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GEOTHERMIE 2020

SIG

A seismotectonic study and minimum 1D velocity model for the Greater Geneva Basin, Western Switzerland (16519)

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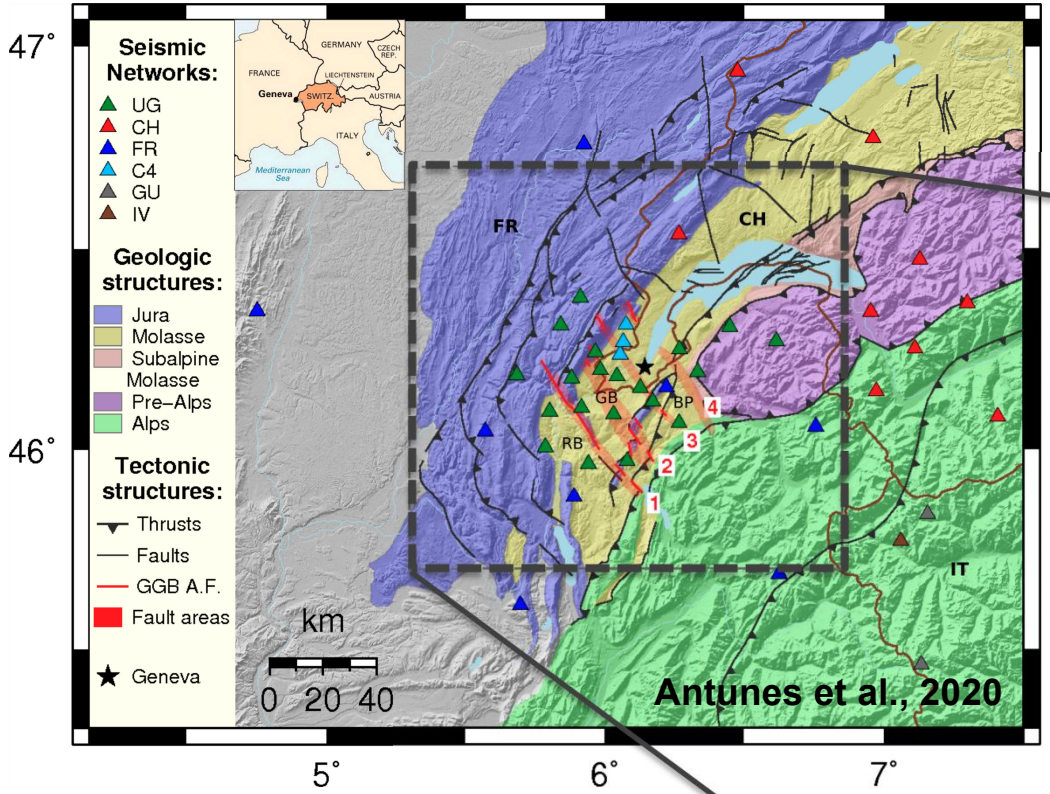
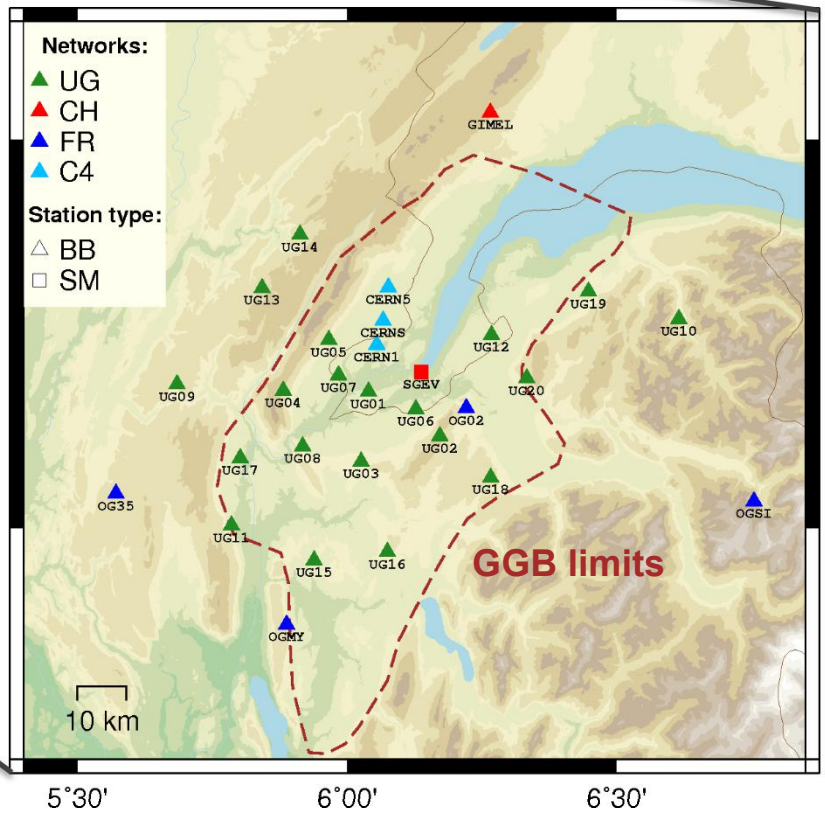
INTRODUCTION



