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Slab seismicity in the Western Hellenic Subduction Zone: Constraints from tomography and double-difference relocation

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The Western Hellenic subduction zone is characterized by a transition from oceanic to continental subduction. In the southern oceanic portion of the system, abundant seismicity reaches intermediate depths of 100-120 km, while the northern continental portion rarely exhibits deep earthquakes. Our study aims to investigate how this oceanic-continental transition affects fluid release and related seismicity along strike, by focusing on the distribution of intermediate depth earthquakes. To obtain a detailed image of the seismicity, we carry out a tomographic inversion for P- and S-velocities and double-difference earthquake relocation using a dataset of unprecedented spatial coverage in this area. Here we present results of these analyses in conjunction with high-resolution profiles from migrated receiver function images obtained from the MEDUSA experiment. We generate tomographic models by inverting data from 237 manually picked, well locatable events recorded at up to 130 stations. Stations from the permanent Greek network and the EGELADOS experiment supplement the 3-D coverage of the modeled domain, which covers a large part of mainland Greece and surrounding offshore areas. Corrections for the sphericity of the Earth and our update to the SIMULR16 package, which now allows S-inversion, help improve our previous models. Flexible gridding focusses the inversion on the domains of highest gradient around the slab, and we evaluate the resolution with checker board tests. We use the resulting velocity model to relocate earthquakes via the Double-Difference method, using a large dataset of differential traveltimes obtained by crosscorrelation of seismograms. Tens of earthquakes align along two planes forming a double seismic zone in the southern, oceanic portion of the subduction zone. With increasing subduction depth, the earthquakes appear closer to the center of the slab, outlining probable deserpentinization of the slab and concomitant eclogitization of dry crustal rocks. Against expectations, we relocate one robust deep event at $\approx$70 km depth in the northern, continental part of the subduction zone.