FIRST EDITION

GEOLOGICAL SURVEY OF CANADA
DEPARTMENT OF MINES AND TECHNICAL SURVEYS

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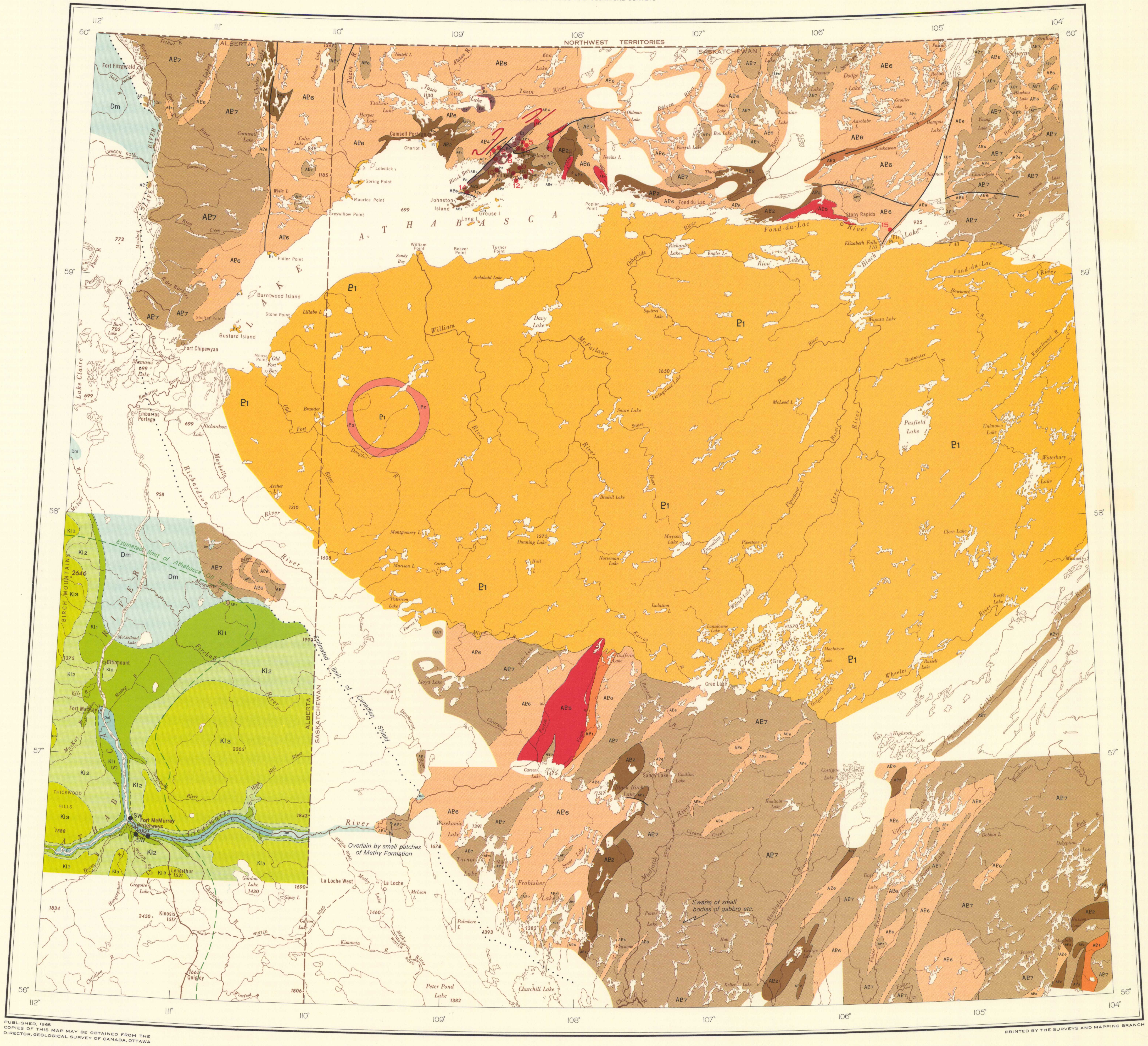

PUBLISHED, 1965
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85 SLAVE RIVER	75 LOCKHART RIVER	65 DUBAWNT RIVER
84 1161A HAY RIVER	74 1162A CLEARWATER RIVER	64 COCHRANE RIVER
83 ATHABASCA RIVER	73 1163A NORTH SASKATCHEWAN RIVER	63 1164A CARROT RIVER

