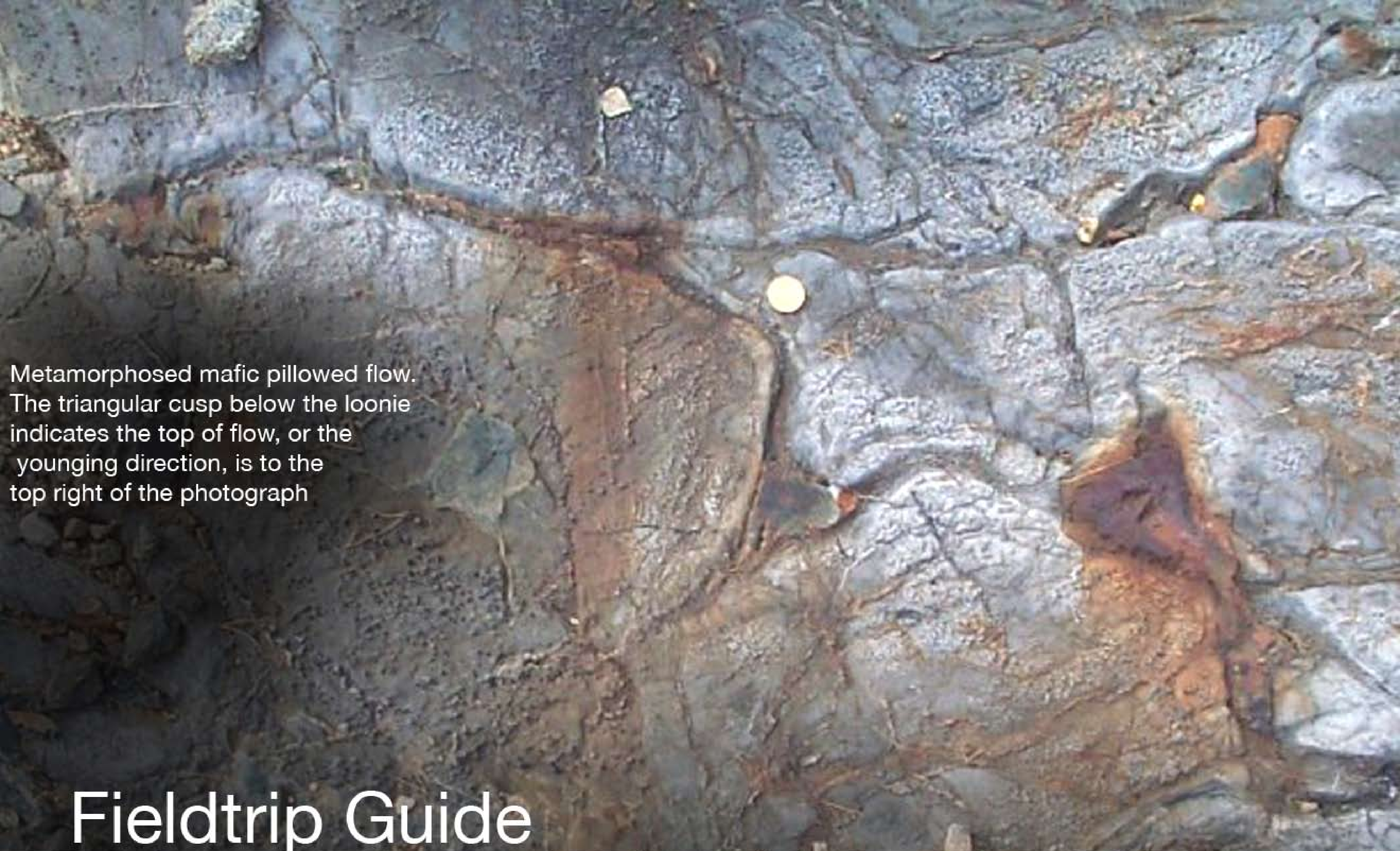

Metamorphosed mafic pillowed flow. The triangular cusp below the loonie indicates the top of flow, or the younging direction, is to the top right of the photograph

Fieldtrip Guide
Geology of the Kenora Area

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Kenora
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Introduction

This field trip is intended to provide High School students and members of the general public with some basic knowledge of the geology in the Kenora area.

In twelve easily accessible stops students can see examples of the most common rock-types in the Kenora area. The outcrops are described in basic terms in the event a geologist is not available to guide the trip. Should questions arise from the field trip individuals may wish to contact the District Geologist's office of the Ontario Geological Survey in Kenora, for additional information or clarification.

