GEOLOGICAL SURVEY OF CANADA
DEPARTMENT OF MINES AND TECHNICAL SURVEYS

PRELIMINARY SERIES

SHEET 74 N/7 (PART OF)

LAKE ATHABASCA

699'

LEGEND

ARCHAEAN (?)

TAZIN GROUP

9 — Meta-diorite and meta-gabbro; in part amphibolite

8 — Quartz veins; 8a, quartz stockworks

6 — Granite; leucogranite; microcline, albite granite; minor aplite dykes

5 — Granitoid gneiss; 5a, 'Gunnar granite', quartz-monzonite and granodiorite gneiss, 5b, porphyroblastic phase; 5c, syenitic phase

3 | 4 — 3. Acid paragneiss; 3a, transition meta-sediment; 3b, layered acid paragneiss, less than 15% mafic minerals; quartz-feldspar granoblastic gneiss; 3c, massive phase, in part giant layered gneiss, in part granitoid; 3d, quartz-monzonite gneiss; 3e, feldspar porphyroblasts developed in 3c; 3f, syenitic phase, quartz replaced by feldspar and carbonate; 3g, agmatite; granodiorite (5a) surrounding fragments of 3b, 3c, etc.
4. Intermediate paragneiss; striped, in part migmatite; 15% - 40% mafic minerals; plagioclase-, biotite-, hornblende-, chlorite-, quartz gneiss

1 | 2 | 1 — 1. Sedimentary rocks; 1a, conglomerate; 1b, pebble conglomerate; 1c, grit and sandy quartzite; 1d, metaquartzite; 1e, ferruginous grit and quartzite; 1f, chert, cherty quartzite; 1g, mudstone, meta-siltstone, in part ferruginous; 1h, sericitic, schistose quartzite and grit; 1i, phyllite; graphite and hematite schist; 1j, garnetiferous quartz-biotite-staurolite schist
2. Meta-volcanic rocks; minor intercalated chert; 2a, meta-andesite, meta-dacite, amphibolite and hornblendite; 2b, pillow structured; 2c, amygdaloidal; 2d, chert and quartzite

7 — Basic gneiss; 7a, amphibolite, hornblendite, etc; more than 40% mafic minerals; 7b, chlorite schist; 7c, feldspathized phase; 7d, agmatite; 5 and 6 surrounding fragments of 7a

Drift-covered area
Area of rock outcrop
Geological contact, in part based on diamond-drill information (defined, with dip where known; approximate, gradational)
Bedding, tops known (inclined)
Bedding, flow structure, tops unknown (inclined, vertical)
Schistosity (inclined, vertical)
Stratiform gneissosity; parallel alternating layers of different composition (inclined, vertical)
Gneissosity; parallel fabric caused by planar disposition of rock forming minerals; to be distinguished from schistosity and stratiform gneissosity above (inclined, vertical)
Lineation, plunge known; may be combined with other symbols; slickensides marked ss . . . 40
Drag-fold (arrow gives plunge, relative movement between layers indicated) may be combined with other symbols . . . 40
Fault (defined, approximate, assumed, dip unknown)
Fault (inclined, vertical, arrow indicates relative movement)
Glacial striae (direction of ice-movement known)
Rock trench and stripped area (mineral if known) . . . py
Mineral occurrence . . . × cp
Breccia, mylonite (alone, combined or as subscript to legend symbols) . . . x,m
Highly contorted beds, layers or gneissosity (alone or as subscript to legend symbols) . . . k

MINERAL SYMBOLS

Carbonate	carb	Hematite	hem
Chalcopyrite	cp	Pyrite	py
Graphite	gf	Radioactive mineral stain	ra

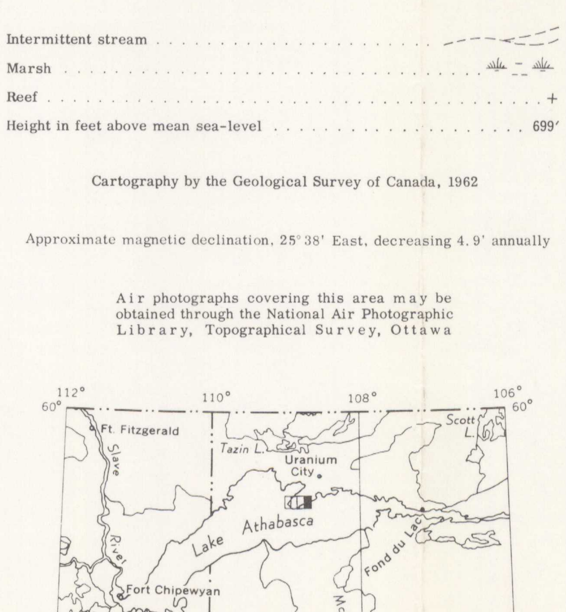
Geology by C.K. Bell, 1956, 1957

Intermittent stream
Marsh
Reef . . . +
Height in feet above mean sea-level . . . 699'

