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GEOLOGY OF THE FALL CREEK AREA
SNAKE RIVER RANGE, WYOMING

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Submitted in partial fulfillment
of the requirements for the degree
of Master of Arts in Geology,
University of Michigan, January,
1948.

CONTENTS

ILLUSTRATIONS

ABSTRACT

About 13,000 feet of sediments ranging in age from Carboniferous to Cretaceous are exposed in the Fall Creek area of the Snake River Range. The Paleozoics represent deposits in the margin of the eastern shelf and the Paleozoic cordilleran geosyncline, and the later rocks reflect sedimentation to the east of the Rocky Mountain geanticline. The sedimentary rocks were subjected to deformation during the Laramide orogeny, which resulted in northeasterly trending folds and thrust faults. The Absaroka thrust sheet has a stratigraphic displacement of about 5,000 feet, and the later St. John thrust of about 8,000 feet in this area, but the forward movement on the fault surfaces in undoubtedly many times this amount. The thrust sheets are cut by a reverse fault of several hundred feet throw and by a few small high angle faults. Late Tertiary uplift resulted in youthful topography which was modified by two glacial advances and a few small landslides and rockflows.

INTRODUCTION

This report is the result of an investigation of the geology of a portion of the Snake River Range, Wyoming, made in partial fulfillment of the requirements for the degree of Master of Arts from the University of Michigan. The location of the area mapped and described is shown on the index map, plate I. It comprises about sixty square miles, extending from Mosquito Creek on the north to the drainage divide and Observation Peak on the south, and from the divide on the west to the trail joining North and South Fall Creeks on the east.

The work was done jointly by the writer and her able field partner, Janet Cook, during the summer session of 1947 at Camp Davis, Jackson, Wyoming. The valuable help given by Prof. A. J. Eardley of the University of Michigan and Prof. Harold Wanless of the University of Illinois is gratefully acknowledged.

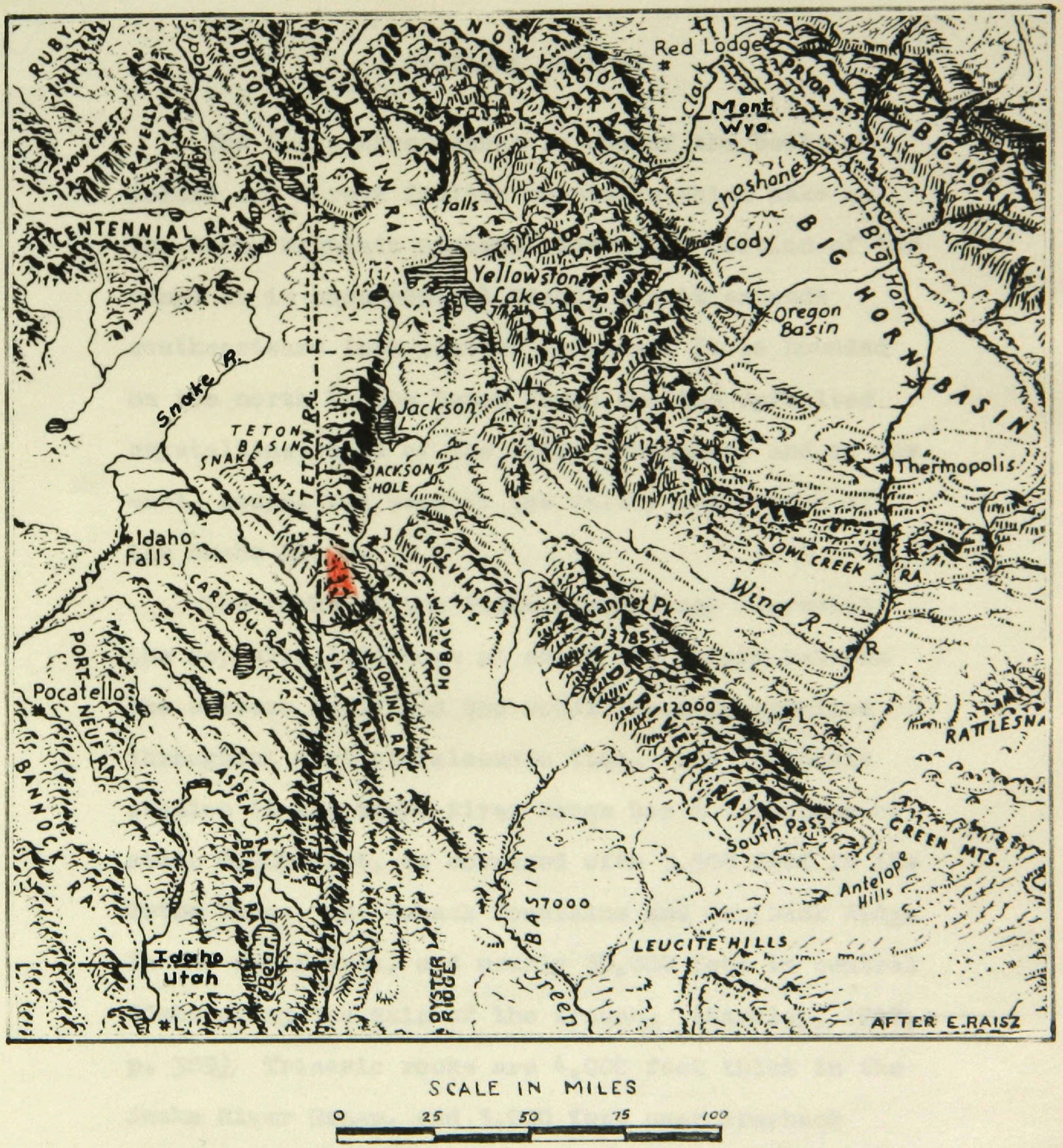

Plate I. Index map showing location of South Fall Creek area (in red) and other geographic features.

REGIONAL GEOLOGY

The Snake River Range is one of the belts of folded and thrust faulted mountains which make up the Rocky Mountain System. The major portion of the range is in east-central Idaho, but it extends southeastward into western Wyoming. It is bounded on the north by the Teton Basin and the upfaulted crystalline rocks of the Teton Mountains, and on the east, south, and west by the valley and canyon of the Snake River.

