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Regional magnetic profiles over Cuddapah basin north of 16° parallel

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ABSTRACT. Cuddapah basin, since the observation of high negative Bouguer anomalies, has been an area of considerable geophysical interest. The Geophysics Department of Andhra University has conducted regional magnetic investigations in the Cuddapah basin north of 16° parallel. The surface geology and a brief qualitative discussion of the anomalies observed are presented. Results obtained over eight long regional magnetic profiles across the Cuddapah basin are presented and discussed qualitatively. The possibility of the extension of the boundaries of the basin and a mid-basin uplift are indicated.

1. Introduction

Cuddapah basin has been an area of considerable geophysical interest since the observation of high negative Bouguer gravity anomalies over the basin sedimentaries inspite of their nearly equal or slightly greater densities compared to those of the rocks of the surrounding country. Glennie (1932, 1933 and 1951) had attributed these gravity anomalies to a downwarping of the crust. His explanation, however, did produce clinching evidence neither for the crustal downwarp nor an over thrust in the east. Interest in the Cuddapah basin has grown ever since and a vast volume of geological data and some geophysical data, mostly confined to local areas, had accumulated in recent years.

In its pursuance of a long range project of covering the entire State of Andhra Pradesh with a close network of gravity and magnetic stations, the Geophysics Department of Andhra University has already covered over 25,000 square miles over Gondwana basin, Godavari valley, Cuddapah basin and Eastern Ghats of Andhra Pradesh. In this paper, the results obtained over a few regional magnetic profiles laid across North Cuddapah basin, are discussed qualitatively.

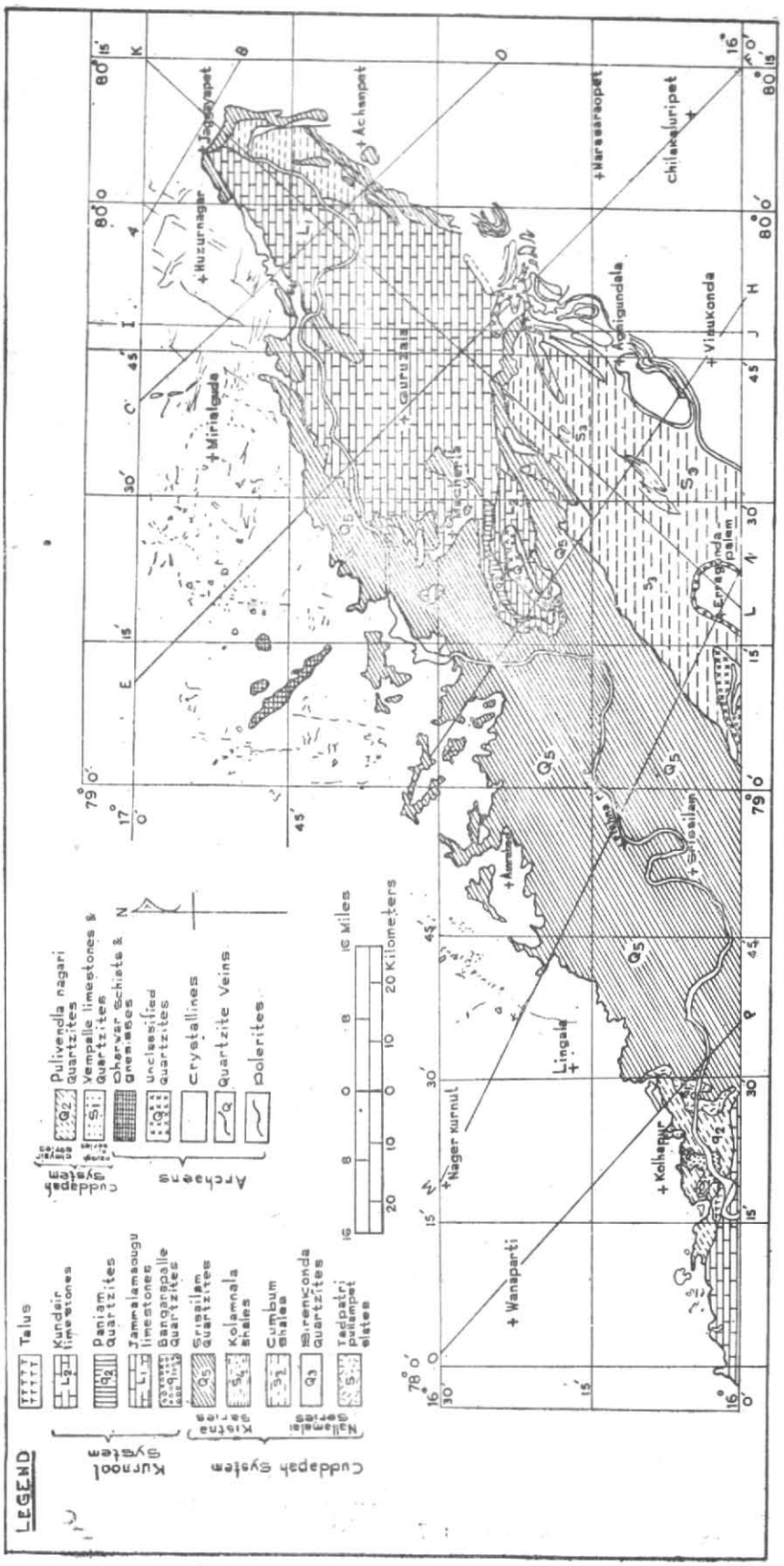
Fig. 1 presents the surface geology of the northern part of the Cuddapah basin and the adjoining country. Major part of the area is occupied by the older Cuddapah series, while the Kurnools are exposed in the southern and southwestern sides of the area. Srisailam Quartzites of Kistna series are found in the western part of the basin extending from the western boundary right up to the centre of the basin and as a rim enclosing it round the northern tip, and the eastern part, upto Nekanikallu. Outliers of Srisailam Quartzites are well recognised on the eastern as well as the western sides of the basin. Achampet dome is one of such outliers in the east.

