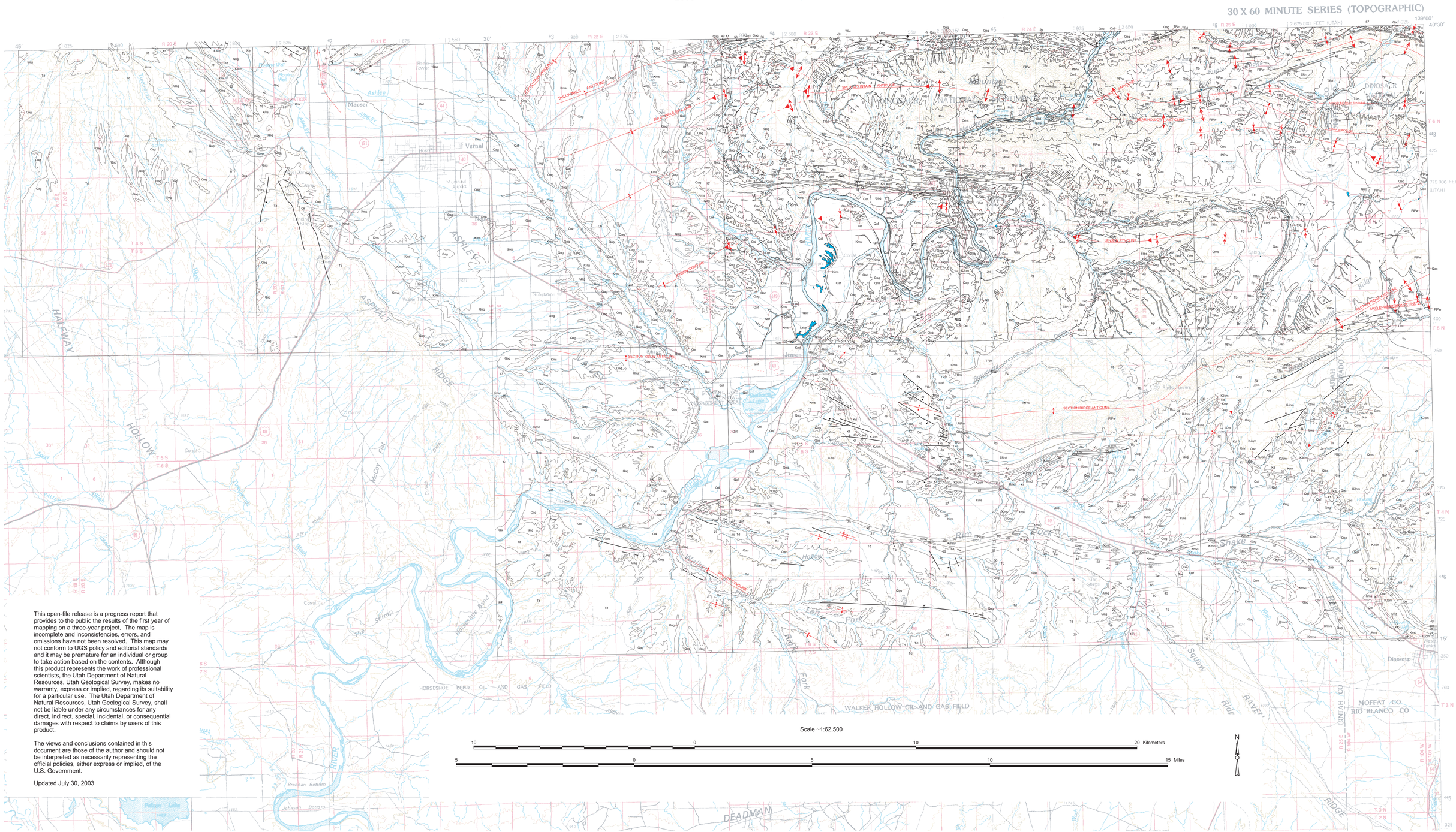
Utah Geological Survey
a division of
Utah Department of Natural Resources
in cooperation with
U.S. Geological Survey
STATEMAP Agreement No. 02HQAG055

Progress Report Geologic Map of the Vernal 30' x 60' Quadrangle, Utah and Colorado
Year 1 of 3

Compiled by Douglas A. Sprinkel

2003



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Description of Map Units

Qal FLOOD-PLAIN ALLUVIUM (HOLOCENE) - Unconsolidated silt, sand, and gravel in flood plains of Green River and Ashley and Brush Creeks; 1-30 m thick.

