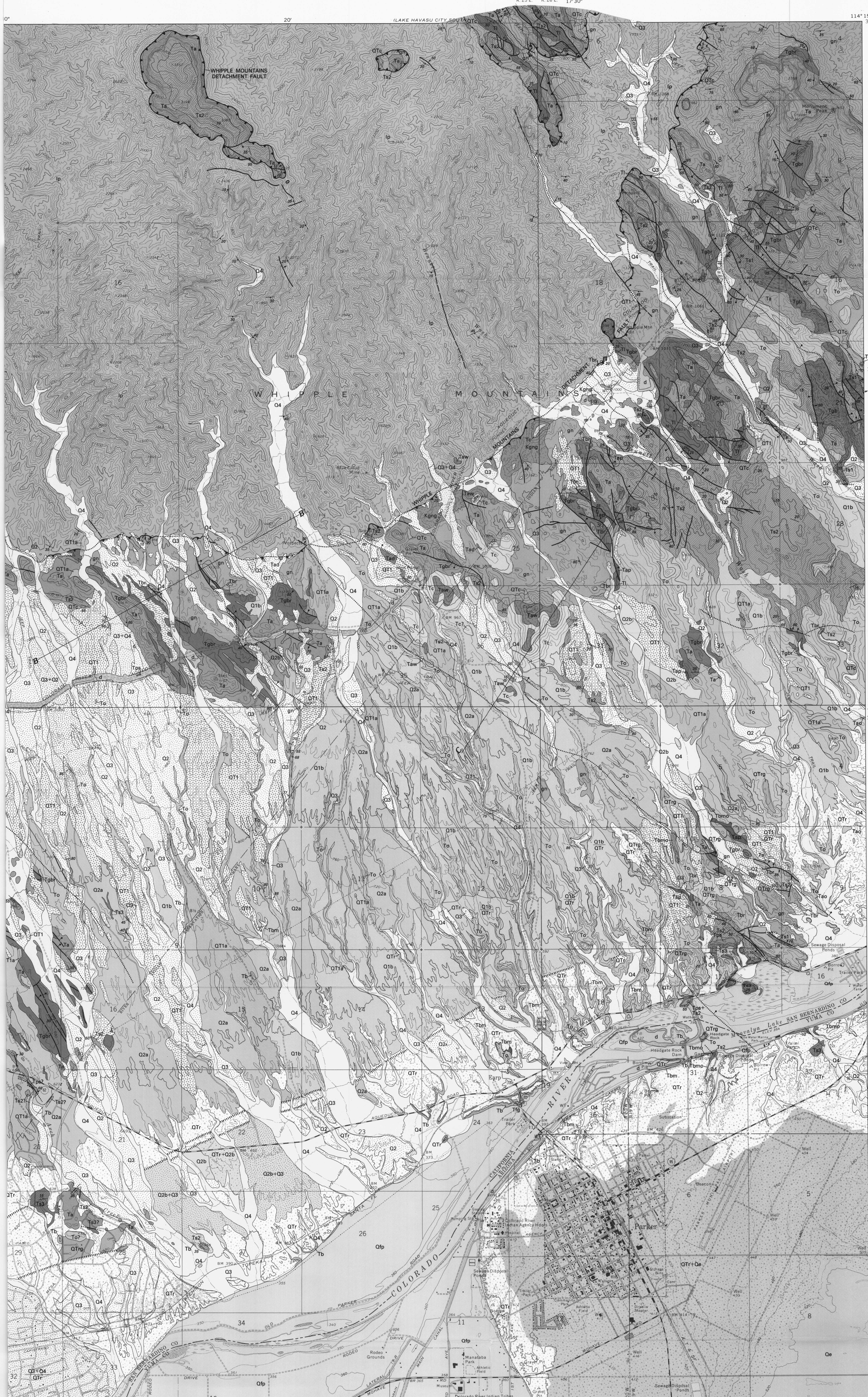


:24 000

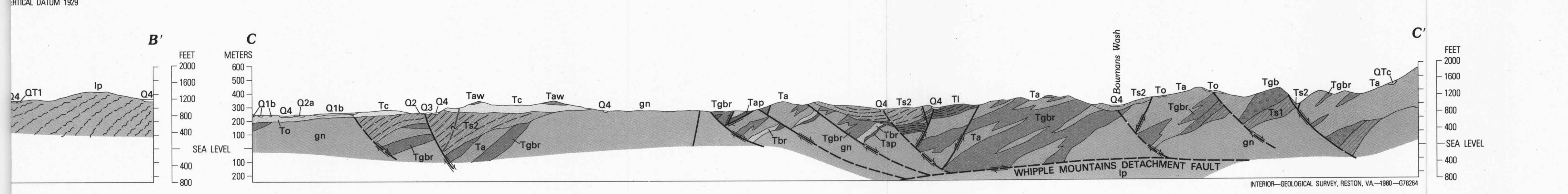
2 3 MILES

2 3 KILOMETERS

20 AND 40 FEET
...T 10-FOOT CONTOURS
...ERTICAL DATUM 1929

QUADRANGLE LOCATION

Bedrock geology mapped by W. J. Carr and W. D. Quinlivan, 1974–76
Alluvial geology mapped by D. D. Dickey 1974–76 with part of the original Quaternary Stratigraphy by W. B. Bull



INTERIOR—GEOLOGICAL SURVEY, RESTON, VA.—1980—G78264

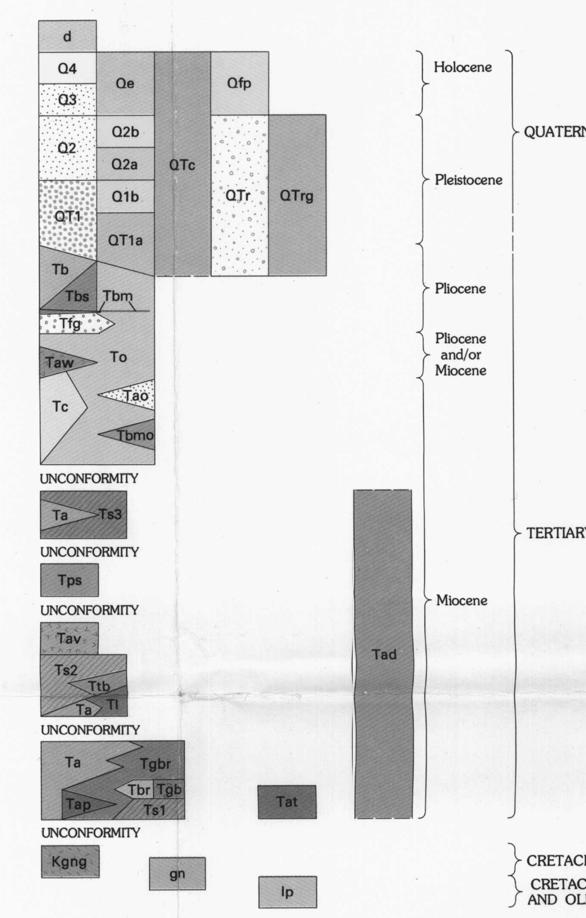
...OUNTAINS SW AND WHIPPLE WASH QUADRANGLES, CALIFORNIA AND ARIZONA

...y

...Carr, and W. B. Bull

...80

CORRELATION OF MAP UNITS



DESCRIPTION OF MAP UNITS

A combined map symbol (Q4+Q3) is used for Quaternary units where two are interlaced in such detail that separate mapping was impractical; the first unit listed predominates in areal distribution.

Fractional symbols (Q4+Q3/QTr) are used where a veneer of the younger units(s) masks, but may not completely conceal, the underlying unit.

Described soil profiles are characteristic of the coarse alluvial deposits derived from volcanic and metamorphic terrain. In a few areas where the source area yields a finer grained material, or where much fine material from reworked river deposits or Bouse Formation is incorporated into the alluvium, the soil profiles are less well developed. The alluvial units are generally poorly bedded, but bedding structures noted appear to conform to the underlying bedrock surface.

Minor unconformities are present throughout the alluvial sequence. They probably represent base-level changes related to alternate periods of downcutting and backfilling by the Colorado River; Q1b and Q2 deposits represent periods of backfilling. No significant unconformities were recognized between units Q2 and Q3 or between Q3 and Q4. The different styles of deposition of Q2b and Q3 may reflect the change from a wetter climate to the present drier one (Bull, 1974). In sec. 22, T. 1 N., R. 25 E., in the Parker quadrangle, Q2b deposits have a soil development no greater than that of some of the older Q3 deposits.

The separation of Q3 and Q4 deposits is arbitrary and does not represent an important regional base level or climatic change. The Q3 designation indicates that the last flood over that area was probably about 2,000 or more years ago.

