Mine tailings: Environmental Problem or Geological Resource?

Allan Krill Professor og Geology
Department of Geology and Mineral Resources Engineering (IGB)
Norwegian University of Science and Technology (NTNU)
Trondheim, norway

krill@ntnu.no
(This presentation represents the views of the author, not an institution.)

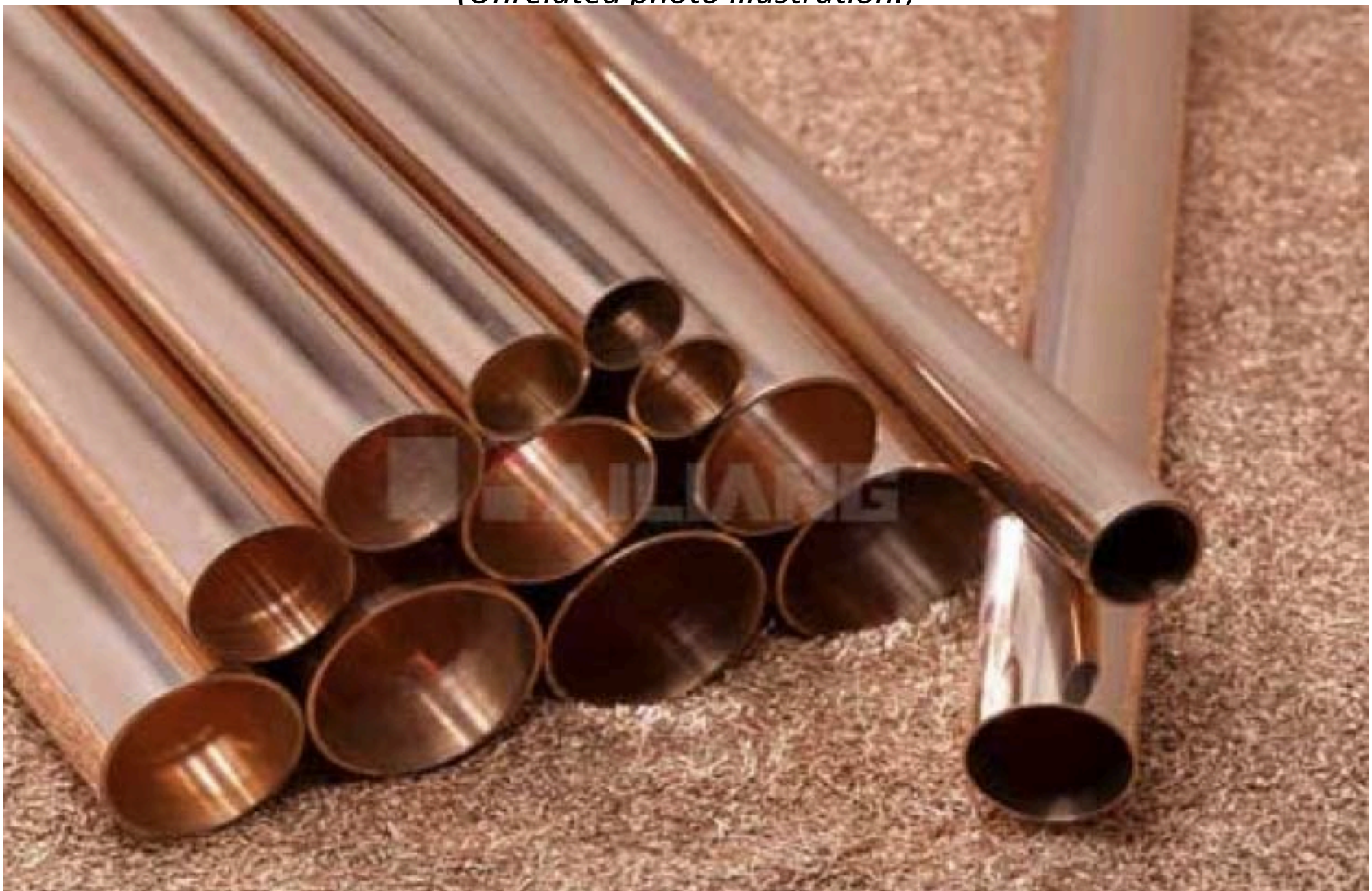
"Mineraler, milliarder, miljø, og motstand – gruvekonferanse i Guovdageaidnu"
(Minerals, billions, environment, and opposition – mining conference in Kautokeino)
01.– 03.11.2013
Naturvernforbundet i Finnmark *(Friends of the Earth, Norway)*

Norway has been waiting the past 30 years for new gold and copper mines to open.

I think we should wait longer, perhaps as much as 30 years more.

(Photo of Repparfjord copper mine, closed since 1978)

Ore and metals are “gifts” from the Earth.
They can be extracted only once.
They should be taken at the right time, in the right way.
(Unrelated photo illustration.)



Current techniques are still “old fashioned.” Valuable resources are wasted. A mine that gives 2% ore concentrate gives 98% tailings that are simply dumped in nature.

(Tailings and poisonous water polluting the reindeer herding area near the abandoned Biedjovággi mine. Photo from finn.no)

Wouldn’t if be absurd to take out the hearts reindeer and simply dump the rest?
(Unrelated photo illustration.)

Or to take the livers of fish, and leave the rest to rot?
(Unrelated photo illustration.)

