BUNDESGESELLSCHAFT FÜR ENDLAGERUNG

10TH IGD-TP EXCHANGE FORUM

German site selection – current status and moving forward towards upcoming milestones

ASTRID GÖBEL

Prague, 25/11/2025

GZ: SG01202/2/5-2025#2 | Objekt-ID: 14710969

AGENDA

German site selection

01 SITE SELECTION PROCEDURE

02 CURRENT WORKS AND PROGRESS

03 TOWARDS PHASE II – EXPLORATION, SAFETY ASSESSMENTS, AND RESEARCH

04 SOME CURRENT PROJECTS

05 CONCLUSIONS

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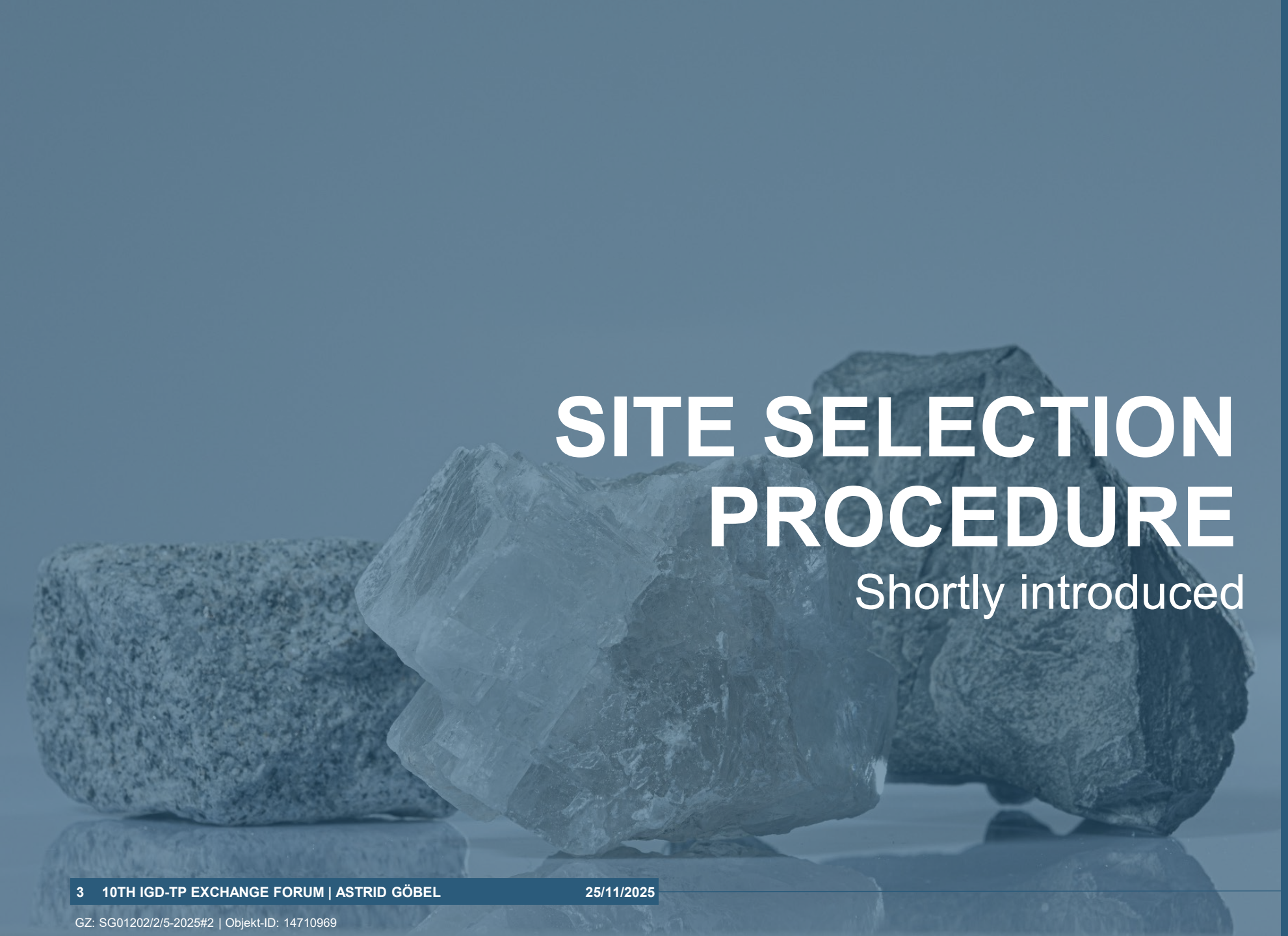

SITE SELECTION PROCEDURE

Shortly introduced

01

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TASKS OF BGE

BGE BUNDESGESELLSCHAFT FÜR ENDLAGERUNG

Retrieval of radioactive waste from the Asse II mine

Completion of the Konrad repository for around 300,000 m³ of low- and intermediate-level radioactive waste

Decom-missioning of the Morsleben repository

Selection of a site for a repository for high-level radioactive waste

Product control – only approved waste packages can be stored

Decom-missioning of the Gorleben mine

Source: BGE

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INVENTORY

Radioactive waste in Germany

High-level radioactive waste:

- Forecast: approx. 1,750 castor containers
- Approx. 10,500 tons of heavy metal from fuel elements and 3,836 vitrified waste packages from reprocessing

99% radioactivity

5% volume

Low- and intermediate-level radioactive waste:

- Approx. 360,000 m^3 from the operating and decommissioning of NPPs, thereof 303,000 m^3 for the Konrad repository
- Approx. 200,000 m^3 from the Asse II mine
- Up to 100,000 m^3 from uranium enrichment

1% radioactivity

95% volume

Source: BGE

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SITE SELECTION PROCEDURE

Specific requirements and conditions in Germany

- Find the most-suitable site (“providing the best possible safety”, not just any suitable site)
- Three potential host rocks
- 1 million years
- Heterogeneous data availability, lack of digitalization
- Transparency, traceability, and involvement of the public and many different stakeholders
- Science-based, self-questioning and learning procedure

Crystalline rock

Rock salt

Claystone

Source: BGE

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CURRENT WORKS AND PROGRESS

02

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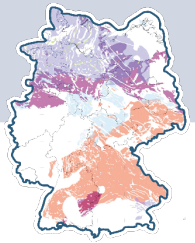
SITE SELECTION PROCEDURE

Sequence of procedure steps

Phase I

Step 1
Identification of sub-areas (54% of Germany's area)



Step 2
Identification of siting regions for surface exploration

Phase II

Surface exploration
Proposal for underground exploration

Phase III

Underground exploration
Final site comparison and site proposal

Scope of Phase I, Step 2

- Representative preliminary safety analyses (rvSU)
- Focus on most suitable areas

