



Introduction

This guide takes you on a geological walking tour of the Frame Lake Trail and describes the rocks and geological features along the way. The hike begins at the Visitor's Centre and continues clockwise around Frame Lake. You will find the accompanying geology map a useful tool for navigating the trail and for keeping track of the exposed rock types along the trail.

As shown on the map, the Frame Lake Trail is a 7-kilometre loop that can be completed by a moderate walker in about 1.5 hours. In order to fully appreciate the geological features, allow more time to complete the circuit. Similar rocks appear along the length of the trail, therefore the same rock types may be seen along the route.

The trail is paved from the RCMP building on the town side to Stanton Hospital on Frame Lake's south-side, but for the most part, the trail has lots of rocks to clamber over, wooden

bridges across low swampy areas and gravel paths. Look for orange capped grey metal posts embedded in the rocks and white painted prospector symbols along the way where there is no obvious path. Sturdy footwear and insect repellent are recommended. Please remember to bring your litter bag with you.

The flora and fauna of this sub-arctic environment are in delicate balance - please show respect by staying on the trail and do not pick flowers or plants. The trail has many scenic lookouts with benches and signs along the way detailing the flora and fauna that you may encounter: fireweed, foxtail barley, wild roses bushes, creeping juniper, paper birch, jack pine and black spruce trees, in addition to a wide variety of other trees, flowers, bushes and plants which can all be seen at various points along the trail.

Take your time and enjoy.



The Geological Map

The rocks that you are walking over are more than 2.6 billion years old and are made up of many different rock types, often composed of a number of different grains (minerals). The various minerals that appear together are related to how the rock formed and provide clues for geologists to help them determine what processes formed the rocks and better understand the earth. Rocks are divided into three main types based on their origin: **Igneous, Sedimentary and Metamorphic.**

The Frame Lake Trail is underlain by both volcanic and plutonic igneous rocks. The volcanic rocks formed about 2,700 million years ago during a time known as the Archean Eon. The volcanic rocks in the Yellowknife area are called the Kam Formation and hosted the former Con and Giant gold mines. The plutonic rocks are also Archean and were formed about 100 million years after the volcanic rocks.

The contact between the Kam Formation and the Western Granodiorite (a type of granite) is the most obvious geological feature of the trail. Other symbols indicating the location of faults, shear zones, gabbro or diabase dykes, lakes and areas covered with sand and gravel (overburden) are also shown on the map. The symbols are explained in the map legend. The geological map is simplified so that only the largest and most easily recognizable features are shown.

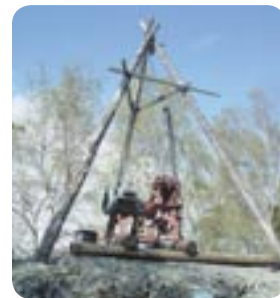


Station Guide to the Frame Lake Trail

Remember to refer to the geological map frequently and as you proceed along the trail you may begin to recognize familiar rock types. This guide highlights some of the interesting geological features in the area.

Station 1

The diamond drill on display is one of the early models used for exploration by Giant Mine - similar drills are used today. The drill brings up a cylindrical core of rock from below the surface and geologists examine and analyze it for mineral content, including gold.



Station 2



Behind the playground equipment at Somba K'e Park, formerly Petitot Park, the volcanic rocks preserve glacial scours (scrape marks) and striae (scored lines). Geologists use these features to determine the direction the glaciers travelled. In this case, the glacier ice was moving roughly southwestward.

As the glaciers receded they also rounded, smoothed and sometimes even polished the rocks as a result of moving back and forth over them. You will see both glacial effects along the trail.



Station 3



Wander out to the right of the trail onto the point of land that juts out into Frame Lake.



Look across Frame Lake to the island and you will see a white quartz vein. This suggests that the quartz fluid came into the rock as a crack was opening up.



Station 4

The depression that forms McNiven Beach is present because the area is underlain by the Pud Fault. This fault has moved the rocks on one side by over 400 metres relative to the other side. If you examine the geology map you will notice that the rocks do not connect across this fault line.

After the glaciers retreated, most of the western Northwest Territories was covered by a huge lake called Glacial Lake McConnell. When the lake receded fine sand was left in low lying areas, like McNiven Beach and the sand pits near the airport.



When you reach the Ruth Inch Memorial Pool, on your left past the playground and mini-golf, look to your right across Frame Lake towards the pink hills near the hospital. Notice that the rock at the base of the hill is dark green, whereas the rocks of the hill above are definitely pink in colour. This is a geological contact (the surface between two different rock types).



Station 5



After crossing the small wooden foot bridge the trail winds up a small incline. At the top of the rise, observe the pink granite veins crosscutting the dark volcanic rocks on both sides of the trail. Try to follow these and imagine the magma squeezing into these cracks.

The next wooden bridge is over a depression geologists call the Kam Fault. This fault extends south along the east shore of Kam Lake (just outside the city centre). Comparable to the famous San Andreas Fault in California, the Kam Lake Fault is no longer active.



