GEOLOGY OF THE FALL CREEK AREA, SNAKE RIVER RANGE, WYOMING

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CONTENTS

ILLUSTRATIONS

ABSTRACT

The Fall Creek area in the Snake River Range, Wyoming, is a part of a belt of folded, faulted, and thrust sediments of Paleozoic and Mesozoic age. Paleozoic sediments represent relatively thin shelf-zone deposits near the border of the geosyncline to the west; whereas, the Mesozoic sediments represent thick deposits which collected in the Rocky Mountain trough east of the rising Cordilleran geanticline. Strata exposed in the Fall Creek area range in age from lower Mississippian (Madison formation) to Upper Cretaceous (Aspen formation). The Absaroka and St. John thrust sheets, with associated reverse faults and folds, are the prominent structural features of the area. A group of Tertiary intrusives occurs in the southern part. Pleistocene glaciation was widespread in the eastern slopes of the Range as is evident from the various glacial deposits and erosional features.

INTRODUCTION

Object of investigation

The Fall Creek area was assigned to Jean Richards and the writer as a cooperative problem for Master's theses at the University of Michigan. The object of the investigation was to determine the geologic structure, and from this the geologic history of the Fall Creek area.

Aerial photographs, supplemented by a topographic map, were used for mapping purposes. Limited time and inaccessibility of some parts did not permit a thorough study of the area. However, by studying the photographs under a stereoscope we were able to trace faults and formational contacts across those parts so as to produce a fairly accurate geologic map.

Index Map Showing Location of Fall Creek Area and Other Geographic Features

Location of area

The Fall Creek area lies in the Snake River Range, Wyoming, which is bounded on the north by the Teton Range, on the east by the Hoback Range, on the southeast by the Wyoming Range, on the south by the Salt River Range, and on the west by the Caribou Range. The area of this report lies in the part of the Snake River Range south of Mosquito Creek, west of a north-south line through Red Top Meadows, north of Dog Creek, and east of the Jackson Quadrangle border line.

Acknowledgments

During the field work the University of Michigan Rocky Mountain Field Station at Camp Davis served as a base camp, while temporary camps were set up on Mosquito and South Fall creeks. For assistance in this work I am grateful to my partner, Jean Richards, to Prof. A.J. Eardley of the University of Michigan who directed the field work and aided in the writing of the report, to Prof. H.R. Wanless of the University of Illinois who furnished many detailed stratigraphic sections, and to Prof. E.W. Heinrich of the University of Michigan who helped in the petrographical analysis of the igneous rock.

STRATIGRAPHY

General considerations

The entire stratigraphic section is not exposed in the Fall Creek area; however the rocks which are exposed range in age from lower Mississippian (Madison formation) to Upper Cretaceous (Aspen formation). The following formations described are taken from different parts of the Snake River Range as well as from

There is no place on earth where entire section is exposed

Are the formations taken or are the descriptions taken from other areas?

STRATIGRAPHIC COLUMN

Age	Formation	Thickness	Good Exposure
L.Plio.-U.Mioc.	Camp Davis	5500-6300	West front Snake River Range
Eocene	Pass Peak	1000-5000	Hoback Basin
Paleocene	Hoback	15,000	Hoback Basin
U. Cretaceous	Frontier	645+	Palisade Creek, Sn. R. Range
	Aspen	2015	Palisade Creek
	Bear River	585	South of Red Top Meadows
L. Cretaceous	Gannett	940	Palisade-Trail creeks
U. Jurassic	Stump	105	Cabin Creek, Sn. R. Range
	Preuss	98	Cabin Creek
M.-U.Jurassic	Twin Creek	793	Cabin Creek
	Gypsum Spring	106	Cabin Creek
L. Jurassic	Nugget	262	Cabin Creek
U. Triassic(?)	Ankareh	370	Wolf Creek, Sn. R. Range
L. Triassic	Thaynes	695	Wolf Creek
	Woodside	468	Red Creek, Sn. R. Range
	Dinwoody	598	Red Creek
Permian	Phosphoria	177	Dog Creek, Sn. R. Range
U.Pennsylvanian	Tensleep	404	Red Creek
L.Pennsylvanian	Amsden	580	Red-Little Red creeks
Mississippian	Brazer	270	Taylor Mt., Teton Range
	Madison	900	Taylor Mt.
Devonian	Darby	470	Taylor Mt.
	Leigh	85	Taylor Mt.
Ordovician(?)	Big Horn	395	Taylor Mt.
U. Cambrian	Boysen	180-220	Teton Range
	Gros Ventre	600	Teton Range
L. Cambrian	Flathead	175	Teton Range
pre-Cambrian	gneisses and schists		

Table 1

the Teton Range and Hoback Basin (see index map, plate 1). Due to great local variations in the thickness of some of the beds, the values given here do not necessarily hold for all parts of the region.

Pre-Cambrian rock

Pre-Cambrian rock, forming the core of the Teton Range, is described by Horberg (1938, p.13) as steeply dipping gneisses and schists which have been intruded by pegmatite, granite, and basic dikes. Quartzites are in scattered localities.

The stratigraphy is summarized in Table 1.

Cambrian system

Flathead formation. The Flathead formation, exposed in the Teton Range, is composed of two members which together are 175 feet thick. The lower member, 140 feet thick, contains conglomerate, quartzite, and sandstone. The upper member is composed of ferruginous sandstone, oolitic hematite, and glauconitic shale, and is 35 feet thick (Horberg, 1938, p. 13).

Gros Ventre formation. The Gros Ventre formation, exposed in the Teton Range, is 600 feet thick. An upper shale member, 220 feet thick, contains beds of intraformational breccia, pebbly limestone, and algal reefs. Below this lies the Death Canyon member, a thin-bedded, dark gray limestone with some fossiliferous shale partings. The basal 100 feet is a shale unit (Horberg, 1938, pp. 12-14).

Boysen formation. The Boysen formation lies disconformably on the Gros Ventre formation. It is a massive, mottled, blue-gray limestone 180-220 feet thick. It is oolitic in places and weathers to a pitted surface. Fossils are rarely found. (Horberg, 1938, p.12).

