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STATE OF OREGON
DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES
DONALD A. HULL, STATE GEOLOGIST

Geologic Map of the Damascus Quadrangle, Clackamas and Multnomah Counties, Oregon

1994

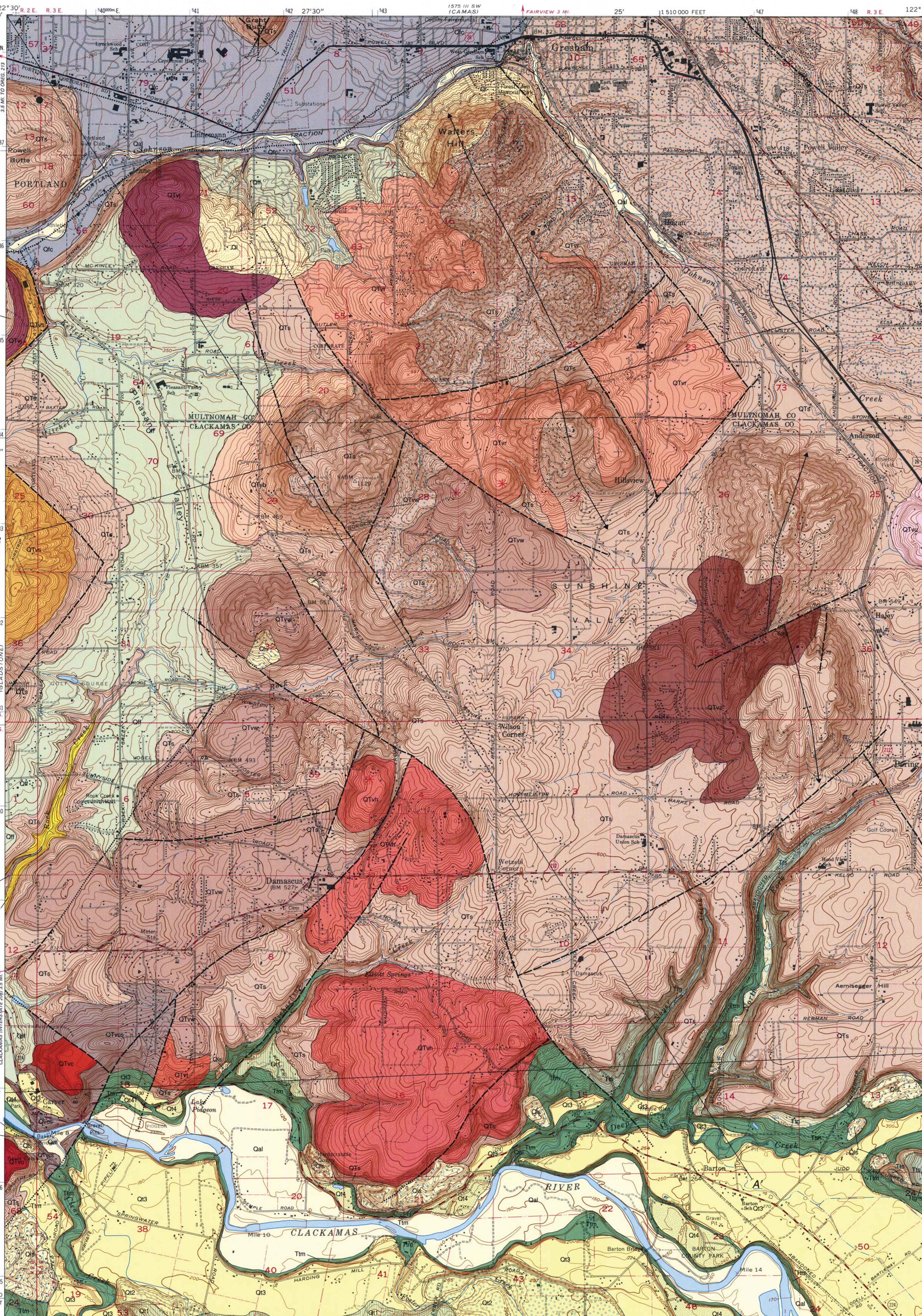
GMS-60

Geologic Map of the Damascus Quadrangle, Clackamas and Multnomah Counties, Oregon

By Ian P. Madin

Funded by the Oregon Department of Geology and Mineral Industries and the U.S. Geological Survey under awards 1434-93-G-2324 and 14-08-0001-AO512

Plate 1



Base map by U.S. Geological Survey, 1961, revised 1984
Control by USGS and NOS/NOAA, and State of Oregon
Polyconic projection. 1927 North American Datum
10,000-foot grid based on Oregon coordinate system, north zone
1000-meter Universal Transverse Mercator grid ticks, zone 10
National geodetic vertical datum of 1929

NORTH

SCALE 1:24 000

CONTOUR INTERVAL 10 FEET

OREGON
QUADRANGLE LOCATION

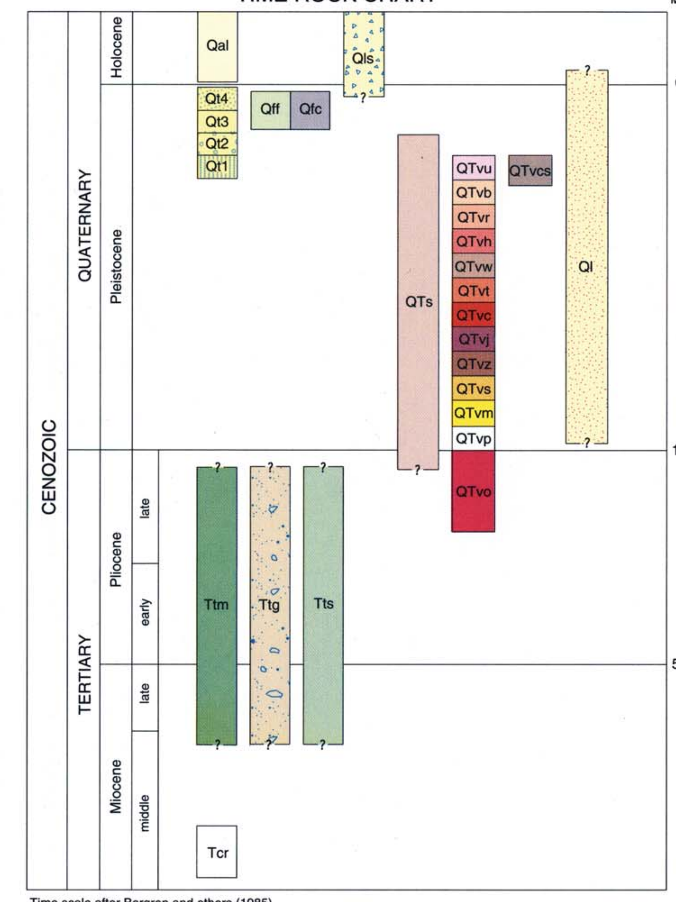
Geology by Ian P. Madin, Oregon Department of Geology and Mineral Industries

Field work conducted 1990-92

Cartography by Paul E. Staub

The geologic information on this map is available in digital formats

TIME ROCK CHART



Time scale after Bergren and others (1985).

EXPLANATION OF MAP UNITS

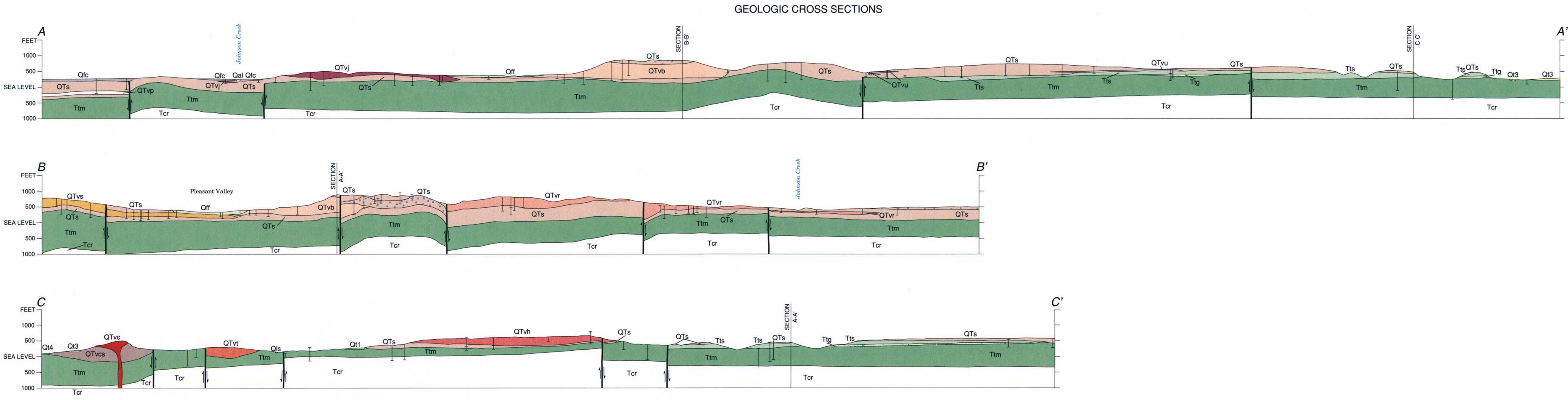
(see accompanying text for complete geologic explanation)

