UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

Mineral resource potential of the Thousand Lakes Wilderness, Shasta County, California

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STUDIES RELATED TO WILDERNESS

Under the provisions of the Wilderness Act (Public Law 88-577, September 3, 1964) and the Joint Conference Report on Senate Bill 4, 88th Congress, the U.S. Geological Survey and the U.S. Bureau of Mines have been conducting mineral surveys of wilderness and primitive areas. Areas officially designated as "wilderness," "wild," or "canoe" when the act was passed were incorporated into the National Wilderness Preservation System, and some of them are presently being studied. The act provided that areas under consideration for wilderness designation should be studied for suitability for incorporation into the Wilderness System. The mineral surveys constitute one aspect of the suitability studies. The act directs that the results of such surveys are to be made available to the public and be submitted to the President and the Congress. This report discusses the results of a mineral survey of the Thousand Lakes Wilderness, Lassen National Forest, Shasta County, California. The area was established as a wilderness by Public Law 88-577, September 3, 1964.

SUMMARY

Geologic mapping, geochemical sampling, and an aeromagnetic survey by the U.S. Geological Survey and field assessment by the U.S. Bureau of Mines show low potential for mineral or geothermal resources within the Thousand Lakes Wilderness. No mining claims are known in the area. Large volumes of cinders, useful for road building, are found in the area; some of the dense volcanic rock of the wilderness is suitable for construction. However, both commodities are plentiful and more accessible at developed sites outside the wilderness. No signs of metallic mineralization were found during field examination of the rocks or in chemical analyses done on 39 rock samples. There are no hot springs, deposits of minerals that might be sublimates of hot gas, or other surface evidence that potential exists for a geothermal-energy resource within the Thousand Lakes Wilderness. Because of the proximity of the wilderness to known geothermal resources of Lassen Volcanic National Park, 18 miles to the south, and hot springs along Pit River approximately 24 miles to the northeast, complete assessment of the geothermal resources of Thousand Lakes Wilderness would require drilling.

INTRODUCTION

Thousand Lakes Wilderness is located about 40 mi east of Redding and 12 mi south of Burney, in eastern Shasta County, Calif. (fig. 1). The wilderness is part of Lassen National Forest and is roughly 5 mi from north to south and 6 mi from east to west. The wilderness is on the Cascade Range crest and is dominated by a deeply eroded composite volcano. This volcano is the major volcanic edifice between Lassen Peak and Mount Shasta. Crater Peak, Magee Peak, and Fredonyer Peak are all on the volcano, which will be called Crater-Magee volcano in this report (see fig. 2). North and east of Crater-Magee volcano is the Thousand Lakes Valley, which is at the center of the wilderness. Numerous small lakes are found in the valley between elevations of 5,600 and 8,677 ft. Small Pleistocene shield volcanoes and Holocene flows and cinder cones are found on the north and east sides of the wilderness. The Thousand Lakes Valley is forested; peaks above the valley floor are generally free of vegetation.

Access to the wilderness is by four trailheads located at Cypress Campground on the northwest, Tamarack Swale on the northeast, Bunchgrass Valley on the southeast, and Cow Creek on the southwest.

Thousand Lakes Wilderness is part of the Manzanita Lake 15-minute quadrangle mapped by Macdonald (1963). A regional summary by Macdonald (1966) also provided a basis for understanding the regional geologic setting and relative ages of rock units.

