JOURNAL OF GEOPHYSICAL RESEARCH, VOL. 87, NO. B2, PAGES 1107–1120, FEBRUARY 10, 1982

The Bangui Magnetic Anomaly: Its Geological Origin

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Satellite magnetometer data have revealed a long-wave length magnetic anomaly in the vicinity of Bangui, Central African Republic. Substantiation of the anomaly has been made through analysis of air and ground magnetic surveys. A correlative gravity anomaly has also been observed in ground gravity data. The anomaly, in an area of highly metamorphosed Precambrian rocks, does not correlate with any surficial features but is definitely crustal in origin. An interpretation consistent with all available geophysical and geological data is that the anomaly could be the result of an early intrusion into the crustal rocks of this region, followed by subsidence and deformation.

INTRODUCTION

During the past decade the concept of utilizing magnetic measurements from satellites to study crustal regions of the earth has intrigued a steadily increasing number of earth scientists. The initial paper by *Zietz et al.* [1970] indicated the potential for such work, and the quasi-global magnetic anomaly map published by *Regan et al.* [1975] demonstrated that anomalies of scales commensurate with crustal features could be derived from such data. However, the many complexities of analyzing and reducing satellite data inhibited its direct application to crustal studies. Also, the dimensions of the anomalies observed in the data raised intriguing questions regarding crustal structure and magnetization. Nevertheless, various studies [e.g., *Regan et al.*, 1973; *Langel et al.*, 1975; *Mayhew and Davis*, 1976] repeatedly called attention to the potential of such data and ultimately led to the highly successful MAGSAT program.

One feature on the original map by *Regan et al.* [1975] that has been studied in detail and often used as an example of the utility of satellite magnetics is the anomaly situated over central Africa. This feature, the first to be identified in satellite magnetometer data and termed the Bangui anomaly, is of particular interest because it is an unusually large, isolated anomaly occurring over a stable continental interior.

This paper presents an analysis of this interesting anomaly. This analysis, the first of its type, is not complete owing to the lack of direct information on the hypothesized causative body. However, by considering the satellite data as well as correlative geophysical and geological data, a plausible geological origin can be put forth for the anomaly. The postulated origin of the anomaly raises many questions on the structure of this particular part of the crust that may have some bearing on other areas of the globe and that may be answered by detailed studies of this and other anomalies in the MAGSAT data.

MAGNETIC ANOMALY

The analysis and reduction of satellite magnetometer data for anomaly studies have been described by *Regan et al.* [1975] and *Regan and Davis* [1975]. The most desirable data are those obtained when the geomagnetic field is undisturbed and the satellite is at as low an altitude as possible. To obtain such data from the POGO satellites [*Cain and Langel*, 1971], which operated during a period of variable magnetic field activity and over an altitude range of 400–1500 km, the available measurements were screened to select only those made at low altitude and during minimum magnetic field activity.

A regional-residual separation, in which the regional field was modeled by a function of four variables (latitude, longitude, geocentric distance, and time), was then utilized to define anomalies. This function was computed by the least squares fitting of a thirteenth degree and order spherical harmonic series to the observed data on a global basis. The anomalies, or residuals, termed ΔF, were then defined as the difference between the measured and computed total field values at each measurement point.

In examining residual values obtained on individual satellite passes, a secondary minimum was noted near the equatorial electrojet anomaly over the area of central Africa [*Cain and Sweeney*, 1973; *Regan et al.*, 1973]. This feature was quite evident when only the midnight (local time) parts of individual orbits in this area were examined (Figure 1). Further examination of all the satellite passes revealed the anomaly to be independent of satellite, local time, and geomagnetic activity. The anomaly amplitude was also found to decay in a consistent and predictable manner with altitude. The ΔF values in the area of the anomaly were averaged over 1-deg latitude-longitude blocks to determine its areal extent. The resulting map (Figure 2) shows the total field magnetic anomaly at an average altitude of 525 km. The anomaly, centered over an area slightly north of Bangui, Central African Republic (formerly Central African Empire), is a broad low, trending approximately east and having a maximum amplitude of -12 nT.

Two Project MAGNET [*Stockard*, 1971] flight lines that cross the area of the anomaly at an altitude of 3 km provide an independent check of the satellite data. Residual values of these data (lines T217 and T207) relative to the thirteenth degree and order field model were calculated and are shown along the flight paths in Figure 3. These reveal a magnetic low of approximately 800 nT over a broad area of 200–300 km along each flight line. The anomaly is also quite apparent in the raw (measured) values of the Project MAGNET data and thus is not an artifact of the field model or any subsequent data reduction.

Paper number 1B1528.
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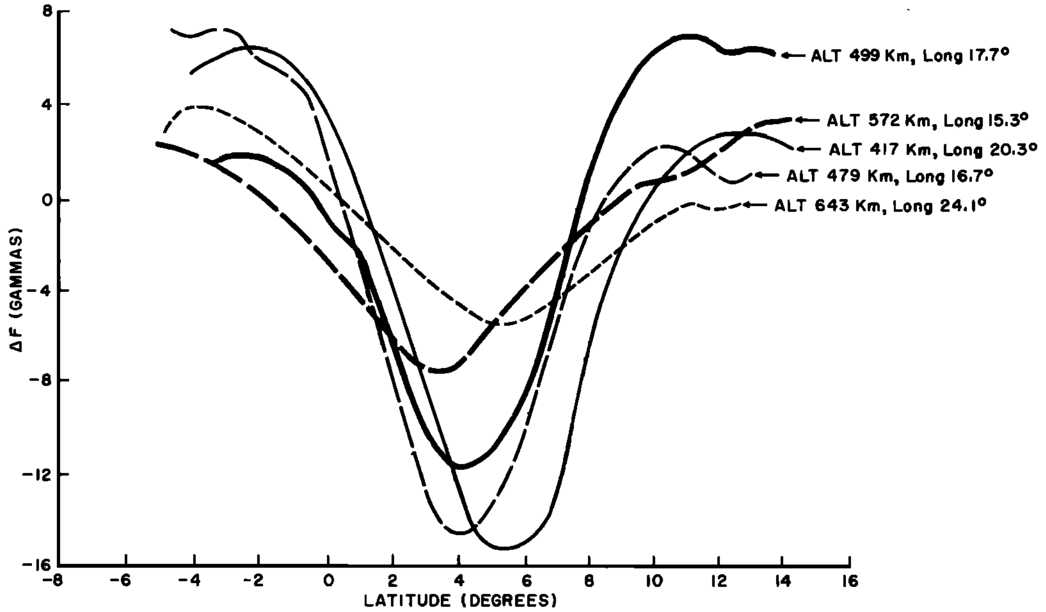

Fig. 1. The Bangui anomaly as measured on several satellite passes at midnight local time at various altitudes.

Further substantiation of the anomaly is provided by analysis of the ground magnetic measurements made by R. Godivier and L. LeDonche of the Office de la Recherche Scientifique et Technique Outre-Mer (ORSTOM) in 1956. By use of their measurements of both the horizontal and vertical field components, the total field was calculated and the thirteenth degree and order regional field was removed from the data. Upon combining these data with additional ground measurements made by the authors [*Regan*, 1976], a total field magnetic anomaly map was compiled (Figure 4). This map clearly shows a large negative magnetic anomaly that coincides closely with the satellite anomaly. A subsequent, and more detailed, ground magnetic survey by ORSTOM (J. Vassal, personal communication, 1978) is in general agreement with these data and also reveals some interesting fine structure (Figure 5). In particular, the main part of the ground anomaly is shown to have a maximum intensity of −1800 nT. Also, immediately to the east of this main part of the anomaly is a locally intense bipolar anomaly over an outcrop of banded iron formation.

The fact that the anomaly is of the same sense in the ground, airborne, and satellite data and is more intense at the lower altitude indicates that the source is indeed within the earth. This is also implied by the observed decay of the anomaly as altitude increases, as measured on individual satellite passes at various altitudes. In addition, the analytical continuation of the aircraft anomaly to satellite altitude by *Regan et al.* [1975] indicates that the same anomaly is measured by both satellite and aircraft magnetometers.

