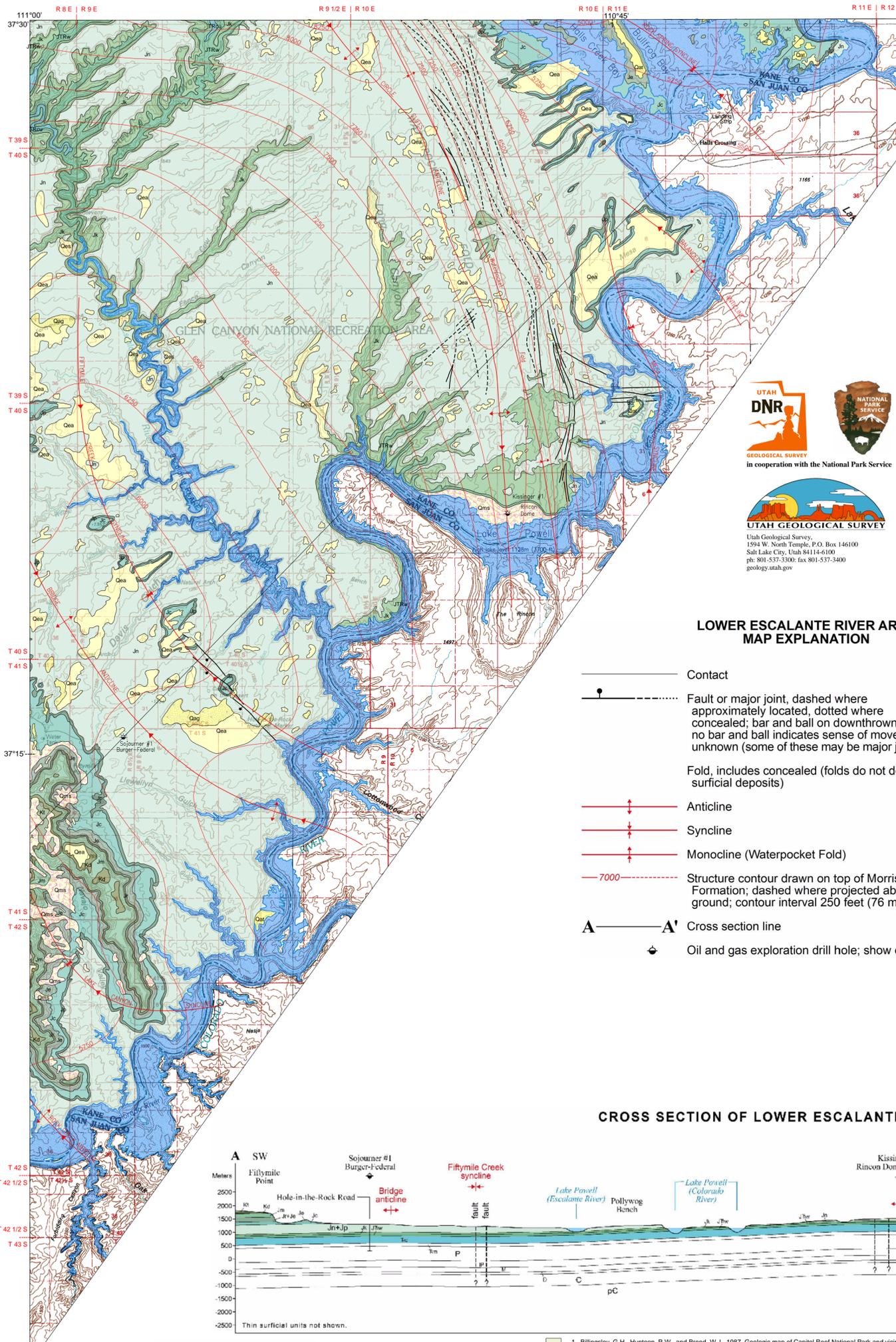


Geologic Map of the Lower Escalante River Area, Glen Canyon National Recreation Area, Eastern Kane County, Utah

by
Hellmut H. Doelling and Grant C. Willis
2007

Utah Geological Survey Miscellaneous Publication 06-3DM
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Glen Canyon National Recreation Area,
Eastern Kane County, Utah