GEOLOGY, GEOCHEMISTRY, AND GEOPHYSICS PERTAINING TO MINERAL RESOURCE ASSESSMENT

Geology

Thousand Lakes Wilderness is in the southern part of the Cascade volcanic province (Macdonald, 1966), a belt of Tertiary and Quaternary volcanic centers which extends from southern British Columbia to northern California. The wilderness is dominated by the composite volcano of Crater and Magee Peaks The bedrock in the wilderness is composed of volcanic rocks of Tertiary and Quaternary age (fig. 3). The oldest rocks exposed are pyroxene andesite of late Pliocene age (Macdonald, 1963). The pyroxene andesite is composed of a thick sequence of flows and is regionally extensive. Younger (Pleistocene) shield and composite volcanoes overlie these flows. In the Thousand Lakes Wilderness the andesite of Crater Peak, dacite of Magee Peak, and massive andesite and andesites of Freaner Peak and Logan Mountain rest on the pyroxene andesite. A north-northwest-trending system of vertical to steeply dipping faults subsequently cut flows in the eastern part of the wilderness. Basalt and andesite flows (olivine basalt and andesite of Devils Rock Garden unit) occurred during Holocene time.

Glaciation of Crater-Magee volcano was the next event recorded in the stratigraphy of Thousand Lakes Wilderness. Ground moraine and outwash deposits (Macdonald, 1963) are found in Thousand Lakes Valley and Eiler Gulch. Rock types observed in the moraine correspond to those now exposed in the cirque walls on the north and east faces of Crater Peak and Magee Peak.

Rocks erupted since the glacial period were localized by faulting rather than by the conduit system of Crater-Magee volcano.

Cinder cones and flows of olivine basalt in the eastern side of the wilderness are confined by the slopes of Crater-Magee and Freaner Peaks and Logan Mountain and the fault scarps in the underlying Tertiary and Quaternary andesites. Cinder cones from which the flows emanated define a strong north-northwest trend from the Devils Rock Garden to Freaner Peak, following local fault trends.

Geochemistry

Thirty-nine bedrock samples collected by the U.S. Geological Survey from each of the mapped geologic units were analyzed for thirty-five elements. A summary of average values and the range of values determined for the 35 elements by semiquantitative spectrographic analysis are presented in table 1 (major units only). In such a small study area, sample coverage was inadequate to allow statistical analysis of the data. These analyses were compared to background data for similar rocks outside of the study area in order to identify anomalous values.

Small zones of alteration were observed at the contacts between shallow intrusive neck rocks and the basaltic cinders unit. No signs of mineralization were found; geochemical analyses show no significant anomalies. No other signs of mineralization were found in the field or the geochemical data. Values within each unit (table 1) were generally consistent, and values were similar from unit to unit.

Geophysics

An aeromagnetic survey made of the wilderness revealed a large positive anomaly over Magee Peak. This anomaly may be at least in part due to topography, or may indicate that the intrusive rocks contain more magnetite than the flow rocks or cinders. The anomaly may also indicate that the shallow intrusive rocks of the volcanic neck are voluminous at depth. The data show no unusual patterns elsewhere in the wilderness.

MINING DISTRICTS AND MINERALIZATION

No mining claims or prospects are found within the wilderness. Gold and silver were produced before 1934 from altered Cenozoic rhyolitic tuff at Hayden Hill, 50 mi northeast of the wilderness. The more mafic Cenozoic rocks within the wilderness contain no analogous alteration. Gold, silver, copper, lead, and zinc have been mined from Mesozoic metavolcanic and sedimentary rocks 15 to 20 mi to the west, but similar mineralized rocks do not occur within the wilderness. Coal, diatomite, and sulfur were also produced in the region but are not found in the wilderness.

ASSESSMENT OF MINERAL RESOURCE POTENTIAL

Mineral resource potential of the Thousand Lakes Wilderness is low. No metallic mineral deposits are known. The Thousand Lakes Wilderness is in an area recognized as having potential for geothermal resources (U.S. Geological Survey, 1978). Hot springs are found both north, along the Pit River, and south beyond the wilderness. To the south, geothermal activity occurs in several places within Lassen Volcanic National Park. The Morgan Springs Known Geothermal Resource Area (KGRA) along the south side of the park is 17 mi south of the wilderness.