The area surrounding Kenora has a long geological history. There are two types of geological features highlighted in this tour. The features are separated by approximately 2.6 billion years. The oldest features are the bedrock geological features and the younger are the Quaternary geological features

The bedrock in this area ranges in age from 2.1 to 3.1 billion years. The main rock types you will see include: granite and gabbro, both igneous intrusive rocks; gneiss, a metamorphic rock; mafic and felsic volcanic rocks; and sedimentary rocks.

Quaternary geology deals with the overburden (unconsolidated materials) such as sand, gravel and boulders, as well as glacial landforms. The last period of glaciation in this area was the Laurentide Ice Sheet. Glaciers started advancing over the area approximately 100,000 years ago and reached thicknesses of approximately 1 kilometre. The ice advanced as far south as central Wisconsin. Glacial ice receded from the Kenora area approximately 10,000 years ago.

The field of geology is exciting and challenging. The development of geological concepts are based on the study of current geologic processes, such as volcanic eruptions, earthquakes and erosion, and the interpretation of rocks formed billions of years ago. The author encourages any students interested in pursuing geology as a field of study to talk to their teacher or Ontario Geological Survey geologist.

THE KENORA AREA

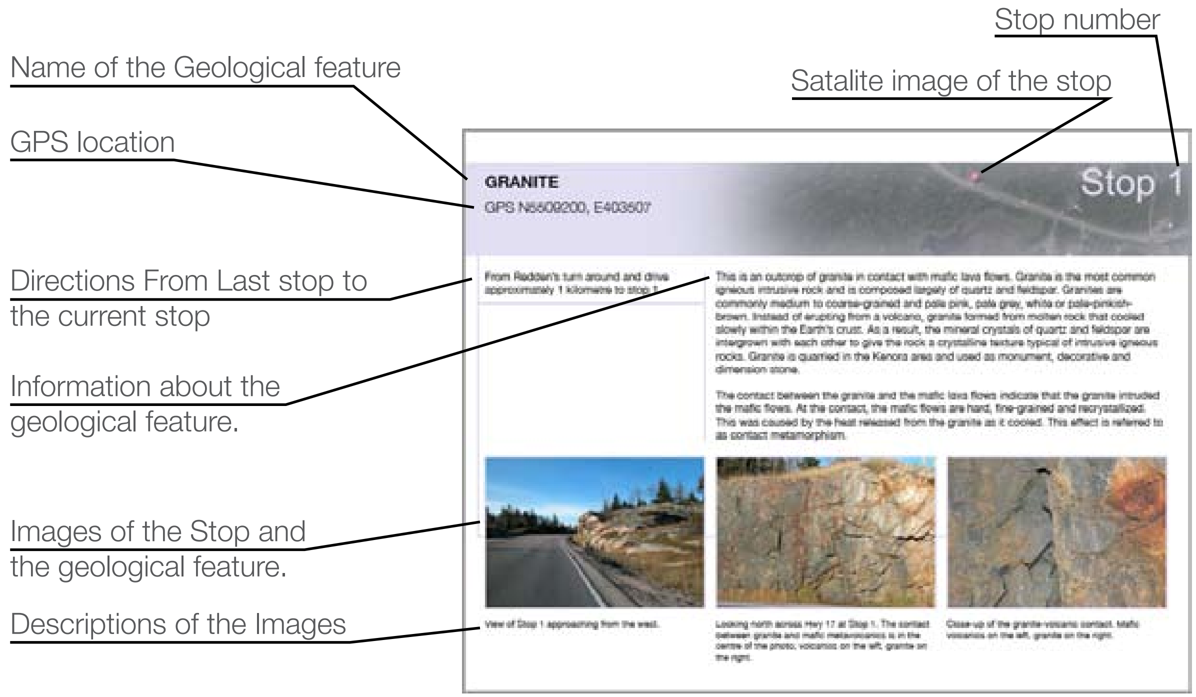
The Kenora area is located within the Lake of the Woods greenstone belt in the Canadian Shield of Ontario. The Lake of the woods greenstone belt is a complex assemblage of volcanic and sedimentary rocks that were deposited in ancient oceans that covered the area between 2.8 and 2.7 billion years ago.

