Lower Deadman Quartzite (Proterozoic) and associated rocks of the Mazatzal Group, Northern Mazatzal Mountains, central Arizona

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INTRODUCTION

The Lower Deadman Quartzite (LDQ) is found only on the southeastern side of Cactus Ridge, Northern Mazatzal Mountains, Arizona (figure 1) Detailed investigation of the unit along the ridge shows that its upper member is a thin (1-2 meter) layer of rhyolitic tuff, separating it from the Upper Deadman Quartzite (UDQ). The rhyolitic tuff rests with angular unconformity on the LDQ. Faults along Shake Tree Canyon make the angular unconformity difficult to follow, yet the rhyolitic tuff layer can be traced along the length of Cactus Ridge. This angular unconformity requires that the LDQ, according to the stratigraphic code, be given a new name, and also adds a separate uplift event for the Northern Mazatzal Mountains.

The Mazatzal Group is undifferentiated at Tonto Bridge National Monument (figure 1); however, stratigraphic observations imply that the LDQ is present above the Red Rock Rhyolite and beneath a separate, unnamed unit of rhyolite, therefore making it correlative with the LDQ on Cactus Ridge. My correlation hypothesis is being tested with U/Pb geochronology (J. Comstock, this volume.)

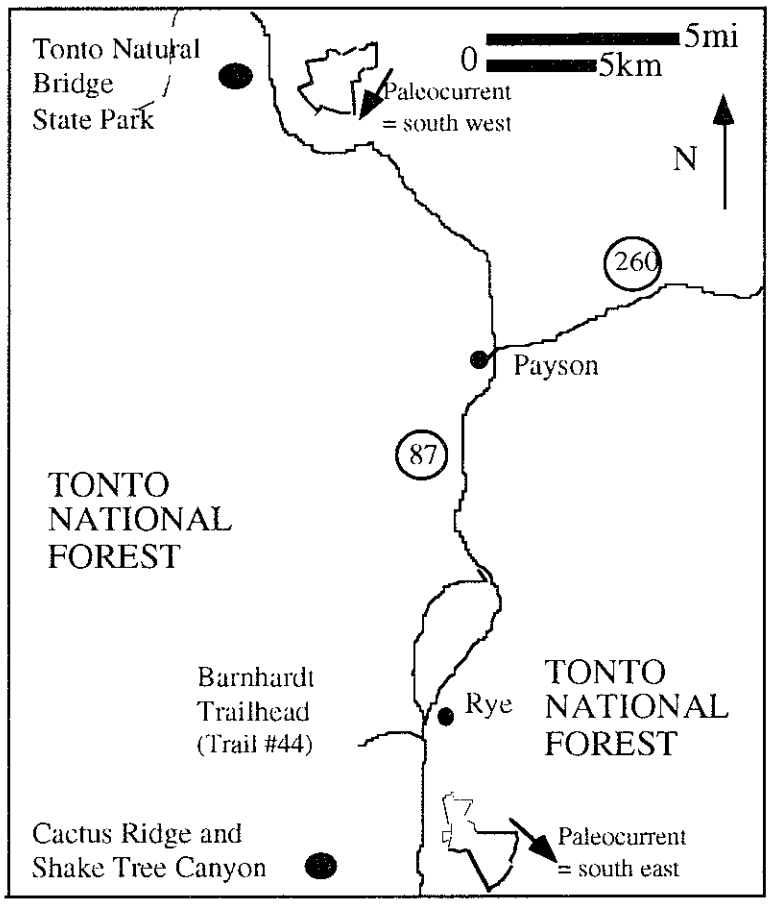

Figure 1: Location of Tonto Natural Bridge State Park and Cactus Ridge, Northern Mazatzal Mountains. Paleocurrent directions from Trevena, 1979.

