also the contacts of the two formations within the group are unconformable. The Gondwana Supergroup has been subdivided into four groups, viz., (i) Singareni, (ii) Kamthi, (iii) Sironcha and (iv) Peddavagu (Figure 1).

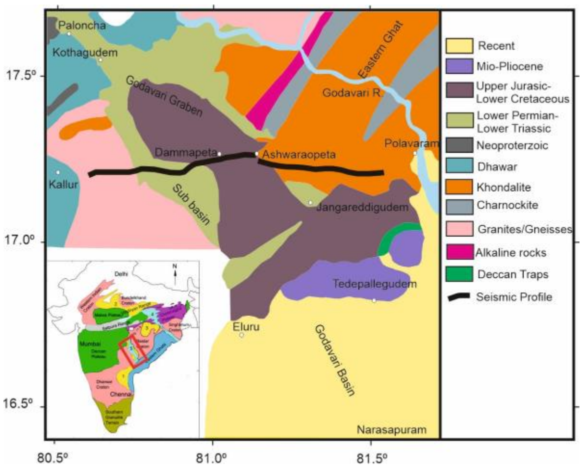


Figure 1: Geology map of the Godavari graben. Deep Seismic sounding (DSS) profile from Kollur to Polavaram is marked over it in black line.

3. Present Study:

3.1 Methodology:

The Magnetotelluric (MT) method uses the natural electromagnetic field variation to image subsurface resistivity structure, and usually involves measuring two horizontal electric field components (E_x and E_y) and three magnetic field components (B_x, B_y, B_z) at the Earth's surface, where the subscript x and y indicate the N-S and E-W directions respectively. This method is preferred due to the great depth of penetration over the seismic and provides information on resistivity. The shallow seismic depth section derived from DSS data along the Kallur – Polavaram 100 km long profile (Figure 2a) has been utilized to prepare the electrical resistivity model. The 11 MT stations (S_1 to S_{11}) are used with a station interval of 10 km to compute the Magnetotelluric response. The Gondawana sediments with resistivity of 50 Ω-m and crystalline basement with resistivity of 1000 Ω-m (Based on resistivity values given by Naskar and Saha, 2015) have been considered in the numerical model. The Gondwana sediments are located at Sattupalli, Dammapeta and Ashwaraopet at 20-70 km in this profile.

The 2-D resistivity model has been prepared from the resistivity values of the above profile, by using forward option in the WinGLink software (WinGlink, 2004). In this process, we have computed a model with the X-axis corresponds to distance in kilometers and Y-axis represents depth in meters. The entire resistivity section has been divided into 56 columns and 31 rows with a minimum cell width of 2.04 km and minimum column thickness of 49.75m. The blue colour in the model indicates basement with resistivity of (1000 Ω-m) and green colour indicates Gondwana sediments with 50 Ω-m resistivity. The final resistivity section derived for the above said DSS profile is shown in Figure 2b.

