Interim Geologic Map of the Steves Mountain Quadrangle, Sevier County, Utah

by

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DISCLAIMER

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OVERVIEW

Exposed bedrock in the Steves Mountain quadrangle ranges from Late Cretaceous (Campanian) to late Eocene in age (representing deposition from 77 to 40 million years ago) and includes the Blackhawk, Castlegate, Price River, North Horn, Flagstaff, Colton, and Green River Formations. Quaternary surficial deposits of Holocene and Pleistocene age include alluvial, mass-movement, and mixed-environment deposits. Bedrock in the quadrangle generally dip toward the west on the flank of the Wasatch monocline. The 2-mile (3 km) wide Water Hollow normal fault zone is in the eastern part of the quadrangle.

The Steves Mountain 7.5-minute quadrangle is located in central Utah; its southwest corner is about 9 miles (15 km) east of the town of Salina in the northwest corner of the Fish Lake Plateau and the southwest corner of the Wasatch Plateau. The terrain is mountainous with elevations between 6200 and 9300 feet (1890–2840 m) above sea level. A few ranches are present in the southwest quarter of the quadrangle; the remainder is part of Fish Lake National Forest. Principal access is via Interstate 70 that traverses the area about 2 to 3 miles (3–5 km) north of the quadrangle's southern boundary.

Spieker (1946, 1949) first described the Salina area geology in detail and was responsible for naming most of the formations of the region and defining its structural nature. Later, some of his students from Ohio State University, including McGookey (1958, 1960), geologically mapped part of the quadrangle area; Bachman (1959) discussed the Water Hollow fault zone. Alexander (1965) and Buckley and others (2010) also worked in the area mapping at a 1:24,000 scale. Kuehne and Doelling (2015) geologically mapped the Gooseberry Creek quadrangle to the south, Doelling and Kuehne (in press) mapped the Water Hollow Ridge quadrangle to the east, and Willis (1986) mapped the Salina 7.5' quadrangle to the west. Williams and Hackman (1971) included the area in their 1:250,000-scale map of the Salina 1° x 2° quadrangle.

DESCRIPTION OF MAP UNITS

QUATERNARY

Q **Undifferentiated surficial deposits (Quaternary)** – Shown on cross section only.

Alluvial Deposits

Qaly **Young flood plain and channel alluvium (Holocene)** – Moderately sorted cobbles, pebbles, grit, sand, silt, and clay deposited along the course of creeks and washes; present along Salina Creek; locally mixed with colluvium that creeps into creek by gravity; contains volcanic debris; during flooding or spring runoff, the carried load is commonly deposited high on the banks; locally includes stream terrace deposits above channel (some small, poorly developed terraces not mapped); up to 25 feet (8 m) thick.

Qal **Alluvial stream deposits (Holocene)** – Moderately sorted sand, silt, clay, gravel, cobbles, and boulders along small, wide, flat-bottomed stream channels; generally less-sorted than Qaly and less colluvial or alluvial fan input than units Qac or Qacf; commonly contains volcanic debris; mapped in larger side drainages to Salina Canyon; up to 10 feet (3 m) thick.

Qaf, Qafo

Alluvial fans and local alluvium (Holocene to Pleistocene) – Unconsolidated, poorly sorted sand, silt, clay granules, cobbles, and sparse boulders; angular to subrounded; deposited as debris flows at the bases of steep slopes, cliffs, and at decreases in gradient along drainages at the mouths of some streams and washes; older dissected deposits in southeast corner mapped as Qafo and form poorly to well-defined fans and pediment-like surfaces; up to 30 feet (10 m) thick.

Mixed Deposits

Qac **Mixed alluvium and colluvium (Holocene)** – Moderately to poorly sorted sand, silt, clay, gravel, cobbles, and boulders in small ephemeral canyons and washes with abundant colluvial contribution from side slopes; small drainages are dry most of the year, but are active during rainstorms and spring run-off; similar to Qacf deposits but generally has smaller alluvial fan component; up to 10 feet (3 m) thick.

Qacf **Mixed alluvium, colluvium, and alluvial fan deposits (Holocene to late Pleistocene)** – Moderately to poorly sorted sand, silt, clay, gravel, cobbles, and boulders in small ephemeral canyons and washes and on low incised benches, with abundant colluvial contribution from side slopes and small alluvial fans from side washes and gullies; small drainages are dry most of the year, but are active during rainstorms and spring run-off; similar to Qac deposits but generally has larger alluvial fan component; up to 10 feet (3 m) thick.

Qacl **Mixed alluvium, colluvium, and lacustrine deposits (Holocene to Pleistocene)** – Poorly sorted clay, silt, sand, and pebbles with some cobbles; common in hollows on gentle slopes and in undrained depressions mostly in mass-movement deposits; similar to Qac and Qacf deposits but locally includes minor ephemeral lake or marsh deposits in shallow closed depressions or human-made reservoirs; up to 10 feet (3 m) thick.

Mass-Movement and Colluvial Deposits

Qcv **Volcanic colluvium (Holocene to middle Pleistocene)** – Mostly volcanic debris; clasts subrounded to angular; poorly sorted; overall, unit is light- to dark-gray; similar to Qmsc, but includes fewer landslide deposits; some deposits cap separate geomorphic surfaces including small benches and pediments, others mantle broad slopes and hills; commonly at higher levels than most alluvial fan and terrace deposits; primarily composed of volcanic boulders, but has smaller amounts of sand, cobbles, and silt; volcanic boulders can exceed 10 feet (3 m) in diameter; where deposits are thin, bedrock material is worked into the deposit; calcic soil (caliche) coats bottom of some boulders; 5 to 20 feet (2–6 m) thick.

Qmcs **Colluvial and landslide deposits (Holocene to early Pleistocene)** – Poorly sorted, mostly angular debris that covers bedrock; generally more hummocky and eroded than colluvium; mostly sedimentary clasts; commonly forms veneers on old bedrock surfaces; hummocky; includes slope-creep, slopewash, debris flow, mud flow, and landslide deposits; 5 to 20 feet (2–6 m) thick.

Qmt **Talus (Holocene)** – Unconsolidated angular rock debris on steep slopes; form steep fan-shaped deposits derived from weathering of the rock forming the cliff or ridge; at the base of cliffs and ridges; locally grade into Qapc deposits; 10 to 20 feet (3–6 m) thick.

Qmtc **Mixed talus and colluvial deposits (Holocene to Pleistocene)** – Poorly to very poorly sorted, mostly angular to subangular boulders, cobbles, gravel, silt, and clay deposited on steep bedrock slopes beneath fault scarps or steep cliffs; formed by rock fall, sheet wash, and occasional mudflows; commonly forms armored pediment-like sloping surface that is often deeply incised; continues to collect talus from adjacent fault scarps and cliffs after alluvial deposition decreases; some alluvial deposition in lower parts of deposits; talus and colluvium more pronounced on the upper parts; up to15 feet (5 m) thick.

Qmsh **Historical landslides (late Holocene)** – Unconsolidated masses of poorly sorted mud, sand, and angular broken rock that have moved down steep slopes; surfaces of deposits have open fractures and are deformed; younger and smaller than Qms deposits; some are reactivated parts of Qms; deposits commonly form long narrow strips in and adjacent to gullies; perennial vegetation disturbed; commonly contain undrained depressions and springs; formed during consecutive years of higher-than-average precipitation; most in Water Hollow fault zone, down-dip of a retreating resistant ledge; thickness varies.

