

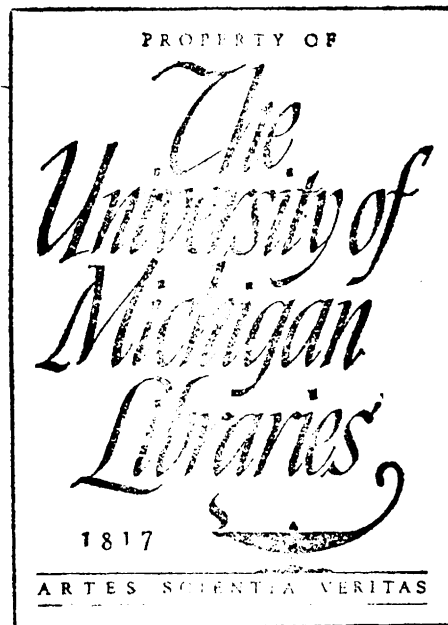
GEOLOGY OF
THE NORTHERN WYOMING RANGE, WYOMING
by
A. R. Ross and J. W. St. John

1950

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of the requirements for the degree
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ABSTRACT

Formations used in dating the stages of deformation in the northern Wyoming and Hoback ranges are the Frontier (Upper Cretaceous), Hoback (lower Eocene), Pass Peak (middle Eocene), and Camp Davis (upper Miocene or lower Pliocene). Stages of deformation are: (1) folding and thrusting of a western highland in Paleocene time (Darby and Absaroka thrusts), (2) thrusting in post-Hoback - pre-Pass Peak time (Cabin, Clause, Jackson, and Shepard (?) thrusts), (3) thrusting in late middle or upper Eocene time (Grizzly and Cache thrusts), (4) high angle faulting in pre-Camp Davis time (Hoback, Teton (?) and Gros Ventre Butte faults). The time and spacial relations of the local and the regional structures are discussed.

INTRODUCTION

Location of area

The present report concerns the northern part of the Wyoming Range which extends from the Snake River Canyon on the west central border of Wyoming southward to Oyster Ridge on the western margin of Bridger Basin. Jackson, Wyoming is about fifteen miles north of the northern end of the range and Kemmerer, Wyoming is about thirty miles south of the southern end of the range. The area designated the northern Wyoming range in this report is restricted to the part of the range north of latitude 43° . This area is shown on the index map, Plate 1. The area covers most of the southeast quarter of the Jackson Quadrangle topographic sheet.

The area extends from Pow Wow Point, the northern end of Grayback Ridge, south to Deadman Mountain, just north of Deadman Creek. Grayback Ridge forms the northern two thirds of the northern Wyoming Range in the area of this report and Deadman Mountain the southern third. These two features are separated by a canyon cut by the headwaters of the Little Grays River.

The western side of the northern Wyoming Range is drained by a number of small creeks which either empty into the Snake River directly or into the Grays or Little Grays River and then into the Snake. On the east, the drainage from Grayback Ridge enters Willow Creek. Willow Creek flows into the Hoback River which in turn empties into the Snake River about two miles north of Pow Wow Point. From Pickle Pass to Roosevelt Meadows



INDEX MAP

(Plate 2) the east side of Deadman Mountain is drained by tributaries of the Little Grays River. From Roosevelt Meadows to the southern edge of the area the east side of Deadman Mountain is drained by tributaries of the upper Hoback River.



Figure 1. - Looking north along Grayback Ridge from a point above Phosphate Creek.

Purpose of Study

The present study is part of a program sponsored by the Rocky Mountain Field Station, University of Michigan, to map the Jackson quadrangle. It also is intended as a Master's thesis for each of the authors.

Acknowledgements

Field work for this paper was done during a two weeks period in the summer of 1946. The University of Michigan Rocky Mountain Field Station (Camp Davis) near Jackson, Wyoming served as a base for the study, which was done under

the supervision of A.J. Eardley, Professor of Geology, University of Michigan. Fossils collected from the Cretaceous Frontier formation were examined and identified by Dr. Lewis B. Kellum, Director, Museum of Paleontology, University of Michigan.

STRATIGRAPHY

Although no rocks older than the Ordovician Bighorn dolomite are exposed in the area of this report, it seems advisable to include the entire section found in the Jackson quadrangle. It is as follows (see table 1).

Pre-Cambrian rocks

Pre-Cambrian rocks exposed in the Teton Range to the north are mostly steeply dipping gneisses and schists with intrusions of pegmatite, granite and basic dikes. In addition to the crystalline rocks, metaconglomerates and metaquartzites occur in scattered localities (Horberg, 1938, p.13).

Cambrian system

Flathead quartzite. - The Flathead quartzite overlies the pre-Cambrian rocks in the Teton Range (Horberg, 1938, p. 12). A well developed basal conglomerate with quartz pebbles is overlain by white to pink quartzite. The upper part of the formation consists of ferruginous sandstones and glauconitic shales. The formation is unconformable on the pre-Cambrian and about 240 feet thick in the Teton Range. Its thickness is unknown in the northern Wyoming Range because it is not exposed there.

Gros Ventre Formation.- The Gros Ventre formation includes an upper and lower shale unit separated by the

TABLE 1. - Stratified rocks of the Northern Wyoming Range.

Age	Formation	Thick- ness (feet)	Lithology
Miocene	Camp Davis formation	2250+ —	Gray conglomerate at base, 200 feet, overlain by 50 feet of freshwater limestone. The top 2000 feet is red conglomerate.
Middle Eocene	Pass Peak formation	3000+ —	Coarse red and gray conglomerate grading upward into sandstones and shales.
Lower Eocene	Hoback formation	15000+ —	Sandstones and shales with interbedded conglomerate lenses and fresh water, impure limestone beds. Coal in lower part.
Upper Cretaceous	Frontier formation	5000+ —	Gray and buff sandstones and shales. Several thin coal beds and one fifteen foot coal bed.
	Aspen formation	1200+ —	Upper 600 feet largely gray-green, porcellaneous, vitrified, rhyolitic tuff. Interbedded tuffaceous siltstones and sandstones. Lower part interbedded black shales and gray-green "salt and pepper" sandstones.
Lower Cretaceous	Bear River formation	700+ —	Upper half largely black shale with a few thin sandstones and limestones. Abundant fresh water invertebrates. Lower half tan sandstones and shales.
	Gannett formation	250+ —	Gray shales and limestones underlain by fifty feet of gray, lithographic limestone, underlain in turn by light gray sandstones and red shales.
Upper Jurassic	Stump formation	120+ —	Green to greenish gray sandstones and shaly sandstones with glauconite. Contains <u>Pentacrinus</u> stems.
	Preuss formation	180+ —	Red, green, and white, calcareous sandstone, which is thin, cross-bedded and fine grained.

