KANSAS GEOLOGICAL SURVEY
OPEN-FILE REPORT 2003-20

FIELD GEOLOGY MAPS
CRAWFORD COUNTY, KANSAS
Preliminary Field Geology Maps for
Arma, Cherokee, Liberal, Radley
1:24,000-scale quadrangles

By

R. R. West
R. S. Sawin

Disclaimer

The Kansas Geological Survey does not guarantee this document to be free from errors or inaccuracies and disclaims any responsibility or liability for interpretations based on data used in the production of this document or decisions based thereon. This report is intended to make results of research available at the earliest possible date, but is not intended to constitute final or formal publications.

Kansas Geological Survey
1930 Constant Avenue
University of Kansas
Lawrence, KS 66047-3726

FIELD GEOLOGY MAPS
CRAWFORD COUNTY, KANSAS

Preliminary Field Geology Maps for

ARMA
CHEROKEE
LIBERAL
RADLEY

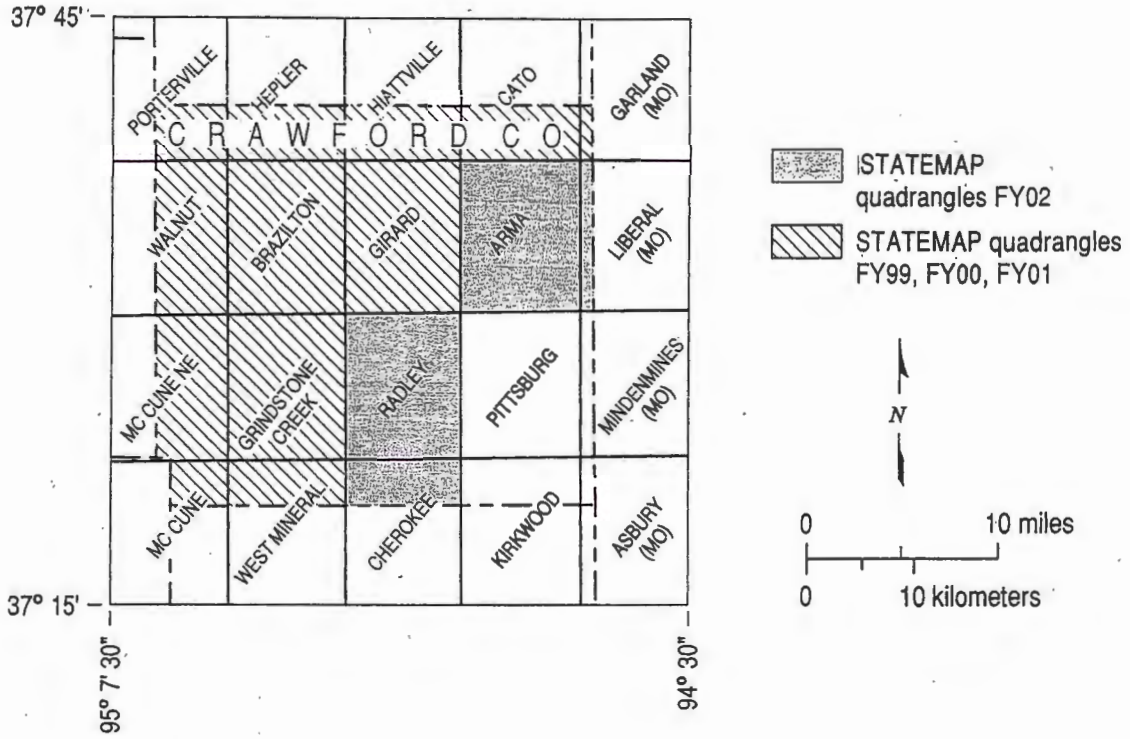
1:24,000-Scale Quadrangles

Ronald R. West and Robert S. Sawin

Kansas Geological Survey
Open-file Report 2003- 20

CRAWFORD COUNTY, KANSAS

INDEX TO 1:24,000-SCALE MAPS



Copies of the field maps are open-filed at the Kansas Geological Survey, Lawrence, Kansas.

LEGEND

IT IS IMPORTANT TO NOTE THAT THESE MAPS INDICATE LITHOSTRATIGRAPHIC UNITS ONLY. NO TEMPORAL, GENETIC, OR RELATED DEPOSITIONAL ASPECTS ARE MEANT OR IMPLIED.

The stratigraphic sequence in this report extends from the upper part of the Cabaniss Formation (Cherokee Group) to the Pawnee Limestone (Marmaton Group). Overlying these Pennsylvanian rocks are Quaternary alluvium and terrace deposits.

Terminology on the left side of the Composite Lithologic Sequence is that of Zeller (1968), with one exception. The Holdenville Shale has been divided into the Memorial Shale below and the Lost Branch Formation above (Heckel, 1991). On the right side of the graphic column are the units shown on the maps.

The following lithostratigrahic contacts, from lowest to highest, were mapped in the Crawford County quadrangles of this report:

- Top of Verdigris Limestone Member (Cabaniss Formation) = v
- Top of Cabaniss Formation/base of Fort Scott Limestone
- Top of Fort Scott Limestone/base of Labette Shale
- Top of Anna Shale Member/base of Myrick Station Limestone Member*

* Stratigraphically the Anna Shale Member is recognized as the basal member of the Pawnee Limestone, however, our studies do not support the mappability of the base of the Anna Shale Member (Pawnee Limestone)/ top of the Labette Shale. We found the thickness of the Anna to be variable, sometimes absent, and often underlain by a black to very dark gray mudrock/shale of the uppermost Labette, making a reliable (i.e. mappable) contact questionable. Since formations are defined by the North American Code of Stratigraphic Nomenclature as mappable lithostratigraphic units, we would propose that the Pawnee Limestone be defined to exclude the Anna and that the Anna be included in the Labette Shale.

Qal = Alluvial and terrace deposits were mapped using the Soil Survey of Crawford County, Kansas (Rott, 1973). Holocene alluvial deposits five feet or greater in thickness were included in this unit. Alluvial deposits include sand, gravel, silt, and clay that was deposited on floodplains by streams, creeks, and rivers.

Pits and quarries:

Ptc = coal strip pit
Ptl = limestone quarry
Ptss = sandstone quarry
Ptcl = clay pit
Ptg - gravel pit

Coals:

W-P = Wier-Pittsburg coal
Mi =Mineral coal
Fl = Fleming coal
Cr = Croweburg coal
Be = Bevier coal
Mu = Mulky coal
UCM = underground coal mine shaft, tailings, etc. (from Abernathy, 1954)

REFERENCES

Abernathy, G. E., 1944, Mined Areas of the Weir-Pittsburg Coal Bed: Kansas Geological Survey Bulletin 52, part 5, p 213-228.

Abernathy, G. E., 1946, Strip-mined Areas in the Southeastern Kansas Coal field: Kansas Geological Survey Bulletin 64, part 4, p.125-144.

Howe, W. B., 1956, Stratigraphy of Pre-Marmaton Desmoinesian (Cherokee) Rocks in Southeastern Kansas: Kansas Geological Survey Bulletin 123, 132 p.

Jewett, J. M., 1945, Stratigraphy of the Marmaton Group, Pennsylvanian, in Kansas: Kansas Geological Survey Bulletin 58, 148 p.

Heckel, P. H., 1991, Lost Branch Formation and Revision of Upper Desmoinesian Stratigraphy along Midcontinent Pennsylvanian Outcrop Belt: Kansas Geological Survey Geology Series 4, 67 p.

Howe, W. B., 1956, Stratigraphy of Pre-Marmaton Desmoinesian (Cherokee) Rocks in Southeastern Kansas: Kansas Geological Survey Bulletin 123, 132 p.

