EUROLITHOS European Ornamental Stone Resources





EuroLithos country atlas: Norway

EuroLithos Atlas

Ornamental stone resources in Norway

Thematic focus: Country

Responsible partner(s): NGU

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Geology of Norway

Norway's bedrock reflects a long history, that extends nearly 3 billion years. In the rocks, we find traces of ancient mountain ranges that had risen and have eroded down to sediments as Earth has undergone changes.

Norway is part of the *Fennoscandian shield* that constitutes the Precambrian bedrock of Scandinavia. The oldest rocks in Norway date back 3 billion years and can be found far north, in Finnmark and along the coast in Troms and Vesterålen. These rocks include various igneous rocks and gneisses. On top of these are several successions of volcanic and sedimentary rocks, including banded iron formations, ranging in age from 2800 – 2000 Ma (**Feil! Fant ikke referansekilden.**).

Moving south and west the Precambrian bedrock becomes gradually younger. In southwest Norway, along the Swedish border, are *Mesoproterozoic magmatic and sedimentary rocks*. Most of the Precambrian terrains in south Norway do, however, belong to a broad range of magmatic, volcanic and sedimentary rocks of the *Sveco-Norwegian* orogeny (1200-950 Ma. These units also carry remains from a continental arc formation around 1500 Ma.

In the far north, in East Finnmark, there are autochtonous sedimentary rocks, showing little impact from the Caledonian orogeny. The range in age from Neoproterozoic to Silurian. In the northern part of the area, they gradually turn into folded successions, influenced by the Timanian orogeny (1000-500 Ma).

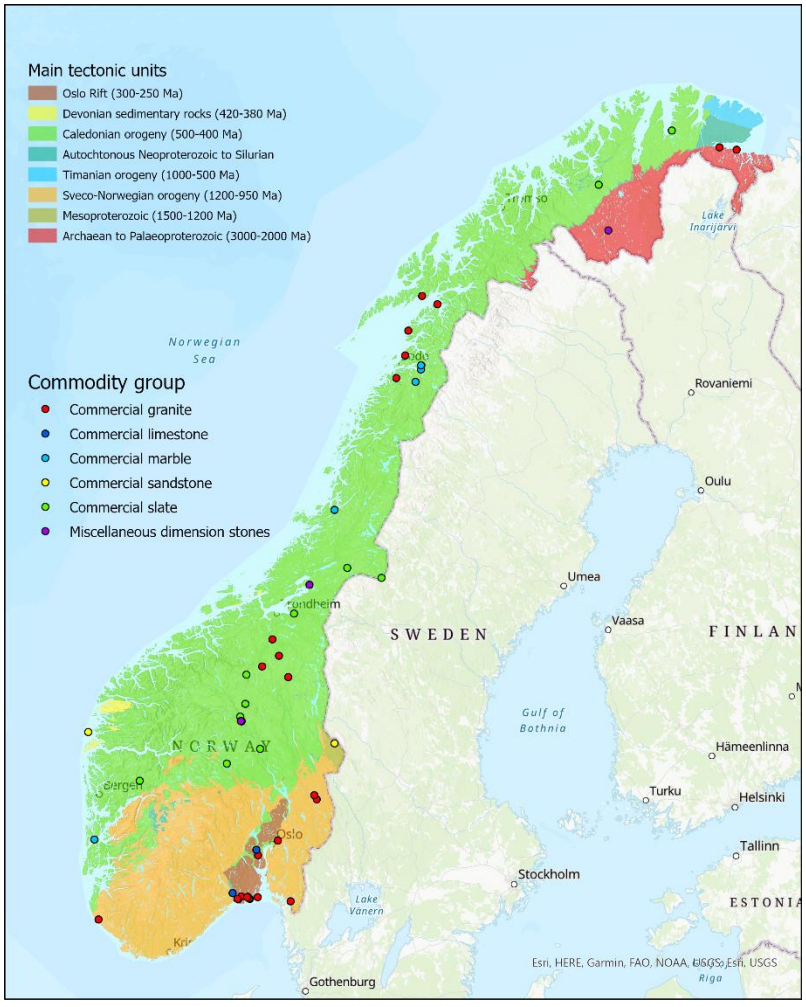


Figure 1. Main tectonic units in Norway and a selection of ornamental stone resources.

Most of the Norwegian mainland is covered by rocks involved in the *Caledonian* orogeny (500-400 Ma), including fragments of older basement rocks. The mountain range, once of Himalayan size, is long gone, but in its ruins a vast diversity of igneous, volcanic and sedimentary rocks are found, most of them metamorphosed under greenschist to amphibolite phasis conditions.

The erosion of the mountain range, that took place immediately after its formation, are represented by thick units of conglomerate and sandstone deposited in the *Devonian* period (420-380 Ma).

The youngest rocks to be found in mainland Norway, are in the *Oslo Rift* (300-250 Ma). This was a continental rift system similar to the Rift Valley in Africa, that for some reason never evolved to form a new ocean. A variety of plutonic and volcanic rocks are the main constituents. The rift was formed in older rocks (Cambro-silurian sedimentary rocks) that belonged to a foreland to the Caledonian orogeny.

Ornamental stone resources in Norway

Ornamental stone resources are present in all the main tectonic units in Norway (**Feil! Fant ikke referansekilden.**). The Archean and Palaeoproterozoic rocks of the far north contain ornamental stone deposits of migmatite gneiss and green quartzites. In the south of Norway, both sandstone and gabbro deposits are included in the Mesoproterozoic successions.

The Sveco-Norwegian orogeny contributed with some of the best quality granite resources in Norway, and in addition anorthosites with blue play of colours. The *Caledonian mountain range* is composed of thrust sheets and fold belts of a diversity of predominantly metamorphic rocks, including schist, slate, marble and soapstone. There are also various plutonic rocks (mostly granite) related to island arc formation, and sandstone and conglomerate deposited during Devonian erosion of the massive mountain range.

The Oslo Rift hosts perhaps the most valuable of the Norwegian ornamental stones, Larvikite. This is a plutonic rock formed beneath the continental rift, known for its blue play of colours. The rift also include syenite and granite, mostly used for domestic purposes.

Ornamental stone production

The production value of ornamental stone in Norway has shown a slight increase during the last five years, around 1 billion NOK (100 mill. Euro). The most important activity is the production of larvikite, most of the production exported as raw blocks. Such export also occurs in less quantity from anorthosite and granite resources. The production of schist is different, processing factories are usually situated close to the quarries. Thus, only finished products are sold, much of which for export.

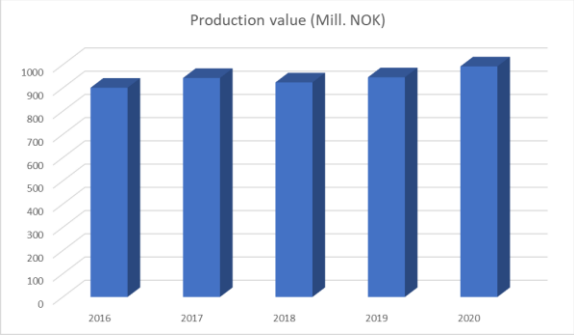


Figure 2. Total production value Norwegian Ornamental stone

There are two interesting and innovative trends in Norwegian ornamental stone production in recent years. One is the reduction of waste from raw block production. This includes the use of waste for coastal protection blocks, production of drywall-stone and paving stone, production of rock aggregate, and even the employment of sawing dust for agricultural purposes.

The other line of innovation is the development of new products in the schist industry. From being solely focused on extracting only the stone usable for roofing slate, there is now a wide range of products, from sawed and honed slabs from schist blocks not applicable for splitting, to drywall-stone. This has created a much better utilisation of the resources, less waste and more valuable products.

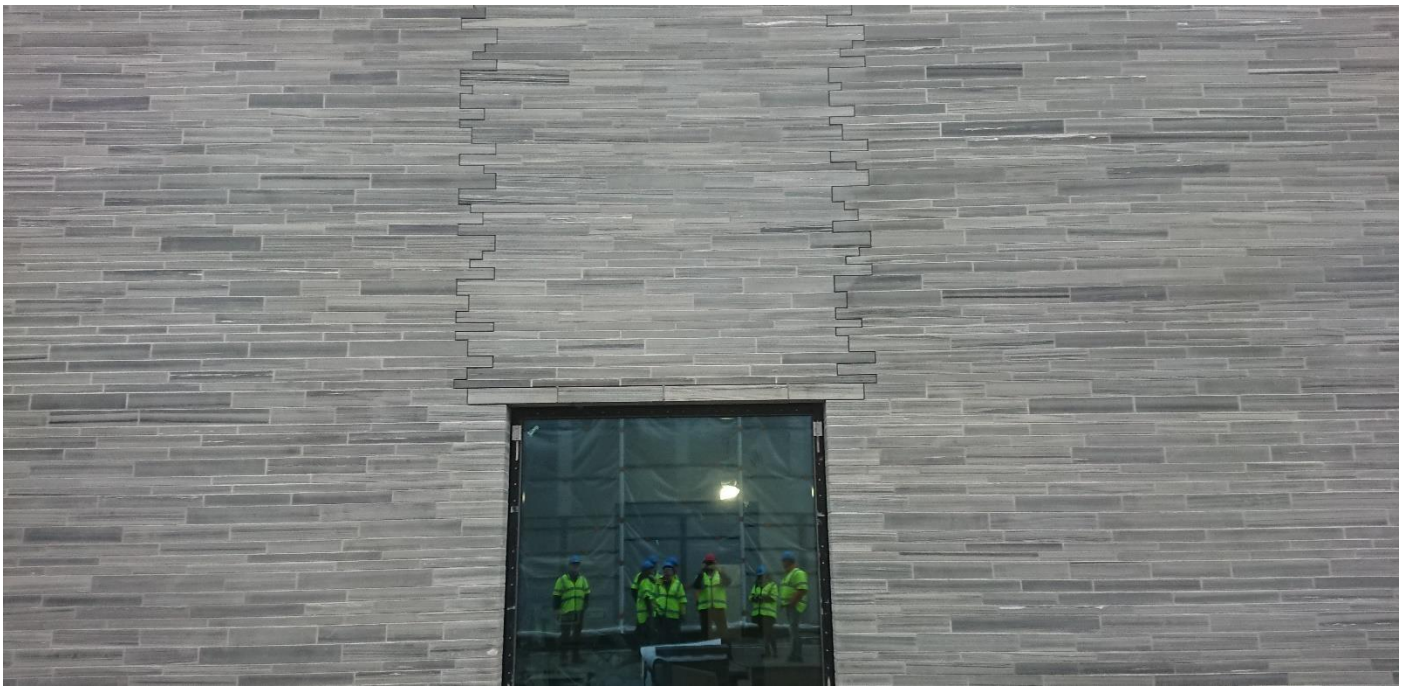


Figure 3. The use of sawn and sandblasted, cross-schistosity cuts of the Oppdal schist in the facade of the new Norwegian National Art Museum (to open in 2022) crossed an innovation barrier.

Use of ornamental stone and heritage values

In Norwegian context, the use of ornamental stone became an issue shortly after the Viking period. Christianity brought demands for stone buildings (churches and monasteries), and during the 12th century, many foreign stone masons found their way to Norway for helping the locals finding and using stones for the holy constructions. The Nidaros Cathedral (Figure 4) is the most prominent example from this period, with extensive use of soapstone and marble. However, there are many other buildings, applying the best possible, nearby resource of stone; soapstone, marble, granite, monzonite, greenstone.

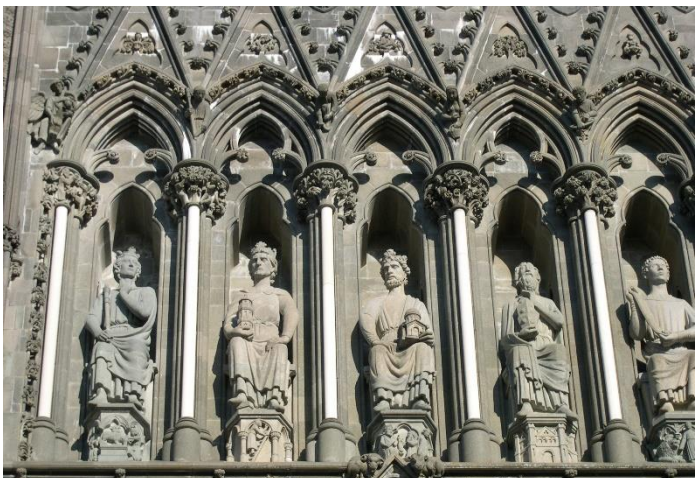


Figure 4. Soapstone and white marble in the Nidaros Cathedral, Trondheim.

After the plague in 1348-50, much of the acquired knowledge of stone construction was lost. After the Reformation in 1537, many of the medieval buildings were nothing but quarries for people in power. The Norwegian stone industries did not recover until the 18th century, when the Danish king wanted “rare and beautiful stones”, and marble production started in southern Norway. Most of the marble were brought to Copenhagen, where we still can find it in royal castles and the infamous Marble Church.

In Norway, not so much marble was used, but rather schist. The Caledonian orogeny transformed sandstone and claystone to schist, readily available most part of the country and easy to exploit and use for building. Most likely was the roof of the King Håkons Hall in Bergen (1261)

covered with roofing slate. Over the years to come, schist became used much in traditional architecture, particularly in the rural areas.

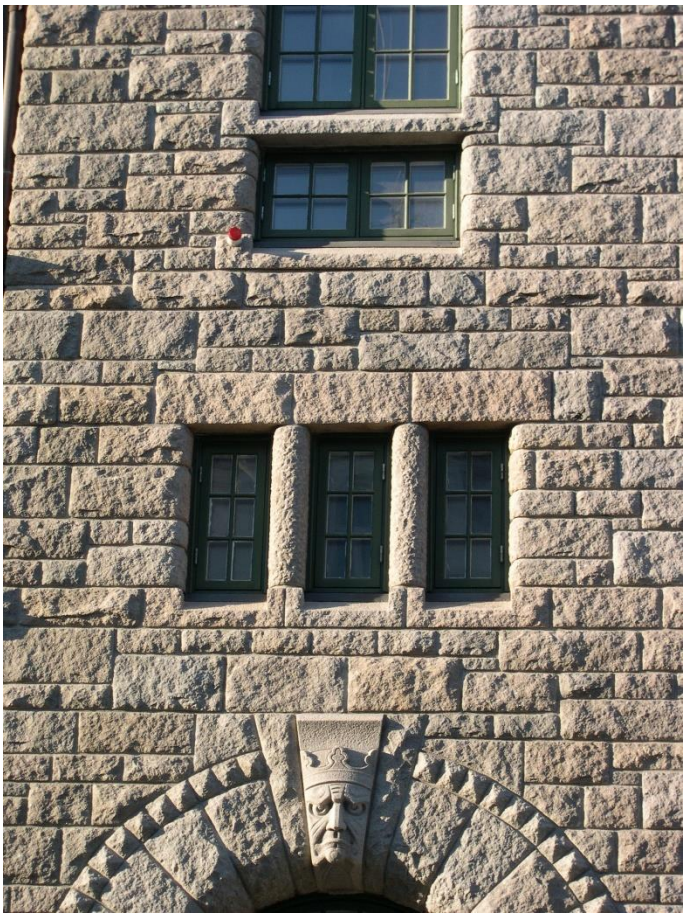


Figure 5. "Scottish Rubble" facade, Iddefjord granite, Trondheim (early 20th century).

With the industrial revolution came new technology and need for building materials. The modern stone industry in Norway was born between 1820 and 1870, and towards the end of the 19th century, thousands of people were employed in granite, gneiss, schist, marble and soapstone quarries all over the country. Early 20th century public buildings were made of stone, and the streets were covered with paving stone. Much of the production was exported to other countries as far as Argentina.

After WW2, the use of stone was rather limited except for roofing slate and funerary monuments. During the late 20th century things changed, and ornamental stone became again important building material. Recent large building projects have often included innovative ways of using ornamental stone, i.e. the Oslo Opera House and the new National Museum.

The most important heritage of stone in Norway are buildings. In particular, the group of medieval stone buildings (churches, monasteries and some profane buildings) is important, but also a large group of buildings between 1870 and 1930. However, many of the quarries and quarry landscapes left behind from extensive exploitation are important; both as heritage in themselves or as sources for future material for restoration and new constructions.

Descriptions of ornamental stone resources

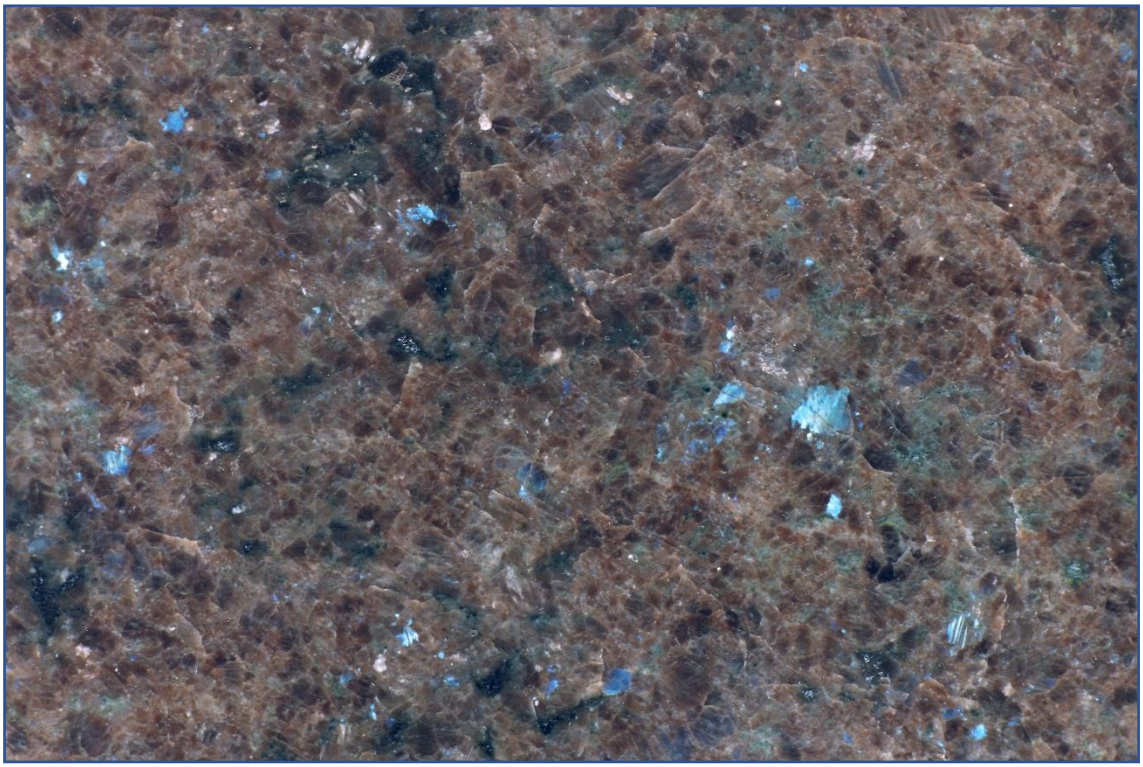
A selection of ornamental stones in Norway are described below in the order shown in the table.

Stone Name	Commodity	Lithology
Sirevåg Anortositt	commercial granite	Anorthosite
Flisagabbro	commercial granite	Gabbro
Barents Red	commercial granite	Gneiss
Drammensgranitt	commercial granite	Granite
Evjengranitt	commercial granite	Granite
Iddefjordsgranitt	commercial granite	Granite
Barents Blue	commercial granite	Migmatite
Bergan larvikitt	commercial granite	Monzonite
Krukåsen larvikitt	commercial granite	Monzonite
Lys larvikitt	commercial granite	Monzonite
Malerød larvikitt	commercial granite	Monzonite
Mørk larvikitt	commercial granite	Monzonite
Stålaker larvikitt	commercial granite	Monzonite
Arctic black	commercial granite	Syenite
Grorudsyenitt	commercial granite	Syenite
Ice Green	commercial granite	Tonalite
Størengranitt	commercial granite	Tonalite
Antique Foncé	commercial marble	Calcite marble
Norwegian Rose	commercial marble	Calcite-dolomite marble
Furuli	commercial marble	Marble
Leivsetmarmor	commercial marble	Marble
Trysilsandstein	commercial sandstone	Arkose
Værlandet breksje	commercial sandstone	Breccia
Masikvartsitt	commercial sandstone	Quartzite
Hardangerskifer	Commercial slate	Mica schist
Ottaskifer	commercial slate	Mica schist
Altaskifer	commercial slate	Schist
Dovreskifer	commercial slate	Schist
Liskifer	commercial slate	Schist
Oppdalskifer	commercial slate	Schist

Sirevåg Anortositt (Sirevåg Anorthosite)

Labrador Antique

Lundhs Antique

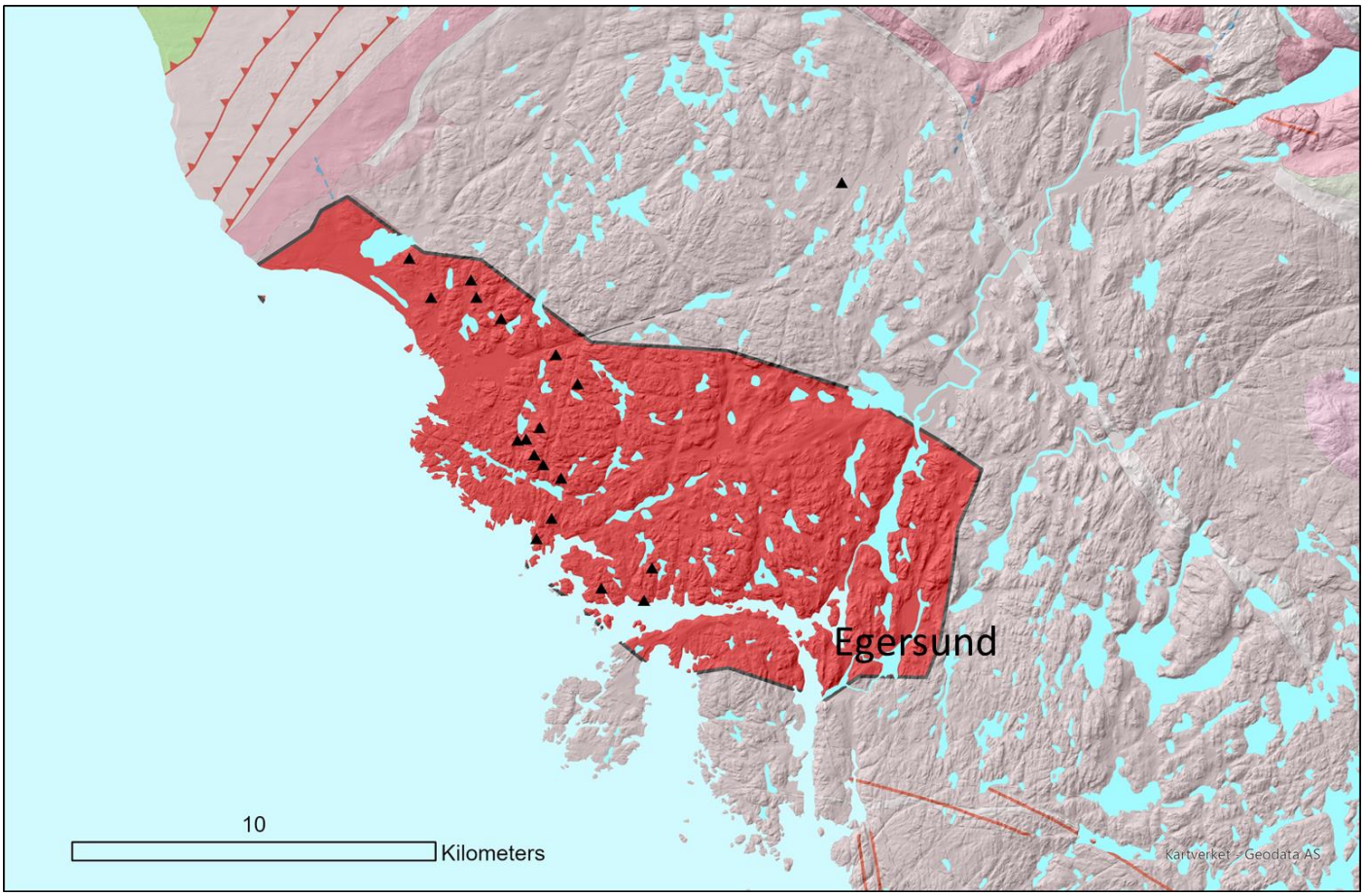


5 centimeters

Short description: Brown with black streaks and blue to green schillerization within plagioclase crystals with labradorite composition. The image displays a polished surface.

Commodity (vocabulary)	Lithology (vocabulary)	Typical colour (code list)	Place of origin			
			Country	County / District / Province	Municipality / Community	Place/town / Village
Commercial Granite	Anorthosite	Brown	Norway	Rogaland	Hå Eigersund	Sirevåg Hellvik

Geological setting



Geology: Brown, labradorite-containing anorthosite (red marking) forms a part of a large igneous complex of app. 950 Ma age, situated in SW Norway. Nearest town is Egersund. Black triangles are quarries, registrations and/or deposits.

Production: There are two main quarry areas in the central part of the map. Else, there are mapped, unexploited resources. Early 20th century there some exploitation on a small scale. New production started around 1995 at several sites.

Geological age: Vendian (Late Proterozoic) 950 Ma
Geological unit: Rogaland Anorthosite Complex

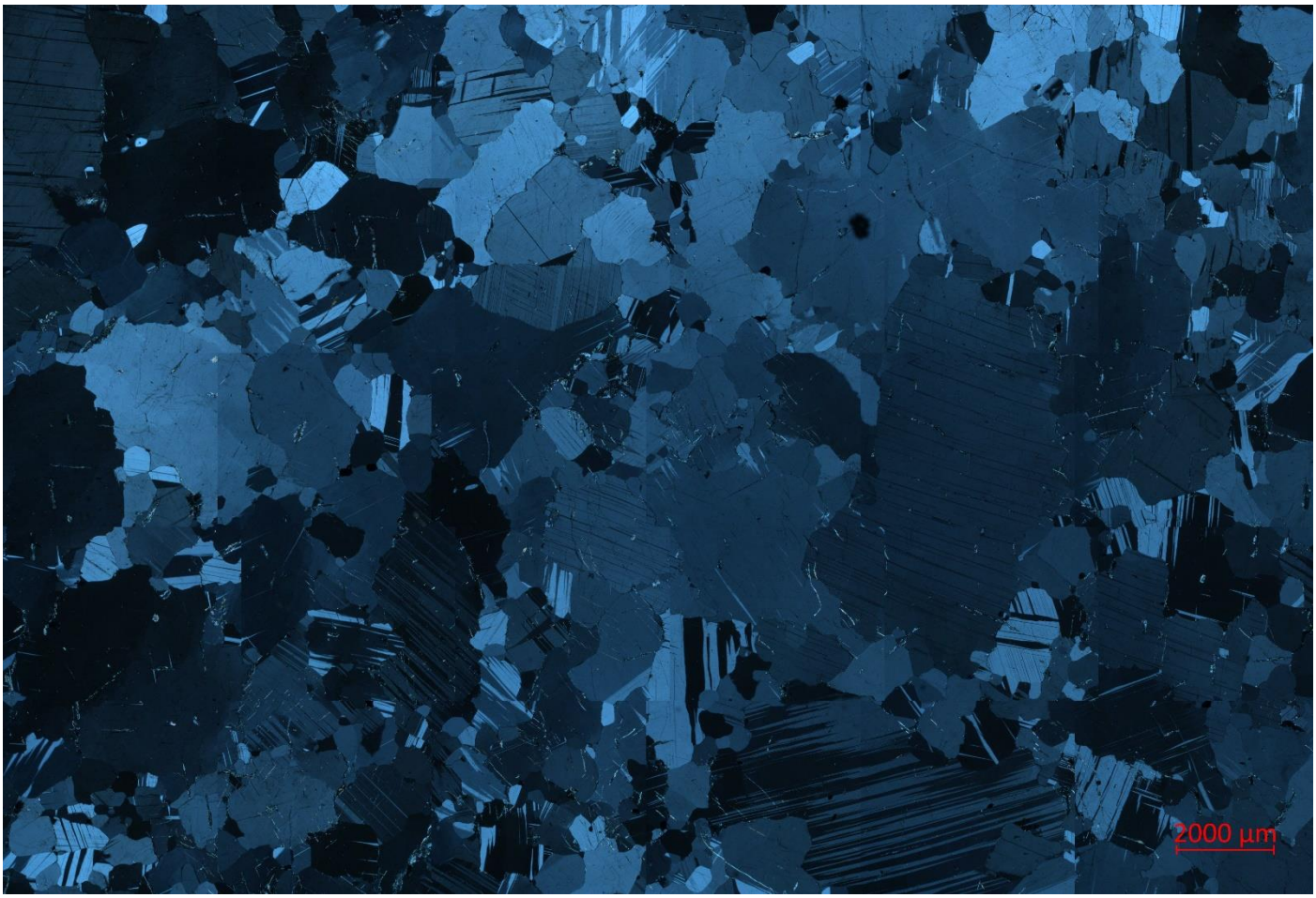
Application, use and heritage

Description: Anorthosite with the labradorite crystals were first discovered and exploited in a small scale in the early 20th century. It was later rediscovered in the 1990s, and quarrying has taken place since 1995. Most of the production is exported and the main uses are kitchen tops, facades and interior floors.



Use of the anorthosite in kitchen and bathroom (Photo: Lundhs/Morten Rakke)

Petrography



Description: The rock is predominantly composed of plagioclase feldspar (more than 90%) but may also contain orthopyroxene, chlorite and magnetite/ilmenite. The blue play of colour is caused by twin lamellae in the labradorite feldspar crystals. Photomicrograph of thin section (mosaic), crossed polarized light showing plagioclase (andesine to labradorite in composition). Small, bright lines and dots are secondary sericite.

Source of information: Geological Survey of Norway

Mineral composition

If no accurate number, use MM=main minerals, SM = Subordinate minerals, AM=accessory minerals

Feldspars (%)	Pyroxene (%)	Chlorite (%)	Opaques (%)			
92	**5**	**1,5**	**1,5**			

Source of information: Lundhs

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Physical properties

Apparent density (EN 1936), kg/m3	Open porosity (EN 1936), % vol	Water absorption at atmospheric pressure (EN 13755), % wt	Uniaxial Compressive strength (EN 1926), MPa	Flexural strength under concentrated load (EN 12372), MPa
2698	**0,27**	**0,09**	**155,5**	**10,7**

Real density (EN 1936), kg/m3	Total porosity (EN 1936), % vol	Water absorption coefficient by capillary (EN 1925) (g/m2 x s0,5)	Flexural strength under constant moment (EN 13161), MPa

Frost resistance (EN 12371)				
Technological Test (Test A)				Identification Test (Test B): Number of cycles completed prior to stone failure
Flexural strength (EN 12372) after freeze-thaw cycling, MPa	Number of cycles	Uniaxial compressive strength (EN 1926) after freeze-thaw cycling, MPa	Number of cycles	
11,1	**56**			

Resistance to ageing by thermal shock (EN 14066)			
Change in dynamic modulus of elasticity (increase: +; decrease: -), %	Change in open porosity (increase: +; decrease: -), %	Change in ultrasound pulse velocity (increase: +; decrease: -), %	Change in flexural strength under conc. load (increase: +; decrease: -) %

Abrasion resistance (EN 14157)			**Resistance to salt crystallisation (EN 12370)**	**Breaking load at dowel hole (EN 13364)**	
Method A - Wide Wheel Abrasion Test, mm	Method B - Böhme Abrasion Test, cm^3 / $50cm^2$	Method C - Amsler Abrasion Test, mm	Change in mass (increase: +; decrease: -), %	Breaking load, N	Thickness of the test specimens, mm
17,5					

Slip resistance by means of the pendulum tester (EN 14231 / CEN/TS 16165)			**Rupture energy (EN 14158), Joule**	**Thermal Conductivity (EN 1745), W/m·K**
Tested surface finish	Slip Resistance Value — SRV			
	Dry test condition	Wet test condition		
Polished	**67**	**8**		

Source of information: Lundhs

Chemical properties

Main elements

SiO_2 (%)	Al_2O_3 (%)	Fe_2O_3 (%)	TiO_2 (%)	MgO (%)	CaO (%)	Na_2O (%)	K_2O (%)	MnO (%)	P_2O_5 (%)	SO_3 (%)	LOI (%)

Trace elements

V (ppm)	Cr (ppm)	Mn (ppm)	Co (ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	As (ppm)
Sr (ppm)	Cd (ppm)	Ba (ppm)	Pb (ppm)	Be (ppm)	Rb (ppm)	Bi (ppm)	U (ppm)
Sc (ppm)	Y (ppm)	Th (ppm)	Sb (ppm)	Ta (ppm)	Nb (ppm)	Zr (ppm)	Sn (ppm)
Ag (ppm)	B (ppm)	Mo (ppm)	W (ppm)	Ga (ppm)	Ge (ppm)	Se (ppm)	Cs (ppm)
Tl (ppm)							

REE

La (ppm)	Ce (ppm)	Pr (ppm)	Nd (ppm)	Sm (ppm)	Eu (ppm)	Gd (ppm)	Tb (ppm)
Dy (ppm)	Ho (ppm)	Er (ppm)	Tm (ppm)	Yb (ppm)	Lu (ppm)		

Methods applied and source of information:

Sources of more information

Type of information	Name of provider	URL
This data sheet	Geological Survey of Norway	
Maplink	Geological Survey of Norway	https://geo.ngu.no/kart/common_mobil/?_/kart/mineralressurser_mobil/__lang=eng::extent=-44623.852497632164,6515435.699831528,-15089.72749763216,6527790.949831528::map=9
Non-commercial directory	Natural stone online	Detailansicht (naturalstone-online.com)
Commercial directory		
Scientific publication	Geological Survey of Norway	https://www.ngu.no/FileArchive/NGUPublikasjoner/Bulletin427_123-126.pdf
Other publication		

Compiled by:	Geological Survey of Norway (NGU) https://www.ngu.no/	GEOLOGICAL SURVEY OF NORWAY - NGU -

Barents Red

Nyelvgneis (Nyelv Gneiss)

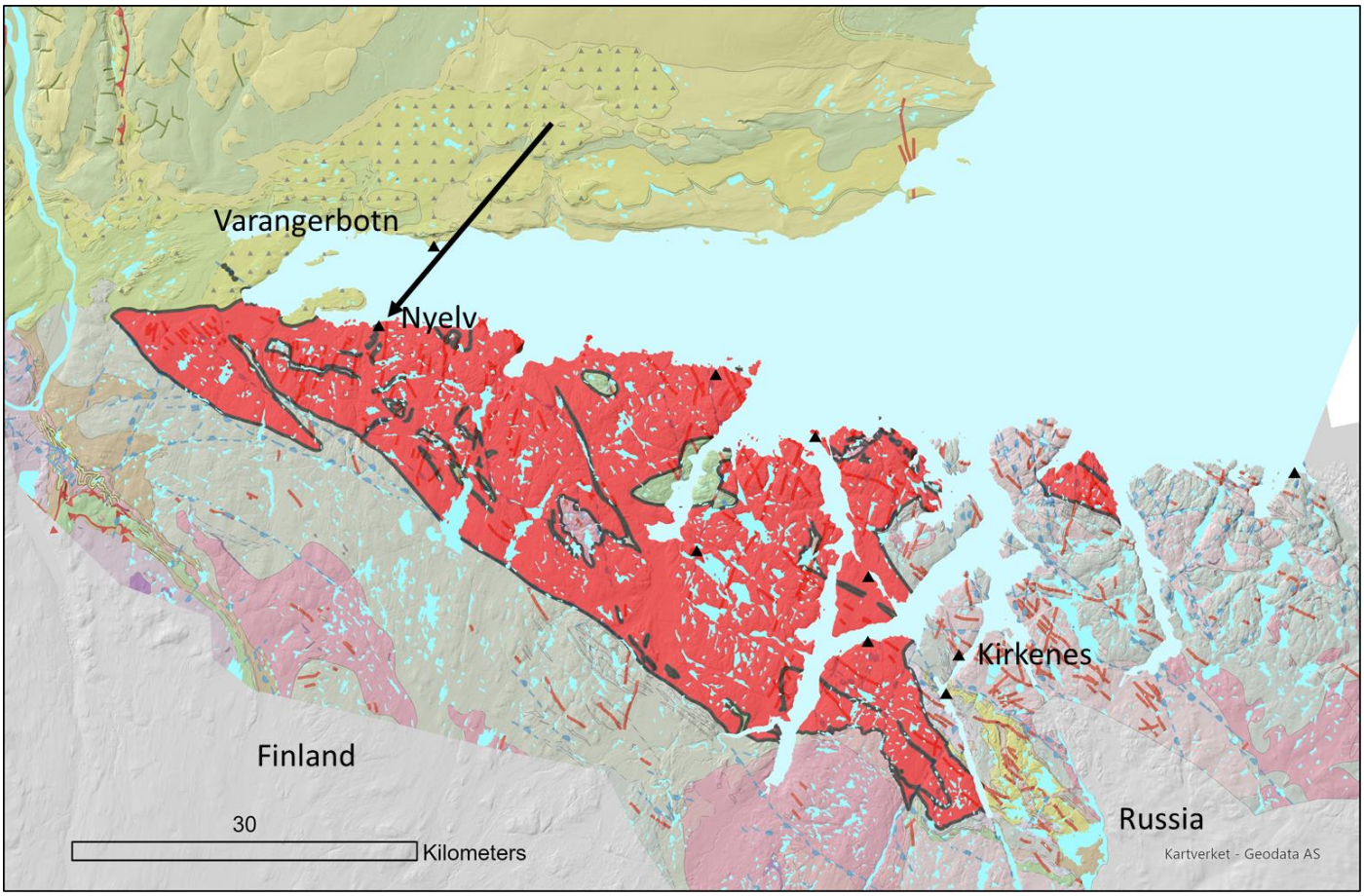


5 centimeters

Short description: Migmatitic gneiss with pink fields (potassium feldspar and quartz) and grey fields (quartz, plagioclase and biotite). The image displays a polished surface.

Commodity (vocabulary)	Lithology (vocabulary)	Typical colour (code list)	Place of origin			
			Country	County / District / Province	Municipality / Community	Place/town / Village
Commercial Granite	Gneiss	Multicolour	Norway	Troms-Finnmark	Unjárgga /Nesseby	Nyelv

Geological setting



Geology: The Varanger Complex contains a variety of migmatitic gneisses, of uncertain origin. These are among the oldest rocks in the Norwegian geology. The reddish Nyelv variety is situated at the south coast of the Varanger bay.

Production: Production started in the early 1990s, and continued as a small production combined with aggregate production.

Geological age: Archean 2800 Ma
Geological unit: Varanger Complex

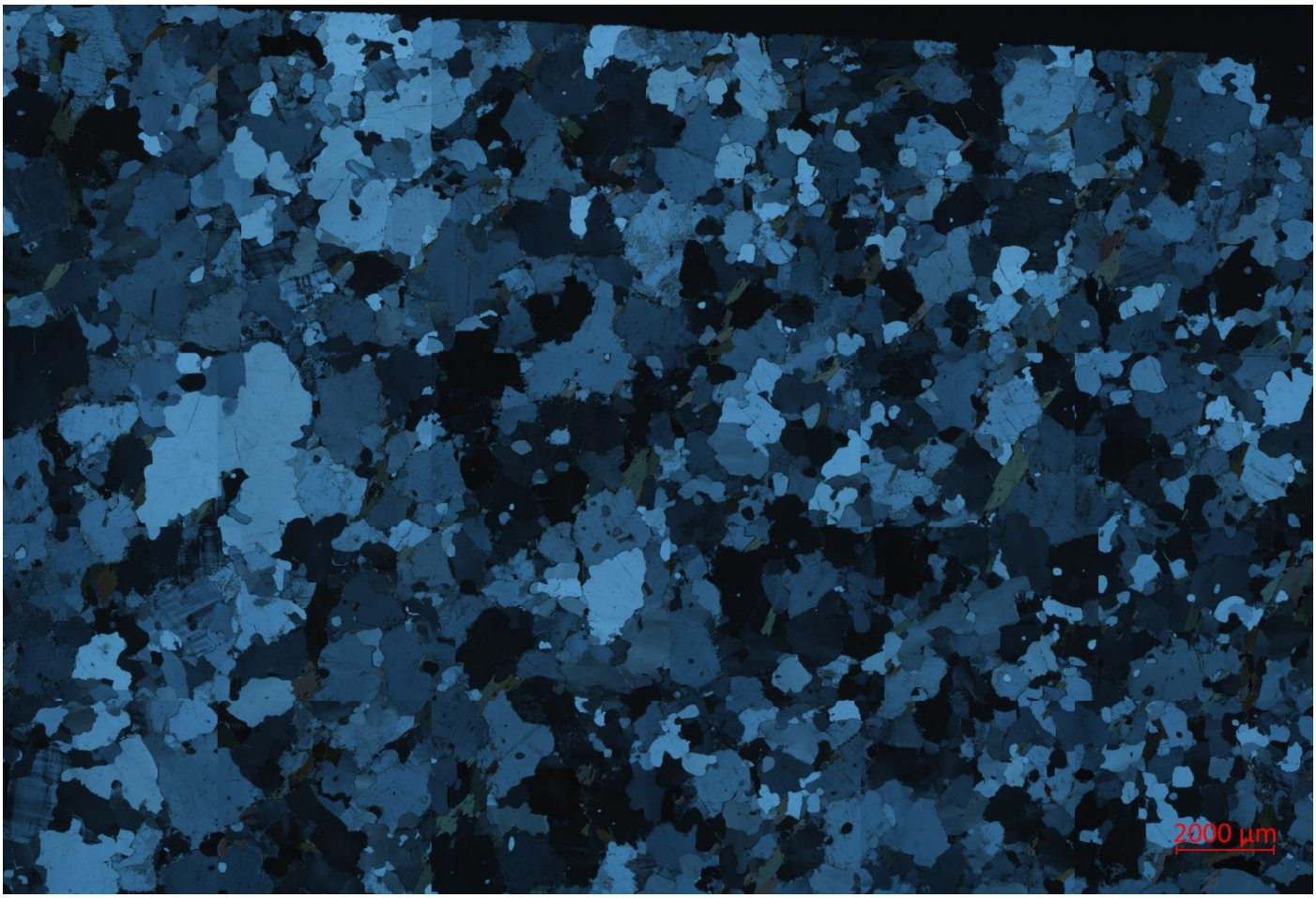
Application, use and heritage

Description: Mostly used for funerary monuments and floor tiles.



Floor tiles in a reception area in a hotel, Bergen.

Petrography



Description: Photomicrograph of thin section, crossed polarized light showing potassium feldspar, plagioclase, polygonal quartz and lepidoblastic mica (predominantly biotite).

Source of information: Geological Survey of Norway

Mineral composition

If no accurate number, use MM=main minerals, SM = Subordinate minerals, AM=accessory minerals

Potassium feldspar (%)	Plagioclase (%)	Quartz (%)	Biotite (%)	Opaques (%)	Others (%)	
25	**25**	**35**	**10**	**2**	**3**	

Source of information: NGU estimate for the present survey

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Physical properties

Apparent density (EN 1936), kg/m3	Open porosity (EN 1936), % vol	Water absorption at atmospheric pressure (EN 13755), % wt	Uniaxial Compressive strength (EN 1926), MPa	Flexural strength under concentrated load (EN 12372), MPa
2600		**0,09**	**237,7**	**22,5**

Real density (EN 1936), kg/m3	Total porosity (EN 1936), % vol	Water absorption coefficient by capillary (EN 1925) (g/m2 x s0,5)	Flexural strength under constant moment (EN 13161), MPa

Frost resistance (EN 12371)				
Technological Test (Test A)				Identification Test (Test B): Number of cycles completed prior to stone failure
Flexural strength (EN 12372) after freeze-thaw cycling, MPa	Number of cycles	Uniaxial compressive strength (EN 1926) after freeze-thaw cycling, MPa	Number of cycles	

Resistance to ageing by thermal shock (EN 14066)			
Change in dynamic modulus of elasticity (increase: +; decrease: -), %	Change in open porosity (increase: +; decrease: -), %	Change in ultrasound pulse velocity (increase: +; decrease: -), %	Change in flexural strength under conc. load (increase: +; decrease: -) %

Abrasion resistance (EN 14157)			**Resistance to salt crystallisation (EN 12370)**	**Breaking load at dowel hole (EN 13364)**	
Method A - Wide Wheel Abrasion Test, mm	Method B - Böhme Abrasion Test, cm^3 / $50cm^2$	Method C - Amsler Abrasion Test, mm	Change in mass (increase: +; decrease: -), %	Breaking load, N	Thickness of the test specimens, mm

Slip resistance by means of the pendulum tester (EN 14231 / CEN/TS 16165)			**Rupture energy (EN 14158), Joule**	**Thermal Conductivity (EN 1745), W/m·K**
Tested surface finish	Slip Resistance Value — SRV			
	Dry test condition	Wet test condition		
Polished				

Source of information: Historic data from Norwegian Stone Industry, c. 1995

Chemical properties

Main elements

SiO_2 (%)	Al_2O_3 (%)	Fe_2O_3 (%)	TiO_2 (%)	MgO (%)	CaO (%)	Na_2O (%)	K_2O (%)	MnO (%)	P_2O_5 (%)	SO_3 (%)	LOI (%)

Trace elements

V (ppm)	Cr (ppm)	Mn (ppm)	Co (ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	As (ppm)
Sr (ppm)	Cd (ppm)	Ba (ppm)	Pb (ppm)	Be (ppm)	Rb (ppm)	Bi (ppm)	U (ppm)
Sc (ppm)	Y (ppm)	Th (ppm)	Sb (ppm)	Ta (ppm)	Nb (ppm)	Zr (ppm)	Sn (ppm)
Ag (ppm)	B (ppm)	Mo (ppm)	W (ppm)	Ga (ppm)	Ge (ppm)	Se (ppm)	Cs (ppm)
Tl (ppm)							

REE

La (ppm)	Ce (ppm)	Pr (ppm)	Nd (ppm)	Sm (ppm)	Eu (ppm)	Gd (ppm)	Tb (ppm)
Dy (ppm)	Ho (ppm)	Er (ppm)	Tm (ppm)	Yb (ppm)	Lu (ppm)		

Methods applied and source of information:

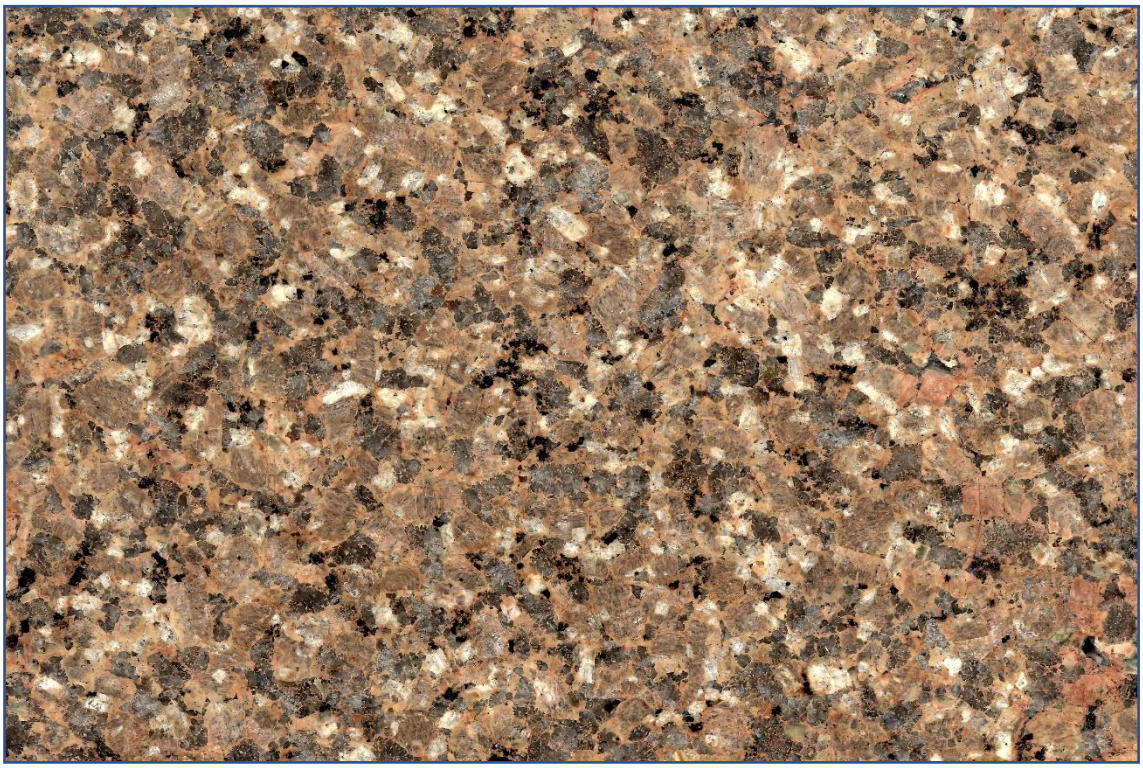
Sources of more information

Type of information	Name of provider	URL
Data sheet	Geological Survey of Norway	https://geo.ngu.no/api/faktaark/mineralressurser/visNaturstein.php?objid=12491&lang=eng
Maplink	Geological Survey of Norway	https://geo.ngu.no/kart/common_mobil/?_/kart/mineralressurser_mobil/__lang=eng::extent=1021892.9522697626,7833202.438709877,1025584.7178947626,7834805.024647377::map=9
Non-commercial directory	Natural stone online	Detail view (naturalstone-online.com)
Commercial directory		
Scientific publication		
Other publication		

Compiled by:	Geological Survey of Norway (NGU) https://www.ngu.no/	

Drammensgranitt (Drammen Granite)

Røykengranitt



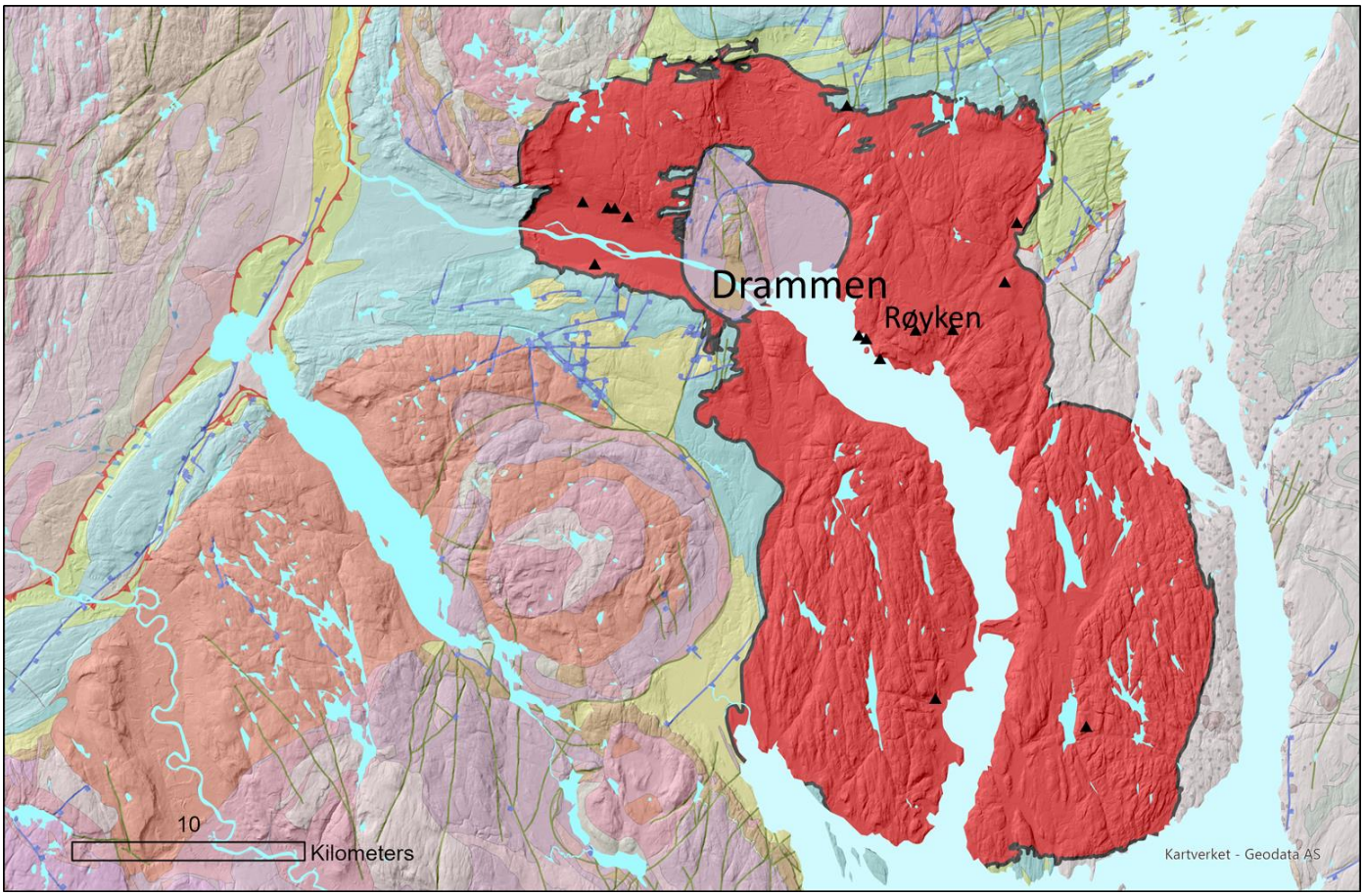
5 centimeters

Short description: Brownish red, coarse-grained granite. The image displays a polished surface.

Commodity (vocabulary)	Lithology (vocabulary)	Typical colour (code list)	Place of origin			
			Country	County / District / Province	Municipality / Community	Place/town / Village
Commercial Granite	Granite	Redish brown	Norway	Viken	Røyken	Høgåsen

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Geological setting



Geology: The Drammen Granite is the collective name of a group of plutons of predominantly granitic composition. It crops out SW Oslo around the city of Drammen (red colour). Black triangles are main quarry sites, most of them historic. The Drammen granite belongs to a range of igneous rocks in the Carboniferous-Permian Oslo rift.

Production: There are tens of historic quarry sites in the area, producing building-stone, monuments and paving stone. Quarrying initiated in the late 19th century, reaching a peak in the early 20th century. Around 1900, 5000 workers produced granite in the area for domestic and foreign markets. At present time, only one quarry near Røyken is in production.

Geological age: Permian 267 Ma
Geological unit: Drammensgranitten

Application, use and heritage

Description: The granite was employed for buildings and monuments from the mid-1800's, and was important in the Oslo architecture early 20th century. Many cities in Norway have listed buildings with Drammen granite façades. It was also used for acid-resistant production towers at a Norwegian nitrate factory. Post WW2 the granite has been most important for outdoor use, such as kerbs and urban furniture. The main office of the Norwegian National Bank (1986) has Drammen granite façade.



Drammen granite façade in the main office of the Norwegian National Bank, Oslo, constructed 1986.

Petrography

Description: Medium- to coarse-grained granite, composed of K-feldspar (red), quartz (grey), plagioclase (white) and biotite (black). The colour of the granite vary from redish brown to lighter yellowish grey, and it may contain small cavities due to the shallow emplacement depth during crystallization.

