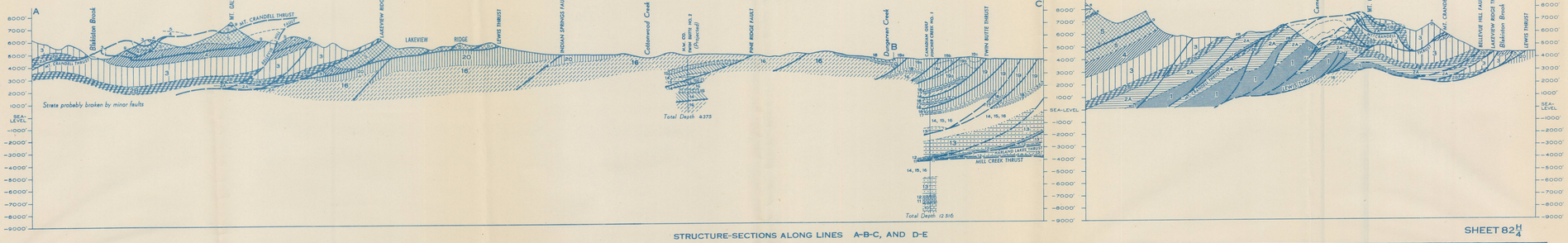
CANADA
DEPARTMENT
OF
MINES AND TECHNICAL SURVEYS
GEOLOGICAL SURVEY OF CANADA



STRUCTURE-SECTIONS ALONG LINES A-B-C, AND D-E

SHEET 82 H/4

LEGEND

CRETACEOUS

UPPER CRETACEOUS

23 — *ST. MARY RIVER FORMATION (Lower part)*: brackish water grey shale, coal, sandstone

22 — *BLOOD RESERVE FORMATION*: massive-bedded marine sandstone; basal transition beds

21 — *BEARPAW FORMATION*: marine, dark grey shale

BELLY RIVER FORMATION (17-20) — *Upper part*; mainly sandstone and shale, coal;
19a, *thick sandstones with interbedded shale*;
19b, *green shale*; 19c, *red shale*;
19d, *mainly shales*

18 — *Lower Sandstone member*: massive marine sandstone, indurated at top

17 — *Transition beds*: thin-bedded sandstone and silty shale

20 — *Undivided*

ALBERTA GROUP (14-16)

16 — *WAPIABI FORMATION*: marine, dark grey, sandy, silty, and fissile shale; thin sandstone beds

15 — *BIGHORN (Cardium) FORMATION*: marine sandstone, shale, and conglomerate *(In structure-sections only)*

14 — *BLACKSTONE FORMATION*: marine, sandy, silty, and fissile shale; thin sandstones *(In structure-sections only)*

LOWER CRETACEOUS

BLAIRMORE GROUP (13)

13 — *Basal quartzose sandstones and limestone; green, grey, and maroon shales; green arkosic sandstones; includes undifferentiated Cowansest formation*

12 — *KOOTENAY FORMATION*: black sandstone, dark grey and carbonaceous shale; coal *(In structure-section A-C only)*

JURASSIC

FERNIE GROUP

11 — *Sandstone and dark grey shale (In structure-section A-C only)*

MISSISSIPPIAN

10 — *RUNDLE FORMATION*: dense and porous dolomites and limestone *(In structure-section A-C only)*

PURCELL

UPPER PURCELL

9 — *Gabbro intrusions*

8 — *KINTLA FORMATION*: red and green argillite; red, green, and grey quartzite

7 — *SHEPPARD FORMATION*: brown weathering grey dolomite and argillite

LOWER PURCELL

6 — *Dark purplish green amygdaloidal basalt*

5 — *SIYEH FORMATION*: limestone and dolomite; grey, green, and red argillite; algal limestone

4 — *GRINNELL FORMATION*: red and green argillites; quartzite and conglomerate

3 — *APPEKUNNY FORMATION*: green and red argillite; quartzite and sandy dolomite

ALTYN FORMATION (2A, 2B) — *Middle and Upper parts*: sandy and gritty dolomites; algal dolomite; fissile black argillite

2A — *Lower part*: finely laminated grey dolomite; mottled dolomite

1 — *WATERTON FORMATION*: red, green, and grey dolomite; grey and algal limestone; green and fissile grey argillite

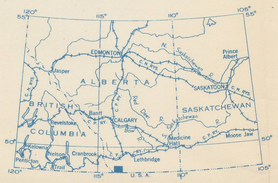
MESOZOIC — PALEOZOIC — PROTEROZOIC

Rock outcrop ..... *
Bedding (horizontal, inclined, vertical, overturned) ..... +
Fault (showing direction of dip) .....
Anticlinal axis (showing direction of plunge) .....
Synclinal axis (showing direction of plunge) .....
Natural gas well ..... ☼
Well abandoned ..... ☒
Test-hole (diamond drill) ..... T.H.