Qal	Alluvium (Quaternary)
Qls	Landslides (Quaternary)
	Strath terraces (Pleistocene)
Qt4	Strath terrace (Pleistocene)
Qt3	Strath terrace (Pleistocene)
Qt2	Strath terrace (Pleistocene)
Qt1	Strath terrace (Pleistocene)
	Catastrophic flood deposits (Pleistocene)
Qff	Fine-grained facies (Pleistocene)
Qfc	Coarse-grained facies (Pleistocene)
Ql	Loess (Pleistocene to Holocene)
	Boring Lava (Pliocene to Pleistocene)
QTvu	Undifferentiated Boring Lava (Pleistocene)
QTvb	Basalt of Borges Road (Pleistocene)
QTvr	Basalt of Rodlun Road (Pleistocene)
QTvh	Basalt of Hardscrabble (Pleistocene)
QTvw	Basalt of Winston Road (Pleistocene)
QTvt	Basalt of Tong Road (Pleistocene)
QTvc	Basalt of Carver (Pleistocene)
QTvcs	Volcanic sandstone and conglomerate (Pleistocene)
QTvj	Basalt of Jenne (Pleistocene)
QTvz	Basalt of Zion Hill (Pleistocene)
QTvs	Basalt of Mount Scott (Pleistocene)
QTvm	Basalt of Mount Talbert (Pleistocene)
QTvp	Basalt of Powell Butte (Pleistocene) (shown only in cross section)
QTvo	Basalt of Outlook (Pliocene)
QTs	Springwater Formation (Pliocene? to Pleistocene)
	Troutdale Formation (Miocene-Pliocene)
Ttg	Troutdale Formation Conglomerate (Miocene-Pliocene)
Tts	Troutdale Formation volcaniclastic sandstone (Miocene-Pliocene)
Ttm	Troutdale Formation mudstone and siltstone (Miocene-Pliocene)
Tcr	Columbia River Basalt Group (middle Miocene) (shown only in cross section)

MAP SYMBOLS

- Contact--Approximately located
- Fault--dashed where approximate; dotted where concealed; ball and bar on downthrown side
- Anticline axis
- Strike and dip of bedding
- Possible volcanic vent

GEOLOGIC CROSS SECTIONS



Analytical Data, Damascus Quadrangle, Clackamas and Multnomah Counties, Oregon

1994

By Ian P. Madin

Plate 2

Table 1. Geochemical data for Boring Lava, Damascus Quadrangle, Clackamas and Multnomah Counties, Oregon