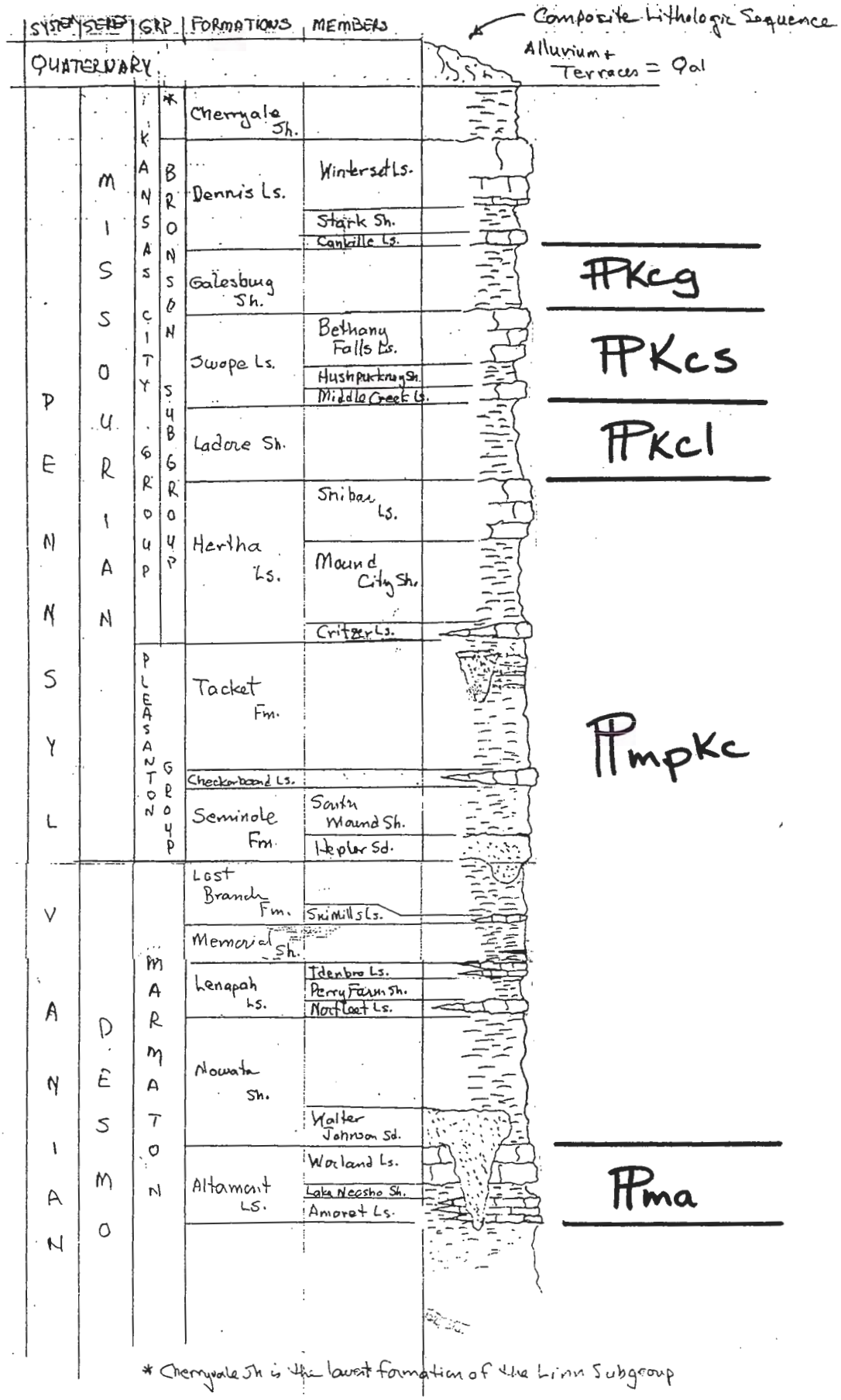
Pierce, W. G. and W. H. Courtier, 1937 (1938), Geology and Coal resources of the Southeastern Kansas Coal Field in Crawford, Cherokee, and Labette Counties: Kansas Geological Survey Bulletin 24, 122 p.

Pierce, W. G. and W. H. Courtier, 1935, Englevale Channel Sandstone of Pennsylvanian Age, Southeastern Kansas: Bulletin of the American Association of Petroleum Geologists, vol. 19, no. 7, p. 1061-1068.

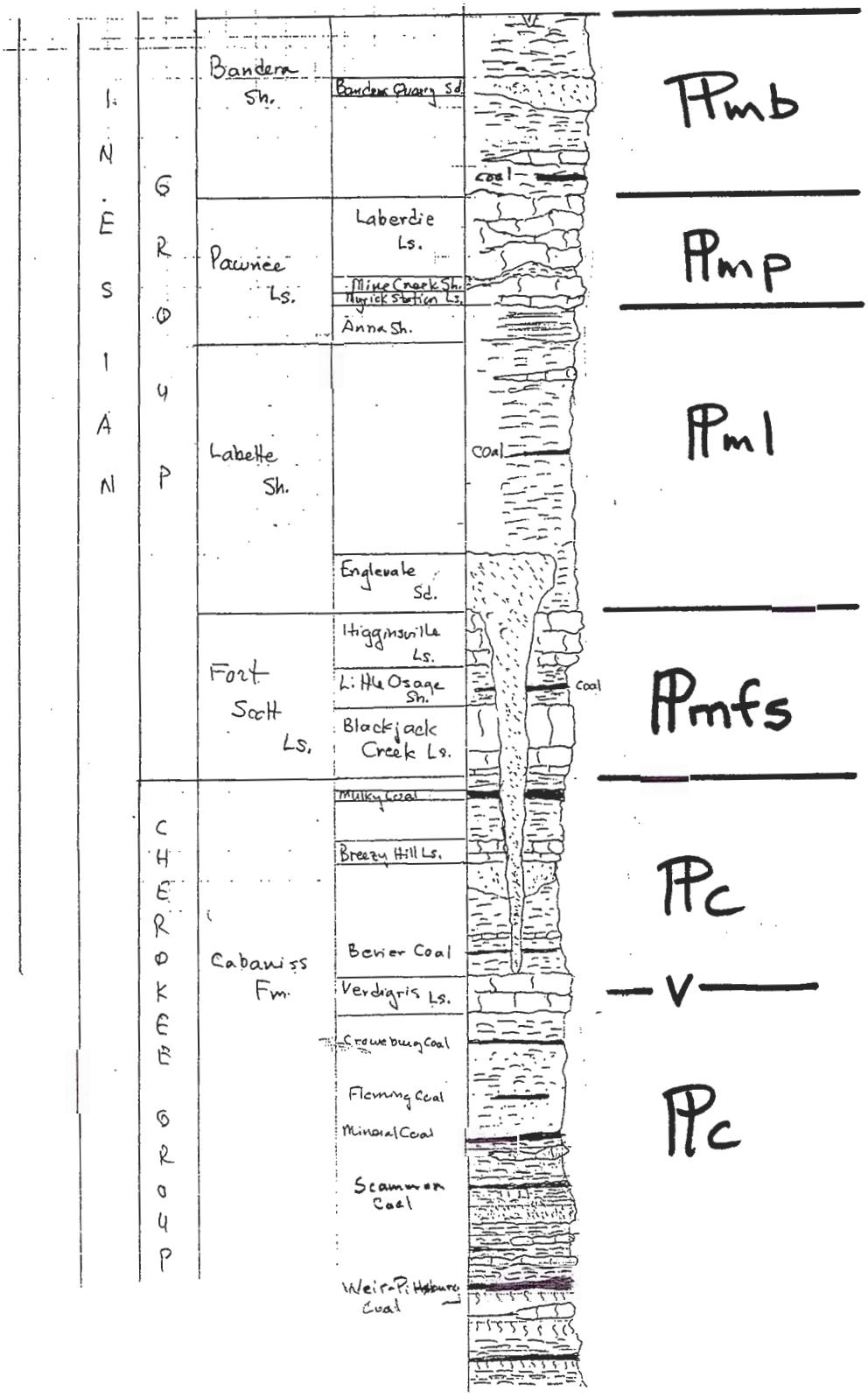
Roth, S. M., 1991, Regional Stratigraphic Analysis of the Blackjack Creek Limestone (Desmoinesian, Middle Pennsylvanian) in Southeast Kansas and Northeast Oklahoma: unpublished Master's Thesis, Kansas State University; Kansas Geological Survey Open-File Report 91-50, 243 p.

Rott, D. E., Swanson, D.W., and Jorgensen, G.N., Jr., 1973, Soil Survey of Crawford County, Kansas: U.S. Department of Agriculture, Soil Conservation Service and Kansas Agricultural Experiment Station, 50 p., 48 maps.

Zeller, D. N., 1968, The Stratigraphic Succession in Kansas: Kansas Geological Survey Bulletin 189, 81 p.



* Cherryvale Sh is the lowest formation of the Linn Subgroup


INSEAN
GROUP
CHEROKEE GROUP
Bandera Sh.
Bandera Quarry Sd.
Coal
Pawnee Ls.
Laberdie Ls.
Mine Creek Sh.
Nyrick Station Ls.
Anna Sh.
Labette Sh.
Coal
Englevale Sd.
Fort Scott Ls.
Higginsville Ls.
Little Osage Sh.
Coal
Blackjack Creek Ls.
Mulky Coal
Breezy Hill Ls.
Cabaniss Fm.
Bevier Coal
Verdigris Ls.
Crowe Burg Coal
Fleming Coal
Mineral Coal
Scammon Coal
Weir-Pittsburg Coal
PPmb
PPmp
PPml
PPmfs
PPc
V
PPc

ARMA QUADRANGLE

EXPLANATION - CONTROL POINTS FOR THE CRAWFORD COUNTY MAP ARE IDENTIFIED AS FOLLOWS:

(1) NUMBERS PRECEEDED BY THE LETTER **C** REFER TO MEASURED SECTIONS IN THE CRAWFORD COUNTY, KANSAS BOOKS IN THE FILES OF THE KANSAS GEOLOGICAL SURVEY, NUMBERING BEGAN AT FIRST SECTION IN THE BOOK AND PRECEEDED SEQUENTIALLY TO THE LAST SECTION;

(2) NUMBERS PRECEEDED BY THE LETTER **L** REFER TO SITES FROM WHICH I HAVE COLLECTED GEOLOGICAL SPECIMENS; AND

(3) NUMBERS PRECEEDED BY THE LETTERS **CR** ARE SITES EXAMINED AND EVALUATED SPECIFICALLY FOR THIS MAPPING PROJECT.

OBVIOUSLY, ANY GIVEN SITE MAY BE IDENTIFIED BY ANY ONE, TWO, OR ALL THREE OF THESE DESIGNATIONS.

