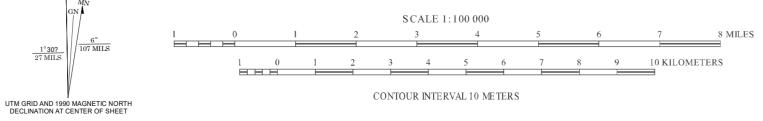
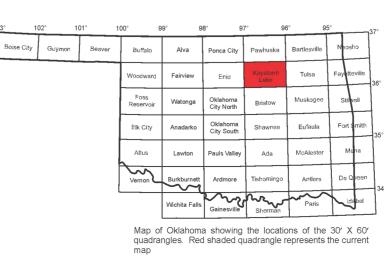


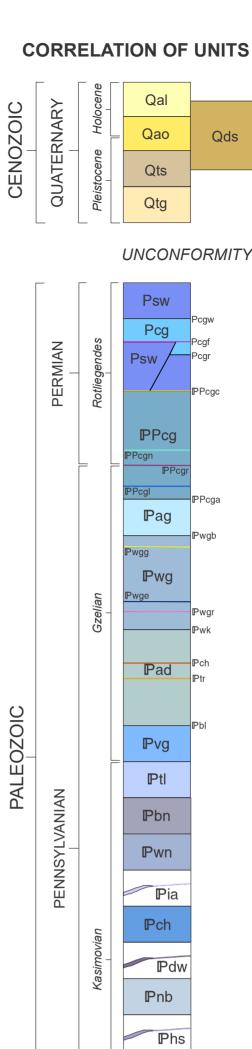
GEOLOGIC MAP OF THE KEYSTONE LAKE 30 X60-MINUTE QUADRANGLE, CREEK, NOBLE, PAWNEE, PAYNE, OS AGE, TULSA, AND WASHINGTON COUNTIES, OKLAHOMA Thomas M. Stanley and Julie M. Chang





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## **CORRELATION OF UNITS**



## **DESCRIPTION OF UNITS**

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

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.

TERRACE GRAVEL—Unconsolidated gravel, sand, silt, and clay deposited at several levels above and along the former courses of modern rivers and streams.

DUNE SAND—Generally windblown, fine- to very fine-grained, unconsolidated sand formed into definite dune structure 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.

STILLWATER FORMATION—Poorly exposed series of red to gray mudstones and claystones nterbedded with fine-grained, lenticular quartz arenites. Toward the southern parts of the quad, unit nterfingers with lithologic elements of the Chase Group. Only the basal 20 to 25 meters exposed

CHASE GROUP—Along the northern part of the map, the group is comprised of three limestone and two shale members. In descending order, they are: Winfield Limestone, Doyle Shale, Barneston Limestone, Matland Shale, and the Wreford 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 Winfield Limestone (Pcgw), 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 (Pcgf), 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. Toward the southern half of the quad, the unit grads into a thin (less than 3 feet), fine-crystalline limestone; and 4) the Wreford Limestone (Pcgr), which represents the base of the group in the northern part of the quad, ranges from  $\sim 1/2$  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. The Wreford pinches out about 6 miles south of the northern quad boundary, where lithologic elements of the Stillwater Formation begin to interfinger with the Chase Group. Total thickness of the Chase Group varies from 50 to 75 meters.

COUNCIL GROVE GROUP—Group comprised of a number of thin limestone packages interbedded with shale. In descending order, they are: the Beattie Formation, Eskridge Shale, Grenola ormation, 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 imestones. Important limestones include, in descending order: 1) the Cottonwood Limestone (PPcgc) of the Beattie Formation is a 1 meter thick resistant bed of light greenish-gray limestone; 2) the Neva Limestone (PPcgn) 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 (PPcgr) 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 (PPcgl) is the upper member of the Foraker Formation and is ~3.5 to 5 meters thick, poorly exposed, and thin- to mediumbedded. The limestone is chert-bearing and fusulinid-rich in some areas; 5) the Americus 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 ~100 meters.

ADMIRE GROUP—Consists of undifferentiated 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, but which was unmappable at this scale. Total thickness of the group varies from 10 to 30 meters.

