Integrated analysis of Gravity and Magnetic data in the Upper Assam shelf and adjoining Schupen belt area, -A critical review.

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Summary The exploration of oil and gas in the petroliferous Assam – Arakan Basin is continuing for several decades. The Gravity and Magnetic data play an important role in the exploration, planning and integrated geophysical data interpretation. Poor quality and sparse seismic data arising from tectonic complexities and rugged terrain particularly in the vicinity of the Schupen belt area confuse interpreter to estimate proper sediment thickness and identify the Basement marker in this thrust belt. Because of limitation of seismic imaging, the GM data can provide some meaningful information for interpreting the basement topography in the shelf as well as in the Schupen belt region.

The objective of this study is to bring out the prospect of thick Gondowna sediments through gravity modeling from the existing GM and Seismic data in the Schupen belt region and explanation of high magnetic intensity with a approach that ophiolite may be the cause of the tremendous magnetic high in the Schupen belt area. The highly deformed slices of ophiolitic rocks can be seen along a linear belt and parallel to the Schupen belt axis in Nagaland and Manipur states of NE India which are known as the Naga Hills Ophiolites (NHO). The principal rock types include dunite, harzburgite, lherzolite, wehrlite, pyroxenite and mafic volcanics. An Ophiolite is a section of the Earth's oceanic crust and the underlying upper mantle that has been uplifted or emplaced to be exposed within continental crustal rocks. So the the intrusion of ophiolite can't be ignored as easily as the Schupen belt is a thrust fold area and has evoled due to numerous thrusts developed due to colision of Indian Plate and the Burmese Plate

Two type of gravity modelling integrated with the available seismic data one with conventional approach that basement is rising up and other with a new approach that the basement is going down in the Schuppen belt area is discussed here. The second approach suggest presence of thick gondwana sediments of 5 to 8 km in the Schupen belt region, which may give rise to hydrocarbon potential in the area.

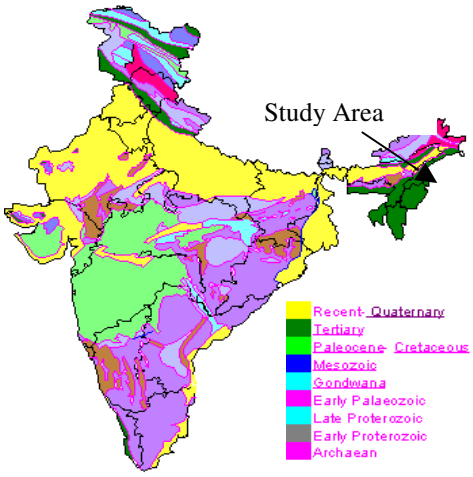

Fig1: Index map

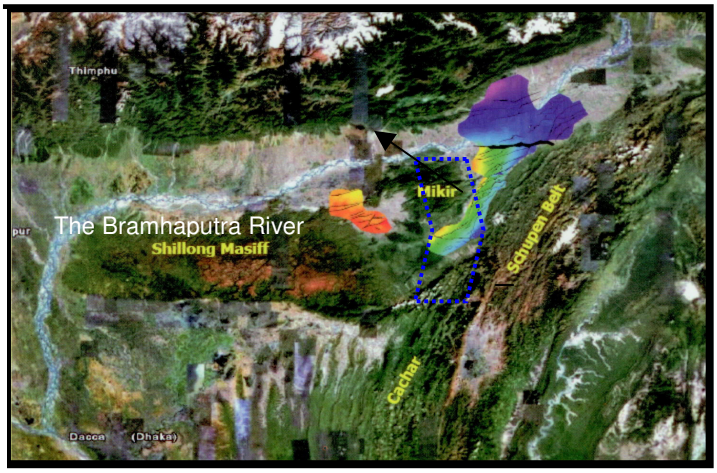

Fig-2: Upper Assam Shelf on Satellite Image.

Geological framework of Assam -Arakan Basin:

The Upper Assam foreland basin is situated in the far northeast of India, within curve of the Assam Syntaxis which is a major orocline in the Himalayan Orogenic Belt.The Assam geological province reflects three distinct tectonic phases. The earliest was Late Cretaceous to Eocene block faulting and development of a southeasterlydevelopment of a southeasterly dipping shelf.(Fig-1 and 2). During the second phase, in Oligocene time, uplift and erosion occurred north of the river Brahamaputra, and many basement faults were reactivated with many basement-controlled structures became prominent. Oligocene uplift and erosion were followed by late Miocene through Pliocene extensive alluvial deposition. The resultant sedimentary column is as much as 7,000 m thick. The thickest section is along the Naga thrust fault and in the Dhansiri Valley where it is greater than 4,500 m. The thinnest section lies along the axis of the central basement ridge, where it is less than 2,000 m thick .