C-22 = SEE DATA FOR GIRARD QUAD.

C-23 = SEE DATA FOR GIRARD QUAD.

C-24 = Exposure at small isolated hill about 0.75 mile West of Mulberry, Kansas of 16" coal (Mineral?) with overlying black, fissile shale, thin, fossiliferous limestone (caprock) followed by more black, fissile shale with variegated mudrock and then 5+' of sandstone with 3+' of red clay soil; SW1/4, NE1/4, Sec. 35, T.28S., R.25E., Crawford Co., Kansas; measured and described by W. Howe 10 June 1948; based on present topography the small isolated hill is near the Center SE1/4, NE1/4, Sec. 35, T.28S., R.25E.

C-25 = Exposure in strip pit in the corner just northeast of main junction at Croweburg, Kansas of coal (Croweburg) to the lower beds of Verdigris Limestone above, suggested as the type section of Croweburg coal; SW cor. Sec. 34, T.28S., R.25E., Crawford Co., Kansas; measured and described by W. Howe 10 June 1948.

C-27 = C-28 = C-29 = Exposure in abandoned strip pit about 2.5 miles North of Mulberry, Kansas of a thick coal below the Tebo coal to beds associated with the Verdigris above the Croweburg coal, one of the most complete section available at the time; NE1/4, NW1/4, Sec. 24, T.28S., R.25E., Crawford Co., Kansas; measured and described by W. Howe 11 June 1948; on or near the Arma/Liberal quadrangle line.

C-47 = Exposure in active strip pit of Mackie-Clemens Co. approximately 4 miles North of main junction at Frontenac, Kansas of thin limestone (probably upper part of Verdigris) below coal (Bevier) into a claystone in the "Lagonda"; SW1/4, SW1/4, Sec. 16, T.29S., R.25E., Crawford Co., Kansas; measured and described by W. Howe 10 June 1948.

C-48 = Exposure in active (at this date) strip pit of Mackie-Clemens South of Breezy Hill area of Verdigris Limestone through coal (Bevier) into a claystones in the "Lagonda"; NE1/4, NE1/4, Sec. 15, T. 29S., R.25E., Crawford Co., Kansas; measured and describe by W. Howe 17 June 1948.

C-49 = Exposure in abandoned strip pit on West side of road of coal (Mineral)

upward through sandstone, mudrock, a thinner coal bed, black, fissile shales, thin bedded, fossiliferous limestones, channel-like sandstone, claystone, coal, to thick (3 to 4 feet) of soil; SE1/4, NW1/4, Sec. 14, T.29S., R.25E., Crawford Co., Kansas; measured and describe by W. Howe 27 June 1948.

C-50 = Exposure in abandoned strip pit on hilltop of coal (Mulky) overlain by Excello shale and 10 feet of Blackjack Creek Limestone with numerous flat (tabular) chaetetid masses; SE1/4, NE1/4, Sec. 10, T.29S., R.25E., Crawford Co., Kansas; measured and describe by W. Howe 17 June 1948; Howe, 1956 Sec. 77

C-79 = Exposure in highwall of Clemens Mine 22 extending from coal (Mineral) at base through Fleming, Croweburg, and Bevier with clay soil at top; SW1/4, SW1/4, NW1/4, Sec. 15, T.28S., R.25E., Crawford Co., Kansas; measured and described by L. Brady 24 March 1976.

L-703 = SEE CR-543

L-704 = SEE CR-523 and CR-523A

L-706 = Exposures in abandoned quarries (Cukjati Quarries) of Higginsville Limestone with chaetetids, also KGS core documented in Roth, 1991 MS thesis that began in the Higginsville Limestone at a surface elevation of 968' and extended into the Breezy Hill Limestone, the Blackjack Creek Limestone contains low domical to tabular chaetetids, based on this core the base of the Fort Scott (Blackjack Creek) Limestone is at @ 943', estimated top of Fort Scott (Higginsville) Limestone at 975' ; NW1/4, NW1/4, Sec. 25, T.28S., R.24E., Crawford Co., Kansas

L-986 = Exposure from "Lagonda" into Fort Scott (Higginsville) Limestone in roadcuts on both sides of U.S. Hwy 69, base of Fort Scott (Blackjack Creek) Limestone at 945' based on KDOT profile, domical chaetetids in Blackjack Creek Limestone; SE1/4, SE1/4, Sec. 19, T.28S., R.25E., Crawford Co., Kansas.

CR-519 = Sandstone exposed in road at 972', possibly the Englevale, and extends East from this point for 0.6 mile near CR-546; above sandstone is a black, platy shale with a thin, fossiliferous (numerous shells of *Derbyia*), soft black limestone containing pieces of black mudrock/shale; Pierce & Courtier (1935) reported the Englevale Sandstone rests on 4.0' of Blackjack Creek Limestone at this locality; Center of North lineNW1/4, NE1/4, Sec. 24, T.28S., R.24E., Crawford Co., Kansas.

CR-520 = Limestone float in field North of road, limestone is thin and resembles the lower bed of the Myrick Station Limestone; approximately 250' West of Center of South line SE1/4, SW1/4, Sec. 13, T.28S., R.24E., Crawford Co., Kansas.

CR-521 = Limestone in place at 930' under bridge, possibly the Higginsville Limestone; approximately 200' West of Center of South line SW1/4, SE1/4, Sec. 14, T.28S., R.24E., Crawford Co., Kansas.

CR-522 = Exposure of mudrock and several thin sandy limestones to calcareous

sandstones, limestones occur as float in field East of road and appear similar to those at CR-520; along West line of NW1/4, SW1/4, SW1/4, Sec. 13, T.28S., R.24E., Crawford Co., Kansas.

CR-523 = L-704 = Base of Fort Scott (Blackjack Creek) Limestone exposed at 915' in road with Excello shale Mulky coal, and "Lagonda" exposed below into creek, Blackjack Creek in road contains domical chaetetid masses 1 to 2 dm. in diameter; near Center of South line SE1/4, SE1/4, Sec. 11, T.28S., R.24E., Crawford Co., Kansas.

CR-523A = Blackjack Creek Limestone on South side of road and West side of stream contains large domical chaetetid masses > 3 dm. across, collected two pieces; approximately 100' West of CR-523 and approximately 100' West of Center of North line NE1/4, NE1/4, Sec. 14, T.28S., R.24E., Crawford Co., Kansas.

CR-524 = Higginsville Limestone exposed in road and in pond bank North of road at @ 928'; approximately 250' West of Center of South line SE1/4, Sec. 11, T.28S., R.24E., Crawford Co., Kansas.

CR-525 = Base of Fort Scott (Blackjack Creek) Limestone at 915' with Excello shale exposed below at Rocky Point Boat Ramp on Bone Creel Lake, chaetetid masses in Blackjack Creek Limestone 5 dm wide and 4 dm. high (digital photos 100-0364 to 100-0367); approximately 150' North of Center of West line Se1/4, Sec. 11, T.28S., R.24E., Crawford Co., Kansas.

CR-526 = Exposure of Higginsville Limestone and Little Osage Shale along both sides of road below about 932' with base of Fort Scott (Blackjack Creek) Limestone exposed on both sides of road at 900' with Excello shale exposed below' Blackjack Creek Limestone contains very large (6 to 7 by 8 dm.) smooth domical chaetetid masses, some with multithecoporoid corals attached; from approximately 1000' East and 750' South of NW cor. Sec. 13 to near Center of N1/2 of NW1/4, Sec. 13, T.28S., R.24E., Crawford Co., Kansas.

CR-527 = Higginsville Limestone in field East of road at 940'; approximately 200' West of Center of North line, Sec. 13, T.28S., R.24E., Crawford Co., Kansas.

CR-528 = Base of Pawnee (Myrick Station) Limestone exposed in road at @ 1020' with Anna Shale in place (dug out) below in road ditch on East side of road; approximately 200' South of Center of West line, Sec. 24, T.28S., R.24E., Crawford Co., Kansas.

CR-529 = Base of Pawnee (Myrick Station) Limestone with Anna Shale below in road ditch on North side of road (not a very good point, but usable); approximately 100' West of Center of South line SE1/4, SE1/4, Sec. 23, T.28S., R.24E., Crawford Co., Kansas.

CR-530 = Sandstone in road at 940', Englevale; approximately 250' South of Center of East line SE1/4, Sec. 13, T.28S., R.24E., Crawford Co., Kansas.

CR-531 = Base of Fort Scott (Blackjack Creek) Limestone at @920' with Excello

shale exposed below, Blackjack Creek Limestone with smooth domical chaetetid masses with a very wide base (see sketch in field notes, collected edge of wide base); approximately 250' North of Center of East line SE1/4, Sec. 13, T.28S., R.24E., Crawford Co., Kansas.

CR-532 = Base of Fort Scott (Blackjack Creek) Limestone exposed at 920' with thin, poorly exposed Excello shale and top of Breezy Hill Limestone well exposed in road ditch on East side of road, tabular to domical chaetetids in Blackjack Creek Limestone; Center of West line, Sec. 18, T.28S., R.25E., Crawford Co., Kansas.