INDEX TO ADJACENT SHEETS

MAP 1162A

GEOLOGY

CLEARWATER RIVER

SASKATCHEWAN-ALBERTA

Scale 1:1,000,000
1 inch to 15.78 miles

Miles 20 0 20 40 60 Miles

Kilometres 25 0 25 50 75 100 Kilometres

LEGEND

MESOZOIC

CRETACEOUS
LOWER CRETACEOUS

- Kl3 — *GRAND RAPIDS FORMATION: white and yellow sand and sandstone*
- Kl2 — *CLEARWATER FORMATION: grey and black shale; grey and green sandstone*
- Kl1 — *McMURRAY FORMATION: sandstone, shale, conglomerate. Parts impregnated with oil*

PALAEOZOIC

DEVONIAN
UPPER AND/OR MIDDLE DEVONIAN

- Du — *BEAVERHILL LAKE (Waterways) FORMATION: limestone, argillaceous limestone, shale*

MIDDLE DEVONIAN AND (?) OLDER

- Dm — *METHY FORMATION: dolomite, calcareous dolomite*
  LA BUTTE FORMATION: limestone
  McLEAN RIVER FORMATION: shale, sandy and silty shale, dolomite, sandy and calcareous dolomite
  FITZGERALD FORMATION: dolomite, dolomitic limestone, calcareous shale
  LA LOCHE FORMATION: arkosic sandstone

PROTEROZOIC

- P3 — *MARTIN LAKE FORMATION: arkose, sandstone, feldspathic siltstone, conglomerate, basalt*
- P2 — *CARSWELL FORMATION: dolomite*
- P1 — *ATHABASCA FORMATION: sandstone, grit, conglomerate, siltstone, shale*

ARCHAEAN AND/OR LOWER PROTEROZOIC

- AP7 — *Granite, granodiorite, and related rocks, and gneissic equivalents. Includes unseparated bodies of units AP1, AP2, and AP4*
- AP6 — *Gneisses, schists, migmatites, granitized rocks, and unseparated bodies of units AP1, AP2, AP4, and AP7*
- AP4,5 / AP4 — **AP4.** *Amphibolite and other metamorphosed mafic and ultramafic rocks of sedimentary, volcanic, and igneous origins. Includes unseparated bodies of AP5*
  AP5. *Gabbro, norite, and other mafic or ultramafic intrusions*
- AP2 — *Quartzite, ferruginous quartzite, dolomite, dolomitic quartzite, conglomerate, limestone, argillite and gneissic and schistose equivalents. Includes part of TAZIN GROUP*
- AP3 — *Unseparated sedimentary, volcanic, and metamorphic rocks equivalent to units AP1 and AP2*
- AP1 — *Andesite, basalt, rhyolite, tuff, and metamorphic equivalents. Includes part of TAZIN GROUP*

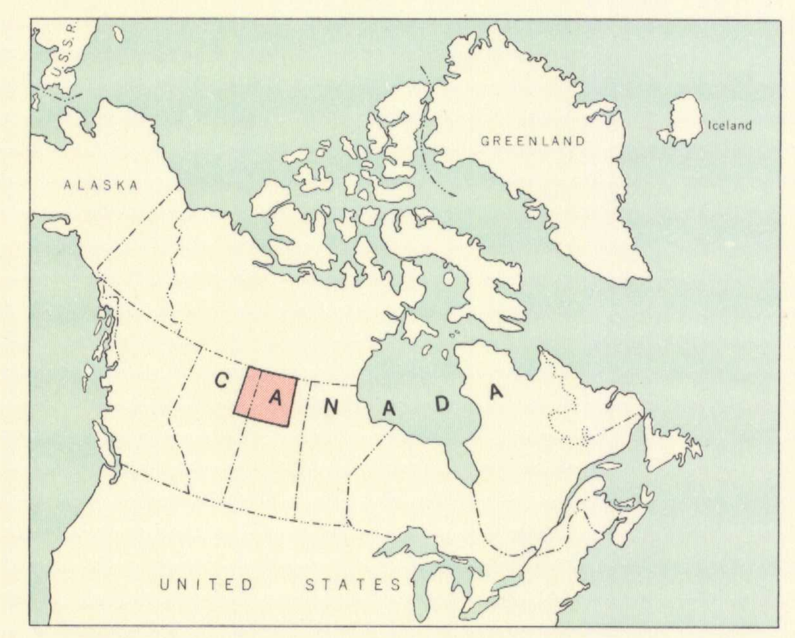
Geological boundary (defined or approximate)
Geological boundary (inferred or gradational)
Principal fault
Estimated limit of Athabasca Oil Sands
Mine (gold, uranium) . . . Au,U
Salt well . . . SW

