WYOMING STATE GEOLOGICAL SURVEY
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Geology - Interpreting the past to provide for the future

USGS science for a changing world

Prepared in cooperation with the U.S. GEOLOGICAL SURVEY

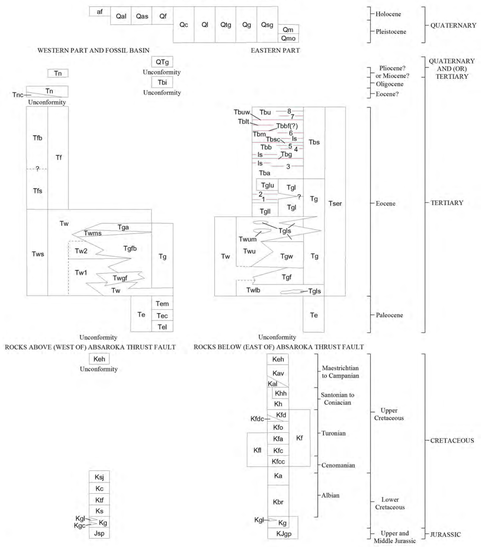
OPEN FILE REPORT 04-6
Evanston 1:100,000 - scale Geologic Map
Sheet 1 of 2

GEOLOGIC MAP OF THE EVANSTON 30' x 60' QUADRANGLE, UINTA AND SWEETWATER COUNTIES, WYOMING

by
J.H. Dover and J.W. M'Gonigle, 2004
digitized from J.H. Dover and J.W. M'Gonigle, 1993

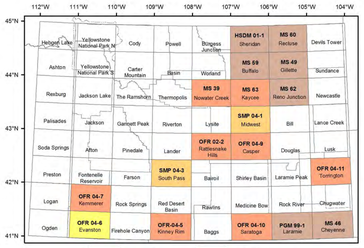
EXPLANATION

CORRELATION OF MAP UNITS



MAP SYMBOLS

- **Contact**—Dashed where approximately located; queried where uncertain
- **High-angle fault**—Dashed where approximately located; dotted where concealed; queried where uncertain. Bar and ball on downthrown side
- **Thrust or reverse fault**—Dashed where approximately located; dotted where concealed; queried where uncertain. Sawteeth on upper plate
- **Overturned thrust fault**—Dashed where approximately located; dotted where concealed. Sawteeth on upper plate
- **Lineament**—Possible fracture or fault trace mapped from aerial photographs; in southwestern part of quadrangle
- **Fold**—Showing crestline and direction of axial plunge
- **Syncline**
- **Trace of bedding, marker bed, or morainal ridge**
- **Limestone or marlstone bed**—Arrow indicates pinchout of bed
- **Landslide scarp**—Hachures point downslope
- **River terrace scarps**—Locally mapped in terrace deposits (Qtg) along Black Forks River
- **Windblown sand and sand dunes**—Pattern indicates approximate boundary (after Gibbons, 1986)



INDEX TO 1:100,000-SCALE BEDROCK GEOLOGIC MAPS OF WYOMING

Projection: Universal Transverse Mercator (UTM), zone 12
North American Datum of 1927 (NAD 27)
10,000-meter grid ticks: UTM, zone 12
25,000-foot grid ticks: Wyoming State Plane Coordinate System, West and West Central Zones

SCALE 1:100,000
Contour Interval 20 meters

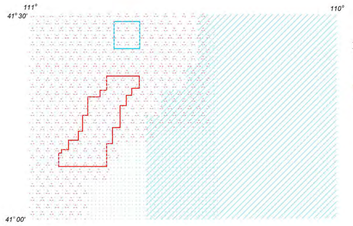
0 1 2 4 6 8 10 12 14 16 18 20 Kilometers
0 1 2 3 4 5 6 7 8 9 10 11 12 Miles
0 2,000 4,000 6,000 8,000 10,000 12,000 14,000 16,000 18,000 20,000 Meters
0 5,000 10,000 15,000 20,000 25,000 30,000 35,000 40,000 45,000 50,000 55,000 60,000 65,000 Feet

UTM GRID CONVERGENCE (GN)
1982 MAGNETIC DECLINATION (MN) AT CENTER OF SHEET
DIAGRAM IS APPROXIMATE

Geology mapped in 1978-82 and compiled from sources shown on index map. Minor corrections and revisions by R.W. Jones, 2004.

Prepared in cooperation with the U.S. Geological Survey, National Cooperative Geologic Mapping Program, under Cooperative Agreement Number 03HQAG0097.

