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 33N, from the east side of Range 39E to the east side of Range 55E.

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.

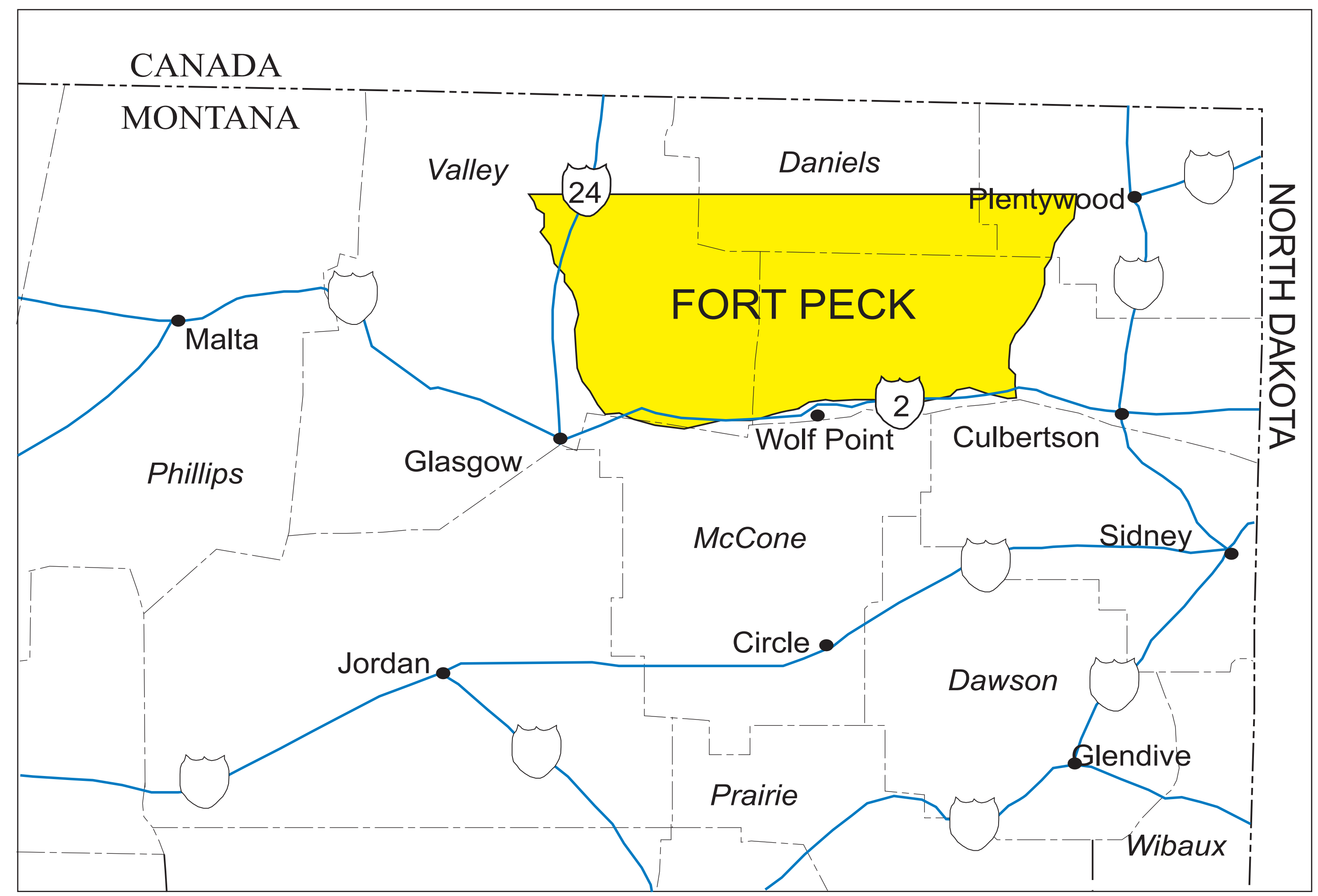


Figure 1.....

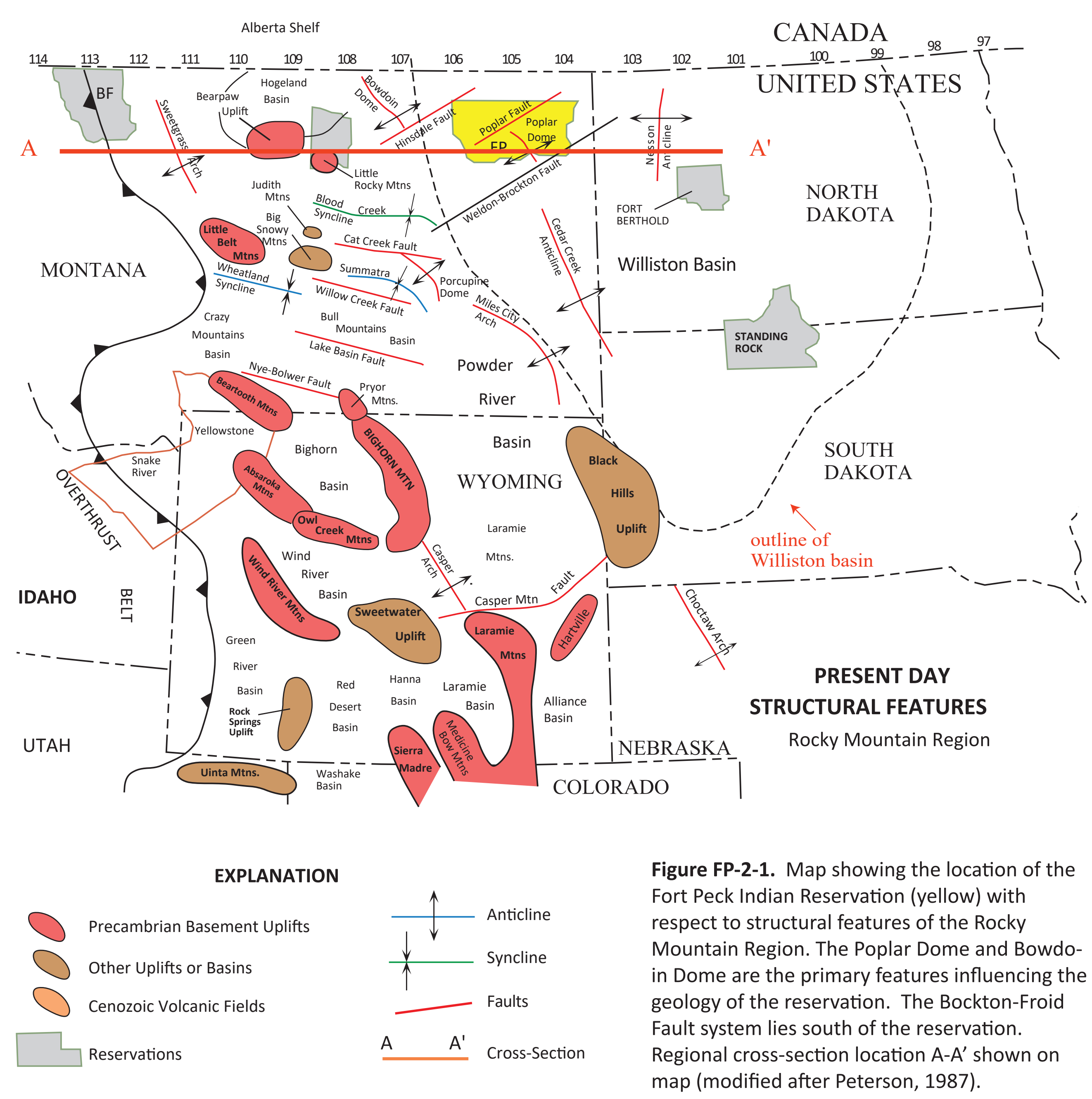


Figure FP-2-1. Map showing the location of the Fort Peck Indian Reservation (yellow) with respect to structural features of the Rocky Mountain Region. The Poplar Dome and Bowdoin Dome are the primary features influencing the geology of the reservation. The Bockton-Froid Fault system lies south of the reservation. Regional cross-section location A-A' shown on map (modified after Peterson, 1987).

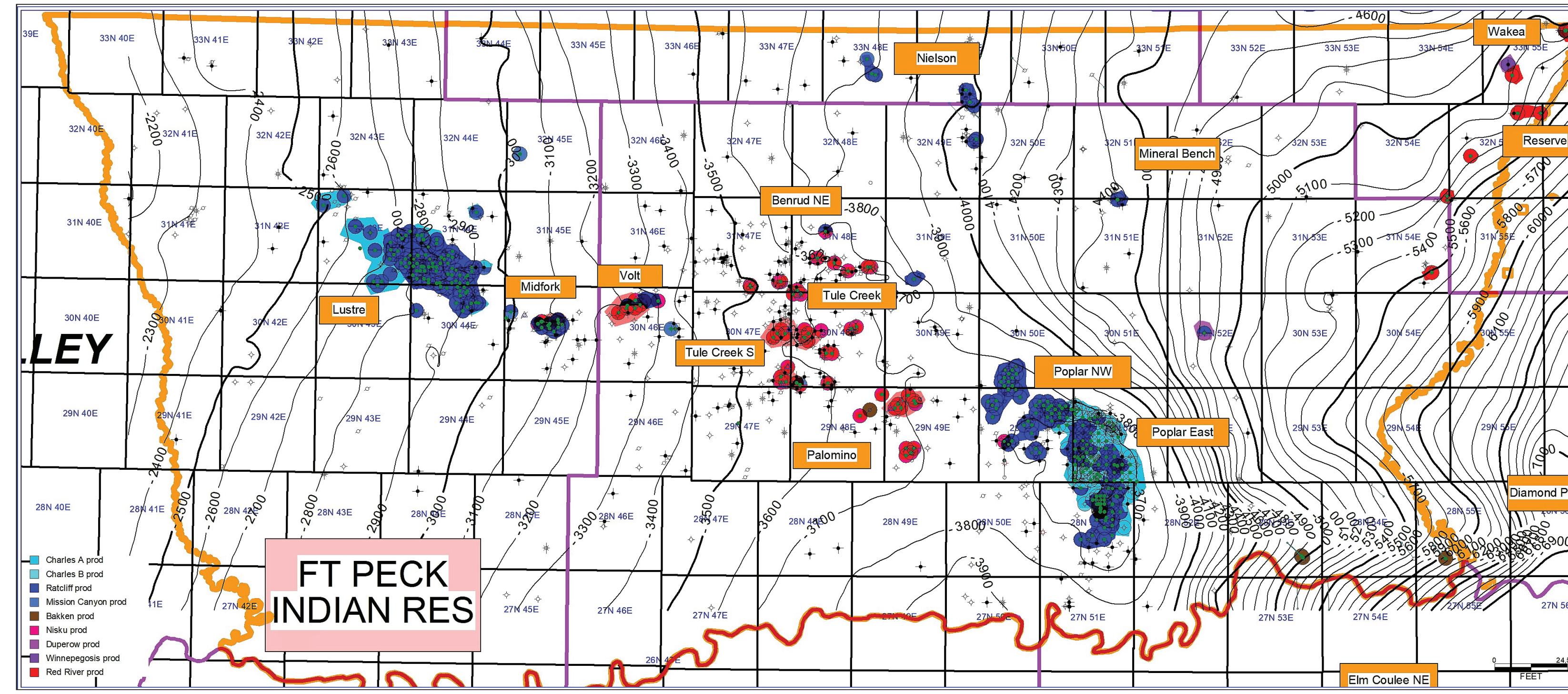


Figure FP-2.2 Regional structure map of the Greenhorn Formation with producing formations for fields and for individual wells (IHS Energy Data 2018) color-coded according to the legend. Field and/or wells producing from more than one formation are shown in multiple colors. Field outlines illustrate trends for a given formation, while well data provide production details and additional potential.

REGIONAL GEOLOGY

The Fort Peck Reservation is situated on the western flank of the Williston Basin (Figure 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 sabkha 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 north-west trending Poplar Dome (see Figure 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 or Near Reservation Area

1. Upper Cretaceous (Judith River, Claggett, Eagle SS, Virgelle)
2. Niobrara (Niobrara shale, Cody, Carlile, Greenhorn, Belle Fourche)
3. Lower Cretaceous (Dakota, Muddy, Kootenai, Lakota, Fuson)
4. Mississippian (Tyler, Charles, Ratcliffe, Mission Canyon, Lodgepole)
5. Bakken /Three Forks
6. Nisku/Duperow (Nisku, Duperow, Souris River)
7. Middle Devonian (Dawson Bay, Winnepegosis, Ashern)
8. Red River (Interlake, Gunton, Stony Mtn, Red River, Winnepeg, Deadwood)

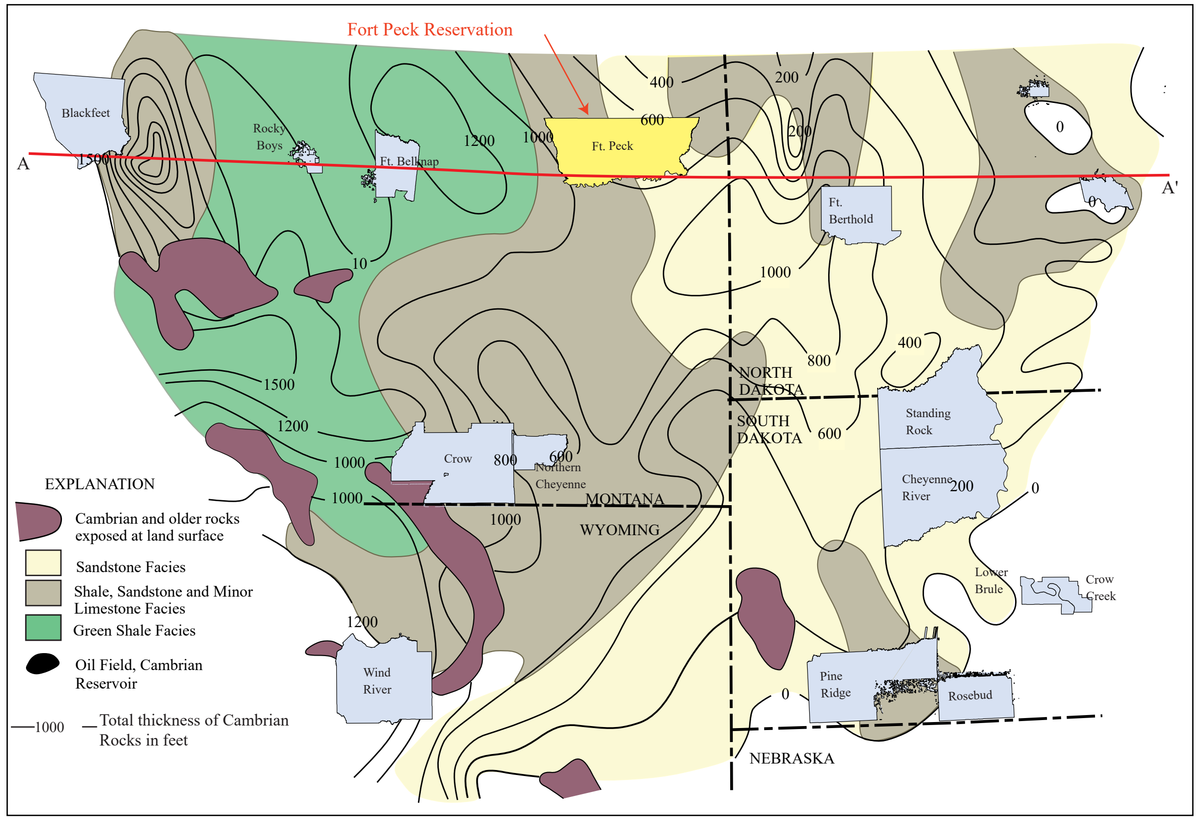


Figure FP-3.1. Thickness of Deadwood and equivalent rocks. Blackfeet Reservation, location of analog fields and location of regional cross-section A-A" (modified after Peterson, 1987).