Limestones are also extensively developed in the area. These are considered to be the equivalents of Jammalamadugus by King (1872), while Foote (1872) favours Cuddapah age for them. In the southwestern corner of the area also, Jammalamadugu Limestones are exposed. Cumbum Shales, the other major formation, are developed in the north and south along the eastern margin of the basin. All along the eastern margin, they are highly folded, contorted and overturned.

The other formations occurring in the area are a patch of Kurnools, consisting of Paniam Quartzites, Kundair Limestones and Banganapalle Quartzites in the centre of the area. Unclassified Quartzites are exposed at different places in the basin. In the southwestern side, Vempalle Limestones and Gulcheru Quartzites, Pulivendla/Nagari Quartzites and Tadpatri/Pullampet Shales are exposed.

2. Magnetic Surveys

The area has been covered by establishing more than 900 magnetic stations and the anomalies have been computed with reference to Vijayawada as the primary base ($H = 0.38$ Oe, $I = 20°$). The vertical magnetic isoanomaly map thus prepared is



GEOLOGY OF THE NORTH CUDDAPAH BASIN.

Fig. 1

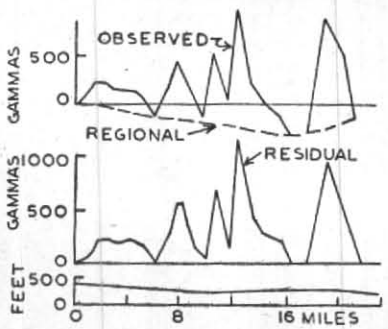


Fig. 2. Section AB

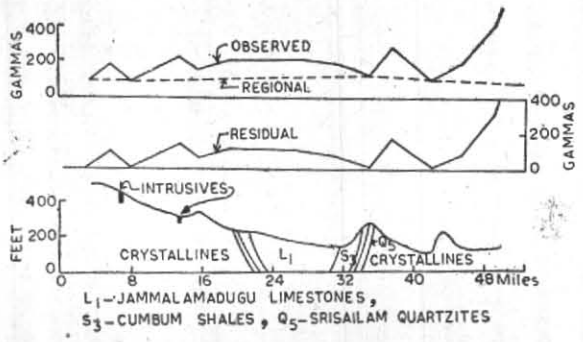


Fig. 3. Section CD

presented in Fig. 4. In contrast with the area outside, the basin is magnetically flat and clear magnetic gradients could be observed across the boundary on all sides of the basin. While the basin is generally characterised by a 200 gamma anomaly there are quite a few anomalies of the order of 300 gammas along the axis of the basin indicating a broad magnetic high in the middle of the basin. This magnetic high is supposed to be associated with basement configuration in the form of a mid-basin upliftment. The distribution of the magnetic anomalies in the eastern part of the basin and on the crystallines east of the eastern margin seems to suggest that the magnetically flat area of the basin seems to extend east beyond the eastern margin before intense magnetic fluctuations are encountered. The high and broad magnetic disturbance observed near Macherla has been surmised as due to a huge deep-seated structure and its possible causative relationship with the mineralisation along the eastern margin of the basin has been worked out. The presence of a singular series of ellipsoidal anticlinal domes (Foote 1880), along the eastern margin, could not find expression well in the magnetic anomaly picture. The area east of the basin from Jaggayyapet in the north to Chilakaluripet in the south is characterised by intense magnetic fluctuations. The anomalies northeast of Jaggayyapet are mostly local in nature and are, perhaps, caused by the float iron ore deposits. The intense tectonic disturbance and the igneous activity in the area resulting in numerous basic intrusives may account for the anomalies south of Jaggayyapet up to Chilakaluripet.

3. Magnetic profiles

Eight representative magnetic profiles AB to OP, six of them cutting across, one along (KL) and one (AB) outside the basin as shown in Figs. 1 and 4, traversing all geological formations in the area are presented and discussed qualitatively. In all the profiles the magnetic anomalies are plotted and the broad, low gradient regional variation is graphically estimated by drawing smooth curves through the magnetic lows in the observed anomalies. The regional anomaly is then eliminated from the observed anomalies to obtain a residual anomaly. These residual anomalies are plotted separately and studied in relation to the corresponding regional geological section presented with topographic relief (elevation above mean sea level in feet) under each profile as shown in Figs. 2, 3, 5-10. It may be pointed out that the regional magnetic variation is found to be fairly consistent and regular on all the profiles.

Section AB — This section (Fig. 2), outside the basin, is on crystallines. It starts near Kodad and runs in NW-SE direction for about 22 miles ending near Mundlapadu. This section is characterised by intense magnetic fluctuations over most of the Jaggayyapet area. The regional trend is smooth and regular and makes the residual anomalies positive over the whole section.

Section CD — Fig. 3 shows the section CD of about 50 miles in length extending from Lingal in the north to a point on the southern bank of the *Krishna* river 4 miles north of Garapadu. Starting on the Archaeans, it cuts across Srisailum Quartzites, Kolamnala Shales, Jammalamadugu Limestones, Cumbum Shales and again Srisailum Quartzites ending up on the Archaeans. Two major dykes, among many other minor intrusives, have been traversed by this profile in the area, west of the basin, and both of them are represented by positive anomalies of the order of 100 gammas. Over the basin, the residual anomaly remains nearly uniform. East of the basin, it gradually rises to a positive high of 400 gammas. A gentle and broad high can be observed in the anomalies over the basin, which is viewed as due to mid-basin upliftment.

Section EF — This section of about 94 miles long (Fig. 5) extends from Duppalapalle along Torgal, Utukur in the north upto Paruchuru on the

