GEOLOGY OF THE JACKSON AREA, TETON COUNTY, WYOMING

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Submitted in partial fulfillment
of the requirements for the degree
of Master of Science in Geology,
University of Michigan, 1947

M.S. June 1947

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INTRODUCTION

Location of area

The Jackson area designates the country immediately around the town of Jackson in the southern part of Jackson Hole, Teton County, Wyoming. It includes specifically the Gros Ventre Buttes, west and northwest of the town, and Cache Creek east of town. The area mapped covered approximately 16 square miles.

The Gros Ventre Mountains lie in the west central part of Wyoming, approximately 40 miles south of Yellowstone Park, and trend northwest-southeast. They are offset on the southeast from the Wind River Mountains and separated from it by the valley of the Green River. To the north the Gros Ventres are bounded by the Gros Ventre River and to the west by Jackson Hole. The southwestern limit of the range is the canyon of Cache Creek, beyond which is the Hoback Range. See index map. In this region the ridges of the Hoback Range and the Gros Ventre Mountains are less than one-half mile apart in places. It is this area with which this report largely deals.

Cache Creek heads in the Gros Ventre Mountains southeast of Jackson and flows northwest for 8 miles before it reaches Jackson Hole and enters Flat Creek. The channel of the creek was used as the southwestern boundry of the area, but the geological map of the report also includes the south side of the valley which was mapped by the writer's field associate, Lyman Galbraith. The divide between that creek and Nowlin Creek was used as the northeastern boundry. A trail, the Flat Creek Trail, which

PLATE 1

SCALE IN MILES

0 25 50 75 100

INDEX MAP

leads over a pass between the headwaters of Cache Creek and Flat Creek, was chosen as the southeastern limit and Jackson Hole the northwestern boundry. This section will hereafter be referred to as the Cache Creek area.

In addition to the Cache Creek area the buttes west and northwest of Jackson were also mapped. These buttes are East Gros Ventre Butte, which lies directly west of Jackson, its western neighbor, West Gros Ventre Butte and three smaller unnamed buttes in the vicinity.

Purpose of study

This report was written as partial fulfillment of the requirements for a Master of Science degree at the University of Michigan.

Acknowledgements

Field work and preparation of the manuscript for this report was carried on under the supervision of A. J. Eardley, Professor of Geology at the University of Michigan. Valuable assistance in the field was given by Lyman Galbraith, a graduate student at the University of Michigan.

STRATIGRAPHY

Pre-Cambrian system

The rocks of the pre-Cambrian system do not crop out in the area mapped, but they are widely exposed in the Teton Range to the northwest and in the higher part of the Gros Ventre Mountains to the east. In the Tetons the pre-Cambrian rocks consist of steeply dipping gneisses and schists which have been intruded by pegmatite, granite, and basic dikes. The schists and gneisses make up the nucleus of the range, but quartzites

Table 1, Stratigraphic column of the Jackson area, Teton County, Wyoming.

Age	Formation	Thickness in feet
Quaternary	Alluvium	Unknown
Upper Miocene	Volcanic deposits	Unknown
Upper Miocene	Camp Davis formation	2250
Upper Cretaceous	Frontier formation	3000
Upper Jurassic	Stump sandstone	100
Upper Jurassic	Preuss sandstone	120
Middle to Upper Jurassic	Twin Creek formation	350
Middle Jurassic	Gypsum Spring formation	160
Lower Jurassic	Nugget sandstone	200
Middle to Upper Triassic	Ankareh formation	160
Lower Triassic	Thaynes limestone	100
Lower Triassic	Woodside formation	350
Lower Triassic	Dinwoody formation	200
Permian	Phosphoria formation	270
Pennsylvanian	Tensleep sandstone	200
Pennsylvanian	Amsden formation	220
Middle and Upper Mississippian	Brazer limestone	200
Lower Mississippian	Madison limestone	800
Devonian	Darby formation	200
Devonian (?)	Leigh formation	40
Upper Ordovician	Bighorn dolomite	300
Upper Cambrian	Boysen formation	200
Middle Cambrian	Gros Ventre formation	350
Middle Cambrian	Flathead quartzite	175

are found in some scattered localities. (Horberg, 1938,p.13)

Cambrian system

Flathead quartzite-The Flathead quartzite is exposed along Flat Creek Trail in the southeast section of the area. The formation is a buff orthoquartzite, made up of silicious grains of nearly uniform size in a silicious matrix. In the Teton Pass area the beds are 175 feet thick and rest unconformably upon the pre-Cambrian schists and gneisses. (Horberg, 1938, p.13). In the Cache Creek area the base of the quartzite is not exposed and consequently, the total thickness can not be determined.

The type exposure is in Flathead Pass in the northeast corner of the Threeforks quadrangle, Montana and was first described by Peale (1893, p.20). The Flathead quartzite is Middle Cambrian in age. (Miller, 1936, p.115).

Gros Ventre formation-The Gros Ventre formation is exposed along the Flat Creek Trail in the southeast extremity of the area, and also in the small butte to the southwest of West Gros Ventre Butte. The formation consists of three distinct lithologic units, a lower shale member, a middle limestone member and an upper shale member. The lower member, the Lower Gros Ventre shale, consists of red to green glauconitic, chloritic and hematitic shales with a few thin interbedded red to tan sandstones. The middle member, the Death Canyon limestone, is made up of a fine grained, thin bedded, medium to dark gray limestone in places characterized by a rusty mottling. The upper member, the Upper Gros Ventre shale, is a grayish green, paper-thin, calcareous shale with a few interbedded layers of a flat pebble conglomerate. Along Flat Creek Trail, where the total thickness

is 350 feet, the Gros Ventre formation lies conformably upon the Flathead quartzite. Horberg (1938, p.12) reports the formation to be 600 feet thick in the Teton Pass area.

Blackwelder (1918, pp.417-426) first described the Gros Ventre formation where it crops out on the west slope of Doubletop Peak in the Gros Ventre Range, Wyoming. The formation is Middle Cambrian in age. (Miller, 1936, p.115).

