Rock Physics Finland

ONKALOn termiseen mitoitukseen liittyvää kalliomekaniikkaa

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1.12.2025

Contents

Disclaimer

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Introduction

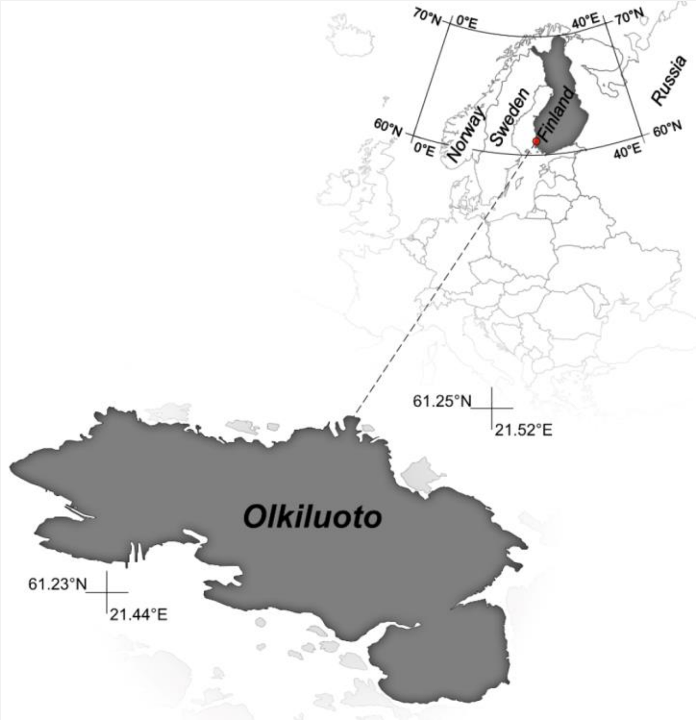
Background

Posiva Oy is responsible for the final disposal of the used nuclear fuel of its owners Teollisuuden Voima Oyj and Fortum Power & Heat Oy

- Posiva is constructing a geological nuclear waste repository in Olkiluoto, Finland

Finland is the first to move forward with geological disposal

- First canisters should be deposited in the 2020's



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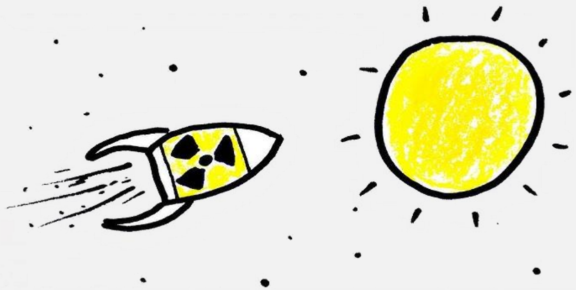
Management of radioactive waste

The aim is to prevent harmful effects to humans or the environment

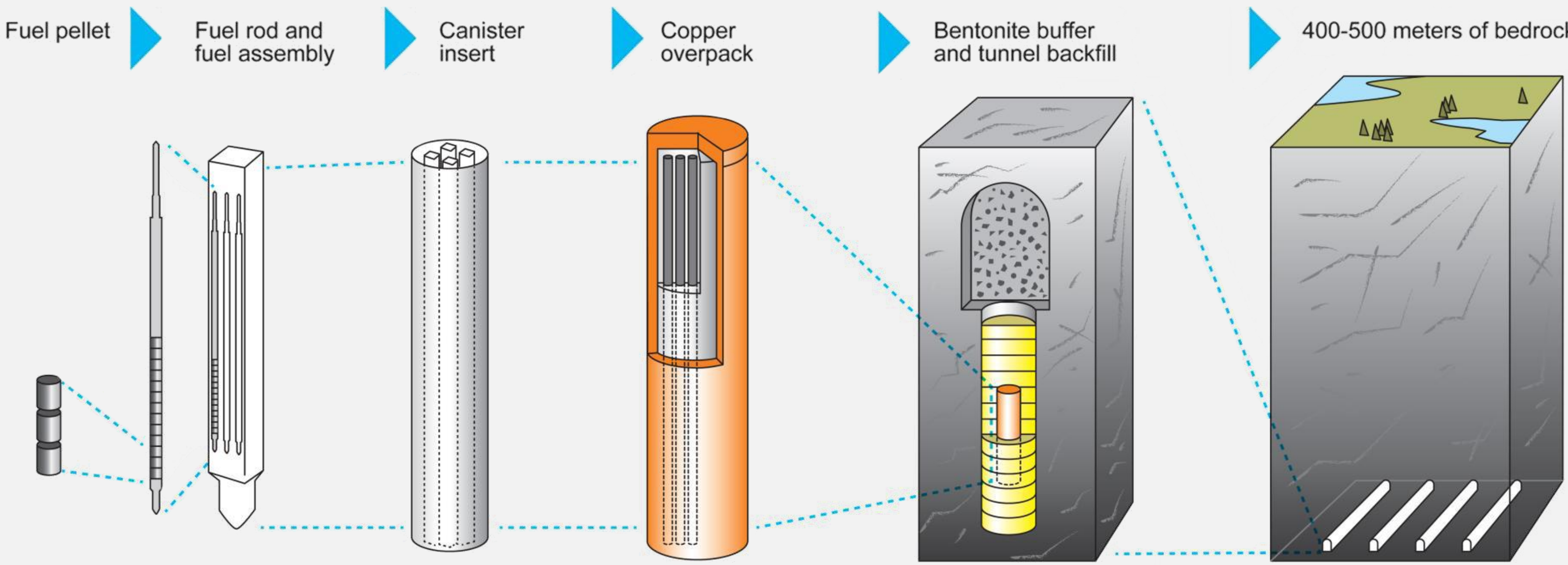
- Delay & Decay
- Dilute & Disperse
- Concentrate & Confine

