UNITED STATES DEPARTMENT OF INTERIOR
GEOLOGICAL SURVEY

Mineral resource potential of the Lost Creek Roadless Area, Shasta County, California

by

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STUDIES RELATED TO WILDERNESS

Under the provisions of the Wilderness Act (Public Law 88-577, September 3, 1964) and related acts, 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 in 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 Lost Creek Roadless Area (5089), Lassen National Forest, Shasta County, California. The Lost Creek Roadless Area was classified as a further planning area during the Second Roadless Area Review and Evaluation (RARE II) by the U.S. Forest Service, January 1979.

SUMMARY

U.S. Bureau of Mines and U.S. Geological Survey investigations identified no mineral deposits in Lost Creek Roadless Area. Sand and gravel have been mined from fluvial deposits just outside the roadless area; these deposits may extend into the roadless area beneath a Holocene basalt flow that may be as much as 40 ft thick. An oil and gas lease application which includes the eastern portion of the roadless area is pending. Abundant basalt in the area can be crushed and used as aggregate, but it could not compete with similar deposits in more favorable locations or with cheaper substitutes such as volcanic cinders or sand and gravel which are available outside the study area closer to major markets. No indication of coal or geothermal energy resources was found.

INTRODUCTION

Lost Creek Roadless Area encompasses 8,300 acres of Lassen National Forest in northeastern California, about 20 mi north of Lassen Peak. The closest city is Redding, California, 50 mi to the southwest. Peripheral access is provided by California State Highway 89 passing near the west boundary of the roadless area (fig. 1). The Pacific Crest Trail lies along the west margin of Hat Creek Rim adjacent to the east boundary of the roadless area. Most of the roadless area is a valley 3.5 mi wide, sloping from an elevation of 3800 ft at the south boundary to 3,220 ft on the north. The Hat Creek Rim, along the east boundary of the roadless area, is a series of precipitous cliffs that rise to elevations of nearly 4,500 ft. Hat Creek flows from south to north near the west boundary of the roadless area. Lost Creek enters the valley from the southeast and disappears into the porous basalt and gravels near the Bidwell Ranch.

Bureau of Mines fieldwork in Lost Creek Roadless Area was conducted during July 1982 by personnel of the Western Field Operations Center, Spokane, Washington. Prior to the field study, Bureau personnel searched for information pertaining to mining or prospecting activity and mineral resources by reviewing publications and records of county, state, and Federal agencies. Fieldwork consisted of sampling, mapping, and evaluating known claims and mineral occurrences in the area. Three grab samples were taken from a sand and gravel pit adjacent to the roadless area.

Geological Survey fieldwork in Lost Creek Roadless Area was conducted during May 1981 by L. J. Patrick Muffler and Marcus H. Moench. In addition to geologic mapping, five stream-sediment samples were collected and were analyzed for 32 elements (table 2).

The geology, geochemistry, and petrography of the Hat Creek Basalt that covers most of Lost Creek Roadless Area have been described by Finch (1933), Anderson (1940), Macdonald (1964), Anderson (1971), Anderson and Gottfried (1971), and Anderson and others (1982). Anderson (1940) presents a geologic map at a scale of approximately 1:190,000 that includes Lost Creek Roadless Area, and the geologic map of Macdonald (1964) at a scale of 1:62,500 extends to just south of the roadless area. Regional gravity data are available (Pakiser, 1964; LaFehr, 1965; Oliver and others, 1975; Oliver and others, 1980; Griscom, 1980), and high-quality aeromagnetic data have been acquired recently by Couch (1982) under contract from the USGS. Heat-flow data from shallow wells in northeastern California are presented by Mase and others (1982).

GEOLOGIC SETTING

Lost Creek Roadless Area lies just east of the crest of the Cascade Range in a major north-trending valley containing Hat Creek, the principal northerly drainage of the volcanic highlands 20 mi to the south near Lassen Peak. The valley is bounded on the east by the conspicuous young fault scarps of the Hat Creek Rim. Faults on the west side of the valley are less noticeable; the valley can be considered to be an asymmetric fault block tilted to the east and partly filled by alluvial material and volcanic rocks derived primarily from the south.

