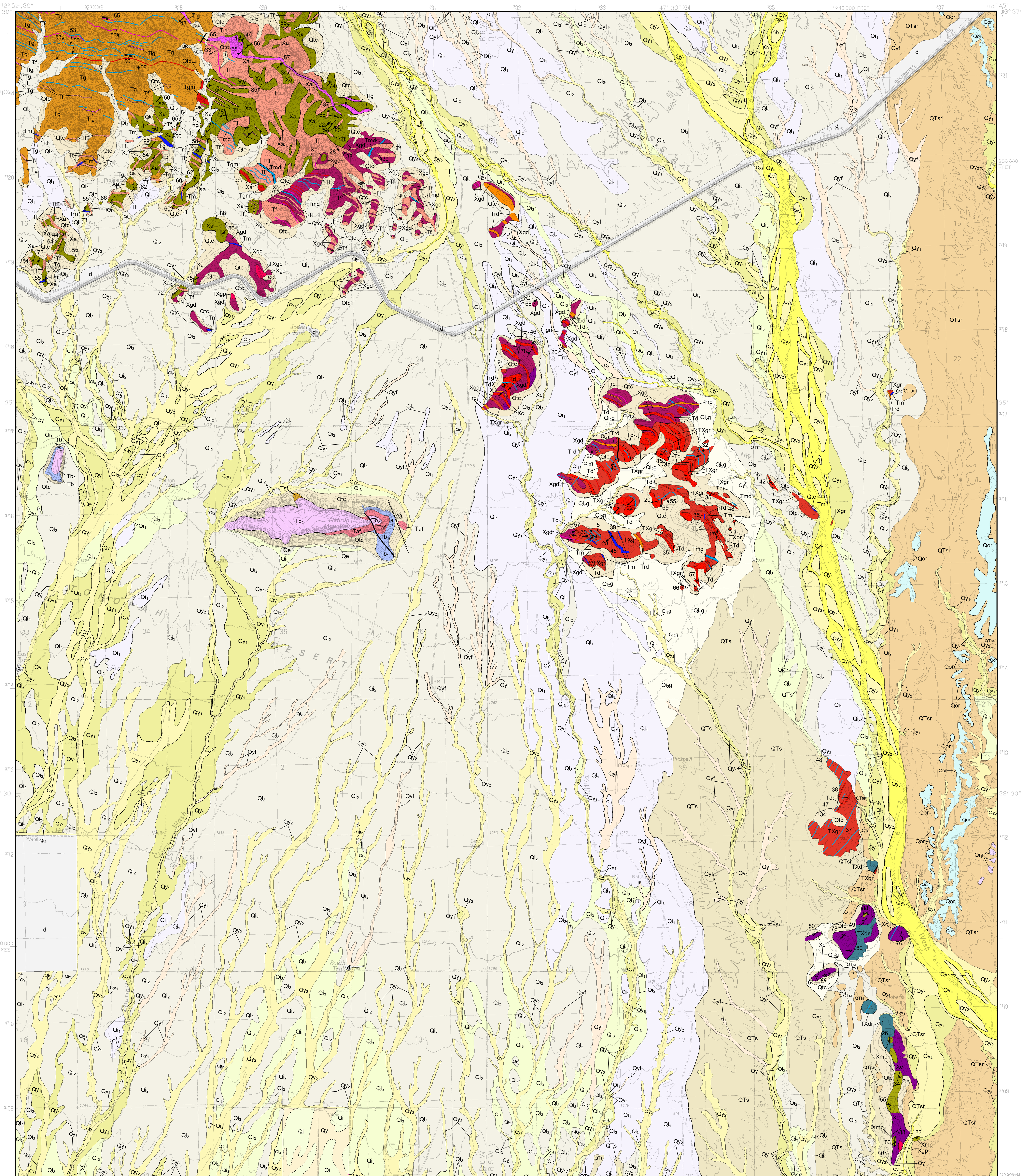
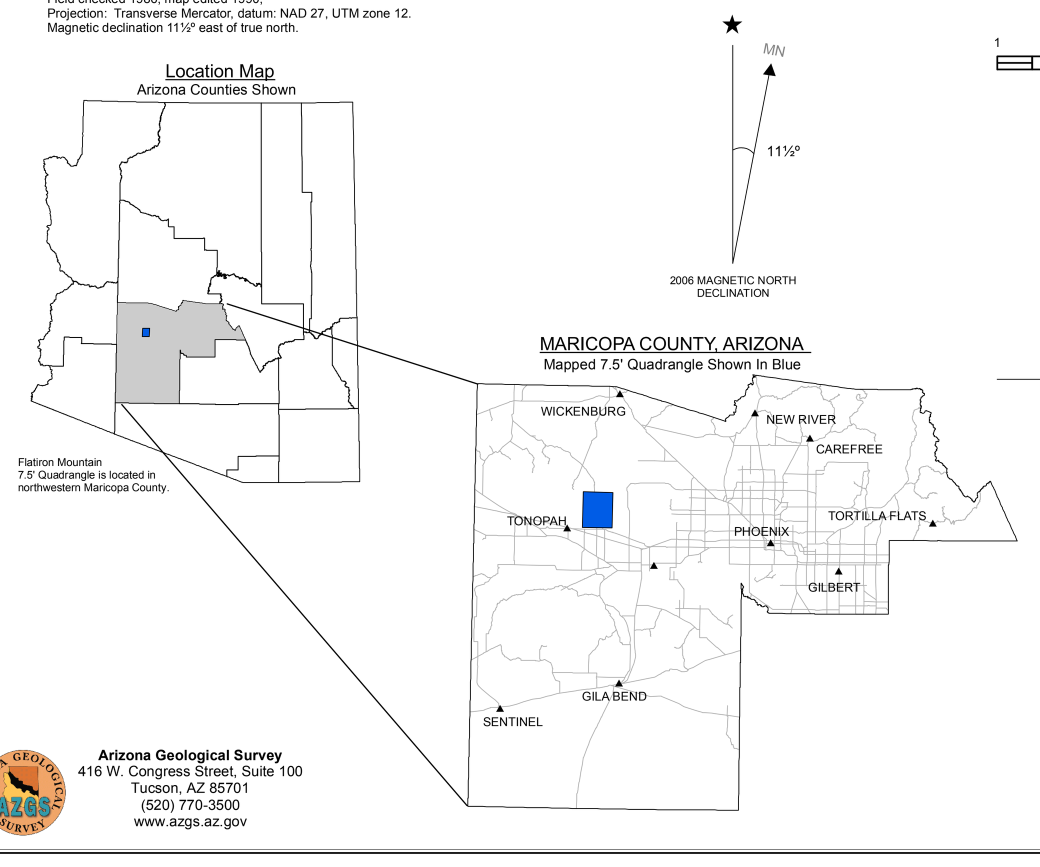
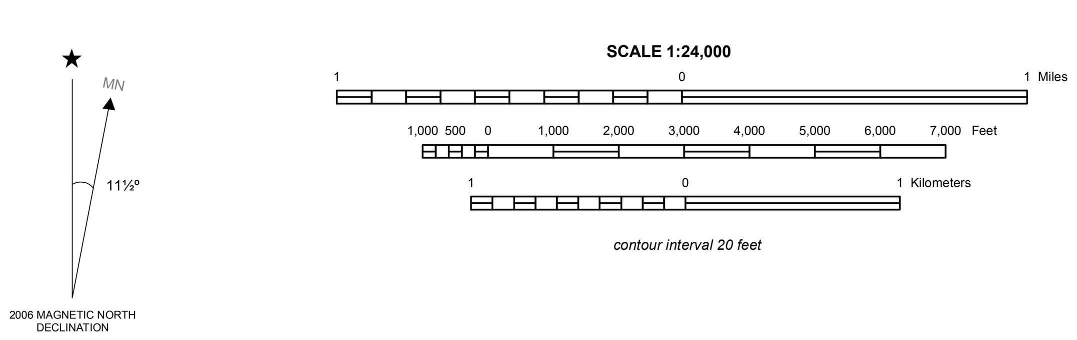


