NORTH DAKOTA GEOLOGICAL SURVEY
Edward C. Murphy, State Geologist
Lynn D. Helms, Director, Department of Mineral Resources

NORTH DAKOTA STRATIGRAPHIC COLUMN

by Edward C. Murphy, Stephan H. Nordeng, Bruce J. Juenker, and John W. Hoganson

MISCELLANEOUS SERIES 91
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AGE MILLIONS OF YEARS BEFORE PRESENT	ERATHEM	SYSTEM / SERIES	SEQUENCE	ROCK UNIT: GROUP	ROCK UNIT: FORMATION	ROCK UNIT: MEMBER	RESOURCE Proven / Potential	ROCK COLUMN	MAXIMUM THICKNESS FEET (METERS)	LITHOLOGY, DEPOSITIONAL ENVIRONMENTS, AND OTHER ATTRIBUTES
0.01	CENOZOIC	QUATERNARY / Holocene	TEJAS		OAHE	RIVERDALE PICK CITY AGGIE BROWN MALLARD ISLAND	Salt Water Gravel		100 (30)	Clay, silt, sand, and gravel; tan to gray to black; organic-rich or organic-rich lenses; pebbles of locally derived materials such as intraformational concretions and nodules as well as clinker and lignite fragments in western North Dakota; crystalline sodium sulfate in some playa lake deposits; paleosols. Two prominent paleosols have been identified in the Oahe Formation, the Thompson paleosol (Riverdale Member) and the Leonard paleosol (Aggie Brown Member). River, lake, slough, and windblown deposits.
		Pleistocene		COLEHARBOR	WEST CENTRAL / EASTERN: RED RIVER VALLEY, SHERACK, POPLAR RIVER, BRENNA, FALCONER, HUOT, ARGUSVILLE, WYLIE, RED LAKE FALLS, ST. HILAIRE, MARCOUX; SNOW SCHOOL, HORSESHOE VALLEY, MEDICINE HILL, DAHLEN, GARDAR, CHURCHS FERRY, CAMP GRAFTON, CANDO		Gravel Water Stone Peat Clay		1,000 (300)	Clay, silt, sand, and gravel; primarily glacial till, olive-gray to tan, pebbly, silty clay that may contain fragments or pebbles of lignite and clinker, iron stained, often jointed, contains cobbles and large boulders that when left at the surface by erosion are called erratics. Pebbles and boulders consist primarily of granite, gneiss, banded iron, basalt, limestone, and dolostone. Numerous glacial advances created tills that can be differentiated based on lithologic and mineral content. Till generally forms rounded, well vegetated slopes, and steep, barren slopes along river and lake cuts. Glaciolacustrine clays, gray to black, laminated, varved, organic-rich. Glacial deposits cover all but southwestern North Dakota; windblown silts and sands scattered across North Dakota; glacial outwash is an important source of sand, gravel, and water. Remains of Ice Age plants and animals have been found in the glaciolacustrine and glaciofluvial sediments. Sixteen stratigraphic units of the Coleharbor Group have been formally recognized in North Dakota. The Sherack, Brenna, and Wylie Formations are glaciolacustrine sediments, the Poplar River Formation is river sediment, and the remaining units consist primarily of till.
2.6		Pliocene			(Unnamed Unit)		Gravel Water		300 (91)	Gravel, sand, sandstone, silicified wood, concretions; locally derived river sediment; mainly pebbles and cobbles; terrace, fan, and pediment deposits. Clay, silt, sand, and gravel; western-derived pebbles and cobbles; volcanic porphyries, quartzites, and chert. Includes both upland gravels and valley fills.
5.3		NEOGENE / Miocene			ARIKAREE		Rock		330 (101)	Limestone, sandstone, and siltstone; tuffaceous; light-gray, green, to white; green chert nodules in marlstone; contains the burrowed marker unit; found as caprock on several of the major buttes in southwestern North Dakota. Lake and river deposits.
