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Using a New Cenozoic Glacial History Paradigm to Explain Saline-Smoky Hill River Drainage Divide Area Topographic Map Evidence: Kansas, USA

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Abstract

A recently proposed glacial history paradigm (new paradigm) explains previously ignored Saline-Smoky Hill River drainage divide area topographic map drainage system and erosional landform evidence by headward erosion of the east-oriented Saline River valley across large and prolonged south-oriented meltwater floods which flowed in complexes of closely-spaced anastomosing channels. The eastward sloping drainage divide extends from the Saline River's western Kansas headwaters between the Saline River (north) and the Smoky Hill River (south) until in central Kansas the Smoky Hill River turns in a southeast and then north direction to join the Saline River with their combined flow continuing as the Smoky Hill River in an east direction to join the Republican River with the combined flow then becoming the Kansas River. Evidence for closely-spaced south-oriented anastomosing channels consists of previously undescribed low points (divide crossings) which are found along the drainage divide and which link north-oriented Saline River tributaries with south-oriented Smoky Hill River tributaries. Evidence that Saline River valley headward erosion beheaded and reversed south-oriented anastomosing channels also consists of the numerous low points along the drainage divide and of barbed tributaries to the now north-oriented Saline River tributaries which suggest large south-oriented meltwater floods extended much further west than commonly accepted glacial history interpretations permit. The topographic map evidence is consistent with the new paradigm interpretation that a thick continental icesheet by its weight and by deep erosion created and occupied a deep "hole" as massive south-oriented meltwater floods flowed across the rising deep "hole" rim until the deep "hole" rim uplift diverted the floodwaters toward what became the deep "hole's" only remaining southern outlet (the Mississippi River valley).

Keywords: erosional landforms, geomorphology, High Plains, Wilson Valley

1. Introduction

United States Geological Survey (USGS) topographic maps provide much of the information needed to reconstruct how present-day drainage systems evolved. The best information is found on 1:24,000 scale topographic maps, although 1:62,500, 1:100,000, 1:125,000, and even 1:250,000 scale maps contain useful information. USGS topographic maps at one or more of the above scales have been available for decades, yet the geologic literature rarely mentions the use of topographic map drainage system and erosional landform evidence. For example, topographic maps at a scale of 1:125,000 covering the eastern Saline-Smoky Hill River drainage divide area were first published prior to 1900 (see the USGS Topoview website), yet Bayne and Fent (1963) in a paper titled "The drainage history of the upper Kansas River" which includes the Saline-Smoky River drainage divide area do not mention using topographic maps as an information source (although they probably used topographic maps for some of their elevation data).

The Saline River (see figure 1) flows in an east direction from western Kansas and for much of its distance is 20 to 35 kilometers to the north of the roughly parallel east-oriented Smoky Hill River, although before joining the Saline River the Smoky Hill River turns in a southeast and then north direction. Using physiographic regions defined by Frye and Schoewe (1953) the Saline-Smoky Hill River drainage divide slopes from elevations in excess of 1000 meters in the High Plains region to an elevation of less than 370 meters in the Smoky Hills region where the Saline and Smoky Hill Rivers come together with the combined rivers then flowing eastward as the Smoky Hill River. The Saline-Smoky Hill River drainage divide is located west and slightly to the south of northeast Kansas glaciated areas. Cooper (2001) uses present-day elevation data to argue against a Sharp (1894) and Frye and Leonard (1952) hypothesis that ice-marginal lake water spilled westward to the Saline-Smoky Hill River confluence area and then southward perhaps along the now north-oriented Smoky Hill River alignment. Otherwise, previous investigators have not reported evidence or even suggested that icesheet meltwater crossed any of the higher elevation Saline-Smoky Hill River drainage divide areas to the west.

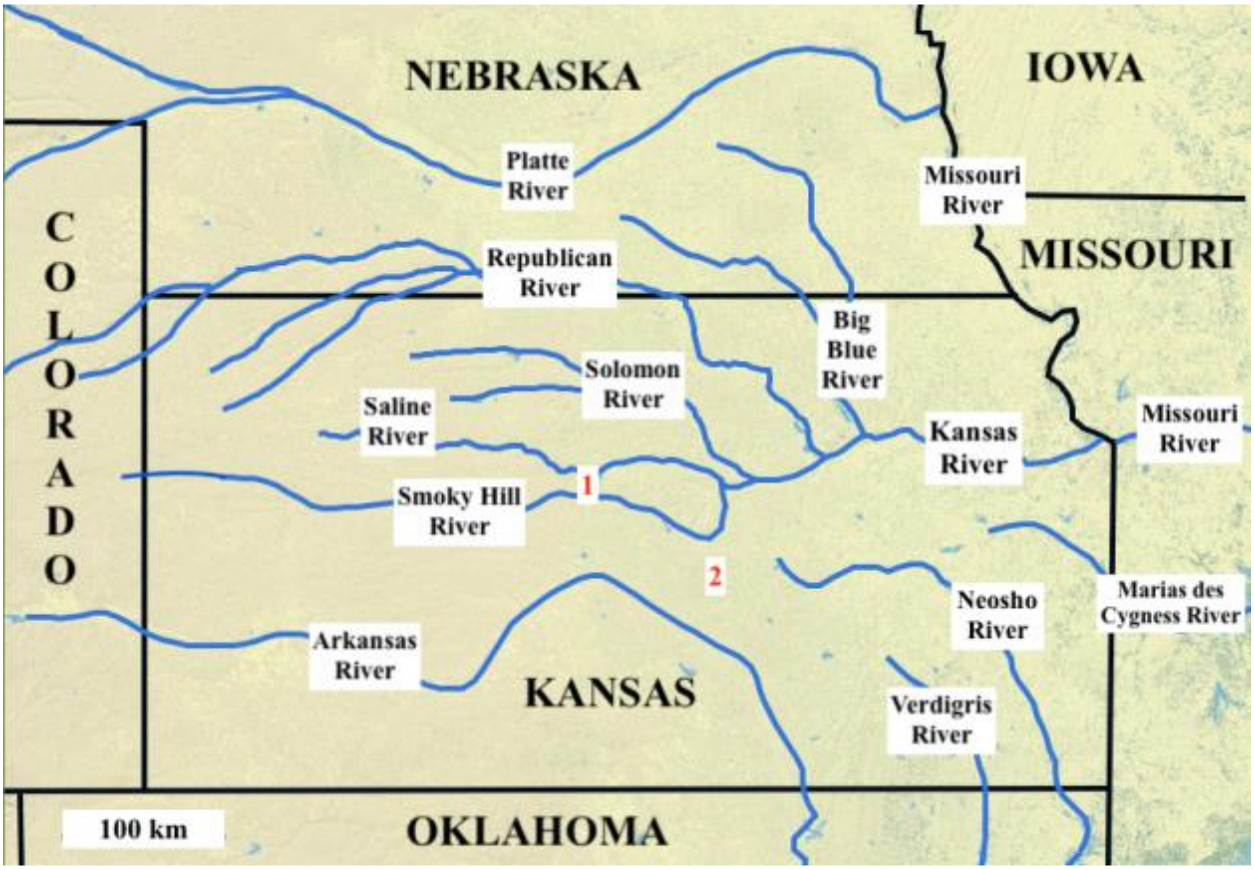

Figure 1. Modified map from the USGS National Map website showing the Saline-Smoky Hill River drainage divide location in reference to state boundaries and other rivers. Red number 1 shows the Wilson Valley location and red number 2 shows the McPherson Channel location

The 1963 Bayne and Fent paper was written when 1:125,000 scale topographic maps (first published prior to 1900) were the most detailed maps available for most eastern Saline-Smoky Hill River drainage divide areas (1:250,000 scale topographic maps became available for the entire drainage divide area in the 1950s with 1:24,000 scale maps becoming available at various dates during the 1960s, 1970s, and 1980s). While containing considerable useful drainage system and erosional landform information the early 1:125,000 scale maps contained misinformation as well. For example, figure 2 illustrates the south-southwest and north-oriented East Elkhorn Creek drainage route (located about 15 km to the north and east of Ellsworth, Kansas) as shown on all USGS topographic maps published since 1985. Prior to 1985 the published USGS topographic maps did not show the south-southwest oriented East Elkhorn Creek headwaters, but instead showed north-oriented Brush Creek headwaters flowing on much of the same route. In spite of such errors enough of the early topographic map drainage system and erosional landform evidence was correctly shown that meaningful regional drainage history reconstructions could have been done. Interestingly, Bayne *et al* (1971) and Cline (1974) who also do not mention using topographic maps include a drainage system map which shows the correct East Elkhorn Creek drainage route and suggest headward erosion of the north-oriented East Elkhorn Creek valley captured what originally were south-southwest oriented Clear Creek headwaters.

