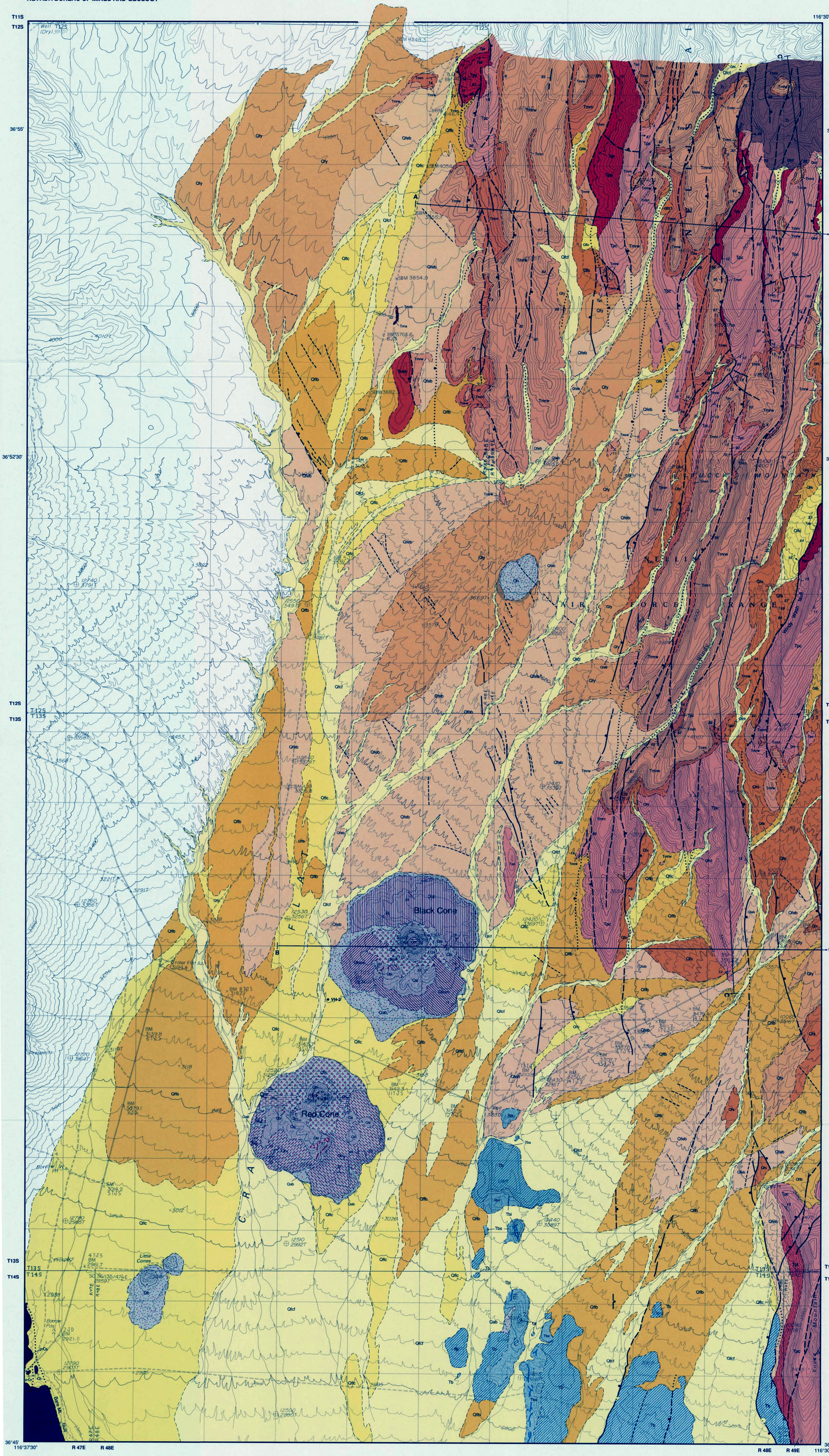
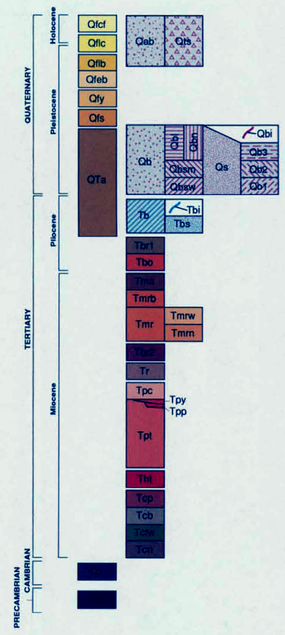
NEVADA BUREAU OF MINES AND GEOLOGY