Rocks exposed in the hills to the west of the roadless area are a variety of locally derived andesite flows, faulted and partly eroded. No analytical ages are available, but the degree of faulting and erosion is similar to andesites just to the south, considered by Macdonald (1964) to be of Pliocene age. The andesites are stratigraphically beneath and significantly older than the dacites of Burney Mountain, 7 mi to the west, dated at 240,000 yr B.P. by the potassium-argon method (G. B. Dalrymple, USGS, written communication, 1982).

Rocks exposed on the fault scarps on the east side of the Hat Creek fault block comprise a series of low-potassium high-alumina diktytaxitic olivine basalts correlative with those mapped by Macdonald (1964) as the Burney Basalt just south of Lost Creek Roadless Area. Similar basalts ranging in age from late Miocene to Quaternary are widespread in northeastern California east of the Cascade Range. No analytical ages are available for the Burney Basalt on the Hat Creek Rim, and stratigraphic relations are not clear. Present information provides no basis for disagreeing with Macdonald's assignment of the Burney Basalt in this area to the early Pleistocene.

Macdonald (1964) shows Pliocene andesites underlying the Burney Basalt along the Hat Creek Rim south of Lost Creek Roadless Area. Similar Pliocene andesites probably are exposed on the Hat Creek Rim in or just east of the roadless area but are not discriminated on figure 2. Coarse talus mantles much of the lower parts of the fault scarps.

The exposed rocks in the Hat Creek fault block in and adjacent to Lost Creek Roadless Area appear to be interbedded fluvial gravel and mafic volcanic rock ranging in composition from basalt to mafic andesite. All geologic units exposed in the Hat Creek fault block are very young, probably entirely Holocene.

Two volcanic units have been mapped in the Hat Creek fault block in and adjacent to Lost Creek Roadless Area. The older unit makes up Cinder Butte, a small shield volcano of mafic andesite located just north of Lost Creek Roadless Area. Cinder Butte shows very rugged topography unmodified by erosion, but is cut by one branch of the young fault system along the Hat Creek Rim. The vent areas of this shield volcano lie 2 to 3 mi north of the northernmost part of Lost Creek Roadless Area.

The younger volcanic unit in the Hat Creek fault block in and adjacent to Lost Creek Roadless Area is the Hat Creek Basalt, a low-potassium, high-alumina diktytaxitic olivine basalt which flowed north from vents near Old Station, 8 mi south of the southern boundary of Lost Creek Roadless Area (Anderson, 1940; Macdonald, 1964). The distal extremity of the lava flow is 6 mi north of Lost Creek Roadless Area area. Within the roadless area, the Hat Creek Basalt has a rugged blocky surface with local relief of up to 20 ft. The thickness of the flow is is uncertain, but is unlikely to exceed 40 ft except where ponded locally. Conspicuous on the east side of the flow are lava slump scarps, where the cooled crust of the lava slumped westward over the fault scarps of the Hat Creek Rim as underlying still-liquid lava drained to the northwest (Finch, 1933; Anderson, 1940).

The Hat Creek lava flow is almost certainly Holocene in age; paleointensity data (Coe, 1967, p. 3258) and preliminary analysis of paleomagnetic secular variation (Duane Champion, USGS, Oral Communication, 1982) suggest an age of approximately 5,000 years.

Interbedded with the volcanic rocks are fluvial gravel and sand, in part interlayered with silicic ash derived from the pyroclastic eruptions from the Lassen Peak area. At least 30 ft of coarse fluvial gravel and sand are exposed in the Wilcox sand and gravel pit 0.5 mi southeast of Lost Creek Roadless Area (fig. 2; table 1). The clasts in the gravel are well rounded and consist of a wide variety of volcanic rocks ranging in composition from basalt to dacite. These rocks are probably all derived from the highlands to the south in and adjacent to Lassen Volcanic National Park. Underlying the gravel at the deepest part of the gravel pit there is a silicic ash and a few angular boulders of olivine basalt, interpreted by the U.S. Geological Survey investigator as the top of a basalt flow underlying the gravel and sand. The U.S. Geological Survey investigator further concluded that these basalt boulders, if in place, could not be from the Hat Creek Basalt; visual observation and interpretation of aerial photographs suggest that the scarps in the Hat Creek Basalt north and east of the gravel pit are flow-front scarps, and that therefore the Hat Creek Basalt never extended to the gravel pit.

