FROM ANCIENT SEA TO SAIMAA
A GEOLOGICAL GUIDE TO SOUTHERN LAKE SAIMAA
LAKE SAIMAA - PUREST FINLAND

Lake Saimaa, the jewel of Finnish Lakeland, is the ultimate recovery platform designed by nature. A hidden gem filled with space, safety and heartfelt, hospitable locals. Lake Saimaa is the destination to discover yourself.

 Feast your eyes on the labyrinth of clear, sparkling waters or the winding green forestry full of nature’s delights from early spring to late summer. Experience the rainbow of colours of Saimaa in the autumn and the glint of pure snow under the stars in the winter, and listen to the silence.

Saimaa is the fourth biggest lake in Europe with over 15 000 islands and 15 000 km of shoreline - more than France has altogether - and 70 000 lakeside cottages with saunas. Lake Saimaa is not far from Helsinki or St Petersburg and hosts charming towns like Imatra, Lappeenranta, Mikkeli, Savonlinna and Varkaus.

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FROM ANCIENT SEA TO SAIMAA
A geological guide to southern lake Saimaa

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Embark on a journey through time to Lammassaari and learn about its almost 1,900,000,000 year-old rocks, how the area emerged from underneath the continental ice sheet around 12,100 years ago, and the arrival of ancient human settlement on the shores of Saimaa!

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This local lagoon tells the story of how Saimaa developed over the course of 12,100 years. Navigate the windy waters to arrive at Satamosaari’s quirky-shaped bay – only the palm trees are missing.
Archaeological finds and rock paintings show that people have been living and boating in the southern Saimaa area for 10,000 years. The photo shows detail of the Kolmiköytinen rock painting near the boating route. The rock painting is estimated to be 4,700–3,700 years old.

You have in your hands a boater’s geological guide to Saimaa, which will take you on a journey through the history of Finland’s best-known waters. The area map, site maps and the related mobile applications present eight areas of terrain, of which half are islands. The sites contain geological terrain formations, each of which bears witness to its own piece of Saimaa’s complex history. In addition, hard bedrock, which consists of many different types of rock, can be seen peeking out from the loose topsoil. It is a world of its own that takes you back 1,900-1,800 million years into the past to the ancient seabed and to the base of the mountain ranges which formed as the Earth’s tectonic plates collided. Signs of human activity in the terrain include the Kutvele canal built by General Aleksandr Suvorov and the Second World War defence fortifications which remain on Pullikainen island and in Rastinniemi.

The tour of Saimaa departs from and returns Lammassaari harbour, in Imatra. Sites that can be reached by car include the departure harbour, Huuhanranta, the tip of Kyläniemi, and Suuri Sarviniemi. Taka-Ruuho, Satamosaari and Pullikainen are esker islands. Rocky Ilkonsaari stands out from the other islands due to its geology and orthodox tsasounas. It is a good place to wind down, relax, and ponder life’s big issues amid the ancient rocks and beautiful lakeland nature. The geological time travel provides boaters and other people in the area with a new perspective of southern Saimaa’s nature, which can truly be described without exaggeration as unique.
**THE COMPLEX HISTORY OF THE LANDSCAPE**

**An ancient rock base**

The bedrock in the Saimaa area began to form around 1,900 million years ago, when clay and sand washed away from islands and the surrounding continental areas was deposited and began to accumulate on the ancient seabed. The deposition phase was followed by tectonic collision in the lithosphere (1,885 million years ago), which resulted in the ancient sea becoming closed off, and a mountain range rose from the site of impact. During the mountain-folding process, the layers of seabed deposits were pushed deep into the Earth’s crust, where the heat and high pressure caused the rocky masses to recrystallise. The change took place in solid form without any melting of the rock material. As a result of this process, the layers of deposited sand and clay transformed into mica gneiss, which has a very similar chemical composition to modern clays. The rocks also contain pyritic intermediate layers and meta-volcanic components. These tell of changes that took place during the “seabed phase”, which resulted in sulphur-rich and volcanic material mixing with the clay. The primary mineral in mica gneiss is dark mica, or biotite, accompanied by plagioclase and quartz. Coarse-grained variations of the rock type also contain garnet and a certain amount of cordierite.

During the mountain folding, at a depth of around 15km, granitic magma formed or penetrated the semi-solid mica gneiss mass. It crystallised into veins and stripes among the mica gneiss, forming a type of rock we call veined gneiss. As the granitic parts of the veined gneiss crystallised slowly from the magma, they are typically coarse-grained; individual grains of red or light-coloured feldspar can often be distinguished in the granite veins.

The mica gneiss was therefore formed in conditions whereby mineral grains reformed but did not melt. Such conditions require a temperature of 650-700 degrees Celsius and around four kilobars of pressure. The same pressure can be achieved by placing three medium-sized passenger cars onto an fingertip-sized area (1cm²). A standard kitchen hob can achieve a maximum
red-hot temperature of 650 degrees. Such heat and pressure is achieved in the Earth’s crust at a depth of around 15km. Nowadays we could find equivalent conditions at the base of the Alps, for example.

The aforementioned mica and veined gneiss are two of the main types of rock on the Saimaa boating route. In addition, **granites and various granitic types of plutonic rock** can be found in the area. They crystallised during mountain folding 1,890 - 1,870 million years ago or clearly after folding 1,840 - 1,810 million years ago in magma chambers formed in the Earth’s crust.

The mountain range which dominated Finland’s landscape in ancient times has worn down and levelled out over the last 1,885 million years. As erosion progressed, the light base parts of the mountains have risen, which has resulted in the types of rock in the Saimaa area becoming visible on the surface of the ground today, despite them forming at a depth of 15km.

**Open water emerges from underneath the continental ice sheet**

The boating route took on its current form as a result of repeated glaciations. The last of these, the Weichselian glaciation, began in the northern parts of Fennoscandia 115,000 years ago. For a long time, all of southern Finland, including Saimaa, was glacier foreland. The flora was open tundra ruled by large herds of wandering mammoths.