Thus this magnetic anomaly is evidently not an artifact of data reduction or external field contamination but rather of internal origin, several hundred kilometers long, and several hundred nanoteslas in amplitude at the surface. Because the anomaly is approximately at the geomagnetic equator and has negative polarity, it is caused by a positive contrast in magnetization, which in the northern hemisphere would produce an anomaly of positive polarity.

Gravity Anomaly

An extensive gravity survey of the Central African Republic (ORSTOM, unpublished data, 1978) consists of observations collected at 2-km intervals along all available roads and reduced to Bouguer anomaly values by using standard techniques. A second order polynomial surface has been removed from the data, and the resultant residual gravity values range from about 10 to 100 mGal. The map (Figure 6) shows a major gravity low over the central part of the country, the most intense part of the anomaly being at the same location as the major ground magnetic anomaly. The gravity anomaly, however, does not end abruptly to the south; it is, instead, open and is encircled throughout the rest of the Central African Republic by a ridge of relatively high values that is interrupted in only two places, in the eastern and southeastern parts of the country, by several isolated northeast-trending anomalies. Unfortunately, because no gravity measurements are available from the neighboring country of Zaire, the nature of the southern border of the major anomaly is unknown.

Geology

The Central African Republic occupies a zone of relative tectonic uplift, late Precambrian to early Paleozoic in age, between the Chad basin to the north and the Congo basin to the south. This zone has probably been inactive since the early Paleozoic time. A simplified geologic map of the region is presented in Figure 7 and the general rock types and the structural settings of the area are briefly discussed in this section.

In general, the oldest rocks in this country are termed the Basal Complex or lower Precambrian, which for the most part is composed of migmatite, charnockite, metadiabase, and metasedimentary rocks. Above the Basal Complex, in the middle Precambrian and upper Precambrian, the sedimentary rocks become increasingly siliceous. These sedi-

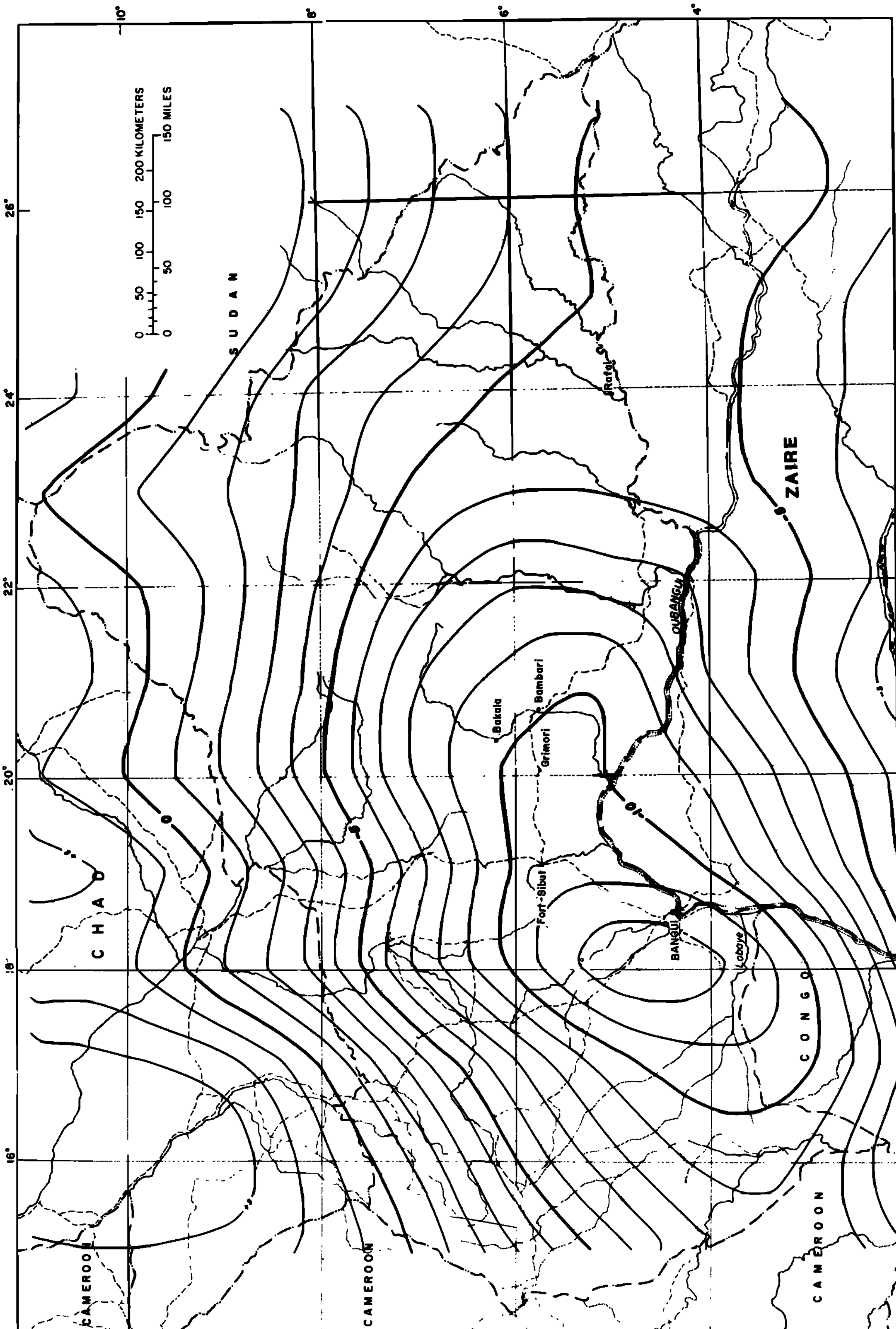

Fig. 2. Total field magnetic anomaly at an average altitude of 525 km. Contour interval is 1 nT.

