

Making of the 1937 Geologic Map of Kansas

Daniel F. Merriam

Senior Scientist (emeritus), Kansas Geological Survey, University of Kansas, Lawrence, Kansas 66047

Introduction

Erasmus Haworth, the third State Geologist and Director of the Kansas Geological Survey, compiled and issued the first modern geologic map of the state in 1896 (Merriam, 1996). Prior to the late 1800s several geologic maps published by the U.S. Geological Survey included Kansas. Earlier maps were generalized and incomplete as the geology of the state had not been investigated in detail.

Haworth revised and updated his 1896 map in 1908. In 1916, Raymond C. Moore replaced William H. Twenhofel as State Geologist and Director and began at once his mastery of the geology of Kansas. He and his students started detailed stratigraphic and paleontologic studies of outcropping rock in the state no doubt with the intent of issuing a revised up-to-date geologic map (Buchanan, 1989). In fact, Moss (1932) noted that the Kansas Geological Survey '...is preparing a large-scale geologic map of the state.'

A geologic map is the basic database for geologists. It gives two-dimensional information on the age and relation of rock units to each other, and their spatial position. From these data then a reconstruction of the history of an area can be made. The better the field geologic map, the better the interpretation.

R.C. Moore and the 1937 State Geological Map

Raymond Cecil Moore arrived on the scene in Kansas in 1916 with his fresh doctorate from the University of Chicago ready to go. He had been appointed State Geologist and Director of the Geological Survey and an Assistant Professor in the KU Department of Geology. He immediately set out to understand the geology of the state, but his priorities were changed with WWI. He had to revise his objectives in terms of supporting the war effort. On conclusion of hostilities, he returned his attention to the basic geology of Kansas, especially mineral resources.

Moore and his colleagues and students started a mapping program of counties in the state that could provide basic data on geology of that particular geologic province. Several of the mapping projects were in conjunction with an assessment of the oil and gas resources others were selected as important in understanding the stratigraphy and general geology. Survey geologists - Maxim K. Elias, paleontologist/geologist; J. Mark Jewett, stratigraphic geologist; Raymond P. Kerher, Geologist in Charge of Subsurface Geology; Kenneth K. Landes, Assistant Director and State Geologist; Moore, Director and State Geologist; and John W. Ockerman, geologist - were all involved to some extent.

Norman D. Newell (MS 1931), both staff member and student, mostly mapped in the Permo-Pennsylvanian of eastern Kansas using some of the material in support of his advanced degrees at KU. Students Rycroft G. Moss (MS 1931), Emmett R. Elledge (BS in Mining Engineering, 1919), and Monta E. Wing (AB 1920, MA 1921) as R.C. Moore's assistant (Delo, 1978) mapped in both the eastern and western part (Cloud and Republic counties) of the state usually with a permanent staff member or under their supervision. Charles W. Boughton (AB 1919) from Iola, Kansas, apparently was a petroleum geologist working in southeastern Kansas and familiar with the geology in that part of the state.

A cooperative venture with the U.S. Geological Survey allowed the mapping of several counties - one in southeastern Kansas (Cowley), three others (Ellis, Hamilton, and Russell) in the Cretaceous and Tertiary of the west, and three in the extreme southeastern corner of the state involving the coal resources in the Pennsylvanian Cherokee Group. USGS mapping in the western part of the state was by N. Wood Bass and William W. Ruby (Ruby and Bass, 1925; Bass, 1926), in south-central Kansas by Bass (1926), and in southeastern Kansas by William Pierce and William Courtier (1937). The maps were finished between 1921 and 1941. Results of these investigations were available or published prior to issuing the 1937 state geologic map and were used in its construction. Some of the data also were not recorded until later, especially some of the measured geologic field stratigraphic sections.

The measured section books in the Survey provide some information on the early mapping. For example, there is a colored map by township and range in the Johnson County book. Some of the measured sections in this book are included in Kansas Geological Survey Bulletin 21 (the geology of Johnson County). Other counties, such as Nemaha, have just the key beds mapped as shown on the state map. Obviously, the maps were prepared in such a manner as to be included in the 'new' state map. It should be emphasized that all the data available were used in preparation of the new map - published or not.

