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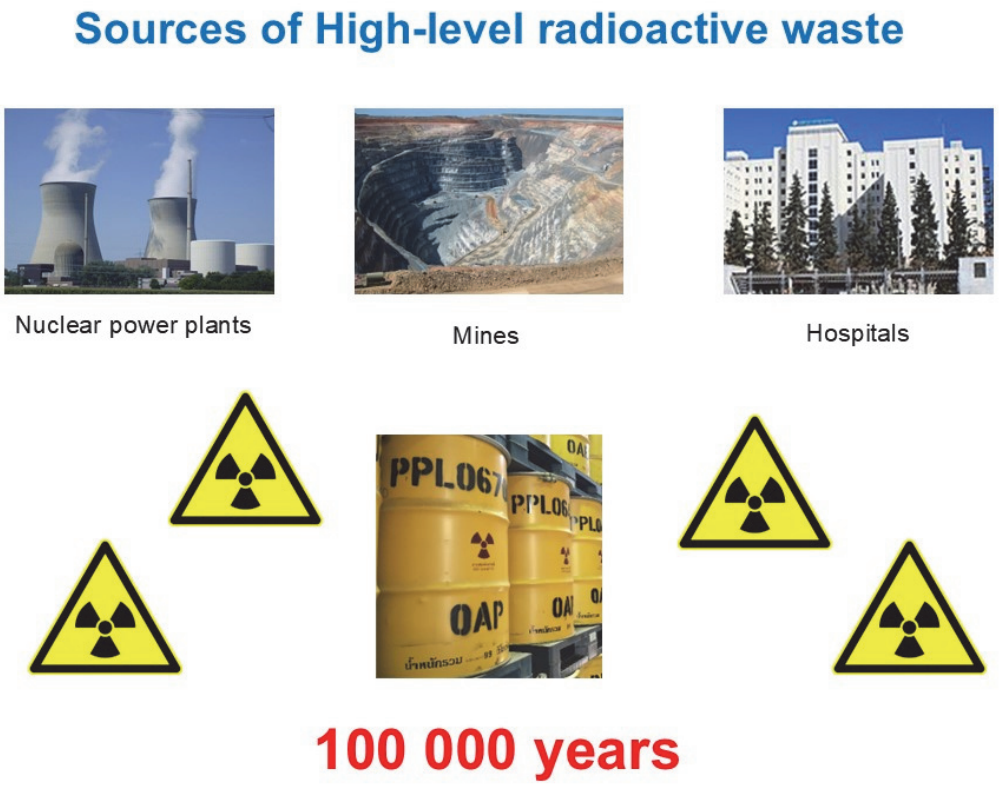
Discover bentonites, the heroes of radioactive waste repositories

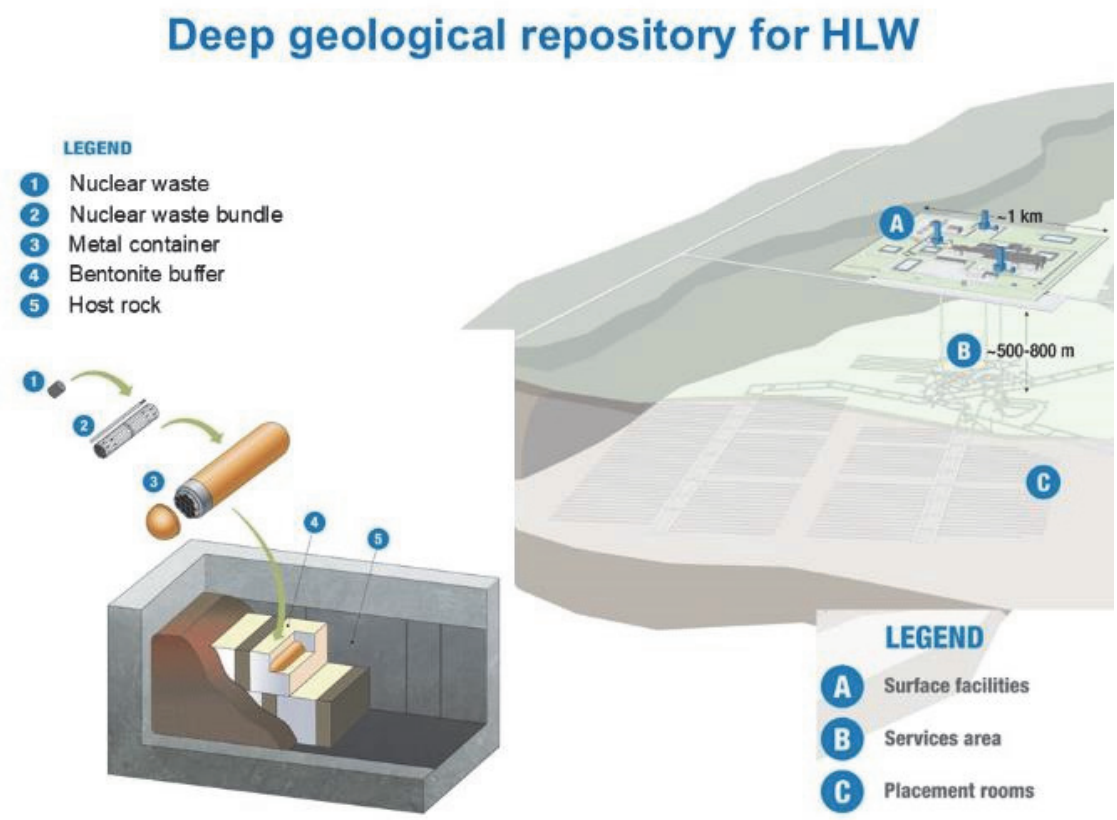
Infosheet 1: Managing nuclear waste

High-level waste (HLW) is mainly generated by nuclear power plants. It is composed of highly radioactive materials produced inside nuclear reactors, but also in residues from mining, research, and industry. HLW must be safely stored for at least 100 000 years for the high temperature to be reduced and the radiotoxicity to decrease to nondangerous levels.[1]



