Geologic Waste Isolation

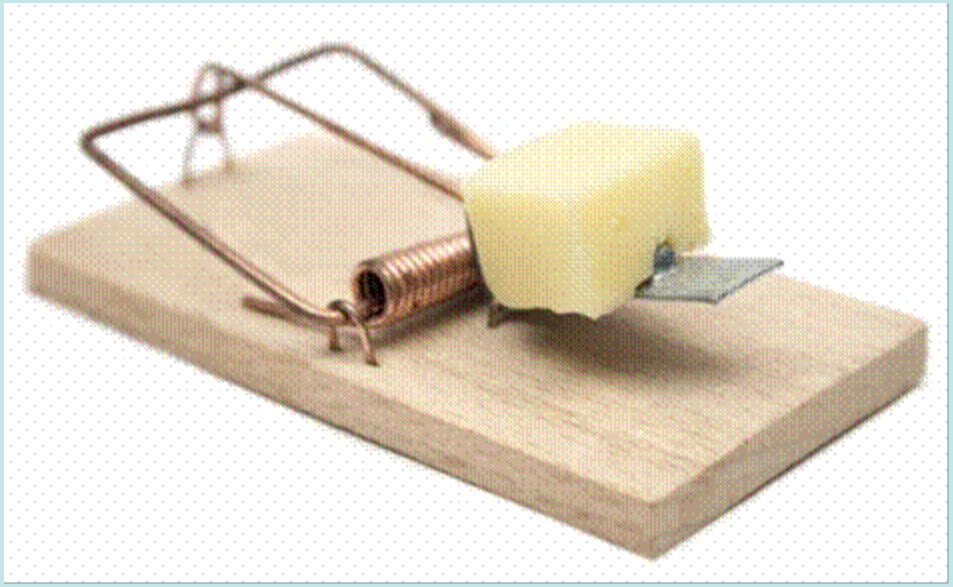
the hardly known practical

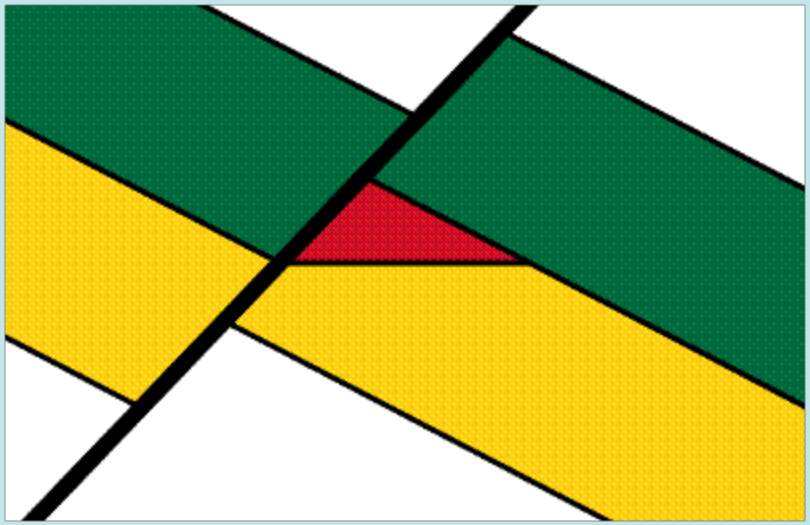
Success Story

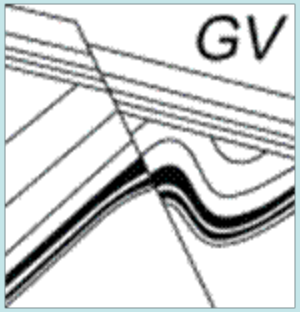
Norbert T. Rempe
Carlsbad, NM

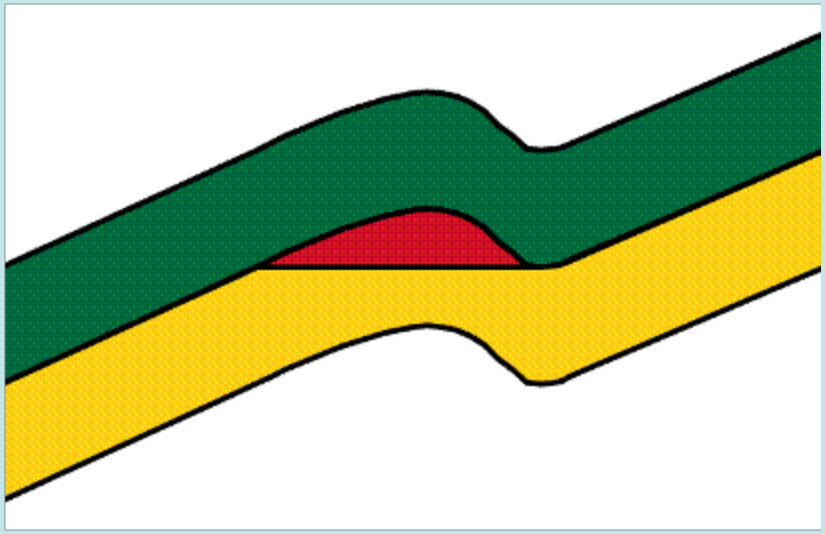
rempent@yahoo.com

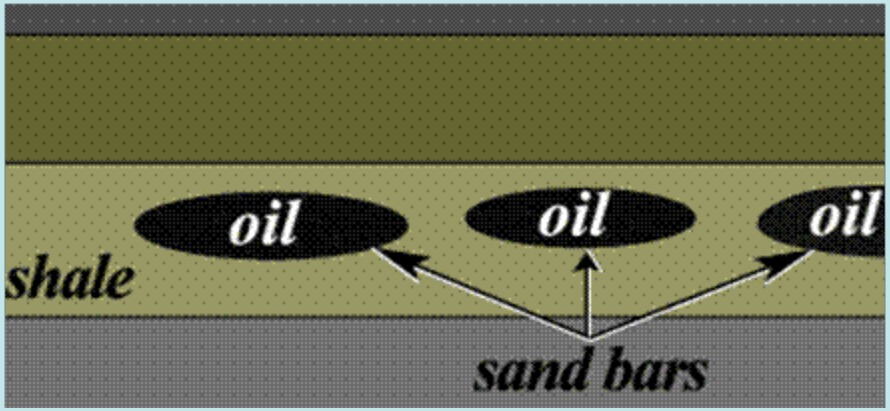
ng(o)$_3$











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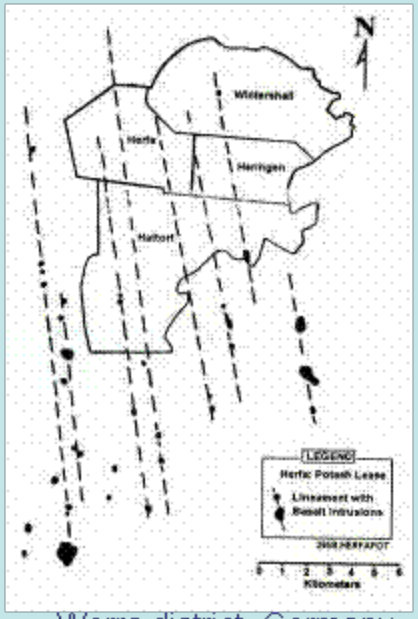
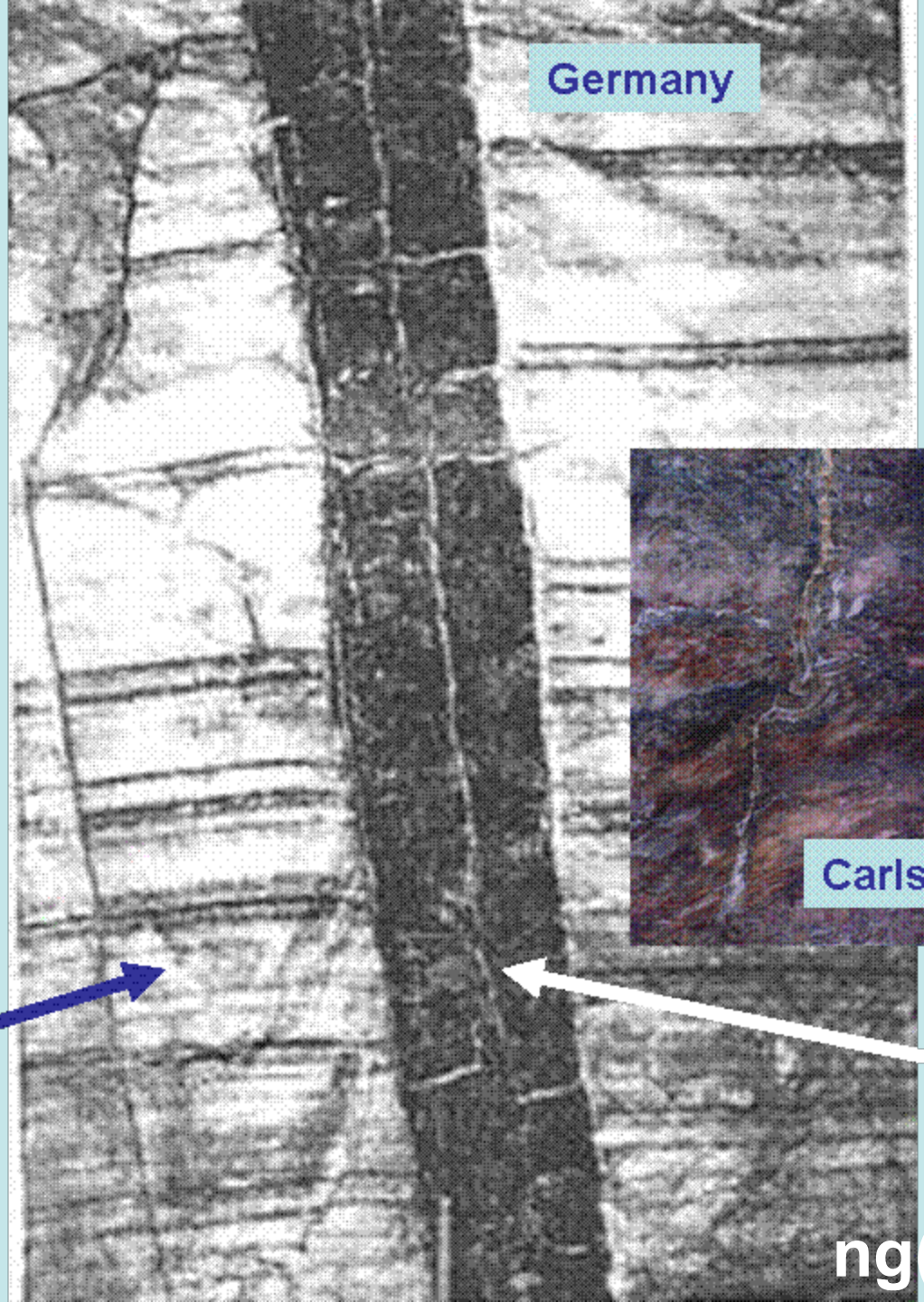
Carlsbad potash district, U.S.



