

# **Historic background to the nomenclature used in regional geological correlations within Fennoscandia**



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**Key note lecture**

**Baltic Basement Spring School, May 27-29, 2026**

**Arbavere research center**

# **Part I**

## **a. Introduction**

## **b. Precambrian regions in SE Sweden**

**This presentation is dedicated to**

**Väino Puura, Jaan Kivisilla, Heino Koppelmaa, Valter Petersell  
and Roland Gorbatshev**

**who, together with**

**Vello Klein, Matti Niin, Juho Kirs, Kalle Suuroja,  
Gediminas Motuza and Grazina Skridlaite**

**were here in Arbavere, on April 24, 1990,**

**participating in the 1<sup>st</sup> meeting of Precambrian crust in the Baltic Sea region**

## Something more to remember

It is also important to remember even earlier scientific ancestors to us.



Alfred Elias Törnebohm  
1838-1911



Jakob Sederholm  
1863-1934



Wilhelm Ramsay  
1865-1928



Walter Wahl  
1879-1970



Nils Harald Magnusson  
1890-1976



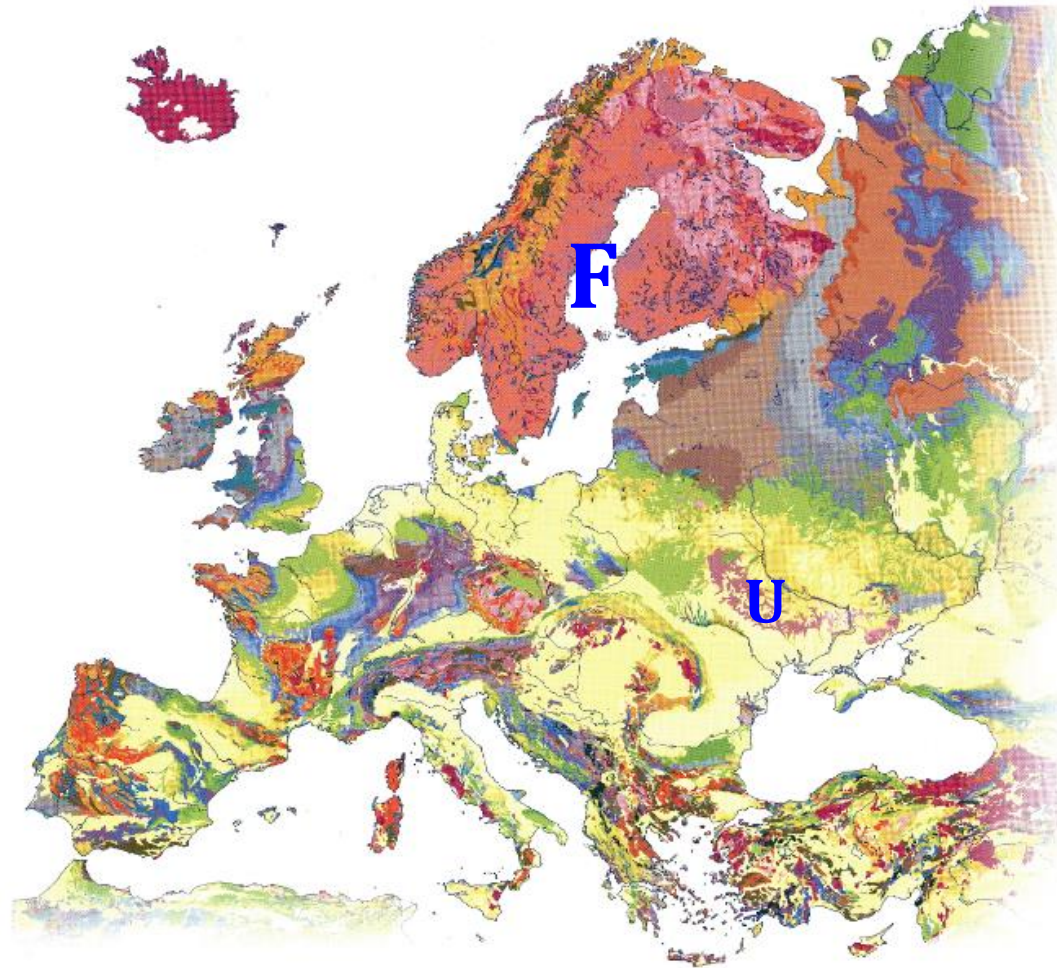
Pentti Eskola  
1883-1964

When they were active, no one had any access to electronic communication devices, computers or any advanced analytical tools.

And all their models were made without any plate tectonic inspiration.

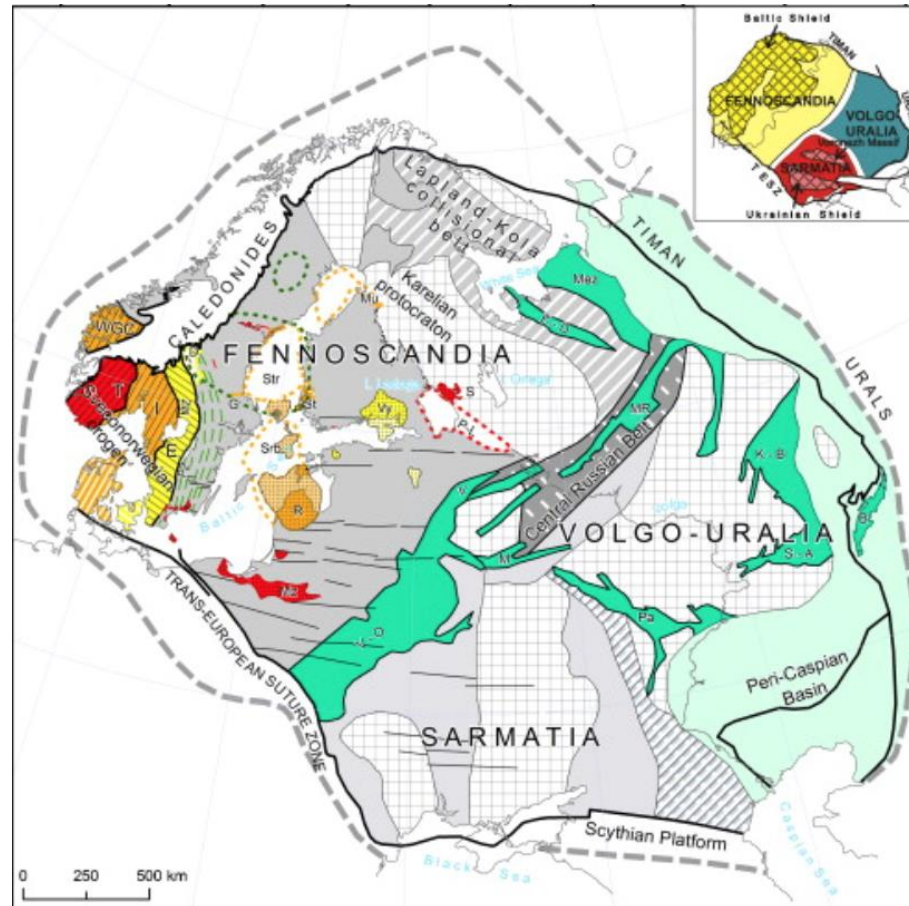
But still, they managed to make quite a lot, in *creating a base for our knowledge...*

**Now, in the 21<sup>st</sup> century, we all know now that...**



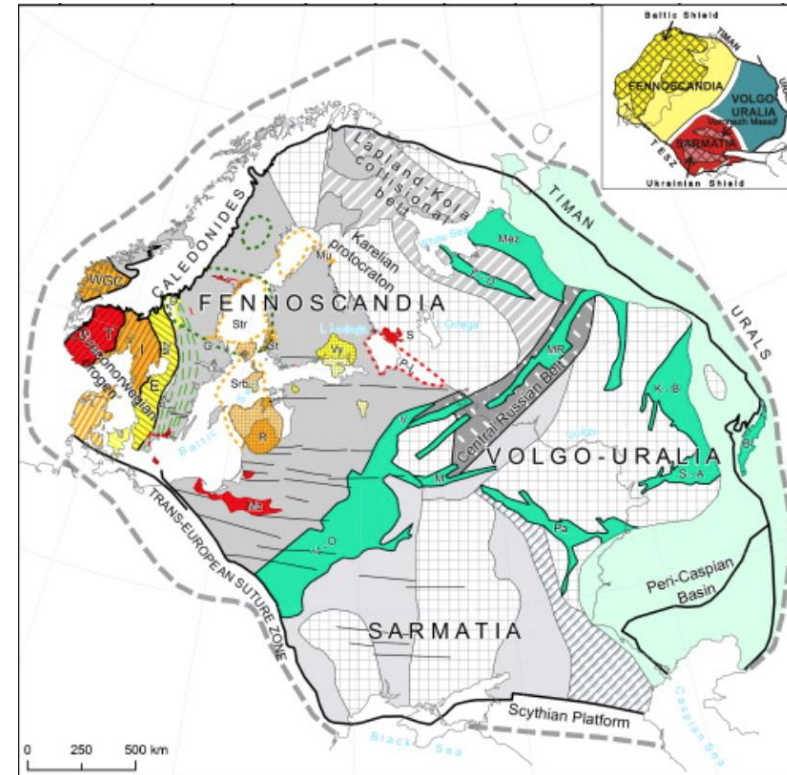
**... Precambrian crust is widely distributed in northern and eastern Europe; it is exposed in the *Fennoscandian Shield* (F) and the *Ukrainian Shield* (U).**

and if we undress all Phanerozoic cover formations,  
we see a large Precambrian complex; the *East European Platform*, ...



... consisting of three major blocks: Fennoscandia, Sarmatia and Volgo-Uralia.