23.0		Oligocene		WHITE RIVER	BRULE				200 (61)	Siltstone, sandstone, and claystone; brown to pink; nodular, siltstones may contain claystone inclusions; weathers to steep slopes with rounded, pitted surfaces; mammal fossils are common. River and lake deposits.
33.9		PALEOGENE / Eocene			CHADRON	SOUTH HEART CHALKY BUTTES	Clay Gravel		140 (43)	South Heart Member: 60 feet (18 m) thick, claystone; brown, pink, and green; contains silicified zones; bentonitic; popcorn weathering surface; lake deposit. Chalky Buttes Member: 80 feet (24 m) thick, sandstone and conglomerate; grayish green to white; cross-bedded, poorly-cemented sandstone. Pebbles include volcanic porphyries, quartz, and some petrified wood. River deposits.
					GOLDEN VALLEY	CAMELS BUTTE BEAR DEN	Clay		400 (122)	Camels Butte Member: 350 feet (107 m) thick, sandstone, siltstone, mudstone, claystone, and thin lignite; shades of yellow and brown; sandstone is poorly-cemented to well-cemented; the lower part is very similar lithologically to the Sentinel Butte Formation except that it is generally micaceous; the upper part contains a massive fluvial sandstone that caps many of the major buttes in southwestern North Dakota. River, lake, and swamp deposits. Bear Den Member: 50 feet (15 m) thick, claystone, siltstone, and sandstone; kaolinitic; white, gold, to purple; small iron spheres; forms steep, nonvegetated slopes; capped in places by a siliceous bed; a weathering horizon or paleosol.
55.8		Paleocene		FORT UNION	SENTINEL BUTTE		Clinker Uranium Coal Leonard-ite Water		650 (198)	Sandstone, siltstone, claystone, mudstone, clinker, and lignite; generally somber colored gray, blue, and brown; poorly-cemented to well-cemented sandstones; swelling bentonitic and nonswelling claystones; limestone and iron oxide nodules and concretions; abundant petrified wood; tuffaceous bed(s); forms steep, rilled slopes and badlands topography throughout much of southwestern North Dakota; most coal mining has taken place in this unit. The HT Butte lignite marks the base of the Sentinel Butte Formation locally in southwestern North Dakota. River, lake, and swamp deposits.
					BULLION CREEK		Water Stone Coal Clinker		650 (198)	Sandstone, siltstone, claystone, mudstone, clinker, and lignite; generally brightly colored, yellow, brown, gray; poorly-cemented to well-cemented sandstones; swelling and nonswelling claystones; limestone and iron oxide nodules and concretions; forms steep, rilled slopes and badlands topography in southwestern North Dakota. Contains the Harmon Bed, 54 feet (16 m) thick, the thickest lignite in North Dakota. Essentially equivalent to the Tongue River Formation in pre-1977 stratigraphic nomenclature. River, lake, and swamp deposits.
					SLOPE		Clay Coal Clinker		270 (82)	Sandstone, siltstone, claystone, mudstone, clinker, and lignite; generally dark colored, brown and gray; poorly-cemented to well-cemented sandstones; swelling and nonswelling claystones; limestone and iron oxide nodules and concretions; forms steep, rilled slopes and badlands topography in southwestern North Dakota. Upper contact is the Rhame Bed (weathering horizon, paleosol) a dazzling white, kaolinitic claystone and siltstone that forms steep, nonvegetated slopes. Equivalent to the upper Ludlow Formation in pre-1977 stratigraphic nomenclature. River, lake, and swamp deposits.
					CANNONBALL		Clay		255 (78)	Mudstone and sandstone; dark gray to black mudstone, greenish gray to yellow sandstone; glauconitic; mudstone contains lenses of siltstone and sandstone; sandstone is poorly-cemented to well-cemented; contains at least three well-cemented, lenticular, ledge forming sandstones in south-central North Dakota; abundant marine fossils. Interfingers with the Ludlow and Slope Formations. Represents last sea to cover North Dakota. Marine and brackish deposits.