Ordovician system

Bighorn formation. The Bighorn formation is exposed on the east side of Taylor Mountain at the south end of the Teton Range. It was measured by Prof. H.R. Wanless, J.R. Gaebe, and Kenneth Kenniston in August, 1947. It is 395 feet thick and is composed of massive, light gray dolomite which weathers white or tan and contains pitted members.

Devonian system

Leigh formation. The Leigh formation was measured on the east side of Taylor Mountain in the Teton Range by Wanless, et al in August, 1947. The thickness of the formation is 85 feet. The lithology is massive, light gray to blue-gray dolomite which weathers white to gray. Its extensively pitted surface is mottled with yellow near the base. A few corals and crinoid stems were found.

Darby formation. The Darby formation is 470 feet thick on the east side of Taylor Mountain in the Teton Range where it was measured by Wanless, et al in 1947. The formation consists of interbedded limestone, sandstone, shale, and siltstone beds ranging from 1 foot to 37 feet in thickness. The siltstone is yellow to tan, thinly bedded, and lies near the top of the formation. The limestone ranges from yellow to black, is thin-bedded to massive, lithographic to coarsely crystalline, and contains some calcite veins. Some beds are petroliferous. Corals were found in one bed near the top.

Mississippian system

Madison formation. The Madison formation is the oldest formation exposed in the Fall Creek area. It was measured, however, on the east side of Taylor Mountain in the Teton Range by Wanless, et al. Here the Madison formation is 900 feet thick. It is composed entirely of light gray to blue-gray limestone in beds up to 35 feet thick. The limestone is massive, sub-lithographic to coarse-grained, resistant,and contains calcite veins, calcitic geodes, and cavities. Corals crinoids, and some brachiopods were found. (Wanless, et al, 1947).

Brazer formation. The Brazer formation was measured on the east side of Taylor Mountain in the Teton Range in August, 1947 by Wanless, J.C. Bayless, R.M. Hutchinson, Walter Kupsch, and Robert Scholten. The thickness of the formation is 270 feet. It is a massive, lithographic to coarse-grained, dark gray limestone containing some calcite veins. Some beds are pitted by solution. Coral and crinoidal traces were found. (Wanless, et al,1947).

Pennsylvanian system

Amsden formation. The Amsden formation, as measured by Ruth Bachrach on a spur between Red and Little Red creeks in the Snake River Range, has a total thickness of about 580 feet. The upper part is mainly cherty to coarse-grained, gray limestone containing some crinoid stems. Some red and gray shales are interbedded with the limestone. Below this limestone member, which grades to pink mottled with gray near the base, lies the Darwin sandstone member. It is a 50-foot, tan to reddish-tan, quartzitic sandstone containing some red shale partings. At the base of the Amsden formation are 10-20 feet of conglomeratic limestone and red shale. (Bachrach, 1945, pp. 15-17).

Tensleep formation. The Tensleep formation, measured in Red Creek, is 404 feet thick. The formation is mainly interbedded limestone and sandstone with some dolomite and shale. The limestone is white to light gray, lithographic to coarse-grained, and somewhat chalky in places. The sandstone is white to light gray, fine-grained, massive, quartzitic, jointed, and cross-bedded. (Bachrach, 1945, pp. 14-15).

Permian system

Phosphoria formation. The Phosphoria formation, measured by Wanless in September, 1946 opposite Johnny Counts Flats near the mouth of Dog Creek in the Snake River Range, is 177 feet thick. The upper Rex Chert member includes 67 feet of light gray and brownish-gray, fossiliferous (Derbya) limestone; 33 feet of light gray to black, thin-bedded to massive chert which is conglomeratic at the base with black phosphorite fragments; and 6 feet of dark gray, phosphatic shale. The lower Phosphorite member contains 22 feet of black phosphatic shale underlain by interbedded dark brown limestone and phosphorite. Chert, dolomite, sandstone, and siltstone make up the base.

Triassic system

Dinwoody formation. Wanless measured the Dinwoody formation at the head of Red Creek in August, 1946. The thickness here is 598 feet. The upper member is a gray siltstone 253 feet thick which is calcareous, shaly, somewhat fucoidal, and weathers tan or rusty. Below this are 123 feet of soft, gray, greenish-gray and brown shales overlying 92 feet of gray to blue-gray limestone which is slabby to massive, and weathers reddish to brown. Some Lingula were found in the limestone. The base of the Dinwoody is a 23-foot unit of brown sandstone resting on a half-foot of a black siltstone conglomerate.

Woodside formation. The Woodside formation was measured by Wanless at the head of Red Creek in August, 1946. The formation is 468 feet thick and is composed of interbedded red shale and siltstone. The upper 50 feet is the most resistant part of the formation.

Thaynes formation. The Thaynes formation was measured along the north side of Wolf Creek 1½ miles southeast of Red Pass by Wanless in August, 1947. The upper Fort Hall member, mainly limestone with some sandstone and shaly siltstone layers, is 695 feet thick. The limestone is buff to light gray, massive, sandy, and contains Pentacrinus, crinoid and echinoid debris, pelecypods, and gastropods. The lower Ross Fork member is 460 feet thick and is composed chiefly of brownish-gray, calcareous sandstone underlain by some light gray to black, sandy limestone.

Sounds as though Pentacrinus were not a crinoid

Ankareh formation. The Ankareh formation, measured in Wolf Creek by Wanless in August, 1947, is 370 feet thick. It is mainly interbedded limestone and red shale with some sandstone and siltstone. The limestone varies from pinkish, red, and purplish to olive and yellow-gray; it is massive in thin beds ½-22 feet thick and is somewhat fractured. The base is composed of a 250-foot shale unit containing 14 feet of thin-bedded, ripple-marked, red sandstone.

Jurassic system

Nugget formation. The Nugget formation at the mouth of Cabin Creek, as measured by Wanless in August, 1946, is 262 feet thick. It is composed of white and pink to purplish sandstone which is quartzitic, massive, and somewhat cross-bedded.