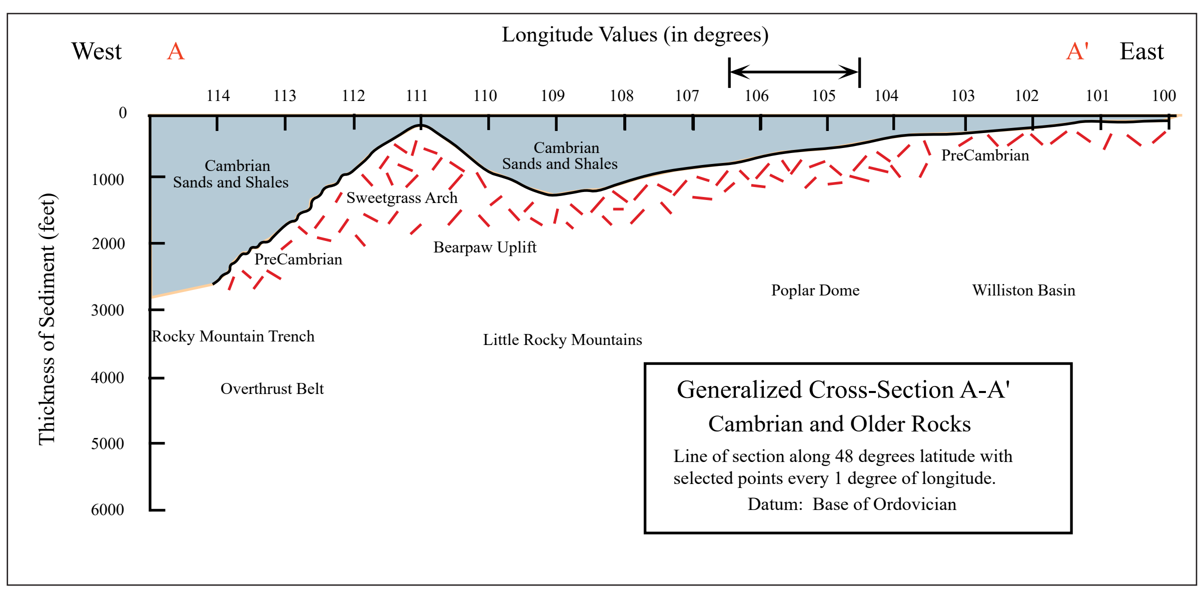


Figure FP-3.3. Generalized paleostructural cross-section' showing Cambrian and older rocks. Line of section along A-A'.

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.

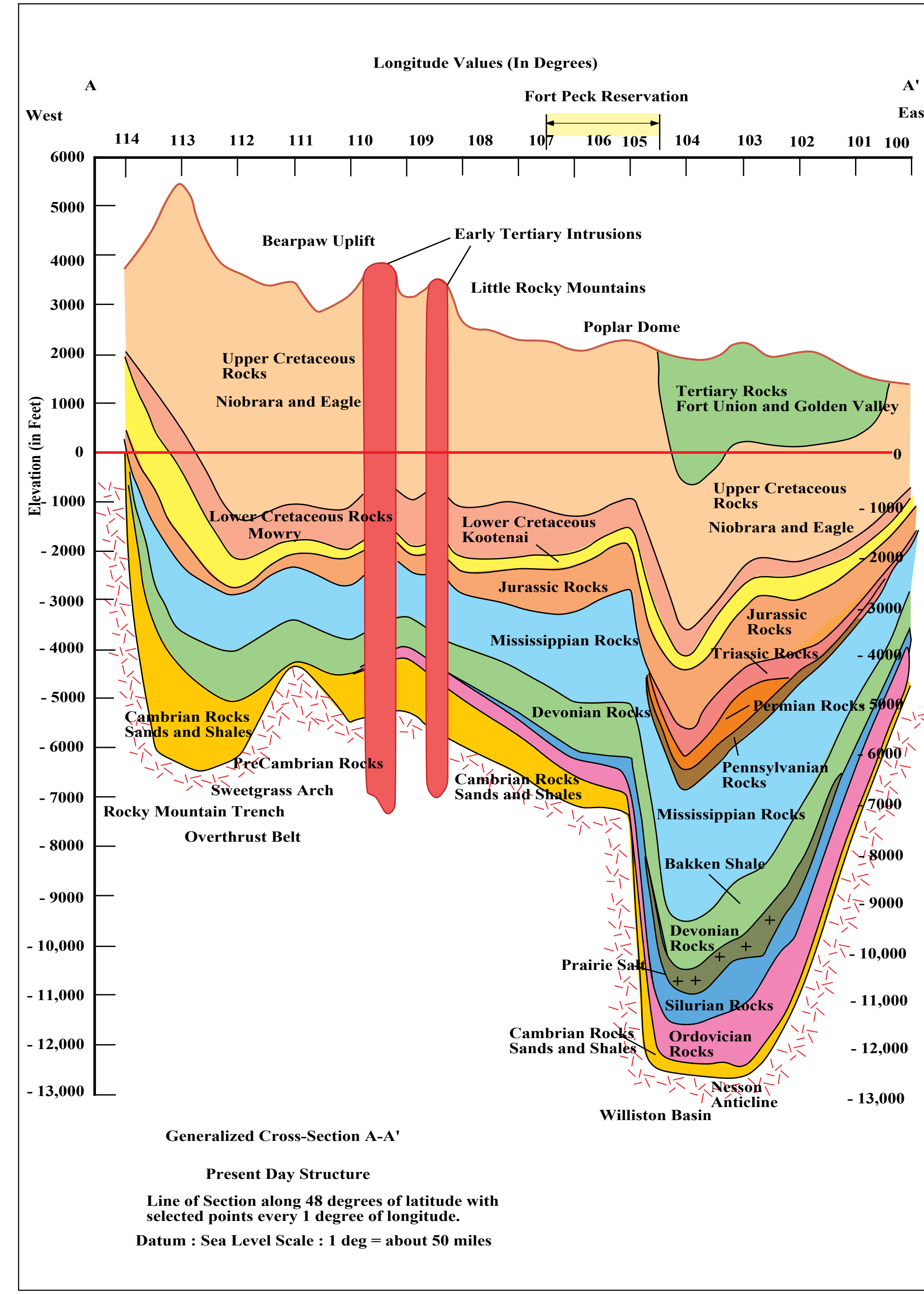


Figure FP-3.2. Generalized cross-section A-A', showing present day structure. The location of the Fort Peck Reservation is shown in yellow along the upper footage scale (from BIA Atlas, 1997).

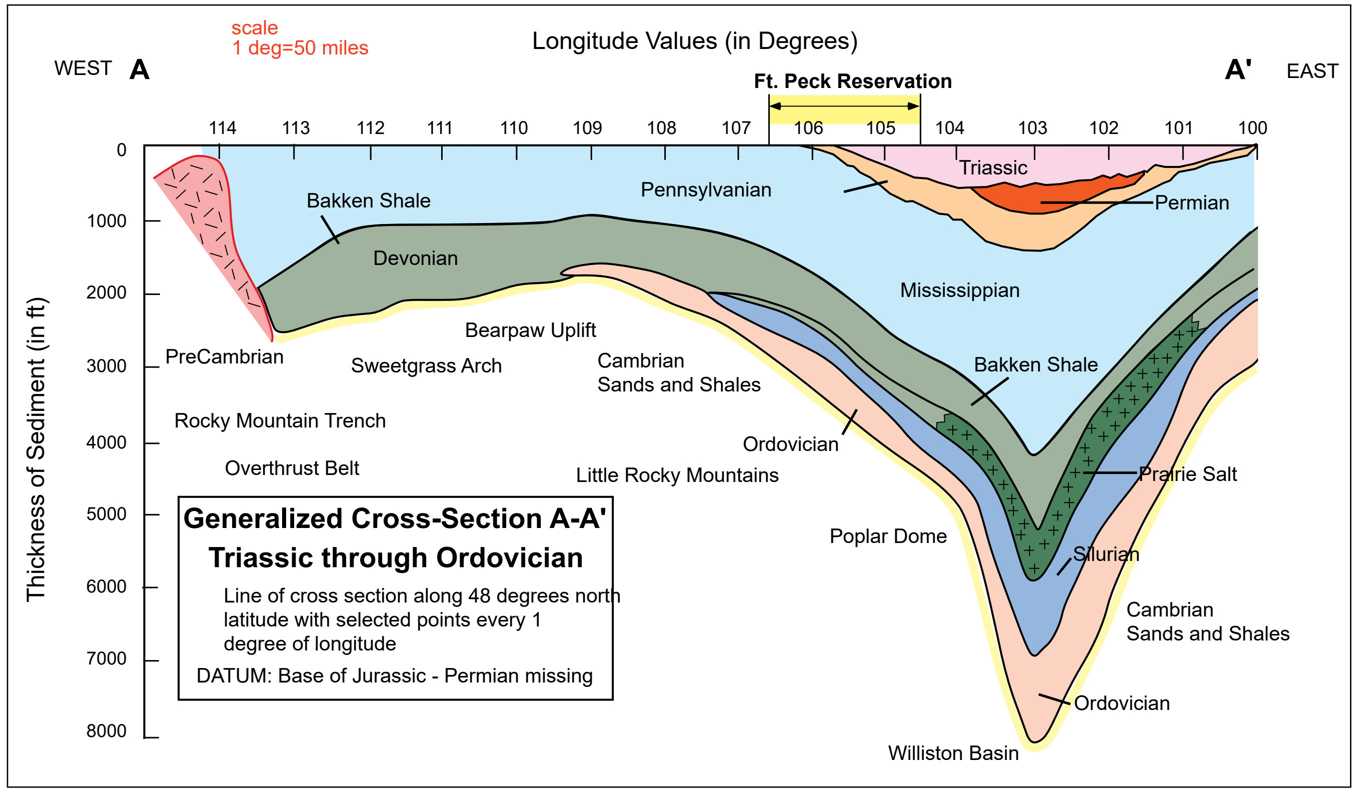


FIGURE FP-4.1. Generalized paleo-structure cross-section. Line of section along 48 degrees of latitude with selected points every 1 degree of longitude. For location of A-A', refer to Figs. FP-3.1 and FP-4.1 (modified after O'Melveny, 1997).

