The effects of continental lithospheric segments on long term evolution of Hellenic slab

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Subduction of the African plate beneath the Aegean has been active since the Jurassic. Currently, the subduction velocity is ~2 cm/yr, and the trench is rolling back with a velocity of ~1 cm/yr. While seismic tomography reveals that the slab-related structure penetrates to the lower mantle, reaching depths of about 1200 km, seismicity ceases sharply at depths of 200 km. Reconstruction of the subducting plate structure shows the presence of several fragments of continental lithosphere and lower crust that have been subducted since Early Cretaceous. Considering the presence of the continental segments on the subducting plate, the slab geometry and morphology consistent with seismic tomographic images can be obtained by exploring a wide range of model parameters.

Here we test the hypothesis that seismicity pattern might be linked to the presence of subducted continental segments. Mostly, intermediate-depth seismicity has been linked to the dehydration embrittlement mechanism, which is inactive in the dry continental lithosphere. Tracking the potentially hydrated oceanic plate material within the subducting slab provides insights into the areas where dehydration embrittlement could be active. Comparing the (P, T) conditions of the subducted potentially hydrated material with stability phase diagrams quantifies the dehydration depths and thus provides an explanation for the observed seismicity. Our model shows that there is no wet subcrustal lithospheric material within the slab below 200 km depth and that the potentially hydrated crustal material should already be dehydrated by a depth of 150 km, leaving no reason for active dehydration embrittlement.