Cartography by the Geological Survey of Canada, 1962

Approximate magnetic declination, 25°38' East, decreasing 4.9' annually

Air photographs covering this area may be obtained through the National Air Photographic Library, Topographical Survey, Ottawa



DESCRIPTIVE NOTES

Elliot Point is 14 1/2 miles south of Uranium City and 4 1/2 miles east of Gunnar Mines. These towns have scheduled flights from Edmonton and Prince Albert. From them the area is accessible by small boat or float-equipped aircraft. During summer, heavy freight enters the region by a 250-mile tug-and-barge trip from the railway at Waterways, Alberta.

Maximum relief is 200 feet. Topography is stratigraphically controlled and most faults are in prominent valleys. Glacial striations indicate an ice-sheet advance from the northeast.

Members of the Tazin Group are here arranged in order of increasing metamorphism. Units 3 to 5 were probably formed by feldspathization or partial granitization, and selective melting with accompanying local intrusion in rocks of surficial origin. However, structural evidence suggests that the original (pre-granitization) stratigraphic succession progressed from the oldest rocks in the northwest corner of the map-area to the youngest along the shore of Lake Athabasca. This stratigraphic succession may be, in part, repeated by faulting.

Conglomerate (1a) is thickly bedded, complexly cross-fractured, intruded by quartz stockworks and gash-veins, and is difficult to distinguish from the surrounding quartzite. It contains up to 80% of unsorted cobbles of sandy quartzite and quartzite. These are 1-foot or smaller, averaging 5 inches in diameter, and are variegated white, grey, or red, and subrounded to angular to stretched. The matrix is chert, quartzite, sandy quartzite or grit. It varies from white, through mauve to various shades of red and red-brown. Where the cobbles are stretched the matrix is schistose and the omnipresent quartz grains are elongated parallel to the schistosity. Sandy quartzites and pebble-conglomerates form intraformational lenses. Pebble-conglomerate (1b) is composed of imbricately arranged, oval, 2-inch or smaller, pebbles of quartzite and black chert in a grey cherty quartzite matrix. Individual beds, rarely more than 2 feet thick, form stratigraphic sections up to 300 feet thick. Interformational pebble-conglomerate beds are widespread. Grit (1c) and metaquartzite (1d) are white and grey, or coloured buff to purple by iron-oxide dust and cement and by hematite veinlets. In places the rocks are blotched by hematite-rich patches. Near the contact with the diorite dykes west of Blake Lake the quartzite has been recrystallized to an igneous-looking body of nearly pure silica (silexite). The beds are massive and generally tens of feet thick. Individual bedding planes were traced for 7,000 feet, but groups of beds commonly lense out or show gradational facies changes along strike. They contain rare, isolated, quartzite cobbles that appear to have been rafted into position. Complex joints and recent mechanical weathering have produced a rubble surface. These rocks grade into maroon ferruginous grits and quartzites (1e) that contain more than 5% hematite and/or limonite dust. They are altered to hematite-rich schists, mylonites, and breccias adjacent to fault and shear zones. Thinly bedded, caramel-coloured cherts (1f) form conspicuously rare interlaminations within quartzite or siltstone. Sericite-phlogopite schist (1h) contains rounded to stretched colourless quartz eyes in a matrix that varies from schistose to a microcrystalline, grey-green, rhyolitic-looking material. The strip that parallels the east shore of Elliot Bay is derived from units 1b, 1c, and 1d, and appears to be related to movement along the Elliot Point fault. In places this rock has a distinct flaggy parting. What were probably argillaceous sediments have recrystallized to scattered thin beds of curly, knotted schists and phyllites (1i). The matrix may contain graphite, hematite, biotite, sericite, and quartz in deformation zones and in pressure shadows. The knots may be quartz aggregates, andalusite, or mixtures of hematite, or magnetite, that are in part derived from pyrite. Some of the graphite and hematite schists occur in fault zones. Overlying the volcanic rocks west of Elliot Creek are garnetiferous quartz-biotite, quartz-biotite-chlorite, and staurolite-biotite gneiss and schist (1j). These are interbedded with sedimentary breccias consisting of quartzite fragments in a silty ferruginous matrix, with sandy chloritic schists, and with beds similar to the rocks in unit (1g). They are combined in one unit here because they are all garnetiferous.

