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Geoscientific Characterisation and Interpretation (Geosynthesis) within the Preliminary Safety Assessment in the German Site-Selection Procedure for a High-Level Nuclear Waste Repository

Sönke Reiche, Reinhard Fink, Nils-Peter Nilius
& BGE Site-Selection Team

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Characterisation and
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within the Preliminary Safety
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Repository

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Working Example from the Area for Methodology Development -
Bahlburg



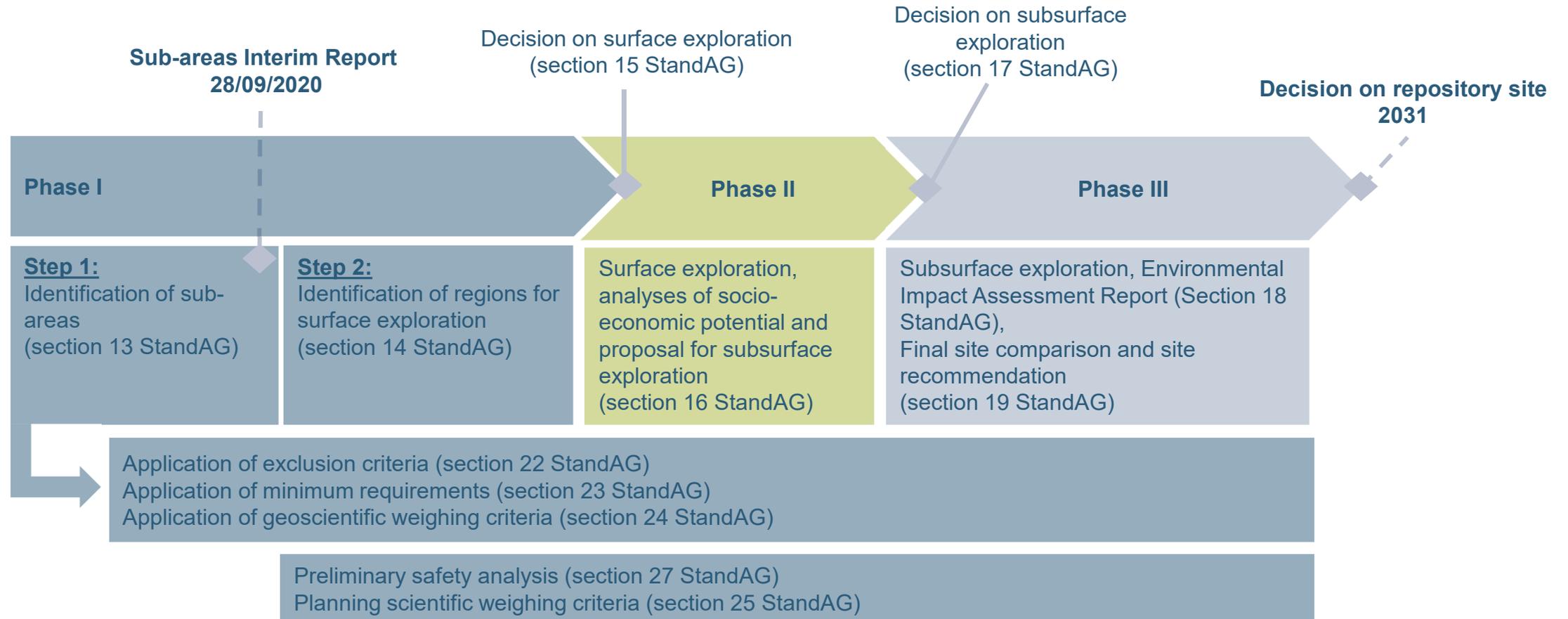


Introduction

Steps and Phases of the Site Selection Procedure

01

Process of the Site Selection Procedure (1/2)



Source: BGE

¹Standortauswahlgesetz vom 5. Mai 2017 (BGBl. I S. 1074), das zuletzt durch Artikel 1 des Gesetzes vom 7. Dezember 2020 (BGBl. I S. 2760) geändert worden ist

Process of the Site Selection Procedure (2/2)



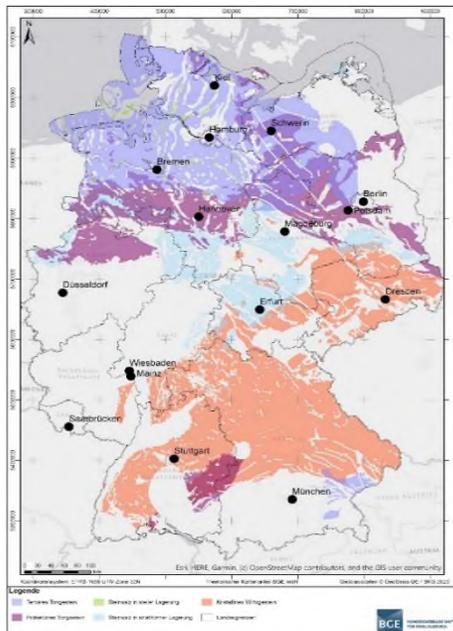
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Step 1, Phase I

