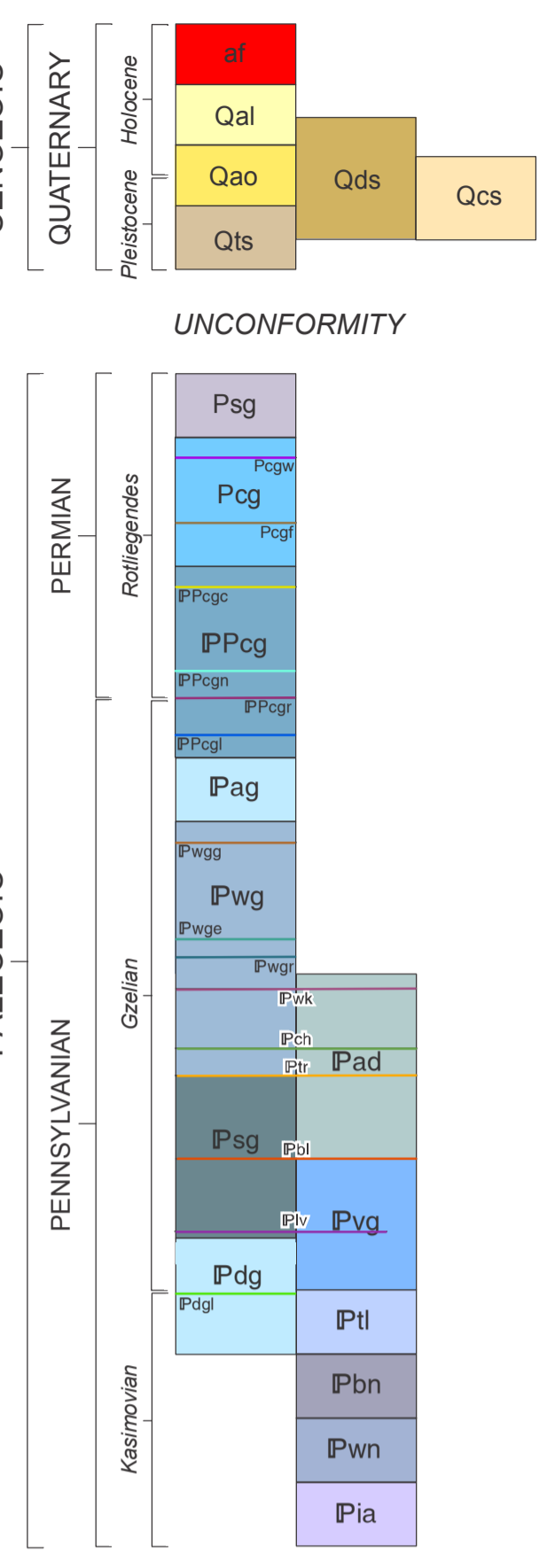


CORRELATION OF UNITS



DESCRIPTION OF UNITS

- ARTIFICIAL FILL**—Natural or artificial talus, slumps, and tailings covering formally exposed areas around active and inactive mining operations.
- ALLUVIUM**—Clay, silt, sand, and some gravel composed of locally derived unconsolidated sediment deposited in channels and on flood plains of modern streams.
- OLDER ALLUVIUM**—Clay, silt, sand, and some gravel composed of locally derived unconsolidated sediment located between 1.5 to 6 meters above and adjacent to modern flood plains and alluvial valleys.
- TERRACE SAND**—Mostly unconsolidated sand, silt, and clay, with little to no gravel-sized material. Unit formed at several levels along former courses of present-day rivers and streams.
- DUNE SAND**—Generally windblown, fine- to very fine-grained, unconsolidated sand formed into definite dune structures and ridges. Deposits most likely derived from Aeolian reworking of modern and older alluvial and terrace deposit, often vegetated except for most recently formed structures.
- COVER SHEET SAND**—Composed of unconsolidated windblown, very fine-grained sand and silt deposited as a featureless plain. Derivation similar to that of dune deposits.
- SUMNER GROUP**—The Sumner Group includes primarily reddish-brown shales and siltstones that are stratigraphically equivalent to the Wellington Formation and the Garber Sandstone of central Oklahoma. Only the basal 10 to 15 meters exposed along the far western parts of the quad.
- CHASE GROUP**—Along the Kansas-Oklahoma border, the group is comprised of four limestone and three shale members. In descending order, they are: the Nolans Limestone at top, Ocell Shale, Winfield Limestone, Doyle Shale, Barnston Limestone, Matland Shale, and the Weford Limestone at base. Only the more prominent limestone members are shown. Overall, the Chase Group consists of multicolored calcareous, silty clayshales, claystones, and mudstones interlayered with prominent, escarpment-forming limestone intervals. Important limestones include, in descending order: 1) the Henington Limestone, a 1.5 meter thick, thin-bedded, argillaceous, carbonate mudstone, the top of which marks the top of the Chase Group; 2) the Winfield Limestone (Pwgf), a 3.5 meter thick limestone consisting of two thin-bedded cherty carbonate mudstones to wackestones separated by a thin shale interval; 3) the Fort Riley Limestone (Pcfr), a unit that is variable in character but is generally ~6 meters thick and consists of a lower molluscan and algal limestone interbedded with gray shale and overlain by a thick sandstone; and 4) the Winford Limestone, which represents the base of the group, and ranges from ~12 to 5 meters thick and consists of a lower, middle, and upper zone. The lower and middle zones consist of gray, thick-bedded, algal limestone that is sandy in some areas. When sandy, the rock is brown to yellow in color and commonly weathers into large rectangular blocks. The upper zone consists of interbedded gray, thin-bedded, non-fossiliferous limestone with gray shale. Algal pellets are present within the limestone. Total thickness of the Chase Group is ~91 meters.
