurassic basin, and the formations present in Saskatchewan are only partially represented in typical outcrop sections of the Ellis group. Despite this, equivalents of the Swift, Rierdon, and Sawtooth formations of Montana can be recognized in Saskatchewan.

The Jurassic seas covered most of Southern Saskatchewan and the northern shoreline of this Jurassic basin extended in a general east-west arc across the Province approximately 150–200 miles north of the International Boundary. Sediments deposited in this basin thicken southward, the maximum thickness in Saskatchewan being about 1,400 feet. The western side of the basin is marked by an extensive shelf area extending eastward from the Sweetgrass arch across Saskatchewan as far as a line running approximately through the Dollard-Fosterton trend.

Minor fluctuations in the strand line during Bajocian to Oxfordian or Kimmeridgian time are expressed by the deposition of both clastic and carbonate sediments in the basin. The deposition of suitable reservoir rocks, including both sands and fossil debris, is closely related to transgression and retreat of the Jurassic seas, while local relief on the ocean floor due to the irregular topography on the old Paleozoic surface was important in controlling the deposition of these reservoir rocks.

Oil occurrences in the area are mainly stratigraphic in nature although minor structural features related to compaction and regional downwarping of the area in Jurassic and Cretaceous time have played some part in localizing oil accumulation. Oil production has been established in the upper and lower members of the Shaunavon formation, in the middle Vanguard, and in the basal sands of questionable Cretaceous age.

The geologic reasons for the deposition of reservoir rocks in the Jurassic of southwestern Saskatchewan are illustrated by means of isopach maps of the various formations and members, and an attempt is made to relate the occurrences of oil in these reservoirs to the geologic history of the area.

A. KLINGSPOR, Imperial Oil Limited, Regina, Saskatchewan
Jurassic Stratigraphy of Sweetgrass Arch—Manitoba Section

In southern Saskatchewan and Manitoba the interval between the late Paleozoic and late Jurassic epeirogenies is represented in stratigraphic order by continental redbeds, evaporites, carbonates, and clastics. The sequence is in excess of 1,400 feet thick in south-central Saskatchewan and thins north, west, and east. Depositional and erosional thinning are complementary and the northern limits are determined by late to post-Jurassic truncation.

The system was divided (Milner and Thomas, 1954) into the Watrous, Gravelbourg, Shaunavon, and Vanguard formations, each representing widely recognizable lithologic units.

Proof of Jurassic age is available for the Gravelbourg, the Shaunavon, and Vanguard formations. These formations together appear to represent the Bajocian to Kimmeridgian time interval. The evaporites of the Watrous formation possibly represent the lower Bajocian or earlier Jurassic stages. Recent findings, still unpublished (Peterson, 1955), indicate that rocks of Triassic age may be included in the lowermost continental sediments of the Watrous.

A minor unconformity of Middle Jurassic age is indicated by the occurrence of chert on top of marine carbonates of the Gravelbourg. The evidence for this unconformity is strongest in central and southeast Saskatchewan. There the anhydrite of the Watrous formation thickens markedly and the evaporite conditions appear to have lasted into a higher stratigraphic level than in western Saskatchewan. In the same area the marine sediments above the unconformity thin and gradually change facies. The carbonates to the west are substituted by clastics, and coarse clastics appear in increasing