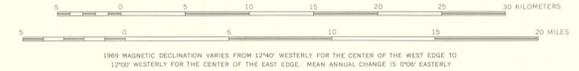


Coordinates based on Hotines rectified skew orthomorphic projection, U.S. Coast and Geodetic Survey, 1956

SCALE 1:250,000



INTERPRETATION
By John C. Behrendt, U.S. Geological Survey, and
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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 Development 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 Setts (in press).
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.
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 aeromagnetic map of the Voinjama quadrangle (Behrendt and Woterson, 1974) should be used in conjunction with this total-count gamma radiation map.

This map shows variations in the natural energy spectrum ± 0.05 mev (million electron volts). The data have been normalized to an altitude of 220 m above terrain, and the cosmic background was removed by utilizing calibration data obtained over the Atlantic Ocean. The contoured data were adjusted to base-level datums obtained from the east-west control lines. The radiometric detector used in this survey consisted of three thallium-activated sodium iodide crystals, each 12 cm in diameter and 5 cm thick. The original data were contoured at intervals of 25 and 50 cps (counts per second) referred to 150 cps equivalent to 1 μ r/hr.
The gamma radiation generally detected in airborne surveys is that produced by the naturally occurring isotopes of K-40 and the U and Th decay series. Only these isotopes in the uppermost 20-30 cm of rock or soil at the earth's surface can be measured by airborne methods. The distribution of these isotopes is dependent on original bedrock composition modified by the geologic processes of weathering, solution, and erosion. Comparison of gamma radiation data and K₂O analysis for various rock types (Behrendt and Woterson, 1971) shows that granitic rocks have a high variability in K and in radiation level, ranging from 2 to 5 percent K₂O and from 100 to >500 cps, respectively. Iron-formation, granite, and other mafic rocks range from 0-1.5 percent K₂O and from 25-200 cps. In general all of the area above 250 cps is granitic terrain, as well as most areas between 100 and 250 cps.
Figure 1 shows the generalized radiation level for the data in this quadrangle. Figure 2 is a map showing possible geologic contacts inferred from the radioactivity and magnetic data.

GEOLOGY

Bedrock in the Voinjama quadrangle consists predominantly of granitic gneiss and a relatively large area of metasedimentary iron-formation in the Wologizi Range (White and Leo, 1969). Diabase dikes in the northwest part of the quadrangle strike east or east-northeast. The predominant trends on the geologic map (White and Leo, 1969) are northeast, which coincides with the general pattern in this part of Liberia. The Voinjama

quadrangle is within the Liberian age province (about 2,700 m.y.) described by Harley, Leo, White, and Fairbairn (1971). Much of the area mapped as granite by White and Leo (1969) has a linear magnetic grain that suggests a gneissic texture (Behrendt and Woterson, 1974, fig. 1). The difference is largely one of scale, as a rock may appear to be a granite in hand specimen and a gneiss when viewed areally.

RADIOMETRIC INTERPRETATION

Most of the Voinjama quadrangle has a moderate to high count rate consistent with granitic terrain. The iron-formation of the Wologizi Range is characterized by a low count, and the configuration shown on figure 2 is based partially on magnetic data. The northeast-trending International Boundary fault (fig. 2) is inferred also from the radiometric data, but to a lesser extent than from the magnetic data. The fault is in the western part of the quadrangle and is indicated by a suggested geologic contact on the map. On the west side of the fault, especially to the north, the count rate is significantly higher, corresponding presumably to more felsic rocks. The radioactivity data show a difference in the two kinds of rocks that were mapped as granitic rocks by White and Leo (1969). The rocks immediately west of the Wologizi Range (fig. 2) are less radioactive (or are possibly masked by canga and alluvium) than the rocks in the western part of the quadrangle.
A northeast-trending zone (fig. 1 and map) of high radioactivity of more than 300 cps and about 30 km in width is in the eastern part of the quadrangle; the contact on the east side of the zone cuts across areas mapped as granite and granite gneiss by White and Leo (1969). This area generally correlates with one of the broad residual negative magnetic anomalies (Behrendt and Woterson, 1974). Possibly this area is still another type of granite or granite gneiss. The highest radioactivity is in the east part of the quadrangle. Several areas larger than 5 km² have anomalies greater than 300 cps (fig. 1), and some anomalies are as much as 900 cps.