The rocks in the area were subjected to a period of mountain building called the Kenoran Orogeny, which took place between 2.7 and 2.6 billion years ago. During this time the rocks were uplifted, tilted vertically, buckled and folded, fractured and faulted. The volcanic rocks were also intruded by very large bodies of granite known as batholiths. About 20 000 years ago the area was covered by glaciers which scoured and scraped the landscape.

The Lake of the Woods greenstone belt and other greenstone belt areas in the Kenora District are endowed with considerable mineral wealth and have produced commoidities such as gold, silver, copper, nickel, platinum, cobalt, talc and soapstone. These greenstone areas have had a very long history of mineral exploration and mining which began in the late 1800's. Numerous gold occurrences are located throughout Lake of the Woods as well as many old gold mines (Sultana Mine, Kenricia Mine, Mikado Mine, Duport Mine, Wendigo Mine and Regina Mine) that produced during the early 1900's. Dimension and decorative stone is quarried from some large bodies of granite that surround the greenstone belts. Deposits of sand and gravel, left by the glaciers are an important source of aggregate for construction in the area. Peat moss, which grew in lowland areas after the glaciers receded, has been harvested in the Fort Frances area for horticultural purposes.

The various bedrock exposures in this self-guided field trip will demonstrate some of the igneous intrusive and volcanic rocks, metamorphic rocks and sedimentary rock types that can be found in the Kenora District. A few of the field trip stops also demonstrate the effects of glaciation in the local area.

Using this Guide



Departure

Before embarking on this trip remember that many of the field trip stops are located along busy highways and roads. Always park your vehicle as far over on the shoulder of the road as is safetly possible for all highway stops. Please be sure you signal long before you pull-over and take care when making turns. It is recommended you activate your four-way flashers while examining the highway stops. Use extreme caution at all times when crossing roadways.

GPS (Global Positioning System) co-ordinates are provided for all field trip stops. The positions are in UTM co-ordinates, Unit 15, NAD83. The last page of the guide is a map wich shows all the stops and lists there GPS locations.

This tour starts east of Kenora approximately 13.4 kilometres east, of the A&W Restaurant (GPS Location 5513017/393701), at Redden’s Camp and Trailer Resort (GPS Location 5509022/404467).

GRANITE

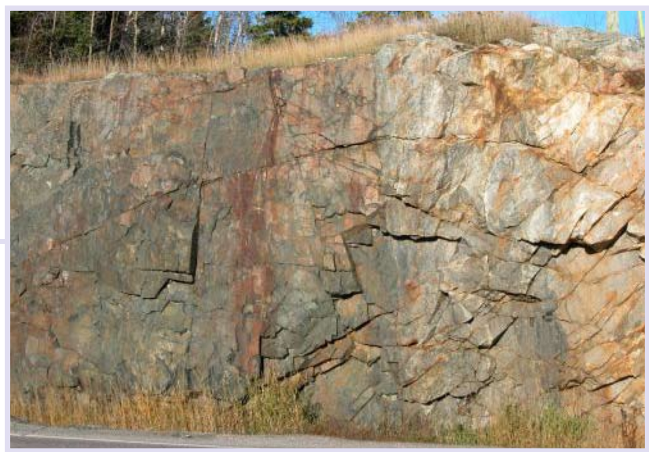
GPS N5509200, E403507

From Redden's turn around and drive approximately 1 kilometre to stop 1

This is an outcrop of granite in contact with mafic lava flows. Granite is the most common igneous intrusive rock and is composed largely of quartz and feldspar. Granites are commonly medium to coarse-grained and pale pink, pale grey, white or pale-pinkish-brown. Instead of erupting from a volcano, granite formed from molten rock that cooled slowly within the Earth's crust. As a result, the mineral crystals of quartz and feldspar are intergrown with each other to give the rock a crystalline texture typical of intrusive igneous rocks. Granite is quarried in the Kenora area and used as monument, decorative and dimension stone.

The contact between the granite and the mafic lava flows indicate that the granite intruded the mafic flows. At the contact, the mafic flows are hard, fine-grained and recrystallized. This was caused by the heat released from the granite as it cooled. This effect is referred to as contact metamorphism.

View of Stop 1 approaching from the west.



Looking north across Hwy 17 at Stop 1. The contact between granite and mafic metavolcanics is in the centre of the photo, volcanics on the left, granite on the right.

Close-up of the granite-volcanic contact. Mafic volcanics on the left, granite on the right.

DIORITE

GPS N5511389, E400721

Continue west on Highway 17 for 4.3 kilometres to Stop 2.

