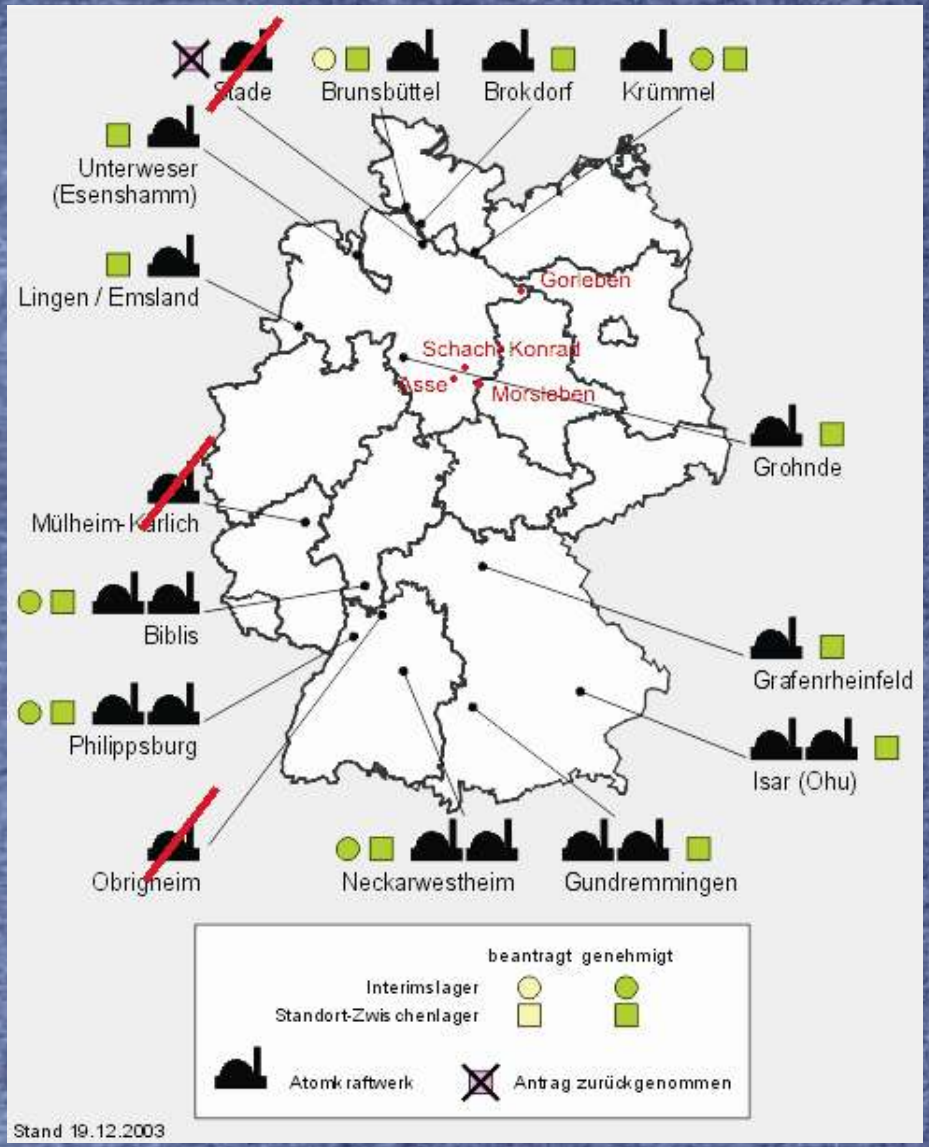
# Nuclear Waste Disposal Disaster in Germany



# General Situation in Germany


- final disposal concepts:

