EGU23-5748, updated on 01 Mar 2023
https://doi.org/10.5194/egusphere-egu23-5748
EGU General Assembly 2023


# Evidence of water transport in the Earth's mantle from an Undetected Seismic Phase in Waveforms from Southern Tyrrhenian (Italy) intermediate-depth and Deep Earthquakes

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We found a previously unreported later seismic phase from intermediate-depth and deep earthquakes of the Southern Tyrrhenian subduction zone recorded by European seismic stations. Later phases are useful to constrain local-scale discontinuities, especially in subduction zones, but their observation is infrequent, since it depends on seismic stations distribution and slab geometry. Their detection, therefore, is a great opportunity to improve our knowledge of subduction systems and Earth's interior. They also represent a powerful mean to retrieve the chemical composition of such deep structures.

We analysed thousands of waveforms of the strongest earthquakes occurred in the Southern Tyrrhenian subduction system and recorded by European seismic stations from 1990 to 2020.

The unknown seismic phase is visible at stations from 6 to 9 degrees from the epicentre, towards the north. Only earthquakes located in a well-defined region of the slab, in the depth range of 215–320 km, generate this secondary phase. We built a direct 2D P-velocity model of the Tyrrhenian slab to reproduce observed travel times and ray paths of direct and later phases. We interpret the later phase as a compressional (P) wave that propagates downward in a narrow, high P-wave velocity layer within the deepest part of the subducting slab. We proprose that the high P-wave velocity layer in the subducting slab could be related to the presence of the dense hydrous magnesium silicate phase A, which is probably the main (meta) stable hydrous phase in the upper-mantle deep slab. Our findings provide further insights on the Southern Tyrrhenian slab structure and have also relevant implications on water transport in the Earth's mantle and slab petrology.