Around 30,000 years ago, the climate cooled. The glaciers expanded and around 20,000 years ago the edge of the ice mass had already reached present-day Moscow. Around 20,000 years ago, the boating route landscape consisted of large expanses of windswept ice, the likes of which can be found in modern Antarctica. Back then, the current ground was covered by two kilometres of thick ice.
The last glaciation’s glacial maximum was followed by a deglaciation period lasting around 10,000 years, punctuated by climate fluctuations. Around 12,300 years ago, a temporary cooling of the climate stopped the melting glacier’s edge along a line from Imatra to Lappeenranta. Over the course of two centuries, an ice-marginal formation field consisting of moraine ridges and glaciofluvial deltas formed. The formation is part of the First Salpausselkä, which is hundreds of kilometres in length and spans all of Southern Finland.

*A journey through time to southern Saimaa*

We will set off on our travels from our departure harbour in Lammassaari, which is part of the First Salpausselkä and which was in the process of emerging from underneath the ice 12,100 years ago, but was still at a depth of 25m at the bottom of the Baltic ice lake. In other areas of our boating route, the continental ice sheet was still grinding and forming shoreline rocks for sunbathing and making natural harbours and sandy beaches in meltwater tunnels and cracks.

If our helmsman turns the dial on our geological time travel machine from 12,100 to 11,600 years ago, the waters of southern Saimaa become much more open. Now the edge of the ice sheet is at the Second Salpausselkä, and our boat bobs along with icebergs on the open waters of the Baltic ice lake, which formed at the edge of the Fennoscandian ice sheet. In that environment, boating with the kind of vessels docked at the Lammassaari excursion harbour today would be life-threatening. The ice sheet cooled the air masses above it, causing a permanent area of high atmospheric pressure. The related winds caused heavy northerly and northeast-eur storms on the southeastern edge of the ice sheet. The only safe harbour for time travellers are the low sandbars and gravelbars deposited by meltwaters, nowadays these bars are the Salpausselkäs’ summit plains. We turn the dial towards a more favourable time period.
Around 11,590 years ago, a new outlet channel to the Baltic ice lake opened up in central Sweden and the water level rapidly fell 28 metres. In the Baltic sea basin, the event started the Yoldia Sea phase, while in the glacial foreland at Saimaa, it heralded in a period of local ice lakes. The ice lakes and wide expanses of open waters had already disappeared from Saimaa 11,400 years ago. To the Saimaa boater travelling in geological time, this is all very reminiscent of the biblical flood and Noah’s ark. The rapid drop in water levels however would not cause our boat to land on the top of a mountain, but instead come to rest on the slope of one of the high esker ridges typical to Saimaa. The crew can safely leave the vessel and walk along dry land through areas which are nowadays large expanses of lake.

Between 11,400–11,000 years ago, the waves in the narrow and protected bays of the ancient Baltic Sea, or Yoldia Sea, would have lapped against the bow of our time traveller’s boat. The water level achieved a record low 11,000 years ago when Saimaa became isolated into an independent lake for the first time. At that time, the water areas were smaller than they are now. In places, the water level had fallen to more than 50m below the highest level.

After rising from the Yoldia Sea and becoming an independent lake around 11,000 years ago, southern Saimaa’s northern outlet channel was at the tip of Kyläniemi at Rastinniemi.
A flood lasting millennia (11,000 – 5,700)

When you’ve hit rock bottom, the only way is up. That is what happened to the water levels in ancient Saimaa. Behind this development was the slow uplift of the Earth’s crust, which had been pressed underneath the continental ice sheet, towards the previous position before the glaciation. The reason for the millennia-long rise in water levels in lake areas was not however uplift itself; rather the tilting of the crust towards the southeast as a result of uneven uplift. As the outlet channels of the lakes in the ancient Vuoksi watercourse area were located in the north, where the basins were rising most rapidly, water began to rise onto dry land in the southern parts of the basins. This led to a flood which lasted five thousand years, during which time the water areas expanded and merged to form Greater Saimaa. It extended from the First Salpausselkä to lisalmi in Northern Savonia. Greater Saimaa therefore refers to the large, ancient lake which covered the present-day Saimaa watercourse area. The form “Suur-Saimaa”, which is now used as a map name, encompasses only the southernmost bay of the ancient Greater Saimaa lake area. Around 7,500 – 7,000 years ago, Greater Saimaa was also connected to Ancient Päijänne. Together they formed a water area known as the Great Lake of Central Finland.

In southern Saimaa, the all-engulfing flood only began to recede once the Greater Saimaa lake complex’s outlet channel moved first from the Selkämyslampi channel in Northern Savonia to Matkuslampi in Ristiina, and then to Kärenlampi in Lappeenranta. Matkuslampi functioned as an outlet channel for Greater Saimaa 6,900–5,700 years ago, and Kärenlampi from 6,300–5,700 years ago.

What happened to the time travellers? During the Greater Saimaa phase, the water levels in southern Saimaa rose by around 30m from their lowest level, and as a result of the ice lakes discharging, our boat, which became stranded on the slope of a high esker ridge around 11,400 years ago, finally takes float again.
As the outlet channels of the lakes in the ancient Vuoksi watercourse area were located in the north, where the basins were rising most rapidly, water began to rise onto dry land in the southern parts of the basins. This led to a flood which lasted more than five thousand years, during which time the water areas expanded and merged to form Greater Saimaa. In southern Saimaa, the Greater Saimaa flood only began to recede around approximately 6,300 years ago, when the Kärenlampi channel in Lappeenranta opened up.
The map shows the Greater Saimaa water system at its greatest extent. The red arrows show the direction of flow of Greater Saimaa’s outlet channels.
The dams break

Greater Saimaa achieved its greatest extent shown on the boating map area 6,300-5,700 years ago. The period following the last glaciation was the warmest phase in the climate’s development. There was plenty of game and fish. Our Stone-Age ancestors sailed on their rickety row boats across the waters of Greater Saimaa, dammed inside of the curve of the First Salpausselkä, unaware that nature still had one surprise up her sleeve for our rowers, who liked to paint with red ochre.

