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

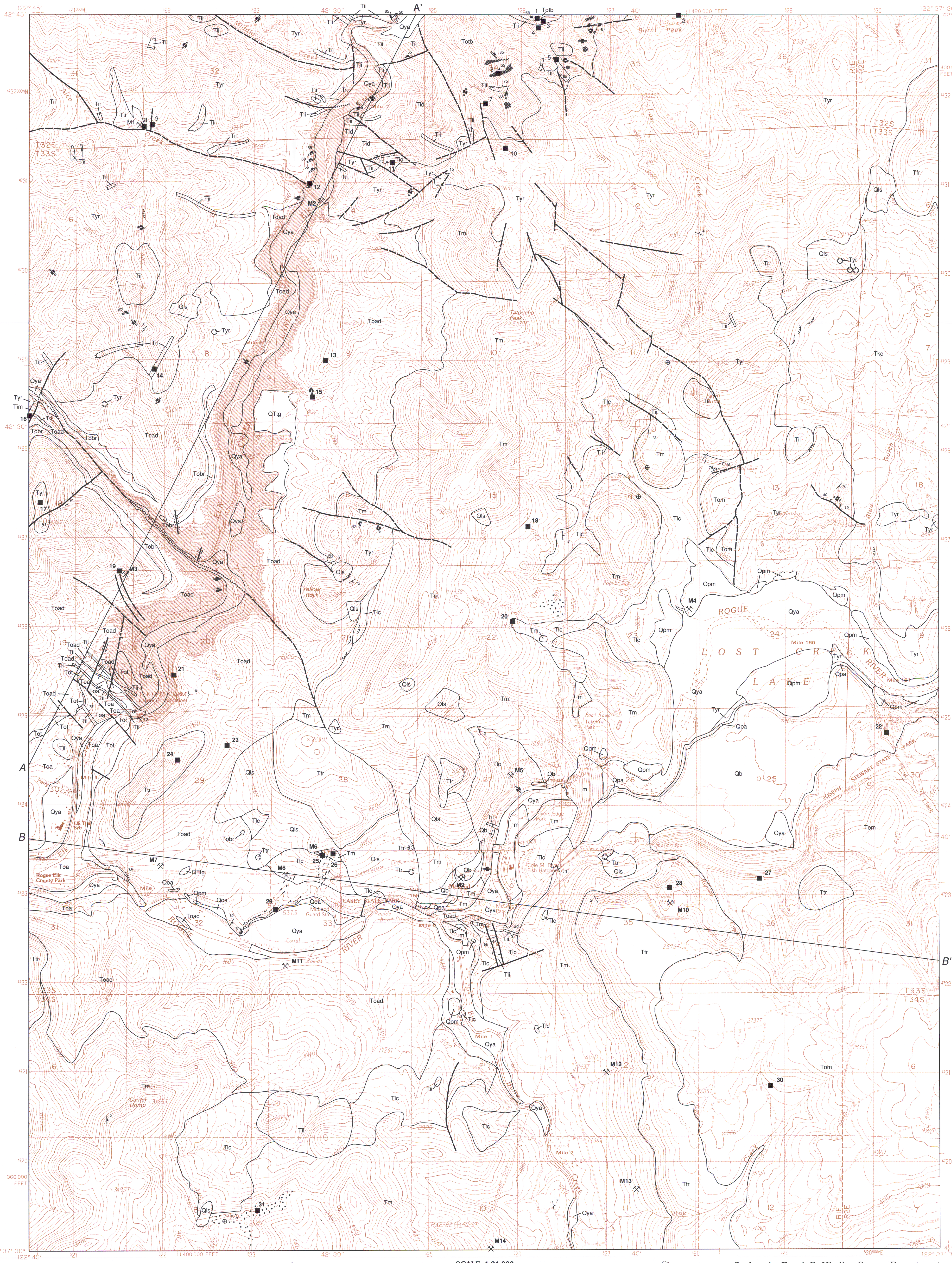
Geology and Mineral Resources Map of the McLeod Quadrangle, Jackson County, Oregon

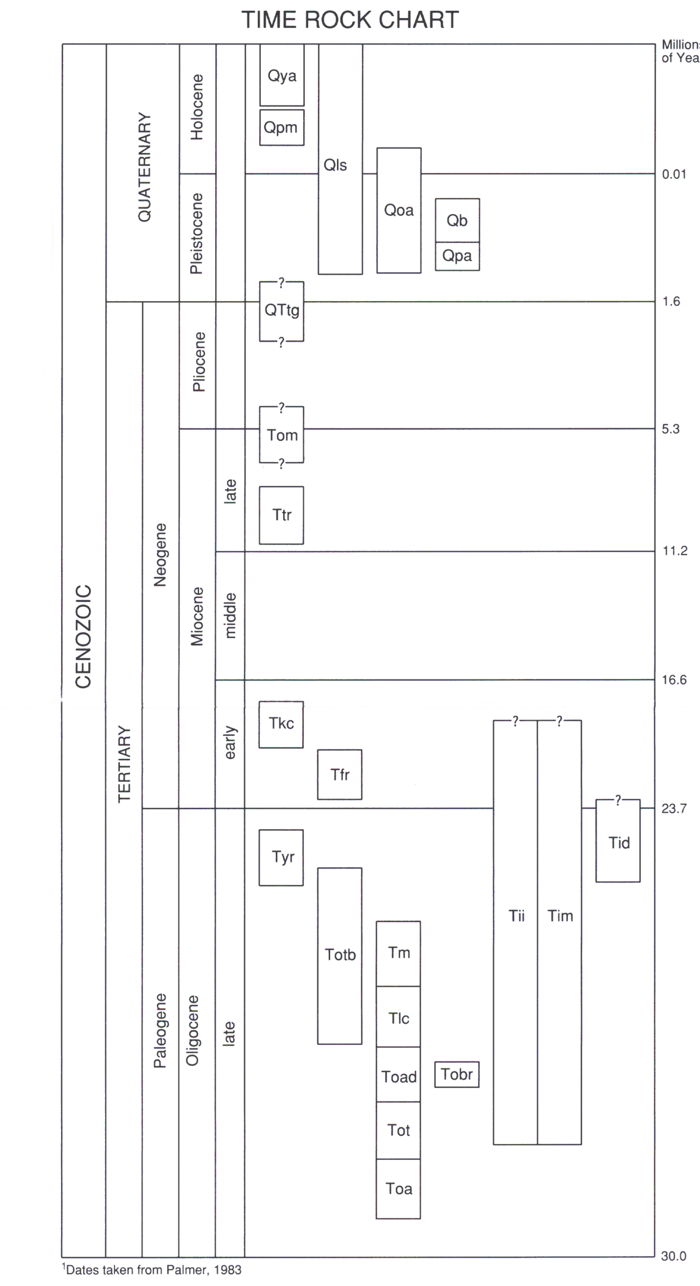
1993

GMS-80

Geology and Mineral Resources Map of the McLeod Quadrangle, Jackson County, Oregon
By F.R. Hladky

Plate 1





EXPLANATION

QUATERNARY DEPOSITS

Qya	Young alluvium (Holocene)
Qpm	Pumice and ash of Mount Mazama (Holocene)
Qls	Landslide deposits (Holocene and Pleistocene)
Qoa	Undifferentiated old alluvium (Holocene and Pleistocene)
Qb	Basalt (Pleistocene)
Qpa	Old alluvium (Pleistocene)

QUATERNARY AND TERTIARY SEDIMENTARY ROCKS

QTtg	Terrace gravel (Pleistocene? and Pliocene?)

TERTIARY (NEOGENE) SEDIMENTARY AND VOLCANIC ROCKS

Tom	Basalt of Olson Mountain (Pliocene? and upper Miocene?)
Ttr	Andesite of Table Rock (upper Miocene)

ANGULAR UNCONFORMITY

Tkc	Andesite of Knighten Creek (lower Miocene)
Tfr	Andesite of Flounce Rock (lower Miocene)

DISCONFORMITY

TERTIARY (PALEOGENE) VOLCANIC ROCKS

Tyr	Tuff of Yellow Rock (upper Oligocene)
Totb	Dacitic tuff breccia (upper Oligocene)
Tm	Andesite of McLeod (upper Oligocene)
Tlc	Tuff of Lost Creek Dam (upper Oligocene)
Toad	Andesite and dacite (upper Oligocene)
Tobr	Tuff breccia
Tot	Tuff (upper Oligocene)
Toa	Andesite (upper Oligocene)

INTRUSIVE ROCKS

Tii	Intermediate intrusive rocks (upper Oligocene and lower Miocene?)
Tim	Mafic intrusive rocks (upper Oligocene and lower Miocene?)
Tid	Intrusive dacite (upper Oligocene and lower Miocene?)

