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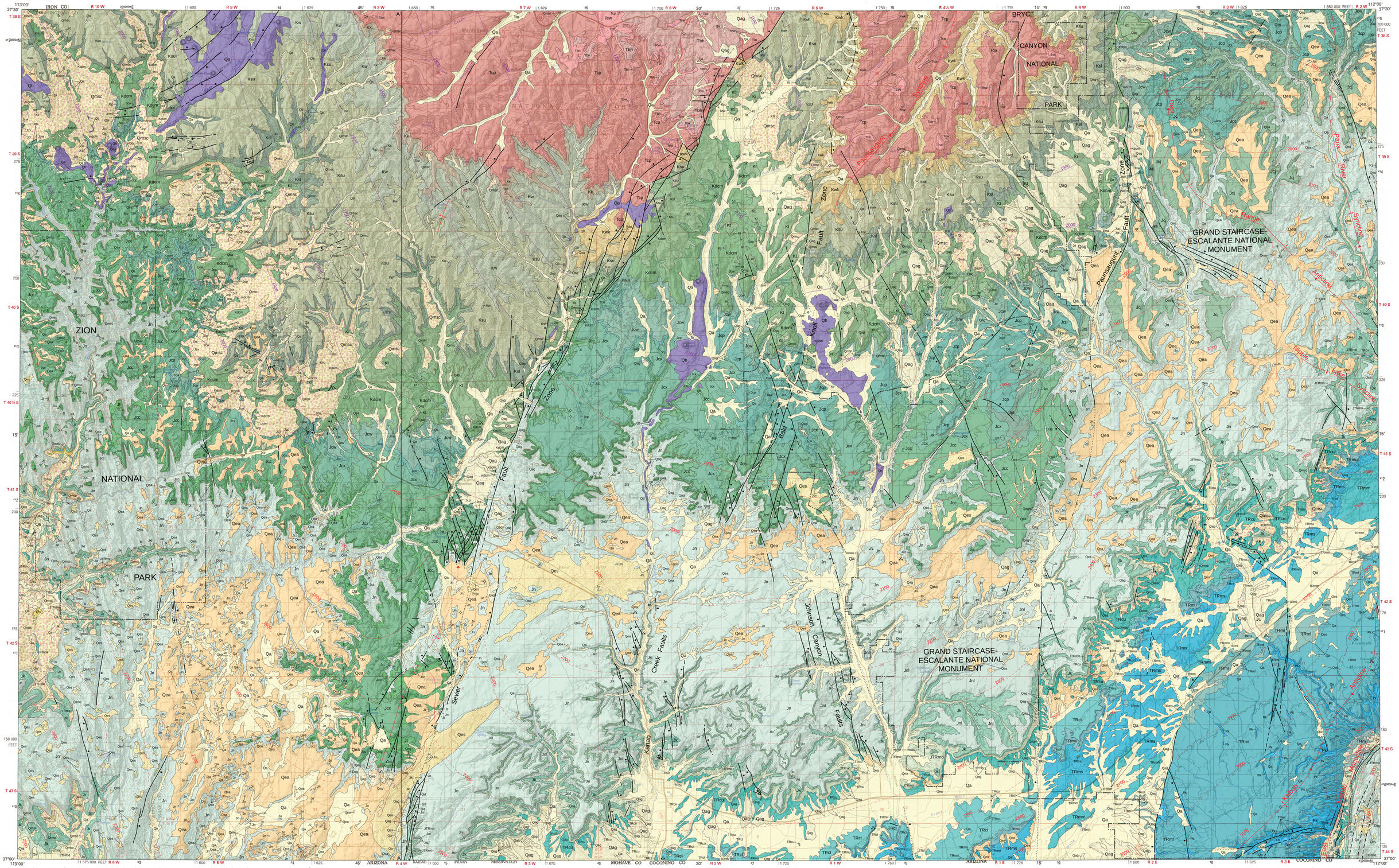

This geologic map was funded by the Utah Geological Survey and the U.S. Geological Survey, National Cooperative Geologic Mapping Program, through USGS STATEMAP award number 97HQAG1797.

12½°
TRUE NORTH
MAGNETIC NORTH
2006 MAGNETIC DECLINATION
AT CENTER OF SHEET

QUADRANGLE LOCATION

GEOLOGIC MAP OF THE KANAB 30' x 60' QUADRANGLE KANE AND WASHINGTON COUNTIES, UTAH, AND COCONINO AND MOHAVE COUNTIES, ARIZONA

compiled by
Hellmut H. Doelling

2008
www.geology.utah.gov

SCALE 1:100,000

TOPOGRAPHIC CONTOUR INTERVAL 50 METERS
GEOLOGIC STRUCTURE CONTOUR INTERVAL 100 METERS

0 1 2 4 6 8 10 12 Miles
0 1 2 4 6 8 10 12 14 16 Kilometers

Base from U.S. Geological Survey, 1980
Projection: UTM, Zone 12
Units: Meters
Datum: NAD 1927
Spheriod: Clarke 1866

Project Manager: Grant C. Willis
Cartography: J. Buck Ehler
James W. Parker
GIS Production Specialists: J. Buck Ehler
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DESCRIPTION OF GEOLOGIC UNITS

QUATERNARY DEPOSITS

Qa **Alluvium** – Mostly sand with lenses of silty clay, sandy silt, and gravel deposited in stream beds, washes, adjacent floodplains, and on low alluvial slopes; includes lower terrace and alluvial fan deposits; 0 to 36 m (0-120 ft) thick.

Qes **Windblown sand** – Sand in active to partially stabilized dunes and sheets; mostly fine to medium grained; generally derived from and deposited on and downwind of large exposures of eolian sandstone formations (primarily Navajo and Entrada Sandstones); locally includes alluvial deposits; 0 to 30 m (0-100 ft) thick.

Qea **Mixed eolian and alluvial sand** – Mostly sand with minor amounts of clay, silt, and gravel; stabilized sand sheets locally reworked by alluvial processes and with well-developed calcic soil; 0 to 30 m (0-100 ft) thick.

