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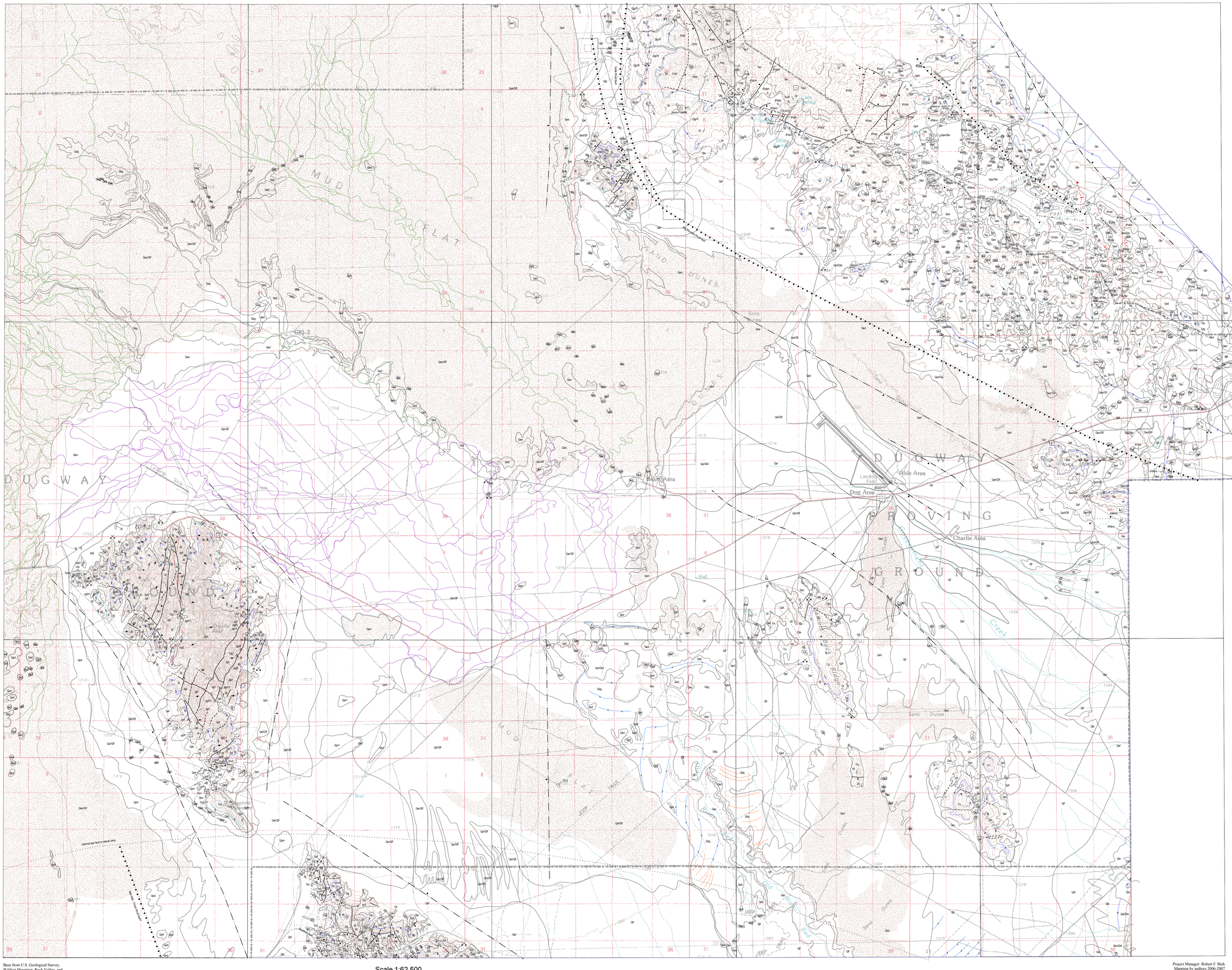

Base from U.S. Geological Survey,
Wildcat Mountain, Rush Valley, and
Fish Springs Quadrangles, Utah

North American Datum of 1927 (NAD27).

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Scale 1:62,500

2 1 0 2 4 6 Miles

3 1.5 0 3 6 9 Kilometers

Progress Report Geologic Map of Dugway Proving Ground and Adjacent Areas, Parts of the Wildcat Mountain, Rush Valley, and Fish Springs 30' x 60' Quadrangles, Tooele County, Utah (Year 1 of 2)

by

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UTAH GEOLOGICAL SURVEY
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Plate 3
Utah Geological Survey Open-File Report 501
Progress Report Geologic Map of Dugway Proving Ground and Adjacent Areas,
Parts of the Wildcat Mountain, Rush Valley, and Fish Springs 30'x60' Quadrangles,
Tooele County, Utah (Year 1 of 2)

Table 2. Major- and trace-element whole-rock analyses for Dugway Proving Ground and adjacent areas.

Map Number	Sample #	Map Unit	Rock Name	7.5' Quadrangle	Latitude (N)	Longitude (W)
Trd2	GP081605-1a	Trd	Rhyolite dike	Granite Peak	40°07'23"	113°17'14"
Trd3	GP081605-10a	Trd	Rhyolite dike	Granite Peak	40°10'03"	113°17'06"
Trd1	GP081605-6b	Trd	Rhyolite dike	Granite Peak	40°07'44"	113°17'04"
Trs1	GP071405-11	Trs	Rhyolite flow	Granite Peak SE	40°03'55.4"	113°16'18.5"
Trs2	GP102605-4	Trs	Rhyolite flow	Granite Peak SE	40°03'40.9"	113°16'14.6"
Trs3	GP102605-5	Trs	Rhyolite flow	Granite Peak SE	40°03'41.3"	113°15'32.2"
*Trr1	D-47	Trr	Rhyolite	Tabbys Peak	40°26'18.0"	112°56'57.2"
*Trr2	D-48	Trr	Rhyolite	Tabbys Peak	40°25'10.8"	112°58'38.3"
*Trr3	D-49	Trr	Rhyolite	Tabbys Peak	40°22'38.1"	112°57'38.9"
*Trr4	D-51	Trr	Rhyolite	Tabbys Peak	40°23'11.7"	112°57'13.1"
Tdd1	GP080905-3	Tdd	Latite dike	Granite Peak SE	40°07'09"	113°15'20"
Tdd2	GP081005-12	Tdd	Dacite dike	Granite Peak	40°09'01"	113°20'15'
Tdd3	GP081005-9	Tdd	Dacite dike	Granite Peak	40°09'17"	113°20'06"
Tac1	D-7	Tac	Andesite	Wig Mountain	40°21'37.8"	113°00'04.0'
Tac6	D-9	Tac	Dacite	Wig Mountain	40°22'03.5'	113°00'11.9"
Tac7	D-10	Tac	Andesite	Tabbys Peak SW	40°21'33.4"	112°59'42.4"
Tac8	D-12	Tac	Andesite	Tabbys Peak SW	40°20'12.9"	112°58'21.1"
Tac2	D-15	Tac	Dacite	Tabbys Peak SW	40°20'33.7"	112°58'07.7"
Tac3	D-17	Tac	Andesite	Tabbys Peak SW	40°18'39.6"	112°56'36.3"
Tac9	D-19	Tac	Dacite	Tabbys Peak SW	40°19'01.9"	112°56'32.6"
Tac10	D-20	Tac	Andesite	Tabbys Peak SW	40°19'05.1"	112°56'26.7"
Tac11	D-21	Tac	Dacite	Tabbys Peak SW	40°19'06.1"	112°56'23.8"
Tac4	D-25	Tac	Andesite	Tabbys Peak SW	40°16'13.7"	112°56'23.9"
Tac12	D-31	Tac	Andesite	Tabbys Peak SW	40°16'11.5"	112°52'39.7"
Tac13	D-32	Tac	Andesite	Tabbys Peak SW	40°16'06.8"	112°53'04.2"
Tac14	D-37	Tac	Dacite	Camels Back Ridge NE	40°13'40.9"	112°48'36.5"
Tac15	D-38	Tac	Andesite	Tabbys Peak SE	40°15'04.8"	112°46'02.3"
*Tac5	D-42	Tac	Andesite	Wig Mountain NE	40°26'55.3"	113°01'57.8"
*Tac16	D-44	Tac	Dacite	Wig Mountain NE	40°27'21.0"	113°00'49.0"
*Tac17	D-46	Tac	Andesite	Tabbys Peak	40°27'58.0"	112°54'25.1"
Tai1	D-6	Tai	Andesite	Wig Mountain	40°20'03.3"	113°01'42.2"
*Tai2	D-40	Tai	Andesite	Tabbys Peak	40°27'47.7"	112°59'13.8"
*Tai3	D-59	Tai	Andesite	Wig Mountain NE	40°23'21.6"	113°01'11.5"
Tdi1	FM083105-1	Tdi	Dacite	Camels Back Ridge NE	40°12'08"	112°50'16"
Tdi2	D-4	Tdi	Dacite	Tabbys Peak SW	40°19'17.9"	112°54'01.1"
Tti1	D-2	Tti	Trachyte	Dugway Proving Ground SW	40°00'31.8"	113°12'41.9"
Tti2	D-3	Tti	Tephriphonolite	Dugway Proving Ground SW	40°00'35.9"	113°12'47.9"
Jgd2	GP102605-2	Jgd	Monzodiorite	Granite Peak SE	40°04'37.1"	113°15'51.5"
Jgd1	GP102605-3	Jgd	Monzonite	Granite Peak SE	40°05'16.2"	113°16'45.9"
Jgd3	GP080405-7a	Jgd	Granodiorite	Granite Peak	40°07'54"	113°15'06"
Jgd4	GP080905-1a	Jgd	Monzonite	Granite Peak SE	40°07'17"	113°15'13"
Jgd5	GP080905-4	Jgd	Quartz Monzonite	Granite Peak SE	40°06'56"	113°15'16"
Jgd6	GP081005-10	Jgd	Granodiorite	Granite Peak	40°08'00"	113°18'53"
Jgd7	GP081105-10	Jgd	Monzonite	Granite Peak SE	40°04'53"	113°15'39'
Jgd8	GP081105-2	Jgd	Diorite	Granite Peak SE	40°04'37"	113°15'48"
Jgd9	GP081105-7	Jgd	Monzodiorite	Granite Peak SE	40°04'49"	113°15'55"
Jgd10	GP081505-2a	Jgd	Granodiorite	Granite Peak SE	40°06'04"	113°16'00"
Jgd11	GP081605-5a	Jgd	Monzonite	Granite Peak	40°07'44"	113°17'04"
Jgd12	GP081805-2	Jgd	Quartz Monzonite	Granite Peak	40°07'48"	113°18'01"
Jgd13	GP081505-1b	Jgd	Granodiorite porphyry	Granite Peak SE	40°06'22"	113°15'50"
Jg3	GP080405-2a	Jg	Granite	Granite Peak	40°08'04"	113°15'12"
Jg4	GP080405-8	Jg	Granite	Granite Peak	40°08'13"	113°15'00"
Jg2	GP081005-13a	Jg	Granite	Granite Peak	40°09'58.2"	113°15'56.2"
Jg5	GP081005-1b	Jg	Granite	Granite Peak	40°08'34"	113°18'17"
Jg6	GP081005-4	Jg	Granite	Granite Peak	40°08'38"	113°18'34"
Jg7	GP081005-5b	Jg	Granite	Granite Peak	40°08'47"	113°18'45"
Jg8	GP081705-2b	Jg	Granite	Granite Peak	40°09'30"	113°16'56"
Jg9	GP080405-6b	Jg	Granite porphyry	Granite Peak	40°07'55"	113°15'07"
Jg10	GP081005-8a	Jg	Granite porphyry	Granite Peak	40°08'57"	113°19'54"
Jg1	GP081605-9	Jg	Granite porphyry	Granite Peak	40°07'40"	113°18'23"
Jgu1	GP081805-1	Jgu	Granite dike in Jgd	Granite Peak	40°07'46"	113°17'59"
Jgdx1	GP081005-7	Jgd	xenolith in Jgd	Granite Peak	40°08'35"	113°19'42"
Jgx1	GP081005-6	Jg	quartz dike in Jg	Granite Peak	40°08'47"	113°18'45"
Jgx2	GP081005-3b	Jg	aplite dike in Jg	Granite Peak	40°08'34"	113°18'17"
Jgx3	GP080405-6a	Jg	schistose lenses in Jg	Granite Peak	40°07'55"	113°15'07"
Jgx4	GP081005-8b	Jg	xenolith in Jg	Granite Peak	40°08'57"	113°19'54"
Zm1	GP081805-3	Zm	schist	Granite Peak SE	40°04'31"	113°16'03"
Zm2	GP081105-4b	Zm	schist	Granite Peak SE	40°04'38"	113°15'42"