MAP SYMBOLS

37	Contact—Approximately located; bar indicates dip
	Fault—Dashed where inferred; dotted where concealed; ball and bar on downthrown side; arrow indicates dip; double arrows indicate relative horizontal movement
55	Strike and dip of beds
48	Strike and dip of beds (estimated)
⊕	Horizontal bed
57	Strike and dip of foliation
38	Strike and dip of joints
27	Strike and dip of slickensides
36	Strike and dip of cleavage
35	Strike and dip of intermediate dike (related to unit Tii)
	Vertical intermediate dike (related to unit Tii)
	Intermediate dike (as shown in cross section) (related to unit Tii)
	Shear zone
	Slumps
	Landslide boulder—Up to 10 m across; rock type indicated
	Significant amygdaloidal horizon—Vesicles and amygdules commonly 1-1.5 cm
	Altered zone—Area of intense argillization and bleaching associated with seritization
30	Rock-sample location and map number (Tables 1 and 2, plate 2)
M13	Mine site and map number (Table 3, plate 2)
m	Fill

Base map by the U.S. Geological Survey
CONTROL BY .... USGS, NOS/NOAA
COMPILED FROM AERIAL PHOTOGRAPHS TAKEN ....1980 AND 1982
FIELD CHECKED..............1983. MAP EDITED 1988
PROJECTION ....LAMBERT CONFORMAL CONIC
GRID: 1000-METER UNIVERSAL TRANSVERSE MERCATOR .....ZONE 10
10,000-FOOT STATE GRID TICKS..........OREGON, SOUTH ZONE
UTM GRID DECLINATION .... 0°13' EAST
1990 MAGNETIC NORTH DECLINATION.................... 18° EAST
VERTICAL DATUM ... NATIONAL GEODETIC VERTICAL DATUM OF 1929
HORIZONTAL DATUM .... 1927 NORTH AMERICAN DATUM

To place on the predicted North American Datum of 1983, move the projection lines as shown by dashed corner ticks (20 meters north and 95 meters east)

There may be private inholdings within the boundaries of any Federal and State Reservations shown on this map

No distinction made between houses, barns, and other buildings

NORTH

SCALE 1:24 000

KILOMETERS: 1 .5 0 1 2
METERS: 1000 0 1000 2000
MILES: 1 .5 0 1
FEET: 1000 0 1000 2000 3000 4000 5000 6000 7000 8000 9000 10 000

CONTOUR INTERVAL 40 FEET

CONTROL ELEVATIONS SHOWN TO THE NEAREST 0.1 FOOT
OTHER ELEVATIONS SHOWN TO THE NEAREST FOOT
To convert meters to feet multiply by 3.2808
To convert feet to meters multiply by 0.3048

OREGON
QUADRANGLE LOCATION

Geology by Frank R. Hladky, Oregon Department of Geology and Mineral Industries

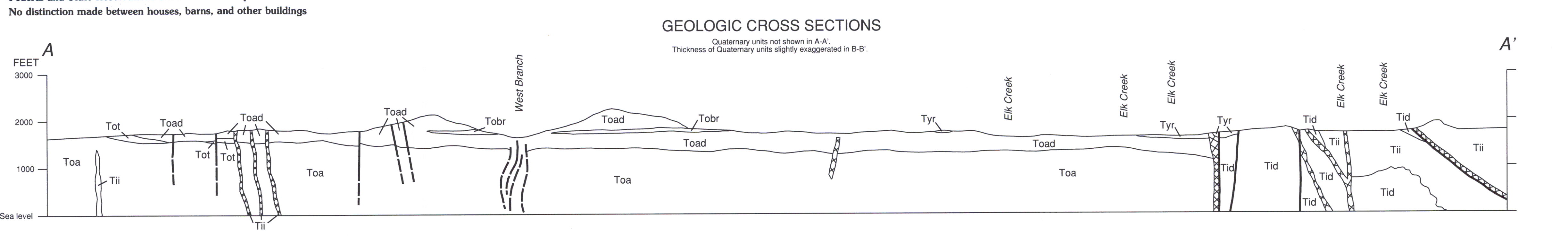
Field work conducted from March 1992 to August 1993. Geology beneath Lost Creek Lake modified from U.S. Army Corps of Engineers (1982), Plate 5.

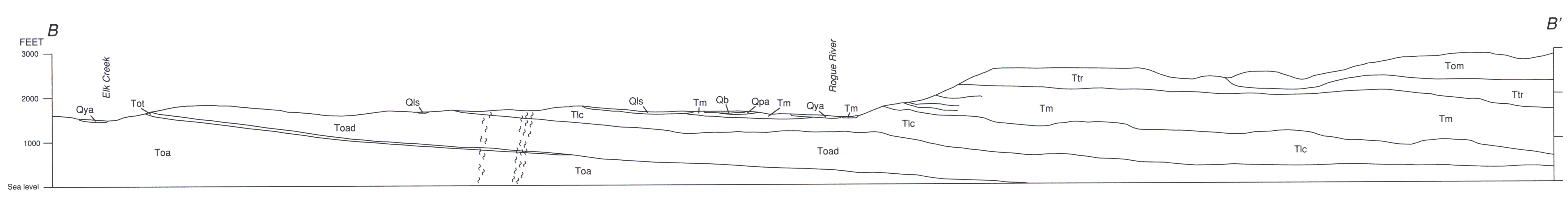
Reviewed by Clayton "Tom" Amundson of the U.S. Army Corps of Engineers and by Thomas J. Wiley, Oregon Department of Geology and Mineral Industries

Cartography by Mark E. Neuhaus

GEOLOGIC CROSS SECTIONS

Quaternary units not shown in A-A'.
Thickness of Quaternary units slightly exaggerated in B-B'.





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STATE OF OREGON
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DONALD A. HULL, STATE GEOLOGIST

Analytical Data, McLeod Quadrangle, Jackson County, Oregon
1993

GMS-80

Geology and Mineral Resources Map of the McLeod Quadrangle, Jackson County, Oregon

By F.R. Hladky

Plate 2

Table 1. Whole-rock analyses, McLeod quadrangle, Jackson County, Oregon[1]

Map no.	Laboratory no.	1/4	1/4	Sec.	T.(S.)	R.(E.)	UTM coordinates	Elev. (ft)	Lithology	Map unit	Oxides (wt. percent) SiO_2	Al_2O_3	TiO_2	Fe_2O_3T	MnO	CaO	MgO	K_2O	Na_2O	P_2O_5	LOI	SUM	Selected trace elements (ppm) Cr	Rb	Sr	Y	Zr	Nb	Ba
1	BAG-211	NE	NE	34	32	1	4732868N 526178E	2,500	Dacite dike	Totb	68.8	13.4	0.68	3.71	0.08	0.91	0.62	2.00	4.55	0.15	3.55	98.598	11	71	172	36	191	19	760
2	BAG-216	NE	NE	35	32	1	4732888N 527761E	3,680	Limonitic, brecciated, densely welded dacite	Tyr	67.1	15.4	0.753	4.14	0.07	2.59	0.78	2.09	4.75	0.2	1.85	99.892	<10	65	486	23	199	38	620
3	BAG-210	NE	NE	34	32	1	4732802N 526284E	2,450	Andesite dike	Tii	64.3	15.1	0.765	4.98	0.14	2.96	1.34	1.97	5.4	0.21	2.1	99.44	88	57	515	28	166	41	568
4	BAG-212	NE	NE	34	32	1	4732761N 526203E	2,400	Spherulitic dacite ash tuff	Totb	71.8	13.2	0.356	2.43	0.07	0.99	0.38	3.58	4.47	0.08	1.95	99.469	<10	107	174	16	192	30	883
5	BAG-213	SE	NE	34	32	1	4732381N 526391E	2,400	Black andesite dike	Tii	55.5	15.4	1.46	10.5	0.18	7.19	3.42	0.74	3.45	0.37	2.0	100.329	31	25	409	26	119	38	344
6	BAG-214	NW	SE	34	32	1	4732228N 525736E	2,500	Bleached, seriticized dacite	Totb	71.4	13.4	0.323	2.25	0.07	1.99	0.27	2.18	3.71	0.07	4.5	100.304	23	77	123	20	191	28	741
7	BAG-215	SE	SW	34	32	1	4731883N 525589E	2,600	Limonitic, dacite ash tuff	Totb	73.0	13.6	0.264	1.65	0.02	0.79	0.12	2.57	4.44	0.05	1.75	98.421	<10	68	228	34	222	25	851
10	BAG-227	NW	NE	3	33	1	4731386N 525827E	3,160	Welded dacite ash tuff	Tyr	64.5	15.5	1.02	5.66	0.08	3.77	0.66	1.95	4.31	0.28	2.0	99.9	<10	59	345	12	172	18	586
11	BAG-209	NW	NE	4	33	1	4731228N 524513E	2,300	Banded, quartz-phyric dacite	Tid	70.8	12.9	0.391	2.46	0.06	2.59	0.84	2.92	3.0	0.09	2.65	98.868	22	77	215	16	132	34	942
12	BAG-208	SW	NW	4	33	1	4731010N 533629E	1,680	Coarse ash, altered, partially welded dacite tuff	Tyr	65.2	14.3	0.484	3.44	0.08	4.01	0.76	2.04	3.07	0.11	6.35	99.983	<10	73	300	24	161	32	596
14	BAG-201	NW	SW	8	33	1	4728914N 521878E	2,650	Pyroxene andesite dike	Tii	58.4	15.7	1.23	8.09	0.14	6.43	2.96	1.32	3.01	0.31	2.85	100.568	33	33	388	42	128	26	424
15	BAG-204	SE	SW	9	33	1	4728609N 523676E	1,750	Dacite dike	Tii	59.6	15.9	0.903	6.41	0.12	4.57	2.33	1.13	3.85	0.3	3.2	98.431	<10	48	452	23	100	39	332
16	BAG-203	SW	SW	7	33	1	4728370N 520477E	1,880	Pyroxene basalt	Tm	49.6	16.6	1.23	11.3	0.24	8.85	4.27	0.62	2.71	0.17	3.15	98.838	22	17	333	14	59	26	357
17	BAG-223	SE	NW	18	33	1	4727426N 520609E	2,950	Slightly altered, dacite crystal vitric tuff	Tyr	75.0	12.7	0.192	1.53	0.04	0.98	0.14	3.02	4.32	0.21	0.95	99.2	<10	98	142	28	183	19	819
19	BAG-222	SE	SE	18	33	1	4726665N 521508E	2,250	Dacite	Toad	61.4	16.2	0.811	5.93	0.12	5.76	2.1	1.57	3.05	0.19	3.35	100.6	11	57	386	30	117	<10	490
20	BAG-202	SW	NE	22	33	1	4726066N 535939E	2,380	Coarse ash, slightly altered, welded dacite tuff	Tlc	69.9	13.9	0.573	3.79	0.04	2.21	0.41	2.13	4.13	0.11	2.3	99.635	<10	63	210	52	203	25	649
21	BAG-230	NE	SW	20	33	1	4725457N 522112E	1,700	Andesite	Toad	51.9	16.6	1.25	12.3	0.24	9.24	4.21	0.58	2.75	0.15	0.65	100.0	25	31	360	<10	45	36	184
22	BAG-225	NE	NW	30	33	2	4724827N 530132E	1,850	Basalt	Qb	46.9	18.1	1.00	10.3	0.16	9.8	9.25	0.11	2.09	0.13	2.5	100.5	241	12	238	<10	75	21	409
23	BAG-206	NW	NE	29	33	1	4724670N 522716E	2,230	Weathered andesite	Toad	52.4	16.9	1.15	9.32	0.17	8.37	3.17	0.33	2.57	0.13	4.55	99.152	32	24	395	28	55	21	213
24	BAG-207	SE	NW	29	33	1	4724497N 522173E	2,560	Andesite	Ttr	57.4	16.3	1.34	7.82	0.15	5.29	2.67	2.71	4.2	0.62	1.3	100.021	13	38	698	30	195	27	883
27	BAG-224	NE	NW	36	33	1	4723203N 528711E	2,200	Basalt (hawaiite)	Tom	50.2	17.6	1.50	11.3	0.18	8.24	4.43	1.44	3.73	0.77	0.75	100.4	94	30	902	29	166	19	627
28	BAG-205	SE	NE	35	33	1	4723081N 527706E	2,480	Andesite	Ttr	57.1	16.5	1.34	7.96	0.15	5.75	2.65	2.28	4.46	0.61	1.05	100.063	16	25	734	29	174	36	796
30	BAG-229	NW	SE	1	34	1	4720853N 528853E	2,600	Andesite	Tom	52.9	17.3	1.31	9.77	0.22	7.46	3.89	1.76	3.97	0.86	0.5	100.2	61	18	791	38	215	28	939
31	BAG-226	SE	NE	8	34	1	4719452N 523076E	2,580	Amygdaloidal andesite	Tm	51.1	16.5	1.54	11.5	0.15	8.7	3.08	0.49	2.59	0.23	4.4	100.4	<10	19	388	12	64	19	188