Mineral resources within the Thousand Lakes Wilderness are limited to volcanic stone and cinders. Large volumes of good-quality basaltic cinders are found at Eiler Butte, Hall Butte, and Tumble Buttes. Cinders from nearby sources have been used in road building, for railroad ballast, and as lightweight aggregate. The hard, dense, and partly vesicular dark-gray andesite at Freaner Peak, Logan Mountain, and Devils Rock Garden could provide stone for construction. Plentiful and more accessible deposits of both commodities, however, are available at several developed sites within 20 mi of the wilderness (Lydon and O'Brien, 1974, p. 144-147); the Thousand Lakes Wilderness is far from large markets.

REFERENCES CITED

Lydon, P. A., and O'Brien, J. C., 1974, Mines and mineral resources of Shasta County, California: California Division of Mines and Geology County Report 6, 154 p.

Macdonald, G. A., 1963, Geology of the Manzanita Lake quadrangle, California: U.S. Geological Survey Geologic Quadrangle Map GQ-248.

_____1964, Geology of the Prospect Peak quadrangle, California: U.S. Geological Survey Geologic Quadrangle Map GQ-345.

_____1966, Geology of the Cascade Range and Modoc Plateau in Bailey, E. H., ed., Geology of northern California: California Division of Mines and Geology Bulletin 190, p. 65-96.

U.S. Geological Survey, 1978, Lands valuable for geothermal resources, northern California: Washington, D.C., scale 1:500,000.

TABLE 1. Averages and range of values for semiquantitative spectrographic analyses of units from the Thousand Lakes Wilderness. [Al, Ti, Ca, Na, Mg, Fe are in weight percent. All other values are in parts per million. Uranium was determined by spectrographic analysis. Figures in parentheses following map symbols represent number of analyses per unit. See figure 3 for explanation of map symbols. "tr" indicates trace of element detected; dashes indicate value below detection limit.]

	Qam[7]	Range	Qac[10]	Range	Qi[3]	Range	Qda[6]	Range
Al%	7	(7)	7	(7)	7	(7)	7	(7)
Ti%	0.25	(0.2-0.5)	0.25	(0.2-0.5)	0.3	(0.3)	0.2	(0.07-3)
Ca%	4.1	(3-7)	3.3	(3-5)	3	(3)	2	(1.5-3)
Na%	2.3	(1-4)	2.8	(2-5)	2.7	(2-3)	2.8	(2-3)
Mg%	2.3	(1.5-3)	1.8	(1.5-3)	1.8	(1.5-2)	1.2	(0.7-3)
Fe%	7	(3-10)	4.7	(3-7)	2.7	(2-3)	2.3	(0.7-3)
(ppm)								
Mn	614	(300-700)	495	(150-700)	633	(500-700)	433	(300-700)
Au	--	--	--	--	--	--	--	--
Ag	--	--	--	--	--	--	--	--
Cu	53	(50-70)	25	(20-50)	33	(20-50)	20	(7-50)
Pb	5	(0-10)	15	(10-20)	13	(10-20)	38	(10-70)
Zn	--	--	--	--	--	--	--	--
Mo	--	--	--	--	--	--	--	--
W	--	--	--	--	--	--	--	--
Ni	44	(30-70)	19	(10-30)	30	(30)	12	(7-30)
Co	34	(20-70)	19	(10-50)	37	(30-50)	10	(0-30)
Cr	146	(70-200)	38	(20-70)	90	(50-150)	25	(10-50)
Cd	--	--	--	--	--	--	--	--
As	--	--	--	--	--	--	--	--
Sb	--	--	--	--	--	--	--	--
V	193	(150-200)	132	(70-200)	183	(150-200)	102	(30-300)
Bl	--	--	--	--	--	--	--	--
Sn	--	--	--	--	--	--	--	--
Zr	61	(50-70)	74	(70-200)	63	(50-70)	107	(70-200)
B	7	(1-10)	10	(tr-15)	tr	(tr)	tr	(0-15)
Ba	242	(100-700)	510	(300-700)	300	(300)	817	(200-1000)
Be	tr	(0-1)	1	(tr-2)	tr	(tr)	2	(tr-2)
La	3	(0-20)	8	(0-20)	--	--	50	(0-50)
Nb	--	--	--	--	--	--	0	(0-10)
Sc	26	(20-30)	15	(15-20)	23	(20-30)	10	(5-20)
Sr	786	(700-1000)	620	(500-700)	700	(700)	467	(300-700)
Y	24	(20-30)	22	(20-30)	20	(20)	25	(20-30)
Li	--	--	--	--	--	--	--	--
Th	--	--	--	--	--	--	--	--
U	<1	(<1)	<1	(<1)	<1	(<1)	<1	(<1-2)

