MBMG Open File 541

Geologic Map of the Scobey 30' x 60' Quadrangle (Surficial Emphasis), Daniels, Roosevelt, McCone and Valley Counties, Montana

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Note:

1. The geologic information on this map was prepared by the authors as part of field studies for the U.S. Geological Survey. Although the maps have been peer-reviewed for scientific interpretation, the report is preliminary and has not been edited to conform with U.S. Geological Survey publication standards.

2. The Montana Bureau of Mines and Geology is publishing this information with the cooperation of the U.S. Geological Survey and has not edited or reviewed the document.

3. The map is a scan of a map hand-drawn by the authors. The collar information is from documents provided by the authors. Layout of the final map was done by Susan Smith, Geologic Cartographer, MBMG.

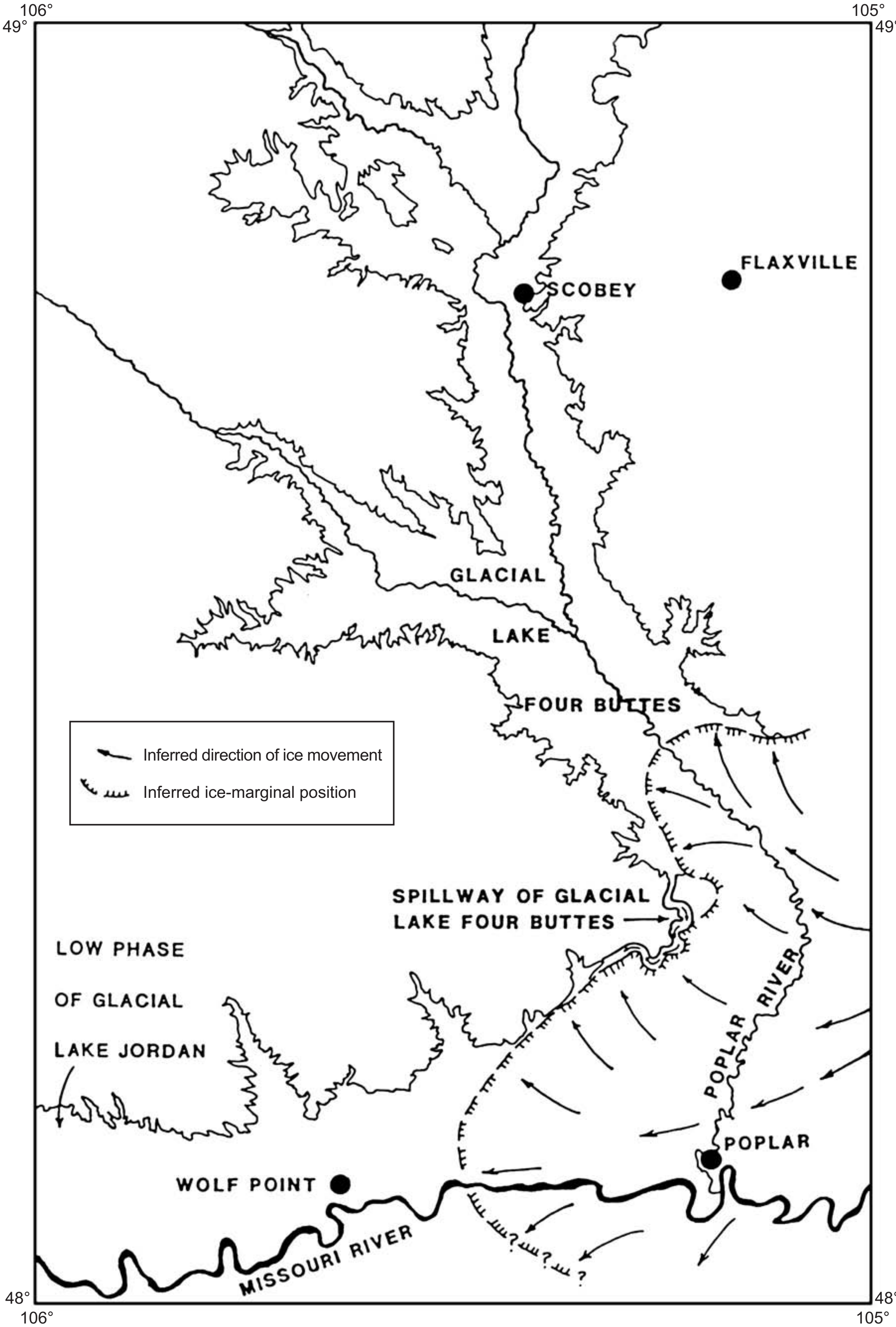
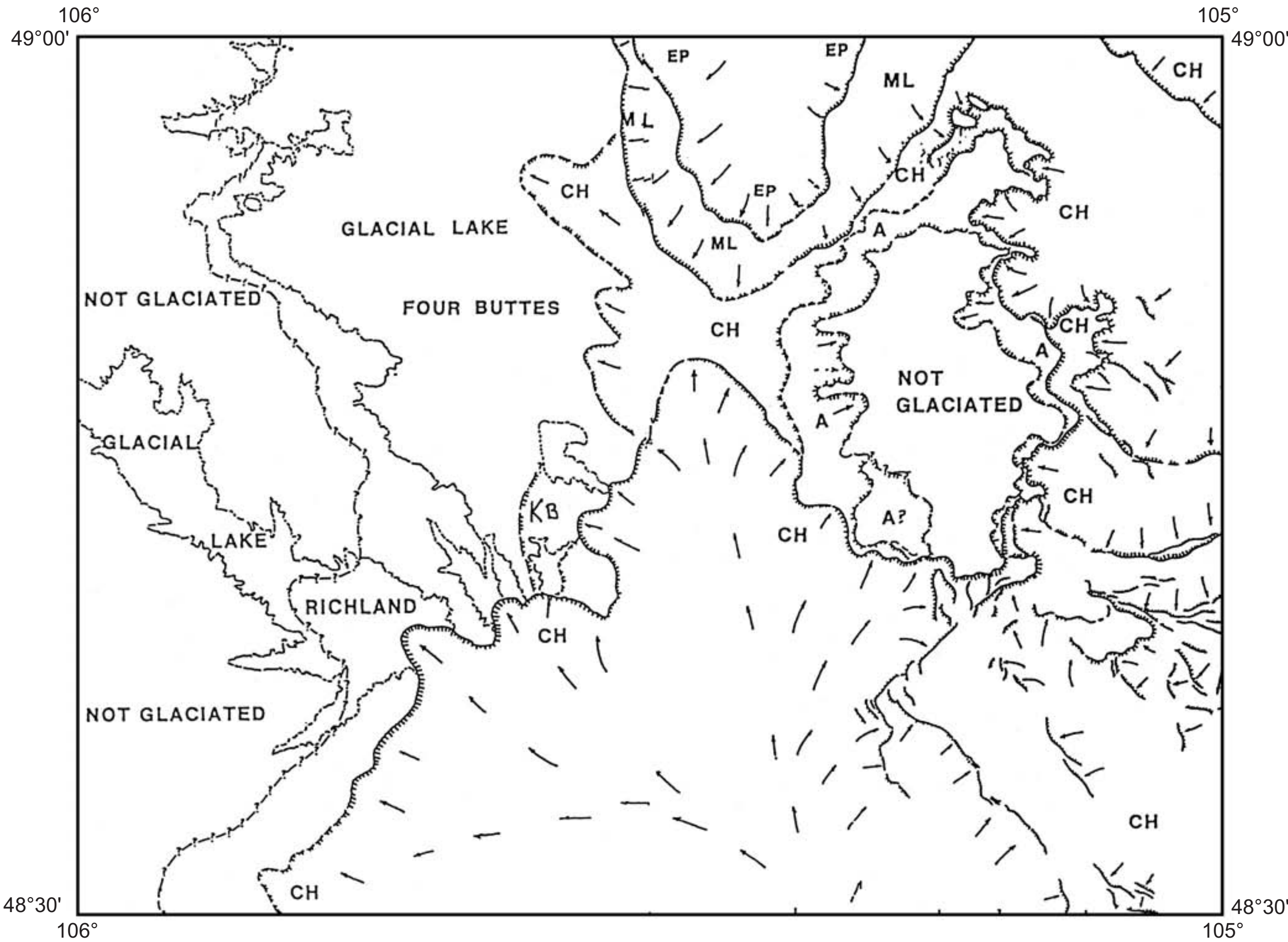


Figure 1. Approximate extent of the low phase of Glacial Lake Four Buttes.



