Nevada Bureau of Mines and Geology

USGS Prepared in cooperation with the US Geological Survey

MAP 145 GEOLOGIC MAP OF THE BIG BALD MOUNTAIN QUADRANGLE AND PART OF THE TOGNINI SPRING QUADRANGLE, WHITE PINE COUNTY, NEVADA

# GEOLOGIC MAP OF THE BIG BALD MOUNTAIN QUADRANGLE AND PART OF THE TOGNINI SPRING QUADRANGLE, WHITE PINE COUNTY, NEVADA

Constance J. Nutt and Kerry S. Hart
2004

115°37'30" 40°00' 35' 32'30" 115°30' 39°52'30" 27'30" 520 000 | FEET 530 000 | FEET 490 000 | FEET 1 910 000 FEET 1 870 000 FEET

BIG BALD MOUNTAIN QUADRANGLE

TOGNINI SPRING QUADRANGLE

115°22'30" 40°00' 39°52'30" 115°37'30"

See accompanying text for figures, references, table 1, and description of the geologic framework of the Big Bald Mountain and Tognini Spring area.

## DESCRIPTION OF MAP UNITS

**Qa** **Stream alluvium (Holocene)** Sand, silt, clay, and gravel deposited in confined ephemeral stream channels.

**Qaf** **Alluvial deposits (Holocene)** Sand, silt, clay, and gravel deposited at the mouths of ephemeral streams and on gentle slopes. Up to a few feet thick.

**Qly** **Young alluvial fan deposits (Holocene)** Poorly sorted sand, silt, clay, pebble, gravel, and cobbles deposited in small alluvial fans along the margins of Mooney Basin. Tens of feet thick.

**Qc** **Clay, silt, sand, and gravel deposits (Holocene to Pleistocene)** Unconsolidated slope wash and alluvium. In west part of the map area covers Paleozoic rocks. In Mooney Basin covers Paleozoic rocks and Tv, probably covers Tsy and Qfo. Included in Qao in Nutt (2000). Qc on Paleozoic rock along Mooney Basin in the south part of the map area suggests the Cenozoic fill is shallower than to the north and south. Thickness a few feet to tens of feet.

**Qu** **Alluvium, slopewash, and fans, undivided (Holocene to Pleistocene)** Shown on cross sections only.

**QTao** **Older alluvium (Pleistocene to Pliocene)** Sand, silt, clay, and gravel deposits unconsolidated to poorly bedded and cemented by calcium carbonate. Thickness unknown, but probably hundreds of feet. Cut by Pleistocene lakebed south of map area.

**QTo** **Older alluvial fans (Pleistocene to Pliocene)** Poorly sorted sand, silt, clay, and gravel deposited in well-developed fans west of the range and in Mooney Basin; may include more than one age of older fan. Southwest of map area, late Pleistocene lake shorelines are preserved on the fans. Along two roads to mine pits on the west side, exposures show cut by range-front fault. Incised by streams. Thickness unknown, but probably hundreds of feet.

**QTu** **Alluvium, slopewash, and fans, and Tsy, undivided (Holocene to Miocene)** Shown on cross sections only.

**Tsy** **Volcaniclastic sedimentary rocks (Pliocene to Miocene)** Poor outcrops of friable, light-tan, fine- to medium-grained sandstone and conglomerate in Mooney Basin. Sandstone consists primarily of quartz and biotite grains with calcareous cement. Conglomerate clasts, typically less than 1 inch (2.5 cm) but as wide as 6 inches (15 cm), include Paleozoic limestone and sandstone, jasperoid, and Oligocene to Eocene igneous rocks. Clasts in conglomerate are subrounded to angular and poorly to moderately sorted. Where unit crops out, dips 14° to east-northeast. Probably makes up most of the fill in Mooney Basin. Thickness unknown.

**Tls** **Landslide deposit (Pliocene to Eocene)** Blocks of brecciated, mostly Devonian and Mississippian rocks intruded by Jurassic intrusive rock in the central part of the map area and east of the Dynasty fault. Paleozoic and Jurassic rocks silicified prior to landslide. Large blocks are labeled: Devonian, Silurian, and Ordovician dolomites, undivided (**DOd**); Guilmette Formation (**Dg**); Pilot Shale, (**MDp**); Joana Limestone (**Mj**); Chainman Shale, Pilot Shale, Guilmette Formation, undivided (**Mch/MDp/Dg**), shown with stipple pattern. Chainman and Pilot Shales, undivided (**Mch/MDp**) are shown as making up most of the landslide. Landslide in part due to detachment along dip slope of Pilot Shale. Blocks locally derived. Age uncertain, may be same as Tch.