65.5					LUDLOW		Water Clinker Coal		300 (91)	Sandstone, siltstone, claystone, mudstone, clinker, and lignite; brown and gray; poorly-cemented to well-cemented sandstones; swelling and nonswelling claystones; limestone and iron oxide nodules and concretions; forms steep, rilled slopes and badlands topography in southwestern North Dakota. The T Cross lignite marks the top of the Ludlow Formation locally in southwestern North Dakota. Equivalent to the lower Ludlow Formation in pre-1977 stratigraphic nomenclature. River, lake, and swamp deposits.
		CRETACEOUS / Upper	ZUNI		HELL CREEK		Clay Water		330 (101)	Sandstone, siltstone, claystone, mudstone, and thin, discontinuous lignite; somber tones of gray, brown, and purple; moderately-cemented to poorly-cemented, organic-rich, cross-bedded sandstone; bentonitic claystone: tuffaceous beds; limestone, manganese-oxide, and iron-oxide nodules and concretions; dinosaur fossils. Characterized by rapid facies changes; forms rilled to rounded, poorly vegetated slopes and badlands topography. The Brein Member is one of at least two marine/brackish tongues. River, lake, and swamp deposits.
				MONTANA		BREIEN	Water			
					FOX HILLS	COLGATE ≷ LINTON BULLHEAD TIMBER LAKE TRAIL CITY	Ash Water Water Stone		400 (122)	Mudstone, siltstone, sandstone; yellowish brown to gray; poorly-cemented to well-cemented sandstone; organic laminae; tuffaceous bed(s); mollusk-rich beds; abundant marine and brackish-water fossils. Generally forms gentle, rounded slopes, but can form flat-topped hills and buttes. The Colgate Member (sandstone) weathers to bright white with steep cliffs and is an important aquifer throughout western North Dakota. The Linton Member is a grayish brown sandstone that caps many of the buttes in central and southwestern Emmons County. Offshore marine and nearshore deposits.
					PIERRE	ODANAH DEGREY GREGORY PEMBINA GAMMON	Stone Water Bentonite Gas		2,300 (701)	Shale; light to dark gray; generally noncalcareous; fissile to blocky. The Pierre and Fox Hills contact is gradational over an interval of approximately 30 feet (9m). The Pierre Formation is subdivided into five members, four of these members (Odanah, DeGrey, Gregory, and Pembina) are exposed in North Dakota. Offshore marine deposits. Odanah Member: shale; light gray; siliceous, noncalcareous; hard, slate-like; iron stained joints; yellow bentonite near base; ferruginous concretions; forms conspicuous cliffs. DeGrey Member: shale; olive to dark gray; noncalcareous; flaky; abundant ironstone concretions. Contains marine vertebrate fossils. Gregory Member: shale; yellow to dark gray; slightly calcareous to marly; pyritic; soft; thinly bedded. Upper part; pale, yellowish gray marlstone; loose surface, prone to slumping; lower part; shale, containing ironstone concretions. Contains marine invertebrate fossils. Pembina Member: shale; grayish brown to brownish black; noncalcareous; soft; jarosite and selenite-encrusted phosphate nodules; organic-rich in the middle portion; Fuller's earth (bentonite) beds near base of unit. Contains marine vertebrate fossils. Gammon Member: mudstone; gray; calcareous and iron concretions. Originally named the Gammon Ferruginous Member. The Ardmore Bentonite marks the contact between the Gammon and Pembina Members. Two sandstone/siltstone tongues are present in the subsurface of western North Dakota, the lower is referred to as the *Eagle* and the upper the *Judith River*. These may be equivalent to the Eagle Sandstone and the Judith River Formations in Montana. In addition, there are a number of sandstone and siltstone lenses in the Pierre Formation that are often mistakenly referred to as the *Eagle* or *Judith River.* The Pierre\Fox Hills contact is the last (highest stratigraphic) consistent pick that can be made on electric logs with any degree of confidence.