Units queried where correlation is uncertain.

d DISTURBED GROUND—Ground disturbed by man for agriculture, urban development, gravel pits, and so forth

ALLUVIAL DEPOSITS (HOLOCENE, PLEISTOCENE AND PLIOCENE)

Q4 Recent alluvium (Holocene)—Silt, sand, pebbles, cobbles, and boulders in modern drainage areas. Consists of poorly sorted, angular to subrounded, unconsolidated material of local origin. Age estimated at 0–2,000 years. Thickness generally less than 2 m

Q3 Young alluvium (Holocene)—Poorly sorted angular to subrounded silt, sand, pebbles, cobbles, and boulders of origin similar to that of unit Q4, and generally spatially associated with it. The deposits form bars and channels and have a slight to occasionally dark desert varnish. An incipient soil formation consists of a vesicular, silty A2 horizon and a few centimeters of very light orange-tinted silt and sand with a few pebbles having a very thin partial coating of calcite. Th^{230}–U^{234} and C^{14} dates on calcite gave ages of 6,000 and 7,000 years (Bull, Ku, and Long, 1975), which agree with the age estimated by Bull (1975) on the basis of soil development of 2,000–11,000 years. Q3 deposits are usually less than 1 m higher than unit Q4, except in and very near the mountains, where the elevation difference may be several meters

Q2 Intermediate alluvium, undivided (Pleistocene)—Mapped where subdivision of unit is impractical

Q2b Unit B—Angular to subrounded, fairly well sorted gravel, sand, and silt of local origin. Cobbles and boulders are much less common than in the younger or older units. Surface of Q2b deposits is smooth, darkly varnished, well-sorted, tightly packed pavement. A well-defined soil profile consists of a vesicular silty A2 horizon more than 3 cm thick; a reddish-orange B horizon, usually 10 to 20 cm thick with very minor clay formation; and a Cca horizon as much as 10 to 12 cm thick containing scattered small soft calcite nodules or filaments, and pebbles coated on the underside with as much as 5 mm of calcite. Th^{230}–U^{234} and C^{14} dates (Bull, Ku, and Long, 1975) are 61,000 years and 20,000–25,000 years, which is in general agreement with the 11,000–50,000 years age estimated by Bull (1975) from soil development. Surface is usually less than 5 m above present drainage except in and near mountains. Q2b deposits mapped across the east boundary of sec. 25, T. 1 N., R. 24 E., were deposited on a terrace cut into river deposits and contain very scarce, well-rounded pebbles. Thickness generally less than 3 m

Q2a Unit A—Angular to subrounded, poorly sorted silt, sand, pebbles, cobbles, and boulders of local origin. Pavement is heavily varnished but generally not as tightly packed or as smooth as Q2b surfaces. Some remnant, subdued bar and channel forms are discernible. Soil development is greater than that of Q2b deposits; the vesicular, silty A2 horizon exceeds 3 cm in thickness; the red-orange B horizon, as much as 30 cm thick, contains carbonate mottles and sand grains with clay skins; the Cca horizon, as much as 30 cm thick, contains hard carbonate nodules, interpebble fillings, and carbonate pebble coatings as much as 2 cm thick. Th^{230}–U^{234} dates (Ku, 1975) on seven samples collected from a fan about 5 km east of Vidal Junction range from 74,000 to 93,000 years, which agrees with the 50,000–200,000 years age estimated by Bull (1975) on the basis of the well-developed soil. Q2a surfaces average about 3–5 m higher than present stream channels, but range from surfaces being buried by modern streams to 25 m higher than modern drainages in the mountains. Thickness generally less than 3 m

QT1 Old alluvium, undivided (Pleistocene and Pliocene)—Mapped where subdivision is impractical