Topographic base from USGS Flatiron Mountain 7.5' quadrangle.
Topography by photogrammetric methods from aerial photographs taken 1951 and 1960.
Field checked 1966; map edited 1990.
Projection: Transverse Mercator, datum: NAD 27, UTM zone 12.
Magnetic declination 11½° east of true north.





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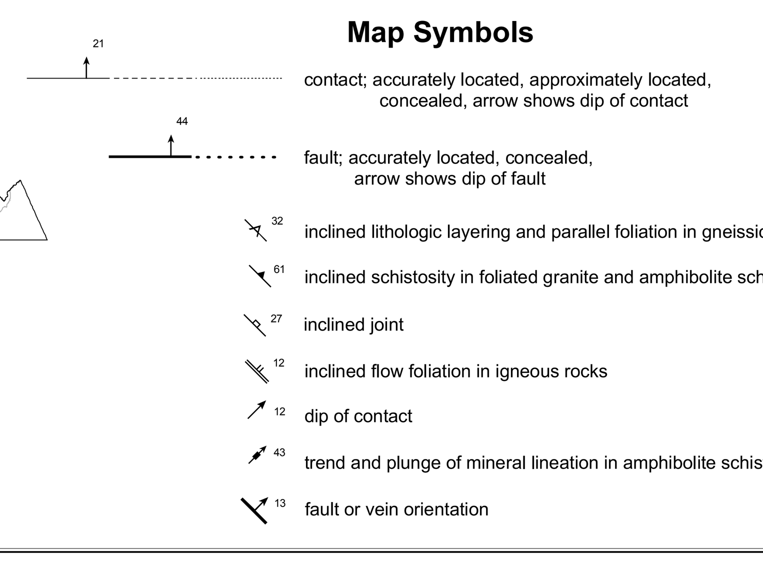
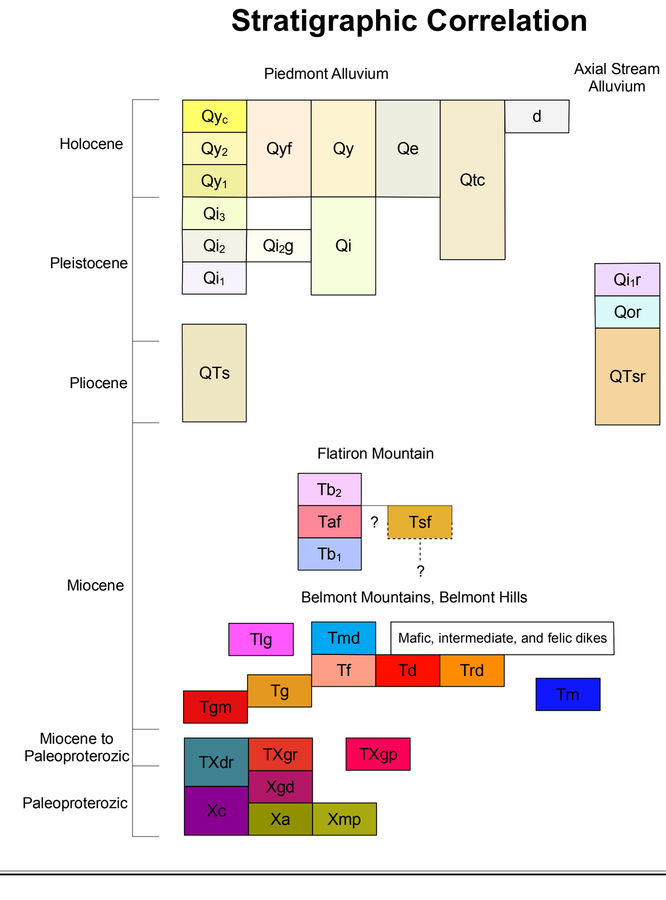
Map Symbols



Stratigraphic Correlation



Surficial Units

Piedmont Alluvium

Quaternary and late Tertiary piedmont deposits from several mountain ranges to the north cover most of the Flatiron Mountain quadrangle. This alluvium was deposited primarily by larger tributary streams that head to the north of the quadrangle; these larger streams and local, smaller streams have eroded and reworked some of these deposits. Deposits range in age from modern to Pliocene. Abbreviations are ka, thousands of years before present, and Ma, millions of years before present.

Qy_c **Modern channel deposits (<~100 yrs)** — Active channel deposits composed of very poorly-sorted sand, pebbles, and cobbles with some boulders to moderately-sorted sand and pebbles. Channels are generally incised 1 to 2 m below adjacent Holocene terraces and alluvial fans, but may be incised as much as 4 m below adjacent Pleistocene deposits. Channel morphologies generally consist of a single-thread high flow channel or multi-threaded low flow channels with gravel bars. Channels are extremely flood prone and are subject to deep, high velocity in moderate to large flow events, and severe lateral bank erosion.

Qy_2 **Late Holocene alluvium (<~2 ka)** — Young deposits in low terraces and small channels that are part of the modern drainage system. Includes Qy_c where not mapped separately. Along the larger drainages, unit Qy_2 sediment is generally poorly to very poorly sorted sand, pebbles, cobbles, and boulders; terrace surfaces typically are mantled with pebbles, sand, and finer sediment. On lower piedmont areas and in smaller tributary washes young deposits consist of moderately sorted sand and silt, with some pebbles and cobbles in channels. Channels generally are incised less than 1 m below adjacent terraces, but locally incision may be as much as 2 m. Channels are flood prone and may be subject to deep, high velocity flows in large flow events. Potential lateral bank erosion is severe. Channel morphologies generally consist of a single-thread high flow channel or multi-threaded low flow channels with gravel bars adjacent to low flow channels. Flood flows may significantly change channel morphology and flow paths. Local relief varies from fairly smooth channel bottoms to undulating bar-and-swale topography that is characteristic of coarser deposits. Terraces have planar surfaces, but small channels are common. Qy_2 have no to weak soil development.

