

what do we do with the
High Level Nuclear Waste
???

what we must NOT do (KBS-3)
what we may do instead (DRD)

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High Level Nuclear Waste

needs to be isolated from the biosphere in 100,000 years

From the fuel:

via CLAB *“for up to 100 years or more”*
to a final KBS-3 repository in the bedrock
(a closed, wet repository at 500 m)

From the reactors:

the reactor tanks

No program available at present !

A temporary storage in BFA deposit
(an unsafe surface bedrock shelter)

KBS-3: a method with triple barriers
they claim
that will stay intact for, at least, 100,000 years
they claim

We will now show that all this
is just nonsense
and disinformation

The KBS-3 method is a fake
that will not work – no chance

The 3 so-called barriers of the KBS-3 method

The copper canisters:

They may be corroded away in 1000 years

The bentonite backfill:

They still don't know how to do it

There is no long-term safety at all

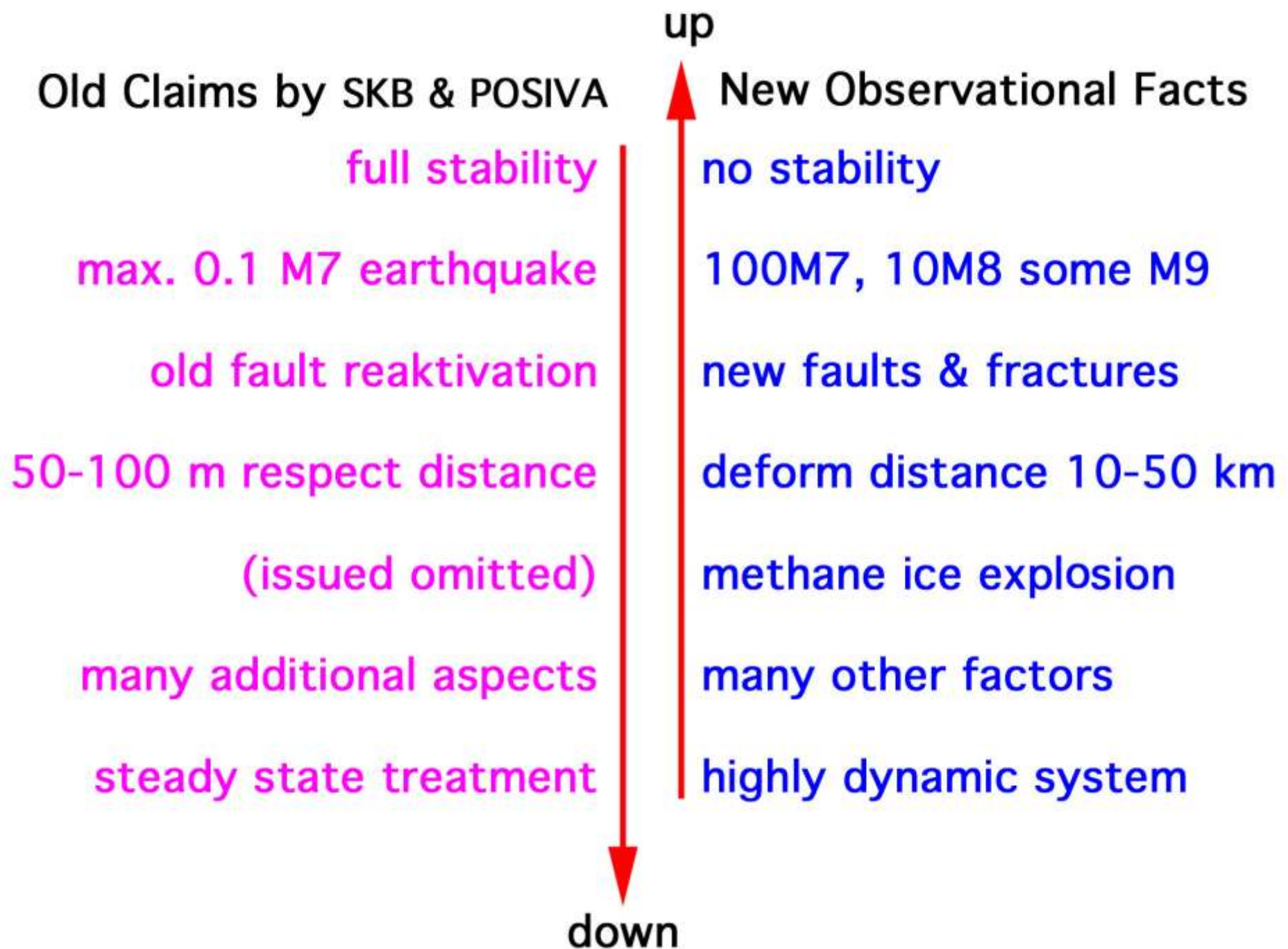
The bedrock itself – the very base for the method

There is no long-term safety at all

- far too many & large earthquakes**
- far too large “respect distances”**
- unpredicted “methane gas tectonics”**
- etc., etc.**

The KBS-3 method and the 100,000 years of required safety

DURING 100,000 YEARS	<p>Assumptions and Models by SKB and POSIVA</p>	<p>Assumptions & Models COLLAPSED stability concept seismic concept respect distance methane explosion lots of other things</p>
TODAY	<p>CLAIMS by SKB and POSIVA</p>	<p>MUCH REMAINS to solve to show to improve</p>
	RELIABLE	UNRELIABLE



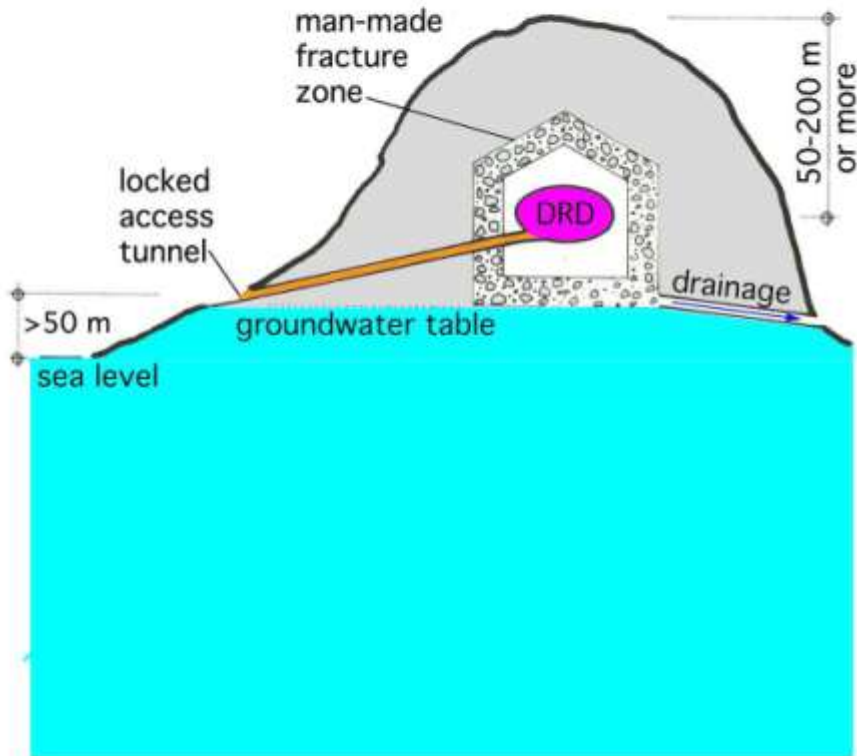
Now we know that the KBS-3 method does not work
Now we have to do something different

”the best under the circumstances”

This is a storage
in a Dry Rock Deposit (DRD)
– remaining accessible and controllable –

Dry Rock Deposit (DRD)

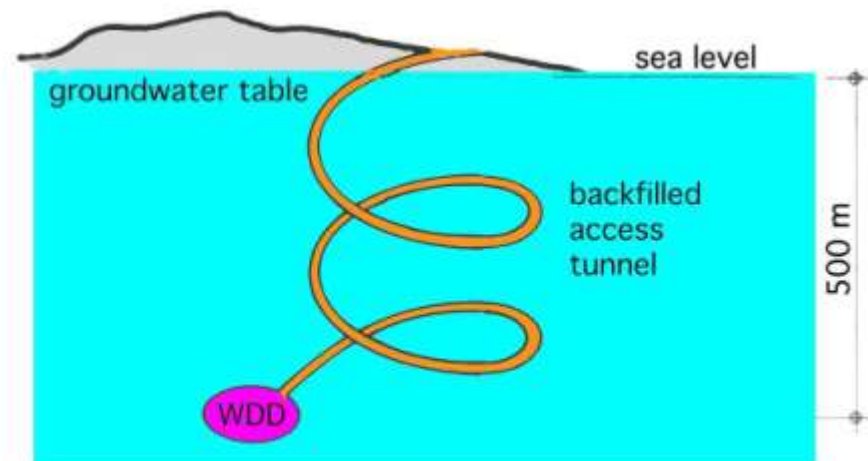
high relief area
far above sea level



Accessible and Controllable

Wet Deep Disposal (WDD) of KBS-3 type

low relief area
close to sea level



Closed and Final

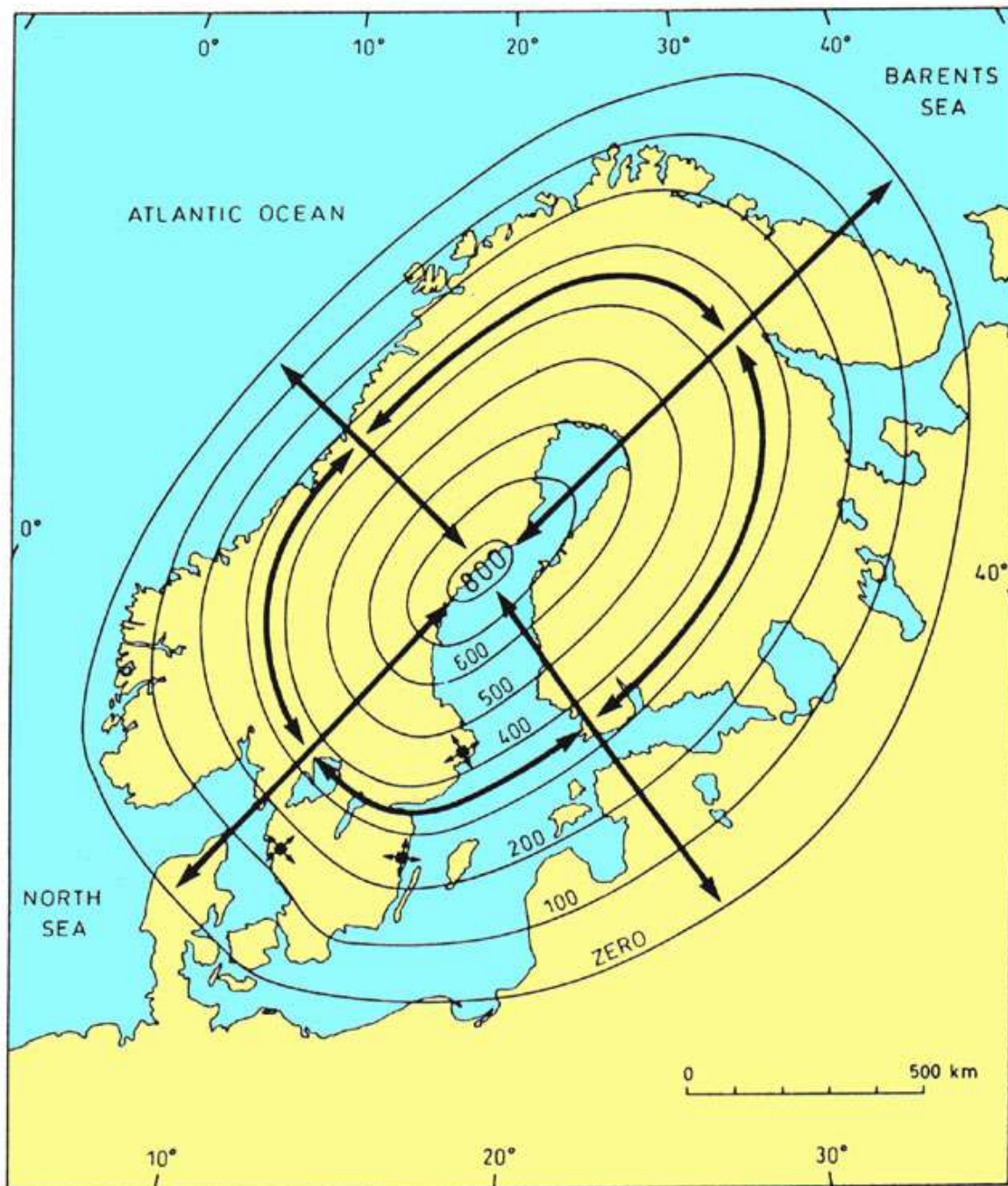
1.