Map Number	SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	Na_2O	K_2O	Cr_2O_3	TiO_2	MnO	P_2O_5	SrO	BaO	LOI	Total
Trd2	72.31	14.75	1.77	1.6	0.4	3.64	4.38	0.01	0.21	0.05	0.06	0.03	0.15	0.68	100.05
Trd3	69.01	13.19	3.52	0.75	0.55	0.9	8.8	<0.01	0.63	0.05	0.12	0.02	0.19	1.64	99.38
Trd1	75.23	12.07	1.14	0.64	0.1	0.56	8.75	<0.01	0.17	0.02	0.02	0.01	0.06	1.32	100.1
Trs1	69.95	13.18	3.46	1.14	0.11	1.34	8.51	<0.01	0.71	0.04	0.17	0.02	0.2	1.06	99.88
Trs2	72.48	10.53	2.74	1.53	0.64	0.76	7.48	<0.01	0.58	0.07	0.11	0.02	0.21	1.9	99.04
Trs3	73.05	11.42	2.59	0.84	0.23	1.06	7.56	<0.01	0.59	0.08	0.15	0.01	0.14	0.9	98.62
*Trr1	68.97	14.05	1.31	2.04	0.37	2.74	3.98	<0.01	0.1	0.03	0.03	0.04	0.16	4.57	98.38
*Trr2	67.55	14.38	2.96	2.61	0.89	3.18	4.45	<0.01	0.36	0.03	0.14	0.05	0.16	1.84	98.6
*Trr3	68.18	14.87	2.12	2.2	1.02	3.18	3.78	<0.01	0.43	0.01	0.17	0.06	0.18	2.25	98.46
*Trr4	75.73	14.96	0.61	0.71	0.16	0.06	0.05	<0.01	0.45	<0.01	0.14	0.01	0.08	6.43	99.37
Tdd1	56.56	16.94	8.61	3.54	3.08	3.48	3.23	<0.01	1.26	0.11	0.52	0.09	0.22	2.24	99.87
Tdd2	62.41	15.13	5.39	4.8	3.54	3.22	3.04	0.02	0.64	0.1	0.17	0.05	0.1	1.37	99.97
Tdd3	61.93	14.85	5.51	4.96	3.94	3.11	3.02	0.02	0.66	0.09	0.16	0.05	0.11	1.45	99.87
Tac1	60.25	15.15	6.58	5.22	3.45	2.93	3.12	0.03	0.76	0.08	0.19	0.05	0.14	1.4	99.35
Tac6	60.99	16.4	4.86	4.71	2.79	3	2.13	<0.01	0.52	0.07	0.1	0.05	0.1	4.15	99.88
Tac7	59.97	16.24	6.19	4.83	1.78	2.95	3.62	<0.01	0.84	0.08	0.25	0.06	0.15	2.06	99.01
Tac8	59	16.41	7.34	6.22	3.86	2.66	2.24	0.01	0.81	0.11	0.19	0.03	0.1	1.02	100
Tac2	62.68	15.82	5.65	4.27	1.68	2.81	3.87	<0.01	0.76	0.07	0.25	0.05	0.15	1.54	99.6
Tac3	60.15	15.85	6.89	5.05	2.96	2.73	3.62	0.01	0.94	0.1	0.29	0.05	0.16	1.18	99.98
Tac9	63.54	15.71	5.77	4	1.88	2.85	3.69	0.01	0.66	0.06	0.22	0.05	0.15	1.49	100.1
Tac10	61.8	16.34	5.8	4.44	2.09	2.82	3.8	0.01	0.71	0.08	0.24	0.05	0.16	1.49	99.83
Tac11	61.21	16.03	5.69	4.26	1.71	3	3.64	<0.01	0.67	0.06	0.23	0.06	0.16	1.92	98.64
Tac4	61.01	15.33	6.25	4.56	2.79	2.78	3.72	0.01	0.75	0.09	0.24	0.05	0.15	1.69	99.42
Tac12	60.04	14.74	6.5	4.89	3.44	2.55	3.47	0.01	0.76	0.09	0.25	0.05	0.16	2.38	99.33
Tac13	58.71	15.13	7.55	5.36	4.21	2.24	3.43	0.02	0.99	0.11	0.29	0.05	0.13	1.2	99.42
Tac14	63.03	14.6	6.32	4.11	3.1	2.83	3.46	0.01	0.64	0.08	0.21	0.05	0.18	1.25	99.87
Tac15	60.56	14.88	7.2	4.63	3.31	2.52	3.59	0.02	0.85	0.08	0.26	0.05	0.15	1.34	99.43
*Tac5	59.59	16.58	6.96	6.01	3.3	2.84	2.12	0.01	0.77	0.1	0.17	0.03	0.11	1.1	99.69
*Tac16	63.88	15.69	4.31	5.12	1.12	3.34	2.64	<0.01	0.44	0.07	0.12	0.04	0.12	2.83	99.72
*Tac17	61.24	16.09	5.63	4.67	2.64	3.32	2.75	0.01	0.88	0.07	0.24	0.05	0.15	2.26	100
Tai1	61.19	16.71	6.26	5.36	2.72	3.07	2.41	<0.01	0.69	0.1	0.15	0.03	0.1	1.15	99.94
*Tai2	59.96	16.84	6.8	5.89	3.25	2.84	2.34	<0.01	0.77	0.1	0.18	0.04	0.09	0.96	100.05
*Tai3	60.34	17.24	6.15	5.51	2.12	3.03	2.34	<0.01	0.74	0.1	0.2	0.04	0.1	1.71	99.61
Tdi1	67.9	15.29	3.62	2.69	1.44	3.55	3.6	<0.01	0.5	0.05	0.18	0.06	0.19	0.91	99.99
Tdi2	63.46	14.65	3.7	3.51	1.95	3.34	3.73	0.01	0.53	0.05	0.18	0.07	0.17	3.15	98.5
Tti1	58.07	15.6	4.52	2.66	1.26	0.49	11.39	0.04	1.11	0.13	0.34	0.01	0.25	4.04	99.91
Tti2	46.22	12.17	6.85	10.29	2.38	0.21	8.62	0.08	0.73	0.47	0.18	0.02	0.23	10.3	98.76
Jgd2	53.32	13.83	7.31	8.11	5.79	1.99	5.05	0.01	0.94	0.15	0.73	0.07	0.25	1.34	98.91
Jgd1	61.76	15.98	5.34	3.72	2.05	3.55	3.79	<0.01	0.8	0.08	0.61	0.08	0.17	1.18	99.13
Jgd3	63.21	16.48	5.08	3.52	2.22	3.84	2.72	<0.01	0.77	0.09	0.51	0.09	0.14	1.38	100.05
Jgd4	61.24	16.32	5.26	4.18	2.32	3.62	3.57	0.08	0.96	0.09	0.63	0.1	0.18	1.11	99.66
Jgd5	64.53	16.13	4.45	3.34	1.68	3.92	3.17	<0.01	0.71	0.1	0.5	0.08	0.15	1.18	99.95
Jgd6	61.04	15.44	4.72	3.86	2.95	2.34	4.19	0.01	0.67	0.11	0.42	0.05	0.15	3.79	99.73
Jgd7	59.68	15.11	5.41	5.68	4.34	3.4	3.68	0.02	0.79	0.09	0.49	0.08	0.13	1.12	100
Jgd8	56.35	15.09	7.39	6.96	4.59	2.92	2.2	<0.01	1.2	0.09	0.72	0.1	0.13	2.15	99.91
Jgd9	53.85	13.64	6.88	8.81	6.55	2.52	3.76	0.01	1.08	0.1	0.92	0.15	0.19	1.13	99.6
Jgd10	67.95	15.08	3.62	2.03	1.3	3.32	3.96	<0.01	0.57	0.1	0.34	0.04	0.1	1.45	99.85
Jgd11	58.42	16.59	5.52	4.19	2.55	3.78	4.78	<0.01	0.87	0.11	0.61	0.1	0.22	2.02	99.75
Jgd12	61.97	16.02	4.78	3.75	2.12	4.33	3.33	<0.01	0.83	0.1	0.58	0.08	0.14	1.89	99.93
Jgd13	67.29	15.22	3.4	2.87	1.13	3.44	4.33	<0.01	0.56	0.06	0.35	0.07	0.14	0.97	99.82
Jg3	73.53	14.58	1.26	0.86	0.23	2.66	5.02	<0.01	0.23	0.02	0.16	0.03	0.06	1.04	99.67
Jg4	73.12	15.09	1.24	1.18	0.17	3.47	4.67	0.01	0.14	0.01	0.1	0.02	0.04	0.73	100
Jg2	74.13	14.78	0.88	0.38	0.14	2.59	4.98	<0.01	0.21	0.01	0.09	0.01	0.02	1.1	99.31
Jg5	72.15	14.89	1.56	1.05	0.28	3.16	5.14	<0.01	0.22	0.02	0.19	0.02	0.05	0.81	99.54
Jg6	73.77	14.71	1.02	0.93	0.15	3.28	4.45	<0.01	0.15	0.03	0.2	0.02	0.02	1.08	99.82
Jg7	75.05	14.32	0.94	0.86	0.1	3.81	3.75	<0.01	0.06	0.03	0.19	0.01	0.01	0.99	100.15
Jg8	73.16	14.33	1.1	1.08	0.13	3.45	4.91	<0.01	0.2	0.02	0.13	0.01	0.04	1.06	99.62
Jg9	68.44	15.61	3.46	1.91	0.66	3.48	4.09	<0.01	0.45	0.05	0.37	0.05	0.09	0.89	99.56
Jg10	67.62	15.46	3.23	2.32	0.95	3.35	4.76	<0.01	0.6	0.07	0.32	0.06	0.11	1.08	99.92
Jg1	71.57	14.31	2.81	2	0.74	3.61	3.34	<0.01	0.49	0.06	0.26	0.06	0.07	0.58	99.89
Jgu1	72.65	15.34	1.12	1.06	0.14	3.57	4.23	<0.01	0.15	0.03	0.16	0.02	0.02	1.06	99.53
Jgdx1	57.73	15.84	6.64	4.87	3.45	2.53	3.5	0.01	0.8	0.09	0.17	0.03	0.09	4.34	100.1
Jgx1	95.23	0.98	0.99	0.41	0.01	0.15	0.46	0.03	<0.01	<0.01	0.01	<0.01	0.01	0.45	98.74
Jgx2	70.63	15.28	4.02	0.66	0.06	4.76	1.89	0.02	0.07	1.44	0.14	0.01	0.01	0.71	99.69
Jgx3	60.15	16.33	7.07	2.75	2.42	3.59	2.47	0.01	1.45	0.12	0.82	0.04	0.06	2.52	99.8
Jgx4	51	18.68	9.78	3.96	3.7	3.33	4.76	<0.01	1.65	0.22	1.65	0.04	0.05	1.28	100.1
Zm1	51.61	15.08	7.88	8.03	7.23	3.26	2.35	0.05	1.25	0.14	0.72	0.09	0.12	1.7	99.49
Zm2	54.58	21.05	9.2	0.56	2.9	1.12	3.77	0.02	1.17	0.17	0.08	0.03	0.12	5.12	99.89

Map Number	Ag	Ba	Ce	Co	Cr	Cs	Cu	Dy	Er	Eu	Ga	Gd	Hf	Ho	La	Lu
Trd2	<1	1335	27.3	2.7	90	2.2	25	3.4	2.2	0.8	21	3	3	0.7	15	0.3
Trd3	<1	1925	193	3.2	50	0.7	<5	7.9	4.9	1.8	17	10.7	8	1.6	100.5	0.7
Trd1	<1	662	70	1.4	50	2.4	5	6.7	5	0.5	18	5.8	6	1.5	34.6	0.9
Trs1	<1	2110	214	3.8	60	3.4	6	7.8	4.6	1.9	19	10.3	10	1.5	110.5	0.7
Trs2	<1	1855	150.5	3.3	50	2.5	<5	6	3.5	1.7	15	8.1	8	1.2	78.6	0.5
Trs3	<1	1230	177	4.3	100	3.4	<5	6.6	3.8	1.7	16	9.3	8	1.3	92.8	0.6
*Trr1	<1	1490	72.2	0.6	<10	3	<5	2.47	1.63	1.06	17.6	3.76	4.2	0.49	41.6	0.26
*Trr2	<1	1305	45.7	6.5	40	4.42	16	2.43	1.49	0.95	16.2	3.26	4.3	0.48	25.9	0.21
*Trr3	<1	1625	88.9	4.7	30	3.17	10	2.04	1.12	1.23	21.2	4.18	5.7	0.35	50.4	0.14
*Trr4	<1	678	89.6	2.1	30	1.29	12	1.88	1.01	1.08	20.7	4.09	5.5	0.33	51	0.13
Tdd1	<1	2410	166.5	18.8	30	10.8	<5	7.1	3.6	2.6	25	9.9	9	1.3	86.3	0.5
Tdd2	<1	1325	82.8	18.2	200	5.3	15	3.9	2.2	1.3	22	4.8	5	0.7	45.4	0.3
Tdd3	<1	1240	79.9	18.4	200	4.3	20	3.9	2.2	1.1	22	4.6	6	0.7	43.3	0.4
Tac1	<1	1225	78.9	19.7	220	3.42	28	4.54	2.46	1.48	17.9	5.58	5.1	0.85	44.3	0.35
Tac6	<1	940	51.5	12.9	80	1.62	10	4.78	2.62	1.32	19.4	4.83	4.3	0.86	32.1	0.36
Tac7	<1	1245	79.9	12.9	20	1.59	10	4.61	2.54	1.71	21.1	5.96	5.8	0.87	45	0.37
Tac8	<1	863	81.4	20.3	130	3.08	18	5.34	3.15	1.65	20.3	6.26	6.3	1.06	43.2	0.45
Tac2	<1	1325	86.7	14.7	50	4.49	12	3.79	2.68	1.44	22.6	5.73	6.7	0.88	48.8	0.36
Tac3	<1	1395	92.2	23.3	140	4.9	20	4.54	2.98	1.67	24.2	6.66	7.3	0.97	49.2	0.39
Tac9	<1	1350	88.4	14.2	70	4.7	18	3.85	2.71	1.48	23	5.84	6.7	0.89	50.2	0.38
Tac10	<1	1350	86.9	13.2	70	5.51	8	3.64	2.56	1.41	21.7	5.6	6.2	0.85	47.7	0.36
Tac11	<1	1420	85.8	13.3	60	4.11	17	3.54	2.46	1.46	21.5	5.63	6.3	0.82	48.9	0.34
Tac4	<1	1255	87.9	16.4	130	3.9	22	3.91	2.79	1.48	19.8	5.84	6.6	0.91	47.6	0.38
Tac12	<1	1245	85.5	20.7	170	4.7	32	3.72	2.73	1.39	20.6	6.03	6.6	0.9	47.8	0.37
Tac13	<1	1100	88.3	27.1	220	3.82	32	4.35	3.03	1.58	20.7	6.48	6.8	1.01	46.8	0.41
Tac14	<1	1375	78.1	20	140	4.17	30	2.56	2.06	1.25	20	4.9	5.5	0.69	44.4	0.25
Tac15	<1	1140	82.1	18.5	160	4.85	25	3.81	2.66	1.45	19.6	5.78	6.1	0.91	44.3	0.32
*Tac5	<1	870	85.2	20.6	100	1.99	16	5.18	3.77	1.5	21.1	6.42	7	1.24	45.7	0.53
*Tac16	<1	978	50.7	10.5	20	0.78	5	2.95	2.36	1.01	19.4	3.95	4.4	0.75	28.5	0.32
*Tac17	<1	1215	120	18.8	100	2.29	27	2.86	1.98	1.49	20.9	6.19	6.9	0.64	66.6	0.21
Tai1	<1	852	76.9	15.4	40	3.61	13	5.32	2.94	1.54	18.7	5.72	5.7	0.95	41.6	0.41
*Tai2	<1	740	75.1	19.6	40	2.3	16	3.87	2.89	1.34	20.2	5.35	5.7	0.95	41	0.39
*Tai3	<1	828	91.7	11.8	10	2.92	11	5.15	3.11	1.43	20.5	6.37	6.4	1	49.4	0.47
Tdi1	<1	1775	108.5	8.7	70	2.5	8	3	1.7	1.5	20	4.9	6	0.6	61.6	0.2
Tdi2	<1	1505	115	10.6	110	6.3	15	3.43	1.9	1.49	18.7	5.58	5.8	0.6	64.9	0.24
Tti1	<1	2070	124.5	15.8	300	2.15	42	5.63	3.05	2.2	15.7	7.78	7.4	1.01	66.6	0.4
Tti2	<1	2000	95.3	28	540	1.48	7	4.54	2.29	1.65	14.8	6.32	5.6	0.81	53.3	0.28
Jgd2	<1	2600	256	28	200	7.9	6	8.4	4	3.6	18	15.6	8	1.5	128	0.5
Jgd1	<1	1605	250	13.8	80	8.4	9	5.4	2.7	2.9	21	10.4	7	1	142	0.3
Jgd3	<1	1590	207	13.4	70	7.3	<5	4.6	2.3	2.1	23	8.6	6	0.8	113.5	0.3
Jgd4	<1	1935	281	14.4	50	7.4	7	6.4	3.1	2.9	22	11.8	7	1.1	152.5	0.4
Jgd5	<1	1650	264	9.9	50	11.2	<5	5	2.5	2.4	23	9.7	7	0.9	150.5	0.4
Jgd6	<1	1680	215	14.4	100	25.5	13	5.1	2.4	2.3	23	9.4	6	0.8	117.5	0.3
Jgd7	<1	1310	169.5	18.8	190	5.1	17	5	2.6	2.4	18	9.7	6	0.9	96.7	0.3
Jgd8	<1	1210	192.5	24.1	70	10	32	6.9	3.3	3.3	19	13	4	1.2	100	0.4
Jgd9	<1	2110	265	31	180	4	64	7.1	3.3	4	18	16	4	1.2	134.5	0.3
Jgd10	<1	973	165	8.5	50	15.4	<5	3.7	2	1.7	20	7.4	5	0.7	103.5	0.3
Jgd11	<1	2140	256	14	60	11.4	5	9.3	4.7	4.3	21	16.2	6	1.7	137.5	0.5
Jgd12	<1	1295	226	12.1	50	9.8	13	4.8	2.6	2.6	20	10.2	6	0.9	135	0.3
Jgd13	<1	1385	179.5	6.2	50	4.5	<5	4.1	2.3	2	20	7.9	5	0.7	111	0.3
Jg3	<1	503	63.2	1.4	60	3.7	<5	2.4	0.9	1.6	21	3.6	3	0.4	34.3	0.1
Jg4	<1	380	99.7	1.4	70	3	<5	4.3	2.1	1.5	19	5.3	5	0.8	56.3	0.3
Jg2	<1	266	59.2	0.7	50	3.5	<5	3.4	1.8	0.8	35	3.7	3	0.6	32.6	0.3
Jg5	<1	702	66.7	1.4	60	4.9	<5	3	1.5	1	25	3.5	4	0.5	35.7	0.2
Jg6	<1	192.5	15.6	0.8	60	5.3	<5	2.4	1.2	0.7	19	1.7	2	0.4	8.3	0.2
Jg7	<1	169.5	13.9	0.6	60	7.7	<5	1.8	1	0.6	18	1.2	1	0.3	8.1	0.2
Jg8	<1	292	54.7	0.9	50	4.6	<5	2.7	1.3	0.7	22	3.7	2	0.4	32.7	0.1
Jg9	<1	960	191	3.8	60	5.6	<5	5.6	3	1.7	25	7.6	7	1	108.5	0.4
Jg10	<1	1325	187.5	5.7	60	9.5	<5	3.1	1.5	1.6	24	6.7	7	0.5	106	0.2
Jg1	<1	766	172.5	4	60	7.1	<5	3.8	2	1.7	21	7.6	5	0.6	102.5	0.2
Jgu1	<1	99.8	11.4	0.8	70	3.9	15	2.2	1.2	0.6	17	1.2	1	0.4	6.7	0.1
Jgdx1	<1	1005	86.8	18.8	90	31.2	14	4.8	2.9	1.3	21	5.4	6	1	45.8	0.5
Jgx1	5	29.9	1.5	0.9	210	0.6	19	0.1	0.1	0.1	2	0.1	<1	<0.1	1.3	<0.1
Jgx2	<1	25.3	8	0.9	180	3.6	<5	6.1	3.6	0.1	26	1.3	5	1.2	4.9	0.7
Jgx3	<1	645	358	9.8	80	5	<5	7.5	3.6	2.9	27	14.4	11	1.2	188.5	0.5
Jgx4	<1	517	506	22.6	20	56.1	90	13	6.1	4.1	37	21.7	12	2.3	278	0.7
Zm1	<1	1325	218	31.9	410	2	17	5.9	2.9	3.3	21	12.2	7	1	124	0.3
Zm2	<1	1125	123.5	33.1	180	8.1	40	10.2	7.1	1.9	26	10.1	5	2.2	67.4	1

