MINERAL AND METAL DEMAND

The potential of the Swedish bedrock

Professor Christina Wanhainen

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Demand for minerals and metals

Sweden as mining nation today

The potential of the Swedish bedrock

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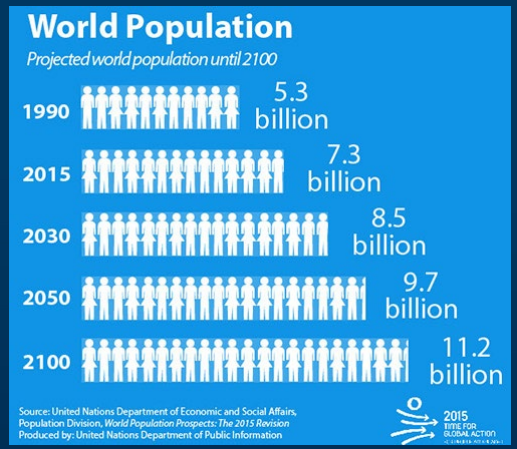
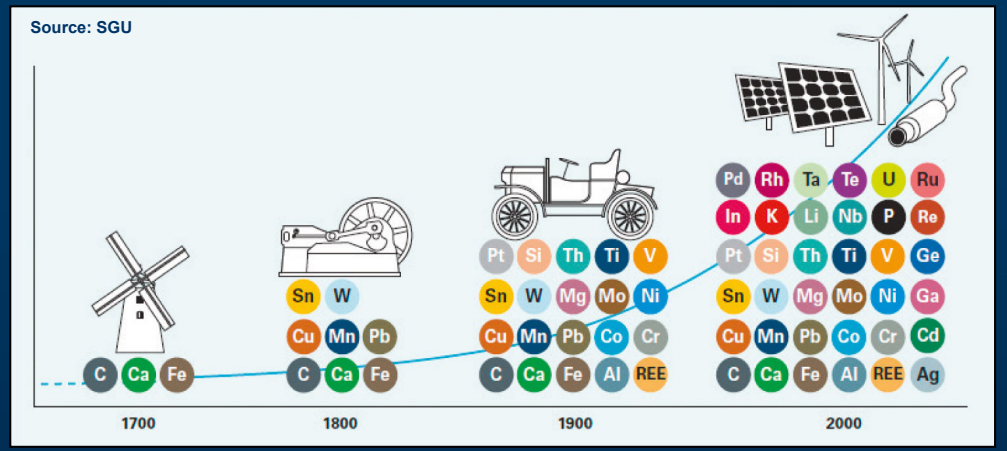
Demand for minerals and metals





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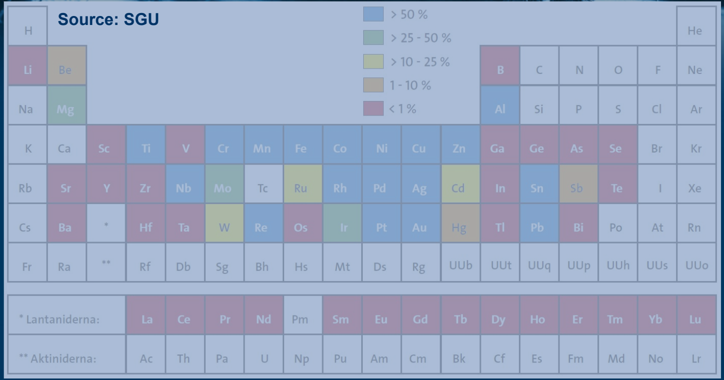