LITHOLOGIC COLUMN - LOWER ESCALANTE RIVER AREA

SYSTEM/SERIES	GEOLOGIC UNIT	SYMBOL	THICKNESS Meters (Feet)	LITHOLOGY
CRETACEOUS	Tropic Shale (partial)	Kt	60+ (200+)	Unconformity
	Dakota Formation	Kd	14-17 (45-55)	
JURASSIC	Morrison Formation	Jm	170-210 (550-680)	Unconformity
	Romana Sandstone	Jr	12-40 (40-130)	
	Entrada Sandstone (Cannonville and Gunsight Butte Members)	Je	220-240 (720-780)	Unconformity
	Carmel Formation (Winsor and Paria River Members)	Jc	33-52 (110-170)	
	Page Sandstone	Jp	10-75 (30-250)	
TRIASSIC	Navajo Sandstone	Jn	290-425 (950-1400)	Unconformity?
	Kayenta Formation	Jk	58-104 (190-340)	
	Wingate Sandstone	Jrw	60-90 (200-300)	
	Chinle Formation - upper unit	Rcu	70+ (230+)	

Diagram is schematic--no fixed thickness scale



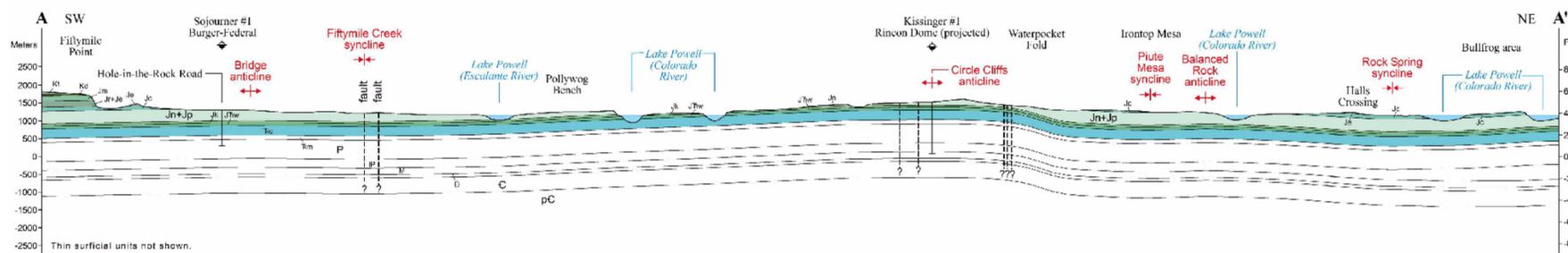
LOWER ESCALANTE RIVER AREA MAP EXPLANATION

- Contact
- Fault or major joint, dashed where approximately located, dotted where concealed; bar and ball on downthrown side; no bar and ball indicates sense of movement unknown (some of these may be major joints)
- Fold, includes concealed (folds do not deform surficial deposits)
- Anticline
- Syncline
- Monocline (Waterpocket Fold)
- Structure contour drawn on top of Morrison Formation; dashed where projected above ground; contour interval 250 feet (76 m)
- Cross section line
- Oil and gas exploration drill hole; show of oil

LOWER ESCALANTE RIVER AREA CORRELATION

QUAT.	Qa	Qag	Qat	Qea	Qes	Qmst	DESCRIPTION
CRETACEOUS	Kt	unconformity					Tropic Shale
	Kd	unconformity					Dakota Formation
JURASSIC	Jm	unconformity					Morrison Formation (mostly Salt Wash Member)
	Jr	unconformity					Romana Sandstone
	Je	unconformity					Entrada Sandstone
TRIASSIC	Jc	unconformity					Carmel Formation (Winsor and Paria River Members)
	Jp	unconformity					Page Sandstone
	Jn	unconformity					Navajo Sandstone
TRIASSIC	Jk	unconformity					Kayenta Formation
	Jrw	unconformity					Wingate Sandstone
TRIASSIC	Rcu	unconformity					Chinle Formation, upper unit (Church Rock, Owl Rock, Petrified Forest Members)

CROSS SECTION OF LOWER ESCALANTE RIVER AREA



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- 10 Willis, G.C., and Cragun, S., 2006 in preparation. Interim geologic map of the Glen Canyon Dam to Lees Ferry area, Glen Canyon National Recreation Area, Garfield and San Juan Counties, Utah: Utah Geological Survey Open-File Report, scale 1:50,000, CD-ROM.