Map Number	Mo	Nb	Nd	Ni	Pb	Pr	Rb	Sm	Sn	Sr	Ta	Tb	Th	Tl	Tm	U	V	W	Y	Yb	Zn	Zr
Trd2	<2	25	12.2	7	45	3.3	176.5	2.8	6	234	1.9	0.5	6	<0.5	0.3	4.9	21	3	20.8	2.2	55	94.4
Trd3	3	32	69.7	<5	9	20.9	301	10.8	<1	130.5	1.8	1.4	27	<0.5	0.7	6.5	30	3	43.3	4.6	61	336
Trd1	2	44	27.9	<5	31	8.4	472	5.7	8	87.7	3.4	1	51	0.6	0.9	15	9	6	41.9	6.2	29	167.5
Trs1	4	35	79.3	7	48	22.8	402	12.8	3	174.5	1.6	1.4	24	1.1	0.6	4.6	42	8	46.7	4.4	54	376
Trs2	3	25	55	<5	28	16.2	362	8.8	3	178	1.4	1.1	21	<0.5	0.5	5	33	2	34.4	3.4	41	268
Trs3	3	28	64	<5	30	19.2	325	10.3	3	130.5	1.6	1.2	24	0.8	0.5	4.6	35	3	36.4	3.7	94	285
*Trr1	<2	14	23.9	<5	28	7.26	130	3.83	1	304	1	0.48	17.2	<0.5	0.23	3.72	8	5	14.7	1.73	39	130
*Trr2	<2	11.4	18.9	7	25	5.18	135.5	3.52	1	409	0.8	0.46	12.7	0.5	0.2	3.1	45	1	13.9	1.48	41	142
*Trr3	<2	18.1	30.9	9	32	9.12	161.5	4.63	2	568	1.5	0.48	22.8	0.6	0.14	6.04	57	3	9.7	1.03	40	192
*Trr4	<2	17.4	30.9	5	12	9.26	3.9	4.61	2	26.2	1.4	0.44	23.5	<0.5	0.12	9.82	42	6	9.2	0.95	18	184
Tdd1	<2	23	70.4	8	20	18.8	147.5	12.4	6	838	1	1.4	15	0.6	0.5	2.4	161	4	40.1	3	138	369
Tdd2	<2	22	31.3	38	27	8.7	130.5	5.7	5	458	1.7	0.7	14	0.5	0.3	5.1	124	3	23.5	2	71	171.5
Tdd3	<2	22	31.3	36	21	8.5	134	5.6	8	440	1.7	0.7	13	0.6	0.3	4.3	126	4	24	2.2	74	207
Tac1	<2	16.4	32.7	50	21	9.17	103	5.74	2	417	1.4	0.79	15.95	<0.5	0.33	4.58	115	3	21	2.2	71	174
Tac6	<2	9.7	26.2	11	22	7	65.1	4.86	1	441	0.7	0.73	7.25	<0.5	0.36	1.62	96	1	21.8	2.35	68	144
Tac7	<2	13.5	34.4	<5	19	9.55	120	6.18	1	515	0.9	0.84	13.95	<0.5	0.37	2.95	135	2	23.8	2.44	82	214
Tac8	3	17.2	34.1	14	17	9.55	80.2	6.19	2	300	1.2	0.91	11.6	<0.5	0.46	2.89	154	2	27.5	2.85	85	232
Tac2	2	20.8	36.5	11	26	10.15	152	6.53	3	473	1.7	0.83	19.4	0.5	0.39	5.74	133	5	27.6	2.53	73	259
Tac3	4	20.2	40.5	18	26	10.9	143.5	7.18	3	545	1.5	0.93	17.2	0.5	0.45	4.61	188	4	30.3	2.77	96	271
Tac9	2	19.7	36.5	15	29	10.15	145	6.55	3	464	1.7	0.85	19.95	0.6	0.4	5.77	113	5	27.5	2.49	74	261
Tac10	3	17.1	35.4	7	27	9.84	135.5	6.21	3	490	1.6	0.82	18	0.5	0.38	4.83	122	29	25.5	2.45	74	240
Tac11	2	17.1	35.1	15	28	9.81	122.5	6.25	2	524	1.3	0.78	18.05	<0.5	0.37	4.74	104	5	25.7	2.46	75	236
Tac4	2	19.2	37	19	25	10.05	136	6.39	3	440	1.4	0.84	17.75	<0.5	0.43	4.52	127	4	27.9	2.65	70	257
Tac12	2	19.1	36.5	35	24	10.05	135	6.37	3	479	1.4	0.87	18	<0.5	0.41	4.77	144	3	28.7	2.61	78	257
Tac13	3	18.6	38.2	38	21	10.35	121	6.93	2	466	1.2	0.93	16.6	<0.5	0.44	3.73	183	3	31.8	2.91	84	265
Tac14	3	14.1	32.1	32	25	8.79	133	5.49	2	438	1	0.68	19.4	0.5	0.29	4.72	117	4	21.4	2.01	68	222
Tac15	2	17.3	36	22	24	9.59	138	6.44	2	460	1.2	0.83	16.35	0.5	0.37	4.18	165	3	27.4	2.54	72	246
*Tac5	2	19.4	35.4	10	19	9.98	75.8	6.83	2	318	1.2	1.03	14.7	<0.5	0.55	3.05	153	3	37.3	3.48	90	274
*Tac16	<2	11.4	22.3	5	20	5.98	74.8	3.96	1	384	0.8	0.62	9.08	<0.5	0.35	2.33	51	5	24.5	2.36	49	168
*Tac17	3	23.7	45.7	44	25	13.25	105	6.99	2	482	1.6	0.78	28.1	<0.5	0.26	5.04	100	3	19.8	1.6	82	266
Tai1	2	19.9	31.1	7	21	9.01	93.9	5.74	3	295	1.6	0.85	12.95	<0.5	0.41	4.71	128	2	25	2.76	80	201
*Tai2	2	20.1	30.9	11	19	8.51	84.9	5.45	3	347	1.3	0.81	14.35	<0.5	0.41	3.65	152	3	28.2	2.69	74	219
*Tai3	2	22.5	36.8	<5	20	10.4	85.7	6.48	2	349	1.5	0.89	14.25	<0.5	0.43	3.88	110	3	27.4	3.09	89	250
Tdi1	<2	15	37.3	14	49	11.2	127.5	5.7	2	634	1.1	0.6	21	<0.5	0.2	3.4	67	1	16.7	1.5	59	198
Tdi2	2	18	42	31	33	12.6	144	6.36	2	574	1.8	0.68	26.6	<0.5	0.24	9.13	67	2	15.7	1.62	63	193
Tti1	<2	17.7	49.8	76	101	14.3	503	8.4	2	141.5	1	1.06	19.9	<0.5	0.41	4.21	107	7	27.5	2.68	332	272
Tti2	<2	13.7	39.8	181	13	11.45	368	6.68	1	245	0.8	0.83	14.2	1.3	0.32	2.19	107	6	20.3	1.97	93	203
Jgd2	2	51	110	68	29	30.5	224	18.8	6	764	2.4	1.8	19	<0.5	0.5	6.7	198	1	41.9	3.3	85	316
Jgd1	3	85	87.1	11	25	26.2	178	12.6	5	848	4.9	1.2	39	<0.5	0.3	9.5	112	1	28	2.4	60	278
Jgd3	2	76	74.3	18	18	21.7	196.5	11.2	7	824	3.4	1	25	0.5	0.3	8.5	98	4	25.3	1.9	80	276
Jgd4	6	106	102	14	37	29.6	189.5	15.2	7	1005	4.5	1.4	34	0.5	0.4	8.6	111	2	33.9	2.5	73	325
Jgd5	2	120	86.1	8	22	26.2	234	12	9	767	5.8	1.1	35	0.6	0.3	4.7	79	2	28.4	2.2	75	317
Jgd6	2	63	78.5	34	20	22.6	455	11.9	11	549	3.1	1.1	34	1.3	0.3	8.5	109	8	27.5	2.2	76	229
Jgd7	<2	44	69.7	66	24	19.8	141.5	10.9	4	717	2.2	1.1	21	<0.5	0.3	4.5	118	2	24.2	2.2	67	281
Jgd8	2	46	90.6	26	91	24.1	142.5	15.2	7	872	2.2	1.5	18	<0.5	0.4	4.1	218	3	31.7	2.7	84	172.5
Jgd9	2	33	123	86	21	33.4	147.5	19.2	2	1315	1.7	1.7	26	<0.5	0.4	4.9	215	3	31.9	2.4	72	150
Jgd10	<2	81	56.2	9	16	17.7	293	8	10	363	4.3	0.8	42	0.5	0.3	7.9	68	4	19.1	1.7	78	205
Jgd11	2	98	114.5	16	24	31.7	219	19	9	864	5.2	2	28	<0.5	0.6	7.2	118	4	44.8	3.7	83	297
Jgd12	5	86	82.6	13	19	25.1	186.5	11.4	15	667	5.2	1.1	31	<0.5	0.3	10.2	101	5	24.7	2.1	80	284
Jgd13	2	99	63.1	5	30	20	181	8.8	6	572	6.3	0.9	46	<0.5	0.3	8.1	50	3	21.3	2.1	47	232
Jg3	<2	40	21.6	5	63	6.6	265	4.1	9	257	3.3	0.5	15	0.7	0.1	3.7	8	4	12.4	0.8	49	105
Jg4	3	36	31.8	12	53	9.9	236	6	5	192.5	1.3	0.8	21	0.7	0.3	5.1	5	3	25.8	1.7	51	182
Jg2	<2	112	19.8	<5	33	6.1	331	4.1	22	81.7	4.6	0.6	17	0.7	0.3	3.7	11	8	22.6	1.8	21	91.2
Jg5	<2	70	22.3	<5	46	6.9	312	4.2	3	222	3	0.5	19	0.8	0.2	9.6	13	4	17.9	1.5	73	148
Jg6	<2	31	5.6	<5	60	1.7	294	1.5	9	140.5	4.3	0.4	3	0.6	0.2	1.5	8	3	16.2	1.1	64	55.7
Jg7	3	29	5	<5	89	1.5	276	1.2	9	109.5	2.8	0.3	3	0.8	0.2	1.4	6	3	12.5	1.1	104	39.9
Jg8	<2	62	19.6	<5	35	6.1	306	3.9	9	93	4.6	0.5	18	<0.5	0.2	3.3	5	5	14.1	1.1	55	78.2
Jg9	<2	79	59.1	6	30	18.8	266	8.6	22	420	3	1	39	0.8	0.4	7.6	28	3	34.8	2.6	85	315
Jg10	2	63	59.3	5	33	18.6	263	8.1	7	561	1.1	0.7	40	0.6	0.2	10.4	46	42	18	1.2	57	274
Jg1	2	76	58.3	<5	26	18.6	179.5	8.4	10	454	3.5	0.8	36	<0.5	0.2	4.4	33	3	18.8	1.6	54	253
Jgu1	2	27	4.3	<5	62	1.2	236	1	9	104.5	3.2	0.3	3	<0.5	0.2	1.9	5	3	14.2	1.1	56	35.2
Jgdx1	<2	20	35.2	13	23	9.5	282	6.7	6	339	1.1	0.8	12	0.8	0.4	3	158	4	29.3	2.8	85	240
Jgx1	2	2	0.6	5	128	0.2	31.2	0.1	7	10.5	<0.5	<0.1	<1	<0.5	<0.1	2.4	<5	3	1.5	0.1	84	13.6
Jgx2	4	83	2.4	5	19	0.8	203	0.8	17	27	17	0.6	6	<0.5	0.7	6.9	6	4	54.4	4.8	75	99.8
Jgx3	<2	174	129	17	32	38.2	197	18.4	17	416	6.4	1.6	34	0.6	0.5	5.3	90	10	39.8	3	128	537
Jgx4	3	196	173.5	6	36	51.8	860	25	23	429	3.6	2.7	56	2.6	0.8	6.6	147	4	73.2	4.3	219	561
Zm1	2	59	91.6	120	31	26	90.1	14.2	6	813	2.8	1.3	19	<0.5	0.3	2.5	176	2	26.9	2.1	204	346
Zm2	3	20	56.8	114	13	15.4	170	10.2	4	212	1.2	1.6	25	<0.5	1	2.7	189	4	61.5	7	128	186

Notes:
Major oxides reported in weight percent by x-ray fluorescence (XRF); minor and trace elements reported in ppm by inductively coupled plasma-mass spectrometry (ICP-MS).
All analyses performed by ALS Chemex Labs, Inc., Sparks, NV
Rock names using total alkali-silica diagram of LeBas and others (1986).
LOI is loss on ignition.
Location data based on NAD27.
* Not on year 1 map

Table 1. Ages and elevations of major shorelines of Lake Bonneville in Dugway Proving Ground and adjacent areas.

Lake Cycle and Phase	Shoreline (map symbol)	Age: radiocarbon years B.P.	Age: calendar years B.P.[1]	Elevation feet (meters)
Lake Bonneville				
Transgressive Phase	Stansbury (S)	22,000-20,000[2]	24,400-23,200	4450-4480 (1357-1366)
	Bonneville (B) — flood	15,500-14,500[3]	18,000-16,800	5220-5262 (1591-1604)
Regressive Phase	Provo (P)	14,500-12,000[4]	16,800-13,500[5]	4860-4880 (1482-1488)
	Gilbert	11,000-10,000[6]	12,800-11,600	Not exposed

[1]Calendar-calibrated ages of most shorelines have not been published. Calendar-calibrated ages shown here, except for the age of the end of the Provo shoreline, are from D.R. Currey, University of Utah (written communication to Utah Geological Survey, 1996; cal yr B.P. = 1.16 ^{14}C yr B.P.).
[2]Oviatt and others (1990); Currey (written communication to Utah Geological Survey, 1996, assumed a maximum age for the Stansbury shoreline of 21,000 ^{14}C yr B.P., which is used in the conversion to calendar years).
[3]Oviatt and others (1992), Oviatt (1997).
[4]Godsey and others (2005) revised the timing of the occupation of the Provo shoreline and subsequent regression; Oviatt and others (1992) and Oviatt (1997) proposed a range from 14,500 to 14,000 ^{14}C yr B.P. Oviatt and Thompson (2002) summarized many recent changes in the interpretation of the Lake Bonneville radiocarbon chronology.
[5]Calendar-calibrated age of the end of the Provo shoreline estimated by interpolation from data in Godsey and others (2005), table 1, who used Stuiver and Reimer (1993) for calibration.
[6]Murchison (1989), figure 20.

Table 3. Summary of U-Pb zircon age analyses from Granite Mountain.

Map Number	Sample Number	Map Unit	Rock Name	7.5' Quadrangle	Latitude (N)	Longitude (W)	Weighted Average $^{238}U/^{206}Pb$ Age Mean (Ma)
Jgd1	GP102605-3	Jgd	Granodiorite	Granite Peak	40°05'16.2"	113°16'45.9"	149.8±1.3
Jg1	GP081605-9	Jg	Granite porphyry	Granite Peak	40°07'40"	113°18'23"	148.8±1.3
Zm1	GP081805-3	Zm	Schist	Granite Peak	40°04'31"	113°16'03"	149.9±3.9*

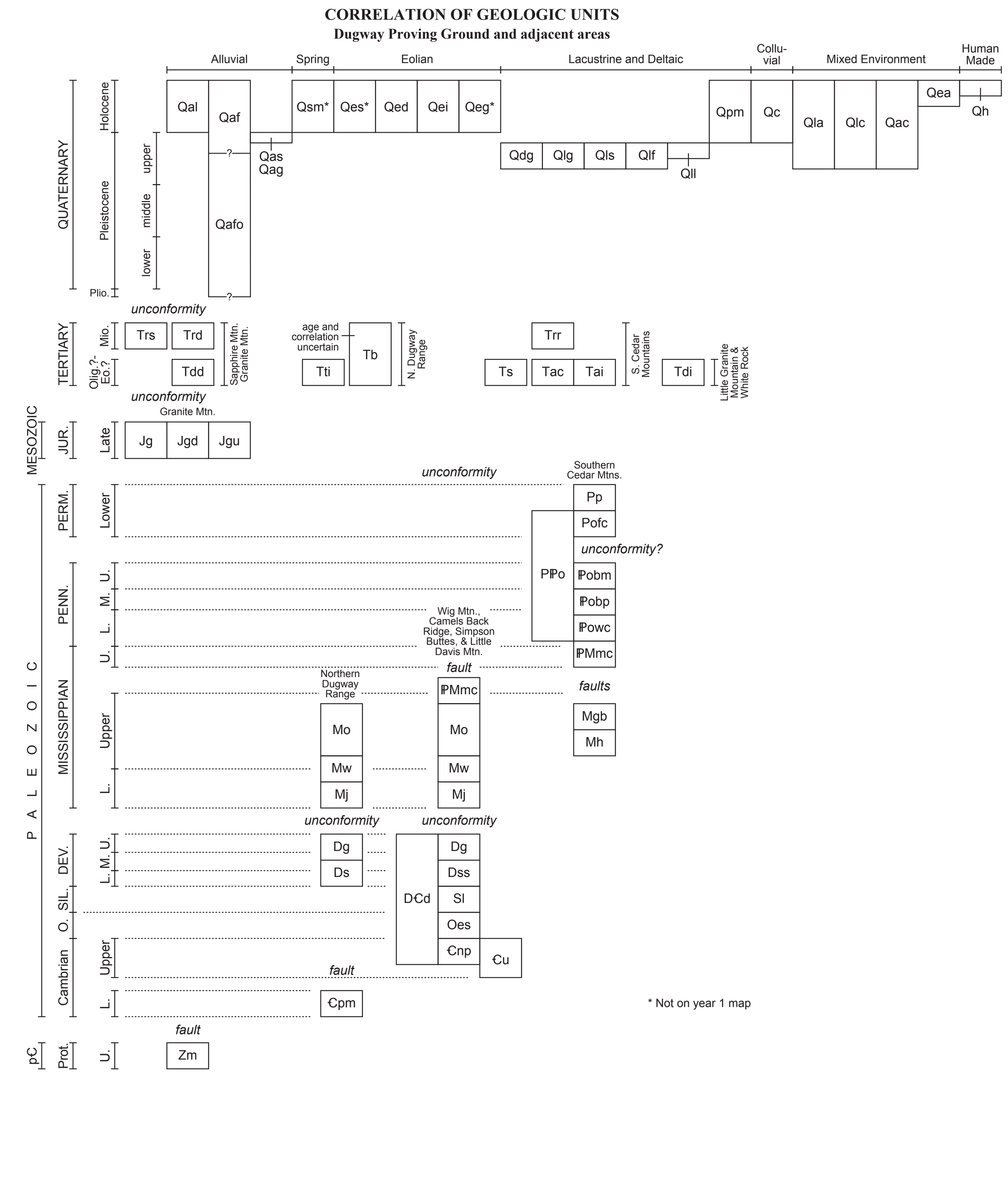
Notes:
Location data in NAD27.
Analyses performed by Eric H. Christiansen (Brigham Young University) and Jeffrey D. Vervoort (Washington State University).
Analyses by laser ablation-inductively coupled mass spectrometry.
*Age based on limited zircon data.

