Geophysical Research Abstracts, Vol. 8, 09118, 2006
SRef-ID: 1607-7962/gra/EGU06-A-09118

Crustal eclogitization and dynamics of the plateau building

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Recent delamination of the subcrustal lithopshere under the high Puna plateau in Central Andes, as manifested by petrological and geophysical studies, was probably triggered by the progressive eclogitization of the thickened lower crust. A plausible delamination scenario begins with pure-shear tectonic shortening that thickens the crust causing the depressed mafic lower crust to enter the eclogite stability field, with a corresponding increase in density. The density of the lower crust becomes higher than that of the underlying mantle and growing Rayleigh-Taylor instability finally leads to the delamination of the eclogitic lowermost crust. The sinking eclogite blobs entrain large portions of the relatively cold and, hence, also unstable sub-Moho mantle. Available geological timing of the plateau building provides rather strict temporal constraints to the delamination process. Among main control parameters are: initial thermal structure under the plateau, viscosity of eclogite, kinetics of phase transformation. Special attention in the present study is paid to the dynamics of the plateau building (i.e., how eclogitization and delamination affect the total resistivity of the growing plateau in respect to ongoing shortening). Numerical tests are made using thermo-mechanical code LAPEX-2D with incorporated model of the gabbro-to-eclogite transformation. The most important parameter is initial thickness of the lithosphere under the plateau. Thinner lithosphere means higher mantle and crustal temperatures and, hence, lower viscosities. In turn, this means better conditions for delamination and reaction kinetics. At the same time, however, higher temperatures shift the gabbro-to-eclogite transition to greater depths because of the positive Clayperon slope of the transition. Thicker lithosphere means earlier eclogitization but less favourable conditions for delamination. Ongoing eclogitization of the mafic crust of the plateau increases the average density of the crust and works against an increase in topography on the tectonically in-

flated plateau. This results in a reduction of the effective lithospheric strength against shortening by about of 30 per cent. After the eclogitic crust is removed by delamination, the plateau starts to grow, increasing its resistance to shortening. The overall strength of the delaminated lithosphere is, contrary to expectations, not markedly lower than prior to delamination. The reason for this behaviour is that the viscous dissipation is only minor compared to growing topographic load and strength of the brittle upper crust.