MAP 101 GEOLOGIC MAP OF THE CRATER FLAT AREA, NEVADA PLATE 1





MAP SYMBOLS

Lithologic contact, approximately located.

Moderately to steeply dipping normal fault Showing dip and trend of striae (arrow); ball on downthrown side. Dashed where approximately located or inferred. Dotted where concealed.

Structural lineament Possible fault or fracture in alluvium.

Strike and dip of bedding or layering

- Inclined
- Vertical
- Horizontal

Strike and dip of foliation in volcanic rocks

- Inclined

Drill hole

- VH-2

Qbn, Qbl, Qbsm, Qbsw **Lava flows of Black Cone** **Qbn**: Aa and block basalt flows erupted from scoria mounds directly north of Black Cone; up to 35 m thick. **Qbl**: Basaltic lava lake on Black Cone probably produced by lava fountaining at summit of Black Cone; basalt locally grades into agglutinated spatter; contains sparse inclusions of Paintbrush Tuff (?). K-Ar feldspar concentrate age of 1.09 ± 0.12 Ma (M. Shafiqullah, written commun., 1991). **Qbsm**: Scoria mound basalt flows; aa and block flows erupted from scoria mounds south and southeast of Black Cone; up to 25 m thick. K-Ar feldspar concentrate age of 0.71 ± 0.06 Ma. **Qbsw**: Southwestern basalt flows; aa and block flows erupted from near the base of Black Cone.

Qb3, Qb2, Qb1 **Lava flows of Red Cone** **Qb3**: Basalt flows erupted from base of Red Cone; aa and block flows east and west of Red Cone; probably youngest flows associated with Red Cone; approximately 12 m thick. **Qb2**: Aa and block basalt flows south and southeast of Red Cone erupted from scoria mounds southeast of Red Cone; some flows probably fed by dike exposed south-southeast of Red Cone; these flows postdate scoria mounds south of Red Cone; up to 40 m thick. **Qb1**: Aa and block basalt flows erupted from scoria mounds south and southwest of Red Cone; flowed south and southwest from their source.

QTa **Quaternary/late Tertiary alluvium** Yellowish-brown to gray, poorly to moderately consolidated, poorly sorted, pebble to boulder conglomerate; clasts are mainly subangular and consist of volcanic rocks, limestone, dolomite, and quartzite; matrix is mostly silt- and sand-size grains of volcanic rocks; weakly cemented by calcite and clay; does not crop out in map area; shown only in cross sections; observed in drill hole USW VH-2 near Black Cone (Carr and Parrish, 1985). Thickness ranges from 0 to at least 300 m.

Tb **Pliocene porphyritic alkali-basalt flows** Contain subhedral to euhedral, partially iddingsitized olivine phenocrysts and lesser amounts of subhedral plagioclase and clinopyroxene phenocrysts set in a matrix of plagioclase, clinopyroxene, and olivine; glomeroporphyritic clots of olivine, augite, and plagioclase common; most flows erupted from a north-trending fissure in southeastern Crater Flat; K-Ar ages cluster around 3.7 Ma (Vaniman and others, 1982). Thickness estimated at 0 to 50 m.

Tbi **Pliocene alkali-basalt dikes intruding Tbs** Contain subhedral to euhedral, partially iddingsitized olivine phenocrysts and lesser subhedral plagioclase and clinopyroxene phenocrysts in matrix of plagioclase, clinopyroxene, and olivine. Glomeroporphyritic clots of olivine, clinopyroxene, and plagioclase are common.

Tbs **Pliocene pyroclastic deposits** Poorly to moderately welded scoria, ash, bombs, and agglutinated scoria deposited by Strombolian to Hawaiian eruptions; locally intruded by many dikes. Thickness ranges from 0 to 25 m.