Qa ALLUVIUM (HOLOCENE) - Unconsolidated mud, silt, sand, and gravel in small intermittent stream drainages on the Yampa Plateau; less than 5 m thick.

Qat TERRACE DEPOSITS (HOLOCENE) - Unconsolidated to locally cemented silt, sand, gravel, cobbles, and boulders; remnants of alluvial terraces deposited along the Green River and Ashley and Brush Creeks; less than a few tens of meters thick.

Qaf YOUNGER ALLUVIAL-FAN DEPOSITS (HOLOCENE) - Unconsolidated, poorly sorted boulder, gravel, sand, and silt; less than 30 m thick.

Qac MIXED ALLUVIUM AND COLLUVIUM (HOLOCENE) - Unconsolidated mud, silt, sand, and gravel in intermittent stream drainages and in areas of low topographic relief. On the Mancos Shale or other soft formations, this unit is mostly reworked mud; less than 10 m thick.

Qae MIXED ALLUVIUM AND EOLIAN DEPOSITS (HOLOCENE) - Unconsolidated alluvial mud, silt, and sand mixed with well-sorted, fine-grained, windblown sand and silt; many of these deposits are in tributary stream channels of the Green River, along smaller streams, and in other intermittent stream drainages. less than 10 m thick.

Qe EOLIAN DEPOSITS (HOLOCENE) - Unconsolidated, well-sorted, fine-grained, windblown sand and silt; less than 10 m thick.

Qc* COLLUVIUM (HOLOCENE) - Heterogeneous mixture of boulders, gravel, cobbles, sand and silt that may grade into talus, landslide, and alluvial deposits; thin to a few tens of meters thick.

Qh DISTURBED GROUND (HISTORIC) - Modern gravel pit operation mostly along the the flood plain of the Green River; material excavated is from unconcolidated deposits of Qal and Qaf; includes sewage lagoon along Ashley Creek.

Qmf DEBRIS-FLOW DEPOSITS (HISTORIC) - Unconsolidated and poorly sorted heterogenous mixture of boulders, gravel, sand, silt, and mud; matrix supported; less than 2 m thick.

Qmt TALUS DEPOSITS (HOLOCENE AND PLEISTOCENE?) - Unconsolidated and unstratified angular rock fragments that accumulate at the base of cliffs. Colluvium may be a significant part of this deposit; less than 5 m thick.

Qms SLIDES, SLUMPS AND FLOWS (HOLOCENE AND PLEISTOCENE) - Earthflow and rotational slumps and slides in formations prone to slope failure; some Qms units may include mass movements of slightly different age or may share a common boundary with an adjoining mass movement.

Qag ALLUVIAL-GRAVEL DEPOSITS (HOLOCENE AND PLEISTOCENE) - Unconsolidated to moderately consolidated, poorly sorted sand, gravel, cobbles and boulders deposited on near-planar bedrock surfaces; as many as four levels are recognized but are not subdivided for the first year of the project so deposits of different ages can share a common boundary; the topographically highest level are oldest; weak to strong soil profile developed in all levels with the best-developed profile in the topographically highest deposit; some calcium carbonate (caliche; stage I) developed on the underside of clasts in younger (lower) deposits and well-delveloped calcium carbonate (caliche; stage IV) in upper 1 m of highest (oldest) deposit; all deposits may not be alluvial in origin; less than 2 m thick.

Qaf$_2$* OLDER ALLUVIAL-FAN DEPOSITS (PLEISTOCENE) - Dissected, unconsolidated, poorly sorted boulders, gravel, sand, and silt; less than 10 m thick. Mapped in the Island Park 7.5-minute quadrangle (Rowley and others, 1981) within the Dutch John 30' x 60' quadrangle, but may be preserved in nearby areas of the Vernal 30' x 60' quadrangle.

Qga* GLACIAL OUTWASH, UNDIVIDED (UPPER PLEISTOCENE) - Unconsolidated, well-rounded, mostly red quartzose sandstone and quartzite (Uinta Mountain Group) boulders to pebbles and sand derived from the high-energy meltwaters of glaciers of undetermined age that are preserved in the Whiterocks Canyon drainage in the northwest part of the Vernal 30' x 60' quadrangle (see Sprinkel, 2002); thickness not determined but probably less than 10 m thick.

