

**GEOLOGIC MAP OF THE TONTO BASIN 7.5'
QUADRANGLE, GILA AND MARICOPA
COUNTIES, ARIZONA**

by
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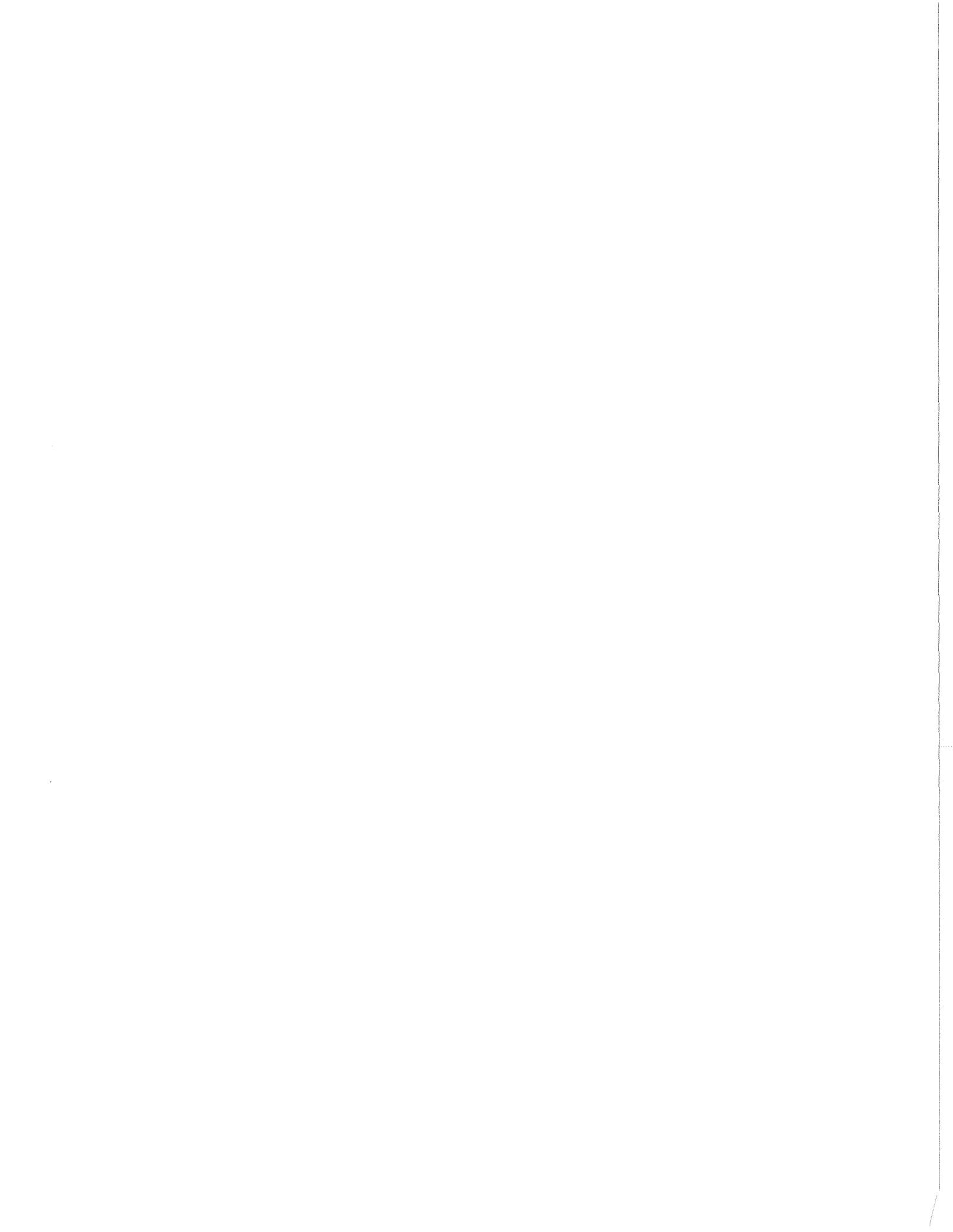
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and cross-sections (2 sheets)

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Introduction

Tonto Basin is a Mid-Tertiary, west-tilted half-graben located in the Transition Zone tectonic province of central Arizona (Figure 1). Along with the northerly adjacent Payson Basin, Tonto Basin is bounded on the west by a major east-side-down normal fault that accomodates at least 3,000' of displacement. In the Payson basin, the basin-bounding fault was named Payson fault (Muehlberger, 1990) and it forms the abrupt, east-facing escarpment of the Mazatzal Mountains. The western basin-bounding fault of Tonto Basin is also referred to as Payson fault, even though there is an abrupt change of strike where the two basins merge (Figure 1). The eastern margin of both basins is defined by a gentle, west-dipping, depositional unconformity with Proterozoic rocks of the Sierra Ancha (Martin, 1990; Mayes, 1990). Tonto Basin is filled with Miocene and younger mudstone and conglomerate that in general dip gently to the west. Locally along the western margin of the Tonto Basin and in the center of Payson Basin (Muehlberger, 1988), an older sequence of east-tilted conglomerates are present suggesting a complex structural history along the Payson fault. A sequence of Pliocene and younger conglomerate and mudstone in the Payson basin overlap the Payson fault (Muehlberger, 1988), and are probably equivalent with a sequence of flat-lying, post-tectonic, younger Tertiary conglomerates in the Tonto Basin which also bury the Payson fault.

Previous work

Mapping of the The Tonto Basin 7.5' quadrangle connects to the north with a series of Master's thesis maps of the northern Tonto Basin, and the northerly adjacent Payson Basin (Muehlberger, 1988; Martin, 1990; and Mayes, 1990). Prior to these detailed studies, Feth (1954) proposed dividing the former "Tonto Basin" into the Payson and Tonto basins, and Lance and others (1962) described the Tertiary sedimentary rocks of Tonto Basin. Pederson (1969) made a sedimentologic study of the sediments in the Payson Basin. Royse and Barsch (1971) and Barsch and Royse (1972) studied the Quaternary axial alluvial terraces and piedmont terraces, and Anderson and others (1987) conducted a seismotectonic investigation of the Tonto Basin. Pearthree and Scarborough (1984) examined the range-bounding escarpments for evidence of Quaternary motion. Mayes (1990) provides an extensive review of all geologic work conducted in the area.