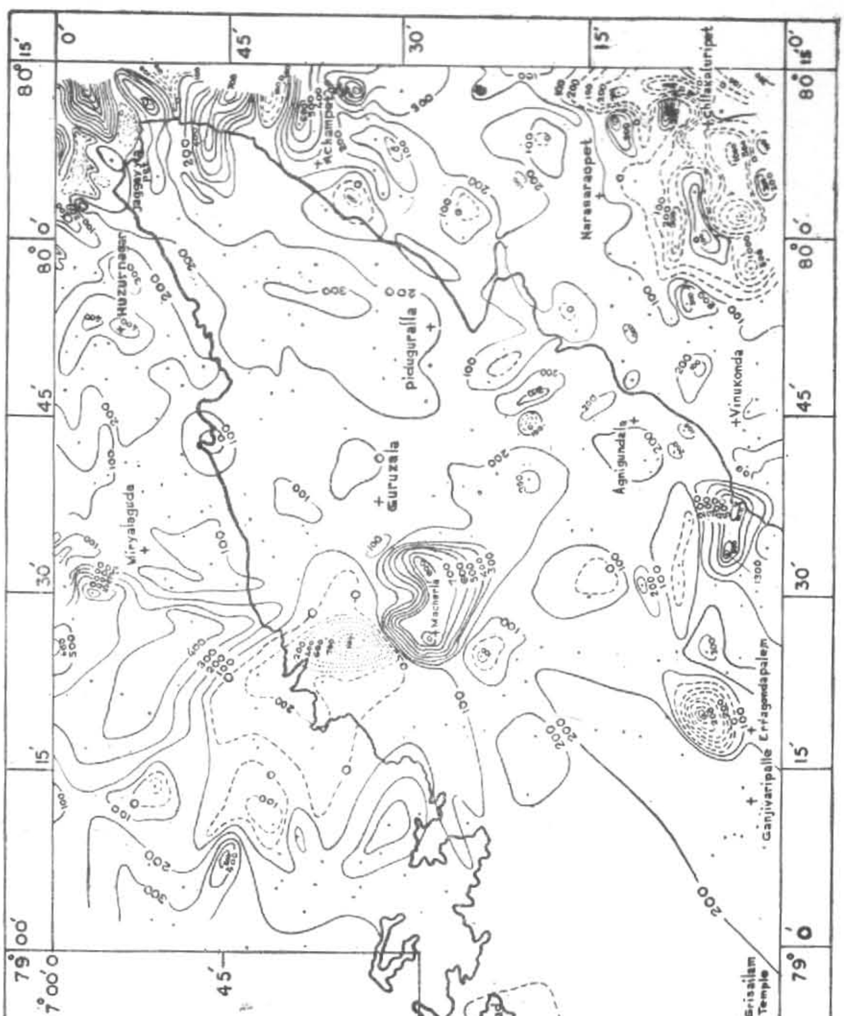

VERTICAL MAGNETIC ANOMALY MAP OF
NORTH CUDDAPAH BASIN
POSITIVE CONTOURS
NEGATIVE CONTOURS
BASIN BOUNDARY
16 Miles
20 Kilometers
Huzurnagar
Piduguralla
Guruzala
Miryalaguda
Macherla
Narasaraopet
Chilakaluripet
Vinukonda
Agnigundala
Erragondapalem
Ganjivaripalle
Srisailam Temple
Amrabad
Lingala
Nagar kurnul
Kothapur
Vanaparthi

Fig. 4

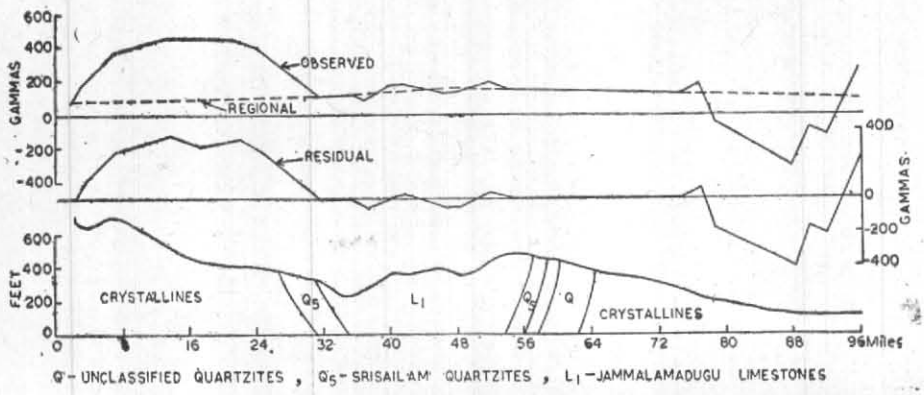


Fig. 5. Section EF

Chilakaluripet-Chirala road in the southeast. Starting and ending up on the Archaeans, over the basin it cuts across Srisailum Quartzites, Jammalamadugu Limestones and again Srisailum Quartzites followed by the unclassified Quartzites. A broad high anomaly of amplitude 380 gammas over the Archaeans followed by low anomalies of the order of 40 to 50 gammas over the sedimentaries are observed. The positive anomaly over the crystallines might be the combined effect of the numerous basic dykes reported in the area and shown on the geology map (Fig. 1). Except for the slight variations, the basin area is practically magnetically 'flat', whereas in the east, over the crystallines, the anomaly takes a negative turn and attains a value of —400 gammas becoming positive again a little further east. A clear demarcation could be seen in the magnetic anomalies between the area outside and inside the basin, in this section.