QTa* OLDER ALLUVIUM (PLEISTOCENE AND UPPER TERTIARY[?]) - Unconsolidated, poorly sorted, silt, sand, gravel, and cobble to boulder deposit; clasts are subangular to subrounded Uinta Mountain Group, mostly matrix supported with internal channel deposits; these deposits are best exposed but not yet mapped on the Yampa Plateau in this quadrangle and mapped as Qaco (Sprinkel, 2002) on the nearby Diamond Mountain Plateau in the adjoining Dutch John 30' x 60' quadrangle; less than 10 m thick.

Tb BISHOP CONGLOMERATE (OLIGOCENE) - Light-gray to pinkish-gray, friable sandstone with tuffaceous interbeds, and poorly sorted, loosely cemented, boulder to pebble conglomerate mapped on the Yampa Plateau; biotite and hornblende crystals from a tuff bed yielded K-Ar ages of about 29 Ma (Hansen, 1986) on nearby Diamond Mountain Plateau in the adjoining Dutch John 30' x 60' quadrangle (Sprinkel, 2002); less than 50 m thick.

Td DUCHESNE RIVER FORMATION (EOCENE) - Reddish-brown, yellowish-gray, and greenish-gray lithic sandstone, siltstone, claystone, and conglomerate; contains well-developed paleosols; formation has been divided into four members--in ascending order, Brennan Basin, Dry Gulch, LaPoint, and Starr Flat Members (Anderson and Picard, 1972)--but they have not been mapped for the first year of the project; the lower part of formation intertongues with underlying Uinta Formation to the south in the Uinta Basin; 270 m in quadrangle, but more than 1,000 m thick southward in the Uinta Basin.

Tu* UINTA FORMATION (EOCENE) - "Soft," light-green-gray, light-brown, light-gray, and pale-yellow shale, marlstone, siltstone, and sandstone with locally tuffaceous interbeds; divided into informal members, which have not been mapped for the first year of this project; contains significant gilsonite deposits in the southeastern part of the quadrangle and around Bonanza, Utah; a tuff bed in the formation yielded K-Ar age of 43 Ma (Mauger, 1977); 0-600 m thick.

Tg GREEN RIVER FORMATION (EOCENE) - Soft to moderately resistant, light- to medium-gray, light- to medium-brown, yellow, and greenish-gray mudstone, organic-rich marlstone, siltstone, sandstone, and cherty limestone; the formation is divided into formal members, which includes the Mahogany ledge oil shale unit, but have not been mapped for the first year of the project; lower part intertongues with underlying Wasatch Formation and the upper part pinches out and is unconformably overlain by the Duchesne Formation near the Rim Rock; the formation intertongues with the overlying Uinta Formation near the White River drainage in the southeastern part of the quadrangle, which has yet to be mapped; exposed thickness in the quadrangle is as much as 600 m thick, but is much thicker in the subsurface of the Uinta Basin.

Tw WASATCH FORMATION (EOCENE AND PALEOCENE[?]) - Red, yellow, and light-gray friable sandstone, siltstone, claystone, and conglomerate; upper part intertongues with overlying Green River Formation; conglomerate clasts consist of mostly gray limestone (Paleozoic), sandstone (Mesozoic), and some red quartzose sandstone and quartzite (Uinta Mountain Group); 610 m thick.

Tfu* FORT UNION FORMATION (PALEOCENE) - Light-gray, light-brown, light-green, and brown sandstone, shale, and claystone with some carbonaceous shale, coal, siltstone, and conglomerate beds; beds of probable Fort Union age are currently included in the base of the overlying Wasatch Formation; thickness not determined.

Kmvu UPPER UNIT OF MESAVERDE GROUP (UPPER CRETACEOUS) - Moderately resistant, light-gray to pale-grayish-orange, fine-grained, lenticular cross-bedded sandstone with carbonaceous shale and thick coal beds; 425-550 m thick.

Kmvr RIM ROCK FORMATION OF MESAVERDE GROUP (UPPER CRETACEOUS) - Resistant, light-gray, tan, and light-yellow, cross-bedded sandstone with subordinate gray carbonaceous shale and minor coal; local unit defined by Walton (1944); 200-250 m thick.

