Distribution of Marginal Texture in the Quanah Granite Pluton, Wichita Mountains, Oklahoma

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We studied an area in the eastern Wichita Mountains northwest of Lawton in southern Oklahoma (Figure 1). The area is in the western part of the Wichita Mountains Wildlife Refuge, in the Central Lowlands between Burford and French Lakes. This area contains the exposed northern margin of the Quanah Granite pluton, emplaced as part of igneous activity due to Eocambrian rifting (Figure 2). Based on radiometric dating and contact relationships, the Quanah Granite pluton is one of the younger intrusions in the eastern Wichitas. The pluton intruded a substantially older layered gabbroic series, the Glen Mountains Layered Complex and the nearly contemporaneous Mount Scott Granite.

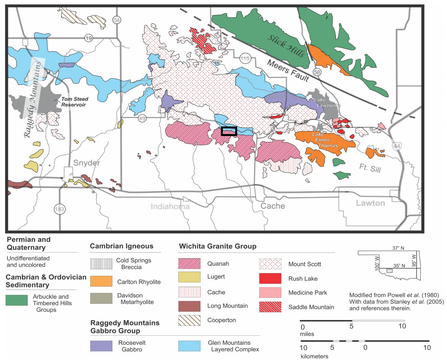


Figure 1- A geologic map of the eastern Wichita Mountains. The Quanah Granite can be found along much of the southern margin. Our study area is outlined in the black box.

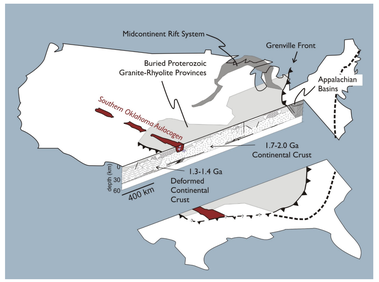


Figure 2- Eocambrian rifting of Laurentia formed the Southern Oklahoma Aualcogen, shown in red. The igneous rocks on figure 1 are all products of this rifting. Figure from Price (2012), modified from Pratt et al. (1992).

Why Quanah Granite?

Previous workers documented textural variation in the margins of the Quanah Granite pluton (Gilbert, 2014 and references therein). We are hoping an accurate map might lead to understanding emplacement and cooling regimens for this pluton. The eventual aim with continued characterization is to better resolve the timing and cooling history of the pluton. The northern margin is well exposed (Figure 3A), and our work was aided by a July 2016 controlled burn (Figures 3C and B).

Figure 3 – The Quanah Granite is well exposed along its northern margin. The rocks support thin soils and are therefore lightly vegetated. A.) Fine-grained area by the dam at Buford Lake facing east. B.) Controlled burning reduced grass cover and trees, exposing numerous small outcrops. C) Fire spalling exposed rock surfaces.

How did we go about it?

We conducted several field surveys over the area. We located important features and contacts with a handheld GPS-WAAS (Figure 4). We collected a number of representative samples. Upon returning to the lab, we uploaded the waypoints into DeLorme's Topo North America 10 digital mapping software. Waypoints were projected on the software's digital elevation model, the USGS Quanah Mountain 7.5' quadrangle, and USGS DOQQ 1m resolution aerial images. We mapped the best fit the trend of contacts.

Figure 4 Field observations A.) Recording a waypoint on the GPS of for the coarse-grain facies. B.) An exploration mine pit from the late 1800's early 1900's. The Wichitas saw rampant speculative mining during this period. The pits typically mark interesting geologic features including facies boundaries.

What did we find?

The texture variations in the marginal Quanah Granite are subtle in places, but three distinct types emerged from our field observations. We divided the textures into different facies of the Quanah Granite: coarse-grained, fine-grained, and porphyritic. The coarse-grained texture has 6mm alkali feldspar and slightly smaller quartz crystals (Figure 5A). The fine-grained texture has 2mm alkali feldspar and quartz (Figure 5B). The porphyritic texture has 5mm phenocrysts with a sub-millimeter alkali feldspar and quartz matrix (Figure 5C).

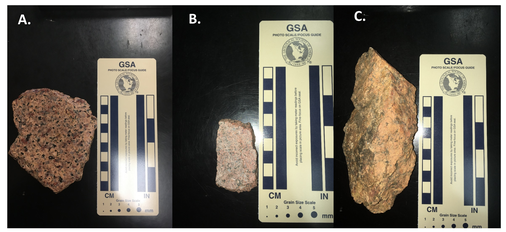
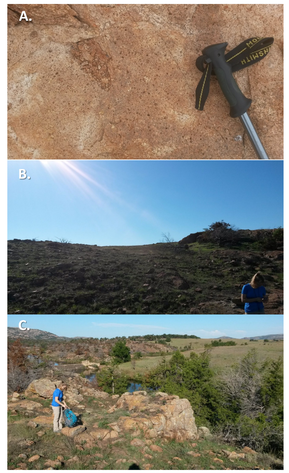


Figure 5 - Example of the three facies. A.) Coarse-grained. B). Fine grained. C). Porphyritic

Figure 6 – Field photos of the Quanah Granite margin. A.) Porphyritic facies texture in the field. B.) Porphyritic facies area south of French Lake. C). Coarse-grained facies area south of the Fish Lakes. Outcrop faces northwest. The smoother slope to the right (north) of the lake is underlain by the GMLC.