The volcanic rocks (2) are contemporaneous with and lie within map-unit 1. Rare pillow-structured members (2b), rocks with quartz amygdules (2c), and flow breccias indicate a volcanic origin. These original textures have been largely destroyed and the volcanic rocks are now amphibolites containing up to 66% hornblende in euhedral crystals, feathered aggregates, or rosettes. The hornblende is partly replaced by sericitized, dusty-red, microcrystalline plagioclase and has a sieve texture. Quartz, epidote, garnet and apatite are accessory minerals. The opaque minerals are hematite or red limonite, with minor magnetite and leucoxene. Chlorite is conspicuously rare except near the contact with members of unit 1 where the rock becomes chlorite schist. The rock is generally coarse grained and massive to slightly gneissic. In places it becomes fine grained and rudely layered; elsewhere it is typical greenstone. Beds of quartzite and chert (2d) are intercalated and occur as swarms of short narrow lenses. Each swarm may be up to 50 feet thick and hundreds of feet long. A few have been granitized and contain combinations of quartz, orthoclase, albite, biotite, carbonate, and hematite.

A transition phase (3a) exists between the more siliceous sediments (1) and the acid paragneiss (3b, 3c). The quartzitic sediments alter through schistose and gneissic facies to a granitoid rock that contains proportions varying up to 45% quartz, 40% microcline, 30% plagioclase, 10% mica (muscovite, minor biotite), with traces of chlorite, opaque minerals, accessory apatite and secondary carbonate. Some members contain remnant subrounded sand grains in a matrix of the above minerals. The transition zone at the head of Elliot Bay, east of the Elliot Point fault, is derived from a conglomerate that still contains boulder remnants. Along with the modified boulders that now have ghost-like outlines, this rock has pods and lenses of amphibolite and chlorite, which suggest boulders of volcanic origin. This is the only locality that indicates a volcanic provenance for the conglomerate. The transition rock is intruded by granitic material and quartz veins. The layered appearance of the acid paragneiss (3b) is the result of variations in both the texture and relative amounts of minerals. The predominating silicic layers are white to red, and weather pink, red, and green-brown. The regional red colour is the result of iron-oxide dust that clouds the feldspars. The silicic layers average 30% quartz, 28% microcline-orthoclase, 34% sericitized albite (An_2 - An_6), and 4% retrograde chlorite, with minor biotite, muscovite, epidote, and opaque material. Apatite and rare zircon are the accessory minerals. These silicic layers are in knife-sharp contact with grey to dark green layers rich in biotite, hornblende, retrograde chlorite, and plagioclase, with minor quartz and orthoclase. Microscopic carbonate stringers commonly intrude both rock types. Individual layers are generally less than a foot thick and probably represent the position of original beds. Rare pebble-conglomerate lenses are found in them. In places, plastic deformation has resulted in swirled layering and boudinage structures; elsewhere, complete remobilization has obliterated all structure. Where the parent sediments were thickly bedded, or where all traces of primary layering has been destroyed, the resulting paragneiss (3c) is massive to gneissic, with any megascopic foliation tending to parallel the regional structure. These paragneisses are distinguishable from granite by their medium-grained granoblastic texture. The end-phase paragneiss is a monzonite or quartz-monzonite gneiss (3d) that contains an average of 15% chlorite. The granulated appearance of the feldspars, the high percentage of chlorite, and abundant accessory apatite, zircon, and garnet help to distinguish this rock from 'Gunnar granite'. Albitization, and carbonitization of microcline and quartz have produced a fine-grained, hematite-rich, quartz-poor, 'syenite-like' rock (3f) that may be associated with faults.

The layered intermediate paragneiss (4) is contemporaneous with the acid paragneiss (3) and occurs as belts and lenses within it. The basic layers consist of hornblende and biotite, much of which is altered to retrograde chlorite, albite-oligoclase, and rare quartz. Individual layers range in thickness from a few millimetres to a few feet, the chloritized amphibolite being separated by lenses or lit-par-lit ribbons of quartz or granitic material. Some of these striped gneisses are highly crenulated. The fresh rock has a medium-grained granoblastic texture, is pale green to black, and weathers dark green.