TABLE 1. - Continued.

Age	Formation	Thickness (feet)	Lithology
Middle Jurassic	Twin Creek formation	550	Massive, oolitic limestone at top 50 feet thick underlain by gray, splintery, limy shale and shaly limestone. <u>Gryphea</u> abundant in upper 300 feet.
	Gypsum Spring formation	160+	Gray, splintery, shaly limestone and limy shale with some red shale.
Lower Jurassic	Nugget sandstone	750+	Massive to thin bedded sandstone, usually soft, locally quartzitic. White to pink to tan color. Aeolian cross-bedding is locally conspicuous.
Middle or Upper Triassic	Ankareh formation	200+	Red siltstones and shales considerably altered near upper contact.
Lower Triassic	Thaynes formation	1125+	Buff siltstones and limestones and interbedded red to tan siltstones and shales.
	Woodside formation	350+	Red, thin-bedded shales and siltstones.
	Dinwoody formation	250+	Tan, limy siltstone, resistant.
Permian	Phosphoria formation	240+	Cherty, fossiliferous limestone in upper part underlain by black, phosphatic shales.
Pennsylvanian	Tensleep formation	700+	White to pink "ortho" quartzite with some thin-bedded, silicious, dolomitic, white limestone.
Mississippian and Pennsylvanian	Amsden formation	500+	Gray, cherty limestone with small amounts of red sandstone and shales. Some gypsum locally.

TABLE 1. - Continued.

Age	Formation	Thickness (feet)	Lithology
Mississippian	Brazer formation	350+	Light gray, lithographic limestone with calcite veins. Interbedded breccias and gypsum locally near top.
	Madison formation	950+	Blue gray limestone, weathers tan, massive to thin-bedded. Corals abundant.
Devonian	Darby formation	400+	Brownish gray, massive dolomite with inter-bedded gray and black shales. Bituminous odor when struck.
Silurian	Leigh formation	40+	White, brittle, finely crystalline dolomite.
Ordovician	Bighorn dolomite	300+	Light gray to cream dolomite, massive, cliff-forming. Weathers to rough pitted surface.
Upper Cambrian	Boysen formation	260	Gray limestone, weathers tan, massive to thin-bedded. Locally oolitic, weathers to pitted surface.
Middle Cambrian	Gros Ventre formation	725	Upper 75 feet, shale, thin, gray, green, with flat pebble conglomerate. Underlain by Death Canyon limestone member, 250 feet, medium to dark gray, rusty mottling. Lower 400 feet green and red shale, glauconitic, chloritic and hematitic.
	Flathead formation	240	White to tan ortho quartzite, medium-bedded, well developed basal conglomerate.
Pre-Cambrian			Gneiss and schist intruded by pegmatite and granite and later by basic dikes.

Death Canyon limestone member. The upper shale is gray-green with some flat pebble conglomerates and the lower shale is red and green due to glauconite, chlorite and hematite. The Death Canyon member is blue to gray limestone with rusty mottlings on the weathered surface (Miller, 1936, p. 119). Horberg gives a thickness of 725 feet for the Gros Ventre formation in the Teton Range. It is conformable on the underlying Flathead quartzite. The formation is of middle Cambrian age (Horberg, 1938, p. 13-14).

Boysen formation. - A 260 foot bed of gray limestone overlies the Gros Ventre formation in the Teton Range. It is the Boysen formation and is thick to thin-bedded, locally oolitic and weathers to a pitted surface. It is disconformable on the Gros Ventre formation and is of upper Cambrian age (Deiss, 1938, p. 1104-1105). Neither the Gros Ventre or Boysen formations are exposed in the northern Wyoming Range.

Ordovician system

Bighorn dolomite.- A massive dolomite, the Bighorn, is the oldest rock exposed in the northern Wyoming Range. The dolomite is light gray to cream in color and weathers to a rough pitted surface. It crops out on the east side of Grayback Ridge about 200 feet below the crest and extends nearly the entire length of the ridge. Only the upper 75 feet of the formation is present. The lower part of the formation is cut off by the Darby thrust. In the Teton range to the north the Bighorn is about 300 feet thick, and is separated from the underlying Boysen formation by a

disconformity (Horberg, 1938, p. 15). The Bighorn dolomite is Ordovician in age.

Devonian system

Leigh formation.- The Leigh formation consists of a white, finely crystalline, brittle dolomite. It is about 40 feet thick in the northern Wyoming Range. The formation is parallel with the underlying Bighorn dolomite but may be separated from it by an erosion surface (Wanless, H., personal communication). The Leigh formation was first recognized and described by Blackwelder (1918, p. 419-420), who considered it to be a member of the Ordovician Bighorn dolomite. Recently, however, Devonian (?) fish scales and a post-Ordovician coral have been found in the Leigh member by the members of the staff of Camp Davis so it is now considered Devonian in age and here elevated to formational rank.

Darby formation.- The type locality of the Darby formation is on the west slope of the Teton Range in the Canyon of Darby Creek. It was named and described by Blackwelder (1918, p. 420-422) as a varied series of shales and dolomites in many colors from white to gray, green, buff, red, brown and black. In the northern Wyoming Range the Darby is a brown to brownish gray dolomite with some interbedded gray and black shales. It is about 400 feet thick in the northern Wyoming Range and disconformably overlies the Leigh formation. The Darby is of Devonian age (Blackwelder, 1918, p. 420-422) but its correlation with the Jefferson and Three Forks formation of Montana has not yet been established.

Mississippian system

Madison formation.- The Madison formation is a blue-gray, massively bedded limestone and for the most part is coarsely crystalline with abundant cup corals and brachiopods. In the northern Wyoming Range the entire formation is badly fractured, with abundant fault breccia and talus. The Madison forms the upper portion of Grayback Ridge and numerous small cirques along the ridge have been eroded in it. The formation is about 950 feet thick and overlies the Darby unconformably. It is Lower Mississippian is age (Mansfield, 1927, p. 60).

Brazer formation.- The Brazer formation is mostly made up of limestone beds which are not readily distinguishable from those of the Madison, and hence the two are mapped together as a single unit. The Brazer is more finely crystalline than the Madison, nearly lithographic locally, and has abundant calcite veins. It forms the upper west slope of Grayback Ridge and in some places caps the ridge although the Madison usually does so. In the area, the formation is about 350 feet thick and conformably overlies the Madison. The Brazer is of Upper Mississippian age (Mansfield, 1927, p. 71).