								Oxides (wt. percent)												Trace elements (ppm)												
Unit	Sample no.	UTM coordinates	Elevation (ft)	Outcrop quality[1]	Lab[2]	Radiometric age	Magnetic polarity	SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O	P_2O_5	Total	Cr	Rb	Sr	Y	Zr	Nb	Ba	Ni	Sc	V	Ga	Cu	Zn
QTvb	DA 9090	542080E 5033350N	750	B outcrop	XRAL	--	--	54.24	1.13	18.56	1.9	6.34	0.16	6.8	6.94	3.09	0.63	0.2	100	238	13	563	13	105	21	254	--	--	--	--	--	--
QTvb	DA 9090-92	542080E 5033350N	750	B outcrop	Conrey	510±8	Normal	54.42	1.19	18.09	1.91	6.36	0.14	6.86	6.94	3.13	0.73	0.24	100	237	6	487	24	134	--	265	137	--	168	--	56	74
QTvr	DA 9154A	545460E 5035060N	480	Float	XRAL	--	--	54.79	1.21	17.79	1.81	6.03	0.13	5.42	7.81	3.79	0.97	0.25	100	139	25	761	-10	129	20	331	--	--	--	--	--	--
QTvr	DA 9149A	544860E 5036100N	500	Float	XRAL	--	--	54.93	1.28	17.9	1.97	6.58	0.14	4.83	7.53	3.66	0.92	0.26	100	129	19	661	24	131	24	356	--	--	--	--	--	--
QTvr	DA 9145	543450E 5036720N	400	A outcrop	XRAL	--	--	55.79	1.18	18.05	1.87	6.23	0.12	4.31	7.46	3.79	0.97	0.24	100	105	14	709	15	133	18	356	--	--	--	--	--	--
QTvr	DA 9103	543170E 5035060N	550	Float	XRAL	--	--	54.33	1.29	18.39	1.85	6.18	0.14	5.16	7.94	3.56	0.87	0.28	100	142	26	697	19	145	27	286	--	--	--	--	--	--
QTvr	DA 9139	543990E 5035680N	960	Float	XRAL	--	--	53.82	1.35	20.01	2.05	6.82	0.15	5.5	6.31	3.23	0.51	0.25	100	126	19	655	15	148	17	380	--	--	--	--	--	--
QTvr	DA 9154B	545460E 5035060N	480	A outcrop	XRAL	--	--	55.11	1.23	17.76	1.83	6.1	0.12	5.05	7.81	3.75	0.99	0.26	100	133	25	761	14	152	32	340	--	--	--	--	--	--
QTvr	DA 9157C	544740E 5034560N	710	Float	XRAL	--	--	55.4	1.24	18.26	1.85	6.18	0.14	4.87	7.08	3.7	1.04	0.24	100	126	21	676	-10	135	19	360	--	--	--	--	--	--
QTvr	DA 9104	543550E 5035760N	730	C outcrop	XRAL	--	--	55.86	1.22	18.31	1.82	6.08	0.14	4.62	6.99	3.73	0.97	0.25	100	124	24	674	13	147	21	289	--	--	--	--	--	--
QTvr	DA 9160	545780E 5034540N	430	Cuttings	XRAL	--	--	55.22	1.21	17.83	1.78	5.94	0.13	5.14	7.78	3.75	0.99	0.23	100	132	26	770	24	142	12	334	--	--	--	--	--	--
QTvr	DA 9120	543130E 5034280N	550	A outcrop	XRAL	--	Weak reverse	55.6	1.3	18.71	2	6.65	0.12	4	6.94	3.49	0.95	0.24	100	132	17	643	29	128	22	431	--	--	--	--	--	--
QTvr	DA 9121	542950E 5034480N	510	B outcrop	XRAL	--	--	54.75	1.22	17.74	1.8	6.01	0.14	5.42	7.99	3.73	0.94	0.23	100	125	21	720	15	131	23	285	--	--	--	--	--	--
QTvr	DA 9121RC	542950E 5034480N	510	B outcrop	Conrey	--	--	54.56	1.33	17.67	1.86	6.19	0.13	5.47	7.98	3.58	0.93	0.3	100	182	9	651	21	148	--	249	97	--	180	--	59	77
QTvh	DA-9028	542880E 5026090N	350	A outcrop	XRAL	612±23	Normal	56.16	1.14	18.38	1.75	5.85	0.13	4.41	7.2	3.66	1.02	0.3	100	87	24	655	32	121	19	271	--	--	--	--	--	--
QTvh	DA-9049	542500E 5026300N	360	A outcrop	XRAL	--	Normal	55.9	1.13	17.9	1.75	5.84	0.13	4.36	7.69	4.05	1	0.25	100	103	32	742	154	12	234	--	--	--	--	--	--	--
QTvh	DA-9050A	544050E 5029310N	580	B Outcrop	XRAL	--	--	57.04	1.08	17.74	1.66	5.54	0.12	4.07	7.35	4.03	1.1	0.26	100	95	25	709	19	154	12	280	--	--	--	--	--	--
QTvh	DA-9054	543030E 5030430N	800	C outcrop	XRAL	--	--	56.04	1.22	18.78	1.84	6.14	0.14	3.99	5.79	4.65	1.12	0.27	100	90	12	555	24	182	17	407	--	--	--	--	--	--
QTvh	DA 9077	544550E 5027520N	820	Float	XRAL	--	--	56.1	1.18	18.5	1.84	6.13	0.14	4.46	6.93	3.57	0.93	0.25	100	122	17	693	19	130	17	369	--	--	--	--	--	--
QTvh	DA 9055	542750E 5029870N	700	Foundation	Conrey	--	--	56.31	1.25	18.88	1.81	6.02	0.12	4.36	6.46	3.58	0.91	0.3	100	84	9	553	22	188	--	335	52	--	147	--	66	83
QTvw	DA 9174	542960E 5032980N	625	Foundation	WSU	--	--	53.76	1.51	17.46	2.08	6.95	0.14	6.12	7.1	3.52	0.93	0.43	100	183	14	489	24	161	14.4	286	118	26	179	20	39	84
QTvw	DA 9063	541180E 5027880N	400	Float	Conrey	--	--	53.03	1.44	17.13	2.08	6.95	0.15	6.6	7.88	3.45	0.9	0.39	100	227	8	510	33	162	--	305	134	--	164	--	63	85
QTvw	DA-9052	540350E 5028500N	400	C outcrop	Conrey	--	--	52.7	1.5	17.31	2.13	7.11	0.15	6.69	7.58	3.55	0.86	0.42	100	214	7	511	28	164	--	351	130	--	149	--	57	79
QTvw	DA-9051	540200E 5028570N	370	C outcrop	XRAL	--	--	52.88	1.49	17.69	2.17	7.25	0.16	6.27	7.3	3.47	0.92	0.39	100	204	15	500	34	157	20	325	--	--	--	--	--	--
QTvw	DA-9053	540350E 5028500N	430	Float	XRAL	--	--	52.23	1.44	17.65	2.14	7.12	0.17	6.62	7.97	3.45	0.81	0.4	100	198	19	544	34	153	305	--	--	--	--	--	--	--
QTvw	DA 9062	541100E 5029260N	520	Float	XRAL	--	--	52.84	1.45	17.72	2.12	7.06	0.17	6.35	7.82	3.34	0.78	0.36	100	207	28	549	19	146	25	280	--	--	--	--		--
QTvw	DA 9135	541850E 5031940N	700	Foundation	XRAL	--	--	51.26	1.59	18.33	2.11	7.04	0.16	6.63	8.12	3.77	0.68	0.31	100	217	20	734	-10	155	31	499	--	--	--	--	--	--
QTvw	DA 9079	540390E 5029390N	435	Float	XRAL	--	--	53.35	1.38	17.41	2.08	6.94	0.16	6.29	7.76	3.45	0.84	0.34	100	197	21	537	21	145	31	295	--	--	--	--	--	--
QTvw	DA 9061	541830E 5032280N	630	Float	XRAL	--	--	51.91	1.63	18.56	2.2	7.34	0.17	5.85	7.91	3.33	0.68	0.43	100	211	13	564	25	140	15	376	--	--	--	--	--	--
QTvw	DA 9161	543900E 5033540N	840	Cuttings	XRAL	--	--	53.1	1.46	18.01	2.08	6.94	0.16	5.6	7.99	3.56	0.75	0.35	100	181	25	602	16	143	22	369	--	--	--	--	--	--
QTvw	DA 9170	541600E 5031180N	600	A outcrop	XRAL	646±27	Normal																									
QTvt	DA 9167	540650E 5027370N	400	Pipetrench	WSU	--	--	58.95	0.93	19.71	1.53	5.09	0.11	3.57	5.79	3.35	0.8	0.17	100	40	6	717	14	118	6.3	277	31	21	127	17	27	65
QTvt	DA 9064	541070E 5027120N	300	C outcrop	XRAL	--	--	57.7	0.87	19.23	1.48	4.93	0.12	3.68	7.45	3.61	0.78	0.14	100	57	1010	31	85	12	182	--	--	--	--	--	--	--
QTvt	DA-9015B	540710E 5026950N	170	A outcrop	XRAL	--	Normal	57.05	0.87	18.82	1.47	4.88	0.12	3.86	8.03	3.89	0.85	0.16	100	50	27	1050	75	149	--	--	--	--	--	--	--	--
QTvt	DA 9069	541140E 5027270N	350	C outcrop	XRAL	--	--	57.81	0.87	19.41	1.45	4.84	0.11	3.63	7.41	3.6	0.74	0.14	100	56	12	1010	25	94	169	--	--	--	--	--	--	--
QTvt	DA-9068	541250E 5027400N	390	Foundation	Conrey	--	Normal	57.81	0.89	19.05	1.46	4.88	0.11	3.71	7.31	3.77	0.82	0.17	100	67	4	844	16	101	--	178	34	--	156	--	18	65
QTvc	DA-9041A	539620E 5027050N	300	A outcrop	XRAL	--	--	50.88	1.31	15.71	1.98	6.62	0.15	8.66	9.02	3.65	1.53	0.49	100	362	26	1410	29	130	18	646	--	--	--	--	--	--
QTvc	DA-9048B	540980E 5027000N	450	A outcrop	XRAL	--	--	50.88	1.23	15.52	1.94	6.46	0.14	9	9.33	3.46	1.53	0.48	100	345	20	1390	19	142	16	613	--	--	--	--	--	--
QTvc	DA-9035	539900E 5026680N	100	A outcrop	XRAL	427±26	--	51.55	1.19	16.74	1.8	6	0.14	8.2	9.26	3.62	1.13	0.38	100	308	14	1180	82	16	417	--	--	--	--	--	--	--
QTvc	DA 9043	539990E 5027040N	425	Float	Conrey	--	--	50.7	1.32	16.02	1.98	6.61	0.14	8.91	8.79	3.39	1.45	0.67	100	397	13	1260	23	156	--	758	224	--	226	--	64	87
QTvc	DA 9044	540060E 5027280N	460	A outcrop	Conrey	--	--	50.95	1.35	15.85	1.99	6.63	0.13	8.78	8.73	3.4	1.63	0.57	100	338	13	1395	22	166	--	920	192	--	212	--	84	76
QTvj	DA 912420	540800E 5036650N	600	Cuttings	XRAL	--	--	52.74	1.2	16.46	1.79	5.95	0.12	7.61	8.86	3.78	1.14	0.35	100	280	26	1380	25	124	14	500	--	--	--	--	--	--
QTvj	DA 9097A	540810E 5036720N	560	Float	XRAL	--	--	51.59	1.34	17.76	1.95	6.49	0.14	7.95	7.67	3.52	1.19	0.4	100	332	1060	11	125	11	590	--	--	--	--	--	--	--
QTvj	DA 9102B	539240E 5035530N	320	A outcrop	XRAL	832±128	Normal	52.31	1.26	16.79	1.8	6	0.13	7.6	8.7	3.85	1.17	0.39	100	305	38	1310	125	29	487	--	--	--	--	--	--	--
QTvj	DA 9101	540380E 5036530N	375	Float	XRAL	--	--	51.87	1.31	17.39	1.9	6.34	0.15	7.75	8.11	3.61	1.21	0.35	100	320	16	1130	28	104	24	544	--	--	--	--	--	--
QTvz	DA 9172	546720E 5030550N	645	Float	WSU	--	--	54.3	1.13	16.97	1.82	6.07	0.13	6.89	7.92	3.69	0.8	0.26	100	329	8	567	21	130	11.4	203	166	30	150	17	78	77
QTvz	DA 9128	547720E 5031870N	850	C outcrop	XRAL	--	--	48.14	1.53	23.24	2.48	8.28	0.19	9.45	4.59	1.59	0.24	0.27	100	404	-10	219	16	157	-10	373	--	--	--	--	--	--
QTvz	DA 9084	547160E 5031550N	860	B outcrop	XRAL	--	Normal	52.72	1.29	18.64	2.1	7.01	0.17	7.55	6.49	2.98	0.78	0.27	100	405	542	25	138	26	270	--	--	--	--	--	--	
QTvz	DA 9081	546585E 5030190N	680	Float	XRAL	--	--	53.43	1.16	17.43	1.96	6.53	0.14	7.43	7.59	3.31	0.77	0.24	100	363	20	613	24	119	15	260	--	--	--	--	--	--
QTvz	DA 9078	547020E 5030370N	675	Float	Conrey	--	--	53.26	1.2	17	1.9	6.34	0.14	7.91	7.91	3.2	0.86	0.28	100	398	8	559	25	135	--	230	179	--	172	--	63	77
QTvs	DA 9102 ARC	539240E 5035530N	320	A outcrop	Conrey	--	Reverse	48.93	1.47	17.79	2.7	9	0.18	6.88	9.76	2.95	0.2	0.14	100	223	1	321	28	101	--	66	143	--	174	--	67	78
QTvs	DA 9118 (G9047)	539580E 5033110N	630	Float	XRAL	--	--	49.37	1.34	17.51	2.57	8.57	0.19	7.15	9.98	2.99	0.2	0.12	100	195	21	311	26	94	24	116	--	--	--	--	--	--
QTvs	GS 9041B	538740E 5035860N	250	A outcrop	XRAL	--	Normal	49.09	1.47	17.35	2.69	8.95	0.21	6.87	10.03	3	0.23	0.12	100	196	305	16	105	129	--	--	--	--	--	--		
QTvs	DA 9097B	540810E 5036720N	430	Float	XRAL	--	--	49.05	1.36	17.76	2.63	8.78	0.21	6.99	9.94	2.95	0.2	0.12	100	217	14	296	32	86	19	114	--	--	--	--	--	--
QTvs	GS 9045	537770E 5034900N	600	Foundation	XRAL	--	--	50.06	1.38	17.61	2.52	8.39	0.21	7.06	9.16	3.04	0.37	0.21	100	217	11	447	34	101	10	255	--	--	--	--	--	--
QTvs	DA 9102A	539240E 5035530N	320	A outcrop	XRAL	711±20	Reverse	49.11	1.34	17.39	2.7	8.99	0.19	7.14	10	2.86	0.14	0.13	100	237	10	296	12	68	10	145	--	--	--	--	--	--
QTvs	GS 9046	538090E 5033650N	570	C outcrop	XRAL	--	--	49.06	1.3	17.82	2.5	8.35	0.19	7.41	10.08	2.99	0.18	0.11	100	202	309	22	83	16	95	--	--	--	--	--	--	
QTvs	GS 9041A	538740E 5035860N	250	A outcrop	XRAL	--	--	49.33	1.35	17.47	2.58	8.59	0.18	7.38	9.84	2.97	0.18	0.12	100	203	21	294	18	84	13	92	--	--	--	--	--	--
QTvm	GS 9017	535180E 5029840N	490	Float	Conrey	--	--	52.16	1.49	18.74	1.92	6.42	0.13	5.9	8.17	3.95	0.74	0.38	100	225	2	901	19	154	--	461	129	--	206	--	39	88
QTvm	GS 9010	534900E 5030370N	555	Float	Conrey	--	--	50.19	1.52	16.72	2.37	7.91	0.16	7.93	9.17	3.19	0.57	0.26	100	292	5	527	30	116	--	292	152	--	215	--	70	86
QTvm	GS 9008	534430E 5030480N	165	B outcrop	Conrey	--	--	48.49	1.46	17.39	2.59	8.62	0.19	7.77	9.06	3.1	0.26	0.22	99.15	242	1	467	29	105	--	331	152	--	29	--	56	81
QTvm	GS 9009	534420E 5030490N	180	A outcrop	XRAL	--	Reverse	50.4	1.42	17.28	2.43	8.11	0.18	7.01	9.26	3.13	0.52	0.24	100	252	15	581	104	13	313	--	--	--	--	--	--	
QTvm	PC-29	539540E 5029680N	215	B outcrop	XRAL	--	--	48.78	1.44	17.47	2.71	9.04	0.27	8.93	8.7	2.37	0.15	0.14	100	242	14	212	20	82	87	--	--	--	--	--	--	
QTvm	GS 9036	535030E 5030850N	280	Foundation	XRAL	--	--	50.21	1.4	17.74	2.54	8.45	0.21	6.65	9.18	3.03	0.38	0.21	100	219	450	35	105	34	310	--	--	--	--	--	--	
QTvm	GS 9011	535020E 5030400N	615	Float	XRAL	--	--	50.62	1.43	17.08	2.5	8.33	0.19	7.19	8.99	2.96	0.49	0.21	100	208	13	446	16	100	287	--	--	--	--	--	--	
QTvm	GS-9001	537300E 5028670N	210	A outcrop	XRAL	1590±170	Normal	50.02	1.43	17.45	2.42	8.05	0.18	7.15	9.31	3.25	0.51	0.23	100	199	18	509	25	118	17	218	--	--	--	--	--	--
QTvm	GS-9001-92	537300E 5028670N	210	A outcrop	Conrey	--	Normal	50.23	1.43	17.11	2.46	8.19	0.16	7.67	9.11	2.93	0.47	0.23	100	244	4	488	29	106	--	230	125	--	182	--	56	81
QTvp	GS 9044B	538000E 5037170N	370	B outcrop	XRAL	--	Weak Reverse	52.06	1.27	16.33	1.8	6	0.13	7.71	9.06	3.69	1.43	0.52	100	322	30	1800	34	136	14	793	--	--	--	--	--	--
QTvp	GS 9044A	538000E 5037170N	500	Float	XRAL	--	--	51.5	1.34	16.71	1.88	6.26	0.14	8.23	8.45	3.36	1.6	0.54	100	334	25	1580	136	10	851	--	--	--	--	--	--	
QTvp	GS 9044C	538000E 5037170N	280	B outcrop	XRAL	--	Weak Reverse	51.93	1.3	16.48	1.84	6.13	0.13	7.72	8.66	3.72	1.58	0.52	100	321	28	1650	17	128	11	823	--	--	--	--	--	--
QTvo	GS 9028	537650E 5026560N	275	A outcrop	XRAL	--	Reverse	54.65	1.24	17.33	1.88	6.28	0.15	5.56	7.92	3.79	0.9	0.29	100	197	41	772	12	122	15	350	--	--	--	--	--	--
QTvo	GS 9015	534620E 5029700N	260	A outcrop	XRAL	--	Reverse	53.69	1.39	18.38	1.87	6.22	0.13	5.49	7.7	3.87	0.93	0.32	100	213	14	959	132	32	447	--	--	--	--	--	--	
QTvo	GS 9023	536740E 5024890N	580	C outcrop	XRAL	--	Reverse	54.85	1.13	17.77	1.78	5.92	0.13	5.92	7.55	3.79	0.91	0.23	100	212	29	802	13	115	29	356	--	--	--	--	--	--
QTvo	GS 9022	536450E 5025230N	360	A outcrop	XRAL	--	Reverse	54.91	1.29	18.16	1.92	6.4	0.16	5.86	6.57	3.5	0.94	0.29	100	199	672	45	139	23	366	--	--	--	--	--	--	
QTvo	GS 9027	537240E 5025750N	500	B outcrop	XRAL	--	Reverse	55.18	1.24	17.81	1.92	6.41	0.14	5.58	6.82	3.72	0.9	0.28	100	207	29	692	19	130	394	--	--	--	--	--	--	
QTvo	GS 9033	537690E 5025250N	750	B outcrop	XRAL	--	Reverse	55.8	1.22	18.67	1.9	6.34	0.15	5.02	6.04	3.6	1.01	0.26	100	203	32	636	16	144	30	427	--	--	--	--	--	--
QTvo	GS 9021	536060E 5024810N	320	Float	XRAL	--	--	55.21	1.2	17.65	1.81	6.02	0.13	5.82	7.16	3.8	0.96	0.25	100	182	20	738	16	124	303	--	--	--	--	--	--	
QTvo	GS 9019	534990E 5024860N	455	C outcrop	XRAL	--	--	55.32	1.14	17.38	1.77	5.9	0.14	5.5	7.89	3.81	0.92	0.24	100	182	23	823	122	24	331	--	--	--	--	--	--	
QTvo	GS 9031	537300E 5026330N	400	B outcrop	XRAL	--	Reverse	53.98	1.39	18.98	2.12	7.07	0.16	6.06	6.1	3.14	0.72	0.28	100	223	14	596	154	23	516	--	--	--	--	--	--	
QTvo	GS 9025A	536600E 5025220N	375	Float	XRAL	--	--	55.53	1.17	18.37	1.84	6.15	0.15	5.19	6.74	3.71	0.92	0.23	100	196	20	732	12	117	11	347	--	--	--	--	--	--
QTvo	DA 9045	539330E 5026350N	270	A outcrop	XRAL	3,146±62 ka	Reverse	54.85	1.19	17.5	1.85	6.18	0.14	5.58	7.77	3.83	0.84	0.26	100	210	16	803	16	124	23	312	--	--	--	--	--	--
QTvo	GS 9013	534490E 5030180N	245	B outcrop	Conrey	--	Reverse	53.29	1.46	18.48	1.91	6.38	0.13	5.74	7.53	3.7	0.99	0.39	100	225	5	902	22	152	--	571	133	--	190	--	44	89
QTvo	GS 9016 A	534770E 5029100N	145	C outcrop	Conrey	--	--	52.7	1.4	17.8	1.94	6.47	0.13	6.38	7.67	3.72	1.35	0.44	100	191	8	1325	23	146	--	722	149	--	128	--	55	97