Sub-areas



Source: BGE

90 sub-
areas (TG)

Sub-areas
cover ca.
54 % of
BRD

TG rock
salt

TG clay
stone

TG
crystalline
rock

Step 2, Phase I

1) Representative Preliminary Safety Analyses

(section 27 StandAG)

2) Geoscientific Weighing Criteria

(section 24 StandAG)

3) Planning-Scientific Weighing Criteria

(section 25 StandAG)

The image features three distinct mineral specimens. The central specimen is a large, clear, faceted crystal with a complex, multi-faceted structure. To its left is a smaller, more rectangular, and less transparent specimen. To its right is a larger, dark, and more irregularly shaped specimen. All three are resting on a highly reflective surface, creating clear reflections below them. The background is a solid, light blue color.

Geosynthesis

02

What is a Geosynthesis?

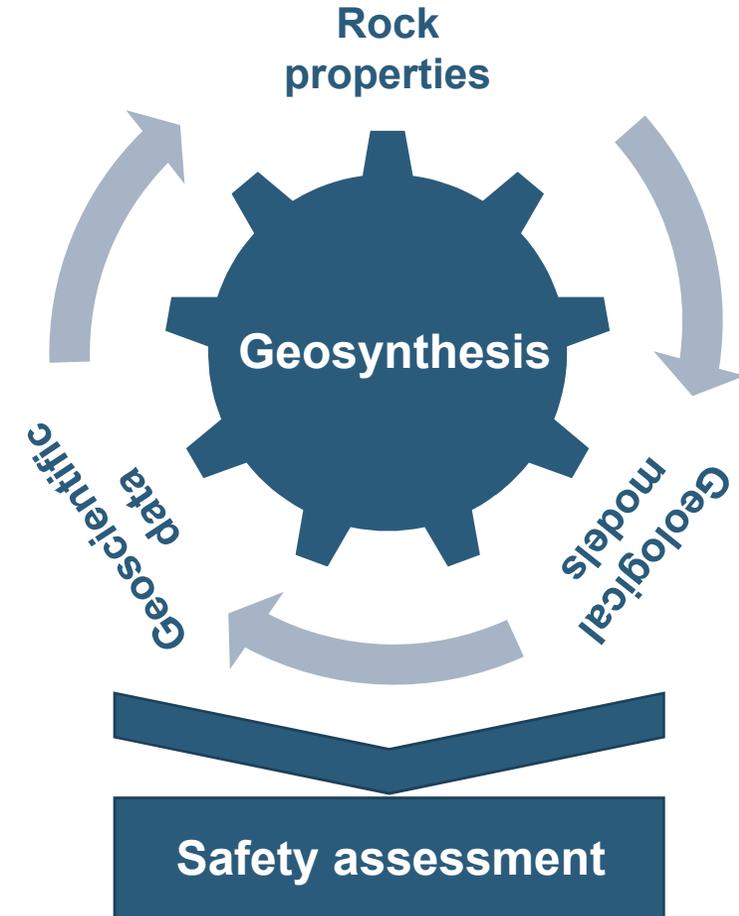
Definition based on section 5 EndlSiUntV:

“The geosynthesis contains the documentation and interpretation of all geoscientific information on a sub-area. The aim of the geosynthesis is a consistent representation, in particular, of the geoscientific conditions relevant to the safety of the High-Level Nuclear Waste Repository.”

- Component of the Representative Preliminary Safety Analyses (rvSU)
- Basis for the assessment of safety



Required input for the Geosynthesis



¹Endlagersicherheitsuntersuchungsverordnung vom 6. Oktober 2020 (BGBl. I S. 2094, 2103)

