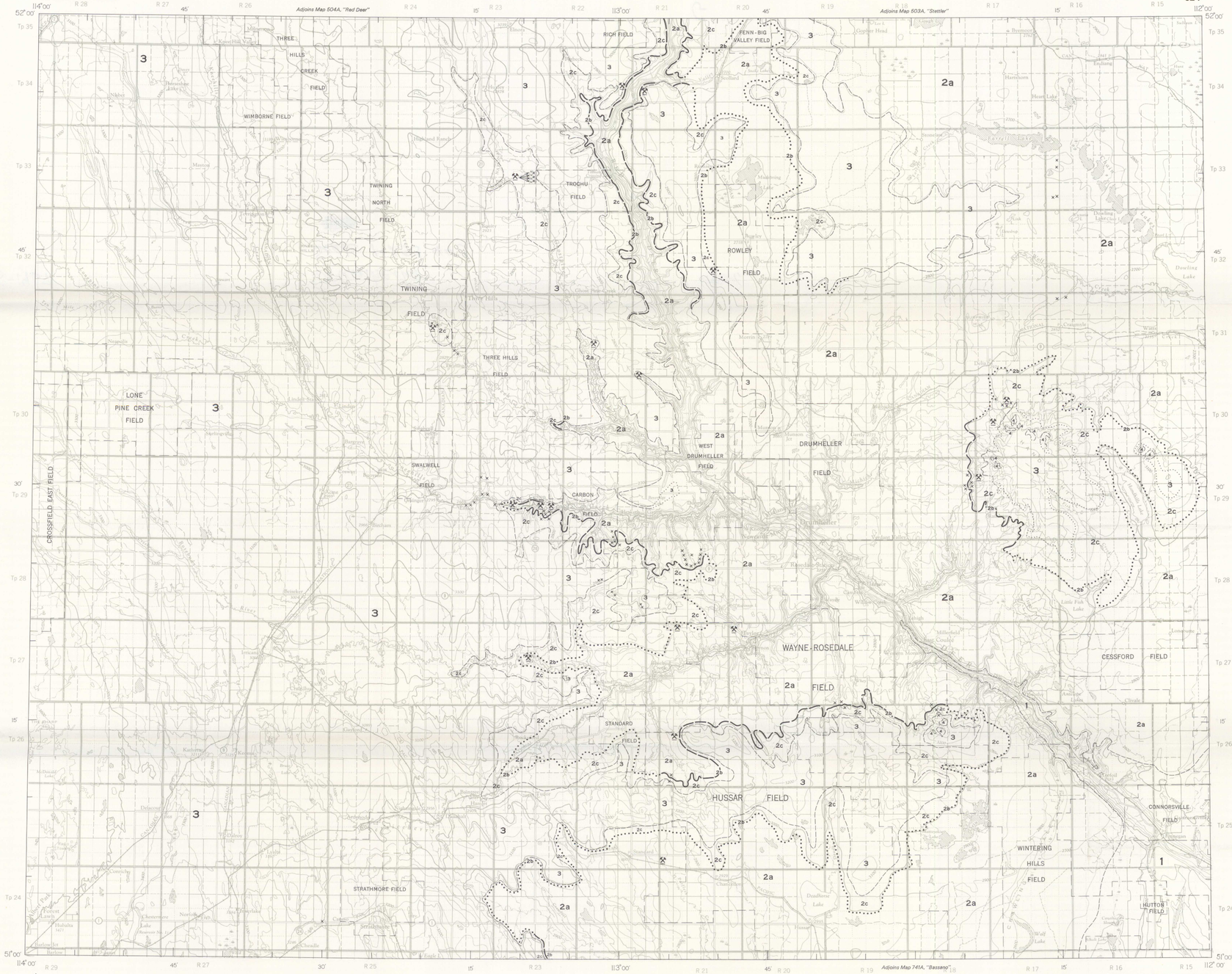
GEOLOGICAL SURVEY OF CANADA
DEPARTMENT OF ENERGY, MINES AND RESOURCES

PRELIMINARY SERIES

82 P



LEGEND

CENOZOIC

TERTIARY

4 — Conglomerate; gravel; sandstone (non-marine)

PALEOCENE

3 — PASKAPOO FORMATION: buff- and brown-weathering, grey sandstone; grey and green siltstone; grey, green, and brown clay shale; pebble conglomerate (non-marine)

MESOZOIC

CRETACEOUS

UPPER CRETACEOUS

2a / 2b / 2c — EDMONTON FORMATION: 2a, lower Edmonton: light-grey weathering, grey, argillaceous sandstone; grey, sandy and silty shale; carbonaceous shale; ironstone; bentonite; coal seams; 2b, Knechills Tuff Zone; bentonitic sandstone; purplish-black, bentonitic shale; volcanic tuff; 2c, upper Edmonton: light-grey weathering, grey, argillaceous sandstone; green and dull green shale, grey siltstone; coal seams (non-marine)

1 — BEARPAW FORMATION: grey and brown shale and silty shale; chocolate-brown, argillaceous sandstone; ironstone bands; calcareous concretions (marine)