Nuclear power station: Felix König/Wikipedia, CC BY-SA 3.0. Mines: Calistemon/Wikipedia, CC BY-SA 4.0. Hospitals: falconaumanni/Wikipedia, CC BY-SA 3.0. Barrels: ShinRyu Forgers/Wikipedia, CC BY-SA 4.0. Radioactive symbol: Torsten Henning/Wikipedia, Public domain.

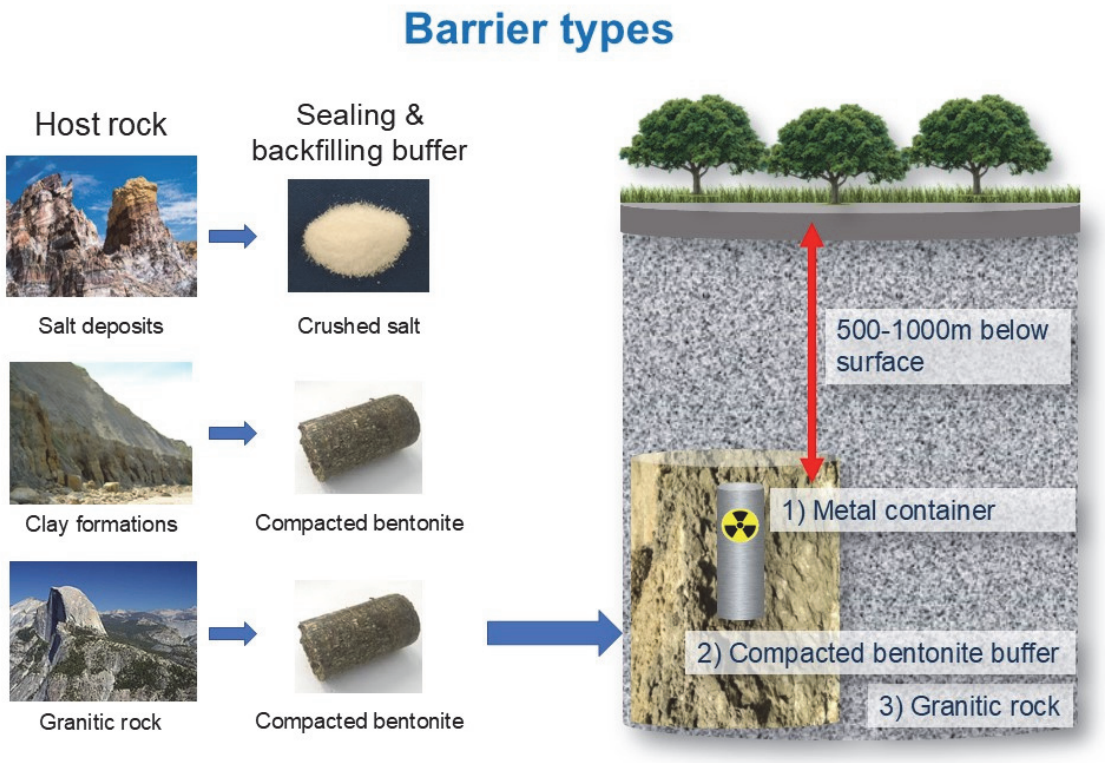
The problem is that there are already tonnes of nuclear waste that must be stored in a safe way to protect people and the environment. Thus, the management of HLW is a serious and worldwide environmental problem. Scientists have decided that burying this hazardous waste deep underground is the safest option. Deep geological repositories (DGRs) are multibarrier storage systems, where the highly radioactive waste is placed in containers that are surrounded by a sealing and backfilling buffer material and buried deeply (500–1000 m underground) within a stable geological formation.[2]



A diagram of a DGR designed by Canada's Nuclear Waste Management Organization (NWMO)
Image modified from CNW Group/Nuclear Waste Management Organization, used with kind permission

DGRs: barrier by barrier

In a DGR, the first barrier isolating highly radioactive waste is a technical barrier (a metal container), the second barrier is a geotechnical barrier (for example, compacted bentonite or crushed salts), and finally the third barrier is a geological one (a natural host rock, for example, granitic rocks, clay formations, or salt deposits).[3] Each country selects the best host rock based on its region and the stability of geological formations.



Images: Salt deposit: Hossein Abdollah Asl/Wikipedia, CC BY 4.0. Granitic rock: Half Dome/Wikipedia, Public domain. Clay formation, salt, bentonite, DGR: Courtesy of the author.

References

[1] Hedin A (1999) Deep repository for spent nuclear fuel. Technical report: TR-99-06. *Swedish Nuclear Fuel and Waste Management Company*.

[2] IAEA (2003) Scientific and technical basis for the geological disposal of radioactive wastes. *International Atomic Energy Agency*.

[3] Ojovan MI, Lee WE, Kalmykov SN (2019) *An Introduction to Nuclear Waste Immobilisation*. Elsevier. ISBN: 978-0-08-102702-8