ECOLE LEMANIQUE DES SCIENCES DE LA TERRE
DES UNIVERSITES DE GENEVE ET DE LAUSANNE

Master ès Sciences in Earth sciences

Passive seismic exploration of high-enthalpy geothermal systems

Contact persons: Matteo Lupi (Matteo.Lupi@unige.ch), Geneviève Savard (Genevieve.Savard@unige.ch)

Context

Geothermal energy is part of the portfolio that will help the renewable transition towards a more sustainable society. Among renewable energies, geothermal resources are theoretically available anywhere and at any time. However, one of the major challenges that geothermal development is facing is subsurface uncertainty. Compared to the mining and to the hydrocarbon sectors, the geothermal industry suffers a much more reduced budget for the exploration of the upper crust. For this reason, it is necessary to develop innovative, yet affordable, methods for the investigation of the upper crust. This project will test and further develop nodal ambient noise tomography (NANT) and compare it available geological and geophysical data to deep electrical resistivity tomography.

Objectives and Methods

Methods: Nodal ambient noise tomography.
Objectives: In the framework of financed research projects, this MSc subject aims at deploying hundreds of seismic nodes to recover the velocity structure of a high enthalpy system. Various study cases are available and include systems in Guadaloupe, Indonesia, Italy, Greece and Iceland.

The MSc will have the goal of understanding the architecture and the spatial relationships between magmatic reservoirs and geothermal systems using passive seismology.

Ambient Noise Tomography is a passive seismic method traditionally used to reconstruct the velocity structure of the upper lithosphere. Early ambient noise tomography studies have shown that the noise generated by oceans, anthropic activity, winds resonating in cliffs and forests as well as thunderstorms can be exploited and treated as a source signal (Shapiro et al., 2005; Shapiro and Campillo, 2004). This MSc project proposes using nodal sensors to increase resolution and use ambient noise tomography for the investigation of geothermal resources. Data acquisition for ambient noise tomography is fully passive. The project will use 200 3C wireless geophones to record ambient noise for one month. The outcome of this study will contribute towards the development of geothermal energy and will help pushing the energetic transition.

This quantitative project is suited for students interested in geophysics, willing to dvelop strong programming skills and enjoying team fieldwork.

Literature

Shapiro, N.M., Campillo, M., 2004. Emergence of broadband Rayleigh waves from correlations of the ambient seismic noise. Geophys. Res. Lett. 31, n/a-n/a. doi:10.1029/2004GL019491

Shapiro, N.M., Campillo, M., Stehly, L., Ritzwoller, M.H., 2005. High-resolution surface-wave tomography from ambient seismic noise. Science 307, 1615–8. doi:10.1126/science.1108339

Winter thermal bathing at the Leukerbad thermal baths. Finding geothermal resources in logistically complex regions is not only convenient for winter mountain bathing but also to supply the energetic green resources to remote regions. © Leukerbad tourism	

Choice of orientation:
1) Dynamic earth, earth resources