The precise age of this gravel and sand of the Wilcox sand and gravel pit is thus subject to disagreement. The U.S. Geological Survey interpretation described above indicates that the Hat Creek Basalt is younger than the gravel and sand and that therefore the gravel and sand may extend north under the flow. The U.S. Bureau of Mines interpretion, however, suggests that the gravel and sand are younger than the Hat Creek Basalt and therefore cannot extend north under the Hat Creek Basalt.

Overlying the Hat Creek Basalt and the fluvial gravel and sand are patches of Holocene alluvium, in part interlayered with silicic ash derived from the pyroclastic eruptions that accompanied the extrusion of Chaos Crags domes in Lassen Volcanic National Park 1,050 years ago (unpublished ^{14}C date by S. W. Robinson, USGS, 1982). This ash lies in hollows on the Hat Creek Basalt and commonly has been reworked and winnowed by wind and water action.

TRACE ELEMENT GEOCHEMISTRY

Five samples of silt- or sand-sized sediment from all significant perennial and ephemeral streams draining Lost Creek Roadless Area were collected for trace-element analysis. The stream-sediment samples were dried, sieved to minus-80 mesh, split, pulverized, and analyzed by standard semiquantitative emission spectrography for 31 elements and by instrumentation methods for mercury (table 2). The results are within the expected ranges for sediments derived from volcanic rocks (cf. Turekian and Wedepohl, 1961, table 2). In addition, no individual samples stand out as anomalously enriched in any element or set of elements.

REGIONAL MINING ACTIVITY

No mines or prospects were found in Lost Creek Roadless Area. Sand and gravel deposits have been mined from open pits just north and south of the boundary of the roadless area (fig. 2; table 1). Over 100,000 yd^3 of sand and gravel have been removed from these pits; most was used for roadfill and concrete aggregate. The Maahcooatchee Cinder Pit 2 mi west of the area has intermittently produced cinders for several years. At least 12 other volcanic cinder pits in the region have been active since World War II (Lydon and O'Brien, 1974, p. 88, 145). Other mineral commodities in this region include diatomite, pumice, perlite, and stone.

ASSESSMENT OF MINERAL DEPOSITS

Significant sand and gravel deposits occur adjacent to the Lost Creek Roadless Area (fig. 2 and Table 1); the Wilcox sand and gravel pit in particular is a commercially important source of construction aggregate for the region. If this deposit is older than the Hat Creek Basalt (see p. 4), it is likely to extend to the north for an unknown distance under the flow. Even if this particular deposit of gravel and sand is younger than the Hat Creek Basalt, other layers of sand and gravel may well occur beneath the Hat Creek Basalt. Production of gravel from under the flow, however, would be at an economic disadvantage because of the additional expense of removing the resistant basalt. The basalt itself could be crushed and used as aggregate, but could not compete with volcanic cinders, sand, and gravel that are readily available outside the roadless area and require less expensive processing. Similar considerations would apply to the possible use of the basalt for dimension stone; transportation costs are a significant part of total cost for commodity of high bulk and low unit value, and abundant similar or better quality stone is available closer to major markets.

No mineral deposits were identified in or adjacent to Lost Creek Roadless Area. A pending oil and gas lease application includes the eastern part of the roadless area. No indication of coal or geothermal energy resources was found. The area lies in a pronounced heat-flow low due to regional movement of cold ground water north from the volcanic highlands near Lassen Peak (Mase and others, 1982, fig. 7). Although the Hat Creek Basalt is indeed very young, any thermal energy in the flow itself has long since dissipated, and its vent area is 8 mi south of Lost Creek Roadless Area.

