DIVISION OF MINES
Ian Campbell, Chief

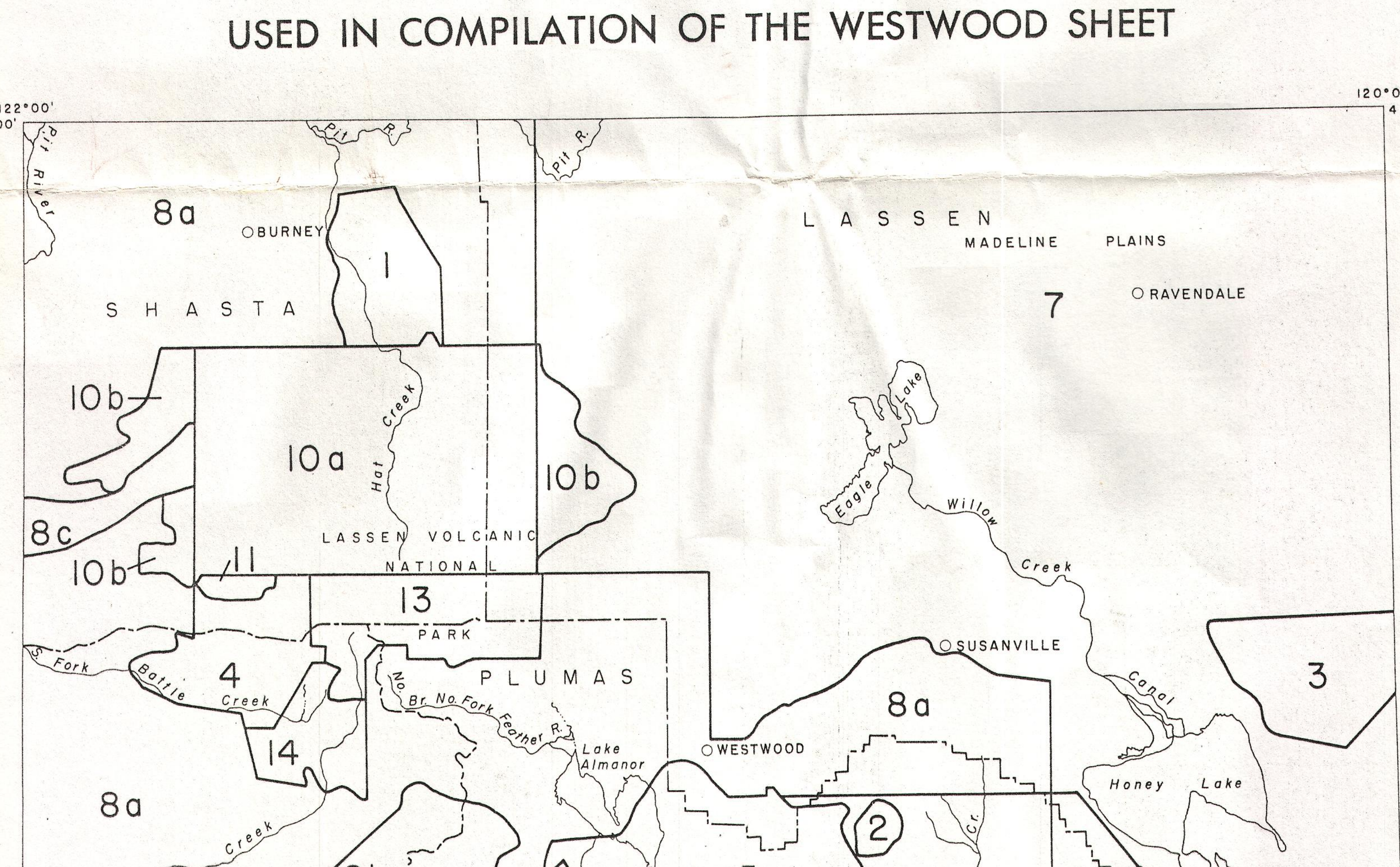
STATE OF CALIFORNIA
Edmund G. Brown, Governor

DEPARTMENT OF NATURAL RESOURCES
DeWitt Nelson, Director

EXPLANATORY DATA
WESTWOOD SHEET
GEOLOGIC MAP OF CALIFORNIA
OLAF P. JENKINS EDITION

Compiled by Philip A. Lydon, Thomas E. Gay, Jr., and Charles W. Jennings, 1960

INDEX TO GEOLOGIC MAPPING
USED IN COMPILATION OF THE WESTWOOD SHEET



1. Anderson, C. A., 1940, Hat Creek lava flow: Am. Jour. Sci., vol. 238, July 1940, pp. 477-492, Fig. 2: Geologic map of Hat Creek Valley, scale 1:187,500. Modified by Anderson, C. A., unpublished geologic map of parts of Burney and Halls Flat quadrangles, scale 1:125,000 (1940 et seq.). (Modified locally by P. A. Lydon, 1960).