For this project, the Tonto Basin quadrangle was mapped in reconnaissance during the winter and spring of 1998. The Proterozoic granitoids of the Mazatzal Mountains and a small portion of the range bounding escarpment were mapped by Steve Skotnicki in the winter of 1997-98. Later, in the spring of 1998 Ferguson and Gilbert completed the geologic quadrangle by mapping the Tertiary and Quaternary geology of the basin and the remainder of the range bounding escarpment.

Proterozoic geology

Proterozoic rocks in the Tonto Basin quadrangle are almost entirely plutonic in origin. Three plutons of medium-grained and fine-grained granite or quartz monzonite of presumed Early Proterozoic age make up most of the Mazatzal Mountains in the map area (Xgo, Xgr, Xf). Smaller bodies of hornblendite gabbro (Xh) occur within the fine-grained ganitoid (Xf). A large pluton of Middle Proterozoic K-feldspar porphyritic granite occurs in the south (Ygc,

Ygm). A small area of the Sierra Ancha in the map area's northeast corner consists of a quartz monzonite (Xgs) that is correlated with the quartz monzonite (Xgo) of the Mazatzal Mountains. No major structures of Proterozoic age were identified in the map area, although a zone of north-striking mylonitic foliations occur in the Early Proterozoic plutons along their contact with the Middle Proterozoic granite. In the northwest part of the map area, a small body of blue-gray quartzite is surrounded by the fine-grained granite (Xf).

Tertiary

Red mudstone

The principal Tertiary unit in the map area is a red mudstone and siltstone (Tm) with conspicuous beds, ranging in thickness from a few centimeters to over 4 meters, of thin-bedded to laminated gypsum and green mudstone. The gypsum beds are thickest in the south where they comprise up to 10% of the unit, and they pinch out altogether just north of the map area (Mayes, 1990). The gypsum beds provide strong evidence of a lacustrine depositional environment for the unit.

The mudstone unit is present throughout the central and eastern part of the basin, but to the west it interfingers with and is overlain by younger conglomerate (Figure 2). Previously thought to be Pliocene in age based on a *Pliohippus* tooth (Lance and others, 1962) from near Punkin Center, a middle to early Miocene age is probably more realistic, based on a biotite K-Ar 18.55 ± 0.56 Ma date from a thin, water-laid tuff near the top of the mudstone sequence (Nations, 1987; Mayes, 1990) and whole rock K-Ar dates of 22.6 ± 1.2 Ma (Muehlberger, 1988; Mayes, 1990) and $27.16 \text{ Ma} \pm 1.2$ Ma (Damon and others, 1996) from two basalt flows interbedded with correlative conglomerates farther north.

Conglomerate

Three map units of Tertiary conglomerate in the map area are recognized based principally on age relationships with the red mudstone unit. A fourth unit, consists of a thin veneer of rounded, extra-basinal clast conglomerate that is preserved along a part of the ridge crest of the Mazatzal Mountains near Edwards Peak (Tcr). Lying nearly 1 km above the basin floor, it is not known how these conglomerates correlate with the other Tertiary units of Tonto Basin.

Post-tectonic conglomerate (Tcp)

Post-tectonic conglomerates (Tcp) are defined on the basis of their lack of structural tilt, and their composition. Along the east-facing escarpment of the Mazatzal Mountains, the post-tectonic conglomerate is very coarse-grained, generally massive in appearance, and composed of very large sub-angular blocks (up to 4 meters) of local derivation. These conglomerates overlap the crystalline rocks of the Mazatzal Mountains along an east-dipping buttress unconformity that is interpreted to represent the degraded scarp of the Payson fault. Towards the middle of the basin the post-tectonic conglomerates are generally finer grained, with clasts chiefly of sub-rounded, locally derived cobbles, but there are also lenses of distinctive extra-basinal, rounded-clast, clast-supported (chiefly Proterozoic quartzite and metavolcanic lithologies) conglomerates. These rounded-clast conglomerates are interpreted

as deposits of an ancestral Tonto Creek alluvial system interfingering with conglomerates derived from the Mazatzal Mountains.

The post-tectonic conglomerates are typically poorly indurated and rarely exposed. Since they are similar in composition and sedimentology to the terraced alluvial gravels (Qt) and piedmont terraces (Qp) of Quaternary age, it is possible that the contact between these units is gradational in some areas.

Younger Conglomerate (Tcy)

The lacustrine mudstone unit (Tm) is overlain gradationally and interfingers to the west with a tan conglomerate containing clasts derived chiefly from erosion of granitic rocks of the Mazatzal Mountains (Tcy). Clasts in the younger conglomerate are typically sub-rounded to sub-angular and the conglomerates have a granule to pebbly arkosic matrix. The younger conglomerates do not contain the extra-basinal, rounded-clast conglomerate lenses which are abundant in the post-tectonic conglomerate unit (Tcp). South of Walnut Canyon, the contact between the mudstone (Tm) and younger conglomerate (Tcy) is defined by interbedded green mudstone and pebbly, granule sandstone. At one locality (in the gulch about a mile south of Walnut Canyon Spring), the contact is marked by a 2 meter-thick, massive, white, fine-grained sandstone that may represent a shoreface deposit.

