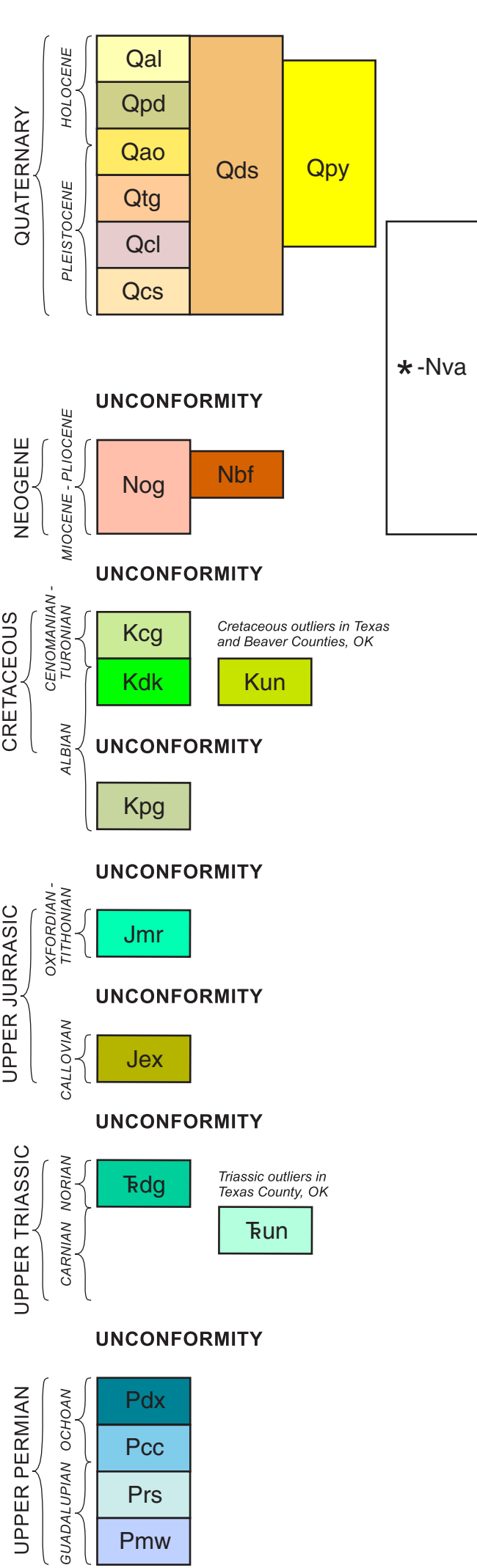


Produced by the Oklahoma Geological Survey. Geology compiled by Thomas M. Stanley, 2020-2021. Base map derived from USGS 7.5-minute topographic maps. Horizontal Transverse Mercator projection. 1927 North American Datum. Reliance on USGS data. The views and conclusions contained in this document are those of the authors and should not be interpreted as necessarily representing the official policies, other expressed or implied, of the U.S. Government. Cartography prepared by G. Russell Standridge and Thomas M. Stanley, 2020-2021.

- Qal** ALLUVIUM (*Holocene, Recent*) — Unconsolidated flood-plain and channel deposits composed of locally derived sand, silt, clay, and occasionally gravel found along present-day rivers and streams. Thickness 0 to no more than 50 feet.
- Qpd** PEDIMENT DEPOSIT (*Holocene*) — Unconsolidated, locally derived sand, silt, clay, and gravel forming an immature alluvial fan or debris field that gently slopes away from bedrock escarpments; observed only in the far northeast corner of the map area. Thickness from 0 to no more than 100 feet.
- Qty** PLAYA DEPOSIT (*Pleistocene, Wisconsinan?* - *Holocene*) — Unconsolidated clay and silt found in shallow depressions that contain water for variable periods of time. Includes Randall and Lofton clay loam soils (Allgood and others, 1962; Meinders and others, 1961; Murphy and others, 1960). Water in depressions not shown. Average surficial thickness less than 5 feet but some deposits of the Randall clay may extend to a depth of 60 feet or more.