Boysen formation-The Boysen formation is exposed along the Flat Creek Trail in the southeast end of the area and also in the small butte southwest of West Gros Ventre Butte. The formation consists of gray, thick to thin bedded, finely crystalline limestone, which weathers brown to tan. Locally the formation is oolitic. Rusty mottling and a rough pitted surface characterize the weathered rock. Interbedded in the limestone are a few thin beds of limey shale. The Boysen is 200 feet thick and rests unconformably upon the Upper Gros Ventre shale.

The type locality of the formation is two miles north of Boysen Dam in the Wind River Canyon, Wyoming. (Deiss, 1938, pp. 1104-1105). The Boysen is Upper Cambrian in age.

Ordovician system

Bighorn dolomite-The Bighorn dolomite is present in the southeastern part of the area where it is exposed on the east side of a tear fault. Faulting has also exposed the dolomite at the east foot of West Gros Ventre Butte and in the small butte southwest of West Gros Ventre Butte. The Bighorn is a massive, light gray to cream colored dolomite which has a characteristic rough and pitted weathered surface. The bed,

because of its massive and resistant nature, forms imposing light colored cliffs wherever it is exposed. The formation is 300 feet thick and rests unconformably upon the Boysen.

In the Teton Pass area (Horberg, 1938, p.14) and in the Camp Davis section the Bighorn has a lithology and thickness comparable to that found in the area covered by the author. Darton (1904, p.396), however, in his original description of the formation in its type locality on the east side of the Bighorn Mountains, Wyoming describes three distinct units of limestone and impure limestone, but makes no mention of dolomite. The Bighorn is Upper Ordovician in age.

Devonian system

Leigh formation-The Leigh formation and the Bighorn dolomite were mapped as one unit because lithologic similarities often makes the accurate location of their contact difficult. In the Teton Range the Leigh consists of a white, finely crystalline, brittle dolomite having a thickness of 30 to 40 feet. It lies unconformably upon the Bighorn. (Horberg,1938, p.14).

Tomlinson (1917, pp.255-257) first used the name Leigh in print, although Blackwelder had originally submitted the name in 1913. Later, Blackwelder (1918, p.419) described the formation where it is exposed on the south side of Leigh Canyon on the west slope of the Teton Range, Wyoming. For many years the Leigh was thought to be a unit of the Bighorn and it was referred to as the Leigh member of the Bighorn dolomite. Recent investigation of a few fish plates found in the dolomite, however, has

led the staff at Camp Davis to regard the Leigh as either Silurian or Devonian in age and consequently a formation in itself.

Darby formation-The Darby formation is not well exposed in the area, but weathers to a covered slope between the cliff-forming Bighorn dolomite and Madison limestone. The Darby rests disconformably upon the Leigh in the Teton Range. (Horberg,1938, p.15). It has an apparent thickness of 200 feet. Where exposed in the Camp Davis section the formation consists of a brownish gray, massive dolomite with a high iron sulfide content. A few gray and black shales are to be found interbedded in the dolomite.

Blackwelder (1918, p.420) originally described the Darby where it is exposed in the canyon of Darby Creek on the west slope of the Teton Range, Wyoming and reported it to be Devonian in age. It has not yet been correlated with the Jefferson limestone and Threeforks shale of Montana.

Mississippian system

Madison limestone-The Madison limestone is well exposed in the southeast and northwest portions of the Cache Creek area as well as in the buttes in Jackson Hole. The Madison is a dark gray, coarse grained limestone which weathers somewhat tan. It is thin-bedded in the upper third, and massively bedded in the lower two-thirds. It forms prominent cliffs throughout the area. The limestone is fossiliferous, especially in the upper thin-bedded unit. The formation has a thickness of 800 feet and it rests unconformably on the Darby.

The type locality of the Madison is in the Madison Range, in the central part of the Threeforks quadrangle, Montana where the limestone was first described by Peale (1893, pp.32-39). Mansfield (1927, p.60) reports the formation to be Lower Mississippian in age.

Brazer limestone-The Brazer limestone and Madison limestone contact is not readily discernable, and this feature necessitates the mapping of the two formations as one unit. The Brazer is a massive, blue to light gray, lithographic limestone containing numerous calcite veins. Interbedded gypsum and breccia is found near the top of the formation in some areas, but not within the area mapped. The limestone is 200 feet thick and it rests conformably upon the Madison.

In the Teton Pass area Horberg (1938, p.14) reports 1000 feet of Brazer and in the type locality, Brazer Canyon, Crawford Mountains, Rich County, Utah, Richardson (1913, pp.407-413) describes 800 feet to 1400 feet of the limestone. The Brazer is Middle and Upper Mississippian in age. (Mansfield, 1927, p.63).

Pennsylvanian system

Amsden formation-The Amsden formation is well exposed in the area covered by this report. It caps parts of East and West Gros Ventre Buttes and crops out high on the ridge between Cache Creek and Nowlin Creek. The author has adopted the practice used by Horberg (1938, p.17) whereby the Amsden formation and the Tensleep sandstone are mapped as a unit and called the Wells formation. Bachrach (1946, pp.44-46) measured the Amsden section in the small butte in the Flat Creek Elk Refuge and reports that the formation consists of three

major units, the lower Amsden, the Darwin member, and the upper Amsden. The lower Amsden is made up of 45 feet of interbedded gray, massive and fine grained limestones and red, calcareous shales. The Darwin member consists of 54 feet of a buff, very fine grained, cross-bedded, calcareous sandstone which weathers dark brown to rose. The upper Amsden is made up of 120 feet of very light gray to dark gray, fine grained, massive limestones, some units of which are cherty. A red calcareous shale, which is 22 feet thick, is present near the top of this limestone section. In places the formation rests unconformably upon the Brazer. (Bachrach, 1946, p.71).

Darton (1904, pp.194-401) first described the Amsden where it is exposed along Amsden Branch of the Tongue River, west of Dayton, Wyoming. The formation is of Pennsylvanian age (Richards and Mansfield, 1912, pp.683-684, 689-693), although the basal units may be of Mississippian age. (Condit, 1918, pp.111-112) (Bachrach, 1946, p.71).

Tensleep sandstone-The Tensleep sandstone is well exposed on the divide between Cache Creek and Nowlin Creek and crops out in scattered localities on the Gros Ventre Buttes. The Tensleep and the Amsden have been mapped together as the Wells formation. The Tensleep consists of white to pink, massive quartzitic sandstone with a few thin interbedded layers of white, dolomitic limestone. The sandstone is 200 feet thick and it rests conformably upon the Amsden formation.

