

Two Dimensional Modelling of Subsurface Structures Over Upper Benue Trough and Borno Basin, Northeast Nigeria

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INTRODUCTION

- The entire Benue Trough is believed to have evolved as a result of the continental separation of Africa and South America (King, 1950)
- It is variously described as a rift system (Cratchley and Jones, 1965), an extensional graben system (Stoneley, 1966 and Wright, 1968)
- The Bornu Basin (or “Maiduguri Subbasin” of Avbovbo *et al.* (1986) is the south-western part of the Chad Basin (Figure 1).

Introduction Contd...

- The Cretaceous sediments in the Bornu Basin reaches a thickness of over 1500 m (Olugbemi, 1997).
- The 2D modelling of aeromagnetic fields over the area would differentiate and characterise regions of sedimentary thickening from those of uplifted or shallow basement and also to determine the depths to the magnetic sources.
- The depth results might suggests its possibility of hydrocarbon potential
- Similarly, the Basement architecture will also be determined

Location and Geology of the study Area

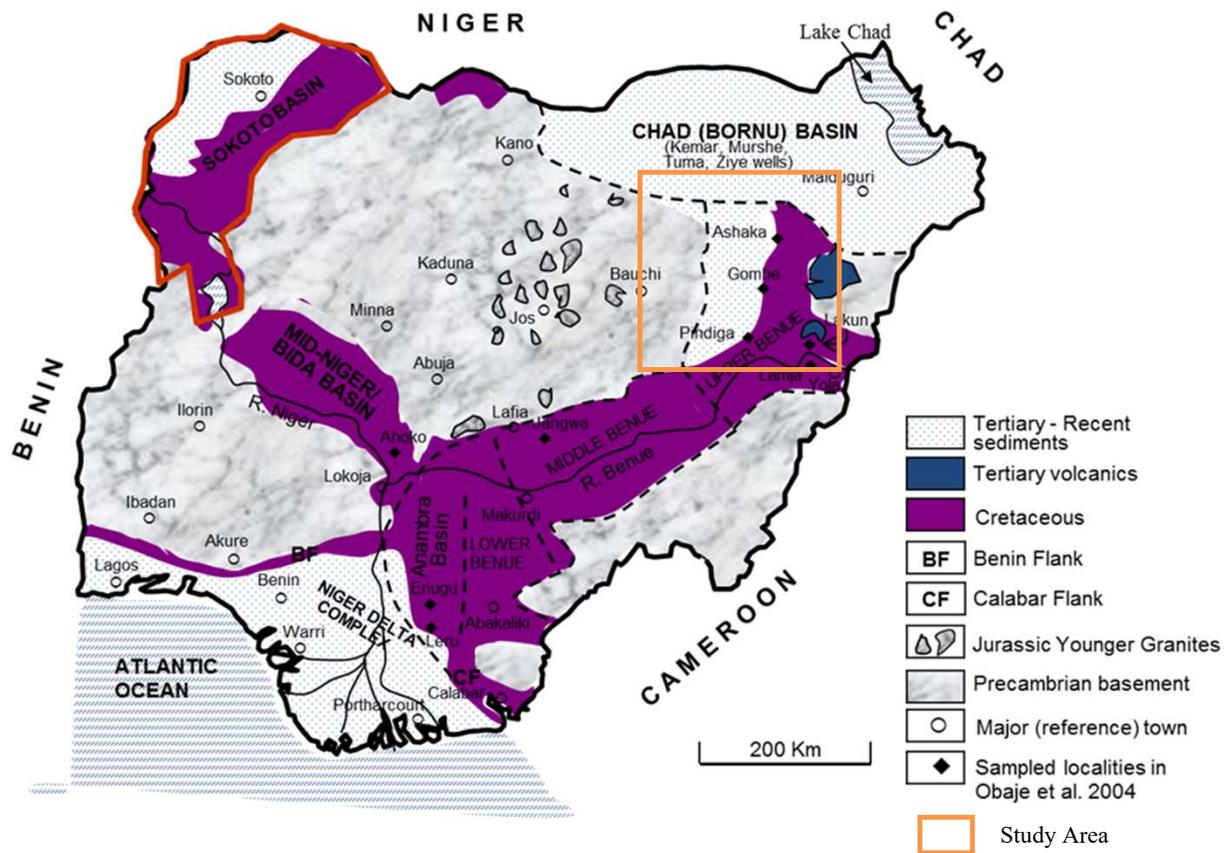
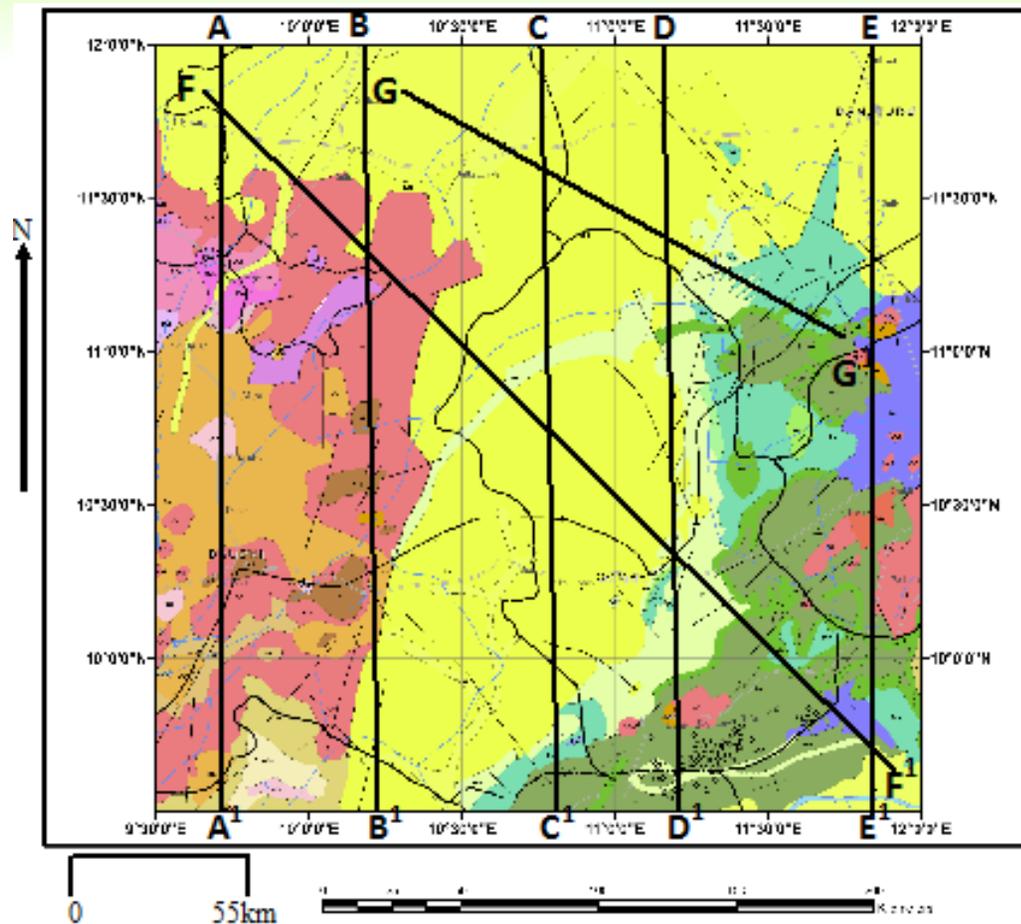