Tbr1 **Breccia** Consists mainly of blocks of Paleozoic carbonate and calcareous siltstone; abundant narrow fractures and vugs filled with manganese oxide, quartz, and calcite; probable landslide origin; does not crop out in map area; shown only in cross section; observed in drill hole USW VH-2 near Black Cone (Carr and Parrish, 1985). Thickness ranges from 0 to at least 50 m.

Tbo **Basaltic lava flows and scoria** Dark-gray to reddish-brown basalt and scoria containing phenocrysts of olivine (commonly iddingsitized). Does not crop out in map area; shown only in cross section; observed in drill hole USW VH-2 near Black Cone (Carr and Parrish, 1985); probably correlative with 10.5 ± 0.1 Ma basalts (Swadley and Carr, 1987) present directly south of map area. Thickness ranges from 0 to at least 30 m.

Tma **Timber Mountain Tuff, Ammonia Tanks Member** Single cooling unit of nonwelded to moderately welded ash-flow tuff. White to light-gray nonwelded base grades upward into brownish-gray, moderately welded tuff; contains 5-20% phenocrysts composed of 45-50% sanidine, 10-20% plagioclase, 8-30% quartz, 8-20% biotite, and accessory clinopyroxene, sphene, and hornblende; crops out only in northwestern part of map area; also observed in drill hole USW VH-2 near Black Cone (Carr and Parrish, 1985). Sanidine yielded an $^{40}Ar/^{39}Ar$ age of 11.45 ± 0.03 Ma (D. A. Sawyer, R. J. Fleck, and M. A. Lanphere, written commun., 1993). Thickness ranges from 0 to at least 55 m.

Tmrb **Breccia** Consists primarily of light-brown to purplish-brown blocks of moderately to densely welded Tmr; probable landslide origin; crops out only in northwestern part of map area; thickness ranges from 0 to at least 20 m.

Tmr, Tmrw, Tmrn **Timber Mountain Tuff, Rainier Mesa Member** **Tmr**: Undifferentiated, single cooling unit of nonwelded to densely welded white to light-brown ash-flow tuff; contains 10-25% subhedral to anhedral phenocrysts of sanidine, quartz, plagioclase, biotite, and rare clinopyroxene. Sanidine yielded an $^{40}Ar/^{39}Ar$ age of 11.6 ± 0.03 Ma (D. A. Sawyer and others, written commun., 1993). 90-305 m thick. **Tmrw**: Light-gray to purplish-brown, moderately to densely welded tuff; contains 20-25% subhedral to anhedral phenocrysts composed of 50-65% sanidine, 12-26% quartz, 10-18% biotite, 5-10% plagioclase, and rare clinopyroxene; 90-110 m thick. **Tmrn**: White to light-gray, thinly to massively bedded nonwelded tuff, air-fall, and surge deposits; includes basal nonwelded part of the simple cooling unit of Tmr, as well as all nonwelded tuffs, air-fall, and surge deposits resting between Tmrw and Tpc; contains 10-15% anhedral to subhedral phenocrysts composed of 50-58% sanidine, 19-28% quartz, 13-20% biotite, 5-10% plagioclase, and rare clinopyroxene; thicker in the hanging walls of some normal faults. Thickness ranges from 5 to 180 m.

Tbr2 **Breccia** Light- to dark-gray, subangular to angular fragments of limestone and dolomite and lesser greenish-gray silty limestone; probable landslide origin; does not crop out in map area; shown only in cross section; observed in drill hole USW VH-2 near Black Cone (Carr and Parrish, 1985). Thickness ranges from 0 to at least 60 m.

Tr **Rhyolite flows and domes** Light-gray, crystal rich; contain phenocrysts of plagioclase, quartz, alkali feldspar, and biotite. Crops out only in northeastern part of map area along the margin of the Claim Canyon caldera; probably intruded along the ring-fracture of this caldera. Thickness ranges from 0 to at least 600 m.