The Tensleep sandstone was originally described by Darton (1904, pp.394-401) in the lower canyon of Tensleep Creek, Bighorn Mountains, Wyoming. The sandstone is Pennsylvanian in age.

Permian system

Phosphoria formation-The Phosphoria formation is exposed in two synclines in the Cache Creek area. The dolomites and shales of the formation are usually covered by debris from the beds higher on the slopes, whereas the chert members rise above the surface as wall-like or dike-like structures, often 20 feet high.

Mrs. Lily Marie Krusekoff (personal communication) measured the Phosphoria in the lower syncline and reports an upper zone of light gray to black, brecciated chert, the Rex chert member, and a lower zone of blue black to brown, laminated phosphatic shale. This shale is underlain by a zone of light tan to gray, arenaceous dolomite below which is another zone of chert. The total thickness of the formation is 270 feet, and it rests conformably upon the Tensleep sandstone.

The Phosphoria was first described by Richards and Mansfield (1912, pp.683-689) and was named for Phosphoria Gulch, 2.5 miles northwest of Meade Park, Idaho. The Phosphoria is Permian in age. (Newell and Kummel, 1940, p.66).

Triassic system

Dinwoody formation-The Dinwoody formation appears in scattered localities in the syncline along Cache Creek. Where exposed the formation consists of buff to tan, calcareous, thin-bedded siltstones, which are 200 feet thick and lie conformably upon the Phosphoria formation.

Blackwelder (1918, pp.425-426) first described the Dinwoody as 250 feet of greenish gray shale with some thin plates of dense calcareous sandstone and argillaceous dolomite. The

beds described were in the canyon of the Dinwoody Lakes, Wind River Mountains, Wyoming. Newell and Kummel (1942, p.941) have since restricted the name Dinwoody to include only those dominantly silty strata which make up the lower half of the formation as described by Blackwelder. Condit (1918, p.264) reports the Dinwoody to be of Lower Triassic age.

Woodside formation-The Woodside formation crops out in the syncline near Cache Creek. The formation consists of dark red shales and shaly, very thin-bedded limestone. The formation usually forms deep red, covered slopes. The redbeds are 350 feet thick and they rest conformably upon the Dinwoody.

Condit (1918, p.264) and others have stated that the Dinwoody is to be correlated with the Woodside as described by Boutwell (1907, pp.446-448). Newell and Kummel (1942, p.947), however, state that the Dinwoody is probably the time equivalent of only the lower half of the type Woodside, and that the redbeds found in western Wyoming should be regarded as a northeastern tongue of the Woodside of Utah. The type locality of the formation is in Woodside Gulch, Park City district, Utah. Newell and Kummel (1942, p.938) report the Woodside to be Lower Triassic in age.

Thaynes limestone-The Thaynes limestone and the Woodside formation were mapped as one unit for reasons of expediency. The Thaynes consists of a buff, silty limestone with a few red to tan siltstones and shales. Although 935 feet of Thaynes has been measured in the Camp Davis section, there is not over 100 feet of the limestone in the Cache Creek area. The Thaynes rests conformably upon the Woodside formation.

Boutwell (1907, pp.448-452) first described the Thaynes where it crops out in Thaynes Canyon, Park City district, Utah. He described the beds as essentially a calcareous formation of two parts, each consisting of limestones, normal sandstones and shales. The Thaynes is Lower Triassic in age. (Newell and Kummel, 1942, p.947-948).

Ankareh formation-The Ankareh formation is well exposed in the syncline in the Cache Creek area. On one particular nose, the formation dips 85°, and one unit stands upright above the surrounding softer beds to form a wall at least 15 feet high and 20 feet thick. The Ankareh consists of a series of red siltstones and shales 160 feet thick. It rests conformably upon the Thaynes.

The Ankareh was first described by Boutwell (1907, pp.452-454) as consisting chiefly of red shales with a number of whitish gray interbedded sandstones. Later, however, he redefined the formation and placed the upper sandstones in the Nugget. The formation is named for Ankareh Ridge, Park City district, Utah. Mansfield (1927, p.374) has assigned the Ankareh to the Middle to Upper Triassic.

Jurassic system

Nugget sandstone-The Nugget sandstone is well exposed in the small syncline in the Cache Creek area. The beds consist of white to pink to buff, massive to thin-bedded sandstone. Usually the weathered rock is soft and crumbly, but locally it is quartzitic and stands out as low cliffs where exposed on the noses. Aeolian cross-bedding is often a characteristic feature. The Nugget is 200 feet thick and it rests unconformably upon the

Ankareh formation.

Veatch (1907, p.56) first described the Nugget as a group of yellow, pink, and red sandstones and named it for Nugget Station on the Oregon Short Line in southwestern Wyoming. Mansfield (1927, pp.96-97) reports the Nugget to be Lower Jurassic in age.

Gypsum Spring formation-The Gypsum Spring formation was not identifiable in the field, and consequently, if it was present, it has been mapped as part of the Twin Creek. As described in the Camp Davis section, the formation consists of 160 feet of gray shaly limestone and limey shales and some red shales with locally a basal breccia present.

As described in the type locality in the Wind River Basin, Wyoming, the Gypsum Spring is made up of 100 feet of red blocky siltstones, overlain by an alternating series of limestones, shales and dolomite. The formation is Middle Jurassic in age. (Love, et. al., 1945).

Twin Creek formation-The Twin Creek formation is exposed at the center of the syncline in the Cache Creek area. The formation is made up of a lower splintery, gray, limey shale and shaly limestone overlain by 50 feet of gray, medium-bedded to massive oolitic limestone. Gryphea, Pentacrinus, and Camptonectes are found in the thin shales and thin-bedded limestones. (Dobrovolny, 1940, p.431). Since the basal members of the Twin Creek are covered by debris, the thickness of the formation can not be ascertained. In the Teton Pass area, however, Horberg (1938, p.11) measured 350 feet of dark gray, calcareous shales and thin-bedded shaly limestones. The

formation was originally described by Veatch (1907, p.56) where it crops out along Twin Creek, between Sage and Fossil, Wyoming. Imlay (1945, pp.1019-1027) reports that the formation is Middle to Upper Jurassic in age.