Source: BGE

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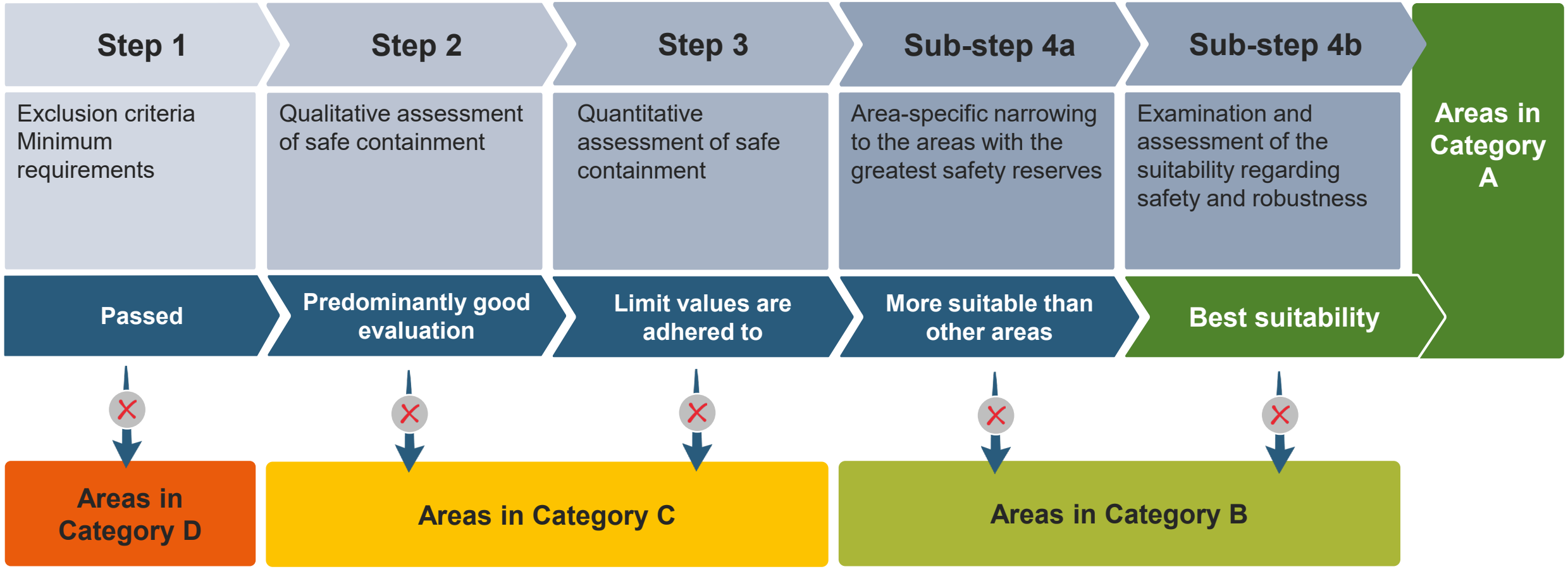
SITE SELECTION PROCEDURE

rvSU procedure – four assessment steps



Source: BGE

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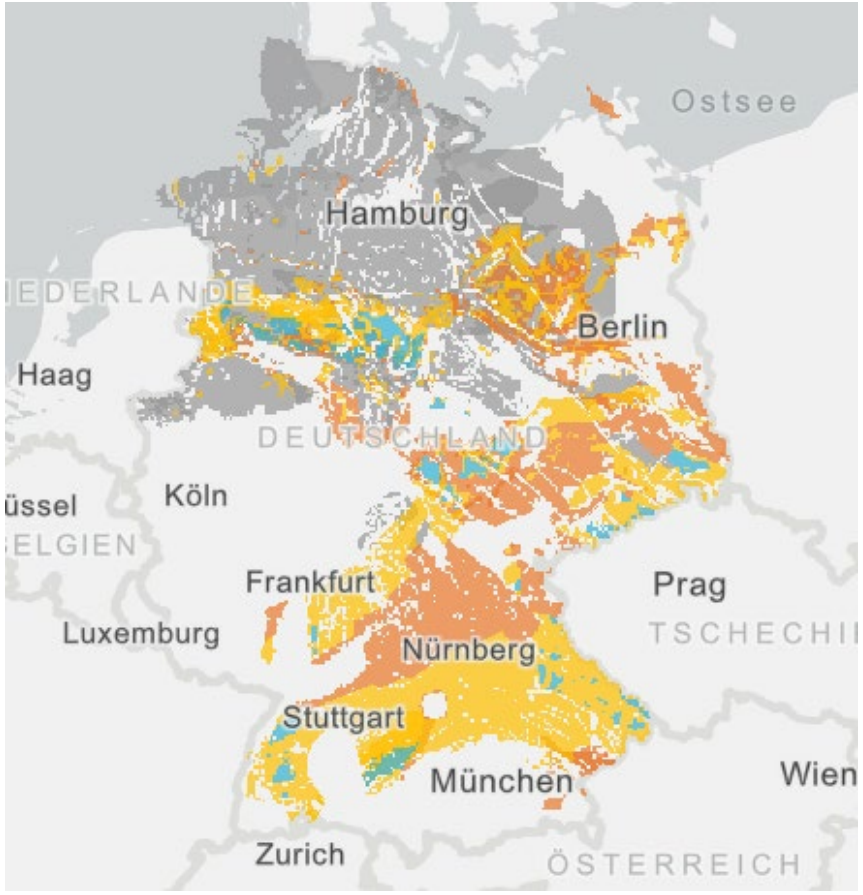
SITE SELECTION PROCEDURE

Step 2, Phase I – Current status of work – published 4/11/2025



Legend

Sub areas: preliminary status

Current status of the representative preliminary safety analyses (rvSU)

- Category C
- Category D
- rvSU Steps 1 and 2 still in process
- rvSU Steps 1 and 2 passed