- Qao** OLDER ALLUVIUM (*Pleistocene, Wisconsinan?*) — Unconsolidated remnants of older channel and flood-plain deposits consisting of sand, silt, clay, and gravel; top of deposits usually positioned 5 feet to as much as 50 feet above modern alluvial deposits (Qal). Sand, fine- to coarse-grained; gravel usually in the pebble-sized fraction consisting of locally derived clasts; cross-bedded to structureless, with lenticular to tabular bedforms. Thickness 10 - 50 feet.
- Qtg** TERRACE GRAVELS (*Pleistocene, Wisconsinan?*) — Unconsolidated gravel, sand, and silt; gravel is sandy, bordering on a matrix-supported texture, and composed of pebble- and cobble-sized clasts of quartz, quartzite, and calciche; sand is fine to medium-grained. Thickness 0 - to about 20 feet.
- Qcl** COVER LOESS (*Pleistocene, Wisconsinan?*) — Featureless sheet of loess and silt-sized material with minor sand; distinguishable from Qcs only on grain size differences between soil associations. Mapped as Richfield-Ulysses soil association by Allgood and others (1962), Meinders and others (1961), and Murphy and others (1960), which is predominantly composed of loess and other silt-sized material. Unit may correlate to the Vanhorn Formation of Kansas (Smith, 1940; Barnes, 1970). Thickness from 0 to no more than 20 feet.
- Qch** DUNE SAND (*Pleistocene, Illinoian*) — Unconsolidated, fine- to very fine-grained sand and silt formed into definite vegetated dunes and sand ridges; low-angle wedge crossbedding frequently observed along base of structures. Thickness 0 to no more than 50 feet.
- Qcs** COVER SAND (*Pleistocene, Illinoian*) — Featureless sheet of fine- to very fine-grained sand with minor silt and clay; distinguishable from Qcl only on grain size differences between soil associations. Mapped as Richfield-Ulysses soil association by Allgood and others (1962), Meinders and others (1961), and Murphy and others (1960), which is dominated by sand-sized material. Unit may correlate to the Blackwater Draw Formation of Texas (Reeves, 1976). Thickness 0 to no more than 40 feet.
- Nbg** BASALT FLOW (*Pliocene*) — Dark to light olive gray olive basalt, mostly aphanitic except for small olivine phenocrysts that comprise less than 10% of the rock; groundmass dense, compact to vesicular, composed of near-equal amounts of augite, magnetite, and labradorite (Barnes, 1984). At Black Mesa there is clear evidence it laterally interfingers with the Ogallala Formation. According to Scott and others (1990), radiometric dates of 3.5-4.0 Ma places this and other associated basalt flows into the middle Pliocene. Thickness between 50 feet to 85 feet, with thickness part of section occurring along the Oklahoma-New Mexico state line.
- Nvg** VOLCANIC ASH DEPOSITS (*Quaternary - Neogene, Pleistocene - Pliocene*) — White, partially devitrified (locally), felsic volcanic ash; numerous, small deposits associated with the Ogallala Formation, and possibly high gravel terrace deposits in northeast Beaver County. Thickness varies from 10 to 30 feet.
- Kcg** COLORADO GROUP (in part) (*Upper Cretaceous, Cenomanian - Turonian*) — Includes the lower part of the Greenhorn Limestone (Bridge Creek [in part], Hartland, and Lincoln Members) and Graneros Shale. Both formations poorly exposed. The Greenhorn is a light gray to bluish-white, thin-bedded whole-fossil carbonate mudstone, interbedded with brownish-yellow, calcareous clayshale and occasional bedded, whole *Inoceramus* and other silt-sized material. Unit may correlate to the post-Cretaceous erosion; thickness 256 feet. The Graneros consists predominantly of moderate to dark gray mudshale, interbedded with light gray to light brown calcareous quartz arenites; arenites more prevalent in basal and upper third of formation; top marked by a thick (~1 foot) bentonite bed, thickness about 99 feet. Total thickness of the Colorado Group in this area is 355 feet.
