SCCER SoE

SWISS COMPETENCE CENTER for ENERGY RESEARCH
SUPPLY of ELECTRICITY

SCCER-Supply of Electricity

Results from Geothermie 2020

Luca Guglielmetti

In cooperation with the CTI

Energy
Swiss Competence Centers for Energy Research

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Confederation

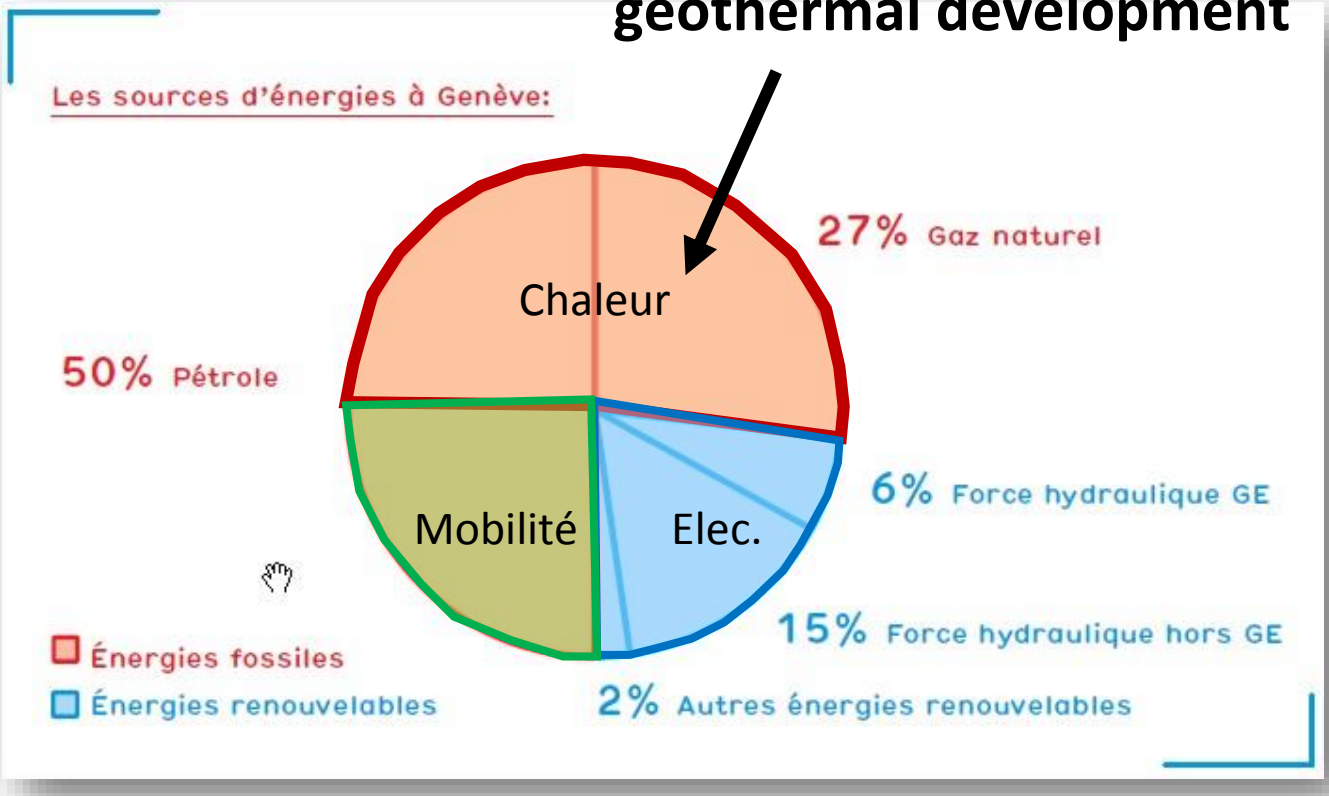
Commission for Technology and Innovation CTI

1. Introduction
2. Geophysics
    1. VSP Thonex
    2. Natural Seismicity Monitoring
    3. Gravity
3. Drilling Program
    1. GEo-01 well
4. Other projects