EP — Extent of East Poplar readvance

ML — Extent of Medicine Lake readvance

CH — Extent of Crazy Horse glaciation (Late Wisconsin)

A — Extent of Archer glaciation

← Inferred direction of ice movement

?–?–? Western limit of Canadian erratic cobbles and boulders

Ice-marginal position, dashed where approximately located, tics on ice side.

Figure 2. Features and effects of glaciation in the Scobey 30' x 60' quadrangle.

DESCRIPTION OF MAP UNITS

af Artificial fill (Recent)—Brown and gray sand and gravel in highway and railroad embankments

Qal Alluvium (Holocene and late Wisconsin)—Light-yellowish-brown, yellowish-brown, grayish-brown, and light-gray coarse to fine gravel, sand, silt, and clay deposited on floodplains and in stream channels. It is poorly to well stratified, and poorly to well sorted. In the Scobey quadrangle, alluvium is underlain by glacial outwash, especially under the Poplar River and its East, Middle, and West Forks.

Most of the alluvium is yellowish brown and moderate brown: most of the clay plugs are yellowish brown, medium gray, or bluish gray. The upper several feet of the alluvium commonly contain lenticular dark-brown or dark-gray beds alternating with light brown beds. Light-brown iron staining occurs as isolated blebs along rootlets and irregularly through some beds, staining individual laminae. Iron staining is prominent in some areas.

Floodplain alluvium is chiefly unconsolidated, well-sorted, silt and fine and medium sand; in valleys of some small streams it includes fine to coarse gravel. Silt and organic clay generally are present in discontinuous lenses or beds or are mixed with fine sand. In general, the upper part of the floodplain alluvium consists of unconsolidated, well-sorted very fine sand, silt, and clay, whereas the lower part (channel alluvium, and outwash) consists of coarse sand and gravel. Vertical and horizontal facies changes within short distances are common. Grain size analyses of alluvium indicate great variation of texture: 28-58 percent clay, 5-60 percent silt, 4-100 percent sand, 0-14 percent granules, and 0-53 percent pebbles. In the Scobey area, alluvium underlies flood plains that have scalloped (meander scroll) or braided surface patterns.

Drilling in the floodplains of the Poplar River and its East and West Forks indicated that the alluvium (and underlying outwash) is 3-5 m (10-16 ft) thick (Feltis, 1979)

Qac Alluvial and colluvial deposits (Holocene and late Pleistocene)—Light-brown, brown, grayish-brown, and gray nonstratified or poorly stratified gravel, sand, silt, and clay deposited by sheet wash, stream flow, and gravity processes on slopes. Primarily sheetwash alluvium, derived from bedrock outcrops and other surficial deposits higher on slopes and deposited by unconfined sheet flow and rill wash. Colluvium is generally present only on and below slopes steeper than 8 percent. Sheetwash alluvium is chiefly fine sand and silt with scattered granules and small pebbles; colluvium is chiefly gravel and sand or a heterogeneous mixture of boulders, cobbles, pebbles, and granules in a clayey to sandy matrix. Colors, textures, and particle lithologies vary, reflecting those of the parent bedrock and surficial materials higher on slopes. The downslope surface profile of alluvial/colluvial deposits is concave upward. Sheetwash alluvium commonly interfingers with and overlaps flood-plain alluvium (Qal), and it forms fans and aprons on terraces in major valleys. Buried soils (humic horizons) are present locally in the sheetwash alluvium and colluvium; fossil snail shells and vertebrate fossils are present locally. Unit includes small areas of windblown deposits (Qe) that interfinger with and overlie sheetwash alluvium.

The composition and color of the alluvial fan and colluvial deposits vary considerably depending on the lithologies of the source bedrock and surficial materials. The colluvium derived from outcrops of Bearpaw shale in the southwest corner of the quadrangle is composed almost exclusively of fragments of weathered Bearpaw Shale. Where till is the source material, the resulting colluvium is pebbly clay that resembles till. Adjacent to outcrops of the Flaxville Formation colluvium is loose, poorly sorted, crudely stratified, slightly clayey, sandy gravel. Where it is derived from sandy beds of the Hell Creek Formation the alluvium and colluvium is nearly 100 percent sand.

Great variation in thickness within short distances is characteristic of fan alluvium and colluvium. Generally, the thickness of colluvium is less than 3 m (10 ft), seldom more than 2 m (6 ft), and averages only 0.3 m (1 ft). There is actually a range from zero at the edge of the upslope part of the deposit to the maximum thickness where the colluvium is in contact with or interfingers with alluvial deposits.

The thickness of alluvial fans ranges from zero at the apex and reaches a maximum about one-third or one-fourth of the distance to the toe. At the toe, the fan alluvium is thin and commonly it interfingers with the adjacent floodplain alluvium. Fans are as much as 15 m (50 ft) thick but average 3 m (10 ft) and seldom exceed 8 m (25 ft) thick. Generally, the deposits have not been mapped where they are less than 0.3 m (1 ft) thick

Qat Alluvial terrace deposits (Pleistocene) —Light-yellowish brown, yellowish brown, grayish brown, and light gray coarse to fine gravel, sand, silt and clay deposited by streams. Deposits are poorly to well-stratified, and poorly to well-sorted. Deposits are 5 to 10 m (15 to 30 ft) above adjacent alluvial deposits. Thickness ranges from 2 to 3 m (6 to 10 ft)

Qc Clinker (Holocene, Pleistocene, and Pliocene)—Very resistant red, pink, orange, black, and yellow metamorphosed shale, siltstone, and sandstone of Fort Union Formation and locally till. Bedrock was baked by natural burning of underlying lignite. Locally, baked rock melted and fused to form buchite, a black, glassy, vesicular, or scoraceous rock. Clinker is very resistant to erosion and caps hills or knolls and forms ledges on steep slopes. This map unit includes colluvium and rubble on 8-15 percent slopes. This map unit includes colluvium and rubble on 8-15 percent slopes. Some areas of clinker are older than till, others are younger. Thickness is as much as 10 m (33 ft) but is commonly only about 4 m (13 ft)

Qls Landslide deposit (Holocene and late Pleistocene?)—Slump, rockfall, and earthflow deposits (individual or in series) produced by gravity downslope movement of bedrock or surficial materials. Colors, textures, and lithologies vary, reflecting parent material. Size of detritus ranges from clay to blocks of sandstone and clinker as large as 3 m (10 ft) in diameter. Thicknesses of some landslide deposits are estimated to be as much as 30 m (100 ft)

Qe Eolium (Holocene and Pleistocene and Pliocene)—Light-brown to light-gray windblown silt (loess) and sand with some granules. Generally massive or crossbedded; quartz grains are commonly frosted. Buried soils (humic horizons) are present locally. Most of the sand grains are well-rounded quartz coated with organic matter; locally the grains are clean angular quartz.

