

On solid ground

The German Centre for Astrophysics (DZA)
a centre for research, technology, and digitisation.

Michèle Heurs for the DZA team
ET-PP INFRA-DEV Annual Meeting, 12.06.2023, Barcelona



Neutron star merger, AEI Golm

Lusatia, a region in the centre of Europe



Lusatia



A competition historically unique in Germany

**ANNUAL BUDGET AFTER RAMP-UP PHASE 170 M€,
TOTAL VOLUME OF THE APPLICATION 1.4 B€**

Structural change

KNOWLEDGE CREATES PERSPECTIVES FOR THE REGION!

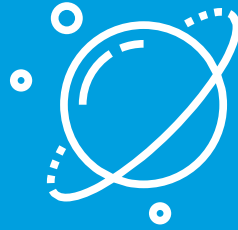
Two new large-scale research centres will be established in Lusatia in Saxony and in the Central German mining region. With "Knowledge creates perspectives for the region!", the BMBF and the Free State of Saxony are launching a competition for the establishment of the centres.

<https://www.bmbf.de/de/wissen-schafft-perspektiven-fuer-die-region-13122.html>

Who we are

The DZA is a joint initiative of German astronomy and astroparticle physics with the idea of creating a national and also international hub of astrophysics. The idea was born out of the need for cooperation, and it is supported by many research institutions, universities and partners.

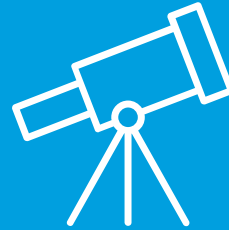
DZA concept : the challenges of astrophysics today



Astronomy

Square Kilometre Array
Observatory (SKAO)

Einstein Telescope
(Low Seismic Lab)



Instruments

Developments for future
astronomical experiments

Strong participation of
Saxon industry



Data Intensive Computing

Processing huge amounts
of astrophysics data from
all over the world

Innovative AI based and
Smart Green Computing

Interlocking of pillars → unique synergies

29. September 2022



Katharina Henjes-Kunst and Günther Hasinger in Görlitz



Michèle Heurs and Christian Stegmann in Cunnewitz

The German Centre for Astrophysics

Two sites for research,
technology, digitisation



The German Centre for Astrophysics

Two sites for research, technology, digitisation



The DZA campus on the Kahlbaum site in Görlitz

The German Centre for Astrophysics

Two sites for research, technology, digitisation



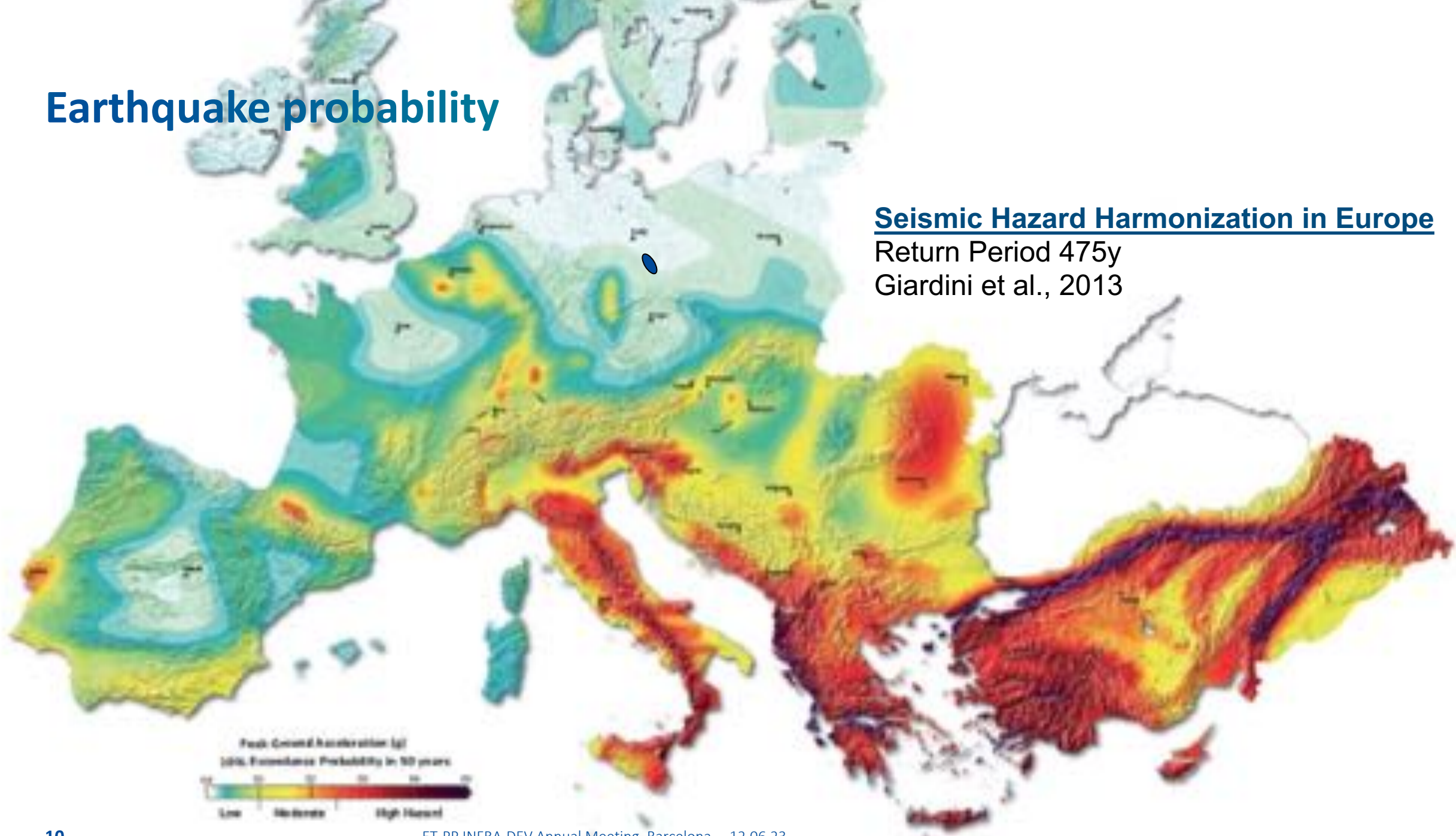
The Low Seismic Lab in the granite of Lusatia