**Tch** **Chaotic unit (Miocene to Eocene)** Hanging wall to Ruby fault. Includes slide blocks, debris flows, and fault breccia. Blocks, outlined in dashed line and labeled, include Silurian, Ordovician, and Devonian dolomite, undivided (**DOd**); Devonian Guilmette Formation (**Dg**); Jurassic intrusive rock (**Ji**); Cretaceous(?) to Eocene sedimentary rocks and volcanic rocks (**Tv/TKs**); Devonian-Mississippian Pilot Shale/Mississippian Joana Limestone /Chainman Shale undivided and jumbled (**Mch/Mj/MDp**); upper part of Chainman Shale/lower part of Diamond Peak Formation, undivided (**Mdp/Mch**) are shown as making up most of chaotic unit. Slide blocks up to half a km (quarter of mi) across. Brecciated jasperoid in Water Canyon that has igneous (**Ji?**) and Ordovician Eureka Quartzite fragments is interpreted to be along fault plane of Ruby fault (**Tcf**). Debris flows of Paleozoic rocks and Jurassic intrusive rock in finely milled carbonate matrix are near top of unit (**Tcd**). **Tch** unit interpreted as slide blocks and debris shed off the Ruby fault.

**TPsu** **Tertiary to Paleozoic rocks, undivided** Shown on cross sections only.

**Tv** **Rhyolite flows, quartz biotite tuff, and intermediate-composition flow rock (Lower Oligocene to Eocene)** Crops out in and along edges of Mooney Basin and to west on downdropped block of the Bald Mountain fault. Rhyolite is foliated at less than an inch scale, is porphyritic, and pinkish gray to light brownish gray, and consists of medium-grained quartz, feldspar, and biotite phenocrysts in fine-grained matrix. White quartz-biotite lithic tuff dated to the south in the Alligator Ridge area by $^{40}Ar/^{39}Ar$ analysis on sanidine from reworked tuff at 34.99±0.08 Ma (Nutt, 2000). Rhyolite crops out extensively just east of the map area and lies on Pennsylvanian and Permian rocks; $^{40}Ar/^{39}Ar$ age determinations on biotite from two samples collected from this area gave ages of 36.27± 0.11 Ma and 36.56±0.10 Ma (R.J. Fleck, oral commun., 1999). A shallow quartz-sanidine-biotite rhyolite dike (**Tvl**) from the east side of Mooney Basin is dated by U–Pb of zircon as 35.9±0.1 Ma (Mortensen and others, 2000). Thickness variable, up to tens of feet.

**TKs** **Sedimentary rocks (Tertiary to Cretaceous?)** In Mooney Basin, poorly sorted silicified conglomerate with quartzite and black chert clasts in a fine- to medium-grained quartz sand matrix. Common clasts are boulders to pebbles derived from Mississippian Diamond Peak Formation; pebble- to cobble-sized chert fragments are subordinate, and glassy quartz grains interpreted as derived from Jurassic intrusive rock. Alternatively, glassy quartz may be derived from volcanic rock. Matrix consists of quartz, mostly reworked from sandstone. In places, conglomerate identified by weathered out Diamond Peak Formation clasts on ground surface. Present as scabs along west side of Mooney Basin. Thickness unknown; exposures less than 50 feet (15 m) thick. On west side of Ruby fault, occurs in slide blocks and consist of conglomerate, mudstone, and volcaniclastic rocks. Interpreted as correlative with Eocene rocks at Alligator Ridge (Nutt, 2000).

**TJd** **Dikes (Eocene to Upper Jurassic)** Dikes with quartz phenocrysts in the southeast part of the map area.

**Ji** **Stock (Upper Jurassic)** Light- to medium-gray, medium- to coarse-grained composite quartz monzonite with orthoclase phenocrysts as much as 1 inch (2.5 cm), and locally 2 inches (5 cm) long, distinctive anhedral glassy quartz "eyes," andesine, and biotite; hornblende present in outer margin of the intrusion (Blake, 1964). The stock is Late Jurassic, dated by U–Pb on zircon as 159±0.5 Ma (Mortensen and others, 2000). Stock is elongate in a northwesterly direction and surrounded by a metamorphic aureole as wide as 5,000 feet (1.5 km); contact metamorphosed rocks are hornblende hornfels adjacent to stock and lower-grade albite-epidote hornfels and marble outward. Unit includes dikes of aplite, clay-altered intrusive rock with conspicuous rounded quartz phenocrysts, intermediate-composition intrusive rock, and lamprophyre. Stock underlies low hills.