Rock outcrop

Geological boundary (defined, approximate, assumed)

Coal mine (abandoned)

Boundary of oil and gas fields

Geology by E. J. W. Irish, 1963, 1964

Geological cartography by the Geological Survey of Canada, 1967

Base-map compiled and drawn by the Surveys and Mapping Branch, 1955

Magnetic declination 1967 varies from 20° 51' easterly at centre of east edge to 21° 50' easterly at centre of west edge. Mean annual change: 3.2' westerly

All elevations in feet above mean sea-level

INDEX MAP

Published 1967, the Centennial of Canadian Confederation
1867 | 1967

MAP 5-1967

GEOLOGY

DRUMHELLER

WEST OF FOURTH MERIDIAN

ALBERTA

Scale 1:253,440

1 inch to 4 miles

Miles 4 0 4 8 12 Miles

Kilometres 6 0 6 12 18 Kilometres

Printed by the Surveys and Mapping Branch

Copies of this map may be obtained from the Director, Geological Survey of Canada, Ottawa

DESCRIPTIVE NOTES

The map-area is mantled with glacial and glacio-fluvial deposits and bedrock exposures are rare except in the deeply eroded parts of stream valleys. Red Deer River, the main stream, crosses the map-area from the centre of the northern boundary to the southeast corner. Throughout most of this distance, the river flows through a rather narrow, steep-sided valley more than 300 feet below prairie level. Bedrock, at places forming precipitous cliffs, is continuously exposed along both sides of Red Deer Valley, and along the lower reaches of the main tributary streams, such as Big Valley Creek, Threehills Creek, Knechills Creek, Rosebud River and Willow Creek. Small areas of outcrop also occur on the west and south flanks of Hand Hills, and on the north-facing slopes of Wintering Hills.

The geological formations that occur at the surface or immediately below the unconsolidated deposits are of late Upper Cretaceous and Tertiary ages. The oldest strata within the Drumheller map-area are those of the Bearpaw Formation (1). They outcrop in the valley of Red Deer River, from a point just west of the mouth of Willow Creek to and beyond the east border of the area. The formation is estimated to be about 650 feet thick along Red Deer River, but only the upper 450 to 500 feet are exposed. The beds consist chiefly of dark grey to brownish-grey, clay shales and silty shales of marine origin, and contain a typical Upper Cretaceous marine invertebrate fauna. Because of the gentle westerly dip of the formation progressively younger beds are exposed from southeast to northwest along the valley. The upper boundary of the formation is transitional with the overlying Edmonton Formation. The transition zone, which is well-exposed between the mouth of Willow Creek and the town of East Coulée along the northeast side of Red Deer River, consists of 30 to 40 feet of chocolate-brown, argillaceous sandstones and sandy shales overlain by a white-weathering, clayey sandstone typical of the Edmonton Formation. The contact is placed arbitrarily at the base of this sandstone unit even though in some places it contains thin beds and lenses of the underlying brown sandstone and sandy shale.

The non-marine Edmonton Formation (2) consists largely of sediments deposited in deltaic, estuarine and flood plain environments. It is the surface formation throughout most of the eastern half of the map-area and is continuously exposed along the slopes of Red Deer River valley, as far south as East Coulée. As much as 300 feet of section may be seen in one outcrop. Minor exposures occur along the tributary valleys below the prairie level. The predominant rock types are fine-grained, argillaceous sandstones, siltstones, sandy shales, and shales with some interbedded ironstone layers, calcareous sandstones, carbonaceous shales, and coal. Bentonite is an important constituent in most of the rock types throughout the succession. Thin beds of pure bentonite that range in thickness from a fraction of an inch to a few feet occur at several places, and many beds are classed as bentonitic clays, shales and sandstones.

Strata of the Edmonton Formation are predominantly lenticular and, except for one zone, the Knechills Tuff Zone, no bed or lens can be followed for more than a few hundreds of feet. For local correlation of sections, coal seams or coaly zones are adequate.

The Knechills Tuff Zone (2b) is composed of a lower white-weathering, grey, fine-grained, bentonitic sandstone between 6 and 20 feet thick, overlain by 15 to 30 feet of violet-grey weathering, purplish-black, silty, bentonitic shale containing thin bentonite beds. The Knechills Tuff proper is a light-grey weathering, brownish-grey, silicified volcanic tuff bed that occurs near the top of the dark shale unit. The combination of these strata is unique, and their colour and weathering characteristics are such as to make them easily recognized in outcrop. Because the combination of these two units forms the only distinctive and widespread marker within the Edmonton Formation, the zone has been mapped separately, thus dividing the formation into upper and lower parts.

The lower Edmonton (2a) is between 750 and 850 feet thick. Brown to grey and dark grey shales, carbonaceous shales, grey to light grey sandstones, and coal seams are typical, with the exception of 200 feet of strata lying approximately between 450 and 750 feet above the base of the formation. Along Red Deer River valley, this 200-foot thick succession of beds is not only barren of coal seams, but contains one or two beds of sandy limestone containing brackish-water fossils. These limestone beds, each about 2 feet thick, lie about 300 feet below the Knechills Tuff.