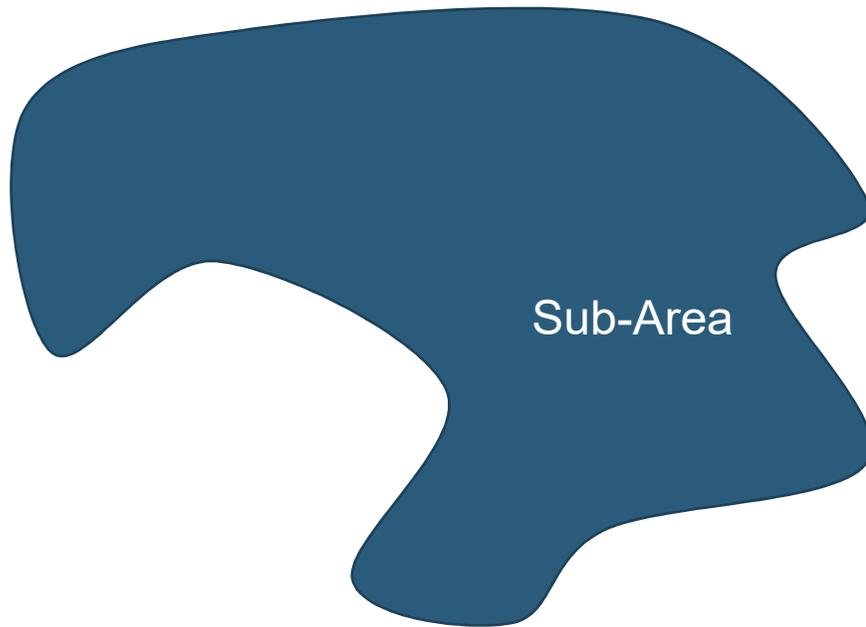
Geosynthesis – Required input (1/3)



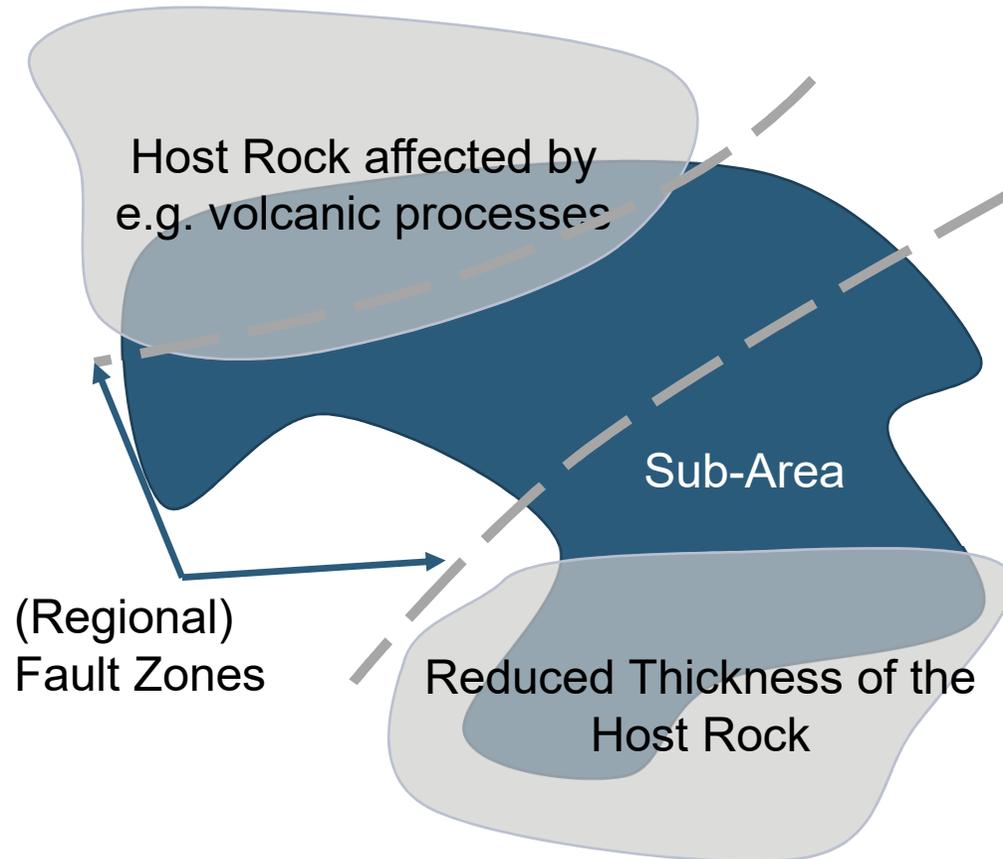
Preceding steps for the Geosynthesis:

Geological Characterization of Sub-Areas and Preliminary Safety Concept

- Within the Geological Characterization, the geological features of large Sub-Areas are described and relevant processes are identified
- Basis for dividing Sub-Areas into multiple Investigation Areas
- Needed to define Preliminary Safety Concept and target host-rock formation



Geosynthesis – Required input (2/3)



Preceding steps for the Geosynthesis:

Geological Characterization of Sub-Areas and Preliminary Safety Concept

- Within the Geological Characterization, the geological features of large Sub-Areas are described and relevant processes are identified
- Basis for dividing Sub-Areas into multiple Investigation Areas
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Geosynthesis – Required input (3/3)