Unpublished Maps

Recently, a treasure trove of unpublished maps were recognized for what they are. After the discovery and recognition of the importance of the township/range Wabaunsee map, all the measured section books were scrutinized for additional unpublished county maps and several were located¹. Atchison and Greenwood counties apparently were mapped by Moore with no date, but presumably in the 1930s; Mark Jewett mapped Linn County, probably with Norman Newell's help, in conjunction with his eastern Kansas stratigraphic studies; Maxim K. Elias, surprisingly so, mapped Marshall County in 1932 and Morris County in the mid-1930s; Nemaha and Pottawatomie counties were apparently mapped by Rycroft Moss, and Wabaunsee County also was mapped presumably by R.G. Moss in the 1930s. Both Norman Newell and Rycroft Moss state in their theses that the maps were made in response to the compilation of '...a large-scale geologic map of the state' (Moss, 1932).

¹The county measured section books are unpublished field notes by Survey geologists and maintained and located in the Survey. The books are open to the public for use in the Survey.

Atchison County

A township/range map of Atchison County, included in the Survey measured section book, is in segments and color coded with no explanation; the map has no author nor date. From the date of the measured sections in the book, however, it is assumed that the map was made by R.C. Moore, who spent considerable time in the county in the summer of 1929. Although the map does not have the signature of Moore, it is likely he had it drawn from his field-map compilation and it was used in the preparation of the 1937 state geologic map because the patterns match. The county had been glaciated but Moore, in true form, was not interested in the Pleistocene and deposits of that age are not shown on the map.

Barber County

A report on the *Geology of Barber County, Kansas* was prepared by Gerald L. Knight in 1929. It is noted by Knight that the field study of the county was made in the summer of 1929 and a geologic map of the rock formations was prepared. The map was made in the field using county highway maps, ownership maps, and USGS topographic sheets. Knight was assisted in the field by Harold H. Hawkins. Knight specifically says the map was prepared to be part of the new geologic map of Kansas (the map of 1937) being compiled. Unfortunately, no map is with the written report and there is no indication there ever was one, and Gerald Knight remains a mystery (Janice Sorensen, pers. comm., 2008).

Greenwood County

A copy of the R.C. Moore map of the geology of Greenwood County (presumably made in the 1930s) was 'willed' to Virgil Cole in Wichita after Moore decided he was finished with the project and the map had served his purpose. Moore knew Cole was interested in geology of the county. That map was passed on to me by Cole prior to his death in 1984. At the time the significance of the preliminary map unfortunately escaped me.

Linn County

In the mid-1930s, J. Mark Jewett was working in Linn County collecting data for his Kansas Geological Survey Bulletin 30. He did considerable work on the stratigraphy of the county and presumably prepared the geologic map of the county, which, in turn, was included in the compilation of the new state map. Jewett had been working on the Pennsylvanian stratigraphy in east-central Kansas for his master and doctoral degrees, but apparently his geologic map of Linn County was never published as such. Some of the sections in the county were measured by Norman Newell and it is possible that Newell served as his field assistant. The results are included in the measured section books at the Survey on a township/range basis. There are more identification of units on this map than on some of the other unpublished maps.

Marshall County

Perhaps the most surprising aspect of these ventures was the discovery of a geologic map of Marshall County in north-central Kansas. There was no previous indication that the county had been mapped by Max Elias, but the only measured sections in the book are by Elias and all dated 1932. The map undoubtedly is a byproduct of his study of the Big Blue Series. Although the eastern part of the county had been glaciated, no glacial deposits are shown on the bedrock map.

Morris County

If the Marshall County map was a surprise, the Morris County map was even more of a surprise. The county map in township and range segments were 'found' in the Morris County measured section book at the Survey. All of the sections in the county but three were measured in the mid-1930s by Max Elias. As usual there was no name nor date on the segmented map.

Nemaha County

Only the key beds are mapped and part of the county in the east seemingly is blank. There are no other markings on the map. The few early measured sections from 1931 are all by Rycroft Moss, so the map presumably is by him. Moss was a master degree student of Ken Landes and no doubt was mapping under Landes' supervision.

Pottawatomie County

Pottawatomie County also is mapped showing only key beds. These beds are the markers that are shown on the state map. Moore had been working in the county since 1929 and Rycroft Moss in 1931 to 1933. Moore, accompanied by Mark Jewett, Walter Schoewe, and H.H. Hawkins, visited the county in 1932 in connection with preparation of a Kansas Geological Society field trip, one of the several led by Moore in the 1930s. The map contains additional markings obviously made later to the original map. The mapping presentation and the numerous measured sections by Moss strongly indicate he is the author.

Wabaunsee County

The Rycroft Moss map of Wabaunsee County was discovered in 2008, the first of several noted here, in an open file of measured surface rock sections in the Survey. The map was in township/range segments with a key to map units but no name and no date. It is presumed to be by Moss because many of the measured rock sections in the county book are by him.