Qms **Landslides and related debris flows (Holocene to Pleistocene)** – Unconsolidated masses of poorly sorted mud, sand, and angular broken rock that have moved downslope; display typical landslide morphology; most occur on weak slopes in the North Horn Formation and some show evidence of historical movement; locally includes remobilized alluvial material in lower parts of deposit; hummocky upper surface with many small internal basins; landslides develop where weak, soft, clayey deposits underlie a hard layer (sandstone or limestone) that slumps or rotates down the dip slope and ends as lobate masses of disarticulated debris; shallow slides also develop along cliff faces covered with talus and debris accumulating from an overlying soft layer that slumps down the face of the more resistant ledges; stands of quaking aspens commonly grow on these deposits; thickness varies.

Tertiary

Tgu **Upper Green River Formation (Eocene)** – Yellow-gray to light-gray limestone and calcareous shale; mostly thin to medium bedded; weathers slabby to blocky; some limestone is oolitic and cherty; forms massive cliffs above gently dipping light-green-gray slopes of lower member; typically forms two prominent ledges or cliffs with an intervening shale slope; "cauliflower" texture limestone is present near the base of the unit, probably formed by algae; upper contact not preserved in quadrangle; 500 to 650 feet (150–200 m) thick.

Tgl **Lower Green River (Eocene)** – Interbedded light-green-gray limestone, calcareous sandstone, and laminated mudstone; forms poorly exposed steep slopes with scattered ledges; limestone is finely crystalline and commonly oolitic; less resistant than cliff-forming upper unit; 400 feet (120 m) thick.

The Green River Formation is a mainly lacustrine deposit that overlies the Colton Formation. The lower contact is marked by a downward change from green-gray limestone to red-brown silty mudstone. McGookey (1960) noted that the top of the Green River Formation was truncated by a pre-Crazy Hollow unconformity and thinned southward. He measured about 730 feet (220 m) of the upper unit at the mouth of Soldier Canyon. A complete section of the upper Green River (Tgu) is not preserved in the Steves Mountain quadrangle, however we measured 580 feet (180 m) at Brush Trail Hollow about 5 miles (8 km) southeast of McGookey's section in the Gooseberry Creek quadrangle. We measured about 468 feet (143 m) of lower Green River Formation in section 24, T. 22 S., R. 1 E. in the southwest part of the quadrangle; this section compares well with the 431 feet (131 m) that McGookey (1960) measured in Soldier Canyon about 3.5 miles (5.6 km) west of Steves Mountain quadrangle. The contact between the Tgu and Tgl is placed below cliffy yellow-gray to tan limestone beds. The Green River is Eocene in age (Bryant and others, 1989; Remy, 1992; Judge, 2007; Smith and others, 2008).

Tc **Colton Formation (Eocene)** – Interbedded mudstone, shale, limestone, and minor sandstone; mudstone and shale beds are generally mottled red-brown, purple-red, olive-green, and gray; limestone is gray, yellow-gray, and pink-gray; forms slope at the base of Green River Formation and above limestone ledges of Flagstaff Formation; 500 to 550 feet (150–170 m) thick.

The Colton Formation is commonly covered by surficial deposits and forms a bench on the uppermost ledge of the Flagstaff Formation. Locally variegated siltstone and mudstone, along with thin limestone deposits, indicate the Colton Formation is an interbedded fluvial-lacustrine deposit. McGookey (1960) reported the presence of various fossil genera of ostracods including *Heterocypris, Cyprois*, and *Cypris*. The Colton Formation is early Eocene in age (Franczyk and others, 1992; Judge, 2007; Dickinson and others, 2012) and is interbedded with the upper Flagstaff Formation.

Tf **Flagstaff Formation (Early Eocene to Paleocene)** – Mostly sandstone interbedded with siltstone, mudstone, and limestone or calcarenite, becoming mostly limestone or limy shale in the eastern part of the quadrangle; sandstone forms ledges and is fine to medium grained, light tan-gray, and gray-pink to red-brown, thin to medium bedded, and calcareous; siltstone forms slopes and is mostly red brown, thin bedded, sandy, and calcareous; mudstone forms slopes and is medium-brown to lavender-gray, argillaceous, and calcareous; limestone forms ledges and is generally light-gray, finely to coarsely crystalline, thin to medium bedded; muddy limestone forms slopes and is light-gray to light green-gray, and thin bedded; the Flagstaff Formation is poorly exposed, but has a few ribs of resistant calcareous sandstone and limestone separated by steep slopes of reddish fine-grained sandstone, siltstone, and mudstone or shale; 400 to 685 feet (120–210 m) thick in the quadrangle, thickening eastward, although eastern sections are incomplete and broken up in the Water Hollow graben.

The Flagstaff Formation overlies the North Horn Formation in the Steves Mountain quadrangle. In the western part of the quadrangle the Flagstaff contains reddish-gray to gray calcareous siltstone, argillaceous limestone, and some interbedded conglomeratic sandstones. A dominant resistant ledge of sandstone is near the top of the unit. However, slope-forming, red-brown, argillaceous limestone and calcareous siltstone interrupted by ledges of yellow-gray, fine-grained sandstone underlie this capping unit. These lower units resemble the outcrop pattern of the North Horn below, but are mostly thin and evenly bedded in contrast to the variegated, indistinctly bedded mudstones of the North Horn. Eastward, the Flagstaff ledges grade into limestone or calcarenite, and the red-brown calcareous siltstone reverts to thin-bedded, light-gray marl. A few of the reddish calcareous siltstone beds are also recognizable in the Water Hollow fault zone area. The Flagstaff strata in the Steves Mountain quadrangle are nearshore lake deposits that received sediments from a source of red rocks exposed along the Sanpete-Sevier Valley anticline (SSVA) (Willis, 1986). These deposits overlap the North Horn and older deposits to the west above the angular unconformity exposed in Salina Canyon. The Flagstaff Formation eventually pinches out westward in lower Salina Canyon above the unconformity. The North Horn-Flagstaff contact appears concordant there.

We measured about 580 feet (180 m) of Flagstaff Formation in the southwest corner of the quadrangle in SE 1/4, secs. 13 and 24, T. 21 S., R. 1 E. In secs. 30 and 32, T. 21 S., R. 2 E., it is 685 feet (210 m) thick. The Flagstaff thickens to the east; Spieker and Reeside (1925) indicated it is 800 to 1500 feet (240–460 m) thick on the Wasatch Plateau. The Flagstaff Formation is early Eocene to late Paleocene in age (La Rocque, 1960; Stanley and Collinson, 1979; Franczyk and others, 1992).

Tertiary-Cretaceous

TKn **North Horn Formation (early Paleocene to Late Cretaceous)** – Variegated gray, green, yellow-orange, purple, and pink argillaceous mudstone; light-gray, yellow-brown, and pink sandstone; light- to dark-gray limestone and calcarenite; subordinate red-brown to yellow-gray pebble conglomerate; forms slopes and is prone to landslides; 500 to 600 feet (150–180 m) thick.

