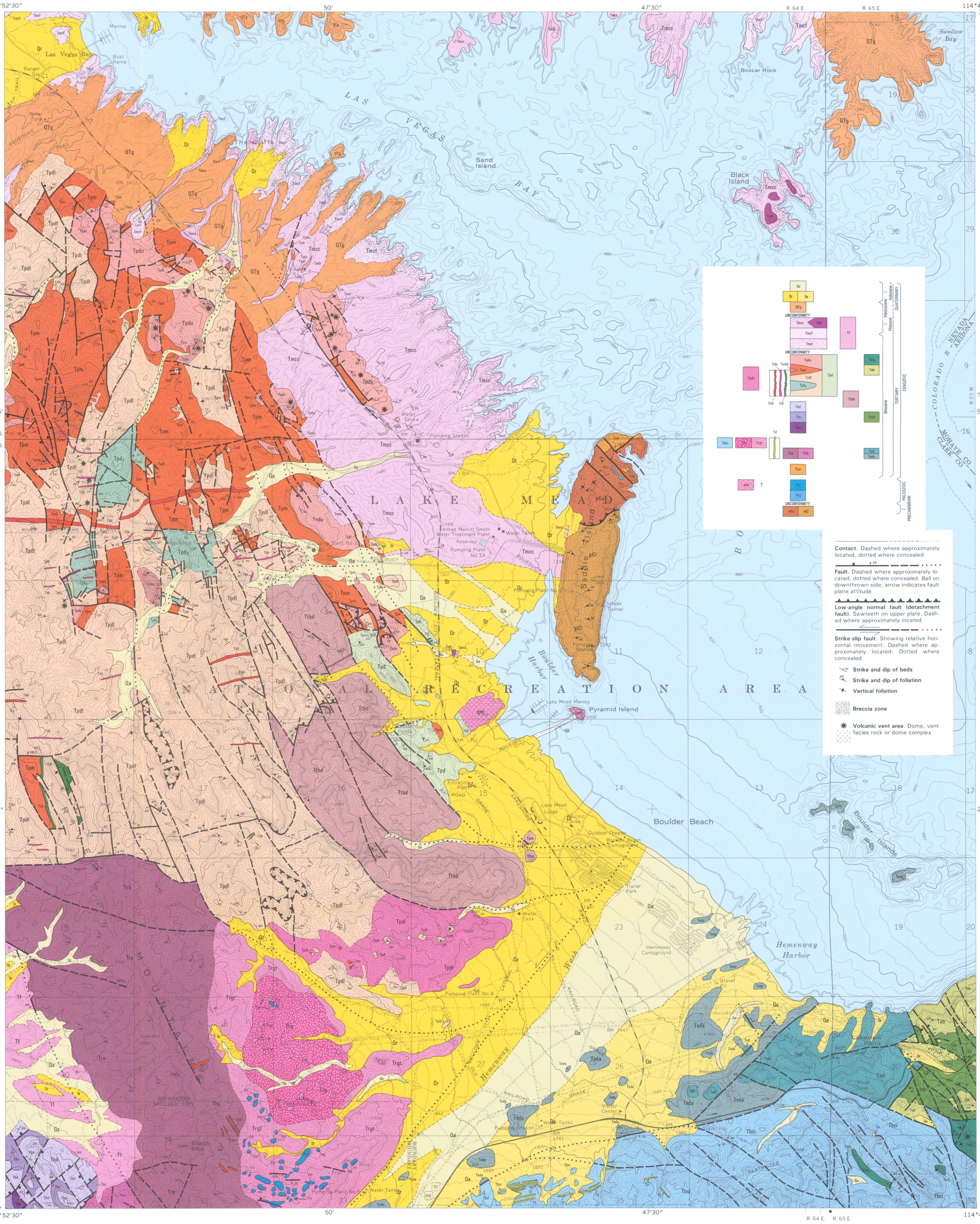

GEOLOGIC MAP OF THE BOULDER BEACH QUADRANGLE, NEVADA

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LITHOLOGY

SEDIMENTARY ROCKS

QUATERNARY DEPOSITS

Qa **Modern wash deposits.** Mostly unlithified, poorly to moderately sorted wash gravel deposits. Poorly to moderately stratified; generally < 3m (10 ft) thick.

Qr **Pediment and fan deposits of the River Mountains.** Silty, sandy pebble to cobble gravel; poorly to nonindurated; composed mainly of dacite clasts with locally high concentrations of basalt and volcaniclastic sedimentary clasts. Poorly to very poorly sorted; poorly to moderately stratified. Equivalent to Qr_1, Qr_2, and Qr_3 of Bell and Smith (1980).