Geology compiled by A. H. Lang, 1962, from maps and reports published by the Geological Survey of Canada, the Saskatchewan Department of Mineral Resources, and the Research Council of Alberta

Base-map from Map 2141. "Clearwater River" by the Surveys and Mapping Branch, 1949, with minor revisions, 1964

INDEX TO MINES
*Former producer

1. *Rix (Rix-Athabaska Uranium Mines Ltd.) U
2. *Cayzor (Cayzor Athabaska Mines Ltd.) U
3. *Jam-Maj (Nesbitt—La Bine Uranium Mines Ltd.) U
4. *National Explorations (National Exploration Ltd.) U
5. Verna (Eldorado Mining and Refining Ltd.) U
6. Ace-Fay (Eldorado Mining and Refining Ltd.) U
7. *Lake Cinch (Lake Cinch Mines Ltd.) U
8. *Martin Lake (Eldorado Mining and Refining Ltd.) U
9. *Gretta (Black Bay Uranium Ltd.) U
10. *Lorado (Lorado Uranium Mines Ltd.) U
11. *Box (The Consolidated Mining and Smelting Co. of Canada Ltd.) Au
12. *Athona (Athona Mines Ltd.) Au
13. *Nicholson (Consolidated Nicholson Mines Ltd.) U
14. Gunnar (Gunnar Mines Ltd.) U
15. *Nisto (Haymac Mines Ltd.) U



INDEX MAP

NOTES

GENERAL

Most of the map-area is in the Churchill 'province' of the Canadian Shield, but the eastern part is in the Interior Plains and Lowlands. Physiographically, the part in the Shield is divisible into two main areas. One is a flat area extending eastward from the mouth of Athabasca River to Wollaston Lake, and northward from Cree Lake to Lake Athabasca. It slopes gently northward from an elevation of about 1,600 feet along its southern limit to about 700 feet, the level of Lake Athabasca. It is underlain mainly by the Athabasca Formation, which is poorly exposed and covered mainly by sand and other glacial deposits. This area is flanked to the north and south by hilly areas containing elevations up to about 1,400 feet above sea-level, and underlain by older Precambrian rocks, which are fairly well exposed. The surface of the area within the Interior Plains and Lowlands varies from flat to hilly, with elevations up to about 2,800 feet above sea-level. It is underlain by flat-lying Palaeozoic and Mesozoic strata, exposures of which are virtually restricted to the banks of the larger streams.

Almost all the 'Precambrian' part of the map-area has been mapped geologically on the scale of 1 inch to 4 miles, much of it has also been mapped at 1 inch to 1 mile, and a large area extending from the vicinity of Johnston Island to a line about 5 miles north of Beaverlodge Lake has been mapped at 1 inch to 400 feet. As much of the detail cannot be shown at the scale of this map, it has been possible to illustrate only the larger geological features and a few smaller ones that illustrate structures or other phenomena particularly well.

PRECAMBRIAN

The older strata exposed are sedimentary and volcanic rocks exhibiting various degrees of metamorphism. It is not clear whether volcanic or sedimentary strata are the oldest, and it is possible that rocks of several ages are represented. North of Lake Athabasca these strata have been named the Tazin Group, to which at least some of the analogous strata in other parts of the area are probably related. The strata are intensely folded, generally along northeasterly trending axes. Evidence available at present from age determinations on samples from the Churchill province indicates that the orogenies within it took place in Proterozoic rather than Archaean times, but this does not preclude the possibility that some of the rocks involved may be Archaean. Much of the Precambrian terrane is composed of granites and related rocks, and of complexes made up of gneisses, migmatites, grantizied rocks, and small bodies of granite and other rocks. In areas that have been mapped at 1 inch to 1 mile or in greater detail the various components of the complexes have been separated and in some areas several varieties of gneisses have been mapped separately. It proved impossible to indicate these details on the present map, not only because of limitations of scale, but also because various workers used different classifications.