- Nva** DAKOTA FORMATION (*Lower to Upper Cretaceous, Albian - Cenomanian*) — Composed of three informal members or divisions (Schoff and Stovall, 1943). Upper member is a brownish-yellow, light gray, or white, planar crossbedded, fine-grained, slightly argillaceous quartzarenite; bedding thin to medium (usually between 6 to 12 inches), although laminations separating cross bed sets are common. Unit thickness about 53 feet, poorly exposed. The middle division is predominately a light to medium gray, silty clayshale with occasional interbeds of thin coal (6 to 12 inches thick) and bentonite (usually no more than 6 inches thick); bentonite and coal more common in the upper half of division. Unit thickness about 47 feet. The lower division is very similar to the upper sandstone division, being a planar crossbedded, fine-grained quartzarenite; however, the lower sandstone is consistently better cemented than the upper, and as such, is better exposed. Thickness of the lower sandstone division varies due to erosion, maximum thickness about 115 feet. Total thickness of the Dakota Formation is 215 feet.
- Kun** CRETACEOUS(?) UNKNOWN — Small outliers of probable Cretaceous sandstones (mostly in-situ) that appear similar to one of the two Dakota Formation sandstones; outliers located in the SE1/4, NW1/4, Sec. 15, T.3N., R.13E., Texas County, Oklahoma and S1/2, Sec. 6, and NE1/4, Sec. 7, T.1N., R.20E., Beaver County, Oklahoma. One outlier in N1/2, SW1/4, Sec. 14, T.3N., R.13E., Texas County, Oklahoma is not in-situ, consisting of a chaotic mixture of large blocks of either Dakota or Cheyenne sandstone intercalated with possible Kiowa Shale, all of which collapsed into underlying formations. The upper 38 to 40 feet of unit is a light gray to white, friable to weakly indurated, trough crossbedded, medium-grained quartzarenite. Total thickness varies between 40 and 55 feet.
- Kpg** PURGATOIRE GROUP (*Lower Cretaceous, Albian*) — Consists of two formations, the upper Kiowa Shale and the lower Cheyenne Sandstone. The Kiowa Shale is a medium dark gray to dark gray, locally calcareous clayshale that grades in the upper half into a fossiliferous, sandy mudshale interbedded with thin (about 1 inch thick) argillaceous sandstone beds; sandstone more common in uppermost quarter of unit, *Gryphaea* the most common fossil found in the upper half. Formation thickness varies from 0 to 63 feet. The Cheyenne Sandstone is light gray to very light gray, weakly to moderately indurated, thin-bedded to seemingly massive (structureless), trough and planar crossbedding with wedge crossbedding in lower third, medium- to coarse-grained quartzarenite; locally conglomeratic in the lower half of the member with clast size ranging from granule- to cobble, and composed of milky quartz, and rock fragments of schist, chert, and limestone. Thickness of the formation 0 to 70 feet; absent in the eastern part of the outcrop belt northwest of Boise City as the unit is truncated by the overlying Kiowa Shale. Total thickness of the Purgatoire Group varies considerably due to a pre-Dakota Formation erosional surface, ranging from 0 to as much as 133 feet.