Preuss sandstone-The Preuss sandstone is not exposed anywhere within the area, but its presence within the syncline along Cache Creek is implied by float in that vicinity. The sandstone itself has apparently been buried by wash from the adjoining ridges. In the Camp Davis section the Preuss consists of red green or white, thin-bedded and cross-bedded, calcareous sandstone about 120 feet thick. Horberg (1938, p.20) reports 50 feet of Preuss lying unconformably upon the Twin Creek limestone.

Mansfield and Roundy (1916, p.81) originally described the sandstone where it crops out along Preuss Creek, about 12 miles northeast of Montpelier, Idaho. Mansfield (1927, p.99) later reported the beds to be of Upper Jurassic age.

Stump sandstone-Outcrops of the Stump sandstone are not found in the area, but its presence in the syncline in the Cache Creek area is implied by float found in the overlying debris. The Stump present in the Camp Davis area consists of 100 feet of green to greenish gray, glauconitic, fine grained sandstone and shaly sandstone. A few Pentacrinus columnals have been found in the beds. Across Jackson Hole in the Teton Pass area Horberg (1938, p.11) has measured 75 feet of Stump which rests conformably upon the Preuss.

Mansfield and Roundy (1916, p.81) named the sandstone for Stump Peak, at the head of north fork of Stump Creek about the

center of T.6S.,R.45E. Boise, Idaho meridian. Mansfield (1927, p.101) has assigned the Stump to the Upper Jurassic.

Cretaceous system

Gannett group-The Gannett group is not present in the area covered by this report. Horberg (1938, p.11) reports the Gannett of the Teton Pass area to consist of a series of red shales, sandstones, conglomerates and flinty limestones 250 feet in thickness. In the Camp Davis section the group consists of an upper 250 feet of gray shale and limestone, a middle zone of 55 feet of gray, massive, lithographic limestone, and a lower 430 feet of light gray sandstone and red shale. The Gannett rests unconformably upon the Stump.

Mansfield and Roundy (1916, p.82) described and named the group from exposures in the Gannett Hills, Bannock County, Idaho and Lincoln County, Wyoming. Later, Mansfield (1927, pp.101-105) assigned the Gannett to the Lower Cretaceous.

Bear River formation-The Bear River formation is not present in the area covered by this report. In other localities in the Jackson Hole area, however, the formation is well exposed. It consists essentially of two zones; an upper zone of black shales with a few interbedded thin sandstones and limestones, and a lower zone of interbedded tan sandstones and black shales. Fresh water invertebrate fossils are very abundant in the upper units. The thickness of the formation is 300 feet and it rests unconformably upon the Gannett formation.

Hayden (1869, pp.91-92) first described the formation where upheaval has exposed it at Bear River City, Wyoming. He

believed it to be Tertiary in age. Veatch (1907, p.63) later concluded that the formation was Upper Cretaceous in age. Recent intensive study by Aurelle La Rocque (personal communication) has led him to believe that the formation is older than previously believed, possibly as old as Lower Cretaceous.

Aspen formation-The Aspen formation is not present in the area mapped. In the Camp Davis area and the Teton Pass area (Horberg, 1938, p.21) the formation is well exposed. It consists of an upper 600 feet of grayish green, porcelainous, vitrified rhyolite tuff with a few interbedded tuffaceous siltstones and lower a series of gray green, speckled, "salt and pepper" sandstones and interbedded black shales. Fish scales are abundant throughout. The formation is 1000 feet thick and it rests conformably upon the Bear River formation.

Veatch (1907, pp.64-65) first described the formation where it is exposed near Aspen Station, Uinta County, Wyoming and he reported it to be of Upper Cretaceous age.

Frontier formation-The Frontier formation is poorly exposed in the area along Cache Creek. The beds are largely covered by the Paleozoic rocks of the Cache thrust sheet and by wash from the neighboring ridges. Where exposed the formation consists of gray to buff siltstone and sandstone, which is extremely crumbly when weathered. Interbedded in the sandstones and siltstones are a few thin beds of subbituminous coal, some of which were formerly worked at two locations within the area.

In the Camp Davis area the Frontier has been largely eroded away, consequently, the formation is found capping ridges

only in a few scattered localities. Horberg (1938, p.21) reports that the Frontier may be present in the Teton Pass area. In that locality it is 3000 feet thick and rests conformably upon the Aspen.

Knight (1902, p.721) first described the Frontier and defined it as essentially a coal-bearing formation containing a marked sandstone layer 200 feet thick. The formation was named for the town of Frontier, Uinta County, Wyoming, where the beds are well exposed and developed. Veatch (1907, p.69) reported that the Frontier is Upper Cretaceous in age.

Tertiary system

Hoback formation-The Hoback formation is not present in the area mapped by the author. The formation is found, however, in the Hoback Basin. In that area it consists of gray interbedded sandstones, shales, impure fresh water limestones and several lenses of conglomerate. A few coal beds are present in the lower units. The total thickness of the formation is 15,000 feet and it rests unconformably upon the Frontier. The Hoback is reported to be of Lower Eocene age. (Eardley, et. al., 1944).

Pass Peak conglomerate-The Pass Peak conglomerate is not present in the area discussed in this report, but good exposures are to be found in the Hoback Basin area to the south. In the latter region the Pass Peak consists of a red to gray conglomerate which grades into sandstones and shales. Pressure cracks are characteristic features found on the larger cobbles of the conglomerate. The Pass Peak rests conformably upon the Hoback formation. It is 3000 feet thick. The conglomerate is of

Middle Eocene age. (Eardley, et. al., 1944).

Camp Davis formation-The Camp Davis formation is not present in the area mapped for this report. It is, however, well exposed approximately 4 miles to the southeast, as well as in the vicinity of Camp Davis. In these areas the formation consists of an upper 2000 feet of red conglomerate, separated from a lower 200 feet of gray conglomerate by 50 feet of an impure fresh water limestone. The formation rests unconformably upon the underlying formations.