This is an outcrop of massive diorite which, is part of a larger intrusive body called the Island Lake Diorite. The diorite is equigranular and medium-grained, it is primarily composed of sodic-plagioclase feldspar and mafic minerals including hornblende, biotite and or pyroxene.

View of Stop 2 approaching from the west.

Close-up of intrusive diorite. Diorite has a distinctive “salt and pepper” appearance. Dark minerals are hornblende, light minerals are quartz and feldspar.

PILLOW LAVA

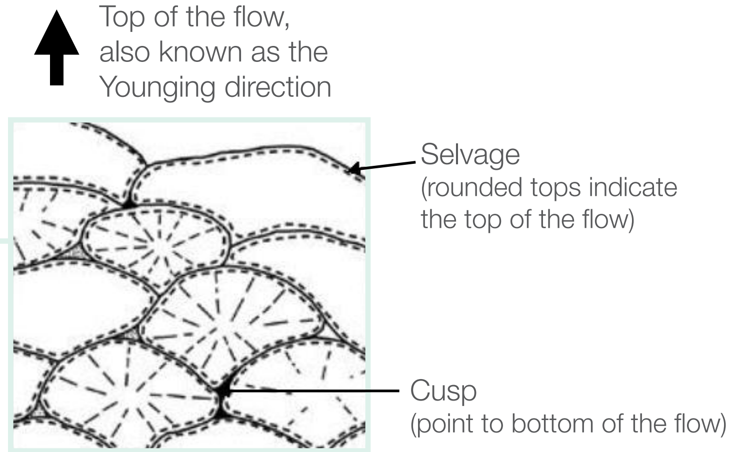
GPS N05512157, E0395690

Continue west on Highway 17 for 5.2 kilometres and turn right onto Whitehead Road. Continue 200 metres up Whitehead Road to Stop 3.

These rocks are mafic, pillowed flows which are iron-rich, dark green rocks that were erupted as molten lava from an underwater volcano during relatively a relatively peaceful eruption. These rocks are very similar to the volcanic rocks that are erupted at Hawaii and Iceland today.

The “pillows” appear as close-fitting, irregular shapes with dark green or black rims. The pillows are formed as mafic lava is extruded underwater. The lava forms large tubes and irregular masses and lumps. The surfaces of these lumps cool instantly into glass which forms the dark rims around the pillows. The pillows have solid glassy rims but are semi-molten in the middle, therefore, the pillows ontop of a lava flow sag over the pillows at the bottom of the lava flow. The pillows are coarser-grained near their centre and commonly contain gas bubbles or “vesicles” along their rims.

View of Stop 3, pillowed mafic lavas from the side of the road.



Stop 4

GLACIAL STRIATIONS

GPS N05513419, E403507

Return to Highway 17 turn right and travel 1.3 kilometres, turn right onto Transmitter Road. Travel 0.9 kilometres down Transmitter Road to Stop 4.

This outcrop is an exposure of glacially sculpted bedrock. The smooth surface of the outcrop contains long scrapes called glacial striations. They were formed by boulders scraping against the bare outcrop at the base of a flowing glacier. At this location the glacier traveled from the northeast to the southwest. The striations indicated the direction of movement.

View of Stop 4 approaching from the south.

Glacially smoothed outcrop displaying striations. Striations are the linear scrapes on the outcrop surface from the lower left to upper right.

Stop 5

GABBRO

GPS N5513881, E395631

Continue on Transmitter Road for 800 m to the intersection with Gould Road. Turn left onto Gould Road and drive 800m to the old railway rock cuts.

This rock is called gabbro. In chemical composition it is the intrusive equivalent to the pillowed volcanic flows we have seen at stops 4 and 5. The difference is that this gabbro was not extruded on surface by volcanic processes, but cooled below the surface of the earth where it developed this coarse grained texture. Rusty patches on the outcrop indicate the presence of sulphide minerals such as pyrite, pyrrhotite and chalcopyrite. Some gabbros are known to host copper, nickel, platinum and gold mineralization.

SANDSTONE

GPS N5514617, E395662

Stop 6

Continue west on Gould Drive to the intersection with Railway Street. Turn right onto Railway Street and continue for approximately 1.5 km to the railway crossing. Cross the tracks and immediately park on the right hand side of the road next to the large outcrop adjacent to the tracks.