Q1b Unit B (Pleistocene)—Angular to subrounded, poorly sorted silt, sand, pebbles, cobbles, and boulders of local origin. Pavement is darkly varnished, poorly sorted, with cobbles and boulders common. Individual cobbles may have a varnish and dark rind as thick as 0.5 cm. Petrocalcic (caliche) fragments are common on the pavement surface and the pavement composition is partly depleted of the more easily disintegrated rock material. A vesicular, silty A2 horizon more than 5 cm thick underlies the pavement. The B horizon is dull red in color, composed of sand and gravel which is clayey in places, and may be as much as a meter thick. The Cca horizon is as much as a meter thick, and continuous impermeable caliche zones are extensive. Th^{230}–U^{234} dates (Ku, 1975) are 66,000 and 176,000 years, which is considerably younger than the 500,000 to 1,000,000 years estimated by Bull (1975) on the basis of soil development. Q1b surfaces are commonly 5–10 m higher than modern stream channels but, like the other alluvial deposits, range from elevations of modern stream channels in some valley locations to more than 25 m higher in the mountains. Commonly, near the mountains, two nearby Q1b surfaces may be as much as 3 m different in elevation. Some of the deposits mapped as Q1b in the southeastern part of the Parker NW quadrangle contain abundant rounded pebbles that may be reworked from older river deposits. Alternatively, these deposits could have originated by reworking of a local gravel by the Colorado River. The first interpretation is preferred, as units Q2a and QT1a of this area also contain common to abundant rounded pebbles. Thickness as much as 3 m

QT1a Unit A (Pleistocene and Pliocene)—Angular to rounded, poorly bedded, poorly sorted silt, sand, pebbles, cobbles, and boulders of local origin. Poorly to locally well indurated. Deposits are usually completely dissected, with no original fan surfaces or soil profiles preserved. Th^{230}–U^{234} ages (Ku, 1975) are 55,000, 131,000, and greater than 300,000 years, the limit of the method. Bull (1975) estimated the age as greater than 1,500,000 years. Thickness may be as much as 30 m

QTc COLLUVIUM (HOLOCENE TO PLIOCENE)—Angular to subrounded, well-cemented, poorly sorted boulders, cobbles, gravel, and sand derived mainly from adjacent bedrock. These deposits are largely late Pliocene and early Pleistocene in age but are still accumulating. Calcite cement is abundant and in some places may constitute more than half the volume of the deposits. Thickness 0–10 m

Qe EOLIAN DEPOSITS (HOLOCENE)—Windblown sand and silt. Reworked largely from Colorado River deposits (QTr) and Bouse Formation (Tb). As much as 5 m thick

COLORADO RIVER DEPOSITS

Qfp Floodplain deposits (Holocene)—Unconsolidated, mostly sand, silt, and clay deposited at flood stage of the Colorado River. Predates construction of dams to control riverflow. Thickness 0–60 m

QTr Old fluvial deposits (Pleistocene and Pliocene)—Moderately to poorly indurated clay, silt, sand, pebbles, cobbles, and marl deposited by the Colorado River. Colors are predominantly shades of red and brown. A thin limestone intercalated in the river deposits south of the Mesquite Mountains (see index map) contains unidentified ostracods, and a plant fossil tentatively identified as *Chara homemannii* Wallman by V. W. Proctor (written commun., 1975). Fossil wood is present in sand deposits south of the Mesquite Mountains. Fine-grained deposits near the Mesquite Mountains have normal paleomagnetic polarity, indicating an age younger than 700,000 years (Kukla, 1975). Terraces at different levels exhibit different degrees of soil formation, indicating a wide range of ages. Some deposits channel into underlying units To, Tb, or other river deposits. Thickness as much as 70 m. A terrace associated with these deposits occurs at an altitude of about 480 feet (144 m) on the west side of the Colorado River

QTrg Old fluvial gravel (Pleistocene and Pliocene)—Well-sorted pebbles and some cobbles of a variety of durable rocks, such as quartzite, chert, and so forth, which have been transported a considerable distance. Individual stones are well rounded, polished, and on the exposed surface of the deposit are coated with desert varnish. Thickness as much as several meters

Tb BOUSE FORMATION (PLIOCENE)—Pink, tan, and pale-grayish-green calcareous clay, silt, sand, and marl, moderately to poorly indurated, well bedded. Locally contains foraminifera, gastropods, and other fossils of brackish marine environment (Metzger, 1968). Clay commonly contains minor montmorillonite. Thickness 0–90 m. Except for a few places near the hills, where dips are as much as 10°, formation is nearly flat lying

Tbs Sand—Tan to light-red sandstone, generally loosely cemented and well sorted with massive to large-scale crossbedding; subaerially deposited shorelines facies of the Bouse Formation. Locally indistinguishable from sandy zones in the upper part of the fanglomerate of Osborne Wash (To). Thickness 0–10 m. In the SE¼NW¼ sec. 22, T. 2 N., R. 24 E., contains a small lens of reworked volcanic ash