Digital cartography by Justin M. Mulbay and Joseph M. Huss



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- Worrall, 1977, scale 1:48,000
- Vuntch, 1907, scale 1:125,000
- Schroeder, unpublished mapping, 1982, scale 1:24,000
- Schroeder and Lunceford, 1979, scale 1:24,000
- Schroeder, 1977, scale 1:24,000
- Schroeder, 1976, scale 1:24,000
- Schroeder, 1979, scale 1:24,000
- Lawrence, 1962, scale 1:31,680

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Sheet 2 of 2

DESCRIPTION OF MAP UNITS

Surficial deposits

af — **Artificial fill (Holocene)**

Qal — **Alluvium (Holocene and upper? Pleistocene)**—Unconsolidated, crudely to well-stratified clay, silt, sand, and gravel deposited along present main streams, primarily as channel-fill and flood-plain deposits; locally includes alluvial-fan and terrace deposits, valley-side colluvium or talus, and sediments deposited in small bogs, lakes, or deltas; gradational into other surficial deposits. Thickness locally exceeds 33 feet (10 m)

Qas — **Secondary-stream alluvium (Holocene and upper? Pleistocene)**—Undifferentiated alluvium, colluvium, and alluvial-fan deposits in tributary stream valleys and drainage basins; commonly graded to terraces above level of main stream channels. Locally includes small landslide deposits. Grades into other surficial deposits. Thickness locally more than 16 feet (5 m)

Qf — **Alluvial-fan deposits (Holocene and upper? Pleistocene)**—Unconsolidated, crudely stratified alluvium and colluvium forming well-defined fan-shaped deposits at mouths of tributary valleys. Thickness variable, commonly 33 feet (10 m) or more

Qc — **Colluvium (Holocene and Pleistocene)**—Unconsolidated and unstratified angular debris mantling major stream-valley sides, tributary valleys, and hill slopes; locally includes soil and gravel. Thickness variable, commonly 3 feet (1 m) or more

Ql — **Landslide deposits (Holocene and Pleistocene)**—Slumps, landslides, and mudflows of soil and rock. Includes unconsolidated angular rock debris and large slump blocks that have moved or rotated downslope in mass under gravity, commonly as a result of removal of lateral support. Colored on map according to formation involved; landslide scarp shown by hachured symbol. Thickness locally more than 33 feet (10 m)

Qtg — **Terrace deposits and gravel (Holocene and Pleistocene)**—Sand, silt, and unconsolidated boulder, cobble, and pebble gravels occurring in numerous terraces or benches at various levels above present streams. Some terrace levels represent glacial outwash trains graded to moraines in the Uinta Mountains to the south; other terrace levels represent redistributed older, higher-level conglomerate and gravel deposits. Thickness variable, usually less than 16 feet (5 m)

Qg — **Gravel (Holocene and Pleistocene)**—Unconsolidated gravel veneer or pavement commonly on pediment surfaces; includes lag concentrate from erosion of nearby formations; commonly caps dissected pediment surfaces or pediment remnants. Thickness variable, locally more than 16 feet (5 m)

Well-rounded clasts from Keetley Volcanics (Oligocene)—As much as 6 inches (15 cm) in diameter; originally derived from Norwood Tuff (unit Tn)

Well-rounded clasts from Evanston Formation (Paleocene and Upper Cretaceous)—Quartzite, carbonate, and sandstone clasts recycled from, and having identical range of composition and size as, clasts in conglomerate of Evanston Formation; original source of clasts was Precambrian and Paleozoic rocks in thrust sheets to the west

Qsg — **Slumped gravel (Holocene and Pleistocene?)**—Slumped blocks of semiconsolidated boulder and cobble conglomerate and/or gravelly rubble derived from adjacent conglomerate and gravel benches. Thickness variable, usually less than 16 feet (5 m)

Qm — **Moraine (Pleistocene)**—Poorly sorted bouldery till having well-defined lateral and terminal ridges and kettles; typically slumped. Thickness uncertain, probably at least 230 feet (70 m) locally

Qmo — **Older moraine (Pleistocene)**—Poorly sorted glacial till having subdued morphology; much more extensively slumped and forested than unit Qm. Thickness uncertain, probably at least 131 feet (40 m) locally

QTg — **High-level terrace gravel (Quaternary and/or Tertiary)**—Boulder and cobble gravels on terraces and pediments more than 246 feet (75 m) above present major stream drainages. Contains mainly well-rounded Precambrian quartzite clasts, possibly recycled from the Bishop Conglomerate (unit Tbi), but probably from the Uinta Mountains to the south. Usually less than 16 feet (5 m) thick

Tertiary rocks (Western part and Fossil basin)

Tbi — **Bishop Conglomerate (Oligocene)**—Poorly consolidated boulder and cobble conglomerate; well-rounded clasts of predominantly Precambrian quartzite from the Uinta Mountains, as well as Paleozoic sandstone, chert, limestone, and cherty limestone; sand and gravel matrix. Unit generally poorly sorted. Completely indurated in local areas, cemented with coarse-grained to sucrosic calcite. Occurs in southern part of quadrangle as isolated ridge caps thought to be remnants of a formerly much more extensive sheet which capped a pediment surface graded to the Uinta Mountains. Commonly more than 131 feet (40 m) thick