1 A outcrop = undisturbed outcrop; B outcrop = definitely outcrop, may be disturbed; C = probably outcrop disturbed

2 Laboratories are: XRAL = X-Ray Assay Laboratories, Dons Mills, Ontario, Canada; WSU = Washington State University GeoAnalytical Laboratory, Pullman, Washington; Conrey = Analyses performed by Richard Conrey at the Isotope Geosciences Laboratory of the Geological Survey of Japan, Tsukuba, Japan

Geology of the Damascus Quadrangle, Clackamas and Multnomah Counties, Oregon

1994

Ian P. Madin, Oregon Department of Geology and Mineral Industries

EXPLANATION OF MAP UNITS

Qal **Alluvium (Quaternary)**—Channel and flood plain deposits of gravel, silt, and sand associated with modern rivers and streams. In the Clackamas River, alluvial deposits are typically cobble gravel with clasts of basalt, andesite, and dacite and subordinate lithic and feldspathic sand. Alluvium in the channel of the Clackamas River is typically thin or absent; much of the river flows across bedrock

Qls **Landslides (Quaternary)**—Slumps and rockfalls. Most large landslides occur on Troutdale Formation mudstone, but some also occur on Springwater Formation conglomerate, probably where it is deeply weathered. Two spectacular rockfalls occur where the Clackamas River has undermined cliffs of Boring Lava overlying Springwater Formation conglomerate and Troutdale Formation mudstone. One rockfall is located just south of the Clackamas River at Carver and involves the basalt of Outlook; the other occurs north of the Clackamas River near Hardscrabble Quarry, and involves the basalt of Hardscrabble. The slide at Hardscrabble Quarry consists of jumbled blocks of lava up to 10 m (33 ft) covering about 33 ha (90 acres). The landowner reports an extensive talus cave system within the rockfall debris

Strath terraces (Pleistocene)—Strath terraces cut by the Clackamas River into bedrock units. The planed bedrock surfaces are typically capped by sandy cobble gravel deposits up to 9 m (30 ft) thick. The gravel is typically composed of basalt, andesite, and dacite lava with feldspathic-lithic sand matrix. Four distinct terraces are differentiated based on height above the current flood plain on a profile perpendicular to the gross modern channel trend. The four terraces probably represent four ages of terrace formation related to Pleistocene glaciation in the Cascade Range or changes in downstream base level associated with Pleistocene catastrophic flood events

Qt4 **Strath terrace 4 (Pleistocene)**—Surface elevation typically 15 m (50 ft) above the modern flood plain. Scattered remnants preserved largely along the north side of the Clackamas River. Mapped as Quaternary alluvium or Quaternary terrace deposits by Trimble (1963)