The deposits of windblown sand and silt unconformably overlie all other map units in the area. The deposits are not all of the same age; for example, some of those on the driftless parts of the Flaxville plateau may be as old as early Pleistocene but most of the windblown sand and silt in the driftless areas is probably late Pleistocene or Holocene in age.

Three analyses of eolium indicate that the eolium consists of 7-30 percent clay, 10-38 percent silt, and 51-60 percent sand.

A veneer of eolium, generally 1 m (3 ft) thick, but locally 4 m (13 ft) thick, is present on most flat or nearly flat surfaces throughout the quadrangle

Qgl/Qb

Glacial lake deposits (middle and Late Pleistocene)—Light brown and gray clay, silt and sand with sparse scattered dropstones. Beach bar and strandline deposits are sandy fine to medium pebble gravel deposited as spits, hooks, bay mouth bars, offshore bars. Quiet and deep water deposits are varved. Analyses of glacial lake samples indicated that they range from 22 to 56% clay, 39-50% silt, and 2-30% sand. The size distribution of beach deposits is 3% silt, 49% sand, and 48% gravel. The glacial lake deposits are generally only one to 3 m (3-9 ft) thick. The bar and spit deposits are as much as 5 m (16 ft) thick

Qp Pond deposits (Holocene)—Brown, dark-gray, or black fine sand, silt, and clay in depressions that retain ephemeral ponds. Commonly includes thin laminae of windblown sand and silt. Depressions in the till plain and other areas are partially or completely filled with dark, tough, plastic, organic, silty or sandy clay containing scattered granules and pebbles. Most deposits are less than an acre in areal extent; a few are larger than 1 sq mi (2.6 sq km), all have relatively flat surfaces. Shallow ponds form in them during wet weather but disappear during dry weather.

A sample was composed of 68 percent clay, 26 percent silt, and 6 percent sand. The organic content is high, about 7 percent of a sample was consumed during an ignition test.

The deposits are well-bedded to massive; beds generally are thin. Natural exposures in pond deposits do not exist, but auger holes revealed as much as 5 m (16 ft) of black or brown plastic, stiff clay, and some scattered pebbles. Pond deposits are not indurated or cemented.

Pond deposits are as much as 5 m (16 ft) thick, but the average thickness is only about 2 m (6 ft). Generally, the deposit is thickest near the center, where the closed depression is deepest. The cross section of most deposits resembles that of a shallow bowl

Qo Glacial outwash deposits (Middle and late Pleistocene)—Light-brown, yellowish-brown, brown, and light-gray sand and gravel with minor silt, deposited by glacial meltwater streams. Generally horizontally bedded, well stratified and moderately well sorted. Granules and larger clasts are subrounded to well rounded. Clast lithology in most places is similar to that of the Flaxville Formation, but reworked erratic glacial pebbles, cobbles, and boulders of limestone, dolomite, granite, gneiss, and schist from Canada are conspicuous. Outwash deposits typically consist of 2-18 percent clay, 2-8 percent silt, 20-27 percent sand, 4-20 percent granules, 42-73 percent pebbles, and 2-5 percent cobbles. Outwash deposits associated with the Late Wisconsin Crazy Horse glaciation and the Medicine Lake glaciation have not been differentiated as to age on the map; some ice-marginal channels appear to have been used more than once. The lower parts of some alluvial deposits may be outwash. Most of the outwash deposits are about 3 m (10 ft) thick but some are as much as 6 m (20 ft) thick

Qic Ice-contact stratified deposits (Middle to Late Pleistocene)—Brown to light-brown poorly to well-stratified, poorly- to well-sorted, fine to coarse sand and gravel with minor silt. Deposited by glacial meltwater flowing in channels beneath, within, or on top of ice and, subsequently, let down as the supporting or surrounding ice melted. Deposits are long, discontinuous, narrow and sinuous (eskers), or conical heaps or irregular ridges (kames).

Esker and kame deposits are composed of gravel derived from the Flaxville Formation and numerous clasts of granite, gneiss, limestone-dolomite and other erratic clasts from Canada, and consequently, these deposits are similar except for a small percentage of erratics.

Esker and kame deposits are generally poorly bedded and sorted, but well-stratified silt, sand, or fine gravel beds commonly abut poorly sorted material, or, locally, lenses of till; crossbedding is pronounced in some beds in eskers and kames. Bedding along the sides of eskers tends to be parallel to the side slopes owing to collapse of the retaining ice walls. Local faults and tilted and contorted bedding in the deposits indicate collapse when the enclosing ice melted.

The few exposures seen in the area indicate till is the material underlying esker and kame deposits. Till is on the sides and crests of some eskers and kames, indicating they were formed in and under ice. Locally, esker and kame deposits are overlain by alluvium, colluvium, lake deposits, and eolian deposits.

Thickness of the esker and kame deposits varies greatly within short distances. Generally, they are at least as thick as their height above the immediately adjacent till plain. Therefore, eskers are as much as 20 m (60 ft) thick and kames are as much as 30 m (100 ft) thick

Qt Till (Middle and Late Pleistocene)—Heterogenous mixture of clay, silt, sand, and gravel with rare to abundant cobbles and boulders deposited by continental ice sheets during three glaciations. Nonstratified or very poorly stratified; nonsorted or poorly sorted. Locally faintly layered, particularly near base and top. May be interbedded, intertongued, or intercalated with sand and gravel or clay and silt. Analyses of 11 samples of till indicated the tills are composed of 22-44 percent clay, 30-54 percent silt, 26-31 percent sand, 1-4 percent granules, 1-21 percent pebbles.

Sixteen analyses of samples of till indicate it is almost all fine-grained: 22-55% to clay, 22% silt, 23-31% sand, with 1-2% granules, pebbles, cobbles and boulders. Because pebbles, cobbles, and boulders are left as a lag concentrate on the surface of the till by erosion, it seems that they comprise a large percentage of the till. Most of the till in the Scobey area was deposited in glacial lakes which formed each time the Poplar River was blocked by glacial ice. The floating snouts of the various ice lobes melted and dropped their loads of sediment in the glacial lakes and thus the till was waterlaid. Only on and around the edges of high remnants of the Flaxville Formation was till deposited directly by the ice.

The Scobey 30' x 60' quadrangle was glaciated at least 5 times (Fullerton and Colton, 1986): the first time during pre-Illinoian time; the second during Illinoian time; and the third, fourth, and fifth during Wisconsin time. The oldest glaciation is now represented by scattered Canadian-type erratics around the edges of high remnants of the Flaxville Formation at altitudes as great as 833 m (2800 ft) near Flaxville and 5 miles north of Madoc. An ice-marginal channel crosses the northwest part of the Flaxville Plain in that area. We infer that the meltwater stream flowed across a minor drainage divide at an altitude of at least 833 m (2800 ft). This indicates that during the pre-Illinoian glaciation the ice probably reached corresponding altitudes near Peerless 22 km (14 mi) west of Scobey. Exactly where the limit of pre-Illinoian and Illinoian glaciation is on the west side of the Poplar River Valley is not known because the deposits of those glaciations only consist of scattered Canadian-type erratics such as those found 4 mi NE of Peerless. An almost complete blanket of eolium and glacial lake deposits obscures the distribution of till and erratics. The till resulting from this earliest glaciation has been named the Archer till (Fullerton and Colton, 1986); it is exposed 3 km (2 mi) west northwest of Scobey in the NE ¼ sec. 7, T. 35 N., R. 48 E.) Fig. 1. This is Parizek's phase No. 1 (Parizek, 1964, p. 29).

