# *“Koke-no-kairo Gulley (Moss Corridor)”*

# *~Kaede-sawa~*

Shikotsuko Branch, Natural Parks Foundation Japan

## 1 Background of Koke-no-kairo Gulley (Moss Corridor)

Morappu area and four valleys

"Koke-no-kairo gulley" or "Moss Corridor" is part of a dry valley called "Kaede-sawa". It is located in an area called Morappu, which is on the north face of Mt Tarumae. The pyroclastic flow deposits formed the northern part of the foot of Mt. Tarumae from its eruption in 1739, which piled up nearly 1 meter of pumice fall deposits in downtown Chitose.

There are four dry valleys in this area. Until around the 1960s, climbers used to call the four dry valleys, from East to West, "Morappu Ichi-no-sawa (Morappu 1st valley)", "Morappu Ni-no-sawa (Morappu 2nd valley)", "Ichi-no-sawa (1st valley)," and "Ni-no-sawa (2nd valley)" in that order. Nowadays, they are called, still from east to west, "Ichi-no-sawa (1st valley)", "Ni-no-sawa (2nd valley)", "San-no-sawa (3rd valley)", and "Kaede-sawa". All of them are deep box-shaped gulleys running from north to south. You can reach Mt. Tarumae and Alpine Meadow by climbing up the gulleys.

Among these, a trail from Lake Shikotsu to Mt. Tarumae, called the Morappu route, was already established along "Ichi-no-sawa" in the Taisho era (or the late Meiji Period). Likewise, "Kaede-sawa" was already known as a trail to Mt. Tarumae and Mt. Fuppushi.

Name of "Kaede-sawa"

The people in the forestry industry have had the name "Kaede-sawa" since the 1960s. It corresponded to when the Sapporo regional forestry office constructed the neighboring forest road, "Kohan Douro", as the first automobile road connecting Bihue and Morappu.

In his book "Chitose Place Name Walk" (1976), Osami Gizou describes the original name of "Kaede-sawa" as "yuk-turasi-pinay" in the Ainu language, meaning "dry valley along which deer climb" paired with the "San-no-sawa" as "yuk-rupespe-pinay" (dry valley along which deer descend).

Name of "Koke-no-kairo Gulley (Moss Corridor)"

As for the name "Koke-no-kairo Gulley (Moss Corridor)", it is not clear when it was first called. Although there are no articles found, the writer thinks that the Hokkaido Shimbun (Hokkaido newspaper) first used the name "Moss Corridor" in an article around 2004~2006. In the mid-2010s, it was sometimes called "Green Corridor". After the closure of "Koke-no-domon Gulley (Moss Gorge)" in 2000 due to a collapse, "Kaede-sawa" became known as a scenic area with mosses comparable to those of "Koke-no-domon Gulley", which is also famous for the scenery with mosses.

## 2 Scenery and route of "Kaede-sawa"

Figure 1 shows the trail route of "Kaede-sawa". The entrance of "Kaede-sawa" is located about 800 meters south of the Monbetsu Bridge on National Road 276 (about 1.7 km West of Morappu). "Kaede-sawa" is thought to have been formed by erosion by debris flow after pyroclastic flow deposits cooled down. About 500 meters further south from the entrance, you will find that the valley splits in two, and the first dry waterfall (F1) will appear just upstream of where it breaks. The section between the entrance and F1 is the "First-Kairo of Kaede-sawa".

To proceed upstream of Kaede-sawa, you must detour F1 from "Futa-mata-no-sawa" stream. After detouring, you will enter the "Second-Kairo of Kaede-sawa", about 300 m long, and become very dangerous due to frequent collapses of the gulley wall in recent years.

After climbing about 250m, the second dry waterfall (F2) will appear at the top of the "Second-Kairo of Kaede-sawa". No clear gulley topography can be seen upstream of this point. After climbing 700m from F2, the third dry waterfall (F3) will appear. The "Koke-no-kairo Gulley" is surrounded by a sheer rock wall with a height of 3 to 7 meters in the "First-Kairo " and 5 to 10 meters in the "Second-Kairo". "Koke-no-kairo Gulley" is densely covered with moss, like the "Koke-no-domon Gulley", and the bryophytes covering the entire face of the sheer rock wall create a unique landscape. Although detailed surveys have not been conducted yet, it is thought that about 100 species of mosses inhabit the area.