CR-533 = Sandstone in road at 910', sandstone in the "Lagonda"; approximately 800' North of Center of East line, Sec. 13, T.28S., R.24E., Crawford Co., Kansas.

CR-534 = Base of Fort Scott (Blackjack Creek) Limestone at 920' with Excello shale below exposed in road ditch on East side of road; approximately 900' South of NW cor., Sec. 18, T.28S., R.25E., Crawford Co., Kansas.

CR-535 = Base of Fort Scott (Blackjack Creek) Limestone at 920' with Excello shale below exposed in road ditch on East side of road near NW cor., Sec. 18, T.28S., R.25E., Crawford Co., Kansas.

CR-536 = Sandstone and siltstone exposed in road at 910' like at CR-533 with Excello shale above; approximately 100' North of Center of East line SE1/4, Sec. 12, T.28S., R.24E., Crawford Co., Kansas.

CR-537 = Mudrock in "Lagonda" exposed in stream bank East of road with thin, dark, fossiliferous limestone exposed in stream bed; Center of West line SW1/4, NW1/4, Sec. 7, T.28S./, R.25E., Crawford Co., Kansas.

CR-538 = "Lagonda" exposed on both sides of U.S. Hwy 69; near Center of West line, SW1/4, SW1/4, NW1/4, Sec. 8, T.28S., R.25E., Crawford Co., Kansas.

CR-539 = "Lagonda" with sandstone through the Breezy Hill Limestone, Mulky coal, and Excello shale into the Blackjack Creek Limestone in road cut exposures on both sides of U. S. Hwy 69, base of Fort Scott (Blackjack Creek) Limestone at 941' based on KDOT profile', tabular to small and VERY large (several dm. high and wide) chaetetid masses in upper Blackjack Creek, collected two pieces of tabular forms; near Center of East line SE1/4, Sec. 7, T.28S., R.25E., Crawford Co., Kansas.

CR-540 = Base of Fort Scott (Blackjack Creek) Limestone at 970' with Excello shale and Breezy Hill Limestone below in road ditch on West side of road, large domical chaetetid masses close to 1 m. across in Blackjack Creek Limestone; approximately 250' South of Center of East line of Sec. 8, T.28S., R.25E., Crawford Co., Kansas.

CR-541 = Sandstone in road at 960'; approximately 200' West of Center of South line SE1/4, SE1/4, Sec. 8, T.28S., R.25E., Crawford Co., Kansas.

CR-542 = Base of Fort Scott (Blackjack Creek) Limestone at @ 974' in road with

Excello shale and Breezy Hill Limestone exposed below in road ditch on North side of road; Center of South line, SE1/4, Sec. 8, T.28S., R.25E., Crawford Co., Kansas.

CR-543 = L-703 = Base of Fort Scott (Blackjack Creek) Limestone at 955' in road and road ditches on both sides of North-South drainage with Excello shale and Breezy Hill Limestone exposed below, good point, domical chaetetids in upper Blackjack Creek Limestone; at Center of South line of SW1/4 and Center of South line of SE1/4, SW1/4, SW1/4, Sec. 8, T.28S., R.25E., Crawford Co., Kansas.

CR-544 = Limestone (Higginsville) in road ditch on South side of road and on East side of U.S. Hwy 69 at @ 965', contains chaetetids similar to those in Blackjack Creek Limestone; NE cor., Sec. 19, T.28S., R.25E., Crawford Co., Kansas.

CR-545 = Base of Higginsville Limestone at @ 953' along U.S. Hwy 69, not a very good point; near Center of East line NE1/4, Sec. 19, T.28S., R.25E., Crawford Co., Kansas.

CR-545A = Base of Fort Scott (Blackjack Creek) Limestone at 941' based on KDOT profile; along U. s. Hwy 69 300' South of CR-545; 1300' South of NW cor. Sec. 20, T.28S., R.25E., Crawford Co., Kansas.

CR-546 = Base of Fort Scott (Blackjack Creek) Limestone at 940' in road with Excello exposed below and an old quarry where the Mulky coal was removed is North of road, VERY large chaetetid masses in Blackjack Creek Limestone; near Center of South line SW1/4, Sec. 18, T.28S., R.25E., Crawford Co., Kansas.

CR-547 = Sandstone and siltstone in road ditch East of road; approximately 100' North of Center of West line SW1/4, Sec. 19, T.28S., R.25E., Crawford Co., Kansas.

CR-548 = Base of Fort Scott (Blackjack Creek) Limestone at @ 930' on both sides of stream, large domical chaetetid masses in Blackjack Creek Limestone exposed in road and in spoil piles on both sides of broad, no Excello shale seen, Mulky coal was mined here; along North half of West line of SW1/4, SW1/4, SW1/4, Sec. 19, T.28S., R.25E., Crawford Co., Kansas.

CR-549 = Limestone in road and fields on both sides of road, probably Higginsville, but no contact observed; approximately 250' North of Center of West line SW1/4, Sec. 30, T.28S., R.25E., Crawford Co., Kansas.

CR-550 = Active quarry, the Englevale Quarry of the Mulberry Limestone Quarry Co., Mulberry, Kansas; base of Fort Scott (Blackjack Creek) Limestone in floor of quarry at @ 960' at top of Excello shale, Blackjack Creek Limestone is 10 to 12 feet thick with abundant chaetetid masses, tabular to large and small domical forms in upper part of unit, collected 2 samples; covers most of the area bounded by the S1/2, NW1/4, and N1/2, SW1/4, in SW1/4, Sec. 25, T.28S., R.24E., Crawford Co., Kansas.

CR-551 = Base of Fort Scott (Blackjack Creek) Limestone at 960' based on KDOT

profile with Excello shale exposed below along both sides of U.S. Hwy 69; Center of East line, Sec.30, T.28S., R.25E., Crawford Co., Kansas.

CR-552 = Base of Fort Scott (Blackjack Creek) Limestone at 963' based on KDOT profile with Excello shale exposed below along both sides of U.S. Hwy 69; SE cor., Sec.30, T.28S., R.25E., Crawford Co., Kansas.

CR-552A = Cabaniss/Labette contact (Englevale Sandstone) at 968' based on KDOT profile; along U. S. Hwy 69; near Center West line SW1/4, NW1/4, Sec. 32, T.28S., R.25E., Crawford Co., Kansas.

CR-553 = Base of Fort Scott (Blackjack Creek) Limestone at @ 960' with no clear contact, chaetetid masses as typical of Blackjack Creek Limestone in this area; approximately 200' East of SE cor., Sec.28, T.28S., R.25E., Crawford Co., Kansas.

CR-553A = Exposure in strip pit being reclaimed at the time the sequence was measured and described from the Croweburg coal to the mudrock above the Bevier coal; near SW cor. Sec. 27, T.28S., R.25E., Crawford Co., Kansas; measured and described by R. West with USGS colleagues (B. Cecil & F. Dulong) 7 June 1993.

CR-554 = Sandstone in road; near Center of South line, Sec. 27, T.28S., R.25E., Crawford Co., Kansas.

CR-555 = Mulberry Limestone Quarry, 10 to 12 feet of Blackjack Creek Limestone with Excello shale in quarry floor, base of Fort Scott (Blackjack Creek) Limestone estimate at 1000' in roadcut just South of entrance to quarry; near Center of East line NE1/4, SE1/4, SE1/4, Sec. 2, T.29S., R.,25E., Crawford Co., Kansas.

CR-555A = Base of Fort Scott (Blackjack Creek) Limestone at @ 1000' with Excello shale poorly exposed below along both sides of road; Center of East line, Sec.30, T.28S., R.25E., Crawford Co., Kansas.

CR-556 = Base of Fort Scott (Blackjack Creek) Limestone at @ 1000' with Excello shale exposed below along both sides of road; approximately 400' West of SE cor., Sec. 2, T.29S., R.25E., Crawford Co., Kansas.

CR-557 = Base of Fort Scott (Blackjack Creek) Limestone at @ 1012' with Excello shale exposed below along both sides of road, poorly exposed; Center of South line, SW1/4, NE1/4, Sec.1, T.29S., R.25E., Crawford Co., Kansas.

CR-558 = Sandstone in road; near Center of East line, SE1/4, SE1/4, Sec. 11, T.29S., R.25E., Crawford Co., Kansas.

CR-559 = Sandstone in road; near Center of East line, Sec. 14, T.29S., R.25E., Crawford Co., Kansas.

CR-560 = Base of Fort Scott (Blackjack Creek) Limestone at @ 1010' with Excello shale poorly exposed below along East side of road; approximately 400' South of Center of West line, Sec. 11, T.29S., R.25E., Crawford Co., Kansas; just South of C-50, Howe, 1956, Sec. 77.

CR-560A = Base of Breezy Hill Limestone at approximately 1000', thick, massive limestone beds that look like Blackjack Creek Limestone; according to KGS Bulletin 24 the Breezy Hill is up to 8' thick in the area with 4 to 8 feet of shale between the top of the Breezy Hill and the base of the Fort Scott (Blackjack Creek) Limestone; NW1/4, NW1/4, Sec. 11, T.29S., R.25E., Crawford Co., Kansas.