Source of information: Geological Survey of Norway

Mineral composition

If no accurate number, use MM=main minerals, SM = Subordinate minerals, AM=accessory minerals

Potassium feldspar (%)	Plagioclase (%)	Quartz (%)	Biotite (%)	Opaques (%)		
60	**15**	**15**	**7**	**3**		

Source of information: NGU estimate

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Physical properties

Apparent density (EN 1936), kg/m3	Open porosity (EN 1936), % vol	Water absorption at atmospheric pressure (EN 13755), % wt	Uniaxial Compressive strength (EN 1926), MPa	Flexural strength under concentrated load (EN 12372), MPa
2570		**0,44**	**206,5**	**11,2**

Real density (EN 1936), kg/m3	Total porosity (EN 1936), % vol	Water absorption coefficient by capillary (EN 1925) (g/m2 x s0,5)	Flexural strength under constant moment (EN 13161), MPa

Frost resistance (EN 12371)				
Technological Test (Test A)				Identification Test (Test B): Number of cycles completed prior to stone failure
Flexural strength (EN 12372) after freeze-thaw cycling, MPa	Number of cycles	Uniaxial compressive strength (EN 1926) after freeze-thaw cycling, MPa	Number of cycles	

Resistance to ageing by thermal shock (EN 14066)			
Change in dynamic modulus of elasticity (increase: +; decrease: -), %	Change in open porosity (increase: +; decrease: -), %	Change in ultrasound pulse velocity (increase: +; decrease: -), %	Change in flexural strength under conc. load (increase: +; decrease: -) %

Abrasion resistance (EN 14157)			**Resistance to salt crystallisation (EN 12370)**	**Breaking load at dowel hole (EN 13364)**	
Method A - Wide Wheel Abrasion Test, mm	Method B - Böhme Abrasion Test, cm^3 / $50cm^2$	Method C - Amsler Abrasion Test, mm	Change in mass (increase: +; decrease: -), %	Breaking load, N	Thickness of the test specimens, mm

Slip resistance by means of the pendulum tester (EN 14231 / CEN/TS 16165)			**Rupture energy (EN 14158), Joule**	**Thermal Conductivity (EN 1745), W/m·K**
Tested surface finish	Slip Resistance Value — SRV			
	Dry test condition	Wet test condition		
Polished				

Source of information: Natursteinskompaniet

Chemical properties

Main elements

SiO_2 (%)	Al_2O_3 (%)	Fe_2O_3 (%)	TiO_2 (%)	MgO (%)	CaO (%)	Na_2O (%)	K_2O (%)	MnO (%)	P_2O_5 (%)	SO_3 (%)	LOI (%)

Trace elements

V (ppm)	Cr (ppm)	Mn (ppm)	Co (ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	As (ppm)
Sr (ppm)	Cd (ppm)	Ba (ppm)	Pb (ppm)	Be (ppm)	Rb (ppm)	Bi (ppm)	U (ppm)
Sc (ppm)	Y (ppm)	Th (ppm)	Sb (ppm)	Ta (ppm)	Nb (ppm)	Zr (ppm)	Sn (ppm)
Ag (ppm)	B (ppm)	Mo (ppm)	W (ppm)	Ga (ppm)	Ge (ppm)	Se (ppm)	Cs (ppm)
Tl (ppm)							

REE

La (ppm)	Ce (ppm)	Pr (ppm)	Nd (ppm)	Sm (ppm)	Eu (ppm)	Gd (ppm)	Tb (ppm)
Dy (ppm)	Ho (ppm)	Er (ppm)	Tm (ppm)	Yb (ppm)	Lu (ppm)		

Methods applied and source of information:

Sources of more information

Type of information	Name of provider	URL
This data sheet	Geological Survey of Norway	https://geo.ngu.no/api/faktaark/mineralressurser/visNaturstein.php?objid=9642&lang=nor
Map link	Geological Survey of Norway	https://geo.ngu.no/kart/common_mobil/?_/kart/mineralressurser_mobil/__lang=nor::extent=237781.83351250825,6629963.378910098,239627.716325000825,6630764.671878848::map=9
Non-commercial directory	Natural stone online	Detailansicht (naturalstone-online.com)
Commercial directory		
Scientific publication	NGU Bulletin	https://aps.ngu.no/pls/oradb/rf.Visdok?c_dokid=00000036174
Other publication		

Compiled by:	Geological Survey of Norway (NGU) https://www.ngu.no/	

Evjengranitt (Evjen Granite)

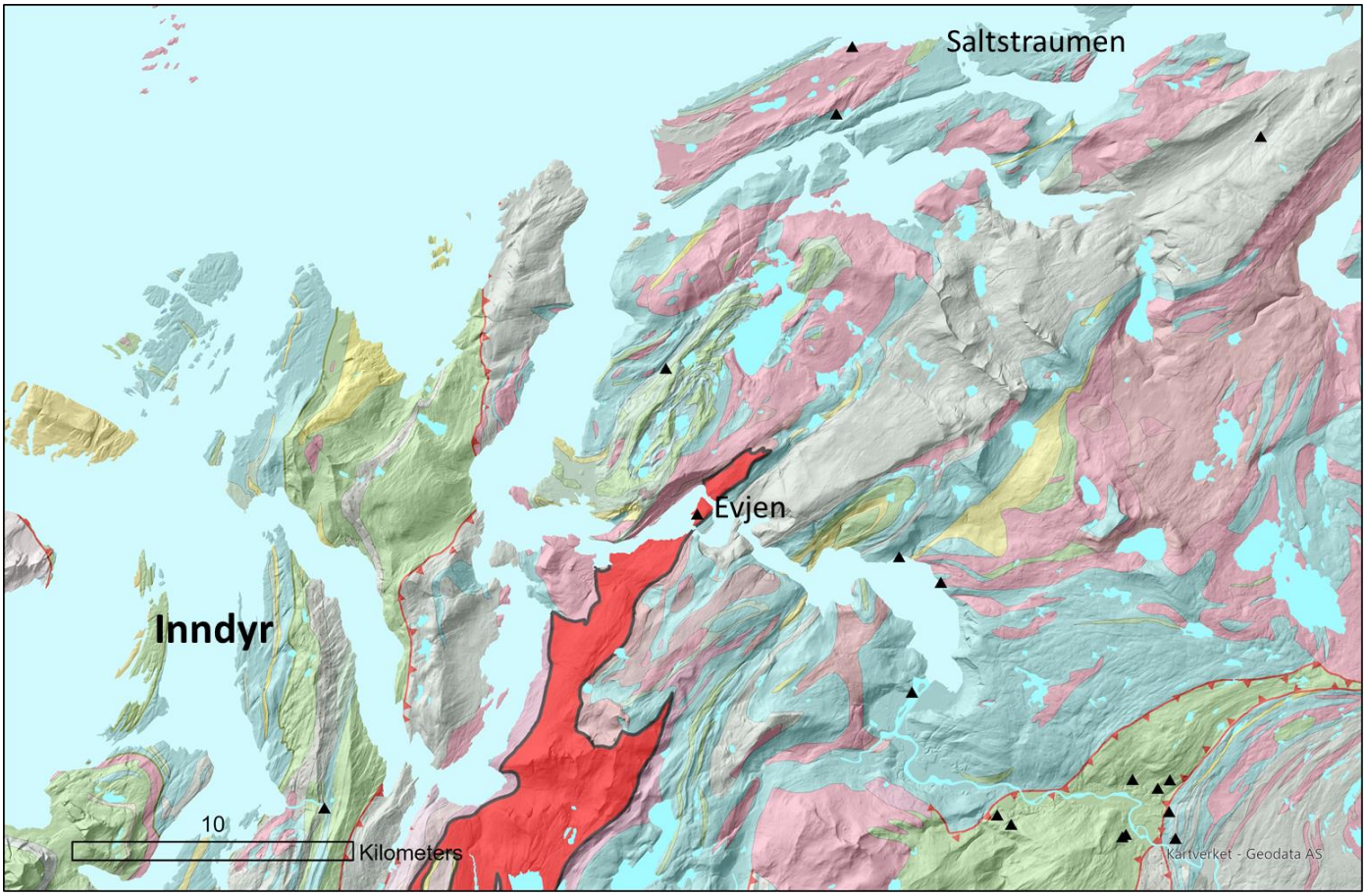


Short description: Medium- to coarse-grained, porphyritic granite. The image displays a polished surface.

Commodity (vocabulary)	Lithology (vocabulary)	Typical colour (code list)	Place of origin			
			Country	County / District / Province	Municipality / Community	Place/town / Village
Commercial Granite	Granite	Grey	Norway	Nordland	Beiarn	Evjen

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Geological setting



Geology: The Evjen granite belongs to a series of plutonic intrusions formed during the early stages of the Caledonian orogeny, and later emplaced in the Beiarn Nappe. The granite contains pegmatitic veins and patches, features that are valuated among users.

Production: Production started in 1985.

Geological age: Silurian 433 Ma
Geological unit: Beiarn Nappe

Application, use and heritage

Description: The Evjen Granite is predominantly applied for outdoor floors, elements and drywall-stone.



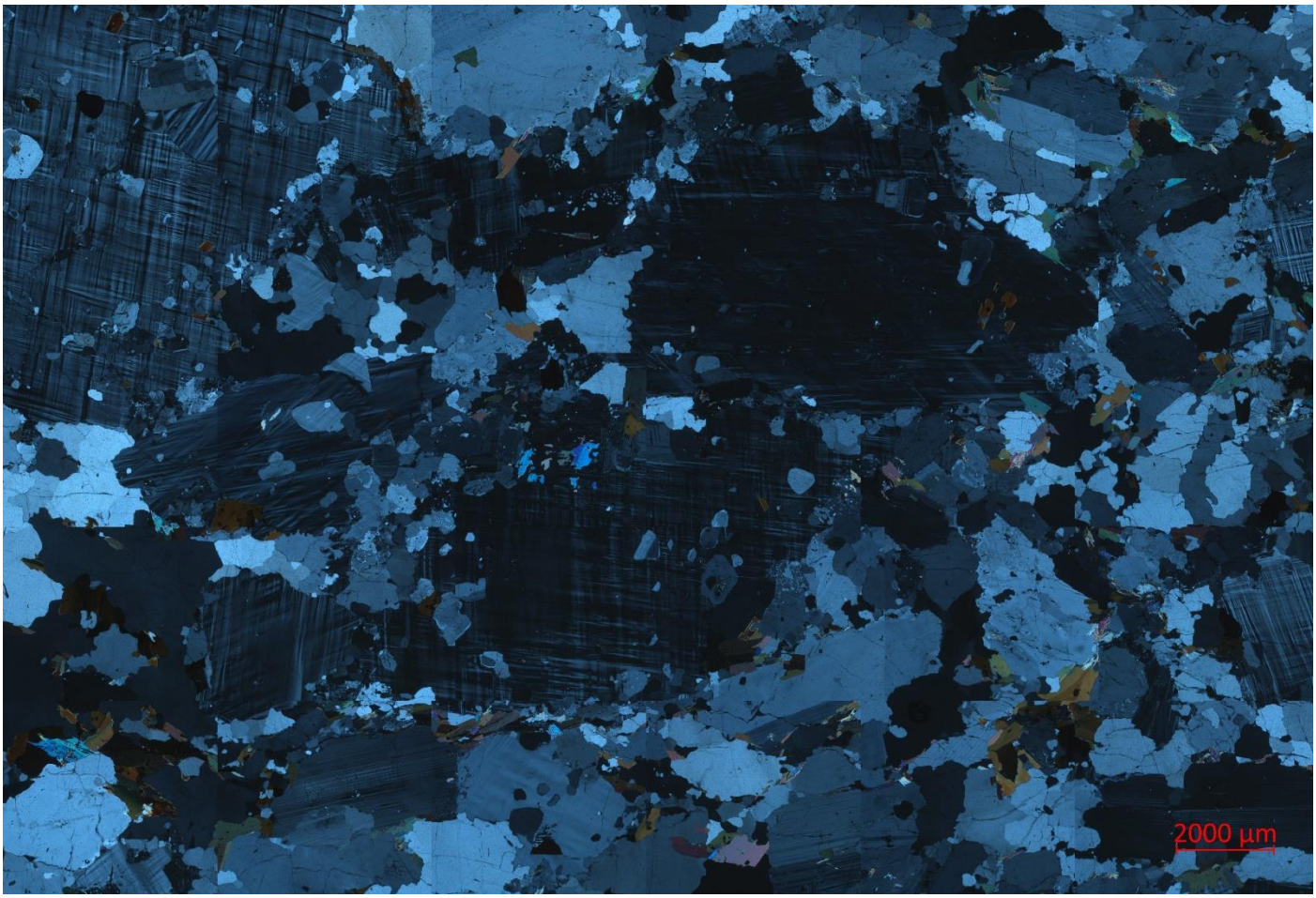
Examples of use outside granite factory



Pavement, displaying both pegmatitic and aplitic veins.

CC BY

Petrography



Description: Photomicrograph of thin section (mosaic), crossed polarized light showing large potassium feldspar fenocrysts surrounded by plagioclase, quartz and biotite.

Source of information: Geological Survey of Norway

Mineral composition

If no accurate number, use MM=main minerals, SM = Subordinate minerals, AM=accessory minerals

Potassium feldspar (%)	Plagioclase (%)	Quartz (%)	Biotite (%)	Zircon (%)	Muscovite (%)	Magnetite (%)
MM	**MM**	**MM**	**SM**	**AM**	**AM**	**AM**

Source of information: NGU

CC BY

Physical properties

Apparent density (EN 1936), kg/m3	Open porosity (EN 1936), % vol	Water absorption at atmospheric pressure (EN 13755), % wt	Uniaxial Compressive strength (EN 1926), MPa	Flexural strength under concentrated load (EN 12372), MPa

Real density (EN 1936), kg/m3	Total porosity (EN 1936), % vol	Water absorption coefficient by capillary (EN 1925) (g/m2 x s0,5)	Flexural strength under constant moment (EN 13161), MPa

Frost resistance (EN 12371)				
Technological Test (Test A)				Identification Test (Test B): Number of cycles completed prior to stone failure
Flexural strength (EN 12372) after freeze-thaw cycling, MPa	Number of cycles	Uniaxial compressive strength (EN 1926) after freeze-thaw cycling, MPa	Number of cycles	

Resistance to ageing by thermal shock (EN 14066)			
Change in dynamic modulus of elasticity (increase: +; decrease: -), %	Change in open porosity (increase: +; decrease: -), %	Change in ultrasound pulse velocity (increase: +; decrease: -), %	Change in flexural strength under conc. load (increase: +; decrease: -) %

Abrasion resistance (EN 14157)			**Resistance to salt crystallisation (EN 12370)**	**Breaking load at dowel hole (EN 13364)**	
Method A - Wide Wheel Abrasion Test, mm	Method B - Böhme Abrasion Test, cm^3 / $50cm^2$	Method C - Amsler Abrasion Test, mm	Change in mass (increase: +; decrease: -), %	Breaking load, N	Thickness of the test specimens, mm

Slip resistance by means of the pendulum tester (EN 14231 / CEN/TS 16165)			**Rupture energy (EN 14158), Joule**	**Thermal Conductivity (EN 1745), W/m·K**
Tested surface finish	Slip Resistance Value — SRV			
	Dry test condition	Wet test condition		
Polished				

Source of information:

CC BY

Chemical properties

Main elements

SiO_2 (%)	Al_2O_3 (%)	Fe_2O_3 (%)	TiO_2 (%)	MgO (%)	CaO (%)	Na_2O (%)	K_2O (%)	MnO (%)	P_2O_5 (%)	SO_3 (%)	LOI (%)

Trace elements

V (ppm)	Cr (ppm)	Mn (ppm)	Co (ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	As (ppm)
Sr (ppm)	Cd (ppm)	Ba (ppm)	Pb (ppm)	Be (ppm)	Rb (ppm)	Bi (ppm)	U (ppm)
Sc (ppm)	Y (ppm)	Th (ppm)	Sb (ppm)	Ta (ppm)	Nb (ppm)	Zr (ppm)	Sn (ppm)
Ag (ppm)	B (ppm)	Mo (ppm)	W (ppm)	Ga (ppm)	Ge (ppm)	Se (ppm)	Cs (ppm)
Tl (ppm)							

REE

La (ppm)	Ce (ppm)	Pr (ppm)	Nd (ppm)	Sm (ppm)	Eu (ppm)	Gd (ppm)	Tb (ppm)
Dy (ppm)	Ho (ppm)	Er (ppm)	Tm (ppm)	Yb (ppm)	Lu (ppm)		

Methods applied and source of information:

Sources of more information

Type of information	Name of provider	URL
Data sheet	Geological Survey of Norway	https://geo.ngu.no/api/faktaark/mineralressurser/visNaturstein.php?objid=9255&lang=eng
Maplink	Geological Survey of Norway	https://geo.ngu.no/kart/common_mobil/?_/kart/mineralressurser_mobil/__lang=eng::extent=468683.71740043553,7438675.386143816,480991.36583793553,7444652.026768816::map=9
Non-commercial directory	Natural stone online	
Commercial directory		
Scientific publication		
Other publication		https://www.ngu.no/upload/Georessurser/Naturstein/niba.pdf

Compiled by:	Geological Survey of Norway (NGU) https://www.ngu.no/	GEOLOGICAL SURVEY OF NORWAY - NGU -

Iddefjordsgranitt (Iddefjord Granite)

Østfoldgranitten

Østfold Granite



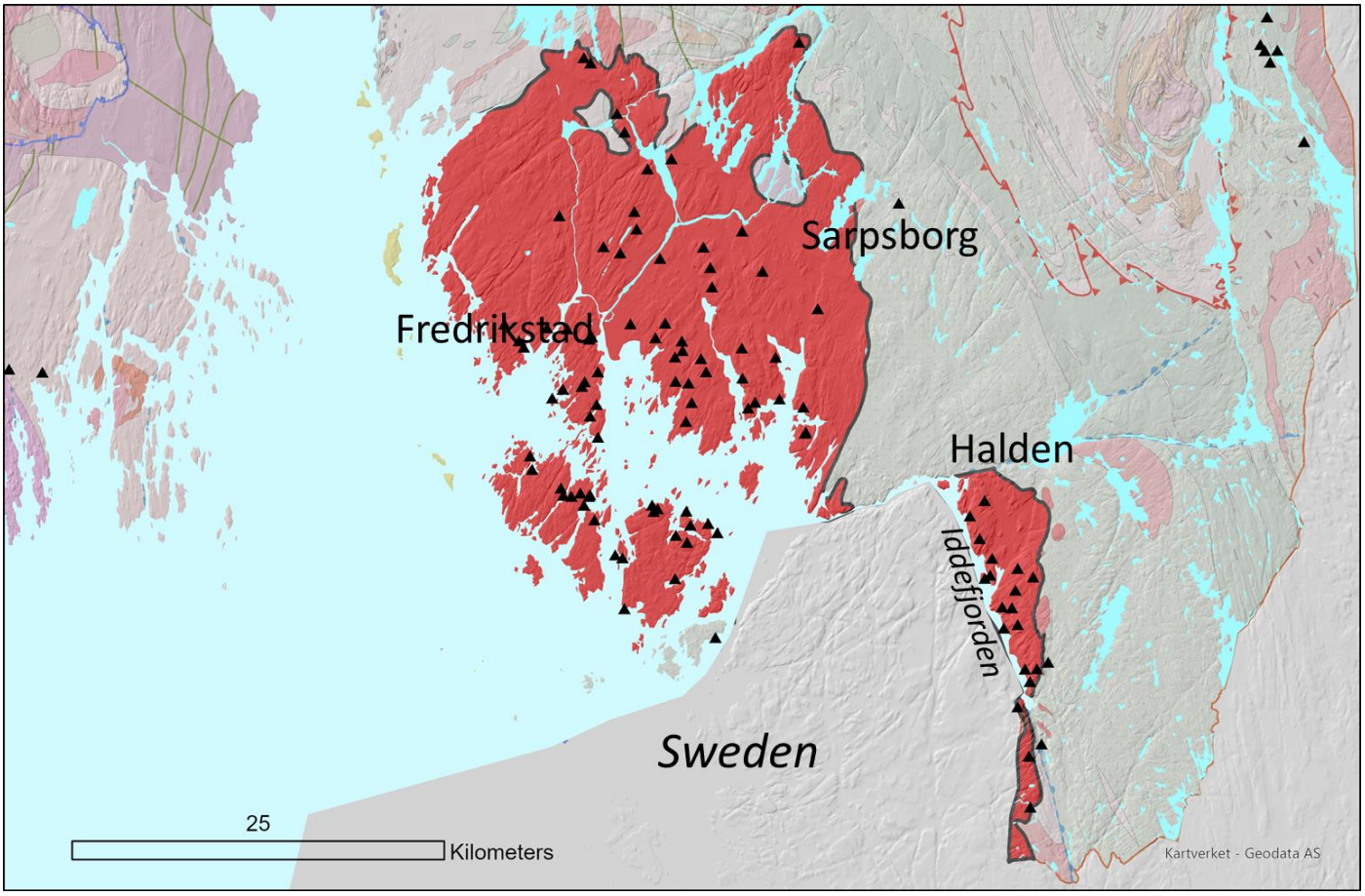
5 centimeters

Short description: Grey, medium-grained granite. The image displays a polished surface.

Commodity (vocabulary)	Lithology (vocabulary)	Typical colour (code list)	Place of origin			
			Country	County / District / Province	Municipality / Community	Place/town / Village
Commercial Granite	Granite	Grey	Norway	Viken	Halden Sarpsborg Fredrikstad	Skriverøya

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Geological setting



Geology: The Iddefjord Granite is the collective name of a group of plutons of predominantly granitic composition. It crops out near the Swedish border in SE Norway (red colour), and on the Swedish side the Bohus Granite is the equivalent.

Production: There are hundreds of historic quarry sites in the area, previously producing building-stone, monuments, sculptures and paving stone. Around 1900, 5000 workers produced granite in the area for domestic and foreign markets. At present time, production only takes place along Iddefjorden at Skriverøya.

Geological age: Late Proterozoic 918 Ma
Geological unit: Iddefjordsgranitten

Application, use and heritage

Description: The granite was employed already in the Middle Ages for stone churches. Later, in the 17th – 19th century, it was applied for fortifications and castles. Industrial scaled production started around 1850. Since then, the granite has been used for a large amount of monumental building and sculpture. Due to good splitting properties, it was widely applied for paving stone and kerbs.



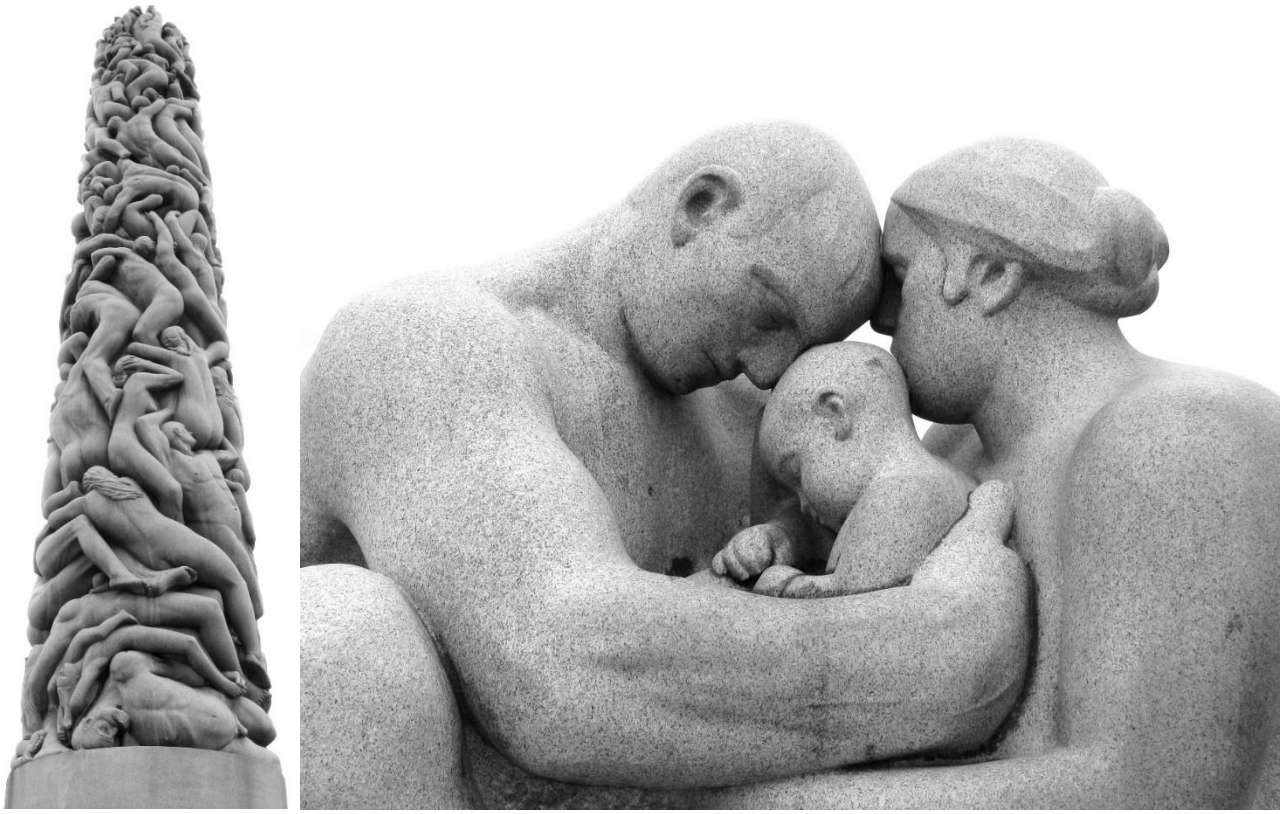
12th century church portal.

CC BY



The main post office building, Trondheim (1911).

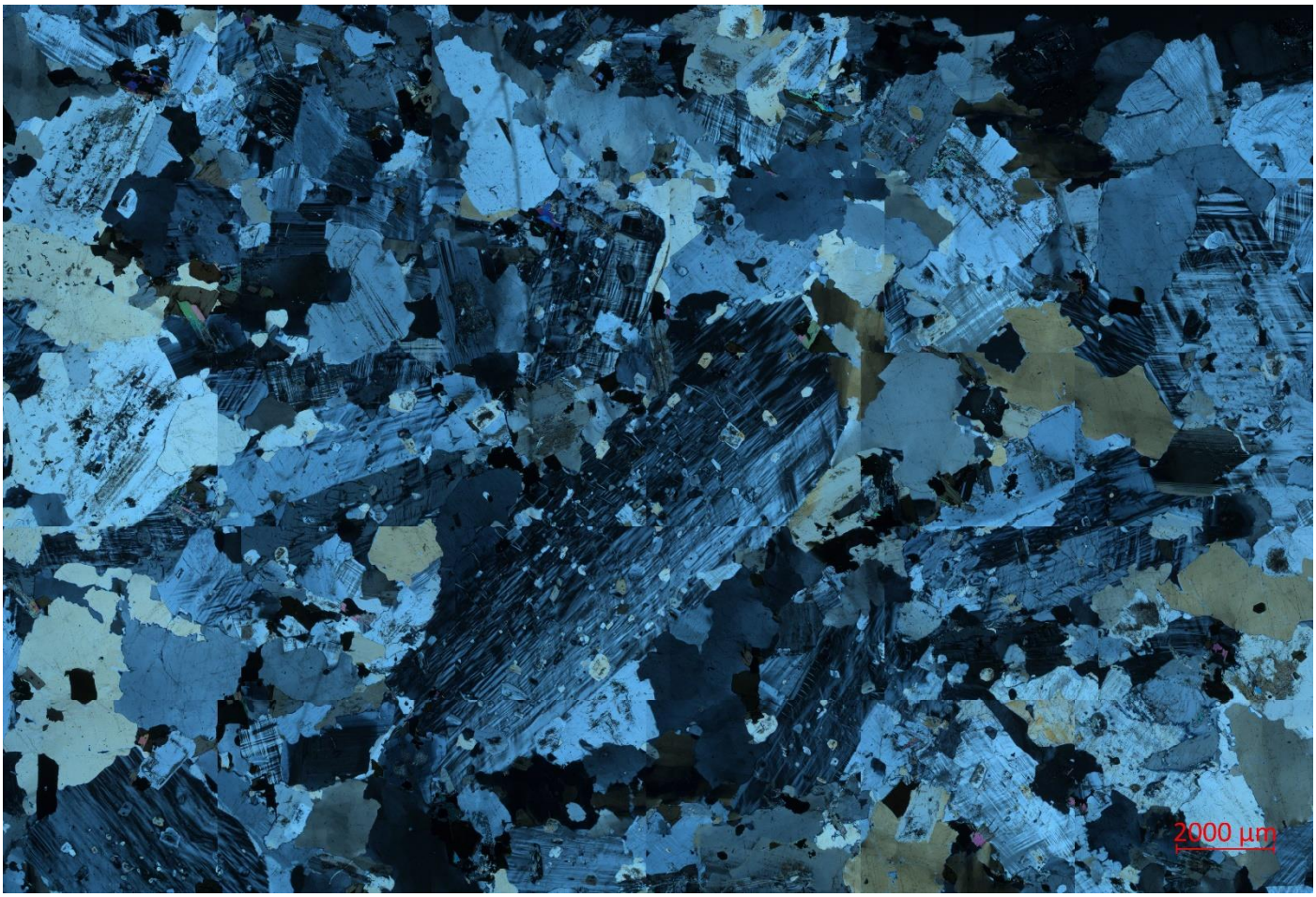
CC BY



Iddefjord Granite sculptures – works by Gustav Vigeland, Oslo.

CC BY

Petrography



Description: Photomicrograph (mosaic), crossed nichols, of medium-grained, microcline-plagioclase-quartz granite, varying in colour from warm grey to slightly redish, due to variations in feldspar colour. Most of the varieties are even-grained, but some minor deposits display porphyritic texture. The photo is of the Brekke variety of granite.

Source of information: Geological Survey of Norway

Mineral composition

If no accurate number, use MM=main minerals, SM = Subordinate minerals, AM=accessory minerals

Potassium feldspar (%)	Plagioclase (%)	Quartz (%)	Biotite (%)	Opaques (%)		
35	**30**	**26**	**7**	**3**		

Source of information: NGU

Physical properties

Apparent density (EN 1936), kg/m3	Open porosity (EN 1936), % vol	Water absorption at atmospheric pressure (EN 13755), % wt	Uniaxial Compressive strength (EN 1926), MPa	Flexural strength under concentrated load (EN 12372), MPa
2630		**0,2**	**153**	**13,2**

Real density (EN 1936), kg/m3	Total porosity (EN 1936), % vol	Water absorption coefficient by capillary (EN 1925) (g/m2 x s0,5)	Flexural strength under constant moment (EN 13161), MPa

Frost resistance (EN 12371)				
Technological Test (Test A)				Identification Test (Test B): Number of cycles completed prior to stone failure
Flexural strength (EN 12372) after freeze-thaw cycling, MPa	Number of cycles	Uniaxial compressive strength (EN 1926) after freeze-thaw cycling, MPa	Number of cycles	

Resistance to ageing by thermal shock (EN 14066)			
Change in dynamic modulus of elasticity (increase: +; decrease: -), %	Change in open porosity (increase: +; decrease: -), %	Change in ultrasound pulse velocity (increase: +; decrease: -), %	Change in flexural strength under conc. load (increase: +; decrease: -) %

Abrasion resistance (EN 14157)			**Resistance to salt crystallisation (EN 12370)**	**Breaking load at dowel hole (EN 13364)**	
Method A - Wide Wheel Abrasion Test, mm	Method B - Böhme Abrasion Test, cm^3 / $50cm^2$	Method C - Amsler Abrasion Test, mm	Change in mass (increase: +; decrease: -), %	Breaking load, N	Thickness of the test specimens, mm

Slip resistance by means of the pendulum tester (EN 14231 / CEN/TS 16165)			**Rupture energy (EN 14158), Joule**	**Thermal Conductivity (EN 1745), W/m·K**
Tested surface finish	Slip Resistance Value — SRV			
	Dry test condition	Wet test condition		
Polished				

Source of information: Natursteinskompaniet

Chemical properties

Main elements

SiO_2 (%)	Al_2O_3 (%)	Fe_2O_3 (%)	TiO_2 (%)	MgO (%)	CaO (%)	Na_2O (%)	K_2O (%)	MnO (%)	P_2O_5 (%)	SO_3 (%)	LOI (%)
71,3	**14,44**	**1**	**0,4**	**0,4**	**1,69**	**3,44**	**5,45**	**0,03**	**0,1**		

Trace elements

V (ppm)	Cr (ppm)	Mn (ppm)	Co (ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	As (ppm)
Sr (ppm)	Cd (ppm)	Ba (ppm)	Pb (ppm)	Be (ppm)	Rb (ppm)	Bi (ppm)	U (ppm)
Sc (ppm)	Y (ppm)	Th (ppm)	Sb (ppm)	Ta (ppm)	Nb (ppm)	Zr (ppm)	Sn (ppm)
Ag (ppm)	B (ppm)	Mo (ppm)	W (ppm)	Ga (ppm)	Ge (ppm)	Se (ppm)	Cs (ppm)
Tl (ppm)							

REE

La (ppm)	Ce (ppm)	Pr (ppm)	Nd (ppm)	Sm (ppm)	Eu (ppm)	Gd (ppm)	Tb (ppm)
Dy (ppm)	Ho (ppm)	Er (ppm)	Tm (ppm)	Yb (ppm)	Lu (ppm)		

Methods applied and source of information: Pedersen & Maaløe 1990

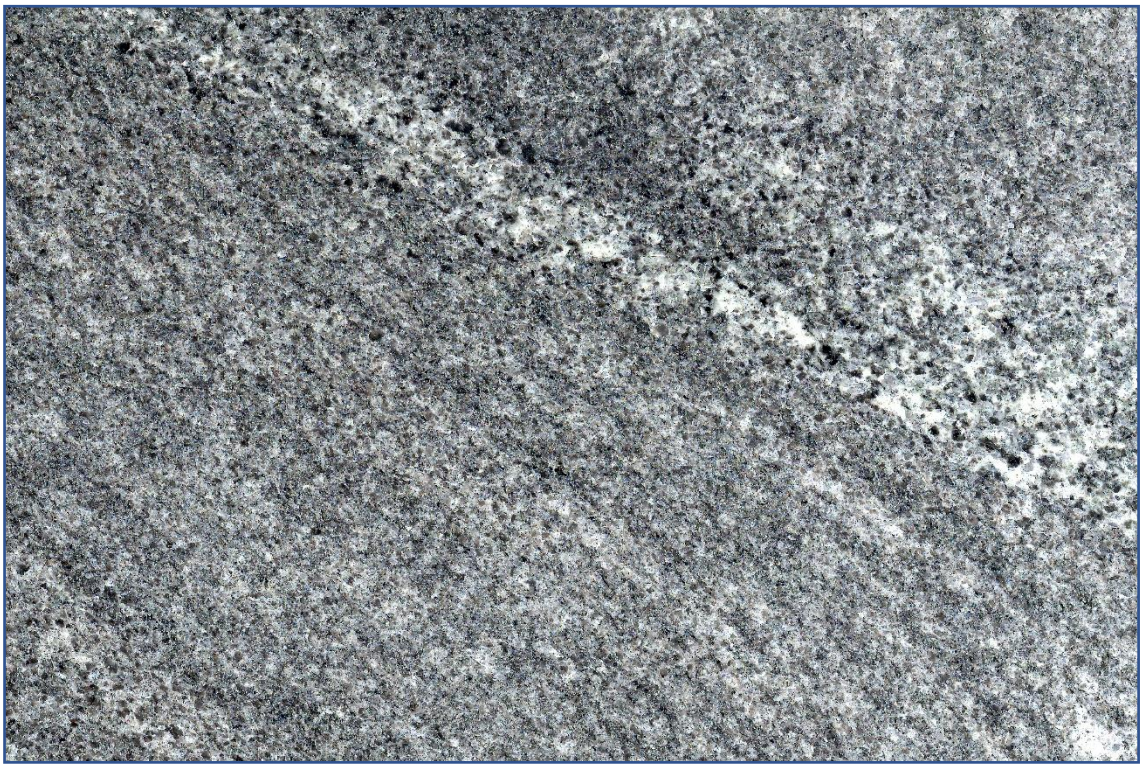
Sources of more information

Type of information	Name of provider	URL
This data sheet	Geological Survey of Norway	https://geo.ngu.no/api/faktaark/mineralressurser/visNaturstein.php?objid=9808&lang=eng
Map link	Geological Survey of Norway	https://geo.ngu.no/kart/common_mobil/?_/kart/mineralressurser_mobil/__lang=eng::extent=223892.5987701465,6532552.62249186,342029.0987701465,6586374.12249186::map=9
Non-commercial directory	Natural stone online	Detailansicht (naturalstone-online.com)
Commercial directory		
Scientific publication	NGU Bulletin	https://www.ngu.no/FileArchive/NGUPublikasjoner/Bulletin417_55-64.pdf
Other publication		

Compiled by:	Geological Survey of Norway (NGU) https://www.ngu.no/	GEOLOGICAL SURVEY OF NORWAY - NGU -

Barents Blue

Bugøynesgneis



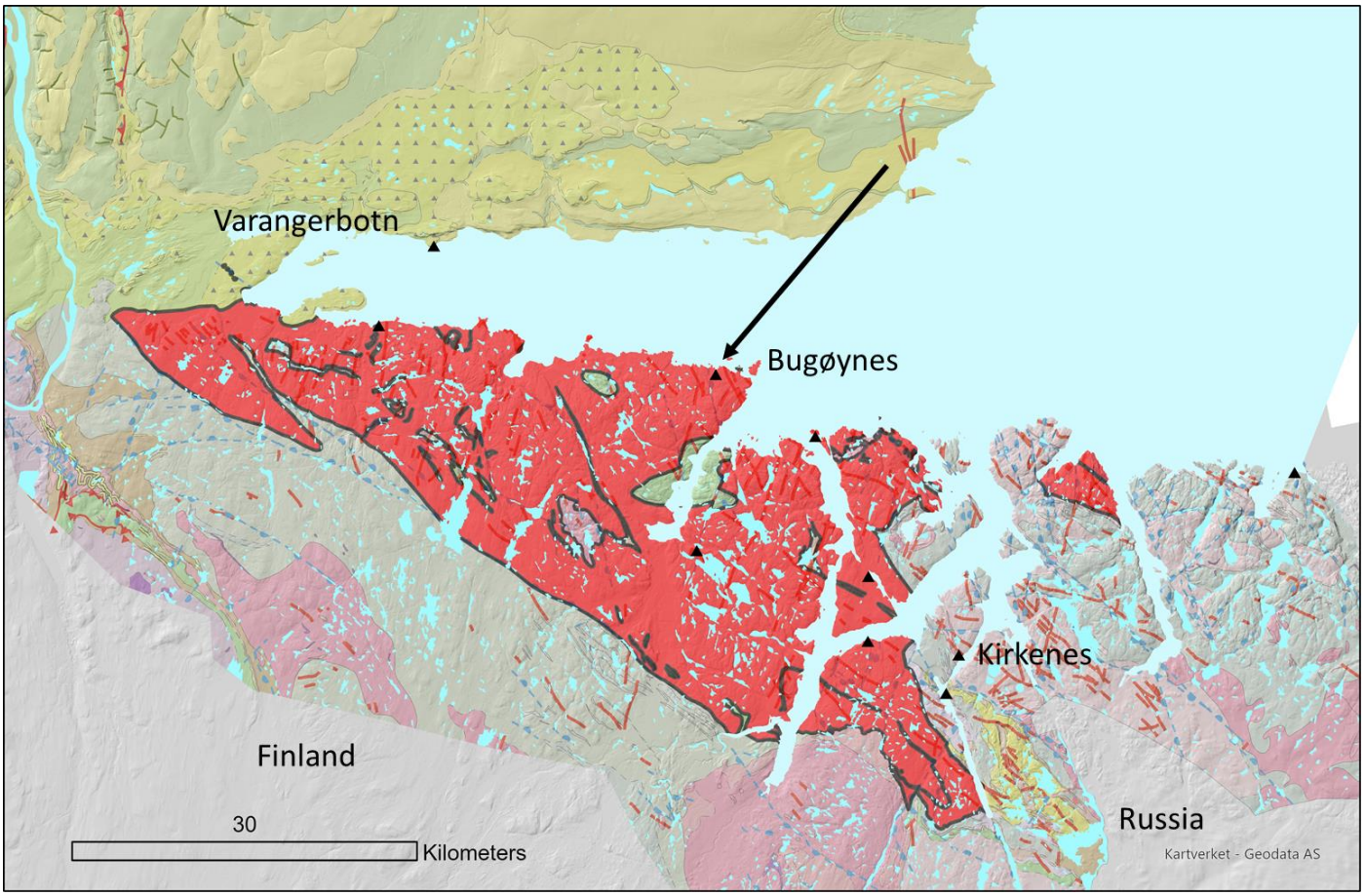
5 centimeters

Short description: The image displays a polished surface, showing light, quartz rich veins in a darker, greyish groundmass.

Commodity (vocabulary)	Lithology (vocabulary)	Typical colour (code list)	Place of origin			
			Country	County / District / Province	Municipality / Community	Place/town / Village
Commercial Granite	Migmatite	Blue-grey	Norway	Finnmark	Sør-Varanger	Bugøynes

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Geological setting



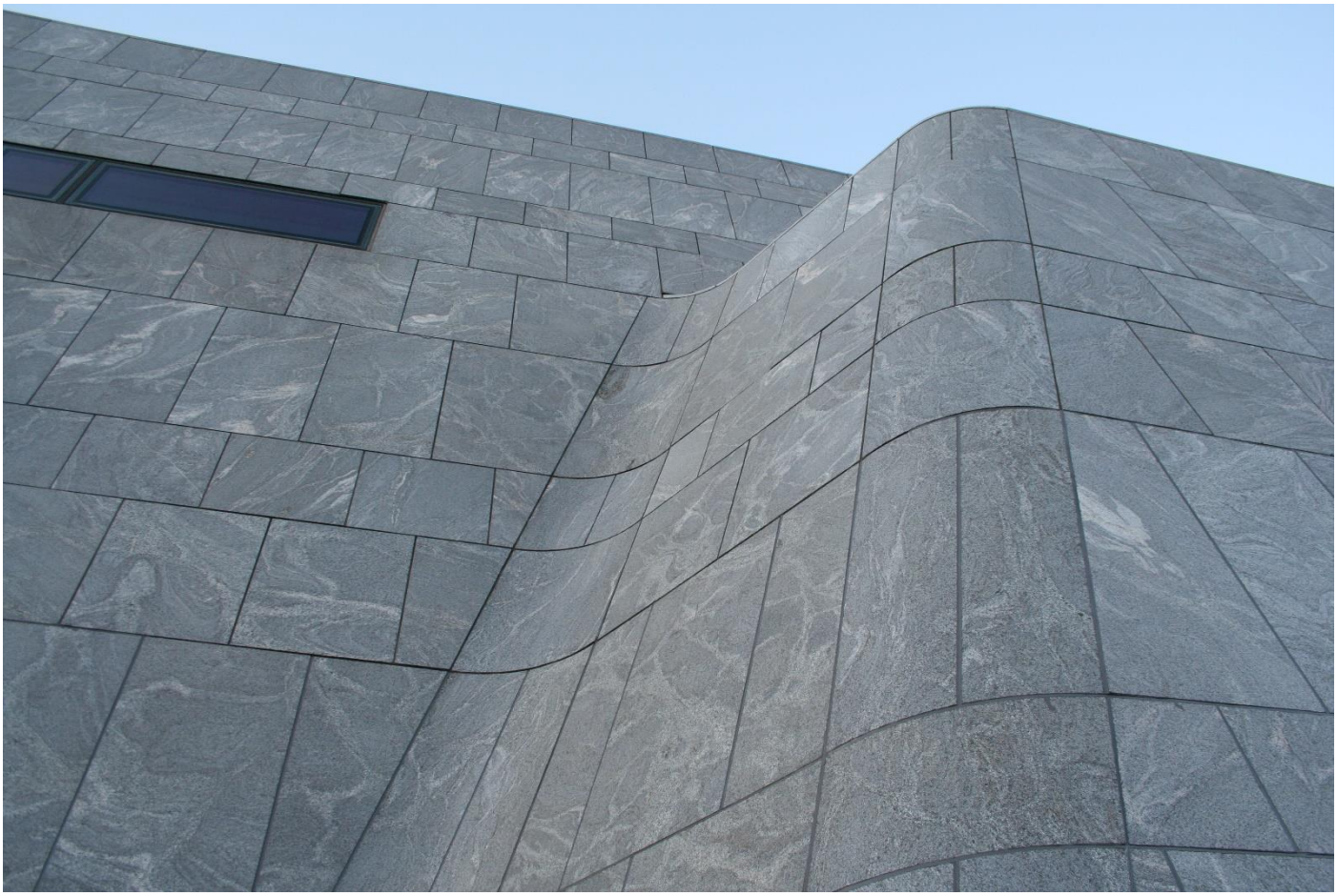
Geology: The Varanger Complex contains a variety of migmatitic gneisses, of uncertain origin. These are among the oldest rocks in the Norwegian geology. The blue-grey Bugøynes variety is situated at the south coast of the Varanger bay, close to the Bugøynes village.

Production: Production started in the early 1990s, and continued as a small production with sporadic quarrying campaigns.

Geological age: Archean 2800 Ma
Geological unit: Varanger Complex

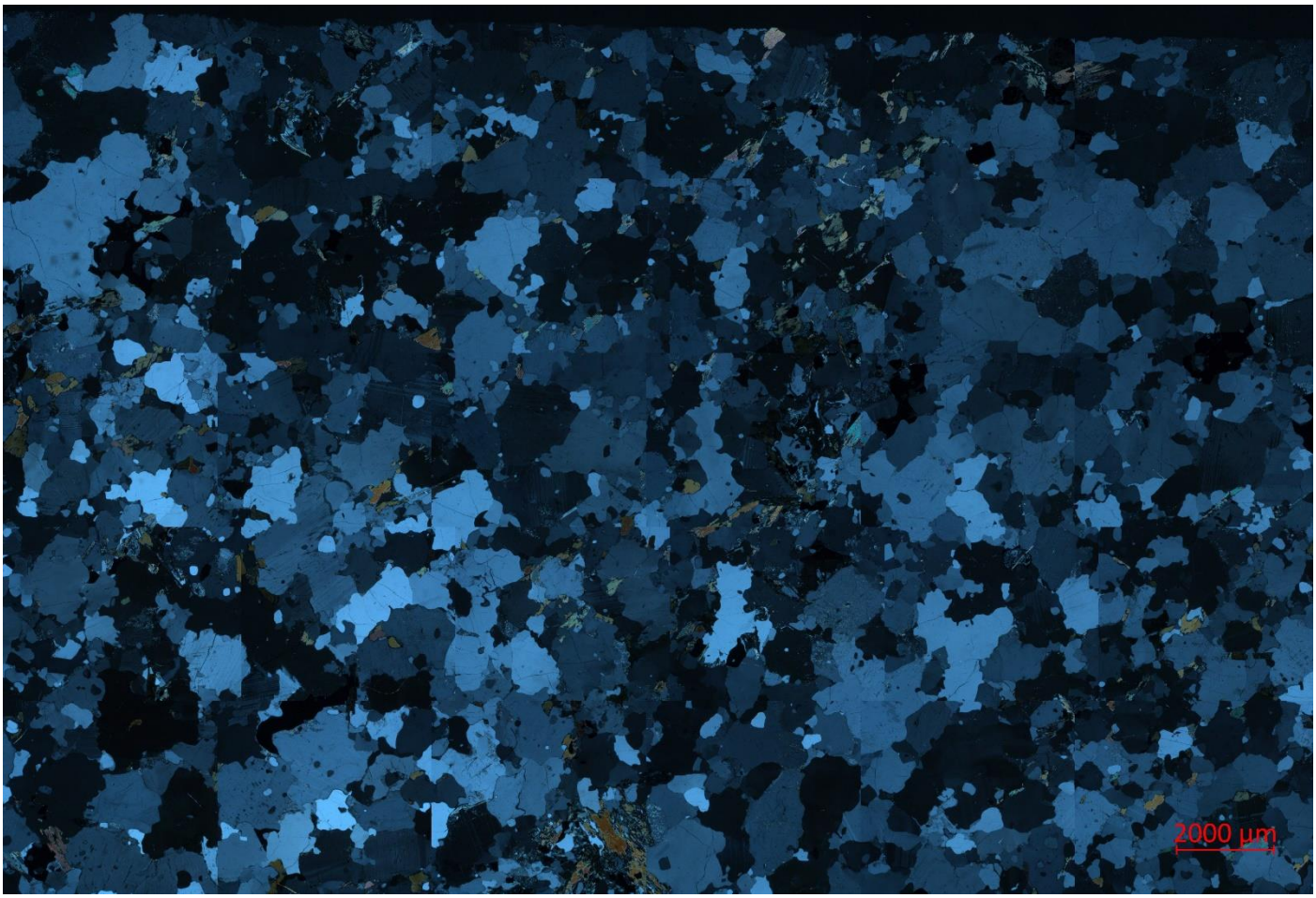
Application, use and heritage

Description: Barents Blue is considered to be of high technical quality and durability. Its use has mainly been for indoor purposes, funeral monuments and façades.



The Norwegian Petroleum Museum, Stavanger (1999), with façade of Barents Blue.

Petrography



Description: Photomicrograph of thin section (mosaic), crossed polarized light showing polygonal texture of predominantly quartz and plagioclase, and patches of biotite and amphiboles.

Source of information: Geological Survey of Norway

Mineral composition

If no accurate number, use MM=main minerals, SM = Subordinate minerals, AM=accessory minerals

Feldspar (pred. Plagioclase (%)	Quartz (%)	Biotite (%)	Amphibole (%)	Opaques (%)	Others (%)	
50	**42**	**3**	**2**	**2**	**1**	

Source of information: NGU estimate

CC BY

Physical properties

Apparent density (EN 1936), kg/m3	Open porosity (EN 1936), % vol	Water absorption at atmospheric pressure (EN 13755), % wt	Uniaxial Compressive strength (EN 1926), MPa	Flexural strength under concentrated load (EN 12372), MPa
2630		**0,09**	**182**	**22,4**

Real density (EN 1936), kg/m3	Total porosity (EN 1936), % vol	Water absorption coefficient by capillary (EN 1925) (g/m2 x s0,5)	Flexural strength under constant moment (EN 13161), MPa

Frost resistance (EN 12371)				
Technological Test (Test A)				Identification Test (Test B): Number of cycles completed prior to stone failure
Flexural strength (EN 12372) after freeze-thaw cycling, MPa	Number of cycles	Uniaxial compressive strength (EN 1926) after freeze-thaw cycling, MPa	Number of cycles	

Resistance to ageing by thermal shock (EN 14066)			
Change in dynamic modulus of elasticity (increase: +; decrease: -), %	Change in open porosity (increase: +; decrease: -), %	Change in ultrasound pulse velocity (increase: +; decrease: -), %	Change in flexural strength under conc. load (increase: +; decrease: -) %

Abrasion resistance (EN 14157)			**Resistance to salt crystallisation (EN 12370)**	**Breaking load at dowel hole (EN 13364)**	
Method A - Wide Wheel Abrasion Test, mm	Method B - Böhme Abrasion Test, cm^3 / $50cm^2$	Method C - Amsler Abrasion Test, mm	Change in mass (increase: +; decrease: -), %	Breaking load, N	Thickness of the test specimens, mm

Slip resistance by means of the pendulum tester (EN 14231 / CEN/TS 16165)			**Rupture energy (EN 14158), Joule**	**Thermal Conductivity (EN 1745), W/m·K**
Tested surface finish	Slip Resistance Value — SRV			
	Dry test condition	Wet test condition		
Polished				

Source of information: Historic data from Norwegian Stone Industry, c. 1995

Chemical properties

Main elements

SiO_2 (%)	Al_2O_3 (%)	Fe_2O_3 (%)	TiO_2 (%)	MgO (%)	CaO (%)	Na_2O (%)	K_2O (%)	MnO (%)	P_2O_5 (%)	SO_3 (%)	LOI (%)

Trace elements

V (ppm)	Cr (ppm)	Mn (ppm)	Co (ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	As (ppm)
Sr (ppm)	Cd (ppm)	Ba (ppm)	Pb (ppm)	Be (ppm)	Rb (ppm)	Bi (ppm)	U (ppm)
Sc (ppm)	Y (ppm)	Th (ppm)	Sb (ppm)	Ta (ppm)	Nb (ppm)	Zr (ppm)	Sn (ppm)
Ag (ppm)	B (ppm)	Mo (ppm)	W (ppm)	Ga (ppm)	Ge (ppm)	Se (ppm)	Cs (ppm)
Tl (ppm)							

REE

La (ppm)	Ce (ppm)	Pr (ppm)	Nd (ppm)	Sm (ppm)	Eu (ppm)	Gd (ppm)	Tb (ppm)
Dy (ppm)	Ho (ppm)	Er (ppm)	Tm (ppm)	Yb (ppm)	Lu (ppm)		

Methods applied and source of information: NGU

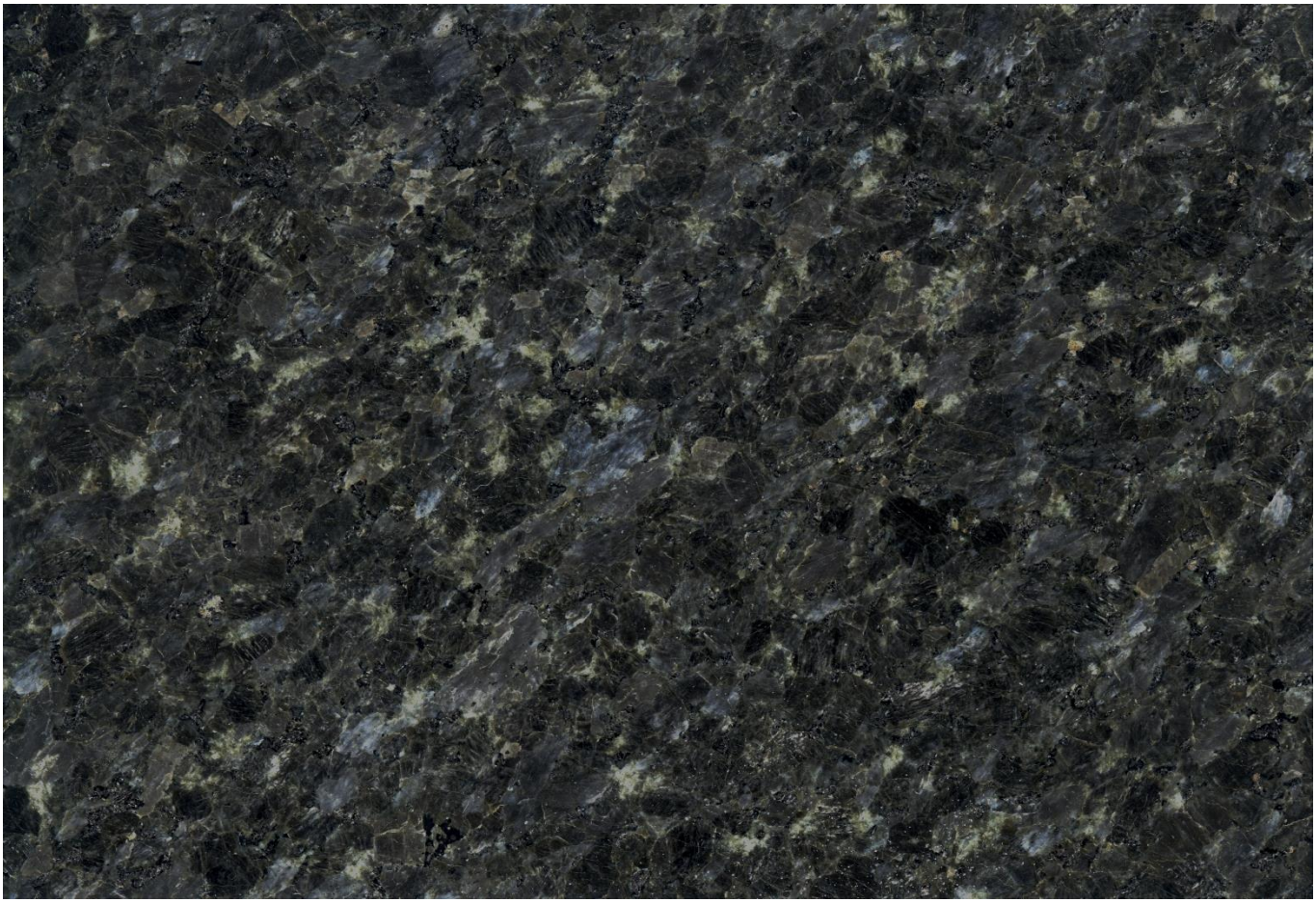
Sources of more information

Type of information	Name of provider	URL
Data sheet	Geological Survey of Norway	https://geo.ngu.no/api/faktaark/mineralressurser/visNaturstein.php?objid=12490&lang=eng
Maplink	Geological Survey of Norway	https://geo.ngu.no/kart/common_mobil/?_/kart/mineralressurser_mobil/__lang=eng::extent=1049344.0666316613,7827849.584047607,1056727.5978816613,7831054.755922607::map=9
Non-commercial directory	Natural stone online	Detail view (naturalstone-online.com)
Commercial directory		
Scientific publication		
Other publication		

Compiled by:	Geological Survey of Norway (NGU) https://www.ngu.no/	

Bergan larvikitt (Bergan larvikite)

Lundhs Black

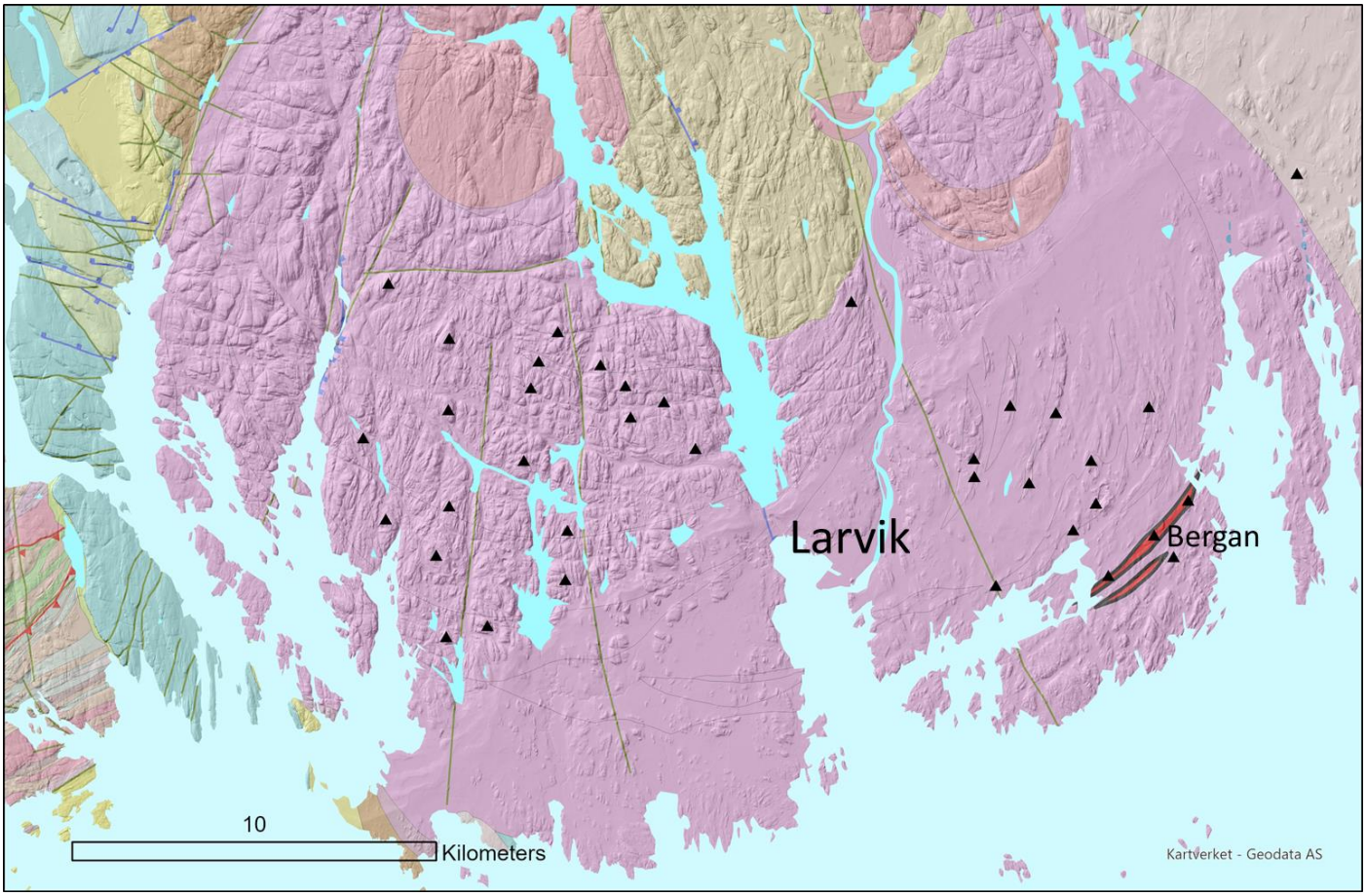


5 centimeters

Short description: Bluish-grey, coarse-grained monzonite displaying grey to blue schillerisation within ternary feldspar crystals. The image displays a polished surface.

