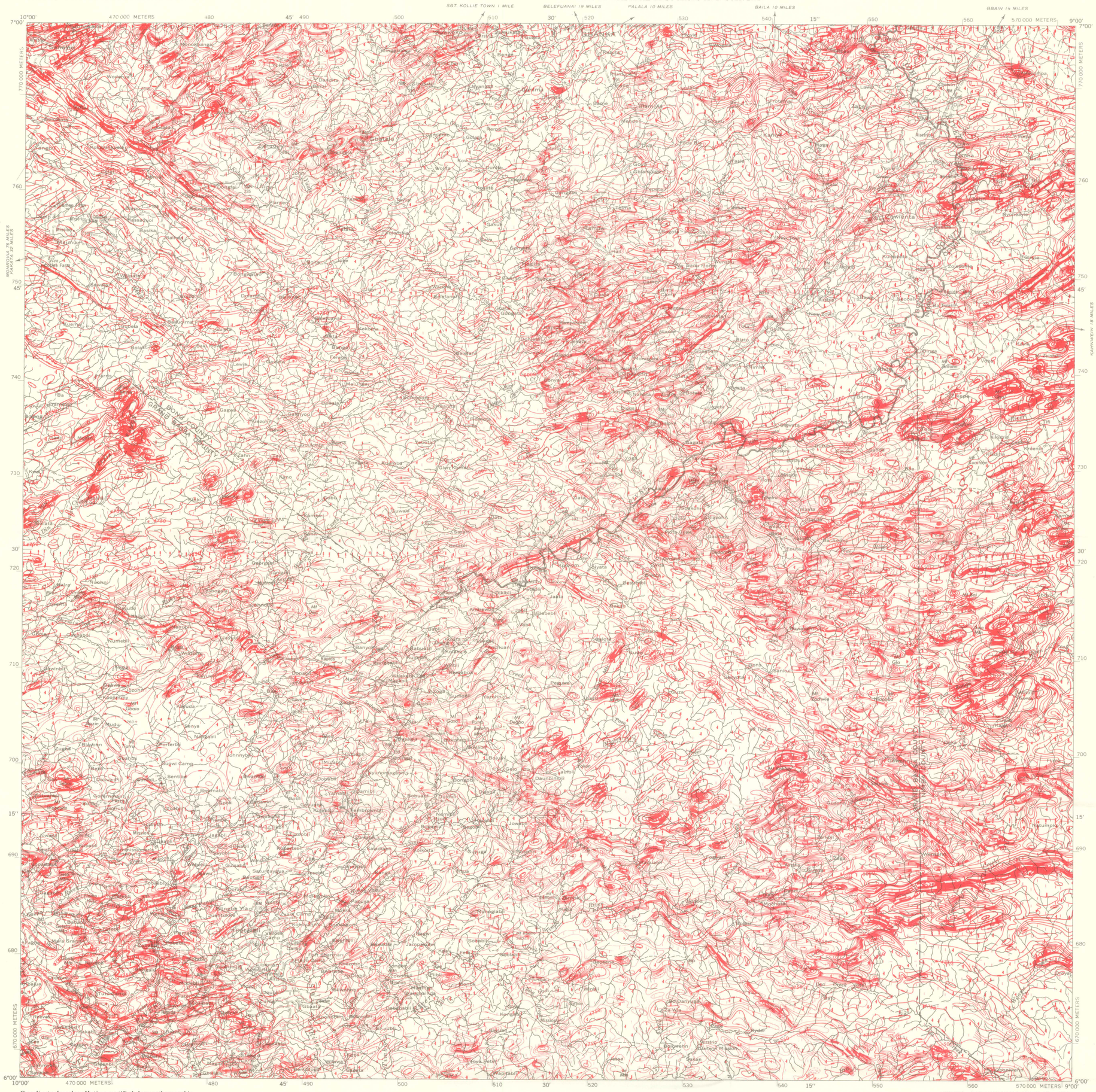
DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

Prepared in cooperation with the
REPUBLIC OF LIBERIA
BUREAU OF NATURAL RESOURCES AND SURVEYS

FOLIO OF THE GBANKA QUADRANGLE, LIBERIA
MAP I-776-B



Coordinates based on Hotines rectified skew orthomorphic projection, U.S. Coast and Geodetic Survey, 1956

SCALE 1:250,000

5 0 5 10 15 20 KILOMETERS

5 0 5 10 15 MILES

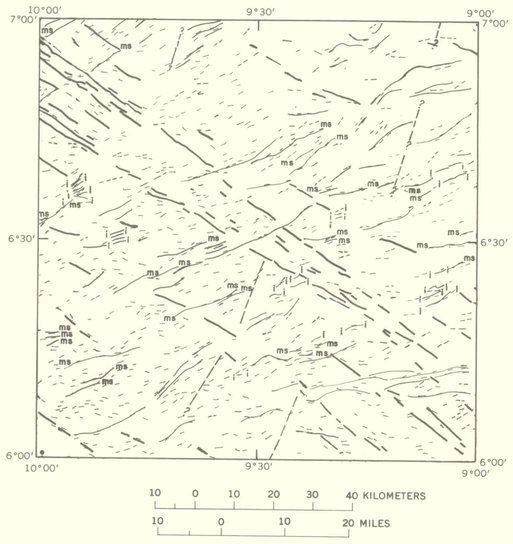
1970 MAGNETIC DECLINATION VARIES FROM 13°30′ WESTERLY FOR THE CENTER OF THE WEST EDGE TO 13°00′ WESTERLY FOR THE CENTER OF THE EAST EDGE. MEAN ANNUAL CHANGE IS 0°06′ EASTERLY