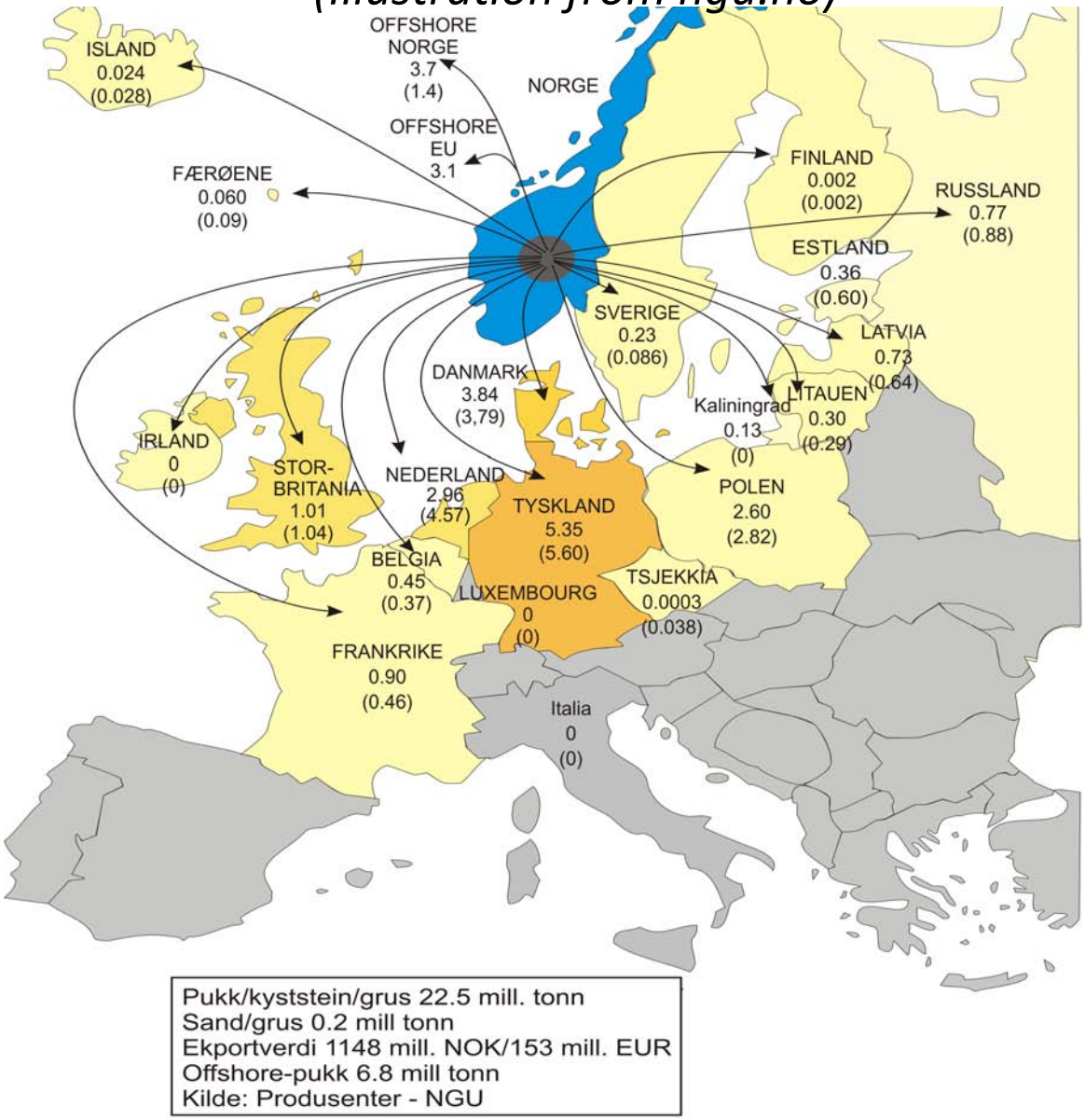
Here is where the 16km-long Langfjorden west of Kirkenes has been nearly closed off by a tailings dump.
This is not BAT (Best Available Technology.) It is CAT (Cheapest Available Technology.)
(Photo from finn.no.)

Tailings are crushed rock, and should be a resource, not an environmental problem. In the past 30 years the Norwegian export of blasted and crushed rock has increased dramatically.

(Photo from ngu.no)

Pukkproduksjon i Kristiansund. Foto: Rolv M. Dahl

The export increased from
0.5 million tons in 1982 to 22.5 million tons in 2012.
In a few years there will be a market for the export of mine tailings as well.
(Illustration from ngu.no)



Tailings that are easily shipped from fjords can be used to build and protect.
Perhaps dikes of mine tailings will protect coastal cities from rising sea levels.

Researchers are looking for ways to use finely crushed mine tailings:

Anvendelse av overskuddsmasser - Muligheter

- **Utnytte volum; byggeråstoff**
  - Veianlegg, infrastruktur
  - Nytt landareal
  - Elveforbygginger
  - Tildekking av forurensede sedimenter
  - Betongtilslag
  - Kalking og jordforbedring

- **Nye produkter; Bygg/Byggkeramer**
  - Betong-/betongprodukter (inkl, mørtel, avrettingsmasse
  - Murstein, takstein
  - Fliser, gulv, vegg, ute, inne
  - Syntetisk skifer
  - Glass, skumglass (light aggregates)
  - Isolasjonsmaterialer ("RockWool")