Tn — **Norwood Tuff (Oligocene and Eocene?)**—White to light-gray, moderately indurated, tuffaceous and limey sandstone and siltstone containing gritty to pebbly lenses, disseminated cobbles and boulders, and scattered volcanic ash beds. Contains well-rounded purple, tan, and green porphyritic and vesicular volcanic clasts similar in intermediate composition and texture to rocks in the Keetley volcanic field to the south; other clasts are mainly quartzite and limestone. Commonly covered by veneer of lag gravel in which coarser clasts from the Norwood Tuff are concentrated. Contains unidentified mammal bone fragments. Ash bed above basal conglomerate yields fission-track age on zircon of 34.4± 1.3 millions of years before present (Ma) (C.W. Naeser, written communication, 1981). Unit mapped may contain some of the Gooseberry Member (Pliocene? or Miocene?) of Fowkes Formation (Oriel and Tracey, 1970); mapped only in Bear River area along west edge of quadrangle. Local thickness at least 984 feet (300 m)

Tnc — **Basal conglomerate (Eocene?)**—Poorly consolidated boulder and cobble conglomerate having a white tuffaceous and calcareous sandstone matrix; characterized by abundant well-rounded clasts of Keetley Volcanics (Oligocene). Thickness unknown

Tf — **Fowkes Formation (Pliocene? and Eocene)**—Generally light-colored, partly tuffaceous mudstone, siltstone, and sandstone; locally contains ostracodal and gastropodal limestone. Not present in eastern part of quadrangle. Thickness ranges from 492 feet (150 m) to as much as 2887 feet (880 m)

Tfb — **Bulldog Hollow Member (middle Eocene)**—Greenish-gray and green tuffaceous sandstone and siltstone and interbeds of ostracodal and gastropodal limestone; member contains late Bridgerian mammal fauna (Nelson, 1973). Disseminated biotite and hornblende crystals are characteristic and locally abundant. Oriel and Tracey (1970) reported a K-Ar age on hornblende of 47.7± 1.5 Ma; recalculation using new constants (Dalrymple, 1979) give a K-Ar age of 48.9 Ma. Unit may be as much as 2297 feet (700 m) thick

Tfs — **Sillem Member (middle Eocene)**—Pale-pink, buff, and gray, slightly tuffaceous mudstone, claystone, and sandstone containing conglomerate lenses and ostracodal or algal limestone and marlstone interbeds. Basal contact with Wasatch Formation is gradational; thickness reported by Oriel and Tracey (1970) ranges from 98 to 394 feet (30 to 120 m)

Wasatch Formation (middle and lower Eocene and upper Paleocene?)—Red, brown, green, yellow, and gray sequence of mudstone, fluvial sandstone, siltstone, and claystone; subordinate diamictite, conglomerate, grit, marlstone, and pisolitic limestone. Formation varies from west to east across quadrangle. See correlation of map units for members found in western and eastern parts of map area. As much as 1050 feet (320 m) thick in western part; about 1017 feet (310 m) thick in eastern part of quadrangle

Tw — **Main body of Wasatch Formation (middle and lower Eocene)**—Variegated but mainly red interbedded sequence of mudstone, fluvial sandstone, siltstone and claystone, conglomerate, and marlstone. Thickness at least 1050 feet (320 m)

Tw2 — **Upper part (middle and lower Eocene)**—Above angular unconformity developed along western margin of Fossil basin; merges with unit Tw to south and west. About 459 feet (140 m) thick in map area

Tw1 — **Lower part (lower Eocene)**—Mapped where unconformably overlain by unit Tw along western margin of Fossil basin; merges with unit Tw elsewhere. About 459 feet (140 m) thick where mapped

Tws — **Slumped masses of Wasatch Formation**—Mapped only along southern border of quadrangle. Thickness variable; locally includes all of unit

Twms — **Southern mudstone tongue (lower Eocene)**—Red mudstone, shale, and minor sandstone. Derived from main body of Wasatch Formation (unit Tw) and lies stratigraphically between Angelo (Tga) and Fossil Butte Members (Tgfb) of Green River Formation in southern part of quadrangle. Pinches out both to the north in the Kemmerer quadrangle and to the east, and merges into unit Tw south of quadrangle. Does not merge with unit Twm to the north in Kemmerer quadrangle. Maximum thickness about 131 feet (40 m)

Twgf — **Calcareous member (lower Eocene)**—Light-gray to tan, crossbedded sandstone and shale unit containing 1.5- to 3-foot (0.5- to 1-m) thick light-gray limestone beds similar to those in Green River Formation. Merges with Fossil Butte Member (unit Tgfb) of Green River Formation to the north and east and merges with lower part of Wasatch Formation (Tw) to the south. As much as 262 feet (80 m) thick