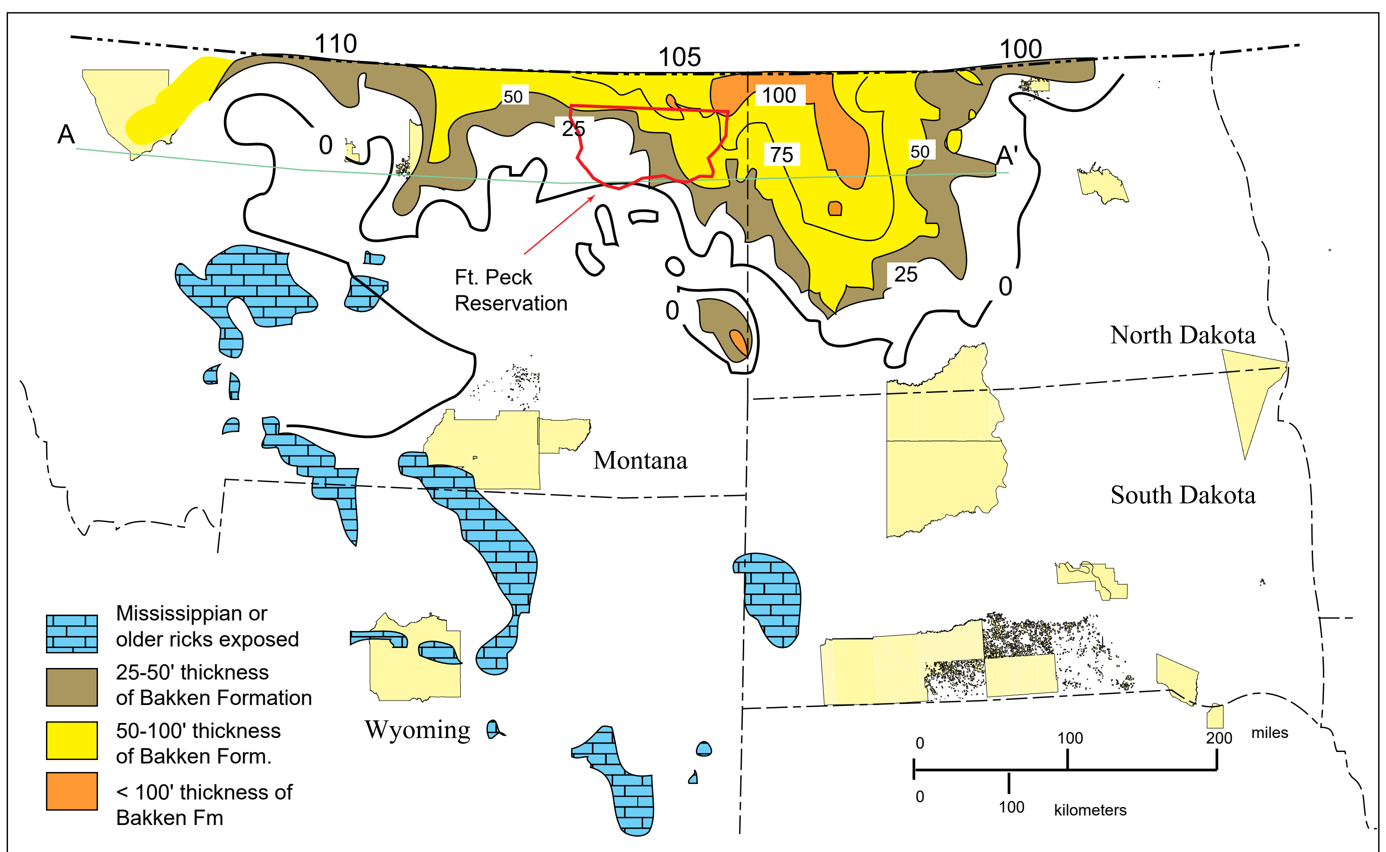


FIGURE FP-4.2. Map showing thickness of Bakken Formation, location of reservation, and location of regional cross-section A-A' (modified after Peterson, 1987).

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 and 4.3). 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 6, 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. 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 thick 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.

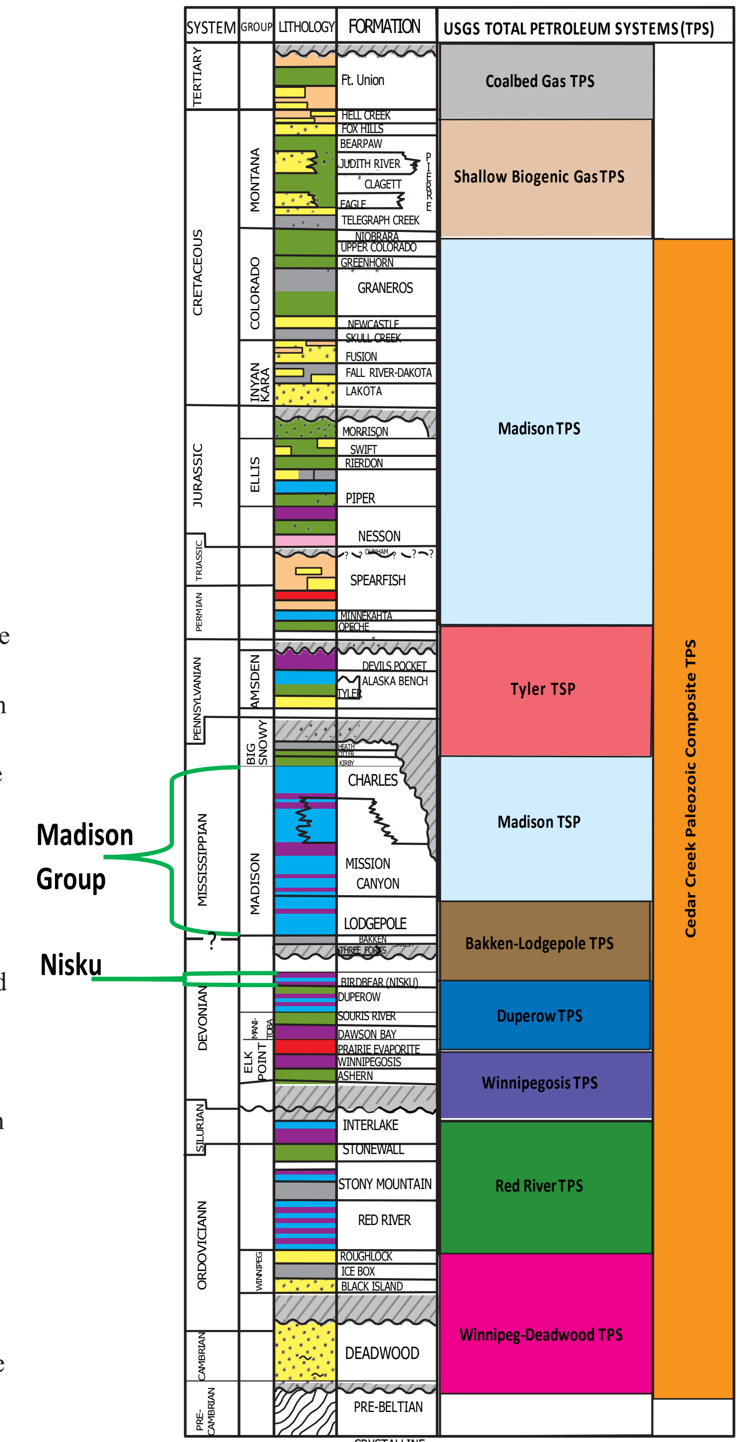


FIGURE FF 4-3. Generalized stratigraphic column for the Williston Basin. Total petroleum systems (TPS) defined by the U.S.G. S. are designated to the right. Waved lines indicated unconrormities. *(modified from Pollastro et al. 2010)*

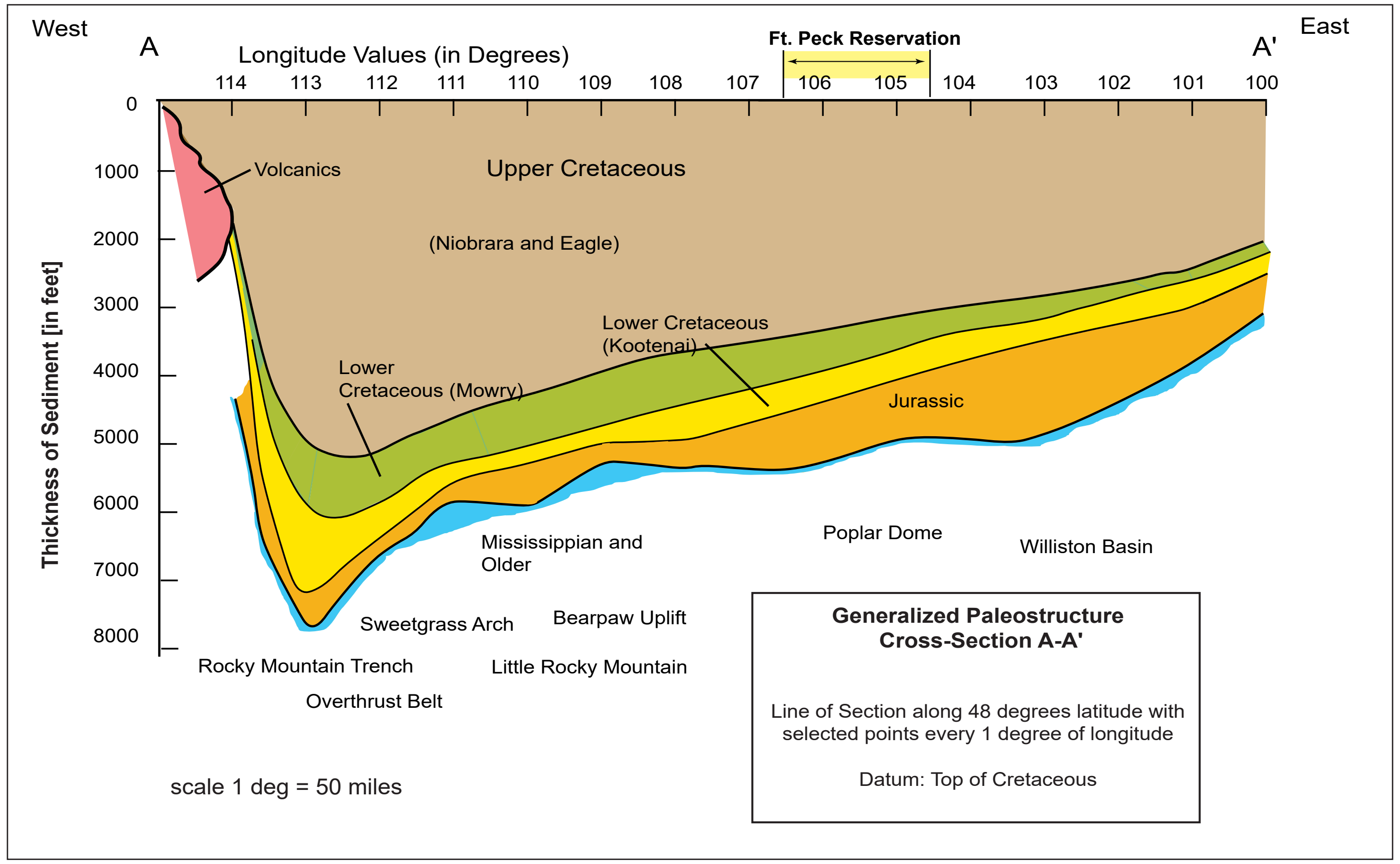


FIGURE FP-5.1. Generalized paleostructure cross-section A-A', Jurassic to Cretaceous (modified after O'Melveny, 1997).

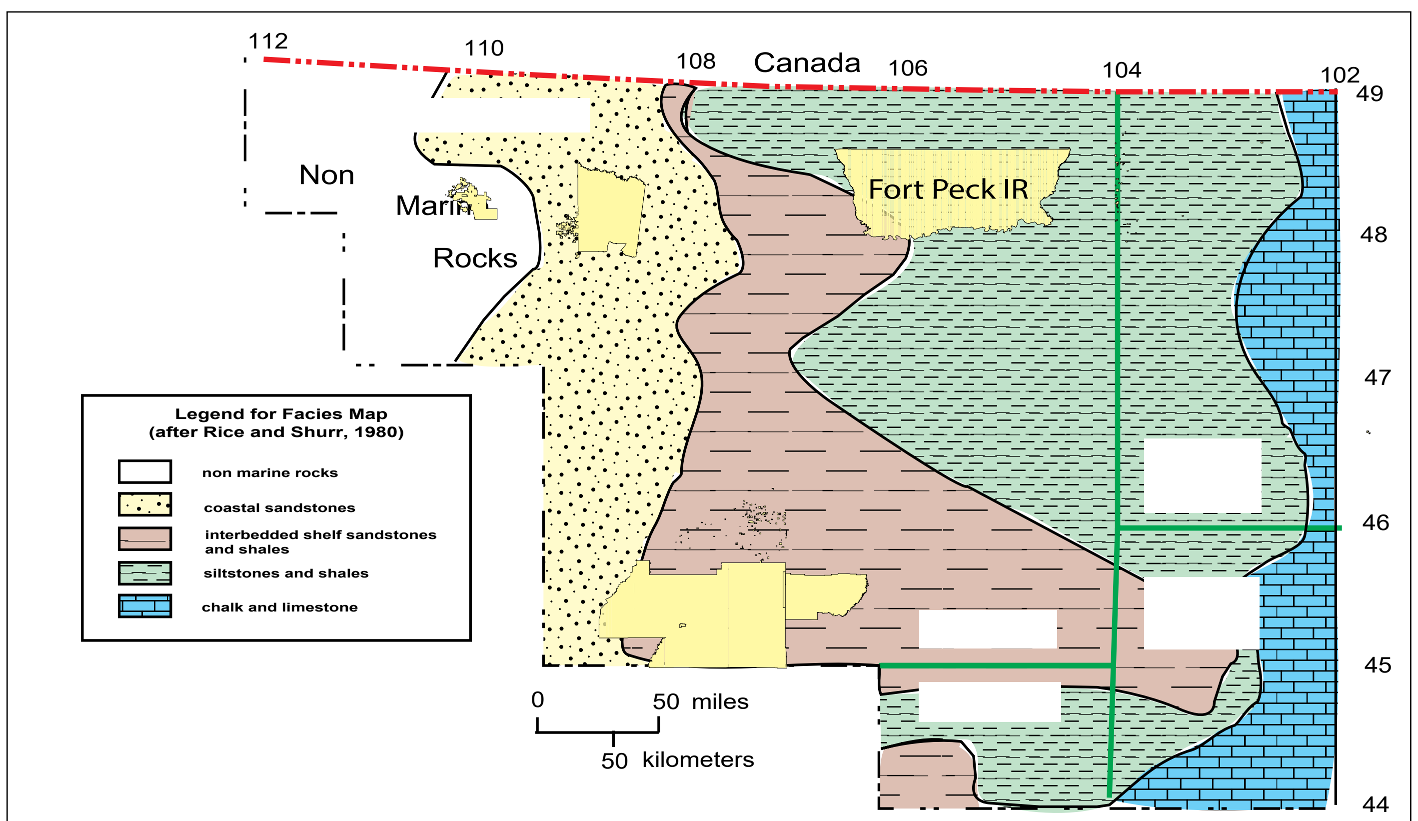


FIGURE FP-5.2. Regional distribution of diagenetic and petrophysical facies of the Niobrara.

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 (Figure 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 Figure 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 (Figure FP-5.2). Extensive Greenhorn / Niobrara chalks were deposited in the Williston Basin and southeast into South Dakota, Nebraska and Colorado (Figure FP 5.3). 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 existed 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 existed 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.