[1] XRF analyses by XRAL

Table 2. Trace-element analyses, McLeod quadrangle, Jackson County, Oregon

Map no.	Laboratory no.	1/4	1/4	Sec.	T.(S.)	R.(E.)	UTM coordinates	Elev. (ft)	Lithology	Map unit
2	BAG-108	NE	NE	35	32	1	4732888N 527761E	3,680	Limonitic, brecciated, densely welded dacite tuff	Tyr
3	BAG-103	NE	NE	34	32	1	4732802N 526284E	2,450	Andesite dike	Tii
4	BAG-104	NE	NE	34	32	1	4732761N 526203E	2,400	Spherulitic dacite ash tuff	Totb
5	BAG-105	SE	NE	34	32	1	4732381N 526391E	2,400	Black andesite dike	Tii
6	BAG-106	NW	SE	34	32	1	4732228N 525736E	2,500	Bleached, seriticized dacite	Totb
7	BAG-107	SE	SW	34	32	1	4731883N 525589E	2,600	Limonitic, dacite ash tuff	Totb
8	BAG-110	SE	SE	31	32	1	4731660N 521711E	2,160	Pyrite-rich andesite	Tii
9	BAG-111	SW	SW	32	32	1	4731680N 521837E	2,160	Cinnabar and hematitic gouge in tuff	Tyr
11	BAG-102	NW	NE	4	33	1	4731231N 524513E	2,300	Brecciated, limonitic dacite	Tid
12	BAG-101	SW	NW	4	33	1	4731010N 533629E	1,680	Coarse ash, altered, partially welded, dacite tuff	Tyr
13	BAG-112	NE	SW	9	33	1	4729000N 523812E	2,040	Limonitic, bleached andesite	Toad
18	BAG-109	NE	SE	15	33	1	4727132N 526101E	2,360	Chalcedonic, hematitic andesite	Tm
25	BAG-113	NE	NW	33	33	1	4723457N 523802E	2,000	Argillized and brecciated andesite	Tm
26	BAG-114	NE	NW	33	33	1	4723457N 523924E	1,980	Jasperoid	Tm
29	BAG-115	SW	NW	33	33	1	4722802N 523274E	1,540	Bleached, argillized andesite	Toad

Map no.	Au (ppb)	Ag (ppm)	As (ppm)	Au (ppm)	Cu (ppm)	Hg (ppm)	Mo (ppm)	Pb (ppm)	Sb (ppm)	Tl (ppm)	Zn (ppm)	Bi (ppm)	Cd (ppm)	Ga (ppm)	Se (ppm)	Te (ppm)	Ba[2] (ppm)	Co (ppm)	Cr[2] (ppm)	Cu (ppm)	Fe (%)	Li (ppm)	Mn (ppm)	Ni (ppm)	Zn (ppm)
Laboratory[1]:	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3
2	6	0.042	12.6	<0.0005	5.92	<0.1	0.861	3.72	0.709	<0.499	77.2	<0.25	<0.1	7.09	<0.999	<0.499	264	8	57	6	3.48	49	544	4	72
3	9	0.029	11.1	<0.0005	7.39	<0.1	1.38	5.28	<0.249	<0.498	76.1	<0.249	0.111	9.51	<0.995	<0.498	333	3	55	8	3.59	36	779	7	68
4	8	<0.015	7.55	<0.0005	3.47	<0.099	1.02	9.06	0.63	<0.497	41.4	<0.249	<0.099	2.84	<0.994	<0.497	542	<1	60	3	1.61	15	295	<1	37
5	7	0.026	3.53	<0.0005	30.5	<0.099	0.695	2.48	<0.247	<0.494	70.1	<0.247	<0.099	6.4	<0.988	<0.494	269	24	37	34	8.28	17	1,223	16	95
6	16	0.015	8.18	<0.0005	1.51	<0.099	0.835	6.06	<0.248	<0.497	45.3	<0.248	<0.099	2.31	<0.993	<0.497	474	2	26	2	1.86	22	316	2	44
7	9	<0.015	22.7	<0.0005	1.76	<0.1	1.17	4.65	<0.249	<0.498	69.8	<0.249	<0.1	2.08	<0.996	<0.498	297	4	37	1	1.75	15	86	6	65
8	6	0.073	4.18	<0.0005	33	<0.098	1.04	2.41	<0.246	<0.492	76.2	<0.246	<0.098	7.15	1.96	<0.492	249	14	66	39	5.22	14	1,149	10	88
9	8	0.051	2.25	0.002	16.3	<0.099	8.76	2.82	<0.248	<0.496	5.47	0.655	<0.099	2.62	4.48	1.23	174	7	50	50	4.81	14	66	6	24
11	4	0.021	129	<0.0005	3.08	0.546	5.15	6.44	1.67	<0.493	32.5	<0.247	<0.099	10.5	<0.987	<0.493	46	13	48	3	11.4	37	1,587	8	35
12	4	0.038	1.84	<0.0005	4.23	<0.099	0.653	4.93	<0.248	<0.495	40.1	<0.248	<0.099	1.69	<0.991	<0.495	409	8	54	4	2.53	33	458	6	45
13	23	0.035	10.8	0.001	16.1	<0.098	0.433	2.41	<0.246	<0.492	65.4	<0.246	0.142	3.07	<0.984	<0.492	224	12	22	17	3.68	30	987	7	70
18	8	0.027	5.31	<0.0005	8.97	<0.098	0.125	1.4	<0.246	<0.492	67.5	<0.246	<0.098	3.21	<0.985	<0.492	225	9	20	12	4.55	26	8.68	7	85
25	<1	<0.015	20.6	0.001	39.9	42.4	0.615	3.76	7.02	<0.497	32.3	<0.249	0.226	1.16	<0.995	<0.497	—	—	—	—	—	—	—	—	—
26	7	<0.015	5	0.007	4.02	<0.099	3.17	0.416	<0.247	<0.494	<0.988	<0.247	<0.099	<0.494	<0.988	0.516	—	—	—	—	—	—	—	—	—
29	17	0.031	7.61	0.015	55.3	<0.097	0.828	1.41	<0.244	<0.487	47.1	<0.244	0.141	6.68	<0.975	<0.487	—	—	—	—	—	—	—	—	—

[1]Laboratories: 1 = Bondar-Clegg, 2 = MB Associates, 3 = DOGAMI
[2]Partial digestion.

