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Geodynamic evolution of the lithosphere beneath the Eastern Anatolia region: Constraints from geodynamic modeling

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The east Anatolian orogenic plateau is characterized by an average elevation of 2 km, and is delimited by the Bitlis-Zagros collision zone to the south and the Pontide arc to the north. Stratigraphic evidence suggests that the high plateau attained its current elevation since the Serravallian (about 12 million years ago), but probably did not reach its present height until at least the latest Pliocene. While the crustal shortening following the Arabia-Eurasia collision in the south enabled its relatively rapid rise and regional tectonic evolution, the presumed removal of the downgoing slab beneath east Anatolia has potentially played a significant role in this geodynamic configuration. According to the proposed scenario, the northward subducting slab of Neo-Tethys peels away from the overlying crust similar to the lithospheric delamination model. In this work, we performed a series of lithospheric removal models by varying rheological, physical and mechanical properties by using 2D numerical geodynamic experiments, (e.g. plate convergence rate, crustal thickness, mantle lithosphere yield-stress). Our model results show that the average amount of delamination hinge motion is maximum (18 km/my) when the lower crustal rheology is felsic granulite. The slab break-off only occurs at lower convergence rates ($\leq$ 2 cm/yr), and is imposed on the margin of delaminating mantle lithosphere. The surface uplift takes place above the asthenospheric column (or plateau gap) through isostatic and thermal support of asthenospheric upwelling, and varies dependent on the width of the asthenospheric column. However; with higher plate convergence rates ($\geq$3 cm/yr), the asthenospheric column does not widen enough and the continental collision occurs rather than delamination/peeling away. In this case, the average uplift appears in the central section of the crust, and this exceeds a surface elevation of 3 km. All model results are consistent with the observations from the Eastern Anatolia (e.g. heat flow estimates, crustal thickness, surface topography, the pattern of volcanism). The results of this parametric modeling may provide important quantitative information on the lithospheric structure and the geodynamic evolution of the east Anatolia and the other tectonic regions (e.g. Tibetan Plateau, Altiplano, Colorado Plateau) where delamination may have occurred.