This outcrop is an exposure of sandstone which is a sedimentary rock. Sandstone was formed by the erosion of other pre-existing rocks by weathering, wind and water. The eroded material was deposited as loose sand in a body of water and was later cemented into rock. Close inspection of the sandstone demonstrates that it is largely composed of rounded, weathered grains of quartz and other mineral fragments that were cemented together. Also note the layering or "bedding" in the sandstone. This bedding represents layers of sand that were deposited on top of each other. Closer to the railway tracks, adjacent to the wire fence, you may be able to see small dark "strips" 1-2 centimetres in length, these are mud chips or rip-ups. These would have been picked up by the water flowing over dried up ponds or accumulations of mud.

View of Stop 6 approaching from the south

Close-up of well-bedded sandstones.

Close-up of mudchips contained within medium grained sandstone. Arrows point to mudchips.

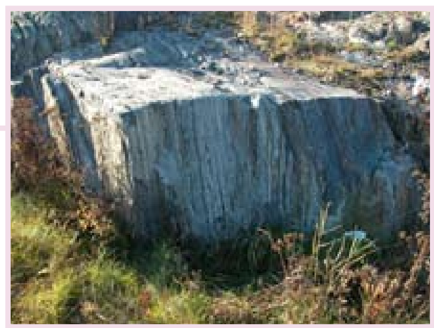
SHEARED PILLOW LAVA

GPS N05515405, E0396195

You are now on Airport Road. Continue on Airport Road and drive 1.0 kilometre (Round Lake will be on your right hand side). The outcrop of interest is at the intersection of Airport Road and Valley Drive. Park on the right side of the road. Using caution for traffic, cross the road to the low outcrop on the west side of Airport Road.

The outcrop is composed of mafic pillow lava as in field trip stop 2, however, the pillow lava in this outcrop is intensely deformed. The rocks have been compressed and flattened so that the round shapes of the pillows now appear as long, stretched-out ribbons. The dark green bands in the rock are the pillow selvages (See Figure 6). The rock has also been sheared into variable thicknesses of sliced, sheared and schistose rock. Sheared rock will break into thin slabs and loose pieces when struck with a hammer. This type of deformation is caused by movement along a fault. The Kenora Fault passes just to the south of this location and is indicated by a low swampy area. These rocks have also been intruded by felsic dikes which are lighter in colour. These dikes have a high silica content and are much harder than the rocks they intruded. The fact that these dikes cut across the pillowed lavas indicates that they are younger.

View of Stop 7 approaching from the south.



Outcrop of sheared pillowed mafic flows. The dark streaks are the stretched pillow slevages.

Close-up of sheared and broken pillow selvages.

GNEISS

GPS N5515614, E395614

Make an immediate left turn onto Valley Drive, drive for approximately 1.0 km. Park just past the intersection with Rabbit Lake Road. Cautiously cross the road to the rounded outcrop on the south side of the road.

This is an outcrop of gneiss, which is a medium-grained, highly metamorphosed rock that is colour banded and composed of light and dark layers of minerals. All of the light-coloured granular bands are composed of minerals such as quartz and feldspar. The dark-coloured bands are composed of schistose, linear or platy minerals, such as biotite, mica, amphibole and pyroxene. The coloured mineral layering in a gneiss is commonly wavy and discontinuous. This characteristic layering defines a coarse foliation, which is known as a gneissosity.

KEEWATIN POTHOLES & GLACIAL STRIATIONS

GPS N5512671, E387579

Continue along Valley Drive. When confronted with a "Y" intersection, take the left branch (look for the low concrete retaining wall).

At the Loaf n'Jug Convenience Store turn right onto Ninth Street North. Pass the Kenora Cemetery on the right and the Abitibi Consolidated paper mill on the left. At the four-way intersection, turn left onto Veterans Drive proceed to the underpass leading to the Harbourfront. Turn right at the lights and proceed to Keewatin on Highway 17. Turn left on Fifth Street, look for the sign pointing to the Keewatin Potholes! Drive to the top of the hill to the small parking area by the potholes.

These round, cylindrical holes in the outcrop appear to be man-made but they were formed by the action of running water during glaciation. Though the sign says they are "rockholes", the proper geological term is potholes. These holes are thought to have formed from water-spun rock fragments that have slowly eroded holes in the bedrock. Potholes occur throughout the Kenora-Keewatin area and may be as large as 2 or 3 m deep and 2 m in diameter.

