Nuclear waste repository plans in Finland

Finnish solution to nuclear waste - Silencing the debate

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What is happening in Finland?

- Miracle bedrock with no cracks? (Conveniently found under the reactor sites)
- Most advanced research project in the world? (Answering the questions, which major countries have not been able to solve after decades and billions of dollars?)
- Political decisions taken with consensus (And few if any opponents?)
- Nuclear oasis, municipalities competing to get the next high level waste repository?

What is happening in Finland?

Or ?

What is happening in Finland?

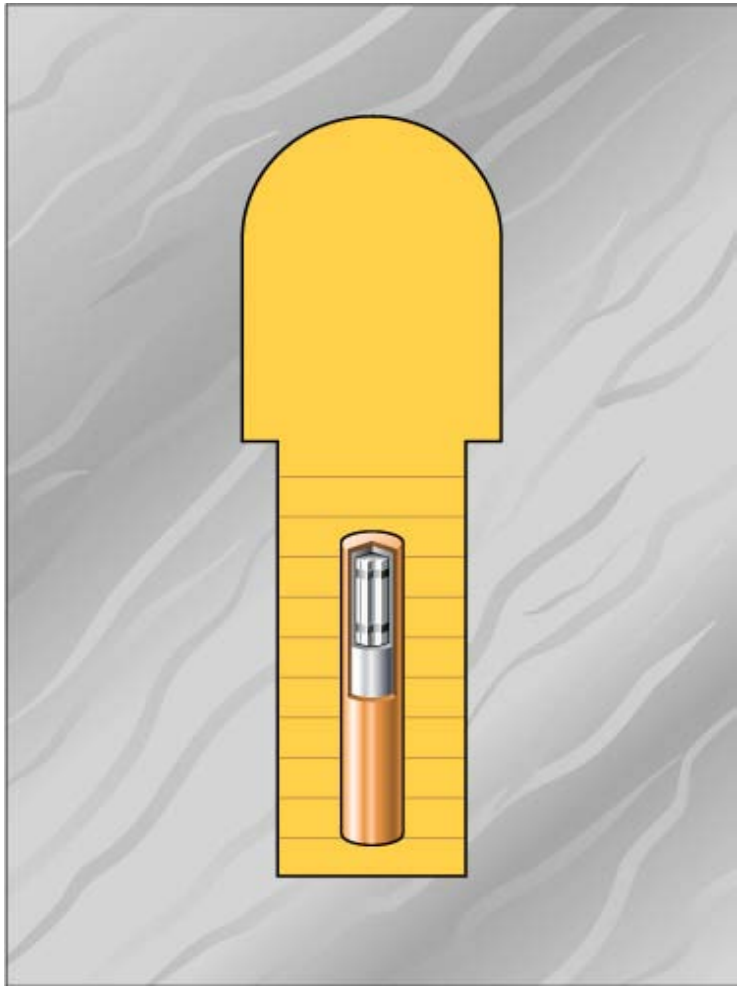
- Technical and moral challenges brushed under the mat - race for government approval with minimal time and costs
- A group of same-minded experts and very limited public debate, confused politicians
- Only research available done by nuclear companies
- STUK and nuclear companies very close with documented exchange of people
- Very few other jobs and independent researchers
- RESULT: No real discussion about the risks and moral challenges

What is happening in Finland?

- Challenges raised by international research downplayed in public by experts
- Problems raised by Posiva research reports downplayed in their own public communication
- Finnish public still wary of nuclear waste and opposed to new reactors
- Parlamentarians asked to approve a permit for a “research tunnel” which turned into “the solution to nuclear waste” before research even started
- Heading towards another “Olkiluoto” project with cost overruns, major safety and quality problems + high level nuclear waste?

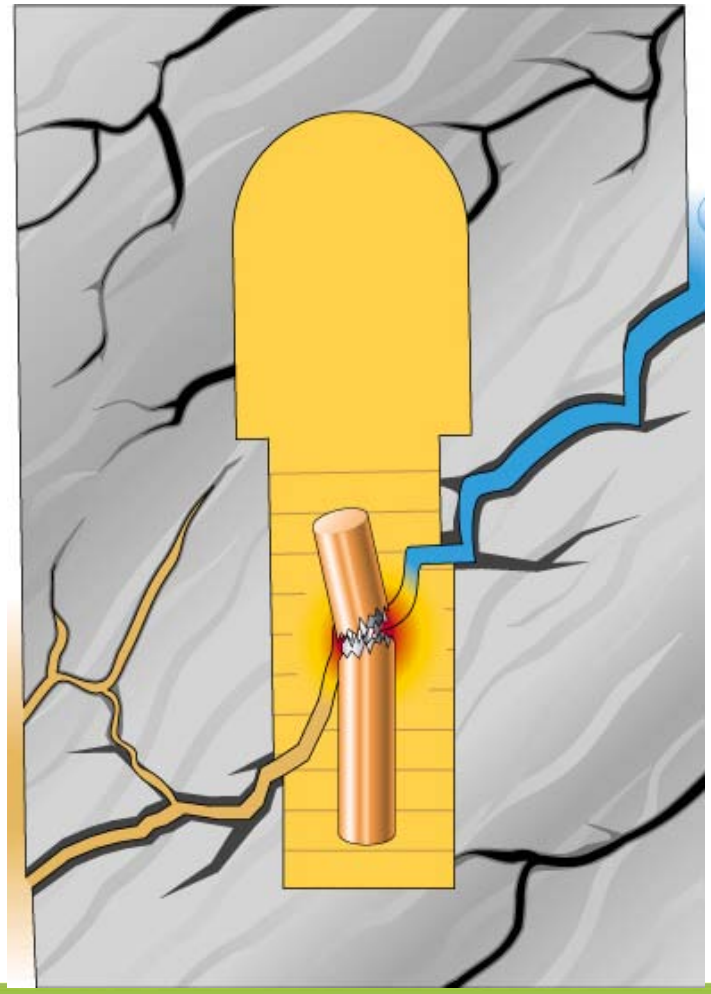
The KBS3 method- challenges

- Planned geologic repository in Finnish bedrock at a depth of 400-500 m has brackish groundwater flowing through the repository cracks
- A repository relies on barriers (bedrock, bentonite, copper) to isolate the nuclear waste from the environment.



