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Geology mapped by I. Lucchitta and N. Suneson, 1977

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ARIZONA
QUADRANGLE LOCATION

GEOLOGIC MAP OF THE PLANET 2 SW QUADRANGLE, MOHAVE COUNTY, ARIZONA

By
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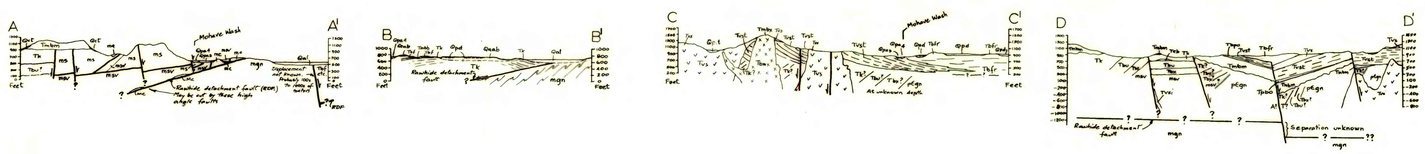
1988



DESCRIPTION OF MAP UNITS

Surficial deposits generally are 1 m or more in thickness where mapped. Piedmont slope deposits (Qpa4, Qpa3, Qpd, Qpc) were delineated by field mapping in areas where bedrock crops out, and by photointerpretation techniques augmented by field checks elsewhere. Unit symbols are designed to be used in conjunction with those in quadrangles to the north and east.

BEDS REFLECTING THROUGH-FLOWING DRAINAGE

Alluvium of the Bill Williams River (Holocene and Pleistocene)--Material that includes non-local lithologies and deposited by the Bill Williams River. Consists of rounded to subangular, well- to moderately sorted, poorly unconsolidated silt, sand, and gravel. Clasts typically are 1 to 10 cm in diameter, and consist of a wide variety of rock types, including basalt, rhyolite, mylonitic quartz-feldspar gneiss, granitic rocks, quartzite, marble, and low-grade metasedimentary and metavolcanic rocks

Qal **Sand and gravel of present channel (Holocene)**--Very pale yellowish-brown to yellowish-gray, floodplain and channel deposits. Includes artificial fill. Laterally equivalent to Qpa4 but generally finer grained. Locally stabilized by vegetation, especially in irrigated cultivated areas. Unstabilized silt and fine sand are reworked by wind action in places. Best local source of moderately clean sand. Thickness unknown

Qaab **Lower and intermediate terrace gravels (Holocene and Pleistocene)**--Light-colored reddish-brown to very light-brownish-gray silt, sand, and well-rounded gravel forming highly dissected terraces as much as 25 m above the present floodplain. At least three terrace levels recognizable locally. Good source of sand and gravel. Thickness 0–25 m

Qac **Upper terrace gravels (Pleistocene)**--Very light-brown to very pale-yellowish-brown sand and well-rounded gravel forming terrace level about 35 m above present floodplain. Present as small discontinuous remnants. Too small and discontinuous to be a good source of sand and gravel. Thickness 1–2 m

Piedmont slope deposits (Holocene and Pleistocene)--Unit consists of locally derived pediment deposits and channel deposits of arroyos that dissect the pediments. Differs from alluvial deposits of the Bill Williams River in degree of rounding, composition, source, and environment of deposition. Composed of poorly sorted, angular to subangular silt, sand, and gravel with varying degrees of cementation and dissection

Qpa4 **Alluvium of active channels (Holocene)**--Sand and pebble- and cobble-size gravel in channels affected by modern floods. Channels unvegetated, except for scattered trees of substantial dimensions. Within quadrangle, areas underlain by this unit are in greatest danger of flooding. Grades into unit Qal at confluences with Bill Williams River. Thickness unknown

Qpa3 **Alluvium of inactive channels (Holocene and upper Pleistocene)**--Poorly sorted sand, pebble- and cobble-size gravel, and local boulder, cobble, or gravel, in those parts of arroyos not reached, or seldom reached, by modern flood waters. Typically 0.5–1 m above active channels. Extensive vegetation, including grasses, forbes, cacti, bushes, and trees. Thickness unknown