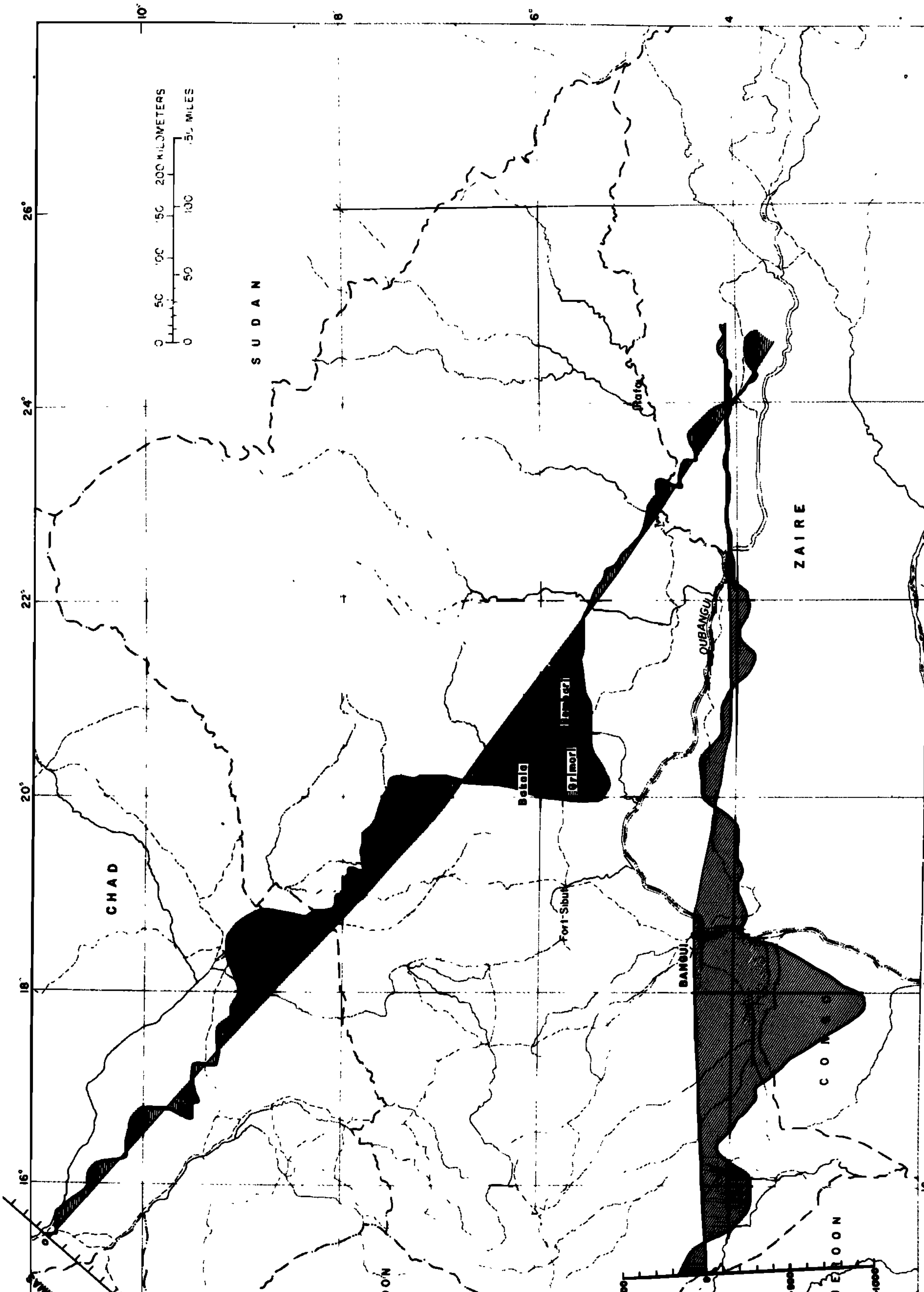

Fig. 3. Total field magnetic anomaly along Project MAGNET flight lines.

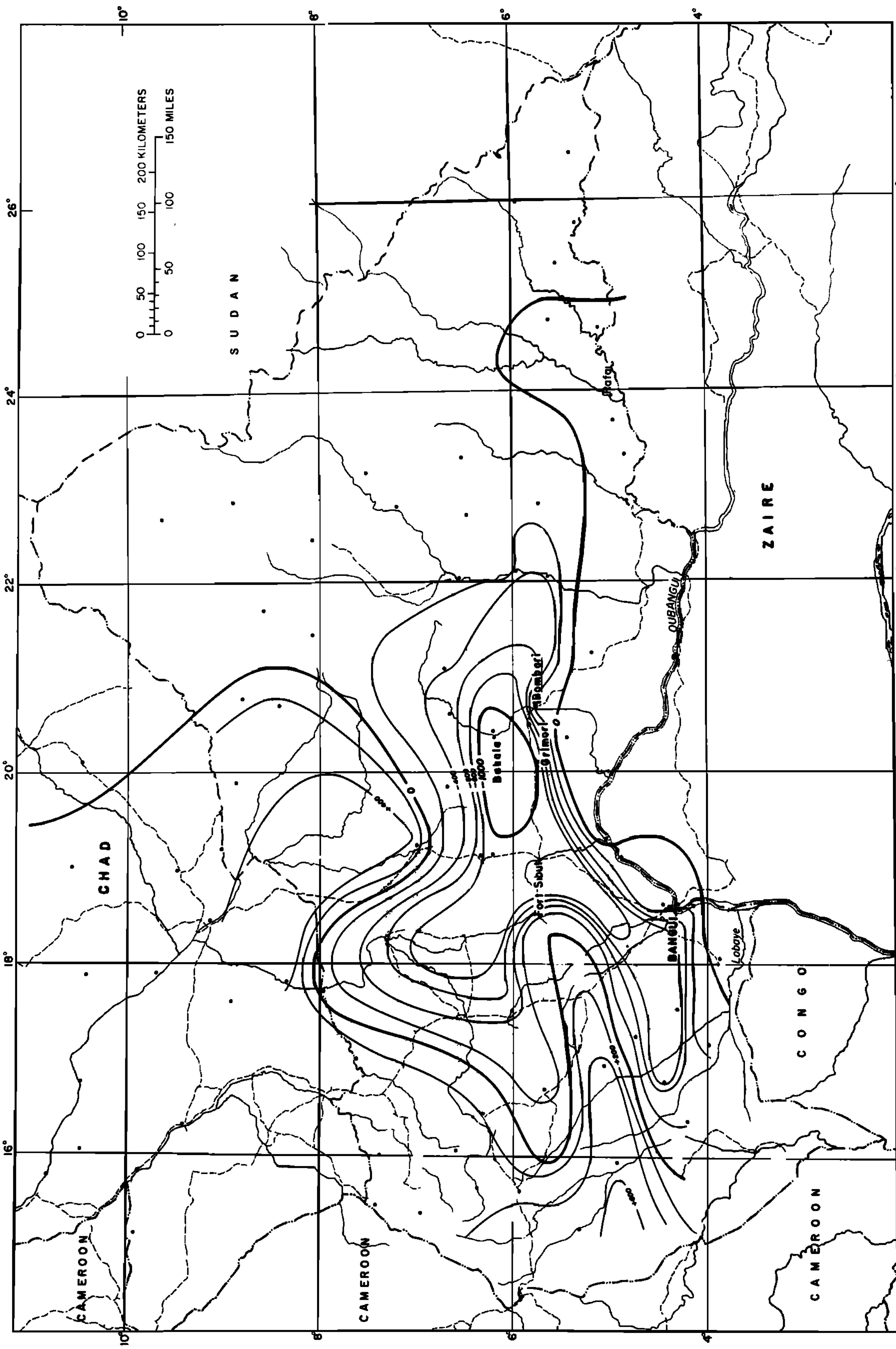

Fig. 4. Total field magnetic anomaly from ground measurements. Contour interval is 200 nT.

