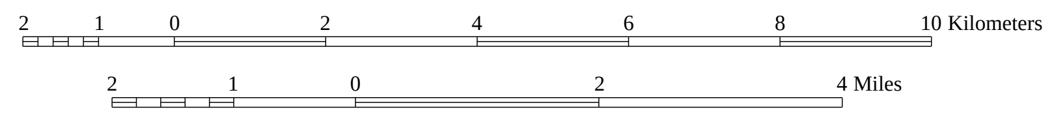
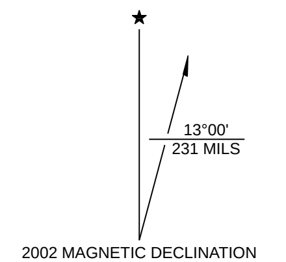
SCALE 1:100,000
Contour interval 40 meters
Supplementary contour interval 10 meters



Base from U.S.G.S. Richfield 30' x 60' quadrangle, 1980



2002 MAGNETIC DECLINATION
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GEOLOGIC MAP OF THE RICHFIELD 30' x 60' QUADRANGLE, SOUTHEAST MILLARD COUNTY AND PARTS OF BEAVER, PIUTE, AND SEVIER COUNTIES, UTAH

by

Lehi F. Hintze[1,2], Fitzhugh D. Davis[2], Peter D. Rowley[3], Charles G. Cunningham[4], Thomas A. Steven[4], and Grant C. Willis[2]

2003

[1]Brigham Young University [2]Utah Geological Survey [3]Geologic Mapping, Inc. [4]U.S. Geological Survey

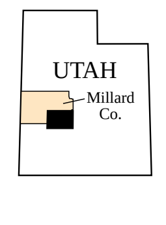

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Plate 1 of 2
Utah Geological Survey Map 195

Utah Geological Survey
a division of
Utah Department of Natural Resources
***in cooperation with* U.S. Geological Survey**
National Cooperative Geologic Mapping Program
Statemap Agreement No. 00HQAG0109

GIS compilation: Basia Matyjasik, Angela Wadman (UGS),
and Jeremiah B. Workman (USGS)
Cartographer: James W. Parker
Project Manager: Jon K. King

Plate 2 of 2

Utah Geological Survey Map 195

GEOLOGIC MAP OF THE RICHFIELD 30' x 60' QUADRANGLE, SOUTHEAST MILLARD COUNTY AND PARTS OF BEAVER, PIUTE, AND SEVIER COUNTIES, UTAH

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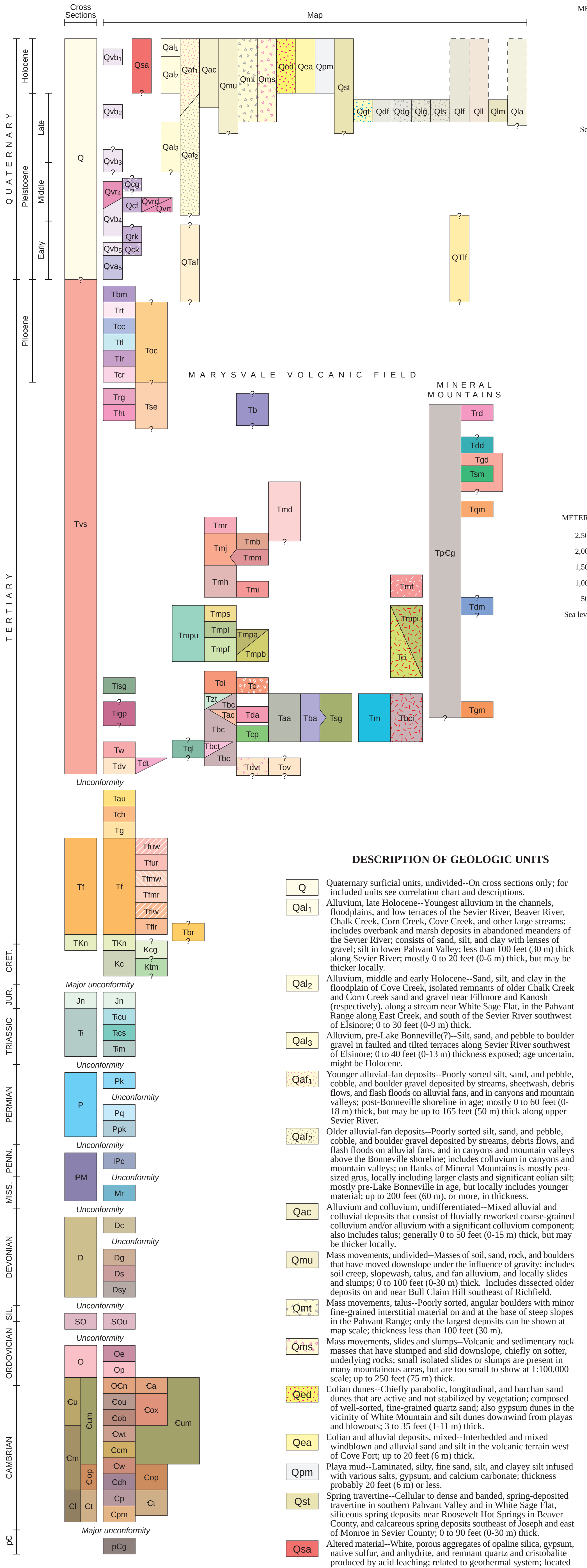
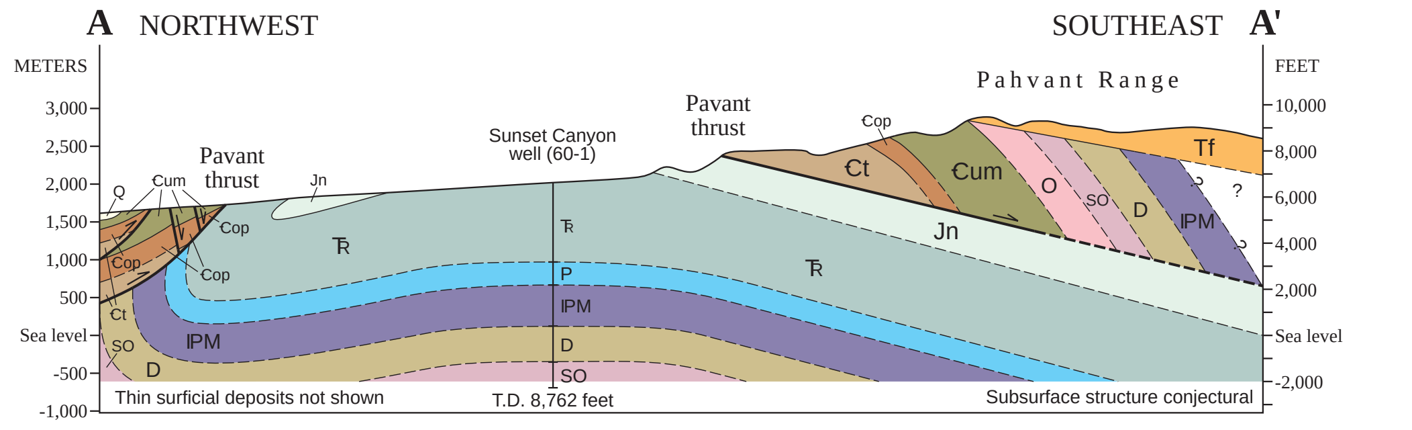
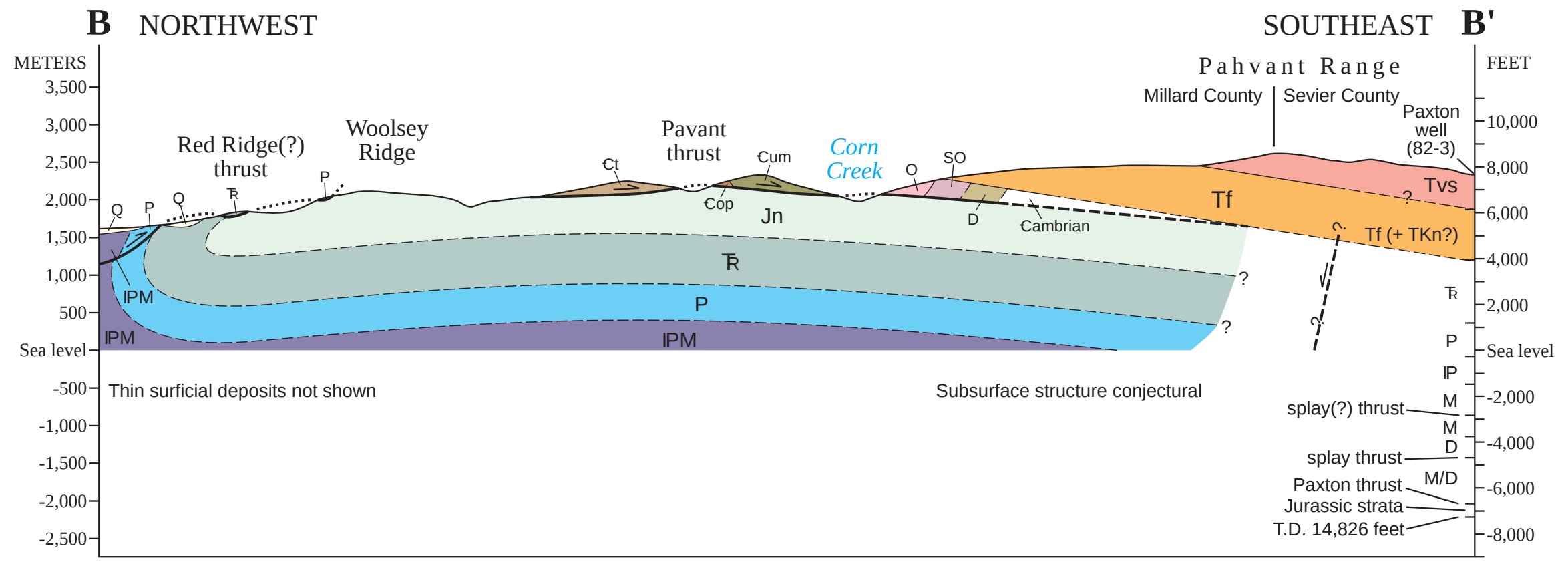
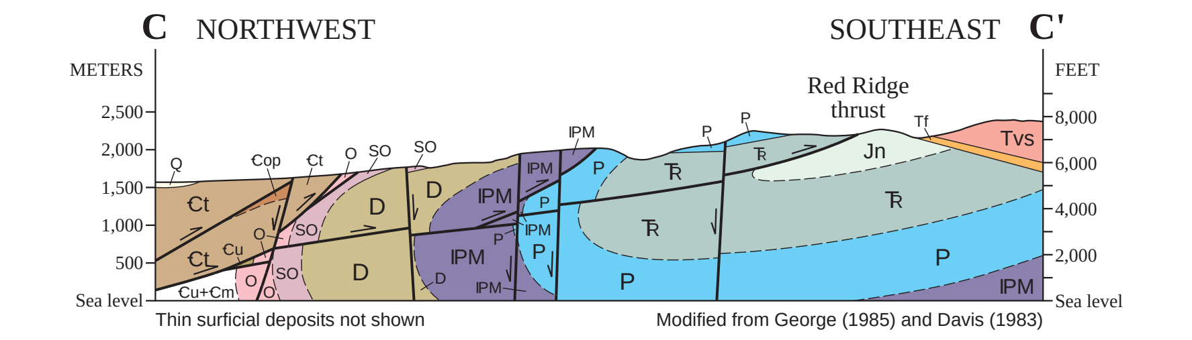
CORRELATION OF GEOLOGIC UNITS