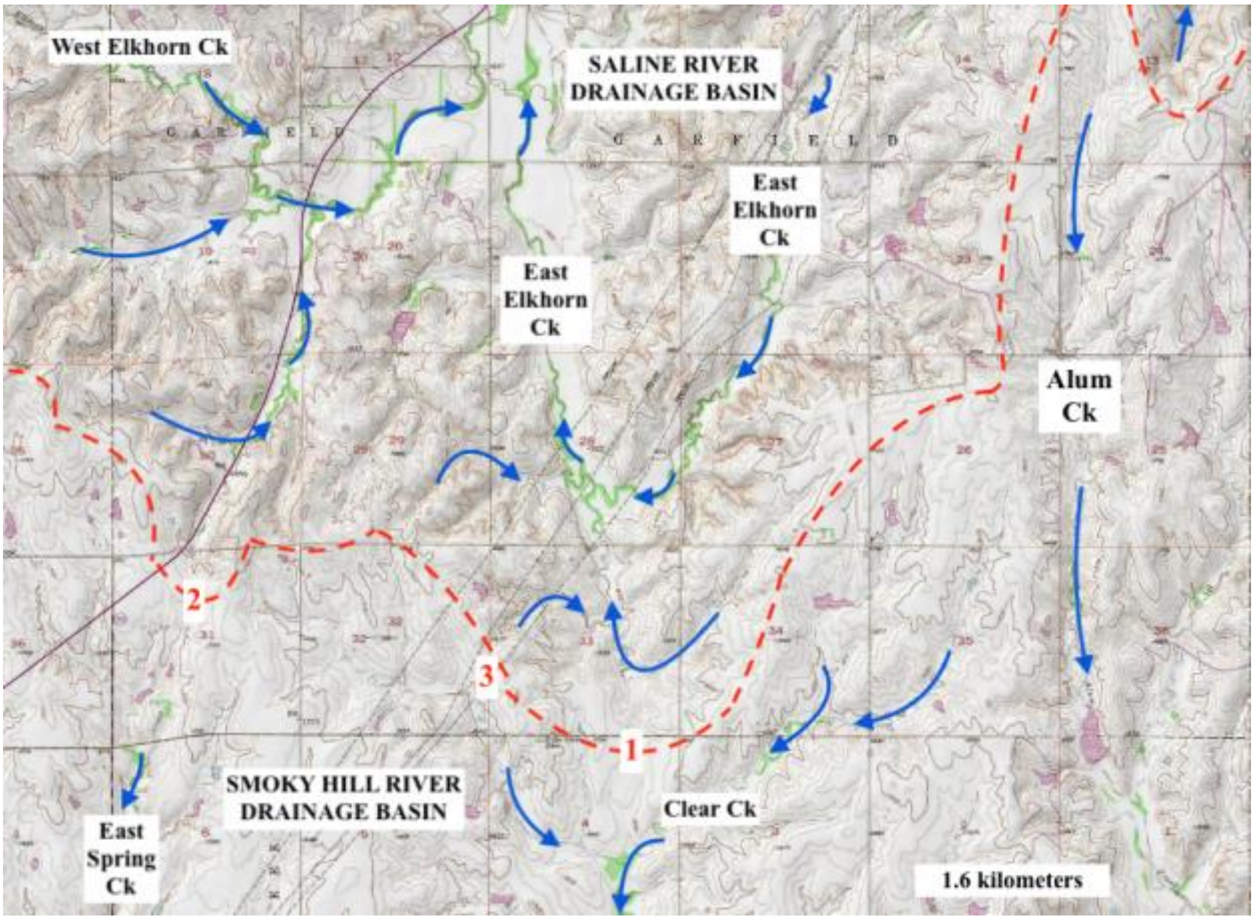

Figure 2. Modified topographic map from USGS National Map website showing West and East Elkhorn Creeks and some of the divide crossings along the Saline-Smoky Hill River drainage divide. Contour interval is 10 feet (3 m). Top left corner: 38° 50' 21.880" N., 98° 09' 39.911 W."

Pre-1985 USGS topographic maps of the Saline-Smoky Hill River drainage divide area probably aided researchers in identifying the abandoned Wilson Valley (located at the red number 1 in figure 1), which stretches in a southeast direction across the present-day Saline-Smoky Hill River drainage divide from where the Saline River valley (now flooded by Wilson Lake) makes a turn from a southeast direction to a northeast direction. Bayne and Fent (1963) based on earlier work by Fent (1950) and Frye and Leonard (1952) consider the ancestral Saline River to have flowed through the Wilson Valley to reach the southeast-oriented Smoky Hill River valley. According to this interpretation which is discussed in Cooper (2001) during Nebraskan and Kansan times upper Saline River water flowed through the Wilson Valley to join south-oriented water flowing on the now north-oriented Smoky Hill River segment and which continued to flow in a south direction through another abandoned valley (known as the McPherson Channel–which is located to the south of where the Smoky Hill River turns from a southeast to a north direction and which is shown by number 2 in figure 1) to reach the Arkansas River valley. By late Illinoian time lower Saline River valley headward erosion somehow captured the Wilson Valley flow and at an undefined subsequent time headward erosion of a north tributary valley from the east-oriented lower Saline River valley captured the southeast-oriented Smoky Hill River so as to create the present-day north-oriented Smoky Hill River segment and to end all Smoky Hill River flow through the McPherson Channel (to the Arkansas River). These previously published interpretations were made by investigators who do not report using topographic maps as an information source but who do report making detailed studies of surficial and subsurface sediments (which topographic maps both past and present do not show).

USGS 1:24,000 scale topographic maps suggest there is much more to Saline-Smoky Hill River drainage divide history than what the above previously published interpretations describe. As noted, previously published interpretations do not mention using topographic map drainage system and erosional landform evidence and such an omission is not unusual. In spite of excellent 1:24,000 scale topographic map coverage the geologic literature rarely mentions any use of the topographic map drainage system or erosional landform evidence probably because much of the topographic map drainage system and erosional landform evidence is anomalous evidence which the accepted Cenozoic geology and glacial history paradigm (accepted paradigm) cannot satisfactorily explain.

According to Kuhn (1970) scientists address anomalous evidence in one of three ways: 1.) the accepted paradigm, perhaps with some creative tweaking, eventually develops a way to explain the evidence and the accepted paradigm continues without a serious interruption; 2.) the anomalous evidence is described, or in this case mapped, and set aside for future scientists to explain; or 3.) someone finds a new paradigm able to explain what the accepted paradigm cannot explain and a battle over which paradigm to use then ensues. Most of the well-mapped drainage system and erosional landform evidence, not just in the Saline-Smoky Hill River drainage divide area but throughout the entire United States, has been set aside and is waiting for future geologists to figure out how that evidence can be explained.

Realizing the geologic literature has for many decades been ignoring much of the well-mapped USGS topographic map drainage system and erosional landform evidence the author of this paper (Clausen) spent many years trying to find a Cenozoic geology and glacial history paradigm (new paradigm) which would be able to explain Missouri River drainage basin topographic map drainage system and erosional landform evidence. The resulting new paradigm is fundamentally different from the accepted paradigm and the two paradigms are incommensurable and cannot be easily compared, but the new paradigm explains the topographic map drainage system and erosional landform evidence and the accepted paradigm does not.

Briefly the new paradigm, as described in Clausen (2020a) sees a Cenozoic glacial history which began with a thick North America continental icesheet (located where icesheets are usually reported to have been) and which created and occupied a deep "hole". The deep "hole" southwest rim followed what is now the east-west continental divide stretching from the Canadian border to the Arkansas River headwaters and then extending eastward along what is now the western Arkansas River drainage basin while the deep "hole" southeast rim followed what is now the Ohio River-Atlantic Ocean drainage divide (see figure 3). Immense south-oriented meltwater floods first flowed across the rising the deep "hole" rim, but were diverted by deep "hole" rim uplift to flow inside the deep "hole" rim to reach what eventually became the deep "hole's" only remaining southern outlet (the Mississippi River valley). Late during the thick icesheet's decay, headward erosion of north-oriented valleys from deep "hole" space that icesheet melting was opening up diverted huge icesheet-marginal floods into the deep "hole" and eventually across the deep "hole" floor to reach northern oceans. The diversion of the immense meltwater floods and other drainage from the Gulf of Mexico to northern oceans triggered much colder climates which froze north-oriented water around detached and semi-detached thick icesheet remnants to create a second and much thinner icesheet and which resulted in an "Ice Age" and alpine glacier development in higher mountain ranges.