Table 4. Summary of $^{40}Ar/^{39}Ar$ age analyses from Dugway Proving Ground and adjacent areas.

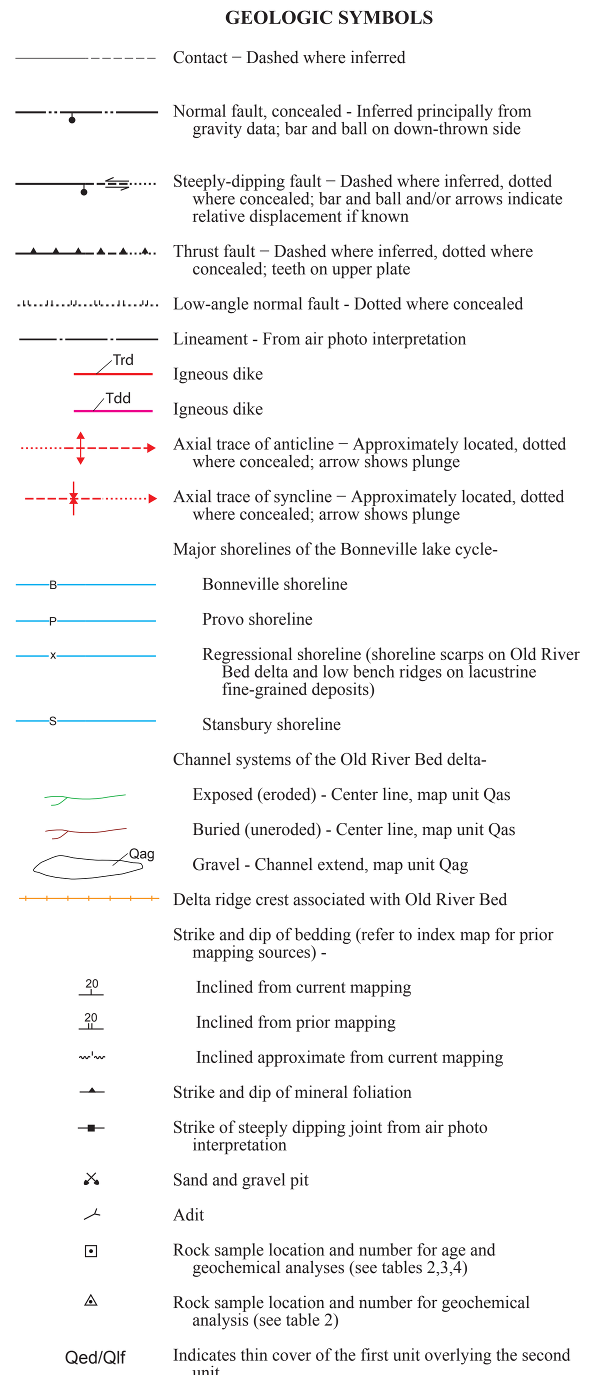
Map Number	Sample Number	Map Unit	Rock Name	7.5' Quadrangle	Latitude (N)	Longitude (W)	Age±2sd (Ma)	Material Dated	Comments
Trd1	GP081605-6c	Trd	Rhyolite	Granite Peak	40°07'44"	113°17'04"	7.78 ± 0.05	sanidine	single-crystal laser fusion
Trs1	SM071405-11	Trs	Rhyolite	Granite Peak SE	40°03'55.4"	113°16'18.5"	8.20 ± 0.05	sanidine	single-crystal laser fusion
Tdi1	FM083105-1	Tdi	Dacite	Camels Back Ridge NE	40°12'08"	112°50'16"	pending		
Jgd1	GP102605-3	Jgd	Monzonite	Granite Peak SE	40°05'16.2"	113°16'45.9"	pending		
Jg2	GP102605-1	Jg	Granite	Granite Peak	40°09'58.2"	113°15'56.2"	pending		
*Trr1	D-47	Trr	Rhyolite	Tabbys Peak	40°26'18"	112°56'57.2"	pending		
Tdi2	D-4	Tdi	Dacite	Tabbys Peak SW	40°19'17.9"	112°54'01.1"	pending		
Tac1	D-7	Tac	Andesite	Wig Mountain	40°21'37.8"	113°00'04.0"	pending		
Tac2	D-15	Tac	Dacite	Tabbys Peak SW	40°20'33.7"	112°58'07.7"	pending		
Tac3	D-17	Tac	Andesite	Tabbys Peak SW	40°18'39.6"	112°56'36.3"	pending		
Tac4	D-25	Tac	Andesite	Tabbys Peak SW	40°16'13.7"	112°56'23.9"	pending		
*Tac5	D-42	Tac	Andesite	Wig Mountain NE	40°26'55.3"	113°01'57.8"	pending		
Tai1	D-6	Tai	Andesite	Wig Mountain	40°20'03.3"	113°01'42.2"	pending		
*Tai2	D-40	Tai	Andesite	Tabbys Peak	40°27'47.7"	112°59'13.8"	pending		
Tti1	D-2	Tti	Trachyte	Dugway Proving Ground SW	40°00'31.8"	113°12'41.9"	pending		

Notes:
Location data in NAD27.
All analyses performed at the New Mexico Geochronology Research Laboratory, Socorro, New Mexico.
Complete presentation of data in Clark (in preparation).
* Not on year 1 map

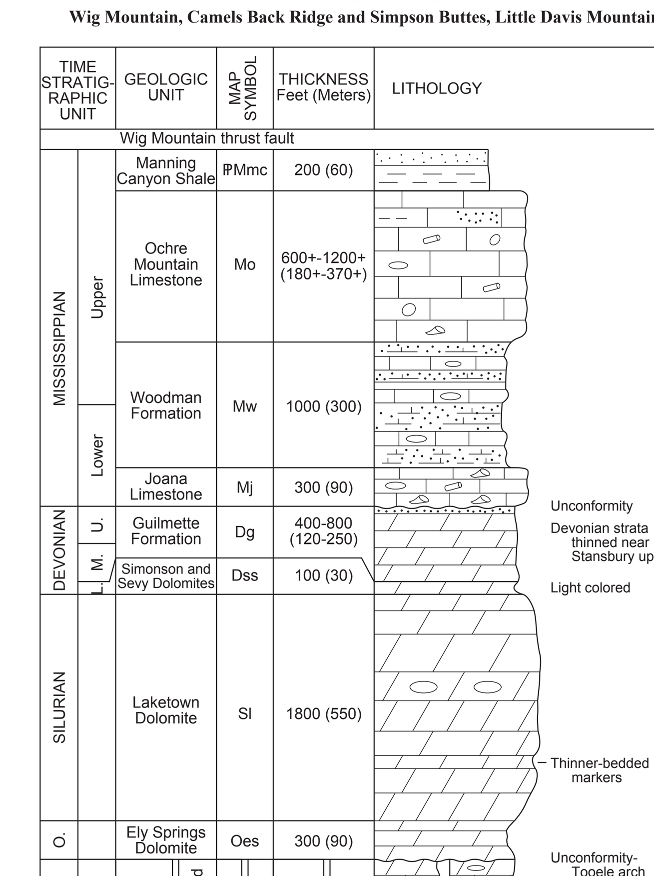
CORRELATION OF GEOLOGIC UNITS
Dugway Proving Ground and adjacent areas



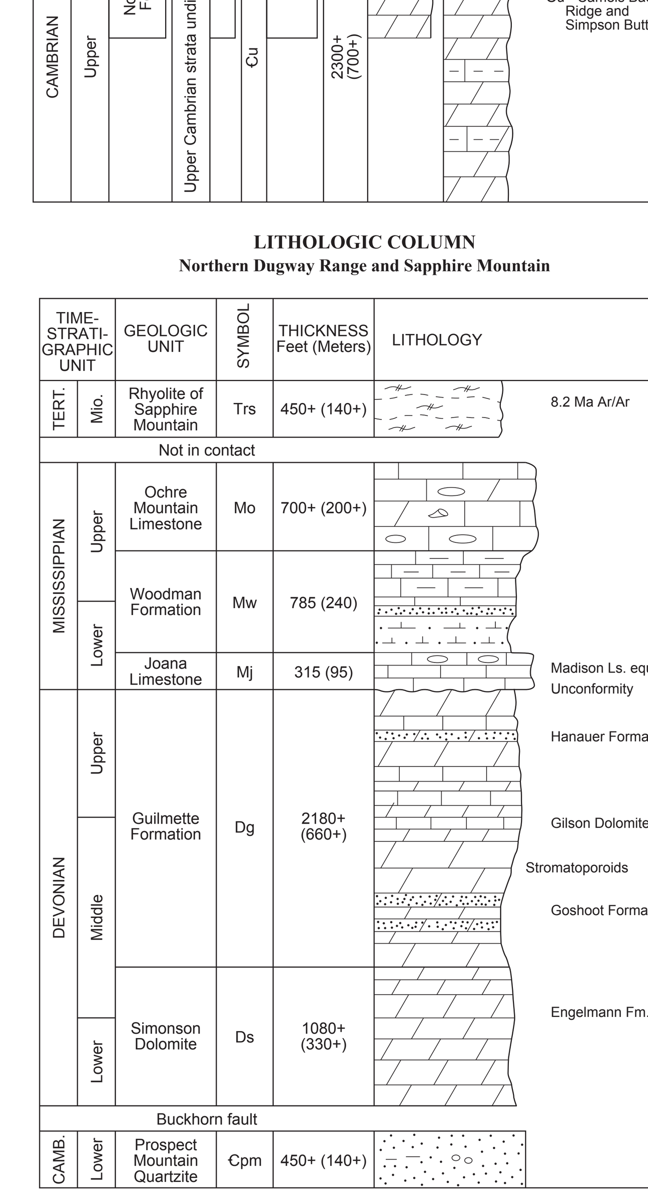
GEOLOGIC SYMBOLS



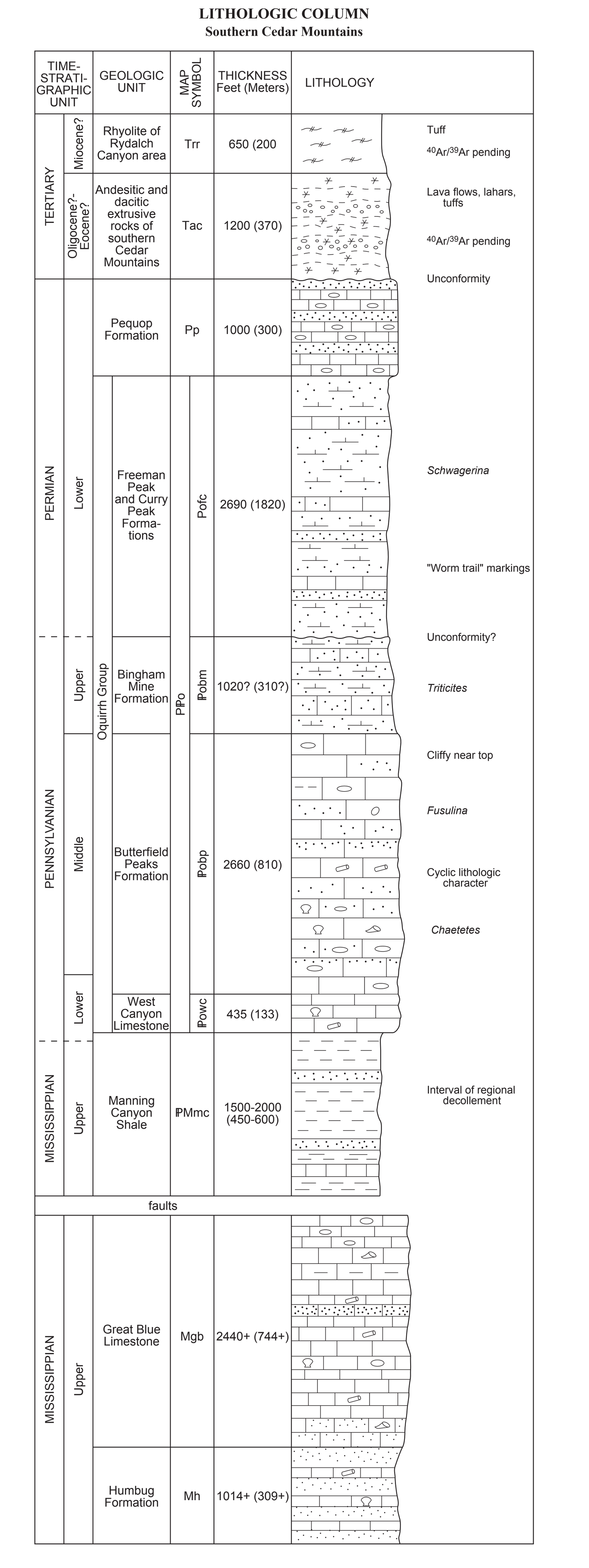
LITHOLOGIC COLUMN
Wig Mountain, Camels Back Ridge and Simpson Buttes, Little Davis Mountain



LITHOLOGIC COLUMN
Northern Dugway Range and Sapphire Mountain



LITHOLOGIC COLUMN
Southern Cedar Mountains



UTAH GEOLOGICAL SURVEY
a division of
Utah Department of Natural Resources

GEOLOGIC UNIT DESCRIPTIONS

Alluvial deposits

Qal **Alluvial deposits** (Holocene) – Primarily clay, silt, and sand with some gravel lenses, deposited by streams in channels and filling drainages; locally includes alluvial-fan, colluvial, and eolian deposits; thickness generally less than about 20 feet (6 m).

Qaf **Alluvial-fan deposits, undifferentiated** (Holocene to upper Pleistocene?) – Poorly sorted gravel with sand, silt, and clay deposited by streams, debris flows, and flash floods on alluvial fans and in canyon and mountain valleys above the Bonneville shoreline; includes alluvium and colluvium in canyon and mountain valleys; may include small areas of eolian deposits and lacustrine fine-grained deposits below the Bonneville shoreline; thickness variable, to 100 feet (30 m) or more.

Qafo **Older alluvial-fan deposits** (upper Pleistocene? to Pliocene?) – Deposits of higher-level, poorly sorted gravel with sand, silt, and clay that have been incised by younger alluvial deposits; present along the margin and interior valleys of the eastern Cedar Mountains; may locally include small areas of lacustrine or eolian deposits; thickness variable, to 100 feet (30 m) or more.

The Old River Bed is an abandoned river valley present on the southern part of Dugway Proving Ground and southward to the Sevier River southwest of Delta. The Old River Bed formed during the most recent episode of overflow from the Sevier basin (Lake Gunnison) to the Great Salt Lake basin (Lake Bonneville) (Oviatt, 1987; Oviatt and others, 1994). Where the river entered Lake Bonneville, a delta formed with various distributary channels. Two types of channel systems were mapped: younger sand channels and older gravel channels described below.

