Geologic Map of the Bodie Hills, California and Nevada

By David A. John, Edward A. du Bray, Stephen E. Box, Peter G. Vikre, James J. Rytuba, Robert J. Fleck, and Barry C. Moring

Pamphlet to accompany

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Cover: Photograph showing approximately 6 Ma, flow-banded rhyolite of Big Alkali dome intruding lower Paleozoic metasedimentary rocks at the mouth of Cinnabar Canyon.

U.S. Department of the Interior
SALLY JEWELL, Secretary

U.S. Geological Survey
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Introduction

The Bodie Hills covers about 1,200 km^2 straddling the California-Nevada state boundary just north of Mono Lake in the western part of the Basin and Range Province, about 20 km east of the central Sierra Nevada (fig. 1). The area is mostly underlain by the partly overlapping, middle to late Miocene Bodie Hills volcanic field and Pliocene to late Pleistocene Aurora volcanic field (John and others, 2012). Upper Miocene to Pliocene sedimentary deposits, mostly basin-filling sediments, gravel deposits, and fanglomerates, lap onto the west, north, and east sides of the Bodie Hills, where they cover older Miocene volcanic rocks. Quaternary surficial deposits, including extensive colluvial, fluvial, glacial, and lacustrine deposits, locally cover all older rocks. Miocene and younger rocks are tilted ≤30° in variable directions. These rocks are cut by several sets of high-angle faults that exhibit a temporal change from conjugate northeast-striking left-lateral and north-striking right-lateral oblique-slip faults in rocks older than about 9 Ma to north- and northwest-striking dip-slip faults in late Miocene rocks. The youngest faults are north-striking normal and northeast-striking left-lateral oblique-slip faults that cut Pliocene-Pleistocene rocks. Numerous hydrothermal systems were active during Miocene magmatism and formed extensive zones of hydrothermally altered rocks and several large mineral deposits, including gold- and silver-rich veins in the Bodie and Aurora mining districts (Vikre and others, in press).

Previous and Present Geologic Mapping

This new 1:50,000-scale digital geologic map of the Bodie Hills (sheet 1) covers about 1,400 km^2 and combines extensive new geologic mapping with significant modification of previously published geologic maps (fig. 2). These maps include those of Johnson (1951), Stanford Geological Survey (1961), Al-Rawi (1969), Chesterman and Gray (1975), Kleinhampl and others (1975), Dohrenwend (1981, 1982), Dohrenwend and Brem (1982), Stewart and others (1982), Chesterman and others (1986), Lange and Carmichael (1996), Silberman and Kleinhampl (unpub. mapping; M.L. Silberman, written commun., 2000), Reheis and others (2002), and Smailbegovic (2002).

Field studies for this new geologic map began in 2000–2001 by D.A. John, although most fieldwork and map compilation were undertaken from 2006 through 2013. Field studies focused on rocks of the Miocene Bodie Hills volcanic field, which host most of the mineral deposits in the Bodie Hills. Pre-Cenozoic basement rocks, Miocene sedimentary rocks fringing the Bodie Hills, Pliocene to late Pleistocene rocks of the Aurora volcanic field, and surficial deposits were studied in less detail. Many contacts (sheet 1) of basement rocks and Aurora volcanic field contacts are from published maps (Chesterman and Gray, 1975; Lange and Carmichael, 1996; Silberman and Kleinhampl, [unpub. mapping; M.L. Silberman, written commun., 2000]; and Smailbegovic, 2002). John and others (2012) presented a preliminary version of the new geologic map and discussed the geologic history of the Bodie Hills.

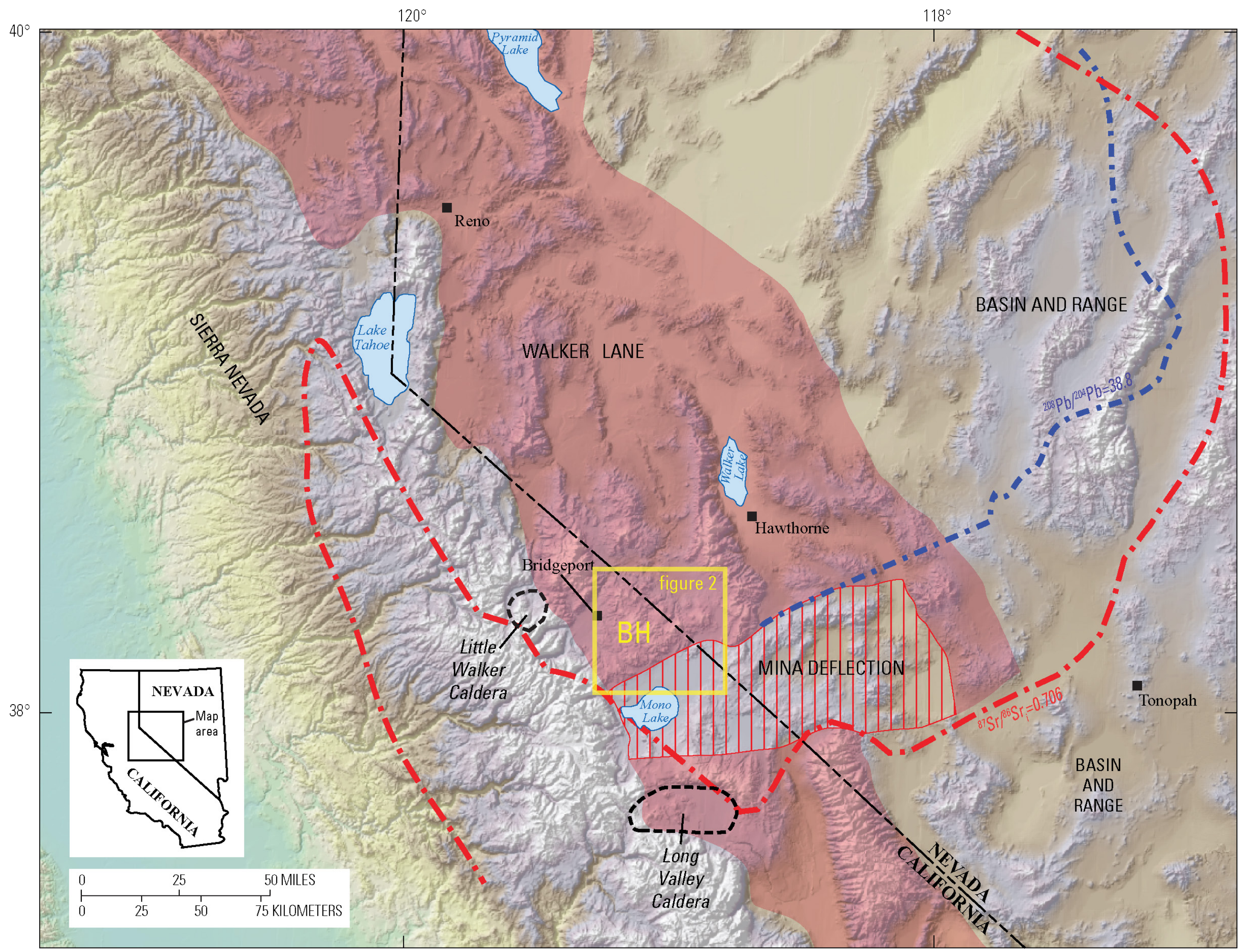

Figure 1. Map showing regional geologic setting of the Bodie Hills (BH) and major physiographic features. Mina deflection (vertical red line pattern) and outline of the Walker Lane (red shaded area) modified from Faulds and Henry (2008), Busby (2013), and Carlson and others (2013). Red dashed line is initial $^{87}Sr/^{86}Sr=0.706$ isopleth for Mesozoic plutonic rocks in California (Kistler, 1990) and Nevada (Tosdal and others, 2000). Blue dashed line is $^{208}Pb/^{204}Pb=38.8$ isopleth for Mesozoic plutonic rocks in Nevada (Tosdal and others, 2000). Yellow box outlines area of figure 2.

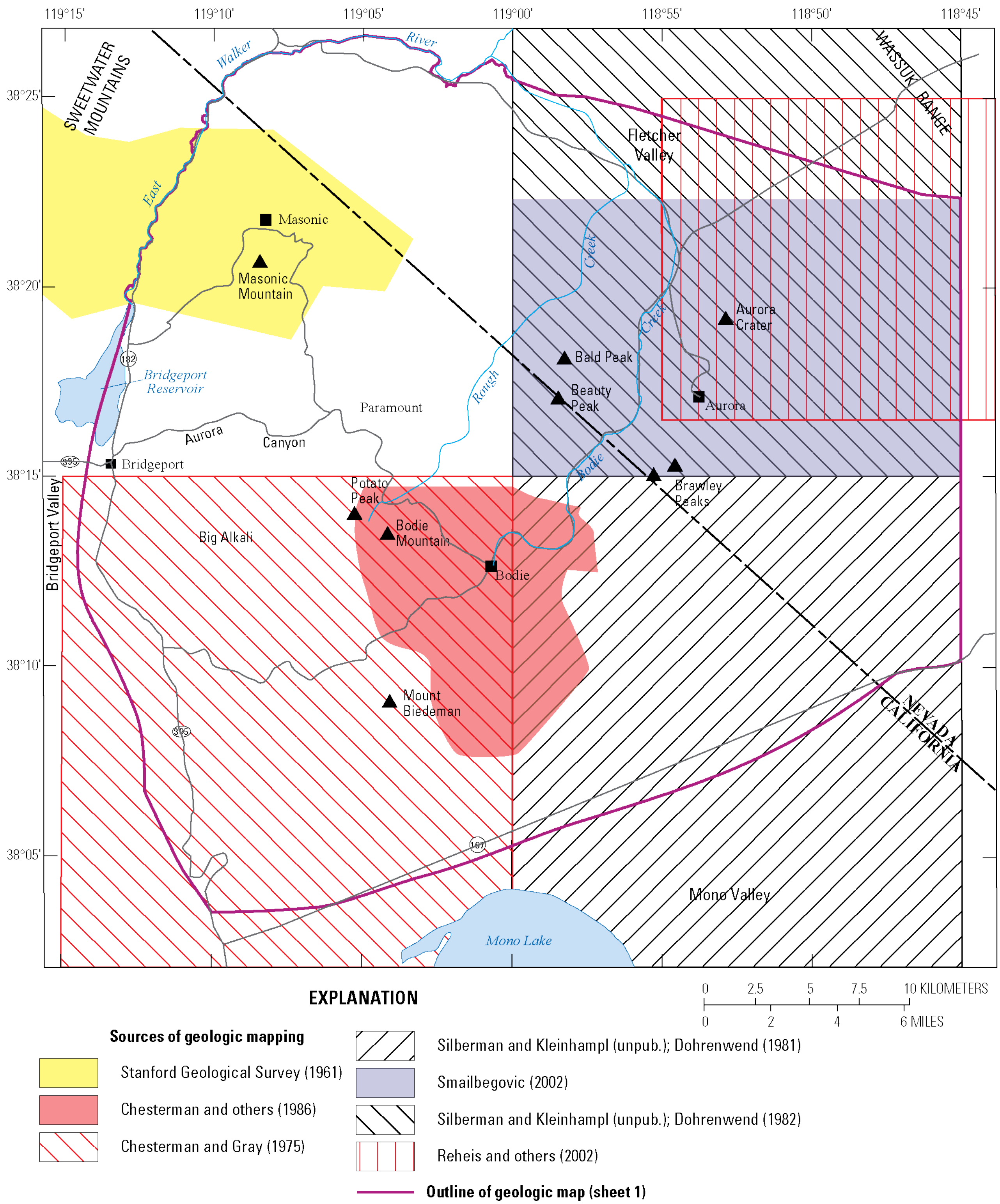

Figure 2. Index map showing principal sources of previous geologic mapping used as a basis for the new geologic map, demarked by purple line.

Regional Geologic Setting of the Bodie Hills

The Bodie Hills covers a roughly 40 by 30 km area along the California-Nevada border and rises to an elevation of 10,210 ft (3,112 m) at Potato Peak, about 1,100 to 1,400 m above Bridgeport and Fletcher Valleys, Mono Basin, and the East Walker River (fig. 2). The central Sierra Nevada rises nearly 2,000 m above Bridgeport Valley and Mono Basin about 8 km west of the Bodie Hills. The Bodie Hills is in a complex tectonic domain near the west edge of the Walker Lane and the Basin and Range physiographic province and at the northwest limit of the Mina deflection (fig. 1; Stewart, 1988; Faulds and Henry, 2008; Busby, 2013). The Walker Lane is a broad, northwest-striking zone of right-lateral shear that accommodates about 20 percent of the right-lateral motion between the Pacific and North America plates (Oldow, 2003; Faulds and Henry, 2008; Busby, 2013). The Mina deflection is a 60-km right step in the Walker Lane (Stewart, 1988; Oldow, 1992; Faulds and Henry, 2008), in which slip is transferred across an approximately 80-km-wide, complex array of northwest-striking right-lateral faults, northeast-striking normal faults, and east- to east-northeast-striking left-lateral faults (Oldow, 1992; Wesnousky, 2005). The Bodie Hills is at the northwest corner of the Mina deflection, where east-striking left-lateral faults rotate into northeast-striking normal faults. Slip transfer in the Mina deflection apparently began after approximately 11 Ma (Faulds and Henry, 2008) and may have been concentrated along the east-northeast-trending Neoproterozoic continental margin generally considered to correspond to the initial $^{87}Sr/^{86}Sr$ (Sr_i)=0.706 and (or) $^{208}Pb/^{204}Pb$=38.8 isopleths in Mesozoic granitic plutons (fig. 1; Kistler and Peterman, 1978; Stewart, 1988; Tosdal and others, 2000).

Late Cenozoic igneous rocks of the Bodie Hills were erupted onto now discontinuously exposed pre-Tertiary basement rocks. Pre-Tertiary rocks consist of (1) Lower Paleozoic hornfelsed argillite, sandstone, chert, and pebble conglomerate; (2) Mesozoic (Triassic?) metamorphosed sandstone, siltstone, chert, tuff, and pillow basalt; (3) Mesozoic, probably Jurassic, meta-andesite, metatuff, and metavolcaniclastic rocks; and (4) Mesozoic (probably mostly Late Cretaceous) granitic rocks of the Sierra Nevada batholith (Chesterman and Gray, 1975; Stewart and others, 1982; Robinson and Kistler, 1986). Granitic rocks crop out mostly around the margins of the Bodie Hills, whereas metavolcanic rocks are exposed in the northern and eastern parts, and metasedimentary rocks occur in the southwestern and northern parts.

The Bodie Hills area likely was a topographic high during the early and mid Tertiary. Tertiary sedimentary and volcanic rocks generally are not present beneath the Miocene volcanic rocks. Paleosols that developed on pre-Tertiary basement rocks are exposed locally, notably south of the Homestead Mine in the northeastern part of the Bodie Hills volcanic field and at the north end of Bridgeport Canyon. Unlike many other areas in the western Great Basin and Sierra Nevada, early to mid Tertiary, westward-draining paleochannels apparently did not cross the 40 km north-south extent of the Bodie Hills (Henry, 2008; Busby and Putirka, 2009; Henry and Faulds, 2010).

Cenozoic Magmatism in the Bodie Hills

Cenozoic volcanic rocks in the Bodie Hills are products of two long-lived volcanic fields, the Miocene Bodie Hills and Pliocene to late Pleistocene Aurora fields. The Bodie Hills volcanic field is a continental margin arc sequence (part of the ancestral Cascades arc), and formed during and shortly after subduction of the Farallon Plate beneath southwestern North America (Atwater and Stock, 1998; John and others, 2012; du Bray and others, 2014). In contrast, the Aurora volcanic field postdates subduction and formed in an extensional setting near the western edge of the Walker Lane and the Basin and Range Province (fig. 1; Lange and Carmichael, 1996; John and others, 2012).

Miocene Magmatism of the Bodie Hills Volcanic Field

Magmatic activity associated with the Bodie Hills volcanic field spanned 9.5 m.y., from about 15.0 to 5.5 Ma (tables 1 and 2). Volcanic rocks erupted during this period are exposed over about 600 km^2 and may underlie a much larger area now covered by younger rocks and surficial deposits. The Bodie Hills volcanic field consists of about 25 eruptive centers, which include several large, intermediate to mafic composition stratovolcanoes and more abundant intermediate to silicic composition lava dome complexes and exogenous rhyolite intrusions (fig. 3*A* and table 1). Eruptive activity across the field was nearly continuous between about 15 to 8 Ma, although eruption rates were notably higher between about 15 to 14 Ma and 10 to 8 Ma (John and others, 2012). A final, volumetrically minor pulse of rhyolitic volcanism between about 6.2 to 5.5 Ma followed an approximately 1.8 m.y. hiatus in volcanic activity. Clastic sedimentary rocks were deposited around eruptive center margins during much of the Miocene volcanic activity, and the approximately 9.4 Ma Eureka Valley Tuff of the Stanislaus Group (hereafter referred to as the Eureka Valley Tuff), which is inferred to have erupted from the Little Walker caldera approximately 20 km west of the Bodie Hills (fig. 1; Pluhar and others, 2009), flowed in eastward-draining paleochannels carved around and across the eruptive centers. Small outcrops of the 12.0 Ma tuff of Jacks Spring, which may have erupted from the Adobe Hills-Huntoon Valley area 50 km southeast of the Bodie Hills (Stewart, 1981), are exposed locally at the base of the Miocene section in the southwest part of the Bodie Hills.

Compositions of rocks in the Bodie Hills volcanic field range nearly continuously from trachybasalt to high silica rhyolite (about 50 to 78 weight percent SiO_2), but most rocks have >55 percent SiO_2 (fig. 4). Most intermediate and mafic composition Bodie Hills volcanic field rocks are porphyritic, commonly containing 15–35 volume percent phenocrysts of plagioclase, pyroxene, and hornblende±biotite and olivine; rhyolites commonly contain minor quartz, sanidine, plagioclase, biotite, and hornblende (table 3, available for download online at http://dx.doi.org/10.3133/sim3318).

Notable features of the most significant eruptive centers of the Bodie Hills volcanic field are briefly described in the following paragraphs and summarized in table 1. Major volcanic features are shown in figure 3*A*. The $^{40}Ar/^{39}Ar$ dates for most units are tabulated in table 2.

Masonic Center

The Masonic center, the largest and oldest eruptive center in the Bodie Hills, constitutes a dissected trachyandesite stratovolcano about 16 to 18 km in diameter near Masonic Mountain. It is composed of interbedded sequences of lava flows and debris-flow beds intruded by small plugs. Thick lava flows dominate exposures near the center of the volcano, including prominent south-trending ridges just east of Logan Spring. Debris-flow deposits are dominant in more distal locales, notably on the south side of Aurora Canyon and between Cow Camp Creek and Paramount and in Masonic Gulch and Red Wash on its north side. Small intrusions on the flanks of the volcano may define vents for some lava flows; these include a prominent columnar jointed plug and associated lava flows exposed near the Homestead Mine on the northeast side of the volcano. A plug on the southwest flank of Masonic Mountain may be one of the central vents of the volcano. $^{40}Ar/^{39}Ar$ ages indicate that the Masonic center formed between about 15.0 to 14.1 Ma. The volcano is a highly dissected horst, cut by several sets of northeast-striking faults; basement rocks are exposed in the center of the volcano on Masonic Mountain. Voluminous debris flows emplaced on the north side of the volcano in the Masonic mining district and in the Red Wash alteration zone were hydrothermally altered during emplacement of the Masonic Gulch and Lakeview Spring domes at about 13.5 and 12.9 Ma, respectively (fig. 5).

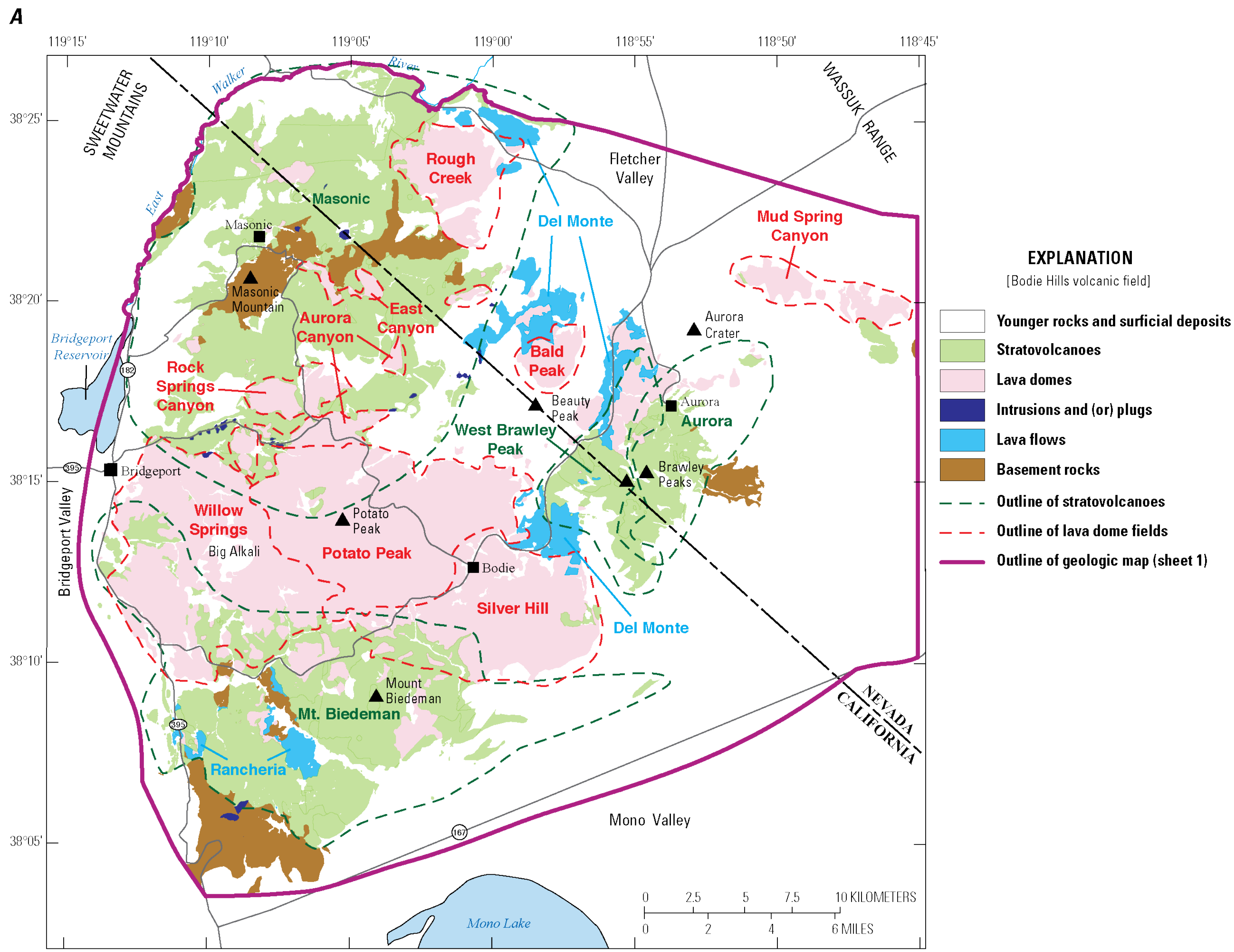

Figure 3. Maps showing major volcanoes and eruptive centers and types of eruptive products in the Bodie Hills. *A*, Bodie Hills volcanic field. *B*, Aurora volcanic field. Black lines on *B* outline volcanic features mentioned in the text.