During Illinoian time glacial ice again invaded the Scobey area from the north and the south. This glaciation, which deposited the Kisler Butte till, was less extensive than the Pre-Illinoian one that surrounded the Flaxville Plain. We infer that the ice margin reached an altitude of 793 m (2600 ft) just east of Scobey. The margin of the lobe on the west side of the Poplar River Valley west of Scobey was probably in a glacial lake and thus consists of thin waterlaid till and iceberg-dropped scattered erratics (dropstones).

The third glaciation to affect the Scobey area occurred in late Wisconsin time. The ice advanced north up the Poplar River from the Missouri River lobe to a point about 1.6 km (1 mile) northwest of Scobey. The till deposited during this glaciation which began approximately 150,000 years ago, is named the Kisler Butte till (Fullerton and Colton, 1986). As the ice advanced, drainage in the Poplar River Valley was blocked and a large glacial lake formed. Strandlines, beach deposits, hooks, bars, spits, and spillways indicate the extent of the lake.

Two minor late Wisconsin glaciations advanced southward across the 49th parallel to a point two miles north of Scobey. These glaciations apparently occurred after the lobe which advanced from the south had retreated; no glacial lake deposits were found on the surface of the till. These late Wisconsin tills have been termed the Crazy Horse till, two and three (Fullerton and Colton, 1986, chart 1).

A readvance about 14,000 years ago deposited the Medicine Lake drift (Fullerton, personal communication) which is present 10 km (6 mi) north of Scobey.

Till generally is preserved only on rolling or relatively flat surfaces. In badlands and other areas of dissected bedrock, it was deposited only as a thin and discontinuous veneer. During interglacial and postglacial intervals, dissection was resumed in those areas and most of the till was removed. Where tills deposited during different glaciations are superposed, each till is commonly discontinuous laterally. Crazy Horse till may be at the surface in one exposure, and in other exposures Archer till may be at the surface. Where till is mapped in areas of intense erosion, only small remnants of the younger Crazy Horse have been preserved and most of the exposed till is the more resistant pre-Illinoian Archer till. Because of the discontinuous lateral distribution of the tills and the sparsity of exposures, the tills deposited during several glaciations cannot be mapped as separate units

Crazy Horse till (late Wisconsin, late Pleistocene)—Yellowish-brown, grayish-brown, brown, brownish-gray, gray, or mottled clay loam and loam. Silty clay or clay where the ice incorporated lake clay and silt in the Missouri River valley; sandy loam and loamy sand where ice incorporated older alluvial sand and gravel. Very calcareous; generally oxidized to depths of as much as 1.2 m (4 ft). Friable; granular or blocky structure. Loose or poorly consolidated; not extremely compact or hard. Slumps readily in exposures. Pencil-shaped columnar joints are common where the till is oxidized. White streaks of secondary carbonate and coatings of powdery gypsum (selenite) locally on joint surfaces. Selenite crystals less than 3 mm (⅛ in) long are present on joint surfaces locally; larger crystal, clusters of crystals, and crusts of selenite are absent. Iron oxide stains typically are present in matrix only adjacent to carbonate grains and granules; generally absent on joint surfaces. Manganese oxide stains very uncommon. Moderately pebbly to very pebbly; pebbles, cobbles, and boulders typically much more abundant than in older tills. Granules and pebbles are subangular to well rounded, dominantly erratic limestone and dolomite from Canada; some granite, gneiss, schist, quartzite, chert, sandstone, siltstone, shale; minor ironstone concretions, clinker, agate, silicified wood, and chalcedony. Lignite fragments are ubiquitous in the matrix. Cobbles and boulders, which are mostly erratic limestone, dolomite, granite, and gneiss, litter till surfaces that have not been cultivated and cleared of large erratics.

Much of the Crazy Horse till was deposited beneath an ice lobe whose front was floating in a lake that covered this area and that debris in the base of the ice fell out as the floating ice melted; thus, this is a water-laid till. Removal of the silt and clay could have occurred during the fall of the debris through the water. Such a lake did exist in this area, so it is inferred that part of the till was deposited this way.

The thickness of the till is as much as 5 m (16.4 ft) and as little as 1 ft but generally is only 1 m (3 ft) thick

Kisler Butte till (Illinoian, late middle Pleistocene)—Pale-yellow, yellowish-brown, grayish-brown, brown, yellowish-gray, brownish-gray, gray, or mottled calcareous clay loam, silty loam, and loam. Silty clay or clay where ice incorporated lake clay and silt in the Missouri River valley; sandy loam or loamy sand where ice incorporated alluvial sand and gravel. Generally oxidized to depths less than 2.4 m (8 ft) where not covered by younger till, less than 1.5 m (5 ft) where covered by younger till. Commonly massive or with blocky structure. Typically very compact but not overconsolidated. Brittle where dry and tends to break around large sand grains and granules. Moderately resistant; typically does not slump in exposures. Parting irregular to platy. Columnar joints 1.25-2.5 cm

(0.5-1 in) apart are common in oxidized till. White streaks of secondary carbonate and coatings of powdery gypsum (selenite) are common on joint and parting surfaces; selenite crystals less than 3 mm (0.12 in) long are common on joint surfaces; larger crystals, clusters of crystals, and crusts of selenite are absent. Iron oxide stains are common on joint surfaces and in oxidized matrix. Minor manganese oxide stains. Locally, granules of erratic limestone and dolomite are abundant. Kisler Butte till is sparingly to moderately pebbly; pebbles, cobbles, and boulders are less abundant than in Crazy Horse till. Granule and pebble composition is similar to that of Crazy Horse till but reworked clasts from older alluvial deposits (Tf) are more abundant. Cobbles are mostly quartzite, ironstone (siderite) concretions, and erratic limestone, dolomite, igneous, and metamorphic rocks from Canada. Erratic boulders are rare in exposures but locally are common as a lag concentrate on the surface. Physical and chemical characteristics of Kisler Butte and Crazy Horse tills are generally similar; the tills are distinguished with difficulty where they are not superposed or are poorly exposed. Thickness is generally 0.6-1.5 m (2-5 ft); rarely more than 2.4 m (8 ft)

Archer till upper Member (pre-Illinoian, early middle Pleistocene)—Pale-yellow, pale-yellowish-brown, pale-olive-brown, grayish-brown, brown, olive, yellowish-gray, brownish-gray, olive-gray, gray, grayish-black, or mottled clay loam, loam, silt loam, and sandy loam; locally loamy sand and light-gray calcareous loam and clay loam. Mechanical analyses show that the till is 25-30 percent clay, 25-40 percent silt, 25-40 percent sand, and 2-15 percent pebbles and cobbles. Colors are typically lighter hues than colors of younger tills; matrix is typically more sandy.

Weakly to strongly calcareous. Generally oxidized throughout where less than 3 m (10 ft) thick and weathered profile was eroded. In buried valleys where till was not eroded subsequently, oxidation may extend to depths of 8-14 m (26-46 ft). Till is overconsolidated, commonly massive, breaks into large irregular blocks. It is very resistant to erosion; thick till commonly erodes to form hoodoos, spires, and pinnacles. Typically intensely jointed where oxidized. Vertical columnar joints commonly are 5-25 cm (2-10 in) apart; in places, oxidized till also has closely spaced horizontal joints and till breaks into plates or blade-like fragments. Individual gypsum (selenite) crystals 0.5-5 cm (0.25-2 in) long, clusters of crystals, seams of crystals, or crusts of crystals are common on joint surfaces or as joint fillings. Brownish-yellow and reddish-brown iron oxide stains and crusts are common on joint surfaces; black manganese oxide stains and crusts occur locally. Typically sparingly pebbly or nearly clast free; very gravelly where ice incorporated older sand and gravel. Granules and pebbles are subangular to well-rounded, chiefly erratic limestone and dolomite from Canada, quartzite, chert, and sandstone; some igneous and metamorphic rocks, ironstone (siderite) concretions, and chert; minor siltstone, shale, clinker, agate, silicified wood, and chalcedony. Large cobbles and boulders are rare in exposures, however where found, they are chiefly limestone, dolomite, granite, and schist from Canada. Where ice-incorporated gravel in terraces, clasts may be entirely reworked from the gravel.