Tg — **Green River Formation (lower Eocene)**—Gray to tan limestone, gray to brown shale, and beds of marlstone, oil shale, and tuff. Formation varies from west to east across map area. See correlation of map units for members found in western and eastern parts of map area. About 328 feet (100 m) thick in western part of quadrangle and about 525 feet (160 m) thick in eastern part

Tga — **Angelo Member**—Light-gray to buff, mainly white-weathering siliceous limestone, calcareous shale, and siltstone; includes subordinate tan or laminated limestone, brown algal limestone, marlstone, sandstone, and brown organic shale. Calcareous beds interfinger with sandstone and shale beds of Wasatch Formation to the south and southwest. Maximum thickness about 131 feet (40 m)

Tgfb — **Fossil Butte Member**—Includes light-gray, tan, and buff limestone, calcareous siltstone, marlstone, and shale; brown, laminated carbonaceous shale and very thinly laminated ("papery") oil shale; tuffaceous interbeds common. Some calcareous beds rich in fossil-fish remains; algal, gastropodal, and ostracodal limestones occur mainly along basin margins between Sillem Ridge and Absaroka thrust fault. Grades into and interfingers with light-gray to buff sandstone and pale-red mudstone beds of Wasatch Formation to the south and southwest. Thickness about 197 feet (60 m)

Upper part (Paleocene) of Evanston Formation (Paleocene and Upper Cretaceous)

Te — **Upper unit (upper to middle Paleocene)**—Gray claystone and siltstone containing tan sandstone, carbonaceous claystone, and coal interbeds and a prominent zone of boulder conglomerate beds. Lies with major angular unconformity on pre-Tertiary rocks, including Hams Fork Conglomerate Member (unit Keh) of Evanston Formation along Absaroka thrust; may be disconformable on Hams Fork Member elsewhere. Late to middle Paleocene age based on palynomorphs (D.J. Nichols, written communication, 1980-82; Lamerson, 1982) and vertebrate fauna (Gazin, 1956; Oriel and Tracey, 1970). Locally as much as 984 feet (300 m) thick

Tem — **Main body (upper and middle Paleocene)**—Gray carbonaceous claystone and siltstone and tan sandstone interbeds; gritty and coaly interbeds present locally. Mapped only in small area along Absaroka thrust at northern edge of quadrangle. Age based on palynomorphs (D.J. Nichols, written communication, 1980-82; Lamerson, 1982). Maximum thickness 656 feet (200 m)

Tec — **Conglomerate unit (middle? Paleocene)**—Poorly consolidated boulder and cobble conglomerate containing well-rounded clasts mainly of quartzite; lithologically identical to and probably derived from Hams Fork Conglomerate Member (unit Keh). Mapped only in Shurtleff Creek-Clear Creek area along Absaroka thrust. Age indicated by stratigraphic position. Maximum thickness estimated at 164 feet (50 m)

Tel — **Lower unit (middle and upper lower? Paleocene)**—Gray carbonaceous claystone and siltstone; not distinguishable from unit Tem without intervening conglomerate of unit Tec. Mapped only in Little Muddy Creek area along Absaroka thrust. Age based on palynomorphs (D.J. Nichols, written communication, 1980-82; Lamerson, 1982). Maximum thickness about 164 feet (50 m)

Tertiary rocks (Eastern part)

Bridger Formation (middle Eocene)—Light- and medium-gray to greenish-gray mudstone, claystone, siltstone, and sandstone; minor interbeds of light-gray and green tuff, tan to light-gray limestone and marlstone; and thin lignite and coal. Pink or red colors sparsely developed. Nomenclature follows that of McGrew and Sullivan (1970, p. 68). Boundaries of stratigraphic and biostratigraphic subdivisions have been placed at certain widespread limestone and marlstone interbeds or "white layers" (Sinclair, 1906; Matthew, 1909; Koenig, 1960; Bradley, 1964; and McGrew and Sullivan, 1970). Several widespread limestone layers have been numbered on this map. Middle Eocene age is assigned on the basis of vertebrate fauna and radiometric ages (Mauger, 1977; Berggren and others, 1978). Formation is at least 1821 feet (555 m) thick in map area

Tbs — **Slumped masses of Bridger Formation**—Blocks and gravel from the ridge-capping Bishop Conglomerate (unit Tbi), as well as transitional facies to sandstone and conglomerate of Wasatch-type lithologies along southern border of quadrangle. Unit poorly exposed; thickness variable

Tbu — **Upper part**—Base bounded by upper white layer of Matthew (1909) (unit Tbuw). Includes upper part of horizons D and E of Matthew (1909). Top eroded, not exposed in quadrangle. Near top of unit, directly below Bishop Conglomerate (unit Tbi) on Cedar and Sage Creek Mountains, is a prominent 15- to 30-foot (5- to 10-m) thick, light-gray to white, locally calcareous tuff containing abundant biotite crystals. Unit contains more light-brown and red zones than rest of formation. Light-colored lacustrine layers and zones are mapped as numbered units. At least 427 feet (130 m) thick