The rocks of the Snake River Range represent the deposits laid down at about the margin between the eastern shelf and the Cordilleran geosyncline throughout most of Paleozoic time. The Paleozoic section in the Snake River Range has a thickness of about 6,200 feet, as compared with 3,500 feet in the Teton Range, the Hoback Mountains and Grayback Ridge in the shelf area, and nearly 30,000 feet in central Idaho along the axis of the trough (Eardley, 1947, p. 309). Triassic rocks are 4,000 feet thick in the Snake River Range, and 3,000 feet near Grayback Ridge. By Cretaceous time the Cordilleran geosyncline had become divided by the Rocky Mountain geanticline. The eastern trough of sedimentation thus formed in

Wyoming received about 8,000 feet of sediments (Eardley, unpublished maps), of which 3,500 feet is represented in the Snake River Range.

The Snake River Range is the result of compressional stresses from the southwest, a phase of the Laramide Revolution. Within the area of this report two major thrust sheets, a small reverse fault, and a few small high-angle faults were found. There followed in Tertiary time some igneous activity when a few small stocks and sills were intruded. In late Tertiary time regional uplift occurred.

The area was glaciated during at least two stages in the Pleistocene, when probably a few small glaciers originated in the valleys of the range, and tongues of the large ice sheets from the north spread over foreland hills and extended upward into some of the valleys along the northeastern side of the range.

STRATIGRAPHY

Except where otherwise accredited, the section described here is summarized from an excellent stratigraphic column for the Snake River Range compiled by Louis S. Gardner (1944,p.6), which corresponds very well to that in the area of this report. Only those systems of rocks represented within the area of this report are included.

Carboniferous system

Madison and Brazer formations. The Madison and Brazer have been mapped as a unit. The formations are Mississippian in age and are the oldest outcropping beds within the area. The lower 265 feet is a resistant, thin-bedded, light gray to black, fine-grained, fossiliferous limestone. The remainder is a generally massive, bluish gray to gray, cliff-forming limestone. The total thickness is 1,425 feet.

Amsden formation. The Amsden formation consists of brown to yellow, non-resistant sandstone, limestone, siltstone, breccia, and conglomerate beds that have a thickness of 710 feet. This formation is of lower Pennsylvanian age except for the lowermost beds which are Mississippian.

Tensleep formation. The lower 300 feet of the Tensleep formation consists of cherty gray dolomite and limestone, and gray to yellow sandstone, quartzite and siltstone. Above this is 390 feet of yellow and brown quartzite and sandstone. The total thickness is 1,140 feet. The details of the Amsden and Tensleep formations, viz., the lateral lithologic variations, paleontology and regional correlations, are the subject of a thesis by Ruth Bachrach (1945).

Permian system

Phosphoria formation. The lower 30 feet of the Phosphoria formation, known as the "shale member," is gray to brown to black mudstone, shale, and incoherent phosphate rock. The upper Rex chert member is chiefly gray, blue and brown cherty and silty somewhat fossiliferous dolomite and limestone with small amounts of shale and phosphate rock and some massive sandstone. The total thickness is 176 feet. The Phosphoria formation of the Caribou, Snake River, Hoback, Teton, and Gros Ventre Ranges is the subject of a thesis by Lillie Marie Krusekopf (1947).

Triassic system

Dinwoody formation. The lower Triassic Dinwoody formation is thin-bedded, fine-grained, olive green to brownish-gray, sandy calcareous mudstone with a few impure resistant limestones in the lower part. It is 760 feet thick.

Woodside shale. The Woodside shale is composed of non-resistant brick red shale and sandstone and is 1,130 feet thick. It is of lower Triassic age.

Thaynes formation. The lower 80 feet of the Thaynes formation is dull brown to gray limestone or calcareous sandstone which weathers dark brown. A middle unit of 285 feet is deep red siltstone and gray sandy limestone. The uppermost 625 feet is gray to brown sandy limestone and calcareous sandstone. The total thickness is 1,000 feet. It is the uppermost formation of the lower Triassic.

Ankareh formation. The Ankareh formation is deep red, non-resistant shale, gray quartzite, and red sandstone with a thickness of 550 feet. It is probably upper Triassic.

Jurassic system

Nugget sandstone. The Nugget is a massive, resistant, reddish sandstone 340 feet thick. It is of lower Jurassic age (Imlay, 1945, p. 1020).

Twin Creek formation. The lower unit is 250 feet of light gray splintery and platy somewhat fossiliferous limestone. Above is 35 feet of red shale. The upper 685 feet is a limestone similar to the lowest unit. The total thickness of the formation is 970 feet. A red shaly sandstone 55 feet above the Twin Creek, known as the Preuss, was not differentiated. The Twin Creek is middle to upper Jurassic in age (Imlay, 1943, p. 1020).

Stump formation. The Stump formation is a brownish or greenish gray, sandy limestone with a bluish-gray limestone near the top. Its thickness is 140 feet. It is upper Jurassic (Imlay, 1945, p. 1020).

Cretaceous system

<u>Gannett group</u>. The lower Cretaceous Gannett group was mapped as a single formation. The basal Ephraim conglomerate, which is particularly well-developed in the area, consists of 535 feet of red and purple non-resistant sandy shale and many discontinuous beds of light gray resistant quartzite with conglomerates and pebbly sandstone in the lower half, and lenticular, impure, thin-bedded, nodular limestone beds throughout.

This conglomerate, where it is exposed in the valley of Coburn Creek and on the divide south of the creek, contains rounded to angular, dark and light colored chert and limestone pebbles in a massive, pinkish-tan to gray ground mass with calcareous cementing material. The pebbles range in size from about one-sixteenth of an inch to about eight inches, although most of them are under two inches in diameter. Sorting and stratification are fairly well-developed. The outcrop is massive with few bedding planes. Some of the rock weathered a blue-gray color. See Plate II.

The Ephraim conglomerate was deposited during the lower Cretaceous following the rise of the Rocky Mountain Cordilleran geanticline in east central Idaho and central Utah, which split the geosyncline

Plate II. A fragment of the Ephraim conglomerate, lowest member of the lower Cretaceous Gannett group, at an outcrop along Coburn Creek.

into an eastern and a western trough. The land mass of the geanticline provided a source for the pebbles of the conglomerate in the eastern trough. In the area of the Snake River Range the conglomerate, as mentioned, is more than 500 feet thick, but it thins rapidly eastward. Along Cabin Creek, in front of the Absaroka thrust sheet, the Gannett contains a single basal conglomerate just one foot thick.[1]

Above the Ephraim conglomerate is the Peterson limestone which is dark gray and resistant, weathers light gray and purple, and is 125 feet thick. Still higher, the Bechler shale is a unit of red shale and mudstone 35 feet thick. The uppermost member of the group is the Draney limestone, which is dark gray limestone with interbedded lavender shale about half way up. The thickness of the Draney member is 245 feet. The total thickness of the Gannett group is 940 feet.

