FORT PECK RESERVATION

List of Topics

OVERVIEW

FORT PECK INDIAN RESERVATION

The Assiniboine and Sioux Tribes

Tribal Headquarters	Poplar, Montana
Geologic Setting	Western Williston Basin

General Setting

The Fort Peck Indian Reservation occupies about 1,456 square miles (931,792 acres) in Valley, Roosevelt, Daniels, and Sheridan Counties in northeastern Montana. The reservation has natural boundaries on three sides; the Missouri River on the south, Porcupine Creek on the west, and Big Muddy Creek on the east. The northern boundary is along the upper part of the second tier of sections through township 33 N., from the east side of Range 39 E. to the east side of Range 55 E.

The Fort Peck Indian Reservation is in the Northern Great Plains and typically has rolling uplands that are dissected by the Missouri and Poplar Rivers and their tributaries. The Missouri River is the largest stream in the area, flowing eastward at a gradient of about 1 foot per mile. The Poplar River flows south across the central part of the reservation to join the Missouri River at Poplar. The altitude ranges from about 3,050 feet in the northwestern part of the reservation to less than 1,900 feet in the southeastern part.

The main settlements are in the valley of the Missouri River, along U.S. Highway 2; the largest city is Wolf Point. The largest nearby city is Glasgow, about 15 miles west of the southwest corner of the reservation. A few Post Office stations are in the northern part of the reservation.

Standard Operating Procedures

The Standard Operating Procedures handbook is to assist the Oil and Gas Industry with the task involved in the leasing and exploration of Indian lands. Due to the uniqueness and diversified management, every Tribal government maintains in dealing with Mineral Development, the S.O.P. was conceived to eliminate any confusion in dealing specifically with the Fort Peck Tribes.

The contents within the S.O.P. are not set in stone and allow for negotiations, particularly in dealing with Tribal lands. Leasing of tribal lands is more flexible especially with joint venture agreements.

Melcher Bill

The Indian Minerals Development Act of 1982, also known as the Melcher Bill, has greatly expanded the authority of Tribes to govern the development of their resources. Since the enactment of the Bill in 1982, the Fort Peck Tribes success in negotiating joint venture agreements has attracted the interest and participation of several oil companies. Due to the trust status of Indian Reservations, various tax incentives have given the Fort Peck Tribes authority in offering oil companies part interest in operations or revenue sharing agreements. This has given the Tribes greater flexibility with greater financial returns.

Leasing

The Bureau of Indian Affairs handles the leasing of Tribal and Allotted lands on the Fort Peck Reservation. This occurs primarily during two sales each year, although negotiated leases are also permitted.

The Bureau of Land Management under Federal law oversees the drilling and production. This includes all phases of the surface disturbance during drilling and production operations. Supervising environmental and cultural assessments are the responsibility of the Bureau of Indian Affairs.

Royalty Payments

The Federal Minerals and Management Service handles royalty payments to the Fort Peck Tribes. They handle the collection of royalties from operations and the payment of the money to the Bureau of Indian Affairs for distribution. Production and revenue accounting on Tribal lands (not Allotted) under joint venture agreements, or operating agreements is handled by an independent accounting firm other than the MMS.

The Bureau of Land Management under Federal law oversees the drilling phases of a prospect from site development to production. Environmental and cultural assessments are also monitored.

Companies operating on the Fort Peck Reservation are required to employ Indian people while working on trust lands. They are encouraged to do so while operating on adjacent, non-Indian lands. The maximum collectible tax is 7 percent. Any revenue above 27 percent is written off as a credit against the tax. Payment is made quarterly to the Tribes. At this time, operators are still paying all regular state and local taxes in Trust production as well.

Contractors Business Tax

The Tribes also levy a tax similar to the Navajo Business Activity Tax. This is a 0.5 percent tax on the gross receipts of any contractor making more than $100,000 in real improvements on Trust land. Large construction projects, mining and related developments, and utility construction are all liable for this tax. Businesses wholly owned by the Tribes are exempt.

Utilities Tax

A third tax, enacted in May 1987, is imposed on the property of utilities within the reservation, excluding Tribally owned entities or utilities located on Tribal lands with a total value less than $200,000. Property is assessed annually and based on a value computed using Montana Codes Chapters 15-23. An appointed three member Tax Commission arbitrates disputes over property valuation.

The Burlington Northern Railroad sued the Tribes over this tax, but the Federal District Court in Great Falls upheld the Tribe's power to impose the tax. BN appealed the case to the Ninth Circuit Court in San Francisco and lost. Their present appeal has been taken to the U.S. Supreme Court and a ruling is pending.

Uses of Revenue

All revenues received from the three taxes go to the Tribal general fund. At present the issue of dual taxation by both State and Tribes is of great concern. The Cotton Petroleum case decided both States and Tribes have the authority to tax natural resource production. When poverty and unemployment are higher on reservations than off reservation, a net drain of tax resources is unwelcome. The Tribes have recently negotiated tax revenue sharing agreements with the State of Montana affecting, gasoline, alcohol, and cigarette taxes.

Fort Peck Oil and Gas Lease Sales

Sale dates are set in accordance with Fort Peck Tribal Resolution #474-86-1 passed by the Fort Peck Tribal Executive Board. The Oil and Gas sales are conducted the second Thursday in March and the second Thursday in September of each year, with a minimum of forty-five (45) day advertisement.

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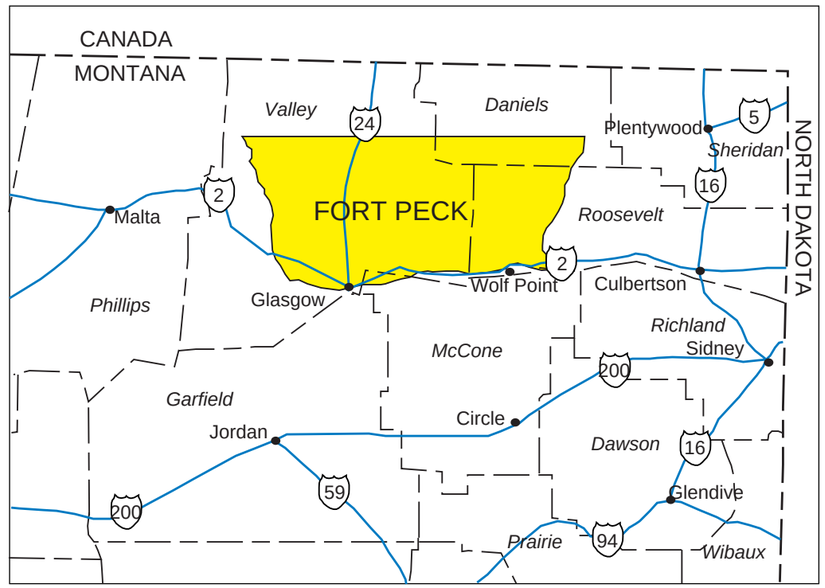


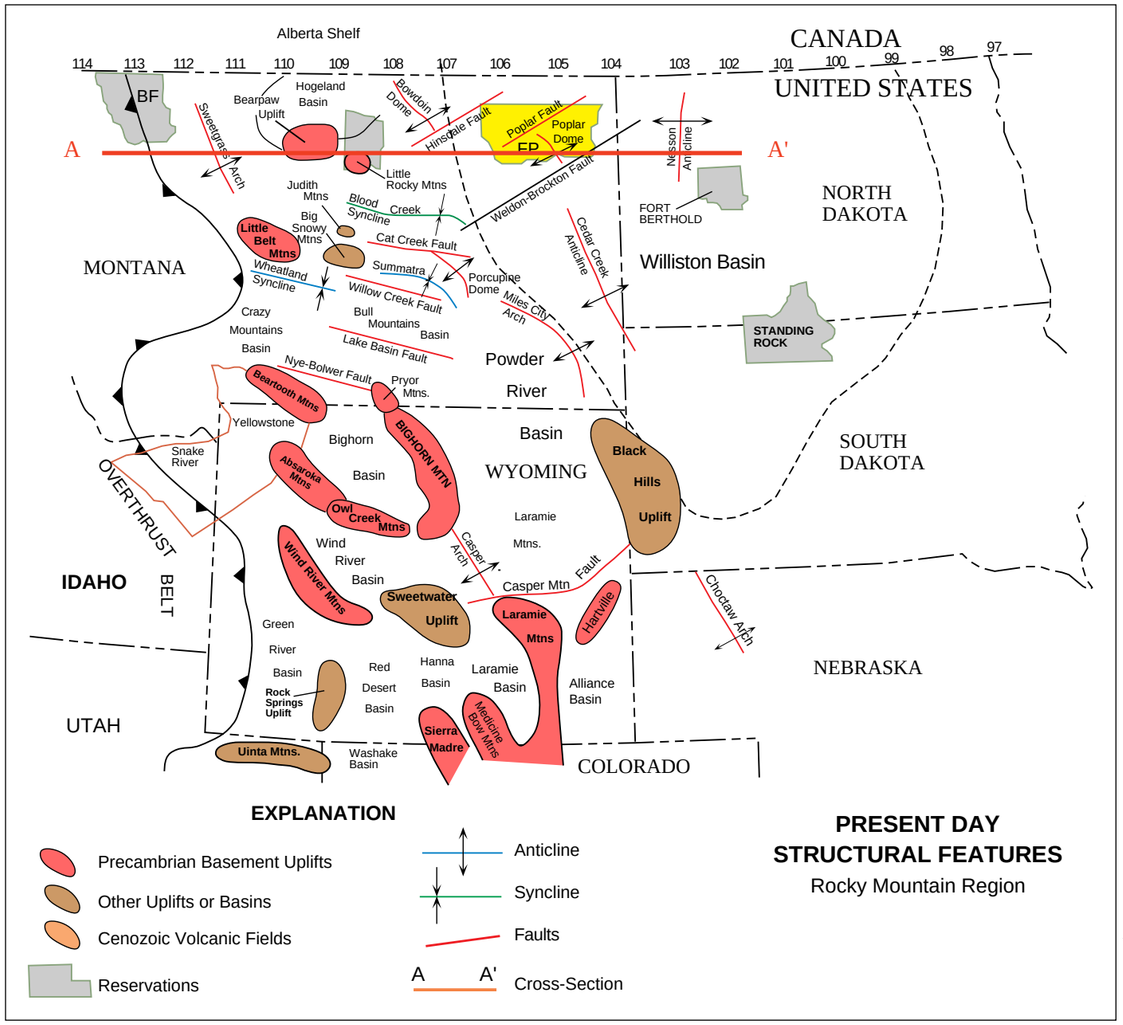


Figure FP-2.1. Present day structural uplifts and basins, Fort Peck Reservation and location of regional cross-section A-A' (modified after Peterson, 1987).