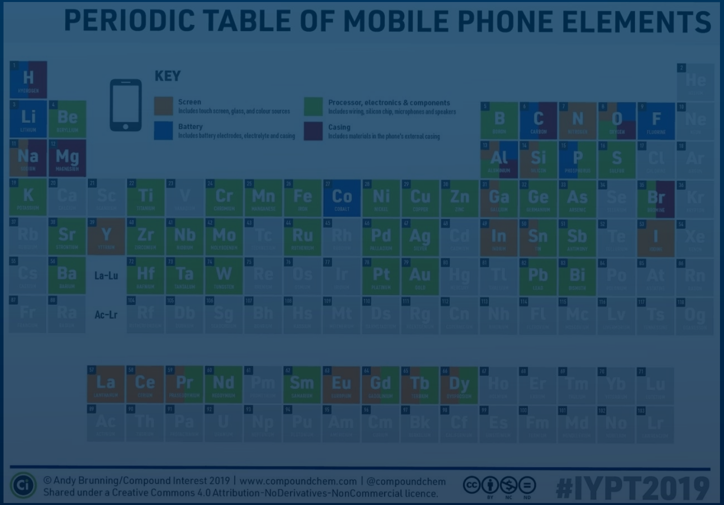

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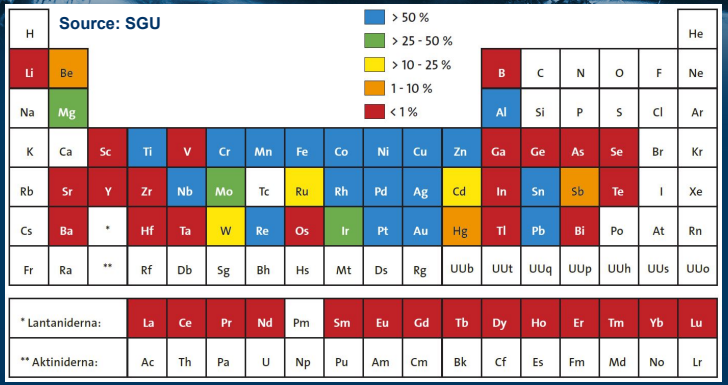
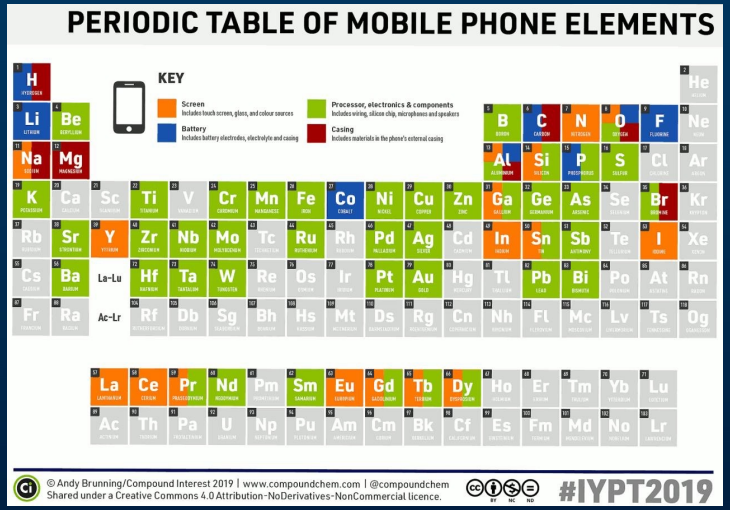
Recycling – critical metals, how??





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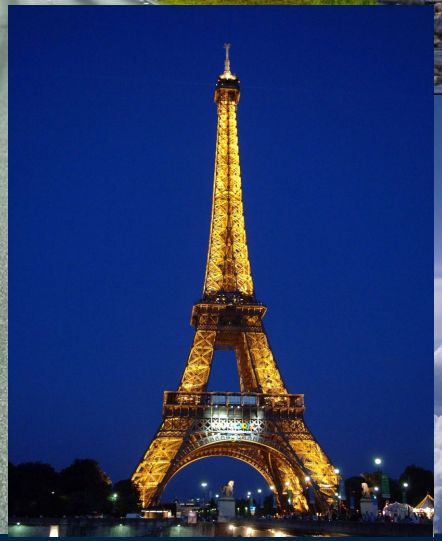

Recycling – base metals in infrastructure, when??

