DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

PREPARED IN COOPERATION WITH
THE COASTAL PLAINS REGIONAL COMMISSION

MISCELLANEOUS
MAP MF
FORCE AND BO
AERORADIOACT
N.C.-V

INTERPRETATION OF GAMMA AERORADIOACTIVITY MAP

Introduction

The total-count gamma aeroradioactivity survey was flown for the U.S. Geological Survey (USGS) by LKB Resources, Incorporated in 1975 and 1976. Interpretation of the survey was funded in part by Coastal Plains Regional Commission.

Stratigraphy, location, and mineralogy of the predominantly Pleistocene units are known in the immediately adjacent part of Virginia (Oaks and Coch, 1973; Force and Geraci, 1975). It was thought that concentrations of heavy minerals in Pleistocene sands would correlate with highs on the aeroradioactivity map as such concentrations have in some other areas (Moxham, 1955; Stockman and others, 1976).

Discussion

Map accuracy.--The aeroradiometric map faithfully reproduces the outline of water bodies in the map area, indicating that location accuracy and instrument calibration are unusually good for maps of this sort.

In addition, the map was checked by the authors with a roughly calibrated hand-held scintillometer. Agreement was good at those points where readings were made over freshly excavated subsoil. Agreement was also good at the locations of steep gradients, checked from a moving automobile. Figure 1 suggests that about 37.5 counts on the map as recorded by the airborne instrument corresponds with 1 μR/hr in the subsoil.

First-order variations.--The most noticeable contrasts on the map are those between water or wetlands (lows, as high as roughly 150 counts) and dry land (highs, more than 150 counts). The contoured surface of aeroradiometric values can be considered an irregular surface with "plateaus" of high values formed by dry land and "gullies" of low values formed by water and wetlands (fig. 2). This is consistent with results in other areas and with the fact that water is an effective absorber of gamma radiation.

Scintillometer measurements of spoil piles of dry detrital sediment from the Dismal Swamp and of drained sediment from the former Bear Swamp give values characteristic of dry land, indicating that wetness rather than detrital lithology causes the low values in some swamps. Wet peat gives low values; the values given by dry peat are not known.

Second-order variations.--Within areas of dry land, high values (more than about 250 counts) on the aeroradiometric map generally are present over clay, sandy clay, clayey sand, and sandy silt. Curvilinear bands of low values (between 150 and 250 counts) are present over clean well-sorted sands. Heavy minerals are conspicuous in some of these sands. A sand at Sandy Cross registered only 7 μR/hr (~250 counts) even though a sample contained 4.7 percent heavy minerals (specific gravity, >2.85). The heavy fraction contains 9.8 percent zircon and about 2 percent epidote; monazite was neither observed nor detected by X-ray diffraction of appropriate magnetic fractions (the X-ray work suggests that the maximum amount of monazite present is 0.2 percent of the heavy fraction).

In one area (near Indian Town) clean sand containing biotite in addition to other heavy minerals is interbedded with clay and organic matter. Heavy-mineral content is only 0.5 percent. The hand-held instrument read 8 μR/hr (~300 counts) at this location.

The boundaries of second-order radiometric lows correspond in four areas to the boundaries of sand bodies--one body above the Suffolk Scarp which extends from Sandy Cross to Valhalla and Rockyhock, two bodies at Hickory and Northwest near the Virginia-North Carolina border, and a body at Hastings Corner near Elizabeth City. Sand bodies are enclosed by a dashed line on main map. Scarps are shown by hachured line; hachures point downslope. The boundaries of the Indian Town body were not determined but probably correspond to the prominent bench in radiometric values.

In Chowan and adjacent counties, areas covered by soils with sandy subsoils (as shown on soils maps by Lapham and Lyman (1905), Hearn (1907), and Davis and Devereux (1929)) correspond to those areas where radiometric lows were found to be underlain by sand bodies. Somewhat less definitive correspondence between the lows and sandy subsoils was found in Camden County (Perkins and others, 1928). County soil surveys incorporated many more observations than we were able to make, and they are the best indicators that the second-order lows and the sand bodies are correlative.

Geologic interpretation

The map shows a few geologic boundaries which we believe are warranted on the basis of the aeroradioactivity data, our own reconnaissance data, soils maps, and published data describing nearby areas.