Figure 1: Location of the Study Area (parts of Upper Benue Trough and southern Bornu Basin)

Geology Contd...



The study area is bounded by latitudes 9.5°N to 12.0°N and longitudes 9.5°E to 12.0°E located within the Upper Benue Trough and southern Borno Basin, Northeast Nigeria (Figure 1 and 2). It is approximately 275,000 km² and was covered by 25 aeromagnetic data sheets.

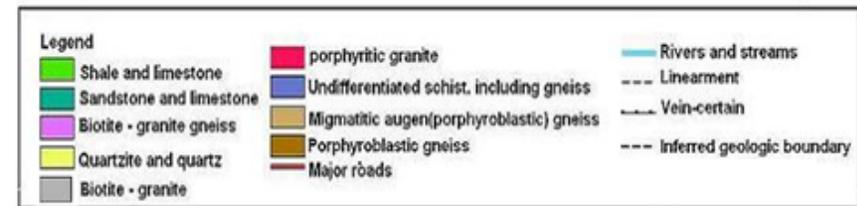


Figure 2: Map of selected profiles for modelling on the geologic map of the area (scale 1:2000000)

Geology Cont'd

- The Upper Benue Trough comprises the area extending from the Bashar-Mutum-Biyu line as far north as the “Dumbulwa-Bage high” of Zaborski *et al.*, 1988, which separates it from the Bornu Basin.
- Early studies of the Upper Benue Trough and Southern Bornu Basin were carried out by Falconer, 1911, Jones, 1932, Raeburn and Jones, (1934) and Barber, 1965.
- The basis for all later work was provided by Carter *et al.* (1963) who undertook a regional study of the area covered by the Geological Survey of Nigeria 1/250,000 Series map sheets 25 (Potiskum), 36 (Gombe) and 47 (Lau).

Materials and Method

- 25 Aeromagnetic Data sheets
- They are numbers 83 - 87, 106 - 110, 128 - 132, 149 - 153 and 170 – 174 on a scale of 1:100,000.
- The SRTM Data
- Digital Geologic Map
- SPI Depth was used as the depth constraint
- GMSys in Montaj

Materials and Method Contd..

