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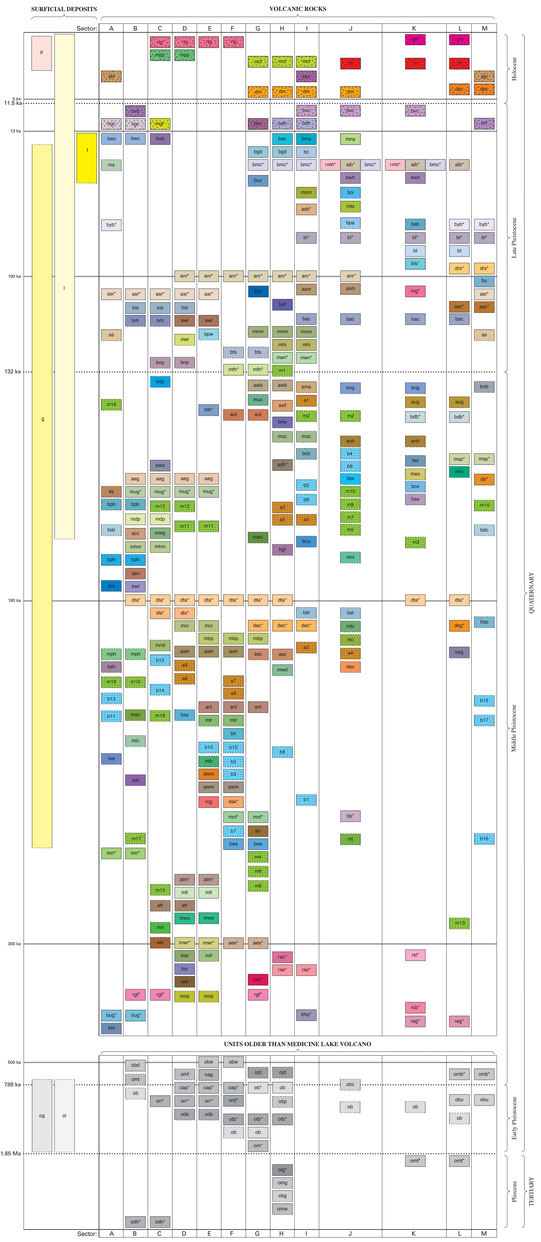
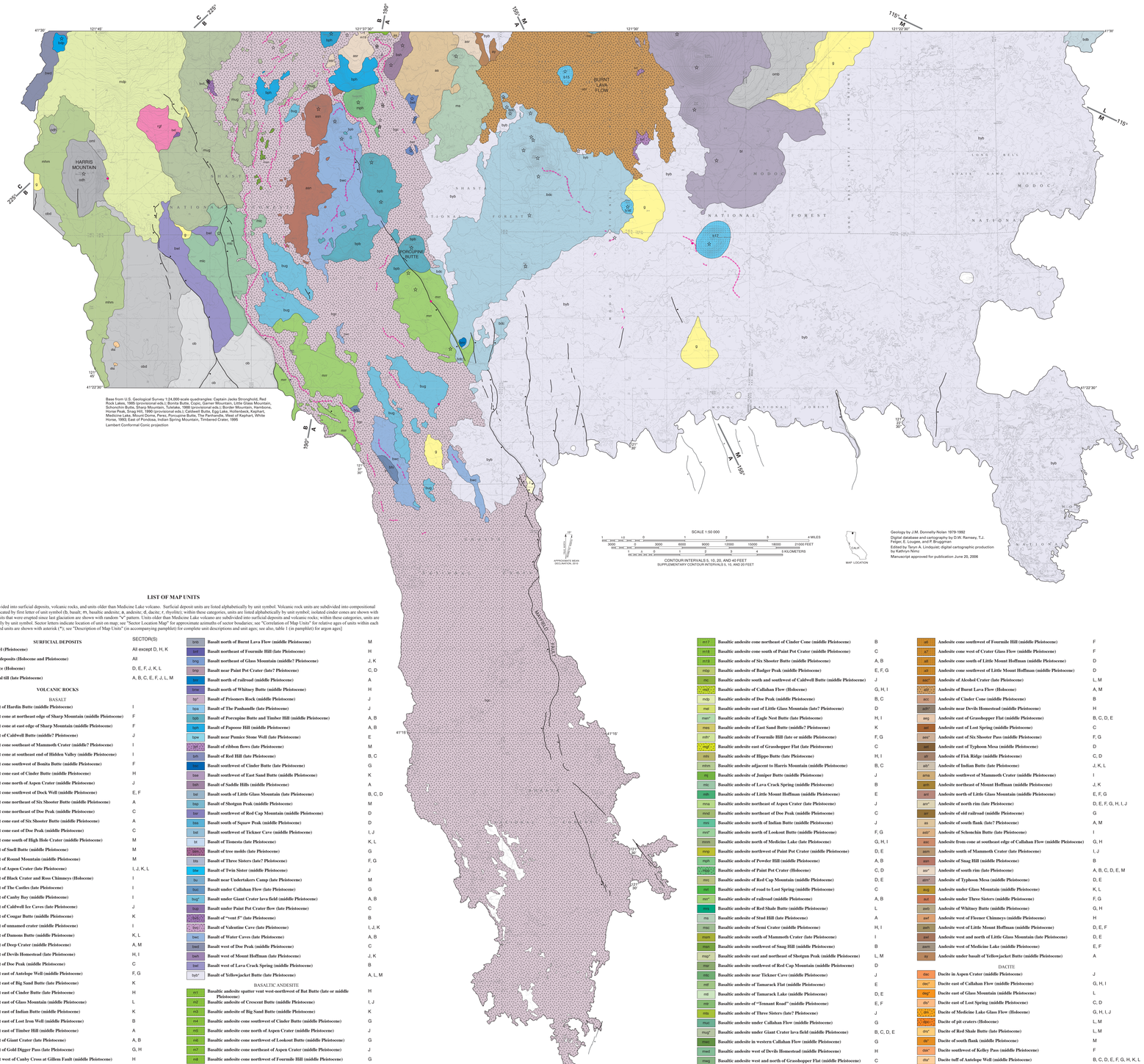
U.S. Geological Survey