2. Anderson, C. A., 1931, The geology of the Engels and Superior mines, Plumas County, California: California Univ., Dept. Geol. Sci., vol. 20, no. 8, pp. 293-330, Pl. 51: Geologic map of a small area surrounding the Engels and Superior mines, scale 1:50,000.

3. Chesterman, C. W., Geologic reconnaissance of part of the Wendel quadrangle, scale 1:62,500, California Div. Mines, unpublished (1959).

4. Curtis, G. H., Geologic reconnaissance of an area southwest of Lassen Volcanic National Park, Mineral quadrangle, scale 1:125,000, unpublished (1958).

5a. Diller, J. S., 1908, Geology of the Taylorsville region, California: U.S. Geol. Survey Bull. 353, 128 pp., Pl. III: Topography and geology of area covered by Indian Valley map, scale 1:62,500 (modified by V. E. McMath, 1960), and Pl. II: Topography and geology of the southern half of Honey Lake quadrangle, California, scale 1:250,000 (modified by V. E. McMath, 1960).

5b. Diller, J. S., 1908, Geology of the Taylorsville region, California: U.S. Geol. Survey Bull. 353, 128 pp., Pl. II: Topography and geology of the southern half of Honey Lake quadrangle, California, scale 1:250,000. (Modified by M. C. Stinson, California Div. Mines unpublished reconnaissance, 1959; W. R. Hail, California Dept. Water Resources unpublished mapping, 1959-60; and Gianella, V. P., 1957, Earthquake and faulting, Fort Sage Mountains, California, December, 1950: Seismol. Soc. America Bull. vol. 47, no. 3, pp. 173-177, Fig. 1: Faults associated with the Fort Sage Mountains, California, earthquake of December, 1950, scale approximately 1:75,000).

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7. Gay, T. E. Jr., Reconnaissance geology of the northeastern portion of the Westwood sheet, California, scale 1:62,500, California Div. Mines, unpublished (1959-60). (Sedimentary units in Madeline Plains and Honey Lake basins mapped in consultation with W. R. Hail, California Dept. Water Resources. Volcanic units north of Honey Lake mapped in consultation with C. W. Chesterman, California Div. Mines.)

8a. Lydon, P. A., Reconnaissance geology of the western and south-central portions of the Westwood sheet, California, scales 1:48,000 and 1:62,500, California Div. Mines, unpublished (1959-60). (NW part of Montgomery Creek quadrangle based on photogeologic interpretation without field check).

8b. Lydon, P. A., Geology of the Butt Mountain area, California, scale 1:62,500, California Div. Mines, unpublished work in progress (1959-60).

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9a. McMath, V. E., Geology of the Taylorsville area, Plumas County, California, scale 1:31,680, University of California, Los Angeles, unpublished Ph. D. thesis, 1958. (Preliminary geologic map, scale 1:62,500, included in syllabus of Geological Society of Sacramento, Spring Field Trip, June 23-24, 1956). In part modified by the author for this map sheet.