The Greater Saimaa phase ended dramatically. A new outlet channel broke through to the south of the great lake around 5,700 years ago, leaving a deep cut across the First Salpausselkä. Vuoksi apparently broke through during the peak of the flood and the water eroded several metres of sandy soil away in just a few days. The formation of Vuoksi caused the water level of Greater Saimaa to fall several metres from peak-flood levels over just a few months. The red-ochre rock paintings on the shoreline rocks were left as if on the top shelf. Meanwhile, moss-free rocky surfaces left dry by the receding waters provided new, clean canvasses for the settlers of the time. The tribes who lived downstream of Vuoksi however, were not so lucky, and had to run for their lives to escape the discharged waters rushing towards Lake Ladoga.

Minor changes towards the present

After Vuoksi formed, the water level at Saimaa receded slowly and is nowadays on average 76 metres above sea level. The change was largest in the northern parts of the boating map, but the situation on the southeastern shores near Vuoksi has remained almost unchanged. “General of generals” Aleksander Suvorov had Finnish heritage, and just over two centuries ago (between 1791–1798) he was tasked with using four canals to combine the badly sunken yet strategic Saimaa bays into a functioning waterway and part of the Russian system of fortifications.

The Kutvele, Käyhkää, Kukonharju and Telataipale canals allowed for Russia’s Saimaa navy to pass safely between the Lappeenranta, Kärnäkoski and Olavinlinna fortifications near the border. The canal system and fortifications were to counter neighbouring Sweden and its Saimaa navy operating out of Ristiina.

In fact, Suvorov fortification system and the canals were the culmination of process that had been ongoing for centuries in Saimaa. During prehistoric times, the steep hill fortifications were a place for the population to escape the restive border areas. The Treaty of Nöteborg in 1323, the Treaty of Teusina in 1595, the Treaty of Nystad in 1721 and the Treaty of Åbo in 1743 all drew national borders at Saimaa. The situation changed after Suvorov with the Treaty of Hamina in 1809, which incorporated Finland into the Russian empire as a grand duchy. Finland’s eastern border became a kind of internal border within Mother Russia.
Almost the entire map area was covered by water after the last period of glaciation. The highest shoreline was formed during the deglaciation of the continental ice sheet around 12,300–11,400 years ago. The lowest water level was reached in southern Saimaa around 11,000 years ago. That phase was followed by the Greater Saimaa flood, which lasted more than five thousand years and ended with the breakthrough of Vuoksi 5,700 years ago. The water level fell rapidly by several metres. After Vuoksi formed, the shoreline receded slowly to its current position.

Present-day water areas are marked on the map in dark blue. Since the slow southeastern tilting of the crust continues, and Vuoksi is located in the part of Saimaa that rises the slowest, the water areas will shrink for thousands of years to come. In our human time scale, these changes have no significance.
DID YOU KNOW..?

The veined gneiss with garnet crystals shown in the picture is Saimaa’s most common type of rock and was formed from clay. Its overall chemical composition resembles that of clay.
Three time domains in

LAMMASSAARI

IMATRA
X=591853, Y=6787243

SAIMAA GEOPARK FINLAND
**Boulders and rocks in the north of Lammassaari (time domain 1)**

The shoreline rocks in the north of Lammassaari (site 1 on the map) are veined gneiss, which consists of dark mica gneiss and younger, lighter granite veins. The formation of veined gneiss is outlined in more detail on page 7. Lammassaari’s most impressive veined gneiss rocks and boulders are found in the northern part of the island along the hiking path. The shore area also features salmon-pink granite pegmatite boulders. Granite pegmatite is the second main type of rock along the arm of the River Vuoksi, and was formed around 1,840–1,810 million years ago, as hundreds of cubic kilometres of granitic magma penetrated the upper part of the lithosphere and crystallised. The cause was probably a tectonic collision which took place further away, causing the crust to melt in Saimaa.

**A glacier river delta dotted by kettle holes (time domain 2)**

Lammassaari is a delta that is part of the First Salpausselkä and was formed from sand and gravel deposited at the mouth of the glacial river’s tunnel channel. As melting progressed, the tunnel channel turned into an open channel in the ice, and then into a glacial bay. As there are several marginal moraines and extensive delta plains in the southeast of Lammassaari, the deposition of the Lammassaari summit plain in the glacial bay is assumed to date back to the younger part of the First Salpausselkä’s development period (12,300 –12,100 years ago).

As the Lammassaari delta formed, large chunks of ice were buried in the sand. As they melted, the surface of the delta plain sank into undulating esker terrain dotted with kettle holes (site 2).
Valleys in the current terrain indicate the location of blocks of ice buried in the sand. The ridges are the spaces between them which filled with sand. Only a small area of the original delta plain has remained in the south of the island. Its elevation (101–102msl (metres above sea level) or 25-26 metres above the current surface of Saimaa) indicates the level of the Baltic ice lake at the edge of the ancient continental ice sheet at the time when the delta formed.

The mouth of the glacier river’s tunnel channel was located at the northern tip of Lammassaari. The curves of the northeast and western shore of the island roughly depict the wedge-like shape of the bay, which was bordered by walls of ice. The esker ridge which is largely stony to the north and borders the harbour indicates the location of the edge of an ice block which filled the harbour basin around 12,100 years ago.

**From deglaciation to the present day (time domain 3)**

Over three centuries, the edge of the continental ice sheet retreated 20km northwest from the First Salpausselkä to a new marginal position, where the Second Salpausselkä was deposited 11,800–11,600 years ago. At that time, the shore of Lammassaari had lowered around a dozen metres from its highest point to an elevation of 91msl due to land uplift. This can be seen in the terrain as a shore terrace which circles the island around 15m above the current shoreline (B III level, site 3).