CORRELATION OF MAP UNITS

[Sector letters **A-M** indicate location of unit on map: see "Sector Location Map" for approximate azimuths of sector boundaries; on map, ends of sector boundaries are indicated by short lines adjacent to map area. Units other than surficial deposits are arranged chronologically within each sector column; units present in more than one sector are shown in multiple sector columns; dashed lines at top and (or) bottom of unit indicate that upper and (or) lower chronologic position(s) of unit is (are) poorly constrained. Time division boundaries (dotted lines) are from Richmond and Fullerton (1986); interim ages (5, 13, 100, 180, 500, and 500 ka), which are approximate boundaries of five eruptive stages discussed in text (in accompanying pamphlet), are shown as thicker gray lines for reference. Argon-dated units are shown with asterisk (*); see "Description of Map Units" and table 1 (both in pamphlet) for unit ages. Note that, in sector columns *J* and **K**, units rmb, ab, and brnc are shown joined together because their argon ages overlap, but these units actually do not overlap in field and so their relative ages are unknown]





Geology by J.M. Donnelly-Nolan 1979-1992
Digital database and cartography by D.W. Ramsey, T.J. Felger, E. Lougee, and P. Bruggman
Edited by Taryn A. Lindquist; digital cartographic production by Kathryn Nimz
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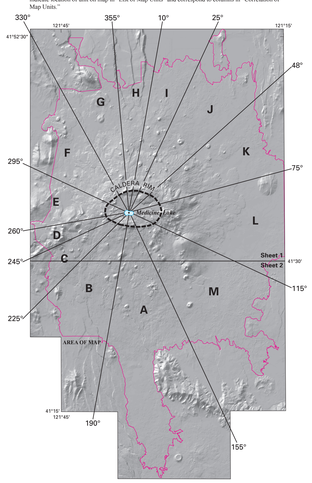
SECTOR LOCATION MAP

Shaded relief map showing Medicine Lake volcano (magenta outline) divided into 13 radial sectors (**A-M**). Approximate azimuths of sector boundaries are shown at end of each sector boundary line (dot near center of Medicine Lake is starting point for each azimuthal direction). Sector letters indicate location of unit on map in "List of Map Units" and correspond to columns in "Correlation of Map Units."