The North Horn Formation overlies the Price River Formation concordantly in the Steves Mountain quadrangle. It was deposited under fluvial conditions with the lenticular sandstone representing channel deposits and the mudstone representing overbank deposits. The argillaceous mudstone, which commonly weathers into badland topography, makes the North Horn Formation landslide prone. McGookey (1960) measured the North Horn Formation in the northwest part of the Gooseberry Creek quadrangle and the southwest corner of the Steves Mountain quadrangle at 1200 feet (370 m) thick. We measured only 587 feet (179 m) in the Steves Mountain quadrangle in unsurveyed SW1/4 section 28, T. 21 S., R. 2 E. McGookey's measurement probably includes much of our Flagstaff Formation since he recognized less than 100 feet (30 m) of Flagstaff Formation (see discussion under Flagstaff Formation and Kuehne and Doelling, 2015). The North Horn Formation is Late Cretaceous (Maastrichtian) to Paleocene in age (Franczyk and others, 1992; Difley, 2007). No direct evidence of the Cretaceous-Tertiary boundary is recognized in the quadrangle.

Cretaceous

Kpr **Price River Formation (Late Cretaceous, Campanian)** – Sandstone, tan-gray, subangular to subrounded, quartzose, medium- to coarse-grained in lower part and fines upward; dark minerals and lithics make up 5 percent of the rock; locally contains conglomerate or conglomeratic sandstone in lower part; gray, muddy, fine-grained sandstone and siltstone make up partings and slope intervals, especially in the upper part of the formation; bedding is mostly planar, with some low-angle cross-beds; forms a steep sequence of cliffs broken by short slopes; about 300 to 350 feet (90–110 m) thick.

The Price River Formation conformably overlies the Kc3 unit of the Castlegate Sandstone. It is not as resistant as the two Castlegate Sandstone ledges, but is locally difficult to distinguish from them. However, it contrasts sharply with the more gentle slopes and ledges of the North Horn Formation above it. The top is generally a bench upon which thin scabs of the North Horn remain. The Price River consists of fluvial and floodplain deposits (Horton and others, 2004). We measured about 335 feet (102 m) of Price River Formation on the west side of Maple Spring Canyon in section 21, T. 22 S., R. 2 E. and about 730 feet (220 m) of Castlegate in section 9, T. 22 S., R. 2E. Previous investigators considered the Castlegate to consist of only the lower cliff (Kc1) (McGooky, 1960), but our mapping shows that the Kc1 and Kc2 are more closely associated with Kc1 than the Price River Formation. If we add our 335 feet (102 m) of Price River to the 730 feet (220 m) of Castlegate, our interval total is 1065 feet (558 m) and compares well to the 1118 feet (341 m) combined total measured by McGookey (1960). Fouche and others (1983) show the Price River Formation to have been deposited between 72 and 75 Ma during the latest Campanian (Late Cretaceous). Later studies have confirmed this age (Tidwell and others, 2007, figure 3).

Castlegate Sandstone

Kc3 **Upper cliff unit (Late Cretaceous, Campanian)** – Sandstone, light-gray, fine-grained, quartzose, calcareous, and contains 15% dark grains and lithic fragments; coarsens upward and has pebble and grit streaks at top; beds are thick to massive with low-angle cross-beds; 200 feet (60 m) thick.

Kc2 **Medial slope unit (Late Cretaceous, Campanian)** – Interbedded sandstone and shale; sandstone is light to medium yellow-gray, fine grained and dominates the upper half of the unit; shale is mostly silty and gray and dominates the lower half; indistinct bedding; forms a narrow bench above the lower cliff that changes to a steep slope under the upper cliff; about 300 feet (100 m) thick.

Kc1 **Lower cliff unit (Late Cretaceous, Campanian)** – Sandstone, forms cliff, interbedded with 15 percent slope-forming gray shale, silty shale, and carbonaceous shale; mostly yellow-gray; contains fine- to coarse-grained beds, but generally coarsens upward; mostly quartzose, but some beds contain abundant lithic grains and dark minerals; grains are subrounded to subangular; calcareous; bedding ranges from thin to massive, but is dominantly thick bedded; locally bioturbated and contains impressions of branches and twigs; about 200 feet (60 m) thick.

The Castlegate Sandstone overlies the Blackhawk Formation in the southeast corner of the Steves Mountain quadrangle on the east side of the east-bounding fault of the Water Hollow fault zone. The total thickness of the Castlegate is 730 feet (220 m). It is Campanian in age, deposited about 74 Ma (Fouch and others, 1983; Tidwell and others, 2007, figure 3).

Kb **Blackhawk Formation (Late Cretaceous, Campanian)** – Interbedded, fine-grained, tan- to yellow-gray, mostly fine-grained sandstone, gray shale, and coal beds; coal beds are about 1 to 5 feet (0.3–2 m) thick; forms slopes below Castlegate cliffs with minor sandstone ledges about 2 to 10 feet (0.6–3 m) thick; about 800–900 feet (240–270 m) exposed but lower part not exposed in quadrangle.

The Blackhawk Formation is the oldest exposed unit and crops out along Salina Canyon in the east half of the quadrangle. Bachman (1959) measured an incomplete section on the north wall of Salina Canyon of about 550 feet (170 m) east of the quadrangle. Doelling (1972) reported about 800 to 900 feet (240–270 m) of Blackhawk Formation in upper Salina Canyon. It is largely a lagoonal deposit east of the quadrangle, becoming more terrestrial westward. The Blackhawk Formation is Campanian in age, deposited about 77 Ma (Fouch and others, 1983).

GEOLOGIC HISTORY AND STRUCTURAL GEOLOGY

Cretaceous formations exposed in the Steves Mountain quadrangle were deposited on an alluvial to coastal plain east of an active Sevier orogenic belt. Mountains to the west supplied sediment that fined eastward, and the presence of coal in the Blackhawk Formation, the oldest unit exposed in the quadrangle, alludes to lagoonal deposition marginal to the Cretaceous interior seaway. The shoreline retreated eastward and deposition gradually shifted from marine-influenced deposition to fluvial deposition. Fluvial processes were prevalent by North Horn time, with lacustrine and overbank deposits more common than channel deposition. Muddy paleosols dominate the North Horn Formation in the Steves Mountain quadrangle.

The angular unconformity exposed in the lower part of Salina Canyon (Willis, 1986), west of the Steves Mountain quadrangle, is evidence of late Cretaceous tectonic activity that developed to the west, which the Middle Jurassic Arapien Formation was folded upward, pushing overlying rocks into steeply dipping attitudes. This anticlinal fold developed near the front of the Sevier thrust belt. Through a probable combination of buoyancy and flowage of weak Arapien mudstone and micrite, isostatic rebound, Tertiary tectonics, and gravitational unroofing, the Sanpete Sevier Valley Anticline (SSVA) continued as a positive structure throughout the Tertiary and Quaternary (Willis, 1986; Cline and Bartley, 2007; Schelling and others, 2007).

The Salina Canyon unconformity developed along the east flank of the SSVA where Upper Jurassic and Cretaceous formations, in vertical or angular attitudes are overlain by a thin Flagstaff Formation (cross section A–A"). The position of the unconformity in the Steves Mountain quadrangle is less clear since Cretaceous and Tertiary strata are parallel and a major erosional surface is not apparent. The Flagstaff Formation was mostly deposited under lacustrine conditions (La Rocque, 1960), but in the western Steves Mountain quadrangle area it is partially fluvial and received sediment from islands or highlands to the west. Close to the anticline, Flagstaff sediments consist mostly of gravel and sandstone, but fine eastward into reddish mudstones and shales and calcareous sandstones, and then into light-gray and nearly white limestone and gray calcareous shale farther to the east. In some places the Flagstaff Formation pinches out over paleohighs. It thickens eastward across the Salina and Steves Mountain 7.5' quadrangles (Willis, 1986). The Flagstaff was deposited as an onlap on top of the North Horn Formation.