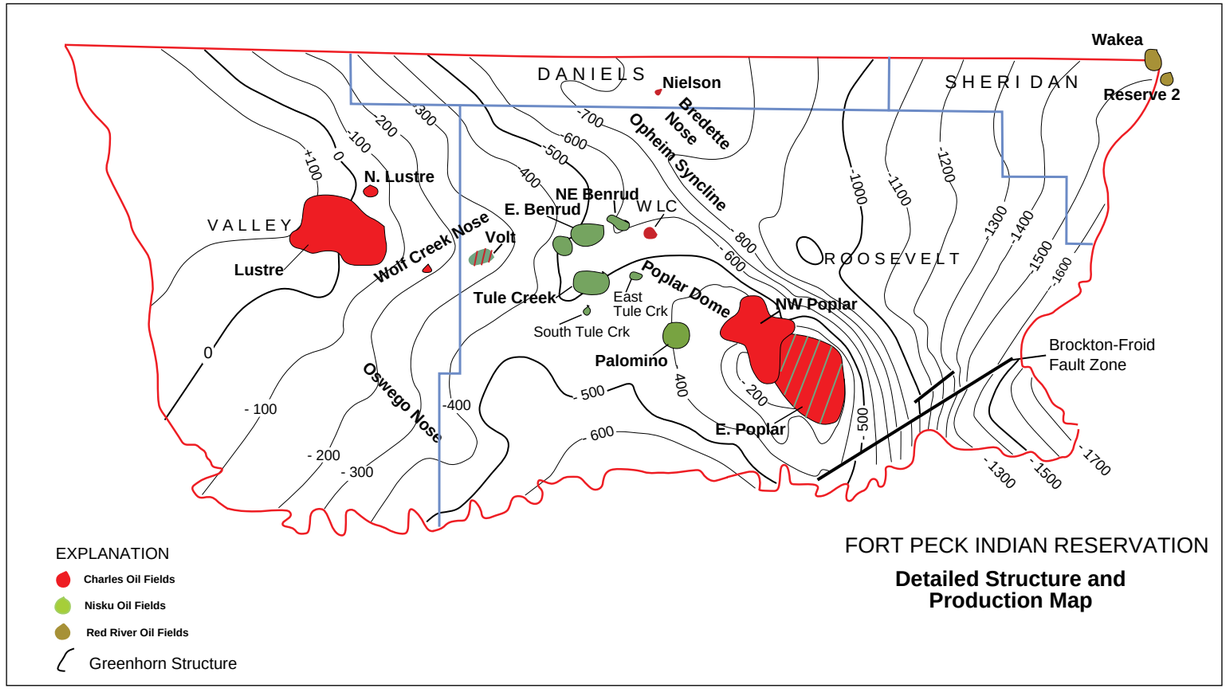


Figure FP-2.2. Structure map of the Greenhorn Formation and Fort Peck Reservation boundaries. Shows production information regarding position and play type.

Regional Geology

The Fort Peck Reservation is situated on the western flank of the Williston Basin (Fig. FP-2.1). The basin is predominantly a carbonate depocenter interbedded with clastics and evaporites. The clastic units are composed of both marine, organic rich shales, which are the principle source rock, and marine or fluvial sandstones. The carbonates and evaporites are mainly tidal flat, bioherm / reefs or sabhka deposits. Cyclic sedimentation of marine shales, limestone and dolomites and anhydrites / salts are typical of the Paleozoic section. Reservoir rock can be formed in the limestone or dolomite with both primary and secondary porosity. Porosity may be intergranular, vuggy, intercrystalline or fractured, depending on the rock type and depositional environment.

Structural Geology

The Fort Peck Reservation is dominated by the Eastern Flank of the Bowdoin Dome and the northwest trending Poplar Dome (see Fig. FP-2.2). The Poplar Dome is west of the basin hinge axis which separates the Williston Basin from the Bowboin Dome; both features are of Laramide age. The Brockton-Froid Fault system trends Northeast to Southwest and is one of the major lineaments in the Williston-Blood Creek structural system. Minor structural features include the Wolf Creek Nose, the Oswego, the Bredette Nose and the Opeim Syncline.

Geologic History

A generalized structural cross-section (see cross-section A-A', FP-3.1) has been constructed to summarize present day tectonic provinces and older paleostructure. The cross-section uses rock thickness values from each of the geologic periods. The section runs along the 48 degree latitude line and values were selected at one degree longitude intervals.

The western end of the section, near the Blackfeet Reservation is dominated by high relief (> 5000 feet). The Cretaceous and older Paleozoic section is about 11,000 feet thick. Major basement uplifts, such as the Sweetgrass Arch and Bearpaw Uplift, influenced sedimentation throughout geologic time.

The eastern side of the cross-section is dominated by the Williston Basin, a stable cratonic basin which comprises more than 15,000 feet of sediments. The Fort Peck Reservation is located west of the depocenter on a shallow shelf.

Play Types Encountered Within Reservation Area

Conventional

1. Mississippian Carbonate Structure
2. Ordovician Red River
3. Devonian Nisku Salt Collapse
4. Winnipegosis and Interlake

Unconventional

5. Pre Red River Gas (Winnipeg/Deadwood)
6. Fractured Bakken Play
7. Judith River and Eagle Sandstones Biogenic Gas

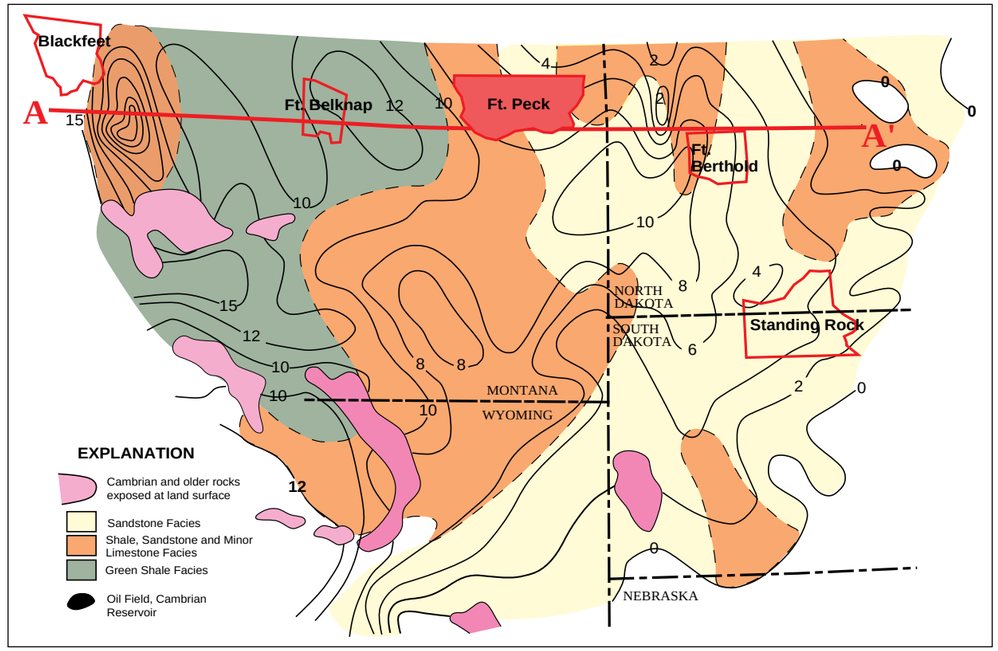


Figure FP-3.1. Thickness of Deadwood and equivalent rocks. Blackfeet Reservation, location of analog fields and location of regional cross-section A-A" (modified after Peterson, 1987).

To better illustrate the geologic history of the region, which has been influenced by all of these tectonic provinces, a series of paleo cross-sections are shown. Each section summarizes a particular time interval; Cambrian and older rocks, Ordovician to Triassic and Cretaceous to Jurassic. Since Tertiary sediments are present only in the Williston Basin, no paleostructure section is shown. All the paleo-cross sections are drawn along the line of section A-A' indicated in figure FP 3.1.

A paleo-cross section attempts to show what the subsurface geology may have looked like within a particular time interval; no older rocks are illustrated. The rock units above the interval have not yet been deposited; so the top of the section is the datum. The datum is flat, representing the paleo ground surface.

Present Day Structure

Figure FP 3.2 illustrates the main structural features along the line of section A-A'. Across the Fort Peck Reservation the main features include Poplar Dome and the Brockton-Froid Fault system. The reservation is situated along the shallower western flank of the Williston Basin.

Cambrian to Older Rocks

During Cambrian time, a major seaway existed in western Montana and eastern Idaho (Figure FP-3.3 and isopach of Cambrian rocks in FP 3.1). This seaway gradually transgressed from west to east across eastern Montana and the Dakotas. The major source of coarse-grained clastics was to the east (from the Sioux Arch) and graded into shales and limestones to the west. Thickness of the Cambrian varies from over 2000 feet in the Montana Disturbed Belt to less than 100 feet thick at the eastern edge of the Williston Basin. Cambrian rocks at the Fort Peck Reservation are about 500-700 feet thick. There is no evidence of Poplar and Bowdoin domes at this time.

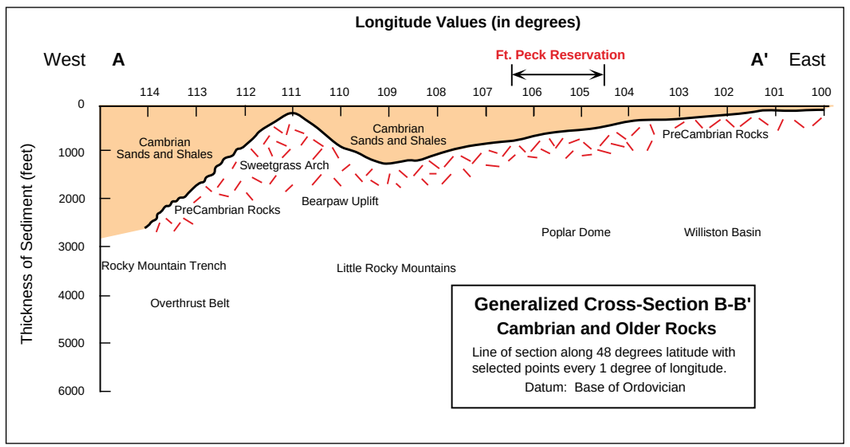


Figure FP-3.3. Generalized paleostructural cross-section' showing Cambrian and older rocks. Line of section along A-A'.

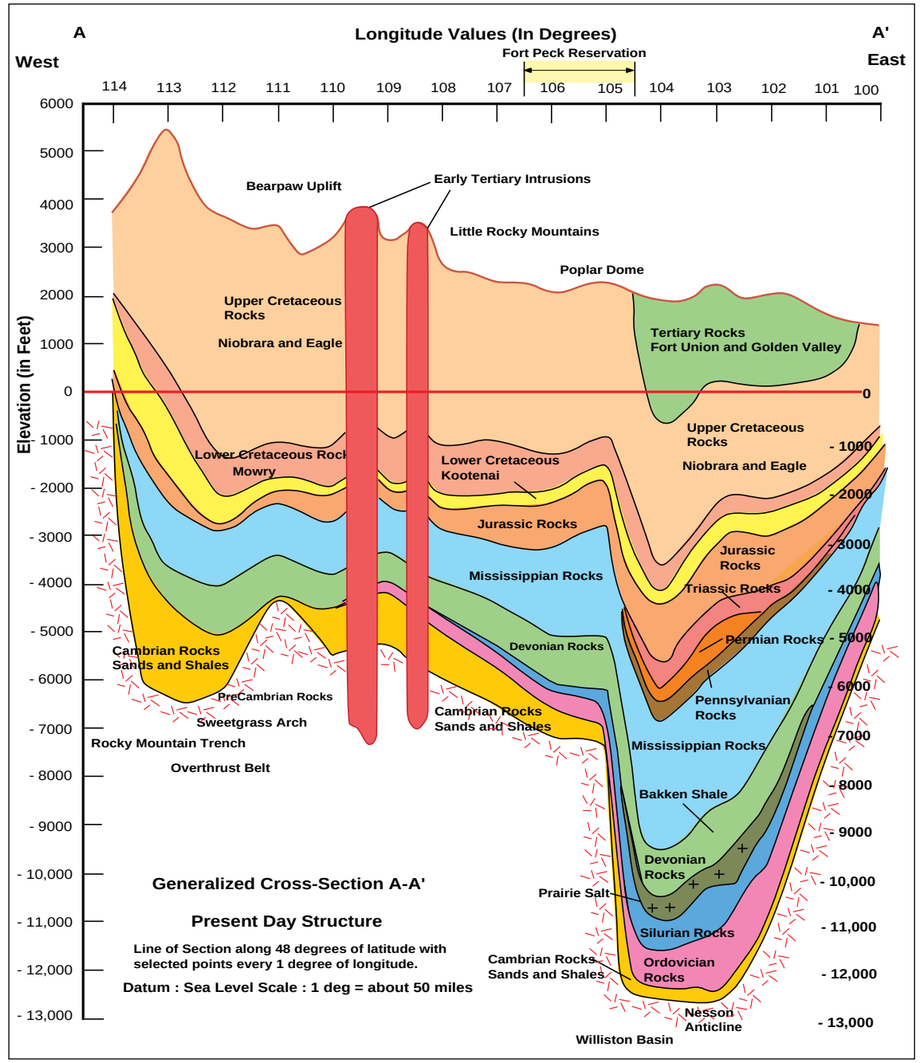


Figure FP-3.2. Generalized cross-section A-A', present day structure.