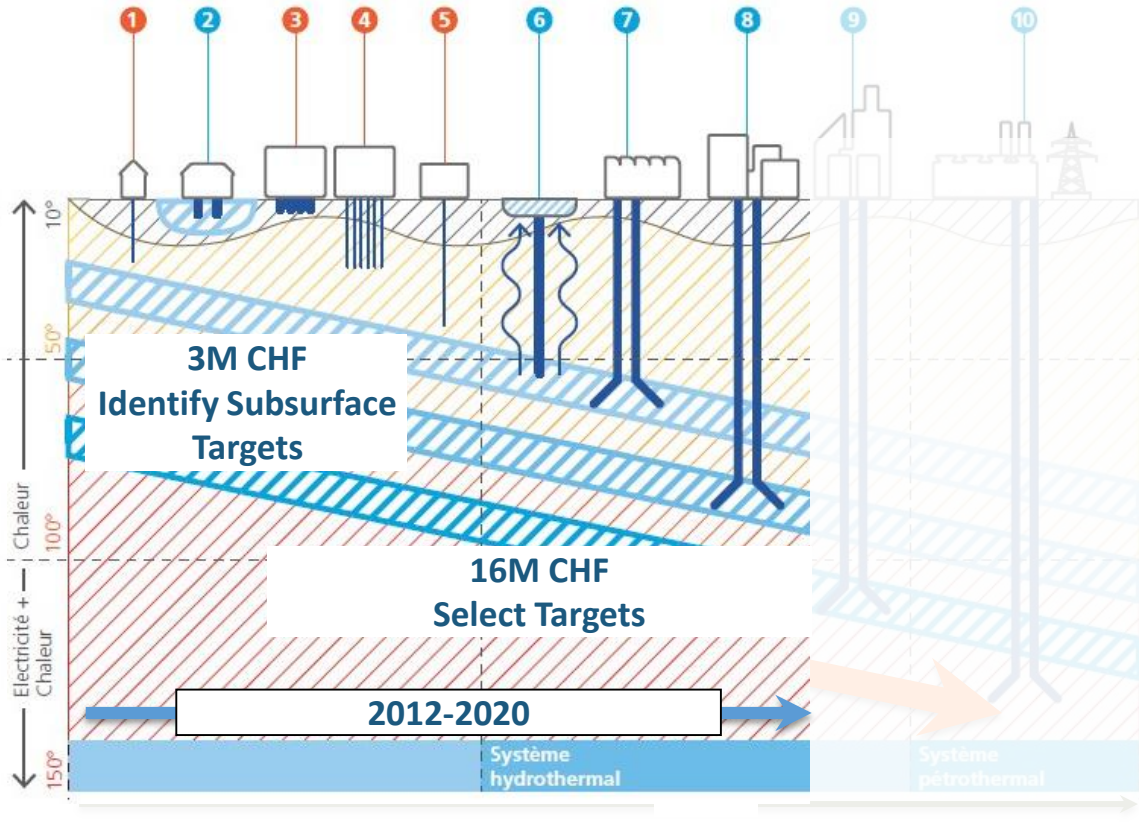
1. Introduction

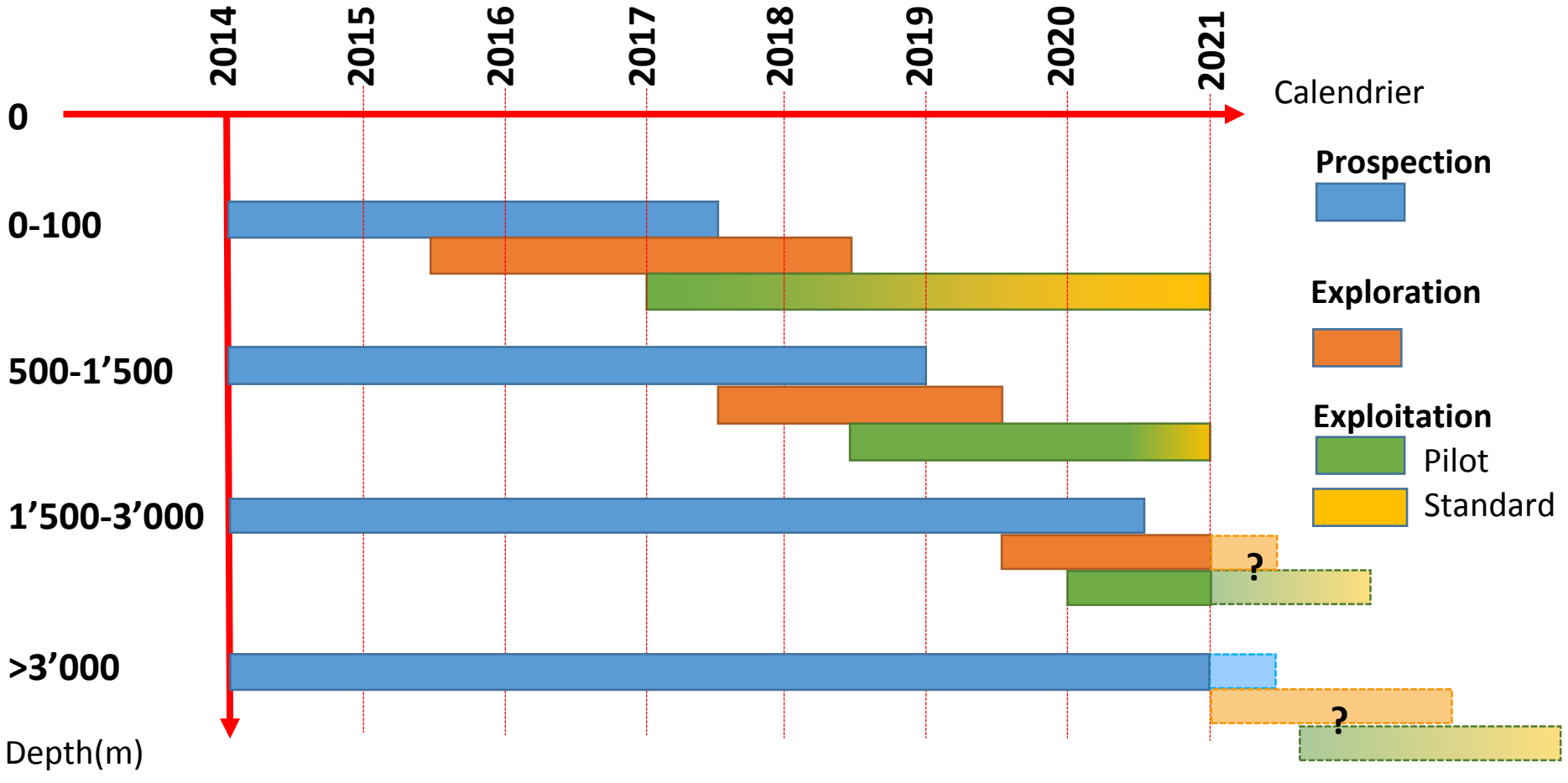
- Strong fossil fuels dependancy
- 90% of energy is produced outside the Canton

HIGH PRIORITY for geothermal development

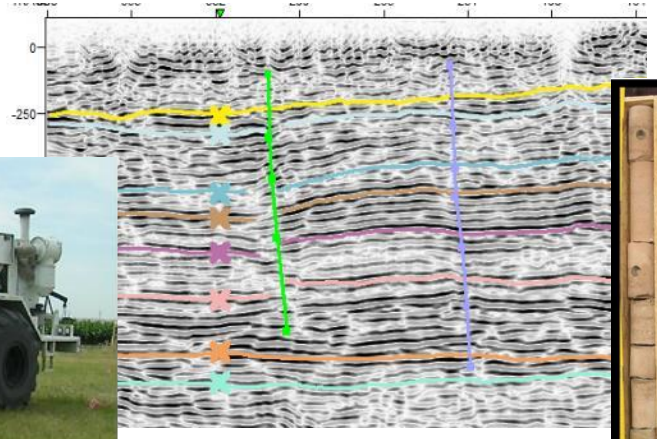


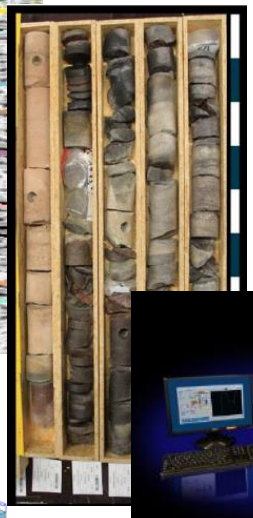
GEothermie 2020: a Stepwise Approach

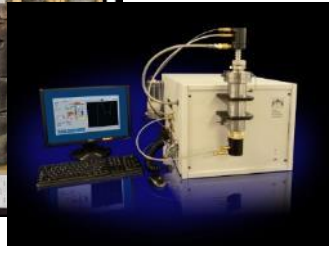


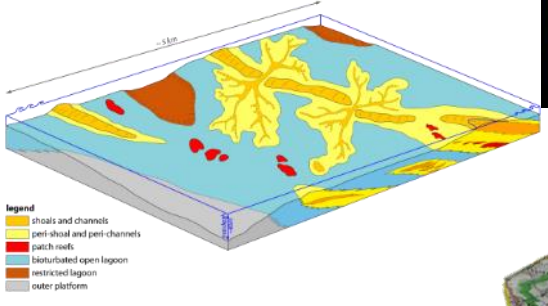

2014
2015
2016
2017
2018
2019
2020
2021
Calendrier
0
0-100
500-1'500
1'500-3'000
>3'000
Depth(m)
Prospection
Exploration
Exploitation
Pilot
Standard
?
?

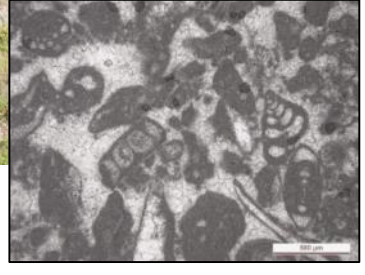
Prospection

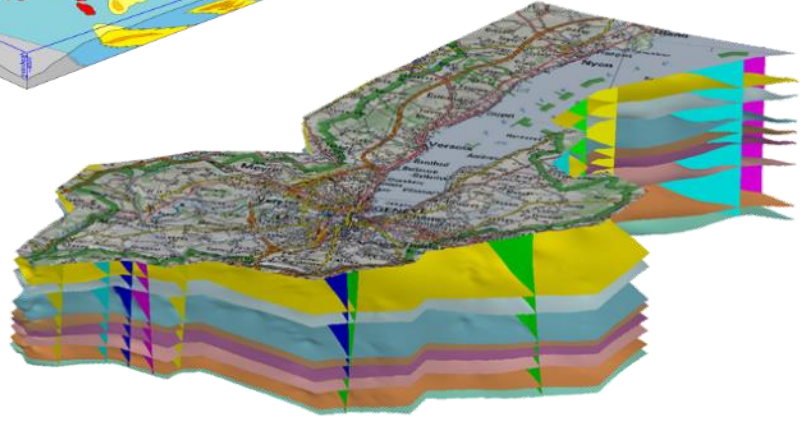


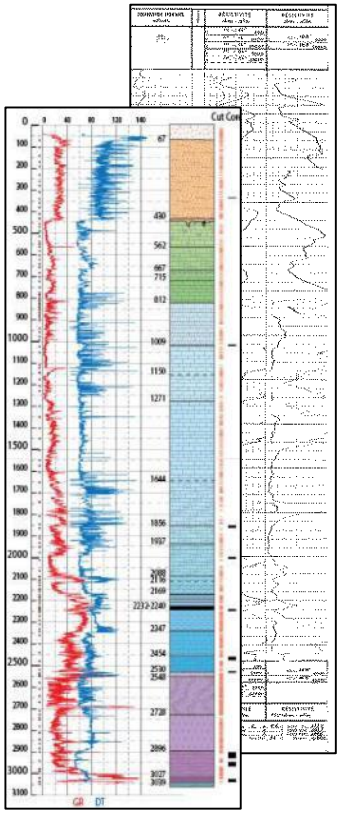




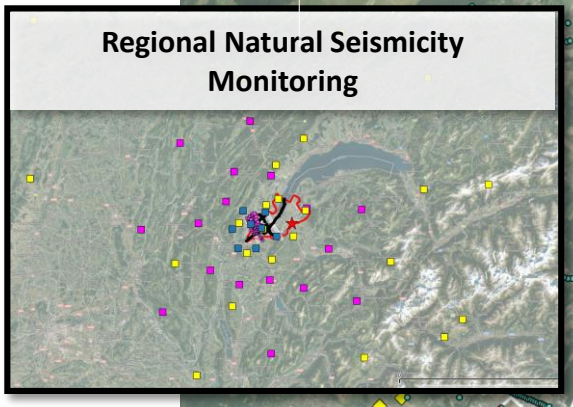








Ongoing Geophysical Acquisition and Integration with existing data



Satigny:
- Gravity: 50 stations
- 2D RS reprocessing and reinterpretation
- 1st Exploration well (650m)

Thonex:
- VSP and Geochemistry (**IMAGE FP7**)
- Gravity: 180 new stations
- 2D RS reprocessing and reinterpretation

Allondon:
- CSEM (**IMAGE H2020**)
- Gravity: 150 new stations
- 2D RS reprocessing and reinterpretation

Bernex (**GECOS KTI Project APPROVED in Sept 2017**)
- Gravity: 750 new stations
- 2D RS reprocessing and reinterpretation ongoing
- S-waves Active Seismic in 2018
- 3D DAS VSP in 2018