'Gunnar granite' (5a) was formed by a further granitization of paragneiss. In the map-area to the west, the 'Gunnar granite'-paragneiss contact may be knife-sharp, faulted, or rarely gradational, and may parallel or cross the local gneissic structure[1]. A coarse-grained, hypidiomorphic granular quartz-monzonite gneiss (5a) in the northwestern corner of the map-area contains 29.5% quartz, 37% altered untwinned orthoclase and twinned microcline-perthite, 26% albite (An_2 - An_{10}) and 4% retrograde chlorite rimming minor biotite. The opaque minerals are hematite and limonite; accessory zircon and apatite are rare or absent. The large mass west of Blake Lake contains less orthoclase, only minor chlorite, and up to 20% biotite. Its composition approaches that of a biotite-granodiorite gneiss. Fresh 'Gunnar granite' is mostly pink, owing to hematite dust in the feldspars. Weathered surfaces are a distinctive orange-red. The rock is gneissic; foliation is formed by platy mafic minerals and by flat ovoids of strained quartz up to 2 inches long. One- to two-inch, euhedral, orthoclase porphyroblasts occur in a quartz-monzonite (5b) that has a gradational contact with 'Gunnar granite'. In places this rock approaches the composition of an intrusive granite porphyry that outcrops a few miles to the west[1]. 'Gunnar granite' is altered to a 'syenite-like' rock (5c) by the metasomatic replacement of K-feldspar and quartz by Na-feldspar. The end product of this syenitization is is a rock composed almost entirely of fine-grained, unaltered, equant albite grains. Between the two extremes are gradations in which the original K-feldspars are intensely albitized; dusty, undulatory quartz is recrystallized as late, clean quartz that is occasionally euhedral; and the micas are completely altered to chorite. Members of unit 5 may be crushed and mylonitized and most samples show mortar structure between individual grains. Irregular, sharp-boundaried, chlorite-rich breccia zones are common and small chlorite-filled shear zones crisscross these rocks everywhere.

Leucogranite (6) is massive, aplitic to medium-grained, and white to pink. A typical sample is a grey microcline-granite containing 45% quartz, 32% microcline, 20% albite (Ab94), muscovite with minor biotite, chlorite and accessory sphene. It may possibly be a mobilized phase of the 'Gunnar granite'. Its contacts crosscut members of map-unit 3.

Amphibolite gneisses (7a) occur as roughly lenticular sill-like and dyke-like swarms within map-units 3 to 6. Their textures vary from massive through gneissic to striped and finally schistose. All textural gradations exist within these gneisses, but their contacts with the surrounding rocks are knife-sharp. The average rock is a homogeneous aggregate containing 50% hornblende, 35% sericitized plagioclase (Ab65 - Ab80), 6% retrograde chlorite after hornblende, 5% quartz and minor orthoclase and biotite. Some may contain 5% hematite as veinlets, joint coatings, and dust, 2% garnet, and 1% apatite. They are generally medium grained and a few have chilled edges. The striped amphibolites result from variations in texture and from the alternation of abundant dark hornblende-plagioclase rock with streaks rich in pink sericitized plagioclase, and minor quartz, hornblende, and chlorite. The amphibolites (7a) are dark green to black on a fresh surface and weather brown, green, or black. The plagioclase weathers orange, flecking exposed surfaces. The rocks contain segregations and injections of quartz, plagioclase-rich pegmatites, and granite. Where these segregations and injections form more than 25% of the rock it is mapped as agmatite (7d). Many of these basic gneisses became remobilized after consolidation and locally intruded the surrounding rocks as irregularly shaped apophyses, stockworks, and isolated pods. Assignment of these rocks to a sedimentary or igneous origin is impossible at present. The striped character is likely the result of metamorphic or tectonic action and is not related to original depositional features. Retrograde chlorite locally replaces up to 100% of the mafic minerals in these rocks, resulting in chlorite schist (7b). Northwest of Lake 'C' is a coarse-grained gneiss that is here considered to be feldspathized amphibolite (7c). The hornblende has been altered to biotite and the rock contains appreciable quantities of secondary microcline and quartz.

Quartz veins (8) are small and of many ages. Colourless quartz fills the hexagonal joints in the volcanic rocks. Late vuggy quartz veins fill the northwest-striking tension faults and some of the longitudinal faults that occur in rocks of map-unit 1. Quartz stockworks (8a) in these quartzitic sediments may also be associated with deformation zones. Quartz veins are not economically important.

