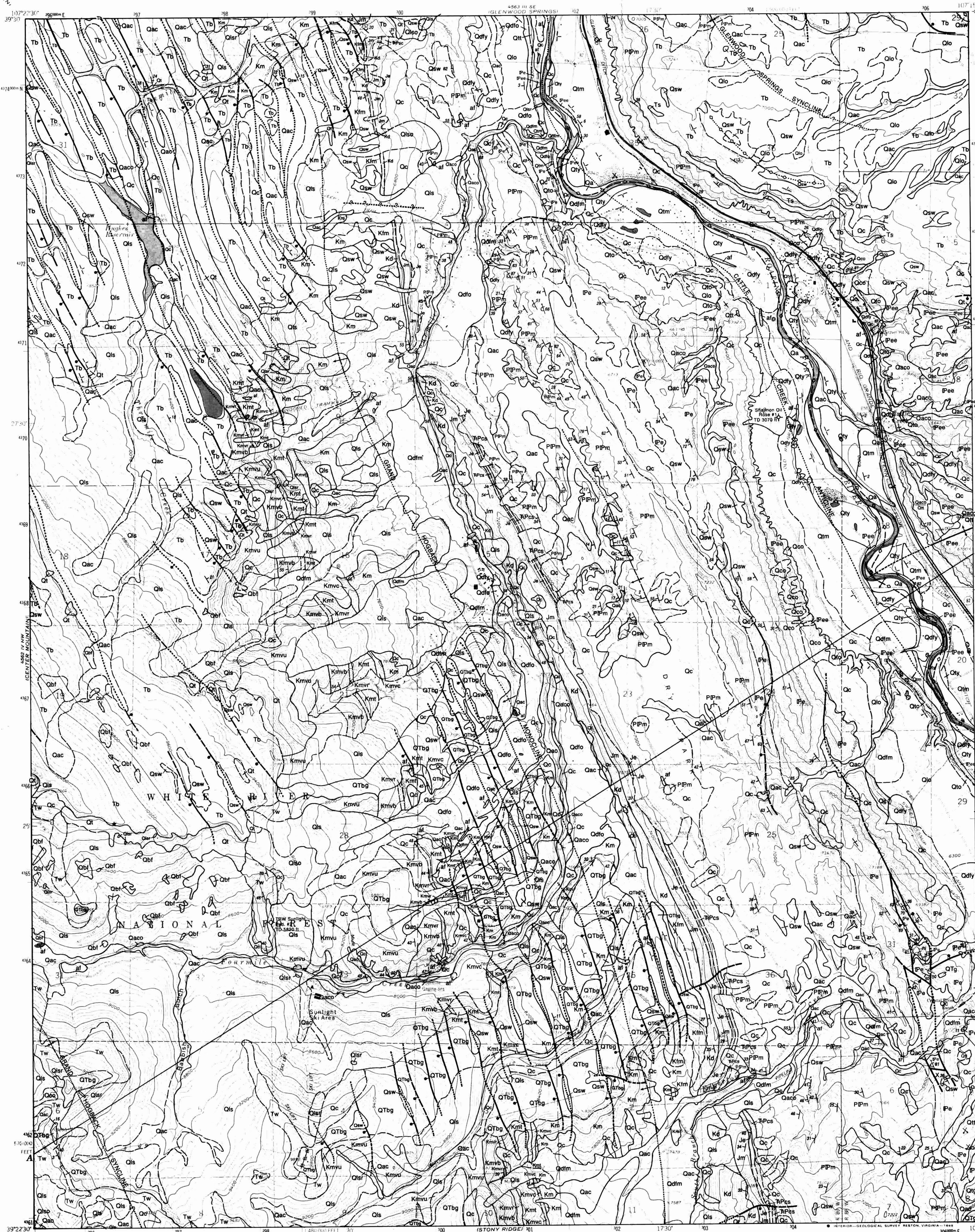
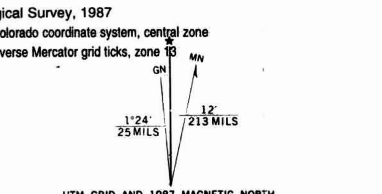
COLORADO GEOLOGICAL SURVEY
DIVISION OF MINERALS AND GEOLOGY
DEPARTMENT OF NATURAL RESOURCES