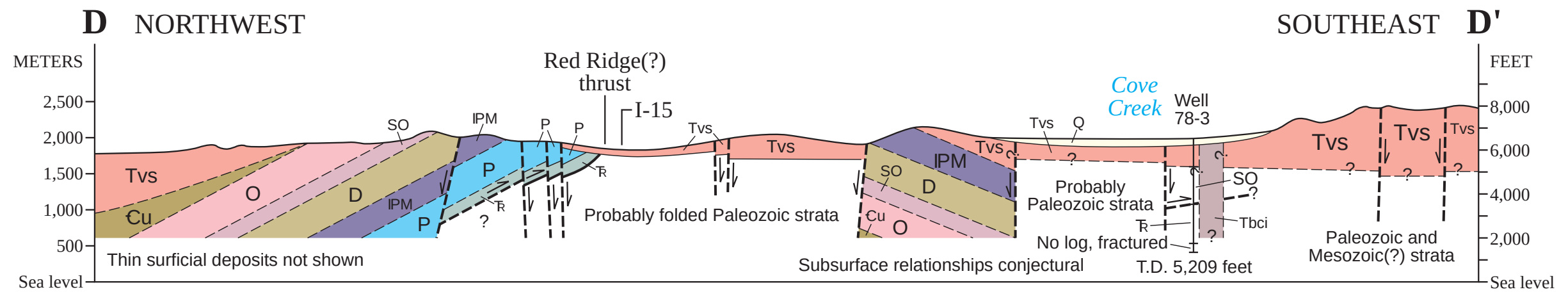


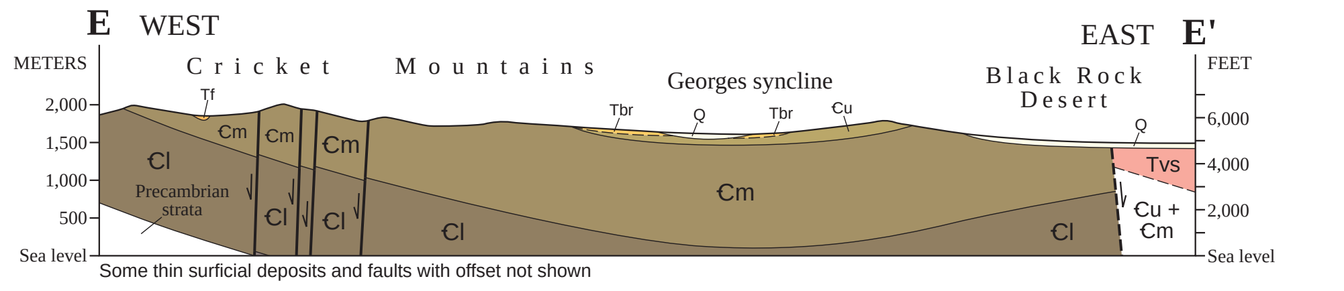
Note: "Pavant" and "Pahvant" are both used in this document. "Pahvant" is now the accepted spelling for geographic features. "Pavant" usage is for geologic features named in publications.











LITHOLOGIC COLUMN

AGE		MAP SYMBOL		MAP UNIT		THICKNESS Feet	THICKNESS Meters	SCHEMATIC COLUMN	OTHER INFORMATION
QUATERNARY		Q-various		Alluvial, eolian, glacial, and Lake Bonneville deposits		0-300±	0-90±		
		Qvb$_1$		Basalt of Ice Springs		0-200	0-60		660?-4,000? years old
		Qvb$_2$		Basalt of Tabernacle Hill		0-200	0-60		14,320 yrs B.P.
		Qvb$_3$		Basalt of Pahvant Butte		0-100	0-30		
		Qvr$_4$,*Qvrt,*Qvrd		Rhyolite of White Mountain and Mineral Mountains		0-120	0-40		0.4 and 0.5 Ma, respectively
		Qcg,Qcf		Basaltic andesite of Cedar Grove (cg), Cove Fort (cf)		0-800	0-250		0.3 and 0.5 Ma, respectively
		Qvb$_4$		Basalt of Kanosh, Beaver Ridge and Mineral Mountains		0-300	0-90		0.5 to 0.9 Ma
		*Qrk,*Qck		Basaltic andesite of Red and Crater Knolls		0-200	0-60		~1.0 Ma
		Qvb$_5$,Qva$_5$		Basalt of Black Rock, Andesite of Beaver Ridge		0-200	0-60		1.0-1.5 Ma
		QTlf,QTaf		Fine-grained lake sediments (lf); alluvial-fan deposits (af)		0-1,000	0-300		0.7-2.0 Ma in Sevier Lake
TERTIARY	PLIOCENE	Tbm		Basaltic andesite of Burnt Mountain		0-500	0-150		2.1 Ma
		Trt	Toc	Rhyolite of N. Twin Peak, S. Twin Peak, Mid-Dome	Oak City Fm. 0-2,000 ft (0-600 m)	------	------		2.35-2.5 Ma
		Tcc		Basalt of Cove Creek		0-400	0-120		2.55 Ma
		Ttl		Limestone of Twin Peaks		0-262	0-80		Lacustrine
		Tlr		Basalt of Lava Ridge		0-200	0-60		2.5 Ma
		Tcr		Rhyolite of Cudahy Mine, Rhyodacite of Coyote Hills		0-650	0-200		2.6 & 2.7 Ma
		Tse		Sevier River Formation		600-1,000	180-300		5 to 14 Ma
		*Trg		Rhyolite of Gillies Hill		------	------		~9 Ma
		Tht		Tuff of Holden		0-200?	0-60?		10.5-10.8 Ma?
	MIOCENE	*various		Intrusions and gneiss complex in Mineral Mountains		--------			11-25 Ma
		Tqm		Quartz monzonite of Mineral Mountains		Stock			18 Ma
		Tmj		Joe Lott Tuff Member, Mt. Belknap Volcanics		0-400	0-120		19 Ma, from Mt. Belknap caldera
		To		Osiris Tuff		0-200	0-60		23 Ma, from Monroe Peak caldera
	?	*Tisg, *Tigp		Syenite (sg) and gabbro (gp) of Cedar Grove		Intrusions			~23 Ma
	OLIGOCENE	Tgm		Granodiorite of Mineral Mountains		Stock			25 Ma
		Tac		Tuff of Albinus Canyon		0-650	0-200		25.3 Ma
		Tbct		Three Creeks Tuff Member, Bullion Canyon Volcanics		0-720	0-220		27 Ma
		Tw		Volcanic rocks of Wales Canyon		440	135		
		Tdv		Volcanic rocks of Dog Valley		0-1,200	0-370		~33 Ma
		Tdt		Tuff of Dog Valley		400±	120±		33.6 Ma Ar/Ar
		Tdvt, Tov		Dipping Vat Formation, older volcanic rocks		~600	~180		Age uncertain
		Tau		Aurora Formation		0-1,200	0-360		38-40 Ma; Hiatus and unconformity
		Tch		Crazy Hollow Formation		0-350	0-107		
	PALEO.-EO.	Tg		Green River Formation		0-800	0-245		
		Tf-various		Flagstaff Formation		0-3,500	0-1,070		Freshwater limestone, bioturbated
		Tbr		Breccia of Cat Canyon		0-165	0-50		
		TKn		North Horn Formation		0-2,500	0-760		Sandstone and pebble conglomerate
CRET.		Ktm		Tectonic melange beneath Pavant thrust plate		0-200	0-60		
		Kc,Kcg		Canyon Range Conglomerate, Conglomerate of Mineral Mtns.		0-866	0-264		
JUR.		Jn		Navajo Sandstone		2,000±	600±		Eolian, cross-bedded
TRIASSIC		Ꞧcu		Chinle Formation, upper member		69-274	21-83		Clayey, prone to slump
		Ꞧcs		Chinle Formation, Shinarump Conglomerate Member		177-566	54-172		
		Ꞧm		Moenkopi Formation		1,876	572		Ripple marks, marine fossils
PERMIAN		Pk		Kaibab Limestone		1,160	353		Cherty; 497 feet (152 m) thick in subsurface
		Pq		Queantoweap Sandstone		817	249		
		Ppk		Pakoon Dolomite		445	136		
IP.		IPc		Callville Limestone		538	164		
MISS.		Mr		Redwall Limestone		1,545	471		Fossil corals and gastropods; Pinyon Peak Ls equivalent
DEVONIAN		Dc		Cove Fort Quartzite		82-160	25-49		
		Dg		Guilmette Formation		575	175		Stromatoporoids
		Ds		Simonson Dolomite		185	56		
		Dsy		Sevy Dolomite		710	217		Light-gray dolomite
S.		SOu		Laketown and Fish Haven Dolomites, undivided		566-1,000	173-300		
ORDOVICIAN		Oe		Eureka Quartzite		150-180	45-55		
		Op		Pogonip Group		1,125-1,200	343-350		Orthid brachiopods at top; Intraformational conglomerate

AGE		MAP SYMBOL	MAP UNIT	THICKNESS	SCHEMATIC COLUMN
CAMBRIAN	UPPER	Ꞓa	Ajax Dolomite	700 ft (210 m)	
		Ꞓox	Opex Formation	390 ft (120 m)	
	MIDDLE	Ꞓum	Upper and Middle Cambrian carbonate rocks	2,400 ft (735 m)	
		Ꞓop	Ophir Formation	850 ft (260 m)	
	LOWER	Ꞓt	Tintic Quartzite	est. 3,300 ft (1,000 m)	

THRUST FAULTED BASE

Paleozoic sequence listed above is part of the parautocthonous Pavant thrust plate in the eastern part of the quadrangle.