WABAUNSEE GROUP—The group is comprised of six limestone and six shale members. In descending order, they are: the Wood Siding Formation at top, Root Shale, Stotler Limestone, Pillsbury Shale, Zendale Limestone, Willard Shale, Emporia Limestone, Auburn Shale, Bern Limestone, Scranton Shale, Howard Limestone, and the Severy Shale at base. Only the more prominent limestone members are shown. Overall, the Wabaunsee 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 Wabaunsee 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, echinoids, and pelecypods, which are often replaced by calcite. Myalina is also present, especially in the upper part of the lower bed. The upper bed is light gray to tan, argillaceous, and fossiliferous. Fossils include fusulinids, which increase in size upward, and crinoid stems, which are abundant on the surface of the rock; 2) the Grayhorse 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, echinoids, 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 underclay. Total thickness of the Wabaunsee Group is ~180 meters. ADA GROUP—Contains interbedded gray shales, lenticular sandstones, and limestones, and correlates with the lower part of the Wabaunsee Group and the upper part of the Shawnee Group. Important limestones include: 1) 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 intervening 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 organisms (algal pellets) that have been called "Cryptozoon." The shales are gray, calcareous, and fossiliferous; and 2) the Church Limestone (Pch), 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 Wabaunsee 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.; 3) the Turkey Run Limestone (Ptr), which correlates with the Coal Creek Limestone 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 concretions, 1 to 5 millimeters in diameter, in a dark gray matrix of sandy limestone; and 4) the Beil 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 coral. Total thickness of the Ada Formation is ~38 meters. VAMOOSA FORMATION—Consists of locally calcareous, gray-green, blue-green, and maroon shale; siltstone; fine- to coarse-grained sandstone; and thin limestones. The base of the Cheshewalla Sandstone marks the base of the Vamoosa Formation; it is a  $\sim$ 2 to 6 meters thick, finegrained, moderately well-cemented, and cross-bedded, argillaceous quartz arenite that roughly correlates with the Tonganoxie Sandstone of Kansas. Total thickness ranges from ~120 to 190 meters. TALLANT FORMATION—Consists of greenish-gray and grayish-blue shale, sandstone, and thin Ptl limestone beds. The Bigheart Sandstone marks the base of the Tallant Formation. Thickness ranges from  $\sim$  30 to 75 meters. BARNSDALL FORMATION—Consists of blue-gray shale, buff siltstone and fine-grained sandstone, Pbn and thin limestone beds. Total thickness of formation ranges from ~40 to 50 meters, increasing WANN FORMATION—Consists of shale and fine- to medium-grained sandstone with many thin layers of fossiliferous limestone. Total thickness of formation ranges from 20 to 122 m IOLA FORMATION—Consists of three members, which are, in descending order: 1) Avant Limestone; 2) Muncie Creek Shale; and 3) the Paola Limestone. Total thickness of the formation varies from 2, to as much as 20 meters, depending on the thickness of the middle clastic unit within the Avant Limestone. The Avant Limestone consists of an upper and lower limestone, separated by and an intervening interbedded sandstone and shale interval; the Muncie Creek Shale is a well-laminated to fissile, phosphatic clayshale; and the Paola Limestone is usually a single bed of skeletal wackestone to packstone; oolids and glauconite may occur locally CHANUTE FORMATION—Mostly a grayish orange to pale yellowish brown, laminated to blocky edded, weakly calcareous, very silty clavshale to mudshale. Locally, an 8' to 10' thick, indurated, aminated to thin-bedded, fine to very fine-grained sandstone, which may correlate to the Cottage Grove Sandstone, occurs near the top of the formation. The Thayer Coal also occurs within this unit, but was not observed in the field area. Total thickness of the formation varies from 16 to 23 meters thick. DEWEY FORMATION—Consists of two, thin, slightly sandy limestone beds with an intervening hale and sandstone interval. Thickness of the Dewey varies between 2 to 15 meters thick. NELLIE BLY FORMATION—Consists mostly of clavshale and mudstone, interbedded with some Pnb prominent sandstones, none of which can be easily separated into mappable units. Sandstones typically indurated to moderately indurated, fine-grained quartz arenites. Total thickness of formation, 130 meters. HOGSHOOTER FORMATION—In the southern part of sheet, formation composed of an upper, thin Winterset Member and a lower, thicker Lost City Member. The Lost City member pinches out north of the Arkansas River. Total thickness of formation varies from as much as 17 meters thick to less than a meter thick, depending on the presence or absence of the Lost City Member. COFFEYVILLE FORMATION—Gray to light brown, well-laminated to fissile, slightly silty clayshale, nterbedded with a fairly thick intervals of fine-grained sandstone of the Dodds Creek Member near the top, and an unnamed sandstone interval near the base. The basal sandstone interval pinches out north of the Arkansas River. Thickness varies from 80 to 135 meters. CHECKERBOARD LIMESTONE—The Checkerboard Limestone is medium gray when fresh, but weathers to a distinct dark yellowish orange color. Texturally, it is a skeletal to whole-fossil carbonate mudstone to wackestone. Thickness about 1 meter. SEMINOLE FORMATION—Consists of a lower sandstone interval, called the Tulsa Sandstone, and a basal and upper suite of interbedded with laminated, concretionary, silty clayshales, mudshales and siltstones. The Tulsa coal also occurs within the uppermost shale interval, just above the top of the Tulsa Sandstone. Thickness of the Seminole Formation about 25 meters. LOST BRANCH FORMATION—Poorly exposed, except for the Glenpool Limestone bed. Overall, a light brown, laminated, slightly calcareous, micaceous, silty clayshale. Basal 3 ft of formation, just above the Dawson Coal, consists of a medium dark gray, well-laminated to fissile, phosphatic mudshale to clayshale called the Nuyaka Creek shale bed. The top of the formation is marked at the top the Glenpool Limestone. Thickness about 12 meters. MEMORIAL FORMATION—The top of the formation is represented by the Dawson Coal, although Pmm not observed throughout the sheet. Mostly, the formation consists of interbedded sandy, weakly calcareous mudstone, and friable, fine-grained sandstone. Only the upper 5 meters of the Memorial Formation is exposed in the quad.



## SYMBOLS

————— Unit contact; dashed were approximate **—**•**—**••••• Normal fault; dashed where approximate, dotted where concealed; bar and ball on downthrown side ----- Facies contact; approximately located

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