BGE Endlagersuche Navigator

Source: BGE

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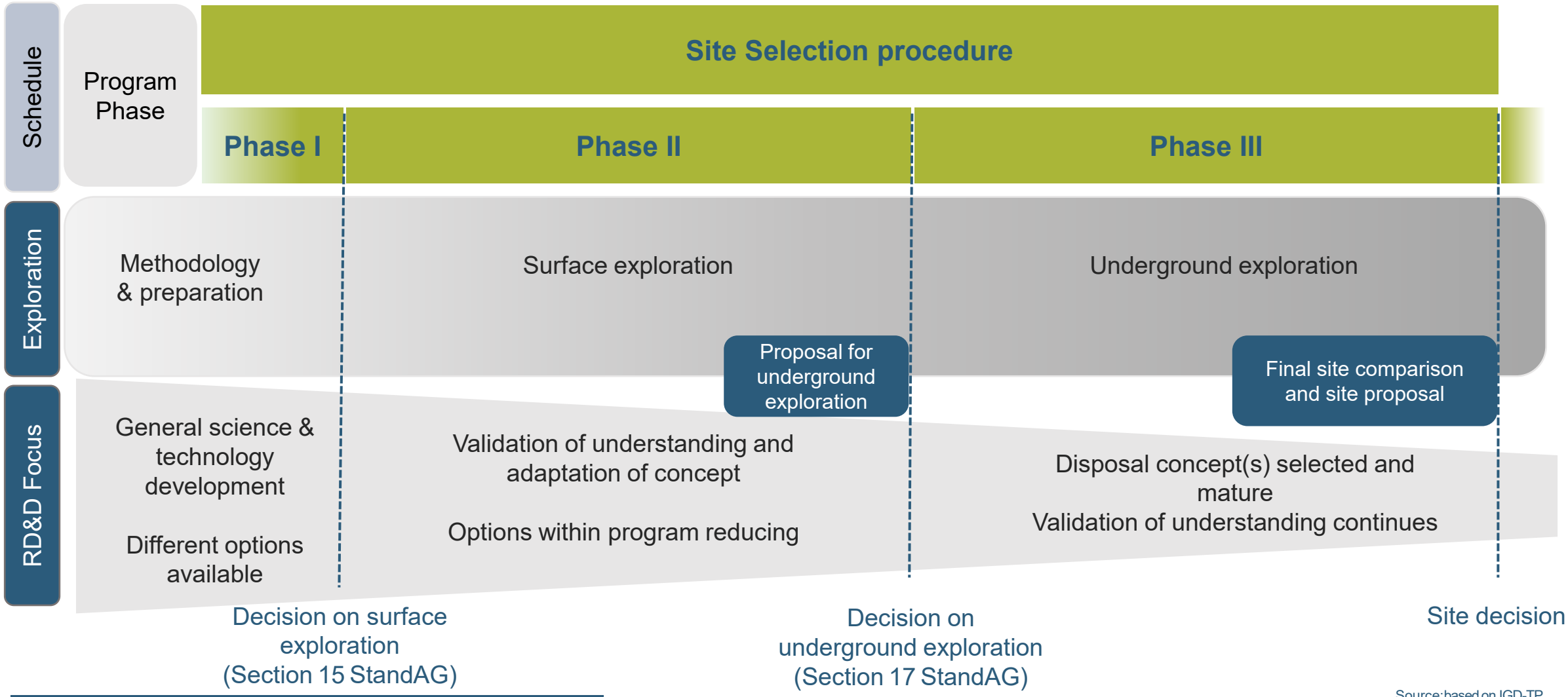
TOWARDS PHASE II – EXPLORATION, SAFETY ASSESSMENTS AND RESEARCH

03

SCHEDULE AND ESTIMATIONS



Source: based on IGD-TP

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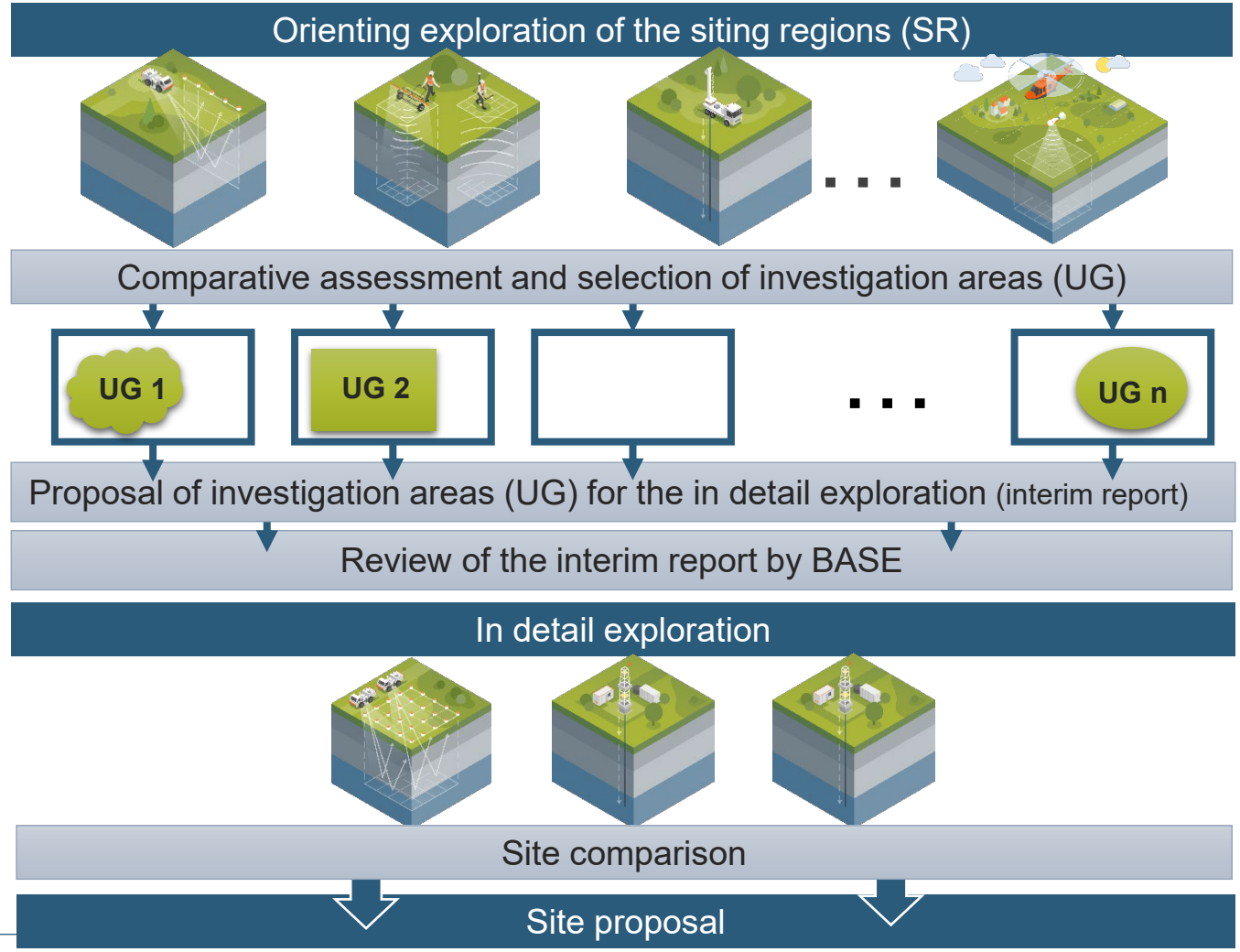
SUGGESTION – OPTIMIZATION OF SCHEDULE

Combination of Phase II and III

- Decision about siting regions
- **Orienting exploration**
  Site-specific through 2D seismic and drilling incl. requirement driven measurement program
  Result:
  Proposal of a minimum of 3 investigation areas (interim report)
  Short review by BASE
- **In-detail exploration**
  minimum 3 investigation areas through 3D seismic and rd. 9 drilling
- Submission of site proposal to BASE:
  estimated time depending on the number of siting regions



Source: BGE

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APPROACH FOR SURFACE EXPLORATION PHASE

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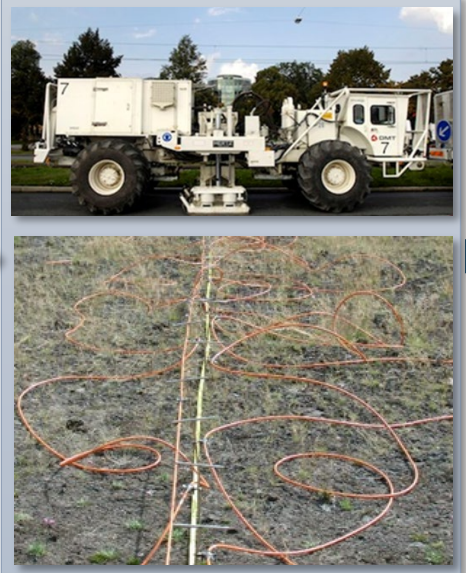
Phase I