Qas **Alluvial sand deposits** (upper Pleistocene) – Sand and silt, locally with gravel, present in "exposed channels" (exposed due to deflation of mudflat surfaces) on mudflats north and west of Granite Mountain, and in "buried channels" (buried by eolian sand and silt) extending between the Old River Bed and the mudflats of the southern Great Salt Lake Desert; associated with alluvial gravel deposits (Qag); probably related to continued Sevier-basin overflow and to groundwater discharge; ages of 8800 to 11,400 14C years B.P. (10,000 to 13,500 calendar years B.P.); thickness to about 3 feet (1 m) (see Oviatt and others, 2003).

Qag **Alluvial gravel deposits** (upper Pleistocene) – Coarse sand and gravel, dominated by volcanic clasts, present in topographically inverted "gravel channels" on mudflats north of Granite Mountain; these "gravel channels" have a distinct morphology–straight to curved, digitate, and with abrupt bulbous ends; associated with alluvial sand deposits (Qas); formed by a river delta that originated as overflow from the Sevier Basin along the Old River Bed during the late regressive phases of Lake Bonneville, prior to 11,000 and after 12,500 14C yr B.P.; thickness to about 12 feet (4 m) (see Oviatt and others, 2003).

Spring and marsh deposits

Qsm **Spring and marsh deposits** (Holocene) – Clay, silt, and sand that is locally organic-rich, calcareous, or saline; present in saturated areas near flowing and seeping springs; thickness undetermined. [not shown on year 1 map]

Eolian deposits

Qei **Eolian silt** (Holocene) – Windblown silt included below solely as stacked unit Qei/Qlf.

Qes **Eolian sheet sand deposits** (Holocene) – Windblown sand and silt deposited as sheets rather than well-developed dunes; generally thin with no distinct bedding; mostly silty, well-sorted, fine-grained quartz sand; generally greater than 3 feet (1 m) thick. [not shown on year 1 map]

Qed **Eolian dune sand deposits** (Holocene) – Poorly to well sorted sand in well-developed dunes and dune fields; mostly fine-grained quartz sand but also aggregates of clay, silt, and sand; present as parabolic, linear, dome, lunette, and shrub-coppice dunes (see Dean, 1978); to 50 feet (15 m) thick.

Qeg **Eolian gypsum deposits** (Holocene) – Windblown gypsum grains in sheets and dunes (see Dean, 1978); thickness undetermined. [not shown on year 1 map]

Lacustrine and Deltaic deposits

Qpm **Playa mud** (Holocene to upper Pleistocene) – Laminated clay and silt, with minor sand, typically calcareous or saline; present east of Granite Mountain at areas of local groundwater discharge; probably less than 20 feet (6 m) thick.

Table 1 presents ages and elevations of Lake Bonneville shorelines in the map area. Crittenden (1963) and Currey (1982) provided regional data on shoreline elevations.

Qdg **Deltaic gravel** (upper Pleistocene) – Sand and gravel deposited near the mouth of the Sevier River in the Old River Bed area during the Bonneville lake cycle; well-sorted pebbly sand containing volcanic and sedimentary pebbles; cross-bedded to very thick bedded; regressive deposits were locally reworked by waves into a thin sheet; to 50 feet (15 m) thick.

Qlg **Lacustrine gravel** (upper Pleistocene) – Sandy gravel to boulders composed of locally derived rock fragments deposited in shore zones of Lake Bonneville; locally tufa-cemented and draped on bedrock; thickness variable, to 100 feet (30 m) or more.

Qls **Lacustrine sand** (upper Pleistocene) – Sand and silt deposited by regressional phase of Lake Bonneville; thickness to 100 feet (30 m) or more.

Qlf **Lacustrine fine-grained deposits** (upper Pleistocene) – Sand, silt, marl, and calcareous clay of Lake Bonneville; thinly to very thick bedded; locally includes the white marl of Gilbert (1890) and other fine-grained lacustrine deposits; thickness to 100 feet (30 m) or more.

Qll **Lacustrine lagoonal deposits** (upper Pleistocene) – Silt and clay deposited behind beaches of highest transgressional phase of Lake Bonneville at south margin of Cedar Mountains; thickness to 40 feet (12 m).

Colluvial deposits

Qc **Colluvial deposits** (Holocene to upper Pleistocene) – Fine- to coarse-grained detritus derived from local bedrock; commonly includes talus in upper parts of deposits; may locally include lacustrine, alluvial, or eolian deposits; more common on Granite Mountain and northern Dugway Range than elsewhere; to 20 feet (6 m) or more thick.

Mixed-environment deposits

Qla **Lacustrine and alluvial deposits, undifferentiated** (Holocene to upper Pleistocene) – Mixed and reworked, gravelly lacustrine and alluvial deposits on piedmont slopes; includes pre-Bonneville alluvial fans etched by waves in Lake Bonneville, and thin alluvial-fan deposits overlying fine to coarse-grained lake sediments; grades from pebbly sand and silt to sandy pebble gravel; thickness locally exceeds 30 feet (10 m).

Qac **Alluvial and colluvial deposits, undifferentiated** (Holocene to upper Pleistocene) – Primarily gravel, with sand, silt, and clay; form aprons of small alluvial-fan and colluvial surfaces that spill out onto and grade into alluvial-fan deposits, and also present within upland valleys; thickness generally less than 20 feet (6 m).

Qlc **Lacustrine and colluvial deposits, undifferentiated** (Holocene to upper Pleistocene) – Primarily gravel and sand, but may include lacustrine fine-grained deposits; commonly includes talus in upper parts of deposits; mantles bedrock and fills washes, locally remobilized by slope-wash and rock-fall processes; locally marked by prominent secondary shorelines; mapped on northwest side of Granite Mountain; thickness to 10 feet (3 m), or locally more.

Human-made deposits

Qh **Human-made deposits** (Historical) – Deposits from human development on Dugway Proving Ground that cover more extensive areas, consisting of wastewater treatment lagoons, sanitary landfill, and Michael Army Airfield; thickness less than about 20 feet (6 m).

Stacked-unit deposits

Qea/Qlf **Eolian and alluvial deposits over lacustrine fine-grained deposits** (Holocene/upper Pleistocene) – Windblown silt in sheet form adjacent to and locally covering alluvial sand and gravel in unmapped channels that collectively overlie lacustrine marl and fine-grained deposits; locally saline or gypsiferous; form extensive mudflats of southern Great Salt Lake Desert; may locally include small areas of thicker eolian deposits; cover unit thickness probably less than 15 feet (5 m) thick.

Qei/Qlf **Eolian silt over lacustrine fine-grained deposits** (Holocene/upper Pleistocene) – Windblown silt overlying lacustrine silt, clay, marl, and some sand over a large area east of Granite Mountain; surface commonly contains distinctive vegetation stripes (characteristic landforms of sheetflow plains in arid to semiarid regions) (Oviatt and others, 2003); may locally include areas of thicker eolian deposits; cover unit thickness probably less than 3 feet (1 m).

Qes/Qlf **Eolian sheet sand deposits over lacustrine fine-grained deposits** (Holocene/upper Pleistocene) – Windblown sand and some silt in sheets overlying lacustrine silt, clay, marl, and some sand northeast of Little Granite Mountain; may locally include areas of thicker eolian deposits; cover unit thickness probably less than 6 feet (2 m).

Qed/Qlf **Eolian dune sand deposits over lacustrine fine-grained deposits** (Holocene/upper Pleistocene) – Windblown dune sand and some silt overlying lacustrine sand, silt, marl, and clay; cover unit thickness probably less than 20 feet (6 m).

Qes/Qla **Eolian sheet sand deposits over lacustrine and alluvial deposits** (Holocene/Holocene to upper Pleistocene) – Windblown dune sand and silt overlying gravelly to fine-grained lacustrine and alluvial deposits; present at and northwest of Dugway; cover unit thickness probably less than 10 feet (3 m).

Qed/Qla **Eolian dune sand deposits over lacustrine and alluvial deposits** (Holocene/Holocene to upper Pleistocene) – Windblown sand and some silt that forms well-developed dunes overlying gravelly to fine-grained lacustrine and alluvial deposits; locally well exposed in large gravel pit on southern margin of Cedar Mountains and north of Michael Army Airfield (Prime Road pit); cover unit thickness probably less than 20 feet (6 m).

Qal/Qlf **Alluvial deposits over lacustrine fine-grained deposits** (Holocene/upper Pleistocene) – Sand, silt, clay, and some gravel in alluvial channels and sheets overlying lacustrine silt, clay, marl, and some sand; present between Granite Mountain and Old River Bed; cover unit thickness probably less than 6 feet (2 m).

Qaf/Qlf **Alluvial-fan deposits over lacustrine fine-grained deposits** (Holocene to upper Pleistocene?/upper Pleistocene) – Gravel, sand, and fine-grained alluvial-fan deposits overlying lacustrine sand, silt, marl, and clay; present along periphery of Granite Mountain and in some upland valleys of eastern Cedar Mountains; cover unit thickness probably less than 10 feet (3 m).

Qaf/Qla **Alluvial-fan deposits over lacustrine and alluvial deposits** (Holocene to upper Pleistocene?/Holocene to upper Pleistocene) – Gravel, sand, and fine-grained alluvial-fan deposits overlying gravelly to fine-grained lacustrine and alluvial deposits; locally present along western margin of Skull Valley; cover unit thickness probably less than 10 feet (3 m).

Qed/Tac **Eolian dune sand deposits over andesitic and dacitic extrusive rocks of southern Cedar Mountains** (Holocene/Oligocene? to Eocene?) – Windblown dune sand and silt overlying bedrock unit; locally includes small bedrock exposures; cover unit thickness probably less than 10 feet (3 m).

Qlg/R **Lacustrine gravel over undifferentiated bedrock** (upper Pleistocene/Miocene? to Cambrian?) – Sandy and pebbly gravel overlying various bedrock units along western and southern margin of Cedar Mountains and southwest of Dugway; locally includes small bedrock exposures of map units Ts, Tac, Pp, and ℙPo; cover unit thickness probably less than 10 feet (3 m).

Geochemical and age data for Tertiary and Jurassic rocks presented in tables 2 through 4 and figures 2 through 4, and also by Clark (in preparation a, b). Rock names from total alkali-silica classification diagram of LeBas and others (1986).

Trd **Rhyolite dikes of Granite Mountain** (Miocene) – Grayish-orange, weathering to dark-yellowish-brown porphyritic rhyolite; phenocrysts of feldspar and biotite; cross-cuts granite (Jg), granodiorite (Jgd) and pegmatite dikes; prior K-Ar age of about 13 Ma (Moore and McKee, 1983), new $^{40}Ar/^{39}Ar$ age of 7.78 ± 0.05 Ma; dikes probably related to rhyolite of Sapphire Mountain; width to 30 feet (10 m).

Trs **Rhyolite of Sapphire Mountain** (Miocene) – Pale-red, weathering to dark-yellowish-brown and moderate-red, porphyritic rhyolite lava flow; phenocrysts (~10%) of quartz, sanidine, and minor biotite in an aphanitic groundmass; also some local flow breccia; forms cliffy exposures on Sapphire Mountain; $^{40}Ar/^{39}Ar$ age of 8.20 ± 0.05 Ma; exposed thickness is 450 feet (140 m).

Trr **Rhyolite of Rydalch Canyon area** (Miocene?) – Light-gray and very pale orange rhyolite ash-flow tuff exposed south and east of Rydalch Canyon in southern Cedar Mountains; phenocrysts (~25%) of feldspar, quartz, hornblende, and biotite; $^{40}Ar/^{39}Ar$ age pending; exposed thickness to 650 feet (200 m).

Tdd **Dacite dikes of Granite Mountain** (Oligocene? - Eocene?) – Medium-gray to medium-dark-gray porphyritic dacite dikes on northwest side of mountain; only one such dike is mapped, and uncommon, unmapped latite dikes are also present; cross-cuts granite (Jg), granodiorite (Jgd) and pegmatite dikes; width to 30 feet (10 m).

Tdi **Dacitic intrusions of Little Granite Mountain and White Rock** (Oligocene? - Eocene?) – Light-gray weathering to white and yellowish gray porphyritic dacite; phenocrysts (~25%) of plagioclase, quartz, biotite, and amphibole (0.5-2 mm long average), and groundmass is intergrowth of plagioclase, potassium feldspar, and quartz (Maurer, 1970; Moore and Sorensen, 1977); $^{40}Ar/^{39}Ar$ ages for Little Granite Mountain and White Rock are pending; exposures to 9500 feet (2900 m) across.

Ts **Tertiary strata** (Oligocene? - Eocene?) – One area southwest of Dugway of grayish orange, very pale orange, and moderate orange pink lacustrine limestone that is locally oncolitic, moderately crystalline, indistinctly to thin bedded; underlain by small exposure of moderate reddish orange tuffaceous sandstone; exposed thickness is 12 feet (4 m).

Tac **Andesitic and dacitic extrusive rocks of southern Cedar Mountains** (Oligocene? - Eocene?) – Dark- to light-gray and pale-red lava flows interlayered with lahars and less common tuffs; lava flows are porphyritic to aphanitic, and phenocrysts include feldspar, quartz, and biotite; lahars contain clasts of intermediate volcanic rocks to 4 feet (1 m) across; variously welded ash-flow tuffs contain phenocrysts of feldspar, hornblende, biotite; calc-alkaline affinities are similar to those of Oligocene-Eocene rocks in the region; local vents as map unit Tai below; $^{40}Ar/^{39}Ar$ ages pending; exposed thickness to 1200 feet (370 m).

Tai **Andesitic intrusions of southern Cedar Mountains** (Devils Postpile, Six Horse Pass, Tabbys Peak) (Oligocene? - Eocene?) – Dark-gray porphyritic to aphanitic andesitic intrusions associated with local vents for extrusive suite of calc-alkaline volcanic rocks (Tac); phenocrysts of feldspar, hornblende, and lesser biotite; columnar jointing of exposures common; Devils Postpile previously called Moronis Postpile (Maurer, 1970); $^{40}Ar/^{39}Ar$ ages pending; exposures to 1600 feet (490 m) across.

Tti **Trachytic intrusions of northern Dugway Range** (late Eocene?) – Gray to reddish-brown aphanitic to porphyritic trachyte and tephriphonolite (previously called rhyodacite); locally with phenocrysts of quartz, plagioclase, biotite, and amphibole; locally vesicular, highly oxidized and devitrified; occurs as plugs along Buckhorn fault; also includes small areas of flow breccia and associated tuffs (see Staatz and Carr, 1964; Staatz, 1972; Kelley and others, 1987; Kelley and Yambrick, 1988); age estimate of 36? Ma (Lindsey, 1979; Hintze, 1988), $^{40}Ar/^{39}Ar$ age pending; exposures to 1400 feet (430 m) across.

Tb **Breccia** (Tertiary?) – One northern Dugway Range exposure of heterogeneous jumbled bedrock blocks and fragments in a reddish, clayey, calcareous matrix (possible breccia pipe); blocks are chiefly limestone and siltstone of the Woodman Formation, but in places include fragments of limestone from the Ochre Mountain Limestone and Joana Limestone (Staatz, 1972); age unknown, assumed Tertiary; Staatz (1972) mapped as intrusive breccia; circular exposure is about 500 feet (150 m) in diameter.

Jgu **Foliated granodiorite and granite of Granite Mountain, undivided** (Late Jurassic) – Foliated granodiorite (Jgd) with sills and dikes of granite (Jg) exposed in the central and western part of mountain; exposed thickness is 400 feet (120 m).

Jgd **Foliated granodiorite of Granite Mountain** (Late Jurassic) − Medium-light-gray to medium-gray granodiorite with variable chemical composition (decreasing silica) to quartz monzonite, monzonite, diorite, and monzodiorite; primary minerals include plagioclase > quartz > alkali-feldspar >biotite > amphibole > muscovite (Fowkes, 1964; B. Jensen and E.H. Christiansen, Brigham Young University, unpublished data, 2007); rock is weakly to strongly foliated, contains uncommon dark xenoliths and local large feldspar crystals; cut by numerous, unmapped, white, beryl-bearing pegmatite dikes in various forms (Fowkes, 1964) (pegmatites to 100 feet [30 m] thick); also cut by minor aplite and quartz dikes and younger dikes (Trd, Tdd); granodiorite is believed to be altered upper part of granite intrusion (Jg) (Clark and Christiansen, 2006); some fault and fracture zones in granodiorite and associated granite (Jg) are mineralized with hematite and lesser amounts of base metal-bearing minerals; isotopic data on granodiorite is pending (Christiansen and Hart, in preparation); U-Pb zircon age determination of 150 Ma (Clark and Christiansen, 2006; Christiansen and Vervoort, in preparation), $^{40}Ar/^{39}Ar$ age pending; exposed thickness is about 2000 feet (600 m).