CR-561 = Exposure of black, platy, fissile shale with limestone blocks above on South side of road, limestone looks like the basal bed of Blackjack Creek Limestone at CR-511; approximately 200' West and 150' South of Center of North line, NW1/4, SE1/4, Sec. 9, T.29S., R.25E., Crawford Co., Kansas.

CR-562 = Base of Fort Scott (Blackjack Creek) Limestone inferred at 1020' in road, underlying unit not seen; approximately 300' West of Center, Sec. 9, T.29S., R.25E., Crawford Co., Kansas.

CR-563 = Base of Fort Scott (Blackjack Creek) Limestone at 1000' in road with Excello shale exposed below, typical Blackjack Creek Limestone chaetetid masses in limestone; approximately 400' East of Center of North line, Sec. 9, T.29S., R.25E., Crawford Co., Kansas.

CR-564 = Limestone in road ditch on East side of road; approximately 500' South of Center of West line, Sec. 4, T.29S., R.25E., Crawford Co., Kansas.

CR-565 = Limestone-shale contact exposed in road, Base of Fort Scott (Blackjack Creek) Limestone at 975' with limestone blocks in fields on both sides of road; approximately 600' South of NW cor. Sec. 4, T.29S., R.25E., Crawford Co., Kansas.

CR-566 = Sandstone, siltstone, and mudrock in roadcut on North side of road at 970'; approximately 200' East of Center of South line SW1/4, Sec. 33, T.28S., R.25E., Crawford Co., Kansas.

CR-567 = Base of Fort Scott (Blackjack Creek) Limestone at 975' with limestone exposed in road, but underlying unit not seen; approximately 200' East of Center of South line SE1/4, Sec. 32, T.28S., R.25E., Crawford Co., Kansas.

CR-567A = Excavation in field that appears to exposed a limestone (Blackjack Creek) and an underlying black shale (Excello); approximately 500' South and 200' East of Center SE1/4, Sec. 32, T.28S., R.25E., Crawford Co., Kansas.

CR-568 = Sandstone in road with limestone above, possibly Breezy Hill; approximately 400' South of NW cor., Sec. 33, T.28S., R.25E., Crawford Co., Kansas.

CR-569 = Base of Fort Scott (Blackjack Creek) Limestone at 974' with very thin Excello shale and Breezy Hill Limestone below in road, latter two units underlain by thin, platy, sandy, silty beds in road ditch on North side of road; Center of South line, Sec. 9, T.28S., R.25E., Crawford Co., Kansas.

CR-570 = Estimated top of Verdigris Limestone at 895' exposed in West face of two old strip pits on both sides of East-West road; pit on North side of

road is approximately 800' East of Center of South line, Sec. 9, T.28S., R.25E., Crawford Co., Kansas (CR-569).

CR-571 = Three or possibly four thin limestone beds separated by black shales/mudrocks well exposed in West face of old strip pit South of road (possibly Verdigris Limestone, see sketch in field notes); estimated top of Verdigris Limestone at 890'; just East of the Center of N1/2, NE1/4, Sec. 21, T.28S., R.25E., Crawford Co., Kansas.

CR-572 = Basal beds of Blackjack Creek Limestone in fields on both sides of road; near Center of South line, Sec. 17, T.28S., R.25E., Crawford Co., Kansas.

CR-573 = Sandstone in road; near Center of South line, SE1/4, Sec. 23, T.28S., R.25E., Crawford Co., Kansas.

CR-574 = Sandstone in road; approximately 200' West of SE cor., Sec.22, T.28S., R.25E., Crawford Co., Kansas.

CR-575 = Sandstone in road; approximately 200' North of Center of N1/2, NE1/4, Sec. 27, T.28S., R.25E., Crawford Co., Kansas.

CHEROKEE QUADRANGLE

EXPLANATION - CONTROL POINTS FOR THE CRAWFORD COUNTY MAP ARE IDENTIFIED AS FOLLOWS:

(1) NUMBERS PRECEEDED BY THE LETTER **C** REFER TO MEASURED SECTIONS IN THE CRAWFORD COUNTY, KANSAS BOOKS IN THE FILES OF THE KANSAS GEOLOGICAL SURVEY, NUMBERING BEGAN AT FIRST SECTION IN THE BOOK AND PRECEEDED SEQUENTIALLY TO THE LAST SECTION;

(2) NUMBERS PRECEEDED BY THE LETTER **L** REFER TO SITES FROM WHICH I HAVE COLLECTED GEOLOGICAL SPECIMENS; AND

(3) NUMBERS PRECEEDED BY THE LETTERS **CR** ARE SITES EXAMINED AND EVALUATED SPECIFICALLY FOR THIS MAPPING PROJECT.

OBVIOUSLY, ANY GIVEN SITE MAY BE IDENTIFIED BY ANY ONE, TWO, OR ALL THREE OF THESE DESIGNATIONS.

C-73 = Exposure in Sterling Coal Company pit just North of Scammon, Kansas from Mineral coal to claystone above Fleming coal; S1/2, SE1/4, SW1/4, Sec. 30., T.31S., R.24E., Cherokee Co., Kansas; measured and described by W. Howe 14 July 1948

C-74 = Exposure in Chero-Ka Coal Company pit of Fleming coal through 8 to 10 feet of black, platy, fissile shale with had, black, dense, fossiliferous (marginiferid brachiopods)limestone concretions into a thick (6') sandstone; near Center SE1/4, SE1/4, Sec. 19, T.31S.,R.24E., Cherokee Co., Kansas; measured and describe by W. Howe 13 June 1950.

C-75 = Exposure in Barbero Coal Company pit of coal (W-P) and overlying mudrock; SW1/4, NW1/4, Sec. 14, T.31S., R.24E., Crawford Co., Kansas; measured and described by W. Howe 17 August 1948; probably the Mineral coal.

L-766 = Exposure in abandoned quarry of Blackjack Creek Limestone with tabular chaetetids, also KGS core documented in Roth, 1991 MS thesis that began in the Blackjack Creek Limestone at a surface elevation of 898' and extended into a laminated siltstone below the Breezy Hill Limestone, based on this core the base of the Fort Scott (Blackjack Creek) Limestone is at @ 892.5' ; NW1/4, SW1/4, NE1/4, Sec. 13, T.32S., R.21E., Cherokee Co., Kansas.

CR-366 = SEE WEST MINERAL QUAD.

CR-367 = Fort Scott Limestone, in place? in road; near Center of East line, NE1/4, SE1/4, NE1/4, Sec. 10, T.31S., R.23E., Crawford Co., Kansas.

CR-368 = Hard, dense, fossiliferous, dark gray fresh, weathers yellowish brown limestone less than one foot thick in ditch on North side of bridge on the East side of road, elevation about 900'; approximately 300 feet South of NW cor. Sec. 11, T.31S., R.23E., Crawford Co., Kansas.

CR-510 = Limestone float, possibly Blackjack Creek, in field South of road at 938'; near Center of North line, NE1/4, Sec. 15, T.31S., R.23E., Crawford Co., Kansas.

CR-511 = Two limestone beds separated by approx. 4.0' of largely covered mudrock, the upper one 2.5 dm thick and the lower one 3.5 dm thick (see sketch in field notes); both are hard, dense, dark gray to black and sparsely fossiliferous; below the lower one are several feet of dark gray to black, fossiliferous mudrock; elevation of the base of the lower one is 915', looks like the Verdigris Limestone, but the Verdigris should be 70 to 80 feet below the base of the Fort Scott, not 20 feet like here; exposure in road ditch on East side of road just South of stream approximately 100' North of Center of West line NW1/4, SW1/4, Sec. 1, T.31S., R.23E., Crawford Co., Kansas.

CR-511A = Float of Blackjack Creek Limestone in plowed field; SE1/4, SE1/4, Sec. 2, T.31S., R.23E., Crawford Co., Kansas.

CR-512 = Exposure similar to the lower mudrock and limestone at CR-511, with the limestone only 1.5 dm. thick and a grayish mudrock separating it from the underlying dark gray to black, platy mudrock (see sketch in field notes); elevation at base of limestone is 900'; exposed in stream bank on North side of road with the second limestone as seen at CR-511 is underwater under the bridge; approximately 1000' East of SW cor. Sec. 2, T.31S., R.23E., Crawford Co., Kansas.

CR-513 = Exposure of sequence similar to that at CR-512 in Wolf Creek West of Road, limestone is thin (1.5 dm. thick) and dense with a black shale in place in stream bed, elevation of base of limestone is approximately 890' near Center of East line SE1/4, NE1/4, Sec. 22, T.31S., R.23E., Cherokee Co., Kansas.

CR-514 = Exposure similar to that at CR-513 on both sides of road in drainage with large black limestone concretions below 4 dm. of dark gray to black, hard, dense limestone with concentrations of marginiferid brachiopods, elevation at the top of limestone bed is 890', probably the Verdigris Limestone; approximately 1500' East of NW cor. Sec. 23, T.31S., R.23E., Cherokee Co., Kansas.

CR-515 = Exposure similar to that at CR-514 on North side of U.S. Hwy 400 with top of thick massive limestone at 895', probably the Verdigris Limestone; near Center of South line of Sec. 14, T.31S., R.23E., Crawford Co., Kansas.