- Check existing data vs. requirements
- Gap analysis
- Exploration program

Phase II – Surface exploration and proposal for underground exploration

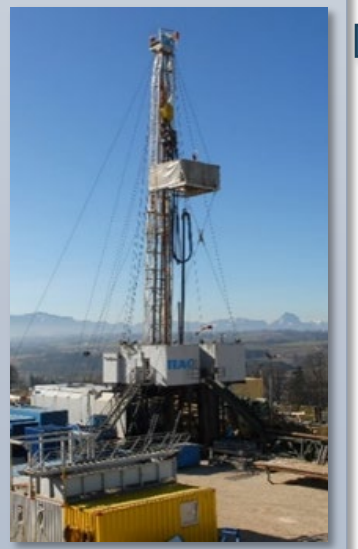
Seismic / surface measurements



Source: BGR

(Re-)Processing and Interpretation

Drilling program



Source: BGE

Interpretation

- Geological model
- Geomechanics
- Hydrogeology
- Assessment of the repository system and overburden

Site proposal for underground exploration

In case of existing and suitable seismic data

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SOME CURRENT PROJECTS

towards next steps

04

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GeoMetEr

Development of geophysical measurement methods and method combinations for creating high resolution surface exploration programs (1/2)

- **Project goal:** Determination of the optimal geophysical exploration methods and method combinations
  - Application of new geophysical measurement methods in practice
  - (Further) development of new data processing and inversion methods
  - Joint interpretation and inversion
  - Verification of the results through drilling
- **Project duration:** January 1, 2023–March 31, 2028
- **Research funding:** 8.77 million €
- **Main contractor:** TU Bergakademie Freiberg, Germany
- **Scientific coordination:** Leibniz-Institut für angewandte Geophysik

Source: BGE

Source: BGE

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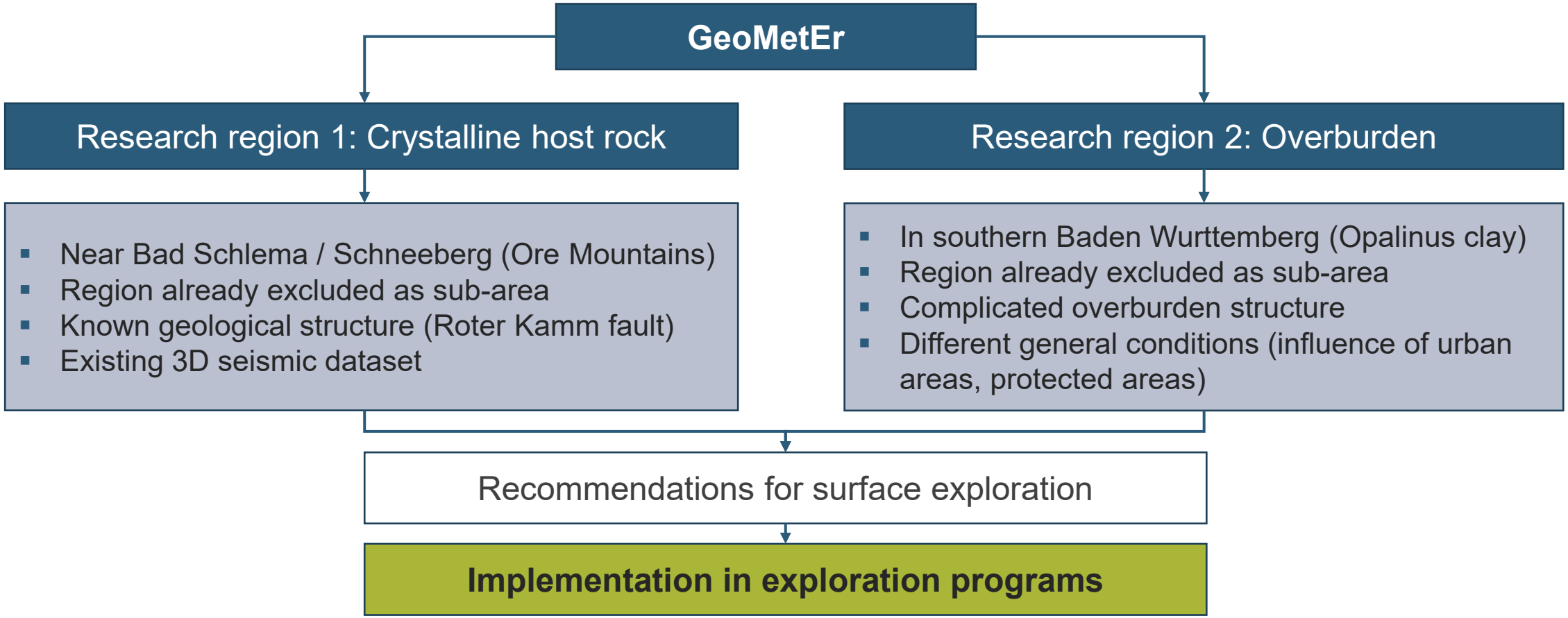
GeoMetEr

BUNDESGESELLSCHAFT FÜR ENDLAGERUNG

Development of geophysical measurement methods and method combinations for creating high resolution surface exploration programs (2/2)



Source: BGE

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GeoLaB

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Underground research laboratory GeoLaB (Geothermal Laboratory in the crystalline Basement)

Research will significantly improve the understanding of hydraulic processes in fractured crystalline rock under enhanced flow rates

Project sponsors are Helmholtz research centers:

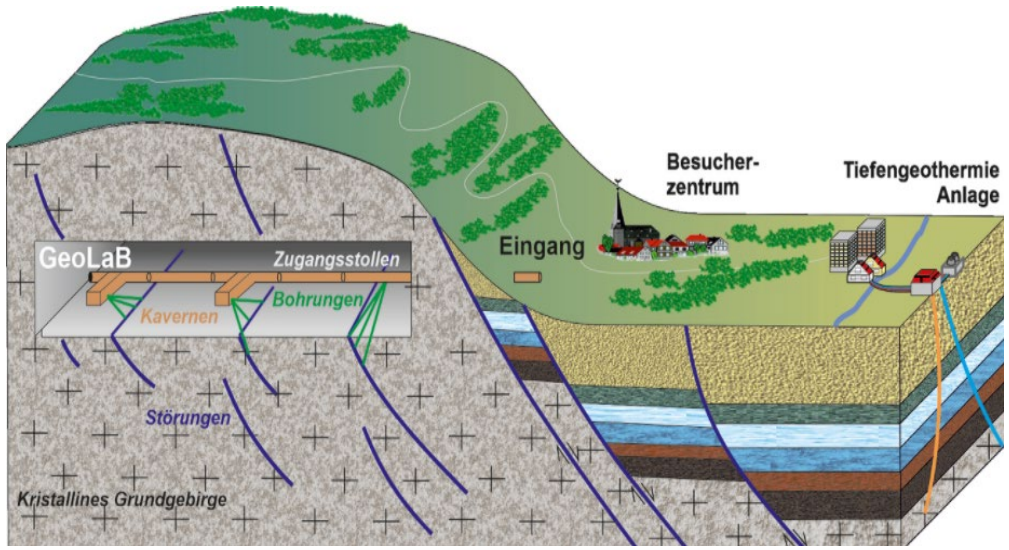
- Karlsruhe Institute of Technology (KIT)
- Deutsches Geoforschungszentrum Potsdam (GFZ)
- Helmholtz-Zentrum für Umweltforschung (UFZ)