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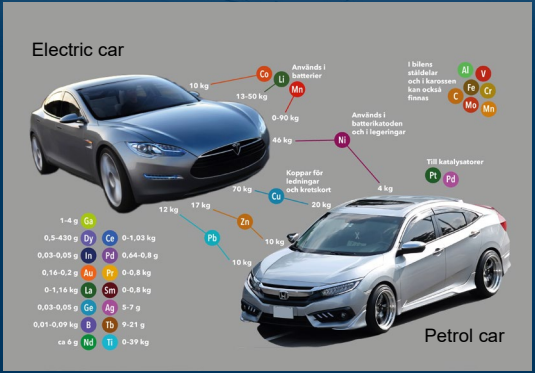

Needed for modern solar panels:
Al, C, Cu, Ga, In, Fe, Pb, Te, Ti…….

World production of dysprosium is 1350 tonnes/year

Needed to get 1 megawatt from a windmill:
132 t of steel
370 kg Al
10 t Cu
111 kg Ni
6,7 t Pb
124 kg Nd (neodymium)
22 kg Dy (dysprosium)

Metals and minerals are natural resources that are indispensable for the sustainable development of our society.

Fossil-free energy requires more metals than fossil-produced energy

So, demand increases and while recycling will play an important role in meeting demand, primary production will still be needed. A sustainable development requires *a combination of*:

Less consumption
Improved recycling (by improved product design)
Improved extraction techniques
Exploration for new resources
……and more

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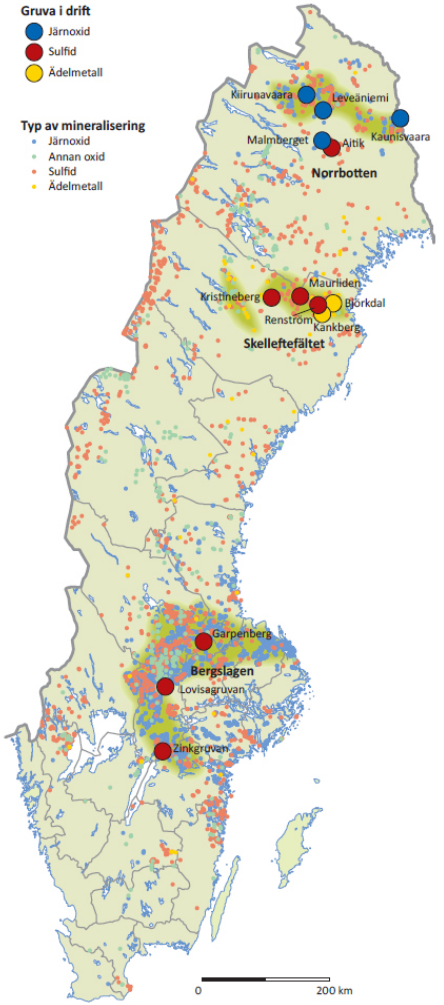
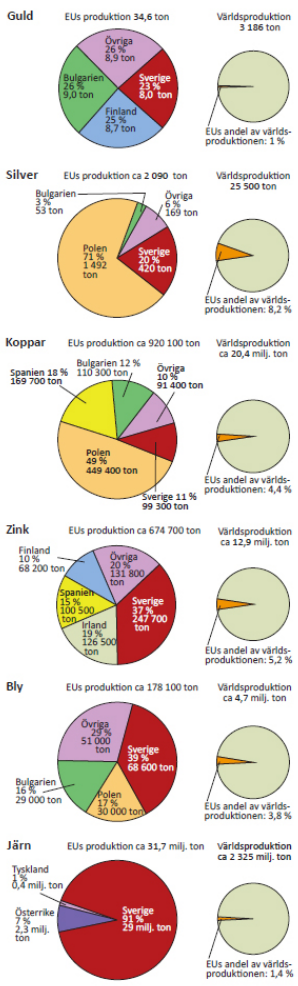


Figur 21. Sveriges gruvor och mineraliseringar 2019.
Sweden's mines and mineralizations 2019.

Source: SGU



Figur 22. Sveriges gruvproduktion år 2019 i relation till EU28 och världen.
Sweden's mine production 2019 in relation to EU28 and the world.