NIKHEF, NL



The DZA campus on the Kahlbaum site in Görlitz

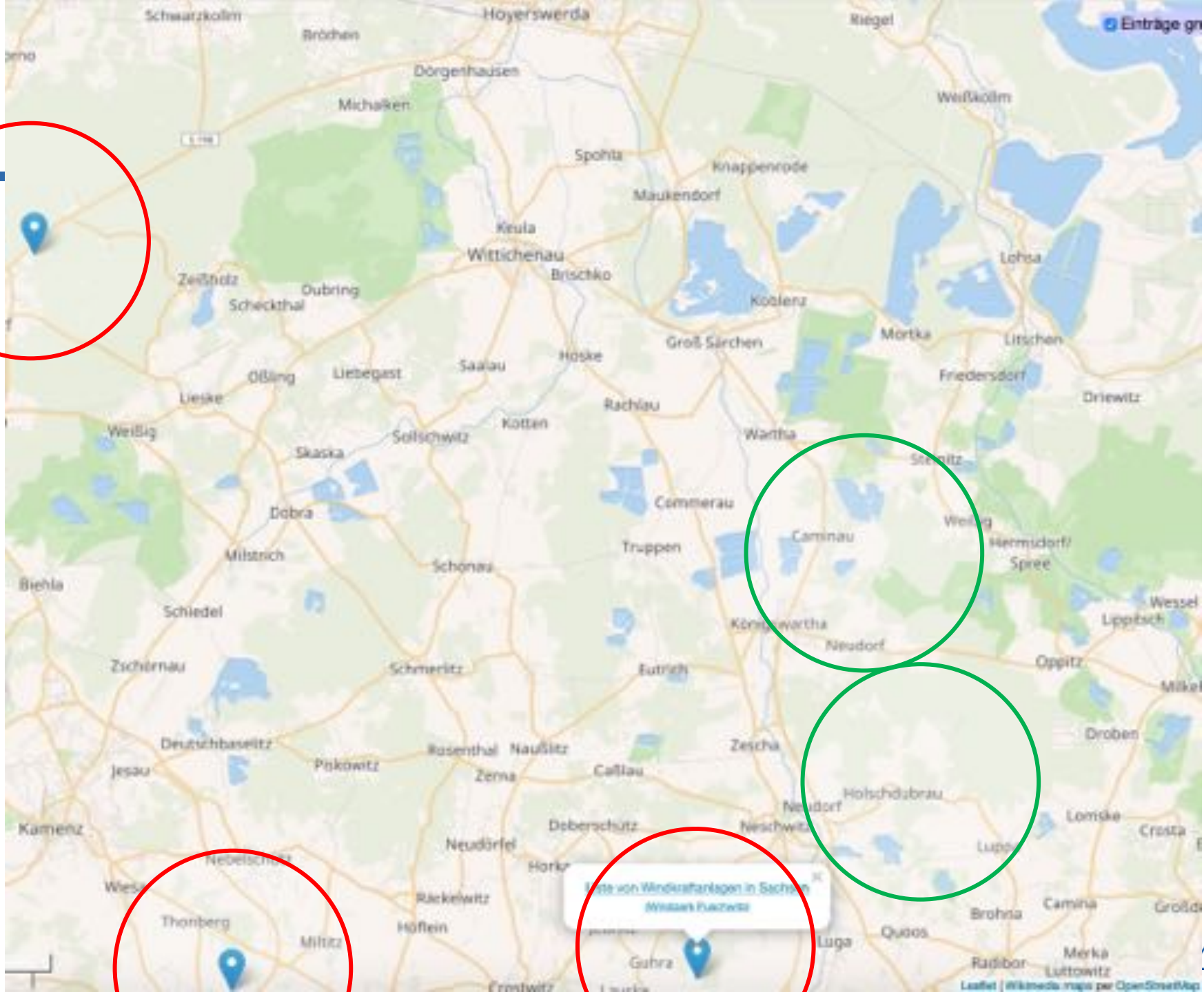