MAP SYMBOL	MAP UNIT	Feet	Meters	SCHEMATIC COLUMN	OTHER INFORMATION
OꞒn	Notch Peak Fm.	100+	30+		Top not preserved in map area
Ꞓou	Orr Fm, upper mbrs.	405	122		*Tricrepicephalus*
Ꞓob	Orr Fm, Big Horse Mbr.	656	200		
Ꞓwt	Wah Wah Summit - Trippe Fms., undivided	1,420±	433±		*Eldoradia*
Ꞓcm	Limestone of Cricket Mountains	1,970	600		
Ꞓw	Whirlwind Fm.	200-265	60-80		*Ehmaniella*
Ꞓdh	Dome-Chisholm (Peasely)-Howell Fms.	850±	260±		*Glossopleura*
Ꞓp	Pioche Formation	800±	245±		Trace fossils
Ꞓpm	Prospect Mountain Quartzite	4,000+	1,200+		Pink vitreous quartzite

AGE	MAP SYMBOL	MAP UNIT	SCHEMATIC COLUMN	OTHER INFORMATION
PRECAM.	pꞒg	Banded gneiss in Mineral Mountains		1,750 Ma

Cambrian rocks above are exposed in the Cricket Mountains (on the Canyon Range thrust plate), and are partially exposed and structurally thinned in the Mineral Mountains

NOTE: Ma ages are from K-Ar data and may contain substantial error. Most units are local and thus not superposed on one another. Stacking on this chart is a best estimate. Some thicknesses were estimated from topographic maps.

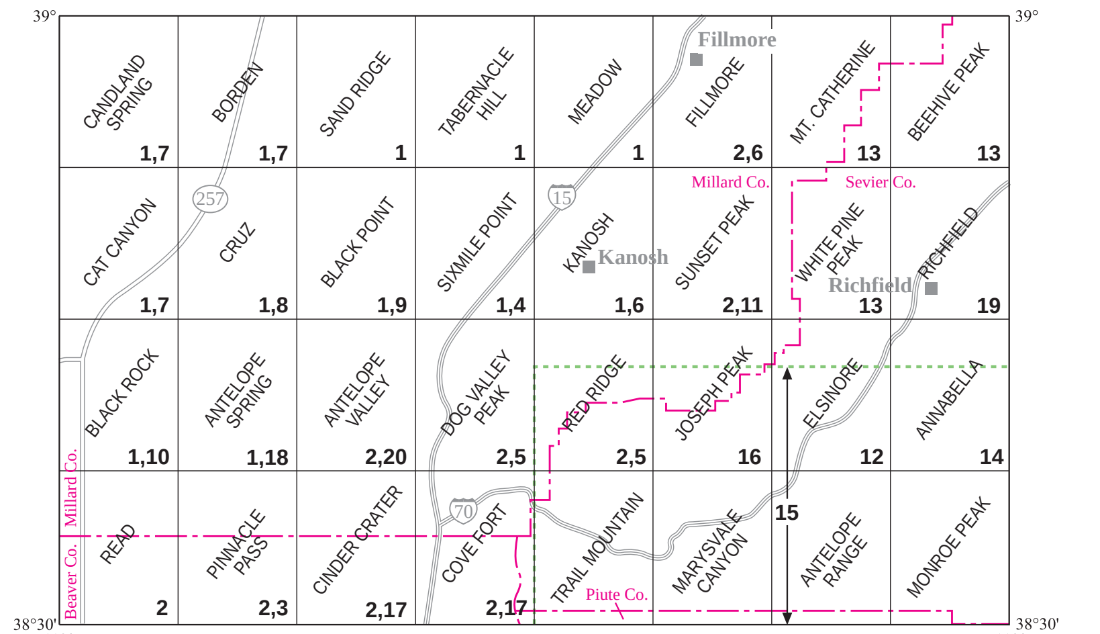
*Unit mostly in Beaver County

Diagram is schematic-- no fixed thickness scale

MARYSVALE VOLCANIC FIELD LITHOLOGIC COLUMN

AGE		MAP SYMBOL	MAP UNIT	THICKNESS Feet	THICKNESS Meters	SCHEMATIC COLUMN	OTHER INFORMATION
MIOCENE		Tb	Basalt flows in northernTushar Mountains	0-425	0-130		11-13 Ma?
	Mount Belknap Volcanics	Tmd	Late rhyolite rocks	----	----		14-19 Ma
		Tmr	Red Hills Tuff Member	<600	<180		18.9 Ma K-Ar
		Tmj	*Joe Lott Tuff Member	0-400	0-120		Mount Belknap caldera is source
		Tmb	Mount Baldy Rhyolite Member	<2,600	<800		Age uncertain
		Tmm	Middle tuff member	<1,640	<500		Present in upper Tmj
		Tmh	Lower heterogeneous member	230	70		
		Tmf	Fine-grained granite	intrusions			20-21 Ma
		Tmi	Crystal-rich domes and plugs	----	----		
	Volcanics of Monroe Peak Caldera	Tmpi, Tci	Intracaldera intrusions	intrusions			21-22 Ma
	Tmpu: intracaldera rocks, undivided	Tmps	Sedimentary rocks	200	60		
		Tmpl	Lava flows of Monroe Peak	500	150		21.3 Ma K-Ar
		Tmpa	Volcanic rocks of Sage Flat	200	60		Andesitic
		Tmpf	Lava flows of Monkey Flat Ridge	<500	<150		Dacitic
		Tmpb	Lava flows of Bagley Meadows	650	200		Flows or dome
		Toi,To	*Osiris Tuff (i=intracaldera)	0-1,150+	0-350+		Monroe Peak caldera is source
?		Tzt	Zeolite tuff	400	120		24.6 Ma?
OLIGOCENE		Tsg	Volcanic rocks of Signal Peak	2,100	650		Andesitic
	Taa	Tda	Antimony Tuff Member, Mt. Dutton Fm.	200	60		25.4 Ma K-Ar
		Tba	Basaltic andesite lava flows	500	150		May be part of unit Tsg
		Tac	*Tuff of Albinus Canyon	0-650	0-200		25.3 Ma
		Tcp	Crystal-poor dacitic lava flows	100-160	30-50		
		Tbc	Bullion Canyon Volcanics	5,000±	1,500+		22-30 Ma
		Tbci	Monzonitic / latitic intrusions	intrusions			23-27 Ma
		Tbct	*Three Creeks Tuff Member	0-720	0-220		27 Ma
		Tql	Quartz latite dome and rhyodacite flow	650	200		Age uncertain

*Also on main lithologic column



Index map showing sources of geologic mapping and 7.5-minute quadrangles

MAP AND CROSS-SECTION SYMBOLS

(On map) (Shown vertical or inclined on cross section)	CONTACT-- Dashed where location inferred; queried where speculative on cross sections
	NORMAL FAULT-- Dashed where location inferred; dotted where concealed; queried where existence uncertain; bar and ball on downthrown side; arrows show relative movement on cross section
	STEEPLY DIPPING FAULT-- Sense of motion not known or complex; dashed where location inferred; dotted where concealed
	NORMAL FAULT-- Inferred and delineated from gravity data; concealed; bar and ball on downthrown side
	TEAR FAULT-- High-angle fault with strike-slip offset; dashed where location inferred; dotted where concealed; arrows show relative movement on map
(Map) (Cross section)	THRUST FAULT-- Dashed where location inferred; dotted where concealed; barbs on upper plate; arrows show relative movement on cross sections
	ATTENUATION FAULT -- Younger over older rocks with strata thinned and cut out between; present in Mineral Mountains; barbs on upper plate
	CALDERA MARGIN-- Dashed where location inferred; dotted where concealed; hachures on downthrown side; mostly topographic boundary of caldera.
	DETACHMENT RELATED TO MASS MOVEMENTS-- Dashed where location inferred; present on west side of Pahvant Range (where Navajo Sandstone has crept downslope on underlying Chinle)
	LINEAMENT -- Shown west of White Sage Flat, may be concealed fault trace
	FOLD AXES -- Dotted where concealed (arrows on axes show plunge)
	anticline
	syncline
	overturned anticline
	ESCARPMENT AT HEAD OF SLUMP/SLIDE AREA
	STRIKE AND DIP OF BEDDING--
65	inclined
	vertical
42	overturned
⊕	horizontal
6	STRIKE AND DIP OF PLANAR FEATURES IN ASH-FLOW TUFF
	DEEP EXPLORATION WELL-- map symbol on left, cross section symbol on right
	SINKHOLE (in QTlf)
	VOLCANIC VENT/CINDER CONE
	SHORELINES-- dashed where inferred; dotted where concealed; queried where conjectural
P ?	Provo shoreline of Lake Bonneville-- queried where uncertain
B	Bonneville shoreline of Lake Bonneville
Qlf/QTaf	Indicates thin cover of the first unit overlying the second unit
Qms (Ꞧc)	Indicates unit(s) involved in mass movement

SOURCE LIST FOR GEOLOGIC MAPPING

Surficial Geology

1. Oviatt, C.G., 1991, Quaternary geology of the Black Rock Desert, Millard County, Utah: Utah Geological and Mineral Survey Special Study 73, 23 p., scale 1:100,000; locally modified by L.F. Hintze and F.D. Davis, 1991 and 1992, unpublished mapping for this publication, scale 1:24,000.
2. Davis, F.D., and Hintze, L.F., 1991, 1992, and 1999, unpublished mapping for this publication, scales ~1:50,000 and 1:24,000.