Table 3. Mines and prospects, McLeod quadrangle, Jackson County, Oregon

Map no.	Name	1/4	1/4	Sec.	T.(S.)	R.(E.)	UTM coordinates	Elev. (ft)	Commodity	Map unit	Comments
M1	Alco Creek prospect	SE	SE	31	32	1	4731660N 521721E	2,180	Mercury	Tii	——
M2	Unnamed	SE	NW	4	33	1	4730689N 523809E	1,650	Sand and gravel	Qya	——
M3	Elk Creek quarry	SE	SE	18	33	1	4726600N 521600E	2,050	Stone (dacite)	Toad	Reclaimed.
M4	Carlton	SE	NE	23	33	1	4726200N 527900E	1,640	Pumice	Qpm	Now under Lost Creek Lake.
M5	Butte Falls	SW	NE	27	33	1	4724343N 525925E	1,700	Beryllium	Tlc	Not found.
M6	Midnight	NE	NW	33	33	1	4723450N 523750E	2,000	Mercury	Tm	——
M7	Fabricators	NE	NW	32	33	1	4723300N 522157E	1,660	Stone	Toad	——
M8	Rayome prospect	NW	NW	33	33	1	4723200N 523400E	1,700	Mercury	Tlc	——
M9	Kindschi quarry	NE	NW	34	33	1	4723200N 525360E	1,680	Stone (basalt)	Qpa/Qb	——
M10	Lost Creek Dam quarry	—	NE	35	33	1	4722900N 527710E	2,400	Stone (andesite)	Ttr	Reclaimed.
M11	Rogue River prospect	SW	SW	33	33	1	4722200N 523400E	1,580	Mercury	Toad	Not found.
M12	Dawson Mercury prospect	NE	SW	2	34	1	4721000N 527000E	1,940	Mercury	Tm	Not found.
M13	Beryllium claim	SW	NE	11	34	1	4719691N 527332E	1,950	Beryllium	Tm	Not found.
M14	Ryno	NW	SE	10	34	1	4721011N 525710E	1,900	Beryllium	Tm	Not found.

See accompanying text for discussion of geochemistry

Geology and Mineral Resources Map of the McLeod Quadrangle, Jackson County, Oregon
1993

By Frank R. Hladky, Oregon Department of Geology and Mineral Industries

INTRODUCTION

The McLeod 7½-minute quadrangle lies within the Western Cascades subprovince of the Cascade Range. Elevations range from 437 to 1,104 m (1,457 to 3,680 ft). Major geographical features include the Rogue River, Lost Creek Lake, and Elk Creek Dam.

The geology is dominated by volcanic rocks of dacitic to basaltic composition that were erupted, deposited, or intruded episodically during the last 30 million years (Ma) as part of the construction of now deeply eroded volcanoes. Lesser amounts of ancient and modern sand and gravel are distributed at or near the present valley floors. The aggregate thickness of the rock units in the quadrangle exceeds 3,000 m (10,000 ft). Volcanic rocks were deposited on the often sloping flanks of ancient volcanoes. The orientation of faults and dikes is complex, related in part to an upper Oligocene caldera complex; fault displacements are generally small. Tectonic tilting of strata reflects pre-middle Miocene regional downwarping or loading of the crust parallel to the axis of the Cascade Range and loading of the earth's crust around volcanic centers of late Miocene or Pliocene age. Notably, the drainage of the Rogue River was entrenched within the McLeod quadrangle as early as 10 Ma and was also the pathway for an andesite lava flow that caps Upper and Lower Table Rocks near Medford. The Rogue River also channeled a Pleistocene intracanyon basalt flow and mudflows from the catastrophic eruption of Mount Mazama 6,900 years ago.

Economic minerals have been produced in the McLeod quadrangle. Dacite and andesite were used to construct Elk Creek and Lost Creek Dams. Pumice was produced prior to World War II. Mercury and beryllium have been sought but not produced. Although the mineral potential of the caldera-complex rocks remains largely unexplored, north of the quadrangle similar rocks have been found to contain significant anomalies of gold, silver, mercury, lead, and zinc.

EXPLANATION

QUATERNARY DEPOSITS

Qya **Young alluvium (Holocene)**—Gravel, sand, and silt deposited along modern stream channels. Includes high-water gravels along stream channels and an active alluvial fan on the south shore of Lost Creek Lake. Thickness varies; maximum about 8 m (25 ft)

Qpm **Pumice and ash of Mount Mazama (Holocene)**—Very pale-orange, unconsolidated pumiceous pebbles, sand, silt, and mud interpreted as hyperconcentrated flows incident to the eruption of Mount Mazama about 6,900 years ago (Bacon, 1983). Hyperconcentrated flows traveled down the Rogue River as far west as Trail in the adjacent Trail quadrangle and part way up Big Butte Creek. Many deposits are now inundated by Lost Creek Lake. Thickness varies; generally less than 12 m (40 ft)

Qls **Landslide deposits (Holocene and Pleistocene)**—Fragments of bedrock mixed with gravel, sand, silt, or clay and displaced downslope by gravity sliding. Thickness varies; mapped where greater than about 3 m (10 ft)

Qoa **Undifferentiated old alluvium (Holocene and Pleistocene)**—Well-rounded unconsolidated gravel, sand, and silt of Holocene or Pleistocene age; dissected. Generally exposed below terraces but above modern flood plains. Maximum thickness about 6 m (20 ft)

Qb **Basalt (Pleistocene)**—Medium-light-gray to medium-dark-gray, very fine- to medium-grained, locally diktytaxitic, canyon-filling basalt. Randomly oriented, white, plagioclase laths less than 0.5 mm in length resemble oatmeal in texture; sparse pyroxene phenocrysts. Columns up to 30 cm in diameter; flow is vesicular near top; pipe vesicles up to 2 cm (0.8 in.) in diameter and 1 m (3 ft) long. Probably correlates with a series of canyon-filling basalt flows near Prospect, one of which has K-Ar age of 1.25 ± 0.11 Ma (Fiebelkorn and others, 1983). Thins downstream to about 5 m (15 ft) at the Kindschi quarry (mine site M9), NW¼ sec. 34, T. 33 S., R. 1 E., where it disconformably overlies unconsolidated gravel (unit **Qpa**). Maximum thickness 60 m (200 ft)

Qpa **Old alluvium (Pleistocene)**—Well-rounded, unconsolidated gravel, sand, and silt, devoid of significant clay, roots, or organic matter; dissected. Directly overlain by basalt (unit **Qb**). Excavation of the Lost Creek Dam foundation revealed a thickness up to 30 m (100 ft) in the left abutment (U.S. Army Corps of Engineers, 1982). Downstream of dam in SE¼NW¼ sec. 34, T. 33 S., R. 1 E., unit thins to about 6 m (20 ft)

QUATERNARY AND TERTIARY SEDIMENTARY ROCKS

QTtg **Terrace gravel (Pleistocene? and Pliocene?)**—Poorly exposed remnants of well-rounded, unconsolidated gravel, sand, and silt deposited on bench above Rogue River and along Elk Creek above Elk Creek Dam (U.S. Army Corps of Engineers, 1987). Thickness approximately 3 m (10 ft)

TERTIARY (NEOGENE) SEDIMENTARY AND VOLCANIC ROCKS

Tom **Basalt of Olson Mountain (Pliocene? and upper Miocene?)**—Tan- to light-gray-weathering, light- to medium-gray, fine-grained "oatmeal" basalt and andesite. Sparse, fine-grained (less than 1 mm) pyroxene and rare olivine phenocrysts in groundmass composed mostly of fine-grained plagioclase laths (less than 0.5 mm). Some flows consist of olivine basalt with andesine as the normative plagioclase and with a soda:potash ratio greater than 2:1, classifying it as a hawaiite (Bates and Jackson, 1987). Elevated range of P_2O_5 is characteristic of rocks of Olson Mountain (map nos. 27 and 30, Table 1). Overlies andesite of Table Rock exposed at the Lost Creek Dam quarry near Rumley Creek, except in areas where it filled in canyons incised into unit **Ttr**. Unit is a complex of lava flows and minor basaltic tephra that formed a broad, shield volcano, the morphology of which is still largely preserved as Olson Mountain. Stratigraphic position based on Smith and others (1982). Named after Olson Mountain. In areas where humus is sparse, soil is characteristically orange-brown, often several meters thick; regolith characteristically weathers spheroidally. Thickness at least 300 m (1,000 ft)

