CANADA

DEPARTMENT OF MINES AND RESOURCES

MINES AND GEOLOGY BRANCH

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FALL CREEK MAP-AREA,

ALBERTA

(Report and Map)

BY

J. F. Henderson

OTTAWA

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Illustration

Fall Creek Map-Area, Alberta

INTRODUCTION

Fall Creek map-area lies between longitudes 115°30' and 115°45' and latitudes 52°00' and 52°15' in the Foothills Belt of central Alberta, 70 miles west of Innisfail. Graded roads from Innisfail or Rocky Mountain House extend to within 18 miles of the area, and a wagon road continues to two abandoned oil wells on Clearwater River 8 miles east of the area. Forestry trails follow the Clearwater west across the southern part of the map-area. The area may also be reached from Saunders on the Canadian National Railway by a good trail that enters the northern border at the Forks of Ram River, and joins the Clearwater trail near the southeast corner.

The map-area has a maximum relief of about 2,000 feet, ranging from 4,500 to 6,590 feet above sea-level. The topography is controlled by the structure and character of the bedrock formations. Thus the highest range of hills, extending across the northeastern part of the area, is formed of resistant Palaeozoic limestones outcropping in the core of an anticlinal structure. Southwest of this range, in the area underlain by Mesozoic sandstones and shales, the relief is effected to a large extent by the thin, but resistant, Bighorn sandstone formation, which caps the higher hills and forms mesa-like topography where the beds are gently inclined, or conspicuous ridges or hogbacks where they are steeply inclined.

The field work on which this report and the accompanying map are based was done by the writer in 1944, with the capable assistance of Messrs. A. G. Jones, J. B. Black, and J. E. Procter.

STRATIGRAPHY

The rock formations are all of sedimentary origin and range in age from Devonian to Upper Cretaceous.

Devonian

Devonian strata are exposed in the northeastern part of the map-area, in the valley of Fall Creek. They consist mainly of thick-bedded, massive, dark blue-grey limestone.

Mississippian

Banff Formation. The Banff formation is composed of buff weathering, platy, dark grey limestone, shaly limestone, and calcareous shale, with occasional thick beds of light weathering, blue-grey limestone. It is estimated to be 600 to 650 feet thick.

Mississippian and (?) Pennsylvanian

Rundle Formation. The Rundle formation is exposed along the crests of three major anticlines, and forms the highest hills in the area. It may be divided into three lithologic units consisting, at the base, of about 200 feet of massive, thickly bedded, white weathering, light grey, coarse-grained limestone, succeeded by 150 feet or more of thinly bedded, buff to grey weathering, shaly limestone,

which is overlain by about 350 feet of white weathering, massively bedded limestone similar to that at the base of the formation. The total thickness is estimated to be about 700 feet.

A pinkish weathering, very hard, fine-grained quartzite, 20 to 30 feet thick, outcrops between the Rundle and Fernie formations 2,000 feet northwest of Cutoff Creek, on the southwest flank of an anticline. It was not observed at any other place in the area, and probably represents the Pennsylvanian, Rocky Mountain formation.

Jurassic

Fernie Group. The Fernie group is divisible into two lithologic units. The lower unit consists of 125 to 150 feet of thin-bedded, fine-grained, platy, black limestone with much interbedded chert. The beds weather buff to purplish grey, with a hackly surface. They are resistant to weathering, and generally form conspicuous cliffs and dip slopes. A bed of dark, phosphatic limestone at or near the top contains fossils that have been identified tentatively by F.H. McLearn of the Geological Survey as of Lower Jurassic age. No fossils have been found in the lower part of the limestone, and some of it may be of Triassic age.

The upper unit of the Fernie consists of 200 to 250 feet of black shale and sandstone. Much of the shale contains thin interbeds of crumbly, rusty weathering sandstone, 1 to 2 inches thick. The shale and interbedded sandstone grades upward into 50 feet or more of buff to brown weathering, thickly bedded, medium-grained sandstone, which is overlain by a conglomerate that marks the base of the Blairmore group. The sandstone underlying the Blairmore conglomerate has been mapped with the Fernie formation, but may be in part of Lower Cretaceous (Nikanassin) age.

Lower Cretaceous

Blairmore Group. The base of the Blairmore group is marked by a pebble-conglomerate 35 to 45 feet thick. The conglomerate is resistant to weathering, and generally forms prominent ridges. The well-rounded pebbles average 1 to 2 inches in diameter, and are made up of white and grey quartzite and pink, grey, and black chert. The matrix is a medium- to rather coarse-grained, hard, quartzitic sandstone and the conglomerate contains many lenses of this sandstone among the pebble layers.

The basal conglomerate is overlain by coarse-grained, quartzitic sandstones, crossbedded, dark brown sandstones, and brown to black carbonaceous shale. Conglomerates are interbedded with the sandstones, but unlike the basal conglomerate are not continuous throughout the area. Coal seams occur some 650 to 750 feet above the basal conglomerate.