The KBS3 method- challenges

- However, all these barriers have challenges and uncertainties which present research has not adequately answered
- Future changes of the barriers over long timescales can prove to be impossible to predict

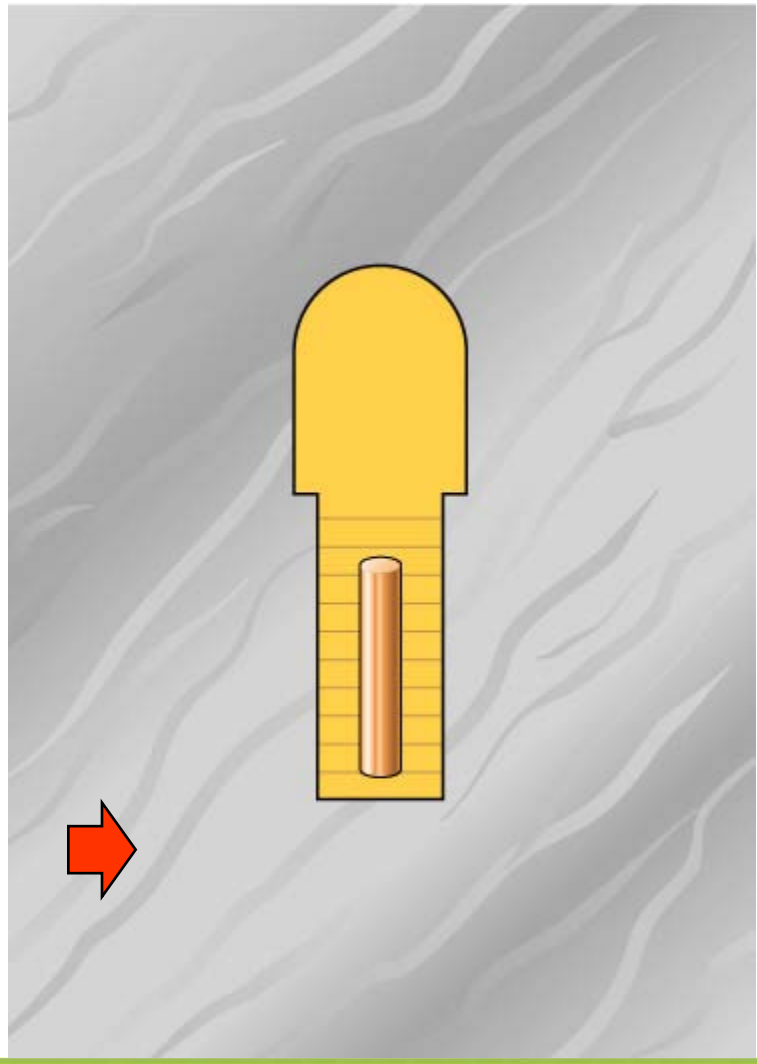


The KBS3 method- Challenges

- Research done while excavating, not the other way around
- Mapping of initial state of the bedrock before excavation was done hastily- we do not know how the bedrock was before it was changed
- This makes the prediction of future changes of the bedrock is even more complicated.

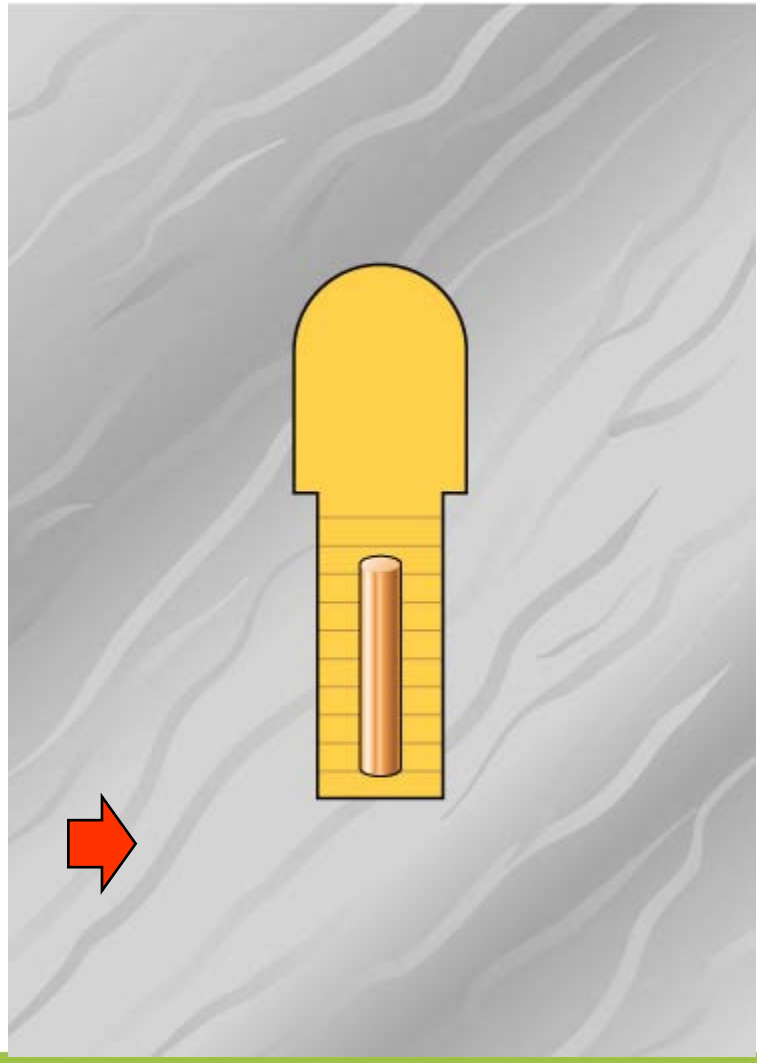
BEDROCK

- All existing cracks in the bedrock must be detected – some difficult to detect
- The planned storage is in between two rupture zones, both horizontal and vertical
- Zones take groundwater to surface



