TECTONOPHYSICS
ELSEVIER
Tectonophysics 290 (1998) 271-283

The crustal structure of the western Arabian platform from the spectral analysis of long-period P-wave amplitude ratios

Abdullh M.S. Al-Amri *
Department of Geology, King Saud University, Riyadh 11451, Saudi Arabia Received 12 December 1996; accepted 12 January 1998

Abstract
The crustal structure of the western Arabian platform is derived using the spectral analysis of long-period P-wave amplitude ratios. The ratio of the vertical to the horizontal component is used to obtain the crustal transfer function based on thickness variations, crustal velocities, densities and the angle of emergence at the lower crust and upper mantle interface. Eleven well-defined earthquakes recorded at the long-period RYD station during the period from 1985 to 1994 were selected for analysis based on the following criteria: focal depths with a range between 7 and 89 km, body-wave magnitudes greater than 4.7, epicentral distances with a range from 8.8° to 26.5°, and back azimuthal coverage from 196° to 340°. Spectral analysis calculations were based on the comparison of the observed spectral ratios with those computed from theoretical P-wave motion obtained using the Thomson-Haskell matrix formulation for horizontally layered crustal models. The selection of the most suitable model was based on the identification of the theoretical model which exhibits the highest cross-correlation coefficient with the observed transfer function ratio. By comparing the spectral peak positions of the observed and theoretical values, the thickness and velocity can be resolved within 3 km and 1 km/s, respectively, of the observed values. The spectral analysis of long-period P-waves can detect a thin layer near the surface of about 1.6 km thick and a velocity contrast of about 10% with that of the underlying layer. A strong velocity gradient of about 0.05 km/s per km was found in the upper crust and 0.02 km/s per km in the lower crust. The derived crustal model is not unique due to the theoretical assumptions (horizontal layering, constant densities and velocities in each layer), quality of the data and complexities of the crustal structure. The crustal model suggests that the crust consists of five distinct layers. The upper crustal layer has a P-wave velocity of about 5.6 km/s and is about 1.6 km thick. The second layer has a velocity of about 6.2 km/s and is 10.2 km thick. The third layer shows a velocity of 6.6 km/s and is 6.8 km thick. The fourth layer has a velocity of about 6.8 km/s and is 12.3 km thick. The lower crustal layer has a velocity of about 7.5 km/s and is 9.3 km thick. The Mohorovicic discontinuity beneath the western Arabian platform indicates a velocity of 8.2 km/s of the upper mantle and 42 km depth.
Keywords: crustal structure; amplitude ratios; Arabian platform; velocity