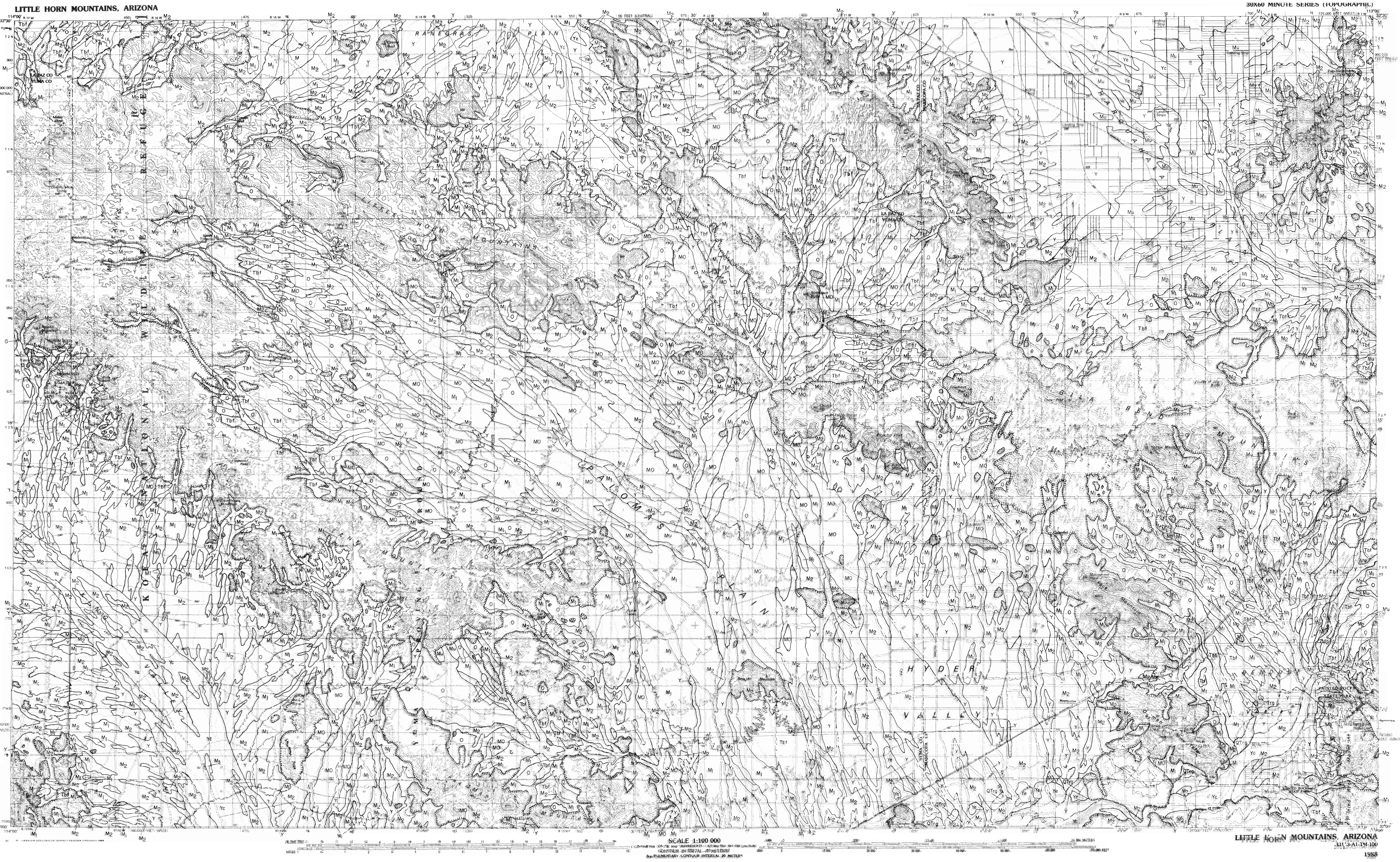

Geologic Map of Quaternary and Upper Tertiary Alluvium in the Little Horn Mountains 30' x 60' Quadrangle, Arizona

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Explanation

Unit — Estimated age (ka = thousand years before present)

Yc late Holocene (≤ 1 ka)

Active and recently active channel deposits of major axial drainages. Primarily silt, sand, and fine gravel deposits (hue generally 7.5 YR); locally (in the Gila River bed), coarser gravel and cobbles. Surfaces are characterized by bar-and-swale topography on coarser deposits, and are relatively smooth and planar with dense drainage networks in silty deposits; clasts are not varnished.