Commodity (vocabulary)	Lithology (vocabulary)	Typical colour (code list)	Place of origin			
			Country	County / District / Province	Municipality / Community	Place/town / Village
Commercial Granite	Monzonite	Dark grey	Norway	Vestfold-Telemark	Larvik	Bergan

Geological setting



Geology: Bergan larvikite (red marking) forms a part of a rift related, monzonitic pluton of Carboniferous-Permian age, situated in SE Norway. Nearest town is Larvik, which has given the name for the group of ornamental stones extracted in the area. The Bergan Larvikite is less coarse-grained than the other types, and has a weaker play of colour in feldspar crystals, and has a near black colour. Violet-pink colour on the map are larvikites, red colour the distribution of the Bergan type. Black triangles are deposit/quarry areas.

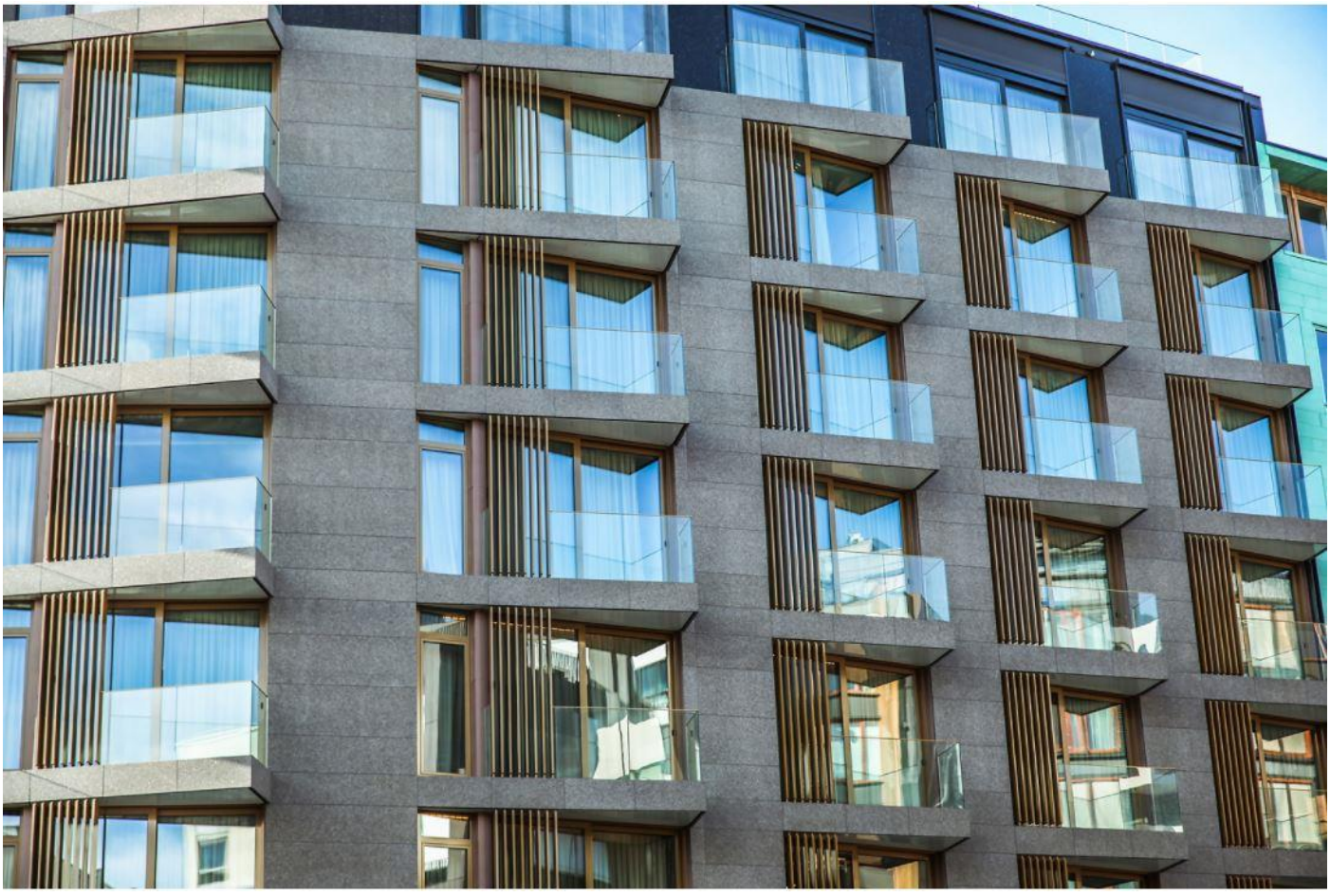
Production: Bergan Larvikite has been produced through most of the 20th century, mainly for domestic purposes. At time of writing, there is no production in the quarries.

Geological age: Carboniferous-Permian (298-272 million years)

Geological unit: Larvik Plutonic Complex

Application, use and heritage

Description: Larvikite has been extracted in an industrial scale since 1878, and has since been applied all over the world. It is particularly appreciated for façade cladding, indoor floors, table tops and funeral monuments. Light larvikite is the subtype mostly produced in large quantities. Larvikite is among the designated IUGS Global Heritage Stone Resource. Bergan larvikite is less exclusive than some other types of larvikite (smaller crystals and poorer play of colour) and has mainly been used domestically for floors and paving, sometimes facades.



Façade, building “The Thief Hotel” Oslo, Norway, 2013 (photo: Lundhs/Jenny Solem)

Petrography

Description: Larvikite is a monzonitic rock predominantly composed of felspar (75 – 85 %), with clusters of dark minerals such as olivine, amphibole, pyroxene and biotite. Nepheline and apatite may be present in small amounts. The feldspars are ternary, i.e. showing intergrowth patterns of lamellae of different composition. The lamellae cause the blue play of colours (schillerization). The Bergan larvikite has in general smaller grains and weaker blue play of colours that the other commercial larvikite types.

Source of information: Geological Survey of Norway

Mineral composition

If no accurate number, use MM=main minerals, SM = Subordinate minerals, AM=accessory minerals

Feldspars (%)	Pyroxene (%)	Amphiboles (%)	Olivine (%)	Biotite (%)	Apatite (%)	Opaques (%)
MM	**SM**	**SM**	**SM**	**SM**	**AM**	**AM**

Source of information: NGU estimate

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Physical properties

Apparent density (EN 1936), kg/m3	Open porosity (EN 1936), % vol	Water absorption at atmospheric pressure (EN 13755), % wt	Uniaxial Compressive strength (EN 1926), MPa	Flexural strength under concentrated load (EN 12372), MPa
2750		**0,26**	**166**	**16,9**

Real density (EN 1936), kg/m3	Total porosity (EN 1936), % vol	Water absorption coefficient by capillary (EN 1925) (g/m2 x s0,5)	Flexural strength under constant moment (EN 13161), MPa

Frost resistance (EN 12371)				
Technological Test (Test A)				Identification Test (Test B): Number of cycles completed prior to stone failure
Flexural strength (EN 12372) after freeze-thaw cycling, MPa	Number of cycles	Uniaxial compressive strength (EN 1926) after freeze-thaw cycling, MPa	Number of cycles	

Resistance to ageing by thermal shock (EN 14066)			
Change in dynamic modulus of elasticity (increase: +; decrease: -), %	Change in open porosity (increase: +; decrease: -), %	Change in ultrasound pulse velocity (increase: +; decrease: -), %	Change in flexural strength under conc. load (increase: +; decrease: -) %

Abrasion resistance (EN 14157)			**Resistance to salt crystallisation (EN 12370)**	**Breaking load at dowel hole (EN 13364)**	
Method A - Wide Wheel Abrasion Test, mm	Method B - Böhme Abrasion Test, cm^3 / $50cm^2$	Method C - Amsler Abrasion Test, mm	Change in mass (increase: +; decrease: -), %	Breaking load, N	Thickness of the test specimens, mm

Slip resistance by means of the pendulum tester (EN 14231 / CEN/TS 16165)			**Rupture energy (EN 14158), Joule**	**Thermal Conductivity (EN 1745), W/m·K**
Tested surface finish	Slip Resistance Value — SRV			
	Dry test condition	Wet test condition		

Source of information: Historical data, published at [Natural-stone online]

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Chemical properties

Main elements

SiO_2 (%)	Al_2O_3 (%)	Fe_2O_3 (%)	TiO_2 (%)	MgO (%)	CaO (%)	Na_2O (%)	K_2O (%)	MnO (%)	P_2O_5 (%)	SO_3 (%)	LOI (%)

Trace elements

V (ppm)	Cr (ppm)	Mn (ppm)	Co (ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	As (ppm)
Sr (ppm)	Cd (ppm)	Ba (ppm)	Pb (ppm)	Be (ppm)	Rb (ppm)	Bi (ppm)	U (ppm)
Sc (ppm)	Y (ppm)	Th (ppm)	Sb (ppm)	Ta (ppm)	Nb (ppm)	Zr (ppm)	Sn (ppm)
Ag (ppm)	B (ppm)	Mo (ppm)	W (ppm)	Ga (ppm)	Ge (ppm)	Se (ppm)	Cs (ppm)
Tl (ppm)							

REE

La (ppm)	Ce (ppm)	Pr (ppm)	Nd (ppm)	Sm (ppm)	Eu (ppm)	Gd (ppm)	Tb (ppm)
Dy (ppm)	Ho (ppm)	Er (ppm)	Tm (ppm)	Yb (ppm)	Lu (ppm)		

Methods applied and source of information:

Sources of more information

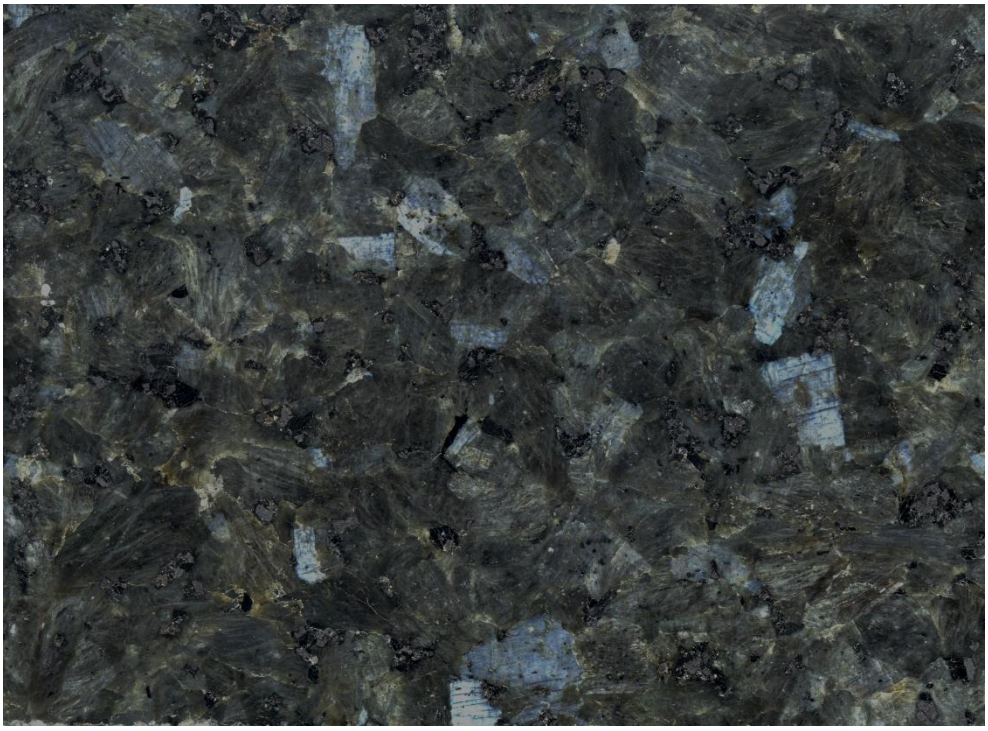
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Non-commercial directory	Natural stone online	Detail view (naturalstone-online.com)
Commercial directory		
Scientific publication	Lyell Collection	https://sp.lyellcollection.org/content/407/1/21
Other publication		

Compiled by:	Geological Survey of Norway (NGU) https://www.ngu.no/	GEOLOGICAL SURVEY OF NORWAY - NGU -

Krukåsen larvikitt (Krukåsen larvikite)

Lundhs Ocean

Ocean Pearl

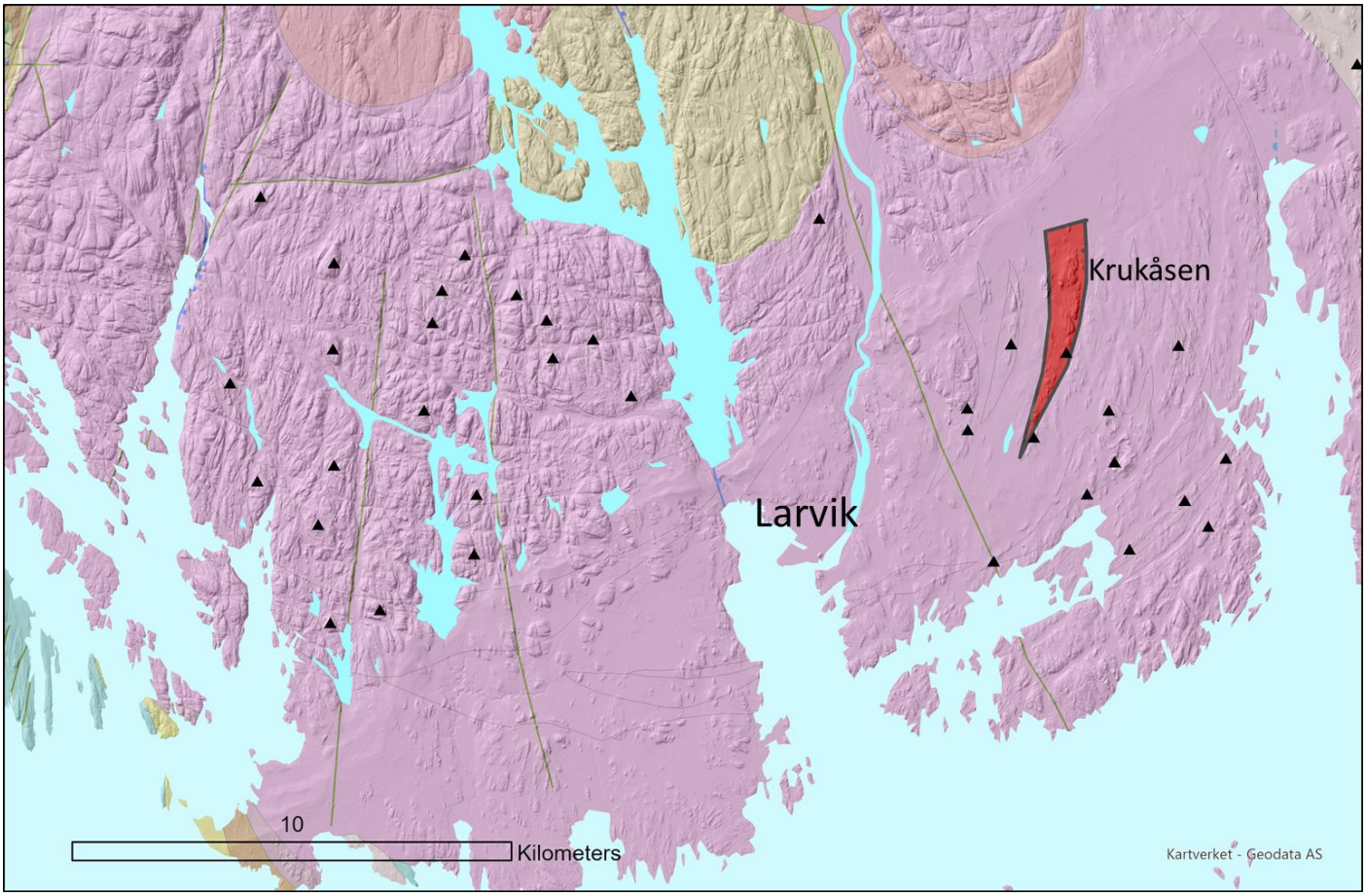


5 centimeters

Short description: Bluish-grey, coarse-grained monzonite displaying grey to blue schillerization within ternary feldspar crystals. The image displays a polished surface.

Commodity (vocabulary)	Lithology (vocabulary)	Typical colour (code list)	Place of origin			
			Country	County / District / Province	Municipality / Community	Place/town / Village
Commercial Granite	Monzonite	Grey	Norway	Vestfold-Telemark	Larvik	Krukåsen

Geological setting



Geology: Krukåsen larvikite (red marking) forms a part of a rift related, monzonitic pluton of Carboniferous-Permian age, situated in SE Norway. Nearest town is Larvik, which has given the name for the group of ornamental stones extracted in the area. Red colour is the outcrop area for this type of larvikite, black triangles are deposit areas.

Production: Krukåsen quarry is situated in the northern part of the outcrop area. It has been exploited through most of the 20th century.

Geological age: Carboniferous-Permian (298-272 million years)
Geological unit: Larvik Plutonic Complex

Application, use and heritage

Description: Larvikite has been extracted in an industrial scale since 1878, and has since been applied all over the world. It is particularly appreciated for façade cladding, indoor floors, table tops and funeral monuments. Larvikite is among the designated IUGS Global Heritage Stone Resource.



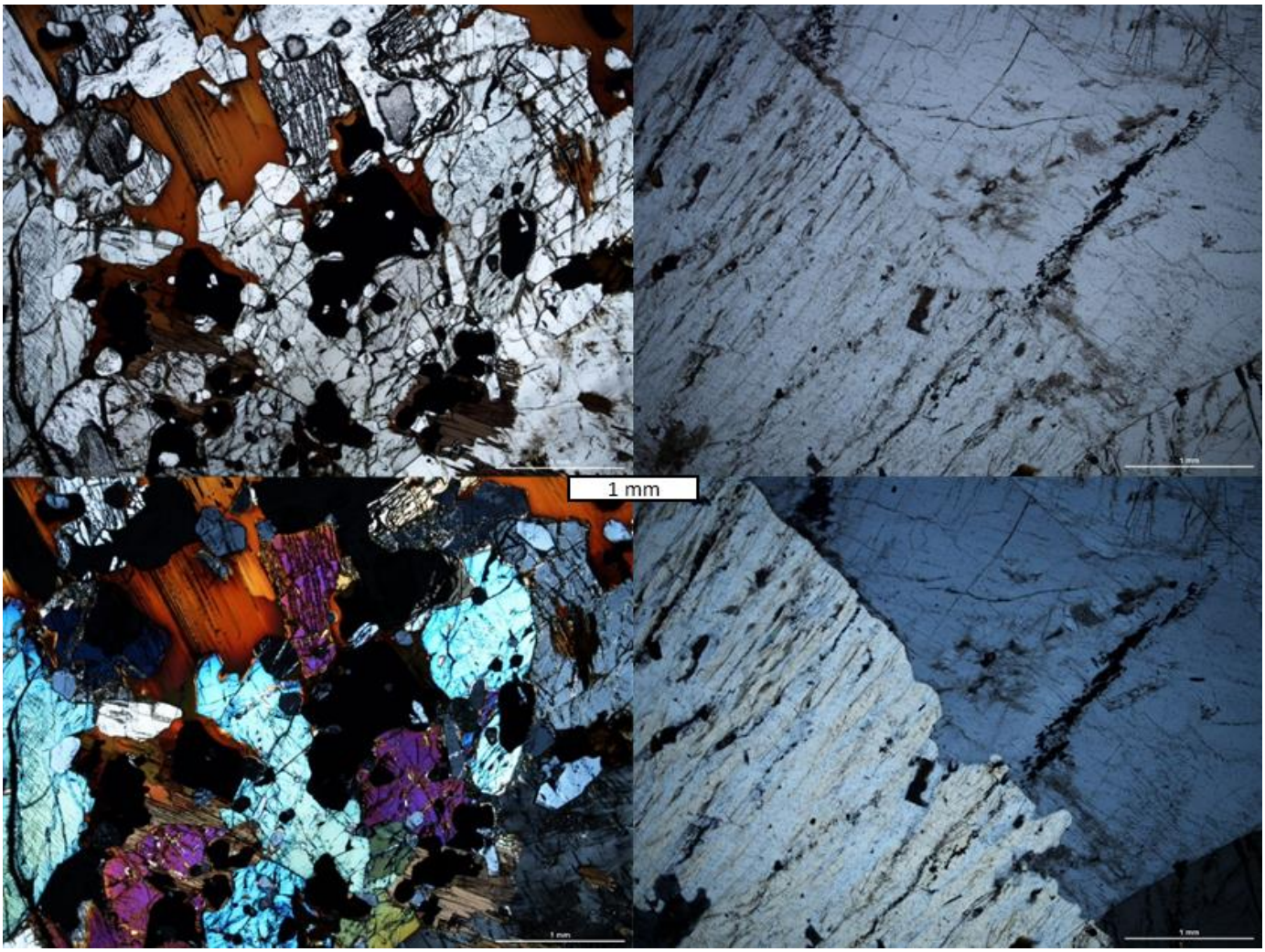
Façade, polished, Shanghai (photo Lundhs/Mr. Tu)



Façade, flamed and polished, Shanghai (photo Lundhs/Mr. Tu)

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Petrography



Description: Larvikite is a monzonitic rock predominantly composed of felspar (75 – 85 %), with clusters of dark minerals such as olivine, amphibole, pyroxene and biotite. Nepheline and apatite may be present in small amounts. The feldspars are ternary, i.e. showing intergrowth patterns of lamellae of different composition. The lamellae cause the blue play of colours (schillerization). The photomicrograph shows two thin sections, top plane polized light, bottom crossed nichols. Right: large, ternary feldspar crystals. Left: cluster of mafic minerals.

Source of information: Lundhs and SINTEF

Mineral composition

If no accurate number, use MM=main minerals, SM = Subordinate minerals, AM=accessory minerals

Feldspars (%)	Pyroxene (%)	Amphiboles (%)	Olivine (%)	Biotite (%)	Apatite (%)	Opaques (%)
77,5	**5,5**	**2**	**3**	**3,5**	**2**	**3,5**

Source of information: Lundhs

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Physical properties

Apparent density (EN 1936), kg/m3	Open porosity (EN 1936), % vol	Water absorption at atmospheric pressure (EN 13755), % wt	Uniaxial Compressive strength (EN 1926), MPa	Flexural strength under concentrated load (EN 12372), MPa
2732	**0,4**	**0,14**	**175,8**	**11,4**

Real density (EN 1936), kg/m3	Total porosity (EN 1936), % vol	Water absorption coefficient by capillary (EN 1925) (g/m2 x s0,5)	Flexural strength under constant moment (EN 13161), MPa

Frost resistance (EN 12371)				
Technological Test (Test A)				Identification Test (Test B): Number of cycles completed prior to stone failure
Flexural strength (EN 12372) after freeze-thaw cycling, MPa	Number of cycles	Uniaxial compressive strength (EN 1926) after freeze-thaw cycling, MPa	Number of cycles	

Resistance to ageing by thermal shock (EN 14066)			
Change in dynamic modulus of elasticity (increase: +; decrease: -), %	Change in open porosity (increase: +; decrease: -), %	Change in ultrasound pulse velocity (increase: +; decrease: -), %	Change in flexural strength under conc. load (increase: +; decrease: -) %

Abrasion resistance (EN 14157)			**Resistance to salt crystallisation (EN 12370)**	**Breaking load at dowel hole (EN 13364)**	
Method A - Wide Wheel Abrasion Test, mm	Method B - Böhme Abrasion Test, cm^3 / $50cm^2$	Method C - Amsler Abrasion Test, mm	Change in mass (increase: +; decrease: -), %	Breaking load, N	Thickness of the test specimens, mm
18					

Slip resistance by means of the pendulum tester (EN 14231 / CEN/TS 16165)			**Rupture energy (EN 14158), Joule**	**Thermal Conductivity (EN 1745), W/m·K**
Tested surface finish	Slip Resistance Value — SRV			
	Dry test condition	Wet test condition		
Polished	**92**	**8**		

Source of information: Lundhs

Chemical properties

Main elements

SiO_2 (%)	Al_2O_3 (%)	Fe_2O_3 (%)	TiO_2 (%)	MgO (%)	CaO (%)	Na_2O (%)	K_2O (%)	MnO (%)	P_2O_5 (%)	SO_3 (%)	LOI (%)

Trace elements

V (ppm)	Cr (ppm)	Mn (ppm)	Co (ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	As (ppm)
Sr (ppm)	Cd (ppm)	Ba (ppm)	Pb (ppm)	Be (ppm)	Rb (ppm)	Bi (ppm)	U (ppm)
Sc (ppm)	Y (ppm)	Th (ppm)	Sb (ppm)	Ta (ppm)	Nb (ppm)	Zr (ppm)	Sn (ppm)
Ag (ppm)	B (ppm)	Mo (ppm)	W (ppm)	Ga (ppm)	Ge (ppm)	Se (ppm)	Cs (ppm)
Tl (ppm)							

REE

La (ppm)	Ce (ppm)	Pr (ppm)	Nd (ppm)	Sm (ppm)	Eu (ppm)	Gd (ppm)	Tb (ppm)
Dy (ppm)	Ho (ppm)	Er (ppm)	Tm (ppm)	Yb (ppm)	Lu (ppm)		

Methods applied and source of information:

Sources of more information

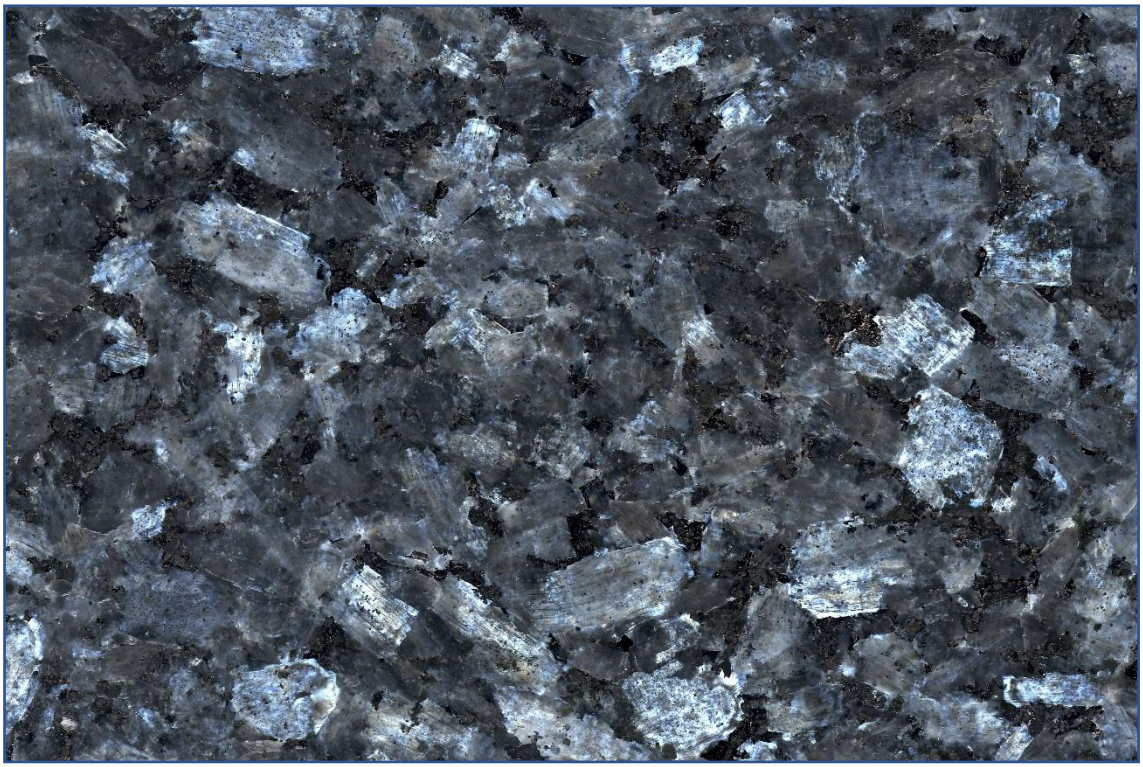
Type of information	Name of provider	URL
This data sheet	Geological Survey of Norway	https://geo.ngu.no/api/faktaark/mineralressurser/visNaturstein.php?objid=14807&lang=eng
Maplink	Geological Survey of Norway	https://geo.ngu.no/kart/common_mobil/?_/kart/mineralressurser_mobil/__lang=eng::extent=219975.09849508991,6559483.630046582,221820.98130758991,6560324.590984082::map=9
Non-commercial directory	Natural stone online	Detailansicht (naturalstone-online.com)
Commercial directory		
Scientific publication	Lyell Collection	https://sp.lyellcollection.org/content/407/1/21
Other publication		

Compiled by:	Geological Survey of Norway (NGU) https://www.ngu.no/	GEOLOGICAL SURVEY OF NORWAY - NGU -

Lys larvikitt (Light larvikite)

Blue Pearl

Lundhs Blue

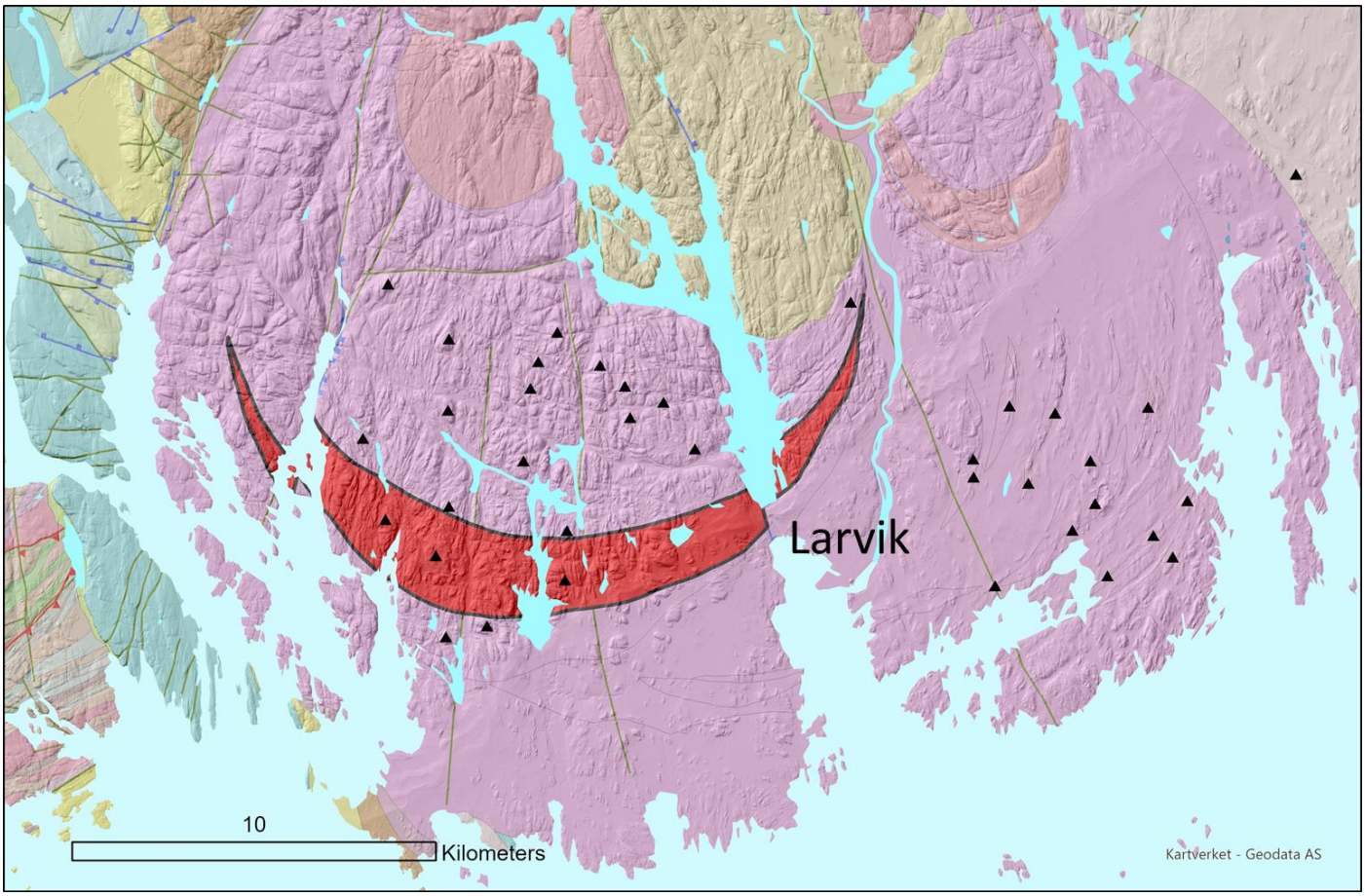


5 centimeters

Short description: Bluish-grey, coarse-grained monzonite displaying blue schillerization within ternary feldspar crystals. The image displays a polished surface.

Commodity (vocabulary)	Lithology (vocabulary)	Typical colour (code list)	Place of origin			
			Country	County / District / Province	Municipality / Community	Place/town / Village
Commercial Granite	Monzonite	Blue	Norway	Vestfold-Telemark	Larvik Porsgrunn	Tvedalen Auen

Geological setting



Geology: Light larvikite (red marking) forms a part of a rift related, monzonitic pluton of Carboniferous-Permian age, situated in SE Norway. Nearest town is Larvik, which has given the name for the group of ornamental stones extracted in the area. Red area marks the outcrop area for this type of larvikite, black triangles quarry areas.

Production: The most important quarry area is Tvedalen, where there are several companies producing the stone in numerous quarries.

Geological age: Carboniferous-Permian (298-272 million years)
Geological unit: Larvik Plutonic Complex

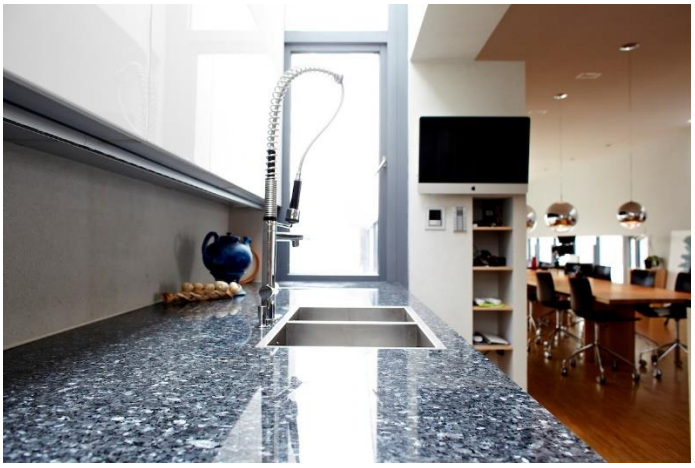
Application, use and heritage

Description: Larvikite has been extracted in an industrial scale since 1878, and has since been applied all over the world. It is particularly appreciated for façade cladding, indoor floors, table tops and funeral monuments. Light larvikite is the subtype mostly produced in large quantities. Larvikite is among the designated IUGS Global Heritage Stone Resource.



The old Norwegian National Bank building (1907), made of light larvikite.



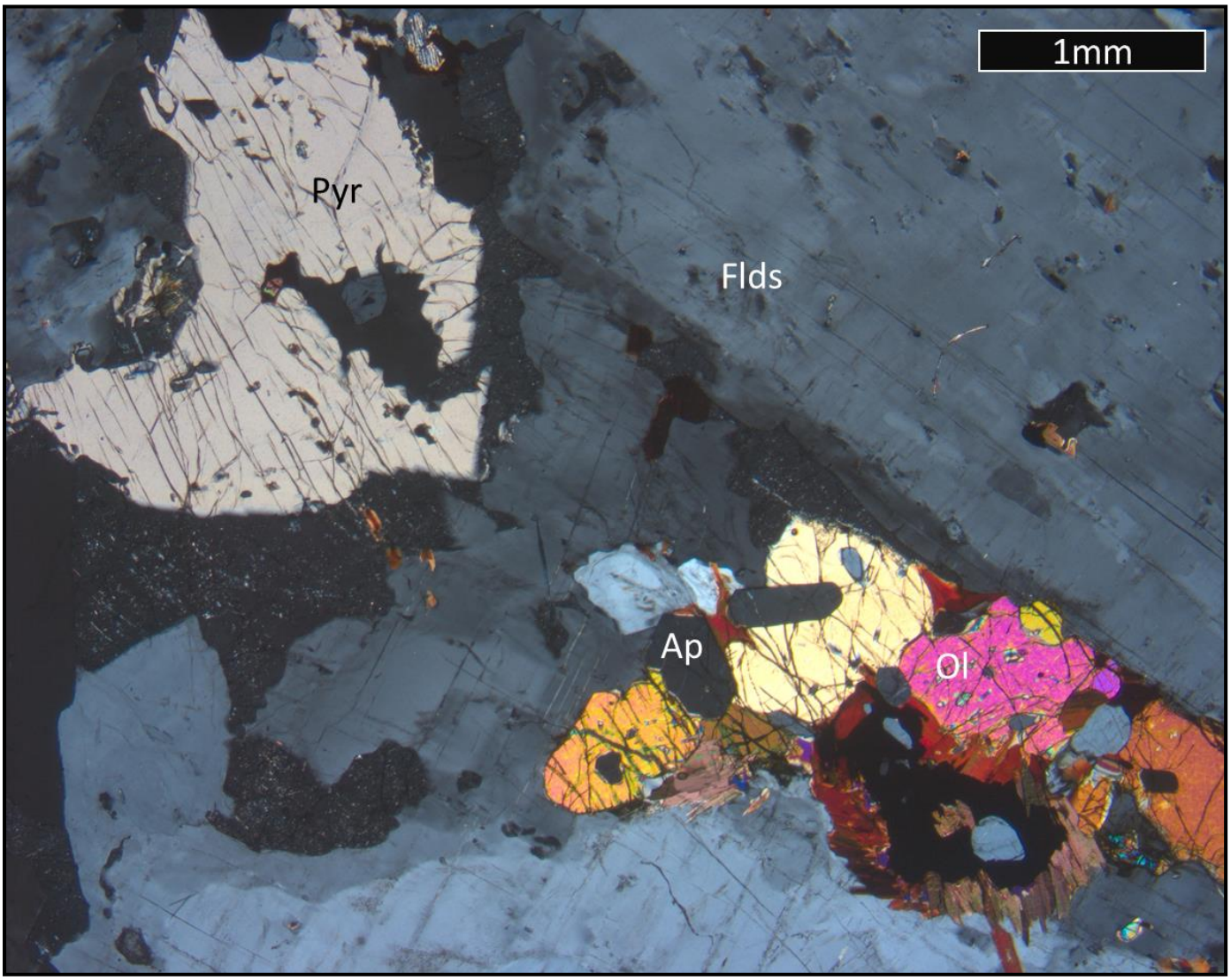


Light larvikite floor tiles and kitchen top (photo Lundhs/Morten Rakke



Façade with different surface treatment (photo Lundhs/Morten Rakke

Petrography



Description: Larvikite is a monzonitic rock predominantly composed of felspar (75 – 85 %), with clusters of dark minerals such as olivine, amphibole, pyroxene and biotite. Nepheline and apatite may be present in small amounts. The feldspars are ternary, i.e. showing intergrowth patterns of lamellae of different composition. The lamellae cause the blue play of colours (schillerization). Photomicrograph of thin section, crossed polarized light showing large ternary feldspar grains and smaller grains of pyroxene, olivine and apatite.

Source of information: Geological Survey of Norway

Mineral composition

If no accurate number, use MM=main minerals, SM = Subordinate minerals, AM=accessory minerals

Feldspars (%)	Pyroxene (%)	Amphiboles (%)	Olivine (%)	Biotite (%)	Nepheline (%)	Apatite (%)
78,5	**5,5**	**3**	**3,5**	**3**	**2**	**1**
Opaques (%)						
3,5						

Source of information: Lundhs

Physical properties

Apparent density (EN 1936), kg/m3	Open porosity (EN 1936), % vol	Water absorption at atmospheric pressure (EN 13755), % wt	Uniaxial Compressive strength (EN 1926), MPa	Flexural strength under concentrated load (EN 12372), MPa
2730	**0,09**	**0,03**	**251,8**	**14,9**

Real density (EN 1936), kg/m3	Total porosity (EN 1936), % vol	Water absorption coefficient by capillary (EN 1925) (g/m2 x s0,5)	Flexural strength under constant moment (EN 13161), MPa

Frost resistance (EN 12371)				
Technological Test (Test A)				Identification Test (Test B): Number of cycles completed prior to stone failure
Flexural strength (EN 12372) after freeze-thaw cycling, MPa	Number of cycles	Uniaxial compressive strength (EN 1926) after freeze-thaw cycling, MPa	Number of cycles	
14,3	**56**			

Resistance to ageing by thermal shock (EN 14066)			
Change in dynamic modulus of elasticity (increase: +; decrease: -), %	Change in open porosity (increase: +; decrease: -), %	Change in ultrasound pulse velocity (increase: +; decrease: -), %	Change in flexural strength under conc. load (increase: +; decrease: -) %

Abrasion resistance (EN 14157)			**Resistance to salt crystallisation (EN 12370)**	**Breaking load at dowel hole (EN 13364)**	
Method A - Wide Wheel Abrasion Test, mm	Method B - Böhme Abrasion Test, cm^3 / $50cm^2$	Method C - Amsler Abrasion Test, mm	Change in mass (increase: +; decrease: -), %	Breaking load, N	Thickness of the test specimens, mm
17,5					

Slip resistance by means of the pendulum tester (EN 14231 / CEN/TS 16165)			**Rupture energy (EN 14158), Joule**	**Thermal Conductivity (EN 1745), W/m·K**
Tested surface finish	Slip Resistance Value — SRV			
	Dry test condition	Wet test condition		
Polished	**98**	**8**		

Source of information: Lundhs

Chemical properties

Main elements

SiO_2 (%)	Al_2O_3 (%)	Fe_2O_3 (%)	TiO_2 (%)	MgO (%)	CaO (%)	Na_2O (%)	K_2O (%)	MnO (%)	P_2O_5 (%)	SO_3 (%)	LOI (%)

Trace elements

V (ppm)	Cr (ppm)	Mn (ppm)	Co (ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	As (ppm)
Sr (ppm)	Cd (ppm)	Ba (ppm)	Pb (ppm)	Be (ppm)	Rb (ppm)	Bi (ppm)	U (ppm)
Sc (ppm)	Y (ppm)	Th (ppm)	Sb (ppm)	Ta (ppm)	Nb (ppm)	Zr (ppm)	Sn (ppm)
Ag (ppm)	B (ppm)	Mo (ppm)	W (ppm)	Ga (ppm)	Ge (ppm)	Se (ppm)	Cs (ppm)
Tl (ppm)							

REE

La (ppm)	Ce (ppm)	Pr (ppm)	Nd (ppm)	Sm (ppm)	Eu (ppm)	Gd (ppm)	Tb (ppm)
Dy (ppm)	Ho (ppm)	Er (ppm)	Tm (ppm)	Yb (ppm)	Lu (ppm)		

Methods applied and source of information:

Sources of more information

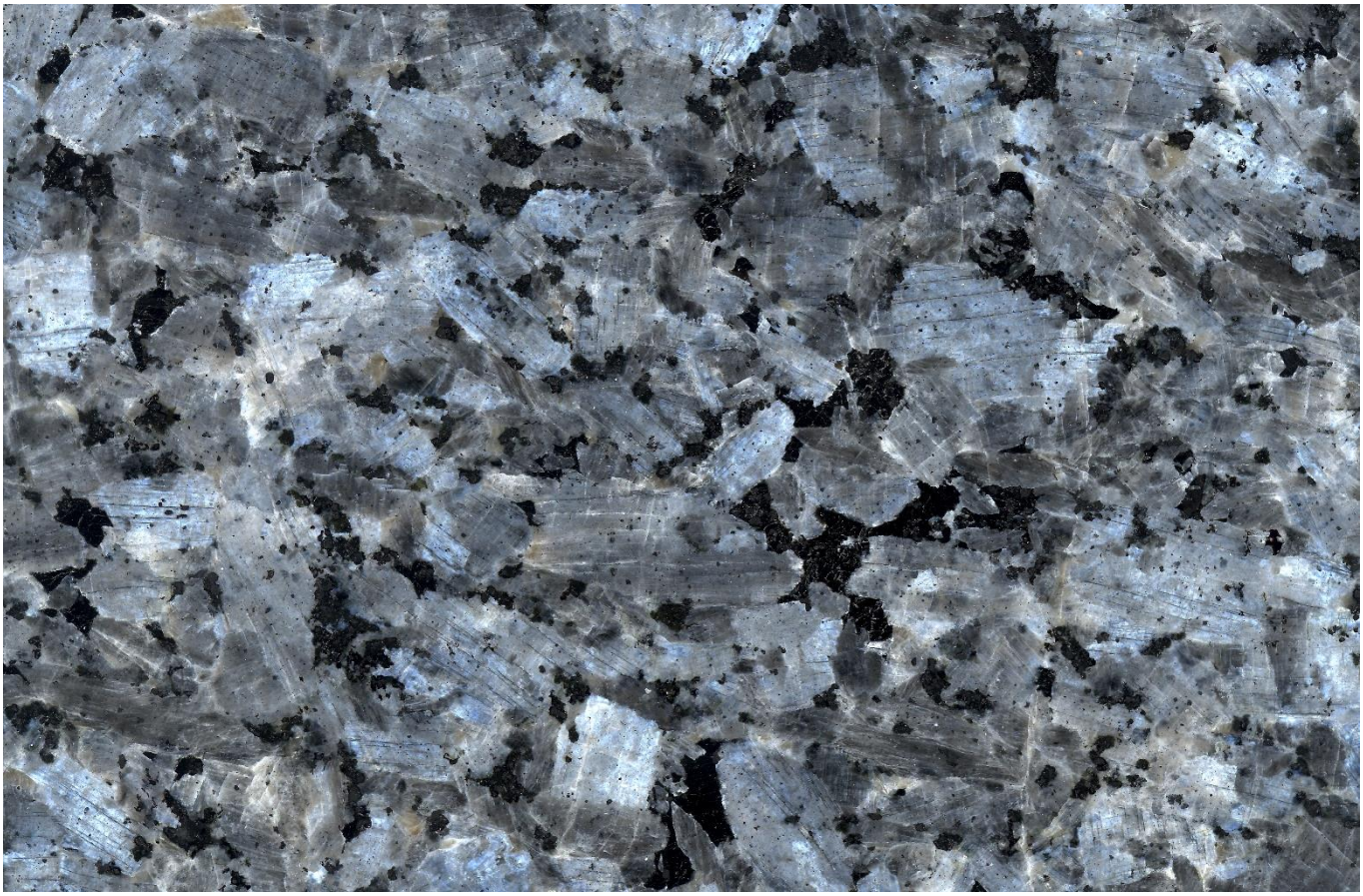
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Maplink	Geological Survey of Norway	https://geo.ngu.no/kart/common_mobil/?_/kart/mineralressurser_mobil/__lang=eng::extent=201936.74384081876,6553578.879619948,209320.27509081876,6556942.723369948::map=9
Non-commercial directory	Natural stone online	https://www.naturalstone-online.com/index.php?id=356&user_dnsaeng_pi1%5BsteinID%5D=23
Commercial directory		
Scientific publication	Lyell Collection	https://sp.lyellcollection.org/content/407/1/21
Other publication		

Compiled by:	Geological Survey of Norway (NGU) https://www.ngu.no/	

Malerød larvikitt (Malerød larvikite)

Lundhs Royal

Royal Pearl

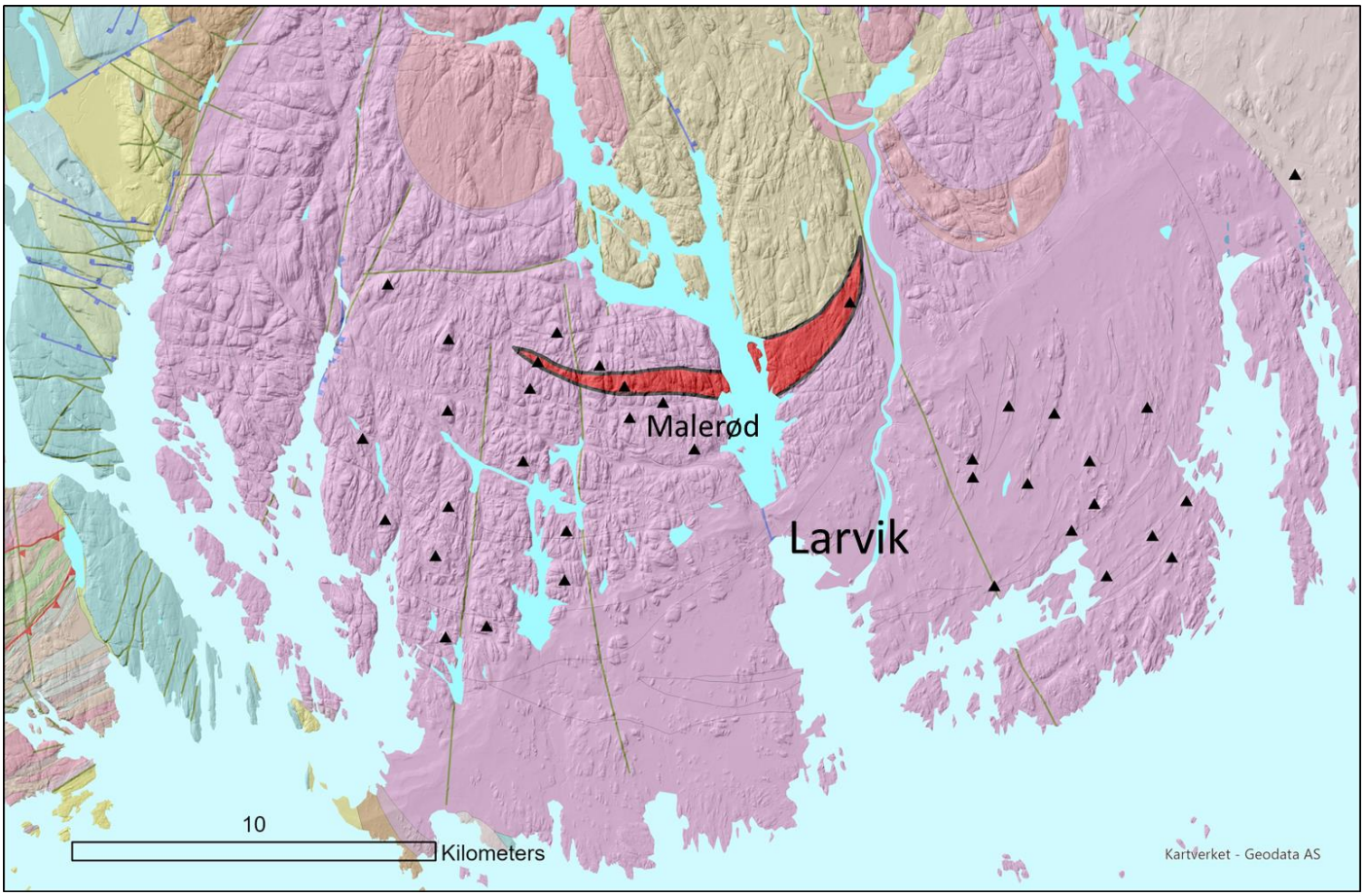


5 centimeters

Short description: Bluish-grey, very coarse-grained monzonite displaying blue schillerization within ternary feldspar crystals. The image displays a polished surface.