Werra district, Germany

Age of salt:

>250 million years

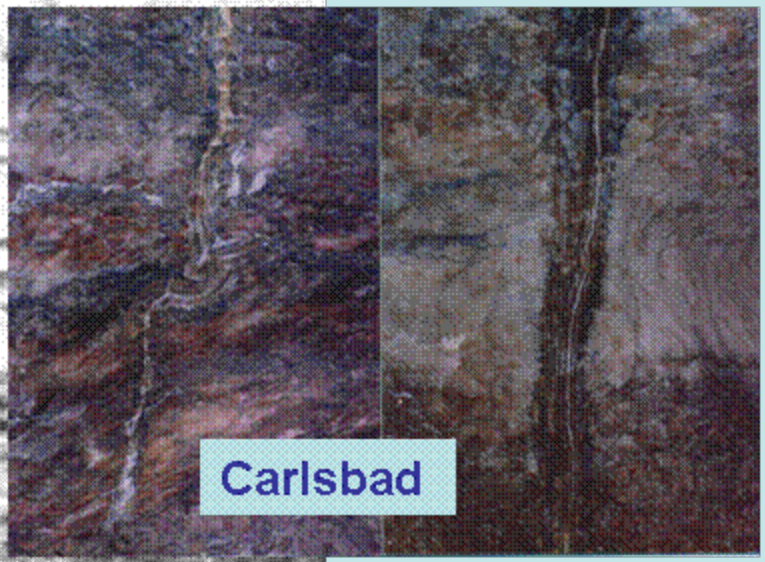


Knipping 1989, cited in Steinmann & Stille, 2004 (Geol. Soc. Spec. Pub. 236, p. 140):

Basalt melt ~1150°C

Dike 1-1.8m

Salt temperature <800°C at contact, ~200°C at 3m



Age of basalt:

~30 million years

$ng(o)_3$

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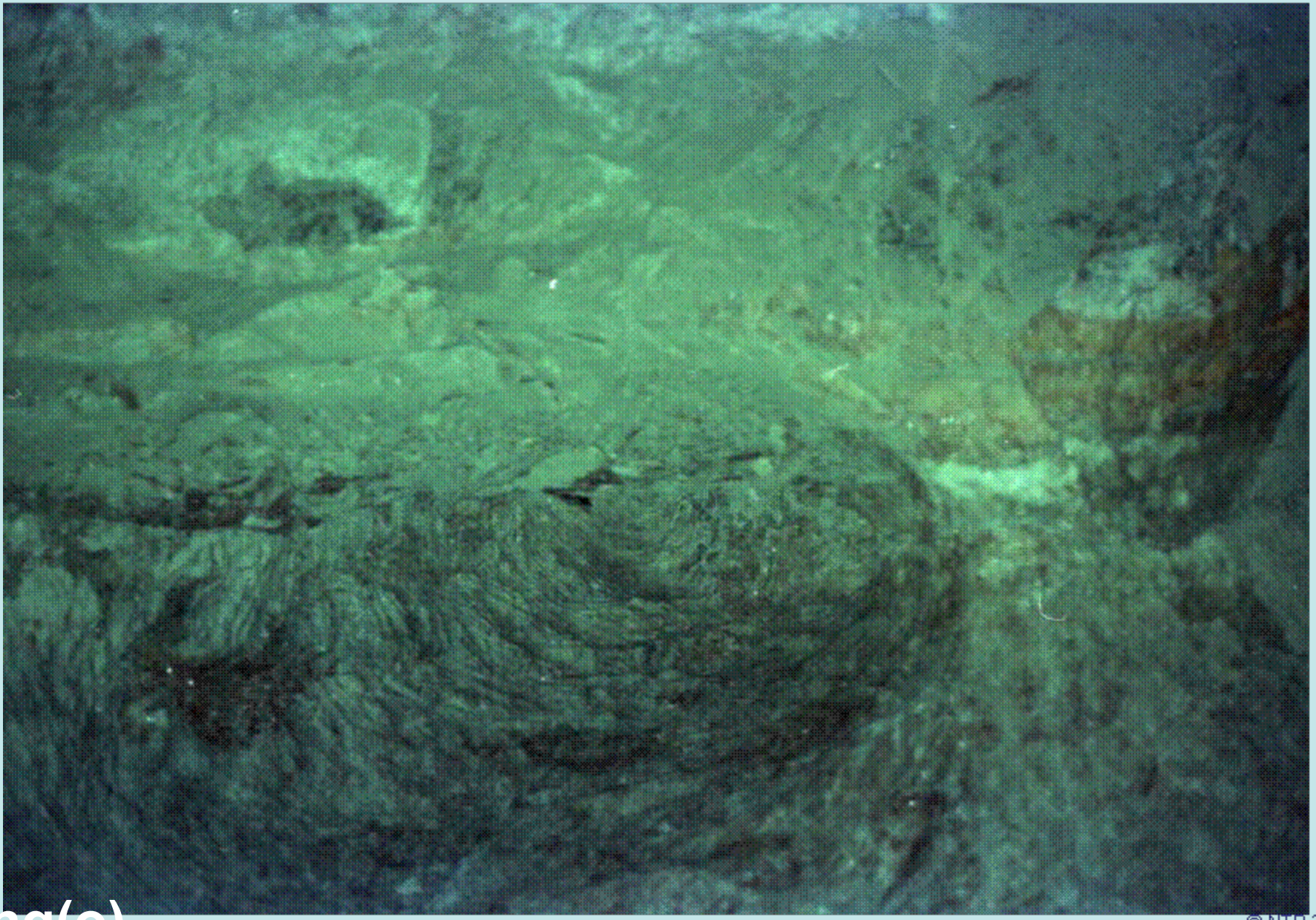
CO_2 blow-out feature near dike in IMC mine, ca. 1980



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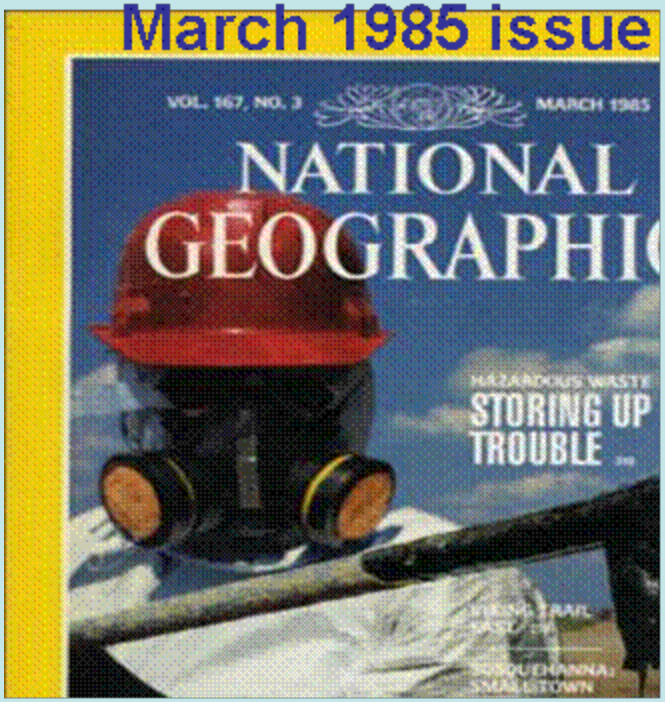
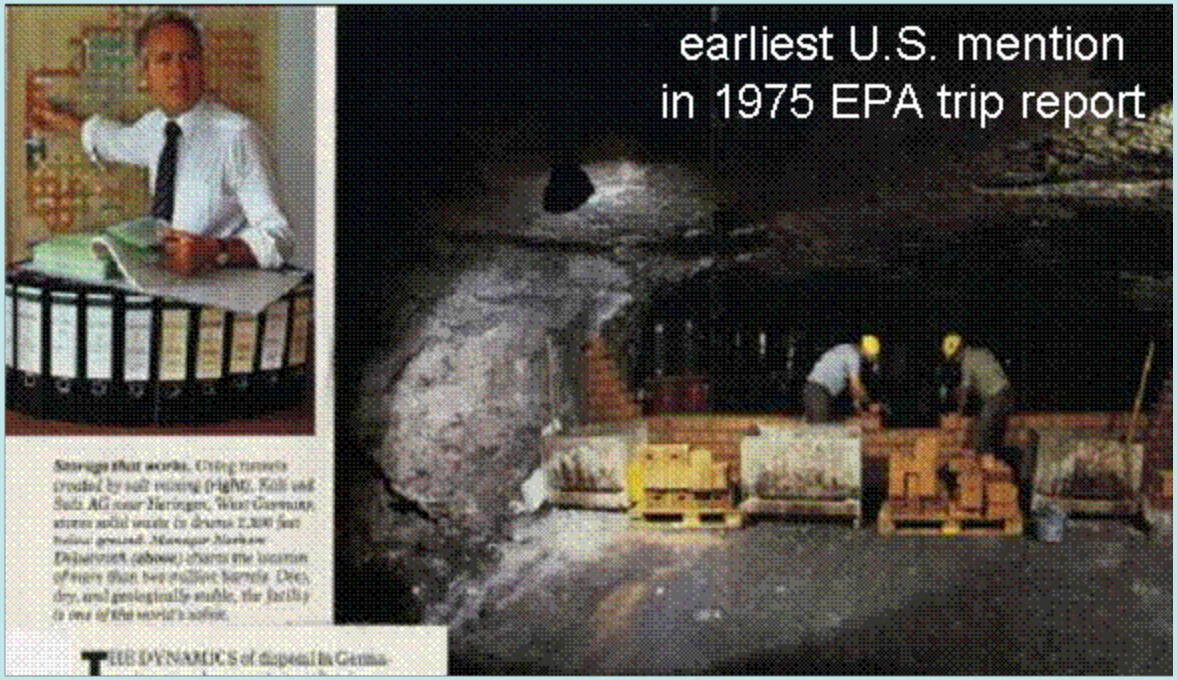
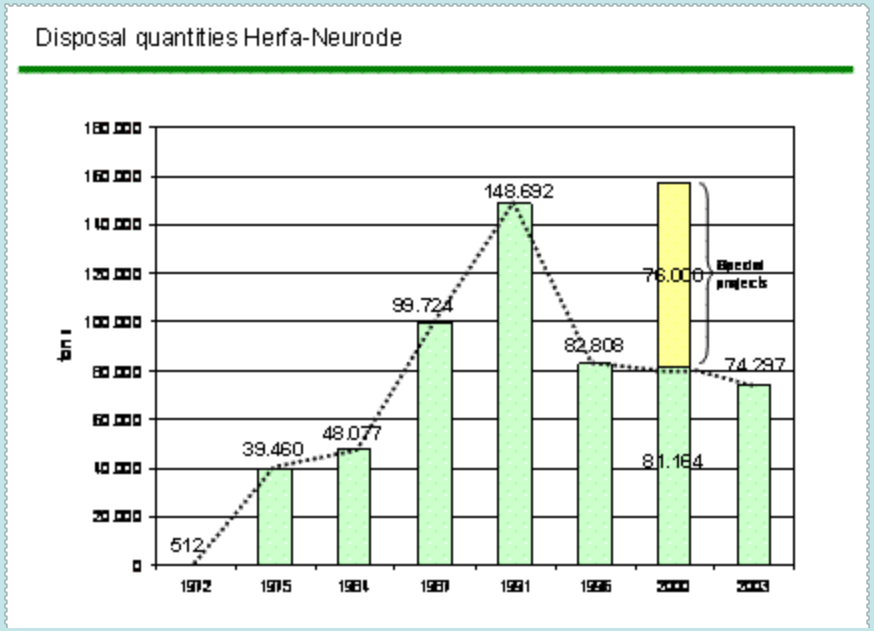
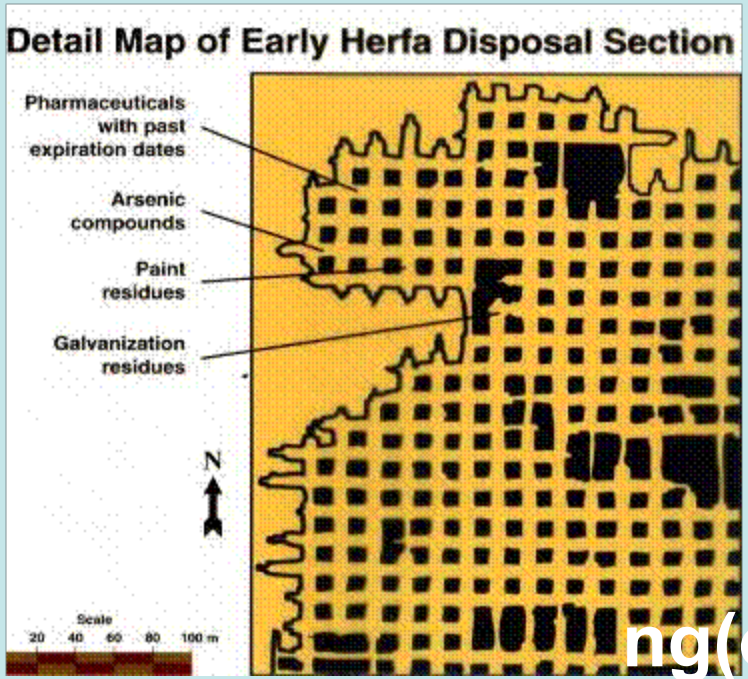
March 1985 issue