Qpd **Piedmont gravels with desert varnish (Pleistocene)**--Unconsolidated to poorly consolidated silt, sand, and gravel forming a veneer, from several tens of centimeters to a few meters thick, on weathering regolith developed on older rocks. Forms smooth, flat to gently sloping surfaces characterized by well-developed desert pavement consisting of moderately well-sorted, angular pebbles typically 1–10 cm in size. Most pebbles are heavily coated with black desert varnish, giving the surface of unit a gravish-brown to grayish-red color. Buried parts of pebbles and cobbles are lightly coated with caliche. Beneath the desert pavement, the unit consists of loose, porous, pebbly sand and silt. Where exposed in cross section, the lower and middle parts of the unit are characterized by caliche veins that are in part subparallel and in part at a high angle to the topographic surface. Pediment surface on which unit is deposited is dissected to depths as great as 30 m by modern arroyos. Subject to sheet flow but not to flash flooding. Excellent location for roads and other construction. Present chiefly where clast lithology is suitable for formation of desert varnish. Thickness <3 m

Qpc **Calcrete unit (Pleistocene)**--Pale-yellowish-brown to light-olive-gray, poorly to moderately consolidated, massive to poorly bedded, strongly caliche-cemented pebble-, cobble-, and boulder conglomerate and breccia containing angular to subangular clasts heavily coated with caliche. Typically, little or no soil or unconsolidated material is present on the surface of the unit, which is conspicuously light toned on aerial photographs. Unit generally occurs as erosional remnants of small extent that form flat to gently sloping mesa-like surfaces. Although dissection is variable, unit typically occurs at a considerable altitude above present arroyos. Subject to little sheet flow and no flooding. Thickness <5 m

Qct **Colluvium and talus (Holocene and Pleistocene)**--Locally derived, unconsolidated slope wash, talus, and rockfall material. Moderately stable to stable

BEDS REFLECTING THROUGH-FLOWING DRAINAGE

Tbmx **Megacryst basalt (Pliocene(?) and Miocene)**--Dark- to medium-gray, generally fresh, vesicular to dense, olivine-basalt flows and irregularly-shaped intrusive masses (shown on map by "+" pattern) characterized by conspicuous megacrysts whose amount is variable. Vent areas marked by asterisks. Maximum observed size of megacrysts: plagioclase, 7 cm; clinopyroxene, 5 cm; spinel, 3 cm; magnetite, 1 cm; olivine, 1 cm. Also contains rare nodules (10 cm) of mafic and ultramafic plutonic rocks. Locally contains rhyolite (Tvs) xenoliths. Megacrysts set in phenocrysts of plagioclase, iddingsitized olivine, and clinopyroxene and opaques in trace amounts. Groundmass is composed of 40–65 percent plagioclase, 20–40 percent clinopyroxene, 10–20 percent olivine, and trace amounts of altered glass. Groundmass texture typically is intergranular. Quadrangles to north and east have yielded K-Ar ages of 7.7 +/- 0.5, 7.5 +/- 0.2, 6.8 +/- 0.2 m.y. (Suneson and Lucchitta, 1979), and 5.4 +/- 0.6 m.y. (Suneson and Lucchitta, 1983). The unit consists of a suite of rocks that are petrographically distinctive but were emplaced over a time interval of several million years; these are the youngest basaltic rocks of the area. Along Mohave Wash, directly east of the Bill Williams Mountains, the basalt is a few meters to a few tens of meters above the present grade of the wash; the outcrop pattern indicates that the basalt flowed down an ancestral course of this wash, thus postdating the establishment of through-flowing drainge, which on regional grounds is thought to have happened 5.5 to 8.5 m.y. ago (Lucchitta, 1979). In the same area, however, the basalt is overlain in places by fanglomerate indistinguishable from, and therefore mapped with, the basin fill (Tbf). In the Bill Williams Mountains, megacryst basalt dikes (Tbmx) intrude and are intruded by silicic volcanic rocks (Tvs) dated at 10.3 +/- 0.1 m.y. (K-Ar)(Suneson and Lucchitta, 1979). These older megacryst basalts were probably eroded at the time of transition from interior-basin to through-flowing drainage. Therefore, the basin-fill deposits (Tbf) probably contain pediment gravels that are later than the basin fill proper but cannot be mapped separately because they are lithologically indistinguishable. The porphyritic olivine basalt may represent an early phase of the megacryst basalt, but it is mapped separately because it is lithologically distinguishable. Thickness 0–50 m