SEDIMENTOLOGY AND STRATIGRAPHY

Cactus Ridge: Lower Deadman Quartzite. The Deadman Quartzite was named for its type location at Deadman Creek on the south side of the Northern Mazatzal Mountains. It was further divided into Upper and Lower members by Doe and Karlstrom (1991). The LDQ is the basal unit of the Mazatzal Group and lies unconformably on the Red Rock Rhyolite (Wilson, 1939) (figure 2). The Red Rock Rhyolite has been dated at about 1.7 billion years (Conway et al., 1989), making the age of the Lower Deadman somewhat younger and impossible to date exactly due to its lack of fossils. The Lower Deadman varies in thickness across the ridge, from about 360 meters on the southernmost side and thinning northward to zero at the mouth of Shake Tree Canyon. This thinning is thought to be a combination of fluvial sedimentation in topographic lows and structural deformation due to its rapid thickening (Anderson et al., 1981; Doe et al., 1991). The Lower Deadman is divisible into three units along the southeast side of Cactus Ridge: a basal conglomerate (50 - 100 m), a well stratified quartz-litharenite (100 - 200 m), and a upper massively bedded quartzite (0 - 50 m) (Doe et al., 1991). The Lower Deadman contains an uppermost layer of hematitic fine-grained siltstone which is the bed that thins near the contact of the rhyolite and Lower Deadman. Clast lithologies of the basal conglomerate include rhyolite, jasper, hematitic siltstone, and quartzite (Doe et al., 1991). A detailed column of the Lower Deadman was not possible to construct due to the isolated exposure along the steep ridge. However, the upper massive quartzite had numerous sets of cross beds, all indicating paleocurrents to the south (Trevena, 1979).

Tonto Natural Bridge National Monument: Mazatzal Group undifferentiated. The Tonto Natural Bridge National Monument is located approximately 25 km north of the Northern Mazatzal Mountains. The Red Rock Rhyolite is exposed in the bed of Pine Creek, as is the overlying undifferentiated Mazatzal Group. Lying unconformably on Red Rock Rhyolite are approximately 170 meters of quartzite that may be correlative with the LDQ. This unit can be divided into two units: a basal layered conglomerate (0-100m) which grades into a massive quartzite (100-170m). The lower unit contains clasts ranging from 80 cm to 2 cm in diameter. The detrital clasts are thought to have been derived from the Red Rock Rhyolite and Alder Group as well as some unidentified source (Trevena, 1979). Clast lithologies include rhyolite, jasper, hematitic sandstone/siltstone, and some deformed granites of Alder Group age (Trevena, 1979). Paleocurrent directions as measured by cross bedding in this unit vary from southeast to southwest (see figure 1). This data combined with the stratigraphy of the conglomeratic portion of the unit supports an alluvial fan depositional model. General paleocurrent direction is in a southerly direction, indicating a source to the north (Trevena, 1979).

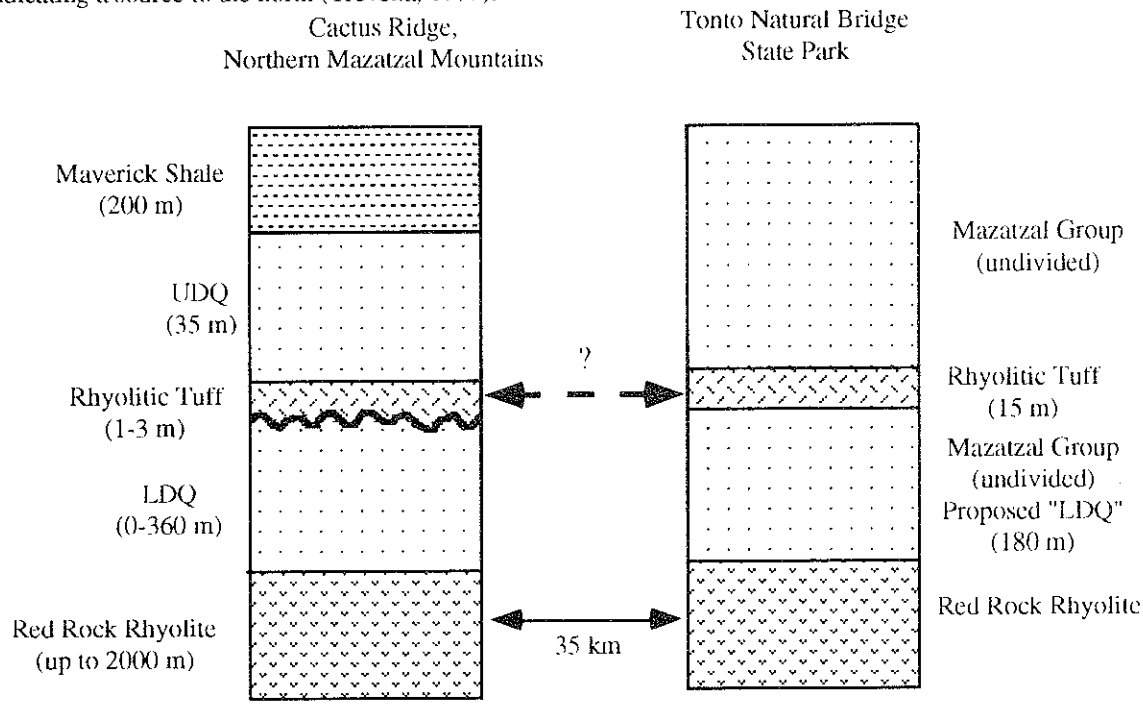

Figure 2: Generalized stratigraphy for Cactus Ridge, Northern Mazatzal Mountains and Tonto Natural Bridge State Park and proposed rhyolitic tuff correlation between areas.