Willis (1986, p. 5) reported that the Colton Formation thins over the anticlinal high to the west, but was the first formation to cover it. The Colton thickens eastward from the paleohigh and is over 500 feet (150 m) thick at its exposures on the west side of Steves Mountain. The Green River Formation sparsely covered the fold. The structure has had renewed movement that may continue to the present.

All sedimentary units exposed in the Steves Mountain quadrangle were folded to form the Wasatch monocline. Sedimentary units exposed in the western two-thirds of the quadrangle dip westward from 5 to 30 degrees, with the steeper dips prevalent along its west edge (see cross section A–A"). Witkind (1994) indicated that the monocline trends north-northeastward along the east side of Sevier and Sanpete Valleys from 20 miles (30 km) south of the Steves Mountain quadrangle (where it is buried beneath or involves volcanic deposits) to about 50 miles (80 km) north. The monocline formed between about 40 and 30 million years ago, but the mechanism is still unclear (Willis, 1986, p. 10; Schelling and others, 2007); however, Judge (2007) stated that it is an extensional roll-over fold produced during slip on the listric fault, bounding the half-graben in Sanpete Valley. All sedimentary formations through the late Eocene are present in the structure.

The Water Hollow fault zone consists of north-south trending faults and has a width of about 2 miles (3 km). All large-displacement faults, except one, are down to the east; the east-bounding fault is down to the west. The fault zone appears to die out southward (Kuehne and Doelling, in press), but extends northward on the east side of the Wasatch monocline about 50 miles (80 km). The displacement on the east-bounding fault is at least 1000 feet (300 m) in the northeast corner of the quadrangle. The cumulative displacement of the western faults is at least 1400 feet (430 m). Some of the fault blocks are also folded, and unmapped faults and shattered zones of small displacement may also be present in some areas. Displacements diminish in the southern part of the quadrangle but are difficult to determine because of ubiquitous landslide cover. The Water Hollow fault zone marks the west edge of the Wasatch Plateau; to the east strata exhibit only gentle dips and have small faults.

The timing of faulting is unclear, but movement may have occurred in connection with or after the formation of the Wasatch monocline. Bailey and others (2007), working to the south, dated the Fremont graben, which is probably related to the Water Hollow fault zone, at 1 to 5 Ma. Regional uplift of the SSVA and the Wasatch Plateau continues today. The relief of the region is the product of Neogene and Quaternary erosion and uplift.

SELECTED ECONOMIC RESOURCES

Four sand, gravel, and roadfill pits are in the Steves Mountain quadrangle; two at the mouth of Gooseberry Valley south of Interstate 70, and two north of Interstate 70 just east of Gooseberry Valley. All of them are Utah Department of Transportation pits used for road base. The pits are located in the Price River, North Horn, and Flagstaff Formations.

The Blackhawk Formation contains coal beds that are actively mined east of the area in the Wasatch Plateau. Several small mines were opened in the Steves Mountain quadrangle, mostly in the 1920s, along Salina Creek Canyon. The coal beds are thin and are not considered an exploitable resource under present (2015) economic conditions. Doelling (1972) noted the presence of three coal zones, none of which contain beds over 4 feet (1 m) in thickness, that thin westward. Spieker and Baker (1928) noted that the coal beds along Salina Creek are resinous, especially the upper beds. Buranek and Crawford (1943) reported that selected samples contained up to 15 percent resin by volume and that the average coal contained 8 percent.

Three small coal mines were opened in the Steves Mountain quadrangle. These include the Wilson mine (SW1/4SE1/4 section 10, T. 22 S., R. 2 E.), the Boston Acme #1 mine (NE1/4SW1/4 section 18, T. 22 S., R. 3 E.), and the Coal Hollow (Kearns and Duggins) mine (NW1/4 section 18, T. 22 S., R. 3 E.). The Wilson mine was opened in the Wilson coal zone approximately 170 feet (50 m) below the Castlegate Sandstone, the other two were opened in the Sevier coal zone about 385 feet (117 m) below the Castlegate. The Wilson coal zone beds are lenticular ranging up to 3.3 feet (1 m) in thickness. The Sevier coal zone bed ranges up to 2.8 feet (0.85 m) in thickness. These mines served a small market in the town of Salina and operated intermittently from about 1910 to 1930 (Doelling, 1972).

SELECTED GEOLOGIC HAZARDS

Geologic hazards are common in Utah, and a comprehensive review of all hazards in this quadrangle is not possible in this report. For a more comprehensive review of hazards in the area please refer to the Utah Geological Survey website at http://geology.utah.gov/hazards/. Landslides and slumps are prevalent in the Steves Mountain quadrangle. The North Horn, Flagstaff, and Colton Formations are commonly affected during "wet years." Several landslides formed on steep slopes during the unusually wet year of 1983. Gooseberry Creek and Salina Creek run through the quadrangle and could be susceptible to flooding. Some areas may have problem soils, including expansive clays, collapsible soils, or liquefaction.

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Figure 1. *Blackhawk Formation as exposed along Interstate 70 in Salina Canyon. The steep slopes of the Blackhawk are capped by the lower ledge of the Castlegate Sandstone (*Kc1*).*