A small outcrop at the entrance to the boardwalk displays glacial striations. The rocks in this outcrop have been polished and scratched by the movement of a glacier. The long grooves and scratches on the outcrop surface are glacial striations. These were formed by fragments of rock, embedded in the ice at the base of the glacier, which scratched and gouged the outcrop surface as the ice moved over the land.

Close-up of sheared and broken pillow selvages.

Close-up of glacial pot-hole.

DIABASE DIKE

GPS N5512916, E387340

Return to Highway 17, turn left and drive to McDiarmid Lumber. Turn into the parking lot and park on the far right side a short distance from the highway. A series of low outcrops may be observed east from the parking lot.

This outcrop represents the last intrusive activity, 2.12 billion years ago, in the Kenora area. This is one of many diabase dikes in the area which, are called the Kenora-Fort Frances dike swarm. All these dikes are northwest-oriented and some can be traced for hundred's of kilometres. Diabase is a medium-grained intrusive igneous rock composed of calcic-plagioclase and pyroxene with minor magnetite and sometimes olivine.

As you walk from the parking lot the first rock unit to be observed is a felsic metavolcanic, probably an ash to lapilli tuff. The contact with the diabase is sharp and at one spot a quartz vein can be seen to have been cut-off by the dike. If you continue to the other side of the dike the tuffs can be seen again and the quartz vein continues. This is a perfect example of how cross-cutting relationships can help in determining the geological history of an area. The felsic tuffs would have been deposited. Once they were consolidated they would have been intruded by quartz veins developed in fractures caused by deformation. Much later the diabase dikes would have followed fractures developed in the pre-existing rocks.

View of Stop 10 location. Walk east to series of low outcrops.

View of felsic volcanic-diabase contact. Marker indicates the actual contact. Diabase is on the left and felsic volcanic on the right.

CONGLOMERATE

GPS N5509200, E403507

Return to Highway 17, turn left and return to downtown Kenora. At the main intersection by the Kenricia Hotel, Main Street and Second Street South, turn left. Travel past the Shell Gas station and pull into the parking lot of Brown's Funeral Home. By the back door of the Presbyterian Church a small outcrop of conglomerate may be observed.

This outcrop provides a small two-dimensional view of a conglomerate. This unit has been interpreted to have been deposited in a fluvial (river or stream) environment. The cobbles (boulders) would have been moved down stream in the main channel with sand being deposited between the cobbles. The river or stream would have collected material from all the rock-types it flowed over. If you look at the cobbles you will notice that they are of a wide range of composition. The conglomerate in this area has been subjected to deformation as evidenced by the shape of the various cobbles. Look closely at the cobbles and you will notice that many have been flattened and stretched out while others are still quite rounded and recognizable as cobbles. The difference is the composition of the cobbles. Rock-types like mafic volcanics and sediments are softer and affected by deformation more easily than harder rock types like rhyolite, chert or granite.

View of Stop 11 outcrop. Note the different rock-types represented within the conglomerate.

Close-up of conglomerate cobbles. Rounded cobbles indicated a greater hardness. Softer rock-types are more flattened and stretched