Meta-diorite (9) outcrops as sills and dykes northwest of Blake Lake and on an island in Lake Athabasca west of Blake Creek. These are thought to form the southernmost extension of basic intrusive rocks described by Christie[2]. They contain inclusions of the host rocks.

Athabasca Formation 'clastic dykes' occur in the highly jointed and cracked Tazin substratum at the southwestern tip of Elliot Point and possibly in a few places farther northeast on the mainland. They are too small to map.

The rocks in the map-area for the most part form a southeast-dipping monocline. The small area of anomalous strikes and dips northeast of Lake 'A' may be the result of drag caused by faulting. Restricted areas of extremely complex folding occur on a scale of tens of feet (symbol 'k' on map). Lineations formed by a parallel orientation of stretched quartz aggregates are rare but tend to plunge south and west of south between 35 and 55°. Exceptions to this orientation are the slickensides along fault planes.

The main regional shear fracture is the transverse Heatherington fault. The trace of the longitudinal Hill Creek fault and its probable projection into the southeast arm of Aadland Lake is marked by scattered outcrops of hematite-rich, siliceous mylonite and breccia. Similar breccia and hematite-rich schist are found outcropping along Blake Creek fault. The existence and location of the Elliot Point fault is conjectural and is based on the fact that the structure of the Tazin sediments (1) strikes into the volcanic rocks (2) at a low angle at the head of Elliot Bay. A strike separations of less than 500 feet along the Heatherington fault is measured on the Hill Creek fault and its Aadland Lake projection. This contrasts with the 1,800-foot strike separation on the Zeemel-Heatherington fault intersection 3.4 miles to the west[3]. The movement on the longitudinal faults in unknown. Many minor faults and joints occur within the Tazin rocks; most are too small to map or are hidden by drift. The major strike and bedding faults in the Tazin sediments (1) are filled with a hydrothermally altered, brown ferruginous mudstone gouge and are marked 'x,m'. The fault zone may be as much as 4 feet wide and has been traced for 1 mile. The set of northwest-striking tension faults in rocks of map-unit 1 east of Elliot Creek is probably complementary to the Elliot Point fault. They are steeply dipping and have small right- and left-hand strike separations suggesting minor movement. They are filled with brecciated fragments of sediments (1) and are cemented by vuggy, low-temperature milky quartz.

No deposits of economic importance have been found within the map-area and the only drilling has been on the radioactive syenite zone in the northwestern corner of the region. Areas of test-pitting and trenching have been plotted with the mineralogy where known.

[1] Bell, C.K.: Geology, Milliken Lake, Sheet 2, Saskatchewan; Geol. Surv., Canada, Map 33-1961 (1962).
[2] Christie, A.M.: Goldfields - Martin Lake Map-area, Saskatchewan; Geol. Surv., Canada, Mem. 269, p. 19 (1953).
[3] Bell, C.K.: Geology, Milliken Lake, Sheet 3, Saskatchewan; Geol. Surv., Canada, Map 10-1962 (1962).

REFERENCES TO SURROUNDING AREAS

Alcock, F.J.: Geology of Lake Athabasca Region, Saskatchewan; Geol. Surv., Canada, Mem. 196 (1936).
Bell, C.K.: Geology, Milliken Lake, Sheet 1, Saskatchewan; Geol. Surv., Canada, Map 38-1959 (1959).
Evoy, E.F.: Geology of the Gunnar Uranium Deposit, Beaverlodge Area, Saskatchewan; Univ. Wisconsin, Ph.D. thesis, Geology, 1961 (1962).
Fahrig, W.F.: The Geology of the Athabasca Formation; Geol. Surv., Canada, Bull. 68 (1962).
Fraser, J.A.: Geology, Crackingstone, Saskatchewan; Geol. Surv., Canada, Map 1095A (1960).

PUBLISHED, 1963
COPIES OF THIS MAP MAY BE OBTAINED FROM THE DIRECTOR, GEOLOGICAL SURVEY OF CANADA, OTTAWA

MAP 11-1962
GEOLOGY
MILLIKEN LAKE
SHEET 4
SASKATCHEWAN

Scale: One Inch to 800 Feet = 1/9,600
Feet
800 0 800 1600 2400

PRINTED BY THE SURVEYS AND MAPPING BRANCH

MAP 11-1962
MILLIKEN LAKE
SASKATCHEWAN