The new paradigm considers most Missouri River drainage basin valleys (large enough to be shown on 1:24,000 scale topographic maps) to have been eroded headward along and/or across immense and long-lived meltwater floods. This headward erosion process is described in many papers this author (Clausen) has published to demonstrate how the new paradigm enables explanations of detailed topographic map drainage system and erosional landform evidence such as in western North and South Dakota (Clausen, 2017), western Nebraska (Clausen, 2020b), and eastern Colorado (Clausen, 2022). In the case of the Saline-Smoky Hill River drainage divide the new paradigm requires the east-oriented Saline River valley to have been eroded headward across massive south-oriented meltwater floods which headward erosion of the Smoky Hill River valley had previously captured and which Arkansas River valley headward erosion had captured prior to the Smoky Hill River valley headward erosion. The research question asked here is does detailed topographic map drainage system and erosional landform evidence in the Saline-Smoky Hill drainage divide area support a new paradigm prediction that the present-day Saline-Smoky Hill River drainage divide originated when the Saline River valley eroded headward in a west direction across what must have been enormous south-oriented floods?

2. Research Method

Research was primarily done using USGS detailed topographic maps (originally mapped at a scale of 1:24,000) and tools (such as a spot elevation tool) which are now available at the USGS National Map website. The Saline-Smoky Hill River drainage divide was first subdivided into county size subsections and in each county subsection the Saline-Smoky Hill River drainage divide, as identified on detailed topographic maps, was studied to determine the presence of low points (referred to as divide crossings) linking north-oriented Saline River tributary valleys with south-oriented Smoky Hill River tributary valleys. Divide crossings were interpreted to be where water once flowed across the drainage divide with the drainage divide being formed when headward erosion of a deeper valley beheaded the flow so as to reverse flow in one of the two opposing valleys so as to create the drainage divide. Barbed tributaries where present were used to determine in which of the two opposing tributary valleys the drainage had been reversed and which of the two major river valleys had beheaded the flow. Closely-spaced divide crossings found all along the drainage divide were interpreted to be evidence that large complexes of flood-formed diverging and converging channels once crossed the drainage divide.

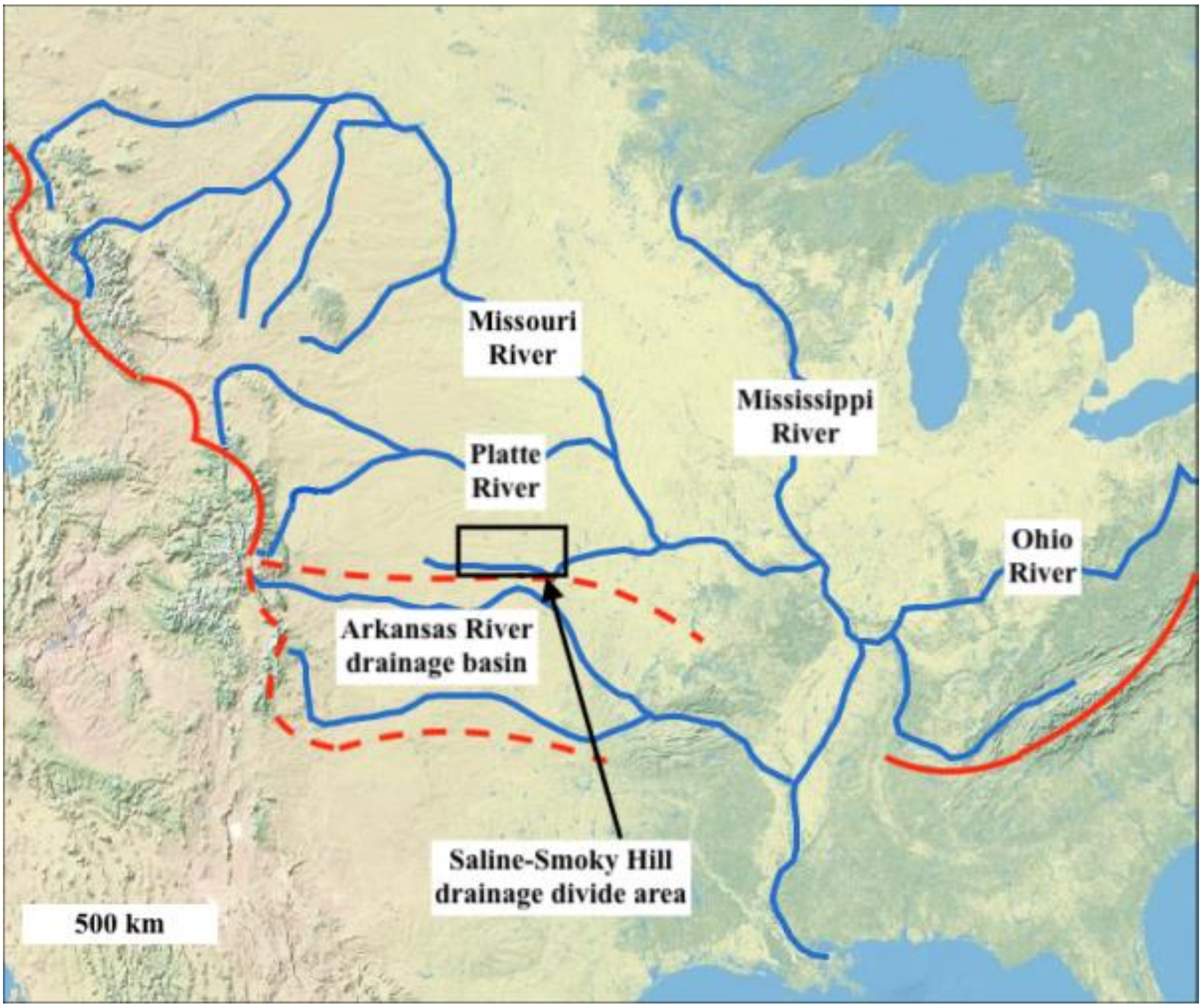

Figure 3. Modified map from the USGS National Map website showing the Saline-Smoky Hill drainage divide area in relation to the location of the new paradigm's deep "hole" rim (shown with red lines). The Arkansas River drainage basin developed on the deep "hole" rim

The new paradigm predicts large floods should have caused the east-oriented Saline and Smoky Hill River valleys (and their east-oriented tributary valleys which include northeast- and southeast-oriented tributary valleys) to have eroded headward across large south-oriented flood formed diverging and converging channel complexes. If so, each east-oriented valley should have eroded headward in advance of the east-oriented valley immediately to the north, although the two valleys may have been eroding simultaneously with the southern valley's headward erosion being only slightly ahead of the northern valley's headward erosion. For this reason, drainage divides between all larger east-, southeast-, and northeast-oriented tributary streams which are located between the Saline and Smoky Hill Rivers were also checked for evidence of closely-spaced divide crossings linking opposing north- and south-oriented tributary valleys and to determine if map evidence suggested their north-oriented headwaters and tributaries had originated as south-oriented drainage routes (e. g. by checking for barbed tributaries).

3. Results

3.1 Saline County Drainage Divide Segment

The Saline-Smoky Hill River drainage divide's easternmost segment is in Saline County and is immediately to the west of where the Smoky Hill River turns and flows in a north direction. The drainage divide extends in a southwest direction from Salina (the city) between the northeast-oriented Spring Creek drainage basin (which empties into the Saline River) and the northeast- and east-oriented Dry Creek drainage basin (which empties into the Smoky Hill River). The Dry Creek drainage basin is interesting as Dry Creek originates near Linsborg where the Smoky Hill River turns in a north direction and then meanders in the Smoky Hill River valley on a route that for a distance is parallel and almost adjacent to the north-oriented and meandering Smoky Hill River. However, the Dry Creek drainage basin includes north-, northeast-, and east-oriented West and Middle Dry Creeks which join north-oriented Dry Creek to flow in an east direction to join the north-oriented Smoky Hill River. A 55-meter-deep divide crossing west of Linsborg links the north-oriented Middle Dry Creek valley with east-oriented Dry Creek headwaters and multiple shallower divide crossings link north-oriented West Dry Creek headwaters with short south-oriented drainage routes flowing to the southeast-oriented Smoky Hill River.

Based on geologic evidence and with no mention of topographic map drainage system and erosional landform evidence previous investigators including Frye and Leonard (1952) and McCauley *et al* (2011) suggested glacial isostatic adjustment reversed south-oriented drainage to create the north-oriented Smoky Hill River route (remarkably consistent with new paradigm predictions), however their reports do not mention implications of that drainage reversal for the Dry Creek drainage basin. Today north-and east-oriented West Dry Creek, Middle Dry Creek, an unnamed Dry Creek tributary, and Dry Creek join to form east-oriented Dry Creek which flows to the north-oriented Smoky Hill River. A reversal of flow on the now north-oriented Smoky Hill River alignment implies flow in the Dry Creek drainage basin should have also been reversed which suggests the previous south-oriented flow must have moved in a complex of flood formed diverging and converging channels. A similar pattern is seen in the north- and northeast-oriented Spring Creek drainage basin (now flowing to the Saline River) which also has multiple north-oriented headwaters streams which are linked by divide crossings across an asymmetric Saline-Smoky Hill River drainage divide segment in the Saline County southwest corner. Barbed tributaries flowing to some north-oriented Spring Creek headwaters further indicate a drainage reversal must have taken place. Saline County topographic map evidence supports previous interpretations that south-oriented drainage preceded the present-day north-oriented Smoky Hill River drainage and also supports the new paradigm prediction that massive south-oriented floods flowing in complexes of diverging and converging channels crossed Saline County prior to the drainage reversal that created the north-oriented Smoky Hill River route.