Ttr **Andesite of Table Rock (upper Miocene)**—Dark-gray to black, olivine-bearing, augite-bearing andesite with distinctive tabular plagioclase (oligoclase) as large as 0.5 by 6 mm. Phenocrysts of equant alkali feldspar (up to 3 mm); augite (up to 1 mm); less than 1 percent iddingsitized olivine (up to 1 mm). Groundmass comprised of andesine and labradorite laths, brown glass, magnetite and hematite. Normative plagioclase composition of $An_{32\text{-}38}$ (andesine). Sodic plagioclase, alkali feldspar, pyroxene content, and ratio of alkalis to silica qualify this rock as a trachyandesite (Bates and Jackson, 1987; Cox and others, 1979). TiO_2 content of 1.3 percent and P_2O_5 content of 0.6 percent are distinctive (map nos. 24 and 28, Table 1). Columns in upper middle part of unit are up to 45 cm (17 in.) across, elsewhere typically 15 cm (5.8 in.). Locally vesicular near flow top and bottom and locally at base of colonnade. Base of unit along Highway 62 in NW¼ sec. 35, T. 33 S., R. 1 E., displays what is interpreted to be autoclastic frontal flow breccia up to 8 m (25 ft) thick that has been overridden by the rest of the flow. Prominent exposures at the Lost Creek Dam quarry (mine site M10) near Rumley Creek and Bear Mountain south of Rogue River and in secs. 27, 28, and 29 north of the Rogue River. Flow extends several miles to the southeast along Big Butte Creek and McNeil Creek. Correlates petrographically and chemically (unpublished Oregon Department of Geology and Mineral Industries [DOGAMI] data, 1993) with basalt that caps Upper Table Rock and Lower Table Rock in the Sams Valley area. Unit is overlain by the Olson Mountain complex and originates somewhere east of Prospect from vents that are now covered by younger volcanoes of the High Cascades (Smith and others, 1982). Unit yielded whole-rock K-Ar ages of 6.77 ± 0.2 and 7.1 ± 0.2 Ma (Fiebelkorn and others, 1983) from Bear Mountain in adjacent Trail quadrangle. K-Ar age of 9.6 Ma from a boulder located near the intersection of Modoc and Antioch Roads southeast of Upper Table Rock (Robert Duncan and Clifton Mitchell, Oregon State University, unpublished data, 1991); the sampled boulder originated from Upper Table Rock (Wiley and Smith, 1993). Unit named after Table Rock, a community located at the base of the prominent buttes of Upper and Lower Table Rocks. As this unit is relatively young and impermeable, soil development on it is usually poor on steep slopes but can be extensive on flat surfaces; regolith weathers out into broken, imperfect columns. Maximum thickness 180 m (600 ft)

ANGULAR UNCONFORMITY

Tkc **Andesite of Knighten Creek (lower Miocene)**—Brown-weathering, medium-dark-gray to dark-gray andesite. Phenocrysts of pyroxene (up to 2 mm) and plagioclase (up to 2 mm) in a fine-grained, felsic matrix containing iron oxides. Exposed in the area of Blue Gulch, north of Lost Creek Lake; named for exposures in Knighten Creek in the adjacent Cascade Gorge quadrangle. Flow emanates from near the base of Flounce Rock in adjoining Cascade Gorge quadrangle and has K-Ar age slightly younger than topographically higher rocks that form Flounce Rock. Flow forms the gently undulating surface along the north shore of Lost Creek Lake and overlies tuff of unit **Tyr**. Flow top is rubbly, and regolith development is several meters thick. Pressure ridges, vesicular rubble, inflation mounds, and deflation pits form a hummocky surface morphology that was originally interpreted by Smith and others (1982) to be a large landslide. Recent sliding is prevalent locally in areas of steep topography. Whole-rock K-Ar age of 20.0 ± 0.6 Ma (Fiebelkorn and others, 1983) in adjacent Cascade Gorge quadrangle. Thickness about 30 m (100 ft)

Tfr **Andesite of Flounce Rock (lower Miocene)**—Mostly brown- and gray-weathering andesite flows. K-Ar age of 20.8 ± 0.6 Ma in adjoining Cascade Gorge quadrangle (Fiebelkorn and others, 1983). Named after Flounce Rock, where well-exposed series of flows crop out. Thickness at least 150 m (500 ft)

DISCONFORMITY

TERTIARY (PALEOGENE) VOLCANIC ROCKS

Tyr **Tuff of Yellow Rock (upper Oligocene)**—Mostly very pale-orange and yellow but also green and reddish-brown, thinly laminated, foliated, or massive dacitic crystal vitric tuff. Includes both welded and unwelded lithologies and minor thickly laminated (up to 1 cm [0.4 in.]) fine ash-tuff lacustrine deposits in SW¼NW¼ sec. 8, T. 33 S., R. 1 E.

Near Yellow Rock, whence unit name originates, in NW¼NE¼ sec. 21, T. 33 S., R. 1 E., are exposed impact block sags in thick-bedded and partially welded lithic lapilli ash deposits, andesitic and dacitic lithic blocks (up to 0.5 m), and carbonized tree limbs (up to 1.5 m long); impacted block indicates trajectory from north to south. K-Ar ages on plagioclase of 25.6 ± 0.8, 25.9 ± 0.7, and 25.4 ± 0.8 Ma (Fiebelkorn and others, 1983) from north shore of Lost Creek Lake. From Lost Creek Lake to Burnt Peak, the unit displays compaction foliation. Unit includes multiple flow and cooling units. Soil is usually light tan, depending upon the humus content; generally supports manzanita, oak, and pine in preference to Douglas fir on south-facing slopes. Thickness up to 550 m (1,800 ft)

Totb **Dacitic tuff breccia (upper Oligocene)**—Chaotic collage of light-colored tuffs, tuff breccias, silicic flows, penecontemporaneous dikes, and small intrusions of dacitic composition. Unit is interpreted to consist of intra-caldera facies eruptive and intrusive rocks penecontemporaneous with units **Tlc** and **Tyr**. Mafic dikes intrude across all silicic facies in a variety of orientations. Soil is usually light tan, depending upon the humus content; lithologic and structural complexity of this unit frequently provides a permeable substrate that develops thick soils. Thickness at least 450 m (1,500 ft)

Tm **Andesite of McLeod (upper Oligocene)**—Mostly brown-, tan-, and gray-weathering andesite flows that are usually thick bedded but also platy; also includes amygdaloidal andesite with vesicles up to 1.5 cm in diameter concentrated along flow top in SE¼NE¼ sec. 22, T. 33 S., R. 1 E., and in secs. 8 and 9, T. 34 S., R. 1 E.; undivided coarse-grained andesite dikes; minor andesitic tuff and breccia; and red agglutinate in SE¼NE¼ sec. 15, T. 33 S., R. 1 E. Whole-rock K-Ar age of 25.4 ± 0.8 Ma at community of McLeod in NW¼ sec. 34, T. 33 S., R. 1 E. (Fiebelkorn and others, 1983). Individual lava flows, 3 to 15 m (10 to 50 ft) thick, exposed in the outlet works of Lost Creek Dam at the left abutment, are separated by thin paleosols. Unit is named for community of McLeod. Soil development on this unit can be many meters thick, especially in areas of sliding or low relief; weathering of the regolith often penetrates tens of meters. Thickness about 300 m (1,000 ft)

Tlc **Tuff of Lost Creek Dam (upper Oligocene)**—Pale-green to tan, lapilli-ash, welded, dacitic lithic vitric ash-flow tuff; large green pumice lapilli locally abundant. In SW¼ sec. 23 T. 33 S., R. 1 E., unit contains block-and-ash tuff consisting of blocks of andesite and dacite up to 1.5 m (5 ft) long and chunks of carbonized wood up to 0.4 m (1.3 ft) across in a lapilli and ash matrix that grades upward into fine-ash (co-ignimbrite?) tuff. K-Ar age on plagioclase of 28.6 ± 0.9 Ma in NW¼SE¼ sec. 27, T. 33 S., R. 1 E. (Fiebelkorn and others, 1983). Prominent exposures are found near Lost Creek Dam, after which the unit is named. Soil development and vegetative cover similar to tuff of Yellow Rock. Thickness up to 300 m (1,000 ft)

Toad **Andesite and dacite (upper Oligocene)**—Brown-, tan-, reddish- and medium-gray-weathering, fine- to coarse-grained, usually thick-bedded andesite flows, massive to thick-bedded greenish-gray dacite, and lenses of stratified, poorly sorted, unconsolidated to welded andesitic tuff and tuff breccia (lahar deposits). Includes dacite at Elk Creek quarry, secs. 18 and 19, T. 33 S., R. 1 E. Lava caves in laminated andesite in SW¼ sec. 20, T. 33 S., R. 1 E. Weathering of the regolith often penetrates tens of meters; thick soils developed; slumping occurs in areas of high relief; vegetative cover can be extreme. Thickness at least 370 m (1,200 ft)

Tobr **Tuff breccia**—Dark-reddish-brown- to brown-weathering, dark-greenish-gray tuff breccia. Consists of angular, porphyritic lapilli- and block-size andesite and dacite clasts welded in a fine-grained matrix of andesitic to dacitic composition. Generally massive; however, locally stratified. Probably represents vent-clearing, pyroclastic volcanism associated with the more effusive flows of unit **Toad**. Local dacitic block-and-ash vent facies exposed in SE¼SE¼ sec. 29, T. 33 S., R. 1 E., probably represents a small, parasitic eruptive vent. Maximum thickness about 110 m (360 ft)