Qe **Pediment and fan deposits of the Eldorado Mountains.** Sandy pebble to cobble gravel. Poorly to nonindurated; composed mainly of altered and nonaltered dacite, pyroxene basalt, ash-flow tuff and locally abundant clasts of volcaniclastic rock.

QUATERNARY-TERTIARY DEPOSITS

QTg **Older alluvial fan deposits.** Sandy pebble to boulder gravel composed mainly of dacite and pyroxene-basalt clasts. Fan surfaces are well dissected and characteristically consist of rounded linear ridges. Poorly to very poorly sorted; poorly to moderately stratified; moderately indurated. Deposits typically unconformably overlie Tmcc and Tmcf and are 1–10 m (3–33 ft) thick.

TERTIARY ROCKS

Tmcc Tmcf Tmcl **Muddy Creek Formation.** Basin-fill sediments of lacustrine and subaerial origin (Longwell, 1963; Longwell and others, 1965). Formation is overlain by basalt flows at Fortification Hill in the Lake Mead area, K-Ar dated at 5.88 ± 0.18 m.y. (Damon and others, 1978). Formation is > 50 m (160 ft) thick and dips gently away from bedrock highs. Tmcc abruptly grades into Tmcf just west of the present Lake Mead shoreline. **Tmcc:** Coarse-grained facies consisting of reddish-brown fanglomerate and well-cemented, coarse, sandy pebble to cobble gravel. Well bedded and consists mainly of felsic volcanic clasts 1–4 cm (½–2 in) in diameter. Beds are 0.3–0.6 m (1–2 ft) thick. **Tmcf:** Fine-grained facies. Dominantly pink to red gypsiferous siltstone, sandy siltstone, and claystone; beds of white siltstone locally occur. The unit forms the prominent badland and bluff topography along the shores of Lake Mead. **Tmcl:** Lower to middle Muddy Creek Formation. Consists of pink to tan coarse-grained fanglomerate; well-cemented, coarse, sandy pebble to cobble gravel. Usually lies directly on bedrock and is separated from overlying Tmcc by an angular unconformity.

Tf **Fanglomerate of the Interior Valley.** Yellowish-brown to reddish-brown fanglomerate. Sandy pebble to cobble gravel composed of volcanic clasts in a calcareous matrix. Poorly sorted; moderately to well bedded with 1–15 cm (½–6 in) thick beds common; well indurated. Contains one or more tuff layers 15 cm (6 in) thick. Probably equivalent to Tmcc.

Tcsi **Conglomerate of Saddle Island.** Well indurated, poorly sorted and bedded conglomerate. Contains clasts (< 1 cm–40 cm [< ½–12 in] in diameter) of carbonate, quartzite, and plutonic and volcanic rock in a silty to sandy matrix. Unit crops out only in the northern part of Saddle Island where it overlies brecciated amphibolite, schist, and granitoid intrusive rock. Carbonate clasts contain brachiopod, coral, and crinoid fossils that suggest a Mississippian age for the clasts.

PALEOZOIC ROCKS

Pzl **Paleozoic limestone.** Exotic blocks of fine-grained, thinly bedded limestone that were structurally emplaced into the southern margin of the River Mountain stratovolcano by movement along the Lake Mead shear zone (Smith, 1982). The exposures are intruded by dikes related to the River Mountain stock. The age of the limestone is uncertain, but it in part resembles the Banded Mountain Member of the Bonanza King Formation (Cambrian). The limestone and adjacent igneous rock are commonly cut by veins of barite and magnetite; iron-oxide and manganese-oxide mineralization is widespread.

Pzq **Quartzite.** Medium- to fine-grained, massive reddish-brown orthoquartzite; locally crossbedded. Quartzite contains fragments of schist and other metamorphic rock types. The unit is 5–10 m (16–33 ft) thick and lies on Precambrian basement and a breccia containing Precambrian clasts. Probably equivalent to the Tapeats Sandstone (Cambrian).

PLUTONIC, METAMORPHIC, AND DIKE ROCKS

MID-TERTIARY ROCKS

Tpdi **Intrusive rocks of Powerline Road.** Highly brecciated plagioclase-biotite-bearing dacite. Locally contains xenoliths or roof pendants (up to 50 m [160 ft] in diameter) of relatively unbrecciated dacitic and basaltic country rock.

Trg **Quartz monzonite of the River Mountain stock.** Composite pluton composed of fine- to medium-grained plagioclase-, orthoclase-, and biotite-bearing quartz monzonite. Fine-grained varieties near margin of pluton resemble dacite. Includes many large xenoliths (3 m [10 ft] in diameter) of dark basaltic volcanic rock and limestone (Pzl). Dikes of porphyritic dacite radiate from the plug; only a few of the most prominent are shown on the map. The pluton is distinguished chemically from the surrounding alkalic volcanic pile (Tra) by its subalkalic composition.