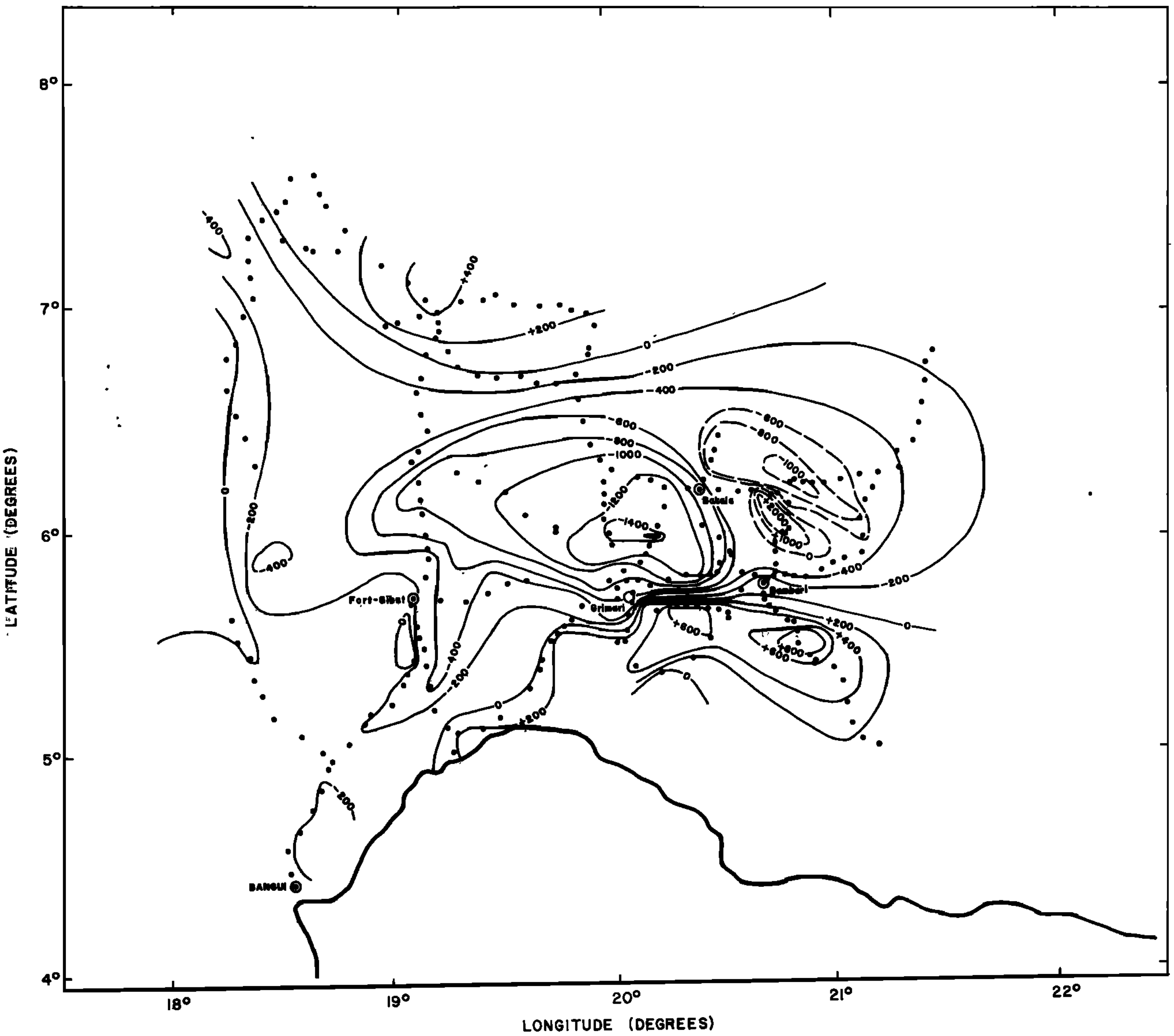

Fig. 5. Total field magnetic anomaly over central portion of anomaly. Contour interval is 100 nT (J. Vassal, unpublished data, 1978).

mentary rocks locally form basins, which, in turn, constitute a much larger basin or perhaps a synclinorium. The basin deposits are intruded by diabase and granitic rocks, which have ages of approximately 550 m.y.

Lower Precambrian rocks make up about 75% of the Precambrian exposures in this region. The oldest rocks, the Basal Complex, which are highly metamorphosed basic and silicic igneous rocks and siliceous sedimentary rocks, border the area of the observed magnetic anomaly and the major Oubangui basin. On the southeast side of the magnetic anomaly, in the Baidou basin, the metamorphosed sedimentary rocks are almost exclusively crystalline schist rich in silica and alumina with subordinate calcmagnesian horizons. The complex is formed almost completely of metabasalts [*Mestraud*, 1953]. In the western part of the Central African Republic, *Gerard and Gerard* [1952] have described a highly metamorphosed sequence of sedimentary rocks and lavas that are now schist, gneiss, orthogneiss, and migmatite.

Middle Precambrian rocks, as observed in the Lobaye basin, lie unconformably upon those of the adjacent M'Poko basin. The Lobaye rocks are mostly quartzitic sandstone containing lenses of conglomerate and shale. The Lobaye sedimentary rocks are the least metamorphosed of all the sedimentary units in the region, although the diabase units are usually intensely chloritized.

Upper Precambrian rocks are represented by a series of granitic plutons, which are often extensive and heterogeneous. A large batholith-like body near Fort-Sibut (see Figure 2) strikes north-northwest; a similar body parallels this intrusion some 150 km to the east near Bakala. Both intrusions must cut all the units of the Oubangui basin. These young intrusions largely consist of granite, although more mafic rocks are also found within these bodies [*Pouit*, 1959].

STRUCTURE

In general, the oldest rocks have a general strike of about N20°E and N40°E, whereas the youngest rocks, the intrusions, strike nearly perpendicular to the trend. In the north-

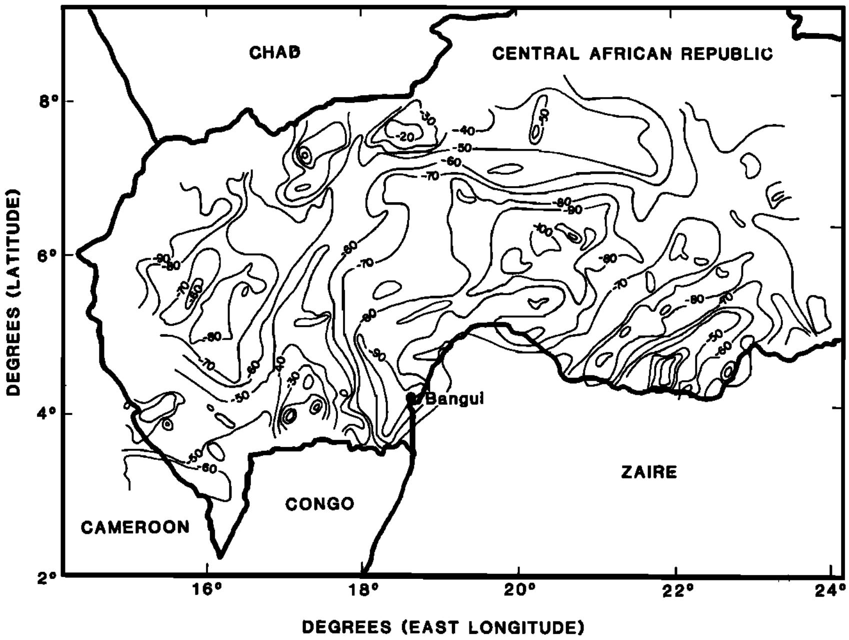

Fig. 6. Simple Bouguer gravity anomaly map of the Central African Republic. Contour interval is 10 mGal (ORSTOM unpublished data, 1978).

eastern part of the country, along the border with Sudan, the northeast structural trend is obvious from the simplified geologic map (Figure 7). In the north-central Oubangui basin, the quartzites are strongly folded along a roughly north-trending axis with near-vertical dips.

South of Rafai (Figure 2) (5°N., 24°E.) in the northernmost part of Zaire, *Cahen* [1954, p. 192] has presented a north-south structural profile showing the Bando Granite dipping northward under metamorphosed sedimentary rocks of the Central African Republic. Above the granite are the basin-

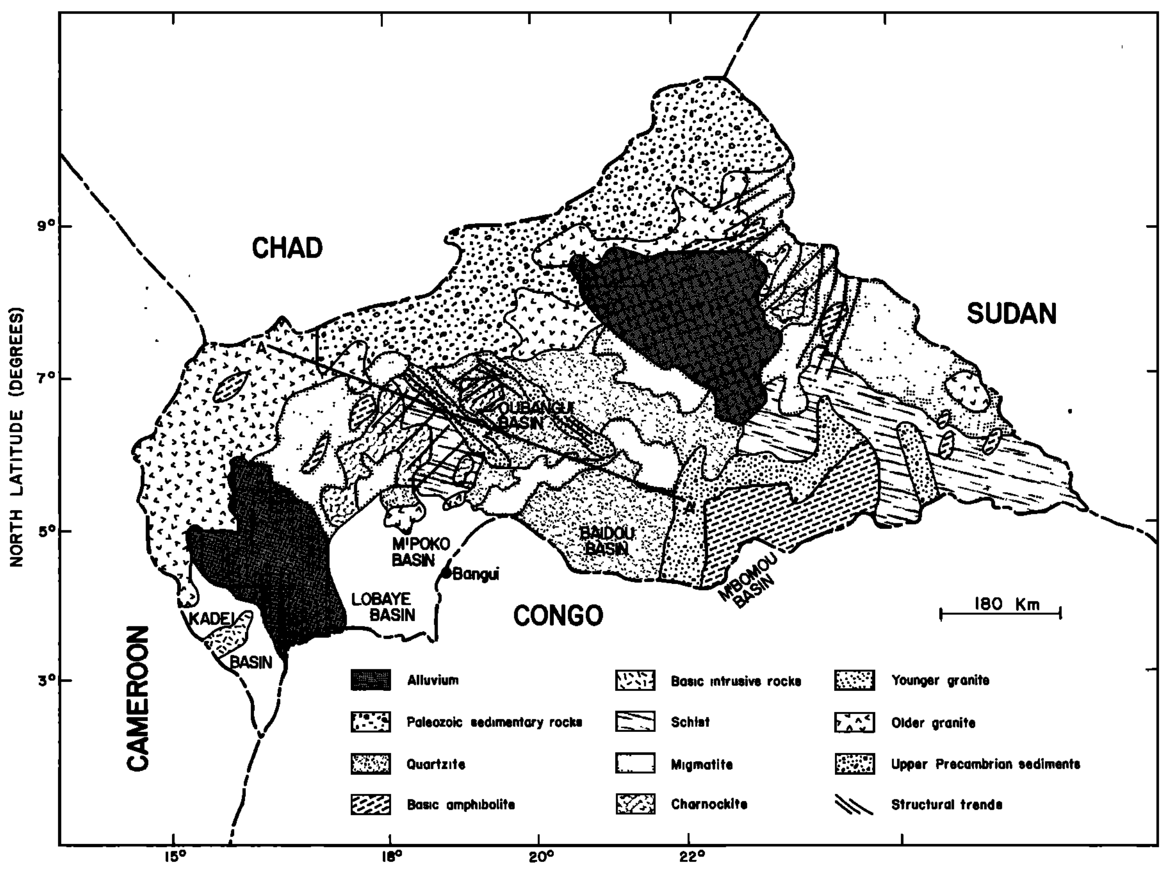

Fig. 7. Simplified geologic map of the Central African Republic.