There are thus two concepts with rather similar names:



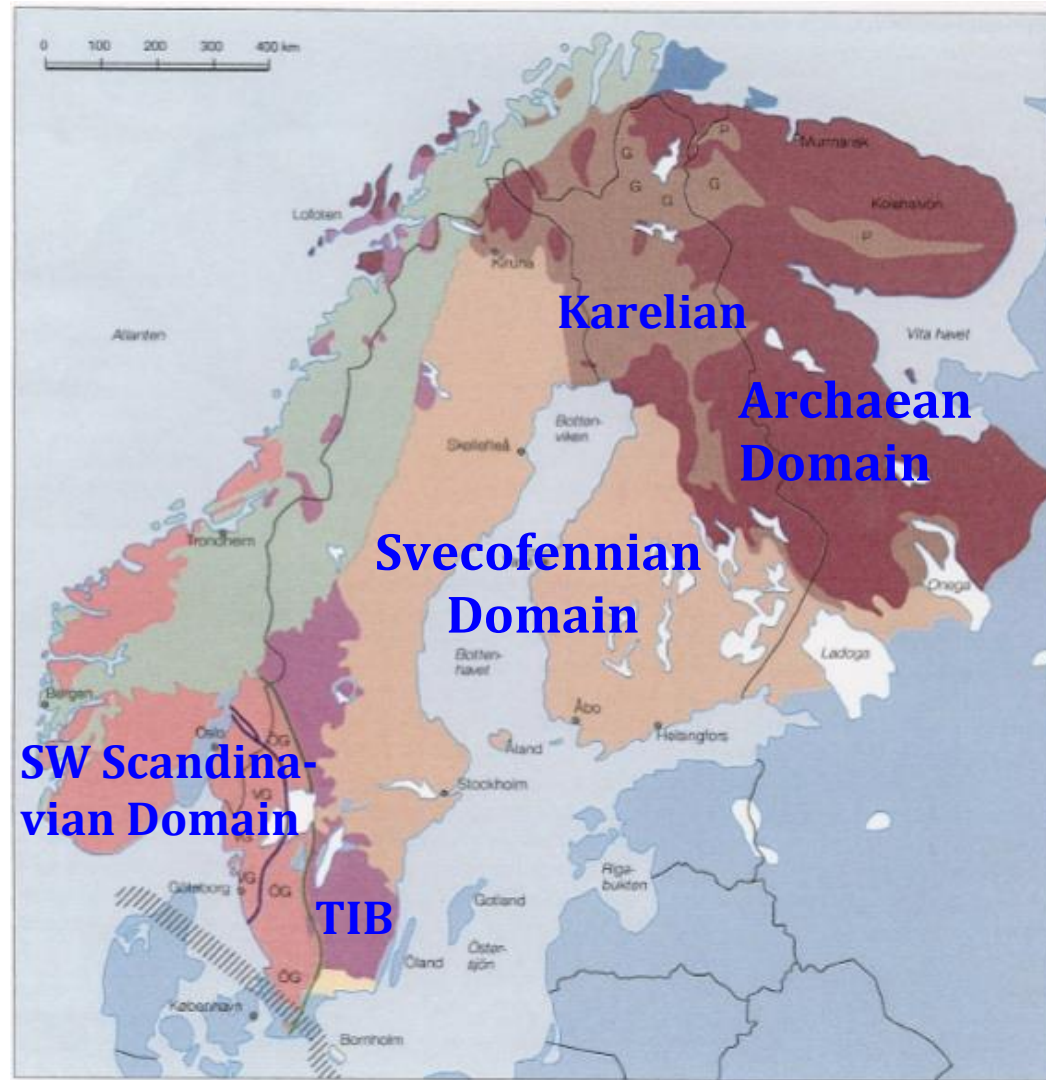
the *Fennoscandian Shield* is the exposed part of the crustal block *Fennoscandia*.

**Sometimes, the *Fennoscandian Shield* is inadequately referred to as the *Baltic Shield*.**

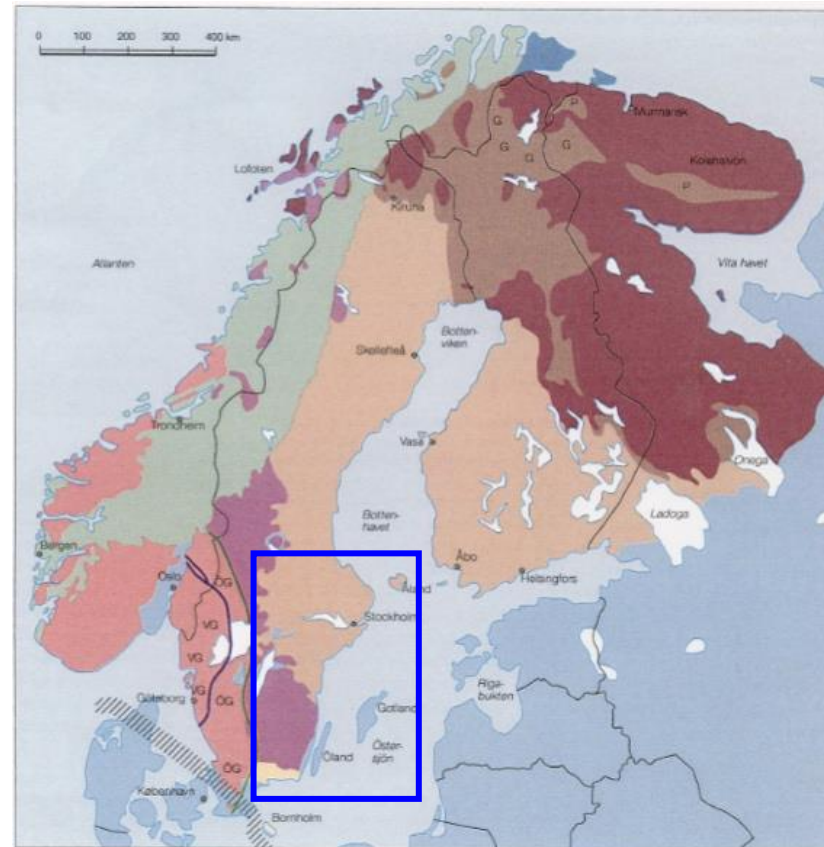
**However, this shield is *not* exposed at one single spot in the Baltic republics,  
and the shield is *not* exposed at one single spot in the Baltic Sea.**

**So, please, let us call the shield what it is, the *Fennoscandian Shield*.**

**The Fennoscandian Shield can be divided into three formal domains and several other units**



The main focus in this lecture will be on the Precambrian in SE Sweden...

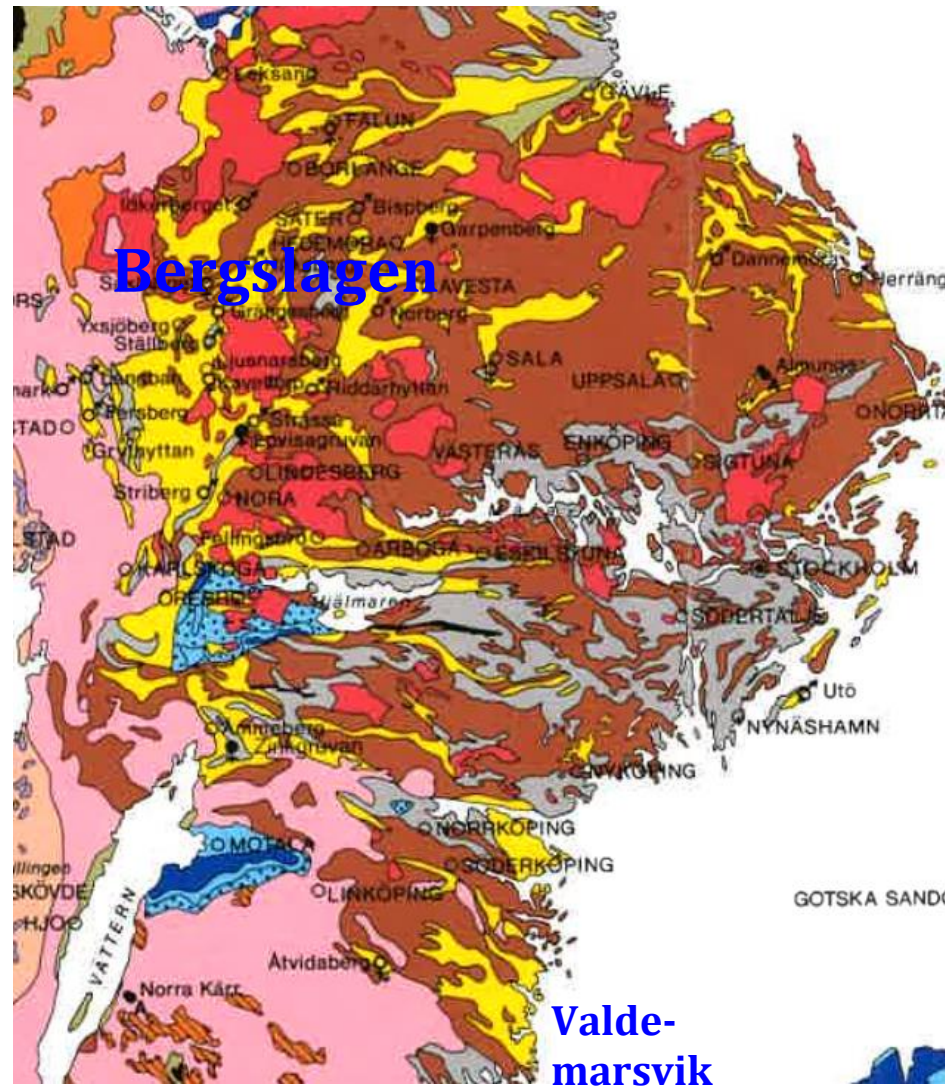


... with an *ambition to promote correlations* of the Fennoscandian Shield with the hidden Precambrian crust in the Baltic republics.