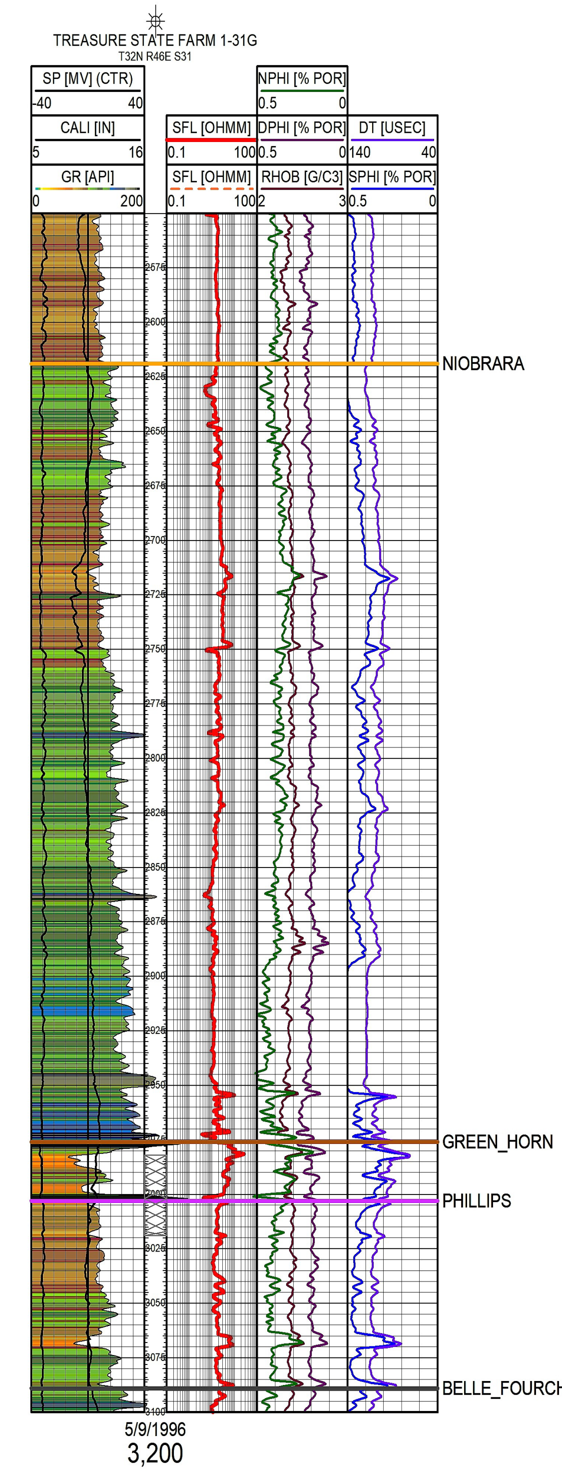


FIGURE FP-5.3. Niobrara type log for Fort Peck Indian Reservation.

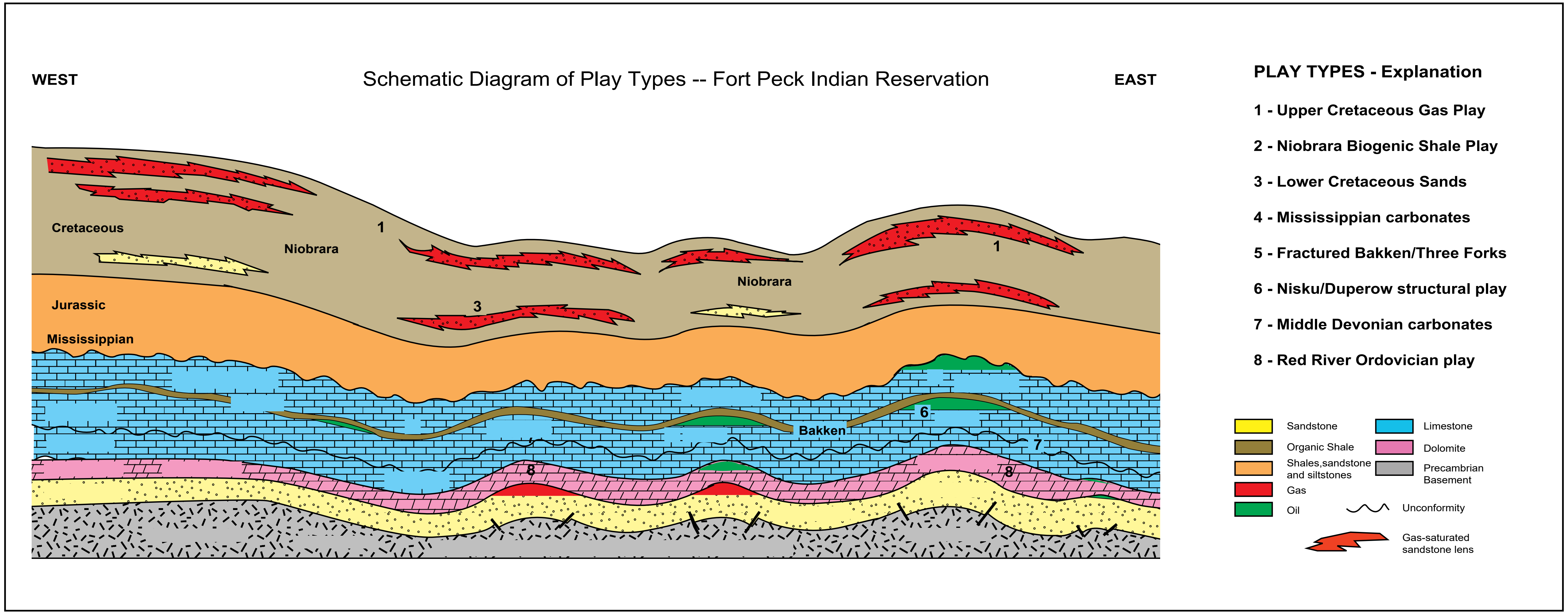


FIGURE FP-6.1. Schematic diagram of play types within the Fort Peck Reservation. No scale implied, thickness of stratigraphic section and size of traps only shown in a relative sense.

Reservation:	Fort Peck	Total Production (by Play Type)	Williston Basin
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

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	Description of Play	Oil or Gas	Formations	Cum Oil [bbls]	Cum Gas [mmcf]	Cum Water [bbls]	Basin	Known Accumulations	Drilling depths	Favorable factors	Unfavorable factors
Upper Cretaceous gas 1	Only production to date is Cedar Creek Anticline and Bowdoin Dome These fields are from Eagle and Judith River sands	NGL and Low BTU gas	Judith River Claggett Eagle Virgelle	0 0 13,413 0	6,383,867 61,345 843,672,664 790,601	216 0 10,268,322 24,068	 Sweetgrass Arc Bearpaw-Little Rocky uplift and Hogeland Basin Bearpaw-Little Rocky uplift and Hogeland Basin	Large shallow accumulations in the Tiger Ridge and other fields on the Bowdoin Dome. These fields produce gas from Eagle and Judith River sands. No production within the reservation.	500-4,000 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 test data
Niobrara biogenic gas 2	Niobrara Limestone and other shallow reservoirs self-sourced; Porosity decreases with increasing depth. Large accumulations possible.	Gas Biogenic Gas	Niobrara Cody Carlile Greenhorn Belle Fourche Mowry	0 0 0 3,564 0	6,366,745 0 0 81,053,347 395,909	72,482 0 0 576,918 11,846	Bowdoin Dome (West of Rez) Bowdoin Dome (West of Rez) Bowdoin Dome (West of Rez)	Large shallow biogenic gas accumulations to the west. No production within the reservation.	1500-4,000 ft.	1) large volume play 2) shallow drilling depths 3) unconventional resource	1) probable gas play only 2) probable thermally immature 3) lack of production near reservation
Lower Cretaceous gas sands 3	Sand / shale sequences. Fluvial and nearshore blanket sands. Large, faulted structures	Gas NGL	Dakota Muddy Kootenai Lakota Fuson Bow Island Blackleaf Fall River Cutbank	46,458 95,680,632 0 51,567 0	7,992,945 134,721,378 1,250,839 7,601,437 0	5,488 570,976,770 0 149,222 0	Sweetgrass Arc Miles City Arch and Powder River Basin Sweetgrass Arc Big Horn Basin and Big Coulee-Hailstone Dome	Very spotty production surrounding the reservation. Good oil and gas production farther west in the Cutbank Field.	2000-4,500 ft.	1) good potential reserves 2) generally found on structure 3) oil & gas shows on reservation	1) lack of significant production in the region 2) play may be small 3) traps probably stratigraphic in nature

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

Reservation:	**Fort Peck**	**Total Production (by Reservation)**	**Fort Peck Indian Reservation**
Geologic Province:	**North Central Montana, Sweetgrass Arch, Montana Disturbed Belt**	**Oil:**	**440 MMBO**
Province Area:	**North Central Montana (62,500 sq. miles), Thrust Belt (41,400 sq. miles)**	**Gas:**	**1.1 TCFG**
Reservation Area:	**2385 sq. miles (1,525,712 acres)**	**NGL:**	**?**

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	Formations	Description of Play	Oil or Gas	Known Accumulations	Drilling depths	Favorable factors	Unfavorable factors
Mississippian Carbonates 4	Tyler, Charles A & B Ratcliffe, Mission Canyon, Lodgepole	Cyclic evaporite/ carbonate sequence, structure/stratigraphic updip pinchout, multiple shoreline cycles. Small, fault block structures	Both	62.0 MMBO 5.8 BCFG 337 MMBW	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
Bakken/Three Forks 5	Bakken and Three Forks	Organic rich shale; marine siltstone; fractured; Thermally mature oil shale.	Both	<15 MBO <20 MMCFG <86 MBW	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 2. formation thins In west side of reservation 3) production gets less toward reservation from Williston basin
Nisku/Duperow 6	Nisku, Duperow, Souris River	Cyclic evaporite/ carbonate sequences. Salt collapse structures. Excellent porosity and permeability	Both	27.8 MMBO 4.2 BCFG 5.7 MMBW	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 5) Nisku is prolific reservoir; one of best in Rockies	1) difficult targets to identify 2) small areal extent, may be difficult to explore for
Middle Devonian 7	Dawson Bay, Winnepegosis, Ashern	Folded structures, primary and secondary porosity in carbonates	Both	< 100 MBO < 200 MMCFG <1 MMBW For detailed production see individual play descriptions	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
Red River Group 8	Interlake, Gunton, Stony Mtn, Red River, Winnepeg, Deadwood	Cyclic evaporite / carbonate sequences; erosional surfaces. Primary and secondary porosity. Structural/ unconformity traps. Occurs as multi-pay zone with Red River	Both	1.4MMBO 875 MMCFG 570 MMBW	10,000-16,000 ft.	1) confirmed play; production exists near reservation 2) source and reservoir 3) thermally mature 4) structure detected on seismic	1) lack of deep well control 2) current production east side of reservation 3) possible small target size 4) formation is tight throughout reservation 5) Low BTU, contains N2

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

Conventional Play Types

Unconventional/Hypothetical Play Types

UPPER CRETACEOUS

The Upper Cretaceous reservoirs consist of the Mowry Shale, Belle Fourche Shale, Green Horn Shale, Hell Creek, Judith River, Claggett shale, Eagle Sandstone and Telegraph Creek (Figures FP 8.1 and 8.2). These formations were deposited as marine sandstones and shales in a large asymmetric foreland basin. Thicknesses vary from several hundred feet over the Bowdoin Dome and Sweet Grass Arch to upwards of 5000 feet in the reservation and into the deeper parts of the Williston Basin. Sandstones within this time consist of marine transgressive sands and shales deposited along a broad shelf starting with non-marine on the west and progressing to marginal marine and increasingly deeper marine clastics to the east. Lithologies consist of mostly fine to medium grained sanstone, siltstone, mudstone and shale (Condon, 2000). Production is mainly biogenic gas (Figure FP - 8.3). Ultimate recovereable gas reserves are commonly from 100 MM to several billion cu ft. per well (Figure FP - 8.4).

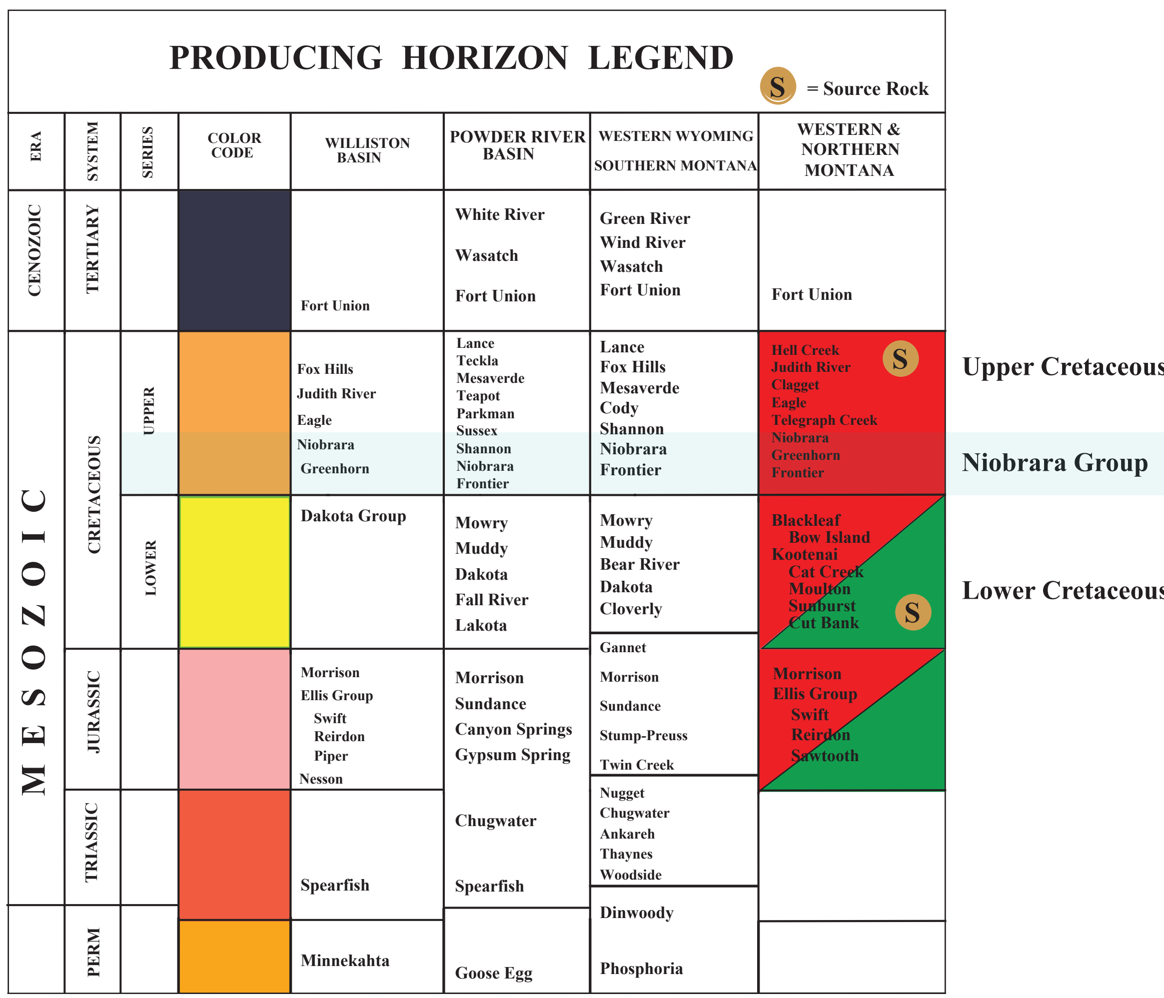


Figure FP - 8.1. Stratigraphic column with oil (green)/gas (red) producing zones.

