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Ionian Abyssal Plain: A window into the Tethys oceanic lithosphere

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The nature of the Ionian Sea crust has been the subject of scientific debate for more than 30 years, mainly because seismic imaging of the deep crust and upper mantle of the Ionian Abyssal Plain (IAP) has not been conclusive to date. The IAP is sandwiched between the Calabrian and Hellenic subduction zones in the central Mediterranean. To unequivocally confirm the proposed oceanic nature of the IAP crust, RV Meteor cruise M111 in 2014 targeted the crustal and lithospheric structure of the Ionian Abyssal Plain in a joint French-German project. Along the NE-SW oriented 131 km long seismic refraction and wide-angle reflection profile DY-05, data were acquired using four ocean bottom seismometers and four ocean bottom hydrophones. The aim of this work is to provide information on the seismic velocity distribution and the structure of the crust to confirm the nature of the crust in the IAP.

A P-wave velocity model was developed using a travel time forward modelling approach that was refined using synthetic modelling of the seismic data. In addition, gravimetric modelling validates these findings. A roughly 6 km thick crust with velocities ranging from 5.1 km/s to 7.2 km/s, top to bottom, can be traced throughout the IAP. In the vicinity of the Medina Seamounts at the southern IAP boundary, the crust thickens to about 9 km and seismic velocities decrease to 6.8 km/s at the crust-mantle boundary. We interpret the layer above the crystalline basement, earlier interpreted as layer 2a, as a unit of fast sediments, possibly carbonates. The seismic velocity distribution and depth of the crust-mantle boundary in the IAP document its oceanic nature, and support the interpretation of the IAP as a remnant of the Tethys oceanic lithosphere.