

# ***PNASTINA-project***

*Promotion of natural stone industry in the northern areas*



This project is being part-financed by  
the European Union

European Regional Development Fund



## Report

The soapstone deposits in the Linnajavri area, Hamarøy Municipality, Nordland County – the largest deposit area in Norway – a resource of national importance.

*By:*

*Ingvar Lindahl*

*Lars Petter Nilsson*

*Leif Furuhaug*

*Release date:*

*20.3.2006*

## **Introduction and background**

The soapstone deposits in the Linnajavri area was discovered in the autumn of 2000. The initiative to carry out investigations was a joint effort by NGU (L. P. Nilsson) and Statskog (I. Lindahl), based on elderly descriptions and maps both from the Norwegian and Swedish side of the border. There is no record of previous use of the soapstone in the Linnajavri area, and during our work in the area no signs of previous use has been recognized. The reason is supposed to be the localization of the deposit area, an area that was first logistically opened during the 1980ies when building the water magazines for the hydroelectric power station at Kobbelv (Fig.1).

At Elvkroken on the shore of Leirfjorden there was established an industrial area during the build up of the hydroelectric power plant and a deep-water harbor was built. In the process a road was constructed through Gjerdalen to the lake Reinoksvatnet. The total distance from the deep-water harbor up Gjerdalen to the central part of the Linnajavri deposit area is 35 km, where no road exist for 9 km from Reinoksvatnet to the deposit area (Fig. 1).

The investigations have been a cooperation project between NGU (more than 50% of the cost), in part from the PNASTINA project in 2004 and 2005. Other participants have been Statskog SF as landowner, Nordland County Council, Salten Regionråd, Indre Salten Vekst and Hamarøy Municipality. Statskog SF has partly financed their contribution to the project through agreements with Hustad Marmor AS and Norwegian Talc AS.

The Linnajavri area was situated inside the working borders of a planned new national park in the region. In the autumn of 2005, however, it was decided to abandon the national park plans, but the actual area, or parts of it, will still be subjected to special environmental regulations. Future use of the area is going to be decided after mapping of all previous use. This work has been started and will be continued in 2006.

## **Purpose of investigation and methodology**

The purpose for investigation of the area was to localize deposits of soapstone that can be exploited, either as soapstone for dimension stone, or soapstone for talc flotation. The contribution from PNASTINA was especially focused on the dimension stone part of the project.

In the first phase of the overall project the ultramafic rocks in the area and their alteration to serpentinite and soapstone was mapped out emphasizing a detailed mapping of key areas for interpreting the geological environment. The ultramafics are regarded as ophiolite fragments, with serpentinite and soapstone alteration



Fig. 1: Location map of the Linnajavri area.