Tot **Tuff (upper Oligocene)**—Brown to tan, thickly laminated, coarse-ash to fine-ash, unwelded, lithic andesitic air-fall tuff; unwelded, poorly sorted, stratified lithic tuff breccia and mudstone (lahar deposits); dacitic lithic vitric ash-flow tuff; and local, thin andesite flows and andesite breccia. The excavation at the left abutment of Elk Creek Dam exposes a sequence of thin andesite lava flows and breccia overlain successively by dacitic ash-flow tuff containing carbonized wood and unwelded, stratified andesitic air-fall tuff; beneath the concrete foundation, this sequence is underlain by tuff and lahar deposits of unit **Tot** (Tom Amundson, U.S. Army Corps of Engineers, personal communication, 1993). Welded ash-flow facies diminish, and lahar facies dominate west of Elk Creek. Thickness up to 60 m (200 ft)

Toa **Andesite (upper Oligocene)**—Mostly brown-, tan-, and gray-weathering platy to massive andesite flows; also andesitic tuff and breccia. Whole-rock K-Ar age of 29.0 ± 0.9 Ma given to sample taken east of Rogue-Elk County Park in NE¼ sec. 31, T. 33 S., R. 1 E. (Fiebelkorn and others, 1983). Weathering of the regolith often penetrates tens of meters; thick soils are often developed; slumping occurs in areas of high relief; vegetative cover can be extreme. Thickness in quadrangle at least 100 m (300 ft)

INTRUSIVE ROCKS

Tii **Intermediate intrusive rocks (upper Oligocene and lower Miocene?)**—Tan- and brown-weathering gray and greenish-gray, medium- to coarse-grained pyroxene andesite and less commonly dacite. Morphology most frequently dikes but also sills, stocks, small laccoliths, or some combination thereof. Includes small laccolith in sec. 30, T. 33 S., R. 1 E. Often smaller intermediate dikes intrude other dikes or small intrusive stocks

Tim **Mafic intrusive rocks (upper Oligocene and lower Miocene?)**—Greenish-gray, fine- to medium-grained basalt dike at west edge of quadrangle along West Branch

Tid **Intrusive dacite (upper Oligocene and lower Miocene?)**—Light-gray, quartz-phyric banded dacite. Banding scale of 5 to 20 cm; spherical quartz phenocrysts up to 5 mm in diameter contain irregular clay-filled tubules (about 0.1 mm in diameter) emanating from a felsic groundmass; tubules represent partial resorption of quartz phenocrysts. Unit interpreted to be shallow hypabyssal intrusions that may have locally breached the surface, producing extrusive domes. This local late-stage resurgent doming was probably penecontemporaneous with eruption of unit **Tyr**

STRUCTURE

The structure of the McLeod quadrangle is reflected in the two cross sections. A west-northwest-trending fabric of dikes and small-displacement faults is evident in cross section A-A′. To the north, the intrusive character of rocks within the quadrangle becomes increasingly evident. The constructional nature of volcanism in the Western Cascades is evident in cross section B-B′. Loading of the earth's crust parallel to the axis of the Cascade Range from the construction of volcanic edifices has imparted a regional eastward tilt. Volcanic centers have superimposed their own localized distortion to the crust.

Faulting and folding of rock units are largely obscured by soil, duff cover, and the products of mass wasting. Observation of tectonic structure is further hampered by the lack of laterally continuous, planar units. Fault displacements are generally small (cross section A-A′) and are largely overwhelmed by the dramatic paleo-relief caused by constructional volcanism in the area (cross section B-B′). Quaternary sliding also hides structural details. During periods of extensive precipitation during the winter of 1993, several debris avalanches several cubic meters in size occurred along Highway 62. The landslides sloughed soil, regolith, and bedrock onto the highway right-of-way. Mass-wasting also occurred in unroaded areas of steep terrain. Evidence of centuries-old mass-wasting is indicated by large boulders (up to 10 m [33 ft] across) and headwall scarps overgrown with mature timber.

Faults have been mapped by any combination of indicators including gouge on the surface, pervasive and penetrative slickensides, unit offset, and the association of linear streams with sporadic exposures of shear zones. Dikes are commonly associated with faults. Some fault zones consist of distributed shear zones where rock shattering is evident across a broad area, e.g., West Branch fault (cross section B-B′). Fault offsets in bedded ash-flow units east of Tatouche Peak indicate vertical displacements on the order of 15 to 20 m (50 to 66 ft). Small-scale faulting (offsets of a few meters) and jointing are much more pervasive in the quadrangle than are indicated on the map, partly for reasons of map scale and partly because such detail is obscured in most places.

Upper Oligocene silicic rocks of a caldera complex, unit Totb, in the northernmost part of the quadrangle are chaotically disposed; intruded by andesite dikes, hypabyssal dacite stocks, and surface-breaching(?) exogenous domes; and peripherally overlain by bedded ash-flow tuffs that appear to emanate from this locus of explosive, silicic activity.

Complex faulting is evident within the silicic caldera-complex rocks. Faults in this area are manifested by linear gouge and breccia, hydrothermal alteration, and minor offsets in overlying tuffs. Emplacement of what are inferred to be resurgent dacite intrusions may have been controlled partly by ring fractures or radially disposed fractures related to caldera formation. Faults associated with the caldera complex are generally poorly exposed. Postcaldera faulting and diking appear to have occurred along preexistent zones of weakness but are also incident to an as yet poorly understood regional, postcaldera stress field.

West Branch fault is a prominent northwest-trending linear feature that locally shows evidence of shearing, including fault gouge and slickensides. The total amount of vertical displacement across the West Branch fault is inferred to be less than 15 m (50 ft) because of the current lack of measurable change in lithofacies across the fault. The shearing that is evident along the fault appears to be distributed among multiple, poorly exposed shear planes. The amount of horizontal displacement across the fault can not be determined.

Small-scale displacements (a few centimeters) occurred along a series of subhorizontal shears in the abutments of Elk Creek Dam immediately following its excavation (Tom Amundson, U.S. Army Corps of Engineers, personal communication, 1992). These shears are found within the mud-rich intervals of lahar deposits. An individual shear zone may span a thickness of up to 50 cm (20 in.) and is identified by its anastomosing network of thin (< 5 mm [0.2 in.]), usually continuous shear planes that define a subhorizontal zone of shearing.

Rock facets are ubiquitous in the quadrangle. Rock facets are shears, joints, or planes of weakness that have developed as the rock crumbles in response to weathering and gravity. Some rock facets that develop the characteristics of gouge may be confused with poorly developed paleosols, faults, or intrusive contacts. Rock facets in the Western Cascades are often more indicative of gravitational and decompressive stresses than of tectonic stresses.

Tilting of the dominantly volcanic strata of the quadrangle reflects the constructional nature of the area's volcanism, loading of the crust around regional volcanic centers of late Miocene age, and pre-middle Miocene regional downwarping of the crust parallel to the axis of Cascade Range. Upper Oligocene to lower Miocene rocks usually dip east, having dips that range from nearly horizontal to about 10° to the east. Local westward perturbations occur, frequently the result of Quaternary slumping. Rocks of late Miocene age at the base of Olson Mountain are depressed eastward as much as 2° as a result of the crustal loading of Olson Mountain. However, lava flows higher on the flanks dip radially from the summit of the mountain. Quaternary and latest Tertiary rocks show no discernible regional tilting.

Determining the average regional tilt of lower Miocene and lower rocks is difficult because (1) the ancient volcanoes had initially sloping flanks, (2) post-eruptive faulting has occurred, and (3) the terrain has weathered, causing much of the top several meters of bed rock to creep or slump downhill.

Quaternary units are subhorizontally deposited upon incised Tertiary surfaces. Tectonic rotation is not evident. Quaternary units were deposited on surfaces gouged by the Rogue River and its tributaries. The disposition of the andesite of Table Rock indicates that the ancestral Rogue River drainage had its present morphology as long ago as 10 Ma.

GEOLOGIC HISTORY

The classification of igneous rocks in the quadrangle follows that of Streckeisen (1979) where geochemistry exists. Percent SiO_2 is normalized to 100 percent. In addition, normative mineral abundances of quartz, plagioclase, and alkali feldspar, corrected for loss on ignition, are calculated to determine the rock classification. Where geochemistry is absent, rock nomenclature generally follows that of Bates and Jackson (1987).

This report sets forth several new informal names for units. They are as follows: tuff of Lost Creek Dam (unit Tlc), andesite of McLeod (unit Tm), tuff of Yellow Rock (unit Tyr), andesite of Flounce Rock (unit Tfr), andesite of Knighten Creek (unit Tkc), andesite of Table Rock (unit Ttr), and basalt of Olson Mountain (unit Tom). Names were selected from permanent natural or cultural features within Jackson County at or near significant outcrops. Names are from localities recognized by the Branch of Geographic Names, U.S. Geological Survey. None of the new names appear to have been used previously in the geological literature (Ron LeCompte, Geologic Names Committee, U.S. Geological Survey, personal communication, 1993). This map, however, does not attempt to formalize the nomenclature of these units.

Rocks exposed within the McLeod quadrangle provide a glimpse into the geologic history of the Western Cascades of southern Oregon from the late Oligocene to the present. Volcanism has contributed most of the rocks to the quadrangle. During Oligocene time the character of volcanism switched alternately on and off between a dominance of intermediate lava flows and tuffs to a dominance of silicic tuffs and intrusions.