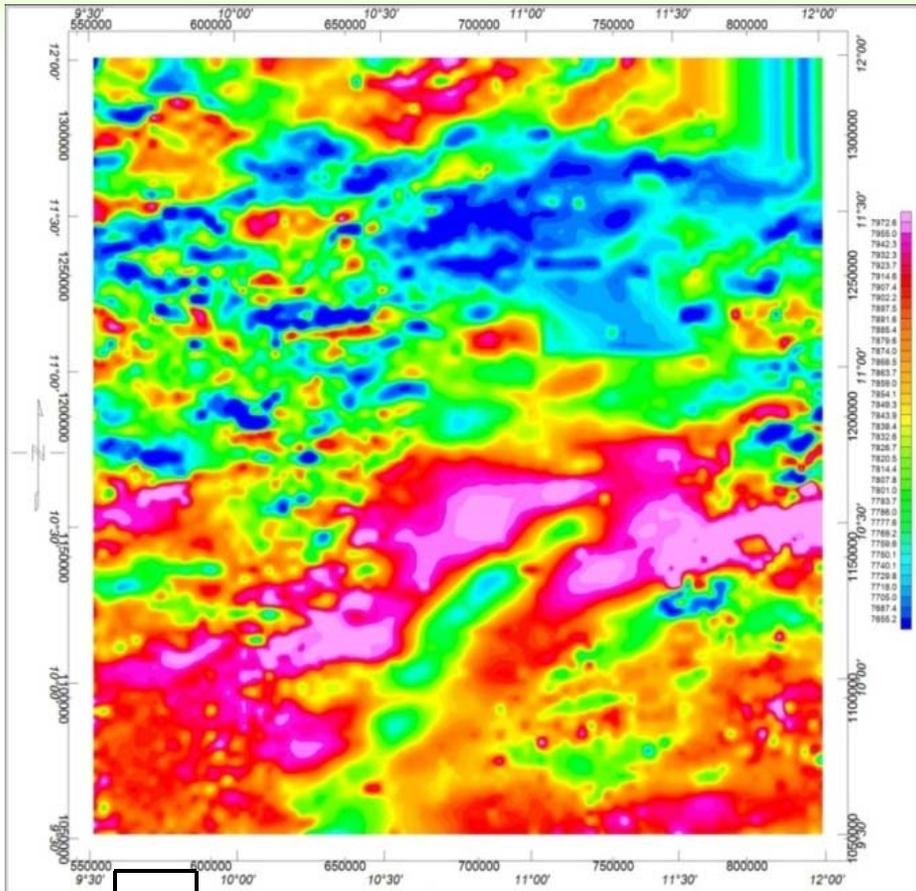


Figure 3

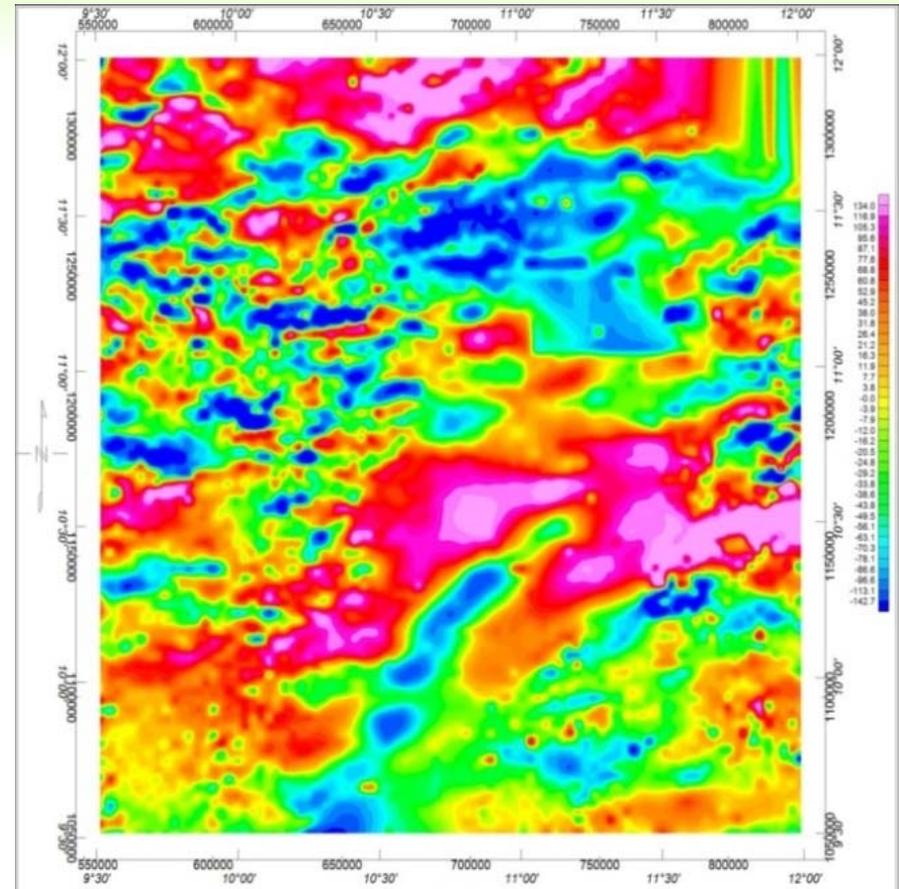


Figure 4

Figure 3: Total magnetic intensity map of parts of Upper Benue Trough and southern Bornu Basin; Figure 3: Residual-magnetic map of parts of Upper Benue Trough and southern Bornu Basin. Unit of total magnetic intensity is nano tesla (nT).