TABLE 1. (continued)

	Qafl[8]	Range	Qbo[5]	Range	Detection limit
Al%	7	(7)	7	(7)	0.5
Ti%	0.3	(0.2-0.5)	0.3	(0.3-0.5)	0.002
Ca%	3	(2-3)	3.6	(2-5)	0.05
Na%	2.3	(1.5-3)	3	(3)	0.15
Mg%	1.7	(1-3)	2	(1.5-3)	0.02
Fe%	5.7	(3-10)	5.4	(3-7)	0.05
(ppm)					
Mn	700	(700)	660	(500-700)	10
Au	--	--	--	--	10
Ag	--	--	--	--	0.5
Cu	37	(30-50)	50	(50)	5
Pb	17.5	(10-30)	22	(20-30)	10
Zn	--	--	--	--	200
Mo	--	--	--	--	5
W	--	--	--	--	50
Ni	57	(30-70)	74	(30-100)	5
Co	22	(15-30)	28	(20-50)	5
Cr	114	(70-200)	150	(70-200)	10
Cd	--	--	--	--	20
As	--	--	--	--	200
Sb	--	--	--	--	100
V	156	(100-200)	150	(150)	10
Bl	--	--	--	--	10
Sn	--	--	--	--	10
Zr	119	(50-200)	88	(70-100)	10
B	12	(10-20)	12	(10-20)	10
Ba	575	(300-700)	540	(300-700)	20
Be	1	(1-2)	1	(1-2)	1
La	21	(20-50)	20	(20)	20
Nb	--	--	--	--	20
Sc	20	(20)	21	(15-30)	5
Sr	575	(300-700)	580	(300-700)	100
Y	26	(10-30)	26	(10-30)	10
Li	--	--	--	--	100
Th	--	--	--	--	100
U	<1	(<1-2)	<1	(<1)	