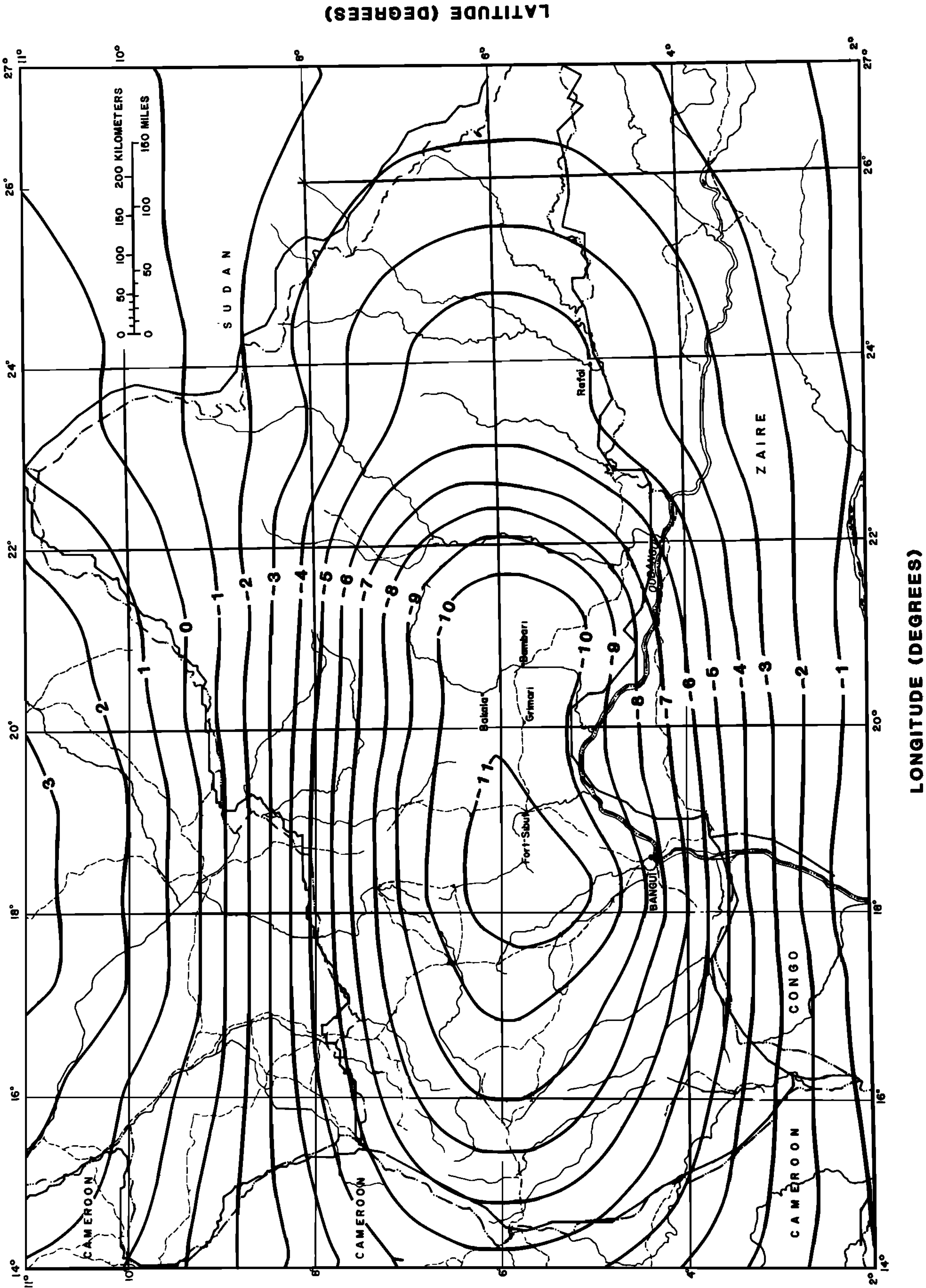

Fig. 8. Satellite magnetic anomaly map generated by computer.

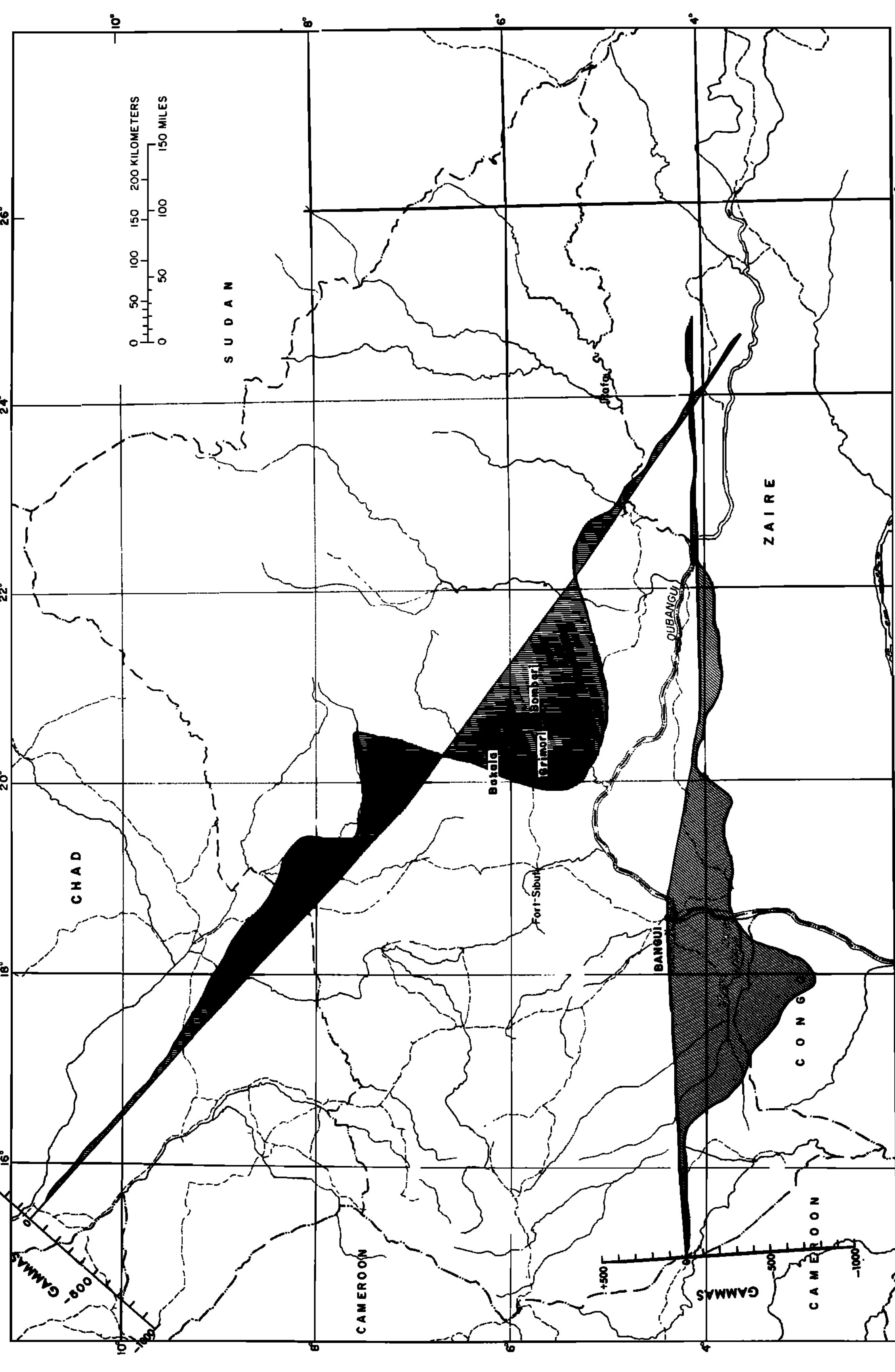

Fig. 9. Computed aeromagnetic values along Project MAGNET flight lines.

filling quartzite and schist and secondary basic intrusive rocks. This structure probably represents the beginning of the Baidou and M'Bomou basins; additionally, the occurrence of extensive migmatite and other high-grade metamorphic rocks in an east-trending band between Grimari and Bambari at 6°N (Figure 2) may indicate the northern limit of these basins and the shallowing of the regional Oubangui basin. North of the Grimari-Bambari migmatite band, the quartzite equivalent of the M'Poko formation begins again; this quartzite marks the beginning of the central Oubangui basin, which continues northward for an additional 150 km. The band of migmatite seems surely to have some structural significance, for the ground magnetic anomaly ends at this feature.