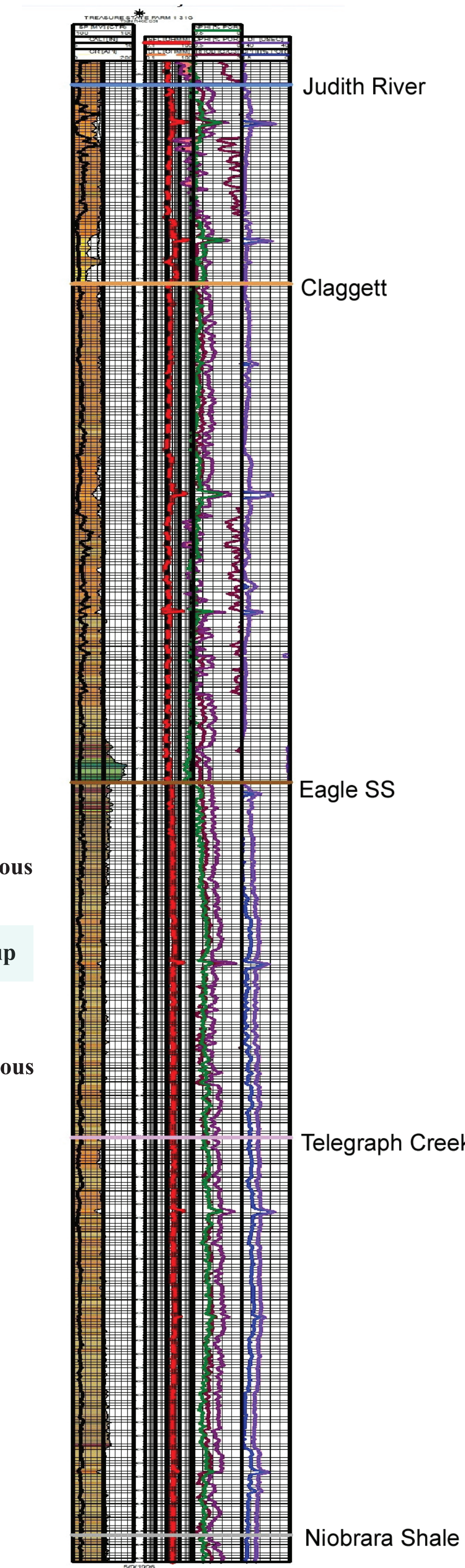


Figure FP - 8.2. Upper Cretaceous type log.

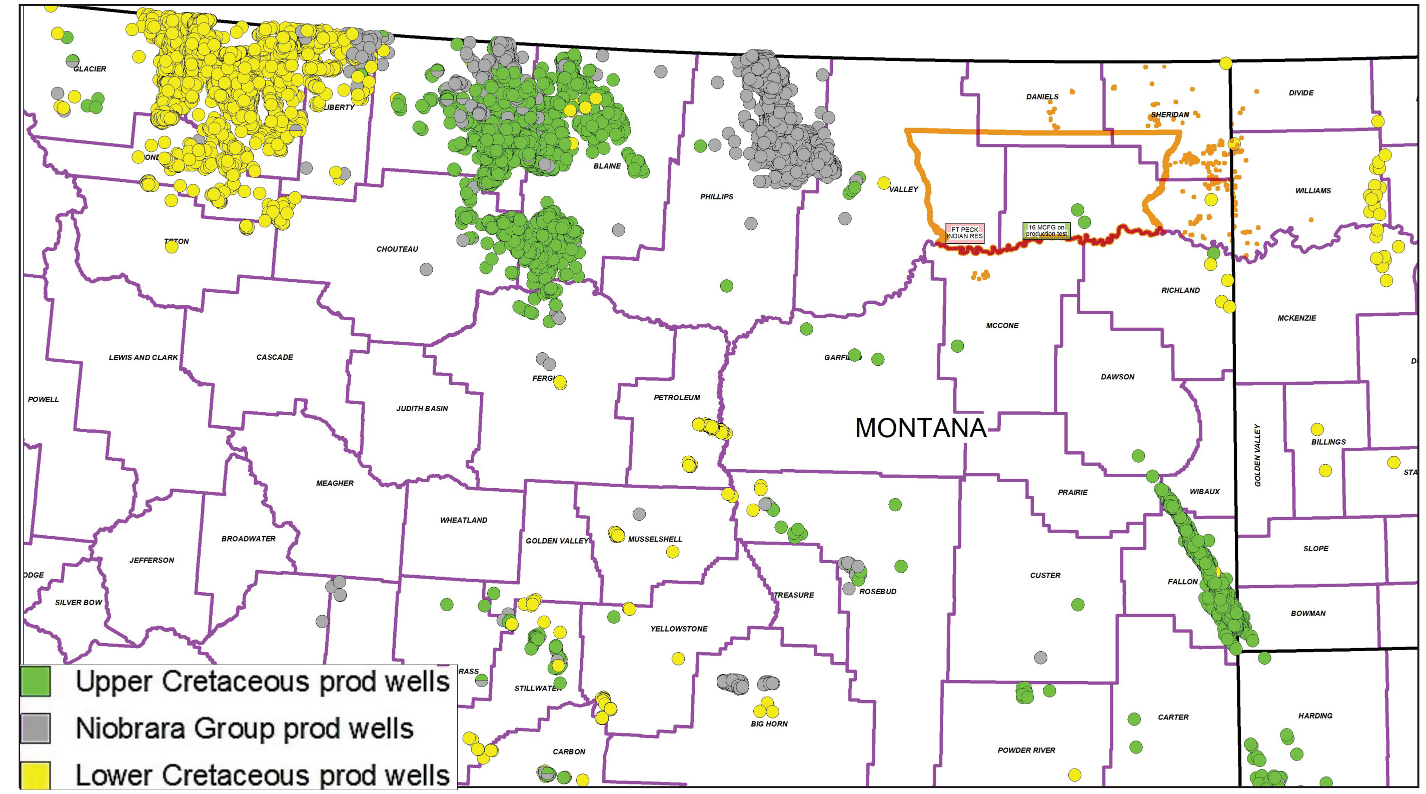


Figure FP - 8.3. Cretaceous age reservoirs production by unit.

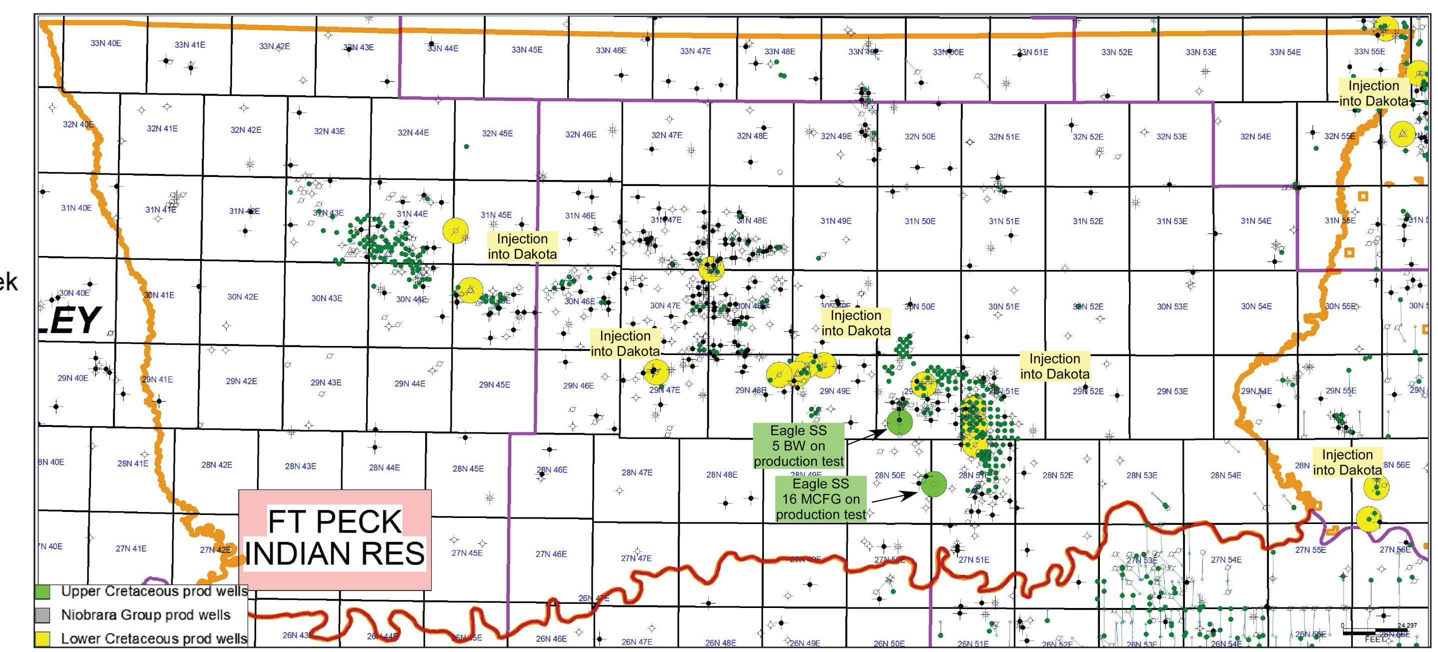


Figure FP - 8.4. Oil and gas shows or wells with water disposal in the Cretaceous.

NIOBRARA-WHITE SPECS

The Niobrara Group is composed of the Niobrara Shale (White Specs), Greenhorn Shale and Phillips Sandstone (Figures FP - 9.1 and 9.2). The Niobrara is a self sourced shale play composed of low permeability chalks, marlstones, shales and occasional sandstones (Figure FP - 9.4). Gas produced from this group is biogenic in nature (Figure FP - 9.3). Drilling depths are commonly between 300 to 500 feet in Bowdoin Field directly west of Fort Peck reservation. Further west into Sage Creek field, Niobrara production is from 1500 to 2000 feet. Wells are commonly drilled vertically and production is from the Bowdoin sandstone or Greenhorn shale as well as the Niobrara. Ultimate recoverable gas production is commonly 100 MMCF to 2 BCF.