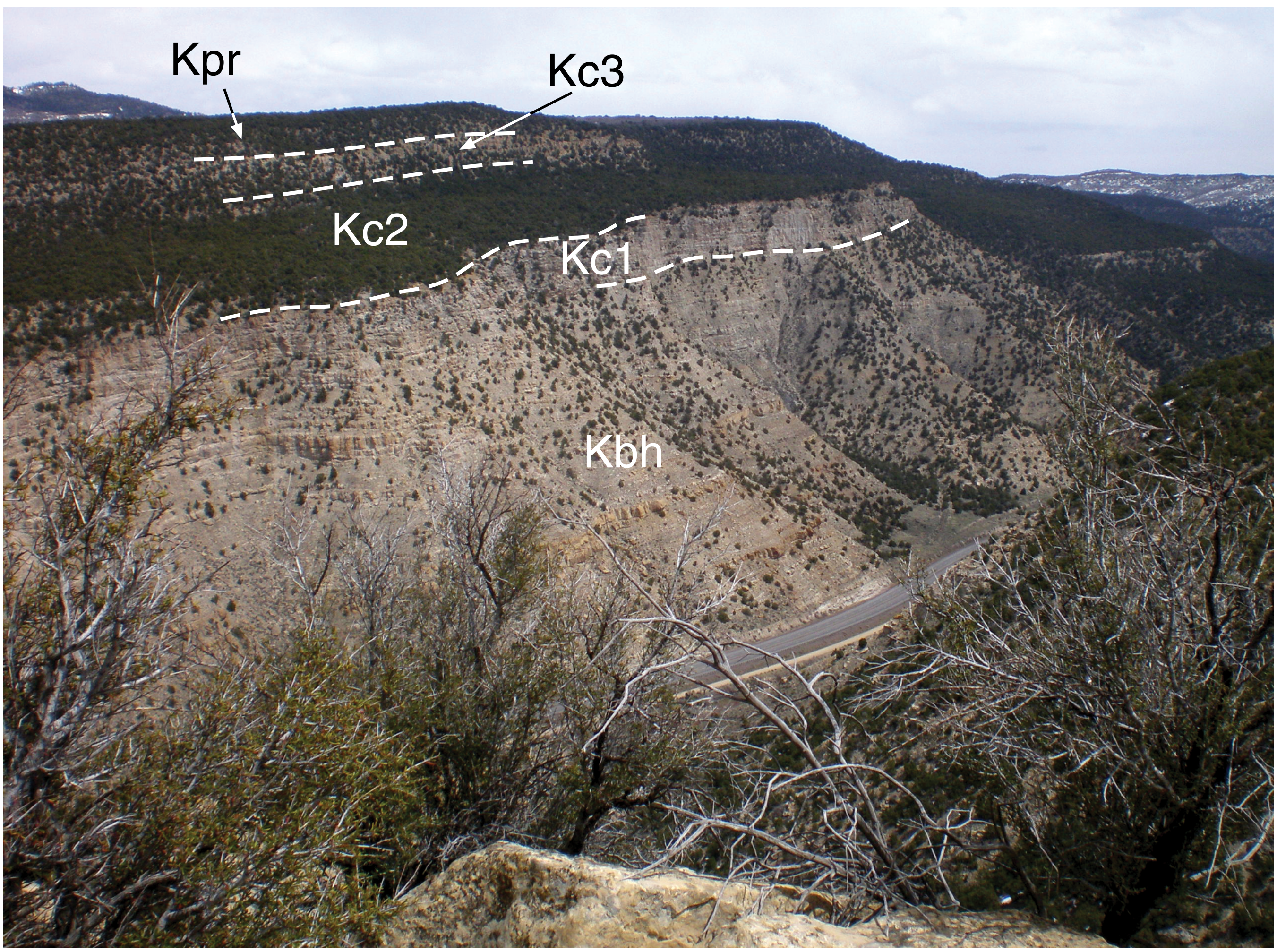


Figure 2. *Cretaceous rocks in the Steves Mountain quadrangle near Interstate 70 (at base of slope). The Blackhawk Formation (*Kbh*) is overlain by the Castlegate Sandstone (units* Kc1*,* Kc2*, and* Kc3*) which in turn is overlain by the Price River Formation (*Kpr*).*

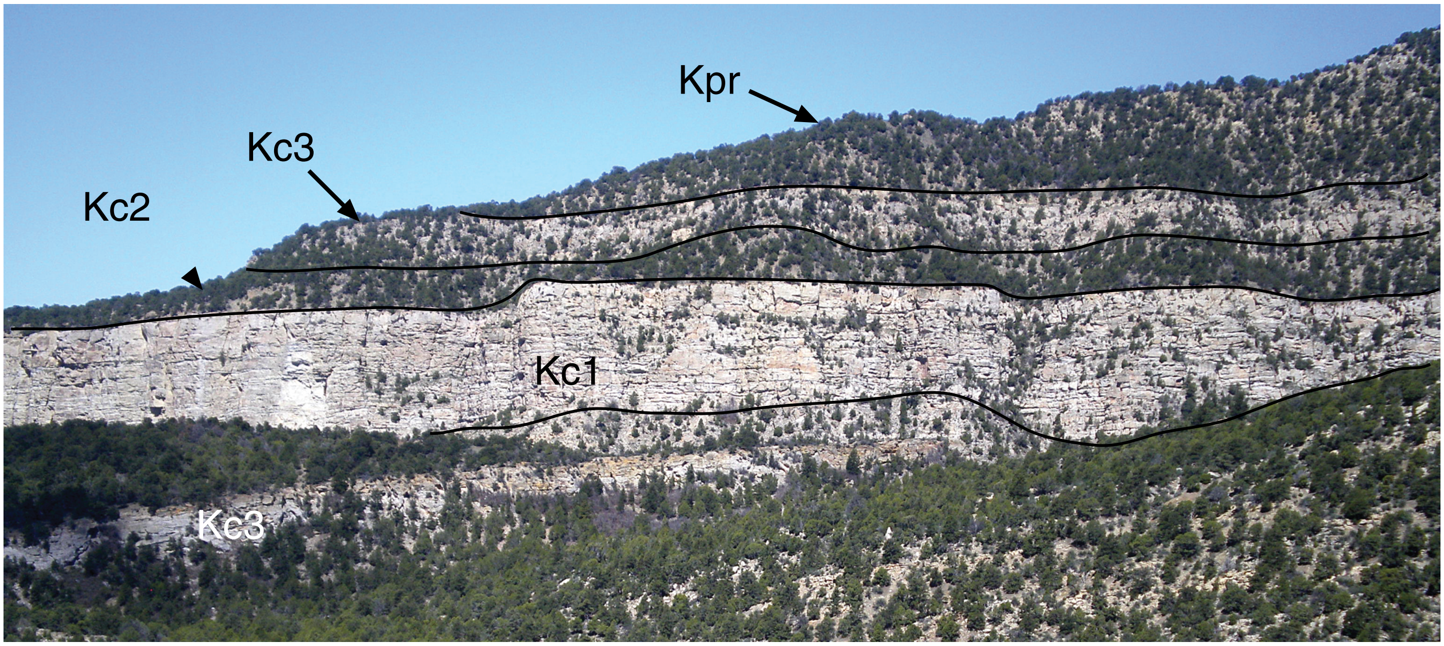


Figure 3. Castlegate Sandstone in the Steves Mountain quadrangle. Geologic units Kc1, Kc2, *and* Kc3 *represent the Castlegate Sandstone; units 1 and 3 are prominent sandstone cliffs or ledges with the more slope-forming* Kc2 *between.* Kpr *represents the Price River Formation. The foreground is separated from main mass of the photograph by a fault, and the ledge in the foreground is a repeat of the* Kc3 *Castlegate Sandstone.*

*Figure 4. Northward panorama of the west half of the Steves Mountain quadrangle. The high end of the cuesta is Steves Mountain. The Flagstaff Formation (*Tf*), consisting of reddish slope-forming mudstone and siltstone and hard white limestone ledges holds up the cuesta, a part of the Wasatch monocline. The mudstone, siltstone, and lenticular sandstone of the North Horn Formation (*TKn*) forms much less well-defined ledges and slopes and is mostly less resistant than the Flagstaff Formation.*