3.2 Ellsworth and Lincoln County Drainage Divide Segment

The Ellsworth and Lincoln County Saline-Smoky Hill River drainage divide segment is located to the north of the abandoned southeast-oriented Wilson Valley and its Smoky Hill River valley continuation to the southeast. The Saline County southwest corner asymmetric Saline-Smoky Hill River drainage divide continues into eastern Ellsworth County between north-oriented drainage to east-, northeast-, and east-oriented West Spring Creek (flowing to northeast-oriented Spring Creek and the Saline River) and short south-oriented drainage routes to the southeast-oriented Smoky Hill River. Elevations along this drainage divide segment are slightly more than 500 meters with 10-meter-deep divide crossings linking north- and south-oriented drainage routes (which suggest multiple streams of water once crossed the drainage divide). To the west and north of West Spring Creek is north-, northeast-, and southeast-oriented Mulberry Creek which flows to northeast-oriented Spring Creek. A 25-meter-deep divide crossing links north-oriented Mulberry Creek headwaters with a south-oriented tributary to south-oriented Alum Creek. Study of the Mulberry-Spring Creek and Saline River-Mulberry Creek drainage divides suggests headward erosion of the Mulberry Creek valley beheaded and reversed south-oriented flood flow to the Spring Creek drainage basin and Saline River valley headward erosion beheaded multiple south-oriented flood flow channels to the Mulberry Creek drainage basin.

To the west of the north-oriented Mulberry Creek headwaters is south-oriented Alum Creek which can be seen in figure 2 (and which is located in Ellsworth County). Before reaching figure 2 the Saline-Smoky Hill River drainage divide is located between north-oriented Mulberry Creek drainage and south-oriented Alum Creek drainage and in figure 2 the drainage divide (shown with a red dashed line) circles around the north-oriented East Elkhorn Creek drainage basin and is crossed by several obvious divide crossings (shown with red numbers). The most obvious divide crossing is at the red number 1 and is a 25-meter-deep or deeper valley linking the north-oriented East Elkhorn Creek valley with the south-oriented Clear Creek valley. The divide crossing at the red number 2 is at least 15 meters deep and links north-oriented West Elkhorn Creek drainage with south-oriented East Spring Creek drainage. More common are divide crossings like at the red number 3 which are only a few meters deep. The divide crossing at number 3 links a north- and south-oriented East Elkhorn Creek tributary valley with a south-oriented Clear Creek tributary valley. In the case of figure 2 the barbed tributaries indicate two or more closely spaced and probably diverging and converging streams of water in the East Elkhorn and West Elkhorn Creek drainage basins once flowed in a south direction to what is now the Smoky Hill River drainage basin and that the flow has subsequently been reversed to create the Saline-Smoky Hill River drainage divide and the present-day drainage systems. Sizes and depths of the north-oriented valleys suggest large volumes of water must have reversed their flow direction which would only be possible if headward erosion of a deep east-oriented Saline River valley had been across massive south-oriented floods as the new paradigm predicts.

East and West Elkhorn Creeks join to the north of figure 2 and flow as north-oriented Elkhorn Creek to the east-oriented Saline River in Lincoln County (north of Ellsworth County). Berry (1952) who does not mention using topographic map evidence reported "By Kansan time... the Saline River... flowed through [the] Wilson Valley into the Smoky Hill River. Deposits of Kansan age fill the Wilson Valley channel.... A period of erosion and downcutting followed the deposition of the Kansan channel deposits.... During this erosion period, a stream flowing in the lower Saline Valley cut down and captured the stream in [the] upper Wilson Valley causing it to flow in approximately the present Saline River Valley." Berry does not explain what caused lower Saline River valley headward erosion nor does he mention northeast-oriented Bullfoot Creek which joins the Saline River west of Elkhorn Creek and which has north-oriented headwaters and tributaries. North-oriented Bullfoot Creek headwaters are linked by a 15-meter-deep divide crossing with south-oriented Cow Creek which flows into the Wilson valley and then the Smoky Hill River. Divide crossings linking north-oriented Bullfoot Creek tributaries with south-oriented Smoky Hill River tributaries suggest the northeast-oriented Bullfoot Creek valley eroded headward in advance of east-oriented lower Saline River valley headward erosion. Figure 4 illustrates divide crossings along a Saline River-Bullfoot Creek drainage divide segment which suggest Saline River valley headward erosion captured multiple south-oriented flood flow channels that had been moving water to a probably newly-eroded Bullfoot Creek valley.

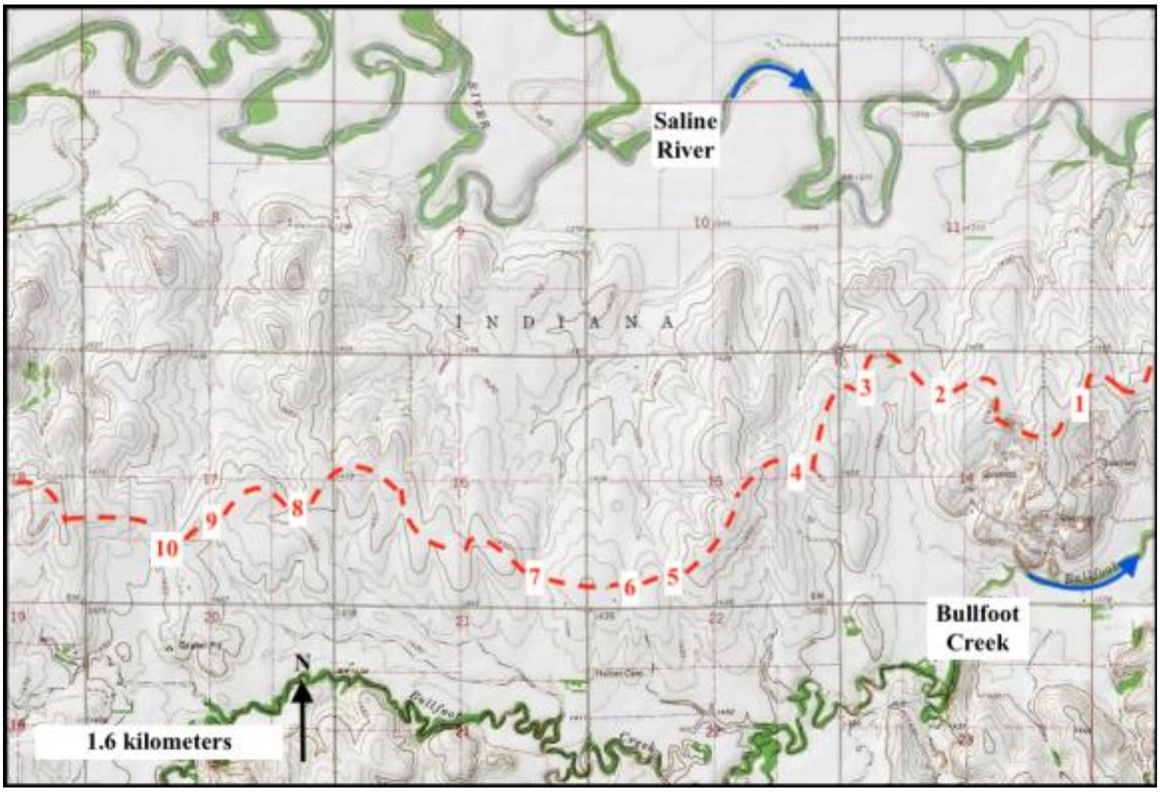

Figure 4. Modified topographic map from the USGS National Map website showing the Saline River-Bullfoot Creek drainage divide (red dashed line). Red numbers identify divide crossings. The contour interval is 10 feet (3 meters). Top left corner 39^0 02' 08.546" N., 98^0 14' 59.639" W

West of the Bullfoot Creek drainage basin is the north-oriented Twin Creek drainage basin which is linked by at least three obvious divide crossings with south-oriented drainage flowing into the southeast-oriented Wilson Valley. These divide crossings suggest Saline River valley headward erosion beheaded and reversed what had been south-oriented diverging and converging flood flow channels moving floodwaters into what was probably a newly eroded Wilson Valley so as to create what is now the north-oriented Twin Creek drainage system. West of the Twin Creek drainage basin and just before reaching Russell County southeast-oriented Wolf Creek joins a short northeast-oriented Saline River segment to create the east-oriented lower Saline River. The abrupt Saline River direction change in extreme eastern Russell County from a southeast orientation to a northeast orientation suggests headward erosion of the short northeast-oriented Saline River valley segment captured southeast-oriented upper Saline River valley flow which had been moving into the Wilson Valley which apparently had eroded headward in a northwest direction from what was probably an actively eroding Smoky Hill River valley to the south. Figure 5 illustrates two obvious divide crossings on a short segment of the Wilson Valley-Smoky Hill River drainage divide segment which suggest Wilson Valley headward erosion beheaded and reversed multiple south-oriented flood flow channels moving water to what was probably at that time a newly eroded Smoky Hill River valley. The upper Saline River valley (in Russell County and westward) probably eroded headward from the Wilson Valley until being captured by lower Saline River valley headward erosion.