Fault areas: 1 - Vuache; 2 - Cruseilles; 3 - Le Coin; 4 - Arve.

AIM: **Seismic monitoring before geothermal activities start in the Greater Geneva Basin (GGB) with a new temporary network (UG) composed of 20 broadband stations.**

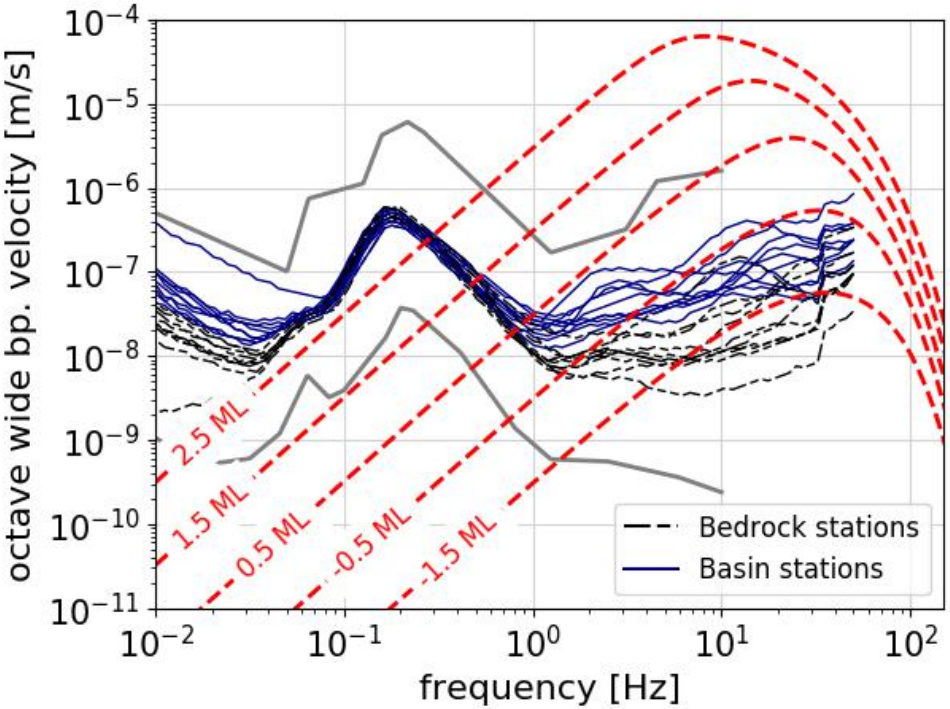


Temporary Network (UG):

- Investigate the ongoing seismic activity,
- Relationship of seismicity with local faults;
- Large-scale kinematics of the area.

