Geophysical Research Abstracts, Vol. 7, 01550, 2005
SRef-ID: 1607-7962/gra/EGU05-A-01550

Inherent gravitational instability of hot continental crust: implications for exhumation of UHT granulite facies terrains

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Petrological and numerical modeling of in situ rock properties based on the Gibbs free energy minimization shows that the hugh-grade metamorphism may critically lead to decrease of density at the lower continental crust. This leads to a gravitational instability of the hot crust resulting in regional doming and diapirism particularly in the terrains located between green stone belts. Two types of crustal models have been studied: (1) lithologically homogeneous crust and (2) heterogeneous multilayered crust. Gravitational instability of relatively homogeneous continental crust is related to a vertical density contrast developed during prograde changes in mineral assemblages and thermal expansion of minerals with temperature. Gravitational instability of lithologically heterogeneous crust is related to an initial density contrast of dissimilar intercalated layers enhanced by high-temperature phase transformations. In addition, the thermal regime of heterogeneous crust depends on the pattern of vertical interlayering: a strong positive correlation between temperature and the estimated degree of lithological gravitational instability is indicated. An interrelated combination of 2-D numerical thermomechanical experiments and modeling of in situ physical properties of rocks was used for studding the processes of gravitational redistribution within a doubly stacked, heterogeneously layered continental crust. Both the exponential lowering of viscosity with increasing temperature and the prograde changes in

metamorphic mineral assemblages during thermal relaxation after collisional thickening of the crust and lead to regional doming and diapirism. These processes trigger exhumation of high-grade terrains and provide rapid exhumation rates (>5 mm/a) for UHT (> 900 ^{o}C) granulite complexes, in particular, because of extremely high degree of internal gravitational instability of the UHT crust.