- COUNCIL GROVE GROUP**—Along the northern border of Oklahoma and extending south, the group is comprised of a number of thin limestone packages interbedded with shale. In descending order, they are: the Spenser Shale at the top, Funston Limestone, Blue Rapids Shale, Crouse Limestone, Easy Creek Shale, Bader Limestone, Steamers Shale, Beattie Formation, Eskridge Shale, Grenora Formation, Roca Shale, Red Eagle Formation, Johnson Shale, and the Foraker Formation at base. Only the more prominent limestone members are shown. Overall, the upper part of the Council Grove Group consists of red shales and lenticular sandstones with thin interbedded limestones. The lower part consists of fine-grained sandstones and red to gray shales interbedded with thin fossiliferous limestones. Important limestones include, in descending order: 1) the Cottonwood Limestone (Ppccg), the Beattie (Ppbe) is a 1 meter thick resistant bed of light greenish-gray limestone; 2) the Neva Limestone (Ppncg) of the Grenola Formation is 3 to 4 meters thick and consists of three limestone zones separated by and interbedded with shales. The lower zone consists of a light gray to blue-gray, dense limestone. In parts it is cherty and/or slightly fossiliferous (fusulinids). The middle zone is a light gray, argillaceous, slightly fossiliferous (fusulinids), limestone with abundant chert locally. The upper zone is a light gray to yellowish, massive to thin-bedded limestone with abundant fusulinids and locally rich in chert; 3) the Red Eagle Formation (Ppgr) constitutes the boundary between the Permian and Pennsylvanian Periods. It is poorly exposed and absent in some areas. The limestone is gray, light gray, or off-white in color and can be subdivided into a lower, middle, and upper zones, each about 1.2 meters thick. The lower and upper limestones are thin-bedded, and the middle limestone is medium- to thick-bedded; 4) the Long Creek Limestone (Ppccg) is the upper member of the Foraker Formation and is ~3.5 to 5 meters thick, poorly exposed, and thin- to medium-bedded. The limestone is chert-bearing and fusulinid-rich in some areas; 5) the American Limestone is the lower member of the Foraker Formation and represents the base of the Council Grove Group. It is ~3 meters thick and contains limestones separated by thin shale intervals. In particular, it contains two lower massive limestones that are gray, crystalline, dense, and fossiliferous, with abundant fusulinids, separated by a marly, extremely fossiliferous (fusulinid-rich) shale. Total thickness of the Council Grove Group is ~145 meters.
- ADMIRE GROUP**—Consists of unfossiliferated red and gray shales, fine-grained sandstones, and undistinguishable thin, fossiliferous limestones. The only prominent member is the Five Point Limestone that occurs in the middle of the group and which was unmappable at this scale. Total thickness of the group is ~43 meters.