Geology by R. J. W. Douglas, 1950, 1951

Provincial highway ..... NO. 6
Other road .....
Road not well travelled .....
Road along township boundary .....
Trail .....
Church .....
School .....
Post Office .....
Irrigation ditch .....
International boundary .....
Township boundary .....
Section line .....
Forest Reserve boundary .....
Park boundary .....
Intermittent lake and stream .....
Marsh .....
Contours (interval 500 feet) .....
Sand or gravel .....
Reef or small island .....
Height in feet above mean sea-level 4000

Approximate magnetic declination, 22° 15' East



INDEX MAP

PRELIMINARY MAP 52-10

WATERTON
WEST OF FOURTH MERIDIAN
ALBERTA

Scale: 1 Inch to ¼ Mile = 1/47,520

Miles: 1 0 1 2 3 4 5

Feet: 5,000 0 5,000 10,000

PUBLISHED, 1952

DESCRIPTIVE NOTES

The map-area includes part of the Lewis and Clarke Ranges of the southern Rocky Mountains in the southwest and extends almost to the eastern margin of the Disturbed belt in the northeast. The Rocky Mountains are underlain by the Lewis thrust, along which Proterozoic rocks of the Purcell series are in contact for most of its length with Belly River strata of Upper Cretaceous age. Two thrusts of considerable horizontal displacement, the Mount Crandell and Lakeview Ridge thrusts, divide the mountainous region into three structural units. Relief permits observation of associated structures both above and below the Mount Crandell thrust, which has undergone warping and folding subsequent to and during its formation.

Within the Disturbed belt, the structures are continuations of those shown and described in the adjoining Pincher Creek map-area[1], the more northeasterly of which, apparently, have undergone little change. The Canadian Gulf Oil Company, Pincher Creek No. 1 and MacLeod Kanuse No. 1 wells were drilled through the Twin Butte and Harland Lakes thrust sheets and encountered considerable volumes of natural gas within the Rundle formation below drilled depths of 11,705 and 11,470 feet respectively. The Fred Schaempp No. 1 well reached the top of the Rundle formation at a depth of 12,453 feet, too low on the structure for commercial production.

The Twin Butte thrust sheet, in the southeast, is divided into several small slices by faults of small displacement, and appears to be partly overlapped and compressed by the Pine Ridge and Indian Springs faults. No single interpretation of the region underlain by the Twin Butte thrust is favoured. The thrust may be represented in the Twin Butte No. 2 and Jenkins No. 1 wells by the faults at 3,380 and 1,980 feet depth respectively, which lie entirely within strata of the Alberta group. If so, wells have been drilled into the Harland Lakes thrust sheet to near the top of the Blairmore group, and a structural high, underlain by Rundle strata above the Harland Lakes thrust, may be inferred in the vicinity of the wells. Alternatively, the Twin Butte thrust may not have been encountered in these wells, but may lie within Kootenay and Fernie strata below their present depths. In this case, a structural high, west of the Indian Springs fault, may be inferred in which the Twin Butte thrust is anticlinally folded, with Rundle strata of the Harland Lakes thrust sheet lying beneath it.

The oldest rocks of the area (1-9) comprise what have formerly been referred to as the Lewis series. They are of Purcell age, and are separable by a widespread lava flow (6) at the top of the Siyeh formation (5) into Lower and Upper Purcell Series.

The oldest exposed rocks of Lower Purcell age, those of the Waterton formation (1), may be divided into several distinctive units. The lowest beds outcropping on cliffs bordering Waterton Lakes between Cameron and Bertha Creeks, consist of 15 feet of grey weathering, banded and laminated, grey limestone, overlain by 35 feet of massive-bedded green and greenish grey dolomite, 37 feet of massive-bedded green argillite, and 100 feet of buff weathering, cherty, grey dolomite with thin, grey argillite bands. Higher strata are better exposed along Cameron Creek and in road-cuts 2 to 3 miles above Cameron Falls. There, 105 feet of banded and streaked, grey limestone and dolomite interbedded with thin, grey argillite, and containing numerous algal growths in the lower part, are overlain by 95 feet of massive-bedded green and greenish grey dolomite. The dolomite, in turn, grades upward into 130 feet of interbedded, banded and streaked, grey limestone and dolomite and fissile black argillite, and are succeeded by 100 feet of finely laminated and crossbedded, red, brown, and greenish grey dolomite, with interbedded, thin, grey and green argillite. The total thickness of the Waterton formation at these localities is 617 feet. The uppermost red and brown dolomite unit corresponds with the basal part of Daly's type section[2] of the Waterton formation at Cameron Falls.