Qt3 **Strath terrace 3 (Pleistocene)**—Surface elevation typically 24 m (80 ft) above the modern flood plain. Well preserved along both sides of the Clackamas River and up major tributaries. Underlies the broad flats near Barton and along Springwater Road southeast of Carver. Trimble (1963) mapped this unit mostly as Estacada Formation of late Pleistocene age, partly as Quaternary terrace deposits

Qt2 **Strath terrace 2 (Pleistocene)**—Terrace surface typically 39 to 45 m (130 to 150 ft) above modern flood plain. Terraces preserved only along the south side of the Clackamas River within the map area. Mapped by Trimble (1963) as Gresham Formation of late Pleistocene age

Qt1 **Strath terrace 1 (Pleistocene)**—Oldest terrace; surface elevation approximately 52 to 58 m (170 to 190 ft) above modern flood plain. Scattered remnants occur north and south of the Clackamas River. Mapped by Trimble (1963) as Gresham Formation

Catastrophic flood deposits (Pleistocene)—Boulder to pebble gravel; sandy gravel, sand, and silt containing high percentages of Columbia River basalt clasts and representing high-energy, subfluvial deposition during catastrophic floods caused by the repeated failure of the glacial ice dam that impounded glacial Lake Missoula (Bretz and others, 1956; Baker and Nummedal, 1978; Waitt, 1985; Allen and others, 1986). Date of most recent catastrophic flood is estimated to be 15,500 to 13,000 years B.P. (Mullineaux and others, 1978; Waitt, 1987). Within map area, flood sediments are subdivided into two facies listed below:

Qff **Fine-grained facies (Pleistocene)**—Coarse sand to silt deposited by catastrophic floods. The finer sediments are predominantly quartz and feldspar and also contain white mica. The coarser sediments are predominantly Columbia River basalt fragments. Poorly defined beds 0.3 to 1 m (1 to 3 ft) thick are observed in outcrop. Soil development commonly introduces significant clay into the upper 2–3 m (5–10 ft) of the deposits. The fine sediments are up to 18 m (60 ft) thick and mantle slopes up to an elevation of 122 m (400 ft)

Qfc **Coarse-grained facies (Pleistocene)**—Pebble to boulder gravel with silt and coarse sand matrix. The coarse sediments are poorly sorted and subrounded to well rounded and range from openwork gravel to gravel with a considerable amount of fine-grained matrix material. Clasts are largely basalt, but other lithologies may dominate downstream from bedrock exposures. The coarse flood sediments are up to 15 m (50 ft) thick in the map area

Ql **Loess (Holocene to Pleistocene)**—Tan to dark-brown quartzo-micaceous silt and fine sand. Loess up to 15 m (50 ft) thick drapes the northern slopes of the northernmost hills in the map area. Typically the loess is massive silt with abundant pedogenic clay and coarse sand-sized iron oxide nodules. In some exposures (e.g., Grant Butte, NW¼ sec. 17, T. 1 S., R. 3 E.), the loess consists of fine-laminated and cross-laminated sand. The loess mantles units QTvj (basalt of Jenne), QTvh (basalt of Hardscrabble), QTvr (basalt of Rodlun Road), and QTs (Springwater Formation) and is therefore late Pleistocene to Holocene in age. The age of similar deposits in the Portland Hills were estimated by Lentz (1981) as 34,000 to 700,000 years

Boring Lava (Pleistocene to Pliocene)—Light-gray to gray, diktytaxitic, olivine- (less commonly plagioclase-) phyric basalt and basaltic andesite flows and associated scoria erupted from a series of local vents. Boring Lava flows typically display blocky to columnar jointing, and, if preserved, vesicular flow tops. Twelve chemically distinct Boring Lava flows or groups of flows occur in the map area (Figure 1, Table 1 on Plate 2). Contact relations are rarely observed, but channel filling is clearly common. Individual flow unit characteristics are summarized below:

QTvu **Undifferentiated Boring Lava (Pleistocene)**—Basalt flows of unknown chemistry. Unsampled flows are present at the surface along the eastern edge of the map and as thin layers in the subsurface in the central part of the map. Those that crop out in sec. 25, T. 1 S., R. 3 E. (Ken Lite, personal communication, 1994) probably originate from a vent located about 1 mi east of the eastern edge of the map in sec. 30, T. 1 S., R. 4 E. (Lite, 1992). The radiometric age and magnetic polarity are also unknown

QTvb **Basalt of Borges Road (Pleistocene)**—Flow or flows of basalt and associated scoria restricted to the hill just north of Borges Road in sec. 29, T. 2 S., R. 3 E. Maximum thickness penetrated in water wells is at least 145 m (475 ft), but this section may be deformed. Magnetic polarity is normal; the radiometric age is 510±8 ka (personal communication, R. Duncan, Oregon State University, 1993) from the only exposure located on Wooded Hills Road near the center of sec. 29, T. 3 E., R. 1 S. The vent may be located on the west flank of the hill described above, where there is a strong positive aeromagnetic anomaly (Figure 2)

QTvr **Basalt of Rodlun Road (Pleistocene)**—Flow or series of flows up to 50 m (170 ft) thick covering large regions in the hills just south of Gresham. All measured outcrops have normal magnetic polarity. The radiometric age is 544±25 ka (personal communication, R. Duncan, Oregon State University, 1993) from a sample taken from a roadcut in the NW¼SE¼ sec. 22, T. 1 S., R. 3 E. A possible vent may be located at the small conical hill in the SW¼NW¼ sec. 27, T. 1 S., R. 3 E, which is associated with a strong positive aeromagnetic anomaly (Figure 2)

QTvh **Basalt of Hardscrabble (Pleistocene)**—Flow or series of flows forming a broad plateau south and southeast of Damascus. All measured outcrops have normal magnetic polarity. Excellent exposures in Hardscrabble Quarry (sec. 17, T. 2 ,S., R. 3 E.) indicate that one flow was at least 45 m (150 ft) thick. The radiometric age is 612±23 ka (personal communication, R.. Duncan, Oregon State University, 1992) at Hardscrabble Quarry. One likely vent for these flows is a small conical hill in the NW¼ sec. 15, T. 2 S., R. 3 E., which is associated with a strong positive aeromagnetic anomaly (Figure 2). This basalt is chemically very similar to the basalt of Rodlun Road but can be distinguished by higher SiO_2 and lower TiO_2, MgO, and Cr (Table 1, Plate 2)

QTvw **Basalt of Winston Road (Pleistocene)**—Flow or flows with associated scoria located to the west and north of Damascus, up to 110 m (360 ft) thick. The radiometric age is 646±27 ka (personal communication, R. Duncan, Oregon State University, 1993) from a cut on Winston Road just east of Foster Road. All measured outcrops have normal magnetic polarity. The likely vent is located in the SW¼NE¼ sec. 28, T. 1 S., R. 3 E. A water well at this site penetrated over 30 m (100 ft) of unit QTvw scoria. The unit is associated with a moderate positive aeromagnetic anomaly (Figure 2)

QTvt **Basalt of Tong Road (Pleistocene)**—Flow or flows of basaltic andesite or andesite forming a small body north of the Clackamas River and west of Tong Road (secs. 8 and 18, T. 2 S., R. 3 E.). The basalt may be as much as 61 m (200 ft) thick but covers only about 60 ha (160 acres). The chemistry is significantly different from the other units (Table 1, Plate 2), with relatively high Al_20_3 and SiO_2 and low TiO_2 and MgO. There is neither an obvious vent nor strong aeromagnetic signature

QTvc **Basalt of Carver (Pleistocene)**—Basalt flows, scoria, and at least one dike form a small volcanic edifice north of the Clackamas River at Carver. The dike intrudes volcaniclastic sandstone and scoria conglomerate (unit QTvcs), which is capped by unit QTvc flows. Most exposures are too deeply weathered for radiometric dating. Samples of the dike were dated at 427±26 ka (personal communication, R. Duncan, Oregon State University, 1991). The vent for this flow was probably in the modern Clackamas River channel just upstream of Carver. A moderately strong positive magnetic anomaly is associated with this unit (Figure 2)

QTvcs **Volcanic sandstone and conglomerate (Pleistocene)**—Well-lithified crudely-bedded tuffaceous siltstone, sandstone, and pebble conglomerate. Restricted to the area immediately around the unit QTvc vent at Carver. Massive to well bedded; composed largely of vitric silt and sand, angular to subrounded pebbles and cobbles of scoria, basalt, and rare quartzite, and feldspathic and lithic sand with some mica

QTvj **Basalt of Jenne (Pleistocene)**—Basaltic scoria and at least one flow making up the hill south of the communities of Jenne and Linneman. The flow or flows are up to 18 m (60 ft) thick. At the eastern foot of the hill in sec. 24, T. 1 S., R. 2 E., a flow directly overlies a flow of basalt of Mount Scott. The flow is normally magnetically polarized and has a radiometric age of 832±128 ka (personal communication, R. Duncan, Oregon State University, 1992). The vent is probably the bowl-shaped depression in the SE¼ sec. 18, T. 1 S., R. 3 E. The vent area is associated with a modest positive aeromagnetic anomaly (see Figure 2)