<u>Bear River formation</u>. The basal unit of the Bear River is a rusty brown thin-bedded quartzite with some black shale, and is 150 feet thick. The remainder is chiefly black shale with small amounts of green shale and sandstone. The total thickness

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1. Section measured by Dr. Harold Wanless.

is 880 feet. The formation is of upper Cretaceous age.

Aspen formation. The Aspen formation is composed chiefly of olive-green, somewhat siliceous shale and siltstone with some interbedded sandstone. In the upper 350 feet, mottled gray, green and pink porcelainite and olive green quartzite and sandstone are interbedded with the shale. The total thickness of the Aspen is 2,105 feet (Gardner, 1944, p. 6).

A thickness of 1925 feet of the Aspen formation was measured by Dr. Harold Wanless along the north side of the Snake River and on the west side of Little Gray's anticline (Oesterling, 1947, p. 15). There, a lower unit 860 feet thick referred to as the salt and pepper sandstone consists of interbedded sandstone and gray to gray-green shale. The middle porcelainite member is 193 feet thick, and contains about 30 feet of green to gray to mottled porcelainite 970 feet from the base of the formation. The upper 872 feet is interbedded shale and salt and pepper sandstone. It contains a distinctive pink porcelainite bed about 220 feet from the top of the formation.

Frontier formation. This formation consists of gray, grayish-green and olive-brown shale and coarse sandstone. A few small conglomerate units are present. The total thickness measured was 645 feet.

STRUCTURE

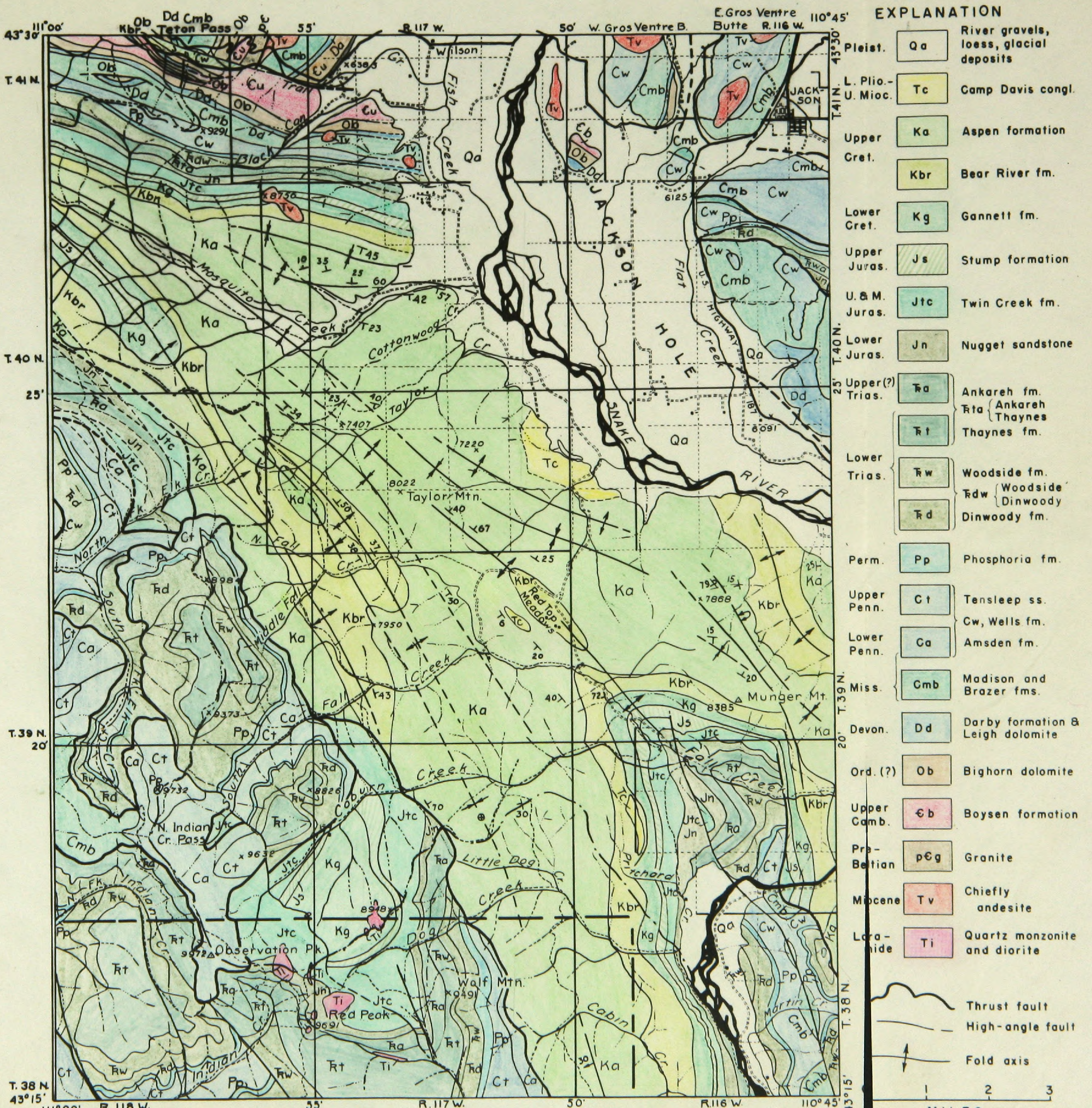
General characteristics

The area with which this paper is concerned is striking in the complexity of its structure. There are two major thrust sheets, the St. John and the Absaroka, which have nearly horizontal soles and may be traced a number of miles along both sides of the major valleys. A third reverse fault, the Coburn, cuts through both of the thrust sheets. There are also two small high angle faults. As is to be expected in a region of thrust faulting, many of the strata are upturned, and sharp folding occurs at the edges and in front of the thrust sheets.

Plate III is a geologic map of the area. The structure is shown in cross section in plate IV.