The thickness of the till is highly variable but probably averages 15 ft; it is as much as 46 ft thick 6 mi north of Scobey. Borings made 8 mi north of Scobey and at the international border (Feltis, 1979) indicate that the till is 40 ft and 29 ft thick respectively

Qw Wiota Formation (Early to Late Pleistocene)—Light-brown, brown or gray sand, silt, clay, and fine to coarse gravel. Unit is well stratified to poorly stratified and poorly to well sorted.

In the Scobey area, several pebbles that are Canadian igneous and metamorphic rock types were found in the upper part of pre-till gravel deposits that seem to be identical in overall appearance, altitude (below 827 m (2,700 ft)) and lithology with those sand and gravel deposits at Wiota (Jensen and Varnes, 1964). Jensen and Varnes report (1964, p. F29 and F30) that the Wiota gravels are mostly clay, silt, sandy silt, and sand and that gravel is a minor component. Outcrops in the Scobey area also indicated gravel is a minor part; therefore, the name is changed to Wiota Formation.

Mechanical analyses of samples indicate that the Wiota Formation is poorly graded and contains a large percentage of sand. The lower part of the formation generally consists of moderately well-bedded sandy gravel containing numerous lenses of medium-grained sand and silt. The upper part is generally finer grained and contains intercalated lenses of clay. The formation grades laterally within short distances from deposits consisting entirely of sand, silt, or clay to those consisting of coarse gravel. Because it was stream deposited, the texture of the formation varies from outcrop to outcrop and most exposures exhibit crossbedding. A few feet of silt and fine- to medium-grained sand generally constitute the top of the deposit.

The Wiota Formation unconformably overlies each of the bedrock formations and in turn is unconformably overlain by younger Pleistocene deposits, generally till. In unglaciated areas, the formation is locally thinly veneered with loess, alluvium, and colluvium. In glaciated areas, deposits of the Wiota Formation were overridden and buried by the advancing glaciers, and till was deposited on them. Contacts with underlying units are generally sharp, but contacts with overlying units are not always sharp, especially where the upper part of the Wiota Formation was partly incorporated into the overlying till. Frost action has tended to obscure the upper contact of the Wiota Formation where thin surficial deposits such as loess, alluvium, and colluvium overlie the gravels.

The age of the Wiota Formation probably ranges from Pliocene to middle Pleistocene. Some of the higher older, parts of the formation were probably deposited just after the last and lowest parts of the Flaxville Formation were laid down in late Pliocene time, whereas the youngest and lowest parts were deposited just prior to the pre-Illinoian glaciation.

The earlier parts of the Wiota Formation consist of reworked gravels from the Flaxville Formation and are generally at or above 670 m (2,200 ft) but below 822 m (2,700 ft). The later parts of the Wiota Formation are similar to the older parts but include a small additional percentage of granitic, gneissic, schistose, limestone, and dolomitic pebbles derived from Canada. D.S. Fullerton (personal communication, 1993) concluded that erratics were injected into the upper part of the formation by overriding ice. The later parts of the Wiota are generally below 640 m (2,100 ft). Most of the deposits in the Scobey 30’ x 60’ quadrangle are pediment gravel deposits formed around the edges of remnants of the Flaxville Fm. by erosion of those remnants and deposited as fan deposits.

The thickness of the Wiota Formation varies widely within any given deposit. Jensen and Varnes (1964, p. F28) state that the thickness of the formation is commonly 3-6 m (9-20 ft) and that the maximum observed is 10 m (30 ft) at the type locality Wiota railroad junction which is 104 km (65 mi) south-south west of the Scobey 30’ x 60’ quadrangle

Tf Flaxville Formation (Miocene and Pliocene) —Sand, silt, clay, volcanic ash and gravel.

Collier (1917) first described the Flaxville Formation from exposures near the town of Flaxville. A year later, Collier and Thom (1918) renamed the unit the Flaxville gravel. In the Scobey area, the term “Flaxville Formation” is again used because gravel actually is a minor part of the unit (Whitaker, 1980).

The Flaxville Formation is composed of several lithologic units. In nearly all exposures, the basal part of the formation is a coarse sandy quartzite gravel 6-15 m (20-50 ft) thick. Lenticular sandy and clayey strata 6-12 m (20-40 ft) thick overlie this part of the formation. Volcanic ash was found by Collier and Thom (1918, p. 182) in the gravel about 12 km (8 mi) west of the Scobey 30’ x 60’ quadrangle in secs. 19 and 20, T. 35 N., R. 43 E. Volcanic ash as much as 12 m (38 ft) thick was found by the authors in several other places: in Sections 8, 9 and 16, T. 34 N., R. 46 E., in sections 9, 10, 11, and 13, T. 35 N., R. 48 E., and in Sections 11, 12, 13, and 14, T. 36 N., R. 44 E. U.S.G.S. power auger drilling at the quarter corner between secs. 35 and 36, T. 43 N., R. 32 N. penetrated 7.6 m

(25 ft) of sand, 3 m (10 ft) clay and silt, 1 m (3 ft) clay, 1 m (3 ft) sandstone, 10.4 m (34 ft) sandy clay, and 5.2 m (17 ft) sand. A basal gravel was not penetrated.

Clasts in the Flaxville Formation consist chiefly of well-rounded quartzite pebbles, although smooth, well-rounded cobbles and boulders as large as 1 ft in diameter are also common. Fifty-four to eighty-one percent of the pebbles are fine- to medium-grained quartzite, mostly grayish red but including some yellowish or grayish green. Five to fourteen percent of the pebbles are moderate red chert and jasperlike argillite and a smaller percentage are olive-gray to black argillite, chert, and agate. A minor, but distinctive, group of pebbles is composed of green tinguaite porphyry. Most of the pebbles, cobbles, and boulders in the formation are coated with a moderate yellowish-brown stain, probably iron oxide, which has penetrated the quartzites to depths of as much as one-eighth inch.

Locally, the formation has been cemented by calcium carbonate to form sandstone and conglomerate. Individual beds in the formation range in thickness from 0.3 to 3 m (1 to 10 ft) and most are crossbedded.

The organic content of the formation is very low. However, Russell (1950, p. 58) found two gravels separated by a soil 7.6 cm (3 in) thick indicating a time break during deposition of the formation. The author found thin carbonaceous beds a few miles north of the Wolf Point area.

The map shows a large number of remnants of the Flaxville Formation which are at various altitudes and of various ages – some Miocene and some probably Pliocene. For example, the bases of the remnant of the Formation on Square Butte and Long Butte, 16 km (10 mi) north of the type locality at

Flaxville, are 41 m (135 ft) higher and thus older than the Flaxville Formation at Flaxville. Remnants of the Formation west of Scobey are 20 m (66 ft) lower than those at the type locality and therefore younger.

Vertebrate fossils of Pliocene age are abundant in the Flaxville Formation. Some of these were examined by Gidley (*in* Collier and Thom, 1918, p. 180), who concluded that "the beds from which these fragments were collected cannot be older than Miocene or younger than lower Pliocene." Flaxville Formation is late Miocene in age, according to G.E. Lewis (*in* Denson and Gill, 1965, p. 17). Fossils found by the author were examined by Jean Hough who reported that they were of Pliocene age and probably early Pliocene. Bones of *Hipparion*, *Procamelus*, and mastodon were found.