Y Holocene (0 - 10 ka)

Young alluvial fan deposits, active deposits and low terraces of small channels, and terraces of major drainages; primarily silt, sand, and fine gravel, with local occurrences of coarser gravels and cobbles. Surfaces are characterized by bar-and-swale topography on coarser deposits and are relatively smooth and planar on silty deposits; surface clasts are unvarnished to lightly varnished (on basaltic clasts). Depth of dissection is generally ≤ 1 m. These deposits are most commonly 7.5 YR in hue and exhibit no surficial zones of reddening (cambic soil horizons) or marked clay accumulation (argillic horizons); in places, maximum soil development on unit **Y** deposits comprises a thin surficial cap of vesicular eolian silt and clay, incipient reddening (typically 7.5 YR hue; locally 5 YR), and zones of carbonate accumulation (calcic horizons) with Stage II morphologic development (see Machette, 1985, for description of morphologic stages of calcic-horizon development). Soil great groups are typically Torriorthents, Calciorthids, or Camborthids.

Ye Holocene (0 - 10 ka)

Eolian sand and silt deposits; typified by small sand dunes and hummocky or corrugated overall surface textures. These deposits occur predominantly toward central parts of valleys where fine-grained sediment is abundant, and generally overlie units Y and M_2; locally they overlie older Pleistocene surfaces.

M_2 late Pleistocene (10 - 250 ka)

Channel terrace and alluvial fan deposits; typically gravelly (locally extremely gravelly) sand and silty sand. Surfaces are characterized by relatively smooth and planar fine-gravelly to coarse-cobbly pavement; bar-and-swale topography is preserved in coarser deposits; surface clasts are lightly to very darkly varnished and commonly slightly reddened on undersides. Depth of dissection is generally ≤ 2 m. Soils typically exhibit a thin cap of vesicular eolian silt and clay, incipient to weak argillic horizons, weak to moderate reddening (5 YR hue), and Stage II-III calcic horizons. Soil great groups are Camborthids and Haplargids.

M_1 middle Pleistocene (250 - 790 ka)

Terrace and alluvial fan deposits; typically gravelly to extremely gravelly sand and silty sand. Surfaces are characterized by gravelly and cobbly pavements; bar-and-swale topography is preserved locally where deposits are extremely coarse (e.g., on cobbly and bouldery fan remnants emanating from southern sides of the Little Horn and Gila Bend Mountains); surface clasts are generally very darkly varnished, and have well-reddened undersides; overall surface appearance is very dark; margins of interfluves are typically erosionally rounded adjacent to dissecting channels and gullies. Depth of dissection is generally ≤ 3 m; locally (Dendora Valley) up to 5 m. Soils are characteristically very strongly developed, comprising well developed argillic horizons, bright reddening (5 YR hue), and Stage III calcic (locally petrocalcic) horizons. Soil great groups are Haplargids and Paleargids.

Mu latest to middle Pleistocene (10 - 790 ka)

Undifferentiated M_1 and M_2 units; in some places Mu represents areas in which the two units are mixed to a degree that precludes their differentiation at this scale of mapping. In other places, this broader designation is used because of uncertainty in assigning the deposits to either a late or a middle Pleistocene age category. This unit is most widely shown here in the agricultural areas of the Harquahala Plains, where mapping is based primarily on Soil Conservation Service soil survey maps.

MO middle to early Pleistocene (500 - 1,000 ka ?)

Axial-valley terraces and alluvial fan deposits; generally gravelly to extremely gravelly material. Surfaces are characterized by abundant pedogenic carbonate fragments (≤ about 3 cm thick) and abundant very darkly varnished clasts; pavement is moderately to poorly preserved; surface remnants are typically somewhat degraded, and interfluves moderately erosionally rounded (extremely degraded members of this unit occur locally on the southwest side of the Little Horn Mountains); overall surface appearance is intermediate between very dark M_1 and very light O surfaces. Depth of dissection is generally about 2 - 4 m; locally (head of Palomas Plain) up to 10 m. Soils are typically degraded; locally, reddened (5 YR hue), well developed argillic horizons are preserved; fragments of underlying petrocalcic horizons litter these surfaces.

O early Pleistocene (790 - 1,800 ka)

Axial-valley terraces and alluvial fan deposits; typically very coarse gravelly to bouldery material. This designation is restricted to the oldest alluvial deposits with at least partially preserved depositional surfaces (inferred to be predominantly early Quaternary in age, but may locally be late Tertiary). Remnants of depositional surfaces are generally confined to broad, erosionally rounded ridges between intervening gullies and deeply incised channels; surface remnants are highly degraded and abundantly covered by pedogenic carbonate fragments (≤ about 7 cm thick), imparting an overall whiteness to these surfaces. Depth of dissection is generally about 2 - 15 m; locally (Dendora Valley) up to about 25 m. Soils are highly degraded above the remnants of Stage III to VI petrocalcic horizons that dominate the surfaces. Soil great groups are Paleorthids.