2. VSP Thonex

VSP Thonex

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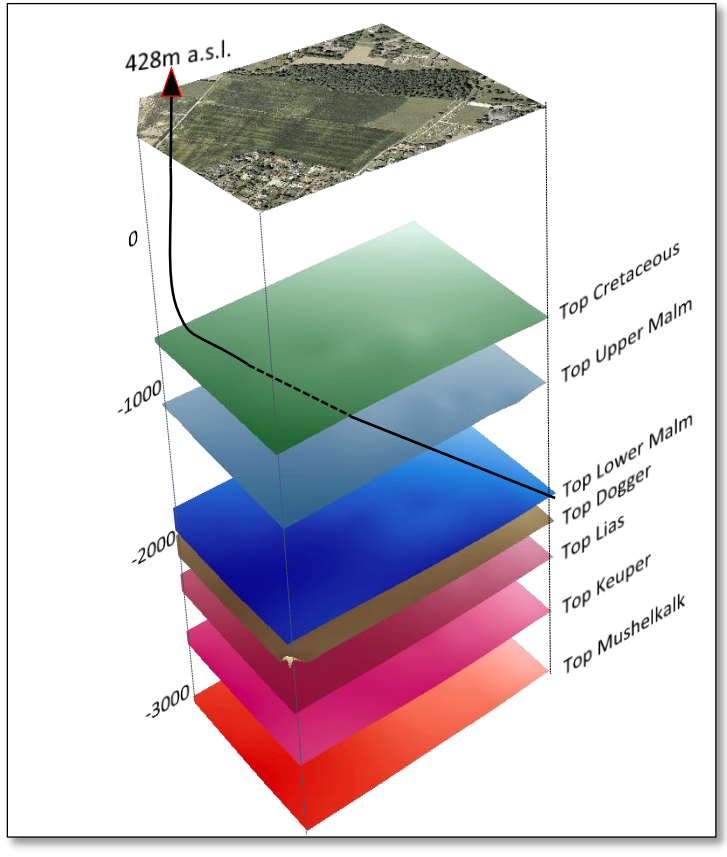
IMAGE

UNIVERSITÉ DE GENÈVE
FACULTÉ DES SCIENCES
Earth and Environmental Sciences

ETH Zürich

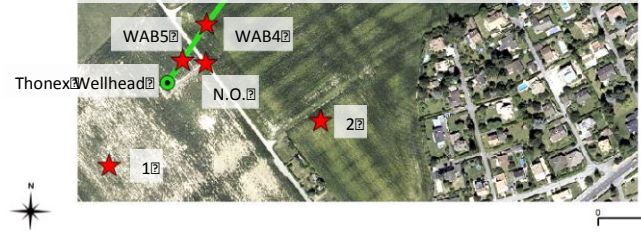
brgm
Géosciences pour une Terre durable

OGS



Goals

- Acquire a detailed velocity model to improve the GeoMol 3D Model
- Characterize the carbonate formations
- Highlight fault zones
- Develop an acquisition approach which can be applied for further wells



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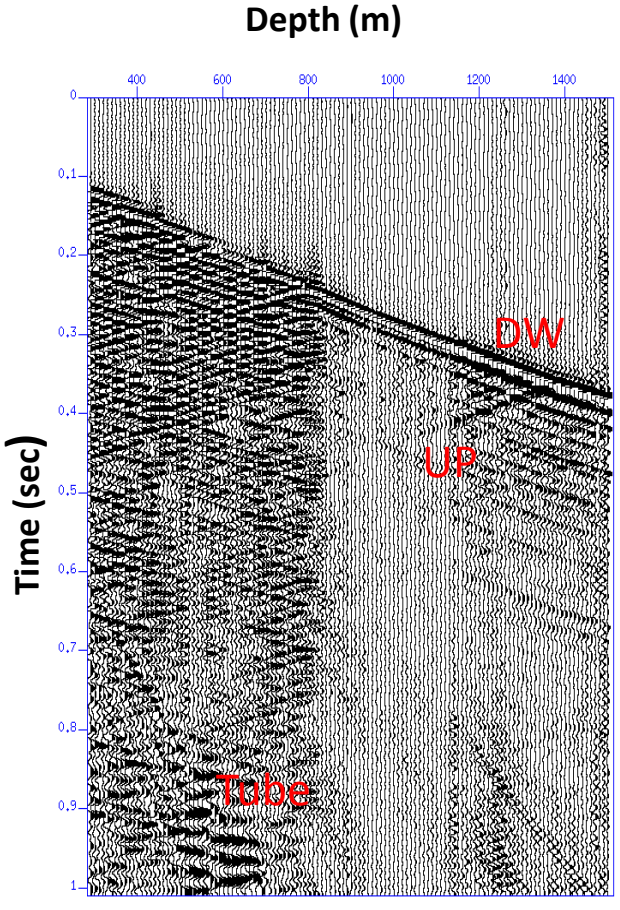
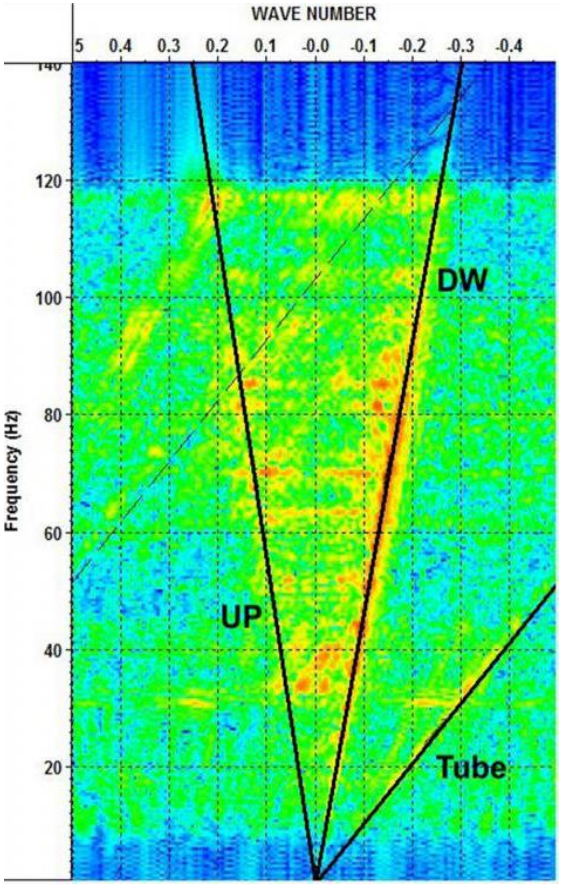
SIG

Thonex VSP acquisition

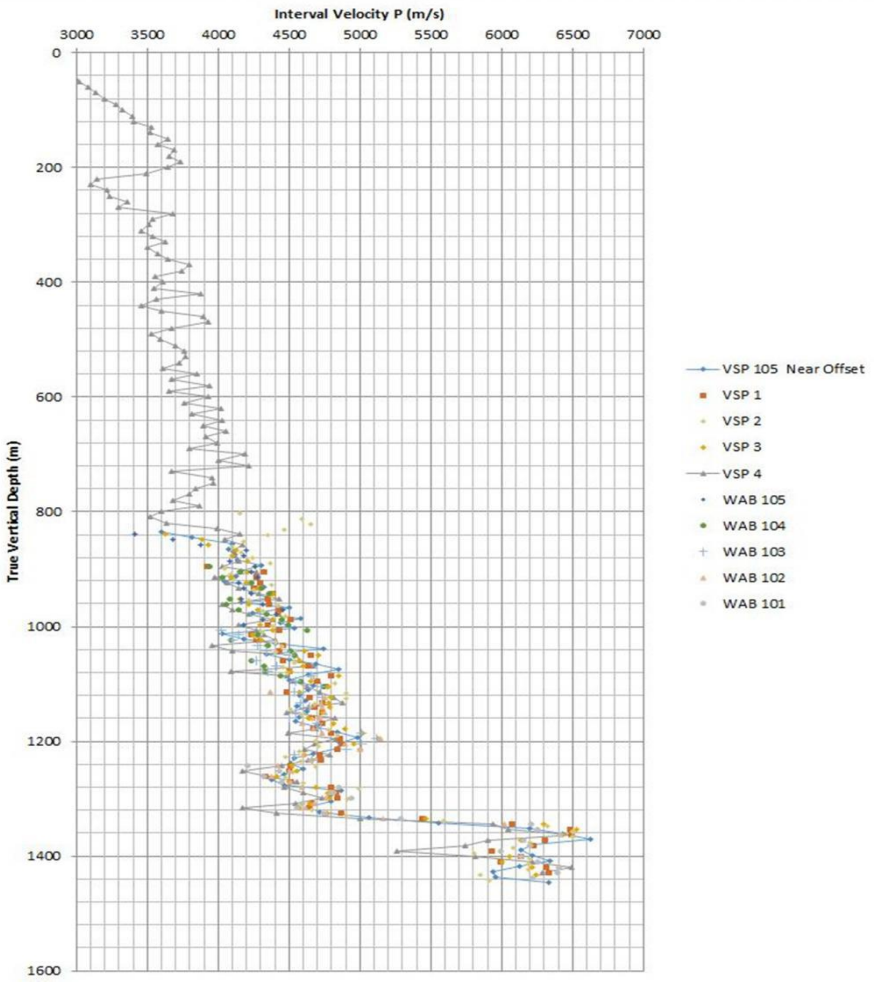




DW- Down-going wave
UP- Up-going wave

- Good quality data below 800m depth (0.25ms)
- Poor quality data above 800: condition of the casing or cement bond