# **Precambrian regions in SE Sweden**



## a. Bergslagen (and the Valdemarsvik region)



**Bergslagen is a region in south-central Sweden, where mining started long before any nation existed in northern Europe.**



**Mining for copper at Falun was initiated already in the 8<sup>th</sup> century, which makes the *historic mining* records of Bergslagen 2<sup>nd</sup> in Europe.**

**The *present Bergslagen mines* contribute to make Sweden as leading mining nation in Europe.**

**Bergslagen is also unique for the *historic discoveries of elements* in the periodic table.**

## Mining

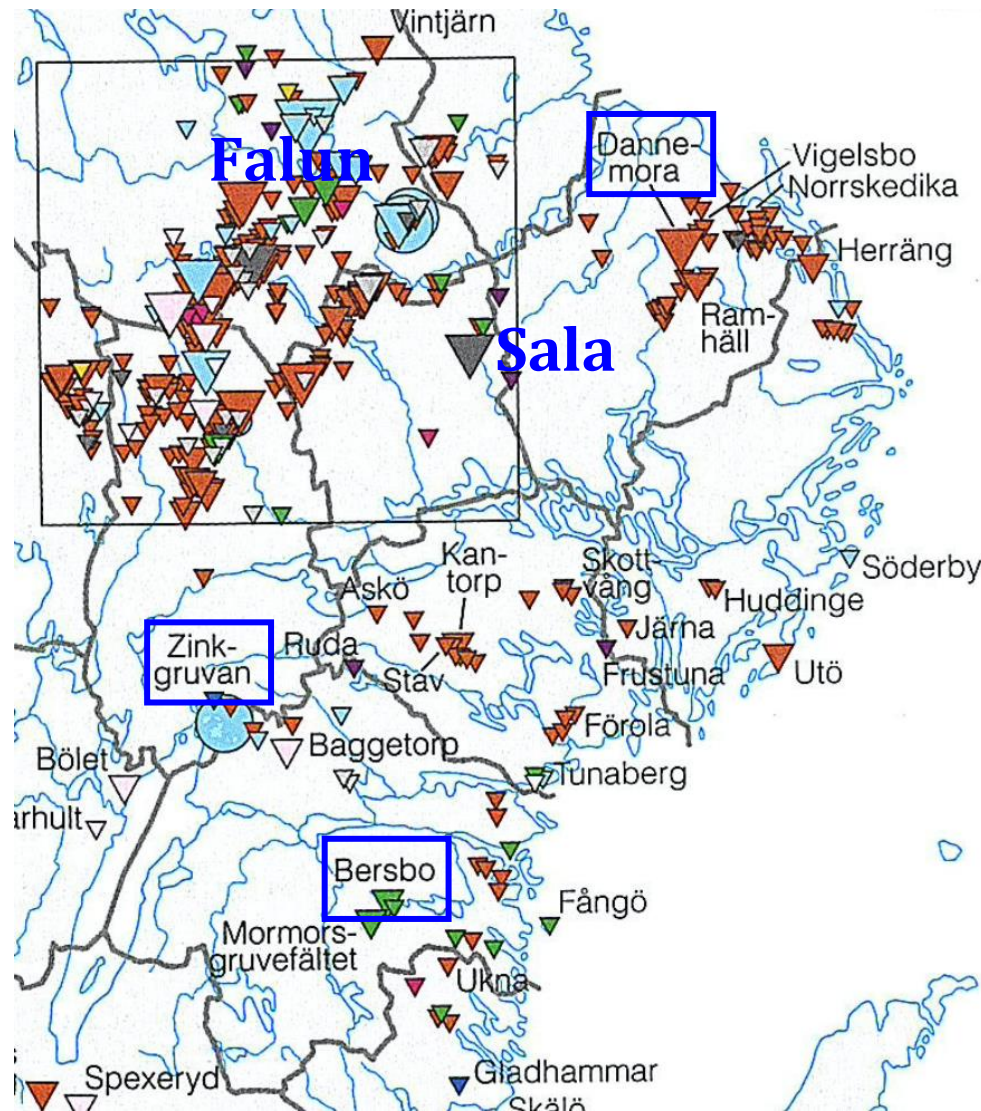
Thousands of Fe, Cu, Zn, Ag and W ores have been mined in Bergslagen through the history

Falun (Cu), Garpenberg (Cu-Zn-Ag) and Grängesberg (Fe) occur in a main cluster of Bergslagen. Dannemora (Fe), Sala (Ag), Zinkgruvan (Zn) and Bersbo (Cu) are located elsewhere.

All of them have been part of a “bergslag”, a region with **Royal permission for mining**.

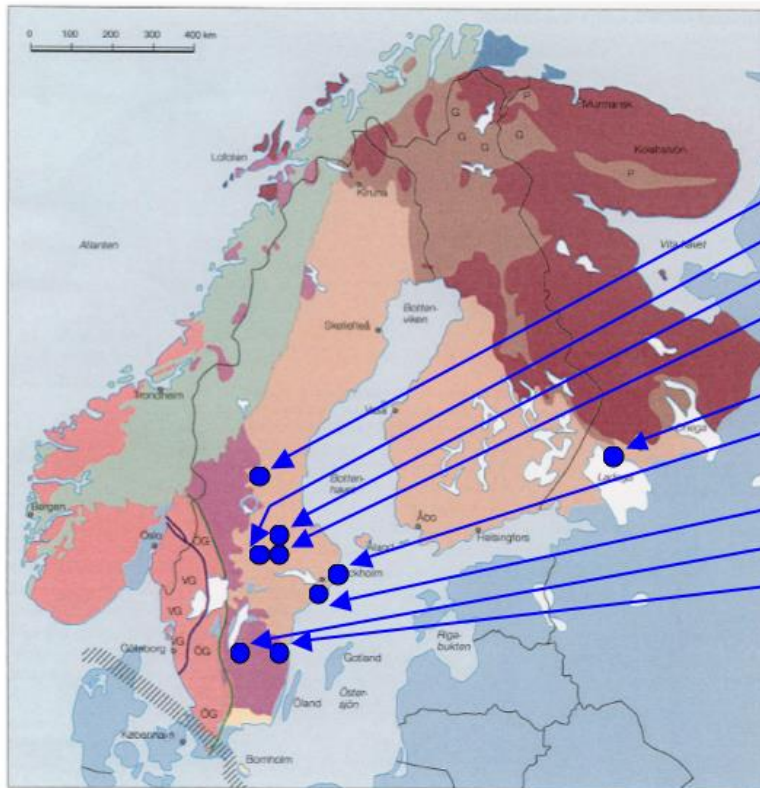
Bergslagen is a well-known mining region to every Swedish person. However, ...

... only a geologist would consider Zinkgruvan or Bersbo to belong to Bergslagen.



# Element discoveries

Mo, W, Li, Ni and Se were all discovered in ores in Bergslagen and surroundings  
 the REE metals Y, Yb, Tb and Er were discovered in a pegmatite in the Stockholm region



## Discovery sites

Los	Ni	1751
Bastnäs	Ce	1804
Falun	Se	1817
Bispgberg	Mo, W	1781-1783
Pitkäranta	In	1910
Ytterby	Y, Tb, Er, Yb, Ho, Tm, Sc, Gd, Dy, Lu	1794-1907
Utö	Li	1817
Taberg	V	1831
Gladhammar	Co	1735

Only few of these metals have so far been exploited.

## Periodic Table of the Elements 2006

1 H 1.01																	18 He 4.00
3 Li 6.94	4 Be 9.01											5 B 10.81	6 C 12.01	7 N 14.01	8 O 15.99	9 F 18.99	10 Ne 20.18
11 Na 22.99	12 Mg 24.31											13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.07	17 Cl 35.45	18 Ar 39.95
19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.87	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.69	29 Cu 63.55	30 Zn 65.41	31 Ga 69.72	32 Ge 72.64	33 As 74.92	34 Se 78.96	35 Br 79.90	36 Kr 83.80
37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.94	43 Tc (98)	44 Ru 101.07	45 Rh 102.91	46 Pd 106.42	47 Ag 107.87	48 Cd 112.41	49 In 114.82	50 Sn 118.71	51 Sb 121.76	52 Te 127.60	53 I 126.90	54 Xe 131.29
55 Cs 132.91	56 Ba 137.33	57 La 138.91	72 Hf 178.49	73 Ta 180.95	74 W 183.84	75 Re 186.21	76 Os 190.23	77 Ir 192.22	78 Pt 195.08	79 Au 196.97	80 Hg 200.59	81 Tl 204.38	82 Pb 207.2	83 Bi 208.98	84 Po (209)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra (226)	89 Ac (227)	104 Rf (261)	105 Db (262)	106 Sg (266)	107 Bh (264)	108 Hs (270)	109 Mt (268)	110 Ds (281)	111 Rg (272)	See "It's Elemental: The Periodic Table" <a href="http://pubs.acs.org/cen/80lh/elements.html">http://pubs.acs.org/cen/80lh/elements.html</a>						
		58 Ce 140.12	59 Pr 140.91	60 Nd 144.24	61 Pm (145)	62 Sm 150.36	63 Eu 151.97	64 Gd 157.25	65 Tb 158.93	66 Dy 162.50	67 Ho 164.93	68 Er 167.26	69 Tm 168.93	70 Yb 173.05	71 Lu 174.97		
		90 Th 232.04	91 Pa 231.04	92 U 238.03	93 Np (237)	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)	103 Lr (262)		



Note in particular the number of metals and REE (Rare Earth Elements).

Elements discovered in Fennoscandia 1735-1910, in most case for the first time in history.

## **Geological evolution**

**The Bergslagen region formed by intense igneous and sedimentary activity at c. 1.9 Ga, relatively close to an Archaean continent.**