the collapse of the bedrock barrier

Earthquakes

“Respect distances”

Methane Gas Tectonics



After the Ice Age
land has gone up
by 800 m
in the centre
in Ångermanland
and by 450 m
at Stockholm

These movements
(vertical & horizontal)
made Sweden
9000-10,000 years BP
a

high-seismic area

A total of 59
paleoseismic events
recorded by 2009

ICE COVER

32 30 28

ICE COVER

13 10 5 0

15
10
5
0

13 KA

Pärve

Lansjärv

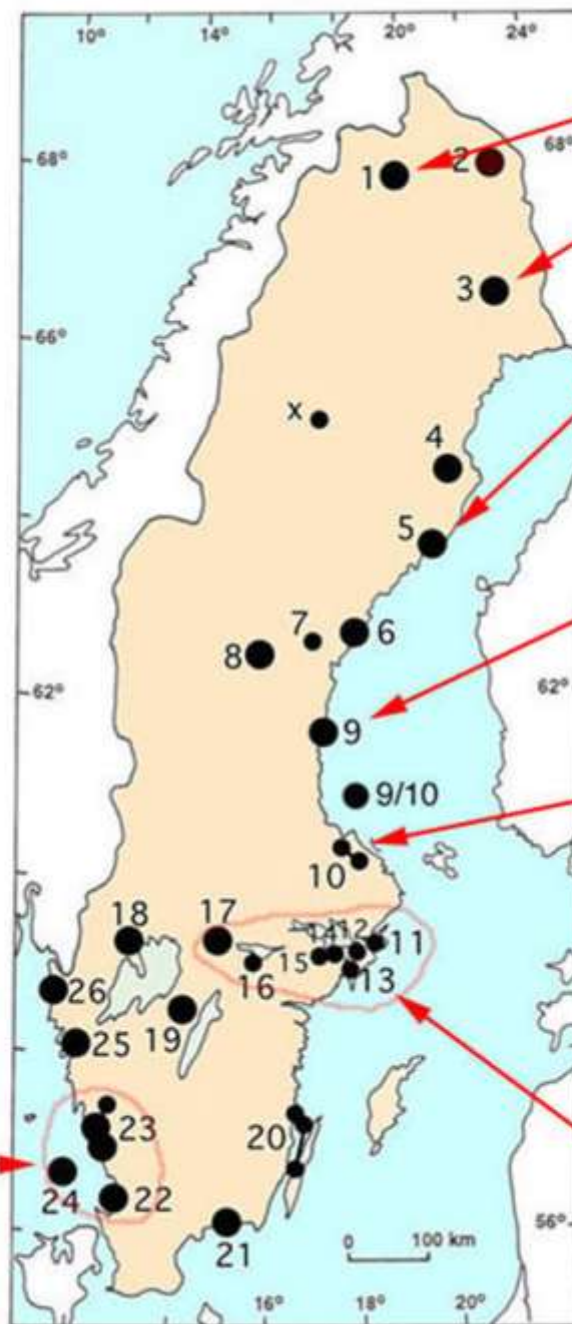
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7

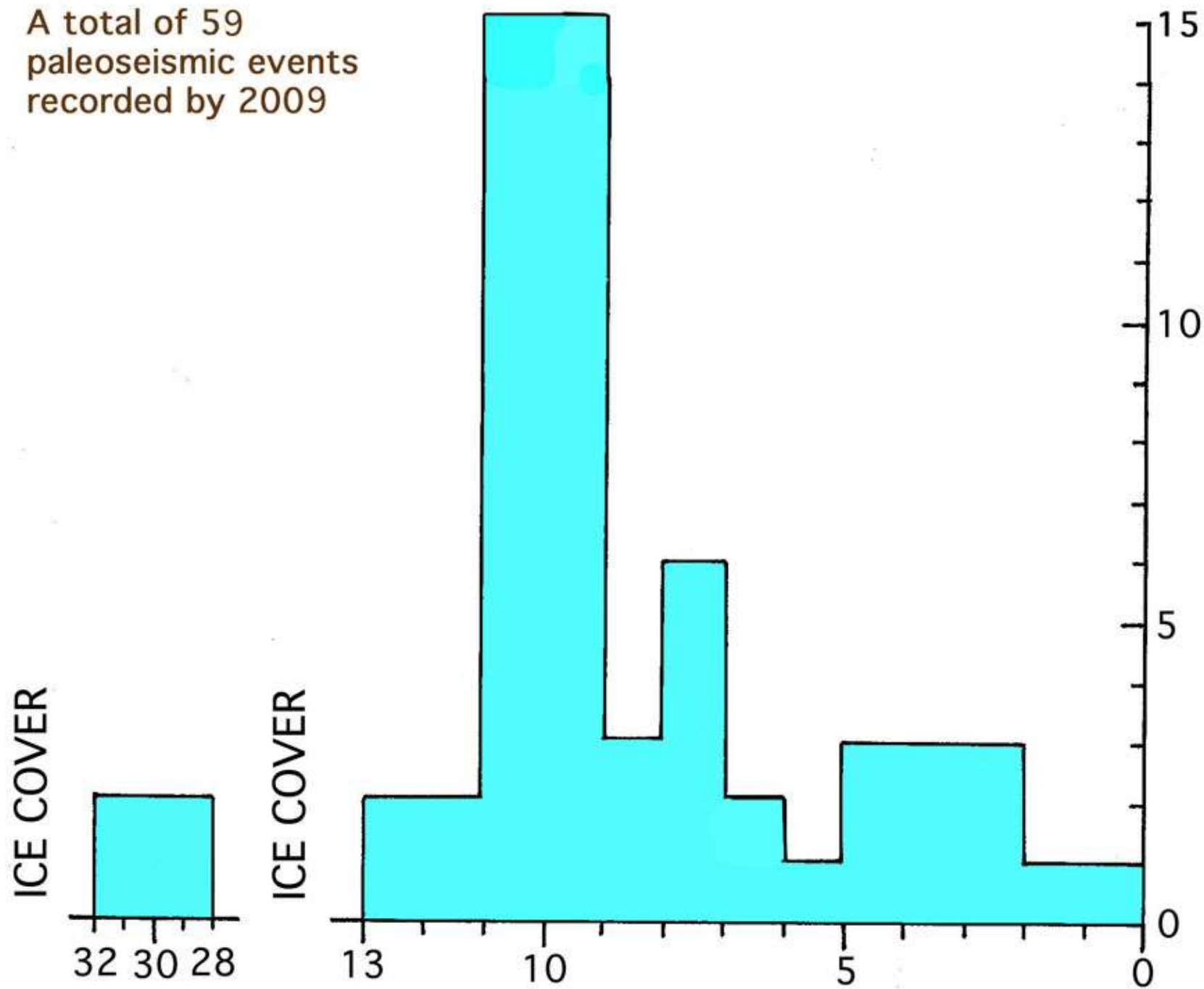
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14

11 KA



A total of 59
paleoseismic events
recorded by 2009

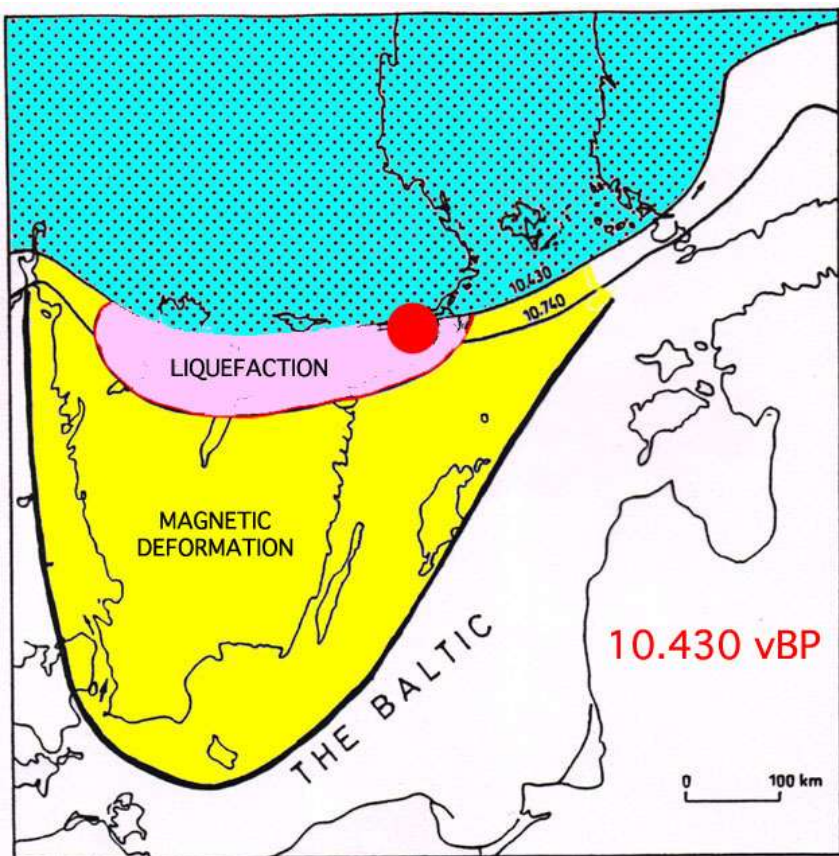


Distribution of paleoseismic events in Sweden
(the 2004 Calalogue of 54 events)
in magnitude groups per 1000 years