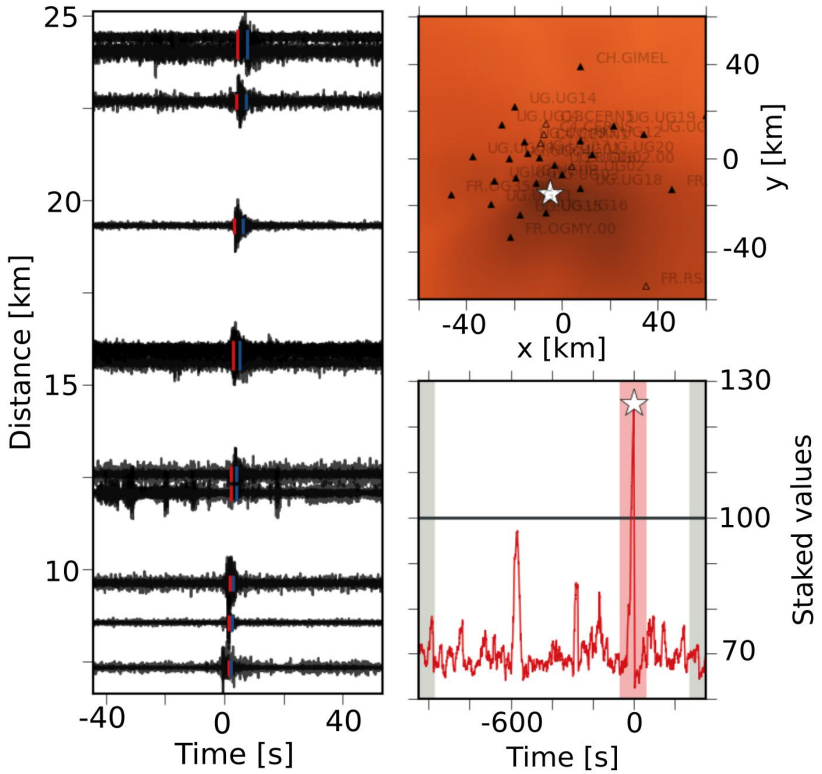
DETECTION THRESHOLD

Background noise level all UG stations
Power spectra density (PSD)
Theoretical Brune
S-wave source spectra (7km)



Antunes et al., 2020

Event Detection (LASSIE[1])
M_L0.8 (Cruseilles Fault)
18-02-2017 23:16 (UTC)



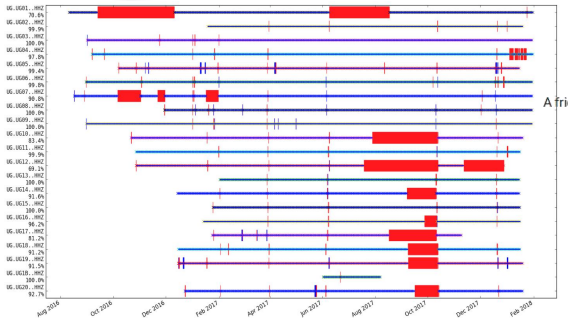
Antunes et al., 2020

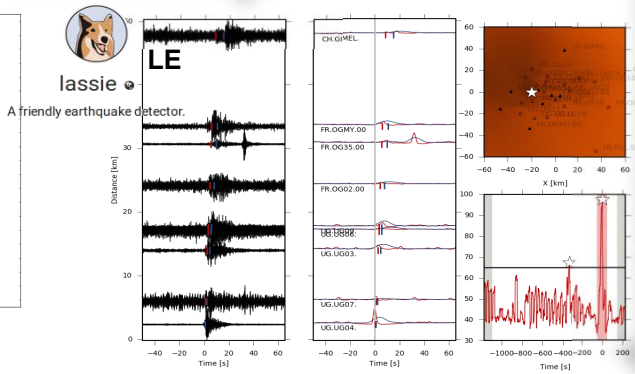
> M_L0.5

[1]https://gitext.gfz-potsdam.de/heimann/lassie

SEISMIC CATALOGUE

RAW DATA → OBSPY²/PYTHON → **CONVERSION** → LASSIE¹ → **DETECTION**





SEISAN³

MAGNITUDE ← OBSPY²/PYTHON ← **IDENTIFICATION AND LOCATION**

SED (Kradolfer, 1984)