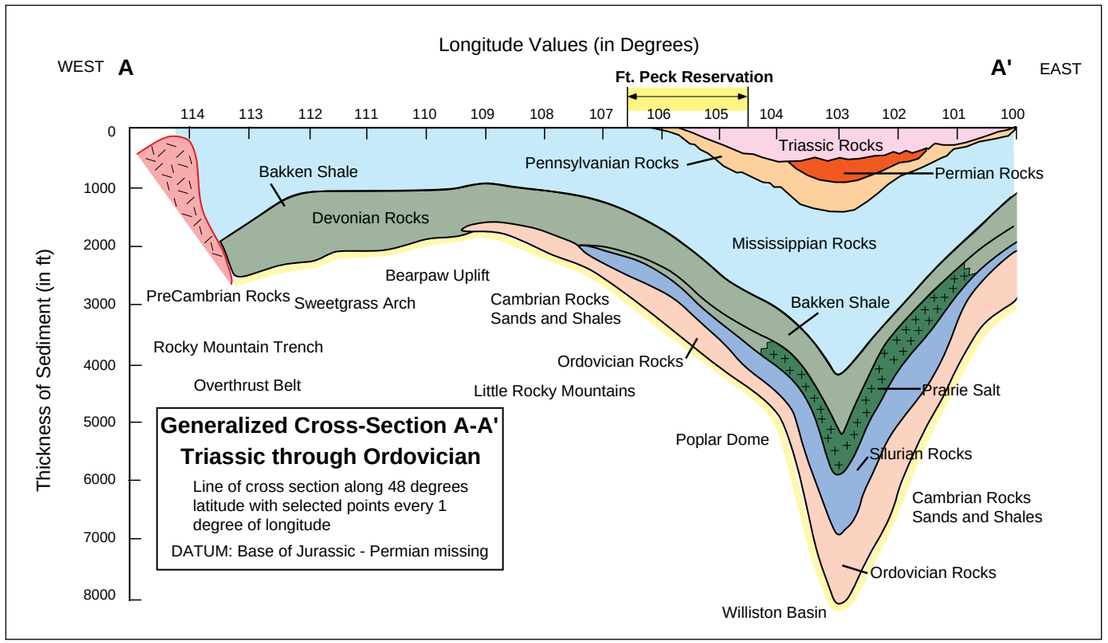


Figure FP-4.1. Generalized paleo-structure cross-section. Line of section along 48 degrees of latitude with selected points every 1 degree of longitude. For location of A-A', refer to Figs.FP-3.1 and FP-4.1.

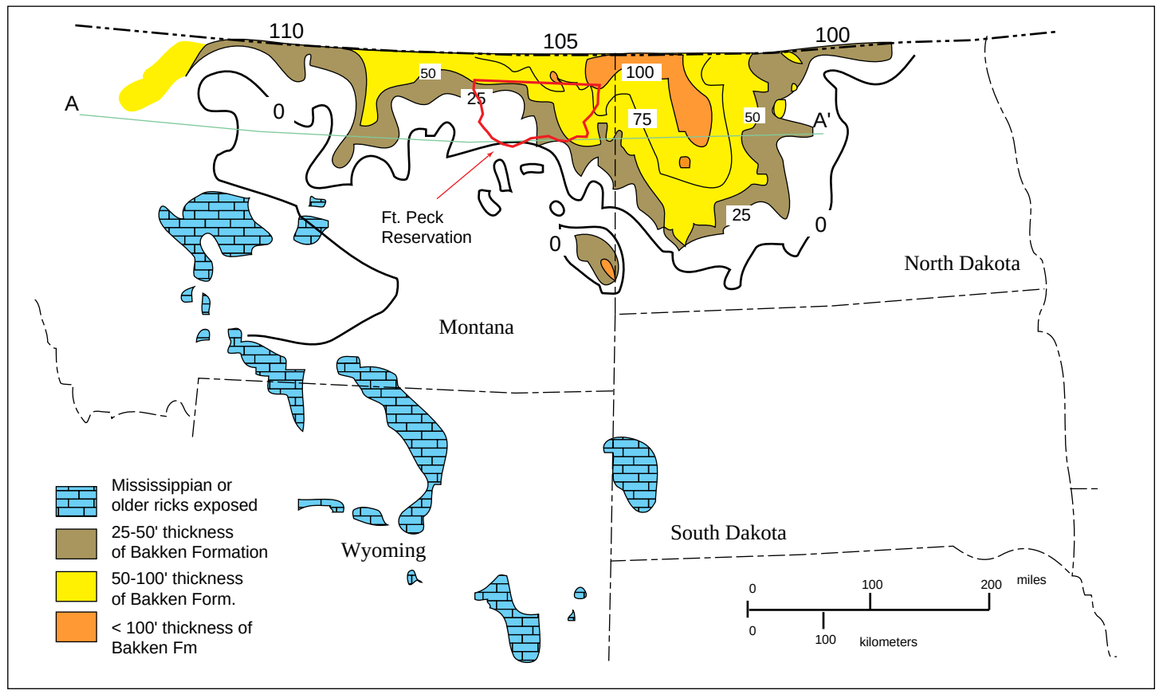


Figure FP 4.2 - Map showing thickness of Bakken Formation, location of reservation, and location of regional cross-section A-A' (modified from Peterson, 1987).

Ordovician to Triassic Rocks

From late Cambrian through most of the Paleozoic, the Williston Basin on the east side of the cross-section was the dominant receiver of sediments (see, Figure FP-4.1). The Williston Basin has been a stable, shallow marine shelf through most of the Paleozoic era. Ordovician and Silurian rocks were deposited in a tidal flat environment with alternating cycles of limestone / dolomite, marine shales and evaporites. At the end of Silurian time, a regional unconformity extended across the Williston Basin and to the west. Present thickness of Ordovician and Silurian rocks on the Fort Peck Reservation are 500 feet and 200 feet, respectively. Apparently Bowdoin Dome and Poplar Dome, if they existed, are poorly expressed features.

Deposition during Devonian time was similar to that during Ordovician and Silurian time. Within the Reservation boundaries, Devonian rocks are about 1700 feet thick and include the regional Souris River (200 feet or less), and the Bakken Shale (50 to 75 feet thick) formations (see Figure FP 4.2). The Prairie Salt was dissolved out of the section near the western edge of the basin (near 105 degrees longitude), and forms the structural traps within the Nisku Formation. Details of Nisku trap formation are discussed in Play 3, Devonian Nisku section of the Atlas. Bakken Shale is organically rich and is thought to be the prime source rock for Mississippian production.

By Mississippian time, the Williston Basin to the west was continually depositing limestones and evaporites in a shallow, marine shelf environment. Cyclic changes in sea level produced shoreline trends in the carbonate intervals (see Figure FP 4.3). Most of the producing reservoirs in the Williston Basin area are from these cyclic marine shales, limestones / dolomites and evaporite seal sequences. Eventually, the Charles Salt would cover the entire basin and part of eastern and central Montana. By late Mississippian time, deposition was mainly of shales and mudstones confined to the Central Williston Basin and the Big Snowy Trough in central Montana. Detailed field studies of Poplar Dome indicate that production is from the Charles A and B zones and reservoir rock is not plugged with salt crystals. This could be due to either salt dissolution or lack of evaporite deposition, implying that Poplar Dome has always been structurally positive.

A smaller depocenter of Mississippian rocks exists west of the Sweetgrass Arch and Bearpaw Uplift which were positive features in Mississippian time. Total thickness of Mississippian rocks within reservation boundaries is about 1500 feet. All Mississippian rocks are thermally mature.

Exposure at the end of Mississippian time led to widespread erosion, karstification and unconformity development. Pennsylvanian sediments are confined to the center of the Williston Basin in central Montana, south of the Reservation. Tyler sands and shales are present in the Williston. Pennsylvanian rocks are about 100 to 200 feet at Fort Peck.

Permian deposits are confined to the central Williston Basin and are predominantly sand/shale and evaporite sequences. Major erosion at the end of Permian time has removed any evidence of these rocks west of longitude 104 degrees; hence none are present on the Reservation. Triassic rocks are present, but apparently pinch out within the Reservation boundaries. Work by Shurr and Monson (1995) indicate that Bowdoin and Poplar Domes were positive features.

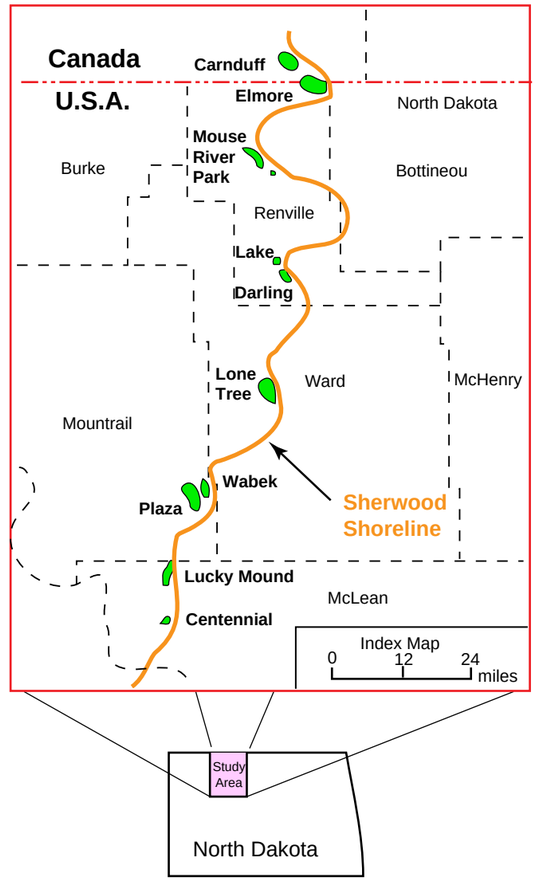


Figure FP 4.3 - Mississippian Sherwood shoreline trend and position of major oil fields (after Sperr, et al, 1993).