				COLORADO	NIOBRARA				250 (76)	Shale, chalk; light to medium gray, upper exposures weather to yellow; calcareous; zones contain limy inclusions or specks that are referred to as the *First White Specks* by drillers and are used to differentiate it from the overlying Pierre Formation; very calcareous or marly zone in the lower part of the unit; laminated and bioturbated strata; some pyritized burrows; marine fossils; forms steep slopes. Offshore marine deposits.
					CARLILE				400 (122)	Shale; medium gray to black; noncalcareous; soft; a zone of selenite and large ellipsoidal concretions and septarian nodules near the top; marine fossils; forms rounded slopes. Offshore marine deposits. *The column changes below this point to indicate these rocks are not exposed at the surface in North Dakota.*
					GREENHORN				150 (46)	Shale; dark gray; micaceous; soft; thin-bedded shaly limestone; referred to as the *Second White Specks* by drillers; the top is a good marker on gamma-ray and resistivity logs. Offshore marine deposits.
					BELLE FOURCHE				350 (107)	Shale; medium to dark gray; micaceous; soft; lumpy to massive; includes beds of bluish gray bentonitic clay; sandstone and siltstone near the base in eastern North Dakota. Offshore marine deposits.
99.6		Lower		DAKOTA	MOWRY				300 (91)	Shale; medium to dark gray; soft; flaky; traces of bluish gray bentonitic claystone; top is marked by a persistent bentonite that has a strong response on a gamma-ray log. Offshore marine deposits.
					NEWCASTLE		Water		150 (46)	Sandstone; light gray; fine-grained to medium-grained, angular quartz grains; silty; some calcareous cement. Shale; medium to dark gray; micaceous; fissile to blocky; soft. Also referred to as the *Muddy*. Shallow marine and fluvial deposits.
					SKULL CREEK		Water		140 (43)	Shale; medium to dark gray; micaceous; soft, flaky to lumpy. Sandstone; light gray; glauconitic, calcareous; fine-grained; friable. Traces of pyrite and white bentonitic claystone. Offshore marine deposits.
					INYAN KARA		Water		625 (191)	Upper part: Sandstone; light gray; quartzose; fine-grained to coarse-grained. Shale: gray; silty; lumpy. Marine to nonmarine. Lower part: Sandstone; gray; quartzose; medium-grained to coarse-grained; angular to subrounded; occasional lenses of shale; gray; bentonitic; contains manganese and siderite spheres. Equivalent, in part, to the Lakota, Fusion, and Fall River Formations in South Dakota, Wyoming, and Montana. Most oilfield brine injection occurs in this unit. Primarily nonmarine.
145.5		JURASSIC			SWIFT				725 (221)	Shale; dark gray to greenish gray; interbedded with siltstone and sandstone; calcareous; fissile; waxy. Sandstone; grayish green; glauconitic. Lower third contains limestone bodies; light gray to pinkish gray; carbonate bioclasts; fine-grained to coarse-grained; well-rounded; laminated. Shallow marine deposits.
					RIERDON				100 (30)	Shale; multicolored shades of gray, green, and red; calcareous; some limestone. This unit contains a log marker on gamma-ray and lateral logs referred to as the *Rierdon Shoulder*. Offshore marine deposits.
					PIPER	BOWES FIREMOON TAMPICO KLINE PICARD POE DUNHAM	Salt		625 (191)	Shale; red, purple, and greenish gray; silty; gypsum and anhydrite layers. Limestone; white, brown, or gray; dolomitic; finely crystalline, dense; oolitic, fossiliferous. The Piper is subdivided based upon three general lithologies; shale (Bowes, Tampico, Picard, and Poe, Poe is shale and anhydrite), limestone (Firemoon and Kline), and salt (Dunham). The Kline, Picard, and Poe Members are equivalent to the Nesson Formation in Montana. The upper Piper contains offshore marine deposits and the lower Piper (Picard, Poe, Dunham) is a shallow marine, redbed evaporite sequence.