Qag **Alluvial gravel** – Poorly to well-sorted gravel, sand, and boulders with interlayers of silt and mud; present on pediments and higher river terraces, and as older erosional remnants; 0 to 20 m (0-60 ft) thick.

Qls **Lacustrine sand** – Well stratified sand, clay, silt, and minor gravel deposited where drainage was blocked by a landslide in Zion Canyon; also mapped in a human-made reservoir on South Creek near southwest corner of the quadrangle; 0 to 40 m (0-135 ft) thick.

Qmsc **Mass-movement deposits, undifferentiated** – Includes landslides, slumps, colluvium, talus, and other mass-movement deposits; very poorly sorted; nonstratified; common on moderate to steep slopes; only larger deposits mapped; 0 to 75 m (0-250 ft) thick.

Qb **Basalt lava flows and cinder cones** – Blocky vesicular basalt and basaltic andesite lava flows and cinder cones, commonly partially covered by a thin veneer of eolian silt and sand; phenocrysts include olivine, labradorite, titaniferous augite, plagioclase, and iron-titanium oxides (Sable and Hereford, 2004; Biek and Hylland, 2007); remnants of four flows are preserved near the Sevier fault and southwest to southeast of the Paunsaugunt Plateau (Sable and Hereford, 2004; Tilton, 1991a,b) – Best and others (1980) obtained K-Ar ages of 0.56±0.05 Ma on the Spencer Bench (Black Mountain) flow and 1.1±0.1 Ma on the Tenny Creek flow (26 km [16 mi] east-northeast of Glendale); Schiefelbein (2002) obtained ^{40}Ar/^{39}Ar ages of 0.58+0.05 Ma and 0.564+0.02 Ma on the Spencer Bench (Black Mountain) flow; remnants of six or more flows are preserved in the Markagunt Plateau area in the northwest part of the quadrangle – Best and others (1980) obtained K-Ar ages of 1.2±0.6 Ma on the Hornet Point flow (age is probably unreliable – note large standard error), 0.81±0.05 Ma on the Horse Knoll flow, and 0.36±0.08 Ma on the Volcano Knoll flow; Biek and Hylland (2007) obtained ^{40}Ar/^{39}Ar ages of 0.74±0.05 Ma on the Hornet Point flow, 0.37±0.02 Ma on the Virgin Flats flow, and 0.34±0.03 on the Volcano Knoll flow, and estimated the Three Creeks flow (near China Point) at less than 0.3 Ma; other flows have not been dated but are probably similar in age to the dated flows; some flows are cut by post-flow movement on Quaternary faults.

TERTIARY ROCKS

Ta **Older Boulder Gravel Deposits** (Miocene?) – Unconsolidated, very poorly sorted, clay- to large boulder-size sediment characterized by very large quartz monzonite boulders as much as 30 feet (10 m) long; also includes large boulders of limestone, sandstone, and quartzite; probably deposited by debris flows originating in the Pine Valley Mountains west of the quadrangle (Biek and Hylland, 2007); 0 to 90 feet (0-27 m) thick.

Tbh **Brian Head Formation** (Oligocene - late Eocene) – Yellow-gray to pale-orange tuffaceous sandstone, conglomerate, mudstone, and minor limestone, shale, and claystone; weathers to drab gray and brown slopes; sandstone is mostly poorly sorted and cross-bedded; lower part is largely yellow-orange weathering siltstone and claystone; lower contact may be an unconformity; as much as 120 m (400 ft) thick.

unconformity

Claron Formation (Eocene - Paleocene)

Tcw **White member** – White to light-gray limestone and chalky claystone; calcite-filled vugs and fractures are common; forms massive rough-weathering cliffs; contains some limy shale partings; 20 to 40 m (60-120 ft) thick.

Tcp **Pink member** – Pink, orange, and pale gray, commonly stained limestone, limey mudstone, dolomite, mudstone, and conglomerate; irregularly bedded; nodular and mottled paleosols common; weathers into picturesque cliffs, columns, spires, and pinnacles; commonly overlying limestone breccia and a basal conglomerate; basal beds of map unit locally equivalent to Pine Hollow and Canaan Peak Formations (Bowers, 1972); unit forms the Pink Cliffs of the Grand Staircase; 150 to 250 m (490-820 ft) thick.

unconformity

CRETACEOUS ROCKS

(see Eaton, 1991, for additional discussion of Cretaceous units and contacts in this quadrangle and surrounding area)

Kk **Kaiparowits Formation** (Upper Cretaceous) – Drab-gray, olive-gray, brown-gray, and green-gray sandstone, mudstone, and siltstone; sandstone is very fine to fine grained; bedding is poorly defined and lenticular; forms ledgy steep slopes and badlands; lesser amounts of thin light-gray mudstone and light yellow-gray calcareous siltstone are interbedded; locally contains molluscan fragments, plant debris, and dinosaur bones; 0 to 75 m (0-250 ft) thick; absent or thin and mapped with the Wahweap Formation (Kwk) in Paunsaugunt Plateau area.

Kwk **Wahweap and Kaiparowits Formations, undivided**

Kw **Wahweap Formation** (Upper Cretaceous) – Mostly gray to yellow-gray, interbedded mudstone, claystone, sandstone, siltstone, and conglomerate with some brown fine- to medium-grained sandstone beds; forms slopes and ledges; 100 to 200 m (330-660 ft) thick below and south of the Paunsaugunt Plateau and 245 to 300 m (800-1000 ft) thick south of the Markagunt Plateau.

Straight Cliffs Formation (Upper Cretaceous)

Ksu **Upper unit** – Interbedded yellow-gray to light-brown sandstone and gray mudstone and siltstone; forms ledges, cliffs, and slopes; sandstone is fine to coarse grained and locally conglomeratic; upper part commonly forms a sandy conglomeratic cliff that may correlate with the Drip Tank Member of the Straight Cliffs Formation in the Kaiparowits Plateau; mudstones are locally carbonaceous and contain thin coal beds, especially toward the east; 300 to 380 m (900-1250 ft) thick.

