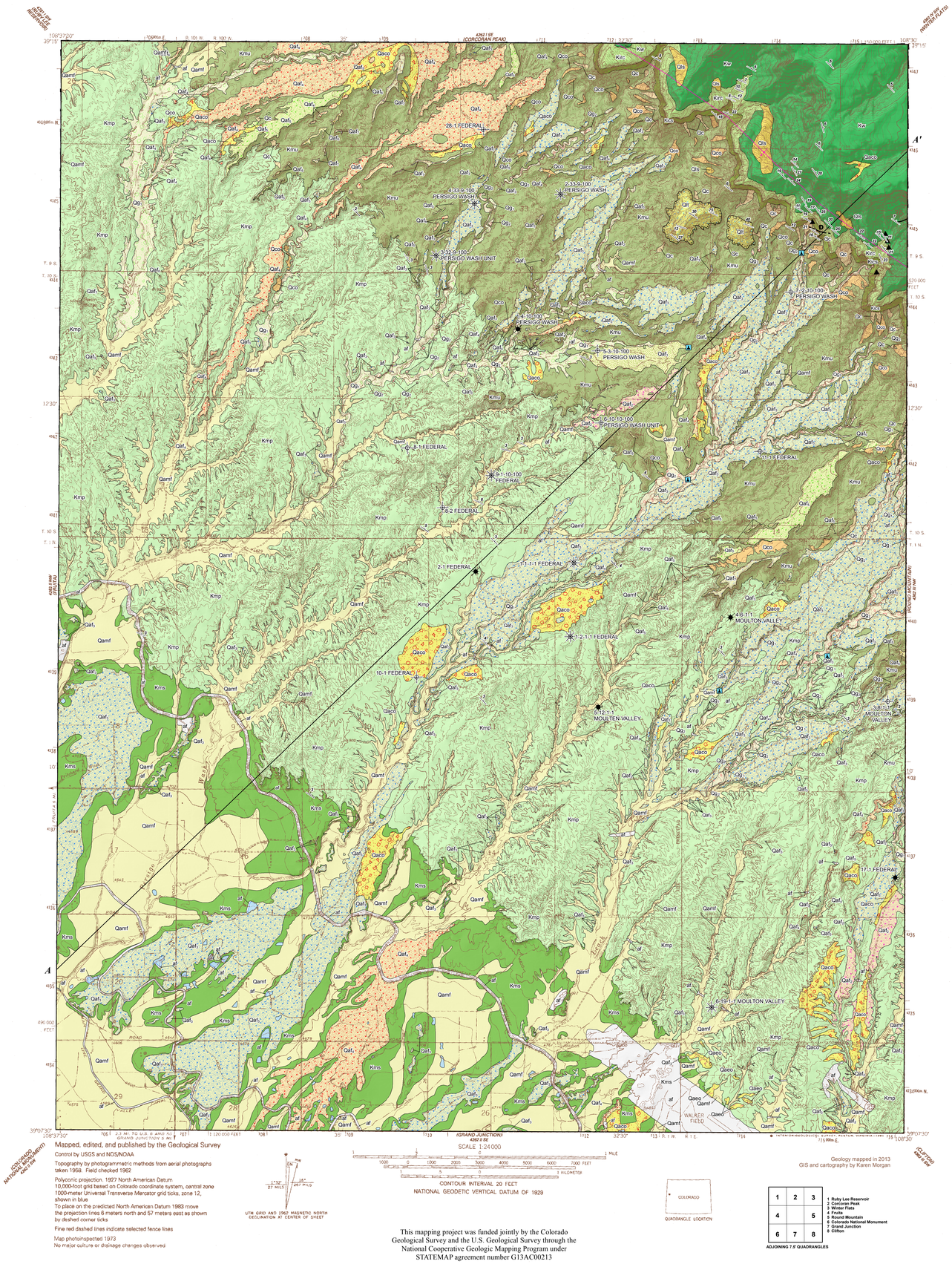
COLORADO GEOLOGICAL SURVEY
COLORADO SCHOOL OF MINES
GOLDEN, COLORADO



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LIST OF MAP UNITS

SURFICIAL DEPOSITS

HUMAN MADE DEPOSITS

af

Artificial fill and disturbed areas (latest Holocene) – Gravel, sand, silt, clay, and rock or concrete debris emplaced to construct roads, canals, embankments, airport runways, or other human-made structures. Fills may be engineered or uncontrolled. Their compositions, thicknesses, and properties are varied. Unit also includes disturbed land and borrow pits/excavations.