Project duration: 2023 to min. 2038 **(BGE participation until 2028)**

Project budget: €50 million, initial BGE contribution €15 million

BGE objective for participation:

- Gain competence in licensing (operating plans according to the mining law, environmental permits, etc.)
- Practice exploration planning and operation, e.g., seismic exploration and drilling, and gain experience in mining technologies in crystalline rock
- Develop organizational and communication skills for the exploration campaign required by StandAG in Phase II



Source: KIT

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COLLABORATIVE R&D ON-SITE CHARACTERIZATION (1/2)

„*Suchtiefe*“ – Implications of subglacial erosion for the Selection procedure of a repository site for high-level radioactive waste

- Aim: prognosis of the potential reach and location-dependent penetration of possible future erosion/tunnel valleys. Focus on areas, determined as sub-areas in step 1 of phase I of the Site Selection Procedure. Based on the obtained results, location-dependent depth values for the upper boundary of the effective containment zone for a repository site for high-level radioactive waste are to be determined.
- Projektpartner: Bundesanstalt für Geo-wissenschaften und Rohstoffe (2021 – 2023), Germany

„QUASI“ – Dynamical modelling of subglacial meltwater erosion during past and future glaciations

- Aim: depth of subglacial meltwater erosion during future glaciations based on numerical simulations. Model uncertainties will be quantified and discussed.
- Projektpartner: Aarhus Universitet, Denmark
  Leibniz Universität Hannover, Germany
  (2022 – 2025)

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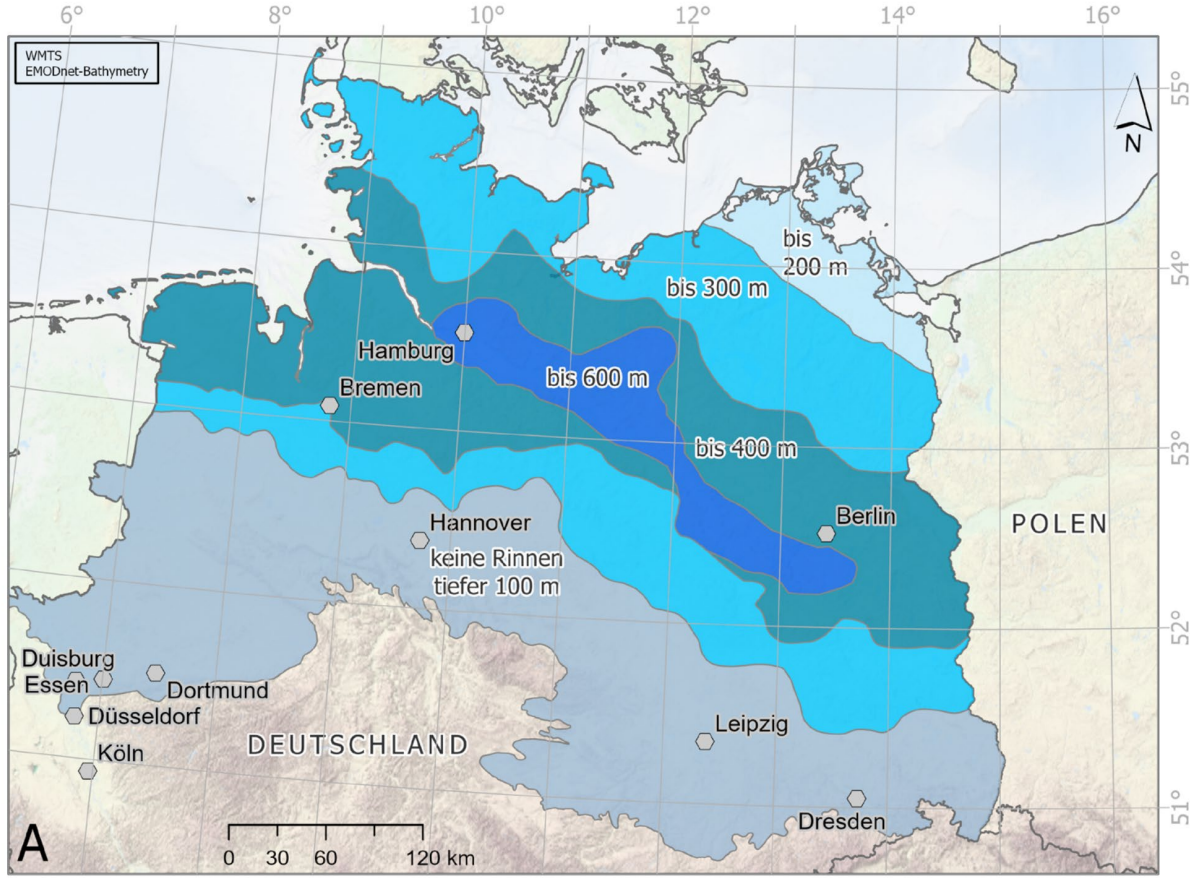
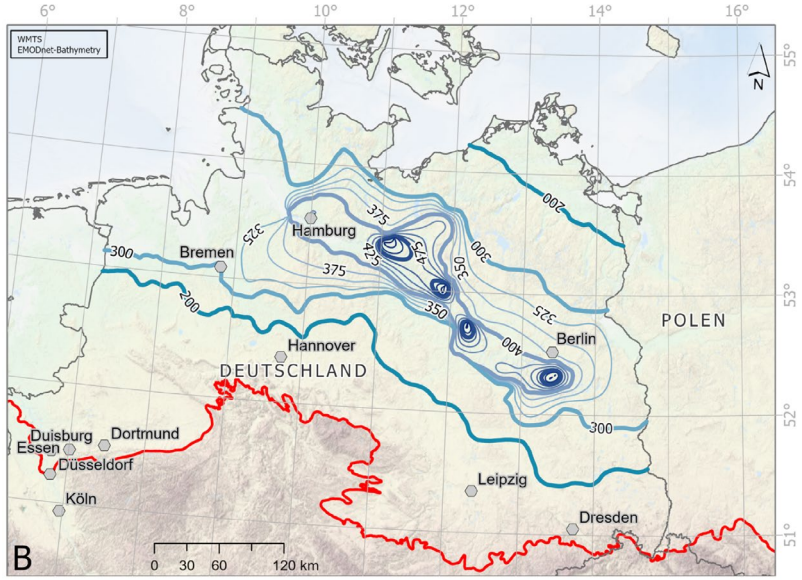
COLLABORATIVE R&D ON-SITE CHARACTERISATION (2/2)