- Jmx** MORRISON FORMATION (*Upper Jurassic, Oxfordian - Tithonian*) — Interbedded argillaceous, fine- to very fine-grained quartzarenites, variegated sandy mudstones, and carbonate mudstones that commonly show internal algal laminations. Sandstones are light gray, greenish-gray, brownish-yellow, and white, and have a lenticular geometry that pinch and swell laterally for short distances along exposures; they tend to be more common in the upper half to two-thirds of the unit. Mudstones predominantly greenish-gray, brownish-yellow to brown, but moderate red, dusky red, purple, and grayish-purple shales may occur; bedding blocky to massive and caused by extensive bioturbation development. Carbonate mudstones usually light gray to medium gray, but maroon and orangish-yellow colors also occur; partial dolomitization common; beds average 6 inches thick, but 2 to 3 foot thick beds have been described in other reports; bedding and bedding contacts even and planar; internal algal laminations common. An angular unconformity between the Morrison and overlying Purgatoire Group occurs throughout much of the area due to a prominent pre-Purgatoire flexure. Total thickness of the Morrison Formation range from 250 to 315 feet, thinning to the east.
- Jex** EXETER FORMATION (*Middle Jurassic, Callovian*) — Basal 13 to 15 feet a brown to yellowish-brown, moderately indurated, wedge crossbedded, fine- to occasionally medium-grained, pebbly quartzarenite; cross-beds not pronounced on weathered surfaces; very fine-grained sand and silt may occur as bedding laminae separating cross bed sets; pebbles usually observed along base of cross bed sets and are composed of chert. This basal part of the Exeter is absent in the outcrop belt located north and northwest of Boise City. The upper 38 to 40 feet of unit is a light gray to white, friable to weakly indurated, trough crossbedded, medium-grained quartzarenite. Total thickness varies between 40 and 55 feet.
- Jkdg** DOCKUM GROUP, UNDIVIDED (*Upper Triassic, Carnian - Norian*) — Includes in ascending order: the Sheep Pen Sandstone, Sloan Canyon Formation, Travesser Formation, and the top of the Baldy Hill Formation represented by the Cobert Canyon Bed (Lucas and others, 1987). SHEEP PEN SANDSTONE: brown to yellowish-brown, wavy laminated to thin-bedded, fine- to medium-grained quartzarenite; bedding contacts both planar and wavy with wavy contacts more common in basal and upper third of unit; trough crossbedding common in thicker sandstone beds; vertical burrows of *Skolithos* (?) common in upper part of unit. Thickness about 15 feet; upper contact represented by a disconformity, basal contact conformable. SLOAN CANYON FORMATION: predominantly greenish-gray in color, with local variations of dark red, maroon, to reddish-purple; mostly a calcareous sandy siltstone with sandy mudstones and local interbeds of fine- to very fine-grained, calcareous quartzarenites and very argillaceous carbonate mudstones (lithologically bordering on marls). Sandstones planar laminated, wavy laminated to thin-bedded, and typically no more than 1 to 1.5 feet thick; however, some intervals and beds may be as much as 8 feet thick. Thickness 70 to 125 feet; basal contact represented by a disconformity. TRAVESSER FORMATION (description based on Lucas and others, 1987, p. 100-102): predominantly reddish-brown in color, consisting of interbedded sandy siltstones and thin argillaceous, thin- to very thin-bedded quartzarenites, with local associations with limestone conglomerates. Sandstone appears more concentrated in upper third of unit. Bedding characteristic of siltstones typically planar to wavy laminated; sandstones wavy, thin- to medium-bedded. Thickness about 350 feet with a sharp, but disconformable basal contact. BALDY HILL FORMATION (description based on Lucas and others, 1987, p. 98-100): represented by the Cobert Canyon Bed, a 6 to 10 foot thick, pale red, planar crossbedded, paraconglomerate; clasts mostly fall within the pebble- to cobble-size range and consist of limestone with minor siltstone rock fragments; matrix consists of fine-grained quartzarenite. The unit was only observed in the outcrop belt north-northwest of Boise City, near the termination of Picket House Draw, Sec. 31, T.1N., R.6E., Cimarron County, Oklahoma (Lucas and others, 1987). It does not appear to crop out anywhere west of this location. The Cobert Canyon Bed most likely correlates with the Trujillo Formation of Palo Duro Canyon, Texas (Lucas and others, 1987, fig. 13). Overall, the Dockum Group has a minimum-maximum thickness range of 421 to 480 feet; base is not exposed.