Since 1972



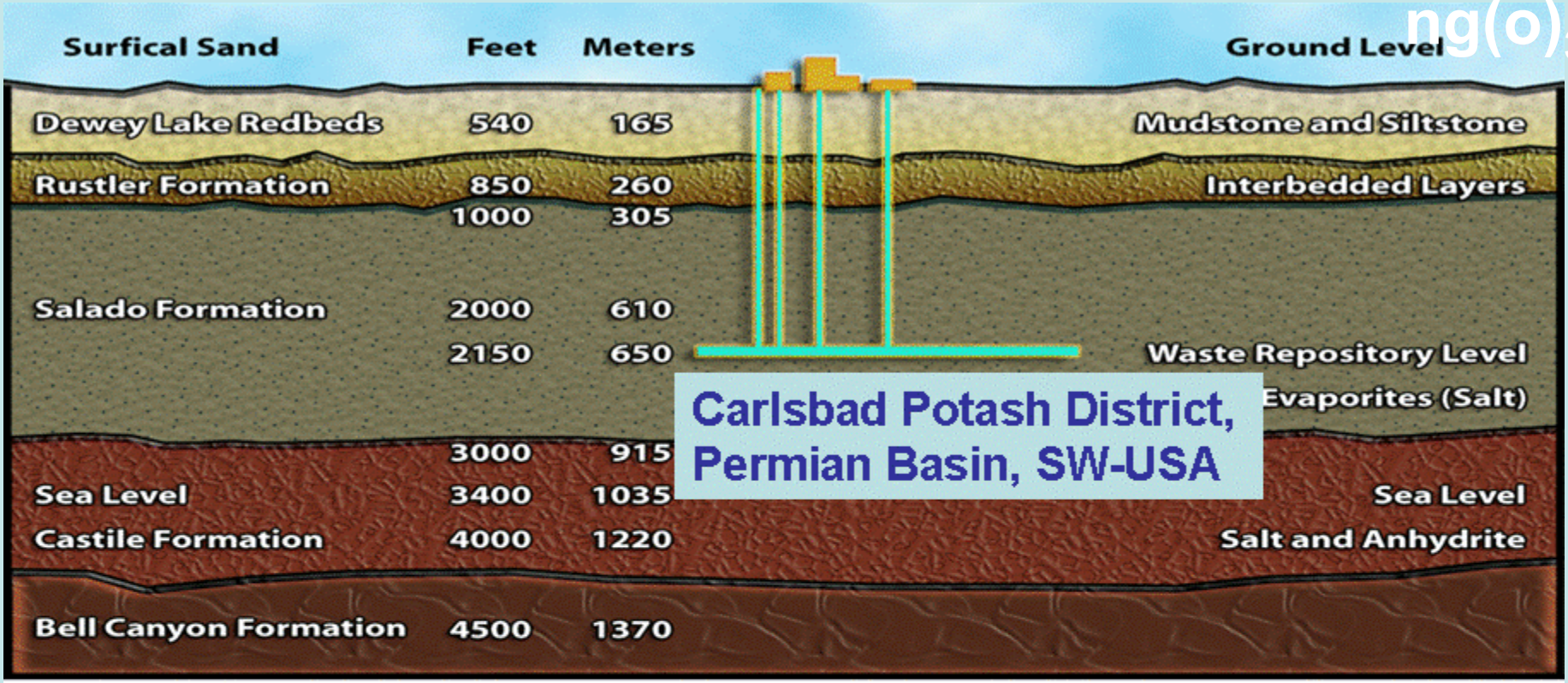


ng(o)$_3$

EPA, 1975 Report

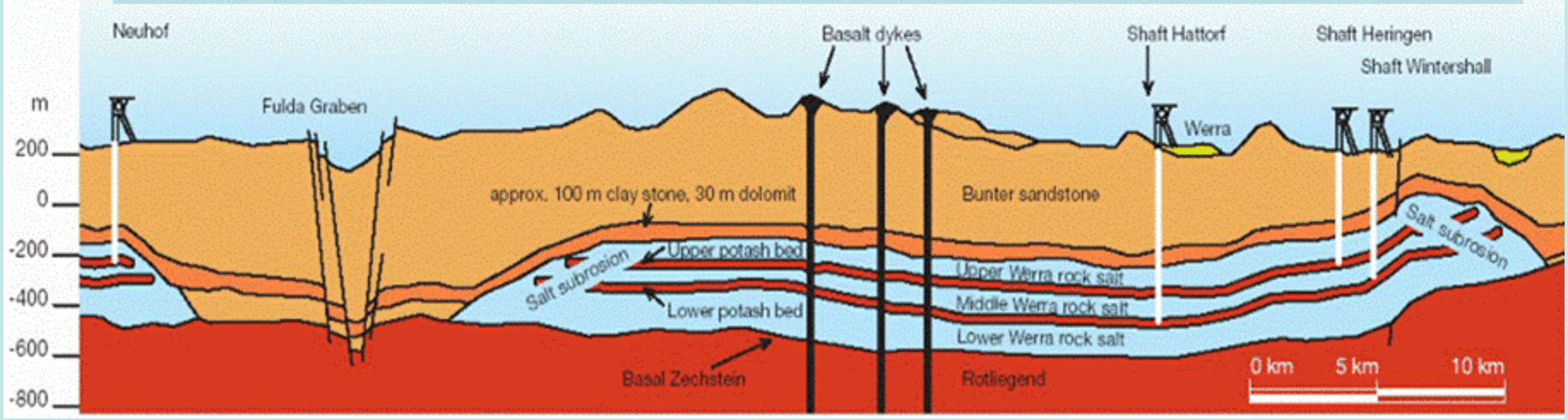
- Environmentally suitable underground space for the storage of industrial hazardous waste now exists within the United States
- Room and pillar mines in salt, potash, and/or gypsum offer the most suitable containment
- Locating regional waste storage facilities at existing mines is technically feasible

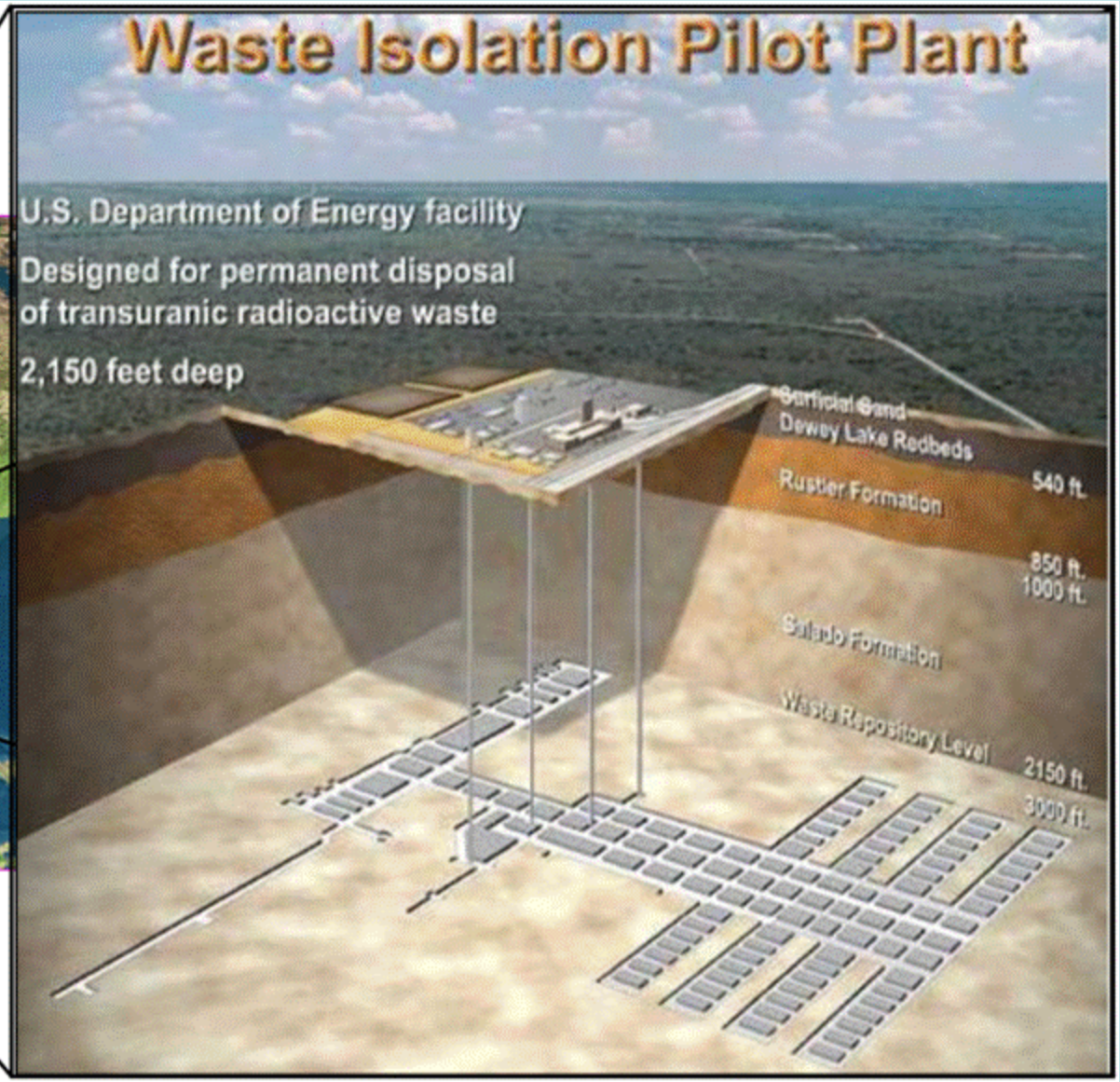
(EPA-600/2-75-040)



Carlsbad Potash District, Permian Basin, SW-USA

Werra Potash District – N-European Permian Basin, Germany



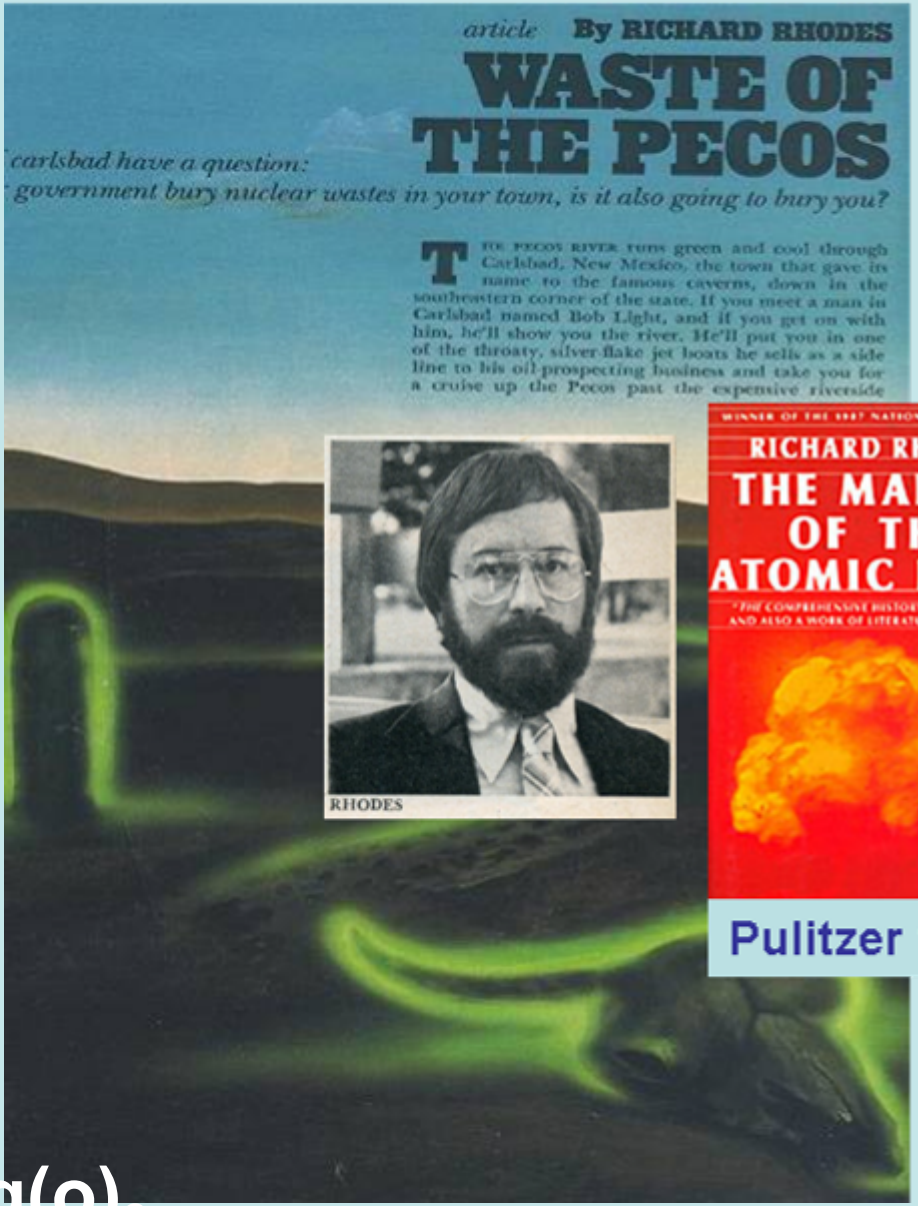

Waste Isolation Pilot Plant
U.S. Department of Energy facility
Designed for permanent disposal
of transuranic radioactive waste
2,150 feet deep
Surficial Sand
Dewey Lake Redbeds
Rustler Formation
540 ft.
850 ft.
1000 ft.
Salado Formation
Waste Repository Level
2150 ft.
3000 ft.