Bedrock Geology

3. Coleman, D.S., Bartley, J.M., Walker, J.D., Price, D.E., and Friedrich, A.M., 1997, Extensional faulting, footwall deformation and plutonism in the Mineral Mountains, southern Sevier Desert: Brigham Young University Geology Studies, v. 42, part 2, p. 203-233, scale 1:21,300; Walker, J.D., and Bartley, J.M., 1992, unpublished map, scale 1:12,000; and Sibbett, B.S., and Nielson, D.L., 1980, Geology of the central Mineral Mountains, Beaver County, Utah: Earth Science Laboratory, University of Utah Research Institute Report ESL-33 (DOE/ET/28392-40), 42 p., scale 1:24,000.
4. Crosby, G.W., 1959, Geology of the south Pavant Range, Millard and Sevier Counties, Utah: Brigham Young University Geology Studies, v. 6, no. 3, 59 p., scale 1:65,000; modified by L.F. Hintze, 1992, unpublished mapping for this publication, scale 1:24,000.
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6. George, S.E., 1985, Geology of the Fillmore and Kanosh quadrangles, Millard County, Utah: Brigham Young University Geology Studies, v. 32, part 1, p. 39-62, scale 1:24,000; modified locally by L.F. Hintze for this publication.
7. Hintze, L.F., 1984, Geology of the Cricket Mountains, Millard County, Utah: U.S. Geological Survey Open-File Report 84-683, 14 p., plates 4, 5, and 7, scale 1:24,000.
8. Hintze, L.F., 1984, Geology of the Cricket Mountains, Millard County, Utah: U.S. Geological Survey Open-File Report 84-683, 14 p., plate 8, map scale 1:24,000; mapping of volcanic rocks by L.F. Hintze for this publication, scale 1:24,000, modified from Crecraft, H.R., Nash, W.P., and Evans, S.H. Jr., 1981, Late Cenozoic volcanism at Twin Peaks, Utah, geology and petrology: Journal of Geophysical Research, v. 86, p. 10,303-10,320, scale 1:200,000.
9. Hintze, L.F., 1990 and 1991, unpublished mapping for this publication, scale 1:24,000.
10. Hintze, L.F., 1991, unpublished mapping for this publication, scale 1:24,000, partly modified from Crecraft, H.R., Nash, W.P., and Evans, S.H. Jr., 1981, Late Cenozoic volcanism at Twin Peaks, Utah, geology and petrology: Journal of Geophysical Research, v. 86, p. 10,303-10,320, scale 1:200,000.
11. Hintze, L.F., 1992, and Hintze, L.F., and Willis, G.C., 1999, unpublished mapping for this publication, scale 1:24,000, partly modified from Hickox, C.W., 1971, Geology of a portion of the Pavant Range allochthon, Millard County, Utah: Houston, Texas, Rice University, Ph.D. dissertation, 67 p., scales 1:63,360 and 1:31,360.
12. Hintze, L.F., 1992, and Hintze, L.F., and Willis, G.C., 1999, unpublished mapping for this publication, scale 1:24,000 and ~1:50,000; modified from Steven, T.A., 1979a, Geologic map of the Monroe NW (Elsinore) quadrangle, west-central Utah: U.S. Geological Survey Miscellaneous Field Studies Map MF-1107, scale 1:24,000.
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15. Rowley, P.D., Cunningham, C.G., Steven, T.A., Workman, J.B., Anderson, J.J., and Theissen, K.M., 2002, Geologic map of the central Marysvale volcanic field, southwestern Utah: U.S. Geological Survey Geologic Investigations Map I-2645A, scale 1:100,000; with clarification locally from Cunningham, C.G., Steven, T.A., Rowley, P.D., Glassgold, L.B., and Anderson, J.J., 1983, Geologic map of the Tushar Mountains and adjoining areas, Marysvale volcanic field, Utah: U.S. Geological Survey Miscellaneous Investigations Map I-1430, scale 1:50,000.
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17. Steven, T.A., and Morris, H.T., 1983, Geologic map of the Cove Fort [15'] quadrangle west-central Utah: U.S. Geological Survey Miscellaneous Investigations Series Map I-1481, scale 1:50,000; modified by L.F. Hintze, 1991, 1999, unpublished mapping for this publication, scale 1:24,000.
18. Whelan, J.A., and Bowdler, James, 1979, Geology of the Antelope Springs quadrangle, Millard County, Utah: Utah Geology, v. 6, no. 2, p. 81-85, scale 1:62,500; and Hintze, L.F., 1991-1992, unpublished mapping for this publication, scale 1:24,000; north end of Mineral Mountains from Coleman, D.S., Bartley, J.M., Walker, J.D., Price, D.E., and Friedrich, A.M., 1997, Extensional faulting, footwall deformation and plutonism in the Mineral Mountains, southern Sevier Desert: Brigham Young University Geology Studies, v. 42, part 2, p. 203-233, scale 1:21,300.
19. Willis, G.C., 1994, Interim geologic map of the Richfield [7.5'] quadrangle: Utah Geological Survey Open-File Report 309, 105 p., scale 1:24,000.
20. Zimmerman, J.T., 1961, Geology of the Cove Creek area, Millard and Beaver Counties, Utah: Salt Lake City, University of Utah, M.S. thesis, 91 p., scale 1:24,000; and Hintze, L.F., 1991, unpublished mapping for this publication, scale 1:24,000, partly modified from Crecraft, H.R., Nash, W.P., and Evans, S.H. Jr., 1981, Late Cenozoic volcanism at Twin Peaks, Utah, geology and petrology: Journal of Geophysical Research, v. 86, p. 10,303-10,320, scale 1:200,000.