Gypsum Spring formation. The Gypsum Spring formation is 106 feet thick at the mouth of Cabin Creek where it was measured by Wanless in August, 1946. The formation is a reddish shale overlying light gray to blue-gray limestone which weathers buff and contains some resistant beds.

Twin Creek formation. The Twin Creek formation was measured at the mouth of Cabin Creek by Wanless in August, 1946. The thickness of the formation here is 793 feet. It is composed of light gray shale with a 46-foot horizon of red shale and interbedded limestones in the top 124 feet of the formation. The shale is thin-bedded, calcareous, soft, and very fossiliferous containing *Gryphaea*, *Camptonectes*, *Pentacrinus*, and *Ostrea*. At the base of the formation there is a medium blue-gray limestone which is slabby, resistant, slightly fossiliferous, and contains calcite veins.

what species?

Preuss formation. The Preuss formation, measured at the mouth of Cabin Creek by Wanless in August, 1946, is 98 feet thick. The upper part of the formation consists of poorly bedded, red siltstone and platy, silty shale. The base is a massive, light gray to reddish sandstone.

Stump formation. The Stump formation is 105 feet thick at the mouth of Cabin Creek where is was measured by Wanless in August, 1946. It consists of greenish to brownish-gray, finely crystalline, slabby limestone containing a few fossils; platy, pinkish-gray siltstone; platy, reddish-gray shale; and slabby, greenish-gray sandstone.

Cretaceous system

Gannett formation. The Gannett formation exposed on the ridge between Palisade and Trail creeks in the Snake River Range, as described by Gardner (1944, p. 7), is 940 feet thick. The upper Draney limestone member which is 245 feet thick is composed of non-resistant, dark gray limestone with a zone of interbedded, non-resistant, lavender shales. Below this lies the red Bechler shale member which rests on the Peterson limestone, a resistant, dark gray limestone containing gastropod fossils. The Ephraim conglomerate is the basal member. This is 535 feet thick and is composed of non-resistant, red and purple shale with many discontinuous beds of resistant, light gray quartzite, conglomerate, and pebbly sandstone in the lower half.

The basal conglomerate of the Gannett formation exposed in the south wall of Coburn Creek is a striking feature. The conglomerate is resistant and massive, and contains sub-angular pebbles of limestone and chert ranging up to several inches across. The matrix is a coarse, buff to purplish sandstone.

Bear River formation. The Bear River formation was measured by Wanless along the Fall Creek road ½-1½ miles south of Red Top Meadows in August, 1947. The thickness here is 585 feet. The upper part is chiefly shale in beds from ½ to 33 feet thick. The shale is light gray to black, and soft and flaky near the top to hard and splintery at the base. The hard shale beds contain abundant fossils, including *Pyrgulifera*, *Arctica*, *Nuculana*, *Ostrea*, and *Corbicula*. Interbedded gray to brownish-gray limestone coquina beds contain *Corbicula*, *Ostrea*, *Nuculana*, *Aplexa*, *Goniobasis*, and *Campeloma*. Gray to brownish-gray sandstones and siltstones are also interbedded. A marker bed of hard, black porcelainite-like shale 3.5 feet thick lies near the center of the formation. The lower part of the formation is composed of 100-150 feet of massive, medium-grained tan sandstone weathering to brownish-gray. A poorly exposed, gray to black shale occurs at the base.

Aspen formation. The Aspen formation, measured between the forks of Palisade Creek, is 2015 feet thick. It is composed of pale green to olive green shales, siltstones, and sandstones with interbedded mottled gray, green and pink procelainite and some olive green quartzites (Gardner, 1944, p.6). In other localities a characteristic massive, salt and pepper sandstone occurs interbedded with soft, gray shales.

Frontier formation. An incomplete section of the Frontier formation exposed on a ridge between the forks of Palisade Creek is 645 feet thick. It is composed of olive green to greenish-gray sandstone and shale with some interbedded olive brown conglomerates and quartzites. (Gardner, 1944, p. 6). The formation reaches a thickness of over 5,000 feet in Grayback Ridge of the Wyoming Range (Ross and St. John, 1946, p. 17).

Paleocene series

Hoback formation. The Hoback formation exposed in the Hoback Basin is around 15,000 feet thick. The lithology is interbedded gray sandstone and shale with several conglomerate lenses and impure, fresh-water limestone beds. The lower part contains coal. (Eardley, et al, 1944).

Eocene series

Pass Peak formation. The Pass Peak formation is 1000-5000 feet thick in the Hoback Basin. It is a coarse, red and gray conglomerate that grades into sandstone and shale toward the Basin. It is probably lower or middle Eocene in age. (Eardley, et al, 1944).