Chemical backfill imposed by regulation
Remotely-handled
TRU waste
Contact-handled TRU waste

WIPP gives the lie to anybody who says "we haven't solved the waste disposal problem". Yes, we have. What's left is the political problem of basically, people don't want it in their neck of the woods.

Richard Rhodes, Pulitzer-winning author of "The Making of the Atomic Bomb", interviewed by *Plutonium Page* for the Daily Kos, November 1, 2009 (http://www.dailykos.com/story/2009/11/1/799409/-Bringing-Oppenheimer-Back-To-Life:-An-Interview-With-Richard-Rhodes) accessed November 3, 2009

August 1979



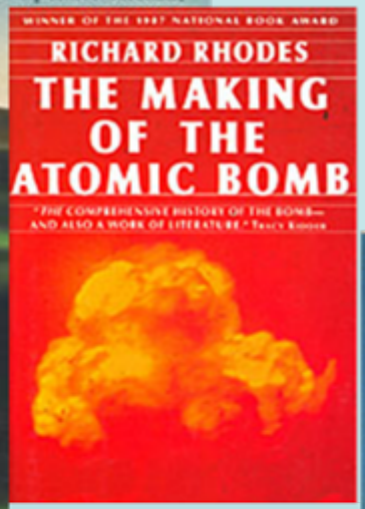
article By RICHARD RHODES

WASTE OF THE PECOS

carlsbad have a question:
government bury nuclear wastes in your town, is it also going to bury you?

THE PECOS RIVER runs green and cool through Carlsbad, New Mexico, the town that gave its name to the famous caverns, down in the southeastern corner of the state. If you meet a man in Carlsbad named Bob Light, and if you get on with him, he'll show you the river. He'll put you in one of the throaty, silver-flake jet boats he sells as a side line to his oil-prospecting business and take you for a cruise up the Pecos past the expensive riverside

RHODES



WINNER OF THE 1987 NATIONAL BOOK AWARD

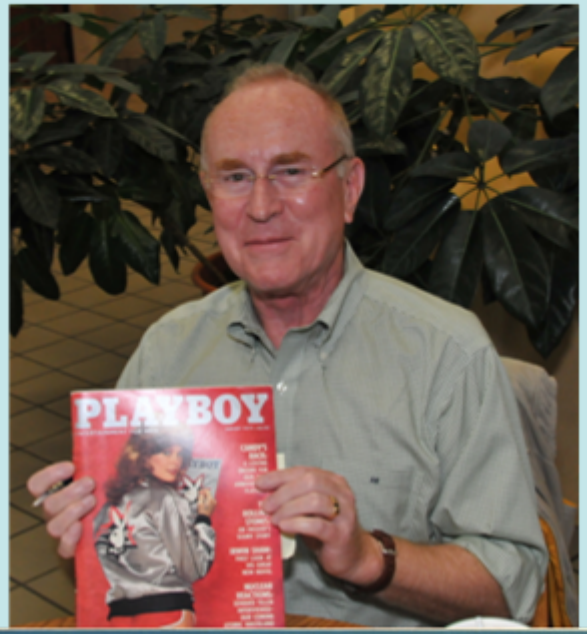
RICHARD RHODES

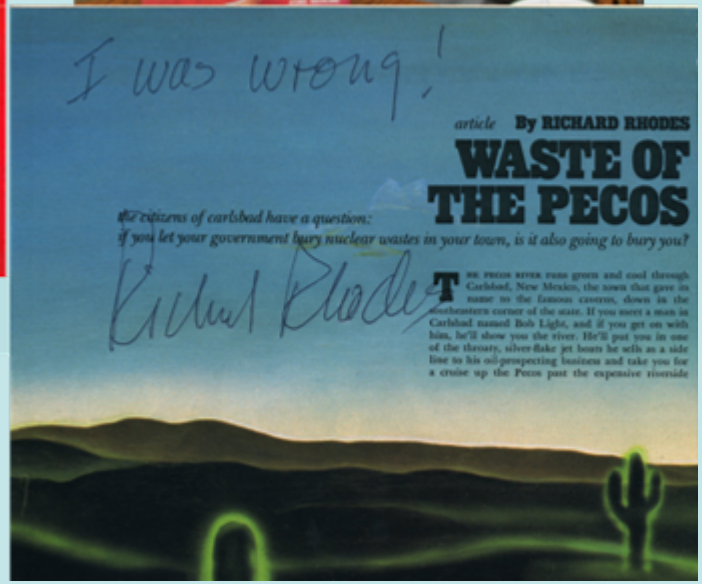
THE MAKING OF THE ATOMIC BOMB

"THE COMPREHENSIVE HISTORY OF THE BOMB—AND ALSO A WORK OF LITERATURE." TIME'S KIDDER

Pulitzer 1988

August 2009





I was wrong!

Richard Rhodes

article By RICHARD RHODES

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the citizens of carlsbad have a question:
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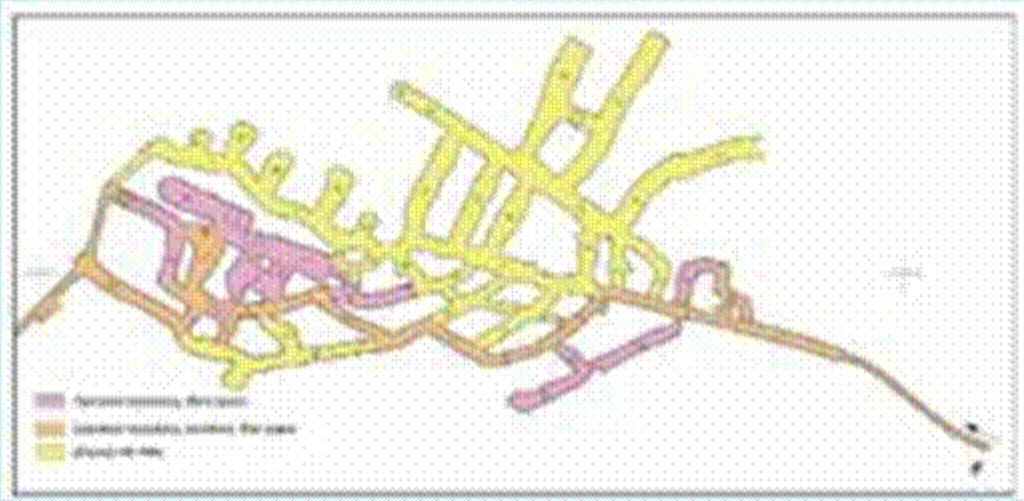
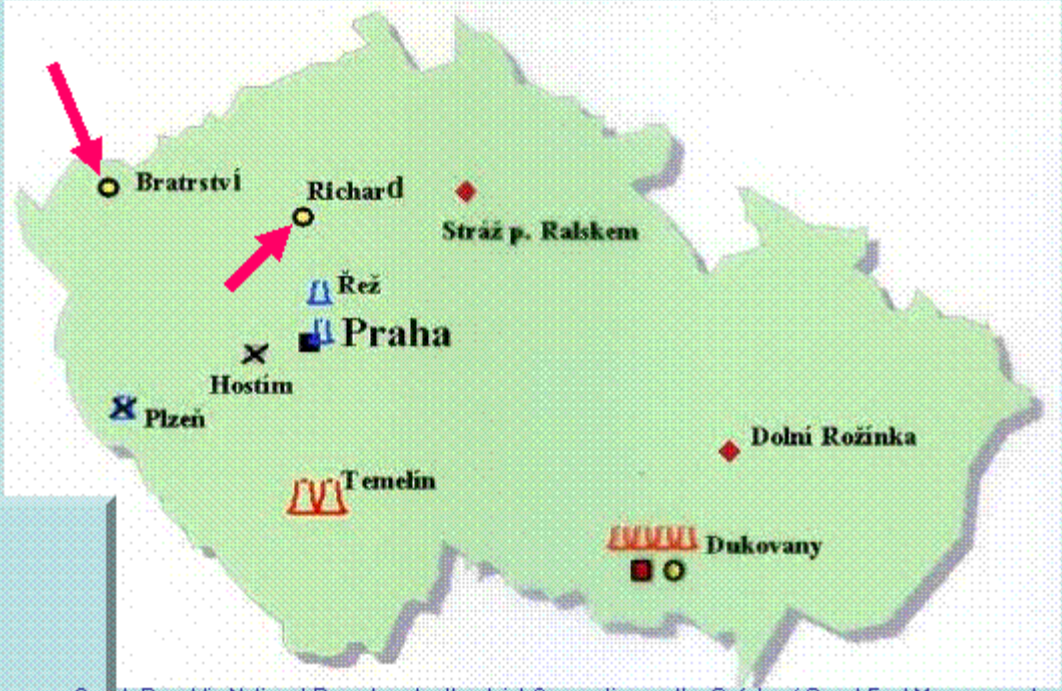
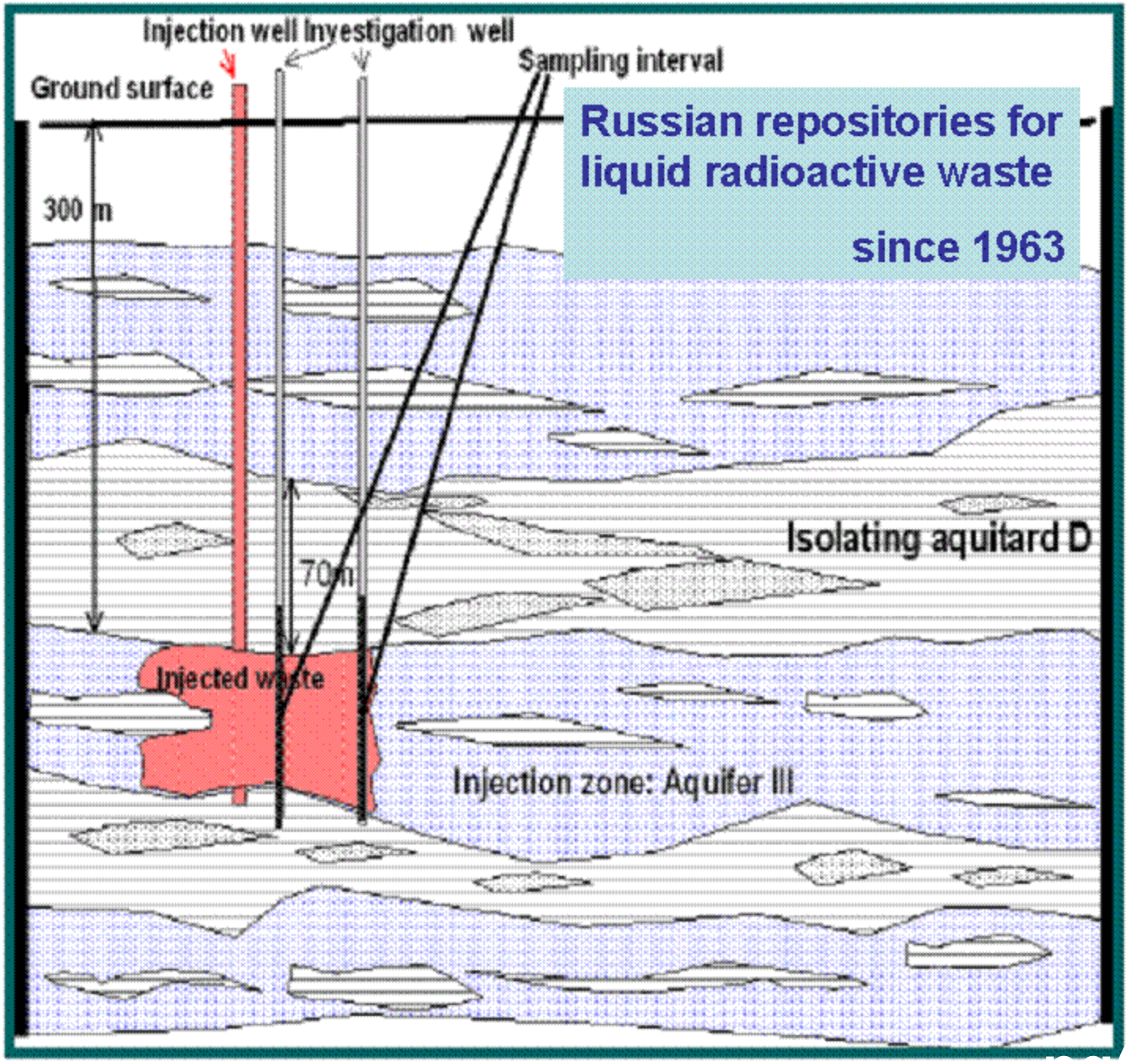