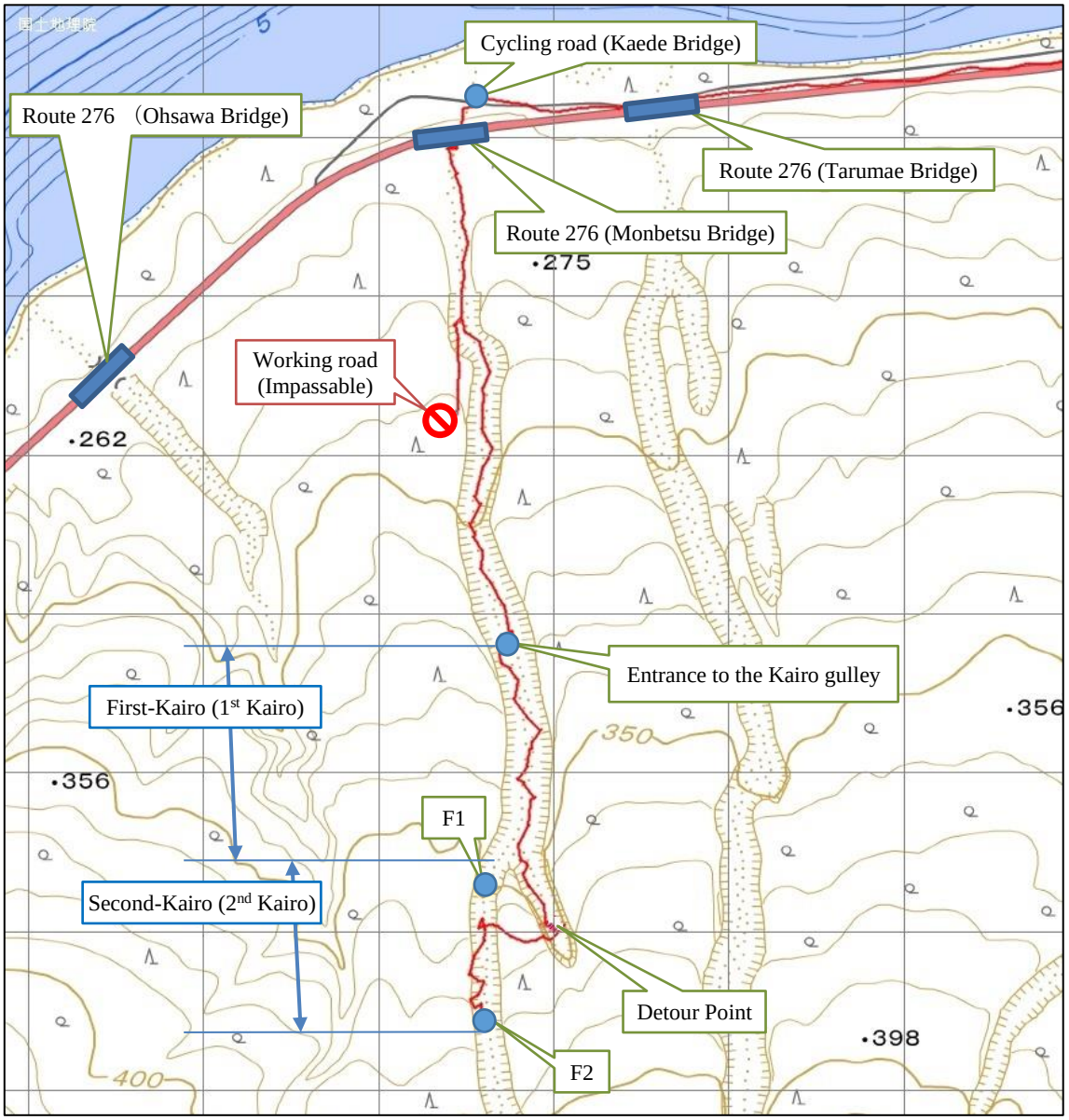



Figure 1 Trail route of Kaede-sawa （Mesh interval: 250m)

*First Kairo (1st Kairo): Entrance of the Kairo gulley ~ F1 (First Waterfall)
*Second Kairo (2nd Kairo): F1 ~ F2 (Second Waterfall)