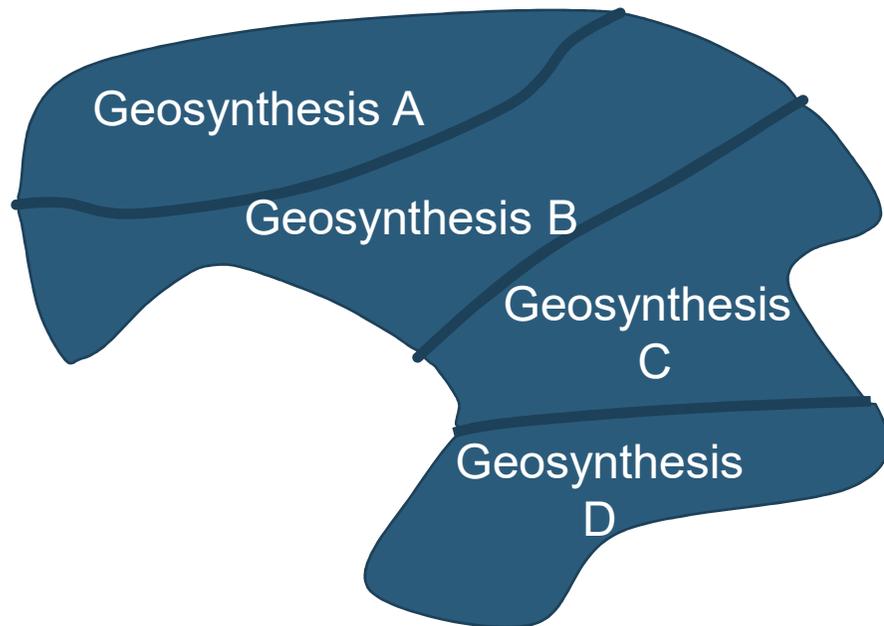


Preceding steps for the Geosynthesis:

Definition of Investigation Areas

- In the Representative Preliminary Safety Analyses , the Investigation Areas shall be identified. Investigation Areas are those spatial areas that are intended for evaluation as a potential disposal site within a single rvSU and therefore a single Geosynthesis.
- Sub-Areas may be sub-divided into multiple Investigation Areas to be able to analyze distinct host rock formations with similar properties and a single Preliminary Safety Concept. In combination, all Investigation Areas will fully cover the area of the Sub-Areas.

The Geosynthesis (1/3)

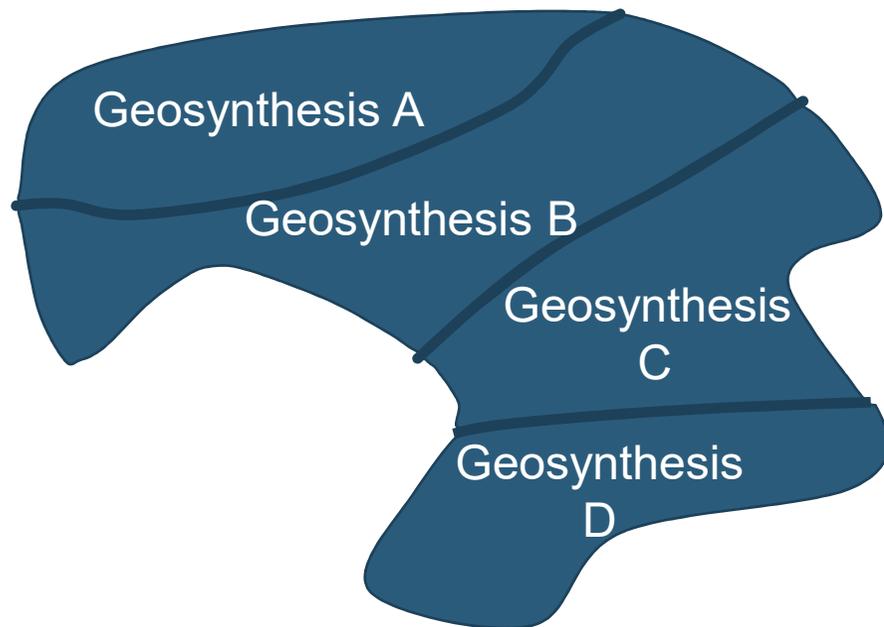


Geosynthesis – Scope and content:

For each rvSU (each Investigation Area) a single Geosynthesis will be prepared.

- The Geosynthesis describes all the information (and data) that is relevant for the safety assessment of a given Investigation Area and serves as a fully transparent information basis for a given rvSU (and area).
- Focuses on the **local** data – used information that has been gathered from analogues outside will be marked.