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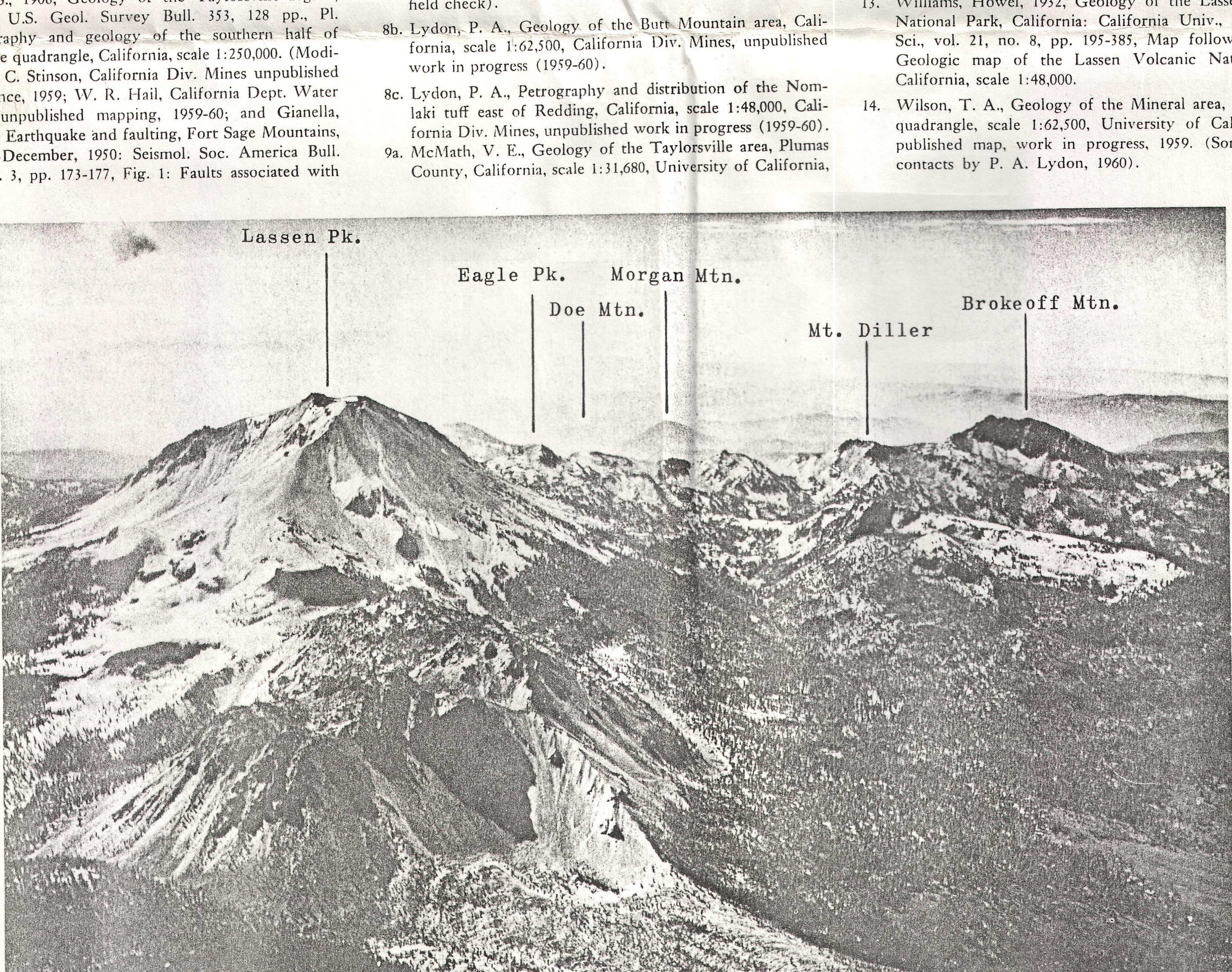

View southward toward Lassen Peak, showing Chaos Crags (lower left middleground), and other features of Lassen Volcanic National Park. Brokeoff Mtn. and Mt. Diller are remnants of an extensive Pleistocene volcano, now largely eroded. Pleistocene dacite domes make up Morgan and Doe Mountains, and Eagle and Lassen Peaks; Chaos Crags are composed of Recent dacite domes. Chaos Jumbles (light band, right foreground) is a volcanic mudflow that originated from collapse of part of Chaos Crags (note concave scar at head of Jumbles), probably about 1690, as dated by count of tree rings.
Photo by J. S. Shelton, 1959