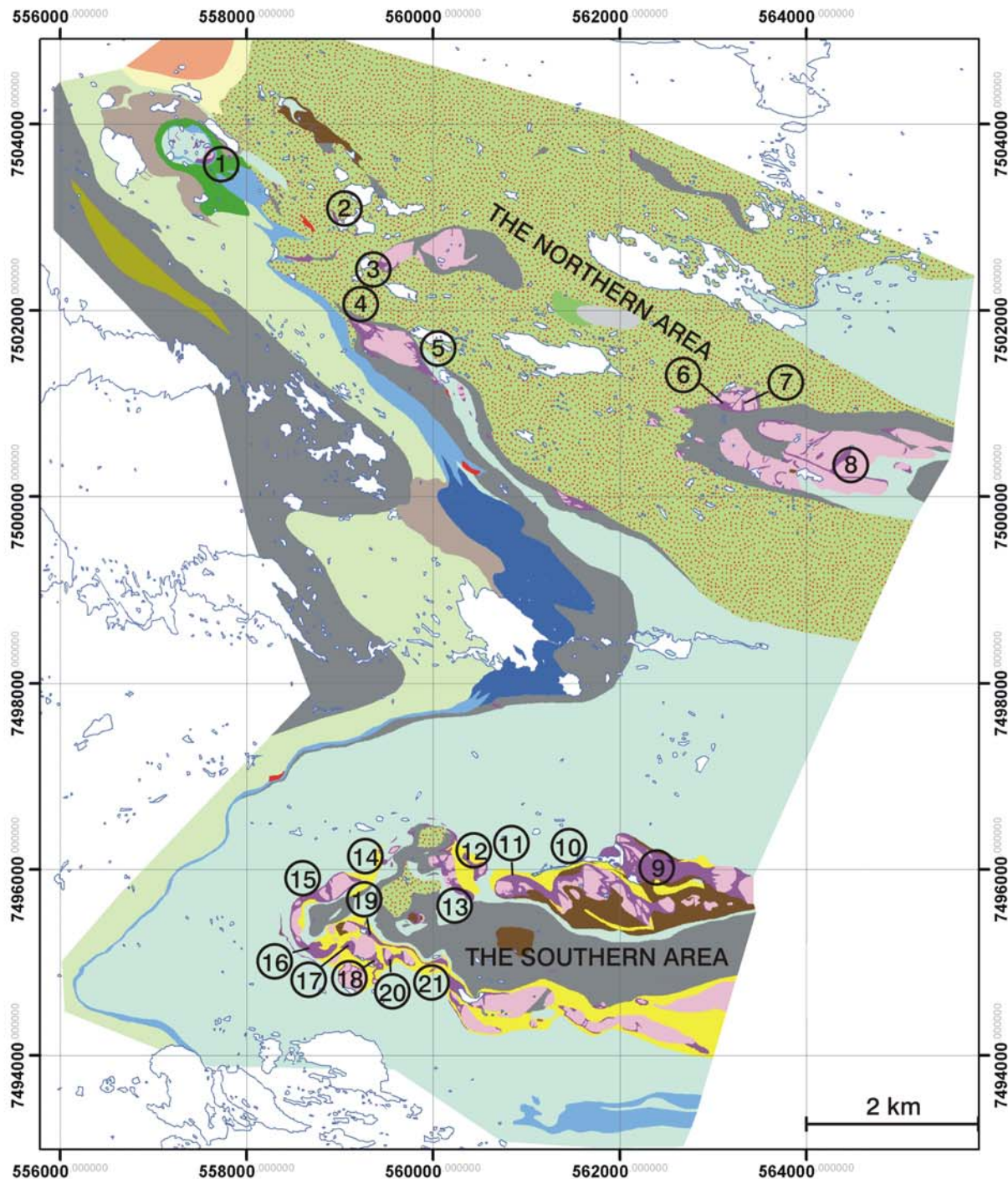


Fig. 2: Geological map of the Linnajavri area with major soapstone deposit numbered.

### Legend

-  Amphibolite
-  Amphibolite, hornblendite and greenstone
-  Arkosic sandstone
-  Dolomite- and calcite marble
-  Gabbro
-  Mica schist and mica gneiss
-  Mica schist, in part carbonate bearing
-  Graphite bearing mica schist
-  Garnet mica schist
-  Granitic gneiss and granite
-  Carbonate mica schist with quartzitic layers
-  Soapstone
-  Conglomerate
-  Leucogabbro
-  Listvenite
-  Marble with trondhjemite lenses
-  Massive mica schist
-  Metaarkose, rusty
-  Serpentinite, dunite, peridotite
-  Trondhjemite
-  Deposit number (see text)

that has taken place at an early oceanic stage. Later the ophiolite, or more precisely its oceanic crust + mantle precursor, was obducted, exposed for weathering, then strongly eroded and dismembered. Finally the fragmented remains of the ophiolite were incorporated into Caledonian nappes being thrust onto the Precambrian granitic basement of continent Baltica. The geology of the area is dominated by tectonic nappes and flakes of rocks separated by a net of tectonic mélangé zones.

The area has a high percentage of outcrops, and the mapping of the ultramafics and their soapstone alteration has thereby been substantially facilitated. That also applies to the estimation of the reserves of the area where the ultramafics are occurring in two different open synclines with axes dipping at a low angle towards the east. The reserves are calculated as reserves being possible to mine in open pits with minor amounts of wall rocks involved in the quarrying operation.

The soapstone has been sampled by collecting representative geological chip samples and by chain saw. Bigger samples cut by chain saw have been taken for flotation tests and/or for slabs suitable for evaluating the quality as dimension stone. The size of the flotation samples is 40-100 kilos taken of unoxidized material, i.e. 0.2-1 m under the outcropping surface, which often show ice striation. The number of blocks extracted from the area has passed 100. Sampling has been done to evaluate the soapstone types concerning color and structure. Photos and scans of the soapstone with a variation in structure and grain size are shown in Figs. 3-8.