- Tun** TRIASSIC(?) UNKNOWN — Possible outliers of Triassic redbeds occur along the Beaver River and its tributaries, mostly within Secs. 13 to 25, T.3N., R.13E., and in Secs. 7 and 8, and Secs. 19 and 20, T.3N., R.12E., Texas County, Oklahoma. Consists of yellowish-gray to reddish-brown, crossbedded paraconglomerate, reddish-brown, fine- to coarse-grained argillaceous quartzarenites, and reddish-orange interbedded siltstone and mudstone. Conglomerate with pebble-sized clasts consisting of fine-grained sandstone fragments, dolomite, and volcanic rock fragments set in a coarse-grained sand matrix. Sandstones friable, medium-grained, micaceous lenticular, and laterally grade into shales and siltstones. Beds may be equivalent to the Trujillo and Tecovas Formations of Palo Duro Canyon (Barnes, 1970). Thickness from 45 to 95 feet; top truncated by the Ogallala Formation, base not exposed.
- Poc** DOXEY FORMATION (*Upper Permian, Guadalupian - Ochoan*) — Dark reddish-brown to dark yellowish-brown, moderately indurated, interlaminated, clayshale and siltstone; light yellowish-brown mottling or iron reduction spots common throughout. Minor orangish-brown, fine-grained, argillaceous quartzarenite locally at base of unit. Thickness about 30 feet; top truncated by the Ogallala Formation and by an outlier of Cretaceous(?) sandstone in Sec. 6, T.1N., R.20E., Beaver County, Oklahoma.
- Pprw** CLOUD CHIEF FORMATION (*Upper Permian, Guadalupian - Ochoan*) — Reddish-brown to orangish-brown, locally greenish-gray, interbedded poorly laminated clayshale and mudshale, fine- to very-fine grained, argillaceous quartzarenite, gypsum and thin dolomite beds; gypsum and sandstone, with minor siltstone more common in middle of unit. Calcite and/or gypsum veins, oriented oblique to main bedding, common throughout. Base of formation marked at the base of the Moccasin Creek Dolomite, a light gray, fine-crystalline dolostone. The Dog Creek Dolomite (which appears similar to the Moccasin Creek) poorly exposed and stratigraphically located near the middle of formation. Thickness 220 feet.
- Ppr** RUSH SPRINGS FORMATION (*Upper Permian, Guadalupian*) — Reddish-brown, fine-grained quartzarenite, commonly cross-bedded with local interbeds of reddish-brown shale. Thickness 175 feet.
- Pmw** MARLOW FORMATION (*Upper Permian, Guadalupian*) — Poorly exposed, orangish-brown, fine-grained sandstone, with local interbeds of very sandy mudstone and siltstone. Thin gypsum beds in upper 5 to 10 feet of exposures. Thickness 50 feet, base not exposed.