CR-516 = Limestone in place in road and in fields on both sides of road at 970'; near Center of W1/2, Sec. 7, T.31S., R.24E., Crawford Co., Kansas.

CR-517 = Limestone, similar to that at CR-516, in fields on both sides of road at approximately 970'; approximately 900' North of Center of Sec. 7, T.31S., R.24E., Crawford Co., Kansas.

CR-518 = Limestone like that at CR-368 in road at 950'; approximately 400' West of Center of South line, Sec. 1. T.31S., R.23E., Crawford Co., Kansas.

LIBERAL QUADRANGLE

EXPLANATION - CONTROL POINTS FOR THE CRAWFORD COUNTY MAP ARE IDENTIFIED AS FOLLOWS:

(1) NUMBERS PRECEEDED BY THE LETTER **C** REFER TO MEASURED SECTIONS IN THE CRAWFORD COUNTY, KANSAS BOOKS IN THE FILES OF THE KANSAS GEOLOGICAL SURVEY, NUMBERING BEGAN AT FIRST SECTION IN THE BOOK AND PRECEEDED SEQUENTIALLY TO THE LAST SECTION;

(2) NUMBERS PRECEEDED BY THE LETTER **L** REFER TO SITES FROM WHICH I HAVE COLLECTED GEOLOGICAL SPECIMENS; AND

(3) NUMBERS PRECEEDED BY THE LETTERS **CR** ARE SITES EXAMINED AND EVALUATED SPECIFICALLY FOR THIS MAPPING PROJECT.

OBVIOUSLY, ANY GIVEN SITE MAY BE IDENTIFIED BY ANY ONE, TWO, OR ALL THREE OF THESE DESIGNATIONS.

C-26 = Exposure from road ditch and railroad cut of gray mudrock through a thin coal (Tebo) and thin limestone to a mudrock siltstone totaling about 35.5'; near Center SW1/4, SE1/4, Sec. 25., T.28S., R.25E., Crawford Co., Kansas; measured and described by W. Howe, 28 July 1948.

C-27 = C-28 = C-29 = SEE DATA FOR ARMA QUAD.

RADLEY QUADRANGLE

EXPLANATION - CONTROL POINTS FOR THE CRAWFORD COUNTY MAP ARE IDENTIFIED AS FOLLOWS:

(1) NUMBERS PRECEEDED BY THE LETTER **C** REFER TO MEASURED SECTIONS IN THE CRAWFORD COUNTY, KANSAS BOOKS IN THE FILES OF THE KANSAS GEOLOGICAL SURVEY, NUMBERING BEGAN AT FIRST SECTION IN THE BOOK AND PRECEEDED SEQUENTIALLY TO THE LAST SECTION;

(2) NUMBERS PRECEEDED BY THE LETTER **L** REFER TO SITES FROM WHICH I HAVE COLLECTED GEOLOGICAL SPECIMENS; AND

(3) NUMBERS PRECEEDED BY THE LETTERS **CR** ARE SITES EXAMINED AND EVALUATED SPECIFICALLY FOR THIS MAPPING PROJECT.

OBVIOUSLY, ANY GIVEN SITE MAY BE IDENTIFIED BY ANY ONE, TWO, OR ALL THREE OF THESE DESIGNATIONS.

C-43 = Higginsville Limestone with black shale below in old quarry; near Center North line SW1/4, SW1/4, Sec. 29, T.29S., R.24E., Crawford Co., Kansas; measured and describe by W. Ives 12 August 1952; our efforts indicate that this is the Blackjack Creek Limestone with the Excello shale below.

C-57 = Exposure in abandoned strip pit from a thin coal (Fleming) through thin beds of fossiliferous mudrocks and limestone into a black platy, fissile shale to claystone with 1 to 4 feet of sandstone at the top; Sec. 34, T.30S., R.24E., Crawford Co., Kansas; measured and described by W. Howe 6 August 1948.

C-58 = Exposure of claystone with overlying coal (Fleming) through a black platy, fissile shale to a gray mudrock unit with approximately 8 feet of sandstone at the top; SW1/4, SW1/4, Sec. 34, T.30S., R.24E., Crawford Co., Kansas; measured and describe by W. Howe 13 June 1950 with note that Mineral coal was removed from below this exposure.

C-59 = Exposure from sandstone below thin coal (Croweburg) with black, platy, fissile shale and 16+' of gray mudrock and approximately 4' of black, fissile shale with phosphate nodules [unit below Verdigris Limestone]; near Center NW1/4, SW1/4, Sec. 27, T.30S., R.24E., Crawford Co., Kansas; measured and described by W. Howe 13 June 1950.

C-60 = Exposure in abandoned strip pit partially full of water from sandstone a base through thin coal (Fleming) overlaid by fossiliferous limestone followed by more mudrock, limestone, claystone, black, fissile shale to a claystone with basal gravel; near Center NE1/4, NW1/4, Sec. 27, T.30S., R.24E., Crawford Co., Kansas; measured and describe by W. Howe 18 June 1948.

C-61 = Same as C-60

C-62 = J-121 = Higginsville Limestone with black, fissile shale below in road ditch on North side of road; SW cor. Sec. 19, T.30S., R.24E., Crawford Co., Kansas; measured and described by J. Jewett in 1940; our efforts indicate that this is the Blackjack Creek Limestone with the Excello shale below.

C-63 = Exposure in active pit of Eagle-Cherokee Coal Company from Verdigris Limestone through Bevier coal and thin, very fossiliferous limestone into a claystone at the top; near Center NW1/4, NE1/4, Sec. 10, T.30S., R.24E., Crawford Co., Kansas; measured and described by W. Howe 18 June 1948.

C-64 = Exposure of Bevier coal along Cow Creek in SE1/4, SE1/4, Sec. 9, T.30S., R.24E., Crawford Co., Kansas

C-77 = Exposure in abandoned strip pit nearly full of water of coal (Fleming) black, fissile shale and thin, fossiliferous limestone overlain by mudrock with a channel-like sandstone at the top; SW1/4, NW1/4, Sec. 4, T.31S., R.24E., Crawford Co., Kansas; measured and describe by W. Howe 17 August 1948 who noted that the Mineral coal below this sequence was the object of the mining.

CR-438 = Limestone in drainage on East side of road; near center of East line, SW1/4, NW1/4, SW1/4, Sec. 11, T.30S., R23E., Crawford Co., Kansas.

CR-453 = Large, hard, dense, dark gray to black limestone septarian concretions in a light chocolate brown, silty mudrock in place in creek on West side of road, possibly Excello shale, compare with C-55; near center of West line, SE1/4, SE1/4, NE1/4, Sec. 27, T.30S., R.23E., Crawford Co., Kansas.

CR-454 = Reddish sandstone in road; near Center of west line, NE1/4, NE1/4, SE1/4, Sec. 27, T.30S., R.23E., Crawford Co., Kansas.

CR-455 = Fort Scott Limestone from presumed Houx limestone to base of Blackjack Creek Limestone top of Excello shale exposed in Midwest Minerals quarry along West side of Sec. 30, T. 30S., R.24E., Crawford Co., Kansas; quarry extends from NE cor. of Sec. 30 South approximately 0.7 mile, at the North end the Blackjack Creek is approximately 3' thick, near the center of the West line of Sec. 30 it is 15 to 18 feet thick and at the South end it is approximately 19' thick; it is at the South end that the Little Osage Shale and Houx limestone are exposed; approximately the northern third of the quarry is an algal limestone with a thin, approximately two feet of thin platy, argillaceous limestone with domical chaetetids (collected three chaetetid specimens and took five digital photos of exposures in this area), at the southern end the limestone is all algal; base of Fort Scott (Blackjack Creek) Limestone is at an elevation of 968'.

CR-456 = Exposure of thick sandstone along West side of abandoned strip pit on East side of road, area of KGS sections C-57 and C-58; near Center of West line SW1/4, SW1/4, Sec. 34, T.30S., R.24E., Crawford Co., Kansas.

CR-457 = Exposure of thick sandstone, same as at CR-307, along West bank of abandoned strip pit on West side of road; approximately 200' West and 100' South of Center of East line SE1/4, NE1/4, SE1/4, Sec. 33. T.30S., R.24E., Crawford Co., Kansas.

CR-458 = Upper 5 to 6 feet of Fort Scott (Blackjack Creek) Limestone as exposed

at CR-306 with the upper approx. 2' a thin bedded, argillaceous limestone with domical chaetetids and the lower 3 to 4 feet an algal limestone (small piece of *in situ* chaetetid collected); exposed in old quarry mostly full of water South of Kansas Hwy 126 in NW cor, NE1/4, NE1/4, NW1/4, Sec. 30, T.30S., R.24E., Crawford Co., Kansas; a similar sequence of limestone exposed in a similar quarry, also nearly full of water, occurs on the North side of Kansas Hwy 126 in West 1/2, SE 1/4, SE1/4, SW1/4, Sec. 19, T.30S., R.24E., Crawford Co., Kansas.

CR-459 = Limestone, Pawnee (Myrick Station) float in road ditch on East side of Road, estimate base of Pawnee (Myrick Station) Limestone at approx. 980': NW cor., Sec. 26, T.29S., R.23E., Crawford Co., Kansas.