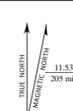
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SCALE 1:100,000



GIS digital cartography by: Buck Ehler and Darryl Greer
Base from U.S.G.S. Navajo Mountain (1981) 30x60 quadrangle
Projection: UTM Zone 12
Units: Meters
Datum: NAD 1983
Spheroid: Clarke 1866

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Utah Geological Survey
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in cooperation with
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This geologic map and digital data set were funded by the Utah Geological Survey and the National Park Service. 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.

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DESCRIPTION OF MAP UNITS

Quaternary

- Qa Alluvial Deposits** (Holocene) – Small amounts of poorly to moderately sorted alluvial gravel, sand, silt, and clay are present in the bottom of most drainages; however, because canyons are narrow and deposits are small, none are mappable at this scale; these alluvial deposits consist of poorly to moderately well sorted boulder to pebble gravel, sand, silt, and clay deposited in small drainages; and locally include small debris-flow deposits, eolian sand and silt, colluvium, rockfall debris, low-level alluvial terrace deposits, and alluvial-fan deposits; includes deposits in active part of wash and up to about 20 feet (6 m) above wash floor; 0 to 20 feet (0-6 m) thick.
- Qea Mixed eolian and alluvial deposits** (Holocene to Middle? Pleistocene) – Moderately to very well sorted sand, silt, with lesser clay, deposited by wind and locally reworked by water; locally mixed with small angular to subrounded rock fragments, pebbles, and cobbles deposited as sheetwash and ephemeral-wash alluvium; commonly capped by thick calcic soil (caliche) that commonly forms a resistant bench; common on broad stable surfaces where it partially covers the bedrock and includes residual lag of underlying rock; similar in setting and composition to Qes deposits except evidence of alluvial activity is more common and dune forms are less developed; much of the unit is locally derived; locally covers or partially covers undifferentiated coarse alluvial gravel and alluvial fan deposits; 0 to 15 meters (0-50 ft) thick.
- Qes Eolian sand** (Holocene to Middle? Pleistocene) – Well- to very well sorted, well-rounded sand with minor silt, deposited by wind; forms poorly to well developed dunes, mounds, and sheet-like deposits in depressions and on the lee side of slopes where protected from erosion for long periods of time; locally slightly reworked by alluvial processes and burrowing animals; mostly derived from and present on upper surface of Navajo and Kayenta Formations; residual lag of underlying rock is common; locally has well-developed calcic soil (caliche); 0 to 15 meters (0-50 ft) thick.
- Qat Alluvial river terrace deposits** (Middle to Lower Pleistocene) – Moderately to well-sorted cobble to pebble gravel and sand with minor silt and clay; forms terrace remnants on benches and slopes near the Colorado River; clasts were transported by the river from sources in eastern Utah and western Colorado; includes reworked terrace deposits that drape down slope from the original deposits; present up to about 200 m (600 ft) above the modern river bed; mapped deposits (exposed above high lake level) probably about 0.5 to 1 million years old (Willis, 2004); terrace deposits are common at several levels between the river channel and the Lake Powell high-water line and are exposed when the lake is low; probably about 0 to 9 meters (0-30 ft) thick.

- Qag **Alluvial gravels, undifferentiated** (Upper to Lower Pleistocene) – Poorly to moderately well sorted, boulder- to clay-sized, alluvial stream-terrace and pediment-mantle deposits preserved as remnants above present streams and washes; commonly dominated by gravel to small boulder sediments; composition reflects local sources; commonly includes eolian silt and sand and calcic soil that gradually accumulates in upper part of deposits such that older deposits have thicker accumulations; in general, older deposits are preserved at higher levels above nearby streams and washes, but various levels have not been differentiated; mostly Quaternary in age but age of highest-level deposits is poorly constrained; 0 to 18 meters (0-60 ft) thick.
- Qmst **Mass-movement landslides, slumps, and talus, undifferentiated** (Holocene to Pleistocene) – Includes rock-fall deposits, colluvium, talus, talus blocks, landslides, slumps, and landslide complexes; very poorly sorted, chaotic deposits range in composition from silt to large blocks several tens of meters in average diameter; upper surfaces are typically hummocky; most landslides and slumps are inactive but some show evidence of historical movement or reactivation near incised washes and along lake shorelines; primarily forms in weaker rock units of the Cretaceous Straight Cliffs Formation (forms cliffs and ledges of Kaiparowits Plateau just west of map border) and Tropic Shale near Fiftymile Point, and in the core of the Circle Cliffs anticline near The Rincon where rockfall debris is sliding on Chinle strata; in this area lake water and wave action have saturated and weakened Chinle strata and previously existing landslides, creating unstable slopes that are slumping into the lake, causing safety hazards (Grundvig, 1980); map unit locally includes alluvial, colluvial, and eolian deposits; highly variable from 0 to 75 meters (0-250 ft) thick.