Also present are numerous bands of amphibolite of different sizes. Some of the narrower ones have been indicated symbolically because they illustrate the folding; many others had to be omitted.

In the large flat area south of Lake Athabasca the older rocks are overlain by the gently tilted Athabasca Formation, which was originally thought to be of Cambrian age but is now generally regarded as Proterozoic. At and near Carswell Lake several outcrops of dolomite in a circular pattern have been grouped as the Carswell Formation. The contact between these beds and the Athabasca Formation has not been found exposed, but nearby dips suggest that the Carswell overlies the the Athabasca and has been infolded in a domal structure. In the vicinity of Beaverlodge Lake beds of arkose and other sedimentary rocks interbedded with flows of basalt, which were formerly considered part of the Athabasca 'series' have recently been redefined as the Martin Lake Formation.

The older Precambrian rocks are traversed by numerous faults, many of which strike northeasterly. Only a few of the more prominent ones could be shown on this map. North of Lake Athabasca two main periods of faulting have been recognized. The older followed the granitization of rocks of the Taxin Group, and the younger took place after the deposition of the Martin Lake Formation. Wide zones of fracturing, brecciation, and mylonitization are believed to have resulted from still earlier deformation or faulting, rather than from faults that can now be mapped.

PALAEOZOIC AND MESOZOIC

The Palaeozoic strata exposed in the area mainly contain fossils indicative of Middle and Upper Devonian ages. The Fitzgerald Formation found along Slave River was formerly considered to be Upper Silurian, and because the evidence available at present is uncertain its age is now stated as "Upper Silurian and/or Middle Devonian". In the southwestern part of the map-area Lower Cretaceous strata rest on an erosion surface in the Devonian beds. The distribution of the Palaeozoic and Mesozoic formations is reasonably well known from exposures along streams and from drilling records, but the precise locations of the boundaries between them is in most places indefinite because of the extensive overburden of glacial and post-glacial deposits. Some additional formations have been recognized in drill sections but are not mappable from surface information.

ECONOMIC FEATURES

The map-area contains occurrences of a large variety of metals, discoveries to date being almost entirely confined to the earlier Precambrian rocks. The region first attracted prospectors in and following 1910 when interest was mainly in copper-nickel occurrences associated with norite, and in iron-bearing sedimentary rocks, neither of which were developed successfully. Gold discoveries in 1934 caused establishment of the town of Goldfields, near which two mines produced for a few years. An occurrence of pitchblende found at the Nicholson copper prospect near Goldfields in 1935 was not then of particular interest, but in and following 1942 it caused much prospecting for uranium in the area. This resulted in discovery of more than 3,000 occurrences of pitchblende in the general vicinity of Beaverlodge Lake, and establishment of 12 producing mines, the town of Uranium City, and several roads and airstrips. The larger pitchblende deposits consist of stringer-systems and disseminations in a variety of earlier Precambrian rocks and in the Martin Lake Formation; most are associated with prominent faults. Many additional uranium occurrences were found between Slave River and Beaverlodge area, and between that area and Porcupine River; some are of the pitchblende type described above, and most others contain crystalline uraninite in pegmatites, migmatites, and related rocks. Many occurrences of the latter type were also found in the general vicinity of Foster Lakes.

The map-area contains the northeastern part of the Athabasca Oil Sands, which in their entirety are considered to be the world's largest reserve of petroleum. They are mainly in the McMurray Formation, which is impregnated with viscous petroleum, and are regarded as an oil reservoir that was exposed sufficiently by erosion to permit escape of the more volatile constituents. Whether the oil originated in these beds, in the underlying Devonian strata, or in overlying Cretaceous formations has not yet been proved. Many investigations have been undertaken regarding the extent of the sands, and methods of exploiting them, but to date commerical production has not been achieved.

Devonian strata contain thick beds of salt, anhydrite, and gypsum. Salt was produced for several years from wells drilled near McMurray.

REFERENCES

The maps and reports used in this compilation are too numerous to be listed here. Most will be found in the Index to Publications of the Geological Survey of Canada (1845-1958) and its supplements, and in the lists of the Research Council of Alberta and the Saskatchewan Department of Mineral Resources.