The upper Edmonton (2c) consists essentially of pale green, dull green and grey, slightly bentonitic shales and siltstones, fine- to medium-grained, grey-weathering sandstones, and coal seams. Erosion has partially or wholly removed upper Edmonton strata at many places, so that its thickness ranges from zero to 350 feet along Red Deer River and its tributaries. At several places in the map-area, coarse, brown-weathering sandstone has cut through and replaced beds of known upper Edmonton age. The contact between the two is sharp and uneven, and fragments of shale in the base of the sandstone indicate channeling. This sandstone has been considered to be the base of the Paskapoo Formation by most workers, mainly because of its lithological similarity to the Paskapoo beds farther west. A Tertiary age has yet to be established for the brown-weathering sandstone.

The total thickness of the Edmonton Formation ranges from about 1,100 feet in the Red Deer River region to about 1,400 feet at the western boundary of the map-area. The strata dip west and northwest at a few feet per mile.

West of Red Deer River, the surface strata belong to the non-marine Paskapoo Formation. East of the river there are large, residual areas of Paskapoo beds up to 300 feet thick. The base of this formation is assumed to lie on the eroded surface of the Edmonton Formation. The upper limit of the formation is the present land surface except for small areas in Hand Hills and Wintering Hills, where it is covered by gravels of late Tertiary age. At these localities the Paskapoo Formation is between 200 and 300 feet thick. At the western border of the map-area the thickness of the formation is close to 1,800 feet. Paskapoo strata consist of buff- to brown-weathering, grey, medium- to coarse-grained, "pepper-and-salt" sandstones interbedded with beds of grey and greenish-grey siltstone and clay shale. There are some calcareous beds containing fresh water or terrestrial gastropods in the succession. The sandstones are well-sorted and contain little clay. The units are normally lenticular, cross-bedded, and contain large, calcareous concretions up to 15 feet in diameter. Locally, rounded-pebble conglomerate lenses occur.

The Paskapoo Formation is overlain disconformably in Hand Hills and Wintering Hills by small remnants of younger Tertiary sediments. At both localities these younger strata consist predominantly of gravel, which is in part, cemented with calcium carbonate to form a conglomerate. Some sandstone beds are intercalated with the conglomerate. There is close lithological similarity between these gravels and the Oligocene gravels of the Cypress Hills Formation although fossil evidence suggests that the gravels within Drumheller map-area may be younger than Oligocene. The gravel is composed of well-rounded pebbles and cobbles consisting mainly of quartzite and chert. Many cobbles are as much as 8 inches in diameter, but the average is less than this.

The youngest deposits in the map-area are of Pleistocene and Recent ages. Pleistocene materials include boulder tills, glacio-fluvial gravels, and lacustrine silts and clays. Recent stream deposits consist of gravels and sands.

The map-area lies on the eastern flank of the Alberta Syncline and all strata dip at low angles in a westerly direction. Along the eastern side of the area, the strata are nearly horizontal but, about rge. 18 W. 4th mer., the dips increase both from east to west and from south to north. North of Tp. 28, the Knechills Tuff Zone decreases in elevation from 3,000 feet in the Hand Hills to about 2,700 feet on Red Deer River giving an average westerly dip of 12.5 feet per mile. The same zone decreases in elevation from 3,000 feet near the south border of the map-area, to 2,700 feet on Red Deer River in Tp. 31 giving an average northward dip of 6 feet per mile. Thus, in the southeastern part of the map-area, the general dip of the surface strata is to the northwest.

In the central one-third of the area, several very gentle, northwest-trending flexures are suggested, but it has not been possible to trace and outline these because of lack of outcrop. Besides these possible undulations, irregularities or "rolls" occur in some coal seams. These "anticlinal folds" range from a few feet to more than 100 feet in width, and may rise above the normal level as much as 10 feet. They are probably due to uneven settling of the beds during compaction. Small faults have been reported at depth in several wells, but they have not been located on the surface. The only fault seen at the surface occurs on a small branch of Michichi Creek in the NW1/4 of sec. 14, Tp. 29, rge. 20 W. 4th mer. A vertical displacement of about 75 feet is indicated by a coal seam marker. The fault strikes about N50° E, and dips 80° to the southeast.

Coal, formerly the most important mineral deposit in the map-area, occurs in the Edmonton Formation. About 14 coal seams are known within the map-area and most of these have been mined in a small way at one time or another. Coal production was formerly the chief industry at the towns of Drumheller, East Coulée, and Rosedale, but for the past several years most of the large mines have either been closed or now operate on a part time basis. Several small strip-mining operations are active along Red Deer River in the vicinity of Drumheller.

Natural gas and crude oil are produced within the map-area from Devonian and Lower Cretaceous strata. The various fields are shown on the map.

Beds of pure and impure bentonite ranging in thickness from less than an inch to 6 feet occur within the Edmonton Formation, but have little economic value at this time.

Gravel for road building is obtained principally from the Tertiary deposits on the top of Hand Hills and Wintering Hills.

MAP 5-1967
DRUMHELLER
ALBERTA
82 P