**Jia** **Aplite (Middle to Lower Jurassic)** White, fine-grained, and sugary aplite exposed as sills along the west side of Bald Mountain. Sills are at contact between the Cambrian Geddes Limestone and Secret Canyon Shale and within Secret Canyon Shale. Best exposure is in the 3 pit where it contains euhedral pyrite and is about 20 feet (6 m) thick. U–Pb age on zircon is 185.9±3.8 Ma, which is considered a minimum age (Mortensen, personal comm., 2001; Mortensen and others, 2000).

**Mdp** **Diamond Peak Formation (Lower Pennsylvanian to Upper Mississippian)** Distinctive clastic unit of sandstone, quartzite, siltstone, shale, conglomerate, and subordinate limestone that is characterized by cliffs of conglomerate. Sandstone and quartzite are medium grained, well sorted, and grayish orange, pale orange, pale yellowish orange, grayish orange to moderate yellowish brown, grayish red to moderate red, and white. Shale and siltstone rarely crop out, but form slopes between outcrops of sandstone beds. Conglomerate is moderate reddish orange, dark yellowish orange, grayish orange and pale yellowish orange; includes both matrix- and clast-supported facies. Most conglomerate is moderately sorted, and contains rounded to subangular pebbles and cobbles in a quartz-sand matrix. Clasts are predominantly quartzite and green and red chert pebbles derived from the Ordovician Vinini Formation that crops out west of map area. Exposed in the east part of the map area; most noticeably forming a cliff on the east side of Mooney Basin. Only lower part of unit is exposed in map area, and is predominantly sandstone, quartzite, and conglomerate.

**Mch** **Chainman Shale (Upper and Lower Mississippian)** Generally forms poor outcrops of shale, siltstone, and thin-bedded limestone along Mooney Basin and in central part of map area. Limestone is micritic and characteristically dark gray on fresh surfaces. Upper part is predominantly poorly exposed grayish-green to black carbonaceous shale with sandstone beds and lenses increasing upward in the section; Black shale exposed in Windfall pit on east side of Mooney Basin. No complete section in the area, but estimated to be about 1,000 feet (300 m) thick in Alligator Ridge area (Nutt, 2000).

**Mj** **Joana Limestone (Lower Mississippian)** Ledge-forming, medium- to coarse-grained, thin- to thick-bedded limestone characterized by abundant crinoid stem fragments and black chert. Forms regular bedding that includes resistant 2–5 cm chert layers. Commonly replaced by moderate-red to very light gray jasperoid; silicified crinoid fragments visible in many jasperoids. Crops out along Mooney Basin and in central part of map area. Labeled Mjj on east side of map area where unit is massive hill of jasperoid. Contact with underlying Pilot Shale is sharp. Thickness uncertain because of silicification and fragmentation, but estimated as about 120 feet (37 m).

**MDp** **Pilot Shale (Lower Mississippian and Upper Devonian)** Slope-forming, poor outcrops of platy, dark-yellowish-orange calcareous siltstone that contains interbedded thin-bedded micritic limestone. Crops out along Mooney Basin and in central part of map area. In many places silicified. Pinches and swells and folds between more competent limestones of the Guilmette Formation and the Joana Limestone. Lower contact with Guilmette Formation is brecciated and silicified. Thickness uncertain due to deformation and silicification; section estimated from drilling by mining company to be 450 feet (137 m).

**Dg** **Guilmette Formation (Upper and Middle Devonian)** Cliff-forming, massive to thick- and thin-bedded, fine-grained, medium-gray to medium-dark-gray limestone in eastern part of the map area. Laminated in places, and contains algal structures. Interbedded laminated dolomite and limestone near base. Jasperoid present at top of the unit. Correlative with Devils Gate Limestone and upper part of the Nevada Formation of Nolan and others (1956). Laminated dolomite interbedded with limestone in central part of map area. Lower contact gradational; however, contact typically covered. Thickness uncertain due to breccia and fault zones parallel or nearly parallel to bedding; estimated to be about 1,500 feet (457 m) to the south at Alligator Ridge (Nutt, 2000).

**Dsi** **Simonson Dolomite, undivided (Middle Devonian)** In this area includes:

**Dsiu** **Upper member** Ledge- and slope-forming, thin-bedded dolomite characterized by distinctive alternating grayish black to black and light brownish gray and light gray laminations. Lower contact placed where laminated dolomite becomes dominant rock type. Thickness variable from 250 to 550 feet (75 to 168 m).