Czech waste repositories in limestone and uranium mines

since 1959

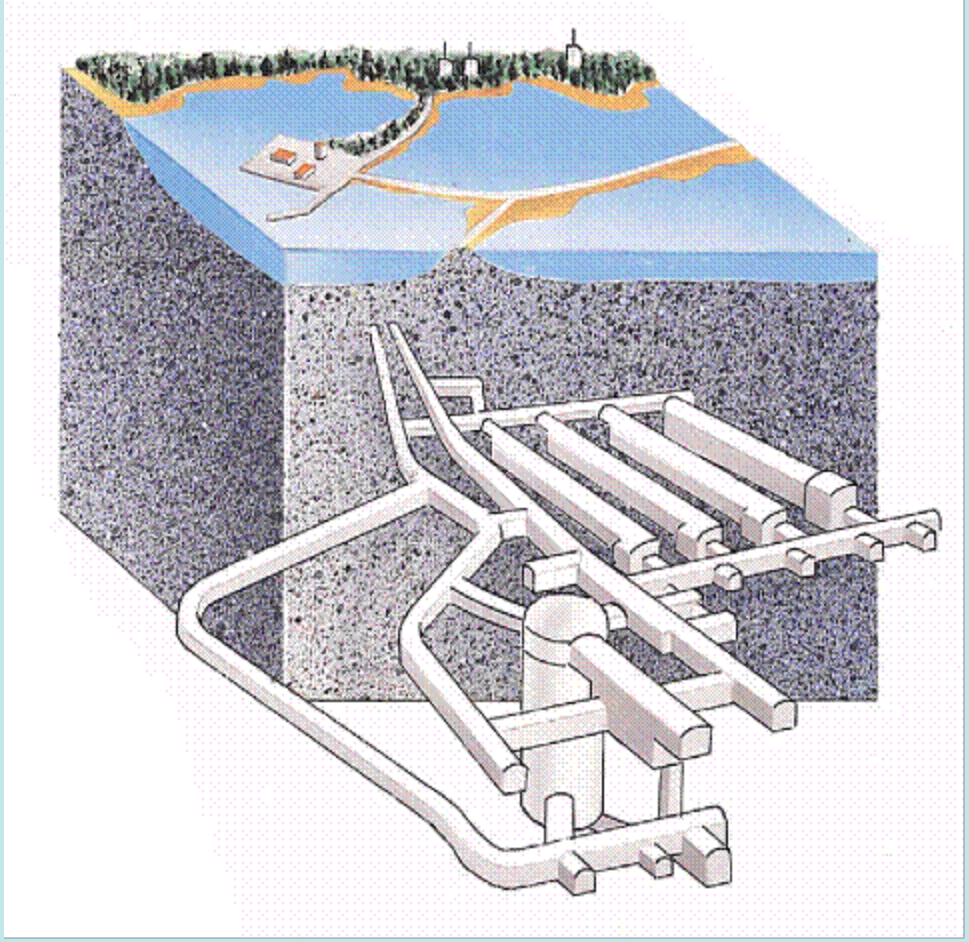


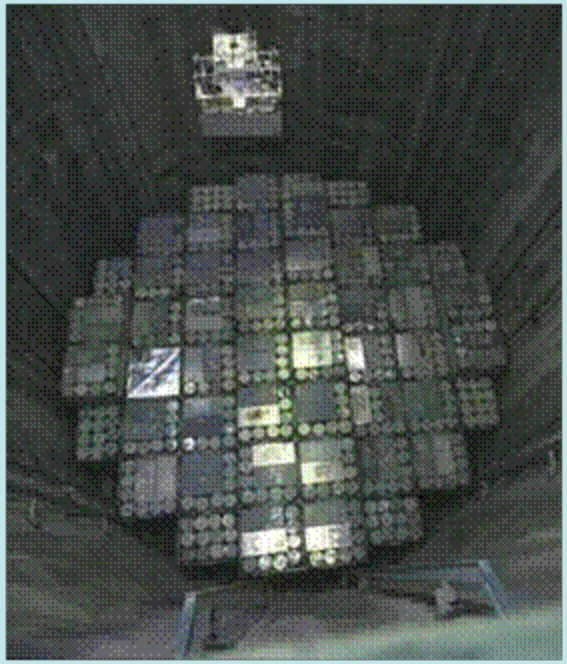
ng(o)3



Russian repositories for liquid radioactive waste since 1963

http://www.iiasa.ac.at/Publications/Documents/RR-00-001.pdf

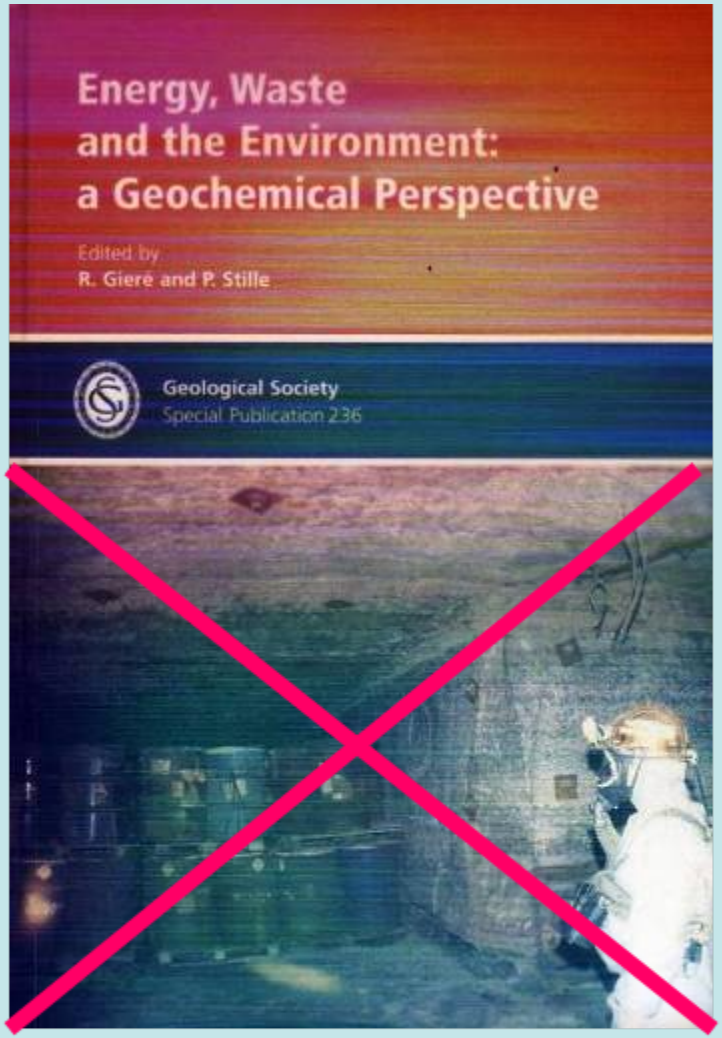




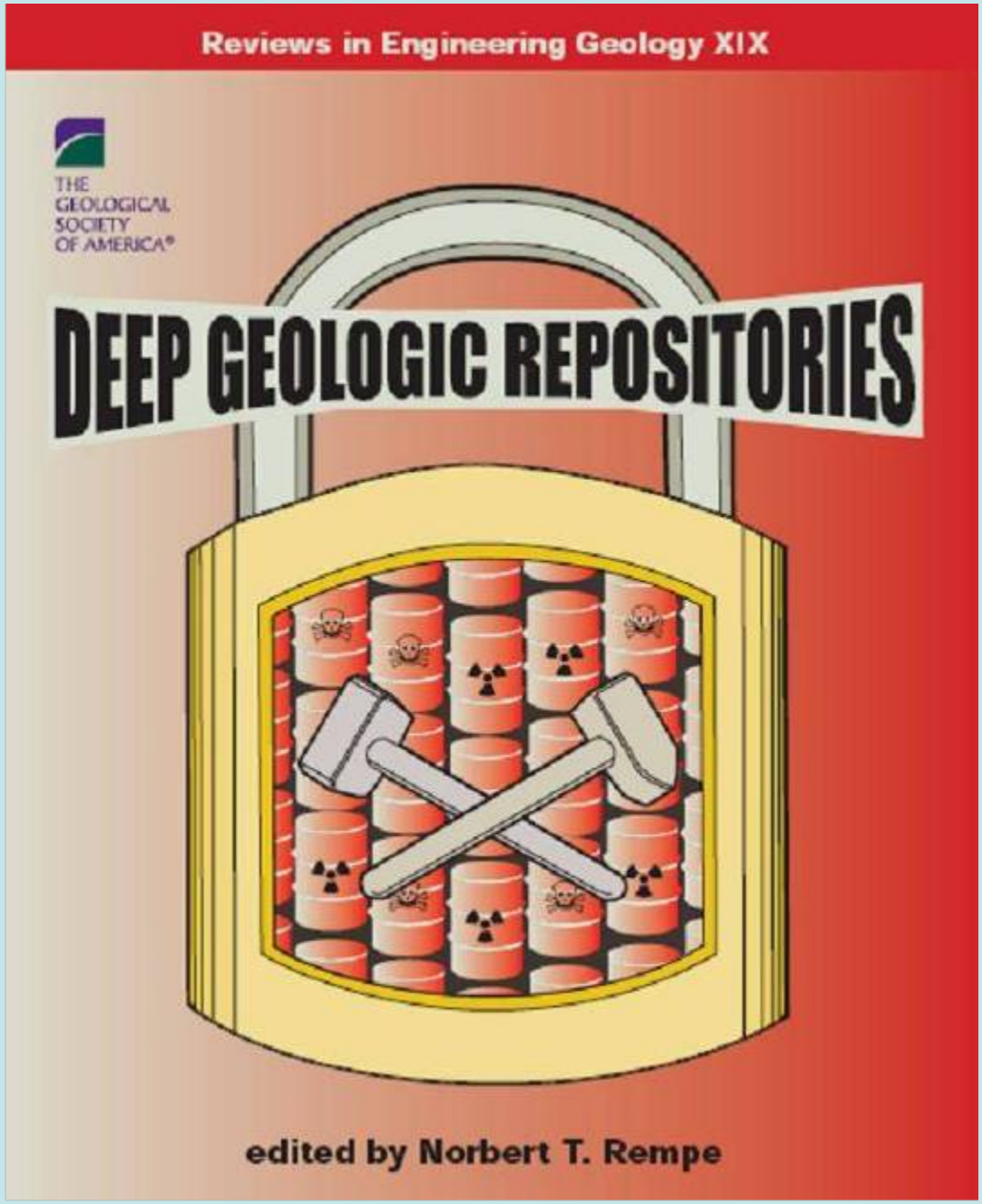
Finnish and Swedish repositories for radioactive waste in crystalline basement rock (granite, gneiss, etc.)