Pwg WABAUSSÉE GROUP—Along the Kansas-Oklahoma border, the group is comprised of six limestone and six shale members. In descending order, they are: the Wood Siding Formation at top, Root Shale, Stoller Limestone, Pillsbury Shale, Zendale Limestone, Willard Shale, Emporia Limestone, Auburn Shale, Bern Limestone, Sumner Shale, Howard Limestone, and the Severyn Shale at base. Only the more prominent limestone members are shown. Overall, the Wabaussée Group consists of massive limestone beds with interbedded calcareous, argillaceous, and arenaceous shale. Important limestones include, in descending order: 1) the Brownville Limestone at the top of the Wood Siding Formation constitutes the top of the Wabaussée Group. It is ~2 meters thick and consists of two limestone beds, both ~0.4 meters thick, separated by gray, calcareous shale. The lower limestone bed is silty, light gray to buff, and fossiliferous. Fossils include fragments of brachiopods, ecrinoids, and brachiopods, which are often replaced by calcite. *Murchisonia* is also present, especially in the upper part of the lower bed. The upper bed is light gray to buff, argillaceous, and fossiliferous. Fossils include brachiopods, which increase in size upward, and crinoid stems, which are abundant on the surface of the rock; 2) the Crayhorse Limestone (Pwgg) in the middle of the Wood Siding is ~1 meter thick and consists of two light gray limestone beds separated by a greenish-gray shale with intercalated limestones. The lower limestone bed is fossiliferous, with bryozoans, ecrinoids, brachiopods, and mollusks, which are replaced by calcite. The upper limestone bed is well-indurated, ferruginous, and sparsely fossiliferous; 3) the Elmont Limestone (Pwge) at the top of the Emporia Limestone is ~3 meters thick and consists of two limestone beds separated by a gray shale. The lower bed is gray and contains abundant fusulinids. The upper bed is brown, irregularly bedded, and fossiliferous; 4) the Reading Limestone (Pwgr), located at the base of the Emporia, is 6 meters thick and consists of four limestone beds separated by gray shales. The lower and upper limestones are algal pellet limestones with irregular upper surfaces. They are fossiliferous to locally fossiliferous, with pelecypod fragments in the lower limestone. The middle two limestones are gray to dark gray, dense, brittle, and fossiliferous. The upper-middle limestone contains fusulinids, algal pellets, horn corals, and gastropods locally. The shale between the lower and lower-middle limestones contains a thin coal and underlay; 5) the Wakarusa Limestone (Pwk) at the top of the Bern Limestone is 0.5 to 1.5 meters thick and consists of limestone beds separated by silty shaly shales. The limestone beds are dense and dark gray to steel blue in color. They are sometimes brittle and/or display conchoidal fracture. Fossils present include fusulinids, brachiopods, bryozoans, and concentrically laminated algal (crinoid) stems (algal pellets) that have been called "Cryptozoon". The shales are gray, calcareous, and fossiliferous; and 6) the Church Limestone (Pwc), in the middle of the Howard Limestone, correlates with the Bird Creek Limestone of Oklahoma and stratigraphically occurs no more than 20 to 30 feet above the base of the Wabaussée Group. It consists of a persistent ~0.5 to 1 meter thick bed of dark gray to black, dense, well-indurated, brittle limestone containing sparse fusulinids, bryozoans, and brachiopods. Subconchoidal fractures are also present. Total thickness of the Wabaussée Group is ~210 meters.

Ppog SHAWNEE GROUP—in the north, the group is comprised of four limestone and three shale members in descending order, they are: Topoka Limestone at top, Calhoun Shale, Deer Creek Limestone, Tecumseh Shale, LeCompton Limestone, Kanawha Shale, and the Oread Limestone at base. Only the more prominent limestone members are shown. Overall, the group is characterized by interbedded intervals of clayshale, silty clayshale, and mudstone of varying thickness, with predominantly yellow-brown weathering limestones. Mapped intervals with the Shawnee Group include: 1) the Turkey Run Limestone (Ptr), which represents the top of the group and correlates with the Coal Creek Limestone of the top of the Topoka Formation of Kansas, is 0.3 to 0.6 meters thick, varies in character, and is poorly exposed in some areas. It is sometimes a dark gray, shaly, fossiliferous limestone. Other times it is a pellet limestone, with light gray to blue limestone balls, 1 to 5 millimeters in diameter, in a dark gray matrix of sandy limestone; 2) the Bell Limestone (Pbl), is 2.2 to 4 meters thick, varies in character, and is poorly exposed in some areas. Where the limestone is thicker to the north, it has massive bedding and a pitted surface. Southward, the limestone becomes thinner, wavy bedded, and more interbedded with shales. The limestone may become a calcareous sandstone to the south as well. The limestone contains fusulinids, crinoid fragments, and corals; and 3) the Leavenworth Limestone (Plv), a single (<1 meter thick) bed of medium gray, carbonate mudstone with abundant fusulinids. The bed pinches out near the southern boundary of the Pawhuska Sheet. Total thickness of the Shawnee Group ~70 meters.