Tbmx; Tmbm **Intrusive facies of megacryst basalt (Pliocene(?) and Miocene)**--Consists of dikes and a few small, irregularly-shaped intrusive masses identical in lithology to the megacryst basalt (Tbmx). Locally forms small constructional basalt cones associated with cinder deposits.

DEPOSITS LAID DOWN IN PRESENT BASINS MOSTLY UNDER CONDITIONS OF THROUGH- FLOWING DRAINAGE

Basin-fill deposits (Pliocene(?) and Miocene)--Heterogeneous assemblage of clastic strata filling present basins

Tbf **Basin fill, undifferentiated**--Typically grayish-orange, yellowish-gray, and pale-yellowish-brown, moderately to poorly sorted, moderately to poorly bedded, moderately to poorly consolidated, locally calcite-cemented pebble- to cobble fanglomerate, sand, and silt. Clasts typically angular, 0.5–50 cm in diameter, and locally derived. Most clasts are granitic or metamorphic; "r" denotes areas within unit where rhyolite clasts are common. Clasts are unsupported in a sand matrix. Unit may be equivalent to the Muddy Creek Formation, the fanglomerate of Metzger and others (1973), and the fanglomerate of Osborne Wash of Dickey and others (1980). Locally, the unit probably includes pediment gravels that are related to through-flowing drainage and thus younger than the basin fill, but are mapped with the fill because they are lithologically indistinguishable from it. Maximum thickness unknown; probably as much as several hundred to a few thousand meters

Tbfr **Rhyolite-clast facies**--Fanglomerate similar to basin fill (Tbf) but with clasts dominantly of rhyolite. Mapped where unit forms large continuous outcrops distinguishable from Tbf. Thickness possibly as much as 100 m

Tbft **Tuffaceous facies**--Moderately to well-bedded, poorly to moderately consolidated tuffaceous siltstone and sandstone, and poorly consolidated pebble conglomerate containing abundant clasts of rhyolite and pumice. Mostly consists of reworked rhyolitic and tuffaceous pyroclastic and epiclastic rocks (Tvst), locally possibly interbedded and thus correlative with them. Small outcrop restricted to west-central part of quadrangle. Thickness about 10 m

Tvs **Rhyolite lava flows, domes, plugs and dikes (Miocene)**--Very pale gray to very pale-orange, fresh, aphyric to porphyritic (with as much as 5 percent phenocrysts) rhyolites, light-colored where devitrified, commonly flow-banded. Domes, plugs, and dikes (shown on map by check pattern) are characterized by black to gray glassy selvages. Flows have brecciated bases. Miarolitic cavities present but scarce. Nearly aphyric varieties generally contain very small amounts of highly embayed quartz phenocrysts. Porphyritic varieties contain quartz, sanidine, and (or) plagioclase in various amounts and commonly as aggregates. Maximum size of phenocrysts rarely over 1 mm. Groundmass generally devitrified, microcrystalline, and locally spherulitic. Flows locally contain basaltic inclusions. Many domes and dikes are closely associated spatially with intrusive masses of megacryst basalt (Tbmx). Domes and dikes tend to occur along faults or at intersection of faults. Rhyolitic rocks (Tvs) from adjacent quadrangles to the east range in age from 12 to 15 m.y., and underlie the mesa-forming mafic lava flows. Most of the rhyolitic rocks (Tvs and Tvst) in this quadrangle may be younger because they locally overlie the mesa-forming basalt of Mohave Wash (Tmbm). They may thus be part of the interior-basin deposits laid down in present basins. K-Ar age is 10.3 +/- 0.1 m.y. (Suneson and Lucchitta, 1979). Thickness of flows 0–45 m