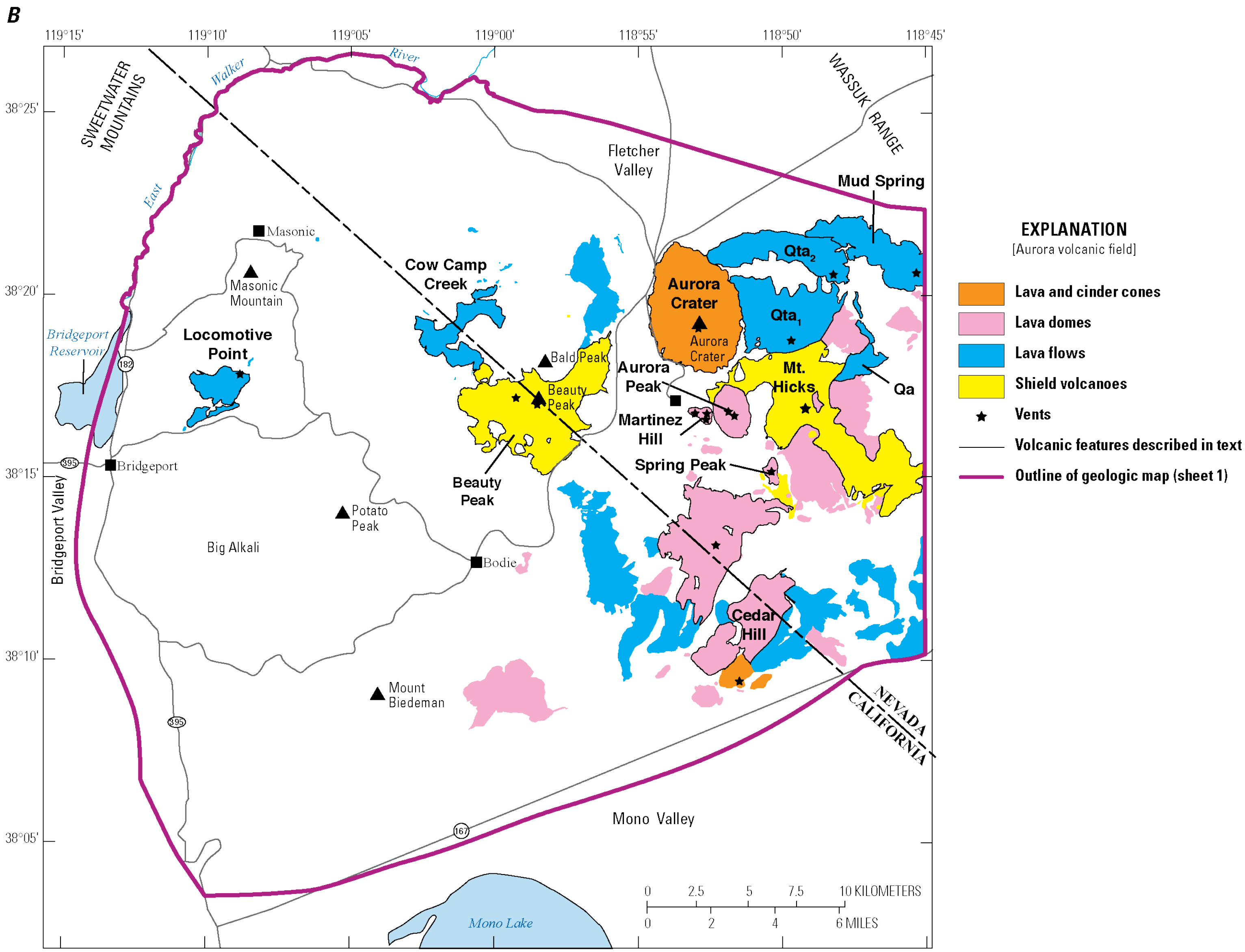

Figure 3. Maps showing major volcanoes and eruptive centers and types of eruptive products in the Bodie Hills. *A*, Bodie Hills volcanic field. *B*, Aurora volcanic field. Black lines on *B* outline volcanic features mentioned in text.—Continued

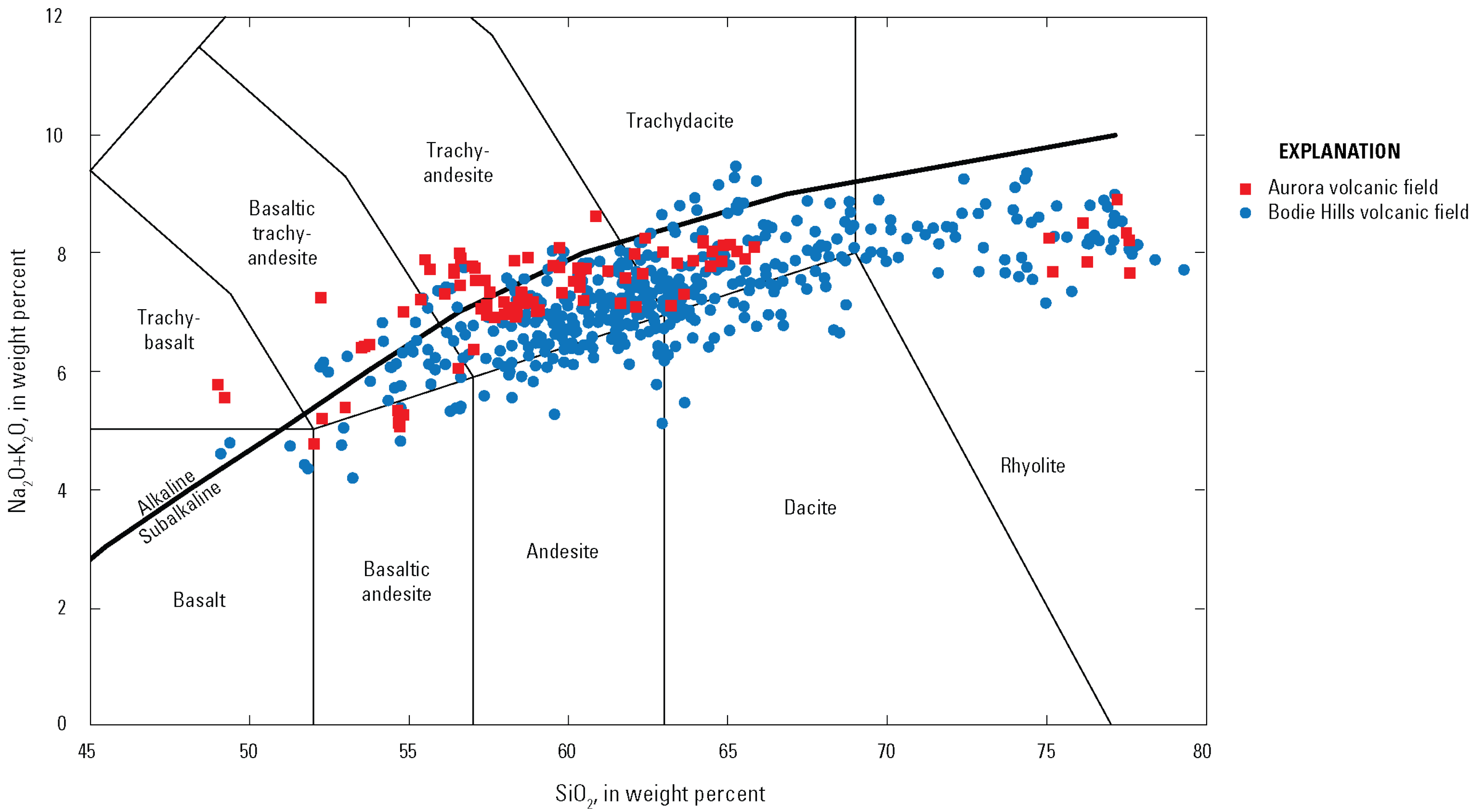

Figure 4. Total alkali-silica variation diagram for rocks of the Bodie Hills and Aurora volcanic fields. Field boundaries are from Le Maitre (2002). Alkaline-subalkaline boundary is from Irvine and Baragar (1971).

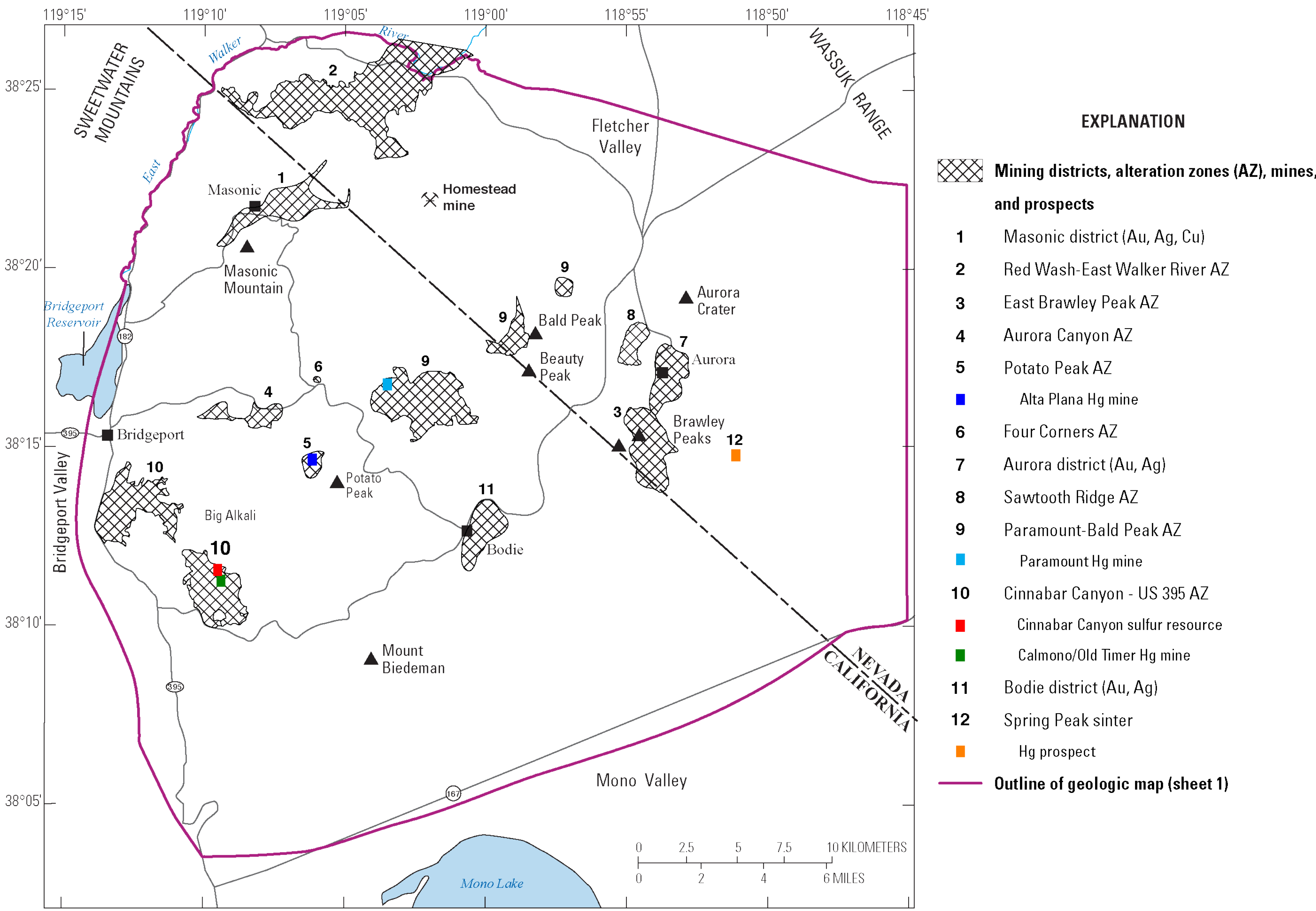

Figure 5. Map showing mining districts and alteration zones in the Bodie Hills.

Table 1. Characteristics of eruptive centers of the Bodie Hills and Aurora volcanic fields.

Eruptive center or unit	Map units	Volcanic landform	Eruptive products	Composition	Area; dimensions	Age (Ma)[1]	Notable features
Bodie Hills volcanic field							
Masonic	Tma, Tmai	Stratovolcano	Lava flows, debris flows, volcaniclastic sedimentary rocks, plugs and domes, minor block and ash flows	Trachyandesite and basaltic trachyandesite; with minor basaltic andesite and dacite	145 km^2 exposed area, inferred total area >200 km^2; circular, ~16–18 km diameter	15.0 to 14.1	E-W-trending horst of Mesozoic rocks bifurcates unit; debris flows and volcaniclastic rocks more abundant near margins of unit
Mud Spring Canyon	Tams	Domes	Lava domes	Trachyandesite	8.5 km^2; 1 by 8 km elongated east-west	13.9	Series of domes and thick lava flows
East Canyon	Tec	Domes	Lava domes and small intrusions	Trachydacite	2.7 km^2; 2 domes 0.5 by 2–2.5 km and 3 very small intrusions	13.8	Abundantly porphyritic lava domes, northwest elongated
Sinnamon Cut	Tasc	Intrusions	Hypabyssal intrusions and lava flows(?)	Trachyandesite	0.5 km^2; 2 bodies each 0.3 by 0.8 km	13.7	Hornblende-rich, platy jointed
Masonic Gulch	Tamg	Domes	Lava domes	Trachyandesite	~2.2 km^2; largest dome 0.6–1.2 by 2 km	13.5 to 13.4	Three domes
Aurora	Taa, Taai, Tadi	Stratovoclano(?)	Lava flows, debris flows, block and ash flows, small shallow intrusions, minor volcaniclastic sedimentary rocks	Trachyandesite with minor andesite	~20 km^2; 2–4 by 8 km but largely covered by younger rocks	13.1 to 12.6	Hydrothermally altered in most places
Lakeview Spring	Tals	Domes	Lava domes and flows, small intrusions	Andesite	0.35 km^2; largest dome 0.3 by 1 km	12.9	Domes postdate adjacent hydrothermal alteration in the Masonic mining district
Rough Creek	Trcd	Domes	Lava domes, carapace breccias, and minor block and ash flows	Trachydacite and trachyandesite	>20 km^2, largest mass ~4 by 4 km; extensive cover by younger deposits	12.9 to 11.7	Abundantly and coarsely porphyritic, northwest-elongated flow domes; unconformably overlie hydrothermally altered Masonic center rocks

[1]K-Ar and $^{40}Ar/^{39}Ar$ ages; see table 2

Table 1. Characteristics of eruptive centers of the Bodie Hills and Aurora volcanic fields.—Continued

Eruptive center or unit	Map units	Volcanic landform	Eruptive products	Composition	Area; dimensions	Age (Ma)[1]	Notable features
Bodie Hills volcanic field							
Hornblende trachyandesite intrusions	Thai	Intrusions	Small plugs	Trachyandesite	0.2 km^2; largest plug 0.3 by 0.3 km	11.8	Hornblende-rich
Rancheria	Trwa, Trwai	Unknown	Lava flows, small plug	Basaltic trachyandesite	~5 km^2; largest exposure about 1.5 by 2.3 km; extensive cover by younger deposits	11.7	Olivine-rich
West Brawley Peak	Twba, Twbi	Stratovolcano	Central plug, lava flows and breccias	Trachyandesite, andesite, and trachydacite	~16 km^2 exposed area; semicircle ~3–4 km in diameter with flow lobe extending 2 km farther south; southwest part covered by younger rocks	11.5 to 11.3	Outward-dipping lava flows and flow breccias on south, west, and north sides of plug forming West Brawley Peak; buttress unconformity with hydrothermally altered Aurora center rocks forming East Brawley Peak
Clark Canyon	Tcc	Intrusions	Small plugs, lava flow	Trachyandesite	0.4 km^2	11.3	Series of 7 east-northeast aligned plugs and small lava flow
Trachydacite intrusions	Tdi	Domes	Small plugs and domes	Trachydacite	0.4 km^2; 5 exposures; 0.5 km in diameter Dome Hill largest body	11.3 to 11.2	Biotite rich
Aurora Creek rhyolite	Tra	Domes	Flow domes, carapace breccias, lava flows, and lithic-rich tuffs	Rhyolite	10 km^2; L-shaped, 4 km, north-south, 5 km east-west, ~1 km wide	11.2	Nearly aphyric, sparse phenocrysts
Del Monte Canyon rhyolite	Tdm	Domes	Lava flows and pyroclastic rocks	Rhyolite	3 km^2; ~1 by 3 km	11.2 to 11.1	North-dipping sequence of coarsely porphyritic lava flows and underlying lithic tuffs that flowed down Del Monte Canyon

[1]K-Ar and $^{40}Ar/^{39}Ar$ ages; see table 2

Table 1. Characteristics of eruptive centers of the Bodie Hills and Aurora volcanic fields.—Continued

Eruptive center or unit	Map units	Volcanic landform	Eruptive products	Composition	Area; dimensions	Age (Ma)[1]	Notable features
Bodie Hills volcanic field							
East Brawley Peak	Treb	Domes	Small domes and lava flows	Rhyolite	0.5 km^2; three masses, largest 0.2–0.5 by 1 km	11.2	Small domes intrusive into Aurora and West Brawley Peak centers
Pyroxene rhyolite	Tr	Domes	Lava domes	Rhyolite	~0.3 km^2; 4 exposures, largest 0.1 by 0.8 km	11.2	Small flow domes north of Bald Peak
Trachydacite of Bridgeport Canyon	Tdbc	Domes	Lava flows and domes	Trachydacite	0.9 km^2; several flow domes largely covered by younger deposits	11.1	Small domes and associated lava flows locally erupted onto Paleozoic basement rocks
Del Monte	Tdm	Unknown; stratovolcano?	Lava flows, flow breccias, debris flows, volcaniclastic sedimentary rocks	Basaltic trachyandesite, trachyandesite, and trachydacite	~26 km^2 exposed in four main masses separated by younger rocks	11.0	Northern and central masses: lava flows, flow breccias, debris flows, and possible vent in Rough Creek; southern masses: interbedded lava flows, debris flows, sedimentary rocks; unit filled paleotopography (ancestral Bodie Creek)
Aurora Canyon	Tac	Domes	Lava domes, carapace breccias, and minor block and ash flows	Trachyandesite and trachydacite	7.5 km^2, largest body ~1 by 5 km	10.5 to 10.3	Abundantly porphyritic, northeast-elongated lava domes
Bodie Creek	Trbc	Domes	Domes and lava flows	Rhyolite	2.1 km^2; 4 small domes, largest ~1 by 1.5 km	10.2	Erosional domes largely covered by Pliocene-Pleistocene lava flows

[1]K-Ar and $^{40}Ar/^{39}Ar$ ages; see table 2

Table 1. Characteristics of eruptive centers of the Bodie Hills and Aurora volcanic fields.—Continued

Eruptive center or unit	Map units	Volcanic landform	Eruptive products	Composition	Area; dimensions	Age (Ma)[1]	Notable features
Bodie Hills volcanic field							
Mount Biedeman	Tamb, Tsmb, Timb	Stratovolcano	Lava flows, debris flows, intrusions, and minor block and ash flows	Trachyandesite and basaltic trachyandesite with minor basalt and dacite	~100 km^2 exposed area with extensive younger cover; circular volcano ~5–6 km in diameter with debris aprons extending 3 to 15 km farther outward	9.9 to 8.9	Central intrusion forming Mount Biedeman surrounded by outward dipping lava flows and more distal debris flows and volcaniclastic sedimentary rocks
Bodie Hills	Trbh	Domes	Lava domes and minor pyroclastic rocks	Rhyolite and minor dacite	~8 km^2; largest body ~2 by 2 km; extensive cover by younger rocks	9.9 to 9.6	Porphyritic rhyolite domes partly surround Mount Biedeman stratovolcano and extend 15 km to northwest; includes several outcrops of rhyolite with mingled hornblende andesite blobs
Bald Peak-Paramount	Trb, Tpst	Domes	Lava domes and carapace breccia (Bald Peak), lithic-rich tuff and volcaniclastic sedimentary rocks (Paramount basin)	Rhyolite	Bald Peak: 6.5 km^2; dome ~2.5 by 3 km; Paramount basin: ~20 km^2, 2–3 by 8 km; extensive younger cover	9.7	North-northeast elongated, nearly aphyric rhyolite domes surrounded by cogenetic lithic tuffs and volcaniclastic sedimentary rocks mostly deposited in shallow northeast-elongated basin to southwest of domes
Silver Hill	Tsd, Tdsd, Tsdi	Domes	Lava domes, carapace breccias, block and ash flows, debris flows, volcaniclastic sedimentary rocks	Dacite, trachydacite, andesite, and trachyandesite	~46 km^2 exposed area with extensive younger cover; circular field ~7–8 km in diameter	9.1 to 8.9	Host rock for Bodie Au-Ag deposits

[1]K-Ar and $^{40}Ar/^{39}Ar$ ages; see table 2

Table 1. Characteristics of eruptive centers of the Bodie Hills and Aurora volcanic fields.—Continued

Eruptive center or unit	Map units	Volcanic landform	Eruptive products	Composition	Area; dimensions	Age (Ma)[1]	Notable features
Bodie Hills volcanic field							
Potato Peak	Tpp, Tppd	Domes	Lava domes, lava flows and flow breccias, block and ash flows, debris flows	Trachydacite and trachyandesite	~80 km^2; 3–8 by 14 km with ~3 by 6 km debris flow apron on south side	9.0 to 8.8	Thick sequences of lava flows with rubbly flow tops and fronts forming prominent flow lobes on west, north, and east sides; flow-banded intrusions exposed on south side
Cinnabar Canyon	Tdcc	Domes	Lava flows and flow breccias	Trachydacite and rhyolite	0.3 km^2	8.8	Three small exposures north of Clearwater Creek intruding debris flows associated with the Mount Biedeman stratovolcano
Willow Springs	Twa	Domes	Lava domes, lava flows, minor flow breccias	Trachydacite and trachyandesite	~60 km^2 exposed area; ~9 by 12 km with extensive younger cover	8.6 to 8.0	Coarsely porphyritic lava flows and flow domes
Hot Springs Canyon	Ths	Domes	Lava domes	Dacite	0.5 km^2; largest exposure ~0.5 by 1 km	8.1	Small intrusions and associated flows emplaced into Willow Springs lavas
Big Alkali	Tbar	Domes	Lava domes, minor air fall tuff	Rhyolite, dacite, and trachydacite	~6 km^2; largest body circular ~1 km in diameter	6.2 to 5.4	North-south-trending series of glassy, spongy, locally flow-banded domes
Rock Springs Canyon	Trs	Domes	Lava domes	Rhyolite	7 km^2; two lobes, 1.5 by 2.5 km and 2 by 2 km	<14 and >10.5	Two east-west elongated elliptical lobes of nearly aphryic rhyolite; local zones of black obsidian

[1]K-Ar and $^{40}Ar/^{39}Ar$ ages; see table 2

Table 1. Characteristics of eruptive centers of the Bodie Hills and Aurora volcanic fields.—Continued

Eruptive center or unit	Map units	Volcanic landform	Eruptive products	Composition	Area; dimensions	Age (Ma)[1]	Notable features
Aurora volcanic field							
Locomotive Point	Tmlp	Lava flows	Lava flows and small cone	Basaltic andesite	4.8 km^2; flows extend 2.5 to 4 km from vent	3.9	Series of west- to southwest-trending lava flows emanating from plug-filled vent
Trachyandesite of Cedar Hill	Tach	Lava flows and lava cones	Lava flows	Trachyandesite	~24 km^2; numerous exposures	3.7	Numerous ridges composed of lava flows and composite lava cones near Cedar Hill and extending east of map area
Spring Peak	Trsp	Domes	Lava domes, plugs, and dikes	Rhyolite	22 km^2; largest exposure 3 by 4 km; extensively covered by younger rocks	3.6	Series of flow domes
Hornblende trachydacite	Thd	Lava flows	Lava flows	Trachydacite	~7 km^2; 2 by 5 km north elongated	3.5	Series of lava flows northeast of Beauty Peak
Hornblende trachydacite of Cedar Hill	Thdch	Lava flows and lava cones	Lava flows	Trachydacite	46 km^2; largest exposure ~4.5 by 6 km	3.5 to 2.4	Several series of lava flows and composite lava cones on and near Cedar Hill
Beauty Peak	Tba	Shield volcano	Lava flows, central plug	Basaltic trachyandesite, trachyandesite	25 km^2; 2–4 by 8 km	2.9	Series of lava flows centered on Beauty Peak
Pyroxene trachyandesite of Cedar Hill	Tpach	Lava flows and lava cones	Lava flows	Trachyandesite	14.5 km^2; largest exposure ~1.7 by 6.2 km	2.8	Composite lava cones and lava flows on southwest side of West Brawley Peak and on Cedar Hill
Trachybasalt of Cedar Hill	Tbch	Cinder cone	Cinder cone, lava flows	Trachybasalt	2.4 km^2; 0.5–1.5 by 2.5 km	2.6	Cinder cone and interbedded lava flows
Aurora Peak	Tdap	Domes	Domes and lava flows	Trachydacite	3.9 km^2; 2 by 2.5 km elliptical dome	2.8 to 2.6	Flow dome with two vents centered on Aurora Peak
Trachyandesite south of Aurora Peak	Taap	Lava flows	Lava flows	Trachyandesite	1.8 km^2; lobes 2–2.5 km long	2.6 to 2.3	Erosional remnants of two lobes of lava flows

[1]K-Ar and $^{40}Ar/^{39}Ar$ ages; see table 2

Table 1. Characteristics of eruptive centers of the Bodie Hills and Aurora volcanic fields.—Continued

Eruptive center or unit	Map units	Volcanic landform	Eruptive products	Composition	Area; dimensions	Age (Ma)[1]	Notable features
Aurora volcanic field							
Martinez Hill	Tmr	Dome	Lava domes	Rhyolite	0.7 km^2; triangular 0.6 by 1.2 km	2.5	Three coalescing domes
Cow Camp Creek	Tacc	Lava flows	Lava flows and scoria deposits	Trachyandesite	7.4 km^2 with extensive talus; largest exposure ~3 by 4.5 km	2.0	Lava flow sequence possibly related to shield volcano; minor scoria deposits
Mount Hicks	Qmh	Shield volcano	Lava flows	Trachyandesite	31 km^2; 3.5–6 by 10 km NW-elongate, draped over older rocks	1.6	Shield volcano centered on Mount Hicks
Andesite	Qa	Lava flows	Lava flows	Andesite(?)	2.9 km^2; 6 km long, northeast- to north-trending	1.6 to 1.4	Lava flow filling paleochannel draining Pleistocene Lake Russell
Trachyandesite 1	Qta1	Shield volcano	Lava flows	Trachyandesite	15 km^2; 4 by 4.5 km	undated; 1.6 to 1.3	Numerous lava flows forming shield volcano
Trachyandesite 2	Qta2	Lava flow and small cone	Lava flow and plug	Trachyandesite	10.5 km^2; 1.5–2 by 7 km west-trending	1.3	Fills west-trending paleovalley; prominent vent at east end
Aurora Crater	Qaca	Cone	Lava flows and cinder deposits	Trachyandesite	~23 km^2; 4.5 by 7 km	0.3 to 0.5	Elliptical cone with prominent central crater
Mud Spring	Qmsa	Lava flow	Lava flow	Trachyandesite	10 km^2; 1–2.5 by 6 km	0.04 to 0.1	West-northwest-trending lava flow emanating from prominent vent and filling paleodrainage

[1]K-Ar and $^{40}Ar/^{39}Ar$ ages; see table 2

Table 2. K-Ar and $^{40}Ar/^{39}Ar$ ages of rocks in the Bodie Hills and Aurora volcanic fields.