DESCRIPTION OF GEOLOGIC UNITS

Q	Quaternary surficial units, undivided--On cross sections only; for included units see correlation chart and descriptions.
Qal$_1$	Alluvium, late Holocene--Youngest alluvium in the channels, floodplains, and low terraces of the Sevier River, Beaver River, Chalk Creek, Corn Creek, Cove Creek, and other large streams; includes overbank and marsh deposits in abandoned meanders of the Sevier River; consists of sand, silt, and clay with lenses of gravel; silt in lower Pahvant Valley; less than 100 feet (30 m) thick along Sevier River; mostly 0 to 20 feet (0-6 m) thick, but may be thicker locally.
Qal$_2$	Alluvium, middle and early Holocene--Sand, silt, and clay in the floodplain of Cove Creek, isolated remnants of older Chalk Creek and Corn Creek sand and gravel near Fillmore and Kanosh (respectively), along a stream near White Sage Flat, in the Pahvant Range along East Creek, and south of the Sevier River southwest of Elsinore; 0 to 30 feet (0-9 m) thick.
Qal$_3$	Alluvium, pre-Lake Bonneville(?)--Silt, sand, and pebble to boulder gravel in faulted and tilted terraces along Sevier River southwest of Elsinore; 0 to 40 feet (0-13 m) thickness exposed; age uncertain, might be Holocene.
Qaf$_1$	Younger alluvial-fan deposits--Poorly sorted silt, sand, and pebble, cobble, and boulder gravel deposited by streams, sheetwash, debris flows, and flash floods on alluvial fans, and in canyons and mountain valleys; post-Bonneville shoreline in age; mostly 0 to 60 feet (0-18 m) thick, but may be up to 165 feet (50 m) thick along upper Sevier River.
Qaf$_2$	Older alluvial-fan deposits--Poorly sorted silt, sand, and pebble, cobble, and boulder gravel deposited by streams, debris flows, and flash floods on alluvial fans, and in canyons and mountain valleys above the Bonneville shoreline; includes colluvium in canyons and mountain valleys; on flanks of Mineral Mountains is mostly pea-sized grus, locally including larger clasts and significant eolian silt; mostly pre-Lake Bonneville in age, but locally includes younger material; up to 200 feet (60 m), or more, in thickness.
Qac	Alluvium and colluvium, undifferentiated--Mixed alluvial and colluvial deposits that consist of fluvially reworked coarse-grained colluvium and/or alluvium with a significant colluvium component; also includes talus; generally 0 to 50 feet (0-15 m) thick, but may be thicker locally.
Qmu	Mass movements, undivided--Masses of soil, sand, rock, and boulders that have moved downslope under the influence of gravity; includes soil creep, slopewash, talus, and fan alluvium, and locally slides and slumps; 0 to 100 feet (0-30 m) thick. Includes dissected older deposits on and near Bull Claim Hill southeast of Richfield.
Qmt	Mass movements, talus--Poorly sorted, angular boulders with minor fine-grained interstitial material on and at the base of steep slopes in the Pahvant Range; only the largest deposits can be shown at map scale; thickness less than 100 feet (30 m).
Qms	Mass movements, slides and slumps--Volcanic and sedimentary rock masses that have slumped and slid downslope, chiefly on softer, underlying rocks; small isolated slides or slumps are present in many mountainous areas, but are too small to show at 1:100,000 scale; up to 250 feet (75 m) thick.
Qed	Eolian dunes--Chiefly parabolic, longitudinal, and barchan sand dunes that are active and not stabilized by vegetation; composed of well-sorted, fine-grained quartz sand; also gypsum dunes in the vicinity of White Mountain and silt dunes downwind from playas and blowouts; 3 to 35 feet (1-11 m) thick.
Qea	Eolian and alluvial deposits, mixed--Interbedded and mixed windblown and alluvial sand and silt in the volcanic terrain west of Cove Fort; up to 20 feet (6 m) thick.
Qpm	Playa mud--Laminated, silty, fine sand, silt, and clayey silt infused with various salts, gypsum, and calcium carbonate; thickness probably 20 feet (6 m) or less.
Qst	Spring travertine--Cellular to dense and banded, spring-deposited travertine in southern Pahvant Valley and in White Sage Flat, siliceous spring deposits near Roosevelt Hot Springs in Beaver County, and calcareous spring deposits southeast of Joseph and east of Monroe in Sevier County; 0 to 90 feet (0-30 m) thick.
Qsa	Altered material--White, porous aggregates of opaline silica, gypsum, native sulfur, and anhydrite, and remnant quartz and cristobalite produced by acid leaching; related to geothermal system; located near Cove Fort in Holocene(?) and likely Pleistocene alluvial fans and bedrock; only the largest area, exposed in a pit, is mapped; up to 105 feet (33 m) thick in this pit.
Qgt	Glacial till--Unsorted mixtures of clay, silt, sand, and angular pebbles, cobbles, and boulders in Pahvant Range; includes lateral and other moraines and outwash on Sevier Plateau; probably late Wisconsin (Pinedale) in age; 0 to 200 feet (0-60 m) thick.
Qdf	Underflow-fan deposits--Thin-bedded to laminated, calcareous silt with minor interbedded very fine sand in thin beds; deposited in the Lake Bonneville delta of the Beaver River south of Borden; 0 to more than 30 feet (0-10+ m) thick.
Qdg	Deltaic sand and gravel--Silty, fine- to coarse-grained sand and gravel deposited by the Beaver River in Lake Bonneville and then distributed by waves and currents; 0 to 24 feet (0-7 m) thick.
Qlg	Lacustrine gravel--Silty, fine- to coarse-grained sand and gravel in shore zone deposits of Lake Bonneville; 0 to 30 feet (0-9 m) thick.
Qls	Lacustrine sand--Fine- to coarse-grained sand, marly sand, and pebbly sand deposited in shore zone of Lake Bonneville as beaches, spits, and offshore bars; 0 to 30 feet (0-9 m) thick.
Qlf	Fine-grained lacustrine deposits--Tan to light-gray, calcareous silts that are deep-water sediments of Lake Bonneville; locally includes younger alluvium; thickness probably 10 feet (3 m) or less.
Qll	Lacustrine lagoon deposits--Sand, silt, clay, and silty marl that accumulated in lagoons behind (landward from) gravel barrier beaches of Lake Bonneville; present south of Borden and east of Twin Peaks; locally includes younger alluvium; generally less than 10 feet (3 m) thick.
Qlm	Lacustrine marl--Fine-grained, thinly bedded to laminated, white to light-gray, offshore to deep-water marl deposited in Lake Bonneville; ostracodes are abundant throughout marl and, locally, gastropods are present at top and base of marl; 0 to 30 feet (0-9 m) thick. A layer of basaltic ash of Pahvant Butte is interbedded in the upper part of Qlm and is commonly 1 to 6 inches (2.5-15 cm) thick. This gray to black basaltic ash was blown into the atmosphere during a hydrovolcanic eruption when Lake Bonneville was near its highest level about 15,500 yr B.P.
Qla	Lacustrine and alluvial deposits, undifferentiated--Mixed and reworked gravelly lacustrine and alluvial deposits on piedmont slopes; grades from pebbly sand and silt to sandy pebble gravel; generally 0 to 12 feet (0-4 m) thick, but may be thicker locally.
Qvb$_1$	Basalt of Ice Springs--Contains 2 % phenocrysts and has a greater glass content than other lavas in the Black Rock Desert; estimated to be between 4,000 and 660 years old; may be as much as 200 feet (60 m) thick.
Qvb$_2$	Basalt of Tabernacle Hill--Fine-grained holocrystalline basalt with olivine and plagioclase in a groundmass made opaque by clinopyroxene aggregates formed by quenching of the lava during its eruption into Lake Bonneville; radiocarbon age 14,320 ± 90 yr B.P.; maximum thickness about 200 feet (60 m).
Qvb$_3$	Basalt of Pahvant Butte--Basalt flows of probable late and/or middle Pleistocene age; K-Ar dated as 0.031 to 0.22 Ma; 0 to about 100 feet (0-30 m) thick.
Qcg	Basaltic andesite of Cedar Grove--Dark-gray to black, porphyritic basaltic andesite with phenocrysts of plagioclase, clinopyroxene, hypersthene, magnetite, and olivine in a felted matrix; maximum thickness about 200 feet (60 m); age about 0.3 Ma.
Qvr$_4$	Rhyolite dome of White Mountain--Black obsidian and devitrified felsite with spherulites and lithophysae; about 120 feet (40 m) high; age about 0.4 Ma.
Qcf	Basaltic andesite of Cove Fort--Dark-gray to black, vesicular to dense basaltic andesite containing small phenocrysts of plagioclase, pyroxene, magnetite, olivine, and sparse corroded quartz in a felted to glassy matrix; age about 0.5 Ma; maximum thickness about 800 feet (250 m).
Qvrd	Rhyolite of Mineral Mountains, dome--Tan perlitic glassy dome, commonly pumiceous and brecciated and containing scattered black obsidian fragments; northernmost of several similar domes in the Mineral Mountains; age 0.54 Ma.
Qvrt	Rhyolite of Mineral Mountains, tuff--White to tan, poorly consolidated tuff vented from nearby rhyolite dome in Mineral Mountains; less than 100 feet (30 m) thick; probably same age as nearby rhyolite dome (Qvrd).
Qvb$_4$	Basalt of Kanosh--Red-weathering, vesicular basalt with large plagioclase phenocrysts and small phenocrysts of olivine and clinopyroxene in a microcrystalline matrix; age 0.67 Ma; locally stands as much as 300 feet (90 m) above the desert floor west of Kanosh.
Qvb$_4$	Basalt of Beaver Ridge--Consists of older flow series, dated at 0.9 Ma, of diabasic basalts about 80 feet (24 m) thick, and younger series, dated at 0.5 Ma, of similar composition but fine-grained to glassy, and about 120 feet (37 m) thick.
Qvb$_4$	Basalt of Mineral Mountains--Dark-gray, vesicular basalt that forms two spatter cones and flow remnants on northeast end of the Mineral Mountains; dated at 0.9 Ma; cone is about 200 feet (60 m) high.
Qrk	Basaltic andesite of Red Knoll--Dark-gray to black, dense to vesicular, porphyritic basaltic andesite to latite lava flow with a blocky scoriaceous surface; contains 30 to 45 % phenocrysts, mostly labradorite and pyroxene, in glassy to finely crystalline matrix; located southwest of Cove Fort and overlies basaltic andesite of Crater Knoll; vent lies a mile (1.6 km) south of map area; maximum thickness less than 200 feet (60 m).
Qck	Basaltic andesite of Crater Knoll--Dark-gray to black, porphyritic basaltic andesite lava flows similar to Qrk; 40 to 45 % phenocrysts, mostly labradorite and pyroxene; glassy to finely crystalline matrix, containing microlites of plagioclase, pyroxene, olivine(?), and opaque minerals; vent is 2 miles (3 km) south of map area southwest of Cove Fort; age 1.0 Ma; thickness in map area less than 100 feet (30 m).
Qvb$_5$	Basalt of Black Rock--Dark-gray, vesicular basalt composed of about 40% small zoned plagioclase phenocrysts, with lesser phenocrysts of clinopyroxene, olivine, and Fe-Ti oxides; age about 1.0-1.3 Ma; maximum thickness about 200 feet (60 m).
Qva$_5$	Andesite of Beaver Ridge--Dark-gray, crystal-poor andesite characterized by small microlites of resorbed quartz, plagioclase, and pyroxene crystals; age about 1.5 Ma; thickness about 200 feet (60 m).
QTlf	Fine-grained lacustrine deposits of Sevier Desert--Brown and light-olive-gray, calcareous, lacustrine silt and silty clay with minor sand; offshore to deep-water sediments; Pliocene to middle Pleistocene in age; 0 to 872 or more feet (0-255+ m) thick; contains sinkholes.
QTaf	Quaternary-Tertiary alluvial-fan deposits--Poorly sorted silt, sand, and gravel, including boulders, in Dog Valley, upper Cove Creek, and in northeast corner of map area; locally has a calcic soil with a stage IV carbonate morphology (so early Pleistocene age) near the top of the deposit; 0 to 300 feet (0-90 m), or more, thick.
Tvs	Tertiary volcanic and sedimentary units, undivided--On cross sections only; for included units see correlation chart and descriptions.
Tbm	Basaltic andesite of Burnt Mountain--Black to medium-gray, fine- to medium-grained, porphyritic, crystal-rich basaltic andesite with phenocrysts of labradorite, olivine, orthopyroxene, and clinopyroxene; map unit includes vent cone; age about 2.1 Ma; maximum thickness about 500 feet (150 m).
Trt	Rhyolite of North Twin Peak, South Twin Peak, and Mid-Dome--Light-brownish-gray rocks from these three rhyolite domes are of similar, but not identical, composition; phenocryst content from 3 to 30 % and includes plagioclase, quartz, sanidine, and biotite; groundmass is microcrystalline quartz, feldspar, Fe-Ti oxides, apatite, sphene, and zircon; age 2.35 to 2.5 Ma; thickness (exposed height) up to 1,000 feet (300 m).
Tcc	Basalt of Cove Creek--Dark-gray, olivine-tholeiite flow rock; map unit includes cone; age about 2.55 Ma; maximum thickness about 400 feet (120 m).
Ttl	Limestone of Twin Peaks--Light-gray to yellowish-gray lacustrine limestone and marlstone with thin interbeds of silt, sand, and pebble conglomerate; locally prone to slumping; maximum thickness 262 feet (80 m).
Tlr	Basalt of Lava Ridge--Dark-gray olivine-normative basaltic andesite; age about 2.2 to 2.5 Ma; maximum thickness about 200 feet (60 m).
Tcr	Rhyolite of Cudahy Mine--Interbedded black obsidian and light-gray felsite; felsite is devitrified and shows relict flow-layering, spherulites, and lithophysae; obsidian commonly shows "snowflake" clusters; age about 2.2 to 2.6 Ma; maximum thickness about 500 feet (150 m).
Tcr	Rhyodacite of Coyote Hills--Light-gray to medium-brownish-gray with less than 15 % phenocrysts of zoned plagioclase and sanidine in a microcrystalline matrix of plagioclase, quartz, sanidine, Fe-Ti oxides, and zircon; age about 2.7 Ma; maximum thickness about 650 feet (200 m).
Toc	Oak City Formation--Sandy, bouldery gravel; poorly to well cemented; forms dissected alluvial apron on west side of Pahvant Range; bed of Cudahy Mine pumice, K-Ar dated as 2.6 Ma, is within upper Oak City Formation in map area, so upper Pliocene and Miocene(?) age; base of formation not exposed; estimated thickness as much as 2,000 feet (600 m).
Tse	Sevier River Formation--In northeast corner of map area in Sevier County, light-gray, yellowish- or greenish-gray, poorly to moderately sorted mudstone, sandstone, conglomerate, and carbonaceous mudstone that is probably more than 600 feet (180 m) thick. South of Richfield in Sevier County, mostly moderately indurated, pale brownish- or reddish-gray sandstone, pebble to boulder conglomerate, mudstone, and siltstone of fluvial and, locally, lacustrine origin; volcanic clasts are common in south, decreasing northward; local interbedded tuffs and intertongued basalts yield K-Ar ages of 5.6 to 13.6 Ma; exposed thickness at least 330 feet (100 m), but total thickness may be up to 1,000 feet (300 m).
Tb	Basalt flows in northern Tushar Mountains--Dark-gray, black, and red, locally vesicular and amygdaloidal olivine basalt and basaltic andesite lava flows, flow breccia, and cinder cones, scoria, and ash; not isotopically dated within map area, but similar basalts K-Ar dated as at least 10.9 to 12.9 Ma, and other basalts are as young as 7.4 Ma; maximum thickness about 425 feet (130 m).
Trg	Rhyolite of Gillies Hill--Lava flows and domes of light-gray to white, flow-layered, dense to vesicular rhyolite; aphyric to porphyritic, with phenocrysts of plagioclase and biotite; located south-southwest of Cove Fort; age about 9 Ma; more than 1,000 feet (300 m) high.
Tht	Tuff of Holden--White tuff interbedded with pink to white, shaly siltstone, clay, grit, and gravel exposed east of Fillmore; age probably 10.5 to 10.8 Ma; may be as much as 200 feet (60 m) thick.
Trd	Rhyolite porphyry dikes--Speckled gray rock with about 10 % phenocrysts each of K-feldspar and quartz, and a trace to 3 % biotite in a matrix of granophyric intergrowths; age about 11-12 Ma; dikes cut granodiorite stock (Tgm) and quartz monzonite (Tqm) in Mineral Mountains.
TpꞒg	Intrusion and gneiss complex--Tertiary dikes and other intrusive bodies interleaved with Precambrian(?) gneisses; individual units cannot be shown at map scale; age of youngest dikes (Trd) 11 Ma; exposed on west side of Mineral Mountains.
Tdd	Microdiorite dikes--Thin, resistant, dark-green to black dikes with subdiabasic texture; contain plagioclase (andesine), hornblende, actinolite, and biotite, with minor K-feldspar, and 1 to 3 % each sphene, Fe-Ti oxides, apatite, orthopyroxene, and alteration minerals; cut granite dikes (Tgd) and quartz monzonite (Tqm) in Mineral Mountains, so less than 18 Ma.
Tgd	Granite dikes--Includes fine-grained, leucocratic, and biotite-rich varieties, listed youngest first from intrusive relations; contain about 54 % K-feldspar, 27 % quartz, 9 to 16 % plagioclase, and 3 to 7 % biotite; biotite-granite dikes are medium grained and older than the syenite (Tsm); dikes intrude Tqm in Mineral Mountains, so less than 18 Ma.
Tsm	Syenite of Mineral Mountains--Light-gray, coarse- to medium-grained syenite stock; weathers to grus; contains microcline, lesser plagioclase and quartz, minor biotite and sphene, and accessory Fe-Ti oxides, apatite, hornblende, and zircon; cut by most granite dikes, intrudes unit Tqm in Mineral Mountains, so less than 18 Ma.
Tqm	Quartz monzonite of Mineral Mountains--Speckled gray, biotite-rich, coarse-grained quartz monzonite that forms massive light-brownish-gray stock exposed extensively in the central Mineral Mountains south of the Millard County line; age about 18 Ma.
Tdm	Diorite of Mineral Mountains--Medium-grained, equigranular, biotite hornblende diorite; contains small apatite and sphene crystals; exposed on northwest flank of Mineral Mountains; age between 18 and 25 Ma based on intrusive relationships with Tqm and Tgm.