Earthquake probability

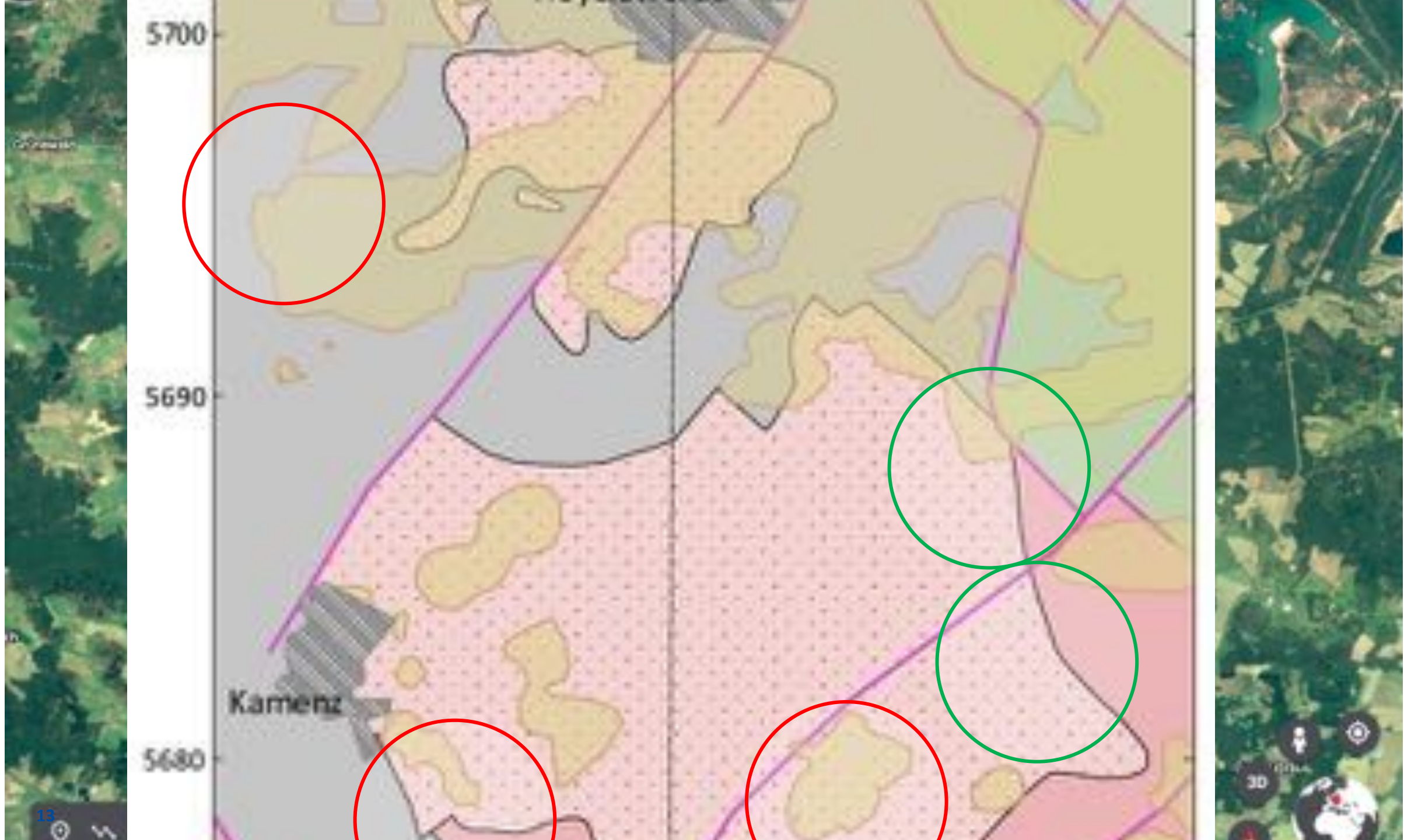


Seismic Hazard Harmonization in Europe

Return Period 475y