Pennsylvanian system

Amsden formation.- The best exposure of the Amsden formation in the northern Wyoming Range is seen on the east side of Deadman Mountain where it consists of gray, cherty limestones, interbedded reddish sandstones and shales. In nearby localities it ranges from 600 to 710 feet thick but on Deadman Mountain the base is cut out by the Darby thrust

and only 500 feet of the formation is exposed. The Amsden unconformably overlies the Brazer formation. It is probably all Lower Pennsylvanian in age, but a basal member may be Mississippian (Wanless, Backrack etc., 1945).

Tensleep sandstone.- The Tensleep sandstone consists of white to pink sandstones and "ortho" quartzites. Some thin layers of silicious, dolomitic, white limestone are intercalated in the sandstones. The formation caps Deadman Mountain and forms the lower west slope of Grayback Ridge where it is about 700 feet thick. It overlies the Amsden conformably and is Pennsylvanian in age (Darton, 1904, p. 397).

Permian system

Phosphoria formation.- The Phosphoria formation crops out on the west side of Grayback Ridge and Deadman Mountain and to the east of the Hoback fault. The lower member is black phosphatic shales and the upper Rex Chert member is dark gray to black, cherty, fossiliferous limestone. Only the Rex Chert was seen, as the formation is usually covered with Tensleep talus in the northern Wyoming Range. The formation is about 240 feet thick and conformably overlies the Tensleep sandstone (Krusekopf, personal communication). Richards and Mansfield (1912, p. 684-689) assigned a Permian age to the Phosphoria.

Triassic system

Dinwoody formation.- The Dinwoody formation consists of a group of gray to tan and brown shales and siltstones. Some of the siltstones are calcareous, and some thin-bedded dense limestones are intercalated in the shales and siltstones.

The formation is about 250 feet thick in the northern Wyoming Range and rests unconformably on the Phosphoria formation. According to Newall and Kummel (1942, p. 947) the Dinwoody is Lower Triassic, probably the time equivalent of the lower part of the Woodside formation in the type area.

Woodside formation.- In the northern Wyoming Range the Woodside formation consists of red, thin-bedded shales and siltstones. The Woodside is about 350 feet thick and conformably overlies the Dinwoody formation. Newall and Kummel (1942, p. 947) state that the red beds above the Dinwoody in southeastern Idaho are stratigraphically equivalent to the upper half of the type Woodside and are Lower Triassic in age. They state further that these red beds should be considered a northeastern tongue of the Woodside. The same situation seems to exist in the northern Wyoming Range. The Dinwoody and Woodside formation were mapped as a single unit.

Thaynes formation.- The Thaynes formation is composed of silty, buff colored limestones with interbedded, red to tan siltstones and shales. In the northern Wyoming Range the Thaynes is 1125 feet thick. Mansfield (1920, p.42) reports 3600 feet of Thaynes in southeastern Idaho. The Thaynes overlies the Woodside unconformably and is of Lower Triassic age (Newall and Kummel, 1942, p. 947-948).

Ankareh formation.- In the northern Wyoming Range the Ankareh formation consists of red siltstones and shales considerably altered near the upper contact. The formation is about 200 feet thick in the area studied and unconformably overlies the Thaynes. The Ankareh is considered the time equivalent of the Higham, Deadman and Wood formations which

are Upper and Middle (?) Triassic (Mansfield, 1927, p 374). No attempt was made to separate the Thaynes and Ankareh in mapping.

Jurassic system

Nugget sandstone.- The Nugget sandstone is a massive, cross-bedded, cliff-making sandstone. It is generally pink to salmon in color but white and tan units occur. The formation is 750 feet thick in the northern Wyoming Range and rests unconformably on the Ankareh. It is thought to be of Lower Jurassic age (Mansfield, 1927, p. 27).

Gypsum Spring formation.- In the type area in the Wind River Basin the Gypsum Spring formation consists of a red, blocky siltstone overlain by a massive gypsum bed. Overlying the gypsum is an alternating sequence of limestones, shales, and dolomite. (Love, et al 1945). The gypsum is absent throughout the northern Wyoming Range. A basal brecciated limestone is overlain by gray, shaly limestones and limey shales. The whole formation is about 100 feet thick and overlies the Nugget unconformably. It is of Middle Jurassic age (Love, et al 1945).

Twin Creek formation.- The Twin Creek formation consists of gray shales and gray, oolitic limestones. At the top is a massive, oolitic limestone bed underlain by 300 feet of gray, splintery, limey shale in which Gryphea nebrascensis are abundant. The Twin Creek is about 650 feet thick in the northern Wyoming Range and unconformably overlies the Gypsum Spring formation (Love, et al 1945). Mansfield (1927, p.98) placed the Twin Creek in the Upper Jurassic and stated it

might be Middle Jurassic at the base. Imlay (1945, pp. 1019-1022) has assigned a Middle Jurassic and Lower Upper Jurassic age to the formation on faunal evidence. The Twin Creek and Gypsum Spring formations were mapped as a unit.

Preuss formation.- In the northern Wyoming Range, the Preuss formation consists of thin, cross-bedded, calcareous, red, green and white sandstones. It is about 180 feet thick in the area and overlies the Twin Creek unconformably. The formation is of Upper Jurassic age (Mansfield, 1927, p. 99).

Stump formation.- The Stump formation is a green to greenish gray sandstone to shaly sandstone with abundant glauconite in some beds. Pentacrinus columnals are common. In the northern Wyoming Range the Stump is 120 feet thick and it is conformable on the underlying Preuss. On faunal evidence the Stump is assigned to the Upper Jurassic (Mansfield, 1927, p. 101).

Cretaceous system

Gannett formation.- In the northern Wyoming Range the Gannett formation consists of shale, sandstone, siltstone and limestone. The lower part of the formation is light gray sandstone with some reddish shale. Above this is gray, massive, freshwater, lithographic limestone, and at the top are beds of gray shale and limestone. The formation is about 250 feet thick in the area and disconformably overlies the Stump formation. The Gannett is generally considered to be Lower Cretaceous in age (Mansfield, 1927, p. 101). Horberg 1938, p. 21) reports coarse conglomerate in the Gannett in

the Teton Range but none was observed in the area of this report.

