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WAWA CREEK
ALBERTA

(PRELIMINARY MAP AND DESCRIPTIVE NOTES)

BY

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DESCRIPTIVE NOTES

to accompany Preliminary Geological Map of WAWA CREEK, ALBERTA

By

B. R. MacKay

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DESCRIPTIVE NOTES, WAWA CREEK MAP-AREA, ALBERTA

INTRODUCTION

Wawa Creek map-area is in the Foothills Belt of Central Alberta, 100 miles west of Red Deer. Its southeastern corner is touched by the Canadian National Railway at a point 4 miles northeast of the railway terminus at Nordegg (Brazeau Station). The southwest part of the map-area is traversed by a road that runs from Nordegg northwesterly across the area to the abandoned oil well on Chungo Creek. The more inaccessible parts of the area are served by three forestry trails. One of the trails starts at the road about 5 miles northwest of Nordegg, runs northerly through the gap in Brazeau Range north of Shunda Mountain to Nordegg River, and thence along the river to beyond the northeast corner of the map-area. The second trail commences west of the map-area at Nelson Flats forestry cabin on Blackstone River and runs almost due east across the high divide to join the Nordegg River trail at Sunbeam forestry cabin. The third trail leaves the main highway near the southeast corner of the map-area, at the mouth of Shunda Creek gap, runs north to the headwaters of Colt Creek, and thence down Colt Creek to join the Nordegg River trail near the junction of the two streams. The "Lookout" on the summit of Coliseum Mountain is reached from forestry headquarters, near Nordegg, by a trail that climbs up the western slope of Brazeau Range.

The map-area has a maximum relief of over 3,100 feet, ranging from less than 3,700 feet at its northeast corner to over 6,800 feet on the summit of Coliseum Mountain. The topographical features take their expression largely from the character and structure of the underlying bedrock formations. The most prominent topographical feature is Brazeau Range, an asymmetrical anticline of resistant Palaeozoic limestones, flanked by much less resistant shales and sandstones of Mesozoic age. The areas of lower relief are underlain by softer sandstones and shales of Late Mesozoic and Cenozoic ages. The results of differential erosion are here also apparent, the relatively more resistant sandstones forming the uplands and prominent ridges, and the softer shales, the lowlands. During Pleistocene time the region was completely submerged beneath an ice-sheet that moved from the mountains in the southwest, as evidenced by the presence of boulders of foreign origin and by pronounced striation and gouges trending north 50 to 55 degrees east that occur on the summit of Brazeau Range. The drift covering in the lowlands is thick and bedrock exposures there are confined largely to the channels of the major streams. No continuous section of any of the formations could be measured, but outcrops are sufficient to reveal the character and structure of the formations and to permit a graphical representation of approximate thicknesses of those involved in the faulting and folding of the different structural units. Palaeozoic and early Mesozoic formations reach the surface only in Brazeau Range; the younger Mesozoic formations outcrop along its borders, and the youngest, Cenozoic formation, is confined to the northern part of the map-area (See map).

STRATIGRAPHY

The rocks exposed within the map-area have an aggregate thickness of approximately 17,500 feet, and represent fifteen formations ranging in age from Devonian to Tertiary. The Rocky Mountain formation of Pennsylvanian age and the Spray River formation of Triassic age, which are present on Bighorn Range about 15 miles to the west of the area, are absent on Brazeau Range, their stratigraphic positions being represented by an erosional unconformity that occurs between the Rundle and Fernie formations.

Devonian rocks (1) form the core of the Brazeau anticlinal range and are exposed in five prominent erosional windows along its crest and western flank. The best section is that which occurs south of the map-area on the north side of Shunda Creek gap, where a thickness of approximately 1,500 feet is exposed. The rocks are mainly dense, blue-grey limestones and grey, calcareous shales with some dark shale.

The Banff formation (2) has an estimated thickness of 425 feet and consists of interbedded, hard compact platy bluish grey limestone, shaly limestone, cherty limestone, and calcareous shales. The formation is traversed by the trail leading up the west slope of Brazeau Range to the "Lookout", and along it and in the bordering gulches are exposed several thick zones that carry a prolific brachiopod fauna of Mississippian age.

