

Abstract

From a geological point of view, Ethiopia is a unique country where active tectonics displays can be studied, in the context of extensive East African Rift System (EARS) evolution, where the Main Ethiopian Rift (MER) is a part. The Main Ethiopian Rift (MER) is typical continental rift structure spread between the African, Somali, and Arabian lithospheric plates stretching over 6,000 kilometres from Syria to central Mozambique.

This study of the gravity pattern in Ethiopia reveals significant crustal thinning in the Main Ethiopian Rift and Northern Afar regions. In the southern Afar, the earth's crust has a slightly higher thickness and, moreover, probably contains a significant proportion of the continental crust. The understanding of crustal thinning in the context of active rifting is essential to predict future geodynamic events in that region, which is crucial for the sustainable life of a rapidly expanding population and the necessary construction of infrastructure.

This work provides an analysis and re-interpretation of archival gravity data collected from land surface surveys and airborne gravity studies (archive of Geological Survey of Ethiopia) in conjunction with available geological and structural data to evaluate overall gravimetric pattern of Ethiopia and determine main geological structures in two key areas of the southern MER – in Gedeo and Sidama Regions. The gravity datasets were processed in ArcGis and Surfer softwares to create Bouguer gravity anomaly maps.

The Complete Bouguer Anomalies (CBA) map of the entire Ethiopian territory reveals contrasting regions with manifestations of gravity maxima and minima, including MER (local gravity maxima due to crustal thinning). The western plateau shows a low gravity pattern, and the eastern plateau reveals a negative anomaly. The Afar triple junction shows slightly positive anomalies in line with the Ethiopian rift, while the southern Ethiopian rift and the Turkana rift have negative gravity anomalies. The increase in CBA values estimates that crustal thickness decreases northward from about 50 km in the non-rifted areas to about 20 km in the Afar region where a more significant presence of higher-density oceanic crust is also assumed.

Maps of the Complete Bouguer Anomalies of the land and airborne gravity datasets demonstrate similar gravity anomaly variations in the Gedeo Zone and Sidama Region with a slight difference in the south and southeast. The main geological and tectonic features of the Gedeo Zone and Sidama Region are compared with newly calculated Linsser's indications. The results are in strong agreement with previous research done for the Ethiopian region in terms of different origin of geological structure, orientation, and nature.

Key words: geology, gravity, Ethiopia, Main Ethiopian Rift