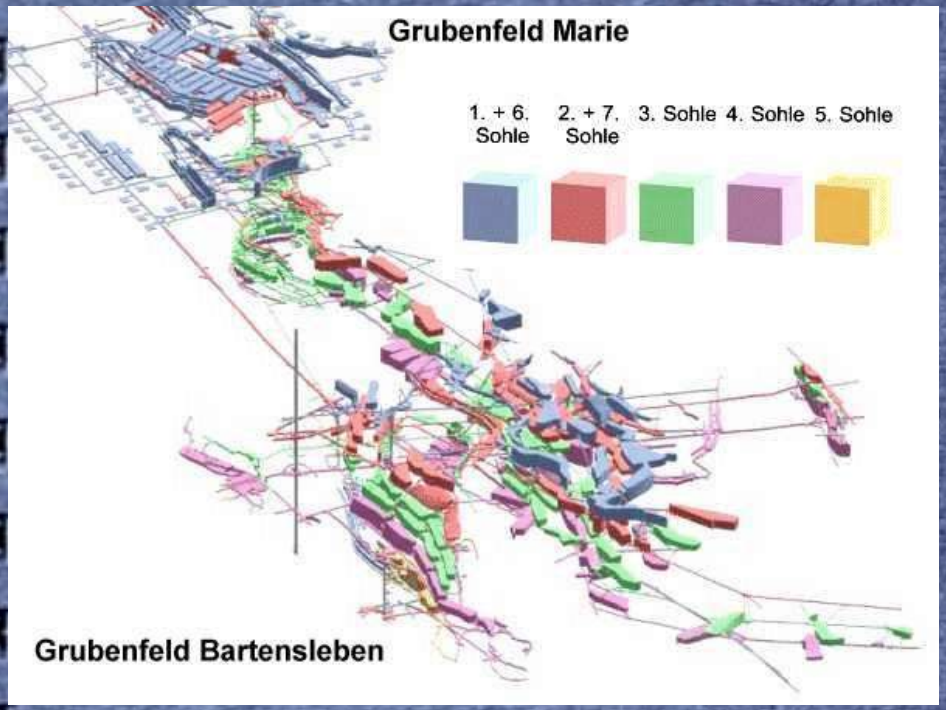
–salt rock + other geological formations

–deep mine (more difficult: access, attacks, natural catastrophes, pristine=safety)

–geological barrier provides safety

–non-retrievable final disposal (costs,

# Morsleben




- between Braunschweig and Magdeburg (Sachsen-Anhalt)
- formerly GDR's central final repository for L/MAW + planned HAW final repository
- operation started