Zircons from volcanic ash in the Flaxville Formation were examined by Nancy Briggs Naeser for fission tracks (Colton, Naeser, and Naeser, 1986). Three samples of ash were dated as follows:

SE¼ sec. 11, T. 36 N., R. 44 E.; age, 9.6±.9 million years

SE¼ sec. 8, T. 34 N., R. 46 E.; age, 6.4±1 million years

SE¼ sec. 19, T. 35 N., R. 43 E.; age, 8.7±1.1 million years

The thickness of the formation varies considerably. A maximum thickness of 49 m (160 ft) was measured in sec. 35, T. 33 N., R. 43 E., 3 km (2 mi) west of 106° but the average thickness is about 12 m (40 ft). Drilling by the USGS (Gruber, 1980) in the northwestern part of the quadrangle, showed that the formation is 24 m (80 ft) thick in several places. The unit thins to a featheredge around the borders of the mesa-like remnants. The formation unconformably overlies each of the older bedrock units, and in places it is overlain by glacial and eolian deposits

Tfu Fort Union formation (Paleocene)—Yellowish-brown sequence of interbedded continental deposits of sand, sandstone, siltstone, silt, clay, clayey shale, and lignite.

Weathering of outcrops of the Fort Union Formation generally produces lighter and brighter colors than those of the weathered Hell Creek Formation. For example, yellowish-gray shale weathers to light yellowish gray, and dark-grayish-orange sandstone weathers to pale yellowish brown. The formation is relatively free of organic matter other than in the carbonaceous shale and lignite beds.

The Fort Union Formation is conformably underlain by the Hell Creek Formation and unconformably overlain by the Flaxville Formation. The gradational contact between the Hell Creek and the Fort Union Formations is arbitrarily placed at the base of the lowest mappable lignite bed. No dinosaur bones were found above this bed in this area; the absence of dinosaur bones has been used in other areas as a criterion for the recognition of the Fort Union Formation.

Four types of concretions are in the Fort Union—calcareous sandstone, siltstone, limonite, and pyrite. Most of the concretions seen in the field are sandstone and relatively few are siltstone, limonite, and pyrite. Some of the limy sandstone concretions show cone-in-cone structure.

The colors of the different concretions vary widely. For example, the weathered pyrite concretions are dark yellowish brown, but the unweathered interiors of these pyrite concretions are greenish gray. Limonite concretions usually are disk shaped, are from 7.6 to 18 cm (3-7 in) thick, and are moderately yellowish brown to blackish red when weathered. The sandstone concretions range from yellowish gray to medium olive gray.

The beds in the formation are well sorted, and within any one bed there is little variation in grain size. Lateral facies changes are common. Channeling is present locally but is not common.

The contacts between the different kinds of beds range from sharp to gradational. Most of the exposures examined show gradational contacts between beds, but where channeling occurred or where there were short periods of nondeposition, sharp contacts may be seen.

Nearly all the fossils found were plant remains. Vertebrate fossils are very rare in the formation; a few shells of the *Unio* freshwater dam were found.

The sediments of the Fort Union Formation were deposited by eastward-flowing streams meandering on a broad swampy flood plain that slowly subsided until at least 304 m (1,000 ft) of the formation accumulated in this area.

The Fort Union Formation contains many beds of lignite that are as much as nine feet thick. The formation underlies most of the Scobey area, and resources of lignite are large. The lignite beds and resources in Daniels County were discussed by Collier (1924). Biewick and others (1990) evaluated the coal resources in the southeastern part of the area. Several studies of coal resources in the Ft. Peck Indian Reservation were made by Hardie and Arndt (1981, 1987, 1988, 1989, 1990), by Arndt and Hardie (1985), by Arndt, Hardie, and Kehn

(1982a, 1982b) and by Hardie and Van Gosen (1986). Mudge and others (1977) analyzed the status of mineral resource information for the Fort Peck Indian Reservation which includes the southern part of the Scobey 30' x 60' quadrangle.

The upper part of the Fort Union Formation was removed by erosion before the deposition of the Flaxville Formation. As a result of structural deformation, the thickness of the formation varies considerably throughout the area. The thickest remnant is in the northeastern part of the area where approximately 300 m (984 ft) of strata remain

Hell Creek Formation (Upper Cretaceous)—Well stratified shales, siltstones, sandstones, and carbonaceous shales. The lower 15-30 m (50-100 ft) is predominantly a medium-tan friable sandstone; the upper half is gray siltstone and shale. The overall color of the formation is a somber greenish gray. Weathered surfaces of many bentonitic shale beds have a spongy appearance.

The lower half of the formation consists of beds of coarse sandstone with abundant dark minerals that contrast markedly with the underlying fine-grained, lighter colored sandstone of the Fox Hills Formation. Large-scale crossbedding in channels contrasts sharply with the underlying parallel-bedded sandstone of the Fox Hills Formation.

The lower half of the formation is a conglomeratic sandstone that contains mud balls as much as 0.3 m (1 ft) in diameter, fragments of sandstone, limonite concretions, sparse well-rounded olive-gray quartzite pebbles several inches in diameter, and fragments of dinosaur bone and petrified wood. Many large blocks of lignite and silicified wood are also included locally. Some lignitized wood fragments and quartzite pebbles are present at and above the contact with the Fox Hills Formation, but none were found below this contact.

Large, log-shaped, crossbedded calcareous sandstone concretions are in the basal conglomeratic sandstone unit of the Hell Creek Formation, and are especially common in the lower 30 m (100 ft). The concretions are circular to oval in cross section and range in diameter from 1-2 m (3-6 ft) and in length from 3-10 m (10-30 ft). Spherical concretions as much as 7.6 cm (3 in) in diameter are also common in the sandy lower half of the formation.

The upper half of the formation consists mainly of sandstone, siltstone, claystone, carbonaceous shale and lignite. Individual beds are generally 0.3-1 m (1-3 ft) thick and of uniform texture over short distances. Sandstone beds are more lenticular than are siltstone and claystone beds. The rest of the unit consists of bentonitic and carbonaceous shale beds. The bentonitic shale outcrops have a characteristic spongy appearance caused by the swelling of the bentonite. The carbonaceous shales, which contain a large proportion of macerated plant fragments, are brown, thick bedded, and fissile. The strata generally are greenish gray but some are shades of light olive gray, brownish gray, and gray. Because of its dull color, the formation has been referred to informally by some writers as the "somber beds." The carbonaceous shale beds are as much as 2.7 m (9 ft) thick.

Dinosaur bones and bone fragments are common throughout the formation, and in some areas their presence is enough to differentiate the strata in which they occur from the underlying Fox Hills Formation and the overlying Fort

Union Formation. Most of the vertebrate remains found are of Triceratops (R.W. Brown, personal communication, 1951).

Several pieces of fossil wood were found in conglomeratic beds in the lower part of the formation. Most of the wood is silicified but some is limonitized. One log, 1.5 m (5 ft) long and 15 cm (6 in) in diameter, was found in the southwest corner of the quadrangle in sec. 21, T. 32 N., R. 44 E. Richard A. Scott, U.S. Geological Survey (personal communication), examined fragments of this log and found it to be petrified wood of the conifer *Cupressaceae*(?). Fragments of several other logs were found in this general vicinity.

The range in color of the formation is virtually from black to white. The carbonaceous shale and lignitic beds are black and weather to grayish black; some of the sandstone beds that are nearly white in appearance are actually light yellowish gray and weather to about the same color. Shale beds are light gray or olive gray and weather to pale olive. Some of the sandstone is dusky yellow and dark yellowish orange and weathers to pale olive.

An analysis of measured sections of the Hell Creek Formation revealed that 61 percent is sandstone, 4 percent is siltstone, 34 percent is claystone and shale, and 1 percent is carbonaceous shale and lignite.