Kms MANCOS SHALE (UPPER CRETACEOUS) - Dark-gray, soft, slope-forming calcareous shale containing beds of siltstone and bentonitic clay; 1,500-4,900 m thick.

Kfd FRONTIER SANDSTONE, MOWRY SHALE AND DAKOTA SANDSTONE, UNDIVIDED - These formations are shown as one unit along part of the south flank of the Yampa Plateau; see below for descriptions and thickness.

Kf FRONTIER SANDSTONE (UPPER CRETACEOUS) - Upper part resistant, light-brown to light-gray and yellow, fine-grained and ripple-marked sandstone with local petrified wood and fossils; lower part soft, light- to dark-gray calcareous shale; may include minor limestone and coal beds in the lower part; 52-83 m thick.

Kmd MOWRY SHALE AND DAKOTA SANDSTONE, UNDIVIDED - These formations are locally shown as one unit along Snake John Reef because they were too thin to map separately at this scale. See below for descriptions and thickness.

Kmr MOWRY SHALE (LOWER CRETACEOUS) - Dark-gray, siliceous shale that weathers silver gray; contains abundant fossil fish scales; 10-67 m thick.

Kd DAKOTA SANDSTONE (LOWER CRETACEOUS) - Upper and lower resistant, yellow and light-gray, medium- to coarse-grained sandstone beds separated by a carbonaceous shale; contains coal beds in exposures along the flank of Split Mountain (Doelling and Graham, 1972); 15-76 m thick.

KJcm CEDAR MOUNTAIN FORMATION AND MORRISON FORMATION - Cedar Mountain is mapped with the underlying Morrison Formation because it is generally thin and the contact with the underlying Morrison is difficult to determine; total thickness of map unit is 244-347 m.

Cedar Mountain Formation (Lower Cretaceous) - Purple, gray, and greenish-gray mudstone, siltstone, minor sandstone and limestone; contains calcrete beds that weather out as carbonate nodules; 0-60 m thick.

Morrison Formation (Upper Jurassic) - Upper Brushy Basin Member consists of soft, banded, variegated (light-gray, olive-gray, red, and light-purple) shale, claystone, siltstone, and minor cross-bedded sandstone, conglomerate, and bentonite; lower Salt Wash Member consists of resistant, light-gray to white cross-bedded sandstone; dinosaur remains are preserved in the Salt Wash Member at Dinosaur National Monument; Morrison is 244-287 m thick .

Jsc STUMP FORMATION, ENTRADA SANDSTONE, AND CARMEL FORMATION, UNDIVIDED - These formation are mapped as one unit where too thin to show separately at this scale; see below for unit description and thickness.

Js STUMP FORMATION (UPPER AND MIDDLE JURASSIC) - Upper Redwater Member is greenish-gray and light-green slope-forming shale with glauconitic, fossiliferous (belemnites) sandstone and limestone. Lower Curtis Member is resistant, light-gray to greenish-gray, cross-bedded, fossiliferous, glauconitic sandstone, oolitic limestone, and fissile shale; total thickness is 40-80 m.

Je ENTRADA SANDSTONE (MIDDLE JURASSIC) - Upper reddish-brown siltstone and fine-grained sandstone and a lower light-gray, pink, and light-brown sandstone; lower sandstone is resistant to erosion and forms cliffs and ridges; 12-75 m thick.

Jca CARMEL FORMATION (MIDDLE JURASSIC) - Medium- to dark-red, green, and gray sandy shale, sandstone, siltstone, limestone and gypsum; upper part is mostly slope-forming red shale, siltstone, and sandstone underlain by a middle gypsiferous unit; lower part is mostly red siltstone and thin ledge-forming limestone, which is commonly oolitic and fossiliferous; 30-118 m thick.

Jg GLEN CANYON SANDSTONE (LOWER JURASSIC) - Pink, light-gray, and light-brown, resistant, large-scale cross-bedded sandstone; forms cliffs and ridges; top 2-10 m of the formation may include beds of the Middle Jurassic Page Sandstone. Dinosaur tracks of Late Triassic age are reportedly preserved in strata 7 m above the base of the Glen Canyon Sandstone in the Red Fleet area of the adjoining Dutch John 30' x 60' quadrangle (Lockley and others, 1992), but these beds may really be part of the underlying Chinle Formation; 180-310 m thick.