The Geosynthesis (2/3)



Geosynthesis – Scope and content:

The Geosynthesis describes the geological features and processes of an Investigation Area. For the following steps of the Preliminary Safety Assessment important information and data, such as:

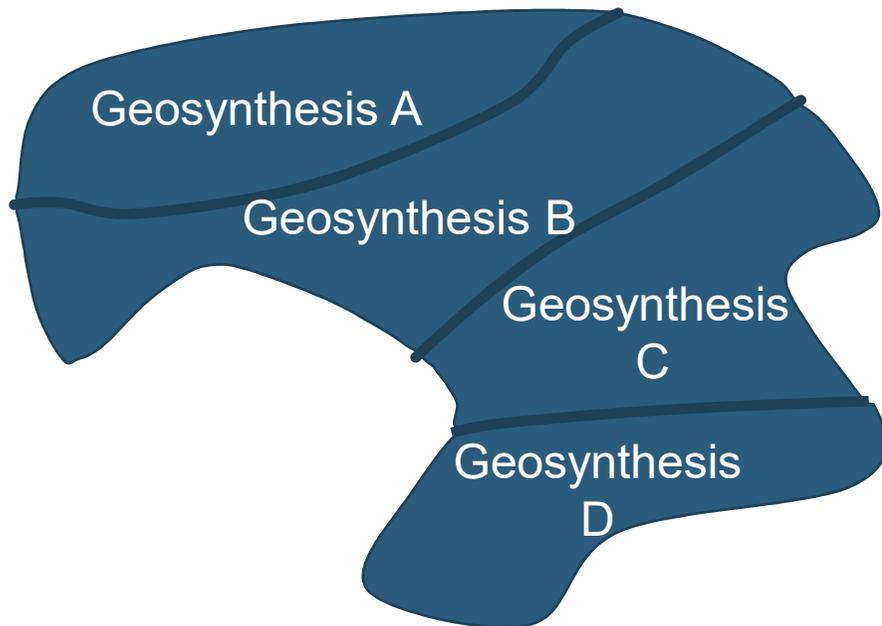
- Host rock thickness and distribution maps
- Local host rock information and parameters
- Characteristics and parameters of rock units adjoining the host rock formation
- Geological models
- Relevant geological processes for the safety assessment on local scale
- ...

need to be derived, evaluated and clearly documented

The Geosynthesis (3/3)

Data Queries

- As of October 2021, 30 queries for geological information and data with special emphasis on:
 - Information on input data of geological 3D-Models
 - Bore logs of drillings with 100 to 300 m depth
 - Digital bore logs
 - Geophysical data from borehole measurements
 - Hydrogeological parameters
 - Reflection seismic data
 - Gravimetric data
 - Magnetic data (Maps)
 - Petrophysical Parameters