Other Maps

A small-scale geologic map of Cowley County accompanies Emmett Elledge's (1921) publication on *The Economic Geology of the Arkansas City District*. This preliminary map pre-dates Wood Bass' work published in 1929, but Bass makes no reference to the Elledge map. The 1921 map is in the same format as another geologic map, apparently published for Jefferson, Leavenworth,

Wyandotte, and Johnson counties. This map was discovered in a master thesis by Monta E. Wing (1921), but not referenced in the thesis nor identified with a date or author. Howard G. O'Connor, Janice Sorensen, and I could not identify the author, but presume it was compiled by Wing and used in the preparation of the state geological map.

Published Maps

In 1926 Moore compiled a list of publications and maps. In his introduction he notes the Survey '...has gathered for convenient reference available to the public, as nearly complete of Kansas maps as possible.' This compilation perhaps was not only for the public but his assessment of what had been mapped and what remained to be mapped for his project of a new state geological maps.

Additional counties mapped and the results published that undoubtedly were used for the 1937 state map included Allen and Neosho counties by R.C. Moore and E.R. Elledge (1921); Monta Wing mapped and published a map of Cloud and Republic counties in 1930, and made available through a Kansas Survey map (n.d.) his University of Kansas masters thesis (1921) geologic map of Jefferson, Leavenworth, Wyandotte, Douglas, and Johnson counties. Cowley County was mapped by N. Wood Bass in 1929; Rush County by Landes and Keroher in 1938; Mitchell and Osborne counties by Landes and Ockerman (1930), Wallace County by Max Elias (1931), Wilson and Montgomery counties (Boughton, 1921), and Wyandotte County by Jewett and Newell (1935). A rudimentary geologic map of Logan and Gove counties was published by George Adams in 1898.

Mapping Techniques

From condition of the maps in the measured section notebooks, it is obvious they were not the field maps, but copies. The geologic units were transferred from the field maps and hand-colored to form the distinctive patterns. All of the unpublished maps in the measured section books are on a scale of 1 inch = 1 mile, standard size for these types of maps. They were cut into township/range squares and pasted in each book at the appropriate place for information for the user on location of units and sections in that township and range. The mapping presumably was on State Highway Department maps or U.S. Bureau of Soils maps with a few noted exceptions. Some areas were checked with commercial geologist's maps.

Much field work went into the county mapping to define and verify rock units. In addition, aerial photographs flown by the U.S. Air Corps in the summer of 1926 were used for portions of some of the maps; scale of the photographs was 1:17,500 and a stereoscope was used in their study. Jewett (1941) noted that the rock strata patterns identified in the field in Riley and Geary counties were transferred to a base map, scale 1:2,000, obtained from the Federal Survey. Because the base map had been made from air photographs, the topographic features were correctly and accurately depicted. It seems possible that, at least, the geologic map of Wabaunsee County was mapped in the same fashion.

Summary

Much, if not all the field work, was either accomplished or supervised by Moore and Landes as they were the authors of the 1937 geologic map. The multi-colored map was issued by the Survey on a standard base at a scale of 1:500,000. The credit line says 'This map has been prepared under the direction of Raymond C. Moore and Kenneth K. Landes from surveys by members of the State Geological Staff, especially M.K. Elias and N.D. Newell, from data supplied by oil companies and consulting geologists and from surveys of the U.S. Geological Survey and State Geological Survey in cooperation.' Contributions by students Mark Jewett, Rycroft Moss, Emmett Elledge, and Monta Wing, for some reason, were not singled out for recognition. Moore and Landes may have thought the students received recognition enough for their academic work, experience, and published results.

Admittedly, the evidence for use of the maps included in the measured section books for the state map is circumstantial. However, the geologist involved, the timing, and the other publications that resulted from the field work make it logical that the county maps they were making were for the 1937 state geological map. Moore and Landes could not accomplish all the field mapping themselves and had to depend on others to contribute.

Considering the scale and details of mapping these county maps match the state map fairly well in overall pattern and in detail. I should be remembered too, that the map compilers probably modified the original maps as they were introduced to the final map based on their knowledge or further field checking. That information is not available now and probably will never be known.

The 1937 geologic map was later slightly revised and reissued in 1964 prepared under the supervision of Mark Jewett as Kansas Geological Survey Map M-1. This map also was on a scale of 1:500,000.

Acknowledgments. I want to thank Janice Sorensen of the Survey for information on available through the Survey on mapping. Larry Brady, retired Survey geologist, provided additional information on mapping in Kansas. James Merriam digitized and reproduced the map images. The reassembled maps at full scale have been placed in the KGS archives for future reference.