Ksl **Lower unit** – Yellow-gray, orange-gray, and light-brown sandstone interbedded with lesser quantities of mudstone, siltstone, and claystone; generally forms a cliff or a series of ledges; locally contains carbonaceous mudstone and very thin beds of coal and coaly shale in upper part, especially toward the east; locally intertongues with the Tropic Shale below; 26 to as much as 100 m (85-330 ft) thick.

Kt / Kt **Tropic Shale** (Upper Cretaceous) – Mapped as single line where thin in western part of map area. Drab-gray, marine shale with subordinate gray sandstone; generally forms a steep slope; sandstone becomes more abundant in the upper part and to the west; thins to the west where unit interfingers with non-marine sandstone beds and contains carbonaceous mudstone and very thin coaly beds; lower contact placed stratigraphically higher to west (see Dakota discussion); 90 to 300 m (300-1000 ft) thick; thickness varies irregularly, but generally is thicker to the east.

Kdcm **Dakota and Cedar Mountain Formations, undivided** (Upper-Lower Cretaceous; Cenomanian to Albian?) (Cedar Mountain beds locally present at base of unit) – Yellowish-brown, gray, and white, thin- to thick-bedded, interbedded sandstone, sandy shale, carbonaceous shale, shaly sandstone, conglomerate, smectitic mudstone, coal, and marl; forms a moderate to steep slope with ledgy cliffs; sandstone is fine to medium grained; smectitic strata become more common westward; oysters, clams, and gastropods are common; map unit is conducive to landsliding and complete, undeformed exposures are uncommon; lower contact is a regional unconformity; forms the Gray Cliffs of the Grand Staircase with the cliff-forming units of the Straight Cliffs Formation; 60 to 270 m (200-900 ft) thick; thickens westward across quadrangle; in western part of quadrangle (west of 112°45' W.) upper contact is placed at top of "sugarledge sandstone" (Hylland, 2000; Biek and Hylland, 2007; also see Gustason, 1989; Elder and others, 1994), making contact stratigraphically higher than in central part of map area where sugarledge sandstone is included in Tropic Shale (Cashion, 1961; Doelling and Davis, 1989; Sable and Hereford, 2004). Lower part of unit is 0 to 30 m (0-100 ft) of yellowish-brown, brown, pale-olive-gray, and gray, commonly variegated, thin- to medium-bedded sandstone, smectitic mudstone, and pebble conglomerate with a local thick basal conglomerate ledge; overall, this lower interval is thin, locally not present, and commonly difficult to distinguish from remaining Dakota strata; Hylland (2000) and Biek and Hylland (2007) mapped this interval as Cedar Mountain Formation because lithologic similarity and age data suggest it is correlative with the Cedar Mountain Formation of central Utah, while some workers consider it the basal part of the Dakota Formation (Titus and others, 2005).

unconformity

JURASSIC ROCKS

Je **Entrada Sandstone** (Middle Jurassic) – Pale-yellow to pale-green-gray sandstone and siltstone, very fine to fine-grained sandstone, and coarse siltstone in exposures between Indian Hollow and Adams Wash; forms earthy weathering steep slopes or mud-plastered cliffs; in the extreme northeast corner of the quadrangle, the lower part of the unit is present and is red-brown, fine-grained sandstone that forms smooth rounded, "slickrim" cliffs; 0 to 170 m (0-560 ft) thick; thins westward and is entirely "cut out" beneath a pre-Cedar Mountain unconformity west of Adams Wash; in the northeast corner of the quadrangle only the lower 88 m (290 ft) of the formation is exposed.

Jc **Carmel Formation** (Middle Jurassic) (cross section only)

Carmel Formation – upper part (Middle Jurassic)

Jcw **Winsor Member –** Red and yellow silty sandstone; contains a few thin gypsum beds near the top in the extreme northeast part of the quadrangle; red colors dominate to the east and yellow colors dominate to the west; forms earthy-weathering steep slopes; 60 to 85 m (200-280 ft) thick; thins to the west.

Jcp **Paria River Member** – White alabaster gypsum at base with overlying red siltstone, white sandstone, and chippy weathering white to pink microgranular limestone at the top; locally the basal gypsum is missing; limestone at top locally contains casts and molds of pelecypods; overlies the Thousand Pockets Tongue of the Page Sandstone to the east and the Crystal Creek Member of the Carmel Formation to the west; 18 to 50 m (60-165 ft) thick; unit thins and thickens irregularly in relation to the thickness of gypsum, but generally thins westward; thickest gypsum bed is about 12 m (40 ft) thick.

Page Sandstone (Middle Jurassic)

Jpt **Thousand Pockets Tongue** – Yellow, white, or brown sandstone; generally massive and cross-bedded with thin red siltstone intercalations; overlies the Crystal Creek Member of the Carmel Formation to the west and the Judd Hollow Tongue of the Carmel Formation east of the Paunsaugunt fault; 0 to 30 m (0-100 ft) thick; thins westward and pinches out near Skutumpah Creek.

Carmel Formation – lower part (Middle Jurassic)

Jcx **Crystal Creek Member –** Brown-banded sandstone, siltstone, and mudstone; generally earthy weathering; forms slopes and mounds; common gypsum as cement or veinlets; 15 to 55 m (50-180 ft) thick where not mapped as part of the Judd Hollow Tongue; thickens westward.

Jcc **Co-op Creek Limestone Member** – Light-gray limestone and tan limey shale; forms thick limestone ledges at base and top with steep limestone shale in the middle; 3 to 4 m (9-12 ft) of red to brown siltstone interbedded with thin limestone beds common at base; locally fossiliferous with pelecypods, gastropods, and star-shaped crinoid columnals; unconformably overlies Navajo Sandstone to the east and Temple Cap Sandstone to the west; 15 to 80 m (50-260 ft) thick where not mapped as part of the Judd Hollow Tongue; thickens westward.