LIST OF MAP UNITS

[Map units are divided into surficial deposits, volcanic rocks, and units older than Medicine Lake volcano. Surficial deposit units are listed alphabetically by unit symbol. Volcanic rock units are subdivided into compositional categories, as indicated by first letter of unit symbol (b, basalt; rh, basaltic andesite; a, andesite; d, dacite; r, rhyolite); within these categories, units are listed alphabetically by unit symbol; isolated cinder cones are shown with stipple pattern; units that were erupted since last glaciation are shown with random "v" pattern. Units older than Medicine Lake volcano are subdivided into surficial deposits and volcanic rocks; within these categories, units are listed alphabetically by unit symbol. Sector letters indicate location of unit on map; see "Sector Location Map" for approximate azimuths of sector boundaries; see "Correlation of Map Units" for relative ages of units within each sector. Argon-dated units are shown with asterisk (*); see "Description of Map Units" (in accompanying pamphlet) for complete unit descriptions and unit ages; see also, table 1 (in pamphlet) for argon ages]

	SURFICIAL DEPOSITS	SECTOR(S)
g	**Gravel (Pleistocene)**	All except D, H, K
l	**Lake deposits (Holocene and Pleistocene)**	All
p	**Pumice (Holocene)**	D, E, F, J, K, L
t	**Glacial till (late Pleistocene)**	A, B, C, E, F, J, L, M