Tvsi **Intrusive facies of rhyolite (Miocene)**--Mostly thin rhyolite dikes and less common small irregular intrusive masses identical in lithology to Tvs

Tvst **Pyroclastic and epiclastic rocks (Miocene)**--Very pale-orange, pale-greenish-yellow, and yellowish-gray, well-bedded to massive vitrolithic tuff, tuffaceous sandstone, and tuffaceous conglomerate. Punice lapilli and angular xenoliths or rhyolite are common in the ashy groundmass of fine-grained rocks. Thin air-fall tuff and reworked tuff are interbedded with thicker, more massive, and coarser grained air-fall and ash-flow tuffs. Locally, tuff of probable ash-flow or block-flow origin contains rhyolite clasts as much as 0.5 m long. In places, the tuff has a pinkish cast because of weathering or because of oxidation related to post-depositional cooling. Unit may locally include rocks equivalent to the tuffaceous facies of the basin-fill deposits (Tbft). Thickness 0–350 m

Tpbo **Porphyritic olivine basalt (Miocene)**--Black, fresh, phenocryst-rich olivine basalt with approximately 35 percent phenocrysts of plagioclase (as much as 2 cm), olivine (as much as 3 cm), and scarce clinopyroxene (2 mm). Minor hornblende in groundmass. May represent an early megacryst basalt flow (Tbmx) but is lithologically distinctive and therefore mapped separately. Locally includes thin, discontinuous bright-red to tan siltstone, sandstone, and pebbly sandstone at base (shown on map by stippled pattern). Sandstone contains fragments of altered rhyolite, basalt, and metavolcanic rocks similar to nearby underlying units. Present only in southwest corner of quadrangle. As much as 20 m thick in quadrangle and appears to thicken to the west

Mesa-forming mafic lava flows (Miocene)--Basalt and basaltic andesite lava flows, subhorizontal to gently tilted erosional remnants that typically form equidimensional mesas. Each mesa consists of many flows that are petrographically similar and different from flows of other mesas

Tmbt **Basalt of Mohave Wash**--Medium- to dark-gray, fresh, vesicular to dense, locally brecciated, glomeroporphyritic-intergranular basalt lava flows and minor cinder deposits. Phenocrysts include about 8–16 percent plagioclase, 3–6 percent clinopyroxene, and 2–5 percent olivine. Larger plagioclase phenocrysts typically are sieve-textured and the olivine is altered to iddingsite. Phenocryst aggregates are common. This basalt locally underlies porphyritic olivine basalt (Tbpo) and some rhyolitic pyroclastic and epiclastic rocks (Tvst). This contrasts with adjoining quadrangles to the north and east, where the silicic volcanic rocks (Tvs) were deposited in basins not related to present topography and are thus older than the mesa-forming mafic lava flows that were deposited in present basins. In this quadrangle, most of the silicic volcanic rocks (Tvs, Tvst) may be interior-basin deposits laid down in present basins. Age of the Tmbm is 9.2 +/- 0.2 m.y. (K-Ar)(Suneson and Lucchitta, 1979). Tmbm probably correlates with basalt of the Mesa to the west, dated at 9.2 m.y. (K-Ar) by Armstrong and others (1976). Thickness ranges from 0 to about 150 m

Tmbmi **Intrusive facies of basalt of Mohave Wash**--Small, irregularly-shaped intrusive mass identical in lithology to the basalt of Mojave Wash (Tmbm). Dikes locally abundant.

