Corrrelation and mapping of a Tertiary alluvial fan complex, central Arizona

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Introduction:

The Tonto Basin is a northwest-trending, closed basin found south of the Mogollon Rim in central Arizona about 60 miles northeast of Phoenix. Recent work on Tertiary conglomeratic units in the Tonto Basin suggests that they were deposited as parts of an alluvial fan complex. The sources for these conglomerates include the Mazatzal Mountains to the west and the Sierra Ancha Mountains to the east. This project was an attempt to divide this fan complex into three main types based on these mountain sources (*Figure 1*).

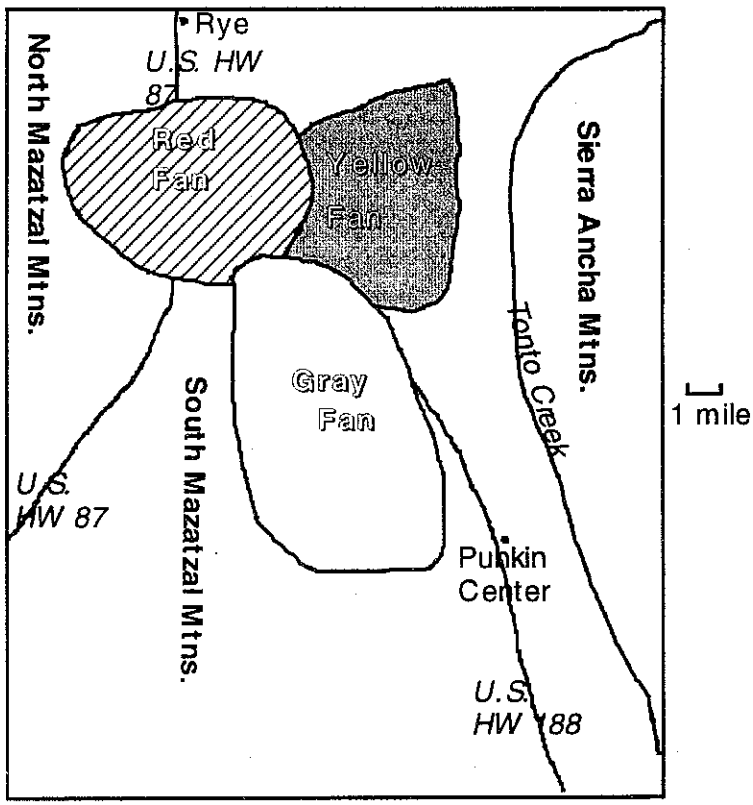

Figure 1: General map of basin-fill deposits discussed in this paper. The deposits examined are located between the towns of Rye in the north and Punkin Center in the south. For clarification of source area, the Mazatzal Mountains have been divided into the northern Mazatzal Mountains and the southern Mazatzal Mountains. The Red Fan is derived from the northern Mazatzal Mountains and the Gray Fan is derived from the southern Mazatzal Mountains.

Field and laboratory methods:

Field:

Fieldwork was performed between the towns of Rye and Punkin Center and consisted of describing in detail the alluvial basin-fill deposits in the Tonto Basin. Pebble counts, paleocurrent readings, as well as strike and dip measurements were taken at each site when possible. A GPS unit was used to determine the exact location of each field site to plot on topographic maps.

Laboratory:

Lab work involved finishing pebble counts on collected samples, as well as performing several grain size analyses on sediment samples, and examining aerial photographs of the Tonto Basin. Sediment samples were also examined microscopically to compare mineralogies at each site.

Source area geology:

Lithologies of the surrounding mountains include the Tonto Basin Supergroup in the west and the Tonto-Apache Supergroup in the east. The Mid-Proterozoic Tonto Basin Supergroup is subdivided into the (from oldest to youngest) Alder Group, the Red Rock Rhyolite, and the Mazatzal Group (Conway and Silver, 1989). The 1.1 B.y. Tonto-Apache Supergroup has been subdivided into the (from oldest to youngest) Pioneer Formation, the Dripping Springs Quartzite, the Mescal Limestone, and the Troy Quartzite with some diabase sills and dikes (Kreiger, 1968). Both supergroups were deposited in similar environments (Conway and Silver, 1989). The Mazatzal Group and the Red Rock Rhyolite are found in the northern Mazatzal Mountains, the Alder Group is found in southern Mazatzal Mountains, and the Troy Quartzite of the Tonto-Apache Supergroup is found in the Sierra Ancha Mountains (Conway and Silver, 1989). The Mazatzal Mountains are capped with Tertiary volcanics. Figure 2 displays stratigraphic columns of the lithologies found in the Mazatzal and Sierra Ancha Mountains surrounding Tonto Basin.