The Hell Creek Formation unconformably overlies the Fox Hills Formation, conformably underlies the Tertiary Fort Union Formation, and fills channels in the Fox Hills Formation in many places. Most of the channels are 3-5 m (10-15 ft) deep but one was 15 m (45 ft) deep. Channels are filled with fragments of limonite concretions and scattered gray quartzite pebbles (Bauer, 1925).

The contact between the Hell Creek Formation and the overlying Fort Union Formation is gradational. Brown (1962, p. 9) has described the contact as follows: "The base of the Fort Union Formation is marked by a persistent lignitic zone or lignite bed, above which lignite beds are common and below which even discontinuous lignite beds are uncommon. At or within 15 m (50 ft) above the first persistent lignite bed, the somber colors typical of the Hell Creek Formation yield to brighter yellowish colors typical of the Fort Union Formation. Below this contact, dinosaur bones may be found but are lacking above it."

The continental Hell Creek Formation was deposited by streams flowing across a vast floodplain. The basal conglomerates probably were deposited by swiftly flowing streams and the finer grained upper half of the formation was deposited probably by more sluggish streams. Many of the beds of shale and lignite were probably deposited in shallow standing water.

The thickness of the formation ranges from 52 to 86 m (170-282 ft); the average is about 76 m (250 ft)

Kfh Fox Hills Formation (Late Cretaceous)—Shale and siltstone 18 m (60 ft) thick in the lower part and an overlying continental cliff-forming sandstone as much as 10.6 m (35-40 ft) thick.

The colors of the lower transition beds become gradually lighter upward from the dark olive gray of the Bearpaw shale to light olive gray. Shale beds are darker than sandy beds, which are olive brown, yellowish brown, or dusky yellow. As the sandstone part of the formation weathers, it changes from pale yellowish brown to yellowish brown or to dark yellowish orange. The lower part of the formation consists of parallel-bedded layers of gray shale, siltstone, and fine-grained clean sandstone a few inches thick. These grade upward from more clayey beds at the bottom to more sandy crossbedded layers at the top. The upper part of the formation is a crossbedded fine-grained sandstone. In most places, spheroidal calcareous sandstone concretions predominate in a matrix of unconsolidated sand. Locally, however, the sand has been cemented by calcium carbonate into a ledge-forming sandstone.

The Fox Hills Formation is conformably underlain by the Bearpaw shale and unconformably overlain by the Hell Creek Formation. Stream channels, locally as much as 15 m (50 ft) deep, were cut into the Fox Hills Formation prior to deposition of the Hell Creek Formation. In these places, the overlying Hell Creek Formation rests upon the transitional shale beds of the lower part of the Fox Hills Formation. The unconformity on the top of the Fox Hills Formation was first detected in Garfield County, Mont. (Brown, 1907), and was subsequently mapped in northern Garfield County by F.S. Jensen, R.W. Brown, J.O. Kistler, and R.B. Colton in 1950 and traced northward into the area.

Several types of concretions are in the formation. The largest and most abundant are disk shaped and occur in the upper sandstone part of the formation. Ball-shaped pyrite concretions as much as 5 cm (2 in) in diameter are common. Disk-shaped limonite or clay ironstone concretions as much as 15 cm (6 in) in diameter are abundant. Soft, white, round, very fine grained sand concretions as much as 5 cm (2 in) in diameter are scattered through some of the sandstone beds. Large disk-shaped aragonite concretions as much as 0.6 m (2 ft) in diameter and several inches thick are common in some strata in the transition beds.

All the cemented sandstone in the upper part of the formation above the transition beds is calcareous, but the transition beds of the lower part are noncalcareous. Carbonaceous shale and lignite occur locally in the upper part of the formation.

The basal transition beds of the Fox Hills Formation were deposited in the same shallow sea in which the underlying Bearpaw shale was formed, but during Fox Hills time the sea gradually became shallower. Eventually, the shoreline migrated eastward, leaving the Scobey area above sea level, and the uppermost part of the Fox Hills Formation was deposited in a littoral environment.

The formation varies greatly in thickness within short distances, and in places it has been almost completely removed by erosion

Kb Bearpaw Shale (Upper Cretaceous)—Olive-gray and dark-gray fissile marine shale containing numerous bentonite beds and fossiliferous concretionary zones. A complete discussion of these zones appears in Jensen and Varnes (1964, p. F5-F11).

The unit is chiefly olive-gray shale. Two mechanical analyses of the shale made by the Materials Testing Laboratory, Montana State Highway Commission, Helena, Mont., indicate that the shale consists of a silty, slightly sandy clay; clay and silt range from 62 to 67 percent and sand ranges from 33 to 38 percent. A wet analysis by the U.S. Corps of Engineers showed that weathered shale is 5 percent sand, 40 percent silt, and 55 percent clay (Jensen and Varnes, 1964, fig 18) (n.b. the title for fig. 18 belongs where the title for fig. 5 is; the title for fig. 5 belongs where the title of fig. 18 is). The clay fraction is tough, highly plastic, and has high compressibility.

Bentonite interbedded in the shale occurs as beds or as disseminated particles, and because of its swelling properties imparts a spongy texture to the weathered surfaces of the shale. Several beds of bentonite crop out in the area but none are well enough exposed to map. An examination of eight bentonite samples by Byrne and Farvolden (1959, p. 19) showed that montmorillonite is the only clay mineral present. The color of unweathered bentonite ranges from pale green to pale yellow. Lower contacts of the bentonite beds are sharp but upper contacts are gradational.

Two types of concretions occur in the Bearpaw shale. The most abundant concretions, composed of iron oxide and clay, are as much as15 cm (6 in) in diameter and are disk shaped. Other concretions consisting of medium-dark-gray nearly pure limestone are round, egg-shaped, or irregularly rounded, and their diameters range from 15 cm to 2 m (6 in to 6 ft); most are about 30 cm (1 ft). The interiors of many limestone concretions are full of shrinkage cracks; some have been partly filled with yellow calcite crystals and a few contain barite crystals. Many of the limestone concretions contain well-preserved fossils such as baculites and scaphites, but only a few of the ironstone concretions contain fossils and these are poorly preserved.

Several fossiliferous concretion horizons were recognized by Jensen and Varnes (1964) in the Fort Peck area but only the three uppermost zones are exposed in the Scobey area. Here, the zones could not be traced laterally because of the general thick cover of till.

The Bearpaw shale was deposited in a sea as indicated by the numerous marine fossils. Bentonite beds and disseminated bentonite in the shale indicate that many volcanic eruptions occurred during the deposition of the shale (Byrne and Farvolden, 1959, p. 19).

The formation is transitional into beds of the Fox Hills Formation. The base of the Bearpaw shale is not exposed in the area, but to the west it conformably overlies the Upper Cretaceous Judith River Formation. A comprehensive description of the Bearpaw shale is in Jensen and Varnes (1964, p. F5-F11).

According to Collier and Knechtel (1939, p. 9), the formation is approximately 305 m (1,000 ft) thick in this part of Montana. F.S. Jensen (written communication, 1951) reports that the formation is more than 347 m (1,140 ft) thick. Bateman (*in* Colton and Bateman, 1956) reports that the thickness ranges from 335 to 361 m (1,095 to 1,186 ft). Because of poor exposures, no sections of the shale were measured in the Scobey quadrangle; only the upper hundred feet of the formation are exposed.