Bear River formation.- The Bear River formation consists largely of interbedded gray sandstone that weathers tan and dark gray shale in the lower half. Black shales make up the upper half. A very thin, impure coal bed was observed a few feet below the top. A piece of petrified wood was collected at the Aspen-Bear River contact about one quarter of a mile above the mouth of Phosphate Creek (see plate 2). The formation is 700 feet thick in the northern Wyoming Range and unconformably overlies the Gannett formation (Dobrovlny, 1940, p. 435). Veatch (1907, p. 63) considered the Bear River to be at the base of the Upper Cretaceous section but Aurelle La Rocque, a graduate student at the University of Michigan, has tentatively assigned a Lower Cretaceous age to the Bear River on faunal evidence supplied by extensive collections made during the summer of 1946.

Aspen formation.- The Aspen formation in the northern Wyoming Range consists of shales, sandstones and vitrified, rhyolitic tuff. The lower part of the formation consists of gray-green, "salt and pepper" sandstones with interbedded black shales. The upper 600 feet of the formation is largely gray-green, vitrified, rhyolitic tuff with some interbedded tuffaceous siltstones. The vitrified tuff has been called porcellinite. In the northern Wyoming Range the Aspen is about 1200 feet thick and conformably overlies the Bear River formation (Dobrovlny, 1940, p. 438). The tuff beds in the Aspen mark a time of volcanism and Dobrovlny (1940,

p. 438) concludes that the site of volcanism was closer to the Camp Davis area than to the area of the Mowry shale, the age equivalent of the Aspen in northeastern Wyoming. Eardley (1944, p. 824) reports 250 feet of Aspen with some tuff beds in the north-central Wasatch Mountains. In view of the preceding the site of volcanism must have been nearby. The Aspen belongs to the Colorado epoch of the Upper Cretaceous (Veatch, 1907, p. 64).

Frontier formation.- The Frontier formation is a thick group of sandstones and shales with some coal beds. The thickest section of the Frontier in the area was found just to the east of Deadman Mountain (see plate 2). With the aid of aerial photographs, the section was measured. The units were plotted on the photo, strike and dip noted, and samples collected. Utilizing a graphic solution the following section was determined:

<u>Units</u>	<u>Thickness</u> <u>(Feet)</u>
20 Sandstone, light gray, medium to coarse grained. <u>Cardium</u> sp. aff--? Meek, <u>Ostrea soleniscus</u> Meek, <u>Donax Cuneata</u> Stanton. Lenses of calcareous, gray, dense limestone at irregular intervals.	610
19 Sandstone, gray, massive, crossbedded, weathers dark buff to dark gray. Five foot coal bed near middle of unit.	375
18 Sandstone, reddish brown, medium grained small mud balls at irregular intervals, ridge former.	325
17 Sandstone, calcareous, light gray, fine to coarse grained, calcite veins, weathers gray. A coal bed near middle of unit.	115
16 Sandstone, calcareous, white to light gray massive, calcite veins and limestone nodules. Contains lenses of brown, dense sandstone up to ten feet in length and three feet in thickness at irregular intervals.	630

<u>Units</u>	<u>Thickness (Feet)</u>
15 Sandstone, calcareous, gray, medium to fine grained, weathers buff. Two to three foot coal bed about 140 feet above base of unit.	210
14 Interbedded limestone and calcareous shale, blue gray, weathers deeply to a reddish orange.	25
13 Sandstone, calcareous, gray, fine grained, weathers tan.	105
12 Sandstone, calcareous, gray, weathers yellow brown, 15 to 18 foot coal bed in middle of unit.	30
11 Sandstone, calcareous, light gray with yellow cast, some calcite veins, fossiliferous.	125
10 Sandstone, calcareous, light gray, coarse grained, ridge former. This coal bed near middle of unit.	530
9 Sandstone, very calcareous, gray, fine grained, tan on weathered surface.	190
8 Sandstone, very calcareous, gray, fine grained, some calcite veins, brown on weathered surface.	420
7 Shale, calcareous, blue gray, weak, thin interbedded sandstones near top.	500
6 Sandstone, locally calcareous, light gray, coarse to medium grained, ridge former, <u>Inoceramus cf. acuteplicatus</u> Stanton.	190
5 Sandstone, light gray, fine grained, weathers purplish brown.	295
4 Sandstone, gray, medium grained, ridge former.	235
3 Sandstone, calcareous, gray, fine grained, with interbedded and calcareous shales.	135
2 Sandstone, light gray, medium grained.	220
1 Sandstone, light gray to yellow gray and and greenish brown, medium to coarse grained, conglomeratic layers, quartzitic at top, weathers purple near base of unit.	25
Total thickness <u>5290</u>	

The upper part of the formation is cut off by the Darby fault so the section represents part of the Frontier only. The fossils in units 20 and 6 proved to have too wide a range to be used for close correlation but are common Frontier types (Kellum, personal communication). The Frontier formation conformably overlies the Aspen and belongs to the Colorado epoch of the Upper Cretaceous (Veatch, 1907, p. 69).



Figure 2. - Outcrop of Frontier formation (unit 16 of measured section) about one mile east of Deadman Mountain.

About three miles south of the southern edge of the area a coal mine, the Blind Bull, is in operation. The coal is probably from the bed in unit 12 of the measured section. Just south of Deadman Mountain another mine, no longer in operation, obtained slack coal probably from the bed in either unit 15 or 17.

Eocene series

Hoback formation.- The Hoback formation is not known to occur in the area but does crop out a short distance to the northeast in the Hoback Basin. It is composed of interbedded gray sandstones and shales. Scattered throughout the formation are several conglomerate lenses and impure, freshwater limestone beds. Some coal is found in the lower part. In the Hoback Basin, Eardley estimated the formation to be 15,000 feet thick (Eardley and Kellum, 1944). Its lower relations are unknown. It is lower Eocene in age (Eardley and Kellum, 1944).

Pass Peak formation.- The Pass Peak formation crops out just outside the southeast corner of the area of this report. It consists of coarse red and gray conglomerates at the base grading upward into sandstones and shales. The formation is about 3000 feet thick and rests unconformably on the underlying formations. It is of middle Eocene age (Eardley and Kellum, 1944).