Qy_1 **Holocene alluvium (<~10 ka)** — Older Holocene terrace deposits found at scattered locations along incised drainages throughout the study area. Qy_1 surfaces are higher and less subject to inundation than adjacent Qy_2 surfaces. Qy_1 terraces are generally planar but local surface relief may be up to 1 m where gravel bars are present. Qy_1 surfaces are <2 m above adjacent active channels. Surfaces typically are sandy but locally have unvarnished open fine gravel lags or pebble and cobble deposits. Qy_1 soils typically are weakly developed, with some soil structure but little clay and no to stage I calcium carbonate accumulation (see Machette, 1985, for description of stages of calcium carbonate accumulation in soils). Yellow brown (10 YR) soil color is similar to original fluvial deposits.

Qyf **Fine-grained Holocene alluvium (<~10 ka)** — Thin, fine-grain Holocene alluvial deposits formed in swales on ridges of mid- to early Pleistocene fan deposits. Qyf deposits are very thin, typically less than 0.5 m thick, but locally may be up to 1 m thick. Sediment is mainly silt and sand, with occasional deposits of open, unvarnished, fine gravel lag. Soil development is minimal. Where it has developed soil is typically a reddened (7.5 YR) sandy loam with substantial disseminated carbonate but no visible carbonate accumulation.

Qy **Holocene alluvial deposits, undifferentiated (<~10 ka)**

Qe **Eolian deposits (<~10 ka)** — Thin, fine-grain Holocene eolian deposits formed in low ridges at the base of Flatiron Mountain. Sediment is mainly silt and fine sand. Soil development is minimal.

Qi_3 **Late Pleistocene alluvium (~10 to 130 ka)** — Unit Qi_3 is composed of slightly to moderately dissected relict alluvial fans and terraces. Active channels are incised up to about 2 m below Qi_3 surfaces. Qi_3 fans and terraces are lower in elevation than adjacent older surfaces. Qi_3 deposits consist of pebbles, cobbles, and finer-grained sediment. Qi_3 surfaces commonly have bar and swale topography moderately preserved, loose to moderately packed pebble and cobble lags, and are moderately reddened. Surface clasts typically exhibit weak to moderate rock varnish but some surfaces in the northern and eastern areas of the quadrangle are mainly composed of volcanics and are darkly varnished. Qi_3 soils are moderately developed, with orange to reddish brown (7.5 YR) clay loam to light clay argillic horizons and stage II calcium carbonate accumulation.

Qi_2 **Middle Pleistocene alluvium (~130 to 750 ka)** — Unit Qi_2 is composed of moderately to highly dissected relict alluvial fans with strong soil development found throughout the map area. Qi_2 surfaces are drained by broad swales and well-developed, moderately to deeply incised tributary channel networks; channels are typically several meters below adjacent Qi_2 surfaces. Well preserved, planar Qi_2 surfaces are smooth with scattered pebble and cobble lags; surface color is reddish brown; surface clasts are moderately to strongly varnished. More eroded, rounded Qi_2 surfaces are characterized by strongly varnished, scattered, cobble to cobble and pebble lags with broad ridge-like topography. Soils typically contain reddened (5 to 7.5 YR), modestly clay-rich argillic horizons, with clay skins and subangular blocky structure. Underlying soil carbonate development is typically stage III with areas to stage IV, and abundant carbonate through at least 1 m of the soil profile.

Qi_2g **Locally derived late Pleistocene alluvium (~10 to 130 ka)** — Unit Qi_2g is composed of moderately dissected relict alluvial fans locally derived from bedrock units TXgr, Td, and Xgd. Active channels are incised up to about 2 to 3 m below Qi_2g surfaces, exposing underlying bedrock. Qi_2g deposits consist of angular to subangular pebbles, cobbles, boulders, and finer-grained sediment with loose to moderately packed pebble and cobble lags. Surface clasts of these lithologies exhibit no to strong rock varnish. Qi_2g soils are moderately developed, with orange to reddish brown (7.5 YR) clay loam to clay argillic horizons with strong stage III to IV carbonate accumulations.

Qi_1 **Middle to Early Pleistocene alluvium (~500 ka to 1 Ma)** — Unit Qi_1 is composed of deeply dissected relict alluvial fans. Qi_1 surfaces form rounded ridges that are higher than adjacent Qi_2 surfaces. Drainage networks include broad swales on the ridge tops and tributary channels incised 3 to 4 m. Underlying eroded QTs deposits are occasionally exposed along some ridge slopes and wash banks. Well-preserved Qi_1 surfaces have moderately to tightly packed cobble, boulder, and pebble lag. Surface clasts are strongly to very strongly varnished and often have carbonate rinds up to 2 mm. More eroded, rounded Qi_1 surfaces are characterized by very strongly varnished, scattered, cobble and boulder lags with exposed laminar carbonate horizons. Where well preserved, Qi_1 soils are strongly developed with a dark red (5-2.5 YR), heavy clay argillic horizon and subangular blocky to prismatic structure. Carbonate accumulations are 1-2 m thick and range from stage IV-V. This unit approximately correlates to Field's and Pearthree's (1991) unit M1a.