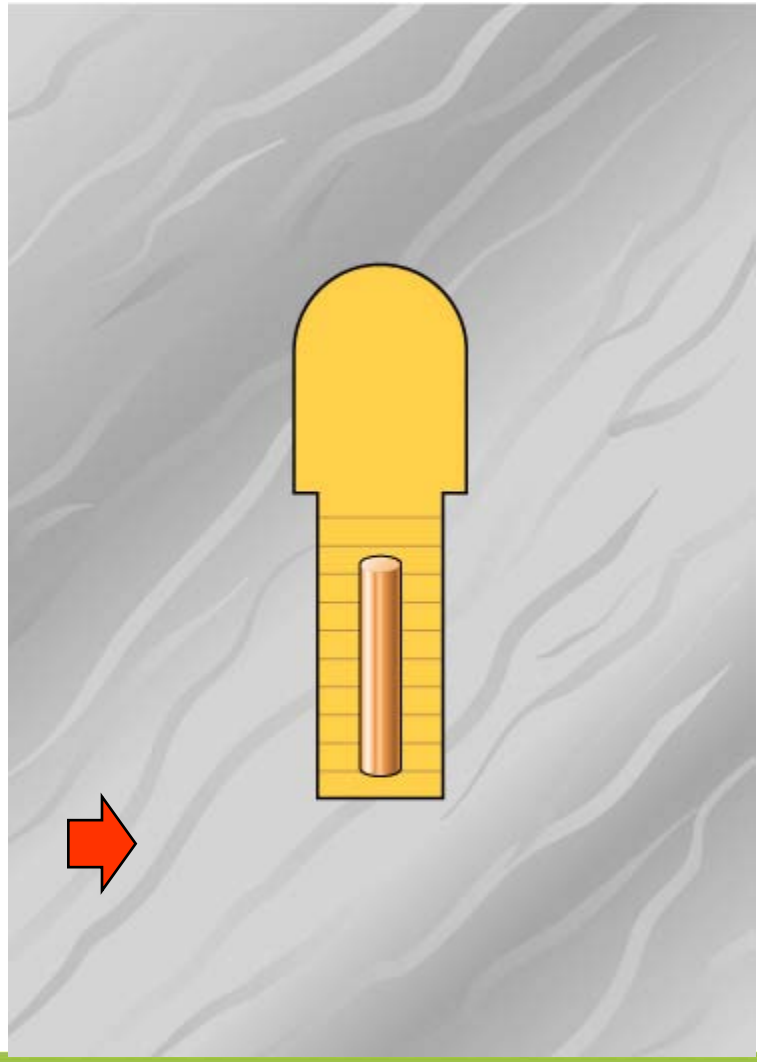
BEDROCK

- Groundwater flow in these cracks must be detected and water quality examined



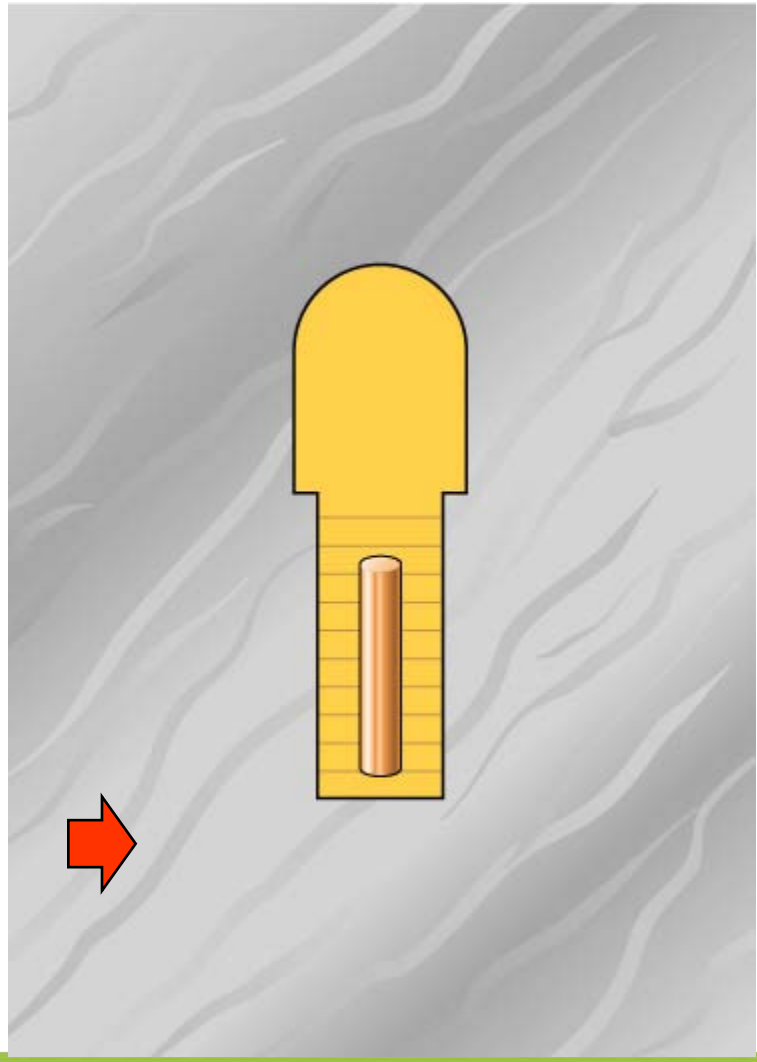
BEDROCK

- Future cracking, water flow and composition must be predicted for coming 100 000 years