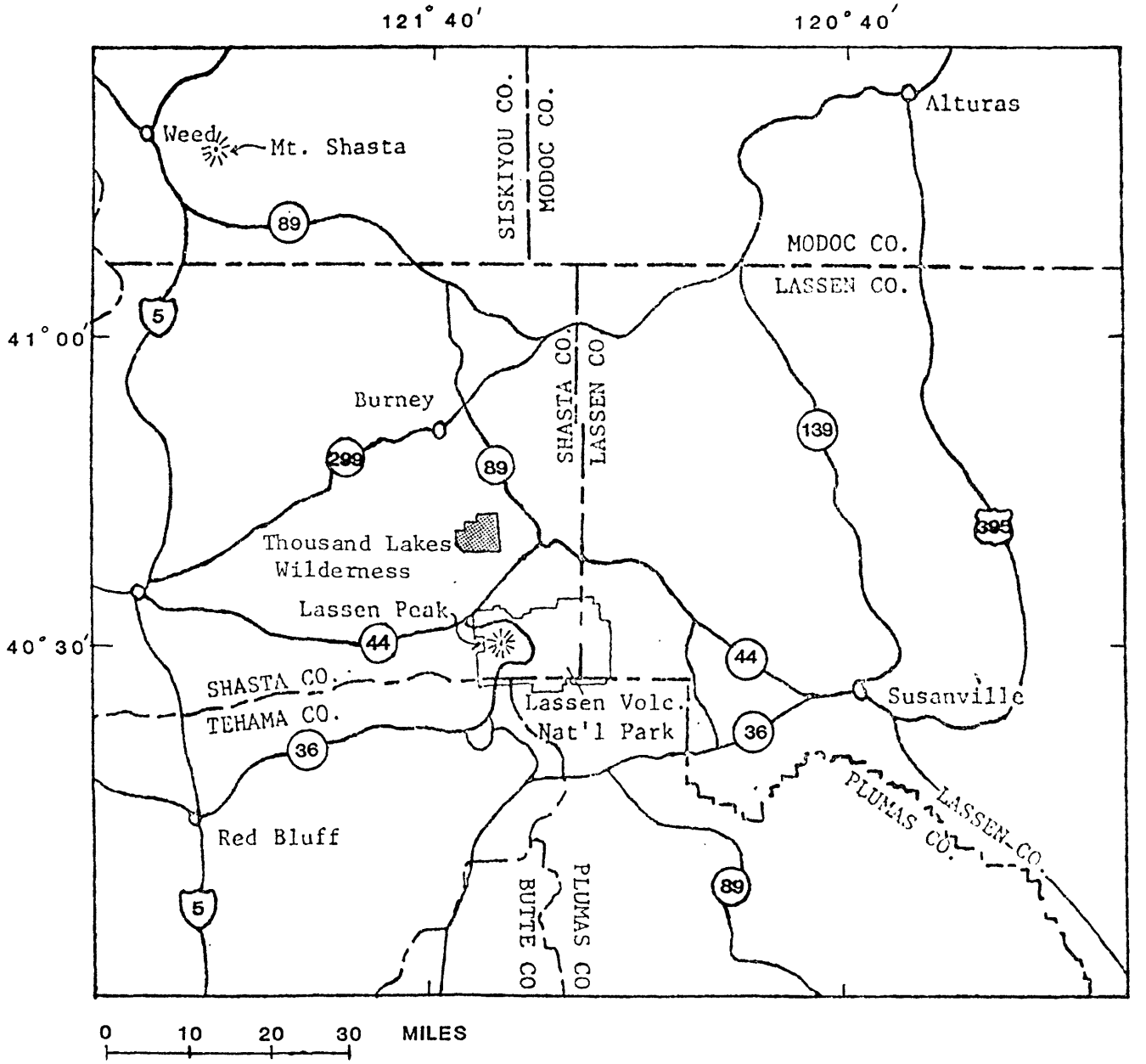


Figure 1: Location of Thousand Lakes Wilderness