Commodity (vocabulary)	Lithology (vocabulary)	Typical colour (code list)	Place of origin			
			Country	County / District / Province	Municipality / Community	Place/town / Village
Commercial Granite	Monzonite	Blue	Norway	Vestfold-Telemark	Larvik	Malerød Vardeåsen

Geological setting



Geology: Malerød larvikite forms a part of a rift related, monzonitic pluton of Carboniferous-Permian age, situated in SE Norway. Nearest town is Larvik, which has given the name for the group of ornamental stones extracted in the area. Red area marks outcrop area for this type of larvikite, black triangles quarry areas.

Production: The most important quarry area is Malerød NW of Larvik town. This is one of the last deposits to be employed, starting in the 1970'ies.

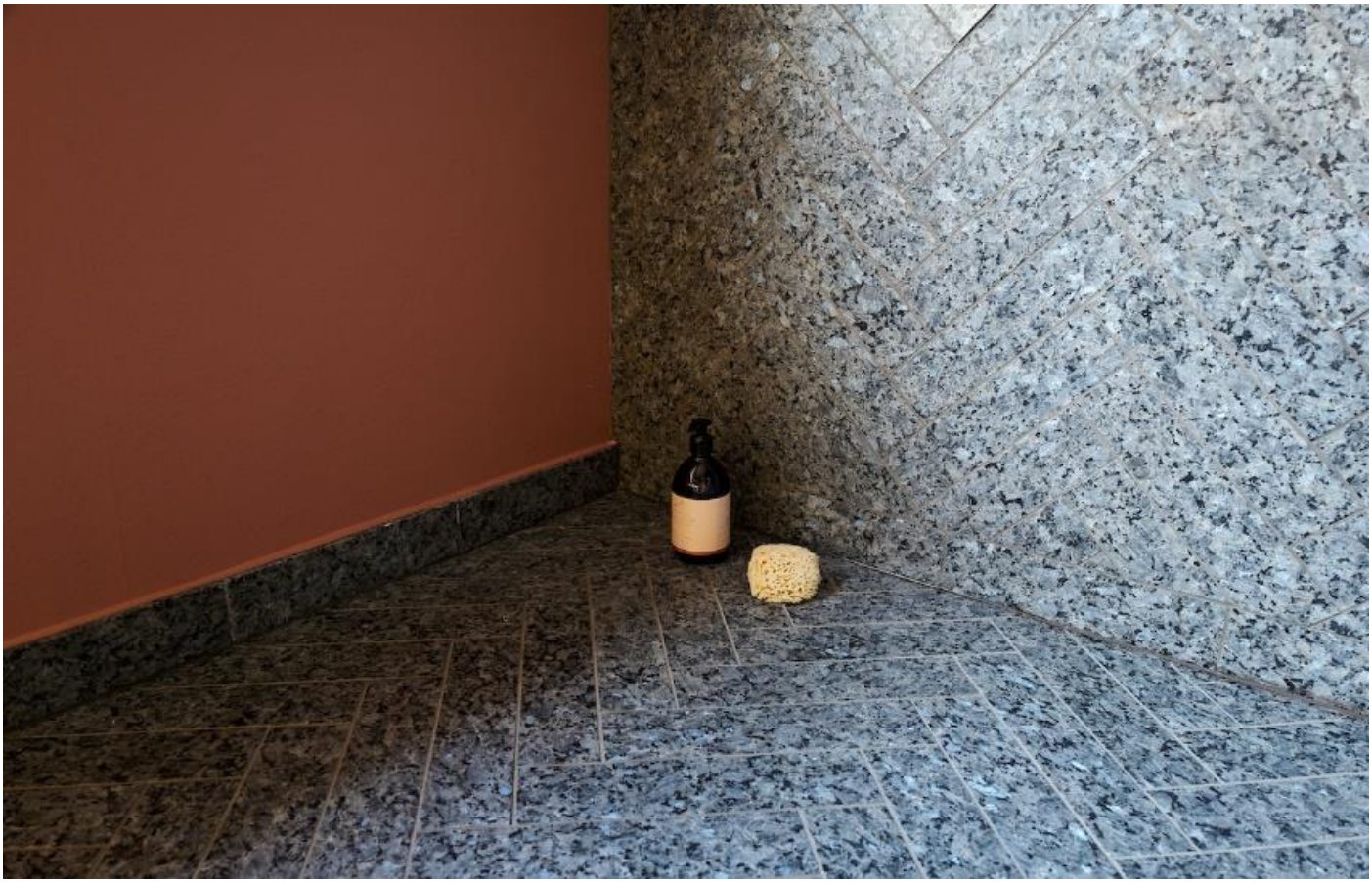
Geological age: Carboniferous-Permian (298-272 million years)
Geological unit: Larvik Plutonic Complex

Application, use and heritage

Description: Larvikite has been extracted in an industrial scale since 1878, and has since been applied all over the world. It is particularly appreciated for façade cladding, indoor floors, table tops and funeral monuments. The Malerød Larvikite type is a subtype particularly used for façades. Larvikite is among the designated IUGS Global Heritage Stone Resource.



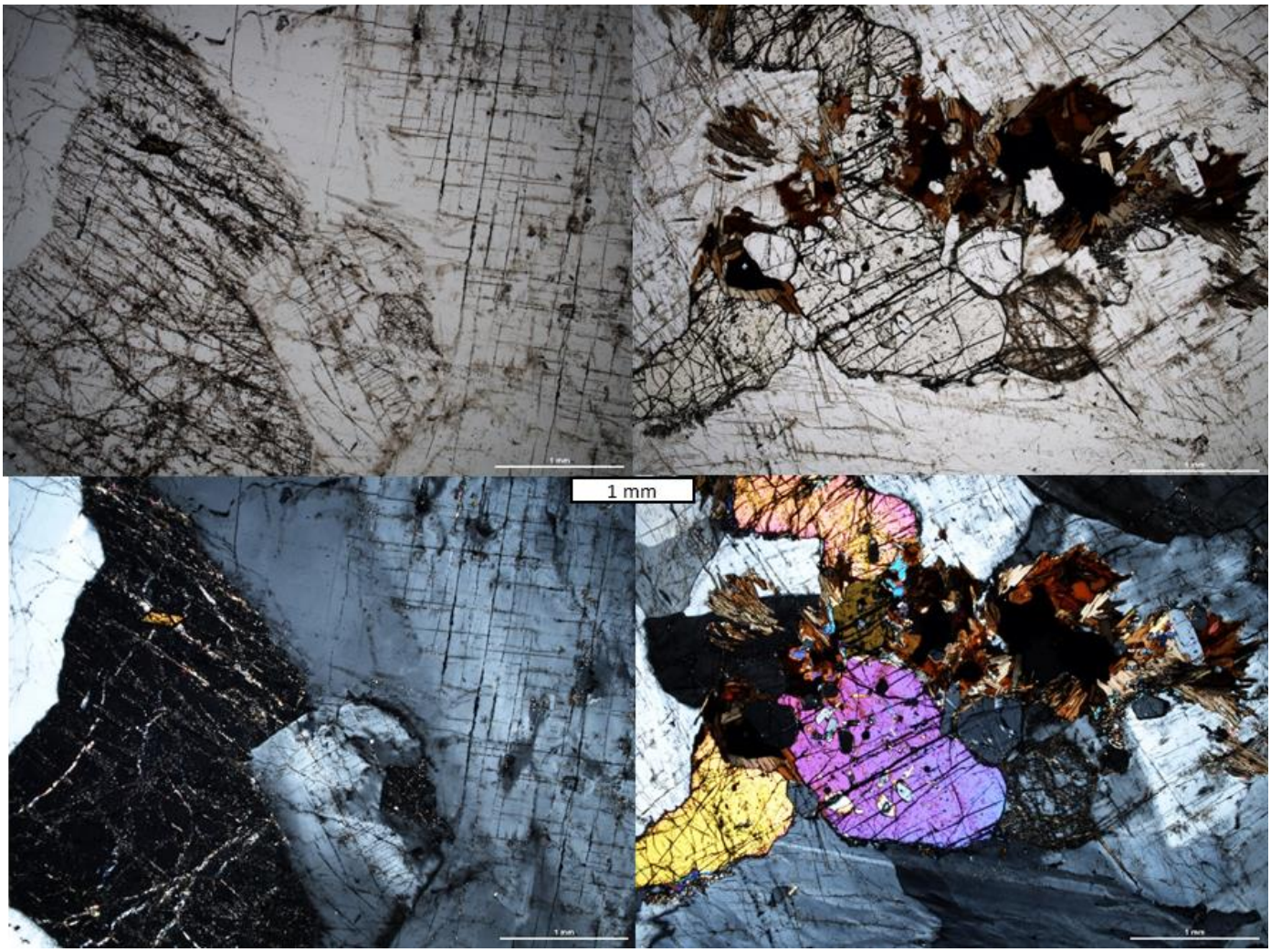
Façade Devon's Tower, USA (photo: Lundhs/Sean Phillips)



Bathroom tiles (photo: Lundhs/Morten Rakke)

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Petrography



Description: Larvikite is a monzonitic rock predominantly composed of felspar (75 – 85 %), with clusters of dark minerals such as olivine, amphibole, pyroxene and biotite. Nepheline and apatite may be present in small amounts. The feldspars are ternary, i.e. showing intergrowth patterns of lamellae of different composition. The lamellae cause the blue play of colours (schillerization). The photomicrograph shows two thin sections, top plane polized light, bottom crossed nichols. Right: cluster of mafic minerals. Left: large, ternary feldspar crystals.

Source of information: Geological Survey of Norway

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Mineral composition

If no accurate number, use MM=main minerals, SM = Subordinate minerals, AM=accessory minerals

Feldspars (%)	Pyroxene (%)	Amphiboles (%)	Olivine (%)	Biotite (%)	Nepheline (%)	Apatite (%)
81,5	**4**	**2**	**2**	**2,5**	**3**	**1,5**
Opaques (%)						
3						

Source of information: Lundhs

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Physical properties

Apparent density (EN 1936), kg/m3	Open porosity (EN 1936), % vol	Water absorption at atmospheric pressure (EN 13755), % wt	Uniaxial Compressive strength (EN 1926), MPa	Flexural strength under concentrated load (EN 12372), MPa
2711	**0,1**	**0,03**	**264,2**	**14,6**

Real density (EN 1936), kg/m3	Total porosity (EN 1936), % vol	Water absorption coefficient by capillary (EN 1925) (g/m2 x s0,5)	Flexural strength under constant moment (EN 13161), MPa

Frost resistance (EN 12371)				
Technological Test (Test A)				Identification Test (Test B): Number of cycles completed prior to stone failure
Flexural strength (EN 12372) after freeze-thaw cycling, MPa	Number of cycles	Uniaxial compressive strength (EN 1926) after freeze-thaw cycling, MPa	Number of cycles	
14,2	**56**			

Resistance to ageing by thermal shock (EN 14066)			
Change in dynamic modulus of elasticity (increase: +; decrease: -), %	Change in open porosity (increase: +; decrease: -), %	Change in ultrasound pulse velocity (increase: +; decrease: -), %	Change in flexural strength under conc. load (increase: +; decrease: -) %

Abrasion resistance (EN 14157)			**Resistance to salt crystallisation (EN 12370)**	**Breaking load at dowel hole (EN 13364)**	
Method A - Wide Wheel Abrasion Test, mm	Method B - Böhme Abrasion Test, cm^3 / $50cm^2$	Method C - Amsler Abrasion Test, mm	Change in mass (increase: +; decrease: -), %	Breaking load, N	Thickness of the test specimens, mm
17,5					

Slip resistance by means of the pendulum tester (EN 14231 / CEN/TS 16165)			**Rupture energy (EN 14158), Joule**	**Thermal Conductivity (EN 1745), W/m·K**
Tested surface finish	Slip Resistance Value — SRV			
	Dry test condition	Wet test condition		
Polished	**94**	**8**		

Source of information: Lundhs

Chemical properties

Main elements

SiO_2 (%)	Al_2O_3 (%)	Fe_2O_3 (%)	TiO_2 (%)	MgO (%)	CaO (%)	Na_2O (%)	K_2O (%)	MnO (%)	P_2O_5 (%)	SO_3 (%)	LOI (%)

Trace elements

V (ppm)	Cr (ppm)	Mn (ppm)	Co (ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	As (ppm)
Sr (ppm)	Cd (ppm)	Ba (ppm)	Pb (ppm)	Be (ppm)	Rb (ppm)	Bi (ppm)	U (ppm)
Sc (ppm)	Y (ppm)	Th (ppm)	Sb (ppm)	Ta (ppm)	Nb (ppm)	Zr (ppm)	Sn (ppm)
Ag (ppm)	B (ppm)	Mo (ppm)	W (ppm)	Ga (ppm)	Ge (ppm)	Se (ppm)	Cs (ppm)
Tl (ppm)							

REE

La (ppm)	Ce (ppm)	Pr (ppm)	Nd (ppm)	Sm (ppm)	Eu (ppm)	Gd (ppm)	Tb (ppm)
Dy (ppm)	Ho (ppm)	Er (ppm)	Tm (ppm)	Yb (ppm)	Lu (ppm)		

Methods applied and source of information:

Sources of more information

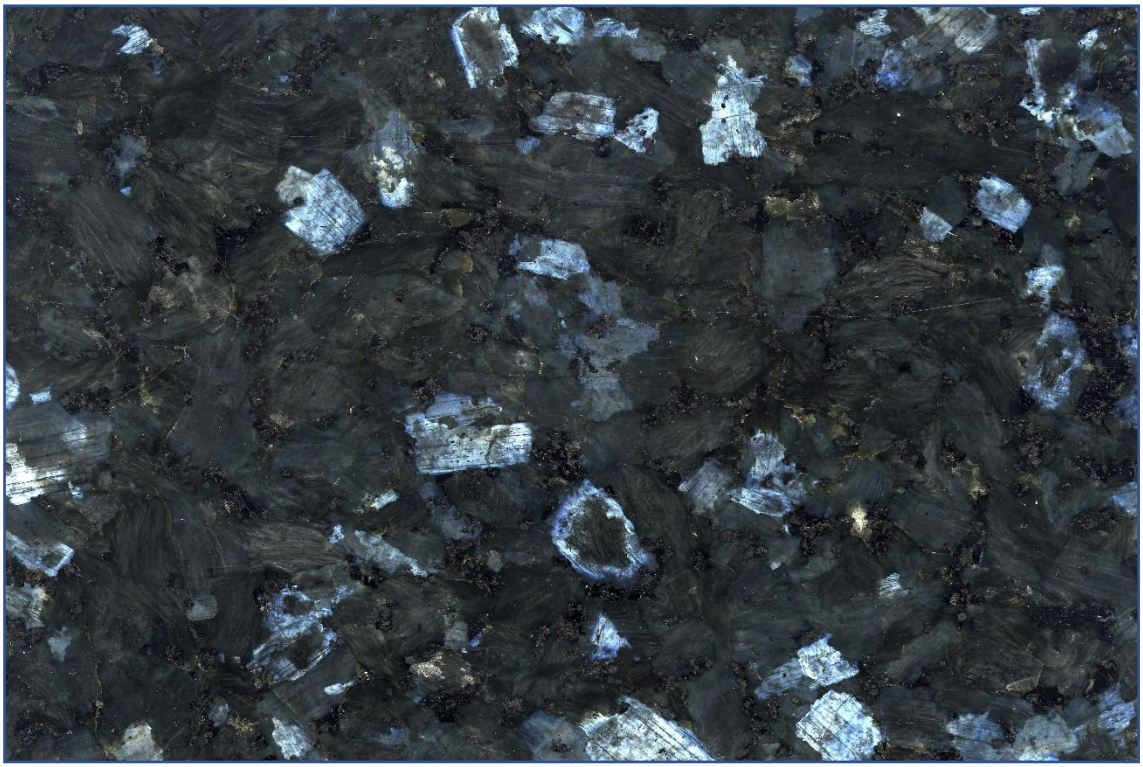
Type of information	Name of provider	URL
This data sheet	Geological Survey of Norway	https://geo.ngu.no/api/faktaark/mineralressurser/visNaturstein.php?objid=13124&lang=eng
Maplink	Geological Survey of Norway	https://geo.ngu.no/kart/common_mobil/?_/kart/mineralressurser_mobil/__lang=eng::extent=208818.11664272036,6559605.859317353,212509.88226772036,6561287.781192353::map=9
Non-commercial directory	Natural stone online	
Commercial directory		
Scientific publication	Lyell Collection	https://sp.lyellcollection.org/content/407/1/21
Other publication		

Compiled by:	Geological Survey of Norway (NGU) https://www.ngu.no/	

Mørk larvikitt (dark larvikite)

Emerald Pearl

Lundhs Emerald

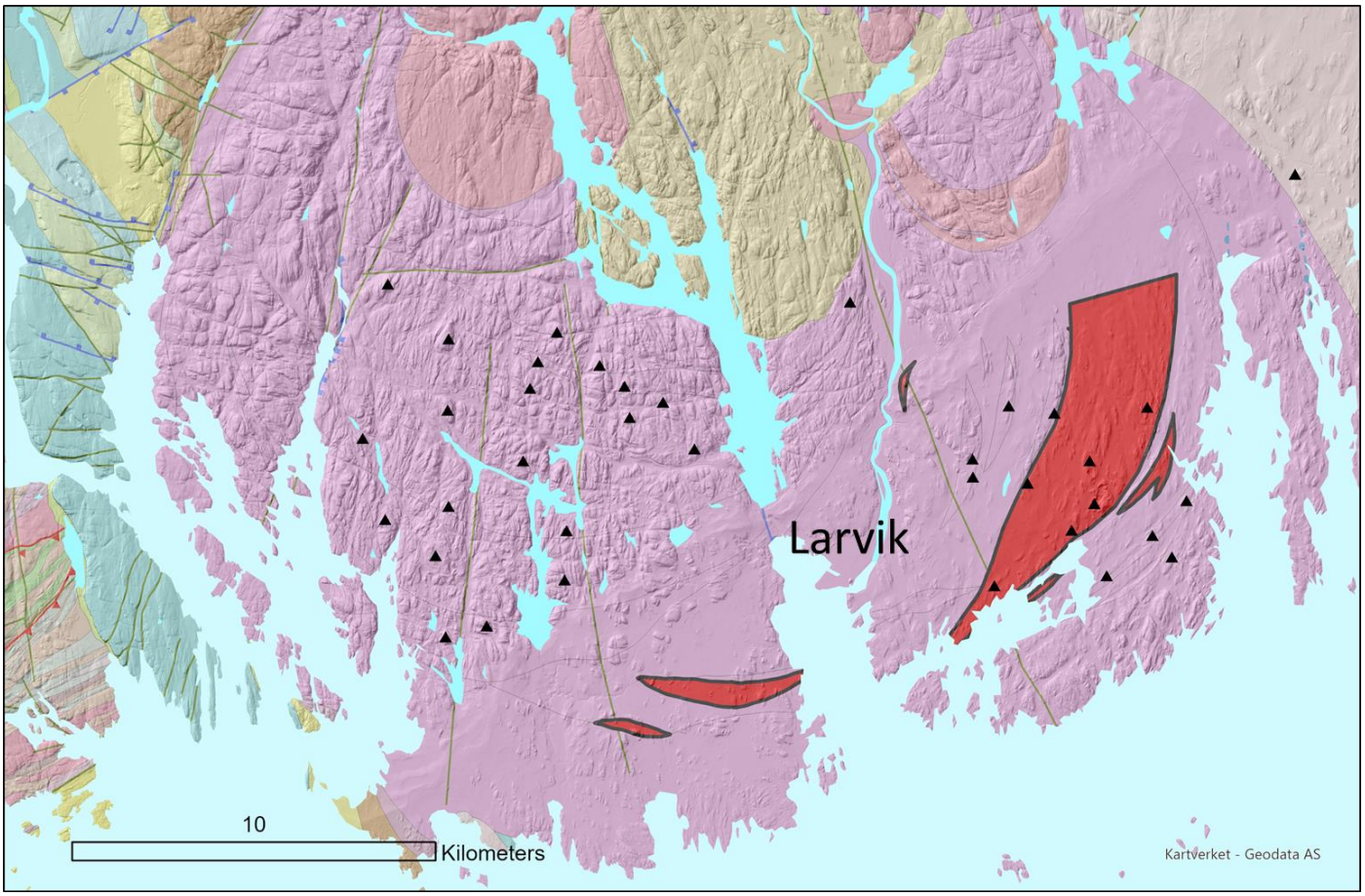


5 centimeters

Short description: Almost black, coarse-grained monzonite displaying blue schillerization within ternary feldspar crystals. The image displays a polished surface.

Commodity (vocabulary)	Lithology (vocabulary)	Typical colour (code list)	Place of origin			
			Country	County / District / Province	Municipality / Community	Place/town / Village
Commercial Granite	Monzonite	black	Norway	Vestfold-Telemark	Larvik	Klåstad

Geological setting



Geology: Dark larvikite forms a part of a rift related, monzonitic pluton of Carboniferous-Permian age, situated in SE Norway. Nearest town is Larvik, wich has given the name for the group of ornamental stones extracted in the area. Red colour marks the outcrop area for this type of larvikite, black triangles quarry areas.

Production: The most important quarry area is Klåstad, where there are several companies producing the stone in two large quarries. Production on this subtype was initiated in the late 19th century.

Geological age: Carboniferous-Permian (298-272 million years)
Geological unit: Larvik Plutonic Complex

Application, use and heritage

Description: Larvikite has been extracted in an industrial scale since 1878, and has since been applied all over the world. It is particularly appreciated for façade cladding, indoor floors, table tops and funeral monuments. Dark larvikite has been one of the main subtypes produced in large quantities, since the 19th century. Larvikite is among the designated IUGS Global Heritage Stone Resource.

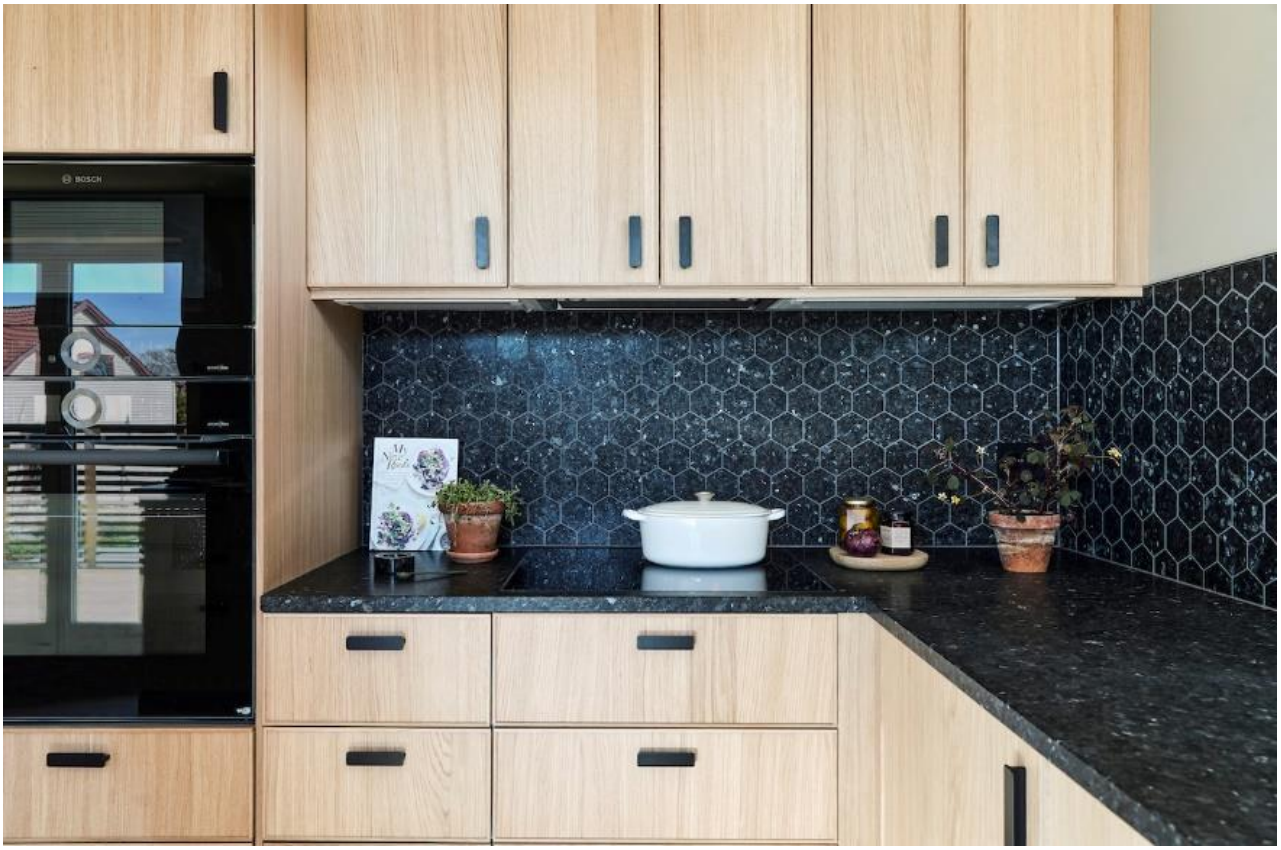


Fashion shop building in Oslo, dark larvikite used in polished and rough formats.



Dark larvikite “ship” on an art deco building façade, London city

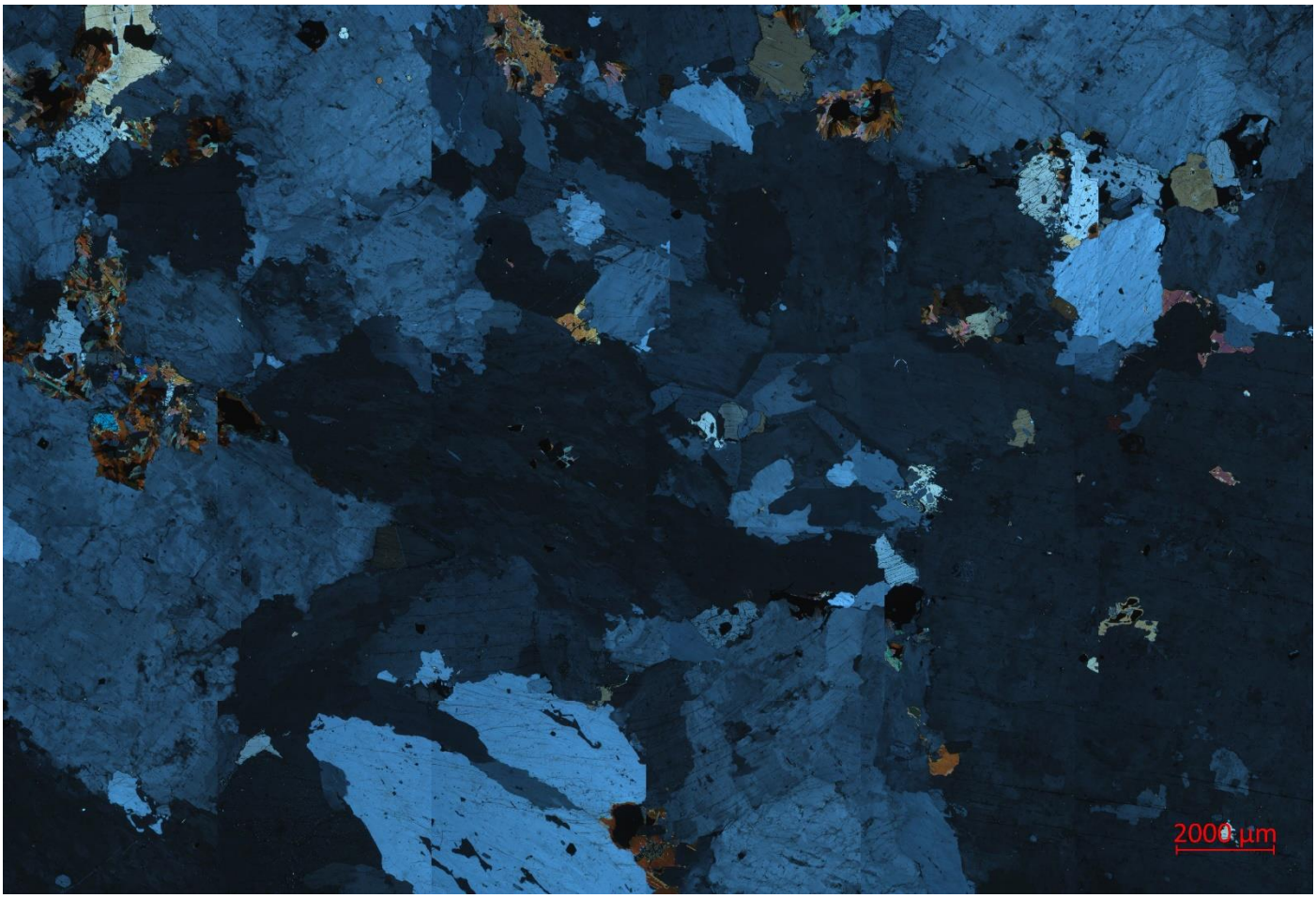
CC BY



Kitchen top and tiles (photo: Lundhs/Morten Rakke)

CC BY

Petrography



Description: Photomicrograph of thin section (mosaic), crossed polarized light showing large ternary feldspar grains and smaller grains of pyroxene, olivine, biotite and apatite.

Source of information: Geological Survey of Norway

Mineral composition

If no accurate number, use MM=main minerals, SM = Subordinate minerals, AM=accessory minerals

Feldspars (%)	Pyroxene (%)	Amphiboles (%)	Olivine (%)	Biotite (%)	Apatite (%)	Opaques (%)
83,5	**3,5**	**4,5**	**2,5**	**1,5**	**1**	**3**

Source of information: Lundhs

Physical properties

Apparent density (EN 1936), kg/m3	Open porosity (EN 1936), % vol	Water absorption at atmospheric pressure (EN 13755), % wt	Uniaxial Compressive strength (EN 1926), MPa	Flexural strength under concentrated load (EN 12372), MPa
2699	**0,45**	**0,16**	**174,8**	**12,5**

Real density (EN 1936), kg/m3	Total porosity (EN 1936), % vol	Water absorption coefficient by capillary (EN 1925) (g/m2 x s0,5)	Flexural strength under constant moment (EN 13161), MPa

Frost resistance (EN 12371)				
Technological Test (Test A)				Identification Test (Test B): Number of cycles completed prior to stone failure
Flexural strength (EN 12372) after freeze-thaw cycling, MPa	Number of cycles	Uniaxial compressive strength (EN 1926) after freeze-thaw cycling, MPa	Number of cycles	
13,3	**56**			

Resistance to ageing by thermal shock (EN 14066)			
Change in dynamic modulus of elasticity (increase: +; decrease: -), %	Change in open porosity (increase: +; decrease: -), %	Change in ultrasound pulse velocity (increase: +; decrease: -), %	Change in flexural strength under conc. load (increase: +; decrease: -) %
			-2,4

Abrasion resistance (EN 14157)			**Resistance to salt crystallisation (EN 12370)**	**Breaking load at dowel hole (EN 13364)**	
Method A - Wide Wheel Abrasion Test, mm	Method B - Böhme Abrasion Test, cm^3 / $50cm^2$	Method C - Amsler Abrasion Test, mm	Change in mass (increase: +; decrease: -), %	Breaking load, N	Thickness of the test specimens, mm

Slip resistance by means of the pendulum tester (EN 14231 / CEN/TS 16165)			**Rupture energy (EN 14158), Joule**	**Thermal Conductivity (EN 1745), W/m·K**
Tested surface finish	Slip Resistance Value — SRV			
	Dry test condition	Wet test condition		
Polished	**59**	**8**	**5,8**	

Source of information:
Lundhs

Chemical properties

Main elements

SiO_2 (%)	Al_2O_3 (%)	Fe_2O_3 (%)	TiO_2 (%)	MgO (%)	CaO (%)	Na_2O (%)	K_2O (%)	MnO (%)	P_2O_5 (%)	SO_3 (%)	LOI (%)

Trace elements

V (ppm)	Cr (ppm)	Mn (ppm)	Co (ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	As (ppm)
Sr (ppm)	Cd (ppm)	Ba (ppm)	Pb (ppm)	Be (ppm)	Rb (ppm)	Bi (ppm)	U (ppm)
Sc (ppm)	Y (ppm)	Th (ppm)	Sb (ppm)	Ta (ppm)	Nb (ppm)	Zr (ppm)	Sn (ppm)
Ag (ppm)	B (ppm)	Mo (ppm)	W (ppm)	Ga (ppm)	Ge (ppm)	Se (ppm)	Cs (ppm)
Tl (ppm)							

REE

La (ppm)	Ce (ppm)	Pr (ppm)	Nd (ppm)	Sm (ppm)	Eu (ppm)	Gd (ppm)	Tb (ppm)
Dy (ppm)	Ho (ppm)	Er (ppm)	Tm (ppm)	Yb (ppm)	Lu (ppm)		

Methods applied and source of information:

Sources of more information

Type of information	Name of provider	URL
This data sheet	Geological Survey of Norway	https://geo.ngu.no/api/faktaark/mineralressurser/visNaturstein.php?objid=13128&lang=eng
Map link	Geological Survey of Norway	https://geo.ngu.no/kart/common_mobil/?_/kart/mineralressurser_mobil/__lang=eng::extent=219710.6821567807,6555885.7141567245,227094.2134067807,6559249.5579067245::map=9
Non-commercial directory	Natural stone online	Detailansicht (naturalstone-online.com)
Commercial directory		
Scientific publication	Lyell Collection	https://sp.lyellcollection.org/content/407/1/21
Other publication		

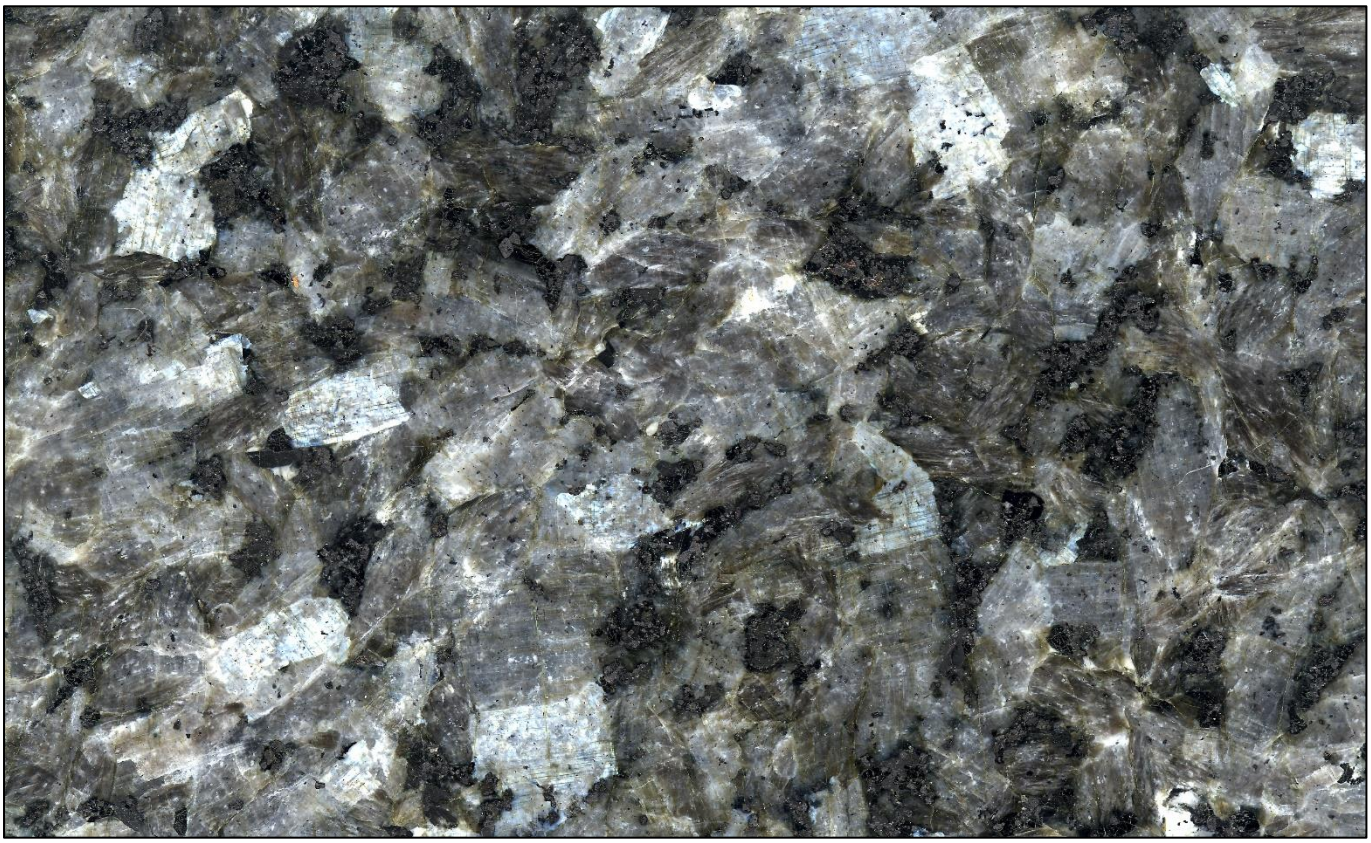
Compiled by:	Geological Survey of Norway (NGU) https://www.ngu.no/	

Stålaker larvikitt (Stålaker larvikite)

Marina Pearl

Lundhs Marina

Silver Pearl



5 centimeters

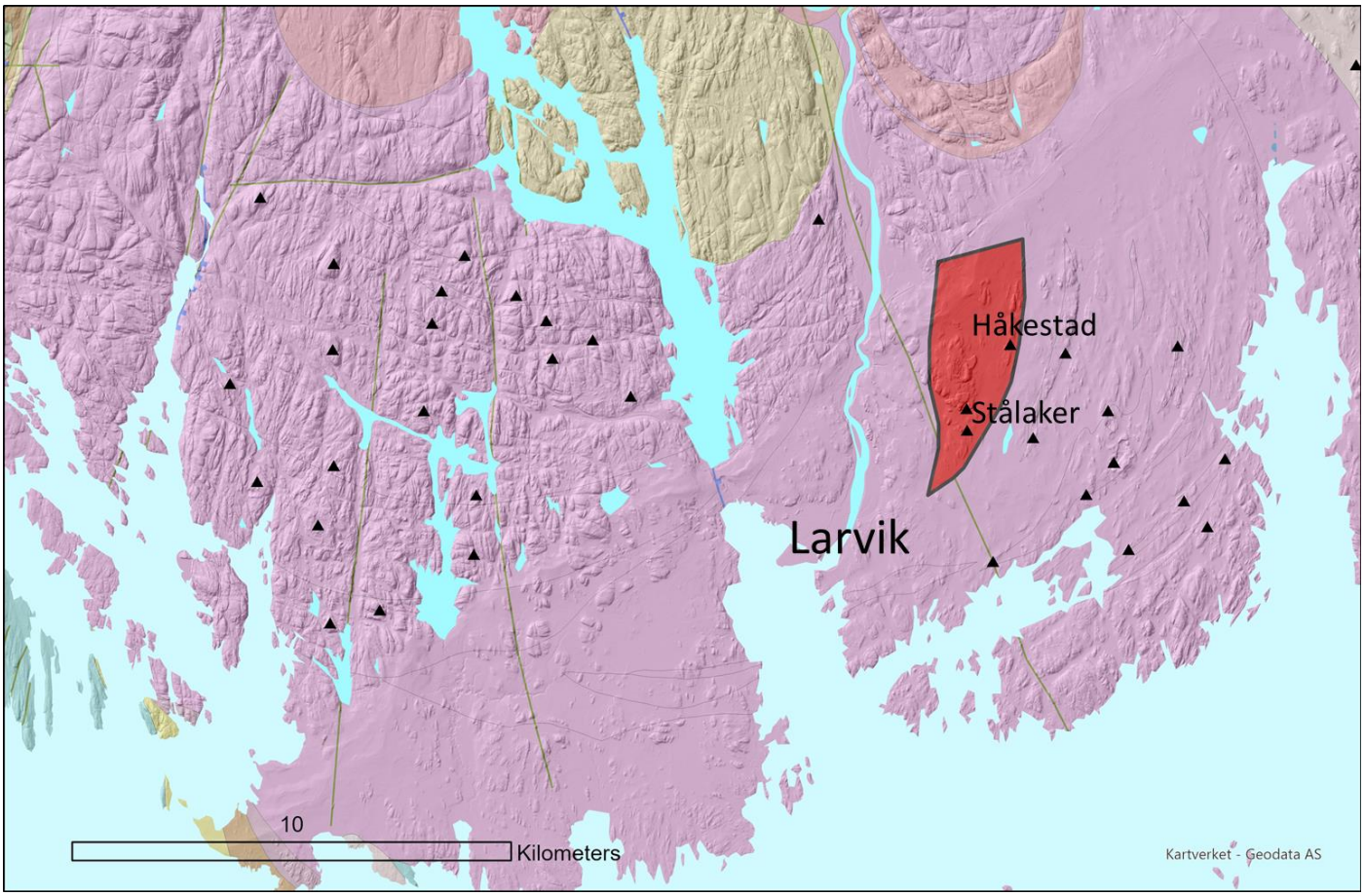
Short description: Bluish-grey, coarse-grained monzonite displaying grey to blue schillerization within ternary feldspar crystals. The image displays a polished surface.

Commodity (vocabulary)	Lithology (vocabulary)	Typical colour (code list)	Place of origin			
			Country	County / District / Province	Municipality / Community	Place/town / Village
Commercial Granite	Monzonite	Grey	Norway	Vestfold-Telemark	Larvik	Stålaker Håkestad

CC BY

Geological setting

q



Geology: Stålaker larvikite forms a part of a rift related, monzonitic pluton of Carboniferous-Permian age, situated in SE Norway. Nearest town is Larvik, which has given the name for the group of ornamental stones extracted in the area. Red colour marks the outcrop area of this type of larvikite. Black triangles are quarry areas/deposits.

Production: The most important quarry areas are Håkestadåsen and Stålaker. The southernmost part is being explored.

Geological age: Carboniferous-Permian (298-272 million years)
Geological unit: Larvik Plutonic Complex

Application, use and heritage

Description: Larvikite has been extracted in an industrial scale since 1878, and has since been applied all over the world. It is particularly appreciated for façade cladding, indoor floors, table tops and funeral monuments. Stålaker larvikite is a subtype mostly produced for facades and kitchen tops. Larvikite is among the designated IUGS Global Heritage Stone Resource.



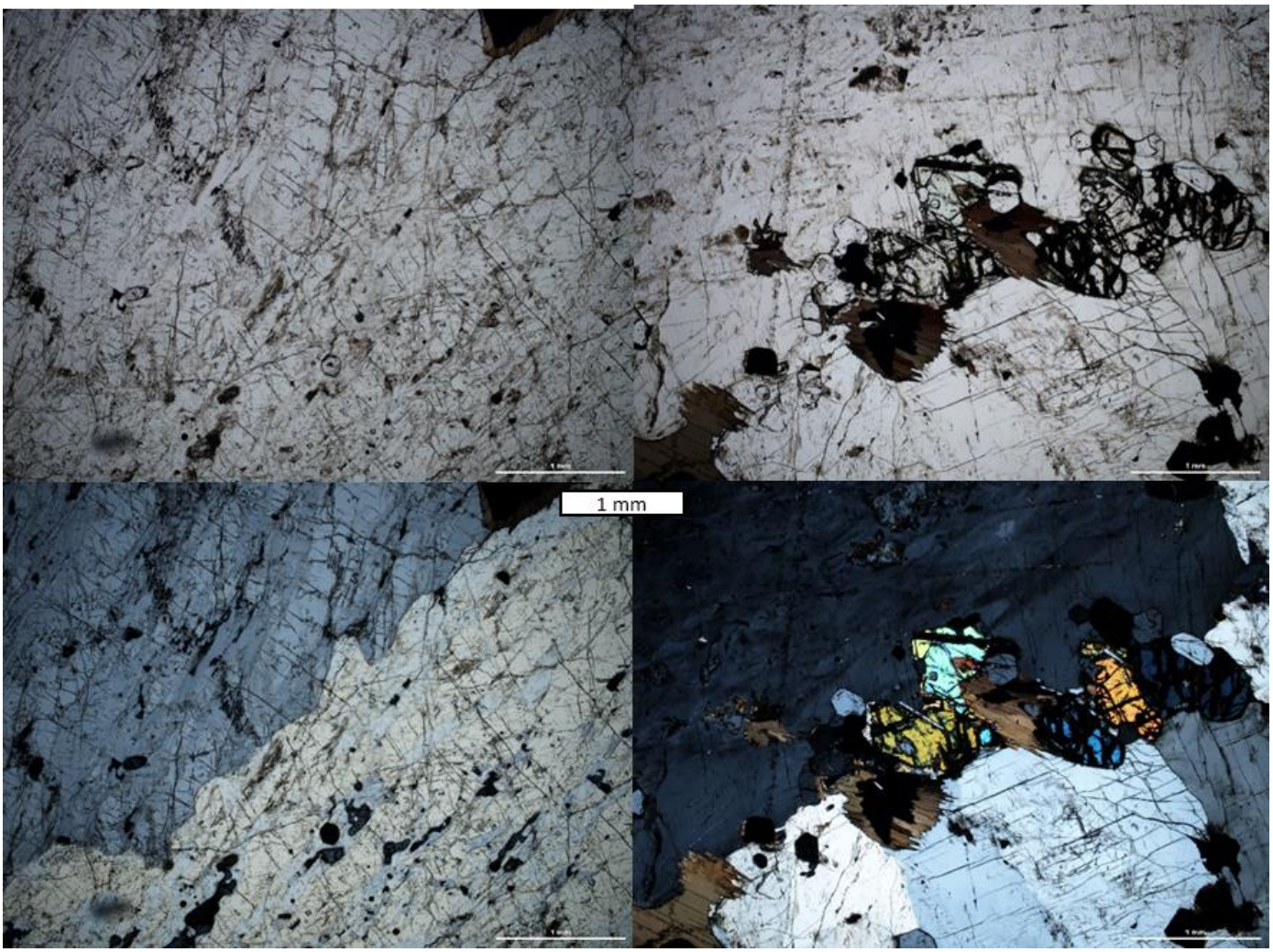
Kitchen top (phto: Lundhs/Morten Rakke)



Outdoor tiles (phto: Lundhs/Morten Rakke)

CC BY

Petrography



Description: Larvikite is a monzonitic rock predominantly composed of felspar (75 – 85 %), with clusters of dark minerals such as olivine, amphibole, pyroxene and biotite. Nepheline and apatite may be present in small amounts. The feldspars are ternary, i.e. showing intergrowth patterns of lamellae of different composition. The lamellae cause the blue play of colours (schillerization). The photomicrograph shows two thin sections, top plane polized light, bottom crossed nichols. Right: large, ternary feldspar crystals. Left: cluster of mafic minerals.

Source of information: Lundhs and SINTEF

Mineral composition

If no accurate number, use MM=main minerals, SM = Subordinate minerals, AM=accessory minerals

Feldspars (%)	Pyroxene (%)	Amphiboles (%)	Olivine (%)	Biotite (%)	Nepheline (%)	Apatite (%)
82	**3,5**	**3**	**2,5**	**2,5**	**2**	**1,5**
Opaques (%)						
3						

Source of information: Lundhs

CC BY

Physical properties

Apparent density (EN 1936), kg/m3	Open porosity (EN 1936), % vol	Water absorption at atmospheric pressure (EN 13755), % wt	Uniaxial Compressive strength (EN 1926), MPa	Flexural strength under concentrated load (EN 12372), MPa
2741	**0,1**	**0,04**	**206**	**15,9**

Real density (EN 1936), kg/m3	Total porosity (EN 1936), % vol	Water absorption coefficient by capillary (EN 1925) (g/m2 x s0,5)	Flexural strength under constant moment (EN 13161), MPa

Frost resistance (EN 12371)				
Technological Test (Test A)				Identification Test (Test B): Number of cycles completed prior to stone failure
Flexural strength (EN 12372) after freeze-thaw cycling, MPa	Number of cycles	Uniaxial compressive strength (EN 1926) after freeze-thaw cycling, MPa	Number of cycles	
14,9	**56**			

Resistance to ageing by thermal shock (EN 14066)			
Change in dynamic modulus of elasticity (increase: +; decrease: -), %	Change in open porosity (increase: +; decrease: -), %	Change in ultrasound pulse velocity (increase: +; decrease: -), %	Change in flexural strength under conc. load (increase: +; decrease: -) %

Abrasion resistance (EN 14157)			**Resistance to salt crystallisation (EN 12370)**	**Breaking load at dowel hole (EN 13364)**	
Method A - Wide Wheel Abrasion Test, mm	Method B - Böhme Abrasion Test, cm^3 / $50cm^2$	Method C - Amsler Abrasion Test, mm	Change in mass (increase: +; decrease: -), %	Breaking load, N	Thickness of the test specimens, mm
18					

Slip resistance by means of the pendulum tester (EN 14231 / CEN/TS 16165)			**Rupture energy (EN 14158), Joule**	**Thermal Conductivity (EN 1745), W/m·K**
Tested surface finish	Slip Resistance Value — SRV			
	Dry test condition	Wet test condition		
Polished	**60**	**8**		

Source of information: Lundhs

Chemical properties

Main elements

SiO_2 (%)	Al_2O_3 (%)	Fe_2O_3 (%)	TiO_2 (%)	MgO (%)	CaO (%)	Na_2O (%)	K_2O (%)	MnO (%)	P_2O_5 (%)	SO_3 (%)	LOI (%)

Trace elements

V (ppm)	Cr (ppm)	Mn (ppm)	Co (ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	As (ppm)
Sr (ppm)	Cd (ppm)	Ba (ppm)	Pb (ppm)	Be (ppm)	Rb (ppm)	Bi (ppm)	U (ppm)
Sc (ppm)	Y (ppm)	Th (ppm)	Sb (ppm)	Ta (ppm)	Nb (ppm)	Zr (ppm)	Sn (ppm)
Ag (ppm)	B (ppm)	Mo (ppm)	W (ppm)	Ga (ppm)	Ge (ppm)	Se (ppm)	Cs (ppm)
Tl (ppm)							

REE

La (ppm)	Ce (ppm)	Pr (ppm)	Nd (ppm)	Sm (ppm)	Eu (ppm)	Gd (ppm)	Tb (ppm)
Dy (ppm)	Ho (ppm)	Er (ppm)	Tm (ppm)	Yb (ppm)	Lu (ppm)		

Methods applied and source of information:

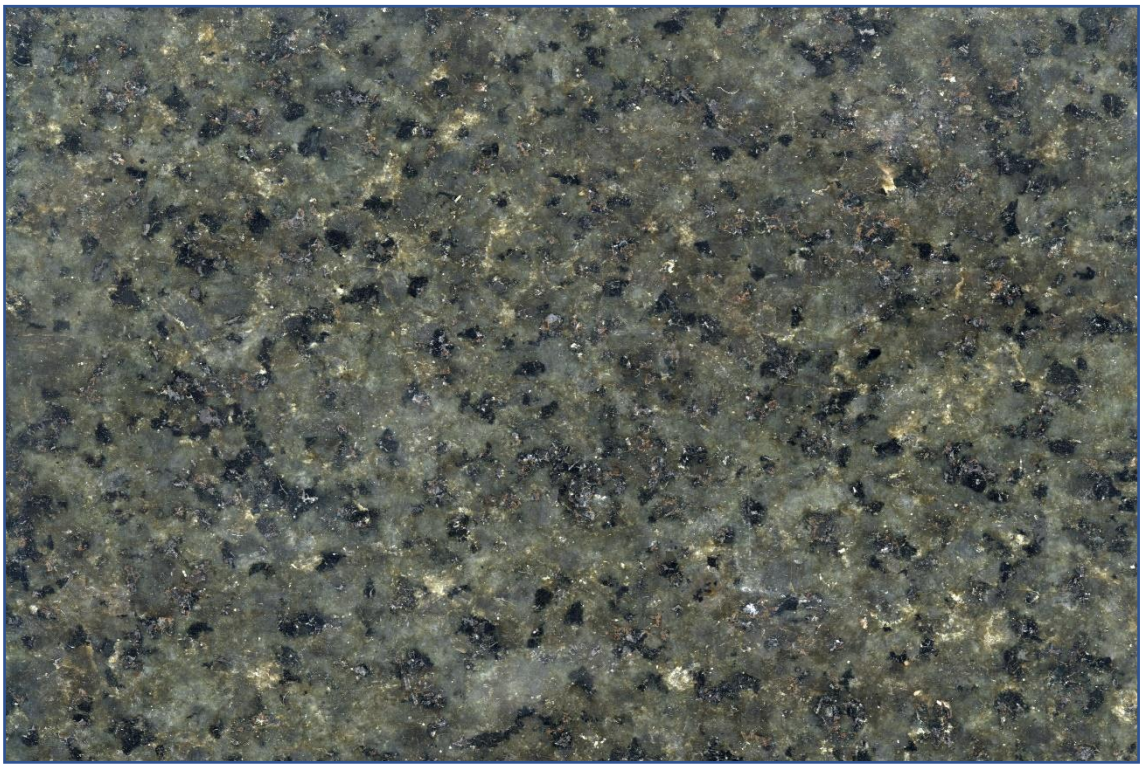
Sources of more information

Type of information	Name of provider	URL
This data sheet	Geological Survey of Norway	https://geo.ngu.no/api/faktaark/mineralressurser/visNaturstein.php?objid=13125&lang=eng
Maplink	Geological Survey of Norway	https://geo.ngu.no/kart/common_mobil/?_/kart/mineralressurser_mobil/__lang=eng::extent=215483.28118979745,6557571.0536808595,222866.81243979745,6560934.8974308595::map=9
Non-commercial directory	Natural stone online	Detailansicht (naturalstone-online.com)
Commercial directory		
Scientific publication	Lyell Collection	https://sp.lyellcollection.org/content/407/1/21
Other publication		

Compiled by:	Geological Survey of Norway (NGU) https://www.ngu.no/	GEOLOGICAL SURVEY OF NORWAY - NGU -

Arctic black

Lødingengranitt

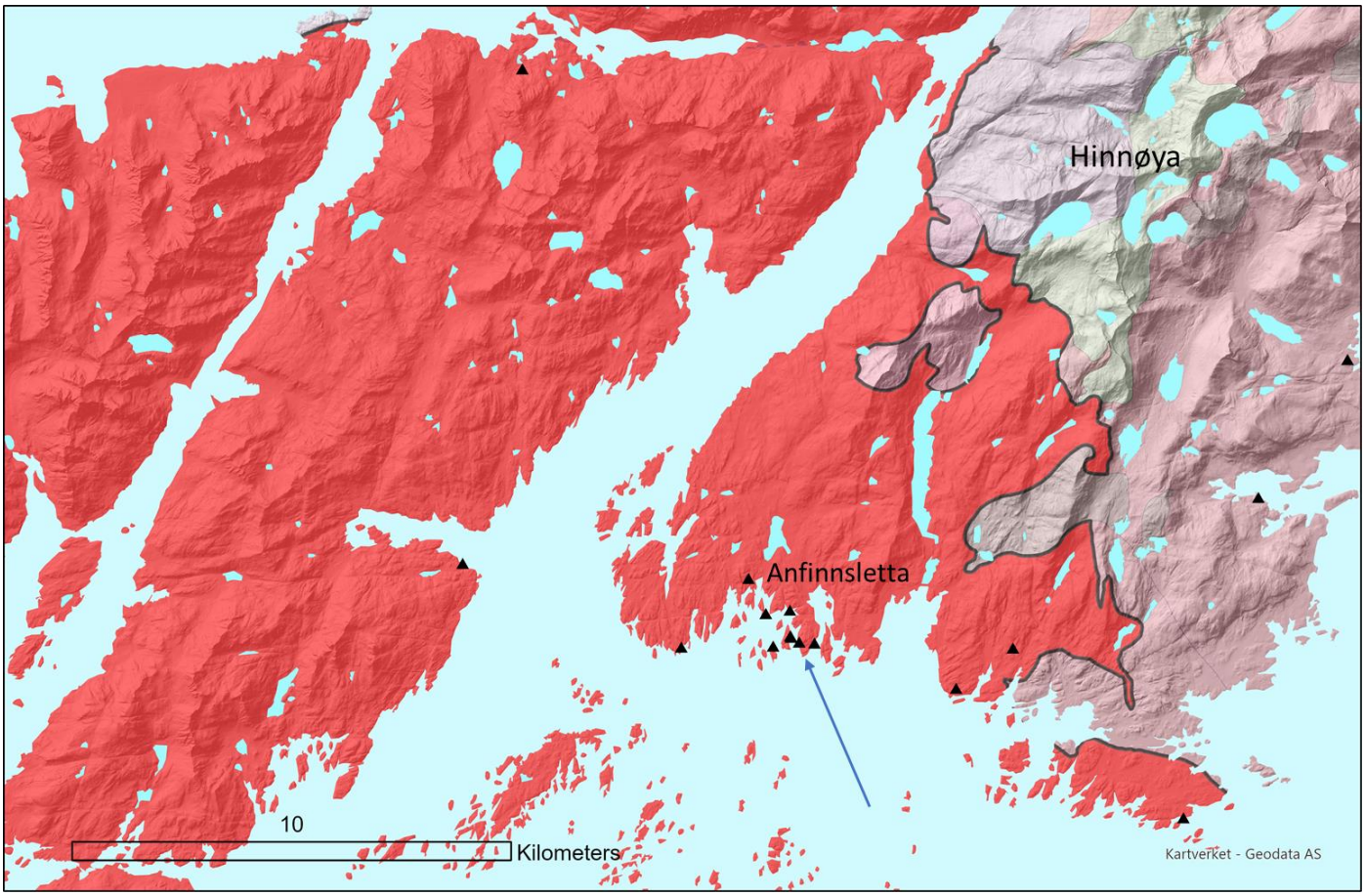


5 centimeters

Short description: Arctic black is a black-green syenite. The image displays a polished surface.