Number	Sample number	Longitude (°W)[1]	Latitude (°N)[1]	Unit, mine, or alteration zone (AZ)	Age, Ma[2]	Uncertainty[3]	Material dated	Method	Data source[4]
Aurora volcanic field									
1	EL-KA-6	−118.8169	38.3635	Trachyandesite of Mud Spring	0.04	0.04	Groundmass	Ar-Ar	12
2	158	−118.8120	38.3680	Trachyandesite of Mud Spring	0.11	0.08	Groundmass	K-Ar	6
3	USGS(M)-672-2	−118.8825	38.3128	Trachyandesite of Aurora Crater	0.26	0.05	Whole rock	K-Ar	2
4	160	−118.8960	38.3570	Trachyandesite of Aurora Crater	0.47	0.19	Groundmass	K-Ar	6
5	EL-KA-9	−118.8461	38.3630	Trachyandesite 2	1.32	0.08	Groundmass	Ar-Ar	12
6	EL-KA-2	−118.7799	38.3047	Andesite	1.44	0.06	Whole rock	K-Ar	12
7	EL-KA-7	−118.7901	38.3306	Andesite	1.6	0.02	Groundmass	Ar-Ar	12
8	120	−118.8290	38.2400	Trachyandesite of Mount Hicks	1.6	0.1	Whole rock	K-Ar	1
9	09-BA-1	−119.0441	38.3197	Trachyandesite of Cow Camp Creek	1.99	0.04	Whole rock	Ar-Ar	13
10	USGS(M)-670G4	−118.8842	38.2811	Rhyolite of Martinez Hill	2.6	0.1	Biotite	K-Ar	2
11	USGS(M)-611-5	−118.8558	38.2578	Trachyandesite south of Aurora Peak	2.3	0.1	Whole rock	K-Ar	2
12	USGS(M)-611-5	−118.8558	38.2578	Trachyandesite south of Aurora Peak	2.6	0.2	Hornblende	K-Ar	2
13	23	−118.8600	38.1560	Trachybasalt of Cedar Hill	2.60	0.06	Groundmass	K-Ar	6
14	USGS(M)-610-1B	−118.8586	38.2778	Trachydacite of Aurora Peak	2.6	0.2	Biotite	K-Ar	2
15	USGS(M)-610-1B	−118.8586	38.2778	Trachydacite of Aurora Peak	2.8	0.2	Hornblende	K-Ar	2
16	466	−118.8205	38.1785	Pyroxene trachyandesite of Cedar Hill	2.8	0.2	Biotite	K-Ar	1
17	469	−118.8260	38.1790	Pyroxene trachyandesite of Cedar Hill	2.8	0.8	Plagioclase	K-Ar	1
18	25	−118.9730	38.2610	Basaltic trachyandesite of Beauty Peak	2.9	0.1	Whole rock	K-Ar	1
19	468	−118.8185	38.1775	Hornblende trachydacite of Cedar Hill	2.9	0.4	Plagioclase	K-Ar	1
20	USGS(M)-7346-3	−118.9810	38.2160	Hornblende trachydacite of Cedar Hill	2.8	0.1	Whole rock	K-Ar	4
21	1069	−118.8500	38.1880	Hornblende trachydacite of Cedar Hill	2.6	0.3	Plagioclase	K-Ar	1
22	1069	−118.8500	38.1880	Hornblende trachydacite of Cedar Hill	2.6	0.1	Biotite	K-Ar	1
23	139	−118.8800	38.2090	Hornblende trachydacite of Cedar Hill	3.5	0.3	Biotite	K-Ar	1
24	139	−118.8800	38.2090	Hornblende trachydacite of Cedar Hill	3.2	0.3	Biotite	K-Ar	1
25	139	−118.8800	38.2090	Hornblende trachydacite of Cedar Hill	2.4	1.6	Plagioclase	K-Ar	1

[1]NAD27 coordinates
[2]All $^{40}Ar/^{39}Ar$ ages relative to Fish Canyon Tuff sanidine=28.02 Ma; pre-1976 K-Ar ages recalculated using 1977 decay constants (Steiger and Jäger, 1977)
[3]1 sigma
[4]Data sources: 1, Gilbert and others, 1968; 2, Silberman and McKee, 1972; 3, Kleinhampl and others, 1975; 4, Silberman and Chesterman, 1972; 5, Fleck and others, in press; 6, Lange and others, 1993; 7, L.W. Snee and B.R. Berger, written commun., 2012; 8, L.W. Snee, written commun., 2002; 9, L.W. Snee and F. Breit, written commun., 2012; 10, L.W. Snee, B.R. Berger, and E.A. Anderson, written commun., 2012; 11, Marvin and Dobson, 1979; 12, Reheis and others, 2002; 13, M.A. Cosca, written commun., 2013

Table 2. K-Ar and $^{40}Ar/^{39}Ar$ ages of rocks in the Bodie Hills and Aurora volcanic fields—Continued

Number	Sample number	Longitude (°W)[1]	Latitude (°N)[1]	Unit, mine, or alteration zone (AZ)	Age, Ma[2]	Uncertainty[3]	Material dated	Method	Data source[4]
				Aurora volcanic field					
26	199	−119.0080	38.1530	Hornblende trachydacite of Cedar Hill	3.3	0.7	Plagioclase	K-Ar	1
27	5-152-9	−118.9261	38.3548	Hornblende trachydacite	3.02	0.03	Whole rock	Ar-Ar	10
28	5-152-9	−118.9261	38.3548	Hornblende trachydacite	3.5	0.2	Plagioclase	Ar-Ar	10
29	144	−118.8940	38.1840	Trachyandesite of Cedar Hill	3.7	0.4	Plagioclase	K-Ar	1
30	1092A	−118.8100	38.2550	Rhyolite of Spring Peak	3.7	0.1	Sanidine	K-Ar	1
31	203195	−119.1479	38.2823	Basaltic trachyandesite of Locomotive Point	3.9	0.06	Groundmass	Ar-Ar	13
				Bodie Hills volcanic field					
32	USGS(M)-BH6	−119.1512	38.1655	Rhyolite of Big Alkali	5.9	0.2	Biotite	K-Ar	4
33	USGS(M)-BH20	−119.1490	38.2200	Rhyolite of Big Alkali	5.3	0.3	Biotite	K-Ar	4
34	USGS(M)-BH20	−119.1490	38.2200	Rhyolite of Big Alkali	5.5	0.6	Hornblende	K-Ar	4
35	077-7C	−119.1583	38.1968	Rhyolite of Big Alkali	5.48	0.02	Plagioclase	Ar-Ar	5
36	088-24A	−119.1395	38.2528	Rhyolite of Big Alkali	6.201	0.026	Plagioclase	Ar-Ar	5
37	098-13A	−119.1279	38.2575	Rhyolite of Big Alkali	6.173	0.028	Plagioclase	Ar-Ar	5
38	09-BA-42	−119.1489	38.2700	Rhyolite of Big Alkali	5.455	0.026	Biotite	Ar-Ar	5
39	39509-10	−119.2276	38.2153	Dacite of Hot Springs Canyon	8.070	0.017	Plagioclase	Ar-Ar	5
40	414	−119.1930	38.1770	Trachyandesite of Willow Springs	8.0	0.2	Plagioclase	K-Ar	1
41	USGS(M)-BH19A	−119.1720	38.2220	Trachyandesite of Willow Springs	8.2	0.2	Biotite	K-Ar	4
42	077-7A	−119.1948	38.1786	Trachyandesite of Willow Springs	8.00	0.04	Biotite	Ar-Ar	5
43	077-7A	−119.1948	38.1786	Trachyandesite of Willow Springs	8.05	0.02	Plagioclase	Ar-Ar	5
44	077-7B	−119.1524	38.1918	Trachyandesite of Willow Springs	8.12	0.03	Biotite	Ar-Ar	5
45	077-7B	−119.1524	38.1918	Trachyandesite of Willow Springs	8.07	0.02	Hornblende	Ar-Ar	5
46	077-7B	−119.1524	38.1918	Trachyandesite of Willow Springs	8.09	0.03	Plagioclase	Ar-Ar	5
47	088-24B	−119.1412	38.2550	Trachyandesite of Willow Springs	8.575	0.022	Plagioclase	Ar-Ar	5
48	088-24F	−119.0898	38.2018	Trachyandesite of Willow Springs	8.15	0.02	Plagioclase	Ar-Ar	5
49	08-BA-51	−119.1544	38.1745	Trachyandesite of Willow Springs	8.305	0.0169	Plagioclase	Ar-Ar	5

[1]NAD27 coordinates

[2]All $^{40}Ar/^{39}Ar$ ages relative to Fish Canyon Tuff sanidine=28.02 Ma; pre-1976 K-Ar ages recalculated using 1977 decay constants (Steiger and Jäger, 1977)

[3]1 sigma

[4]Data sources: 1, Gilbert and others, 1968; 2, Silberman and McKee, 1972; 3, Kleinhampl and others, 1975; 4, Silberman and Chesterman, 1972; 5, Fleck and others, in press; 6, Lange and others, 1993; 7, L.W. Snee and B.R. Berger, written commun., 2012; 8, L.W. Snee, written commun., 2002; 9, L.W. Snee and F. Breit, written commun., 2012; 10, L.W. Snee, B.R. Berger, and E.A. Anderson, written commun., 2012; 11, Marvin and Dobson, 1979; 12, Reheis and others, 2002; 13, M.A. Cosca, written commun., 2013

Table 2. K-Ar and $^{40}Ar/^{39}Ar$ ages of rocks in the Bodie Hills and Aurora volcanic fields—Continued

Number	Sample number	Longitude (°W)[1]	Latitude (°N)[1]	Unit, mine, or alteration zone (AZ)	Age, Ma[2]	Uncertainty[3]	Material dated	Method	Data source[4]
Bodie Hills volcanic field									
50	12-BA-1	−119.1651	38.1900	Trachydacite of Cinnabar Canyon	8.548	0.028	Plagioclase	Ar-Ar	5
51	406	−119.0850	38.2340	Trachydacite of Potato Peak	8.6	0.2	Plagioclase	K-Ar	1
52	USGS(M)-856-10	−119.0280	38.2050	Trachydacite of Potato Peak	9.3	0.2	Biotite	K-Ar	4
53	USGS(M)-856-10	−119.0280	38.2050	Trachydacite of Potato Peak	9.2	0.2	Hornblende	K-Ar	4
54	USGS(M)-BM2	−119.0570	38.2210	Trachydacite of Potato Peak	9.3	0.1	Biotite	K-Ar	4
55	088-21B	−119.0750	38.2642	Trachydacite of Potato Peak	8.927	0.010	Plagioclase	Ar-Ar	5
56	088-21D	−119.0921	38.2433	Trachydacite of Potato Peak	8.81	0.07	Plagioclase	Ar-Ar	5
57	088-21E	−119.0858	38.2346	Trachydacite of Potato Peak	8.86	0.05	Plagioclase	Ar-Ar	5
58	088-24C	−119.1121	38.2479	Trachydacite of Potato Peak	8.996	0.025	Plagioclase	Ar-Ar	5
59	088-24D	−119.1038	38.2268	Trachydacite of Potato Peak	9.09	0.04	Plagioclase	Ar-Ar	5
60	088-24E	−119.1019	38.2181	Trachydacite of Potato Peak	8.93	0.03	Plagioclase	Ar-Ar	5
61	08-BA-61	−119.1017	38.2077	Trachydacite of Potato Peak	8.93	0.71	Plagioclase	Ar-Ar	5
62	08-BA-68	−119.0684	38.1932	Trachydacite of Potato Peak	8.99	0.02	Plagioclase	Ar-Ar	5
63	098-10C	−119.0920	38.2492	Trachydacite of Potato Peak	8.982	0.023	Plagioclase	Ar-Ar	5
64	098-13C	−119.0922	38.2507	Trachydacite of Potato Peak	8.998	0.021	Plagioclase	Ar-Ar	5
65	108-12A	−119.0483	38.2425	Trachydacite of Potato Peak	8.963	0.016	Plagioclase	Ar-Ar	5
66	108-12B	−119.0078	38.2383	Trachydacite of Potato Peak	9.032	0.022	Biotite	Ar-Ar	5
67	10-BA-66	−119.1013	38.1725	Trachydacite of Potato Peak	8.749	0.019	Plagioclase	Ar-Ar	5
68	10-BA-66	−119.1013	38.1725	Trachydacite of Potato Peak	8.734	0.015	Sanidine	Ar-Ar	5
69	10-BA-46	−119.1151	38.1738	Trachydacite of Potato Peak	8.779	0.013	Plagioclase	Ar-Ar	5
70	15	−118.9610	38.1940	Dacite of Silver Hill	9.1	0.2	Plagioclase	K-Ar	1
71	USGS(M)-BH15	−119.0030	38.2010	Dacite of Silver Hill	8.8	0.4	Hornblende	K-Ar	4
72	USGS(M)-BH15	−119.0030	38.2010	Dacite of Silver Hill	8.9	0.2	Biotite	K-Ar	4
73	USGS(M)-S1	−119.0080	38.1880	Dacite of Silver Hill	8.7	0.4	Whole rock	K-Ar	4
74	USGS(M)-S1	−119.0080	38.1880	Dacite of Silver Hill	8.5	0.4	Plagioclase	K-Ar	4
75	USGS(M)-S1	−119.0080	38.1880	Dacite of Silver Hill	9.1	0.4	Plagioclase	K-Ar	4

[1]NAD27 coordinates

[2]All $^{40}Ar/^{39}Ar$ ages relative to Fish Canyon Tuff sanidine=28.02 Ma; pre-1976 K-Ar ages recalculated using 1977 decay constants (Steiger and Jäger, 1977)

[3]1 sigma

[4]Data sources: 1, Gilbert and others, 1968; 2, Silberman and McKee, 1972; 3, Kleinhampl and others, 1975; 4, Silberman and Chesterman, 1972; 5, Fleck and others, in press; 6, Lange and others, 1993; 7, L.W. Snee and B.R. Berger, written commun., 2012; 8, L.W. Snee, written commun., 2002; 9, L.W. Snee and F. Breit, written commun., 2012; 10, L.W. Snee, B.R. Berger, and E.A. Anderson, written commun., 2012; 11, Marvin and Dobson, 1979; 12, Reheis and others, 2002; 13, M.A. Cosca, written commun., 2013

Table 2. K-Ar and $^{40}Ar/^{39}Ar$ ages of rocks in the Bodie Hills and Aurora volcanic fields—Continued

Number	Sample number	Longitude (°W)[1]	Latitude (°N)[1]	Unit, mine, or alteration zone (AZ)	Age, Ma[2]	Uncertainty[3]	Material dated	Method	Data source[4]
Bodie Hills volcanic field									
76	USGS(M)-B271	−119.0030	38.2150	Dacite of Silver Hill	8.6	0.2	Hornblende	K-Ar	4
77	USGS(M)-B271	−119.0030	38.2150	Dacite of Silver Hill	8.7	0.3	Plagioclase	K-Ar	4
78	USGS(M)-856-8	−119.0040	38.2140	Dacite of Silver Hill	9.4	0.5	Hornblende	K-Ar	4
79	USGS(M)-BH17	−119.0120	38.1930	Dacite of Silver Hill	9.4	0.5	Hornblende	K-Ar	4
80	USGS(M)-BH32	−118.9950	38.2000	Dacite of Silver Hill	9.0	0.2	Biotite	K-Ar	4
81	USGS(M)-856-32	−118.9970	38.2090	Dacite of Silver Hill	9.1	0.3	Biotite	K-Ar	4
82	USGS(M)-854-1	−119.0030	38.1820	Dacite of Silver Hill	8.9	0.2	Biotite	K-Ar	4
83	USGS(M)-BH29	−118.9580	38.1960	Dacite of Silver Hill	8.9	0.2	Biotite	K-Ar	4
84	077-7F	−119.0263	38.2025	Dacite of Silver Hill	8.93	0.03	Plagioclase	Ar-Ar	5
85	09-BA-26	−119.0002	38.2036	Dacite of Silver Hill	9.132	0.020	Biotite	Ar-Ar	5
86	108-12C	−118.9834	38.1893	Dacite of Silver Hill	9.089	0.014	Plagioclase	Ar-Ar	5
87	108-12D	−118.9780	38.1732	Dacite of Silver Hill	9.018	0.014	Plagioclase	Ar-Ar	5
88	108-12E	−118.9649	38.2076	Dacite of Silver Hill	9.140	0.020	Plagioclase	Ar-Ar	5
89	077-6F	−119.0085	38.1881	Dacite of Silver Hill-Sugarloaf plug	9.09	0.03	Plagioclase	Ar-Ar	5
90	08-BA-66	−119.0568	38.1863	Dacite of Silver Hill debris flow clast	9.07	0.024	Plagioclase	Ar-Ar	5
91	USGS(M)-BH9	−119.1160	38.1570	Trachyandesite of Mount Biedeman	9.5	0.3	Whole rock	K-Ar	4
92	USGS(M)-MTB1	−119.0730	38.1460	Trachyandesite of Mount Biedeman	9.8	0.2	Hornblende	K-Ar	4
93	098-11E	−119.1584	38.1110	Trachyandesite of Mount Biedeman	9.019	0.028	Plagioclase	Ar-Ar	5
94	09-BA-22	−119.1797	38.1430	Trachyandesite of Mount Biedeman	8.996	0.101	Plagioclase	Ar-Ar	5
95	09SB015A	−119.1484	38.1231	Trachyandesite of Mount Biedeman	8.895	0.061	Plagioclase	Ar-Ar	5
96	108-12F	−119.0992	38.1634	Trachyandesite of Mount Biedeman	9.939	0.024	Plagioclase	Ar-Ar	5
97	108-9A	−119.0982	38.1654	Trachyandesite of Mount Biedeman	9.947	0.019	Plagioclase	Ar-Ar	5
98	10-BA-61	−119.0155	38.1401	Trachyandesite of Mount Biedeman	9.676	0.061	Plagioclase	Ar-Ar	5
99	119-20B	−119.0761	38.1345	Trachyandesite of Mount Biedeman	9.073	0.033	Plagioclase	Ar-Ar	5
100	12-BA-22	−119.1240	38.1016	Trachyandesite of Mount Biedeman	8.931	0.041	Plagioclase	Ar-Ar	5

[1]NAD27 coordinates

[2]All $^{40}Ar/^{39}Ar$ ages relative to Fish Canyon Tuff sanidine=28.02 Ma; pre-1976 K-Ar ages recalculated using 1977 decay constants (Steiger and Jäger, 1977)

[3]1 sigma

[4]Data sources: 1, Gilbert and others, 1968; 2, Silberman and McKee, 1972; 3, Kleinhampl and others, 1975; 4, Silberman and Chesterman, 1972; 5, Fleck and others, in press; 6, Lange and others, 1993; 7, L.W. Snee and B.R. Berger, written commun., 2012; 8, L.W. Snee, written commun., 2002; 9, L.W. Snee and F. Breit, written commun., 2012; 10, L.W. Snee, B.R. Berger, and E.A. Anderson, written commun., 2012; 11, Marvin and Dobson, 1979; 12, Reheis and others, 2002; 13, M.A. Cosca, written commun., 2013

Table 2. K-Ar and $^{40}Ar/^{39}Ar$ ages of rocks in the Bodie Hills and Aurora volcanic fields—Continued

Number	Sample number	Longitude (°W)[1]	Latitude (°N)[1]	Unit, mine, or alteration zone (AZ)	Age, Ma[2]	Uncertainty[3]	Material dated	Method	Data source[4]
Bodie Hills volcanic field									
101	6-215-1	−119.0825	38.1344	Trachyandesite of Mount Biedeman	9.24	0.08	Hornblende	Ar-Ar	10
102	MC-12-18	−119.0783	38.1558	Trachyandesite of Mount Biedeman	9.18	0.09	Hornblende	Ar-Ar	13
103	08-BA-65	−118.9781	38.3107	Rhyolite of Bald Peak	9.690	0.01	Sanidine	Ar-Ar	5
104	10-BA-67	−118.9830	38.2620	Rhyolite of Bald Peak	9.652	0.016	Sanidine	Ar-Ar	5
105	507	−119.0890	38.1540	Rhyolite of Bodie Hills	9.8	0.3	Plagioclase	K-Ar	1
106	507	−119.0890	38.1540	Rhyolite of Bodie Hills	9.5	0.3	Biotite	K-Ar	1
107	USGS(M)-BH27	−119.0560	38.1400	Rhyolite of Bodie Hills	9.3	0.2	Biotite	K-Ar	4
108	077-7D	−119.0998	38.1672	Rhyolite of Bodie Hills	9.86	0.01	Sanidine	Ar-Ar	5
109	077-7D	−119.0998	38.1672	Rhyolite of Bodie Hills	9.86	0.01	Plagioclase	Ar-Ar	5
110	088-21C	−119.0838	38.2513	Rhyolite of Bodie Hills	9.776	0.017	Biotite	Ar-Ar	5
111	088-21C	−119.0838	38.2513	Rhyolite of Bodie Hills	9.806	0.019	Plagioclase	Ar-Ar	5
112	088-21C	−119.0838	38.2513	Rhyolite of Bodie Hills	9.740	0.023	Plagioclase	Ar-Ar	5
113	088-21C	−119.0838	38.2513	Rhyolite of Bodie Hills	9.824	0.046	Biotite	Ar-Ar	5
114	08-BA-50	−119.0966	38.2482	Rhyolite of Bodie Hills	9.757	0.013	Sanidine	Ar-Ar	5
115	098-10B	−119.0838	38.2514	Rhyolite of Bodie Hills	9.771	0.003	Sanidine	Ar-Ar	5
116	098-13B	−119.1322	38.2680	Rhyolite of Bodie Hills	9.813	0.027	Sanidine	Ar-Ar	5
117	09-BA-20	−119.0474	38.1566	Rhyolite of Bodie Hills	9.609	0.013	Sanidine	Ar-Ar	5
118	09-BA-47	−119.1382	38.2841	Rhyolite of Bodie Hills	9.877	0.013	Sanidine	Ar-Ar	5
119	USGS(M)-Baghdad	−118.9467	38.2786	Rhyolite of Bodie Creek	10.2	0.3	Sanidine	K-Ar	2
120	USGS(M)-Baghdad	−118.9467	38.2786	Rhyolite of Bodie Creek	10.5	0.4	Plagioclase	K-Ar	2
121	077-9B	−118.9506	38.2697	Rhyolite of Bodie Creek	10.16	0.03	Sanidine	Ar-Ar	5
122	108-11A	−118.9481	38.2783	Rhyolite of Bodie Creek	9.890	0.008	Sanidine	Ar-Ar	5
123	11-BA-32	−118.9780	38.3364	Rhyolite of Bodie Creek	10.127	0.013	Sanidine	Ar-Ar	5
124	077-8C	−119.0778	38.2715	Trachyandesite of Aurora Canyon	10.45	0.01	Sanidine	Ar-Ar	5
125	077-8C	−119.0778	38.2715	Trachyandesite of Aurora Canyon	10.43	0.03	Plagioclase	Ar-Ar	5

[1]NAD27 coordinates

[2]All $^{40}Ar/^{39}Ar$ ages relative to Fish Canyon Tuff sanidine=28.02 Ma; pre-1976 K-Ar ages recalculated using 1977 decay constants (Steiger and Jäger, 1977)

[3]1 sigma

[4]Data sources: 1, Gilbert and others, 1968; 2, Silberman and McKee, 1972; 3, Kleinhampl and others, 1975; 4, Silberman and Chesterman, 1972; 5, Fleck and others, in press; 6, Lange and others, 1993; 7, L.W. Snee and B.R. Berger, written commun., 2012; 8, L.W. Snee, written commun., 2002; 9, L.W. Snee and F. Breit, written commun., 2012; 10, L.W. Snee, B.R. Berger, and E.A. Anderson, written commun., 2012; 11, Marvin and Dobson, 1979; 12, Reheis and others, 2002; 13, M.A. Cosca, written commun., 2013

Table 2. K-Ar and $^{40}Ar/^{39}Ar$ ages of rocks in the Bodie Hills and Aurora volcanic fields—Continued