Station 6

At the top of the next hill you will see a lamp post on the left and an orange topped trail marker on the rocks to the right. Much of the trail is now over rocks so look for the trail markers and prospector symbols to help guide you.

Climb the rocks to the bench at the lookout point near the hospital. Notice the pink granite, granite dykes, quartz veins, pegmatites (coarse-grained rock), and shear zones (similar to faults but involving a wider zone of movement and deformation). Look in front of the bench and you will see that the pegmatite is made up of very coarse grains of quartz and pink feldspar.



The large white "X" painted on the rock and the marker cemented into the centre of the rock is a Canada Lands Survey station marker. Surveyors link this to other similar points that provide a ground location for topographical maps and surveying activities.

Walk down to the shoreline and straddle this contact - put one foot on the pink granodiorite and the other foot on the dark grey volcanic rock: you are straddling 100 million years of geologic history. Imagine the hot granodiorite magma intruding into the cooler volcanic rocks.

Station 7

As you continue over the pink granite hills the rock type becomes whiter/greyer in colour. White granite has more white feldspar and pink granite has more pink feldspar. Look for the fine-grained white dykes and the rusty spots that result from iron in the rock. Notice that the transition between pink and white granites is a gradational rather than a sharp change.



Station 8

Closest to Old Airport Road, granite hills lie off to the right towards the lake. The granite is pink and very coarse-grained and you can see the white-grey mineral quartz, pink feldspar and amphibole (dark) minerals.



Don't be fooled by the lichen that covers most of the rock in this area.

Lichen is a combination of fungus and algae, and various types occur here: a flat/smooth black lichen, flat/smooth grey lichen, a black leafy lichen, and a pale green leafy lichen. Although lichen can sometimes make rock identification difficult, it is a vital part of the food chain in northern ecosystems.

Station 9



When you reach this post (close to the wooden bridge), you will see lots of pink granite dykes and white quartz veins in coarse-grained gabbro (a coarse-grained, greenish-gray plutonic

rock). Crosscutting relationships between different rock types can be used to determine which rock formed first. Here the gabbro formed first, followed by intrusion of the granite, followed by intrusion of the quartz veins which crosscut both the granite and the gabbro.

Station 10



Before stepping on the bridge look very carefully at the rocks. This rock is called a breccia (a rock that consists of fragments of one or more older rock types).

This rock is made up of lots of light green fragments surrounded by a darker green, fine-grained material (matrix). It has formed as a result of explosive volcanic activity. In this case, the light green fragments consist of a volcanic rock known as dacite (fine-grained quartz and feldspar) so the rock is called a dacite breccia.



Just before the next little wooden foot bridge there are a few bands of quartz. These are called tension gashes and formed as the dacite split open allowing the quartz fluid to fill in the cracks.

Station 11

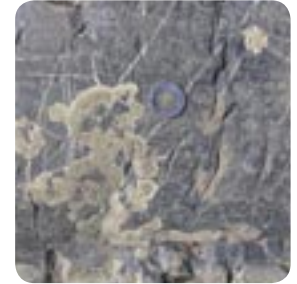
Look around the trail signs and benches and identify the pale tan coloured dacite. Here the dacite is not broken up or brecciated but forms pillows that have large gas bubbles infilled with white quartz and calcite. The green rounded patches up to 30 cm in diameter largely consist of epidote, a pistachio-coloured mineral that is common in low-grade metamorphic rocks.



The dacite is crosscut by an approximately 1 metre wide black gabbro dyke that parallels the trail. As you continue parallel to the dyke you may be aware of a change in rock type. You will begin in a spotted, very coarse-grained gabbro sill and as you go farther along you will cross over the contact into the dacite. The gabbro dyke crosses the spotted gabbro sill and dacite indicating that the gabbro dyke is the most recent (youngest) rock type here.

Station 12

On the hilltop, between the two posts and before reaching the stairs, look for large tan coloured phenocrysts (large crystals) of feldspar up to 3 cm in length within a gabbro dyke.



Station 13



Which rock types look like they do not come from nearby? You will observe some flat red sandstone boulders along with granite, sedimentary rocks and volcanic rocks of different colour. The sandstone

does not represent a local rock type. All of these boulders were transported here by the glaciers. The degree of rounding of a boulder can sometimes help to determine the distance it was transported. The most rounded boulders have been transported the farthest distance.

Station 14

Beneath the large explanatory trail sign called “Waterlords,” look for pillowed basaltic volcanic rock forms. These are rounded blobs with lighter edges which were once the outer edges of lava tubes that cooled quickly in the sea and formed a crust around the interior molten lava that crystallized and cooled to form the rounded, pillow shapes. The pillows have small round white spots in them. These are preserved gas bubbles called vesicles that been infilled with quartz and calcite.