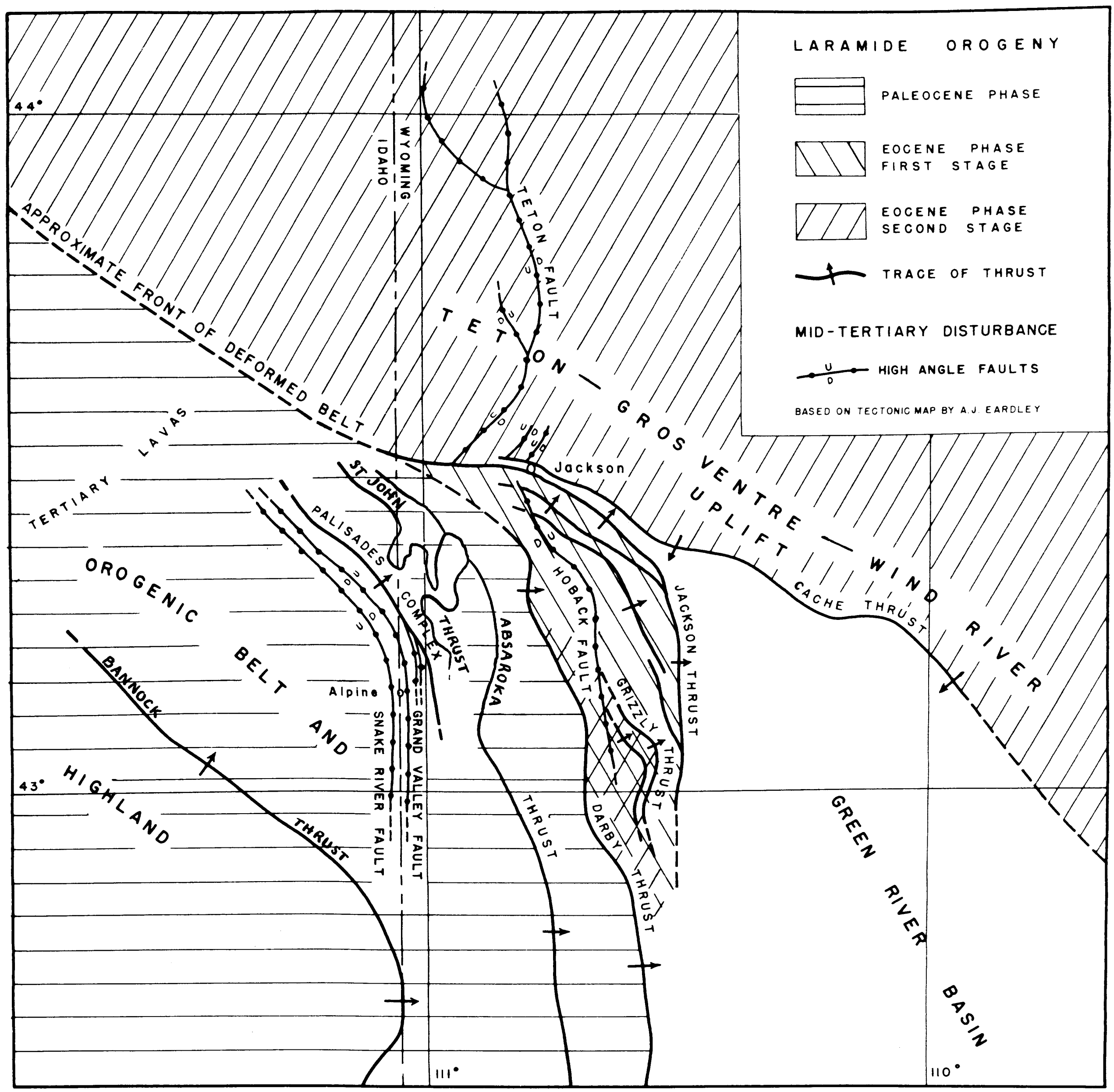
Miocene series

Camp Davis formation. An exposure of the Camp Davis formation along the west front of the Snake River Range has been described by Enyert (1946, pp. 16-18). Here it is 5500-6300 feet thick. Four members, separated by unconformities, comprise the formation. Starting with the basal member, these are a lower andesite, a compacted silt, an upper andesite, and a tan and gray conglomerate. The lower andesite is a zeolitic hypersthene-augite andesite 1200 feet thick. The silt member is 800 feet thick. The upper andesite is similar in composition to the lower andesite and is 300-1000 feet thick. The conglomerate member is 3200-3300 feet thick and contains boulders of Paleozoic rock.

REGIONAL HISTORY

Paleozoic history

Shelf zone. During the Paleozoic era a great geosyncline, trending north-south, occupied the western states. Wyoming lay at the eastern edge of this geosyncline in the shelf zone. The relatively shallow deposits of this zone are characterized by



Tectonic Map Showing Absaroka and St. John Thrusts in Relation to Other Structures in Eastern Idaho and Western Wyoming clastic sediments of early Paleozoic age - mainly sandstones and shales; by chemical deposits of middle Paleozoic age - limestones and dolomites; and by both clastic and chemical deposits of late Paleozoic age. The total thickness of the Paleozoic deposits is around 5,000 feet. (Eardley, communication).

Mesozoic history

Rocky Mountain trough. Early in the Mesozoic era the Cordilleran geanticline began to rise in the Paleozoic sediments forming a trough on either side. The Rocky Mountain trough on the east, extending through western Wyoming, began to receive the thick deposits characteristic of a trough. Triassic and Jurassic sediments reached a thickness of about 4,000 feet and Cretaceous sediments a thickness of about 5,000 feet. (Eardley, communication).

Laramide orogeny. The Laramide orogeny began in early Cretaceous times and continued into the Tertiary period. Horizontal forces from the west folded and thrust the thick sediments. A series of low-angle thrusts are dominant structural features in eastern Idaho and western Wyoming.

STRUCTURE

Major regional Laramide structures

Bannock thrust. The Bannock thrust (see tectonic map, plate 2), the greatest of the series of thrusts, lies in eastern Idaho. It was first described by Richards and Mansfield in 1912 and named for Bannock County, Idaho. (Mansfield, 1927, p. 150). The horizontal displacement may be as great as 40 miles.

St. John thrust. The St. John thrust lies east of the

Bannock thrust and trends northwest-southeast through eastern Idaho and western Wyoming. Kirkham named the St. John thrust in 1924 (Kirkham, 1924, pp. 33-34). Its southern extent is unknown; however it has been traced into the Bradley Mountain area where it splits into three smaller thrust sheets (Bastanchury, 1946, p.30).

Absaroka thrust. The Absaroka thrust, east of the St. John thrust, has a length of about 200 miles, a breadth of over 25 miles, and a stratigraphic displacement of over 20,000 feet. Peale was the first to recognize this thrust (Mansfield, 1927, p. 381).