Results and Discussion

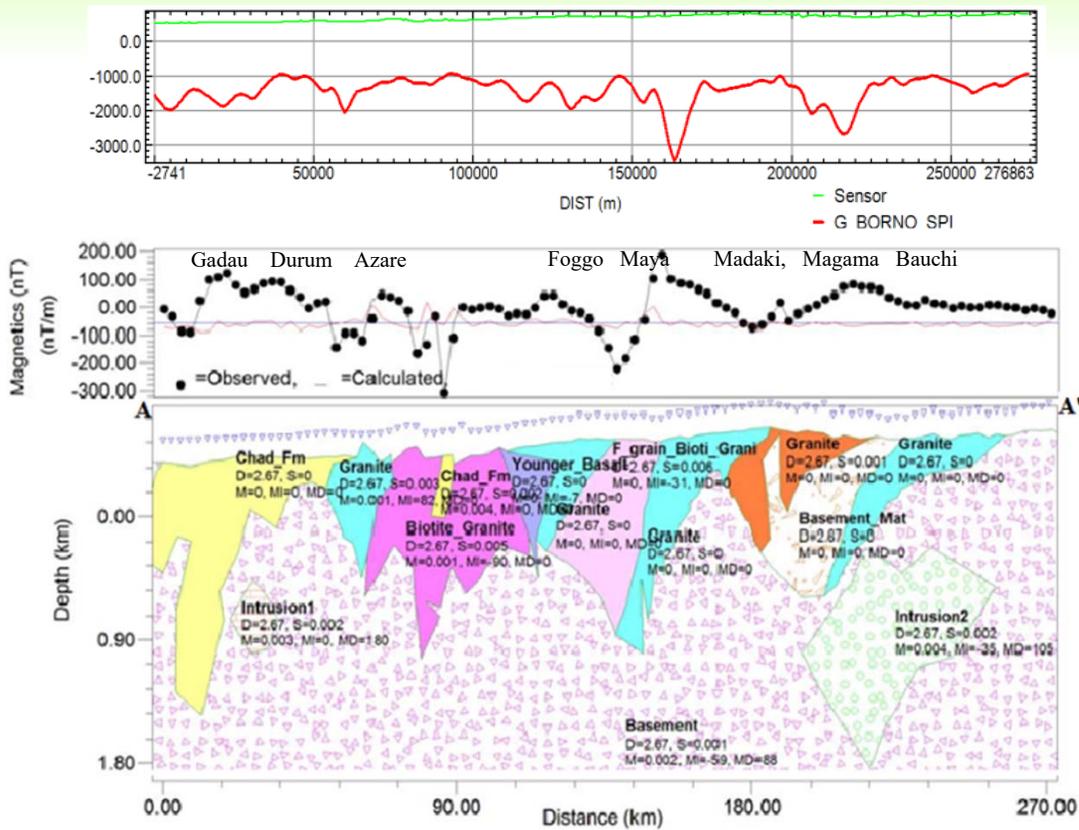


Figure 5: Model results for profile AA¹

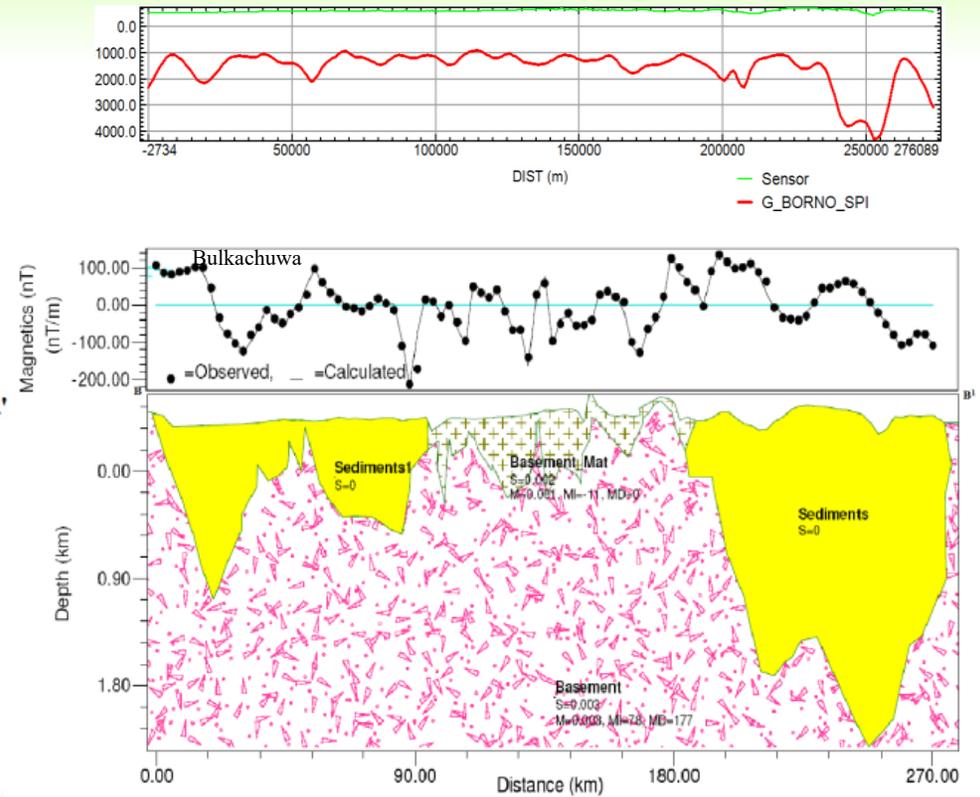


Figure 6: Model results for profile BB¹

Results and Discussion Contd...

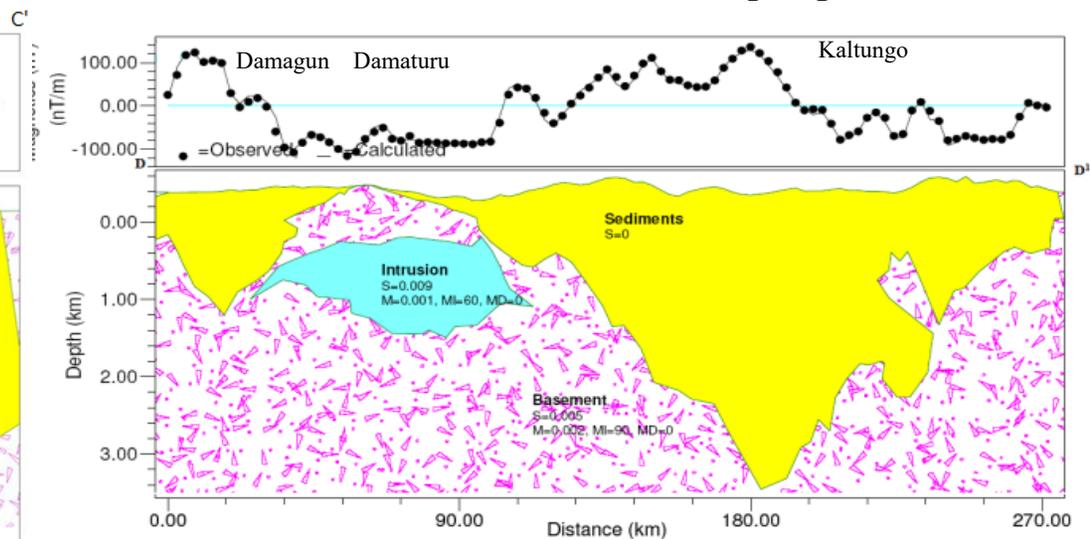
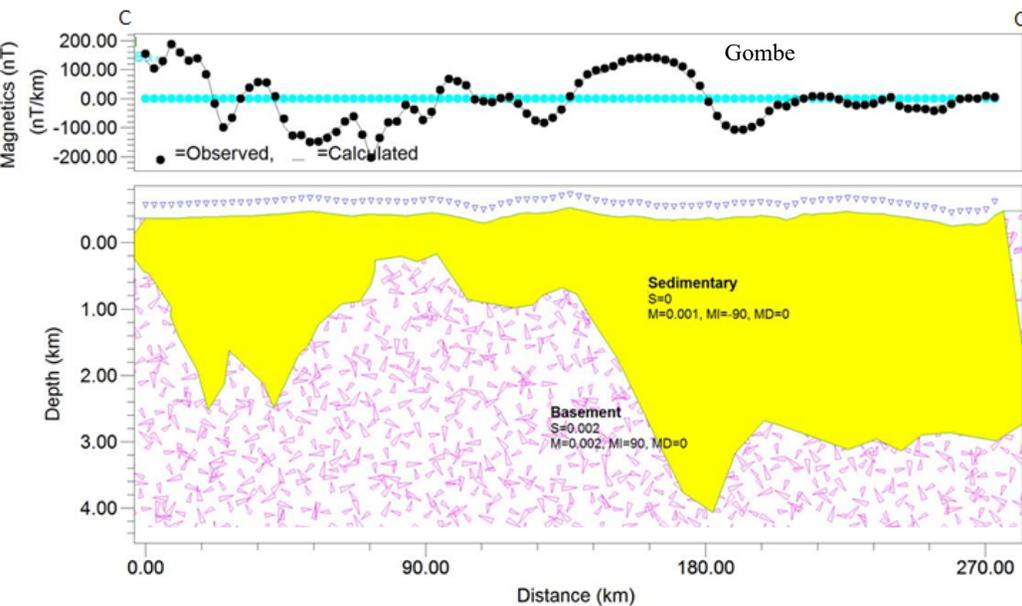
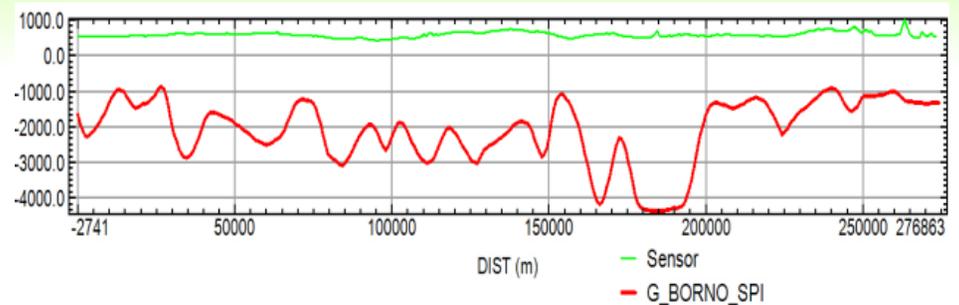
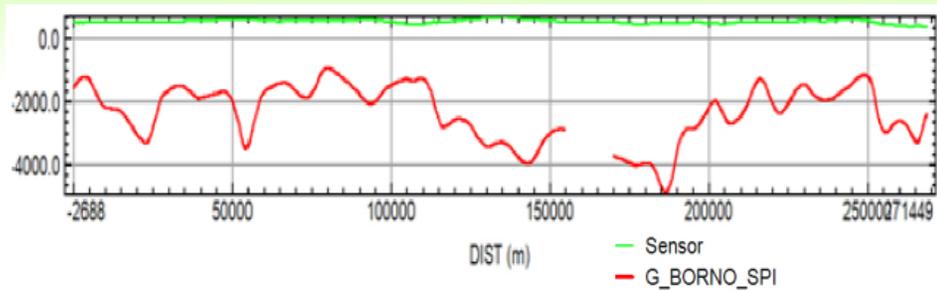