Mine production in Sweden

- EU produces c. 3% and consumes more than 20% of the yearly, global metal production
- A continous addition of metals is required, but few giant deposits discovered lately, and no new mines have opened in Sweden in 12 years
- Good potential to find more metals in Sweden, how can we claim that?

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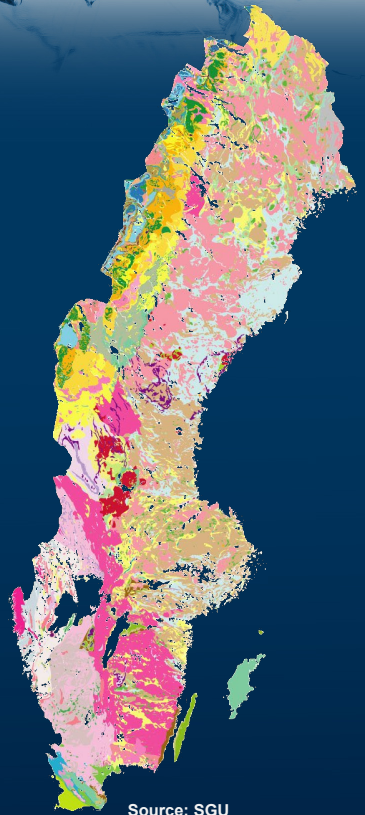
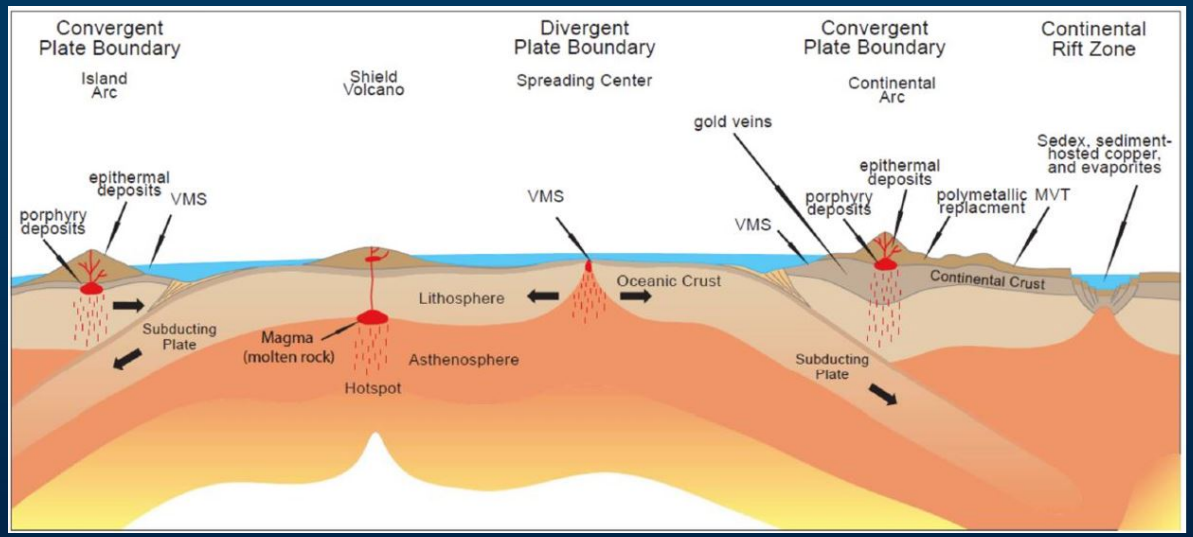


Source: SGU

In ore geology we study the processes that concentrate metals and minerals in the crust.

Most ore deposits are related to specific geological environments, where the most productive are mantle plumes, continental rift zones and continental arcs.