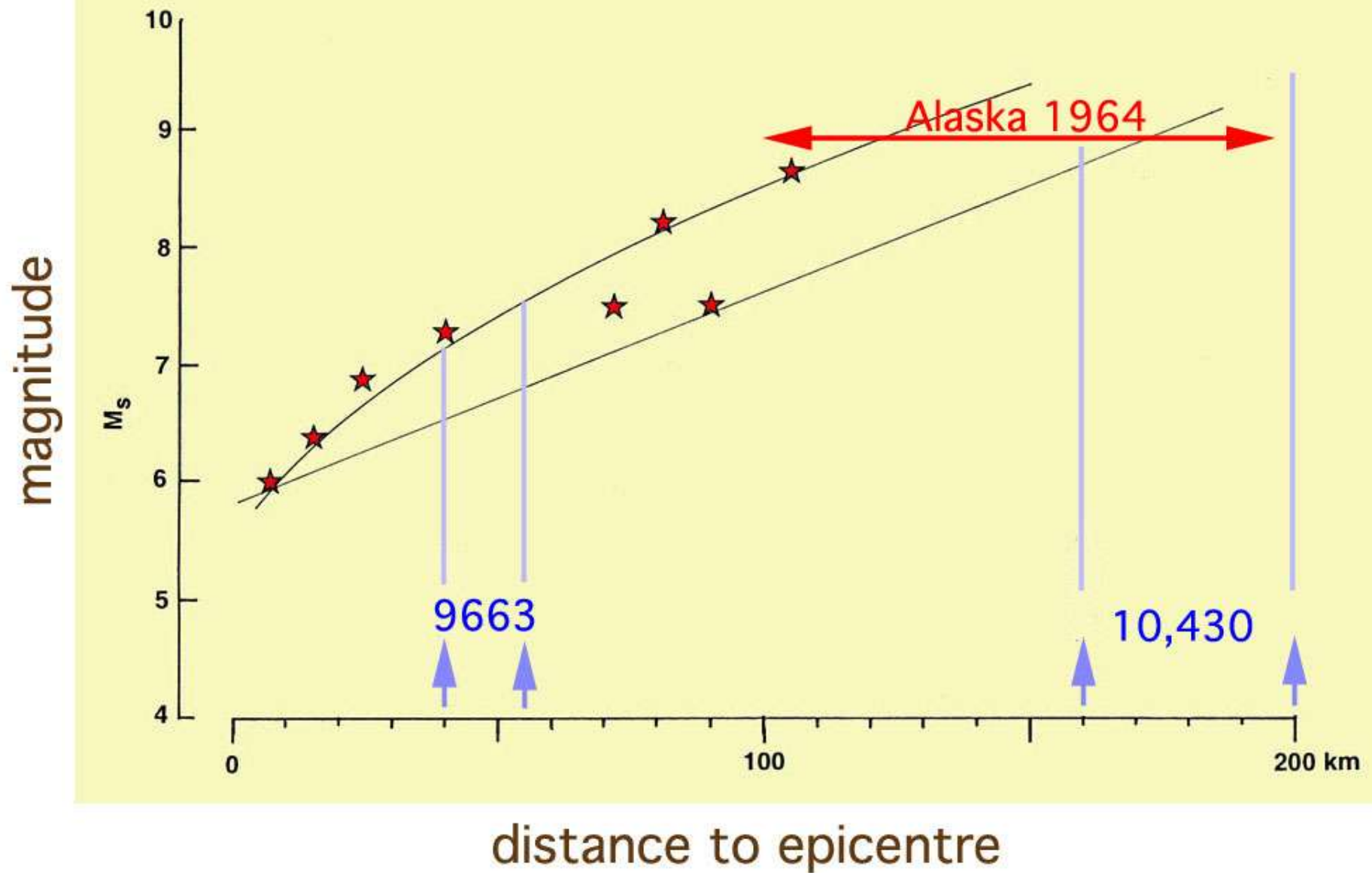
Time in yrs BP	M5-6	M6-7	M7-8	M>8	Total
>12000	-	1	-	1	2
11000–12000	-	-	2	-	2
10000–11000	-	9	4	1	14
9000–10000	2	5	4	3	14
8000–9000	-	2	1	-	3
7000–8000	2	4	-	-	6
6000–7000	-	-	-	1	1
5000–6000	-	-	1	-	1
4000–5000	-	2	1	-	3
3000–4000	-	1	2	-	3
2000–3000	-	2	1	-	3
1000–2000	1	-	-	-	1
<1000	-	-	1	-	1
total:	5	26	17	6	54

7 earthquakes within 102 years in Mälardalen

(10,490–10,388 vBP)



<i>year</i>	<i>magnitud</i>	<i>epicenter</i>
10,490	6–7	Stockholm
10,469	7–8	Mariefred
10,447	6–7	Stockholm
10,430	8–9	Stockholm
10,400	7–8	Säffle
10,410	~6	Stockholm
10,388	>8	Mariefred



Because we can tie the Swedish liquefaction structures to one single varve (year), we can calculate their spatial distribution & magnitude

With increasing time units, the maximum earthquake magnitude increases dramatically; from below 4.5 to well above 8.

Seismology	<100 years	<4.5
Historical data	last 600 years	<5.5
Late Holocene	last 5000 years	>6 to ~7
Deglacial phase	9–11 Ka BP	>8

This implies that we can only achieve a meaningful long-term seismic hazard assessment, if the paleoseismic records of past earthquake events are included.

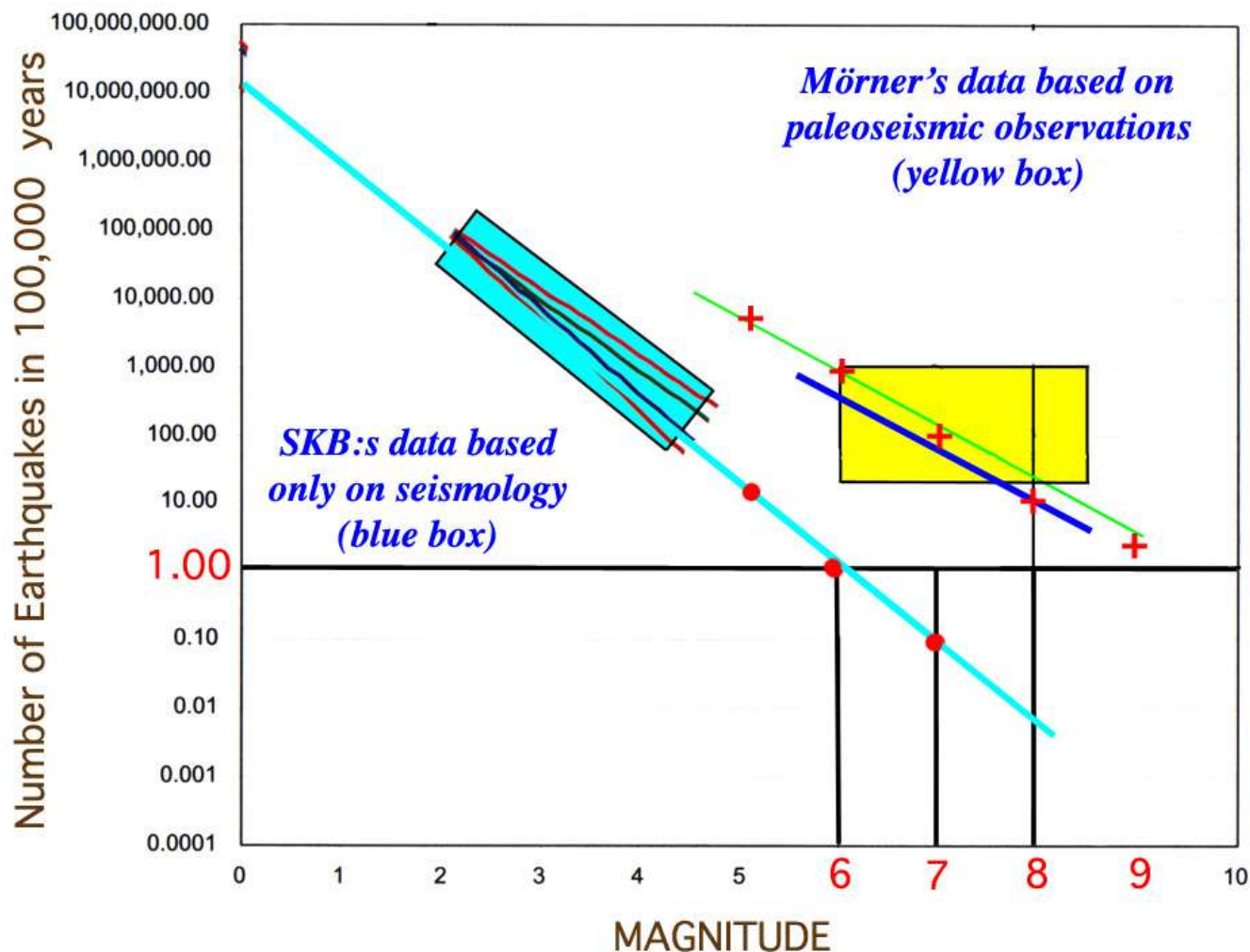
Seismic Hazard Prediction for the next 100,000 years

A: **Blue box** – based on seismic data only (SKB, Posiva)

max 1 M 6 event in 100,000 years

B: **Yellow box** – based on paleoseismic data (Mörner)

