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RESULTS OF THE RADIOLOGICAL SURVEY AT 19 REDSTONE LANE, LODI, NEW JERSEY (LJ056)

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HEALTH AND SAFETY RESEARCH DIVISION**Waste Management Research and Development Programs
(Activity No. AH 10 05 00 0; NEAH001)****RESULTS OF THE RADIOLOGICAL SURVEY AT
19 REDSTONE LANE, LODI, NEW JERSEY
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ACKNOWLEDGMENTS

Research for this project was sponsored by the Division of Facility and Site Decommissioning Projects, U.S. Department of Energy, under contract DE-AC05-84O-R21400 with Martin Marietta Energy Systems, Inc. The authors wish to acknowledge the support of J. E. Baublitz, Acting Director, Office of Remedial Action and Waste Technology; J. J. Fiore, Director, Division of Facility and Site Decommissioning Projects; and members of their staffs. The authors also appreciate the contributions of J. L. Rich, S. W. Hawthorne, and L. J. Jeffers of the Publications Division; M. S. Uziel of the Environmental Remediation Group; D. A. Roberts of the Measurement Applications and Development Group; E. T. Loy of Don Stone Associates; and B. S. Ellis, R. W. Doane, and J. A. Roberts, former employee of Martin Marietta Energy Systems, Inc. for participation in the collection, analyses, editing, and reporting of data for this survey.

ABSTRACT

Maywood Chemical Works (MCW) of Maywood, New Jersey, generated process wastes and residues associated with the production and refining of thorium and thorium compounds from monazite ores from 1916 to 1956. MCW supplied rare earth metals and thorium compounds to the Atomic Energy Commission and various other government agencies from the late 1940s to the mid-1950s. Area residents used the sandlike waste from this thorium extraction process mixed with tea and cocoa leaves as mulch in their yards. Some of these contaminated wastes were also eroded from the site into Lodi Brook. At the request of the U.S. Department of Energy (DOE), a group from Oak Ridge National Laboratory conducts investigative radiological surveys of properties in the vicinity of MCW to determine whether a property is contaminated with radioactive residues, principally ^{232}Th , derived from the MCW site. The survey typically includes direct measurement of gamma radiation levels and soil sampling for radionuclide analyses. The survey of this site, 19 Redstone Lane, Lodi, New Jersey (LJ056), was conducted during 1985 and 1986.

Results of the survey demonstrated no radionuclide concentrations in excess of the DOE Formerly Utilized Sites Remedial Action Program criteria. The radionuclide distributions were not significantly different from normal background levels in the northern New Jersey area.

RESULTS OF THE RADIOLOGICAL SURVEY AT 19 REDSTONE LANE, LODI, NEW JERSEY (LJ056)*

INTRODUCTION

From 1916 to 1956, process wastes and residues associated with the production and refining of thorium and thorium compounds from monazite ores were generated by the Maywood Chemical Works (MCW), Maywood, New Jersey. During the latter part of this period, MCW supplied rare earth metals and thorium compounds to various government agencies. In the 1940s and 1950s, MCW produced thorium and lithium, under contract, for the Atomic Energy Commission (AEC). These activities ceased in 1956, and, approximately three years later, the 30-acre real estate was purchased by the Stepan Company. The property is located at 100 Hunter Avenue in a highly developed area in Maywood and Rochelle Park, Bergen County, New Jersey.

During the early years of operation, MCW stored wastes and residues in low-lying areas west of the processing facilities. In the early 1930s, these areas were separated from the rest of the property by the construction of New Jersey State Highway 17. The Stepan property, the interim storage facility, and several vicinity properties have been designated for remedial action by the Department of Energy (DOE).

The waste produced by the thorium extraction process was a sandlike material containing residual amounts of thorium and its decay products, with smaller quantities of uranium and its decay products. During the years 1928 and 1944 to 1946, area residents used these process wastes mixed with tea and cocoa leaves as mulch in their lawns and gardens. In addition, some of the contaminated wastes were apparently eroded from the site into Lodi Brook and carried downstream.