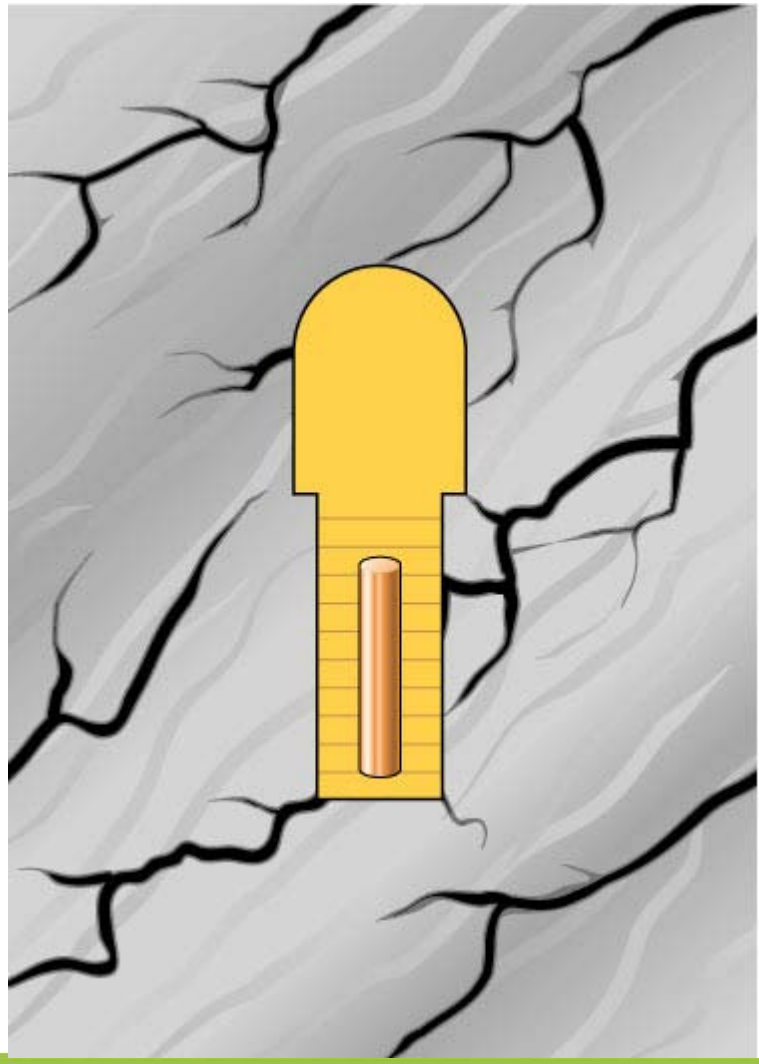
BEDROCK

- New cracks can develop when storage is being built



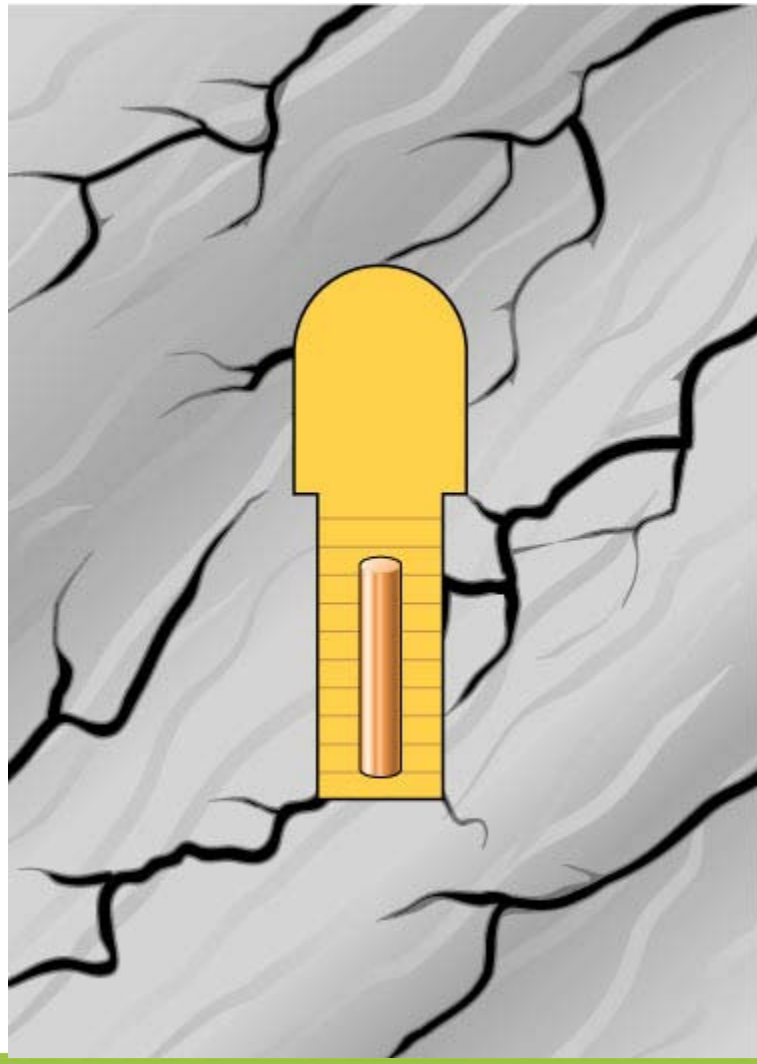
BEDROCK

- Present knowledge of geology does not enable us to predict cracking hundreds of thousands of years into future
- In 1970s bedrock was thought to be quite stable. Now we know e.g. that Scandinavia experiences 6 Richter earthquakes after ice ages