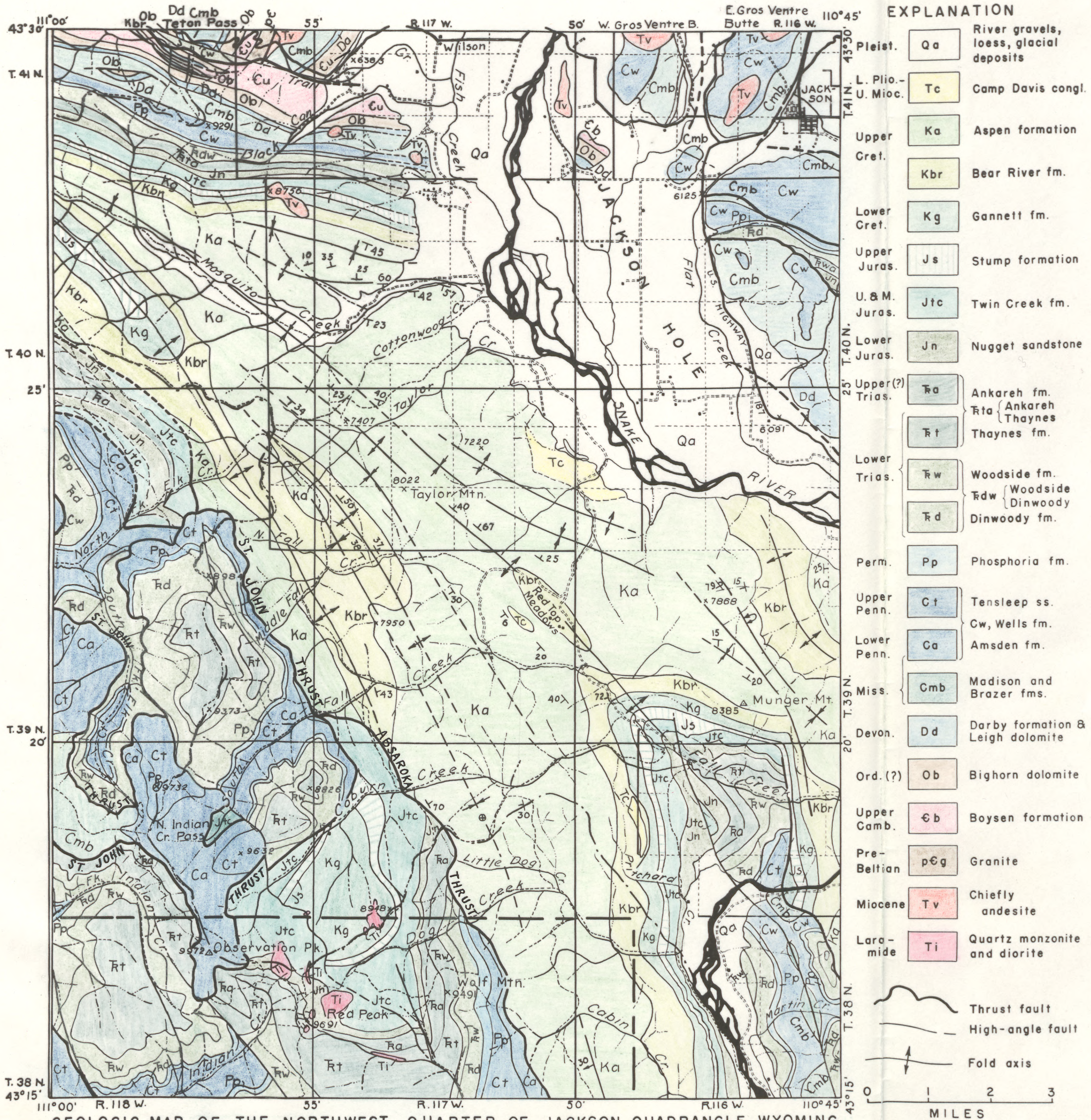
Darby thrust. The Darby thrust, the easternmost of the series, was discovered by Peale. Its known length is over 100 miles and its breadth over 15 miles. (Horberg, 1938, p. 28).

Minor regional Laramide structures

Palisades thrust complex. The Palisades thrust complex lies between the Bannock and St. John thrusts and consists of three minor thrusts in a closely related series. The upper sheet is the Blowout thrust having a stratigraphic throw of 400 feet. Below this is the Needle Peak thrust having a stratigraphic throw of 400 feet and a horizontal displacement of at least 2 miles. At the bottom lies the Ferry Peak thrust having a stratigraphic throw of 2300 feet and a breadth of 2 miles. (McIntosh, 1946, pp. 15-16).

High-angle faults. High-angle reverse faults are common in the thrust sheets. These are compressional features of relatively minor importance.