Geologically, it is divisible into Eastern Himalayas in the north, Mishmi massif in the Northeast, Naga Hills in the southeast, Shillong and Mikkir Massifs in the southwest, upper Assam valley in the center and the Tripura-Manipur geosynclinal fold belt in the south (Fig-2). Each one of these units has its characteristic features. Between two hills, eastern Himalayas and Naga Hills lies the upper Assam Valley occupied by Brahmaputra and its tributaries. The Upper Assam valley, at present, represents an intermountain platform basin developed between the eastern Himalayas and Naga Hills.

The basin has thrust margins on three sides; The Naga Hills Thrust Belt and Manipur ophiolite belt is on the south ; the Main Frontal Thrust of the Himalayas, which was active from the mid Miocene to present-day, bends around the Assam Syntaxis is on the North and East .The basement of North East India comprises various Gondwanide fragments, mainly **Peninsular India** (Indian Craton) and in the **West Burma Block**, with the **Lhasa** and **Sibumasu Blocks** framing the regional picture.

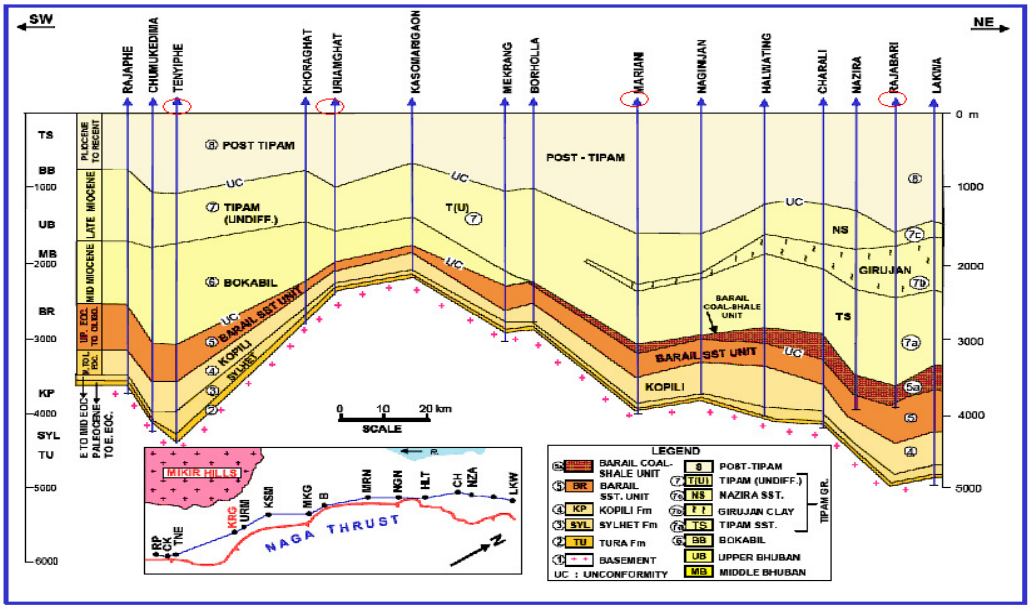

Fig-3: The Geological Section between the Bramhaputra and Dhansiri

The depth of the basement and sedimentay sequences along the naga thrust in the shelf area is given in figure-3.

GM Data Interpretation

The Bouguer anomaly map of Assam valley shows many interesting & peculiar features. In Upper Assam valley i.e. roughly between Brahmaputra river & Naga-Patkai hills though sediment thickness increases towards SE i.e. to Naga thrust the gravity anomaly instead showing corresponding lowering actually increases by 10 mgals (Fig-1). However further south east i.e. beyond Naga thrust the bouguer anomaly increases abruptly & continues to rise in the area where data is limited though sediment thickness is expected to increase significantly beyond Naga thrust. In Dhansiri valley area also the bouguer anomaly become more & more negative from eastern margin of Mikir hills to Naga thrust, mostly due to increase of sediment thickness (Fig-4).