Section GH — Starting on the granites and gneisses of the Archaeans near Palutla west of Peddamunagal, this section (Fig. 6) of 60 miles long runs approximately NW-SE cutting through the Srisailum Quartzites, Jammalamadugu Limestones, Paniam Quartzites, Kundair Limestones, Unclassified Quartzites and again Kundair Limestones underlain and overlain by the Jammalamadugu Limestones followed by Srisailum Quartzites and finally ending up on the Archaeans again in the east near Enugupalem, southeast of Vinukonda. Though the profile extends across the basin, the basin is not clearly represented by the low magnetic anomalies in the profile. Starting from a positive value, it runs close to zero to some length and the anomalies fluctuate considerably in the middle of the basin, followed by low and uniform anomalies except for the few positive and the negative anomalies in the far east. The high fluctuations over the basin, especially over the patch of Kurnool formations and the subsequent Cumbum Shales are ascribed to intrusive activity reported there as shown in Fig. 1.

Section IJ — This section (Fig. 7) cuts across the northern part of the basin in the north-south direction and extends for about 68 miles. It traverses through the Srisailum Quartzites, Jammalamadugu Limestones, Unclassified Quartzites, again Srisailum Quartzites and finally ending up on the Archaeans. The anomalies over the basin show a definite high up to the contact between the Unclassified Quartzites and the limestones. Thereafter, the anomalies take a negative turn over the patch of granite gneisses. Subsequent positive anomaly at the contact between the quartzites and the Archaeans is followed by a broad low over the Archaeans. It is difficult to say whether the broad low, flanked by two positive anomalies, is in any way related to the Vellatur dome north of Vinukonda.

Section KL — Along the strike of the basin, in the NE-SW direction approximately, section KL extends for about 92 miles starting near Dabbakupalle in the northeastern corner of the map and ending near Erragondapalem in the south (Fig. 8). The formations traversed are Srisailum Quartzites, Cumbum Shales, Jammalamadugu Limestones and again Srisailum Quartzites, Cumbum Shales followed by a patch of Unclassified Quartzites. The initial part of the profile is marked by high anomalies of 600 gamma over the iron ore deposits near Jaggayyapet and these anomalies continue a little on to the Cumbum Shales also thus making it difficult to delineate the basin boundary from this section. Over the limestones, a broad positive high is again observed, followed by a negative trough like feature, and positive anomalies over the Cumbums. The Unclassified Quartzites are marked by zero followed by negative residual thereafter.