Giardini et al., 2013



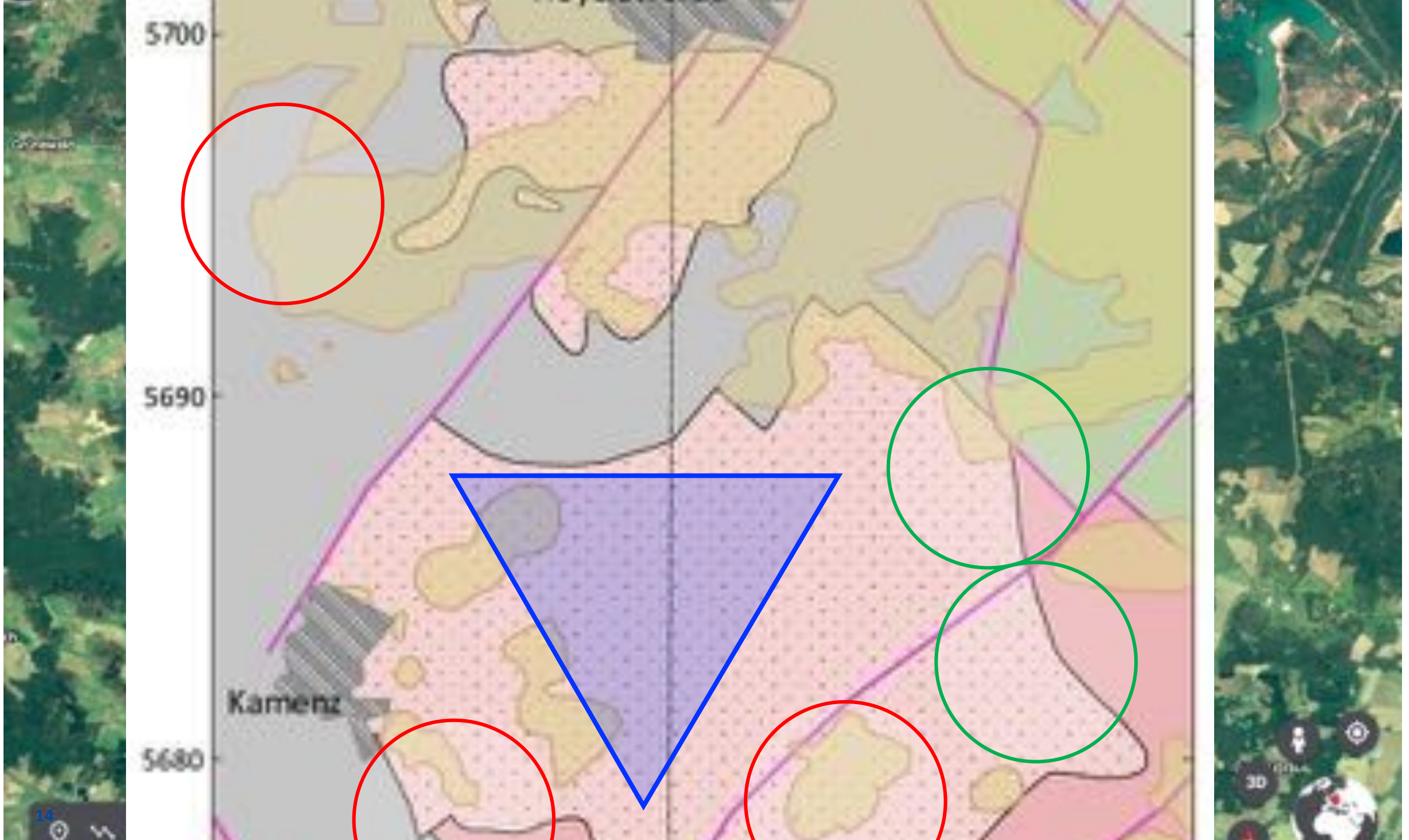


5700

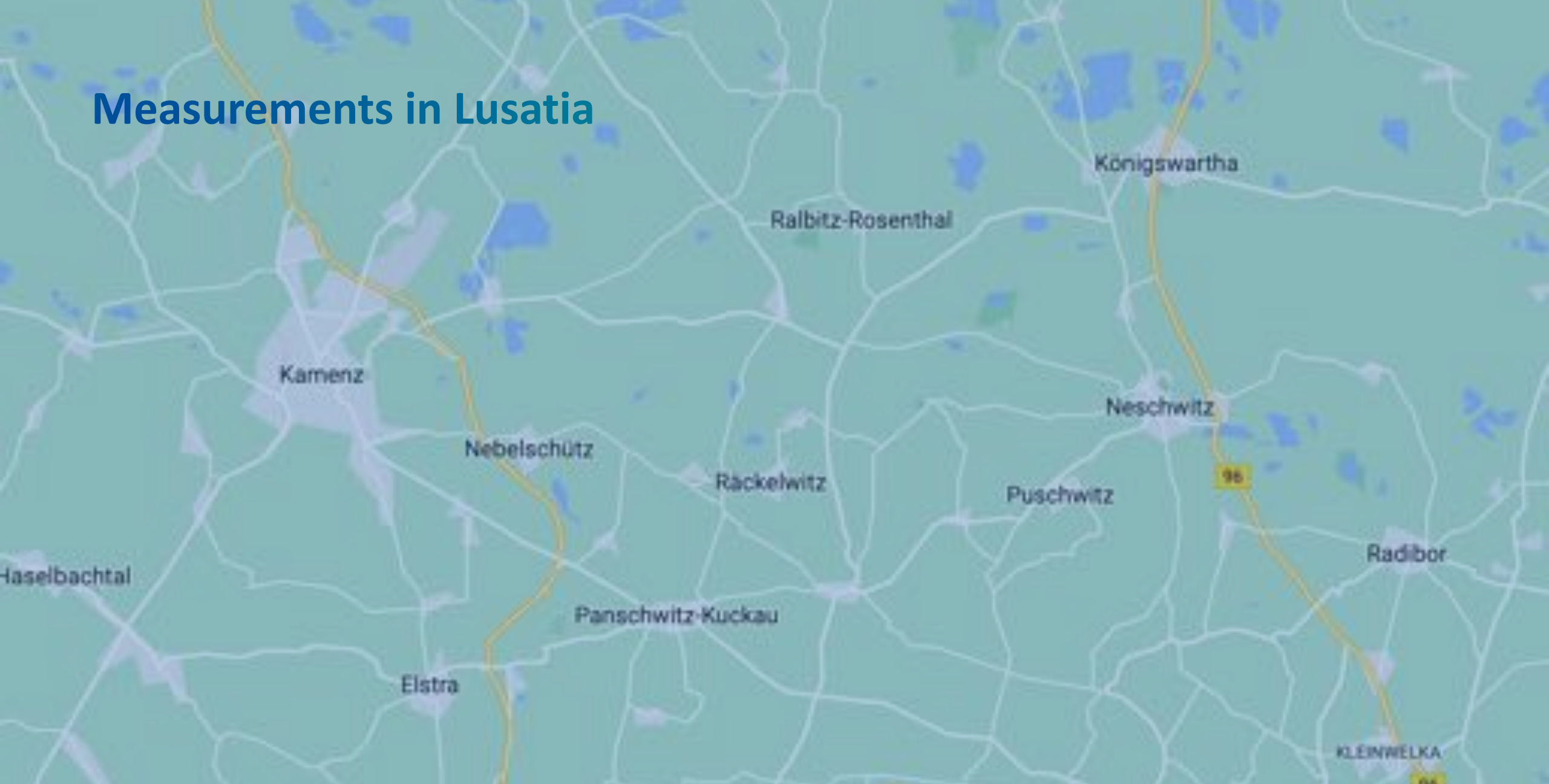