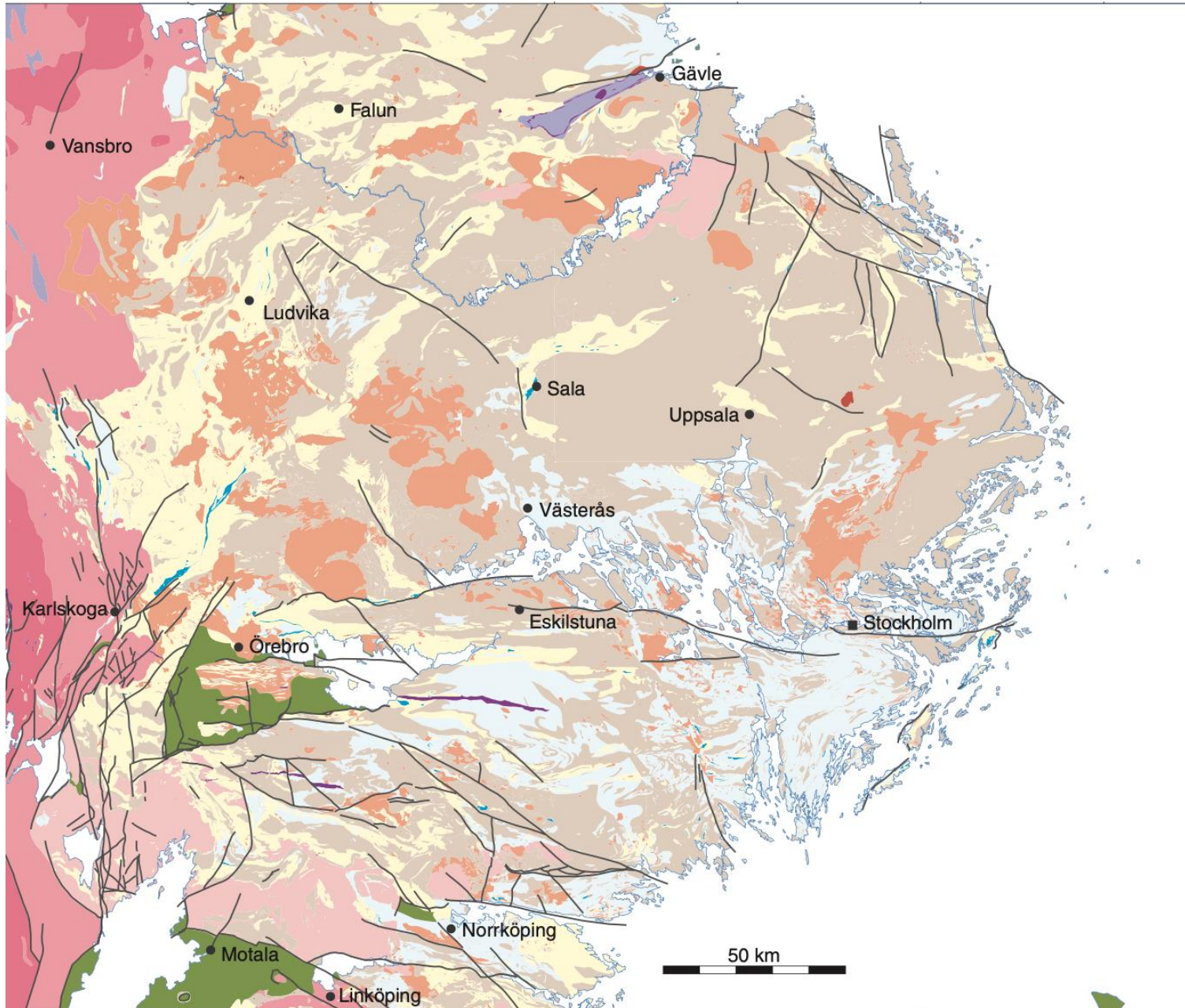
**The igneous activity is dominated by granitoids and their comagmatic volcanic rocks.**

**Felsic volcanism is common in most of Bergslagen, often interlayered with marble layers and turbiditic sediments.**

**Mafic volcanism is more common in SW Bergslagen (Tiveden-Valdemarsvik regions).**

**Traces of an early metamorphic phase has been recorded at 1.87 Ga.**

**A second, and more intense, metamorphic generation occurred at 1.78 Ga, closely associated with anatectic granites (sometimes referred to as Late Svecofennian).**



## The Svecofennian concept

The 1880-1910 Ma igneous and sedimentary units in Bergslagen are often referred to as *Svecofennian* (or *Early Svecofennian*).

The *Svecofennian Domain* is a term introduced by Gaal and Gorbatshev (1987) for all Svecofennian crust in Sweden and Finland.

When the subsequent metamorphic events are included, the term *Svecofennian* (or *Svecokarelian*) *orogeny* is often used.

The Svecofennian/Svecokarelian orogeny affected both proper Svecofennian crust and the 2000-2200 Ma Karelian crust (in Finland).

The concept *Late Svecofennian* is referred 1.8 Ga anatectic granites.

The western border of the Svecofennian successions in Bergslagen is *either* marked by various generations of the Transscandinavian Igneous Belt (mainly TIB 0 and TIB 1) or by the LLDZ shear zone.

## **Ore types in Bergslagen**

**Most of the Cu, Zn, Pb, Ag, Fe and Mn ores are hosted by 1.9 Ga Svecofennian rocks, particularly felsic volcanic rocks and marbles.**

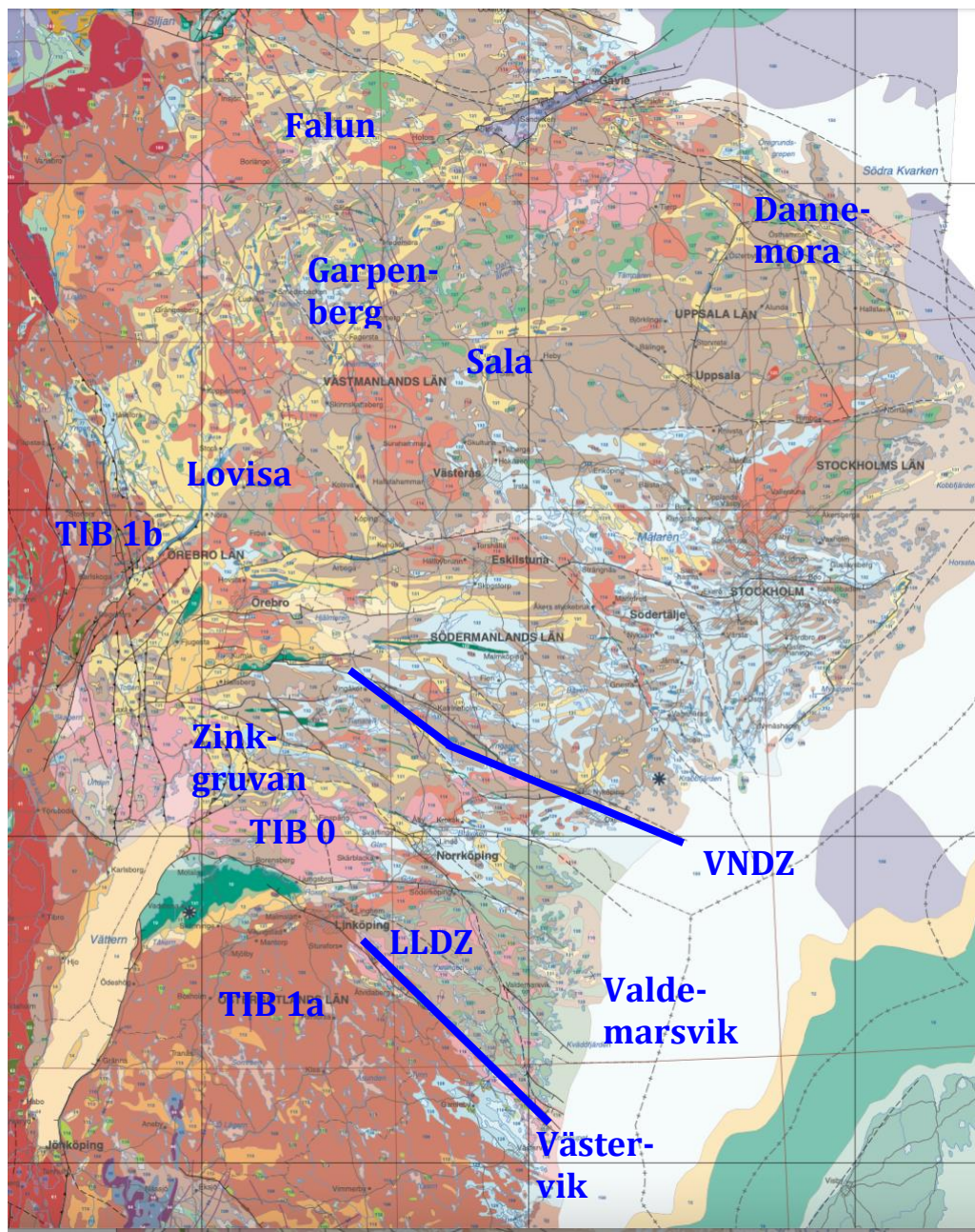
**Mo and W are related to 1.8 Ga “Late Svecofennian” granites.**

## **LLDZ and VNDZ**

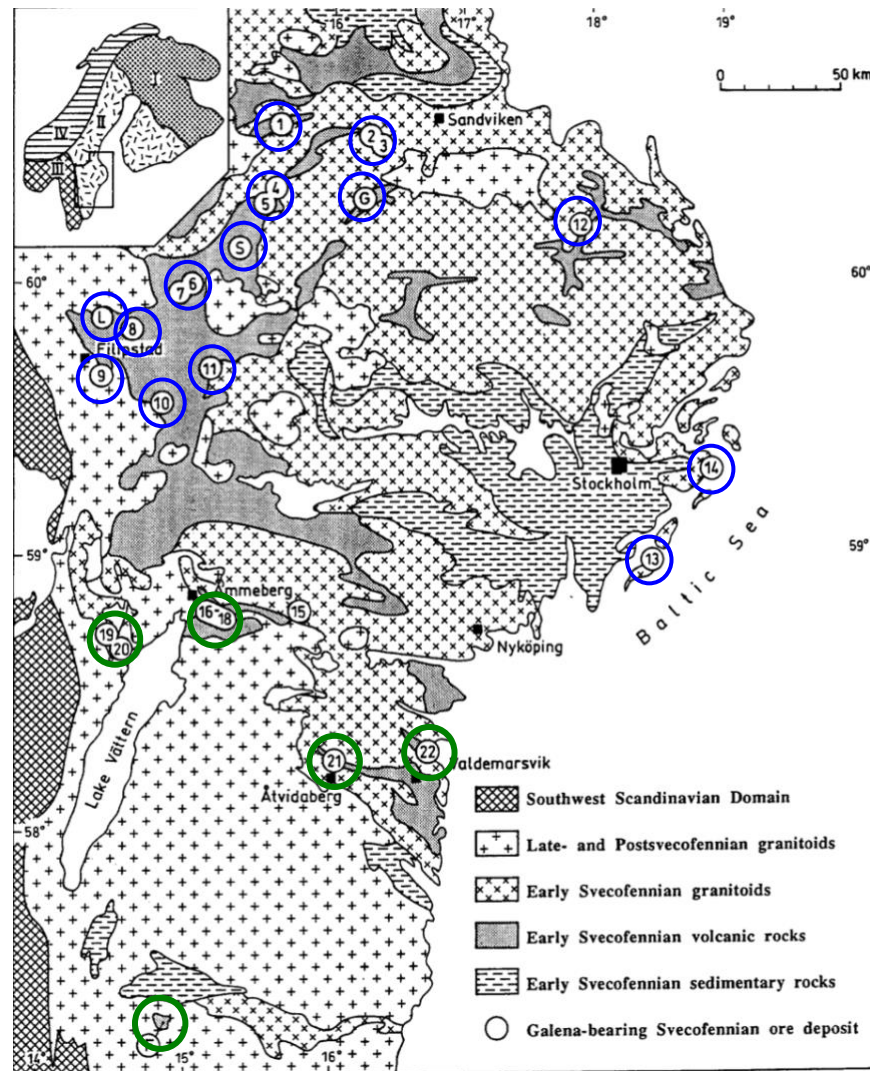
**VNDZ and LLDZ are two major shear zones in the southern parts of the Bergslagen region.**