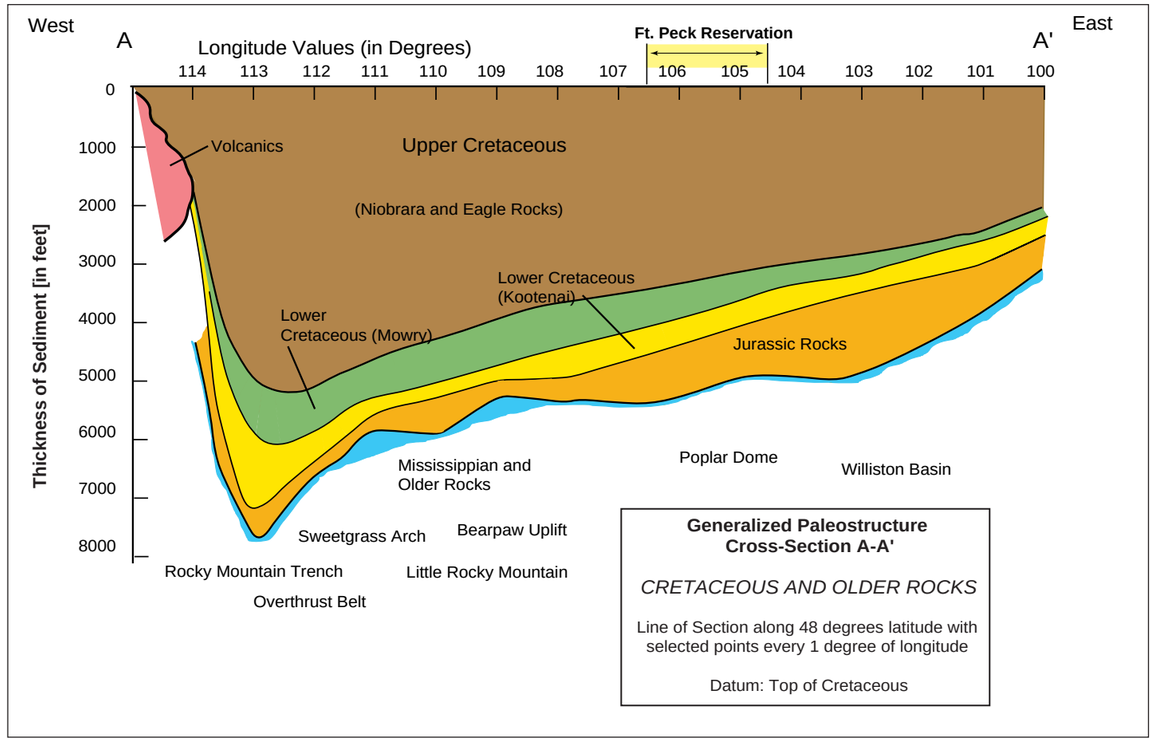
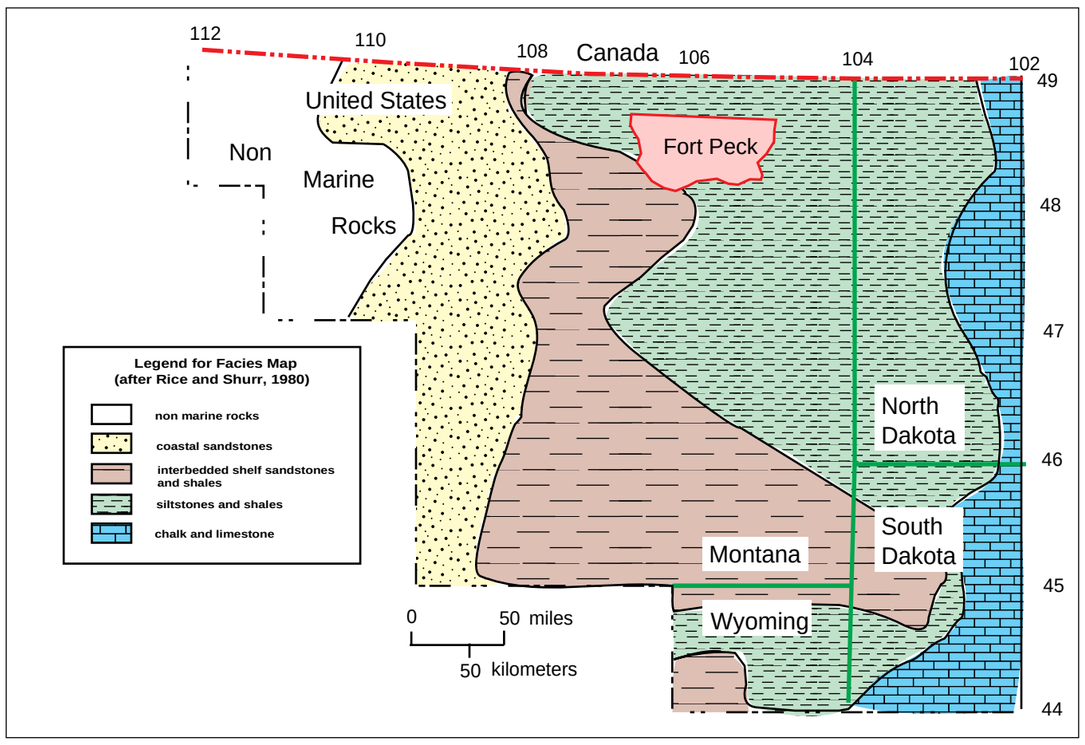


Figure FP-5.1. Generalized paleostructure cross-section A-A', Jurassic to Cretaceous Rocks (after C.W. O'Melveny, 1996).



◀ **Figure FP 5.2** - Regional distribution of diagenetic and petrophysical facies of the Niobrara. Area within 3000 feet or less of burial should contain chalks with porosity greater than 35%. Areas between 3000 to 4000 feet of burial should average 30-35% porosity (after Rice and Shurr, 1980).

Jurassic to Cretaceous Rocks

In Jurassic time, the Williston Basin was still the major depocenter for clastic and marine/evaporite sediments. Thickness of Jurassic rocks is estimated to be about 1000 feet thick and shows evidence of thinning at Bowdoin and Poplar Domes (Fig. FP-5.1).

A tectonic structural reorganization of the North American continent occurred during Jurassic-Cretaceous time. This resulted in a major change of depocenter position in the Williston Basin; shifting from the east to the western side (refer to Fig. FP-5.1). The initial pulses of the Sevier and later Laramide thrusting resulted in dominantly clastic deposition in the Cretaceous Seaway during this time. Early Cretaceous (lower Kootenai) rocks are about 200 feet thick within the Reservation. The lower Early Cretaceous environment is thought to have been continental with deposition of fluvial sediments. Source area for these deposits (i.e. Lakota Formation) is thought to have been to the southwest in Montana and south into Wyoming.

Late Early Cretaceous (Montana Group-Mowry / Skull Creek strata) are about 400 to 500 feet thick. These rocks were deposited as a transgressive marine sequence that extended from western Montana eastward into the Dakotas and from Texas into Canada. The fluvial and marine sands, such as the Muddy/Newcastle are present in this interval.

Upper Cretaceous rocks are more than 3500 feet thick in the reservation area and consist of calcareous siltstones, thin limestone intervals, and calcareous shale (Fig. FP-5.2). Extensive Greenhorn / Niobrara chalks were deposited in the Williston Basin and southeast into South Dakota, Nebraska and Colorado. The Eagle and Judith River Formations were deposited as nearshore marine and barrier island sands.

Tertiary and Younger Rocks

Tertiary time saw the erosion of older Cretaceous rocks. Swamps exsisted in Paleocene and Eocene time in the central Williston Basin, and formed coal. By the end of the Eocene, most of the older highlands had been eroded away. Only about 350 feet of Tertiary and Quaternary sediments exist at Fort Peck.

Quaternary time was a period of major continental ice sheets extending into North Dakota and Montana. Alpine glaciers exsisted in Montana's western mountains. Extensive glacial lakes were present along the ancestral Missouri River and its tributaries. Ice sheets covered the present day Fort Peck Reservation.

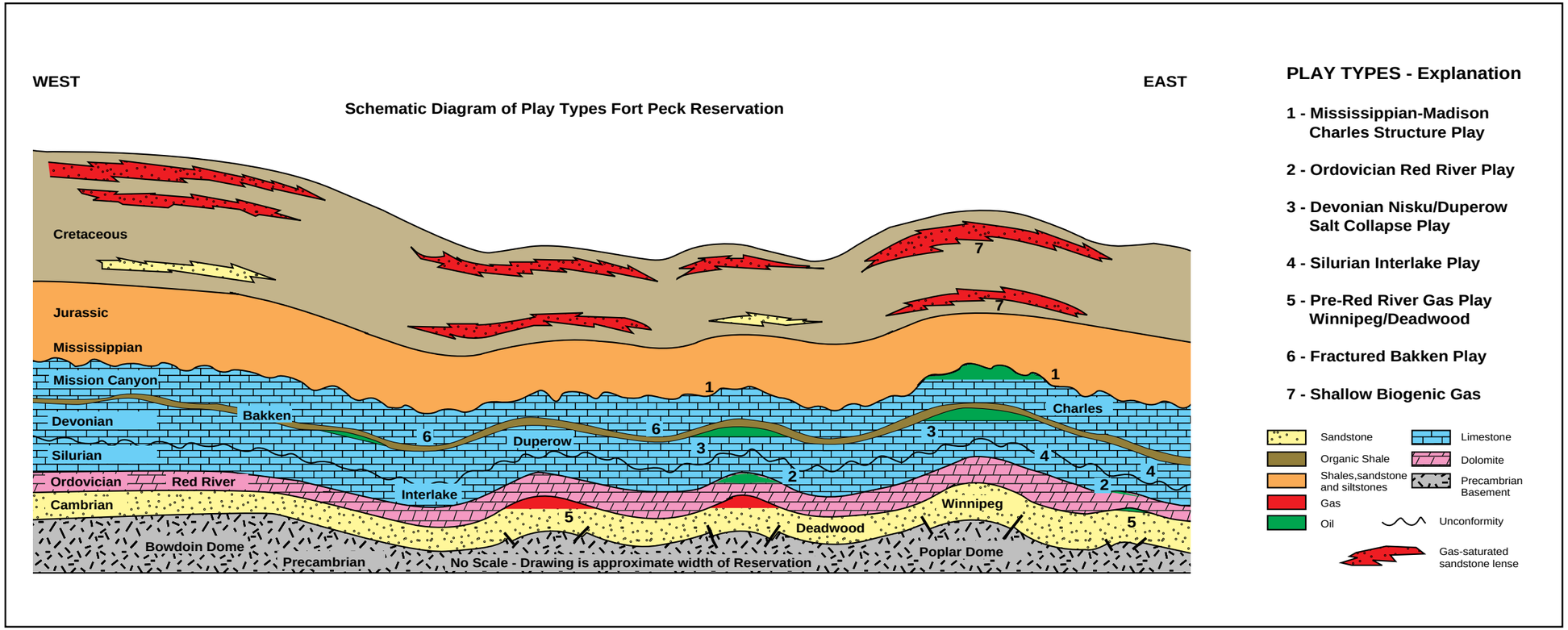


Figure FP-6.1 - Schematic diagram of play types within the Fort Peck Reservation. No scale implied, thickness of stratigraphic section and size of traps only shown in a relative sense.

Reservation:	**Fort Peck**	**Total Production (by province-1996)**	**Williston Basin**	**Undiscovered resources and numbers of fields are for Province-wide plays. No attempt has been made to estimate number of undiscovered fields within the Fort Peck Reservation**
Geologic Province:	**Western flank of Williston Basin**	**Oil:**	**1496 MMBO**	
Province Area:	**Williston Basin (143,000 sq. miles)**	**Gas:**	**1735 BCFG**	
Reservation Area:	**3271 sq. miles (2, 093, 318 acres)**	**NGL:**	**192 MBNGL**	

Play Type	USGS Designation	Description of Play	Oil or Gas	Known Accumulations	Undiscovered Resource (MMBOE) Field Size (> 1 MMBOE) min, median, mean	Play Probability (chance of success)	Drilling depths	Favorable factors	Unfavorable factors
Mississippian Structure **1**	3101	folded structures, primary and secondary porosity in carbonates	Both	878 MMBO 916.5 BCFG 77.9 MMBNGL	estimated 600 MMBO (30 fields @ 20MMBO) **Field Size (>1 MMBOE)** 2 MMBO 20 MMBO 5.3 MMBO **# of undiscovered fields (> 1 MMBOE)** 9 (min) 30 (median) 60 (max) 31.9 (mean)	1 not estimated	5,000 - 6,000 ft	1) confirmed play; excellent production within reservation 2) thermally mature source rocks in portion of reservation 3) source rocks and reservoir present 4) seismic delineation is useful	1) production confined to structures or structural noses 2) source rock immature on flanks of basin 3) porosity can be salt plugged
Ordovician Red River play **2**	3102	Cyclic evaporite/ carbonate sequence, structure/stratigraphic updip pinchout, multiple shoreline cycles. Small, fault block structures	Both	192.3MMBO 586.7 BCFG 74.5 MMBNGL	estimated 250 MMBO (25 fields @ 10MMBO) **Field Size (>1 MMBOE)** 2 MMBO/10 BCFG 10 MMBO/35 BCFG 2.1MMBO/11.7 BCFG **# of undiscovered fields (> 1 MMBOE)** 5 (min) 25 (median) 50 (max) 26 (mean)	1 not estimated	10,000 - 11,500 ft	1) confirmed play; production within reservation 2) thermally mature source rocks 3) source rocks and reservoir present 4) seismic delineation is useful	1) lack of deep well control 2) current production east side of reservation 3) possible small target size
Mid-Upper Devonian Nisku/Duperow Play **3**	3103	Cyclic evaporite/ carbonate sequences. Salt collapse structures. Excellent porosity and permeability	Both	164.2 MMBO 169.5 BCFG 13 MMBNGL	estimated 250 MMBO (25 fields @ 10 MMBO) **Field Size (>1 MMBOE)** 2 MMBO/10 BCFG 10 MMBO/60 BCFG 2.1 MMBO/13.1 BCFG **# of undiscovered fields (> 1 MMBOE)** 9 (min) 25 (median) 60 (max) 26.9 (mean)	1 not estimated	7,000 - 8,000 ft	1) confirmed play; production exists on reservation 2) thermally mature source rocks 3) source rocks and reservoir present and may be excellent in quality 4) seismic may be very useful	1) difficult targets to identify 2) small areal extent, may be difficult to explore for