EXPLANATION

MAGNETIC CONTOURS — Showing total intensity magnetic field of the earth in gammas relative to arbitrary datum. Regional magnetic gradient not removed. Hachured to indicate closed areas of lower magnetic intensity. Contour intervals are 10, 50, 250, and 1,000 gammas. Selected contour values shown in larger type

FLIGHT PATH

Aeromagnetic survey flown by Lockwood, Kessler, and Bartlet, Inc. at 150 meters above terrain, 1967–68. Flight-line spacing of 0.8 kilometers over the land. Geophysical data reduced from original compilation at 1:40,000-scale by Lockwood, Kessler, and Bartlet, Inc., with minor modifications to improve legibility.



EXPLANATION

TREND DIRECTION OF SHORT WAVELENGTH MAGNETIC ANOMALIES — Assumed to be associated with near-surface geology and interpreted as indicative of rock foliation directions.

LOCATION OF LONG LINEAR MAGNETIC ANOMALIES — Interpreted as being caused by diabase dikes.

INFERRED BOUNDARY SEPARATING PAN-AFRICAN AGE PROVINCE TO SOUTHWEST FROM LIBERIAN AGE PROVINCE TO NORTHEAST

POSSIBLE FAULT — Suggested by linear change in magnetic or radiometric contour

LINEAR MAGNETIC ANOMALIES — Caused by magnetization contrasts interpreted as geologic structures that may include folds, faults, and contacts

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MAGNETICALLY DETERMINED LINEAR STRUCTURE — Inferred to be locally associated with magnetic metasedimentary rocks including schist, quartzite, amphibolites, iron-formation, paragneiss, and migmatite. May include folds, faults, and contacts

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MAGNETICALLY DETERMINED LINEAR STRUCTURE — With anomaly greater than 1,000 gammas interpreted as being caused by magnatite iron-formation. May include folds, faults, and contacts

FIGURE 1. — Tectonic map, Gbanka quadrangle. Construction is based primarily on magnetic data.

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NOTE: Country boundaries indefinite

INTERPRETATION

By John C. Behrendt, U.S. Geological Survey, and
Cletus S. Wotorson, Liberian Geological Survey

INTRODUCTION

Aeromagnetic and total-count gamma radiation surveys were flown simultaneously over Liberia during the 1967-68 dry season. These geophysical surveys were designed to contribute to the geologic mapping program undertaken cooperatively by the Liberian Geological Survey and the U.S. Geological Survey under the auspices of the Liberian Government and the Agency for International Development, U.S. Department of State. The surveys were flown by Lockwood, Kessler, and Bartlett under contract to the Liberian Geological Survey. The geology of the quadrangle has been mapped by Seitz (in press) as part of the cooperative program.

The entire country of Liberia is heavily forested, access is difficult, outcrops are sparse, and thick laterite is widespread. Accordingly, throughout large areas aeromagnetic and aeroradiometric surveys are the only feasible means of gathering virtually continuous data which can be related to near-surface geology, and they are useful in extrapolating geologic observations and in locating potential targets for mineral exploration.

The airborne surveys, which cover the entire country, required approximately 140,000 km of traverse, mostly along north-south lines 0.8 km apart over land and 4 km apart over the continental shelf. Continuous photography and Doppler navigation provided horizontal control; flight altitude was 150 m above mean terrain. Temporal variations in the magnetic field measured with a fluxgate magnetometer were removed by adjustment at crossings of east-west control lines. Varied contour intervals of 10, 50, 250, and 1,000 gammas were used, depending on horizontal gradient.

The geophysical data obtained from these airborne surveys are presented, by quadrangle, in these folios of 1:250,000-scale maps that show on separate sheets geographic, geologic, aeromagnetic, and total-count gamma radiation data for each of 10 quadrangles. The index map shows the locations of these quadrangles and their folio number designations. The total-count gamma radiation map of the Gbanka quadrangle (Behrendt and Wotorson, 1974) should be used in conjunction with this aeromagnetic map.

Figure 1 shows the tectonic interpretation for the area covered by this map. The interpretation is based primarily on aeromagnetic data, but partly on aeroradiometric data and readily available geologic information (White and Leo, 1969; Liberian Geol. Survey, unpub. data).

Figure 2 shows part of the residual total magnetic intensity map of Liberia obtained by digitizing the data from the map area on a 1-minute grid, tying to an absolute survey (Lowrie and Escowitz, 1969) by a constant of +25,980±35 gammas, and removing Cain's "Field G" (Cain and others, 1965).