Qi **Pleistocene alluvium, undivided (~10 ka to 1 Ma)**

QTs **Early Pleistocene to Pliocene alluvium (~1 to 5 Ma)** — Unit QTs is composed of dissected and highly eroded alluvial fan deposits. Locally these deposits are overlain by younger Quaternary units and are mainly exposed on eroded ridge slopes, in wash banks, and in channels as strath terraces. QTs deposits include carbonate cemented, tan, pebble to cobble conglomerates, poorly sorted, subangular to subrounded, pebbles and cobbles in layers or lenses, and moderately to well sorted, subangular to subrounded, moderately indurated, cross-bedded, red, pebbly sandy beds. In the southeast corner of the quadrangle unit QTs is preserved in high, rounded ridges with tributary drainages incised 3 to 4 m. These ridges have moderately packed, moderately to strongly varnished, pebble and cobble surface lag and stage IV carbonate accumulations. In aerial photographs the dark brown, coarse surface lag on ridge crests appears distinctly different from underlying, lighter, carbonate cemented sediments. The thickness of QTs deposits is not known.

Hassayampa River Alluvium

Qi_1r **Middle Pleistocene river deposits (~130 to 750 ka)** — Deposits associated with a set of high terraces along the Hassayampa River. Terrace surfaces are of limited extent in this quadrangle. Terraces are fairly flat or slope gently toward the river, but terrace surfaces are dissected by tributary drainages. Deposits typically are quite gravelly at the surface but limited exposures indicate that they also contain sand and silt. Qi_1r terrace surfaces range from about 10 to 20 m above the active river channel.

Qor **Early Pleistocene river deposits (~500 ka to 1 Ma)** — Deposits associated with the high terraces along the Hassayampa River that record the maximum aggradation of the river. Terrace surfaces are fairly flat or broadly rounded, but all terrace surfaces are moderately to deeply dissected by tributary drainages and the river and have been substantially modified by erosion. Exposures are poor, but well-rounded gravel is evident at the surface. Terrace surfaces are also typically covered with litter from underlying petrocalcic soil horizons. Qor terrace surfaces are more extensive than any of the younger Pleistocene terraces (Qi_2r). Terrace surfaces range from about 15 to 20 m above the active river channel, and rise slightly to the north across the quadrangle.

QTsr **Pliocene to early Pleistocene river deposits (~1 to 5 Ma)** — A moderately thick sequence of old Hassayampa River deposits that underlies the Qor terrace/fan deposits. These deposits consist of river sand, gravel and silt with a substantial component of tributary sand and gravel. Local zones of substantial carbonate accumulation may represent moderately to strongly developed buried soils.

Other Units

d **Disturbed areas (<~100 yrs)** — Much of the quadrangle has been disturbed by human activities, particularly agricultural activities. This unit designation is used only in areas of substantial excavation or anthropogenic deposition, for example, major flood-control levees.

Qtc **Hillslope talus and colluvium** — Unit Qtc consists of locally-derived deposits on moderately steep hillslopes. Deposits are very poorly sorted, ranging from clay to cobbles and boulders. Clasts are typically subangular to angular because they have not been transported very far. Bedding is weak and dips are quite steep, reflecting the steep depositional environment. Deposits are a few meters thick or less; thickest deposits are found at the bases of hillslopes. Some stable hillslopes are covered primarily with Pleistocene deposits, which are typically reddened and enriched in clay. Other more active hillslopes are covered with Holocene deposits, which have minimal soil development.

Bedrock Units

Volcanic and sedimentary rocks at Flatiron Mountain

Note: Basaltic lava to west that is probably correlative with basalts of Flatiron Mountain was dated by Shafiqullah et al. (1980) at 15.0 ± 0.4 Ma (K-Ar whole-rock analysis).

Tb_2 **Upper basalt of Flatiron Mountain (Miocene)** — Dark, vesicular basaltic lava with 7%, approximately 1 mm olivine and pyroxene, and 1-2 mm euhedral to subhedral plagioclase. (Samples: CAF-2-8002, 8010).

Taf **Andesitic lava at Flatiron Mountain (Miocene)** — Andesitic lava with a light matrix containing ~5-15%, conspicuous, 5-70 mm, fine-grained, medium to dark gray, aphanitic mafic inclusions, and phenocrysts of feldspar (~2-5%, 1-10 mm), and biotite (2-3%, 1-3 mm). On the north face of eastern Flatiron Mountain unit appears as a black, vitric lava flow approximately 10 m thick with autobreccia at the top and base. (Samples: CAF-2-8008, 8015)

Tb_1 **Lower basalt of Flatiron Mountain (Miocene)** — A sequence of at least three lava flows of dark, vesicular basaltic lava with slightly vitric matrix, 7% 1-3 mm olivine and pyroxene, and 1-2 mm euhedral to subhedral plagioclase phenocrysts. (Samples: CAF-2-8016, 8018, 8019, 8020)

Tsf **Sedimentary rocks of Flatiron Mountain (Miocene)** — A unit known only from rock debris on the north slope of Flatiron Mountain, recognized by conspicuous clasts of medium-grained, equigranular granodiorite with 15% biotite (map unit Xgd), and leucogranite porphyry.