- Morappu Tarumaesou Parking ~ Kaede Bridge : 1.7km
- Kaede Bridge ~ entrance to the Kairo gulley : Approx. 0.8km
- Entrance to the Kairo gulley ~ F 1 : Approx. 0.5km
- F1 ~ F2 : Approx. 0.3km

■ **Traces of pyroclastic flow**

**Figure 2 Traces of pyroclastic flow**

**Figure 3 Traces of pyroclastic flow (Taken in the Taisho era)**

On the lakeshore in Morappu, there are traces of pyroclastic flows from the 1739 eruption of Mt. Tarumae. Figure 2 shows the pyroclastic flow trace that can be seen today on the lakeshore in front of the Morappu Tarumae-so parking lot, and it was taken in the early Taisho era (1912-1926). The lake's water level was once high, and people used to go sightseeing by boat.

Some estimates suggest that if a large eruption of the same scale as in 1739 were to occur and pyroclastic flows flowed into the lake, a tsunami of 7 to 8 meters high would generate and inundate the hot spring resort area on the other side of the lake.

■ Kaede Bridge and Monbetsu Bridge

**Figure 4 Kaede Bridge (Cycling road)**

**Figure 5 Monbetsu Bridge (Route 276)**

Monbetsu Bridge was built in 1970 at the time of "Kohan Road" and was upgraded to National Road No. 276 in 1970. "Kohan Road" was constructed under Sapporo regional forestry office and was the main road of the "Toyako Shikotsu lake line" in 1965.

Nowadays, "Kohan Road" is utilized as a cycling road, and "Kaede Bridge" was constructed in 1966.

As for the names of both bridges, "Kaede Bridge" uses the name of a stream by the Sapporo regional forestry office. As for Monbetsu Br., a bridge over a national highway usually takes the local name of a stream or river used, but when there is none, it is named by construction workers and others. Also, from Morappu to Bihue, there are Morappu Bridge, Shikotsu Kobashi, Tarumae Br., Monbetsu Br., Ohsawa Br., Himemasu Br., and Nijimasu Br. The names of these bridges are different from the actual place names except for Morappu Bridge.

■ **Walking** Path

**Figure 6 Walking Path**

"Kaede-sawa" does not have a walking trail like most tourist areas, including the "Koke-no-kairo Gulley (Moss Corridor)". Instead, you will follow a sandy step-off path to get to the "Koke-no-kairo Gulley (Moss Corridor)". It is difficult to walk due to fallen trees and rocks of various sizes, and there is a risk of injury. Therefore, wearing shoes with firm footing, such as hiking boots, boots, or sneakers, is necessary when entering the stream.

When the 24-hour rainfall at Shikotsuko Onsen, Shiraoi, and Morino exceeds 150mm, according to AMeDAS, water begins to make flow in the stream. When the amount of water is low, sand and pebbles accumulate in the stream, and when the amount is high, they become mudslides and wash away large boulders and thick fallen trees.

■ **Adventitious root**

**Figure 7 Adventitious root**

In Kaede-sawa, you can see adventitious roots that have emerged from the middle of the trunk. An adventitious root is a root that forms from any non-root tissue. For example, it can happen when a tree is buried in sediment or volcanic ash. Due to the humus formation on sediments, the trunk above the new roots is thicker than the trunk below.

Around Lake Shikotsu, adventitious roots are also found in trees buried by earth movement caused by debris flow and eruptions, especially in Morappu and streams at the foot of Mt. Tarumae in the Shisamunai area. The adventitious roots seen in “Kaede-sawa” are due to debris flow.