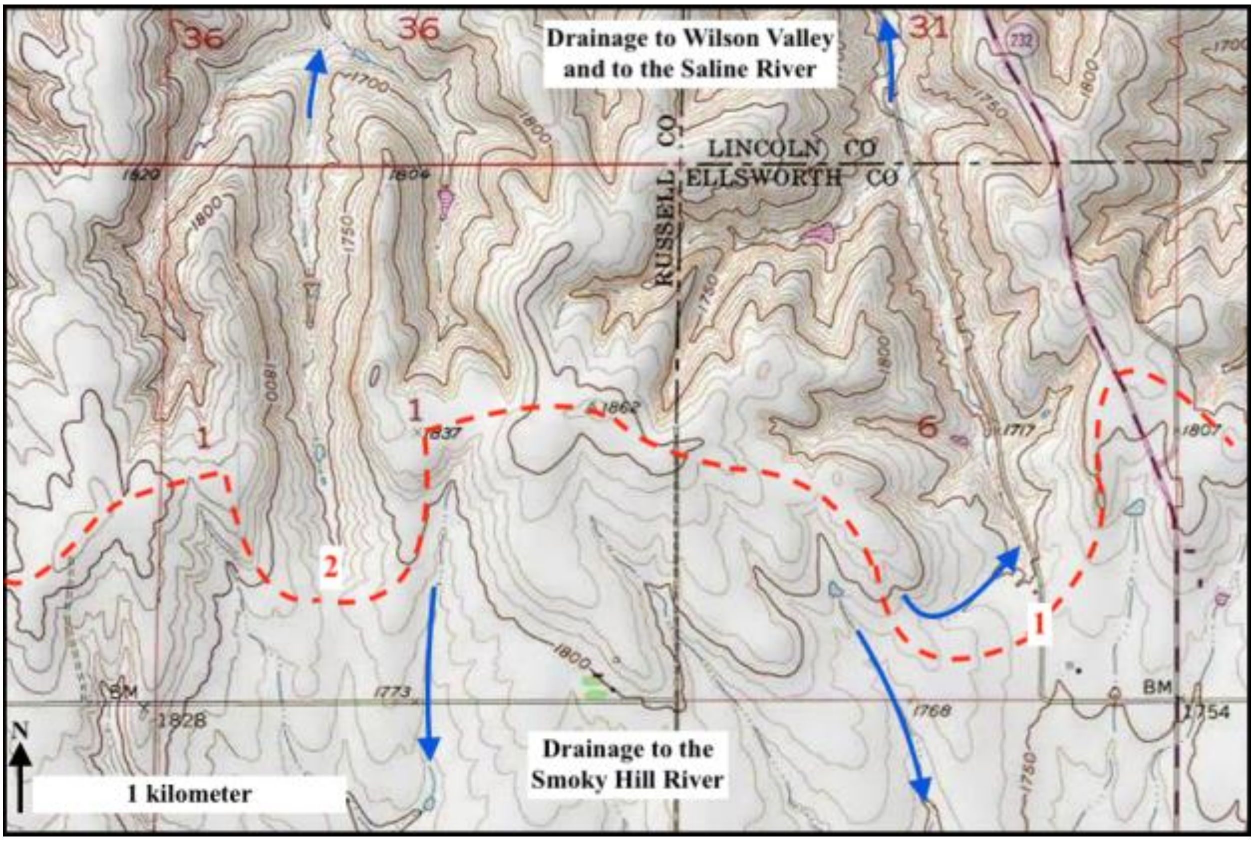

Figure 5. Modified topographic map from the USGS National Map website showing divide crossings with red numbers across the Wilson Valley-Smoky Hill River drainage divide. The contour interval is 10 feet (3 meters). Top left corner: 38^0 52’ 29.766” N, 98^0 30’ 31.168” W

3.3 Russell County Drainage Divide Segment

The simplest Saline-Smoky Hill River drainage divide segment is located in eastern Russell County (to the east of the town of Russell) where the east-oriented Saline River is located approximately 20 kilometers to the north of the east-oriented Smoky Hill River. This simple drainage divide segment is characterized by shallow divide crossings linking opposing south-oriented Smoky Hill River and north-oriented Saline River tributaries. Figure 6 illustrates one such divide crossing at the red number 1 which is approximately 9 kilometers to the southeast of Russell (the town) and which shows up well on the detailed topographic maps. Shallow divide crossings cross the western Russell County Saline-Smoky Hill River drainage divide which is located between east-oriented Salt

Creek (which flows to the Saline River at a point where the Saline River turns from flowing in a southeast direction to an east direction) and the Smoky Hill River. Numerous shallow divide crossings are present along the Saline River-Salt Creek drainage divide and also along drainage divides between east-oriented Salt Creek tributaries. The divide crossings provide evidence that multiple streams of south-oriented water once crossed all of the west-to-east oriented drainage divides and must have been captured in sequence from the south to the north by Smoky Hill River valley headward erosion, Salt Creek valley (and tributary valley) headward erosion, and finally by Saline River valley headward erosion.

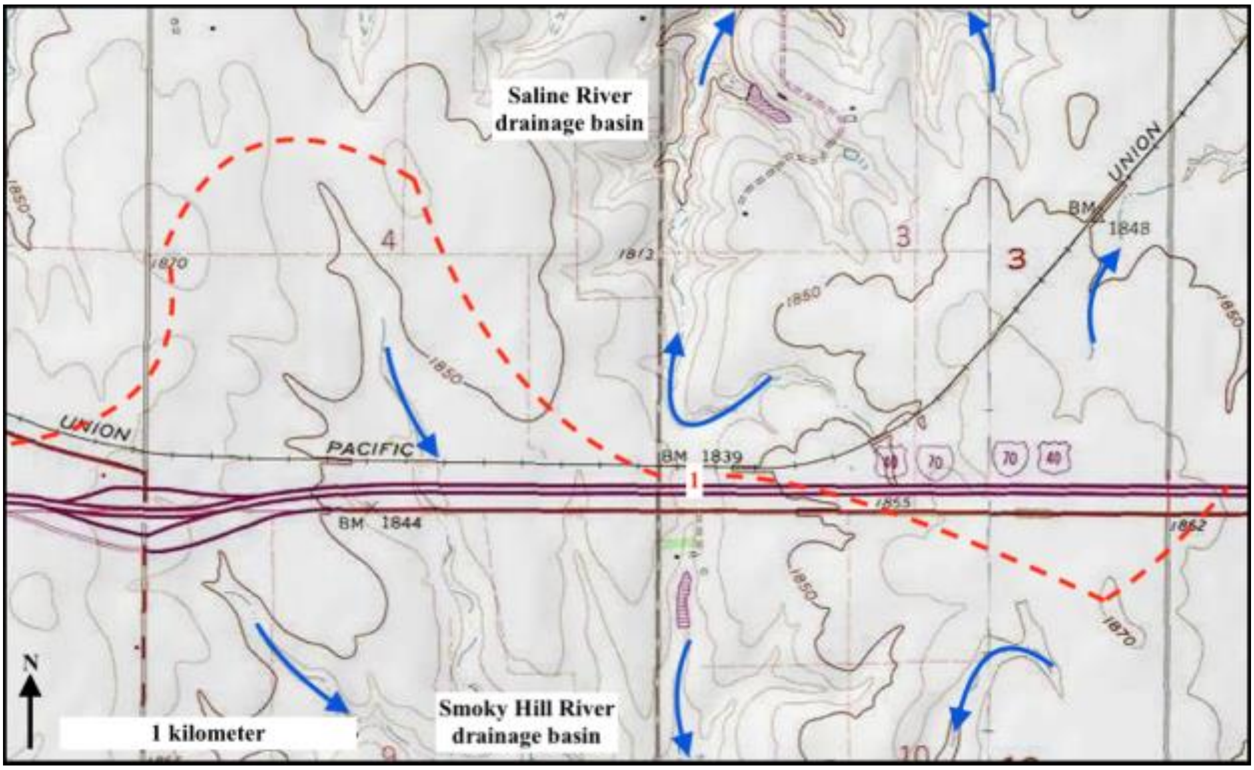

Figure 6. Modified topographic map from the USGS National Map website showing a Russell County divide crossing across the Saline-Smoky Hill River drainage divide (red dashed line). The contour interval is 10 feet (3 meters). Top left corner: 38^0 52’ 15.002” N, 98^0 47’ 09.980” W

