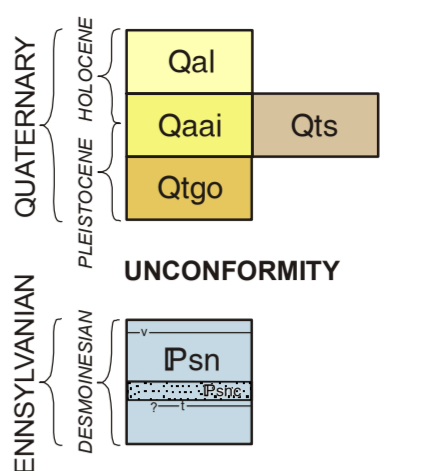


CORRELATION OF MAP UNITS

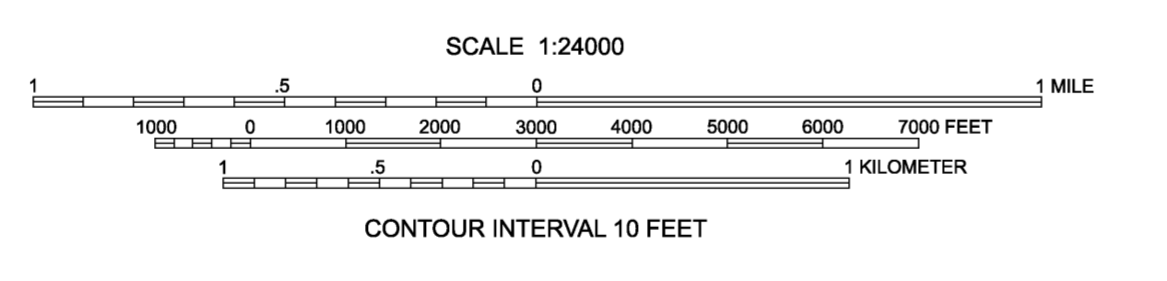


DESCRIPTION OF UNITS*

- Qal** ALLUVIUM (Holocene) - Clay, silt, sand, and gravel in channels and on flood plains bordering modern streams. Includes terrace deposits of similar composition located directly above and adjacent to modern channels and flood plains. Deposit also includes all dominant modern alluvial terraces associated with the Arkansas River drainage that are subject to frequent flooding. Thickness: 0 to about 50 ft.
- Qaai** ALLUVIUM OF ARKANSAS RIVER OF INTERMEDIATE AGE (Holocene and Pleistocene(?)) - Clay, silt, sand, and minor gravel on adjacent to, and 10 to 20 ft above, modern flood plains of the Arkansas River. Area rarely subject to flooding. Thickness: unknown, most likely between 20 to 50 ft.
- Qts** UPPER TERRACE SANDS (Holocene and Pleistocene(?)) - Similar to Qaai deposits, but associated with minor streams and drainages. Consists mostly of unconsolidated fine- to medium-grained quartz sand, silt, and clay, little to no gravel-sized material observed. Situated adjacent to, and just above, modern flood plains. Thickness: 0 ft to at most 20 ft; averages closer to 10 ft thick.
- Qtgo** REMNANTS OF OLDER TERRACE DEPOSITS (Pleistocene) - Clay, silt, sand, and gravel adjacent to the flood plain of the Arkansas River. Sand commonly is medium- to rarely coarse-grained and very light colored; when present, gravel locally consists of concentrations of local and distally derived, subrounded pebble and cobble-sized clasts of limestone and dolomite composition. The upper third to half of the deposit exhibits signs of aeolian reworking and modification that suggests a prevailing northeast wind direction throughout the Holocene. Thickness: 0 to 100 ft.
- Psn** SENORA FORMATION (Pennsylvanian, Desmoinesian) - Complex sequence of silty and concretionary clayshale interbedded with a number of mappable limestone and sandstone members and beds (including: v. Verdigris Limestone; IPsnC, Chelsea Sandstone; T. Tiawah Limestone); and various minor sandstone intervals and coal beds (including: Coweta sandstone; and the Crowburg, and Mineral coal beds).
A silty to sandy clayshale, interlaminated with 0.16-1" thick very fine-grained sandstone and siltstone beds is the predominant lithology of the formation, silt and sand content increasing adjacent to significant sandstone intervals (such as the Chelsea or Lagonda Sandstones), clayshale bedding laminated, becoming blocky where deeply weathered, color variable, ranging, from the most frequent to infrequent: medium light gray (N6), brownish gray (5YR4/1), grayish orange (10YR7/4), very pale orange (10YR8/2), dark yellowish orange (10YR6/2), pale brown (5YR5/2), light brown (5YR5/6), grayish yellow (5Y8/4), and yellowish gray (5Y7/2), typically, shale associated with concretionary zones tend to be more orange or brown, instead of gray in hue; clay is predominant cement, calcite rare.
Clayshales immediately above coal seams tend to be harder, silt-free, slightly phosphatic, with slightly thicker bedding laminae, and are weakly calcareous; color of these shale intervals usually a medium dark gray (N4).
The interlaminated sandstones and siltstones are friable to poorly indurated, usually a very pale orange (10YR8/2), pale orange (10YR8/2), or dark yellowish orange (10YR6/2); sandstone more common than siltstone, typically fine- to very fine-grained; predominant cement is clay, with a possible weak silica.
Ironstone and calcite concretions occur sporadically throughout the shale section, but concentrations may occur just above the Verdigris Limestone, and just above any of the major coal beds; concretions stratigraphically associated with coal composed predominantly of hematite, occurring as 0.5-2" thick, discontinuous beds, or as narrow zones composed of small (between 1-2") individual, hollow, ovoid-shaped clasts; color a light red (5R6/6) to moderate red (5R5/4). Concretions stratigraphically associated with the Verdigris composed of a medium dark gray (N4), dense, micritic limestone; small goniatite cephalopods common within calcite concretions.
Overall, formation is about 340 to 345 ft thick based on cross section.