To the west, the Oubangui basin may be terminated by the young heterogeneous granite and the massive charnockite bodies. These latter rocks are of a high metamorphic grade (granulitic in places) and were surely once quite deep-seated. Thus they may represent the Basal Complex of the Oubangui basin. The common close proximity of the mica schists, which presumably underlie the extensive exposed quartzites and are in the lower part of the sequence of the basin, also indicates the shallowing of the Oubangui basin in this region.

In general, it seems reasonable from the geology that the best preserved and perhaps deepest part of the Oubangui basin, excluding the areas southwest of Bangui, is in the region immediately north of the Grimari-Bambari migmatite band. The largest magnetic anomaly, as well as the most intense Bouguer gravity anomaly, is also in this locale.

Anomaly Interpretation and Model

While the question of internal or geological origin is usually not directly addressed in the analysis of conventional magnetic data, the same is not true for satellite measurements. As of this time no observed satellite anomaly has been demonstrated to be of geological origin. Thus the first consideration of possible sources for the anomaly is whether or not it is crustal, and if it is crustal, whether it is related to surface geology. Certainly one approach with the satellite data would be to utilize one of the standard estimates of depth as outlined by *Vacquier et al.* [1963] or those indicated in standard geophysical exploration texts such as *Dobrin* [1952]. However, all such indices indicated depths at a 200- to 300-km altitude. As there is no known external current source at this altitide, either the data or the validity of these techniques in the case of the satellite data is suspect. Because the consistency of the satellite data both internally and with regard to the more conventional magnetic data has already been demonstrated, the validity of the indices is suspect. The basic tenets of such magnetic interpretation techniques, namely that the earth is flat and that the inducing field is constant in direction and intensity, are not valid in the case of the satellite data and most likely affect the depth calculations. A posteriori, depth analyses of satellite profiles computed from a computer model, to be discussed in a later section, under these conditions also indicated depths at the 200- to 300-km altitude range. Clearly, this is impossible as the source of the anomaly is known to be within the earth.

However, the satellite data can be analyzed in another way. In considering the origin of this and other anomalies on their global magnetic-anomaly map, *Regan et al.* [1975] argued for a crustal source on the basis of correlation with geologic and tectonic data and the fact that a thirteenth degree and order field model has been removed from the data. Although there is no direct correlation between harmonic degree and depth of source, the decay rate of the various harmonics is known, and this decay rate was used to argue that hormonics of the fourteenth and higher degrees would produce impossibly high fields at the core (the mantle being considered a forbidden zone for magnetic anomaly sources). Further justification for this is contained in the spectral analysis of such data by *Cain* [1975].

The Project MAGNET data were not amenable to depth analysis by curve fitting techniques. However, *Green* [1975] used spectral techniques on these and other Project MAGNET lines throughout Africa to calculate depths. In this region he determined an average anomaly depth of 30 km.

Undoubtedly, the best indication of the crustal origin of the Bangui anomaly is the interrelation between the satellite anomaly and the airborne and ground data and the correlation of both the main part of the magnetic anomaly and the Bouguer anomaly with the Oubangui sedimentary basin, a relatively isolated crustal feature.

While the anomaly is correlatable with this structural feature, it shows little or no correlation with surficial geology. Also, an anomaly of this intensity and extent, if due to a single geologic source body, or multiple source bodies, would require that they be highly magnetized and of considerable volume. The banded iron formation, determined to be sufficiently magnetic from field measurements [*Regan*, 1976], is of a small volume. Surficial sedimentary features of this type, which are rarely thicker than about 500 m, cause a magnetic anomaly that attenuates rapidly as altitude increases and that would not be detectable at satellite altitudes. The diabase dikes in the Lobaye basin are younger than the Oubangui sedimentary basin, of a very small volume, and only moderately magnetic ($k \approx 1.5 \times 10^{-3}$ cgs units) [*Regan*, 1976]. The charnockite bodies mostly surrounding the Oubangui basin are voluminous and in some places moderately magnetic ($k \approx 1.9 \times 10^{-3}$ cgs units) [*Regan*, 1976], but the regional magnetic anomaly map of *Godivier and LeDonche* [1956] shows only minor anomalies around many of these bodies. Hence the major part of the anomaly must be attributable to a rock type that is probably not seen on the surface.

The close correlation between the principal magnetic anomaly, the large negative Bouguer gravity anomaly, and the Oubangui sedimentary basin could be explained as a result of the intrusion of a large mafic pluton into the crust. This dense, voluminous, and now highly magnetic intrusive body rose high into the crust, grew denser through cooling, and then isostatically settled, warping down the crust to form the Oubangui sedimentary basin. If such an intrustion took place, the presently observed gravity anomaly would probably be caused by the basin-filling sedimentary rock and the root of the intrusive body protruding into the mantle. Other features of the anomaly, for example, the secondary lobes to the west and southwest, can be attributed to subsequent deformation of the basin.

Computer Model

To test this hypothesis and demonstrate the crustal origin of the anomaly, a computer model was constructed utilizing the available information on surficial geology, structure, and

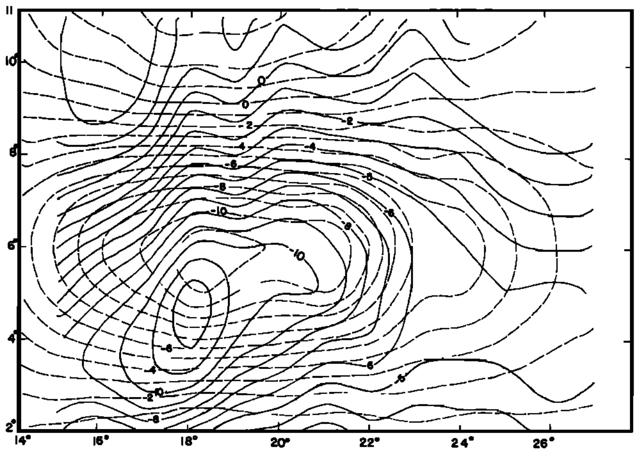

Fig. 10. Measured and computed satellite magnetic anomaly (dashed lines are computed values).

tectonics as guidelines or boundary conditions. While undoubtedly the lack of correlation between the anomaly and surface geology implies that some of these boundary conditions are loose, they are nevertheless restrictive and can be used in both a direct and indirect (e.g., using surficial geological evidence to hypothesize a deep-seated structure) manner.

In constructing a computer model of an anomaly of this size, the curvature of the earth and the variation in direction and magnitude of the geomagnetic field should be considered. In classical magnetic interpretational theory, these effects rarely need be considered. However, because the causative body dimensions are approximately 700 km east-west and 200 km north-south, no significant error is introduced if we neglect the curvature of the earth over the dimensions of this body and use sufficiently small prisms to model the source. Therefore the equation for the magnetic anomaly of a rectangular three-dimensional prismatic body was used.