Previous publications in which the use of topographic map drainage system and erosional landform evidence is not mentioned describe the development of the Russell County drainage system as a Pleistocene event. For example, Arbogast and Johnson (1996, p. 37) who used topographic maps for geologic mapping purposes, but who otherwise emphasized stratigraphic information commented “at some time during the early Pleistocene, after aggradation of stream channels with a Rocky Mountain sediment load, a period of major erosion, stream system development, and entrenchment occurred in Russell County. No sediments from this time have been positively identified owing to their antiquity, unconsolidated nature, and probable high topographic position. The present drainage pattern in Russell County was apparently established no later than late pre-Illinoian.” Arbogast and Johnson give no details and make no mention of east-oriented valleys that eroded headward across large south-oriented floods, although large south-oriented floods were probably responsible for the erosion event they mention.

3.4 Ellis County Drainage Divide Segment

The Saline-Smoky Hill River drainage divide as it progresses westward from Russell County into Ellis County becomes asymmetrical with southeast- and east-oriented Big Creek located between the two rivers (Big Creek flows to the Smoky Hill River). To the north of the Big Creek drainage basin the Saline River flows in an east and southeast direction as it crosses northern Ellis County. The northeast Ellis County Blue Hills which are a 50-meter-high northeast-facing escarpment in northeastern Ellis County (seen in figure 7) are located to the southwest of the southeast-oriented Saline River segment. The northeast-facing escarpment appears to be an erosional feature as the Neuhauser and Pool (1988) Ellis County geologic map shows no surficial evidence of geologic structures (although oil fields underly the region).

Divide crossings along the escarpment crest (some are identified by red numbers) link north-oriented Saline River tributary valleys with south- and southeast-oriented valleys draining to southeast-oriented Walker Creek and North Fork Big Creek which both flow to east-oriented Big Creek. More detailed topographic maps with a 10-foot (3-meter) contour interval (as opposed to the 10-meter contour interval seen in figure 7) show many more such divide crossings. These divide crossings indicate that prior to Saline River valley headward erosion multiple channels of south-oriented water must have flowed across the area to what was probably an actively eroding Big Creek valley head. In eastern Ellis County shallow divide crossings (similar to the divide crossing seen in figure 6) cross the Big Creek-Smoky Hill River drainage divide and indicate that prior to Big Creek valley headward erosion the south-oriented floodwaters had been flowing to what was probably a newly eroded Smoky Hill River valley.

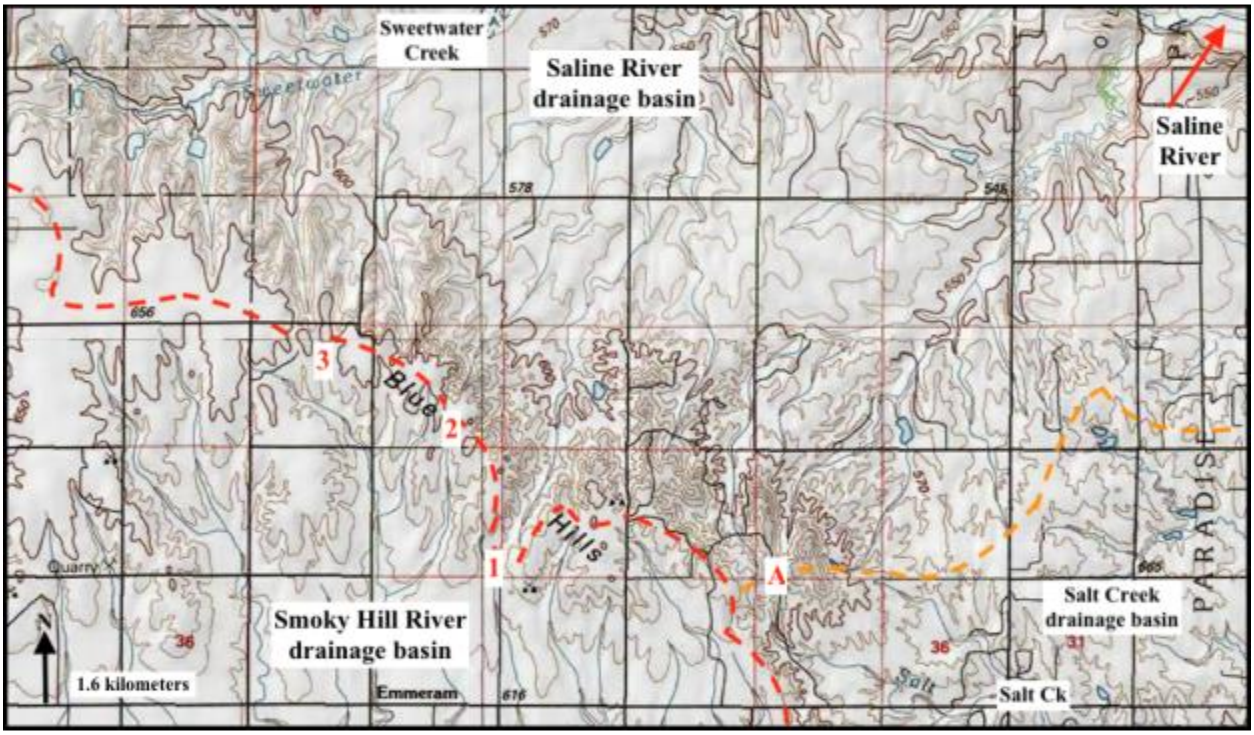

Figure 7. Modified topographic map from USGS National Map website showing Saline-Smoky Hill River drainage divide (red dashed line) in the Blue Hills area of northeast Ellis County. The contour interval is 10 meters. Top left corner: 39^0 02' 16.916" N, 99^0 11' 05.627" W

To the west of the northeast Ellis County Blue Hills the Saline-Smoky Hill River drainage divide is located between the east-oriented Saline River and east- and southeast-oriented Big Creek except in northwest Ellis County where east- and north-oriented East Spring Creek is located between a southeast-oriented Saline River segment and Big Creek. In western Ellis County several shallow divide crossings cross the Saline River-East Spring Creek drainage divide and link north- and northeast-oriented Saline River tributary valleys with south-oriented East Spring Creek tributary valleys. The deepest (about 15 meters) and most obvious divide crossing along the East Spring-Big Creek drainage divide is to the south of the north-oriented East Spring Creek segment. That obvious divide crossing links a north-oriented East Spring Creek tributary valley (draining to north-oriented East Spring Creek) with a south-oriented Big Creek tributary valley. Other East Spring-Big Creek drainage divide crossings while shallower also link north-oriented East Spring Creek tributary valleys with south-oriented Big Creek tributary valleys. To the east of the East Spring Creek drainage basin and to the west of the Blue Hills shallow divide crossings along the Saline River-Big Creek drainage divide link north-oriented Saline River and south-oriented Big Creek tributary valleys and provide evidence that Saline River valley headward erosion beheaded and reversed multiple south-oriented flood flow channels.

The Smoky Hill River flows in an east direction across southern Ellis County and as stated is to the south of southeast- and east-oriented Big Creek with the Big Creek-Smoky Hill River drainage divide width increasing in a westward direction. Shallow divide crossings similar to the one seen in figure 6 cross the southeastern Ellis County Big Creek-Smoky Hill River drainage divide and indicate that Big Creek valley headward erosion captured south-oriented flood flow which was probably moving in multiple diverging and converging channels. Further to the west in southcentral Ellis County (to the south of Hays) several relatively short southeast-oriented Big Creek tributaries parallel what is a southeast-oriented Big Creek valley segment and southeast-oriented Smoky Hill River tributaries including those flowing to the southeast-oriented Lookout Valley. Shallow divide crossings link headwaters of these southeast-oriented Smoky Hill River tributaries with north-oriented Big Creek tributaries and suggest headward erosion of the Big Creek valley may have been capturing southeast-oriented flood flow.