The Sandy Cross-Valhalla-Rockyhock sand body is probably composite, the Rockyhock arm being of estuarine origin and the Sandy Cross arm representing a former barrier island. Both probably belong to the Norfolk Formation as used by Oaks and Coch (1973). As in Virginia, the Suffolk Scarp in North Carolina is a former beach face related to the beach sand facies of the Norfolk Formation.

The Hastings Corner sand body is probably a rough correlative of the Kempsville Formation of Oaks and Coch (1963) and other sand bodies to the east (boundaries not determined) that are correlative with their Sand Bridge Formation.

Areas of lower radiation values above the Hazelton Scarp are physically continuous with the Windsor Formation of Coch (1968) and areas of higher radiation values below the scarp are the lagoonal facies of the Norfolk Formation.

CONCLUSION

In this area, deposits containing clay correlate with radiometric highs. Bodies of clean sand form curvilinear belts of second-order lows even where heavy-mineral contents are relatively high. First-order lows occur over wetlands or water.

REFERENCES CITED

Coch, N. K., 1968, Geology of the Benns Church, Smithfield, Windsor, and Chuckatuck quadrangles, Virginia: Virginia Div. Mineral Resources Rept. Inv. 17, 39 p.

Davis, W. A., and Devereux, R. E., 1929, Soil survey of Gates County, North Carolina: U.S. Dept. Agriculture, Bur. Chemistry and Soils, 1929 series, no. 1, 22 p.

Force, E. R., and Geraci, P. J., 1975, Map showing heavy minerals in Pleistocene(?) shoreline sand bodies of southeastern Virginia: U.S. Geol. Survey Misc. Field Studies Map MF-718.

Hearn, W. E., 1906, Soil survey of Chowan County, North Carolina: U.S. Dept. Agriculture, Bur. Soils, 1906 series, p. 223-244.

Lapham, J. E., and Lyman, W. S., 1905, Soil survey of Perquimans and Pasquotank Counties, North Carolina: U.S. Dept. Agriculture, Bur. Soils, 1905 series, p. 271-288.

Moxham, R. M., 1955, Airborne radioactivity survey in the Folkston area, Charlton County, Georgia, and Nassau County, Florida: U.S. Geol. Survey Geophys. Inv. Map GP-119.

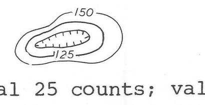
Oaks, R. Q., Jr., and Coch, N. K., 1963, Pleistocene sea levels, southeastern Virginia: Science, v. 140, no. 3570, p. 979-983.

______1973, Post-Miocene stratigraphy and morphology, southeastern Virginia: Virginia Div. Min. Resources Bull. 82, 116 p.

Perkins, S. O., Lee, W. D., Shivery, G. B., and Davidson, S. F., 1923, Soil survey Camden and Currituck Counties, North Carolina: U.S. Dept. Agriculture, Bur. Chemistry and Soils; 1923 series, no. 2, 56 p.

Stockman, K. W., Pickering, S. M., Jr., Higgins, M. W., and Zietz, Isidore, 1976, Application of contoured aeroradioactivity maps for heavy-mineral exploration in Georgia's coastal area: Geol. Soc. America Programs with Abstracts, v. 8, no. 2, p. 277.