Working Example from the Area for Methodology Development - Bahlburg

03

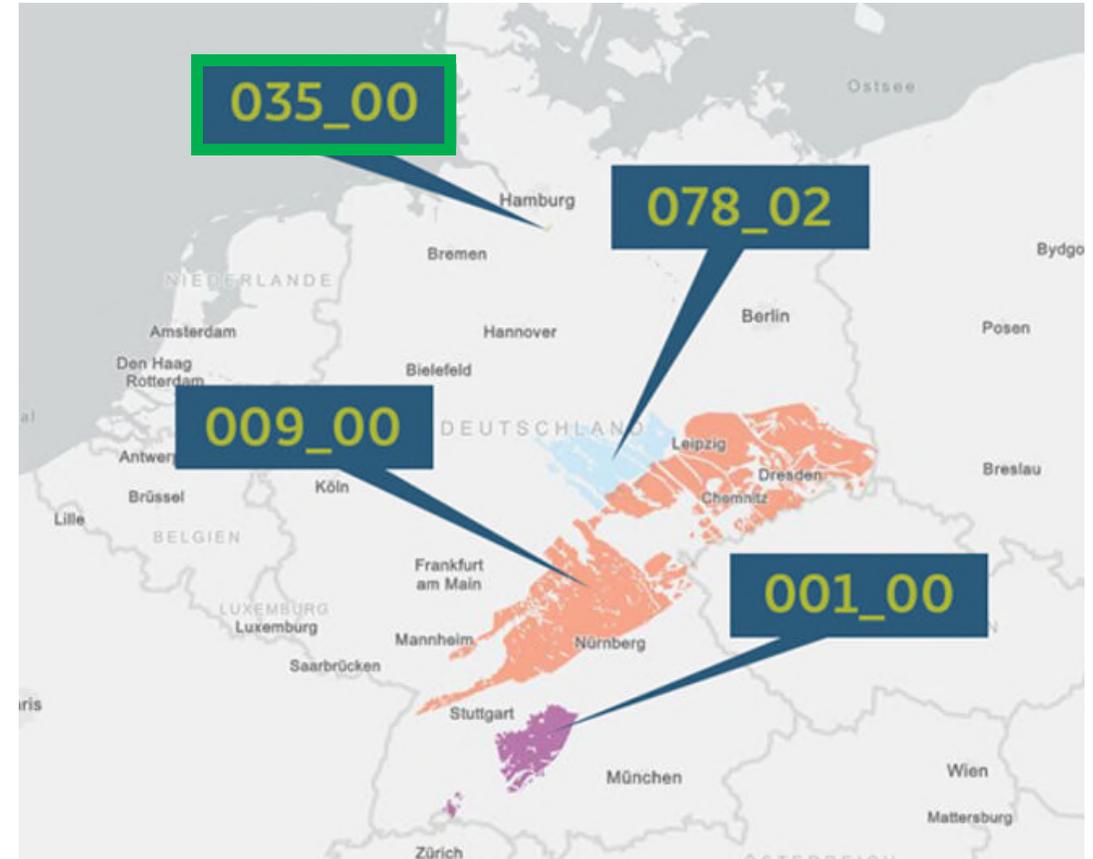
Areas for Methodology Development

General Aspects

- Methods to implement the Representative Preliminary Safety Analyses need to be developed
- The intention of this concept is to develop and test tools and methods to be applied on all Sub-Areas in Step 2 Phase I of the Site Selection Procedure
- Hence, Areas for Method Development are **not** an early determination on siting-regions

The BGE is currently testing methods, tools and procedures for the **Geosynthesis** using real data.

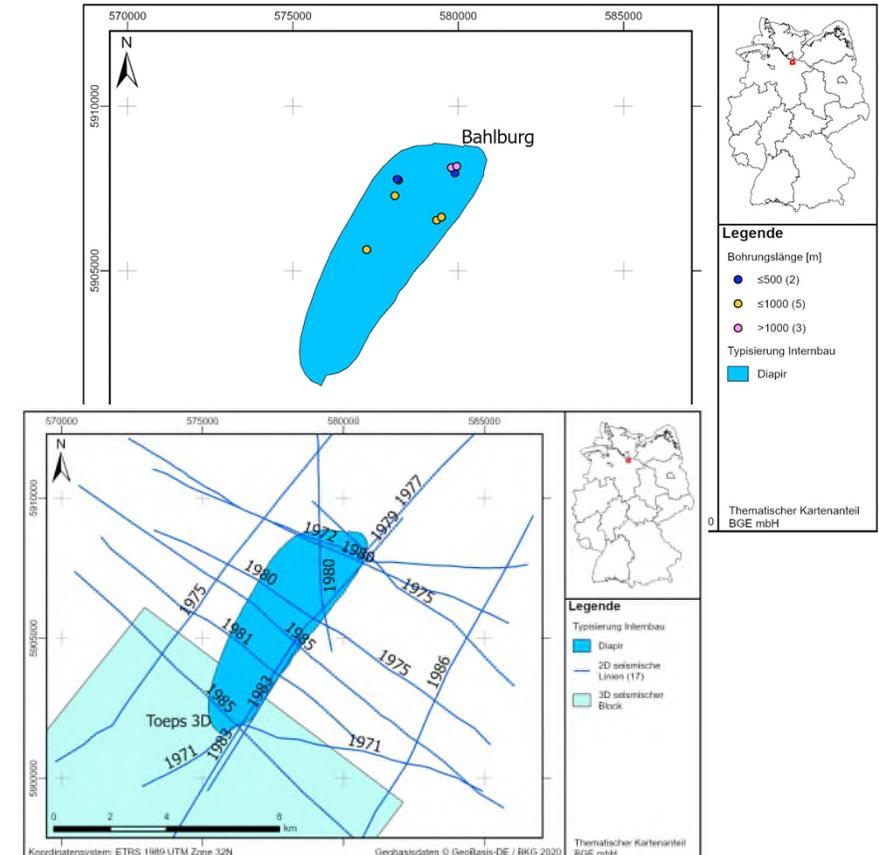
*What can we achieve with the existing information?
How can we get the needed information for the rvSU?*



Working Example from the Area for Methodology Development – Bahlburg (1/3)

Detailed Data Evaluation

- Host rock thickness and distribution maps
Based on evaluation of bore logs, seismic data (including reprocessing)
- Local host rock and adjoining rock units characteristics and parameters
Based on evaluation of bore logs and geophysical borehole measurements, petrophysical parameters, scientific literature
- Geological models
Based on reprocessing and reinterpretation of seismic data and bore log information
- Relevant geological processes for the safety assessment on local scale
Evaluation of scientific literature, funding of external research projects - e.g.: The influence of glacial loading/unloading on salt diapir dynamics; Glacial Tunnel Valleys; ...