Cretaceous

- Kt **Tropic Shale** (Upper Cretaceous, upper Cenomanian to middle Turonian) – Medium-gray, yellow-gray, and olive-gray, fossiliferous, marine mudstone and shale with subordinate gray fine- to very fine-grained sandstone, bentonitic claystone, siltstone, and limestone in the upper and lower parts of the formation; forms badlands slopes; 150 to 230 meters (500-750 ft) thick to west (Doelling, 2006), but only lower about 60 meters (200 ft) preserved in map area.
- Kd **Dakota Formation** (Upper Cretaceous, Cenomanian, with possible upper Lower Cretaceous, Barremian to Albian) – Interbedded gray-orange to light-brown sandstone, sandy mudstone and shale, carbonaceous mudstone, shaley sandstone, conglomerate, and dark-brown to black carbonaceous shale and coal; upper part is sandstone with marine fossils; middle part is ledge- and slope-forming sandstone, mudstone, and coal-bearing unit; lower part is a discontinuous local basal conglomerate that fills paleotopographic lows and may be at least partly Early Cretaceous in age; forms ledges and slopes; deposited in coastal plain, shoreline, near-shore marine, and lagoonal environments; deposited unconformably across Morrison Formation (and older formations to west of map area [Doelling, 2006]); thickness varies significantly across short distances;

regionally is 1 to 45 meters (3-150 ft) thick; within map area is about 14 to 17 meters (45-55 ft) thick.

Jurassic

- Jm Morrison Formation** (Upper Jurassic) – Yellow-gray, gray, and yellow-brown, ledge- and cliff-forming, lenticular conglomerate, conglomeratic sandstone, and sandstone, interbedded with subordinate green-gray to purple-gray, to dark red-brown, smectitic (swelling clay) mudstone; cut out just west of map area due to unconformity at base of Dakota Formation that cuts increasingly down-section to the west; outcrops in map area are primarily Salt Wash Member but thin, slope-forming Brushy Basin Member may be present above the Salt Wash, and a thin interval of Tidwell Member may be present below the Salt Wash; deposited in fluvial-lacustrine environment unconformably across underlying Middle Jurassic units; 170 to 210 meters (550-680 ft) thick (Peterson and Barnum, 1973).
- Jr Romana Sandstone** (Middle Jurassic) – Gray-yellow, green-gray, yellow-gray, and light-tan, very fine- to fine-grained, medium-bedded to massive, planar to cross-bedded, calcareous sandstone with thin planar beds of reddish-brown, calcareous, sandy siltstone; forms massive to ledgy cliff; deposited in shallow marine, tidal flat, and eolian environments; 0 to 45 meters (0-145 ft) thick regionally; about 12 to 40 meters thick (40-130 ft) in map area.
- Je Entrada Sandstone** (Middle Jurassic) – Mostly well-sorted, well-rounded, fine-grained sandstone; consists of two members (not differentiated on map) based on differences in bedding, weathering characteristics, and color; the lower (Gunsight Butte Member) is orange-brown and weathers into smooth, rounded, "slickrim" erosional forms and cliffs; the upper (Cannonville Member) is red-brown, commonly banded, and forms a blocky cliff; an overlying third member (Escalante Member) is not preserved in the map area but is present to the northwest (Doelling and Willis, 2006); 220 to 240 meters (720-780 ft) thick (Peterson and Barnum, 1973).
- Jc Carmel Formation** (Middle Jurassic) – Combined Paria River and Winsor Members of the Carmel Formation; upper part (Winsor Member) is mostly medium- to dark-red-brown to yellow-brown, slope-forming, earthy-weathering, silty sandstone and siltstone intercalated with sporadic irregular beds of white, calcareous, fine-grained sandstone that is locally gypsiferous; lower part (Paria River Member) is mostly dark-red-brown siltstone and silty sandstone with a few tan to brown, fine-grained sandstone beds capped by white to pale-red-gray, silty to sandy, chippy-weathering limestone; conformable and interfingers with Page Sandstone; deposited in shallow marine, sabhka, and tidal flat environment along southeast side of inland sea; 33 to 52 meters (110-170 ft) thick; upper part (Winsor) is 18 to 45 meters (60-150 ft) thick, lower part (Paria River) is 15 to 20 meters (50-65 ft) thick.