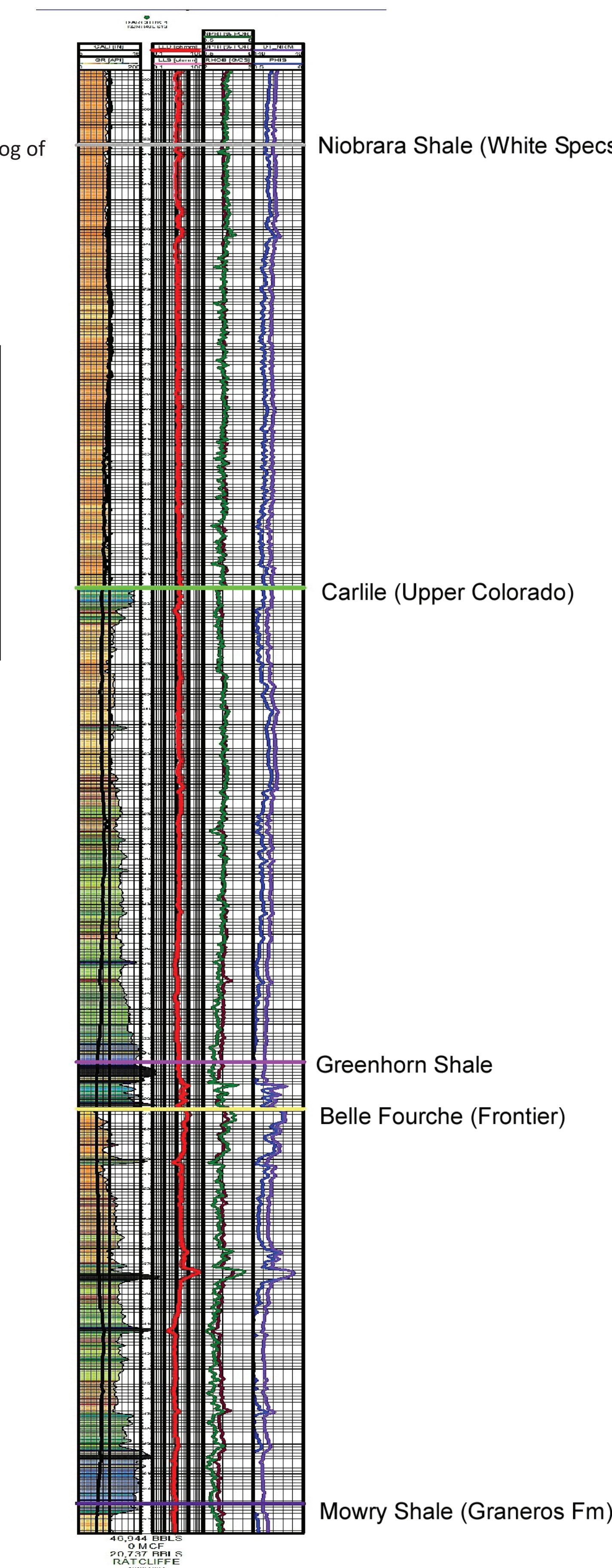
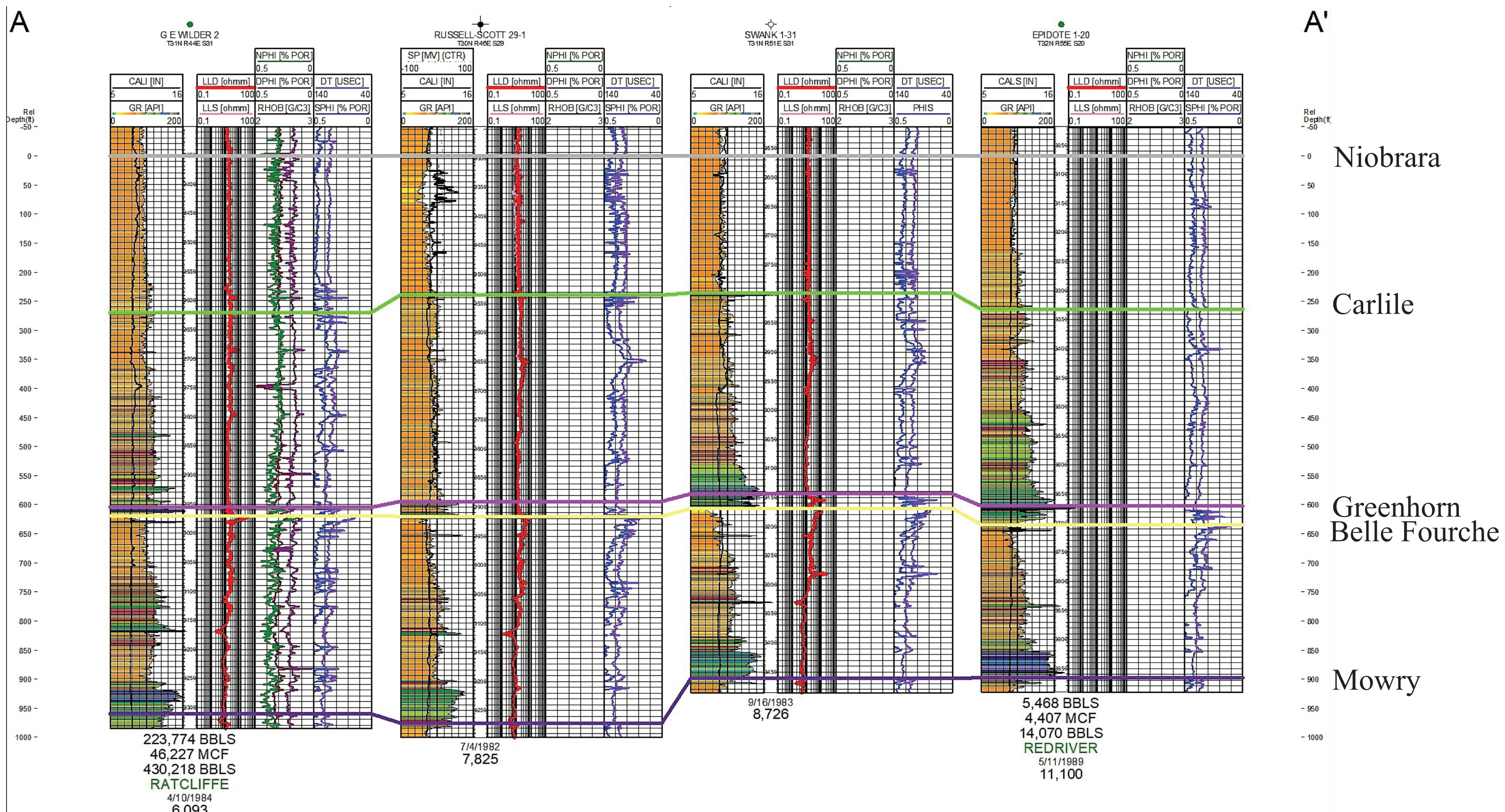


Figure FP - 9.1. Type log of the Niobrara-White Specs Group.



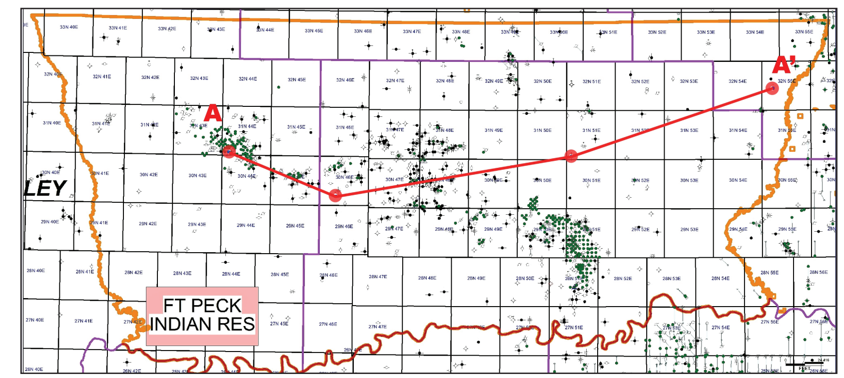


Figure FP - 9.2. Cross section across Fort Peck Indian Reservation showing the Niobrara-White Specs Group.

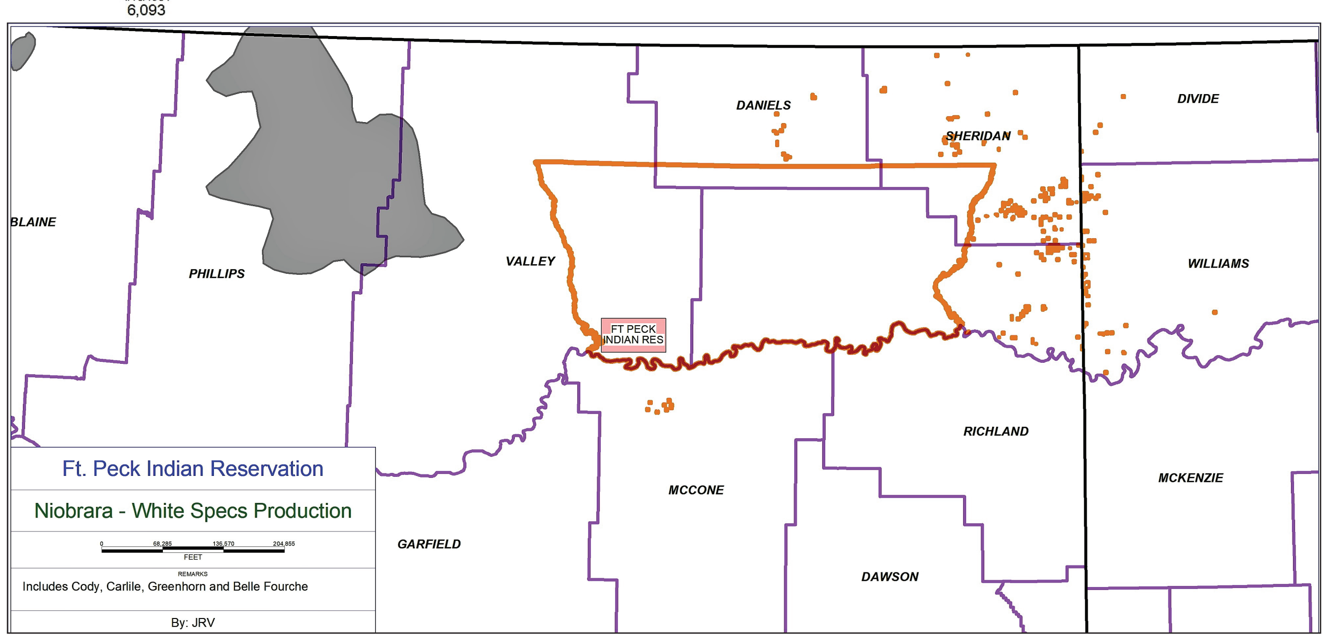


Figure FP - 9.3. Niobrara biogenic gas production in north central Montana.

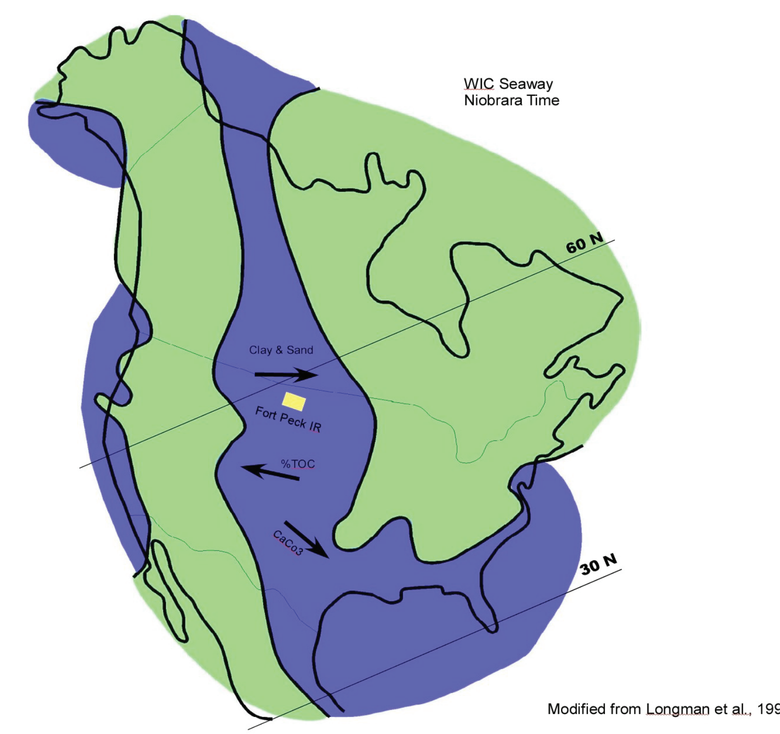
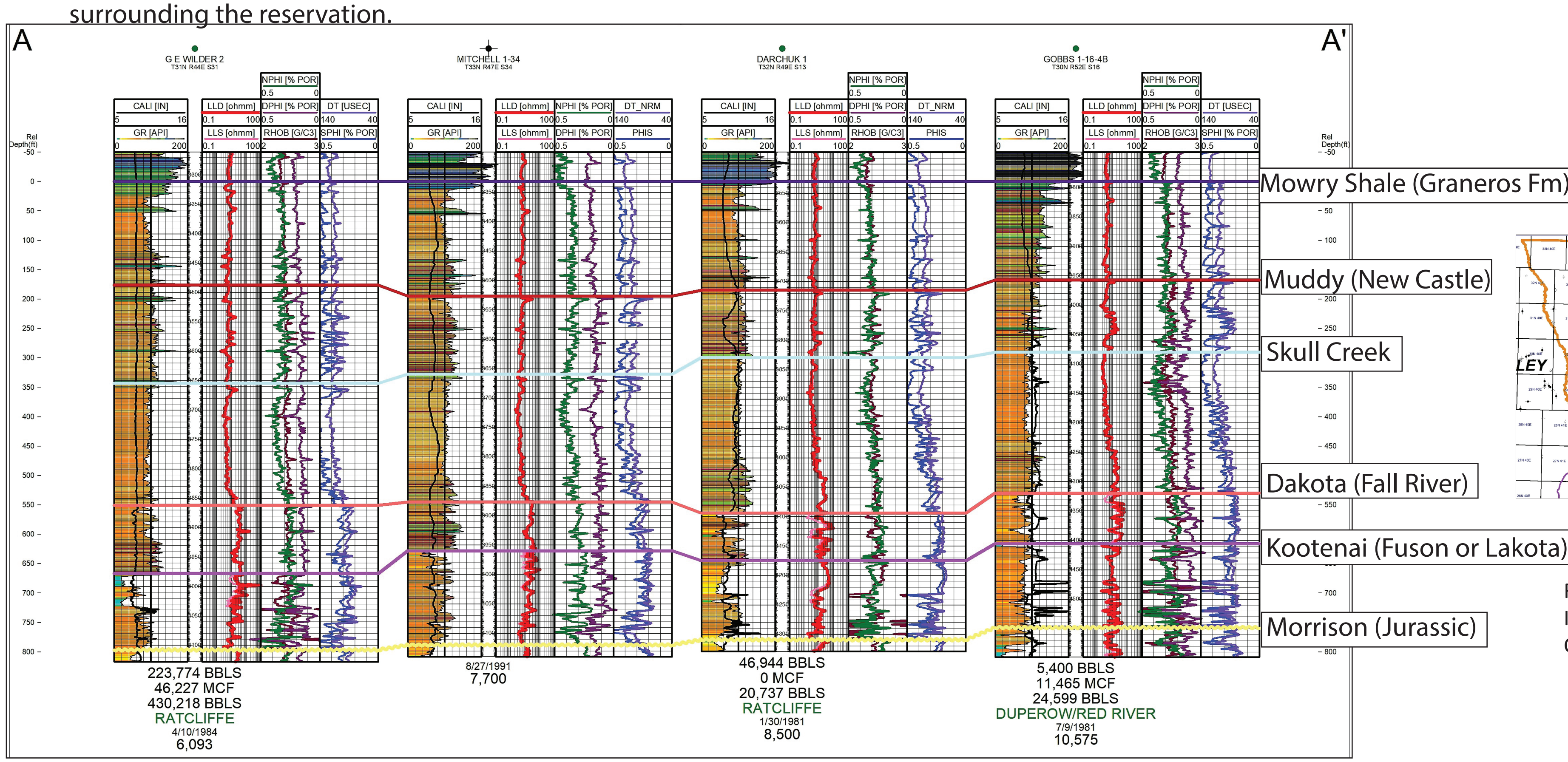


Figure FP - 9.4. Niobrara seaway during late Cretaceous time (after Longman et al 1998).