The upper part of the Blairmore consists of medium- to coarse-grained, grey to buff weathering, massive, crossbedded sandstones; olive green, crumbly shales; and, near the top, maroon weathering, thinly bedded, platy, crossbedded sandstones. A pebble-conglomerate marks the contact of the Blairmore with the overlying Blackstone formation. It is, apparently, continuous throughout the area, and ranges in thickness from more than 22 feet, as on Fall Creek, $2\frac{1}{4}$ miles above its junction with Gloomy Creek, to less than 2 feet, as on Ram River 3 miles west of its junction with North Ram River. The conglomerate consists of well-rounded quartzite and chert

pebbles commonly 1 to 2 inches in diameter, but in places as much as 6 inches. It resembles the basal Blairmore conglomerate, but is of variable thickness and the pebbles are in general somewhat smaller and less firmly cemented in a more siliceous, finer grained, sandy matrix. The conglomerate is a resistant member, forms many outcrops, and is most useful in tracing the Blairmore-Blackstone contact.

Upper Cretaceous

Upper Cretaceous strata comprise a lower marine group that includes the Blackstone, Bighorn, and Wapiabi formations, and an upper, non-marine group that includes the Brazeau and Edmonton formations.

Blackstone Formation. The Blackstone formation consists mainly of black fissile shales, dark grey sandy shales, and some thin beds of fine-grained sandstone. The shales are soft, and weather easily in contrast with the hard, resistant sandstone members of the overlying Bighorn formation. Thus the topography of the large area underlain by these formations consists of high ridges capped by or composed of Bighorn sandstone, below which the soft Blackstone shales form steep slopes to the valley bottoms. The upper 1,000 feet of the Blackstone formation is exposed in the canyon of Ram River. The total thickness of the formation is estimated to be between 1,200 and 1,300 feet.

Bighorn Formation. The Bighorn formation may be divided into three parts, of which the lower part consists of 80 to 90 feet of siliceous sandstone and conglomerate, the middle part of 190 to 205 feet of soft shales and shaly sandstones, and the upper part of 20 to 30 feet of siliceous sandstone very similar to some of the lower sandstone beds. The lower and, to a lesser degree, the upper sandstone members are hard resistant rocks that cap or form many of the higher hills and ridges.

In the following section of the Bighorn formation the upper 214 feet, comprising the upper sandstone and middle shale members, was measured on the canyon of Ram River just beyond the western border of the map-area, where the river abruptly changes course from northwest to northeast. The lower 90 feet of the section, comprising the lower sandstone member, was measured on the southwest side of the 6,100-foot hill 3½ miles east of the canyon.

Description	Feet
Overlying beds - Wapiabi shale	
Sandstone, thin-bedded, platy, fine-grained, siliceous; characterized by abundance of *Cardium pauperculum*; veneer of small, polished, grey and black chert pebbles at top	19
Shale and shaly sandstone with thin ironstone bands	195
Sandstone, massive, thick-bedded, fine-grained, grey, siliceous; contains thin pebble beds; basal 9 feet predominantly conglomerate composed of white, grey, and black quartzite and chert pebbles up to 1½ inches in diameter	34

Ironstone bed	0.5
Sandstone, massive, siliceous; with pebble beds	13.5
Concealed slope covered with talus of soft, shaly sandstone with ironstone bands	15.0
Sandstone, massive, siliceous, fine-grained; veneer of conglomerate at top	27.0
Total thickness	304.0

Wapiabi Formation. The Wapiabi formation consists of black marine shale, sandy shale, and occasional thin beds of buff weathering limestone. The contact with the underlying Bighorn sandstone is sharp, and is marked by a thin layer of small polished chert pebbles. As the contact with the overlying Brazeau sandstone is approached the uppermost 100 feet or so of shales become more and more sandy until a massive greenish grey sandstone is reached that is regarded as the base of the Brazeau formation. No complete section of the Wapiabi formation is exposed, but based on outcrops along Clearwater River, the thickness is estimated to be about 1,500 feet.

Brazeau and Edmonton Formations. Non-marine sandstones and conglomerates of the Brazeau formation lie within the two large synclines in the southwestern part of the area. In contrast with the underlying Wapiabi shales they are resistant rocks that cap high, plateau-like hills below which the soft shales form steep slopes.

The Brazeau sandstones are conspicuously crossbedded, buff to maroon weathering, medium- to rather coarse-grained, arkosic and conglomeratic sandstones. Beds and lenses of chert pebble-conglomerate, with pebbles averaging $\frac{1}{2}$ inch in diameter but as large as 2 inches, are abundant, and many of the sandstone beds contain scattered pebbles.

Light grey, yellowish weathering, thick-bedded, poorly consolidated sandstones that belong to either the Brazeau or Edmonton formations underlie the northeastern corner of the map-area. Exposures are poor within the area but are excellent along Ram River, $1\frac{1}{4}$ miles to the north. The beds there seem more like those of the Edmonton than the Brazeau formation, but the lithology of both formations is very similar.

STRUCTURE AND OIL AND GAS POSSIBILITIES

A major thrust fault passes through the northeastern part of the map-area along the contact between the Blairmore and Brazeau-Edmonton formations. Most of the area southwest of this fault may be considered as part of one large thrust block within which the strata are folded and broken by many subsidiary faults.