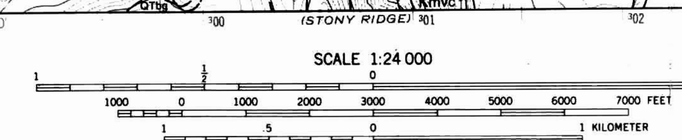


Base from U.S. Geological Survey, 1987
10,000-foot grid bases on Colorado coordinate system, central zone
1000-meter Universal Transverse Mercator grid ticks, zone 13



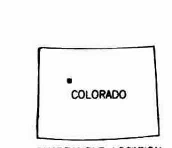
UTM GRID AND 1987 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

SCALE 1:24 000



CONTOUR INTERVAL 40 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

Geology mapped in 1995



QUADRANGLE LOCATION

CONDENSED DESCRIPTION OF MAP UNITS

The complete description of map units and references is in the accompanying booklet.

SURFICIAL DEPOSITS

HUMAN-MADE DEPOSITS

af — **Artificial fill (latest Holocene)**

ALLUVIAL DEPOSITS—Sediments deposited in stream channels, flood plains, terraces, and sheet-wash areas

Qa — **Stream-channel, flood-plain, and low terrace deposits (Holocene and late Pleistocene)**—Mostly poorly sorted, clast-supported gravel in a sandy or silty matrix. Include terraces up to about 12 ft above modern river level

Qsw — **Sheet-wash deposits (Holocene and late Pleistocene)**—Gravelly sand, sandy silt, and clayey silt deposited in ephemeral and intermittent stream valleys, on gentle hillslopes, and in basinal areas

Qty — **Younger terrace alluvium (late Pleistocene)**—Mostly poorly sorted, clast-supported, occasionally bouldery, pebble and cobble gravel with a sand and silt matrix. May include fine-grained overbank deposits. Underlies terraces 15–53 ft above modern stream level

Qtm — **Intermediate terrace alluvium (late Pleistocene)**—Deposits texturally similar to younger terrace alluvium (Qty). Underlies terraces 55–90 ft above modern stream level

Qto — **Older terrace alluvium (middle Pleistocene)**—Deposits texturally similar to younger terrace alluvium (Qty). Clasts moderately weathered. Underlies terraces 200–280 ft above modern streams

Qtt — **Oldest terrace alluvium (middle Pleistocene)**—Deposits texturally similar to younger terrace alluvium (Qty). Clasts moderately to highly weathered. Underlies terraces about 220–460 ft above rivers

QTg — **High-level gravel (early Pleistocene or late Tertiary)**—Chiefly clast-supported, sandy, silty, cobble and pebble gravel occuring on hills and ridges 650–680 ft above the Crystal River. Clasts are very highly weathered

COLLUVIAL DEPOSITS—Sediments on valley sides, valley floors, and hillslopes mobilized, transported, and deposited primarily by gravity

Qlsr — **Recent landslide deposits (latest Holocene)**—Include active and recently active landslides with fresh morphological features. Heterogeneous unit consisting of unsorted, unstratified rock debris, gravel, sand, silt, and clay

Qc — **Colluvium (Holocene and late Pleistocene)**—Ranges from clast-supported, pebble to boulder gravel in a sandy silt matrix to matrix-supported, gravelly, clayey, sandy silt. Usually coarser grained in upper reaches of colluvial slope and finer grained in distal areas

Qt — **Talus (Holocene and late Pleistocene)**—Angular, cobbly and bouldery rubble derived from outcrops of basalt and transported by rockfall, rock slides, and rock topples

Qbf — **Boulder-field deposits (Holocene and late Pleistocene)**—Boulders and cobbles of basalt that lack matrix material. Generally unvegetated