BEDROCK

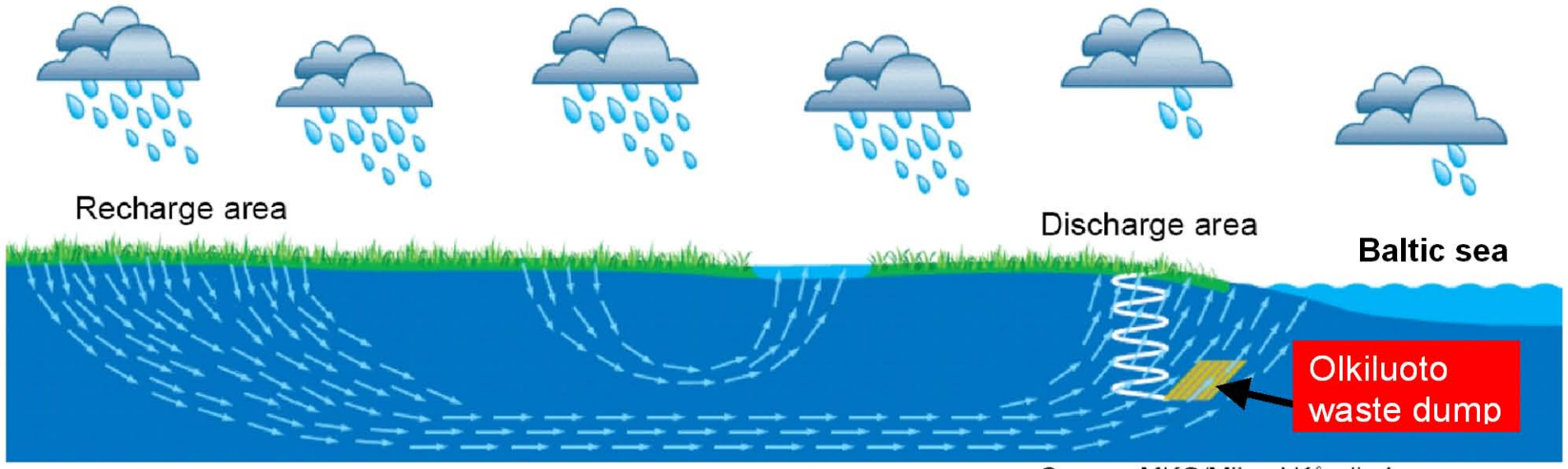
- It is not certain that a bedrock can be found, which would guarantee a shield for nuclear waste now and in the future




Olkiluoto, Eurajoki, Finland
800 m
Waste storage site
© 2008 Tele Atlas
Image © 2008 TerraMetrics
Image © 2008 DigitalGlobe
©2007 Google™
Pointer 61°14'09.23" N 21°28'51.30" E elev 6 m
Streaming 100%
Eye alt 1.12 km

Olkiluoto

- Very old, fractured bedrock
- In the immediate vicinity of the sea

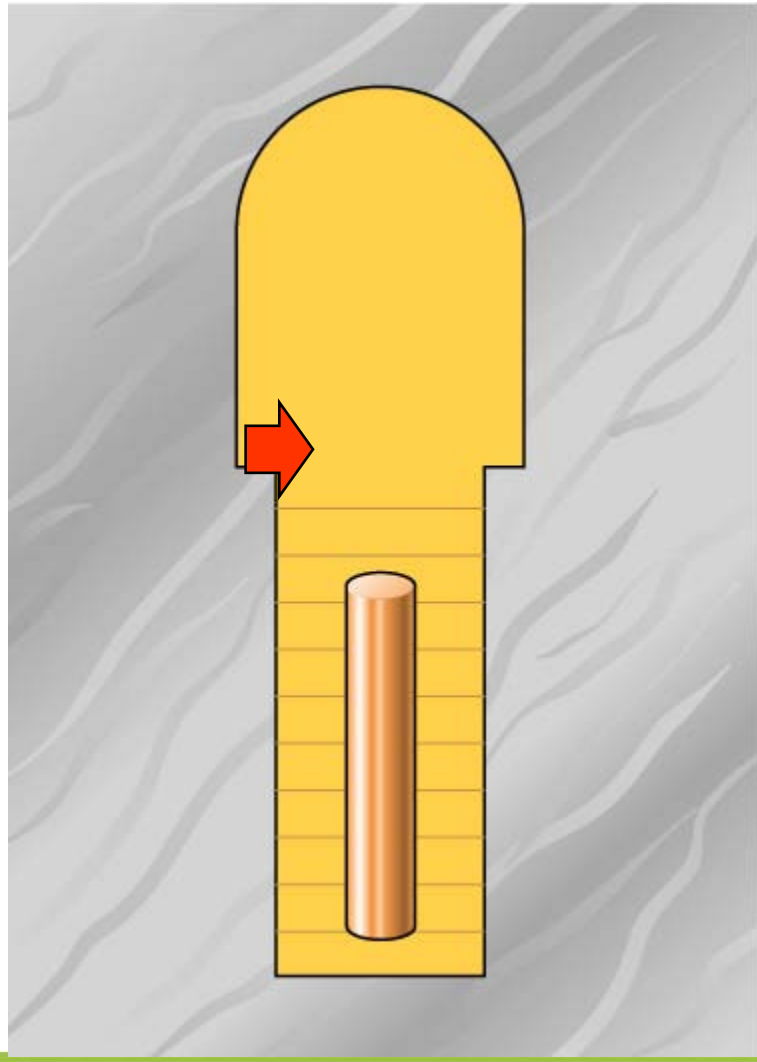


Source: MKG/Mikael Kårelind

- The half-life of plutonium is 24 000 years
- Nuclear waste contamination risk still after hundreds thousands of y