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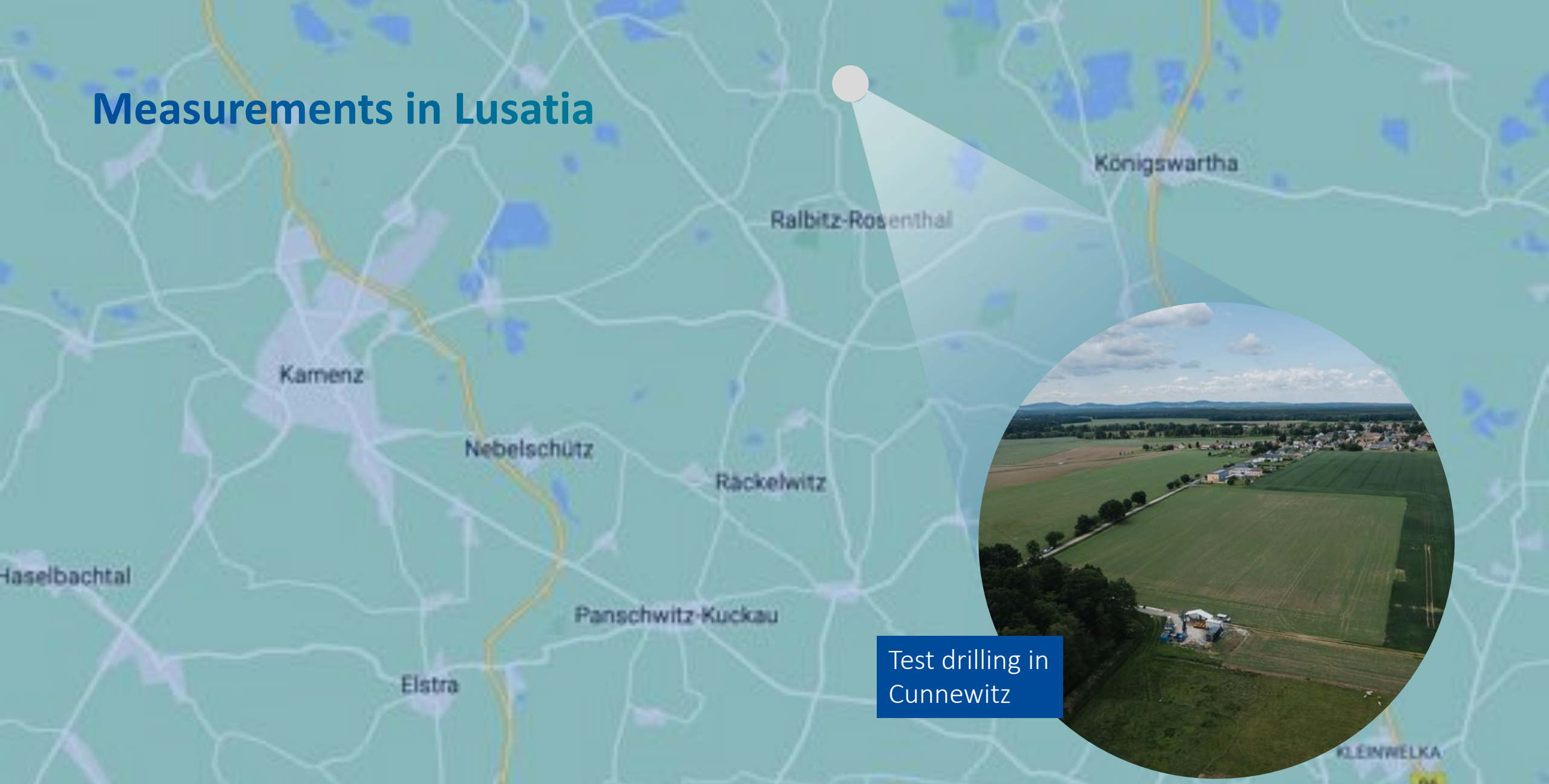
Kamenz



