Constraints on Crustal Structure in the Eastern and eastern Southern Alps

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In the course of this study, an extensive seismological dataset from both the temporary SWATH-D network (Heit et al., 2021) and selected stations of the AlpArray Seismic Network (Hetényi et al., 2018) was analyzed. The primary aim of this endeavor was to gain comprehensive insights into the crustal structure of the southern and eastern Alps. The small inter-station spacing (average of ~15 km within the SWATH-D network) allowed for depicting crustal structure at unprecedented resolution across a key part of the Alps. The methodological approach employed in this study entailed a sequential series of analyses to unveil the underlying features. The preliminary step encompassed the determination of the arrival times of both P and S seismic waves. Subsequently, a Markov chain Monte Carlo inversion technique was deployed to simultaneously calculate robust hypocenters, a 1-D velocity model, and station corrections (Jozi Najafabadi et al., 2021). This data was then utilized for calculation of 3-D V_P and V_P/V_S models (Jozi Najafabadi et al., 2022). In addition, the path-averaged attenuation values were obtained by a spectral inversion of the waveform data of selected earthquakes. The attenuation structure ($1/Q_P$ model) is then calculated using damped least square inversion of the path-averaged attenuation values (Jozi Najafabadi et al., 2023). These analyses resulted in a multidimensional depiction of the subsurface. The derived models for Q_P, V_P and V_P/V_S indicate subsurface anomalies that can be attributed to rock's physical parameters, presence of fluids within rocks and their motion in pores and fractures, temperature, and partial melting.

The findings reflect head-on convergence of the Adriatic indenter (the part of the Adriatic Plate that has modified the Alpine orogenic edifice) with the Alpine orogenic crust. Furthermore, a highly heterogeneous crustal structure within the study area was unveiled. The velocity model illuminated decoupling of the lower crust from both its mantle substratum and upper crust. The Moho, taken to be the iso-velocity contour of Vp = 7.25 km/s, provided insights into the southward subduction of the European lithosphere, a phenomenon previously investigated in the Eastern and eastern Southern Alps (e.g., Kummerow et al., 2004 and Diehl et al., 2009). The most pronounced high-attenuation (low Q_P) anomaly is found to be closely correlated with the high density of faults and fractures in the Friuli-Venetian region, as well as the presence of fluid-filled sediments within the Venetian-Friuli Basin. Furthermore, the northwestern edge of the Dolomites Sub-Indenter (NWDI) corresponds to a low attenuation (high Q_P) anomaly which is interpreted as a reflection of the NWDI's stronger rocks compared to the surrounding areas.

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