LOWER CRETACEOUS

Lower Cretaceous rocks consist of the Kootenai, Fall River Sandstone (Dakota), Skull Creek Shale, Muddy Sandstone (or equivalents), Mowry Shale, and the Shell Creek Shale (Figures FP - 10.1 and 10.2). Muddy Sandstone equivalent formations are the Viking Sanstone, Bow Island Sandstone and the Newcastle Formation. Basal units overly unconformably over the Jurassic Morrison terrestrial rocks where the Cutbank Sandstone is an important oil and gas producer to the west of the reservation. Deposition of the Lower Cretaceous occured as non-marine conglomerate and fluvial/lacustrine clastics to marine transgressive and regressive sequences related to sea level rise and fall. The Muddy is an important oil and gas producer in the Powder River Basin and Miles City Arch (Figure FP - 10.3). Dakota sandstones are used mainly for water disposal within and surrounding the reservation.



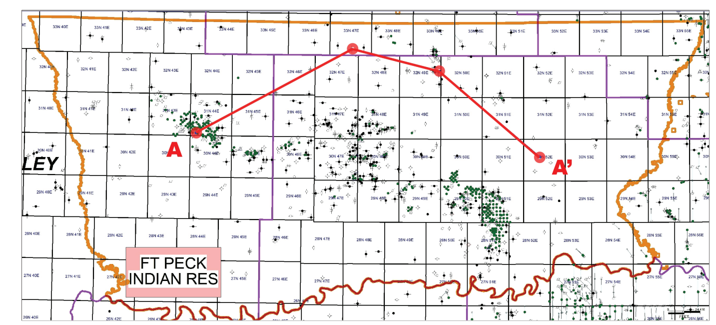


Figure FP - 10.2. Cross section across Fort Peck Indian Reservation showing the Lower Cretaceous Group.

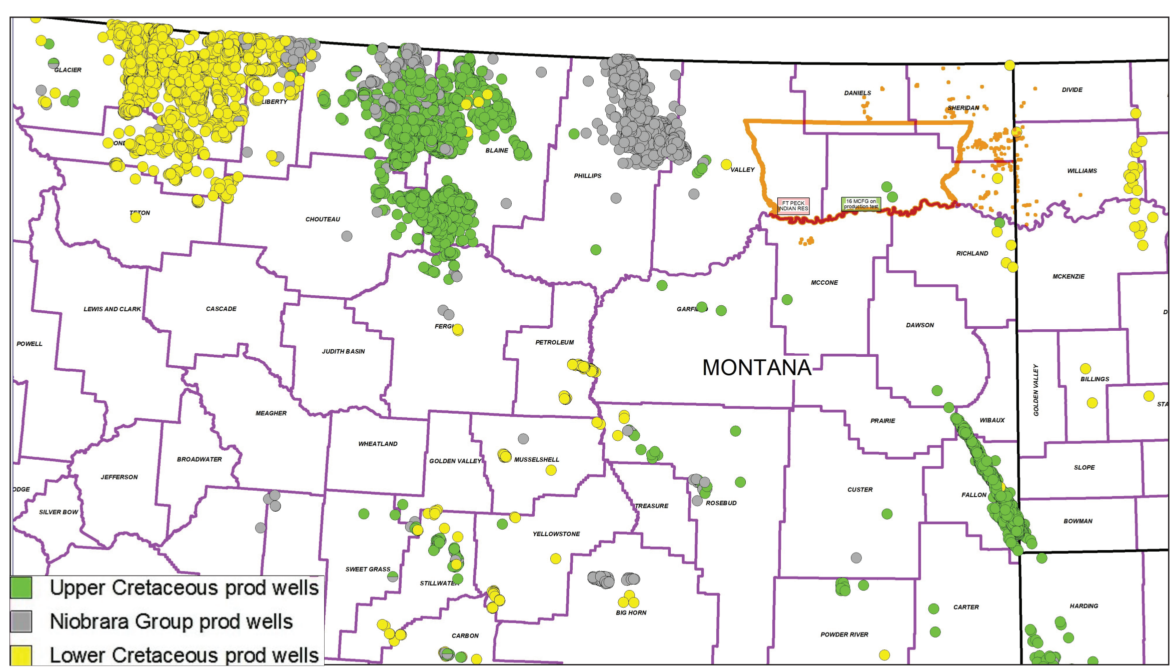


Figure FP - 10.3. Cretaceous age reservoirs production by unit.

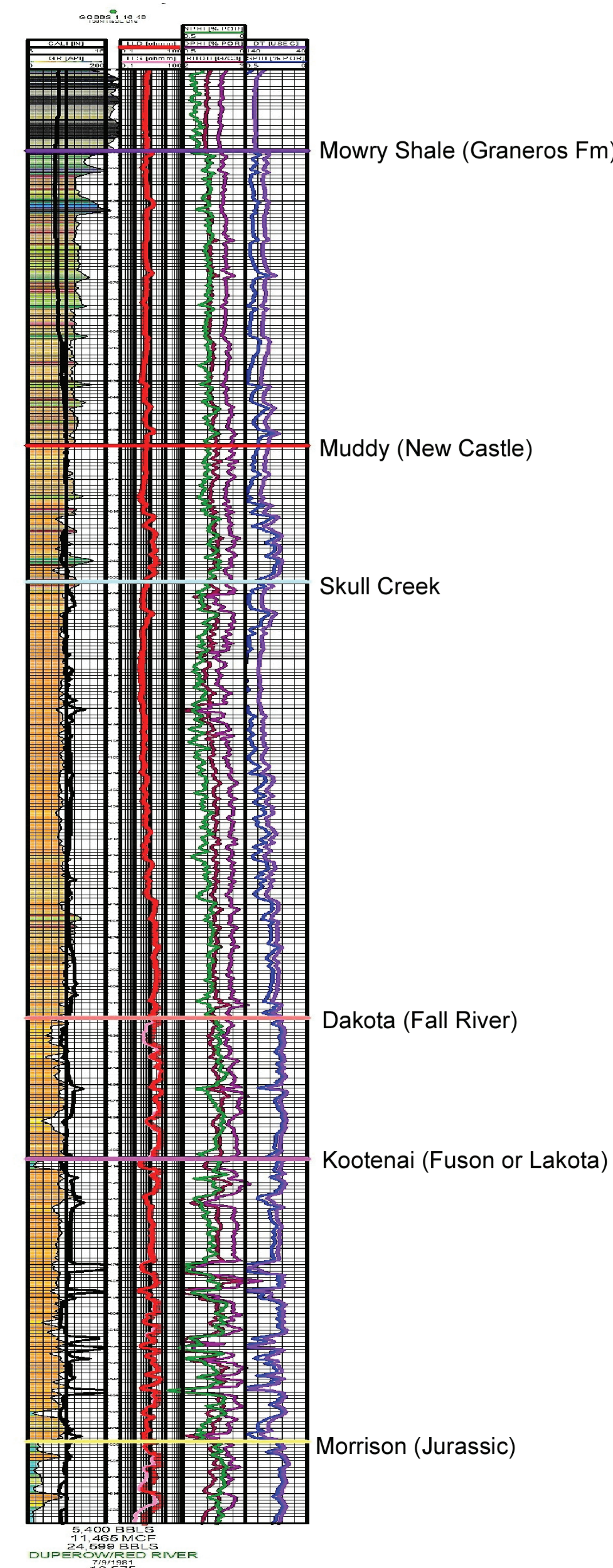


Figure FP 10.1. Type log Lower Cretaceous

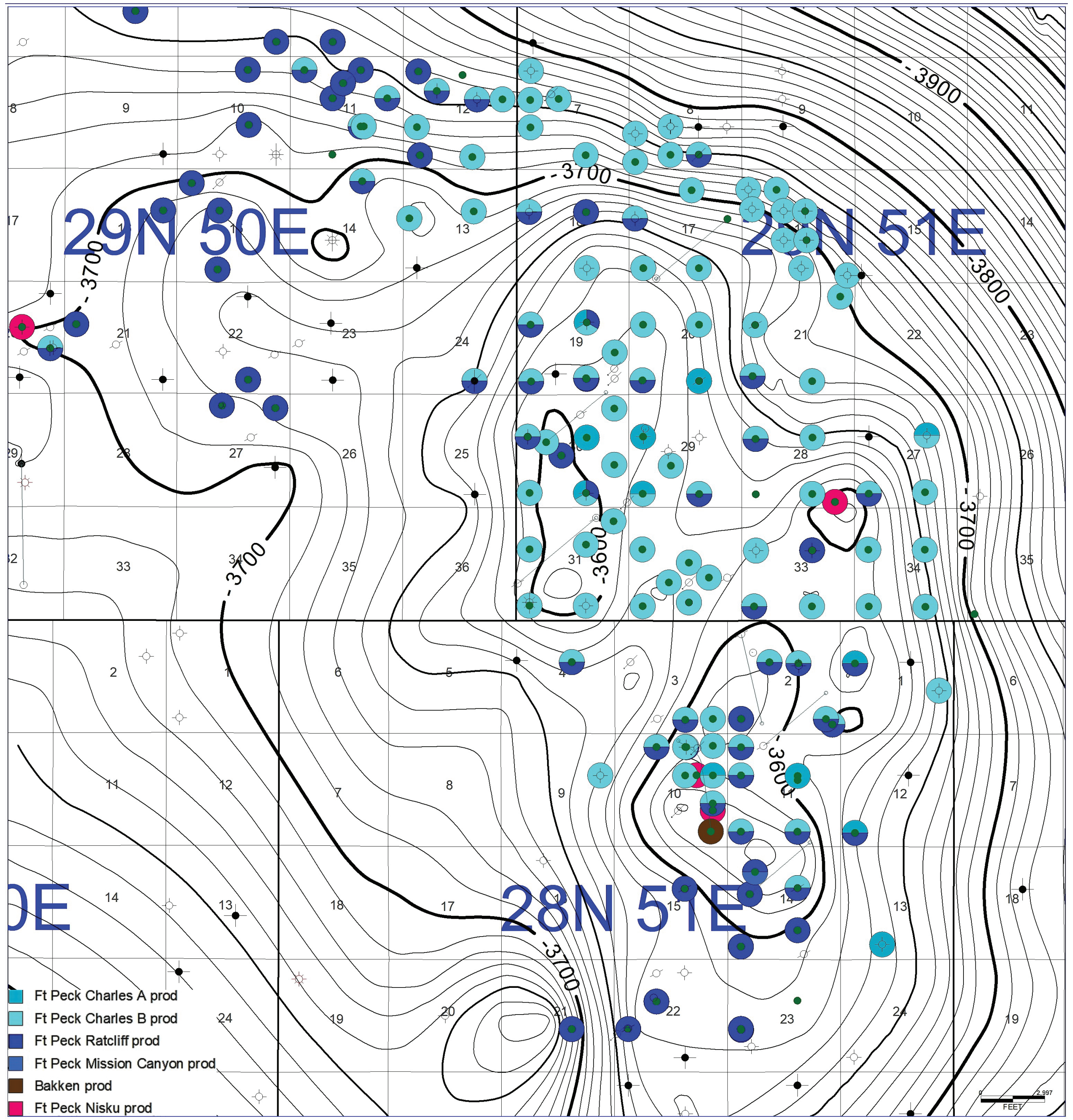
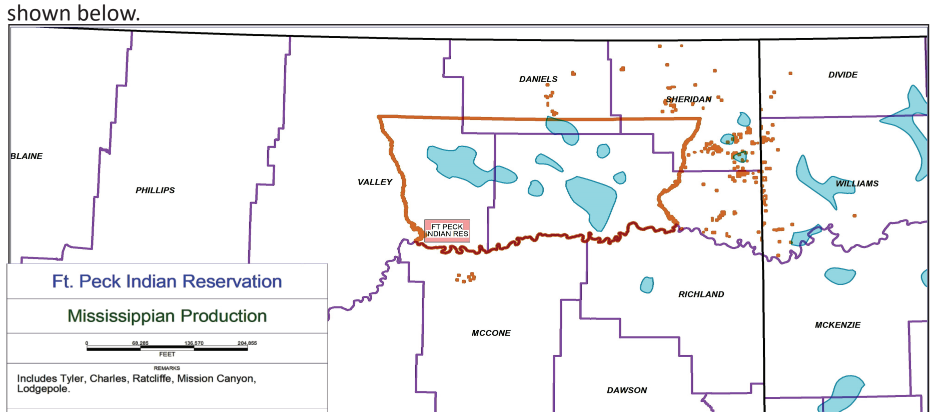


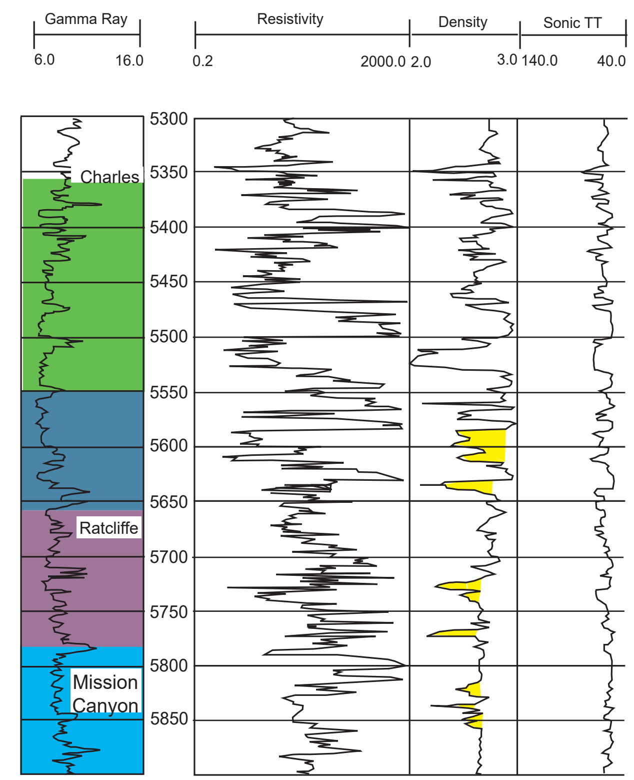
FIGURE FP-8.1. Poplar East Field Ratcliffe structure map, 10' contour interval . General location map of Mississippian production is shown below.