Figure 7: Model results for profile CC¹

Figure 8: Model results for profile DD¹

Results and Discussion Contd...

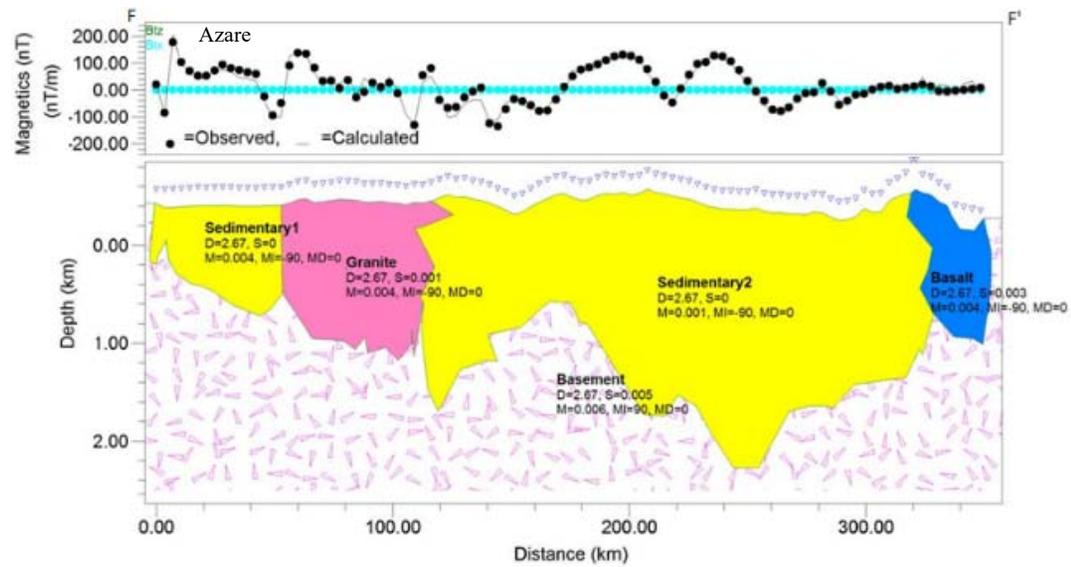
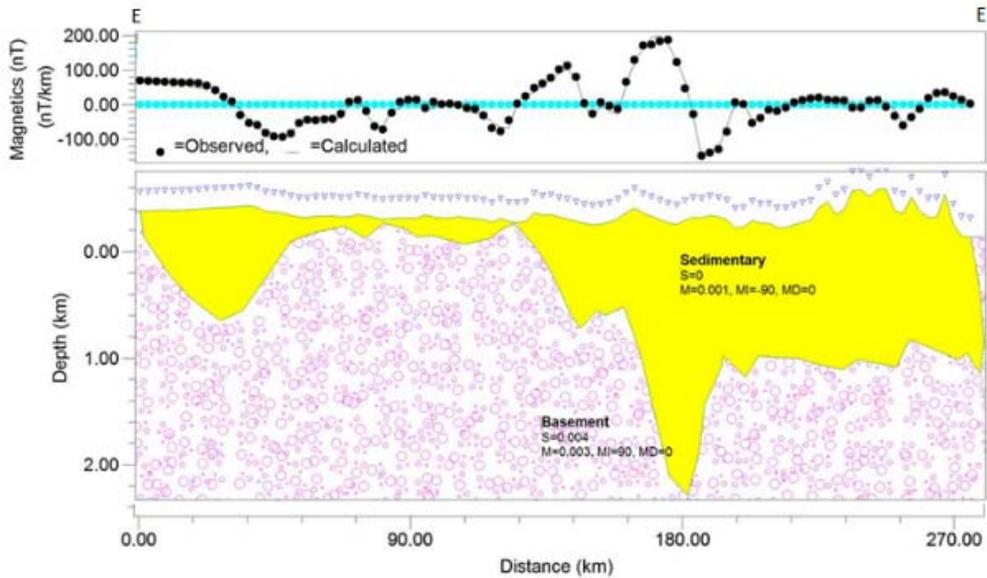
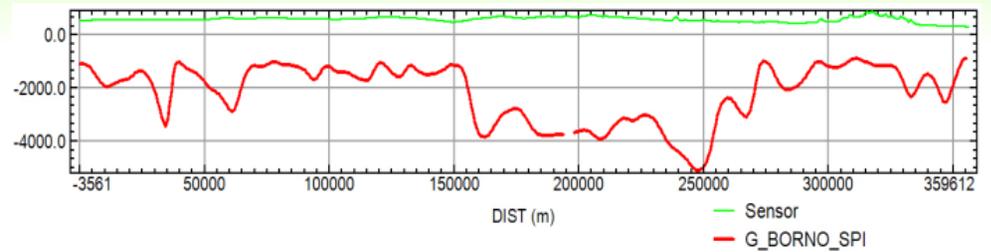
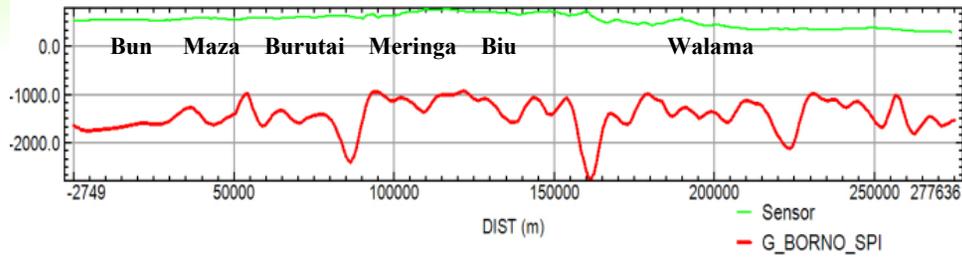