Mount Belknap Volcanics and related rocks--Derived from several volcanic centers, mostly located in the Tushar Mountains; site of uranium, molybdenum, and alunite mineral deposits; Mount Belknap caldera fill equivalent to Joe Lott Tuff Member of Mount Belknap Volcanics, which is caldera outflow; age 12 to 21 Ma; units described separately.

Tmd	Late rhyolite dikes, stocks, and domes--Moderately resistant, gray and pink, flow-foliated, crystal-poor, glassy to aphanitic, rhyolite dikes, small stocks, volcanic domes, and lava flows from scattered vents; age 14-19 Ma; domes as thick as 330 feet (100 m); includes rhyolite of Big Star of Cunningham and others (1983).
Tmr	Red Hills Tuff Member, Mount Belknap Volcanics--Reddish-brown to reddish-tan and light-gray, crystal-poor, densely welded, rhyolite ash-flow tuff; erupted from small Red Hills caldera just south of map area, about 3 miles (5 km) north of Marysvale; K-Ar age 18.9 Ma; maximum thickness about 600 feet (180 m).
Tmj	Joe Lott Tuff Member, Mount Belknap Volcanics--Light-gray or brownish-gray, crystal-poor, slightly to moderately welded, alkali-rhyolite ash-flow tuff containing 1 to 2 % phenocrysts of quartz, sodic plagioclase, sanidine, and a trace of biotite; outflow from Mount Belknap caldera, mostly south of map area; age about 19 Ma; thickness about 200 feet (60 m) near Cove Fort and as much as 400 feet (120 m) to east in Sevier County.
Tmb	Mount Baldy Rhyolite Member, Mount Belknap Volcanics--Resistant, light-gray, flow-foliated, crystal poor, rhyolite lava flows and dikes; consist mostly of fine-grained mosaic of quartz and alkali feldspar, with minor plagioclase, biotite, and hematite; deposited mostly within Mount Belknap caldera; age uncertain; maximum exposed thickness about 2,600 feet (800 m) is in caldera that is mostly south of map area.
Tmm	Middle tuff member--Light-gray and tan, poorly welded, crystal poor, intracaldera rhyolite ash-flow tuff; lithologically similar to, and, locally, continuous across Mount Belknap caldera margin into upper part of Joe Lott Tuff Member (19 Ma; Tmj); thickness to south up to about 1,640 feet (500 m), but thinner in map area.
Tmh	Lower heterogeneous member--Gray rhyolite volcanic domes, lava flows, and subordinate ash-flow tuff and fluvial volcanic sandstone; vent probably located just south of map area, northwest of Marysvale; about 230 feet (70 m) thick.
Tmf	Fine-grained granite--Resistant, gray and greenish-gray, fine-grained granite and granodiorite stock and associated dikes; cuts the Central intrusion (Tci), but is also within and may be a late phase of the Monroe Peak caldera; hosts uranium-bearing veins in Central mining area, just south of map area; age 20-21 Ma.
Tmi	Crystal-rich volcanic domes and plugs--Resistant, tan, pink, and gray, flow-foliated, crystal-rich rhyolitic domes and intrusive feeders for domes; commonly contain phenocrysts of sanidine, plagioclase, biotite, hornblende, quartz, and minor apatite, sphene, and magnetite in a devitrified or glassy matrix; present in southeast Antelope Range quadrangle; age about 21 Ma; maximum dome height about 820 feet (250 m).

Volcanics of Monroe Peak Caldera--Includes lava flows of varied composition, Osiris Tuff, intracaldera intrusions, airfall tuff, and fluvial and lacustrine sedimentary rocks deposited in Monroe Peak caldera after subsidence.