**The Vingåker-Nyköping Deformation Zone (VNDZ) cuts through all Svecofennian units.**

**The Linköping-Loftahammar Deformation Zone (LLDZ) cuts also through the Svecofennian as well as the earliest TIB-generation.**

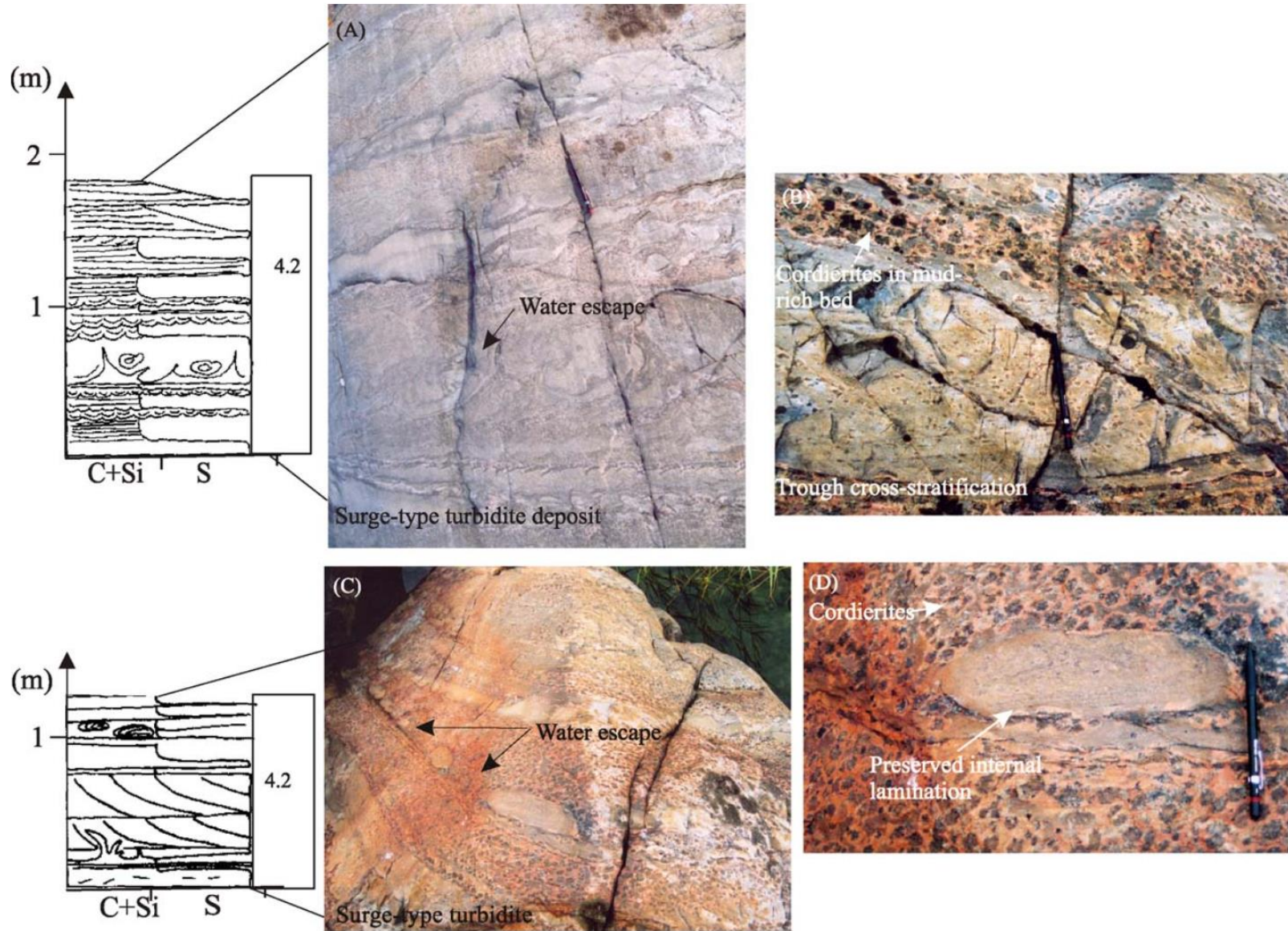


## Pb isotope signature of ore lead in the Bergslagen region



Significant ore lead variations exist between proper Bergslagen and southern Bergslagen (Sundblad, 1994).

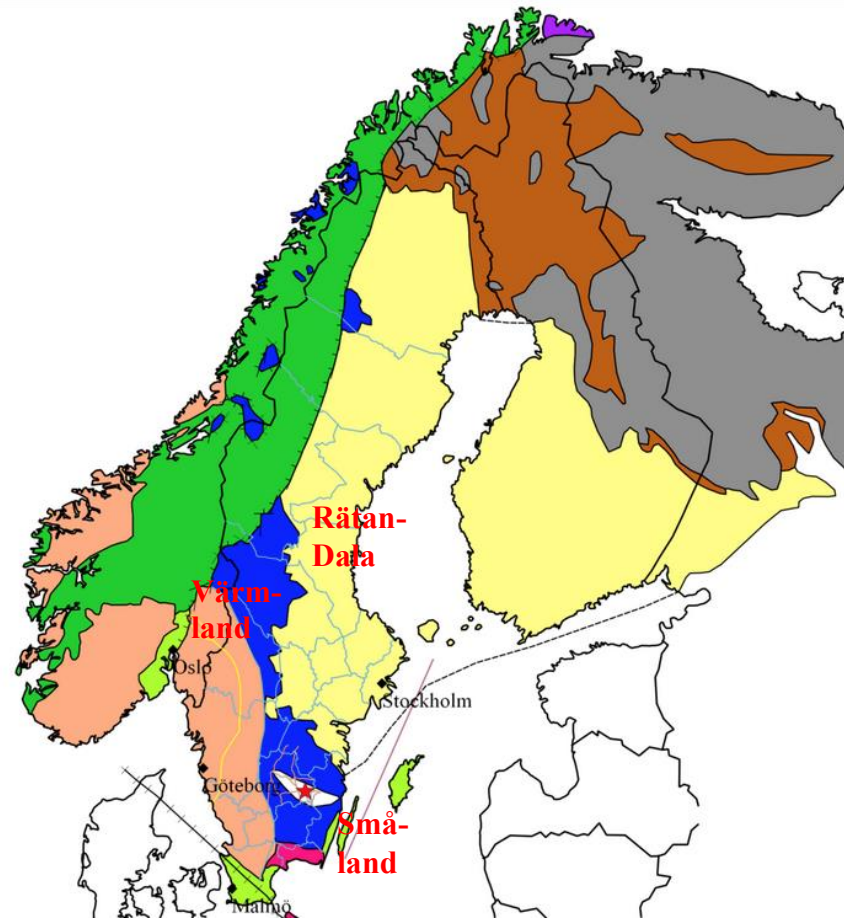




**Piret Plink, Estonia/USA, is an international top scientist in sedimentology.**

## d. TIB (Transscandinavian Igneous Belt);

TIB is a major igneous unit in Fennoscandia that can be followed along the western border of the Svecofennian Domain for 1000 kilometres.



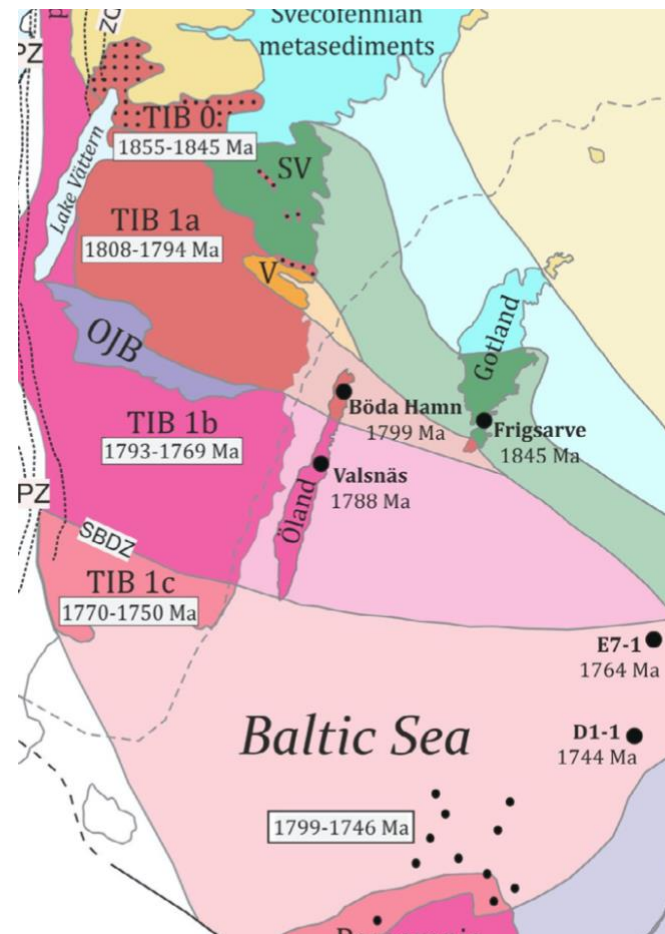
TIB, marked in blue, runs from the Baltic Sea to northern Norway.

The TIB concept was born in the early 1980ies,  
 when it was understood that many granitoids, previously thought to have very different ages,  
 actually form a major coherent igneous belt along the SW margin of the Svecofennian Domain.

TIB is now subdivided into four generations (TIB 0, 1a, 1b and 2) and has many local names.