#### CORRELATION OF MAP UNITS



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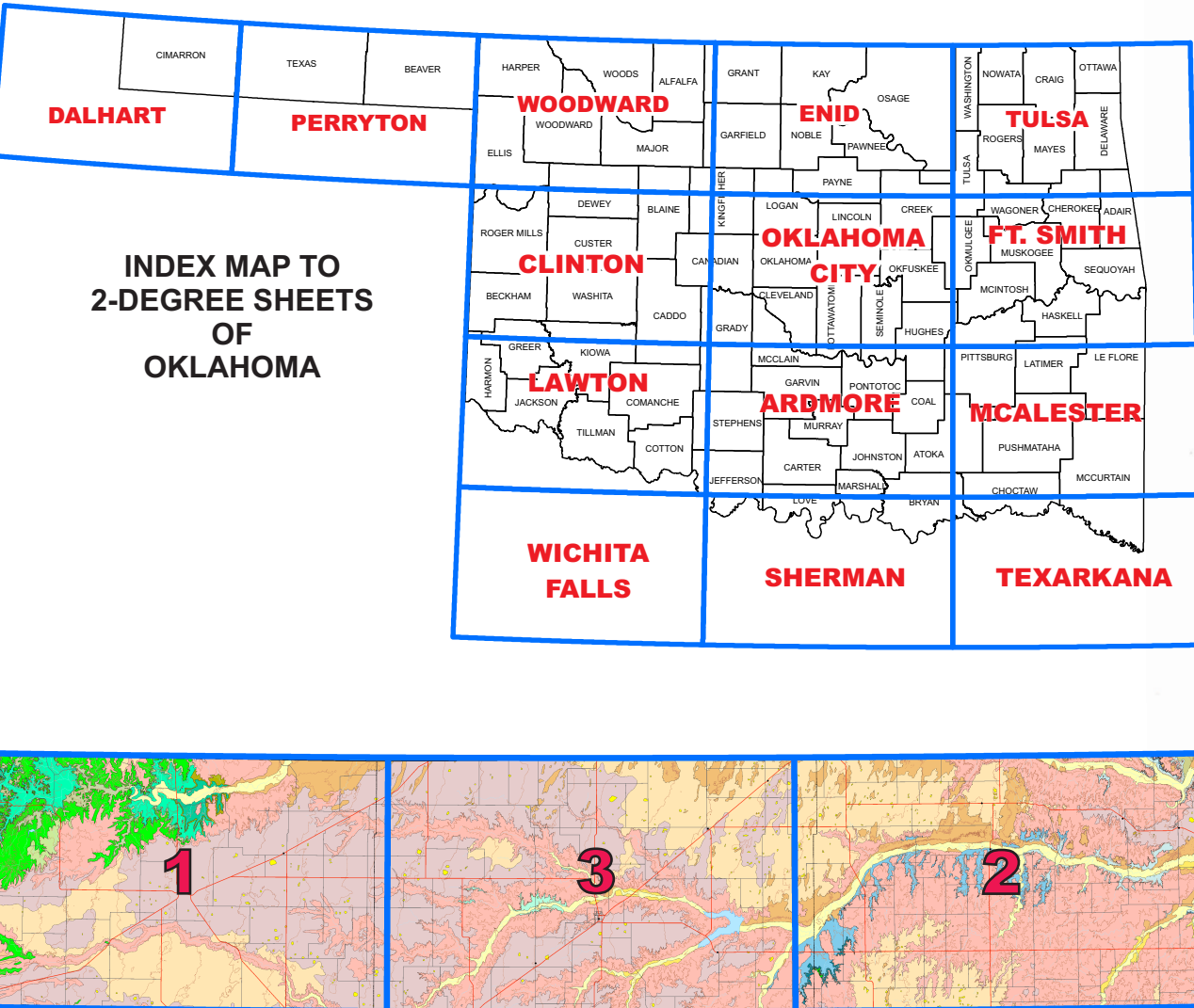
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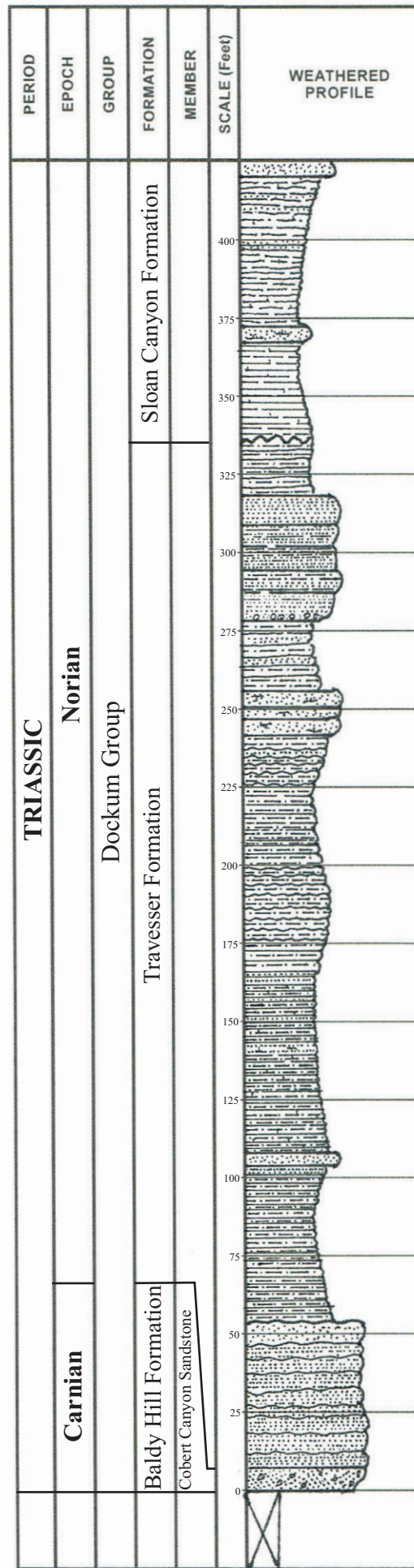