The change in lakeland scenery sped up around 11,590 years ago as a new outlet channel to the Baltic ice lake opened up in central Sweden. In southern Saimaa, the event began the period of local ice lakes, which were dammed above the Yoldia Sea. At first, the water level fell around 13m, coming to an end in Lammassaari near the current elevation level.

*The kettle pond on the western coast of Lammassaari, viewed from the south.*
Around 11,400 years ago when the last ice lake discharged at the Yoldia Sea level, southern Saimaa was briefly a bay in the Yoldia Sea. It became isolated into an independent lake around 11,000 years ago with an outlet channel at the tip of Kyläniemi. Now the water level had practically collapsed from its highest position – in fact, back then it would have been possible to walk across dry land from the Lammassaari harbour (the bottom of the present-day lake area) to Satarsamäe, Pullikainen, Ilkonsaari and Huuhantunturi. Your boat would only reach water on the steep southwestern slopes of Pullikainen and Ilkonsaari, which at that point the lake reached as narrow bays.

The Greater Saimaa flood lasted thousands of years and caused the shoreline, which had moved some 15km, to return to the harbour area. Around 6,500 years ago the shore was approximately at its modern level, but the water level continued to rise. It reached its peak 5,700 years ago just before the breakthrough of Vuoksi. The shore that formed at that point can be seen in the terrain as terraces just over three metres above today’s shoreline. Two Stone-Age settlement areas were found on those terraces at elevations of 79–80msl (quartz flakes) and at 78.6–79.8msl (ceramic findings). The former appears to be a little older and is marked with an informative sign. Pieces of ceramics were found at the latter site and date the settlement back to the typical Pit-Comb Ware Culture (4,000–3,500 BCE).
PULLIKAINEN
A cracked glacial bay
In contrast to other sites on the boating route, Pullikainen is not a Saimaa Geopark site, even though its natural and scenic value correspond to the geopark level. Pullikainen is an esker island with a varied natural environment consisting of summits and their views over the waters, and a bay which extends into the inner part of the island. Part of the island, to the west of the lagoon-like bay in the south, is used for hiking. Visitors approach the island from the west along a signed boating route – there is an excursion harbour in the bay in the inner part of the island, but you can also come ashore at Hiidenhiekka (site 1 on the map). The high southeastern part of Pullikainen is home to excavations which seem to be defence fortifications from the Second World War. There are holiday homes on the narrow central part of the island, meaning that it is not possible to reach the northwestern part of the island on foot from the southeast.

**A cracked glacial bay**

Pullikainen is part of the stretch of esker ridge formed by the glacial river. The total length of the stretch of ridge from north to south from the...
Second Salpausselkä to Kenkäsaari to the south of Pullikainen is approximately 20km. The delta-like part of Pullikainen surrounding the lagoon bay consists of four small plains. The complexity of the formation and the water area that remains at its centre indicate that deposition occurred at a heavily cracked spot on the melting ice edge.

The highest peak in the south of the island around the wartime excavations is at an elevation of 104.5msl (that is, 28.5m above the current shoreline), which corresponds to the elevation of the surface of the Baltic ice lake when the formation was created around 12,000 years ago (A). Otherwise the summit areas have mainly been eroded to a level of 96–98msl (B). That is 20–22m above the current shoreline and corresponds to the elevation of the shore 11,800–11,600 years ago when the ice edge was at the level of the Second Salpausselkä.

**The island and inland areas**

Remnants of the ancient shorelines relating to the Saimaa ice lake can be found on the slopes of Pullikainen at an elevation of 85–86msl (that is, 9-10m above the current shoreline). The shoreline was at that height for at least part of the period between 11,590–11,400 years ago (C). After the ice lakes discharged 11,400 years ago, the shoreline receded several kilometres away from Pullikainen, which remained far inland for thousands of years.

The “island” was once again surrounded by water by the Greater Saimaa flood. Greater Saimaa’s highest shoreline was formed 6,300–5,700 years ago at an elevation of 81–82msl. That shoreline level circles the island about 5–6m above the current shoreline and is marked on the site map with a broken blue line. As the sorted soils that were deposited on the island are gravel-dominated, the ancient shorelines that washed over them and the current shoreline are quite stony in places. For the same reason, boaters should be cautious of the rocks that almost reach the surface in the strait area leading to the island’s lagoon.
DID YOU KNOW..?

The Saimaa ringed seal is not the only species that became trapped in Saimaa. The Saimaa landlocked salmon is smaller than the more common Atlantic salmon and is critically endangered, as its access to its natural spawning grounds has been cut off. Today, the Saimaa landlocked salmon is almost entirely reliant on fish nurseries and restocking. Other relic species in the Saimaa region include the grayling, the brown trout, the Arctic char, the fourhorn sculpin, the amphipods monoporeia affinis, pallaseopsis quadrispinosa and gammaracanthus lacustris, and mysids.
HUUMANRANTA
The Saimaa Riviera

RUOKOLAHTI
X=575216, Y=6801056
Known as the “Saimaa Riviera”, this 1.5km stretch of beautiful, curved sandy beach is one of Saimaa's longest. Due to the shallow coast, coming ashore is easiest in a small boat or canoe, but it is also possible to reach the beach by car. The car park is a few hundred metres inland. The Huuhanranta area and the ancient shorelines which rise step-like behind it are a fantastic natural site. In addition, at the east end of the shore there is an impressive rocky area into which the glacier has carved grooves.

**At the edge of a sandur delta**

Huuhanranta and its surroundings are a sandur delta deposited in the Baltic ice lake. A sandur delta is a delta which is formed of sand and gravel discharged from a glacier and transported along with the meltwater flow. It is part of the Second Salpausselkä, or to be more precise, part of the 14 kilometre-long Kyläniemi ice-marginal formation which formed 11,800–11,600 years ago when the edge of the continental ice sheet stayed in the same area.