Older Conglomerate (Tco)

The older conglomerate is found only along the southern edge of the map area. Its sedimentology and composition is identical to that of the younger conglomerate and it is differentiated purely in terms of its structural orientation. Whereas the mudstone (Tm) and younger conglomerate (Tcy) consistently dip gently to the southwest (3° - 15° towards the Mazatzal Mountains), the older conglomerates dip moderately to steeply to the east (20° - 55°). The contact between the older and younger conglomerates is not exposed but is interpreted as an angular unconformity (Cross-section B-B', sheet 2). The older conglomerate appears to overlie the granitic basement (Ygc) with depositional unconformity along its western contact, but this contact is not exposed.

Quaternary

Three sets of Quaternary map units were recognized in the map area; younger alluvium, terraced alluvium, and piedmont deposits. Younger alluvium (Qa) was mapped along the active channels and braid plains of Tonto Creek and its principal tributaries. Many of these deposits are heavily vegetated and slightly elevated in relation to the active channels.

A complex set of alluvial terraces, composed of well-rounded, clast-supported gravels and poorly indurated conglomerate are preserved at various levels up to 100 meters above and within about a kilometer of Tonto Creek. A set of piedmont terraces slope down from the mountain fronts on both sides of the creek. The piedmont terraces on the west side of Tonto Creek consist of relatively irregular surfaces covered with angular to sub-angular boulders and cobbles of locally derived granitoid lithologies. The piedmont terraces on the east side are composed of the same type of rounded clasts which characterize the alluvial terraces, perhaps reflecting the reduced influence of conglomerate style sedimentation on this

side of the valley.

As noted by Barsch and Royse (1972), the piedmont and alluvial terraces do not appear to merge into each other. Barsch and Royse (1972) identified 5 piedmont and 7 alluvial terraces, and Anderson and others (1987) identified 10 ages of piedmont terraces and 11 ages of fluvial terraces. Because there are a such a large number of terraces in the Tonto Basin quadrangle that are widely scattered and isolated from each other, it was not considered feasible during this study to attempt a comprehensive correlation of all of the surfaces. Although it is fairly easy to identify the sequence of terrace development in a small area, it is not always obvious how this sequence correlates to an adjoining area or across Tonto Creek. For this reason, piedmont and alluvial terraces were mapped simply as Qp and Qt respectively. Locally, contacts may exist between different levels of piedmont and alluvial terraces. Only one major alluvial terrace was differentiated as older alluvium (Qao); an extensive mud-rich alluvial bench that occurs at an elevation of between 3 and 10 meters above Tonto Creek along its west bank. Most of the commercial and residential development in the communities of Punkin Center and Tonto Basin occur on this alluvial bench.

Age and correlation of the Tertiary strata

Figure 3 correlates the Tertiary stratigraphy of this map area with other Tertiary units of the northern Tonto Basin and northerly adjacent Payson Basin. The red mudstone (Tm) and younger conglomerate (Tcy) units of this study correlate directly with the basin-fill unit of Mayes (1990) in the northerly adjacent Kayler Butte quadrangle. The basin-fill unit of Mayes (1990) consists of interfingering mudstones and conglomerates which become coarser-grained and in which the mudstones eventually pinch-out to the north towards a narrow isthmus of Pre-Tertiary bedrock which separates the Tonto and Payson basins (Figure 1). To the north of this isthmus the Miocene strata of Tonto Basin correlate with the lower basin fill units of Martin (1990) and Muehlberger (1988) in the Payson Basin, and even though there is slight disagreement (see Martin, 1990) as to where the contact should be drawn, both workers interpret the Miocene strata of Payson Basin as syntectonic with respect to basin-formation and movement along the basin-bounding fault. Muehlberger's (1988) and Martin's (1990) upper basin-fill conglomerate and mudstone unit contain limestones with Pliocene to Quaternary fossil faunas, and these younger essentially flat-lying strata are interpreted as post-tectonic with respect to basin formation. Martin (1990) also describes a distinct change in the sedimentology between the upper and lower basin-fill units, with the principal difference being that clasts in the upper unit are sub-rounded to rounded as opposed to the sub-angular clasts of the lower unit. These changes are similar to the differences between the Miocene (Tcy and Tco) conglomerates and Pliocene (Tcp and possibly Tcr) conglomerates of the Tonto Basin map area, and are interpreted to represent a change from localized fan-formation sedimentation in a closed basin to deposition in a basin with a throughgoing axial drainage system (see also the discussion by Martin (1990)). Muehlberger (1988) notes that the Pliocene strata of Payson basin both are cut by and overlap the Payson fault along the western edge of the Payson Basin. Muehlberger (1988) also recognized a sequence of moderately east-tilted conglomerate (his Tonto Creek Conglomerate) in the center of Payson Basin that are overlain with angular unconformity by the Tonto Creek basalt

(19.7 Ma). We tentatively correlate Muehlberger's (1988) Tonto Creek Conglomerate with the older conglomerate (Tco) of Tonto Basin map area (Tco).

Structure

Based on radiometric dates reported by Nations (1987), Muehlberger (1988) and Mayes (1990), Tonto Basin was a depocenter for conglomerate and lacustrine mudstone and gypsum by at least the early Miocene and possibly as early as the late Oligocene. In Tonto Basin map area, the lacustrine mudstones are interleaved and overlain to the west with locally derived fanglomerates that were being shed from the Mazatzal Mountains. Based on the offset of middle Miocene basalts (about 15-16 Ma) across Payson fault, Muehlberger (1988) estimated a minimum of 1,000 meters of dip-slip, and Martin (1990) used the base of the Cambrian to estimate at least 1,200 meters of offset. Westerly tilting of the basin and continued motion along Payson fault after deposition of the mudstone and younger conglomerate units in Tonto Basin is required to account for the consistent, gentle westerly tilts of these strata throughout the map area. Motion along Payson fault had ceased by the time that the post-tectonic conglomerate (Tcp) was deposited because it overlaps the fault scarp. It may also have become inactive along some strands before the youngest younger conglomerate was deposited (see Figure 4).