Figure 9: Model results for profile EE¹

Figure 10: Model results for profile FF¹

Results and Discussion Contd...

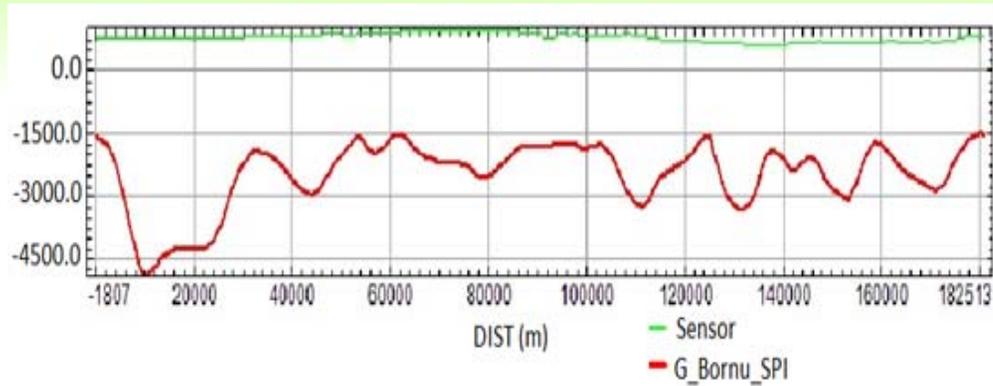


Figure 11: Model results for profile GG¹

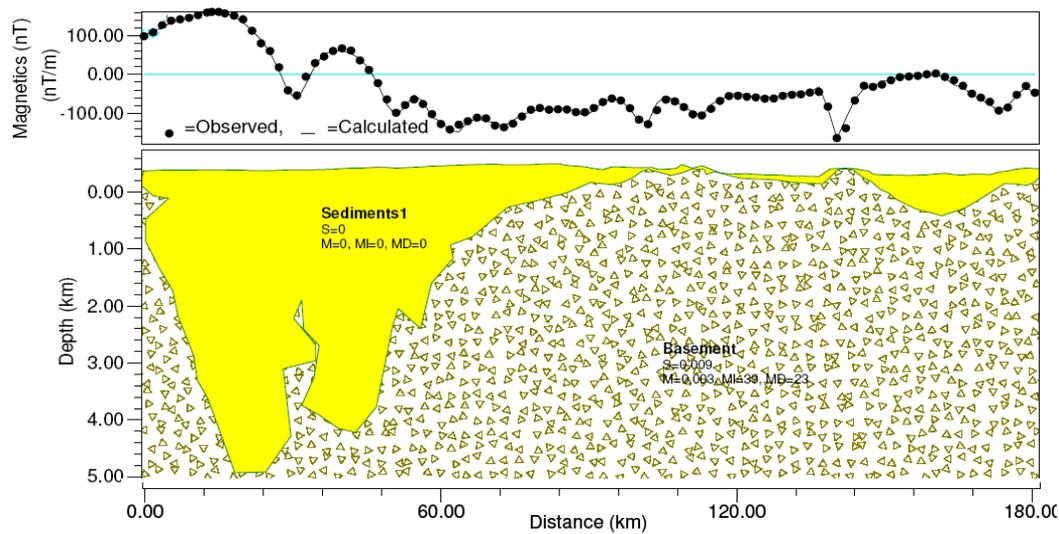


Figure 11: Model results for profile GG¹

Results and Discussion Contd...