VOLCANIC ROCKS

BASALT

b1	**Basalt of Hardin Butte (middle Pleistocene)**	I
b2	**Basalt cone at northeast edge of Sharp Mountain (middle Pleistocene)**	F
b3	**Basalt cone at east edge of Sharp Mountain (middle Pleistocene)**	F
b4	**Basalt of Caldwell Butte (middle? Pleistocene)**	J
b5	**Basalt cone southeast of Mammoth Crater (middle? Pleistocene)**	I
b6	**Basalt cone at southeast end of Hilden Valley (middle Pleistocene)**	I
b7	**Basalt cone southwest of Bonita Butte (middle Pleistocene)**	F
b8	**Basalt cone east of Cinder Butte (middle Pleistocene)**	H
b9	**Basalt cone north of Aspen Crater (middle Pleistocene)**	J
b10	**Basalt cone southwest of Dock Well (middle Pleistocene)**	E, F
b11	**Basalt cone northeast of Six Shooter Butte (middle Pleistocene)**	A
b12	**Basalt cone northeast of Doe Peak (middle Pleistocene)**	C
b13	**Basalt cone east of Six Shooter Butte (middle Pleistocene)**	A
b14	**Basalt cone east of Doe Peak (middle Pleistocene)**	C
b15	**Basalt cone south of High Hole Crater (middle Pleistocene)**	M
b16	**Basalt of Snell Butte (middle Pleistocene)**	M
b17	**Basalt of Round Mountain (middle Pleistocene)**	M
bac	**Basalt of Aspen Crater (late Pleistocene)**	I, J, K, L
bbc	**Basalt of Black Crater and Ross Chimneys (Holocene)**	I
bc	**Basalt of The Castles (late Pleistocene)**	I
bcb	**Basalt of Canby Bay (middle Pleistocene)**	I
bci	**Basalt of Caldwell Ice Caves (late Pleistocene)**	J
bcc	**Basalt of Cougar Butte (middle Pleistocene)**	K
bcu	**Basalt of unnamed crater (middle Pleistocene)**	I
bdb*	**Basalt of Dumons Butte (middle Pleistocene)**	K, L
bdc	**Basalt of Deep Crater (middle Pleistocene)**	A, M
bdh	**Basalt of Devils Homestead (late Pleistocene)**	H, I
bde	**Basalt of Doe Peak (middle Pleistocene)**	C
bea	**Basalt east of Antelope Well (middle Pleistocene)**	F, G
beb	**Basalt east of Big Sand Butte (late Pleistocene)**	K
bec	**Basalt east of Cinder Butte (late Pleistocene)**	H
beg	**Basalt east of Glass Mountain (middle Pleistocene)**	L
bei	**Basalt east of Indian Butte (middle Pleistocene)**	K
bel	**Basalt east of Lost Iron Well (middle Pleistocene)**	B
bet	**Basalt east of Timber Hill (middle Pleistocene)**	A
bgc	**Basalt of Giant Crater (late Pleistocene)**	A, B
bgd	**Basalt of Gold Digger Pass (late Pleistocene)**	G, H
bgf	**Basalt west of Canby Cross at Gillem Fault (middle Pleistocene)**	H
bh	**Basalt of Hill 22 (middle Pleistocene)**	F
bhi	**Basalt of Hamborne Island (middle Pleistocene)**	A