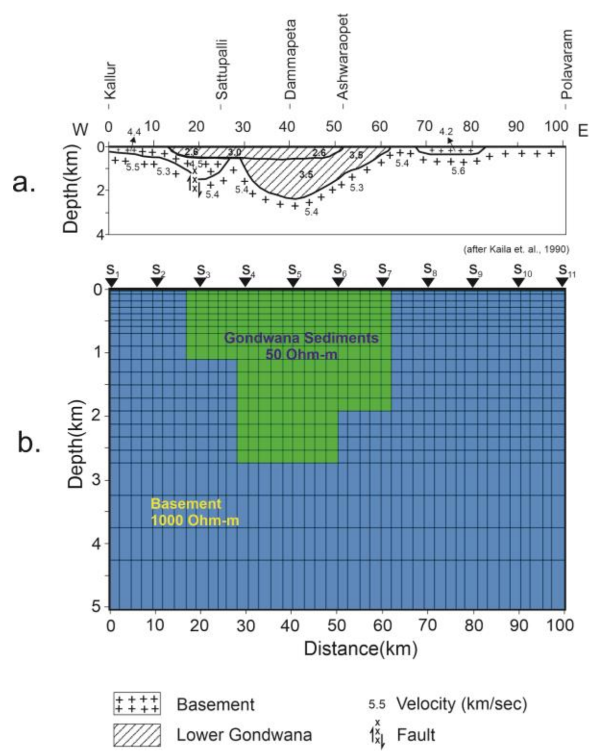
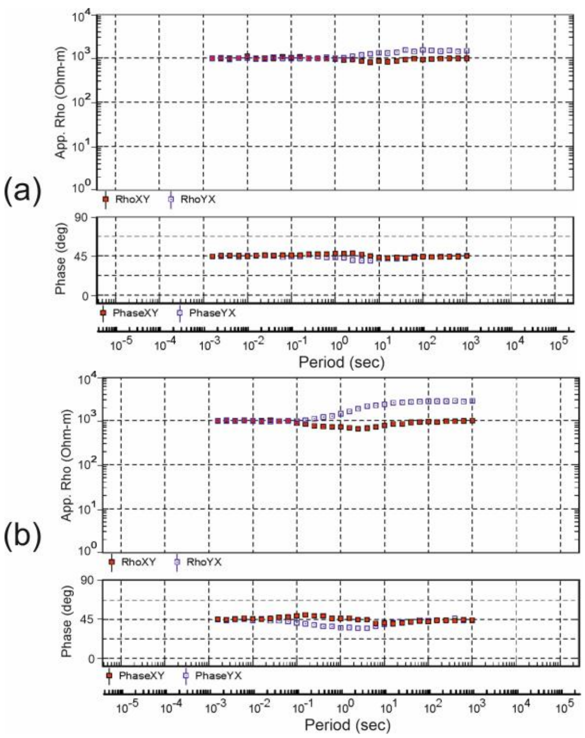
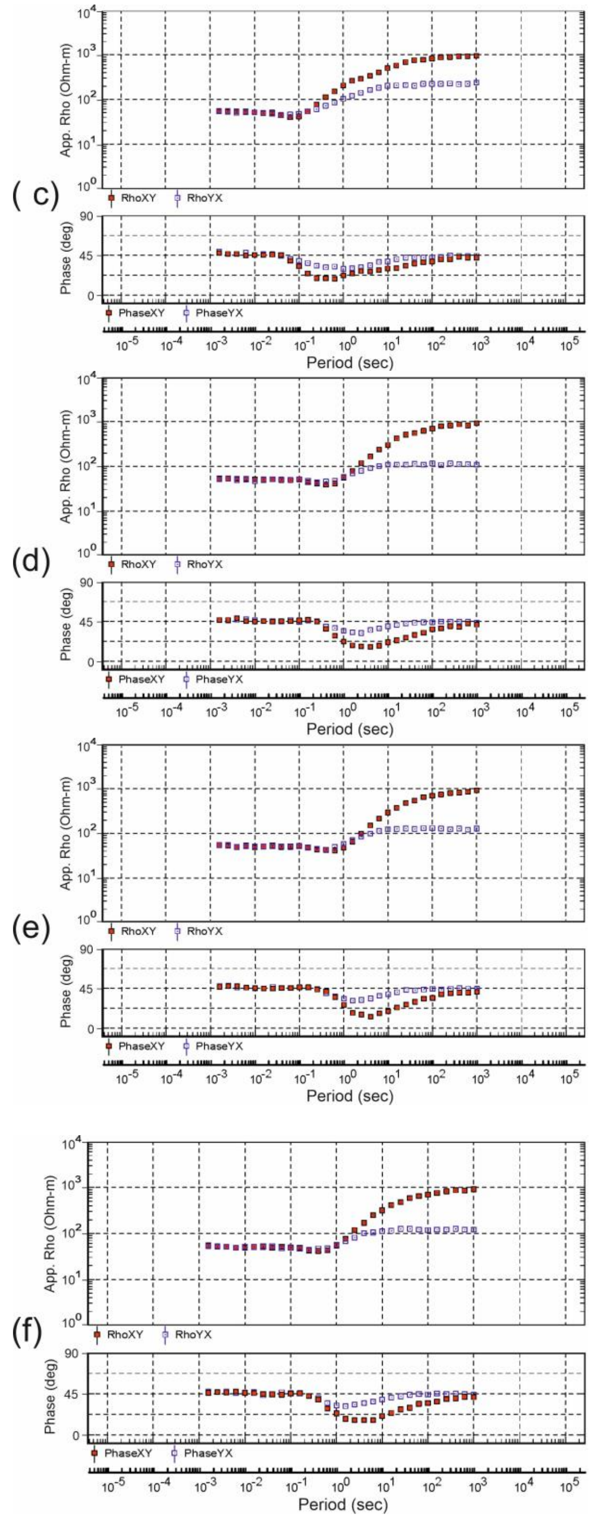