Tmpu	Intracaldera rocks, undivided--Mapped only where hydrothermal alteration precludes identification of individual units described below.
Tmpi	Intracaldera intrusions, undivided--Resistant, tan, light-gray, and light-green, monzonite porphyry and quartz monzonite porphyry intruded into late intracaldera deposits and the Osiris Tuff; age about 21-22 Ma.
Tci	Central intrusion--Resistant, gray and green, porphyritic to locally equigranular quartz monzonite to monzonite stock, with a fine-grained chilled margin; distinct from other intracaldera intrusions; age about 22 Ma.
Tmps	Sedimentary rocks--Mostly poorly resistant, tan, gray, yellow, brown, pink, and green, thin- to medium-bedded, fine- to coarse-grained tuffaceous sandstone and airfall tuff, with minor intertongued crystal-poor and crystal-rich lava flows, siltstone, and conglomerate; primarily fluvial but locally lacustrine deposits; commonly altered and silicified; maximum thickness 200 feet (60 m).
Tmpl	Lava flows of Monroe Peak--Mostly resistant, gray, pink, and dark-green, vesicular and amygdaloidal, generally crystal-rich rhyodacitic lava flows; includes minor crystal-poor lava flows, flow breccia, volcanic mudflow breccia, fluvial sandstone, and airfall tuff; K-Ar age 21.3 Ma; maximum exposed thickness 500 feet (150 m); includes dacite of Big Flat of Cunningham and others (1983).
Tmpa	Volcanic rocks of Sage Flat--Mostly resistant, medium- to dark-gray or black, crystal-poor, andesitic lava flows; includes minor volcanic mudflow breccia, and fluvial sandstone and conglomerate; about 200 feet (60 m) thick.
Tmpf	Lava flows of Monkey Flat Ridge--Moderately resistant, reddish-brown, gray and green, locally vesicular or amygdaloidal dacitic to rhyodacitic lava flows and minor fluvial sandstone and conglomerate; maximum exposed thickness 500 feet (150 m).
Tmpb	Lava flows of Bagley Meadows--Resistant, light- to medium-gray and pink, locally vesicular and amygdaloidal, locally flow-foliated, crystal-rich, dacitic lava flows or a volcanic dome; contains phenocrysts of plagioclase, pyroxene, sanidine, olivine, and Fe-Ti oxides; maximum thickness 650 feet (200 m).
Toi	Osiris Tuff, intracaldera facies--Soft to resistant, orange and tan, densely welded ash-flow tuff and lava flows(?); confined to source Monroe Peak caldera and includes caldera collapse breccia; similar to outflow facies but generally altered to clay by intracaldera intrusions (Tmpi, Tci); age about 23 Ma; thickness at least 1,150 feet (350 m), base not exposed.
To	Osiris Tuff, outflow facies--Resistant light-gray and reddish-brown, moderately crystal-rich, densely welded, rhyodacitic ash-flow tuff with drawn-out pumice fragments; contains one or two cooling units, commonly with basal black vitrophyres; outflow from Monroe Peak caldera in southeast part of map area; age 23 Ma; maximum thickness about 200 feet (60 m).
Tisg	Syenite of Cedar Grove--Medium to coarse-grained, porphyritic to equigranular rock containing mostly orthoclase and plagioclase, lesser hornblende and pyroxene, and sparse biotite; cuts gabbro porphyry (Tigp); age 23 Ma.
Tigp	Gabbro porphyry of Cedar Grove--Dark-gray, strongly porphyritic gabbro with phenocrysts of labradorite and clinopyroxene in a felted matrix of plagioclase microlites and Fe-Ti-oxide grains; cuts and alters Bullion Canyon Volcanics (Tbc) southwest of Cove Fort.
Tgm	Granodiorite of Mineral Mountains--Speckled gray, medium-grained, equigranular, locally foliated rock composed of plagioclase, K-feldspar, quartz, hornblende, biotite, and trace minerals; stock weathers to gray, sandy grus; age about 25 Ma.
Tzt	Zeolite tuff--Soft, white, partially welded, crystal-poor, rhyolitic ash-flow tuff; contains 10 to 30 % lithic fragments; matrix altered to the zeolite mineral clinoptilolite; may correlate with 24.6 Ma (corrected) Leach Canyon Formation; exposed near Cove Fort where it overlies the tuff of Albinus Canyon and intertongues with Bullion Canyon Volcanics; about 400 feet (120 m) thick.
Tsg	Volcanic rocks of Signal Peak--Gray, black, brown, reddish-brown, and red, mostly crystal-poor, andesitic lava flows and flow breccia, and lesser volcanic mudflow breccia, densely welded ash-flow tuff, and conglomerate; overlies tuff of Albinus Canyon northeast of Annabella; vent facies rocks and lesser alluvial-fan facies rocks erupted from shield volcano complex in northern Sevier Plateau; as much as 2,100 feet (650 m) thick.
Taa	Basaltic andesite, Antimony Tuff, and tuff of Albinus Canyon, undivided--Only used in hills southeast of town of Joseph where individual units (Tba, Tda, Tac) cannot be separated.
Tba	Basaltic andesite lava flows--Resistant, dark-gray and black, locally vesicular and amygdaloidal, crystal-poor, basaltic andesite lava flows; exposed in southeast Pahvant Range; intertongued with Antimony Tuff and tuff of Albinus Canyon; may be part of unit Tsg with vents east of Sevier Valley; maximum thickness about 500 feet (150 m).
Tda	Antimony Tuff Member, Mount Dutton Formation--Resistant, mostly red, densely welded, crystal-poor, trachytic ash-flow tuff; contains medium-grained phenocrysts of plagioclase, sanidine, and minor pyroxene and Fe-Ti oxides, and drawn-out pumice lenticules; interlayered with volcanic rocks of Signal Peak; K-Ar age 25.4 Ma; maximum thickness 200 feet (60 m).
Tac	Tuff of Albinus Canyon--Red to gray, crystal-poor, densely welded, trachytic ash-flow tuff; contains few phenocrysts; flow structures and lineate vesicles are characteristic; has several thin cooling units, locally separated by thin beds of volcanic mudflow breccia, conglomerate, and sandstone in map area; lithologically similar to overlying Antimony Tuff Member of the Mount Dutton Formation; age 25.3 Ma; maximum thickness about 650 feet (200 m).
Tcp	Crystal-poor dacitic lava flows--Moderately resistant, light-gray, light- to medium-green, and light-reddish-gray, locally vesicular or amygdaloidal, aphanitic dacitic lava flows and red volcanic mudflow breccia; exposed northeast of Annabella underlying tuff of Albinus Canyon and overlying Three Creeks Tuff; 100 to 160 feet (30-50 m) thick.
Tbc	**Bullion Canyon Volcanics**--Widely distributed, heterogeneous, varicolored, volcanic mudflow breccia, lava flows, flow breccia, ash-flow tuff, and fluvial volcanic conglomerate and sandstone; erupted and eroded from several clustered stratovolcanoes; lava flows are mostly crystal-rich dacite with some fine-grained, crystal-poor, black andesite, as well as rhyodacite and quartz latite lava flows; age at least 30 to 22 Ma; maximum thickness at least 5,000 feet (1,500 m) in Sevier County.
Tbci	Monzonitic/latitic intrusions in Bullion Canyon Volcanics--Dark- to light-gray, tan, and brown, crystal-rich monzonite and quartz monzonite and strongly porphyritic latite and quartz latite in small plutons and plugs; probably solidified magma sources of other rocks in the Bullion Canyon Volcanics; ages cluster about 23 Ma; near Cove Fort intrusions cut Three Creeks Tuff (27 Ma) and are unconformably overlain by Osiris Tuff (23 Ma).
Tm	Metamorphosed rock--Calc-silicate hornfels and quartzite at contact with quartz monzonite of unit Tbci (age about 23 Ma); thought to be metamorphosed Toroweap Formation (Lower Permian), interbedded dolomite, limestone, and sandstone.
Tbct	Three Creeks Tuff Member, Bullion Canyon Volcanics--Resistant, light-gray to light-brown, crystal-rich, moderately to densely welded, dacitic ash-flow tuff containing 40 to 60 % phenocrysts, mostly plagioclase, with lesser hornblende, biotite, and quartz, and traces of sanidine and Fe-Ti oxides; erupted from caldera north of I-15 and east of Cove Fort; age 27 Ma; maximum thickness about 720 feet (220 m).
Tql	Quartz-latite volcanic dome and rhyodacite flow--Resistant, gray, crystal-rich, quartz latite volcanic dome and overlying dark-gray, crystal-poor, rhyodacitic lava flow in Joseph Peak quadrangle; age uncertain; maximum thickness about 650 feet (200 m).
Tw	Volcanic rocks of Wales Canyon--Moderately resistant, red, moderately crystal-rich, intermediate-composition lava flows and densely welded ash-flow tuff; exposed near Cove Fort; overlies volcanic rocks of Dog Valley and locally intertongues with Three Creeks Tuff on north margin of Marysvale volcanic field; about 440 feet (135 m) thick. Locally resembles Wah Wah Springs Formation.
Tdt	Tuff of Dog Valley - Mostly resistant, gray, tan and pink, crystal-rich, moderately welded, dacitic, ash-flow tuff; exposed near Cove Fort and on the north flank of the Marysvale volcanic field; locally interlayered with volcanic rocks of Dog Valley; looks like tuff of Wah Wah Springs Formation and Three Creeks Tuff; Ar/Ar age 33.6 Ma; maximum thickness about 400 feet (120 m).
Tdv	Volcanic rocks of Dog Valley--Heterogeneous assemblage of andesitic to dacitic rocks including lava flows, volcanic mudflow breccias, and minor moderately welded ash-flow tuff similar to some in the Needles Range Group, but here recognized as tuff of Dog Valley; age about 33 Ma; maximum thickness up to 1,200 feet (370 m).
Tov	Older volcanic rocks--Poorly to moderately resistant, light-gray, light- to dark-green, brown, and red volcanic mudflow breccia and subordinate lava flows; flows and clasts are dacitic; exposed in northeast Annabella quadrangle, underlying Three Creeks Tuff and overlying Aurora Formation; lower part may be lateral equivalent of upper Dipping Vat; 660 feet (200 m) thick.
Tdvt	Dipping Vat Formation--Poorly cemented, light-gray to pale-bluish-gray, volcaniclastic sandstone, conglomerate, and reworked volcanic tuff; conglomerate beds are poorly sorted and include clasts of welded tuffs, quartzite, limestone, and dolomite up to boulder size; younger than 35 Ma and older than overlying 27 Ma Three Creeks Tuff; maximum thickness in map area about 600 feet (180 m).
Tau	Aurora Formation--Mostly poorly resistant, pale-gray, reddish-, and yellowish-gray, bentonitic siltstone and claystone, with beds of thin- to medium-bedded, medium-gray limestone, fine-grained sandstone, and pebble to cobble conglomerate; contains upwardly increasing amounts of fine-grained rhyolitic ash and reworked volcanic detritus; coarsens to southwest; 38 to 40 Ma age implies volcanic source in west-central Utah; maximum thickness about 1,200 feet (360 m) southeast of Kanosh thinning to 550 feet (170 m) near Richfield, and to less than 200 feet (60 m) near Cove Fort.
Tch	Crazy Hollow Formation--Mostly moderately resistant, brownish-orange to brownish-red, very thin- to thin-planar-bedded, fine-grained sandstone, siltstone, and mudstone; contains 25 % interbeds of pale-grayish-orange, lenticular, channel sandstone; black chert pebbles in few thin conglomerate lenses are diagnostic for formation; 350 feet (107 m) thick west of Richfield, thinning to zero a short distance to southwest.
Tg	Green River Formation--Yellowish-gray to pale-brown, cherty, algal, and oolitic limestone and dolomite, calcareous, fine-grained sandstone, and greenish-gray shale; about 800 feet (245 m) partial thickness exposed in northeast map area and thins to absence southwest of Richfield.
Tf	Flagstaff Formation--Interbedded pinkish-weathering, freshwater limestone, sandstone, siltstone, mudstone, and conglomerate; typically bioturbated; in southwestern Pahvant Range conglomerate is dominant lithology exposed and strata may grade into upper North Horn Formation; 300 to 585 feet (90-190 m) thick in Cricket Mountains; maximum thickness in Pahvant Range is about 3,500 feet (1,070 m), thinning to nothing east of Dog Valley in southern Pahvant Range. In most of Pahvant Range divided into six informal members described below:
Tfuw	Upper white member - Pale-gray, pale-purplish-gray or pale-yellowish-gray, calcareous mudstone, siltstone and sandstone, and sandy limestone; less resistant than other Flagstaff members, forms a broad slope with a few ledges; commonly covered by rubble from overlying formations; 170 to 185 feet (51-56 m) thick.
Tfur	Upper red member - Interbedded dark-reddish-brown, calcareous mudstone, siltstone, and sandstone, and local conglomerate; forms a distinct red, ledgy slope with local cliffs; less than 50 to at least 162 feet (15-49+ m) thick; thins to northeast.
Tfmw	Middle white member - Interbedded pale-gray, pale-yellowish-gray or pale-pinkish-gray, calcareous sandstone, sandy limestone, and limestone cliffs and ledges, with minor sandy mudstone slopes; lower part mostly gypsiferous mudstone that grades to southwest into mostly limestone and sandstone; 515 to 580 feet (157-177 m) thick.
Tfmr	Middle red member - Interbedded reddish-brown sandstone, siltstone, and mudstone; minor conglomerate beds contain mostly quartzite and carbonate clasts less than 6 inches (15 cm) in diameter; forms cliffs and ledges typically 10 to 50 feet (3-15 m) high separated by steep slopes; about 600 feet (180 m) thick.
Tflw	Lower white member - Interbedded pale-gray to pale-reddish-gray, calcareous sandstone, sandy limestone, and pale-purplish-gray, silty to sandy mudstone; white, clayey limestone beds, locally as thick as 150 feet (45 m) cap the member; less resistant calcareous mudstone, siltstone and sandstone beds comprise middle part; resistant, blocky limestone beds in lower part are up to 200 feet (60 m) thick; total thickness 0 to about 700 feet (0-215 m), thinning to southwest.
Tflr	Lower red member - Interbedded reddish sandstone, siltstone, mudstone, conglomerate; forms cliffs and steep slopes; less than 200 feet (60 m) thick in southwesternmost exposures to about 1,300 feet (400 m) east of Kanosh to about 600 feet (180 m) thick on Pahvant Range crest east of Fillmore.
Tbr	Breccia of Cat Canyon--Coarse, recemented breccia of gray, Cambrian carbonate rocks in Cricket Mountains; likely an indurated talus or rubble, rather than of tectonic origin; as much as 165 feet (50 m) thick.
TKn	North Horn Formation--Predominantly yellowish-gray sandstone with interbeds of siltstone, mudstone, conglomerate, and limestone; as much as about 2,500 feet (760 m) thick in Pahvant Range east of Fillmore, but absent from about Meadow Creek southward; either thins rapidly to south or grades into lower red member of Flagstaff Formation.
Kcg	Conglomerate of Mineral Mountains--Pebble-cobble conglomerate of limestone, quartzite, sandstone, and chert clasts in a sandy limestone matrix where it rests on Cambrian rocks; similar conglomerate present beneath overthrust Cambrian quartzite; may be Tertiary where it rests on other Cambrian rocks; about 110 feet (33 m) thick.
Kc	Canyon Range Conglomerate--Massive, reddish-gray conglomerate with interbedded sandstone lenses; present locally beneath North Horn Formation in the central Pahvant Range and southwest of Kanosh; rests unconformably on Paleozoic strata; maximum exposed thickness about 850 feet (260 m).