Qls — **Landslide deposits (Holocene and Pleistocene)**—Includes various types of landslide deposits texturally similar to recent landslide deposits (Qlsr). Range from active, slowly creeping slides to long-inactive Pleistocene landslides

Qco — **Older colluvium (Pleistocene)**—Texturally similar to colluvium (Qc), but generally not subject to future deposition

Qlso — **Older landslide deposits (Pleistocene and late Tertiary?)**—Landslide deposits dissected by erosion that lack distinctive landslide geomorphology. Similar in texture to recent landslide deposits (Qlsr)

ALLUVIAL AND COLLUVIAL DEPOSITS—Sediments in debris fans, stream channels, flood plains, and hillslopes along tributary valleys

Qdfy — **Younger debris-flow deposits (Holocene)**—Poorly sorted, matrix- and clast-supported deposits ranging from gravelly clayey silt to sandy, silty, cobbly, pebbly, and bouldery gravel. Fan heads tend to be bouldery, while distal fan areas are finer grained. Include debris-flow, hyperconcentrated-flow, and sheet-wash deposits deposited on active fans and in some drainage channels

Qac — **Alluvium and colluvium, undivided (Holocene)**—Moderately well to well sorted, stratified, interbedded sand, pebbly sand, and sandy gravel to poorly sorted, unstratified or poorly stratified clayey, silty sand, bouldery sand, and sandy silt

Qdfm — **Intermediate debris-flow deposits (Holocene and late Pleistocene)**—Poorly sorted gravelly deposits found 10–50 ft above adjacent streams. Similar in texture and genesis to younger debris-flow deposits (Qdfy). Generally not subject to active deposition except during unusually large debris flows or when drainage channels plug with debris and are overtopped

Qaco — **Older alluvium and colluvium, undivided (Pleistocene)**—Deposits texturally similar to alluvium and colluvium (Qac) that underlie terraces and hillslopes above the floor of tributary valleys

Qdfo — **Old debris flow-deposits (Holocene? and Pleistocene)**—Remnants of inactive debris fans found on mesas and adjacent to stream drainages 20–160 ft above adjacent streams. Similar in texture to younger debris-flow deposits (Qdfy)

QTbg — **High-level basaltic gravel (early Pleistocene or late Tertiary)**—Slightly indurated, matrix-supported, gravelly, clayey, sandy silt. Caps four mesas that lie 300 to 1,700 ft above Fourmile and Freeman Creeks

EOLIAN DEPOSITS

Qlo — **Loess (late and middle? Pleistocene)**—Slightly clayey, sandy silt and silty, very fine sand deposited by wind on level to gently sloping surfaces. Usually unstratified, friable, and plastic or slightly plastic

UNDIFFERENTIATED DEPOSITS

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

BEDROCK

Tb — **Basalt (Miocene)**—Multiple flows of tholeiitic, alkaline and subalkaline basalt, olivine basalt, and trachybasalt. Groundmass dominantly plagioclase and pyroxene; phenocrysts chiefly olivine and plagioclase. Locally includes slightly indurated sediments. A whole rock sample from the lowermost flow exposed in cliff northeast of Roaring Fork River is dated at 9.64 ± 0.05 Ma based on its $^{40}Ar/^{39}Ar$ age spectra, while the age spectra of lowermost flow exposed in cliff southeast of Sunlight Peak is disturbed, indicating significant ^{40}Ar loss (L. Snee, 1996, written commun.). An isochron analysis of the latter sample yields an age of 10.4 ± 0.1 Ma, which should be considered as a minimum age.