Tbm Marl—Light-gray to white marl and limestone at the base of the formation. Typically contains more than 95 percent $CaCO_3$. Traces of bleached biotite, feldspar, and quartz. Thickness 1 m or less

Tfg FLUVIAL GRAVEL (PLIOCENE)—Well-sorted pebbles, gravel, and sand; crossbedded, poorly indurated, light gray to yellow brown, iron stained. Underlies Bouse Formation at Earp, Calif., and at several other small unmapped outcrops along the Colorado River between Parker and Headgate Rock dam. Thickness 0–3 m

To FANGLOMERATE OF OSBORNE WASH (PLIOCENE AND MIOCENE)—Poorly sorted, locally well bedded, mostly subangular, generally well indurated sand, pebbles, and cobbles of local origin. Clasts are predominantly volcanic and sedimentary rocks of Tertiary age. Color is dark reddish brown to gray. Some of what is mapped as To may be equivalent in age to Bouse Formation (Tb) or the oldest part of old alluvium (QT1a). To is generally separable from these units on the basis of its better induration and higher content of volcanic rocks. Thickness 0–60 m. In the NW¼NW¼ sec. 25, T. 2 N., R. 24 E., unit contains a volcanic ash bed as much as a meter thick that is similar but probably not the same as one found in sand of the Bouse Formation (Tbs). Named from exposures along Osborne Wash, a major drainage which joins the Colorado River immediately east of the quadrangle boundary at a point about 5 km NE of Parker

Taw ANDESITE OF WEST PORTAL (PLIOCENE OR MIOCENE)—Dense to finely vesicular, dark-gray to black basaltic andesite. Texture intersertal-diabasic, with 5 percent corroded plagioclase phenocrysts as much as 5 mm across; groundmass is largely plagioclase and subordinate clinopyroxene and a few small olivine grains. A few corroded quartz xenocrysts with clinopyroxene coronas. At most outcrops flow consists of blocky rubble. Thickness 0–3 m. Occurs at top of unit Tc. A sample from NE ¼ sec. 35, T. 2 N., R. 25 E., gave a whole-rock K-Ar date of 5.9±0.2 m.y. (R. F. Marvin, written commun., 1976)

Tc COLLUVIUM (PLIOCENE AND MIOCENE)—Coarse, blocky colluvium, generally well cemented with caliche. Contains fairly numerous clasts of gneiss from lower plate of Whipple Mountains detachment fault. Interbedded with part of the fanglomerate of Osborne Wash (To). Thickness 0–90 m

Tao ANDESITE OF OSBORNE WASH (MIOCENE)—Dark-gray, fine-grained olivine basaltic andesite with diabasic texture. Plagioclase laths 75 percent, olivine 10 percent, clinopyroxene 10 percent, opaques 5 percent. Thickness 0–7 m. One of several flows intercalated in the fanglomerate of Osborne Wash (To). Flows become thicker and more numerous east of the quadrangle. A sample from NW¼ sec. 27, T. 10 N., R. 19 W. (2 km east of mapped area), gave a whole-rock K-Ar age of 8.3±0.3 m.y. (R. F. Marvin, written commun., 1976)

Tbmo BASALT OF LAKE MOOVALYA (MIOCENE)—Dark-gray to brownish-gray vesicular porphyritic olivine basalt. Characterized by very large fresh olivine phenocrysts as much as 1.5 cm across. Plagioclase also present as phenocrysts as much as 5 mm long. Plagioclase 60 percent, olivine 30 percent, clinopyroxene and opaques 10 percent. Thickness 0–5 m. Intercalated in lower part of fanglomerate of Osborne Wash (To). A sample from NE¼ sec. 31, T. 10 N., R. 20 W. (2 km east of mapped area), gave a whole-rock K-Ar age of 12.6±0.8 m.y. (R. F. Marvin, written commun., 1976)

Ts3 SEDIMENTARY ROCKS, UNIT 3 (MIOCENE)—Tan to reddish-brown and pink sandstone, siltstone, sedimentary breccia, conglomerate, and a few thin beds of limestone, generally thin bedded amd variably indurated. In western part of map area consists almost entirely of well-indurated conglomerate and sedimentary breccia. Conglomeratic beds contain rare clasts of Peach Springs Tuff (Tps) of Young and Brennan (1974); breccia clasts are largely sandstone and limestone, probably derived largely from sedimentary rocks, unit 2 (Ts2). Includes a few small flows of andesite (Ta). Thickness 0–700 m

