Preliminary seismological monitoring for geothermal development in Vienna, Austria

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Abstract

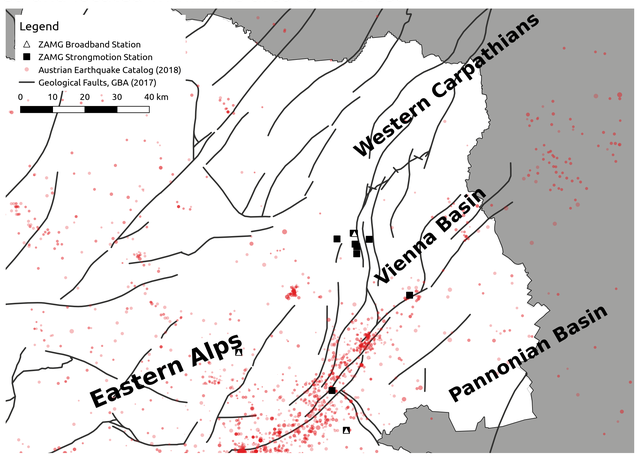
Possible geothermal water resources in the eastern part of Vienna could ideally provide hundreds of thousands of Viennese households with environmentally friendly heat and hot water. Therefore, Vienna's energy supplier (Wien Energie) has set up the research project "GeoTief EXPLORE (3D)". Together with 10 partners (universities, research institutions and companies) the potential of hydro-thermal resources is being investigated comprehensively.

For the development of geothermal projects, studies of historical seismicity and monitoring of current seismicity are a basic requirement. Hence, we deployed a network of four seismic stations. The data will be used for earthquake detection and location. Furthermore, recorded earthquakes will help the identification of possible active fault zones in the area. In the future the station network should also serve as a basis for a permanent monitoring system.

Regional Seismicity

The area of interest is situated at the transition of the Eastern Alps to the Pannonian Basin and the Western Carpathians. The Vienna Basin is a pull-apart basin that originates from the Middle Miocene and is filled with several kilometers of slow-velocity sediments.

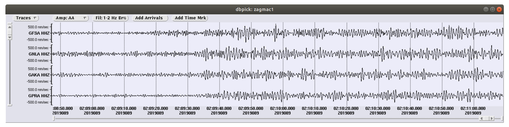
Instrumental seismicity in the region is moderate, with a maximum recorded magnitude considerably stronger than 5. There are historical records of earthquakes with intensities equivalent to magnitudes around 6, and even larger events have been suggested based on paleoseismic studies e.g. by Hintersberger et al. (2010). So far only one earthquake was ever instrumentally recorded and located within the area. of interest.



Seismic Instrumentation

To improve monitoring of seismicity in the area the ZAMG network was densified with 4 broadband stations (Trilllium Compact Posthole 20s).

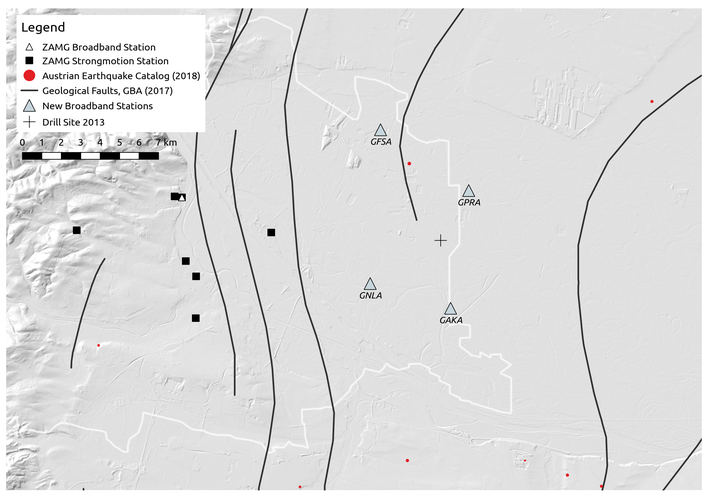
Additionally to recording data locally, data are transmitted in real time to the ZAMG. Arriving data is stored there and can be easily processed using Antelope Software by BRTT.



Station Sites

The network is centered around the old drilling site from 2013 and in the vicinity of geological faults in the area. It is shaped in a cross pattern to get good detection and location capabilities.

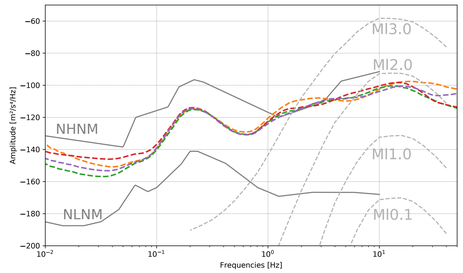
Final selection of the sites was done in collaboration with our project partner Wien Energie. The stations were set up on the ground floors of existing, little used or unused buildings.



Detection Threshold

Given the deployment of additional stations the detection threshold within the network should be sufficient to detect and locate small earthquakes. We calculated Probabilistic Power Spectral Densities for the stations and compared them to typical earthquake signal strengths according to Atkinson & Boore (2006) at 5 km distance. Furthermore, according to Baisch et al. (2012) we calculated I95 levels for each station, which were all below the threshold of 2 µm/s. Both results show that the current configuration should at least be sufficient for recording earthquakes within the network above a local magnitude of 2.

Data starting from the deployment until recently were scanned manually and no event within the network could be discriminated, same as with the National Austrian network. However, a Ml 2.2 earthquake from Gloggnitz at a distance of 80 km, was recorded, which indicates a lower local threshold than estimated.



µm/s	I95.4	I99.7
GAKA	1.60	2.41
GNLA	1.44	2.16
GFSA	1.14	1.69
GPRA	1.58	2.37

Further Steps

Manuel data screening will be continued. If more events can be detected, an automated detection system will be used.
Also a 3D model, which is currently compiled, will enhance location precision.
With the instrument pool of the ZAMG, complementary measurements e.g H/V could be made in the future to study site effects.

References & Software

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Software: obspy, QGIS, BRTT Antelope

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