Geologic Walking Tour of the McKenzie Conservation Area

The McKenzie Conservation Area consists of over 421 acres of lushly forested, diverse terrain. The McKenzie area is indeed excellent habitat for a variety of plants, birds and animals, but it also has a wonderful array of interesting and diverse geology. This self-guided walking tour, which is approximately 2 miles long, highlights some of the many geologic features found at the McKenzie area. Throughout this guide, there will be questions for the various stops. An answer key for the site questions is provided at the end of guide.

Basic Geology

The bedrock geology at the McKenzie Conservation Area consists of one rock formation, the Newman Lake Gneiss. The Newman Lake Gneiss (pronounced "*nice"*) was originally an igneous granite, but was metamorphosed from extreme pressure (and heat) approximately 50 to 70 million years ago.

The topography here at McKenzie is quite diverse, ranging from ravines and wetlands, to knolls and ridges. While hiking here, note how the vegetation changes with the topography. The McKenzie property also hosts several seasonal streams along with rare ice-rafted erratic boulders, evidence of the ancient glacial ice age. Enjoy your tour of this diverse and fascinating place!

Walking Tour

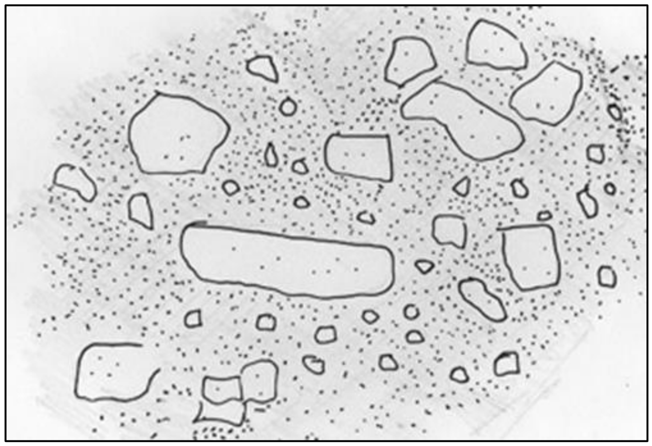
The tour leaves the trailhead at the parking area and follows the main road/trail system in a clockwise direction. Refer to the trail map on the back page with the associated site numbers. The tour is approximately 2 miles long and will take 1 to 1.5 hours to complete.

Site 1 – Groundwater Seep

Very soon after departing the parking area, at the first slight bend, look to the right of the road and notice the bank with many alder trees. Here, during the spring, are abundant horsetails (*Equisetum),* False Hellebore (*Veratrum viride*), and other moisture-loving plants. This is a groundwater seep (spring) and, during wet years, a very small flowing stream develops next to the road. **Question**: turn around and look directly across the trail away from the bank. What large, moisture-loving conifer do you see growing here?

Site 2 – Newman Lake Gneiss

Continue down the road (.1 mile from the trailhead) to the sharp bend to the right. Stop here and look at the partially exposed rock outcropping next to the road and along the bank. Here is the Newman Lake Gneiss. Look closely and note the "salt and pepper" appearance of light and dark minerals. The light minerals are quartz and feldspar, and the dark minerals are biotite mica. Also note the large, blocky, white crystals throughout the rock. These large crystals are the mineral K-spar (potassium feldspar) and are a key distinguishing feature of the Newman Lake Gneiss. **Question**: although the Newman Lake Gneiss is a metamorphic rock, what common igneous rock type does it look like?



Large blocky crystals (megacrysts) of the mineral potassium feldspar

Site 3 – Seasonal Stream & Wetland

Continue down the road for .2 of a mile. As the road begins to level out, you will notice increasingly larger trees. To the left you will begin to see a flat, open, grassy meadow. The large trees include western red cedar, Douglas fir, grand fir, and black cottonwood. Look closely to your right for a metal stake next to the road; this marks where a small seasonal stream flows out of the thick forest and ravine and flows under the road. A seasonal stream is one that flows only during a few months of the year and this stream typically flows from March through June. If you are visiting during the other months, you will likely see no water flowing. To your left, note that the stream flows out into the meadow, which is a wetland, an area of saturated ground, which may have standing water during some months of the year. Just across the road toward the wetland you will see stunning old-growth black cottonwood trees with their distinctive, deep grey furrowed bark. Along the edges of the wetland, other water-loving trees such as cedar and aspen thrive. If you visit in the early morning, you may get lucky and see deer or moose feeding along the edges. **Question**: why does this stream only have water in it during the late winter and spring?