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Table 1.--Sand and gravel pits adjacent to Lost Creek Roadless Area (see fig. 2 for location)

Name	Summary	Workings	Sample data and resource estimate
Forest Service sand and gravel pit	Flood plain sand and gravel form a veneer over depressions on the surface of the Hat Creek Basalt. The deposit rests either directly on the basalt or on an ash layer. Crude stratification is present; a high proportion of the material is sand and fine gravel. Overburden consists of a soil zone about 1 ft thick.	Three pits cover a total area of approximately 70,000 sq ft with average depth of excavation about 6 ft. Test pits have been dug on the east and north.	Clasts are primarily basalt. Screen analyses indicate clasts smaller than 1/4 in. make up 70 to 80 percent of the deposit. About 90 percent are larger than 35 mesh.
Wilcox sand and gravel pit	Flood plain sand and gravel deposit near Hat Creek; consists of well-rounded, volcanic clasts. Composed of dacite, andesite, and olivine basalt, some of which is vesicular. Thin soil layer has been removed. At least one ash layer occurs near the base of the gravel, and the gravel appears to rest on a poorly exposed older basalt.	One large pit from which more than 100,000 cu yd of sand and gravel have been removed.	California Division of Highways test results indicate this sand and gravel will meet specifications for many types of construction aggregate.
Wilcox sand and gravel pit (original site)	A thin veneer of flood plain sand and gravel on the irregular surface of the Hat Creek Basalt. Judging from pits, the deposit was generally less than 5 ft thick and not laterally extensive.	Deposit has been completely mined leaving several water-filled pits. A plant on the site is used to process and stockpile material from the new pit.	The deposit is depleted.

Table 2. Geochemical analyses of stream sediments from Lost Creek Roadless Area. Semiquantitative spectrographic analysis by USGS Branch of Exploration Research, Report no. 20126. The following elements were analyzed for but not detected (detection limits in parts per million (ppm) given in parentheses): Ag (.5), As (200), Au (10), Bi (10), Cd (20), La (20), Mo (5), Nb (20), Sb (100), Sn (100), W (50), Th (100), and Zn (200).

			Percent				ppm														
Lower limit of detection			.05	.02	.05	.002	10	10	20	1	5	10	5	5	10	5	100	10	10	10	
Sample Number (see Fig.2)	Latitude (N.)	Longitude (W.)	Fe	Mg	Ca	Ti	Mn	B	Ba	Be	Co	Cr	Cu	Ni	Pb	Sc	Sr	V	Y	Zr	Hg
922	40°45'56"	121°26'02"	5	1.5	2	.5	1000	10	300	1	20	300	20	150	10	20	500	100	15	100	.06
928	40°45'15"	121°28'56"	3	1	1.5	.3	500	15	500	1	15	100	10	30	10	15	300	100	15	70	.08
931	40°46'42"	121°30'04"	5	1	1.5	.5	700	10	500	1	15	150	20	50	10	15	300	100	15	100	.14
934	40°46'52"	121°29'54"	5	1	1.5	.5	1000	10	500	1.5	15	150	20	50	10	15	300	100	15	300	.10
936	40°48'03"	121°26'47"	5	1.5	2	.5	700	10	300	1	20	200	20	100	10	20	300	100	15	150	.08

Element names: Antimony (Sb), Arsenic (As), Boron (B), Barium (Ba), Beryllium (Be), Bismuth (Bi), Boron (B), Cadmium (Cd), Calcium (Ca), Chromium (Cr), Cobalt (Co), Copper (Cu), Iron (Fe), Gold (Au), Lanthanum (La), Lead (Pb), Magnesium (Mg), Manganese (Mn), Mercury (Hg), Molybdenum (Mo), Niobium (Nb), Nickel (Ni), Scandium (Sc), Silver (Ag), Strontium (Sr), Thorium (Th), Tin (Sn), Titanium (Ti), Tungsten (W), Vanadium (V), Yttrium (Y), Zinc (Zn), Zirconium (Zr).

