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Thermal isostasy below the arabian shield and platform: implications caused by red sea spreading

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Thermal isostatic compensation for the Arabian Shield and Platform is investigated here by an analysis of gravity field, deep seismic refraction profile and heat-flow data. Regression relationships between elevation and gravity anomalies found for the geologic provinces of Arabian Shield and Platform are examined first using both point-values as well as the averaged anomalies over ? degree and 1 degree areas. These suggest for grossly different isostatic status prevailing for the geologic provinces in response to crustal dynamics. The composite terrain-corrected Bouguer anomaly and Airy-Heiskanen Isostatic anomaly maps for Arabian Shield and Platform are prepared using these data sets. The gravitational attraction of the Moho was determined from the 30 arc-seconds topography data; calculation of isostatic correction was made assuming 2.67 g/cm3 and 3.3 g/cm3 densities for the crust and top mantle respectively. A mean thickness of 40 km is used for isostatic data reduction. Mass/unit area under the crustal columns at the assumed level of compensation at 40 km depth for Arabian Shield and Platform is constructed and compared with those for other shield regions in the world. Thermal isostatic compensating model for ASP is constructed using the available deep crustal seismic refraction results and heat-flow data for the Arabian Shield. For modeling, the digitized elevation data are examined in details to look for geological mass anomalies in upper crust. Once these effects are isolated, the long wavelength isostatic anomalies are ascribed to crust-mantle configuration below the Arabian Shield and Platform. The results suggest that the elevated Asir Igneous Province (that initially formed as a magmatic arc but later accreted to the Arabian Shield) is largely uncompensated, whereas, the isostatic compensation for the Arabian Shield and Platform is more complete. Tectonic implications for the moving Arabian lithosphere due to Red Sea spreading for the last 26 M.Y. in influencing the thermal isostatic compensation status is discussed.

Keywords: thermal isostacy, arabian shield, red sea, gravity, Saudi Arabia, isostatic anomalies