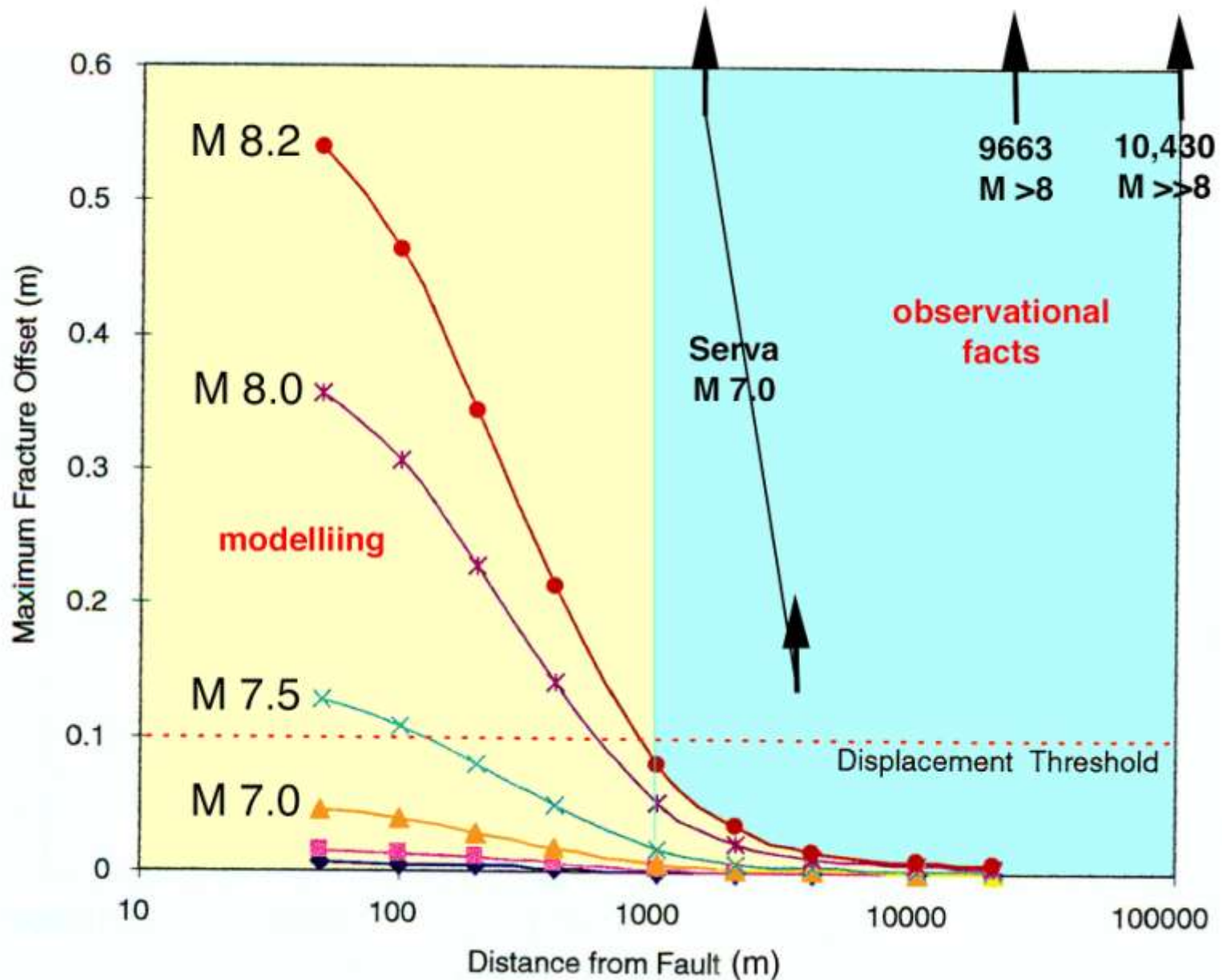
100–1000 M 7 events, ~10 M 8 events and even some M ~9 events



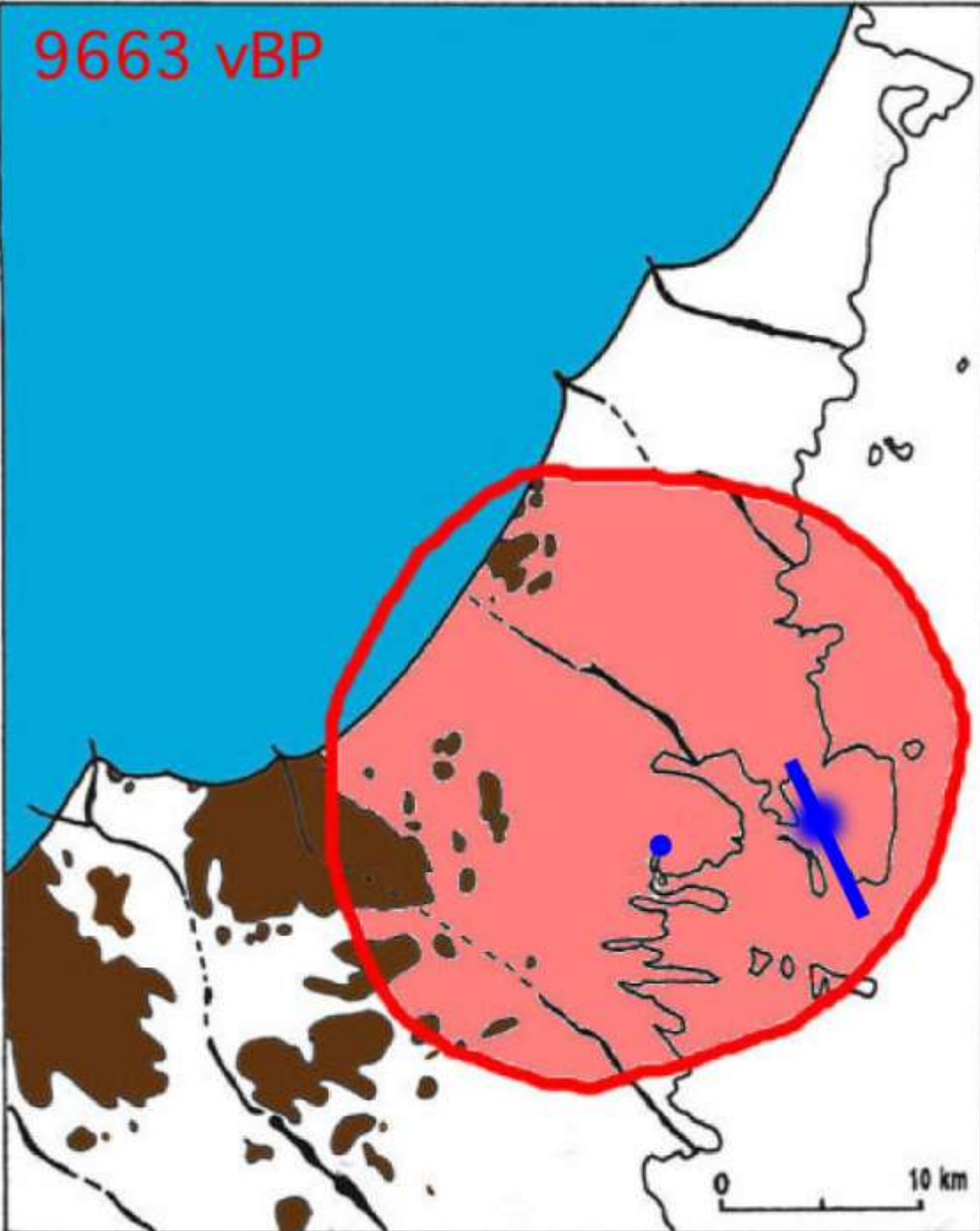
The long-term seismic risk is totally different – a repository would not survive

Energy Release	Richter Scale	Earthquakes in Sweden	in Future 100,000 years	
6.6 x 10 ¹¹	9	<div>Geologic database</div> <div>GEOLOGY paleoseismic field observations</div>		2-3
2.2 x 10 ¹⁰	8			10
7.3 x 10 ⁸	7		0,1	100
2.4 x 10 ⁷	6		1	1000
8.1 x 10 ⁵	5	<div>SEISMOLOGY instruments</div> <div>HISTORIC records (observations)</div> <div>SKB:s database</div>		1000 billion times more seismic energy in yellow field
2.7 x 10 ⁴	4			
9 x 10 ²	3			
3 x 10	2			
1	1			

The safety distance used (from models) does not fit with observational facts implying that there is not room enough for a KBS-3 repository



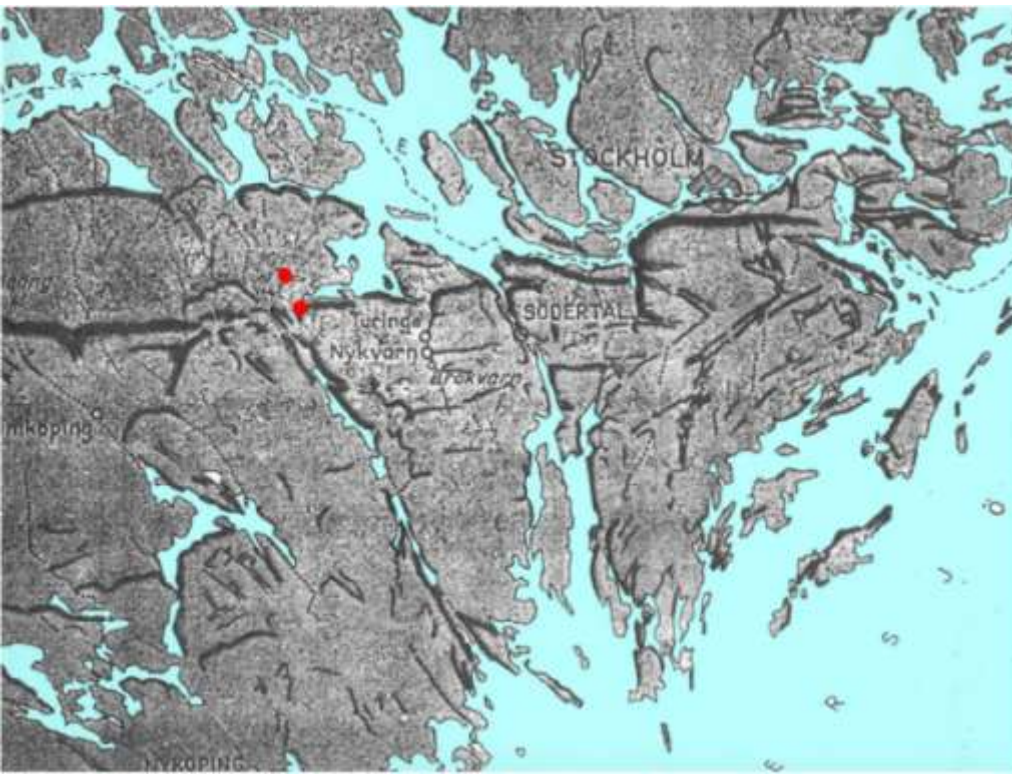
9663 vBP



The Boda Cave (above): a totally fractured bedrock hill with a 2600 m long system of subsurface passages.

Intensive fracturing of the bedrock up to 50 km from the epicentre.
The Boda cave 12,5 km from epicentre is totally fractured into pieces.