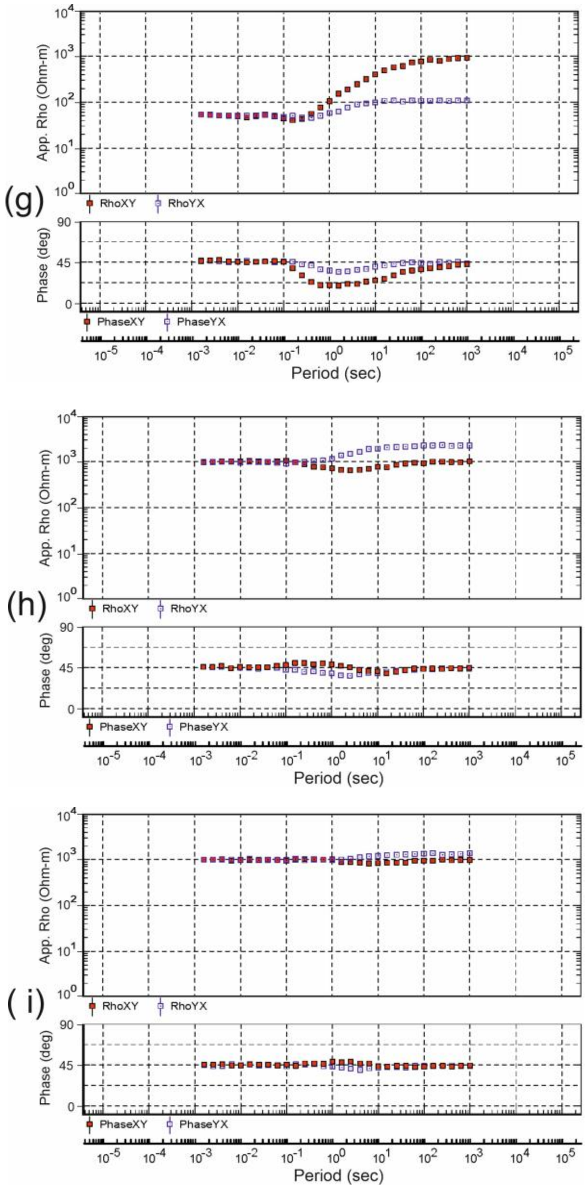
Figure 2: a. Basement configuration along the Kollur – Polavaram DSS profile (modified from Kaila et. al., 1990). b. Resistivity section derived from DSS results.

3.2 Numerical simulation of 2-D Magnetotelluric response:

MT response (Apparent resistivity and Phase) has been computed at 11 locations for both Rho_{xy} and Rho_{yx} covering 6 decades period (i.e. from 10^{-3} to 10^{3} sec). The numerically computed MT responses at 11 locations cutting across the Godavari graben are shown below the Figure 3. The X-axis is time period (sec) and Y-axis is apparent resistivity (Ω-m) and phase (degree). The red color curve indicates Rho_{xy} and the blue color curve indicates Rho_{yx}. The Rho_{xy} and Rho_{yx} curves overlapping each other indicate 1-D structure (i.e. no change in physical properties in horizontal direction) and the split between Rho_{xy} and Rho_{yx} indicates 2-D or 3-D structures.







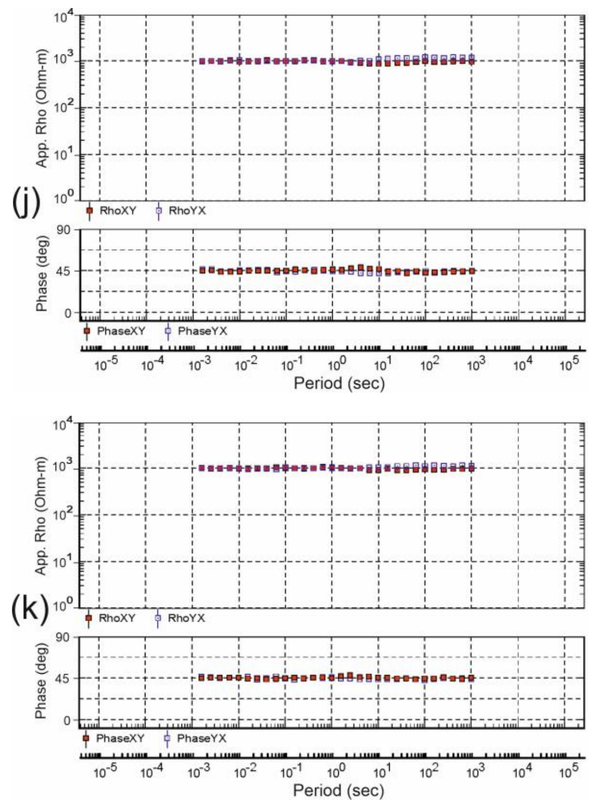


Figure 3. Variation in apparent resistivity and phase from 11 MT stations (a – k) along Kallur to Polavaram profile. Rho_{xy}: apparent resistivity along the strike, Rho_{yx}: apparent resistivity across the strike.