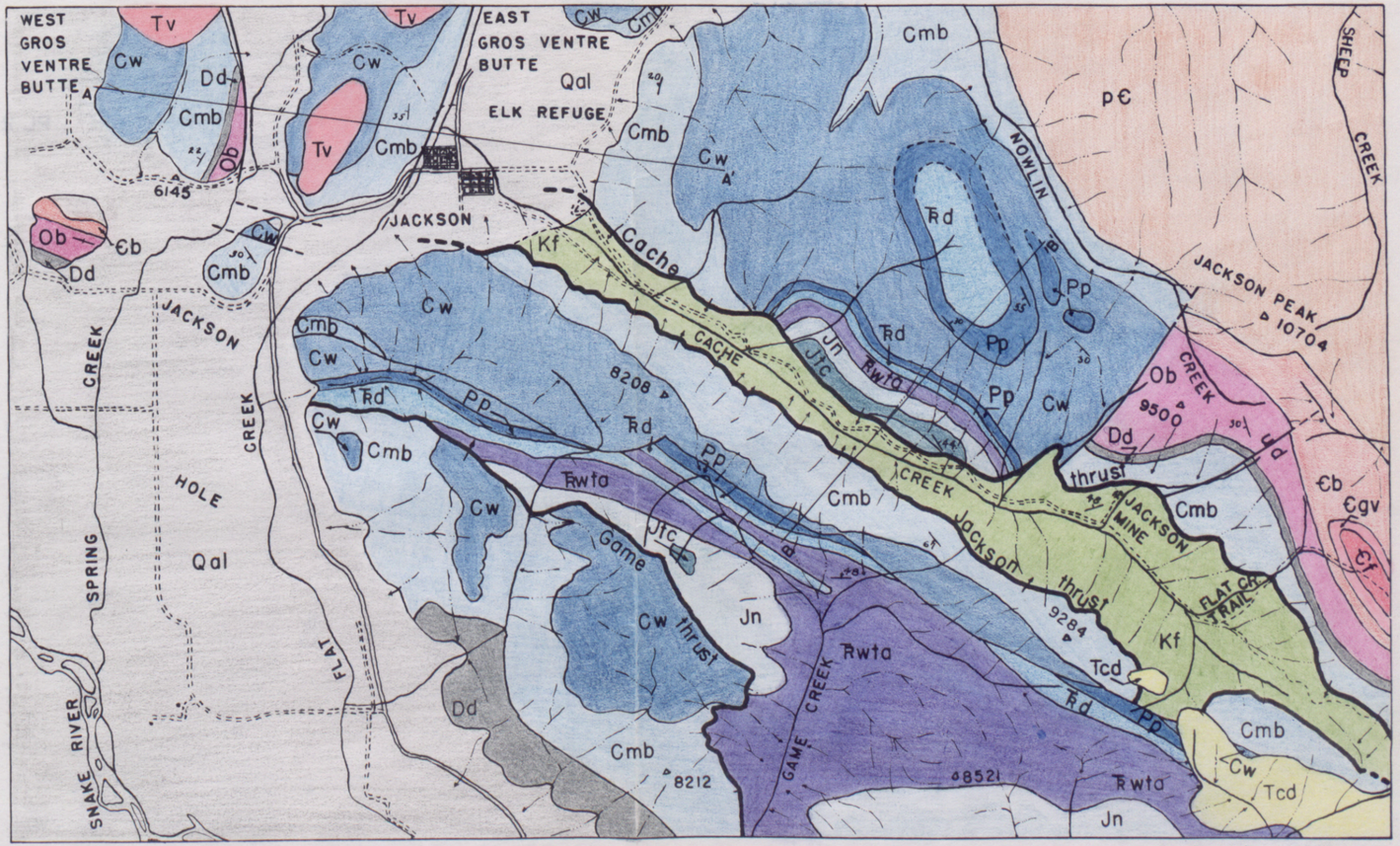
The beds near Camp Davis were formerly described as the Lower Eocene Almy conglomerate (Horberg, 1938, p.22), but subsequent evidence in the form of a fossil horse tooth of Upper Miocene or Lower Pliocene age has necessitated the renaming of the beds. (Eardley, 1942, p.1800).

Volcanic deposits-Volcanic deposits are found capping approximately the northern half of East Gros Ventre Butte and West Gros Ventre Butte. The flows consist of a mottled purple to light blue obsidian-like basalt, which is thin-bedded and very dense. The thickness of the flows could not be determined.

Horberg (1938, p.23) implies that the volcanics in the buttes and in the Teton Pass area are associated with the Eocene stage of volcanism in Yellowstone Park. Foster (1946, pp.166-175), however, believes they are basal units of the Camp Davis formation which she studied a few miles to the northeast. Eardley (personal communication) concurs in this belief.

Qal	alluvium	Quaternary
Tv	volcanics	Tertiary
Tcd	Camp Davis formation	Tertiary
Kf	Frontier formation	Cretaceous
Jps	Preuss-Stump sandstone	Jurassic
Jtc	Twin Creek formation	Jurassic
Jn	Nugget sandstone	Jurassic
Trwta	Woodside-Thaynes-Ankareh formation	Triassic
Trd	Dinwoody formation	Triassic
Pp	Phosphoria formation	Permian
Cw	Wells formation	Carboniferous
Cmb	Madison-Brazer limestone	Carboniferous
Dd	Darby formation	Devonian
Ob	Bighorn dolomite	Ordovician
€b	Boysen limestone	Cambrian
€gv	Gros Ventre formation	Cambrian
€f	Flathead quartzite	Cambrian
p€	schist and gneiss	pre-Cambrian