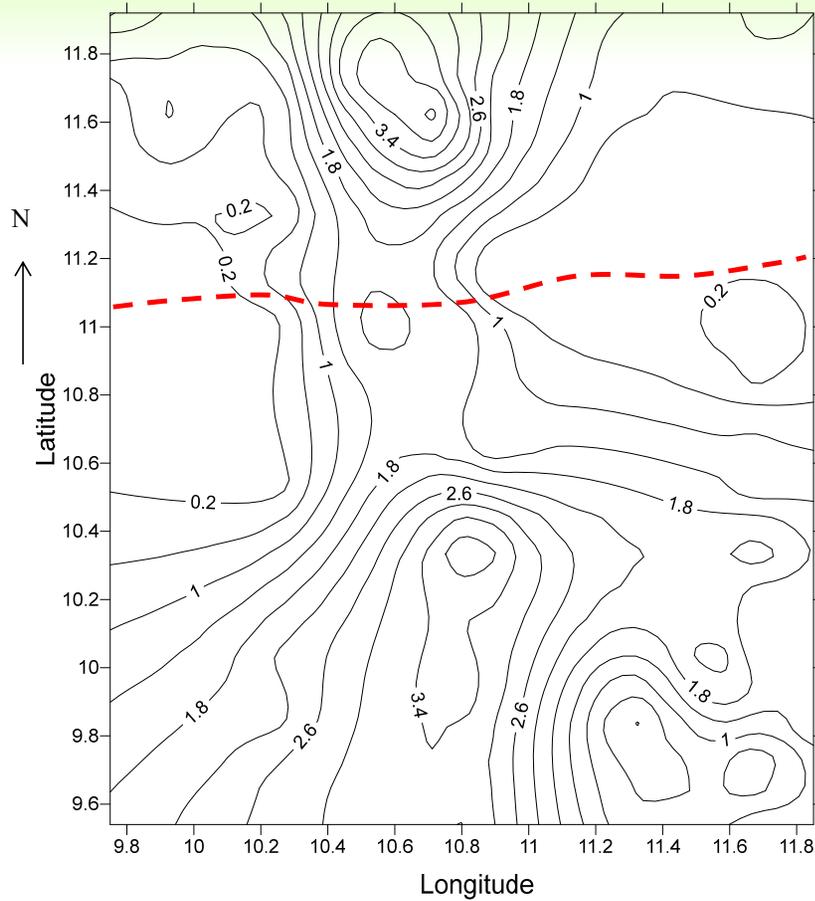


Figure 12: Contour map of sedimentary thickness obtained from 2D models of AA¹ to GG¹. Contour interval is 0.4 km

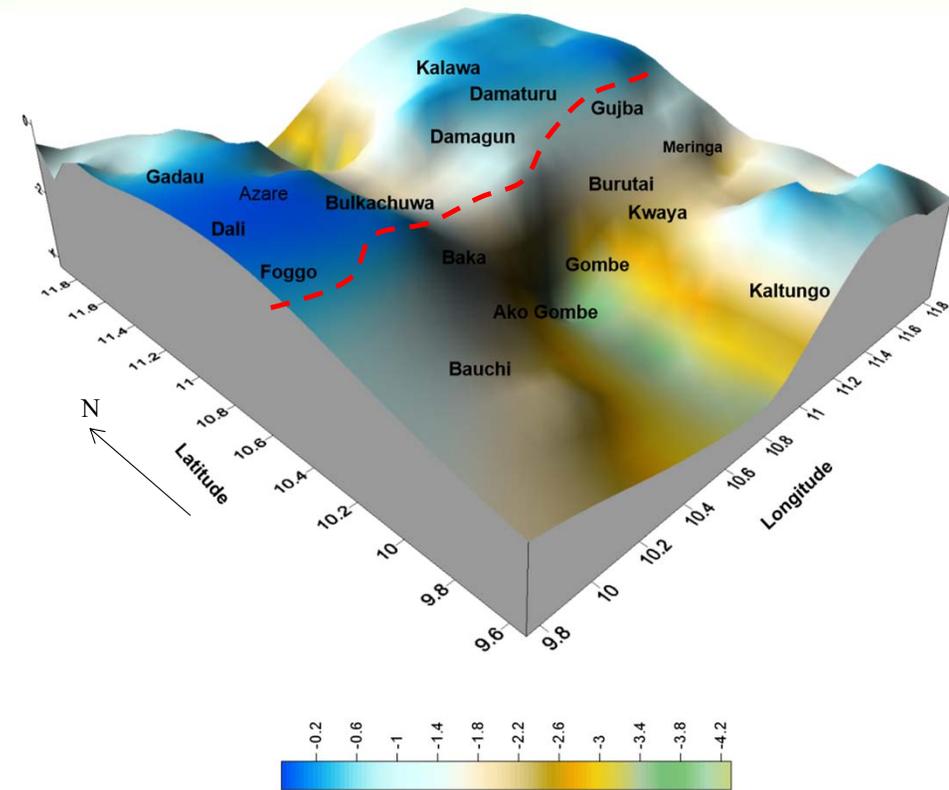


Figure 13: 3D surface map of profile depths obtained from 2D models of AA¹ to GG¹.

Results and Discussion Contd...

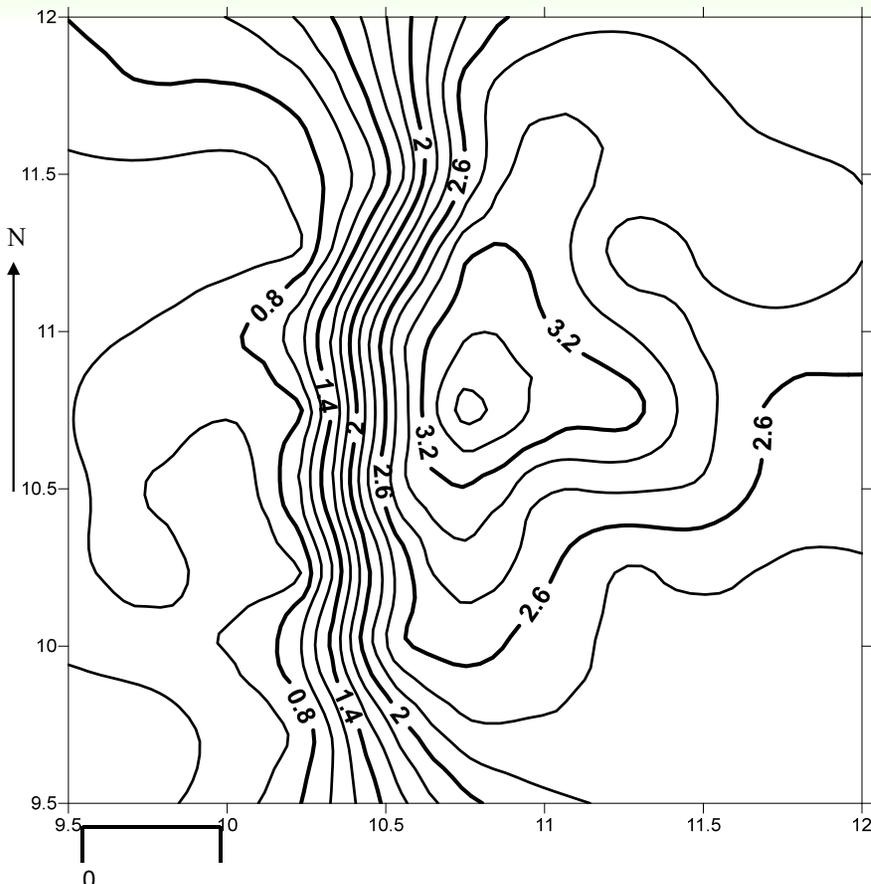


Figure 13: Depth to magnetic deep sources from spectral analysis superimposed on the results of the source parameter imaging (SPI) depth.

