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

Master ès Sciences in Earth sciences

Using nodal ambient noise tomography to investigate geothermal systems.

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Context

Geothermal energy is part of the energetic portfolio that will help the energetic transition for a more sustainable society. Among the renewable resources, geothermal energy is the one deployed the least if compared to the advantage of (theoretically) being available anywhere and at any time. One of the major challenges facing geothermal development is subsurface uncertainty that increases the risk of not drilling into profitable geothermal reservoirs. 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.

Objectives and Methods

Methods: Seismology

Objectives: Understand the architecture and the spatial relationships between magmatic reservoirs and hydrothermal systems at active volcanoes and discharging processes driving geysering eruptions.

Ambient Noise Tomography is a passive seismic method used to reconstruct the velocity structure of the 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 sources can be exploited and treated as a source signal (Shapiro et al., 2005; Shapiro and Campillo, 2004). This MSc project proposed the use nodal sensors for the investigation of geothermal resources. The project will closely collaborate with industrial partners and will capitalise on the geophysical instrument pool of the group of crustal deformation and fluid flow. Data acquisition for ambient noise tomography is fully passive, the project will use 200 3C wireless geophones to record ambient noise for one month. One of the advantages of this method is the non-invasive deployment that may help improving public acceptance and facilitate acquisition in logistically challenging topographic conditions (such as Alpine and Volcanic environments). The outcome of this study will contribute towards the development of geothermal energy and for the non-invasive prospection of the upper crust in general.

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