Lodi Brook is a small stream flowing south from Maywood with its headwaters near the Stepan waste storage site. Approximately 150 ft after passing under State Route 17, the stream has been diverted underground through concrete or steel culverts until it merges with the Saddle River in Lodi, New Jersey. Only a small section near Interstate 80 remains uncovered. From the 1940s to the 1970s when the stream was being diverted underground, its course was altered several times. Some of these changes resulted in the movement of contaminated soil to the surface of a few properties, where it is still in evidence. In other instances, the contaminated soil was covered over or mixed with clean fill, leaving no immediate evidence on the surface. Therefore, properties in question may be drilled in search of former streambed material, even in the absence of surface contamination.

As a result of the Energy and Water Appropriations Act of Fiscal Year 1984, the property discussed in this report and properties in its vicinity contaminated with residues from the former MCW were included as a decontamination research and development project under the DOE Formerly Utilized Sites Remedial Action Program. As part of this project, DOE is conducting radiological surveys in the vicinity of the site to identify properties contaminated with residues derived from the MCW. The principal radionuclide of concern is thorium-232. The radiological surveys discussed in this report are part of that

*The survey was performed by members of the Measurement Applications and Development Group of the Health and Safety Research Division at Oak Ridge National Laboratory under DOE contract DE-AC05-84OR21400.

effort and were conducted, at the request of DOE, by members of the Measurement Applications and Development Group of the Oak Ridge National Laboratory.

A radiological survey of the private, residential property at 19 Redstone Lane, Lodi, New Jersey, was conducted during 1985 and 1986. The survey and sampling of the ground surface were carried out on October 25, 1985, and the follow-up subsurface investigation was performed on September 13, 1986.

SURVEY METHODS

The radiological survey of the property included: (1) a gamma scan of the entire property surface outdoors and (2) collection of soil samples. No indoor survey measurements were performed. The survey methods followed the basic plan outlined in a correspondence from W. D. Cottrell to A. J. Whitman.¹ A comprehensive description of the survey methods and instrumentation has been presented in another report.²

Using a portable gamma scintillation meter, ranges of gamma exposure rates were recorded for areas of the property surface. Systematic soil samples were then obtained at randomly selected locations irrespective of the gamma exposure rates. In addition, biased soil samples were collected in areas of elevated gamma levels; however, not all elevated areas were sampled. Measurements were usually made and soil samples collected from depths of 0 to 15 cm. The samples were analyzed for ²²⁶Ra, ²³²Th, and ²³⁸U content.

To define the extent of possible subsurface soil contamination, auger holes were drilled to depths of approximately 2.3 m. A plastic pipe was placed in each hole, and a NaI scintillation probe was lowered inside the pipe. The probe was encased in a lead shield with a horizontal row of collimating slits on the side. This collimation allows measurement of gamma radiation intensities resulting from contamination within small fractions of the hole depth. Measurements were usually made at 15- or 30-cm intervals. If the gamma readings in the hole were elevated, a soil sample was scraped from the wall of the auger hole at the point showing the highest gamma radiation level. The auger hole loggings were used to select locations where further soil sampling would be useful. A split-spoon sampler was used to collect subsurface samples at known depths. In some auger holes, a combination of split-spoon sampling and side-wall scraping was used to collect samples.

SURVEY RESULTS

Applicable federal guidelines are summarized in Table 1.³ The normal background radiation levels for the northern New Jersey area are presented in Table 2.^{4,5} These data are provided for comparison with survey results presented in this report. All direct measurement results presented in this report are gross readings; background radiation levels have not been subtracted. Similarly, background concentrations have not been subtracted from radionuclide concentrations measured in soil samples.

Surface Gamma Radiation Levels

Gamma radiation levels measured during a gamma scan of the property surface are given in Fig. 1. Gamma exposure rates over the major portion of the property ranged from 5 to 9 μ R/h. No evidence of elevated gamma levels was found.

Systematic Soil Samples

Systematic soil samples were taken from various locations on the property for radionuclide analyses. Locations of these samples (S) are shown in Fig. 2, with results of laboratory analyses provided in Table 3. Concentrations of radium, thorium, and uranium in these samples were all below background levels for the northern New Jersey area (Table 2).

Auger Hole Soil Samples and Gamma Logging

Varying thicknesses of subsurface soil were sampled from depths of 60 to 185 cm in auger holes (A) drilled at two separate locations indicated in Fig. 2. The results of analyses of these samples are given in Table 3. Concentrations of radium and thorium in these samples ranged from 0.64 to 2.8 pCi/g and 0.81 to 3.2 pCi/g, respectively. Radionuclide concentrations in all auger samples were below DOE criteria (Table 1) for thorium.