Waste that cannot be released to the environment after processing and/or storage is disposed of

- Final disposal
- Mostly spent fuel
- Indefinite controlled storage above ground
- Deep geological disposal



Deep geological disposal



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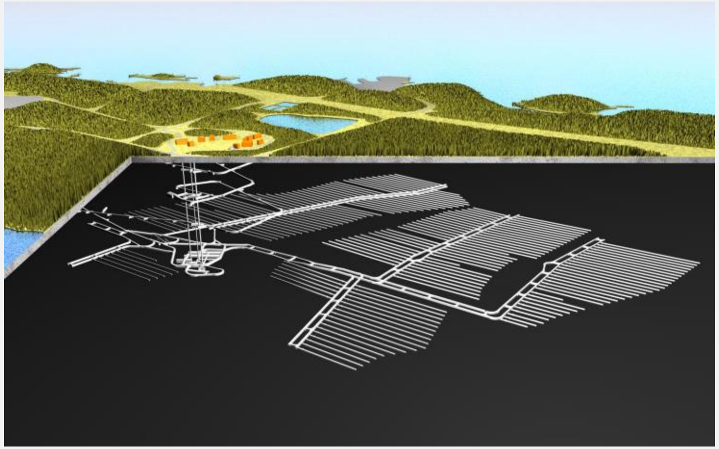
ONKALO® facility

ONKALO® facility is located on the island of Olkiluoto in western Finland

- Olkiluoto island also hosts three of five active nuclear reactors in Finland
- The repository level of ONKALO® is at roughly 430 m depth in crystalline bedrock
- At the end of disposal, ONKALO® will span roughly 50 km of tunnels and house approximately 3300 canisters
- Volume of deposited spent fuel is going to be roughly 6500 tU



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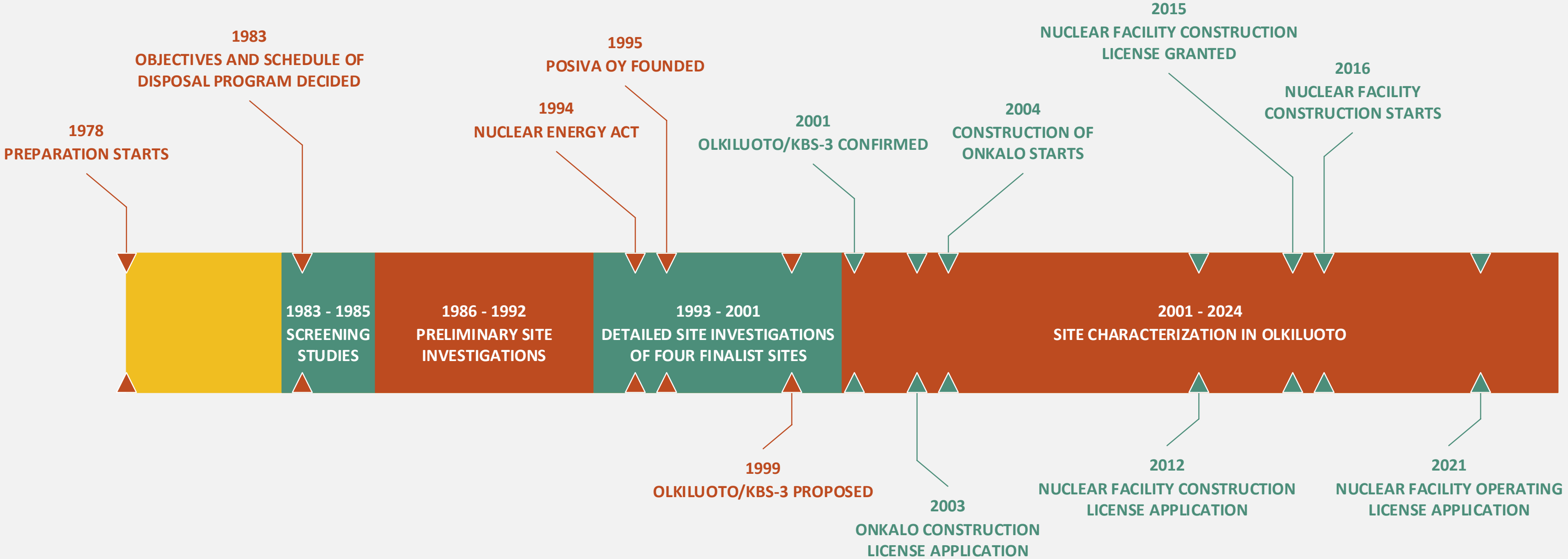
History of the ONKALO® project



