DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

PREPARED IN COOPERATION WITH
DIVISION OF BIOLOGY AND MEDICINE
U.S. ATOMIC ENERGY COMMISSION

GEOPHYSICAL INVESTIGATIONS
MAP GP-555

EXPLANATION

700–900
Radioactive unit boundary
Numbers indicate general range of radioactivity levels in counts per second

700–900
500–750 450–650 350–550
250–450 150–350 0–250
Approximate range of radioactivity within radioactivity units

★ Location of reactor site

Explanatory Text

The survey was made with scintillation detection equipment (Davis and Reinhardt, 1957) installed in a twin-engine aircraft. Parallel north-south flight lines spaced at one-mile intervals were flown at a nominal altitude of 500 feet above the ground. The flight path of the aircraft was recorded by a gyrostabilized continuous-strip-film camera. The radioactivity data were compensated for deviations from the 500-foot surveying altitude, and for the cosmic-ray component.

The effective area of response of the scintillation equipment at an altitude of 500 feet is that encompassed by a circle with a radius of 500 feet, and the radioactivity recorded is the average radioactivity of that area. The scintillation equipment records only pulses from gamma radiation with incident energies greater than 50 kev (thousand electron volts). A cesium-137 source is used during periodic calibrations to assure uniformity of equipment response.

The gamma-ray flux at 500 feet above the ground has three principal sources: cosmic radiation, radionuclides in the air (mostly radon daughter products), and radionuclides in the surficial layer of the ground. The cosmic component, called the cosmic background, is determined twice daily by calibration at 2,000 feet above the ground, and is removed from the radioactivity data prior to recording. The cosmic background during this survey ranged from 240 to 470 cps (counts per second).

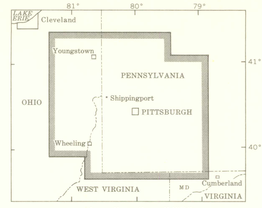
The component due to radionuclides in the air at 500 feet is difficult to evaluate. It is affected by meteorological conditions, and a tenfold change in radon concentration is not unusual under conditions of extreme temperature inversion. However, if inversion conditions are avoided, the air component may be considered to be fairly uniform on a given day in a particular area, and will not mask the differences in radioactivity levels that reflect changes in the ground component.

The ground component comes from approximately the upper few inches of the ground. It consists of gamma rays from natural radionuclides, principally members of the uranium and thorium radioactive decay series and potassium-40, and fallout of radioactive nuclear fission products. The distribution of fallout in the Pittsburgh area, if present, is assumed to be uniform and small in amount. This conclusion is supported by the fact that the minimum radioactivity recorded over the area due to naturally occurring radionuclides and any fallout present was only 150 cps.

Some correlation between geology and aeroradioactivity data was noted in the southeastern corner of the survey area, where radioactivity units having northeasterly trend reflect the general trend of Appalachian structure. Linear low radioactivity units outline strata of Mississippian age exposed along the crests and flanks of eroded anticlines. High values between the linear radioactivity lows are associated with strata of Devonian age exposed along the axes of the anticlines.

Glacial deposits of Illinoian age in the northern part of the survey area have an average radioactivity level of 500 cps, the same as that of rocks of Pennsylvanian age which they overlie and from which they were, in large part, derived. Glacial deposits of Wisconsin age lie to the north of the glacial deposits of Illinoian age and closer to an area of rocks of Mississippian age. The glacial deposits of Wisconsin age therefore contain a greater proportion of material derived from rocks of Mississippian age than do the glacial deposits of Illinoian age. This is reflected in the radioactivity data; the average radioactivity level of 400 cps for glacial deposits of Wisconsin age is intermediate between 350 cps for rocks of Mississippian age and 500 cps for rocks of Pennsylvanian age.

Davis, F. J., and Reinhardt, P. W., 1957, Instrumentation in aircraft for radiation measurements: Nuclear Sci. Eng., v. 2, no. 6, p. 713–727.



LOCATION OF PITTSBURGH SURVEY AREA

Base from Army Map Service, Corps of Engineers 1:250,000 topographic map series, Canton (1957), Clarksburg (1956), Cumberland (1956), Pittsburgh (1941), and Warren (1957) sheets

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Aeroradioactivity survey made at 500 feet above the ground under the direction of P. Popenoe and A. J. Petty, 1960

NATURAL GAMMA AERORADIOACTIVITY MAP OF THE PITTSBURGH AREA, PENNSYLVANIA, OHIO, WEST VIRGINIA, AND MARYLAND

By
Robert G. Bates

SCALE 1:250 000

5 0 5 10 15 20 25 MILES
5 0 5 10 15 20 25 KILOMETERS

1966

For sale by U.S. Geological Survey, price 50 cents