Miocene series

Camp Davis formation.- The Camp Davis formation crops out in the extreme northern part of the area north of Adams Creek (see plate 2). At the type locality along the Hoback River about five miles north of the northern edge of the area of this report, the formation consists of a 200 foot basal gray conglomerate and a 2000 foot upper red conglomerate. The upper conglomerate is separated from the lower by a 50 foot bed of white to buff, freshwater limestone and

and volcanic tuff. The formation is unconformable on the underlying formations. Formerly this formation was referred to as the Almy of Paleocene age but recently a fossil horse tooth of upper Miocene or lower Pliocene age was found in the limestone beds by members of the staff of Camp Davis (Eardley, 1942, p. 1800). On this evidence the formation has been named the Camp Davis formation.

STRUCTURAL GEOLOGY

Laramide structures

Darby overthrust.- The Darby overthrust is the most prominent of the structural features in the area of this report. On the east side of Grayback Ridge (geologic map, plate 2), its trace can be followed southward from Pow Wow Point to Deadman Mountain. At the Little Grays River, which flows westward in a deep canyon through the ridge, the trace of the thrust plane disappears beneath recent flood plain deposits only to reappear a short distance south on the east front of the Deadman Mountain ridge.

The basal formation of the Darby thrust sheet, north of Little Grays River, is mainly a resistant limestone which holds up Grayback Ridge. It is composed of the Mississippian Madison and Brazer formations. South of the Little Grays River, the thrust plane cuts higher into the Paleozoic strata and the Pennsylvanian Amsden is at the bottom of the thrust sheet. The resistant Tensleep sandstone forms the top and upper part of the west slope. Below the thrust plane, Cretaceous beds of the Gannett, Bear River, Aspen, and Frontier formations are exposed. Each of these formations comes into immediate contact with the overriding Paleozoics (plate 2) at some point between Pow Wow Point and Deadman Mountain.

The gentle dip of the Darby thrust plane has been noted by several writers. Schultz (1914, p. 84) has described deep "V's" in the thrust trace across several valleys in the Wyoming Range. The dip of the thrust plane in the northern

Wyoming Range is 30 to 35 degrees west, which is apparently a higher dip (plate 3) than in the southern part of the Range.

G. R. Mansfield (1927, p. 381) has estimated a stratigraphic throw of over 20,000 feet and has postulated horizontal displacement on the Darby thrust of 15 miles. Considerably less horizontal displacement is assumed for the thrust in the northern Wyoming Range. On the basis of graphically measured thicknesses, a stratigraphic throw of 12,500 feet was determined for the fault at Deadman Mountain. This decreases northward to 9,000 feet at Pow Wow Point.

North of Pow Wow Point, the Darby thrust crosses the Snake River, and terminates in the north-plunging anticline of Munger Mountain (Horberg, 1938, p. 28). Southward, the trace follows the eastern side of the Wyoming Range where it joins the Thompson fault about 30 miles south of the area studied. At this point (Schultz, 1914, geologic map), has mapped a change in direction to the east for 10 miles, whereupon the fault resumes its north-south direction again. It follows the eastern side of Labarge Ridge and finally disappears below the Eocene beds of the Green River Basin. Minimum known length of the thrust is 100 miles.

Peale (1879, p. 630) first recognized the Darby overthrust in 1877. He named it from Mount Darby, the highest point along the crest of the Wyoming Range.

Pickle Pass syncline.- The Cretaceous formations below the Darby overthrust are folded into a syncline which is overturned to the east, the direction of movement of the thrust sheet. Small streams flow east toward Willow Creek

(plate 2) and have dissected the area between Grayback Ridge and Willow Creek. Excellent exposures in the valley walls show Frontier, Aspen, and some upper Bear River shales in cross sectional view.

Near Phosphate Creek (fig. 3), the upper Bear River shales are the oldest beds exposed adjacent to the thrust.



Figure 3. - Darby thrust and overturned beds on west flank of Pickle Pass syncline.

Below the Bear River, although younger, are the Aspen formation and some lower Frontier sandstones (plate 3). Much of the Frontier has been removed through erosion but the remaining beds outline the axis of the syncline. Dips on the west flank of the syncline are 70 to 80 degrees west. The east flank dips about 20 degrees in the same direction.

The syncline trends south to Pickle Pass where it veers

westward and the trough passes beneath the thrust so that only the east flank is exposed. South of Pickle Pass, a gentle anticlinal fold occurs in the Cretaceous rocks. The east flank of the syncline north of Pickle Pass becomes the west flank of the anticline south of Pickle Pass. The strata have an average dip of about 25 degrees from Roosevelt Meadows (cross section, plate 3) to the thrust plane.

Thrusts of the Hoback Range.- Several thrusts exist in the Hoback Range to the east of the Wyoming Range (see map and cross sections, plate 2, 3). These have been mapped by Dr. A. J. Eardley and Helen Foster. They are called tentatively, the Shepard, Clause, Cabin, and Grizzly thrusts. With movement from west to east or northeast, they resulted when the Paleozoic and Mesozoic sediments failed under the stresses of the Laramide orogeny.

The Hoback Range is an imbricate structure. Thrust sheets have been thrust over and rest upon previous thrusts. Folding of the thrust sheets occurred as the deformation continued (map and cross sections, plates 2, 3, 4).

The Cabin and the Clause thrusts both terminate on the east flank of a syncline in Ramshorn and Clause Peaks respectively. The syncline probably resulted from folding of the beds in the Cabin thrust sheet by overriding of the Shepard thrust (see plate 3), whose trace is east of and parallels the Cabin and the Clause thrusts.

The Grizzly thrust, of special interest, is located south of Cliff Creek Pass (plate 2). The trace of the thrust was mapped (Eardley and Foster) south of the Upper

Hoback River until it crossed the southwest boundary of the Jackson Quadrangle sheet. Its existence has not been recognized north of Cliff Creek Pass. The gentle dip of the thrust plane is illustrated in section B-B' (plate 3). The thrust has been cut by the Hoback fault and uplifted. It is assumed to exist at depth in the downthrown block of the Hoback fault.

An unnamed klippe, remnant of another thrust, rests on the Grizzly thrust sheet. The klippe has been isolated by headward erosion of the Upper Hoback River from the upper thrust sheet on the south side of the river. This unnamed thrust has also been cut by the Hoback fault.

Stages of thrusting.- Significant folding and faulting of the Paleozoic and Mesozoic sediments did not occur until after the deposition of the Frontier formation. If the Frontier is correctly determined to be of Colorado age, then initial Laramide faulting in the area could not be older than late Upper Cretaceous. Fifty miles north of the area, the Pinyon conglomerate of Paleocene age is thick, coarse, and widespread, and is presumed to represent the first phase of the Laramide orogeny.

