

2017

LABEX

G-EAU-THERMIE
PROFONDE

A YEAR IN BRIEF

labex-geothermie.unistra.fr

LABORATORY OF EXCELLENCE
An university-industry partnership dedicated
to deep geothermal research in Alsace

3D image of the subsurface of Northern Alsace using a novel imaging technique conceived and developed by LabEx researchers, using ambient seismic noise analysis. The vertical lines represent boreholes at Soultz-sous-Forêts and Rittershoffen. At the surface, the seismic stations of the EstOf network are represented by points. The yellow areas indicate warmer or more fluid-rich areas, which are potential zones of heightened geothermal activity (see page 2).

Created in 2012, the LabEx G-eau-thermie Profonde is coordinated by the University of Strasbourg, with support from the French National Centre for Scientific Research (CNRS).

Academic partners :

EOST (School and Observatory of Earth Sciences)

And two of its laboratories

IPGS (Institut de physique du globe de Strasbourg)

LHYGES (Laboratory of Hydrology and Geochemistry of Strasbourg)

ICube (Laboratory for Engineering Science, Computer Science, and Imaging)

LISEC (Laboratory for Education, Information, and Communication Sciences)

Industrial partners :

ÉS (Électricité de Strasbourg), and its affiliate ÉS Géothermie,

GEIE (European Economic Interest Grouping, EEIG) Exploitation Minière de la Chaleur at Soultz-sous-Forêts



École et observatoire

des sciences de la Terre

de l'Université de Strasbourg

et du



Missions

Research

Education

Data dissemination and archiving

Development

KEY FIGURES

92 individuals,

equivalent to **36.5 ETP** people employed full-time

61% from the University of Strasbourg,

25% from the CNRS, 9% from ÉS

5% from other partners

10 scientific working groups

seismology, geodesy,

magneto-tellurics and gravimetry, rock physics,

hydro-geochemistry, geology, social sciences,

the deep geothermal data centre,

modelling, and education

4 governing committees

Supervisory Committee,

Includes the CNRS, University of Strasbourg, ÉS

Steering Committee,

Includes experts from EOST and ÉS

Chair Committee,

Includes all scientific working group leaders

Scientific Committee,

Includes international scientists

3 industrial partners

ÉS (and GEIE EMC), since 2012

Storengy/Engie et Total, since 2017

9 studies

funded by LabEx and completed in 2017 (funded by the French government's Investissement d'avenir initiative)

1. Analogue study of fault slip
2. Geothermal reservoir imaging using ambient seismic noise correlation
3. Geothermal reservoir monitoring using hybrid gravimetry
4. Geothermal reservoir monitoring using magneto-tellurics
5. Geothermal reservoir monitoring using passive electromagnetics
6. Geothermal reservoir stimulation: Study of the influence of natural joints on the rheology and frictional properties of sandstone
7. Mineral dissolution experiments
8. Numerical modelling of geothermal fluid transport after reinjection into the Enhanced Geothermal System at Soultz-sous-Forêts
9. Study of the geology, stratigraphy, mineralogy, and structure of the sedimentary-to-crystalline basement transition in the Rhine Graben, with application to the geothermal wells at Soultz-sous-Forêts, Rittershoffen, and Illkirch

4 large research projects

funded by the French Environment and Energy Management Agency (ADEME), the French National Research Agency (ANR), and the European Union

At the regional level

EGS Alsace 2015-2019
Co-funded by ADEME, in partnership with ÉS
1 250 000 €
Industrialization of geothermal energy in Alsace

At the national level

ANR Cantare 2015-2018
In partnership with the BRGM and ÉS géothermie
360 000 €
Studying the development of high temperature geothermal resources in Alsace

At the European level

H2020 DESTRESS 2016-2020
16 international partners
1 300 000 €
Developing stimulation techniques to enhance reservoir productivity, while minimizing environmental risks