The variation in geomagnetic field direction and intensity is treated by dividing the anomaly model into a number of prisms small enough so that these values may be considered constant. The field inclination and intensity at the center of each prism are used to compute (assuming solely induction) the resulting magnetic field and its direction cosines at the same point. The full anomaly is found by summing the contribution from each component prism.

A trial and error approach was employed so that maximum flexibility could be achieved in the modeling process. Initially, the satellite data were modeled with large prisms, without much regard to their hypothesized structure, to obtain some insight into the general dimensions of the body. Then further refinements were made based on the Project MAGNET data. The surface magnetics further defined and restricted the model parameters. The general intent of the modeling was to demonstrate the hypothesized crustal origin of the satellite anomaly, so the modeling process was not carried

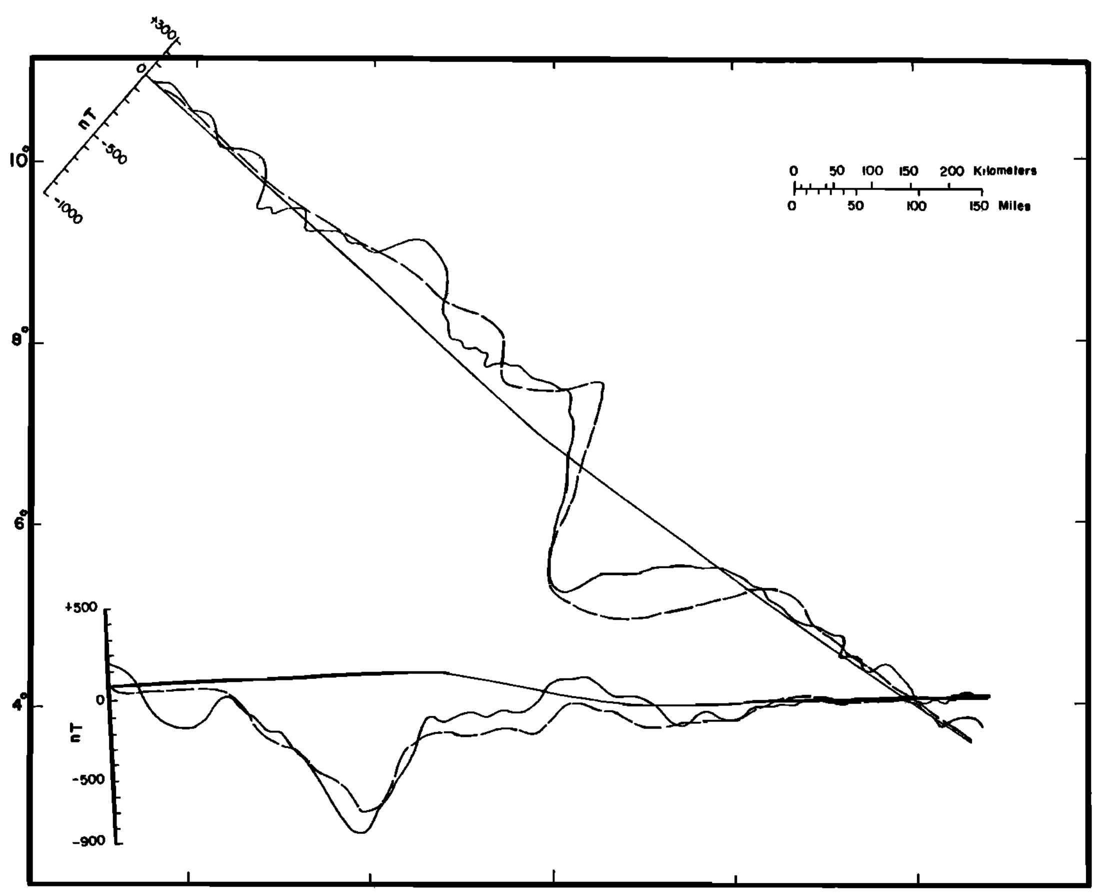

Fig. 11. Measured and computed aeromagnetic values along Project MAGNET flight lines (dashed lines are computed values).

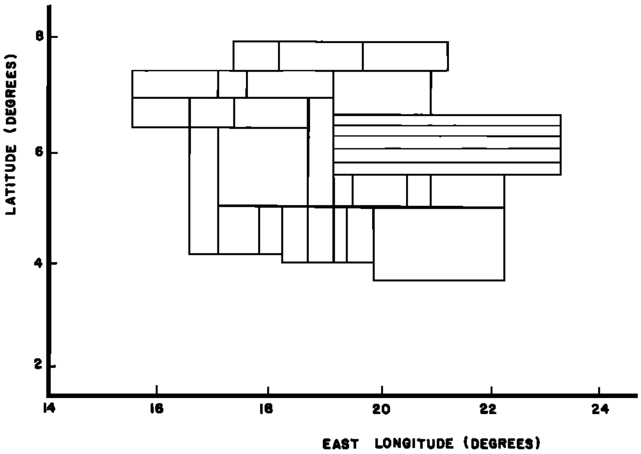

Fig. 12. Planar view of computer block model.

through to obtain a perfect fit. In particular, for example, although the surface magnetic data were fit quite well, the computed surface maps appeared highly irregular owing to the edge effects of the prisms. In general, the magnetic data were the primary factors in defining the model parameters, but the resultant model also fits the gravity data.

The magnetic anomaly at satellite altitude resulting from the final model is shown in Figure 8; this figure should be compared with Figure 2. The computed values at the aircraft locations are shown in Figure 9, which should be compared with Figure 3. Both measured and computed satellite magnetic and aeromagnetic data are shown in Figures 10 and 11. While there is a discrepancy between the most intense portion of the measured and computed satellite anomalies, in general the fit is reasonable. The fit could be improved if the model could be moved slightly southward. However, the primary controlling influence on the southern extent of the model is the east-west Project MAGNET line. Although the navigation on these particular flights was not accurate (R. Lorenson, personal communication, 1978) and the flight path may have indeed been further south, it was not so moved because no quantitative measure of the positional error was available. Again, it should be remarked that the intent is to demonstrate a plausible geological origin for the anomaly observed in the satellite measurements. And it is put forth that these computed values indicate that the anomaly can be reasonably duplicated by the hypothesized crustal body.

The crustal model consists of three main members. The intrusive body appears as a laccolith, its top being at a minimum depth of 3 km and its bottom at about 35 km. The body underlies the area between longitude 19° and 23°E and latitude 5.7° and 6.7°N. The charnockite occurs as an encircling sloping ridge, reaching the surface at observed outcrops and where indicated by the gravity data. Quartzite fills the sedimentary basin and covers the intrusive body and the charnockite. A complete graphic representation of the model is difficult, but certain aspects can be presented. Figure 12 shows a planar view of the body and Figure 13 shows a cross section along the line A-A′ of Figure 7 selected to demonstrate the more relevant aspects of the model. All the parameters of the model are listed in Table 1.

Undoubtedly, as is the case with any interpretation of this type, the model is not a unique explanation of the anomaly, although the inclusion of gravity, geologic, and other supporting data undoubtedly lessens the degree of uncertainty. Other geological hypotheses and models could probably be put forth , but the analysis does indicate that a crustal origin for this satellite anomaly is both possible and plausible. One distrubing aspect of the model is the high apparent susceptibility (of the order of 10^{-2} cgs), especially when combined with the volume of material considered. However, the few analyses of long-wavelength anomalies such as these, as evidenced in aeromagnetic data [e.g., *Caner*, 1969; *Hall*, 1974], have all resulted in interpretations requiring apparent magnetizations of this magnitude.