GEOLOGY

The rocks of the Gbanka quadrangle are mostly granite gneiss and small areas of granite, mafic metamorphic rocks, and iron-formation (White and Leo, 1969); Offerberg and Tremaine, 1961). In most places the rock foliation trends northeast, which is a characteristic of the Liberian age province (about 2,700 m.y.) (Hurley and others, 1971). In the southwest corner of the quadrangle, near the boundary with the Pan-African age province (about 550 m.y.) (Hurley and others 1971), the trend of the rock foliation is irregular but becomes predominantly northwesterly south of the quadrangle. Thin diabase dikes are especially abundant in a zone about 50 km in width, which trends northwest across the quadrangle.

AEROMAGNETIC INTERPRETATION

High-amplitude (2,000 to 5,000 gammas) anomalies are over the iron-formation in the Zezeah Range; other high-amplitude anomalies, correlated with iron-formation, are shown on figure 1. Negative 200-gamma or lower amplitude linear northwest-trending anomalies caused by diabase dikes are the most conspicuous feature on this map and can be traced across the entire quadrangle. Offerberg and Tremaine (1961) mapped more dikes than are interpreted from the aeromagnetic data, but those dikes large enough to be detected at an altitude of 150 m are shown on figure 1.

The northeast grain of the gneissic terrane is predominant in the northern two-thirds of the map (fig. 1). However, the northeast grain changes to a zone of a weak east-west grain and then to a northwest grain in the southern part of the quadrangle near the boundary between the Pan-African and Liberian age provinces. Numerous faults inferred from magnetic and radioactive data are shown in figure 1.

A prominent east-northeast-trending structure (fault?) was mapped from the magnetic data along the St. John River from about lat 6°20′ N., long 9°50′ W. to about lat 6°40′ N. on the east edge of the quadrangle (center of fig. 1). The St. John River is probably controlled by this structural feature and others. At about lat 6°38′ N., long 9°10′ W. the river changes its course abruptly and follows an inferred north-northeast fault (northeast part of fig. 1). The diabase dikes cross the east-northeast fault(?) structure with no apparent offset or displacement, suggesting that the fault(?) structure is older than the dikes. The east-west linear structural features shown near the southeast corner of the quadrangle appear to offset the converging dike zone in a right lateral sense. One diabase anomaly near the southeast corner can be traced across the zone, which suggests that the offset is perhaps more apparent than real. Structural features inferred from numerous small anomalous areas throughout the quadrangle are shown on figure 1.

Examination of the residual map (fig. 2) reveals a pattern of broad positive and negative anomalies, 20-30 km in width and 100-200 gammas in amplitude, that is part of a regional pattern extending across Liberia into Ivory Coast. Magnetic surveys over the Guyana Shield in South America (Strangway and Vogt, 1970) show a similar pattern. The similarity of these anomalies might be expected if the containing rocks originated during the Precambrian before the separation of Africa and South America during Mesozoic time.

The curving north-south boundary near the north edge of the quadrangle is the result of a change in contour interval.

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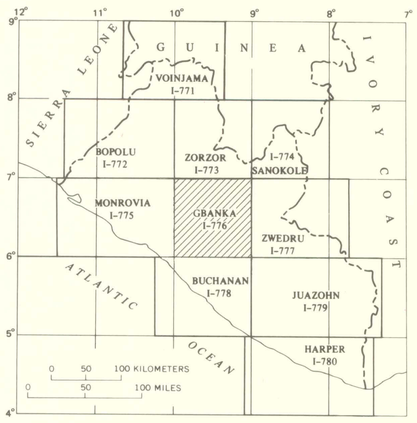

INDEX MAP OF LIBERIA — Showing location of quadrangles and miscellaneous geologic investigation maps published by the U.S. Geological Survey. Area of I-776 shaded.

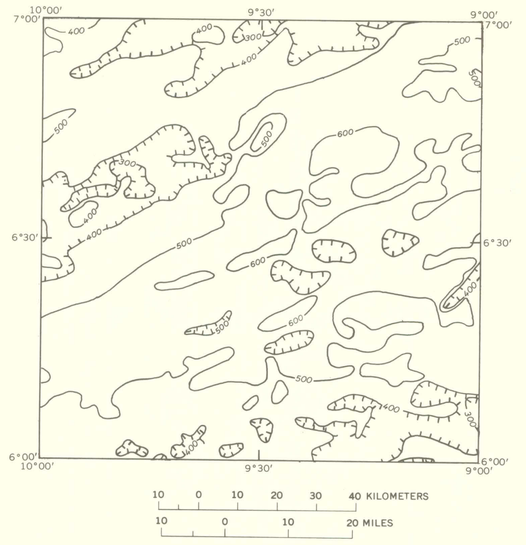

FIGURE 2. — Residual total magnetic intensity map. Compiled by removing the main earth from the map and smoothing to generalized short wavelength anomalies. G. Andreasen and P. Zabel assisted in computer processing. Hachures indicate closed areas of lower magnetic intensity. Contour interval 100 gammas, except for areas of extreme anomaly.

AEROMAGNETIC MAP OF THE GBANKA QUADRANGLE, LIBERIA

By
John C. Behrendt and Cletus S. Wotorson

1974

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