GEOLOGIC MAP OF THE DAVIS DAM SE 7.5' QUADRANGLE, MOHAVE COUNTY, ARIZONA and CLARK COUNTY, NEVADA

by Philip A. Pearthree and P. Kyle House

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The Davis Dam SE 7.5' quadrangle includes the Colorado River and much of the piedmont between the river and the Black Mountains to the east. It is the first Arizona Geological Survey mapping project in the rapidly developing lower Colorado River corridor, but it follows a mapping project by the Nevada Bureau of Mines and Geology in the Davis Dam 7.5' quadrangle to the north (Faulds et al, in prep.).

Introduction

The geology of the Davis Dam SE 7.5' quadrangle reflects the complex interplay of the Colorado River and piedmont drainages that flow from the Black Mountains to join the river. The history of the Colorado River in this area begins with the influx of water and sediment from the north about 5.5 Ma (House et al, 2002). The first deposits associated with the river contain only locally-derived sediment from the northern part of Mohave Valley. These deposits are succeeded by the fine-grained Bouse Formation, which was probably deposited in a series of lakes as the developing Colorado River spilled over successive divides (Spencer and Patchette, 1997; House et al, 2002; Spencer and Pearthree, 2001). The deposits that record this initial phase of the river development have not been observed in the Davis Dam SE quadrangle, but are exposed farther north in Mohave Valley. After the Colorado River was integrated through Mohave Valley, it entered a major phase of aggradation which resulted in the accumulation of about 800 feet of river sand and gravel that interfingers with tributary gravel and sand (the Bullhead alluvium, unit Tcs). The maximum level of aggradation, about 1320 feet above sea level (asl), was reached by about 4 Ma (House et al, 2002). As a result of this major phase of river aggradation, much of the quadrangle is underlain by ancient river sand and gravel mixed with tributary gravel deposits. By 3.3 Ma, the river had begun to incise into the valley fill and tributary deposits were cut into the uppermost part of the old river deposits (unit TQs). The river downcut to a level close to the modern river level by the early Quaternary, but subsequently there were at least 2 major aggradation events during the middle to late Quaternary (unit Qcc). The oldest and highest of these aggradation packages (the Chemehuevi alluvium) peaked at about 840 feet asl; the younger terrace (the Mohave alluvium) is at about 700 feet asl. Since that time, the river has primarily downcut, but left several lower terraces in the Big Bend area (units Qc_2 and Qc_1). The modern river has been greatly modified by the erection of the large dams upstream. The modern channel (unit Qcr_f) is quite narrow and most of the historical floodplain (unit Qcr, Qcr_1, Qcr_2) has been developed, either as part of Bullhead City or as agricultural fields in the Fort Mohave Indian Reservation.

Tributary washes have responded to the variations in base level imposed by the Colorado River during the past 5 million years. As the river aggraded during this period, tributary drainages deposited sediment that interfingers with the Colorado River deposits. In the easternmost and highest part of the quadrangle, deposits of this period are exclusively tributary (unit Ts). As the river began to incise after 4 Ma, tributary alluvium (unit TQs) was deposited over erosion surfaces cut onto the Colorado River / tributary alluvium, and this process may have continued into the early Quaternary. Subsequent to that time, a significant aggradation event (unit Qo) occurred prior to the emplacement of the Chemehuevi alluvium. The next widespread piedmont alluvial deposit (unit Qi_2) is graded approximately to the Mohave river terrace, and all younger units are graded to the younger terraces or the modern river. In the northern 2/3 of the quadrangle, most of the eastern piedmont is deeply dissected and modern washes are entrenched far below surrounding remnants of older deposits. In these areas, flood hazards are limited to valley bottoms. The southern 1/3 of the quadrangle is dramatically different. Here, exposures of older Pleistocene and Pliocene deposits are rare, topographic relief between active washes and younger Pleistocene deposits is minimal, and distributary drainage networks are pervasive. Flood-prone areas in this part of the quadrangle are much more extensive.

Mapping Methods

Surficial geology was mapped primarily using aerial photos taken in 1979 for the Bureau of Land Management. Unit boundaries were spot-checked in the field, and mapping was supplemented by field observations during the fall of 2003 and the spring of 2004. The physical characteristics of Quaternary alluvial surfaces (channels, alluvial fans, floodplains, stream terraces) evident on aerial photographs and in the field were used to differentiate their associated deposits by age. Surficial deposits of the map area were then correlated with regional deposits to roughly estimate their ages. This mapping was compiled in a GIS format over a digital orthophotoquad base, and the final linework was generated from the digital data.