8 — **8 zone**—Light-gray limestone (tuffa?) and marlstone locally as much as 16 feet (5 m) thick, but generally 3 feet (1 m) thick; locally contains 1- to 2-inch (3- to 5-cm) thick gypsum layers

7 — **7 limestone**—Light-gray, dense, vuggy to platy limestone containing ostracods, gastropods, and, locally, black chert nodules. About 3 feet (1 m) thick; in places underlain by marlstone bed 3 feet (1 m) thick

Tbuw — **Upper white layer of Matthew (1909)**—Ledge-forming, light-gray, platy limestone; contains flat coiled gastropods and some dark-gray chert nodules. About 3 to 4.3 feet (1 to 1.3 m) thick; thickness exaggerated on map

Tbm — **Middle part**—Bounded by upper white layer of Matthew (1909) (unit Tbuw) above and Sage Creek white layer of Matthew (1909) (unit Tbsc) below. Includes horizon C and part of horizon D of Matthew (1909). Light-colored lacustrine layers are mapped separately. About 820 feet (250 m) thick

Tblt — **Lonetree white layer of Matthew (1909)**—Marlstone zone containing light-olive-gray limestone lenses. Not present north of Sage Creek Mountain. 10 feet (3 m) thick

Tbbf(?) — **Marlstone zone**—Similar to unit Tblt, but thought to be Burnt Fork white layer of Matthew (1909). Exposed along Henrys Fork River, south of Cedar Mountain

6 — **6 limestone**—Gray to light-brown, platy limestone; pinches out southward north of Sage Creek Mountain. About 3 feet (1 m) thick

ls — **Limestone**—Unnamed local limestone beds generally less than 3 feet (1 m) thick

Tbsc — **Sage Creek white layer of Matthew (1909)**—Gastropod- and ostracod-bearing, gray to light-brown platy limestone and marlstone. Commonly limestone forms two distinct beds at top and near base. Unit widespread; caps mesas and forms prominent ledges. Generally 3 to 10 feet (1 to 3 m) thick; thickness exaggerated on map

Tbb — **Bridger B**—Part of "lower Bridger Formation" defined by "G" marker bed of McGrew and Sullivan (1970) (unit Tbg) at base and by Sage Creek white layer (unit Tbsc) at top. Limestone layers mapped in this member are numbered 5 and 4. About 394 feet (120 m) thick

5 — **5 limestone**—Light- to medium-brown platy limestone locally underlain by brown, slightly calcareous chert. Forms bench and mesa cap in northeastern corner of quadrangle. 1 to 3 feet (0.3 to 1 m) thick

4 — **4 limestone**—Pale-brownish-gray limestone locally platy to splintery, and locally contains brown, yellow-weathering chert. Forms mesa cap in northeastern part of quadrangle. 1 to 2 feet (0.3 to 0.6 m) thick

ls — **Unnamed local limestone bed**—In vicinity of Leavitt Creek; similar to 4 limestone

Tbg — **"G" marker bed of McGrew and Sullivan (1970)**—Widespread light-brown to gray, platy to massive ostracodal limestone. Locally contains algal mounds as much as 3 feet (1 m) high and 15.1 feet (4.6 m) wide. Commonly forms a light-tan caprock on mesas. Thickness 1 to 3 feet (0.3 to 1 m); exaggerated thickness shown on map

Tba — **Bridger A**—Part of "lower Bridger Formation" beneath "G" marker bed; contains layers of white lacustrine limestone numbered here from 3 to 1. Includes Whiskey Butte Bed of Sullivan (1980). Unit split by upper part of Laney Member (Tglu) of Green River Formation. About 328 feet (100 m) thick

ls — **Limestone bed**

3 — **3 limestone**—Light-gray to yellowish-brown ostracodal limestone, generally 2 to 3 feet (0.6 to 1 m) thick

2 — **2 limestone**—Dusky-yellow to light-gray yellow-weathering platy limestone and papery marlstone. Limestone commonly 2 feet (0.6 m thick); marlstone 4.9 to 10 feet (1.5 to 3 m) thick. Increases in thickness and appears to merge with 1 limestone southwest of Fort Bridger where both 2 and 1 limestones were mapped as part of Green River Formation by Bradley (1964)

1 — **1 limestone**—Light-gray platy ostracodal limestone and very light-gray marlstone. Locally contains high-spired gastropod fossils. Forms minor benches generally 3.9 to 4.9 feet (1.2 to 1.5 m) thick. Zone thickens and is bounded by an upper and a lower limestone toward the southwest

Tg — **Green River Formation (middle and lower Eocene)**—See description under "**Tertiary rocks (Western part and Fossil basin)**"