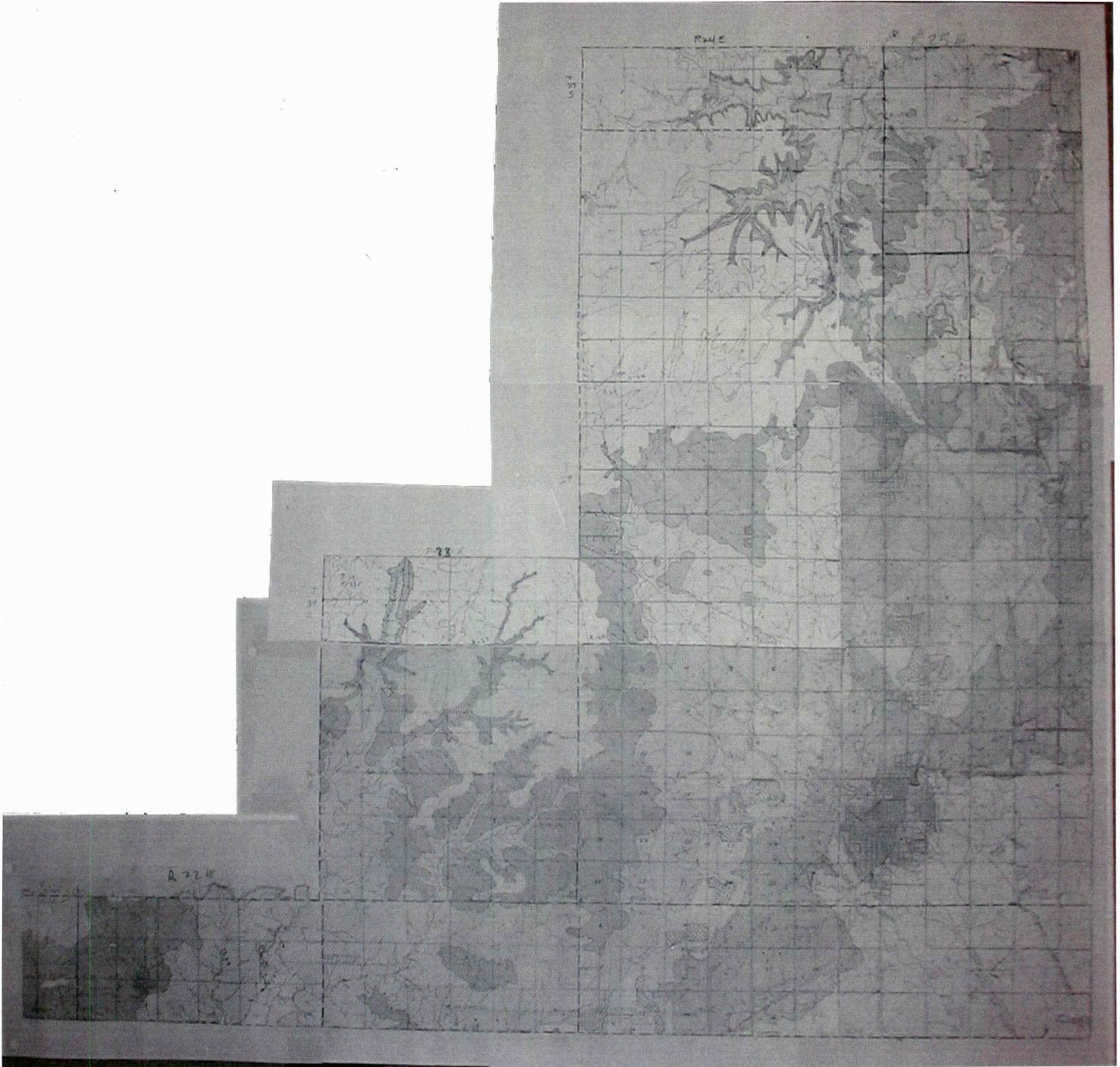
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Atchison

