

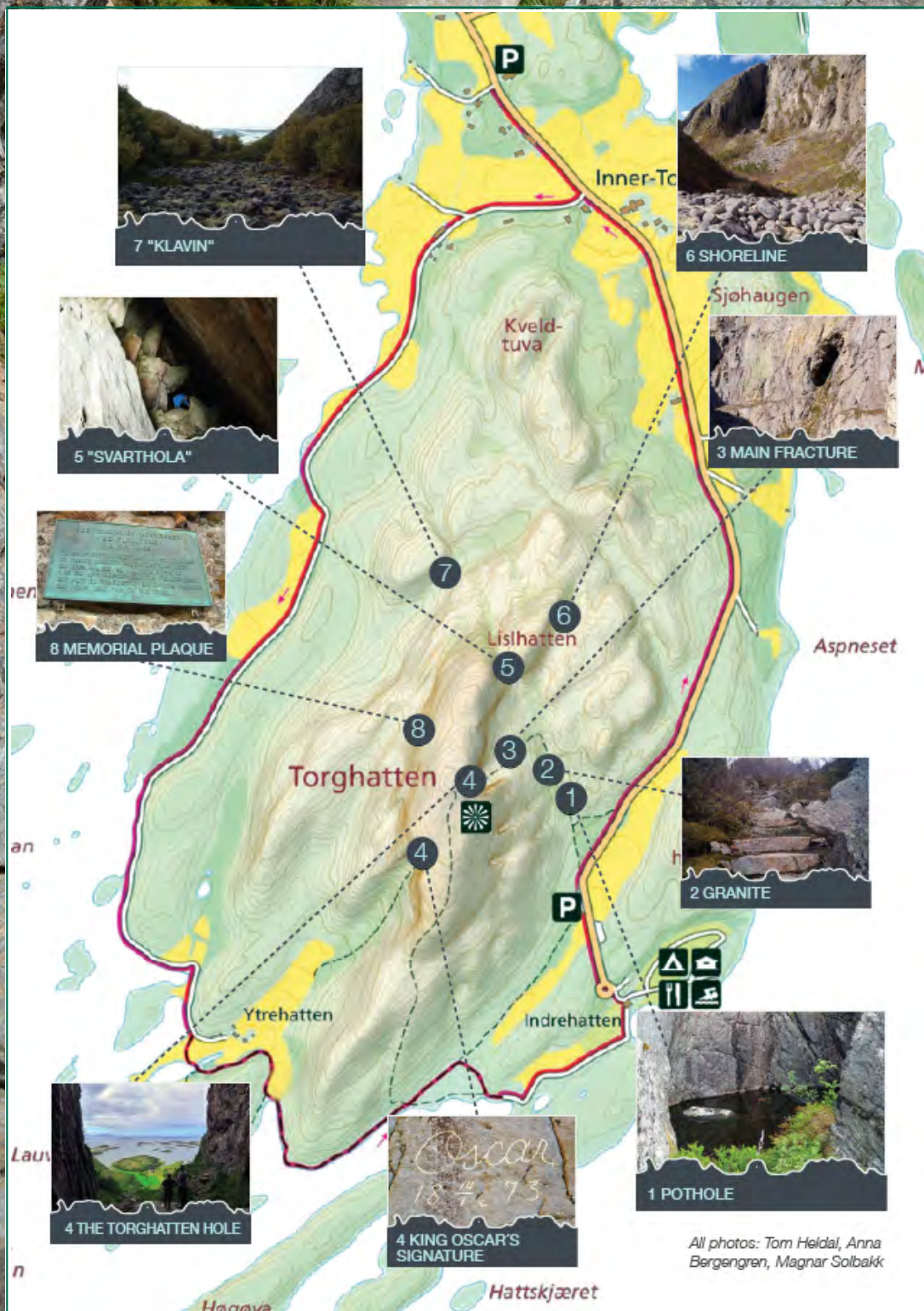
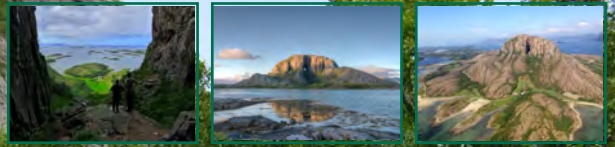
# Torghatten

## Teacher's Sheet

Start from the designated parking place.

Possible tours:

1. Around Torghatten (through the hole and back again to the parking)
2. Torghatten caves, including the Stone Age settlement at the raised shoreline to the right of the caves
3. The west side: the memorial plaque and the Stone Age Settlement at the raised Shoreline at "Klavín".
4. Additional tour: Torghatten top, with a view towards Leka, Vega and the Strandfilat archipelago. To visit Torghatten top, follow the marked trail from the parking place.