In the early 1950's, geologic mapping of the Scobey 30' x 60' quadrangle was done in part on 15' topographic maps which had been compiled by the U.S. Geological Survey from General Land Office township plots at 1:31,680. These maps had a contour interval of 6 m (20 ft) and were made for the Fort Peck Indian Reservation in 1890. Geologic contacts were adjusted to these old plane-table topographic maps (Colton, 1964). In the 1970's, a Water Resources Division Project made it necessary to map the geology of the Flaxville, Four Buttes, and Scobey 15' quadrangles at 1:24,000. The Energy Lands Project made it necessary to compile the Scobey 30' x 60' quadrangle at a scale of 1:100,000. The geologic maps were reduced photographically from a scale of 1:50,000 to a scale of 1:100,000 and compiled on a base enlarged from the Army Map Service 1:250,000 scale topographic map of the Scobey 1° x 2°quadrangle. When a new base map of the Scobey 30' x 60' quadrangle (1:100,000 scale) became available in 1979, the 1:100,000 scale compilation was photographically transferred to the new base. The geologic contacts which were adjusted to old topography have not been adjusted to the new topographic base map

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Base from U.S. Geological Survey
Scobey 30' x 60' topographic quadrangle

SCALE 1:100 000
1 CENTIMETER ON THE MAP REPRESENTS 1 KILOMETER ON THE GROUND
CONTOUR INTERVAL 20 METERS

KILOMETERS 1 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
MILES 1 0 1 2 3 4 5 6 7 8 9 10 11 12 13
1000 0 5000 10 000 15 000 20 000 METERS
5000 0 10 000 20 000 30 000 40 000 50 000 60 000 70 000 FEET

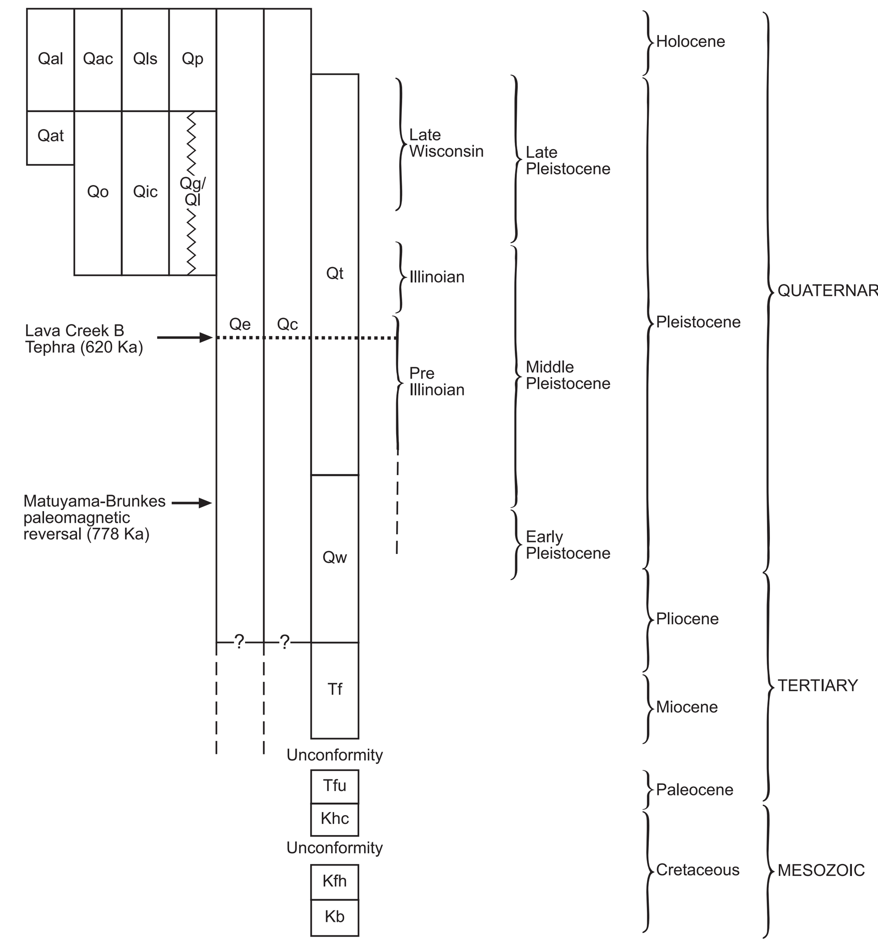
MAP SYMBOLS

Contact: Dashed where approximated, dotted where concealed

DESCRIPTION OF MAP UNITS

- Qal — Alluvium (Holocene and Late Wisconsin)
- Qac — Alluvial and colluvial deposits (Holocene and Late Pleistocene)
- Qat — Alluvial terrace deposits (Pleistocene)
- Qc — Clinker (Holocene, Pleistocene, and Pliocene)
- Qls — Landslide deposit (Holocene and Late Pleistocene?)
- Qe — Eolium (Holocene and Pleistocene and Pliocene)
- Qgl/Qb — Glacial lake deposits (Middle and Late Pleistocene)
- Qp — Pond deposits (Holocene)
- Qo — Glacial outwash deposits (Middle and Late Pleistocene)
- Qic — Ice-contact stratified deposits (Middle to Late Pleistocene)
- Qt — Till (Middle and Late Pleistocene)
- Qw — Wiota Formation (Early to Late Pleistocene)
- Tf — Flaxville Formation (Miocene and Pliocene)
- Tfu — Fort Union Formation (Paleocene)
- Khc — Hell Creek Formation (Upper Cretaceous)
- Kfh — Fox Hills Formation (Late Cretaceous)
- Kb — Bearpaw Shale (Upper Cretaceous)

CORRELATION OF MAP UNITS



INDEX TO TOPOGRAPHIC MAPPING

106° 49°00' — 105° 49°00'

Flaherty Coulee	Carbert	Four Buttes NW 1	Four Buttes NE 1	Scobey NW 1	Si Merrell Slough 1	Whitetail 1	Goodale Coulee 1
Horseshoe Basin	Peerless	Killenbeck Reservoir 1	Four Buttes 1	Scobey 1	Madoc 1	Flaxville 1	Navajo 1
West Fork	West Fork NE	Peerless4 NW	Peerless4 NE	Cabarett Coulee	Line Coulee	Pleasant Prairie NW	Pleasant Prairie NE
Haugens Hill	Poplar Coulee	Peerless4 SW	Peerless4 SE	Nielsen Coulee	Bredette	Pleasant Prairie SW	Pleasant Prairie

48°30' 106° — 48°30' 105°

Aerial photography used during the mapping of the geology of the Scobey 30' x 60' quadrangle was done using 1972 USGS aerial photography project SWGJ; scale 1:33,800, using a 3.5-inch focal length camera.

SOURCES OF GEOLOGIC MAPPING

1. Colton, R.B., Whitaker, S.T., Ehler, W.C., and Fuller, H.K., 1978, Geologic map of the Four Buttes, Scobey and Flaxville Quadrangle (15’), Daniels County, Montana: U.S. Geological Survey Open-File Map 78-898.

Note:

1. The geologic information on this map was prepared by the authors as part of field studies for the U.S. Geological Survey. Although the maps have been peer-reviewed for scientific interpretation, the report is preliminary and has not been edited to conform with U.S. Geological Survey publication standards.

2. The Montana Bureau of Mines and Geology is publishing this information with the cooperation of the U.S. Geological Survey and has not edited or reviewed the document.

3. The map is a scan of a map hand-drawn by the authors. The collar information is from documents provided by the authors. Layout of the final map was done by Susan Smith, Geologic Cartographer, MBMG.

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MBMG Open File 541

Geologic Map of the Scobey 30' x 60' Quadrangle (Surficial Emphasis), Daniels, Roosevelt, McCone, and Valley Counties, Montana

By

Roger B. Colton, David S. Fullerton, William C. Ehler, Steven T. Whitaker, and Margaret S. Ellis

U.S. Geological Survey

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