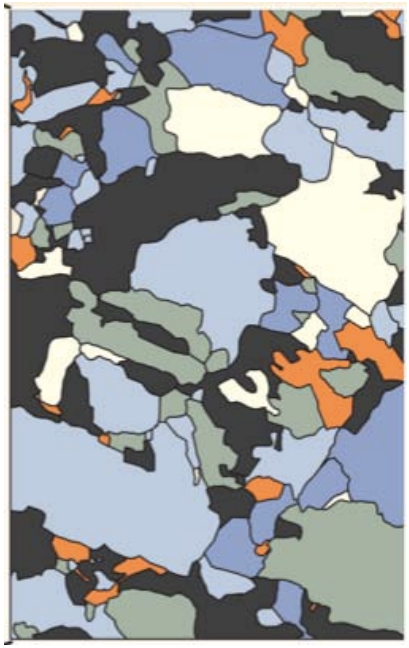
- **Spesialprodukter og -anvendelser**

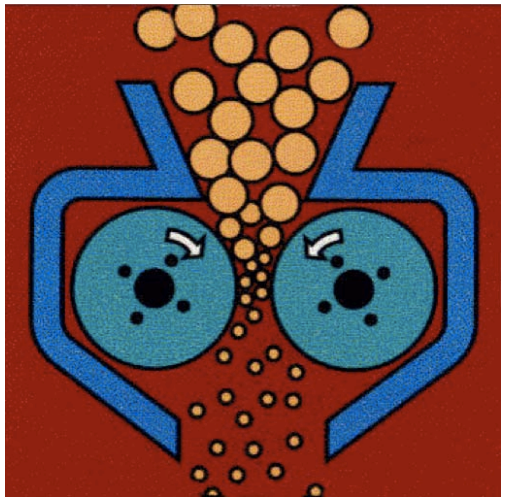
Fra presentasjon på Geonor 2013:
SINTEF Materialer og Kjemi
v/ Ove Paulsen
SINTEF Byggforsk
v/ Lisbeth Alnæs

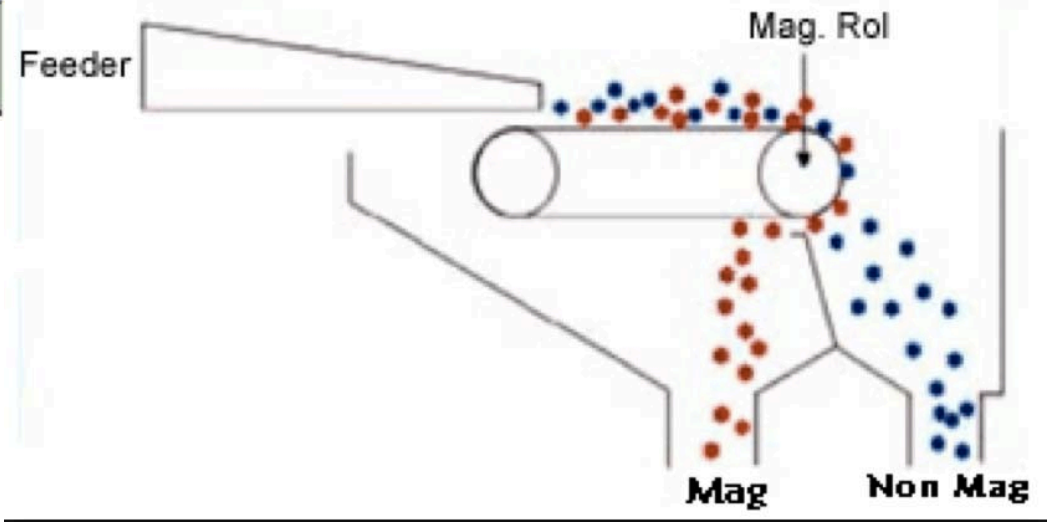
Researchers are also looking for better ways to separate the ore concentrate from the tailings. The results will be cleaner tailings, without heavy metals, sulphur, or unwanted chemicals.

(Ore-dressing laboratory at IGB, NTNU)

The separation of ore-concentrate from tailings is challenging.
The minerals are locked together in the rock and must be released.
Methods are old fashioned: The rock is crushed to a powder. The ore minerals are removed, based on their properties, such as magnetism, density, and attraction to chemicals.

