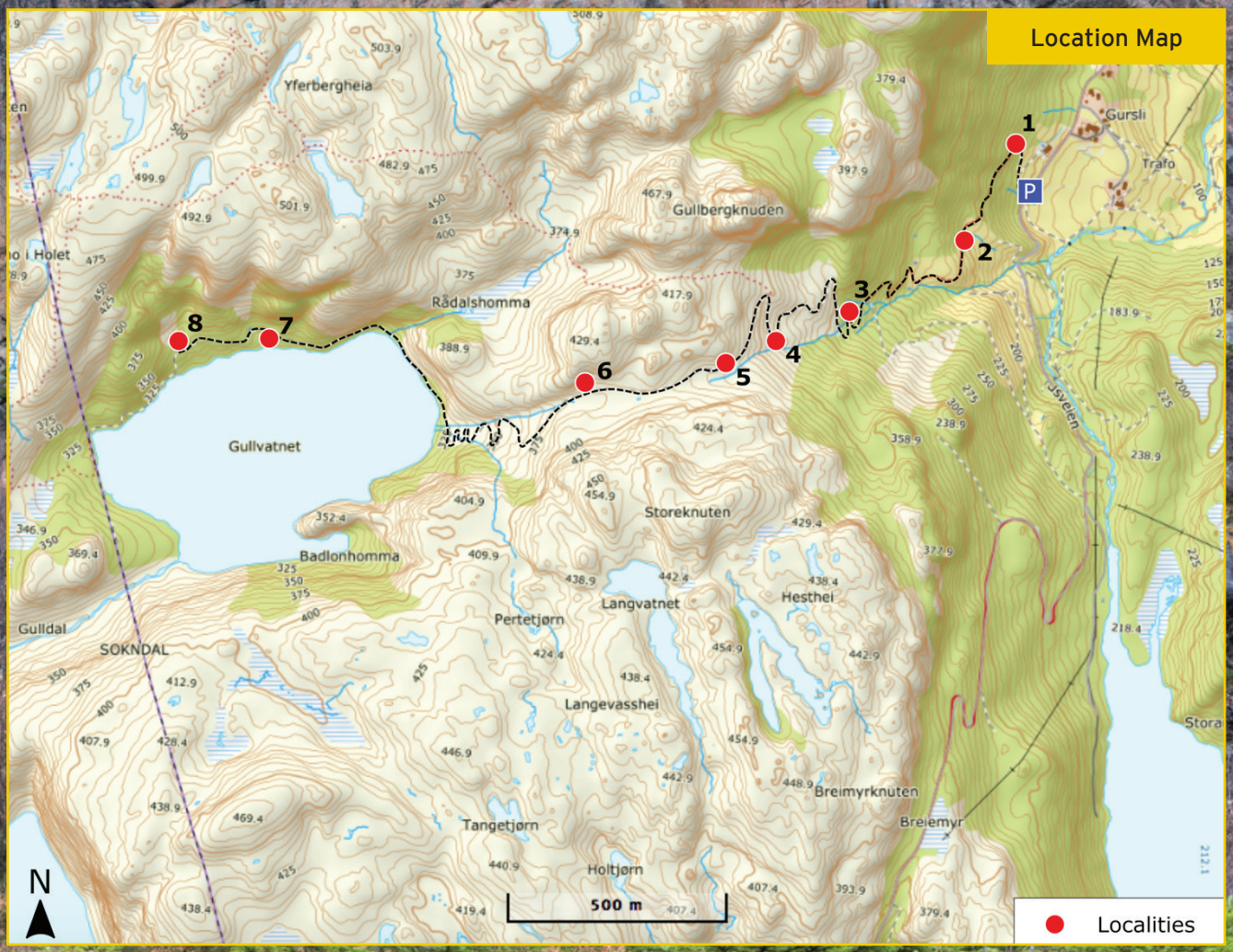
Gursli

Teacher's Sheet



The hike to the old Gursli mines starts along county road 1, about 5 km away from the train station in Moi. It will take about an hour to walk and 20 minutes to bike. The hike itself is along the old road constructed during the time when mines were active. The roads are well made and make for a good and safe hike. The hike starts at Gursli at 150 meters above sea level and take you up to about 420 meters above sea level before descending down to the mines at 330 meters above sea level.