At Huuhanranta, the highest shoreline phase represents the delta plain which formed in the Baltic ice lake (marked ‘A’ on the map) and has a current elevation of 105–106msl, which is 29–30m above the current shoreline. As the edge of the continental ice sheet receded from the Second Salpausselkä around 11,590 years ago, a connection from the Baltic ice lake to the sea opened up in central Sweden, causing water levels to fall around 13m in southern Saimaa, and beginning the period of local ice lakes. The clearest shore terrace in South Saimaa ice lake is 15-16m above the current shoreline (91–92msl (B)) at Huuhanranta. The plain is broken by grooves cut into the deposits by water, some of which formed immediately after the ice lake discharged as fine material deposits saturated by water were left dry.

Around 11,400 years ago a connection from the South Saimaa ice lake to the Yoldia Sea opened up south of Ristiina, causing the lake, which had been dammed in front of the ice, to discharge. The water level fell dramatically and the Yoldia Sea flooded into the Saimaa basin. Around 11,000 years ago, southern Saimaa became isolated from the Yoldia Sea into an independent lake with an outlet channel leading north at the tip of Kyläniemi. During the isolation phase, the water...
level at Huuhanranta had sunk to 8–9m below than the current shoreline. At that time, the wa-
ter area on the site map was dry land.

The southeastern land tilt caused a flood which lasted thousands of years in Saimaa’s basins, which discharged to the north. At Huuhanranta it achieved its highest level around 6,300 years ago when a channel opened up in Kärenlampi, Lappeenranta and acted as the outlet channel for Greater Saimaa. Greater Saimaa’s highest shoreline is visible at Huuhanranta in the form of beach bank terraces around one hundred metres away from the current shore and at an elevation of 7m above the current shoreline (83msl (C)). Below that is a descending series of modern Saimaa’s beach ridges and shore walls.

**Rocks that have had a rough ride**

The main types of rock found in Huuhanranta’s rocky outcrops are mica gneiss (more about mica gneiss can be found on page 7) and tonalite. Among the mica gneiss (marked a in the picture) are thin, light veins of granite (b) typical to the area and granite-pegmatite dikes and patches up to more than 10cm wide (c). In addition, the mica gneiss also features weathered pyritic intermediate layers (d) and dark, sometimes striped meta-volcanic inclusions (e). The tonalite components of the rock on the other hand indicate the crystallisation of a large magma cham-
ber 1,880 million years ago. Tonalite is a greyish type of plutonic rock that resembles granite, but contains only a small amount of K-feldspar, which gives granite its reddish hue. Tonalite is a slightly more even rock than mica gneiss.

Tonalite and mica gneiss appear alongside one another in Huuhanranta’s rocks, and also share some common features. Both were exposed to powerful southeast-northwest stretching at some point in their development. That is why both display the same direction of schistosity in their structure. This means the direction in which the rock breaks into slabs. It is an entirely different from the grooves carved by the continental ice sheet into the shore rocks at Huuhanranta, which just happen to be in exactly the same di-
rection as the schistosity of the rock types.

*The Huuhanranta shore rocks display mica gneiss (a), granite vein (b), granite pegmatite (C), pyritic intermediate layers (d) and metavolcanic inclusions (e).*
DID YOU KNOW..?

Even Saimaa’s most barren rocky surfaces are covered in a paper-thin layer of life consisting of lichen. Lichen is a composite organism consisting of two completely different components, a fungus and a primitive algae. The fungus procures water and nutrients, and protects the algae. The algae on the other hand uses sunlight to refine the nutrients it receives from the fungus into valuable nutrition for itself and its partner. In the form of lichen, they counter each other’s weaknesses and are able to spread to areas where neither would survive apart. The best lichen spots are shoreline boulders favoured by birds, which fertilise the area with their droppings.
THE RUUHONSAARI ISLANDS, OR RUHA
Following the horseshoe

TAIPALSAARI
X=559038.25, Y=6802813.46
**Following in the footsteps of the glacial river**

The lagoon island of Taka-Ruuho, also known locally as “Ruha”, and its natural harbour, is part of a stretch of esker deposited by the glacial river. The western side of the horseshoe is a ridge formation that extends two kilometres to the north. From its tip, a chain of sandy formations belonging to the same esker, or the trail left by our glacial river, continues underneath the lake waters and as undulating ridges over dry land all the way to rural Pieksämäki. The stretch of esker to the south of Ruha island can be monitored using depth-curves to Hietasaari, from where the stretch continues somewhat broken, underwater, to the northern edge of the Rastin-niemi sandur delta.

The overall length of the esker is therefore at least 150km. It is a rather impressive remnant of the glacial river; a kind of “artery” of the ancient continental ice sheet, which pulses in time with the seasons and melting of the ice masses. The esker’s long and sharp ridge formations form sandy and gravelly “crusts” along the artery. They were formed in narrow cracks and tunnels underneath the ice. The wide and even sand and gravel formations like those at Ruuhonsaari are river deltas which were deposited at the mouth of a tunnel channel by waters lapping at the edge of the glacier.

**A landscape shaped by ice**

Ruha island’s delta was deposited at the edge of the continental ice sheet around 11,500–11,400 years ago. During the last phase, the flow of the glacial river and the formation of the delta were shaped by the rocky hill bordering on Ruuhonpurnu to the west, and to the ice mass filling the Ruha lagoon to the east. Today, the shape of the ice mass is depicted in the depth of the steep-sloped and lagoon-like water area. The difference in elevation from the bottom of the bay to the top of the ridge is 40 metres. There are a few channel-like depressions in the curved summit plain of the lagoon island. The Honka-Ruuho summit plain is bordered in the west by mica gneiss and veined gneiss rocks.
When the Ruuhonsaari islands were formed, the South Saimaa ice lake was at the edge of the melting continental ice sheet, which is the level reached by the islands’ summit plains (90–93msl). The fluctuation in elevation of the summit plains may be a sign of changes in the elevation of the surface of the ice lake during deposition. The delta islands and the shallows between them are surrounded to the south by an underwater slope that ends in depths of over 20m. The slope partially outlines the underwater glacial river deposit shaped from its environment by the waves.