ALLUVIAL/ALLUVIAL FAN AND MUDFLOW DEPOSITS

Qg – Alluvial gravel deposits

Qg_1

No. 1 (Holocene) – Laterally constrained, lower-level, stream-channel gravel deposits composed of poorly sorted, angular to subangular, boulder to pebble-sized gravel within a clay, silt, and sand mudflow matrix. Deposit surfaces may contain bouldery levees. Other areas are stratified and imbricated, indicating better-sorted fluvial depositional environments. Clast provenance is sandstone exposed in the Book Cliffs or reworked from headward erosion into older Qaf deposits. Map unit can grade into Qamf unit when gravel content is less than 50%. Deposits may be up to 5 ft thick and are typically incised up to 5 ft by the modern drainage channel. Unit is prone to flash flooding and debris-flow hazards.

Qg_2

No. 2 (early Holocene to late Pleistocene) – Older deposits of gravel similar to Qg_1 in old gully bottoms, meanders, and remnants, now truncated or isolated by channel incision, subsequent shale erosion, and stream capture. Deposit is from 7 to 17 ft above the gully floor with prominent boulder levees at surface. Deposit may thin such that unmapped Mancos Shale is exposed along gully sides. The mud content and poor durability of the sandstone clasts makes this unit an unsuitable aggregate resource.

Qaf - Alluvial and alluvial fan deposits – Forms aggraded gently sloping alluvial fans and constrained stream-channel terraces. More resistant to erosion than the underlying shale, the unit is subdivided and enumerated based on inverted topographic elevations of remnant mesas, hilltops, and narrow ridges. Unconsolidated deposits range from very bouldery, unsorted, non-stratified, matrix-supported, gravelly debris-flow types to better-sorted, stratified, clast-supported, imbricated, sandy-cobbly gravel from a more fluvial environment. Clasts are subangular to slabby sandstone eroded from steep-walled gulches in the Book Cliffs. Many intermediate deposit surfaces contain ancient boulder levees that record individual debris-flow events. Unit holds vegetation better than the surrounding exposed Mancos Shale. Heights recorded for the individual units listed below are to the deepest nearby drainage channels. Fan gradients steepen as they near the Book Cliffs and heights from adjacent drainages increase. The Mancos Shale, exposed to about 30 ft below these units, is typically weathered a blonde color.

Qaf_1

No. 1 (Holocene to late Pleistocene) – Unit forms low fan adjacent to hills of Mancos Shale from 8 to 20 ft above adjacent gullies. This approximately 5-ft thick unit merges into a Qamf unit.

Qaf_2

No. 2 (late Pleistocene) – Unit forms fans and terraces remnants along drainageways in Mancos Shale about 25 to 30 ft above gully floors. Thickness is approximately 5 ft.

Qaf_3

No. 3 (late Pleistocene) – Unit forms the most widespread alluvial fans and terrace remnants in the map area, 50 to 60 ft above adjacent stream channels. Where fan gradients steepen, the height can be as high as 120 ft above the adjacent channel. Clasts have calcic crusts. Surface has a reddish hue where discontinuously mantled with thin loess. Thickness is typically 10 to 15 ft but can range from 5 to 36 ft, Unit broadly correlates with Qpwf unit in Scott and others (2002) and Qta_3 in Livaccari and Hodge (2009).

Qaf_4

No. 4 (late Pleistocene) – Unit forms mesas and ridgelines remnants 80 to 120 feet above adjacent stream channels. Surface has a reddish hue where discontinuously mantled with thin loess. Unit broadly correlates with Qpwf unit in Scott and others (2002). Typical thicknesses are between 5 and 10 ft.

Qaf_5

No. 5 (middle Pleistocene) – Unit occurs as remnants capping isolated hilltops and narrow ridgelines 120 to 160 ft above adjacent stream channels. This unit is typically 10-15 ft thick but may be thinner in places.

Qaf_6

No. 6 (middle Pleistocene) – Unit occurs as remnants capping isolated hilltops and narrow ridgelines about 180 ft above adjacent stream channels. Unit thickness is typically 5-10 ft thick.

Qaf_7

No. 7 (early middle Pleistocene) – Unit occurs as remnants capping isolated hilltops and narrow ridgelines about 220 ft above adjacent stream channels. Unit thickness may be 15-20 ft.