The major thrust fault that passes through the northeastern part of the area is well exposed on Ram River $1\frac{1}{4}$ miles northwest of the map-area. Along it the lower Blairmore sandstones and shales are thrust over poorly consolidated Edmonton or Brazeau sandstones.

An anticline in the northeastern part of the area extends southeast from the falls on Ram River (See structure-section AB on map). It is a nearly symmetrical structure, with a Palaeozoic limestone core and average dips of 45 to 55 degrees on the southwest and northeast limbs. Northeast from Fall Creek to the northern boundary of the area the plunge of the structure is northwest. Southeast from Fall Creek the northwesterly plunge decreases to horizontal or nearly so, as evidenced by several exposures of the Rundle-Fernie contact along the crest of the structure at about the same elevation. There is no evidence of a reversal in plunge, and hence no evidence of southeast closure within the map-area. No important faults were observed northeast of the anticline to where the major fault along the Blairmore-Brazeau and Edmonton contact is reached. This fault seems to have a shallow, southwesterly dip, and may cut off the anticlinal structure at comparatively shallow depth. Search for oil in this structure must be confined to Devonian and older formations, as all strata above the Devonian are exposed in the core.

A large anticlinal structure extends from southeast to northwest across the central part of the map-area. The Palaeozoic limestone core is exposed near the southeastern border of the area, but plunges beneath Mesozoic sandstones and shales to the northwest. In the Palaeozoic limestones the structure consists of two well-defined anticlines, the larger of which lies northeast and the other southwest of Clearwater River. The former is the northwesterly continuation of the Idlewilde anticline, and on Idlewilde Mountain, 1 mile east of where Clearwater River leaves the map-area, the Devonian limestone core is exposed. As the plunge is northwest the Devonian and overlying Banff and Rundle formations disappear beneath Fernie and Blairmore strata near the southeast corner of the area. This anticline may be traced for about 2 miles northwest of the headwaters of Idlewilde Creek where it divides in Blairmore strata into a number of smaller folds, but the structure persists, although becoming less pronounced, to the northern boundary of the map-area, crossing Ram River about a mile southwest of its junction with North Ram River. The smaller anticline, although well defined where the Palaeozoic core is exposed south of Cutoff Creek, is difficult to trace to the northwest where it is exposed in the overlying Blairmore and Blackstone formations as a series of closely spaced folds and minor thrust faults. The anticline in the Bighorn formation, in tp. 37, rge. 13, and the southwest part of tp. 37, rge. 12, may be the northwesterly extension of this fold.

Both anticlinal folds plunge northwest, so that the Palaeozoic core disappears beneath Mesozoic strata, but the plunge decreases to horizontal or nearly so in the central part of the map-area. This is indicated by outcrops of conglomerate marking the top of the Blairmore formation at about the same elevation along the crest of the structure. Thus this conglomerate outcrops: (1) between Tay River and Gloomy Creek at elevations of between 5,200 and 5,300 feet; (2) on the 5,300-foot hill northwest of the junction of Gloomy and Fall Creeks; and (3) on the 5,300-foot hills traversed by the trail in the north-central part of tp. 37, rge. 12. As all these outcrops are on or near the crest of the structure, and as they are all at about the same elevation, the structure must be essentially horizontal for this distance of about 6 miles. Farther northwest the northwesterly plunge is resumed. A thrust fault extends along the Blairmore-Blackstone contact on the northeast flank of the structure, but the displacement along it is minor although increasing in magnitude to the southeast.

As the anticlinal structure has a general northwesterly plunge throughout the area, any oil or gas would tend to migrate up the plunge to the southeast. Accumulation might occur within the area where the fold is essentially horizontal, but this would depend on local reversals in plunge of sufficient magnitude to give southeast closure, of which no evidence has been obtained.

A third anticlinal structure crosses the southwestern part of the area and is flanked to the northeast and southwest by synclines in the Wapiabi and Brazeau formations. The structure consists of two sharp anticlines, with exposed cores of Blairmore sandstone, and an intervening syncline floored by Bighorn and Wapiabi beds. The northeastern flanks of both folds are overturned and faulted. The small part of the structure within the map-area plunges northwest, and the Blairmore sandstones exposed on the crest disappear to the northeast beneath Blackstone, Bighorn, and Wapiabi formations.

COAL

Two thick bituminous coal seams outcrop in Blairmore strata on the north bank of Ram River 1¾ miles southwest of its junction with North Ram River. The lower seam is 6 feet 2 inches thick, and the upper one more than 7 feet thick, with the top not exposed. The two seams are separated by about 80 feet of sandstone. Two thinner seams, 3 feet and 1 foot thick respectively, lie just above the lower, thick seam. The coal seams strike northwest and dip 8 to 12 degrees southwest. Coal seams were observed in the Blairmore formation at several other localities, but none of them is thick enough to be classed as commercial. The coal occurs in a series of coal-bearing strata that form part of the so-called Luscar formation of areas to the north and northwest.