All photos: Tom Heldal, Anna Bergengren, Magnar Solbakk

# Teacher's Notes

SUGGESTED STOPS	POINTS TO NOTE
Access:	Park at the main parking.
1	<p>As you walk towards Torghatten there are several distinct levels of pebbles. Each level is a relic, or ancient shoreline. Shorelines change as sea-level has changed relative to the land. When the last glaciation in Norway ended, sea levels initially rose quite rapidly due to additional volumes of fresh water; however, because the weight of ice was removed from the surface of the land this eventually caused the land to rise relative to sea level in a process known as isostatic rebound. This area provides evidence that until relatively recently the sea extended much further inland than at present.</p> <p>You will also pass naturally occurring potholes. These are formed by rocks and gravel, rotating water movements and lots of time. Ideally a pothole begins with a large rock which is rotated by passing water. After extended periods of time the rotating rock becomes smaller and has created a larger hole which it has ground out. Today we understand that many potholes were formed by rivers beneath glaciers. This helps to explain why we find these natural potholes in areas with no rivers present!</p>
2	<p>As you climb up Torghatten you can easily see the material this mountain is made from; granite. The softer types of rock around it were ground down to a flatter landscape. Within the rock, there are fractures and other zones of weakness. They originate from a much earlier phase in Torghatten's geological history. When the granite cooled and hardened from molten rock nearly a half billion years ago, it shrank somewhat. Just as all materials shrink as their temperature falls. This resulted in cracking in multiple directions, nearly perpendicular to each other.</p> <p>Stop and look closely at the stairway which is made of the mountain granite. It is thought this stairway was built prior to King Oscar's visit in 1873. The stairway demonstrates the relative hardness of the granite as it remains in good condition nearly 150 years later.</p> <p>The granite is grey to reddish in colour and has a striped structure. The pink minerals are orthoclase feldspar, grey is quartz and white is plagioclase feldspar. The black stripes are thin flakes of biotite mica. Torghatten granite was formed around 475 million years ago during the Ordovician as the lapetus Ocean reached its maximum width. The striping is principally due to compression as the viscous granite melt gradually rose up in the Earth's crust like a wedge pushing through other types of rock in its path. All this occurred while it slowly cooled and hardened.</p>
3	<p>When you have almost reached Torghatten hole pause, and look at the mountainside to the right. You will see a distinctive main fracture, along which caves have formed.</p> <p>The lowest cave is small and the higher caves are larger in size. Looking at these caves it is easy to understand how Torghatten hole started as small caves and grew larger of many years.</p> <p>The caves always started along the main cracks fractures. These are zones where the rock is particularly fragmented. We can observe the beginning of caves along just such main fractures. Here, prolonged wave action and frost shattering exploited the weakness in the granite.</p> <p>What makes the hole through Torghatten special is the fact that its vertical edges are along two such fractures. Due to they being so close to each other, it was a particularly well suited site for two smaller caves to become one large one.</p> <p>The caves around the mountain Torghatten is situated in different levels, as the sea level changed.</p>



4	<p>Torghatten is a sea cave, or more precisely two sea caves which have become a fully open tunnel. During long periods and from both sides, the waves, frost and salt have eroded the hard granite rock until the two caves met and became one.</p> <p>It is probable that the ocean and waves have been pounding against Torghatten during long periods over the last 2 to 3 million years, causing cracks to expand into caves and then connecting the two smaller caves as one large one. Between the glacial periods, the forces of nature calmed down and affected lower levels of the topography, such as nowadays.</p> <p>The hole itself is 166 m long, 28-75 m high and 10-28 m wide. As you walk through the hole towards the strandflat to the southwest, note the pits and the soft shapes on the walls due to salt weathering.</p> <p>As you approach the southwest side, the landscape reveals itself in a majestic manner. On a clear day you might see as far south as Leka. On the southwest side of the hole you can see King Oscar's signature in the rock wall, just as King Olav and King Harald have signed the northeast side.</p>
5	<p>When you return to the north-east end of the hole, you can walk down again to follow the path to the two of the largest caves in Torghatten. From a distance they look like a large crack in the mountain. They are called Svarthola 1 and 2 (The Black Hole).</p> <p>The Svarthola 2 cave is the longest cave in Torghatten, about 120 meters. However, it has never broken through the mountain to become a tunnel. Clay found in cracks inside the cave might indicate it dates back to the time when the area was located in a tropical climate zone more than 300 million years ago, long before the glacial periods began to impact the landscape.</p> <p>Notice that it requires a bit of a climbing to enter the caves, and that the rock might be wet and slippery. Any visit is at your own risk, and we recommend helmets and lights.</p>
6&7	<p>To the right of Svarthola you can see a pebbly rock scree. This is an ancient shoreline. The first human settlers came to Torghatten when the sea was at this higher level, about 110 meters above modern sea level.</p> <p>Ten to eleven thousand years ago, when the first people arrived, there was a nice bay just here. It was south-facing and sheltered from wind and sea. In other words, a nice place to settle and harvest the abundant resources of wild game, fish and sea mammals. Lots of pebbly rocks on the beach made it simple to build dwellings. The first settler stacked the rocks in circular wall structures, made roofs of animal skins and wood, and was thus able to attain functional huts.</p> <p>There are at least five visible Stone Age settlement sites around Torghatten. These can be found in the pebbly rock areas and they now look like pits although there would have been rooves above the pits, similar to huts or tents.</p> <p>On the northwest side of Lesshatten is Klavin. This was once an ideal settlement for a hunter-gatherer community as there was easy access to natural harbours. It is though Klavin was inhabited by humans continuously between 6000 BC and 2000 BC.</p> <p>There are traces from a number of settlement sites here at elevations of 60 to 75 metres above sea level.</p>
8	<p>On the evening of May 6th 1988 there was thick fog in the area and sadly a plane flew into the western mountainside of Torghatten. All 36 on board perished. The Widerøe flight was on route from Trondheim and Namsos and the crash occurred during the approach to Brønnøysund.</p> <p>The plane was a Dash-7 and was considered one of the safest passenger aeroplanes in use. The plane crash was the worst Norway had experienced in 16 years. Nearly 700 people attended the memorial church service at Brønnøy Church on 10th May 1988. A memorial plaque was placed at the crash site on Torghatten's western mountainside. It is a place for silence, contemplation and to set flowers.</p>