Tertiary intrusive units

Tm **Mafic dikes, undivided (Miocene)** — Fine-grained to very fine-grained, dark green to gray matrix mafic dikes with sparse <1.5 mm plagioclase phenocrysts.

Tmd **Microdiorite dike (Miocene)** — Fine-grained, holocrystalline mafic dike consisting of plagioclase and hornblende, possibly with biotite and very minor fraction of quartz. Some dikes north of CAP canal consist of fine-grained monzodiorite with 10-20% mafics, and sparse <2.5 mm feldspar phenocrysts, locally with 2-15% 1-10 cm fine-grained dioritic inclusions.

Td **Dacite dike phase of Belmont Granite (Miocene)** — Dikes containing 2-20%, 1-4 mm phenocrysts of feldspar, but locally quartz comprises up to 30% of phenocrysts. Locally with sparse biotite. Matrix is generally microcrystalline and locally flow-foliated. Unit grades into the rhyodacite dike phase, and main phases of the Belmont Granite. Cores of dikes are locally miarolitic and strongly spherulitic (CAF samples: CAF-2-10328, 10336).

Tlg **Fine-grained granitic dikes (Miocene)** — Fine-grained leucogranite not associated with other dikes.

Trd **Rhyodacite dike phase, Belmont Granite (Miocene)** — Phenocryst-rich rhyodacite dikes, commonly flow-foliated and spherulitic, containing 7-35%, 2-4 mm quartz and feldspar phenocrysts. Grades into the dacite dike, and main phase of the Belmont Granite. Cores of dikes are locally miarolitic and strongly spherulitic (CAF samples: CAF-2-10328, 10336).

Tgm **Micro-porphyritic leucogranite phase of Belmont Granite (Miocene)** — Fine-grained micro-porphyritic leucogranite with 15-30% <1 mm phenocrysts of rounded quartz and subhedral feldspar, and sparse mafics (mostly biotite). The unit occurs as small stocks and dikes that grade into the main phase of the Belmont Granite.

Tf **Porphyritic phases of the Belmont Granite, undivided (Miocene)** — A complex of dikes and irregular intrusions that protrude from the southeastern edge of the main body of the Belmont Granite. The unit appears to grade into the main body, but also shows evidence of cross-cutting relationship where dikes of this unit cut the main pluton to the south. Locally, the unit is divided into dacitic (Td) and rhyodacitic phases (Trd) based on the absence and presence of quartz phenocrysts, respectively. A typical small intrusion or thick dike consists of a contact zone marked by <5% potassium-feldspar porphyry (2-6 mm) with sparse biotite and hornblende that grades into phenocryst-rich (10-40%), quartz (2-4 mm), potassium feldspar (2-6 mm) porphyry, commonly with granophyric and myrmekitic texture. The gradual change from phenocryst-poor to phenocryst-rich porphyry occurs over zones less than 10 m wide. Generally, phenocryst-poor porphyry dikes are less than 5 m thick. The granite and its porphyry dikes are all characterized by miarolitic cavities up to 10 mm across that make up <1% to 5% of the rock. In some areas, a very phenocryst-poor to aphyric, aphanitic matrix porphyry occurs along contacts with older rocks. These rocks are commonly flow-foliated and display micro-orbicular to spherulitic textures and <1 mm miarolitic cavities (CAF samples: CAF-2-7955, 7957, 7962, 7974, 7989, 8141, 10238, 10239, 10321, 10475).

Tg **Belmont Granite (Miocene)** — Fine- to medium-grained, potassium feldspar porphyritic, miarolytic granite with <5% mafics (biotite and hornblende) and variably amounts of quartz. The granite grades into highly variable porphyritic textures near intrusive contact with older rocks to the east. Age assignment is based on a rubidium-strontium model age of early to middle Miocene (Spencer et al., 1995).

Geologic Map of the Flatiron Mountain 7.5' Quadrangle, Maricopa County, Arizona

by Jon E. Spencer, Ann Youberg, and Charles A. Ferguson

Arizona Geological Survey Digital Geologic Map 46 (DGM-46), version 1.0

March 2006

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The Flood Control District of Maricopa County provided high-resolution digital orthophotos that were used to accurately locate surficial geologic unit boundaries. Stevan Gyetvai was the cartographer for version 1.0 of DGM-46.