A structural explanation for the relatively steep easterly tilts of the older conglomerate in the southern portion of the map area is more problematic. At the southeast corner of the map area, a prominent linear fault trace, named the El Oso fault is exposed within the Middle Proterozoic K-spar porphyritic granite. There is no evidence of Quaternary motion along this feature or along any of the range bounding escarpment throughout the map area (see also Pearthree and Scarborough, 1984).

The hangingwall block of El Oso fault preserves a steeply east-dipping sequence of older conglomerate that we interpret as overlying basement with depositional unconformity. In turn, these older conglomerates are overlain with angular unconformity by the younger conglomerate (Tcy), mudstone (Tm) and the post-tectonic conglomerate (Tcp). A continuation of cross-section B-B' is shown in Figure 4 using information from the eastern cut bank of Tonto Creek directly above where it empties into Theodore Roosevelt Lake in the easterly adjacent Greenback Creek 7.5' quadrangle. The detailed cross-section of Figure 4 shows the youngest portion of the younger conglomerate overlapping the Payson fault. Continued east-side-down motion along the El Oso fault is invoked to account for the gentle westerly tilts of the younger conglomerates which overlap Payson fault. The post-tectonic conglomerate unit is interpreted to overlap and post-date motion on the slightly younger El Oso fault.

Of critical importance in terms of evaluating the total amount of extension that this area has experienced is the extent and style of faulting associated with the easterly tilted older conglomerates. Because there does not appear to be a widespread zone of easterly tilts and west-dipping faults in the Mazatzal Mountains, this style of faulting is believed to be important only locally and this is illustrated in the regional cross-section of Figure 4. Similar structural relationships are observed along the western, basin-bounding fault of the Verde Valley which lies directly west of this map area (Ferguson and others, in prep). Along the western boundary of the Verde Valley near Horseshoe Dam, a major, north-

striking, east-side-down fault juxtaposes Proterozoic crystalline rocks with a gently to moderately west-tilted lacustrine sequence of Mid-Tertiary age (Wrucke and Conway, 1987). The main fault trace curves or steps to the southeast towards the south as it becomes buried by younger, gently west-tilted conglomerates with splays continuing to the south, just as the Payson fault splays into the slightly younger El Oso fault in the southern Tonto Basin map area. In the Verde Valley, a block of crystalline basement is present in the triangular area south of the buried fault trace and in the hangingwall of the splay, and in this block the basal Tertiary unconformity is preserved. The unconformity dips moderately (20-35°) to the northeast and is offset by several low-angle (10-20°) west-dipping normal faults (Ferguson and others, in preparation). Although no west-dipping normal faults were found associated with the east-dipping conglomerates of Tonto Basin map area, we did map a gently west-dipping fault within crystalline basement that appears to be cut by El Oso fault in the southeastern Tonto Basin map area.

The younger phase (approximately 20-10 Ma) of east-side-down faulting in Tonto Basin and in the Verde Valley was not associated with great amounts of tilting or horizontal extension. Instead this phase of deformation was associated principally with vertical tectonics.