Since 1988 and 1992

http://www.posiva.fi/en/final_disposal
http://www.skb.se/upload/publications/pdf/Engelsk_low_res.pdf



This book, published by the Geological Society (of London) is not bad, but the title illustration is unattributed and defamatory



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2. Data, ideas, and conclusions that are extracted may be in error outside the original context or intent.
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4. None of the material should be assumed to be be original.

Special Note

Norbert T. Rempe prepared this presentation as a private individual, not for profit. This work was *NOT* sponsored by any private organization or government agency.

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Progress in Nuclear Energy 49 (2007) 365–374

PROGRESS IN NUCLEAR ENERGY
An International Review Journal

www.elsevier.com/locate/pnucene

Review

Permanent underground repositories for radioactive waste

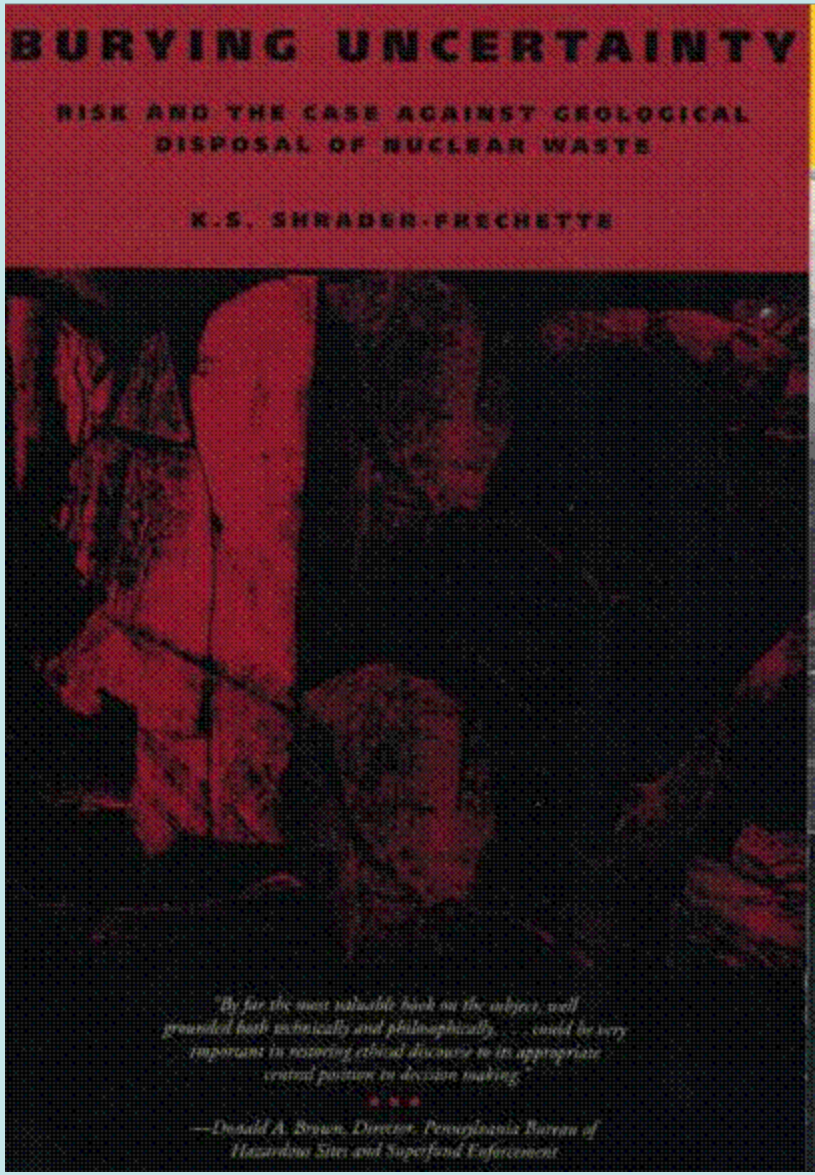
Norbert T. Rempe*

Abstract

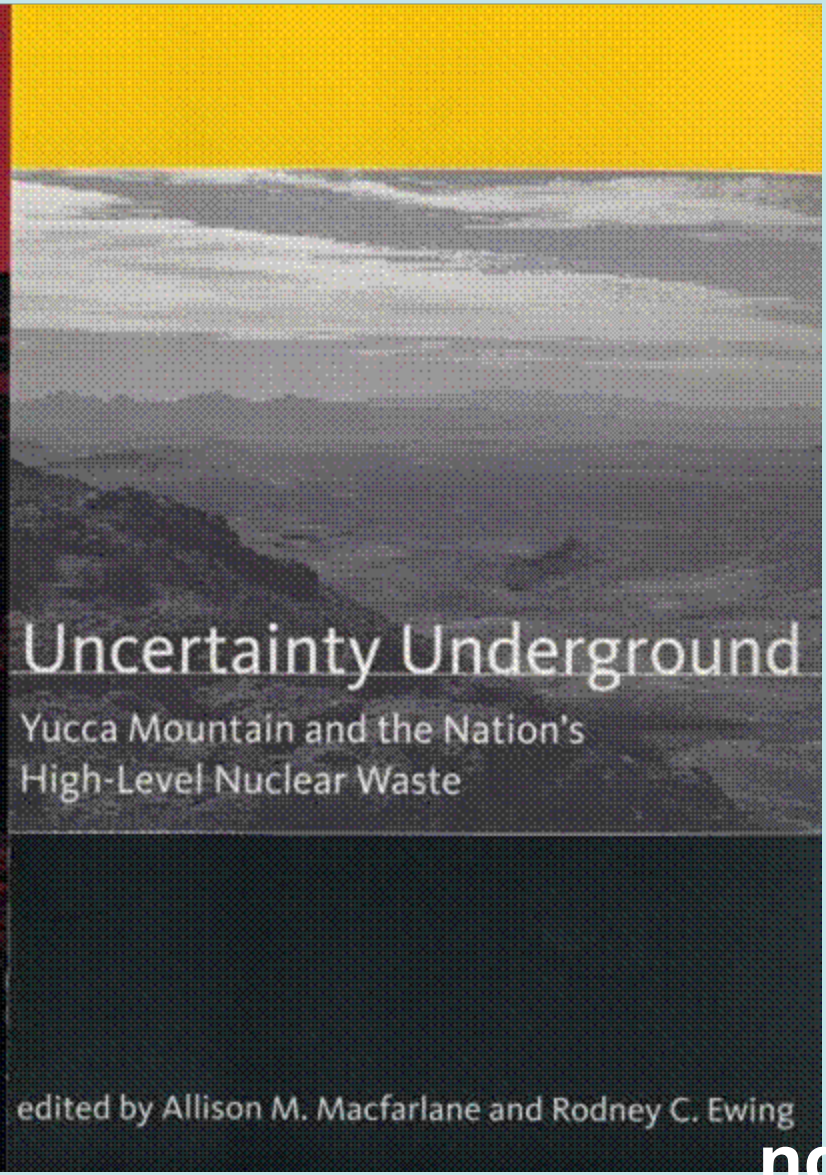
Solid radioactive waste first entered a deep geologic repository in 1959. Liquid radioactive waste has been injected into confined underground reservoirs since 1963. Solid wastes containing chemically toxic constituents with infinite half lives have been isolated underground since 1972. Performance to date of these and other repositories has not caused any of their owners and operators to transfer or contemplate transferring the waste confined in them to presumably safer locations. Natural and engineered analogues offer sound evidence that deep geologic isolation is effective, safe, and compatible with responsible environmental stewardship. Underground isolation of dangerous, including radioactive, wastes is therefore increasingly being used as a safe and reliable method of final disposal.

Cottage Industry in Uncertainty

1993 University of California



2006 MIT

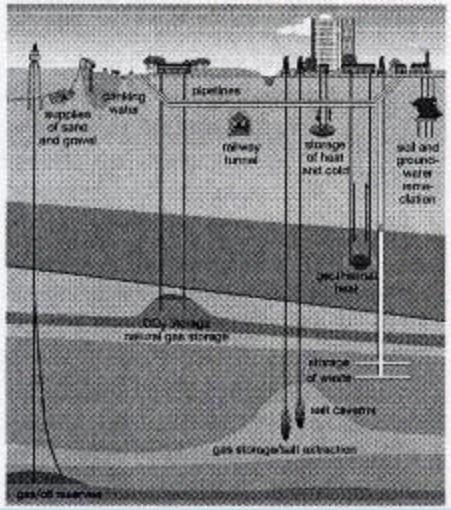


from a publication by the Dutch Geological Survey

erlands Institute of Applied Geoscience TNO
ional Geological Survey

Multiple use of deep subsurface space

Getting things out of the earth (mining) is a very old pre-occupation of mankind. Putting things into the deep subsurface (500 m below groundlevel) is a more recent development. Deep subsurface usage in the Netherlands is changing and intensifying at a rapid pace. To what degree can different options for use be combined or, conversely, to what degree are they mutually exclusive? The allocation of specific parts of the deep underground to competing uses requires a policy concept and a set of criteria. A draft model is being developed at TNO-NITG.



Salt mining

Mining of the sodium and potassium-magnesium salt of the Zechstein and Röt Formations, by subsurface dissolution, is actively pursued in the eastern and north-eastern parts of the country. The salt manifests itself as layered beds, domes and plugs at depths varying from 300 - 3000 m. Its thickness varies from several tens to several hundreds of meters.

Natural gas and oil production

ng(o)$_3$

ὁ δὲ ἀνεξέταστος βίος οὐ βιωτὸς ἀνθρώπω (Socrates)

the unexamined life is not worth living (for a *proper* human being)

Common unexamined assumptions in geologic waste isolation:

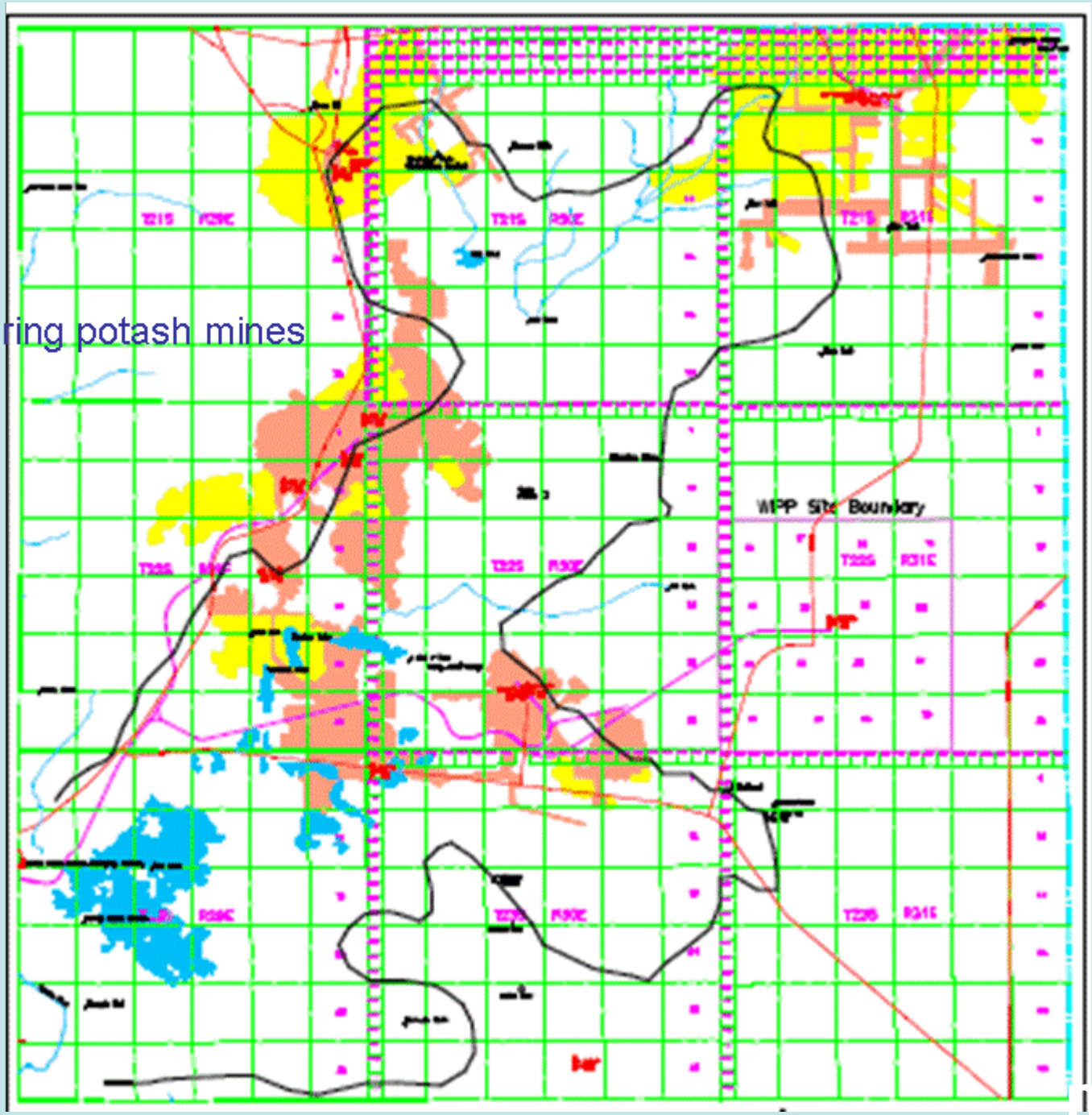
The fascinating impressiveness of rigorous mathematical analysis, with its atmosphere of precision and elegance, should not blind us to the defects of the premises that condition the whole process (T. C. Chamberlin, 1899)