Tad ANDESITE DIKES (MIOCENE)—Dark-gray, fine-grained andesitic dikes, possibly feeders for andesite (Ta)

Ta ANDESITE (MIOCENE)—Lava and breccia flows, dark gray to purplish gray and dark brown, commonly vesicular. Intercalated throughout most of lower part of Tertiary section. Breccia is fine to coarse, fragments are same composition as matrix. Green copper staining locally common on fractures. Typical flows are largely oligoclase microlites, calcite, and brown iron oxides; clinopyroxene was probably present in most flows, but is nearly always altered; some flows have a few scattered small andesine phenocrysts, mostly altered to calcite; calcite and zeolites in vesicles. As mapped includes a few thin flows intercalated in units Ts3 and Ts2, and local thin zones of sandstone and conglomerate and small lenses of granitic breccia (Tgbr). Thickness 0–500 m

Tps PEACH SPRINGS TUFF OF YOUNG AND BRENNAN (1974) (MIOCENE)—Nonwelded to slightly welded white to pink ashflow tuff. Commonly devitrified and shows much vapor-phase alteration. Five to fifteen percent phenocrysts, predominantly alkali feldspar with subordinate plagioclase; biotite, sphene, and hornblende are noticeable. Also contains rare clinopyroxene and quartz. Locally contains conspicuous lithic fragments of metamorphic rocks and intermediate lava. Dated by K-Ar method at 18.8±0.5 m.y. on biotite and 18.2±0.4 m.y. on sanidine from outcrop in SW¼ sec. 8, T. 1 N., R. 26 E. (R. F. Marvin, written commun., 1976). Thickness 0–8 m

Tav ANDESITE OF VIDAL (MIOCENE)—Several flows of dark-gray, locally vesicular basaltic andesite. Intergranular and commonly trachitic texture. A few small phenocrysts of clinopyroxene, sparse small olivine, and occasional tiny quartz xenocrysts. Thickness 0–90 m

Ts2 SEDIMENTARY ROCKS, UNIT 2 (MIOCENE)—Sandstone, conglomerate, siltstone, and limestone, gray and tan to red and maroon, generally moderately well sorted but grains not well rounded. At one locality has lens of tuff (Ttb) near base. Commonly very arkosic. Thickness 0–300 m

Ttb TUFF (MIOCENE)—Light-gray to white, bedded rhyodacitic tuff and tuff breccia. Probably related to lavas of the Mopah Range about 25 km to the west. Thickness 0–15 m

Tl LIMESTONE (MIOCENE)—Lenses of limestone intercalated in unit Ts2, principally in the lower part. Limestone is typically thick bedded, silty, and sandy, gray to reddish brown, with siliceous stringers common. Mapped separately only in eastern part of area. Thickness 0–90 m

Tap ANDESITE PORPHYRY (MIOCENE)—Dark-purplish-gray irregular lava flow with conspicuous "jackstraw" andesine plagioclase phenocrysts as much as 1.5 cm long, together with minor olivine largely altered to iddingsite, and clinopyroxene. Calcite abundant as vesicle fillings and alteration of feldspar. Thickness 0–30 m

Ts1 SEDIMENTARY ROCKS, UNIT 1 (MIOCENE)—Red to reddish-brown arkosic sandstone poorly to well bedded. Upper contact gradational with breccia (Tgb). Crops out mainly northeast of Bowmans Wash. Thickness 0–90 m

Tat ASHFLOW TUFF (MIOCENE)—Light gray, lithic-rich nonwelded ashflow tuff. Contains about 15 percent phenocrysts, largely alkali feldspar, with minor plagioclase and altered biotite. Lithic fragments are mostly intermediate lavas. Mapped only near north edge of sec. 14, T. 2 N., R. 24 E. Resembles an ashflow tuff in the lower part of the Patsy Mine Volcanics (Miocene) of the Nelson area, Nevada (Anderson, 1971, p. 46). Thickness 0–15 m

Tgbr GRANITIC BRECCIA (MIOCENE)—Lenses and wedges of coarse breccia and megabreccia consisting almost entirely of granite, gneissic granite, gneiss, and quartzite; interstratified with beds of poorly sorted sandstone and conglomerate with angular to subrounded fragments like those in the breccia. Conglomerate zones have a small amount of arkosic sand-size matrix. Color is predominantly pinkish gray. Virtually all clasts are derived from pre-Tertiary rocks of the upper plate of the Whipple Mountains detachment fault. As mapped, locally includes a few thin andesite flows (Ta). Thickness 0–150 m