Working Example from the Area for Methodology Development – Bahlburg (2/3)



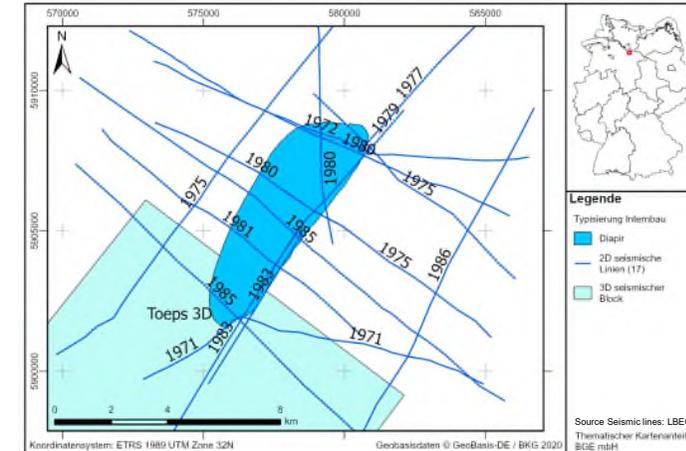
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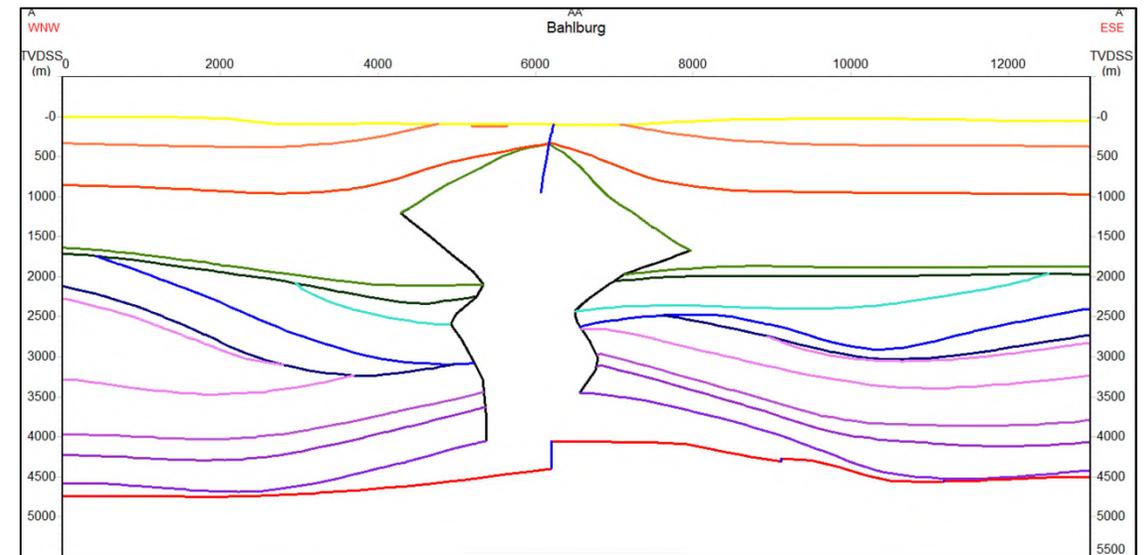
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Seismic Data

- Improving quality and resolution of existing 3D-Models (e.g. GTA-3D, TUNB)
- Re-evaluation of shape, size and volume of the host rock
- Elaboration of geological features with importance for the safety assesment of a potential repository site, e.g. subglacial tunnel valley and faults