In earliest late Oligocene time, the quadrangle was the site of andesitic shield and stratovolcanoes, as recorded by unit Toa. This lowest unit contains an andesite flow with a K-Ar age of 29.0 ± 0.9 Ma (Fiebelkorn and others, 1983). Above this andesite flow is unit Tot, comprised of poorly exposed lahar deposits, dacite ash-flow tuff, and andesitic tuff interbedded with thin andesite flows and breccia. Where unit Tot is absent, paleosols are found, indicating either nondeposition or erosion of unit Tot prior to the deposition of the dacite and andesite of unit Toad. Unit Toad is a composite of several andesite and dacite flows, locally intruded by dikes and stocks of similar composition, which were erupted from several undiscovered sources. One small vent is indicated by a local tuff breccia in the SE¼SE¼ sec. 29, T. 33 S., R. 1 E. Unit Toad includes andesitic tuff breccia, unit Tobr, containing probable near-to-vent pyroclasts. In the vicinity of West Branch, unit Tobr forms a local and discontinuous horizon. Brief pauses in eruptive activity are common between flows in units Toad and Toa, as indicated by numerous paleosols. Paleosols are often discontinuous or covered.

During part of the late Oligocene, the prevalence of intermediate, generally effusive volcanism was superseded by voluminous explosive silicic volcanism that emanated from a silicic eruptive complex centered north of the quadrangle. This silicic eruptive complex produced voluminous ash-flow tuffs that blanketed the lowland areas of the quadrangle, first about 28.6 Ma and then again about 25 Ma. These eruptions were probably of the caldera-forming type. A broad, geomorphic depression northwest of Burnt Peak, largely modified by erosion, exposes caldera complex (intracaldera) lithofacies. Representative caldera complex lithofacies are exposed in the northernmost part of the quadrangle, between Elk Creek and Burnt Peak, primarily as units Totb and Tid. Units Tlc and Tyr are thought to represent mostly extracaldera facies.

The first of the voluminous, silicic ash-flow tuffs, unit Tlc, filled irregular topography near what is now Lost Creek Dam and Big Butte Creek. The tuff of Lost Creek Dam (unit Tlc) is dated at 28.6 Ma (Fiebelkorn and others, 1983). Composed primarily of lapilli-ash lithic vitric tuff, the unit also locally contains a block-and-ash facies and a fine-ash facies. Although often partially eroded or buried, the unit provides a glimpse into the dynamics of a system that erupted broad, yet valley-confined, welded ash-flow tuff, flanking block-and-ash tuff, and co-ignimbrite ash.

In late Oligocene time, mafic volcanism began again. Andesite volcanoes, represented by the andesite of McLeod (unit Tm), rose up along the flanks of the silicic volcanic complex and buried unit Tlc. One probable source area is indicated by red agglutinate in SE¼NE¼ sec. 15, T. 33 S., R. 1 E. The mountain named Camel Hump in sec. 5, T. 34 S., R. 1 E., is also probably a vent area because of radially disposed lava flows that seem to emanate from that area. Unit Tm is a composite unit composed of multiple flows. Moderate relief existed, and brief pauses in eruptive activity occurred between lava flows, as indicated in the left (south) abutment of Lost Creek Dam, where several paleosols are sandwiched between andesite flows. The morphology of the paleosols and andesite flows indicates moderate relief between successive lava flows. A K-Ar whole-rock age of 25.4 ± 0.8 Ma obtained from an andesite flow at the community of McLeod (Fiebelkorn and others, 1983) provides an age for one of the lava flows that directly overlies unit Tlc. Where unit Tlc is absent, poorly exposed paleosols mark the boundary between unit Tm and older lavas.

Renewed volcanic activity about 25 Ma in the silicic complex produced additional voluminous outpouring of dacitic ash-flow sheets (tuff of Yellow Rock, unit Tyr) and also produced penecontemporaneous late-stage dacite hypabyssal intrusions and possible extrusive domes (unit Tid). Once again, incandescent ash-flow tuffs swept over the caldera walls onto what is now the north shore of Lost Creek Lake. These ash-flow tuffs also filled paleovalleys in the vicinities of Elk Creek, Alco Ridge, and Middle Creek. Part of the ridge between Lost Creek and Elk Creek appears to have been topographically elevated during this period of dacitic outpourings, because ash-flow tuffs ponded around the flanks of the paleohigh (rocks of unit Tm). Hydrothermal alteration is associated with the dacite intrusions. Prominent razorbacks up to 10 m (33 ft) wide of white sericite and pyrite were found within brecciated rocks of the caldera complex.

Renewed andesitic magmatism produced many dikes that intruded both the silicic rocks of the caldera complex and, to a much lesser extent, the ash-flow tuffs. It also produced small stocks such as those at Fawn Butte. Field evidence indicates that the intrusion of andesite dikes was most prevalent from late Oligocene to early Miocene time.

These dikes do not intrude the upper Miocene and Pliocene(?) rocks (e.g., units Ttr and Tom) at Olson Mountain.

About 20 Ma, volcanism shifted eastward and became centered near Cascade Gorge, east of the McLeod quadrangle. From this time until the eruption of Mount Mazama, andesitic and basaltic volcanism dominated the McLeod quadrangle. The eruption of andesite lava flows and cinders built an extensive stratovolcanic pile at Flounce Rock (unit Tfr). One of the slightly younger flows, the andesite of Knighten Creek (unit Tkc), emanated from the base of this complex and inundated some of the tuff deposits (unit Tyr) now exposed along the north shore of Lost Creek Lake.

A long hiatus in volcanism ensued. Then, at about 10 Ma, andesitic volcanism began again, this time centered somewhere in the High Cascades east of Prospect. This volcanism produced a thick, canyon-filling trachyandesite, the andesite of Table Rock (unit Ttr), that flowed down the valley of the ancestral Rogue River to the vicinity of Sams Valley. This flow presently caps Upper and Lower Table Rocks (Wiley and Smith, 1993). In the McLeod quadrangle, the remnants of the Table Rock flow thicken toward the river, and the lowest parts are about 180 m (600 ft) above the modern Rogue River channel.

The capping lava flows at Upper and Lower Table Rocks were originally described in Sams Valley by Wells (1939). The andesite of Table Rock was identified as a pre-Mazama basalt with a source in the High Cascades by Williams (1942). Wells (1956) credited the name "pre-Mazama basalt" to Williams (1942) and subsequently adopted that name. The unit was mapped east of Prospect, along the Rogue River, and in Sams Valley by Smith and others (1982). Discrepancies in K-Ar ages of 6.77, 7.1 (Fiebelkorn and others, 1983), and 9.6 (this paper) Ma have not yet been resolved but are probably the result of analytical procedures because the andesite of Table Rock is petrographically and chemically conspicuous, with a distinctive TiO_2 and P_2O_5 content (map nos. 24 and 28, Table 1) that correlates with the "basalt" at Upper and Lower Table Rocks in Sams Valley (unpublished DOGAMI data, 1993).

Subsequent to the eruption in the High Cascades that produced the andesite of Table Rock, volcanism shifted westward to the vicinity of Olson Mountain, whose summit is southeast of the McLeod quadrangle and south-southwest of Prospect. The rocks at Olson Mountain were first described by Wilkinson and others (1941) as "gray Olsen [*sic*] Peak basalt flows." Smith and others (1982) estimated these rocks to be upper Miocene to Pliocene in age. Primarily effusive in character, the basalt and andesite volcanism at what would become Olson Mountain produced a broad, shield volcano with unusual geochemical affinities. A basalt analyzed from the basalt of Olson Mountain (unit Tom) has geochemical characteristics of hawaiite, and an andesite sample is transitional between hawaiite and trachyandesite of Cox and others (1979) (map nos. 27 and 30, Table 1). The Olson Mountain lavas that were analyzed are distinguished like the andesite of Table Rock by elevated phosphorus (Table 1).

The late Tertiary and early Quaternary geologic history of the quadrangle remains shrouded in uncertainty because of the present lack of age data. An erosional terrace of either Pliocene or Pleistocene age occurs on both sides of the Rogue River, downstream of Lost Creek Dam. Although almost everywhere eroded away, terrace gravel of unit QTtg is found on this surface. At the community of McLeod, the terrace elevation is presently about 510 m (1,700 ft). At Rogue Elk Park, 4 km (2½ mi) downstream, the terrace top surface is about 480 m (1,600 ft). At McLeod, the terrace gravels have been eroded away, the terrace incised into Oligocene rocks, and the resulting canyon partly filled, first with Pleistocene gravel (unit Qpa) and then with basalt (unit Qb). Unit QTtg also includes stranded terrace gravels in the Elk Creek drainage.

During the Pleistocene, the Rogue River continued to cut down through rocks of the Western Cascades and deposit alluvium. At McLeod, Pleistocene alluvium of unit Qp is directly buried by Pleistocene basalt (unit Qb). The gravels are effectively encapsulated in time, pristinely preserved, and devoid of significant clay, roots, or organic matter. These gravels and overlying basalt were subsequently incised prior to the deposition of Holocene Mazama ash.