The Rundle formation (3) extends as a continuous belt along the flanks and northern nose of Brazeau Range, and the lower part of the formation occurs as erosion remnants on its five prominent summits. The thickness of the Rundle, as determined graphically from isolated outcrops on the slopes of the range, is 1,025 feet. It consists mainly of interbedded, granular porous rubbly limestone, compact platy limestone, and chert.

The Fernie formation (4) overlies the Rundle without noticeable erosional unconformity. Along the west side of Brazeau Range it consists of 45 feet or more of phosphatic limestone overlain by black, fissile strata, ferruginous limestone, sandy shale, and sandstone, and has an estimated aggregate thickness of 375 feet. No complete section of the formation is obtainable within the map-area. The best exposures occur in vertically dipping beds on the northeastern flank of Brazeau Range, near the Canadian National Railway bridge crossing Shunda Creek.

Lower Cretaceous rocks comprise four formations. The lowermost of these, the Nikanassin (5), has an estimated thickness, on the west flank of Brazeau Range, of 225 feet, and consists of alternating grey to buff-weathering sandstones and black shales with a few thin coal seams.

The Cadomin formation (6) consists of a bed of chert and quartzite pebble-conglomerate 12 to 15 feet thick. It has been traced by isolated outcrops along the flanks and nose of Brazeau Range.

The Luscar formation (7) has a measured thickness at Nordegg of 910 feet. It consists of black and grey, carbonaceous shale, grey sandstone, and five or more coal seams ranging from 1 to 7 feet in thickness, two of which are being mined. No section of the formation was obtainable in the Wawa Creek area, but from the outcrops observed it is believed to be of about the same character and thickness as at Luscar. An abundant flora obtained from the roof of the coal seams at Nordegg indicates a Lower Blairmore age for the coal.

Only a few exposures of the Mountain Park formation (8) occur within the map-area, and the character and thickness of the formation are based on outcrops observed just beyond the southern border, west of Nordegg. There the formation was found to consist of interbedded, olive-green and brown-weathering, grey, sandy shale and sandstone, and to have an aggregate thickness of 650 feet.

Upper Cretaceous strata comprise a lower marine group consisting of three formations, (9), (10), and (11, 12), and an upper freshwater group of two formations, (13) and (14).

The Blackstone formation (9) underlies the southwestern corner of the map-area and occurs along the northern end of Brazeau Range. It is poorly exposed and its character and thickness are based on a fairly complete section obtained along Blackstone River just beyond the west border of the map-area.

The formation consists largely of black marine shale, thin grey quartzitic sandstone, and sandy shale, and has an aggregate thickness of approximately 1,500 feet.

The Bighorn formation (10) forms conspicuous ridges in the southwestern part of the map-area. It thins eastward from approximately 350 feet, west of the map-area, to 250 feet in the section bordering Brazeau Range at the headwaters of Nordegg River. Here the formation consists of three 60-foot thick beds of hard, quartzitic, pink-weathering sandstone separated by two 35-foot beds of hard black shale and an occasional lens of fine conglomerate.

The Wapiabi formation has been divided into two parts. The lower part (11) consists almost wholly of black marine shale, sandy shale, and thin beds and calcareous concretions of brown-weathering ironstone, and is about 1,800 feet thick. The upper part (12) is approximately 150 feet thick and is transitional from the underlying marine sediments into the overlying fresh-water beds. The base of the upper member is placed at the lower of two 4-inch beds of fine black chert-conglomerate that occur in ironstone beds about 4 feet apart and separated by black marine shale. Above these are alternating beds of black shale and sandstone, the top of the member being drawn at the base of a very thick bed of sandstone. These transitional beds carry a fauna similar to that of the overlying Brazeau formation and, perhaps, should be regarded as the basal member of that formation, but for the present they are included with the Wapiabi to conform with earlier mapping.

The Brazeau formation (13) underlies the greater part of the map-area, and good sections of it can be obtained along the headwaters of Nordegg River. The formation consists of inter-bedded sandstone, shale, conglomerate, volcanic ash, and a few thin coal seams, and has an estimated thickness of about 4,700 feet.