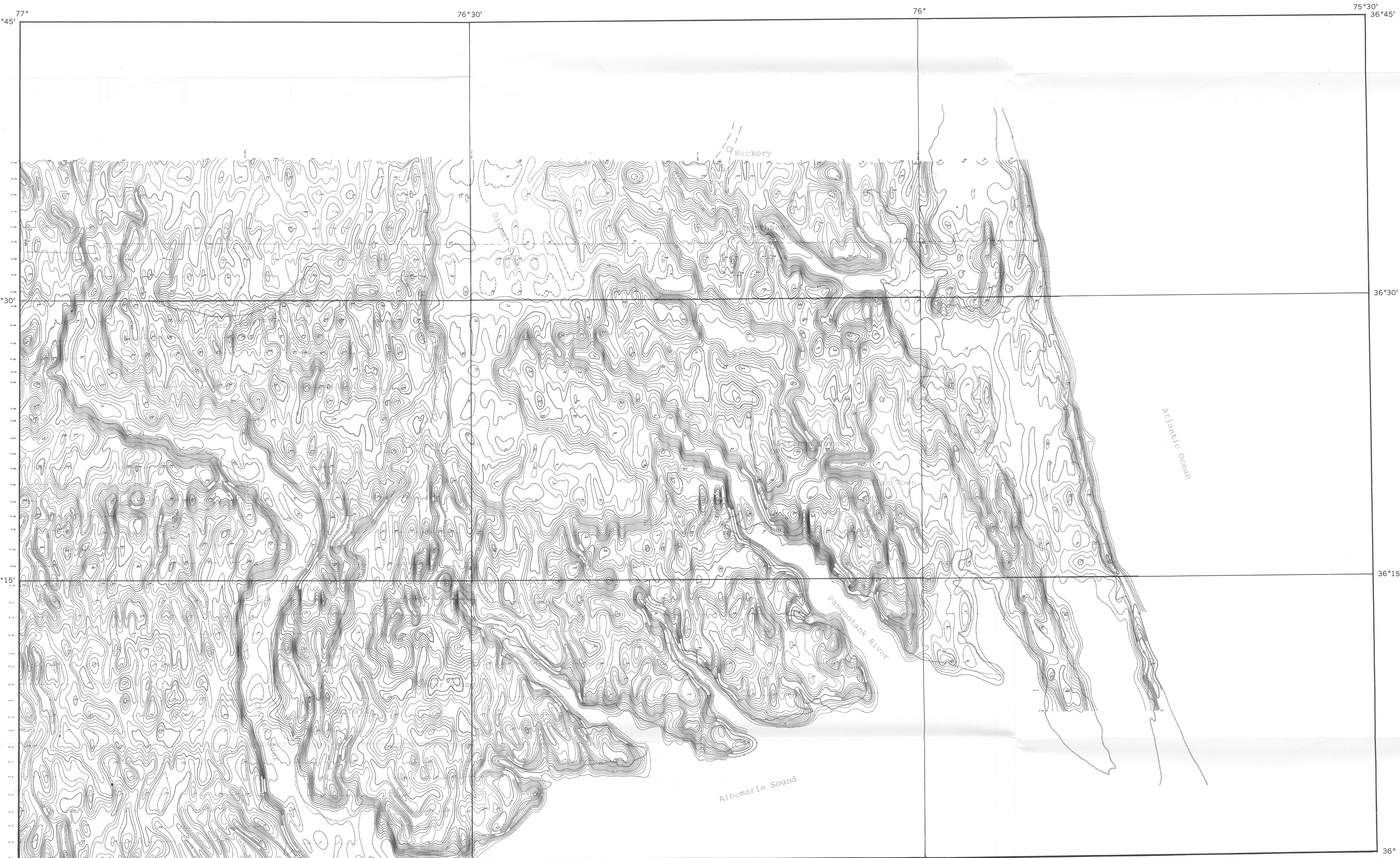
EXPLANATION



Contour--Contour interval 25 counts; values are corrected for altitude and contoured by computer; datum arbitrary

----

Flight line--East-west direction with one-mile spacing. Flight altitude approximately 500 feet

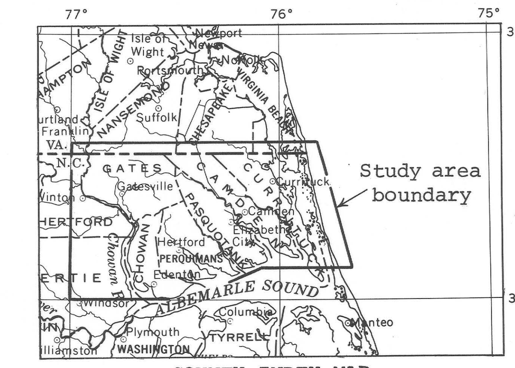


Shoreline from U.S. Geological Survey; Norfolk, 1953-69; Eastville, 1946-69; 1:250,000