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STRATIGRAPHIC NOMENCLATURE — WESTWOOD SHEET

AGE	STATE MAP SYMBOL	STATE MAP UNIT	STRATIGRAPHIC UNITS AND CHARACTERISTIC LITHOLOGY (The formally named formations grouped within an individual State Map Unit are listed hereunder in stratigraphic sequence from youngest to oldest)
CENOZOIC — QUATERNARY — Recent	Qs	**RECENT DUNE SAND**	Dune sand.
	Qal	**RECENT ALLUVIUM**	Alluvial silt, sand, and locally coarse gravel; deltaic, slopewash, stream channel, and floodplain deposits; fans; partially lacustrine bog and swamp deposits; glacial outwash.
	Qf	**RECENT ALLUVIAL FAN DEPOSITS IN THE GREAT VALLEY**	Sediments deposited from streams emerging from high lands surrounding the Great Valley.
		RECENT VOLCANIC ROCKS:	
	Qrv	UNDIFFERENTIATED	Recent dacite domes.
	Qrv^b	BASALTIC	Black, vesicular, scoriaceous flows of olivine basalt near Lassen Peak. Characterized by lack of erosion or weathering; flow surfaces and structures locally well preserved.
	Qrv^p	PYROCLASTIC	Basaltic cinders; dacite breccia and tuff; quartz basalt cinders; historical mudflows near Lassen Peak.
QUATERNARY	Ql	**QUATERNARY LAKE DEPOSITS**	Sand, silt, ash, and diatomaceous earth; locally includes overlying alluvium. Playa-like deposits in scattered basins of interior drainage.
	Qg	**QUATERNARY GLACIAL DEPOSITS**	Terminal and lateral moraines; till and associated later sedimentary accumulations (bog, soil, etc.).
	Qt	**QUATERNARY NONMARINE TERRACE DEPOSITS**	Pleistocene lake terrace; river terrace gravels; some fan, deltaic, and slopewash deposits.
Pleistocene	Qc	**PLEISTOCENE NONMARINE SEDIMENTARY DEPOSITS**	Upper Pliocene (?) to Pleistocene fanglomerate. Deltaic and floodplain gravels. Bedded sandstone, shale, and ash.
		PLEISTOCENE VOLCANIC ROCKS:	
	Qpv	UNDIFFERENTIATED	Intrusive dacite domes of early (?) to late Pleistocene age; unseparated dacite domes and/or flows at Manzanita Lake and along Manzanita Creek.
	Qpv^r	RHYOLITIC	Massive, white, glassy, porphyritic rhyolite and rhyodacite, possibly intrusive; light gray, banded, porphyritic, glassy, hornblende dacite.
	Qpv^a	ANDESITIC	Gray, hornblende and pyroxene andesites; basaltic andesite.
	Qpv^b	BASALTIC	Flat-lying, vesicular, black, olivine basalt flows occupying extensive "plains" areas. Shield-volcano flows of dark colored olivine basalt. Post-glacial lower (?) to upper Pleistocene instrusive olivine basalt. Includes local thin and massive flows of olivine basalt and pyroxene basalt. Weathering light to moderate, with development of red soil.
	Qpv^p	PYROCLASTIC	Basaltic cinders, locally agglutinated; vent tuffs; poorly consolidated rhyolite pumiceous tuff.
Quaternary/Pliocene	✵	**QUATERNARY AND/OR PLIOCENE CINDER CONES**	Cinder cones. Chiefly red or black scoriaceous basaltic cinders.
TERTIARY — Pliocene	Pc	**UNDIVIDED PLIOCENE NONMARINE SEDIMENTARY ROCKS**	Middle to upper Pliocene bedded diatomite, diatomaceous earth, volcanic ash, sandstone, and siltstone. Upper Pliocene (?) to Pleistocene (?) rhyolitic tuffaceous lake beds in Mt. Harkness quadrangle.
		PLIOCENE VOLCANIC ROCKS:	
	Pv^r	RHYOLITIC	Thick flows of light gray, coarse grained, biotite-hornblende rhyolite and dark gray, banded, porphyritic glassy rhyolite. Thin flows of obsidian; local accumulations of perlite and abundant fine fragments of obsidian. Biotite-hornblende dacite flows.
	Pv^a	ANDESITIC	Light to dark gray flows of medium to coarse grained, hornblende, pyroxene, and ferromagnesian-poor andesites; thickness variable. Weathering moderate to extreme; yields subround boulders of fresh rock in red or brown soil. In part pre-Tuscan (Manton and Lassen Pk. quadrangles). Includes basaltic andesite; locally may include tuff and tuff-breccia.
