



Elastic properties and fluid abundance in the source volume of the 2010-2014 Pollino seismic sequence from P and S wave tomography

Ferdinando Napolitano¹, Ortensia Amoroso¹, Valeria Vitale¹, Anna Gervasi^{2,3}, Mario La Rocca³, and Paolo Capuano¹

¹Università degli Studi di Salerno, Via Giovanni Paolo II, 84084, Fisciano (SA), Italy (fnapolitano@unisa.it)

²Istituto Nazionale di Geofisica e Vulcanologia, Via di Vigna Murata 605, 00143, Roma, Italy

³Dipartimento di Biologia, Ecologia e Scienze della Terra, Università della Calabria, Ponte P. Bucci, 87036, Arcavacata di Rende (CS), Italy

The 2010-2014 Pollino seismic sequence occurred in a well known seismic gap zone in Southern Italy. Although paleoseismological studies revealed the occurrence of at least two earthquakes of M_w 6.5-7 in the last 10,000 years, no earthquakes larger than M_6 occurred in historical times. The sequence had a long duration and it was characterized by a variable seismic rate and by two mainshocks (M_L 4.3 and M_L 5.0) occurred in May and October 2012, two years after the beginning of the swarm. In the same area a slow slip event started three months before the M_L 5.0 earthquake and lasted for one year.

The aim of this work is the investigation of the elastic properties of the seismogenic volume and the presence of abundant fluids inferred from the study of attenuation. The role that fluids in highly fractured media play in triggering and driving the occurrence of earthquake swarms is believed very important, but yet to be understood clearly. In order to investigate the elastic properties of the medium, we performed a local P- and S-wave 3D tomographic image. We selected 870 earthquakes (M_L 1.8–5.0) occurred between 2010 and 2014 from the sequence and nearby within a volume of $100 \times 120 \times 25 \text{ km}^3$. We manually picked 9981 P and 6862 S arrivals recorded by 39 seismic stations. The picking consistency was estimated by modified Wadati diagram which also provided an estimate of V_p/V_s equal to 1.786.

We applied a linearized, iterative delay-time inversion approach, which simultaneously inverts the first arrivals of direct waves for both velocity model parameters and earthquake locations. The dataset and the station distribution allow us to set a $5 \times 5 \times 1 \text{ km}^3$ grid for the inversion. We performed several numerical tests to estimate a reliable starting 1D P- and S-wave velocity model. A finer grid of $0.5 \times 0.5 \times 0.5 \text{ km}^3$ has been set to compute the theoretical arrival travel times at each station through a finite-difference solution of the eikonal equation. The model parameters have been inverted using LSQR method. The best regularization parameter of the inversion has been obtained from the trade-off curve between the model parameters and the data variances. The Derivative Weight Sum and the checkerboard tests have been performed to assess the resolved area of the map.

The preliminary results show a significant increase of V_p and V_s velocity at depth of about 6 km beneath Mt. Pollino. This interface likely corresponds to the top of the Apulian platform. A low V_p , low V_p/V_s anomaly is found above the eastern cluster of seismicity, and a low V_p , high V_p/V_s anomaly appear north and south-east of the sequence. The latter is spatially consistent with the fluid-rich volume suggested by the results of attenuation analysis. Further analyses will follow to provide more insights about this complex sequence and, in a broader view, about similar swarm-like sequences.