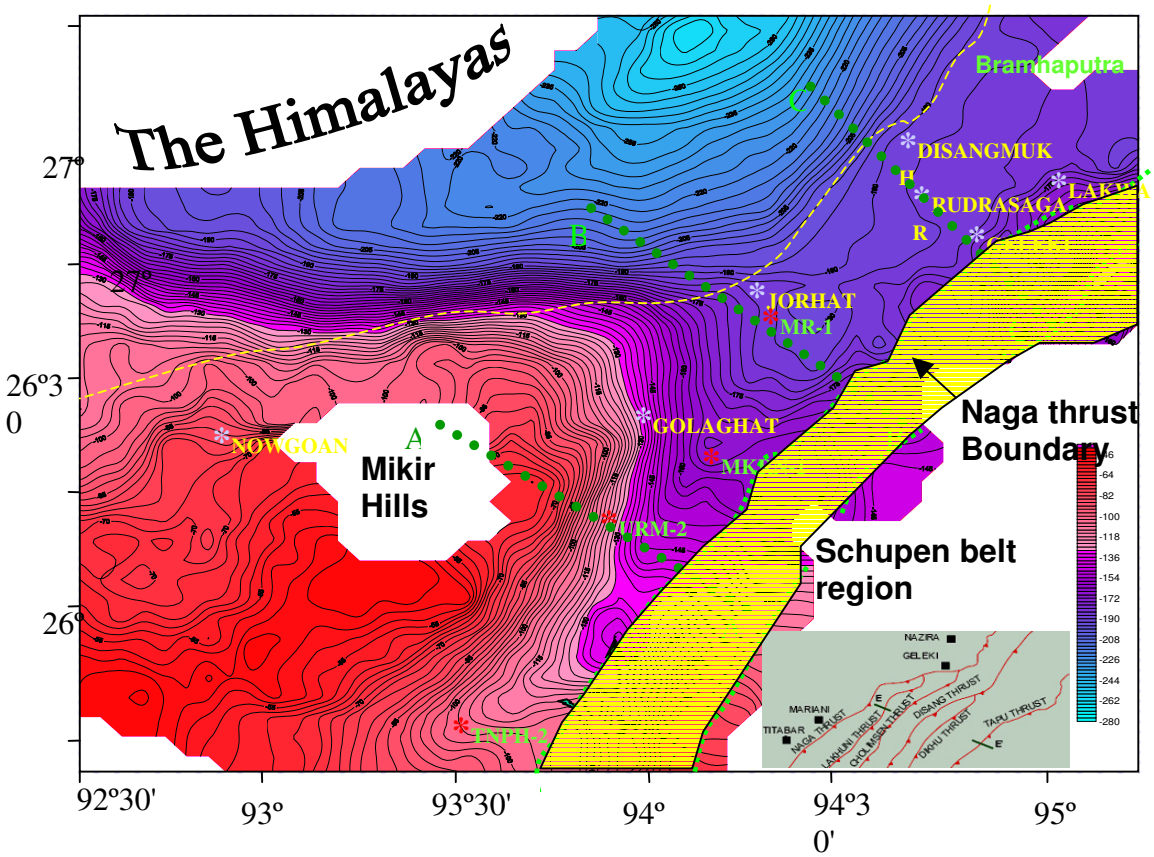

Fig-4 : Bouguer Anomaly Map(2mGal contour intervl) of Assam

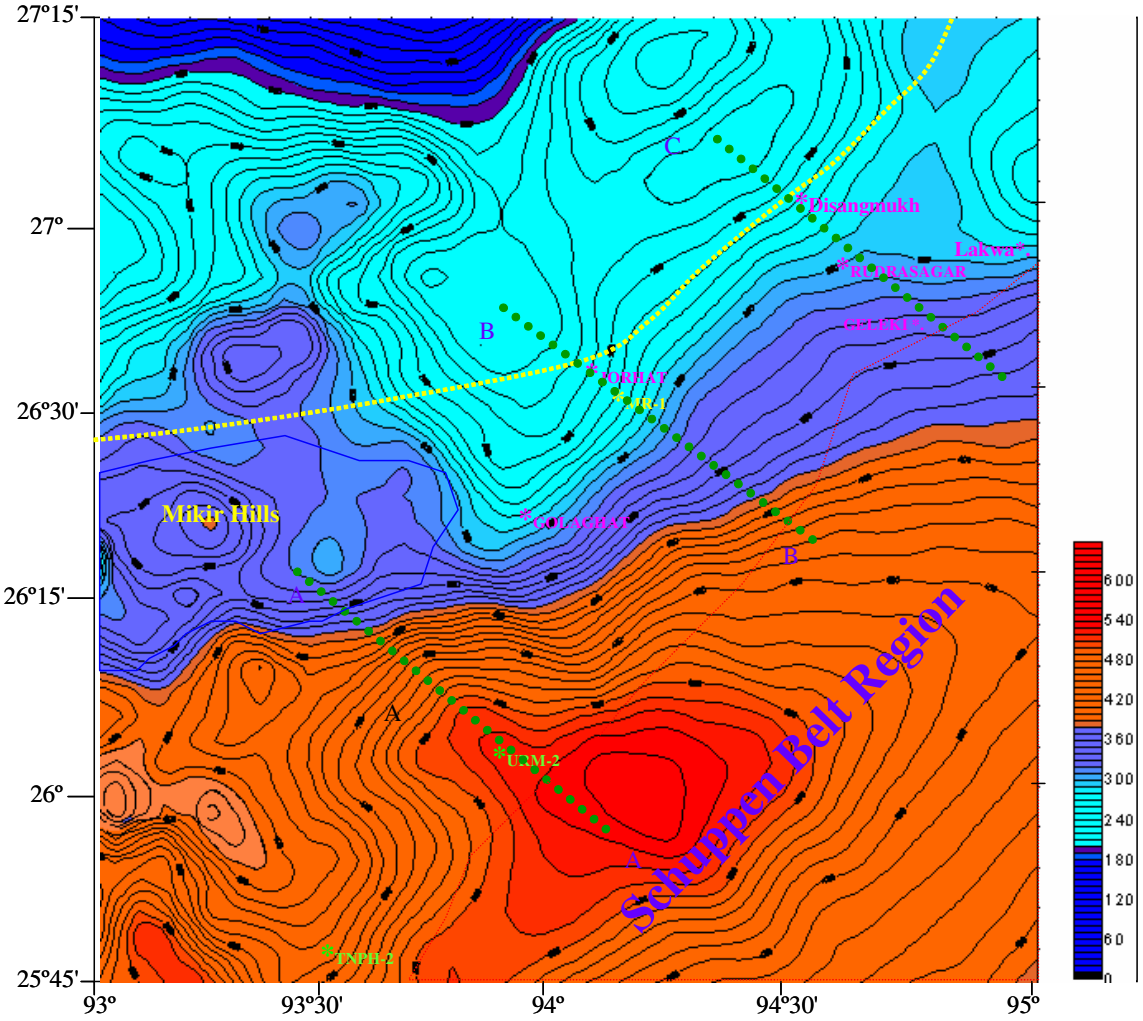

Fig 4a: Aero Magnetic Anomaly Map(10 gamma contour intervl) of Assam

Significant positive magnetic anomaly & progressive increase of bouguer anomaly implies that the area has been involved in basement involved folding i.e. basement has been pushed up tectonic deformation. With this idea gravity modelling along the along a seismic profile aa which is passing through the Well URM-2 has been carried out taking into consideration of drilled basement depth of 4320 mtr and the line is extended towards the Naga hills and the Mikir hills based on the gravity values only (Fig- 1 & 2), where increase of gravity anomaly has been explained by raising the metamorphic basement. But in this approach shows basement has to be modelled as shallow as 1.5 – 2.0 km deep, which is unrealistic (Fig-.7.)

Therefore presence of very thick volcanic type material, which has density around 3.0 gms/c.c and also highly magnetic, is presumed which will satisfactorily explain both gravity & magnetic anomaly pattern of the area. Model with this concept is prepared which shows presence thick igneous material (Ophiolite ?) underneath the sediment (Fig-

8).Implication of this model is that the folding has involved & moved up the oceanic basement (ophiolite ?) in this area.