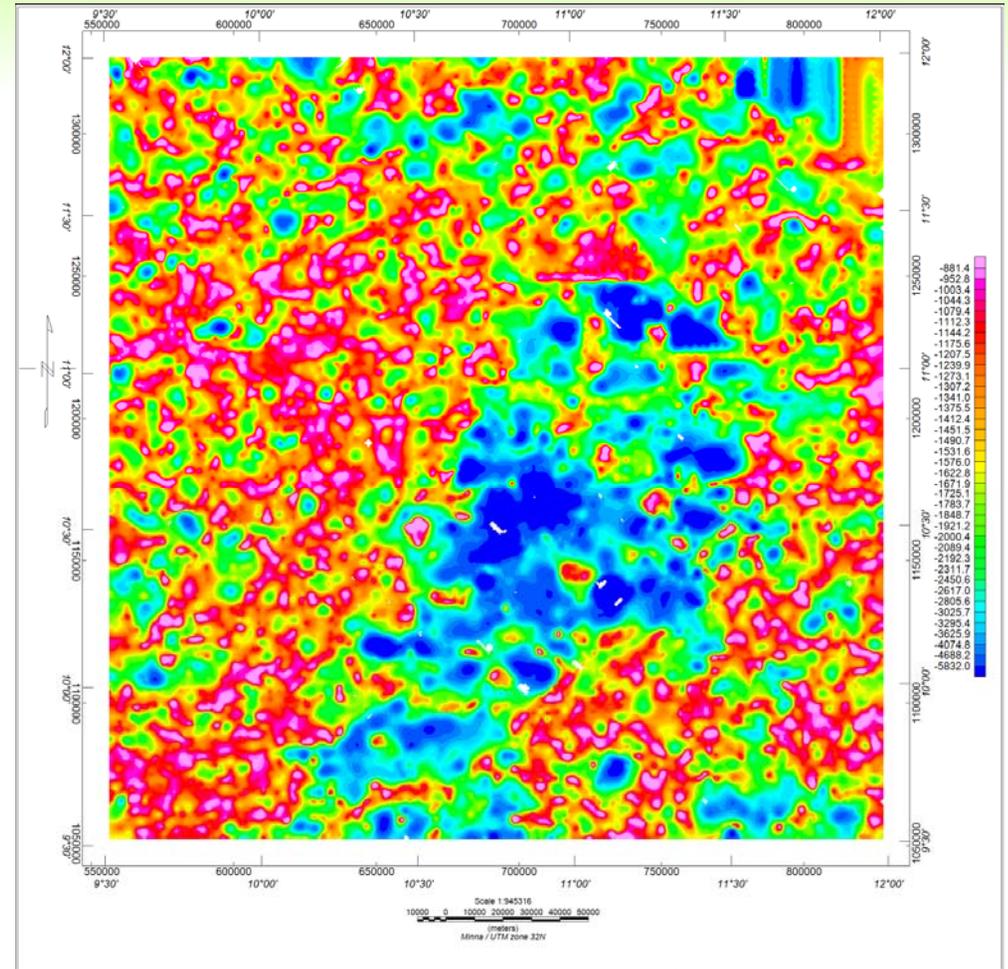


Figure 14: Depth determination from source parameter imaging (SPI). The colour bar shows the depth estimates in meters.

Results and Discussion Contd...

- Figures 12 and 13 show the depth estimate from the digitization of depth models obtained from Figures 5 to 11. Figure 12 is the contour map of the depth estimates from models AA¹ to GG¹.
- The maximum depth of 3.8 km is obtained at the southern part of the study area around Gombe and Ako Gombe.
- Similarly, the maximum depth of about 4.2 km is obtained at the northcentral part towards the northwest of Damagun, Damaturu and to the northeast of Azare. The minimum depths between 0.00 km to about 0.40 km were obtained at the basement area in the western part and in the east around volcanics area.
- Figure 13 is the surface map of the depth models. This result corroborates the results obtained from Salako (2014), Salako and Udensi (2013) and other notable results in the area.
- The dashed lines in Figures 12 and 13 marked the supposed separation between the Benue Trough and the Bornu Basin. This line passes through the study area at about latitude 11.0⁰ N as noted by Zaborski *et al.* (1998). They described the separation area to have occurred around Dumbulwa-Bage High at about latitude of 11.0⁰ N.

Conclusion

- The results of the 2D modelling showed that the sedimentary thicknesses ranged from 0.0 km to a maximum depth of about 5.40 km.
- The least sedimentary thicknesses obtained from this study could be found around Bauchi axis in the basement complex region, Kaltungo and volcanic area at the eastern part of the survey area.
- The results of this study also indicated that Borno Basin is separated from the Upper Benue Trough at about latitude 11.0° N to 11.2° N, which corresponds to “Dulbulwa-Bage High”.

Conclusion Contd...

- This separation could have been aided by the paleostructure called St Paul that passes through the area at that latitude
- The subsurface lithology obtained from 2D modelling of the residual field showed the presence of two lithological units. The sedimentary rock unit underlined by the basement rock consists of shales, sandstones, limestones, siltstones, clay and non-marine facies.
- The Basement rock units were composed of pegmatite, granite gneiss and migmatites.

RECOMMENDATIONS

- The highest sedimentary thicknesses were found around Gombe, AkoGombe, Bulkachuwa and Damaturu areas, with a value of about 3.80 km to 5.40 km.
- The highest sedimentary thicknesses obtained, which range between 3.80 km to about 5.40 km is adequate for the hosting of hydrocarbons.

Acknowledgments

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- FUT, Minna for providing funding through her UBR
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- *THANK*
 - *YOU*
 - *FOR*
 - *LISTENING*