Measurements in Lusatia



Measurements in Lusatia



Test drilling in
Cunnewitz

Measurements in Lusatia

Seismometer on the surface

Test drilling in Cunnewitz



Cunnewitz, part of Ralbitz-Rosenthal





Bundesministerium
für Bildung
und Forschung



Probepbohrung

Für den Bereich Zentrum für Astrophysik



Wissenschaftliche Zwecke sind im ZSM nicht zur Prüfung der
Waffenkapazität der geplanten Außenrichtungs-
beschleuniger-Überspannungsdichten-Teilstrahl und wird
entsprechend festgelegt. In dem Maße, in dem die
Beschleuniger-Überspannung im Teil der Situation der Gründung
des Bereichs Zentrum für Astrophysik ist die Leistung.

Die Beschleunigung der Beschleuniger ist nach Möglichkeit möglich,
die Beschleunigung ist jedoch nicht möglich, wenn über
die Beschleuniger-Überspannung festgelegt ist.

Probewe

Für den Bereich Zentrum für Astrophysik (DZA)

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The boreholes in May 2023

250 m

180 m



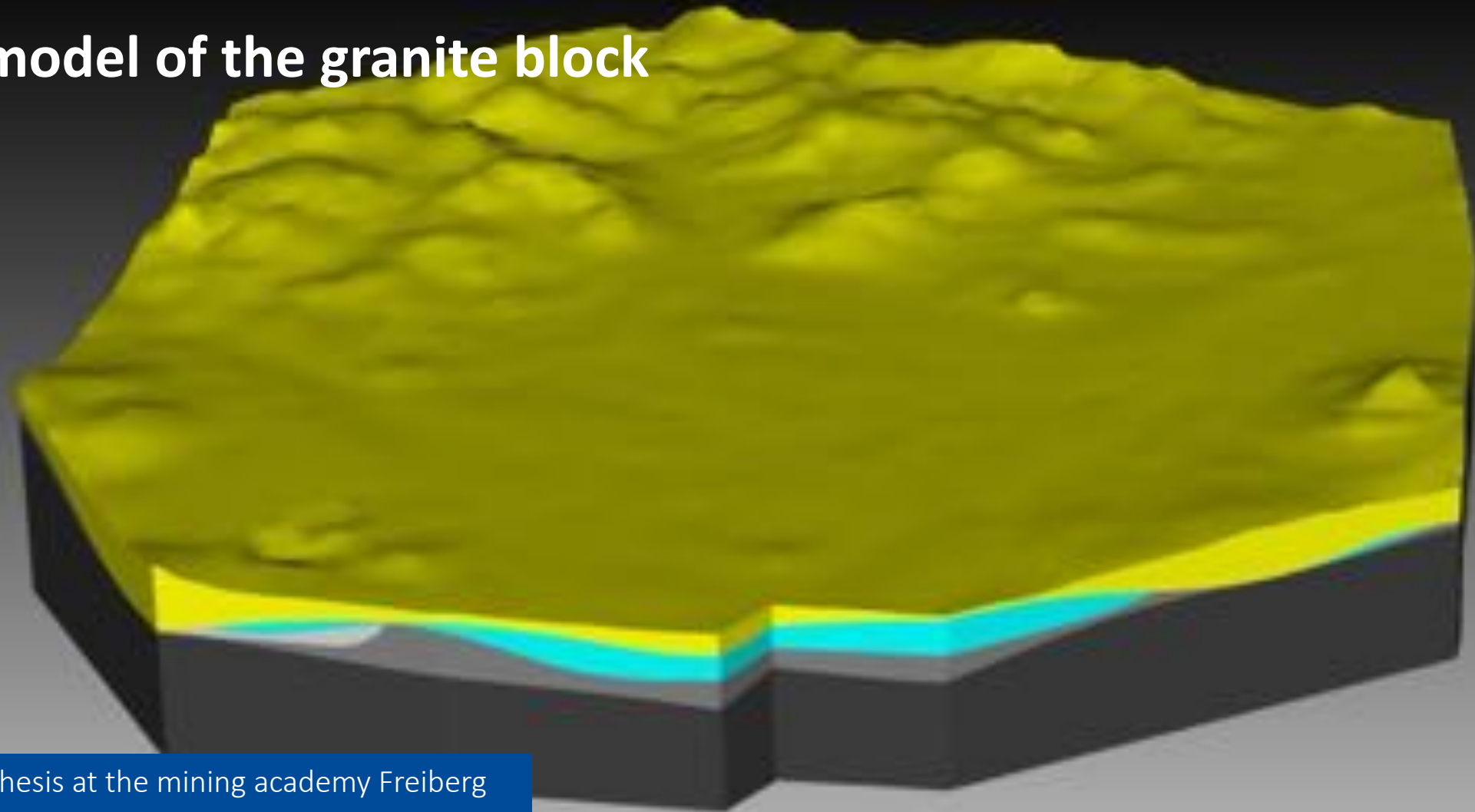
Drill cores



Great public interest



A model of the granite block

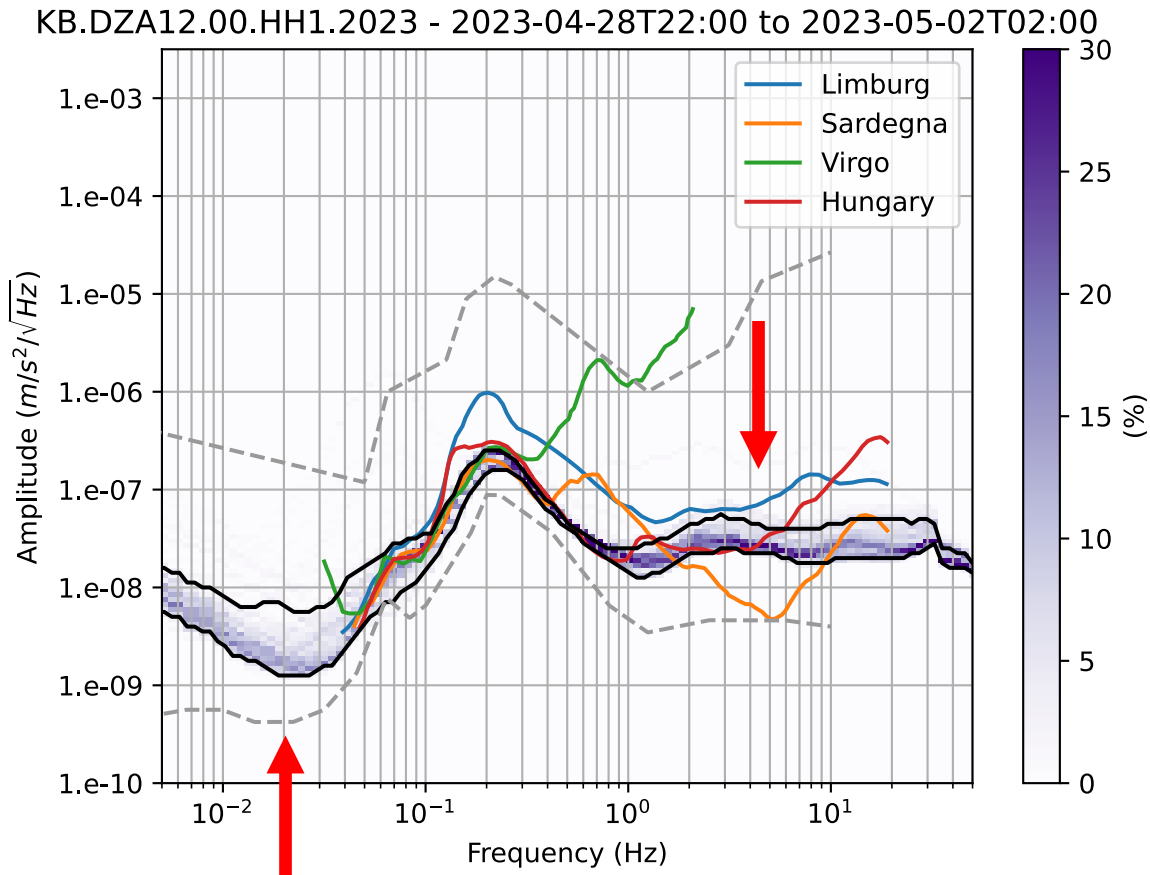


DZA Master thesis at the mining academy Freiberg

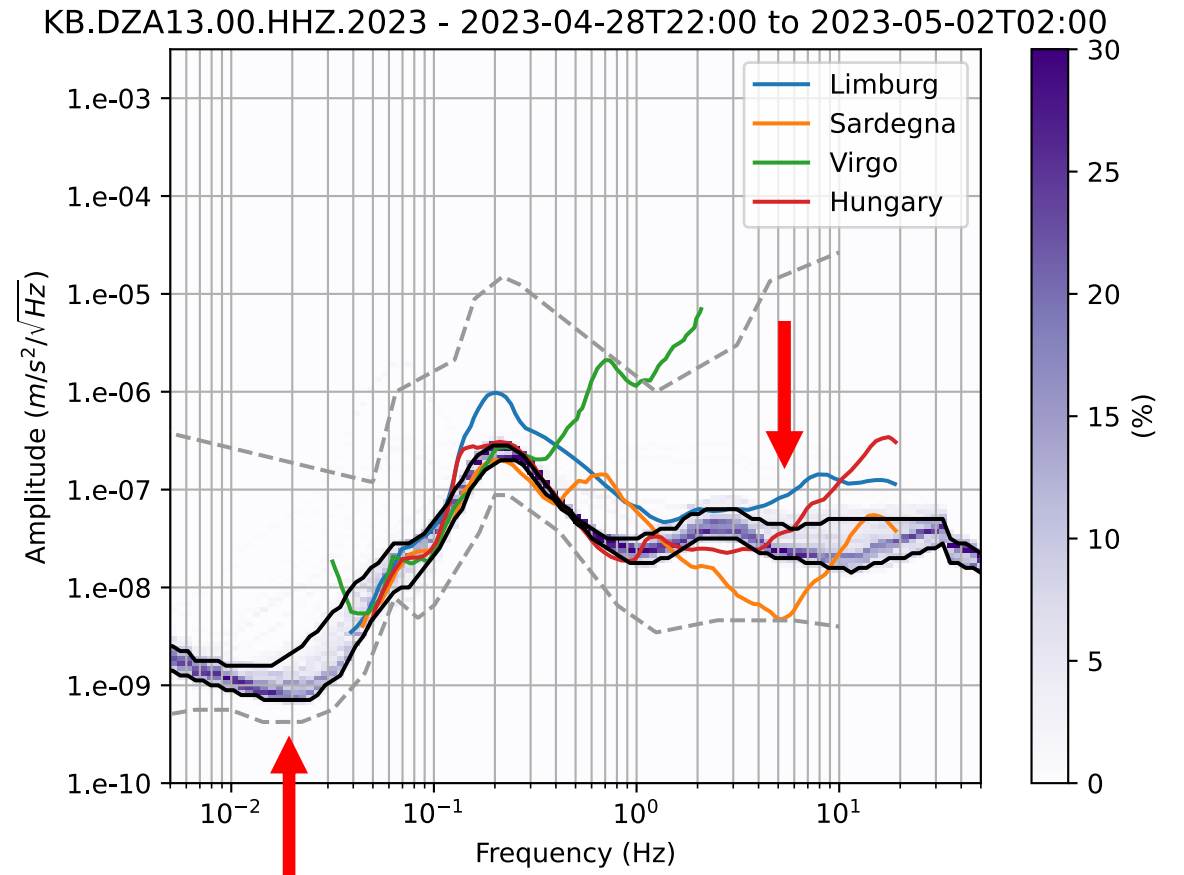


Most recent measurements in the Lausitz

Borehole 1: 165m (2nd hole)



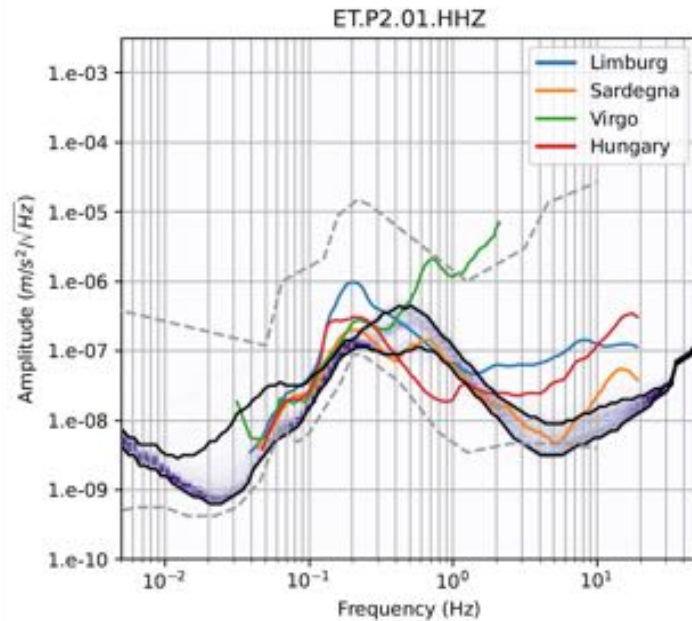
Borehole 2: 170m (1st hole)