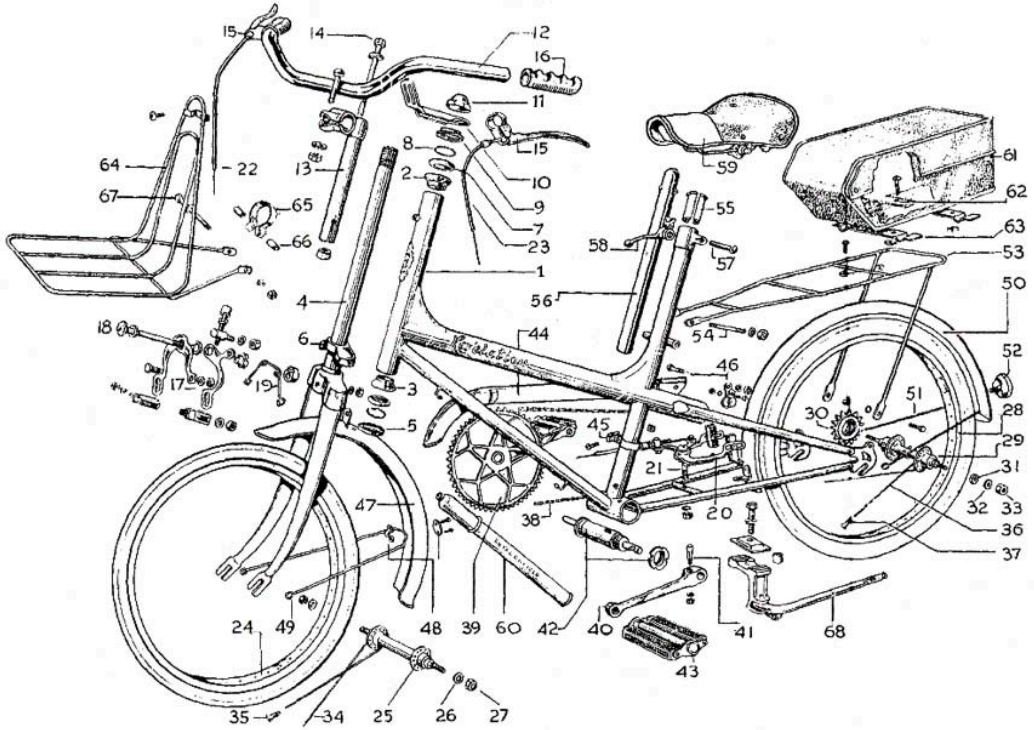




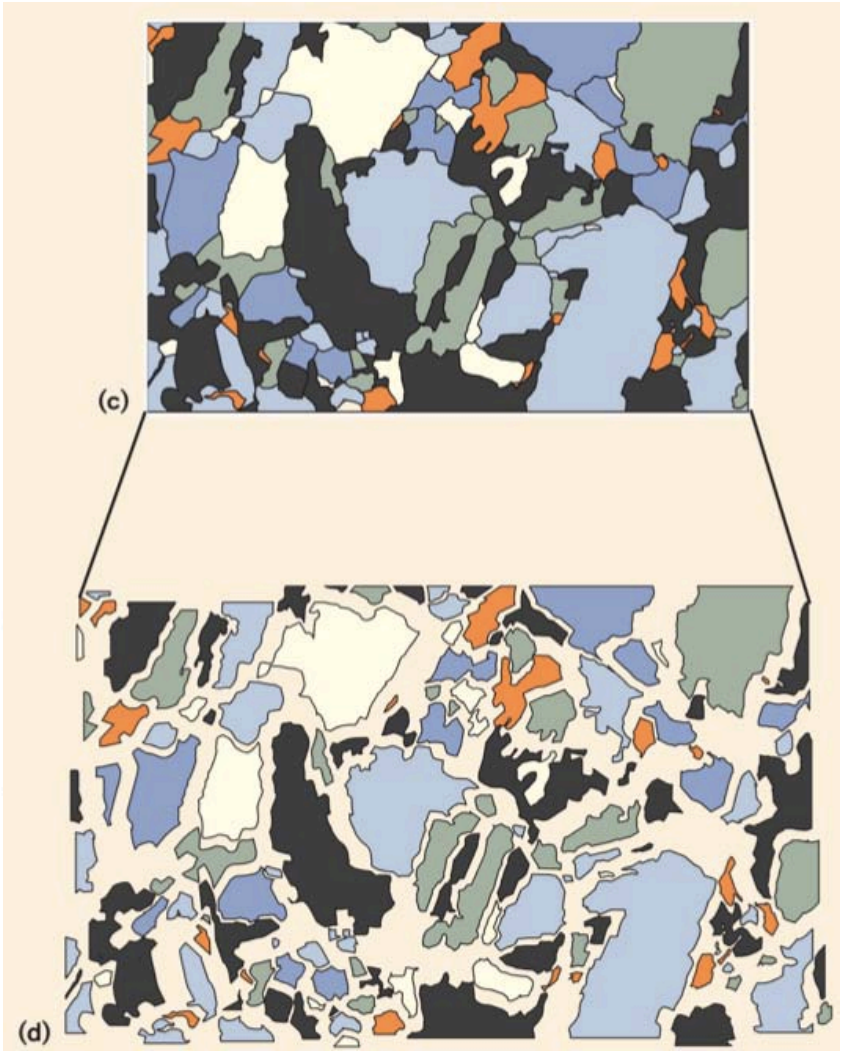


The minerals are crushed too small, and separation is difficult. In the future, it will be possible to “explode” crushed rocks. The minerals will be less damaged, and will be separated more cleanly.

“Exploded” bicycle.

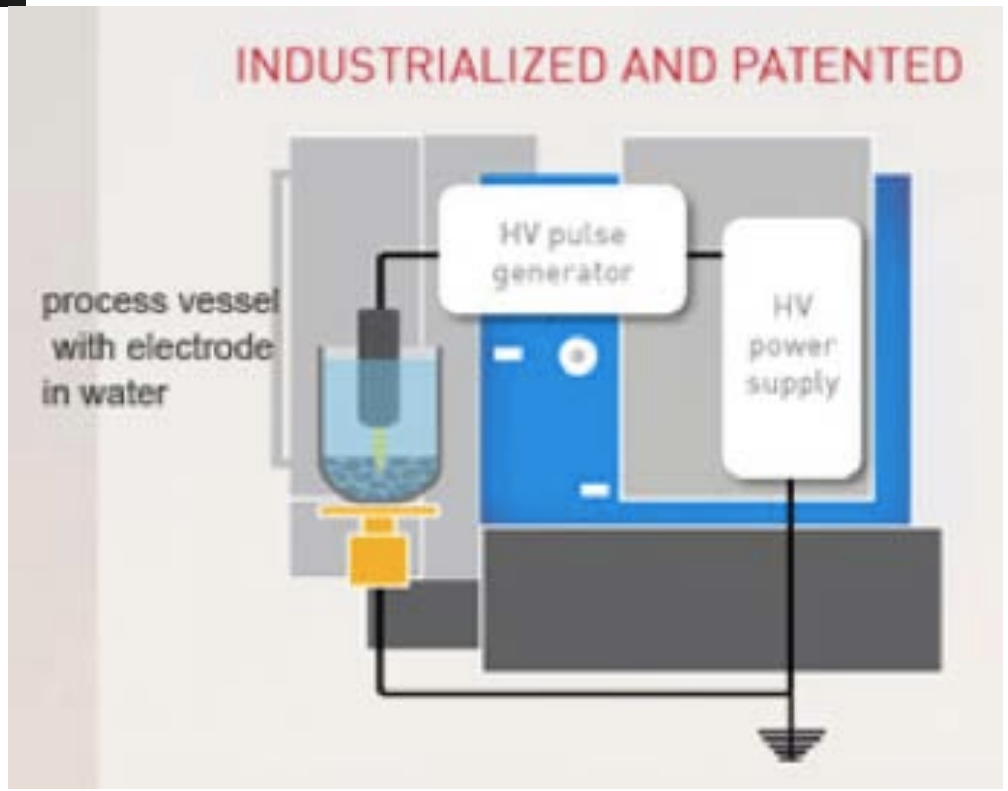


“Exploded” rock.