Qamf

Alluvial mudflow and mudflow-fan deposits (Holocene to late Pleistocene) – Light gray to tan gray, moderately to poorly sorted, poorly to unconsolidated, sandy clay and silt. The muddy sediments are principally derived from the Mancos Shale. The deposit can be locally gravel-bearing. The deposits form by channelized to laterally unconstrained mudflows, mud-and-gravel debris flows, and coalesced alluvial mudflow fans from tributary channels. Thicknesses are 5 to 26 ft in channels and may exceed 30 ft in the southwest. Unit is typically heavily incised by recent arroyos and includes unmapped later Holocene intermediate terraces about 8 ft above arroyos floors. Where steep arroyos exist, thin exposures of unmapped Mancos Shale may outcrop. Unit broadly correlates with Qac map unit in adjacent Clifton (Carrara, 2001) and Grand Junction (Scott and others, 2002) quadrangles. This unit may be prone to dispersion (piping) erosion and susceptible to settlement and/or swelling soil hazards when wetted. Arroyo floors are susceptible to flash flooding and mud/debris flows.

ALLUVIAL/EOLIAN DEPOSITS

Qaeo

Old alluvial and eolian deposits (late Pleistocene) – Pinkish tan silt, clay, and very fine-grained sand that thinly mantles low hills of Mancos Shale near Walker Field airport. Unit was deposited by wind and reworked by sheetwash processes. Reddish hue is related to soil development. Some chalky colored exposures along slopes indicate a Bk soil-horizon development. Unit has better vegetation cover than the surrounding hills of Mancos Shale. Unit thickness is around 5 ft.

ALLUVIAL/COLLUVIAL AND MASS-WASTING DEPOSITS

Qaco

Old alluvial and colluvial deposits (Pleistocene) – Reddish tan to tan, unconsolidated silt, clay, and sand with lesser amounts of dispersed, matrix-supported gravel with scattered larger clasts up to small boulders. These old deposits are poorly sorted, very weakly stratified, and the angular clasts are of local upslope origin. These deposits accumulate as thin mantles on protected, gentle to moderate slopes that abut Qaf deposits where wind and sheetwash environments predominated. This unit may also include reworked loess and regolith atop shale bedrock. Exposures are poor but chalky-white exposures along slope breaks reveal a Bk soil horizon. Soil development, the reddish hue, and elevation above the base level stream suggests a late Pleistocene age for this deposit. Thickness is highly variable and likely does not exceed 8 ft.

Qc

Colluvial deposits (Holocene) – Unsorted, non- to very poorly stratified, very angular, very bouldery to cobbly gravel deposited primarily by gravity on and along the base of steeper slopes. The deposits include talus slopes within the Book Cliff canyons. Deposit generally has an unsorted sandy to clayey matrix that was transported by overland sheet flows and rilling that washed down fine-grained material. Variable thicknesses up to 20 ft.

Qco

Old colluvial deposits (Pleistocene) – Steep talus deposits that mark earlier slope margins of the Book Cliffs. Headward erosion of the softer upper Mancos Shale has resulted in the formation of relict facets and ridge remnants that are capped by the more resistant deposit that armor the slope. These old colluvial slopes have increased percentages of fine-grained sediments at the surface and hold vegetation better than the near-barren Mancos Shale. Unit thickness can exceed 20 ft.

Qls

Landslide deposits (Holocene to late Pleistocene) – Disturbed, chaotic mixtures of mudstone, shale, and sandstone rock fragments that form from the shearing, rupturing, and downslope displacement of strata when gravitational forces exceeds the strength of the material. The largest landslides in the map unit, up to 130-ft thick, are north-facing dip-slope failures that occur above the Cameo Coal Zone in the Book Cliffs. Very small, unmapped slumps also occur in drainage channels banks when weathered shale is exposed.

Qlt

Toreva block landslide deposits (Pleistocene) – Large Toreva-type blocks of Cozzette, Corcoran, Sego, and Mancos strata that have slid, rotated, and buckled en-masse into the shale slope below. Strike and dip symbols show orientation of disturbed strata. The toreva blocks are mapped as faulted strata in Ellis and Gabaldo (1989). Toreva blocks are up to 400 ft thick and form lower escarpments that are offset from intact strata of the Book Cliffs.