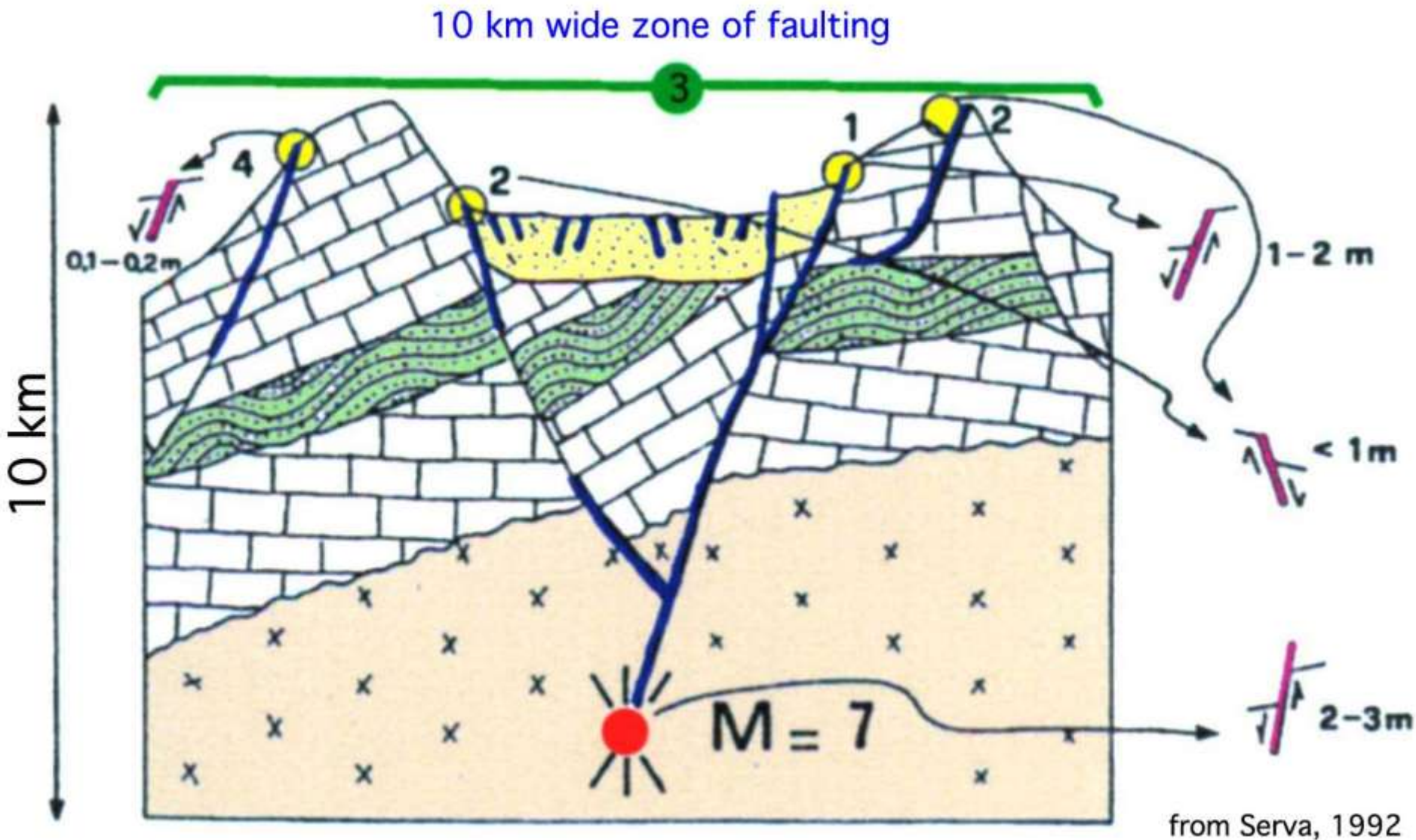
Leggesta-Ärja
a 6-8 m high
fault dated
10,430 vBP



**The main E–W fault that
moved 6 times times in
10,490–10,388 vBP.**

**1 km the the North a new
6-8 m high fault was formed**

**This reveals the nonsense in
SKB:s talk about a safe
distance of only 50-100 m**

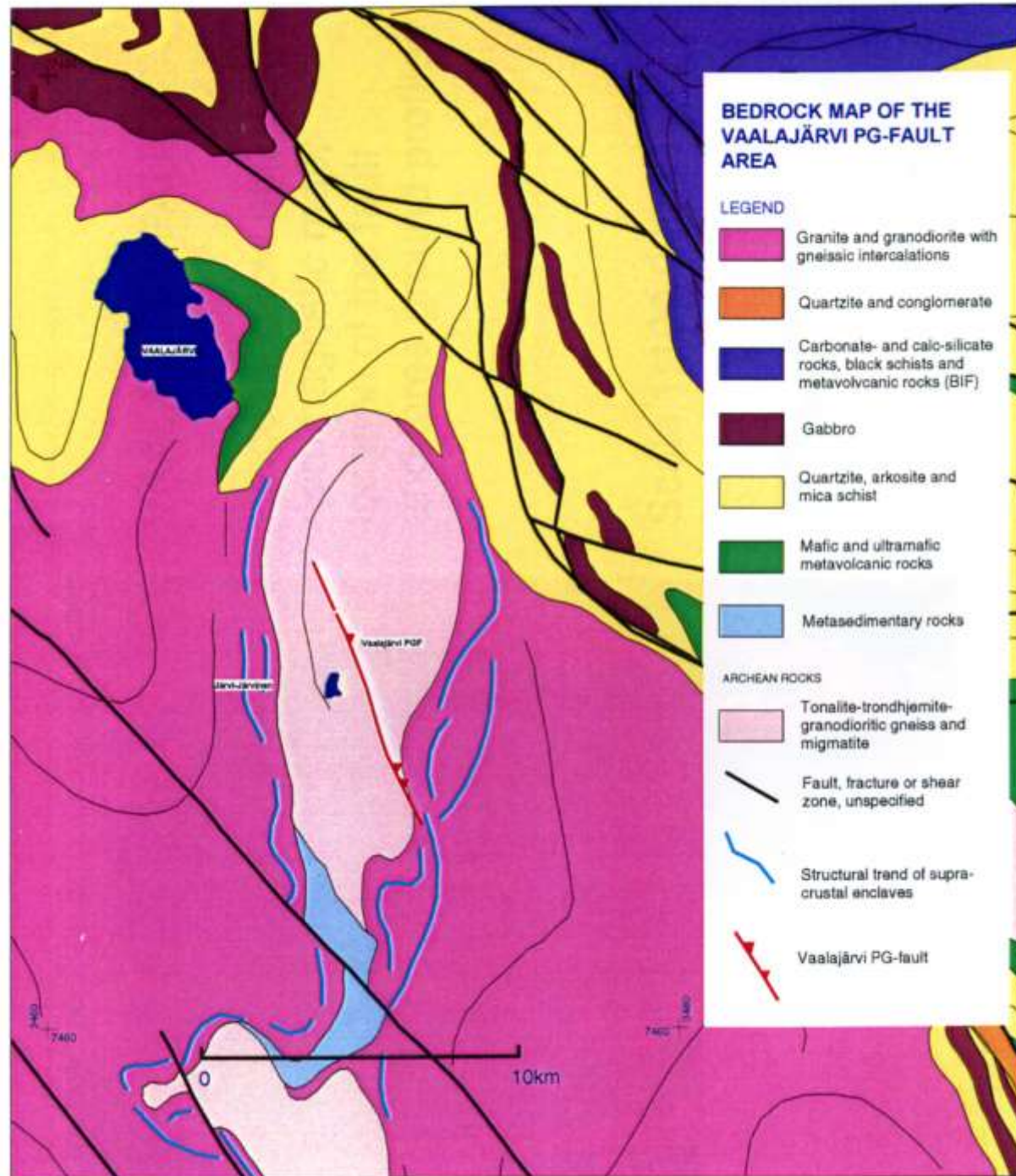


Repository at 500 m for 100,000 years: The claim of a "safe zone" only 50-100 m from a regional fault is, of course, sheer nonsense.

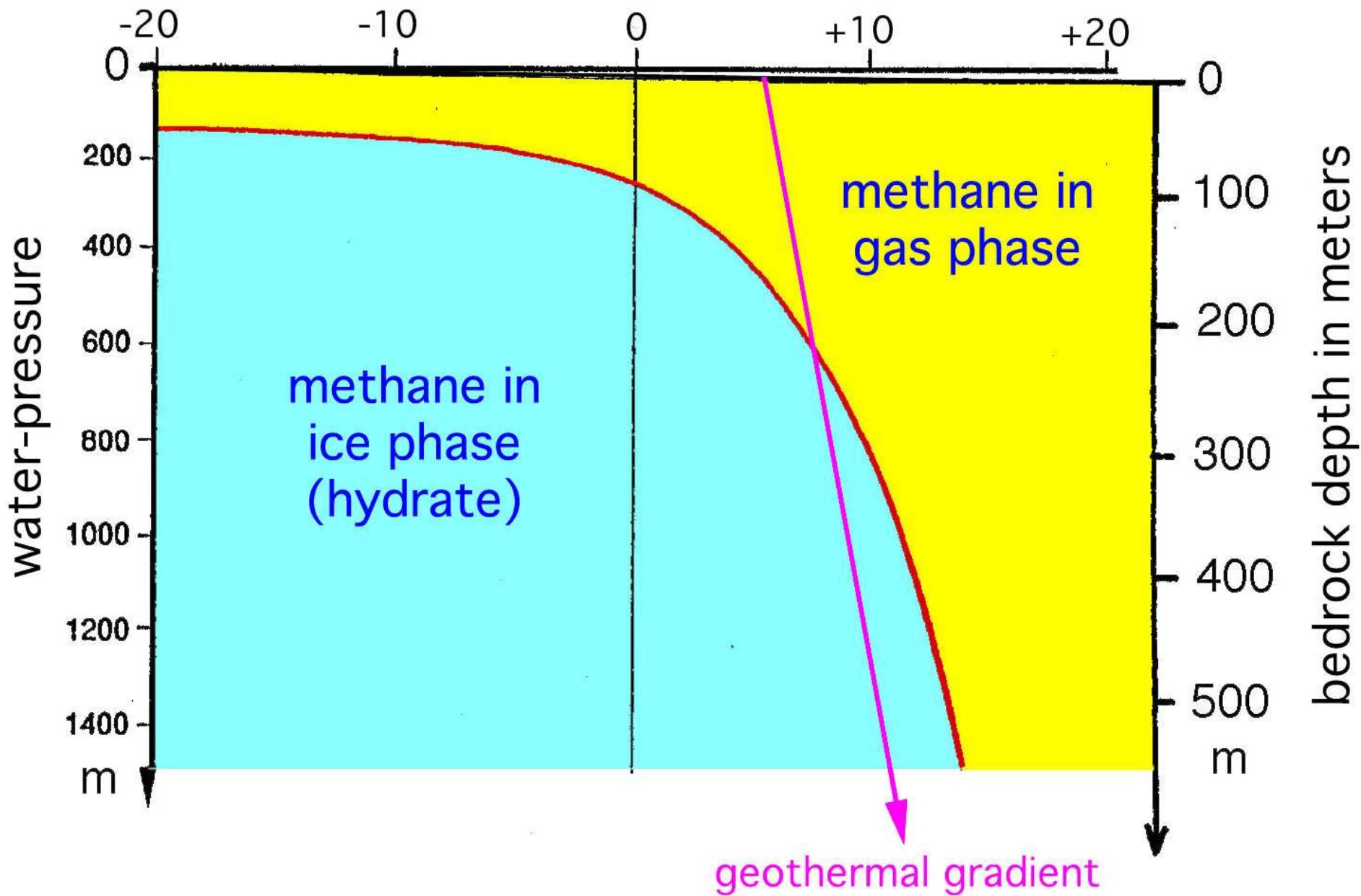
Vaalajärvi Fault (M 6.5–6.8) 10 km long 3 m high

The **FAULT** cuts straight across a bedrock-plinth surrounded by weak zones – totally against what SKB and Posiva claim is possible.