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Thermal characterisation

Rock Physics Finland

Kalliomekaniikan päivä 2025
1.12.2025
Risto Kiuru

Motivation

The repository system relies on engineered barriers, some of which are to some extent sensitive to excess heat

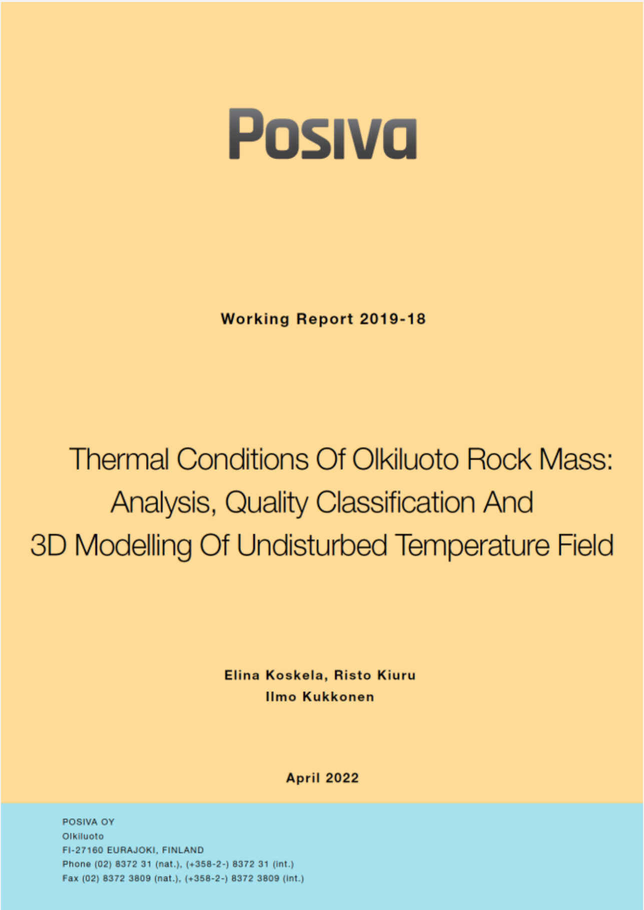
- Transport properties of the bentonite
- In extreme cases, thermal stress may cause fracturing in the rock mass itself

This leads to the need of thermal dimensioning and accurate information on rock thermal properties

Most recent publications

3D Modelling of Undisturbed Temperature

- The aim of the study was to create a unified data classification for the existing temperature measurements
- Estimates for the undisturbed bedrock temperature and thermal gradient
- 3D modelling of the undisturbed bedrock temperature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Working Report 2019-18

Thermal Conditions Of Olkiluoto Rock Mass: Analysis, Quality Classification And 3D Modelling Of Undisturbed Temperature Field