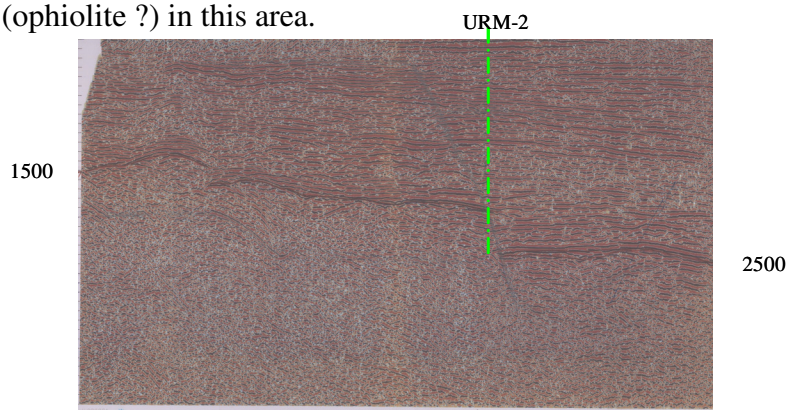

Fig-5: A Time Seismic Section (15 Km long) passing well URM-2

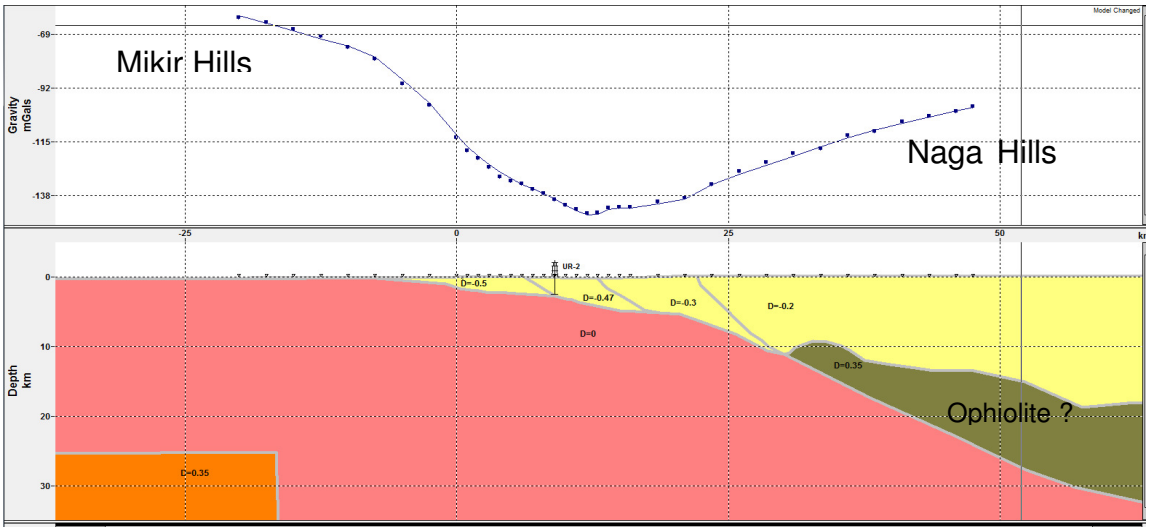

Fig-6 :Gravity Modeling along the line aa and passing through URM-2 .The line has been extended towards the Mikir Hills (NNW) and the Naga Hills (SSW) based on gravity values only.

