

Remediation of sites containing Uranium mining and milling waste:



accomplishments and remaining research needs

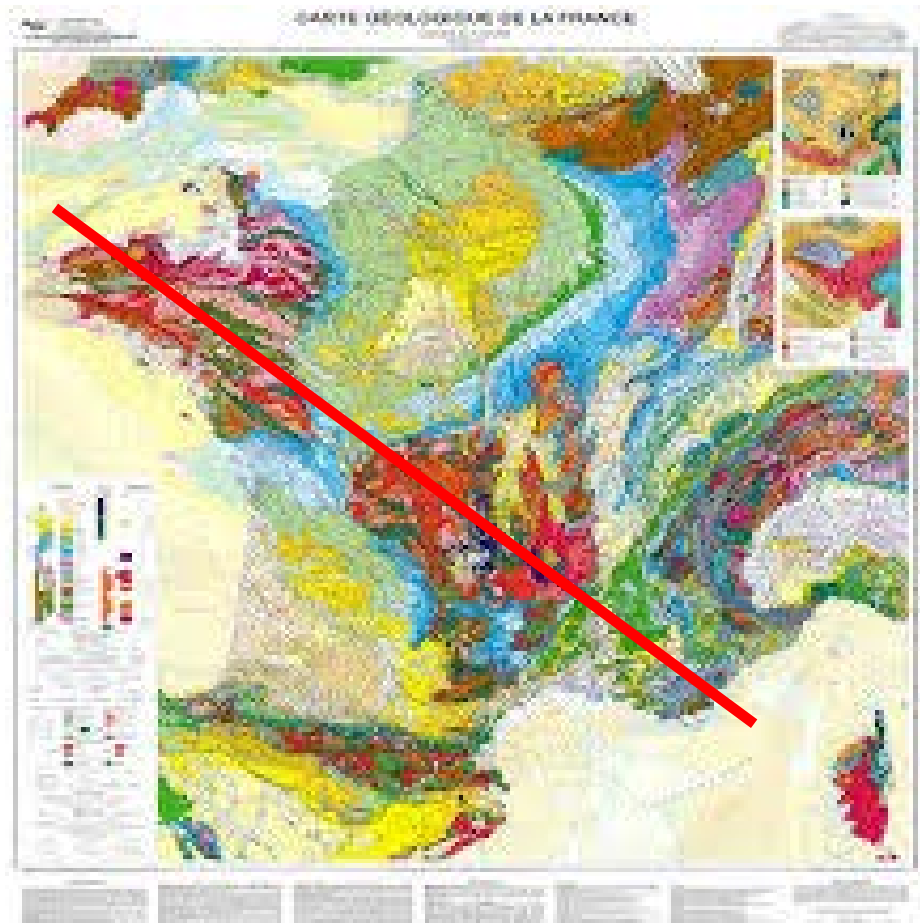
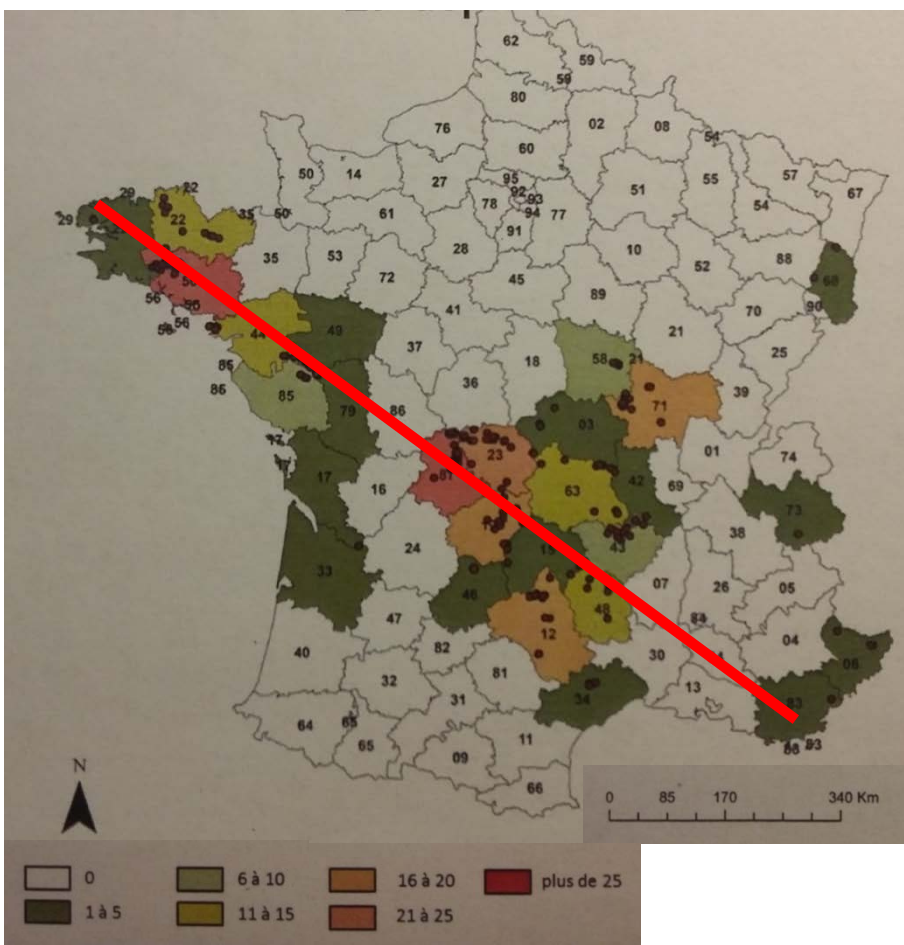
CONTENT

