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Improved assessment of Deep Crustal Thermal Field based on Joint Inversion of Heat Flow, Elevation, Geoid Anomaly data sets

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It is common practice to make use of the results of regional heat flow studies in determination of temperature field of deep crustal layers. There are, however, large uncertainties in the results obtained, a consequence of the uncertainties in the effective values of the model parameters. We present a novel approach that minimizes such uncertainties by making use of readily available data on elevation and geoid anomaly as complementary constraining parameters in determining the deep thermal field in geothermal areas. The technique employed is based on development of an interactive crustal model, with iteration schemes that provide simultaneous checks for compatibility of the inversion results with the observational data sets on elevation and geoid anomalies, in addition to those of surface heat flow and radiogenic heat production. Unlike the previous attempts (for example, Lachenbruch and Morgan, 1990; Fullea et al, 2007) the new approach allows for the non-linear effects of thermal conductivity variation with temperature in the crustal layers and also incorporates surface heat flow variations as independent constraining conditions. The results are found to be far more robust and realistic than those obtained by conventional thermal models. Another remarkable feature of this model is its ability to determine deep temperature field in regions of active subsurface fluid circulation. The method has been used in determining deep thermal structures of the crust in North Africa and Southeast Brazil. In the Atlas Mountain area of North Africa, adjacent to the East Alboran basin, the results obtained point to conditions favorable for occurrence of HDR geothermal systems in upper crustal layers.