SCALE 1:250 000

5 0 5 10 15 20 25 MILES

5 0 5 10 15 20 25 30 35 KILOMETERS



COUNTY INDEX MAP

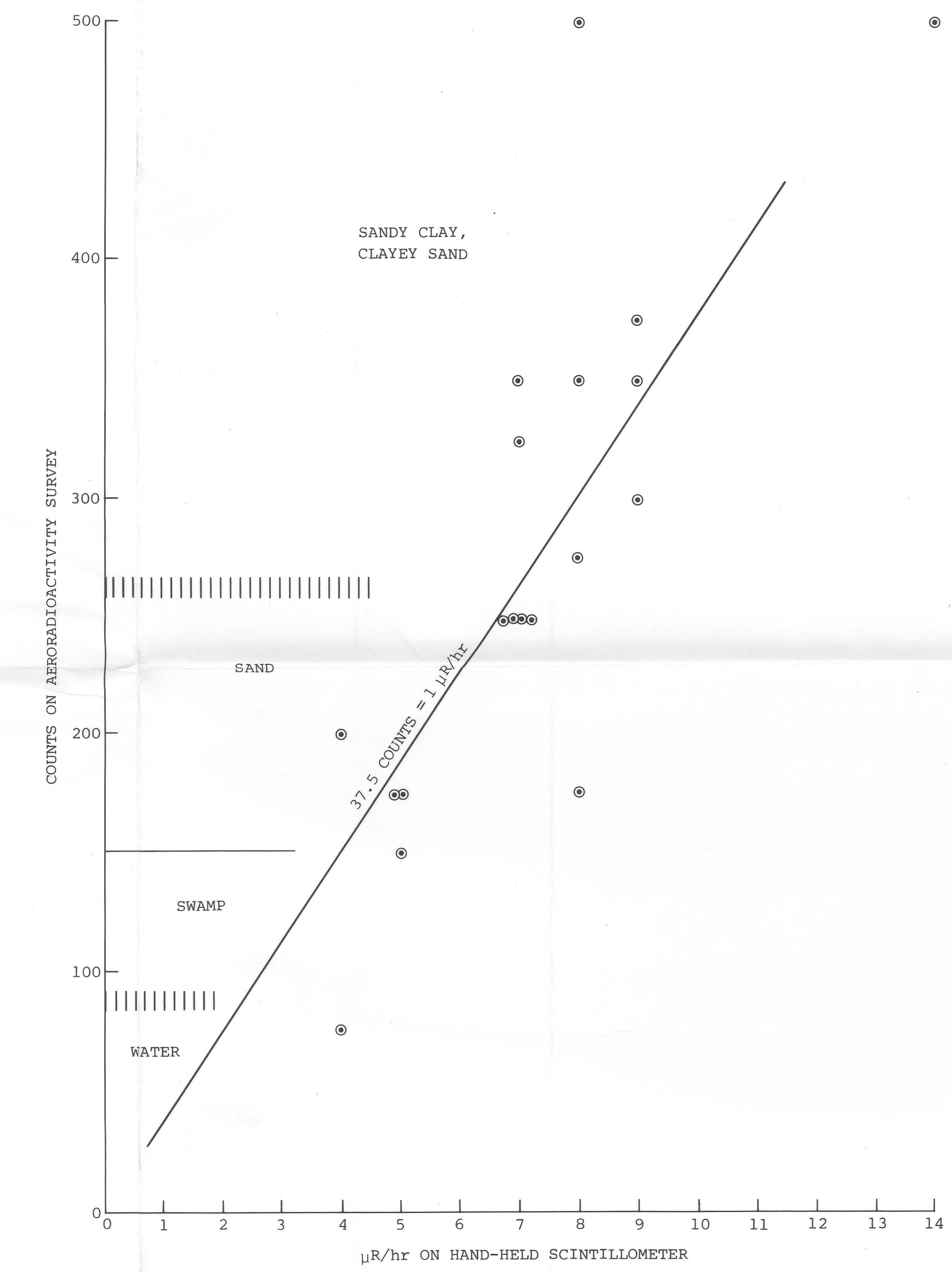


Figure 1.--Graph showing relation between aerial and ground radiation measurements. Surface lithology is roughly superimposed onto graph.

