SURFICIAL GEOLOGIC MAPS OF THE TUCSON METROPOLITAN AREA

by

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Discussion

Four morphologically distinct ages of alluvial fan surfaces can be recognized on the piedmonts flanking the Catalina, Tortolita, and Tucson Mountains. Channel entrenchment on the upper piedmonts during the Quaternary has lead to the preservation of individual fan surfaces that become progresively younger and lower in relief toward the valley axes. Ongoing downcutting of Rillito Creek and Santa Cruz River as well as the Canada del Oro Wash has enhanced incision of mountain-sourced drainages and further increased the relief separating alluvial surfaces of different ages. Thus, periods of climatically induced downcutting separated by times of aggradation or equilibrium produce a sequence of discrete alluvial surfaces of different ages. Episodes of downcutting along the Santa Cruz and Rillito Rivers has further resulted in a series of fluvial terraces within the central Tucson Basin area. Wide pediments flanking each of the mountain fronts in the map area indicate general tectonic quiescence during the Quaternary.

An alluvial surface is abandoned from processes of active sediment transport when a period of pronounced downcutting removes the supply of water and sediment from the once-active alluvial surface. These climatically induced episodes of degradation within the map area alternate with periods of aggradation and/or equilibrium. A geomorphic surface resulting from slow degradation or equilibrium is expressed as a thin veneer (< 1 m) of sediment overlying much older alluvium or bedrock. Alternatively, a period of aggradation is recorded by a thick deposit of alluvium. Because of the similarity in appearance of alluvium of different ages in the map area, it is not possible to determine if an abandoned surface reflects a period of former equilibrium or aggradation. For this reason, ages of alluvial surfaces do not necessarily represent the age of the underlying deposit. The age of the alluvial map units records the time since surface abandonment and provides only a minimum possible age for the underlying deposit. In several locations in the map area, the thin veneer of alluvium once overlying a former surface of equilibrium has been erosionally removed, lending further evidence to the potential for discrepancy between fan surface age and that of the underlying deposit.

The discrimination of alluvial-fan age is based on time-dependent changes in fan surface morphology. Several parameters that show a systematic change through time provide relative-age dating criteria, and date the time elapsed since surface abandonment. The criteria used during this study include relative relief between alluvial surfaces, depth of channels that originate on fan surfaces, rounding of interfluves, and soil development. When these criteria are used in combination they allow different ages of alluvial-fan or fluvial-terrace surfaces

to be distinguished.

Alluvial units were mapped at a scale of 1:24,000 using black and white stereo aerial-photograph pairs at scales of 1:4,000 (1971), 1:48,000 (1973), and 1:129,000 (1972). Reconnaisance field examination was conducted, although time did not permit examination of each surface so that some discrepancies between a map unit and surface features may occur. Each map unit furthermore encompasses a range of values for each criteria so that ages of alluvial surfaces range from the next youngest to the next oldest unit. Several previous studies exist in the map area, many of which are listed under references.

Map Unit Descriptions

PIEDMONT DEPOSITS:

Piedmont deposits of different ages are generally similar within the map area. They typically are poorly sorted, contain subangular clasts ranging in size from silt to boulders, and are often matrix supported. Alluvium tends to be coarser grained near the mountain front and finer grained toward the valley axes. Deposits of comparable position on the piedmont are often finer grained in younger deposits. Composition of alluvium reflects that of the bedrock in the adjacent mountains, being dominated by granitic and crystalline metamorphic detritus on the Catalina and Tortolita piedmonts, and andesite and rhyolite clasts on the Tucson Mountain piedmonts. Map units are based on surface expression which may be younger than that of the surface deposit. Therefore a map unit may contain features of older deposits despite a young map-unit assignment.

Qcha - The most active portion of the main drainage channels. Washes commonly contain coarse to fine-grained sand exhibiting bar-and-swale topography. The channel position is unstable and subject to rapid migration within the finer-grained floodplain deposits that includes terraces 1 and 2. It is the topographically lowest unit in the map area, and is frequently too young to support dense vegetation. These areas are flooded frequently.

Qch - Active and recently active channel deposits that a r e associated with incised channels, except in Avra Valley where main axial drainage is wide, aggradational, and unconfined. The unit includes a complex of low terraces, active channels, gravel bars and floodplains. The average height of the lower terraces above the active channels is about 1 m. These areas are subject to occasional to frequent flooding and sediment transport.