■ **Nurse Log**

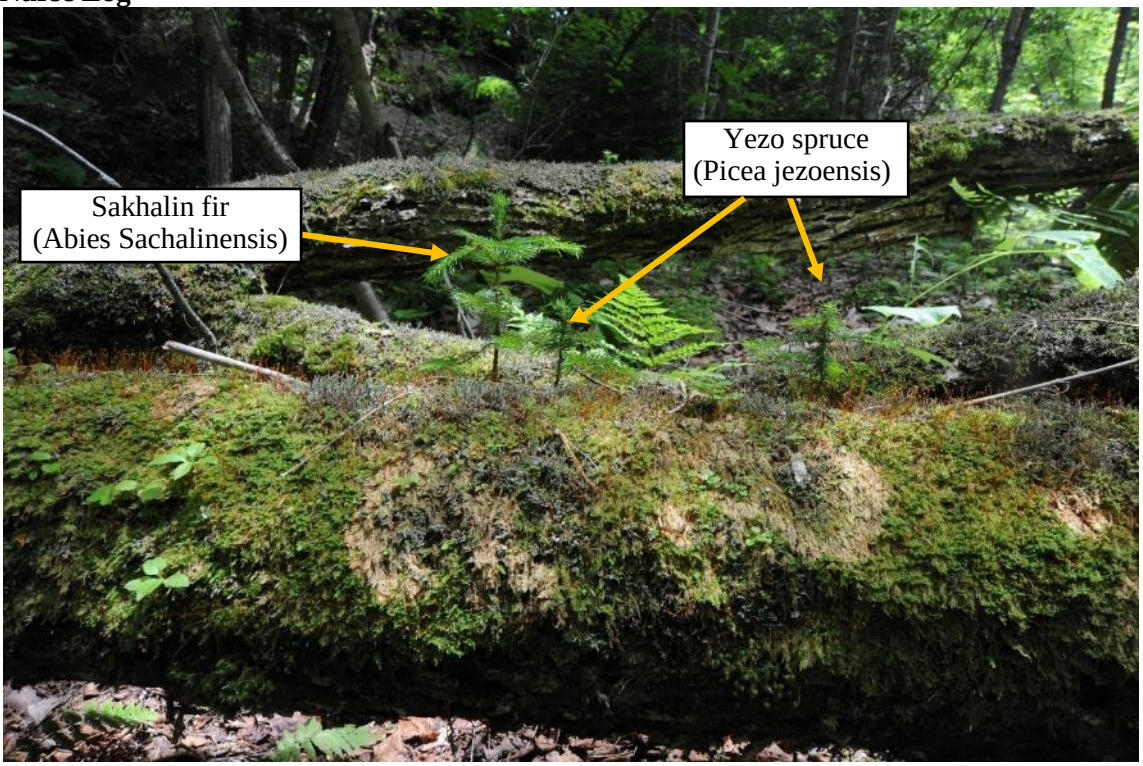



**Figure 8 Nurse Log**

Walking through “Kaede-sawa”, you will find many sites of young trees that have grown from naturally fallen seeds (natural renewal). It is called Nurse Log when a tree grows into mossy fallen trees and becomes a juvenile tree.

Yezo spruce (Picea Jezoensis) is the first pine to grow on land covered by a pyroclastic flow. However, once a forest of Yezo spruce (Picea jezoensis) is formed and decaying soil is created, it is rare for this Yezo spruce (Picea Jezoensis) to renew itself above ground because of its susceptibility to soil-borne pathogens. Instead, Sakhalin fir (Abies Sachalinensis) grows in this decaying soil.

Yezo spruce (Picea Jezoensis) and Sakhalin fir (Abies Sachalinensis) can grow on fallen trees free of soil-borne fungi. The two Nurse Logs in Figure 8 on the left are Yezo spruce (Picea jezoensis), and the one on the right is Sakhalin fir (Abies Sachalinensis).