Remediation

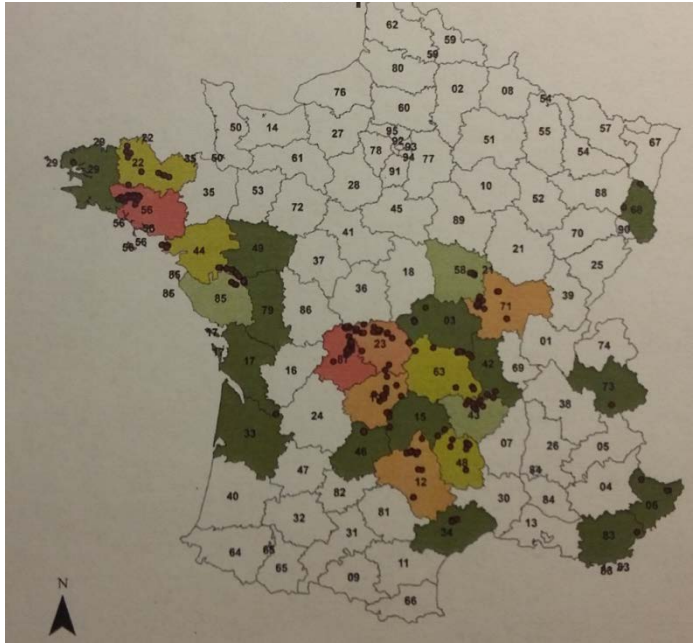
Regulation

Research needs

Key informations

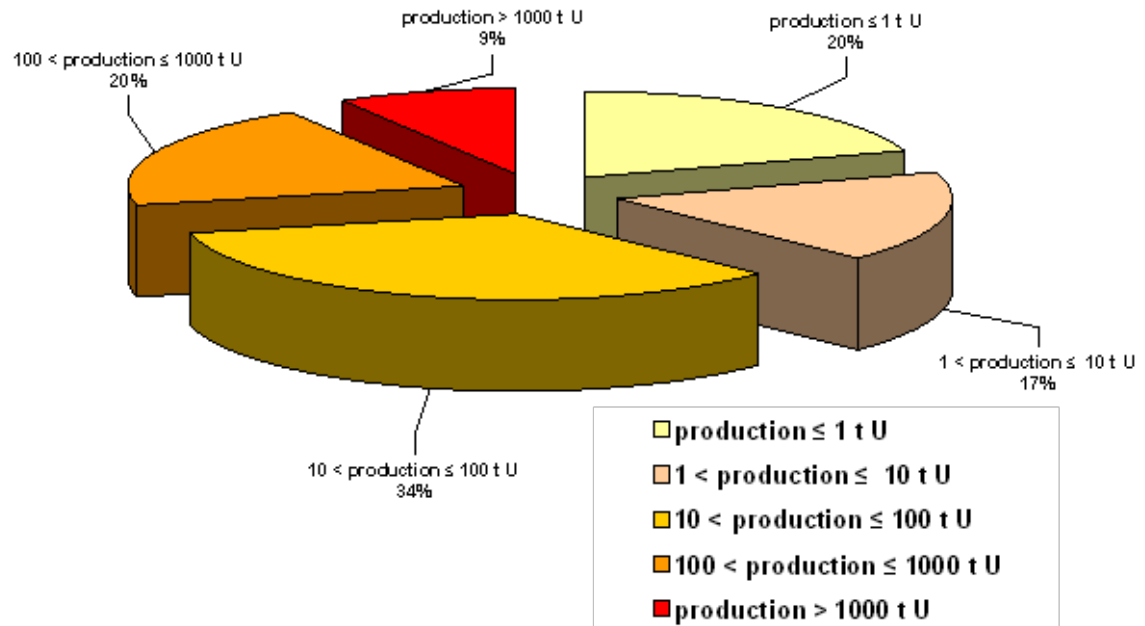


Key informations



Production from 1948 to 2001
Operators: small compagnies, COGEMA, AREVA mines

~ 250 places



Waste rock	200 10 ⁶ t
ore	52 10 ⁶ t
uranium	0,080 10 ⁶ t
tailings	50 10 ⁶ t

Main objectives of remediation:

- Long term stability of the remediated area in terms of safety and public health
- Reduction of total land consumption and resulting needs for institutional control
- Prevention of risk resulting from intrusion
- Favour possible industrial or leisure activities on the land and remaining buildings