A number of prominent stratigraphic horizons occur in the Senora Formation within the Coweta Quadrangle, these are in descending order:
Verdigris Limestone (v): medium dark gray (N4) skeletal mudstone; but may weather to a medium light gray (N6), grayish red (5R4/2), or grayish orange (10YR7/4) color. Represented either by a single massive bed, or by a couple of 6-12" thick, wavy, skeletal mudstone beds; top 3-4" becoming a wavy laminated whole-fossil mudstone to wackestone, with large productid brachiopods and large crinoid stems. Chert pods, or silica replacement of limestone along bedding surfaces common. Thickness about 2 to 3 ft.
Crowburg coal: Poorly exposed in map area, where observed in old mine workings represented by a black (N1) to grayish black (N2), 0.5-2" thick coal bed overlying a comparably thick very light gray (N8) to light bluish gray (5B7/1) underlayer. Locally, a pair of 9-12" thick, whole-fossil mudstones separated by a 6" thick clayshale interval, informally named the McNabb limestone by some geologists, occurs immediately below the underlayer.
Chelsea Sandstone (IPsnC; c. c. 1): Variable sandstone unit that can be loosely segregated into two zones. Lower zone well exposed, consisting of a pale reddish brown (10YR4/2), dark yellowish brown (10YR7/4), grayish orange (10YR8/2), to locally moderate yellow (5Y7/6), pale greenish yellow (10Y8/2), or pale olive (10Y6/2), moderately indurated, medium- to thin-bedded, fine- to medium-grained, calcareous trough-cross-bedded sandstone. Trough cross-bed sets vary from 0.5' to 3' thick, average 5' thick; locally graded, with siltstone, sandstone and limestone pebble conglomerate set within a medium-grained sand matrix at base, that grades upward into a fine-grained sandstone. Thickness of basal Chelsea is about 75 ft. Upper zone of the Chelsea poorly exposed, evidenced often times only by the presence of a sandy loam soil, as opposed to a clay loam; where exposed consists of a pale yellowish brown (10YR6/2) to light brown (5YR5/4), friable, thin-bedded to often planar laminated, weakly calcareous, micaceous, fine-grained sandstone. Thickness is about 25 ft thick. Overall thickness of the Chelsea Sandstone is 100 ft.
Tiawah Limestone (t. c. 1): Similar to the Verdigris Limestone in texture and thickness, usually a grayish orange pink (5YR7/2) to very pale orange (10Y7/2), locally light brownish gray (5B7/1) to pale yellowish brown (10YR6/2), with dark yellowish orange (10YR6/6) splotches; generally a massive bed of whole-fossil mudstone in lower half, grading into a wavy laminated skeletal wackestone in upper half. Fossils usually large crinoid stems with large productid and spiriferid brachiopods. Thickness varies from 2 to 4 ft thick. Outcrops of the Tiawah Limestone were not observed north of the Arkansas River in the map area, but have been reported locally south of the Arkansas River. Where the Tiawah was mapped in close proximity to the Chelsea, base of the limestone labeled with a 'c'.
Tebco coal: Rarely observed; black (N1) to grayish black (N2), 1-2" thick coal seam, with a 2-3" thick underlayer immediately below.
White sandstone: Normally a yellowish gray (5Y7/2) to pale greenish yellow (10Y8/2) color, but can be a very pale orange (10YR8/2) to pale yellowish orange (10YR6/6) in deeply weathered exposures; moderately indurated, fine-grained, slightly micaceous, siliceous sandstone. Bedding planar, medium, varying from 11-16" thick; some tabular cross-bedding observed at the base of unit in some exposures. Thickness from 2-4 ft thick.
Upper Taft sandstone: Overall, a grayish orange (10YR7/4), becoming dark yellowish orange (10YR6/6) in upper third, moderately indurated, medium- to thin-bedded, fine- to very fine-grained, micaceous, calcareous sandstone, with shale interbeds and partings. Interval can be segregated into 3 general lithologic zones: basal zone usually 23" thick, consists of medium to thin planar bedding, with bedding ranging from 0.5-4" thick, shale partings common, sandstone is slightly calcareous; middle zone consists of about 3.2' of alternating beds of sandstone and shale, each about 3-4" thick, sandstone slightly calcareous and indurated, the upper sandstone zone is moderately indurated, siliceous, and thin- to medium-tough-cross-bedded. Upper Taft sandstone about 5 to 7 ft thick.