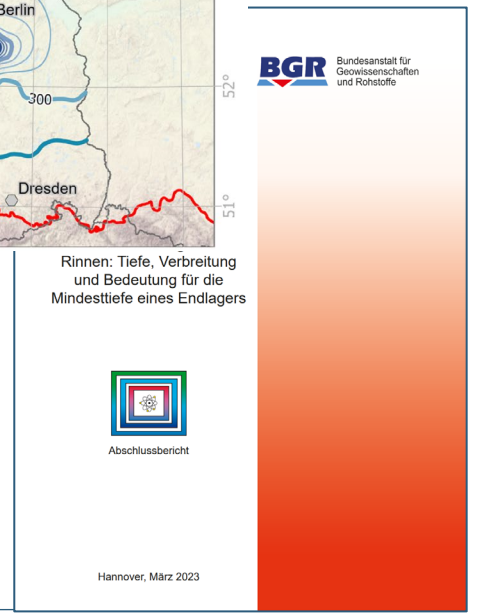
„*Suchtiefe*“ – Application of the results within the Site Selection Process



Quelle: Breuer et al. (2023)



Quelle: Breuer et al. (2023)



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URS

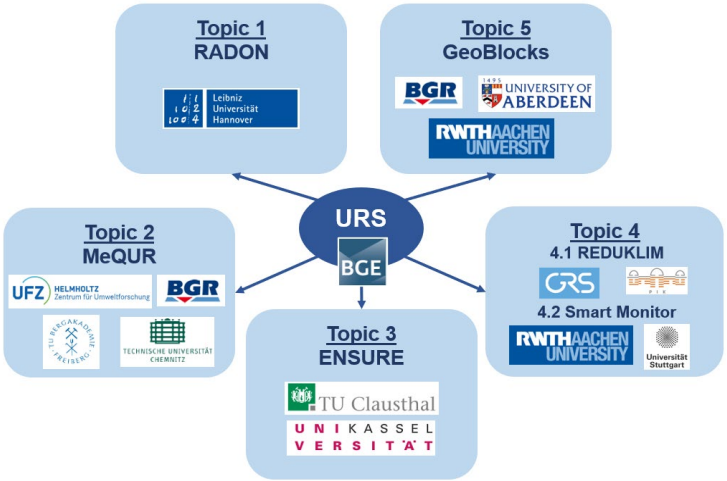
Uncertainties and Robustness with regard to the Safety of a repository for high-level radioactive waste

Research partner: see figure

Budget: Around 6 million €

Project description:

- According to § 11 EndlSiUntV uncertainties have to be assessed and documented.
- The research initiative aims to cover the diverse topics related to uncertainties through investigating different aspects and questions with the overall objective to increase the robustness of safety concepts.
- The project scope covers knowledge building as well as the development of methods in terms of how to manage uncertainties.
- Promotion of young researchers – 13 PhD theses



Source: https://urs.ifgt.tu-freiberg.de/en/home

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CONCLUSIONS

05

DERIVATION OF RESEARCH NEEDS

Research is essential

Mainly driven by safely implementation, optimization, and confidence building

- To consider the permanent progress in terms of methodological approaches and especially in terms of IT capacities (speed, storage)
- To increase drastically the efficiency for the processing/inversion and handling of big data
- To assure the application of cutting-edge technologies with the highest resolution
- To be in accordance with the scientific society
- To evidence the application of the best-possible technologies for public society

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THANK YOU FOR YOUR ATTENTION!
WOULD YOU LIKE TO READ MORE ABOUT IT?

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Sub-areas Interim Report with all documents and annexes

Interactive map with all sub-areas and excluded areas

Interactive introduction to the preparation of the Sub-areas Interim Report

Fact sheets of areas for methodological development

Work progress methodology of representative preliminary safety analyses

NBG report on methodological development

Work progress methodology of planning-scientific weighing criteria

Approach to identification of siting regions in the sub-areas

Statements and expert classifications of BGE

Your questions and our answers

BGE Repository Search Navigator

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ABBREVIATIONS

Approx.	Approximately
BASE	Bundesamt für die Sicherheit der nuklearen Entsorgung
BGE	Bundesgesellschaft für Endlagerung mbH
BGR	Bundesanstalt für Geowissenschaften und Rohstoffe
EndlSiUntV	Endlagersicherheitsuntersuchungsverordnung
GfZ	Deutsches Geoforschungszentrum Potsdam
IGD-TP	Implementing Geological Disposal Technology Platform
KIT	Karlsruhe Institute of Technology
NPP	Nuclear power plant
Rd.	around
RD&D	Research, Development & Demonstration
rvSU	Repräsentative vorläufige Sicherheitsuntersuchungen
SR	Standortregion (Siting region)
StandAG	Standortauswahlgesetz (Site Selection Act)
UFZ	Helmholtz-Zentrum für Umweltforschung
UG	Untersuchungsgebiet (Investigation area)

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LITERATURE

BGE (2020): Zwischenbericht Teilgebiete gemäß § 13 StandAG. Bundesgesellschaft für Endlagerung mbH (BGE). Peine. Online verfügbar unter https://www.bge.de/fileadmin/user_upload/Standortsuche/Wesentliche_Unterlagen/Zwischenbericht_Teilgebiete/Zwischenbericht_Teilgebiete_barrierefrei.pdf.

Breuer, Sonja; Bebiolka, Anke; Noack, Vera; Lang, Jörg (2023): Berücksichtigung subglazialer Erosionsprozesse bei Auswahl eines Standortes für die Endlagerung hochradioaktiver Abfälle ("Suchtiefe"). Pleistozäne subglaziale Rinnen: Tiefe, Verbreitung und Bedeutung für die Mindesttiefe eines Endlagers. Abschlussbericht. Bundesanstalt für Geowissenschaften und Rohstoffe (BGR). Hannover.

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

Implementing Geological Disposal of radioactive waste Technology Platform (2020): IGD-TP Vision 2040 and Strategic Research Agenda. Wettingen. Online verfügbar unter https://eur03.safelinks.protection.outlook.com/?url=https%3A%2F%2Figdtp.eu%2F&data=02%7C01%7Cirina.gaus%40nagra.ch%7C1f2baf281ac94e9933b008d85348030b%7C1903b63211614e84bcebcdb91b46599c%7C1%7C0%7C637350916041755955&sdata=FnuuMgM9LL6UkCqY0mK1CfF3bYfb%2Fy6rcSC3m%2BnE2fc%3D&reserved=0

StandAG: Standortauswahlgesetz vom 5. Mai 2017 (BGBl. I S. 1074), das zuletzt durch Artikel 8 des Gesetzes vom 22. März 2023 (BGBl. 2023 I Nr. 88) geändert worden ist. StandAG, zuletzt geprüft am 17.01.2025.

