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RepoTREND - A Simulation Tool for Safety Analysis of Final Repository for Radioactive Waste

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RepoTREND (Fig. 1) is a novel simulation tool designed for modeling processes in geological repositories for radioactive waste. It enables the analysis of contaminant release, migration through geological barriers, and radiological impacts on the biosphere. The modular structure of RepoTREND allows for flexible and adaptive modeling of different repository subsystems.

The simulation domain of a typical repository is highly heterogeneous, requiring the consideration of multiple physical and chemical processes. RepoTREND incorporates various models, each defined by specific equations and variables, to represent these processes accurately. The framework supports dynamic model selection for different regions, enabling an adaptive and extensible simulation approach.

The computational core of RepoTREND is based on a fully implicit finite volume method. Physical models are implemented as modular libraries, ensuring transparency and ease of extension. The coupling of models is handled implicitly by solving all equations within a unified matrix system, facilitating seamless integration of new effects while maintaining high computational efficiency.

RepoTREND's advanced capabilities support probabilistic analyses, allowing for comprehensive uncertainty assessments over timescales of up to one million years. These features make RepoTREND a powerful and reliable tool for regulatory safety evaluations and repository performance assessments.

Current Work:

- Near field Module NaTREND: Investigating two-phase radionuclide transport in porous media.
- Repository-Specific Modeling: Implementing rock convergence, compaction processes, and corrosion of metals and cement.
- Thermal Impact Studies: Evaluating the influence of heat-generating radioactive waste on repository stability.
- Computational Optimization: Enhancing numerical methods for improved simulation efficiency and scalability.

References:

- [1] Reiche, T. et al.: Simulation von Nahfeldprozessen in einem Endlager für radioaktive Abfälle, Gesellschaft für Anlagen- und Reaktorsicherheit (GRS) mbH, GRS-742, Braunschweig, 2025
- [2] <https://www.grs.de/en/news/projects/repotrend-repository-safety-analysis>

Country

Germany

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References

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