1 0 1 2 Miles

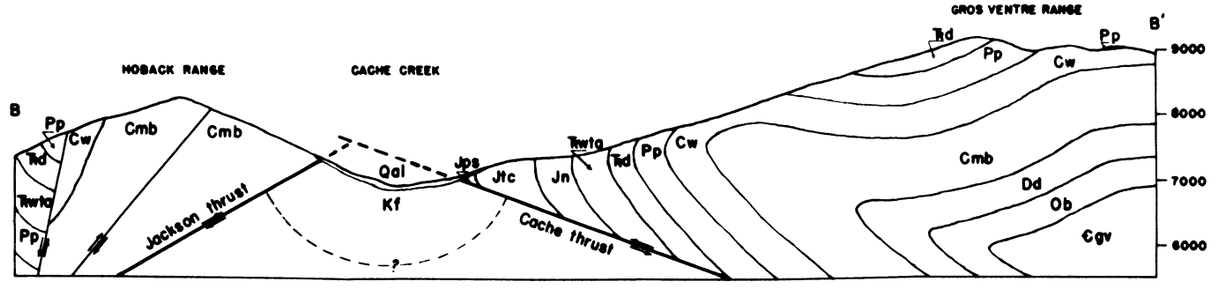


Base from U.S. Geological Survey topographic map
Jackson quadrangle, Wyoming

Geology by A.L. Bergren

GEOLOGIC MAP OF THE JACKSON AREA, TETON COUNTY, WYOMING

PLATE 3



Qal	alluvium
Tv	volcanics
Tcd	Camp Davis formation
Kf	Frontier formation
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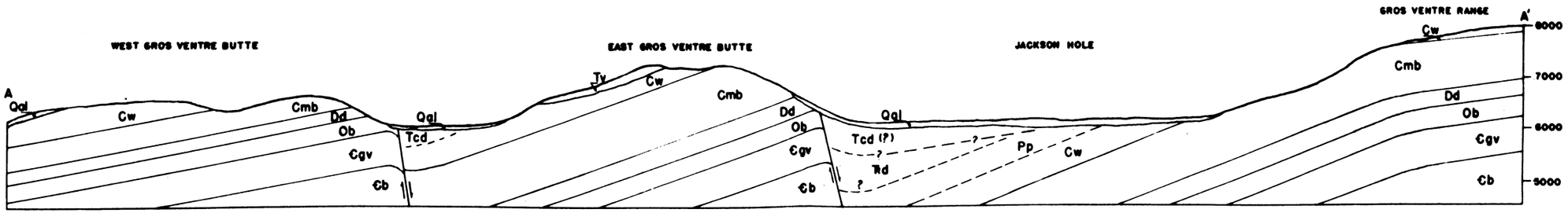
Jn	Nugget sandstone
Twta	Woodside-Thaynes-Ankareh formation
Trd	Dinwoody formation
Pp	Phosphoria formation
Cw	Wells formation
Cmb	Madison-Brazer limestone
Dd	Darby formation
Ob	Bighorn dolomite
Cb	Boysen limestone
Cgv	Gros Ventre formation

1000 Feet

1000 0 1000 2000 3000 Feet



GEOLOGIC STRUCTURE SECTIONS OF
JACKSON AREA, TETON COUNTY, WYOMING
A.L. BERGREN

STRUCTURE

Local structures in the Cache Creek area

General-Throughout its northwesterly course to Jackson Hole Cache Creek flows through a valley that lies between two great thrust sheets, the Cache on the northeast and the Jackson on the southwest. (See plate 2.)

Cache thrust-The Cache thrust was traced to the southeast along the northeast side of Cache Creek Canyon from Jackson Hole to approximately 1 mile beyond the Flat Creek Trail. This does not constitute the entire length of the fault in either direction, however. There is evidence to indicate that the fault extends out into Jackson Hole, or possibly across it. Nelson and Church (1943, p.153) have traced the fault to the southeast approximately 3 miles beyond Flat Creek Trail to where it terminates against the Skyline Trail fault. Eardley (personal communication), however, believes that the Skyline Trail fault and the Shoal Creek fault are continuations of the Cache thrust. If so, the Cache thrust can be traced approximately 25 miles beyond the Flat Creek Trail. The fact that throughout the distance the fault was traced in Cache Creek Canyon it roughly paralleled the contour lines indicates that the fault plane dips northeast at a low angle. The angle of dip is 25° to 30°. Along the trace Carboniferous formations overlie the Cretaceous (Frontier) formation, with the exception of the area of a cross-trending syncline where the Jurassic (Stump sandstone) is in contact with the Cretaceous. Evidence of drag folding is very pronounced both in the Cretaceous formation of the valley floor and in the Paleozoic and Mesozoic formations in

the thrust sheet. A great drag fold, in fact, constitutes the dominant structural feature of the thrust sheet. (See plate 3.)

The Cache thrust sheet is made up of formations ranging in age from Cambrian (Flathead quartzite) to Jurassic (Stump sandstone). These formations form the flanks of the great southwestward dipping monoclinal fold. The strike of the formations approximates the northwest-southeast trend of the fault trace. Minor structural features are superimposed upon this major feature and tend to complicate it slightly.

Prominent among the minor features within the thrust sheet are two small synclines which lie approximately 3 miles up the valley from Jackson Hole. (See plate 2.) Of the two, the syncline nearest the front of the thrust sheet is the more interesting, for in it the phenomenon of drag folding is vividly displayed. (See plate 3.) Near the front of the thrust sheet, that is, near the fault plane, the formations have been strongly overturned and they dip 40° northeast. This angle approaches that of the fault plane. As one travels toward the northeast flank of the syncline, upward and away from the fault plane, the effect of the drag decreases and the dips of the formations increase. They reach 90° in the Triassic formations. The Permian and Pennsylvanian formations which crop out higher on the slope and are more distant from the fault plane than the younger formations, are right-side-up and dip 50° to 60° southwest.

Differential movement along the thrust plane has resulted in two tear faults in the vicinity of the Jackson Mine. (See plate 2.) These faults strike north 40° east. In the eastern-

most fault Ordovician, Devonian and Mississippian formations are in contact with the Wells. Drag folds indicate that the faulting had a considerable vertical component, as well as horizontal. For a short distance the fault line scarp consists of a vertical wall of Bighorn dolomite, which is 100 to 200 feet high. One mile to the east is another tear fault, displacement along which has been very slight. Although the formations have been offset but slightly, lineal folding and brecciation clearly define the fault trace.

The predominant northwest-southeast trending monoclinal structure terminates near Jackson Hole. It is replaced in that area by the northeast-southwest trending downwarp which carries the Carboniferous formations beneath the younger sediments in Jackson Hole.

Jackson thrust-The Jackson thrust and its associated thrust block constitute the southwestern wall of Cache Creek Canyon. Although the area was mapped by Lyman Galbraith and is to be described in detail by him, the writer believes it desirable to discuss it briefly in this report.