Tpc **Paintbrush Tuff, Tiva Canyon Member** Multiple-flow compound cooling unit of nonwelded to densely welded, compositionally zoned rhyolitic to quartz latitic ash-flow tuff; light-gray thin (<5 m thick) basal nonwelded unit grades upward into light-purplish-gray to brown moderately to densely welded tuff, which is typically coated with dark-brown desert varnish; contains 5-20% subhedral to anhedral phenocrysts composed of 80-90% sanidine, 10-15% biotite, and trace amounts of plagioclase, clinopyroxene, and hornblende; phenocryst abundance increases upward in section; lenticular fiamme common. Sanidine yielded an $^{40}Ar/^{39}Ar$ age of 12.7 ± 0.03 Ma (D. A. Sawyer and others, written commun., 1993). Thickness ranges from 90 to 175 m.

Tpy **Paintbrush Tuff, Yucca Mountain Member** Single cooling unit of pale-grayish-brown to brown nonwelded to moderately welded ash-flow tuff; generally devitrified; contains up to 2% subhedral to anhedral phenocrysts of sanidine and lesser plagioclase. Thickness ranges from 0 to 170 m.

Tpp **Paintbrush Tuff, Pah Canyon Member** Single cooling unit of light-gray to pale-brown nonwelded to moderately welded ash-flow tuff; contains 2% anhedral to subhedral phenocrysts composed of 70% sanidine, 15% biotite, 12% plagioclase, and sparse quartz and clinopyroxene. Thickness ranges from 0 to at least 40 m.

Tpt **Paintbrush Tuff, Topopah Spring Member** Undifferentiated multiple-flow, compound cooling unit of nonwelded to densely welded, rhyolitic to quartz latitic ash-flow (see Scott and Bonk, 1984, for comprehensive description); pale-orange-brown, nonwelded base grades upward into purplish-gray to purplish-brown densely welded tuff; contains 2-15% anhedral to subhedral phenocrysts that consist of 70-83% sanidine, 14-23% biotite, 3-7% plagioclase, and up to 3% clinopyroxene; phenocryst abundance increases upward. Sanidine yielded an $^{40}Ar/^{39}Ar$ date of 12.8 ± 0.03 Ma (D. A. Sawyer and others, written commun., 1993). Thickness ranges from 155 to 460 m.

Tht **Tuffaceous beds of Calico Hills** Pale-orange to light-brown nonwelded ash-flow tuffs containing sparse phenocrysts of sanidine, plagioclase, quartz, and biotite; does not crop out in map area; shown only in cross sections. Sanidine yielded an $^{40}Ar/^{39}Ar$ date of 12.9 ± 0.03 Ma (D. A. Sawyer and others, written commun., 1993). Thickness ranges from 0 to 135 m.

Tcp **Crater Flat Tuff, Prow Pass Member** Single cooling unit of nonwelded to slightly welded ash-flow tuff (Scott and Bonk, 1984; Swadley and Carr, 1987). White, nonwelded base grades upward into orange-brown to light-purplish-brown devitrified, partially welded tuff; contains 8-15% phenocrysts of plagioclase, sanidine, quartz, and biotite, as well as traces of hornblende, orthopyroxene, and magnetite; does not crop out in map area; shown only in cross sections. Thickness ranges from 0 to 200 m.

Tcb **Crater Flat Tuff, Bullfrog Member** Single cooling unit of nonwelded to densely welded ash-flow tuff. White nonwelded base grades upward into light-brownish-gray, densely welded tuff; contains ~20% anhedral to subhedral phenocrysts composed of 45-55% sanidine, 15-30% biotite, 10-22% quartz, 5-7% plagioclase, and accessory (<3%) clinopyroxene, hornblende, and magnetite; not exposed in map area; shown only in cross sections. Description based on samples obtained from southeast of Crater Flat. Thickness probably ranges from 100 to 200 m (Swadley and Carr, 1987). Sanidine yielded an $^{40}Ar/^{39}Ar$ date of 13.25 ± 0.04 Ma (D. A. Sawyer and others, written commun., 1993).

Tctw **Crater Flat Tuff, Tram Member** Light-gray ash-flow tuff containing about 10% anhedral to subhedral phenocrysts of quartz, plagioclase, sanidine, biotite, and rare hornblende; not exposed in map area; shown only in cross sections. 0-70 m thick.