From Greater Saimaa’s shores to a sauna

Ruuhonsaari’s most clearly developed ancient shoreline is 7.3–7.8m above the existing Saimaa level (83.3–83.8msl) and relates to Greater Saimaa’s highest phase. The rise in water levels slowed substantially at the Ruuhonsaari islands 6,900 years ago when the Matkuslampi channel opened up in Ristiina and acted as an outlet channel for Greater Saimaa. The shore’s slow descent began when the Kärenlampi channel in Lappeenranta opened up around 6,300 years ago. The ancient shoreline, which had developed over a long period of time, was left dry when Vuoksi broke through 5,700 years ago. At Honkaruuho, the plain corresponding to the elevation of Greater Saimaa is exceptionally extensive.

Now let’s get up and out onto the quay and take a walk in Ruha’s fantastic esker terrain - then it’s time for a sauna!
The brick-red sands found in many places in the Saimaa region take their colour from the mineral K-feldspar. K-feldspar comes from the area’s granite pegmatite rocks.
A natural harbour built by a glacier

SARVINIEMI

TAIPALSAARI
X=556688.44, Y=6794127.69
Suuri Sarviniemi and Pieni Sarviniemi are marginal moraine ridges on the Second Salpausselkä which were formed when the melting continental ice sheet temporarily came to a stop between 11,800–11,600 years ago. The Pieni Sarviniemi ridge is a little older than Suuri Sarviniemi, and both contain boulders, which are a typical feature of moraine ridges. The northern slope on the glacier side of the ridges is a gentler slope than the southern slope. Key processes in the formation of the ridges were the motion of the glacier and the flow and collapse of till at the edge of the melting ice (mass movements). The material was further worn as the Sarviniemi ridges were deposited at the edge of the glacier in water over 30 metres deep. Movement on Pieni Sarviniemi is restricted, as it is part of a nearby shooting range and is managed by the Finnish Defence Forces. The prohibited area is marked with signs.

**Rocks eroded by the waves**

The bouldery nature typical to marginal moraines is even more emphasised at Sarviniemi because the waves of Greater Saimaa eroded the slopes and tops of the ridges 7,000–5,700 years ago. The Greater Saimaa flood reached its highest level in the area around 6,300 years ago. When Vuoksi formed 5,700 years ago, the water level had already been undergoing a slow decrease for some time.

Greater Saimaa's highest ancient shoreline in the Sarviniemi area is 6-7m above the current shoreline (82–83msl). At that point, the waves lapped over the ridges’ summit areas. The road leading to the excursion harbour is partially built along a terraced shoreline corresponding to the highest level of Greater Saimaa. The same ancient shoreline can be seen as stony shore walls at the thick end of the moraine ridges. The boulders on the northern shore of Suuri Sarviniemi make the shoreline interesting from a geological perspective, as they contain a wide collection of rock types typical to the area, including various gneisses and granites. The area’s shoreline displacement is explained in further detail in the site description of the tip of Kyläniemi, which lies on the eastern shore of Rastinvirta.
**Treacherous summit boulders**

Sarviniemi’s marginal moraines extend to the west, where they disappear underneath the 15km long Pönniälänkangas sandur delta, or ancient glacial river delta. On the Rastinvirta side, the tips of the ridges are submerged in the waters of Saimaa right up to their stony islets and rocks. The underwater extensions of the ridges are clearly discernible in depth curves. The curves show that the moraine banks continue in interrupted stretches across the 2.5km wide Rastinvirta strait all the way to the shore of Kyläniemi. There the ridges are covered by the Rastinniemi sandur delta.

The boulders in the summit area of Suuri Sarviniemi will give the boater pause for thought.

What would the sharp boulders of the underwater moraine ridges that cross Rastinvirta do to the fibreglass hull of the boat speeding across it? With depth radar and sea marks there is no need for concern, but the situation was very different in the 19th century. Pieces of shipwrecks from the 19th century have been found on the tip of Suuri Sarviniemi. In the 1970s, the steamship S/S Imatra ran aground on a marginal moraine’s summit boulder at Sarviniemi.

The bay between the Sarviniemis is a great natural harbour. Humans however are known for their desire to master and improve upon the forces of nature. Underwater remnants of rock-filled quay structures from the 19th century have been found even at the two Sarviniemis.
At Rastinvirta, the water used to flow to the north, but the direction of flow has however changed to the south as a result of land tilt. Due to its strong current, the strait never entirely freezes over, even in winter, which is why it is dangerous to walk on the ice.

The rocks in the top pictures are veined gneiss, with granite pegmatite on the right.
RASTINNIEMI & RASTINVIRTA
– a strait or a river?
The lowest part of the “fence”

At Rastinvirta, the continental ice sheet depositing the Second Salpausselkä only pushed low marginal moraine ridges like Pieni Sarviniemi and Suuri Sarviniemi ahead of it. To the east of the strait, the Salpausselkä continues for 14km as the Kyläniemi ice marginal formation, which consists of an almost unbroken chain of sandur deltas. The western shore of the strait however is the beginning of the giant Pönniälänkangas sandur delta, which is 15km long and 4km wide. The summit plains of the sandur deltas rise to an elevation of 100–110 metres above sea level.

Rastinvirta forms a hole in the chain of sandur deltas, where the ground is 35–45 metres below the summit plains of the glacial river deltas. The lowest point (around 65msl) is located 150m from the tip of Rastinniemi. Since water (and often humans) always pass where the “fence” is lowest, Rastinvirta is a key area in the development of southern Saimaa. The flow of events has been saved in Rastinniemi’s ancient shorelines. Some of the history recorded in the landscape is however nowadays underwater.