The different deposits of the Linnajavri area (21), with a significant reserve for soapstone as dimension stone (marked with number at Fig.2), are:

**The Northern area (8):**

1. Boarta, lens 2
2. Klebervann
3. Njaskavarri 985
4. Kvitfjell NV
5. Kvitfjell SØ
6. Kleberlia - *Njaskasvarri 833*
7. Helikoptergangen - *Njaskasvarri 833*
8. Grensegangen – *Gaskavarri*

**The Southern area (13):**

9. Kleberflåget
10. Vakkerdalen
11. Hatten
12. Klebergryta lower
13. Klebergryta upper
14. Kleberbotn
15. Kleberbreen
16. 1248 – Raskleberen
17. 1192 V
18. 1192 Ø
19. Langkleberen
20. Langkleberdalen deposit
21. Bananvann S

Two deposits with large reserves are excluded as soapstone for dimension stone; the Cohkul deposit which has to be exploited by underground mining, and the Nåva deposit because of the steep terrain.

## Results

The work in the Linnjavri area has revealed that the area has, by far, the greatest reserves of soapstone so far known in Norway. During the exploration close to twenty separate soapstone bodies each with more than one million tons of reserves have been mapped and documented otherwise. The geological potential for additional reserves is good. The work that PNASTINA has contributed to is characterizing the soapstone quality in each of the soapstone bodies for use as dimension stone. Some of the soapstone types are coarse-grained and in other deposits fine-grained and the different bodies of soapstone have a certain variation in color and structure (Fig. 8). In general the soapstone is massive to weakly foliated with low density of jointing, which will make it possible to produce large blocks from most of the deposits. In total close to a hundred slabs are collected documenting the soapstone types which can be studied in our sample collection. Scans or photos of the slabs of selected types are presented in the PNASTINA database and a smaller selection is shown in Fig. 8.

## Marketing of deposit information

The results from the investigation have been marketed as soon as the information no longer was confidential. The information has been prepared for the dimension stone and industrial mineral industry and for the local authorities and decision makers for the land use of the area.

A listing of the most important information is given below:

- Presentation for the administration board of Nordland County Council, the first time 30.11.2004, and the second time 10.5.2005.
- Presentation for the three most involved municipalities, Tysfjord, Hamarøy and Sørfold, local industry and local politicians arranged by Kommunemineral AS 01.12.04.
- Presentation of the project and its results on the homepage of Nordland County Council, leading to articles in 35 of the main newspapers in Norway during September 2004.
- Presentation of the project and results on the homepage of NGU, September 2004.
- Presentation of the geology of the Linnjavri area at the winter meeting of the Geological Society of Norway at Røros, January 2005.
- More than 5 times at the NRK radio news for Northern Norway.
- On the NRK TV news for Northern Norway with pictures and interviews, 10.9.2005.

- Presentation of the project and the results at the annual meeting for exploration and mining engineers in Trondheim the 29.10.2005 (100 participants from Norwegian mining industry).
- Through open reports made for the mineral industry and a special status report of April 2005 aimed at decision makers.

NGU/PNASTINA has strongly contributed to provide the present deposit information and data which has been an important goal for the PNASTINA project.

## **Conclusions**

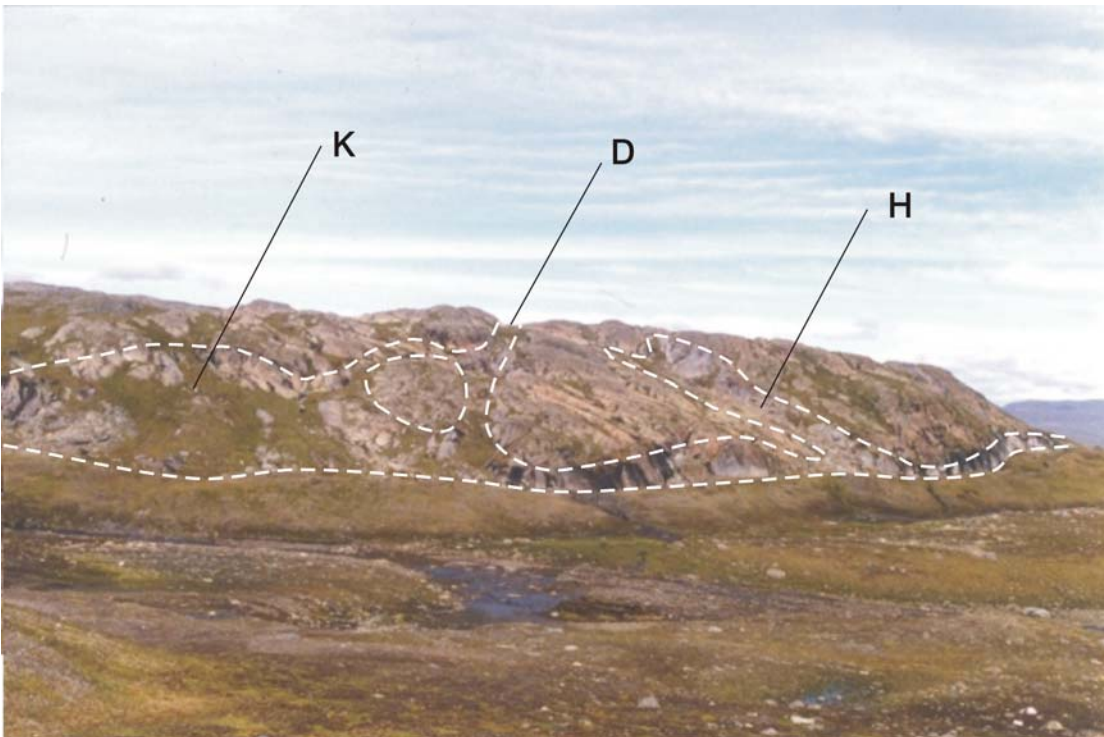
The soapstone deposits in the Linnajavri area represents the largest reserves and potential resources in Norway, in total more than 100 mill. tons of estimated reserves, with a good geological potential for additional resources. The soapstone contains approximately 50 % talc, and can be exploited as dimension stone and possibly also as source for talc flotation. Additional mineralogic characterization of the soapstone and flotation tests is necessary to test the material for flotation.