QTvz **Basalt of Zion Hill (Pleistocene)**—Flow or flows of basalt and associated scoria mantling the hills immediately north of Boring and in the subsurface along the eastern edge of Sunshine Valley. The basalt is up to 61 m (200 ft) thick. Magnetic polarity measured on samples from one poor outcrop was normal. No samples were sufficiently fresh for radiometric dating. A significant negative magnetic anomaly (see Figure 2) is associated with this basalt

QTvs **Basalt of Mount Scott (Pleistocene)**—Flows of basalt and associated scoria capping hills along the western edge of the map area and probably in the subsurface throughout Pleasant Valley. The basalt is up to 78 m (260 ft) thick in the map area. Extensive flows make up an irregular plateau extending over several square miles west of the western edge of the map area, and most of the chemical analyses that define this unit come from the adjacent Gladstone quadrangle. One flow directly underlies a flow of basalt of Jenne on the eastern flank of the hill in sec. 24, T. 1 S., R. 2 E., and has a radiometric age of 711±20 ka (personal communication, R. Duncan, Oregon State University, 1992). Samples from outcrops have both normal and reversed magnetic polarity. A moderate positive aeromagnetic anomaly is associated with this unit (Figure 2). There are no obvious vents in the map area, although the presence of a volcanic bomb of this basalt recovered from the north slope of the hill in sec. 18, T. 1 S., R. 3 E., suggests a nearby vent

QTvm **Basalt of Mount Talbert (Pleistocene)**—Flow or flows of basalt and associated scoria exposed in Rock Creek along the southwestern edge of the map area in sec. 6, T. 2 S., R. 3 E. These exposures are the eastern edge of a thin sheet that extends in the subsurface to the west for about 3 km (2 mi) into the Gladstone quadrangle. The western edge of the unit in the Gladstone quadrangle is marked by Mount Talbert, a conical hill composed of this basalt. Most of the chemical analyses that define this unit come from the adjacent Gladstone quadrangle. Most of the measured outcrops have reversed magnetic polarity. The radiometric age of the unit is 1,590±170 ka (personal communication, R. Conrey, Washington State University, 1993) from a sample taken from a roadcut in the SW¼NW¼ sec. 11, T. 2 S., R. 2 E. (Gladstone quadrangle). The unit has no clear aeromagnetic signature. Mount Talbert is the likely vent

QTvp **Basalt of Powell Butte (Pleistocene)**—Flow or flows of basalt, present only in the subsurface in the northeast corner of the map area. The unit also mantles the northwest slopes of Powell Butte in the adjacent Gladstone quadrangle. All of the chemical analyses that define this unit come from the adjacent Gladstone quadrangle, where samples from the only measurable outcrop have reversed magnetic polarity

QTvo **Basalt of Outlook (Pliocene)**—A flow or series of flows up to 60 m (200 ft) thick that underlie a broad plateau south of the Clackamas River and west of Carver in the adjacent Gladstone and Oregon City quadrangles. This basalt is exposed only in the extreme southwest corner of the map, and most of the chemical analyses that define it come from the adjacent Gladstone quadrangle. The radiometric age of 3,146±62 ka (personal communication, R. Duncan, Oregon State University, 1993) comes from a sample taken from the cliff immediately south of Bakers Bridge at Carver. All measured outcrops of the unit had reversed magnetic polarity. A likely vent for these flows is the hill just south of the community of Outlook, about 1.6 km (1 mi) southwest of the southwest corner of the map area

QTs **Springwater Formation (Pleistocene to Pliocene?)**—Fluvial conglomerate, volcaniclastic sandstone, siltstone, and debris flows derived from the Cascade Range. The conglomerate is moderately indurated and typically consists of well-rounded pebbles, cobbles, and boulders of basalt, andesite, and dacite with rare exotic metamorphic and plutonic rocks. The sand and silt conglomerate matrix contains varying amounts of feldspathic and volcanic lithic and vitric sediment. The conglomerate is commonly massive and profoundly weathered. Weathered conglomerates are strongly varicolored in reds, browns, gray-greens, and oranges. Fresh material is more typically gray and brown. Debris flows consist of angular to rounded clasts of basalt, andesite and dacite lava, scoria, and pumice in a matrix of clay, ash, and sand. Sandstone ranges from fine to coarse and is composed of volcanic lithic, vitric, and feldspathic sand, rarely micaceous. Siltstones and mudstones consist of quartzofeldspathic silt, ash, and clay.

The basal contact is probably conformable with the underlying Troutdale Formation and may be gradational. South of the Clackamas River, the top of the Springwater Formation appears to be part of a deeply weathered bajada surface that is well developed to the south and east of the map area and rises eastward to the foothills of the Cascade Range. This surface was originally noted by Trimble (1963). In most of the map area north and west of Noyer Creek and Highway 212, the Springwater surface is not obvious, either because it is deformed or was never developed. Boring Lava commonly overlies or is interbedded with Springwater Formation rocks. Includes rocks mapped by Trimble (1963) as Gresham, Troutdale, and Walters Hill Formations.

The Springwater Formation is predominantly conglomerate, but locally the sandstone and siltstone units are significant. Exposure in the map area is typically not good enough to map the conglomerate and sandstone-siltstone facies as separate units; instead a pattern is applied in areas where there is significant sandstone and siltstone

Troutdale Formation (Pliocene to Miocene)—Moderately to poorly indurated mudstone, siltstone, sandstone, and conglomerate. This unit includes coarse- and fine-grained fluvial sedimentary rocks with varied provenance, including sediments with exotic origins- presumably carried by the ancestral Columbia River and sediments of local origin. Part of the Troutdale Formation was shown by Tolan and Beeson (1984) to be Miocene to Pliocene in age in the Columbia River Gorge east of the map area. The age of the unit in the map area is poorly constrained. The stratigraphic and facies relationships between these lithologies are poorly understood, so for the purpose of this map, the following purely lithologic units are mapped:

Ttg **Troutdale Formation conglomerate (Pliocene to Miocene)**—Massive pebble and cobble conglomerate composed largely of Columbia River Basalt Group clasts with a significant percentage of metamorphic quartzite, granitoids, and schist. Feldspathic and arkosic micaceous sand matrix and interbeds are common. This unit correlates with unit Ttug of Lite (1992). Exposed only in the North Fork Deep Creek, Noyer Creek, and as small channel fills (not shown on map) in Troutdale Formation mudstone near Carver

Tts **Troutdale Formation volcaniclastic sandstone (Pliocene to Miocene)**—Massive to well-bedded volcanic-lithic and vitric sandstone with some siltstone, locally micaceous. Exposed only in the North Fork Deep Creek and Noyer Creek. Correlates with unit Ttus of Lite (1992)

Ttm **Troutdale Formation mudstone and siltstone (Pliocene to Miocene)**—Mudstone and siltstone with sandstone, rare conglomerate, and water-laid tuff. Predominantly arkosic or feldspathic and micaceous, with some lithic and vitric layers. Blue-green to gray fresh, oxidizing gray-green to brown. Typically thin bedded or laminated in siltstones, sandstone, and tuffs. Claystone is typically massive or pervasively cut by anastomosing slickensided shear surfaces. Organic material, wood, and logs are locally common. This unit was mapped by Trimble (1963) as the lacustrine Sandy River Mudstone, but ripple, channel, and trough cross bedding are common, indicating fluvial origin. Correlates with unit Ttl of Lite (1992)

Tcr **Columbia River Basalt Group (middle Miocene)**—Miocene tholeiitic flood-basalt flows that were erupted from long linear fissure systems in northeastern Oregon, eastern Washington, and western Idaho from approximately 17 to 6 Ma (Swanson and others, 1979; Hooper, 1982). Formally divided into five formations (Swanson and others, 1979) and a host of mappable members and units (Swanson and others, 1979; Beeson and others, 1985; Reidel and others, 1989); in other areas within the Damascus quadrangle the Columbia River basalt is not exposed and is known only from deep borings. Samples from a well near Damascus were identified [(personal communication, Marvin Beeson, Portland State University, 1994)] as basalt of Sand Hollow from the Frenchman Springs Member of the middle Miocene Wanapum Basalt