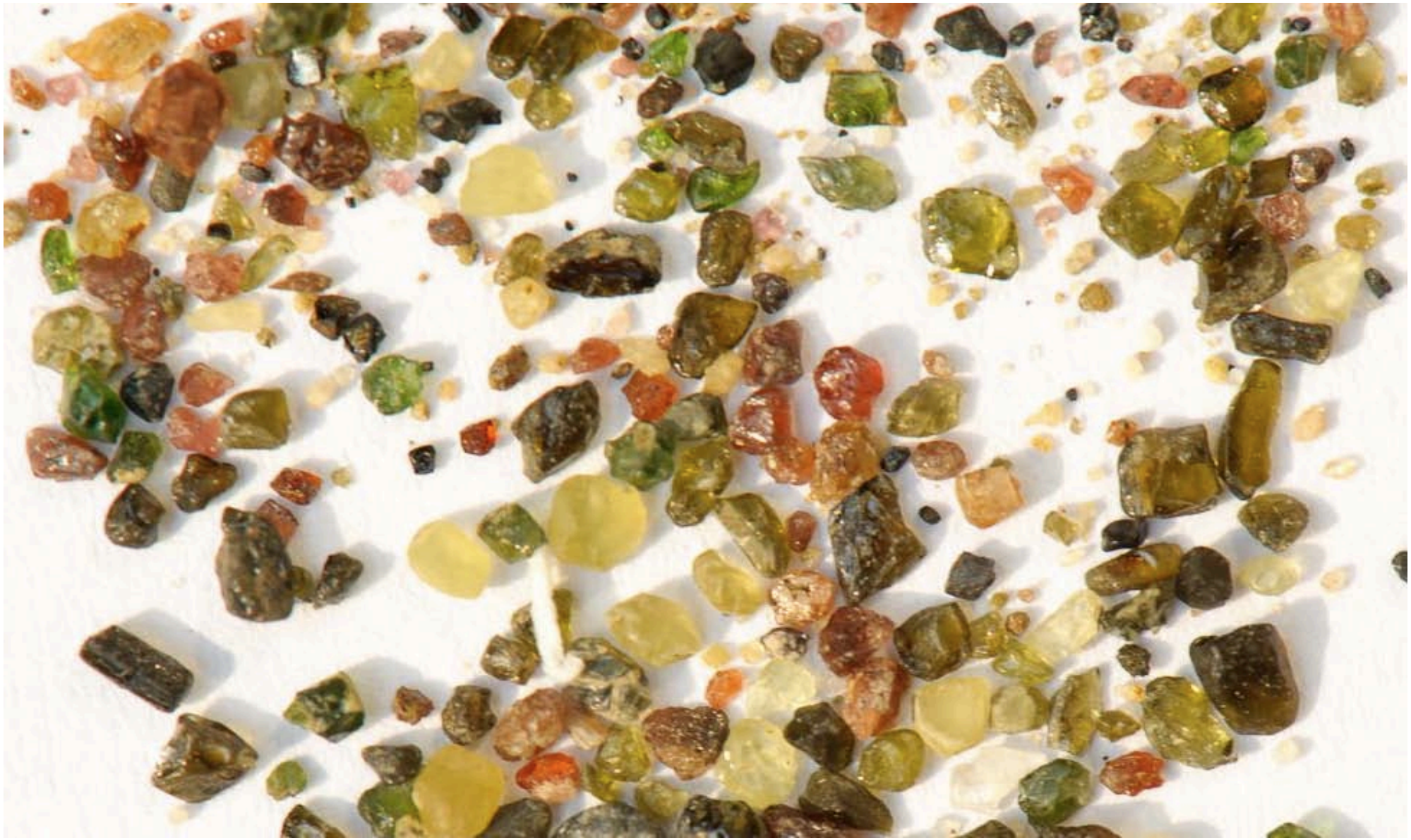


The company Selfrag is developing a method for “exploding” crushed rocks.
Such methods are worth waiting for before new mines are opened.