Folds. Close folds parallel to the general strike of the

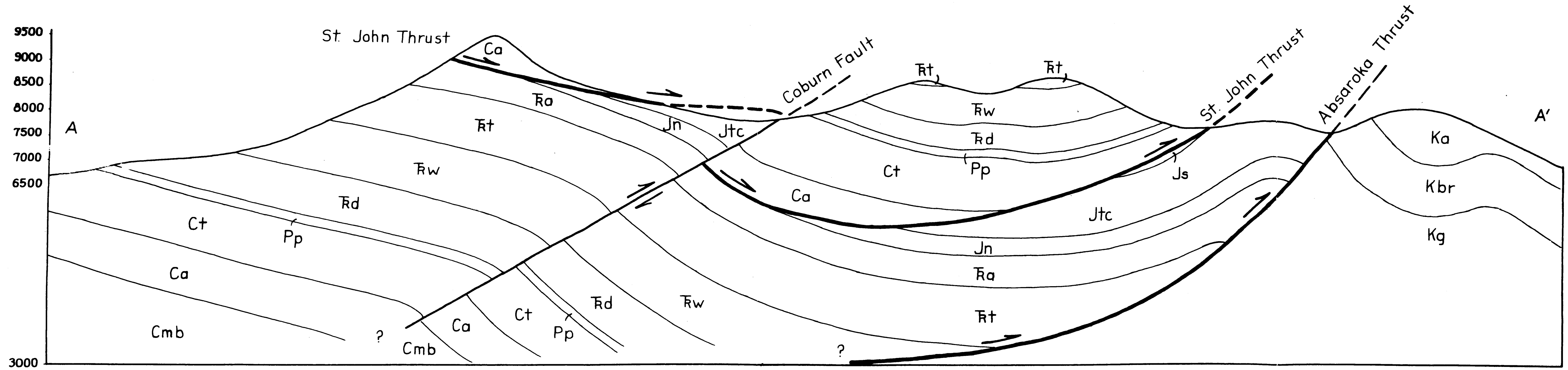


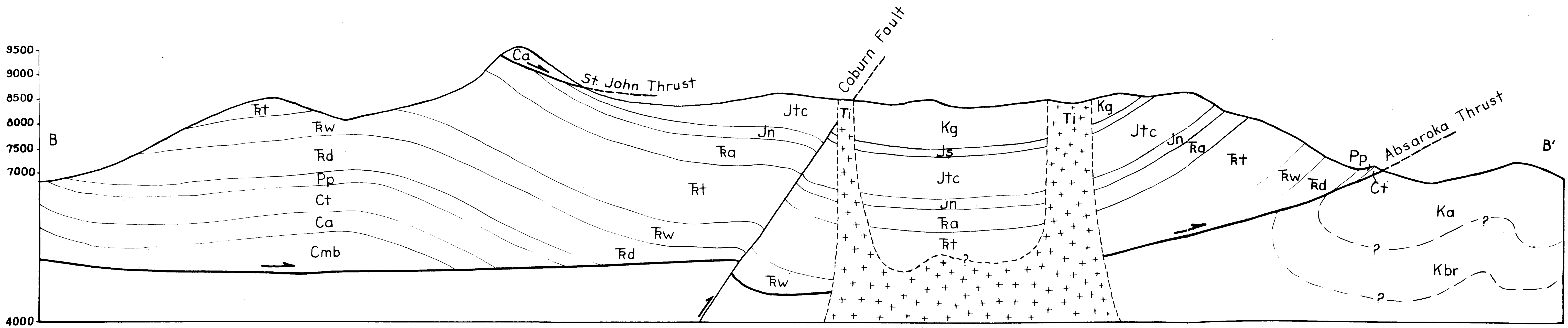
GEOLOGIC MAP OF THE NORTHWEST QUARTER OF JACKSON QUADRANGLE, WYOMING

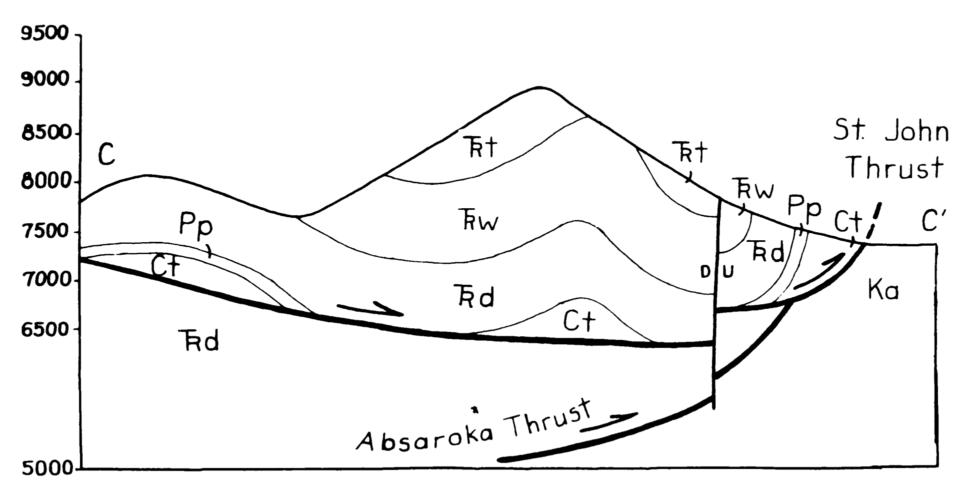
SNAKE RIVER RANGE AND JACKSON HOLE

Mapped on aerial photos and compiled on U.S.G.S. Jackson topographic sheet

Geology by K.A. Keenmon, Janet Cook, Jean Richards, Leland Horberg and A.J. Eardley, 1940-47.

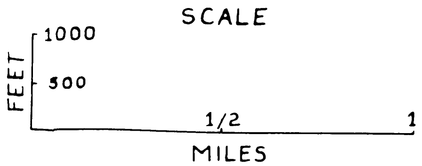






CROSS SECTIONS THROUGH THE SNAKE RIVER RANGE
JACKSON QUADRANGLE, WYOMING

SCALE



LEGEND

Ka - Aspen fm	Jn - Nugget ss	Pp - Phosphoria fm
Kbr - Bear River fm	Ꞧa - Ankareh fm	Ct - Tensleep ss
Kg - Gannett fm	Ꞧt - Thaynes fm	Ca - Amsden fm
Js - Stump fm	Ꞧw - Woodside fm	Cmb - Madison, Brazer fms
Jtc - Twin Creek	Ꞧd - Dinwoody	Ti - Intrusives

thrusts are characteristic structures in the thrust sheets. Some of these are prominent topographic features.

Major Fall Creek area structures

Absaroka thrust. The front of the Absaroka thrust sheet was traced northwestward from Wolf Mountain as far as South Fall Creek (see geologic map, plate 3). Here a sharp change occurs in the lithology of the sediments of the thrust sheet which overlies Cretaceous beds. A change from the Twin Creek formation of middle to upper Jurassic age to the Amsden formation of lower Pennsylvanian age clearly indicates a change of structure. Further north, however, the normal trace of the Absaroka thrust was again recognized in the North Fork of Elk Creek where Twin Creek beds overlie the Cretaceous sediments. Two small thrusts appear here near the front of the main thrust sheet.

St. John thrust. As previously mapped, the St. John thrust has a northwest-southeast trend and lies west of the Fall Creek area. However, on mapping the Fall Creek area, we found that a large salient or lobe of the St. John thrust, having an area of about 50 square miles, extends 10-15 miles east of its general trend to reach beyond the front of the Absaroka sheet between South Fall Creek and the North Fork of Elk Creek. This is the reason for the unusual change in lithology in South Fall Creek and the disappearance of the Absaroka thrust between South Fall and Elk creeks.

The southern boundary of the lobe was traced along the north wall of Coburn Creek to its head. The northern boundary is the North Fork of Elk Creek, however, the South Fork of Elk Creek has cut through the lobe so that the trace of the thrust swings around the head of the South Fork and nearly cuts the lobe free from the main sheet.

The sequence of formations in the St. John lobe ranges from the Amsden formation of lower Pennsylvanian age through the Thaynes formation of lower Triassic age. These beds lie in normal sequence except where they are cut by the Coburn fault.