From Baltic ice lake to Saimaa ice lake

The summit of the Rastinniemi sandur delta was deposited 11,800–11,600 years ago at the mouth of the meltwater flow at the level of the Baltic ice lake. In the last phase the water level was around 105-109msl, or 29–33m higher than Saimaa’s current level. Once the edge of the melting continental ice sheet had receded a few kilometres to the northwest of Rastinniemi, a new outlet channel to the Baltic ice lake formed in central Sweden and the lake rapidly discharged 28 metres to the Yoldia Sea level. In South Saimaa, however, the shoreline only fell 13m, and began the local ice lake phase, which lasted a few centuries.

The Saimaa ice lake’s clearest ancient shoreline is visible in Rastinniemi in the form of 3-4-metre-high beach banks located around 16 metres above the current shoreline level (92msl). When the banks were formed, Karenlampi in Lappeenranta, and possibly also Lavikanlahti in Savitaipale acted as the ice lake’s outlet channels.
Around 11,400 years ago when the ice edge receded to the south of Ristiina, a direct connection opened up from the sea to the Saimaa ice lake. The water level fell rapidly and the Yoldia Sea flooded into southern Saimaa as a narrow bay.

The Rastinvirta river forms and grows in length (Period 11,000–10,700 years ago)

At the start of the Yoldia Sea phase 11,400 years ago, the shoreline at Rastinvirta was a little higher than it is today, but nevertheless it was in decline due to land uplift. The lowest level was reached 11,000 years ago when Rastinvirta’s threshold (nowadays 65msl) rose above the surface of the Yoldia Sea. At that point, southern Saimaa became an independent lake which discharged to the north via Rastinvirta. The shoreline was 7-8m lower than the current shoreline, and a narrow river formed at the isolation point. As the outlet channel was located in one of the areas of the lake basin that was rising the most quickly, the water level quickly began to rise in southern Saimaa. In the northwest, on the Yoldia Sea side, the shoreline continued to descend and the Rastinvirta river delta moved slowly towards the northwest. The river grew in length.

The river extends into a wide strait (Period 10,700–10,000 years ago)

The Rastinvirta river continued to extend and achieved its greatest length around 10,700 years ago. At that time, the Kyrönsalmi threshold in Savonlinna rose above the surface of the Ancylus lake, which followed the Yoldia Sea phase, and Pihlajavesi became isolated into a lake which discharged into the north. Because Kyrönsalmi was located in the northern part of Pihlajavesi and the land tilted towards the southeast, the water now began to rise on the northwestern side of Rastinvirta, and as such, the barely 300-year-old river began to recede to the southeast. Around 10,000 years ago the Pihlajavesi flood reached the southern Saimaa level and in a way, Rastinvirta’s history as a river draining to the north ended. The river bed gradually widened into a broad strait.

The tip of Rastinniemi. Rastinniemi’s erosion bank.
On the shores of Rastinniemi that open out to the southeast, the shoreline either remained in the same place for a period of 11,000–10,000 years ago, or fell a little at the Rastinvirta threshold due to erosion. Our Stone-Age ancestors may have fished those bountiful waters at the mouth of the ancient river. Finland’s oldest known prehistoric settlements are located in Kuurmanpohja just over 30km from Rastinniemi. They are estimated to be around 11,000 years old.

**Rastinniemi from Greater Saimaa to the present day**

The Greater Saimaa flood, which lasted for several thousands of years, achieved its highest level in Rastinniemi around 6,300 years ago. The ancient shorelines from that time are located 6–7m above the current surface of Saimaa at an elevation of 82–83msl. When the Greater Saimaa outlet channel gradually moved from Matkulampi in Ristiina to Kärenlampi in Lappeenranta, the shoreline at Rastinniemi began to fall again. When Vuoksi broke through around 5,700 years ago, the water levels suddenly dropped several metres and then fell gradually to their current position.
Rocks and chapels at

ILKONSAARI

TAIPALSAARI
X=569633.05, Y=6786926.67
The Ilkonsaari islands consist of three rocky islands surrounded by rocky islets. The main island is an excursion site and is divided into two southeast-northwest rocky ridges separated by a bedrock fracture zone. The fracture zone is worn deeper than the rocky ridges and in today’s landscape it is the location of a low, narrow sandy isthmus. On the eastern shore of the isthmus are the island’s beach and one of its two excursion harbours. The larger harbour is on the southeastern part of the island. There is a hiking route with observation points and cultural sites between the two excursion harbours. One special feature of the island is its orthodox tsasounas.

Ilkonsaari’s rocky ridges rise about 20 metres above the surface of Lake Saimaa. They were worn into open rock faces by the Baltic ice lake and subsequent ice lake phases 11,700–11,400 years ago. Between the Arsenius and Tryphon Orthodox chapels known as “tsasounas”, there is a 100-metre-long beach ridge from the Greater Saimaa phase at a height of 80.7 metres above sea level (map site 4). Another rather interesting terrain formation begins next to the beach and continues around 300m northeast as an underwater sandbar. Its formation is presumed to have begun before Greater Saimaa reached its maximum phase, when the water surface was still below the current level.
Granite and related types of rock

In the Saimaa area, mica gneiss and veined gneiss are very common types of rock, but in Ilkonsaari the main rock types are granite, granodiorite and tonalite. They were formed through the slow crystallisation of magma, of which at least some probably originated in completely molten sea strata. The crystallisation took place during mountain folding or shortly thereafter 1,880–1,870 million years ago.

Ilkonsaari’s mica gneiss and veined gneiss can be spotted from the boulders at the southeastern end of the swimming beach (map site 1). There behind the shore, the land rises up as a high, rocky hill, which is largely covered in moss. Peeking out amid the moss is reddish granite, which takes its colour from its primary mineral, K-feldspar. Individual crystals are clearly discernible on the surface of the rock (site 2).

Special dike breccia can be seen in the rocky outcrops at the northwest tip of Ilkonsaari. The dike breccia consists of light dikes around 1-10cm wide which contain quartz, and which penetrated into the tonalite while it was already in a solid state, forming a mesh-like structure. The dikes have withstood erosion well in comparison to their background rock, which has worn a little below the dikes. The site is visually impressive and indicates movement which took place deep within the Earth’s crust (site 3).