Tbmc **Basalt of Black Mesa near Centennial Wash**--Medium- to dark-gray, fresh, vesicular to dense, glomeroporphyritic-intersertal to diabasic basalt lava flows and local cinder deposits. Original constructional cone preserved on top of mesa. Typically spheroidal- but locally extremely platy-weathering. Phenocrysts include 3–4 percent commonly sieve-textured plagioclase and 2–8 percent iddingsitized olivine. Phenocryst aggregates common. Age is 13.0 +/- 0.5 m.y. (K-Ar)(Suneson and Lucchitta, 1979), which ranges from trees of 0 to about 125 m immediately east of quadrangle.

ROCKS DEPOSITED IN BASINS NOT RELATED TO PRESENT TOPOGRAPHY

Tk **Arkose of Keenan Camp (Miocene)**--Pale-red to pale-grayish-red, locally tan, well-indurated to unconsolidated, interbedded boulder- and cobble conglomerate, sandstone, pebbly sandstone, and siltstone, all arkosic in composition. Bedding moderate to poorly developed in places. Clasts include porphyritic granitic rocks, various kinds of gneiss, aplite, leucogranite, diabase, amphibolite, metarhyolite, quartzite, other metavolcanic and metasedimentary rocks, dacite porphyry, and olivine basalt, commonly deeply weathered. Clasts are as much as 2.5 m in diameter, typically 1–10 cm, and rounded to subangular. Manganese stain common locally. Thickness 0 to about 600 m, thickening to northeast

Teb **Early basalt (Miocene)**--Highly altered basalt lava flow and possible dikes and plugs. Medium-grained with plagioclase phenocrysts as much as 5 mm and smaller; olivine phenocrysts altered to iron oxide. Present only in southwest corner of quadrangle in very discontinuous outcrop pattern. Thickness 0–5 m

Tbu **Upper basin beds (Miocene)**--Gray pebbly sandstone and interbedded gray, red, and pink coarse sandstone, sandstone, and siltstone. Locally includes laminated red, gray, and brownish-white highly contorted siltstone. Well-bedded, poorly indurated, locally with abundant limonite stain and/or calcified. Base is interbedded with alluvial facies of the breccia (Tbx). Thickness varies from about 10 to 120 m

Tbx **Breccia (Miocene)**--Medium- to light-gray, light-brownish-gray, pale-brown, and pale-red, unstratified, moderately to poorly indurated, unsorted breccia, chaotic in structure and composed of angular fragments a few centimeters to several meters in diameter. Clasts chiefly composed of weakly foliated metasedimentary and metavolcanic rocks and well-foliated quartz-eye metavolcanic rocks (metaRFP?). Metasedimentary rocks consist chiefly of poorly sorted coarse-grained graywacke sandstone and granule conglomerate. Top of unit is interbedded with upper basin beds (Tbu) and includes an alluvial facies characterized by subangular clasts and distinct, though poor, stratification. The breccia typically does not crop out but forms greenish lag of angular clasts, some very large. Unit is a regional marker bed in quadrangles to east. In this quadrangle, it is restricted to the northeast and southwest corners. Similar unit mapped by Spencer and others (1986a) in extreme southwestern corner of this quadrangle. Thickness ranges from 0 to about 150 m

ROCKS OF INTERDETERMINATE STRATIGRAPHIC POSITION

Tb **Basalt (Miocene)**--Dark-gray, little-weathered, basalt lava flow. Common 3–5 mm plagioclase and 1–3 mm altered clinopyroxene phenocrysts. Appears similar to megacryst basalts (Tbmx) along Mohave Wash but does not contain large crystals and occurs at a higher topographic level. Present only in northwest corner of quadrangle. Thickness 0–6 m