No evidence, structural or stratigraphic, was observed within the area of this report that would permit the correlation of the Darby thrust with the period of orogeny described above. However, upon evidence noted in north-central Utah and southwestern Wyoming, the thrust is thought to be of Paleocene age (Eardley, personal communication). It has been tentatively concluded that the Darby and the

Absaroka (plate 4) were thrusts within the highlands and supplied the clastics of the Pinyon conglomerate. The Absaroka thrust is covered, in southwestern Wyoming, by the Almy conglomerate of Paleocene age. Assuming the above relationships, the Absaroka and the Darby thrusts pre-date the thrusts of the Hoback Range.

In the area to the east of the Hoback fault, the Cabin and the Clause thrust sheets have cut and overridden the lower Eocene Hoback formation (plate 2, 4) but are overlapped by the middle Eocene Pass Peak conglomerate. This late lower Eocene thrusting is regarded as the second phase of the Laramide orogeny. The Grizzly thrust cuts the Pass Peak conglomerate and is therefore representative of a third phase of deformation in late middle or upper Eocene time. The post-Pass Peak thrusting is probably the last of the Laramide deformation.

Relation of local structures to regional.- Two distinct structural provinces exist in western Wyoming (Horberg, 1938, p. 28). An eastern belt of structures (plate 4), including the Teton, Gros Ventre, Wind River, and Bighorn Ranges is located in the shelf zone of sedimentation. Large, asymmetrical, and overturned folds are representative of this area. West of the shelf zone, a belt of deformation developed in geosynclinal thicknesses of Paleozoic and Mesozoic sediments. This latter region includes the structures of the Wyoming Range. The Hoback, Snake River, and Salt Ranges are also along the eastern margin of this western or trough zone. Thrusting is the characteristic expression of orogeny along

the eastern margin of the trough zone.

As stated above , the thrusting Darby and the Absaroka sheets are believed to represent the first phase of Laramide orogeny in the area. Sedimentation followed this event with the deposition of the Pinyon conglomerate and the Hoback formation (see tectonic map and cross section C-C', plate 4). Reduction of the uplands is recorded in the decreased grain size through the beds of the Hoback formation. Thrusting occurred again and initiated a second period of deformation. A series of thrusts developed with movement to the east and northeast. The Jackson, Game, Cabin, Clause, and perhaps the Shepard are considered as part of the second orogeny. The Pass Peak formation was deposited, folded, and overthrust as the final phase of Laramide deformation. The Cache thrust sheet, along the south front of the Gros Ventre Range, moved to the southwest at the same time. Forces developed from the opposite direction and resulted in at least two thrust sheets with eastward movement. These thrusts are the Grizzly and an unnamed thrust which forms a klippe resting on the overthrust block of the Grizzly (plate 2).

Mid-Tertiary faulting

Hoback fault.- The Hoback fault is characteristic of the post-Laramide high angle faults that are superimposed on the previously folded and faulted structures (plates 2, 3). From the north to the south end of the area, the fault trace is deflected little across ridges and depressions and is therefore considered of high dip. The down-thrown block is on the west.

North of Adams Creek, the Hoback fault is covered by the Miocene Camp Davis formation (see plate 2). South of that point, it follows the east wall of Willow Creek to Hunter Creek, then southeast up Hunter Creek and through the Cliff Creek Pass where it can be observed on the east slope of Roosevelt Meadows. The fault trace passes southward out of the area of the report a short distance west of the Lincoln-Sublette county-line.

Formations from the lower Triassic Dinwoody through the Upper Cretaceous Aspen appear in the west block of the Hoback fault. Each of the above formations (plate 2) outcrops in contact with and is cut off at the fault plane. The east block of the fault, north of the Grizzly thrust sheet, is almost entirely composed of Carboniferous rocks. The Phosphoria and Dinwoody formations crop out at the fault plane east of where Hunter and Willow Creek merge and continue northward. Progressively younger formations crop out south of Cliff Creek Pass where Mesozoic rocks of the Grizzly thrust sheet also make up the east block of the gravity fault.

Age of deformation.- The age of the Hoback fault may be tentatively determined as Miocene. This high angle fault cuts and is younger than the Grizzly thrust which was determined to be post-Pass Peak (middle Eocene) in age. The Camp Davis conglomerate (upper Miocene or lower Pliocene) covers the trace of the Hoback fault near Adams Creek. Eardley (1942, p. 1800) has postulated two pre-conglomerate episodes of deformation on the basis of detailed mapping along the borders of the deposit. Initial folding and thrusting was

followed by later high angle faulting. An escarpment was formed by the faulting against which the conglomerate accumulated. As the escarpment was dissected by erosion, it contributed to subsequent deposition which finally buried the fault. It is evident, therefore, that the Hoback fault at least pre-dates the upper group of conglomerates in the Camp Davis formation.

Other faulting.- Three minor faults have been mapped in the vicinity of Mumford (plate 2) and Adams Creeks. These faults are of the high angle variety with little displacement, and may be related to the Hoback faulting.

Relation of local faulting to regional.- Movement on the Hoback fault may have coincided with the uplift of the Teton block and the faults on the east side of the Gros Ventre Buttes (Eardley, personal communication). These features (plate 4) are located about 30 miles north of the report area and east of the Teton Range.

The Hoback and Teton faults seem to be part of a rift zone that stretches from Utah to Nevada, but the details are not yet known.

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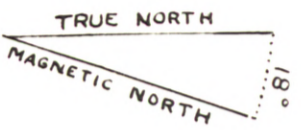
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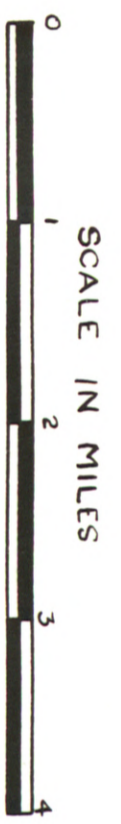
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GEOLOGIC MAP OF NORTHERN WYOMING RANGE AREA