Jg **Granite of Granite Mountain** (Late Jurassic) − White (leucocratic) granite weathers to pale-orange and moderate-yellowish-brown; primary minerals include quartz > plagioclase > alkali-feldspar > muscovite > biotite (Fowkes, 1964; B. Jensen and E.H. Christiansen, Brigham Young University, unpublished data, 2007); locally includes dark schistose inclusions and large potassium feldspar crystals; generally weakly foliated, except in northeastern exposures where strong flow foliation in upper part near contact with foliated granodiorite; cut by a few pegmatite, aplite, and quartz dikes, and younger dikes (Trd, Tdd); isotopic data on granite is pending (Christiansen and Hart, in preparation); U-Pb zircon age determination of 150 Ma (Clark and Christiansen, 2006; Christiansen and Vervoort, in preparation), $^{40}Ar/^{39}Ar$ age pending; exposed thickness is 1400 feet (425 m).

fault

Zm **Metasedimentary rocks of Granite Mountain** (Upper Proterozoic?) − Metasedimentary rocks composed of schist with minor quartzite, and marble with lesser schist intruded by granodiorite (Jgd) and leucogranite (Jg) sills and dikes at the south end of the mountain; approximately 60% metasedimentary rocks and 40% intrusions; metasedimentary rocks may correspond to part of the Proterozoic McCoy Creek Group or Trout Creek Sequence (see Rodgers, 1989); locally cut by pegmatite, quartz, and aplite dikes; in fault contact with granodiorite (Jgd) unit; exposed thickness is 2300 feet (700 m).

MISSISSIPPIAN TO CAMBRIAN STRATA OF NORTHERN DUGWAY RANGE

Mississippian and Devonian stratigraphy for the northern Dugway Range modified from Staatz (1972) after Hintze (1988; unpublished notes on Staatz and Carr, 1964). Exposures near Buckhorn fault are bleached, dolomitized, or silicified (Staatz and Carr, 1964; Staatz, 1972; Kelley and others, 1987; Kelley and Yambrick, 1988).

Mo **Ochre Mountain Limestone** (Upper Mississippian) – Medium-gray limestone and a few interbeds of dark-gray dolomite; locally cherty; horn corals locally common; forms ledgey exposures; top eroded; 700+ feet (200+ m) thick.

Mw **Woodman Formation** (Upper to Lower Mississippian) – Upper part thin-bedded, light-gray silty limestone with a 20-foot-thick (6 m), brown-weathering quartzite near base, and lower part of thin-bedded, reddish-brown, calcareous siltstone; forms slopes with some ledges; 785 feet (240 m) thick.

Mj **Joana Limestone** (Lower Mississippian) – Fine-grained, medium-gray limestone with some chert in upper part; forms ledges; Staatz (1972) mapped as Madison Limestone equivalent; 315 feet (95 m) thick.

unconformity

Dg **Guilmette Formation** (Upper to Middle Devonian) – Light- to dark-gray, commonly sandy-textured dolomite; upper part contains interbedded light-gray limestone and brown-weathering gray to white dolomitic quartzite, middle part contains some medium-bedded gray limestone, and lower part contains interbedded brown-weathering dolomitic quartzite; *Amphipora* (stromatoporoid) common in some dolomite beds of middle part; forms ledgey outcrops; Staatz (1972) mapped as Hanauer Formation, Gilson Dolomite, and Goshoot Formation; 2180+ feet (660+ m) thick.

Ds **Simonson Dolomite** (Middle to Lower? Devonian) – Very thick bedded, sandy-textured, gray to black dolomite; less resistant ledges than overlying Guilmette; Staatz (1972) mapped as Englemann Formation; only upper part exposed, 1080+ feet (330+ m) thick.

Buckhorn fault

Ꞓpm **Prospect Mountain Quartzite** (Lower Cambrian) – White to tan, resistant, thick-bedded quartzite with local thin beds of olive-green micaceous shale and lenses of quartz-pebble conglomerate (Staatz, 1972); ledge to cliff forming unit; partly exposed, 450+ feet (140+ m) thick.

MISSISSIPPIAN TO CAMBRIAN STRATA OF WIG MOUNTAIN, CAMELS BACK RIDGE, SIMPSON BUTTES, AND LITTLE DAVIS MOUNTAIN

Mississippian to Cambrian stratigraphy modified from Moore and Sorensen (1977, 1979), without the benefit of age control.

Wig Mountain thrust fault

ℙMmc **Manning Canyon Shale** (Lower Pennsylvanian to Upper Mississippian) – Gray to black, fissile, slope-forming shale with lesser light-brown and multicolored quartzite and uncommon brownish-gray, carbonaceous limestone; exposed north and south of Little Davis Mountain; interval of regional decollement; exposed thickness to 200 feet (60 m).

Mo **Ochre Mountain Limestone** (Upper Mississippian) – Wig Mountain: medium- to dark-gray limestone and fossiliferous limestone with uncommon black nodular chert; medium- to thick-bedded rock unit forms rugged ledges and cliffs; isolated exposure north of Wig Mountain contains brachiopods and numerous large crinoid columnals; top not exposed, exposed thickness is 600+ feet (180+ m).
Little Davis Mountain: medium- to dark-gray limestone and fossiliferous limestone, black chert locally common as nodules and beds; thin- to thick-bedded; southwestern exposures silicified; base and top? not exposed; exposed thickness is 1200 feet (370 m).

Mw **Woodman Formation** (Upper to Lower Mississippian) – Very pale orange calcareous sandstone and siltstone, medium-gray cherty limestone, fossiliferous limestone, and sandy limestone; black chert in nodules and beds; very thin to thin-bedded; 1000 feet (300 m) thick.

Mj **Joana Limestone** (Lower Mississippian) – Moderate-gray, thin-bedded, fossiliferous limestone with uncommon black chert nodules; limited exposures between north and south parts of Wig Mountain; 300 feet (90 m) thick.

Unconformity

Devonian strata apparently depositionally thinned near Stansbury uplift (Rigby, 1959)

DꞒd **Devonian-Cambrian dolomite** (Upper Devonian? to Upper Cambrian?) – One small exposure on mud flat between the Old River Bed and northern Dugway Range of moderate-gray to moderate-brown dolomite that weathers to light brown, dark brown and pale red; common near-vertical fractures; exposed thickness is 25 feet (8 m).

Dg **Guilmette Formation** (Upper to Middle Devonian) – Moderate-gray to moderate-brown, thick- to very thick bedded dolomite; local laminated surface appearance; ~40-foot-thick (12 m), dark-reddish-brown quartzite at top of formation; thickness is 400 to 800 feet (120-250 m).

Dss **Simonson and Sevy Dolomites** (Middle to Lower Devonian) – Moderate gray, thin- to medium-bedded dolomite; weathers to very light and light gray with laminated surface appearance; lighter colored, more distinctly bedded, and less resistant than adjacent formations; thickness is 100 feet (30 m).

Sl **Laketown Dolomite** (Silurian) – Light- to dark-gray, weathers to light- and moderate-brown, very thick bedded dolomite; dolomite with small open vugs, local black chert, laminated appearance, and case hardening; thinner bedded interval (roughly 50 feet [15 m]) with dark-brown and light-gray dolomite is about 500 feet (150 m) above base; formation generally cliffy and indistinctly bedded; thickness is 1800 feet (550 m).

Oes **Ely Springs Dolomite** (Ordovician) – Moderate-gray dolomite, weathers to moderate brown and light gray, thin- to medium-bedded; forms more distinct and less resistant beds between enclosing formations; thickness is 300 feet (90 m).

Unconformity

Tooele arch (Hintze, 1959) - Eureka Quartzite, Crystal Peak Dolomite, Watson Ranch Quartzite, and Pognip Group not present

Ꞓnp **Notch Peak Formation** (Upper Cambrian) – Southern side of Wig Mountain exposures are moderate-gray dolomite that weathers to light- and moderate-brown and gray-brown, locally with a mottled appearance; locally sandy, with dark brown laminae, and twiggy bodies; thin- to very thick bedded; base not exposed; exposed thickness 1000+ feet (300+ m).

Ꞓu **Upper Cambrian strata, undivided** (Upper Cambrian?) – Carbonate rocks of Camels Back Ridge and Simpson Buttes; medium-bedded, medium-gray to dark-gray dolomite, with subordinate thin-bedded, light-gray, silty limestone and laminated, light-pink-weathering dolomite; commonly pisolitic, rust-colored cherty lenses prominent near top (Moore and Sorensen, 1977); exposures appear to be dolomitized precluding further subdivision; may correspond to Notch Peak Formation, Orr Formation, and Lamb Dolomite; base and top not exposed, 2300+ feet (700+ m) thick.

PERMIAN TO MISSISSIPPIAN STRATA OF SOUTHERN CEDAR MOUNTAINS

Refer to figure 5 for a Lower Permian to Upper Mississippian stratigraphic comparison between this map and Maurer (1970).

Pp **Pequop Formation** (Lower Permian? [Leonardian?-Wolfcampian?]) – Moderate-gray cherty limestone that weathers to light gray, interbedded with light-brown to pale-red sandstone that weathers to dark brown, some calcareous sandstone in lower part; bedding is thin to thick to indistinct, forming ledgey and cliffy outcrops; sandstone is slightly calcareous with fine to medium sand and tabular cross-bedding; limestone is finely crystalline and locally bioclastic, with black chert in nodules and thin beds; fossil age determination pending; Maurer (1970) mapped as Permian unnamed formation; exposed thickness to 1000 feet (300 m), Maurer (1970) reported measurement of 3953 feet (1205 m) north of map area where this unit underlies Grandeur Member of Park City Formation.

ℙPo **Oquirrh Group strata, undivided** (Lower Permian to Lower Pennsylvanian) – Combined unit where formation separation is difficult, particularly in Permian and upper Pennsylvanian part of section; total Oquirrh Group strata thickness roughly 6805 feet (2075 m).

Pofc **Oquirrh Group, Freeman Peak and Curry Peak Formations, undivided** (Lower Permian [Wolfcampian]) – Medium- to dark-gray, weathering to yellowish-gray, calcareous, fine-grained sandstone with uncommon very pale-orange, medium-gray and pale-red orthoquartzite and sandy limestone; laminated to thick-bedded unit breaks into chips and plates forming rounded hills and slopes with occasional ledges; "worm trail" markings common bedding plane feature, also contains *Schwagerina* (fusulinid); corresponds to most of Maurer's Unit 4 and Unit 5; lower contact with Bingham Mine Formation difficult to locate due to similar lithologies; roughly 2690 feet (1820 m) thick near Cochran Spring (2.5 miles [4 km] north of Cane Springs).

ℙobm **Oquirrh Group, Bingham Mine Formation** (Upper to Middle Pennsylvanian [Virgilian-Missourian]) – Medium-gray sandy limestone and very pale-orange to pale-red calcareous sandstone; thin- to medium-bedded, forms ledges and slopes; fossils include brachiopods, bryozoans, fusulinids (*Triticites*); corresponds to upper part of Maurer's Unit 3 and lower part of Unit 4; roughly 1020 feet (310 m) thick near Cochran Spring.

ℙobp **Oquirrh Group, Butterfield Peaks Formation** (Middle to Lower Pennsylvanian [Desmoinesian-Morrowan]) – Medium- to dark-gray, sandy limestone, cherty limestone, fossiliferous limestone, and minor quartzite; thin- to very thick bedded, forms ledges, cliffs, and slopes of a cyclic character, lower part forms ledgey escarpment; limestone is finely crystalline to bioclastic; gray, yellow-brown, and black chert occurs as spherical nodules and semi-bedded masses; contains sandy laminae and horizontally-flattened concretionary structures; fossils include *Chaetetes* and *Syringopora* (colonial corals), rugose corals, fusulinids (*Fusulina*), brachiopods, bryozoans; corresponds to Maurer's Unit 2 and most of Unit 3; roughly 2660 feet (810 m) thick near Cochran Spring.

ℙowc **Oquirrh Group, West Canyon Limestone** (Lower Pennsylvanian [Morrowan]) – Medium- to dark-blue-gray and brown-gray limestone and fossiliferous limestone with sparse chert; weathers to gray and yellow-brown; thin- to medium-bedded unit forms ledges and slopes; corresponds to Maurer's Unit 1; 435 feet (133 m) thick.

ℙMmc **Manning Canyon Shale** (Lower Pennsylvanian to Upper Mississippian) – Gray to black, fissile, slope-forming shale with lesser light-brown and multicolored quartzite and uncommon brownish-gray, carbonaceous limestone; interval of regional decollement; 1500 to 2000 feet (450-600 m) thick.

faults

Mgb **Great Blue Limestone** (Upper Mississippian) – Medium- to dark-gray, medium- and thick-bedded, finely crystalline or bioclastic limestone that forms rugged ledges; gray and black chert locally common in upper part; no obvious shaley intervals; fossils include colonial and horn corals, crinoids, and bryozoan fragments; top not exposed; 2440+ feet (744+ m) thick.

Mh **Humbug Formation** (Upper Mississippian) – Yellow-brown and gray sandstone and quartzite, and medium- to dark-gray limestone mostly in middle part; forms slopes and ledges; sandstone weathers to brown and maroon, is fine to medium grained, thin to medium bedded; limestone is thin to medium bedded with numerous thin horizontal black chert stringers, and locally common corals and brachiopods; base not exposed; 1014+ feet (309+ m) thick.

Note:

Granite Mountain is here used as an informal name for the mountain containing Granite Peak on Dugway Proving Ground; it was previously called Granite Peak Mountain by Fowkes (1964). Granite Mountain is the formal name for a mountain located near the northern end of the Confusion Range (see USGS Geographic Names Information System) that is comprised largely of carbonate rock.

REFERENCES

Cited

Christiansen, E.H., and Hart, G.L., in preparation, Isotopic compositions of rocks from Granite Mountain, Dugway Proving Ground, Tooele County, Utah: Utah Geological Survey Open-File Report.

Christiansen, E.H., and Vervoort, J.D., in preparation, U-Pb zircon geochronologic data for Granite Mountain, Dugway Proving Ground, Tooele County, Utah: Utah Geological Survey Open-File Report.

Clark, D.L., in preparation a, Whole-rock geochemical data for Dugway Proving Ground and adjacent areas, Tooele County, Utah: Utah Geological Survey Open-File Report.

Clark, D.L., in preparation b, $^{40}Ar/^{39}Ar$ geochronologic data for Dugway Proving Ground and adjacent areas, Tooele County, Utah: Utah Geological Survey Open-File Report.

Clark, D.L., and Christiansen, E.H., 2006, Granite Peak Mountain – A geologic mystery revealed: Utah Geological Survey, Survey Notes, v. 38, no. 3, p. 1-2.

Crittenden, M.D., Jr., 1963, New data on the isostatic deformation of Lake Bonneville: U.S. Geological Survey Professional Paper 454-E, 31 p.

Currey, D.R., 1982, Lake Bonneville — Selected features of relevance to neotectonic analysis: U.S. Geological Survey Open-File Report 82-1070, 30 p., 1 plate, scale 1:500,000.

Dean, L.E., 1978, Eolian sand dunes of the Great Salt Lake Basin: Utah Geology, v. 5, no. 2, p. 103-111.

Fowkes, E.J., 1964, Pegmatites of Granite Peak Mountain, Tooele County, Utah: Brigham Young University Geology Studies, v. 11, p. 97-127.

Gilbert, G.K., 1890, Lake Bonneville: U.S. Geological Survey Monograph 1, 438 p.

Godsey, H.S., Currey, D.R., and Chan, M.A., 2005, New evidence for an extended occupation of the Provo shoreline and implications for regional climate change, Pleistocene Lake Bonneville, Utah, USA: Quaternary Research, v. 63, p. 212-223.

Hintze, L.F., 1959, Ordovician regional relationships in north-central Utah and adjacent areas, *in* Williams, N.C., editor, Guidebook to the geology of the Wasatch and Uinta Mountains transition area: Intermountain Association of Petroleum Geologists Tenth Annual Field Conference Guidebook, p. 46-53.

Hintze, L.F., 1988, Geologic history of Utah: Brigham Young University Geology Studies, Special Publication 7, 203 p.

Kelley, D.L., Arbogast, B.F., Adrian, B.M, and Yambrick, R.A., 1987, Analytical results of rock samples and revised geologic map of the Dugway mining district, Tooele County, Utah: U.S. Geological Survey Open-File Report 87-299, 27 p., 1 plate, scale 1:12,000.

Kelley, D.L., Yambrick, R.A., 1988, Map showing wallrock alteration and geology of the Dugway mining district, northern Dugway Range, Tooele County, Utah: U.S. Geological Survey Miscellaneous Field Studies Map MF-2045, scale 1:12,000.

LeBas, M.J., LeMaitre, R.W., Streckheisen, A., and Zenettin, B., 1986, A chemical classification of volcanic rocks based on the total alkali-silica diagram: Journal of Petrology, v. 27, p. 745-750.