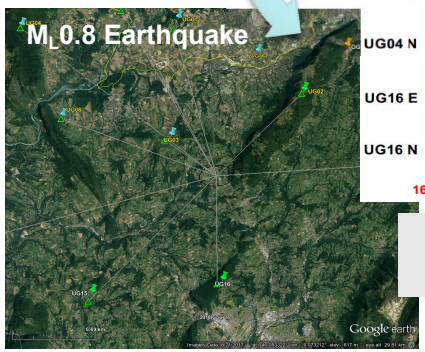
$$M_L = \log(A_{WA}) + 0.0180 * D + 1.77 \quad \text{for } D \leq 60 \text{ km}$$

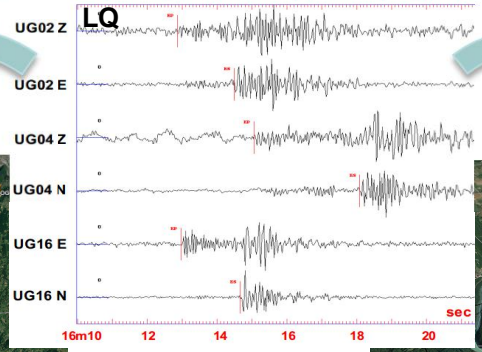
$$M_L = \log(A_{WA}) + 0.0038 * D + 2.62 \quad \text{for } D > 60 \text{ km}$$

D > 15 km

PRELIMINARY CATALOGUE

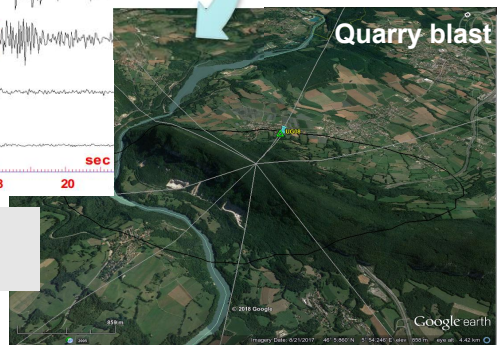
LQ





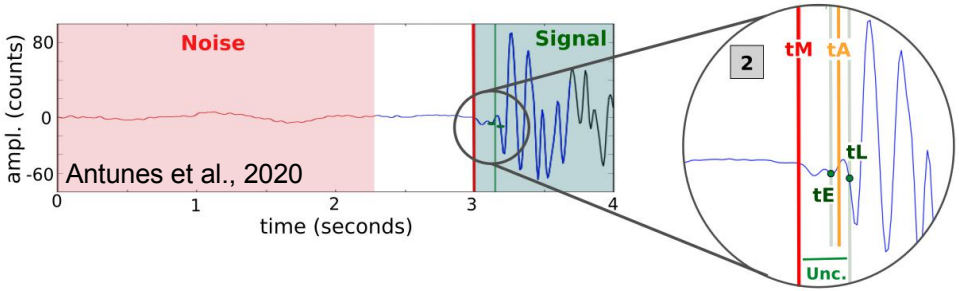
Velocity Model
Husen et al. (2003)