Commodity (vocabulary)	Lithology (vocabulary)	Typical colour (code list)	Place of origin			
			Country	County / District / Province	Municipality / Community	Place/town / Village
Commercial Granite	Monzonite	Black-green	Norway	Nordland	Lødingen	Anfinnsletta

Geological setting



Geology: The Lofoten – Vesterålen area consists predominantly of mangeritic and charnockitic rocks, including the Arctic Black type (mangerite = pryroxene monzonite). The stone is known for high strength and durability.

Production: The Arctic Black has been produced for dimension stone since 1934. At present time, production is less regular and mainly for rock aggregate.

Geological age: Proterozoic 1796 Ma
Geological unit: The Lofoten-Vesterålen Complex

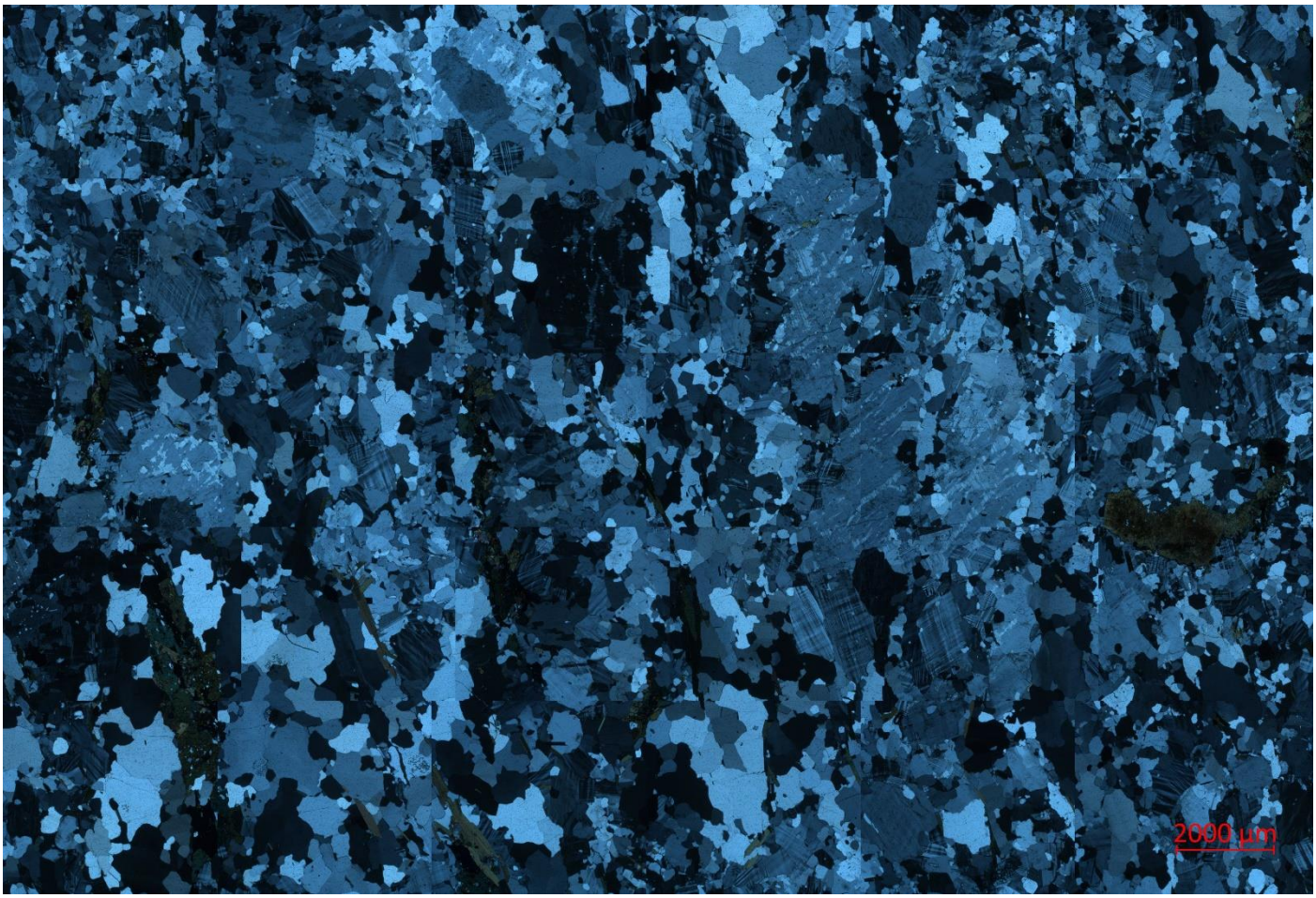
Application, use and heritage

Description: The first 40 years of production, funerary monuments where the main products. Later in the 20th century more stone blocks were sold to the international market but the stone was also used for façade, floors and sculptures in Norway.



Arctic Black (black stripes) at the Geological Survey of Norway

Petrography



Description: Photomicrograph of thin section (mosaic), crossed polarized light. Main minerals are plagioclase, potassium feldspar, pyroxene and quartz.

Source of information: Geological Survey of Norway

Mineral composition

If no accurate number, use MM=main minerals, SM = Subordinate minerals, AM=accessory minerals

Potassium feldspar (%)	Plagioclase (%)	Pyroxene (%)	Quartz (%)	Biotite (%)	Magnetite (%)	Chlorite (%)
MM	**MM**	**MM**	**SM**	**SM**	**SM**	**AM**
Apatite (%)	Sericite (%)	Amphibole (%)	Garnet (%)			
AM	**AM**	**AM**	**AM**			

Source of information: NGU

Physical properties

Apparent density (EN 1936), kg/m3	Open porosity (EN 1936), % vol	Water absorption at atmospheric pressure (EN 13755), % wt	Uniaxial Compressive strength (EN 1926), MPa	Flexural strength under concentrated load (EN 12372), MPa
2720		**0,17**	**140-290**	**16,4-20,5**

Real density (EN 1936), kg/m3	Total porosity (EN 1936), % vol	Water absorption coefficient by capillary (EN 1925) (g/m2 x s0,5)	Flexural strength under constant moment (EN 13161), MPa

Frost resistance (EN 12371)				
Technological Test (Test A)				Identification Test (Test B): Number of cycles completed prior to stone failure
Flexural strength (EN 12372) after freeze-thaw cycling, MPa	Number of cycles	Uniaxial compressive strength (EN 1926) after freeze-thaw cycling, MPa	Number of cycles	

Resistance to ageing by thermal shock (EN 14066)			
Change in dynamic modulus of elasticity (increase: +; decrease: -), %	Change in open porosity (increase: +; decrease: -), %	Change in ultrasound pulse velocity (increase: +; decrease: -), %	Change in flexural strength under conc. load (increase: +; decrease: -) %

Abrasion resistance (EN 14157)			**Resistance to salt crystallisation (EN 12370)**	**Breaking load at dowel hole (EN 13364)**	
Method A - Wide Wheel Abrasion Test, mm	Method B - Böhme Abrasion Test, cm^3 / $50cm^2$	Method C - Amsler Abrasion Test, mm	Change in mass (increase: +; decrease: -), %	Breaking load, N	Thickness of the test specimens, mm

Slip resistance by means of the pendulum tester (EN 14231 / CEN/TS 16165)			**Rupture energy (EN 14158), Joule**	**Thermal Conductivity (EN 1745), W/m·K**
Tested surface finish	Slip Resistance Value — SRV			
	Dry test condition	Wet test condition		
Polished				

Source of information: Historical data, Norwegian Stone Industry

Chemical properties

Main elements

SiO_2 (%)	Al_2O_3 (%)	Fe_2O_3 (%)	TiO_2 (%)	MgO (%)	CaO (%)	Na_2O (%)	K_2O (%)	MnO (%)	P_2O_5 (%)	SO_3 (%)	LOI (%)

Trace elements

V (ppm)	Cr (ppm)	Mn (ppm)	Co (ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	As (ppm)
Sr (ppm)	Cd (ppm)	Ba (ppm)	Pb (ppm)	Be (ppm)	Rb (ppm)	Bi (ppm)	U (ppm)
Sc (ppm)	Y (ppm)	Th (ppm)	Sb (ppm)	Ta (ppm)	Nb (ppm)	Zr (ppm)	Sn (ppm)
Ag (ppm)	B (ppm)	Mo (ppm)	W (ppm)	Ga (ppm)	Ge (ppm)	Se (ppm)	Cs (ppm)
Tl (ppm)							

REE

La (ppm)	Ce (ppm)	Pr (ppm)	Nd (ppm)	Sm (ppm)	Eu (ppm)	Gd (ppm)	Tb (ppm)
Dy (ppm)	Ho (ppm)	Er (ppm)	Tm (ppm)	Yb (ppm)	Lu (ppm)		

Methods applied and source of information:

Sources of more information

Type of information	Name of provider	URL
Data sheet	Geological Survey of Norway	https://geo.ngu.no/api/faktaark/mineralressurser/visNaturstein.php?objid=23583&lang=eng
Maplink	Geological Survey of Norway	https://geo.ngu.no/kart/common_mobil/?_/kart/mineralressurser_mobil/__lang=eng::extent=504820.3791629297,7574989.413676514,529435.6760379297,7586942.694926514::map=9
Non-commercial directory	Natural stone online	Detailansicht (naturalstone-online.com)
Commercial directory		
Scientific publication		
Other publication		https://www.ngu.no/upload/Georessurser/Naturstein/niba.pdf

Compiled by:	Geological Survey of Norway (NGU) https://www.ngu.no/	GEOLOGICAL SURVEY OF NORWAY - NGU -

Grorudsyenitt (Grorud syenite)

Grefsensyenitt

Grorud Granite



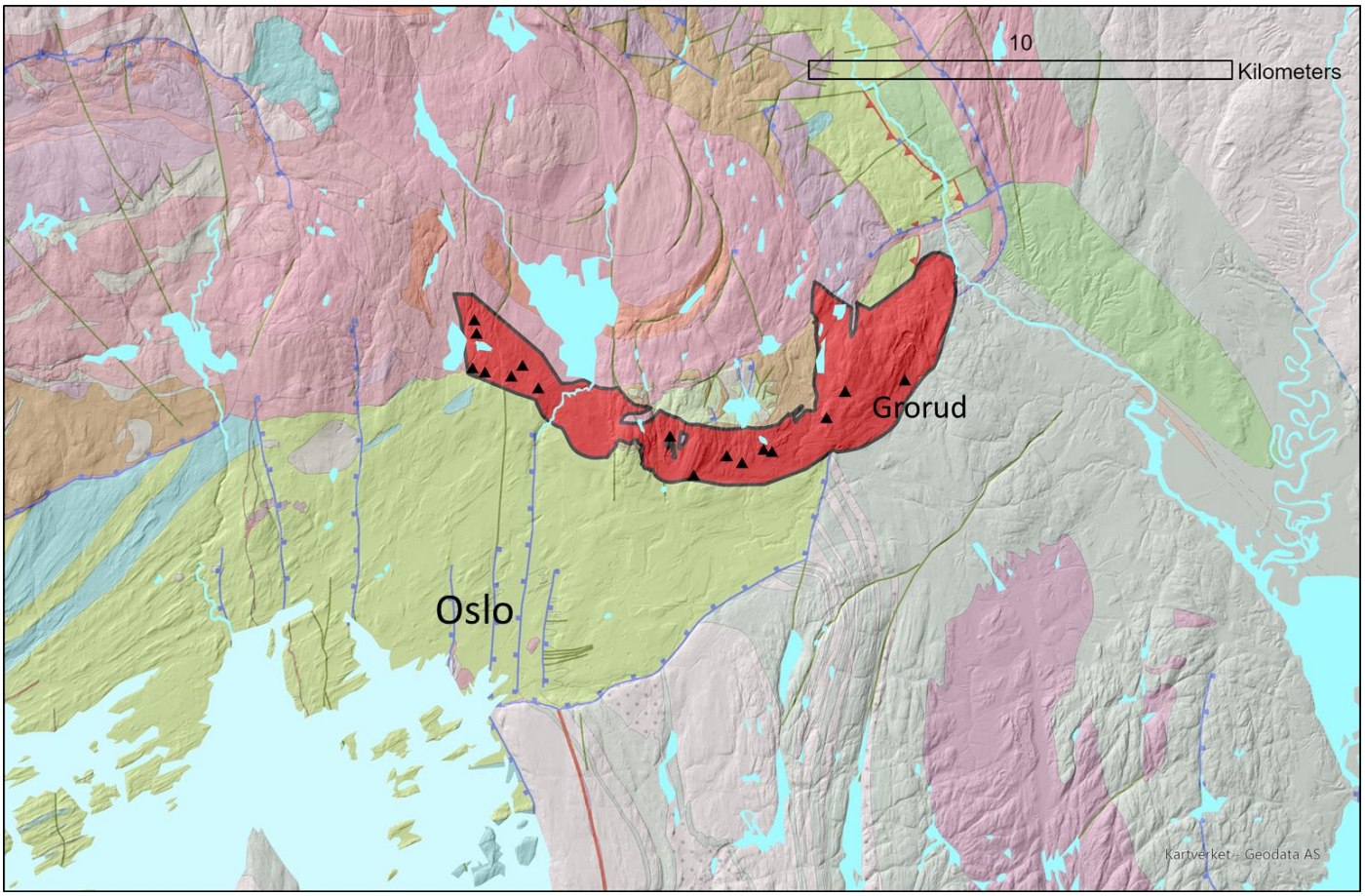
5 centimeters

Short description: Pink, coarse-grained syenite. The image displays a polished surface.

Commodity (vocabulary)	Lithology (vocabulary)	Typical colour (code list)	Place of origin			
			Country	County / District / Province	Municipality / Community	Place/town / Village
Commercial Granite	Syenite	Pink	Norway	Oslo	Oslo	Grorud

CC BY

Geological setting



Geology: The Grorud syenite is one of the younger plutonic rock units of the Oslo Rift, formed by continental rifting and volcanism during permian. The exploited syenite is part of an E-W oriented pluton (red colour on the map), composed of several subtypes, in which medium- to coarse-grained biotite syenite is the most common. Black triangles are quarries/deposits.

Production: There are several historic quarrying areas. The syenite was one of the earliest igneous rocks to be exploited as dimension stone in modern time, starting around 1820. It is an important heritage stone in Norway, but there are few records of any significant export. At present time one quarry operates in a small-scaled production.

Geological age: Permian 255-250 Ma
Geological unit: Nordmarka - Hurdal Syenite Complex

Application, use and heritage

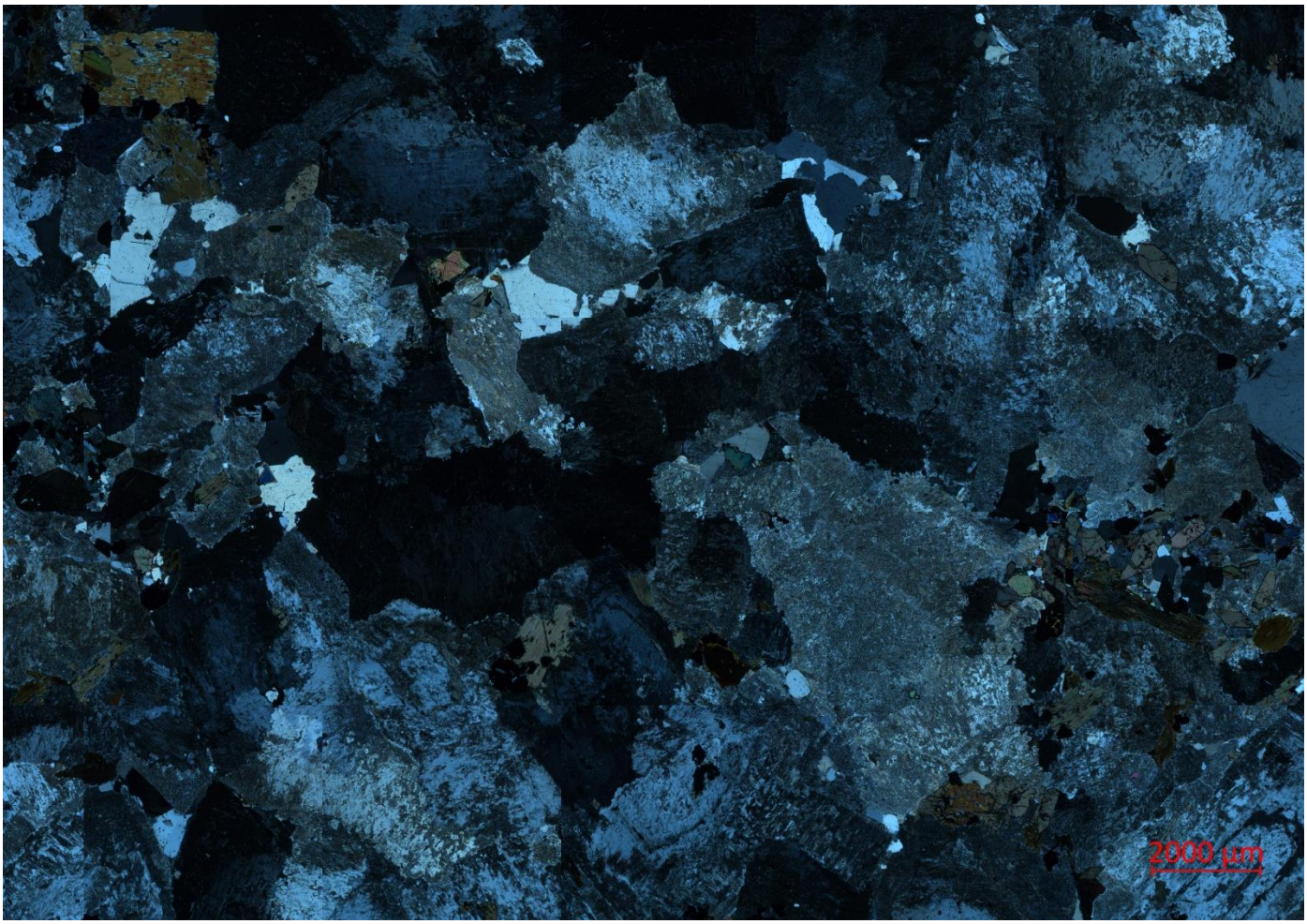
Description: Many of the historic buildings in Oslo and other Norwegian cities and towns were partly made from the syenite. Applications go back as far as around 1820, but the late 19th and early 20th century represented the peak of production and use. It is also widely applied as outdoor furniture and frames around monuments and parks.



Grorud syenite in Hoffmanngården, Ålesund, c. 1906.

CC BY

Petrography



Description: Photomicrograph of thin section (mosaic), crossed polarized light showing patches of quartz in between altered feldspar crystals, predominantly mesoperthite. Small grains of biotite and a selection of other minerals (amphibole, augite, sphene, ilmenite, apatite and zircon) occur in between. The syenite contains scattered miarolitic cavities, typical of such hydrothermally altered, shallow intrusions.

Source of information: Geological Survey of Norway

Mineral composition

If no accurate number, use MM=main minerals, SM = Subordinate minerals, AM=accessory minerals

Feldspar (%)	Quartz (%)	Biotite (%)	Others (%)			
85	**5**	**5**	**5**			

Source of information: NGU

CC BY

Physical properties

Apparent density (EN 1936), kg/m3	Open porosity (EN 1936), % vol	Water absorption at atmospheric pressure (EN 13755), % wt	Uniaxial Compressive strength (EN 1926), MPa	Flexural strength under concentrated load (EN 12372), MPa

Real density (EN 1936), kg/m3	Total porosity (EN 1936), % vol	Water absorption coefficient by capillary (EN 1925) (g/m2 x s0,5)	Flexural strength under constant moment (EN 13161), MPa

Frost resistance (EN 12371)				
Technological Test (Test A)				Identification Test (Test B): Number of cycles completed prior to stone failure
Flexural strength (EN 12372) after freeze-thaw cycling, MPa	Number of cycles	Uniaxial compressive strength (EN 1926) after freeze-thaw cycling, MPa	Number of cycles	

Resistance to ageing by thermal shock (EN 14066)			
Change in dynamic modulus of elasticity (increase: +; decrease: -), %	Change in open porosity (increase: +; decrease: -), %	Change in ultrasound pulse velocity (increase: +; decrease: -), %	Change in flexural strength under conc. load (increase: +; decrease: -) %

Abrasion resistance (EN 14157)			**Resistance to salt crystallisation (EN 12370)**	**Breaking load at dowel hole (EN 13364)**	
Method A - Wide Wheel Abrasion Test, mm	Method B - Böhme Abrasion Test, cm^3 / $50cm^2$	Method C - Amsler Abrasion Test, mm	Change in mass (increase: +; decrease: -), %	Breaking load, N	Thickness of the test specimens, mm

Slip resistance by means of the pendulum tester (EN 14231 / CEN/TS 16165)			**Rupture energy (EN 14158), Joule**	**Thermal Conductivity (EN 1745), W/m·K**
Tested surface finish	Slip Resistance Value — SRV			
	Dry test condition	Wet test condition		
Polished				

Source of information:

CC BY

Chemical properties

Main elements

SiO_2 (%)	Al_2O_3 (%)	Fe_2O_3 (%)	TiO_2 (%)	MgO (%)	CaO (%)	Na_2O (%)	K_2O (%)	MnO (%)	P_2O_5 (%)	SO_3 (%)	LOI (%)
62,56	**16,08**	**2,66**	**0,91**	**0,68**	**0,98**	**7,79**	**5,49**	**0,19**	**0,25**		

Trace elements

V (ppm)	Cr (ppm)	Mn (ppm)	Co (ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	As (ppm)
Sr (ppm)	Cd (ppm)	Ba (ppm)	Pb (ppm)	Be (ppm)	Rb (ppm)	Bi (ppm)	U (ppm)
Sc (ppm)	Y (ppm)	Th (ppm)	Sb (ppm)	Ta (ppm)	Nb (ppm)	Zr (ppm)	Sn (ppm)
Ag (ppm)	B (ppm)	Mo (ppm)	W (ppm)	Ga (ppm)	Ge (ppm)	Se (ppm)	Cs (ppm)
Tl (ppm)							

REE

La (ppm)	Ce (ppm)	Pr (ppm)	Nd (ppm)	Sm (ppm)	Eu (ppm)	Gd (ppm)	Tb (ppm)
Dy (ppm)	Ho (ppm)	Er (ppm)	Tm (ppm)	Yb (ppm)	Lu (ppm)		

Methods applied and source of information: NGU

Sources of more information

Type of information	Name of provider	URL
Data sheet	Geological Survey of Norway	https://geo.ngu.no/api/faktaark/mineralressurser/visNaturstein.php?objid=13133&lang=nor
Maplink	Geological Survey of Norway	https://geo.ngu.no/kart/common_mobil/?_/kart/mineralressurser_mobil/__lang=nor::extent=262470.691470246,6650992.761618852,277237.753970246,6657403.105368852::map=9
Non-commercial directory	Natural stone online	
Commercial directory		
Scientific publication		NGUnr_337_25-34.pdf
Other publication		

Compiled by:	Geological Survey of Norway (NGU) https://www.ngu.no/	

Ice Green

Rennebugranitt

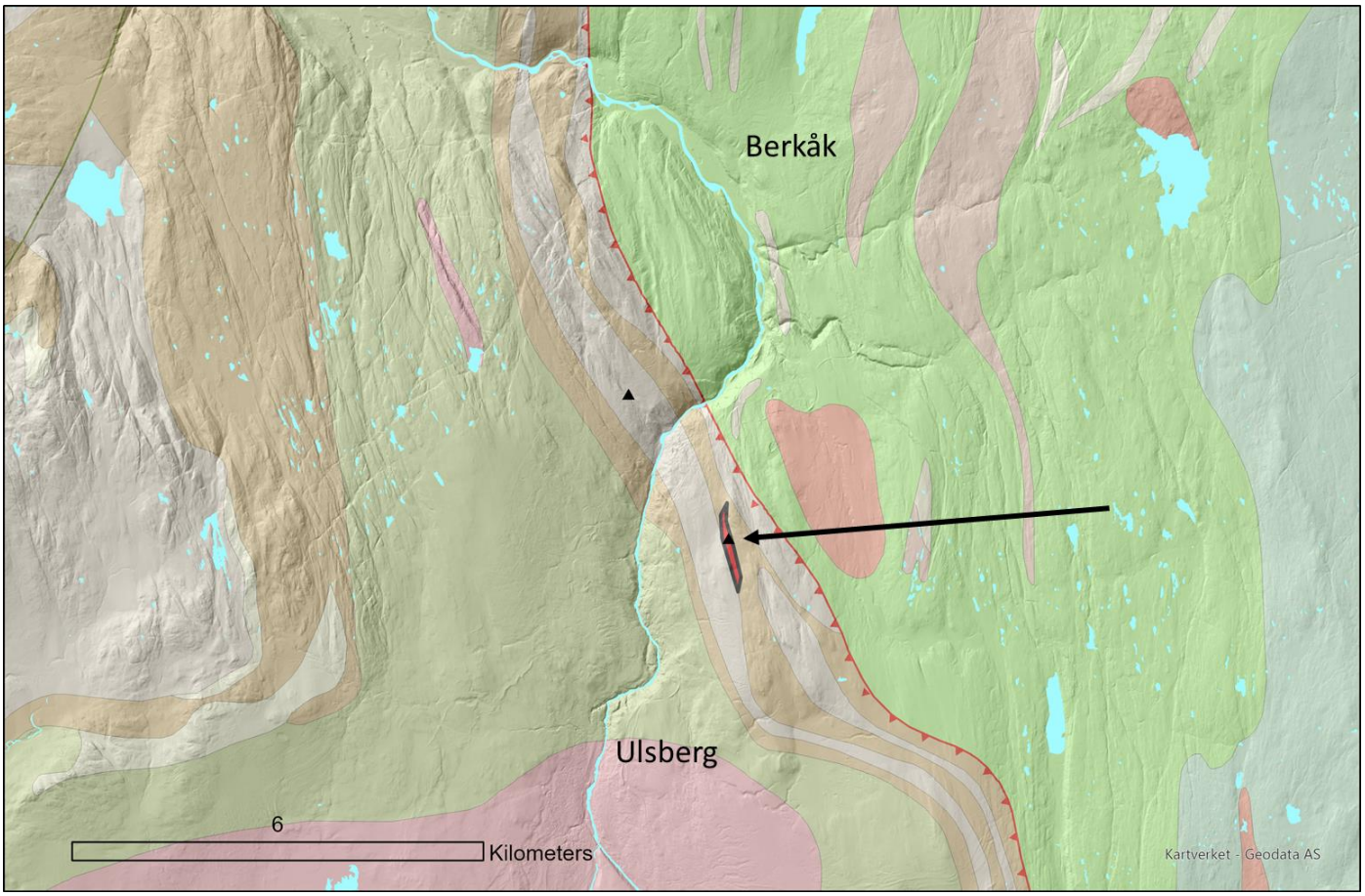


Short description: Tonalite, also referred to as trondhjemite, with a white to week green colour. The image displays a polished surface.

Commodity (vocabulary)	Lithology (vocabulary)	Typical colour (code list)	Place of origin			
			Country	County / District / Province	Municipality / Community	Place/town / Village
Commercial granite	Tonalite	White	Norway	Trøndelag	Rennebu	Toset

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Geological setting



Geology: In the later phases of Caledonian nappe emplacement during the Caledonian orogeny, dyke-like intrusions of tonalitic rocks were formed, particular in the Trøndelag region. These tonalites are usually pure white in colour. The Ice Green variety is slightly greenish due to content of epidote.

Production: Regular production started in 2001, and has continued on a small scale.

Geological age: Silurian c. 430 Ma
Geological unit: Trondheim Nappe Complex

Application, use and heritage

Description: The tonalite is used for floor tiles, façade, outdoor paving and funerary monuments.



On the Oslo Opera House, Ice Green tonalite has been applied where the building meets the water..

Petrography

Description: Samples from the quarry are holocrystalline, medium-grained (0.5-1.5 mm) and hypidiomorphic granular in texture. Slight metamorphic overprint have been found in some samples, and cores of plagioclase crystals may display alteration to sericite. Likewise, secondary epidote adds a greenish hue to the overall white colour.

Source of information: Geological Survey of Norway

Mineral composition

If no accurate number, use MM=main minerals, SM = Subordinate minerals, AM=accessory minerals

Plagioclase (%)	Quartz (%)	Potassium feldspar (%)	Biotite (%)	Epidote (%)	Opaques (%)	Others (%)
MM	**MM**	**SM**	**SM**	**SM**	**AM**	

Source of information: NGU estimate for this survey

Physical properties

Apparent density (EN 1936), kg/m3	Open porosity (EN 1936), % vol	Water absorption at atmospheric pressure (EN 13755), % wt	Uniaxial Compressive strength (EN 1926), MPa	Flexural strength under concentrated load (EN 12372), MPa

Real density (EN 1936), kg/m3	Total porosity (EN 1936), % vol	Water absorption coefficient by capillary (EN 1925) (g/m2 x s0,5)	Flexural strength under constant moment (EN 13161), MPa

Frost resistance (EN 12371)				
Technological Test (Test A)				Identification Test (Test B): Number of cycles completed prior to stone failure
Flexural strength (EN 12372) after freeze-thaw cycling, MPa	Number of cycles	Uniaxial compressive strength (EN 1926) after freeze-thaw cycling, MPa	Number of cycles	

Resistance to ageing by thermal shock (EN 14066)			
Change in dynamic modulus of elasticity (increase: +; decrease: -), %	Change in open porosity (increase: +; decrease: -), %	Change in ultrasound pulse velocity (increase: +; decrease: -), %	Change in flexural strength under conc. load (increase: +; decrease: -) %

Abrasion resistance (EN 14157)			**Resistance to salt crystallisation (EN 12370)**	**Breaking load at dowel hole (EN 13364)**	
Method A - Wide Wheel Abrasion Test, mm	Method B - Böhme Abrasion Test, cm^3 / $50cm^2$	Method C - Amsler Abrasion Test, mm	Change in mass (increase: +; decrease: -), %	Breaking load, N	Thickness of the test specimens, mm

Slip resistance by means of the pendulum tester (EN 14231 / CEN/TS 16165)			**Rupture energy (EN 14158), Joule**	**Thermal Conductivity (EN 1745), W/m·K**
Tested surface finish	Slip Resistance Value — SRV			
	Dry test condition	Wet test condition		
Polished				

Source of information:

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Chemical properties

Main elements

SiO_2 (%)	Al_2O_3 (%)	Fe_2O_3 (%)	TiO_2 (%)	MgO (%)	CaO (%)	Na_2O (%)	K_2O (%)	MnO (%)	P_2O_5 (%)	SO_3 (%)	LOI (%)

Trace elements

V (ppm)	Cr (ppm)	Mn (ppm)	Co (ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	As (ppm)
Sr (ppm)	Cd (ppm)	Ba (ppm)	Pb (ppm)	Be (ppm)	Rb (ppm)	Bi (ppm)	U (ppm)
Sc (ppm)	Y (ppm)	Th (ppm)	Sb (ppm)	Ta (ppm)	Nb (ppm)	Zr (ppm)	Sn (ppm)
Ag (ppm)	B (ppm)	Mo (ppm)	W (ppm)	Ga (ppm)	Ge (ppm)	Se (ppm)	Cs (ppm)
Tl (ppm)							

REE

La (ppm)	Ce (ppm)	Pr (ppm)	Nd (ppm)	Sm (ppm)	Eu (ppm)	Gd (ppm)	Tb (ppm)
Dy (ppm)	Ho (ppm)	Er (ppm)	Tm (ppm)	Yb (ppm)	Lu (ppm)		

Methods applied and source of information:

Sources of more information

Type of information	Name of provider	URL
Data sheet	Geological Survey of Norway	https://geo.ngu.no/api/faktaark/mineralressurser/visNaturstein.php?objid=12726&lang=eng
Maplink	Geological Survey of Norway	https://geo.ngu.no/kart/common_mobil/?_/kart/mineralressurser_mobil/__lang=eng::extent=243460.6896738489,6969540.012018391,247522.6896738489,6971317.137018391::map=9
Non-commercial directory	Natural stone online	Detail view (naturalstone-online.com)
Commercial directory		
Scientific publication		
Other publication		

Compiled by:	Geological Survey of Norway (NGU) https://www.ngu.no/	

Størengranitt (Støren Granite)

Støren Trondhjemitt

Silver White



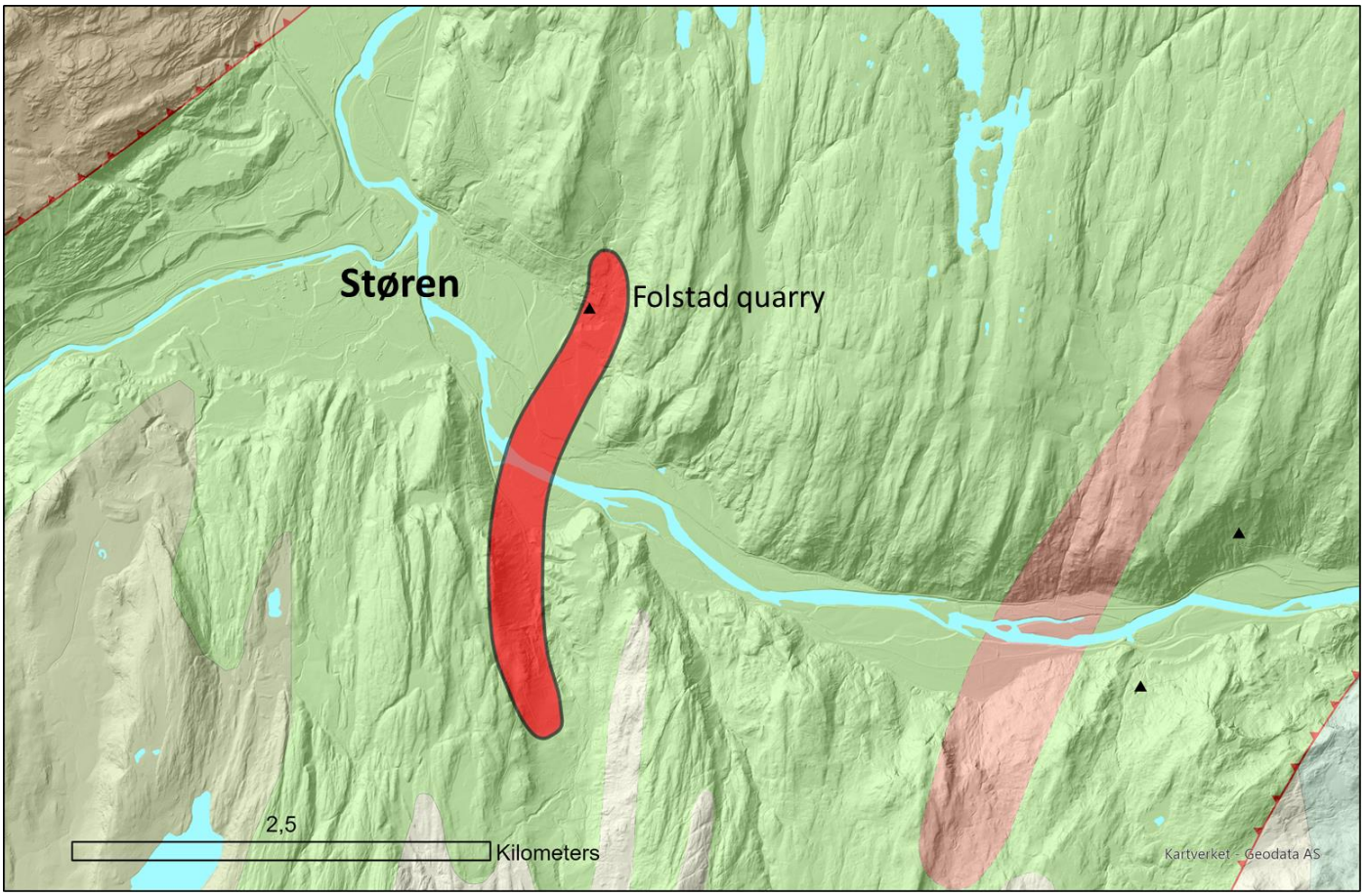
5 centimeters

Short description: White tonalite with black spots. The image displays a polished surface.

Commodity (vocabulary)	Lithology (vocabulary)	Typical colour (code list)	Place of origin			
			Country	County / District / Province	Municipality / Community	Place/town / Village
Commercial Granite	Tonalite	White	Norway	Trøndelag	Midtre Gauldal	Folstad

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Geological setting



Geology: The Støren Granite belongs to a group of dyke-shaped, tonalitic intrusions formed in the later phases of the Caledonian orogeny (Silurian). These tonalitic intrusions were also named “trondhjemite”, and the deposit is the type area for description of such rocks. The quarry is situated at Støren, about 50 km south of Trondheim.

Production: Production may have started as early as 1852, but production grew when the work with the railroad started, and even more when the railroad between Trondheim and Oslo was completed I 1921, facilitating transport to more remote markets. Since, the Folstad quarry has been operating on a small to medium scale.

Geological age: Silurian (332 Ma)
Geological unit: Gula Nappe

Application, use and heritage

Description: The Støren Granite has been widely applied for structural purposes, such as bridges and buildings and paving. In recent years, its most important uses are funerary monuments, building facades and interior floors and walls.



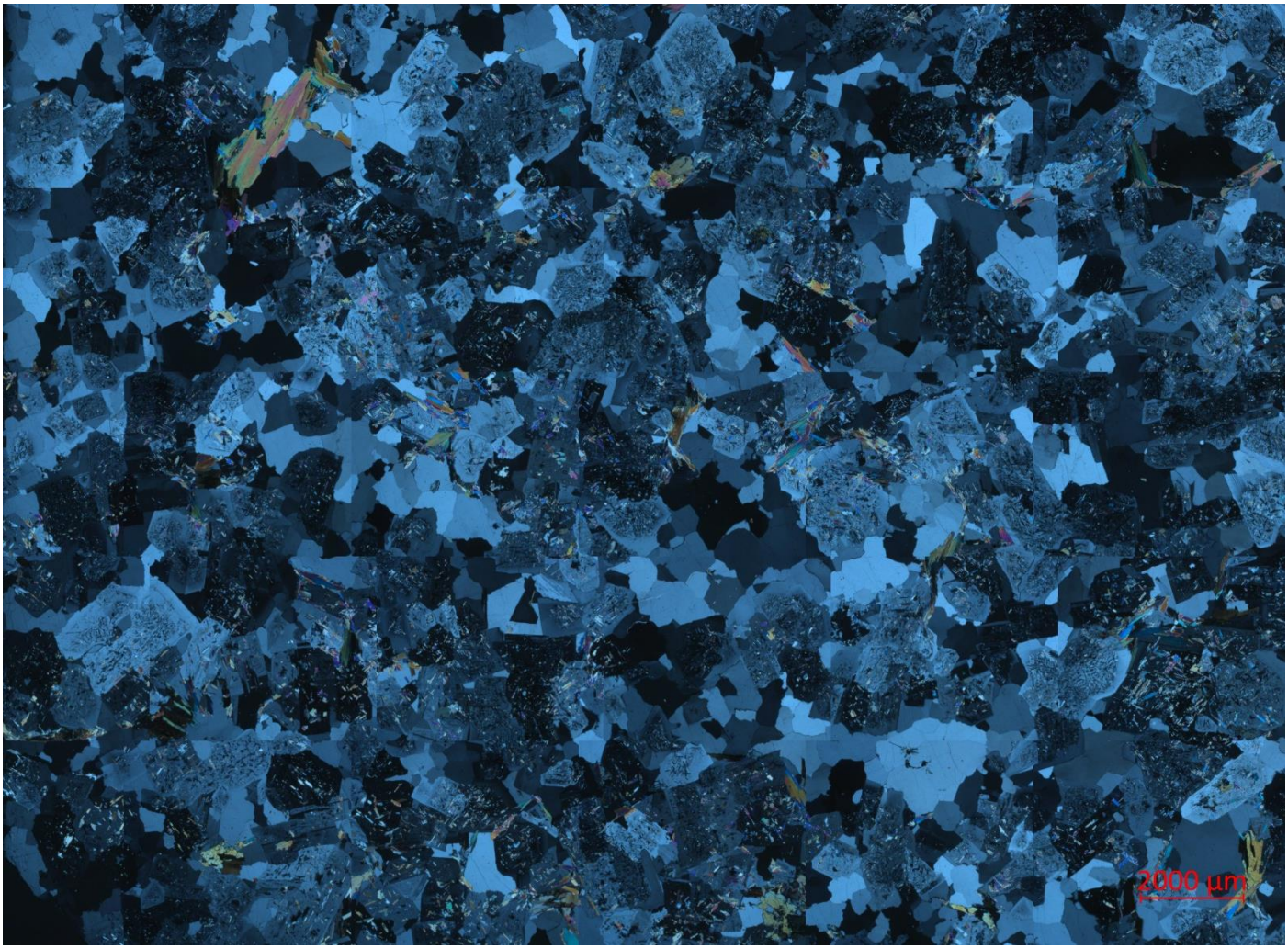
Oslo Concert House (1977) with façade clad with Støren Granite.



Façade of new addition to Grand Hotel, Oslo, with Støren granite slabs showing igneous lamination.

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Petrography



Description: Samples from the quarry are holocrystalline, medium-grained (0.5-1.5 mm) and hypidiomorphic-granular in texture. Slight metamorphic overprint has been found in some samples, and cores of plagioclase crystals may display alteration to sericite. In some samples, magmatic layering defined by biotite-rich planar features may be seen. Photomicrograph (mosaic), crossed Nichols.

Source of information: Geological Survey of Norway

Mineral composition

If no accurate number, use MM=main minerals, SM = Subordinate minerals, AM=accessory minerals

Quartz (%)	Plagioclase (%)	Potassium feldspar (%)	Muscovite (%)	Biotite (%)	Epidote (%)	Magnetite (%)
26,06	**57,78**	**3,3**	**5,96**	**1,84**	**4,42**	**AM**
Apatite (%)	Sphene (%)	Zirkon (%)	Chlorite (%)	Calcite (%)		
AM	**AM**	**AM**	**AM**	**AM**		

Source of information: Average of five samples from Size, 1979

Physical properties

Apparent density (EN 1936), kg/m3	Open porosity (EN 1936), % vol	Water absorption at atmospheric pressure (EN 13755), % wt	Uniaxial Compressive strength (EN 1926), MPa	Flexural strength under concentrated load (EN 12372), MPa
2690		**0,31**	**195-275**	**13,5-15,5**

Real density (EN 1936), kg/m3	Total porosity (EN 1936), % vol	Water absorption coefficient by capillary (EN 1925) (g/m2 x s0,5)	Flexural strength under constant moment (EN 13161), MPa

Frost resistance (EN 12371)				
Technological Test (Test A)				Identification Test (Test B): Number of cycles completed prior to stone failure
Flexural strength (EN 12372) after freeze-thaw cycling, MPa	Number of cycles	Uniaxial compressive strength (EN 1926) after freeze-thaw cycling, MPa	Number of cycles	

Resistance to ageing by thermal shock (EN 14066)			
Change in dynamic modulus of elasticity (increase: +; decrease: -), %	Change in open porosity (increase: +; decrease: -), %	Change in ultrasound pulse velocity (increase: +; decrease: -), %	Change in flexural strength under conc. load (increase: +; decrease: -) %

Abrasion resistance (EN 14157)			**Resistance to salt crystallisation (EN 12370)**	**Breaking load at dowel hole (EN 13364)**	
Method A - Wide Wheel Abrasion Test, mm	Method B - Böhme Abrasion Test, cm^3 / $50cm^2$	Method C - Amsler Abrasion Test, mm	Change in mass (increase: +; decrease: -), %	Breaking load, N	Thickness of the test specimens, mm

Slip resistance by means of the pendulum tester (EN 14231 / CEN/TS 16165)			**Rupture energy (EN 14158), Joule**	**Thermal Conductivity (EN 1745), W/m·K**
Tested surface finish	Slip Resistance Value — SRV			
	Dry test condition	Wet test condition		
Polished				

Source of information: Historical data from Federation of Norwegian Stone Industries

Chemical properties

Main elements

SiO_2 (%)	Al_2O_3 (%)	Fe_2O_3 (%)	TiO_2 (%)	MgO (%)	CaO (%)	Na_2O (%)	K_2O (%)	MnO (%)	P_2O_5 (%)	SO_3 (%)	LOI (%)
71,47	**16,21**	**0,58**	**0,23**	**0,48**	**2,72**	**5,33**	**4,98**	**0,02**	**0,08**		

Trace elements

V (ppm)	Cr (ppm)	Mn (ppm)	Co (ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	As (ppm)
Sr (ppm)	Cd (ppm)	Ba (ppm)	Pb (ppm)	Be (ppm)	Rb (ppm)	Bi (ppm)	U (ppm)
Sc (ppm)	Y (ppm)	Th (ppm)	Sb (ppm)	Ta (ppm)	Nb (ppm)	Zr (ppm)	Sn (ppm)
Ag (ppm)	B (ppm)	Mo (ppm)	W (ppm)	Ga (ppm)	Ge (ppm)	Se (ppm)	Cs (ppm)
Tl (ppm)							

REE

La (ppm)	Ce (ppm)	Pr (ppm)	Nd (ppm)	Sm (ppm)	Eu (ppm)	Gd (ppm)	Tb (ppm)
Dy (ppm)	Ho (ppm)	Er (ppm)	Tm (ppm)	Yb (ppm)	Lu (ppm)		

Methods applied and source of information: Average of five samples from Size, 1979

Sources of more information

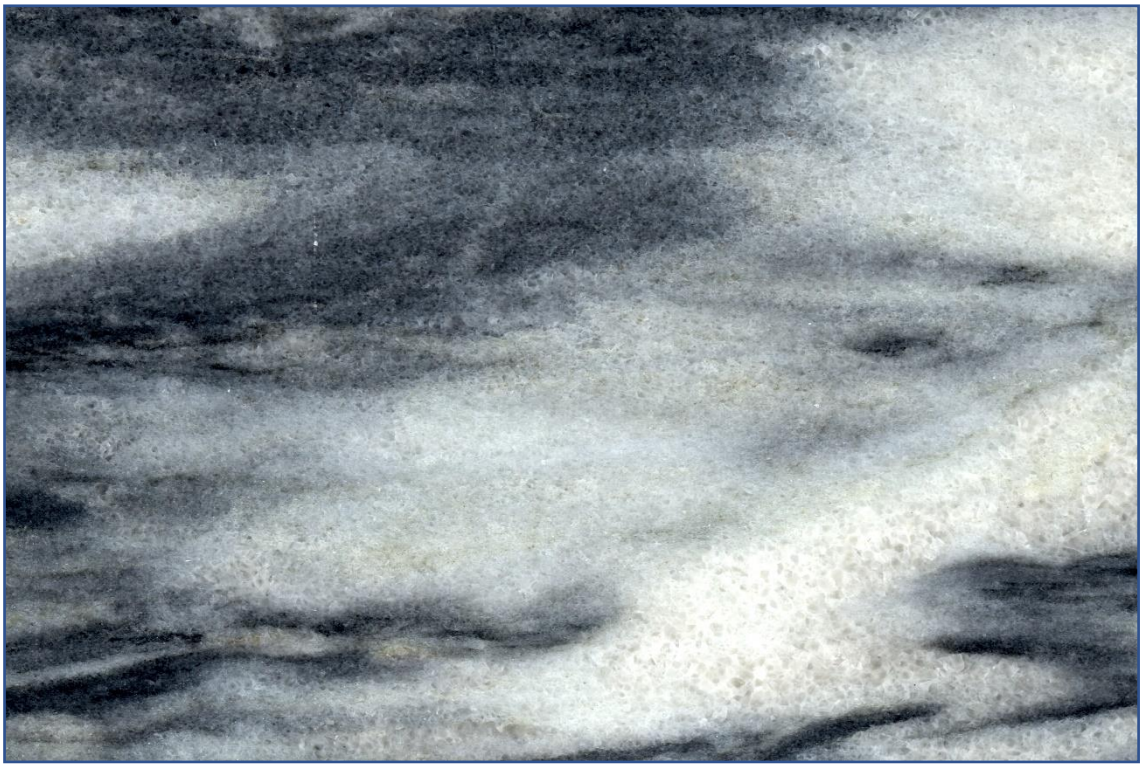
Type of information	Name of provider	URL
Data sheet	Geological Survey of Norway	https://geo.ngu.no/api/faktaark/mineralressurser/visNaturstein.php?objid=9387&lang=eng
Maplink	Geological Survey of Norway	https://geo.ngu.no/kart/common_mobil/?_/kart/mineralressurser_mobil/__lang=eng::extent=262384.611111495493,6997327.719882453,264230.4939620493,6998129.012851203::map=9
Non-commercial directory	Natural stone online	Detailansicht (naturalstone-online.com)
Commercial directory		
Scientific publication	Size 1979 Dunning and Grenne 2000	https://www.ngu.no/FileArchive/NGUPublikasjoner/NGUnr_351_Bulletin_51_Size_51_76.pdf https://www.ngu.no/upload/publikasjoner/Bulletin/Bulletin437_57-65.pdf
Other publication		

Compiled by:	Geological Survey of Norway (NGU) https://www.ngu.no/	GEOLOGICAL SURVEY OF NORWAY - NGU -

Antique Foncé

Hermelin

Fauna

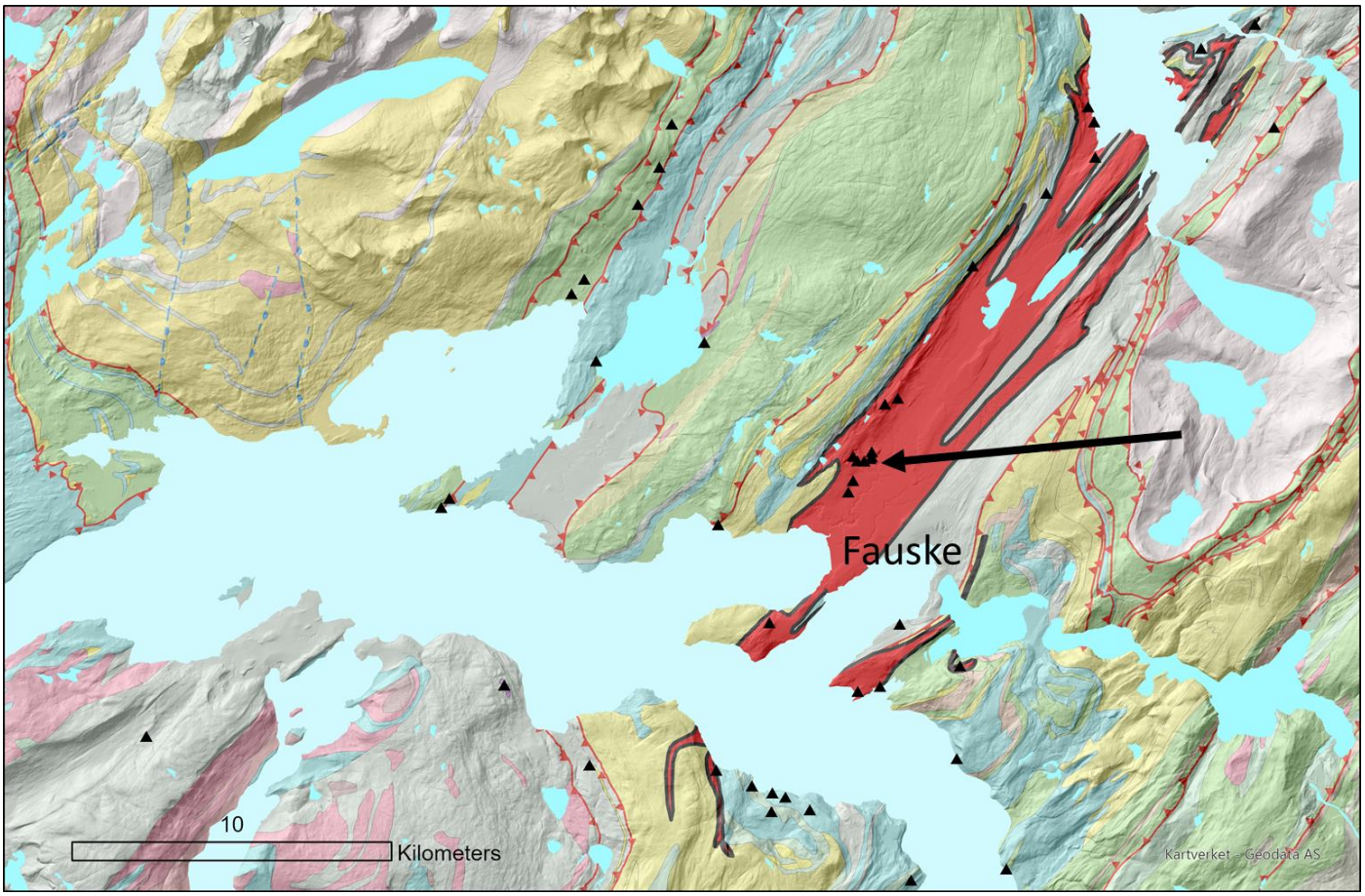


5 centimeters

Short description: White and grey calcite marble, the image displays a polished surface. Darker varieties were traditionally named Antique Foncé, the lighter ones Hermelin.