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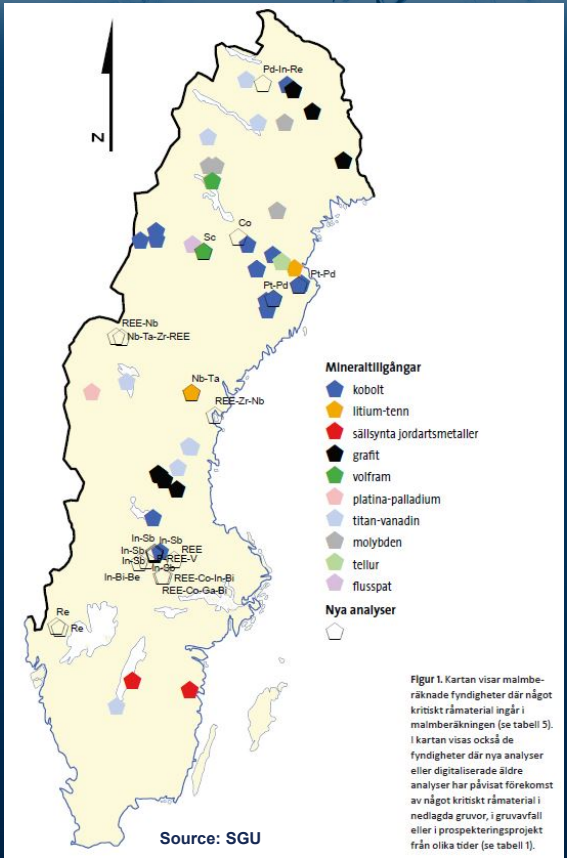
What do we know?



Figur 1. Kartan visar malmberäknade fyndigheter där något kritiskt råmaterial ingår i malmberäkningen (se tabell 5). I kartan visas också de fyndigheter där nya analyser eller digitaliserade äldre analyser har påvisat förekomst av något kritiskt råmaterial i nedlagda gruvor, i gruvavfall eller i prospekteringsprojekt från olika tider (se tabell 1).

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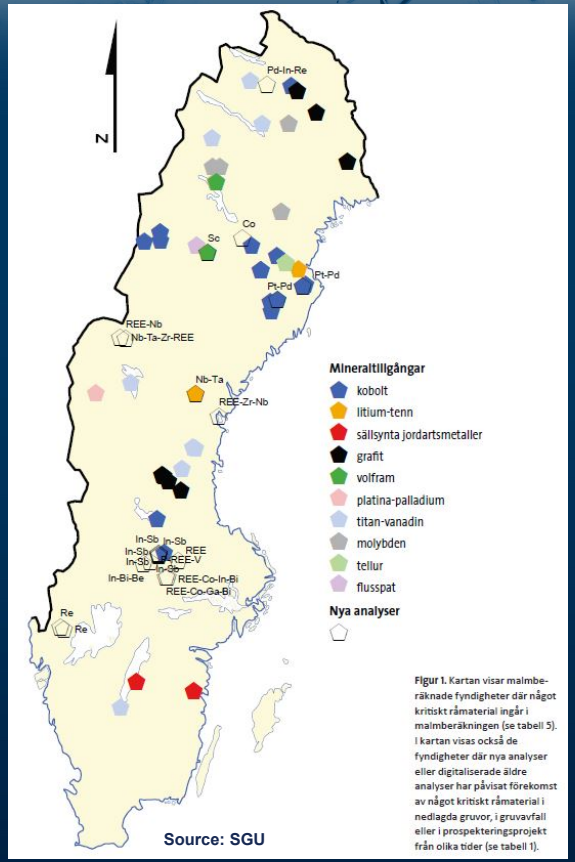
Lithium



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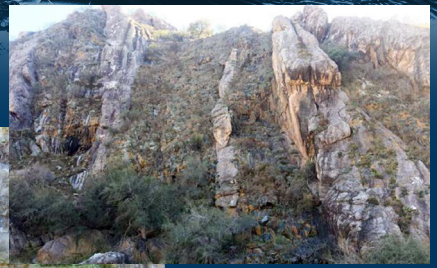

Supply of lithium comes from two main sources: brines and pegmatites

Lithium-rich pegmatites are quite rare and make up only about 0.1% of all known pegmatite occurrences.