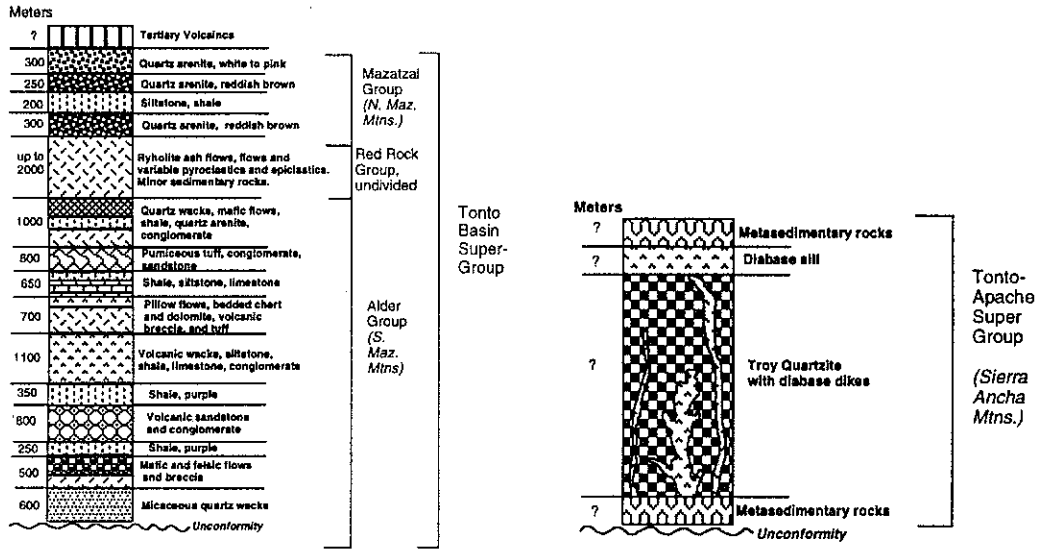

Figure 2: Stratigraphic columns of the mountain sources for the three fan types. The Red Fan is derived from the Mazatzal Group and Red Rock Rhyolite, the Gray Fan from the Red Rock Rhyolite and Alder Group, and the Yellow Fan from the Troy Quartzite with some meta-sedimentary and diabase rocks (After Conway and Silver, 1989; and Kreiger, 1968).

Sedimentology of basin-fill deposits:

The alluvial fan deposits can be divided into three types based on their source area and sediment mineralogy. The first group is the Red fan derived from the northern Mazatzal Mountains, the second is the Yellow fan derived from the Sierra Ancha Mountains, and the third is the Gray fan derived from the southern Mazatzal Mountains.

The three fan types are currently undergoing pedimentation. Many outcrops examined for each fan are capped by approximately 1 m of a muddy matrix containing many clasts (~20-40 cm). While many of these deposits are matrix-rich, some are very coarse-grained and contain large boulders. These deposits are even found on the very distal portions of each fan.

Red Fan (Source area: northern Mazatzal Mountains):

Deposits of the Red fan include red colored, fine-grained sediment consisting mostly of rounded to sub-rounded quartz grains. Each deposit examined contains beds of variable thickness (between 1-2 m) that are horizontal to slightly dipping. Caliche horizons are also exposed at several localities. There is an overall fining sequence, as the fan becomes distal.

Figures 3 and 4 show the clast lithologies typically found in the Red fan. Quartzite is the dominant lithology followed by intrusives and volcanics. The two exposures where pebble counts were taken are considered to be representative of the Red Fan. All other localities examined in the north part of the Mazatzal Mountains were compared to these two exposures for classification as Red Fan.

Microscopic examination of the matrix revealed them to consist of <1 mm-rounded quartz grains cemented together. Some muscovite and biotite flakes are also found. Approximate composition is 97% quartz grains and 3% muscovite and biotite. Grain size analyses indicate that the sediment is not well sorted further away from the fan.