Ts — **Interflow sedimentary deposits (Miocene)**—Lenticular deposits of fluvial and colluvial sediments between basalt flows. Range from clast-supported silty, sandy pebble and cobble gravel to matrix-supported gravelly, sandy silt that is slightly indurated

Tw — **Wasatch Formation (Eocene and Paleocene)**—Variegated claystone, siltstone, sandstone, and conglomerate. Conglomeratic clasts composed of Tertiary igneous rocks and chert

MESAVERDE GROUP (UPPER CRETACEOUS)

Kmvu — **Upper Williams Fork Formation**—Includes lenticular sandstone, siltstone, shale, limestone, and thin coal beds of the Paonia Shale Member at base and overlying unnamed conglomeratic sandstone, siltstone, shale, and very lenticular, thin coal beds. May locally include the Ohio Creek Member

Kmvb — **Bowie Shale Member of Lower Williams Fork Formation**—Shale, sandstone, siltstone, coal, and occasional algal limestone. Includes in ascending order the Cameo–Wheeler–Fairfield coal zone, middle sandstone member, an unnamed sequence of shale and siltstone, and upper sandstone member

Kmvr — **Rollins Sandstone Member of Lower Wiliams Fork Formation**—Buff, gray, and white, medium-grained feldspathic sandstone

Kmt — **Mancos Tongue of Iles Formation**—Light to dark gray, carbonaceous, calcareous shale with thin beds of bentonite, siltstone, and sandstone

Kmvc — **Cozzette Sandstone Member of Iles Formation**—Buff to tan, well-sorted, upward-coarsening sandstone with subconchoidal fractures

Km — **Mancos Shale (Upper Cretaceous)**—Dominantly light to dark gray, carbonaceous shale with thin beds of bentonite, siltstone, and sandstone and a basal calcareous shale zone

Kfm — **Frontier Sandstone and Mowry Shale, undivided (Upper Cretaceous)**—Includes siliceous, gray to black shale with fish scales (Mowry Shale) and overlying yellowish brown, calcareous, fine-grained sandstone (Frontier Sandstone).

Kd — **Dakota Sandstone (Lower Cretaceous)**—Light gray to tan, medium to very coarse-grained, quartzose sandstone and conglomeratic sandstone interbedded with carbonaceous siltstone, sandstone, and shale

Jm — **Morrison Formation (Upper Jurassic)**—Pale green and maroon mudstone and shale and gray limestone. Thin to moderately thick beds of silty sandstone in lower part

Je — **Entrada Sandstone (Upper Jurassic)**—Light gray to light orange, medium to very fine-grained, well sorted sandstone with large-scale cross-bedding

ŦPsc — **Chinle and State Bridge Formation, undivided (Triassic and Permian)**—Red beds of the Lower Triassic? and Permian State Bridge Formation, and overlying Upper Triassic Chinle Formation. State Bridge consists of pale red to reddish brown siltstone, shale, and very fine-grained sandstone. Chinle composed of thin, even-bedded, and structureless red beds including dark reddish brown, orangish red, and purplish red, calcareous siltstone and mudstone with occasional thin lenses of light purplish red and gray limestone and limestone-pebble conglomerate

PIPm — **Maroon Formation (Permian and Pennsylvanian)**—Mainly red beds of sandstone, conglomerate, mudstone, siltstone, and claystone with minor thin beds of gray limestone. Includes fine-grained feldspathic sandstone and conglomeratic sandstone of Schoolhouse Member at top of formation

IPe — **Eagle Valley Formation (Middle Pennsylvanian)**—Reddish brown, gray, reddish gray, and tan siltstone, shale, sandstone, gypsum, and carbonate rocks which are gradational between and intertonguing with the Maroon Formation and Eagle Valley Evaporite

IPee — **Eagle Valley Evaporite (Middle Pennsylvanian)**—Evaporitic sequence of gypsum, anhydrite, and halite interbedded with mudstone, fine-grained sandstone, thin carbonate beds, and black shale. Commonly intensely folded, faulted, and ductily deformed

MAP SYMBOLS

Formation contact—Dashed where approximately located

Fault—Long dashes where approximately located; short dashes where inferred; queried where uncertain; dotted where concealed; bar and ball on downthrown side; includes faults related to flowage of evaporite deposits

Anticline—Showing axial trace; dashed where approximately located; dotted where concealed

Anticline—Showing approximate axial trace of a late Pleistocene and Holocene? anticline which probably owes its origin to diapirism, expansion resultant from hydration of anhydrite, dissolution-induced subsidence, or a combination thereof. Not shown where it coincides with axis of Cattle Creek Anticline