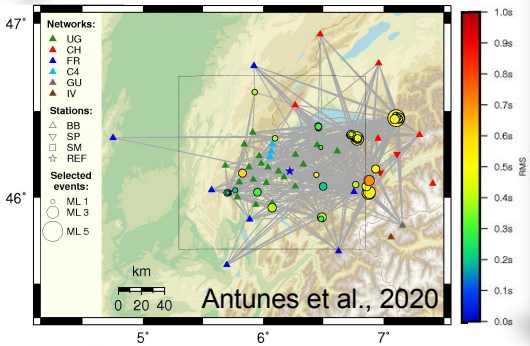
LE

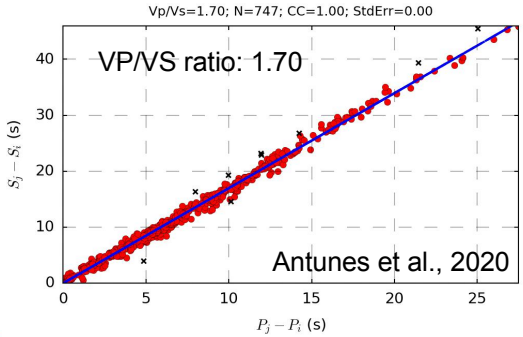


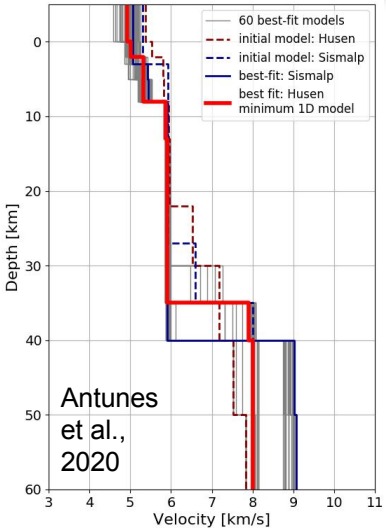
VELOCITY MODEL

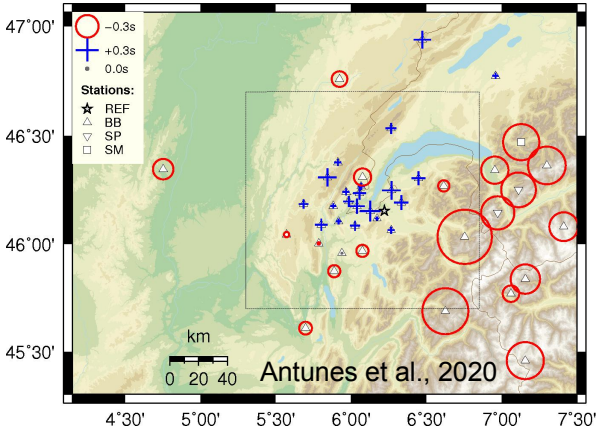
PRELIMINARY SEISMIC CATALOGUE → OBSPY²/PYTHON → **PICK QUALITY** → **SELECTED EVENTS** → VELEST⁴ → **VELOCITY MODEL** → SEISAN³ → **RELOCATION** → OBSPY²/PYTHON → **MAGNITUDE** → **RELOCATED CATALOGUE**











STRESS INVERSION

Focal mechanisms CSPS[5]:
- Polarities (FOCMEC)
- Waveform inversion (ISOLA)