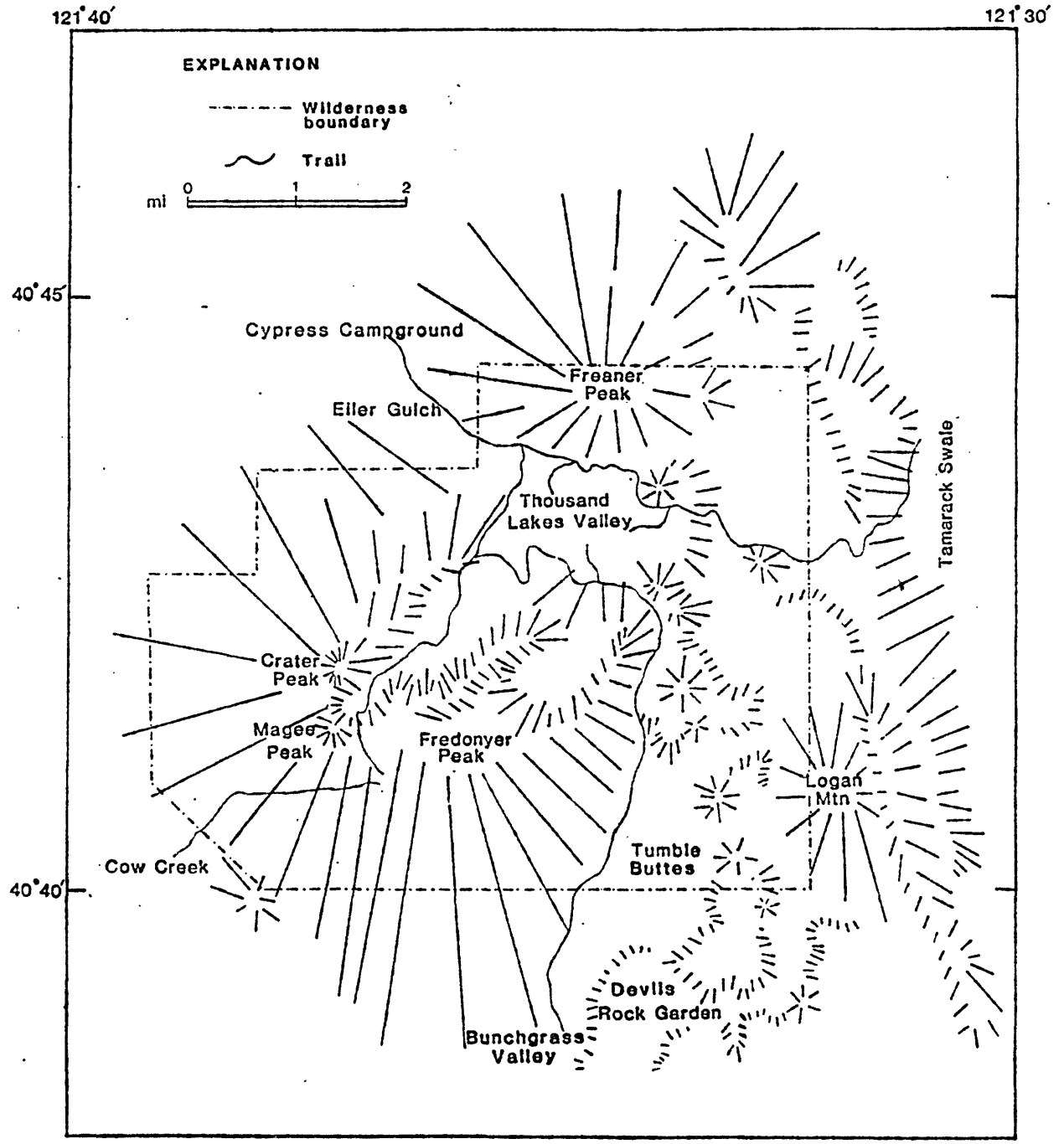


Figure 2: Geographic features of the Thousand Lakes Wilderness, Lassen National Forest