Minor Fall Creek area structures

Coburn fault. The Coburn fault, a high-angle reverse fault, cuts across the St. John lobe near the head of South Fall Creek and extends 2-3 miles beyond it to the south. The length of the fault is about 8 miles, and the maximum displacement is about 2000 feet where the Tensleep formation is in contact with the Thaynes formation between South Fall and Coburn creeks. Its trend is parallel to the major thrusts in the region.

South Fall window. In South Fall Creek, a small window occurs in the upthrown block of the Coburn fault. Exposed here is the Twin Creek formation of the underlying Absaroka thrust sheet. The low angle and shallowness of the St. John sheet, through which South Fall Creek has eroded, is made apparent by the presence of the window.

Folds. Lying partly beneath and to the south of the St. John lobe is a north-south trending syncline in the Absaroka sheet. Beds of the Gannett formation of lower Cretaceous age lie in the center of the fold. Further south it lies in the area of intrusive rock.

East of the Absaroka sheet the thick Cretaceous beds lie in a series of fairly tight folds. Directly in front of the Absaroka sheet, and following the same general trend, is a prominent anticline in the Aspen formation.

IGNEOUS ROCK

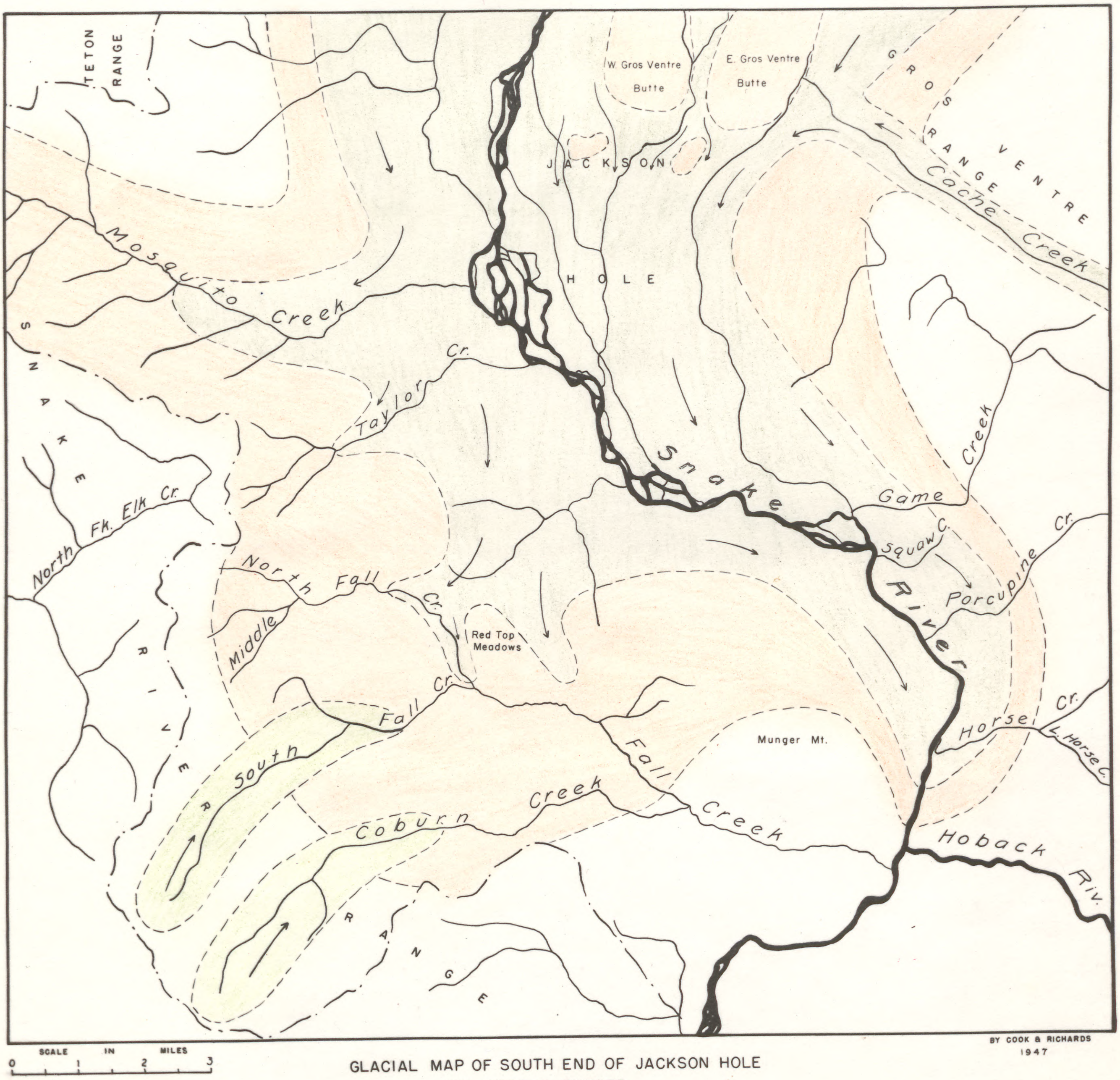
Andesite porphyry

Occurrence. Along the main drainage divide in the southern part of the Fall Creek area occur several small igneous bodies which intrude sediments of upper Jurassic and lower Cretaceous age. They range in size from a few feet to a half-mile in width and are located within an area of about 4 square miles. These dikes and small stocks are probably offshoots of a common parent pluton at depth.

Petrography. A petrographic examination of 3 thin sections of the intrusive rock showed it to be an andesite porphyry bordering on a diorite porphyry. Large phenocrysts of plagioclase and mafic minerals, together with prominent accessory minerals, are set in a fine-grained groundmass of plagioclase and magnetite. The mafic minerals, and to a less extent the plagioclase, are in somewhat parallel orientation and occur in groups. This gives the rock a glomer-porphyritic texture.

The plagioclase phenocrysts, which are zoned and twinned, belong to an oligoclase-andesine group. Sericite, calcite, and kaolinite have replaced the plagioclase in varying amounts.