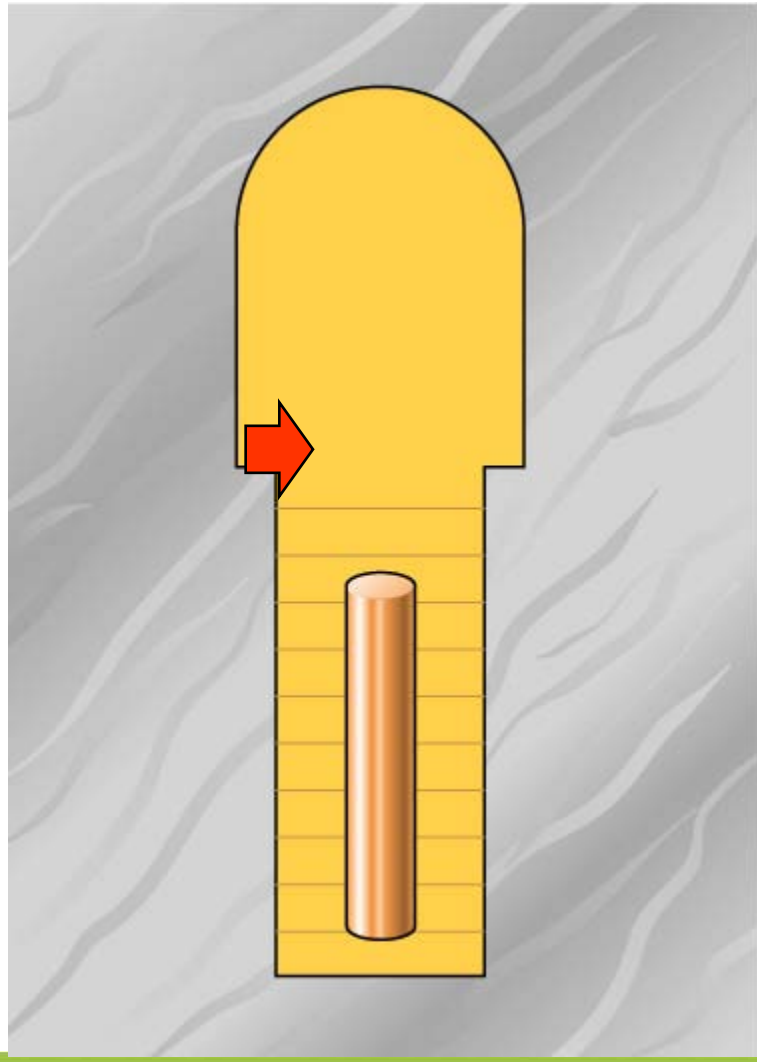
BENTONITE

- Bentonite must have no ruptures
- Before bentonite is placed it must be absolutely dry and free from impurities
- Otherwise it may not protect the canister or may even deform it



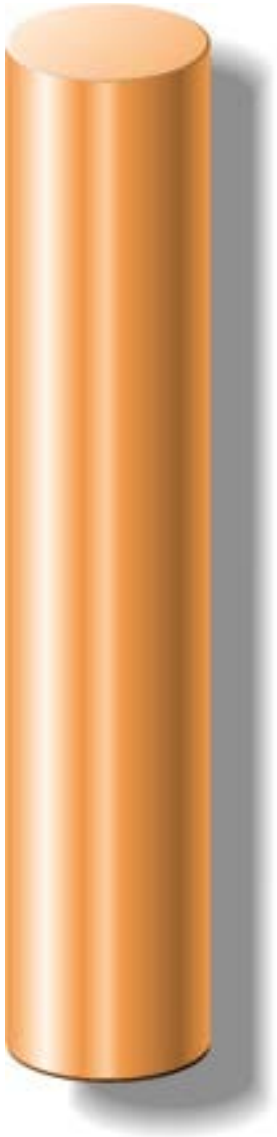
BENTONITE

- Waste develops heat (up to 100 centigrades) over a time period of 100 years
- Heat can change the qualities of the bentonite and let groundwater penetrate



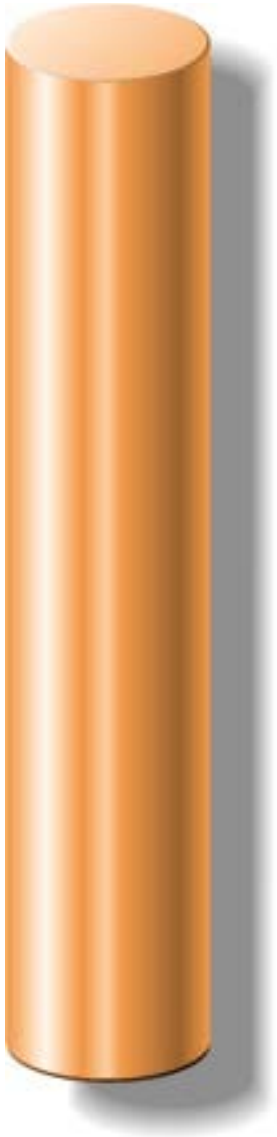
CANISTER

- Copper is a soft metal, which can be damaged in different phases
  - production
  - capsulation
  - transport
  - placement