- Jp **Page Sandstone** (Middle Jurassic) – Mostly pale-yellow-orange, to red-orange, fine- to medium-grained, cross-bedded, quartzose sandstone, locally with thin, dark-red siltstone and silty sandstone beds; unconformably overlies the similar-appearing Navajo Sandstone; in map area consists of three undifferentiated eolian cross-bedded sandstone tongues, the Harris Wash (lower), Thousand Pockets (middle), and Leche-e (upper) (Blakey and others, 1996); to the west and northwest the Judd Hollow Tongue of the Carmel Formation is between the Harris Wash and Thousand Pockets (Doelling and Willis, 2006) but in this map area the Judd Hollow is very thin to missing and is not mappable; 10 to 75 meters (30-250 ft) thick.
- Jn **Navajo Sandstone** (Lower Jurassic) – Pale-yellow-gray, orange-gray, pale-red-brown, brown, and very pale-gray, massive, cross-bedded to locally convolute-bedded, fine- to medium-grained sandstone that forms prominent cliffs, domes and bare-rock outcrops; characterized by massive eolian cross-bed sets; lower part has planar beds that grade upward into cross-beds; has local limestone and dolomite lenses (interdunal playa or lake deposits); 290 to 425 meters (950-1400 ft) thick.
- Jk **Kayenta Formation** (Lower Jurassic) – Ledge- and slope-forming, lenticular sandstone, siltstone, and mudstone with local limestone and intraformational conglomerate beds; mostly medium- to dark-red-brown, but red-orange, red-purple, white, and brown sandstone is common; deposited in alluvial floodplain to lacustrine environments; conformable with units above and below; 58 to 104 meters (190-340 ft) thick.

Jurassic – Triassic

- JTRw **Wingate Sandstone** (Lower Jurassic to Upper Triassic) – Pale- to medium-red-orange to red-brown, massive, cliff-forming, fine- to medium-grained, cross-bedded sandstone; forms “walls” of broad, blocky, strongly jointed, smooth sandstone cliffs and bluffs; 60 to 90 meters (200-300 ft) thick.

Triassic

- TRcu **Upper members of the Chinle Formation** (Upper Triassic) (includes Church Rock, Owl Rock, and Petrified Forest Members) – Individual members are recognizable in the field, but are impractical to map separately at this scale; overall, unit forms a slope to ledgy slope that steepens upward to ledgy cliffs just below the massive Wingate Sandstone cliff. Approximately 70 meters (230 ft) of this combined map unit consisting primarily of Church Rock and Owl Rock Members is poorly exposed along the lower walls of Escalante Canyon and tributaries where it forms a low slope with scattered ledges and is commonly covered by talus; these members, and the Petrified Forest Member, are also present but most covered or incorporated in landslide debris in the core of the Circle Cliffs anticline at The Rincon. The Church Rock Member consists of interbedded red-brown to pale-red-brown siltstone and fine- to medium-grained, micaceous sandstone with abundant ripple laminations, mudcracks, and small-scale cross-beds; lenticular

pebble and rip-up clast conglomerate beds are locally present near base; the Church Rock is similar in color to the overlying Wingate and forms a steep ledgy slope commonly draped with Wingate rock-fall debris. The Owl Rock Member consists of pale-green-gray, pale-purple-gray, and pale-red-gray, calcareous sandstone, mottled limestone, and siltstone; calcrete pedogenic paleosols (fossil soils) are abundant. The Petrified Forest Member consists of vibrant purple-red, red-gray, and green-gray, slope-forming, smectitic (swelling clay) mudstone and thin beds of fine- to coarse-grained sandstone.

Subsurface Units – shown on cross section only

- TRc **Chinle Formation, undivided** (Upper Triassic) (includes members described above, plus possible Mossback, Monitor Butte, and Shinarump Conglomerate Members)
- TRm **Moenkopi Formation** (Lower Triassic)
- P **Permian strata**
- IP **Pennsylvanian strata**
- M **Mississippian strata**
- D **Devonian strata**
- C **Cambrian strata**
- pC **Precambrian rock**

SOURCES AND REFERENCES

This map was compiled primarily from the 1:100,000-scale geologic map of Kane County (Doelling and Davis, 1989; and sources listed therein). The authors made significant modifications in 2005.

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