■ **Pyroclastic flow deposit layer**

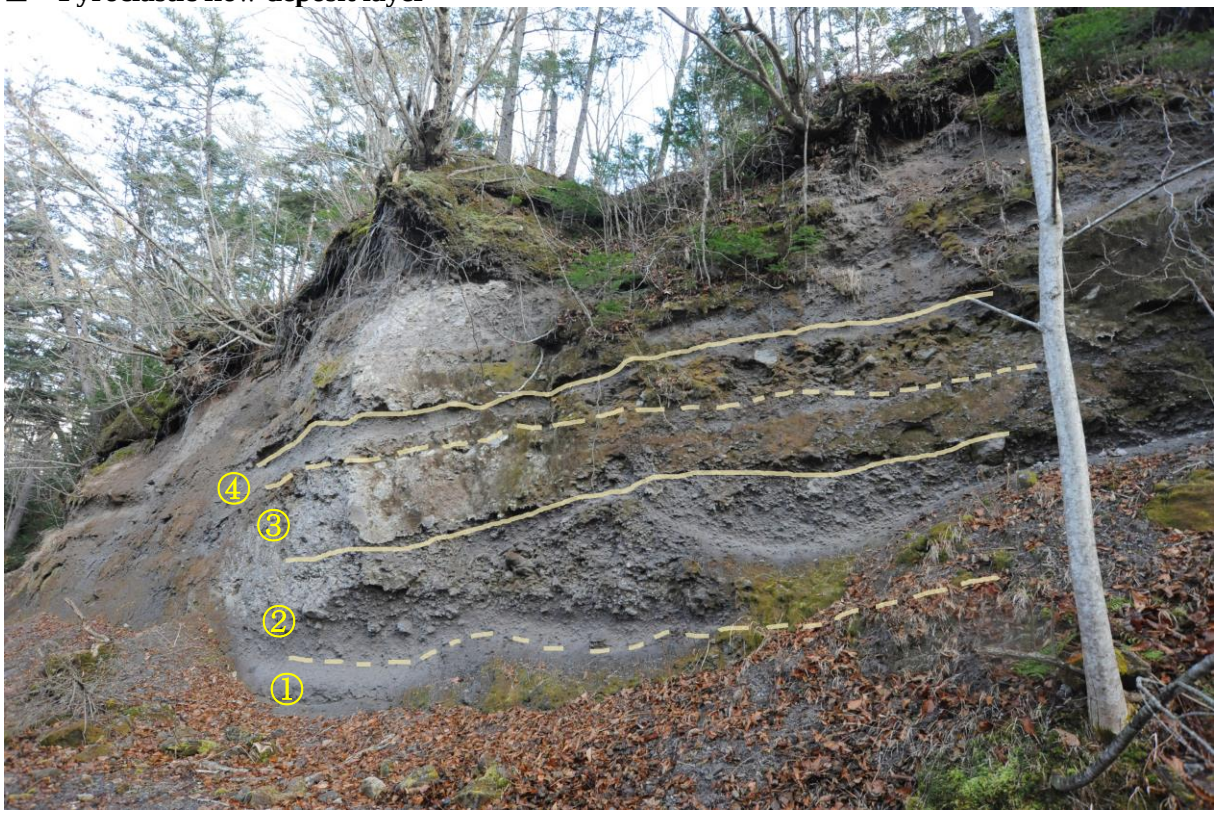



**Figure 9 Pyroclastic flow deposition layer**

About 400 m from the Kaede Sawa entrance, an outcrop of pyroclastic flow deposits from the August 1739 eruption of Mount Tarumae can be seen. As shown in Figure 9, the outcrop is composed of alternating layers of fine volcanic ash and a layer with large pumice from bottom to top.

(1) Relatively uniform fine volcanic ash layer
(2) A layer with large pumice gravel
(3) Relatively uniform fine volcanic ash layer
(4) A Layer with large pumice gravel

Of these, (1) and (2), (3) and (4) are one unit of pyroclastic flow, and pyroclastic flow is also on top of them.

When the pyroclastic flow is fast, large pumice gravels float, fine volcanic ash deposits on the bottom, and vice versa when the flow is slow. Since several units are seen here, it is assumed that when Mt. Tarumae erupted in 1739, pyroclastic flows repeatedly flowed rapidly for a short time and deposited into a thick layer on the Kaede sawa area.

## ■ Rocks erupted from Mt. Tarumae

▼ Pumice

**Figure 10 Pumice**

Pumice is a porous rock formed as follows. When magma, mainly rhyolitic to andesitic magma, rises from deep underground during an eruption and decompresses, volatile components such as water dissolved in the magma bubble up. Those with a diameter of 2 mm or less are called volcanic ash. The degree of foaming varies, and those with poor foaming (little porosity) are classified as volcanic bombs or volcanic gravels, but no clear distinction has been determined. Pumice is usually white, gray, yellow, or other light colors and may contain colorless to black mineral crystals.

▼ Breadcrust bomb

**Figure 11 Breadcrust bomb**

Breadcrust bombs is a volcanic bombs with a bread-like surface. Before blown-up hot and soft lava reaches the ground, cracks develop on the surface as the outside cools and hardens, but the inside expands.

*Volcanic bombs: A mass of molten rock with a diameter of 65 mm or more formed when lava fragments are ejected during a volcanic eruption.

## ■ Miniature Earth Pillar

**Figure 12 Small earth pillar**

Many mysterious columnar formations can be seen on the walls of pyroclastic flow deposits. These are called “Earth pillars”. These are formed when gravel and sand in pyroclastic flow layers (terrace gravel layers) are eroded by rainfall that falls vertically without being affected by the wind. If there are pumice stones or other materials in the layer that are difficult to erode, the underlying sand and gravel remain in the form of pillars.

