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Deep crustal structure of the Calabrian subduction zone and adjacent Ionian basin (Central Mediterranean Sea).

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In the Ionian Sea, the remnant Tethyan oceanic lithosphere of the African plate subducts beneath Eurasia. Since roughly 35 Ma slab retreat and associated back-arc opening has controlled the geodynamics of the western Mediterranean. Rollback of the Calabrian slab to the SE is associated with formation of a major lateral slab tear fault along its south-western side. This study presents data from three wide-angle seismic profiles spanning the complete suduction zone, 3-D gravity modelling, analysis of earthquake hypocenters and earthquake travel-time tomography. 61 marine seismometers from Ifremer and Geomar were deployed along the wide-angle seismic profiles from the Dionysus cruise (M111 in 2014) and co-located along two existing CROP deep seismic profiles. Two of the profiles were extended on-land in Northeast and East-central Sicily using 6 stations from INGV - Rome. These transects span the deep Ionian Basin and the Calabrian accretionary complex. The velocity models produced using seismic tomography on wide-angle seismic data were with a forward approach and were confirmed by gravity modeling. The subducting crust is about 5 km thick with velocities ranging from 6.5 km at the top to 7.25 km at the base and interpreted to be of oceanic in nature. The overlying 200-300 km wide accretionary wedge is up to 12 km thick and can be sub-divided into a pre-Messinian and a post-Messinian wedge. While the pre-Messinian wedge does not include evaporites the post-Messinian wedge includes a 2-4 km thick layer of Messinian evaporites. The seismic velocities of the 5 sedimentary layers range from 2.0 km/s to 4.5 km/s. The Calabrian-Peloritan block forming the backstop is up to 30 km thick and characterized by velocities and velocity gradients typical for continental crust. Regional 3-D gravity modeling was performed using the software IGMAS in order to test two end-member hypotheses regarding the depth of the slab beneath the Calabrian-Peloritan block; (1) sandwiched together with the backstop crust or (2) located roughly 10km deeper with a layer of intervening fore-arc mantle. Joint interpretation of the intersection of our wide-angle seismic lines together with the tomographic images supports the former hypothesis. The hypocenter cross-sections indicate moderate seismicity within the crust and upper mantle of the downgoing slab. Our dip line images for the first time the hinge of the subducting slab where plate dip increases abruptly from 5 degrees to 50 degrees over a few tens of kilometers.