Tgl — **Laney Member (middle Eocene)**—Tan and brown silty algal limestone and ostracodal marlstone containing thin, light-gray, fine- to coarse-grained sandstone interbeds. Unit split by southward-thinning tongue of Bridger A unit (Tba), which includes Whiskey Butte Bed of Sullivan (1980). As much as 262 feet (80 m) thick in southern part of quadrangle

Tglu — **Upper part**—Above Whiskey Butte Bed of Sullivan (1980); equivalent to Cow Hollow Bed of Sullivan (1980). About 59 feet (18 m) thick near northern border of quadrangle

Tgll — **Lower part**—Below Whiskey Butte Bed of Sullivan (1980); equivalent to Craven Creek Bed of Sullivan (1980). About 98 feet (30 m) thick near northern border of quadrangle

Tgls — **Limestone interbeds**—Light-gray silty, dolomitic, or marly limestone representing discontinuous lacustrine interbeds in predominantly fluvial Wasatch Formation. Thickness generally less than 3 feet (1 m)

Tgw — **Wilkins Peak Member (middle and lower Eocene)**—Light-gray to tan, silty and sandy, gastropodal, ostracodal, and algal limestone and marlstone; light-tan oil shale; medium- to coarse-grained sandstone; some siltstone and claystone. Termed "middle tongue of Green River Formation" by Oriel (1969). About 197 feet (60 m) thick

Tgf — **Fontenelle Tongue (lower Eocene)**—Tan to light-gray gastropodal and ostracodal limestone, laminated tan shale and brown oil shale, and light-gray, medium- to coarse-grained sandstone mainly in upper part of unit. As much as 66 feet (20 m) thick; thins and pinches out to the south and west

Tw — **Wasatch Formation (middle and lower Eocene)**—See description under "**Tertiary rocks (Western part and Fossil basin)**"

Twu — **Upper member (middle and lower Eocene)**—Green, gray, brown, and locally red siltstone and fine- to coarse-grained, locally conglomeratic sandstone. Includes Desertion Point tongue of Sullivan (1980). At least 722 feet (220 m) thick

Twum — **Marker bed (middle and lower Eocene)**—Local marker unit of light-gray sandstone and shale in Twu. About 3 feet (1 m) thick

Twlb — **La Barge Member (lower Eocene)**—Red, purple, brown, tan, light-yellow, and green variegated and mottled mudstone; tan, gray, and red sandstone, locally conglomeratic; a few marlstone and limestone lenses present (Lawrence, 1963). Dated as Lost Cabin North American Land Mammal Age (NALMA) and possibly Lysite NALMA, which is not as old as Gray Bull (earliest Wasatchian NALMA) that has been established for beds in Wasatch Formation in Fossil basin area (Oriel and Tracey, 1970; J.G. Honey, written communication, 1984). This difference is depicted in correlation of map units. Exposed thickness as much as 295 feet (90 m)

Tser — **Slumped Eocene rocks, undivided**—Poorly exposed; mapped in generally heavy forested, extensively slumped areas at south edge of quadrangle; may include rocks of Bridger, Green River, and Wasatch formations

Te — **Upper part (Paleocene) of Evanston Formation (Paleocene and Upper Cretaceous)**—See description under "**Tertiary rocks (Western part and Fossil basin)**"

Mesozoic rocks [Rocks above (west of) Absaroka thrust fault]

Lower part (Upper Cretaceous) of Evanston Formation (Paleocene and Upper Cretaceous)

Keh — **Hams Fork Conglomerate Member (Upper Cretaceous)**—Poorly to moderately consolidated cobble- and boulder-conglomerate beds containing gritty sandstone and siltstone matrix interstratified with sandstone and mudstone beds; clasts of quartzite, chert, and limestone are well rounded and average about 6 inches (15 cm), but range to about 1.5 feet (0.5 m) in diameter. Where exposed, forms conspicuous hogbacks, but is generally poorly exposed; bedding commonly marked by trains of loose boulders. Palynomorphs (D.J. Nichols, written communication, 1980-82; Lamerson, 1982), leaves, and vertebrate fossils all indicate Late Cretaceous age (Oriel and Tracey, 1970). Principle exposures are east of Absaroka thrust fault. Thickness about 984 feet (300 m)

Ksj — **Sage Junction Formation (Lower Cretaceous)**—Light-gray siltstone and mudstone containing tan sandstone and quartzite interbeds; thin interbeds of variegated porcellanite are common. Locally contains thin beds of grit and brown to gray fossiliferous limestone. Some coal beds in lower part of unit. Early Cretaceous leaves and invertebrate fauna reported by Rubey (1973). Thickness uncertain, but at least 656 feet (200 m) in this quadrangle