Number	Sample number	Longitude (°W)[1]	Latitude (°N)[1]	Unit, mine, or alteration zone (AZ)	Age, Ma[2]	Uncertainty[3]	Material dated	Method	Data source[4]
				Bodie Hills volcanic field					
126	077-8C	−119.0778	38.2715	Trachyandesite of Aurora Canyon	10.47	0.04	Biotite	Ar-Ar	5
127	088-21A	−119.1396	38.2736	Trachyandesite of Aurora Canyon	10.358	0.025	Plagioclase	Ar-Ar	5
128	088-23A	−119.1002	38.2785	Trachyandesite of Aurora Canyon	10.58	0.03	Biotite	Ar-Ar	5
129	088-23A	−119.1002	38.2785	Trachyandesite of Aurora Canyon	10.27	0.11	Plagioclase	Ar-Ar	5
130	088-23B	−119.0991	38.2783	Trachyandesite of Aurora Canyon	10.54	0.05	Biotite	Ar-Ar	5
131	088-23B	−119.0991	38.2783	Trachyandesite of Aurora Canyon	10.31	0.02	Plagioclase	Ar-Ar	5
132	088-23D	−119.1021	38.2811	Trachyandesite of Aurora Canyon	10.46	0.032	Biotite	Ar-Ar	5
133	088-23D	−119.1021	38.2811	Trachyandesite of Aurora Canyon	10.265	0.052	Plagioclase	Ar-Ar	5
134	088-25A	−119.0908	38.2732	Trachyandesite of Aurora Canyon	10.43	0.03	Plagioclase	Ar-Ar	5
135	10-BA-62	−119.0064	38.3633	Unwelded tuff, Fletcher Basin sediments	10.464	0.042	Biotite	Ar-Ar	5
136	10-BA-62	−119.0064	38.3633	Unwelded tuff, Fletcher Basin sediments	10.582	0.023	Plagioclase	Ar-Ar	5
137	08SB032	−118.9558	38.3456	Unwelded tuff, Fletcher Basin sediments	11.075	0.041	Plagioclase	Ar-Ar	5
138	077-9E	−118.9100	38.3191	Trachyandesite of Del Monte	10.95	0.03	Plagioclase	Ar-Ar	5
139	08SB038	−118.9738	38.4083	Trachyandesite of Del Monte	10.98	0.05	Biotite	Ar-Ar	5
140	11-BA-41	−118.9809	38.3506	Trachyandesite of Del Monte	10.942	0.024	Plagioclase	Ar-Ar	5
141	09SB020A	−119.1328	38.1323	Trachydacite of Bridgeport Canyon	11.080	0.019	Plagioclase	Ar-Ar	5
142	098-11B	−119.1713	38.1245	Trachydacite of Bridgeport Canyon	11.067	0.022	Plagioclase	Ar-Ar	5
143	10-BA-5	−118.9970	38.3394	Pyroxene rhyolite	11.153	0.011	Plagioclase	Ar-Ar	5
144	10-BA-27	−118.9050	38.2750	Rhyolite of East Brawley Peak	11.178	0.016	Sanidine	Ar-Ar	5
145	USGS(M)-NTS10B	−118.8967	38.3021	Rhyolite of Aurora Creek	11.2	0.2	Biotite	K-Ar	2
146	USGS(M)-NTS10B	−118.8967	38.3021	Rhyolite of Aurora Creek	11.3	0.2	Sanidine	K-Ar	2
147	10-BA-20	−118.9113	38.3168	Rhyolite of Aurora Creek	11.177	0.013	Plagioclase	Ar-Ar	5
148	10-BA-21	−118.8974	38.3031	Rhyolite of Aurora Creek	11.181	0.022	Sanidine	Ar-Ar	5
149	077-9C	−118.9304	38.2766	Rhyolite of Del Monte Canyon	11.19	0.02	Sanidine	Ar-Ar	5

[1]NAD27 coordinates

[2]All $^{40}Ar/^{39}Ar$ ages relative to Fish Canyon Tuff sanidine=28.02 Ma; pre-1976 K-Ar ages recalculated using 1977 decay constants (Steiger and Jäger, 1977)

[3]1 sigma

[4]Data sources: 1, Gilbert and others, 1968; 2, Silberman and McKee, 1972; 3, Kleinhampl and others, 1975; 4, Silberman and Chesterman, 1972; 5, Fleck and others, in press; 6, Lange and others, 1993; 7, L.W. Snee and B.R. Berger, written commun., 2012; 8, L.W. Snee, written commun., 2002; 9, L.W. Snee and F. Breit, written commun., 2012; 10, L.W. Snee, B.R. Berger, and E.A. Anderson, written commun., 2012; 11, Marvin and Dobson, 1979; 12, Reheis and others, 2002; 13, M.A. Cosca, written commun., 2013

Table 2. K-Ar and $^{40}Ar/^{39}Ar$ ages of rocks in the Bodie Hills and Aurora volcanic fields—Continued

Number	Sample number	Longitude (°W)[1]	Latitude (°N)[1]	Unit, mine, or alteration zone (AZ)	Age, Ma[2]	Uncertainty[3]	Material dated	Method	Data source[4]
				Bodie Hills volcanic field					
150	077-9C	−118.9304	38.2766	Rhyolite of Del Monte Canyon	11.26	0.14	Plagioclase	Ar-Ar	5
151	077-9D	−118.9280	38.2856	Rhyolite of Del Monte Canyon	11.14	0.02	Sanidine	Ar-Ar	5
152	077-9D	−118.9280	38.2856	Rhyolite of Del Monte Canyon	11.20	0.03	Plagioclase	Ar-Ar	5
153	AU-6/60/DD61	−118.9280	38.2850	Rhyolite of Del Monte Canyon	11.60	0.03	Biotite	Ar-Ar	7
154	USGS(M)-710-7	−118.9281	38.2822	Rhyolite of Del Monte Canyon?	11.5	0.2	Biotite	K-Ar	2
155	077-8B	−119.0562	38.2833	Trachydacite intrusion	11.16	0.03	Plagioclase	Ar-Ar	5
156	09-BA-35	−119.0464	38.2905	Trachydacite intrusion	11.269	0.034	Biotite	Ar-Ar	5
157	098-13D	−119.1606	38.2766	Trachyandesite of Clark Canyon	11.341	0.017	Plagioclase	Ar-Ar	5
158	09-BA-43	−119.1683	38.2636	Trachyandesite of Clark Canyon	11.27	0.11	Plagioclase	Ar-Ar	5
159	077-7G	−118.9667	38.2344	Trachyandesite of West Brawley Peak	11.32	0.03	Plagioclase	Ar-Ar	5
160	108-10C	−118.9062	38.2805	Trachyandesite of West Brawley Peak	11.514	0.019	Plagioclase	Ar-Ar	5
161	547	−118.9480	38.2550	Trachyandesite of West Brawley Peak	11.5	0.2	Plagioclase	K-Ar	1
162	USGS(M)-712-1	−118.9175	38.2522	Trachyandesite of West Brawley Peak	11.5	0.2	Biotite	K-Ar	2
163	USGS(M)-712-1	−118.9175	38.2522	Trachyandesite of West Brawley Peak	11.2	0.3	Plagioclase	K-Ar	2
164	USGS(M)-712-1	−118.9175	38.2522	Trachyandesite of West Brawley Peak	11.9	0.3	Hornblende	K-Ar	2
165	6	−119.1697	38.1256	Basaltic trachyandesite of Rancheria	11.6	0.9	Whole rock	K-Ar	3
166	742-45	−119.1431	38.0869	Basaltic trachyandesite of Rancheria plug	11.7	0.5	Whole rock	K-Ar	11
167	MC-12-20	−119.1261	38.2701	Hornblende trachyandesite intrusion	11.82	0.2	Hornblende	Ar-Ar	13
168	10-BA-6	−119.0247	38.3338	Trachydacite of Rough Creek	12.945	0.020	Plagioclase	Ar-Ar	5
169	10-BA-29	−119.0145	38.3647	Trachydacite of Rough Creek	11.675	0.016	Plagioclase	Ar-Ar	5
170	11-BA-40	−119.0191	38.4116	Trachydacite of Rough Creek	12.804	0.023	Plagioclase	Ar-Ar	5
171	108-10A	−118.9127	38.2729	Trachyandesite of Aurora	12.580	0.024	Plagioclase	Ar-Ar	5
172	00-BA-16	−118.8908	38.2708	Trachyandesite of Aurora	13.13	0.44	Hornblende	Ar-Ar	8
173	00-BA-26	−118.8841	38.2542	Trachyandesite of Aurora	13.13	0.08	Hornblende	Ar-Ar	8
174	07-BA-38	−119.1450	38.3605	Andesite of Lakeview Spring	12.93	0.03	Plagioclase	Ar-Ar	5
175	5	−119.1475	38.0978	Trachyandesite of Sinnamon Cut	13.8	0.4	Hornblende	K-Ar	3

[1]NAD27 coordinates

[2]All $^{40}Ar/^{39}Ar$ ages relative to Fish Canyon Tuff sanidine=28.02 Ma; pre-1976 K-Ar ages recalculated using 1977 decay constants (Steiger and Jäger, 1977)

[3]1 sigma

[4]Data sources: 1, Gilbert and others, 1968; 2, Silberman and McKee, 1972; 3, Kleinhampl and others, 1975; 4, Silberman and Chesterman, 1972; 5, Fleck and others, in press; 6, Lange and others, 1993; 7, L.W. Snee and B.R. Berger, written commun., 2012; 8, L.W. Snee, written commun., 2002; 9, L.W. Snee and F. Breit, written commun., 2012; 10, L.W. Snee, B.R. Berger, and E.A. Anderson, written commun., 2012; 11, Marvin and Dobson, 1979; 12, Reheis and others, 2002; 13, M.A. Cosca, written commun., 2013

Table 2. K-Ar and $^{40}Ar/^{39}Ar$ ages of rocks in the Bodie Hills and Aurora volcanic fields—Continued

Number	Sample number	Longitude (°W)[1]	Latitude (°N)[1]	Unit, mine, or alteration zone (AZ)	Age, Ma[2]	Uncertainty[3]	Material dated	Method	Data source[4]
Bodie Hills volcanic field									
176	12-BA-9	−119.0738	38.3368	Trachydacite of East Canyon	13.782	0.025	Plagioclase	Ar-Ar	5
177	098-12E	−119.1240	38.3914	Trachyandesite of Masonic Gulch	13.441	0.026	Plagioclase	Ar-Ar	5
178	MAS10-72	−119.1372	38.4019	Trachyandesite of Masonic Gulch	13.485	0.017	Plagioclase	Ar-Ar	5
179	MAS10-73	−119.1347	38.3964	Trachyandesite of Masonic Gulch	13.467	0.016	Plagioclase	Ar-Ar	5
180	MAS10-75	−119.1155	38.3917	Trachyandesite of Masonic Gulch	13.467	0.023	Plagioclase	Ar-Ar	5
181	12-BA-3	−118.8473	38.3497	Trachyandesite of Mud Spring Canyon	13.87	0.11	Plagioclase	Ar-Ar	13
182	088-22B	−119.0780	38.3794	Trachyandesite of Masonic	14.07	0.08	Plagioclase	Ar-Ar	5
183	098-12F	−119.1142	38.3754	Trachyandesite of Masonic	14.094	0.017	Plagioclase	Ar-Ar	5
184	10-BA-69	−119.1365	38.3054	Trachyandesite of Masonic	14.107	0.014	Plagioclase	Ar-Ar	5
185	08-BA-62	−119.0494	38.3201	Trachyandesite of Masonic	14.13	0.03	Plagioclase	Ar-Ar	5
186	10-BA-15	−119.1157	38.3413	Trachyandesite of Masonic	14.141	0.017	Plagioclase	Ar-Ar	5
187	088-23F	−119.1170	38.3107	Trachyandesite of Masonic	14.193	0.039	Plagioclase	Ar-Ar	5
188	10-BA-13	−119.1042	38.3515	Trachyandesite of Masonic	14.410	0.016	Plagioclase	Ar-Ar	5
189	09-BA-7	−119.0873	38.3379	Trachyandesite of Masonic	14.674	0.025	Plagioclase	Ar-Ar	5
190	098-12B	−119.1814	38.3876	Trachyandesite of Masonic	14.715	0.025	Plagioclase	Ar-Ar	5
191	098-12D	−119.1194	38.3995	Trachyandesite of Masonic	<14.80	0.11	Plagioclase	Ar-Ar	5
192	12-BA-20	−119.1596	38.3340	Trachyandesite of Masonic	14.136	0.02	Plagioclase	Ar-Ar	5
193	MAS10-76	−119.1153	38.3817	Trachyandesite intrusions of Masonic	14.190	0.021	Hornblende	Ar-Ar	5
194	10-BA-9	−119.0207	38.3528	Trachyandesite intrusions of Masonic	14.998	0.019	Plagioclase	Ar-Ar	5
195	MC-12-19	−118.7815	38.3195	Trachyandesite of Borealis	15.96	0.10	Hornblende	Ar-Ar	13
Distally sourced ash-flow tuffs									
196	31	−118.9900	38.2470	Eureka Valley Tuff	9.8	0.3	Biotite	K-Ar	1
197	27	−118.9900	38.2470	Eureka Valley Tuff	9.9	0.3	Biotite	K-Ar	1
198	W24	−119.0660	38.1020	Eureka Valley Tuff	9.4	0.28	Biotite	K-Ar	1
199	W25	−119.1810	38.1310	Eureka Valley Tuff	9.6	0.37	Biotite	K-Ar	1
200	W25	−119.1810	38.1310	Eureka Valley Tuff	9.2	0.27	Biotite	K-Ar	1

[1]NAD27 coordinates

[2]All $^{40}Ar/^{39}Ar$ ages relative to Fish Canyon Tuff sanidine=28.02 Ma; pre-1976 K-Ar ages recalculated using 1977 decay constants (Steiger and Jäger, 1977)

[3]1 sigma

[4]Data sources: 1, Gilbert and others, 1968; 2, Silberman and McKee, 1972; 3, Kleinhampl and others, 1975; 4, Silberman and Chesterman, 1972; 5, Fleck and others, in press; 6, Lange and others, 1993; 7, L.W. Snee and B.R. Berger, written commun., 2012; 8, L.W. Snee, written commun., 2002; 9, L.W. Snee and F. Breit, written commun., 2012; 10, L.W. Snee, B.R. Berger, and E.A. Anderson, written commun., 2012; 11, Marvin and Dobson, 1979; 12, Reheis and others, 2002; 13, M.A. Cosca, written commun., 2013

Table 2. K-Ar and $^{40}Ar/^{39}Ar$ ages of rocks in the Bodie Hills and Aurora volcanic fields—Continued

Number	Sample number	Longitude (°W)[1]	Latitude (°N)[1]	Unit, mine, or alteration zone (AZ)	Age, Ma[2]	Uncertainty[3]	Material dated	Method	Data source[4]
Distally sourced ash-flow tuffs									
201	077-9A	−118.9744	38.2209	Eureka Valley Tuff	9.40	0.02	Biotite	Ar-Ar	5
202	077-9A	−118.9744	38.2209	Eureka Valley Tuff	9.38	0.03	Plagioclase	Ar-Ar	5
203	098-12A	−119.1992	38.3592	Eureka Valley Tuff	9.453	0.030	Plagioclase	Ar-Ar	5
204	09-BA-49	−119.0475	38.2639	Eureka Valley Tuff	9.267	0.019	Biotite	Ar-Ar	5
205	AU-10/61/DD61	−118.9810	38.2600	Eureka Valley Tuff	9.26	0.04	Biotite	Ar-Ar	7
206	6-289-2	−118.9993	38.3729	Eureka Valley Tuff	9.26	0.06	Biotite	Ar-Ar	10
207	098-11A	−119.1695	38.1224	Tuff of Jacks Spring	12.069	0.015	Sanidine	Ar-Ar	5
208	09-BA-23	−119.1749	38.1285	Tuff of Jacks Spring	12.044	0.016	Sanidine	Ar-Ar	5
209	6-181-12	−119.1039	38.1193	Tuff of Jacks Spring	11.95	0.16	Sanidine	Ar-Ar	10
210	6-181-12	−119.1039	38.1193	Tuff of Jacks Spring	11.98	0.14	Sanidine	Ar-Ar	10
Hydrothermal alteration minerals									
211	39509-3K	−119.2275	38.2079	Highway 395 AZ	8.169	0.013	Alunite	Ar-Ar	5
212	11-BA-21	−119.0092	38.2037	Noonday mine dump, Bodie	8.124	0.006	Adularia	Ar-Ar	5
213	BOD11-3A	−119.0035	38.2196	Upper Hobart Tunnel dump, Bodie	8.194	0.005	Adularia	Ar-Ar	5
214	USGS(M)-B270	−119.0040	38.2160	McClinton shaft dump, Bodie	8.2	0.2	Adularia	K-Ar	6
215	11-BA-7G	−119.0065	38.2042	Oro shaft dump, Bodie	8.217	0.012	Adularia	Ar-Ar	5
216	AU-17/64/DD61	−118.9970	38.2150	Tioga shaft dump, Bodie	8.28	0.04	Adularia	Ar-Ar	7
217	077-6A	−119.0037	38.2149	Roseclip glory hole, Bodie	8.29	0.02	Adularia	Ar-Ar	5
218	12-BA-17	−119.0002	38.2296	West side of Bodie Bluff, Bodie	8.358	0.029	Adularia	Ar-Ar	5
219	AU-16/63/DD61	−119.0040	38.2150	Roseclip glory hole, Bodie	8.38	0.02	Adularia	Ar-Ar	7
220	BOD11-4E	−119.0040	38.2126	Standard Hill mine dump, Bodie	8.426	0.003	Adularia	Ar-Ar	5
221	AU-18/65/DD61	−119.0040	38.2010	Red Cloud shaft dump, Bodie	8.46	0.02	Adularia	Ar-Ar	7
222	11-BA-22	−119.0040	38.2126	Dump at base of Standard Hill, Bodie	8.498	0.005	Adularia	Ar-Ar	5
223	BOD09-5	−119.0066	38.2043	Oro shaft dump, Bodie	8.63	0.007	Adularia	Ar-Ar	5
224	BOD9-3	−119.0048	38.2015	Red Cloud shaft dump, Bodie	8.63	0.014	Adularia	Ar-Ar	5
225	09-BA-28I	−119.0036	38.2015	Red Cloud shaft dump, Bodie	8.85	0.013	Adularia	Ar-Ar	5

[1]NAD27 coordinates

[2]All $^{40}Ar/^{39}Ar$ ages relative to Fish Canyon Tuff sanidine=28.02 Ma; pre-1976 K-Ar ages recalculated using 1977 decay constants (Steiger and Jäger, 1977)

[3]1 sigma

[4]Data sources: 1, Gilbert and others, 1968; 2, Silberman and McKee, 1972; 3, Kleinhampl and others, 1975; 4, Silberman and Chesterman, 1972; 5, Fleck and others, in press; 6, Lange and others, 1993; 7, L.W. Snee and B.R. Berger, written commun., 2012; 8, L.W. Snee, written commun., 2002; 9, L.W. Snee and F. Breit, written commun., 2012; 10, L.W. Snee, B.R. Berger, and E.A. Anderson, written commun., 2012; 11, Marvin and Dobson, 1979; 12, Reheis and others, 2002; 13, M.A. Cosca, written commun., 2013

Table 2. K-Ar and $^{40}Ar/^{39}Ar$ ages of rocks in the Bodie Hills and Aurora volcanic fields—Continued

Number	Sample number	Longitude (°W)[1]	Latitude (°N)[1]	Unit, mine, or alteration zone (AZ)	Age, Ma[2]	Uncertainty[3]	Material dated	Method	Data source[4]
				Hydrothermal alteration minerals					
226	CC09-9D2	−119.1705	38.1987	Cinnabar Canyon AZ	8.68	0.02	Alunite	Ar-Ar	5
227	CC09-9D1	−119.1705	38.1987	Cinnabar Canyon AZ	8.82	0.29	Alunite	Ar-Ar	5
228	FA1	−118.8914	38.2931	Aurora	10.11	0.03	Adularia	Ar-Ar	9
229	AU-1/58/DD61	−118.9000	38.2660	Esmeralda vein, Aurora	10.47	0.1	K-feldspar	Ar-Ar	7
230	37	−118.8870	38.2870	Aurora	10.6	0.2	Adularia	K-Ar	3
231	AU-2/59/DD61	−118.8960	38.2820	Rio Del Monte mine dump, Aurora	10.35	0.05	K-feldspar	Ar-Ar	7
232	08-BA-46	−119.1039	38.2443	Potato Peak AZ	10.83	0.06	Alunite	Ar-Ar	5
233	PP09-10A1	−119.1384	38.2531	Aurora Canyon AZ	10.866	0.065	Alunite	Ar-Ar	5
234	SAW11-9	−118.9166	39.2904	Sawtooth AZ	11.105	0.018	Alunite	Ar-Ar	5
235	AUR10-3	−118.8992	38.2375	East Brawley Peak AZ	11.954	0.016	Alunite	Ar-Ar	5
236	FA66	−118.9008	38.2375	East Brawley Peak AZ	12.42	0.04	Alunite	Ar-Ar	9
237	MAS11-1	−119.0837	38.3604	Perini mine, lower dump, Masonic	12.956	0.020	Alunite	Ar-Ar	5
238	MAS11-2B	−119.0868	38.3606	Perini mine, upper dump, Masonic	12.960	0.014	Alunite	Ar-Ar	5
239	088-22A	−119.1073	38.3673	Maybelle mine, Masonic	13.018	0.061	Alunite	Ar-Ar	5
240	07-BA-40	−119.1161	38.3655	Pittsburg-Liberty mine, Masonic	13.02	0.05	Alunite	Ar-Ar	5
241	MAS07-3	−119.1268	38.3597	Sarita mine, Masonic	13.26	0.05	Alunite	Ar-Ar	5
242	MAS10-55	−119.1026	38.4142	Redwash AZ	13.27	0.02	Alunite	Ar-Ar	5
243	MAS09-1	−119.1327	38.3578	Red Rock mine area, Masonic	13.32	0.14	Alunite	Ar-Ar	5
244	RW08-1	−119.1241	38.4112	Red Wash AZ	13.338	0.035	Alunite	Ar-Ar	5
245	MAS09-1A	−119.1382	38.3585	Red Rock mine area, Masonic	13.37	0.11	Alunite	Ar-Ar	5
246	MAS07-1A	−119.1483	38.3499	Chemung mine, Masonic	13.39	0.07	Alunite	Ar-Ar	5

[1]NAD27 coordinates

[2]All $^{40}Ar/^{39}Ar$ ages relative to Fish Canyon Tuff sanidine=28.02 Ma; pre-1976 K-Ar ages recalculated using 1977 decay constants (Steiger and Jäger, 1977)

[3]1 sigma

[4]Data sources: 1, Gilbert and others, 1968; 2, Silberman and McKee, 1972; 3, Kleinhampl and others, 1975; 4, Silberman and Chesterman, 1972; 5, Fleck and others, in press; 6, Lange and others, 1993; 7, L.W. Snee and B.R. Berger, written commun., 2012; 8, L.W. Snee, written commun., 2002; 9, L.W. Snee and F. Breit, written commun., 2012; 10, L.W. Snee, B.R. Berger, and E.A. Anderson, written commun., 2012; 11, Marvin and Dobson, 1979; 12, Reheis and others, 2002; 13, M.A. Cosca, written commun., 2013

Mud Spring Canyon Center

The 14.0 Ma Mud Spring Canyon center forms a series of coarsely porphyritic trachyandesite lava domes that are exposed beneath mafic lava flows of the Aurora volcanic field on the east side of the Bodie Hills. This unit is the oldest of numerous coarsely and abundantly porphyritic, intermediate composition (silicic trachyandesite to dacite) dome fields in the Bodie Hills.

East Canyon Center

The 13.8 Ma East Canyon center forms two small intrusions and two northwest-elongated trachydacite lava domes emplaced into the Masonic center on the east side of Masonic Mountain.

Aurora Center

The 13.1 to 12.6 Ma Aurora center consists of trachyandesite lava flows, debris-flow deposits, and small intrusions that likely formed a now highly dissected stratovolcano centered near the townsite of Aurora. Younger rocks of the Aurora volcanic field overlie and conceal a significant part of this center. Nearly all rocks in the Aurora center are hydrothermally altered; the center hosts both important epithermal quartz-adularia gold-silver vein deposits in the Aurora mining district and older epithermal quartz-alunite gold prospects in the East Brawley Peak alteration zone (fig. 5).

Rough Creek Center

The Rough Creek center forms a series of prominent, coarsely porphyritic trachydacite lava domes in the north-central part of the Bodie Hills. $^{40}Ar/^{39}Ar$ ages suggest that it may consist of two sets of nearly identical, coarsely porphyritic domes emplaced at about 12.9 to 12.8 Ma and at 11.7 Ma; rocks of the two ages are indistinguishable and are not portrayed separately on the map. The domes are unaltered and postdate hydrothermal activity related to the Red Wash-East Walker River alteration zone; they are, in turn, unconformably overlain by the sedimentary rocks of Fletcher Valley.

Rancheria Center

The 11.7 Ma Rancheria center consists of a series of basaltic trachyandesite lava flows discontinuously exposed beneath the west side of the Mount Biedeman stratovolcano in the southwest corner of the Bodie Hills. The olivine-rich Rancheria flows generally have the most mafic compositions of any unit in the Bodie Hills volcanic field.