Figure FP-6.2. Play summary table containing resource information on all play types

Reservation: Fort Peck
Geologic Province: North Central Montana, Sweetgrass Arch, Montana Disturbed Belt
Province Area: North Central Montana (62,500 sq. miles), Thrust Belt (41,400 sq. miles)
Reservation Area: 2385 sq. miles (1,525,712 acres)

Total Production (by province-1996)

	North Central Montana	Disturbed Belt
Oil:	440 MMBO	
Gas:	1.1 TCFG	6 BCFG
NGL:	192 MBNGL	33,000 BNGL

Undiscovered resources and numbers of fields are for Province-wide plays. No attempt has been made to estimate number of undiscovered fields within the Fort Peck Reservation

Play Type	USGS Designation	Description of Play	Oil or Gas	Known Accumulations	Undiscovered Resource (MMBOE) Field Size (> 1 MMBOE) min, median, mean	Play Probability (chance of success)	Drilling depths	Favorable factors	Unfavorable factors
Silurian Winnipegosis and Interlake **4**	3105	Cyclic evaporite / carbonate sequences; eroisonal surfaces. Primary and secondary porosity. Structural/ unconformity traps. Occurs as multi-pay zone with Red River	Both	55.5 MMBO 179 MMCFG 24.8 MMBNGL For detailed production see individual play descriptions	estimated 225 MMBO (15 fields@ 15 MMBO) **Field Size (>1 MMBOE)** 3 MMBO / 15 BCFG 15/90 3.3/19.7 **No of Fields (>1 MMBOE)** 5 (min) 15 (median) 25 (max) 15 (mean)	1 not estimated	8,000-12,500 ft.	1) confirmed play; production exists on Reservation 2) source and reservoir 3) thermally mature 4) structure detected on seismic	1) lack of deep well control 2) production at this time on northwest corner of reservation
Pre-Red River Gas Ordovician Winnipeg / Cambrian Deadwood **5**	3107	Sand / shale sequences. Fluvial and nearshore blanket sands. Large, faulted structures	NGL and Low BTU gas	No information available. For detailed production, see individual play descriptions	estimated 50 BCFG (5 fields @ 10 BCFG) **Field Size (>1 MMBOE)** 10 BCFG 25 BCFG 13.1 BCFG **No of Fields (>1 MMBOE)** 1 (min) 5 (median) 20 (max) 7.3 (mean)	1 not estimated	10,000-16,000 ft.	1) confirmed play; production exists near Reservation 2) source and reseroir 3) thermally mature 4) structure detected on seismic	1) lack of deep well control 2) low BTU, contains nitrogen
Fractured Bakken Outlying Play **6**	3112	Organic rich shale; marine siltstone; fractured; Thermally mature oil shale.	Both	No information available.	Not estimated 70.3 MMBO / sq. mi. 56.24 MMCFG / sq. mi. Area of play 8185 sq. mi. 7806 sq. mi. untested	0.7 0.1	7,500-11,100 ft.	1) source and reservoir 2) thermally mature 3) structure and flexures exist 4) seismic can probably locate structural trends	1) lack of deep well control
Judith River and Eagle sandstones Biogenic Gas (Medium Potential) **7**	3113 2811	Niobrara Limestone and other shallow reservoirs self-sourced; Porosity decreases with increasing depth. Large accumulations possible.	Biogenic Gas Biogenic Gas	Only production to date is Cedar Creek Anticline and Bowdoin Dome These fields are from Eagle and Judith River sands	Not estimated 180 MMCFG / 160 acres median 256 MMCFG / 160 acres mean Area of Play 55,000 sq. mi. 20,000 sq. mi. untested (median) 29,958 sq. mi. untested (mean)	1 0.70	500-4,500 ft.	1) large volume play 2) shallow drilling depths 3) accumulations in structural traps; seismic can probably locate 4) gas shows on Reservation	1) lack of reservoir may be a problem 2) may be small 3) lack of deep well control

Figure FP-7.1 - Summary of play types *(continued).*

Conventional Play Types
Unconventional/Hypothetical Play Types

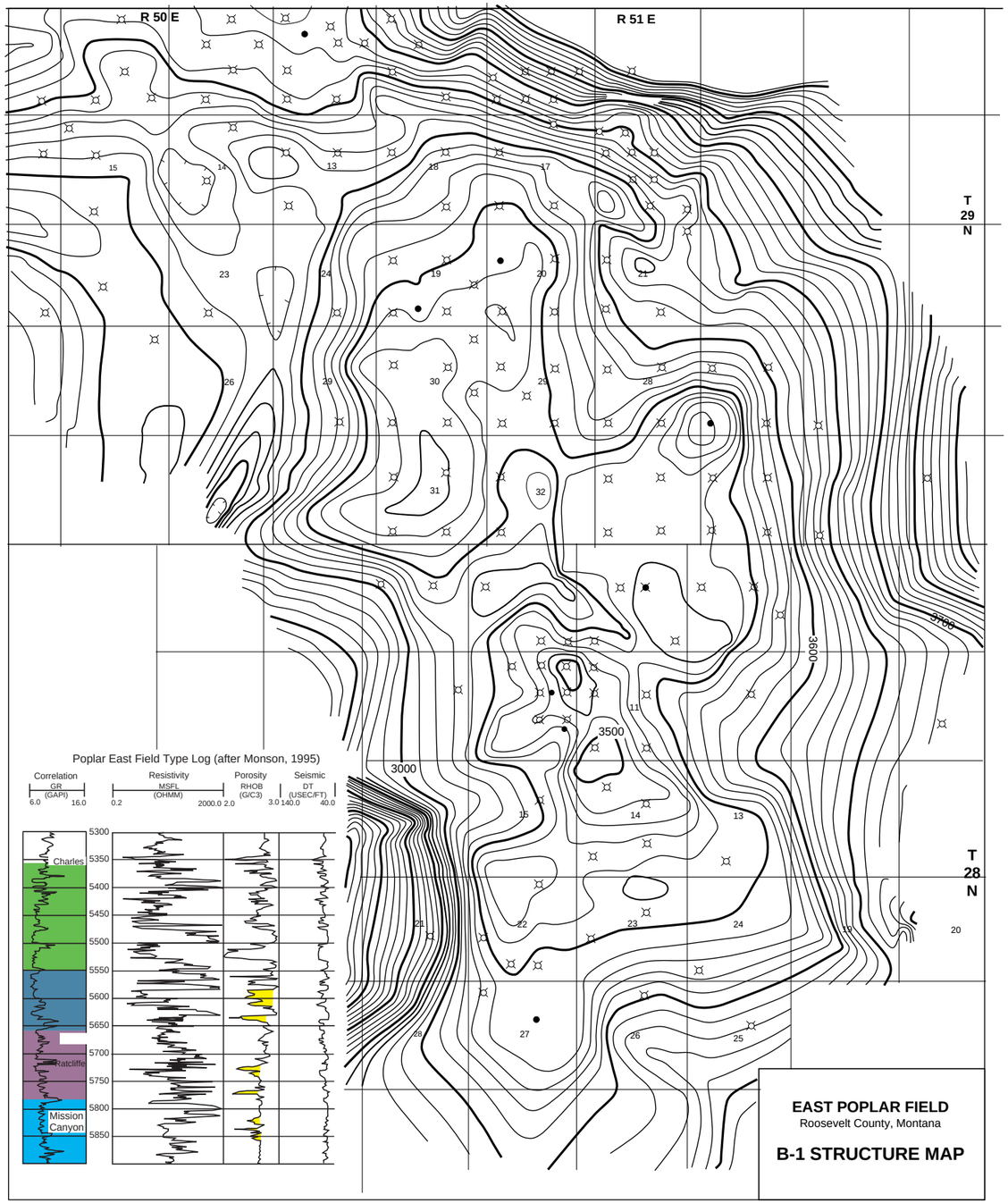


Figure FP-8.1. Poplar East Field Structure Map, 50' contour interval (after Brunson, 1985).

Analog Fields (* denotes fields lying within the Reservation)

(1975) Reagan Field	77,563 BO	1 well
(1982) Lustre	5.9 MMBO	41 wells
(1983) Lustre, North	179,000 BO	1 well
(1985) Midfork	324,000 BO	5 wells
(1992) Nielson Coulee	112,500 BO	1 well
(1952) Poplar East	46 MMBO	46 wells
(1952) Poplar, NW	3.9 MMBO	26 wells
(1987) Reserve 2	194,000 BO	1 well
(1964) Volt	3.4 MMBO	4 wells

TABLE FP-1. Poplar East Field Parameters

Formation:	Mississippian Charles B
Lithology:	Limestone, fossiliferous, fragmental. Lower zones can be dolomite, very fine to crystalline to dolomitic mudstone.
Other Shows:	Production exists within the Charles "A" and "C" zones. Production also develops in the Mississippian Heath and Devonian Nisku Formations. Shows have been recorded in the Kibbey Formation and in the Cretaceous Judith River sands.
Average Depth:	5700 ft
Porosity:	12% gross, intergranular, vuggy
Permeability:	8 md
Oil/Gas Column:	Variable, oil/water contact is tilted 10 to 20 feet per mile. Column to the north
Average Net Pay Thickness:	24 feet

The field is approximately 10 miles long and six miles wide, and has an anticlinal closure of 18,000 acres.

PLAY TYPE 1

Folded Structure Mississippian Carbonate Play

General Characteristics- The Mississippian Madison Charles is a structural-stratigraphic play and is the primary producer on the Fort Peck Reservation. The Charles is subdivided into several producing zones (see type log) by gamma ray marker and porosity zones. These zones are overlain by evporite or shale seals. The Charles Salt is a regional evaporite seal which overlies most of the Madison rocks. Most of the Charles production is confined to structural domes such as Poplar Dome, or to smaller structural noses with up-dip porosity pinchouts. Tilted hydrocarbon columns are present indicating a moderate-strong hydrocarbon drive in the southcentral part of the reservation area.

Reservoir rocks are dolomitized carbonates which are either algal, oolitic, crinoidal, or micritic deposits. Source rocks are both the organic rich, Bakken Shale marine shales within the evaporite-carbonate cycles. Source rocks are thermally mature in the center of the basin and immature on the flanks. Onset of oil migration is thought to have been during late Cretaceous time.