The Arsenius tsasouna in the northwestern part of the island is built on top of tonalite rock (site 5). Tonalite is a greyish type of granite-related rock which crystallises deep inside the Earth, although unlike granite, it features only a little red K-feldspar. White, stick-like mineral crystals can be seen on the rock surface of the site. Some are K-feldspar while others are a mineral known as plagioclase. In addition, younger dikes cut across the main types of rock on the surface as white stripes.
There are extensive granodiorite outcrops in the southeastern area of Ilkonsaari. Granodiorite is a plutonic rock that resembles granite and which consist primarily of the minerals plagioclase, K-feldspar and quartz, as well as small quantities of biotite and hornblende. Ilkonsaari’s granodiorite typically features large and light-coloured dispersed grains of K-feldspar on the rock surface. The grains resemble a matchstick box and are in many places so large that they simply cannot go unnoticed by anyone passing by. The length of individual crystals are 1-5cm, sometimes more (site 6). The best granodiorite rocks are found along the path in the east of the island.

Site 5: The surface of the tonalite rock underneath the Arsenius tsasouna features K-feldspar and plagioclase crystals seen as white baton shapes, as well as light-coloured dikes which cut across the tonalite rock and are therefore younger.

Site 5: The Arsenius tsasouna.

Site 6: Grains of K-feldspar in granodiorite.
Lagoon-like

SATAMOSAARI
Satamosaari, the last stop on our boating route, is named after its excellent excursion harbour, as “satama” is Finnish for harbour. The shape of the island is rather special. Its sandy peninsulas seem to offer boaters a protective embrace, especially those arriving from the open waters to the north.

**Only peaks in sight**

Satamosaari is part of an extensive underwater sand and gravel formation whose visible parts are Keski-Lyly and Ala-Lyly. Depth curves show that the formation has features of a delta formed at the edge of the ice. The fragmented nature of the formation indicates that deposition occurred in spaces bordered by large ice boulders, and partially on top of the ice. The melting of an ice boulder buried in the sand led to the formation of Satamosaari’s lagoon-like bay. Its steep shores make it excellent for use as a harbour. The formation is just under 12,100 years old.

Satamosaari and its underwater extensions were deposited by a glacial river arriving from the direction of the Leutu and Suni islands to the north. The formation did not however have time to grow to the water levels of the time, as the summit plains’ elevation is only 91–92msl, so they are just 15-16m above the current level of Saimaa. That corresponds to the B III level of the Baltic ice lake during the period 11,800–11,600 years ago. As the waves evened out Satamosaari’s summit areas, the edge of the ice had already receded 20km to the southwest to the Second Salpausselkä. Greater Saimaa’s shoreline circles the island’s lower slopes around four metres above the current shoreline (80–81msl). Signs of Stone-Age settlements have been found at that elevation in Keski-Lyly and Ala-Lyly.
An ancient beach ridge.

Satamosaari’s harbour area.
Satamosaari is the last stop on our lake tour. On the way back to our departure harbour of Lammassaari, it’s time to reflect on our findings. Although there may have been headwinds, choppy seas, rain or storms along the way, hopefully there have also been warm and calm summer evenings, too. During the summer, Saimaa calms to a perfect mirror surface and the border to the open waters vanishes into thin air. From afar, a yacht in a gentle breeze appears to float in the air. In those transient moments, Saimaa becomes a part of the sky that has descended to meet the ground. “Golden moments”, which will invariably be imprinted on the log book of memories of those who sail Saimaa.

Perhaps that is why the ringed seal always looks happy, even though it is said to be “imprisoned” in Saimaa. Or could it be as suggested, that it chose its “prison” by following the early Vuoksi river bed? Who knows?

To end this tour we would like to raise our hats to early Saimaa researchers, and especially to Doctor of Philosophy, geologist and docent Aaro Hellaakoski (1893–1952), whose Saimaa studies from 1922 and 1934 are so scientifically valuable that they are still referenced today in publications on the topic. Perhaps Saimaa itself has also played a part in Aaro Hellaakoski leaving science in the 1940s and becoming one of the nation’s top poets. There is undoubtedly something larger than life on those blue open waters, if you manage to find it.
SYMBOL LEGEND

- MOORING
- WASTE SORTING POINT
- CAFÉ
- REPAIR SHOP
- OUTDOOR TOILET
- LEAN-TO/REST SPOT
- DISABLED ACCESS
- NATURE PATH
- CAMPFIRE
- OBSERVATION POINT
- FUEL
- PARKING
- SHORE WITH BOAT ACCESS
- SAUNA
- MIXED WASTE
- SUCTION UNLOADING OF WASTEWATER TANKS
- BOAT HARBOUR
The “From ancient sea to Saimaa” Geological route and guide to southern Lake Saimaa leads visitors on a trip through time to the development of the area’s nature from underneath the ice sheet to today’s archipelago and open waters. The landscape’s details provide undeniable proof of how the kilometres-thick ice sheet acted, and of landscape formations produced by the masses of water that were released.

Ancient shorelines tell of ice lakes dammed in front of the continental ice sheets and of sea phases, as well as of land uplift and tilt caused by the receding ice. The changes have had a significant impact on the landscape, as the difference between the highest and lowest shoreline in southern Saimaa is up to 50m. Prehistoric findings and rock paintings invite visitors to empathise with the early inhabitants and see the Greater Saimaa flood and breakthrough of Vuoksi through their eyes.

The shores’ rocks, worn smooth, prove to be a window into an even more distant past. They lead the reader to the ocean shores and mountain bases, which were a reality in the modern Saimaa area 1.9–1.8 billion years ago.

The route guide consists of eight sites, of which half are reachable by car and half only by boat. The majority of the sites are also Saimaa Geopark sites.

This route guide is available in a printed version and an online pdf version (www.saimaageopark.fi). In addition, there is a mobile version of the guide on Citynomad.

ISBN 978-952-68862-1-3 (PDF)