	Pv^b	BASALTIC	Black to gray flows of aphanitic to medium-grained olivine basalt; thickness variable. Andesitic basalt, pyroxene basalt, and local, thin, interbedded mudflows. Weathering moderate to extreme; yields subround boulders of fresh rock in red soil. In part pre-Tuscan (Lassen Pk. quadrangle). Includes deeply-weathered quartz basalt (Whitmore quadrangle), and moderately extensive flows within the Tuscan formation.
	Pv^p	PYROCLASTIC	Tuscan formation—*basaltic and andesitic volcanic breccia, mudflow, tuff, tuff-breccia, and thin interbedded sediments and basalt flows.* Nomlaki tuff member of Tuscan formation in south half Whitmore quadrangle—*obsidian-bearing dacite lithic pumiceous tuff, locally welded; includes rhyolite flows.* Coarse pumiceous lithic quartz tuff appearing in large areas as quartz-rich soil beneath thin Pleistocene basalt flows in Little Valley area. Obsidian-bearing lithic pumiceous tuff. Isolated outcrops similar in appearance to Tuscan.
Miocene		**MIOCENE VOLCANIC ROCKS:**	
	Mv^r	RHYOLITIC	Light-colored, gray to buff, porphyritic flows and irregular intrusive (?) bodies. Includes silicified rhyolite tuff of Hayden Hill area, and welded rhyolite tuff.
	Mv^a	ANDESITIC	Extremely weathered and altered, ferromagnesian-poor, pre-Tuscan andesite (may possibly be post-Tuscan domical intrusion).
	Mv^p	PYROCLASTIC	Bonta formation—*light colored hornblende and pyroxene andesite mudflow breccia, conglomerate, and tuff.* Miocene (?) to middle Pliocene (?) solfatarized rhyolite tuff. Pumiceous lapilli tuff, ash-beds, and diatomaceous beds in Madeline Plains area.
Oligocene		**OLIGOCENE VOLCANIC ROCKS:**	
	Φv^p	PYROCLASTIC	Chiefly Ingalls formation—*black-weathering, pyroxene and hornblende andesite mudflow breccia.*
Eocene	Ec	**EOCENE NONMARINE SEDIMENTARY ROCKS**	"Auriferous gravels" of Diller—*loosely consolidated to well-cemented, well-rounded gravels of volcanic and metamorphic rock; interbedded arkosic sandstone and tuff.* Montgomery Creek formation—*thick, bedded gravels of volcanic and metavolcanic rock; lenses of clay-rich, quartz, lithic, micaceous sandstone* (gravels absent locally in Whitmore quadrangle).
		EOCENE VOLCANIC ROCKS:	
	Ev^b	BASALTIC	Lovejoy formation—*black, columnar olivine basalt flows.*
Undivided	Tl	**TERTIARY LAKE DEPOSITS**	Folded argillaceous to arenaceous rhyolitic-ash lake beds.
	Tc	**TERTIARY NONMARINE SEDIMENTARY ROCKS**	Isolated outcrops of "auriferous gravels" of Diller, and isolated pre-volcanic gravels. Pliocene (?) poorly indurated arkosic sandstone and conglomerate east of Doyle.
		TERTIARY INTRUSIVE (HYPABYSSAL) ROCKS:	
	Ti	UNDIFFERENTIATED	Intrusive volcanic rock of undifferentiated lithology.
	Ti^r	RHYOLITIC	Light-colored, irregular rhyolitic intrusive bodies (in part silicified) of Hayden Hill area. Probably Miocene.
	Ti^a	ANDESITIC	Partially auto-brecciated plugs intrusive into Tuscan formation.
	Ti^b	BASALTIC	Black basalt and light-colored andesitic basalt plugs.
		TERTIARY VOLCANIC ROCKS:	
	Tv	UNDIFFERENTIATED	Volcanic flows of undifferentiated lithology.
	[illegible]	RHYOLITIC	Light-colored, fine to coarse grained, hornblende rhyolite flows; includes ash and tuff beds and locally perlite.
	[illegible]	[illegible]	Late (?) Tertiary, light green to gray, locally altered hornblende and pyroxene andesite; includes interbedded tuff breccia.
	[illegible]	BASALTIC	[illegible] basalt in Westwood and Susanville quadrangles; intracanyon flows and flows [illegible] basalts of uncertain age. Included in or possibly overlying Tuscan formation. [illegible]
	[illegible]	PYROCLASTIC	Late Tertiary andesitic breccia, mudflow, and tuff. Includes isolated outcrops of andesitic mudflow and local andesite flows.