Local names	Previous “age” estimates	U-Pb age	Generation
Rätan	Algonk	1700 Ma	TIB 2
Dala	Algonk	1700 Ma	TIB 2
Värmland*	“Archaean”	1765-1810 Ma	TIB 1b and 2
Småland*	“Archaean”	1765-1810 Ma	TIB 1 a, 1 b and 2
Växjö	“Archaean”	1765-1810 Ma	textural type within TIB 1b
Filipstad	“Archaean”	1765-1810 Ma	textural type within TIB 1b
Askersund	“Archaean”	1840-1850 Ma	TIB 0
Loftahammar	“Archaean”	1840-1850 Ma	TIB 0

\* key unit in the “Gothian orogeny”

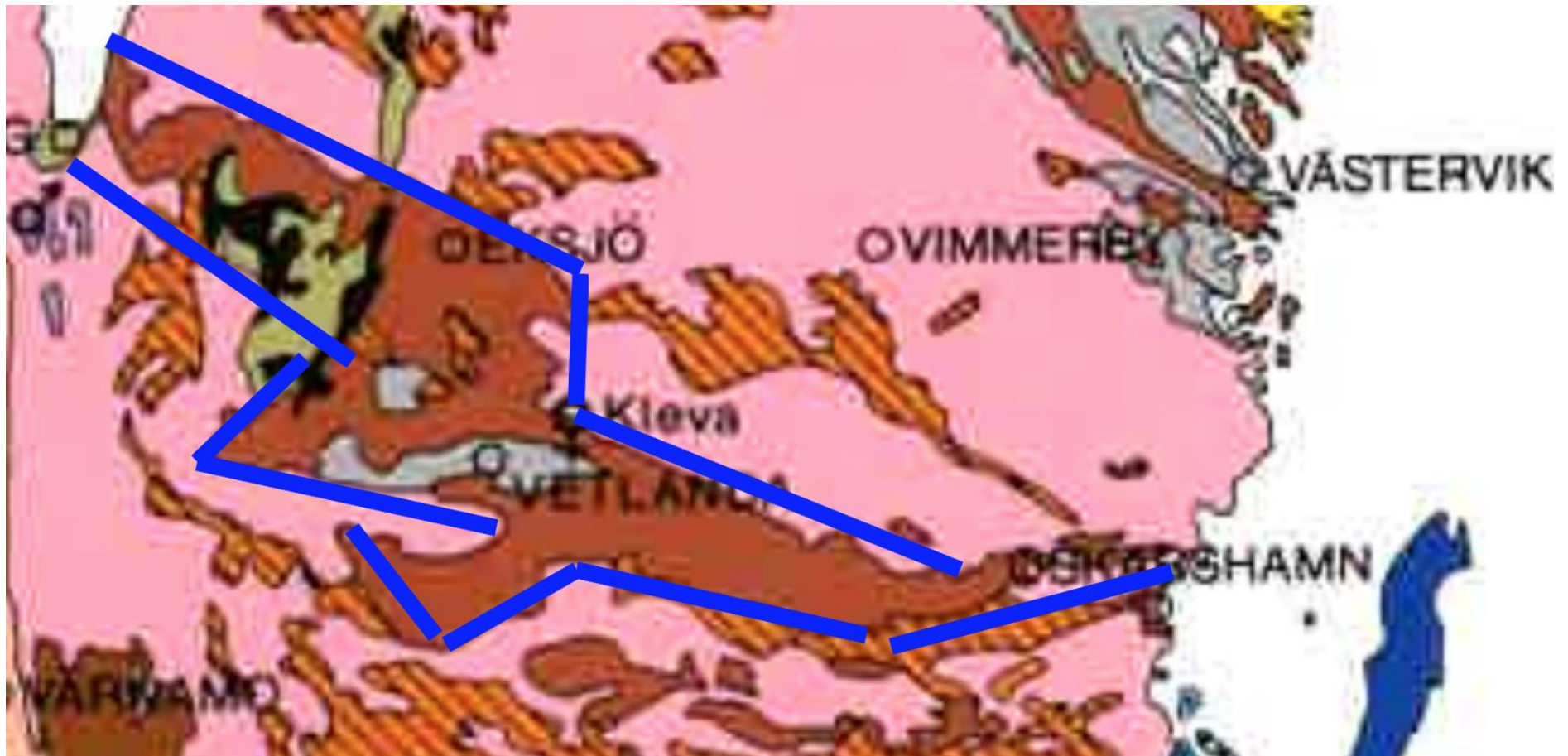


Salin (2019) showed that TIB 1 also exist under the Öland and Gotland islands.

We also suggested to subdivide TIB 1 into 1a, 1b and 1c (which only partly is true).  
*It is enough to separate TIB 1 into a and b.*



The distribution of OJB is commonly depicted like this:



With the definition of Mansfeld (1996),  
OJB consists of  
*1.83 Ga tonalites and Vetlanda supracrustal rocks.*

**The distribution of these two units is, however, much more restricted than on the previous map.**

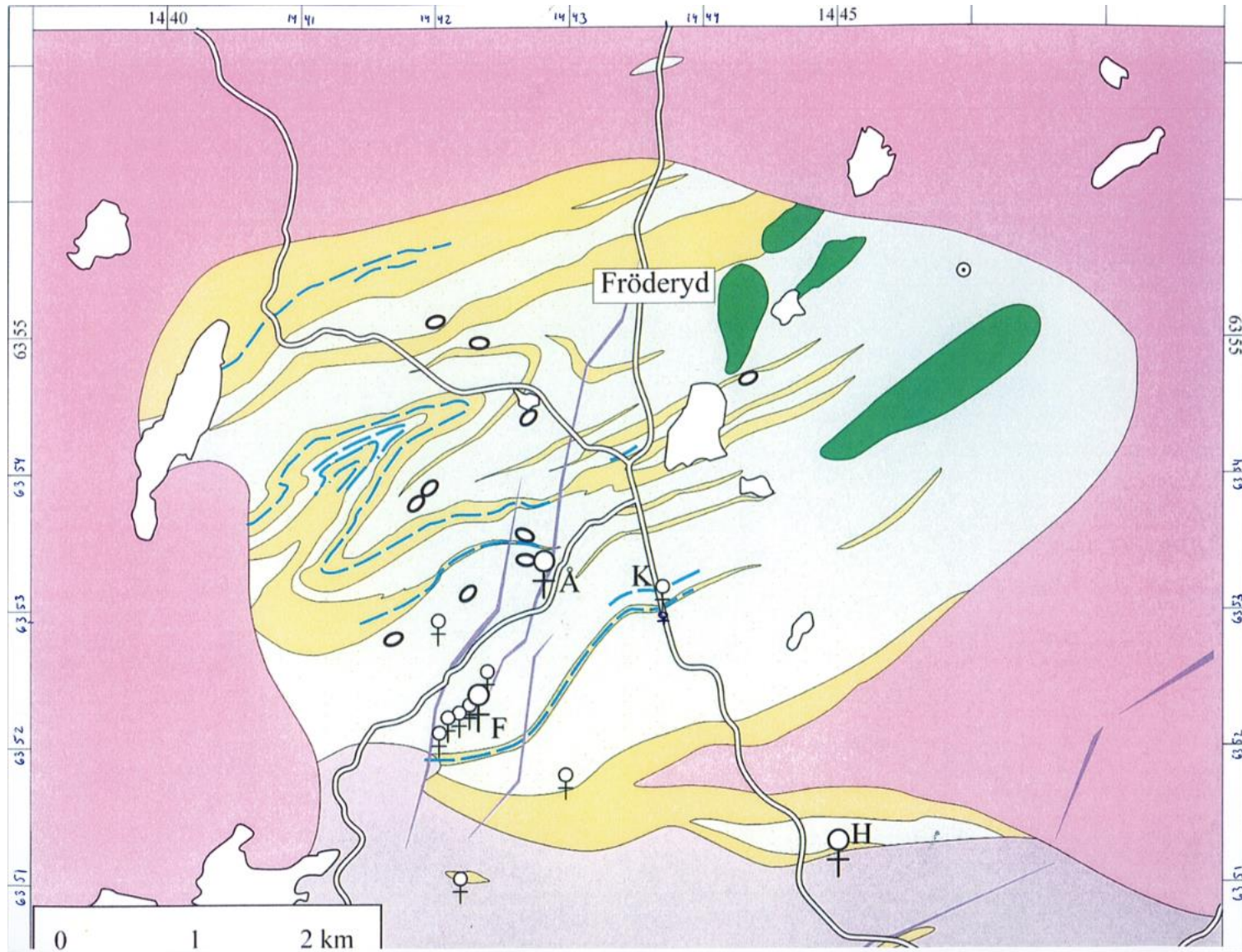
**Instead, several other formations also occur within this structure, which *do not belong to* the OJB definition, e.g.:**