Teacher's Notes

SUGGESTED STOPS	POINTS TO NOTE
Access:	Parking (N58.41745, E006.53763) of car and small busses. The parking above is not suitable for a bus to park, but for drop off. Busses can drop students of and park in Moi just 5 km away.
1	**Moraine** (N58.41856, E006.53678) The last Ice Age is known as 'Weichsel' and began 120 000 years ago and ended approximately 10 000 years ago. Up to 2 km of ice covered the area of Magma Geopark, which with time formed the landscape we see around us today. Glaciers move over the landscape transporting sediments of all sizes and shapes with them. When the glaciers melt all these sediments are left in the landscape – some as moraines. A moraine is a glacial deposit characterized by being poorly sorted, and containing sediments that are little rounded and from different sources. In this moraine, boulders of different type of gneiss and granites can be seen.
2	**Lichens** (N58.41609, E006.53502) Lichens are a composite organism that arises from cyanobacteria or algae living among filaments of multiple fungi in a symbiotic relationship. There are many different types of lichens and they have different requirements to thrive. Some grow where they cannot become covered in snow, some need shadow and a damp environment, while someone prefer it dry and sunny, some react to pollutions in the air and grow in the shelter of the wind, and some are robust and can grow basically everywhere.
3	**Boulder of banded gneiss** (N58.41445, E006.53120) The rocks in the area around Gursli consists of banded and granitic gneisses. A gneiss is a metamorphic rock that has been altered through processes where it became affected by increasing temperature and pressure. The banded gneisses were originally sediments on an ancient sea floor but where exposed to high pressure and temperature as it got squeezed together in between two colliding plates. This resulted in mountains being built and volcanic activity where granites intruded into the forming banded gneisses. This happened more than 1 billion years ago. The collision was part of the formation of the supercontinent Rodinia – a prehistoric continent where all landmasses on earth were gathered. As two plates collide, huge mountain chains start to build like the Andes mountains today. This was also the case when Rodinia was formed – a large mountain chain covered the landmasses of today's Norway. The banded gneiss consists of darker layers containing more mafic minerals (more magnesium and iron) and lighter layers containing more felsic minerals (silicates). After being exposed for some time this banding will become even more apparent since different layers are more resistant to weathering compared to others.
4	**The old mining road** (N58.41378, E006.52859) When the post office in Rogaland opened in 1650, Haukland in Moi was a sub-post office. A subsidiary postal route went over Gullbergheia to deliver the mail to Sokndal. Residents in Sokndal had to finance this postal delivery from the office at Haukland. This postal route over Gullbergheia went in a straight line up the hillside from Gursli in contrast to the later constructed mining road. At Gullskaret the postal route can be seen south of the stone wall. When the extraction of ore started in 1916 it was treated in Flekkefjord. The ore was handsorted at Gursli and the best material was transported to Flekkefjord in boxes. Transport was across lake Gullvannet by ferryboat, and continued with horse and cart to Moi station from where it was transported by train to Flekkefjord. The road to the mines was made with a lot of turns to make it less steep and easier for the horses to transport the heavy load up and down the hills.

5	**Weathered vs. un-weathered gneiss** (N58.41308, E006.52658) When rock gets exposed to the elements is will start to weather. There are many types of weathering, both mechanical and chemical, but it basically means that the rocks are dissolved or worn down. Weathering happens at the surface of rocks and it creates a weathering surface. The surface is the part of the rock affected by weathering and can vary from very thin (mm) to extremely thick – in some countries it can be several metres thick. In Norway and in Magma Geopark the weathering surface is thin. This is due to two reasons; 1) the last ice age ended only 10 000 years ago, and it had over thousands of years eroded the surface of the earth. When the ice melted, the rock surface was "fresh" and hadn't been affected by any weathering. 2) The rocks in Magma Geopark are quite resistant to weathering compared to other types of rock, meaning in the 10 000 years since the ice cap disappeared over Norway it has weathered little. At this locality, you can see rock that hasn't been exposed to the elements for long in the stream and has not developed a weathered surface. It can be compared to the rocks just above the stream which have a weather surface just a few mm thick.
6	**Folded banded gneiss** (N58.41233, E006.52101) During the formation of the mountain chain the rocks didn't just get exposed to heat but also pressure. The pressure could be the same from all sides but it could also be stronger from some directions. Often the pressure was compressive and the rocks being very warm would get deformed in a ductile matter. This led to the banded gneiss getting folded. Folds provide evidence of a compressive regime deforming rocks under high temperature. If the temperature would have been lower the deformation would have been along faults rather than folding.
7	**Rocks constituting the foundation of the mine managers house** (N58.41247, E006.50883) This is where the man responsible for the day-to-day running of Moi Grube Co A/A lived – Johan Didrik Behrens. The foreman for the workers also lived here. The foundation of the house is built up by stones of different rock types. In the foundation it is mostly gneisses, but they vary from amphibolitic (dark, almost black), banded (striped) and granitic (more homogenous than the others). The stones are large and it would be natural to think that they are local, but it is difficult to say if they have been collected locally or taken from a location closer to Gursli or Moi.
8	**Mining and gangue** (N58.41222, E006.50532) Molybdenum (Mo) does not occur in metallic form in nature but occurs in different concentrations in several minerals, including molybdenite (MoS_2) which was extracted at Gursli. Molybdenum is used in a variety of steel alloys (80 of the global production is used for this purpose). The steel products are used for military purposes as well as for space travel, air travel and in the motor industry. Molybdenum alloys are useful because of their heat resistant properties and it also hardens steel so that it can be used for cutting tools. The molybdenum ore at Gursli contained 0.10 – 0.15 molybdenite. It is concentrated in quartz-rich ores that cut through the gneissic rock and where formed many kilometers below the surface of the earth as hot fluids (hydrothermal water) containing dissolved minerals, moved through cracks and weak zones in the gneiss. As the fluids moved upwards it cooled down, resulting in the deposition of molybdenum together with quartz. When hot water cools the ability to carry solutes decreases.