- Liquid waste must be solidified before geologic disposal
- New excavations are better than old mines
- Known mineral resource areas should be avoided
- Radioactivity is more insidious than chemical toxicity
- We must understand everything "perfectly"
  - down below the yocto (10^{-24}) scale
  - up above the nth dimension
  - before deciding to do anything

Your system is perfectly designed to give you the results you're getting

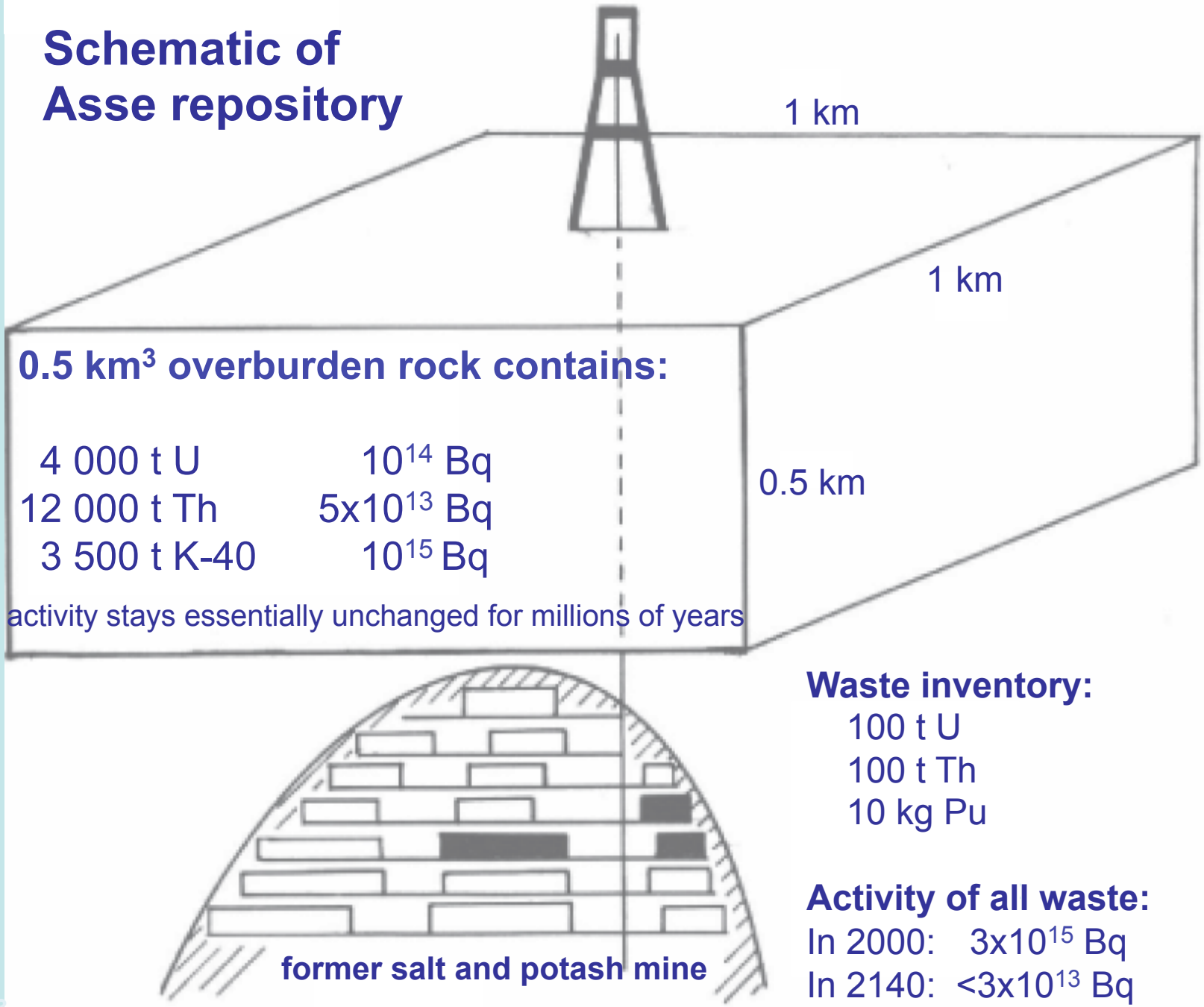
(W. Edwards Deming)

Neighboring potash mines



$hg(o)_3$

Schematic of Asse repository



0.5 km³ overburden rock contains:

4 000 t U	10^{14} Bq
12 000 t Th	5×10^{13} Bq
3 500 t K-40	10^{15} Bq

activity stays essentially unchanged for millions of years

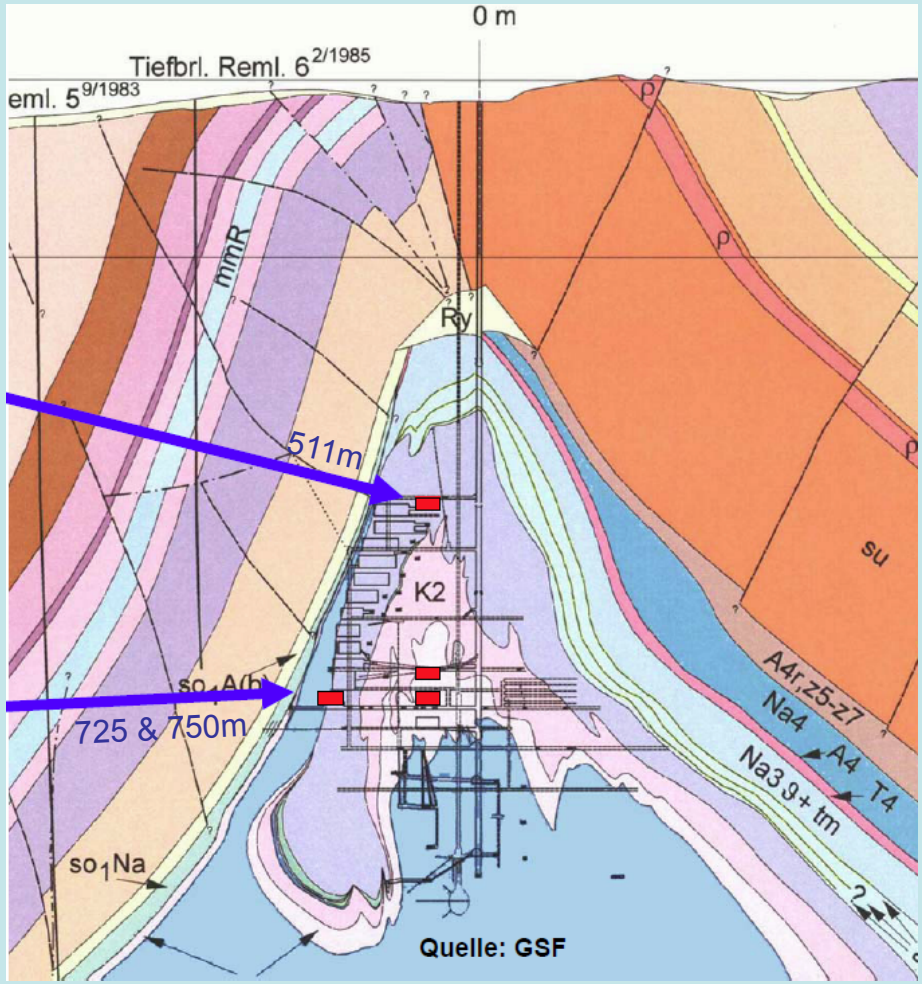
Waste inventory:

100 t U
100 t Th
10 kg Pu

Activity of all waste:

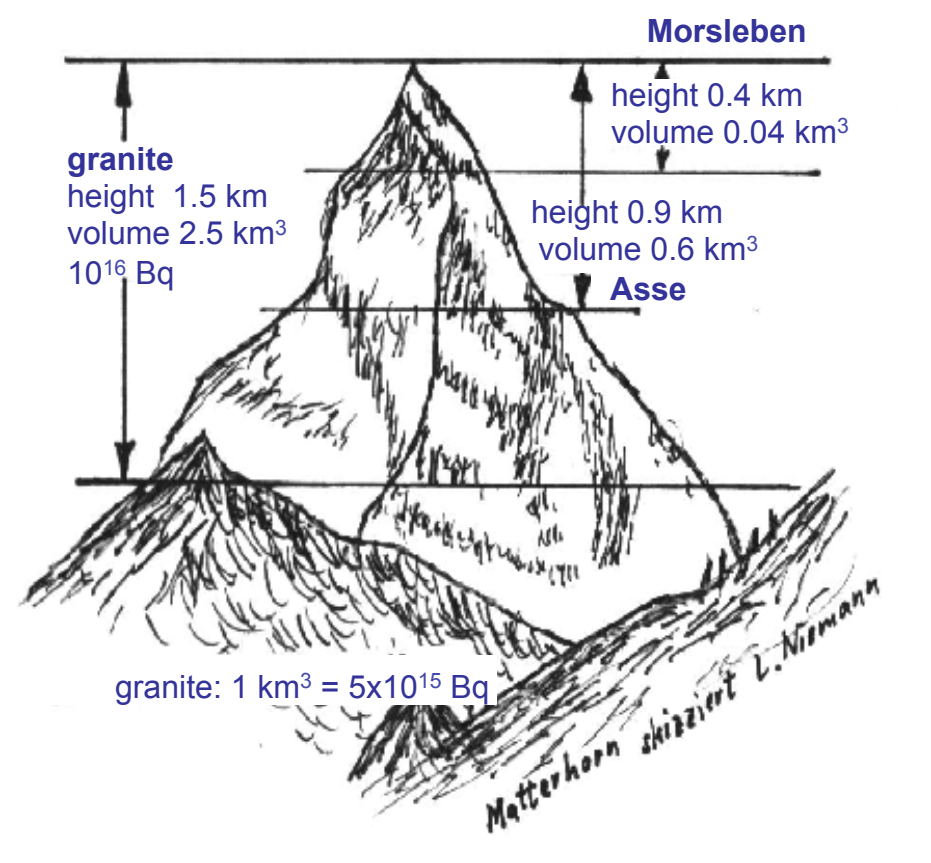
In 2000: 3×10^{15} Bq
In 2140: $<3 \times 10^{13}$ Bq