Faults

Absaroka thrust. The oldest of the faults in this region is the Absaroka thrust which pushed to the northeast to form the eastern edge of the steeper more rugged portion of the range in the southern part of the area. There, near Wolf Mountain, the throw is estimated at about 8,000 feet, and an abrupt change

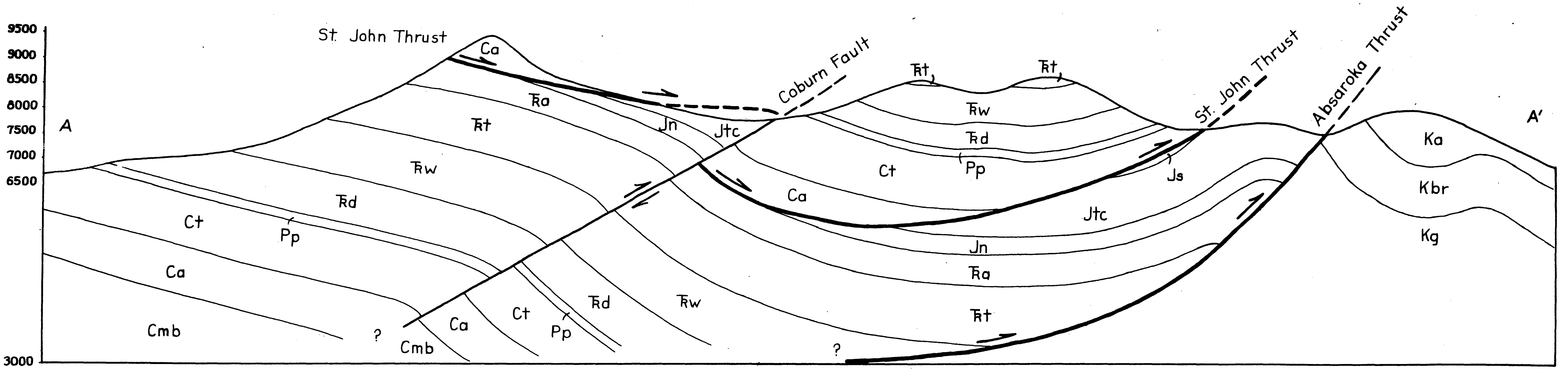


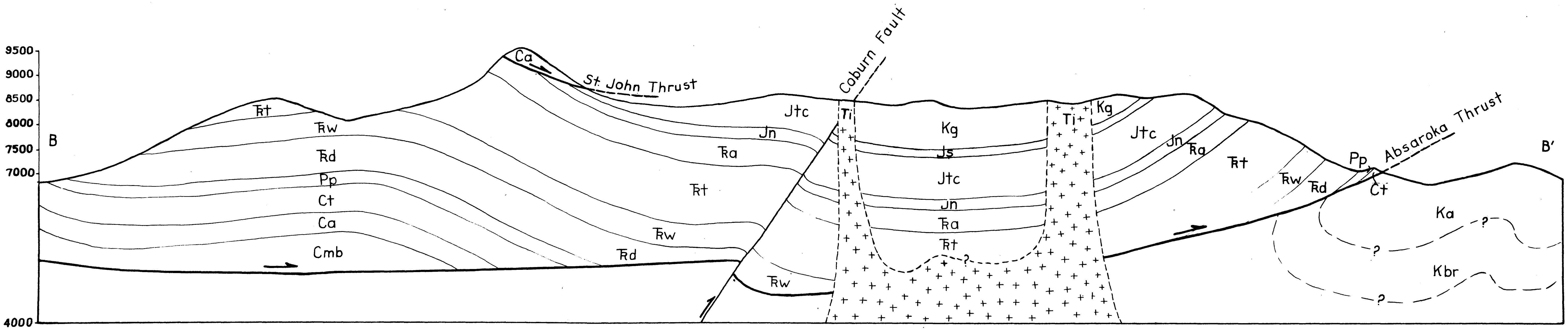
GEOLOGIC MAP OF THE NORTHWEST QUARTER OF JACKSON QUADRANGLE, WYOMING

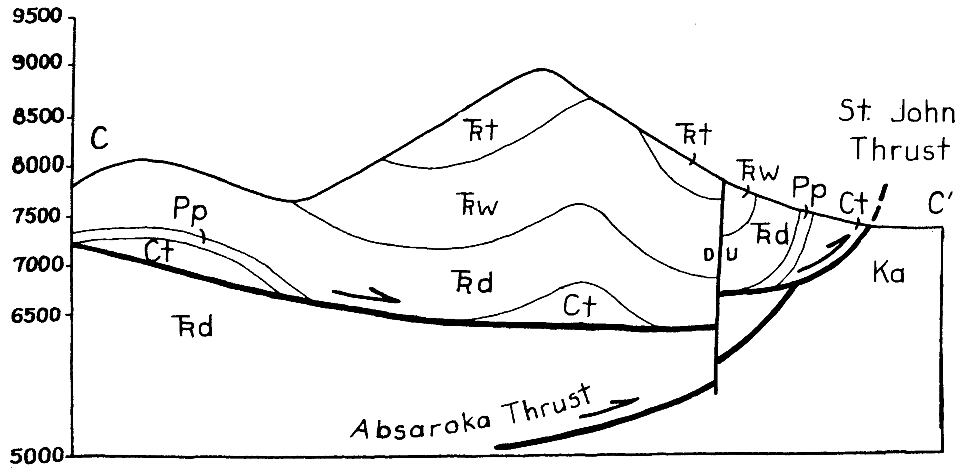
SNAKE RIVER RANGE AND JACKSON HOLE

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

FEET 1000 500

1/2 1

MILES

LEGEND

Ka - Aspen fm	Jn - Nugget ss.	Pp - Phosphoria fm.
Kbr - Bear River fm.	Ŧra - Ankareh fm.	Ct - Tensleep ss.
Kg - Gannett fm.	Ŧrt - Thaynes fm.	Ca - Amsden fm.
Js - Stump fm.	Ŧrw - Woodside fm.	Cmb - Madison, Brazer fms.
Jtc - Twin Creek	Ŧrd - Dinwoody	Ti - Intrusives

in relief occurs, where the Upper Cretaceous Aspen formation is overridden by the Pensylvanian Aspen formation. To the north of Coburn Creek, however, where the Twin Creek shale is thrust upon Aspen, the change in relief is much less marked. Just south of Coburn Creek, the thrust sheet is bowed down to form a synclinal basin with a width of about three miles.