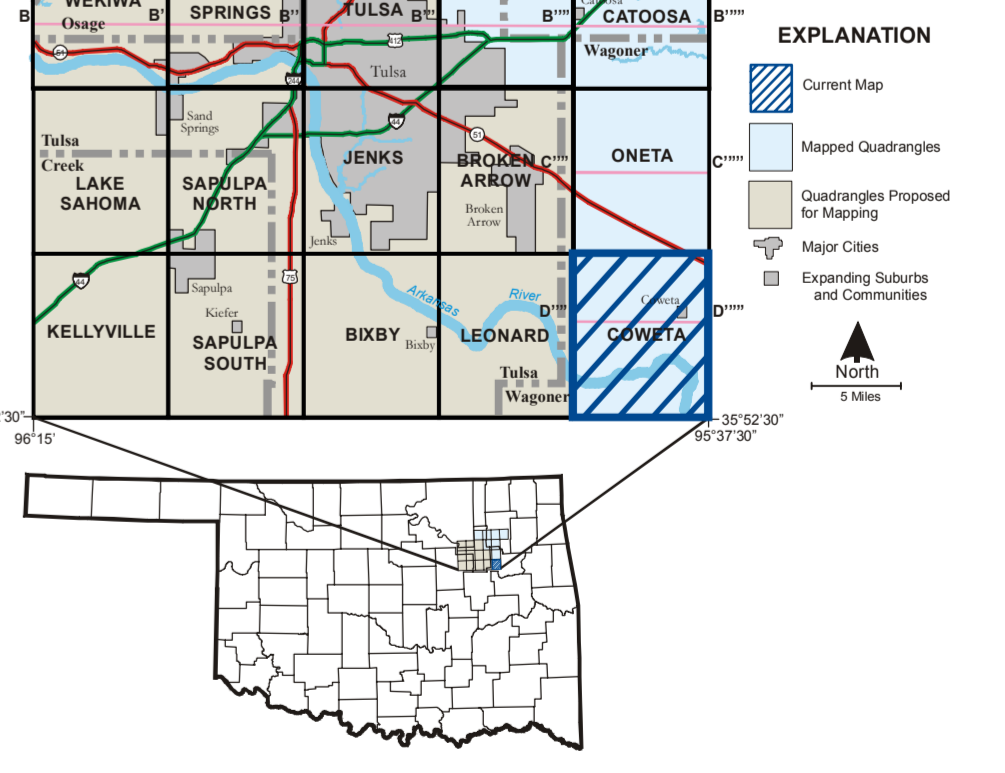
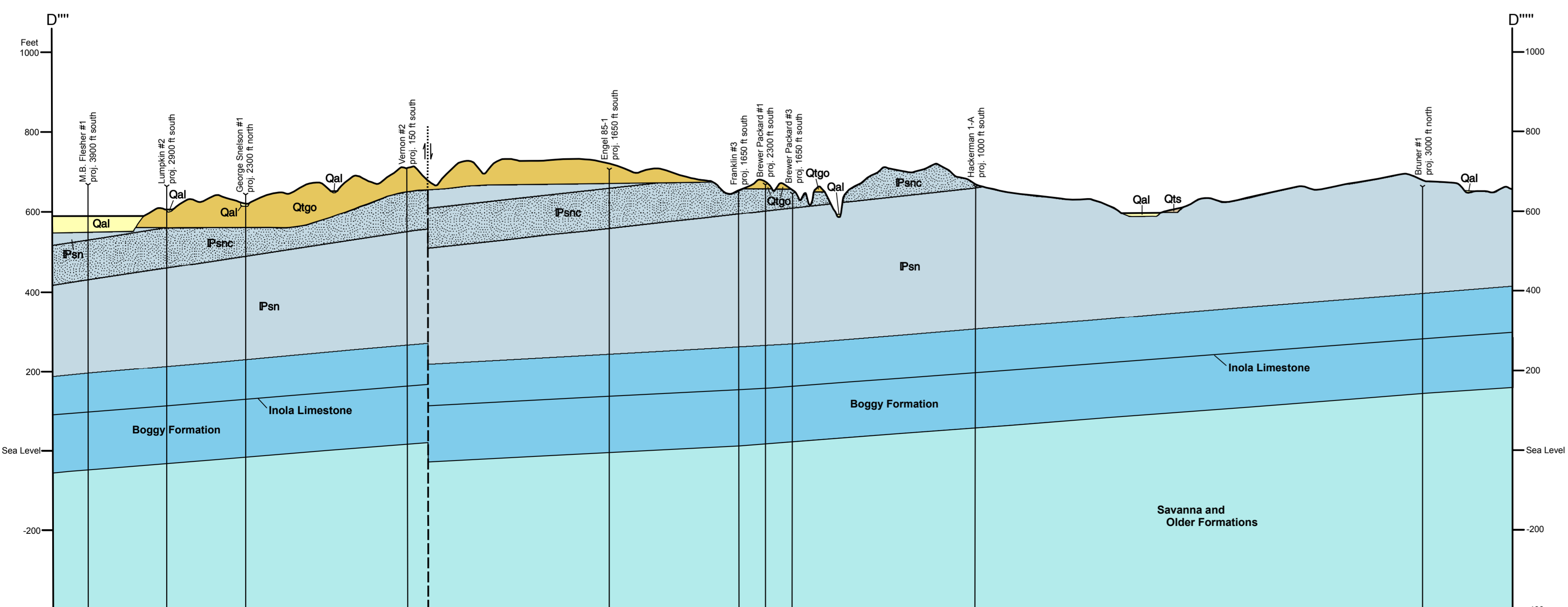
SYMBOLS

- Unit contact: dashed where approximate
- Fault, dotted where covered; ball and spike on downthrown side
- X Outcrop, geologic observation
- Petroleum well. Includes oil, gas, oil and gas, dry service (water supply or injection), junked and abandoned, unknown. Modified from Natural Resources Information System database



Base Map Credits
The base map was compiled by the U.S. Geological Survey Topography by photogrammetric methods from aerial photographs taken 1982. Field checked 1983. Universal Transverse Mercator (UTM) projection, 1927 North American Datum, 10,000-foot grid ticks based on Oklahoma coordinate system, north zone, 1,000-meter Universal Transverse Mercator grid ticks, zone 16.

Geologic Map Credits
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GEOLOGIC MAP OF THE COWETA 7.5' QUADRANGLE, WAGONER COUNTY, OKLAHOMA
Thomas M. Stanley and Galen W. Miller
2007