**Fröderyd oceanic complex**

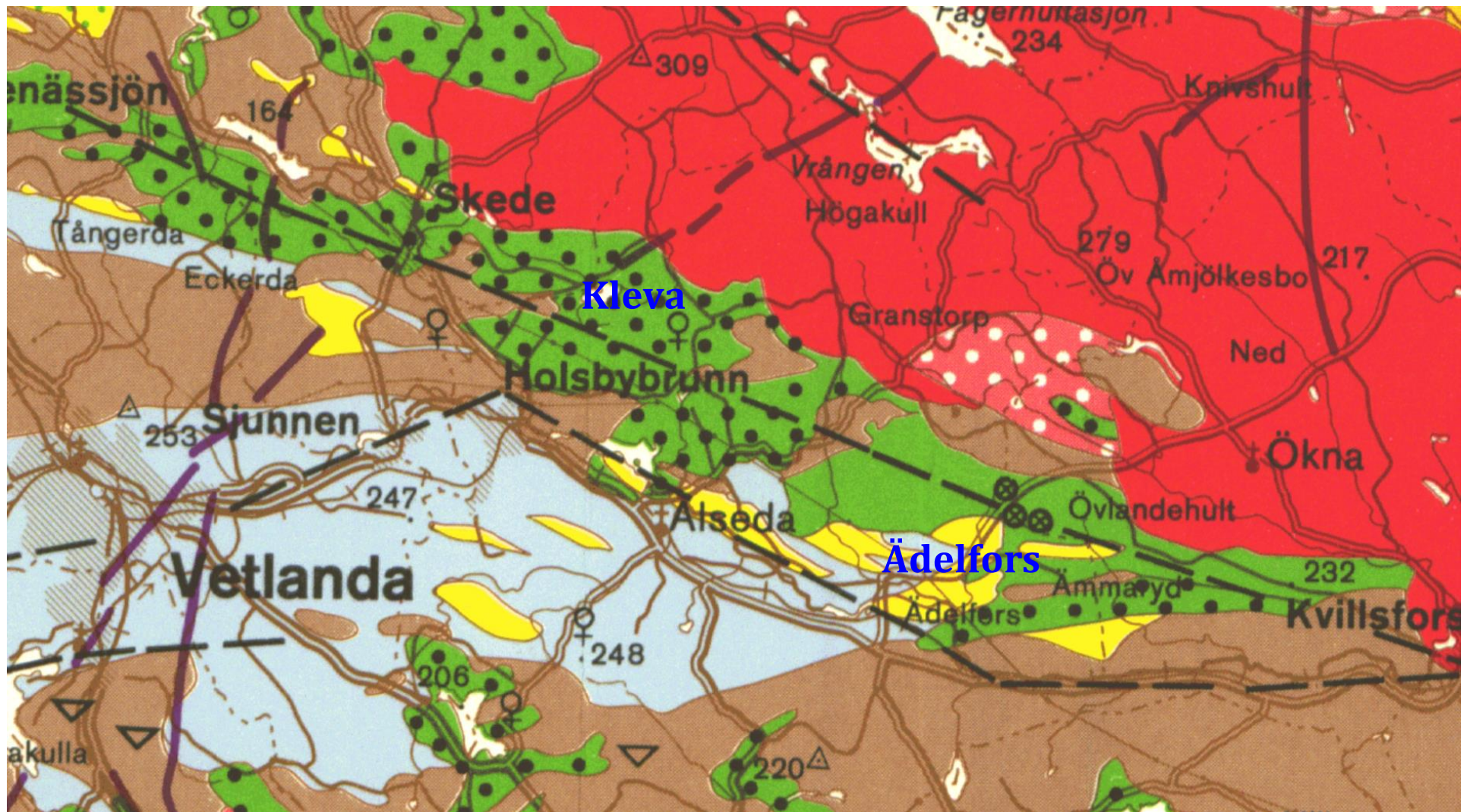
**Kleva-Ädelfors mafic igneous complex**

**Hörnebo rhyolite-conglomerate succession**

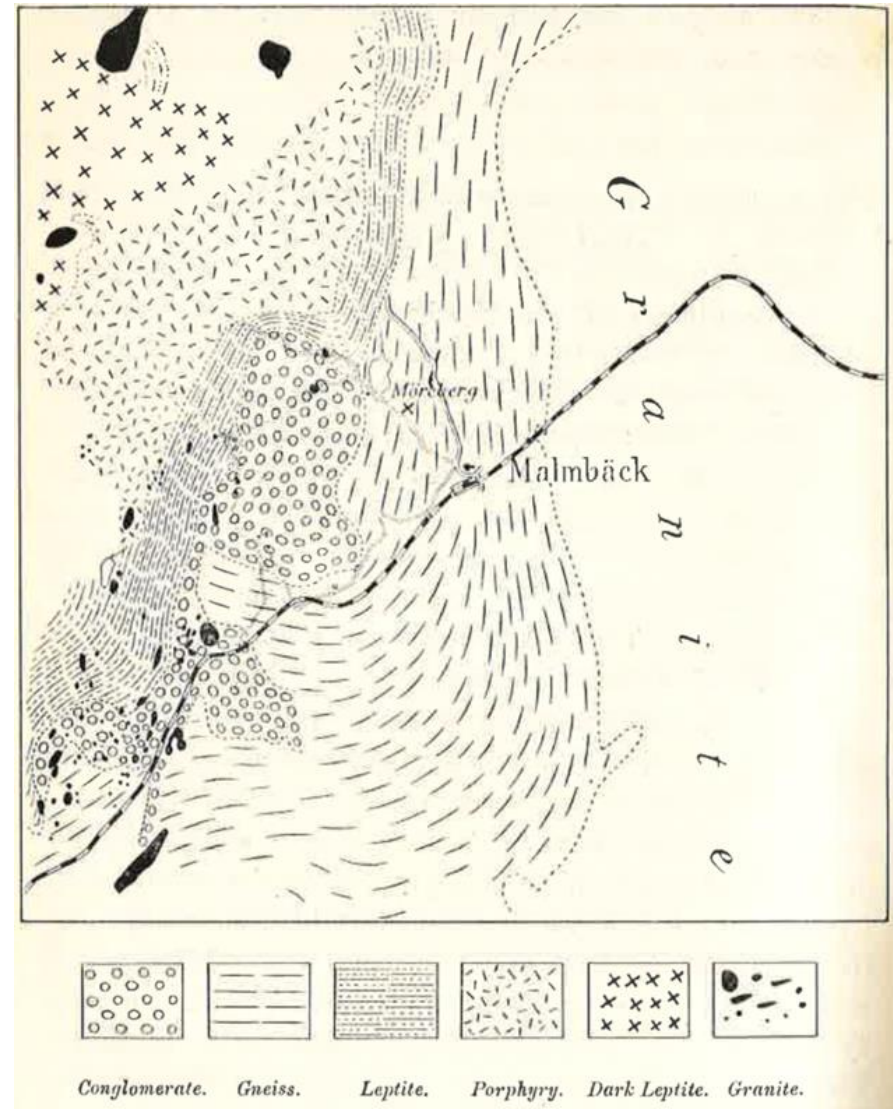
**Malmbäck conglomerate**



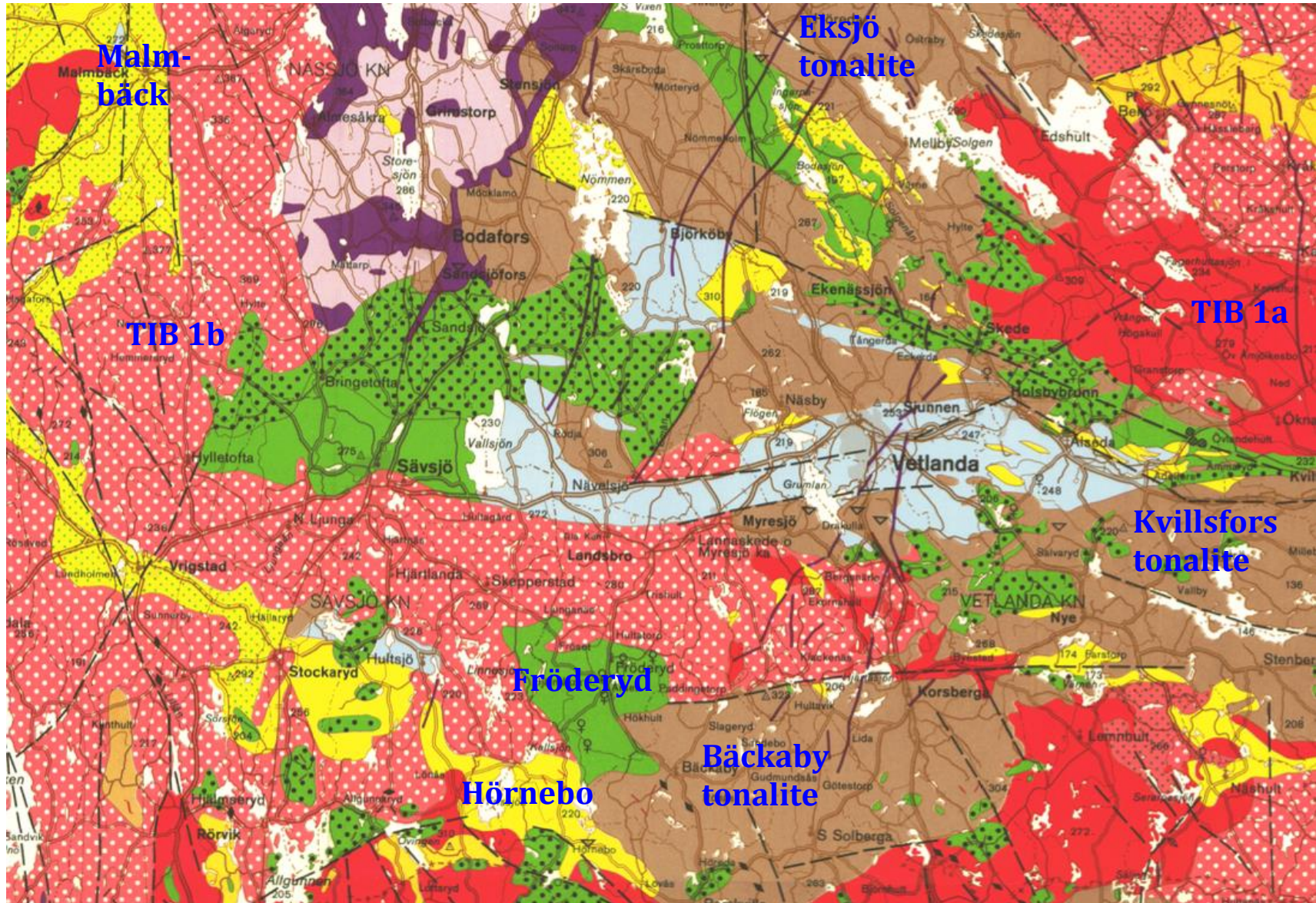
**The 1853 Ma Fröderyd oceanic complex (Sundblad et al., 1997; Salin et al., 2021).**