QTrg early Pleistocene to late Tertiary (> 790 ka)

Deposits of very well rounded, well sorted Gila River gravels. Deposits are typically darkly varnished or stained by weathering, and at least locally indurated by carbonate cement. Exposures of this unit occur 13 - 16 m above the modern channel of the Gila River, and are commonly associated with slight topographic rises above surrounding surfaces.

Tbf late Tertiary (≥ 1,800 ka)

Alluvial fan deposits (inferred to be predominantly late Tertiary [Miocene-Pliocene] in age; locally may be early Quaternary); typically very coarse gravelly to bouldery material. Deposits are characterized by a high degree of dissection and erosional degradation, and lack any remains of original depositional surfaces. Depth of dissection is generally about 2 - 15 m; locally (Dendora Valley) up to about 25 m.

Other map symbols

- alluvial-unit contact (dashed where approximate)
- bedrock-alluvial contact

Introduction

The Little Horn Mountains 30' x 60' quadrangle is situated in the Sonoran Desert section of the Basin and Range Province in southwestern Arizona. The physiography of this area is characterized by relatively narrow, typically linear mountain ranges and broad intervening valleys drained by axial channels that flow into the Gila and lower Colorado rivers. This map depicts the alluvial deposits that compose the piedmonts (broad, gently sloping valley sides) and basins (valley floors). The deposits are classified according to inferred age, based on the estimated time since the end of deposition. Once deposition ceases at a site, processes dominated by erosion, weathering, and eolian inputs of fine-grained begin to act upon the depositional surfaces. Channel entrenchment, height of surfaces above active channels, changes in surface morphology, and the development of soil profiles are the primary criteria used to evaluate time since the end of deposition, and thus relative ages of the deposits. Numerical age estimates for the map units here are derived from comparison of surface and soil characteristics of the deposits to those in similar settings, where previous workers have used independent criteria to constrain the ages of deposits (especially Bull, in press; also, Menges and McFadden, 1981; Morrison and Menges, 1982). No radiometric dates were obtained in this study. The map divisions here include three "young" units (Y, Yc, and Ye), three "middle" Quaternary units (**M_1, M_2, and Mu**), one "middle to old" Quaternary unit (**MO**), and three "old" units (**O, QTrg,** and **Tbf**).

Mapping is based primarily on interpretation of high-altitude U2 aerial photographs (scale 1:129,000) supplemented locally by natural color aerial photographs (scale 1:24,000). The mapping was field-checked in many locations. In areas of extensive agriculture (primarily Harquahala Plains) soil survey maps were used to evaluate soil development and infer unit contacts (Soil Conservation Service, 1977).

This map forms the southwestern part of a series of four 30' x 60' quadrangles showing Quaternary and upper Tertiary alluvium within the Phoenix 1° x 2° map area (Demsey, 1988a; 1988b; 1989).

Depositional patterns and controls

The distribution of alluvium in the Little Horn Mountains quadrangle reflects the interplay of geologic history, regional controls such as climate and tectonism, and local factors such as lithology and drainage-basin size. Normal faulting associated with Basin and Range tectonism waned in this region about 10.5 to 6 Ma, and virtually ceased by the early Pliocene (Shafiqullah and others, 1980; Morrison and others, 1981). Shortly thereafter, exterior drainage of the Gila River was established (Eberly and Stanley, 1978; Shafiqullah and others, 1980). In this region, faulting and base-level change have been minimal throughout the Quaternary, and depositional episodes have been driven largely by large-scale Quaternary climatic oscillations.

Drainage systems in desert regions respond strongly to climatic perturbations. During climatic periods of increased effective moisture, hillslopes tend to become more vegetated and increasingly mantled by weathered material. Subsequent periods of increased aridity are inferred to be associated with sparser vegetation, resultant erosional stripping of weathered material from the hillslopes, and pulses of deposition onto the piedmonts and basins (Bull, 1979). Changes in base level, drainage incision, shifting of loci of deposition, and (or) decrease in sediment supply allow former depositional surfaces to remain isolated and inactive during subsequent episodes of deposition.