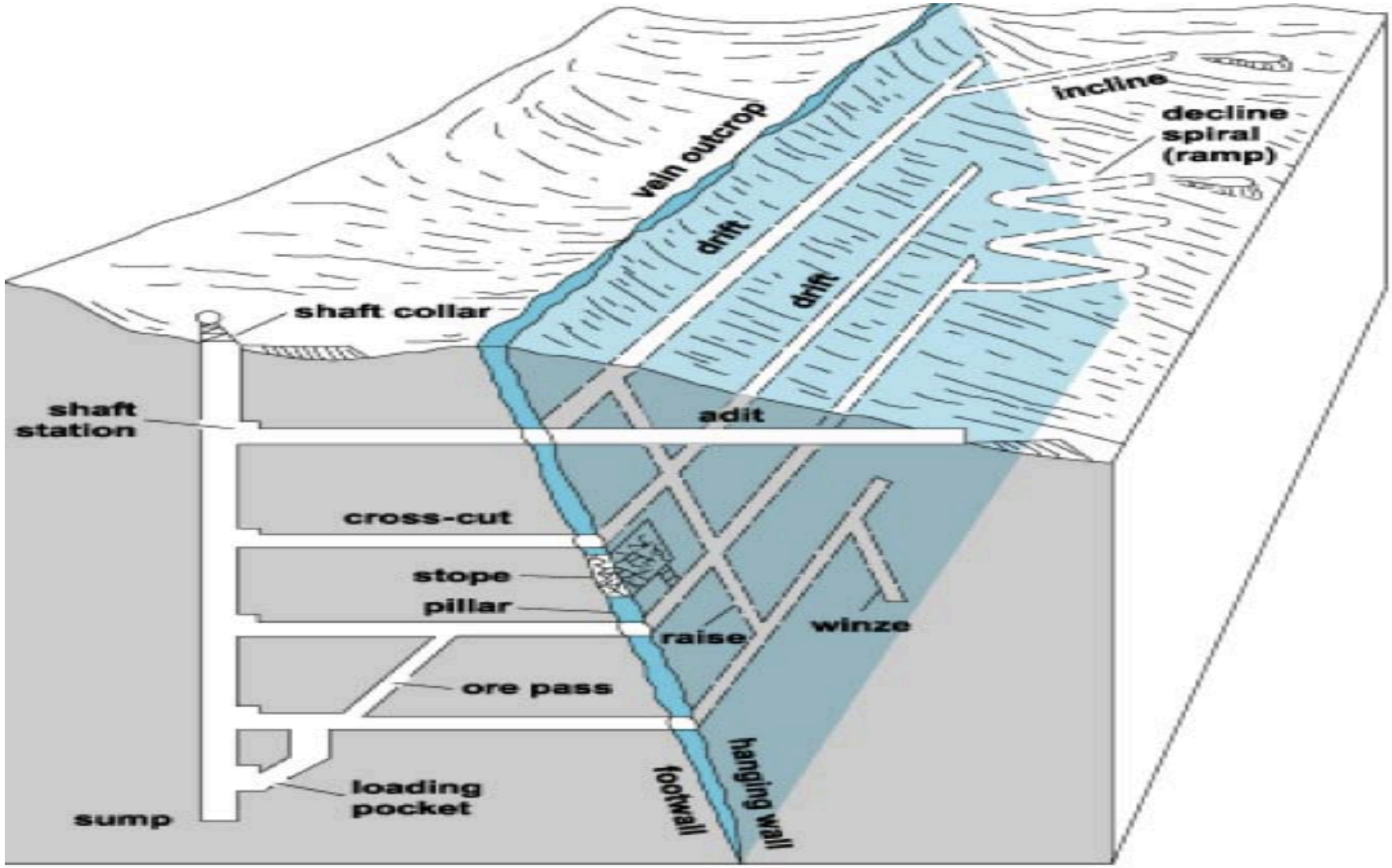
SELFRAG
HIGH VOLTAGE PULSE
POWER FRAGMENTATION



When more minerals can be separated out of the same rock, they will also be sold as concentrates. Clean minerals are not only colorful but have unique and useful chemical and physical properties.



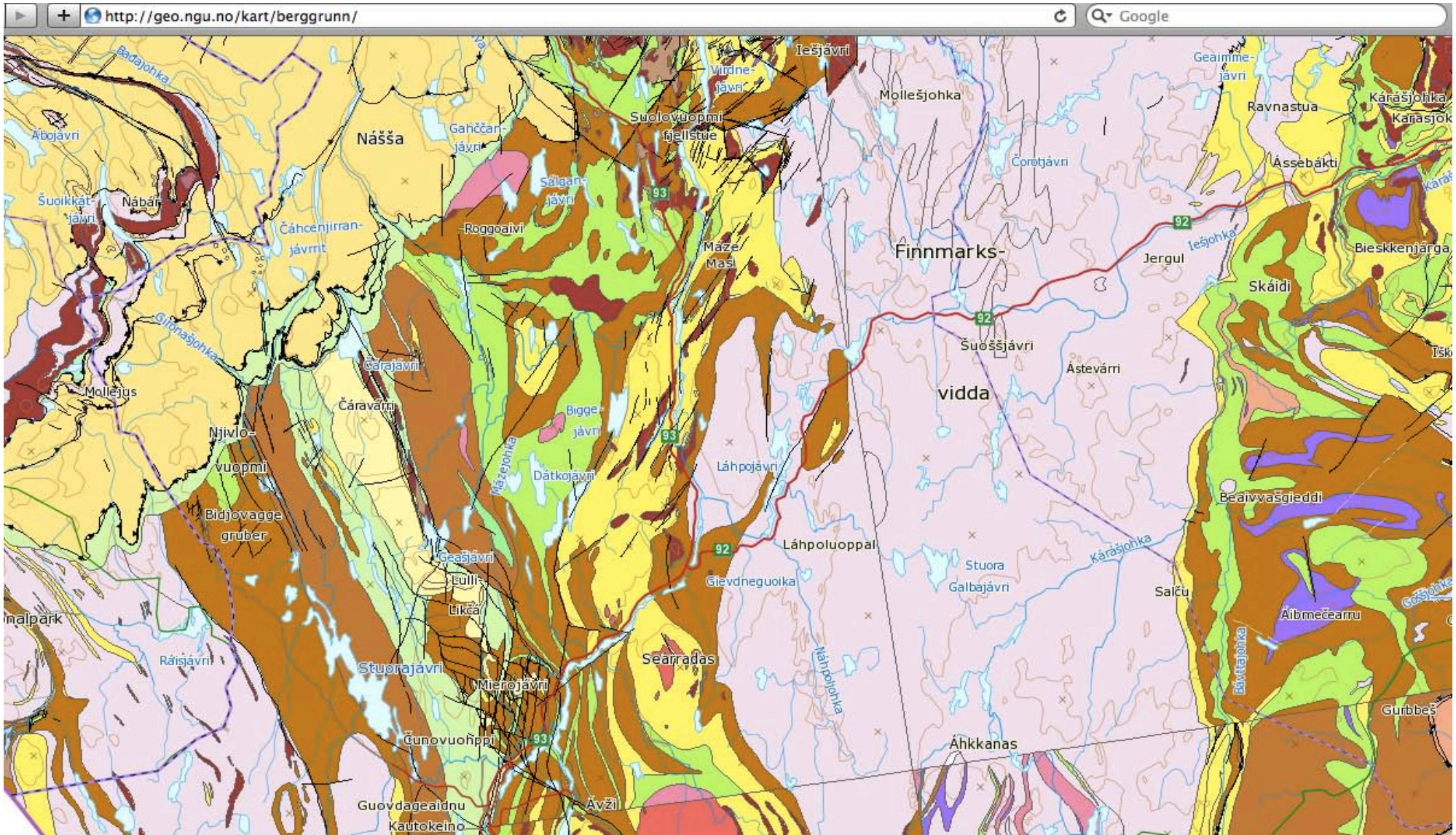
Excavations in solid rock also have value.
Future mines in Norway can be designed to provide local employment after the ore is gone. An example would be special storage, in protected and stable underground conditions.