Yellow Fan (Source area: Sierra Ancha Mountains):

Deposits of the Yellow fan represent the medial facies of an alluvial fan characterized by numerous cut and fill structures. Exposures along Gisela Road display numerous nested channels that truncate each other and are filled with angular clasts (5-20 cm). Outcrops along this road are matrix supported with stringers of pebbles throughout as well as containing large scale cross-stratification. The sediment tended to be fine to medium grained as well as poorly sorted.

Figures 5 and 6 are pebble counts for this fan. The pebble count demonstrated in Figure 5 was taken close to the base of the fan while the Figure 6 pebble count was taken more towards the middle of the fan. The clast lithologies are almost identical, with quartzite and rhyolite dominating. This fan is not found in direct contact with mountain as the other fans are. Tonto Creek has cut a valley that separates this fan from the Sierra Ancha Mountains. The lithologies found in the Yellow Fan are consistent with those found in the Sierra Ancha Mountains, so it can be concluded that recent stream action has cut the gap between the fan and mountains.

Gray Fan (Source area: southern Mazatzal Mountains):

The Gray Fan is the most complex of the three fan types and has been subdivided into three sub-types. The criteria used were location relative to the Alder Mountains and lithologies. The first sub-type consists of pink, medium-grained, matrix supported conglomerates. The second sub-type is younger the first sub-type and consists of coarse-grained conglomerates. The first and second sub-tyoes are not seen in direct stratigraphic contact with each other. The third sub-type overlies the second and consists of yellow, medium-grained, matrix supported conglomerates. The first sub-type is found at the middle and southern parts of the Gray Fan while the other two sub-types are both found in the northern part of the Gray Fan *(Refer to figure 1).*

The stratigraphy is locally complex due to an igneous sill that intrudes the fanglomerates between the second and third sub-types. Below this sill, clast lithologies are predominantly quartzite and basalt, but above the sill, lithologies are mostly meta-basalt with very few quartzites present. This sill is not found elsewhere around the southern Mazatzal Mountains, nor are any intrusive structures known to exist at any other localities examined in the Tonto Basin.

The matrix in each deposit varies as well. Below the sill, the matrix tends to be calcium-rich while above the sill, it is sandier with a distinct yellowish color. Below the sill, the deposits are clast supported while above the dike the deposits are matrix supported. A baked horizon is present in the sediments below the sill. Analysis of the reddish sediments shows them to be a thorough mixture of quartz, granitic, feldspar, muscovite, and biotite grains. The reddish sediment is found horizontally bedded further south in roadcuts along HW 188. Grain size analyses of this sediment show it to be moderately sorted.

Figures 7 and 8 are pebble counts from the first and third sub-types. Although quartzite dominates both pebble counts, the pebble counts are different in terms of lithology types. A pebble count was not included for the second sub-type because it contains predominately basalt with very few pelitics.

Summary:

Conglomerates exposed in the Tonto Basin of central Arizona were deposited as part of a Tertiary alluvial fan complex. The deposits have been categorized based on source area and sediment mineralogy. The three fan types categorized are the Red Fan, the Yellow Fan, and the Gray Fan and their source areas are the Mazatzal Mountains, the Sierra Ancha Mountains, and the Alder Mountains, respectively. As would be expected, the lithologies vary between groups, but there are some underlying similarities. Diabase rocks are found in most deposits as are basalts and quartzites. Sedimentary structures also vary between deposits based upon which facies of the fan (proximal, medial, or distal) is being examined. For the most part, all of the deposits displayed fining upward sequences of gravels or pebbles to a coarse then

to fine sand. Sheet flood deposits with cut and fill structures are seen mainly in the Yellow Fan. Caliche horizons are found in abundance in medial to distal facies of the Red Fan.

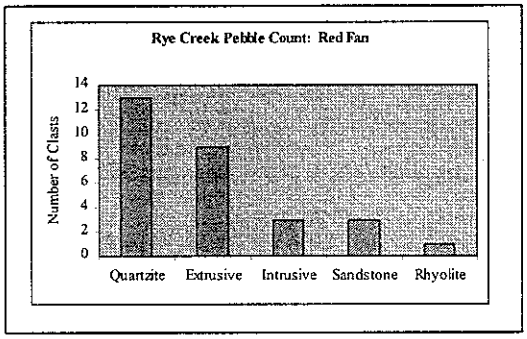

Figure 3: Pebble count from the Rye Creek exposure of the Red Fan. The dominant lithology is quartzite most likely from the upper Mazatzal Group.