The Altyn formation may be divided into three parts. The Lower part (2A), 200 to 800 feet thick, comprises a basal section, transitional to the underlying Waterton formation and occurring in thick beds partly mottled with red and brown spots, overlain by thinly bedded, finely laminated, grey dolomite, weathering light buff. The Middle and Upper parts (2B) are grouped together. The Middle Altyn is 200 to 400 feet thick, and consists of thick, massive-bedded, cliff-forming, sandy and gritty dolomite, chalky white weathering algal dolomite, and thin, fissile, black argillite. In the Upper part, 100 to 200 feet thick, argillite is more abundant, and is interbedded with sandy, gritty, and laminated dolomite in beds 1 foot to 5 feet thick.

The base of the Appekunny formation (3) is marked by 20 to 75 feet of greenish grey quartzite, which thickens to the southwest and is overlain by massive, green, and rare, red, argillite in which are two distinctive resistant beds. The lower of these is composed of 75 feet of greenish grey quartzite, and the upper of gritty and sandy dolomite about 100 feet thick. The top of the upper bed lies about 500 feet above the base of the formation. Both beds thin and grade laterally into argillite in the south and southwest. The remainder of the formation is dominantly green argillite, with thin, green quartzites and red argillite bands, which become more abundant towards the top. The formation, 1,625 feet thick on Ruby Ridge, thins to 1,100 feet on Bellevue Hill; the thinning is accompanied by a considerable increase in the amount of red argillite.

The Grinnell formation (4) consists of bright red argillite with thin green bands, and white, green, and red quartzites and conglomerates, the latter more abundant and thicker in the upper half of the formation. It is 1,000 feet thick in the southwest and 730 feet thick in the north.

The Siyeh formation (5) is from 2,000 to 3,000 feet thick. The lower 500 feet contains much pale green argillite, with interbedded buff weathering dolomite, finely laminated or sandy. Above these beds are 900 feet of mixed dolomites and limestones, in part exhibiting 'molar-tooth' structures, interbedded with some thin, black argillite. Algal limestones are common, one of which, about 50 to 100 feet thick, persists across the area. Thick, green argillites occur in the upper 600 feet of the formation, with three distinct bands of red argillite, the uppermost lying immediately beneath a dark purplish green basalt flow (6) about 200 feet thick, containing amygdules of calcite and quartz. This is the Purcell lava of earlier accounts of the Precambrian succession in southwestern Alberta and southeastern British Columbia, and marks the top of the Lower Purcell Series.

The succeeding Upper Purcell Series comprises the Sheppard formation (7), 600 feet thick, the lower 1,500 feet of the overlying Kintla formation (8), and sills of dark green diabasic gabbro (9), which locally exhibit large, stellate aggregates of plagioclase feldspar. The sills intrude the Altyn, Appekunny, Grinnell, and Siyeh formations.

Younger strata outcropping in the Foothills and penetrated by wells are described in the notes on the map[3] of the adjoining Pincher Creek area. Their succession and thickness are as follows: Rundle formation, + 500 feet; Fernie group, 550 feet; Kootenay formation, 50 feet; Blairmore group and Crowsnest formation, 1,300 to 1,900 feet; Blackstone formation, 350 feet; Bighorn formation, 80 to 240 feet; Wapiabi formation, 750 feet; Belly River formation, 2,250 feet, of which the Transition beds comprise 150 to 350 feet, and the Lower Sandstone member 70 to 125 feet; Bearpaw formation, 700 feet; Blood Reserve formation, 150 feet; and St. Mary River formation, 1,700 feet; of which only the basal 250 feet are represented.

[1] Douglas, R. J. W.: Prelim. map, Pincher Creek, Alberta; Geol. Surv., Canada, Paper 51-22, 1951.

[2] Daly, R. A.: Geology of the North American Cordillera at the Forty-ninth Parallel; Geol. Surv., Canada, Mem. 38, pt. 1, p. 50 (1912).

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