CACTUS RIDGE LOWER DEADMAN: THE ANGULAR UNCONFORMITY

Mapping in Shake Tree Canyon (34° 04.2' N latitude, 111° 25.9' W longitude), revealed an angular unconformity between the LDQ and the thin rhyolitic tuff layer that separates the Upper and Lower members of the Deadman Formation. At this location, the LDQ is overturned, and the rhyolite layer, strikes parallel to the UDQ (figure 3). Along the ridge to the south, however, the three units all run parallel to each other, indicating stratigraphic or structural activity. Existing maps (Puls et al., 1986; Wrucke et al., 1987; and Doe et al., 1991) show the location of the exposure of the angular unconformity to be completely surrounded by faults; however, investigations suggest that the rapid thinning of the LDQ was caused by sedimentation as well as movement along the faults.

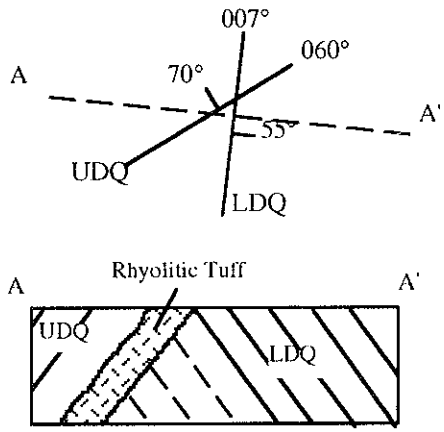

Figure 3: Schematic map and cross-section of unconformity at Shake Tree Canyon.

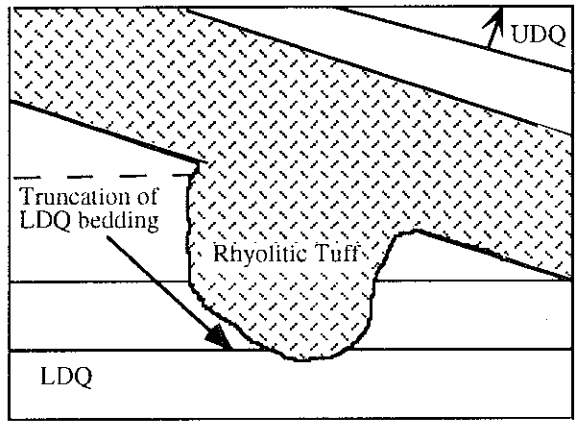

FIgure 4: Cross-section of the rhyolitic tuff layer as it truncates the LDQ in Shake Tree Canyon.

Wilson (1939) interpreted the thickening of the LDQ along Cactus Ridge as part of a thrust sheet, but Doe and Karlstrom (1991) were unable to find evidence to support such a thrust. It is also suggested that because the Lower Deadman is found only on Cactus Ridge, its deposition was limited by pre-existing topography, possibly from pre-Mazatzal Orogeny fault systems and/or caldera related structures (Doe et al., 1991). Interpreting this unit as basin fill explains the majority of the thinning along the ridge, but exposure in Shake Tree Canyon shows that deformation also occurred.

A drag fold present in the upper beds of the Lower Deadman Quartzite is evidence for the structural cause of the unconformity. Crossbeds and ripples within the folded bed parallel the fold itself, indicating that the folding took place after deposition and lithification. Further evidence for the angular unconformity is the down-cutting nature of the rhyolite. Erosion surfaces within the Lower Deadman have been filled by rhyolite as demonstrated by the truncated bedding planes which are cut-off by the rhyolite (figure 4).

The rhyolitic tuff layer varies in thickness (1 - 3 meters) along the ridge, but thickens to about 7 meters in the north. The possibility of this thickness being due to a splay fault at this locality is dismissed by the gradational layering throughout the rhyolite. The rhyolite includes a basal fine-grained layer (about 1 meter) with quartz phenocrysts, followed by about 1 meter of coarse volcanic conglomerate that fines up. The upper contact of the rhyolite layer has cracks in it that are filled with sand from the UDQ (Doe et al., 1991). The basal sands of the UDQ have rhyolite clasts that exhibit graded bedding parallel to the flow banding in the rhyolitic tuff layer. This evidence suggests that the UDQ was deposited in the same orientation as the rhyolite layer, which contrasts with the relationship between the LDQ and rhyolite layer.