- Reduction of the impact as low as reasonably achievable
- Landscape integration, in co-operation with local stakeholders

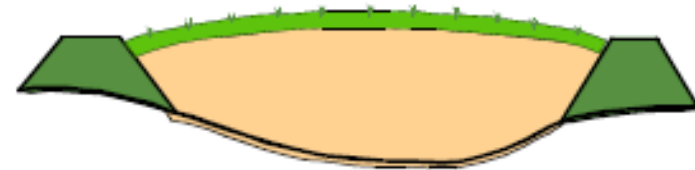
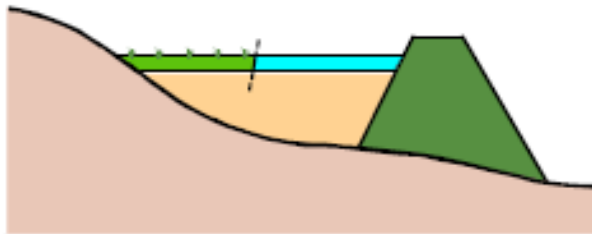
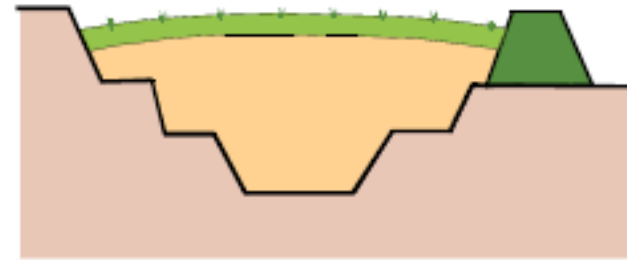
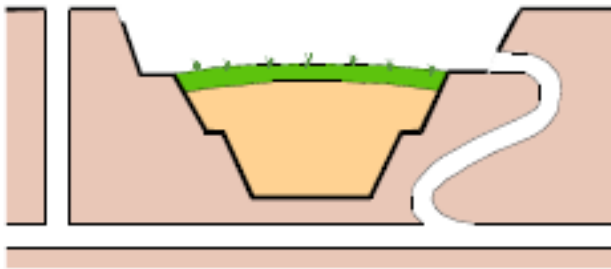
Remediation of factories

- dismantled
- decommissioned
- Reuse of non radioactive sections



Remediation of tailings

- 19 storages (17 with solid cover; 2 with liquid cover)
- Open pit or natural thalweg
- Dam
- **No objective of impermeability**
- **Control/ treatment of outflowing water**