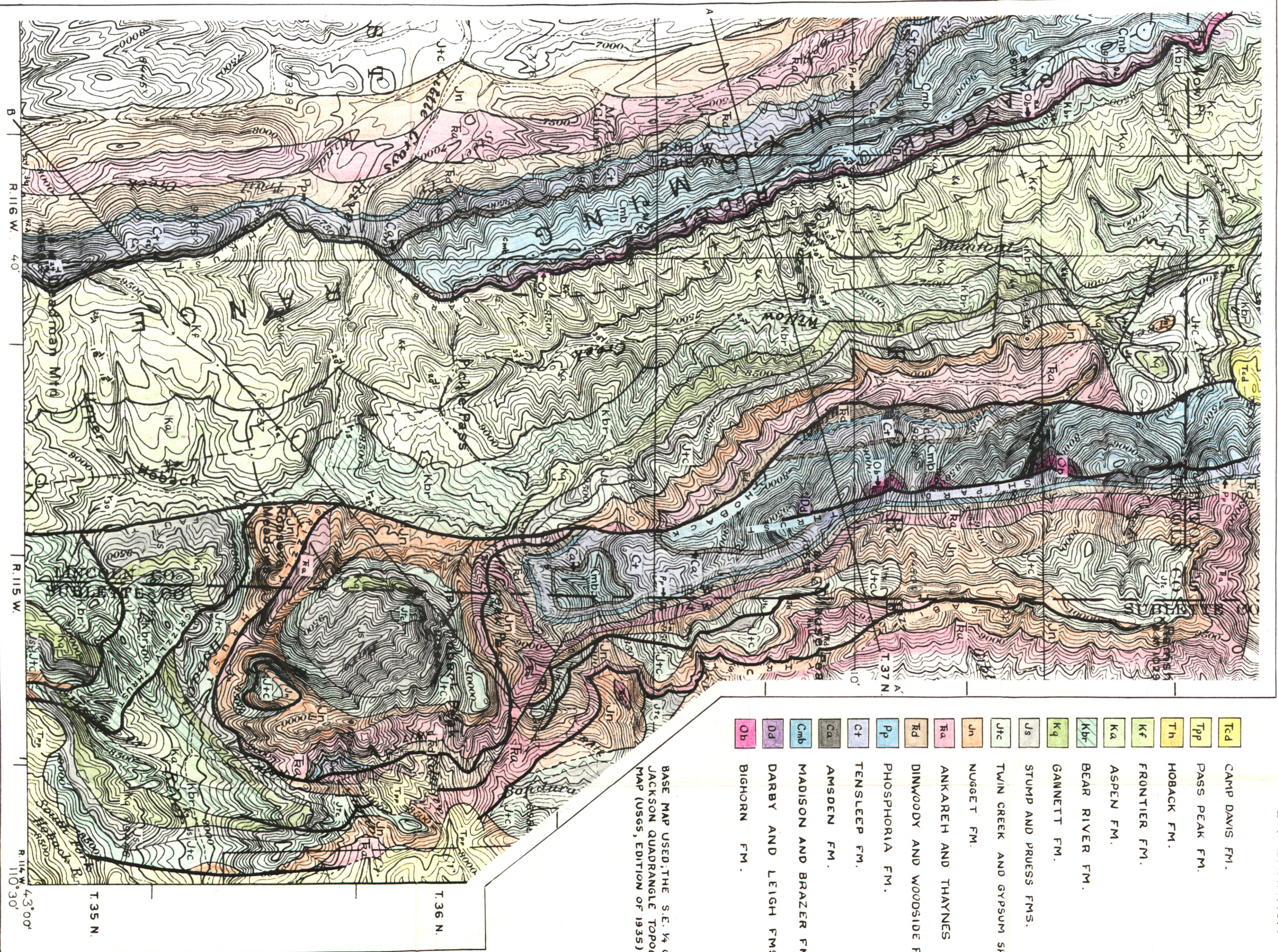


APPROXIMATE MEAN DECLINATION, 1931



CONTOUR INTERVAL 100 FEET

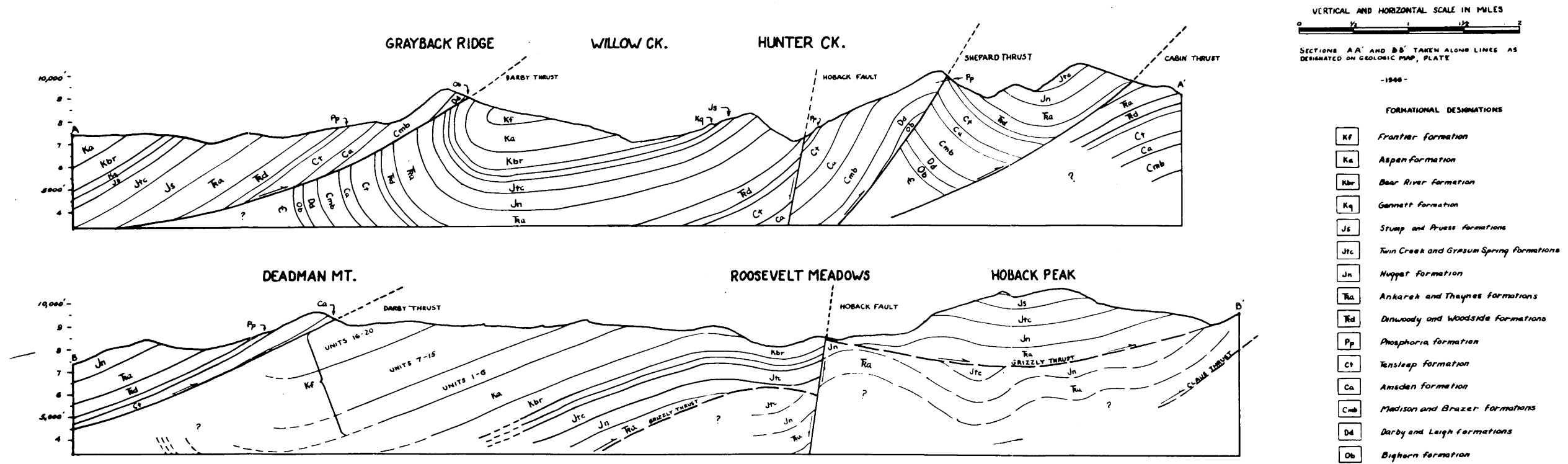
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- EXPLANATION**
- Tcd CAMP DAVIS FM.
 - Tpp PASS PEAK FM.
 - Th HOBACK FM.
 - Kf FRONTIER FM.
 - Ka ASPEN FM.
 - Kbr BEAR RIVER FM.
 - Kq GANNETT FM.
 - Js STUMP AND PRUSS FMS.
 - Jtc TWIN CREEK AND GYPSUM SPRING FMS.
 - Jn NUGGET FM.
 - Ra ANKAREH AND THAYNES FMS.
 - Rd DINWOODY AND WOODSIDE FMS.
 - Pp PHOSPHORIA FM.
 - ct TENSLEEP FM.
 - ca AMSDEN FM.
 - Cmb MADISON AND BRAZER FMS.
 - Dd DARBY AND LEIGH FMS.
 - Ob BIGHORN FM.