EXPLANATION FOR FIGURE 2

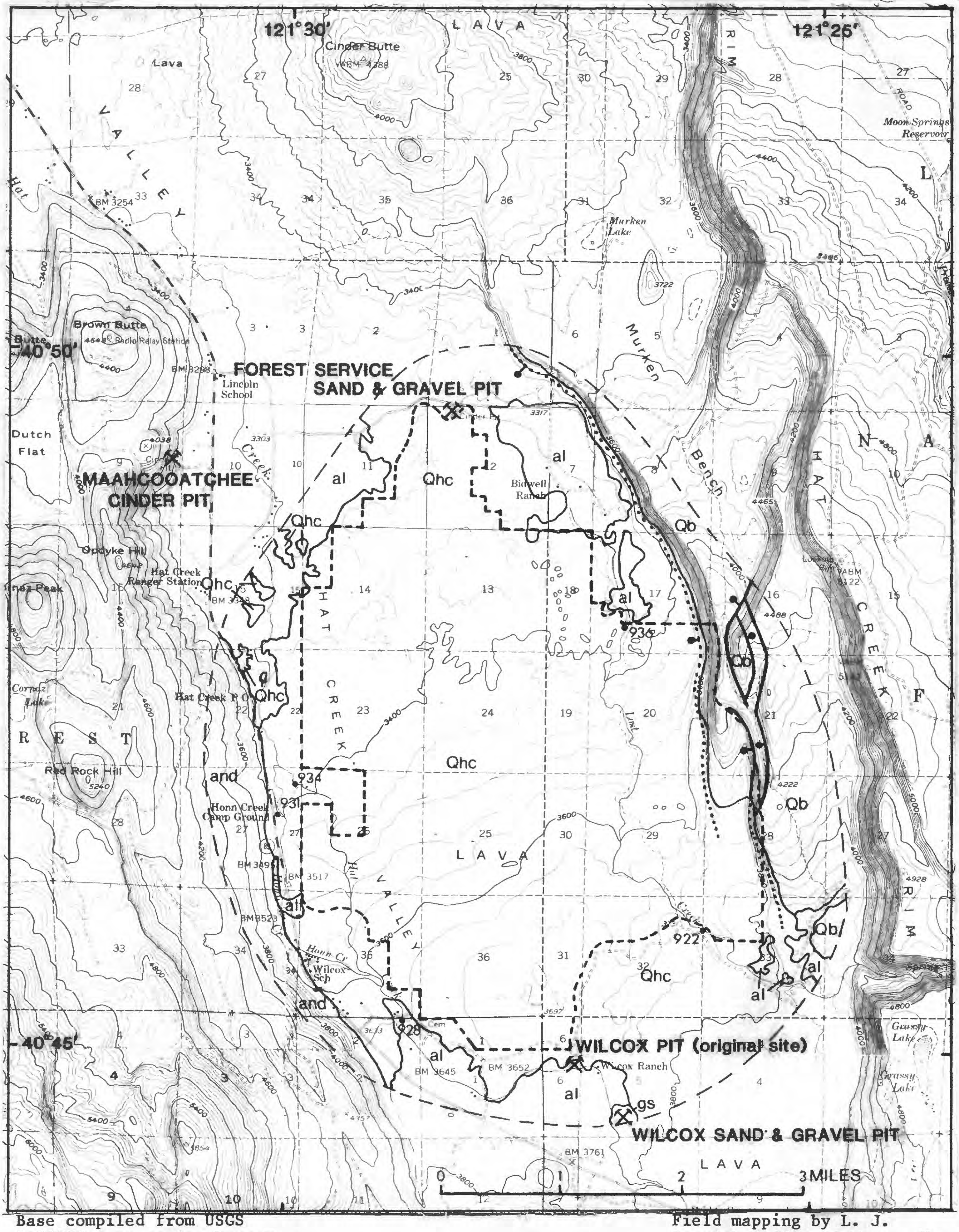
CORRELATION OF MAP UNITS

Map units	Epoch	Period
al	Holocene	QUATERNARY
Qhc, gs	Holocene	QUATERNARY
Qb	Pleistocene	QUATERNARY
and	Pliocene	TERTIARY

DESCRIPTION OF MAP UNITS

al	Alluvium, in part interbedded with silicic ash
Qhc	Hat Creek Basalt--Black, low-potassium, high-alumina diktytaxitic olivine basalt
gs	Fluvial gravel and sand, consisting of clasts of volcanic rock
Qb	Burney Basalt--Dark-gray, low-potassium, high-alumina diktytaxitic olivine basalt
and	Andesites of various textural and compositional varieties, commonly containing phenocrysts of pyroxene and plagioclase

———	Contact
━━••••	Fault, dotted where concealed; ball on downthrown side
.922	Location and number of stream-sediment sample (see table 2)
⚒	Sand and gravel or cinder pit
━ ━ ━	Approximate boundary of roadless area
— — —	Boundary of geologic mapping



Base compiled from USGS
1:62500 topo series Burney,
1957 & Jellico, 1957.