Source AREVA mines

Remediation of tailings



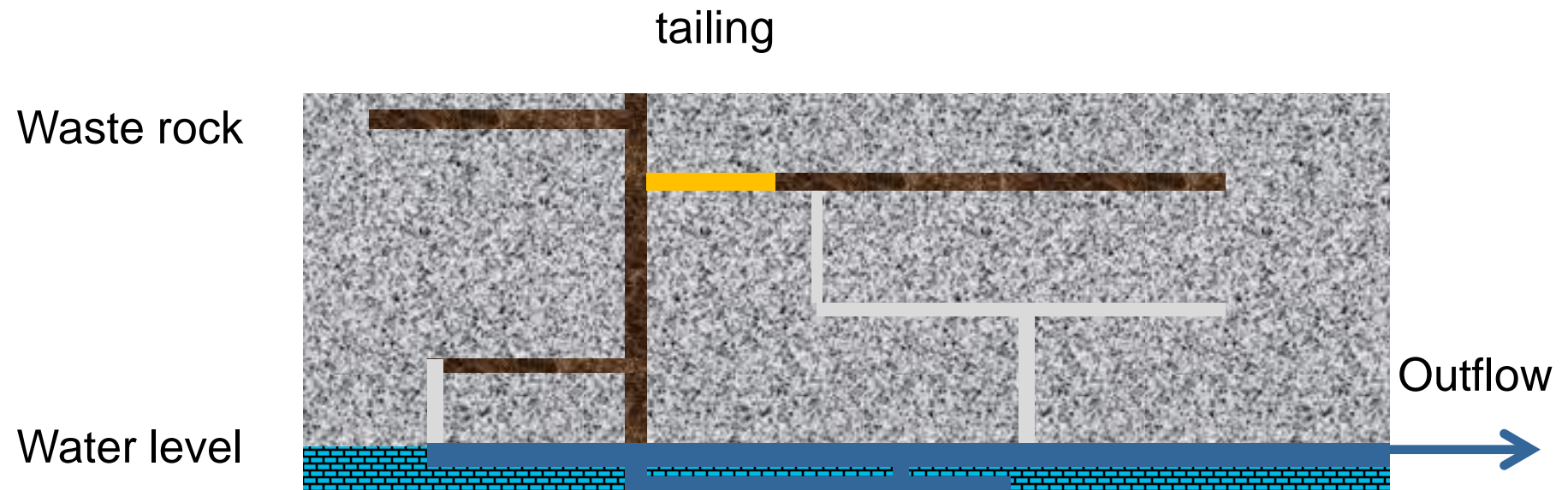
Source: Areva mines



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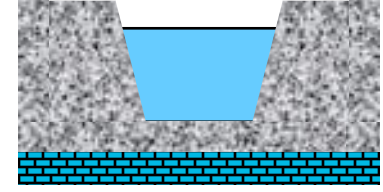
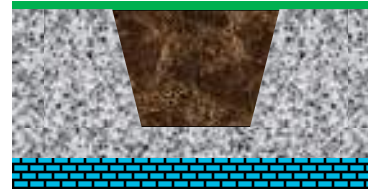
Remediation of Underground mines

- Backfilled with tailing and waste rock
- Flooded
- Passive outflowing



Remediation of open pits

- Filled with waste rock or water
- Water control/treatment



Source: cahiers du patrimoine



Source: cahiers du patrimoine



Source: géoportail

CONTENT

Remediation

Regulation

Research needs

Regulation

All the sites

In accordance with international radiation protection rules

$$5 \text{ mSv/year} \quad \rightarrow \quad \text{TAETA} < 1$$

$$\text{TAETA} = \text{TAET}_{\text{total}} - \text{TAET}_{\text{background}}$$

$$\text{TAET} = \frac{\text{external exposure}}{5 \text{ mSv}} + \frac{^{238}\text{U in dust}}{170 \text{ Bq}} + \frac{\text{PAE } ^{222}\text{Rn}}{2 \text{ mJ}} + \frac{\text{PAE } ^{220}\text{Rn}}{6 \text{ mJ}} + \frac{\text{ingested } ^{226}\text{Ra}}{7\,000 \text{ Bq}} + \frac{\text{ingested } U}{2 \text{ mg}} + \frac{U \text{ in uranate dust}}{3\,000 \text{ Bq}}$$

Tailings

- In situ confinement
- Effectiveness over a period of 300 years
- 5 scenarios
- From active to passive surveillance

Regulation

administration
operator

Specific document



1th certificat



Remediation



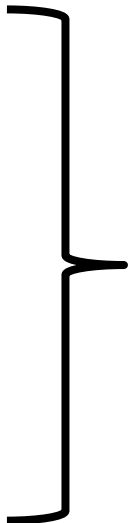
Control and 2nd certificat



Renonciation



Ministerial order



Modification of
international rules
5 mSv → 1mSv

CONTENT

Remediation

National regulation

Research needs

Already engaged program/actions

MIMAUSA:

Inventory of main information
beginning of 2000
ministry of environment, operator and IRSN

GEP:

Recommendations for long term management
from 2004 to 2010
IRSN, administration, operator, academic scientist,
association

Radon:

How to assess the impact of mining operation?

Remaining needs

Reference level - background:

non reference level

upstream, downstream measurements

can we develop new proxi?

Water:

What is the effectiveness of chemical treatment?

Can we switch from active to passive treatment?

Can we assess the evolution of the quality of the water?

Remaining needs

Behavior in watershed:

contamination of sediment and soils

what are the mechanisms of retention and how to limit them?

how long are the pollutants trapped?

how to manage contaminated materials?

Dam:

What is their resilience over the half live of ^{226}Ra ?