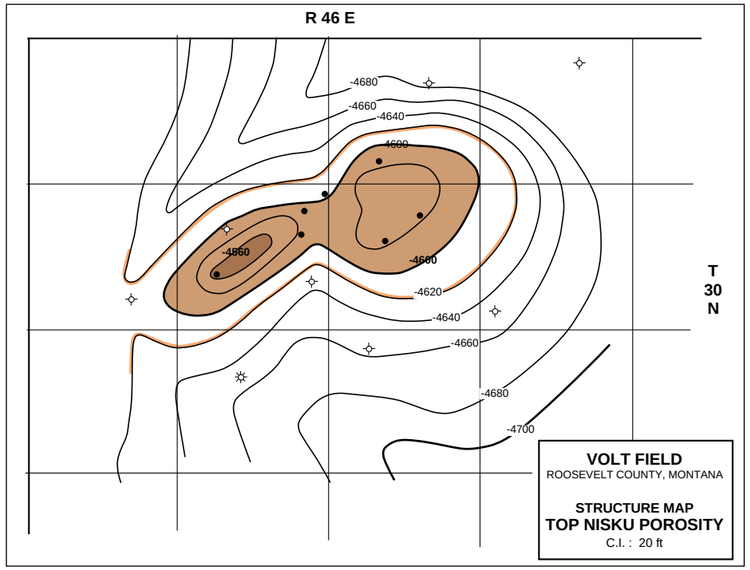


Figure FP-8.2. Volt Field Structure Map with top Nisku porosity zone as datum (after Reeves, 1985).

TABLE FP-2. Volt Field Parameters

Formation:	Mississippian Charles
Lithology:	40 feet of limestone and dolomitic limestone;intercrystalline to cryptocrystalline and microcrystalline porosity
Other Shows:	Devonian Nisku Both Charles and Nisku production are structurally controlled, although the Charles has a stratigraphic component.
Average Depth:	5900 ft
Porosity:	13% average
Permeability:	0.1 md, with numerous vertical fractures
Oil/Gas Column:	unknown
Average Net Pay Thickness:	variable

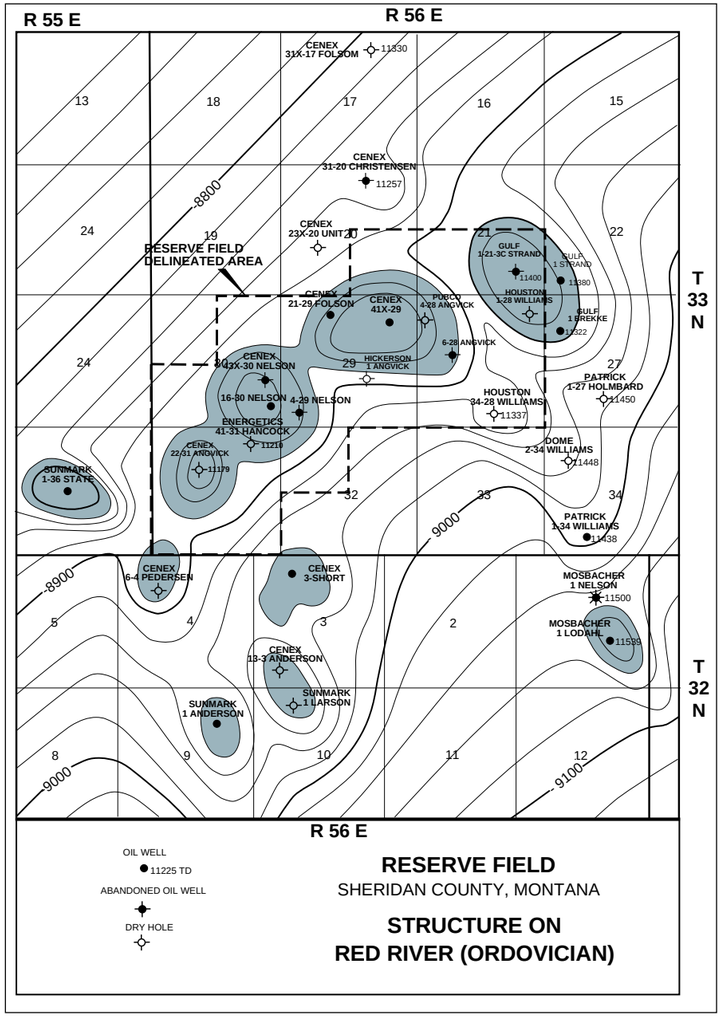


Figure FP-9.1. Reserve Field structure map (after Ames, 1985).

TABLE FP-1. Reserve Field Parameters

Formation:	Ordovician Red River Lithology: Red River "A", dense dolomite fractured on top of structure; "B" - locally continuous, fine sucrosic dolomite; "C" - isolated pods of fine sucrosic dolomite; "D" - discontinuous layers of fine to medium dolomite.
Average Depth:	Red River zone "A" through "D" varies from 11,040 feet to 11,280 feet
Porosity:	variable, 6-15% porosity
Permeability:	no information
Oil/Gas Column:	no information
Average Net Pay Thickness:	"A" is 6 feet; "B" is 2-6 feet "C" is 8-17 feet; "D" is 6-22 feet
Other formations with shows:	Mississippian Ratcliffe, Mission Canyon
Other information:	Production from Red River and Interlake

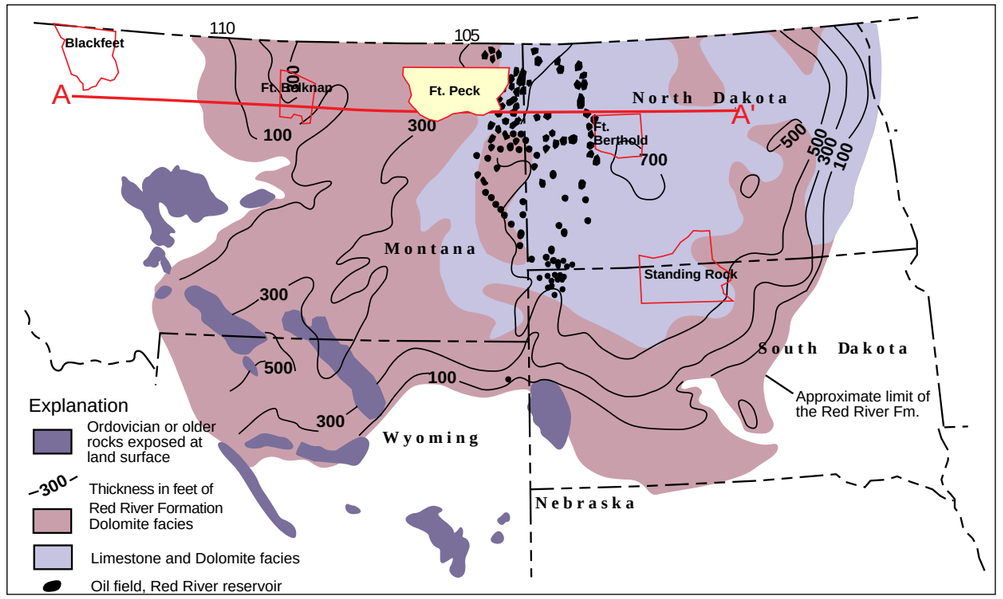


Figure FP-9.2. Approximate thickness of Ordovician Red River Formation within the Williston Basin and surrounding areas, Fort Peck Reservation, Analog Fields and location of Regional cross-section A-A' (modified after Peterson, 1987).

Analog Fields (* denotes fields lying within the Reservation)

(1987) **Reserve Field**	194,000 BO	1 well
(1983) **Wakea Field**	2.4 MMBO	7 wells

Table FP-2. Wakea Field Parameters

Formation:	Ordovician Red River
Lithology:	Sucrosic dolomite
Average Depth:	10,700 ft
Porosity:	14%
Permeability:	no information
Oil/Gas Column:	no information
Average Net Pay Thickness:	6 feet
Other Formations with Shows:	no information
Other Information:	Production is from Red River Winnipegosis, Interlake, Nisku Gunton and Duperow
Cumulative Production:	890,541 BO

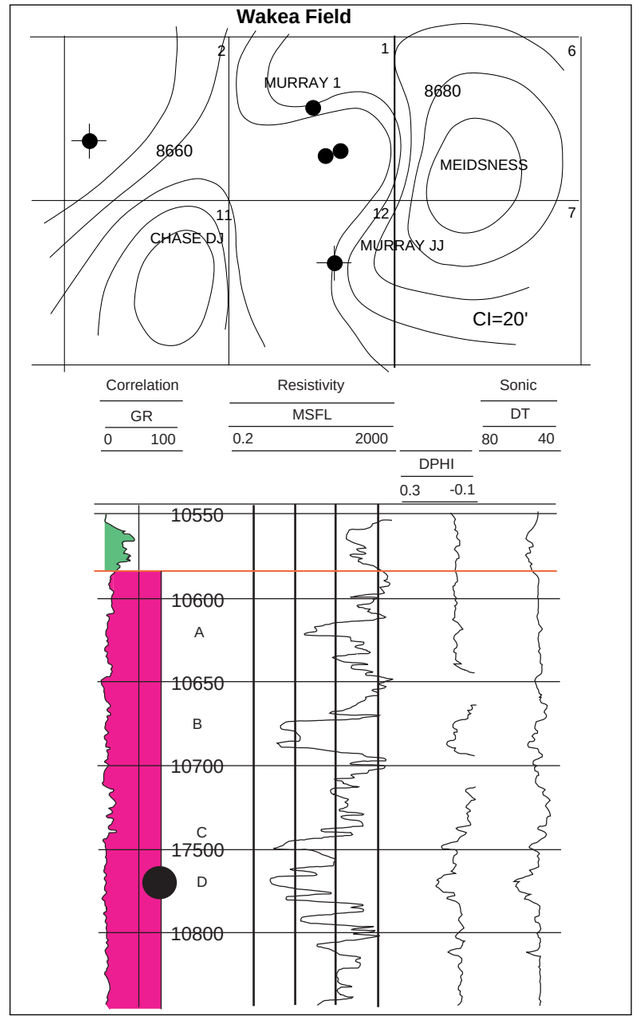


Figure FP-9.3. Wakea field and type log. Top of Red River is datum with a contour interval of 20' (after Monson, 1985).

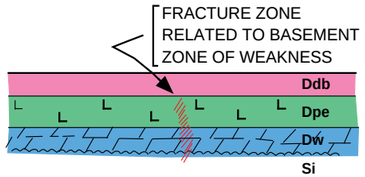
PLAY TYPE 2

Ordovician Red River Play

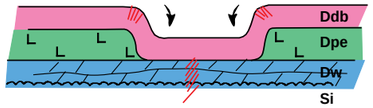
General Characteristics - The Red River is the second most productive formation in the Williston Basin. Reservoirs are dolomites and dolomitic limestones formed from bioclastic mounds, and tidal flat deposits.

Major accumulations are found on structural noses such as Nesson and Cedar Creek Anticlines. Smaller fields are found in fold structures draped over basement fault blocks, or small, carbonate mounds (see Figures FP-9.1 & 9.3). Most of the production is on the extreme eastern side of the Fort Peck Reservation.

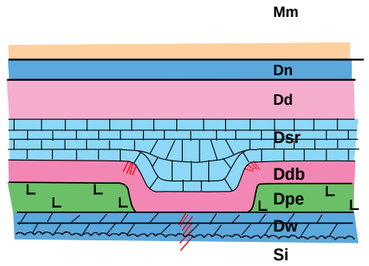
Source rocks are thermally mature to overmature at the basin center, and pinch out on the basin flanks. Winnipeg and Red River shales are thought to be the primary source rocks. Hydrocarbon generation and migration are estimated to have begun in late Paleozoic time.



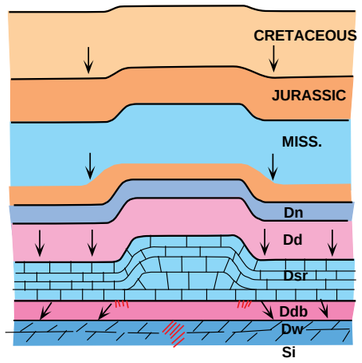
Stage 1 - Stratigraphic diagram showing pre-solution disposition of lower Paleozoic beds in Tule Creek Field Area.



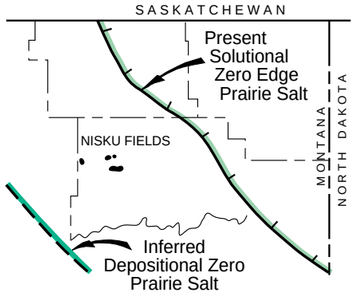
Stage 2 - Stratigraphic diagram showing first stage of salt solution which created local solutional sink.