The Edmonton formation (14) underlies much of the low-lands in the northern part of the map-area as well as the centre of the Sunbeam and Colt Creek synclines, but as it is composed of soft strata, outcrops are few. It consists of sandstone, shale, conglomerate, volcanic ash, and coal seams. The base of the formation has been drawn at a cobblestone quartzite-conglomerate that outcrops on Blackstone River, about one-half mile below Chungo Creek junction, at an horizon 900 feet below the lowest coal seam. Within the map-area the formation is thickest in the Colt Creek coal basin, where it is estimated to comprise about 3,000 feet of beds. These may, however, include some Paskapoo strata.

Overlying the Edmonton beds, in the northern part of the map-area, without any apparent erosional unconformtity, is a series of coarse, brown-weathering sandstones, conglomerates, and earthy shales that, on the uplands north of Wawa Creek, weather into large, fantastically shaped "hoodoos". Lithologically and in their general appearance these beds closely resemble the massive basal strata of the Tertiary, Paskapoo formation of the Fallentimber area farther south and have been correlated with them (15). Their maximum thickness, within the map-area, is estimated to be less than 800 feet.

STRUCTURAL GEOLOGY

Wawa Creek map-area contains a greater variety of structural features than that of any other part of the central Foothills Belt within a mapped area 100 miles long and 35 miles wide. Elsewhere throughout this part of the belt the thrust faults and folds maintain a strikingly uniform trend of south 50 degrees east. On crossing Blackstone River, near the northwestern corner of Wawa Creek map-area, the most northeasterly of the major thrust faults changes its trend abruptly to south 70 degrees east, and continues in this direction across the map-area, crossing Nordegg River about a mile below its junction with Colt Creek. The area to the north of this fault is underlain by Edmonton and Paskapoo strata, and, across a breadth of 6½ miles in the northeastern part of the map area, the dips are generally less than 6 degrees. That structural unit is part of the western rim of the Alberta geosyncline.

Between the first and second major thrust faults is a triangular-shaped thrust block that has a maximum width, at the eastern border of the map-area, of 5 miles. It comprises a prominent southeasterly plunging syncline, designated the Colt Creek coal basin, on the northeast, and a highly compressed anticline, referred to as the Stolberg structure, on the southwest. The flanks of the anticline are modified by thrust faults that dip with the flanks of the fold and converge northwestward to join, near Blackstone River, with the most northeasterly main thrust fault.

The third structural unit, which may be designated the Sunbeam syncline, is a southeasterly trending, nearly symmetrical syncline 5 miles or more in width. Wapiabi beds that outcrop along its northeastern limb have been thrust northeastward, partly overturned, and faulted over Brazeau beds of the southwestern limb of the Stolberg anticline. The southwestern limb of the syncline is concealed beneath that of the overriding fourth and fifth structural blocks.

The fourth structural unit is a thrust block $2\frac{1}{2}$ miles wide. It is in the form of a symmetrical syncline, and lies upon and within the southwestern part of the Sunbeam syncline. On the northeast, its Wapiabi beds are in contact with Edmonton and Brazeau beds of the underlying third structural block; on the southwest, its Blackstone beds are in contact with Palaeozoic formations of the fifth structural block (See structure sections).

The fifth major structural unit, designated the Brazeau thrust block, is 5 miles in width. It comprises three subsidiary structures, as shown on the map and structure section C-D. On the extreme northeast is a syncline that opens with its plunge to the northwest; in the centre is a broad asymmetrical anticline; and in the southwest is a shallow northwesterly trending basin. Traced southeasterly along the fault plane that forms the base of the Palaeozoic fault block of Brazeau Range, progressively older Mesozoic formations appear until at North Saskatchewan River the Devonian limestones may be observed thrust upon Jurassic beds. The fault of smaller displacement within the eastern syncline is believed to be a secondary thrust fault developed during the folding of the range. Another folded thrust fault is shown cutting through the Mesozoic formations on the west side of Brazeau Range and around its northwestern end.