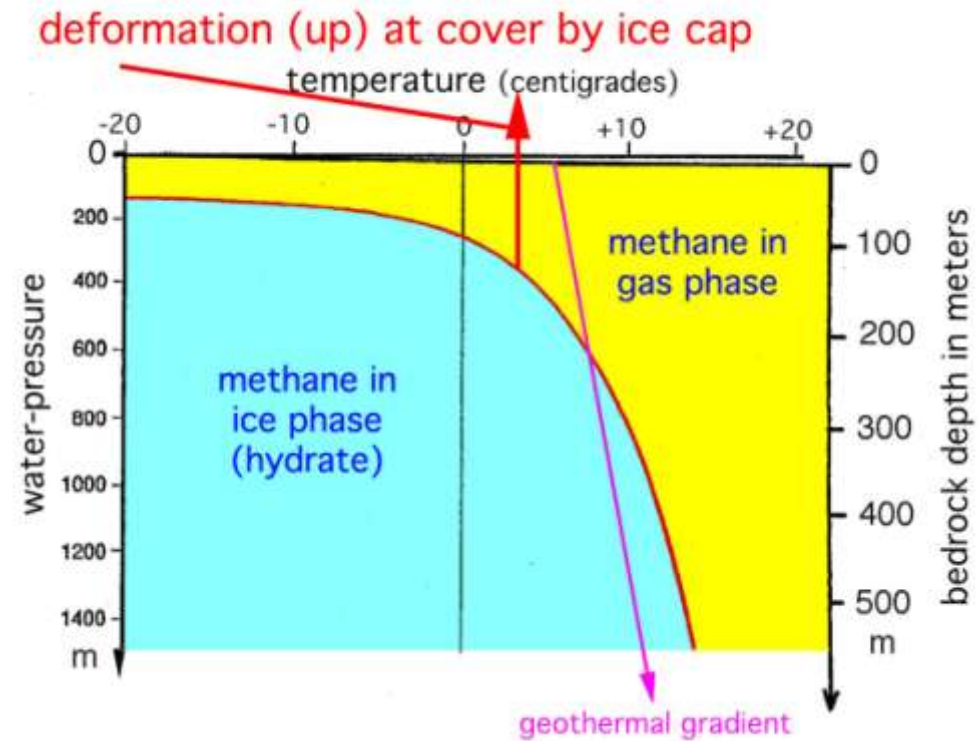
Observation wins



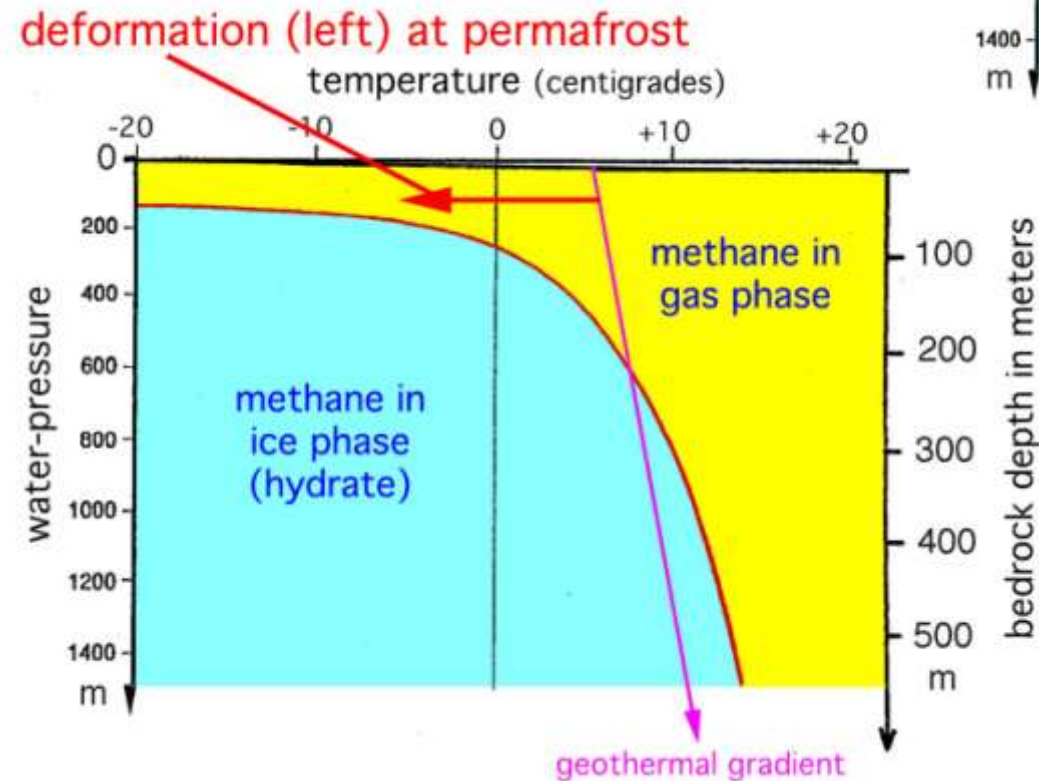
temperature (centigrades)



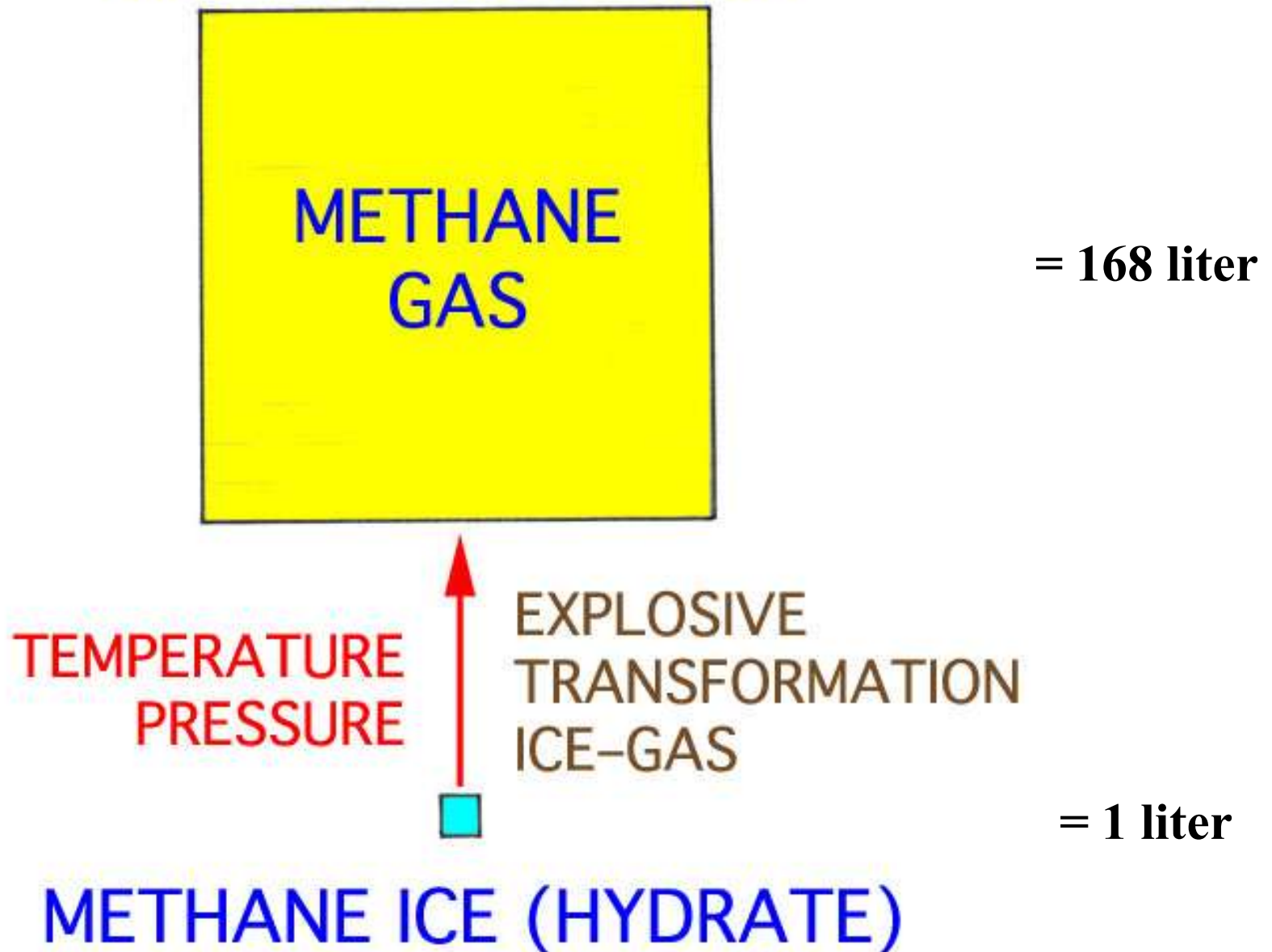
**Phase boundary moves up
at glacial ice cover
(right)**