Several characteristics evident on aerial photographs and on the ground were used to differentiate and map various alluvial surfaces. The color of alluvial surfaces depicted on aerial photographs is primarily controlled by soil color and rock varnish. Significant soil development begins on an alluvial surface after it becomes isolated from active flooding and depositional processes (Gile et al., 1981, Birkeland, 1999). Over thousands of years, distinct soil horizons develop. In the arid lower Colorado River Valley, calcic horizons are most obvious indicator of soil age, but rock varnish and desert pavement development are the more evident on aerial photographs. Older surfaces have a dark brown color where darkly varnished desert pavements are well preserved. Differences in the drainage patterns between surfaces provide clues to surface age and potential flood hazards. Young alluvial surfaces that are subject to flooding commonly display distributary (branching downstream) or braided channel patterns; young surfaces may have very little developed drainage if unconfined shallow flooding predominates. Dendritic tributary drainage patterns are characteristic of older surfaces that are not subject to extensive flooding. Topographic relief between adjacent alluvial surfaces and the depth of entrenchment of channels can be determined using stereo-paired aerial photographs and topographic maps. Active channels are typically entrenched 1 to 40 m below older surfaces in this quadrangle. Comparisons of calcic horizon development on the Black Mountains piedmont with other soil sequences in the western United States provide one of the few methods of estimating the ages of the different alluvial surfaces (Gile et al, 1981; Machette, 1985). Calcic horizon development varies from fine white filaments of calcium carbonate in young soils to soil horizons completely plugged with calcium carbonate (caliche) in very old soils.

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Piedmont surficial deposits cover most of the Davis Dam SE 7.5' quadrangle, with fairly extensive exposures of late Tertiary and Quaternary Colorado River deposits below 1320 feet above sea level (asl). The lower margins of the piedmont deposits are defined by their intersections with river deposits of different ages. In addition, much of the Pliocene aggradation sequence of the Colorado River (unit Tcs) consists of interbedded Colorado River sand and gravel and tributary gravel and sand.

Piedmont Alluvium

Qy_2 **Late Holocene deposits in active stream channels, low terraces, and alluvial fans** – Very young deposits associated with active fluvial systems. Channel deposits typically consist of sand and pebbles with some cobbles and small boulders in middle and upper piedmont areas, and sand and some pebbles lower on the piedmont. Terrace and fan deposits typically consist of gravel, sand and silt. Fan and terrace surfaces typically are gently undulating while deposits with gravel bars and finer-grained swales are coarse-grained. Desert pavement development is minimal and rock varnish is very light or nonexistent. Soil development is weak. Surface dissection is minimal and is associated with channels that are incised up to 1.5 m below adjacent fans or terraces. Channel patterns are variable, including anastamosing or distributary linked channels and separate small tributary channels feeding into larger channels.

Qy_1 **Late to early Holocene deposits on channel bars, terraces and active alluvial fans** – Young deposits associated with recently active washes and alluvial fans. Deposits typically are poorly sorted, consisting of cobbles, pebbles, sand, and silt. Bar and swale topography is common where deposits are gravelly, but where deposits are fine-grained surfaces are relatively smooth. Soil development is weak, with minimal soil structure and minor carbonate accumulation, but gravelly surfaces appear darker brown than younger Qy_2 surfaces due to moderate rock varnish accumulation.

Qy **Holocene alluvial deposits, undivided**

Qi_3 **Late Pleistocene alluvial fan and terrace deposits** – Younger intermediate deposits associated with inactive alluvial fans and terraces along washes. These surfaces grade to low terraces along the Colorado River about 520 to 540 feet asl. Deposits typically are poorly sorted mixtures of silt, sand, pebbles and cobbles with some small boulders. Surfaces are moderately dissected by tributary drainages that head on the surfaces and through-going distributary channels. Local surface topographic relief varies from about 1 to 3 m. Soil development is weak, with no clay accumulation and weak (stage I) calcic horizon development with fine filaments and discontinuous clast coatings. Desert pavement development typically is strong, and rock varnish is dark brown.

Qi_2 **Middle to late Pleistocene alluvial fan deposits** – Older intermediate deposits associated with extensive relict alluvial fans. These surfaces are approximately graded to 700 foot asl terraces of the Colorado River. Deposits are poorly sorted, including sand, pebbles and cobbles, with minor silt and clay. Qi2 surfaces are drained by extensive incised tributary drainage networks. Surfaces are moderately to deeply dissected, with local topographic relief varying from about 2 to 10 m. Original depositional topography typically is modified by erosion along incised valleys, but surfaces commonly are fairly smooth between valleys. Surface color is typically dark brown due to darkly varnished, moderately well developed desert pavements. Soils have weak clay accumulation and slight reddening in the upper 30 cm beneath the surface, and calcic horizons typically are stage II with continuous coatings on gravel clasts and some whitening of the soil matrix.