Site 4 – Foliated Gneiss

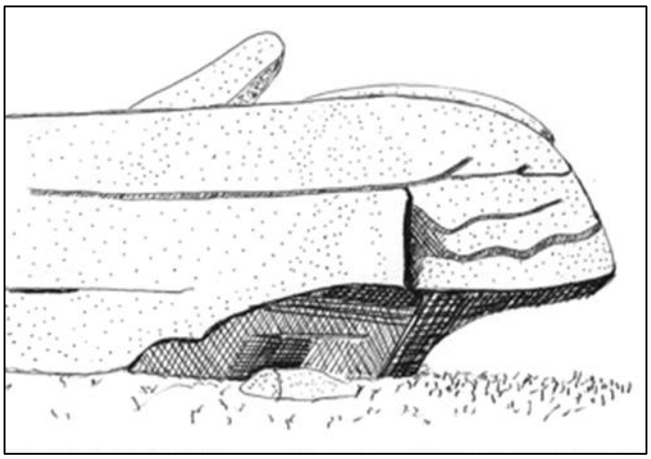
Follow the road through the forest until you begin to break out into the open. Notice that there will be a hillside on your right, and to your left the wetland area has become quite extensive. At .3 of a mile you will pass an old road on your left; continue on the main road for another .05 mile to a small outcrop on your right. **Question**: by looking closely at this rock, what do you see that tells you that this is Newman Lake Gneiss?

Now look closely for the metamorphic rock texture of foliation. Foliation is defined as *the parallel alignment of mineral crystals*, and this texture will be seen as aligned crystals that form a faint "planar" pattern. The foliation is an indication that the rock has undergone high pressure metamorphism. During metamorphism, the crystals of the original parent rock (granite) begin to reform in a preferred, perpendicular orientation to the pressure. Note that the foliation is not horizontal, but it is slightly tilted, and that the rock sometimes breaks along this planar surface. **Question**: how do you know that this rock is a metamorphic rock?

Site 5 – Turtle Rock

Follow the road (.2 of a mile) all the way down to the lake past the boathouse and native plant garden on your left. Here you will find Turtle Rock, named for its obvious shape. Notice the very large old-growth Douglas fir tree growing on the back side of Turtle Rock. Walk around to the side of Turtle Rock that faces the lake. Look closely at the rock surface and you will see large, milky white crystals of K-spar and foliation. Here, again, we see the Newman Lake Gneiss. **<u>Question</u>**: describe the size and shape of the K-spar crystals.

Note that foliation pattern again is not horizontal, but slightly tilted, and that there are numerous fractures that are parallel with the foliation. In fact, the fractures follow the foliation because the foliation defines weaker zones in the rock that crack more easily. Now, examine the way Turtle Rock has been slightly "hollowed out" at the base on the side facing the lake. Think about all that you have learned so far about foliation and fractures in the gneiss at Turtle Rock; now turn around and look out at beautiful Newman Lake. **<u>Question</u>**: what could have caused this unusual "hollowed out" pattern? Think about the process of erosion. Again, look out at beautiful Newman Lake and examine the bank along the lakeshore.



Turtle Rock with wave eroded undercut

<u>Site 6 – Mylonite!</u>

Go back to the main trail and continue westerly (go left) for a short distance (less than .1 mile). Look for small outcrops along the bank to the right of the road. Go to the small but prominent outcrop directly next to the road. Here you will see a unique occurrence of Newman Lake Gneiss, what geologists call mylonite. Mylonite is a special texture that develops when a rock has been affected by shearing stress, due to faulting. When rocks undergo high shearing stress, the original minerals get ground down or pulverized into smaller and smaller pieces. Look closely and you will see that the rock is foliated, but doesn't have large K-spar crystals. In fact, the crystals overall in this outcrop are much smaller than what we have seen previously. So, you are looking at evidence of a deep-level shear zone that was later uplifted to the surface to where it is exposed today. **<u>Question</u>**: what could cause the high shearing stress and mylonite to form?

<u>Site 7 – Rounded Outcrops</u>

Continue to the trail intersection on the right (at the big turn) that begins to climb up the ridge. Turn right here. Note that in less than .1 mile after starting up the ridge you will see rounded, boulder-like masses and outcrops. What caused these rounded shapes? River erosion? Glacier erosion?