STRATIGRAPHIC NOMENCLATURE—Continued

AGE		STATE MAP SYMBOL	STATE MAP UNIT	STRATIGRAPHIC UNITS AND CHARACTERISTIC LITHOLOGY (The formally named formations grouped within an individual State Map Unit are listed hereunder in stratigraphic sequence from youngest to oldest)
MESOZOIC	CRETACEOUS	Ku	UPPER CRETACEOUS MARINE SEDIMENTARY ROCKS	Chico formation—*compact, massive, locally bedded, brown to tan lithic sandstone and shale.*
		gr	MESOZOIC GRANITIC ROCKS	Granitic rock ranging from diorite to quartz monzonite.
		ub	MESOZOIC ULTRABASIC INTRUSIVE ROCKS	Serpentine.
	JURASSIC	Ju	UPPER JURASSIC MARINE SEDIMENTARY AND METASEDIMENTARY ROCKS	* Trail formation—*metamorphosed conglomerate, sandstone, slaty shale, and tuff.*
		Jml	MIDDLE AND/OR LOWER JURASSIC MARINE SEDIMENTARY AND METASEDIMENTARY ROCKS	* Mormon formation—*fossiliferous gray graywacke, slate and conglomerate;* Thompson formation—*metamorphosed fossiliferous red shale, sandstone, and conglomerate, with limestone lenses* (includes minor exposures of underlying Fant meta-andesite); Hardgrave formation—*metamorphosed red fossiliferous tuffaceous sandstone.* Potem formation in Montgomery Creek quadrangle—*dark quartzite and schist.*
		JŦRv	JURASSIC AND/OR TRIASSIC METAVOLCANIC ROCKS	* Kettle formation—*fossiliferous andesite and dacite breccia, tuff, conglomerate, and sills or flows;* unnamed metadacite tuff; * Foreman formation—*metadacite and meta-andesite tuff and fossiliferous slate;* * Hinchman formation—*metamorphosed fossiliferous andesite tuff and conglomerate;* unnamed pre-Hardgrave unit—*felsic flows, andesite conglomerate-breccia, fossiliferous tuff;* * Hull formation—*meta-andesite tuff and breccia.* Includes part of Diller's (1908) undifferentiated "Kettle and Taylor meta-andesites." Bagley meta-andesite in Montgomery Creek and Whitmore quadrangles—*massive greenstone;* Bully Hill "rhyolite" in Whitmore quadrangle—*gray siliceous metarhyolite.*
	TRIASSIC	ŦR	TRIASSIC MARINE SEDIMENTARY AND METASEDIMENTARY ROCKS	Swearinger formation—*fossiliferous dark hornfels, slate, quartzite, calcareous in part;* Hosselkus limestone—*light to dark gray fossiliferous limestone.* Cedar formation—*dark slate quartzite, and limestone* (correlative in part with Hosselkus limestone).
	UNDIVIDED	m	PRE-CRETACEOUS METAMORPHIC ROCKS, UNDIFFERENTIATED	Pre-Cretaceous metamorphic rock of undifferentiated lithology.
		mv	PRE-CRETACEOUS METAVOLCANIC ROCKS	Massive greenstones and tuffaceous schists. Includes metavolcanic rock of Diller's "Calaveras formation" in Jonesville and Butte Meadows quadrangles.
		lP	PALEOZOIC MARINE SEDIMENTARY AND METASEDIMENTARY ROCKS	Shoo Fly formation—*dark phyllite, slate, quartzite, and graywacke* (pre-Permian age); * Grizzly formation—*gray quartzite and slaty sandstone* (pre-Permian age); parts of * Taylorsville (?) formation—*slate, metagraywacke, and limestone* (age possibly Silurian). Dark schistose metasedimentary rocks of Diller's "Calaveras fm." in Jonesville and Butte Meadows quadrangles.
		lPv	PALEOZOIC METAVOLCANIC ROCKS	Lower member * Peale formation—*metamorphosed keratophyre flows, breccia, and tuff;* * Taylor formation—*augite andesite metabreccia, metatuff, and sills or flows;* * "Metarhyolite" of Diller (1908)—*pyroclastic breccias and subordinate sills, chert, argillite and tuff.* Ages may range from Upper Silurian to Lower Mississippian.
PALEOZOIC	PERMIAN	Pm	PERMIAN MARINE SEDIMENTARY AND METASEDIMENTARY ROCKS	* Arlington formation—*water-laid tuff and slate, minor andesitic metabreccia and metaconglomerate.* * Robinson formation—*fossiliferous, water-laid andesitic metaconglomerate-breccia, graywacke, and slate;* * Reeve formation—*porphyritic andesitic metabreccia, fossiliferous metatuff, minor slaty mudstone and quartzite.*
		Pmv	PERMIAN METAVOLCANIC ROCKS	Unnamed pyroclastic greenstone breccia. May be Carboniferous.
	MISSISSIPPIAN	CM	MISSISSIPPIAN MARINE SEDIMENTARY AND METASEDIMENTARY ROCKS	Upper member * Peale formation—*metamorphosed chert, slate, tuffaceous metasandstone, and volcanic flows and breccia* (may include some Pennsylvanian rocks).
	SILURIAN	S	SILURIAN MARINE SEDIMENTARY AND METASEDIMENTARY ROCKS	Taylorsville formation—*largely slate and graywacke, with lesser amounts of conglomerate, breccia, and metamorphosed dikes and sills;* "Montgomery limestone" of Diller (1908).