TONTO NATURAL BRIDGE AND CACTUS RIDGE: THE PROPOSED CORRELATION

The undifferentiated Mazatzal Group at Tonto Natural Bridge can be further divided into an upper and lower unit, separated by a rhyolite. These units resemble the Deadman Quartzite The LDQ in particular is very similar to the LDQ at Cactus Ridge. Both units contain a basal conglomerate that fines upward into a massive bedded quartzite, and similar paleocurrent directions and clast lithologies in both locations are evidence to support a similar source to the north, assuming no subsequent rotation.

A key factor in the stratigraphic correlation of the two localities is the occurrence of a rhyolite 170 meters above the Red Rock Rhyolite (see figure 2). This rhyolite is about 15 meters thick, and appears to be as the quartzite units above and below it. In thickness, comparability and relative stratigraphic position, it is very similar to the rhyolite at Cactus Ridge. The quartzite units above and below it have considerable differences. The unit above the rhyolite contains many crossbeds and well preserved sedimentary features. The unit below the rhyolite, the

proposed "LDQ", contains sedimentary features that are not as obvious as the unit above the rhyolite, perhaps due to the weathering from the stream that exposes the unit.

Although rhyolite ash flows are sometimes restrained locally, they may be regionally extensive. This may be the case with the Red Rock Rhyolite, underlying the Deadman Quartzite, which is a series of ash flows (Wilson, 1939). It is thus possible for the rhyolites at Cactus Ridge and Tonto Natural Bridge State Park to be of the same origin. In any case, these units represent a separate time of volcanism during the late Proterozoic.

CONCLUSIONS

Detailed investigation of the unit directly overlying the Red Rock Rhyolite in the Northern Mazatzal Mountains and Tonto Natural Bridge State Park suggests that:

1) the Lower Deadman found on Cactus Ridge is separated from the Upper Deadman by an angular unconformity, and

2) the undifferentiated Mazatzal Group at Tonto Natural Bridge may be correlated with the Upper and Lower Deadman Quartzite in the Northern Mazatzal Mountains on Cactus Ridge.

The angular unconformity at the mouth of Shake Tree Canyon implies that the Upper and Lower Deadman Quartzite is not a depositionally continuous sequence and demonstrates that the Lower Deadman Quartzite is a separate formation of limited depositional extent and according to stratigraphic code, requires a new name.

REFERENCES

Anderson, P., and Wirth, K.R., 1981, Uranium potential in Precambrian conglomerates of the central Arizona arch: Bendix Field Engineering Corporation Open-file report (GJBX-33(81)) for National Uranium Resource Evaluation, U.S. Department of Energy, 122 p.

Conway, C. M., and Silver, L. T., 1989, Early Proterozoic rocks (1710-1615 Ma) in central to southern Arizona, *in* Jenny, J. P., and Reynolds, S. J., eds., Geologic evolution of Arizona: Arizona Geological Society Digest 17, p. 165-186.

Doe, M. F., and Karlstrom, K. E., 1991, Structural geology of an early Proterozoic foreland thrust belt, Mazatzal Mountains, Arizona, *in* Karlstrom, K. E., ed., Proterozoic Geology and Ore Deposits of Arizona: Arizona Geological Survey Digest 19, p. 181-192.

Doe, M. F., 1991, Geologic map and cross-section of the central and northern Mazatzal Mountains, central Arizona (1:24,000): Arizona Geological Survey Contributed Map Series 91-J (two sheets).

Puls, D. D., and Karlstrom, K. E., 1986, Proposed names for major thrusts in the northern Mazatzal Mountains, central Arizona: Geological Society of America abstracts with programs, Rocky Mountain Section Meeting, v. 18, no. 5, p. 404.

Trevena, A. S., 1979, Studies in sandstone petrology: Origin of the Precambrian Mazatzal Quartzite and provenance of detrital feldspar [Ph.D. Thesis]: Salt Lake City, Utah, University of Utah, 390 p.

Wilson, E. D., 1939, Precambrian Mazatzal Revolution in central Arizona: Geological Society of America Bulletin, v. 50, no. 7, p. 1113-1164.

Wrucke, C. T., and Conway, C. M., 1987, Geologic map of the Mazatzal Wilderness and contiguous roadless area, Gila, Maricopa, and Yavapai Counties, Arizona: U. S. Geological Survey Open-File Report 87-644, 44 p.