H2020 EPOS-AH 2014-2019
250 partners from 25 European countries
186 250 €
Data dissemination and archiving

Exploration : Seismology

Development of a novel geothermal reservoir imaging technique

Using measurements of the ambient seismic noise emitted by the North Sea and regional human activity, this **innovative, passive, continuous, and low-cost technique** reveals variations in temperature or fluid circulation at depth. The work was conducted as part of the first LabEx-funded thesis, completed by Maximilien Lehujeur. This thesis produced a **3D image of the subsurface** (see cover image) several kilometers deep and covering the entire region of Northern Alsace, including the locations of the geothermal sites at Soultz-sous-Forêts, Rittershoffen, Wissembourg and several other geothermal projects currently under development. This study shows **the full potential of these passive methods for geothermal reservoir exploration**.

Data dissemination and preservation

The Data Centre for Deep Geothermal Energy (CDGP) goes live @ cdgp.u-strasbg.fr

The CDGP's objective is to preserve, archive, and disseminate data acquired not only on deep geothermal sites in the Rhine Graben, but worldwide. The first phase of the project is the preservation and dissemination of the enormous back catalogue of scientific data acquired from the Soultz-sous-Forêts pilot project, thus facilitating the scientific community in its continued deep geothermal research and initiating training opportunities for students. The first CDGP data are now available online at <https://cdgp.u-strasbg.fr/> to scientists from around the world, with state-of-the-art online monitoring that allows owners to track the use of their data.

The data distribution platform officially went live in March 2018 : the work continues throughout 2018.



Reservoir Studies

Preparing for chemical stimulation at Soultz-sous-Forêts

To optimize geothermal energy production at Soultz-sous-Forêts, a feasibility study, started in 2017, is using laboratory experiments and numerical simulations to determine the best choice of acid, acid concentration, and length of acid injection into the reservoir. Experiments continue into 2018.

Hydro-geochemistry

Researchers have designed and built an experimental device that can reach high pressure (up to 70 MPa) and high temperature (up to 250°C) to quantitatively study the evolution of permeability in geothermal reservoirs exposed to reactive fluids.

« The successes of 2017 are the result of a huge collective effort carried out by the nine LabEx working groups. Congratulations to all ! »

Jean Schmittbuhl, director of LabEx G-eau-thermie Profonde

Education

12 ongoing doctoral theses
of which **5 were started in 2017**

9 ongoing post-doctoral research projects

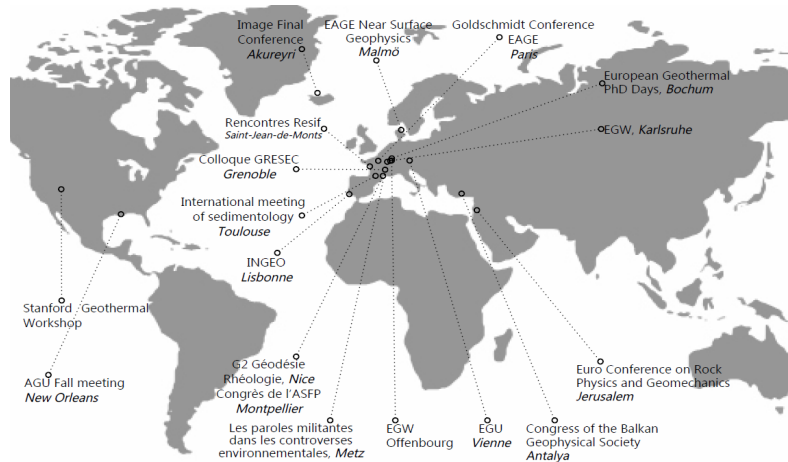
1 PhD defence on the geology of geothermal reservoirs
This is the 5th PhD defense under LabEx

1 new university degree program
"Project Management in Deep Geothermal Energy"
The second group of graduates started in 2017

1 MSc course in deep geothermal energy
taught at EOST (Master 2)

Output

16 articles in peer-reviewed scientific journals
47 abstracts presented at
18 seminars and conferences around the world



5th European Geothermal Workshop (EGW)

Each year, LabEx and KIT (Karlsruhe Institute of Technology) take turns organizing EGW. The 5th EGW took place in Karlsruhe and focused on cutting-edge research on the characterization of deep geothermal systems, bringing together researchers developing new methods and approaches.