METAMORPHIC AND PLUTONIC ROCKS IN UPPER PLATE OF RAWHIDE DETACHMENT FAULT

msv **Schist, quartzite, gneiss, carbonate (undifferentiated)**--Dominant lithology is light-colored to moderate greenish-gray quartz-sericite and quartz-chlorite schist. Probably derived from siliceous tuffs and graywackes. Other lithologies include quartzite, gneiss, metamorphosed quartz sandstone, and recrystallized carbonate. Highly faulted and deformed. Locally mineralized with specular hematite and various copper-bearing minerals. Overlain depositionally only by arkose of Keenan Camp (Tk), basin fill (Tbf), and Quaternary alluvial units. Age cannot be determined in this quadrangle. Rocks are similar to those of known Paleozoic and Mesozoic age that are widespread in southwestern Arizona and southeastern California. Unit present only in southwest corner of quadrangle. Equivalent to parts of the Buckskin Formation (Triassic or Jurassic) and Planet volcanics (Jurassic) of Spencer and others (1986a)

ms **Metamorphosed sandstone**--Very fine-grained, medium- to light gray, weathers dark purplish-brown. Locally contains dikes and irregular masses of greenstone. Highly brecciated and sheared; no bedding or other primary features visible. Present only in the southwest corner of quadrangle. Equivalent to parts of the Buckskin Formation (Triassic or Jurassic) and the sedimentary breccia (upper Oligocene(?) to middle Miocene(?)) of Spencer and others (1986a)

mq **Quartzite**--Light-colored, porcellaneous, highly brecciated and sheared. No bedding visible. Locally strongly hematitized. Present only in the southwest corner of quadrangle. Equivalent to rocks that are believed by Spencer and others (1986a) to be the Vampire Formation (Jurassic(?)).

mc **Carbonate**--Medium- to dark-gray, recrystallized, highly brecciated, comminuted, and sheared. No bedding or other primary features visible. Locally strongly mineralized with specular hematite and various copper-bearing minerals. Present only in the southwest corner of quadrangle. Probably equivalent to carbonate veins in quadrangle to north and to the replacement carbonate (lower to middle Miocene(?)) of Spencer and others (1986a)

pCgn **Gneiss, schist, granitic rocks**--Commonly medium- to dark-gray. Metamorphic rocks include banded quartz-feldspar-biotite gneiss, amphibolite, and fine-grained light-colored metatuff(?). Plutonic rocks include foliated to unfoliated, garnet-bearing, medium-grained aplite; foliated coarse-grained granite; unfoliated fine-grained diorite porphyry; and slightly foliated biotite-rich granodiorite. Quartz and quartz-feldspar veins common. Foliation is well-developed and of consistent orientation over substantial areas. Locally, rocks probably are involved in isoclinal folding. Present only in northern part of quadrangle. Rocks resemble Precambrian rocks of the Hualapai Mountains and Grand Wash Cliffs to the northeast

METAMORPHIC ROCKS IN LOWER PLATE OF RAWHIDE DETACHMENT FAULT

mgn **Mylonitic quartz-feldspar gneiss**--Light-colored, foliated, and lineated. Foliation dips moderately southwest, lineation in foliation plane trend approximately northeast. Based on regional studies to the south and east, the protolith consists largely of Precambrian, Mesozoic, and (or) Tertiary granitic rocks, and Paleozoic(?) clastic and carbonate rocks. Present only in southwest and extreme southeast corners of quadrangle. Equivalent to mylonitic crystalline rocks of Spencer and others (1986a)

Contact--Dashed where approximately located or gradational.

Fault--High-angle. Dashed where approximately located, dotted where concealed, queried where inferred. Arrow shows direction and amount of dip. Bar and ball on downthrown side, where determined. Half arrows indicate sense of lateral slip. In cross section, "A" indicates away, "T" indicates toward on faults with lateral slip.

Rawhide detachment fault--Dashed where approximately located, dotted where concealed. Arrow shows direction and amount of dip. Sawteeth on upper plate.

Area of intense brecciation

Vent area

Anticline--Showing crestline and direction of plunge

Strike and dip
Dot at end of leader shows location of measurement

Beds
- Inclined
- Horizontal
- Approximate
- Apparent (in areas of low dip and poor exposure)

Foliation
- Inclined

GEOLOGIC SETTING

The Planet 2 SW quadrangle is one of a series of quadrangles being mapped in a northeast-trending belt extending from the metamorphic-core-complex terrane of the Rawhide, Buckskin, and Whipple Mountains to the Colorado Plateau near Wikieup, Arizona.

