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Continental subduction without a precursor oceanic slab: geological and geophysical evidence from the Adria-Europe plate boundary zone

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Continental subduction has long been dismissed in the light of the intrinsic buoyancy of continental crust, but it is now considered as a relatively common geodynamic process, either demonstrated by the occurrence of UHP metamorphic rocks of continental origin exposed at the Earth's surface (e.g., Guillot et al. 2009) or by high-resolution geophysical imagery (e.g., Zhao et al. 2015). The driving force for continental subduction is generally provided by the negative buoyancy of old oceanic lithosphere that enters the subduction zone before the adjoining continental margin. However, this may be in conflict with the occurrence of UHP terranes bearing no evidence of oceanic lithospheric rocks involved in the exhumation cycle. This may suggest that, in some specific cases, the role of slab pull may be negligible to enhance the subduction. Here we image the uppermost mantle P velocity structure beneath the Central Mediterranean, and explore the possibility that the initiation of continental subduction may not require a precursor oceanic slab. We combine a three-step inverted 3-D Pn tomography model (Sun et al. 2019) with available geologic constraints (Malusà et al. 2015). Pn tomography reveals elongated regions with Vp <7.6 km/s around the Adriatic microplate, clearly connected with the slab structure inferred from teleseismic P wave tomography (Zhao et al. 2016) and supportive of continental subduction along the Dinaric, Alpine and Apenninic subduction zones. Contrasting styles of subduction are observed on the opposite sides of the Adriatic microplate: a laterally variable SW-dipping subduction is documented beneath the Apennines, continental to the north and oceanic to the south; a laterally continuous NE-dipping continental subduction is documented under the Dinarides, where geologic evidence point to the absence of a precursor oceanic slab. Our results demonstrate that the onset of continental subduction, in complex plate boundary zones, can be controlled by plate-tectonic processes far away from the subduction initiation site, and may take place without the contribution of the negative buoyancy of an old oceanic lithosphere.

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