In Japan, the “Awa earth pillar” (Hatougatake = a national natural monument) in Tokushima Prefecture is well known. However, while Awa’s earth pillars are tens of meters high, Miniature earth pillars found in Kaede sawa are only a few centimeters up to 10 centimeters at most.

■ **The collapse in the 2018 Hokkaido Eastern Iburi earthquake**

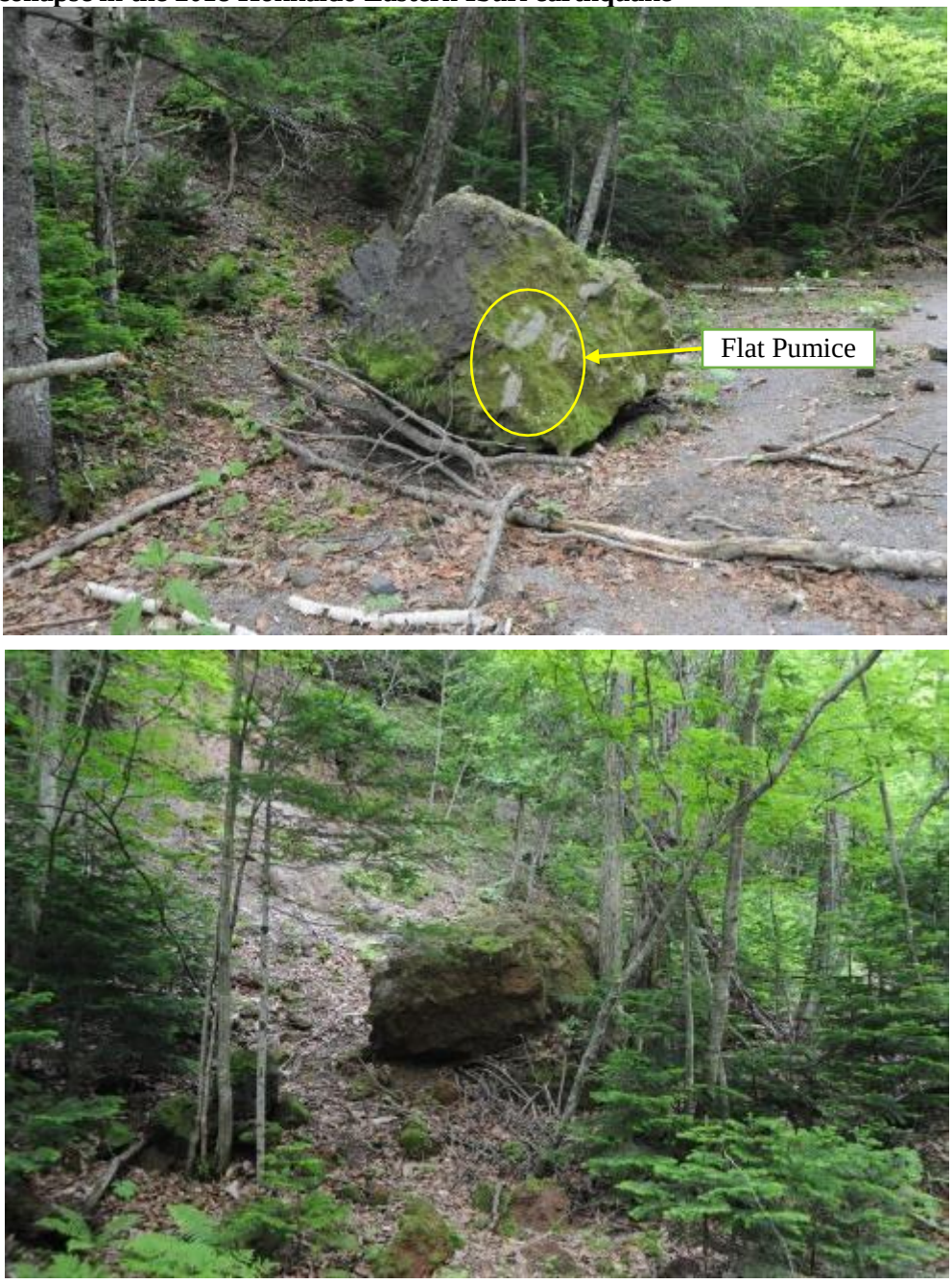



**Figure 13 Collapse in the 2018 Hokkaido Eastern Iburi earthquake**

Kaede-sawa has many large collapsed blocks before entering the “Koke-no-kairo Gulley (Moss Corridor). Figure 19 shows the collapse that occurred during the 2018 Hokkaido Eastern Iburi earthquake Large blocks with a maximum size of 5 m or more fell from two locations on the upper right bank sidewall about 30-50 m before the gulley.