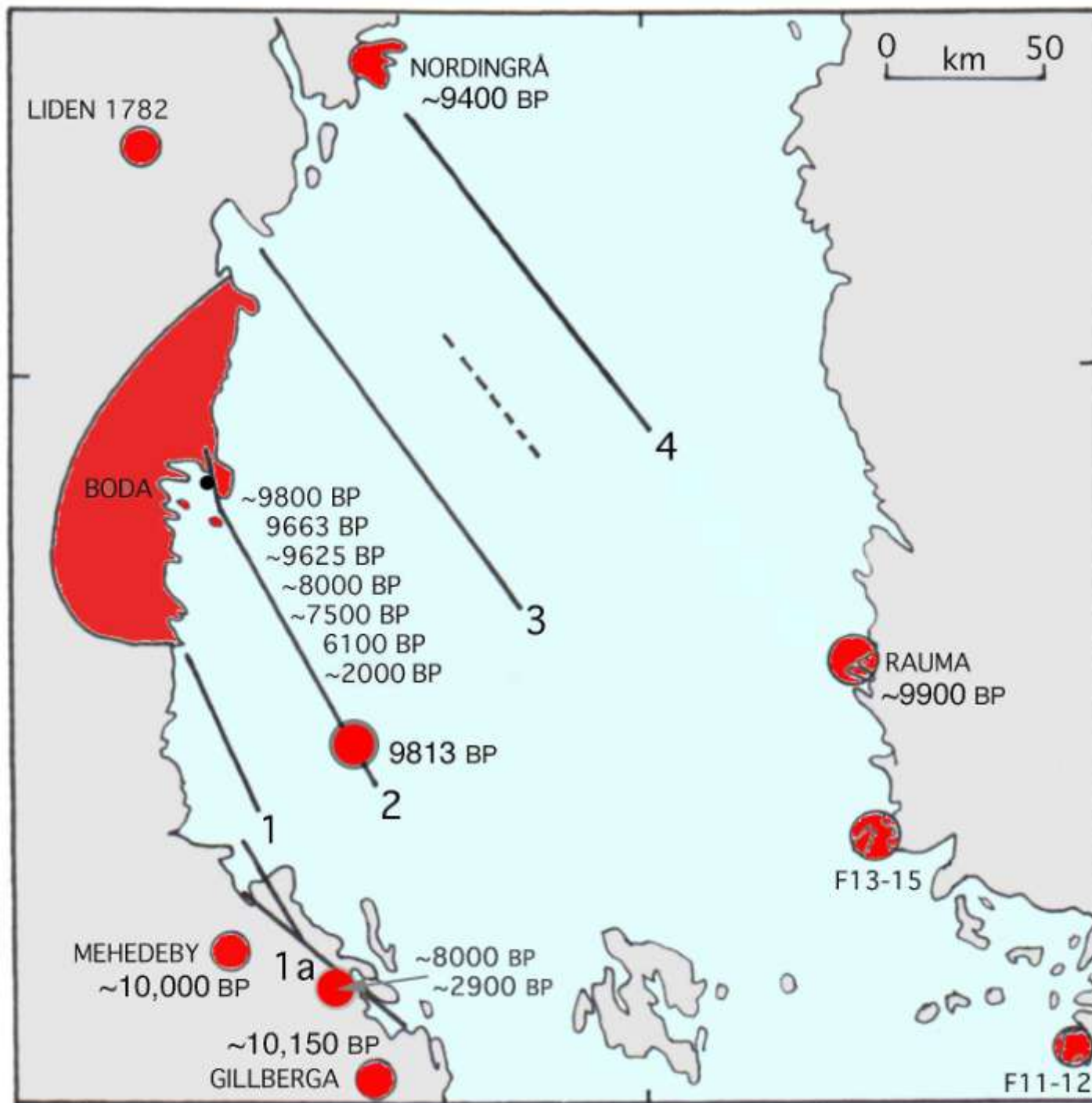


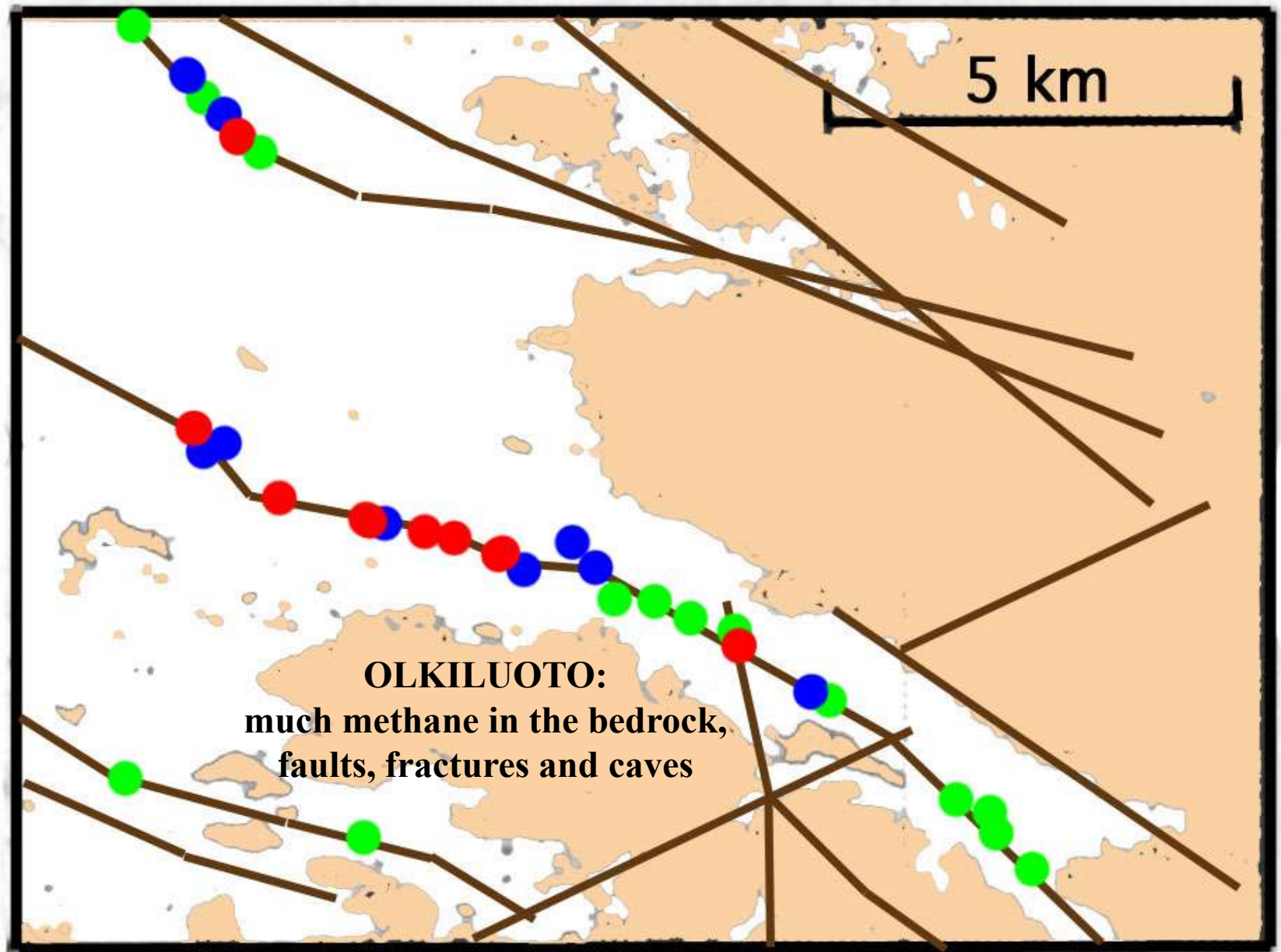
**Geothermal gradient
moves left at permafrost
(left)**