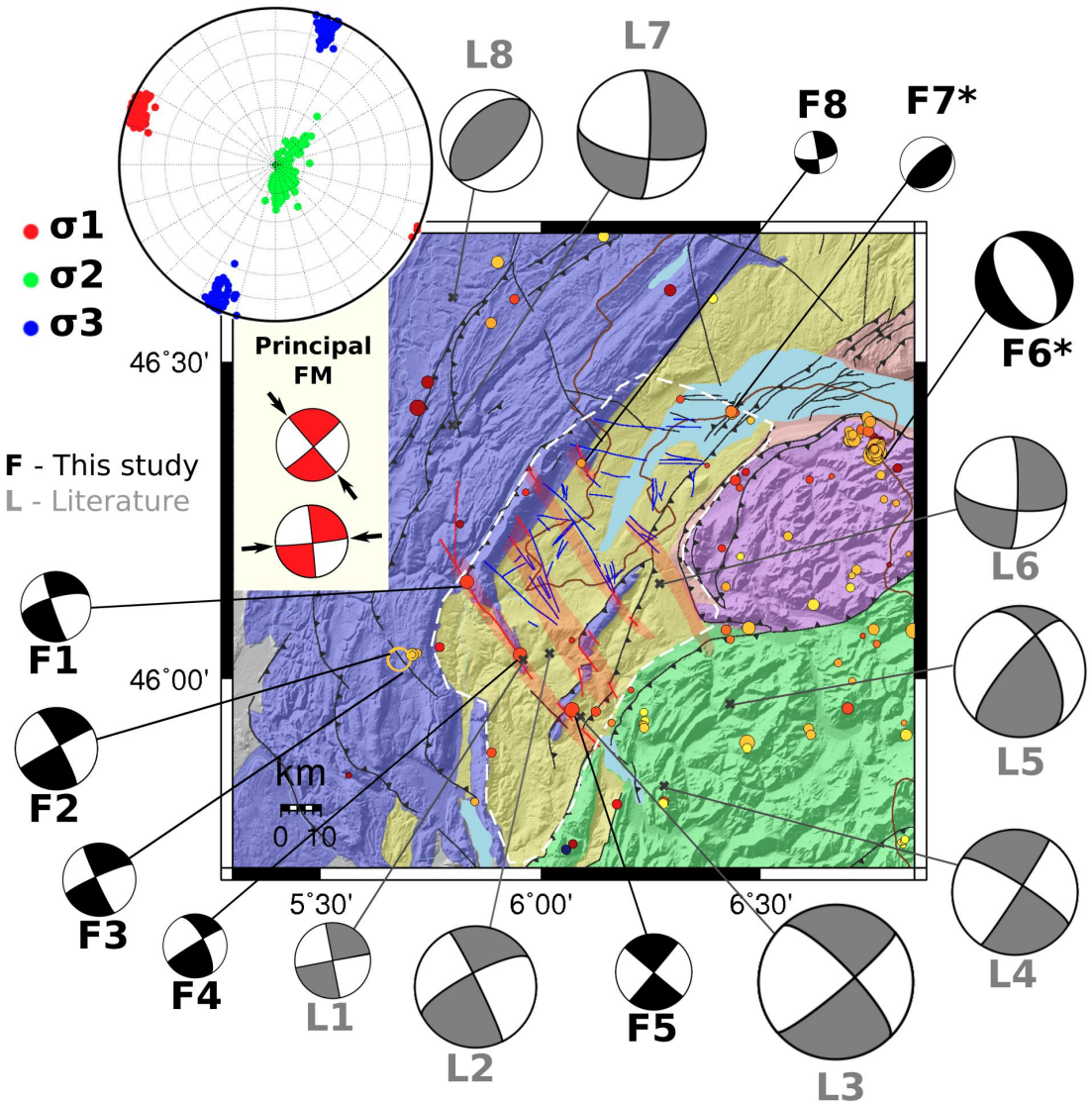
F (Antunes et al., 2020)
L (Kastrup et al., 2004)

Stressinverse[6]:
*excluded from stress inversion >> high uncertainties.

- 17 earthquakes in the GGB, 20 considering the ones close to the GGB limits (white dashed line)

- σ_1 sub-parallel to the principal faults: high possibility of active fault or fault reactivation.