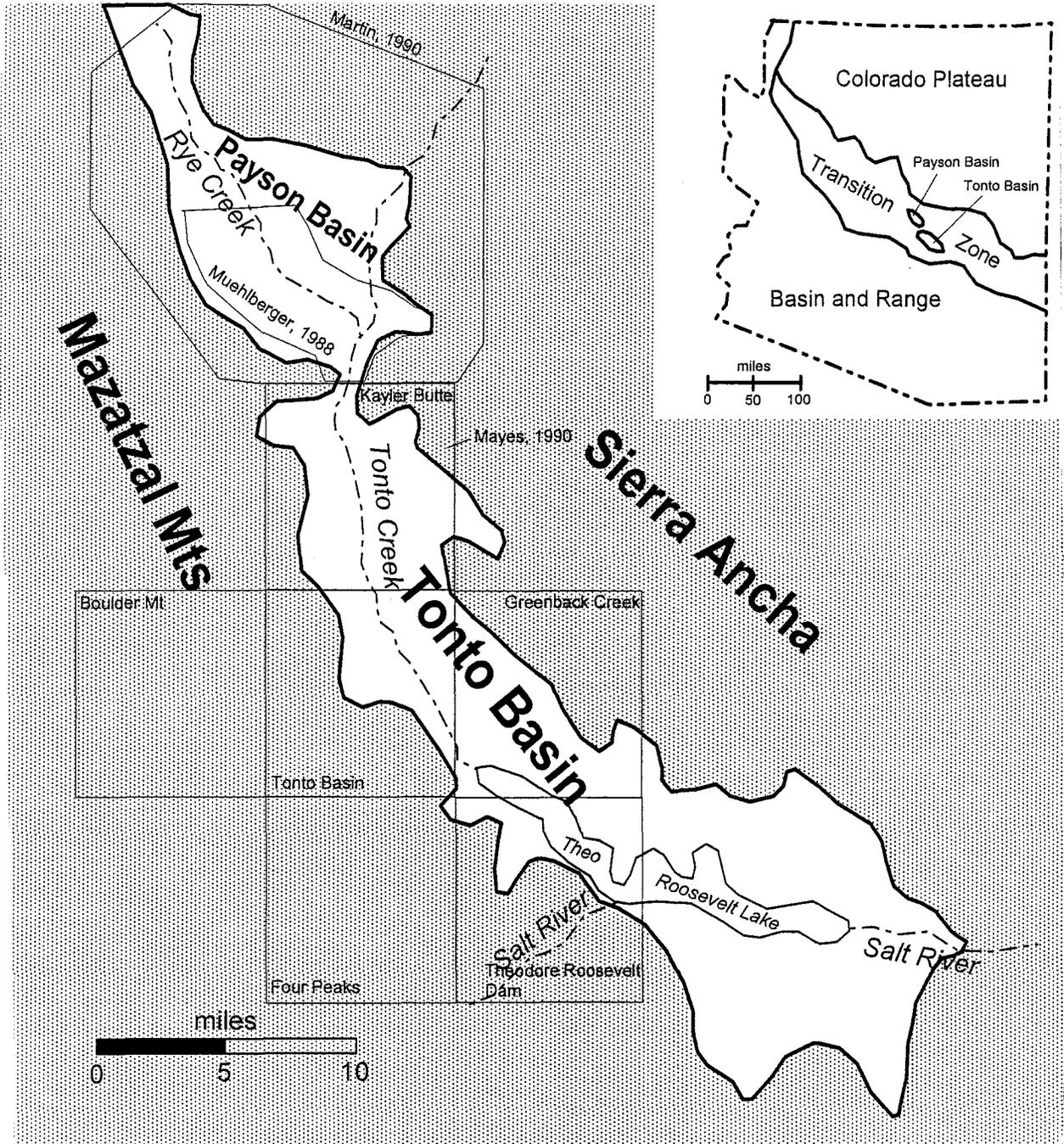


Figure 1 Location of the Tonto Basin 7.5' quadrangle and adjoining quadrangle maps; Kayler Butte, Boulder Mt., Greenback Creek, Theodore Roosevelt Dam, and Four Peaks within and adjacent to the northern Tonto Basin. Also shown is the Payson Basin and the location of student maps by Muehlberger (1988), Martin (1990), and Mayes (1990).

Unit correlation diagram, Tonto Basin Quadrangle

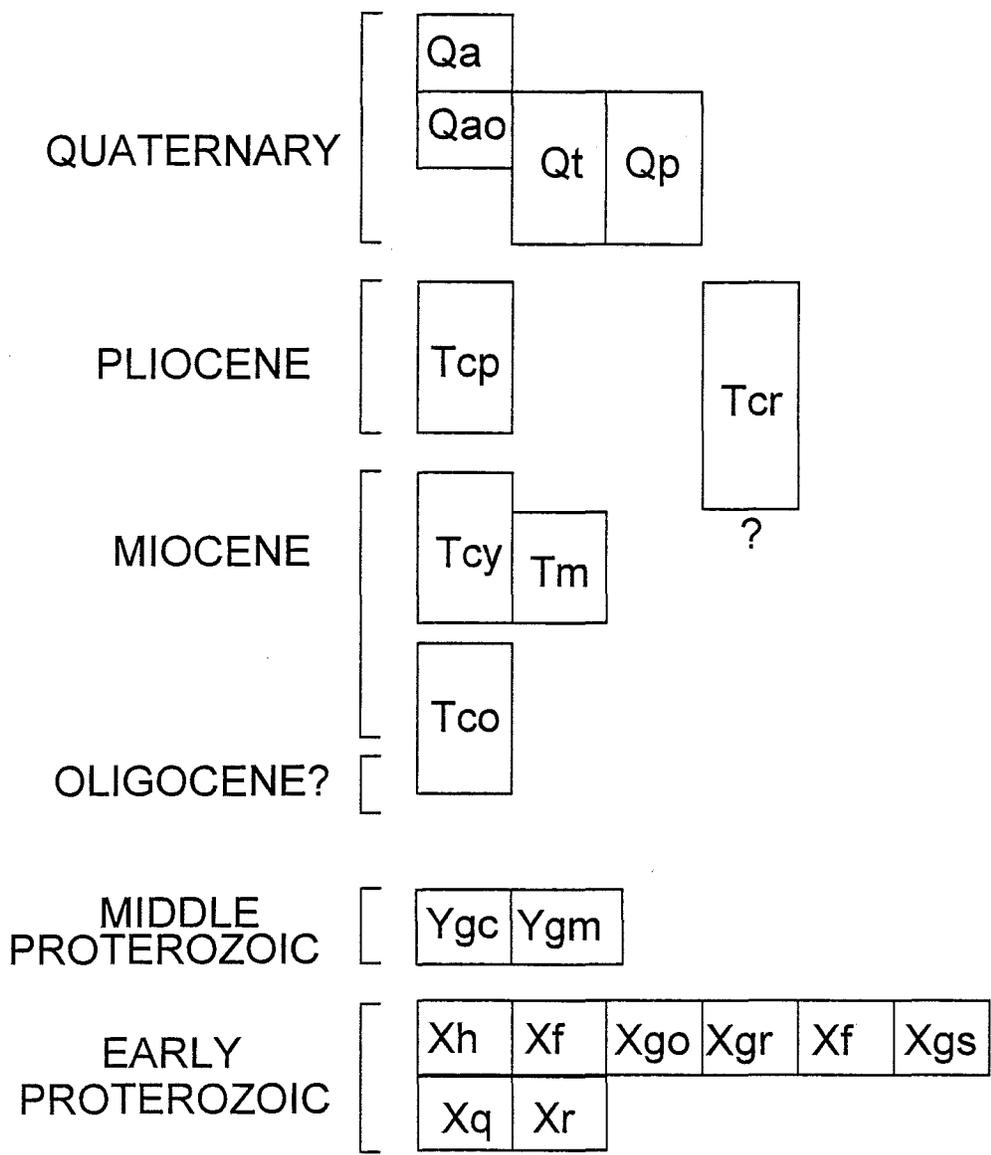


Figure 2 Stratigraphic correlation diagram for map units in the Tonto Basin 7.5' quadrangle.