BASE MAP USED: THE S.E. ¼ OF THE JACKSON QUADRANGLE TOPOGRAPHIC MAP (USGS, EDITION OF 1935).

R. 116 W. 40' R. 115 W. T. 36 N. T. 35 N. R. 114 W. 43°00' 110°30'

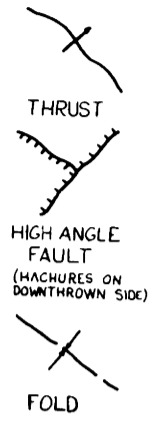


CROSS SECTIONS OF THE GRAYBACK RIDGE AREA, WYOMING RANGE, WYOMING

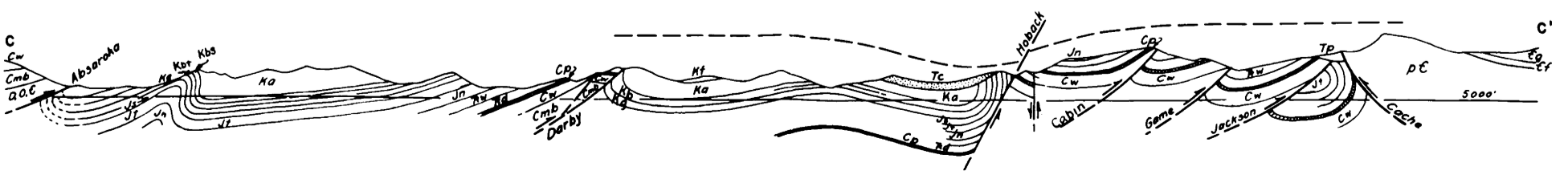
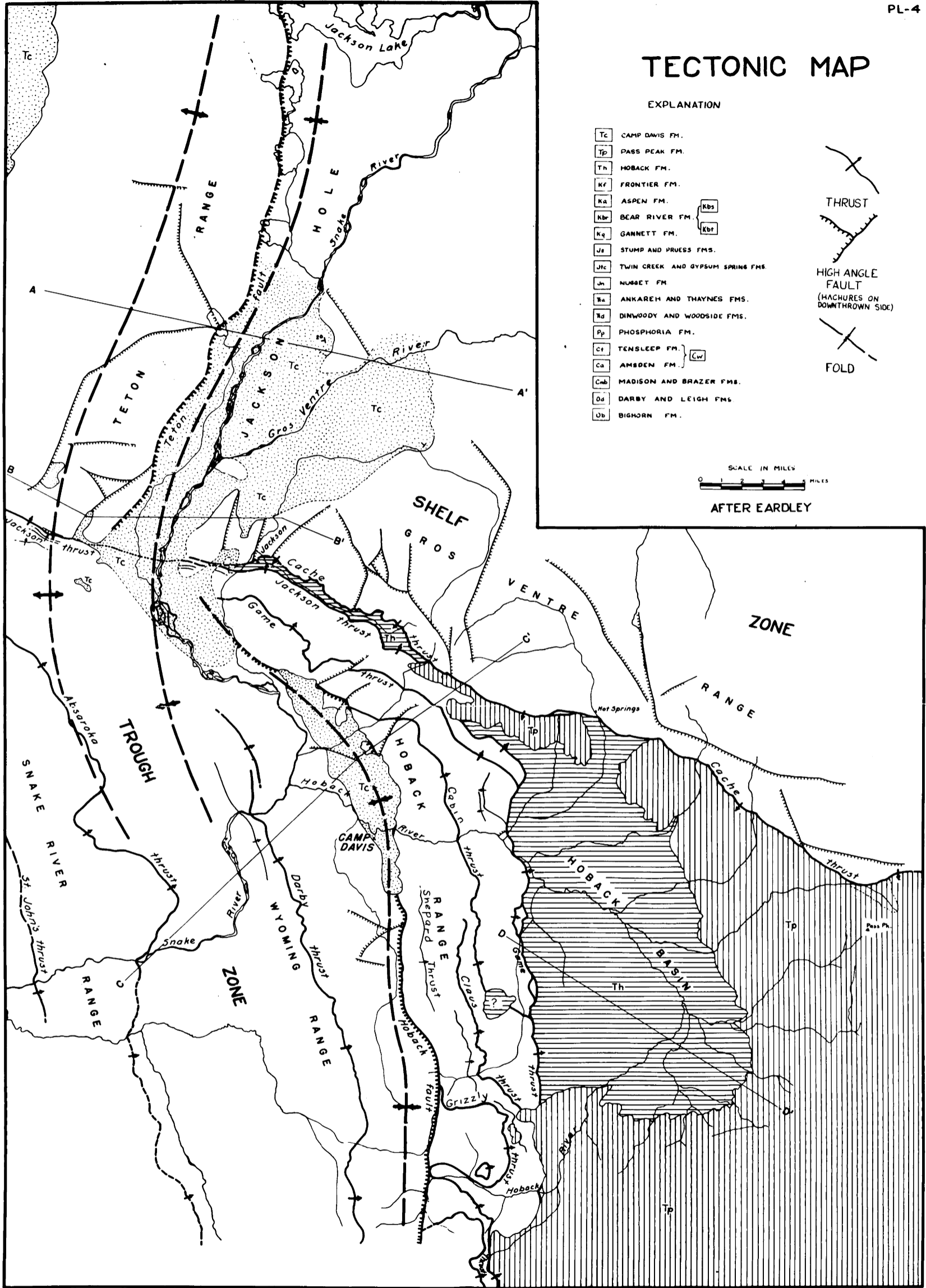
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EXPLANATION

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- Tp PASS PEAK FM.
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- Ka ASPEN FM.
- Kbr BEAR RIVER FM.
- Kq GANNETT FM.
- Jc STUMP AND PRUSS FMS.
- Jtc TWIN CREEK AND GYPSUM SPRING FMS.
- Jn NUGGET FM.
- Ja ANKAREH AND THAYNES FMS.
- Jd DINWOODY AND WOODSIDE FMS.
- Jp PHOSPHORIA FM.
- Cf TENSLEEP FM.
- Ca AMSDEN FM.
- Cmb MADISON AND BRAZER FMS.
- Cd DARBY AND LEIGH FMS.
- Cb BIGHORN FM.



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