The lineation shown on the radioactivity map suggests that much of the area mapped as granite by White and Leo (1969) may be granite gneiss. Probably all areas greater than 250 cps (fig. 1) and most above 150 cps are granitic. The higher radiation level in the eastern part of the quadrangle is part of a broad anomaly over the granitic terrane of central Liberia.

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EXPLANATION

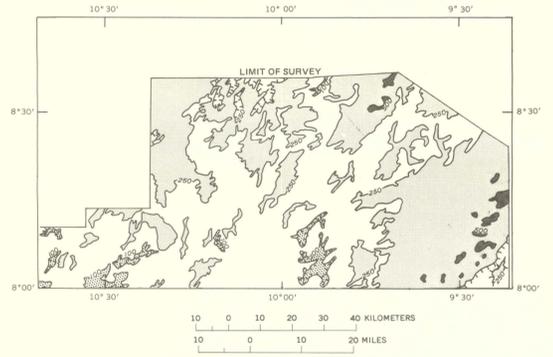


AERORADIOACTIVITY CONTOURS - Showing aeroradioactivity in counts per second relative to arbitrary datum. Cosmic radiation component was removed. Hachured to indicate closed areas of lower aeroradioactivity. Contour interval 25 and 50 counts per second. Selected contour values shown in larger type

NOTE: North-south lineations, marked RLC on map, may be due to radiation level changes after rainfall

NOTE: For flight-path information see corresponding aeromagnetic map of the same quadrangle, Map I-771-B

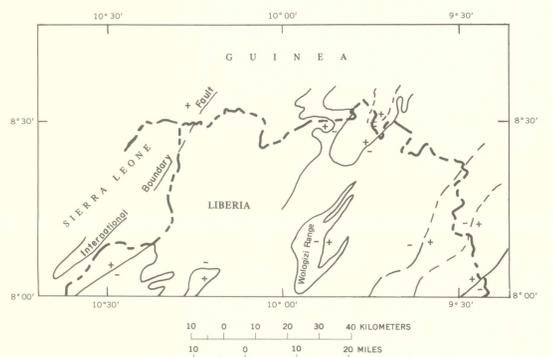
Aeroradioactivity survey flown by Lockwood, Kessler, and Bartlett, Inc. at 150 meters above terrain, 1967-68. All data adjusted to 220 meters (approximately 723 feet) above terrain. Flight-line spacing of 0.8 kilometers over land. Geophysical data reduced from original compilation at 1:40,000 scale by Lockwood, Kessler, and Bartlett, Inc., with minor modifications to improve legibility.



EXPLANATION



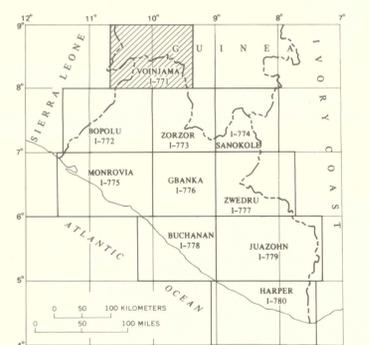
FIGURE 1. - Generalized aeroradioactivity map, Voinjama quadrangle.



EXPLANATION

--- GEOLGIC CONTACT BASED ON RADIATION LEVEL AND MAGNETIC AMPLITUDE
Dashed where less certain
+ indicates higher radiation, lower magnetic amplitude, and generally more felsic rock
- indicates lower radiation, higher magnetic amplitude, and generally less felsic rock

FIGURE 2. - Suggested geologic contacts inferred from aeroradiometric and aeromagnetic data, Voinjama quadrangle.



INDEX MAP OF LIBERIA - Showing location of quadrangle and miscellaneous geologic investigations maps published by the U.S. Geological Survey. Area of I-771 shaded.

TOTAL-COUNT GAMMA RADIATION MAP OF THE VOINJAMA QUADRANGLE, LIBERIA

By
John C. Behrendt and Cletus S. Woterson
1974

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