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Gravimetry and petrophysics in the Chad basin area: determination of the basement depth and the implication for defining a scientific drilling site (ICDP-CHADRILL project)

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The Chad basin is a huge intracratonic sag-basin (2.5 million km2) in the North Central Africa. In this work, we investigated the basement depth under the Chad Lake using the inversion of gravity residual data obtained by the regression analysis between gravity and topography data. It has been carried on with a collaboration between the University of Trieste and the Institut de Physique du Globe, Strasbourg (IPGS) in order to contribute to the decision of the location of a ICDP drilling site (Bol, SE Chad Lake). This project consists in a compared analysis between gravity data with other geological/geophysical data and their interpretation in terms of tectonic features. The main objectives of this work are: (1) estimation of the basement depth under the Chad basin through a joint analysis and interpretation of satellite and terrestrial gravity data (GOCE, BGI) [1] with borehole data and density values of Cameroon-Chadian rock samples. (2) Estimation and interpretation of the Bouguer and residual gravity anomalies. The results obtained gave us information about the basement depth and the thickness of sediment infill of the basin. Observing the residual values of gravity anomaly field we found a large negative anomaly (-30 mGal) under the Chad basin connected to the presence of low-density sediments. Furthermore, there are several positive anomalies around the edges of the basin [3] and a pattern of linear negative anomalies outside of it. Both types of trends are linked to the presence of rifts and extensional structures. Using the inversion modelling, we could observe a deepening variation of the depth of the basement moving from the southern part (2-3 km) to the northern (4-6 km) one of the Chad Lake. The deepening of the basement is connected to the Termit rift basin and the values are consistent with previous seismic surveys [2]. The depth of the basement under the city of Bol is between 3 and 4 km, but unfortunately, there are no other geological/geophysical constraints to confirm these values. For the drilling purpose, since in the inversion we used a minimum value of the density contrast (200 kg/m3) among the range defined (200-400 kg/m3), it is possible to assume that the maximum expected depth of the basement is about 4 km. We suggest an integrative geophysical survey, such as a seismic reflection campaign to get more detailed information about the structure of the basement (faults, highs and lows) as well as on the variability of its depth and the thickness of the sediment cover.

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