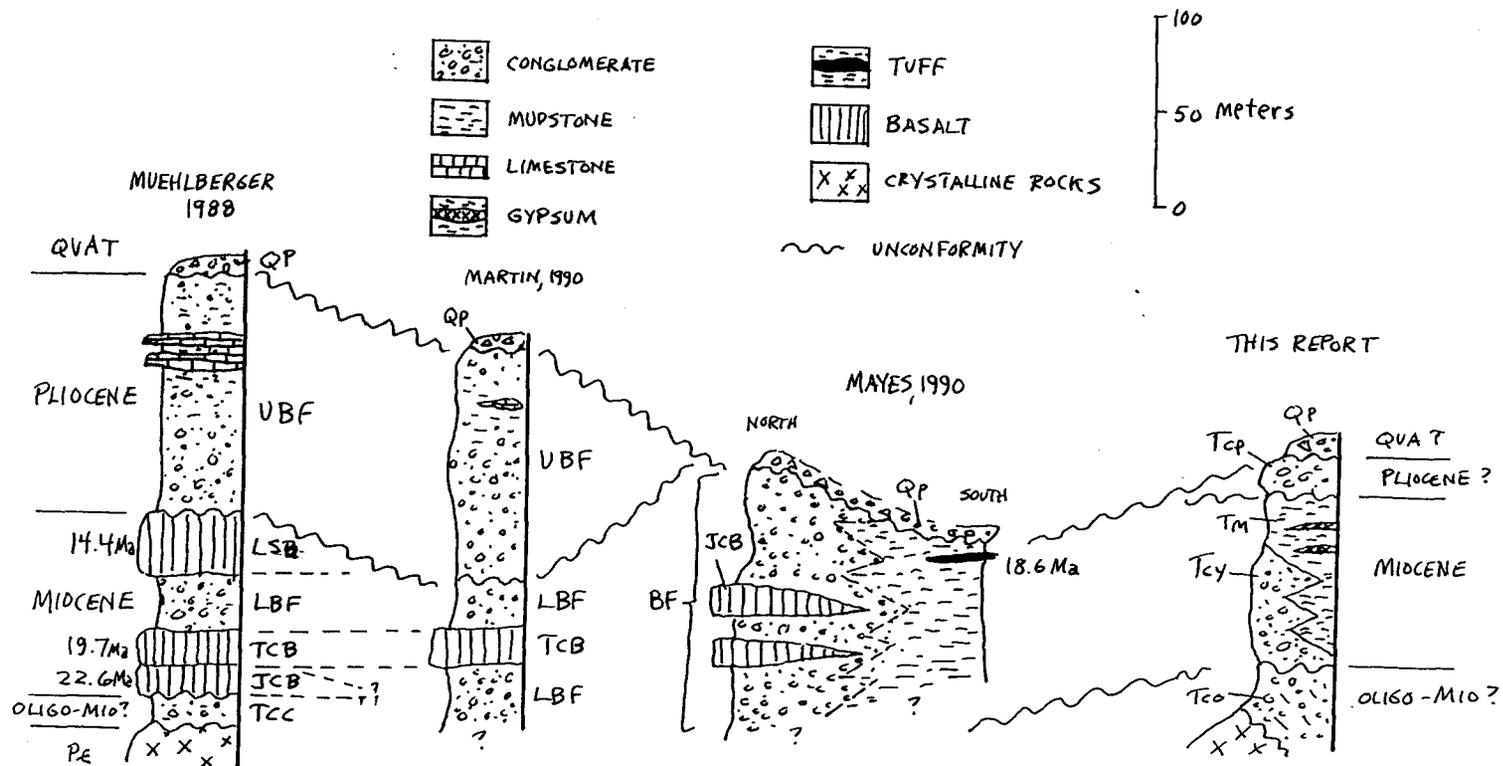


Figure 3 Stratigraphic correlation of units recognized in this report with units recognized by previous workers in areas to the north. Unit symbols for this report correspond to those in the Unit Descriptions section and on sheet 2. **UBF** and **LBF** correspond to the upper basin-fill and lower basin-fill units respectively of Muehlberger (1988) and Martin (1990). **TCC** = Tonto Creek Conglomerate of Muehlberger (1988). **JCB**, **TCB**, and **LSB** correspond to the Jakes Corner, Tonto Creek, and Lincoln Spring basalts of Muehlberger (1988). Whole rock K-Ar dates reported for these basalts are 22.6 ± 1.2 Ma, 19.7 ± 1.1 Ma, and 14.4 ± 1.1 Ma respectively as reported in Muehlberger (1988). The 18.6 Ma date reported by Mayes is a K-Ar biotite date from Nations (1987). **BF** corresponds to the basin-fill unit of Mayes (1990).