TRcd CHINLE, MOENKOPI, AND DINWOODY FORMATIONS, UNDIVIDED - Combined as one map unit where formations are too thin to map at this scale; see below for descriptions and thickness.

TRc CHINLE FORMATION (UPPER TRIASSIC) - Purplish-red, purple, light-gray, greenish-gray, light-green, ripple-marked siltstone, sandstone, claystone, shale, and conglomerate; generally forms slopes; base is resistant conglomerate unit named the Gartra Member; 83-121 m thick.

TRmd MOENKOPI AND DINWOODY FORMATIONS, UNDIVIDED - Combined as one map unit where formations are too thin to map at this scale; see below for descriptions and thickness.

TRm MOENKOPI FORMATION (LOWER TRIASSIC) - Medium- to dark-red, reddish-brown, green, and gray, ripple-marked siltstone, fine-grained sandstone, and shale with gypsum and limestone beds; mostly soft, slope-forming unit; 170-260 m thick.

TRd DINWOODY FORMATION (LOWER TRIASSIC) - Light-gray, greenish-gray, light-brown, and brown, thin-bedded, ripple-marked shale, siltstone, and sandstone with minor amounts of limestone. "Soft," slope-forming unit along the flanks of the Yampa Plateau; 0-162 m thick.

Pp PARK CITY AND PHOSPHORIA FORMATIONS (LOWER PERMIAN) - Combined thickness of Park City and Phosphoria Formations is 20-122 m.

Franson Member of Park City Formation - Gray, thick- to thin-bedded cherty limestone and dolomite interbedded with brownish-gray sandstone and red to ochre shale; generally resistant and forms ledges and cliffs.

Meade Peak Phosphatic Shale Member of the Phosphoria Formation - Slope-forming, dark-gray phosphatic shale with interbeds of sandstone and limestone.

Grandeur Member of Park City Formation - Light-gray to light-brownish-gray sandstone, dolomite, and limestone; generally resistant and forms ledges and cliffs.

PIPw WEBER SANDSTONE (LOWER PERMIAN TO MIDDLE PENNSYLVANIAN) - Light-gray to yellowish-gray, very thick bedded sandstone with interbeds of limestone in the lower part; highly cross-bedded sandstone in the upper part; forms steep cliffs and ridges; 230-472 m thick.

IPm MORGAN FORMATION (MIDDLE PENNSYLVANIAN) - Light- to medium-red, yellow, and gray shale and siltstone, light- to medium-gray fossiliferous and red cherty limestone, and light-red-gray, fine-grained, locally cross-bedded sandstone; 11-290 m thick.

IPrv ROUND VALLEY LIMESTONE (LOWER PENNSYLVANIAN) - Light-gray to light-blue-gray, thin- to very thick bedded limestone interbedded with soft, red shale; limestone is fossiliferous and cherty; chert is blue gray and yellowish gray, but red to pink jasperoid chert is common in the region; forms ledges and cliffs; only exposed in Split Mountain; 65-127 m thick.

Mdh DOUGHNUT SHALE AND HUMBUG FORMATION (UPPER MISSISSIPPIAN) - Thickness of map units is 160-181 m; only exposed in Split Mountain.

Doughnut Shale - Dark-gray shale, with some red shale near base, with beds of coarse sandstone, limestone and coal; shale is slope forming and clayey; only exposed in Split Mountain; 85-91 m thick.

Humbug Formation - Light-gray to red, fine-grained to very fine grained, "soft" to resistant sandstone interbedded with light-gray limestone and red to black shale; sandstone is locally cross-bedded and hematitic near top of formation; 75-90 m thick.

Mm MADISON LIMESTONE (UPPER AND LOWER MISSISSIPPIAN) - Mostly dark-gray, medium to coarse crystalline, cherty limestone; chert is typically light gray; regionally contains numerous caves and sinkholes; only exposed in Split Mountain; 130-300 m thick.

NOT EXPOSED IN VERNAL 30' X 60' QUADRANGLE

Ꞓl LODORE FORMATION (UPPER CAMBRIAN) - Light-brown to greenish-gray sandstone underlain by pink to tan to pale-greenish-gray glauconitic shale interbedded with tan to pale-green sandstone; base is variegated (pink, gray, and pale-green) coarse- to medium-grained cross-bedded sandstone; locally pebbly; upper part forms ledges, middle part forms slopes and ledges, and lower part forms cliffs; Lodore pinches out to the west; 0-180 m thick.

