Floating the Vrancea slab and tectonic reconstruction of the collapse of the PalaeoPannonian Basin

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Here we present the first 4D tectonic reconstruction that models the Vrancea slablet and incorporates the floated slab as a constraint on the magnitude of slab rollback during collapse of the Palaeo-Pannonian Basin. Seismic tomographic images provide insight into the geometry and tectonic history of subducted slabs. High velocity anomalies can be interpreted as ‘cold’ lithosphere penetrating ‘warmer’ lower velocity asthenosphere, and 3D models created using the SKUA-GOCAD modelling software. Combined with information from the 3D distribution of earthquake hypocentres, we thereby obtain a simple approximation to slab geometry beneath the Vrancea region. The resultant DXF was imported into the Pplates tectonic reconstruction software, and floated back to the Earth’s surface. The method utilised assumes no significant deformation (stretching, buckling, folding, shortening) during or after subduction, so that the obtained geometry estimates the pre-subduction configuration. The resultant floated slab is then incorporated as a constraint on 2D + time tectonic reconstructions. We apply a double-saloon-door rollback model, which involves propagation of a slab tear along the mid-Hungarian lineament. Each saloon-door rolls back independently of the other and this leads to two epochs of extension. AlPaCa is ‘pulled’ eastwards and rotated counter-clockwise as the western saloon-door rolls back. The Tisza-Dacia unit is then ‘pulled’ eastward, and rotated, but in a clockwise sense as the eastern saloon-door rolls back. Once the subduction hinge reached the East European Platform, the slab was left hanging. Gravitational forces then drove slab-boudinage and detachment in a similar fashion as occurs today beneath the Hindu Kush. This model explains the large opposing-sense vertical-axis rotations that occurred during convergence of the AlPaCa and Tisza-Dacia terranes. The zipper fault model rotates the microplates without requiring large-scale thrusting. Interpretation of the Mid-Hungarian lineament as a zipper-fault system is also consistent with the geodynamic effects expected because of tearing in a subducting plate leading to a double-saloon-door rollback. The vertical extent of the slab is roughly 300 km, which only fills half of the basin, consistent with the double-saloon-door roll-back model interpretation.