**Dsil** **Lower member** Cliff- and ridge-forming, light-brownish-gray, medium- to coarse-grained, sugary, thick-bedded and commonly laminated, dolomite. Sandy beds containing frosted, medium-grained quartz grains near base. Best exposed in the southeast part of map area. Lower contact placed at topographic break that corresponds with grain size and color change. Thickness variable from 300 to 600 feet (90 to 180 m).

**Dse** **Sevy Dolomite (Lower Devonian)** Slope- and saddle-forming, uniform, very light gray to white, very fine grained, thin- to medium-bedded, laminated dolomite with floating frosted sand grains and fine-grained sandstone lenses in upper part. Exposed in the southeast part of map area. Lower contact, transitional over about 10 feet (3 m), placed at change of slope and change to uniform very light gray to white color. Varies from 175 to 250 feet (50 to 75 m) thick; thins to the north.

**DOd** **Devonian, Silurian, and Ordovician dolomites, undivided (Lower Devonian to Upper Ordovician)** Ledge- to ridge-forming dolomite of variable color, texture, and bedding. Lowest part is light-gray to medium-light-gray, fine-grained to medium-grained, thin- to thick-bedded and commonly laminated dolomite and mottled, medium-light-gray, fine- to medium-grained and brownish gray-dolomite. The lower rocks overlain by ridge-forming, light-gray, medium-grained, medium-bedded to thick-bedded dolomite. Overlying these distinctive rocks is a mix of very light gray and fine-grained dolomite, very light gray, medium-grained, sugary dolomite, brown, thin- to thick-bedded dolomite, and mottled brownish-gray dolomite. Unit includes Fish Haven Dolomite where not mapped separately, Laketown Dolomite, and the lower part of what Rigby (1960) mapped as Sevy Dolomite. Section best exposed in the southeast part of the map area although upper contact is faulted out; elsewhere, only faulted and/or brecciated sequences are present. Thickness estimated at about 1,400 feet (427 m).

**Ofh** **Fish Haven Dolomite, lower part (Upper Ordovician)** Ledge-forming, thin- to thick-bedded, fine- to medium-grained, fetid, pale-brown dolomite containing abundant black chert lenses and fossil fragments. Chert is moderate red to black on the surface and gray to black on fresh surfaces, and is along bedding. Mapped as separate unit only in southern part of map area; elsewhere included in DOd. Upper contact gradational, but shows up well by color change on air photos. Thickness estimated at 300 to 400 feet (91 to 122 m).

**Psu** **Paleozoic rock, undivided (Ordovician to Cambrian)**

**Oe** **Eureka Quartzite (Upper and Middle Ordovician)** Thick-bedded to massive, cross-bedded, fine-grained, distinctive vitreous quartzite. White, weathers grayish pink. To the south of map area (Nutt, 2000) and at the most southern part of the map area, undeformed sequences are about 230 feet (70 m) thick. In the map area, many exposures are tectonically brecciated and thinned, and in places form discontinuous boudins between underlying Ordovician Pogonip Group and overlying Fish Haven Dolomite.

**OC** **Pogonip Group and/or Windfall Formation, undivided (Middle Ordovician to Upper Cambrian)** Mapped only in northeastern part of map area.

### Pogonip Group

**Op** **Pogonip Group, undivided (Middle and Lower Ordovician)** in this area includes:

**Opu** **Informally named upper unit** Mapped where present between middle member and overlying Eureka Quartzite. Ledge-forming, thin-bedded, fossiliferous, silty limestone. Upper contact sharp and placed at base of prominent cliff of Eureka Quartzite. Estimated from drilling by mining company to be 430 feet (130 m) thick.

**Opm** **Informally named middle unit** Slope- and ridge-forming, thin-bedded, light-gray, medium-grained silty limestone that contains thin beds and lenses of resistant sandstone. Moderate reddish orange to moderate reddish brown, fine to medium grained, sandstone typically present in lenses and beds up to 10 inches (25cm) thick. Probably correlates with classic Ninemile Member of Nolan and others (1956). Not present everywhere; best exposed on Big Bald Mountain. Unit thickness estimated from drilling by mining company to be about 350 feet (107 m).