Commodity (vocabulary)	Lithology (vocabulary)	Typical colour (code list)	Place of origin			
			Country	County / District / Province	Municipality / Community	Place/town / Village
Commercial Marble	Marble	Grey	Norway	Nordland	Fauske	Løvgavlen

Geological setting



Geology: The marble units within the Fauske Nappe are composed of a variety of coloured marbles. They were deposited as limestone on a carbonate platform near tidal environments. Tectonic emplacement and metamorphism took place during the Caledonian Orogeny. The Antique Foncé represents at least one thick (50-100 m) layer in the southwestern part of the unit (see arrow on map).

Production: The marble has been in regular production since 1884.

Geological age: Cambrian 520 Ma

Geological unit: Fauske Group

Application, use and heritage

Description: Applied for façade (slabs or Scottish rubble) in some early buildings, but mostly it is used for interior floors and walls. The most well-known example is the departure areas at Oslo Airport. The marble has, through use in high-wear and wet climatic environment, proven to perform durable.



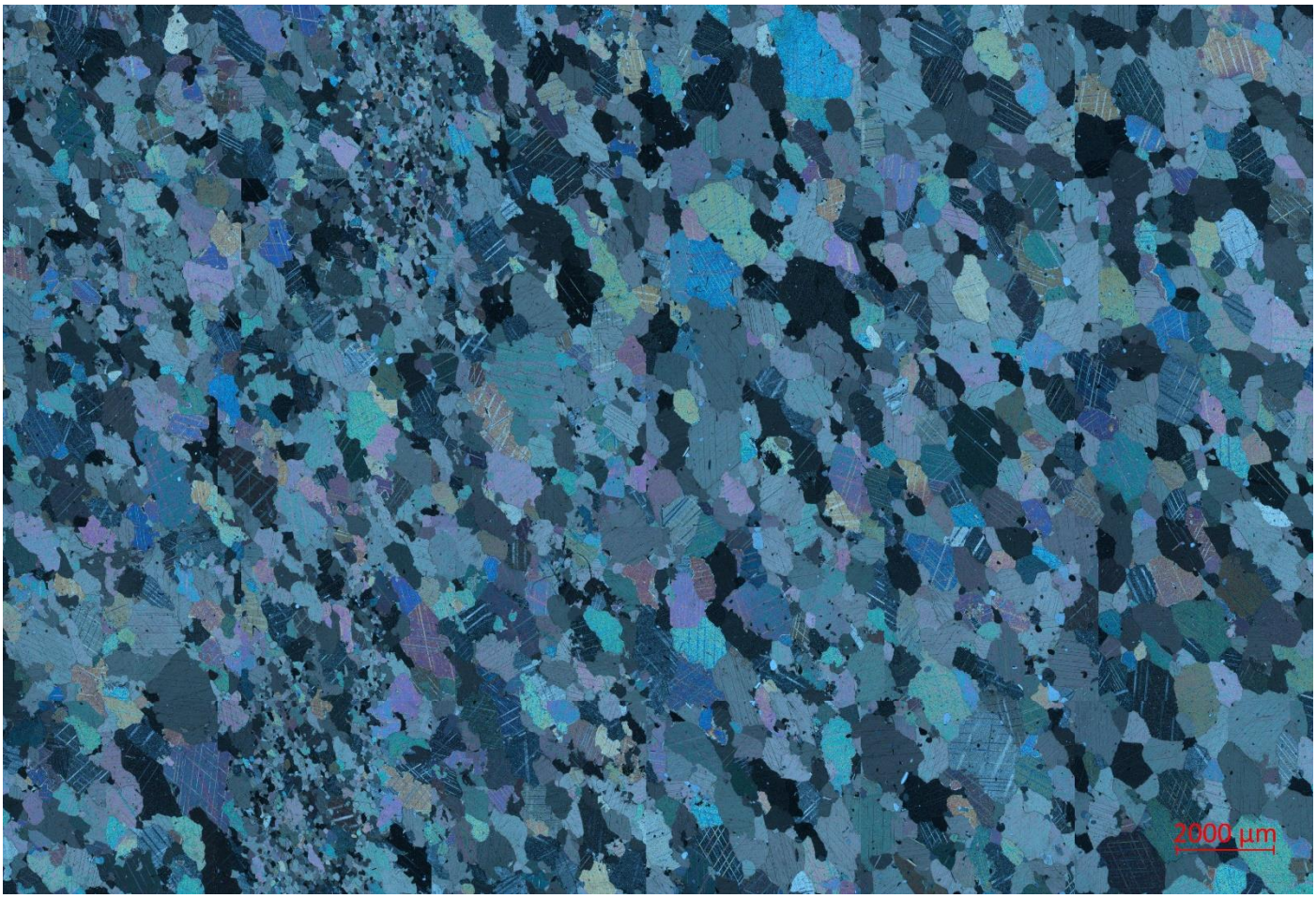
Oslo airport Gardermoen



Entrance area cladded with honed slabs of the darker, Antique Foncé variety. Shopping centre, Trondheim.

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Petrography



Description: Photomicrograph (mosaic) of thin section, crossed polarized light showing predominantly medium- to coarse-grained calcite with smaller, fine-grained patches. These patches also contain small amounts of silicate minerals, such as quartz, feldspar and epidote. The grain boundaries are irregular and interlocked, contributing to high strength and durability.

Source of information: Geological Survey of Norway

Mineral composition

If no accurate number, use MM=main minerals, SM = Subordinate minerals, AM=accessory minerals

Calcite (%)	Feldspar (%)	Quartz (%)	Epidote (%)			
97	**1**	**1**	**1**			

Source of information: Unpublished NGU estimate for this directory

CC BY

Physical properties

Apparent density (EN 1936), kg/m3	Open porosity (EN 1936), % vol	Water absorption at atmospheric pressure (EN 13755), % wt	Uniaxial Compressive strength (EN 1926), MPa	Flexural strength under concentrated load (EN 12372), MPa
2500		**0,11**	**128,72**	**14,9**

Real density (EN 1936), kg/m3	Total porosity (EN 1936), % vol	Water absorption coefficient by capillary (EN 1925) (g/m2 x s0,5)	Flexural strength under constant moment (EN 13161), MPa

Frost resistance (EN 12371)				
Technological Test (Test A)				Identification Test (Test B): Number of cycles completed prior to stone failure
Flexural strength (EN 12372) after freeze-thaw cycling, MPa	Number of cycles	Uniaxial compressive strength (EN 1926) after freeze-thaw cycling, MPa	Number of cycles	

Resistance to ageing by thermal shock (EN 14066)			
Change in dynamic modulus of elasticity (increase: +; decrease: -), %	Change in open porosity (increase: +; decrease: -), %	Change in ultrasound pulse velocity (increase: +; decrease: -), %	Change in flexural strength under conc. load (increase: +; decrease: -) %

Abrasion resistance (EN 14157)			**Resistance to salt crystallisation (EN 12370)**	**Breaking load at dowel hole (EN 13364)**	
Method A - Wide Wheel Abrasion Test, mm	Method B - Böhme Abrasion Test, cm^3 / $50cm^2$	Method C - Amsler Abrasion Test, mm	Change in mass (increase: +; decrease: -), %	Breaking load, N	Thickness of the test specimens, mm

Slip resistance by means of the pendulum tester (EN 14231 / CEN/TS 16165)			**Rupture energy (EN 14158), Joule**	**Thermal Conductivity (EN 1745), W/m·K**
Tested surface finish	Slip Resistance Value — SRV			
	Dry test condition	Wet test condition		
Polished				

Source of information: Norwegian Rose AS

Chemical properties

Main elements

SiO_2 (%)	Al_2O_3 (%)	Fe_2O_3 (%)	TiO_2 (%)	MgO (%)	CaO (%)	Na_2O (%)	K_2O (%)	MnO (%)	P_2O_5 (%)	SO_3 (%)	LOI (%)

Trace elements

V (ppm)	Cr (ppm)	Mn (ppm)	Co (ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	As (ppm)
Sr (ppm)	Cd (ppm)	Ba (ppm)	Pb (ppm)	Be (ppm)	Rb (ppm)	Bi (ppm)	U (ppm)
Sc (ppm)	Y (ppm)	Th (ppm)	Sb (ppm)	Ta (ppm)	Nb (ppm)	Zr (ppm)	Sn (ppm)
Ag (ppm)	B (ppm)	Mo (ppm)	W (ppm)	Ga (ppm)	Ge (ppm)	Se (ppm)	Cs (ppm)
Tl (ppm)							

REE

La (ppm)	Ce (ppm)	Pr (ppm)	Nd (ppm)	Sm (ppm)	Eu (ppm)	Gd (ppm)	Tb (ppm)
Dy (ppm)	Ho (ppm)	Er (ppm)	Tm (ppm)	Yb (ppm)	Lu (ppm)		

Methods applied and source of information:

Sources of more information

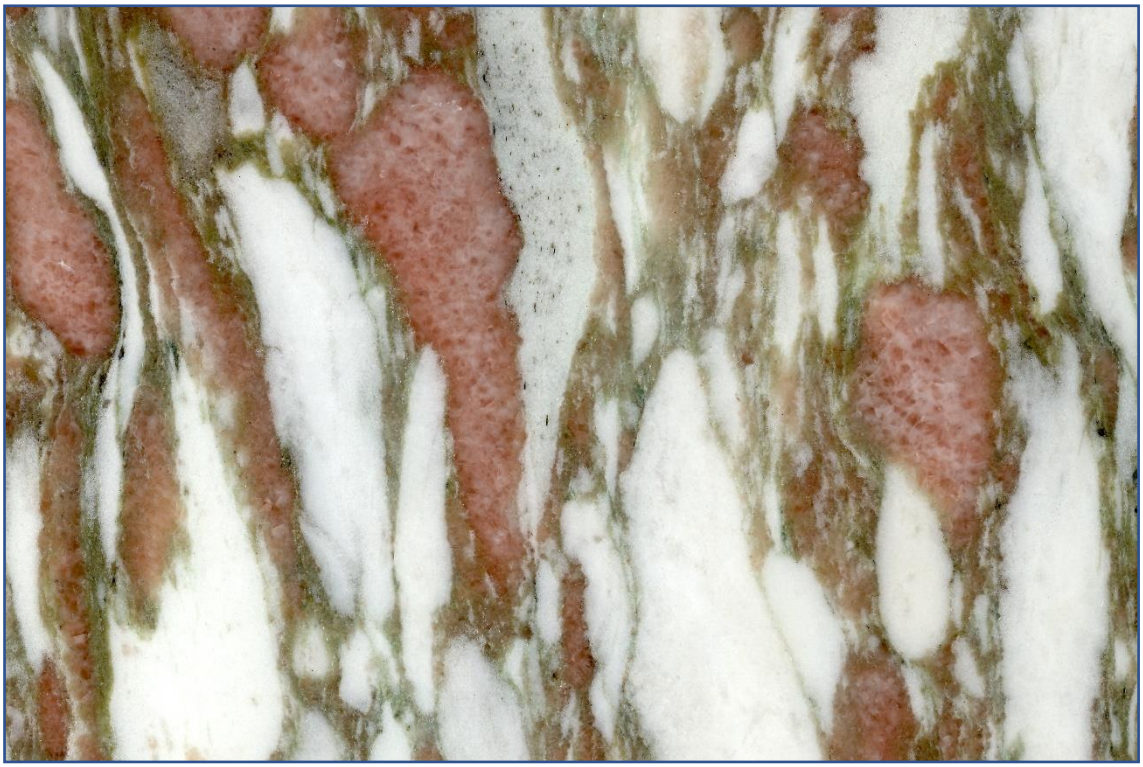
Type of information	Name of provider	URL
Data sheet	Geological Survey of Norway	https://geo.ngu.no/api/faktaark/mineralressurser/visNaturstein.php?objid=9246&lang=nor
Maplink	Geological Survey of Norway	https://geo.ngu.no/kart/common_mobil/?_/kart/mineralressurser_mobil/__lang=nor::extent=514033.53800698643,7462101.246501931,517725.30363198643,7463563.672283181::map=9
Non-commercial directory	Natural stone online	Detailansicht (naturalstone-online.com)
Commercial directory		
Scientific publication		https://www.ngu.no/upload/Publikasjoner/Bulletin/Bulletin436_147-168.pdf
Other publication		

Compiled by:	Geological Survey of Norway (NGU) https://www.ngu.no/	

Norwegian Rose

Fauskemarmor

Fauske Marble

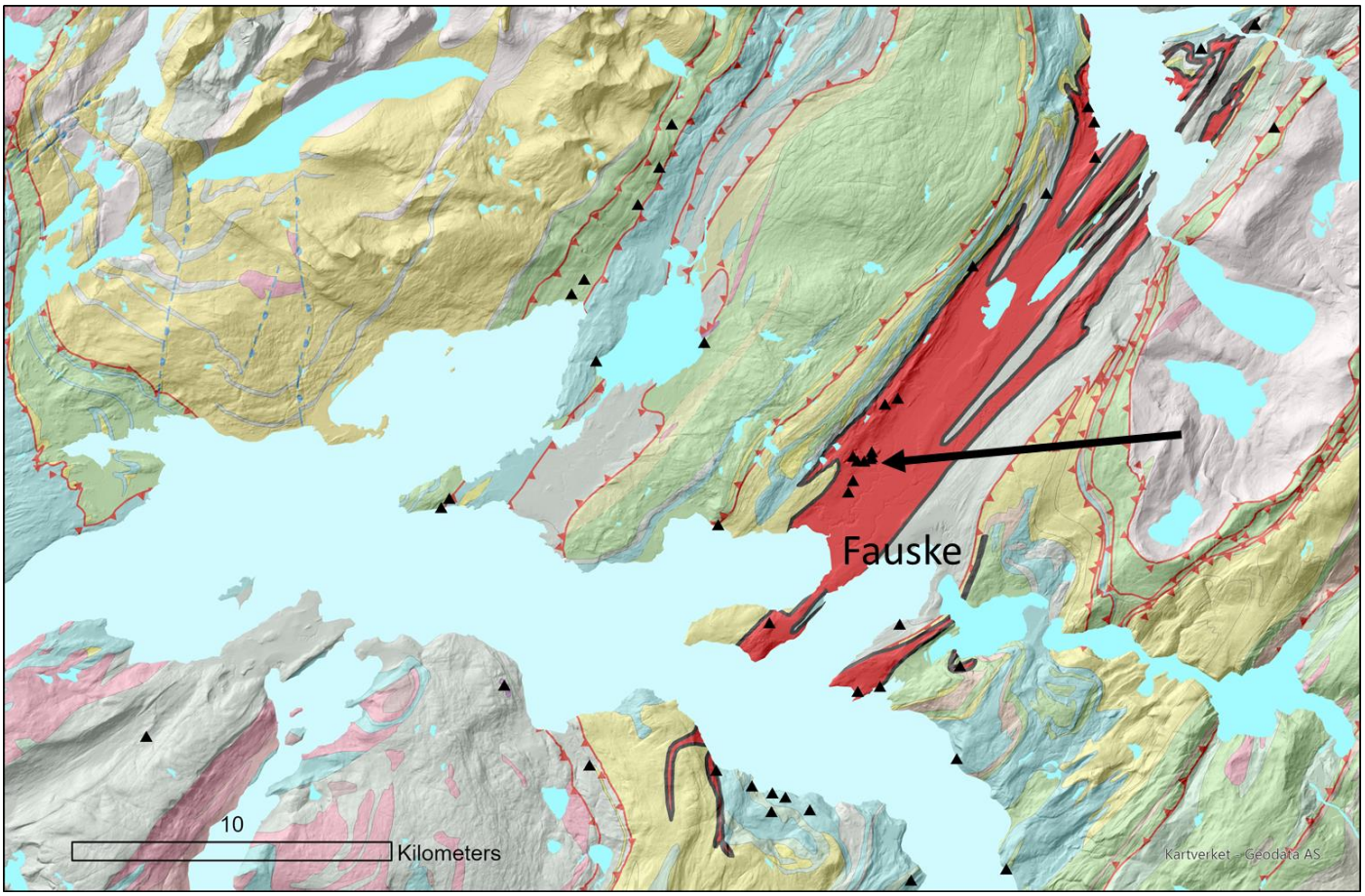


5 centimeters

Short description: White and pink marble, composed of elongated clasts of white dolomite marble within a matrix of pink calcite marble. The image displays a polished surface.

Commodity (vocabulary)	Lithology (vocabulary)	Typical colour (code list)	Place of origin			
			Country	County / District / Province	Municipality / Community	Place/town / Village
Commercial Marble	Marble	Pink	Norway	Nordland	Fauske	Løvgavlen

Geological setting



Geology: The marble units within the Fauske Nappe are composed of a variety of coloured marbles. They were deposited as limestone on a carbonate platform near tidal environments. Tectonic emplacement and metamorphism took place during the Caledonian Orogeny. The Norwegian Rose subtype represents multiple layers of tidal channel conglomerate with white dolomitic clasts in the southwestern part of the unit (see arrow on map).

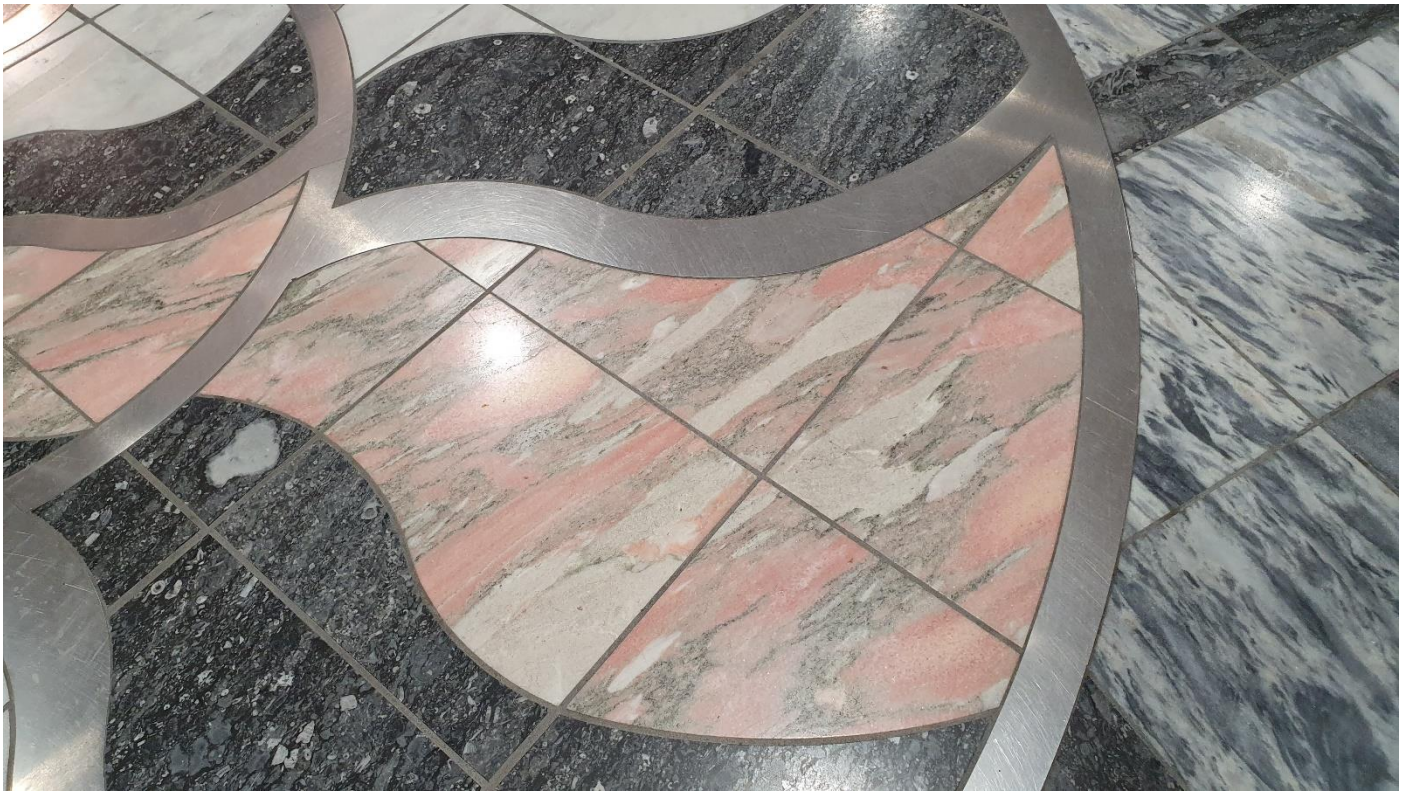
Production: The marble has been in regular production since 1884.

Geological age: Cambrian 520 Ma

Geological unit: Fauske Group

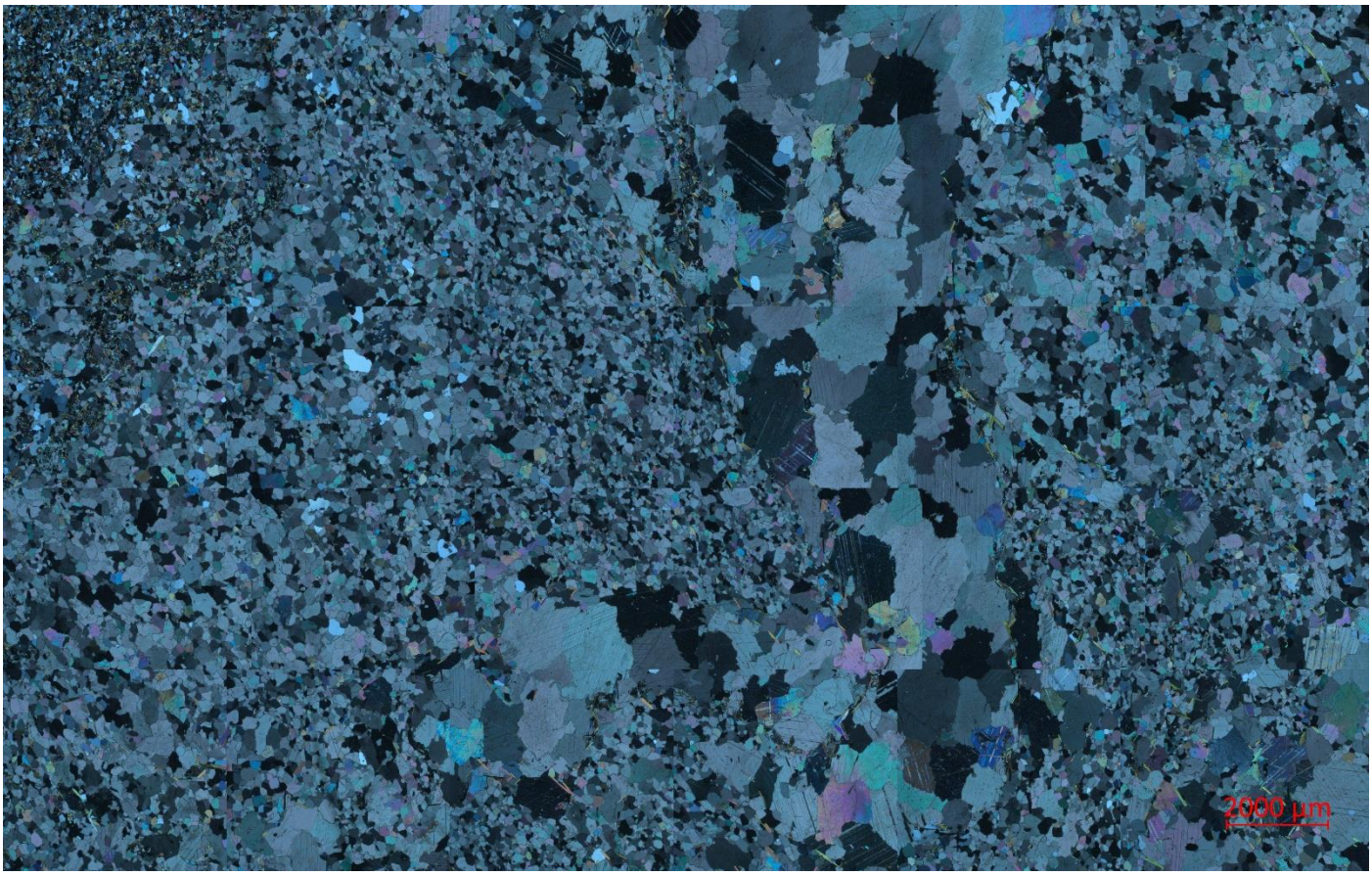
Application, use and heritage

Description: Applied for façade slabs in some early buildings, but mostly it is used for interior floors and walls. Although it appears in buildings since the early days of quarrying, it gained its highest attractivity in international architecture in the 1980s.



The pink Fauske marble among other types, floor, Geological Survey of Norway.

Petrography



Description: Photomicrograph (mosaic) of thin section, crossed polarized light showing predominantly fine-grained clasts within medium- to coarse-grained calcite matrix. Patches are enriched in silicate minerals (such as top-left) including quartz, epidote and mica (predominantly chromium-bearing fuchsite).

Source of information: Geological Survey of Norway

Mineral composition

If no accurate number, use MM=main minerals, SM = Subordinate minerals, AM=accessory minerals

Calcite (%)	Dolomite (%)	Quartz (%)	Epidote (%)	Mica		
40	**55**	**1**	**2**	**2**		

Source of information: Unpublished NGU estimate for this directory

Physical properties

Apparent density (EN 1936), kg/m3	Open porosity (EN 1936), % vol	Water absorption at atmospheric pressure (EN 13755), % wt	Uniaxial Compressive strength (EN 1926), MPa	Flexural strength under concentrated load (EN 12372), MPa
2500		**0,09**	**91,9**	**13,2**

Real density (EN 1936), kg/m3	Total porosity (EN 1936), % vol	Water absorption coefficient by capillary (EN 1925) (g/m2 x s0,5)	Flexural strength under constant moment (EN 13161), MPa

Frost resistance (EN 12371)				
Technological Test (Test A)				Identification Test (Test B): Number of cycles completed prior to stone failure
Flexural strength (EN 12372) after freeze-thaw cycling, MPa	Number of cycles	Uniaxial compressive strength (EN 1926) after freeze-thaw cycling, MPa	Number of cycles	

Resistance to ageing by thermal shock (EN 14066)			
Change in dynamic modulus of elasticity (increase: +; decrease: -), %	Change in open porosity (increase: +; decrease: -), %	Change in ultrasound pulse velocity (increase: +; decrease: -), %	Change in flexural strength under conc. load (increase: +; decrease: -) %

Abrasion resistance (EN 14157)			**Resistance to salt crystallisation (EN 12370)**	**Breaking load at dowel hole (EN 13364)**	
Method A - Wide Wheel Abrasion Test, mm	Method B - Böhme Abrasion Test, cm^3 / $50cm^2$	Method C - Amsler Abrasion Test, mm	Change in mass (increase: +; decrease: -), %	Breaking load, N	Thickness of the test specimens, mm

Slip resistance by means of the pendulum tester (EN 14231 / CEN/TS 16165)			**Rupture energy (EN 14158), Joule**	**Thermal Conductivity (EN 1745), W/m·K**
Tested surface finish	Slip Resistance Value — SRV			
	Dry test condition	Wet test condition		
Polished				

Source of information: Norwegian Rose AS

Chemical properties

Main elements

SiO_2 (%)	Al_2O_3 (%)	Fe_2O_3 (%)	TiO_2 (%)	MgO (%)	CaO (%)	Na_2O (%)	K_2O (%)	MnO (%)	P_2O_5 (%)	SO_3 (%)	LOI (%)

Trace elements

V (ppm)	Cr (ppm)	Mn (ppm)	Co (ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	As (ppm)
Sr (ppm)	Cd (ppm)	Ba (ppm)	Pb (ppm)	Be (ppm)	Rb (ppm)	Bi (ppm)	U (ppm)
Sc (ppm)	Y (ppm)	Th (ppm)	Sb (ppm)	Ta (ppm)	Nb (ppm)	Zr (ppm)	Sn (ppm)
Ag (ppm)	B (ppm)	Mo (ppm)	W (ppm)	Ga (ppm)	Ge (ppm)	Se (ppm)	Cs (ppm)
Tl (ppm)							

REE

La (ppm)	Ce (ppm)	Pr (ppm)	Nd (ppm)	Sm (ppm)	Eu (ppm)	Gd (ppm)	Tb (ppm)
Dy (ppm)	Ho (ppm)	Er (ppm)	Tm (ppm)	Yb (ppm)	Lu (ppm)		

Methods applied and source of information:

Sources of more information

Type of information	Name of provider	URL
Data sheet	Geological Survey of Norway	https://geo.ngu.no/api/faktaark/mineralressurser/visNaturstein.php?objid=9246&lang=nor
Maplink	Geological Survey of Norway	https://geo.ngu.no/kart/common_mobil/?_/kart/mineralressurser_mobil/__lang=nor::extent=514033.53800698643,7462101.246501931,517725.30363198643,7463563.672283181::map=9
Non-commercial directory	Natural stone online	https://www.naturalstone-online.com/index.php?id=356&user_dnsaeng_pi1%5BsteinID%5D=1764
Commercial directory		
Scientific publication		https://www.ngu.no/upload/Publikasjoner/Bulletin/Bulletin436_147-168.pdf
Other publication		

Compiled by:	Geological Survey of Norway (NGU) https://www.ngu.no/	

Furuli

Tortenlia

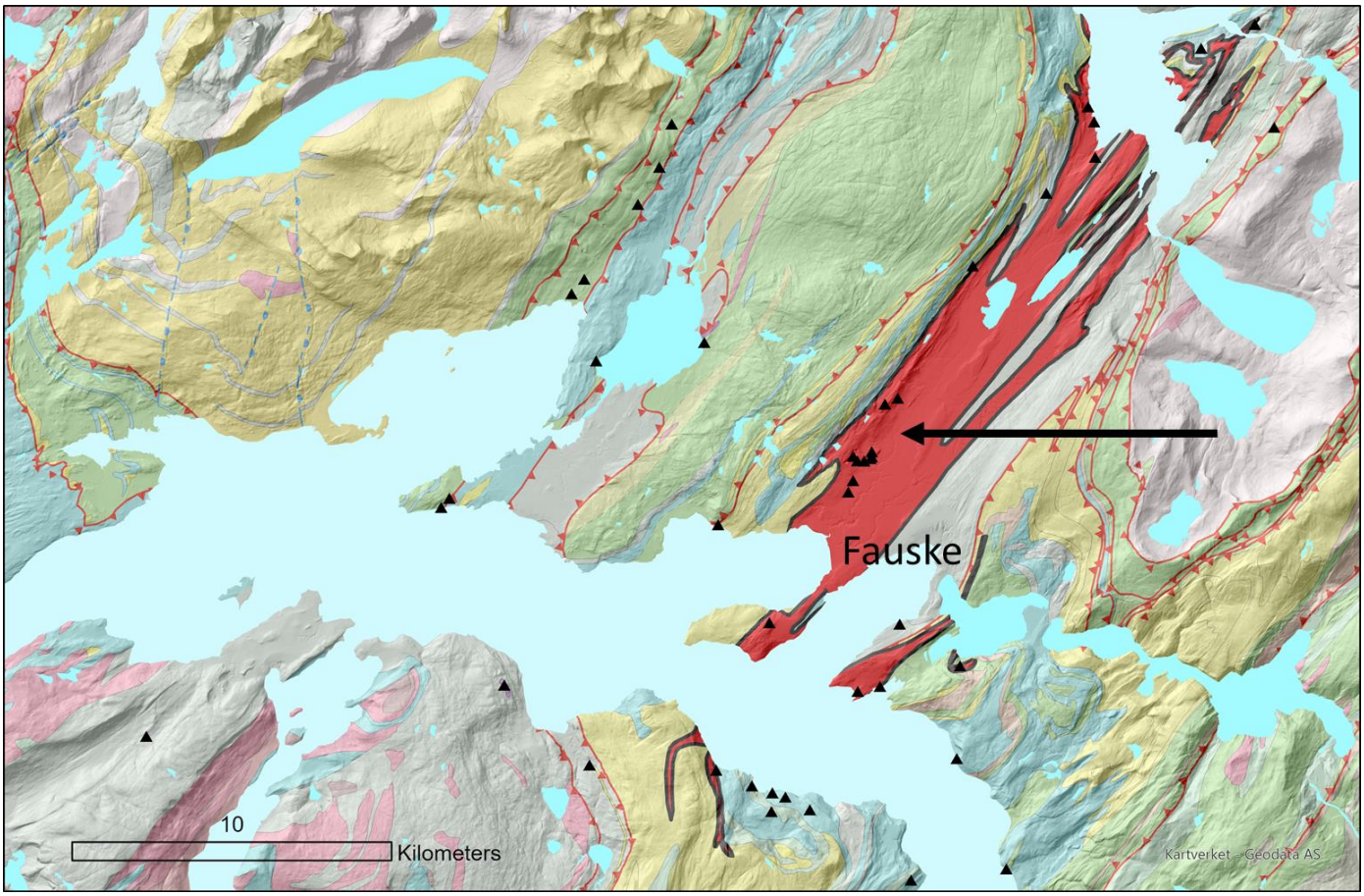


5 centimeters

Short description: White dolomite marble, fine-grained. The image displays a polished surface.

Commodity (vocabulary)	Lithology (vocabulary)	Typical colour (code list)	Place of origin			
			Country	County / District / Province	Municipality / Community	Place/town / Village
Commercial Marble	Marble	White	Norway	Nordland	Fauske	Løvgavlen Tortenlia

Geological setting



Geology: The marble units within the Fauske Nappe are composed of a variety of coloured marbles. They were deposited as limestone on a carbonate platform near tidal environments. Tectonic emplacement and metamorphism took place during the Caledonian Orogeny. The Furuli subtype represents a thick layer (several tens of meters) of dolomitic marble in the western part of the unit (see arrow), almost 20 kilometers along the strike. However, subtle changes within the deposit cause strong variation in technical quality.

Production: The marble has been in regular production since 1884, predominantly at the Furli and Tortenlia sites (see arrows). At the time of writing, it may be difficult to obtain as dimension stone, since parts of the deposit area is employed for production of industrial dolomite.

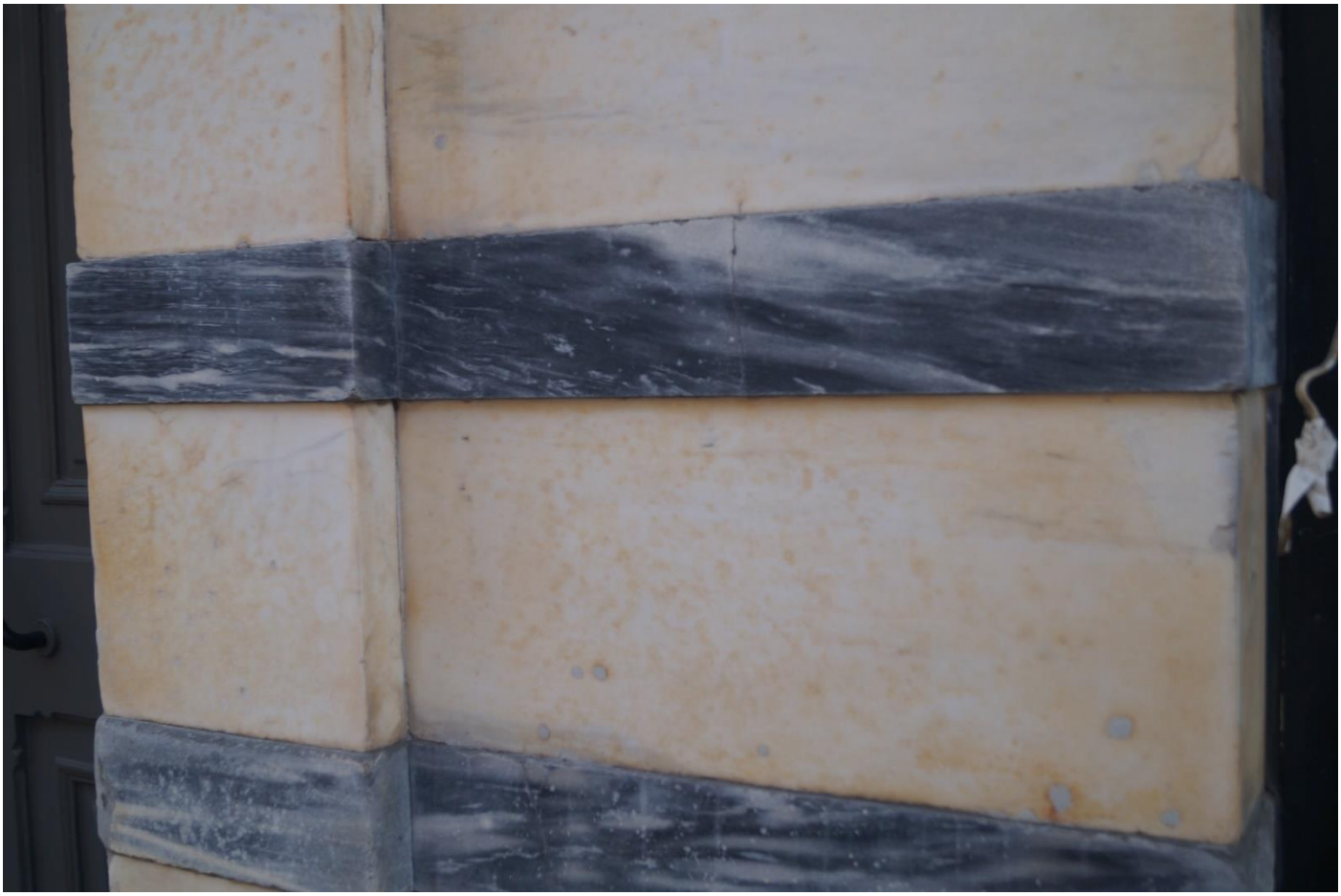
Geological age: Cambrian 520 Ma
Geological unit: Fauske Nappe

Application, use and heritage

Description: Applied for façade blocks in some early buildings, but mostly it is used for interior floors and walls.



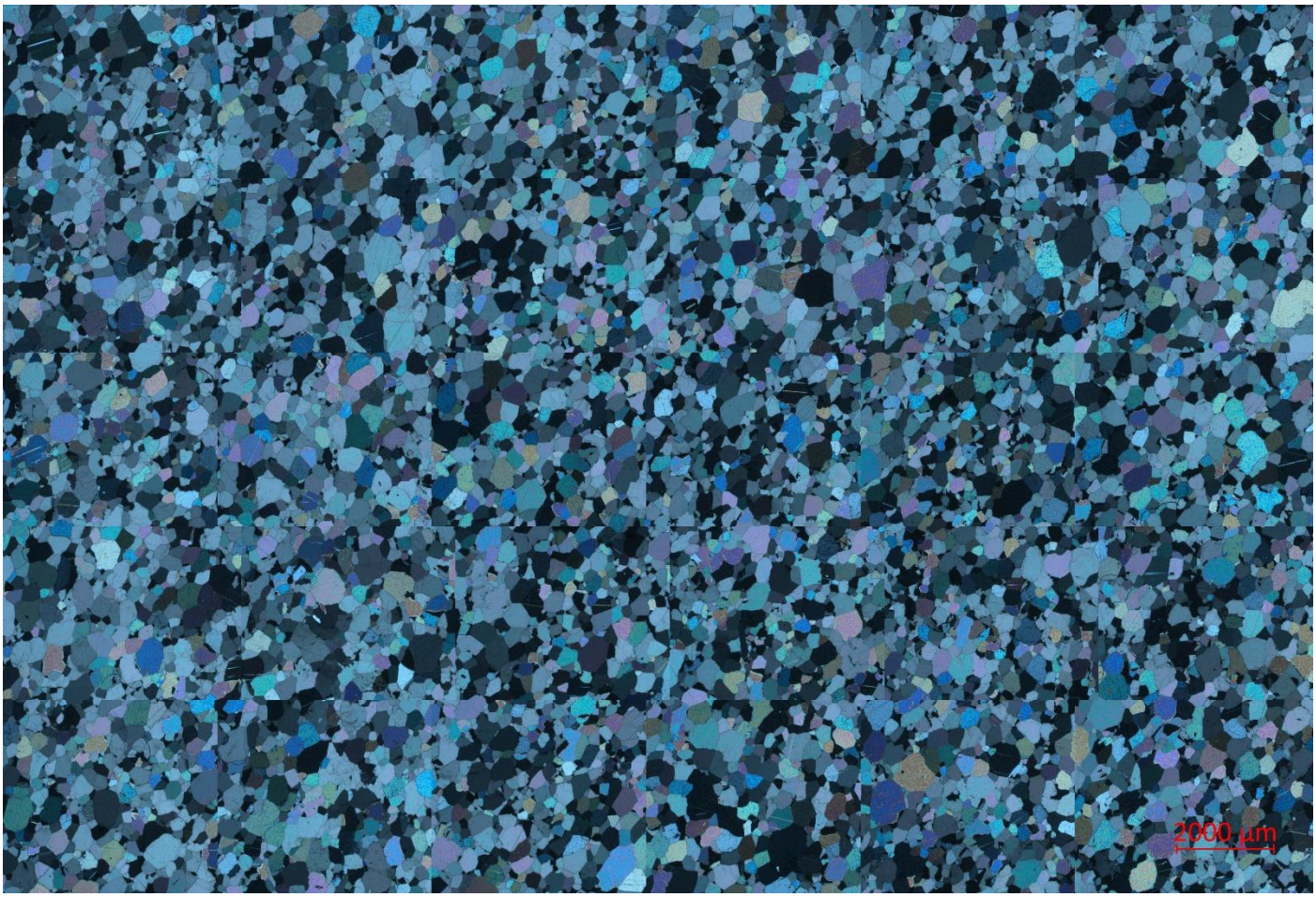
The “Marble Chateau”, Bodø, constructed in 1929. Dolomite marble from Tortenli as Scottish rubble façade. Photo credits: Ingebjørg Hage, published in https://arkitekturguide.uit.no.



Honed slabs of Furuli marble and Antique marble in building in Oslo, late 19th Century. Note rusty spots due to iron content in dolomite.

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Petrography



Description: Photomicrograph (mosaic) of thin section, crossed polarized light showing predominantly fine-grained dolomite grains. Grain-boundaries are usually straight, which do cause the marble to be mechanically weak.

Source of information: Geological Survey of Norway

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Mineral composition

If no accurate number, use MM=main minerals, SM = Subordinate minerals, AM=accessory minerals

Dolomite (%)	Accessory minerals (%)					
99	**1**					

Source of information: Unpublished NGU estimate for this directory

CC BY

Physical properties

Apparent density (EN 1936), kg/m3	Open porosity (EN 1936), % vol	Water absorption at atmospheric pressure (EN 13755), % wt	Uniaxial Compressive strength (EN 1926), MPa	Flexural strength under concentrated load (EN 12372), MPa

Real density (EN 1936), kg/m3	Total porosity (EN 1936), % vol	Water absorption coefficient by capillary (EN 1925) (g/m2 x s0,5)	Flexural strength under constant moment (EN 13161), MPa

Frost resistance (EN 12371)				
Technological Test (Test A)				Identification Test (Test B): Number of cycles completed prior to stone failure
Flexural strength (EN 12372) after freeze-thaw cycling, MPa	Number of cycles	Uniaxial compressive strength (EN 1926) after freeze-thaw cycling, MPa	Number of cycles	

Resistance to ageing by thermal shock (EN 14066)			
Change in dynamic modulus of elasticity (increase: +; decrease: -), %	Change in open porosity (increase: +; decrease: -), %	Change in ultrasound pulse velocity (increase: +; decrease: -), %	Change in flexural strength under conc. load (increase: +; decrease: -) %

Abrasion resistance (EN 14157)			**Resistance to salt crystallisation (EN 12370)**	**Breaking load at dowel hole (EN 13364)**	
Method A - Wide Wheel Abrasion Test, mm	Method B - Böhme Abrasion Test, cm^3 / $50cm^2$	Method C - Amsler Abrasion Test, mm	Change in mass (increase: +; decrease: -), %	Breaking load, N	Thickness of the test specimens, mm

Slip resistance by means of the pendulum tester (EN 14231 / CEN/TS 16165)			**Rupture energy (EN 14158), Joule**	**Thermal Conductivity (EN 1745), W/m·K**
Tested surface finish	Slip Resistance Value — SRV			
	Dry test condition	Wet test condition		
Polished				

Source of information:

CC BY

Chemical properties

Main elements

SiO_2 (%)	Al_2O_3 (%)	Fe_2O_3 (%)	TiO_2 (%)	MgO (%)	CaO (%)	Na_2O (%)	K_2O (%)	MnO (%)	P_2O_5 (%)	SO_3 (%)	LOI (%)

Trace elements

V (ppm)	Cr (ppm)	Mn (ppm)	Co (ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	As (ppm)
Sr (ppm)	Cd (ppm)	Ba (ppm)	Pb (ppm)	Be (ppm)	Rb (ppm)	Bi (ppm)	U (ppm)
Sc (ppm)	Y (ppm)	Th (ppm)	Sb (ppm)	Ta (ppm)	Nb (ppm)	Zr (ppm)	Sn (ppm)
Ag (ppm)	B (ppm)	Mo (ppm)	W (ppm)	Ga (ppm)	Ge (ppm)	Se (ppm)	Cs (ppm)
Tl (ppm)							

REE

La (ppm)	Ce (ppm)	Pr (ppm)	Nd (ppm)	Sm (ppm)	Eu (ppm)	Gd (ppm)	Tb (ppm)
Dy (ppm)	Ho (ppm)	Er (ppm)	Tm (ppm)	Yb (ppm)	Lu (ppm)		

Methods applied and source of information:

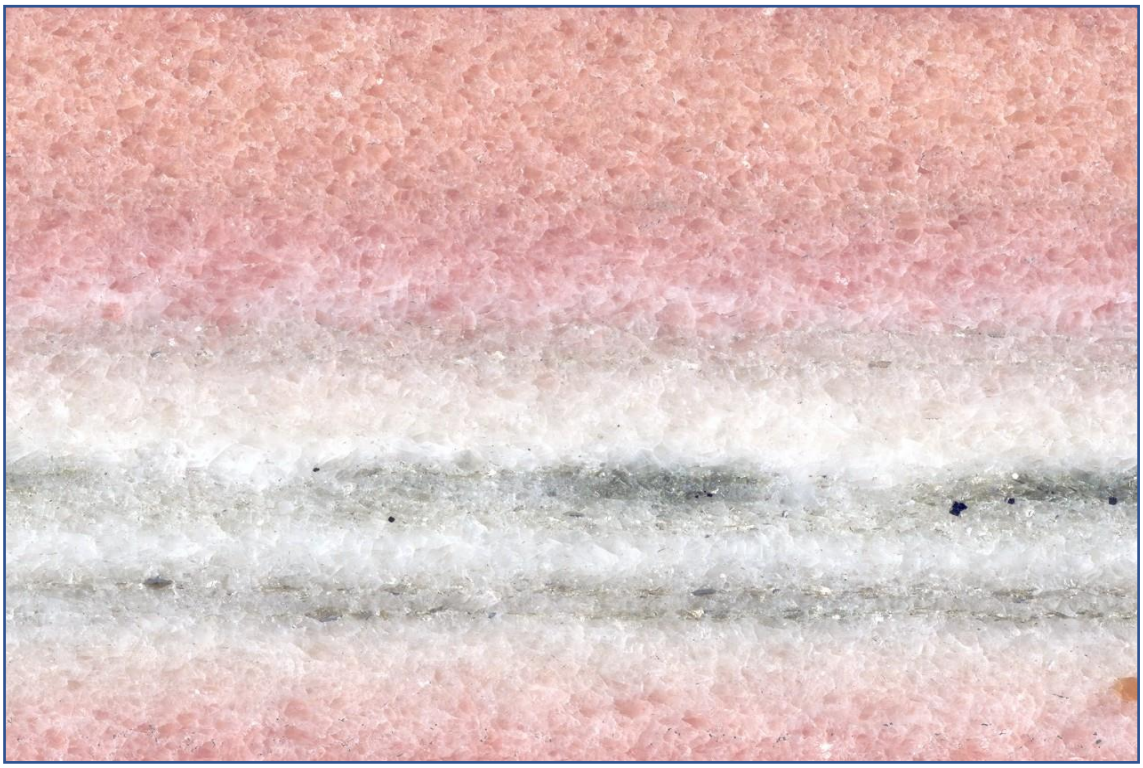
Sources of more information

Type of information	Name of provider	URL
Data sheet	Geological Survey of Norway	https://geo.ngu.no/api/faktaark/mineralressurser/visNaturstein.php?objid=9260&lang=eng https://geo.ngu.no/api/faktaark/mineralressurser/visNaturstein.php?objid=14864&lang=eng
Maplink	Geological Survey of Norway	https://geo.ngu.no/kart/common_mobil/?_/kart/mineralressurser_mobil/__lang=nor::extent=504813.5423853533,7461432.695400183,534347.6673853532,7474253.382900183::map=9
Non-commercial directory	Natural stone online	
Commercial directory		
Scientific publication		https://www.ngu.no/upload/Publikasjoner/Bulletin/Bulletin436_147-168.pdf
Other publication		

Compiled by:	Geological Survey of Norway (NGU) https://www.ngu.no/	

Leivsetmarmor (Leivset Marble)

Koloritt



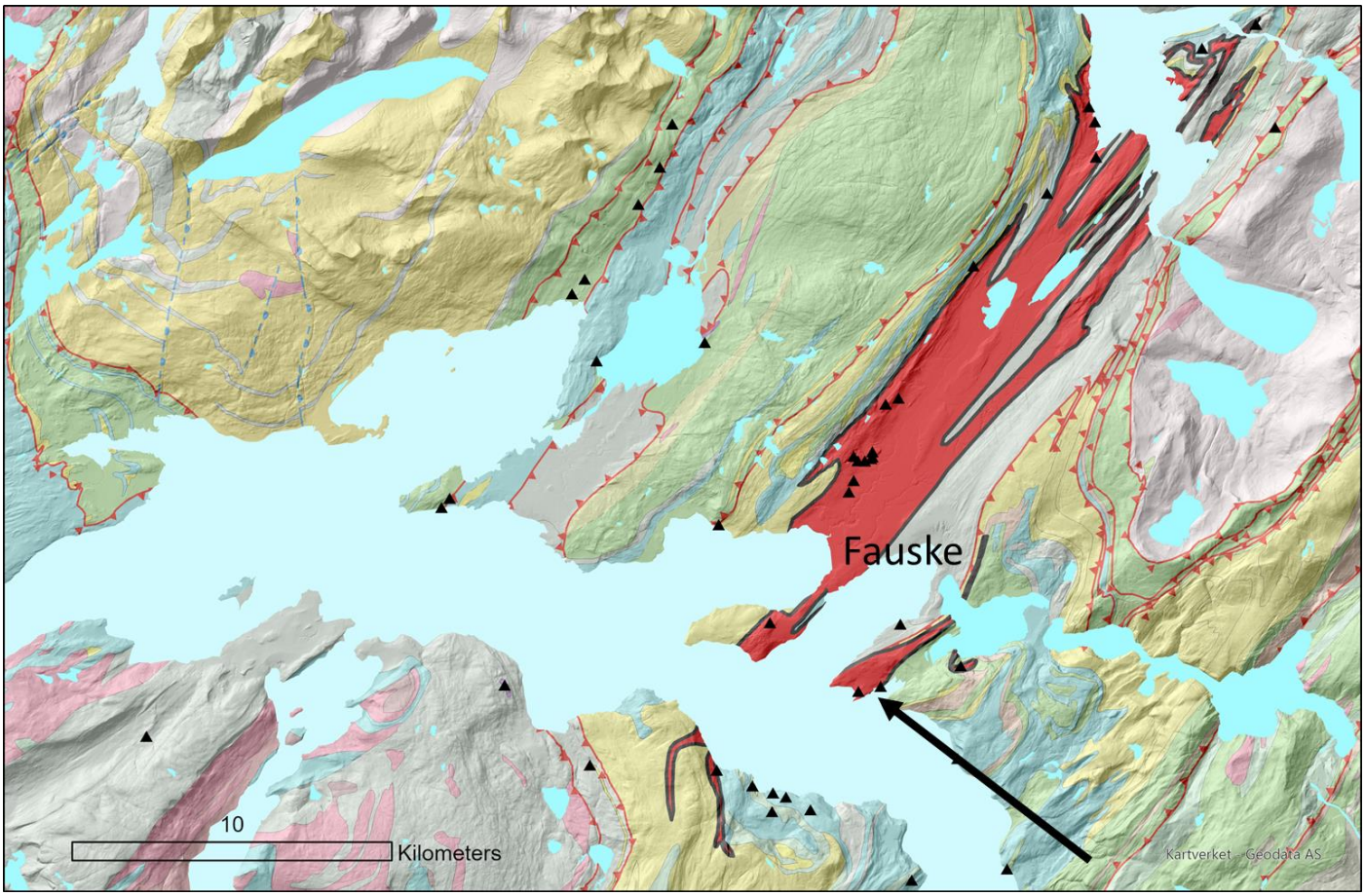
5 centimeters

Short description: Multicoloured, planarly layered marble, displaying grey, white, yellow and pink colours. Polished slab.

Commodity (vocabulary)	Lithology (vocabulary)	Typical colour (code list)	Place of origin			
			Country	County / District / Province	Municipality / Community	Place/town / Village
Commercial Marble	Marble	Multicoloured	Norway	Nordland	Fauske	Leivset

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Geological setting



Geology: The marble units within the Fauske Nappe are composed of a variety of coloured marbles. They were deposited as limestone on a carbonate platform near tidal environments. Tectonic emplacement and metamorphism took place during the Caledonian Orogeny. The Leivset variety is typically planarly layered displaying a range of colours. Some silicate minerals are found in darker laminae. The deposit layer is approximately ten meters thick and crops out in small ridges near the shore.

Production: Most of the production has taken place in two quarries, starting around 1890 and continuing until present day.

Geological age: Cambrian 550 Ma
Geological unit: Fauske Nappe

Application, use and heritage

Description: The Leivset Marble has been applied for facades (early stage production), funerary monuments, sculptures and indoor floors. The most famous example of use is the restored floors of the Nidaros Cathedral, Trondheim. In addition to domestic use, export to Germany also occurred according to written sources.