West Brawley Peak Center

The 11.6 to 11.3 Ma West Brawley Peak center is a conspicuous composite cone on the southwest margin of the Aurora center. A plug of vertically flow-banded trachyandesite, probably a feeder to lava flows, forms West Brawley Peak. This plug is surrounded on its south, west, and north sides by thick sequences of outward-dipping lava flows. The east side of the volcano is a buttress unconformity against resistant ledges of quartz-alunite altered andesite from the Aurora center that form East Brawley Peak.

Trachyandesite of Clark Canyon

The trachyandesite of Clark Canyon forms a northeast-aligned array of small plugs that intrude debris-flow deposits of the Masonic center in Aurora Canyon. The pronounced alignment of these 11.3 Ma intrusions suggest emplacement along a northeast-trending structure.

Bridgeport Canyon Center

The 11.1 Ma Bridgeport Canyon center is composed of trachydacite domes and associated lava flows in the southwest corner of the Bodie Hills. These coarsely porphyritic rocks are notable for their high-K contents and are petrographically and geochemically similar to, but slightly older than, the 10.5 Ma Table Mountain Latite, which emanated from vents in the Little Walker caldera and in the Sonora Pass area 30 to 50 km to the northwest (Putirka and Busby, 2007; Busby and others, 2013).

Del Monte Center

The 11.0 Ma Del Monte center consists of four areas of trachyandesite lava and debris-flow deposits on the northeast and east sides of the Bodie Hills volcanic field. Lavas in all four areas are geochemically and petrographically similar. Lava flows in the northern three areas have indistinguishable $^{40}Ar/^{39}Ar$ ages (table 2); rocks in the southernmost area are undated but are in a similar stratigraphic position.

Aurora Canyon Center

The 10.5 to 10.3 Ma Aurora Canyon center forms a discontinuous series of trachyandesite and trachydacite lava domes emplaced into the southern part of the Masonic center. The largest exposures form a prominent, northeast-elongated series of coalescing domes suggesting emplacement along a northeast-trending structure.

Mount Biedeman Center

The 9.9 to 8.9 Ma Mount Biedeman center is an eroded trachyandesite stratovolcano that forms the second largest volcanic edifice in the Bodie Hills volcanic field. It consists of a central intrusion at Mount Biedeman surrounded by outward dipping lava flows and more distal debris-flow deposits and volcaniclastic sedimentary rocks. The intrusion under Mount Biedeman likely defines a lava-flow vent. The volcano is about 10 to 14 km in diameter with debris flow deposits extending 3 to 15 km farther away from Mount Biedeman. The generally hornblende- and pyroxene-rich Mount Biedeman rocks are presently exposed over approximately 100 km^2.

High-Silica Rhyolite Centers

High-silica rhyolite centers composed of exogenous domes, lava flows, and minor pyroclastic rocks are common in the center of the Bodie Hills volcanic field and include the Rock Springs Canyon (undated but >10.5 Ma), Aurora Creek, Del Monte Canyon, East Brawley Peak (all about 11.2 Ma), Bodie Creek (10.2), and Bald Peak (9.7 Ma) units. The rhyolite of Rock Springs Canyon contains several large volumes of black obsidian that were used by Native Americans for tool manufacture. The rhyolite of Aurora Creek hosts some of the gold-silver veins in the northern part of the Aurora mining district (fig. 5). The rhyolite of Bald Peak forms a prominent lava dome centered on Bald Peak that is largely covered by lava flows from the Pliocene Beauty Peak shield volcano. The Bald Peak dome is flanked on its southwest, west, and north sides by sedimentary rocks and tuff of Paramount, a sequence of rhyolite tuffs and volcaniclastic deposits that likely erupted from the Bald Peak dome and filled the shallow, northeast-elongated Paramount basin to the southwest.

Rhyolite of the Bodie Hills

The 9.9 to 9.6 Ma rhyolite of the Bodie Hills is a more widely distributed rhyolite unit that forms both a semicircular ring of outcrops around the north, east, and south flanks of the Mount Biedeman stratovolcano and a discontinuous series of lava domes that extend about 25 km north from the west side of Mount Biedeman to the north side of Masonic Mountain. Several exposures on the flanks of Mount Biedeman consist of quartz-rich rhyolite containing abundant hornblende-rich andesite blobs. Mingled magmas and overlapping $^{40}Ar/^{39}Ar$ ages suggest the presence of two discrete magmas beneath Mount Biedeman that locally mixed during emplacement of the rhyolite of the Bodie Hills at about 9.8 to 9.6 Ma.

Silver Hill, Potato Peak, and Willow Springs Centers

Magmatic activity in the Bodie Hills volcanic field culminated between about 9.1 to 8.0 Ma with emplacement of three large silicic trachyandesite to dacite lava dome complexes: Silver Hill (9.1 to 8.9 Ma), Potato Peak (9.0 to 8.8 Ma), and Willow Springs (8.6 to 8.0 Ma). Each complex is composed of numerous domes, lava flows, and related pyroclastic rocks and debris flows that together form the core and highest parts of the Bodie Hills; these rocks occupy an area of about 200 km^2. Each of the dome complexes forms a discrete elliptical body with little overlap; lava flows of the Potato Peak center locally lap over rocks of the Silver Hill center, and lava flows of the Willow Springs center locally abut and ramp over Potato Peak lava and debris flows. Rocks from each of the complexes have distinct petrographic and geochemical characteristics suggesting their derivation from discrete magma reservoirs; the focus of magmatism migrated 20–25 km westward as the complexes were successively emplaced.

Big Alkali Center

Miocene magmatic activity resumed following an approximately 2 m.y. hiatus with emplacement of the small silicic trachydacite to rhyolite domes of the Big Alkali center. Most outcrops form a narrow north-trending alignment of domes approximately 20 km long and centered on Big Alkali; an isolated dome crops out 6 km farther north on the north side of Masonic Mountain.

Pliocene to Late Pleistocene Magmatism of the Aurora Volcanic Field

The eastern and southeastern parts of the Bodie Hills volcanic field and Miocene sedimentary rocks on the southern edge of Fletcher Valley are unconformably overlain by Pliocene to late Pleistocene (approximately 3.9 to 0.1 Ma) rocks of the Aurora volcanic field (Fig. 3*B*; tables 1 and 2; Gilbert and others, 1968; Al-Rawi, 1969; Chesterman and Gray, 1975; Kleinhampl and others, 1975; Lange and others, 1993; Lange and Carmichael, 1996; Kingdon and others, 2013). The Aurora volcanic field covers approximately 325 km^2 and contains many well-preserved volcanic features, including Aurora Crater, Beauty Peak, and the trachyandesite of Mud Spring lava flow. These postsubduction rocks erupted in an extensional tectonic setting and are composed of high-K and shoshonitic lavas with a continuum of compositions from trachybasalt through trachydacite and high-silica rhyolite (about 48 to 76 weight percent SiO_2). However, unlike the

Miocene Bodie Hills volcanic field rocks, the Aurora rocks have broadly bimodal compositions, and rocks with SiO_2 contents between 66 and 75 weight percent are conspicuously absent (fig. 4).

The Aurora volcanic field consists primarily of monogenetic lava and cinder cones (for example, Aurora Crater), valley-filling lava flows (for example, the trachyandesite of Mud Spring), shield volcanoes such as Mount Hicks and Beauty Peak, and trachydacitic (Cedar Hill and Aurora Peak) to rhyolitic (Spring Peak) domes. Several lava flows or series of lava flows (for example, Qmsa, Qta2, and Qa) filled paleocanyons that had (prior to eruption of these lavas) allowed northward spillage of Lake Russell (Pleistocene Mono Lake) into the Lahonton drainage basin (Reheis and others, 2002).

The 3.9 Ma Locomotive Point center, the oldest unit in the Aurora volcanic field, consists of small vent-filling plug and basaltic andesite lava flows that extend west and southwest from the vent. This small eruptive center forms a prominent topographic high at Locomotive Point about 5 km south of Masonic Mountain and about 10 km west of other exposures of Pliocene-Pleistocene volcanic rocks in the Bodie Hills. The plug lies along the trend of Big Alkali domes suggesting that the associated magma ascended along the same north-trending structure as that responsible for the domes.

Miocene Sedimentary Rocks and Deposits

Miocene volcanic rocks in the Bodie Hills are locally interbedded with and overlain by poorly consolidated late Miocene and Pliocene(?) fluvial, alluvial-fan, and lacustrine deposits consisting of fanglomerate, conglomerate, sandstone, and siltstone. These sedimentary deposits form extensive pediment surfaces along the margins of the Bodie Hills and extend under Quaternary surficial deposits into Bridgeport Valley to the west and Fletcher Valley to the northeast. Sedimentary rocks along the northern and eastern edges of the Bodie Hills are mostly coarse- to fine-grained fluvial and lacustrine deposits (Tswr and Tfv), whereas deposits on the east side of Bridgeport Reservoir and in the upper parts of Masonic Gulch, Red Wash, and Rough Creek, are coarse gravels and fanglomerates (Tog and Tyg).

The oldest sediments are unconsolidated gravel deposits (unit Tog) that contain exotically derived granite clasts and locally underlie the distally sourced 9.4 Ma Eureka Valley Tuff and 11 Ma trachyandesite of Del Monte lava flows. The gravels and the Eureka Valley Tuff fill paleochannels carved into the trachyandesite of Masonic and other earlier erupted products of the Bodie Hills volcanic field. On the northeast side of the Bodie Hills, these older gravel deposits transition into finer-grained fluvial and lacustrine sedimentary rocks of Fletcher Valley (Tfv) that constitute the southern part of the Coal Valley Formation. The Coal Valley Formation was deposited in a late Miocene extensional basin that extends approximately 50 km north of the Bodie Hills (Gilbert and Reynolds, 1973).

Younger sedimentary units, consisting both of coarse gravels and conglomerates (Tyg) and finer-grained, locally conglomeratic, alluvial fan, fluvial and lacustrine sediments (Tswr) overlie the Eureka Valley Tuff and form extensive terraces above the East Walker River and Bridgeport Reservoir and along Masonic Gulch.

Surficial Deposits

Pleistocene to Holocene surficial deposits, including fluvial, colluvial, glacial, and lacustrine deposits, locally blanket all older rocks. Prominent older gravel banks containing well-rounded cobbles of metamorphic and granitic rocks are present in Bridgeport Canyon and Clearwater Creek. The south end of the Bodie Hills is cut by numerous wave-cut terraces and is locally lapped by beach gravels related to Lake Russell, the Pleistocene predecessor to Mono Lake (Reheis and others, 2002). Several large landslides are present in the Bodie Hills, notably on both sides of Bodie Creek between Beauty Peak and West Brawley Peak, in Rough Creek northwest of Beauty Peak, east of Rancheria Gulch, and north of Mount Hicks.

Structural Geology of the Bodie Hills

Many primary volcanic features in the Bodie Hills are well preserved and the rocks generally are only gently tilted. However, the structural geology of the Bodie Hills is locally complex and multiple generations and types of faults transect rocks in the Bodie Hills volcanic field. In addition, there has been significant vertical axis rotation of the Bodie Hills in the late Cenozoic (Carlson and others, 2013). Mineralized structures in the Masonic, Aurora, and Bodie mining districts, which represent time slices at approximately 13, 10.5 and 8.9 Ma, respectively, provide evidence of the Miocene strain field (John and others, 2012; Carlson and others, 2013). Carlson and others (2013) present a kinematic model for the middle Miocene to Holocene for the Bodie Hills, which includes a change in principal stress orientation and vertical axis rotation that is consistent with their paleomagnetic data for the 9.4 Ma Eureka Valley Tuff and with the kinematic fault data of John and others (2012).

Faults

Relatively few faults have been identified in the Bodie Hills (sheet 1). Most mapped faults have demonstrable stratigraphic offset. Others are the interpreted structural controls of linear zones of hydrothermally altered rock. Many features previously mapped as faults, especially those of Chesterman and Gray (1975) in the Potato Peak area, are reinterpreted as depositional contacts between lava flows or their lobes. Many linear features on air photos are not faults, because demonstrable offset of map units is absent. Units that contain bedded sedimentary rocks, such as the sedimentary rocks and tuff of Paramount and the sedimentary rocks of Fletcher Valley, commonly have erratic bedding orientations suggesting the presence of unrecognized faults that might extend into other rock units. However, these inferred faults do not appear to have large displacements or to significantly offset contacts between major units.

Mapped faults (sheet 1) have three dominant orientations—northeast to east-northeast, north to north-northeast, and northwest to west-northwest. Kinematic data on small mineralized faults in the Masonic and Aurora mining districts (John and others, 2012) that parallel these structures suggest that the oldest faults form a conjugate set of north-striking right-lateral and northeast-striking left-lateral oblique-slip faults, which affected older units, including rocks in the Masonic (15 to 14 Ma), Aurora (13.1 to 12.6 Ma), and Aurora Creek (11.2 Ma) centers and the approximately 9.7 Ma sedimentary rocks and tuff of Paramount. These faults likely guided emplacement of the 11.3 Ma trachyandesite of Clark Canyon intrusions and the 10.5 to 10.3 Ma trachyandesite of Aurora Canyon lava domes, and channelized hydrothermal fluids forming approximately 10.2 Ma epithermal veins in the Aurora mining district. They likely were active from about 13.4 to ≤9.7 Ma (John and others, 2012).

Younger north- to north-northeast-striking normal faults offset both the 9.4 Ma Eureka Valley Tuff and 9.1 to 8.9 Ma rocks of the Silver Hill center. These faults localized formation of approximately 8.9 to 8.1 Ma epithermal veins in the Bodie mining district (John and others, 2012). On the east side of Bridgeport Reservoir, one of these faults is covered by fanglomerate deposits (Tyg) and might extend farther south.

Northwest- to west-northwest-striking faults are mostly limited to the west part of the Bodie Hills and cut rocks of the 8.6 to 8.0 Ma Willow Springs center. The sense of displacement on these faults is uncertain.

The youngest faults in the Bodie Hills are north-striking normal and northeast-striking left-lateral oblique-slip faults that offset rocks of the Aurora volcanic field and late Pleistocene eolian deposits and lake beds (Gilbert and others, 1968; Dohrenwend, 1981; S.E. Box, unpub. data, 2012); some of these faults remain active (Wesnousky, 2005; Jennings and others, 2010). The north-striking faults formed a series of stepover grabens in a system of northeast-striking left-lateral faults at the northwest edge of the Mina deflection (fig. 1; John and others, 2012). On the west side of the Bodie Hills, a north-striking fault also may have controlled emplacement of the Big Alkali domes between about 6.2 and 5.5 Ma and localized the vent for the 3.9 Ma Locomotive Point lava flows.

Veins and Mineralized Faults

The orientation of the regional strain field during Miocene volcanism in the Bodie Hills can be estimated from orientations of mineralized structures. Because mineralization is well dated for the Masonic (approximately 13.4 to 12.9 Ma), Aurora (approximately 10.3 Ma), and Bodie (approximately 8.9 to 8.1 Ma) mining districts, mineralized structures in these districts record the temporal variation of the principal stress orientations (John and others, 2012).

In the Masonic mining district, faults and fractures dominantly have either N-S or N60°E trends. The N-S fractures have right-lateral offset and NE fractures have left-lateral offset, and they are interpreted as a conjugate strike-slip fault set consistent with N60°W extension and N30°E compression (John and others, 2012). Veins in the Aurora mining district constitute a conjugate fracture pair, consisting of a right-lateral north-striking set and a left-lateral N60°E set, also consistent with N60°W extension and N30°E compression (John and others, 2012). Some quartz veins in the Bodie mining district consist of mm- to cm- layers of quartz with inward-facing crystals. Symmetrically layered veins represent repeated tensional dilation of the host fractures (John and others, 2012). Other veins are fault breccias replaced by quartz and sulfide minerals. Veins at Bodie strike about N10°E to N50°E with an average of N28°E in fractures dominated by normal (extensional) faulting. These data indicate that the directions of maximum extension in all three mining districts are subparallel to each other; however, the intermediate and maximum principal stresses are reversed, which indicates that regional deformation changed from a regime of strike-slip (transtension) to one of normal (extensional) faulting between about 10 to 9 Ma.

Paleomagnetic Studies and Vertical Axis Rotation of the Bodie Hills

Paleomagnetic studies of the 9.4 Ma Eureka Valley Tuff indicate that pre-9-Ma rocks in the Bodie Hills have been rotated 10–30° clockwise (Carlson and others, 2013, C.J. Pluhar, oral commun., 2013). The northern part of the Bodie Hills, including the Masonic mining district, was rotated about 10° clockwise, whereas other parts of the Bodie Hills were rotated about 30° clockwise. Consequently, estimates of original fault and principal stresses orientations in the Bodie Hills must be corrected for this clockwise rotation. Early faults in the Masonic and Aurora mining districts restore to right-lateral north-northwest-striking and left-lateral northeast-striking, whereas faults in the Bodie mining district restore to north-striking and are dip-slip.

Tilting

In general, Cenozoic rocks in the Bodie Hills are only slightly tilted. Miocene sedimentary rocks on the margins of the Bodie Hills generally dip ≤30°. These rocks are not systematically tilted, although beds in the sedimentary rocks of Fletcher Valley most commonly dip away from the Bodie Hills into Fletcher Valley and consolidated beds on the east side of Bridgeport Valley (Tswr) typically dip into the Bridgeport Valley. Volcaniclastic sedimentary rocks interbedded in debris flows in the Masonic and Mount Biedeman centers also dip ≤30°, usually away from the inferred volcanic center; consequently, some of this inclination may reflect primary dip. Pliocene and younger rocks of the Aurora volcanic field are nearly flat lying. For example, the top of 3.9 Ma lava flows of the basaltic trachyandesite of Locomotive Point dip 3–4° west to southwest and the top surface of the 1.3 Ma trachyandesite flow 2 (Qta2) dips <1° west. In contrast, compaction foliation in densely welded Eureka Valley Tuff is highly irregular, and although the base of the tuff is generally conformable with underlying, shallowly dipping Miocene units, compaction foliation within these isolated exposures is commonly steep (as much as 90°). The irregular, steep foliation in the tuff may be the result of (1) primary dip due to banking and welding against steep topography, (2) structural or magmatic doming of the Bodie Hills, and (or) (3) tilting due to unrecognized faults (John and others, 2012).

Volcanic Landforms

Bodie Hills volcanic field eruptive centers are dominated by subcircular composite volcanoes and large dome fields that directly overlie deeply rooted intrusions, inferred from geophysical data (John and others, 2012). In aggregate, the 9.1 to 8.0 Ma trachyandesite to dacite dome complexes are elongate in an east-west direction, and the complexes decrease in age progressively to the west. In contrast, late rhyolite of the Big Alkali domes are localized in a narrow north-trending array mostly within the 8.6 to 8.0 Ma trachyandesite of Willow Springs dome field along the west flank of the Bodie Hills.

Dikes, fissure-fed eruptions, monogenetic volcanoes, and elongate grabens or rectilinear volcanotectonic depressions are uncommon to absent in the Miocene Bodie Hills volcanic field, with the notable exception of the northeast-elongate Paramount basin. The paucity of these features and the previously described faulting orientations are consistent with minimal variation in differential horizontal stress during formation of the Bodie Hills volcanic field (for example, Nakamura, 1977; Hildreth, 1981; Takada, 1994; Tosdal and Richards, 2001). In contrast, the Pliocene-Pleistocene (3.9–0.1 Ma) Aurora volcanic field in the Bodie Hills is characterized by north-northeast-elongated monogenetic volcanoes that are locally offset by north-northeast-elongate stepover grabens linked to east-northeast-striking left-lateral faults along the north Mono Basin escarpment. This fault pattern suggests somewhat greater variation in differential horizontal stress during formation of the Aurora volcanic field than during earlier times.

Magmatic Doming(?) of the Central Bodie Hills

In the central part of the Bodie Hills, the present-day elevation of the base of the Eureka Valley Tuff progressively increases from about 6,500 ft (1,980 m) at Bridgeport Reservoir to 9,190 ft (2,800 m) on the north side of Potato Peak and then decreases eastward to <8,200 ft (<2,500 m) in Rough and Bodie Creeks. Because the tuff flowed down paleodrainages from the Little Walker caldera about 25 km to the northwest to a basin in Fletcher Valley and to Mono Basin, this asymmetric domal pattern centered on Potato Peak suggests significant deformation of the tuff following its deposition. Similarly, the distribution of sinter terraces in the Paramount basin on the east side of Potato Peak, which vary in elevation from about 9,020 ft (2,750 m) near Paramount to 7,050 ft (2,150 m) north of Bald Peak, and complex faulting inferred within the Paramount basin indicate significant deformation not explained fully by mapped faults (Vikre and others, in press). In addition, the approximately 500 m elevation difference between the nearly simultaneously formed Aurora Canyon and Potato Peak alteration zones (fig. 5) on the west side of Potato Peak at 10.8 to 10.7 Ma is not consistent with mapped faults (Vikre and others, in press). These observations suggest structural doming of the Bodie Hills following eruption of the 9.4 Ma Eureka Valley Tuff, possibly due to emplacement of a shallow magma reservoir that sourced the trachydacite of Potato Peak dome complex at about 9 Ma. Gravity and aeromagnetic data suggest that relatively silicic but strongly magnetic pluton(s) may underlie this complex in the center of the Bodie Hills (John and others, 2012). Alternatively, this pattern might indicate rollover in the upper plate of the arcuate set of normal faults dipping beneath the northwest side of the Bodie Hills or other unrecognized faults.

Model for Evolution of the Late Cenozoic Stress Field in the Bodie Hills

As described above, rocks of the Bodie Hills volcanic field record a progressive change in the orientation of the regional stress field since middle Miocene time. Prior to about 10 Ma, low differential horizontal stresses with northerly compression and westerly extension (corrected for tectonic rotations) resulted in subcircular, polygenetic volcanoes with episodes of associated hydrothermal mineralization controlled by conjugate sets of strike-slip faults. After about 10–9 Ma, the maximum compressive stress axis became vertical, and extension-related veins accompanied a progressive westerly migration of dacitic to trachyandesitic magmatism. The stress-field change is approximately coincident with arrival of the Mendocino triple junction and cessation of subduction beneath the Bodie Hills (Atwater and Stock, 1998). Eruption of the rhyolite of Big Alkali in the western part of the Bodie Hills at approximately 6 Ma, following a 2 m.y. hiatus, may indicate magma localization along normal faults reflective of more westerly-directed extension. Pliocene-Pleistocene magmatism was even more strongly localized by north-striking extensional faults, which formed stepover grabens in a system of northeast-striking left-lateral faults related to the Mina deflection.

Mineral Deposits and Alteration Zones in the Bodie Hills

The Bodie Hills volcanic field contains several significant epithermal mineral deposits, and large areas of hydrothermally altered rock are intimately associated with development of the field (fig. 5; John and others, 2012; Vikre and others, in press). The most important occurrences are gold-silver deposits in the Bodie and Aurora mining districts and a sulfur resource in Cinnabar Canyon. In contrast, rocks in the Aurora volcanic field are unaltered and do not contain known mineral deposits.

In the Bodie Hills, the largest reported production is from vein deposits in the Aurora and Bodie mining districts. In the Bodie mining district, reported production is 1.46 million troy ounces (Moz) gold and 7.3 Moz silver that were recovered from approximately 1.5 Mt of ore (Long and others, 1998). Veins at Bodie formed at approximately 8.9 to 8.1 Ma (table 2) and are hosted by flows, domes, and volcaniclastic deposits of the approximately 9 Ma dacite of Silver Hill dome complex. Reported production from veins in the Aurora mining district is 1.91 Moz gold and 20.6 Moz silver that were recovered from approximately 3.9 Mt of ore (Long and others, 1998). Veins in the Aurora mining district formed at approximately 10.5 to 10.1 Ma (Vikre and others, in press). Most veins are hosted in the 13.1 to 12.6 Ma lava flows and breccias of the trachyandesite of Aurora, although a few veins occur in the 11.2 Ma rhyolite of Aurora Creek. Veins in both districts strike north to northeast, dip east and west at high to moderate angles, and extend for tens to hundreds of meters. Veins are tabular and mostly < 1 m thick. The most productive veins consist of tens to hundreds of symmetrical layers of quartz, lesser adularia, sericite and calcite, and small amounts of metallic minerals. Sections of veins that were mined contain up to several percent silver sulfide minerals, electrum, and other sulfide minerals in some quartz layers. Ore was largely mined within several hundred meters of the surface. Significant amounts of tetrahedrite, chalcopyrite, galena, sphalerite, and other sulfide and sulfosalt minerals are present in some veins in the Bodie mining district but relatively little ore was recovered from them (Vikre and others, in press).

Reported production from tabular fault breccias and replacement deposits at Masonic is 0.06 Moz gold and 0.04 Moz silver that were recovered from 0.08 Mt of ore (Long and others, 1998). Ore was produced from 1–2 m-wide breccia zones and centimeter-wide veins in a series of en echelon north- and northeast-striking curvilinear faults cutting Mesozoic granitic rocks, metamorphic rocks, and trachyandesite flows and volcaniclastic rocks of the Masonic eruptive center. Ore also was mined from stratiform zones in volcaniclastic strata. Fault breccia matrices, veins, and stratiform deposits consist of quartz, alunite, kaolinite-dickite, enargite, electrum, numerous Cu-As-Sb-Ag-Bi-Te-Se-S minerals, and barite (Vikre and Henry, 2011; Vikre and others, in press).