The Jackson thrust in the area under discussion is easily traced along the southwest side of the Cache Creek Canyon. (See plate 2.) Horberg (1938, p.36) has projected the thrust from Victor, Idaho through the Teton Pass across Jackson Hole to the mouth of Cache Creek, and Nelson and Church (1943, p.159) have traced it about 10 miles up Cache Creek to where it disappears beneath the Camp Davis formation. About 3 miles to the southeast a fault comes out of the Camp Davis formation, and although they have called it the Little Granite Creek thrust, they be-

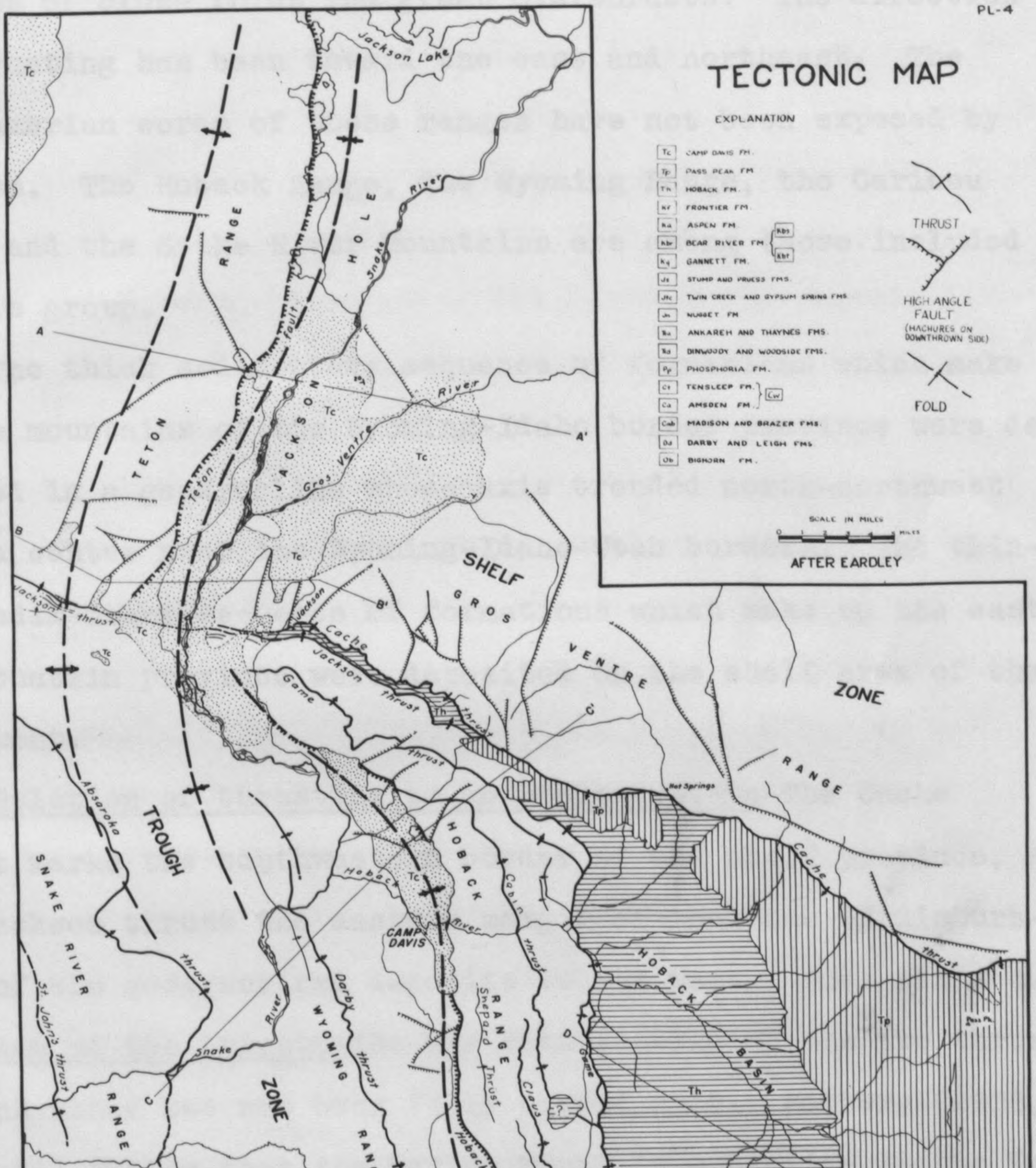
lieve that it may be the continuation of the Jackson thrust. Eardley (personal communication) concurs in this belief. It is evident from the character of its trace that the fault plane dips to the southwest at a small angle. Along the fault trace the Madison-Brazer has been thrust upon the Frontier and forms a high escarpment along the front of the thrust block. An abnormal thickness of Madison-Brazer indicates that high angle faulting has occurred within it. These faults were not located, however.

Relation of local structures to regional

General-The major local structures in the Cache Creek area, that is, the Jackson thrust sheet and the Cache thrust sheet, were formed during the Laramide orogeny. Both thrusts were not active simultaneously during the Laramide orogeny, however, nor did they come from the same direction.

Structural provinces of the Middle Rocky Mountains-The Middle Rocky Mountains can be divided structurally into two distinct provinces. One is made up of a series of linear ranges which radiate southeastward from a center in the Yellowstone Plateau. These mountains consist of broad asymmetrical anticlines, which in places give way to overthrusts. Erosion of the anticlines has exposed the pre-Cambrian "granite" core of these mountains. The Gros Ventre Mountains and the Wind River Mountains make up one element of this province. The direction of overturn and thrusting in these two ranges has been toward the southwest.