MAP SYMBOLS

Contact— Approximately located

D — **Fault—** D on downthrown side

Monocline— Axial trace approximates zone of steepest dip

Landslide slip plane — Line denotes exposed basal shear of toreva block, hachure faces interior of block

Oil and/or gas well, drilled and abandoned

Oil and/or gas well, plugged and abandoned

Oil and/or gas well, shut-in

30 — **Strike and dip of inclined bedding—** Showing direction and angle of dip

Coal mine, abandoned and/or reclaimed— Only mines not shown on topographic base map

A — **Stream piracy point—** Location where headward erosion of gullyheads have intercepted and captured earlier drainage channels. The old channel below the piracy point is now abandoned.

A — A′ **Alignment of cross section**

BEDROCK UNITS

Formation nomenclature for Corcoran Point follows Hettinger and Kirschbaum (2002), where the Mesaverde Group formation names (Iles and Williams Fork) have been extended to the map area from the Piceance Basin and Grand Hogback areas. Other literature sources use the Mount Garfield and Hunter Canyon names for respective equivalent strata of the Iles and Williams Fork formations that form the Book Cliffs. The Sego Sandstone remains a member within the Mancos Shale. However, for mapping purposes, the Sego has been included in the map unit that also contains the Corcoran Member of the Iles Formation. The Anchor Mine tongue and lower Sego Sandstone do not occur in the map area. The map area is located within the Book Cliffs Coal Field. Several historic coal mines, within the map area, produced from coal seams in the Cameo and Palisade coal zones. All are abandoned and the mine openings sealed.

Kw

Williams Fork Formation (Upper Cretaceous) – Terrestrial, alluvial and coastal plain sandstone, mudstone, carboniferous shale, and the **Cameo Coal Zone**. Total unit thickness at Corcoran Point is about 1,300 ft. Upper 600 ft of unit exposed in map area is a benchy cliff-forming interval, containing thick to massive beds of laterally extensive, tan to buff, well sorted, medium- to coarse-grained, cross-bedded sandstone interbedded with mudstone and shale. Contorted penecontemporaneous load-deformation zones occur in the sandstone. A 100-ft thick sandstone bed forms the rim of the Book Cliffs around Corcoran Point (el. 7,352 ft) and the flatter dip-slope topography northeast of it. The middle zone outcrops reveal stacked sequences of thick mudstone and thin channel sandstone beds but no coal. Dispersed channel sandstone beds, up to 25 ft thick, create laterally discontinuous benches in what is predominantly a slope-forming, 400-ft thick stratigraphic interval. The basal Cameo Coal Zone contains several bituminous coal beds, mudstone, carbonaceous shale, and minor, thinly bedded, sandstone. Gastropod-fossil packstone, fossil wood, orange-brown concretions, and *Teredolites* burrowing trace fossils occur. Several red clinker zones are also present.

Ki - Iles Formation (Upper Cretaceous)

Kirc

Rollins Sandstone, Mancos Shale tongue, and Cozzette Member – Sandstone, mudstone, and marine shale. The Rollins is a massive, gray-white, fine- to coarse-grained, 75-ft thick, cross-stratified, cliff-forming sandstone that weathers to a distinctive rounded, slick-rock appearance. Burning of Cameo coal seams has stained the Rollins red in some locations. The middle slope former below the Rollins Sandstone is a Mancos Shale tongue of dark-gray marine shale and thin-bedded, fine-grained sandstone. The Cozzette Member below is a 200-ft thick cliff former containing estuarine thinly bedded sandstone and gray, sandy, flaser-bedded mudstone above a massive 100-ft thick, tan to buff, cross-stratified shoreface sandstone. Near its base, the well sorted, medium- to coarse-grained massive sandstone transitions to a finer-grained, thinner bedded, lower shoreface sandstone with increased shale, hummocky beds, and gutter casts. Combined unit is about 325 ft thick.

Kcs

Corcoran Member, Mancos Shale tongues, and upper Sego Sandstone – Sandstone, shale, and the **Palisade Coal Zone**. The top of the map unit is a slope-forming interval of a Mancos Shale tongue and the Palisade Coal Zone that lies atop a prominent 25-ft thick bench of gray-white, medium- to coarse-grained sandstone. Two thin but prominent Mancos shale marine sequences, separated by a sandstone interval, form a benchy slope below. The base of the unit is the upper Sego Sandstone Member of the Mancos Shale. This cliff-forming, massive, cross-stratified, upper shoreface sandstone is underlain by a basal, lower shoreface interval of more thinly hummocky bedded, finer grained sandstone interbedded with thin-bedded silty to sandy shale. Combined unit is 200 to 250 ft thick.