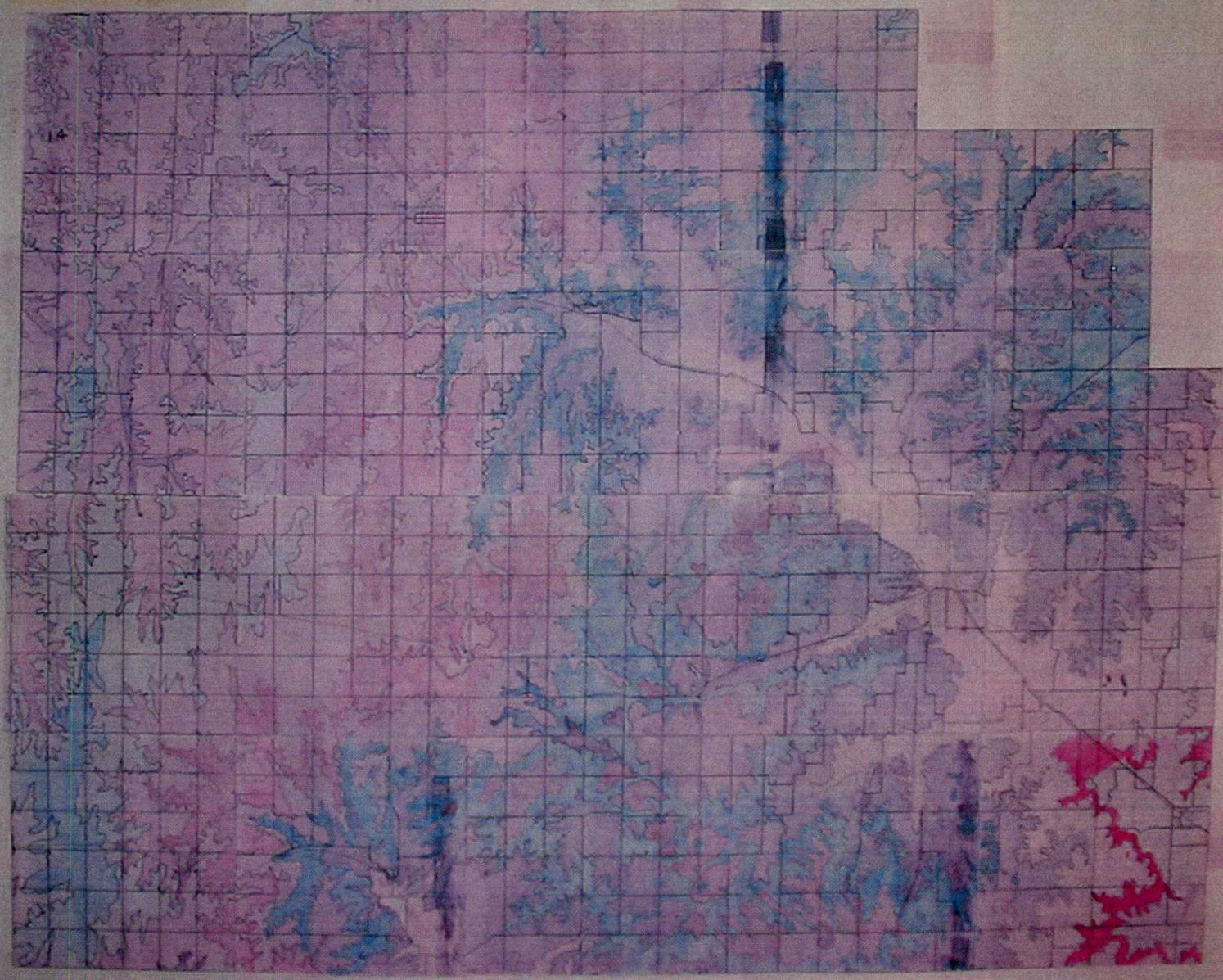


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The maps located on the township pages are of questionable reliability as far as the geology shown is concerned. The symbols used are explained below.

Hr	Herrington
WF	Winfield
FR	Fort Riley
FF	Florence
Wr	Wrayford
C	Cottonwood
N	Nova
A	Andrius

The colors used on the maps do not remain constant and should be regarded as unreliable.

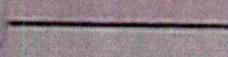
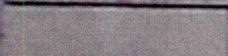
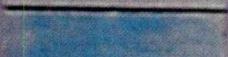
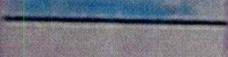
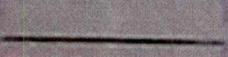
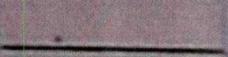
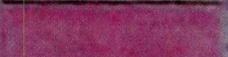