Qi_1 **Middle Pleistocene alluvial fan deposits** – Oldest intermediate deposits associated with relict alluvial fans. These surfaces are graded approximately to the 800 to 840 foot asl terrace of the Colorado River, but locally Qi_1 deposits have low fluvial scarps cut into them at that level. Deposits are poorly sorted, and include sand, pebbles and cobbles. Surfaces are moderately to deeply dissected, with local topographic relief varying from about 2 to 10 m. Original depositional topography is modified by erosion, and surfaces are rounded and seldom planar. Surfaces are slightly higher and much more eroded than adjacent Qi_2 surfaces, and are inset below adjacent Qo surfaces.

Qo **Early Pleistocene alluvial fan deposits** – High, old relict alluvial fan deposits. These surfaces are truncated at high erosional scarps associated with the 840 foot asl terrace of the Colorado River. Deposits typically are very poorly sorted, including angular to subangular cobbles and pebbles with sand and minor silt and clay. Surfaces are moderately to deeply dissected, with 5 to 20 m of relief between channels and ridgecrests. Original fan surfaces have been removed by erosion in most areas; the characteristic topographic expression of these deposits is alternating ridges and valleys. Planar surfaces are preserved locally, however, and these are quite smooth with concentrations of boulders. Soil development is moderate to strong, depending on local preservation, but all soils are dominated by carbonate accumulation. Surfaces typically have some carbonate fragments derived from eroded or disturbed petrocalcic horizons, which gives Qo surfaces a light appearance on aerial photographs.

TQs **Middle Pliocene to early Pleistocene alluvial fan deposits** – Very high, very old relict alluvial fan deposits. These deposits cap the highest ridges in the northeastern 1/4 of the quadrangle. Where exposed, TQs deposits rest unconformably on underlying old Colorado River and tributary deposits (units Tcs and Ts). A volcanic tephra found in TQs deposits in the northern part of the quadrangle has been identified as the 3.3 Ma Nomlaki tephra (see below), so most of these deposits probably date to the late Pliocene. TQs deposits extend downslope to as low as about 900 feet asl. Deposits typically are very poorly sorted, including angular to subangular cobbles and pebbles with sand and fines. Surfaces are deeply dissected, with 10 to 40 m of relief between channels and ridgecrests. Original fan surfaces have been completely removed by erosion in most areas; the characteristic topographic expression of these deposits is rounded ridges. Planar surfaces are preserved locally, however, and these are quite smooth with concentrations of darkly varnished boulders and abundant white fragments derived from petrocalcic soil horizons. Soil development is strong to very strong, depending on local preservation, calcic horizon stage III to V.

Tt **Middle Pliocene airfall tephra** – Thin, discontinuous white tephra beds exposed on the south bank of Silver Creek Wash. Tephra bed is up to about 0.5 m thick, and locally the upper part of the tephra bed is mixed with tributary sand and fine gravel. Tephra is found within tributary gravels of unit TQs, at elevations ranging from 1280 to 1160 feet asl. Samples from the eastern exposure have been identified as the 3.3 Ma Nomlaki tephra (Michael Perkins, Univ. of Utah, written communication, 2004).

Ts **Late Miocene to Pliocene alluvial fan deposits** – Very old piedmont alluvium exposed in the middle and lower portions of dissected ridges near the eastern edge of the quadrangle. This alluvium was deposited before the arrival of the Colorado River and during early Pliocene aggradation of the river. Deposits typically are poorly sorted to very poorly sorted, including angular to subangular cobbles, pebbles and sand with minor silt and clay. Deposits typically are moderately indurated and form steep faces where they have been undercut by recent erosion.

Tsn **Late Miocene granitic alluvial fan deposits –** Limited exposure of distal alluvial fan deposits from the Newberry Mountains to the west that pre-date the inception of the Colorado River.

Colorado River Alluvium

Qcr_f **Active river channel deposits** – Deposits submerged beneath the perennial channel of the river.

Qcr_f **Historical floodplain deposits** – Sand, silt, and gravel deposits associated with the historical flood channels and floodplain of the Colorado River. Terrace surfaces typically are smooth to undulating, and formerly active channels are evident where the surface has not been altered by human activity. Terrace surfaces typically are covered with fine-grained floodplain deposits, but relict gravel bars and lenses are common. Qcr_2 terraces are less than 3 meters above the active channel.