Trgt **Border zone about the River Mountains stock.** Complex transition halo composed of many porphyritic dacite dikes that intrude highly altered and mineralized andesite of the River Mountain stratovolcano and limestone blocks (Pzl). Alteration mainly argillic and ferric; in many places the original rock texture is obscured by alteration. Contact between border zone and stock drawn where plutonic rock no longer predominates. Contact between border zone and volcanic rocks of River Mountain (Tra) drawn where relatively unaltered volcanic rock predominates over highly altered and intruded rock. Both of these contacts are approximately located.

Tbci **Boulder City pluton.** The Boulder City pluton (Anderson, 1969) is part of a large composite batholith. Most of the rock is light-gray, fine- to medium-grained, porphyritic, nonfoliated quartz monzonite containing biotite and hornblende as major mafic constituents.

Tdd Tdb Tdl Td **Dikes. Tdd:** Dikes of dacite that vary in width from 1 to 150 m (3.3 to 490 ft) and in length from 200 m to 3.2 km (650 ft to 2 mi). The rock is aphyric to porphyritic with plagioclase and biotite as dominant phenocrysts. **Tdb:** Dikes of basalt and andesite usually < 3 m (10 ft) wide. Usually fine grained but some dikes contain large phenocrysts of pyroxene or long needles of hornblende. The density of Tdb dikes, especially within the Tpdl, is much greater than depicted on the map. **Tdl:** Dikes and flows(?) of highly alkalic, biotite-, pyroxene-, and plagioclase-bearing lamprophyre (kersantite). Rock is usually dark green to purplish gray and contains biotite phenocrysts up to 1.2 cm (½ in) in diameter. **Td:** Closely spaced dikes that intrude the Boulder City pluton (Tbci). Dikes vary in composition from fine-grained quartz monzonite to pyroxene-bearing basalt.

PRECAMBRIAN ROCKS

p€u p€l **Metamorphic and plutonic rocks of Saddle Island.** Precambrian basement rocks on Saddle Island are separated into two units by a major low-angle detachment fault (Smith, 1982). **p€u:** Basement terrane in the upper plate of the detachment structure. Composed of amphibolite and chlorite schist with steeply dipping foliation intruded by red granite and leucogranite of unknown age and Tertiary(?) dacite and basalt dikes and stocks. In many areas the density of intrusions is so great that basement exposures are rare. All intrusions are rootless (i.e., sliced off by the low-angle fault that passes beneath this terrane). **p€l:** Basement terrane in the lower plate of the detachment structure. Composed of amphibolite and chlorite schist locally intruded by muscovite-bearing pegmatite dikes. Foliation generally strikes east-west and is gently dipping. Broad east-trending antiforms and synforms characterize this terrane; however, complex east-vergent folds are present in the southern part of the island.

ROCK UNIT OF UNKNOWN AGE

qmi **Quartz monzonite of Pyramid Island.** Fine-grained quartz-, plagioclase-, orthoclase-, biotite-quartz monzonite cropping out only on Pyramid Island and on hill 1398 just north of the Lake Mead Marina. On hill 1398 the rock is severely brecciated. May be equivalent to the plutonic rocks of the River Mountains stock or to intrusions in the upper plate of the detachment on Saddle Island.

VOLCANIC ROCKS

MID-TERTIARY ROCKS IN THE RIVER MOUNTAINS

Tmf **Fortification Hill basalt.** Basalt flow containing phenocrysts of plagioclase, olivine (altered to iddingsite), and clinopyroxene. Interbedded with Tmcc.

Tpdu Tpm Tpdl Tpd Tpd_2 Tpmd **Volcanic rocks of Powerline Road. Tpdu:** Flows and domes of texturally variable, gray-purple to tan biotite-, plagioclase-, and hornblende-bearing dacite. Closely associated with debris-flow and carapace breccia, pyroclastic flows, and base-surge deposits. The unit consists almost entirely of volcanic domes and associated fragmental rocks. Dome rock is flow-banded subalkalic dacite; however, several source areas in the eastern part of the range erupted pyroxene-hornblende and pyroxene-hornblende-biotite andesites and dacites (W/2 S4,T22S,R64E). Domes and dome complexes are depicted on the map with an asterisk. Tpdu commonly rests unconformably on Tpm (i.e., on hill 1946 in the northeast part of the range), but in other localities the contact appears to be conformable (east of hill 1785). Where the contact is unconformable it is mapped as a low-angle fault. **Tpm:** Basalt and andesite flows. Three varieties crop out in the map area: 1) porphyritic alkalic basalt with clinopyroxene, plagioclase, and olivine (altered to red-brown iddingsite) as major phases; 2) andesite with large laths of hornblende (up to 1.5 cm [0.6 in] in length) set in a grayish-purple-red matrix. A thick accumulation of basalt, basaltic agglomerate, and debris-flow breccia preserved in a horst in the south tier of sections of T21S,R65E represents a vent area for Tpm. **Tpdl:** Numerous flows of texturally variable dacite, interbedded with epiclastic sandstone, conglomerate, and debris-flow units. The unit is white-gray to gray-black to light green and is commonly intruded by dikes of basalt, andesite and dacite. Unit is locally zeolitized and mineralized. **Tpd:** Powerline Road dacite, undifferentiated. **Tpd_2:** Grayish red to light-gray flows of subalkalic dacite with plagioclase, biotite, and hornblende as phenocrysts. The unit is characterized by numerous xenoliths of dark-gray pyroxene-bearing andesite and basalt. **Tpmd:** Thin beds of air-fall and waterlain ash of dacitic composition that are interbedded with Tpm.