The work done with contribution from PNASTINA has led to a better confirmation of this statement concerning dimension stone. Further the PNASTINA project has contributed to marketing the results of the investigation to the society and industry on a broad scale.

The local authorities (Municipalities and Nordland County Council) are positive to exploitation of the deposits in the Linnajavri area. They want to create jobs on long-term basis, which can be foreseen because of the size of the deposits.



*Fig. 3: The Boarta lens 2 deposit, looking N. A flat-lying c. 40 m thick lens (outcrop) with a thin serpentinite lid on top (top right). Deposit no. 1 in Fig. 2.*



*Fig. 4: The Njaskavarri 833 ultramafic lens, looking NE. Deposits Kleberlia (K) and Helikoptergangen (H). Diagonalgangen (D) not included in reserve estimate. Deposit no. 6 and 7 in Fig. 2.*



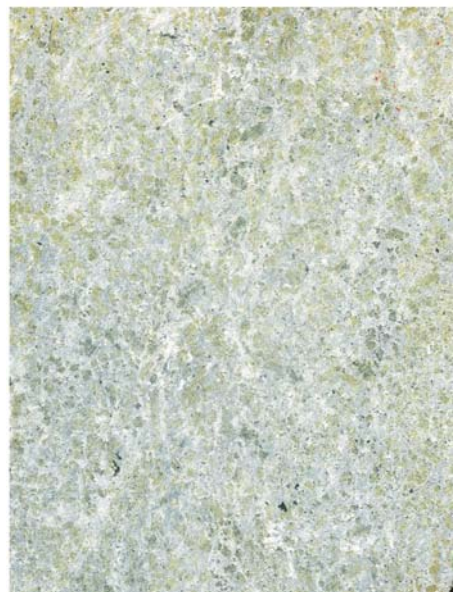
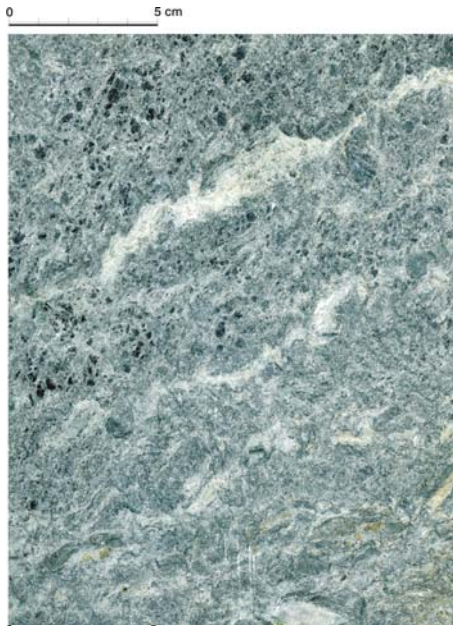
*Fig. 5: The Grensegangen deposit in the Gaskavarri ultramafic body, looking NE. Deposit no. 8 in Fig. 2.*



*Fig. 6: The 1192 Ø deposit, looking N. Deposit no. 18 in Fig. 2.*



*Fig. 7: The Kleberflåget deposit, looking due N. The serpentinite cap on the top protected the soapstone from ice denudation. The thickness of the lens exceeds 100 m, giving a reserve of more than 50 mill. tons of soapstone. Deposit no. 9 in Fig. 2.*



*Fig. 8. A selection of soapstone types from the Linnajavri area.*