# Morsleben (II)

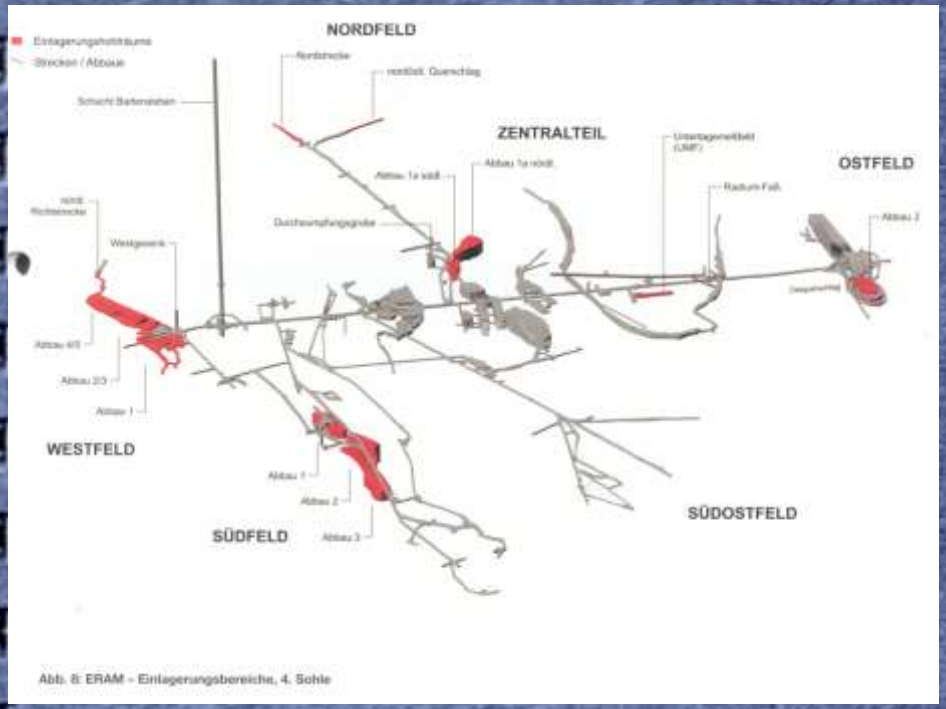


Abb. 8: ERAM – Einlagerungsbereiche, 4. Sohle

- <u>solid waste</u> in barrels stacked or dumped in barrels or loosely into reposition cavaties
- <u>liquids</u> sprayed onto layer of lignite ashes (assuming mixture would solidify)
- total amount