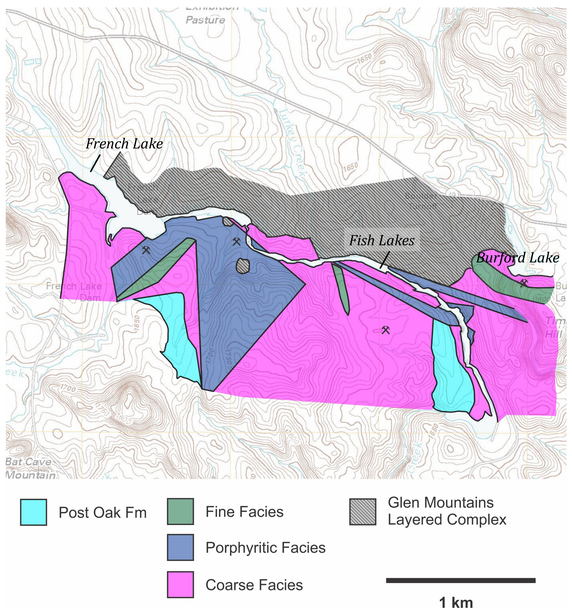


Figure 7 – Geologic map of our study area with the three facies, the adjacent Glen Mountains Layered Complex (GMLC) and Permian Post Oak Formation cover. The Quanah Granite margin includes coarse-grained, fine-grained, and porphyritic facies, GMLC. Note the angular geometries of the fine and porphyritic facies. Mining pits are marked with crossed pick and hammer. The topographic base is the U.S.G.S. Quanah Mountain 7.5' quadrangle, Oklahoma, 10' contour interval.

Outcrops of the material reflect the texture at several scales. The porphyritic facies produces a distinctive weathered surface with prominent raised alkali feldspars (Figure 6A). The porphyritic and fine-grained facies do not form the large boulders and tor features typical of the coarser facies (Figure 6B and C). We also found that the porphyritic texture is dominate south of French Lake and along the Fish Lakes (Figure 7). The coarse-grained texture dominates south and southwest of Buford Lake, and much of the total exposure of the granite. The fine-grained texture has dike-like geometries, the largest is found the dam at Burford Lake. We also discovered several unexpected features, including a quartz-rich pegmatitic pod, a rhyolite dike, and a fine-grained dike-like structure cutting coarse-grained Quanah. There are outcrops of Glen Mountain Layer Complex (GMLC) south of the Fish Lakes.

Figure 8 - Contacts are sharp in many areas. A). The fine- and coarse-grain facies contact south of French Lake. B, C, D). Examples of the coarse-grained and porphyritic facies contact

Discussion

The northern margin of the Quanah Pluton is naturally messy and exhibits considerable variation in microstructure. We documented numerous inclusions, including a large, isolated outcrop of the Glen Mountains Layered Complex (GMLC) about 0.5 km east of French Lake. Additionally the Quanah Granite contains pegmatitic bodies and quartz pods and veins. Gold-mining exploration pits from the turn of the 20th century mark some of these features as well as facies contacts.

We noted other complications, but our survey documented the prominence of three distinctive textural facies sufficiently extensive as to be mapped on a 1:12 000 scale. The contacts, where exposed, appear sharp (Figure 8). The coarse-grained facies is slightly finer than the bulk of the pluton exposed to the south. It is coarser than the other facies and weathers to tors and boulders. The fine-grained facies is easy to segregate based on its granular texture. The weathering expression differs as well; fracture sets produce blocky angular surfaces on outcrop. The porphyritic facies is marked by 3 mm or larger pink alkali feldspar in microgranitic matrix. It is easily identified on weathered surfaces by its raised feldspar grains.

Despite detailed mapping, the relative timing of the facies remains ambiguous. Inclusions of fine and porphyritic granite are found in the coarse-grained facies, along with fragments of the Mount Scott Granite and the Carlton Rhyolite. But the angular nature of facies contacts and the dike-like geometries of the fine-grained facies both suggest that the magmas that formed porphyritic and fine grained intruded the coarse facies. Further work will examine compositional constrains to resolve this problem.

Conclusion

We completed several field surveys to assess and document important features in the northern margin of the Quanah Granite. We located pods, veins, dikes and mining pits. We also mapped three textural facies based on inspection of the texture and general weathering and erosional morphology.

The coarse-grained facies has alkali feldspar grains that are 6mm long with slightly smaller quartz and dominates the margin south and southwest of Buford Lake. The fine-grained facies has 2mm alkali feldspar and quartz and occurs as dike-like features, including a large amount of the area adjacent to the dam at Buford Lake. The porphyritic facies has 5mm alkali feldspar phenocrysts surrounded sub-millimeter alkali feldspar and quartz. It is found also in linear bodies along with more widespread in the area to the southeast of French lake. The relative timing is remains poorly constrained; mapped geometries suggest that the coarse facies precedes the others, but inclusions seemingly contradict this.

Acknowledgements

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