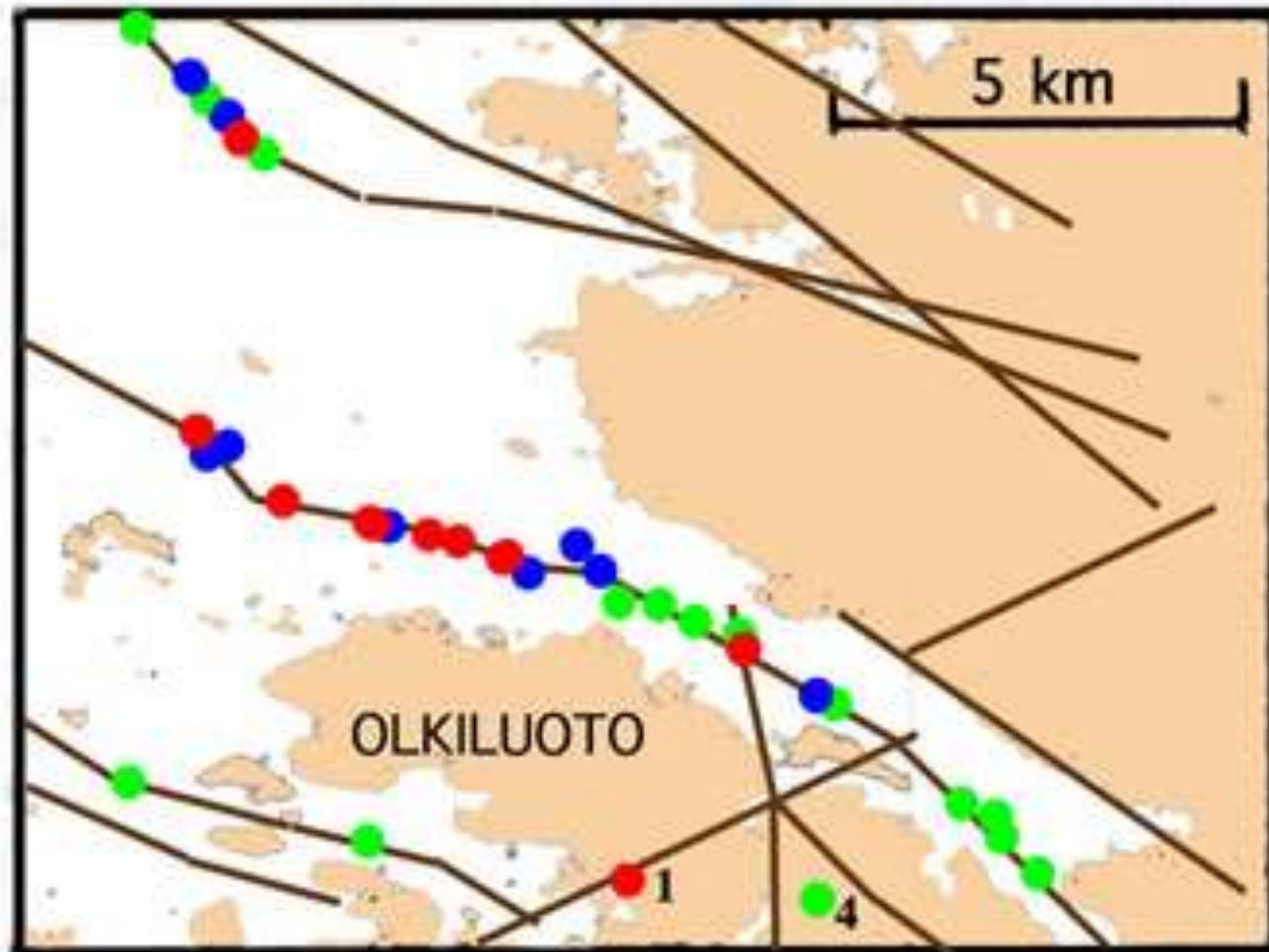
EXPLOSIVE METHANE GAS VENTING-TECTONICS





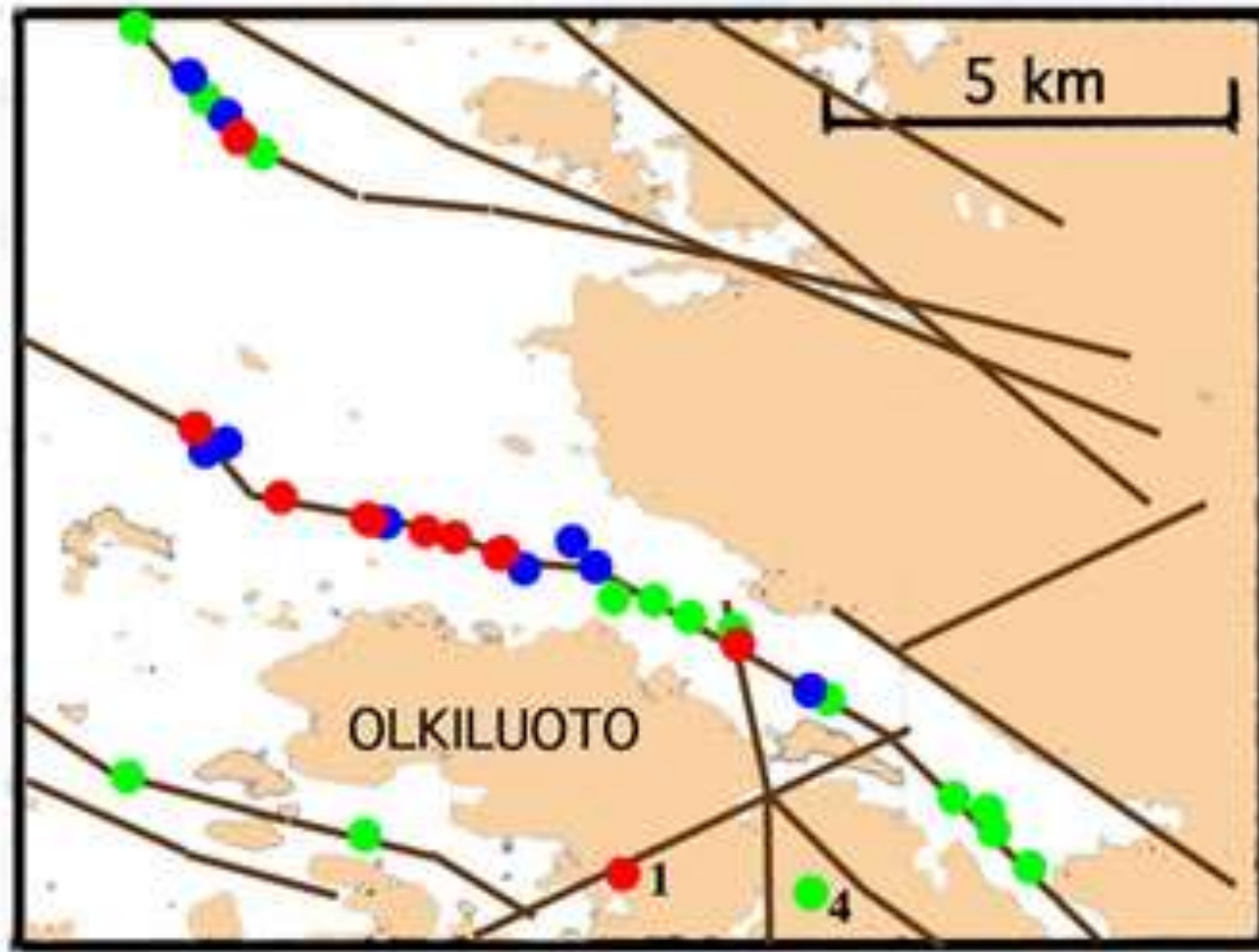


● Fault ● Disturbed sediments ● Gas seepage



New findings:

1. Paleoseismics
2. Liquefaction
3. Mega tectonics
4. Gas seepage



New findings:

1. Paleoseismics
2. Liquefaction
3. Mega tectonics
4. Gas seepage

2



3



2.

benefits with the DRD methods

Freedom of action

Possibility to control, repair, retrieve and remove

Very much cheaper

Harmonizes with:

**scientific knowlege, environmental concern, energy need, and
possible positive technical innovations in the future**

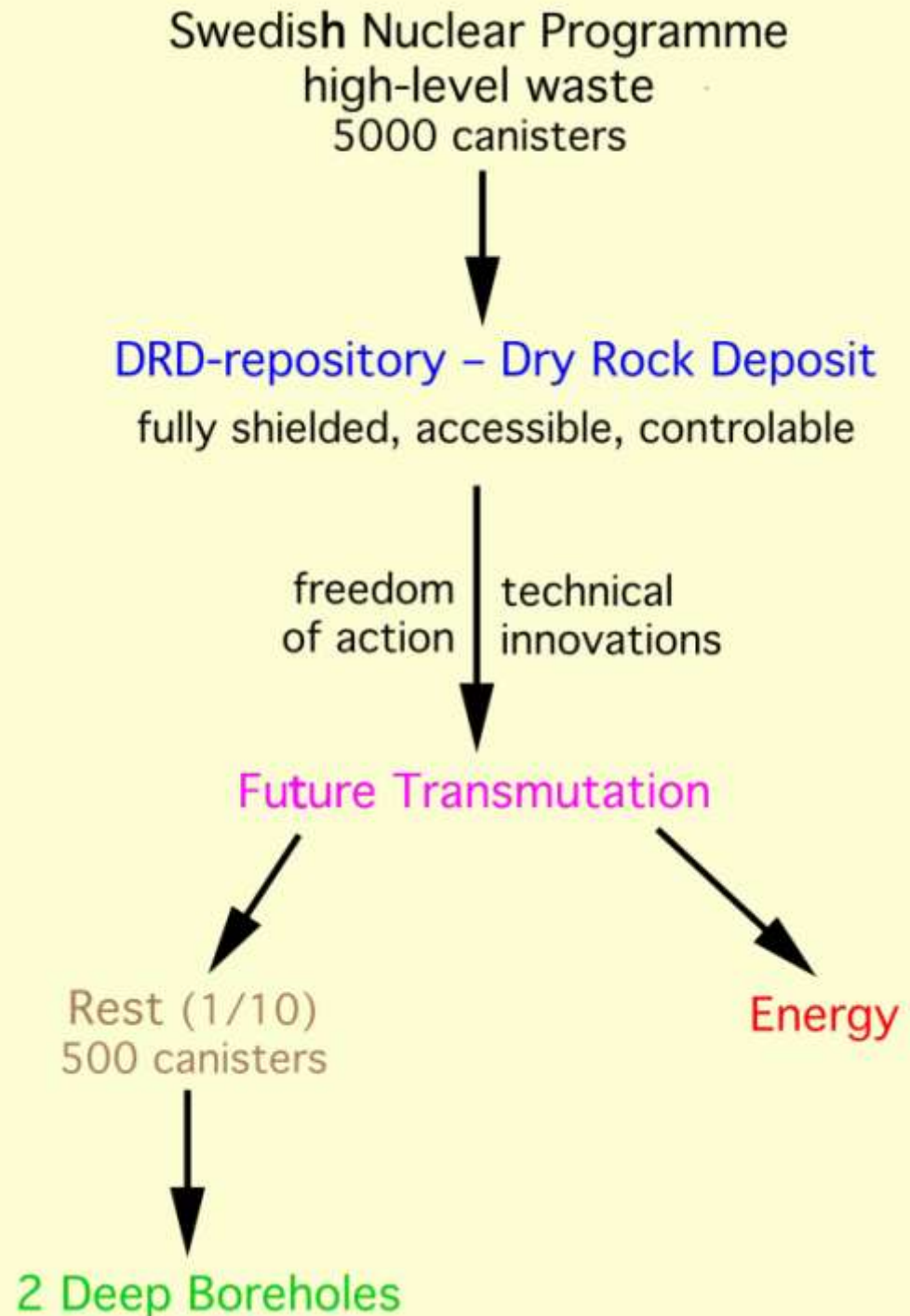
Let us admit that we cannot guarantee an adequate safety for 100,000 years.

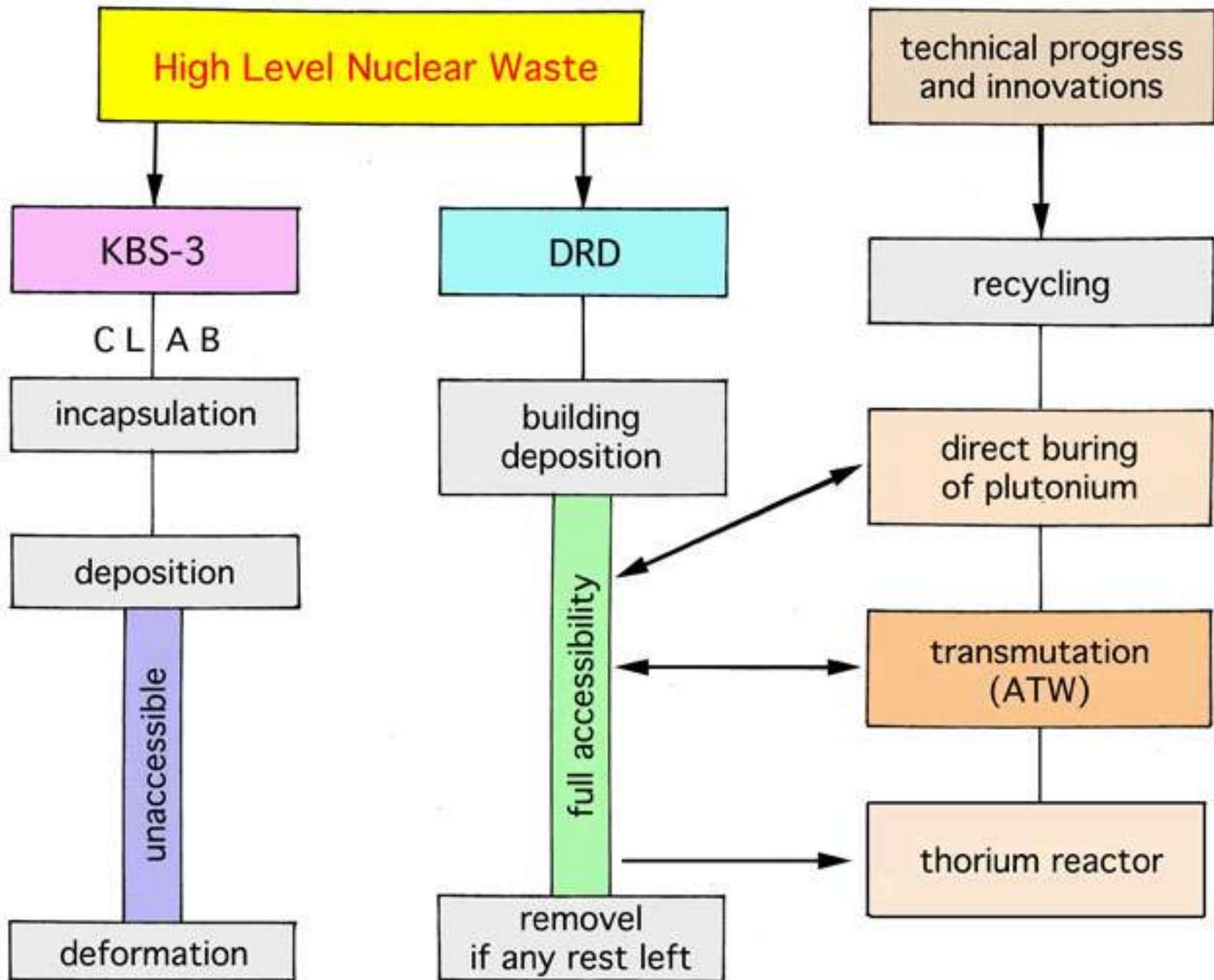
And see how we should handle in the best possible way with the freedom of action kept like the possibility of control.

We have a proposal that harmonizes with:

- modern scientific knowledge
- environmental concern
- energy concern
- technology & innovation

The DRD method (see right)





CONCLUSIONS

To hell with the KBS-3 method (the place where it rightly belongs)

Keep the control and freedom of action (only by the DRD method)

DRD is to do the best under the circumstances (no solution)

DRD is not a solution justifying extended nuclear power and uranium mining

DRD is much cheaper

DRD excludes Clab (the temporary storage of zero safety)

References

Mörner, N.-A., 2003. *Paleoseismicity of Sweden - a novel paradigm.*

Contribution to INQUA from its Sub-commission on Paleoseismology, 320 pp

Sold here today for 25 Euro (originally 40) or 250 kr (originally 360 kr).

Mörner, N.-A., 2009. *Detta Eviga Avfall.* PQR-kultur, 100 pp. Sold for 150 kr.