Stage 3 - Stratigraphic diagram showing post-solution infill of sink with carbonates of Souris River Formation.



Stage 4 - Stratigraphic diagram showing effects of second-stage solution and regional removal of salts of Prairie Formation.



Map showing position of (1) present-day solutional edge of Prairie salt, and (2) inferred depositional edge of Prairie Salt.

Figure FP-10.1 - Stages of Nisku trap development due to salt solution features (after Swenson,1957).

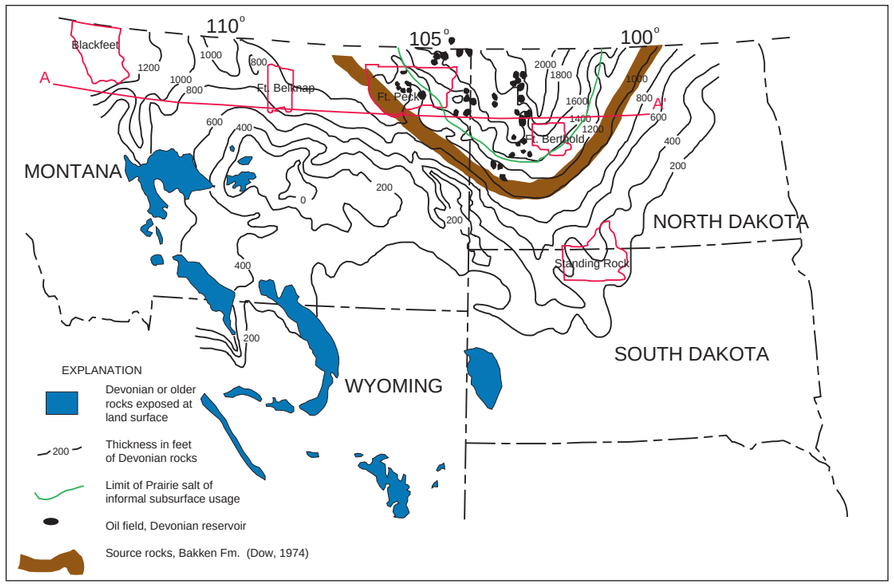


Figure FP-10.2. Thickness of Devonian rocks, limit of Prairie Salt, limit of Bakken Source rock, Fort Peck Reservation and location of regional cross-section A-A' (modified after Peterson, 1987).

Analog Fields
(* denotes fields lying within the Reservation)

Benrud, East (1962)	2.9 MMBO	2 wells
Benrud, NE (1964)	1.0 MMBO	1 well
Lustre, North (1983)	179,000 BO	1 well
Midfork (1985) (multiple pay horizons)	324,000 BO	5 wells
Palomino (1980)	2.13 MMBO	5 wells
Poplar East (1952) (multiple pay horizons)	46 MMBO	46 wells
Poplar, NW (1952) (multiple pay horizons)	3.9 MMBO	26 wells
Tule Creek (1960)	8.2 MMBO	3 wells
Tule Creek, East (1964)	2.1 MMBO	1 well
Tule Creek, So. (1964)	900,000 BO	1 well
Volt (1964) (multiple pay horizons)	3.4 MMBO	4 wells

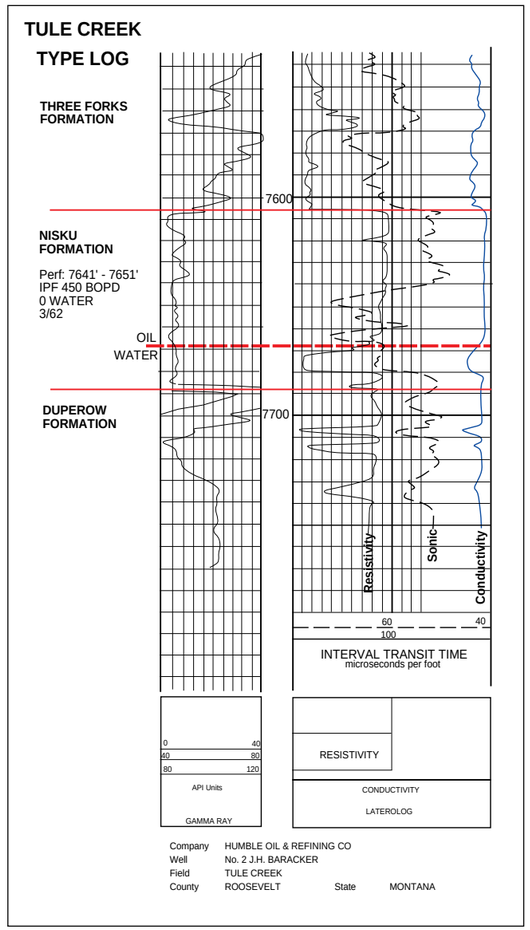


Figure FP-10.3. Tule Creek type log showing position of porosity development and typical initial production data.

PLAY TYPE 3

Devonian Nisku-Salt Collapse Play

General Characteristics - This play is characterized by small scale non-tectonic structures. Multiple episodes of salt solution and collapse resulted in the development of 'turtle' structures. These structures were produced by periodic salt solution, infilling with Nisku carbonate, and final stage of salt solution, withdrawal and compaction (see Figure FP-10.1). Nisku production is 60 miles west of the present day Prairie Salt solution edge (FP-10.1 &10.2).

Fields are characterized by pay thickness of up to 50 feet of saccharodial, porous dolomite (see Figures FP-10.3 & 10.4). Many of the fields have the entire dolomite facies equal to the pay thickness. Porosities and permeabilities are high (10 to 18% porosity, 16-30 md, occasionally as high as 100md). Numerous potential exploration targets of this type may exist within the reservation area however, field size will probably be small (250,000 BO - 1.5 MMBO).

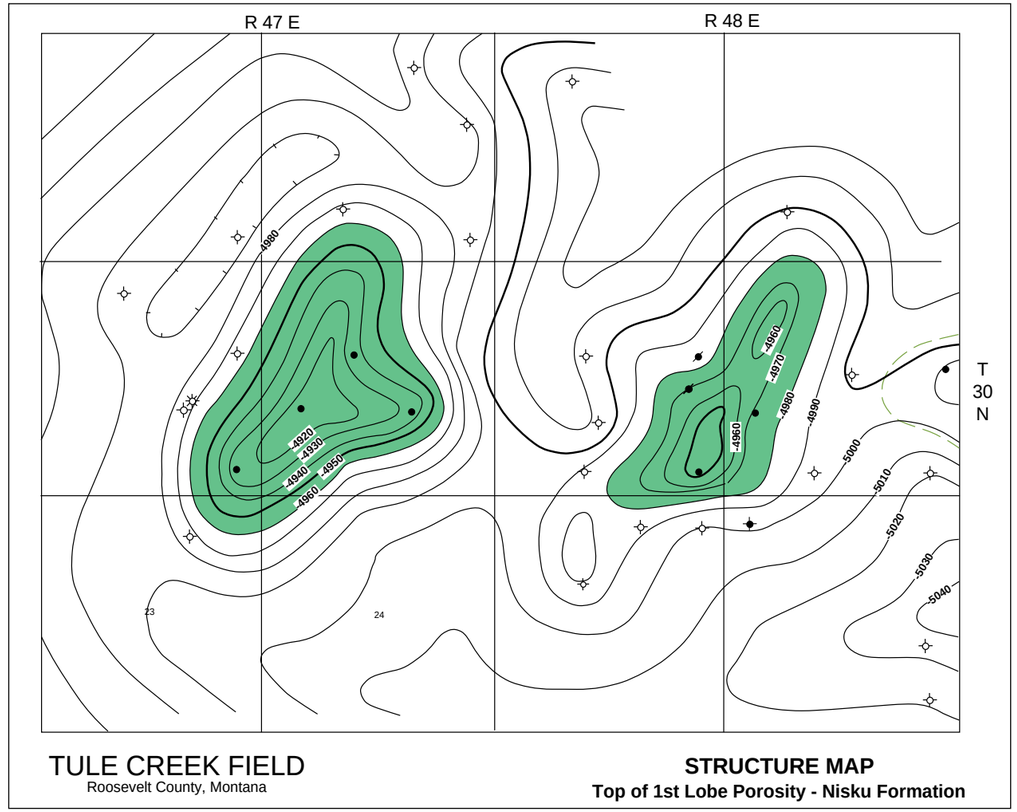


Figure FP-10.4. Tule Creek Field Structure Map, 10' contour interval.

PLAY TYPE 4

Pre-Prairie (Winnipegosis / Interlake) Play

General Characteristics- Regional carbonate units of lower Devonian and Silurian age are overlain by the Prairie Evaporite which acts as a seal rock. Typical reservoirs in the Winnipegosis are reefs or dolomitized carbonate mounds. Unconformity traps are thought to exist in the Silurian Interlake which can be dolomitized reefs or tidal deposits. Thickness of the Interlake Formation across the reservation area ranges from 200-300' (Figure FP-11.1). Production at Fort Peck has been confined to small scale structures in the northeast corner of the Reservation.

The Ordovician Red River shales are thought to be the source rocks for this play and are thermally mature within the basin center. Typical traps are gentle folds with faulting, associated with regional structure. Stratigraphic traps (either pinch-outs or porosity variations) may exist.

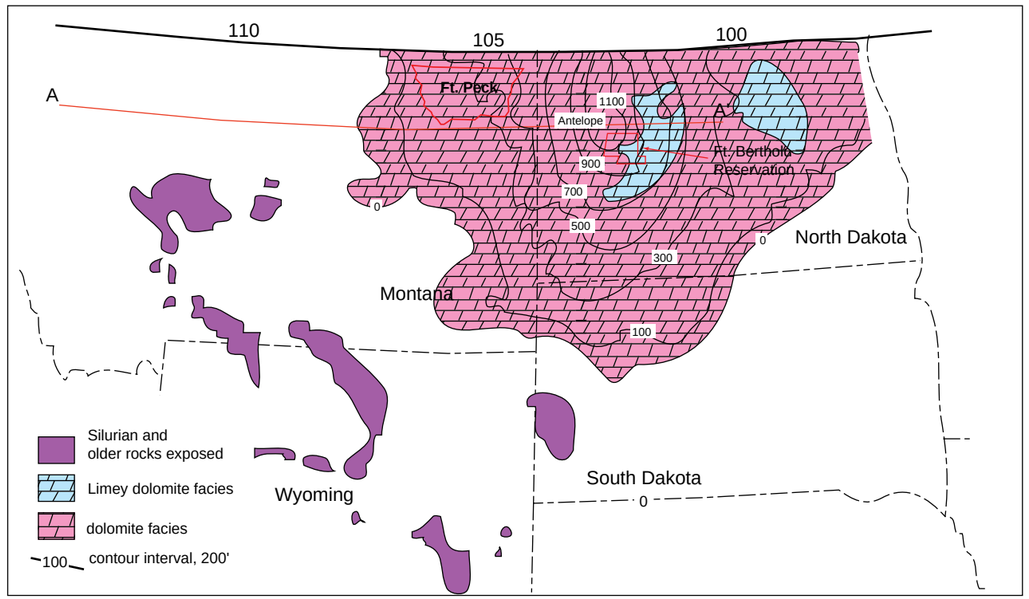


Figure FP-11.1. Thickness of Silurian Interlake Formation, facies, and location of regional cross-section A-A' (modified after Peterson, 1987).

PLAY TYPE 5

Pre-Red River Gas Play

General Characteristics- Production has been established from Ordovician (Winnipeg) and Cambrian (Deadwood) sandstones within the Williston Basin. Typically these intervals contain a diagenetic overprint which has occluded most of the primary porosity; i.e. carbonate and silica secondary cement in pore throats. However, fracture enhanced porosity or preserved primary porosity associated with overpressured source intervals may be present. Between 600-800 feet of Cambrian and Ordovician sediments may be present across the reservation area. Potential reservoir rock is primarily a quartz-arenite sandstone with thin stringers of shale, siltstone, and limestone interbedded within the interval. These units are located within the thermally mature or over mature hydrocarbon window within the basin. Both gas and condensate are produced.