North of South Fall Creek the Absaroka thrust is covered by a salient of the St. John thrust sheet for a distance of about four miles. Further to the northwest where the Absaroka would be expected to emerge, there are two thrusts, of which the one with the larger stratigraphic displacement (about 5,000 feet) should probably be considered the continuation of the Absaroka. In this fault, the Carboniferous Amsden formation is on Jurassic Twin Creek. The stratigraphic displacement of the other, in which the Twin Creek overlies the Cretaceous Aspen formation, is about 2,500 feet. A third reverse fault which brings the Triassic Ankareh on the Twin Creek has decreasing displacement to the west and dies out in an assymetrical anticline at the edge of the map.

The Absaroka fault was first mapped by Veatch (1907, p. 109), and has since been traced from its type area in Uinta County, southwestern Wyoming, to the canyon of the Snake River Range by Schultz (1914, p. 66) and Bastanchury (1947, p. 21). It was mapped in the Snake River Range to the south end of the area of this report by Oesterling (1947, p. 21). The stratigraphic throw decreases to the north. It is estimated to be 20,000 feet in Uinta County (Veatch, 1914, p. 110) and less than 10,000 feet in the Bradley Mountain area (Bastanchury, 1947, p. 28). The total distance over which it has been mapped is more than 200 miles, but it may continue for a greater distance to the northwest. See plate V.

St. John thrust. The most impressive of the faults in the area is the St. John thrust, of which a salient extends eastward beyond the eastern limit of the underlying Absaroka sheet. The fault plane dips relatively steeply along its eastern edge, but it is essentially flat-lying throughout most of the area, and its trace makes a dendritic pattern along the walls of the major valleys.

Like the Absaroka, the St. John thrust has a maximum stratigraphic displacement in this area of about 8,000 feet along South Fall Creek where Amsden rests upon the Aspen.

The St. John thrust has been traced for a distance of only thirty miles, from the Bradley Mountain

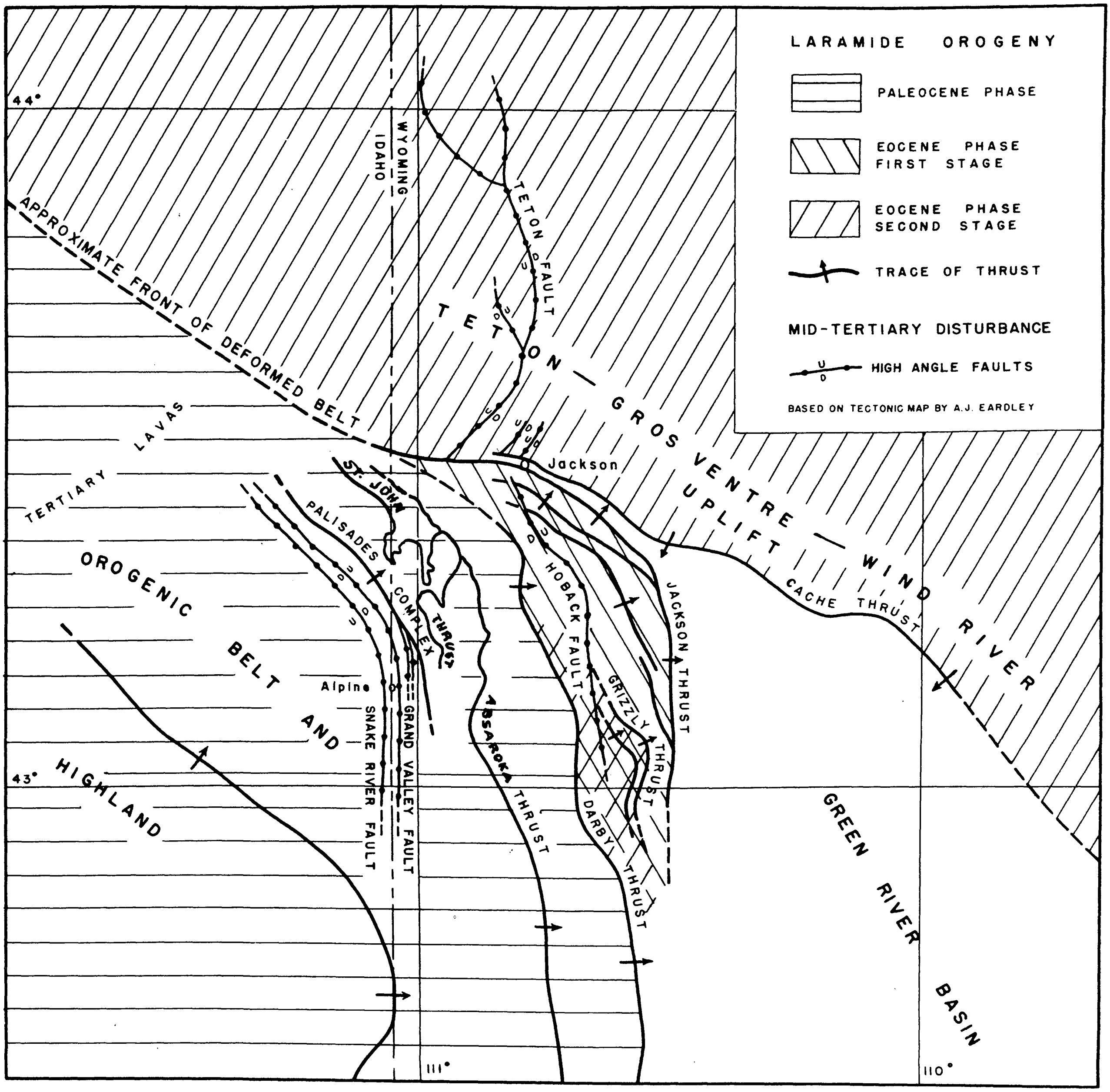


Plate II. Tectonic map showing location of St. John and Absaroka thrusts and geographic relation to other structures in western Wyoming and eastern Idaho.

area just south of the Snake River (Bastanchury, 1947, p. 28) northward into the Snake River Range where it has been mapped by several Camp Davis thesis students. At the north end of the area of this report it swings northwestward into Idaho. It has not been mapped there as the St. John, although it is probably one of the unnamed faults of Gardner's report (1944, geologic map). See plate VI.

This thrust sheet is cut by two small high angle faults, one along the west side of the South Fork of Elk Creek, and the other west of North and Middle Fall Creeks. The latter has a displacement of about 300 feet, and is associated with steeply dipping beds along the front of the thrust sheet. It brings the Dinwoody and Woodside formations in contact with one another. There is a gentle syncline in the sheet along the ridge south of South Fall Creek.