Jcj **Judd Hollow Tongue** – Combined Crystal Creek and Co-op Creek Members where thin in the east part of the quadrangle underlying the Thousand Pockets Tongue of the Page Sandstone (Jpt); mostly forms a lower red slope and an upper white bench between Jpt and the Navajo Sandstone; unconformably overlies the Navajo Sandstone; 30 to 60 m (100-200 ft) thick; thins eastward.

unconformity

Jt **Temple Cap Sandstone** (Middle Jurassic) – Light-pink-gray, cross-bedded, cliff-forming sandstone with a few intercalations of dark-red siltstone (White Throne Member) overlying dark-red siltstone and silty sandstone (Sinawava Member) at the base; present only in the west part of the quadrangle where unconformably overlies Navajo Sandstone; 0 to 60 m (0-200 ft) thick; thickens westward.

unconformity

Jn **Navajo Sandstone** (Lower Jurassic) – White, pink, and brown sandstone; forms cliffs, domes, and bare-rock outcrops; famous for high-angle cross-beds in sets to 10 m (30 ft) thick or more; generally divisible into an upper white, cliff-forming, calcareous part recognized as the White Cliffs in the Grand Staircase, a less resistant pink part commonly covered with sand and cemented with iron oxides, and a lower cliff-forming brown part that contains many planar beds (not mapped separately); the Navajo is an excellent aquifer; 395 to 670 m (1300-2200 ft) thick; thickens westward.

Jkt / Jkt **Tenney Canyon Tongue of the Kayenta Formation** (Lower Jurassic) – (Mapped as single line between Jn and Jnl where thin or locally missing on the Wygaret Terrace west of the Paunsaugunt fault in eastern part of map area.) Red-brown siltstone, mudstone, and fine-grained sandstone; generally forms a steep slope, but locally contains thick to massive, planar, ledge-forming sandstone beds at the top of the unit; 0 to 98 m (0 to 320 ft) thick; pinches out eastward. The type locality (never officially defined) and name source of this unit is a small canyon about 6 km (4 mi) north of Kanab called Tenney Canyon on plate 2 of Gregory (1950) that is now called Tiny Canyon on modern U.S. Geological Survey topographic maps. (This "Tenney" differs from spelling of Tenny Creek in basalt lava flows unit description).

Jnl / Jnl **Lamb Point Tongue of the Navajo Sandstone** (Lower Jurassic) – (Mapped as single line between Jk and Jkt where thin in western part of map area.) White to light-gray, mostly fine-grained sandstone; massive with high-angle cross-beds; red-brown and locally planar bedded in far west exposures; pinches out in southwest part of quadrangle; merges into main part of Navajo Sandstone in eastern part of quadrangle; excellent aquifer in the Kanab area; 0 to 125 m (0-410 ft) thick; thickens eastward.

Jk **Main body of the Kayenta Formation** (Lower Jurassic) – Red to red-brown sandstone, siltstone, and claystone with lesser amounts of limestone and intraformational conglomerate; locally, especially to the east, lavender, white, and brown sandstone is common; sandstone is dominant in eastern exposures, siltstone and claystone in western exposures; forms ledges and slopes to the east and steep slopes to the west; constitutes the entire formation where the Lamb Point Tongue is not present. All of the Kayenta Formation, including the Tenney Canyon Tongue, thickens westward; the entire formation along the Cockscomb is 60 to 90 m (200-300 ft) thick, near Kanab the Tenney Canyon Tongue is about 28 m (90 ft) thick and the main body is about 95 m (315 ft) thick, in the Zion Canyon area the Tenney Canyon Tongue is about 96 m (315 ft) thick and the main body is nearly 106 m (350 ft) thick, and in the southwest corner of the quadrangle the Kayenta Formation (where there is no Lamb Point Tongue) is about 183 m (600 ft) thick.

JURASSIC-TRIASSIC ROCKS

JTRmo **Moenave Formation and Springdale Sandstone Member of Kayenta Formation** (Lower Jurassic - Upper Triassic) – Generally red-orange to brown sandstone, siltstone, and shale; sandstone is mostly fine grained and commonly forms ledges and cliffs; generally divisible into two or three members (not mapped separately): in descending order – Springdale Sandstone Member, Whitmore Point Member, and Dinosaur Canyon Member. At the time source mapping was done, the Springdale was a member of the Moenave Formation; it was recently reassigned to the Kayenta Formation (see discussion and references in Biek and Hylland, 2007); the Springdale Sandstone generally forms cliffs and with the main body of the Kayenta Formation forms the Vermilion Cliffs of the Grand Staircase. In the west part of the quadrangle, the Whitmore Point Member forms a slope or a recess beneath the Springdale Sandstone and commonly contains fish fossil fragments; it pinches out east of Kanab near Johnson Canyon (Hayden, 2006). The Dinosaur Canyon Member forms ledges and steep slopes and rests unconformably on the Triassic Chinle Formation. As far west as Kitchen Corral Wash a thin layer of the Wingate Sandstone may be recognized at the base of the Dinosaur Canyon Member. The Springdale Sandstone is 27 to 60 m (90-200 ft) thick and unconformably overlies lower units, the Whitmore Point is 0 to 24 m (0-80 ft) thick, and the Dinosaur Canyon is 43 to 76 m (140-250 ft) thick.

unconformity

TRIASSIC ROCKS

TRc **Chinle Formation** (Upper Triassic) (cross section only)

TRcu **Upper members (Church Rock, Owl Rock, Petrified Forest, and Monitor Butte Members)** – Picturesque, varicolored and banded mudstone, claystone, sandstone, siltstone, limestone, and conglomerate; generally forms a steep slope; prone to landsliding that commonly involves the overlying Dinosaur Canyon Member of the Moenave Formation; locally contains petrified wood and siliceous nodules; 130 to 240 m (425-800 ft) thick.

TRcl **Lower member (Shinarump Conglomerate Member and locally part of Monitor Butte Member)** – Gray, yellow-gray, and gray-orange conglomeratic sandstone, sandstone, and minor gray mudstone; massive and generally forms cliff; remobilized iron oxides commonly form Liesegang bands; upper part (locally part of Monitor Butte Member) commonly forms ledges or steep slopes rather than cliffs; locally contains large amounts of petrified logs and branches; unconformable with Moenkopi Formation below; 0 to 47 m (0-155 ft) thick; discontinuous and thins and thickens in paleochannels to the east.

unconformity

TRm **Moenkopi Formation** (Lower Triassic) – Entire formation on cross section. Does not include Timpoweap Member along Kaibab monocline in southeast part of map area.