CANISTER

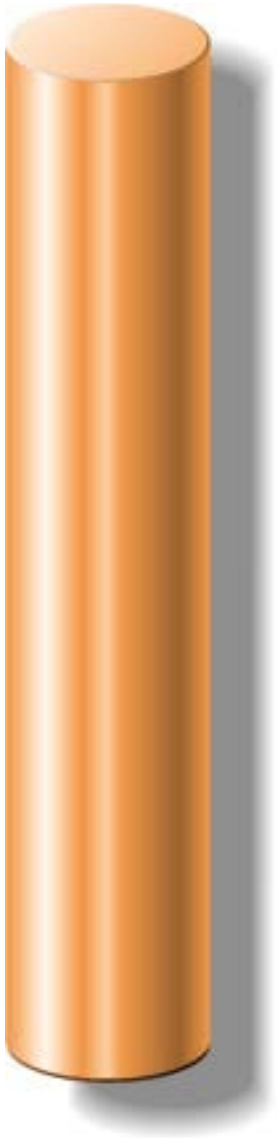
- POSIVA assumes that several canisters can be damaged before capsules are in place in bedrock
- No adequate plan to retrieve canisters
- Effects on bacteria films on copper corrosion not easy to predict



CANISTER

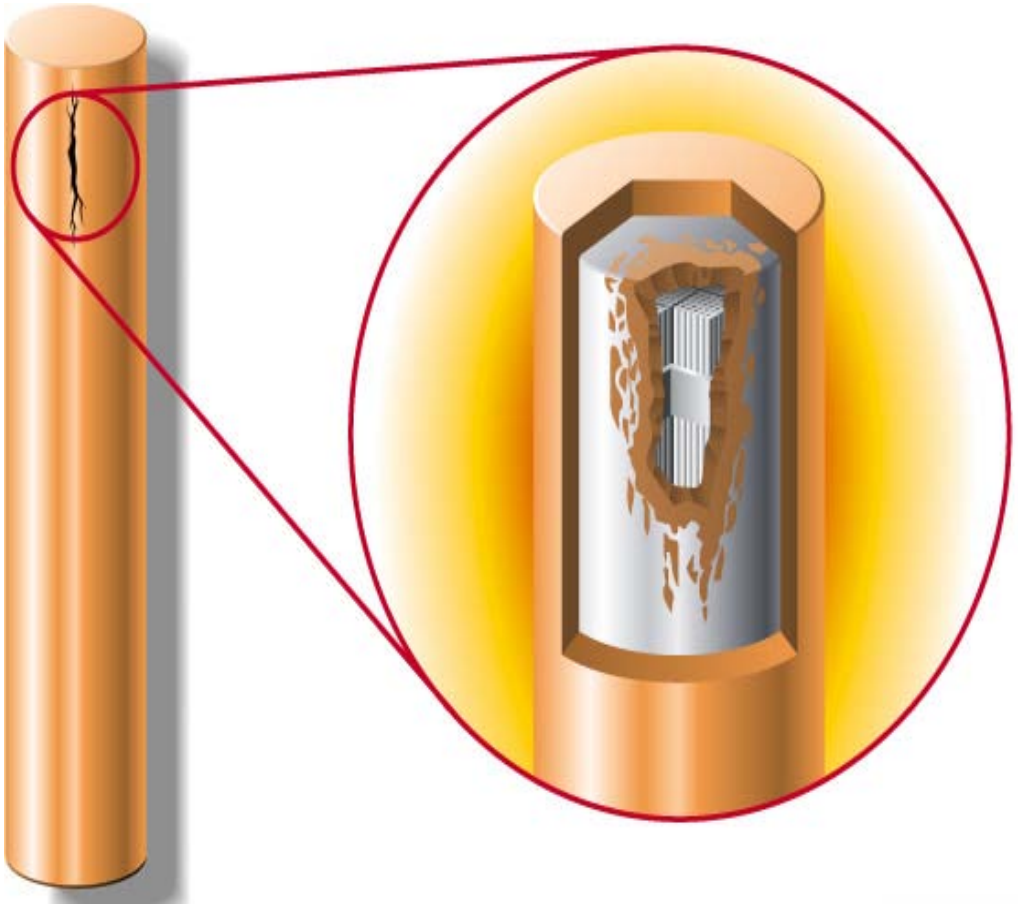
- New studies show that corrosion of copper can be a matter of centuries even in anticipated oxygen/REDOX conditions

FIGURE 1 – Appearance of copper after 15 years of exposure in distilled water at room-temperature. Hydrogen from corrosion can escape from the left container but not from the container to the right. The water volume was equal in the flasks in beginning of the exposure.