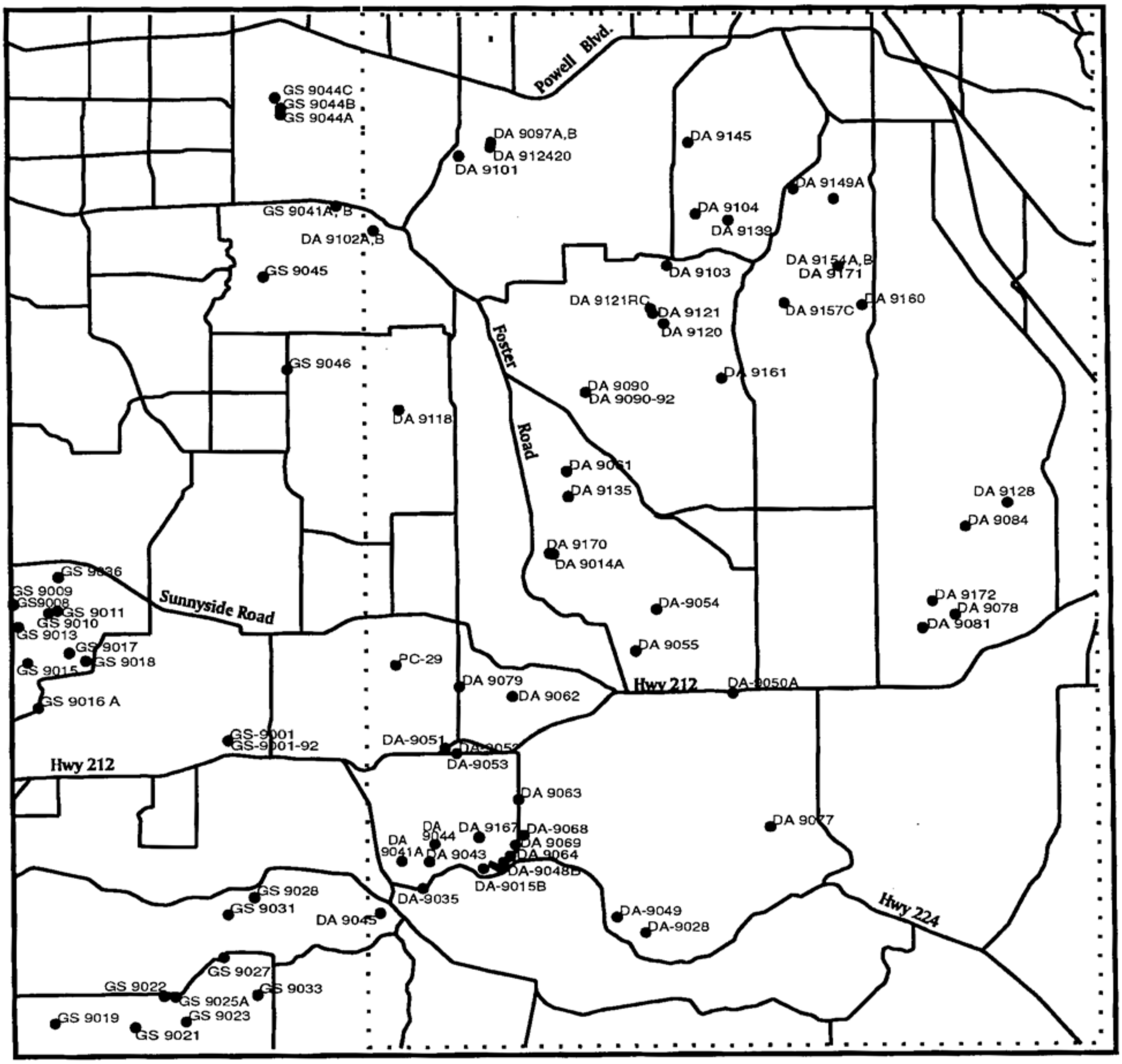


Figure 1.
Geochemical sample location map. Heavy lines are major arteries. Dotted line is Damascus quadrangle border.

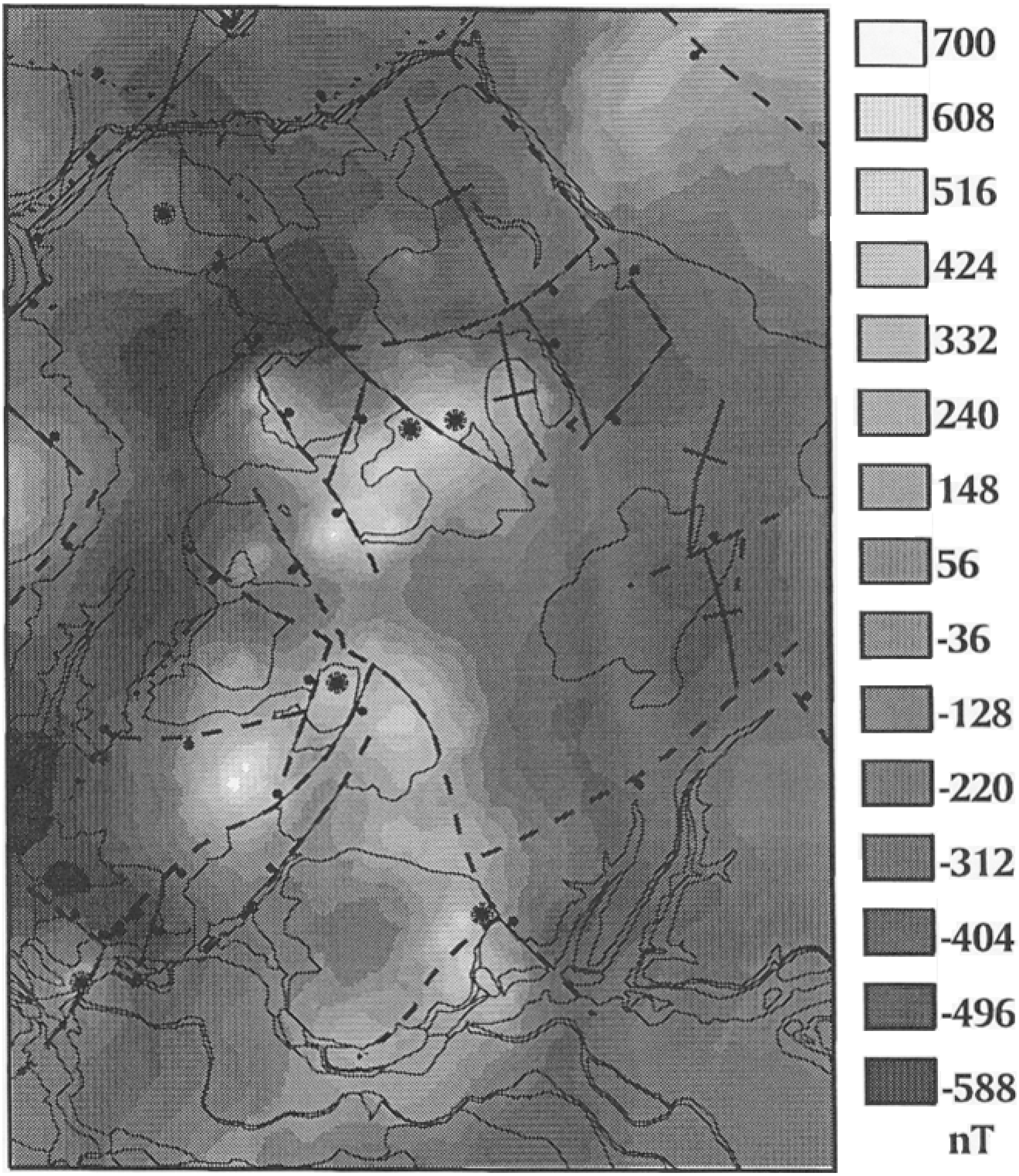


Figure 2.
Aeromagnetic map of the Damascus quadrangle. Interpolated total field data from Snyder and others, 1993.

STRUCTURE

The structure of the Damascus quadrangle is complex, and natural exposures of contact relations, faults, folds, or even bedding are rare. There are few distinctive lithologies in any of the sedimentary units. Therefore, the structure is best understood by analysis of water-well records (Figure 3). The various Boring Lava flows and, to a lesser extent, major sedimentary units serve as markers. Topography and rare fault or bedding exposures fill out the picture.

The quadrangle can be roughly divided into three distinct structural domains: a southern domain south of the Clackamas River, a central domain between the Clackamas River and Johnson Creek (covering the major portion of the map), and a northern domain north of Johnson Creek.

Southern domain

South of the Clackamas River and onto the adjacent Redlands quadrangle, the structure consists of gently north- and west-dipping Springwater and Troutdale Formation rocks (George Priest, personal communication, 1993). Boring Lava is essentially absent, and the topography is dominated by the Springwater surface, which is incised by the strath terraces.

Central domain

Between the Clackamas River and Johnson Creek, the topography is dominated by the Boring Hills, conical or elongated hills that typically rise 105 to 210 m (350 to 700 ft) above the surrounding plateau, which may be a remnant of the Springwater surface. Structurally, most of the Boring Hills are either doubly plunging folds, fault-bounded folds, or fault blocks (see cross sections). One notable exception is the hill in sec. 18, T. 1 S., R. 3 E., which is a small cinder cone associated with basalt of Jenne. Folds are suggested by topography and bedding attitude in some instances (secs. 35 and 36, T. 2 S., R. 3 E., Walters Hill) or topography and outcrop pattern (secs. 22 and 27, T. 2 S., R. 3 E.). Fault-bounded blocks are defined by offset contacts and in some cases (southwest of Rodlun Road in sec. 21, T. 1 S., R. 3 E.) by steeply dipping to overturned bedding. Few of the faults in the central structural domain can be traced more than a few kilometers, and there are few data to constrain fault dips. Strike-slip motion on several of the faults is suggested by the changing sense of dip-slip. The only fault plane exposed (sec. 12, T. 2 S., R. 2 E., in Rock Creek) dips 60° NE, with rare horizontal slickensides and no evidence for sense of slip. The overall pattern is a network of northeast- and northwest-trending faults that bound the uplifted or folded hills. This pattern of fault-bounded rhombic domains suggests strike-slip or oblique slip on northwest- or northeast-trending faults. This style of faulting is consistent with interpretations of the Portland Basin as an area of right-lateral strike-slip faulting (Tolan and Beeson, 1984).

Boring Lava flows or vents are almost exclusively associated with the folded and faulted hills, and few of the hills are volcanic constructions. Most of the hills consist largely of sedimentary rock, with the lava typically located on the flanks. It is likely that the lava was erupted from vents localized by faulting.