Source rock for this interval is considered to be organic-rich marine shales within the Winnipeg horizon. Hydrocarbon generation probably occurred in late Cretaceous to early Tertiary time. Traps are asymmetric folds associated with basement-involved structural trends. These structures are generally highly faulted with multiple episodes of fault re-activation.

PLAY TYPE 6

Bakken Fairway Play

General Characteristics - The fractured Bakken Formation can be subdivided into three distinct rock types. The upper and lower zones are black shale with a high organic matter content. The middle zone is a relatively lean organic shale/siltstone. U.S.G.S. analyses of the Bakken indicates that 11.5-12.1 weight percent of the shale is organic carbon. Evidence suggests that the Bakken has generated hundreds of million barrels of oil (some suggest close to 1 billion) but production/migration from the interval is problematic. Production within the Bakken must be concentrated in intervals where fractures (original or induced) can remain open to fluid flow.

Bakken, where it exists, is thermally mature (see Fig. FP-11.2). It forms a continuously sourced, self-sealed reservoir. Production is controlled by fractures; matrix porosity and permeability are low. Different fairways are assumed to exist. The areas with the highest potential have elevated thermal maturity, proximity to subcrop, close fracture spacing and proximity to basin flexure hinge lines. Vitrinite reflectance should be greater than 0.9-1.02.

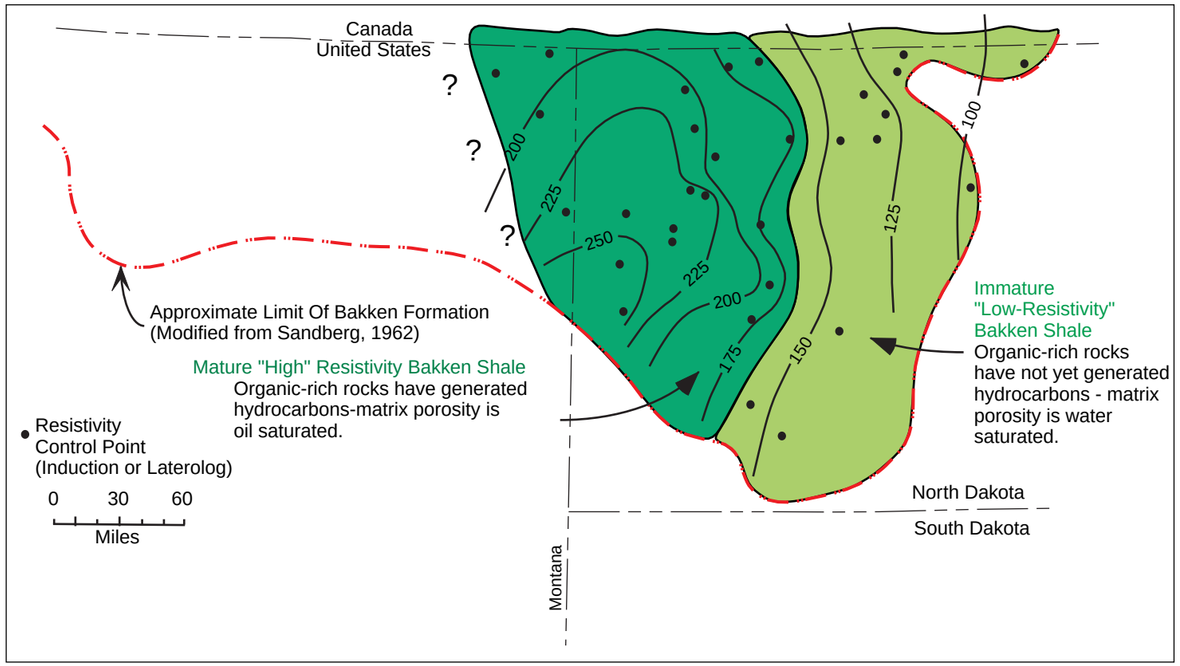


Figure FP-11.2 - Areas of 'high' and 'low' electrical resistivity in Bakken shales, with subsurface isotherm contours (degrees) and interpreted area of source-rock maturity (after F. Meissner, 1987).

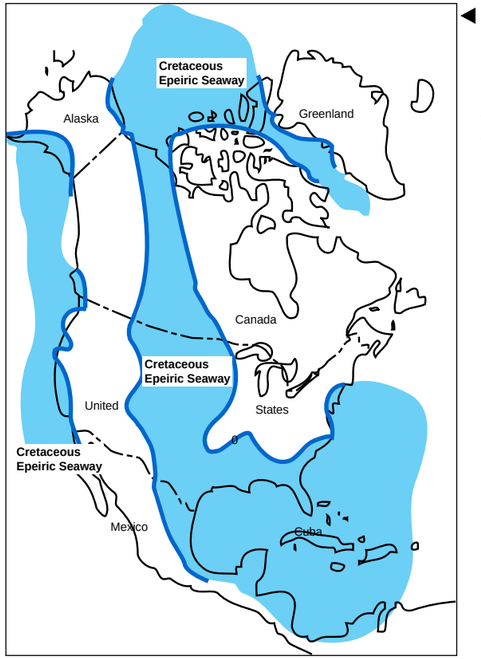


Figure FP-12.1. Paleogeographic map of North America during Late Cretaceous time, showing the Cretaceous seaway (after Rice and Shurr, 1980).

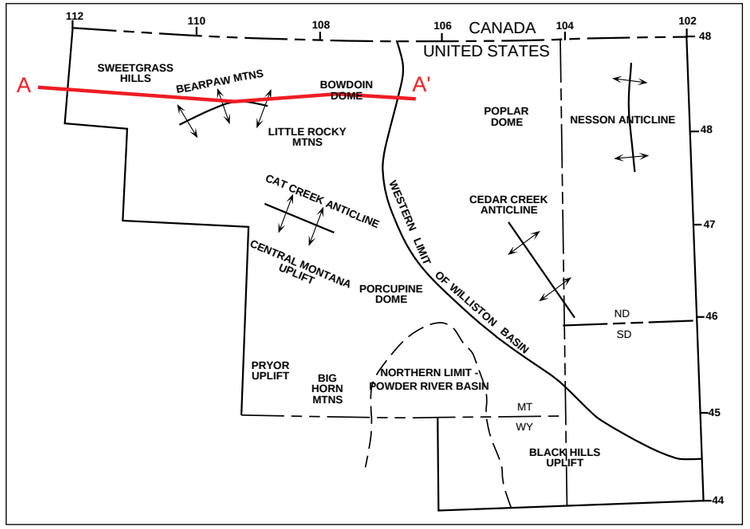


Figure FP-12.2. Major structural elements of the area, showing location of cross-section A-A' (after Rice and Shurr, 1980).

PLAY TYPE 7

Cretaceous Sands-Biogenic Gas (Muddy, Judith River, Eagle)

General Characteristics - Upper Cretaceous sandstones produce west of the Fort Peck Reservation at Bowdoin Dome. Studies by Rice and Shurr (1980) indicate that nearshore and barrier island sandstone deposits exist within the Cretaceous section in the reservation boundaries (Figures FP 12.1 and 12.3). Shallow late Cretaceous and early Tertiary organic-rich shales may provide the source of biogenic gas; especially in the central/western portion of the reservation. Source quality and thickness is unknown, however, the kerogen is a mixture of algal and terrestrially derived material.

Numerous gas shows have been recorded in over a dozen wells on the Fort Peck Reservation (Table FP 12.1). It is unclear whether the shows are all biogenic or a mixture of biogenic/thermogenic gases. Regional structure plays an important role in providing migration conduits but also in creating favorable trapping mechanisms. Presence of sealing horizons are problematic and probably transient with respect to trapping/accumulating gas. Additional exploration data needs to be acquired to address the source and seal issues.

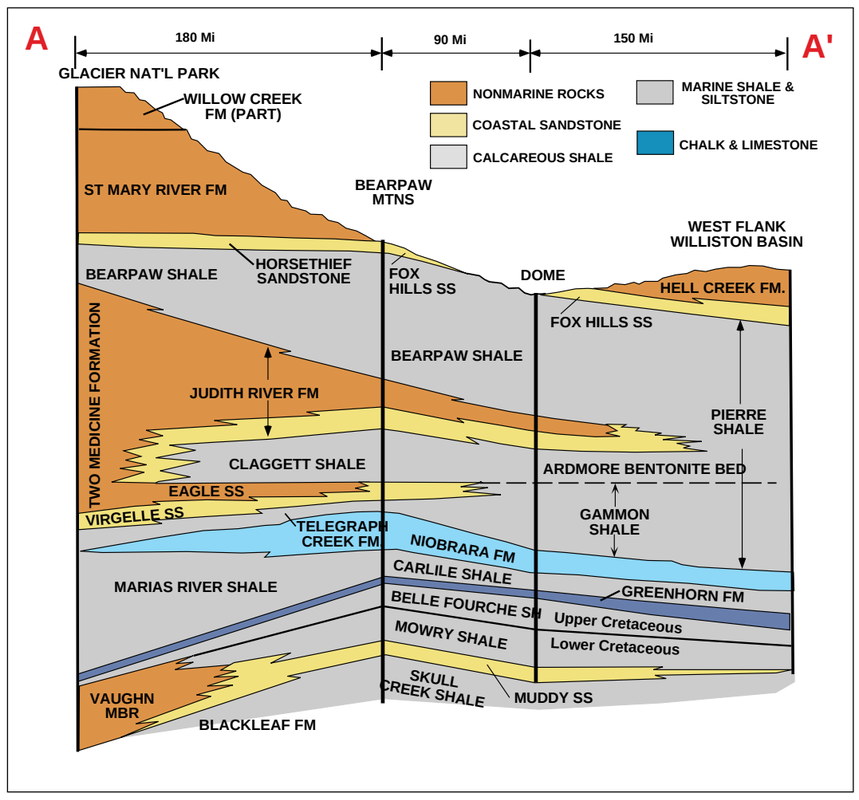


Figure FP-12.3. Diagrammatic sequence of selected Cretaceous Rocks from Glacier National Park to the west flank of the Williston Basin, Montana (after Rice and Shurr, 1980).

Table FP-12.1: **Cretaceous Gas Shows, Fort Peck Reservation**

Well Name	Location	Kjr	Kea	Knb	Kgh	Kmw	Kmd	Kd	Source
BEST WELLS									
W.P. Tribal 1	8-29-49		x	x	x	x	x		GL
Probe Tribal 1	16-31-48	x	x	x	x	x	x		GL
Chaske 42-32	32-30-50	x	x	x	x	x			GL
Franz 1	30-31-45	x	x	x	x				GL
Tweten 1-19	19-31-44	x	x	x	x	x			GL,R
Tovas 21-34	34-30-47	x	x	x	x				GL
Treasure St. Farms	31-32-46	x	x		x				GL
EPU WELLS									
Shows	28,29-50,51	15	1						C
EPU 10 G	30-29-51	x							PT-630
EPU 5 G	29-29-51	x							PT-650
EPU 4 G	33-29-51	x							PT-180
OTHER WELLS									
Multiple Shows	Reservation	3	2	2	1	2	1	1	GL,S
Judith River	Reservation	11							C,DST,S
Multiple Shows	Near Reserv.	3	4	4	4				GL
Total Shows		**42**	**16**	**12**	**12**	**6**	**2**	**1**	

GL=Gas Log, R=Geologist, C=Completion Report, PT=Production IP mcfgpd
DST=Drill Stem Test, S=Sample Log, Kjr=Judith River, Kea=Eagle, Knb=Niobrara, Kgh=Greenhorn, Kmw=Mowry, Kmd=Muddy, Kd=Dakota

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