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-681

EXPLANATION

300–350 Radioactivity boundary
Numbers indicate range of radioactivity levels in counts per second

>1000
550–700
500–550
450–500
400–450
300–400
0–300

Generalized levels of aeroradioactivity in counts per second

NOTES

The survey was made with scintillation detection equipment[1] installed in a twin-engine aircraft. Parallel east-west flight traverses spaced at 1-mile intervals were flown at an approximate 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 approximately 1,000 feet in diameter, and the radioactivity recorded is an average of the radioactivity received from within the area. The scintillation equipment accepts only pulses originating from gamma radiation with 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 is determined twice daily by calibrations at 2,000 feet above the ground, and is removed from the radioactivity data.

The component due to radionuclides in the air at 500 feet above the ground 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 such conditions are avoided, the air component may be considered to be fairly uniform on a given day in a particular area, and will not affect the discrimination of the radioactivity levels that reflect changes in the ground component.

The ground component comes from 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 nuclear fission products. Locally the amount of fallout must be small as the lowest total radioactivity measured is 150 cps (counts per second) in areas not affected by absorption of gamma energy by water. The distribution of fallout in the area surveyed is assumed to be uniform.

The aeroradioactivity measured in the Chicago area ranges from 0 to more than 2,000 cps. Radioactivity of more than 700 cps cannot be related to natural effects and is discussed in the text of another report[2].

The surface geologic material consists of glacial deposits and loess of the Wisconsin stage of Pleistocene glaciation. These deposits almost completely cover the bedrock which consists of sedimentary rocks of Paleozoic age. They are generally of heterogeneous composition and consequently are not well defined by the aeroradioactivity data.

Low radioactivity of 50–300 cps fairly well defines glacial outwash sand and lacustrine material in the eastern part of the area. A similar low of 150–300 cps is associated with the lacustrine material of glacial Lake Chicago around East Chicago and Gary, Ind. Radioactivity of 500–650 cps is approximately associated with end moraine material throughout the area. Locally variations of 50 cps distinguish morainal units from adjacent glacial units.

Detailed information on the aeroradioactivity survey of the Chicago area is contained in the text of another report[2].

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

[2] G. M. Flint, Jr., and J. A. Pitkin, 1969, Aeroradioactivity survey and related surface geology of the Chicago area, Illinois and Indiana (ARMS-1): U.S. Atomic Energy Comm., Civil Effects Test Operations, CEX-59.4.13, Civil Effects Study.

MAP SHOWING AREA SURVEYED

Base from U.S. Geological Survey:
Aurora, 1958; Chicago, 1953; Danville, 1953; Peoria, 1958; Racine, 1958; Rockford, 1958

SCALE 1:250 000
5 0 5 10 15 20 25 MILES
5 0 5 10 15 20 25 KILOMETERS

DATUM IS MEAN SEA LEVEL
DEPTH CURVES SHOWN IN FEET
MAGNETIC NORTH DEVIATES FROM 01°30′ E. TO 03°30′ E. WITHIN MAP AREA

AERORADIOACTIVITY MAP OF THE CHICAGO AREA, ILLINOIS AND INDIANA

By

George M. Flint, Jr., and James A. Pitkin

1970

Aeroradioactivity survey made at 500 feet above the ground under the direction of P. W. Philbin, 1960

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