An eruption in the High Cascades during the Pleistocene produced an extensive basalt lava flow that wound its way down the Rogue River drainage. This diktytaxitic basalt (unit Qb) underlies the bench on which Stewart State Park is located and fills much of the Rogue River canyon near Cascade Gorge. The basalt pinches out near the community of McLeod. This basalt overlies unconsolidated channel gravels (unit Qpa) laid down by the Rogue River during Pleistocene time. This basalt flow originates upstream of Prospect, where it is approximately 140 m (450 ft) thick (Williams, 1942) and may correlate with a basalt flow that has a K-Ar age of 1.25 ± 0.11 Ma and is found near Prospect (Fiebelkorn and others, 1983).

Old, undifferentiated Quaternary alluvium (unit Qoa) includes Pleistocene and Holocene gravels. Remnants of undifferentiated old alluvium (unit Qoa) are exposed in isolated patches below the unit QTtg terrace surface. The unit may be as old as Pleistocene, based upon the approximate terrace level it occupies; however, the unit's stratigraphic position within the Pleistocene is equivocal because unit Qb that overlies similar gravels at McLeod pinches out abruptly downstream of McLeod. Gravel of unit Qpa was being deposited at the time that the High Cascades basalt (unit Qb) made its way to McLeod. The basalt (unit Qb), however, pinches out at McLeod, making the age of some downstream gravels (unit Qoa) uncertain. Patches of gravel are found along the present canyon walls from McLeod to the west edge of the quadrangle. Locally, it appears that unit Qoa grades into Holocene flood gravels (including unit Qya). Overlying Mazama ash (unit Qpm) provides a bounding upper age for unit Qoa.

Landslide deposits are prevalent wherever mountains are formed. The mapped landslide deposits within the quadrangle are the result of landslides that probably have been active during much of the Quaternary and, in addition, generally show evidence of Holocene movement.

An extensive mudflow or hyperconcentrated flow incident with the eruption of Mount Mazama 6,900 years ago (Bacon, 1983) swept down the Rogue River. In its wake, it left unconsolidated pumice deposits (unit Qpm, after Smith and others, 1982). Some of these directly overlie older alluvium (unit Qoa) along Highway 62. From 1930 to 1942, pumice was mined from the Carlton deposit (mine site M4; Gray, 1991) now submerged beneath Lost Creek Lake. Pumice deposits several meters thick are found as far west as Trail.

The incision of the Rogue River into the Western Cascades continues to the present. The Rogue River and its tributaries cut below Pliocene(?) and younger terraces. Young Quaternary alluvium (unit Qya) can be found along modern stream channels.

GROUND-WATER RESOURCES

Ground-water resources are largely unstudied (Doug Woodcock, Oregon Water Resources Department, personal communication, 1993). Domestic wells are relatively few and tend to be concentrated along the stream valley floors. Well characteristics have not been studied. Study of the ground water by the U.S. Army Corps of Engineers at the dam sites was largely concentrated on rock permeability for the foundations (Tom Amundson, U.S. Army Corps of Engineers, personal communication, 1993).

Characterization of ground-water resources is based upon surface observations. Higher elevations act as recharge areas. The Rogue River is the regional discharge. Springs, found at many elevations, are seasonal and largely affected by changes in precipitation. Spring productivity is affected by proximity to valley floors, recharge basin size, and rock transmissivity. Springs emanate from rock fractures, permeable paleosols, and rubbly zones between lava flows, and at contacts between relatively impermeable ash-flow tuffs and more permeable lava flows.

MINERAL RESOURCES

Known mineral production from the McLeod quadrangle has consisted exclusively of rock materials (Gray, 1991). Large quantities of stone (andesite of Table Rock) were extracted from Lost Creek Dam quarry (mine site M10, Table 3) to build Lost Creek Dam, whose total volume is 10.8 million cubic yards (U.S. Army Corps of Engineers, 1982). Smaller quantities of dacite from Elk Creek quarry (mine site M3, Table 3) were stockpiled and used in the partial construction of Elk Creek Dam. A small amount of basalt, about 15,000 cubic yards, has been extracted from the Kindschi quarry (mine site M9, Table 3) for road metal.

Several disseminated mercury occurrences are known in the quadrangle (mine sites M1, M6, M8, M11, M12, Table 3). As reported in Gray (1991), prospecting has also occurred for beryllium (mine sites M5, M13, Table 3), although these sites could not be found. Dense foliage and mass wasting tend to obscure and naturally reclaim, small workings making recognition difficult. For example, Rayome (mine site M8, Table 3), a surface prospect, is mostly naturally reclaimed. Two mercury prospects reported in Gray (1991) were not found (mine sites M11, M12, Table 3). One of these, the Rogue River Prospect (mine site M11, Table 3), has sometimes been referred to as the Red Chief.

Both Rayome (mine site M8, Table 3) and the Midnight Prospect (mine site M6, Table 3) lie on a zone of northeasterly-trending shears in bleached and argillized andesite lavas and dacitic tuff. The Midnight Prospect has about 15 m (50 ft) of underground workings consisting of two shallow horizontal adits. Analyses of argillized andesite within the shear zone of the Midnight Prospect (map nos. 25 and 29, Table 2) and an associated jasperoid (map no. 26, Table 2), however, did not yield significant geochemical anomalies for metals.

Mineralization at Alco Creek, a raw prospect, (mine site M1, Table 3) is associated with propylitized pyritic andesite dikes that intrude brecciated and argillized lapilli ash-flow tuff. Two samples from the area were analyzed (map nos. 8 and 9, Table 2); significant anomalies were not detected. The amount of surface disturbance is less than an eighth of an acre.

Tuffs, dikes, and dacite within the caldera complex were sampled because of the occurrence of intense bleaching, seritization, brecciation, and argillization (map nos. 2, 3, 4, 5, 6, 7, 11, and 12, Table 2). A brecciated, hematitically stained dacite hypabyssal intrusive (map no. 11) yielded a slightly anomalous arsenic value (129 ppm). No other samples yielded geochemical anomalies.

The Al Sarena gold and silver mine, 13 km (8 mi) northeast of Burnt Peak, may be hosted within the same silicic complex identified in the northern part of the McLeod quadrangle. The Al Sarena Mine produced precious metals between 1909 and 1918, which were then valued at $24,000. There, disseminated gold and silver are hosted within locally intensely argillized and sericitized dacite stocks and tuffs and are concentrated along westerly-trending shears. Drilling and surface sampling by Fischer-Watt Gold Company in 1991 yielded highly anomalous values of arsenic, mercury, antimony, lead, and zinc, in addition to low-grade gold-silver ore (Bud Hillemeyer, Fischer-Watt Gold Company, personal communication, 1993).

GEOCHEMISTRY

Sampling methods

Rock samples were collected and analyzed for combined major and minor oxides and trace elements (Tables 1 and 2) to provide an indication of their compositions. The samples that were analyzed do not constitute a complete sampling of all the rock types found within the quadrangle.

Where field evidence indicated alteration or mineralization, altered rock samples were collected and analyzed for a particular suite of trace elements (Table 2).

Sample preparation

The rock samples were crushed to minus ¼in. in a Braun chipmunk crusher and then crushed to about minus 10 mesh in a Marcy cone crusher. Both crushers employed manganese-steel crushing media. Each crushed sample was split in a Jones-type splitter to obtain a nominal 250-g subsample for trace-element analysis (TEA) and, where required for whole-rock analysis (WRA), a nominal 100-g subsample. The subsamples were milled to about minus 200 mesh: each trace element subsample in chrome-steel media and each whole-rock subsample in corundum media.

All sample preparation was done in the Oregon Department of Geology and Mineral Industries (DOGAMI) laboratory.

Chemical analysis

Whole-rock analysis

X-ray fluorescence (XRF) analyses were performed by X-ray Assay Laboratories (XRAL) of Don Mills, Ontario, Canada. XRAL used a fused button for its analyses (1.3 g of sample roasted at 950°C for one hour, fused with 5 g of lithium tetraborate, and melt-cast into a button). Loss on ignition (LOI) was determined by the roasting.

Trace-element analysis

Gold—Bondar-Clegg, Ltd., of North Vancouver, British Columbia, Canada, performed analyses for gold. The method employed was fire assay preconcentration of the gold in a 20-g subsample (gold was collected in added silver), acid dissolution of the resulting bead, and direct current plasma (DCP) emission spectrometer finish. The detection limit was 1 ppb.

15-element package—M.B. Associates (MBA; formerly Geochemical Services, Inc.) of North Highlands, California, performed the analyses for 15 trace elements including gold. The method employed a proprietary acid dissolution and organic extraction of a 15-g subsample. The finish was by induction coupled plasma (ICP) emission spectrometry for the elements other than gold; gold was determined by graphite furnace atomic absorption (GFAA) spectrometry. For gold, the detection limit was 0.5 ppb. MBA considers the digestion to provide total metal contents except for gallium and thallium.

Lithium, barium, chromium, cobalt, copper, iron, manganese, nickel, and zinc—The DOGAMI laboratory performed flame emission analysis for lithium and flame atomic absorption analysis for barium, chromium, cobalt, copper, iron, manganese, nickel, and zinc on some altered rock samples. A 1-g sample was digested with nitric, hydrofluoric, and perchloric acids; taken to incipient dryness; and then redissolved and taken to 100-ml volume with 10-percent nitric acid. The digestion provides total metal content except for barium and possibly chromium.

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