Many more than 50 cm rock blocks fell in the "First-Kairo", and 7 to 8-meter-high blocks on the sidewall collapsed in the "Second-Kairo", toppling over for more than 10 meters during this earthquake. Besides earthquakes, heavy rains and melting snow have caused large and small debris and blocks to collapse from the sidewalls of the stream.

## ■ Compressed Pumice

**Figure 14 Flat Pumice**

Compressed pumice interbed in the rock mass that collapsed during the 2018 Hokkaido Eastern Iburi earthquake. Compressed pumice is a stone that has been softened by high heat and compressed and flattened by gravity.

## ■ Joints found in the "Koke-no-kairo Gulley (Moss Corridor)

**Figure 15 Joints found in the "Koke-no-kairo Gulley (Moss Corridor)**

The bedrock of "Koke-no-kairo Gulley (Moss Corridor)" is weakly welded tuff. As a result, vertical cracks (joints) can be seen at intervals of several meters on the valley walls within the corridor. These are called cooling joints (See Figure 16), formed by the contraction of hot rock deposited as pyroclastic flows cooled down. Most of the joints are perpendicular to the slope of the upper surface of the pyroclastic flow (direction of flow). In addition, there are numerous joints with a depth of 1m at the top part of the wall. These joints are called sheeting joints (parallel joints), which were created by loosening the wall surface (stress release) when the wall was eroded.

You will see find that the inside of the corridor is cool. It is believed that the whole area is like a refrigerator condition for the following two reasons: 1) the narrow width between the walls, the steep walls, and the trees growing on top of the walls causes short daylight hours, and 2) the weakly welded tuff that makes up the corridor contains water and the water that permeates into the rock is frozen for an extended time.

- Welded tuff

When pyroclastic flows occur during a large-scale eruption, the ejecta spreads and accumulates around the volcano while maintaining a high temperature. If the sediment maintains a specific temperature (above 600°C), some components melt and compress to form welded tuff.

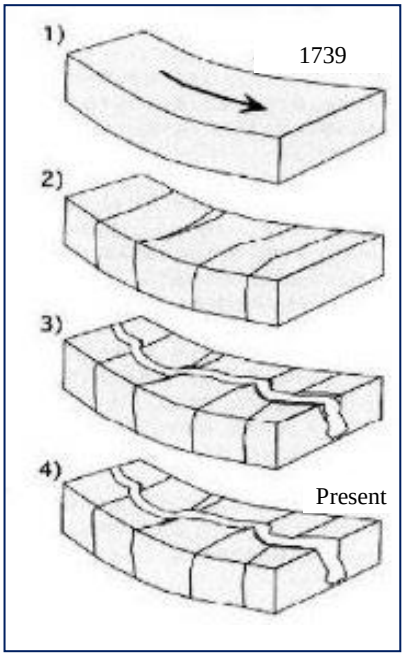



**Figure 16 History of Moss Corridor Formation** (Provided by Hokkaido Research Organization)

■ **Deposition and Movement of Sediment 1**

July 2014

June 2022

**Figure 17 Deposition and Movement of Sediment (1)**

When debris flows caused by heavy rainfall occur water currents transport sediment. Sediment is swept away from the stream bottom where the water flow is fast and accumulates on the stream bottom when the water flow is slow. Figure 17 shows that the rock wall was filled with sediment in 2014, but heavy rains on September 10, 2014, washed away the sediment covering the bedrock and lowered the stream bottom by more than 1 meter.

■ **Deposition and Movement of Sediment 2**

a) October 2014

b) June 2022

**Figure 18 Deposition and Movement of Sediment (2)**

Once a debris flow occurs, fallen trees and large and small rocks in the gulley are swept away and accumulate in curved sections, creating an "earth retaining dam" condition. When water flow is great, sediment accumulates successively, and the stream bottom in the upstream area becomes higher.