Northern domain

North of Johnson Creek, the topography consists of a broad, relatively level plain at an elevation of 90 to 105 m (300 to 350 ft) covered with catastrophic flood gravel. Beneath the flood gravel, the rocks consist of Springwater and/or Troutdale conglomerate with rare interbedded Boring Lava flows. The plateau is broken by rare hills like Grant Butte or Rocky Butte and Kelly Butte (to the north and west on the adjacent Mount Tabor and Gladstone quadrangles). The structure of the plateau is obscured by the gravel cover. The presence of a series of north-side-down faults along Johnson Creek suggests that the northern domain hills may be analogous to the summits of the central domain hills protruding through the gravel cover.

Age of deformation

The youngest deformed rocks in the area are the various Boring Lava and associated Springwater Formation sedimentary rocks. This places the time of faulting as late as late Pleistocene. A fault trench was excavated in fine-grained catastrophic flood sediments in the SE¼ sec. 12, T. 2 S., R. 2 E., by the Oregon Department of Geology and Mineral Industries, Oregon Department of Transportation, and University of Oregon in 1990. The trench was sited across the suspected trace of the northwest trending fault in sec. 12, T. 2 S., R. 2 E., and revealed no conclusive evidence of young faulting, although the catastrophic flood beds were tilted 2° to 3° to the northeast and cut by numerous liquefaction dikes. Elsewhere in the quadrangle, the youngest units, loess, alluvium, strath terraces, and catastrophic flood deposits are not clearly deformed, suggesting that there has been little or no latest Pleistocene or Holocene deformation.

GEOLOGIC HISTORY

The known geologic history of the Damascus quadrangle begins in the Miocene with the eruption of numerous voluminous flows of Columbia River basalt from vents in eastern Oregon and Washington (Swanson and others, 1979; Hooper, 1982). These huge flows traveled west along a broad lowland covering large parts of the Portland area and northern Willamette Valley. As the basalt eruptions waned, parts of the Portland area, including the Damascus quadrangle, began to subside, while others were uplifted, possibly as a result of right-lateral faulting (Tolan and Beeson, 1984; Beeson and others, 1989, 1991). The subsiding area, destined to become the Portland Basin, began to accumulate sediment from the ancestral Columbia River in late Miocene and Pliocene time (Trimble, 1963; Tolan and Beeson, 1984). These sediments (Troutdale Formation) consisted of flood-plain deposits (unit Ttm) and channel deposits (Ttg) distinguished by the presence of exotic lithologies (metamorphic and granitic gravel and minerals). Later during the Pliocene (Tolan and Beeson, 1984), streams draining the western slope of the Cascade Range brought abundant sediment into the subsiding Portland Basin. This sediment, which was largely composed of andesite, dacite, and basalt probably interfingered with the Columbia River-derived sediment, complicated the stratigraphic and facies relations between the Troutdale and Springwater Formations.

Deposition of the Cascade-derived Springwater Formation continued into the Pleistocene, culminating locally in the development of a broad northwest-sloping bajada (Springwater surface of Trimble, 1963). At some time during the middle to late Pleistocene, faulting and associated Boring Lava eruptions occurred in the central and northern domains, possibly extending into the latest Pleistocene. In the southern domain, the late Pleistocene was dominated by incision of the Springwater surface by the Clackamas River and its tributaries. During this time, several changes in the sediment/discharge balance or base level of the Clackamas River resulted in periods of lateral planation, forming the strath terraces. This period of planation probably caused the large rockfalls at Carver and

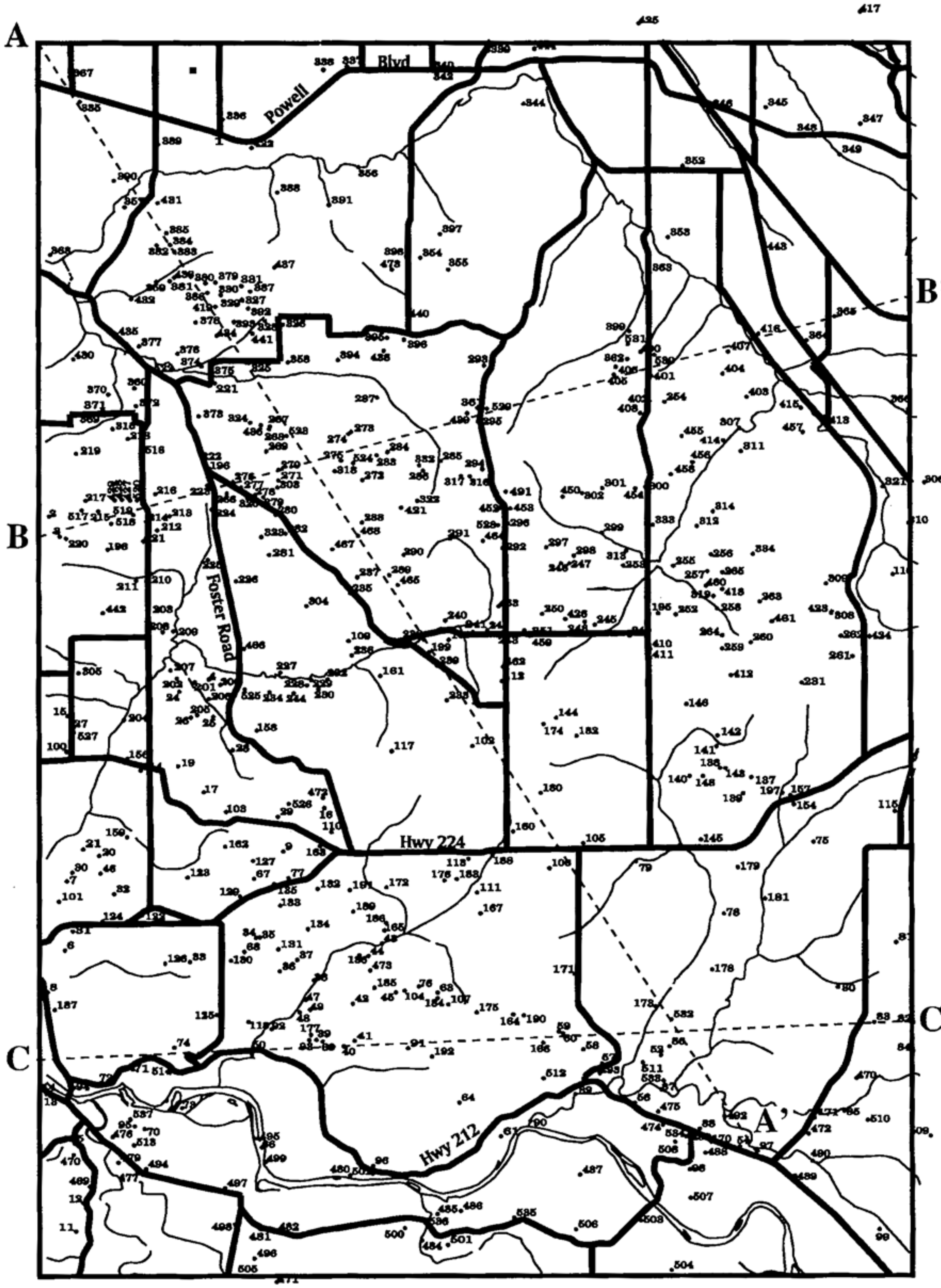


Figure 3.
Water well location map. Fine lines are drainages, heavy lines major arteries, dashed lines cross-sections. Numbers refer to author's unpublished well database.

Hardscrabble Quarry as the river undermined Boring Lava cliffs. These events were probably associated with the late Pleistocene glaciations in the Cascades, which were probably also responsible for the accumulation of loess. At the very end of the Pleistocene, the lowest parts of the Damascus quadrangle were inundated by massive floods released from ice-dammed lakes in Montana. These floods left thick deposits of sand, silt, and gravel on the low flat parts of the quadrangle and scoured hills that stood in their path. The flood apparently overtopped Powell Butte (184 m [600 ft] above sea level) etching linear topography along bedding in the Springwater Formation.

During the Holocene, the Damascus area has been relatively quiet geologically. Minor alluvium is deposited or transported by the Clackamas River and tributaries, and slope processes such as creep and landsliding take place.

The geology of the Damascus area has a significant impact on human activities. Early residents took advantage of the good agricultural soils developed on the catastrophic flood deposits, strath terraces, and the deeply weathered Boring Lava and Springwater Formation. Mineral resources developed in the area included Boring Lava quarried at Carver and Hardscrabble, sand and gravel quarried from numerous sites in Springwater Formation, catastrophic flood sediments and strath terrace deposits, and brick clay quarried from Springwater Formation at Hogan. Large deposits of basalt and aggregate remain throughout the quadrangle; however, competing land uses may severely restrict their development. The varied geology provides unique recreation opportunities for rock climbers at Carver and Hardscrabble Quarry (always check with landowners) and boaters who can float the scenic Clackamas River. The topography born of faulting and volcanic eruptions produced striking scenery that has recently led to significant pressure to develop farm and forest land for housing. Development of both residences and a growing nursery industry are placing increasing demand on the local ground-water resources. Management and understanding of the ground water of the area will be complicated by the complex deformation.

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