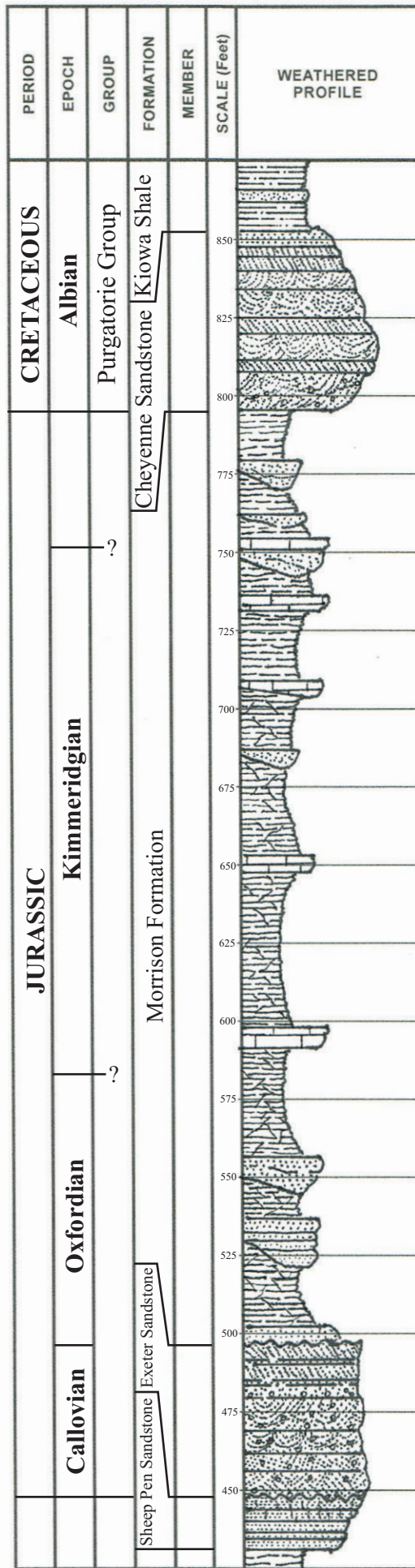
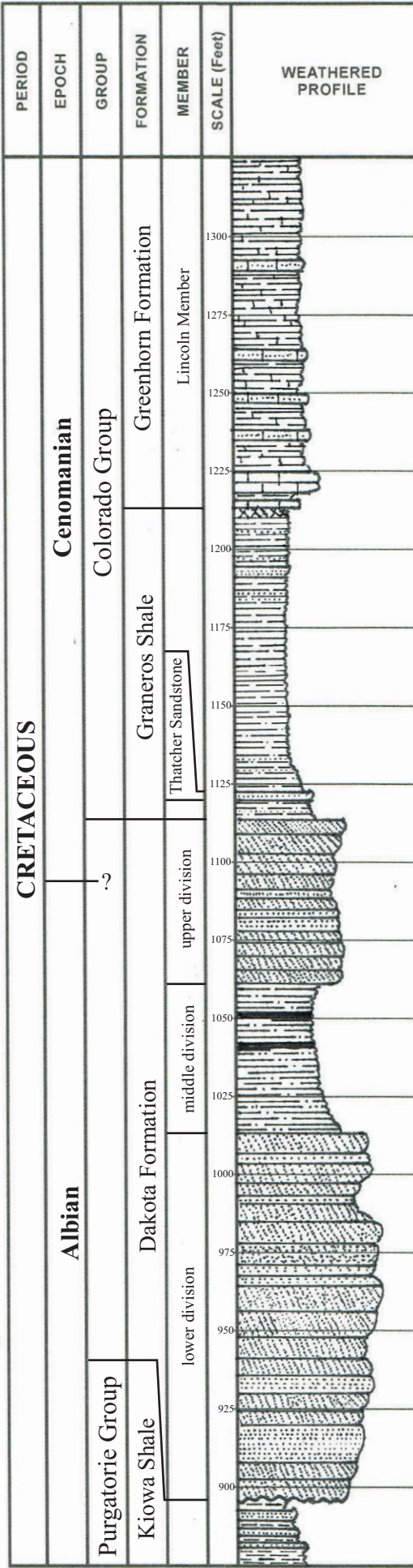
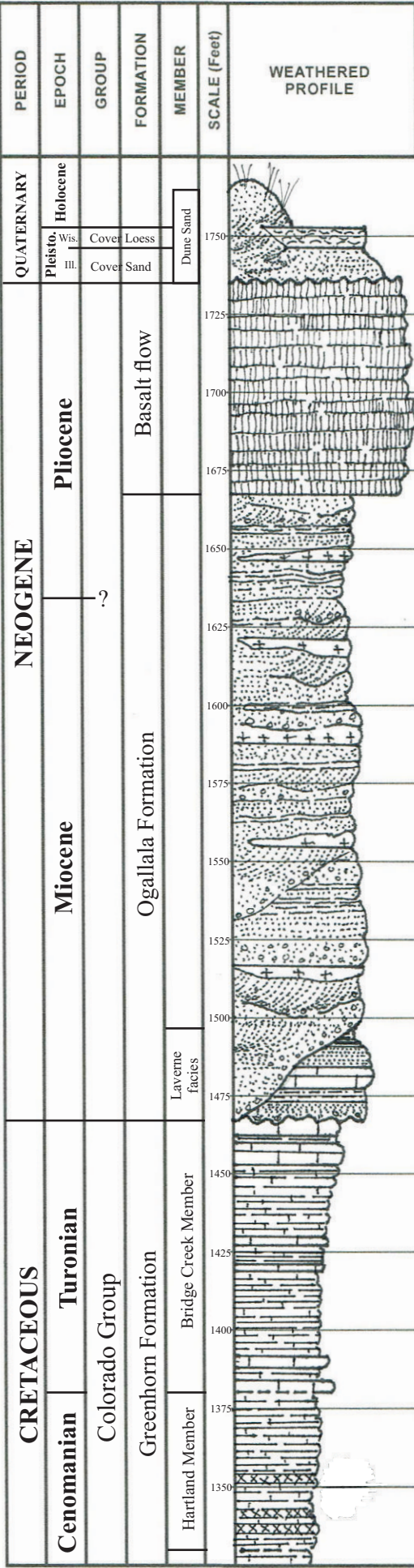
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Weathered profiles of the stratigraphic interval exposed around Black Mesa, located in the far northwest corner of Cimarron County.

## GEOLOGIC MAP OF THE OKLAHOMA PORTION OF THE DALHART 2-DEGREE SHEET AND PERRYTON 2-DEGREE SHEET, BEAVER, CIMARRON, ELLIS, HARPER, AND TEXAS COUNTIES, OKLAHOMA