The most abundant mafic mineral is hornblende occurring in large green phenocrysts. These are twinned and zoned, and show pleochroism from green to yellow-green. Augite and aegirine-augite, a soda variety of pyroxene, are less abundant. These minerals are also zoned and pleochroic. Coarse aggregates of



GLACIAL MAP OF SOUTH END OF JACKSON HOLE
AND BORDER RANGES

(orange)	Buffalo ice
(grey-green)	Bull Lake ice
(light green)	Inferred Bull Lake ice

calcite and colorless chlorite and magnetite have replaced some of the mafic phenocrysts.

Magnetite is abundant in both large and small grains. Quartz is rare. Sphene and apatite are abundant accessory minerals occurring in well-developed crystals.

Age. Intrusives of intermediate type in the Rocky Mountains are generally considered to be of late Laramide age. However, the great similarity between the intrusive andesite porphyry of the Fall Creek area and the extrusive andesites of mid-Tertiary age in the Gros Ventre Buttes may serve as a basis for the determination of the true age of the Fall Creek intrusives.

PHYSIOGRAPHY

Pleistocene glaciation

Buffalo stage. Glaciation of Jackson Hole and surrounding highlands is believed to have occurred in two advances of ice from the north, called the Buffalo and Bull Lake stages, and a third stage of local mountain glaciers, the Pinedale stage (Blackwelder, 1915, pp. 324-328). Of special concern in this report is the glaciation of the Snake River Range and the south end of Jackson Hole.

According to Prof. A.J. Eardley (communication), Buffalo ice (see glacial map, plate 5), the first and largest of the three masses, filled the Hole, which stood at a minimum elevation of 7000 feet, and rode onto the surrounding highlands to an elevation of 8000-8500 feet. This great ice mass which probably originated in the Yellowstone Plateau (Fryxell, 1930, p. 34) (see index map, plate 1) scoured the adjacent highlands, carried the debris into

Figure 1. Granite pegmatite boulder measuring 50x30x25 feet.

Figure 2. Cirque-like head of South Fall Creek

the Hole, and deposited it as morainal material at the margins of the ice. Supporting evidence lies in the presence of residual erratics from the Buffalo drift at high elevations, especially in the northern part of the Snake River Range where observations were made in more detail than elsewhere. Miss Richards and the writer found these erratics at approximately 8200 feet on the north wall of Mosquito Creek, near the drainage divide (7500 feet) at the head of Taylor Creek, and on top of Red Top Meadows (7200 feet).

The glacial erratics are mainly rounded quartzitic cobbles from the Pinyon conglomerate of Eocene age from the Leidy Mountain Highlands northeast of Jackson Lake (Fryxell, 1930, p. 31), but granites, gneisses, and granite pegmatites originating in the Teton Range are common. Boulders of andesite and rhyolite from the Gros Ventre Buttes and boulders of obsidian possibly from Yellowstone Park are present but less abundant. The largest boulder found was one of granite pegmatite measuring roughly 50x30x25 feet (figure 1) and located on the north bank of Mosquito Creek. This boulder is probably the one previously described by Sharp (1946, p. 7) who placed it at an elevation of 7000 feet. We also found boulders nearly as large higher on the same ridge.

Prof. Eardley believes (communication) that following the retreat of the Buffalo ice, dissection of the area occurred. The resulting removal of most of the Buffalo drift left only isolated remnants at the highest elevations. The finer material has mostly been removed, and many of the large boulders let down to lower elevations than originally deposited.

<u>Bull Lake stage</u>. Following the interval of dissection and

Figure 3, U-shaped valley of South Fall Creek

Figure 4. Extent of valley glacier in South Fall Creek

erosion, the Bull Lake glacier advanced (see glacial map, plate 5). This valley glacier formed from ice in the mountains on the east and west which joined the mass on the north and moved southward around the Gros Ventre Buttes and the islands. It carried rounded boulders of quartzite, pegmatite, granite, and gneiss - all smaller and more rounded than those in the Buffalo drift. Some fragments of andesite from the Buttes and limestone and quartzitic sandstone fragments of Paleozoic age, probably Bull Lake material, are present on the north side of Munger Mountain (Sharp, 1946, p. 4). Lobes of ice pushed part way up Mosquito, Taylor, and Fall creeks depositing marginal moraines in these valleys. The main ice mass stopped at the north end of Red Top Meadows, but a lobe of ice moved around either side of the Meadows for about 2 miles. Outwash material and water poured off from these lobes, joined, then continued out to the Snake River through the channel of Fall Creek. The southeast lobe of the main glacier at the mouths of Game, Porcupine, and Horse creeks expelled outwash through the Snake River channel. Munger Mountain seems to have remained unglaciated throughout both Buffalo and Bull Lake stages as indicated by the absence of any erratics on the top and south side.

Miss Richards and the writer observed that the heads of South Fall and Coburn creeks resemble cirques (figure 2) and that their valleys have a U-shape (figure 3). These observations lead us to presume that during Bull Lake times, glaciers formed at the heads of these streams and moved part way down their valleys (figure 4).

Pinedale stage. Pinedale ice, in the third and last stage, formed from small mountain glaciers and moved only as far as Burned Ridge,

Figures 5 and 6. Talus rock flows in South Fall Creek a rough, hummocky end-moraine at the north end of the Hole (Sharp, 1946, p. 10-11). This relatively small glacier floored the Hole with outwash material and expelled its melt water through the Snake River.

Earth movements

Rock flows. Prominent features in the area are talus rock flows (figures 5 and 6), one on either side of South Fall Creek. Both are composed of large angular blocks of the quartzitic sandstone of the Tensleep formation and have a somewhat lobate form. Their formation may be due to over-steepening of the valley walls by a valley glacier.

Landslide. A small landslide occurs in the north wall of Coburn Creek. Movement was down a near dip-slope of the Twin Creek formation in the north flank of a syncline. Sufficient saturation of the shales and thin-bedded limestones together with an unstable slope may have caused the minor movement. The estimated breadth of the landslide is about 15 feet, whereas the amount of movement down slope is about 40 feet.

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