CONCLUSIONS

The combined analysis of satellite and conventional magnetic data and conventional gravity data has resulted in the postulance of a crustal source body. The analysis has also

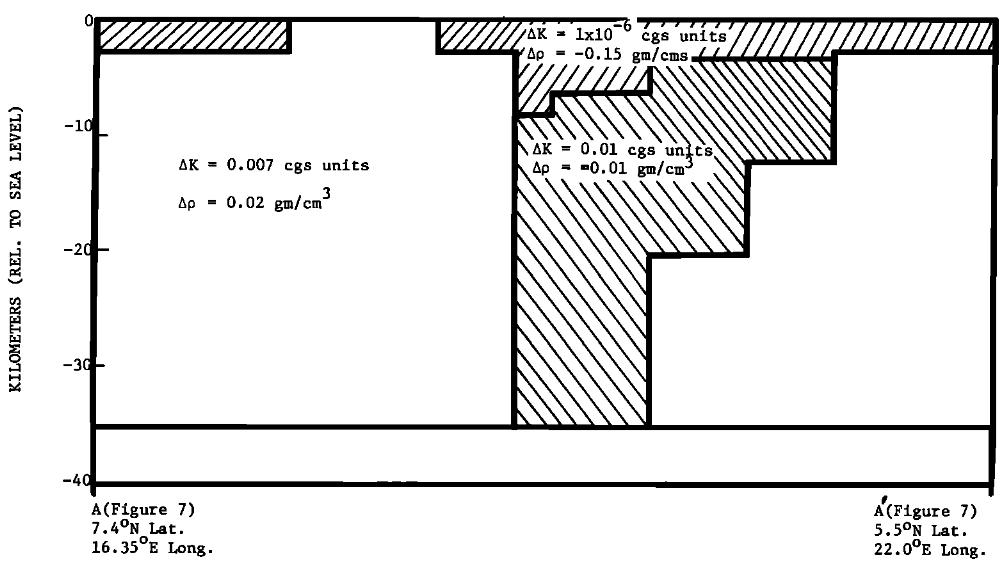

Fig. 13. Cross section (A-A' of Figure 7) of computer model.

TABLE 1. Computer Model Characteristics of Component Prisms

Latitude-Southern Edge of Prism	Latitude-Northern Edge of Prism	East Longitude-Western Edge of Prism	East Longitude-Eastern Edge of Prism	Depth to Top, km (0.0 = Sea Level)	Depth to Bottom, km	Susceptibility Contrast k, cgs	Density Contrast ρ, g/cc
5.70	5.90	19.00	23.00	3.00	12.00	1×10^{-2}	−0.01
5.70	5.90	19.00	23.00	12.00	35.00	7×10^{-3}	−0.02
5.90	6.15	19.00	23.00	3.00	20.00	1×10^{-2}	−0.01
5.90	6.15	19.00	23.00	20.00	35.00	7×10^{-3}	−0.02
6.15	6.35	19.00	23.00	6.00	35.00	1×10^{-2}	−0.01
6.35	6.55	19.00	23.00	8.00	35.00	1×10^{-2}	−0.01
6.55	6.70	19.00	23.00	10.00	35.00	1×10^{-2}	−0.01
5.70	5.90	19.00	23.00	−0.50	3.00	1×10^{-6}	−0.15
5.90	6.15	19.00	23.00	−0.50	3.00	1×10^{-3}	−0.15
6.15	6.35	19.00	23.00	−0.50	6.00	1×10^{-6}	−0.15
6.35	6.55	19.00	23.00	−0.50	8.00	1×10^{-6}	−0.15
6.55	6.70	19.00	23.00	−0.50	10.00	1×10^{-6}	−0.15
6.50	7.00	15.50	16.50	2.50	35.00	7×10^{-3}	−0.02
7.00	7.50	15.50	17.00	2.50	35.00	7×10^{-3}	−0.02
4.30	6.50	16.50	17.00	2.50	35.00	7×10^{-3}	−0.02
4.30	5.15	17.00	17.70	2.50	35.00	7×10^{-3}	−0.02
5.15	6.50	17.00	18.50	−0.50	35.00	7×10^{-3}	−0.02
5.15	7.00	18.50	19.00	2.50	35.00	7×10^{-3}	−0.02
6.50	7.00	16.50	17.25	2.50	35.00	7×10^{-3}	−0.02
6.50	7.00	17.25	18.50	−0.50	35.00	7×10^{-3}	−0.02
7.00	7.50	17.00	17.50	2.50	35.00	7×10^{-3}	−0.02
7.00	7.50	17.50	19.00	0.00	35.00	7×10^{-3}	−0.02
7.50	8.00	17.25	18.00	2.50	35.00	7×10^{-3}	−0.02
5.15	5.70	20.70	22.00	2.50	35.00	7×10^{-3}	−0.02
4.30	6.50	16.50	17.00	−0.50	2.50	1×10^{-6}	−0.15
5.15	5.70	19.35	20.25	−0.50	30.00	1×10^{-6}	−0.15
5.50	5.70	20.25	20.70	−0.50	30.00	1×10^{-6}	−0.15
4.30	5.15	17.00	17.70	−0.50	2.50	1×10^{-6}	−0.15
5.15	7.00	18.50	19.00	−0.50	2.50	1×10^{-6}	−0.15
6.50	7.00	16.50	17.25	−0.50	2.50	1×10^{-6}	−0.15
7.00	7.50	17.00	17.50	−0.50	2.50	1×10^{-6}	−0.15
7.00	7.50	17.50	19.00	−0.50	0.00	1×10^{-6}	−0.15
7.50	8.00	17.25	18.00	−0.50	2.50	1×10^{-6}	−0.15
7.50	8.00	18.00	19.50	−0.50	2.50	1×10^{-6}	−0.15
7.50	8.00	19.50	21.00	−0.50	2.50	1×10^{-6}	−0.15
6.70	7.50	19.00	20.70	−0.50	7.50	1×10^{-6}	−0.15
5.15	5.70	20.70	22.00	−0.50	2.50	1×10^{-6}	−0.15
5.15	5.50	20.25	20.70	−0.50	2.50	1×10^{-6}	−0.15
5.15	5.70	19.00	19.35	−0.50	2.50	1×10^{-6}	−0.15
4.30	5.15	17.70	18.10	−0.50	0.00	1×10^{-6}	−0.15
4.17	5.15	18.10	18.50	−0.50	0.00	1×10^{-6}	−0.15
4.17	5.15	18.50	19.00	−0.50	0.00	1×10^{-6}	−0.15
4.17	5.15	19.00	19.25	−0.50	0.00	1×10^{-6}	−0.15
4.17	5.15	19.25	19.75	−0.50	0.00	1×10^{-6}	−0.15
3.90	5.15	19.75	22.00	−0.50	0.00	1×10^{-6}	−0.15
5.15	5.50	20.20	20.70	2.50	35.00	7×10^{-3}	−0.02
5.15	5.70	19.00	19.35	2.50	35.00	7×10^{-3}	−0.02
4.30	5.15	17.70	18.10	0.00	30.00	7×10^{-3}	−0.02
4.17	5.15	18.10	18.50	0.00	25.00	7×10^{-3}	−0.02
4.17	5.15	18.50	19.00	0.00	15.00	7×10^{-3}	−0.02
4.17	5.15	19.00	19.25	0.00	10.00	7×10^{-3}	−0.02
4.17	5.15	19.25	19.75	0.00	4.00	7×10^{-3}	−0.02
3.90	5.15	19.75	22.00	0.00	4.00	7×10^{-3}	−0.02

demonstrated the complementary nature of the various data types and indicated how the various aspects of satellite and conventional magnetic data can be utilized in a combined interpretation. While the dimensions and physical properties of the postulated body are somewhat surprising, they are consistent with analyses of similar scale magnetic anomalies. Indeed, the nature of the signal portrayed on the quasi-global magnetic anomaly map of *Regan et al.* [1975] has long been puzzling. While some of this signal is undoubtedly artificial as described by *Regan et al.* [1981] other segments are similar to the Bangui anomaly, crustal in origin, and worthy of further analysis.

Acknowledgments. The study of the Bangui anomaly has been in progress for several years, and the authors are greatly indebted to the support and assistance provided by many individual people and agencies. We are deeply indebted to W. M. Davis, who accomplished the Herculean task of developing many of the computer programs utilized in this study. Also, a sincere debt of gratitude is owed to the government of the Central African Republic, the U.S. Embassy in Bangui, and the scientists of the ORSTOM installation in Bangui, who unselfishly shared with us their knowledge and invaluable ground measurements. This research was supported in part by NASA contract S-500-29A to the U.S. Geological Survey and by NASA grant NGS-5090 to The Johns Hopkins University. The work was performed while the authors were at the U.S. Geological Survey, Reston, Virginia.

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(Received January 5, 1979;
revised May 15, 1981;
accepted October 2, 1981.)