201.6		TRIASSIC			SPEARFISH	SAUDE PINE BELFIELD	Salt Oil		750 (229)	Siltstone; light to reddish brown. Sandstone; light brown to reddish brown; fine-grained; rounded, frosted grains; slightly calcareous. Mudstone; reddish orange; traces of pyrite and dolomite. Halite; clear; silty; large crystals, massive; contains anhydrite. Interbedded with gray, fissile, shale. Formal members include the Saude, Pine, and Belfield. The Saude Member contains an unnamed salt and the G salt. The Pine Member contains the Pine salt and may be bounded by unconformities. Shallow marine deposits.
251.0		PERMIAN	ABSAROKA		MINNEKAHTA				70 (21)	Limestone; cream, pink, purple mottled; chalky to microcrystalline; clayey; locally contains anhydrite. Shallow marine deposits.
				MINNELUSA	OPECHE		Salt		500 (152)	Shale to mudstone; reddish orange; silty; slightly dolomitic, contains gypsum and anhydrite laminae; up to 200 feet (61 m) of salt in central basin area; depositional thickness preserved when Minnekahta Formation is present. Contains the A and B salts. Shallow, restricted marine deposits.
					BROOM CREEK		Nitrogen		375 (114)	Sandstone; gray, reddish orange to brownish red; shaly; fine-grained to medium-grained, subangular to well-rounded; locally dolomitic, anhydritic, or cherty; interbedded with microcrystalline dolomite, pinkish gray to reddish gray; and shale; reddish gray; anhydrite and ripup clasts at the unconformable upper contact. Shallow marine deposits.
299.0		PENNSYLVANIAN			AMSDEN	ALASKA BENCH			450 (137)	Dolostone; pinkish gray to yellowish brown; microcrystalline to crystalline; silty; interbedded shale that is reddish brown to dark brown; silty; blocky. Sandstone; light red to gray; fine-grained; near top of unit. Anhydrite; white to gray; fine crystalline; dolomitic. The Alaska Bench Member (micritic, shaly, limestone) is a good electric log marker. Shallow marine deposits.
					TYLER		Nitrogen Oil		270 (82)	Shale to mudstone; light gray to black, red and green hues, varicolored, sometimes mottled; laminated; interbedded sandstone lenses; carbonaceous, occasional thin coal stringers; calcareous to noncalcareous; some pyrite; brecciated in places, intraclasts. Sandstone; grayish brown to reddish brown; fine-grained to medium-grained, coarser grained lenses; subrounded to well-rounded; massive to laminated; basal lag conglomerate. Limestone; gray to black, varicolored; micritic; argillaceous; locally anhydritic. Fossils of marine animals locally abundant. Marine to nonmarine, fluvial channels, swamp, beach, and barrier island deposits.
318		CARBONIFEROUS / MISSISSIPPIAN		BIG SNOWY	OTTER				200 (61)	Shale; greenish gray, reddish gray; carbonaceous; variegated along basin margin. Limestone; gray to green; marly; thin-bedded; fossiliferous; oolitic. Offshore marine deposits.
					KIBBEY		Oil		250 (76)	Sandstone; light gray to reddish gray; fine-grained to medium-grained, silty. Shale; reddish to variegated; silty; interbedded gypsum. Limestone; white to brown; dolomitic. A persistent limestone bed in the middle of the unit (*Kibbey lime*) is an excellent marker on electric logs. Shallow marine deposits.