Pdg DOUGLAS GROUP—in the north, the group is comprised of two predominant clastic members, the upper Lawrence Formation and the basal Stanger Formation, as well as a number of minor limestone beds. Important limestones include: 1) the Labadie Limestone (Pdlg), a gray to white, wavy bedded, fractured, brachiopod-bearing limestone. It is 1 to 3 meters thick, thinning to the north, and roughly correlates to the Haskell Limestone of the Douglas Group of Kansas nomenclature, and is found at the base of the Lawrence Formation. Other limestones include, but were not mapped, the Amazonia Limestone of the Lawrence, and the Westphalia Limestone of the Stanger Formation. The Douglas Group interfingers with the Vamoosa Group lithologies as Douglas limestones pinch out to the south. Total thickness of the Douglas Group ~122 meters.

Pad ADA GROUP—Contains interbedded gray shales, lenticular sandstones, and limestones, and correlates with the lower part of the Wabaussée Group and the upper part of the Shawnee Group. Important limestones include: 1) the Wakarusa Limestone (Pwk), which occurs 10 to 20 feet below the top of the group. See detailed description under the Wabaussée Group; 2) the Church Limestone (Pwc), which correlates to the Bird Creek Limestone of Oklahoma. See detailed description under the Wabaussée Group; 3) the Turkey Run Limestone (Ptr), which correlates with the Coal Creek Limestone of the top of the Topoka Formation of Kansas. See detailed description under the Shawnee Group; and 4) the Bell Limestone (Pbl), which constitutes the base of the Ada Formation. See detailed description under the Shawnee Group. The Pawhuska Formation of Oklahoma is bounded above and below by the Turkey Run Limestone and the Bell Limestone, respectively, but is not shown on this map. Total thickness of the Ada Formation is ~38 meters.