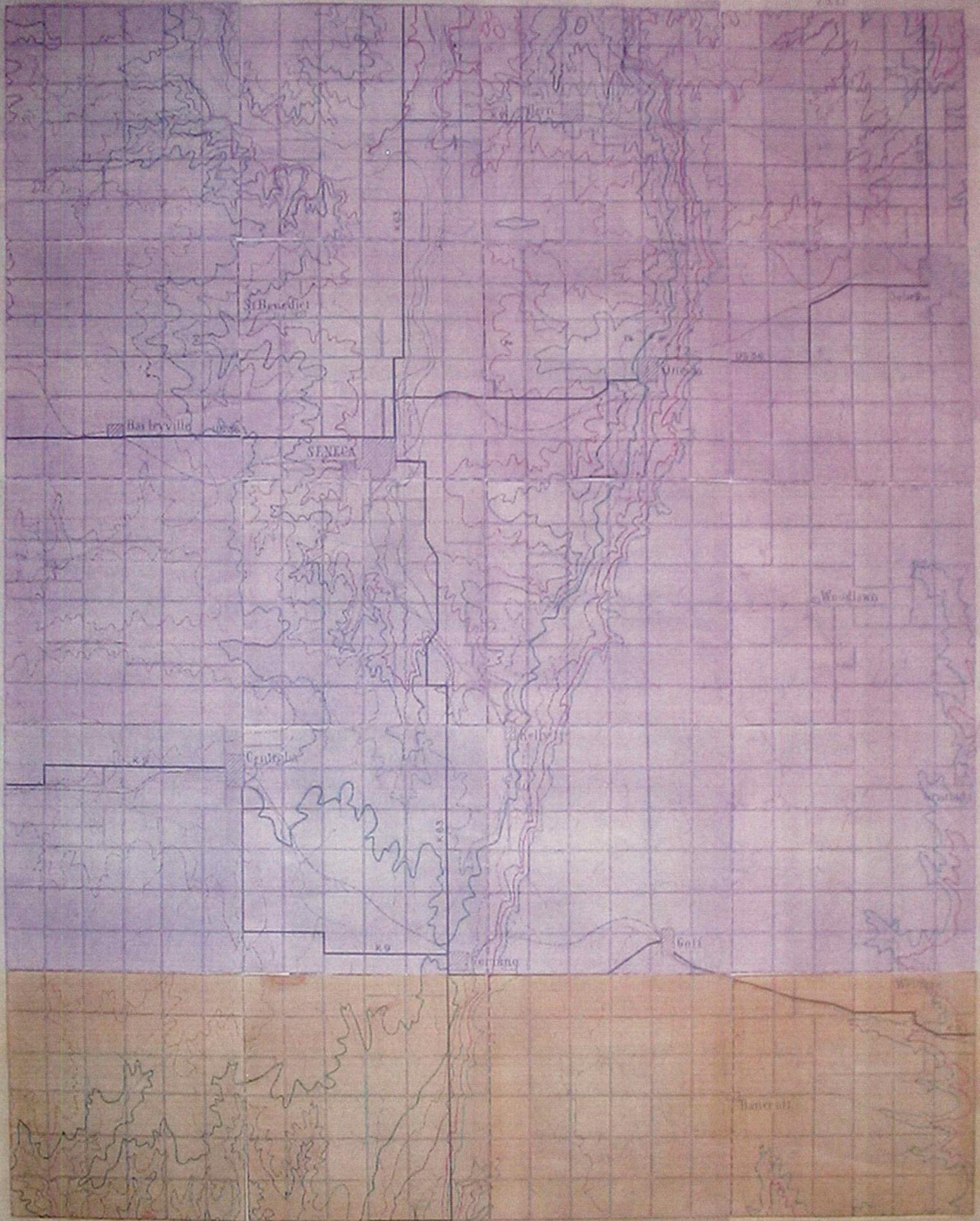
MORRIS

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Preliminary geologic maps are located on each township page. They were compiled by S.P. McCracken from geology done by the Empire Oil Company. Explanation of colors is given below.

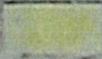
	Strata above base of Hellenburg (?)
	
	Strata from base of Hellenburg to base of Herington
	
	Strata from base of Herington to base of Winfield
	
	Strata from base of Winfield to base of Towanda
	
	Strata from base of Towanda to base of Fort Riley
	
	Strata from base of Fort Riley to base of Florence.
	
	Strata from base of Florence to base of Wreford
	
	Strata from base of Wreford to base of Cottonwood
	
	Strata from base of Cottonwood to base of Neva
	
	Strata below Neva



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Preliminary geologic maps are located on each township page. They are of unknown authorship and of unknown accuracy. The colors used are explained below.