				MADISON	CHARLES		Salt Oil		2,470 (753)	The Charles, Mission Canyon, and Lodgepole Formations are carbonate and evaporite dominated facies that interfinger throughout the basin. The rocks of the Madison Group are informally subdivided by several markers on geophysical logs. These markers frequently cut across facies making correlation difficult. The term *Madison Undifferentiated* is used in the central Williston Basin, where these markers are generally absent. Locally, the Lodgepole Formation contains carbonate mud mounds. Madison Group rocks were deposited in environments ranging from offshore marine to nearshore. A number of intervals and subintervals have been recognized within the Madison Group in various parts of the Williston Basin. These are: Poplar interval: 600 feet (183 m) thick; interbedded, anhydrite, halite, dolostone, mudstone, and shale; iron staining common. This interval contains most of the halite of the Madison Group. Ratcliffe interval: 250 feet (76 m) thick; limestone; yellowish brown to brown; dolomitic; oolitic; alternating with dolomitic limestone, anhydrite, and shale beds; Midale marker is a dolomitic limestone at the base of the interval; Ratcliffe interval includes the *Last salt* marker bed. Frobisher-Alida interval: 585 feet (178 m); limestone; yellowish brown to pink; fine-grained, fragmental, oolitic and pseudo-oolitic; intertonguing lenses of anhydrite and shaly, dolomitic limestone; increasingly evaporitic eastward. The Rival marker at the top of the interval is anhydrite and dolomitic limestone. Tilston interval: 230 feet (70 m) thick; limestone; yellowish brown to pink; dolomitic; cherty; fine-grained to coarsely crystalline; oolitic and crinoidal; anhydrite; some gray shale. Indicated by the MC-2 marker bed. Bottineau interval: 630 feet (192 m) thick; limestone; dark gray to brown, light orange or pinkish; dolomitic to cherty to argillaceous; fragmental; finely crystalline to granular; oolitic; dense; vuggy to fine-intergranular. Roughly equivalent to the Flossie Lake, Whitewater Lake, Virden, and Scallion subintervals. The Carrington shale facies is present only on the eastern flank of the basin and is equivalent to part of the Scallion subinterval. It has a maximum thickness of 90 feet (27 m) and consists of dark gray to red with green mottling, clayey, noncalcareous shale.
					MISSION CANYON		Oil			
					LODGEPOLE		Oil			
359			KASKASKIA		BAKKEN		Oil		160 (49)	Upper and Lower members: shale; dark gray to black; carbonaceous; noncalcareous; fissile; pyritic. Middle member: siltstone; light gray; dolomitic, calcareous; locally sandy. Offshore marine deposits.
					THREE FORKS		Oil		270 (82)	Dolostone and limestone: grayish brown to olive-gray interbedded with greenish blue, yellowish brown, and purplish gray lenses; argillaceous; silty; cross-laminated, mottled, mud cracks; anhydritic; pyritic; fossiliferous zones. Interbedded shale; dark gray to dark brown. Nearshore marine deposits.
				JEFFERSON	BIRDBEAR		Oil		150 (46)	Limestone, some dolostone; medium brown to light grayish brown; finely crystalline, slightly mottled; fossiliferous; anhydritic. Nearshore marine deposits.
		DEVONIAN			DUPEROW		Oil		535 (163)	Limestone; light gray-brown to dark brown; crystalline to granular. Dolostone; gray-green to brown; microcrystalline to crystalline. Mudstone; gray to brown; siltstone and sandstone lenses; laminated; interbedded shale. Contains approximately a half dozen shoaling-upward sedimentary cycles that begin with fossiliferous, stromatoporoid banks and are capped by anhydrite. Nearshore marine deposits.
				MANITOBA	SOURIS RIVER		Oil		375 (114)	Dolostone and limestone; light to dark gray, grayish brown; crystalline to dense; anhydritic; interbeds of siltstone, claystone, and evaporites. Shale; red; occurs at base; referred to as *First Red bed*. Shallow marine deposits.
					DAWSON BAY		Oil		190 (58)	Dolostone; light gray to light brownish gray with dark red, yellow, yellow-brown to black mottling; variable crystal size; anhydritic; porous. Limestone; light gray to brownish gray; dense; fossiliferous. Shale; predominantly red, some green and gray; dolomitic; occurs at base; referred to as the *Second Red bed.* Marginal to nearshore marine deposits.