TRmu **Upper red member** – Dark-brown to dark-red sandstone in thin to thick beds; micaceous; forms cliffs and steep slopes; 38 to 50 m (99-165 ft) thick.

TRms **Shnabkaib Member** – Light-brown and white, interbedded sandstone, shale, and impure gypsum; earthy weathering; forms ledges and slopes; individual gypsum beds as much as 2 m (6 ft) thick; member is about 50 to 67 m (165-220 ft) thick.

TRmm **Middle red member** – Light red-brown to orange-brown, lightly banded sandstone, and red siltstone and mudstone; sandstone is fine grained; thin to thick bedded; crisscrossed with gypsum veinlets and upper part cemented with gypsum; earthy weathering, forming gentle to steep slopes; 85 to 113 m (280-370 ft) thick.

TRml **Lower red member** – Red sandstone and siltstone capped by about 10 m (30 ft) of calcareous sandstone (Virgin Limestone Member equivalent); sandstone is fine grained and the unit forms gentle to steep slopes; upper calcareous sandstone is platy to thin bedded and forms ledges; 43 to 67 m (140-220 ft) thick.

TRmt **Timpoweap Member** – Light gray-brown limestone, dolomite, sandstone, cherty breccia, and siltstone; thin to thick bedded; some sandstone beds are pebbly; upper half is more resistant and forms a cliff over a ledgy lower part; locally a thin section of tan and brown siltstone (Black Dragon Member?) underlies the unit; contact with Kaibab Formation below is an unconformity; 6 to 15 m (20-50 ft) thick at exposures on Buckskin Mountain in the southeast part of the quadrangle; well data indicate the Timpoweap may be as much as 45 m (150 ft) thick in western part of the quadrangle.

unconformity

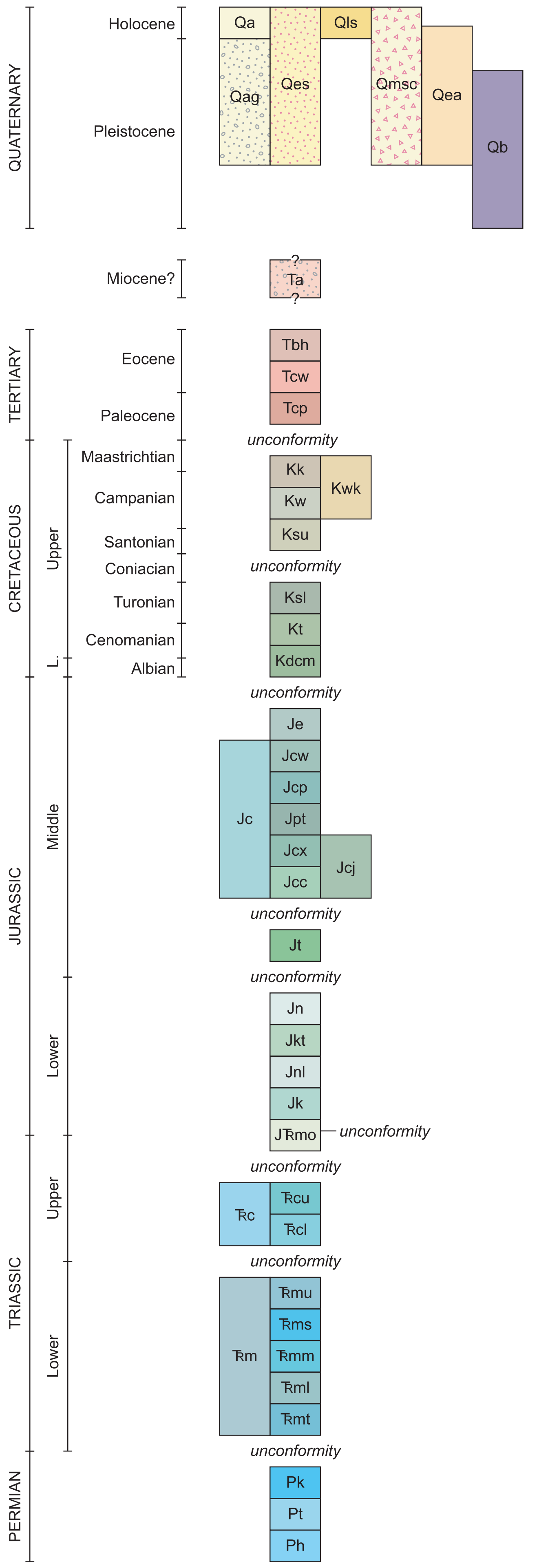
PERMIAN ROCKS

Pk **Kaibab Formation** (lower Permian) – Cherty gray limestone and dolomitic limestone and calcareous, commonly cherty sandstone; divisible into two members (not mapped separately), upper Harrisburg Member and lower Fossil Mountain Member; Harrisburg rocks are ledge-and slope-forming and unfossiliferous; Fossil Mountain rocks are massive, cliff forming, and fossiliferous containing mostly brachiopods, crinoid columnals, and bryozoa; thickness of the Kaibab ranges from 45 to 90 m (150-295 ft) in outcrops in the southeast corner of the quadrangle, of which 5 to 25 m (15-80 ft) is Harrisburg Member; it may be 45 to 155 m (150-500 ft) thick in the quadrangle subsurface and thickens to the west.

Pt **Toroweap Formation** (includes possible thin **Coconino Sandstone)** (lower Permian) – Limestone, dolomite, anhydrite, gypsum, and sandstone. Upper part (Woods Ranch Member) is mostly slope-forming, yellow-gray and red-brown, very fine- to fine-grained calcareous sandstone, with discontinuous gypsum, travertine, and intraformational conglomerate, and is about 46 m (150 ft) thick; middle part (Brady Canyon Member) is yellow-gray, cherty, fossiliferous, cliff-forming limestone and subordinate sandstone, and is about 30 m (100 ft) thick; lower part (Coconino Sandstone) is pale-yellow, fine-grained, cliff-forming, quartz sandstone about 20 m (65 ft) thick. Map unit is 96 to 102 m (315-335 ft) thick in Buckskin Gulch in southeast corner of quadrangle.