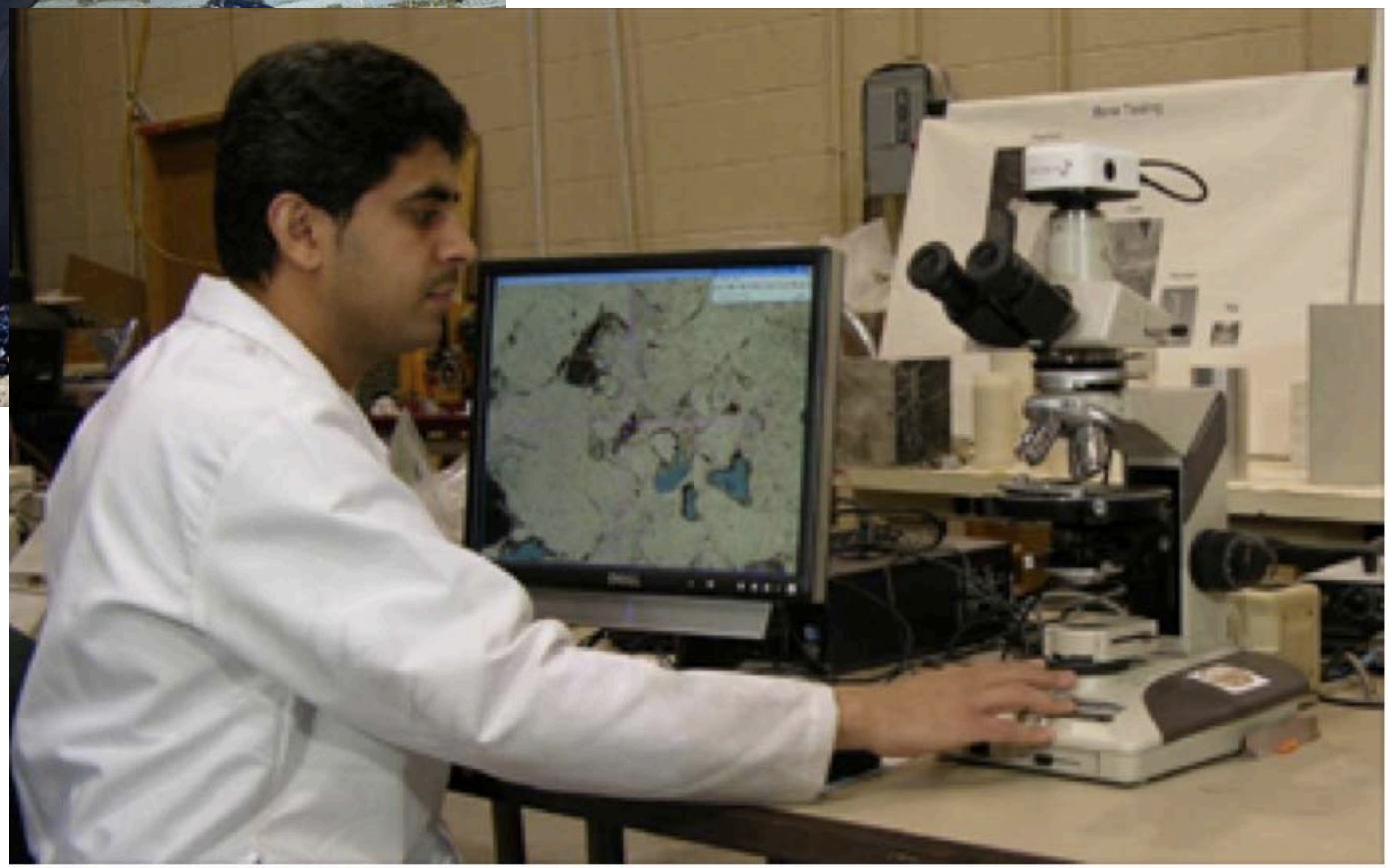
In the near future, it will be possible to use ore resources in nearly optimal ways.

Then why are most geologists in favor of starting new mines now?