# Morsleben (III)

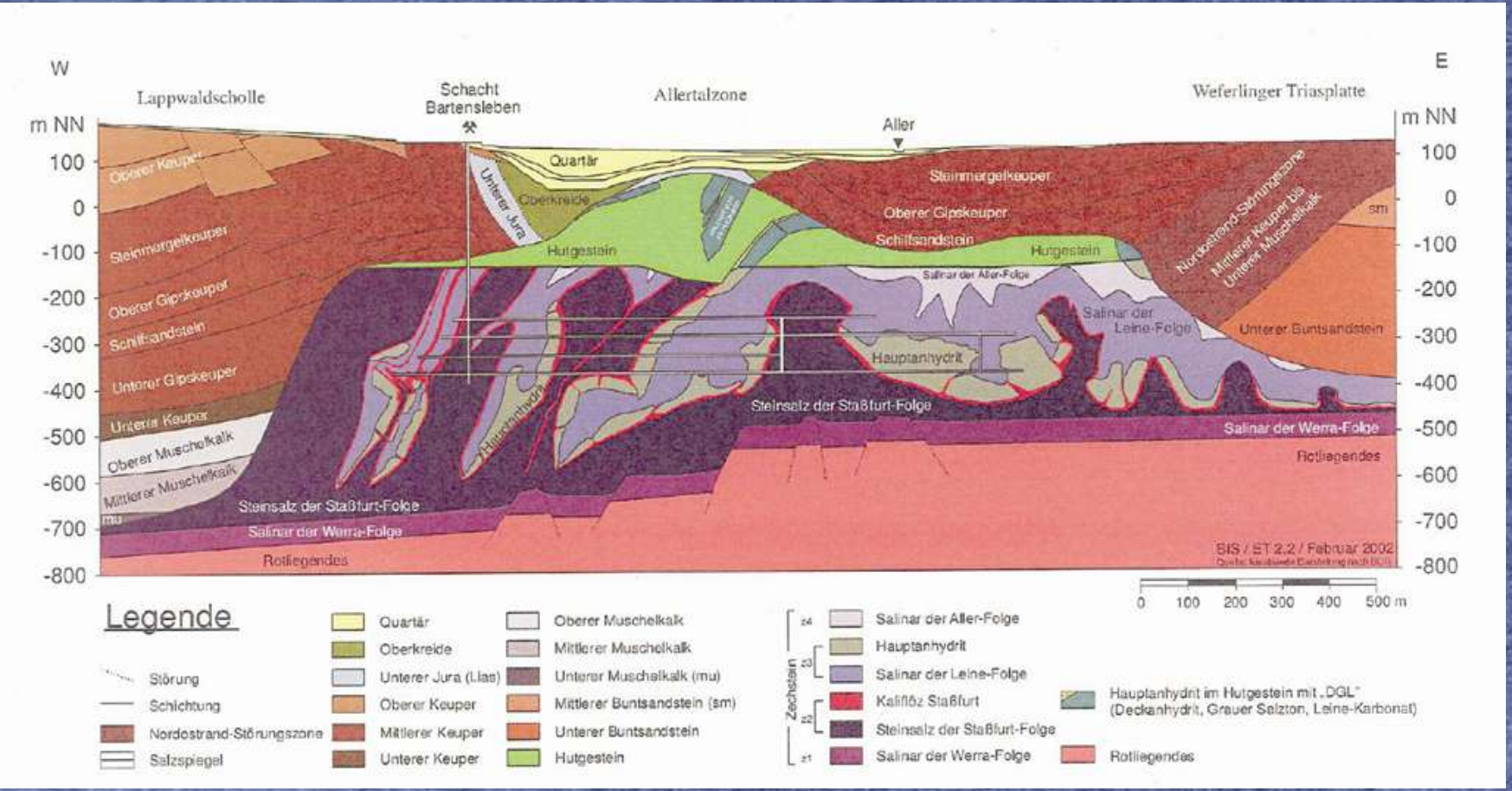

- >6,000 radiation sources (partly HAW) sunk in drill holes
- safety issues:

–water influx: >20 known locations; at least one has connection to biosphere

–collapse: >4,000 t cave-in 2001; 500 t cave-in early 2009; 20,000 t cave-in

# Morsleben (IV)

–unsuitable geological conditions (potassium salt layers, main anhydrite)



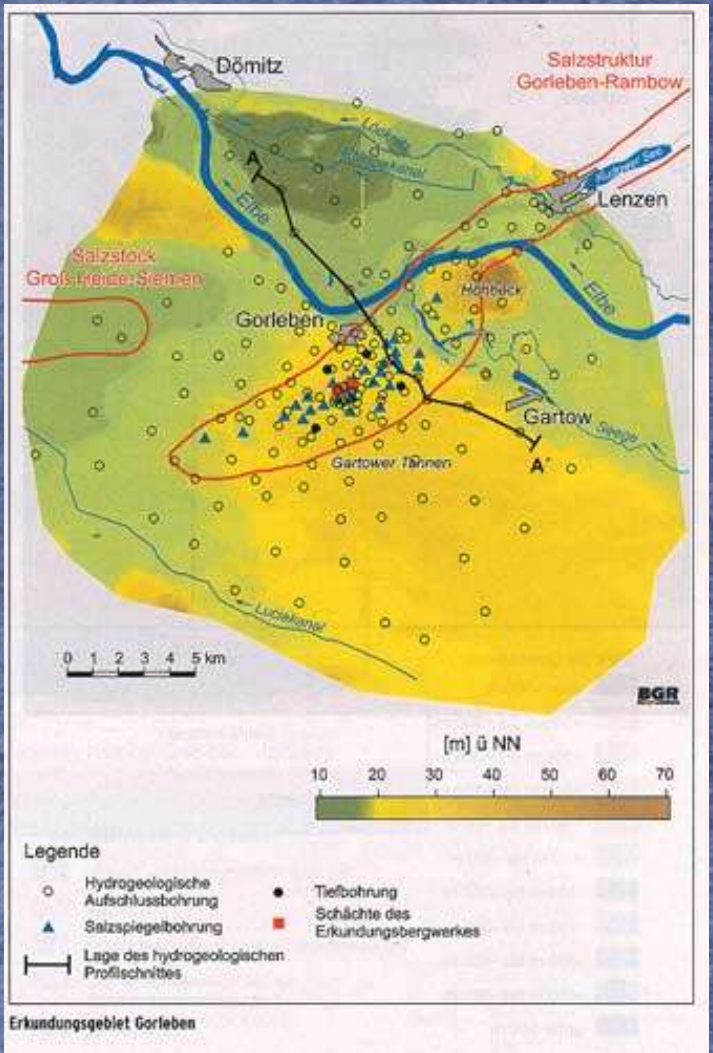
# Operator's Failures

- inventory unknown
- public cheated about inventory & safety issues
- safety issues wellknown from the very beginning
- no public consultations in site selection
- old mines (over 100 years) not suitable for final disposal of nuclear waste
- extension & situation of cavities not completely and not in detail known
- operator increased threat of collapse by backfilling higher levels with ~800 000 $m^3$

# Gorleben

- in Wendland (Lower Saxony)
- „research mine“
- no public consultation yet
- salt rock formation