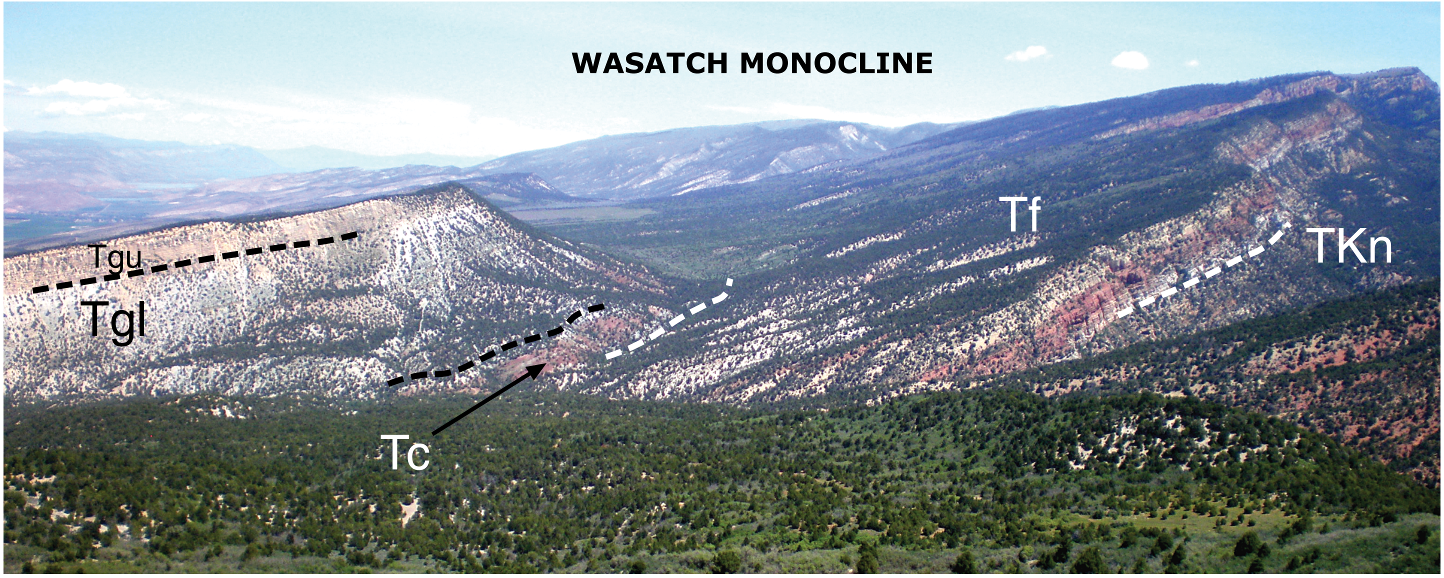


Figure 5. *Northward view of the Wasatch monocline across Willow Creek Canyon from the Steves Mountain quadrangle. The tan or brown unit forming the cap of the west cuesta (left part of photo) is the upper Green River Formation. The greenish slope beneath it is the lower Green River Formation (*Tgl*). The Colton Formation (*Tc*), about 500 feet thick, is found in the hollow between the two cuestas forming the monocline. Forming the east monocline as shown on the photograph is the Flagstaff Formation (*Tf*), the slope beneath and on the right side of the photo is represented by the North Horn Formation (*TKn*).*

Figure 6. *Outcrops of badlands-forming mudstone and siltstone in the North Horn Formation in the Steves Mountain quadrangle. These are interbedded with lenticular sandstone and more rarely conglomerate.*

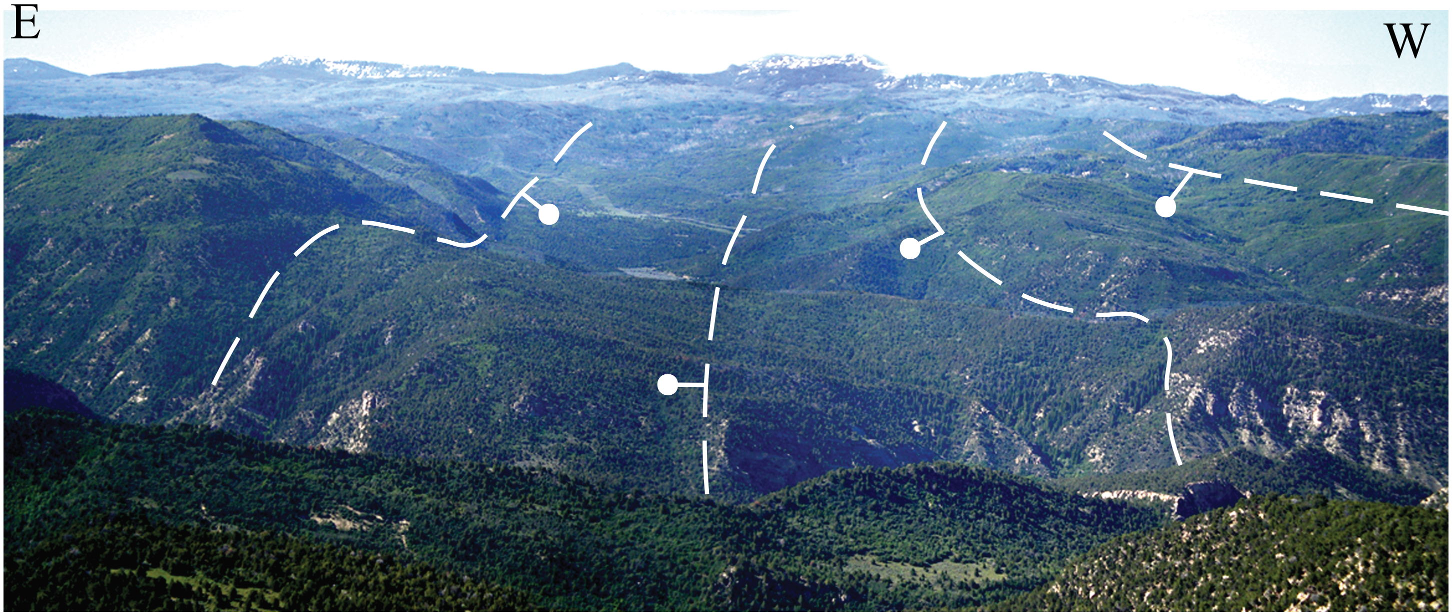
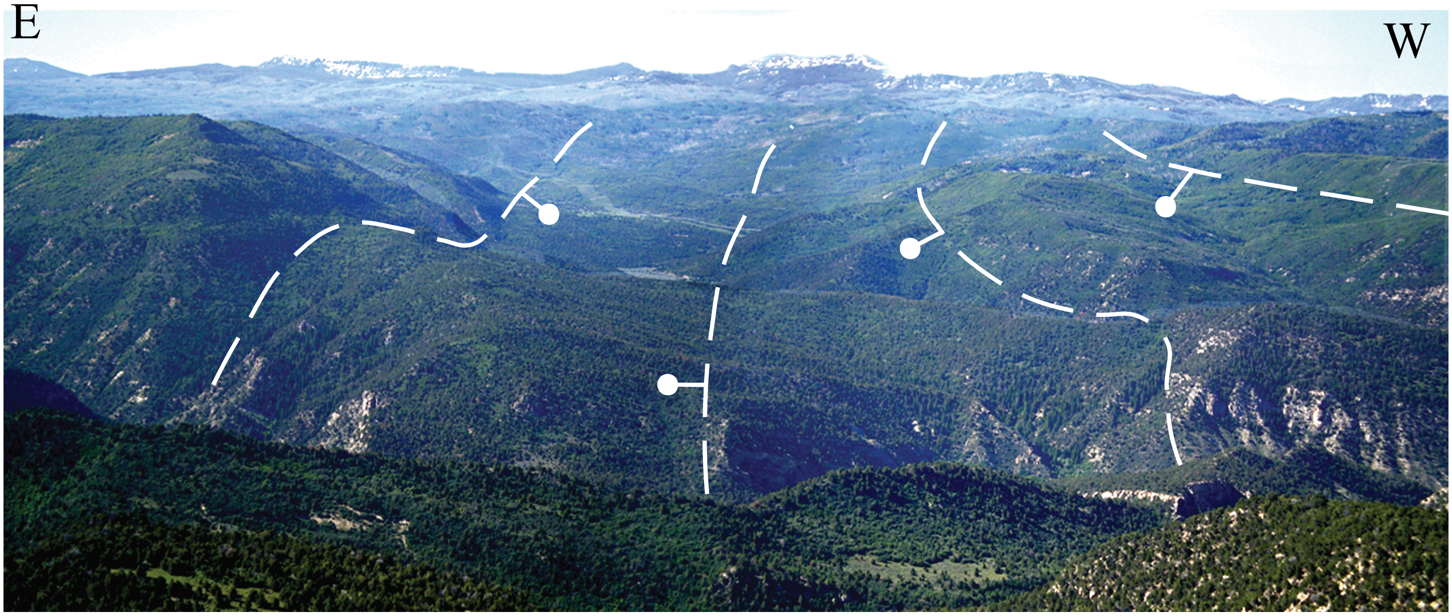