Rho_{xy}, Rho_{yx}, Φ_{xy} and Φ_{yx} responses at different locations:

- At S_1, S_{10} and S_{11} stations (0-10 km and 80-100 km), Rho_{xy} and Rho_{yx} curves are overlapping, i.e. the body may be 1-Dimensional (Figure 3a, 3j and 3k).

- At S_2, S_8 and S_9 stations (10-20 km and 60-80 km), Rho_{xy} and Rho_{yx} curves are split into Rho_{yx} curve is located above the Rho_{xy} curve, i.e. the site is outside the graben, but close to the fault (Figure 3b, 3h and 3i).

- At S_3, S_4, S_5, S_6 and S_7 stations (20-60km), Rho_{xy} and Rho_{yx} curves are split into Rho_{xy} curve is located above the Rho_{yx} curve, i.e. the site is within the graben but close to the fault (Figure 3c, 3d, 3e, 3f and 3g).

3.3 Apparent resistivity and Phase pseudo sections:

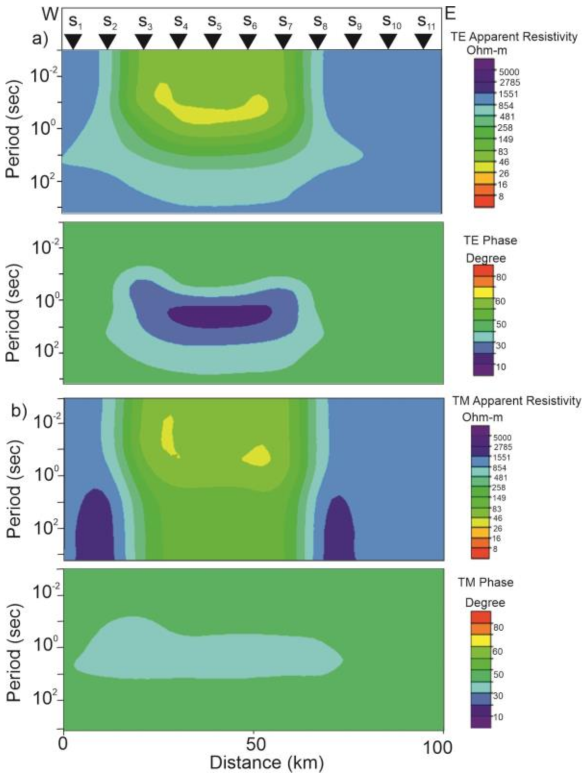


Figure 4: Pseudo sections of the modelled MT data along Kallur - Polavaram profile a) TE apparent resistivity and Phase pseudo section b) TM apparent resistivity and Phase pseudo section.

The TE (Transverse electric) mode apparent resistivity pseudo section is more clearly reflects 2-D resistivity structure, but the TM (Transverse magnetic) mode apparent resistivity pseudo section shows a low-resistive zone extending to deeper levels in the middle of the section. The sediments mostly composed nonmagnetic, so TM mode has poor resolution compared to TE mode (Figure 4).

4. Discussions and Conclusions:

In this study crustal seismic section derived from the deep seismic study by Kaila et al. (1990) has been transformed into the resistivity section to simulate Magnetotelluric response at different locations across the Godavari graben. The resistivity and phase components in the initial distance and in end of the profile, where the stations are away from the graben, almost overlaps and represents 1D structure below these stations. When the stations are located on the western and eastern side of the near the graben, the value of Rho_{yx} is more as compared to Rho_{xy}. The moment the stations are located in the graben, the value of Rho_{yx} becomes less as compared to Rho_{xy}. After crossing the graben again the value of Rho_{yx} is increased as compared to Rho_{xy}. The higher-frequency data correspond to shallower structure, where the lower frequency data correspond to deeper resistivity structure. The phase angle of $<45^{\circ}$ is between 20-60 km because of increases of resistivity with depth. The phase angle is 45˚ in remaining area, because of constant resistivity. The TE mode apparent resistivity pseudo section is more clearly reflects 2-D resistivity structure, but the TM mode apparent resistivity pseudo section shows a low-resistive zone extending to deeper levels in the middle of section. The sediments mostly composed nonmagnetic, so TE mode is more resolution compared to TM mode. From these observations, we interpret that shoulders of the graben can be traced by using nature of the sounding curves. The present method utilizes approximate resistivity values for the sediments in a virgin area.

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