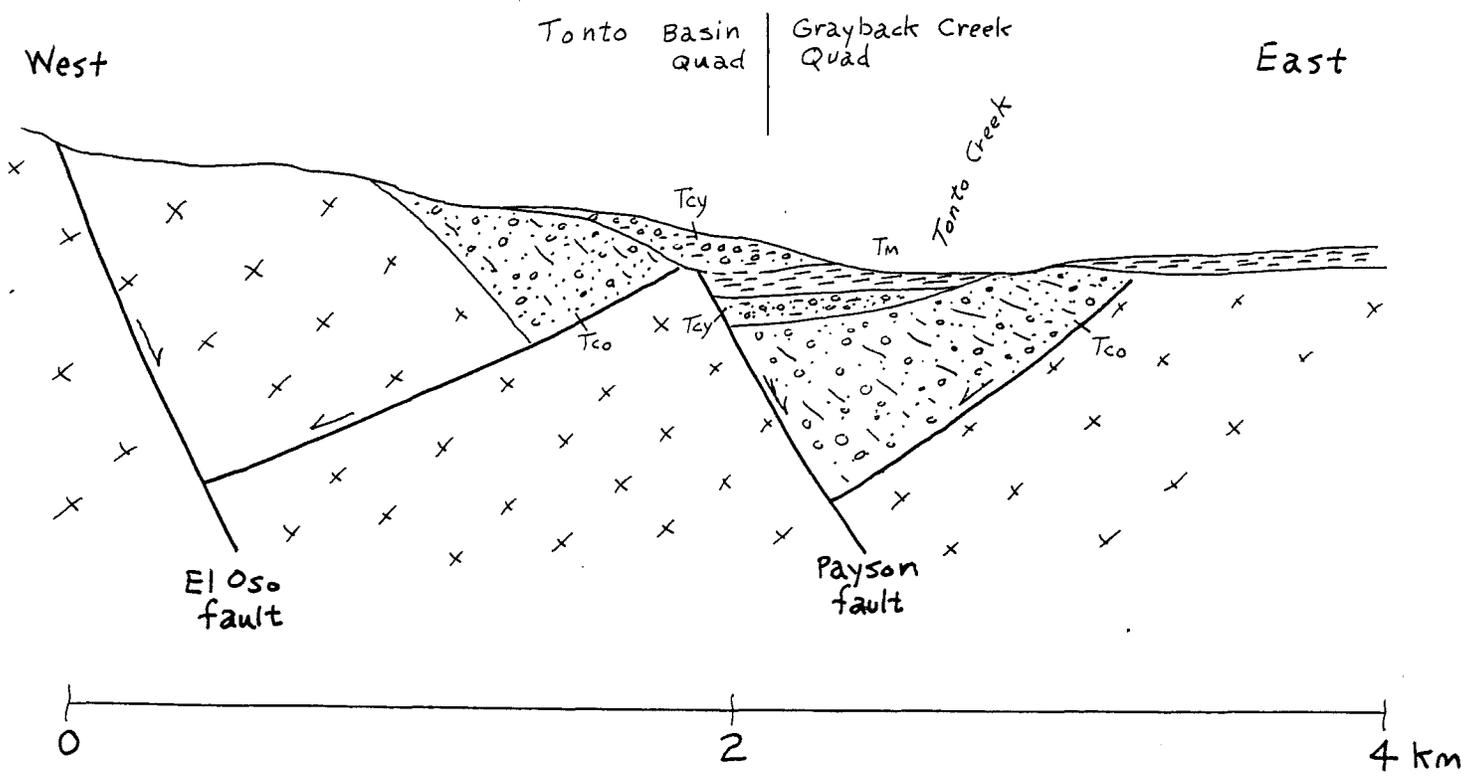
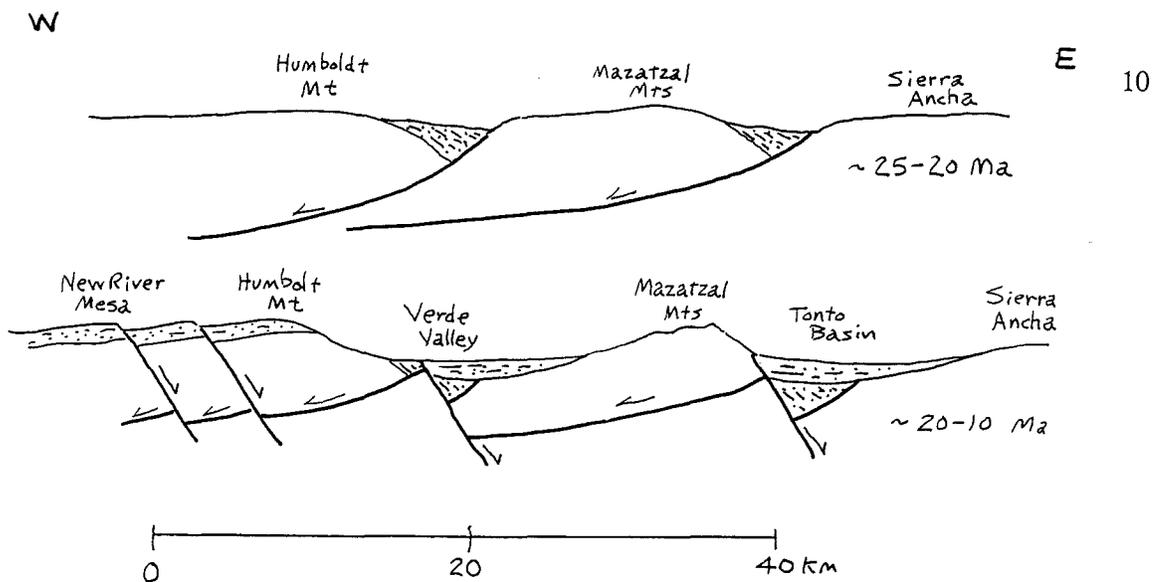


Figure 4 Continuation of cross-section B-B' (sheet 2) into the easterly adjacent Greenback Creek 7.5' quadrangle, and a regional, crustal-scale cross-section showing how an early (late Oligocene to early Miocene) phase of easterly tilting in Tonto Basin and in Verde Valley are related to a gently west-dipping detachment fault system. In the detailed cross-section, note how the younger conglomerate is interpreted to be cut by and overlie the Payson fault. El Oso fault is interpreted to be a slightly younger splay of the Payson fault.

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Unit Descriptions
Tonto Basin 7.5' quadrangle,
Gila and Maricopa Counties, Arizona

- Qa Alluvium** Young alluvium along active channels, in canyon bottoms, and low-lying vegetated terraces.
- Qc Colluvium and talus** Slope deposits, typically soil-covered.
- Qao Older alluvium** An extensive, vegetated and deeply incised, mud-rich alluvial bench that lies along the west bank of Tonto Creek. At the very southeast corner of the map area it is gravel-rich. May be partially correlative in age with the youngest piedmont terraces map unit (Qp) along the east bank of Tonto Creek.
- Qt Terraced alluvium** A series of alluvial benches preserved chiefly along Tonto Creek, but also some of its major tributaries. The terraces are composed of clast-supported, massive to thick-bedded, very weakly indurated boulder and cobble conglomerate and medium-bedded pebbly sandstone, typically light-orange colored. The clasts are characteristically rounded, and extra-basinal in origin (chiefly Apache Group, and Early Proterozoic quartzites and felsic volcanics).
- Qp Piedmont gravels** Vegetated, irregular piedmont surfaces. The surfaces overlap Tertiary and Proterozoic bedrock exposures along the Mazatzal Mountain front and are deeply incised at their lower end by gullies containing younger alluvial (Qa) bottoms. The clasts in this unit are characteristically very coarse-grained, angular, and locally derived from Proterozoic granitoids of the nearby Mazatzal Mountains. Piedmont gravels to the east of Tonto Creek are capped by sub-rounded to rounded clasts of Sierra Ancha lithologies.