NOTE * Formation as redefined and mapped by McMath

Skedaddle Mountains (left of center) and Amedee Mountains (right of center) viewed eastward across Honey Lake Basin toward Nevada. The depression between the ranges is the eroded center of a Pliocene volcano, in which perlitic rhyolite is exposed. Thick sections of andesite flows and layered pyroclastic rocks form the main mountain masses. These are flanked by basaltic flows which appear near the edges of the view. *Photo by C. W. Chesterman, 1959.*

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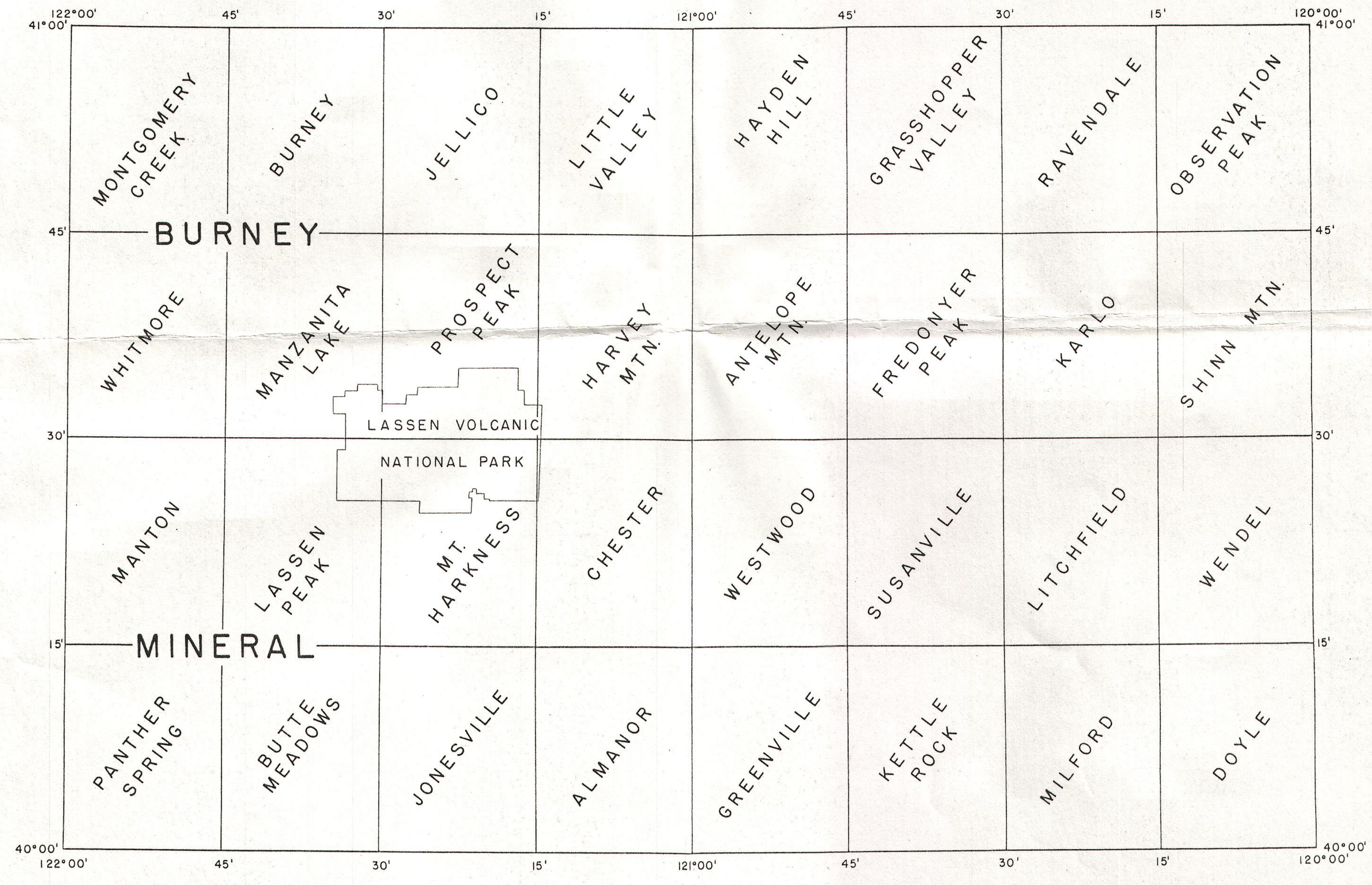
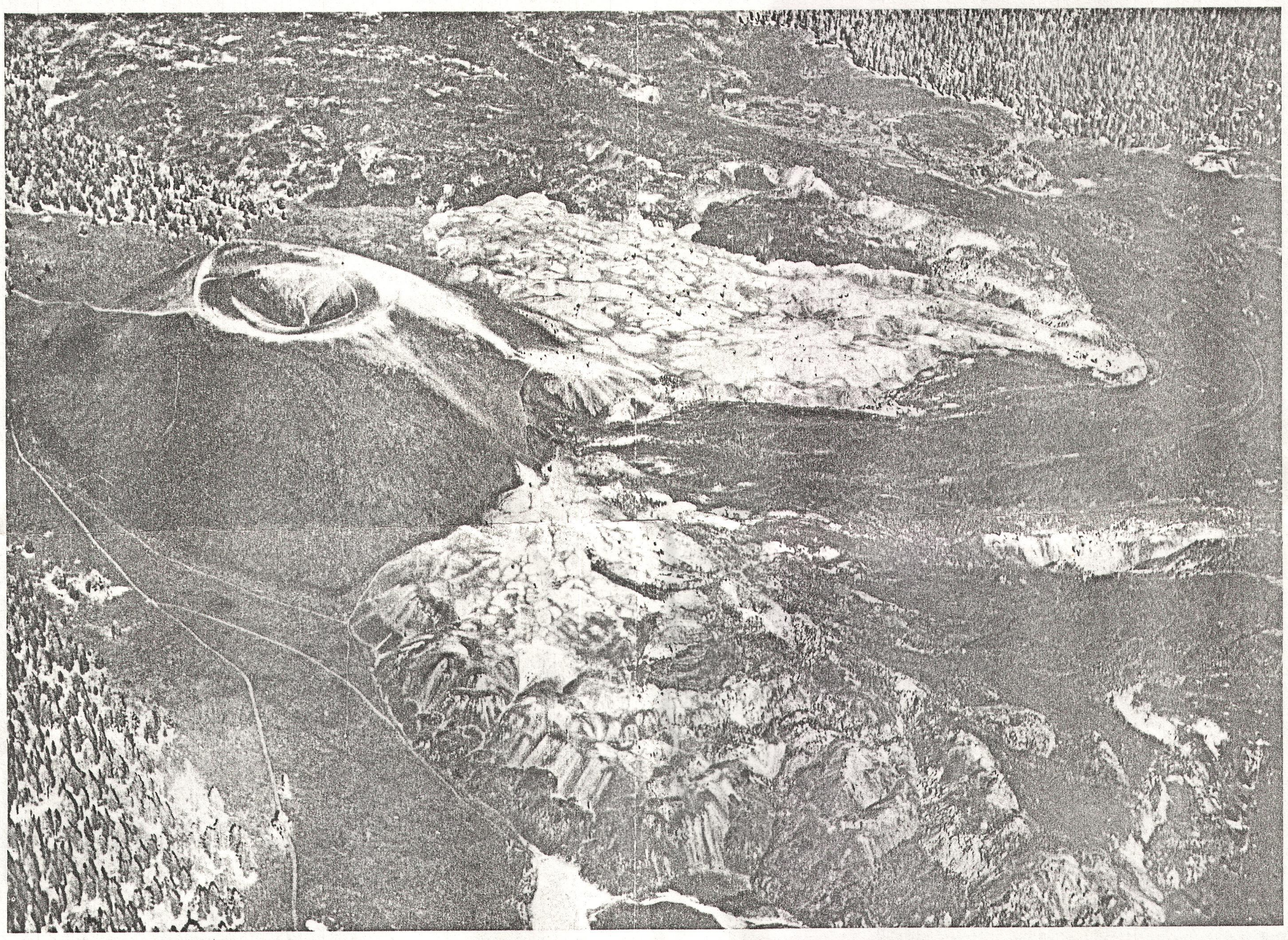
TOPOGRAPHIC QUADRANGLES

WITHIN THE WESTWOOD SHEET
AVAILABLE FROM THE U.S. GEOLOGICAL SURVEY
1960





View east toward Cinder Cone, about ten miles northeast of Lassen Peak. The earliest flows (light-colored area) are quartz basalts, thought to be less than 2,000 years old. The youngest flow (black tongue, center of light-colored area), also a quartz basalt, was extruded from the south flank of Cinder Cone in 1851. The flat-appearing double rim of Cinder Cone indicates that more than one interval of explosive activity occurred during its formation. *Photo by J. S. Shelton, 1959.*

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