Coburn fault. The Coburn fault is a moderately low angle reverse fault which trends northwest and southeast parallel to the major thrusts. It extends through both of the large thrust sheets and offsets the fault plane of the St. John thrust.

The Coburn fault cuts through the Twin Creek formation with small displacement along the divide south of Coburn Creek, where the limestones on each side dip steeply away from the fault. Further northward, the Carboniferous Tensleep is in contact with the Triassic Thaynes formation, and a throw of about 2,000 feet is indicated, which is the maximum anywhere along the fault. Near the head of South Fall Creek the Twin Creek formation in the Absaroka sheet is seen beneath the Carboniferous rocks in the St. John thrust on the upthrown west side of the fault, whereas on the east side only the Carboniferous in the St. John thrust sheet is seen. The Coburn fault was not traced to its northwestward limit because of the relative inaccessibility of the valley of the South Fork of Elk Creek and the lack of time.

The map pattern of the Coburn fault suggests that its fault plane has a dip of about 25 degrees along the front edge. It might be considered a thrust fault, but its displacement is so small in comparison with those of the St. John and Absaroka that the term thrust has not been applied here to the Coburn fault.

Folds

In addition to the aforementioned folds in the thrust sheets there is a series of anticlines and synclines trending northwestward in the Cretaceous rocks in front of the thrust sheets. Near the thrusts the folding is very close, and the dips are steep and even vertical in places. One of the folds, an anticline immediately in front of the thrust, can be traced for a distance of more than ten miles to the northwest, where the trends of the folds become more nearly east-west.

Time relationships

All of the deformation in the Snake River Range represents a phase of the Laramide orogeny. Within the area of this report it can be shown only to be post-Cretaceous, since Upper Cretaceous Aspen and Bear River formations are overriden by the Absaroka thrust sheet. To the west, in the Calamity Point area, a conglomerate tentatively correlated with the Camp Davis conglomerate found to the east in the Hoback Mountains lies unconformably on the folded and thrust rocks of the Snake River Range (Enyert, 1947, p. 16).

Of the structures in the area of this report, the Absaroka thrust is the oldest. It is covered in part by the younger St. John thrust, which in turn is broken by the still younger Coburn fault.

Since the trends of the reverse faults and of the folds is the same and there is no indication of the presence of dynamic stresses other than the compression causing the thrusting and folding, the structures may all be considered to be of essentially the same age.

This is also true of the small high angle faults in the thrust sheets which probably resulted from irregularities of topography beneath the thrusts or lack of uniformity of rocks in the thrust sheets. Like most of the ranges of western Wyoming, the Snake River Range was subjected to regional uplift in late Tertiary time.

IGNEOUS ACTIVITY

Occurrence

Several small stocks and a dike, which range in width from a few feet to about one-half mile, intrude upper Jurassic and lower Cretaceous rocks in the southern part of the area. They are probably offshoots from a large plutonic body at depth. Little contact metamorphism has occurred, although reddish Gannett shales adjacent to one of the bodies are hardened and baked to a dark gray color.

Age

The time of the intrusion of these stocks cannot be determined from field relationships within the area. Most of the Rocky Mountain intrusives of intermediate composition were emplaced during a late phase of the Laramide orogeny. However, the similarity in composition of these stocks to middle to late Tertiary andesite extrusives in the south end of

Jackson Hole suggests that these stocks may belong to that later phase of igneous activity rather than to the Laramide.

Petrography

Megascopically these rocks appear to be fine-grained diorite, but a thin section examination indicates that they grade into andesite porphyry. The ground mass is glassy to fine-grained, and is composed of lath-shaped plagioclase crystals and magnetite grains. Phenocrysts are andesine plagioclase showing zoning and polysynthetic twinning, green and brown hornblende, and pale green slightly zoned augite. Apatite is abundant as an accessory. Sphene is found in both well-developed and anhedral crystals, and a small amount of quartz is present. Much of the plagioclase is altered to sericite, and the central more calcic parts of the crystals are altered to a carbonate, probably calcite. Moderately well-developed flow structure is shown by the hornblende, augite, and plagioclase.