Twenty EOST researchers and PhD students affiliated with the LabEx G-eau-thermie Profonde presented their work at EGW.



Advances

Reservoir monitoring

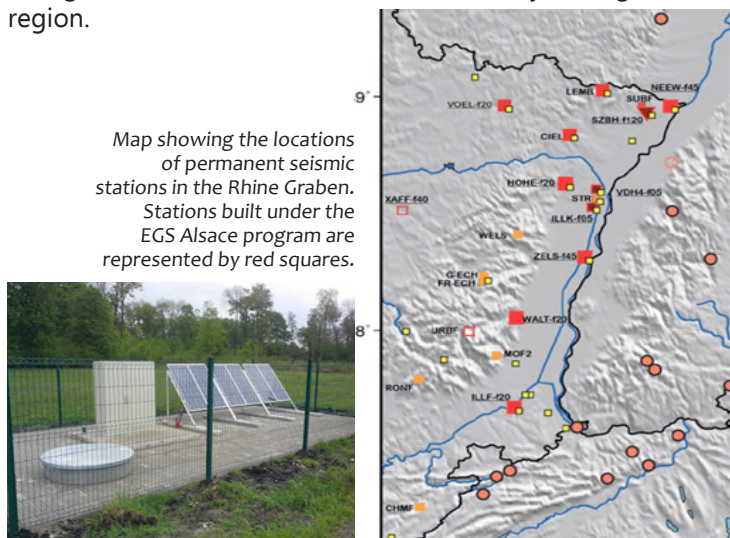
Monitoring of geothermal reservoirs using gravimetry, magneto-tellurics, and passive electromagnetism : Case studies in Iceland

EOST researchers are developing passive methods used to obtain spatially- and temporally-resolved data on the evolution of geothermal reservoirs. In 2017, the team carried out its first field campaign in Iceland on the volcano-geothermal sites of Theistareykir and Krafla. At these Icelandic sites, which are more geothermally active than sites in Alsace, the team hopes to obtain results that will validate and refine the methods used to monitor geothermal reservoirs in Alsace.



Seismic monitoring in Alsace

8 new permanent seismic stations have been installed to increase the density of the regional seismic monitoring network. This network will be able to precisely locate any seismic event with a magnitude of 1.5 or larger, thus ensuring precise monitoring of natural and induced seismic activity throughout the region.



Map showing the locations of permanent seismic stations in the Rhine Graben. Stations built under the EGS Alsace program are represented by red squares.



Social sciences

Understanding public perception

A new sociological study of the controversy surrounding deep geothermal energy in the Strasbourg Eurométropole and in Northern Alsace - using quantitative (questionnaires) and qualitative (focus groups surveys) techniques - is in progress.

IMPORTANT EVENTS

LabEx joins EERA, the European Energy Research Alliance

In 2017, the LabEx G-eau-thermie Profonde became a member (via the University of Strasbourg) of the EERA. The LabEx now belongs to the «Geothermal» program (JPGE), which connects academics from around Europe who are actively working on deep geothermal energy research.



2017 sees the implementation of an agreement, signed in 2016 at DREAL Alsace (now DREAL Grand Est), **designed to pool academic and industrial data** to facilitate collaborative monitoring of deep geothermal projects.