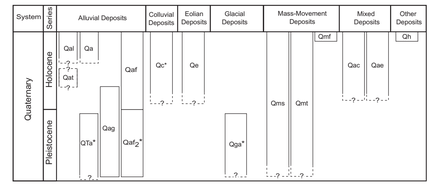
Zur RED PINE SHALE OF THE UINTA MOUNTAIN GROUP (MIDDLE PART OF UPPER PROTEROZOIC) - Dark-gray to dark green-gray shale and siltstone; interbedded with brown-gray to brown-red sandstone and quartzite, thin bedded near base becoming thick bedded near the top; sandstone is medium- to coarse-grained, cross-bedded, and siliceous; age is based on playnomorphs recovered from base of formation in the southwest part of the Dutch John 30' x 60' quadrangle (Sprinkel, 2002; Sprinkel and others, 2002); estimated at 0-550 m thick.

Zuu UNNAMED FORMATION OF THE UINTA MOUNTAIN GROUP (MIDDLE AND LOWER PART OF UPPER PROTEROZOIC) - Dark- to light-red, fine- to coarse-grained, quartzose and lithic sandstone and quartzite, sandstone is thick- to medium-bedded; planar-, cross-, and contorted-bedding is preserved; some beds contain tool and groove marks, ripples, and mudcracks; contains considerable red, green, and dark-gray micaceous shale interbeds and some conglomerate; age is based on palynomorphs recovered from near middle of formation in the Dutch John 30' x 60' quadrangle (Sprinkel, 2002; Sprinkel and others, 2002); as much as 3,500 m thick.

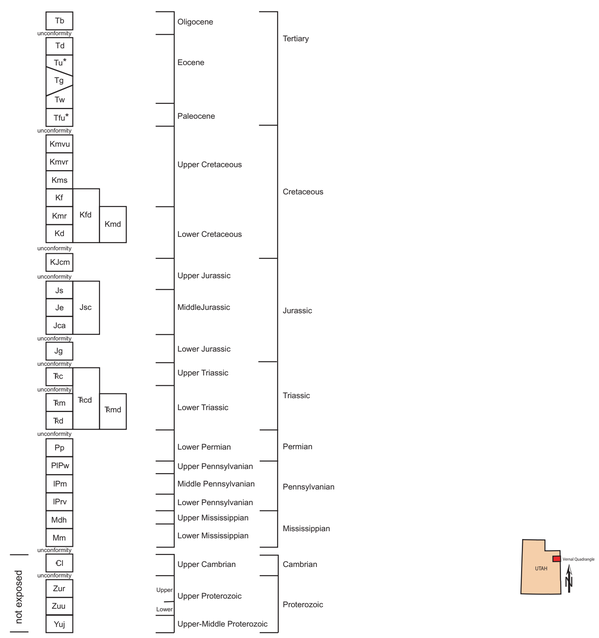
Yuj JESSE EWING CANYON FORMATION OF THE UINTA MOUNTAIN GROUP (MIDDLE PROTEROZOIC) - Dark- to light-red, brown, and reddish-purple pebble to boulder conglomerate interbedded with quartzose and lithic sandstone and shale; clasts are white, pale green, and pink quartzite (from Red Creek Quartzite), subrounded to subangular; thick- to medium-bedded and fining up in individual beds as well as the formation as a whole; age is based on palynomorphs (Sprinkel and others, 2002) preserved in a down-faulted block defined as basal Jesse Ewing Canyon Formation by Sanderson and Wiley (1986) but mapped as the overlying unnamed formation for the Dutch John 30' x 60' quadrangle (Sprinkel, 2002); 225 m thick.

* Exposed in the Vernal 30' x 60' quadrangle, but not in area mapped for the first year of the project