CR-460 = Lots of limestone float in stream bed on North side of road, possible top of Fort Scott (Higginsville) Limestone at 920'; near Center of South line SW1/4, SW1/4, sec. 35, T.29S., R.23E., Crawford Co., Kansas.

CR-461 = Sandstone in road at 962', possible Englevale; near Center South line SW1/4, SE1/4, Sec. 26, T.29S., R.23E., Crawford Co., Kansas.

CR-462 = Top of limestone, Blackjack Creek, in drainage on both sides of road and under bridge with Little Osage Shale in place above in drainage ditch on West side of road, top of limestone very irregular with many pits and/or borings (subaerial exposure surface?), top of Blackjack Creek Limestone at 918'; near Center of West line NW1/4, Sec. 23, T.30S., R.23E., Crawford Co., Kansas.

CR-463 = Limestone, possibly Blackjack Creek, in drainage North of road; near Center of South line, SW1/4, Sec. 14, T.30S., R.23E., Crawford Co., Kansas.

CR-463A = Fort Scott Limestone in place in road ditch South of road; near Center of North line NE1/4, NE1/4, NW1/4, (0.4 mile East of NW cor.) Sec., 23, T.30S., R.23E., Crawford Co., Kansas.

CR-463B = Limestone float in field East of road; SW1/4, SW1/4, Sec. 13, T.30S., R.23E., Crawford Co., Kansas.

CR-463C = Limestone float around pond in field East of road; NW1/4, NW1/4, Sec. 24, T.30S., R.23E., Crawford Co., Kansas.

CR-463D = Limestone float around pond in field West of road; NE1/4, NE1/4, Sec. 23, T.30S., R.23E., Crawford Co., Kansas.

CR-464 = Black shale, Excello, in road ditch on East side of road; SW cor., Sec. 25, T.30S., R.23E., Crawford Co., Kansas.

CR-465 = Black shale (Excello) with limestone, Blackjack Creek, in road ditch on South side of road, base of Fort Scott (Blackjack Creek) Limestone at 940'; near Center of South line SE1/4, SE1/4, Sec. 26, T.30S., R.23E., Crawford Co., Kansas.

CR-466 = Black shale, Excello, in place with Blackjack Creek Limestone above, base of Fort Scott (Blackjack Creek) Limestone at 920', limestone is also limestone float around pond in field East of road; exposed in drainage in

field North of Kansas Hwy 126; tabular to low domical chaetetids in lower Blackjack Creek, collected broken specimen; just South of Center of North line of NE1/4, Sec. 26, T.30S., R.23E., Crawford Co., Kansas.

CR-467 = Limestone in drainages in fields on both sides of road with limestone, possibly Higginsville, at 945' in road; approximately 100' South of Center of West line NW1/4, Sec. 13, T.30S., R.23E., Crawford Co., Kansas.

CR-468 = Limestone in field South of road, possibly Higginsville at 950'; approximately 400' East of Center of North lineNW1/4, Sec. 13, T.30S., R.23E., Crawford Co., Kansas.

CR-469 = Limestone in drainage under bridge and in field East of road, large domical chaetetids in pool of water under bridge (digital photos), occurrence similar those in to upper beds of Higginsville Limestone elsewhere; near Center of West line SW1/4, NW1/4, Sec. 1, T.30S., R.23E., Crawford Co., Kansas.

CR-470 = Exposure similar to that at CR-469 in stream under bridge and in drainage East of road with large domical chaetetids approximately 3 dm in diameter, small loose specimen collected; just North of Center of West line Sec. 36, T.29S., R.23E., Crawford Co., Kansas.

CR-471 = Sandstone in place in drainage under road bridge of Kansas Hwy 7 at about 945'; approximately 200' South of Center of West line NW1/4, Sec. 19, T.30S., R.24E., Crawford Co., Kansas.

CR-472 = Exposure in field West of Kansas Hwy 7 of thin, chaetetid bearing (large, 2 to 3 dm in diameter, domical forms) limestone and thin bedded sandstone in place in field at the same elevation, about 940', possibly the Englevale valley-fill sandstone of the Labette Shale cutting out part of the Fort Scott (Higginsville) Limestone; near Center of NE1/4, Sec. 24, T.30S., R.23E., Crawford Co., Kansas.

CR-473 = Limestone with black shale below in pond bank South of road, shale is in place but limestone blocks resembling the lower beds of the Blackjack Creek Limestone are not in place, base of Fort Scott (Blackjack Creek) Limestone estimated at 958'; just South of Center of North line NE1/4, NE1/4, Sec. 36, T.30S., R.23E., Crawford Co., Kansas.

CR-474 = Limestone in place in drainage North of road, thin, platy limestone that lithologically looks like the lower beds of the Blackjack Creek in this area, chaetetid float in road ditch South of road and East of bridge over drainage at a slightly higher elevation; 300 feet North and 200 feet West of Center of South line Sec. 25, T.30S., R.23E., Crawford Co., Kansas.

CR-475 = Limestone in drainage on both sides of road; near Center of East line NE1/4, NE1/4, NE1/4, Sec. 31, T.30S., R.24E., Crawford Co., Kansas.

CR-476 = Limestone blocks in pond bank in field East of road; near Center of West 1/2, SW1/4, Sec. 20, T.30S., R.24E., Crawford Co., Kansas.

CR-476A = Nelson Quarry, base of Fort Scott (Blackjack Creek) Limestone at @

970' near Northeast corner of quarry, 18' of limestone with large domical chaetetids in the upper beds (collected three small samples); approximately 350' west of Center of N1/2, Sec. 20, T.30S., R.24E., Crawford Co., Kansas.

CR-477 = Sandstone/siltstone/mudrock in road ditch on West side of road at approx. 960'; approximately 200 feet South of Center of East line SE1/4, SE1/4, Sec. 17, T.30S., R.24E., Crawford Co., Kansas.

CR-478 = As at CR-477 in road ditch on West side of road; near NE cor., Sec. 20, T.30S., R.24E., Crawford Co., Kansas.

CR-479 = Mudrock and thin beds of sandstone/siltstone in pond bank in field West of road; approximately 200 feet West and 250 feet South of Center of East line, Sec. 20, T.30S., R.24E., Crawford Co., Kansas.

CR-480 = Platy limestone, possibly in place, in field North of road; just North of Center of South line, Sec. 7, T.30S., R.24E., Crawford Co., Kansas.

CR-481 = Limestone and black shale along pond bank west of road, possibly in place, could be Blackjack Creek Limestone and Excello shale; near Center SE1/4, SE1/4, Sec. 7, T.30S., R.24E., Crawford Co., Kansas.

CR-482 = Thin bedded, platy limestone (Blackjack Creek) and black shale (Excello) in place in drainage West of road; base of Fort Scott (Blackjack Creek) Limestone at @ 938'; approximately 300' South and 150' West of NE cor., Sec. 7, T.30S., R.24E., Crawford Co., Kansas.

CR-483 = Black shale (Excello) well exposed in drainage South of road; approximately 400' East and 100' South of NW cor., Sec. 8, T.30S., R.24E., Crawford Co., Kansas.

CR-484 = Limestone exposed in drainage South of road, probably lower beds of Blackjack Creek Limestone, upper bedding surface pitted and bored, large chaetetid masses occur as float; just South of Center of North line of NE1/4, Sec. 7, T.30S., R.24E., Crawford Co., Kansas.

CR-485 = Limestone, lower beds of Blackjack Creek, exposed in drainage East of road; approximately 300' East of Center of West line of NW1/4, SW1/4, Sec. 5, T.30S., R.24E., Crawford Co., Kansas.

CR-486 = Base of Fort Scott (Blackjack Creek) Limestone at 940' in field South of road with Excello shale exposed below, approx. 10 feet of Blackjack Creek Limestone exposed in ditch South of road and West of drainage, an occasional tabular chaetetid was encountered and a piece of one was collected; approx. 800' East and 100' South of NW cor., Sec. 5, T.30S., R.24E., Crawford Co., Kansas.

CR-487 = Limestone in drainage on both sides of road at 950', probably Blackjack Creek; near Center of West line SW1/4, SW1/4, Sec. 32, T.29S., R.24E., Crawford Co., Kansas.

CR-488 = Limestone blocks and black shale in pond bank East of road;

approximately 300' East of Center of West line of NW1/4, NW1/4, Sec. 32, T.29S., R.24E., Crawford Co., Kansas.

CR-489 = Limestone exposed in old quarry East of road, KGS Section C-43 indicates approx. 10' of limestone identified as Higginsville, but it is Blackjack Creek; near Center of S1/2, NW1/4, SW1/4, Sec. 29, T.29S., R.24E., Crawford Co., Kansas.

CR-490 = Limestone exposed in drainage on both sides of road, probably the upper beds of Blackjack Creek Limestone; near Center of West line of NW1/4, SW1/4, NW1/4, Sec. 29, T.29S., R.24E., Crawford Co., Kansas.

CR-491 = Mudrock exposed in creek North of road; approximately 400' North of Center of South line, Sec. 20, T.29S., R.24E., Crawford Co., Kansas.

CR-492 = Limestone exposed in pond bank South of road at @ 946', probably Blackjack Creek; approximately 1000' East and 100' South of NW cor., Sec. 29, T.29S., R.24E., Crawford Co., Kansas.