				ELK POINT	PRAIRIE	MOUNTRAIL BELLE PLAINE ESTERHAZY	Potash Salt		650 (198)	Evaporites; halite; clear, white, large crystals, interbedded lenses of tan to reddish brown siltstone and claystone; potash, sylvite and carnallite; clear, white, dark red to orange, large crystals. Anhydrite; basal bed; thin, interbedded lenses. Iron staining common; abrupt lateral thickness changes due to variations in deposition and salt dissolution. Three potash intervals have been recognized: the Mountrail, Belle Plaine, and Esterhazy Members. Shallow, restricted marine deposits.
					WINNIPEGOSIS		Oil		220 (67)	Limestone and dolostone; shades of gray, grayish blue, and brown; massive to mottled, laminated; fossiliferous, stromatoporoids. Mudstone; gray to light brown; dolomitic; massive to laminated; occasionally flaggy. Anhydrite, both nodular and interbedded. The facies that formed adjacent to pinnacle reefs resulted in some Winnipegosis rocks being deposited lateral to Prairie rocks. Offshore to shallow marine deposits.
416					ASHERN				180 (55)	Upper two-thirds: dolostone; medium to dark gray; argillaceous; microcrystalline; some laminations; anhydrite, some nodular. Lower third: dolostone: light red to dark reddish brown; argillaceous, microcrystalline; nodular anhydrite; brecciated zone at base. Sometimes referred to as the *Third Red bed*. Shallow, restricted marine deposits.
		SILURIAN	TIPPECANOE		INTERLAKE		Oil Gas		1,100 (335)	Upper: dolostone and limestone; dark brown to black to pale red; fine-crystalline to medium-crystalline; massive to laminated; anhydrite, some nodular; brecciated zones and paleosols indicative of subaerial exposure. Middle: dolostone; grayish yellow; fine-grained; thin-bedded; barren to fossiliferous. Capped by a red/green dolostone interbedded with siltstone and quartz sandstone that has a pronounced radioactive response on gamma-ray logs, locally referred to as the *Grondale marker*, possibly a paleosol. Lower: limestone and dolostone; dark yellowish brown; microcrystalline; argillaceous. Mudstone; dark brown; organic-rich, dolomitic; contains lenses of nodular and contorted anhydrite; anhydrite is white to dark brown. Several cycles containing turbidites, organic-rich laminae, anhydrites, and pebble-bearing intraclasts. Shallowing upward marine to nonmarine deposits.
444				BIG HORN	STONEWALL				120 (37)	Limestone and dolostone; light to dark grayish brown; finely crystalline; weakly laminated to massive; brecciated; anhydrite infilling. Shallow marine deposits.
					STONY MOUNTAIN	GUNTON STOUGHTON	Oil		250 (76)	Gunton Member: dolostone; yellowish gray to grayish brown; finely crystalline. Limestone; grayish brown; fossiliferous; thin anhydrite lenses. Stoughton Member: limestone and shale. Limestone; light bluish gray, olive-gray, to black; clean to argillaceous; interbedded; fossiliferous; pyritic. Interbeds of pure limestone, argillaceous limestone, and highly calcareous shale. Strong gamma-ray deflection at the base of this member. Shallow marine deposits.
		ORDOVICIAN			RED RIVER		Oil Gas		700 (213)	Upper one-third: limestone; gray to brown, mottled; dolomitic in part; medium-grained to fine-grained; zones of brown to black organic detritus; bioturbated zones; some vugs; nodular anhydrite; fossiliferous. Contains four intervals (in descending order A to D) that consist of bioturbated skeletal limestone overlain by porous dolomitic mudstone that, in the center of the basin, is capped by anhydrite and locally thin shales. Lower two-thirds: limestone; yellowish gray to brown; mottled; occasional vugs; fossiliferous, bioturbated. Shallow marine to restricted marine deposits.