The unexposed sulfur resource in Cinnabar Canyon (Cinnabar Canyon sulfur deposit, approximately 2.9 million tons sulfur; Ward, 1992) is hosted by a sequence of volcaniclastic rocks and trachyandesite lavas correlated with the approximately 10 to 9 Ma Mount Biedeman stratovolcano. The resource occurs within an approximately 30 km^2 area of lavas and permeable volcaniclastic strata that were pervasively leached and replaced at approximately 8.7 Ma by quartz-alunite-kaolinite-pyrite-sulfur assemblages (Vikre and Henry, 2011; Vikre and others, in press).

Other large (approximately 25–30 km^2) alteration zones extend from the north side of Bald Peak to the Paramount Hg Mine (Paramount-Bald Peak alteration zone, fig. 5), and from the East Walker River to Fletcher Valley (Red Wash-East Walker River alteration zone, fig. 5). The stratiform Paramount-Bald Peak alteration zone is mostly hosted in approximately 9.7 Ma volcaniclastic deposits (sedimentary rocks and tuff of Paramount) deposited in the northeast-elongate Paramount basin. This alteration zone includes sinter at the Paramount Hg mine, sinter and silicified, clay-altered sandstone and conglomerate south and north of the Paramount mine, and sinter and silicified or clay-altered tuff and tuff breccia with chalcedonic silica veins between Atastra Creek and Bald Peak (Vikre and others, in press). The stratiform and largely stratabound, east-west-oriented Red Wash-East Walker River alteration zone formed in coarse volcaniclastic strata associated with the approximately 15 to 14 Ma Masonic stratovolcano. The permeable volcaniclastic rocks were pervasively replaced by quartz, alunite, kaolinite, pyrite, and other clay minerals at about 13.4 Ma, but contain no identified mineral resources. Smaller quartz-alunite-dominant alteration zones are present on the northwest side of Potato Peak (Potato Peak alteration zone, fig. 5), in Aurora Canyon (Aurora Canyon alteration zone, fig. 5), on East Brawley Peak (East Brawley Peak alteration zone, fig. 5), and 1 km west of Aurora (Sawtooth Ridge alteration zone, fig. 5). A small area of silicified hydrothermal eruption breccia (Four Corners alteration zone, fig. 5) is in distal volcaniclastic deposits associated with the Masonic center. Sinter (unit QTsn) overlying Mesozoic rocks (Spring Peak sinter, fig. 5) contains small Hg prospects.

Additional Descriptive Notes

Volcanic and plutonic rock unit names used in the following Description of Map Units are in accord with the IUGS nomenclature system (LeMaitre, 2002; Streckeisen, 1976). The compositional aspect of each rock unit name is its average composition computed from data presented by du Bray and others (2013) but compositions of all analyzed samples of each unit are also listed. Volcanic-rock phenocryst abundances (table 3, available for download online at http://dx.doi.org/10.3133/sim3318) and grain sizes are based on petrographic microscope observations. Volcanic rock unit ages (table 2) are based mostly on $^{40}Ar/^{39}Ar$ dates (John and others, 2012; Fleck and others, in press). Compositions of Mesozoic plutons are based on modal analyses of stained slabs (table 4) and are plotted on a ternary quartz-alkali feldspar-plagioclase diagram (fig. 6). K-Ar ages of granitoid rocks are calculated using the decay constants of Steiger and Jäger (1977).

Nearly all Bodie Hills volcanic rocks are porphyritic. Most phenocrysts are fine grained (<1 mm) to medium grained (1–5 mm); however, the trachyandesite of Willow Springs, trachydacite of Cinnabar Canyon, trachyandesite of Mud Spring Canyon, trachydacite of Bridgeport Canyon, trachyandesite of West Brawley Peak, and andesite of Lakeview Spring contain distinctive, coarse (≥5 mm) plagioclase phenocrysts. Average phenocryst sizes (by mineral) as well as the average size of the largest phenocryst (by mineral) in all samples of a particular unit are enumerated in table 1. Extent of porphyritic texture development is quantified as aphyric (rare to no phenocrysts), sparsely (<10 percent phenocrysts), moderately (10 to 24 percent phenocrysts), strongly (≥25 percent phenocrysts). Euhedral, albite-twinned plagioclase laths are a nearly ubiquitous component of Bodie Hills volcanic rocks. Almost all plagioclase phenocrysts are oscillatory zoned and some, especially in intermediate-composition lava flows, are variably sieve textured. Many units contain multiple plagioclase populations defined by size and (or) distinctive reaction rims, zones that contain mineral and (or) glass inclusions, and resorption textures. Brown to green pleochroic hornblende forms euhedral to subhedral acicular crystals that have distinctive, variably developed, black opacite reaction rims (Rutherford and Hill, 1993); in weathered or altered samples hornblende is completely replaced by variable assemblages that include alunite, quartz, mica, clay minerals, pyrite, and black amorphous material. Clinopyroxene, common in many Bodie Hills volcanic field rocks, forms pale tan to pale green subhedral to euhedral crystals. Less-common orthopyroxene is colorless to rosy tan and forms euhedral to subhedral crystals. Biotite is subhedral, tan to deep reddish-brown, and like hornblende, is completely altered in many samples. Relatively uncommon olivine forms variably altered subhedral phenocrysts in some mafic- to intermediate-composition Bodie Hills volcanic field rocks. Small amounts of magnetite and less abundant ilmenite are ubiquitous. Quartz is absent in all but the most silicic units; where present, it forms variably resorbed and embayed, rounded, anhedral to subhedral phenocrysts. Sanidine is less common than quartz but forms variably and weakly perthitic Carlsbad-twinned, euhedral to subhedral phenocrysts in several of the rhyolite to silicic trachydacite units.

The groundmass of most Bodie Hills volcanic field rocks contains variable microphenocryst (typically 0.05 to 0.2 mm long) assemblages dominated by plagioclase, but also includes combinations of Fe-Ti oxide minerals, clinopyroxene and, less commonly, hornblende and (or) biotite. Metastable volcanic glass is another major groundmass component. As discussed in the unit descriptions below, groundmass is variably devitrified (crystallized) and the extent of devitrification characteristic of each unit is qualitatively identified, as follows: (1) undevitrified fresh glass is isotropic and contains essentially no microlites; (2) weakly, devitrified glass includes scarce microlites; (3) strongly devitrified glass is almost completely crystallized; (4) moderately devitrified glass has crystallized to an extent intermediate to that of either weakly or strongly crystallized groundmass glass.

Exotic lithic fragments or inclusions are rare but glomerocrysts as much as several millimeters in diameter are present in many samples.

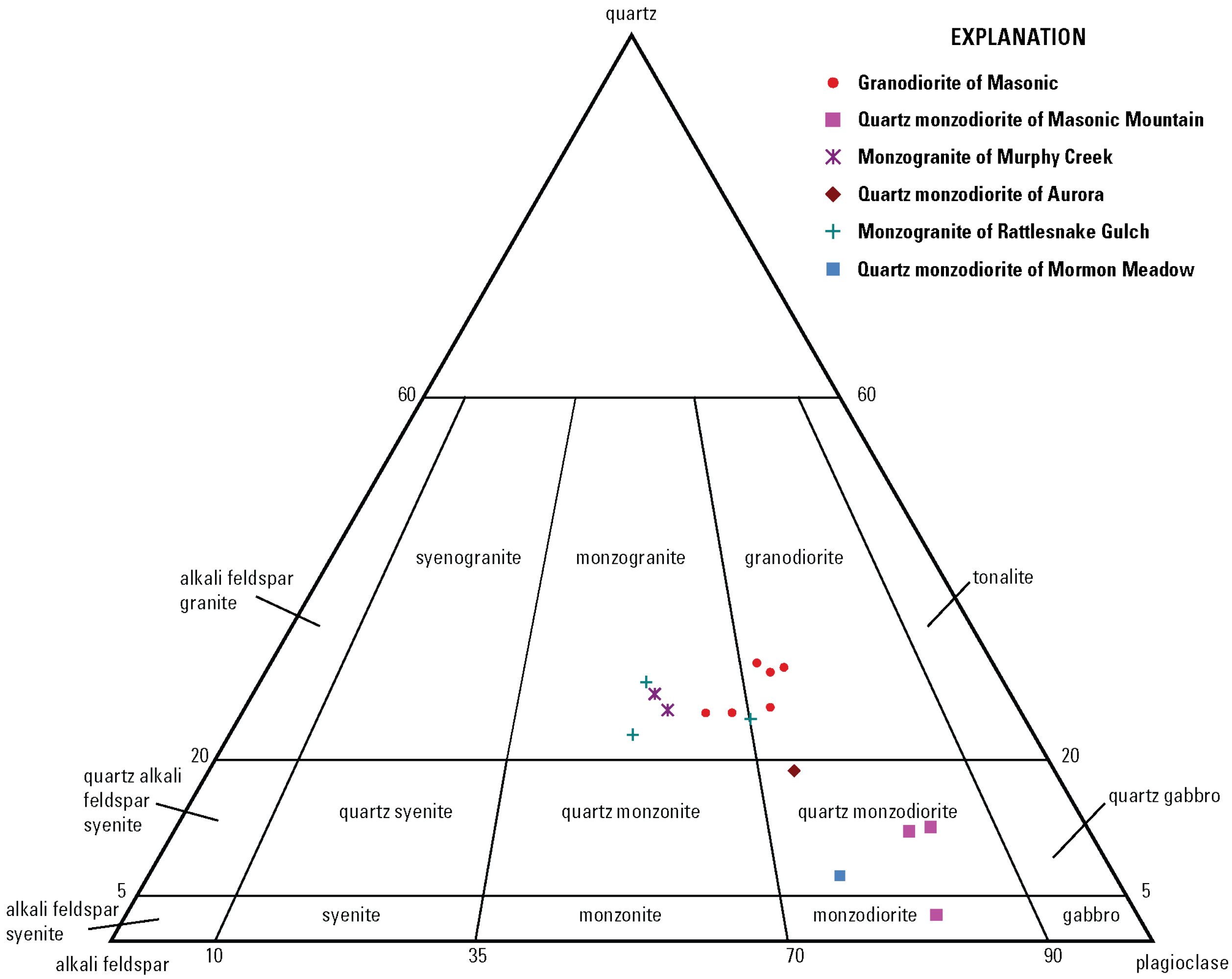

Figure 6. Modes of Mesozoic granitoid rocks in the Bodie Hills plotted on a quartz-alkali feldspar-plagioclase diagram (Streckeisen, 1976). Data listed in table 4.

Table 4. Modal data for Mesozoic granitoid rocks in the Bodie Hills, California and Nevada.

[Qtz, quartz; Alk fspr, alkali feldspar; Plag, plagioclase; mafics, sum of hornblende plus biotite plus opaque Fe-Ti oxides; Q, quartz; K, alkali feldspar; P, plagioclase]

		Points counted					Relative abundances, percent				Ternary proportions, percent		
Sample	Unit	Qtz	Alk fspr	Plag	Mafics	Total	Qtz	Alk fspr	Plag	Mafics	Q	K	P
203224	Granodiorite of Masonic	367	246	601	46	1,260	29.1	19.5	47.7	3.7	30.2	20.3	49.5
203239	Granodiorite of Masonic	319	294	623	39	1,275	25	23.1	48.9	3.1	25.8	23.8	50.4
203242	Granodiorite of Masonic	323	238	528	38	1,127	28.7	21.1	46.9	3.4	29.7	21.9	48.5
203319	Granodiorite of Masonic	274	330	485	46	1,135	24.1	29.1	42.7	4.1	25.2	30.3	44.5
203322	Granodiorite of Masonic	362	267	551	39	1,219	29.7	21.9	45.2	3.2	30.7	22.6	46.7
203377	Granodiorite of Masonic	261	287	486	37	1,071	24.4	26.8	45.4	3.5	25.2	27.8	47
203293	Quartz monzodiorite of Masonic Mountain	30	200	807	124	1,161	2.6	17.2	69.5	10.7	2.9	19.3	77.8
203363	Quartz monzodiorite of Masonic Mountain	133	190	775	90	1,188	11.2	16	65.2	7.6	12.1	17.3	70.6
203364	Quartz monzodiorite of Masonic Mountain	134	160	771	64	1,129	11.9	14.2	68.3	5.7	12.6	15	72.4
203350	Monzogranite of Murphy Creek	322	403	455	17	1,197	26.9	33.7	38	1.4	27.3	34.2	38.6
203351	Monzogranite of Murphy Creek	322	427	514	17	1,280	25.2	33.4	40.2	1.3	25.5	33.8	40.7
203383	Quartz monzodiorite of Aurora	209	278	626	40	1,153	18.1	24.1	54.3	3.5	18.8	25	56.2
203384	Monzogranite of Rattlesnake Gulch	236	398	400	50	1,084	21.8	36.7	36.9	4.6	22.8	38.5	38.7
203385	Monzogranite of Rattlesnake Gulch	330	395	428	41	1,194	27.6	33.1	35.8	3.4	28.6	34.3	37.1
203387	Monzogranite of Rattlesnake Gulch	258	277	517	45	1,097	23.5	25.3	47.1	4.1	24.5	26.3	49.1
12-BA-29	Quartz monzodiorite of Mormon Meadow	60	229	552	308	1,149	5.2	19.9	48	26.8	7.1	27.2	65.6

DESCRIPTION OF MAP UNITS

[Absolute age determinations of volcanic rock units listed in table 2]

SURFICIAL DEPOSITS

md **Tailings and mine dumps (Holocene)**—Tailings consist of fine-grained sediment (produced during ore processing) slurried into holding ponds near mills associated with mining operations. Mine dumps are unsorted piles of subeconomic and unmineralized waste rock produced during mining of mineral deposits

Qtt **Travertine hot springs deposits (Holocene and Pleistocene)**—Very-pale-orange to yellow deposits of calcium carbonate and other minerals precipitated from geothermal water associated with hot springs activity. Deposits are limited to two small areas southeast of Bridgeport near active hot springs

Qtf **Tufa deposits (Holocene and Pleistocene)**—Several 3–5-m tall spires about 2 km southeast and 4 to 9 km northeast of the mouth of Bridgeport Canyon on the north side of Mono Lake are composed of highly porous, yellowish-gray thinolitic tufa. The tufa deposits are composed of calcium carbonate minerals precipitated where freshwater springs discharged beneath Mono Lake and interacted with its alkaline water (Shearman and others, 1989)

Qal **Alluvium (Holocene and Pleistocene)**—Silt, sand, and gravel deposits that occur principally in drainage bottoms. Includes slope wash deposits and minor talus at valley margins

Qes **Eolian sand deposits (Holocene and Pleistocene)**—Well-sorted, medium to fine sand and silt. Derived from lacustrine deposits of Mono Lake and Pleistocene Lake Russell and reworked pyroclastic fall deposits associated with the Mono-Inyo Craters volcanic chain (Bailey, 1989). Form partly stabilized dunes on the north side of Mono Lake (Dohrenwend, 1981), and wind-deposited accumulations elsewhere, most notably in the central part of the Aurora volcanic field

Qf **Fan deposits (Holocene and Pleistocene)**—Massive, poorly sorted, unconsolidated deposits with silt- to boulder-size clasts in a silty to sandy matrix; form aprons at the break in slope where drainages emerge from steeper upland areas

Qls **Landslide deposits (Holocene and Pleistocene)**—Lobate accumulations of poorly sorted soil and rock debris forming hummocky slopes downslope from bedrock scarps. Contain unsorted, chaotic accumulations of intact bedrock blocks; dominant rock type within each landslide deposit is identified using rock-unit labels

Qpd **Pediment deposits (Holocene and Pleistocene)**—Fan-shaped deposits of poorly sorted sand and coarse gravel; thinly mantles relatively smooth pediment surfaces cut on underlying Miocene volcanic and sedimentary rocks on north and northeast sides of the Bodie Hills. Clast compositions reflect the wide array of rock types exposed upslope of each particular pediment

Qpl **Playa deposits (Holocene and Pleistocene)**—Light-colored, reworked silt, clay, and evaporate minerals deposited in lakes within broad, flat, restricted basins of the Aurora volcanic field

Qt **Talus (Holocene and Pleistocene)**—Unconsolidated, poorly sorted, angular rock fragments shed from cliffs and steep slopes; forms cones, aprons, and scree slopes

Ql **Lacustrine deposits (late Pleistocene)**—Shallow-water lacustrine deposits of late Pleistocene Lake Russell (Reheis and others, 2002); commonly includes fine-grained laminated beds, eolian sand, and beach-gravel deposits

Qgd **Glacial deposits (Pleistocene)**—Glacial deposits exposed in the southwest part of the map area. Deposits are part of the 820 ka (Moore and Moring, 2013) Sherwin Till (Chesterman and Gray, 1975), and lack distinct depositional form. The glacial deposits form soil-covered slopes that include rounded and weathered Mesozoic granitoid boulders and less weathered, angular clasts of fine-grained Paleozoic and Mesozoic metamorphic rock; clasts of Miocene volcanic rock are subordinate

Qog **Older gravel deposits (Pleistocene)**—Massive, poorly sorted, unconsolidated deposits with silt- to boulder-size clasts in a silty to sandy matrix; form aprons at the base of topographic highs and distinct gravel banks above younger alluvium and gravel deposits, and mantle some valley walls. Clasts, including petrified wood and hydrothermally altered rocks, reflect derivation from a variety of bedrock sources

ROCKS OF AURORA VOLCANIC FIELD

Qmsa **Trachyandesite of Mud Spring (Pleistocene)**—Medium-dark-gray, moderately porphyritic trachyandesite lava flow; vesicular in most places. Contains about 10 percent phenocrysts of hornblende, plagioclase, and clinopyroxene in a weakly devitrified groundmass; accessory opaque oxides form scarce, small crystals. Forms a distinctive, rubbly lava flow, with the geomorphology of a recently erupted, essentially unweathered flow, which overlies unconsolidated gravel deposits in the northeast part of the Aurora volcanic field, east of Mud Spring. Determined ages 0.04 ±0.04 Ma and 0.11±0.08 Ma

Qaca **Trachyandesite of Aurora Crater (Pleistocene)**—Dark-gray, sparsely porphyritic trachyandesite and minor andesite lava flows and cinder deposits; vesicular in most places. Contains about 3 percent phenocrysts of clinopyroxene and orthopyroxene and minor olivine in an intergranular intergrowth of weakly devitrified glass, plagioclase, clinopyroxene, and opaque oxides. Erupted from Aurora Crater, an elliptical 4.4 by 5.6 km composite cone in the north-central part of the Aurora volcanic field. Determined ages 0.26±0.05 Ma and 0.47±0.19 Ma

Qta2 **Trachyandesite 2 (Pleistocene)**—Pale brown, almost aphyric trachyandesite lava flow and plug; distinctly flow laminated in some places. Contains about 1 percent small phenocrysts of olivine in an aphanitic, intersertal intergrowth of plagioclase, clinopyroxene, and opaque oxides. The lava flow, in the northeast part of the Aurora volcanic field, south of Mud Spring Canyon, preserves primary, flow-morphology features. Determined age 1.32±0.08 Ma

Qta1 **Trachyandesite 1 (Pleistocene)**—Medium-light-gray, sparsely porphyritic trachyandesite and minor basaltic trachyandesite lava flows; vesicular in most places. Contains about 5 to 10 percent (average, about 7 percent) phenocrysts of plagioclase, hornblende, and olivine, in some places, in a pilotaxitic intergrowth of plagioclase, olivine, clinopyroxene, and opaque oxides; accessory apatite. Numerous lava flows form a shield volcano, centered on peak 8172T about 3.5 km north of Mount Hicks, in the northeast part of the Aurora volcanic field. Absolute age unknown but constrained to between 1.3 to 1.6 Ma by geologic relations

Qa **Andesite (Reheis and others, 2002) (Pleistocene)**—Andesite lava flow, fills channel that drained Pleistocene Lake Russell. Determined ages 1.44 ±0.06 and 1.6±0.02 Ma

Qmh **Trachyandesite of Mount Hicks (Pleistocene)**—Dark-gray, almost aphyric trachyandesite lava flows. Contains about 3 percent phenocrysts of olivine that are enclosed in a felty intergrowth of plagioclase, clinopyroxene, and opaque oxides. Numerous lava flows form a shield volcano, centered on Mount Hicks, which dominates the east-central part of the Aurora volcanic field. Determined age 1.6±0.1 Ma

Qacc **Trachyandesite of Cow Camp Creek (Pleistocene)**—Medium-gray, moderately porphyritic trachyandesite; includes basaltic trachyandesite and trachydacite. Contains about 5 to 30 percent (average, about 22 percent) phenocrysts, principally plagioclase, clinopyroxene, and olivine (but includes hornblende and orthopyroxene in some samples) in a weakly devitrified groundmass; accessory opaque oxides. The trachyandesite forms a ≤170-m-thick series of flows associated with an inferred shield volcano probably centered north of Cow Camp Creek; may also include minor moderate-reddish-orange scoria deposits north of Beauty Peak. Determined age 1.99±0.04 Ma

QTai **Trachyandesite (Pleistocene or Pliocene)**—Medium-light-gray, sparsely porphyritic trachyandesite. Contains about 15 percent olivine phenocrysts in an aphanitic, felty intergrowth of plagioclase, clinopyroxene, and opaque oxides. Forms an isolated plug about 15 km northeast of Bridgeport, significantly northwest of all other Aurora volcanic field rocks. Absolute age unknown

QTopb **Olivine pyroxene basaltic trachyandesite (Pleistocene or Pliocene)**—Medium-dark-gray, moderately porphyritic basaltic trachyandesite. Contains about 20 percent phenocrysts of plagioclase, olivine, and clinopyroxene in a groundmass that consists of intergrown plagioclase, clinopyroxene, and opaque oxides; accessory mineral assemblage limited to opaque oxides.