CR-493 = Base of Fort Scott (Blackjack Creek) Limestone exposed at 940' with Excello shale, Breezy Hill Limestone, and thick sequence of Lagonda Fm below along road ditch on South side of road, lower beds of Blackjack Creek Limestone contain very large (5 to 6+ dm across) domical masses of chaetetids, collected two small pieces; approximately 100' West of Center of North line of NW1/4, Sec. 32, T.29S., R.24E., Crawford Co., Kansas.

CR-494 = Cross-bedded sandstones exposed in stream north of road; approximately 150' North of Center of South line of SW1/4, SE1/4. SE1/4, Sec. 32, T.29S., R.24E., Crawford Co., Kansas.

CR-495 = Base of Fort Scott (Blackjack Creek) Limestone exposed at 950' with black shale, Excello, below in drainage West of Kansas Hwy 7, occasional tabular to very low, broad domical chaetetid masses in lower @ 2.0' of Blackjack Creek, collected one specimen; approximately 100' North of Center of East line of SE1/4, Sec. 25, T.30S., R.23E., Crawford Co., Kansas.

CR-496 = Pieces of thin, platy limestone in drainage on West side of Kansas Hwy 7, probably close to the base of the Fort Scott (Blackjack Creek) Limestone; approximately 150' South and 100' West of Center of East line of NE1/4, SE1/4, Sec. 36, T.30S., R.23E., Crawford Co., Kansas.

CR-497 = Limestone, Blackjack Creek, in place in drainage West of Kansas Hwy 7; approximately 300' West of Center of East line of SE1/4, SE1/4, Sec. 36, T.30S., R.23E., Crawford Co., Kansas.

CR-498 = Thin bedded, dark gray to black, hard, dense limestone exposed in drainage West of Kansas Hwy 7, possibly the Verdigris???; approximately 350' West of Center of East line of SE1/4, NE1/4, Sec. 1, T.31S., R.23E., Crawford Co., Kansas.

CR-499 = Limestone exposed in road at @ 1000'; approximately 150' West of NE cor., Sec.27, T.29S., R.24E., Crawford Co., Kansas.

CR-500 = Limestone/black shale contact exposed at 990' in road, chaetetid float in field North of road; near Center of North line of NE1/4, NE1/4, Sec. 27, T.29S., R.24E., Crawford Co., Kansas.

CR-501 = Limestone in road from an elevation of 969' to top of hill at 981'; near Center of North line of NE1/4, NW1/4, NE1/4, Sec. 28, T.29S., R.24E., Crawford Co., Kansas.

CR-502 = Mudrock in drainage North of road, either upper beds of Little Osage or "Lagonda"; near Center of South line of SW1/4, SW1/4, Sec. 21, T.29S., R.24E., Crawford Co., Kansas.

CR-503 = Limestone exposed in road and capping hill above 970'; near Center of West line of SW1/4, NW1/4, Sec. 27, T.29S., R.24E., Crawford Co., Kansas.

CR-504 = Top of Verdigris Limestone exposed in bed of Second Cow Creek at 898', across the road South of KGS Sec. C-64; just West and South of NE cor., Sec. 16, T.30S., R.24E., Crawford Co., Kansas.

CR-505 = Thin bed of limestone possibly in place in pond bank West of Kansas Hwy 126, possibly the base of Fort Scott (Blackjack Creek) Limestone; near Center of NE1/4, NE1/4, NE1/4, Sec. 29, T.30S., R.24E., Crawford Co., Kansas.

CR-506 = Thick bed of hard sandstone exposed in stream bed East of road at 920', near KGS Sec. C-77; approximately 400' North and 150' East of Center of West line of NW1/4, NW1/4, Sec. 4, T.31S., R.24E., Crawford Co., Kansas.

CR-507 = Top of Verdigris Limestone in bed of a tributary of Brush Creek at 928' South of road; approximately 100' South of Center of North line of NE1/4, NE1/4, Sec. 5, T.31S., R.24E., Crawford Co., Kansas.

CR-508 = Sandstone similar to that exposed at CR-506 in drainage South of road; approximately 300' West and 100' South of Center of North line of NW1/4, NW1/4, Sec. 4, T.31S., R.24E., Crawford Co., Kansas.

CR-509 = Sandstone exposed is West wall of old strip pit on North side of road and in drainage on South side of road; near Center of North line of NW1/4, NW1/4, NE1/4, Sec. 33, T.30S., R.24E., Crawford Co., Kansas.

CRAWFORD COUNTY QUADRANGLE MAPS

The following four quadrangle maps are photocopies of field maps submitted by the Kansas Geological Survey as part of the STATEMAP Agreement #02HQAG0029 for FY02 (May 1, 2002 to April 30, 2003). The following four quadrangles form **Kansas Geological Survey Open-File Report 2003-20 "Preliminary Geologic Field Maps of portions of Crawford County, Kansas"**. In addition to the field maps, a report is also included in the open-file report and with these deliverables, that includes a general stratigraphic section, and locations of measured stratigraphic sections that were utilized in the mapping of the enclosed quadrangles.

Quadrangles included in the FY01 mapping effort--

Complete Quadrangles

Arma
Radley

Partial Quadrangles

Cherokee
Liberal (MO)

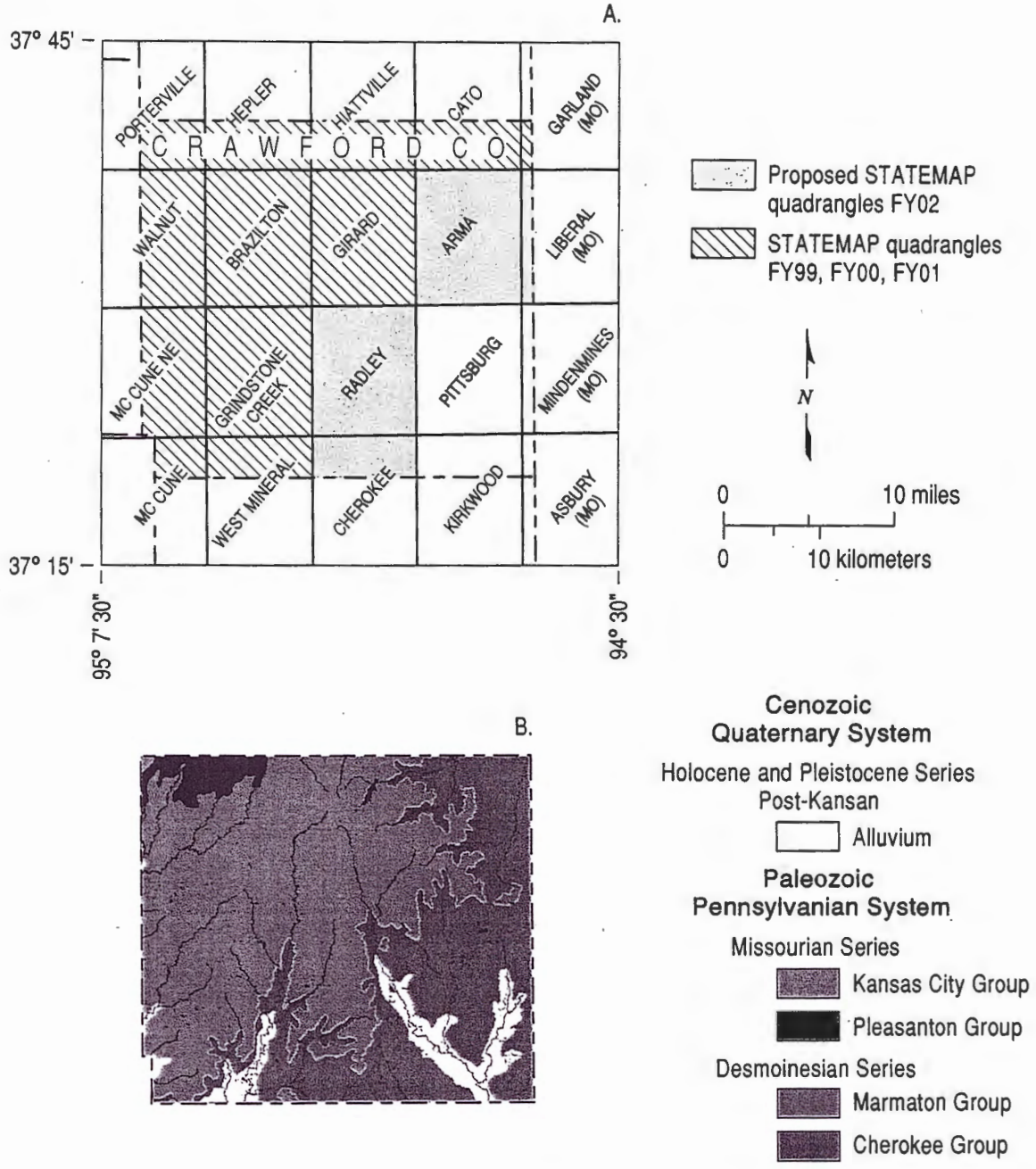


Figure 6—(A) Quadrangle maps covering Crawford County, and quadrangle areas within the county proposed for the FY02 STATEMAP project; and (B) general geology of Crawford County.