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Variations in isochore thickness of the Karoo sediments in the Eastern Cape Province of South Africa, as deduced from gravity models

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South Africa is the latest country in Africa exploring the idea of exploiting the field of shale gas in the Main Karoo basin in order to derive energy which is fundamental for development. The Main Karoo basin covers up to 300, 000 km^2 and represents about 100 Ma of sedimentation spanning from 280 Ma to 180 Ma, and has its rocks covering almost half of the area of South Africa. The basin is considered to be the most prospective area for shale gas in South Africa, due to the presence of deeply buried and thermally mature black carbonaceous shales in the Ecca Group. However, till date, the interconnectivity of dolerite intrusions at depth as well as the variation in isochore thicknesses within the Ecca sequence in the study area has not been established in order to ascertain if the thickness of the sediments across the area will support accumulation of hydrocarbons in areas that host source rock potential for hydrocarbon generation. In this study, we investigate the interconnectivity of dolerite intrusions at depth and the variation in the isochore thickness of the Karoo sediments using existing borehole data, elevation data, density data, Moho depth, and gravity models. The gravity model results showed that dolerite intrusions which are more prominent in the area are interconnected at depth, which could possibly affect the quality of the shale resources and probably pose threat by increasing the risk of fracking the Karoo for shale gas exploration. The isochore thickness maps derived from the gravity models revealed that the Beaufort Group is the thickest of all the geologic succession that make up the Karoo Supergroup with maximum vertical thickness of about 6380 ± 305 m, followed by the Ecca and Dwyka Groups with maximum isochore thicknesses of up to 3215 ± 160 m and 728 ± 24 m, respectively. The maximum depositional surface (elevation) above the sea level for the Dwyka, Ecca and Beaufort sediments are about 900 m, 500 m and 125 m, respectively whilst the depth below sea level are 11000 m, 10000 m and 8000 m, respectively. The correlation of the isochore thickness maps with the depositional surfaces shows that the sediments in the basement highs were subsided, deformed, eroded and deposited in the basement lows. The basement highs possibly served as the source(s) area for the sediments in the basement lows thus basement highs are characterised with thin sediment cover whilst the lows have thick sediment cover.