The reason is that geologists are fond of their rocks (like Norgwegian reindeer owners are fond of their animals.) Rocks get their own names:
Jergul gneiss, Goldenvárri amphibolite, Máze quartzite, Likča basalt, Časkejas greenstone, Bihkkačohkka sandstone, Čaravárri sandstone, Vuopmegielas amphibolite.



Geologists are out with their rocks in the summer,
and in with them in the winter.



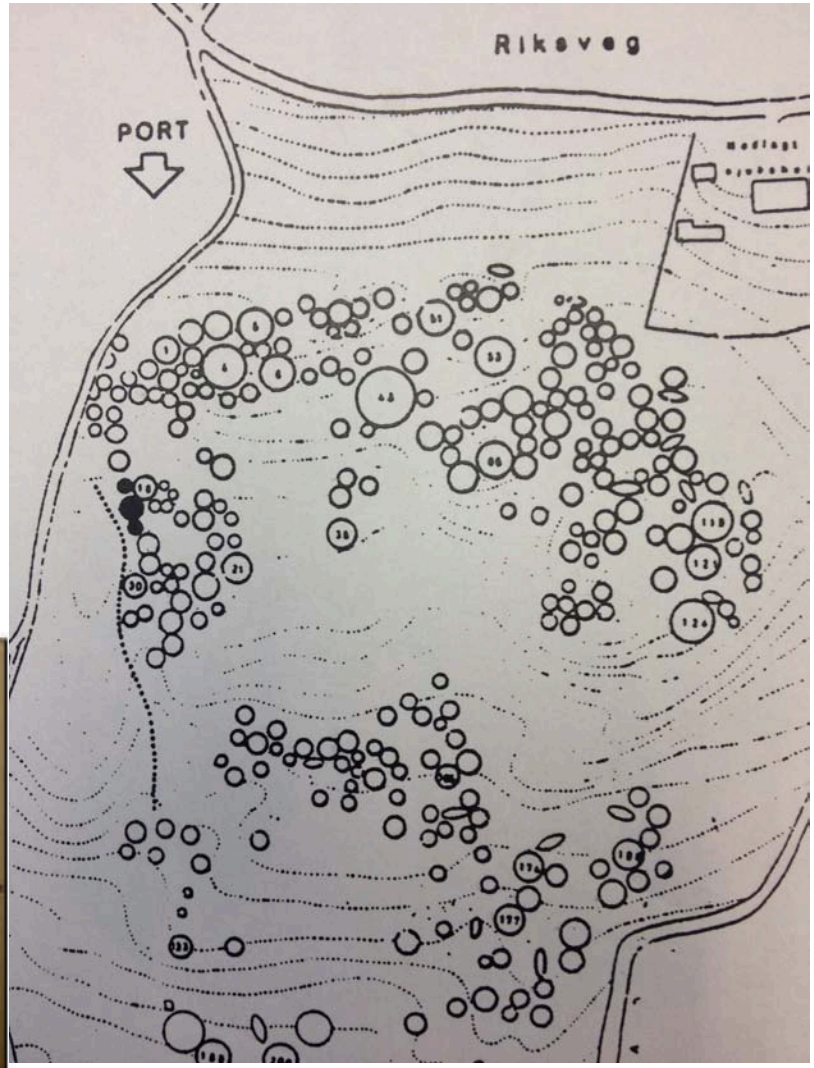
Rocks live their own “inorganic life” over extremely long time:
They are born at a certain time (crystallisation, deposition)
They play and fight with each other (metamorphic reactions and deformation)
They create their own body heat (from radioactivity)
They attract each other (graviation)
They respond to summer and winter (thermal expansion/contraction)
They become old and sick (weathering)
And finally they die (disintegration)

Ore-bearing rocks are slaughtered (mining)
It is almost unthinkable for a geologist to delay this until the next generation.

But to start a new metal mine in Norway now, is like slaughtering a newborn calf.
Rocks and ores can be only taken out once: They are non-renewable.

The authorities do no allow archeologists to use up their non-renewable resources. Here are objects taken from Viking grave mounds in Oppdal, where 850 mounds have been mapped. Most mounds remain untouched, to be opened by future researchers who will have better techniques for investigation

Skålformede spenner. Funn fra gravfeltet på Vang.



But doesn't our generation need new mines?

We want them, but we don't need them. Investors have collected enough gold for 200 years of industrial use. Each year 2500 tons more are mined, and only 300 tons are used in industry. The purpose of starting a new gold mine is to earn money, at the expense of the environment.

Existing mines can also supply the current needs for copper, titanium, etc. Mining is cheaper than recycling, and that is why prices are low.

The world is increasingly wasting non-renewable minerals and natural areas. Finnmarksvidda is a nature area that can be used in sustainable ways, such as reindeer herding, and should not be damaged by short-sighted financial speculation.

The demand for metals will be higher in 30 years.
Mineral resources will be taxable, as petroleum resources are now.
Petroleum tax in Norway is 50%. This has given us our Petroleum Fund.
Mineral tax in Norway is 0.5%. There will be no Mineral Fund at this tax rate.
There will be temporary mining jobs, but as few as possible, because of high Norwegian salary levels.
The mineral deposits will be emptied as quickly as possible. Time is money for mineral investors.

Society today is willing to misuse both human resources and natural resources for minerals.

In Norway, we should reduce our consumption, and not misuse our nature.

Metal prices have been too low for the last 30 years to open a new mine. Now the prices are high enough that investors can earn money by opening new mines; but only if the mines are allowed to dump the tailings in nature, without transport costs.

When will the time be right for new mining operations?

When resource prices are high enough that the mine can afford to:

- pay a significant mineral tax,
- sell the mine tailings as rock material,
- leave the area attractive for those who remain after the minerals are gone.