Figure 7. *View southward along axis of Water Hollow fault zone. The fault zone forms a graben with fault lines down to east on the west side and one master down to the west fault on the east side. Photo is taken in the Steves Mountain quadrangle looking into the Gooseberry Creek quadrangle.*

Figure 8. *Closeup view of Flagstaff Formation in Willow Creek Canyon, just north of the Steves Mountain quadrangle. The outcrop shows interbedded gray and red rocks. Gray rocks are either calcarenite or limestone; red rocks are calcareous sandstone, conglomerate, siltstone and mudstone.*



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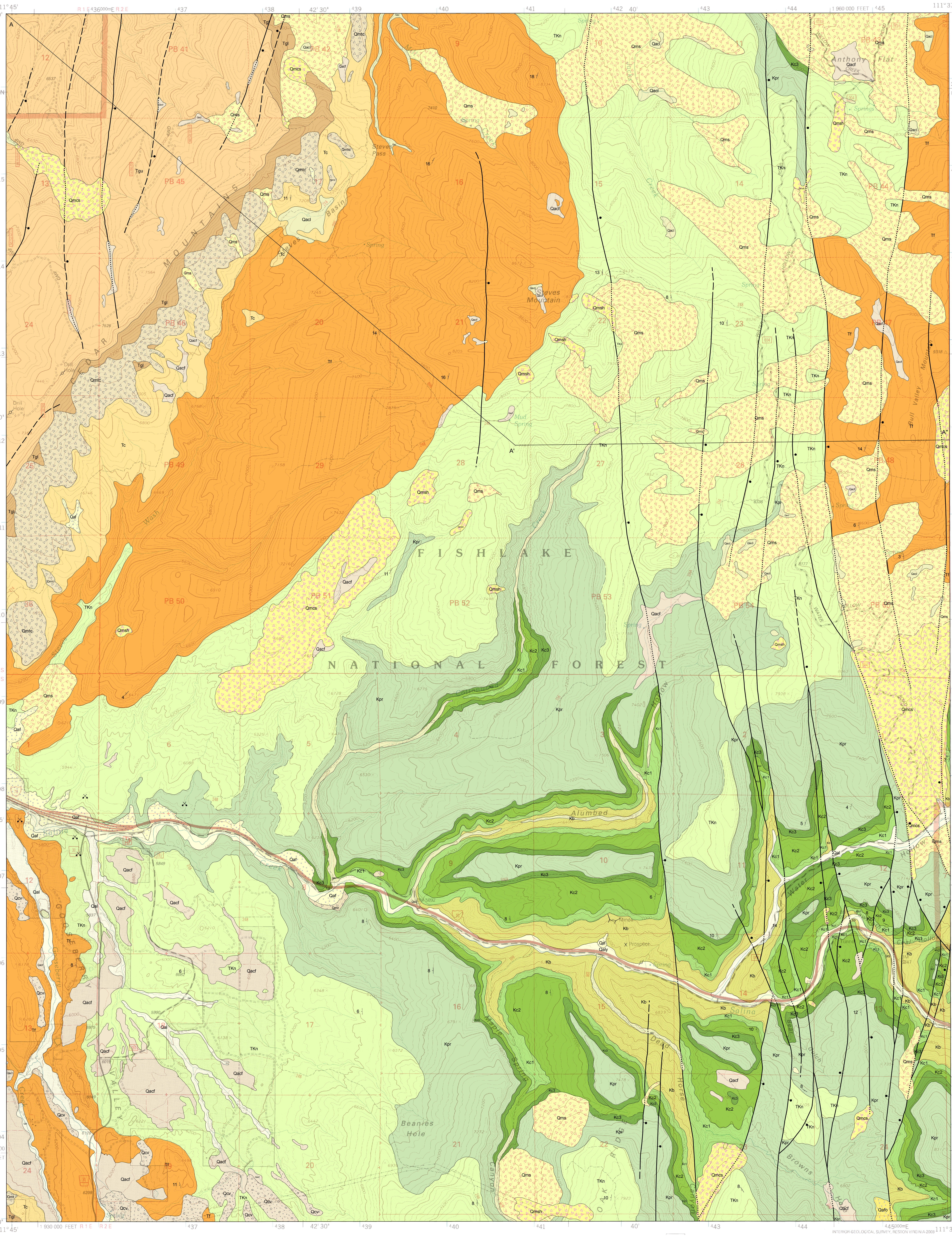
UTAH GEOLOGICAL SURVEY
a division of
Utah Department of Natural Resources

Plate 1
Utah Geological Survey Open-File Report 646
Interim Geologic Map of the Steves Mountain Quadrangle



SCALE 1:24,000

1 0.5 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 0.5 0 1 KILOMETER

CONTOUR INTERVAL 40 FEET

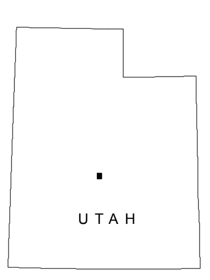
INTERIM GEOLOGIC MAP OF THE STEVES MOUNTAIN QUADRANGLE, SEVIER COUNTY, UTAH

by

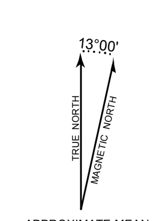
Hellmut H. Doelling and Paul A. Kuehne

2016

This geologic map was funded by the Utah Geological Survey and U.S. Geological Survey, National Cooperative Geologic Mapping Program, through USGS STATEMAP award number G10AC0386. The views and conclusions contained in this document are those of the authors and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the U.S. Government.



MAP LOCATION



APPROXIMATE MEAN DECLINATION, 2001

Base from USGS Steves Mountain 7.5' Quadrangle (2003)
Projection: UTM Zone 12
Datum: NAD 1927
Spheroid: Clarke 1866

Project Manager: Grant Willis
GIS and Cartography: Paul Kuehne and Jay C. Hill

Utah Geological Survey
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P.O. Box 146100, Salt Lake City, UT 84114-6100
(801) 537-3300
geology.utah.gov