The structural relationships that have been described, and that are depicted on the two structure sections, portray various stages in the development of Foothills structure, which may be summarized as follows:

(1) There appears to be a progressive increase in the intensity of folding and faulting of the sedimentary rocks in passing southwestward from the little disturbed outer structural unit, No. 1, into the older sedimentary formations of the Foothills Belt comprising structural unit No. 5, indicating that Foothills structures have developed progressively from southwest to northeast.

(2) The complementary folds comprising Colt Creek syncline and Stolberg anticline, and the accompanying converging thrust faults of the wedge-shaped structural unit No. 2, appear to have been developed by a combination of compressional and torsional stresses arising from a northeasterly advance of the Brazeau thrust block and an eastward swing in the trend of Brazeau Range south of North Saskatchewan River.

(3) The stratigraphic and structural relationships that exist between the various fault blocks, and particularly between structural units Nos. 3, 4, and 5, indicate that thrust faulting of large displacement preceded the folding that now characterizes these blocks; this subsequent folding has resulted in several folded faults and folded fault plates. The three subsidiary structures in the Palaeozoic rocks of the Brazeau structural unit (No. 5), and the steepening and folding of its bordering major fault, illustrate stages in the development of structures within a single westerly dipping fault block.

(4) Minor thrust faulting has also taken place during and subsequent to the folding, as indicated by the two eastward-dipping thrust faults on the east side of Stolberg anticline, and by the westerly dipping thrust fault in the syncline at the northwest end of Brazeau Range (See structure sections).

(5) The thrust fault that separates the little disturbed structural unit, No. 1, from the wedge-shaped structural unit, No. 2, and that appears to dip steeply to the southwest, may have been somewhat folded by the compressive stresses that developed since it was formed. Its original southwesterly dip was, however, derived from torsional as well as from compressive stresses, and is thought to have been sufficiently steep to make its reappearance at the surface farther west, by subsequent folding, very unlikely.

ECONOMIC GEOLOGY

At present, interest is largely centred upon the oil possibilities of the tightly compressed Stolberg anticline in the second structural unit. The apex of this structure is crossed by a western branch of Colt Creek 3 miles south of Nordegg River. The structure appears to have a good closure at the surface. Its oil possibilities are dependent upon: (1) whether the surface closure continues downward to incorporate the Rundle formation, which contains the most favourable oil-producing horizons in the Foothills Belt; (2) whether these horizons are sufficiently petroliferous and porous in this district to form a source rock of commercial oil production; and (3) whether they lie at a sufficiently shallow depth to be reached by drilling.

The presence of thrust faults dipping in opposite directions on the flanks of Stolberg anticline is highly suggestive of the occurrence of one or more folded thrust fault plates, and the possibility that one of them represents the reappearance of the major thrust that bounds the Colt Creek syncline on the northeast. The more easterly trend of this fault makes it improbable, however, that it is folded to such an extent as to reappear at the surface, although it may be involved in the structure at depth. The lowermost horizon exposed on the crest of the anticline on Colt Creek is estimated to be approximately 2,000 feet stratigraphically above the base of the Brazeau formation. Providing there has been no repetition of beds, and that the thicknesses of the formations are about the same as given above, the stratigraphical interval from creek level to the top of the Rundle limestone will be approximately 6,300 feet. Allowance, too, must be made for the thickening of the incompetent shale formations through flowage on the crest of the structure, so that the depth necessary to drill to reach the Rundle formation, providing there has been no repetition of the formations by faulting, will more probably be at least 7,000 feet. The structure sections indicate a strong probability that this outer thrust fault will be penetrated before the Rundle formation is reached.

Coal seams of mineable thicknesses occur in both the Luscar and Edmonton formations, but as yet none of them has been mined. The low volatile, high carbon bituminous coal seams being mined at Brazeau Collieries, Nordegg, and the high volatile coal deposits being mined at Saunders and Alexo, and other localities on the Canadian National Railway, have been traced into the map-area and are exposed at a number of places, but it is unlikely that any attempt will be made to mine them until the more easily accessible deposits have been exhausted. For additional information on the geology and coal deposits of this and adjacent map-areas, the reader is referred to Report 6 of the Scientific and Industrial Research Council, Alberta, 1923—"Saunders Creek and Nordegg Coal Basins" by John A. Allan and Ralph L. Rutherford.