The Nidaros Cathedral floor, restoration period. Photo: Terje Solbakk

Petrography

Description: Predominantly calcite marble, but with some dolomite and quartz grains. Dark laminae contain slilicate minerals, mostly mica, chlorite and amphibole.

Source of information: Geological Survey of Norway

Mineral composition

If no accurate number, use MM=main minerals, SM = Subordinate minerals, AM=accessory minerals

Calcite (%)	Dolomite (%)	Quartz (%)	Biotite, chlorite, amphibole (%)			
90	**1**	**1**	**8**			

Source of information: NGU estimate for the present survey

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Physical properties

Apparent density (EN 1936), kg/m3	Open porosity (EN 1936), % vol	Water absorption at atmospheric pressure (EN 13755), % wt	Uniaxial Compressive strength (EN 1926), MPa	Flexural strength under concentrated load (EN 12372), MPa
2717	**0,3**	**0,09**	**127**	**19**

Real density (EN 1936), kg/m3	Total porosity (EN 1936), % vol	Water absorption coefficient by capillary (EN 1925) (g/m2 x s0,5)	Flexural strength under constant moment (EN 13161), MPa

Frost resistance (EN 12371)				
Technological Test (Test A)				Identification Test (Test B): Number of cycles completed prior to stone failure
Flexural strength (EN 12372) after freeze-thaw cycling, MPa	Number of cycles	Uniaxial compressive strength (EN 1926) after freeze-thaw cycling, MPa	Number of cycles	

Resistance to ageing by thermal shock (EN 14066)			
Change in dynamic modulus of elasticity (increase: +; decrease: -), %	Change in open porosity (increase: +; decrease: -), %	Change in ultrasound pulse velocity (increase: +; decrease: -), %	Change in flexural strength under conc. load (increase: +; decrease: -) %

Abrasion resistance (EN 14157)			**Resistance to salt crystallisation (EN 12370)**	**Breaking load at dowel hole (EN 13364)**	
Method A - Wide Wheel Abrasion Test, mm	Method B - Böhme Abrasion Test, cm^3 / $50cm^2$	Method C - Amsler Abrasion Test, mm	Change in mass (increase: +; decrease: -), %	Breaking load, N	Thickness of the test specimens, mm

Slip resistance by means of the pendulum tester (EN 14231 / CEN/TS 16165)			**Rupture energy (EN 14158), Joule**	**Thermal Conductivity (EN 1745), W/m·K**
Tested surface finish	Slip Resistance Value — SRV			
	Dry test condition	Wet test condition		
Polished				

Source of information: Information from producer Koloritt AS

Chemical properties

Main elements

SiO_2 (%)	Al_2O_3 (%)	Fe_2O_3 (%)	TiO_2 (%)	MgO (%)	CaO (%)	Na_2O (%)	K_2O (%)	MnO (%)	P_2O_5 (%)	SO_3 (%)	LOI (%)

Trace elements

V (ppm)	Cr (ppm)	Mn (ppm)	Co (ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	As (ppm)
Sr (ppm)	Cd (ppm)	Ba (ppm)	Pb (ppm)	Be (ppm)	Rb (ppm)	Bi (ppm)	U (ppm)
Sc (ppm)	Y (ppm)	Th (ppm)	Sb (ppm)	Ta (ppm)	Nb (ppm)	Zr (ppm)	Sn (ppm)
Ag (ppm)	B (ppm)	Mo (ppm)	W (ppm)	Ga (ppm)	Ge (ppm)	Se (ppm)	Cs (ppm)
Tl (ppm)							

REE

La (ppm)	Ce (ppm)	Pr (ppm)	Nd (ppm)	Sm (ppm)	Eu (ppm)	Gd (ppm)	Tb (ppm)
Dy (ppm)	Ho (ppm)	Er (ppm)	Tm (ppm)	Yb (ppm)	Lu (ppm)		

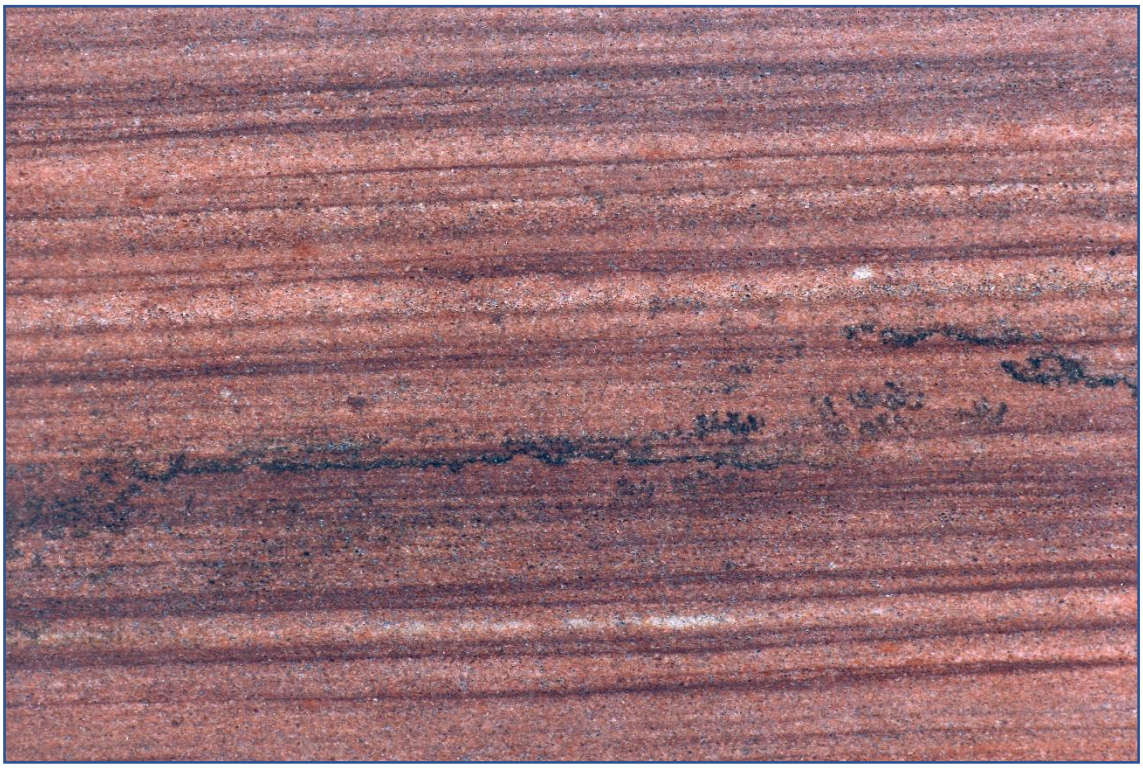
Methods applied and source of information:

Sources of more information

Type of information	Name of provider	URL
Data sheet	Geological Survey of Norway	https://geo.ngu.no/api/faktaark/mineralressurser/visNaturstein.php?objid=9247&lang=eng https://geo.ngu.no/api/faktaark/mineralressurser/visNaturstein.php?objid=23527&lang=eng
Maplink	Geological Survey of Norway	https://geo.ngu.no/kart/common_mobil/?_/kart/mineralressurser_mobil/__lang=nor::extent=515361.67003099504,7455665.774529407,517207.55284349504,7456467.067498157::map=9
Non-commercial directory	Natural stone online	
Commercial directory		
Scientific publication		
Other publication		

Compiled by:	Geological Survey of Norway (NGU) https://www.ngu.no/	

Trysilsandstein (Trysil Sandstone)



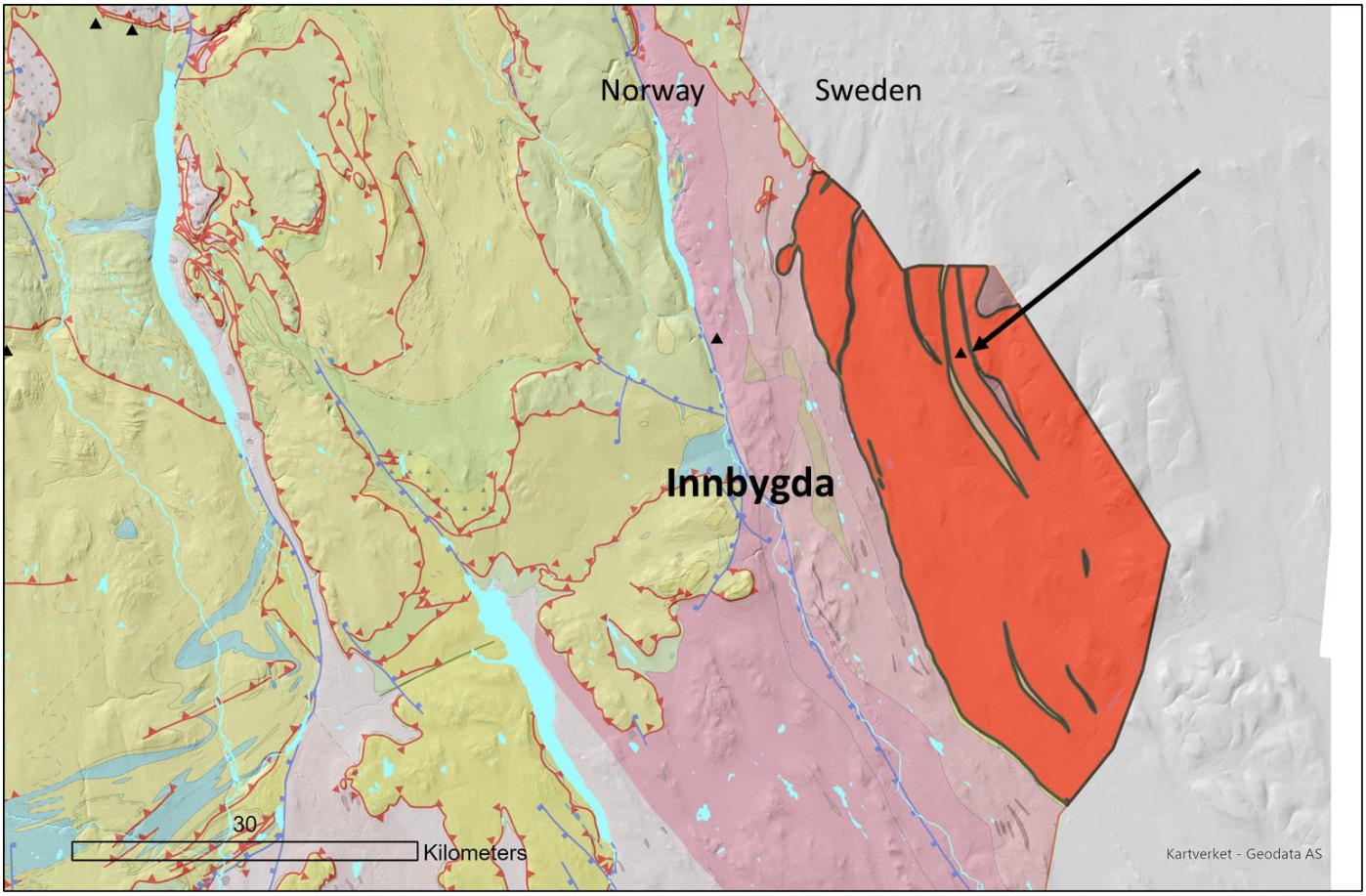
5 centimeters

Short description: Arkosic to quartzitic sandstone displaying horizontal or cross-bedded layering. The image displays a polished surface.

Commodity (vocabulary)	Lithology (vocabulary)	Typical colour (code list)	Place of origin			
			Country	County / District / Province	Municipality / Community	Place/town / Village
Commercial sandstone	Sandstone	Red	Norway	Innlandet	Trysil	Skora

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Geological setting



Geology: The Trysil Sandstone is comparable to the Swedish Wasa Sandstone. It was deposited in the Mesoproterozoicum, and has since been rather undisturbed by metamorphism and tectonic deformation. Most of the sandstone unit were deposited in rivers, lakes and as aeolian sand dunes.

Production: It is not well known when production started in the sandstone, but production gradually increased after WW2. Most of the stone went to local markets. At present time the quarrying is low scaled.

Geological age: Mesoproterozoic (1500-1200 Ma)
Geological unit: Trysil sandstone

Application, use and heritage

Description: Mostly applied for natural split products, such as wall tops, outdoor furniture and drywall-stone, but also applied for funerary monuments and indoor polished slabs.



Outdoor picnic area at the entrance to the Fulufjell National Park, Norway.

Petrography

Description: Arkosic sandstone composed of quartz, potassium feldspar and minor mica, opaques (hematite) and accessory minerals. The sandstone has suffered only weak metamorphism and remains a well-cemented arkose.

Source of information: Geological Survey of Norway

Mineral composition

If no accurate number, use MM=main minerals, SM = Subordinate minerals, AM=accessory minerals

Potassium feldspar (%)	Plagioclase (%)	Quartz (%)	Biotite (%)	Opaques (%)	Others (%)	

Source of information: NGU

CC BY

Physical properties

Apparent density (EN 1936), kg/m3	Open porosity (EN 1936), % vol	Water absorption at atmospheric pressure (EN 13755), % wt	Uniaxial Compressive strength (EN 1926), MPa	Flexural strength under concentrated load (EN 12372), MPa

Real density (EN 1936), kg/m3	Total porosity (EN 1936), % vol	Water absorption coefficient by capillary (EN 1925) (g/m2 x s0,5)	Flexural strength under constant moment (EN 13161), MPa

Frost resistance (EN 12371)				
Technological Test (Test A)				Identification Test (Test B): Number of cycles completed prior to stone failure
Flexural strength (EN 12372) after freeze-thaw cycling, MPa	Number of cycles	Uniaxial compressive strength (EN 1926) after freeze-thaw cycling, MPa	Number of cycles	

Resistance to ageing by thermal shock (EN 14066)			
Change in dynamic modulus of elasticity (increase: +; decrease: -), %	Change in open porosity (increase: +; decrease: -), %	Change in ultrasound pulse velocity (increase: +; decrease: -), %	Change in flexural strength under conc. load (increase: +; decrease: -) %

Abrasion resistance (EN 14157)			**Resistance to salt crystallisation (EN 12370)**	**Breaking load at dowel hole (EN 13364)**	
Method A - Wide Wheel Abrasion Test, mm	Method B - Böhme Abrasion Test, cm^3 / $50cm^2$	Method C - Amsler Abrasion Test, mm	Change in mass (increase: +; decrease: -), %	Breaking load, N	Thickness of the test specimens, mm

Slip resistance by means of the pendulum tester (EN 14231 / CEN/TS 16165)			**Rupture energy (EN 14158), Joule**	**Thermal Conductivity (EN 1745), W/m·K**
Tested surface finish	Slip Resistance Value — SRV			
	Dry test condition	Wet test condition		
Polished				

Source of information:

CC BY

Chemical properties

Main elements

SiO_2 (%)	Al_2O_3 (%)	Fe_2O_3 (%)	TiO_2 (%)	MgO (%)	CaO (%)	Na_2O (%)	K_2O (%)	MnO (%)	P_2O_5 (%)	SO_3 (%)	LOI (%)

Trace elements

V (ppm)	Cr (ppm)	Mn (ppm)	Co (ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	As (ppm)
Sr (ppm)	Cd (ppm)	Ba (ppm)	Pb (ppm)	Be (ppm)	Rb (ppm)	Bi (ppm)	U (ppm)
Sc (ppm)	Y (ppm)	Th (ppm)	Sb (ppm)	Ta (ppm)	Nb (ppm)	Zr (ppm)	Sn (ppm)
Ag (ppm)	B (ppm)	Mo (ppm)	W (ppm)	Ga (ppm)	Ge (ppm)	Se (ppm)	Cs (ppm)
Tl (ppm)							

REE

La (ppm)	Ce (ppm)	Pr (ppm)	Nd (ppm)	Sm (ppm)	Eu (ppm)	Gd (ppm)	Tb (ppm)
Dy (ppm)	Ho (ppm)	Er (ppm)	Tm (ppm)	Yb (ppm)	Lu (ppm)		

Methods applied and source of information:

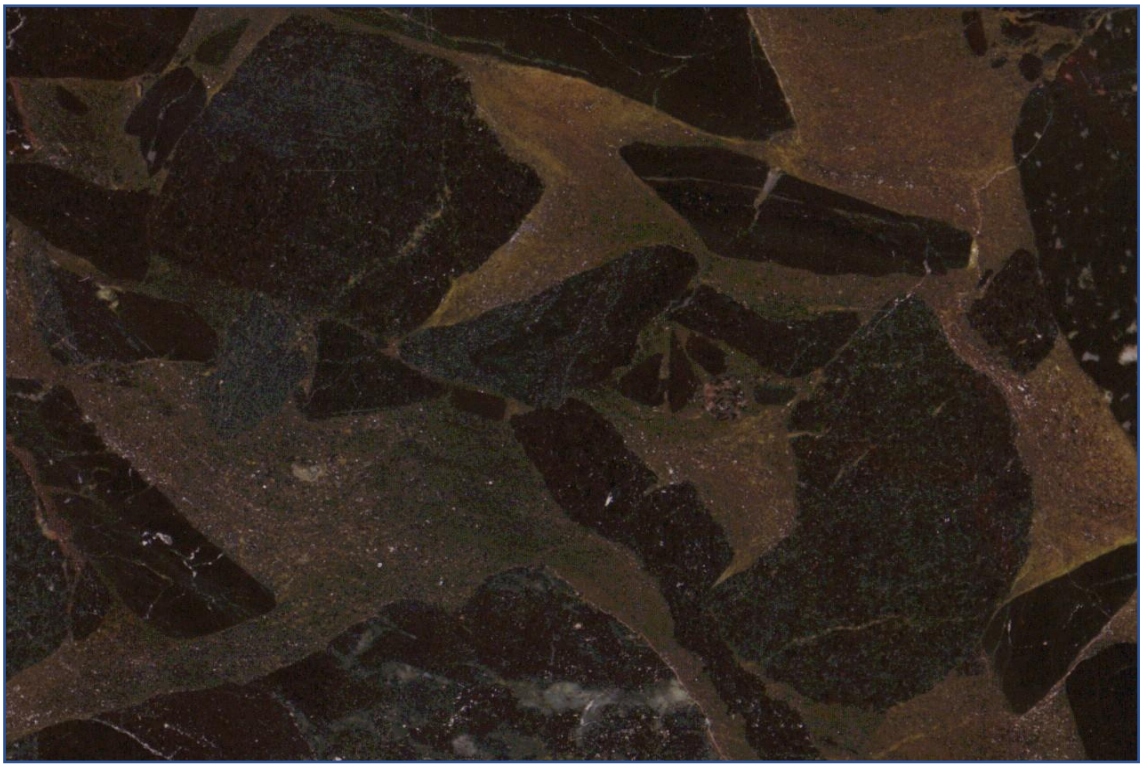
Sources of more information

Type of information	Name of provider	URL
Data sheet	Geological Survey of Norway	https://geo.ngu.no/api/faktaark/mineralressurser/visNaturstein.php?objid=9759&lang=eng
Maplink	Geological Survey of Norway	https://geo.ngu.no/kart/common_mobil/?_/kart/mineralressurser_mobil/__lang=eng::extent=359969.6211104083,6817943.490490799,376217.6211104083,6825051.990490799::map=9
Non-commercial directory	Natural stone online	
Commercial directory		
Scientific publication		
Other publication		

Compiled by:	Geological Survey of Norway (NGU) https://www.ngu.no/	GEOLOGICAL SURVEY OF NORWAY - NGU -

Værlandet breksje (Værlandet Breccia)

Black Beauty

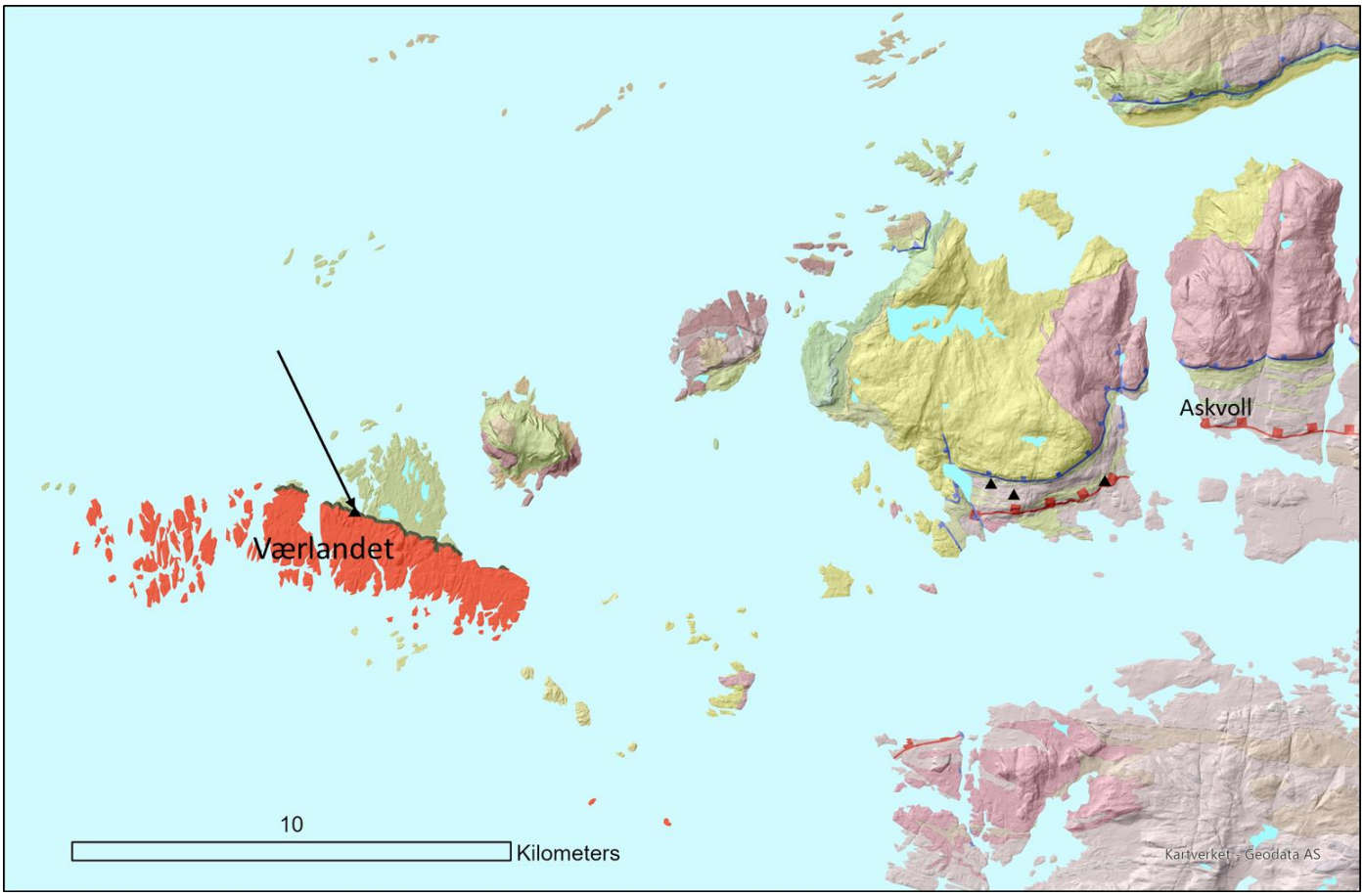


5 centimeters

Short description: Sedimentary breccia containing dark greenstone (basalt) fragments in a lighter brown matrix. The image displays a polished surface. In some occasions, the stone is classified as “commercial granite” due to its hardness.

Commodity (vocabulary)	Lithology (vocabulary)	Typical colour (code list)	Place of origin			
			Country	County / District / Province	Municipality / Community	Place/town / Village
Commercial Sandstone	Breccia	Brown	Norway	Vestland	Askvold	Værlandet

Geological setting



Geology: The major parts of the Værlandet islands consist of Devonian conglomerate, deposited on top of eroded, Silurian volcanic rocks, predominantly basaltic pillow lava. The lower part of the conglomerate is deposited as sedimentary breccia, containing fragments of the underlying basaltic rocks.

Production: Production started in 2003. In addition to the breccia, there is some exploitation of the basaltic rocks and polymict conglomerates.

Geological age: Devonian (419 – 359 Ma)
Geological unit: Devonian

Application, use and heritage

Description: The stone is used for kitchen tops, furniture, indoor cladding and funerary monuments.

Petrography

Description: The rock is composed of a) greenstone (metabasalt) breccia fragments (Chlorite, Amphibole, plagioclase) and b) matrix minerals (in addition quartz and carbonate).

Source of information: Geological Survey of Norway

Mineral composition

Breccia fragments. If no accurate number, use MM=main minerals, SM = Subordinate minerals, AM=accessory minerals

Chlorite (%)	Amphibole (%)	Plagioclase (%)	Muscovite (%)	Hematite (%)	Epidote (%)	
45	**35**	**10**	**3**	**2**	**2**	

Matrix. If no accurate number, use MM=main minerals, SM = Subordinate minerals, AM=accessory minerals

Quartz and feldspar (%)	Chlorite (%)	Carbonate (%)	Epidote (%)	Amphibole (%)	Hematite (%)	Others (%)
45	**15**	**15**	**10**	**10**	**3**	**2**

Source of information: Producing company Landøy.

Physical properties

Apparent density (EN 1936), kg/m3	Open porosity (EN 1936), % vol	Water absorption at atmospheric pressure (EN 13755), % wt	Uniaxial Compressive strength (EN 1926), MPa	Flexural strength under concentrated load (EN 12372), MPa
3002	**0,2**	**0,07**	**191,5**	**22,7**

Real density (EN 1936), kg/m3	Total porosity (EN 1936), % vol	Water absorption coefficient by capillary (EN 1925) (g/m2 x s0,5)	Flexural strength under constant moment (EN 13161), MPa

Frost resistance (EN 12371)				
Technological Test (Test A)				Identification Test (Test B): Number of cycles completed prior to stone failure
Flexural strength (EN 12372) after freeze-thaw cycling, MPa	Number of cycles	Uniaxial compressive strength (EN 1926) after freeze-thaw cycling, MPa	Number of cycles	

Resistance to ageing by thermal shock (EN 14066)			
Change in dynamic modulus of elasticity (increase: +; decrease: -), %	Change in open porosity (increase: +; decrease: -), %	Change in ultrasound pulse velocity (increase: +; decrease: -), %	Change in flexural strength under conc. load (increase: +; decrease: -) %

Abrasion resistance (EN 14157)			**Resistance to salt crystallisation (EN 12370)**	**Breaking load at dowel hole (EN 13364)**	
Method A - Wide Wheel Abrasion Test, mm	Method B - Böhme Abrasion Test, cm^3 / $50cm^2$	Method C - Amsler Abrasion Test, mm	Change in mass (increase: +; decrease: -), %	Breaking load, N	Thickness of the test specimens, mm

Slip resistance by means of the pendulum tester (EN 14231 / CEN/TS 16165)			**Rupture energy (EN 14158), Joule**	**Thermal Conductivity (EN 1745), W/m·K**
Tested surface finish	Slip Resistance Value — SRV			
	Dry test condition	Wet test condition		
Polished				

Source of information: Producing company Landøy.

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Chemical properties

Main elements

SiO_2 (%)	Al_2O_3 (%)	Fe_2O_3 (%)	TiO_2 (%)	MgO (%)	CaO (%)	Na_2O (%)	K_2O (%)	MnO (%)	P_2O_5 (%)	SO_3 (%)	LOI (%)

Trace elements

V (ppm)	Cr (ppm)	Mn (ppm)	Co (ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	As (ppm)
Sr (ppm)	Cd (ppm)	Ba (ppm)	Pb (ppm)	Be (ppm)	Rb (ppm)	Bi (ppm)	U (ppm)
Sc (ppm)	Y (ppm)	Th (ppm)	Sb (ppm)	Ta (ppm)	Nb (ppm)	Zr (ppm)	Sn (ppm)
Ag (ppm)	B (ppm)	Mo (ppm)	W (ppm)	Ga (ppm)	Ge (ppm)	Se (ppm)	Cs (ppm)
Tl (ppm)							

REE

La (ppm)	Ce (ppm)	Pr (ppm)	Nd (ppm)	Sm (ppm)	Eu (ppm)	Gd (ppm)	Tb (ppm)
Dy (ppm)	Ho (ppm)	Er (ppm)	Tm (ppm)	Yb (ppm)	Lu (ppm)		

Methods applied and source of information:

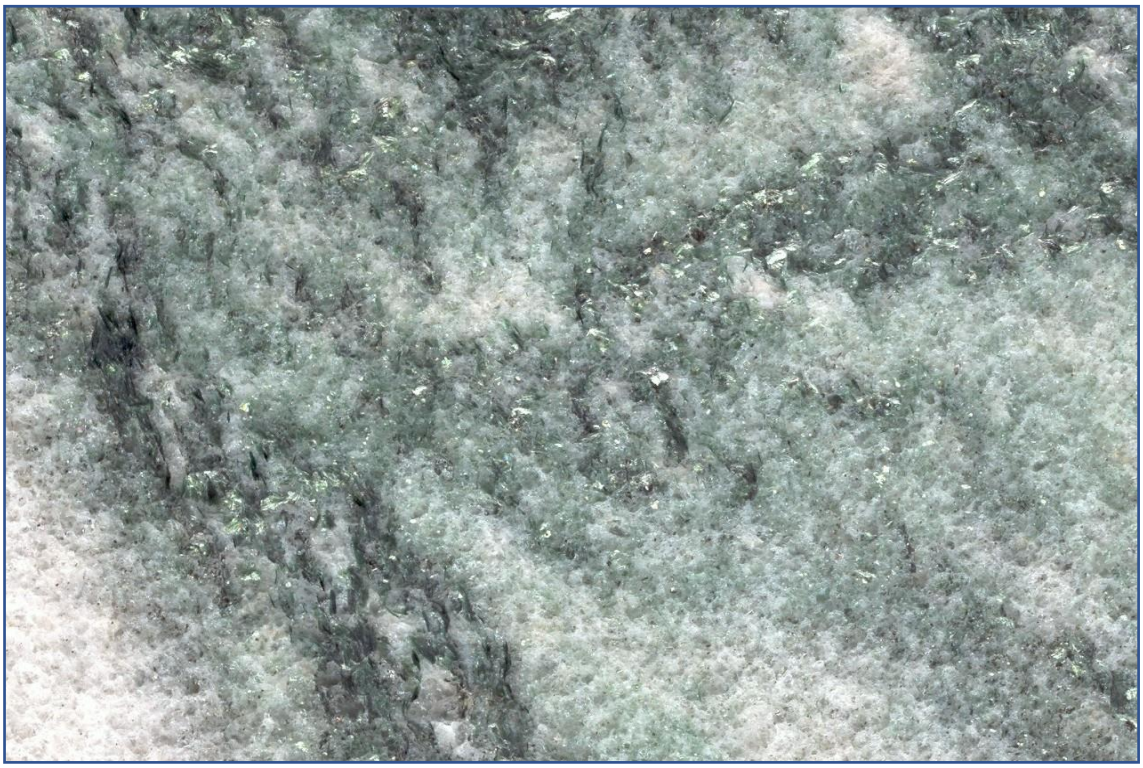
Sources of more information

Type of information	Name of provider	URL
Data sheet	Geological Survey of Norway	https://geo.ngu.no/api/faktaark/mineralressurser/visNaturstein.php?objid=12601&lang=eng
Maplink	Geological Survey of Norway	https://geo.ngu.no/kart/common_mobil/?_/kart/mineralressurser_mobil/__lang=eng::extent=-50559.34117162124,6839775.663259403,-48866.84117162124,6840600.09587659::map=9
Non-commercial directory	Natural stone online	Detail view (naturalstone-online.com)
Commercial directory		
Scientific publication		
Other publication		

Compiled by:	Geological Survey of Norway (NGU) https://www.ngu.no/	

Masikvartsitt (Masi Quartzite)

Norwegian Green

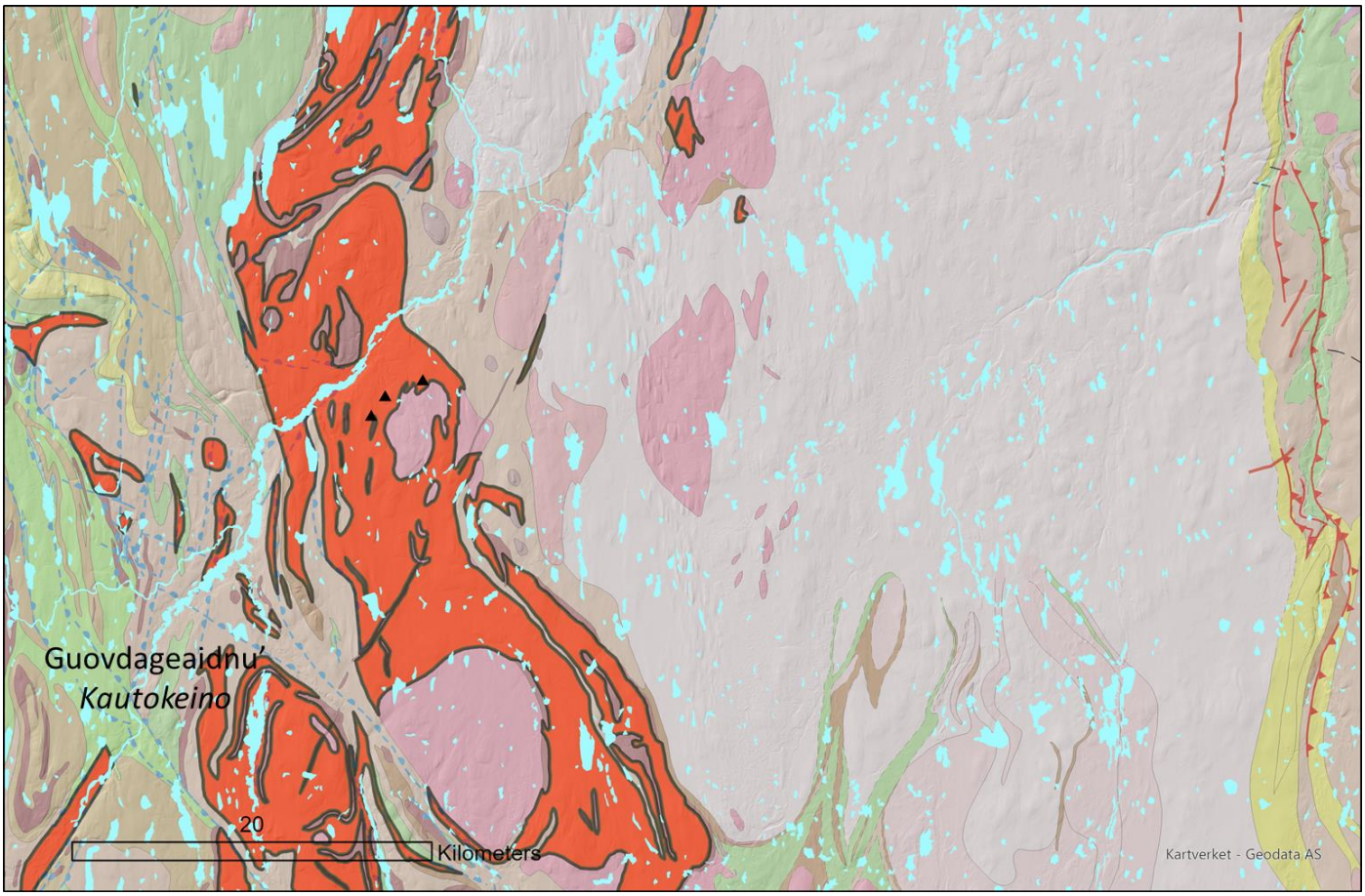


5 centimeters

Short description: The image displays a polished surface, displaying white quartz-rich layers and green fuchsite mica. In some catalogues, this stone is classified as “Commercial Granite”.

Commodity (vocabulary)	Lithology (vocabulary)	Typical colour (code list)	Place of origin			
			Country	County / District / Province	Municipality / Community	Place/town / Village
Commercial Sandstone	Quartzite	Green	Norway	Finnmark	Guovdageaidnu	Narranas

Geological setting



Geology: Thick unit of quartzite and metasandstone, metamorphosed in amphibolite facies. Parts of the unit contain green chromium mica (fuchsite) and the folded green and white layers make an attractive aesthetic appearance. The Masi Formation is coloured red, black triangles are quarries.

Production: Trial production started in the late 1980's, at present time there are two small-scaled operations in the area.

Geological age: Palaeoproterozoicum (2500 – 1600 Ma)
Geological unit: Masi Formation

Application, use and heritage

Description: The Masi Quartzite is predominantly applied for indoor uses, such as floor tiles and kitchen tops, and outdoor as paving and funerary monuments. It is also used as crushed stone for decorative cover in gardens and parks.



Masi Quartzite applied for paving slabs outside the St. Olav Hospital in Trondheim, Norway.

Petrography

Description: Main minerals are quartz, feldspar and fuchsite, subordinates is biotite.

Source of information: Geological Survey of Norway

Mineral composition

If no accurate number, use MM=main minerals, SM = Subordinate minerals, AM=accessory minerals

Feldspar (%)	Quartz (%)	Fuchsite (%)	Biotite (%)			
MM	**MM**	**MM**	**SM**			

Source of information: NGU estimate

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Physical properties

Apparent density (EN 1936), kg/m3	Open porosity (EN 1936), % vol	Water absorption at atmospheric pressure (EN 13755), % wt	Uniaxial Compressive strength (EN 1926), MPa	Flexural strength under concentrated load (EN 12372), MPa
2720		**0,09**	**163**	

Real density (EN 1936), kg/m3	Total porosity (EN 1936), % vol	Water absorption coefficient by capillary (EN 1925) (g/m2 x s0,5)	Flexural strength under constant moment (EN 13161), MPa

Frost resistance (EN 12371)				
Technological Test (Test A)				Identification Test (Test B): Number of cycles completed prior to stone failure
Flexural strength (EN 12372) after freeze-thaw cycling, MPa	Number of cycles	Uniaxial compressive strength (EN 1926) after freeze-thaw cycling, MPa	Number of cycles	

Resistance to ageing by thermal shock (EN 14066)			
Change in dynamic modulus of elasticity (increase: +; decrease: -), %	Change in open porosity (increase: +; decrease: -), %	Change in ultrasound pulse velocity (increase: +; decrease: -), %	Change in flexural strength under conc. load (increase: +; decrease: -) %

Abrasion resistance (EN 14157)			**Resistance to salt crystallisation (EN 12370)**	**Breaking load at dowel hole (EN 13364)**	
Method A - Wide Wheel Abrasion Test, mm	Method B - Böhme Abrasion Test, cm^3 / $50cm^2$	Method C - Amsler Abrasion Test, mm	Change in mass (increase: +; decrease: -), %	Breaking load, N	Thickness of the test specimens, mm

Slip resistance by means of the pendulum tester (EN 14231 / CEN/TS 16165)			**Rupture energy (EN 14158), Joule**	**Thermal Conductivity (EN 1745), W/m·K**
Tested surface finish	Slip Resistance Value — SRV			
	Dry test condition	Wet test condition		
Polished				

Source of information: Stone Contact

Chemical properties

Main elements

SiO_2 (%)	Al_2O_3 (%)	Fe_2O_3 (%)	TiO_2 (%)	MgO (%)	CaO (%)	Na_2O (%)	K_2O (%)	MnO (%)	P_2O_5 (%)	SO_3 (%)	LOI (%)

Trace elements

V (ppm)	Cr (ppm)	Mn (ppm)	Co (ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	As (ppm)
Sr (ppm)	Cd (ppm)	Ba (ppm)	Pb (ppm)	Be (ppm)	Rb (ppm)	Bi (ppm)	U (ppm)
Sc (ppm)	Y (ppm)	Th (ppm)	Sb (ppm)	Ta (ppm)	Nb (ppm)	Zr (ppm)	Sn (ppm)
Ag (ppm)	B (ppm)	Mo (ppm)	W (ppm)	Ga (ppm)	Ge (ppm)	Se (ppm)	Cs (ppm)
Tl (ppm)							

REE

La (ppm)	Ce (ppm)	Pr (ppm)	Nd (ppm)	Sm (ppm)	Eu (ppm)	Gd (ppm)	Tb (ppm)
Dy (ppm)	Ho (ppm)	Er (ppm)	Tm (ppm)	Yb (ppm)	Lu (ppm)		

Methods applied and source of information:

Sources of more information

Type of information	Name of provider	URL
Data sheet	Geological Survey of Norway	https://geo.ngu.no/api/faktaark/mineralressurser/visNaturstein.php?objid=13135&lang=eng
Maplink	Geological Survey of Norway	https://geo.ngu.no/kart/common_mobil/?_/kart/mineralressurser_mobil/__lang=eng::extent=827838.1365564939,7689091.503742283,842605.1990564939,7695501.847492283::map=9
Non-commercial directory	Natural stone online	Detail view (naturalstone-online.com)
Commercial directory		
Scientific publication	Siedlecka et al. 1985	https://openarchive.ngu.no/ngu-xmlui/handle/11250/2674240?locale-attribute=en
Other publication		

Compiled by:	Geological Survey of Norway (NGU) https://www.ngu.no/	

Hardangerskifer (Hardanger Schist)

Jondalskifer

Solesnesskifer



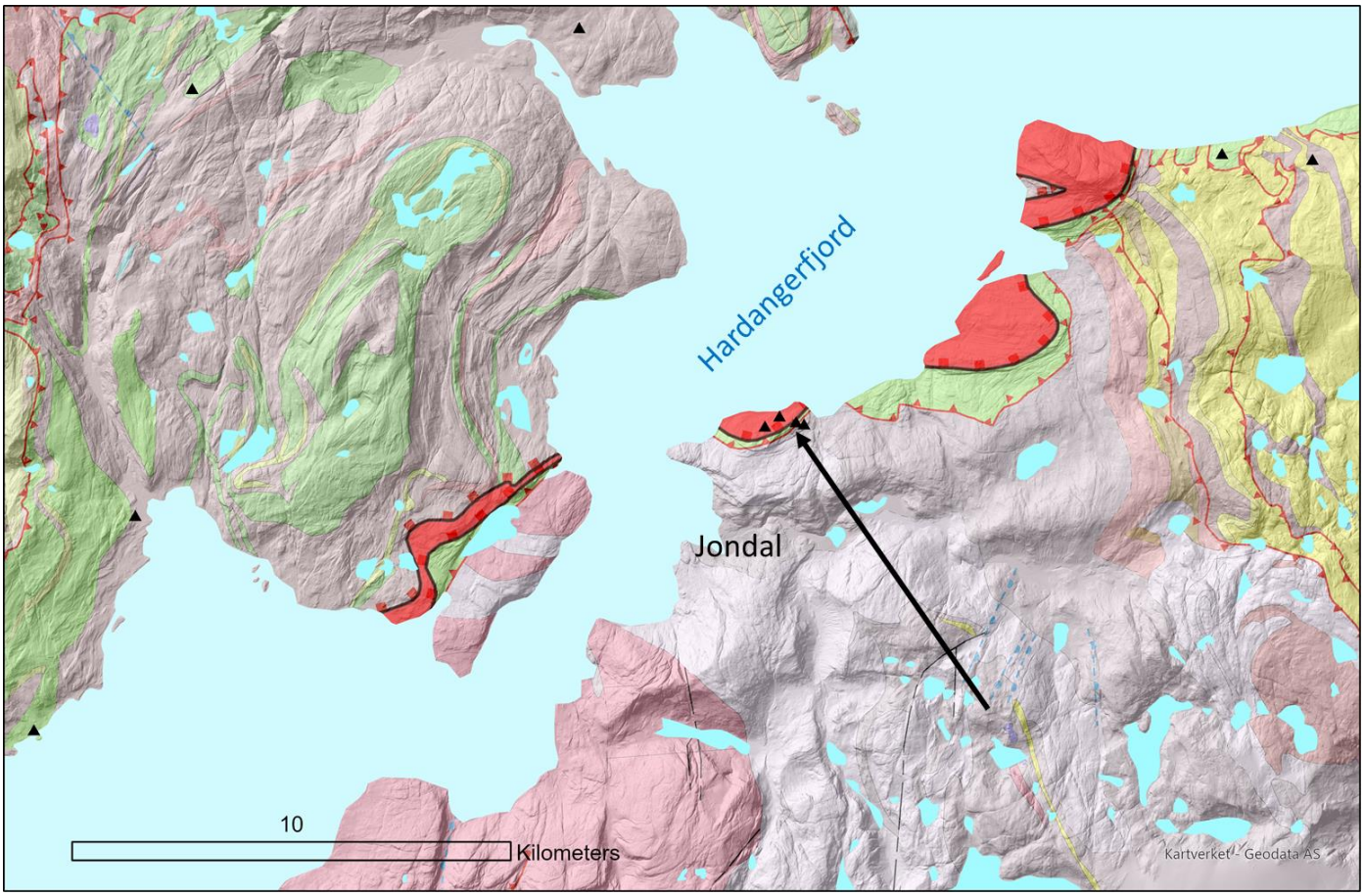
5 centimeters

Short description: Dark grey schist with an undulating surface. The photo displays a natural split surface.

Commodity (vocabulary)	Lithology (vocabulary)	Typical colour (code list)	Place of origin			
			Country	County / District / Province	Municipality / Community	Place/town / Village
Commercial slate	Mica Schist	Dark grey	Norway	Vestland	Ullensvang	Solesnes Kvernuri

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Geological setting



Geology: The Hardanger Schist is a phyllonitic schist, formed by strong deformation and metamorphism of granodioritic gneiss. The deformation took place during emplacement of thrust nappes during the Caledonian orogeny for c. 420 mill. years ago.

Production: Quarying of the Hardanger Schist goes back to the Medieval period, and the oldest written record of schist production dates to 1421.

Geological age: Mesoproterozoicum (1600 – 1000 Ma)
Geological unit: Fykse Nappe

Application, use and heritage

Description: The schist was traditionally used for roofing, paving slabs and stairs, but also funerary monuments have been found. Drying slabs (for drying cereal grains) was also an important product, and according to written sources also millstones. The modern quarrying produces in addition to slabs also drywall-stone in different categories.



Traditional use of the Hardanger Schist; roof, paving slabs and stairs.



Modern use of the Hardanger Schist, drywall-stone. Photo from producer.

CC BY

Petrography

Description: The Hardanger Schist varies from gneissose granodiorite to phyllonitic schist. The gneissose variety display spaced mica laminae along which the stone can split. The phyllonitic variety has more closely spaced mica layers enabling thinner slabs. It also contains more mica on the natural split surface.

Source of information: Geological Survey of Norway

Mineral composition

If no accurate number, use MM=main minerals, SM = Subordinate minerals, AM=accessory minerals

Feldspar (%)	Quartz (%)	Muscovite (%)	Biotite (%)	Epidote (%)	Apatite (%)	Garnet (%)
MM	**MM**	**MM**	**SM**	**AM**	**AM**	**AM**
Clinozoisite (%)	Chlorite (%)	Opaques (%)				
AM	**AM**	**AM**				

Source of information: NGU

Physical properties

Apparent density (EN 1936), kg/m3	Open porosity (EN 1936), % vol	Water absorption at atmospheric pressure (EN 13755), % wt	Uniaxial Compressive strength (EN 1926), MPa	Flexural strength under concentrated load (EN 12372), MPa

Real density (EN 1936), kg/m3	Total porosity (EN 1936), % vol	Water absorption coefficient by capillary (EN 1925) (g/m2 x s0,5)	Flexural strength under constant moment (EN 13161), MPa

Frost resistance (EN 12371)				
Technological Test (Test A)				Identification Test (Test B): Number of cycles completed prior to stone failure
Flexural strength (EN 12372) after freeze-thaw cycling, MPa	Number of cycles	Uniaxial compressive strength (EN 1926) after freeze-thaw cycling, MPa	Number of cycles	

Resistance to ageing by thermal shock (EN 14066)			
Change in dynamic modulus of elasticity (increase: +; decrease: -), %	Change in open porosity (increase: +; decrease: -), %	Change in ultrasound pulse velocity (increase: +; decrease: -), %	Change in flexural strength under conc. load (increase: +; decrease: -) %

Abrasion resistance (EN 14157)			**Resistance to salt crystallisation (EN 12370)**	**Breaking load at dowel hole (EN 13364)**	
Method A - Wide Wheel Abrasion Test, mm	Method B - Böhme Abrasion Test, cm^3 / $50cm^2$	Method C - Amsler Abrasion Test, mm	Change in mass (increase: +; decrease: -), %	Breaking load, N	Thickness of the test specimens, mm

Slip resistance by means of the pendulum tester (EN 14231 / CEN/TS 16165)			**Rupture energy (EN 14158), Joule**	**Thermal Conductivity (EN 1745), W/m·K**
Tested surface finish	Slip Resistance Value — SRV			
	Dry test condition	Wet test condition		
Polished				

Source of information:

CC BY

Chemical properties

Main elements

SiO_2 (%)	Al_2O_3 (%)	Fe_2O_3 (%)	TiO_2 (%)	MgO (%)	CaO (%)	Na_2O (%)	K_2O (%)	MnO (%)	P_2O_5 (%)	SO_3 (%)	LOI (%)

Trace elements

V (ppm)	Cr (ppm)	Mn (ppm)	Co (ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	As (ppm)
Sr (ppm)	Cd (ppm)	Ba (ppm)	Pb (ppm)	Be (ppm)	Rb (ppm)	Bi (ppm)	U (ppm)
Sc (ppm)	Y (ppm)	Th (ppm)	Sb (ppm)	Ta (ppm)	Nb (ppm)	Zr (ppm)	Sn (ppm)
Ag (ppm)	B (ppm)	Mo (ppm)	W (ppm)	Ga (ppm)	Ge (ppm)	Se (ppm)	Cs (ppm)
Tl (ppm)							

REE

La (ppm)	Ce (ppm)	Pr (ppm)	Nd (ppm)	Sm (ppm)	Eu (ppm)	Gd (ppm)	Tb (ppm)
Dy (ppm)	Ho (ppm)	Er (ppm)	Tm (ppm)	Yb (ppm)	Lu (ppm)		

Methods applied and source of information:

Sources of more information

Type of information	Name of provider	URL
Data sheet	Geological Survey of Norway	
Maplink	Geological Survey of Norway	https://geo.ngu.no/kart/common_mobil/?_/kart/mineralressurser_mobil/__lang=eng::extent=16599.675798426717,6716015.116070782,20661.675798426717,6717792.241070782::map=9
Non-commercial directory	Natural stone online	
Commercial directory		
Scientific publication		
Other publication		

Compiled by:	Geological Survey of Norway (NGU) https://www.ngu.no/	

Ottaskifer (Otta Schist)

Pillarguri

Høgseter

Sel Royal

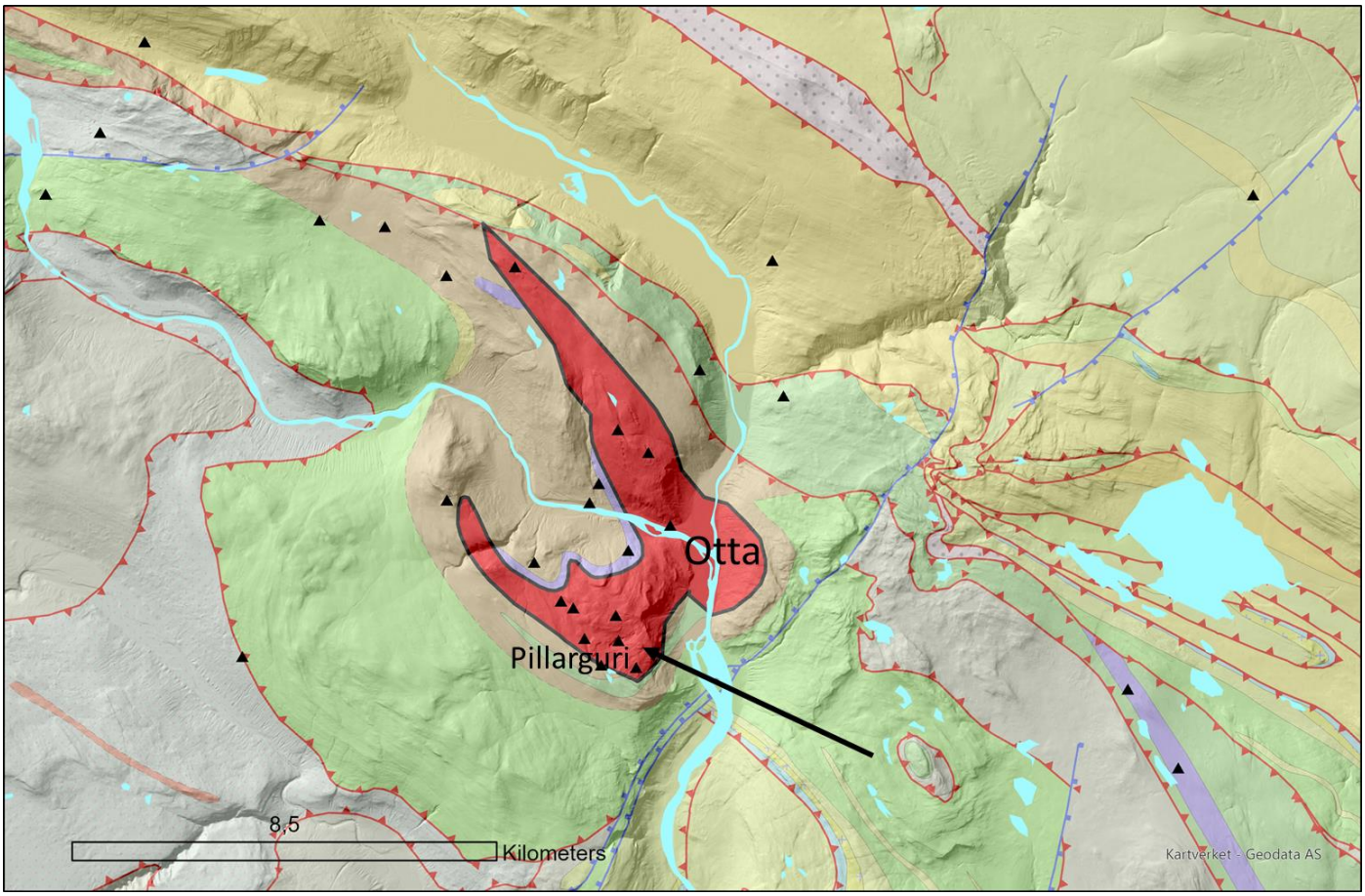


5 centimeters

Short description: The image displays a honed surface of the main variety of the Otta Schist containing needle-like crystals of hornblende. Although dark grey is the predominant colour, brown varieties (secondary colouration by iron hydroxides) are also common and sold as commercial products. Sometimes the stone is classified as phyllite, other times as mica schist. This is due to that the rock is a borderline case between the two definitions.

Commodity (vocabulary)	Lithology (vocabulary)	Typical colour (code list)	Place of origin			
			Country	County / District / Province	Municipality / Community	Place/town / Village
Commercial Slate	Mica Schist	Dark grey	Norway	Innlandet	Sel	Pillarguri

Geological setting



Geology: The Otta Schist is a term covering several varieties of dark grey, schistose rocks. They frequently contain hornblende or garnet porphyroblasts. The most important quarry area is the Pillarguri mountain, but there are several other historical quarry sites. The outcropping area is shown with red colour, arrow points at the Pillarguri site. The main commercial type is the Pillarguri subtype, containing needle-shaped hornblende porphyroblasts. A secondary type is the Sel Royal subtype, containing small garnet porphyroblasts.

Production: Production in an industrial scale most likely started in the 18th century, primarily for roofing slate. During the 19th century, a more diversified production delivered schist also for façade and floors. At present time, The Otta Schist is produced for a wide range of applications.