Ph **Hermit Formation** – Red-brown, silty sandstone, mudstone, and shale; forms slope; only upper 17 m (55 ft) exposed in the southeast corner of the quadrangle in Buckskin Gulch; wells indicate the formation is 32 to 190 m (105-625 ft) thick in the subsurface.

CORRELATION OF GEOLOGIC UNITS



MAP SYMBOLS

Contact – Dashed where approximately located

Fault – Dashed where approximately located; dotted where concealed; bar and ball on down-thrown side

[This map shows many solid and dashed faults bounding surficial deposits in places where the fault and the surficial deposit contact are in approximately the same location; these faults are shown this way on the original source maps; this does not imply that fault movement cut or displaced the surficial deposit]

Anticline – Showing axial trace; arrow on trace shows direction of plunge; dotted where concealed

Syncline – Showing axial trace; arrow on trace shows direction of plunge; dotted where concealed

Monocline – Line placed on axial trace of upper hinge; dotted where concealed

2400
1800
Structural contour – Contours in meters; *red* - drawn on top of Navajo Sandstone (western, southern, and eastern part of map in areas of Jurassic and older outcrops); *purple* - drawn on top of Jurassic Entrada or Carmel Formation (north-central part of map in area of Cretaceous and younger outcrops); dashed where projected above ground

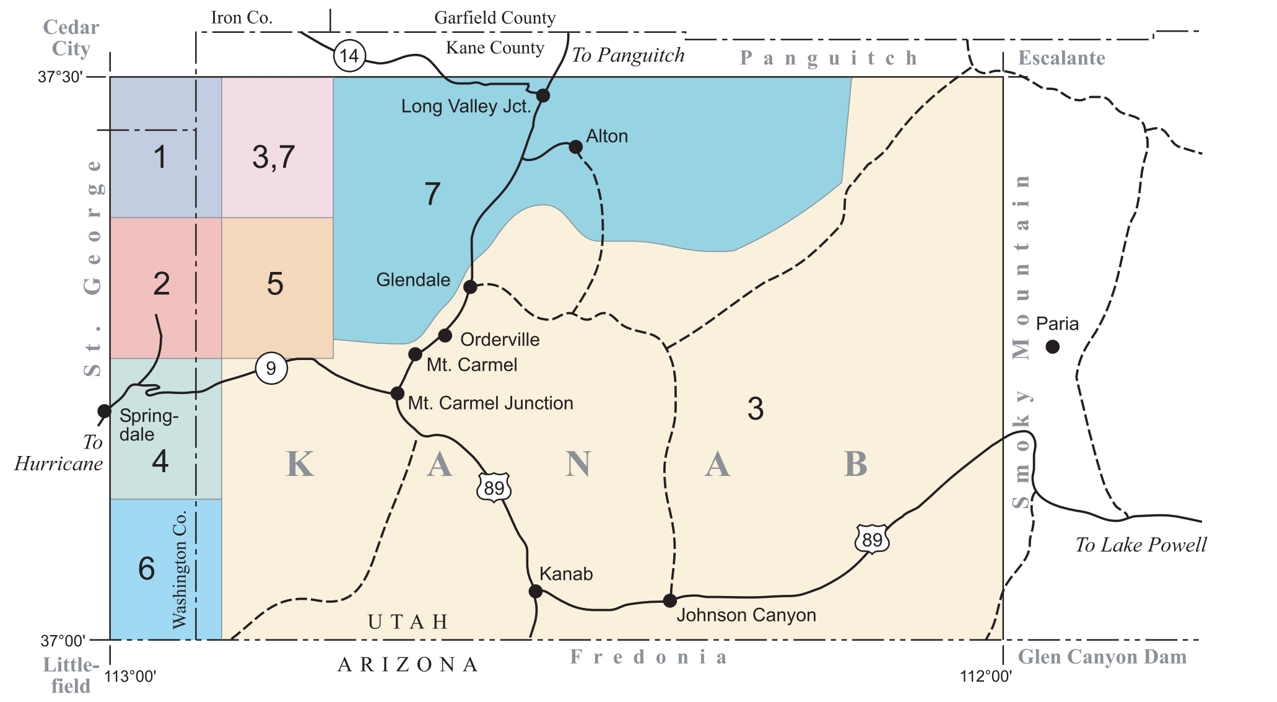
Cinder cone

Oil or gas exploration drill hole – Plugged and abandoned

Sand, gravel, or road-fill quarry

Abandoned mine

A——A' Line of cross section



GEOLOGIC MAP SOURCES

Primary Geologic Map Sources

Numbers refer to accompanying source map. The compiler and UGS made modifications to resolve differences. Compilation, digitizing, and production are commensurate with the 1:100,000 scale.

1. Biek, R.F., and Hylland, M.D., 2007, Geologic map of the Cogswell Point quadrangle, Washington, Kane, and Iron Counties, Utah: Utah Geological Survey Map 221, 2 plates, scale 1:24,000.
2. Doelling, H.H., 2002, Interim geologic map of the Temple of Sinawava quadrangle, Washington and Kane Counties, Utah: Utah Geological Survey Open-File Report 398, 9 p., scale 1:24,000.
3. Doelling, H.H., and Davis, F.D., compilers, 1989, The geology of Kane County, Utah: Utah Geological and Mineral Survey Map 121 (also published in Bulletin 124), plates 1 and 2, scale 1:100,000 (primary source for mapping stratigraphically below top of the Dakota Formation).
4. Doelling, H.H., Willis, G.C., Solomon, B.J., Sable, E.G., Hamilton, W.L., and Naylor, L.P., 2002, Interim geologic map of the Springdale East quadrangle, Washington and Kane Counties, Utah: Utah Geological Survey Open-File Report 393, 11 p., scale 1:24,000.
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Secondary Geologic Map Sources

Doelling and Davis (1989) and Sable and Hereford (2004), listed above, were produced through new mapping and compilation from the sources listed below.

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Hackman, R.J., 1957a, Photogeologic map of the Buckskin Gulch NE (Eightmile Pass) quadrangle, Kane County, Utah: U.S. Geological Survey Map I-259, scale 1:24,000.