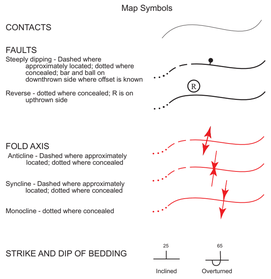
Correlation of Quaternary Units



Correlation of Bedrock Units



Map Symbols

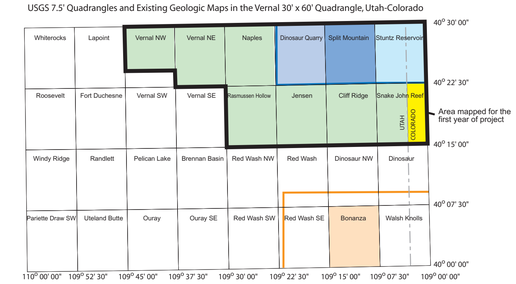


Stratigraphic Column

SYSTEM	SYMBOL		FORMATIONS	Thickness (meters) (not to scale)	NOTES
Quat.	Q**		Unconsolidated deposits	less than 50	Alpine glaciers in Uinta Mountains. Capture of Green River by Colorado River
Tertiary	QTa		Older alluvium	less than 10	Crustal relaxation; Uinta Mountains down dropped along Uinta fault zone and drainage patterns change in eastern Uintas
	Tb		Bishop Conglomerate	less than 50	
	Td		Duchesne River Formation	1,000	Crustal stability; Gilbert Peak erosion surface forms and Bishop Conglomerate is deposited
	Tu		Uinta Formation	0-600	Contains gilsonite deposits
	Tg		Green River Formation	600+	Uinta Mountains continue to uplift, erosion exposed Uinta Mountain Group, and creation of Lake Uinta as the Uinta Basin continues to subside; contains oil shale and oil reserves
	Tw		Wasatch Formation	610	Uinta Mountains continue to uplift, erosion exposed Uinta Mountain Group, and subsidence of Uinta Basin; gas reservoir in Uinta Basin
	Tfu		Fort Union Formation	not determined	Unconformity, 6 m.y.; TK boundary and the extinction of dinosaurs
Cretaceous	Kmvu	Mesaverde Group	Upper unit	425-550	Uplift of Uinta Mountain begins near end of Cretaceous
	Kmvr		Rim Rock Formation	200-250	Strata thins to east
	Kms		Mancos Shale	1,500-4,900	End of great Western Interior Seaway
	Kfd	Kf	Frontier Sandstone	52-83	Gas reservoir in Uinta Basin
		Km	Mowry Shale	10-67	Unconformity, 5 m.y.; Fossil fish scales in Mowry
		Kd	Dakota Sandstone	15-76	Gas reservoir in Uinta Basin; K-1 unconformity, 2 m.y.
Jurassic	KJcm		Cedar Mountain Formation	0-60	K-0 unconformity, 25 m.y.
			Morrison Formation	244-287	Abundant dinosaur remains
	Jsc	Js	Stump Formation	40-80	J-5 unconformity, 2 m.y.; *Belemnites* fossils
		Je	Entrada Sandstone	12-75	J-3 unconformity, 1 m.y.
		Jca	Carmel Formation	30-118	*Isocrinus* fossils
	Jg		Glen Canyon Sandstone	180-310	J-2 unconformity, 14 m.y.; top of Jg may include Page Sandstone
Triassic	TRcd	TRc	Chinle Formation	83-121	J-0 unconformity, 7 m.y.
		TRm	Moenkopi Formation	170-260	Ankareh and Stanaker Fm. of some workers; Gartra Member; Tr-3 unconformity, 15 m.y.
		TRd	Dinwoody Formation	0-162	Tr-1 unconformity, 6 m.y.
Permian	Pp		Park City and Phosphoria Formations	20-122	Phosphate deposits; Unconformity, 3 m.y.
	PIPw		Weber Sandstone	230-472	Unconformity, 3 m.y.; Forms cliffs and important oil reservoir in the Rocky Mountains
Penn.	IPm		Morgan Formation	11-290	
	IPrv		Round Valley Limestone	65-127	
Miss.	Mdh		Doughnut Shale	85-91	
			Humbug Formation	75-90	
	Mm		Madison Limestone	130-300	Forms cliffs, contains marine fossils
Cam.	Ꞓl		Lodore Formation	0-180	Unconformity, about 220-350 m.y.
Proterozoic	Zur	Uinta Mountain Group	Red Pine Shale	~0-550	
	Zuu		Unnamed Formation	as much as 3,500	Forms the core of Uinta Mountains; Flaming Gorge Dam constructed in this unit
	Yuj		Jesse Ewing Canyon Formation	225	not exposed in the quadrangle

**See Correlation of Quaternary Units for symbols

USGS 7.5' Quadrangles and Existing Geologic Maps in the Vernal 30' x 60' Quadrangle, Utah-Colorado



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