Get up close and look at the boulders and you will notice that they are composed of Newman Lake Gneiss. So, they are local and were not transported any significant distance. Continue up the ridge looking at more of these rounded masses. Eventually you will come to a rocky outcrop area and you will notice that the outcrops have very rounded edges similar to the boulders below, and they are composed of Newman Lake Gneiss. This is good evidence that the rocks have not been moved, but are in-place. **Question**: why are the rocks and outcrops so rounded in appearance?

Spheroidal weathering of large boulder

This is the result of spheroidal weathering. Blocky outcrops exposed to rain and chemicals, weather (breakdown) more rapidly along corner intersections than on flat surfaces due to greater surface area exposure. Over time, the corners weather faster and the blocky edges become progressively rounded. This is a chemical weathering process that is not related to erosion. So, all the rounded boulders and outcrops actually weathered in-place and were not transported by streams or glaciers. You will see the spheroidal weathering of rocks all the way up the ridge! **Question**: what is the difference between weathering and erosion?

Site 8 – Elevation

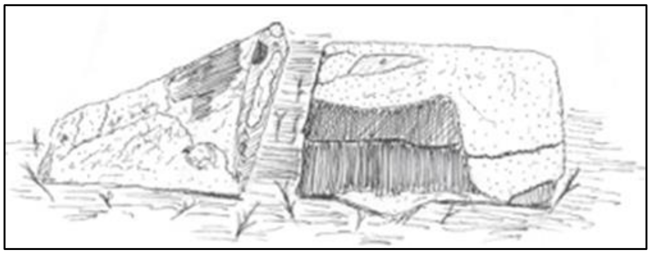
Continue up the ridge trail (.3 mile from the bottom) until you get to the top of hill; stop at the very top. Here is the highest elevational point in the park. You are now standing at approximately 2450 feet above sea level. The elevation at Turtle Rock is approximately 2170 feet in elevation. How much elevation have you gained since Turtle Rock? **Question**: what is elevation?

Elevation is the height or vertical distance of Earth's surface, measured in feet above sea level. Sea level is the base elevation and equals zero. So, as Earth's surface gets higher and higher, the elevation increases. As you are well aware, you have been climbing up the ridge, therefore increasing in elevation. Geologists that study landforms (geomorphologists) are constantly measuring elevation in order to quantify changes in the land surface to accurately describe and define changes in the topography. So, elevation is a key concept when understanding land surface patterns or topography. It's all downhill from here!

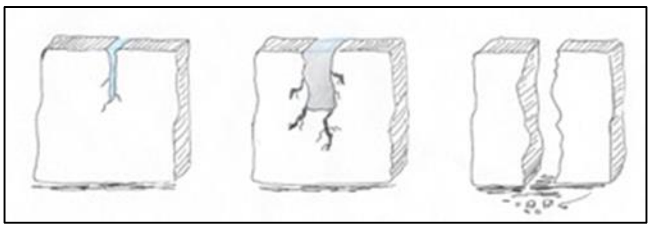
Site 9 – Ice-Rafted Erratic

You will drop slightly in elevation; continue on the trail. At approximately .35 miles from Site 8 you will meet a side trail to your right; stay on the main trail and continue straight for .1 mile to the top of a small hill. Look to the right (behind some small trees) for a dark, moss-covered boulder that has been split in two. This is Site 9.

You are looking at an ice-rafted erratic boulder. Erratics are rocks that have been transported by glaciers a significant distance from where they were eroded. Erratics are composed of a different kind of rock than the surrounding bedrock; hence they are erratic to their surroundings. Look closely at this boulder and you will see that it is not composed of Newman Lake Gneiss. It is darker in color, has much smaller crystals, and is not foliated. This rock type is what geologists call diorite. It is totally unlike the surrounding bedrock here at the McKenzie property, so it has been transported from wherever it was initially eroded.



Ice-rafted boulder, fractured by ***freeze-thaw ice wedging***.



Ice wedging results in the fracturing of solid rock as water gets into cracks and undergoes repeated "***freeze-thaw***". Freezing water expands and enlarges cracks into fractures. Ice wedging is a physical weathering process.