Tbr BRECCIA (MIOCENE)—Heterogeneous to locally almost monolithologic generally coarse breccia. In most areas contains a large amount of Paleozoic(?) carbonate and quartzite rock, some blocks as much as several hundred feet across. The quartzite is very fine grained and resembles that mapped by Carr and Dickey as Permian Queantoweap(?) Sandstone of McNair (1951) (equivalent to part of the Supai Group) in the Parker SW and Vidal quadrangles I–1125. Also locally contains much gneiss from the upper plate of the Whipple Mountains detachment fault. Thickness 0–150 m

Tgb BRECCIA (MIOCENE)—Relatively massive reddish-brown to dark-purplish-brown breccia consisting mainly of gneissic granite fragments, but has noticeable limestone, chert, and quartzite clasts. Fragments are generally 1–15 cm in diameter, averaging about 8 cm. Contains a few thin zones of crudely bedded sandstone. Lower contact with sedimentary rocks (Ts1) gradational. Crops out only northeast of Bowmans Wash. Thickness 0–120 m

Kgng GNEISSIC GRANITE (CRETACEOUS)—Variably gneissic porphyritic granite and quartz monzonite, generally medium grained and weakly foliated; phenocrysts average about 4 mm across, but locally orthoclase is as much as 2 cm across. Contains 25–45 percent quartz, 20–35 percent plagioclase, 20–50 percent orthoclase, and 5 percent biotite. Darker zones with abundant biotite, sphene, and clinopyroxene are locally present. Contacts with gneiss (gn) gradational in most areas. A relatively unfoliated phase of this unit in SW¼NE¼ sec. 36, T. 2 N., R. 24 E., gave K-Ar ages of 85.9±2.1 m.y. on biotite and 88.7±1.4 m.y. on orthoclase (R. F. Marvin, U.S. Geol. Survey)

gn GNEISS (CRETACEOUS AND OLDER?)—Quartzo-feldspathic gneiss of predominantly granitic and monzonitic texture and composition, locally porphyritic; commonly light colored, but locally dark where it contains much epidote, chlorite, biotite, sphene, and iron oxides. Generally grades into unit Kgng. May include rocks as old as Precambrian

Ip LOWER PLATE ROCKS (CRETACEOUS AND OLDER?)—Gneiss, dark greenish gray to bluish gray, fine grained, laminated to weakly foliated, predominantly quartzo-feldspathic, relatively uniform except near the Whipple Mountains detachment fault, where it is dark bluish green. Contains quartz, sodic plagioclase, epidote, and chlorite. Near the detachment fault it shows crushing and destruction of laminae and the development of abundant 1- to 3-mm sodic plagioclase, biotite, and sphene metacrysts. May include rocks as old as Precambrian. Thickness at least 800 m

CONTACT—Showing dip

FAULT—Showing dip, relative horizontal movement, and direction and plunge of slickensides. Bar and ball on downthrown side. Dashed where approximately located or probable, queried where doubtful, dotted where concealed. Shown in red where rocks of Pliocene age are probably displaced

