



Gravimetric investigations in the Tien Shan and in the region of Almaty (Kazakhstan)

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The Tien Shan, one of the seismically most active regions in the world, has been the focus of geophysical investigations for many years. With a distance from 1500 km to the collision zone of the Indian and Eurasian plate, the Tien Shan is the largest intracontinental mountain range in the world. Besides, it is a part of the collision zone of India and Eurasia. Its origin and ongoing seismic activity has been studied. In particular, seismological data have been used. In this study, for the first time, gravity data have been added to these investigations. The data are used to determine the crust-mantle boundary (CMB) of the Tien Shan and to create a three-dimensional (3D) model for the region around Almaty, the former capital of Kazakhstan. The results provide constraints for geodynamic modelling and for a seismic hazard analysis.

The CMB model was calculated by inversion of gravity data. The data used were taken from EGM2008 (Pavlis et al., 2008), the best available gravity data for investigations such as this. Additionally, an isostatic CMB was calculated with topographic data. The comparison between the isostatic CMB and the results of the gravity inversion illuminates the effects of isostatic compensation.

The results of the gravity inversion indicate that the Tien Shan has a mountain root with a thickness of about 70 km. The CMB can be shallow under the basins, e.g., in the Tarim and Ili basins. In general though, the crust thickness is homogeneous at a small scale. The comparison with the isostatic CMB indicates an almost complete compensation of the orogen. It can be concluded that the resolution of the EGM2008 data set is suitable for the determination of the crustal thickness of the Tien Shan. Besides receiver function analysis, the gravity inversion has been proven as a very good method to gain a crustal thickness model of a selected region.

A 3D density model of the subsoil is developed using gravity data from Kazakhstan, collected in the 1970's and 1980's. The gravimetric modelling reveals three geological units as sources for the distinctive gravity anomalies around Almaty: the CMB, the sediments of the Ili basin, and a metamorphic complex in the mountains of the Tien Shan. The CMB is characterised by a steep gradient in the centre of the model, correlating well with the elevation (altitude). The modelled crustal thickness is consistent with previous investigations concerning the CMB for the Tien Shan. The sediment thickness varies between 0 and 6 km in the Ili basin. The locations of the geological units on the surface of the gravimetric model correspond to the geological mapping of this region. Small residuals demonstrate the high quality of the gravity model.