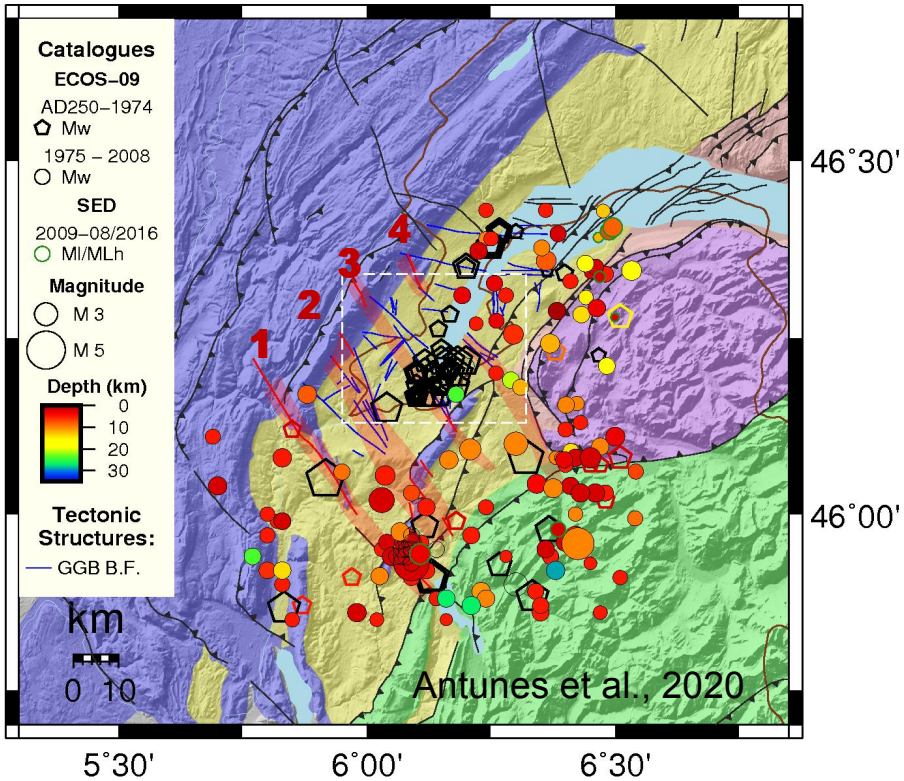
Strike-Sip regime



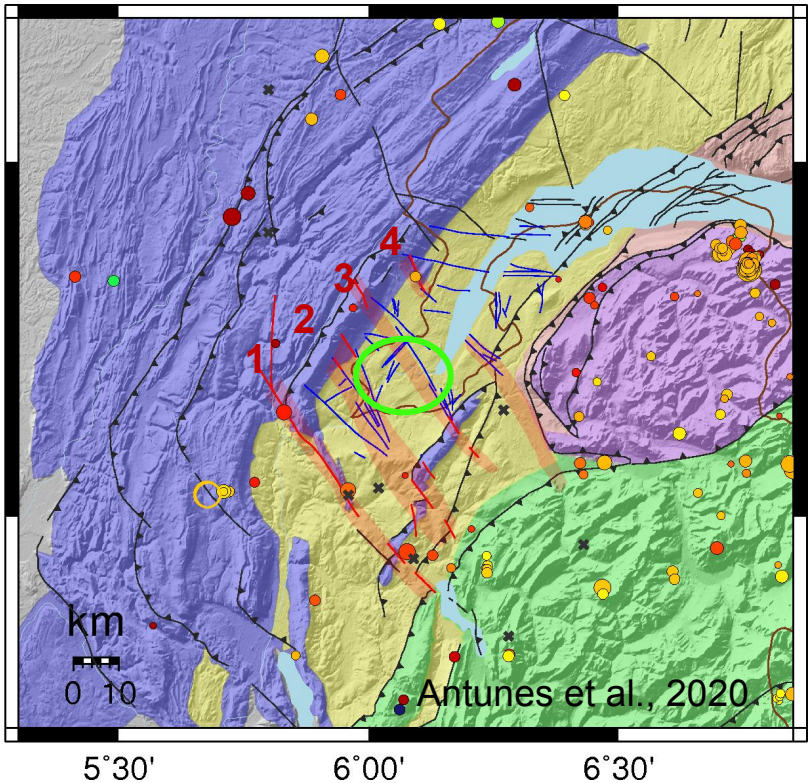
Antunes et al., 2020

CONCLUSION

Background seismicity[7,8]



1.5 years with dedicated network



- **Active seismogenic faults:** 1.Vuache, 2.Cruseilles, 4.Arve (some seismicity associated); 3.Le Coin (?)
- **SW of the canton of Geneva:** most seismically quiet area (green circle).
- **Seismic monotoring of the seismogenic areas is essencially.**
- **Quantify the seismic rate** before geothermal operations start will **help to quantify the impact** that geothermal energy extraction **might have** in the GGB.

[7] http://www.seismo.ethz.ch/en/earthquakes/switzerland/all-earthquakes/

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