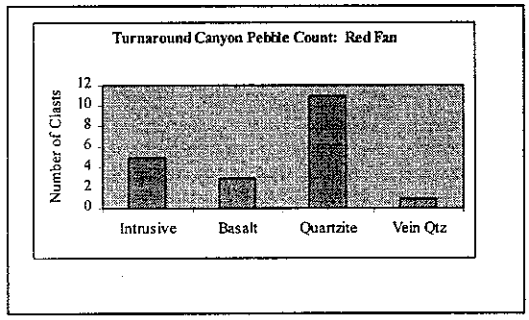

Figure 4: Pebble count from the Turnaround Canyon exposure of the Red Fan. The dominant lithology is quartzite most likely from the upper Mazatzal Group.

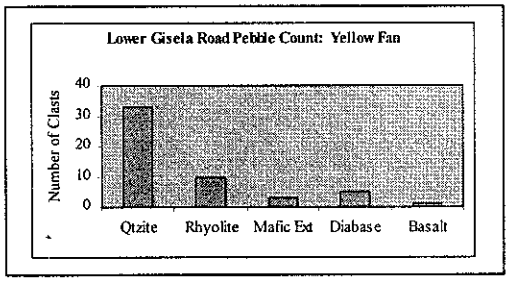

Figure 5: Pebble count from the lower Yellow Fan along the Gisela Road. The dominant lithology is quartzite from the Troy Quartzite. the diabase rocks are from dikes intruding the Troy Quartzite.

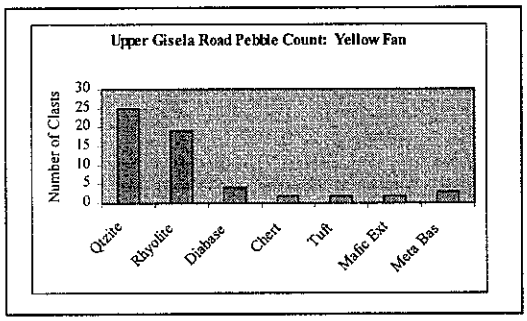

Figure 6: Pebble count from the upper Yellow fan along Gisela Road. This section is matrix supported and contains large-scale cross-stratification.

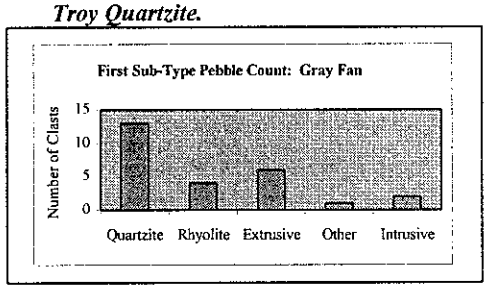

Figure 7: Pebble count from the first sub-type of the Gray Fan. The dominant lithology is quartzite from the Alder Group.

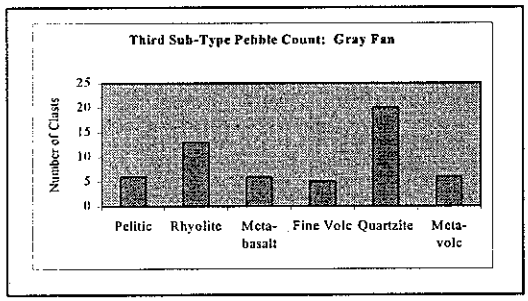

Figure 8: Pebble count from the third sub-type of the Gray Fan. Quartzite is again the dominant lithology, but notice the variety of lithologies as well.

References Cited:

Conway, Clay M., and Silver, Leon T., 1989, Early Proterozoic Rocks (1710-1615 Ma) in Central to Southeastern Arizona, *in* Jenney, J.P., and Reynolds, S.J., 1989, Geologic evolution of Arizona: Tucson, Arizona Geological Society Digest 17, p. 165-186.

Kreiger, Medora H., 1968, Stratigraphic Relations of the Troy Quartzite (Younger Pre-Cambrian) and the Cambrian Formations in Southeastern Arizona, *in* Titley, Spencer R., 1968, Southern Arizona Guidebook III: Tucson, Arizona Geological Society, p. 22-32.