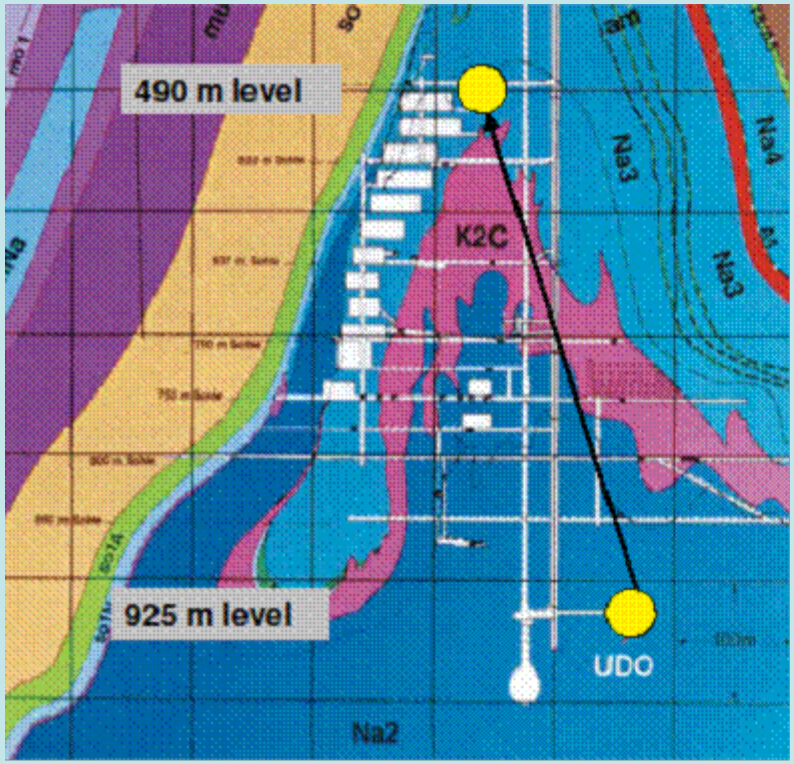
translated from: http://www.novo-argumente.com/artikel/99/novo9943.pdf



Asse

Matterhorn



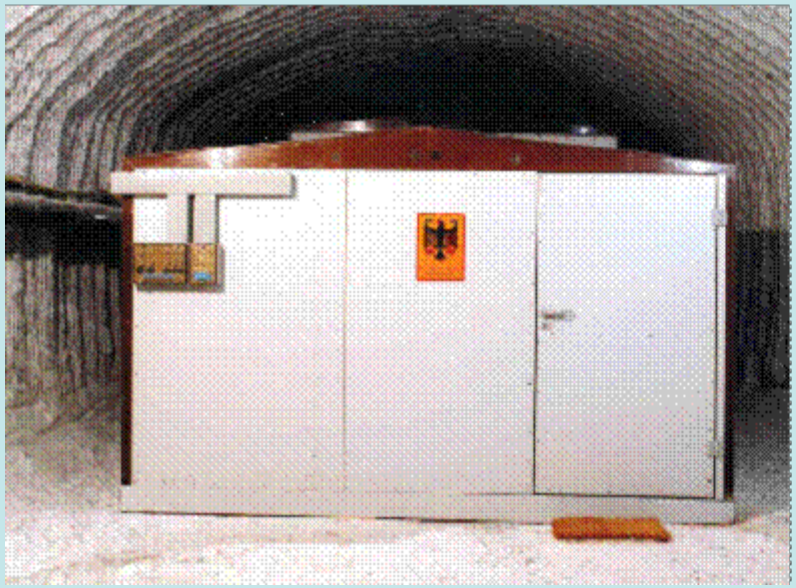


Asse

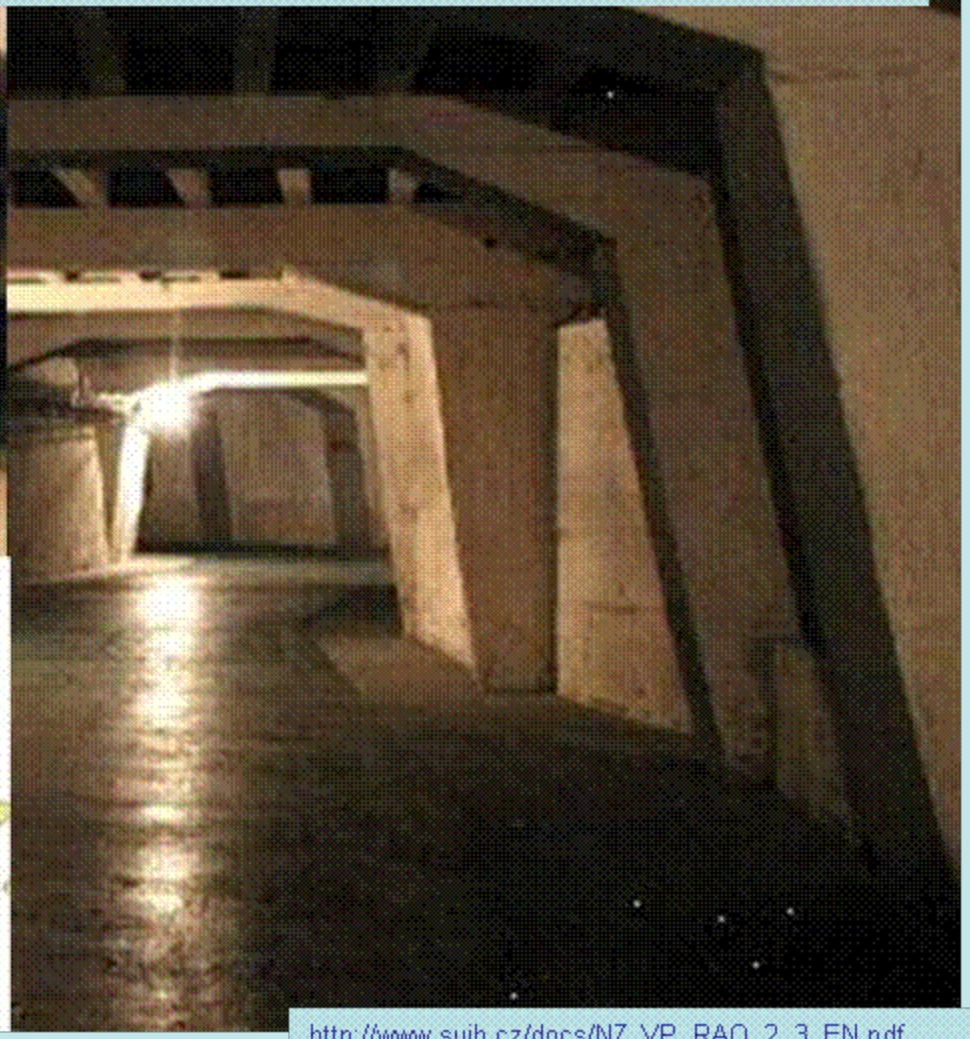
salt & potash

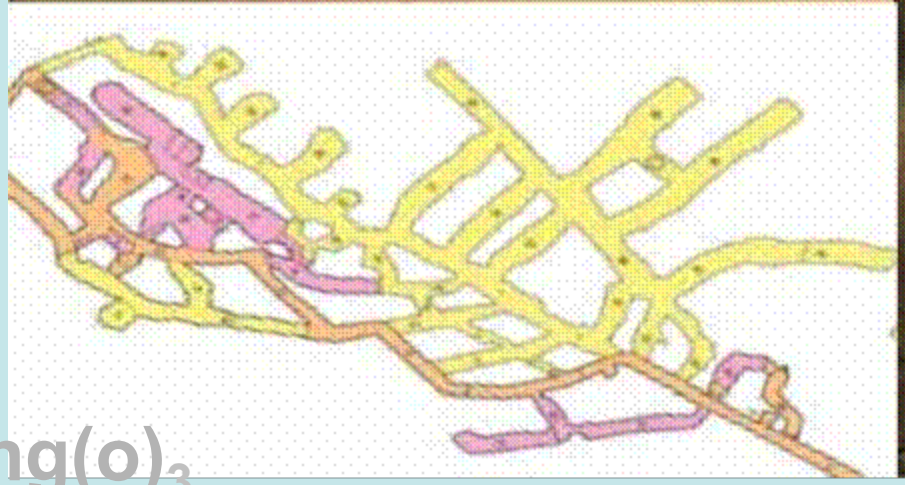
radioactive waste

low-background research



Czech repository for radioactive waste since 1959





http://www.sujb.cz/docs/NZ_VP_RAO_2_3_EN.pdf

Bratrstvi – former uranium mine since 1974 repository for radioactive waste

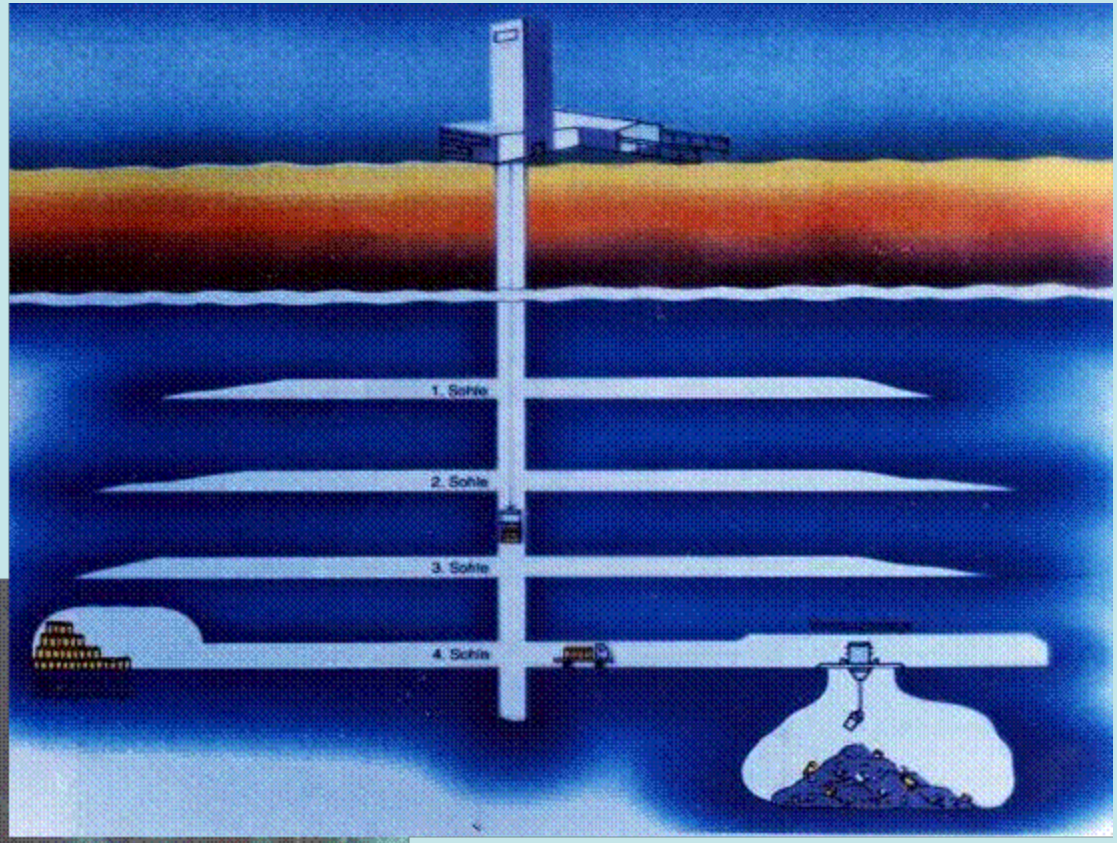
German repositories for chemically toxic waste in salt and potash mines

http://www.uev.de/eng/frame/frameset.html

http://www.geosociety.org/bookstore/default.asp?oID=0&catID=11&pID=REG019

ng(o)$_3$

(Formerly East-) German repository for radioactive waste in former potash and salt mine



http://www.dbe.de/en/sites/morsleben/2/index.php

Geology isn't a real science

Sheldon Cooper, Ph.D. (fictional theoretical physicist in TV series “The Big Bang Theory”)

http://tlcsolutions2.hypermart.net/jal/New%20Site/sculpture.htm

ng(o)$_3$