Introduction

The Flatiron Mountain 7.5' Quadrangle is located approximately 70 km (40 miles) west of downtown Phoenix, and is just north of Interstate Highway 10. The map area includes the southeastern part of the Belmont Mountains and many isolated bedrock hills south and southeast of the Belmont Mountains. Most of the quadrangle, however, is underlain by Quaternary surficial deposits. Jackrabbit and Coyote washes, heading in the proximal piedmonts of the Big Horn Mountain northwest of the map area, are the major drainages. Jackrabbit Wash is incised up to four meters into older Pleistocene deposits. Coyote Wash flows around the Belmont Mountains and diverges into multiple channels to the south. The channels and floodplains of Coyote Wash are less incised than Jackrabbit Wash. Smaller tributary washes on adjacent older Pleistocene deposits generally are not incised more than two meters. Older Hassayampa River deposits are found along the eastern side of the quadrangle.

The Quadrangle was mapped during the 2004-2005 field season. Jon Spencer and Charles Ferguson were responsible for mapping bedrock, and Ann Youberg was responsible for mapping Quaternary surficial deposits. Map compilation was done using ESRI ArcMap software, and the resultant GIS geodatabase will eventually be available to the public. Mapping was done as part of a multiyear mapping program directed at producing complete geologic map coverage for the Phoenix-Tucson metropolitan corridor. During this 2004-2005 field season and the previous 2003-2004 field season, a total of eight geologic maps, listed below, were produced for the Hassayampa Plain area. All these maps were prepared under the joint State-Federal STATEMAP program, as specified in the National Geologic Mapping Act of 1992. Also listed below are detailed maps of bedrock in adjacent areas.

Surficial Geology

Surficial mapping was conducted using natural-color (scale 1:24,000) stereo-pair aerial photographs from the Bureau of Land Management (BLM) taken in 1979, and false color, high resolution digital orthophotographs (2004) provided by Maricopa County Flood Control District. Preliminary unit designations were field checked throughout the map area and mapping was supplemented by observations and descriptions of soils and stratigraphy. This mapping was done in conjunction with geologic mapping of the Wintersburg quadrangle (Pearthree and Ferguson, 2005) to the south, and is one of eight 1:24,000 scale geologic maps covering much of the Hassayampa Plain area that have been produced in 2004 and 2005. Mapping was compiled in a GIS format and the final linework was generated from the digital data. Surficial deposits of the map area were then correlated with regional deposits to roughly estimate their ages.

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, rock varnish and desert pavement development. 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. Two typical soil horizons in Pleistocene alluvial sediments of Arizona are reddish brown argillic horizons and white calcic horizons. As a result, on color aerial photographs older alluvial surfaces characteristically appear slightly redder or whiter (on more eroded surfaces) than younger surfaces. 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. Young flood-prone surfaces appear nearly flat on aerial photographs and are less than 1 m above channel bottoms. Active channels are typically entrenched 1 to 5 m below older surfaces.

Variations in the distribution of surfaces of different ages and sources and concomitant variations in dissection across the quadrangle provide evidence regarding the recent geologic evolution of this area and the distribution of flood hazards. Generally, areas along the Hassayampa River are moderately dissected, whereas dissection on the piedmont to the west is modest. High terrace remnants of the Hassayampa River (unit Qor) record the river bed in the early to middle Quaternary. Qor terraces cap a substantial aggradational sequence that was deposited during late Tertiary to early Quaternary (unit QTsr). Deposits of the Hassayampa River have been exploited as aggregate resources at several locations. Adjacent piedmont areas were likely aggrading at this time as well (unit QTs). At that time the river was probably was depositing sediment across a fairly broad floodplain in the eastern part of the quadrangle, and alluvial fans on both sides of the river were interfingering with the river floodplain. Since then the Hassayampa River has downcut 10 to 15 m, with dissection increasing slightly to the north. The effects of this downcutting are expressed by incision of tributary drainages immediately west of the Hassayampa River. Along these tributary drainages, late Quaternary deposits are quite limited in extent and flood hazards are restricted to relatively narrow valley bottoms.

In the western half of the quadrangle, piedmont washes drain to the south before eventually joining the Gila River. Much of this piedmont is mantled by fairly old Pleistocene tributary deposits (units Qi2 and Qi1) that have been eroded into broadly rounded ridges. Incision along these tributary drainages is less than a few meters, but there is enough topographic confinement that late Pleistocene and Holocene deposits are inset below the ridges and there are no major distributary channel networks or active alluvial fans on the piedmont. Thus, flood hazards are restricted to broad, nearly flat valley bottoms in this area (units Qy_c, Qy_2, and locally Qy_1). Agricultural activity and recent residential development have modified the landscape to greater or lesser degrees. Areas are mapped as "disturbed" where the surficial deposits are profoundly altered (stock tanks, agricultural fields).