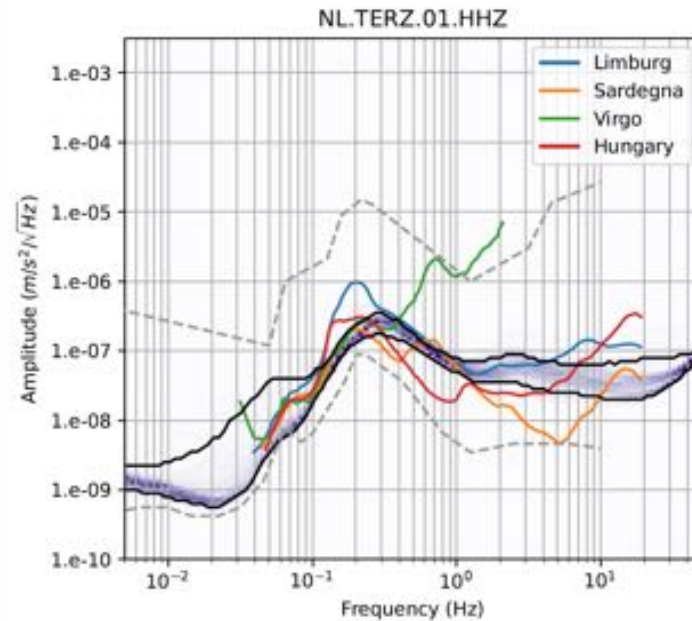
A. Rietbrock, KIT

A very preliminary comparison

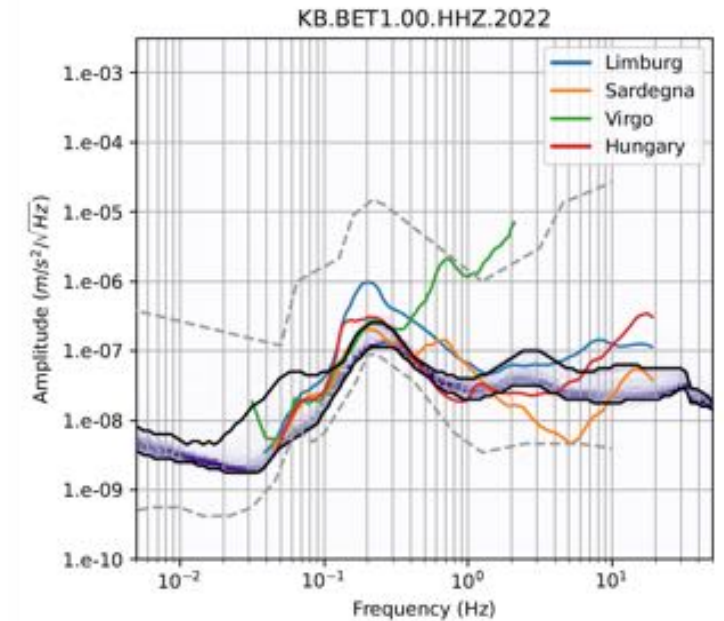
- Sardinia



- Limburg



- Lusatia



A. Rietbrock, KIT

Future seismic noise and geophysical investigations

- DESY, as a partner of the DZA, will perform the investigations in the coming years together with KIT, GFZ, Bergakademie Freiberg, LfUG Sachsen, RWTH Aachen
- **Programm**
 - Development of a 3D subsurface model of the seismic properties of the subsurface (backbone model).
 - Investigations of incident seismic noise field and its temporal and spatial coherence will be investigated.
 - Comparison with the seismic data observed in the pilot borehole at different depths for predictions for potential further borehole locations.
 - Passive seismic measurements on a 10 km x 10 km grid to determine the three-dimensional shear wave velocity.
 - 2D reflection/refraction lines to determine the seismic velocities and calibration of the passive experiment.
 - Development of an integrated geological map for Lusatia incl. evaluation of old data and drill cores
 - Characterisation of the seismic noise including borehole measurements and development of a seismic-geological "back-bone model".
 - 5 further boreholes incl. further geophysical investigations

The Low Seismic Lab

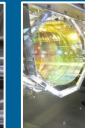
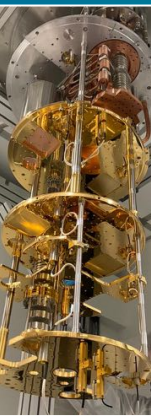
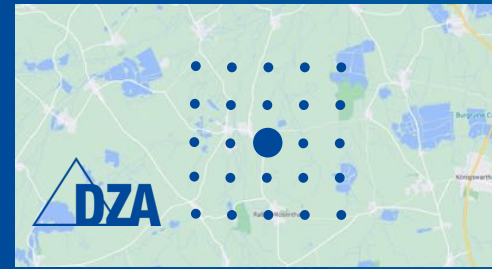
Innovation platform of approx. $(40 \times 30 \times 30) \text{ m}^3$ in 200m depth in the Lusatian granite

With a square kilometre 3D seismometer sensor array.

→ Metrological validation of advanced seismic isolation concepts on a large scale

THE PLACE FOR FUTURE "DEEP TECH":

- Technology development for gravitational wave astronomy
- Adaptive seismic noise reduction
- Subnanometer microscopy and photolithography
- Quantum computing experiments
- Astrophysics with accelerators



NIKHEF, NL

The German Centre for Astrophysics in Lusatia

A big success for fundamental science (or more specifically astronomy, astrophysics and astroparticle physics) and an important step towards a significant German participation in the Einstein Telescope

PROJECT PHASE (2023-2026):

- Further test drills and geological / seismic investigations to determine suitability of granite for LSL & ET

"FULL FUNDING" PHASE (2026 ONGOING):

- Buildings and underground lab construction, full ramp-up of personnel and research & science

IN ANY CASE:

- DZA will conduct technology development for gravitational wave astronomy and in particular for ET



The main points and questions (IMHO)

Our position is an offer to the European GW Community. The investigations and preparations for the Low Seismic Lab and the site for ET are very similar – we're doing them anyway!

We are offering the investigation of a potential site (along the criteria below), so the community is able to find the best location for ET.

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- 1) Can ET's scientific programme be implemented at this location?
- 2) Can ET be built at the site cost-effectively and with foreseeable risks?
- 3) Can ET be operated at the site for decades?
- 4) Is there political support for the site, i.e. is the host country willing to cover at least half of the investment?



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