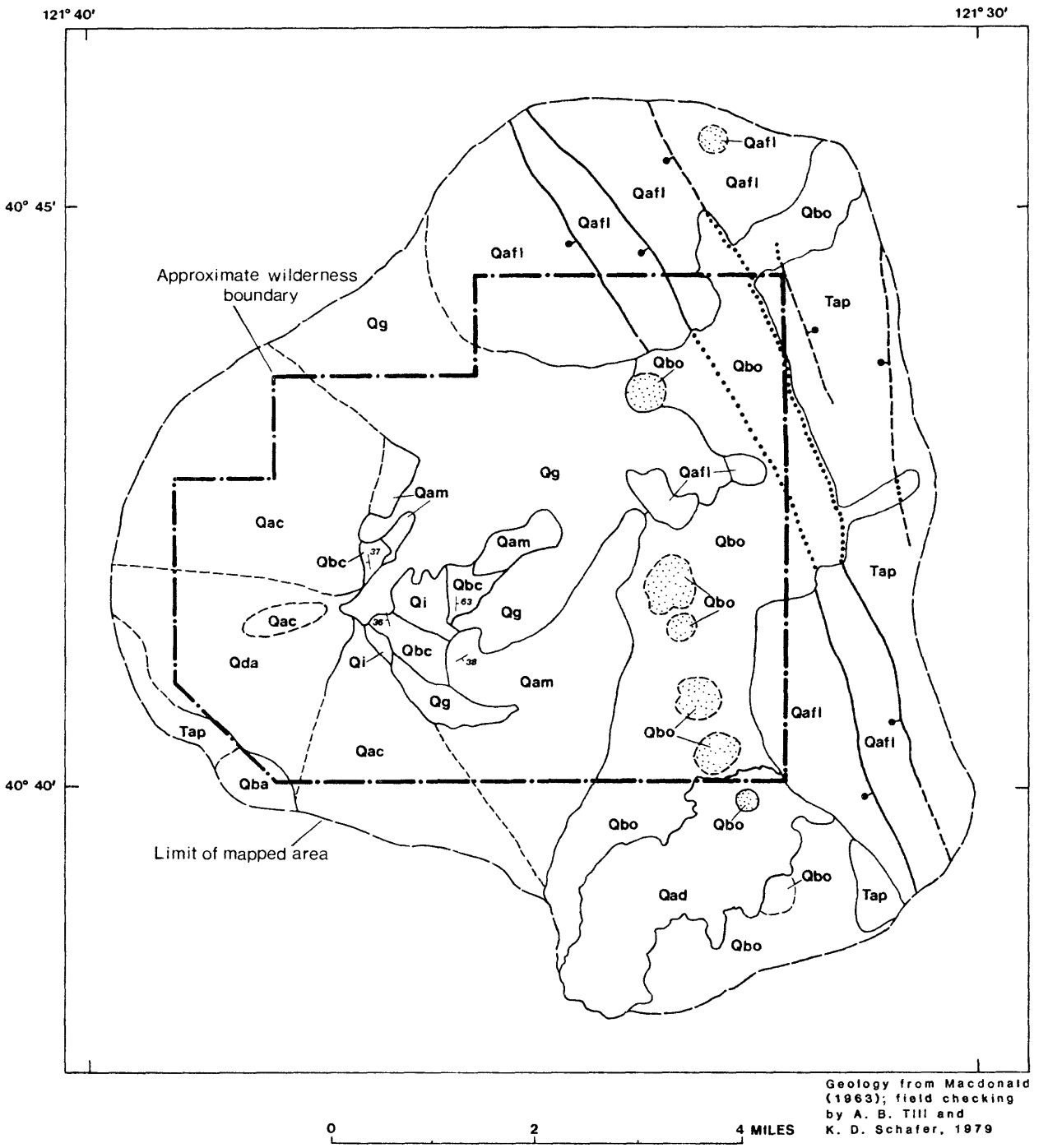
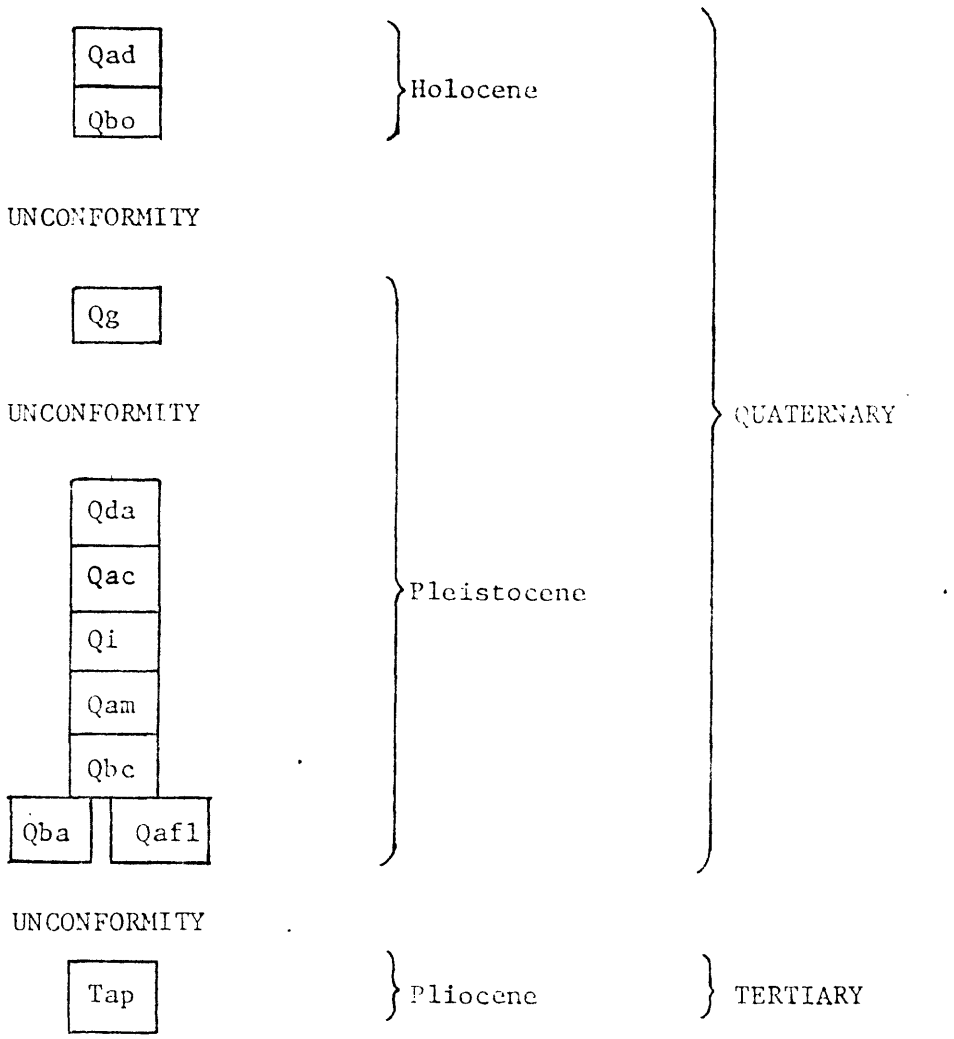