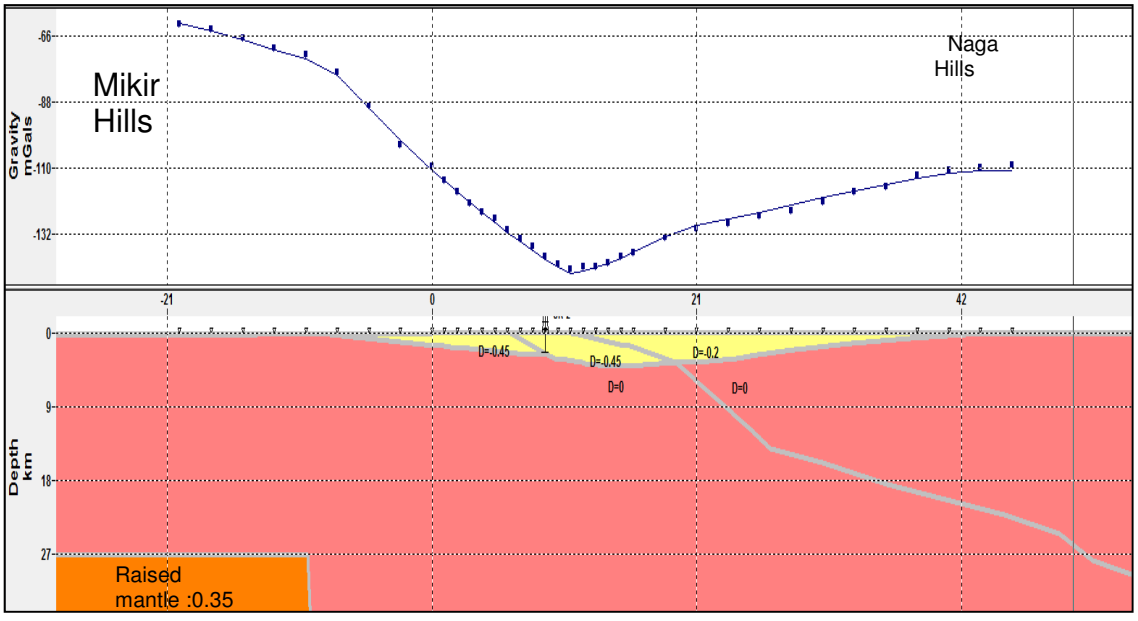

Fig-7:Gravity Modeling (Alternate Model) along a Profile (AA) Through Well URM-2. The modeling has been extended towards the Naga thrust (SE) and towards the Mikir Hills based on the Gravity value only.

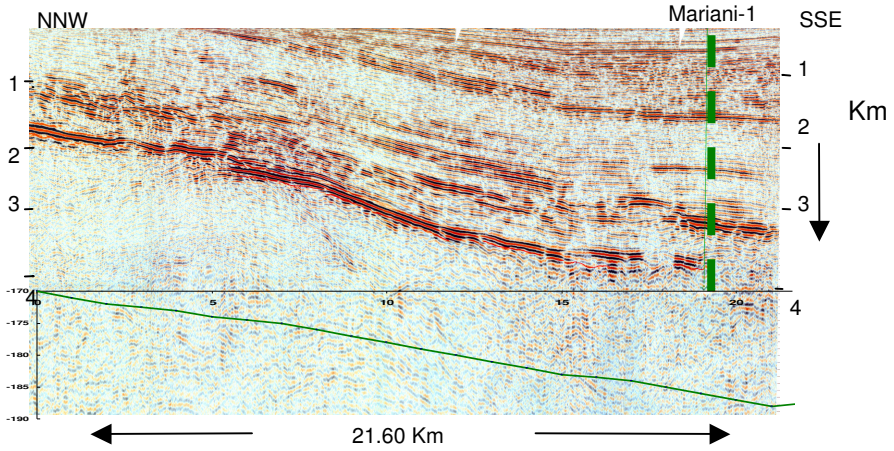

Fig-8 A depth Seismic Section starting adjacent to the Bramhaputra and ending near the Schuppen belt.