	Alluvium	
	base of Wreford	
	base of Cottonwood	
	base of Neva	<i>pink</i>
	base of Americus	<i>purple</i>
	base of Brownsville	<i>dk. green yell</i>
	base of Dover	
	base of Tarkio	
	base of Reading	<i>dk. blue</i>
	base of Burlingame	
	base of Howard	



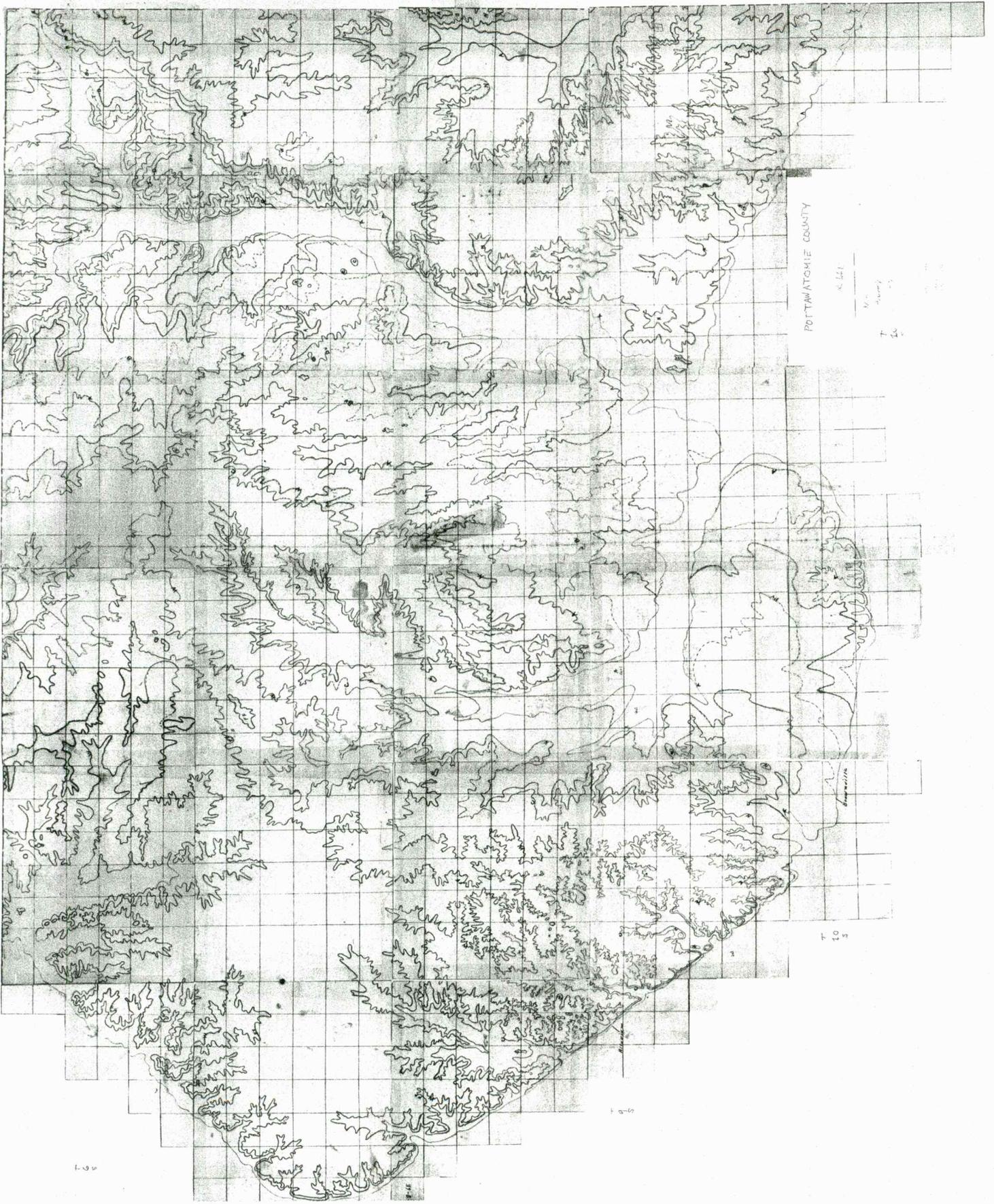
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Preliminary geologic maps are located on each township
page. Explanation of colors is given below.

11	Alluvium
13	Stanton formation
12	Wiles and Plattsburg formations
11	Bonner Springs and Wyandotte formations
10	Lane and Iola formations
9	Chanute and Bram formations
8	Cherryvale formation
7	Dennis formation
6	Galesburg and Swope formations
5	Ladore and Hertha formations
4	Bourbon formation
3	Memorial, Lenape, Nowata and Altamont formations
2	Baniera and Pounce formations
1	LaBette formation



Pottawatomie

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Preliminary geologic maps are located on each transfer case. Explanation of the colors and symbols used is given below.