AGGLOMERATE

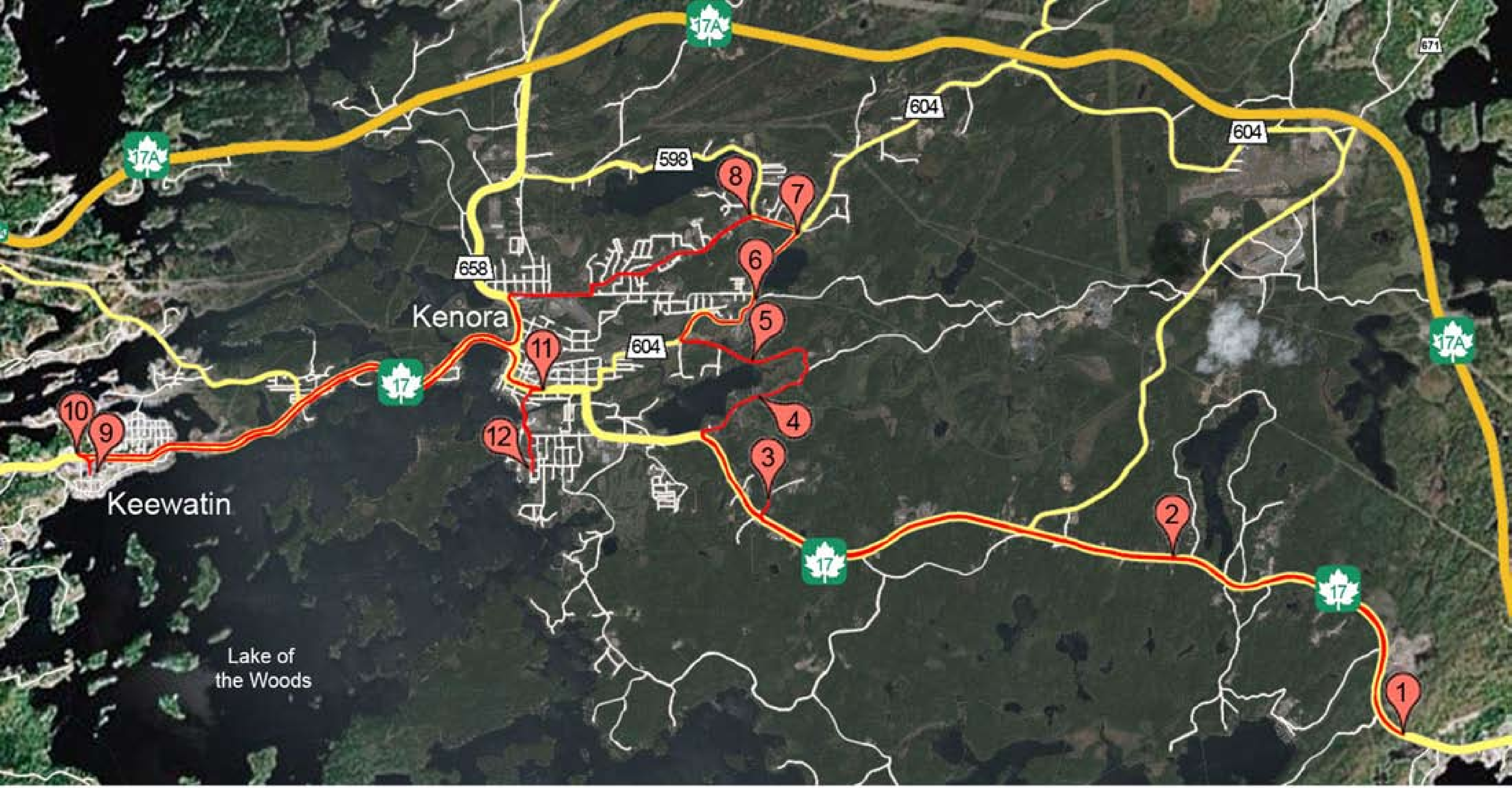
GPS N5509200, E403507

Make your way to the Lakeside Inn and Convention Centre. Continue along First Avenue South past the hotel. Continue through the intersection with Seventh Street South and down the hill. You will see an outcrop at the side of the road at the back of the Government of Ontario complex, opposite a boat launching area.

This outcrop at the back of the Ministry parking lot represents a period of explosive volcanic activity. The rock-type present is a mafic to intermediate agglomerate. Agglomerate is a consolidated pyroclastic deposit composed of volcanic bombs and subangular fragments in a tuff matrix. All the fragments are composed of the same material. This rock was formed close to a volcanic vent and was a result of a violent explosive eruption.

View of Stop 12 at the back of the Government of Ontario complex.

View of agglomerate. Note different size of fragments.



Stop 1: Granite - Highway 17
GPS: N5509200, E403507

Stop 2: Diorite - Highway 17
GPS: N5511389, E400721

Stop 3: Pillow Lava - Whitehead Road
GPS: 05512157N, 0395788E

Stop 4: Glacial striations - Trasmitter Road
GPS: 05513419N, 0395690E

Stop 5: Gabbro - Gould Road
GPS: N5513881, E395631

Stop 6: Sandstone - Railway Street
GPS: N5514617, E395662

Stop 7: Sheared Pillow Lava - Airport Road
GPS: 05515405N, 0396195E

Stop 8: Gneiss -Valley Drive
GPS: N5515614, E395614

Stop 9: Keewatin Potholes & Glacial Striations
5th Street - GPS: N5512671, E387579

Stop 10: Diabase Dike - Parking lot off Highway 17
GPS: N5512916, E387340

Stop 11: Conglomerate - Brown's Funeral Home
GPS: N5513574, E393045

Stop 12: Agglomerate - 1st Ave. South
GPS: N5512621, E392747