EGU General Assembly 2024

EGU24-11436, updated on 08 Oct 2024
https://doi.org/10.5194/egusphere-egu24-11436
EGU General Assembly 2024

Three-dimensional deep crustal structure of the Moncuni ultramafic massif (Western Italian Alps) imaged by ambient noise tomography

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The intermediate-depth earthquakes usually occur at depths between 40-300 km, and are commonly related to deformation along and within the subducting plate. Promising but contrasting mechanisms of their seismic failure are proposed to model their generation and associated deformation processes, including ductile shear instability, dehydration embrittlement and failure of dry rocks. This work exploits one of the best examples worldwide of exposed sources of intermediate-depth earthquakes to better understand their nucleation environment. The study area consists of the Moncuni ultramafic massif (Southern Lanzo Massif, Western Italian Alps), a peridotite and gabbro section considered as a dry remnant of the Tethyan oceanic lithosphere subducted, during the Alpine orogeny, and then exhumed without experiencing ductile deformation and metamorphism. Moncuni geological units are extensively crossed by a network of pseudotachylytes (geological product of seismic slip associated to earthquakes), that locally preserve high-pressure minerals, suggesting an intermediate-depth seismic environment origin.

In this study, we want to better understand the nucleation environment of intermediate-depth earthquakes by peeking into the deeper structure of the ophiolitic peridotite and gabbro of the Moncuni area. We are performing a Nodal Ambient Noise Tomography (NANT), which allows crustal imaging based on the measurement of short-period surface wave dispersion curves between pairs of seismic stations. The used dataset was acquired by installing a temporary seismic network with 197 three-component nodal geophones over 250 km^2 area surronunding the Moncuni massif and operating for about one month.

To perform the ambient noise data processing, we followed the procedure of Bensen et al. (2007). Before using the data, we accomplished a careful data quality analysis by checking the possible occurrence of some perturbations, monitoring several parameters like recording time, and sensor absolute position and stability. We also computed power spectral density curves for each node to

investigate the occurrence of anthropogenic noise, and to select the optimal frequency band to use for the NANT. NANT is being performed extracting the empirical Green's functions (EGFs) cross-correlating time series of noise recorded at pairs of stations, so using the frequency-time analysis (FTAN) as proposed in Bensen et al., (2007), we have produced a huge amount of dispersion curves, and we applied a machine learning approach, deep convolutional neural networks, to perform automatic picking and to attribute a quality picking score. We evaluate as reliable picks with a score > 0.7. Conversely, the picks with a score < 0.7 were checked and manually corrected. The dispersion curves will be used to construct a shear-wave velocity model of the study area, allowing us to obtain a detailed image of the deep structure of the Moncuni massif with the goal of understanding whether these earthquakes originate in presence of fluids or in dry oceanic slab.