Tertiary

- Tcr Uplands conglomerate** Poorly preserved, extra-basinal, rounded-clast conglomerate found locally along the ridge crest of the Mazatzal Mountains near Edwards Park. Preservation of these conglomerates at different levels suggest that in some areas, the ridge crest represents a channelized alluvial surface. Relationship to the other conglomerates is unknown.
- Tcp Post-tectonic conglomerate** The post-tectonic conglomerate is essentially flat-lying throughout the map area. Along the Mazatzal Mountain front where it overlaps the basin-bounding Payson fault, the post-tectonic conglomerate is a massive, extremely coarse-grained (up to 4 meters), angular-clast diamictite with clasts of local derivation. Farther east away from the Payson fault, the conglomerate is finer grained containing sub-angular to sub-rounded granitic clasts. The conglomerate is poorly indurated and rarely exposed. In areas between the Mazatzal Mountain front

and Tonto Creek it appears to be composed mostly of locally derived conglomerate. The unit overlies the mudstone (map unit Tm) with sharp unconformity at Chalk Spring and with angular unconformity south of Cottonwood Creek. Although composed chiefly of locally derived granitic clasts, the post-tectonic conglomerate also contains lenses of well-rounded, extra-basinal clast, cobble conglomerate near Tonto Creek. These rounded conglomerates probably represent an axial, ancestral Tonto Creek alluvial facies. The upper contact between the post-tectonic conglomerate and Quaternary terraced alluvium (Qt) and pediment terraces (Qp) can be very difficult to identify because of poor exposure and similarity of composition.

- Tcy** **Younger conglomerate** Partially to well-indurated, arkosic pebbly sandstone, and sandy conglomerate, composed entirely of locally-derived granitic clasts. The unit could be divided into two subunits or facies if exposures were better: 1) a tan conglomerate that interfingers with and locally overlies the red mudstone unit, and 2) a light greenish gray, muddy matrix conglomerate and sandstone that represents a gradational facies between tan conglomerate and red mudstone. In the vicinity of Sycamore Creek, the contact with the red mudstone is conformable and gradational, with a fairly thick succession of light greenish gray interbedded mudstone and pebbly sandstone (gradational facies) marking the contact.
- Tm** **Mudstone** Mudstone and siltstone, with rare thin-bedded laminated to ripple cross-laminated fine-grained sandstone. The mudstones are chiefly red, but locally (near the mouth of Sycamore creek, they are light green. In the lower part of the unit, sandstones are rare to absent. Instead, < 1 to 4 meter-thick sequences of gypsum interbedded with thin beds or laminae of gray to light green mudstone and gypsum are present, comprising up to 10% of the unit. The gypsum beds are thicker and more abundant to the south, and they pinch out just to the north of the map area. The unit has both gradational and sharp upper contacts with the younger conglomerate. The nature of its lower contact is unknown, but it is thought to overlie and interfinger laterally with the older conglomerate of map unit Tco.
- Tco** **Older conglomerate** Partially to well-indurated arkosic, pebbly sandstone and subrounded to sub-angular granite clast conglomerate. The conglomerate is characterized by the lack of rounded, extra-basinal clast conglomerates which typify parts of the younger conglomerate. All exposures of the older conglomerate in this map area are tilted to the east between 20° and 60°, and their basal contact with crystalline rocks appears to be a depositional unconformity.

Middle Proterozoic

- Ygc** **Coarse-grained, K-spar porphyritic granite** Coarse- to medium-grained hypidiomorphic granular matrix, euhedral K-spar porphyritic (1-4 cm) granite. Contains up to 10% biotite.
- Ygm** **Medium-grained granite** A medium-grained phase of the K-spar porphyritic granite.

Early Proterozoic

- Xh Hornblendite** Medium- to coarse-grained hornblende-porphyritic diorite or gabbro. Hornblende phenocrysts comprising up to 75% of the rock are suspended in a fine- to medium-grained matrix of plagioclase. The rock is locally weakly foliated, but the foliation does not appear to be tectonic in origin.
- Xf Fine-grained granite** Fine- to medium-grained equigranular, quartz monzonite or granite with less than 15% mafic minerals. Locally hosts a mylonitic fabric along the range front. Near the range crest, this unit is intimately intermingled with an intrusive rhyolite/granophyre, and these units were not differentiated. The intrusive rhyolite contains about 5% 1-5mm phenocrysts of feldspar, quartz, and biotite in a microgranular matrix of feldspar and quartz.
- Xgo Quartz monzonite** Foliated, coarse-grained, slightly K-feldspar porphyritic (<2 cm) to hypidiomorphic granular quartz monzonite with 5-10% biotite.
- Xgr Rapakivi granite** Medium- to coarse-grained, hypidiomorphic to idiomorphic granular rapakivi granite. Characterized by blue quartz, rapakivi texture (K-feldspar rimmed by plagioclase), and a slightly porphyritic texture with both K-feldspar and plagioclase exhibiting well-formed, euhedral to subhedral crystal faces. Quartz is typically subhedral and granular, and none of the larger crystals exhibit interlocking texture. The matrix is fine- to medium grained and melanocratic with mafic minerals making up to 20% of the rock.
- Xgs Quartz monzonite (Sierra Ancha)** Pink-weathering, K-feldspar porphyritic (<2 cm) quartz monzonite with less than 15% mafic minerals. Occurs in extreme northeast corner of map area. May be correlative with the Mazatzal Mountains quartz monzonite (Xgo).
- Xr Metarhyolite** Small exposures of the intrusive rhyolite/granophyre associated with the fine-grained granite of map unit Xf but mapped separately.
- Xq Quartzite** Dark bluish-gray massive quartzite. Isoclinally folded bands probably represent relict bedding.