Qcr_1 **Holocene river terrace deposits** – Sand, silt, and gravel deposits associated with marginal terraces along the Colorado River. Terrace and bar surfaces typically are quite smooth and are less than 20 feet above the active channel. Terrace surfaces typically are covered with fine-grained floodplain deposits, but relict gravel bars and lenses are common. These surfaces were likely inundated by large floods on the Colorado River prior to dam construction.

Qcr **Holocene river deposits, undifferentiated** – Floodplain and young terrace deposits, mapped where the land surface has been obscured completely by urban development or agricultural activity.

Qe **Holocene eolian deposits** – Probably an eolian sand dune east of the Fort Mohave site. Deposits are derived from Colorado River deposits and appear to rest on an intermediate Colorado River terrace.

Qc_3 **Holocene to late Pleistocene river terrace deposits** – River deposits associated with terraces found near the ends of several low promontories along the Colorado River, including the Big Bend in Bullhead City. Terrace surfaces are commonly mantled with river gravel and deposits consist of primarily of rounded gravel and cross-bedded sands. Soil development is weak.

Qc_2 **Late Pleistocene river terrace deposits** – River deposits associated with several intermediate terraces found in the Big Bend area of Bullhead City and farther south. Terrace surfaces are commonly mantled with river gravel where well-preserved, but deposits consist of gravel, cross-bedded sands, silt and clay. Soil development is weak with discontinuous to continuous carbonate coatings on gravel clasts where terraces are well preserved. Terrace surfaces are 15 to 30 meters above the active river channel.

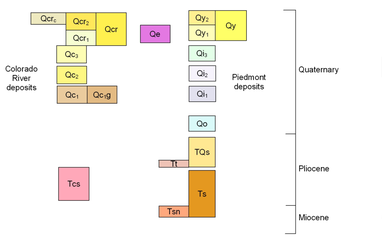
Qc_1 **Middle to late Pleistocene river deposits** – Deposits associated with a major phase of river aggradation and several high terraces along the Colorado River. Terrace surfaces are extensive in this quadrangle and are bounded on the east by erosional scarps cut into older river and piedmont deposits. Terraces are fairly flat or slope gently toward the river, but terrace surfaces are dissected by tributary drainages. Deposits typically are sandy to gravelly at the surface but limited exposures indicate that they also contain abundant sand and are locally dominated by silt and clay. Qc_1 terrace surfaces range from about 60 to 100 meters above the active river channel.

Qc-g **Middle to late Pleistocene river deposits, gravelly member**

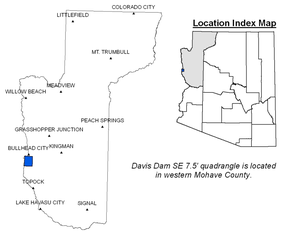
Tcs **Early Pliocene river and tributary deposits** – A moderately thick sequence of old Colorado River deposits that underlies the TQs terrace/fan deposits. These deposits consist of river sand, gravel and silt with a substantial component of tributary sand and gravel. Deposits are variably indurated and locally oxidized. River sands typically are fairly coarse and cross bedding is common. Exposures reveal abundant minor unconformities, but no strong buried soils or other evidence of major depositional hiatuses was observed. In the middle and lower piedmont below about 1100 ft asl, this unit consists primarily of Colorado River deposits and has been exploited for major aggregate resources. Above that level, piedmont deposits predominate, but locally Colorado River sand and gravel can be found as high as 1320 ft asl. At the highest levels of this unit, river deposits and tributary alluvium clearly interfinger in some locations.

d **disturbed areas** - Areas where the landscape has been profoundly altered such that the pre-development surficial geologic units no longer exist.

Stratigraphic Correlation diagram



Location Index Map



Davis Dam SE 7.5' quadrangle is located in western Mohave County.

Topographic base from USGS Davis Dam SE 7½' quadrangle. Compiled by photogrammetric methods from aerial photographs taken 1969; field checked 1970. Projection: polyconic, datum: NAD 27, UTM zone 11. Magnetic declination 14° east of true north.

SCALE 1:24,000

contour interval 40 feet

Map Legend

Contact, accurate

Contact, approximate

Erosional scarps cut by the Colorado River

Arizona Geological Survey
416 W. Congress Street, Suite 100
Tucson, AZ 85701
(520) 770-3500
www.azgs.az.gov