Bedrock Geology

The Belmont Mountains, which form a southeastern extension of the Big Horn Mountains, consist largely of a Middle Tertiary granite that contains sparse fluorite (Reynolds et al., 1985) as well as numerous northwest trending, compositionally diverse dikes. This granite was intruded during a several million year period of volcanic activity and extensional faulting that produced most of the rocks and structures in the Belmont and Big Horn Mountains (Capps et al, 1985; Stimac et al, 1994). Most of this activity occurred between about 16 and 21 Ma (Spencer et al., 1995).

The southeastern tip of the Belmont Mountains is within the map area. In this area the middle Tertiary Belmont Granite grades southeastward into a zone of felsic dikes and irregular hypabyssal intrusions emplaced within a crystalline complex of Proterozoic metamorphic rocks and granitic rocks of uncertain age. Dikes are less abundant southeastward across the quadrangle where bedrock is exposed in scattered hills.

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Tertiary to early Proterozoic intrusive and metamorphic rock units

TXgp **K-feldspar porphyritic granite of the Belmont Mountains (Tertiary to early Proterozoic)** — Granite with fine grained matrix, 5-8% 1-3 mm biotite, grayish white plagioclase phenocrysts typically 2-10 mm diameter but locally up to 20 mm, and pink K-feldspar phenocrysts up to 25 mm diameter. Some K-feldspar crystals are rimmed with plagioclase, and apparent potassium feldspar crystals are locally up to 12 mm diameter. The conspicuously porphyritic character of this granite is its defining characteristic.

TXgr **Porphyritic biotite granite of the Belmont Hills (Tertiary to early Proterozoic)** — Medium grained, potassium-feldspar porphyritic biotite (7-12%) granite. Unit is exposed in the Belmont Hills south of CAP canal and east of Vulture Mine road.

TXdr **Diorite of Roberts Well (Tertiary to early Proterozoic)** — Plagioclase - hornblende diorite near Roberts Well in the southeastern part of Flatiron Mountain Quadrangle. Unit contains approximately 35%, 1-5 mm fresh hornblende and 65%, 1-3 mm gray plagioclase with variable iron oxide staining.

Xgd **Foliated biotite granodiorite or granite (early Proterozoic)** — Somewhat heterogeneous, medium grained, equigranular, variably foliated biotite granodiorite (or granite) in the eastern Belmont Mountains. Mafic minerals are estimated to make up 15 -30% of rock. Locally unit contains less than 10% mafic minerals that consist primarily of biotite, and in some areas this biotite granite is K-feldspar porphyritic.

Xc **Heterogeneous crystalline complex (early Proterozoic)** — Heterogeneous mix of metapsammite (unit Xmp), foliated felsic granitoids, gneissic rocks, and pegmatite and quartz veins.

Xmp **Metapsammite (early Proterozoic)** — Greenschist-grade metasandstone and metasiltstone that generally are not quite metamorphosed sufficiently to develop mica visible with a hand lens or to impart significant schistosity. Generally a dark greenish gray to black rock with lithologic layering interpreted as relict bedding. County, Arizona. Unit is in complex contact with associated granitoids with numerous pegmatites and leucogranites in contact zone. Unit is exposed in the southeastern corner of map area.

Xa **Amphibolite schist (early Proterozoic)** — Heterogeneous, fine to medium grained amphibolite schist and mafic quartzo-feldspathic schist and gneiss with local lenses of quartz-biotite schist, sericite schist, and psammitic schist. Locally contains relict pillow basalt.

Dikes shown on map with single colored line

Mafic dike (Miocene) — Basaltic, andesitic, porphyritic andesite, and fine grained dioritic and monzodioritic dikes, undivided. Includes fine-grained monzodiorite dikes with 10-20% mafics, sparse <2.5 mm feldspar phenocrysts, and 2-15%, 1-10 cm fine grained dioritic inclusions (Tmz). The monzodiorite appears to be gradational with some of the andesite porphyry dikes. Also includes composite dikes containing both basaltic and andesitic components.

Intermediate composition dike (Miocene) — Mafic to intermediate dikes with fine-grained dioritic matrix. Contains 0-20%, 1-8 mm plagioclase phenocrysts, and 0-10%, 1-3 mm mafic-phenocryst clots. Some varieties are very fine-grained with aphanitic matrix. The varieties grade together in zones and swarms. The dikes commonly form the walls of younger (apparently) felsic dikes.

Crystal-poor felsic dike (Miocene) — Two distinct varieties of rhyolitic dikes; aphyric rhyolite dikes with very fine-grained, typically purple-gray, and commonly flow-foliated matrix (CAF samples: CAF-2-10246, 10283), and flow-foliated, sparsely porphyritic rhyolite dikes with 1-3 mm quartz crystals and sparse feldspar and quartz (<2 mm) phenocrysts. The vitric-matrix varieties are typically spherulitic and varicolored (CAF samples: CAF-2-10243, 10288, 10409).