**Opl** **Informally named lower unit** Ledge-, cliff-, and slope-forming, thin- to thick-bedded and massive, medium-light-gray to medium-bluish-gray, medium-grained limestone with abundant grayish-yellow silt lenses and very pale orange knobby chert. Rip-up conglomerates common. Less silty upward. Cliff-forming limestone toward the top. Lower contact gradational. Thickness extremely variable; estimated at about 1,000 feet (305 m).

**Cw** **Windfall Formation, undivided (Upper Cambrian)** In this area includes:

**Cwb** **Bullwacker Member** Ledge- to cliff-forming, thick-bedded to massive, medium-dark gray, medium-grained limestone including sparse silty or sandy detritus. Stromatolitha abundant. Near the top, brecciated and altered to medium-dark-gray dolomite. Exposed on Big Bald Mountain and on south side of Bourne Canyon. Thins or is absent north of Big Bald Mountain. Lower contact commonly tectonically brecciated. Upper contact brecciated and disconformable and interpreted by Placer Dome geologists as erosional and karst-related; may in places be tectonic. Thickness variable, estimate from drilling by mining company is as thick as 640 feet (195 m).

**Cwc** **Catlin Member** Ledge- and slope-forming, medium-gray to medium-bluish-gray, fine- to medium-grained, thick- to thin-bedded limestone containing black chert lenses along bedding. In lower part, limestone interbedded with thin-bedded grayish- or dark-yellowish-orange shale and silt. In upper part, limestone interbedded with moderate-reddish-orange siltstone and fine-grained sandstone lenses. Sandstone and siltstone commonly observed only as float. Thin-bedded black chert at base is present only on Little Bald Mountain. Metamorphosed to calc-silicate mineral assemblages near Jurassic stock. Lower contact placed at slope change and appearance of black chert. In places, thins or missing; upper contact in these areas is interpreted as low-angle fault, but may be erosional. Estimated thickness from drilling by mining company is 275 feet (84 m); apparent thicker section near Big Bald Mountain and on grassy slopes with poor exposure is interpreted as due to folding or faulting.

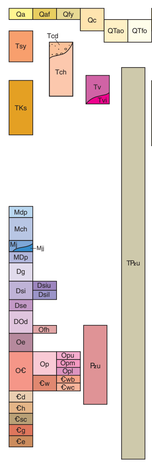
**Cd** **Dunderberg Shale (Upper Cambrian)** Light-olive-gray shale and interbedded light-bluish-gray, fine- to medium-grained, thin-bedded limestone with numerous trilobite fragments. Limestone abundant in upper part of the unit where knobby limestone contains aphanitic dark-gray limestone concretions about 3 inches (8 cm) in diameter. Forms rounded grassy ridges, commonly covered by chips of shale, as at Little Bald Mountain. In open pits exposures, show limestone is more abundant than is apparent in outcrop. Metamorphosed to calc-silicate mineral assemblage near stock. Lower contact with Hamburg Formation is replaced by jasperoid. Estimated thickness from drilling by mining company is about 1,200 feet (365 m).

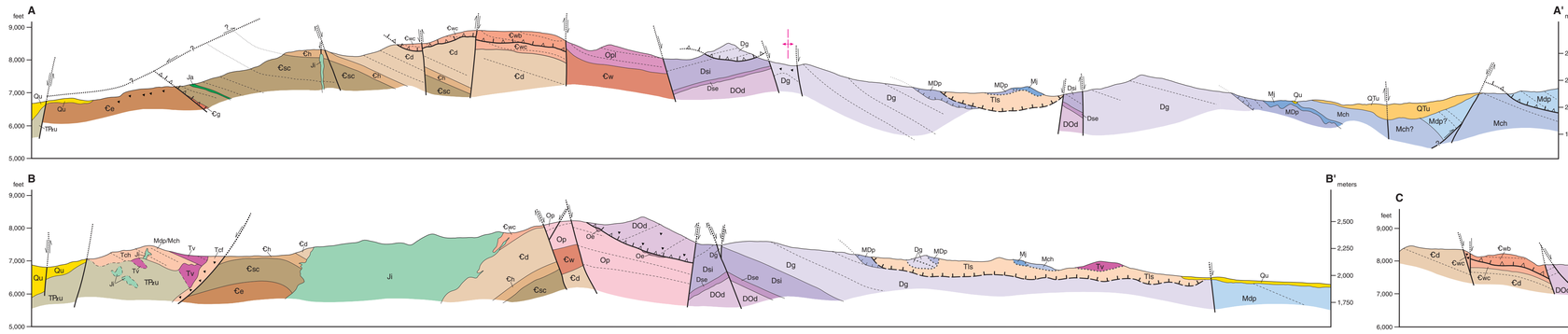
**Ch** **Hamburg Formation (Upper to Middle Cambrian)** Prominent ledge of relatively uniform, medium-blue-gray, fine- to medium-grained limestone. The formation is dolomite at type location near Eureka, Nevada (Nolan and others, 1956). Differs from other Cambrian units by lack of chert and minor clastic content. Due to its high carbonate content, recrystallizes easily to light-gray to light-blue gray marble and is cut by calcite veins. Thin- to thick-bedded and massive; sandy laminations give it a banded appearance in places. Contact gradational; placed at base of prominent ledge. Estimated thickness from drilling is 200 to 300 feet (60 to 90 m).