Y - Active or recently active alluvial deposits. These deposits commonly form thin veneers that mantle older map units. Fan surfaces often contain a concentration of coarser pebbles at the surface that mantle underlying silt, although this surface armor is loose and not continuous. Surface clasts show no rock varnish. The unit is typically lower in relief than older fan surfaces. It covers a portion of Avra Valley, but is primarily confined to small fans close to the mountain fronts in the rest of the map area. Gullies that originate on fan surfaces are usually less than 0.5 m deep, and may be either erosional or distributary. Soils are very weakly developed, if present at all, reflecting the young age and recent activity of the unit. This unit should be considered to be potentially subject to flooding and sediment transport.

M2 - The youngest alluvium abandoned by active depositional processes. This unit is older than Y and generally younger than M1, but ranges between these two units in age and surficial characteristics. A slight pavement occurs on many of the fan surfaces with surface clasts typically averaging 2 cm in diameter. Varnish is rare, although surface clasts can have a slight pinkish hue in some locations. The surface of this unit is generally intermediate in height between M1 and Y. Interfluves are usually flat to slightly rounded. Gullies originating on fan surfaces range from less than 0.5 m to 4 m in depth. Surface expression varies from being fairly flat and smooth to gently undulating. Soil development varies from slight development (Entisol) with a brownish surface color to moderately well developed argillic horizons (Typic Haplargid) and even petrocalcic horizons in a few areas, although the presence of a petrocalcic horizon usually indicates the occurrence of a buried older deposit. Variations in depth and density of dissection cause portions of this unit to be susceptible to flooding during larger events.

M1 - Relatively old geomorphic unit of wide aerial extent. Surfaces tend to have a slight pavement development where concentrations of fairly well-sorted clasts averaging 2 to 3 cm in diameter partially armor fan surfaces. A reddish rock varnish is common on surface clasts. The fan surface is typically hummocky and has well rounded interfluves. Channels heading on fan surfaces are broad and V-shaped, contain sandy floors, and range up to 5 m in depth. Soils commonly contain a petrocalcic horizon with or without an overlying red, clay-rich argillic horizon (Paleargid or Paleorthid). These surfaces are isolated from active fluvial processes, and only gullied areas are subject to flooding.

O - Highest and oldest alluvium in map area that retains a preserved geomorphic surface. This unit encompasses all surfaces that are higher in relief than M1 and may range widely in age. Fans are frequently cored by bedrock on all of the mountain fronts. Surfaces have slight pavement development consisting of scattered clasts overlying silt. A reddish rock varnish is common on the surface clasts in some locations, although absent in others. Interfluves are very rounded, broad, and V-shaped. Gullies heading on fan surfaces range from 1 m to 15 m in depth. Soil development consists of thick petrocalcic horizons at or near the fan surface (Paleorthid) unless removed by erosion. Argillic horizons are not common, although they do occur locally in particularly stable areas. Flooding is restricted to gullies.

QTbf - Alluvium that does not exhibit a preserved geomorphic surface. This unit is usually higher in relief and probably older than M1, although wherever fan surfaces are absent the surface age can not be determined. Flooding is restricted to gullies.

Ts - Middle Tertiary sediment. Primarily includes lower Rillito beds of Pashley (1966) where the distinct maroon color and fine bedding are readily distinquishable from younger alluvial deposits.

TERRACES:

Terrace deposits are usually fairly thin, averaging 10 to 20 m (Pashley, 1966), and silty; the oldest terrace (Qt5) is locally coarse-grained. The terraces appear to be essentially strath terraces cut into older basin fill deposits. Terraces become younger and lower in relief toward the main Santa Cruz River and Rillito Creek drainages. Many of the terraces are comprised of several smaller terraces, with mapped terraces being separated by larger downcutting intervals.

Qt1 - Youngest and lowest terrace that has been recently abandoned. Soil development is very weak to non-existent.

Qt2 - Flat, well preserved terraces associated with modern floodplains of Santa Cruz River, Rillito Creek, and Pantano Wash. Lies topographically above Qt1 but below Qt3. Surfaces are generally well preserved and lacking in erosional modification. Soil development consists of weakly indurated Entisols.

Qt3 - Generally narrow, poorly defined terraces that are

intermediate in height between Qt2 and Qt4. Soils appear to contain moderately developed color and structural argillic horizons with little carbonate accumulation. Corresponds to the Jaynes terrace of Smith (1938).

Qt4 - Broad terrace covering a large aerial extent in the central Tucson basin area. Soils typically contain a fairly well developed argillic horizon with varying degrees of secondary carbonate accumulation. Corresponds to the Cemetery terrace of Smith (1938).

Qt5 - Highest, oldest terraces in the map area. These terraces form elongate ridges that may represent the surface of a former level of maximum alluvial fill in the Tucson basin; they correspond to the University terrace of Smith (1938).

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