bhp*	**Basalt of Hovey Point (middle Pleistocene)**	I
bl*	**Lake Basalt (late Pleistocene)**	I, J, K, L, M
blh*	**Basalt of Little Mount Hoffman (middle Pleistocene)**	E
blk*	**Basalt of Little Sand Butte (late Pleistocene)**	K
bma	**Basalt southeast of Mammoth Crater (late Pleistocene)**	I
bmc*	**Basalt of Mammoth Crater (late Pleistocene)**	G, H, I, J, K
bnb	**Basalt north of Burnt Lava Flow (middle Pleistocene)**	M
bnf	**Basalt northeast of Fourmile Hill (late Pleistocene)**	H
bng	**Basalt northeast of Glass Mountain (middle? Pleistocene)**	J, K
bnp	**Basalt near Paint Pot Crater (late? Pleistocene)**	C, D
bnr	**Basalt north of railroad (middle Pleistocene)**	A
bnw	**Basalt north of Whitney Butte (middle Pleistocene)**	H
bp*	**Basalt of Prisoners Rock (middle Pleistocene)**	J
bpa	**Basalt of The Panhandle (late Pleistocene)**	J
bpb	**Basalt of Porcupine Butte and Timber Hill (middle Pleistocene)**	A, B
bph	**Basalt of Papoose Hill (middle Pleistocene)**	A, B
bpw	**Basalt near Pumice Stone Well (late Pleistocene)**	E
br	**Basalt of ribbon flows (late Pleistocene)**	M
brh	**Basalt of Red Hill (late Pleistocene)**	B, C
bsc	**Basalt southwest of Cinder Butte (late Pleistocene)**	G
bse	**Basalt southwest of East Sand Butte (middle Pleistocene)**	K
bsh	**Basalt of Saddle Hills (middle Pleistocene)**	A
bsl	**Basalt south of Little Glass Mountain (late Pleistocene)**	B, C, D
bsp	**Basalt of Shotgun Peak (middle Pleistocene)**	M
bsr	**Basalt southwest of Red Cap Mountain (middle Pleistocene)**	D
bss	**Basalt south of Squaw Peak (middle Pleistocene)**	D
bst	**Basalt southwest of Tickner Cave (middle Pleistocene)**	I, J
bt	**Basalt of Tionesta (late Pleistocene)**	K, L
bto	**Basalt of tree molds (late Pleistocene)**	G
bts	**Basalt of Three Sisters (late? Pleistocene)**	F, G
btw	**Basalt of Twin Sister (middle Pleistocene)**	J
bu	**Basalt near Undertakers Camp (late Pleistocene)**	M
buc	**Basalt under Callahan Flow (late Pleistocene)**	G
bug*	**Basalt under Giant Crater lava field (middle Pleistocene)**	A, B
bup	**Basalt under Paint Pot Crater flow (late Pleistocene)**	C
bv	**Basalt of "vent 5" (late Pleistocene)**	B
bvc	**Basalt of Valentine Cave (late Pleistocene)**	I, J, K
bwc	**Basalt of Water Caves (late Pleistocene)**	A, B
bwd	**Basalt west of Doe Peak (middle Pleistocene)**	C
bwh	**Basalt west of Mount Hoffman (late Pleistocene)**	J, K
bwl	**Basalt west of Lava Crack Spring (middle Pleistocene)**	B
byb*	**Basalt of Yellowjacket Butte (late Pleistocene)**	A, L, M