Forms an isolated outcrop about 6 km west southwest of the mouth of Trench Canyon. Absolute age unknown

QTob **Olivine basaltic trachyandesite (Pleistocene or Pliocene)**—Medium-light-gray, strongly porphyritic, vesicular basaltic trachyandesite. Contains about 45 percent phenocrysts of plagioclase and olivine in a groundmass that consists of intergrown plagioclase, opaque oxides, and clinopyroxene. Forms two small isolated outcrops about 1 km north of Mount Biedeman. Absolute age unknown

QTaap **Trachyandesite south of Aurora Peak (Pleistocene or Pliocene)**—Medium-dark-gray, moderately porphyritic vesicular trachyandesite. Contains about 15 percent phenocrysts of hornblende and plagioclase in a moderately devitrified groundmass; accessory opaque oxides. Forms several isolated outcrops southwest, south, and southeast of Aurora Peak. Determined ages 2.3±0.1 and 2.6±0.2 Ma (Silberman and McKee, 1972)

QTbbc **Basaltic debris-flow deposits of Cedar Hill (Pleistocene or Pliocene)**—Grayish-black debris-flow deposits that contain angular 5–50 cm clasts of olivine basalt; forms an isolated exposure about 1 km north of Kirkwood Spring; may be correlative with the trachybasalt of Cedar Hill

QThch **Hornblende trachydacite of Cedar Hill (Pleistocene or Pliocene)**—Medium-gray, moderately porphyritic trachydacite and trachyandesite (hornblende andesite of Lange and Carmichael, 1996). Contains about 15 to 30 percent (average, about 19 percent) phenocrysts of plagioclase and hornblende and trace amounts of biotite and clinopyroxene in a weakly devitrified groundmass; accessory opaque oxides and apatite. Forms composite lava cones and flows in the southern part of the Aurora volcanic field. Eight age determinations range from 2.4 to 3.5 Ma

Tmr **Rhyolite of Martinez Hill (Pliocene)**—Light-gray, almost aphyric, high-silica rhyolite. Contains about 4 percent phenocrysts of quartz, sanidine, plagioclase, and biotite in a groundmass composed of fresh glass; accessory opaque oxides, titanite, zircon, and allanite. Lava forms three small-volume, coalescing domes at Martinez Hill, south of Gregory Flats near the center of the Aurora volcanic field. Determined age 2.6±0.1 Ma

Tdap **Trachydacite of Aurora Peak (Pliocene)**—Light-gray to pinkish-gray, moderately porphyritic trachydacite. Contains 15 to 20 percent phenocrysts of plagioclase, hornblende, and biotite; accessory apatite and opaque oxides. Forms a lava dome with two vents near the top of Aurora Peak. Determined ages 2.6 ±0.2 Ma and 2.8±0.2 Ma

Tbch **Trachybasalt of Cedar Hill (Pliocene)**—Medium-gray, moderately porphyritic trachybasalt (basalt of Lange and Carmichael, 1996). Contains about 5 to 20 percent (average, about 15 percent) phenocrysts of plagioclase, olivine, and clinopyroxene in an intergranular groundmass; accessory opaque oxides. Forms a composite cone composed of bedded cinder deposits and interbedded lava flows in the southern part of the Aurora volcanic field. Determined age 2.60±0.06 Ma

Tpch **Pyroxene trachyandesite of Cedar Hill (Pliocene)**—Light-gray to brownish-gray, moderately porphyritic trachyandesite (two-pyroxene andesite of Lange and Carmichael, 1996). Contains 15 to 30 percent (average, about 22 percent) phenocrysts of plagioclase, clinopyroxene, orthopyroxene, and olivine in a moderately devitrified groundmass that includes plagioclase and opaque oxides; accessory apatite. Forms composite lava cones and flows in the southern part of the Aurora volcanic field. Two small outcrops about 3 km west of Trench Canyon are atypically biotite rich. Determined ages 2.8±0.2 and 2.8±0.8 Ma

Tba **Basaltic trachyandesite of Beauty Peak (Pliocene)**—Light-gray, sparsely porphyritic basaltic trachyandesite. Contains about 2 to 5 percent olivine phenocrysts in a groundmass that is an intersertal intergrowth of plagioclase, clinopyroxene, and opaque oxides; accessory apatite. The basaltic trachyandesite forms a ≤250-m thick series of flows that emanate from a shield volcano centered on Beauty Peak. Determined age 2.9±0.1 Ma

Thd **Hornblende trachydacite (Pliocene)**—Dark-gray, sparsely porphyritic trachydacite lava flows. Contains about 6 percent phenocrysts of plagioclase, hornblende, and a trace of clinopyroxene in a weakly devitrified groundmass; accessory scarce, small crystals of opaque oxides. Forms a set of flows that crop out in a relatively small area in the northwest part of the Aurora volcanic field. Determined age 3.5±0.2 Ma

Trsp **Rhyolite of Spring Peak (Pliocene)**—Very-pale-orange, sparsely porphyritic, high-silica rhyolite. Contains trace to about 10 percent (average, about 6 percent) phenocrysts of principally quartz, plagioclase, and biotite (but includes sanidine and hornblende in some places) in a fresh glass groundmass; accessory opaque oxides, titanite, allanite, and apatite. Forms a moderately voluminous series of lava flows and domes and scarce dikes in the central part of the Aurora volcanic field. Determined age 3.7±0.1 Ma

Tach **Trachyandesite of Cedar Hill (Pliocene)**—Dark-gray, strongly porphyritic trachyandesite (basaltic andesite of Lange and Carmichael, 1996); includes minor basaltic trachyandesite. Contains about 15 to 45 percent (average, about 27 percent) phenocrysts of plagioclase, clinopyroxene, and olivine in a moderately devitrified groundmass; accessory assemblage limited to opaque oxides. Forms composite lava cones and flows in the southern part of the Aurora volcanic field. Determined age 3.7±0.4 Ma

Tmlp **Basaltic andesite of Locomotive Point (Pliocene)**—Medium-light-gray, sparsely porphyritic basaltic andesite. Contains about 5 to 10 percent (average, about 7 percent) phenocrysts of clinopyroxene and olivine in an aphanitic, felty intergrowth of plagioclase, clinopyroxene, and opaque oxides; accessory mineral assemblage limited to opaque oxides. Forms a prominent series of lava flows emanating from a vent about 8 km northeast of Bridgeport, significantly west of all other Aurora volcanic field rocks. Determined age 3.9±0.06 Ma

SEDIMENTARY DEPOSITS

QTsn **Sinter deposits (Pleistocene to Miocene)**—White to light-gray, opaline to chalcedonic sinter that forms several small exposures about 1 km southwest of Spring Peak in the eastern part of the map area. The largest sinter terrace has a maximum thickness of ~5 m on its northeastern margin and is <1 m thick elsewhere. Much of the northeastern terrace margin consists of several-meter-long to smaller blocks that have been dismembered and slightly rotated by foundering. Thin, 0.5 to several-meters-thick altered gray- to brown-weathering, pervasively silicified volcaniclastic strata, predominantly composed of well-sorted and locally bedded sand to silt, lie beneath sinter and unconformably on pre-Tertiary rocks

Tsm **Sedimentary rocks of Martinez Hill (Pliocene to Miocene)**—Bedded conglomerate filling a paleochannel (Smailbegovic, 2002). About 60 m thick; contains subrounded 6–40 cm clasts of metavolcanic rock and 1–3 cm andesite and rhyolite clasts. Underlain by trachyandesite of Aurora and overlain by the rhyolite of Martinez Hill, which indicate an age between 2.6 to 12.6 Ma

Tyg **Younger gravels (Pliocene and (or) Miocene)**—Massive, poorly sorted, unconsolidated gravels that contain silt- to boulder-size clasts in a silty to sandy matrix; mantles Miocene volcanic rocks along the range front between Sonoma Gulch and the East Walker River, and east of Bridgeport Reservoir. Clasts, including Eureka Valley Tuff, reflect derivation from proximal bedrock sources

Tswr **Sedimentary rocks of East Walker River (Pliocene and (or) Miocene)**—In the vicinity of lower Sonoma and Masonic Creeks, near their junctions with East Walker River, unit consists of gray, alternating fine lacustrine and coarse fluvial strata dominated by volcanic clasts and, in some places, interbedded with angular sedimentary breccias composed of Mesozoic metasedimentary rocks; includes rare interbedded tuffs. Some deposits, south of the East Walker River, contain small bone fragments of unknown vertebrate taxa and age. On the east side of Bridgeport Valley, east of Bridgeport (where these deposits are >70 m thick), unit consists of braided stream deposits that contain rounded granitic and lesser volcanic clasts; presumed to underlie all or most Bridgeport Valley. Finer-grained facies are clast-supported, moderately well-sorted sandstone that contains 0.1–2 mm quartz, perthitic alkali feldspar, plagioclase, fine-grained sedimentary rock clasts, and minor epidote-bearing metavolcanic hornfels grains; cement is isotropic and possibly opaline. Mafic silicate minerals (biotite>green hornblende>clinopyroxene) compose about 1 percent of the detrital grains. Trough crossbedded volcanic-clast conglomerate and interbedded white lacustrine(?) shale are exposed along the Masonic Road and locally along the east shore of Bridgeport Reservoir. Underlain by the trachyandesite of Willow Springs and the Eureka Valley Tuff and therefore younger than 8.0 Ma; minimum age uncertain

Tog **Older gravels (Miocene)**—Massive, poorly sorted, unconsolidated deposits that contain silt- to boulder-size clasts in a silty to sandy matrix. Clasts include cobbles of exotic Mesozoic granitoid rock, petrified wood, and Bodie Hills volcanic field rocks. Some deposits mantle prominent topographic benches deep within the Bodie Hills. Other deposits conspicuously underlie channelized exposures of Eureka Valley Tuff and may represent material deposited within channels that locally controlled emplacement of Eureka Valley Tuff. In Fletcher Valley, unit consists of massive, poorly sorted, unconsolidated deposits that contain silt- to boulder-size clasts in a silty to sandy matrix. Most clast compositions reflect derivation from proximal bedrock sources. Deposits mantle ridges and the valley bottom about 1.5 km southeast of the Homestead Mine; a much smaller exposure is immediately west to northwest of the Homestead Mine. Age bracketed between 9.4 and 11.0 Ma by ages of underlying and overlying units

Tfv **Sedimentary rocks of Fletcher Valley (Miocene)**—Very light-gray braided stream deposits (at least 200 m thick); contain well-rounded volcanic pebbles and, in places, interbedded felsic tephra. Reasonably well-sorted, clast-supported sandstone and siltstone contain 0.1–2 mm subangular clasts of plagioclase and lesser quartz. Mafic silicate minerals (clinopyroxene>olive green hornblende>biotite) compose about 1 percent of detrital grains. Also contains a significant amount of lithologically diverse volcanic lithic fragments. Overlies the trachydacite of Rough Creek and interbedded with trachyandesite of Del Monte. Interbedded tephras yielded ages of 10.5 to 11.7 Ma (Fleck and others, in press; Gilbert and Reynolds, 1973; and John and others, 2012)

DISTALLY SOURCED ASH-FLOW TUFFS

Tev **Eureka Valley Tuff (Miocene)**—Grayish-black to light-brown, moderately porphyritic trachydacite ash-flow tuff. Contains about 5 to 20 percent (average, about 14 percent) phenocrysts of plagioclase, biotite, clinopyroxene, and trace amounts of hornblende in a grayish-black to iron-stained moderate-reddish-brown glassy groundmass; accessory minerals include opaque oxides and apatite. In the Bodie Hills, where the tuff is moderately to densely welded, most exposures appear to fill paleochannels. Correlated with Eureka Valley Tuff erupted from the Little Walker caldera (Noble and others, 1974; Priest, 1979; Pluhar and others, 2009). Presence of multiple cooling units, abundance of biotite phenocrysts, and variable magnetic polarity (Carlson and others, 2013) indicate that most Eureka Valley Tuff exposures in the Bodie Hills correlate with the Tollhouse Flat and Upper Members. Determined age about 9.4 Ma (table 2; Pluhar and others, 2009; Chris Pluhar, oral commun., 2013)

Tjs **Tuff of Jacks Spring (Miocene)**—Very-light-gray to pinkish-gray, porphyritic rhyolite ash-flow tuff. Contains about 10 to 20 percent (average, about 15 percent) phenocrysts of plagioclase, sanidine, quartz, and biotite in a groundmass composed of fresh to weakly devitrified glass shards;

accessory minerals include opaque oxides, apatite, zircon, titanite, and allanite. Tuff is lithic-rich and poorly welded. In the Bodie Hills, volumetrically insignificant exposures (perhaps atop basement highs) underlie volcanic rocks of the Bodie Hills volcanic field. Correlated with tuff of Jacks Spring (Stewart, 1981), southeast of Huntoon Valley, on the basis of age and lithologic characteristics. Determined age about 12.0 to 12.1 Ma

ROCKS OF BODIE HILLS VOLCANIC FIELD

Rocks of Big Alkali center (Miocene)

Tbar **Rhyolite of Big Alkali (Miocene)**—Light-gray to pinkish-gray, moderately porphyritic rhyolite; includes trachydacite and dacite. Contains about 5 to 30 percent (average, about 20 percent) phenocrysts of plagioclase, hornblende, biotite, and trace amounts of quartz and (or) sanidine in a weakly devitrified, locally glassy groundmass; accessory minerals include opaque oxides, apatite, and combinations of titanite, allanite and zircon in some places. Forms a prominent, north-trending array of small-volume domes from south of Mormon Meadow to north of the Sarita Mine near the west edge of the map area. Determined age 5.5–6.2 Ma

Rocks of Willow Springs center (Miocene)

Twa **Trachyandesite of Willow Springs (Miocene)**—Medium-light-gray, moderately porphyritic, massive but locally flow-laminated, trachyandesite; includes andesite, trachydacite, and dacite. Contains about 10 to 40 percent (average about 24 percent) phenocrysts of plagioclase, hornblende, biotite, clinopyroxene, and rarely olivine in a moderately devitrified, locally glassy groundmass; accessory minerals include opaque oxides, apatite and minor zircon. Plagioclase phenocrysts are characteristically larger (average size of the largest phenocryst in samples of this unit is 4.8 mm) than those in most Bodie Hills volcanic field rocks. Forms a large-volume, north-northwest elongate set of coalesced lava domes and flows in the low hills southeast of Bridgeport. Includes several prominent flow breccias in cliffs west of Willow Springs. Determined age 8.0–8.6 Ma

Ths **Dacite of Hot Springs Canyon (Miocene)**—Very light-gray, moderately porphyritic dacite; includes trachyandesite and trachydacite. Contains about 15 to 25 percent (average, about 18 percent) phenocrysts of plagioclase, hornblende, biotite, and trace amounts of clinopyroxene in a moderately devitrified groundmass; accessory minerals include opaque oxides and apatite. Forms a series of small-volume, isolated, weakly to strongly altered lava domes about 5 km south of Bridgeport, near west edge of the map area. Determined age 8.07±0.02 Ma

Tdcc **Trachydacite of Cinnabar Canyon (Miocene)**—Light-gray, strongly porphyritic trachydacite. Contains about 25 to 30 percent phenocrysts of plagioclase, biotite, hornblende, and trace amounts of quartz in a glassy groundmass; accessory minerals include opaque oxides, apatite, and zircon. Forms two very-small-volume, recessive-weathering lava dome exposures about 2 km south of Big Alkali, in the west part of the map area. Plagioclase phenocrysts are characteristically larger (5.0 mm, average size of the largest phenocryst in each sample of this unit) than those in most Bodie Hills volcanic field rocks. Determined age 8.55±0.03 Ma

Rocks of Potato Peak center (Miocene)—Coalesced lava flows and exogenous lava domes and lesser block-and-ash flow deposits and debris-flow deposits define a large dome field encompassing the crest of the Bodie Hills in central part of the map area. Age determinations indicate emplacement at 8.7 to 9.1 Ma. Consists of:

Tppd **Debris-flow deposits associated with trachydacite of Potato Peak (Miocene)**—Very-light-gray to pinkish-gray, recessive-weathering, poorly sorted, matrix-supported debris-flow deposits shed during the lateral collapse of trachydacite of Potato Peak lava domes; clast population dominated by trachydacite of Potato Peak blocks up to 3 meters in diameter but includes clasts of older Bodie Hills volcanic field rocks, especially trachyandesite of Mount Biedeman and dacite of Silver Hill. Weakly consolidated ashy and clay-rich matrix present in isolated outcrops but absent in most places, which yields a residual surface strewn with a large-boulder lag deposit. Age, approximately coeval with trachydacite of Potato Peak

Tpp **Trachydacite of Potato Peak (Miocene)**—Medium-gray to grayish-orange-pink, massive but locally flow-laminated, moderately porphyritic trachydacite; includes trachyandesite, andesite, and dacite. Contains about 5 to 30 percent (average, about 18 percent) phenocrysts of plagioclase, hornblende, and biotite in a moderately devitrified groundmass; accessory minerals include opaque oxides, apatite, and minor zircon. In the west-central part of the map area, forms a large-volume elliptical eruptive center consisting of coalesced lava flows and exogenous lava domes, especially in the rugged terrane south of Bodie Mountain. Rubbly breccias form the tops and toes of many flows. Massive, steeply jointed outcrops at Potato Peak may constitute a shallow, subvolcanic plug. Recessive weathering areas may reflect the locus of soft, cogenetic block-and-ash and debris-flow deposits. Well-indurated block-and-ash deposits crop out prominently in exposures on the southeast side of Rough Creek, in the upper part of its watershed. Determined $^{40}Ar/^{39}Ar$ age 8.7–9.1 Ma

Rocks of Silver Hill center (Miocene)—Lava domes, related intrusions, and an apron of sedimentary rocks and debris-flow deposits define a moderate-size dome field in south-central part of the map area. Age determinations indicate emplacement at 8.9 to 9.1 Ma. Consists of:

Tdsd **Debris-flow deposits associated with dacite of Silver Hill (Miocene)**—Light-gray to very-pale-orange, recessive-weathering, poorly sorted, matrix-supported debris-flow deposits shed during the lateral collapse of dacite of Silver Hill lava domes; clast population dominated by dacite of Silver Hill blocks as large as several meters in diameter but includes clasts of older Bodie Hills volcanic rocks, especially trachyandesite of Mount Biedeman. Glassy, prismatically jointed blocks of dacite of Silver Hill are common and indicate debris-flow deposition during associated lava dome development. Weakly consolidated ashy and clay-rich matrix present in isolated outcrops but absent in most places, which yields a residual surface strewn with a large-boulder lag deposit. Age, approximately coeval with dacite of Silver Hill

Tisd **Intrusive phase of dacite of Silver Hill (Miocene)**—Petrographically and chemically identical to the dacite of Silver Hill. Forms intrusions at Sugarloaf and three surrounding, topographically prominent features. Determined age 8.8–9.1 Ma

Tsd **Dacite of Silver Hill (Miocene)**—Medium-light-gray to light-brownish-gray, strongly porphyritic, massive but locally flow-laminated dacite; includes trachyandesite, trachydacite, and andesite. Contains about 15 to 35 percent (average, about 23 percent) phenocrysts of plagioclase, hornblende, biotite, and trace amounts of quartz and (or) sanidine in a moderately devitrified (rarely glassy) groundmass; accessory minerals include opaque oxides, apatite, and minor zircon and titanite. Forms a series of lava domes, coalesced to a roughly circular area, in the south-central part of the map area. Determined age 8.9–9.1 Ma

Rocks of Mount Biedeman center (Miocene)—Lava flows, interbedded laharic debris-flow beds, an apron of sedimentary rocks and debris-flow deposits, and related plugs define a moderate-size stratovolcano approximately centered on Mount Biedeman in the south-central part of the map area. Age determinations indicate emplacement at 8.9 to 9.9 Ma. Consists of:

Timb **Trachydacite intrusions of Mount Biedeman (Miocene)**—Grayish-orange-pink to medium-gray, moderately porphyritic trachydacite. Contains about 10 percent phenocrysts of plagioclase, hornblende, and clinopyroxene in a felty intergrowth of plagioclase and opaque oxides; accessory minerals include apatite and opaque oxides. Forms three plugs east of Bridgeport Canyon and three very small-volume plugs west of Bridgeport Canyon; all have prominent, near-vertical jointing and intrude debris-flow deposits of Mount Biedeman or lava flows of the trachyandesite of Mount Biedeman. Age, approximately coeval with the trachyandesite of Mount Biedeman

Tsmb **Sedimentary rocks and debris-flow deposits of Mount Biedeman (Miocene)**—Poorly sorted lahar, block-and-ash-flow, and associated sedimentary deposits shed from the flanks of the Mount Biedeman stratovolcano; includes some trachyandesite of Mount Biedeman lava flows. Clast population dominated by trachyandesite of Mount Biedeman but locally includes blocks of the Eureka Valley Tuff (Tev) and rhyolite of the Bodie Hills (Trbh). Most block-and-ash-flow deposits are brownish-black and clast-supported. Light-gray, recessive-weathering lahar deposits are massive, poorly sorted, and contain silt- to boulder-size clasts in an ash- to clay-rich matrix. Very-light-gray sedimentary facies deposits are remarkably well exposed in road cuts 1.5 km east of Mormon Meadows and near the mouth of Cottonwood Canyon. These matrix-supported deposits contain rounded, compositionally diverse clasts several centimeters to 0.5 meters in diameter. Overlies and locally underlies the

Eureka Valley Tuff (Tev) in southwest part of map area. Age, likely approximately coeval with trachyandesite of Mount Biedeman. A glassy block contained in a debris flow of this unit in Cottonwood Canyon has an age of 9.68±0.06 Ma and interbedded lava flows in the west part of this unit range in age from 8.9 to 9.0 Ma

Tamb **Trachyandesite of Mount Biedeman (Miocene)**—Light- to medium-gray, strongly porphyritic trachyandesite; includes basaltic trachyandesite, trachydacite, andesite, and dacite. Contains about 15 to 50 percent (average, about 33 percent) phenocrysts of plagioclase, hornblende, clinopyroxene, and trace amounts of biotite or olivine in a moderately devitrified groundmass; accessory minerals include opaque oxides and apatite. Phenocrysts are trachytically aligned in some places; prominent hornblende phenocrysts (≥3 mm) are a characteristic feature in some places. Determined ages 8.9 to 9.9 Ma

Tpst **Sedimentary rocks and tuff of Paramount (Miocene)**—Pinkish-gray to pale-red-purple, and dark-tan, sparsely porphyritic rhyolite tuff and associated volcaniclastic rocks; weakly to strongly hydrothermally altered and iron-stained in some places. Pyroclastic rocks contain trace amounts of plagioclase and quartz phenocrysts in a recrystallized ashy groundmass (replaced by secondary silica in some places); accessory minerals include opaque oxides and rare zircon. Contains abundant 0.5- to 10-cm unflattened pumice blocks and exotic lithic fragments of porphyritic intermediate-composition lava as well as almost aphyric rhyolite lava. Interbedded sedimentary rocks include poorly sorted, lithic-and pumice-rich sandstone, conglomerate, and several prominent silica sinter terraces. Tuff likely associated with eruption of the rhyolite of Bald Peak; with cogenetic volcaniclastic deposits, fills northeast-elongated Paramount Basin near Bald Peak in the center of the map area. Approximately coeval with rhyolite of Bald Peak (9.7 Ma) and older than the Eureka Valley Tuff (9.4 Ma)

Trbh **Rhyolite of Bodie Hills (Miocene)**—White to medium-light-gray and pinkish-gray, moderately porphyritic, locally flow-laminated and flow-folded rhyolite. Contains 1 to about 25 percent (average, about 15 percent) phenocrysts of plagioclase, quartz, sanidine, biotite, hornblende, and rarely clinopyroxene in a weakly devitrified, locally glassy groundmass; accessory minerals include opaque oxides, apatite, titanite, zircon, and allanite. Forms a series of small-volume lava domes, most centered on Mount Biedeman in the southwest part of the map area, but also forms a discontinuous north-trending array that extends just north of the Sarita Mine on the north side of Masonic Mountain. White, sparsely porphyritic ash-fall tuff locally preserved on margins of lava domes. Many lava flows include carapace and (or) basal flow breccias. Several distinctive outcrops surrounding Mount Biedeman consist of mingled magma in which 2–20 cm blocks of trachyandesite of Mount Biedeman are contained in a matrix of seemingly partially hybridized, quartz-rich rhyolite of Bodie Hills.

Trachyandesite inclusions are locally flattened and have near vertical elongation. Determined age 9.6–9.9 Ma

Trb **Rhyolite of Bald Peak (Miocene)**—White, pinkish-gray to light-greenish-gray, nearly aphyric flow-laminated rhyolite. Contains trace to about 10 percent (average, about 3 percent) phenocrysts of quartz, sanidine, and trace amounts of plagioclase and biotite in fresh to recrystallized glass; accessory minerals include trace amounts of opaque oxides, zircon, and titanite. Forms a prominent, small-volume lava dome and associated flows at Bald Peak near the center of the map area. Determined age 9.7 Ma

Trbc **Rhyolite of Bodie Creek (Miocene)**—Light-gray to pale-pinkish-gray, moderately porphyritic rhyolite, flow-laminated in some places. Contains about 5 to 20 percent (average, about 15 percent) phenocrysts of plagioclase, quartz, biotite, sanidine, and rare hornblende in devitrified, locally glassy groundmass; accessory minerals include opaque oxides, titanite, apatite, and rare allanite and zircon. Forms a series of small-volume lava domes, mostly covered by lava flows of the basaltic trachyandesite of Beauty Peak, in the central part of the map area; includes a ~150-m thick, prominently jointed flow in Bodie Creek. Determined age 9.9–10.2 Ma

Tac **Trachyandesite of Aurora Canyon (Miocene)**—Light- to medium-gray, locally flow-laminated, moderately porphyritic trachyandesite; includes trachydacite, andesite, and dacite. Contains about 15 to 35 percent (average, about 21 percent) phenocrysts, trachytically aligned in some places, of plagioclase, hornblende, biotite, and clinopyroxene in a weakly devitrified, locally glassy groundmass; accessory minerals include opaque oxides, apatite, and rare titanite and zircon. Forms a discontinuous, northeast-trending series of small-volume lava domes in the west-central part of the map area. Coarse block-and-ash-flow deposits and (or) carapace breccias are preserved along the margins of some domes. Determined age 10.3–10.6 Ma

Tsbr **Silicified breccia (Miocene)**—Dark-red, orange, and brown, densely silicified breccia, finely bedded cavern-filling pebbly sandstone, and dripstone. Consists of two low, crudely bedded outcrops forming an outward dipping semicircle tentatively interpreted as silicified eruption breccias and overlying hydrothermal sediments. Overlies dark-red, clay-rich paleosol formed on trachyandesite of Masonic and lies between domes of the rhyolite of Rock Springs Canyon and trachyandesite of Aurora Canyon. Absolute age unknown

Trs **Rhyolite of Rock Springs Canyon (Miocene)**—Light-gray to pinkish-gray, almost aphyric rhyolite. Contains trace to 3 percent (average, about 1 percent) phenocrysts of plagioclase, sanidine, hornblende, and biotite in a weakly devitrified, locally glassy groundmass; accessory minerals include opaque oxides and rare zircon. Forms two prominent, small-volume lava domes in the west-central part of the map area that intrude the trachyandesite of Masonic and are overlain by the Eureka Valley Tuff.