Tcn **Crater Flat Tuff, basal nonwelded section** Light-gray to white nonwelded tuffs containing phenocrysts of quartz, plagioclase, sanidine, and biotite; not exposed in map area; shown only in cross sections. 0-140 m thick.

Ꞓb **Bonanza King Formation, undivided (Cambrian)** Cliff-forming, light- to dark-gray dolomite and limestone with sparse silty and sandy intervals; crops out only in southwestern corner of map area. Estimated thickness is 580 m (Monsen and others, 1992).

pЄs **Stirling Quartzite, undivided (Late Proterozoic)** Pale-red to purplish-red, thin- to medium-bedded, fine- to coarse-grained quartzite with some beds of quartz-pebble conglomerate; also ledge-forming, pale-gray to pale-orange, medium- to thick-bedded, commonly laminated coarsely crystalline limestone and dolomite (Monsen and others, 1992). Crops out only in southwestern corner of map area. No estimate of thickness.

Qfcf **Crater Flat alluvium** Active and recently active washes, inset fans, and fan skirts (landforms from Peterson, 1981) erosionally inset below all older units; shallowly incised (<2 m) distributive drainage pattern; preserved to slightly subdued bar and swale topography; unvarnished to slight rock varnish; generally no organized pavement; may have proto-pavement; aerial photo character is distinctive due to rough, raw drainage patterns. Soils are Typic Torriorthents (no significant genetic soil horizons); may have very slight carbonate dustings or filaments on pebble bottoms (stage I). Late Holocene age; a rock varnish ^{14}C age of 1,320 ± 70 years was obtained from slightly varnished Qfcf clasts.

Qfic **Little Cones alluvium** Fan-skirt and low basin-floor remnants forming a large series of surfaces along the main axial drainage through Crater Flat; remnants best preserved near Little Cones basaltic center. Surfaces are fully smoothed with slightly varnished desert pavement; aerial photo character is smooth and light toned. Soils are mainly Torriorthents, but are clearly pedogenic; minimal but distinct desert pavement; thin (<5 cm) Av; calcareous cambic B (Bwk); stage I-II Bk horizons; soils may be classified as Camborthids. Latest Pleistocene to early Holocene age; four rock varnish ^{14}C ages range from 6,645 ± 245 to 11,135 ± 105 years.

Qfib **Late Black Cone alluvium** Fan-piedmont remnants; fully smoothed surfaces with broad, flat interfluves; darkly varnished volcanic clasts and moderately etched limestone clasts in well-sorted, tightly packed desert pavements; aerial photo character is smooth, dark toned, and may have mottling (light spots) from biocoppice development. Soils are Haplargids, locally Haplic Durargids with well-developed 5-6 cm thick Av, 20-30 cm thick sandy loam Bt, and 20-40 cm thick stage II-III Bk horizons. On large remnants between Black Cone basalt and Bare Mountain, soils are Calciorthids and contain cambic (Bw) horizons due to the presence of limestone clasts and/or lack of silicic volcanic detritus. Late Pleistocene (late Wisconsin) age; six rock varnish ^{14}C ages range from 17,280 ± 370 to 30,320 ± 460 years. Three $^{230}Th/^{234}U$ age determinations of samples from the southeastern part of map area range from 17,100 ± 2,500 to 39,400 ± 3,000 years (Peterson and others, in press).

Qfeb **Early Black Cone alluvium** Fan-piedmont remnants; fully smoothed surfaces; surficial and aerial photo characteristics are similar to Qfib, although commonly more deeply dissected and in some cases darker; surficial similarities between the two units typically require identification of inset relations and soil differences to discriminate units. Soils are Typic Durargids in the volcanic alluvium, as well as in limestone alluvium near Bare Mountain; soils have strong, prominent 5-10 cm thick Av, 30 cm thick, locally opalized, clay loam Bt, and 1 m thick Bqkm (duripan; stage IV) horizons. Middle to late Pleistocene age; four rock varnish cation-ratio ages ranging from 159 to 201 ka; one sample yielded a ^{14}C rock varnish age of >40,120 years.