FF ——— This marks the base of the Florence.

W ——— This marks the base of the Wrexford.

O ——— This marks the base of the Ottumwa.

M ——— This marks the base of the Mena.

A ——— This marks the base of the Appleton.

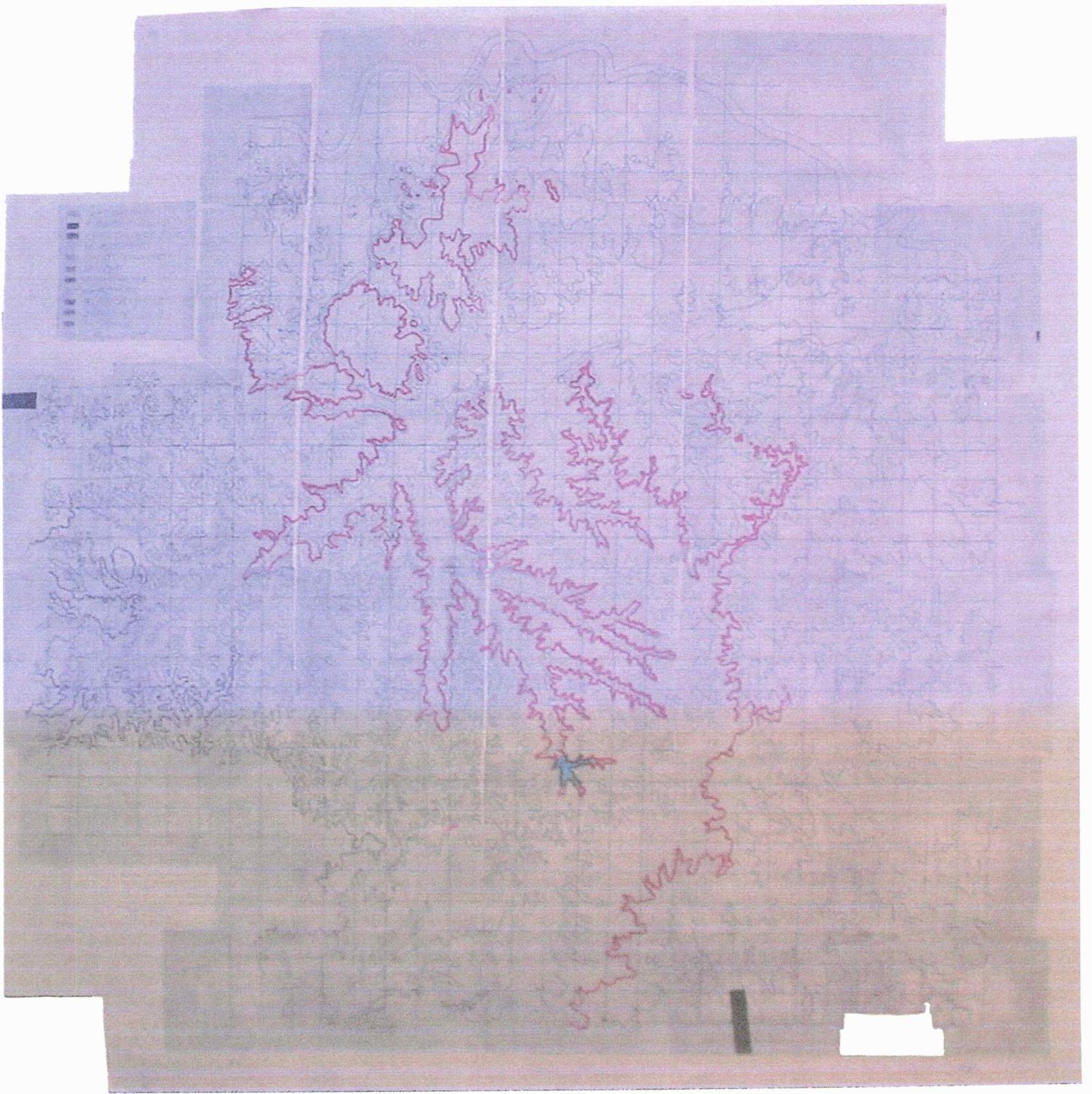
BY ——— This marks the base of the Brownsville.

D ——— This marks the base of the Dover.

T ——— This marks the base of the Tarkenton.

E ——— This marks the base of the Elmont.

——— Border of alluvium



Wabunsee