Figure 3.--Geologic map of Thousand Lakes Wilderness, Lassen National Forest. Explanation on following page.

EXPLANATION TO ACCOMPANY FIGURE 3

CORRELATION OF MAP UNITS



DESCRIPTION OF MAP UNITS

Qad ANDESITE OF DEVILS ROCK GARDEN (HOLOCENE)

Qbo OLIVINE BASALT (HOLOCENE)

Qg GLACIAL DEPOSITS (PLEISTOCENE)

Qda DACITE OF MAGEE PEAK (PLEISTOCENE)

Qac ANDESITE OF CRATER PEAK (PLEISTOCENE)

Qam MASSIVE ANDESITE (PLEISTOCENE)

Qi INTRUSIVE ANDESITE, MICRODIORITE, AND DACITE (PLEISTOCENE)

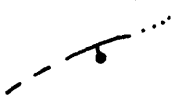
Qbc BASALTIC CINDERS (PLEISTOCENE)

Qba BASALTIC ANDESITE AND ANDESITE (PLEISTOCENE)

Qafl ANDESITES OF FREANER PEAK AND LOGAN MOUNTAIN, UNDIVIDED (PLEISTOCENE)

Tap PYROXENE ANDESITE (PLIOCENE)

CONTACT--Dashed where approximately located



FAULT--Dashed where inferred; dotted where concealed. Ball and bar on downthrown side

CINDERS

STRIKE AND DIP OF PYROCLASTIC AND ANDESITE FLOWS