Geological age: Cambrian-Ordovician
Geological unit:

Application, use and heritage

Description: The Otta Schist (in particular the Pillarguri variety) is a traditional roofing slate material in a large part of eastern Norway, in particular the Gudbrandsdalen Valley. In the 20th century, the use was more diverse, such as flooring, facades and even honed floor tiles. The stone has been exported to many countries during the 20th century.



The 19th Century Otta Church, displaying roof and walls of Otta Schist.



Honed Pillarguri type at Geological Survey of Norway, 1995.

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Petrography

Description: Fine-grained schist, containing mica and quartz as main minerals. Porphyroblasts of hornblende or garnet may occur. The stone contains some pyrrhotite, which may cause a slight brownish patina when exposed outdoor over long time periods.

Source of information: Geological Survey of Norway

Mineral composition

If no accurate number, use MM=main minerals, SM = Subordinate minerals, AM=accessory minerals

Quartz (%)	Muscovite (%)	Biotite (%)	Chlorite (%)	Amphibole (%)	Garnet (%)	Carbonate (%)
21	**31**	**38**	**1,3**	**3**	**0,8**	**0,6**
Phyrrotite (%)	Feldspar (%)	Titanite (%)	Epidote (%)			
1,9	**1,3**	**1,3**	**0,6**			

Source of information: Minera Skifer

CC BY

Physical properties

Apparent density (EN 1936), kg/m3	Open porosity (EN 1936), % vol	Water absorption at atmospheric pressure (EN 13755), % wt	Uniaxial Compressive strength (EN 1926), MPa	Flexural strength under concentrated load (EN 12372), MPa
2820		**0,2**		**39,9**

Real density (EN 1936), kg/m3	Total porosity (EN 1936), % vol	Water absorption coefficient by capillary (EN 1925) (g/m2 x s0,5)	Flexural strength under constant moment (EN 13161), MPa

Frost resistance (EN 12371)				
Technological Test (Test A)				Identification Test (Test B): Number of cycles completed prior to stone failure
Flexural strength (EN 12372) after freeze-thaw cycling, MPa	Number of cycles	Uniaxial compressive strength (EN 1926) after freeze-thaw cycling, MPa	Number of cycles	

Resistance to ageing by thermal shock (EN 14066)			
Change in dynamic modulus of elasticity (increase: +; decrease: -), %	Change in open porosity (increase: +; decrease: -), %	Change in ultrasound pulse velocity (increase: +; decrease: -), %	Change in flexural strength under conc. load (increase: +; decrease: -) %

Abrasion resistance (EN 14157)			**Resistance to salt crystallisation (EN 12370)**	**Breaking load at dowel hole (EN 13364)**	
Method A - Wide Wheel Abrasion Test, mm	Method B - Böhme Abrasion Test, cm^3 / $50cm^2$	Method C - Amsler Abrasion Test, mm	Change in mass (increase: +; decrease: -), %	Breaking load, N	Thickness of the test specimens, mm
25					

Slip resistance by means of the pendulum tester (EN 14231 / CEN/TS 16165)			**Rupture energy (EN 14158), Joule**	**Thermal Conductivity (EN 1745), W/m·K**
Tested surface finish	Slip Resistance Value — SRV			
	Dry test condition	Wet test condition		
Honed	**55**	**18**		
Brushed	**61**	**22**		

Source of information: Minera Skifer

Chemical properties

Main elements

SiO_2 (%)	Al_2O_3 (%)	Fe_2O_3 (%)	TiO_2 (%)	MgO (%)	CaO (%)	Na_2O (%)	K_2O (%)	MnO (%)	P_2O_5 (%)	SO_3 (%)	LOI (%)

Trace elements

V (ppm)	Cr (ppm)	Mn (ppm)	Co (ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	As (ppm)
Sr (ppm)	Cd (ppm)	Ba (ppm)	Pb (ppm)	Be (ppm)	Rb (ppm)	Bi (ppm)	U (ppm)
Sc (ppm)	Y (ppm)	Th (ppm)	Sb (ppm)	Ta (ppm)	Nb (ppm)	Zr (ppm)	Sn (ppm)
Ag (ppm)	B (ppm)	Mo (ppm)	W (ppm)	Ga (ppm)	Ge (ppm)	Se (ppm)	Cs (ppm)
Tl (ppm)							

REE

La (ppm)	Ce (ppm)	Pr (ppm)	Nd (ppm)	Sm (ppm)	Eu (ppm)	Gd (ppm)	Tb (ppm)
Dy (ppm)	Ho (ppm)	Er (ppm)	Tm (ppm)	Yb (ppm)	Lu (ppm)		

Methods applied and source of information:

Sources of more information

Type of information	Name of provider	URL
Data sheet	Geological Survey of Norway	https://geo.ngu.no/api/faktaark/mineralressurser/visNaturstein.php?objid=9717&lang=engv
Maplink	Geological Survey of Norway	https://geo.ngu.no/kart/common_mobil/?_/kart/mineralressurser_mobil/__lang=eng::extent=193565.43810450536,6855511.443893401,226061.43810450536,6869728.443893401::map=9
Non-commercial directory	Natural stone online	Detail view (naturalstone-online.com)
Commercial directory		
Scientific publication		
Other publication		

Compiled by:	Geological Survey of Norway (NGU) https://www.ngu.no/	GEOLOGICAL SURVEY OF NORWAY - NGU -

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Altaskifer (Alta Schist)

Alta Quartzite

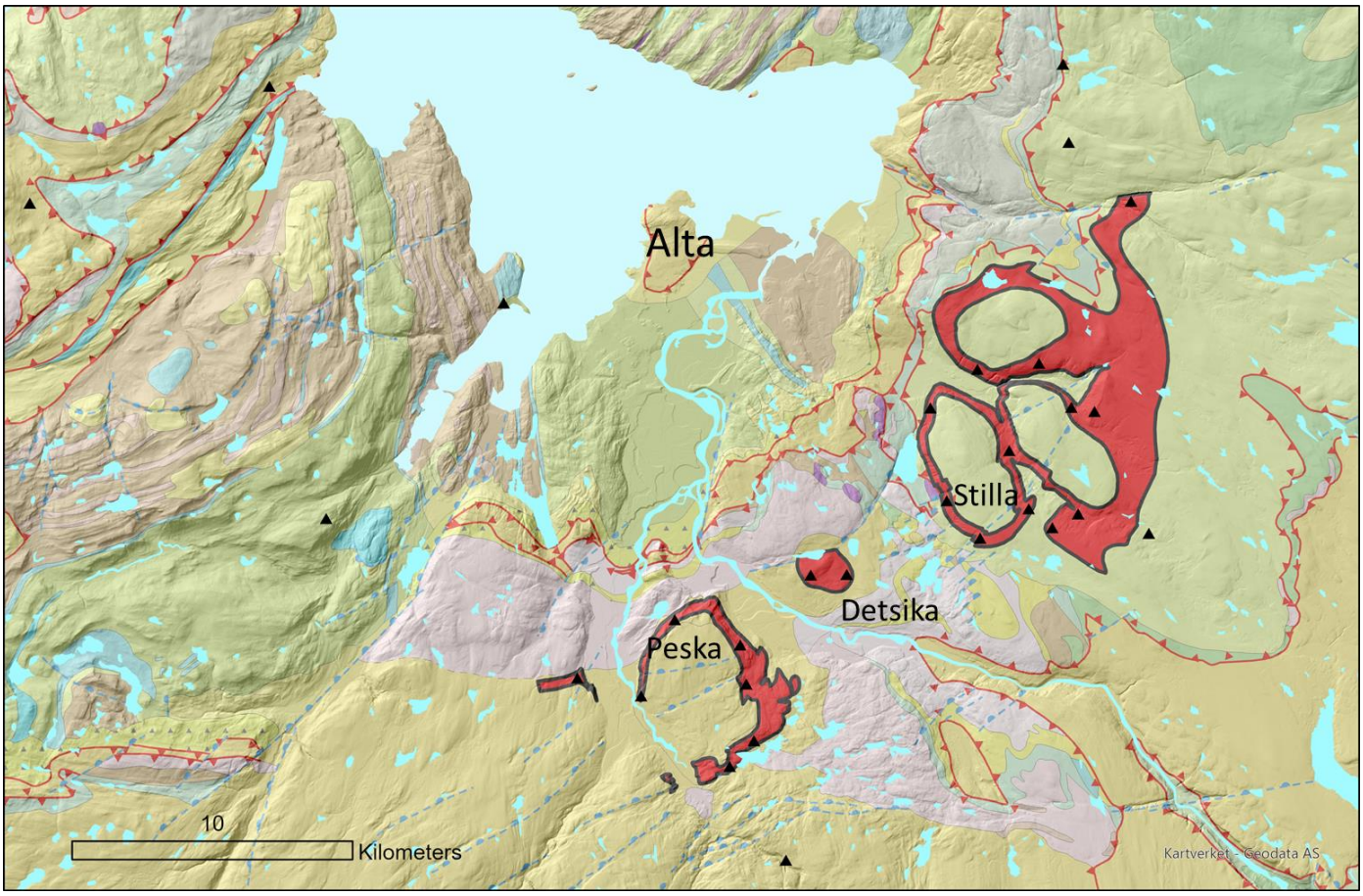


5 centimeters

Short description: Grey quartz-rich schist formed by dynamic metamorphism of sandstone. The image displays a natural split surface.

Commodity (vocabulary)	Lithology (vocabulary)	Typical colour (code list)	Place of origin			
			Country	County / District / Province	Municipality / Community	Place/town / Village
Commercial Slate	Schist	Grey	Norway	Finnmark	Alta	Peska Detsika Stilla

Geological setting



Geology: The Alta Schist represents originally arkosic sandstone units, transformed through dynamic metamorphism to quartz rich schist displaying spaced layers of mica along which the schist can be split to slabs. The main part of this transformation occurred by thrusting of sheets of sandstone and other rocks during the Caledonian Orogeny. The Alta Schist occurs within a few hundred metres thick, almost horizontal, thrust nappe unit to the south and west of the town of Alta. Exploitable thickness varies between 40 and 100 m.

Production: Production started around 1850, and for more than 100 years, the schist was worked in numerous quarries on a cooperative basis. At present time, most of the production is taking place at Peska, the southernmost deposit.

Geological age: Neoproterozoic
Geological unit: Nalganas Nappe

Application, use and heritage

Description: The Alta Schist can be split into thin slabs, and is perhaps the most well-known roofing slate in Norway. It is known to be very durable, and is often traded second hand. It is also much used as floor covering at heavy-traffic sites, such as railway stations.

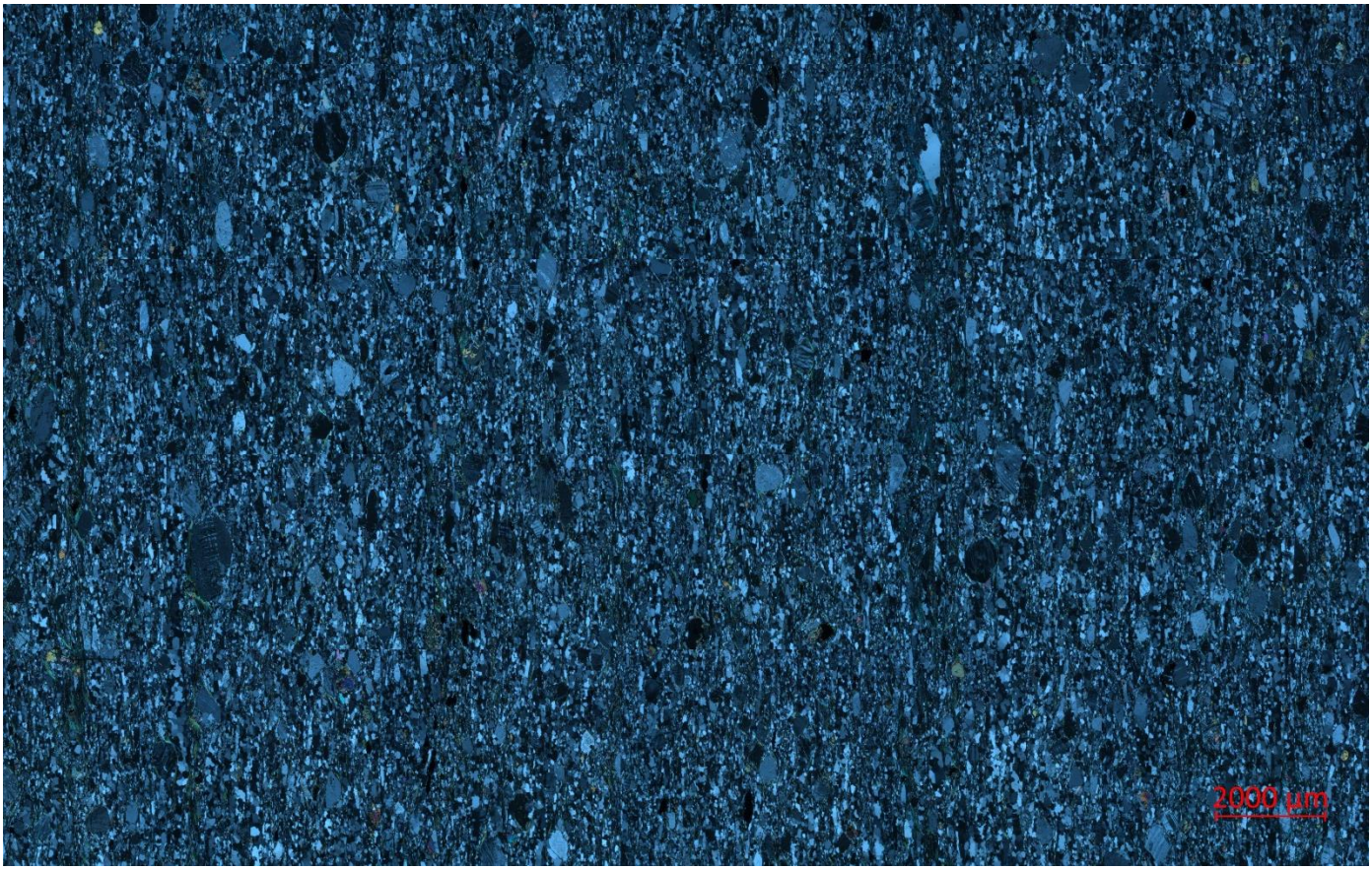


Alta Schist (large slabs) at the main square, Bergen



Alta Schist, 84 years old roofing slate

Petrography



Description: Thin section photomicrograph, mosaic (crossed polars). Fine-grained schist, quartz occurring as granoblastic-elongate aggregates (annealed mylonitic texture), feldspars as porfyroclasts and varying amounts of mica as continuous laminae and/or lepidoblastic grains. The mica laminae define the cleavage planes along which the schist can be split (N-S in image). The mylonitic nature of the schist explains its high strength and durability in use.

Source of information: Geological Survey of Norway

Mineral composition

If no accurate number, use MM=main minerals, SM = Subordinate minerals, AM=accessory minerals

Potassium feldspar (%)	Plagioclase (%)	Quartz (%)	Muscovite (%)	Epidote (%)	Calcite (%)	Biotite (%)
10	**11**	**54**	**7**	**3**	**2**	**1**
Chlorite (%)						
1						

Source of information: NGU

Physical properties

Apparent density (EN 1936), kg/m3	Open porosity (EN 1936), % vol	Water absorption at atmospheric pressure (EN 13755), % wt	Uniaxial Compressive strength (EN 1926), MPa	Flexural strength under concentrated load (EN 12372), MPa
2710		**>0,1**	**246,6**	**34,3**

Real density (EN 1936), kg/m3	Total porosity (EN 1936), % vol	Water absorption coefficient by capillary (EN 1925) (g/m2 x s0,5)	Flexural strength under constant moment (EN 13161), MPa

Frost resistance (EN 12371)				
Technological Test (Test A)				Identification Test (Test B): Number of cycles completed prior to stone failure
Flexural strength (EN 12372) after freeze-thaw cycling, MPa	Number of cycles	Uniaxial compressive strength (EN 1926) after freeze-thaw cycling, MPa	Number of cycles	

Resistance to ageing by thermal shock (EN 14066)			
Change in dynamic modulus of elasticity (increase: +; decrease: -), %	Change in open porosity (increase: +; decrease: -), %	Change in ultrasound pulse velocity (increase: +; decrease: -), %	Change in flexural strength under conc. load (increase: +; decrease: -) %

Abrasion resistance (EN 14157)			**Resistance to salt crystallisation (EN 12370)**	**Breaking load at dowel hole (EN 13364)**	
Method A - Wide Wheel Abrasion Test, mm	Method B - Böhme Abrasion Test, cm^3 / $50cm^2$	Method C - Amsler Abrasion Test, mm	Change in mass (increase: +; decrease: -), %	Breaking load, N	Thickness of the test specimens, mm

Slip resistance by means of the pendulum tester (EN 14231 / CEN/TS 16165)			**Rupture energy (EN 14158), Joule**	**Thermal Conductivity (EN 1745), W/m·K**
Tested surface finish	Slip Resistance Value — SRV			
	Dry test condition	Wet test condition		
Polished				

Source of information: Altaskifer

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Chemical properties

Main elements

SiO_2 (%)	Al_2O_3 (%)	Fe_2O_3 (%)	TiO_2 (%)	MgO (%)	CaO (%)	Na_2O (%)	K_2O (%)	MnO (%)	P_2O_5 (%)	SO_3 (%)	LOI (%)

Trace elements

V (ppm)	Cr (ppm)	Mn (ppm)	Co (ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	As (ppm)
Sr (ppm)	Cd (ppm)	Ba (ppm)	Pb (ppm)	Be (ppm)	Rb (ppm)	Bi (ppm)	U (ppm)
Sc (ppm)	Y (ppm)	Th (ppm)	Sb (ppm)	Ta (ppm)	Nb (ppm)	Zr (ppm)	Sn (ppm)
Ag (ppm)	B (ppm)	Mo (ppm)	W (ppm)	Ga (ppm)	Ge (ppm)	Se (ppm)	Cs (ppm)
Tl (ppm)							

REE

La (ppm)	Ce (ppm)	Pr (ppm)	Nd (ppm)	Sm (ppm)	Eu (ppm)	Gd (ppm)	Tb (ppm)
Dy (ppm)	Ho (ppm)	Er (ppm)	Tm (ppm)	Yb (ppm)	Lu (ppm)		

Methods applied and source of information:

Sources of more information

Type of information	Name of provider	URL
This data sheet	Geological Survey of Norway	https://geo.ngu.no/api/faktaark/mineralressurser/visNaturstein.php?objid=9004&lang=eng
Map link	Geological Survey of Norway	https://geo.ngu.no/kart/common_mobil/?_/kart/mineralressurser_mobil/__lang=eng::extent=807241.7170200596,7765455.930186273,836775.8420200596,7778911.305186273::map=9
Non-commercial directory	Natural stone online	Detailansicht (naturalstone-online.com)
Commercial directory		
Scientific publication	NGU Bulletin	https://www.ngu.no/upload/Publikasjoner/Bulletin/Bulletin436_137-146.pdf
Other publication		

Compiled by:	Geological Survey of Norway (NGU) https://www.ngu.no/	GEOLOGICAL SURVEY OF NORWAY - NGU -

Dovreskifer (Dovre Schist)



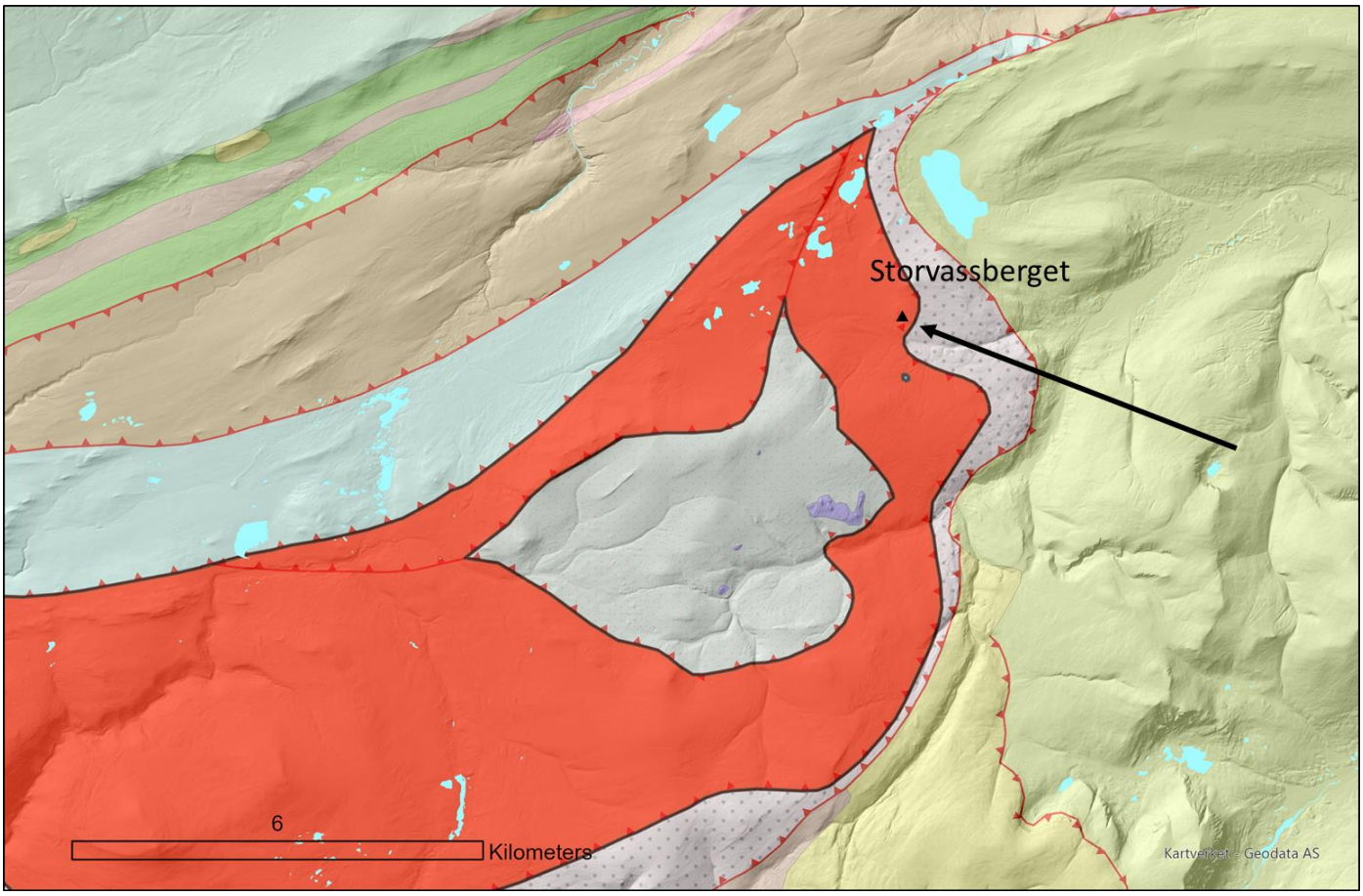
5 centimeters

Short description: Quartz schist that can be split along mica laminae to slabs of various thicknesses. The image displays a natural split surface of the Dovre Schist.

Commodity (vocabulary)	Lithology (vocabulary)	Typical colour (code list)	Place of origin			
			Country	County / District / Province	Municipality / Community	Place/town / Village
Commercial slate	Schist	Grey	Norway	Innlandet	Dovre	Storvassberget

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Geological setting



Geology: The Dovre Schist represents deformed and metamorphosed sandstones of Neoproterozoic age. The transformation from sandstone to schist occurred during the Caledonian orogeny (440-400 Ma) and involved ductile deformation and metamorphic mineral growth. The latter caused a spaced cleavage of mica laminae along which the stone can split. The quarry is situated 1350 m.a.s.l. and thus the highest altitude quarry in Norway.

Production: The production of the schist started around 1930, the first 60 years mainly for roofing slate and paving slabs. At present time, drywall-stone is also an important product.

Geological age: Neoproterozoic (1000-541 Ma)
Geological unit: Remsliklepp Nappe

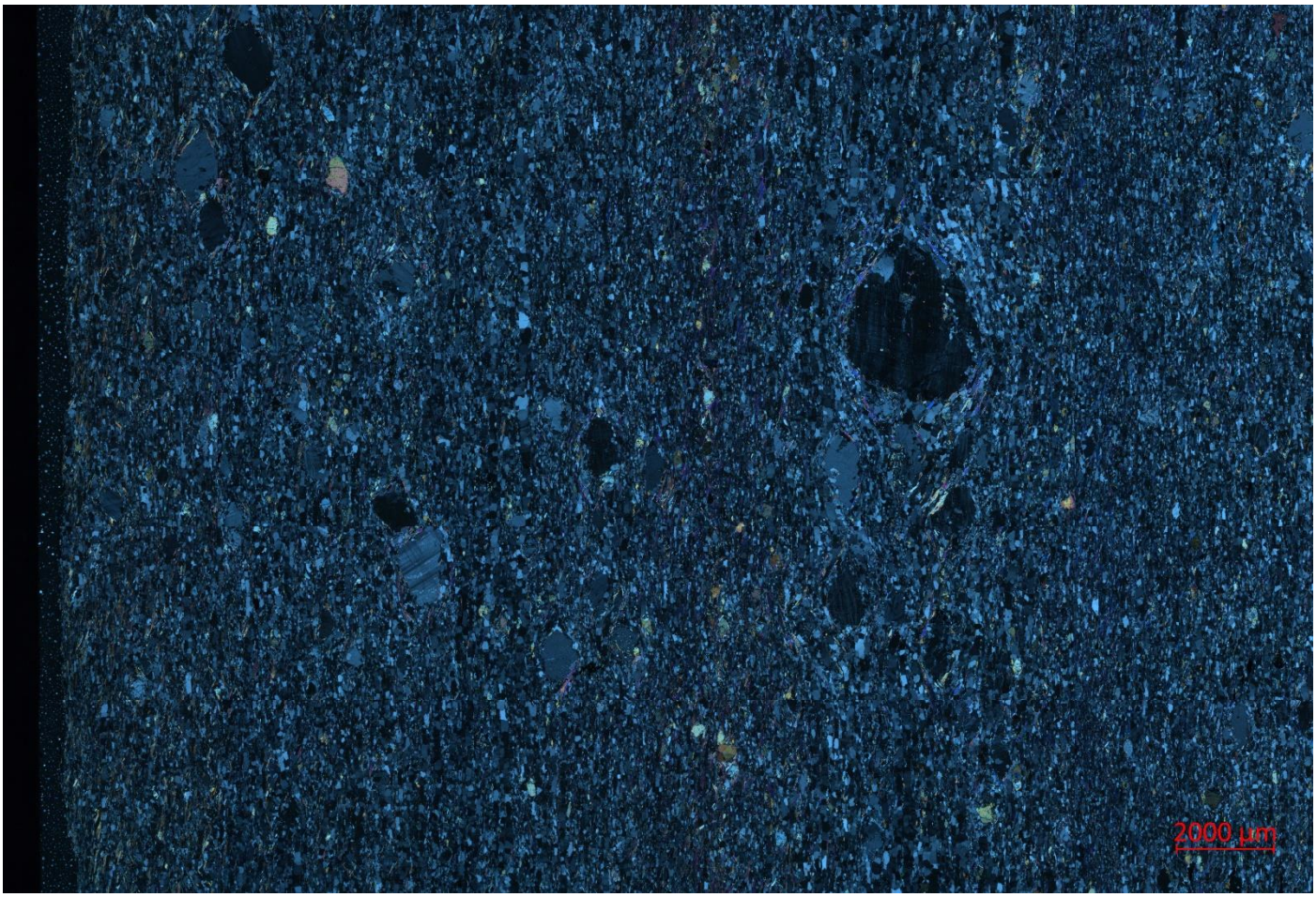
Application, use and heritage

Description: Roofing slate was an important product in the beginning, but today paving slabs and drywall-stone are more important.



The Dovre schist, natural split surface (grey colour), Geological Survey of Norway, Trondheim.

Petrography



Description: Photomicrograph of thin section (mosaic), crossed polarized light showing porphyroclasts of feldspar in a groundmass of granoblastic-elongate quarts and lepidoblastic to nematoblastic muscovite. The natural cleavage, along which the stone can be split, is defined by laminae of muscovite (N-S in the image).

Source of information: Geological Survey of Norway

Mineral composition

If no accurate number, use MM=main minerals, SM = Subordinate minerals, AM=accessory minerals

Quartz	Feldspar	Muscovite	Epidote	Opaques		
MM	**SM**	**MM**	**AM**	**AM**		

Source of information: NGU, estimates

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Physical properties

Apparent density (EN 1936), kg/m3	Open porosity (EN 1936), % vol	Water absorption at atmospheric pressure (EN 13755), % wt	Uniaxial Compressive strength (EN 1926), MPa	Flexural strength under concentrated load (EN 12372), MPa

Real density (EN 1936), kg/m3	Total porosity (EN 1936), % vol	Water absorption coefficient by capillary (EN 1925) (g/m2 x s0,5)	Flexural strength under constant moment (EN 13161), MPa

Frost resistance (EN 12371)				
Technological Test (Test A)				Identification Test (Test B): Number of cycles completed prior to stone failure
Flexural strength (EN 12372) after freeze-thaw cycling, MPa	Number of cycles	Uniaxial compressive strength (EN 1926) after freeze-thaw cycling, MPa	Number of cycles	

Resistance to ageing by thermal shock (EN 14066)			
Change in dynamic modulus of elasticity (increase: +; decrease: -), %	Change in open porosity (increase: +; decrease: -), %	Change in ultrasound pulse velocity (increase: +; decrease: -), %	Change in flexural strength under conc. load (increase: +; decrease: -) %

Abrasion resistance (EN 14157)			**Resistance to salt crystallisation (EN 12370)**	**Breaking load at dowel hole (EN 13364)**	
Method A - Wide Wheel Abrasion Test, mm	Method B - Böhme Abrasion Test, cm^3 / $50cm^2$	Method C - Amsler Abrasion Test, mm	Change in mass (increase: +; decrease: -), %	Breaking load, N	Thickness of the test specimens, mm

Slip resistance by means of the pendulum tester (EN 14231 / CEN/TS 16165)			**Rupture energy (EN 14158), Joule**	**Thermal Conductivity (EN 1745), W/m·K**
Tested surface finish	Slip Resistance Value — SRV			
	Dry test condition	Wet test condition		
Polished				

Source of information:

CC BY

Chemical properties

Main elements

SiO_2 (%)	Al_2O_3 (%)	Fe_2O_3 (%)	TiO_2 (%)	MgO (%)	CaO (%)	Na_2O (%)	K_2O (%)	MnO (%)	P_2O_5 (%)	SO_3 (%)	LOI (%)

Trace elements

V (ppm)	Cr (ppm)	Mn (ppm)	Co (ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	As (ppm)
Sr (ppm)	Cd (ppm)	Ba (ppm)	Pb (ppm)	Be (ppm)	Rb (ppm)	Bi (ppm)	U (ppm)
Sc (ppm)	Y (ppm)	Th (ppm)	Sb (ppm)	Ta (ppm)	Nb (ppm)	Zr (ppm)	Sn (ppm)
Ag (ppm)	B (ppm)	Mo (ppm)	W (ppm)	Ga (ppm)	Ge (ppm)	Se (ppm)	Cs (ppm)
Tl (ppm)							

REE

La (ppm)	Ce (ppm)	Pr (ppm)	Nd (ppm)	Sm (ppm)	Eu (ppm)	Gd (ppm)	Tb (ppm)
Dy (ppm)	Ho (ppm)	Er (ppm)	Tm (ppm)	Yb (ppm)	Lu (ppm)		

Methods applied and source of information:

Sources of more information

Type of information	Name of provider	URL
Data sheet	Geological Survey of Norway	https://geo.ngu.no/api/faktaark/mineralressurser/visNaturstein.php?objid=9734&lang=eng
Maplink	Geological Survey of Norway	https://geo.ngu.no/kart/common_mobil/?_/kart/mineralressurser_mobil/__lang=eng::extent=214619.03051478157,6886945.793822741,218681.03051478157,6888722.918822741::map=9
Non-commercial directory	Natural stone online	
Commercial directory		
Scientific publication		https://www.ngu.no/upload/Publikasjoner/Bulletin/Bulletin436_137-146.pdf
Other publication		

Compiled by:	Geological Survey of Norway (NGU) https://www.ngu.no/	

Liskifer (Li Schist)

Dalbekkenskifer

Aurora

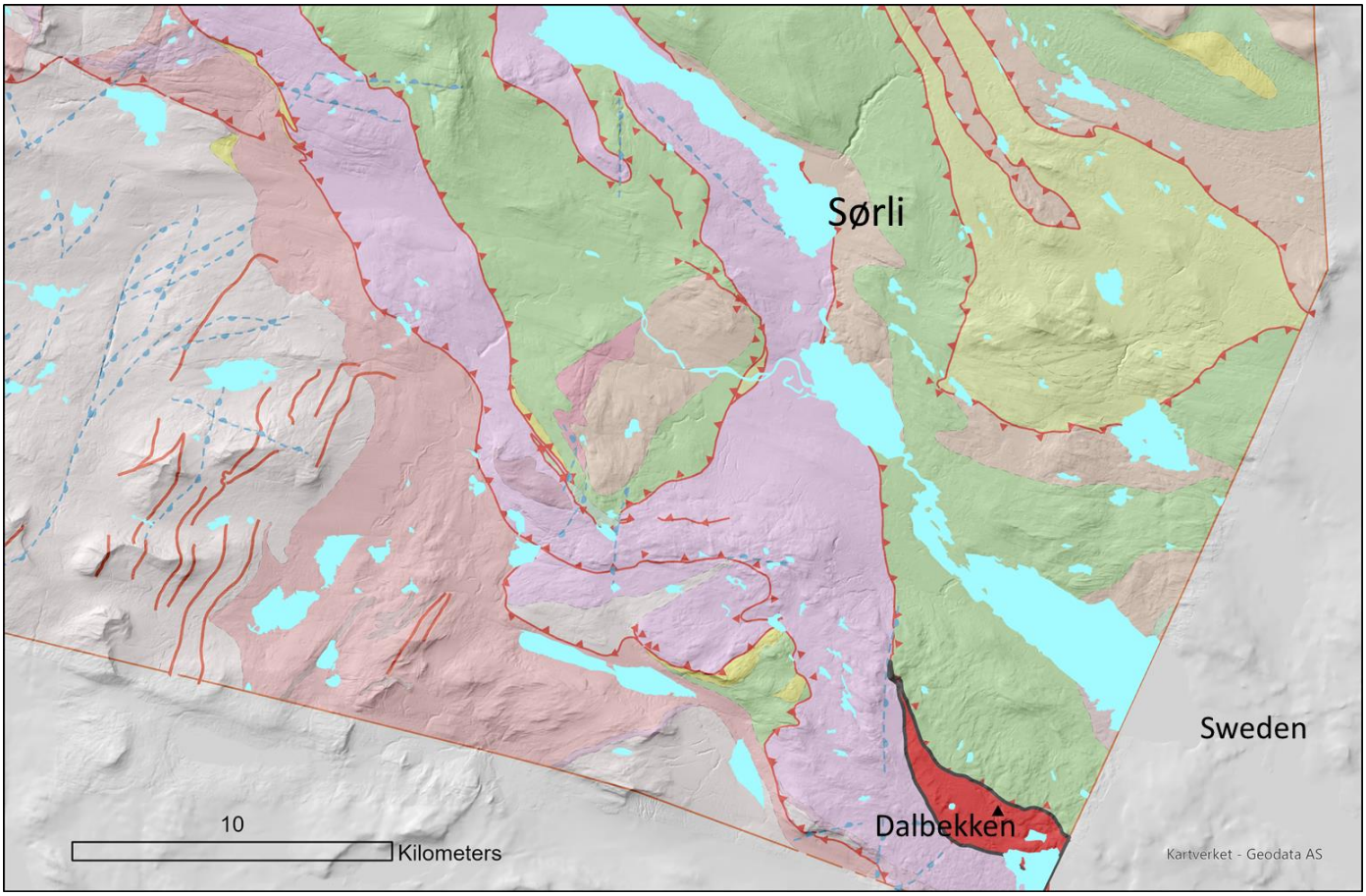


5 centimeters

Short description: The Li schist varies from greenish grey to almost black, with a slightly undulating split surface. If sawn or honed, the stone displays a marble-like pattern in shades from light grey to black. The photo shows natural surface, split along mica laminae.

Commodity (vocabulary)	Lithology (vocabulary)	Typical colour (code list)	Place of origin			
			Country	County / District / Province	Municipality / Community	Place/town / Village
Commercial slate	Schist	Grey	Norway	Trøndelag	Lierne	Dalbekken

Geological setting



Geology: The Li Schist occurs within metasandstone units in Caledonian thrust nappes, where flattening deformation during greenschist facies metamorphism has transformed the sandstones to quartz schist, which can be cleaved along mica laminae to slabs of various thicknesses.

Production: Regular production started in 1972. The main products are slabs with natural split or honed surface and drywall-stone.

Geological age: Neoproterozoicum 1000 – 542 Ma
Geological unit: Offerdal Nappe

Application, use and heritage

Description: The Li Schist is used predominantly for outdoor constructions, such as squares and streets, pavements, roofing, façades and drywall stones.



Li Schist with natural split surface, Norway.



Li Schist with sawn surface (Aurora Natur variety), Norway.



Li Schist drywall-stone, Trondheim, Norway.



Li Schist display of honed slabs (Dark Aurora variety), Norway.

Petrography

Description: The Li Schist is composed of layers of essentially quartz and feldspar displaying a polygonal-elongate texture, separated by thin laminae of mica, defining a week schistosity along which slabs can be split.
The schist may alternate between light varieties and darker, depending on the biotite share of the mica content.

Source of information: Geological Survey of Norway

Mineral composition

If no accurate number, use MM=main minerals, SM = Subordinate minerals, AM=accessory minerals

Quartz (%)	Potassium feldspar (%)	Plagioclase (%)	Muscovite (%)	Biotite (%)	Epidote (%)	Titanite (%)
65	**12,5**	**2**	**15**	**3**	**1,5**	**1**
Carbonate (%)	Pyrite (%)					
0,05	**0,05**					

Source of information: Information from Liskifer

Physical properties

Apparent density (EN 1936), kg/m3	Open porosity (EN 1936), % vol	Water absorption at atmospheric pressure (EN 13755), % wt	Uniaxial Compressive strength (EN 1926), MPa	Flexural strength under concentrated load (EN 12372), MPa
2673	**0,5**	**0,43**		**27,2**

Real density (EN 1936), kg/m3	Total porosity (EN 1936), % vol	Water absorption coefficient by capillary (EN 1925) (g/m2 x s0,5)	Flexural strength under constant moment (EN 13161), MPa

Frost resistance (EN 12371)				
Technological Test (Test A)				Identification Test (Test B): Number of cycles completed prior to stone failure
Flexural strength (EN 12372) after freeze-thaw cycling, MPa	Number of cycles	Uniaxial compressive strength (EN 1926) after freeze-thaw cycling, MPa	Number of cycles	

Resistance to ageing by thermal shock (EN 14066)			
Change in dynamic modulus of elasticity (increase: +; decrease: -), %	Change in open porosity (increase: +; decrease: -), %	Change in ultrasound pulse velocity (increase: +; decrease: -), %	Change in flexural strength under conc. load (increase: +; decrease: -) %

Abrasion resistance (EN 14157)			**Resistance to salt crystallisation (EN 12370)**	**Breaking load at dowel hole (EN 13364)**	
Method A - Wide Wheel Abrasion Test, mm	Method B - Böhme Abrasion Test, cm^3 / $50cm^2$	Method C - Amsler Abrasion Test, mm	Change in mass (increase: +; decrease: -), %	Breaking load, N	Thickness of the test specimens, mm
22,2				**2800**	**37-40**

Slip resistance by means of the pendulum tester (EN 14231 / CEN/TS 16165)			**Rupture energy (EN 14158), Joule**	**Thermal Conductivity (EN 1745), W/m·K**
Tested surface finish	Slip Resistance Value — SRV			
	Dry test condition	Wet test condition		
Split-face	**76**	**54**		

Source of information: Information from Liskifer

Chemical properties

Main elements

SiO_2 (%)	Al_2O_3 (%)	Fe_2O_3 (%)	TiO_2 (%)	MgO (%)	CaO (%)	Na_2O (%)	K_2O (%)	MnO (%)	P_2O_5 (%)	SO_3 (%)	LOI (%)

Trace elements

V (ppm)	Cr (ppm)	Mn (ppm)	Co (ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	As (ppm)
Sr (ppm)	Cd (ppm)	Ba (ppm)	Pb (ppm)	Be (ppm)	Rb (ppm)	Bi (ppm)	U (ppm)
Sc (ppm)	Y (ppm)	Th (ppm)	Sb (ppm)	Ta (ppm)	Nb (ppm)	Zr (ppm)	Sn (ppm)
Ag (ppm)	B (ppm)	Mo (ppm)	W (ppm)	Ga (ppm)	Ge (ppm)	Se (ppm)	Cs (ppm)
Tl (ppm)							

REE

La (ppm)	Ce (ppm)	Pr (ppm)	Nd (ppm)	Sm (ppm)	Eu (ppm)	Gd (ppm)	Tb (ppm)
Dy (ppm)	Ho (ppm)	Er (ppm)	Tm (ppm)	Yb (ppm)	Lu (ppm)		

Methods applied and source of information:

Sources of more information

Type of information	Name of provider	URL
Data sheet	Geological Survey of Norway	https://geo.ngu.no/api/faktaark/mineralressurser/visNaturstein.php?objid=9307&lang=eng
Maplink	Geological Survey of Norway	https://geo.ngu.no/kart/common_mobil/?_/kart/mineralressurser_mobil/__lang=eng::extent=433820.6921417403,7097615.471411416,466316.6921417403,7111832.471411416::map=9
Non-commercial directory	Natural stone online	
Commercial directory		
Scientific publication		
Other publication		

Compiled by:	Geological Survey of Norway (NGU) https://www.ngu.no/	

Oppdalskifer (Oppdal schist)

Lys Oppdal (Light Oppdal)

Mørk Oppdal (Dark Oppdal)

Oppdal Golan

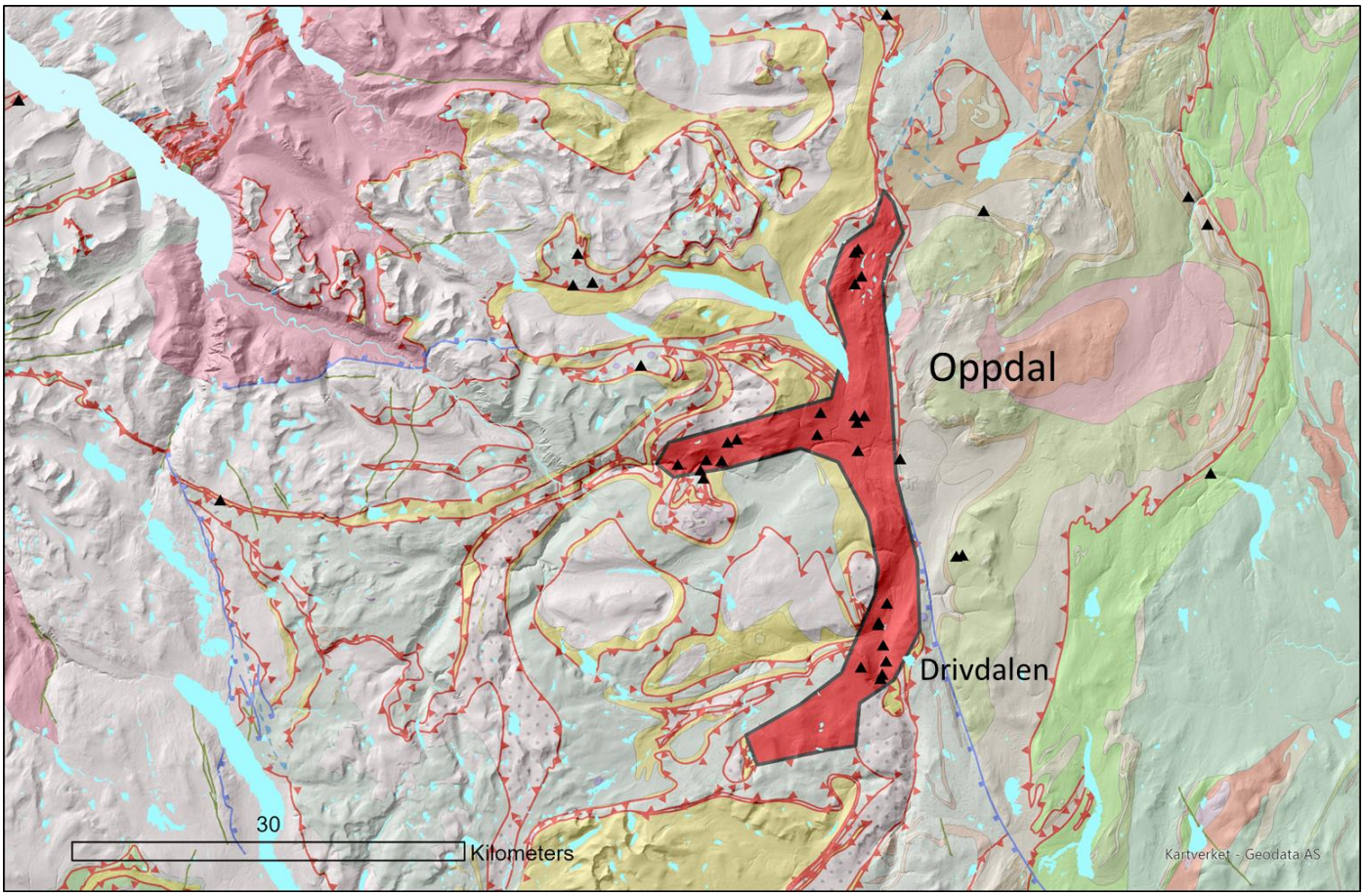


5 centimeters

Short description: Quartz schist that can be split along natural mica-rich laminae. The photo shows natural split surface.

Commodity (vocabulary)	Lithology (vocabulary)	Typical colour (code list)	Place of origin			
			Country	County / District / Province	Municipality / Community	Place/town / Village
Commercial slate	Schist	Grey	Norway	Trøndelag	Oppdal	Drivdalen

Geological setting



Geology: The Oppdal schist represents arkosic sandstones once deposited on a continental margin. Deformation and metamorphism transformed them to quartz schist during the thrusting and folding that occurred in the Caledonian orogeny between 440 and 400 Ma. The Oppdal schist is a large resource, but most of the best qualities and quarries are found in Drivdalen.

Production: Production is known from 1883, but the big opportunities for markets arrived in 1921 when the railway between Oslo and Trondheim opened, passing the Oppdal village. At present time there are four companies producing and processing schist.

Geological age: Neoproterozoicum 1000-541 Ma
Geological unit: Remslikleppen nappe

Application, use and heritage

Description: The Oppdal schist has a rare property not shared with many similar rocks – slabs can easily be broken with straight edges, or curved forms, by carving a line with a pointed tool and then adding force along the line. This workability made a particular niche for the Oppdal schist – broken edge tiles or thicker bricks. Traditionally, only natural split surfaces were produced. But in later years, also sawn, honed and brushing techniques have been applied for creating a variety of surfaces. The most usual type of Oppdal schist is the light one (front picture), but there are also darker and more spotted varieties.



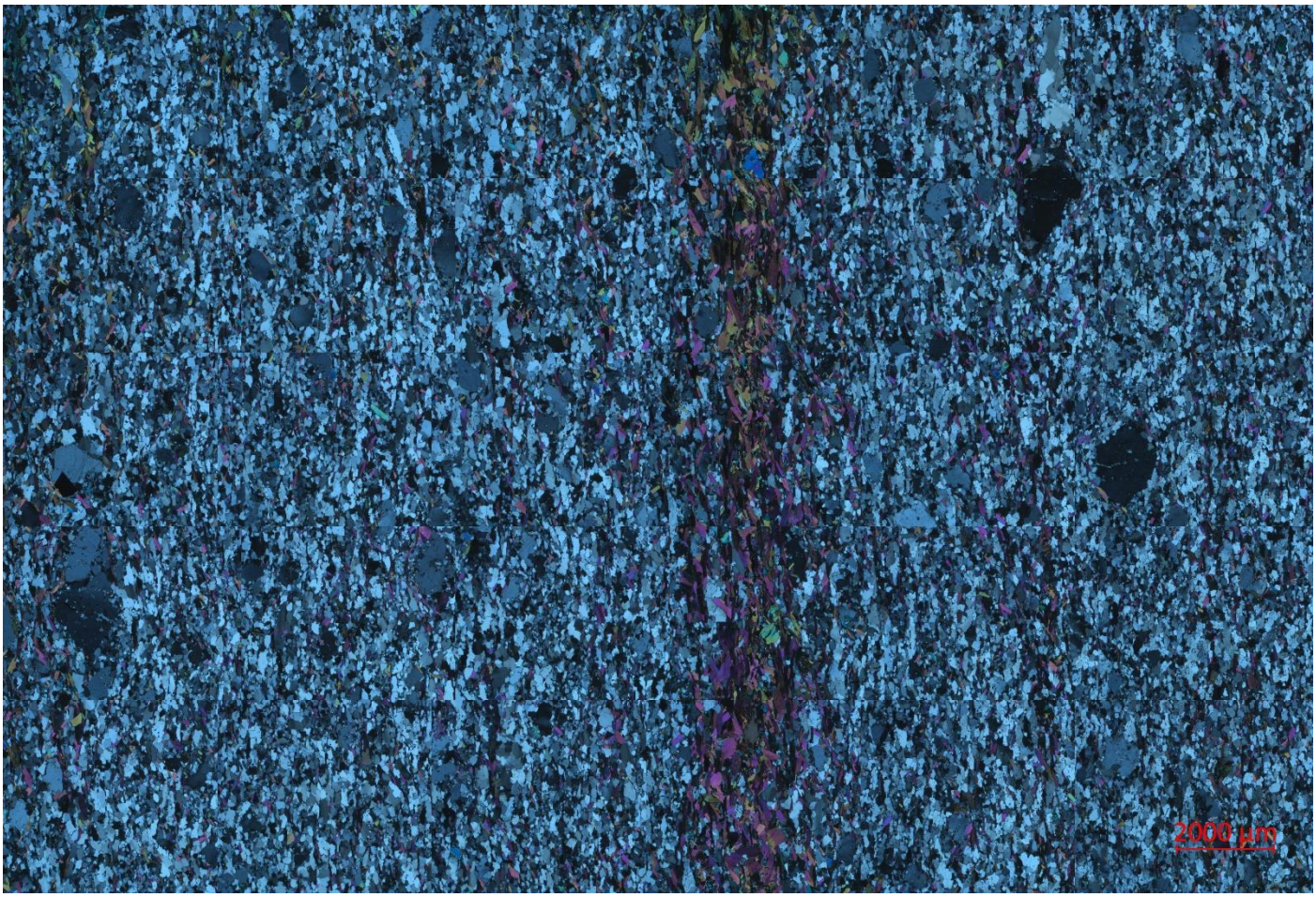
A variety of surface treatments in the Oppdal schist.



Oppdal schist façade (new National Museum in Oslo): sawn and sandblasted, large “bricks”.

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Petrography



Description: Photomicrograph (mosaic) of thin section, crossed Nichols. Vertical field with concentration of mica displays a section through the plane along which the schist can be split. Large grains are feldspar porphyroclasts, remains of sand grains, whilst the groundmass consist of granoblastic-elongate quartz, some felsdspar and lepidoblastic mica.

Source of information: Geological Survey of Norway

Mineral composition

If no accurate number, use MM=main minerals, SM = Subordinate minerals, AM=accessory minerals

Quartz (%)	Feldspar (%)	Mica (%)	Epidote (%)	Titanite (%)		
46	**12**	**34**	**6**	**2**		

Source of information: Minera Skifer

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Physical properties

Apparent density (EN 1936), kg/m3	Open porosity (EN 1936), % vol	Water absorption at atmospheric pressure (EN 13755), % wt	Uniaxial Compressive strength (EN 1926), MPa	Flexural strength under concentrated load (EN 12372), MPa
2700		**0,2**		**35,8**

Real density (EN 1936), kg/m3	Total porosity (EN 1936), % vol	Water absorption coefficient by capillary (EN 1925) (g/m2 x s0,5)	Flexural strength under constant moment (EN 13161), MPa

Frost resistance (EN 12371)				
Technological Test (Test A)				Identification Test (Test B): Number of cycles completed prior to stone failure
Flexural strength (EN 12372) after freeze-thaw cycling, MPa	Number of cycles	Uniaxial compressive strength (EN 1926) after freeze-thaw cycling, MPa	Number of cycles	

Resistance to ageing by thermal shock (EN 14066)			
Change in dynamic modulus of elasticity (increase: +; decrease: -), %	Change in open porosity (increase: +; decrease: -), %	Change in ultrasound pulse velocity (increase: +; decrease: -), %	Change in flexural strength under conc. load (increase: +; decrease: -) %

Abrasion resistance (EN 14157)			**Resistance to salt crystallisation (EN 12370)**	**Breaking load at dowel hole (EN 13364)**	
Method A - Wide Wheel Abrasion Test, mm	Method B - Böhme Abrasion Test, cm^3 / $50cm^2$	Method C - Amsler Abrasion Test, mm	Change in mass (increase: +; decrease: -), %	Breaking load, N	Thickness of the test specimens, mm
20					

Slip resistance by means of the pendulum tester (EN 14231 / CEN/TS 16165)			**Rupture energy (EN 14158), Joule**	**Thermal Conductivity (EN 1745), W/m·K**
Tested surface finish	Slip Resistance Value — SRV			
	Dry test condition	Wet test condition		
Honed **S. brushed**	**81** **71**	**31** **49**		

Source of information: Minera Skifer

Chemical properties

Main elements

SiO_2 (%)	Al_2O_3 (%)	Fe_2O_3 (%)	TiO_2 (%)	MgO (%)	CaO (%)	Na_2O (%)	K_2O (%)	MnO (%)	P_2O_5 (%)	SO_3 (%)	LOI (%)

Trace elements

V (ppm)	Cr (ppm)	Mn (ppm)	Co (ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	As (ppm)
Sr (ppm)	Cd (ppm)	Ba (ppm)	Pb (ppm)	Be (ppm)	Rb (ppm)	Bi (ppm)	U (ppm)
Sc (ppm)	Y (ppm)	Th (ppm)	Sb (ppm)	Ta (ppm)	Nb (ppm)	Zr (ppm)	Sn (ppm)
Ag (ppm)	B (ppm)	Mo (ppm)	W (ppm)	Ga (ppm)	Ge (ppm)	Se (ppm)	Cs (ppm)
Tl (ppm)							

REE

La (ppm)	Ce (ppm)	Pr (ppm)	Nd (ppm)	Sm (ppm)	Eu (ppm)	Gd (ppm)	Tb (ppm)
Dy (ppm)	Ho (ppm)	Er (ppm)	Tm (ppm)	Yb (ppm)	Lu (ppm)		

Methods applied and source of information:

Sources of more information

Type of information	Name of provider	URL
Data sheet	Geological Survey of Norway	
Maplink	Geological Survey of Norway	https://geo.ngu.no/kart/common_mobil/?_/kart/mineralressurser_mobil/__lang=eng::extent=204485.02684219903,6929573.832102898,236981.02684219903,6943790.832102898::map=9
Non-commercial directory	Natural stone online	Detailansicht (naturalstone-online.com)
Commercial directory		
Scientific publication		
Other publication		

Compiled by:	Geological Survey of Norway (NGU) https://www.ngu.no/	