Formed from S-type magmas generated by melting of metasedimentary rocks in the crust.

Occur in crustal domains including significant amounts of metasedimentary rocks affected by metamorphism

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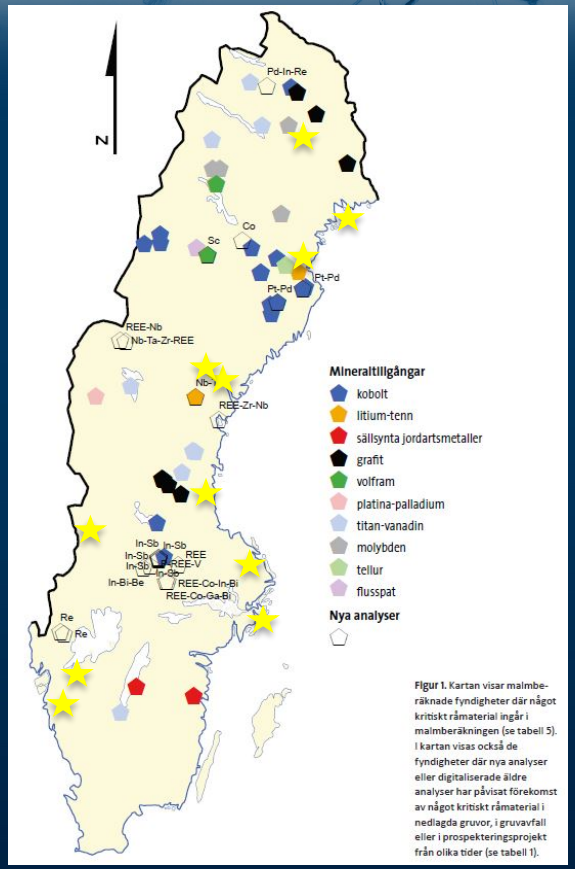

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What else do we know?

Many lithium-pegmatites have been documented in Sweden, mostly due to coincidences during early mapping and exploration activities.

★ Li occurrences in Sweden compiled by O. Martinsson, LTU

The unknown/undiscovered (4% exposure!)

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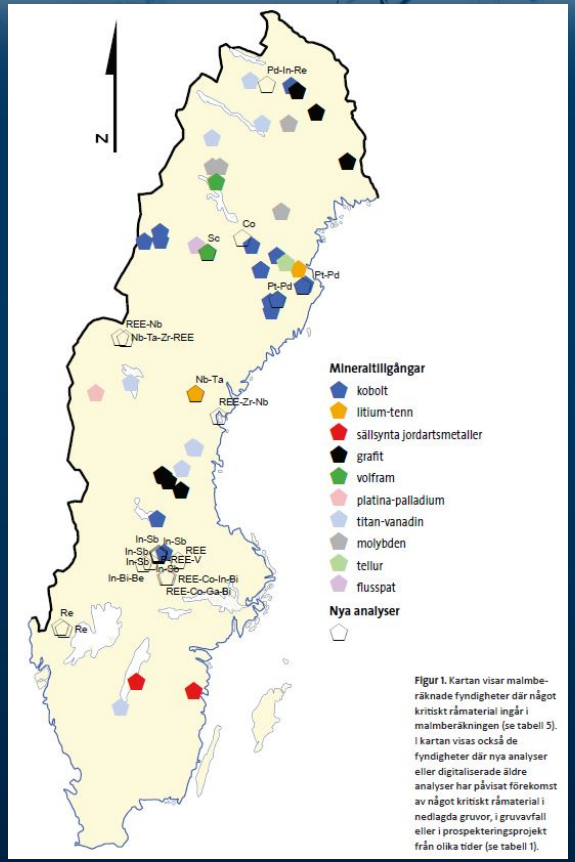
Vanadium