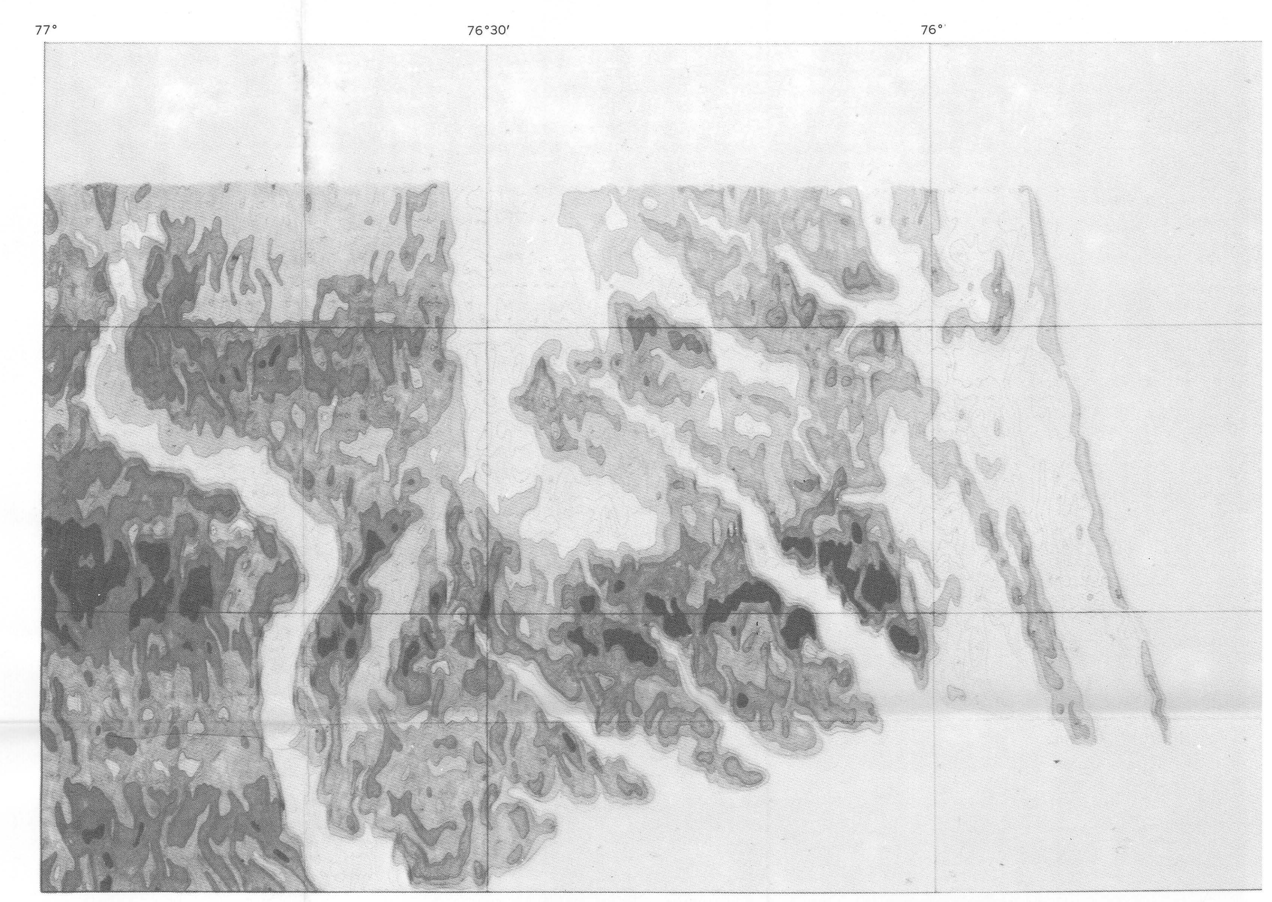


Figure 2.--Photograph of shaded aeroradioactivity map of the study area. Darkest areas show highest total-count values; lightest areas, lowest values.

GAMMA AERORADIOACTIVITY MAP OF PARTS OF NORFOLK AND EASTVILLE QUADRANGLES, OUTER COASTAL PLAIN, NORTH CAROLINA AND VIRGINIA

By

Eric R. Force and Sudip K. Bose

1977

Interior—Geological S

For sale by Branch of Dist
1200 South Eads Street, A