Qfy **Yucca alluvium** Deeply dissected fan-piedmont remnants extensively preserved in the northern part of map area; interfluves are narrow but flat. Distinguished from Qfib and Qfeb units on aerial photos by transverse bands of dark desert pavement, overall lighter tone and generally deeper dissection. Well-developed dark rock varnish and well-sorted, tightly packed desert pavement. Soils are Typic Durargids with strong 7-10 cm thick Av, 40-60 cm thick clay Bt and >1 m thick stage IV Bqkm horizons; Bt horizons locally strongly opalized. Middle Pleistocene age; two rock varnish cation-ratio samples yielded minimum mean ages of 373 and 375 ka.

Qfs **Solitario alluvium** Fully rounded, elongate ridge-line remnants (ballenas); formerly flat-topped interfluves have been erosionally rounded. Irregularly shaped, well-developed, tightly packed desert pavements contain dark varnished clasts intermixed with chips of eroded duripan lamina; aerial photo character distinctive due to broad rounding and light tone. No original soils; original A and Bt horizons have been erosionally stripped forming Typic Durorthids with remnant Bt and stage IV Bqkm horizons preserved. Contains a Bishop-age ash (~730 ka) at one site directly east of map area (M. Reheis, written commun., 1991). Middle Pleistocene age; three rock varnish cation-ratio samples yielded minimum mean ages ranging from 433 to 659 ka.

Qab **Locally derived basaltic alluvium** Unconsolidated, poorly sorted angular gravel and boulders; thin (<1 m) deposits in washes; thicker (1 to 3 m) deposits found near termini of flows; clasts consist of basalt and pyroclastic material shed from local basalt flows, scoria mounds, and cinder cones. Probably late Pleistocene to Holocene age.

Qts **Scoria colluvium** Talus aprons around cinder cones; unconsolidated fragments of pyroclastic material shed from cinder cones and scoria mounds. Estimated thickness ranges from 0 to 15 m. Pleistocene to Holocene age.

Qb **Undifferentiated basalt flows and pyroclastic deposits** Mainly aa and block flows of porphyritic alkali-basalt and lesser bombs, scoria, and ash; contain subhedral to euhedral olivine phenocrysts in a pilotaxitic groundmass of plagioclase, diopsidic augite, and olivine. Feldspar concentrates yielded K-Ar ages of 0.77 ± 0.04 Ma for Little Cones and 1.09 ± 0.07 Ma for the northernmost exposure (M. Shafiqullah, written commun., 1991). All Quaternary basalts are similar in composition to Qb.

Qbi **Porphyritic alkali-basalt dikes and small plugs intruded into Qs** Dikes average 0.5-1.0 m in width, but locally range up to 3 m; plugs are irregular to circular in shape ranging from 3 to 10 m in diameter; generally similar in composition to flows containing phenocrysts of olivine, but small plugs of amphibole-bearing basalt intrude Qs on the flank of the large cone at Red Cone; feldspar concentrates from intrusions into the large cone at Red Cone yielded K-Ar ages of 1.01 ± 0.06 Ma and 0.95 ± 0.08 Ma (M. Shafiqullah, written commun., 1991); a feldspar concentrate from the dike intruding a cinder mound south of the main cone at Red Cone yielded a K-Ar age of 0.98 ± 0.10 Ma.

Qs **Pyroclastic deposits** Major basaltic cinder cones formed from bedded to nonbedded, poorly to moderately welded scoria, ash, bombs, and agglutinated scoria deposited by Strombolian and Hawaiian type eruptions. Thicknesses range up to 60 m. Scoria mounds at Black and Red Cones are mainly <20 m thick accumulations of nonbedded, poorly to moderately welded scoria and volcanic bombs. Sparse inclusions of Paintbrush Tuff found in scoria mound east of Black Cone. Dikes locally cut major cinder cones and scoria mounds.

Base map: U.S. Geological Survey
Crater Flat 7.5' Quadrangle, 1986 and lower portion of East of Beatty Mtn.7.5' Quadrangle, 1987.

Scale 1:24,000

CONTOUR INTERVAL 20 FEET AND 40 FEET

0 0.5 1 kilometer

0 0.5 1 mile

0 1000 2000 3000 4000 5000 feet

See plate 2 for cross sections.
See accompanying text for references and a discussion of stratigraphic and structural framework.

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1994