LOW-ANGLE FAULT—Showing dip; dotted where concealed. Sawteeth on upper plate

PROBABLE LANDSLIDE BLOCK

SYNCLINE—Showing approximate trace of axial plane

STRIKE AND DIP OF BEDS

- Inclined
- Vertical
- Overturned

STRIKE AND DIP OF FOLIATION

BACK OF RIVER TERRACE

FAULT-LINE SCARP—Bedrock scarp against which alluvial units are deposited

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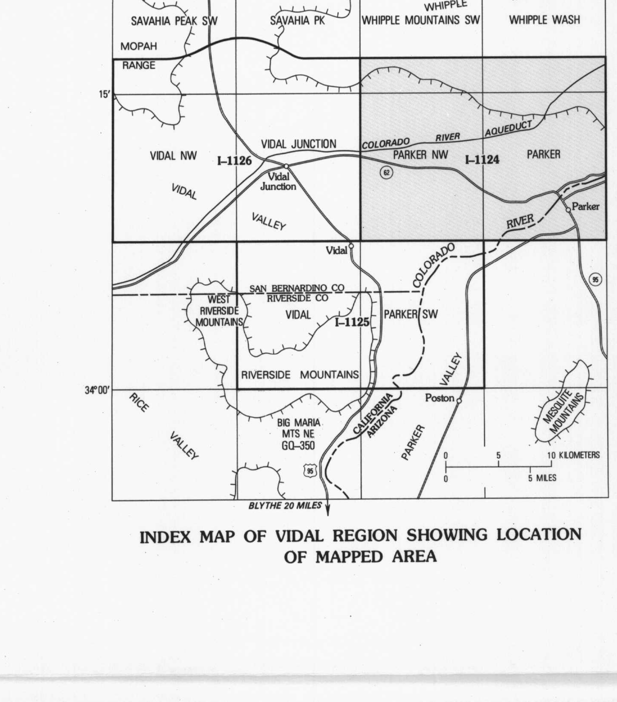
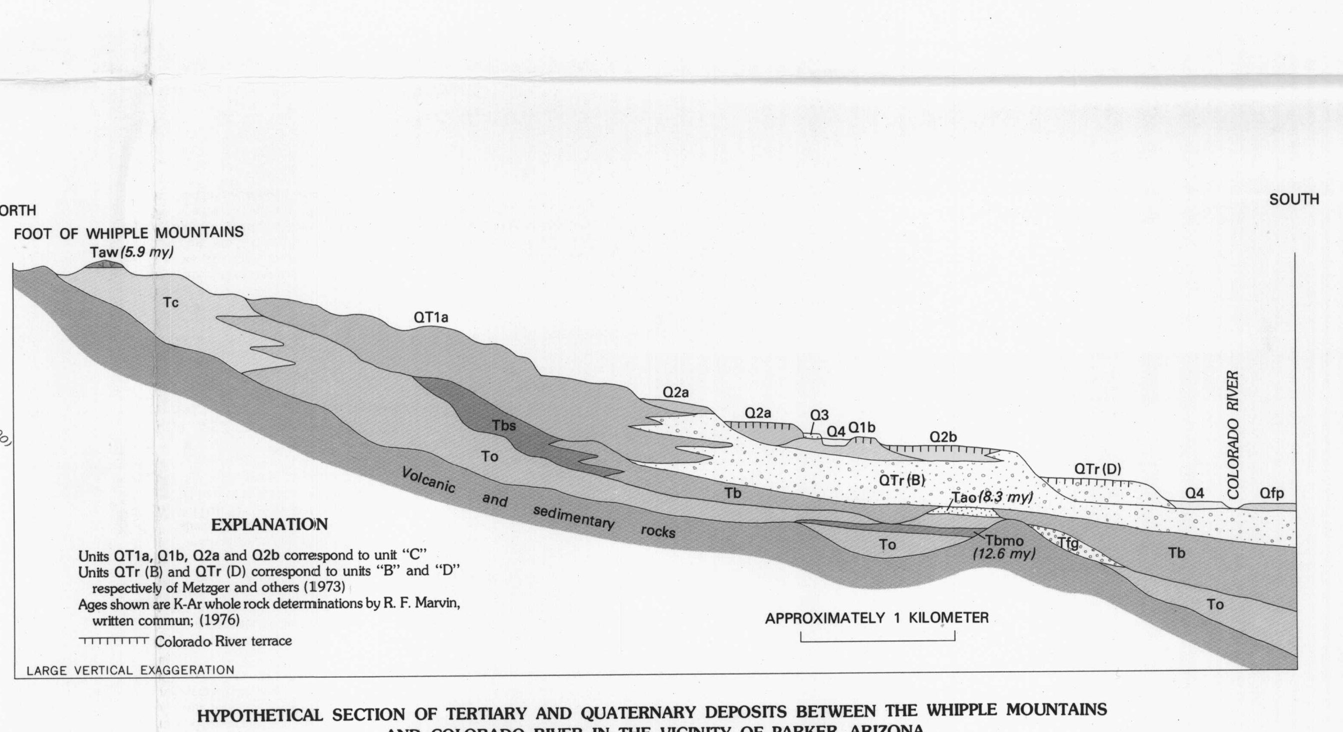


INDEX MAP OF VIDAL REGION SHOWING LOCATION OF MAPPED AREA



HYPOTHETICAL SECTION OF TERTIARY AND QUATERNARY DEPOSITS BETWEEN THE WHIPPLE MOUNTAINS AND COLORADO RIVER IN THE VICINITY OF PARKER, ARIZONA

D-01A

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