Geologists that have studied the glacial history of this area tell us that the ice-age glaciers did not come this far south. So, no glaciers covered this area during the last ice age. How could this "erratic" have gotten here? During the last ice age (Pleistocene ice age), a large glacial lobe dammed the Clark Fork River (near Sandpoint, ID) and formed famous Lake Missoula. Lake Missoula was very large and contained a lot of water. When that ice dam occasionally collapsed, huge floods of water from Lake Missoula, would rush through the Spokane Valley. Icebergs from the ice dam would flow with the flood waters, and embedded within the icebergs, were boulders of rock from northern Idaho and western Montana. As the icebergs melted, the boulders would drop out and be left behind. The floating icebergs acted as "rafts" for the rock debris embedded within them. So, the boulder you see here was an ice-rafted erratic deposited during the great Missoula Floods at the end of the last ice age approximately 15,000 to 20,000 years ago. The massive floodwaters continued west past Spokane into the central part of the state, ripping and eroding the landscape. The spectacular "Channeled Scablands" of eastern and central Washington are testimony of these great floods of the glacial past.

This ends our self-guided tour. As you continue on the trail back to the parking area, you will descend into a very lush conifer forest. Enjoy your walk through the beautiful Douglas fir, grand fir, cedar, and hemlock forest. Here the soils are quite wet supporting a variety of moisture-loving trees. We hope that you have enjoyed your time here at the McKenzie Conservation Area and have a newfound interest and appreciation for the diversity of geology, landscape, and vegetation of this wonderful preserve.

This walking tour was created by Andy Buddington and the drawings were done by Dillon Smith of Spokane Community College. For more information on the area, go to the Spokane County Conservation Futures Research site at: http://www.spokanecounty.org/parks/content.aspx?c=3124

ANSWER KEY to the site questions

Site 1: What large, moisture-loving conifer do you see growing here?

Western red cedar is the large, moisture-loving conifer tree. Conifers are needle-leaved (or scale-leaved), cone-bearing evergreen trees. Cedars are scale-leaved conifers often found in wet areas such as stream bottoms or along the edges of wetlands. Look closely at the characteristic flat, scale-like needles and also the thin, vertical bark.

Site 2: Although the Newman Lake Gneiss is a metamorphic rock, what common igneous rock type does it look like?

Granite. The Newman Lake Gneiss looks very similar to the igneous rock type granite. It is hard, has large crystals and a "salt and pepper" like appearance or color. Granite forms from the slow cooling of magma, deep underground. The Newman Lake Gneiss was once a granite and was later metamorphosed into gneiss, but it retains many of its original characteristics.

Site 3: Why does this stream only have water in it during the late winter and spring?

Seasonal streams do not flow year round but rather flow during the times of the year when there is significant rainfall and/or snowmelt. In general for the Inland Northwest, the wettest months of the year are late winter and spring when there is consistent rainfall and snowmelt. During these wet months, the local groundwater table rises and supplies water to small seasonal streams like this one.

Site 4: How do you know that this rock is a metamorphic rock?

Foliation. The vast majority of rocks that exhibit foliation are the result of metamorphic pressure, so the fact that this rock has foliation is an indication that it is a metamorphic rock.

Site 5: Describe the size and shape of the K-spar crystals.

The K-spar crystals are quite large and range from about 0.5 to several inches in length, and have a blocky to rectangular shape.

What could have caused this unusual "hollowed out" pattern?

Waves along coastlines can be an important erosional force or process. If Newman Lake was several feet higher as some time in the past, and the prevailing winds were from the south, the wave action could haveeasily eroded out the base of Turtle Rock as we see here. Geologists studying the ancient history of Newman Lake have identified numerous "wave-cut" areas around the lake and use these features as evidence that the lake was once several feet higher than the present level.

Site 6: What could cause the high shearing stress and mylonite to form?