Velocity analysis



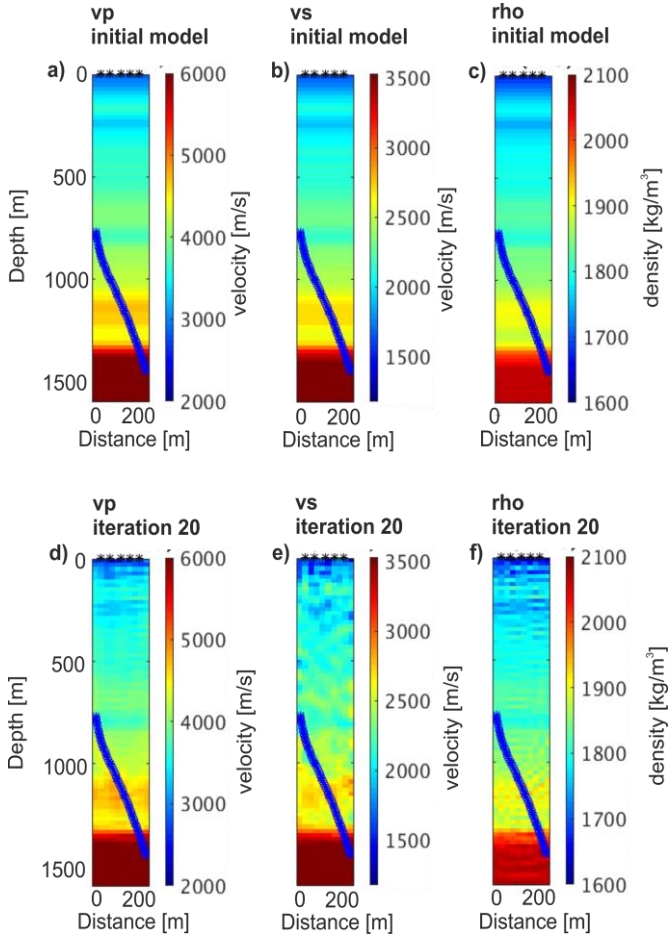
Tertiary Molasse

Cretaceous

WALK-ABOVE

Superposition of depth conversion Thonex-2 reflection seismic line with pre-stack depth migration of WAB, NOFF and VSP1

Full waveform inversion (ETHZ)



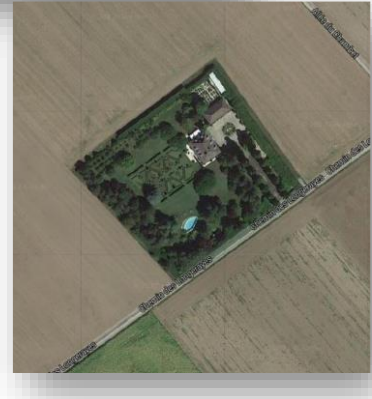
(a-c) Initial models and (d-f) inversion results for P-wave, S-wave and density after 20 iterations, respectively. The velocity model evolves with the inversion and small scale structures can be observed in the final models.

3. Natural Seismicity Monitoring

Natural Seismicity Monitoring (in callaboration with SED and CERN)

Sevaral ongoing projects:

1) Permanent Network
2) Temporary Network
3) FNS project



Natural Seismicity Monitoring (in callaboration with SED and CERN)

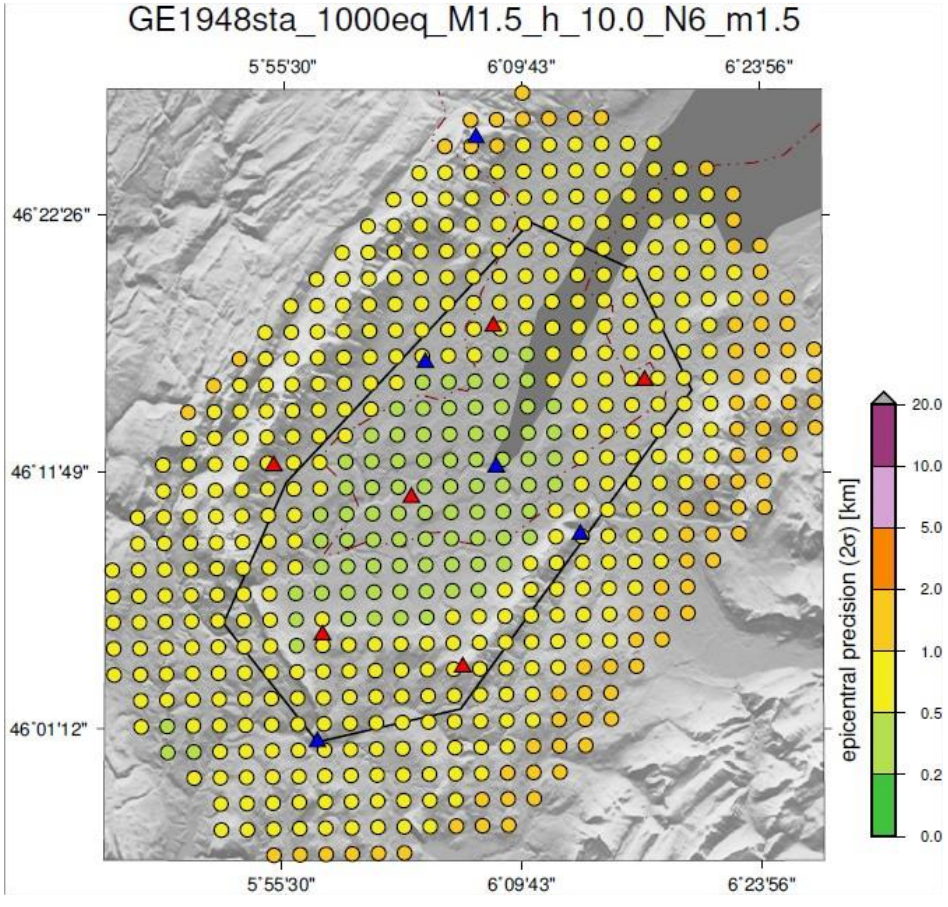
Sevaral ongoing projects:

1) **Permanent Network**
2) Temporary Network
3) FNS project

- 2 new station installed by SED
- Integration to the French et VD networks
- Installation of 6 new stations by UniGe
- Coordination with CERN network

- 5 years minimum

- Collaboration with SED

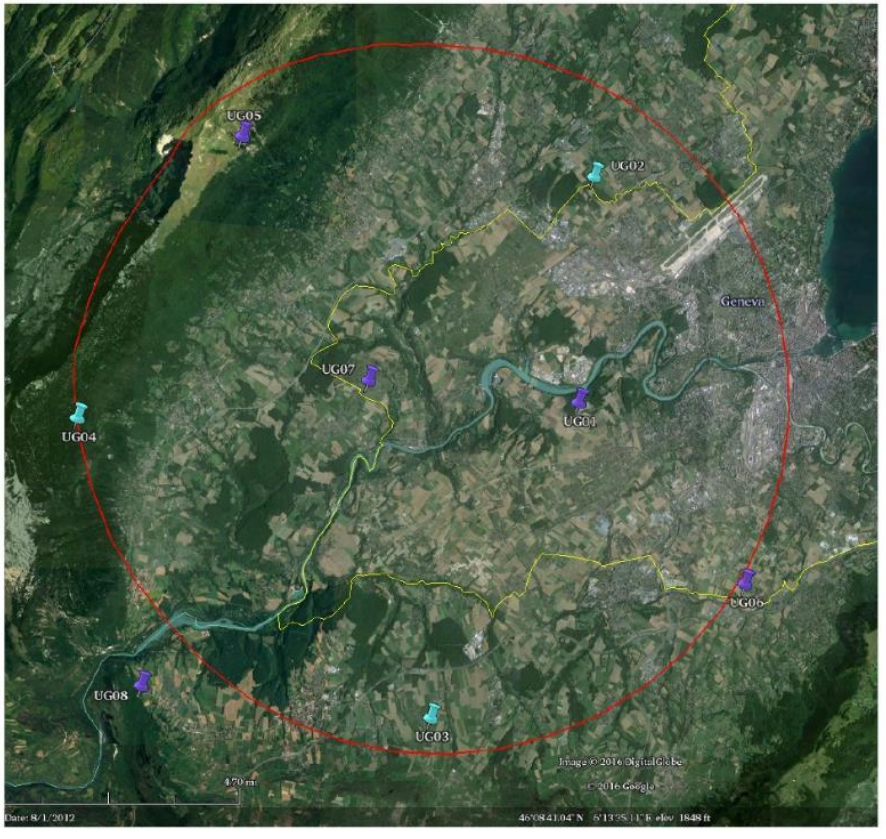


Natural Seismicity Monitoring (in callaboration with SED and CERN)