BASALTIC ANDESITE

m1	**Basaltic andesite spatter vent west-northwest of Bat Butte (late or middle Pleistocene)**	H
m2	**Basaltic andesite of Crescent Butte (middle Pleistocene)**	I, J
m3	**Basaltic andesite of Big Sand Butte (middle Pleistocene)**	K
m4	**Basaltic andesite cone southwest of Cinder Butte (middle Pleistocene)**	G
m5	**Basaltic andesite cone north of Aspen Crater (middle Pleistocene)**	J
m6	**Basaltic andesite cone northwest of Lookout Butte (middle Pleistocene)**	G
m7	**Basaltic andesite cone northeast of Aspen Crater (middle Pleistocene)**	J
m8	**Basaltic andesite cone northwest of Fourmile Hill (middle Pleistocene)**	G
m9	**Basaltic andesite cone southwest of Aspen Crater (middle Pleistocene)**	J
m10	**Basaltic andesite cone southeast of Aspen Crater (middle Pleistocene)**	J
m11	**Basaltic andesite cone west of Medicine Lake (middle Pleistocene)**	D, E
m12	**Basaltic andesite cone southwest of Medicine Lake (middle Pleistocene)**	C, D
m13	**Basaltic andesite southwest of Kephart (middle Pleistocene)**	L
m14	**Basaltic andesite cone southeast of Paynes Springs (middle Pleistocene)**	M
m15	**Basaltic andesite cone south of Little Glass Mountain (middle Pleistocene)**	C
m16	**Basaltic andesite cone north-northeast of Six Shooter Butte (middle Pleistocene)**	A
m17	**Basaltic andesite cone northeast of Cinder Cone (middle Pleistocene)**	B
m18	**Basaltic andesite cone south of Paint Pot Crater (middle Pleistocene)**	C
m19	**Basaltic andesite of Six Shooter Butte (middle Pleistocene)**	A, B
mbp	**Basaltic andesite of Badger Peak (middle Pleistocene)**	E, F, G
mc	**Basaltic andesite south and southwest of Caldwell Butte (middle Pleistocene)**	J
mcf*	**Basaltic andesite of Callahan Flow (Holocene)**	G, H, I
mdp	**Basaltic andesite of Doe Peak (middle Pleistocene)**	B, C
mel	**Basaltic andesite east of Little Glass Mountain (late? Pleistocene)**	D
mer*	**Basaltic andesite of Eagle Nest Butte (late Pleistocene)**	H, I
mes	**Basaltic andesite of East Sand Butte (middle? Pleistocene)**	K
mfh*	**Basaltic andesite of Fourmile Hill (late or middle Pleistocene)**	F, G
mgf*	**Basaltic andesite east of Grasshopper Flat (late Pleistocene)**	C
mhi	**Basaltic andesite of Hippo Butte (late Pleistocene)**	H, I
mhm	**Basaltic andesite adjacent to Harris Mountain (middle Pleistocene)**	B, C
mj	**Basaltic andesite of Juniper Butte (middle Pleistocene)**	J
mlc	**Basaltic andesite of Lava Crack Spring (middle Pleistocene)**	B
mll	**Basaltic andesite of Little Mount Hoffman (middle Pleistocene)**	E
mna	**Basaltic andesite north of Aspen Crater (late Pleistocene)**	J
mnd	**Basaltic andesite northeast of Doe Peak (middle Pleistocene)**	C
mnt	**Basaltic andesite north of Indian Butte (middle Pleistocene)**	J
mw*	**Basaltic andesite north of Lookout Butte (middle Pleistocene)**	F, G
mnm	**Basaltic andesite north of Medicine Lake (late Pleistocene)**	G, H, I
mnp	**Basaltic andesite northwest of Paint Pot Crater (middle Pleistocene)**	D, E
mph	**Basaltic andesite of Powder Hill (middle Pleistocene)**	A, B
mpp*	**Basaltic andesite of Paint Pot Crater (Holocene)**	C, D
mrc	**Basaltic andesite of Red Cap Mountain (middle Pleistocene)**	D, E
mrd	**Basaltic andesite of road to Lost Spring (middle Pleistocene)**	C
mrr*	**Basaltic andesite of railroad (middle Pleistocene)**	A, B
mrs	**Basaltic andesite of Red Shale Butte (middle Pleistocene)**	L
ms	**Basaltic andesite of Stud Hill (late Pleistocene)**	A
msc	**Basaltic andesite of Semi Crater (middle Pleistocene)**	H, I
msm	**Basaltic andesite south of Mammoth Crater (late Pleistocene)**	I
msn	**Basaltic andesite southwest of Snag Hill (middle Pleistocene)**	B
msp*	**Basaltic andesite east and northeast of Shotgun Peak (middle Pleistocene)**	L, M
msr	**Basaltic andesite southwest of Red Cap Mountain (middle Pleistocene)**	D
mtc	**Basaltic andesite near Tickner Cave (middle Pleistocene)**	J
mtf	**Basaltic andesite of Tamarack Flat (middle Pleistocene)**	E
mtl	**Basaltic andesite of Tamarack Lake (middle Pleistocene)**	D, E
mtr	**Basaltic andesite of "Tennant Road" (middle Pleistocene)**	E, F
mts	**Basaltic andesite of Three Sisters (late? Pleistocene)**	J
muc	**Basaltic andesite under Callahan Flow (middle Pleistocene)**	G
mug*	**Basaltic andesite under Giant Crater lava field (middle Pleistocene)**	B, C, D, E
mwc	**Basaltic andesite in western Callahan Flow (middle Pleistocene)**	G
mwd	**Basaltic andesite west of Devils Homestead (middle Pleistocene)**	H
mwg	**Basaltic andesite west and north of Grasshopper Flat (middle Pleistocene)**	C
mwr*	**Basaltic andesite west of Red Cap Mountain (middle Pleistocene)**	D, E
mws	**Basaltic andesite west of Squaw Peak (middle Pleistocene)**	D, E