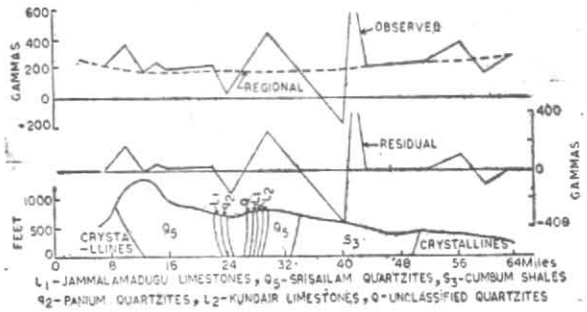


Fig. 6. Section GH

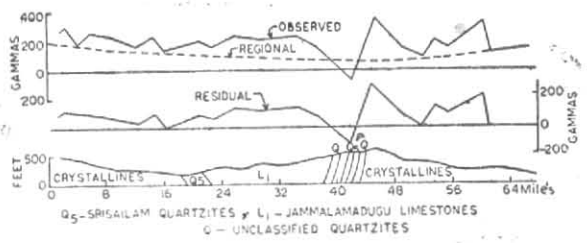


Fig. 7. Section IJ

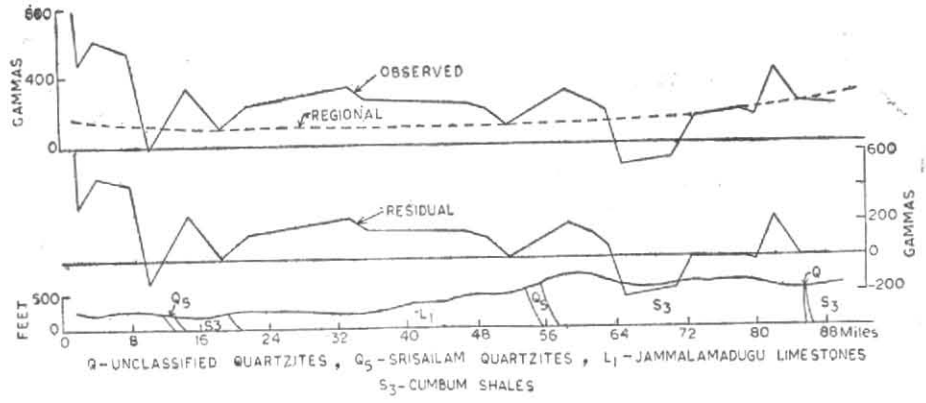


Fig. 8. Section KL

Section MN — Fig. 9 shows the lay of the section MN running approximately in NW-SE direction, starting in the western part of the area and ending up in the middle of the basin in the south. Srisailum Quartzites, Cumbum Shales and the Unclassified Quartzites are the formations traversed by this section in its 76 miles stretch. Two positive isolated anomalies appear on the western part followed by zero residual. These anomalies run similar as those in section CD produced by the dykes. But from the surface geology on this profile no dykes are indicated. Over the middle of the basin, the profile shows a broad high characteristic of the basin, due to the mid basin ridge feature.

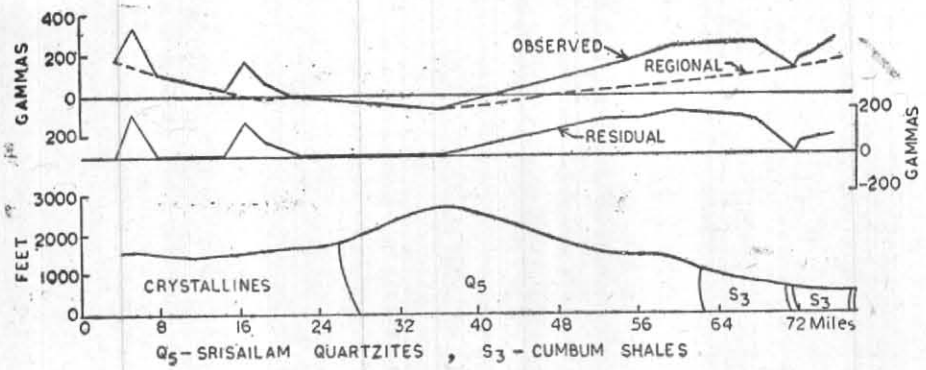


Fig. 9. Section MN

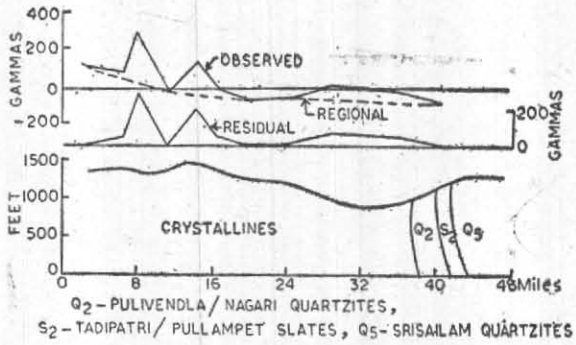


Fig. 10. Section OP

Section OP—This section taken in the western part of the area runs roughly in NW-SE direction from Varaipalle, north of Wanaparti to Peddawat on the bank of *Krishna* river, 2 miles east of Kolhapur. Most of the section runs on granites and gneisses (Fig. 10) and only near the end it crosses the formations in the basin, the Pulivendla Quartzites Tadpatri Slates followed by Srisailum Quartzites. The anomaly profile shows two highs of 300 and 200 gamma in the beginning followed by negative anomalies. The profile shows practically no anomalies over the basin. It may be noticed that the anomalies become smooth subsequent to the two positive anomalies, indicating the suggested boundary extension on to the north.

4. Conclusions

All the magnetic profiles presented above, have generally shown a clear contrast between the sedimentaries in the basin with the surrounding country rock. The anomalies over the basin, especially in the northern part, have shown a broad magnetic high in the middle, indicating the possibility of the existence of a mid-basin ridge. Most of the profiles, that cut across the eastern as well as the western boundaries have represented the suggested extensions of the basin on to the east and west beyond the present boundaries. The possibility of the existence of two separate basins of subsidence, suggested by Heron (1947) has to be re-examined, as it has been indicated slightly in the section KL along the axis of the basin. The various formations encountered in the area are practically nonmagnetic and so their individual representation could not be seen in any of the profiles. The Unclassified Quartzites, wherever they are traversed, have been represented by zero residual anomaly.

The trend of the regional magnetic anomalies is quite consistent in all the profiles with a very broad and gentle low over the basin and a gradual decrease towards east.

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