Five major sequences of rocks are present: one consists of rocks beneath a regionally extensive mid-Tertiary, low-angle detachment fault (Rawhide fault of Shackelford, 1980); the other four overlie this fault, of which they constitute the upper plate.

Rocks beneath the detachment fault consist of lineated, mylonitic gneiss whose protoliths probably are mostly Precambrian and Mesozoic and possibly Tertiary granitic rocks, but also include lithologies such as amphibolite and calc-silicates. The mylonitic gneiss probably represents the deeper, ductile response to brittle extension by listric faulting of the sequence 2 fluvio-lacustrine rocks. The age of mylonitization is thought to be about the same as that of the listric faulting (early to middle Miocene), but may in part be Laramide (latest Mesozoic to early Tertiary).

From oldest to youngest, the upper plate rocks are:

1) Basement rocks, which consist of: (a) Banded gneiss and amphibolite similar to rocks of Precambrian age in the Hualapai Mountains to the northeast. (b) Foliated coarse-grained granite, diorite porphyry, and granodiorite. Age unknown, but probably Precambrian. (c) Aplite dikes, and quartz- and quartz-feldspar veins. Age unknown, most likely Precambrian or Laramide.

(2) Fluvio-lacustrine rocks and thin, discontinuous basaltic rocks that were deposited in basins not related to the present topography and now are highly deformed. Four units composed of brecciated, low-grade metamorphic rocks are included in this unit because similar rocks are interbedded with the fluvio-lacustrine sequence in the quadrangle to the east. The metamorphic units probably are gravity-glide blocks shed into deposits of basins. The fluvio-lacustrine rocks are analogous to the Mesquite Horse Spring Formation and related deposits in the Lake Mead area (Longwell, 1921, 1922; Bohannon, 1980).

(3) Interior-basin deposits filling the present topographic basins, which were formed by basin-range tectonism. Basaltic lava flows associated with these deposits typically form conspicuous mesas or gently sloping cuestas. In this quadrangle, the sequence includes rhyolitic volcanic rocks and megacryst-bearing basalt flows. All these basin-filling deposits are analogous to the Muddy Creek Formation, the fanglomerate of Metzger and others (1973), and the fanglomerate of Osborne Wash of Dickey and others (1980)

(4) Deposits related to through-flowing drainage. Chiefly piedmont-slope deposits, alluvial deposits, and basaltic lava flows that have followed present drainages. Probably younger than 5.5 m.y. (Lucchitta, 1972, 1979).

The upper plate rocks up to and including those of the fluvio-lacustrine sequence are tilted and cut by faults trending northwest and dipping northeast. Based on exposures in adjacent quadrangles to the north and east, these faults are believed to be listric, to merge with the low-angle detachment fault, and to represent a period of extreme extension.

All rocks of the fluvio-lacustrine sequence are Miocene because: (a) K-Ar age determinations on the oldest basalts in adjacent quadrangles range from about 16.5 to about 18.7 m.y. (Suneson and Lucchitta, 1979); (b) These basalts are interbedded with the Miocene Peach Springs Tuff of Young and Brennan (1974); (c) Rocks from the lower part of the sequence to the northeast have yielded Miocene microfossils (R.F. Hevly, written communication, 1979).

Interior-basin deposits are less deformed than older rocks, but nevertheless are affected by high-angle basin-range faulting and mild warping. Faulting and deposition were largely synchronous, but faulting ceased before the end of deposition so that fault traces are mostly buried by the youngest interior-basin deposits. Locally, the basin-range faults offset the older detachment fault.

Basalts that are part of the interior-basin sequence have yielded K-Ar ages ranging from 5 to 13 m.y. (Suneson and Lucchitta, 1979). In this quadrangle, rhyolites within this sequence are about 10 m.y. old (Suneson and Lucchitta, 1979) and thus are the youngest silicic volcanic rocks in the area mapped.

The youngest group of deposits (related to through-flowing drainage) is not cut by faults in this quadrangle.

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