PHYSIOGRAPHY

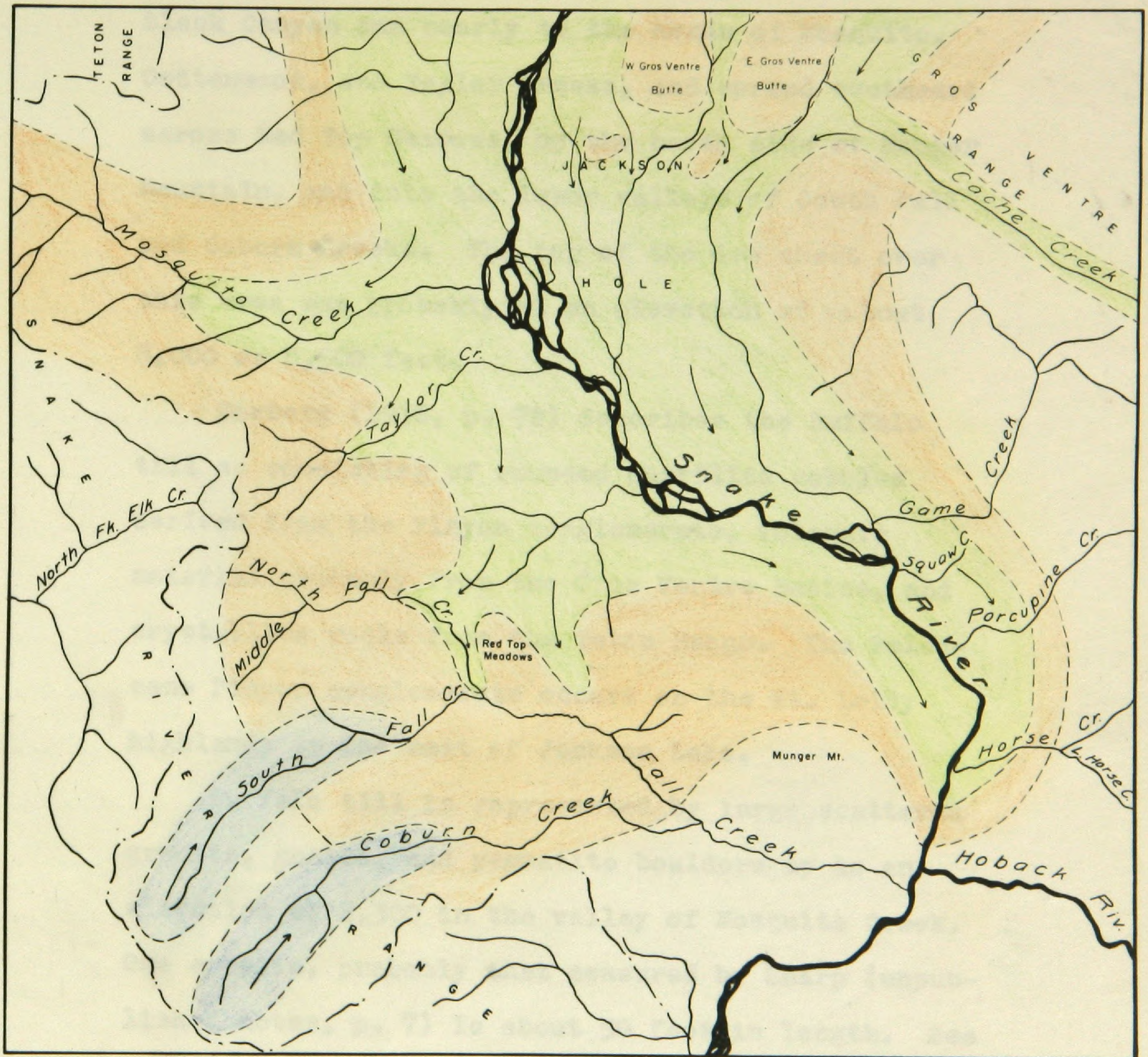
Topography

The Snake River Range is characterized by sharp peaks, steep slopes, and rugged cliffs in the area of the thrust sheets, whereas the hills in front of the thrusts are generally more subdued. The youthful topography is the result of late Tertiary regional uplift, in places accompanied by block faulting, and ensuing dissection. The Union Pass erosion surface of the Gros Ventre and Wind River Mountains may have developed in the Snake River Range, but if so it has been so completely dissected that no remnants of it now remain. The deep V-shaped valleys of the last cycle of erosion have been modified in placed by glaciation. Small landslides occurred in valleys oversteepened by glacial abrasion.

Glaciation

General considerations. Three major stages of the Pleistocene are recognized in Wyoming, two of which affected the Snake River Range either by the invasion of ice sheets or the development of small valley glaciers. The following paragraphs summarize what is known of the glacial history of the region and how it relates to the Snake River Range. The probable extent of the ice sheets is shown on plate VI.

Buffalo stage. The earliest and most extensive of the glacial advances is known as the Buffalo stage. An ice sheet which formed in Yellowstone Park and in the northern part of Jackson Hole moved southward to ride across the Gros Ventre Buttes at the north end of South Park. It pushed lobes of ice up



SCALE IN MILES
0 1 2 3

GLACIAL MAP OF SOUTH END OF JACKSON HOLE
AND BORDER RANGES

BY COOK & RICHARDS
1947

Buffalo ice

Bull Lake ice

Bull Lake (?) ice

Black Canyon and nearly to the heads of Mosquito, Cottonwood, and Taylor Creeks, and spread southward across Red Top Meadows, up the north side of Munger Mountain, and into the lower valleys of South Fall and Coburn Creeks. The top of the ice sheet over this area was probably at an elevation of about 8,000 or 8,500 feet.

Horberg (1938, p. 72) describes the Buffalo till as consisting of rounded quartzite cobbles derived from the Pinyon conglomerate, volcanic material probably from the Gros Ventre Buttes, and crystalline rocks from the Teton Range. The Paleocene Pinyon conglomerate occurs on the Mt. Leidy highlands to the east of Jackson Lake.

Buffalo till is represented by large scattered granite, gneiss, and pegmatite boulders up to an elevation of 8,300 in the valley of Mosquito Creek. One erratic, probably that measured by Sharp (unpublished notes, p. 7) is about 50 feet in length. See plate VII. Several large boulders were seen at the head of Taylor Creek, and a single piece of granite gneiss was found along the South Fall Creek trail about three-fourths of a mile above the Laughry ranch. The material considered to be Buffalo till contained no quartzite cobbles in this area.

Plate VII. A granite erratic, probably of the Buffalo stage of glaciation, along the north side of the valley at the lower end of Mosquito Creek.

It is suggested by Dr. Eardley (personal communication) that the Buffalo glaciation occurred on a surface with a minimum elevation of about 7,000 feet. With the melting of the ice sheet extensive erosion and dissection occurred, resulting in the concentration of the larger granite boulders at the higher elevations, whereas the smaller erratics were washed onto the valley floors. Because of the nature of the Pinyon conglomerate it was broken by the ice in transportation into its constituent cobbles which did not remain on the uplands with the larger erratics.

Bull Lake stage. The second or Bull Lake glaciation occurred on the surface produced by the post-Buffalo erosion. The Bull Lake ice sheet, which also moved into South Park from the north, was less extensive than the Buffalo glacier. The later Bull Lake glacier extended only about four miles up Mosquito Creek, and just a short distance up Taylor Creek. It moved southward as far as Red Top Meadows, pushing a small lobe down each side of the Meadows, and spread to the base of Munger Mountain.

The conception was first held by Horberg (1938, p. 77) and others that during Bull Lake time small glaciers had formed at the heads of Mosquito and Taylor Creeks and had moved downward to form a large piedmont glacier at the foot of the Snake River Range.

However, Sharp (unpublished notes, p. 7) observed that the rock lithologies in the Mosquito Creek moraine could not have come from within that valley and that the upper part of the valley does not appear glaciated. Therefore the ice must have pushed upward into these valleys rather than having originated there.

Bull Lake moraine is strikingly abundant below an elevation of about 7,200 feet in Mosquito Creek. It consists chiefly of granite, granite gneiss, pegmatite, Pinyon quartzite cobbles, obsidian, and a small amount of somewhat basic igneous material. The obsidian, where it occurs in abundance, was probably derived from the Yellowstone Plateau. Pieces were found throughout the area of this report, but one fragment seen on the divide west of Taylor Creek was chipped in such a way as to suggest that Indians rather than glaciers were responsible for its location.

The cirque-like heads and steep valley walls of South Fall and Coburn Creeks indicate that glaciers once existed in these valleys. See plates VIII and IX. The glacier in South Fall Creek apparently moved downstream to a point just below where the trail from North Fall enters. Here the valley becomes much more narrow and sinuous than above, and steeply dipping Cretaceous rocks jut well out into the valley. See

Plate VIII. View looking south toward upper end of South Fall Creek, showing large catchment basin, steep walls, and cirque-like head of valley.