Figure 18-a shows that the stream bottom has become more than 1 m high due to earth retaining created by fallen trees swept away in the September 2014 flooding. Figure 18-b shows how the stream bed becomes lowered due to sediment swept away by melting snow and rain and the rotting and breaking of fallen trees piled on top of each other. If a large-scale debris flow occurs and fallen trees move significantly, the stream bottom will rise and drop significantly.

■ **Deposition and Movement of Sediment 3**

**Figure 19 Deposition and Movement of Sediment (3)**

When the 24-hour rainfall exceeds 150 mm, water begins to make flow in the "Koke-no-kairo Gulley (Moss Corridor)" and sediment begins to move. In areas where the current is fast, the sediment deposited so far is excavated, and where the current is slow, it deposits. Where the stream bottom has been excavated by sediment movement can be seen by looking at the moss growth. For example, in Figure 9, the sediment below the line where the mosses are well-grown has been excavated.

■ **Small-scale collapses, rockfalls**

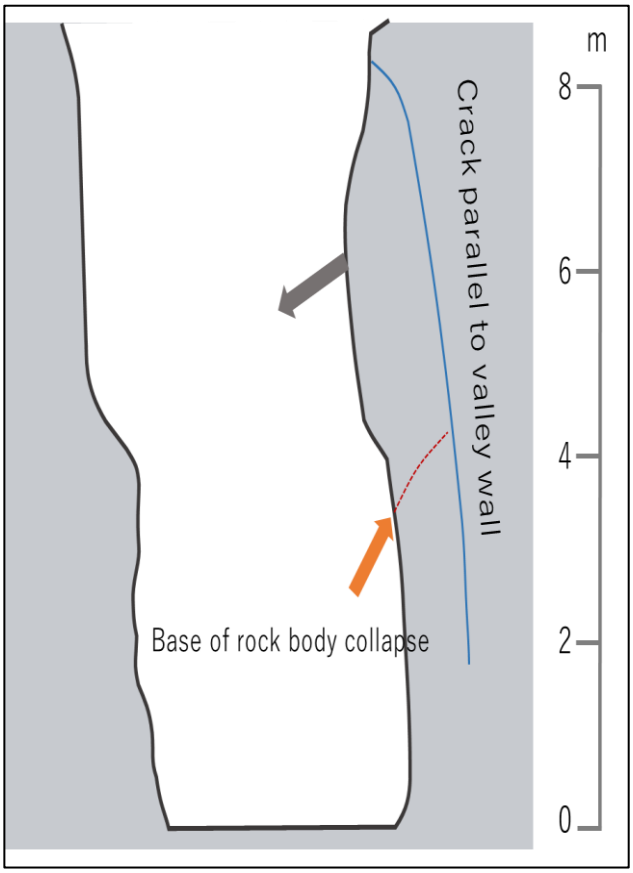
Figure 20 shows where a soil fall occurred during a torrential rainstorm in September 2014. Large and small rocks fall from the loose, compacted sand and gravel slopes during the snowmelt season and whenever it rains. You will find that moss grows on the older ones, and no moss is visible on the newer ones.

Besides the soil fall site, large and small blocks have also collapsed from the upper part of the valley wall. Therefore it is recommended to wear helmets.

**Figure 20 Small-scale collapses, rockfalls**

■ **Large-scale Rockslope failure**

**Figure 21 Large-scale rock slope failure**




The terrain within the “Koke-no-kairo Gulley (Moss Corridor) (especially the upper section) is narrow and surrounded by steep cliffs and unstable-shaped slopes (overhangs). Therefore, it receives almost no sunlight. In addition, this area is always exposed to cold air in winter because the valley walls are cut almost vertically, and there is no snow on the valley walls. Thus, for example, in the valley walls of “Koke-no-domon Gulley”, the freezing depth of the bedrock reaches more than 1.2 meters.

Due to abnormally low temperatures during the winter, the sub-zero range in the bedrock is further extended, and groundwater is supplied to this area by melting snow and precipitation. As a result, the ice body around the fracture grows larger and larger, and the ice body, which has become an impermeable surface, is subjected to water pressure. It causes the protruding rock body at the top of the slope to topple forward, resulting in a significant collapse.

**Figure 22 Cross section of bedrock collapse location** (Provided by Hokkaido Research Organization)