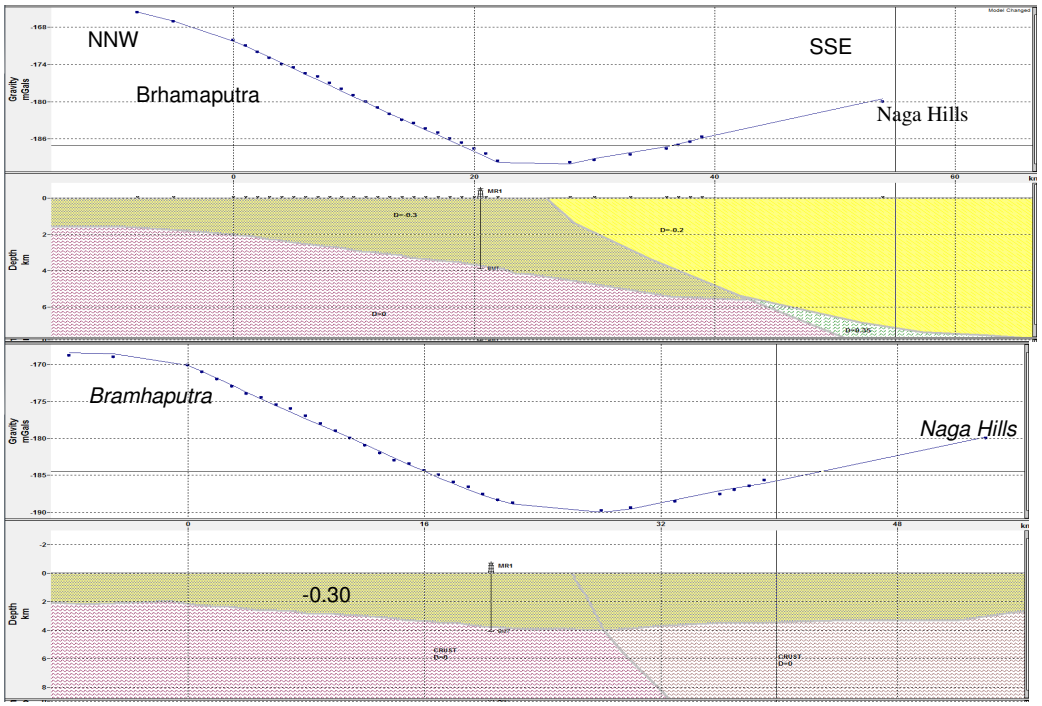

Fig-9 Two type of Gravity Modeling along a profile bb through Well MR-1. The Modeling has been extended towards the Naga Thrust (SSE) and towards the river Bramhaputra (NNW) based on gravity values only.

Similarly wih this approach of gravity modeling is carried out for profile BB (fig- 8 and 9) and for profile CC (fig-10 and.11). In both the cases basement is going down as it is evident from the seismic section thereby increasing sediment thicknesses near the naga

thrust whereas the gravity is going up which suggest that if we have to account for the raising of gravity accompanied by the high magnetic in the schupen belt region then we have to construct this type of modeling which would satisfy the data. This approach of intrusion of high magnetic material may be linked to the that the most geological feature of the thrust fold feature of the Schuppen belt area of the Arakan basin is related to the subduction of the Indian plate under the Burmese sub-plate and presence of volcanic rocks in the naga hills.(fig-12)

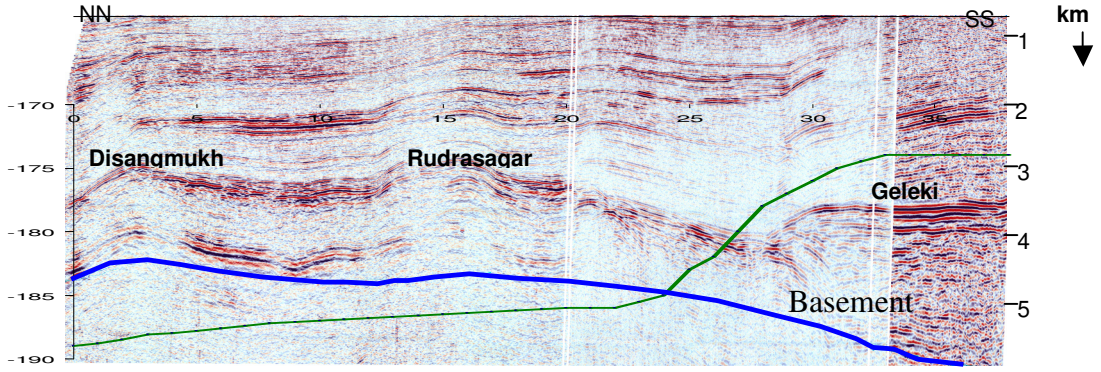

Fig-10 : A depth section from Disangmukh to Gelki field over which gravity values are posted