Syncline—Showing axial trace; dashed where approximately located; dotted where concealed

Syncline—Showing approximate axial trace of synclinal sag related to flowage of evaporite deposits

Monocline—Showing approximate trace of vertical plane placed about equidistant from anticlinal and synclinal fold axes; arrow indicates direction of dip; dashed where approximately located; dotted where concealed

Monocline—Synclinal bend; showing shorter arrow on steeper beds; dashed where approximately located; dotted where concealed

62 **Strike and dip of beds**—Angle of dip shown in degrees; most attitudes in basalt and terrace deposits were measured on top of apparent surface

Inclined beds

Inclined beds—showing approximate attitude of surface on terraces and basalt flows as determined from stereoscopic models set on a Kelsh PG-2 plotter; dip between 0 and 30°

Vertical beds

26 **Overturned beds**

81 **Overturned beds**—Top of beds known from local features

Coal adit

Gravel pit

Prospect pit

Locality of rock sample—Radiometrically dated using the $^{40}Ar/^{39}Ar$ method

A——A′ **Alignment of cross section**

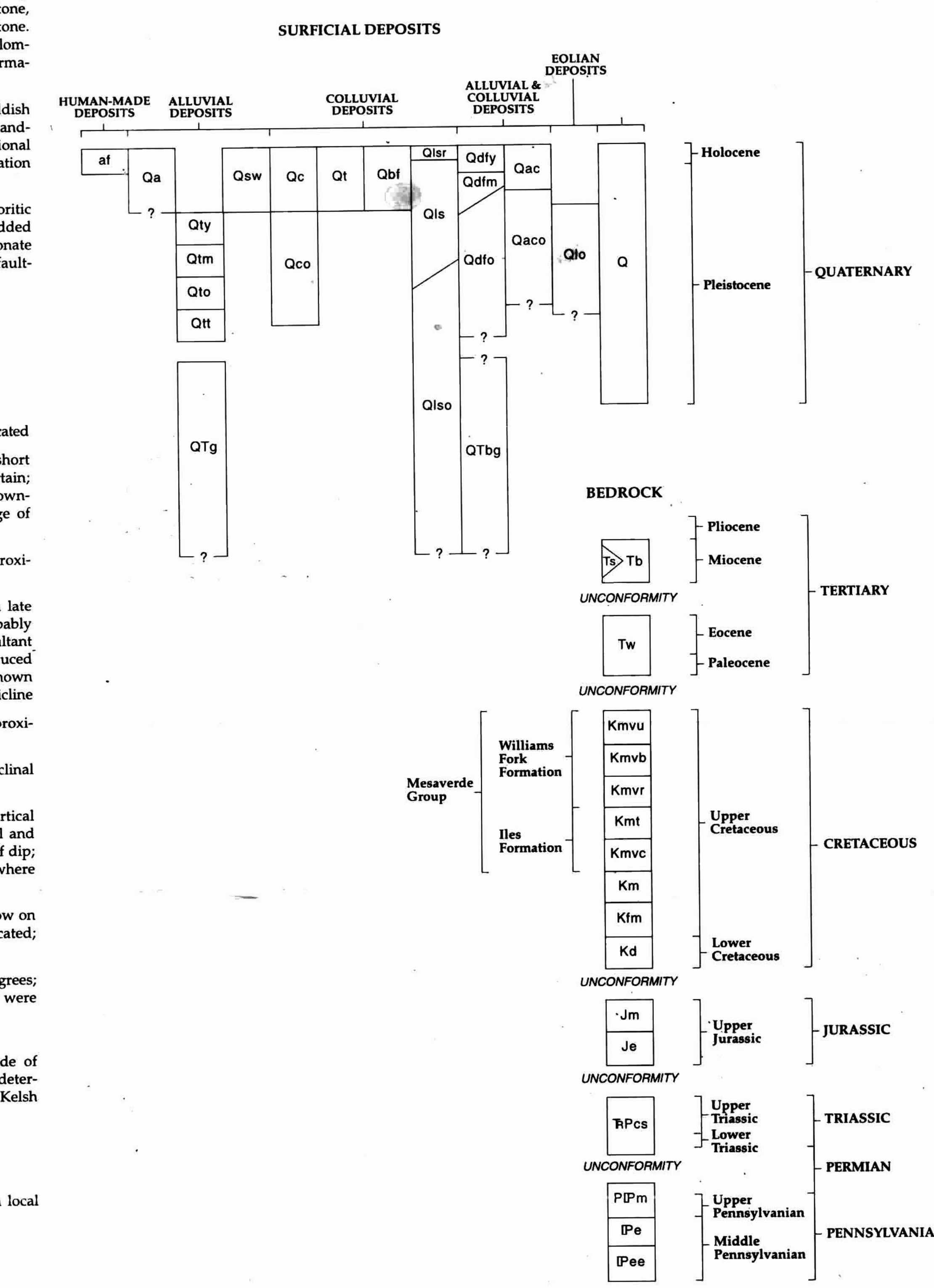
Oil or gas exploration test hole—Plugged and abandoned; operator, well name, and total depth shown