# Gorleben (II)



Erkundungsgebiet Gorleben

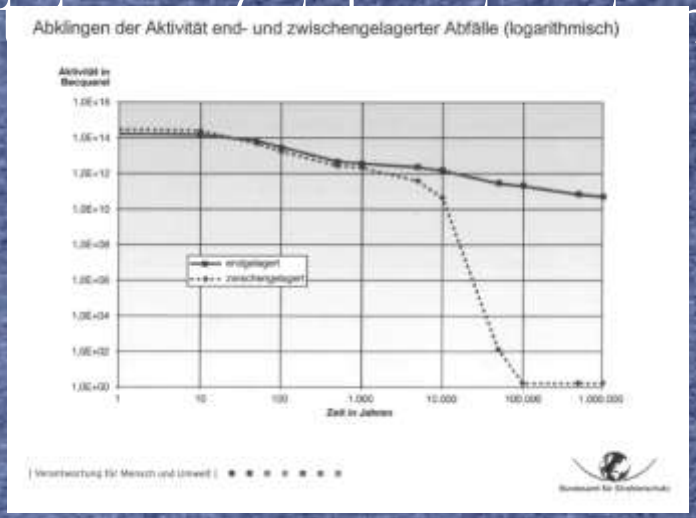
- Known safety issues:
  - water-carrying layers
  - no mighty & gapless layer of clay
  - saltdome not at rest and still rises
  - running salt-dissolution

# General Disposal Challenges

- Estimated <u>longterm safety necessary</u> for at least 1,000,000 years

–no-one knows how *society* & *technology* will look like

–no-one knows how *geological formations* will develop by that ti[illegible] detail)



# General Disposal Challenges (II)

- No complete knowledge about geological rock formations & layers possible
  - destructive methods (e.g. drilling) create *knowledge only about small areas* -> remaining parts only estimated
  - non-destructive methods can't show everything - especially *not details of rock layers / water ways*
- Chemical reactions of waste / materials of container / surrounding rock formations / water not really known
  - every few years new knowledge about *unexpected complications* found in labority

# General Disposal Challenges (III)

- No container is longterm safe against corrosion / damages
  - maybe some 5-70 years
  - copper (Scandinavian KBS model): threats by oxygen and pressure
  - steal (German Pollux model): threats by water and pressure

# General Disposal Challenges (IV)

- No technical barrier (bentonite, salt-concrete) is <u>longterm safe</u>
  - *water will always find ways at the seams* between natural rock formations and technical barrier
  - *reactions* between water / barrier material / rock formation material *unknown*
  - *Pressure of surrounding rock formations* will form & damage technical barriers
- No experimental <u>proof of safety</u> possible (millions of years necessary)
  - *only* small labority experiments for some years with *longterm estimation* possible

# Special Disposal Challenges

- Certain rock formation layers offer points for attacks of water influx (e.g. potassium salt)
- Historical water inclusions can damage rock formations
  - increase *risk of escaping* radioactive particles
- Cave-ins can cause further damages in rock formations
  - increase *risk of escaping* radioactive particles
  - *complete backfilling impossible* – at least 10 % – 20 % will be kept open

# Special Disposal Challenges (II)

- Even a pure, not fissured rock formation will become damaged by drilling / exploration & construction of the repository
  - *can't* completely *be repaired* again
- All risk models only assumptions
  - *no experience* with longterm disposal
- New problem: climate change effects

# Special Disposal Challenges (III)

- How to keep knowledge of radioactive threat?
  - –human experience with longterm knowledge only by religions: e.g. Christianity shows *several changes in interpretation & translation* within 2,000 years
  - –even today former *understanding* of warnings about dangerous places (e.g. Australia – uranium) got *lost or people don't care* about it anymore

# Conclusions

- Longterm safe storage of radioactive waste is impossible
- Knowledge about dangerous reactions & developments remains uncertain
- Operators of repositories & authorities often unreliable

# Conclusions (II)

*Nowhere* in the world a *safe solution* for the longterm radioactive waste has been found for certain reasons.

And it is *not possible* to do safe final disposal as well for general reasons.

Nuclear *waste must not be produced* – all NPPs have to be *shut down immediately* and worldwide.