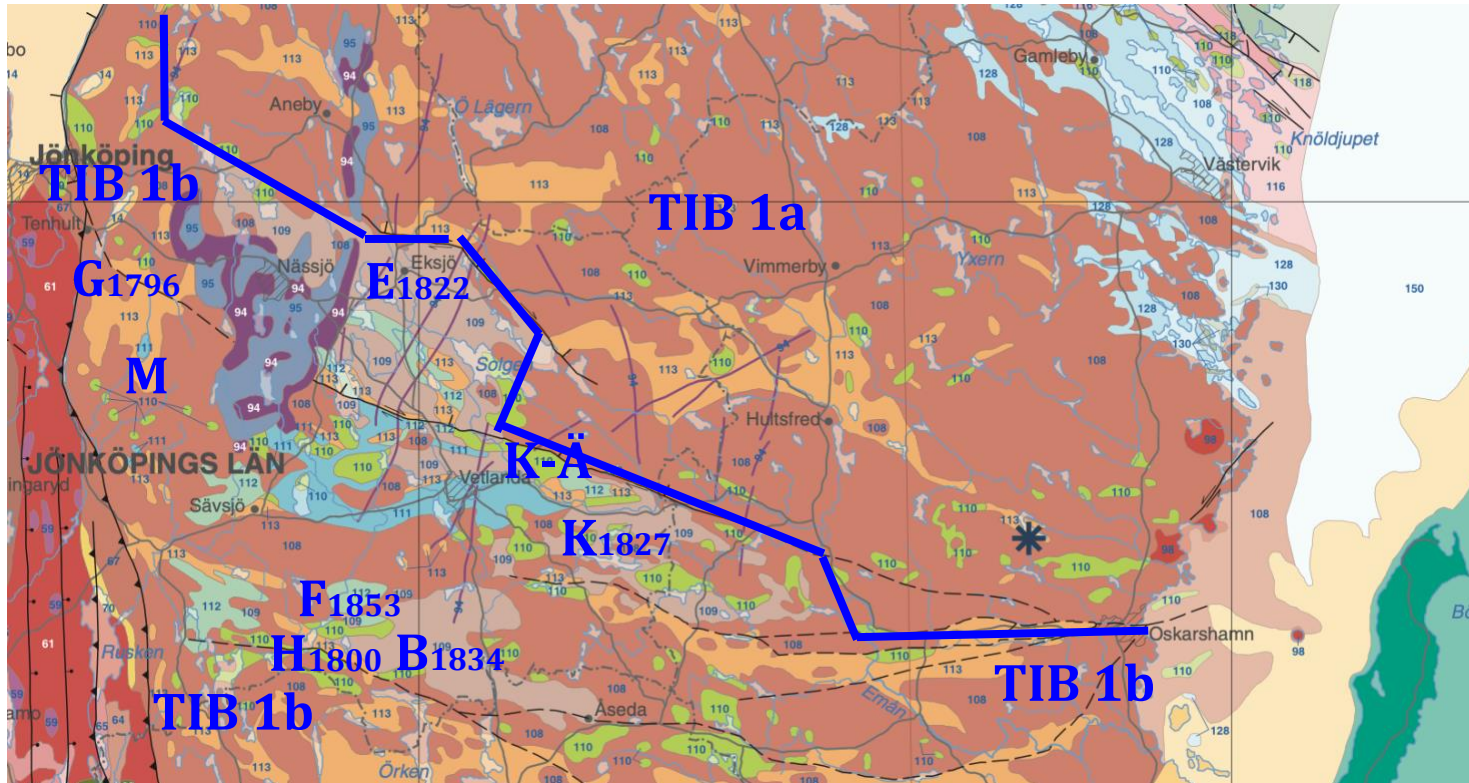


The 1796 Ma Kleva-Ädelfors mafic igneous complex (Björnberg et al., 2015).



**The Malmback conglomerate (Hedström, 1910).**





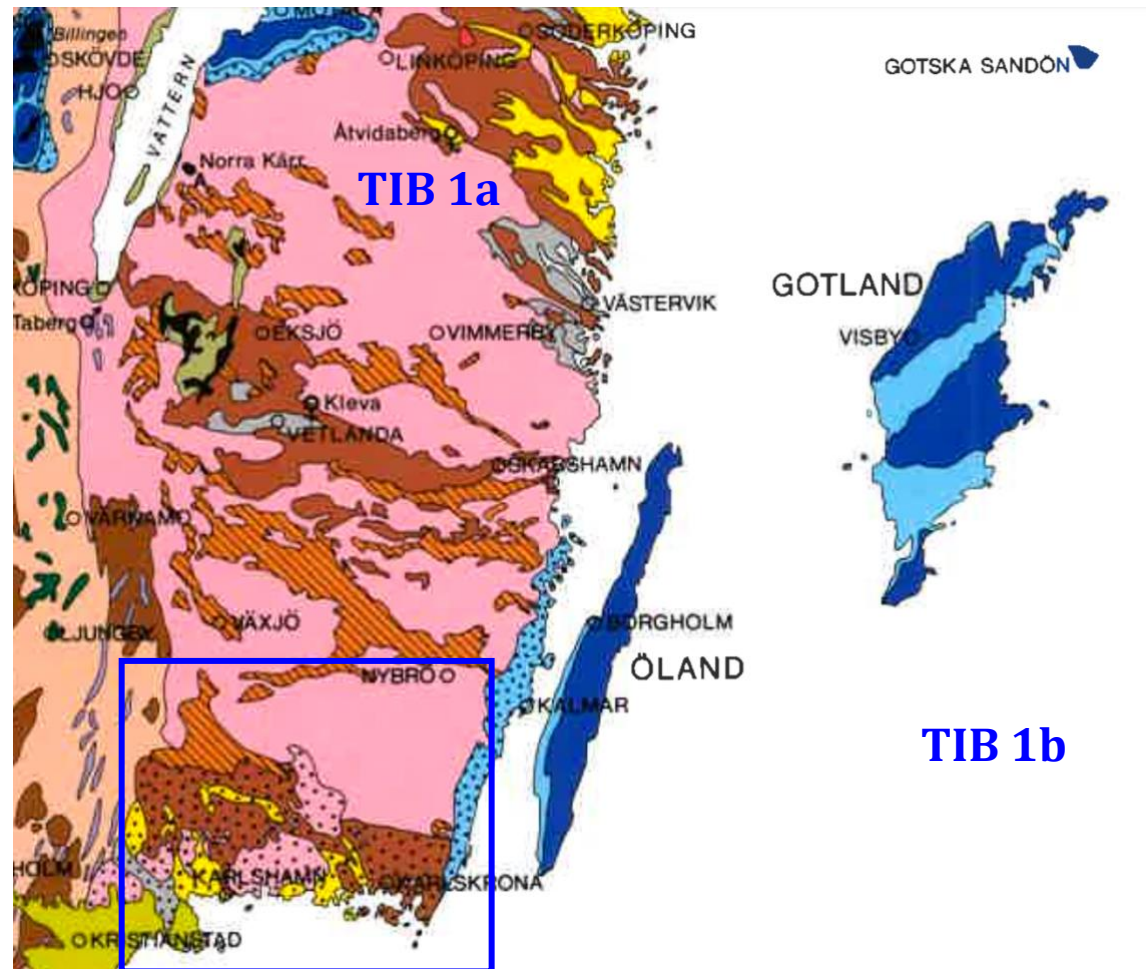
**All these successions are located between TIB 1a and TIB 1b.**

**No part of them are old enough to be considered Svecofennian.**

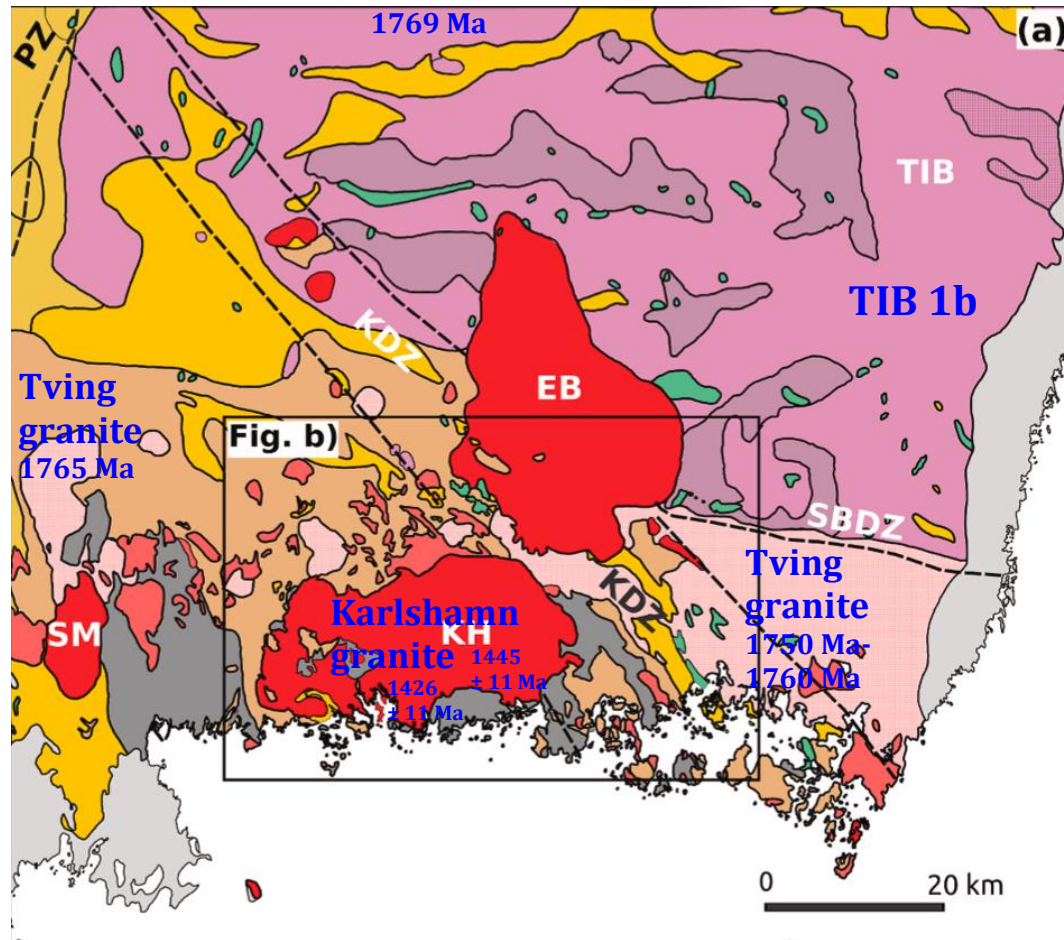
**They were considered to be “Gothian” in older literature.**

**They were characterized as exotic terranes by Sundblad and Salin (2022).**

## f. The Blekinge region



Blekinge is a region in SE Sweden, where the oldest rocks (Tving granites) often are considered different from the neighboring TIB 1b rocks.



Čečys et al. (2025)

but there is no age differences between the TIB 1b granitoids and the Tving granite.

In our opinion, there is no reason to separate the Tving granite from TIB 1b.

Salin et al. (2019) proposed the term TIB 1c, but that cannot anymore be verified.