Includes flow lobes entirely composed of gray to black obsidian. Absolute age unknown

Tdm **Trachyandesite of Del Monte (Miocene)**—Medium-gray, strongly porphyritic, commonly strongly vesicular trachyandesite; includes basaltic trachyandesite and trachydacite. Contains about 10 to 40 percent (average, about 25 percent) phenocrysts of plagioclase, biotite, hornblende, and clinopyroxene in a weakly devitrified groundmass; accessory minerals include opaque oxides and apatite. Forms a discontinuous, north-trending series of exposures that consist of lava flows and interbedded, heterogeneous, laharic debris-flow and volcaniclastic deposits in the north-central and northeast parts of the map area. Debris-flow deposits are massively bedded, poorly sorted, clast- to matrix-supported mass wasting deposits with a clay- and ash-rich matrix. Clasts are 1 cm to about 1 m in diameter, angular to subangular, and principally volcanic rock fragments similar to interbedded lava flows but in some places include quartz-rich rhyolite, possibly the rhyolite of Del Monte Canyon. Determined age 10.9–11.0 Ma

Tdbc **Trachydacite of Bridgeport Canyon (Miocene)**—Medium- to light-gray, moderately porphyritic trachydacite. Contains about 10 to 25 percent (average, about 20 percent) phenocrysts of plagioclase, clinopyroxene, and trace amounts of hornblende in a moderately devitrified groundmass; accessory minerals include opaque oxides and apatite. Forms several isolated, small-volume, topographically prominent lava domes west of Bridgeport Canyon in the southwest part of the map area. Plagioclase phenocrysts are characteristically larger (6.0 mm, average size of the largest phenocryst in each sample of this unit) than those in most Bodie Hills volcanic field rocks. Composition is distinctly more alkaline than those of Bodie Hills volcanic field rocks but similar to those associated with the Little Walker caldera, 25 km to the northwest. Determined ages 11.07±0.02 and 11.08±0.02 Ma

Trdc **Rhyolite of Del Monte Canyon (Miocene)**—Light-gray to pale-grayish-red-purple, moderately porphyritic rhyolite. Contains about 5 to 25 percent (average, about 18 percent) phenocrysts of plagioclase, quartz, hornblende, biotite, sanidine, and rare clinopyroxene in glassy (perlitic in places) to moderately devitrified groundmass; accessory minerals include opaque oxides, apatite, titanite, and rare zircon and allanite. Forms a set of low-volume lava domes and associated pyroclastic deposits in the east-central part of the map area. Pyroclastic deposits are well bedded, lithic rich, and underlie the lava flows. Determined age 11.1–11.6 Ma

Tr **Pyroxene rhyolite (Miocene)**—Light- to medium-gray, moderately porphyritic, flow-laminated and locally vesicular rhyolite. Contains trace to about 25 percent (average, about 15 percent) phenocrysts of plagioclase, orthopyroxene, and clinopyroxene in a glassy groundmass (perlitic in many places); accessory minerals include opaque oxides, apatite, and rare zircon. Forms a series of very-small-volume, discontinuously exposed intrusive lava domes in Rough Creek and west of Sugarloaf Mountain in the central part of the map area. Determined age 11.15±0.01 Ma

Treb **Rhyolite of East Brawley Peak (Miocene)**—Very-light-gray to pinkish-gray, sparsely porphyritic rhyolite. Contains about 5 to 10 percent (average, about 8 percent) phenocrysts of quartz, plagioclase, sanidine, and biotite, in a moderately devitrified, altered, and recrystallized groundmass; accessory minerals include opaque oxides and rare zircon. Forms a discontinuously exposed series of very-small-volume lava domes in the east-central part of the map area. Most exposures are strongly hydrothermally altered. Determined age 11.18±0.02 Ma

Tra **Rhyolite of Aurora Creek (Miocene)**—Light- to medium-gray, sparsely porphyritic rhyolite. Contains trace to about 10 percent (average, about 4 percent) phenocrysts of plagioclase and trace amounts of combinations of quartz, sanidine, hornblende, clinopyroxene, and biotite in a glassy groundmass; accessory minerals include opaque oxides, apatite, and, in some places, titanite and zircon. Forms a group of small-volume lava domes (locally composed of obsidian, perlitic in some places) in the east-central part of the map area. Includes minor cogenetic, lithic-rich pyroclastic flow deposits, especially in the lower reaches of Bodie Creek. Most outcrops are altered to clay minerals, alunite, and opaline silica owing to hydrothermal processes that affected rocks in the Aurora mining district and Sawtooth alteration zone (Vikre and others, in press). Determined age 11.2–11.3 Ma

Tdi **Trachydacite intrusions (Miocene)**—Medium-gray to light-brownish-gray, strongly porphyritic, locally flow-laminated trachydacite; includes minor dacite. Contains about 15 to 25 percent (average, about 21 percent) phenocrysts of plagioclase, biotite, hornblende, and trace amounts of quartz, and clinopyroxene, in a locally glassy, variably devitrified groundmass; accessory minerals include opaque oxides, apatite, and rare zircon and titanite. Forms several widely dispersed, very-low-volume intrusions into the trachyandesite of Masonic in the west-central part of the map area. Determined age 11.2–11.3 Ma

Tcc **Trachyandesite of Clark Canyon (Miocene)**—Light- to medium-gray, strongly porphyritic trachyandesite; includes andesite and trachydacite. Contains about 15 to 35 percent (average, about 22 percent) phenocrysts of plagioclase, clinopyroxene, and trace amounts of hornblende and biotite, in a moderately devitrified groundmass; accessory minerals include opaque oxides and apatite. Forms a series of very-small-volume plugs intruding debris-flow deposits in the trachyandesite of Masonic and arrayed along an east-northeast trend in Aurora Canyon in the west-central part of the map area; includes a very-small-volume lava flow about 1.5 km south of Aurora Canyon. Determined ages 11.27±0.11 and 11.34±0.02 Ma

Rocks of West Brawley Peak center (Miocene)—Lava flows and a plug that forms West Brawley Peak define a moderate-volume composite volcano in the east-central part of the map area. Age determinations indicate emplacement at 11.3 to 11.5 Ma. Consists of:

Twbi **Trachyandesite intrusion of West Brawley Peak (Miocene)**—Medium-gray, strongly porphyritic, vertically flow-laminated trachyandesite. Contains about 30 percent phenocrysts of plagioclase, hornblende, and a trace of biotite and clinopyroxene in a devitrified groundmass; accessory minerals include opaque oxides and apatite. Plagioclase forms tabular to blocky crystals as much as 2 cm long. Forms a prominent, small-volume plug that intrudes the trachyandesite of West Brawley Peak at West Brawley Peak. Likely intrudes vent for lava flows of trachyandesite of West Brawley Peak that radiate away from West Brawley Peak on its south, west, and north sides. Likely approximately coeval with trachyandesite of West Brawley Peak

Twba **Trachyandesite of West Brawley Peak (Miocene)**—Medium-light-gray to pinkish-gray moderately porphyritic trachyandesite; includes andesite and trachydacite. Contains about 10 to 35 percent (average, about 21 percent) phenocrysts of plagioclase, hornblende, biotite, clinopyroxene, and trace amounts of olivine in a moderately devitrified groundmass; accessory minerals include opaque oxides, apatite, and rare zircon. Forms a series of lava flows erupted from the moderate-volume composite volcano centered on West Brawly Peak, in the east-central part of the map area. Toes of some flows are strongly flow-banded and have prominent flow ramps. Plagioclase phenocrysts are characteristically larger (6 mm, average size of the largest phenocryst in each sample of this unit) than those in most Bodie Hills volcanic field rocks. In some places, contains abundant, rounded, fine-grained hornblende-rich mafic (cognate?) inclusions up to 15–20 cm in diameter. Determined $^{40}Ar/^{39}Ar$ age 11.3–11.5 Ma

Rocks of Rancheria center (Miocene)—Lava flows and a very small volume plug that appear to represent the products of a mafic-composition volcano now largely overlain by products of the Mount Biedeman center in the southwest part of the map area. Age determinations indicate emplacement at 11.6 to 11.7 Ma. Consists of:

Trwi **Basalt of Rancheria plug (Miocene)**—Medium-gray, moderately porphyritic basalt. Contains about 10 percent phenocrysts of olivine and clinopyroxene in an intergranular intergrowth of plagioclase, clinopyroxene, and opaque oxides; accessory assemblage limited to opaque oxides. Forms a very-small-volume composite plug that intrudes the monzogranite of Rattlesnake Gulch about 1.5 km east of Conway Summit in the southwest corner of the map area. Plug contains abundant 0.1–1 m rounded cognate fragments, abundant 3–50 cm clasts of the Cretaceous monzogranite of Rattlesnake Gulch, and xenocrysts of plagioclase and quartz, likely derived from the host monzogranite. Likely coeval and cogenetic with compositionally similar basaltic trachyandesite of Rancheria. Determined age 11.7±0.5 Ma

Trwa **Basaltic trachyandesite of Rancheria (Miocene)**—Medium-light-gray to medium-dark-gray, moderately porphyritic basaltic trachyandesite; includes basalt, trachyandesite, basaltic andesite, and andesite. Contains about 5 to 20 percent (average, about 13 percent) phenocrysts, trachytically aligned in some places, of olivine, clinopyroxene, and locally, minor plagioclase and hornblende, in a moderately devitrified groundmass or, in some places, in an intergranular intergrowth of plagioclase, clinopyroxene, and opaque oxides; accessory minerals include opaque oxides and apatite. Forms a set of small-volume, discontinuous exposures of lava flows in the southwest part of the map area beneath the Eureka Valley Tuff (Tev) and sedimentary rocks and debris-flow deposits of Mount Biedeman (Tsmb); appears to represent the products of a mafic-composition volcano that predates the Mount Biedeman stratovolcano. Determined age 11.6±0.9 Ma

Rocks of Trachydacite of Rough Creek (Miocene)

Trcd **Trachydacite of Rough Creek (Miocene)**—Very-light-gray to light-gray, moderately porphyritic trachydacite; includes trachyandesite and minor andesite and dacite. Contains about 15 to 30 percent (average, about 19 percent) phenocrysts of plagioclase, hornblende, biotite, and trace amounts of combinations of clinopyroxene, olivine, and quartz in a locally glassy, moderately devitrified groundmass; accessory minerals include opaque oxides, apatite, and zircon. Forms a moderate-volume group of coalesced lava domes and flows in the northeast part of the map area; includes minor block-and-ash-flow deposits. Plagioclase phenocrysts are characteristically larger (5.8 mm, average size of the largest phenocryst in each sample of this unit) than those in most Bodie Hills volcanic field rocks. In some places, contains rounded, fine-grained mafic (cognate?) inclusions. Determined age 11.7–12.9 Ma

Thai **Hornblende trachyandesite intrusions (Miocene)**—Light- to medium-light-gray, moderately porphyritic trachyandesite. Contains about 10 to 20 percent (average, about 14 percent) phenocrysts of plagioclase, hornblende, and clinopyroxene in a moderately devitrified groundmass; accessory minerals include opaque oxides and apatite. Forms three very-small-volume plugs hosted in trachyandesite of Masonic in Aurora Canyon in the west-central part of the map area; plugs are distinguished by noteworthy 1–5 mm hornblende phenocrysts. Determined age 11.82±0.2 Ma

Rocks of Aurora center (Miocene)—Series of lava flows and interbedded laharic debris-flow beds and volcaniclastic deposits and small-volume intrusions define a moderate-volume stratovolcano centered near the Aurora mining district in the eastern part of the map area. Age determinations indicate emplacement at 12.6 to 13.1 Ma. Consists of:

Taai **Trachyandesite intrusion of Aurora (Miocene)**—Medium-light-gray strongly porphyritic trachyandesite. Contains about 20 to 30 percent phenocrysts of plagioclase, clinopyroxene, and chloritized hornblende in a devitrified intergrowth of plagioclase and opaque oxides; accessory minerals include opaque oxides and apatite. Forms a small plug in the Aurora mining district. Absolute age unknown

Tadi **Dacite intrusions of Aurora (Miocene)**—Light-olive, porphyritic dacite intrusions emplaced into trachyandesite of Aurora. Contains phenocrysts of plagioclase, hornblende, and biotite and in a gray to dark-green groundmass; compositionally similar to trachyandesite of Aurora (Smailbegovic, 2002). Pervasively hydrothermally altered to abundant chlorite, illite, calcite, and epidote. Absolute age unknown

Taa **Trachyandesite of Aurora (Miocene)**—Medium-light-gray or light- to dark-green moderately porphyritic trachyandesite; includes andesite and trachydacite. Contains about 5 to 40 percent (average, about 19 percent) phenocrysts, trachytically aligned in some places, of plagioclase, hornblende, and trace amounts of clinopyroxene and biotite in a moderately devitrified groundmass; accessory minerals include opaque oxides and rare apatite. Hornblende phenocrysts 1–5 mm long (locally as long as 2.5 cm) are distinctive. In the east-central part of the map area, near the Aurora mining district, forms a moderate-volume series of lava flows and associated laharic debris-flow beds and volcaniclastic deposits similar to those included in the trachyandesite of Del Monte. The abundance of debris-flow deposits interbedded with compositionally equivalent lava flows, both intruded by numerous small, intermediate-composition intrusions, suggests that these rocks may also have been erupted from a stratovolcano formerly centered near the Aurora mining district. Pervasive hydrothermal alteration in the Aurora mining district resulted in abundant secondary chlorite, calcite, epidote, clay minerals, and quartz. Determined age 12.6–13.1 Ma

Tals **Andesite of Lakeview Spring (Miocene)**—Medium-light-gray, moderately porphyritic andesite; includes trachyandesite. Contains about 15 to 20 percent phenocrysts of plagioclase, hornblende, clinopyroxene, and trace amounts of olivine in a moderately devitrified groundmass; accessory minerals include opaque oxides and apatite. Forms a small-volume lava dome at Lakeview Spring and two small intrusions into the trachyandesite of Masonic (Tma) about 1 km farther north in the northwest part of the map area. Plagioclase phenocrysts are characteristically larger (5.6 mm, average size of the largest phenocryst in each sample of this unit) than those in most Bodie Hills volcanic field rocks. Determined age 12.93±0.03 Ma

Tamg **Trachyandesite of Masonic Gulch (Miocene)**—Medium-light-gray, strongly porphyritic trachyandesite; includes minor andesite. Contains about 20 to 35 percent (average, about 30 percent) phenocrysts, trachytically aligned in some places, of plagioclase, hornblende, clinopyroxene, and biotite in a weakly devitrified groundmass; accessory minerals include opaque oxides and apatite. Forms a discontinuous series of small-volume lava domes intrusive into trachyandesite of Masonic in the northwest part of the map area. Determined age 13.4–13.5 Ma

Tasc **Trachyandesite of Sinnamon Cut (Miocene)**—Medium-light-gray, sparsely porphyritic trachyandesite. Contains about 5 to 15 percent, trachytically aligned, hornblende phenocrysts in a weakly devitrified groundmass; accessory assemblage limited to opaque oxides. Forms volumetrically minor, platy jointed, shallow intrusions in the southwest part of the map area. Determined age 13.8±0.4 Ma

Tec **Trachydacite of East Canyon (Miocene)**—Light- to medium-gray, locally flow-laminated, moderately porphyritic trachydacite; includes trachyandesite. Contains about 15 to 25 percent (average, about 19 percent) phenocrysts, trachytically aligned in some places, of plagioclase, hornblende, biotite, and clinopyroxene in a weakly devitrified, locally glassy groundmass; accessory minerals include opaque oxides, apatite, and rare zircon. Forms small-volume, northwest-elongated lava domes in the west-central part of the map area. Coarse block-and-ash-flow deposits and (or) carapace breccias are preserved along the margins of some domes. Determined age 13.78 ±0.03 Ma

Rocks of Mud Spring Canyon Center (Miocene)

Tams **Trachyandesite of Mud Spring Canyon (Miocene)**—Medium-light gray, strongly porphyritic trachyandesite. Contains about 25 to 30 percent phenocrysts, trachytically aligned in some places, of plagioclase, hornblende, clinopyroxene and biotite in a moderately devitrified groundmass; accessory minerals include opaque oxides and apatite. In the northeast part of the map area, forms an east-west elongate series of low hills composed of several thick lava flows. Plagioclase phenocrysts are characteristically larger (average size of the largest phenocryst in samples of this unit is about 5 mm) than those in most Bodie Hills volcanic field rocks. Determined age 13.96±0.11 Ma

Rocks of Masonic center (Miocene)—Thick sequence of interbedded lava flows, laharic debris-flow deposits, scarce block-and-ash-flow deposits, and associated volcaniclastic deposits intruded by cogenetic lava domes and small-volume plugs define the large-volume Masonic stratovolcano in the northwestern part of the map area. Age determinations indicate emplacement at 14.1 to 15.0 Ma. Consists of:

Tma **Trachyandesite of Masonic (Miocene)**—Light- to medium-dark-gray, strongly porphyritic trachyandesite; includes basaltic trachyandesite, trachydacite, basaltic andesite, and andesite. Contains about 10 to 40 percent (average, about 28 percent) phenocrysts, trachytically layered in some places, of plagioclase, clinopyroxene, hornblende, and trace amounts of biotite or olivine in a variably devitrified groundmass or, less commonly, in a felty intergrowth of plagioclase, opaque oxides, and clinopyroxene; accessory minerals include opaque oxides and apatite. Euhedral acicular hornblende phenocrysts (2 to 5 mm) are a distinctive constituent in many places. Includes a thick sequence of interbedded lava flows, heterogeneous laharic debris-flow deposits, scarce block-and-ash-flow deposits, and associated volcaniclastic deposits intruded by cogenetic lava domes and small-volume plugs; combined, these rocks define the Masonic stratovolcano. This nearly circular composite volcano, approximately centered on Masonic Mountain in the northwest part of the map area, has the largest eruptive volume of any volcanic center in the Bodie Hills. Debris-flow deposits are massively bedded, poorly sorted, clast- to matrix-supported mass-wasting deposits with a clay- and ash-rich matrix. Clasts are 1 cm to several meters in diameter, angular to subangular, and principally volcanic rock fragments similar to the associated trachyandesite of Masonic. Debris-flow deposits are interbedded locally with poorly sorted volcanic sandstones and pebble conglomerates. Lava flows are most abundant near the inferred core of the eruptive center, whereas volcaniclastic deposits are most abundant in progressively more distal exposures. Most volcaniclastic rocks north of Masonic Mountain dip north, whereas those to the south dip south, consistent with a location for central volcanic vents near Masonic Mountain. Determined age 14.1–14.7 Ma

Tmai **Trachyandesite intrusions of Masonic (Miocene)**—Medium- to dark-gray to black, strongly porphyritic trachyandesite; includes minor basaltic trachyandesite. Contains about 10 to 35 percent (average, about 25 percent) phenocrysts of plagioclase, hornblende, clinopyroxene, and trace amounts of biotite or olivine in an intersertal intergrowth of plagioclase, clinopyroxene, and opaque oxides or in a weakly devitrified groundmass; accessory minerals include opaque oxides and sparse apatite. Form a series of very-small-volume, locally columnar jointed plugs intruded into the trachyandesite of Masonic in the northwest part of the map area. Determined ages 14.19±0.02 and 15.00±0.02 Ma

PRE-BODIE HILLS VOLCANIC FIELD ROCKS

Tabo **Trachyandesite of Borealis (Miocene)**—Medium-gray, trachyandesite debris-flow deposits. Monolithologic clasts are strongly porphyritic and contain about 25 percent phenocrysts of plagioclase, hornblende, clinopyroxene, and trace amounts of biotite in a devitrified groundmass; accessory minerals include opaque oxides and apatite. Euhedral acicular hornblende phenocrysts (1 to 3 mm) are a distinctive constituent. In the northeast part of the map area, forms a thick sequence of laharic debris-flow deposits that crop out in a single mapped polygon; tentatively correlated with volcanic rocks in the Borealis mining district about 8 km to the north. Debris flows are massively bedded, poorly sorted, clast- to matrix-supported mass wasting deposits with a clay- and ash-rich matrix. Clasts are 1 cm to several meters in diameter, angular to subangular, and of remarkably uniform composition. Determined age 15.96±0.10 Ma

BASEMENT ROCKS

[K-Ar ages of granitoid rocks calculated using the decay constants of Steiger and Jäger (1977)]

Kgdr **Monzogranite of Rattlesnake Gulch (Cretaceous)**—Very-light-gray to pinkish-gray, medium-grained, hypidiomorphic inequigranular monzogranite. Contains about 3 percent reddish-brown biotite and 1 percent tan to olive green hornblende; accessory minerals include opaque oxides, zircon, allanite, apatite, and titanite. Weathers to rounded, grus-covered slopes in the extreme southwest part of the map area, east of Conway Summit.

Emplaced into metamorphosed and hornfelsed Mesozoic volcanic and sedimentary rocks; northeast part of the pluton is overlain by rocks of the Bodie Hills volcanic field. Determined age 95.2 Ma (Robinson and Kistler, 1986)

Kgm **Granodiorite of Masonic Mountain (Cretaceous)**—Very-light-gray to pinkish-gray, medium-grained, hypidiomorphic granular, porphyritic granodiorite (includes minor monzogranite). Contains prominent, euhedral, perthitic, pink potassium feldspar megacrysts 2–5 cm long and about 3 percent red-brown biotite; accessory minerals include opaque oxides, titanite, apatite, and zircon. Exposed in the core of the Masonic stratovolcano, where it forms two northeast-elongate masses and a much smaller mass about 6 km to the east. Emplaced into metamorphosed and hornfelsed Mesozoic volcanic rocks; forms a plutonic mass covered in most places by the trachyandesite of Masonic. Determined age 98.0 Ma (Robinson and Kistler, 1986)

Kgmc **Monzogranite of Murphy Creek (Cretaceous)**—Pinkish-gray, medium-grained, xenomorphic granular seriate monzogranite. Contains 2 percent pale-tan to tan, weakly altered biotite; accessory minerals include opaque oxides, zircon, and apatite. Potassium feldspar crystals are strongly perthitic. Forms prominent cliffs east of the East Walker River; overlain to the east by the trachyandesite of Masonic

KJpm **Granite of Powell Mountain (Cretaceous or Jurassic)**—Medium- to coarse-grained hypidiomorphic granular, leucocratic monzogranite (John, 1983). Contains 2 percent biotite. Limited exposures are restricted to the east edge of the map area

KJqmd **Quartz monzodiorite of Aurora (Cretaceous or Jurassic)**—Very-light-gray to yellowish-gray, medium-grained, hypidiomorphic granular porphyritic quartz monzodiorite. Contains prominent, euhedral, perthitic, pink potassium feldspar megacrysts 2–3 cm long and about 2 percent tan to greenish-brown biotite, mostly replaced by chlorite; accessory minerals include opaque oxides, apatite, titanite, allanite, and zircon. Emplaced into metamorphosed and hornfelsed Mesozoic volcanic rocks about 5 km south of Mount Hicks; forms a plutonic mass largely covered by rocks of the Aurora and Bodie Hills volcanic fields. Intruded by a dense nexus of aplite and pegmatite bodies

KJsm **Quartz monzonite of Sinnamon Meadow (Cretaceous or Jurassic)**—Grayish, medium- to coarse-grained biotite-hornblende quartz monzonite (Chesterman and Gray, 1975). Forms single outcrop west of Virginia Creek near southwest edge of map area

KJmm **Quartz monzodiorite of Mormon Meadow (Cretaceous or Jurassic)**—Medium-light-gray, medium-grained, hypidiomorphic granular inequigranular quartz monzodiorite. Contains about 25 percent hornblende; accessory minerals include titanite, apatite, and zircon. Exposure is limited to a very small area about 1.5 km southeast of Mormon Meadow

KJmgd **Quartz monzodiorite of Masonic Mountain (Cretaceous or Jurassic)**—Very-light-gray to pinkish-gray, medium-grained hypidiomorphic inequigranular quartz monzodiorite (to monzodiorite). Contains about 6 percent tan to brown biotite; accessory minerals include opaque oxides, zircon, and apatite, some of which is altered to chlorite. Rock is mildly schistose; quartz is polycrystalline. Forms a small intrusion along the west side of the granodiorite of Masonic. Much of the pluton is altered to a quartz-sericite-pyrite assemblage

Mzmv **Metavolcanic rocks (Mesozoic)**—Medium-dark-gray, greenish-gray, yellowish-gray, and dark-green metavolcanic hornfels and schist. Relict 0.2- to 3-mm igneous feldspar phenocrysts are contained in a very fine-grained intergrowth of feldspar and quartz that includes biotite and (or) muscovite in some places. Protoliths for these rocks probably include intermediate-composition lava flows and breccias and felsic tuffs. Many of these rocks contain abundant metamorphic epidote and chlorite as replacements of primary minerals. Form roof pendants and septa adjacent to Mesozoic granitoid rocks throughout the Bodie Hills and are likely correlative with Mesozoic rocks in roof pendants throughout the Sierra Nevada

Mzsv **Metasedimentary and metavolcanic rocks (Mesozoic)**—Light- to dark-gray quartzofeldspathic hornfels, quartzite, metachert, tuff, and pillow lava (Chesterman and Gray, 1975). These schistose rocks, restricted to the southwest part of the map area east of Conway Summit, are moderately metamorphosed siltstone, sandstone, and chert, with prominent cleavage in many places. Some of these rocks are likely Triassic and may be correlative with the Excelsior Formation in Nevada (Chesterman and Gray, 1975)

Pzms **Metasedimentary rocks (lower Paleozoic)**—Dark-gray to black hornfels, metargillite, metachert, and quartzite; may contain graphite and andalusite in some places (Chesterman and Gray, 1975). These rocks, restricted to the southwest part of the map area, south and west of Mormon Meadow, are likely correlative with Ordovician to Devonian(?) rocks of the Roberts Mountains allochthon in the Log Cabin Mine and Saddlebag Lake roof pendants in the Sierra Nevada (Kistler, 1966; Chesterman and Gray, 1975; Schweickert and Lahern, 1993; Stevens and Greene, 1999)

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