Kc — **Cokeville Formation (Lower Cretaceous)**—Interbedded sequence of dark-gray carbonaceous shaly mudstone and siltstone, tan-weathering sandstone, and highly fossiliferous gray to tan limestone and coquina containing gastropod *(Pyrgulifera)* and pelecypod fauna also characteristic of Bear River Formation (unit Kbr). A few coal beds in upper part. Thickness of 1963 to 2493 feet (580 to 760 m) reported by Rubey (1973) in Kemmerer Quadrangle, but unit thins southward; no more than 1 312 feet (400 m) present in southern part of quadrangle

Ktf — **Thomas Fork Formation (Lower Cretaceous)**—Interbedded pale-red and reddish-brown mudstone; gray, tan, and buff sandstone; and gritty sandstone. Typically mantled by poorly exposed zones of lavender or gray limestone nodules averaging 0.8 to 1.2 inches (2 to 3 cm) across. Merges with and is lithologically indistinguishable from upper part of Kelvin Formation (Lower Cretaceous) in northeastern Utah. Thickens southward from about 328 feet (100 m) in Sage 15' Quadrangle (Rubey and others, 1975) to at least 1312 feet (400 m) in this quadrangle

Ks — **Smiths Formation (Lower Cretaceous)**—Mainly light-olive-brown to tan, fine-grained sandstone or quartzite, locally containing black carbonaceous shale at base. Appears to thin southward from 295 to 394 feet (90 to 120 m) in the Sage 15' Quadrangle (Rubey and others, 1975) to 115 to 197 feet (35 to 60 m) in this quadrangle

Kg — **Gannett Group (Lower Cretaceous)**—Brick-red, orange-brown, and maroon mudstone, siltstone, and sandstone; contains a few limestone interbeds in upper part and conglomerate beds in lower part. Thickness as much as 2100 feet (640 m)

Kgl — **Limestone interbeds**—Prominent gray, pink, or lavender nodular limestone interbeds in upper part. Better developed in northern part of area. Beds are about 3 feet (1 m) thick

Kgc — **Conglomerate beds**—Locally thick, chert-pebble conglomerate or grit beds in lower part. Conglomerate more abundant west of Absaroka thrust. Beds are about 3 feet (1 m) thick

Jsp — **Stump Formation (Upper and Middle Jurassic) and Preuss Redbeds (Middle Jurassic), undivided**—Greenish-gray glauconitic sandstone, siltstone, and limestone of Stump Formation in upper part; thinly interbedded, dark-reddish-brown siltstone, mudstone, and sandstone of Pruess Redbeds in lower part. Contains salt in subsurface near Salt Creek in west-central part of map area. Estimated thickness at least 492 feet (150 m)

Mesozoic rocks [Rocks below (east of) Absaroka thrust fault]

Lower part (Upper Cretaceous) of Evanston Formation (Paleocene and Upper Cretaceous)

Keh — **Hams Fork Conglomerate Member (Upper Cretaceous)**—See description under "**Mesozoic rocks [Rocks above (west of) Absaroka thrust fault]**"

Kav — **Adaville Formation (Upper Cretaceous)**—Interbedded, mainly nonmarine, gray, brown, and tan shale and siltstone; brown and gray, medium- to fine-grained, locally bioturbated, platy to crossbedded sandstone; carbonaceous shale; numerous coal beds, averaging about 16 feet (5 m), but as much as 115 feet (35 m) thick. Early Campanian age is indicated by palynomorphs (D.J. Nichols, written communication, 1980-82; Lamerson, 1982). Thickness of unit about 1805 feet (550 m)

Kal — **Lazeart Sandstone Member**—Very light-gray, yellow-brown, and tan, fine- to medium-grained "salt and pepper" sandstone forming thick cliffs; brownish-gray shale and coal beds in slopes between sandstone cliffs. Sandstone units contain marine fossils and bedding indicative of progradational beach sequences that overlap southward. About 591 feet (180 m) thick

Kh — **Hilliard Shale (Upper Cretaceous)**—Dark-olive-gray marine shale, siltstone, and sandy shale containing thin, tan to light-gray sandstone and limestone interbeds, particularly in upper part. Palynomorphs (D.J. Nichols, written communication, 1980-82; Lamerson, 1982) indicate Santonian and Coniacian age. Poorly exposed; estimated minimum thickness 5906 feet (1800 m)

Khh — **Hinshaw Member of Smith (1965)**—Upper part of Hilliard Shale consisting of interbedded marine shale and sandstone units 1 to 33 feet (0.3 to 10 m) thick; transitional sequence from shales of main body of Hilliard Shale into overlying Lazeart Sandstone Member of Adaville Formation. Sandstone units are gray to tan, fine-grained, somewhat speckled with feldspar and chert grains, and locally burrowed. Sedimentary structures in sandstone include hummocky bedding, large-scale ball and pillow structures, some trough cross-stratification; bedding vague, mainly 0.7 to 1.6 feet (0.2 to 0.5 m) thick. Sandstone units have sharp basal contacts. Member was not identified south of section 17, T15N, R118W. Overall thickness of member approximately 853 to 1001 feet (260 to 305 m)