Sevaral ongoing projects:

1) Permanent Network
2) **Temporary Network**
3) FNS project

- PhD research project (Véronica Antunes) funded by SIG
- 8 new stations installed by SIG and UniGE
- 6-12 months acquisition
- Easy to move station to specific locations in case of seismic events
- Focus on regional faults

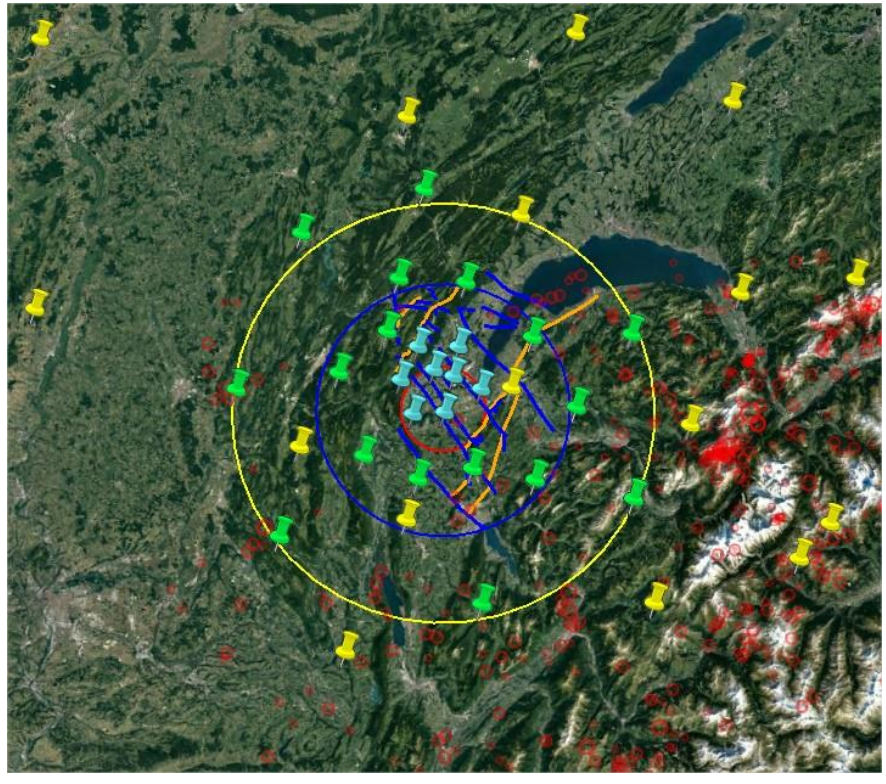


Natural Seismicity Monitoring (in callaboration with SED and CERN)

Sevaral ongoing projects:

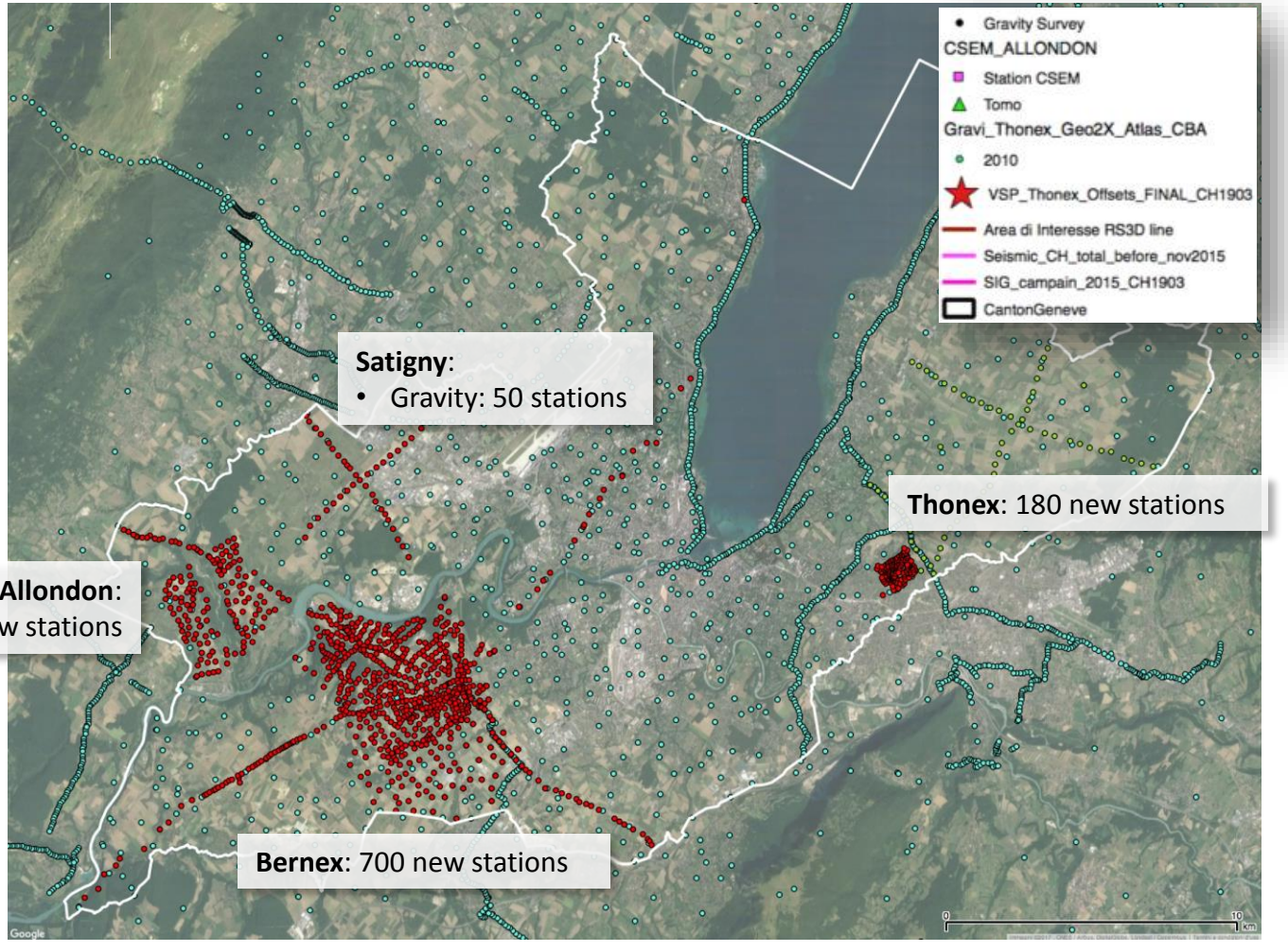
1) Permanent Network
2) Temporary Network
3) **FNS project**