PAVANT THRUST FOOTWALL, PAHVANT RANGE

Ktm	Tectonic melange beneath Pavant thrust plate--Mixture of rocks from Triassic and upper Paleozoic strata that were dragged along beneath the thrust plate; thickness up to 200 feet (60 m), or more locally.
Jn	Navajo Sandstone--Reddish-brown, fine-grained, cross-bedded, cliff-forming sandstone; exposed thickness about 2,000 feet (600 m).
Ꞧ	Triassic strata, undivided--On cross sections only; for included units see correlation chart and descriptions.
Ꞧcu	Chinle Formation, Upper Member--Interbedded, varicolored sandstone, siltstone, mudstone, and shale; prone to slump; thickness 69 to 274 feet (21-83 m).
Ꞧcs	Chinle Formation, Shinarump Conglomerate Member--Interbedded quartzite pebble conglomerate and white to brown, coarse sandstone that contains petrified wood; thickness 177 to 566 feet (54-172 m).
Ꞧm	Moenkopi Formation--Interbedded brownish-red sandstone, siltstone, shale, and gray limestone; minor cross-beds, mud cracks, and ripple marks are common; fossil brachiopods and ammonoids abundant locally; maximum thickness 1,876 feet (572 m).
P	Permian strata, undivided--On cross sections only; for included units see correlation chart and descriptions.
Pk	Kaibab Limestone--Gray, medium-crystalline, medium-bedded, dolomitic limestone; locally sandy and contains abundant brown chert; thickness in map area 497 (subsurface) to 1,160 feet (152-353 m); lower third of this map unit is likely Toroweap Formation equivalent.
Pq	Queantoweap Sandstone--Pinkish- or light-brownish-gray, fine-grained, cross-bedded sandstone; locally poorly cemented; thickness 817 feet (249 m).
Ppk	Pakoon Dolomite--Medium- to light-gray, sandy dolomite characterized by small, white calcite blebs; basal 50 feet (15 m) is a chert pebble conglomerate; thickness 445 feet (136 m).
IPM	Pennsylvanian and Mississippian strata, undivided--On cross sections only; for included units in footwall see correlation chart and descriptions.
IPc	Callville Limestone--Medium- to light-gray, fine- to medium-bedded, medium- to thick-bedded, cherty limestone and dolomite with a few thin pinkish-gray sandstone beds; thickness 538 feet (164 m).
Mr	Redwall Limestone--Upper third is interbedded calcareous sandstone, limestone, and dolomite; middle part is gray, cherty, fossiliferous limestone; basal one-quarter is medium-gray interbedded dolomite and limestone; thickness 1,545 feet (471 m).
D	Devonian strata, undivided--On cross sections only; for included units in footwall see correlation chart and descriptions.
Dc	Cove Fort Quartzite--Yellowish-gray, medium-grained quartzite with thin interbeds of dolomitic quartzite in middle third; forms prominent ledges; thickness 82 to 160 feet (25-49 m).
Dg	Guilmette Formation--Dark-gray, medium-grained, medium-bedded dolomite with a few interbeds of brown-weathering quartzite; thickness 575 feet (175 m).
Ds	Simonson Dolomite--Light-brownish-gray, medium- to coarse-grained, thin-bedded dolomite; thickness 185 feet (56 m).
Dsy	Sevy Dolomite--Very-light-gray, fine-grained, medium-bedded, clayey dolomite; rare fossil fish fragments found in Sevy strata in Dog Valley quadrangle; thickness 710 feet (217 m).
SO	Silurian and Upper Ordovician strata, undivided--On cross sections only; for included units see correlation chart and descriptions.
SOu	Laketown and Fish Haven Dolomites, undivided--Dark-gray, cherty dolomite with stromatolites and rugose corals; thickness 566-1,000 feet (173-300 m).
O	Middle and Lower Ordovician strata, undivided--On cross sections only; for included units see correlation chart and descriptions.
Oe	Eureka Quartzite--Light-pinkish-gray, vitreous quartzite with thin-bedded fucoidal sandstone and shale in lower half; forms ledges; thickness 150 to 180 feet (45-55 m).
Op	Pogonip Group--Medium-gray, medium- to thin-bedded limestone and intraformational conglomerate, locally cherty or fine sandy; upper 89 feet (27 m) includes interbeds of olive shale that contains orthid brachiopods; total thickness 1,125 feet (343 m).
Ꞓu	Upper Cambrian strata, undivided--On cross sections only; for included units see correlation chart; may also include Middle Cambrian strata.
Ꞓa	Ajax(?) Dolomite--Highly fractured, nondescript dolomite exposed in Baker Canyon; likely part of Ajax Dolomite.

PAVANT THRUST SHEET

SOu	Laketown and Fish Haven Dolomites, undivided--Interbedded light-gray and medium dark-gray to brownish-gray, medium- to thick-bedded dolomite; brown chert bands in middle of exposed strata, so Laketown may or may not be exposed; incomplete 200 foot (60 m) thickness exposed in upper Corn Creek Canyon.
Oe	Eureka Quartzite--Light-colored, medium-bedded, vitreous quartzite with lower half thinner bedded quartzite, sandstone, and dark, fissile shale; 172 feet (52 m) thick in upper Corn Creek Canyon.
Op	Pogonip Group--Fossiliferous, interbedded shale and limestone at top; underlain by medium-gray, thin- to medium-bedded limestone, with intraformational conglomerate and sparse chert, and thin shale interbeds; 1,200+ feet (350+ m) thick in upper Corn Creek Canyon.
Ꞓa	Ajax Dolomite--Dark-gray, massive dolomite with a few interbeds of light-gray dolomite and bluish-gray limestone with "algal" stromatolites; thickness about 700 feet (210 m) in upper Corn Creek Canyon.
Ꞓox	Opex Formation--Medium-gray, medium-bedded, bioclastic limestone with a few thin interbeds of dolomite and shale; contains *Tricrepicephalus* trilobites; thickness 390 feet (120 m) in upper Corn Creek Canyon.
Ꞓum	Upper and Middle Cambrian carbonate rocks, undivided--Includes: strata between Opex and Ophir Formations in upper Corn Creek Canyon, strata between the Ajax and Ophir on the north margin of map area, and may include all Cambrian strata above the Ophir Formation in thicker exposures between these two areas and on cross sections. Only includes Middle Cambrian strata above the Ophir southwest of Kanosh. These carbonate rocks are unfossiliferous and mostly dolomites that range from light- to dark-gray, laminated to massive, and include bioturbated, mottled dolomite and limestone beds; the carbonates are generally medium-bedded to massive and generally form cliffs except where tectonically brecciated; thickness up to about 2,400 feet (735 m).
Ꞓop	Ophir Formation--Upper part is medium- to thick-bedded limestone with some shale interbeds, uppermost of which bears *Ehmaniella* trilobites; basal third is phyllitic quartzite, shale, and thin-bedded limestone bearing *Glossopleura* trilobites; both parts form slope-ledge topography; thickness about 850 feet (260 m).
Ꞓt	Tintic Quartzite--White to brownish-orange-weathering, vitreous quartzite, with a few quartzite pebble conglomerate beds; commonly sheared and fractured; estimated thickness 3,300 feet (1,000 m).

CAMBRIAN STRATA IN THE CRICKET AND MINERAL MOUNTAINS

Ꞓu	Upper Cambrian strata, undivided--On cross sections only; for included units see correlation chart and descriptions.
OꞒn	Notch Peak Formation--Medium-dark-gray, massive limestone; only basal 100 feet (30 m) preserved in map area.
Ꞓou	Orr Formation, upper members, undivided--In descending order, the following members constitute this combined unit: Sneakover Limestone Member, 100 feet (30 m) thick; Corset Spring Shale Member, 40 feet (12 m) thick; Johns Wash Limestone Member, 100 feet (30 m) thick; and Candland Shale Member, 165 feet (50 m) thick.
Ꞓob	Orr Formation, Big Horse Limestone Member--Pinkish- to dark-gray limestone with dolomitic "algal" stromatolites and boundstone in the middle; bioclastic beds contain *Crepicephalus* trilobites; thickness 656 feet (200 m).
Ꞓm	Middle Cambrian strata, undivided--On cross sections only; for included units see correlation chart and descriptions.
Ꞓwt	Wah Wah Summit Formation and Trippe Limestone, undivided--Wah Wah Summit Formation includes a white dolomite and limestone sequence that makes up the upper third of the formation, and a dark-gray, ledge- and cliff-forming, carbonate sequence below; thickness 575 to 640 feet (175-195 m). Trippe Limestone includes the Fish Springs Shale Member, about 100 feet (30 m) thick, beneath which the lower member consists of alternating dark-gray, ledge-forming limestone, and light-gray, laminated, slope-forming, dolomitic boundstone, 660 to 760 feet (200-230 m) thick. Combined map unit about 1,420 feet (433 m) thick; structurally thinned and identification uncertain in Mineral Mountains.
Ꞓcm	Limestone of Cricket Mountains--Interbedded, dark-gray limestone, brownish-gray dolomitic limestone, and light-gray, laminated, dolomitic boundstone; forms cliffs and ledges; thickness 1,970 feet (600 m).
Ꞓw	Whirlwind Formation-Light-olive-gray shale interbedded with thin-bedded, nodular limestone bearing coquinas of the trilobite *Ehmaniella*; forms recessive slopes; thickness 200 to 265 feet (60-80 m).
Ꞓdh	Dome-Chisholm-Howell Formations, undivided--Listed from top downward. Dome Limestone is gray, massive, forms cliffs, and is 230 to 330 feet (70-100 m) thick. Chisholm Formation consists of lower and upper shales, bearing the trilobite *Glossopleura*, separated by dark-gray, oncolitic limestone; 165 to 265 feet (50-80 m) thick. Howell Limestone forms cliffs that are light-gray in the upper third and dark-gray below; thickness about 300 to 360 feet (90-110 m). Peasley Limestone is lateral equivalent of Chisholm in Mineral Mountains, where entire map unit is structurally thinned.
Ꞓl	Lower Cambrian strata, undivided--On cross sections only; for included units see correlation chart and descriptions.
Ꞓp	Pioche Formation--Mostly interbedded dark-brown quartzite and dark-greenish-gray, phyllitic siltstone characterized by abundant trace fossils; upper tenth includes beds of orange-weathering dolomite; thickness about 800 feet (245 m).
Ꞓpm	Prospect Mountain Quartzite--Grayish-pink, vitreous quartzite ranging from very fine- to coarse-grained with some thin, quartzite-pebble conglomerate beds; forms ledges and cliffs; at least 4,000 feet (1,200 m) thick.
pꞒg	Banded gneiss--Light bands are composed of quartz and K-feldspar with minor biotite and plagioclase; dark bands are mostly biotite, plagioclase, and quartz with minor hornblende and K-feldspar; accessory minerals are apatite and rounded zircon; present in Mineral Mountains; age 1,750 Ma.