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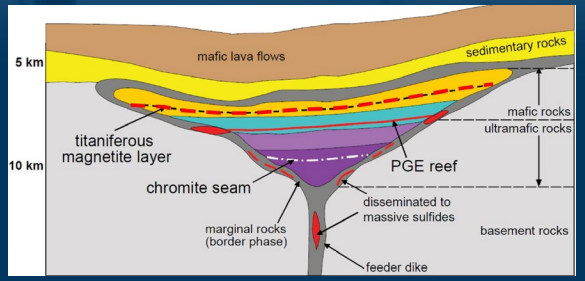

Supply of vanadium comes from four main sources, two relevant for the Swedish bedrock:

Vanadiferous titanomagnetite (Fe-Ti-V) in layered intrusions (e.g. Smålands Taberg)

Shale-hosted vanadium deposits (Deposited in anoxic basins with accumulation of organic matter and absorbing metals from the sea water) e.g. Viken

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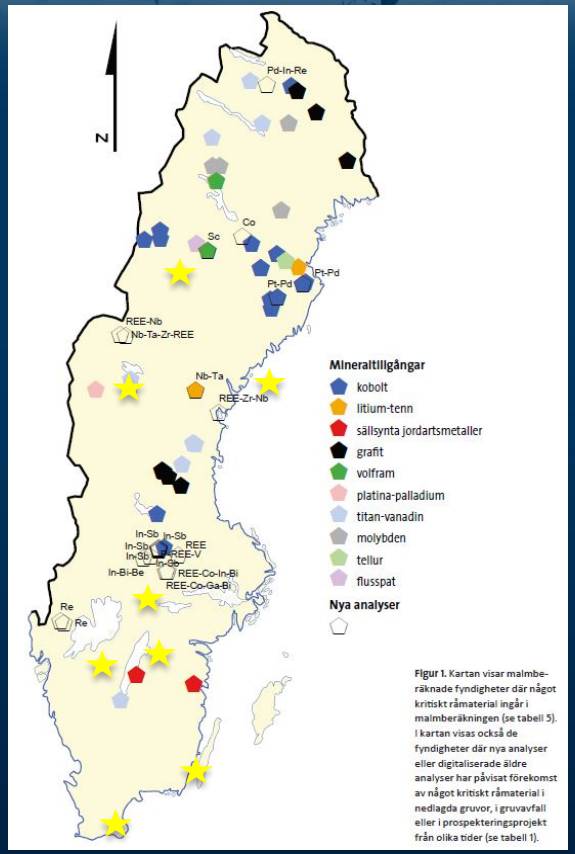

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What else do we know?

Again, most occurrences documented due to coincidences during early mapping and exploration activities.

★ V occurrences in Sweden compiled by O. Martinsson, LTU

There is a clear need to develop capacity in geological mapping!

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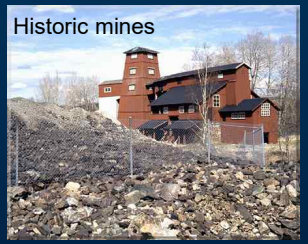

The already crushed waste material at producing and historic mines:

REE
Vanadium
Cobalt
Antimony
Baryte
Bismuth
Germanium
Indium
Phosphorous
Tungsten
Rhenium
Titanium
…… and more

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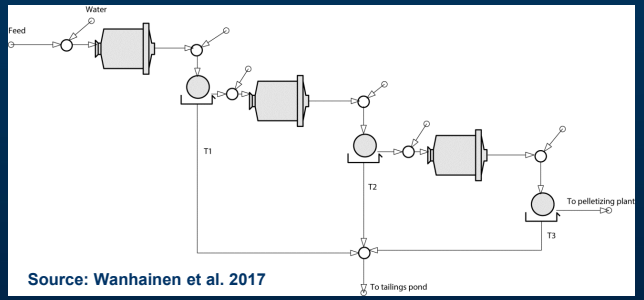
Kilometer- to nano-scale studies

To understand how and where ores are formed
To minimize environmental impact in exploration
To find new (and deep) ores



Source: Wanhainen et al. 2017

To see if a metal is recoverable
To optimize the metal extraction process
To better utilize ores and tailings

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