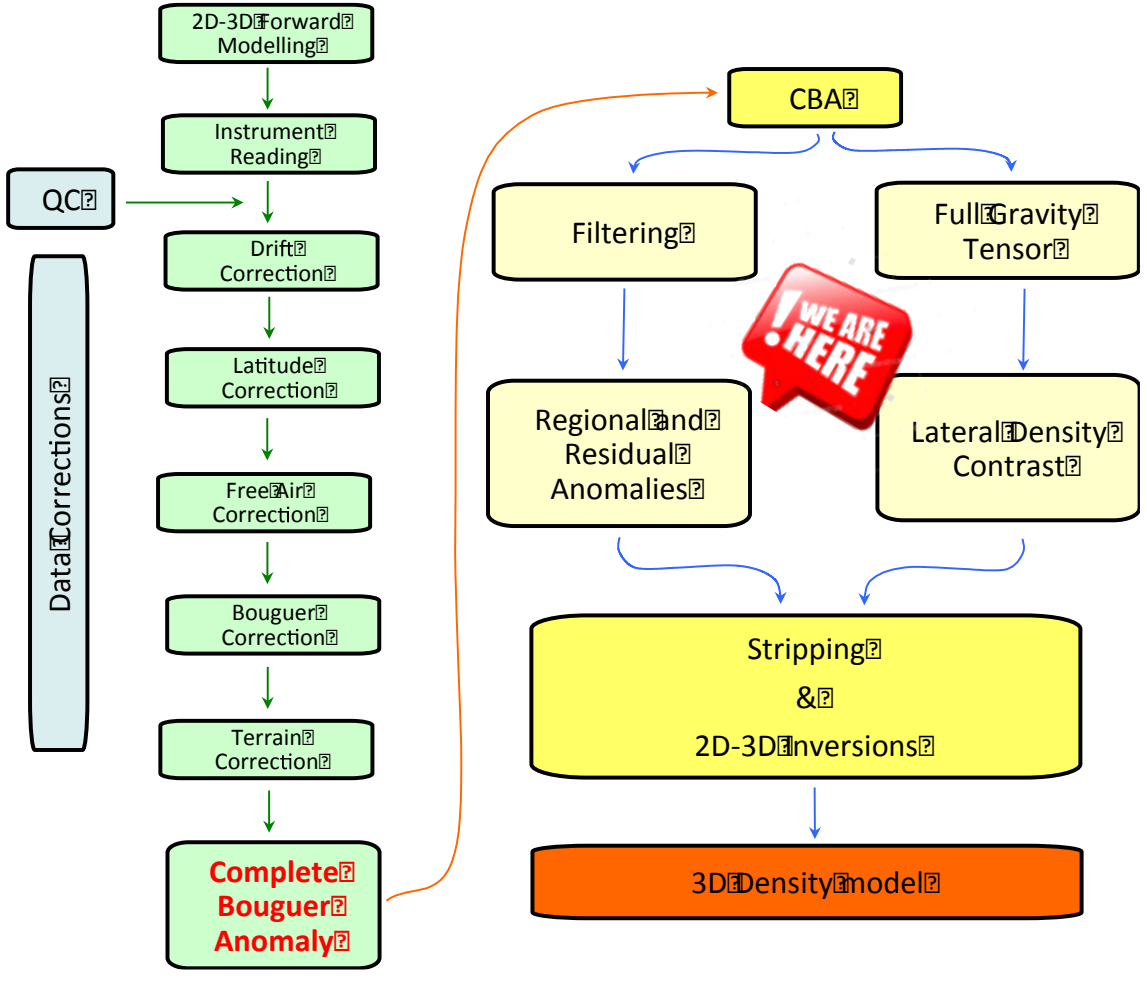
- Projets funded by FNS (2 PhD + 2 Post-doc)
- 24 installed stations by UniGE
- Mobile Network
- Projet GENERATE: *GEophysical and Numerical Experiments for Reservoir Analysis and fluid-Transported Energy*

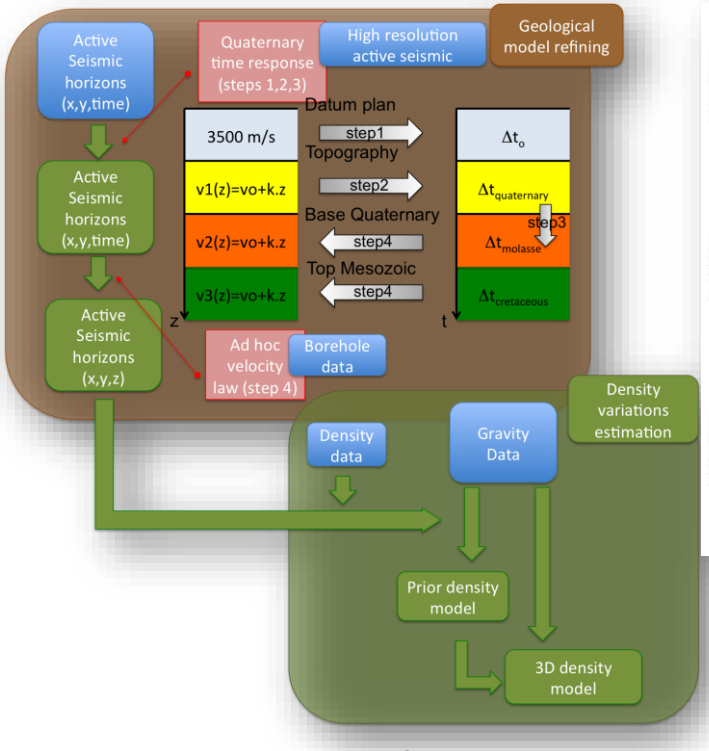


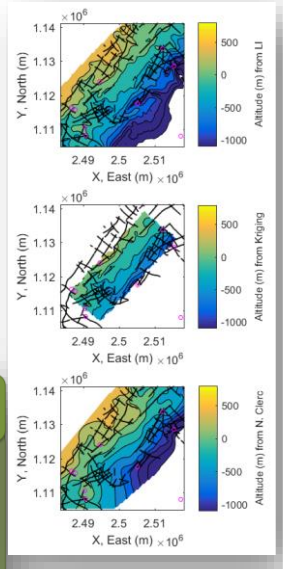
4. Gravity

Gravity

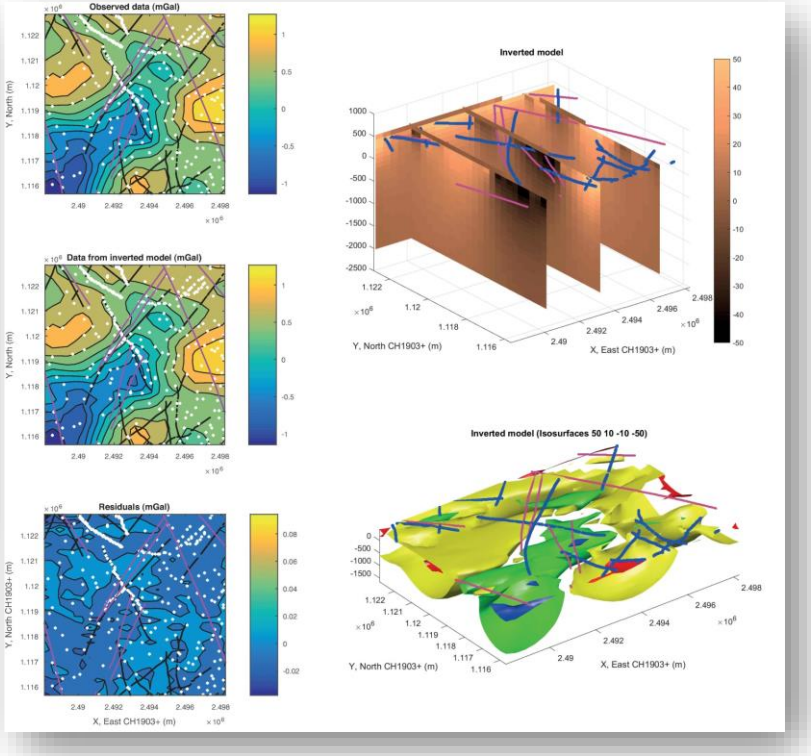

Gravity Survey
CSEM_ALLONDON
Station CSEM
Tomo
Gravi_Thonex_Geo2X_Atlas_CBA
2010
VSP_Thonex_Offsets_FINAL_CH1903
Area di Interesse RS3D line
Seismic_CH_total_before_nov2015
SIG_campain_2015_CH1903
CantonGeneve
Satigny:
• Gravity: 50 stations
Thonex: 180 new stations
Allondon:
150 new stations
Bernex: 700 new stations


2D-3D Forward Modelling
Instrument Reading
QC
Drift Correction
Latitude Correction
Free Air Correction
Bouguer Correction
Terrain Correction
Complete Bouguer Anomaly
Data Corrections
CBA
Filtering
Full Gravity Tensor
WE ARE HERE
Regional and Residual Anomalies
Lateral Density Contrast
Stripping & 2D-3D Inversions
3D Density model