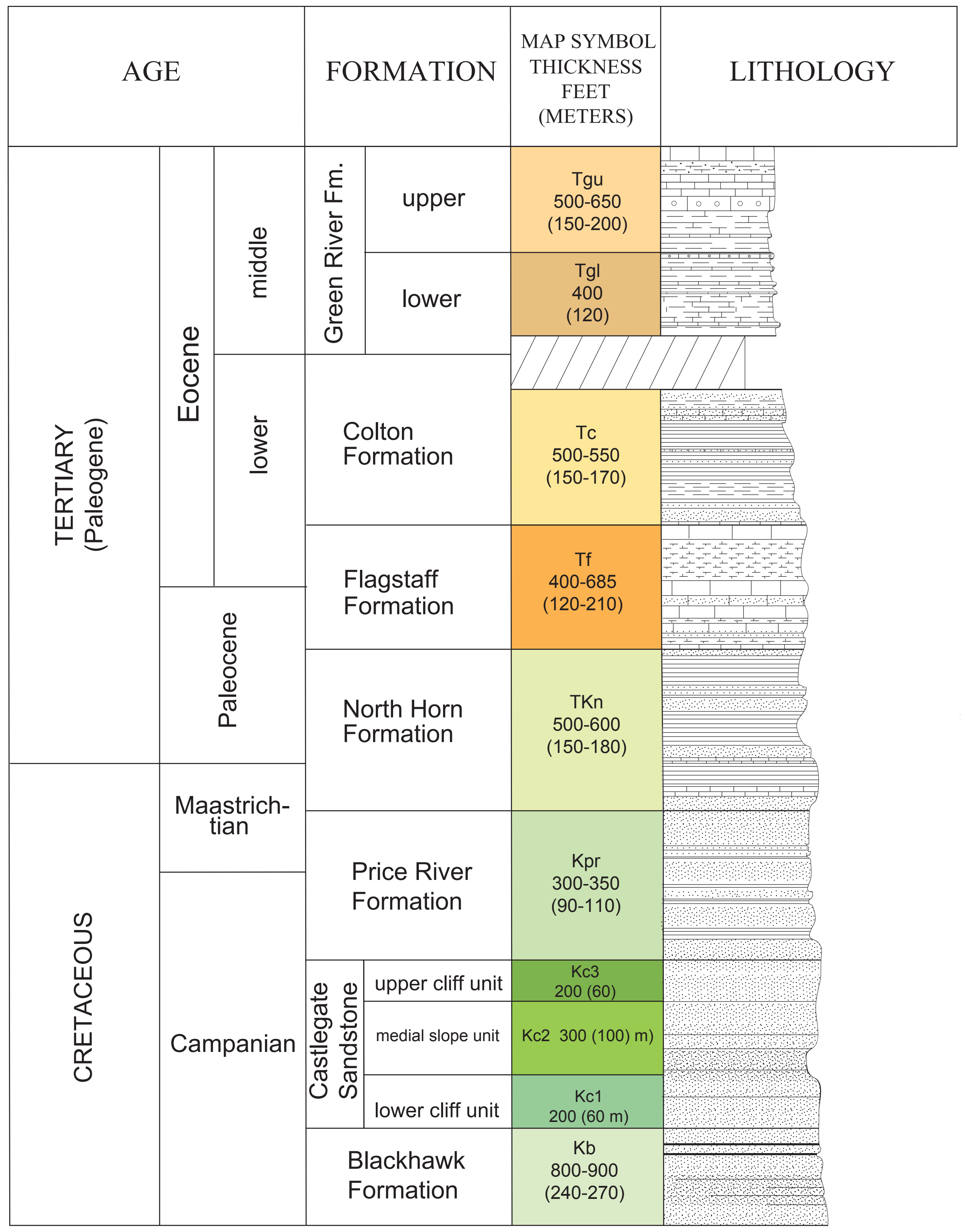
This map was created from Geographic Information System (GIS) data.

1	2	3
4		5
6	7	8

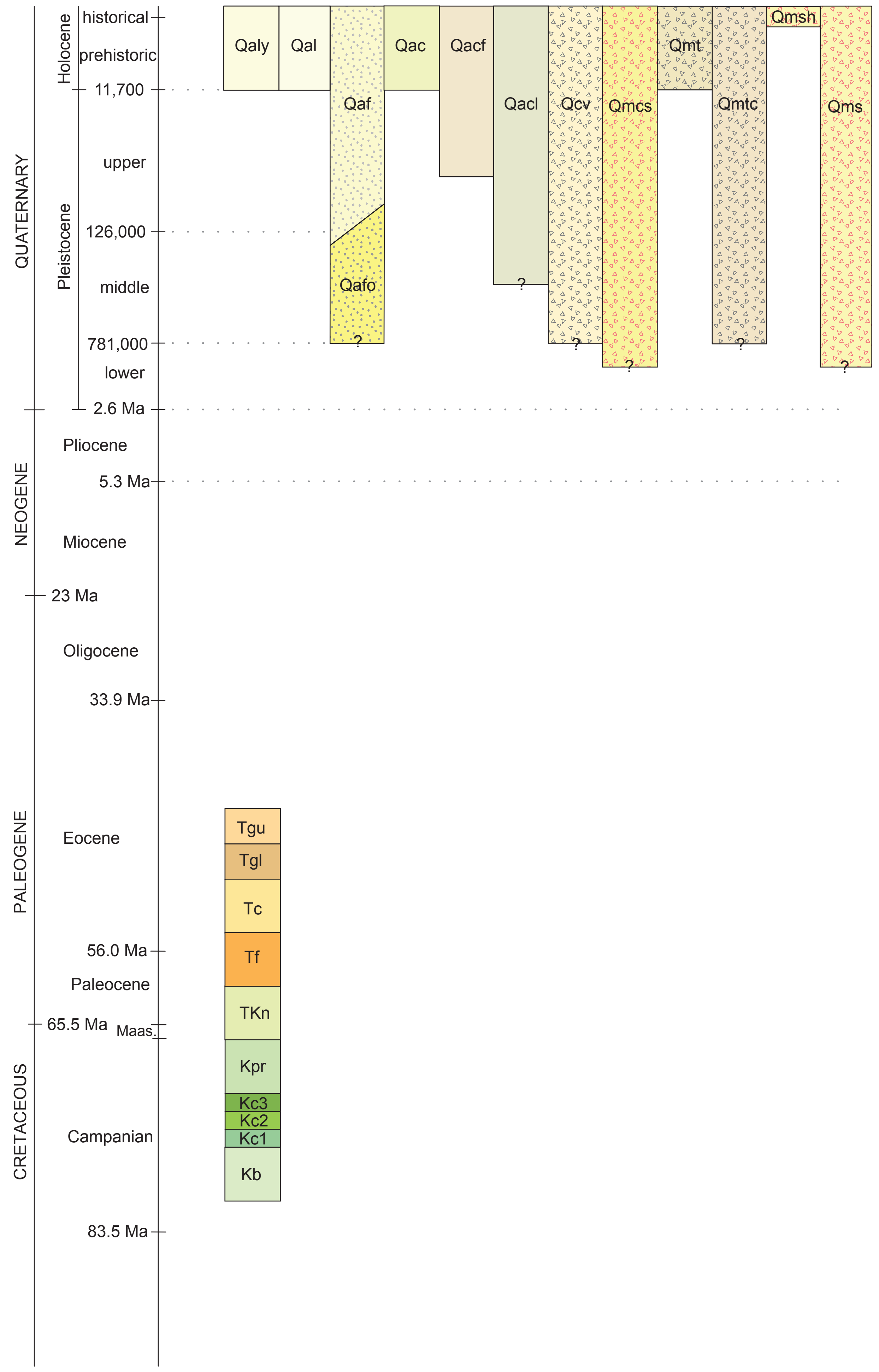
1. Redmond
2. Mayfield
3. Woods Lake
4. Salina
5. Water Hollow Ridge
6. Rex Reservoir
7. Gooseberry Creek
8. Yogo Creek

ADJOINING 7.5' QUADRANGLE NAMES

STEVES MOUNTAIN QUADRANGLE LITHOLOGIC COLUMN



CORRELATION OF MAP UNITS



GEOLOGIC SYMBOLS

- contact, dashed where approximately located
- normal fault, dashed where inferred, dotted where concealed, ball and bar on down-thrown side
- adit
- prospect
- 50 strike and dip of bedding
- road fill or gravel quarry
- drill hole, plugged and abandoned