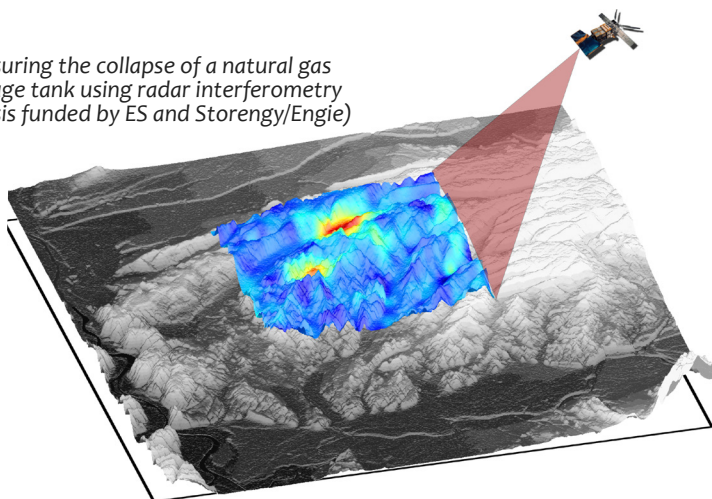
New industrial partnerships with Storengy/Engie and Total

Recent LabEx-supported research has attracted the interest of new industrial partners interested in the study of underground reservoirs.

- Storengy / Engie now co-funds, in partnership with ÉS, two new PhD theses on the application of novel underground reservoir monitoring techniques.
- Total now funds one post-doctoral researcher to study the feasibility of producing natural hydrogen in geothermal reservoirs.

These projects mark the multi-partnership expansion of the LabEx and, specifically, the Industrial Chair for Deep Geothermal Energy (CIGP).

Measuring the collapse of a natural gas storage tank using radar interferometry (thesis funded by ES and Storengy/Engie)



« 2017 is a year of maturity for the LabEx G-eau-thermie Profonde, marked by the culmination of several major projects initiated at the launch of the LabEx. It took six years for these projects to succeed. These successes highlight the importance of the long term strategic planning of the LabEx »

Jean Schmittbuhl

BUDGET

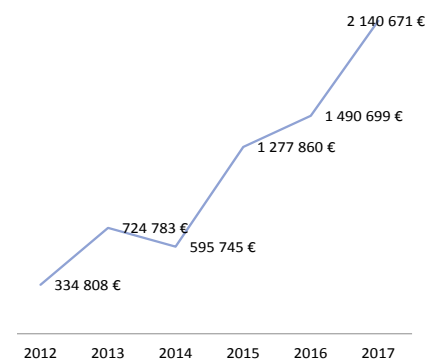
2 140 000 € in funding and endowments were allocated in 2017

Of which **625 000 €** was provided by the original LabEx framework (Investissement d'avenir and ÉS)

And **1 515 000 €** came from French and European research projects (ANR Cantare, ADEME EGS Alsace, H2020 EPOS-AH, H2020 DESTRESS, Storengy/Engie, Co-GeoS Prestations)

ANR LabEx	364 525 €
CoGeoS LabEx ES	260 218 €
CoGeoS Prestations	200 980 €
ADEME EGS Alsace	312 805 €
ANR Cantare	245 398 €
H2020 EPOS	60 962 €
H2020 Destress	634 783 €
Storengy/EPI	61 000 €
TOTAL	2 140 671

6 500 000 € in endowments and funding since 2012, reflecting a sustained increase in funding over time



2018 PROJECTS

EGW 2018 (European Geothermal Workshop) in Strasbourg, France

The LabEx, in partnership with KIT and under the aegis of the EERA, will organize the 6th annual EGW. More than 130 scientists, PhD students, and experts from around the world will present their work and discuss breakthroughs in geothermal energy research.



4 large projects in 2018-2019

- The development of the Citizens Seismicity network (seismology and social sciences)
- The acquisition of an XRF microprobe (geology)
- The setup of the DENSAR - DENSe Seismic ARray - platform (seismology)
- The last phase of the Data Center for Deep Geothermal Energy (CDGP)