D 30

N86-31149



EXTENSIONAL TECTONICS ON CONTINENTS AND THE TRANSPORT OF HEAT AND MATTER; Horst J. Neugebauer, Institut für Geophysik, Technische Universität Clausthal, Federal Republik of Germany

Intracontinental zones of extensional tectonic style are commonly of finite width and length. Associated sedimentary troughs are fault-controlled. The evolution of those structures is accompanied by volcanic activity of variable intensity. The characteristic surface structures are usually underlayn by a lower crust of the transitional type while deeper subcrustal areas show delayed travel times of seismic waves especially at young tectonic provinces.

A correspondence between deep seated processes and zones of continental extension appears obvious, a genetic sequential order of mechanisms and their importance is discussed in the light of both modern data compilations as well as quantitative kinematic and dynamic approaches. For this purpose we refere to the Cenozoic extensional tectonics related with the Rhine River.

Kinematic modelling of fault controlled extensional troughs of sedimentation predicts crustal stretching of 10 % associated with a rather deep crustal detachment level at 20 km depth. Those surface structures obviously find mirror image like correspondence in the lower crust beneath the detachment level as demonstrated by Zucca[1]. Thereafter the broad and gentle domal upwelling of the lower crustal boundary which has approximately ten times the width of the surface tectonic structures is not neccessarily the consequence of mechanical stretching. It is more likely of an interlayered mafic and ultramafic lithology in accord with similar exposed structures and with transitional seismic velocities, Deichmann & Ansorge[2].

The small amount of crustal stretching on one side and the oversized lower crustal transition in addition with a period of 100 ma of volcanic activity indicate a rather puzzling situation. Geobarometric evidence, age and spatial distribution of volcanic rock samples reveal magmatic activity with lower lithosphere origin during a time span of 50 ma before the onset of fault-controlled sedimentation at the surface. Major volumes of magma, however, were extruded 30-40 ma after the extensional surface event.

An accretion of ultramafic mantle material in lower crustal position as well as the evidence of magmatic activity by volcanic erruptions over such a long period support the view of a controlling mechanism of crustal extension involving both the transport of matter and heat. Numerical models on the uprise of small volumes of material within a thermally self-consistent enviroment and the control of variable rheology offer a suitable concept for the understanding of (1) moderate to low heating of the lower crust, (2) the accretion of lense-shaped material, (3) the uprise of crustal detachment level with time, (4) a slow upwelling of upper mantle isotherms above the magma source and thus (6) the preparation of a thermal channel for late voluminous volcanic events and finally, (7) the gentle, continous crustal extension.

References

Zucca, J.J. The crustal structure of the southern Rhinegraben from re-interpretation of seismic refraction data, J. Geophys. 55, 13-23.

Deichmann, N. and Ansorge, J. (1983). Evidence for lamination in the lower continental crust beneath the Black Forest (southwest Germany). J. Geophys. 52, 109-118.