EAST POPLAR FIELD
Roosevelt County, Montana

RATCLIFFE STRUCTURE MAP

Poplar East Field Type Log (after Monson, 1995)



FP - 8.2: Type log illustrating different producing zones by gamma ray marker and porosity zones.

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.	

TABLE FP-2. Poplar East Field Parameters	
FORMATION:	Mississippian Charles, Ratcliffe
LITHOLOGY:	40 feet of limestone and dolomitic limestone;intercrystalline to cryptocrystalline and microcrystalline porosity
OTHER PRODUCTION:	Devonian Nisku Both Charles and Nisku production are structurally controlled, although the Charles has a stratigraphic component.
AVERAGE DEPTH:	5600 ft
POROSITY:	13% average
PERMEABILITY:	0.1 md, with numerous vertical fractures
OIL/GAS COLUMN:	unknown
AVERAGE NET PAY THICKNESS:	variable

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 (FP - 8.2). These zones are overlain by evaporite 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 (FP- 8.1 and 8.3). 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.

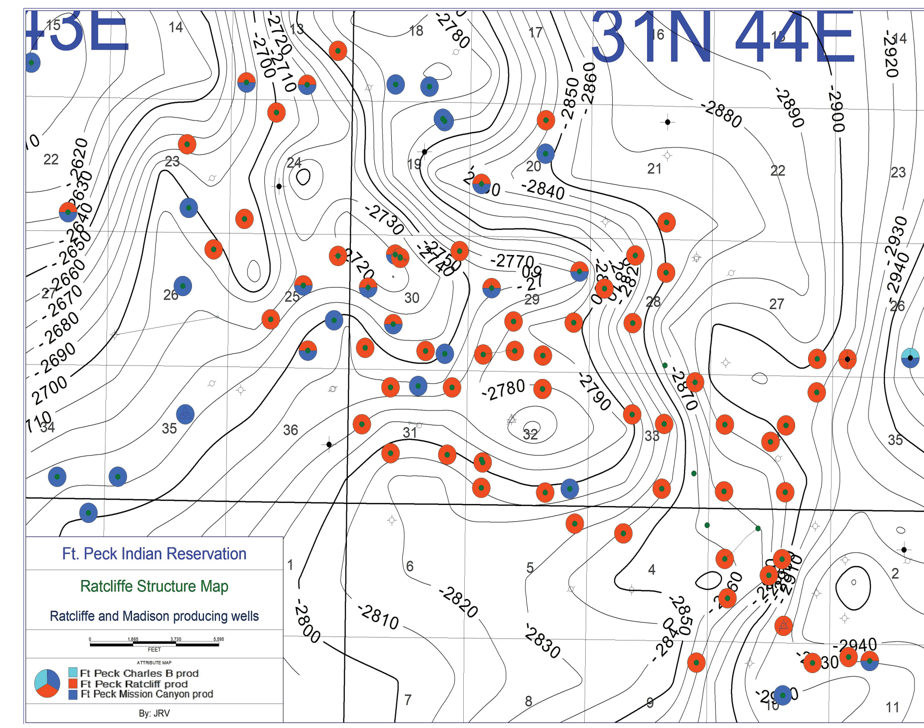


FIGURE FP- 8.3. Lustre Field structure contours with top Ratcliffe marker as datum. Formation producing zone color-coded.

Mississippian Analog Fields
(* denotes fields lying within the Reservation)

(1975) Reagan Field	77,563 BO	1 well
(1982) Lustre	7483000 BO	84 wells
(1983) Lustre, North	189,000 BO	1 well
(1985) Midfork	1173000 BO	13 wells
(1965) Mineral Bench	184000 BO	1 well
(1992) Nielson Coulee	181000 BO	3 wells
(1952) Poplar East	47180000 BO	92 wells
(1952) Poplar, NW	5103000 BO	37 wells
(1987) Reserve 2	194,000 BO	1 well
(1964) Volt	3400 BO	4 wells

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/silt-stone (Figure FP - 12.3). 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 of 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 Figure FP-12.2). 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 (Figure FP - 12.1). 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.

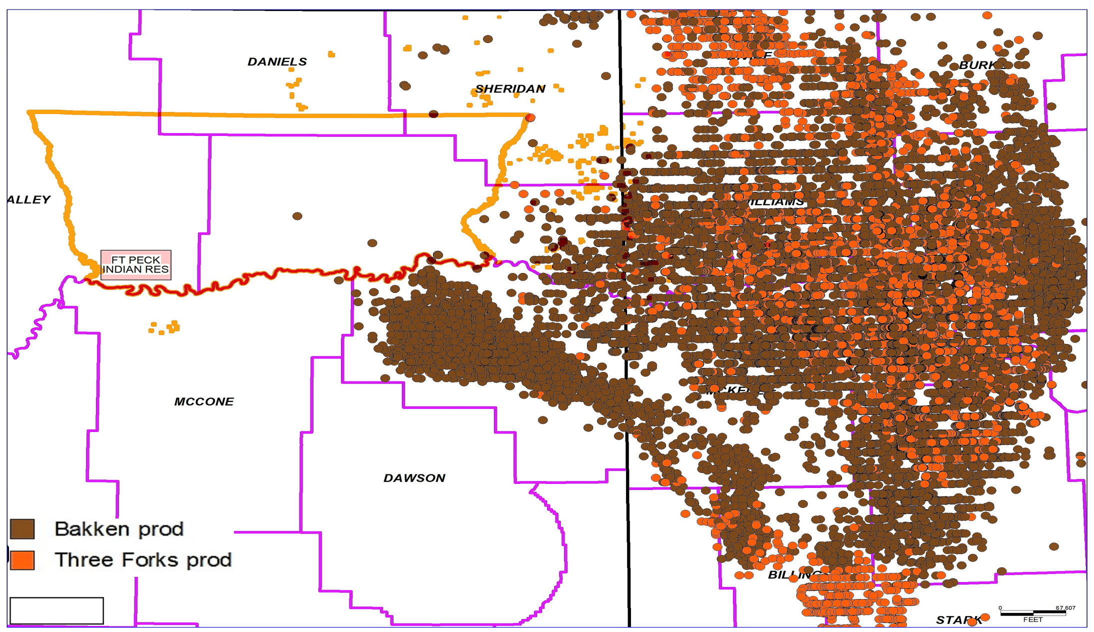


Figure FP-12.1. Bakken and Three Forks production for the Williston basin. Bakken and Three Forks production wells only.

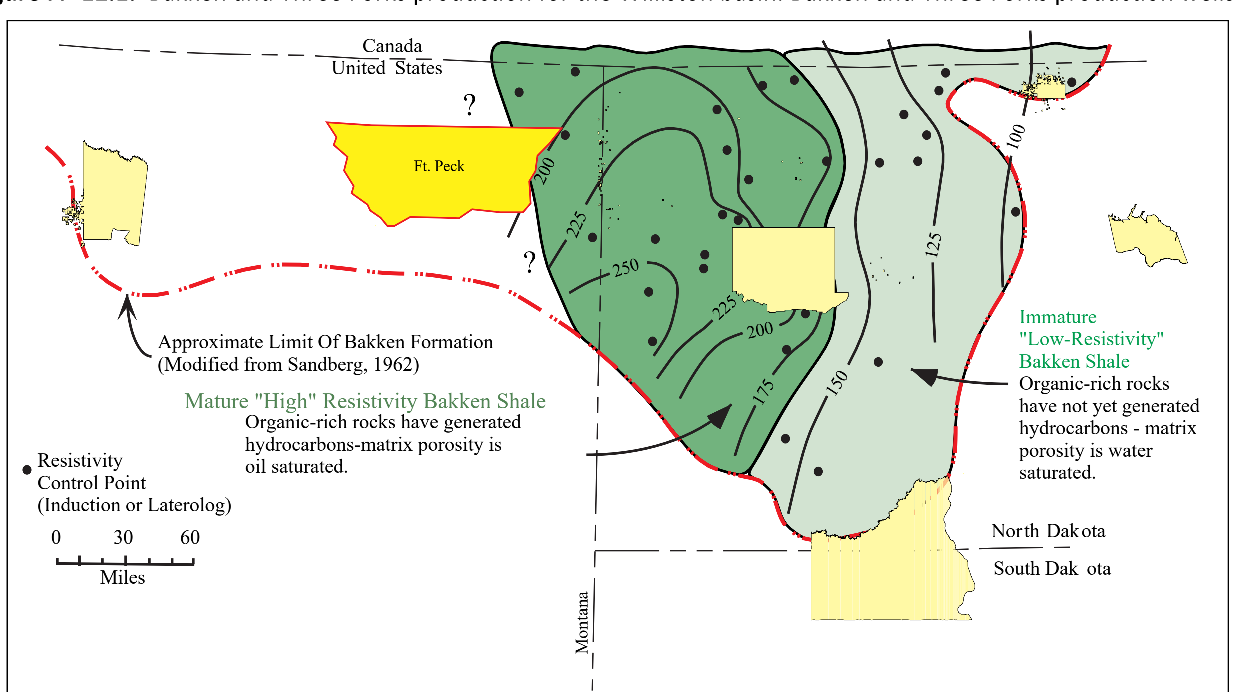


Figure FP-12.2. Areas of 'high' and 'low' electrical resistivity in Bakken shales, with subsurface isotherm contours (degrees) and interpreted area of source-rock maturity (after Meissner, 1987).

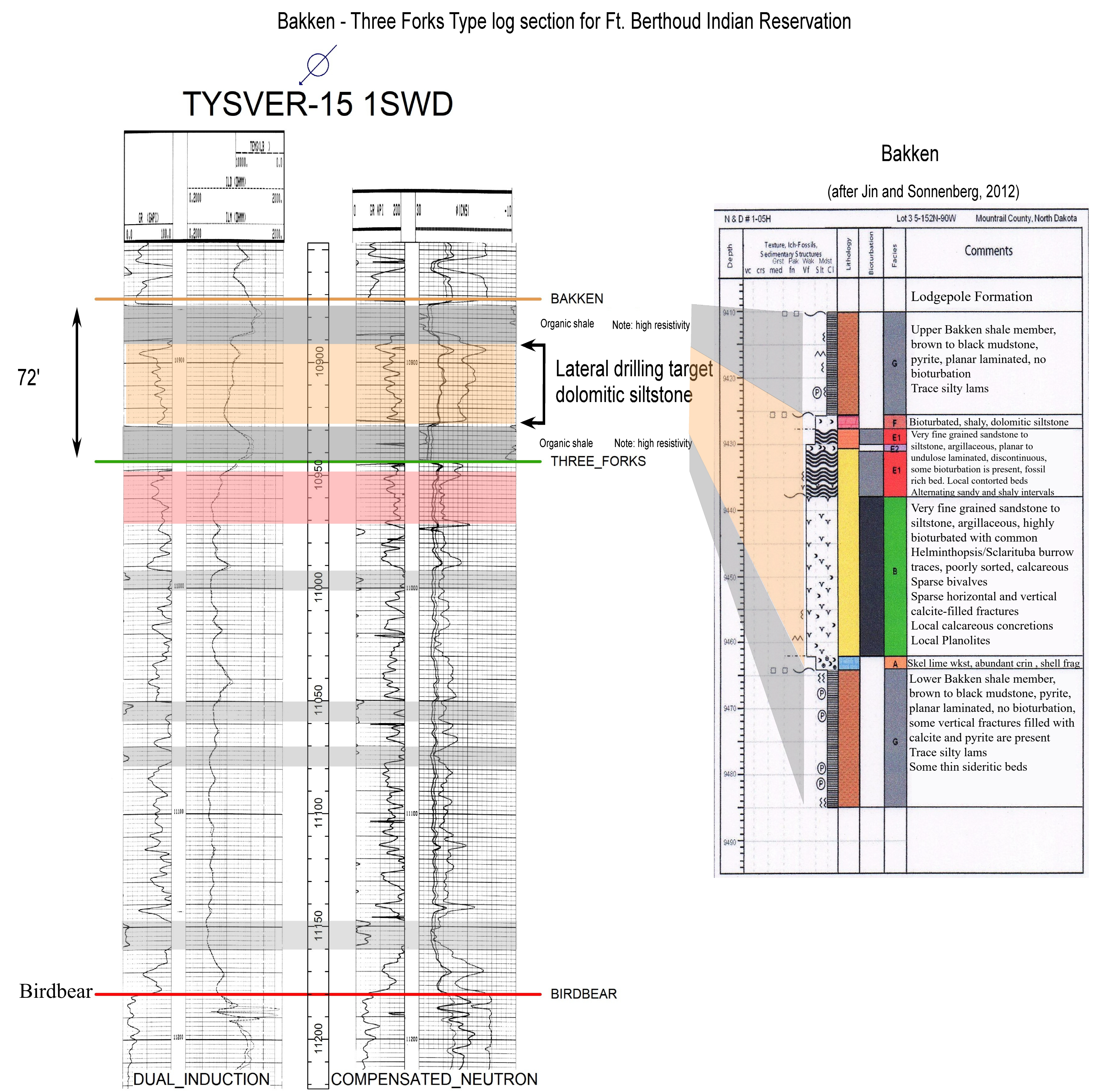


Figure FP-12.3. Type log for the Bakken/Three Forks with lithologic description.