Station 15



This outcrop lies to your left between the Legislative Assembly and the ‘Place of the People’ (an elevated pyramid-like structure). A 5 cm wide quartz vein cuts through the surrounding grey dacite. Notice that the vein is segmented with small cracks,

or faults, separating individual segments of the same vein. Geologists use this kind of feature to determine the direction and amount of displacement that occurred across a fault.

Station 16

Look closely at the rocks used to construct the walkway to the ‘Place of the People’. These pieces of sandstone and mudstone are sedimentary rocks brought here from the East Arm of Great Slave Lake. Look for the preserved ripple marks in some of these rocks. Wave action formed these marks in the same way that ripples form on modern sandy beaches. This feature tells us that this rock formed under water. The red colour in the rock is due to the presence of hematite, an oxidized iron mineral.



Station 17

We finish our tour at the Miners’ Monument. This is dedicated to all the workers who lost their lives working in the mines of the Northwest Territories. The gold mining industry began in Yellowknife in the late 1930s and to date, close to 15,000,000 ounces of gold have come from the gold mines in this area.

Although Yellowknife's Con and Giant mines are now closed, they played a huge role in shaping the community. And who knows ... maybe there's more gold near our city that hasn't been discovered yet!



Glossary of Selected Terms

Basalt: *A volcanic rock formed by lava that is rich in magnesium and iron. Most of the rocks along the Frame Lake Trail are basalt and are often referred to as greenstones because they tend to have a greenish weathered surface.*

Batholith: *A large mass of plutonic rock having a surface exposure of more than 100 square kilometres. A granodiorite batholith underlies part of the trail area.*

Breccia: *A textural term for rocks containing angular fragments of one or more rock types.*

Contact: *A place or surface where two different types or ages of rock meet.*

Dacite: *A volcanic rock made up of fine-grained quartz and feldspar that is similar in composition to granite.*

Diabase: *A common basic igneous rock usually occurring in dykes or sills.*

Dyke: *A long and relatively thin body of igneous rock that, while in the molten state, cut across the layers of rock into which it has intruded.*

- Fault:** *A crack or fracture in the Earth's crust along which movement has taken place.*
- Gabbro:** *A dark greenish-grey plutonic rock that is coarser-grained because it cooled slowly below the surface of the earth.*
- Geology:** *The science concerned with the study of the Earth's processes including the formation of the rocks and minerals that make up the Earth.*
- Granite:** *A coarse-grained (intrusive) igneous (plutonic) rock consisting of quartz, feldspar and mica. The Frame Lake Trail has lots of both pink and white granite.*
- Granodiorite:** *A type of granite that contains more sodium or calcium-rich feldspar than potassium feldspar. In the Frame Lake area, granodiorite is white to pink and primarily coarse-grained.*
- Igneous** *Rocks that have solidified from a molten material*
- Rock:** *(magma) that originated deep below the surface of the earth where the temperature and pressure are high. If the magma finds a path to the surface, it erupts, cools quickly and solidifies to form a fine-grained volcanic rock. This is like the present-day activity on Hawaii or Iceland. If the magma never reaches the surface, it slowly cools and crystallizes*

deep below and forms a coarse-grained plutonic rock which is later exposed by erosion. Most of the Frame Lake area is underlain by volcanic (green on the map) and plutonic (pink on the map) varieties of igneous rock.

- Metamorphic** *Rocks which have undergone a change in texture*
- Rock:** *or composition as the result of heat and/or pressure. Most of the igneous rocks in the area are metamorphosed (changed).*
- Pegmatite:** *A coarse-grained (most grains are larger than 1 cm) igneous rock, usually irregular in texture and composition and similar to a granite in composition; it usually occurs in dykes or veins. There are many pegmatites along the Ingraham Trail, especially in the Frame Lake South neighbourhood near the hospital.*
- Phenocrysts:** *Large, conspicuous, usually well-formed crystals that occur in a volcanic rock or a dyke.*
- Sedimentary** *Rocks that are created by the erosion of other*
- Rock:** *rocks and deposited by surface processes such as wind, water (lakes, rivers, oceans) and glaciers. Sedimentary rocks form where sediment (eroded particles) accumulates - such as the sand on the bottom of lakes, along shorelines and even in deserts (dunes). As the sediment builds up,*

it is subjected to pressure so it compacts and consolidates to form a sedimentary rock such as sandstone. Other sedimentary rocks include mudstone, salt, coal and limestone (formed from coral reefs).

Sill: *A layer of igneous rock that occurs between, and parallel to, layers of older sedimentary or volcanic rock (similar to a dyke, but generally much larger).*

Tuff: *Rock composed of fine volcanic ash.*

Vein: *A typically thin, sheet-like body that infills a crevice or crack in the rock. A vein can contain one or more mineral types. Quartz veins are common along the Frame Lake Trail.*

Vesicles: *Rounded gas bubbles that are preserved in solidified magma or lava.*

We hope you have enjoyed your walk around the Frame Lake Trail and welcome your comments. For further information on trails, facilities, or general travel, please contact:

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