Lindsey, D.A., 1979, Geologic map and cross-sections of Tertiary rocks in the Thomas Range and northern Drum Mountains, Juab County, Utah: U.S. Geological Survey Miscellaneous Investigations Series Map I-1176.

Maurer, R.E., 1970, Geology of the Cedar Mountains, Tooele County, Utah: Salt Lake City, University of Utah, Ph.D. dissertation, 184 p., 10 plates, scale 1:43,700.

Moore, W.J., and McKee, E.H., 1983, Phanerozoic magmatism and mineralization in the Tooele 1° x 2° quadrangle, Utah, *in* Miller, D.M., Todd, V.R., and Howard, K.A., editors, Tectonic and stratigraphic studies in the eastern Great Basin: Geological Society of America Memoir 157, p. 183-190.

Moore, W.J., and Sorensen, M.L., 1977, Reconnaissance geologic map of northern Simpson Mountains, Davis Mountain, and adjacent areas, Tooele County, Utah: U.S. Geological Survey Miscellaneous Field Studies Map MF-905, 1 plate, scale 1:48,000.

Moore, W.J., and Sorensen, M.L., 1979, Geologic map of the Tooele 1° x 2° quadrangle, Utah: U.S. Geological Survey Miscellaneous Investigation Series Map I-1132, scale 1:250,000.

Murchison, S.B., 1989, Fluctuation history of Great Salt Lake, Utah, during the last 13,000 years: Salt Lake City, University of Utah, Ph.D. dissertation, 137 p.

Oviatt, C.G., 1987, Lake Bonneville stratigraphy at the Old River Bed: American Journal of Science, v. 287, p. 383-398.

Oviatt, C.G., 1997, Lake Bonneville and global climate change: Geology, v. 25, p. 155-158.

Oviatt, C.G., Currey, D.R., and Miller, D.M., 1990, Age and paleoclimatic significance of the Stansbury shoreline of Lake Bonneville, northeastern Great Basin: Quaternary Research, v. 33, p. 291-305.

Oviatt, C.G., Currey, D.R., and Sack, Dorothy, 1992, Radiocarbon chronology of Lake Bonneville, eastern Great Basin, USA: Palaeogeography, Palaeoclimatology, Palaeoecology, v. 99, p. 225-241.

Oviatt, C.G., Madsen, D.B., and Schmitt, D.N., 2003, Late Pleistocene and early Holocene rivers and wetlands in the Bonneville basin of western North American: Quaternary Research, v. 60 p. 200-210.

Oviatt, C.G., Sack, D., and Felger, T.J., 1994, Quaternary geologic map of the Old River Bed, and vicinity, Millard, Juab, and Tooele Counties, Utah: Utah Geological Survey Map 161, 24 p., 1 plate, scale 1:62,500.

Oviatt, C.G., and Thompson, R.S., 2002, Recent developments in the study of Lake Bonneville since 1980, *in* Gwynn, J.W., editor, Great Salt Lake — An overview of change: Utah Department of Natural Resources Special Publication, p. 1-6.

Rigby, J.K., 1959, Upper Devonian unconformity in central Utah: Geological Society of America Bulletin, v. 70, p. 207-218.

Rodgers, D.W., 1989, Geologic map of the Deep Creek Mountains Wilderness Study Area, Tooele and Juab Counties, Utah: U.S. Geological Survey Miscellaneous Field Studies Map MF-2099, scale 1:50,000.

Staatz, M.H., 1972, Geologic map of the Dugway Proving Ground SW quadrangle, Tooele County, Utah: U.S. Geological Survey Map GQ-992, scale 1:24,000.

Staatz, M.H., and Carr, W.J., 1964, Geology and mineral deposits of the Thomas and Dugway Ranges, Juab and Tooele Counties, Utah: U.S. Geological Survey Professional Paper 415, 188 p., 9 pl.

Stuiver, M., and Reimer, P.J., 1993, Extended ^{14}C database and revised CALIB radiocarbon calibration program: Radiocarbon, v. 35, p. 215-230.

Swenson, A.J., 1975, Sedimentary and igneous rocks of the Bingham mining district, *in* Bray, R.E., and Wilson, J.C., editors, Guidebook to the Bingham mining district: Society of Economic Geologists and Kennecott Copper Corporation, Bingham Canyon, Utah, p. 21-39.

Tooker, E.W., and Roberts, R.J., 1970, Upper Paleozoic rocks in the Oquirrh Mountains and Bingham mining district, Utah, with a section on biostratigraphy and correlation by Gordon, M., Jr., and Duncan, H.M.: U.S. Geological Survey Professional Paper 629-A, 76 p.

Welsh, J.E., and James, A.H., 1961, Pennsylvanian and Permian stratigraphy of the central Oquirrh Mountains, Utah, *in* Cook, D.R., editor, Geology of the Bingham mining district and northern Oquirrh Mountains: Utah Geological Society Guidebook to the Geology of Utah, no. 16, p. 1-16.

Selected Additional

Additional references that pertain to aspects of regional and local geology.

Barnhard, T.P., and Dodge, R.L., 1988, Map of fault scarps formed on unconsolidated sediments, Tooele 1° x 2° quadrangle, northwestern Utah: U.S. Geological Survey Miscellaneous Field Studies Map MF-1990, scale 1:250,000.

Bedinger, M.S., Sargent, K.A., Langer, W.H., 1984, Studies of geology and hydrology in the Basin and Range Province, southwestern United States, for isolation of high-level radioactive waste, U.S. Geological Survey Open-File Report OF 84-744, 139 p., 5 plates, scale 1:500,000.

Bullock, K.C., 1976, Fluorite occurrences in Utah: Utah Geological and Mineral Survey Bulletin 110, 89 p. [Dugway (Granite Peak) District, p. 76-78].

Butler, B.S., Loughlin, G.F., and Heikes, V.C., 1920, The ore deposits of Utah: U.S. Geological Survey Professional Paper 111, 672 p. [Dugway-Granite Range, p. 458-462].

Chamberlain, C.K., and Clark, D.L., 1973, Trace fossils and conodonts as evidence for deep-water deposits in the Oquirrh Basin of central Utah: Journal of Paleontology, v. 47, no. 4, p. 663-668.

Dean, L.E., 1976, Eolian sand dunes of the Great Salt Lake desert region, Utah: Salt Lake City, University of Utah, M.A. thesis, 138 p.

Eardley, A.J., 1962, Gypsum dunes and evaporite history of the Great Salt Lake Desert: Utah Geological and Mineralogical Survey Special Studies No. 2, 27 p.

Fitzmayer, J., Larsen, D, Braxton, D, and Staes, E., 2004, Hydrogeology of Government Creek Basin, Dugway, Utah, with a recommended practical approach to ground-water management in arid, saline regions of the Great Basin, *in* Spangler, L.E., editor, Ground water in Utah - resource, protection, and remediation: Utah Geological Association Publication 31, p. 161-178.

Fugro National, Inc., 1981, Gravity survey – Dugway Valley, Utah, variously paginated.

Gates, J.S., and Druer, S.A., Hydrologic reconnaissance of the southern Great Salt Lake Desert and summary of the hydrology of west-central Utah: Utah Department of Natural Resources Technical Publication 71, 55 p., 4 plates.

Geomatrix Consultants, Inc., March 2001, Fault evaluation study and seismic hazard assessment at the Private Fuel Storage facility, Skull Valley, Utah (final report, volume I-III), prepared for Stone & Webster Engineering Corporation, Denver, Colorado.

Hanley, J.B., Heinrich, E.W, and Page, L.R., 1950, Pegmatite investigations in Colorado, Wyoming, and Utah 1942-1944: U.S. Geological Survey Professional Paper 227, 125 p. [Utah pegmatites, p. 121-122.]

Harrill, J.R., 1962, Geology of the Davis Knolls and northern Big Davis Mountains area, Tooele county, Utah: Salt Lake City, University of Utah, M.S. thesis, 68 p., 3 plates, scale 1:24,000.

Hintze, L.F., 1980, Preliminary geologic map of the Fish Springs NE and Fish Springs SE quadrangles, Juab and Tooele Counties, Utah: U.S. Geological Survey Miscellaneous Field Studies Map MF-1147, scale 1:24,000.

Ives, R.L., 1946, The Granite Peak area, Utah: Rocks and Minerals, v. 21, p. 339-344.

Ives, R.L., 1949, Resources of the Dugway area, Utah: Economic Geography, v. 25, p. 55-67.

Kelley, D.L., 1989, Gold potential of the Dugway mining district, Tooele County, Utah, based on geology alteration, and lithogeochemistry: Golden, Colorado School of Mines, M.S. thesis, 212 p., 4 plates.

Klatt, H.R., 2006, Copper-gold and other polymetallic mineralization at the Dugway mining district, northern Dugway Range, eastern Great Basin, Utah, *in* Harty, K.M., and Tabet, D.E., editors, Geology of northwest Utah: Utah Geological Association Publication 34, 36 p.

Klausmeier, C.A., 1999, Regular and irregular patterns in semiarid vegetation: Science, v. 284, p. 1826-1828.

Lindsey, D.A., 1982, Tertiary volcanic rocks and uranium in the Thomas Range and northern Drum Mountains, Juab County, Utah: U.S. Geological Survey Professional Paper 1221, 71 p.

Madsen, D.B., 2001, Environmental change and human habitation along the Old River Bed, Tooele County: Utah Geological and Mineral Survey, Survey Notes, v. 33, no. 1, p. 6-7.

Miller, D.M., 1991, Mesozoic and Cenozoic tectonic evolution of the northeastern Great Basin, *in* Buffa, R.H., and Coyner, A.R., editors, Great Basin Symposium, Geology and ore deposits of the Great Basin, Field trip guidebook compendium, Volume 1: Geological Society of Nevada, p. 202-228.

Miller, D.M., Nilsen, T.H., and Bilodeau, W.L., 1992, Late Cretaceous to early Eocene geologic evolution of the U.S. Cordillera, *in* Burchfiel, B.C., Lipman, P.W., and Zoback, M.L., editors, The Cordilleran Orogen—conterminous U.S.: The Geological Society of America, The Geology of North America, V. G-3, p. 205-260.

Moore, W.J., and Sorensen, M.L., 1978, Metamorphic rocks of the Granite Peak area, Tooele County, Utah [abs.]: Geological Society of America Abstract with Programs, v. 10, p. 303.

Morris, H.T., 1987, Preliminary geologic map of the Delta 1x2-degree quadrangle, Tooele, Juab, Millard, and Utah Counties, Utah: U.S. Geological Survey Open-File Report 87-185, scale 1:250,000.

Nolan, T.B., 1927, Potash brines in the Great Salt Lake Desert, Utah: U.S. Geological Survey Bulletin 795, p. 25-44.

Nolan, T.B., 1935, The Gold Hill mining district, Utah: U.S. Geological Survey Professional Paper 177, 172 p., 1 plate, scale 1:62,500.

Oviatt, C.G., 1984, Lake Bonneville stratigraphy of the Old River Bed and Leamington, Utah: Salt Lake City, University of Utah, Ph.D. dissertation, 122 p.

Oviatt, 1991, Quaternary geology of Fish Springs Flat, Juab County, Utah: Utah Geological Survey Special Study 77, 16 p., 1 plate, scale 1:50,000.

Oviatt C.G., and Nash, B.P., in preparation, Geochemical and geochronologic data for volcanic ashes from Dugway Proving Ground, Tooele County, Utah: Utah Geological Survey Open-File Report.

Robinson, J.P., 1993, Provisional geologic map of the Gold Hill quadrangle, Tooele County, Utah: Utah Geological Survey Map 140, 19 p., scale 1:24,000.

Rodgers, D.W., 1989, Geologic map of the Deep Creek Mountains wilderness study area, Tooele and Juab Counties, Utah: U.S. Geological Survey Miscellaneous Field Studies Map MF-2099, scale 1:50,000.

Shaver, M., 1997, Discovering early American lifestyles on Dugway Proving Grounds: Utah Geological Survey, Survey Notes, v. 30, no. 1, p. 1-3.

Shubat, M.A., and Snee, L.W., 1992, High-precision $^{40}Ar/^{39}Ar$ geochronology, volcanic stratigraphy and mineral deposits of Keg Mountain, west-central Utah, *in* Thorman, C.H., editor, Applications of structural geology to mineral and energy resources of the central and western United States: U.S. Geological Survey Bulletin 2012, p. G1-G16.

Stamatakos, J.A., Chen, R., McCann, M.W., and Chowdhury, A.H., September 1999, Seismic ground motion and faulting hazard at Private Fuel Storage Facility in the Skull Valley Indian Reservation, Tooele County, Utah (final report): Center for Nuclear Waste Regulatory Analyses, San Antonio, Texas, NRC contract NRC-02-97-009.

Steiger, J.I., and Freethey, G.W., 2001, Groundwater hydrology of Dugway Proving Ground and adjoining area, Tooele and Juab Counties, Utah: U.S. Geological Survey Water-Resources Investigations report 00-4240, 2 plates.

Stein, H.J., Bankey, Viki, Cunningham, C.G., Zimbelman, D.R., Brickey, D.W., Shubat, M., Campbell, D.L., and Podwysocki, M.H., 1989, Tooele 1° x 2° quadrangle, northwest Utah -- a CUSMAP preassessment study: U.S. Geological Survey Open-File Report 89-0467, 134 p., 22 pl.

Stephen, J.C., 1974, Hydrogeologic reconnaissance of the north Great Salt Lake Desert: Utah Department of Natural Resources Technical Publication 42, 55 p.

Thompson, K.C., 1973, Mineral deposits of the Deep Creek Mountains, Tooele and Juab Counties, Utah: Utah Geological and Mineralogical Survey Bulletin 99, 76 p., 2 plates, scale 1:63,360.

Tooker, E.W., 1983, Variations in structural style and correlation of thrust plates in the Sevier foreland thrust belt, Great Salt Lake area, Utah, *in* Miller, D.M., editor, Tectonic and stratigraphic studies in the eastern Great Basin: Geological Society of America Memoir 157, p. 61-73.

Tooker, E.W., and Roberts, R.J., 1971, Structures related to thrust faults in the Stansbury Mountains, Utah: U.S. Geological Survey Professional Paper 750-B, p. B1-B12.

Utah Department of Highways, 1966, Materials inventory, Tooele County, 25 p.

Utah Geological Survey, 2000, Human occupation along the Old River Bed: Utah Geological Survey, Survey Notes, v. 32, no. 2, p. 7.

Utah Geological Survey and New Mexico Geochronology Research Laboratory, in preparation, $^{40}Ar/^{39}Ar$ geochronology results for Dugway Proving Ground and adjacent areas, Tooele County, Utah: Utah Geological Survey Open-File Report.

Wakelin-King, G.A., 1999, Banded mosaic ("tiger bush") and sheetflow plains – A regional mapping approach: Australian Journal of Earth Sciences, v. 46, p. 53-60.

Whelan, J.A., 1970, Radioactive and isotopic age determinations of Utah rocks: Utah Geological and Mineralogical Survey Bulletin 81, 75 p.

Young, W.E., January 8, 1959, Examination Report – Beryl-bearing pegmatite dikes, Granite Mountain, Tooele County, Utah: Unpublished report, U.S.B.M. Mineral Property File [UGS UMOS files].

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SOURCES OF GEOLOGIC MAP DATA

Geologic mapping data, numbers correspond to index map.

1. Oviatt, C.G. (Kansas State University), 2006-2007, field and photogeologic mapping
2. Oviatt, C.G. (Kansas State University), and Clark, D.L. (Utah Geological Survey), 2006-2007, field and photogeologic mapping
3. Page, D. (Desert Research Institute), 2006-2007, field and photogeologic mapping of Old River Bed delta channel systems
4. Clark, D.L., Biek, R.F., Willis, G.C., Brown, K.D., Kuehne, P.A., Ehler, J.B., and Ege, C.L., in preparation, Reconnaissance geologic map of the Granite Peak and Sapphire Mountain area, U.S. Army Dugway Proving Ground, Tooele County, Utah: Utah Geological Survey Open-File Report, scale 1:24,000.
5. Maurer, R.E., 1970, Geology of the Cedar Mountains, Tooele County, Utah: Salt Lake City, University of Utah, Ph.D. dissertation, 184 p., 10 plates, scale 1:43,700.
6. Moore, W.J., and Sorensen, M.L., 1977, Reconnaissance geologic map of northern Simpson Mountains, Davis Mountain, and adjacent areas, Tooele County, Utah: U.S. Geological Survey Miscellaneous Field Studies Map MF-905, 1 plate, scale 1:48,000.
7. Staatz, M.H., 1972, Geologic map of the Dugway Proving Ground SW quadrangle, Tooele County, Utah: U.S. Geological Survey Map GQ-992, 1 plate, scale 1:24,000.
8. Kelley, D.L., Yambrick, R.A., 1988, Map showing wallrock alteration and geology of the Dugway mining district, northern Dugway Range, Tooele County, Utah: U.S. Geological Survey Miscellaneous Field Studies Map MF-2045, 1 plate, scale 1:12,000.
9. Sack, D., 1993, Quaternary geologic map of Skull Valley, Tooele County, Utah: Utah Geological Survey Map 150, 16 p., 1 plate, scale 1:100,000.