Still further to the west in Ellis County where the Big Creek-Smoky Hill River drainage divide width is the greatest more obvious divide crossings link longer north-oriented Big Creek tributary valleys with south-oriented Smoky Hill River tributary valleys and suggest Big Creek valley headward erosion was across multiple south-oriented diverging and converging channels. In summary, Smoky Hill River valley headward erosion captured what must have been large volumes of south-oriented flood flow that had been flowing across Ellis County, Big Creek valley headward erosion next captured the flood flow and ended all flood flow to what at that time were newly eroded Smoky Hill River valley segments located immediately to the south with Saline River valley headward erosion next capturing the south-oriented floodwaters and ending all flood flow to the then newly eroded Big Creek valley to the south.

3.5 Trego, Sheridan, Gove County and Westward Drainage Divide Segment

The east-oriented Saline River flows across northern Trego County, the east-oriented Smoky Hill River flows across southern Trego County, and southeast- and east-oriented Big Creek flows between the two rivers. Spring Creek is a southeast-oriented Big Creek tributary located in northeastern Trego County where the Saline-Smoky Hill River drainage divide is between the Saline River and Spring Creek. Shallow divide crossings seen on detailed topographic maps link north-oriented Saline River tributary valleys with south-oriented Spring Creek tributary valleys. Shallow divide crossings are also present along the Spring-Big Creek drainage divide and along the Big Creek-Smoky Hill River drainage divide to the south.

In eastern Trego County Big Creek after flowing in a southeast direction makes a turn in a northeast direction before continuing to flow in an east direction. To the south of the northeast turn are several rather obvious and closely spaced divide crossings suggesting Big Creek valley headward erosion beheaded and reversed multiple south-oriented flood flow channels and for a short distance eroded headward along one of the reversed flow channels. Overall, the eastern Trego County evidence is consistent with evidence from the counties further to the east and indicates that Big Creek valley headward erosion captured south-oriented flood flow which had been moving to the Smoky Hill River valley, Spring Creek valley headward erosion captured south-oriented flood flow to the Big Creek valley, and Saline River valley headward erosion next captured south-oriented flood flow to the Spring Creek valley.

To the west of the Spring Creek headwaters (near WaKeeney) east- and northeast-oriented Trego Creek is located between the Saline River and an east-oriented Big Creek segment. The Trego Creek direction change is located to the north of figure 8 which shows four different divide crossings (identified by red numbers) across the Saline River-Big Creek drainage divide. These divide crossings suggest Saline River valley headward erosion beheaded and reversed diverging and converging channels which were moving south-oriented water to the Big Creek drainage basin. To the west of the Trego Creek headwaters in western Trego County the Saline River-Big Creek drainage divide is simpler and is crossed by shallow divide crossings linking north-oriented Saline River tributary valleys with southeast-oriented Big Creek tributary valleys.

To the south of the western Trego County east-oriented Big Creek segment shallow divide crossings along the Big Creek-Smoky Hill River drainage divide link north-oriented Big Creek tributary valleys with south-oriented Smoky Hill River tributary valleys. Western Trego County drainage history is consistent with eastern Trego County drainage history and began with headward erosion of the east-oriented Smoky Hill River valley across a large complex of south-oriented flood flow channels with the floodwaters next being captured in sequence by Big Creek valley headward erosion and then by Saline River valley headward erosion.

To the west of Trego County, the Saline-Smoky Hill River drainage divide continues as an asymmetric drainage divide between short north-oriented Saline River tributaries and much longer southeast-oriented Big Creek tributaries and is located roughly along what is now the Sheridan-Gove County line (with Gove County directly to the west of Trego County and Sheridan County to the north of Gove County). In Gove County, southeast-oriented Hackberry Creek is located between southeast-oriented Big Creek and the east-oriented

Smoky Hill River. Southeast-oriented Hackberry Creek tributaries are located between it and Big Creek and east-oriented Hackberry Creek tributaries are located between it and the Smoky Hill River. The result is to the south of the asymmetric Saline-Smoky Hill River drainage divide and to the north of the Hackberry Creek-Smoky Hill River drainage divide there are multiple southeast- and east-oriented drainage divides which now separate the various southeast- and east-oriented Big Creek and Hackberry Creek drainage system valleys.

Each of these multiple drainage divides gradually slopes in an east direction from western Gove County where elevations exceed 900 meters to eastern Gove County where elevations are less than 800 meters. The most detailed topographic maps show shallow divide crossings (frequently defined by only one 10-foot or 3-meter contour line) along these east-sloping drainage divides with the most prominent divide crossings linking north- and south-oriented tributaries to the southeast- and east-oriented Big and Hackberry Creek drainage system valleys. The shallow divide crossings suggest the east- and southeast-oriented Gove County valleys, like in the counties further to the east, were eroded headward in sequence from south to north across what must have been south-oriented floods flowing in shallow diverging and converging channels as regional uplift gradually raised western Kansas relative to regions further to the east.

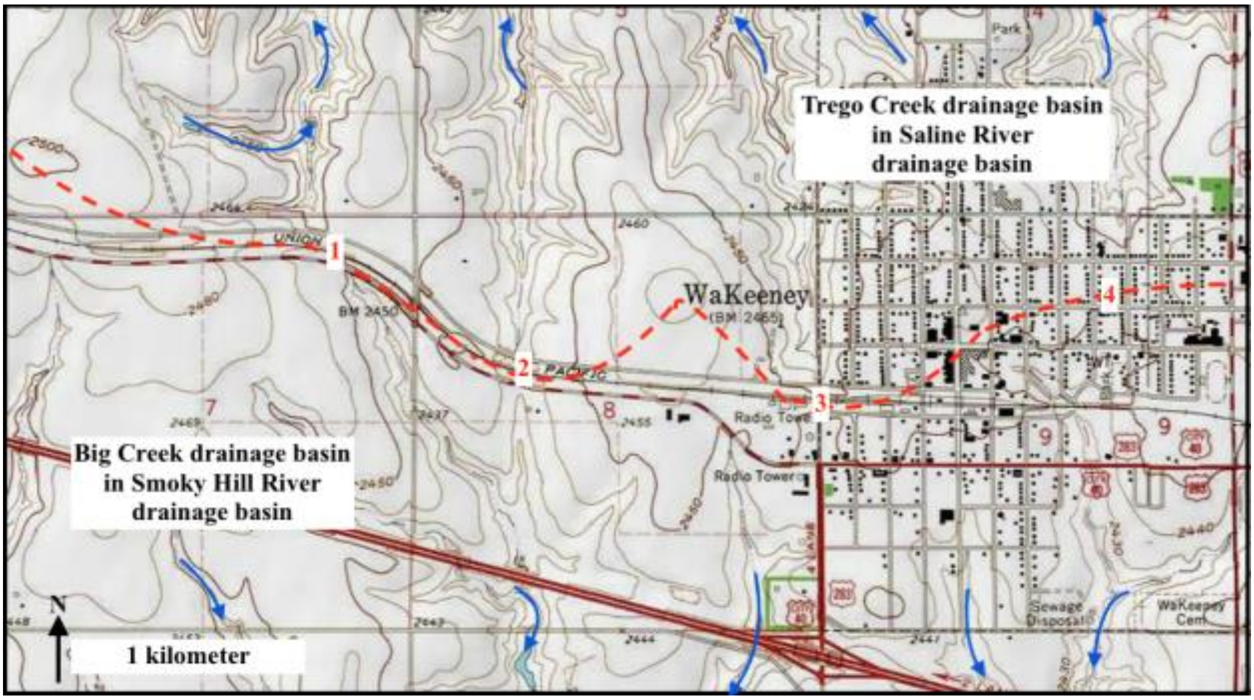

Figure 8. Modified topographic map from the USGS National Map website showing the Saline River-Smoky Hill River drainage divide (red line) at WaKeeney, Kansas. The contour interval is 10 feet (3 meters). Top left corner: 39^0 02' 14.486" N, 99^0 55' 36.772" W

The Saline River is formed in the Sheridan County southwest corner at the confluence of its east-oriented South Fork and east-southeast oriented North Fork. The South Fork flows across southern Thomas County (directly to the west of Sheridan County) and a short distance to the north of the asymmetric Saline-Smoky Hill River drainage divide which separates east-oriented South Fork Saline River drainage from drainage to southeast-oriented Hackberry Creek tributaries and headwaters. Shallow divide crossings which can be seen on detailed topographic maps such as the four divide crossings seen in figure 9 which indicate that headward erosion of the east-oriented South Fork Saline River valley was across multiple streams of south-oriented water.

Previous investigators (many who worked before the most detailed topographic maps became available) apparently did not consider whatever divide crossing evidence they saw as being important, although some early investigators saw evidence for a period of erosion as the present-day drainage system developed. For example, Frye (1945) reported that following deposition of the Ogallala "algal limestone the major streams, in whatever position they happened to occupy, started to entrench their channels through their former deposits and, in those areas where the Ogallala was quite thin, into the underlying bedrock. The causes for this period of erosion are complex and probably include both differential uplift and climate change." Not mentioned in Frye's report are the shallow divide crossings which indicate the South Fork Saline River valley must have eroded headward across multiple south-oriented streams of water.