Elina Koskela, Risto Kiuru
Ilmo Kukkonen

April 2022

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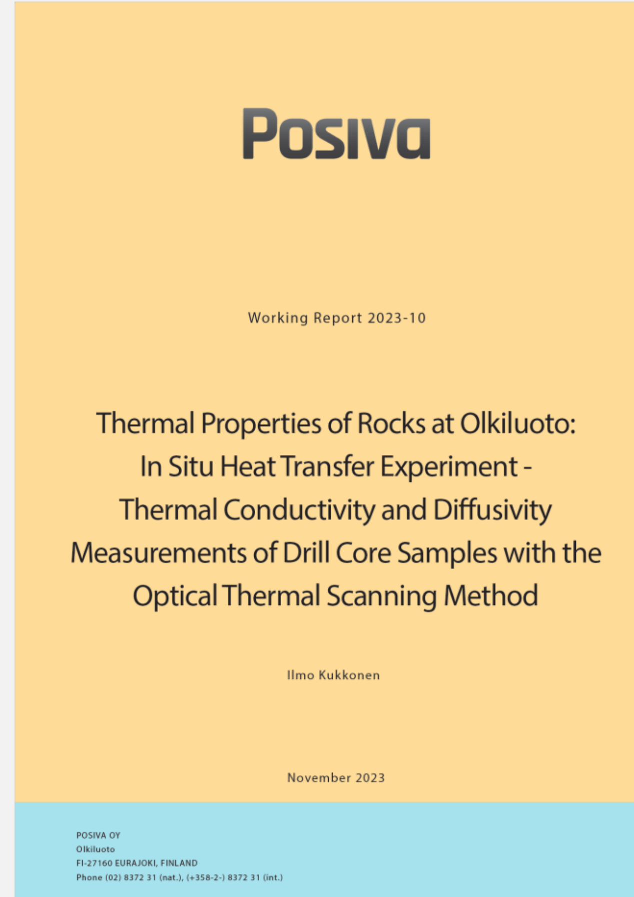
Most recent publications

Optical Thermal Scanning

- Thermal Conductivity Scanning (TCS) method was applied for determining thermal rock properties of the In Situ Heat Transfer Experiment (ISHT) site drill core samples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Working Report 2023-10

Thermal Properties of Rocks at Olkiluoto: In Situ Heat Transfer Experiment - Thermal Conductivity and Diffusivity Measurements of Drill Core Samples with the Optical Thermal Scanning Method

Ilmo Kukkonen

November 2023

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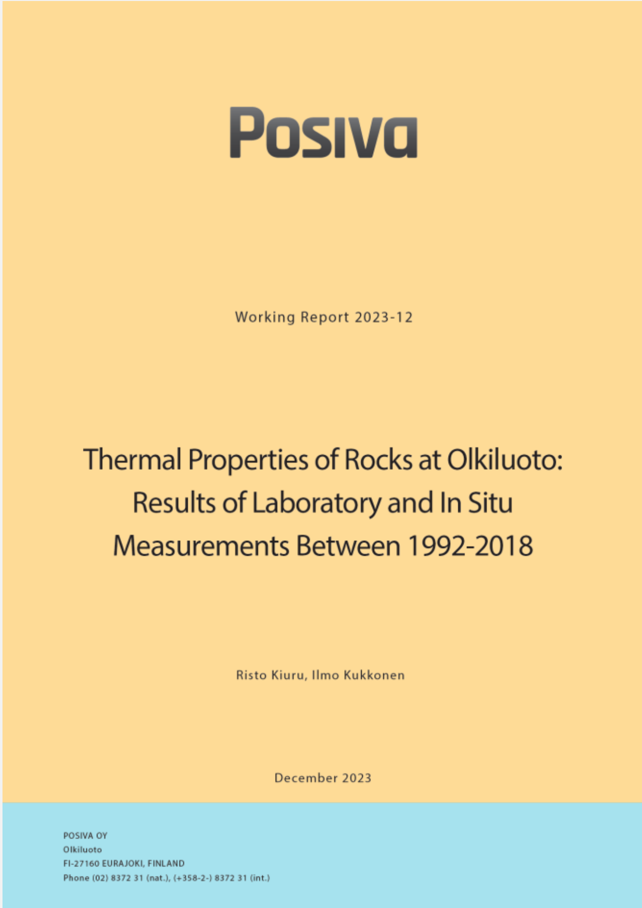
Most recent publications

Compilation of historical laboratory data

- Compilation of all available measurement results on thermal properties collected at the Olkiluoto site from 1992 to 2018
- Demonstrates how overall understanding of the properties has evolved with increasing data



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Working Report 2023-12

Thermal Properties of Rocks at Olkiluoto: Results of Laboratory and In Situ Measurements Between 1992-2018