Field mapping by L. J.
Patrick Muffler & Marcus H.
Moench, 1981.

Figure 2. Geologic map of the Lost Creek roadless area, Shasta County, California

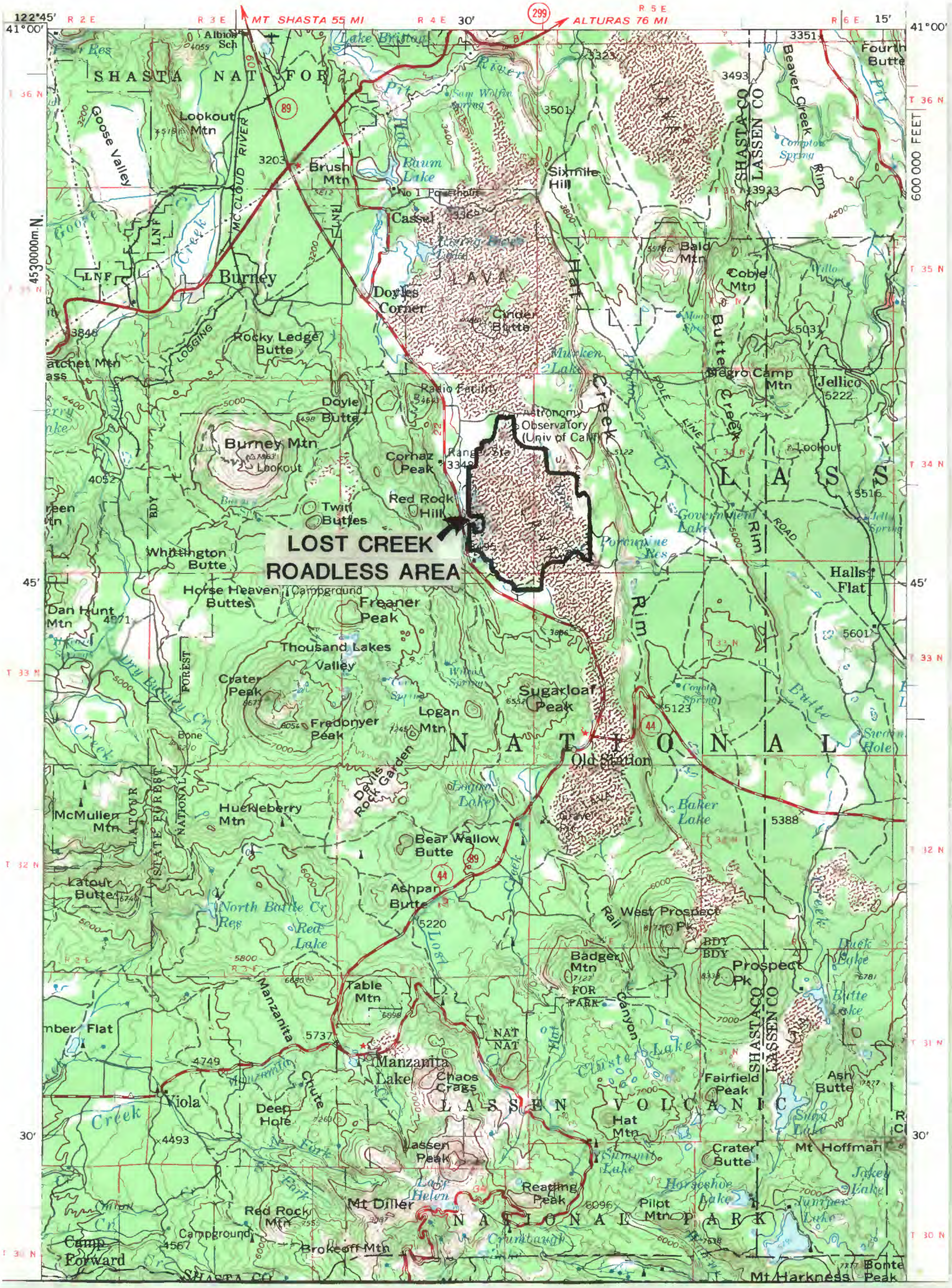


Figure 1. Index map.

0 1 2 MILES