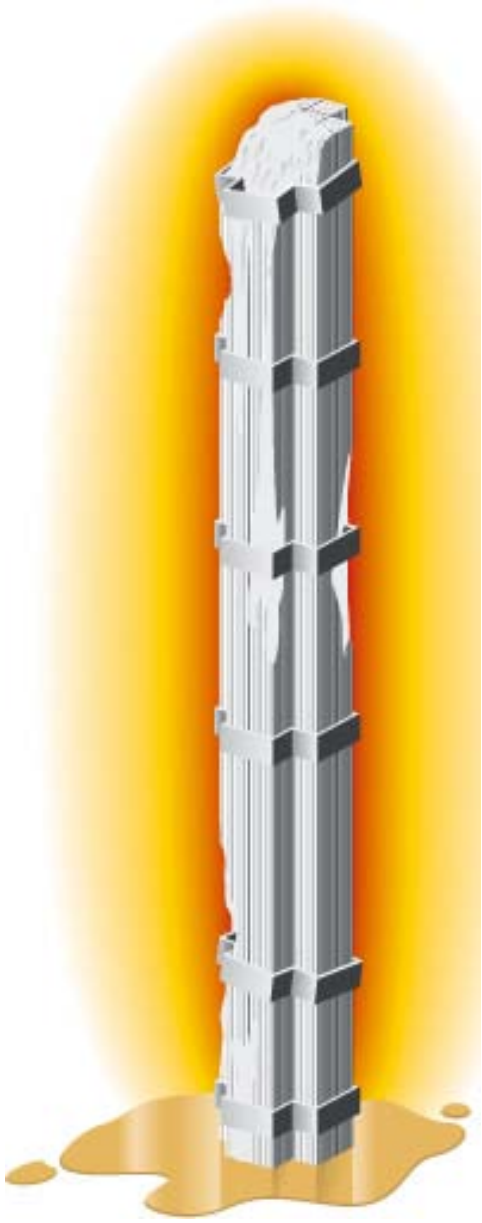
CANISTER

- Even microscopic damage can lead to water getting in contact with steel canister
- Corrosion generates hydrogen, which can widen the damage



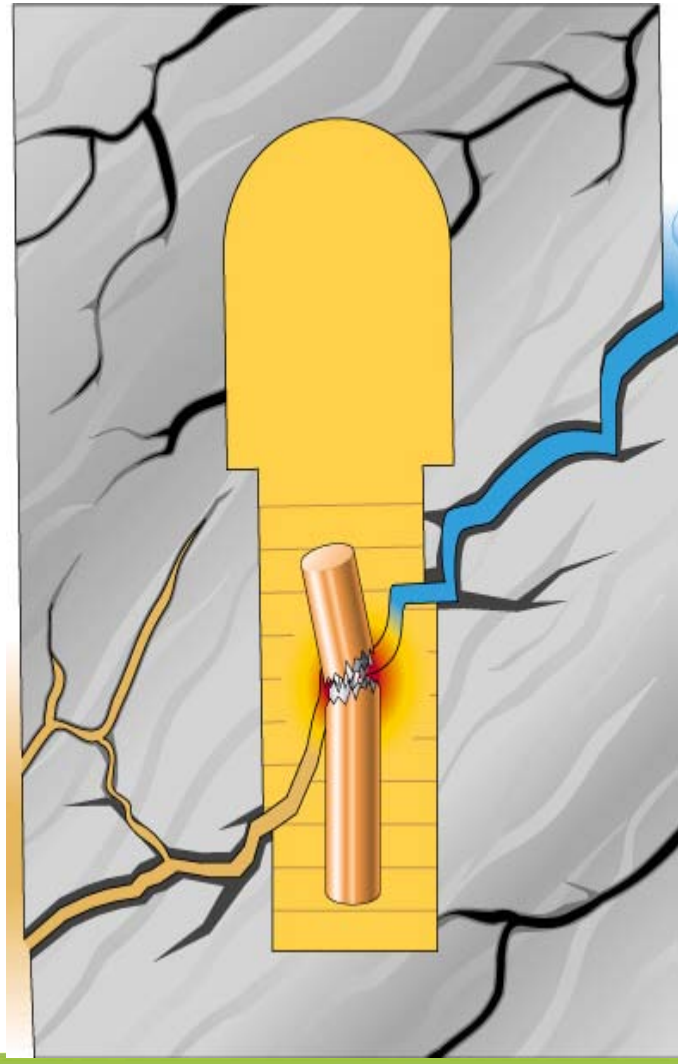
NUCLEAR FUEL

- Chemical composition of future groundwater and composition of the fuel determine how easily fuel releases contamination into the groundwater
- Brackish water of Olkiluoto a challenge
- EPR spent fuel can be higher burnup and thus more radioactive, not discussed in the debate



A COMMON CAUSE

- It is not certain that rest of the barriers will shield the fuel if one barrier fails.
- Major earthquakes can compromise all barriers
- Effect of ice ages limited out of the safety assessment



To sum up – what can go wrong?

- Failures in placement of capsules, saturation of bentonite, faulty/damaged capsules
- Failures in characterization, unsufficient knowledge of changes excavation damage zone
- Geological events: ice ages, earthquakes, salt water intrusion, oxygenized water intrusion, formation of gas pockets, biological activity, faster corrosion
- Human intrusion

RESPONSIBILITY?

- No liability for company once repository is sealed
- No real plans or funding for retrieval
- No funded or planned way of guarding or warning against human intrusion
- Safety artificially limited: examined only first 10 000 years

HUMAN INTRUSION

- We have not found all the burial sites of the Viking times (800 BC)

HUMAN INTRUCION

•It is not credible that knowledge of the storage site could be passed on for

100 000 years.

HUMAN INTRUSION

•Our descendants can unintentionally hit in the storage when they are exploring for minerals or water and release radioactive materials

HUMAN INTRUSION

- Storage will contain large amounts of steel and copper which can interest our descendants to excavate the storage site.

HUMAN INTRUSION

- Storage is going to contain large amounts of plutonium

HUMAN INTRUSION

- How can we communicate the danger to the future generations?

HUMAN INTRUCION

- How long can we sustain guarding?
- How can we develop a guard scheme for 100 000 years?
- Who will pay for the guarding?

FINNISH SOLUTION?

- Decisions made before research or informed debate.
- Shortest testing programme in the world?
  - Why the hurry? Interim storage will be needed at least until 2090
- Interim storage underground is NOT the same as deep repository with no plans or technology for retrieval or monitoring!

What to do with existing waste?

- Continue to seek for solutions, gain knowledge on geology
- Improve interim storage
  - underground
  - guarded
  - reachable

Thank you!