4. Discussion

Detailed topographic maps show closely-spaced and often shallow divide crossings along all Saline-Smoky Hill River drainage divide segments stretching from the western Kansas Saline River headwaters area to the much lower elevation central Kansas Saline-Smoky Hill River confluence area. These divide crossings suggest the Saline River valley eroded headward across massive south-oriented floods. Previous investigators do not mention using topographic maps as an information source nor do they mention the divide crossings or suggest that the Saline River valley eroded headward across large south-oriented floods, although they do mention one or more periods of Pleistocene erosion that occurred as the present-day drainage systems evolved. The topographic map evidence by itself provides no way to determine when during geologic time the Smoky Hill and Saline River valleys eroded headward across south-oriented floods, although continental icesheet meltwater is the most likely floodwater source. If so, from the accepted paradigm perspective (and the perspective of most previous workers) the large south-oriented floods probably would have occurred after deposition of the Pliocene Ogallala formation and perhaps following the Pleistocene Kansan or Nebraskan glaciations.

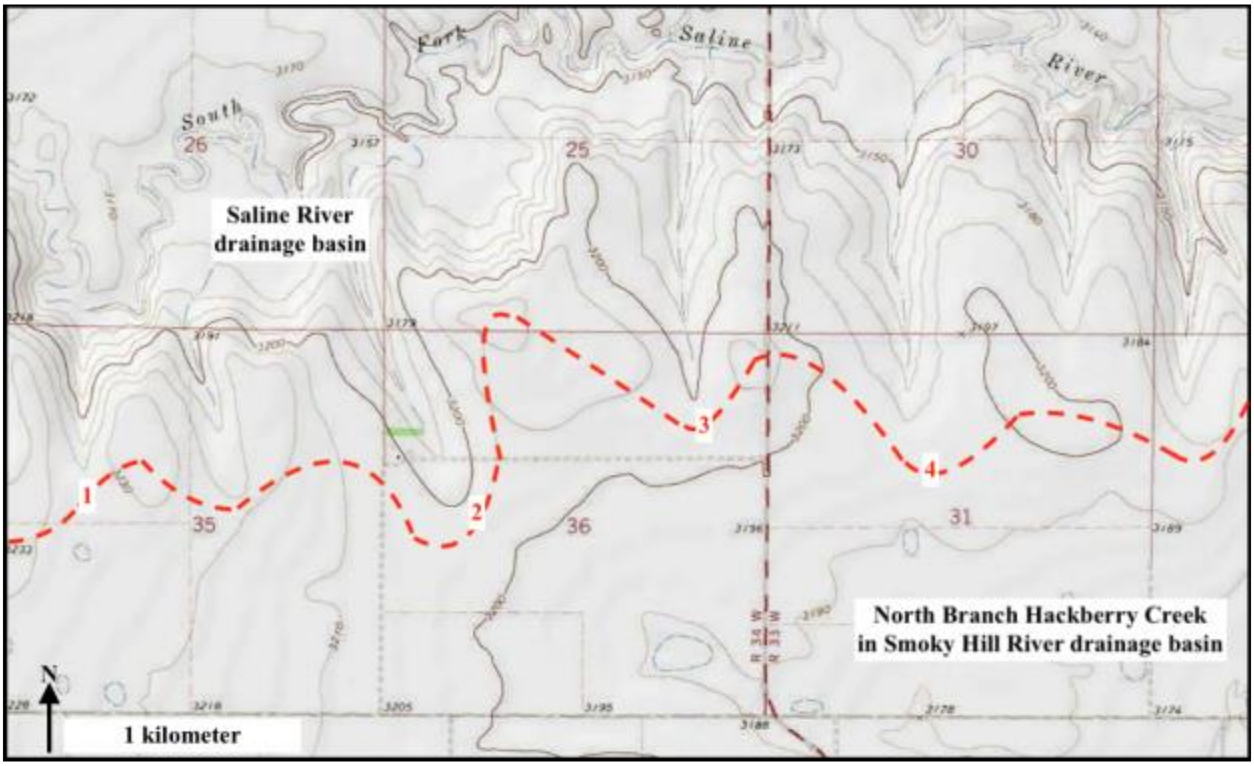

Figure 9. Modified topographic map from USGS National Map website showing shallow divide crossings along the asymmetric South Fork Saline River-Smoky Hill River drainage divide. The contour interval is 10 feet (3 meters). Top left corner: 39^0 09' 35.590" N, 101^0 05' 37.305" W

Probably due to the Saline-Smoky Hill River drainage divide's noticeable eastward slope previous researchers working from the accepted paradigm perspective have not reported evidence for continental icesheet meltwater flowing across regions west of the Saline-Smoky Hill River confluence area. Cooper (2001) interpreted Saline-Smoky Hill River confluence area elevations to be too high to have been reached by icesheet-marginal lake overflow and today's Saline-Smoky Hill River drainage divide elevations rise in a westward direction from about 370 meters in that confluence area to more than 1000 meters in the Saline River headwaters area. Had such elevation differences been present large south-oriented meltwater floods that originated from accepted paradigm described continental icesheets could not have flowed across the entire Saline-Smoky Hill River drainage divide area, which means western Kansas would have to have been uplifted during or after the Saline River valley headward erosion. While not impossible from the accepted paradigm perspective previous investigators have not suggested that western Kansas was uplifted while (or after) massive south-oriented floods crossed the state.

Gradual uplift which occurred while east-oriented Kansas river valleys were eroding headward in sequence from south to north across large south-oriented meltwater floods (as the topographic map evidence indicates) is precisely what the new paradigm predicts. Uplift of the new paradigm's deep "hole" southern rim (located to the south and west of the Saline-Smoky Hill River drainage divide area) would have gradually diverted immense south-oriented meltwater floods from flowing directly to the Gulf of Mexico to flowing in an east direction toward the Mississippi River valley, which eventually became the deep "hole's" only southern exit. This eastward diversion of the immense south-oriented meltwater floods would have been responsible for the headward erosion of east-oriented valleys in sequence (as the detailed topographic map evidence suggests) from the south to the north as uplift raised the deep "hole's" southwestern rim. However, the new and accepted paradigms describe completely different and incommensurable Cenozoic geologic and glacial histories and those histories are incompatible and cannot be easily compared. Topographic map evidence for numerous, yet previously unmentioned, closely-spaced divide crossings along the Saline-Smoky Hill River drainage divide as described here strongly supports the new paradigm interpretation and points out the dangers of failing to study the detailed topographic map drainage system and erosional landform evidence whenever trying to interpret a region's Cenozoic geologic and/or glacial history.

5. Conclusions

Previously published reports describing the Saline-Smoky Hill River drainage divide area geologic history do not mention using USGS topographic maps as an information source, although topographic maps probably provided at least some of the elevation data used. This omission of important topographic map information is unfortunate as topographic maps (especially detailed topographic maps) show valuable drainage history information such as divide crossings or low points along present-day drainage divides. In the case of the Saline-Smoky Hill River drainage divide, closely-spaced divide crossings are found along the entire drainage divide and indicate the east-oriented Saline River valley eroded headward across multiple closely-spaced south-oriented streams of water such as might occur in a large flood-formed anastomosing channel complex. Similar divide crossings are also found along drainage divides separating east-oriented Saline and Smoky Hill River tributaries which are located in the region between the Saline and Smoky Hill Rivers and indicate the east-oriented tributary and Smoky Hill River valleys also eroded headward across large south-oriented floods.

The many asymmetric Saline-Smoky Hill River drainage divide segments and the presence of closely-spaced divide crossings along all Saline-Smoky Hill River drainage divide segments and also along all drainage divides separating east-oriented Saline and Smoky Hill River tributaries from each other and from the Saline and Smoky Hill Rivers support new paradigm predictions that Saline River valley headward erosion must have been across massive south-oriented meltwater floods and must have occurred as uplift of the Kansas and Oklahoma region was gradually diverting immense south-oriented floods toward the Mississippi River valley.

While previous investigators working from the accepted paradigm perspective usually consider the development of most Kansas drainage systems to have occurred during Pleistocene time the accepted and new paradigm are incommensurable and how and even whether new paradigm events fit into the accepted paradigm geologic time scale cannot be determined from the topographic map evidence. The topographic map evidence illustrated here definitely shows that previous investigators have overlooked and/or ignored critically important evidence and also demonstrates the new paradigm's remarkable ability to explain detailed topographic map drainage and erosional landform evidence. Further work in additional geographic regions is needed to further test the new paradigm's ability to explain topographic map evidence.

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