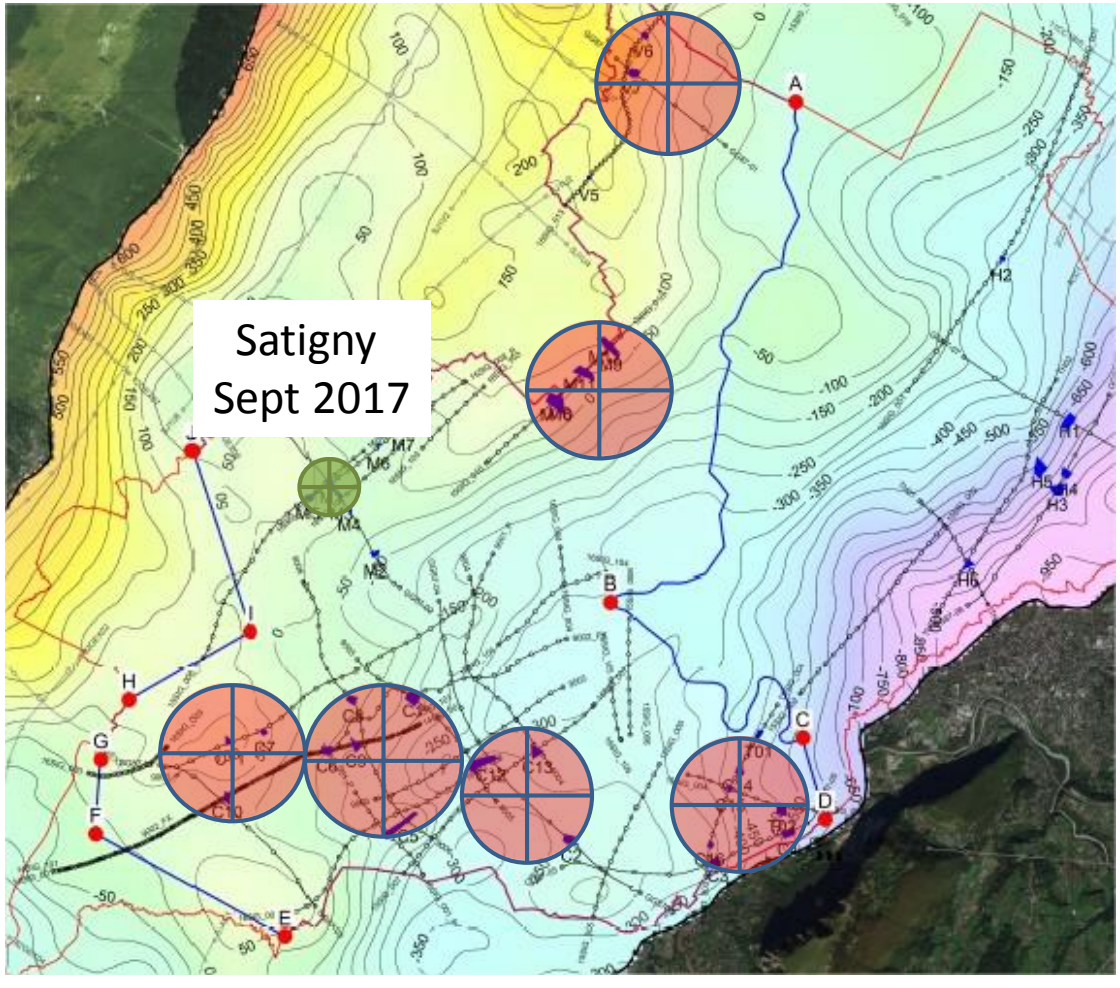


Top Mesozoic depth from linear velocity law, improved kriging and GeoMol project



Inversion results and 3D density variations in Satigny area

5. Drilling program



Lignes sismiques

Altitude du Sommet calcaire

Cibles identifiées

1er forage

Forages explo. potentiels

Cibles identifiées lors de la prospection et calcaires peu profonds <1'500 m

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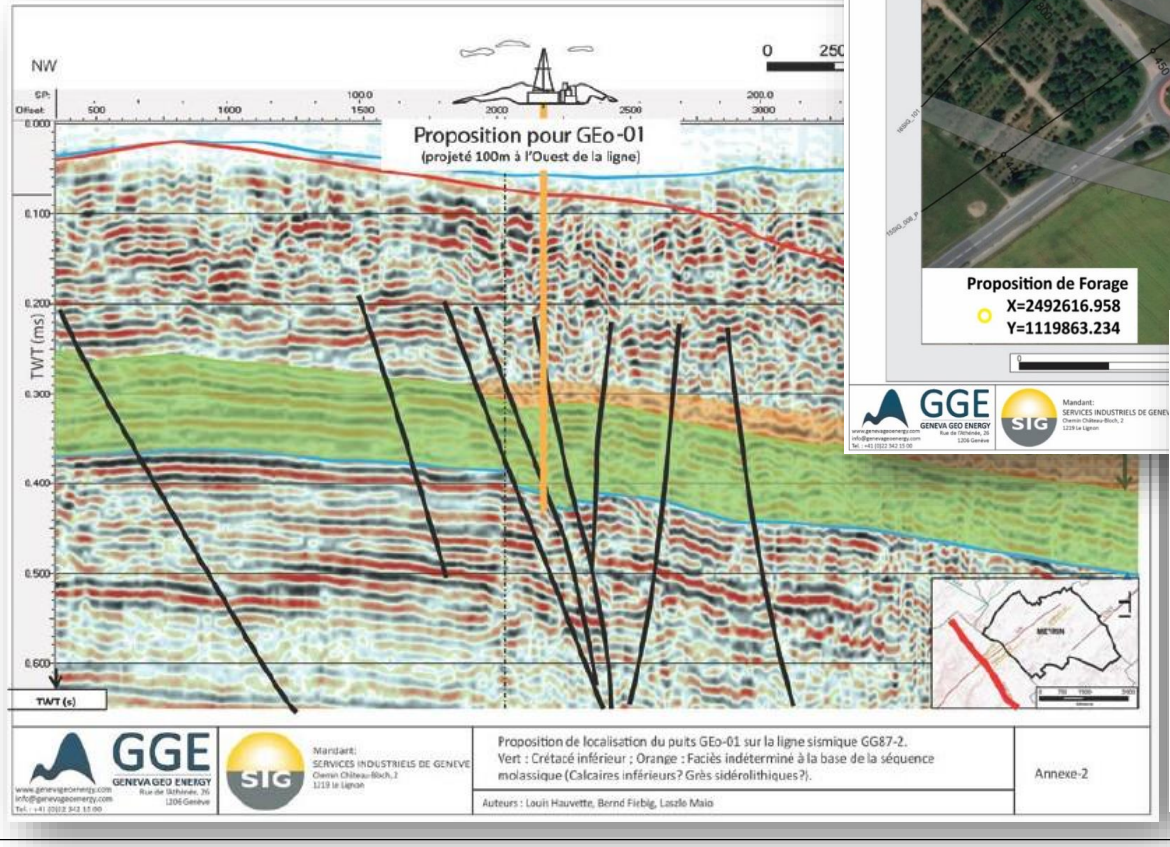
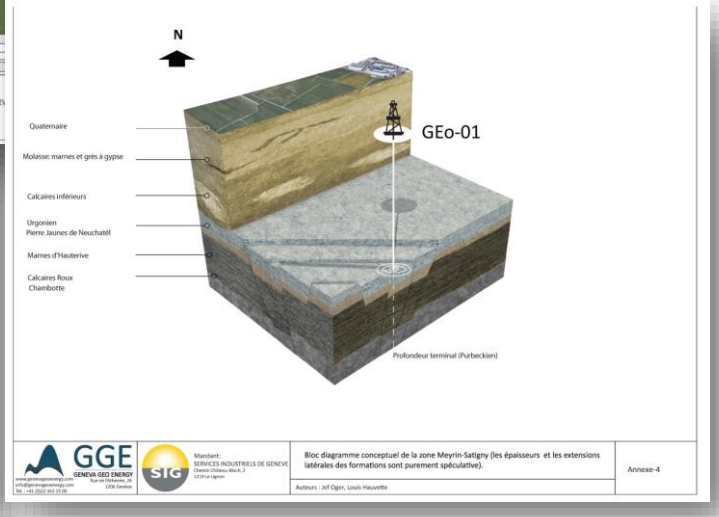
Reprocessing and reinterpreattion of available seismic lines in the Satigny area





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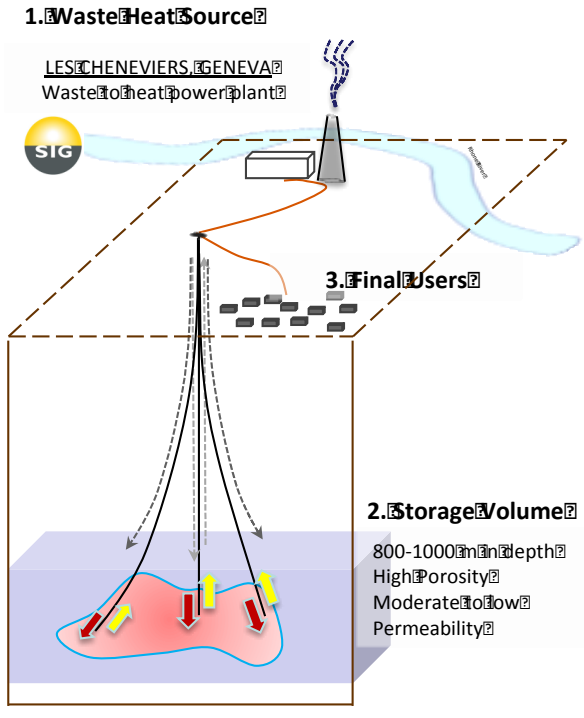
POST TENEBRAS LUX

SIG

6. Other Projects

CTI – Approved three days ago

ATES Project GECOS TEST CASE



GECOS: GEO-ENERGY CHANCE OF SUCCESS

"Reducing costs & risks of ATES projects"

WHY?