Plate IX. Looking northeast down glaciated South Fall Creek from near the head of the valley.

Plate X. Looking east down South Fall Creek at place where glaciation ends. Note constriction where Cretaceous beds jut into the valley below the limit of glaciation, as compared with the width of the valley in the foreground.

plate X. The lower limit of the ice in Coburn Creek was not determined. Time did not permit an examination of deposits resembling moraine below where the trail from South Fall Creek enters Coburn Creek.

Since extensive dissection occurred after the Buffalo stage of glaciation, it seems that little evidence of the Buffalo would remain in the lower part of the South Fall Creek valley, and that the glacial features there were formed during the Bull Lake stage, or during the Pinedale stage which followed.

Pinedale stage. There is little evidence of a third or Pinedale glaciation in this area. If any glaciation did occur then, it would have been in the valleys of South Fall and Coburn Creeks as described above. However, the glaciers of this stage in the Tetons did not extend far beyond the base of the range, and it is improbable that any of the Snake River Range valleys were sufficiently high to have developed glaciers during the Pinedale stage.

Landslides

A few relatively recent landslides have occurred along South Fall and Coburn Creeks, probably as a result of the overstepping of the walls of the valleys by glaciation. Blocks of Tensleep talus have formed steep-fronted lobate rock flows in three places near the head of South Fall Creek. See plates XI and XII. The shape of the flows suggests that the debris may have moved while embedded in semi-fluid snow or ice.

Along the north side of Coburn Creek a small land slide has taken place on a dip slope of the Twin Creek shale which carried a jumble of more massive rocks on top of it.

Plate XI. Rock flow, probably in Tensleep formation, on the southeast side of the valley of South Fall Creek.

Plate XII. Lobate Tensleep rock flow on west side of South Fall Creek valley which has been oversteepened by glaciation.

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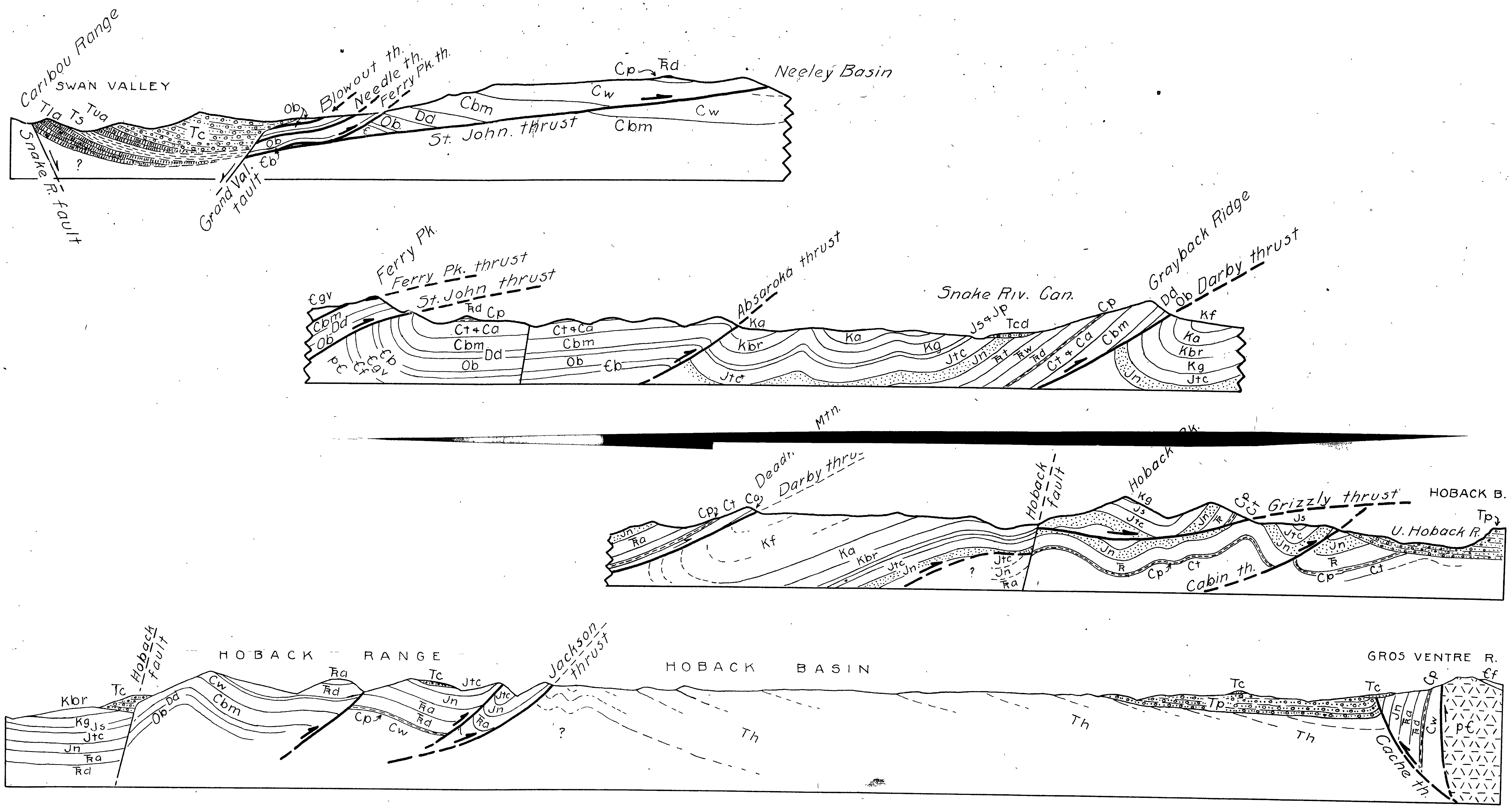

Caribou Range
SWAN VALLEY
Snake R. fault
Grand Val. fault
Blowout th.
Needle th.
Ferry Pk. th.
St. John thrust
Neeley Basin
Ferry Pk.
Ferry Pk. thrust
St. John thrust
Absaroka thrust
Snake Riv. Can.
Grayback Ridge
Darby thrust
Mtn.
Hoback fault
Grizzly thrust
HOBACK B.
U. Hoback R.
Cabin th.
HOBACK RANGE
Hoback fault
Jackson thrust
HOBACK BASIN
GROS VENTRE R.
Cache th.

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