ANDESITE

a1	**Andesite cone west of Crescent Butte (middle? Pleistocene)**	I
a2	**Andesite of Red Butte (middle Pleistocene)**	I
a3	**Andesite of Island Butte (middle Pleistocene)**	H
a4	**Andesite cone east of Cougar Butte (middle Pleistocene)**	J
a5	**Andesite cone east of Fourmile Hill (middle Pleistocene)**	H, I
af	**Andesite cone southwest of Fourmile Hill (middle Pleistocene)**	F
a6	**Andesite cone west of Crater Glass Flow (middle Pleistocene)**	F
a7	**Andesite cone south of Little Mount Hoffman (middle Pleistocene)**	D
ad	**Andesite cone southwest of Little Mount Hoffman (middle Pleistocene)**	D
aac	**Andesite of Alcohol Crater (late Pleistocene)**	L, M
ab	**Andesite of Burnt Lava Flow (Holocene)**	A, M
acc	**Andesite of Cinder Cone (middle Pleistocene)**	B
adh	**Andesite near Devils Homestead (middle Pleistocene)**	H
aeg	**Andesite east of Grasshopper Flat (middle Pleistocene)**	B, C, D, E
aer	**Andesite east of Lost Spring (middle Pleistocene)**	C
aes*	**Andesite east of Six Shooter Pass (middle Pleistocene)**	F, G
aet	**Andesite east of Typhoon Mesa (middle Pleistocene)**	D
afi	**Andesite of Fisk Ridge (middle Pleistocene)**	C, D
afr*	**Andesite of Indian Butte (late Pleistocene)**	J, K, L
ama	**Andesite southwest of Mammoth Crater (middle Pleistocene)**	I
amt	**Andesite northeast of Mount Hoffman (middle Pleistocene)**	J, K
aw	**Andesite north of Little Glass Mountain (middle Pleistocene)**	E, F, G
ana	**Andesite northeast of north rim (late Pleistocene)**	D, E, F, G, H, I, J
aof	**Andesite of old railroad (middle Pleistocene)**	G
as	**Andesite of south flank (late? Pleistocene)**	A, M
asb*	**Andesite of Schonchin Butte (late Pleistocene)**	I
ase	**Andesite from cone at southeast edge of Callahan Flow (middle Pleistocene)**	G, H
asm	**Andesite south of Mammoth Crater (late Pleistocene)**	I, J
asn	**Andesite of Snag Hill (middle Pleistocene)**	B
asr*	**Andesite of south rim (late Pleistocene)**	A, B, C, D, E, M
atw*	**Andesite of Typhoon Mesa (middle Pleistocene)**	D, E
aug	**Andesite under Glass Mountain (middle Pleistocene)**	K, L
aur	**Andesite under Three Sisters (middle Pleistocene)**	F, G
awb	**Andesite of Whitney Butte (middle Pleistocene)**	G, H
awf	**Andesite west of Fissure Chimneys (middle Pleistocene)**	H
awh	**Andesite west of Little Mount Hoffman (middle Pleistocene)**	D, E, F
awl	**Andesite west and north of Little Glass Mountain (late Pleistocene)**	D, E
awm	**Andesite west of Medicine Lake (middle Pleistocene)**	E, F
ay	**Andesite under basalt of Yellowjacket Butte (middle Pleistocene)**	A

DACITE

dac	**Dacite in Aspen Crater (middle Pleistocene)**	J
dec*	**Dacite east of Callahan Flow (middle Pleistocene)**	G, H, I
deg*	**Dacite east of Glass Mountain (middle Pleistocene)**	L
dsr	**Dacite east of Lost Spring (middle Pleistocene)**	C, D
dvc*	**Dacite of Medicine Lake Glass Flow (Holocene)**	G, H, I, J
dpc*	**Dacite of pit craters (Holocene)**	L, M
drs*	**Dacite of Red Shale Butte (late Pleistocene)**	L, M
dsc*	**Dacite of south flank (middle Pleistocene)**	M
dsk*	**Dacite southwest of Kelley Pass (middle Pleistocene)**	F
dtu*	**Dacite tuff of Antelope Well (middle Pleistocene)**	B, C, D, E, F, G, H, K, L
dwm	**Dacite west of Medicine Lake (middle Pleistocene)**	E

RHYOLITE

rcb*	**Rhyolite near Cougar Butte (middle Pleistocene)**	K
rcg	**Rhyolite west of Crater Glass Flow (middle Pleistocene)**	E
rec*	**Rhyolite east of Callahan Flow (middle Pleistocene)**	H
reg*	**Rhyolite east of Glass Mountain (middle Pleistocene)**	K, L
rgf*	**Rhyolite of Grasshopper Flat (middle Pleistocene)**	B, C, G
rgl	**Rhyolite of Glass Mountain (Holocene)**	K, L
rhf	**Rhyolite of "Hoffman flows" (Holocene)**	J, K, L
rlg	**Rhyolite of Little Glass Mountain (Holocene)**	C, D, E, F
rmt*	**Rhyolite of Mount Hoffman (late Pleistocene)**	J, K
rmp*	**Rhyolite northwest of Glass Mountain (late Pleistocene)**	K
rsa*	**Rhyolite at southeast edge of Callahan Flow (middle Pleistocene)**	H, I
rsf*	**Rhyolite south of Little Sand Butte (middle Pleistocene)**	K
rwc*	**Rhyolite west of Callahan Flow (middle Pleistocene)**	G