				WINNIPEG	ROUGHLOCK				90 (27)	Shale; medium to dark gray; silty; calcareous; fossiliferous; contains nodules of light gray limestone. Offshore marine deposits.
					ICEBOX				170 (52)	Shale; greenish gray to black; carbonaceous; bioturbated; locally fossiliferous; black phosphate nodules. Sandstone; gray; fine-grained, silty; bioturbated. Offshore marine deposits.
					BLACK ISLAND		Oil Gas		270 (82)	Upper: sandstone; gray; quartz; rounded to well-rounded; shale lenses; phosphate and pyrite nodules; bioturbated. Lower: sandstone; red; well-rounded. Shale; dark red to gray, siltstone lenses. Shallow marine to fluvial/deltaic.
488			SAUK		DEADWOOD		Oil Gas		1,000 (305)	Upper: limestone; light gray to grayish green; dolomitic in part; silty; interbedded with sandstone and shale. Shale: medium to dark gray; sandy. Sandstone: white to colorless; quartz; very fine-grained to medium-grained; rounded; some shale lenses; silica cemented. Lower: limestone; light gray; fine-crystalline to medium-crystalline; silty to sandy; glauconitic. Shale: medium gray to greenish gray; some sandstone. Sandstone: white; quartz; fine-grained to medium-grained; rounded to subrounded; often frosted. Sandstone: white to light gray; quartz and rock fragments; fine-grained to medium-grained; argillaceous; some shale lenses; glauconitic; calcareous. Locally fossiliferous. Shallow marine to nonmarine deposits.
542		CAMBRIAN								
	PRECAMBRIAN			STRUCTURAL PROVINCES WYOMING PROVINCE / TRANS-HUDSON OROGEN / SUPERIOR PROVINCE			Oil Iron		Unknown	Rocks of the Trans-Hudson Orogen underlie the west half of North Dakota. These rocks are remnants of oceanic arc systems that were caught between the Superior and Wyoming cratons when these two microcontinents collided in the Early Proterozoic, 1.9 billion to 1.8 billion years ago. These rocks include granite, granodiorites, biotite-garnet gneiss, charnockite, hornblende schist, monzonite, and diabase. The Superior Province is an Archean craton (>2.5 billion years old) that underlies much of eastern North Dakota. Test wells drilled into these rocks have encountered; granites, granodiorites, diorites, chlorite schists (greenstone), granitic metamorphic rocks, stretched pebble conglomerates, porphyritic granodiorite-gneiss, banded gneiss, phyllites, metasedimentary and metavolcanic rocks, adamellites, syenites, banded iron formations, and tuffs. The Wyoming Province underlies the very southwestern corner of North Dakota on some geologic maps and on others does not extend into North Dakota at all. The Wyoming Province is an Archean craton that formed over 2.5 billion years ago. Rocks encountered in deep test wells in this area include; granites, granite-gneiss, migmatic gneiss, amphibolite, ultramafic rocks, schists, diabases, iron-banded quartzite, and metaconglomerates. The oldest known rocks on Earth are 3.85 billion years old. The age of the Earth is estimated to be 4.7 billion years old.

ROCK COLUMN LEGEND

- Clastics
  - Sandstone
    - Unconformity
    - Paleosol
    - Coal
    - Kaolinite
    - Bentonite
    - Till
    - Gravel
    - Sand/Sandstone
    - Argillaceous or Shaly
    - Calcareous
  - Mudstone/Siltstone
    - Siltstone
    - Mudstone
    - Calcareous
  - Shale
    - Claystone or Shale
    - Calcareous
    - Dolomitic
    - Carbonaceous
- Carbonates
  - Limestone
    - Fossiliferous
    - Oolitic
    - Sandy
    - Silty
    - Argillaceous or Shaly
  - Dolostone
    - Dolomitic Limestone or Limy Dolostone
    - Dolostone
    - Sandy
    - Silty
    - Shaly
- Evaporites
  - Anhydrite
  - Halite
  - Potash
- Igneous/ Metamorphic Rock

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