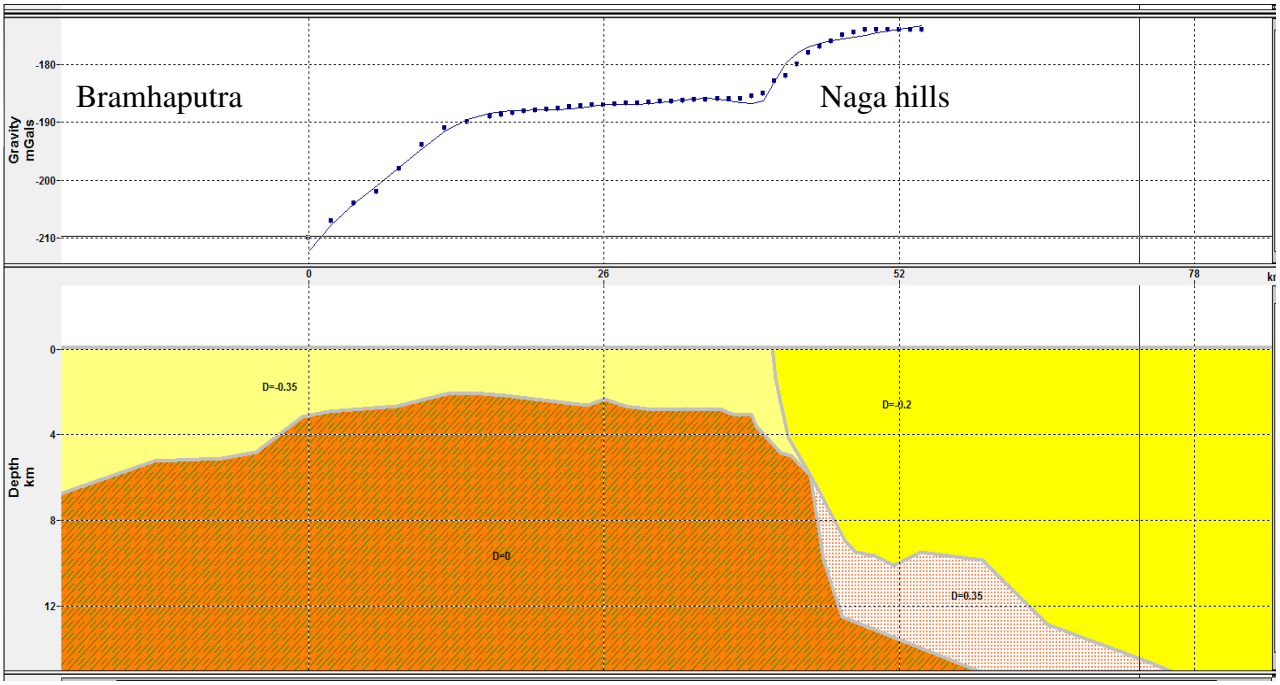

Fig-11 : Gravity Modeling along a line from the Disangmukh field to the Geleki field. The line has been extended toward the Naga hills (SSE) and beyond the Bramhaputra river, (NNW).

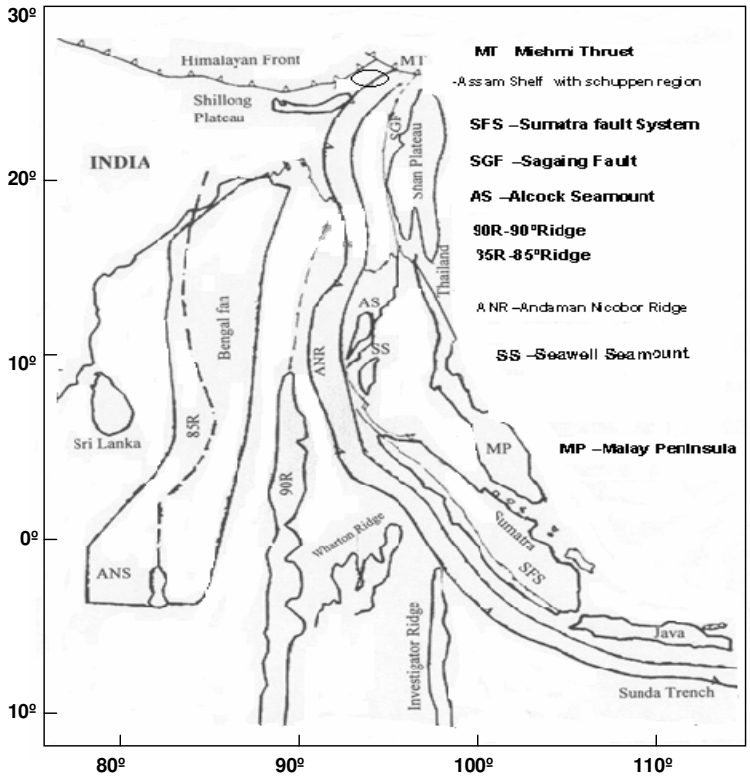

Fig-12 : Major tectonic features of Indian plate subducting under the Burmese plate

Conclusion-

The model discussed here where sediment thickness increases below the Naga thrusts contradicts the conventional approach that the sediment thickness decreases and the basement is shooting up in the Schuppen belt region. So lot of Scientific studies are required to arrive consensus on the basement behaviour in the schupen belt region . Gravity data points in the Schuppen belt area are sparse, Hence for better analysis it is recommended that the whole area may be covered by the close grid GM and magneto telluric survey along with field geological inputs. Seismic data with reasonable shot hole depth of 30-40 mtr particularly in the foothills would also provide useul information for imaging the Basement. So this is a major task before the exploration community to validate the model and explain the high nature of magnetic in the schuppen belt area.

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