UNITS OLDER THAN MEDICINE LAKE VOLCANO

SURFICIAL DEPOSITS

og	**Older gravel deposits (middle and early Pleistocene)**	F, G
ol	**Older lake sediments (middle and early Pleistocene)**	G

VOLCANIC ROCKS

obg	**Older andesite of Garner Mountain (middle Pleistocene)**	E
obp*	**Older andesite of Pumice Stone Mountain (middle or early Pleistocene)**	D, E, F
ob	**Older basalt (middle and early Pleistocene)**	B, F, G, H, J, K, L
obc	**Older basalt of Cassou Mountain (middle or early Pleistocene)**	J
obd	**Older basalt of Dry Lake (middle Pleistocene)**	B
obf	**Older basalt of Gillem Bluff (Pliocene)**	H
obp	**Older basalt on west side of Gillem Fault (early Pleistocene)**	H
obu	**Older basalt under Black Mountain (early Pleistocene)**	L, M
obw	**Older basalt of Garner Mountain (middle Pleistocene)**	E, F
odb*	**Older dacite of Harris Mountain (Pliocene)**	B, C
odk	**Older dacite of Squaw Peak (early? Pleistocene)**	D, E
oer*	**Older basaltic andesite of Bonita Butte (early Pleistocene)**	G
omb*	**Older basaltic andesite of Black Mountain (middle Pleistocene)**	L, M
omf	**Older basaltic andesite of Fisk Ridge (middle Pleistocene)**	D
omg	**Older basaltic andesite of Gillem Bluff (Pliocene)**	H
oml	**Older basaltic andesite of Lost Iron Well (middle or early Pleistocene)**	B
oms*	**Older basaltic andesite of Timber Mountain (late Pleistocene)**	K, L
omw	**Older basaltic andesite in western Lava Beds National Monument (Pliocene)**	H
opt	**Older palagonite tuff (middle? Pleistocene)**	G, H
ord*	**Older rhyolite near Dock Well (early Pleistocene)**	F
orr*	**Older rhyolite of Red Cap Mountain (early Pleistocene)**	C, D, E
otb*	**Older tuff of Box Canyon (early Pleistocene)**	F, G, H
otg*	**Older tuff of Gillem Bluff (Pliocene)**	H

Contact
Internal contact
Fault—Solid where accurately located; dotted where concealed. Bar and ball on downthrown block. Some faults are cracks that have no offset
Lava tube
Lava Beds National Monument boundary
Moraine crest
Dike
Vent
Littoral cone
Argon sample locality
86-23 Drill-hole locality
Approximate topographic boundary of Medicine Lake caldera
Center point for azimuths of radial sector boundaries (see "Sector Location Map")
K 75° L End of radial sector boundary, showing sector letters and approximate azimuthal angle (see "Sector Location Map")

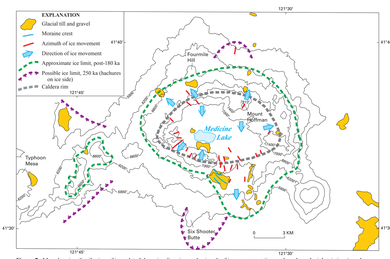


Figure 7. Map showing distribution of ice-related deposits, direction and azimuth of ice movement (in part based on glacial striations), and probable ice limits at various times during history of Medicine Lake volcano. Ice apparently moved away from caldera, but it also accumulated within caldera and flowed out lowest (southeast) side, leaving striations and morainal deposits of gravel. Morainal ridges are present in large area of till approximately 3 km south-southeast of Medicine Lake.

Geologic Map of Medicine Lake Volcano, Northern California

By
Julie M. Donnelly-Nolan
2010

For sale by U.S. Geological Survey, Information Services, Box 25286, Federal Center, Denver, CO, 80225, 1–888–ASK–USGS
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