Hackman, R.J., 1957b, Photogeologic map of the Buckskin Gulch NW (Nephi Point) quadrangle, Kane County, Utah: U.S. Geological Survey Map I-251, scale 1:24,000.

Hackman, R.J., 1957c, Photogeologic map of the Buckskin Gulch SW (Petrified Hollow) quadrangle, Kane County, Utah and Coconino County, Arizona: U.S. Geological Survey Map I-244, scale 1:24,000.

Hamilton, W.L., 1978, Geological map of Zion National Park, Utah: Springdale, Utah, Zion Natural History Association, scale 1:31,680.

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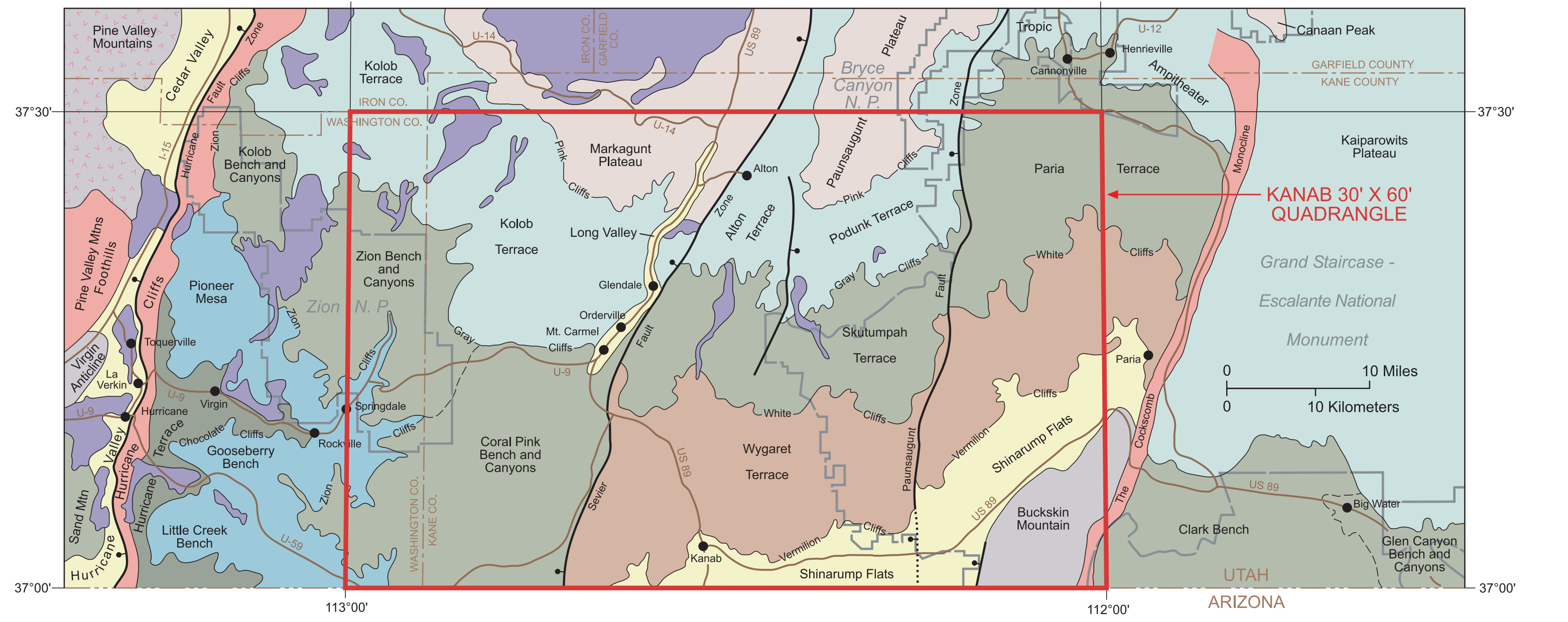
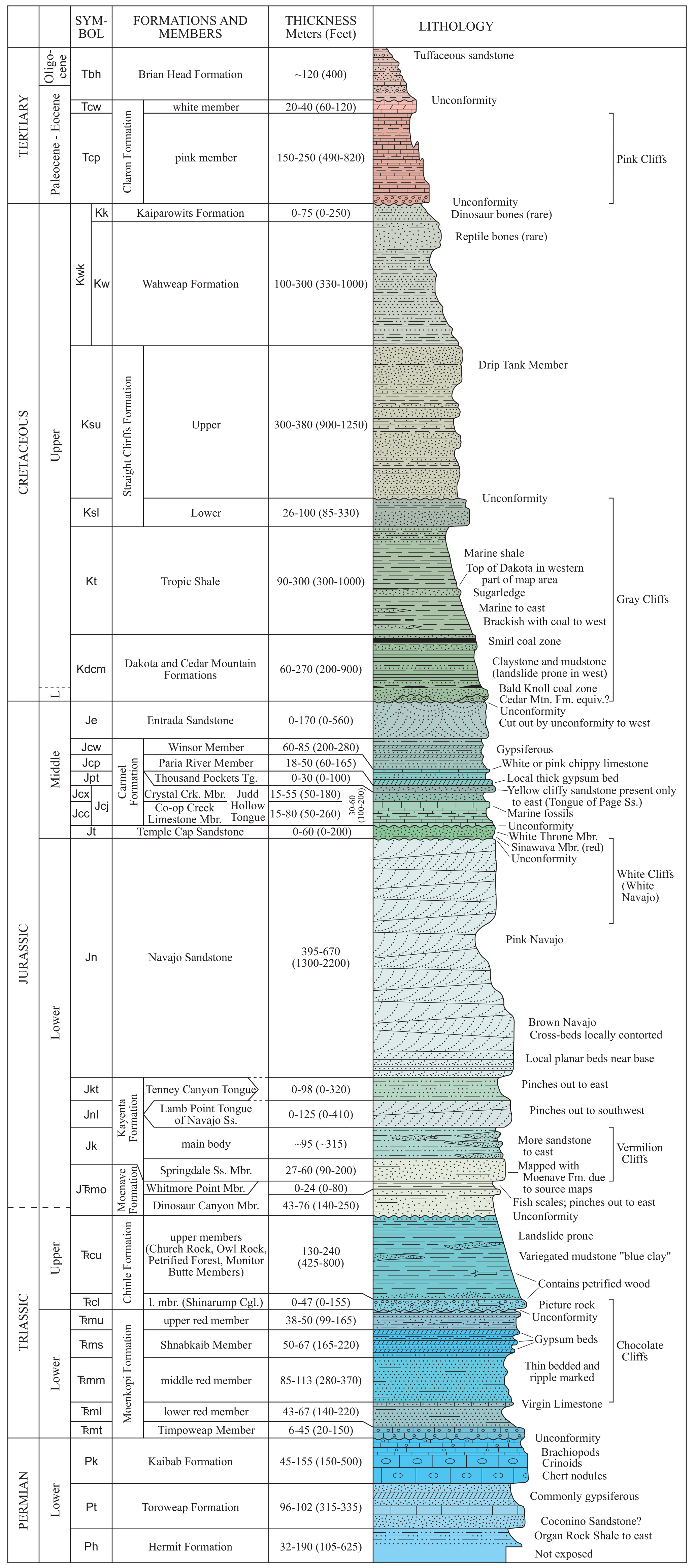
*Vermilion Cliffs west of Kanab formed from mostly Jurassic redbeds. Until recently, the Moenave Formation consisted of three members, the Dinosaur Canyon (*JTRmd*), Whitmore Point (*Jmw*), and Springdale Sandstone. Geologists recently reassigned the Springdale Sandstone to the Kayenta Formation (therefore labeled *Jks*) (see discussion and references in Biek and Hylland, 2007). However, since source maps were completed before this change, on this map the Springdale is included in the Moenave Formation map unit (*JTRmo*). Photograph by Janice Hayden.*