BUNDESGESELLSCHAFT
FÜR ENDLAGERUNG

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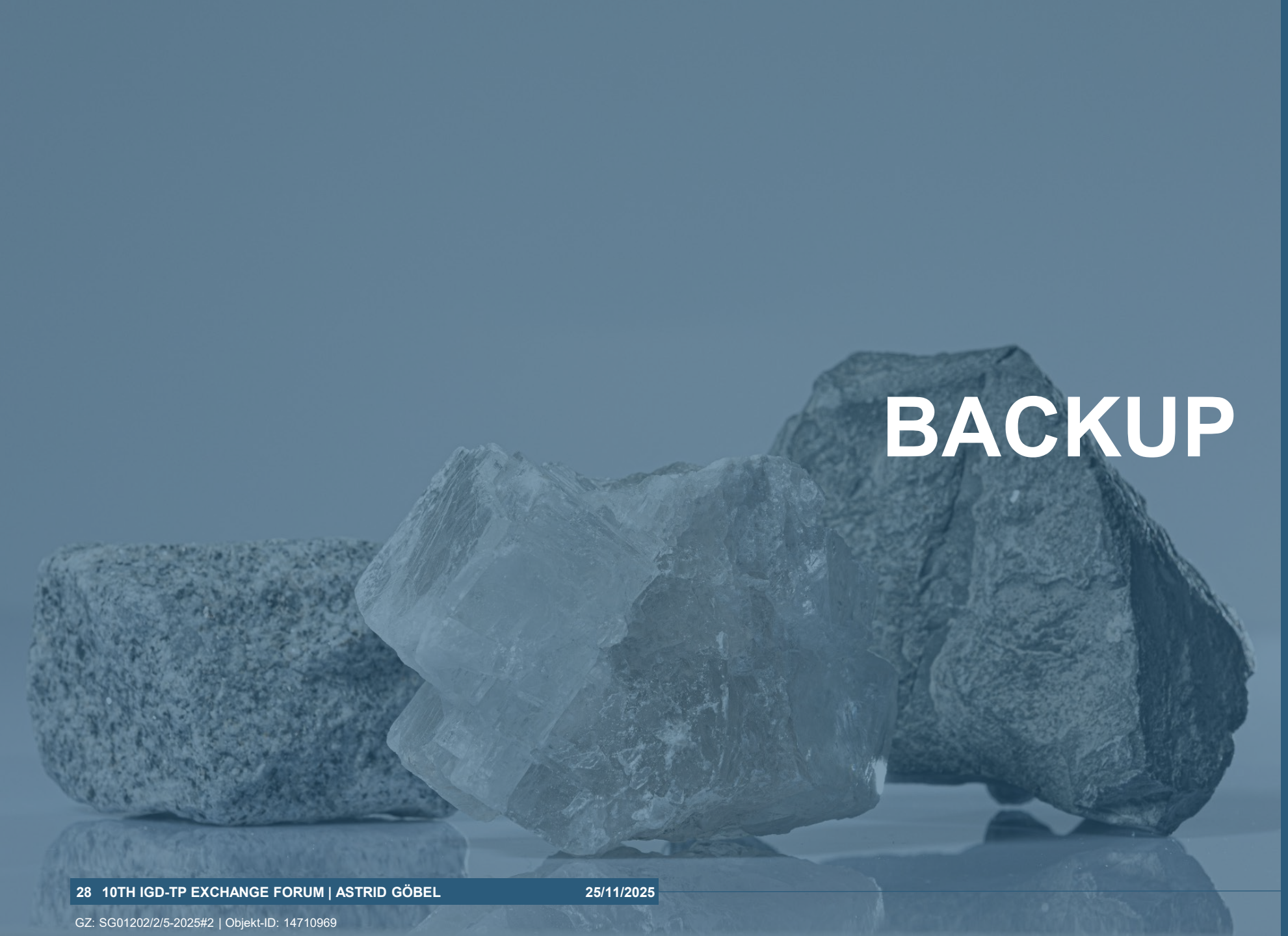
BGE Endlagersuche
Navigator

Die Newsletter
der BGE



BACKUP

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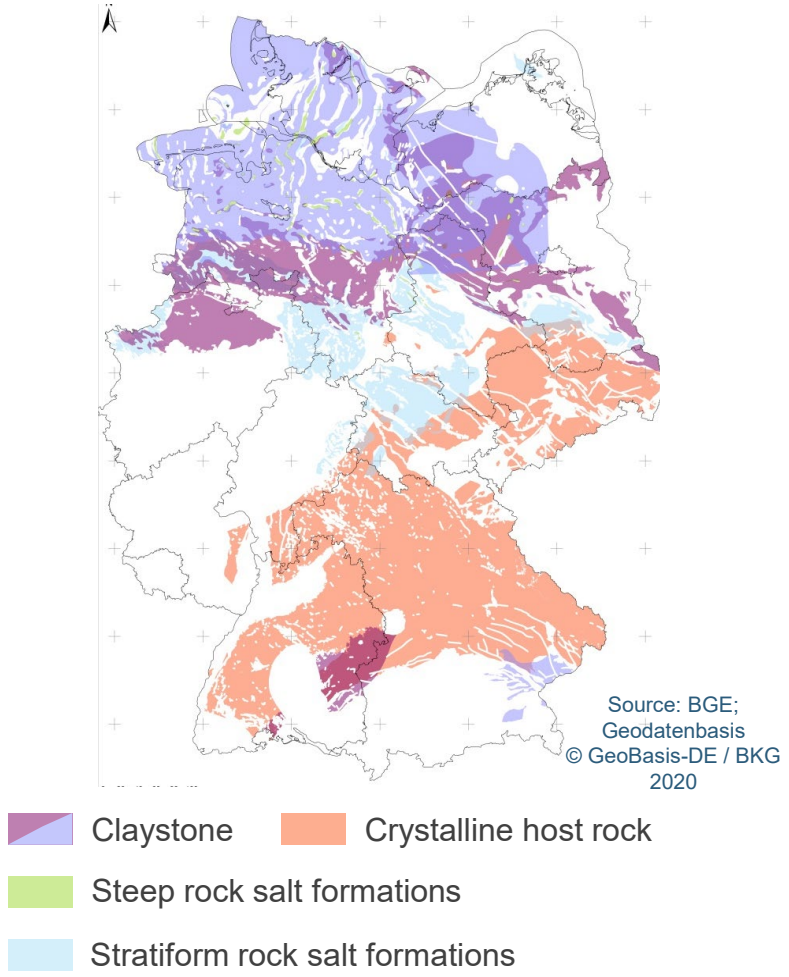
SITE SELECTION PROCEDURE

Sub-areas Interim Report (step 1, phase I) – completed 2020

Host rock	Number of identified areas	Number of sub-areas	Areas of sub-areas (in km²)
Claystone	**12**	**9**	**129,639**
Rock salt, of which			
• **stratiform deposit**	23	14	28,415
• **steep deposit**	139	60	2,034
Rock salt total	**162**	**74**	**30,450**
Crystalline host rock	**7**	**7**	**80,786**
Total	**181**	**90**	**240,874**
Share of federal territory			Roughly 54 %