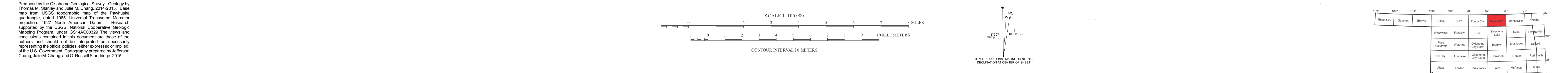
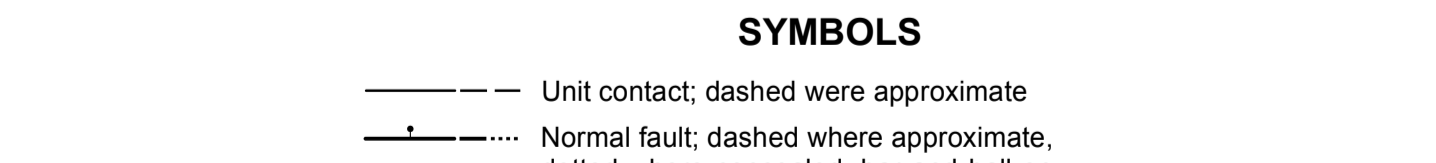
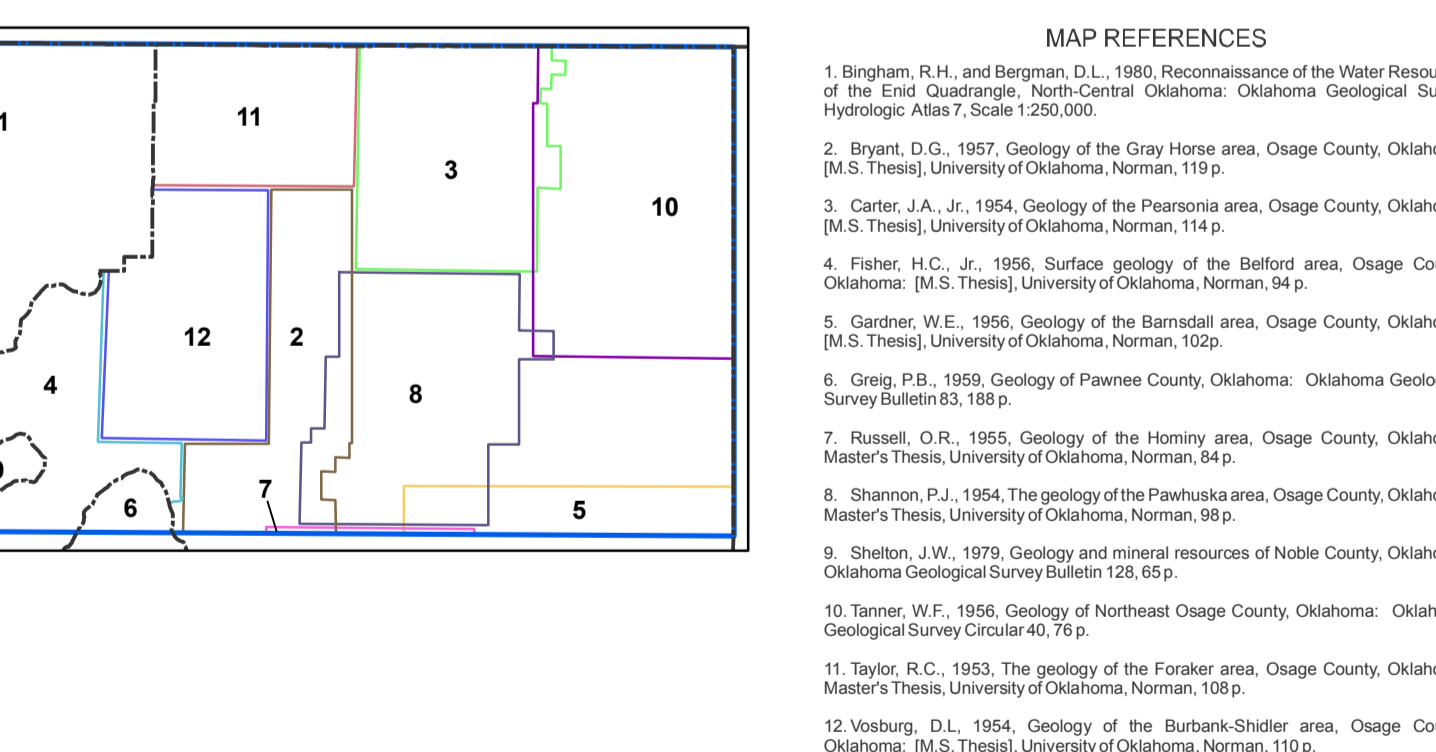
Pvg VAMOOSA GROUP—On the Pawhuska Sheet, the Vamoosa Group consists of locally calcareous, gray-green, blue-green, and maroon shale, siltstone, fine to coarse-grained sandstone, and thin limestones. It correlates roughly with the lower half of the Shawnee Group and the upper half of the Douglas Group of Kansas. The Leavenworth Limestone (Plv; see detailed description under the Shawnee Group) is the only mappable limestone found in the group. The base of the Chesapeake Sandstone marks the base of the Vamoosa Group; it is a ~2 to 6 meters thick, fine-grained, moderately well-sorted, and cross-bedded, argillaceous quartz arenite that roughly correlates with the Tongareva Sandstone of Kansas. Total thickness ranges from ~120 to 190 meters.

Pti TALLANT FORMATION—Consists of greenish-gray and grayish-blue shale, sandstone, and thin limestone beds. It correlates with the Weston Shale of the Stanger Formation at the base of the Douglas Group of Kansas. The Biggest Sandstone marks the base of the Tallant Formation. Thickness ranges from ~30 to 75 meters.

Pbn BARNSDALL FORMATION—Consists of blue-gray shale, buff siltstone and fine-grained sandstone, and thin limestone beds. Total thickness of formation ranges from ~40 to 50 meters, increasing northward.

Pwn WANN FORMATION—Consists of shale and fine- to medium-grained sandstone with many thin layers of fossiliferous limestone. Total thickness of formation ranges from 15 to 122 meters.

Pia IOLA FORMATION—Consists of interbedded limestone, calcareous sandstone, and shale. Only the upper 5 to 10 meters exposed on the sheet.



GEOLOGIC MAP OF THE PAWHUSKA 30X60-MINUTE QUADRANGLE, KAY, NOBLE, OSAGE, AND PAWNEE COUNTIES, OKLAHOMA
Thomas M. Stanley and Julie M. Chang
2015

Produced by the Oklahoma Geological Survey. Geology by Thomas M. Stanley and Julie M. Chang, 2014-2015. Base map from USGS topographic map of the Pawhuska quadrangle, dated 1985. Limestone Transverse Mercator projection, UTM North American Datum. Research supported by the United States Geological Survey, Missouri Program, under 0516AC000303. The views and opinions of the authors should not be interpreted as necessarily representing those of the U.S. Government. Cartography prepared by Jefferson Chang, Julie M. Chang, and G. Russell Brantage, 2015.