Km - Mancos Shale (Upper Cretaceous) – The Mancos Shale is a very thick, marine formation. Easily erodible, it forms the wide Grand Valley from below the Book Cliffs rim where the resistant sandstones of the Iles and Williams Forks Formations are exposed. Marine invertebrate and fish fossils are present. A significant large fish fossil, *Xiphactinus sp.*, was recovered from the Smoky Hill/Niobrara Member near 23 and $K^3/_4$ Roads. The specimen is in the paleontological collection of Dinosaur Journey, Museum of Western Colorado, in Fruita. Surface residuum where the shale is exposed can exhibit "popcorn" texture related to shrink-and-swell expansive clay content. The shale, and sediments derived from it, are prone to swelling-soil hazards.

Kmu

Upper part of the Mancos Shale – Dark gray to gray black, fissile, sometimes broadly banded shale. The lower Sego Sandstone is not present but the upper 50 ft contains very thin (≤3"), rippled, fine-grained, cross-stratified sandstone beds. At top of unit, the shale becomes silty and thin, very fine-grained, hummocky sandstone beds with gutter casts are present as the Mancos Shale transitions to the lower shoreface facies of the upper Sego Sandstone. Bentonite seams and secondary crystalline gypsum are common. Orange-brown dolomite concretion horizons occur; some are fossiliferous; some as large as 13-ft dia. Lower part of the unit becomes increasingly gray-black and bentonitic (beds 8-10" thick were observed), and is lithostratigraphically equivalent to the Sharon Springs Member mapped in North Delta (Noe and others, 2015). Unit is about 1,400-ft thick. Basal contact with Kmp is marked by a color change from uniform gray-black to dark tan-gray, the first presence of sandstone lamina, and heavy concretionary horizons. This unit does not correlate with the Kmu unit in Livaccari and Hodge (2009).

Kmp

Prairie Canyon Member – Dark gray to gray-tan, non-calcareous, silty to sandy shale and interlaminated very fine-grained sandstone. Unit top contains two horizons of large (≤8-ft dia.) septarian dolomite concretions that contain clear to translucent calcite; and clear, transparent blue to translucent cola-colored barite crystals. Concretions have been heavily prospected by mineral collectors. Sandstone lamina may exhibit pinch and swell structure and weather as wavy chips that typically litter hill slopes; chips have ichnofossils, and can be up to ½-in thick and saucer sized. Unit contains very thin bentonite seams and resistant, ≤1-ft thick, orange-brown ferrous dolomite beds. The dolomite beds have lumpy bases and are laterally discontinuous. Formally described by Cole and others (1997), the sandy Prarie Canyon Member forms low, dendritically-incised hills and ridges in the map area. Basal contact is marked by the cessation of interlaminated sandstone, darker color, the presence of calcareous shale and limy beds, and flattened topography. Unit is about 1,000-ft thick.

Kms

Smoky Hill/Niobrara Member – Dark gray to gray-black, fissile, calcareous shale equivalent to the lower Blue Gate Member (Cole and others, 1997). Shale can grade into thin stratigraphic intervals of shaly limestone. Thin bentonite seams (≤5-in thick were observed) are also present. Typically present are thin to thick-shelled *Inoceramus* fragments, often encrusted with *Pseudoperna congesta* oysters, which emit a petroliferous odor when freshly broken. The Smoky Hill Member is often covered by thin residuum or Qamf deposits and is poorly exposed. It is further obscured where agriculture has heavily modified the topography below the Government Highline Canal. In outcrop, the shale is heavily fractured or split along bedding and commonly filled with secondary gypsum (selenite). The lower contact of this unit doesn't outcrop in the map area. Estimated thickness is about 1,300 ft.

Kml

Lower part of the Mancos Shale, undivided - Shown in cross section only. Includes Montezuma Valley, Juana Lopez, Blue Hill, Bridge Creek, and Graneros members. This unit correlates with lower strata of the Kmu unit in Livaccari and Hodge (2009).

Kdb

Dakota Sandstone and Burro Canyon Formation (Lower Cretaceous) – Shown in cross section only. Depth based on oil and gas wells picks.

JR

Undivided formations of the Jurassic and Triassic – Shown in cross section only. Includes the Morrison, Wanakah, Entrada, Wingate, and Chinle formations. Section thickness from Scott and others (2001).

Xu

Undivided Precambrian rocks of the Uncompahgre Uplift (Proterozoic?) – Shown in cross section only.

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GEOLOGIC MAP OF THE CORCORAN POINT QUADRANGLE, MESA COUNTY, COLORADO

By Jonathan L. White
2014

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