**Csc** **Secret Canyon Shale (Middle Cambrian)** Shale, siltstone, and limestone. Lower part crops out poorly, is slope forming, and consists of shale, reddish-orange siltstone, and interbedded light-bluish-gray limestone. Shale is pale reddish brown, contains abundant trilobites, and is best exposed in roadcuts. Shale or siltstone float is phyllitic locally, but in general is not regionally metamorphosed. Upper part is ridge-forming silty limestone with inches-thick siltstone interbeds; silt decreases upward. Near top, includes pale-orange chert lenses. Crops out on west side of Big Bald Mountain. Lower contact, where exposed in 3 pit, is marked by aplite sill. Estimated thickness from drilling by mining company is 2,410 feet (734 m); lower part is about 1,740 feet (530 m) and upper part is about 670 feet (204 m).

**Cg** **Geddes Limestone (Middle Cambrian)** Poorly exposed, thin-bedded, carbonaceous silty limestone along west edge of Big Bald Mountain and best exposed in 3 pit. Lower contact with Eldorado limestone is jasperoid. In pit, aplitic sill is along upper contact. Thickness about 150 feet (46 m).

**Ce** **Eldorado Formation (Middle Cambrian)** Moderate-light-gray to moderate-bluish-gray, fine- to medium-grained, thick-bedded to massive limestone and light brown, medium-grained, thick-bedded to massive dolomite. Dolomite predominant in brecciated rock, and may be alteration product of limestone. Brecciated jasperoid cemented by druxy quartz veins and aphanitic quartz matrix is found below the overlying Geddes Limestone. Only upper part of unit crops out in northwest part of map area, where about 150 feet (46 m) of unit is exposed in the 3 pit. Lower contact not exposed.




Scale 1:24,000

0 0.5 1 kilometer

0 0.5 1 mile

0 1000 2000 3000 4000 5000 feet

CONTOUR INTERVAL 40 FEET (Big Bald Mountain)
CONTOUR INTERVAL 10 METERS (Tognini Spring)
Supplementary Contour Interval 2.5 meters

Base map:
U.S. Geological Survey
7.5' quadrangles:
Big Bald Mountain, 1990 and
Tognini Spring, 1982.
Projection:
Nevada Coordinate System,
east zone (Transverse Mercator),
1927 North American datum.

Field work performed from 1997–2002.

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*Field Review:* Chris Henry, NBMG; Jon Price, NBMG; Keith Howard, USGS, Menlo Park; Chuck Thorman, USGS (Ret.); Larry McMaster, consultant for Placer Dome, NA, Inc. at Bald Mountain.

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**Lithologic contact** Dashed where approximately located, dotted where concealed.

**Slippage contact** Marked by breccia, small-scale folds, and bedding discordance but overall offsets minor. Bars on upper plate. Correlative with attenuation faults shown by Nutt (2000) in Devonian and Mississippian rocks in the Alligator Ridge area.

**Landslide contact** Dashed where approximately located, tick marks on landslide deposit.

**Fault** Bar and ball on apparent downdropped block. Dashed where approximately located, dotted where concealed.

**Thrust fault** Sawteeth on upper plate. Dashed where approximately located.

**Low angle faults that place younger over older rocks** Bars on upper plate. Dashed where approximately located, dotted where concealed. Range from bedding parallel to bedding discordant. Bedding-parallel correlative with attenuation faults of Nutt (2000).

**Block outline**

**Bedding on cross section**

**Syncline axial trace** Dashed where inferred or approximately located.

**Anticline axial trace** Dashed where inferred or approximately located.

**Area disturbed by mining**

**Open pit**

**Strike and dip of beds**

41 Inclined ⊕ Horizontal

**Breccia**

**Sample location for isotopic geochronologic determination;** see table 1