Risto Kiuru, Ilmo Kukkonen

December 2023

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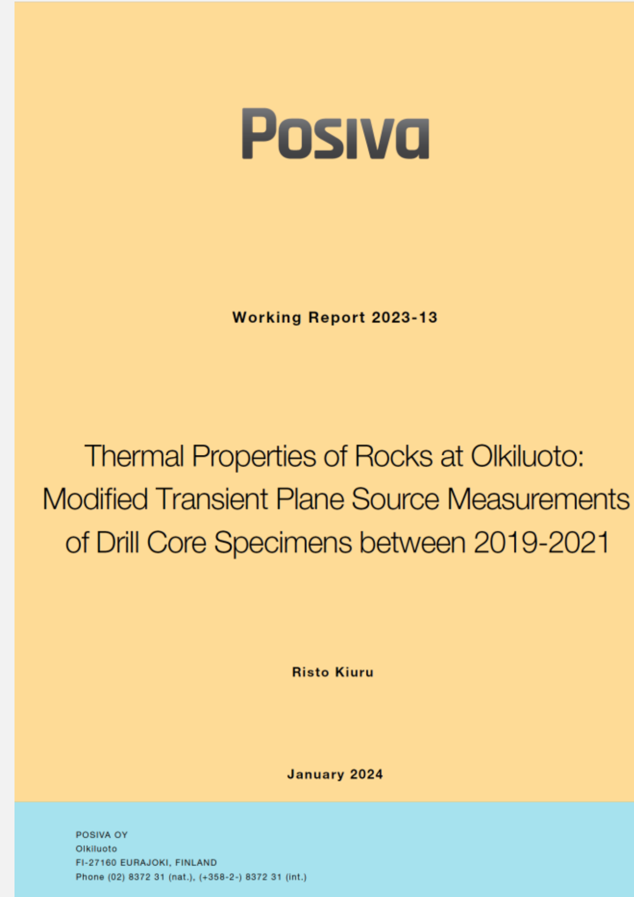
Most recent publications

Compilation of recent laboratory data

- Outlines the modified transient plane source (MTPS) measurements of thermal conductivity and thermal effusivity conducted between 2019 and 2021
- More than 2400 measurements of thermal conductivity and thermal effusivity allow a detailed description of the underlying distributions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Working Report 2023-13

Thermal Properties of Rocks at Olkiluoto: Modified Transient Plane Source Measurements of Drill Core Specimens between 2019-2021

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January 2024

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Ongoing work

Thermal Conditions at Olkiluoto: Temperature gradient and heat flow density

- In press

Thermal Properties of Rocks at Olkiluoto: In Situ Heat Transfer Experiment (ISHT) Simulations Report

Thermal Properties of Rocks at Olkiluoto: In Situ Heat Transfer Experiment (ISHT) Final Report

- Out by the end of 2025

"Master report"

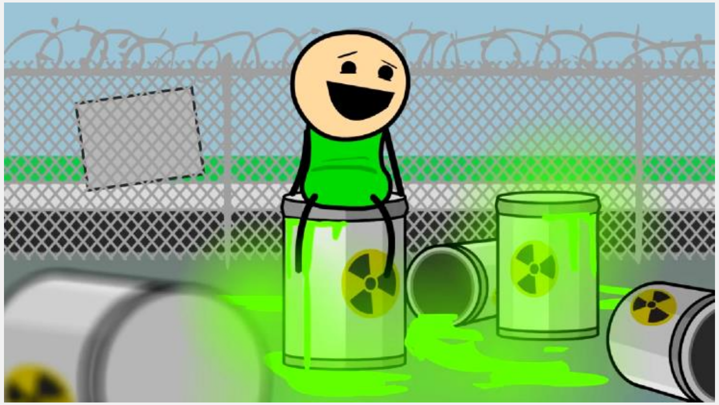
- Combines all current information on the thermal properties and conditions in Olkiluoto
- Out by early 2026

Conclusions and next steps

Conclusions

Olkiluoto rock mass is one of the most researched sites in the world

- This gives us a reasonable understanding of its history and formation, as well as intact properties and behaviour of the rock mass
- Thermal conductivity, effusivity and specific heat capacity can be treated as a single rock mass in facility design
- Thermal conductivity appears to be higher than estimated earlier, leading to significant potential space saving



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Next steps

Posiva submitted the Nuclear Facility operating license application at the end of 2021

- Finnish Nuclear and Radiation Safety Authority STUK is currently in the process of reviewing the application and Posiva's Safety Case (SC-OLA)
- After STUK gives the green light, the operating license will be reviewed by the parliament and the government

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Thank you!

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