In general, the younger deposits are less extensive than the older alluvium in this map area, and also are less dominant than in adjacent areas where Quaternary alluvium has been mapped (Demsey, 1988a; 1989). Units Y and Yc occur primarily in mountain and piedmont channels, distal portions of the piedmonts, and the basins. Late Pleistocene alluvium (unit M_2) locally dominates some piedmont and valley-floor areas, including much of King Valley, Hyder Valley, and Harquahala Plains. Most of the piedmonts in the map area are relatively deeply dissected and dominated by middle Pleistocene and older alluvium. (The two main exceptions to this pattern are Ranegras Plain and the adjacent piedmont on the north side of the Little Horn Mountains, and the piedmont on the northeast side of the Eagletail Mountains, where dissection is minimal and younger deposits are more abundant.) The preponderance of units MO, O, and Tbf in Palomas Plain, Nottbusch Valley, Dendora Valley, and on the southwest side of the Eagletail Mountains is particularly striking.

The predominantly basaltic lithologies of the ranges may be a factor controlling the overall abundance of relatively old alluvium in this map area. In adjacent map areas (Demsey, 1988a; 1989; also, Pearthree and others, 1988) mountain ranges containing Tertiary basalt seem to be consistently associated with relatively older piedmonts overall, compared to piedmonts of more granitic ranges. This tendancy is probably due to a higher rate of sediment supply by granitic mountains (Bull and Schick, 1979) and the greater resistance to weathering and breakdown of basaltic clasts, and hence the resistance to reworking and removal of these typically coarse-grained alluvial deposits.

Although basin-and-range extensional faulting ceased here well before the Quaternary, variations in the extent of older and younger alluvium in this map area suggest the possibility of continuing, albeit subtle, tectonic influence. There appears to be a tendency of piedmonts and basins dominated by middle Pleistocene and older deposits to be associated with axial drainages that flow southward (e.g., Palomas Plain, Nottbusch Valley). These valleys are relatively deeply dissected, especially near their heads. By contrast, valleys that are drained to the north exhibit relatively little topographic relief and overall markedly younger piedmonts, dominated by late Pleistocene and Holocene alluvium (e.g., Ranegras Plain, which continues north on the Salome 30' x 60' quadrangle; Demsey, 1988a).

The differences between north- and south-flowing valleys is also reflected in stream gradients of the corresponding axial drainages. The valley portions of south-flowing axial drainages from King Valley, Palomas Plain, and Nottbusch Valley-Hyder Valley have total-length gradients of 0.53% to 0.67%, whereas Ranegras Plain (Bouse Wash) has a gradient of 0.19%. Additionally, three other similar sized valleys that drain northward into the Gila River just 15 - 25 km directly south of this map area have axial channels with gradients of 0.24% to 0.35%. They also appear to be relatively undissected and dominated by relatively young Quaternary deposits, based on cursory inspection of topographic maps and aerial photographs. Again, lithology may play a role, as the ranges bounding these valleys are more granitic than the dominantly basalt ranges in the Little Horn Mountains map area. However, lithologic differences cannot account for the observed contrasts betweeen overall age of piedmont deposits on the north vs. the south sides of both the Little Horn and Eagletail mountains.

The observed map patterns may reflect a slight ongoing component of uplift to the north. Such a phenomenon might effectively enhance stream gradients and dissection of southward-draining valleys while decreasing gradients of northward-draining valleys. Lucchitta (1979) documented as much as 300 m of progressive uplift from Yuma toward the Colorado Plateau since 5.5 Ma (age of the marine Bouse Formation). Bull (in press) cites progressively lower terrace altitudes and 90 m of post-1.8 Ma downcutting by the lower Colorado River about 30 - 40 km downstream from Parker, Arizona, as evidence for slow regional uplift during the Quaternary. Mayer (1982) calculated that flexure due to sediment loading by the Colorado River delta would theoretically cause downwarping south of Parker; this flexure superimposed on regional uplift (possibly ``recent and/or modern'') could account for the observed tilting of the Bouse Formation. Such regional deformation, then, may indeed be influencing valley gradients and patterns of Quaternary deposition in this map area, which lies as close as 40 km east of the lower Colorado River, between Parker and Yuma.

Regional uplift to the north may also be partly responsible for a slight amount of Quaternary downcutting of the Gila River, which joins the lower Colorado River at Yuma. The inferred rate of downcutting is approximately 5 - 9 m/my (Menges, 1983). This rate is based on 24 - 30 m of entrenchment of the present Gila River into 3 Ma basalt flows that stratigraphically overlie old Gila River gravels near the Gila Bend Mountains (Euge and others, 1978; Shafiqullah and others, 1980). Quaternary downcutting is also evidenced in the occurrence of the late Pliocene-to-early Quaternary (Euge and others, 1978) Gila River gravels (unit QTrg) along the modern course of the Gila River in the southeastern part of this map area and in the adjacent Phoenix South 30' x 60' quadrangle (Demsey, 1989). The resultant lowering of base level for tributary drainages may have contributed to the relatively high degree of dissection on some portions of the piedmonts close to the river (e.g., Dendodora Valley).

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