Tbd Tbs Tba **Volcanic rocks of Bootleg Wash. Tbd:** Flows of gray to grayish-red, flow-banded subalkalic dacite with plagioclase, biotite, hornblende, and quartz phenocrysts. The unit is at least 60 m (200 ft) thick. **Tbs:** Gray to red epiclastic sedimentary rock containing well-bedded and well-sorted sandstone, conglomerate, and breccia. Some beds are rich in pumice lapilli; others contain abundant clasts of volcanic and plutonic rock. Mainly deposited by debris flows but some of the deposit may be waterlain. The unit is locally interbedded with a plagioclase- and biotite-bearing dacite. **Tba:** Dark-gray flows of andesite and andesite breccia. The unit has a minimum thickness of 25 m (80 ft). Plagioclase is the dominant phenocryst. Some units are weakly flow banded.

Ttbd **Dacite of Teddy Bear Wash.** Massive accumulations of debris-flow and flow breccias containing clasts of alkalic dacite. Dacite is gray-purple in color and contains phenocrysts of plagioclase, biotite, and hornblende. Ttbd may be equivalent in age to the volcanics of Bootleg Wash or in part to Tpdl. Unit represents an early episode of dacite dome eruption on the flanks of the River Mountain stratovolcano and forms the prominent cliffs to the west of the Boulder Beach Marina.

Trm **Volcanic rocks of Red Mountain.** Highly altered and oxidized gray to light-red porphyritic intermediate lavas. The unit is cut by numerous dark-colored plagioclase- and biotite-bearing intrusions.

Tra **Volcanic rocks of River Mountain.** Numerous flows of dark gray to black porphyritic alkalic andesite, each 1–5 m (3–15 ft) thick. Flows are cut by numerous sills and dikes of dark-gray plagioclase-and biotite-bearing dacite. Plagioclase phenocrysts in the intrusions characteristically have a greenish tint. The unit forms the flanks of the River Mountain stratovolcano.

MID-TERTIARY ROCKS OF THE HOOVER DAM AREA

Ted_2 **Dacite.** Flows, domes, and dikes of biotite- and hornblende-bearing dacite. Major exposure in the Boulder Beach quadrangle forms an elongated dome just to the west of Hoover Dam. Equivalent to the biotite latite of Ransome (1923).

Teb **Basalt and andesite.** Dark-grayish-red to black flows of andesite and basalt containing plagioclase, clinopyroxene, and olivine (usually altered to iddingsite). Equivalent to the basic latite and basalt of Ransome (1923).

Tthd **Tuff of Hoover Dam.** Thick (up to 180 m [600 ft] near Hoover Dam), compositionally zoned, poorly to moderately welded dacite ash-flow tuff. The tuff is gray brown to white and contains phenocrysts of plagioclase, biotite, and hornblende. Eutaxitic texture is common. The tuff is interbedded with volcaniclastic and debris flow units. Its source is probably in the immediate vicinity of Hoover Dam. Mapped as the latite flow breccia and spillway breccia by Ransome (1923).

Ted **Dacite.** Dark-gray-black flows of fine-grained biotite-plagioclase-bearing dacite locally interbedded with debris flow breccias and volcaniclastic sedimentary rocks (sometimes containing clasts of plutonic rock).

Teda **Highly altered dacite.** Flows of white to red dacite; highly altered and locally mineralized. Underlies Ted but the nature of contact is obscure; it may be a low-angle fault. Both Ted and Teda are probably equivalent to the Patsy Mine volcanic rocks in the Eldorado Mountains (Anderson, 1977).

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Scale 1:24,000

0 0.5 1 KILOMETER

0 0.5 MILE

CONTOUR INTERVAL 40 FEET

DATUM IS MEAN SEA LEVEL

Lake level was 1175 feet during the geological mapping of the quadrangle.

Base map: U.S. Geological Survey Boulder Beach 7½′ quadrangle, 1970
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