Kf — **Frontier Formation (Upper Cretaceous)**—Interbedded marine and nonmarine sequence of sandstone, siltstone, and carbonaceous shale containing interbeds of coal and, locally, porcellanite and conglomerate. Palynomorphs (D.J. Nichols, written communication, 1980-82; Lamerson, 1982) and molluscan fauna (Merewether and others, 1984; Cobban and Reeside, 1952; Cobban and Kennedy, 1989; M'Gonigle, 1982) indicate early Coniacian to Cenomanian age. Mapped in Little Muddy Creek area. Maximum thickness about 2198 feet (670 m)

Kfd — **Dry Hollow Member of Hale (1960)**—Gray, greenish-gray, and tan nonmarine shale and siltstone containing tan and brown, fine- to medium-grained, platy to crossbedded, locally bioturbated thin sandstone interbeds, and coal. Uppermost sandstone unit, which commonly is more than 9 feet (3 m) thick, contains marine fauna in upper part and is directly underlain by the Kemmerer coal zone. Early Coniacian to late Turonian age based on palynomorphs (D.J. Nichols, written communication, 1980-82; Lamerson, 1982). About 328 to 427 feet (100 to 130 m) thick

Kfdc — **Conglomerate**—Pebble conglomerate locally developed in lower part of Dry Hollow Member; locally forms channels cutting into Oyster Ridge Sandstone Member. About 33 to 66 feet (10 to 20 m) thick on east side of Lazeart syncline; thinner to west

Kfo — **Oyster Ridge Sandstone Member**—Predominantly light-tan to white, fine- to medium-grained, parallel-bedded to crossbedded, cliff-forming sandstone containing some brown shale layers. Sandstone units show bedding and fauna indicative of marine shoreline deposition; minor channeling in upper parts. About 79 to 115 feet (24 to 35 m) thick

Kfa — **Allen Hollow Member of Hale (1960)**—Dark-gray to greenish-brown marine shale; sandstone and siltstone beds in upper part. Middle Turonian age based on *Collignoniceras woolgari* fauna (Hale, 1960). Largely covered; about 302 feet (92 m) thick

Kfc — **Coalville Member of Hale (1960)**—Dark-greenish-gray shale and tan, fine-grained, flaggy to crossbedded and ripple-marked, bioturbated sandstone. Contains brackish-water to marine fauna of early Turonian age (Cobban and Reeside, 1952; Merewether and others, 1984). Thickness about 79 to 151 feet (24 to 46 m)

Kfcc — **Chalk Creek Member of Hale (1960)**—Gray, greenish-gray, and brown, largely nonmarine shale, bentonitic shale, tuff and tuffaceous sandstone; carbonaceous shale; coal; and tan, fine- to coarse-grained, platy to crossbedded, locally bioturbated sandstone. Basal part interfingers with Aspen Formation (unit Ka) near Cumberland Gap; Cenomanian age based on molluscan fauna and stratigraphic position (M'Gonigle, 1982; Cobban and Kennedy, 1989). Thickness about 984 to 1312 feet (300 to 400 m)

Kfl — **Allen Hollow, Coalville, and Chalk Creek Members of Hale (1960), undivided**

Ka — **Aspen Formation (Upper and Lower Cretaceous)**—Dark- and light-gray, silvery-weathering marine shale, siltstone, siliceous sandstone, and porcellanite; porcellanite beds form prominent gray ridges. Contains fish scales; palynomorphs and molluscan fauna (Cobban and Reeside, 1952; Cobban and Kennedy, 1989) indicate Cenomanian and Albian age. About 804 to 1214 feet (245 to 370 m) thick

Kbr — **Bear River Formation (Lower Cretaceous)**—Dark-gray carbonaceous shale, fine-grained tan to olive-tan sandstone, and very fossiliferous limestone with characteristic gastropod *(Pyrgulifera)* and pelecypod fauna. Poorly exposed; commonly forms slopes mantled with gastropod and pelecypod shells. Palynomorphs (D.J. Nichols, written communication, 1980-82; Lamerson, 1982) and shelly fauna indicate Albian age. Estimated to be 656 to 1312 feet (200 to 400 m) thick

Kg — **Gannett Group (Lower Cretaceous)**—Brick-red, orange-brown, and maroon mudstone, siltstone, and sandstone; locally, a few chert-pebble-conglomerate beds in lower part. Limestone better developed in northern part of map area. Thickness about 656 feet (200 m)

Kgl — **Limestone interbeds**—Prominent gray, pink, or lavender nodular limestone interbeds in middle and upper part of Gannett Group. Better developed in northern part of map area. Beds are about 3 feet (1 m) thick

KJgp — **Gannett Group (Lower Cretaceous), Stump Formation (Upper and Middle Jurassic), and Preuss Redbeds (Middle Jurassic), undivided**—Thickness at least 1 148 feet (350 m)