Sackungen-like feature (ridge-top trench caused by rock creep)

Sinkhole—Created by hydrocompaction or settlement of low density surficial deposits, by piping of surficial deposits into dissolution caverns within underlying Eagle Valley Evaporite, or by subsidence over underground coal mines; includes dissolution caverns in outcrops of Eagle Valley Evaporite

Qaco/Qtt **Fractional unit**—Indicates a thin veneer of the deposit in the numerator overlies the deposit shown in the denominator

CORRELATION OF MAP UNITS



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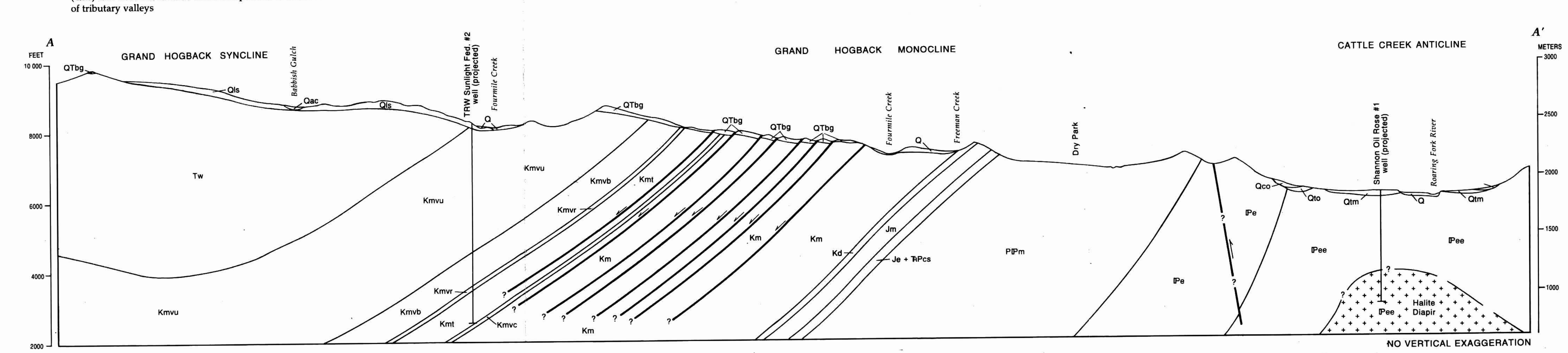
We appreciate the many helpful landowners who gave permission to enter their property and contributed information that only long-time residents possess.

Photogrammetric models were set by James Messerich on a Kelsh PG-2 plotter, courtesy of the U.S. Geological Survey in Denver.



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GEOLOGIC MAP OF THE CATTLE CREEK QUADRANGLE, GARFIELD COUNTY, COLORADO

By
Robert M. Kirkham, Randall K. Streufert, H. Thomas Hemborg, and Peter L. Stelling
1996