Additional data sources used in map preparation.

Cook, K.L., Bankey, V., Mabey, D.R., and DePangher, M., 1989, Complete Bouguer gravity anomaly map of Utah: Utah Geological and Mineral Survey Map 122, scale 1:500,000.

Johnson, J.B., Jr., and Cook, K.L., 1957, Regional gravity survey of parts of Tooele, Juab, and Millard Counties, Utah: Geophysics, v. 22, no. 1, p. 48-61.

Morris, H.R., 1987, Preliminary geologic structure map of the Delta 2° quadrangle and adjacent areas, west-central Utah: U.S. Geological Survey Open-File Report 87-189, scale 1:250,000.

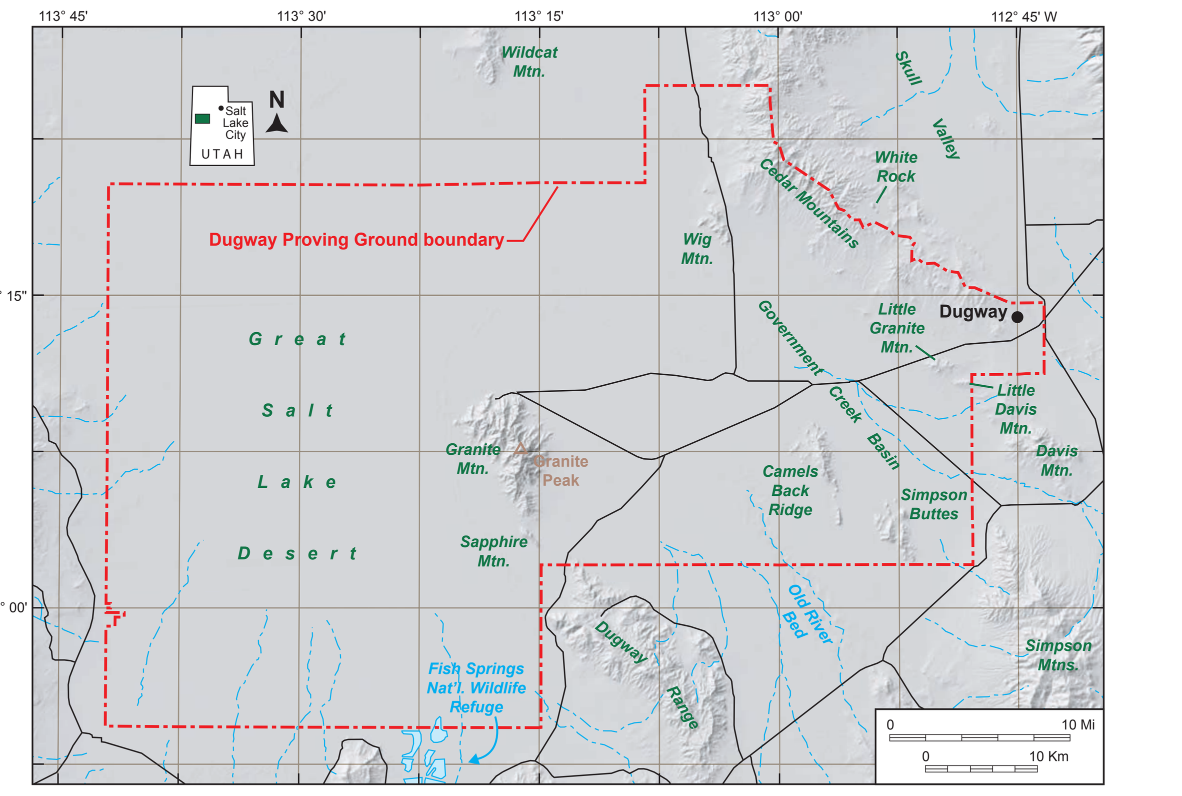


Figure 1. Location map showing primary geographic features associated with Dugway Proving Ground and adjacent areas.

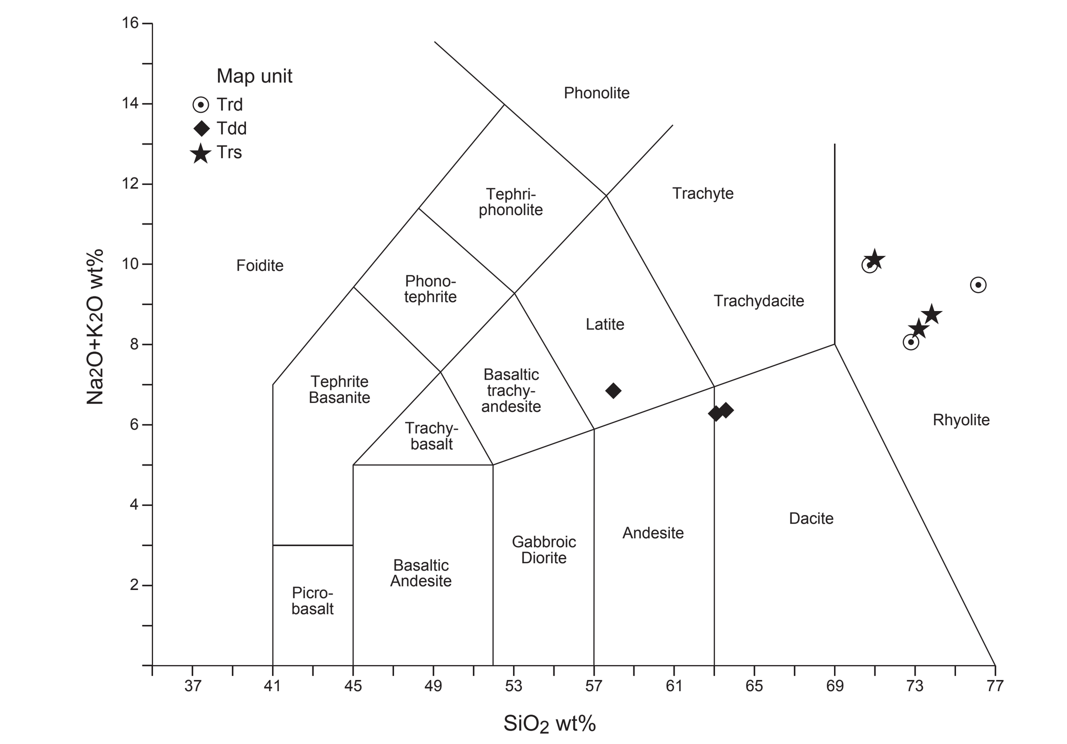


Figure 2. Total alkali-silica classification diagram of LeBas and others (1986) for intrusive rocks from Granite Mountain and extrusive rocks from Sapphire Mountain.

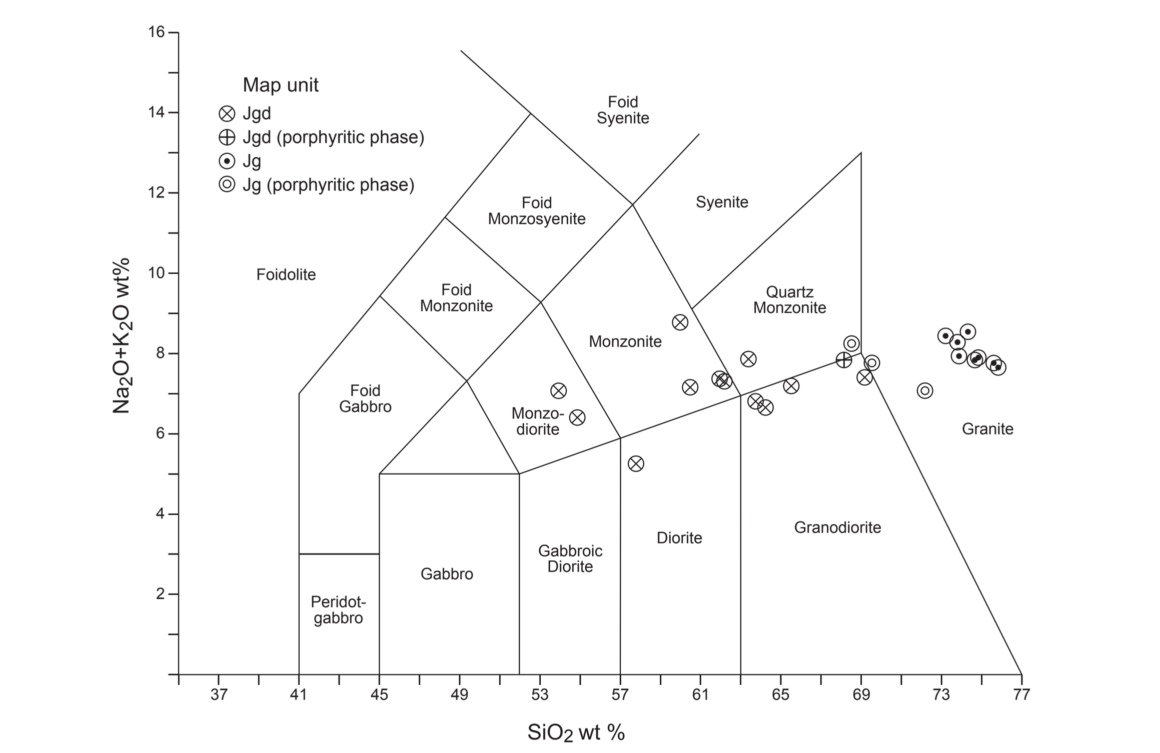


Figure 3. Total alkali-silica classification diagram of LeBas and others (1986) for plutonic rocks from Granite Mountain.

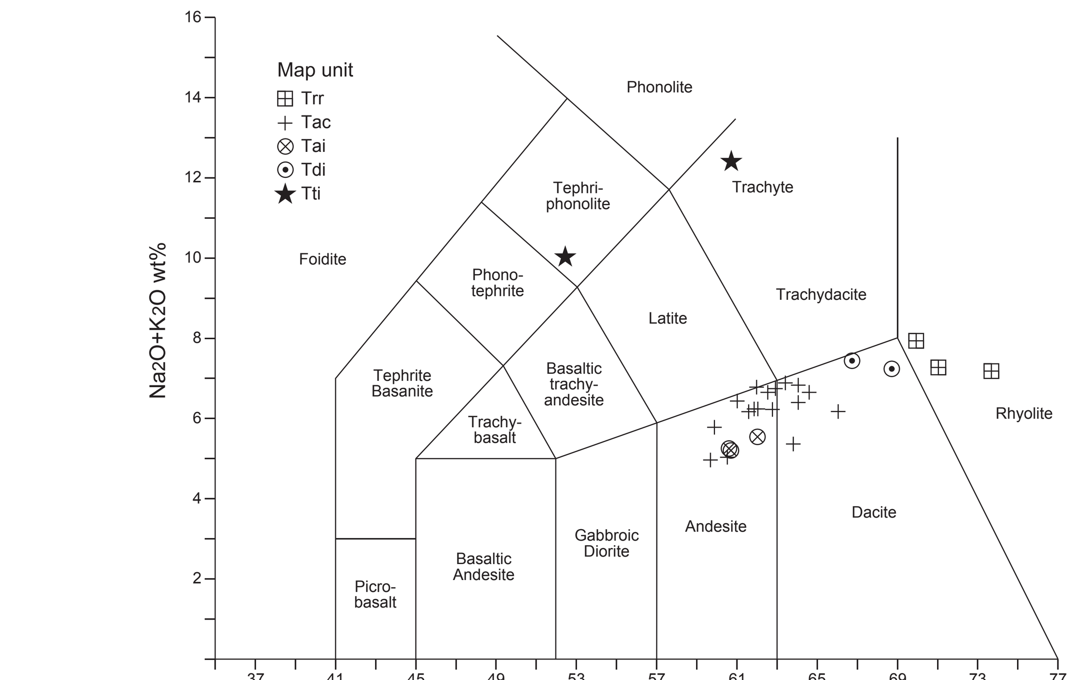


Figure 4. Total alkali-silica classification diagram of LeBas and others (1986) for extrusive and intrusive rocks from southern Cedar Mountains and northern Dugway Range.

Maurer (1970)

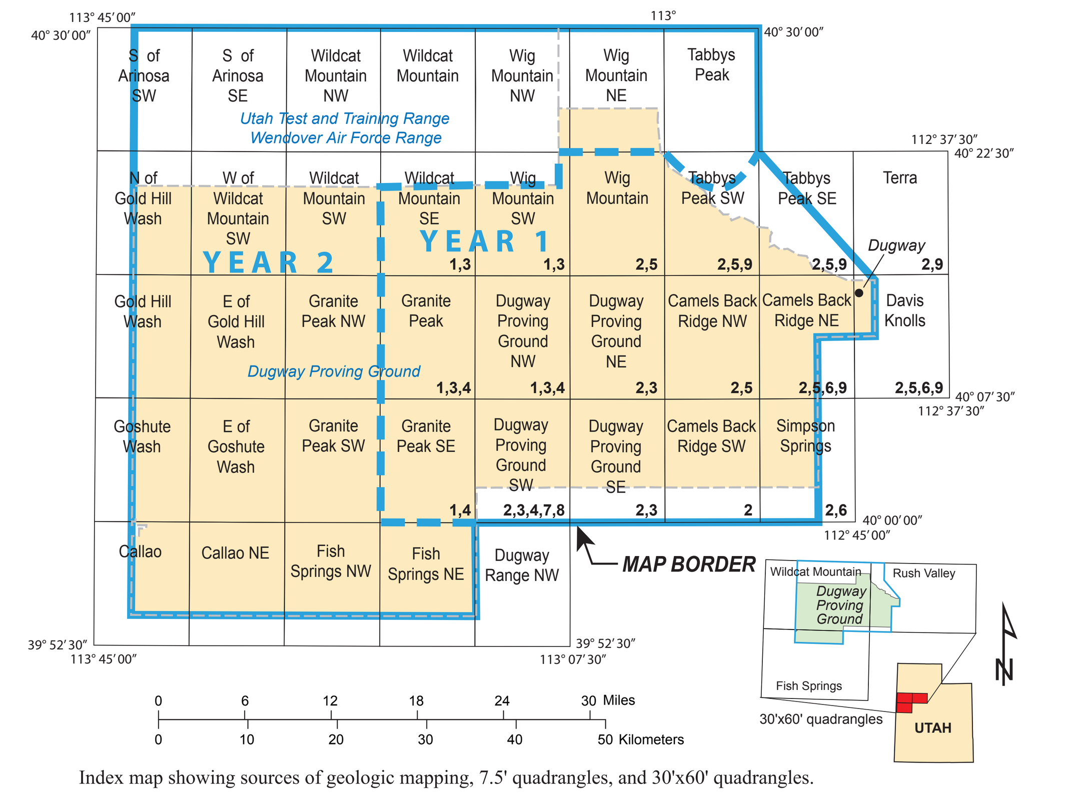
Time-stratigraphic unit		Cochran Spring section Feet (Meters)	Overall Feet (Meters)	Oquirrh Formation unit
PERMIAN	Wolfcampian	340 (104)	1935+ - 2750 (590+ - 838)	Unit 5
PENNSYLVANIAN	Virgilian	2762 (842)	2762 - 3000 (842 - 915)	Unit 4
PENNSYLVANIAN	Desmoi.- Misso.	2556 (779)	2556 - 3000+ (779 - 915+)	Unit 3
PENNSYLVANIAN	Morrowan - Atokan	715 (218)	715 - 1400 (218 - 427)	Unit 2
MISS.	?— Chest.	434 (132)	434 (132)	Unit 1
		6807 (2075)	8402+ - 10,584+ (2562+ - 3229+)	

This Map

Map unit		Cochran Spring section Feet (Meters)	Overall Feet (Meters)	Time-stratigraphic unit	
ℙPo	Pofc	2690 (1820)	*	Wolfcampian	PERMIAN
ℙPo		—?— fault —?—			
ℙPo	ℙobm	1020? (310?)	*	Misso.-Virgil.	PENNSYLVANIAN
ℙPo	ℙobp	2660 (810)	*	Atokan-Desmoinesian	PENNSYLVANIAN
ℙPo	ℙowc	435 (133)	*	Morrowan	PENNSYLVANIAN
		6805 (2075)			

* To be determined

Figure 5. Comparison of Lower Permian to Upper Mississippian stratigraphy of the southern Cedar Mountains. The stratigraphy used in this map for the Oquirrh Group largely follows that of the Bingham mining district/Oquirrh Mountains developed by Welsh and James (1961), Tooker and Roberts (1970), and Swenson (1975).



Index map showing sources of geologic mapping, 7.5' quadrangles, and 30'x60' quadrangles.