Successful ATES projects require **high-accuracy** knowledge of the subsurface. This is typically obtained by standard geophysical surveys which high costs can hinder the economic feasibility of ATES projects.

The **risks** associated with ATES projects are therefore typically related to both subsurface uncertainties and high exploration costs.

HOW IT WILL WORK:

GECOS will combine

- Cost-effective and innovative geophysical data collection (Gravity, S-wave Seismic, 3D DAS VSP)
- Uncertainty quantification and geological risk assessment by a customer tailored software platform

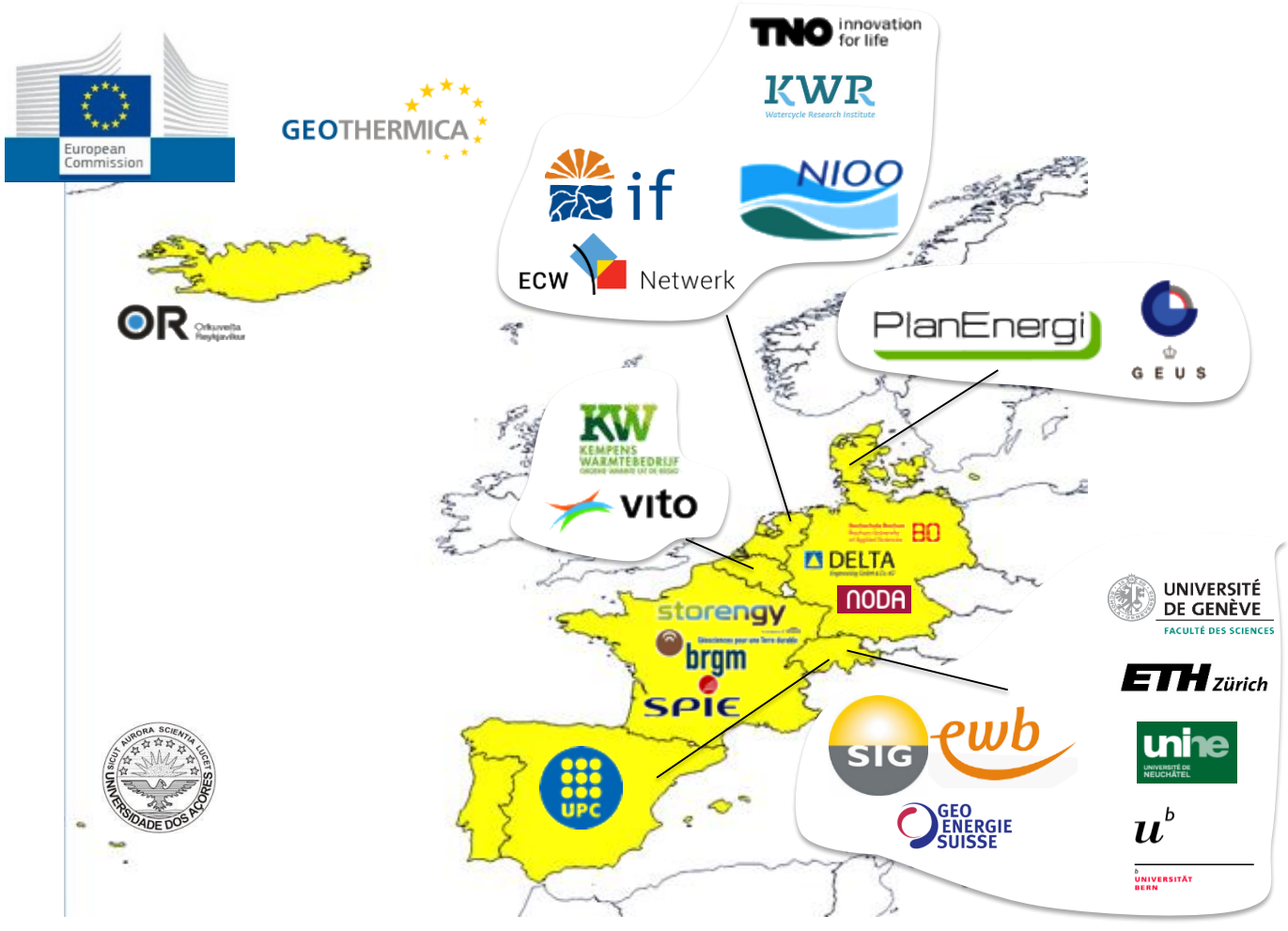
THE PLAYERS

Geo2X (Geophysics for Geology): Project management, gravity, S-wave data acquisition and software development and market uptake

SIG: 3D DS VSP data acquisition on the pilot site in Les Cheneviers

Université de Genève, Faculté des Sciences: UniGe: Project management, Data interpretation, uncertainty & risk assessment

ETH Zürich: ETHZ: Data processing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European Commission
GEOTHERMICA
TNO innovation for life
KWR
Watercycle Research Institute
if
NIOO
ECW Netwerk
OR
PlanEnergi
GEUS
KW
KEMPENS WARMTEBEDRIJF
vito
BO
DELTA
NODA
storengy
brgm
SPIE
UPC
SIG
ewb
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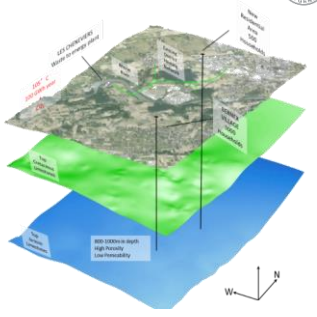
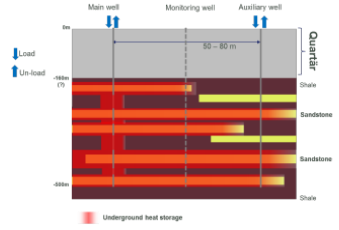
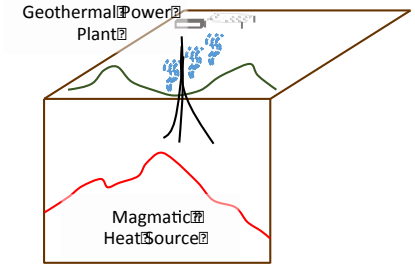
ATES Systems in Geneva and Bern





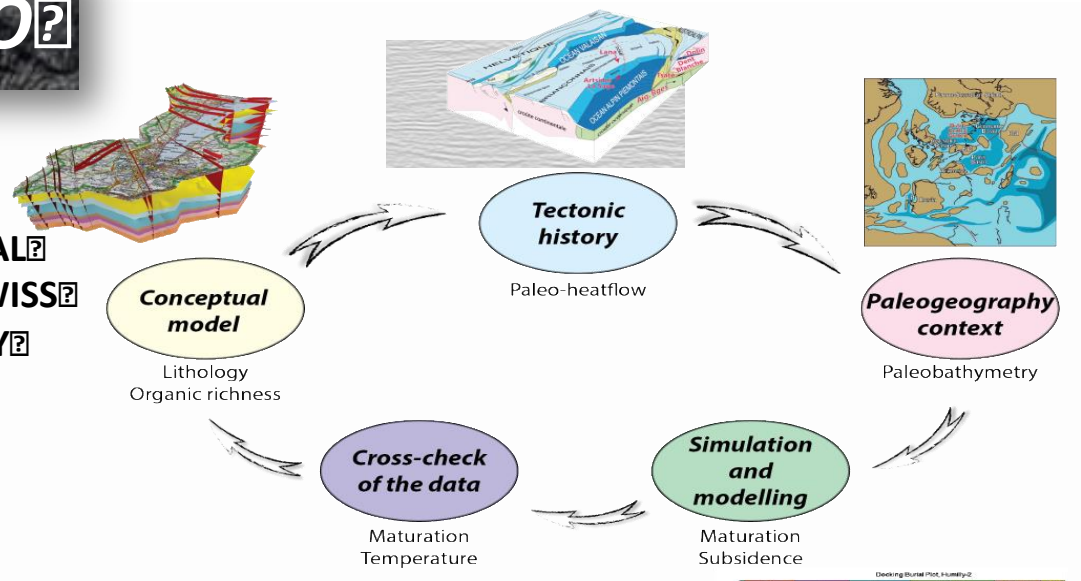
Reservoir Modelling Case Studies in different Scenarios



Iceland

Azores

UNCONGEO



DE-RISKING GEOTHERMAL EXPLORATION IN THE SWISS MOLASSE SEDIMENTARY BASIN

6 YEARS

FOCUS ON RESERVOIR/SEAL PAIRS & HYDROCARBON OCCURRENCE ACROSS THE ENTIRE SWISS MOLASSE BASIN.

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Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Confederation

Swiss Federal Office of Energy SFOE

swisstopo

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