Source: BGE

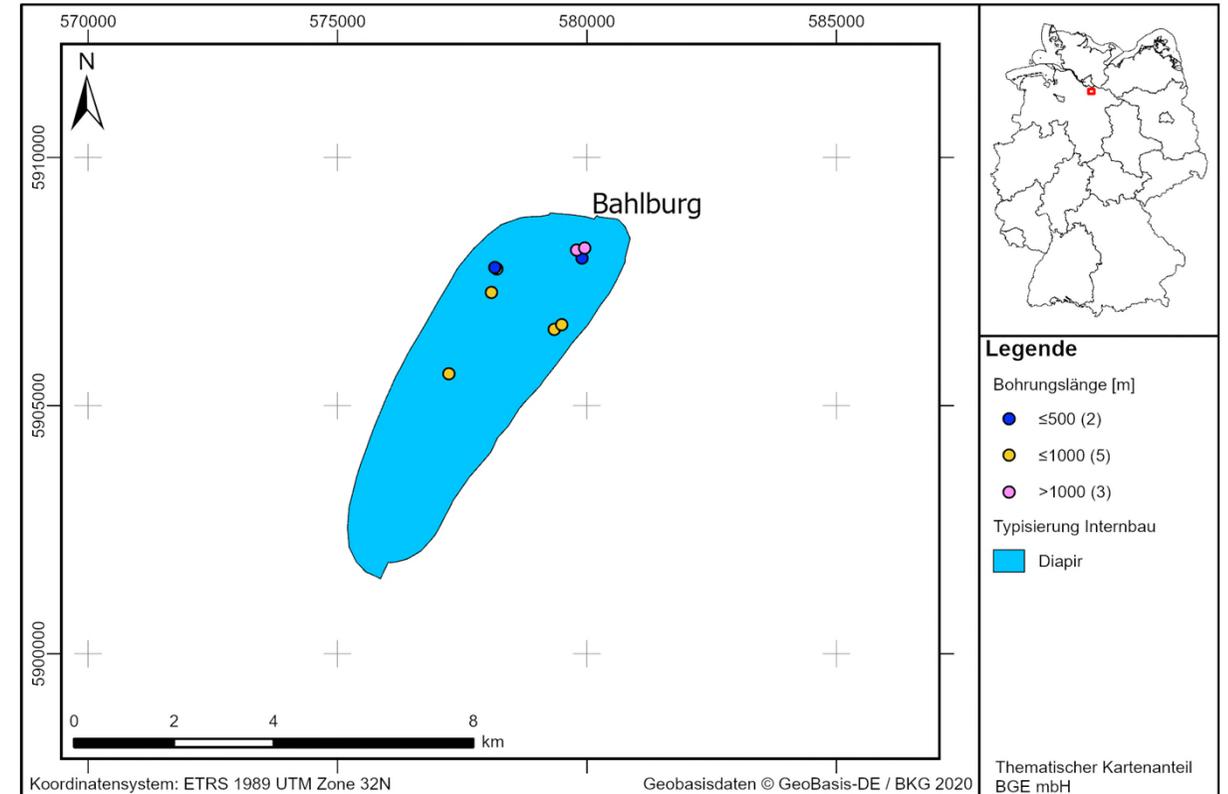


Source: TUNB Model (BGR (2021))

Working Example from the Area for Methodology Development – Bahlburg (3/3)

Borehole Data

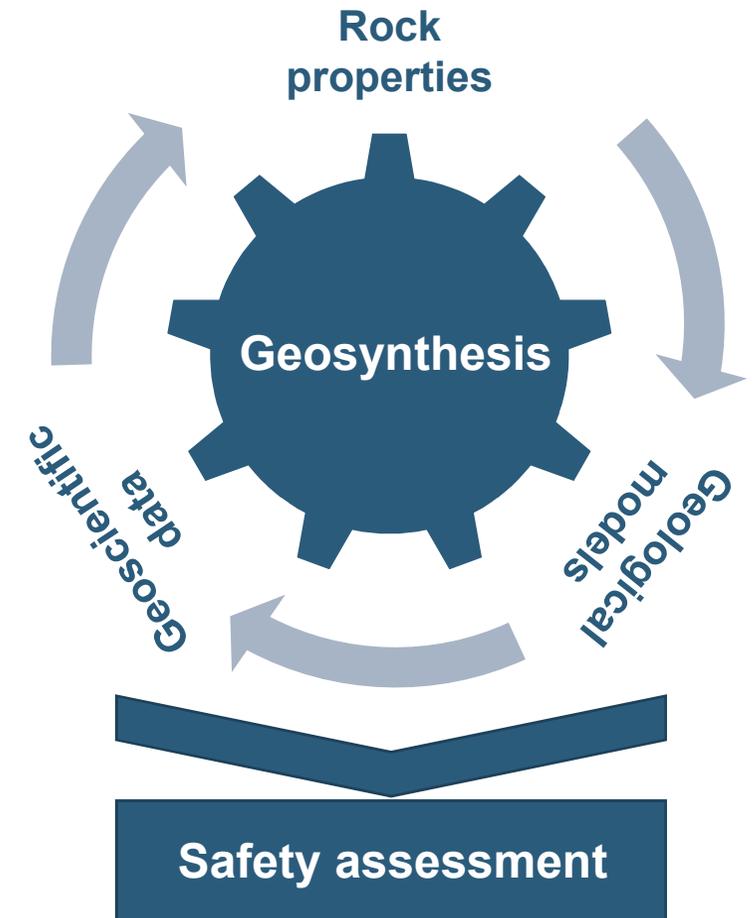
- Lithological characteristics of host rock and overburden by evaluation of borehole data (e.g. logs)
- Analysis of sealing lithologies of the overburden (e.g. Rupelian Claystone) and cap rock characteristics
- Characterisation of the internal structure of the salt dome (e.g. rock salt thickness, occurrences of potash and anhydrites)



Source: BGE

Summary

- The **Geosynthesis** has a fundamental role for the successful implementation of the Representative Preliminary Safety Analyses in section 14 StandAG
- The **Geosynthesis** acts as compilation of all relevant geoscientific data and its interpretation to generate the information and knowledge needed for the succeeding steps of the Representative Preliminary Safety Analyses
- Currently, the BGE is using four Areas for Method Development to test methods, tools and procedures that are needed to optimize the outcomes of each individual **Geosynthesis** using real data



Source: BGE



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Dr. Sönke Reiche
Abteilungsleiter STA-ST

Eschenstraße 55 | Peine

www.bge.de
www.einblicke.de



@die_BGE