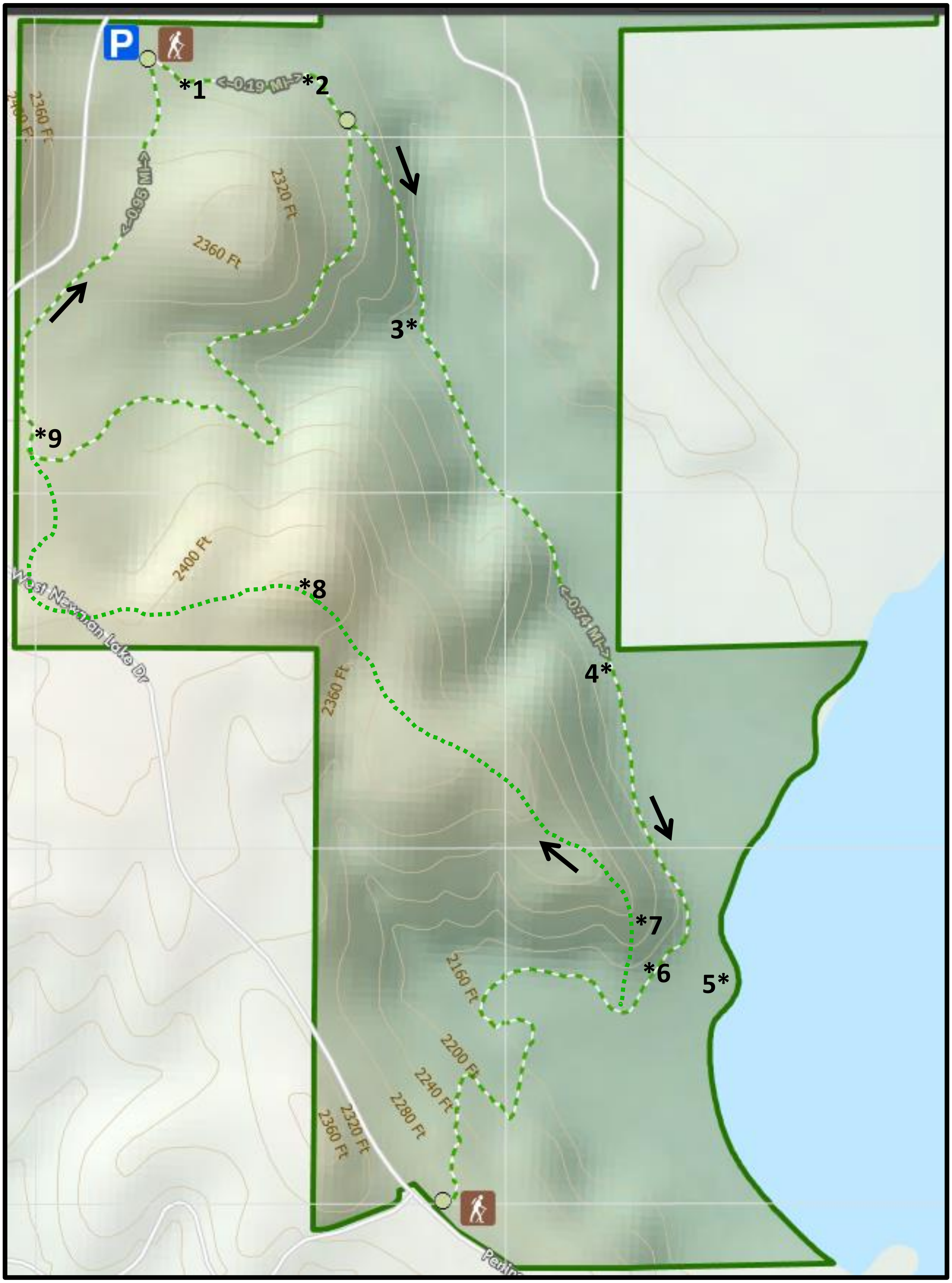
Tectonic stress and a fault deep in the crust is likely the cause for the high shear stress that formed the mylonite. When these rocks were once deeper in the crust, they were subjected to tectonic forces, which ultimately created the mountains you see around our region. The forces caused movement of the crust and in some zones, high stress leading to the formation of mylonite.

Site 7: What is the difference between weathering and erosion?

Weathering is the chemical or mechanical breakdown of rocks and minerals. Water (and dissolved chemicals) can react with rock, slowly breaking down the minerals and rock. Physical weathering such as freeze-thaw causes rocks to physically break or fracture into smaller pieces. Erosion is the physical movement of soil or rock by wind, water, or ice. Weathering and erosion work together; weathering weakens and breaks the rock and erosion moves or carries away the weakened materials, resulting in a variety of distinctive landforms such as canyons or glacial valleys.

Site 8: What is elevation?

Elevation is the height (in feet or meters) above a known reference point. The most commonly used reference point is sea level, which is designated as zero. For example, Mt. Spokane has an elevation of 5883 feet (above sea level). If you look at the trail map provided, you will see “contour lines” which are lines of elevation for the surface at the McKenzie Conservation Area.



Walking Tour Map