PHYSIOGRAPHIC SUBDIVISIONS OF THE KANAB 30' X 60' QUADRANGLE AND VICINITY

- Valleys, flats, and sand-covered areas
- Basalt-- Mostly Quaternary olivine basalt as cinder cones and lava flows
- Laccolithic intrusions and related volcanic rocks
- Monoclines, Hurricane Cliffs, and foothills
- Plateaus, terraces, and benches above the Pink Cliffs
- Terraces, plateaus, and benches above the Gray Cliffs
- Terraces and benches above the White Cliffs of the Navajo Sandstone
- Terraces and benches above the Vermilion Cliffs (wide bench not present west of Sevier fault)
- Terraces and benches above the Chocolate Cliffs or Shinarump Member of the Chinle Formation
- Terrace and bench above the Hurricane Cliffs
- Uplifts and anticlines with Permian limestone
- Major fault

BEDROCK LITHOLOGIC COLUMN



		SYMBOL	FORMATIONS AND MEMBERS		THICKNESS Meters (Feet)
TERTIARY	Oligocene	Tbh	Brian Head Formation		~120 (400)
	Paleocene - Eocene	Tcw	Claron Formation	white member	20-40 (60-120)
		Tcp		pink member	150-250 (490-820)
CRETACEOUS	Upper	Kwk Kk	Kaiparowits Formation		0-75 (0-250)
		Kwk Kw	Wahweap Formation		100-300 (330-1000)
		Ksu	Straight Cliffs Formation	Upper	300-380 (900-1250)
		Ksl		Lower	26-100 (85-330)
		Kt	Tropic Shale		90-300 (300-1000)
	L	Kdcm	Dakota and Cedar Mountain Formations		60-270 (200-900)
JURASSIC	Middle	Je	Entrada Sandstone		0-170 (0-560)
		Jcw	Carmel Formation	Winsor Member	60-85 (200-280)
		Jcp		Paria River Member	18-50 (60-165)
		Jpt		Thousand Pockets Tg.	0-30 (0-100)
		Jcx / Jcj		Crystal Crk. Mbr. / Judd Hollow Tongue	15-55 (50-180) / 30-60 (100-200)
		Jcc / Jcj		Co-op Creek Limestone Mbr.	15-80 (50-260)
		Jt	Temple Cap Sandstone		0-60 (0-200)
	Lower	Jn	Navajo Sandstone		395-670 (1300-2200)
		Jkt	Kayenta Formation	Tenney Canyon Tongue	0-98 (0-320)
		Jnl		Lamb Point Tongue of Navajo Ss.	0-125 (0-410)
		Jk		main body	~95 (~315)
		JTRmo	Moenave Formation	Springdale Ss. Mbr.	27-60 (90-200)
				Whitmore Point Mbr.	0-24 (0-80)
TRIASSIC				Dinosaur Canyon Mbr.	43-76 (140-250)
	Upper	TRcu	Chinle Formation	upper members (Church Rock, Owl Rock, Petrified Forest, Monitor Butte Members)	130-240 (425-800)
		TRcl		l. mbr. (Shinarump Cgl.)	0-47 (0-155)
	Lower	TRmu	Moenkopi Formation	upper red member	38-50 (99-165)
		TRms		Shnabkaib Member	50-67 (165-220)
		TRmm		middle red member	85-113 (280-370)
		TRml		lower red member	43-67 (140-220)
		TRmt		Timpoweap Member	6-45 (20-150)
PERMIAN	Lower	Pk	Kaibab Formation		45-155 (150-500)
		Pt	Toroweap Formation		96-102 (315-335)
		Ph	Hermit Formation		32-190 (105-625)

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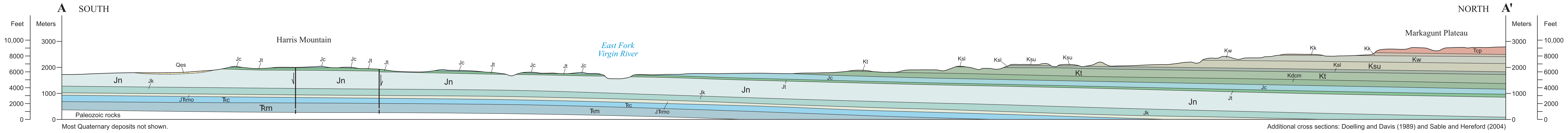

Most Quaternary deposits not shown.

Additional cross sections: Doelling and Davis (1989) and Sable and Hereford (2004)