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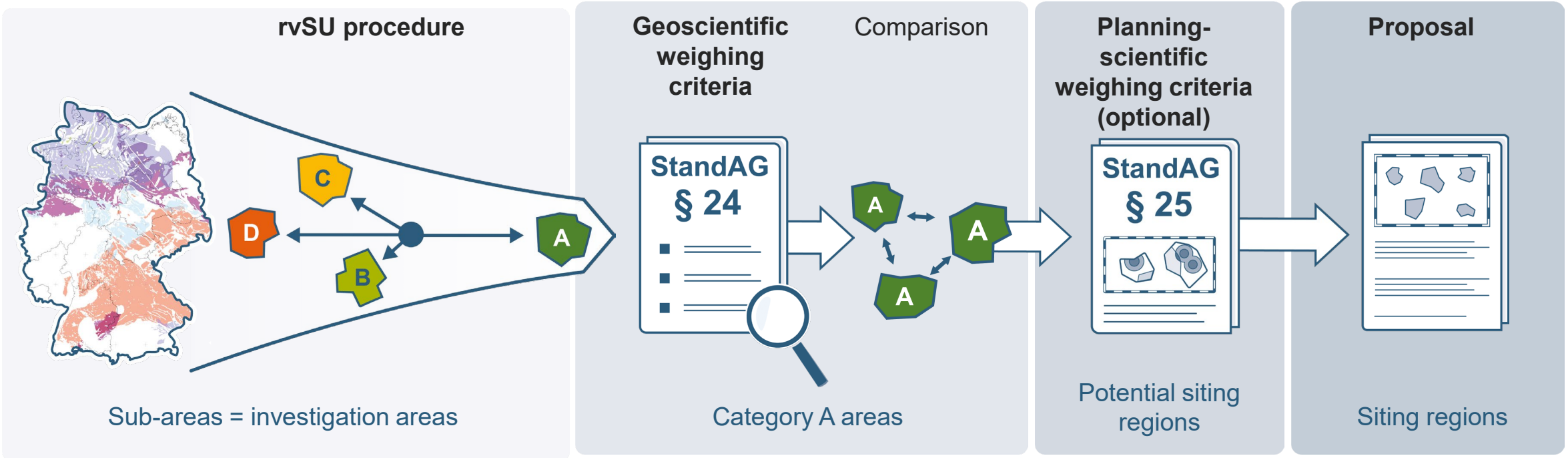
SITE SELECTION PROCEDURE

Step 2, Phase I – Current tasks: creating the siting region proposal



Step-by-step narrowing down of sub-areas to site regions using the tools

Source: BGE

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DERIVATION OF EXPLORATION AND RESEARCH NEEDS

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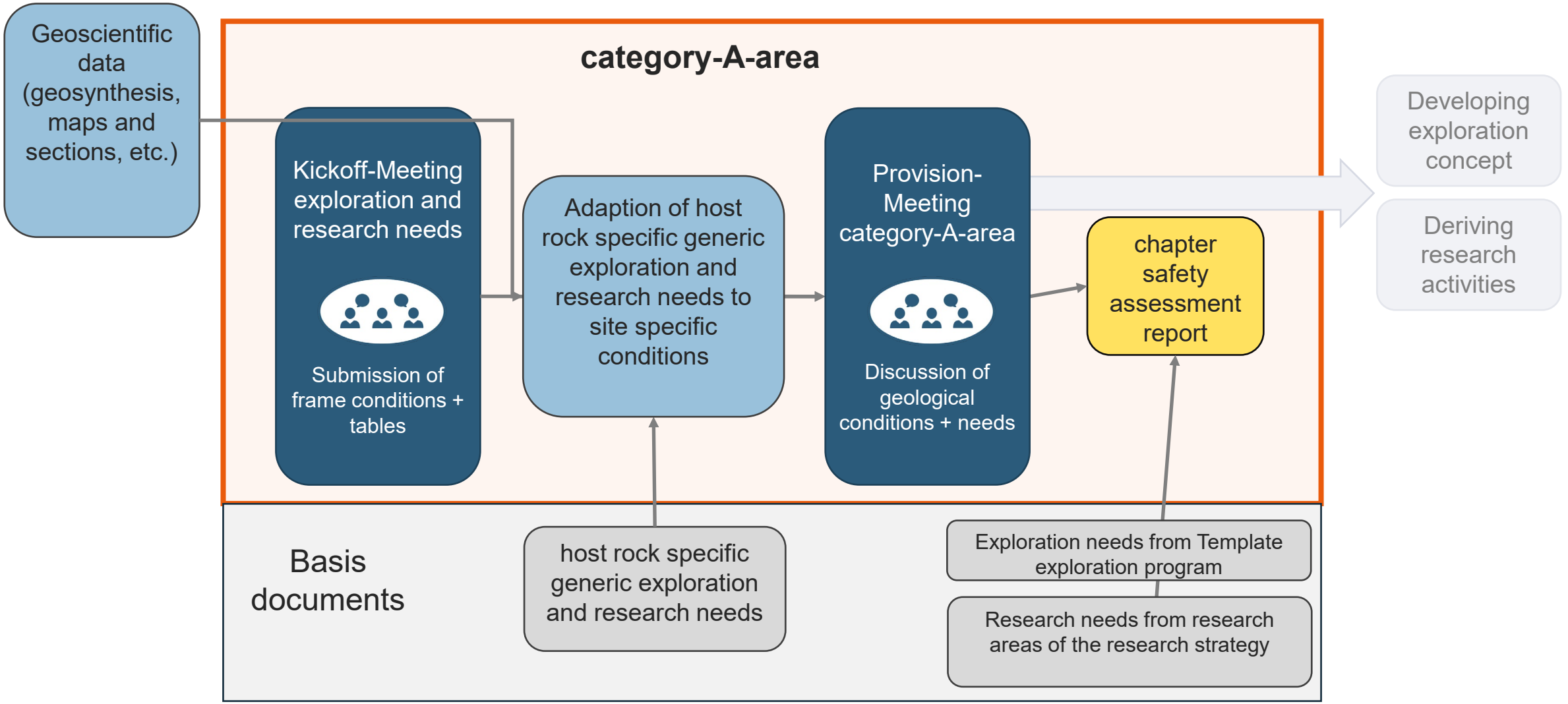

Source: BGE

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POTENTIAL TIME SCENARIOS

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Decision on siting regions for surface exploration

Decision on sites for underground exploration

Decision on the site

Phase I		Phase II	Phase III
Step 1 Identification of sub-areas	**Step 2** Identification of siting regions for surface exploration	**Surface exploration** Proposal for underground exploration	**Underground exploration** Final site comparison and site proposal
Schedule		**Estimations**	
Submission of proposed siting regions 2027		**Szenario A**: Exploration of **6 siting regions**: 9 years → Total duration Phase II: 10 years (incl. BASE review)	**Szenario A**: through drilling: 5 to 6 years
		Szenario B: Exploration of **10 siting regions**: 12 years → Total duration Phase II: 13 years (incl. BASE review)	**Szenario B**: through underground facilities: 13 to 23 years, depending on host rock

Source: BGE

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