The other system of mountains consists of a series of parallel, Appalachian-like ranges, which trend north-south and more


PL-4
TECTONIC MAP
EXPLANATION
Tc CAMP DAVIS FM.
Tp PASS PEAK FM.
Th HOBACK FM.
Kf FRONTIER FM.
Ka ASPEN FM.
Kbr BEAR RIVER FM.
Kg GANNETT FM.
Js STUMP AND PREUSS FMS.
Jtc TWIN CREEK AND GYPSUM SPRING FMS.
Jn NUGGET FM.
ANKAREH AND THAYNES FMS.
DINWOODY AND WOODSIDE FMS.
Pp PHOSPHORIA FM.
Ct TENSLEEP FM.
Ca AMSDEN FM.
MADISON AND BRAZER FMS.
Dd DARBY AND LEIGH FMS.
Ob BIGHORN FM.
THRUST
HIGH ANGLE FAULT
(HACHURES ON DOWNTHROWN SIDE)
FOLD
SCALE IN MILES
AFTER EARDLEY
Jackson Lake
TETON RANGE
JACKSON HOLE
Snake River
Gros Ventre River
Teton fault
SHELF
GROS VENTRE ZONE
RANGE
Cache
Jackson thrust
Game
Hot Springs
TROUGH
Absaroka
HOBACK
CAMP DAVIS
Hoback River
Cabin thrust
HOBACK BASIN
Darby thrust
WYOMING RANGE
ZONE
SNAKE RIVER RANGE
St. Johns thrust
Snake River
Shepard thrust
Hoback fault
Grizzly thrust
Hoback
Tc
Th
Tp

or less straddles the Idaho-Wyoming border. These mountains consist of close folds and great overthrusts. The direction of thrusting has been toward the east and northeast. The pre-Cambrian cores of these ranges have not been exposed by erosion. The Hoback Range, the Wyoming Range, the Caribou Range and the Snake River Mountains are among those included in this group.

The thick sedimentary sequence of formations which make up the mountains of the Wyoming-Idaho border province were deposited in a geosyncline whose axis trended north-northwest from a center near the Wyoming-Idaho-Utah borders. The thinner sedimentary sequence of formations which make up the eastern mountain province were deposited on the shelf area of the embayment.

Relation of thrusting to mountain systems-The Cache thrust marks the southwestern border of the shelf province, and the Jackson thrust the eastern margin of the zone of disturbance of the geosynclinal deposits to the west. (See plate 4.)

Age of the thrusts-The age relationship of the two thrusts to each other has not been fully agreed upon. Horberg (1938, pp.32-36) states that the Taylor Mountain anticline in the Teton Pass area is probably the continuation of the Gros Ventre anticline (Cache Creek monocline) of the Cache Creek area. He also states that the Jackson thrust at Teton Pass overrides the southern flank of the Taylor Mountain anticline. On this evidence the conclusion is drawn that the Jackson thrusting is younger than the Cache thrusting and folding.

As stated previously, Eardley believes that Nelson and

Church's Little Granite Creek thrust is a continuation of the Jackson thrust and that their Skyline Trail fault is the continuation of the Cache thrust. If this is the case, then he has substantial evidence to prove that the Cache thrusting is younger than the Jackson, for in the Granite Creek area his Cache thrust cuts the Middle Eocene Pass Peak conglomerate, whereas his Jackson thrust cuts the Lower Eocene Hoback formation but is overlapped by the Middle Eocene Pass Peak conglomerate.

If the interpretation in each case is correct, then the folding and thrusting in the Cache Creek area must have occurred in three distinct stages. First, forces from the northeast caused the folding of the Cache Creek monocline and its continuation, the Taylor Mountain anticline. After an unknown length of time came the Jackson overthrusting from the southwest. Later, renewed disturbances in the Gros Ventre Mountains caused the Cache Creek monocline to break into the Cache thrust.

Evidence in the Cache Creek area itself indicates only that the thrusting in each case was post-Frontier.

Structure of the Gros Ventre Buttes

The Gros Ventre Buttes consist of Paleozoic rocks which strike a few degrees east of north and dip from 20° to 40° toward the west. (See plate 2.) Volcanic deposits cover the northern half of each butte and a scab of the material remains as a cap on the southern end of East Gros Ventre Butte.

The lineal character of the buttes and the uniformity of the dip and strike of the formations in the buttes indicates that they are tilted blocks formed by faulting along their

east sides. Tunneling has exposed the fault scarp for a short distance on the east side of East Gros Ventre Butte. (Horberg 1938, p.42). In his cross-sections Horberg (1938, p.38) has indicated that the volcanic deposits on the buttes were tilted by the faulting. The writer does not concur in this belief. The cross-sections by Horberg have been drawn so as to include an area on the buttes where erosion has stripped the volcanics from the east slopes. The volcanics on the west slope dip to the west and appear to have been tilted. If, however, the cross-sections had been drawn through the buttes a short distance northward so as to include also the volcanics on the east slope, these deposits would be seen to dip to the east. In addition, the volcanics overlap the upturned edges of the tilted Paleozoic formations. These facts, in the writer's mind, are strong evidence in support of the theory that the normal faulting involved only the Paleozoic rocks.

Structural history of the Gros Ventre Buttes

Eardley (personal communication) believes that the period of high angle faulting and the period of the deposition of the Camp Davis formation were contemporaneous in west-central Wyoming, that is, that the clastics in the Camp Davis formation accumulated as adjacent areas rose due to normal faulting. In light of the fact that the volcanic deposits which make up the basal units of the Camp Davis formation were not involved in the block faulting in the Gros Ventre Buttes, it seems justifiable to state that the block faulting of the buttes predates the period of general block faulting in the surround-

ing area. Since the formations in the Gros Ventre Buttes are a part of the Cache thrust sheet, and since the faulting of the buttes predates the period of deposition of the Camp Davis formation, the faulting of the buttes occurred between the Middle Eocene and the Upper Miocene. Eardley (personal communication) believes that this faulting is a part of the system of high angle faults in the Gros Ventre Mountains that have broken and displaced the Cache thrust sheet. The faulting occurred contemporaneous with the Cache thrusting. Following a period of erosion the volcanic materials and the clastic materials from the neighboring rising areas, that is, the Hoback Range and the Teton Range, buried the buttes to a great thickness. The regional uplifts which resulted in renewed erosion and excavation of the Wyoming Basin in late Pliocene and Pleistocene times undoubtedly caused renewed erosion in the Jackson Hole area. The comparatively soft Camp Davis formation was easily eroded and the process of excavation proceeded rapidly. The presence of scabs of Buffalo glacial till on the buttes indicates the extent of exhumation by that glacial stage. Subsequent scouring by water in the inter-glacial stage and by ice and water during the Bull Lake glacial stage reexposed the Gros Ventre Butte. Triangular facets and an aligned front, which often form as a result of recent faulting, are due to glaciation in the Gros Ventre Buttes.

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