Geophysical Research Abstracts
Vol. 18, EGU2016-13633-1, 2016
EGU General Assembly 2016

Geodynamic Models for Various Styles of Melting in the Lithosphere Delamination Process

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Lithospheric delamination in the sense of peel away of the mantle lithosphere from the overlying crust may occur during and at the terminal phase of the orogenic cycle and it has been recognized as a significant geodynamic process to identify the elevated surface topography, widespread magmatism and distinct crustal deformation patterns (i.e extension and shortening). However, the role of decompression melting of the mantle and slab melting in conjunction with the delamination of the lithosphere as well as the resulting magmatism/surface topography remains uncertain. In this work, by using thermomechanical numerical experiments we investigate the evolution and emplacement of the melt produced by slab-derived fluids and the decompression melting under an accretionary crust. Our numerical experiments with varying activation volume of the mantle lithosphere and the asthenospheric mantle as well as plate convergence velocity aims to configure the orogenic evolution from ocean lithosphere subduction to delamination in the course of melt related weakening process. Our results suggest that the entrainments of the melting induced by the subducting slab reaches under the accretionary wedge and fosters the plate decoupling/delamination between accretionary crust and the underlying mantle lithosphere. With all parameters kept the same and the convergence velocity of Vp = 4 cm/year, decrease in the activation volume in the mantle nearly 5% results in the % 70 increase for the amount of decompression melting, therefore the widening the delamination zone. Surface elevation above the zone of delamination may lower the topography at least 1 km due to the crustal stretching as a response to melt induced weakening of the crust. When there is no decompression melting under the delamination zone the surface crust may uplift as much 3 km. Our results may explain the role of melting and widesprad magmatic activity under the orogenic plateaus where they are underlain by weak accretionary material such as the East Anatolian plateau.