Gamma logging was performed in each of the two auger holes to characterize and further define the extent of possible contamination. The logging technique used here is not radionuclide specific. However, logging data, in conjunction with soil analyses data, may be used to estimate regions of elevated radionuclide concentrations in auger holes when compared with background levels for the area. Following a comparison of these data, it appears that any shielded scintillator readings of 1000 counts per minute (cpm) or greater generally indicate the presence of elevated concentrations of ^{226}Ra and/or ^{232}Th . Data from the gamma profiles of the logged auger holes are graphically represented in Figs. 3 and 4. Readings in all auger holes were near or below 1000 cpm.

SIGNIFICANCE OF FINDINGS

Measurements and results of soil sample analyses taken at 19 Redstone Lane indicate that the property contains no significant radioactive contamination above normal background levels in this area. Radiological assessments of soil samples from the site demonstrate no radionuclide concentrations in excess of applicable Federal guidelines.

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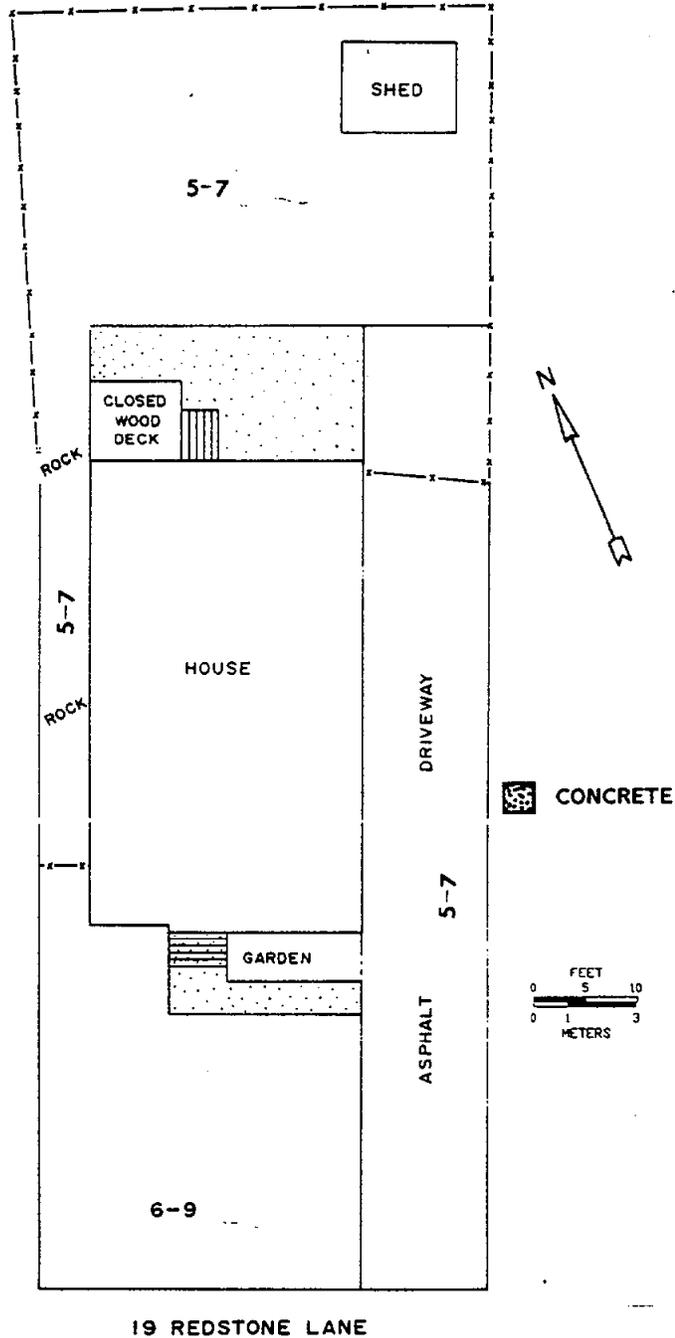


Fig. 1. Gamma radiation levels ($\mu\text{R/h}$) measured on the surface at 19 Redstone Lane, Lodi, New Jersey (LJ056).

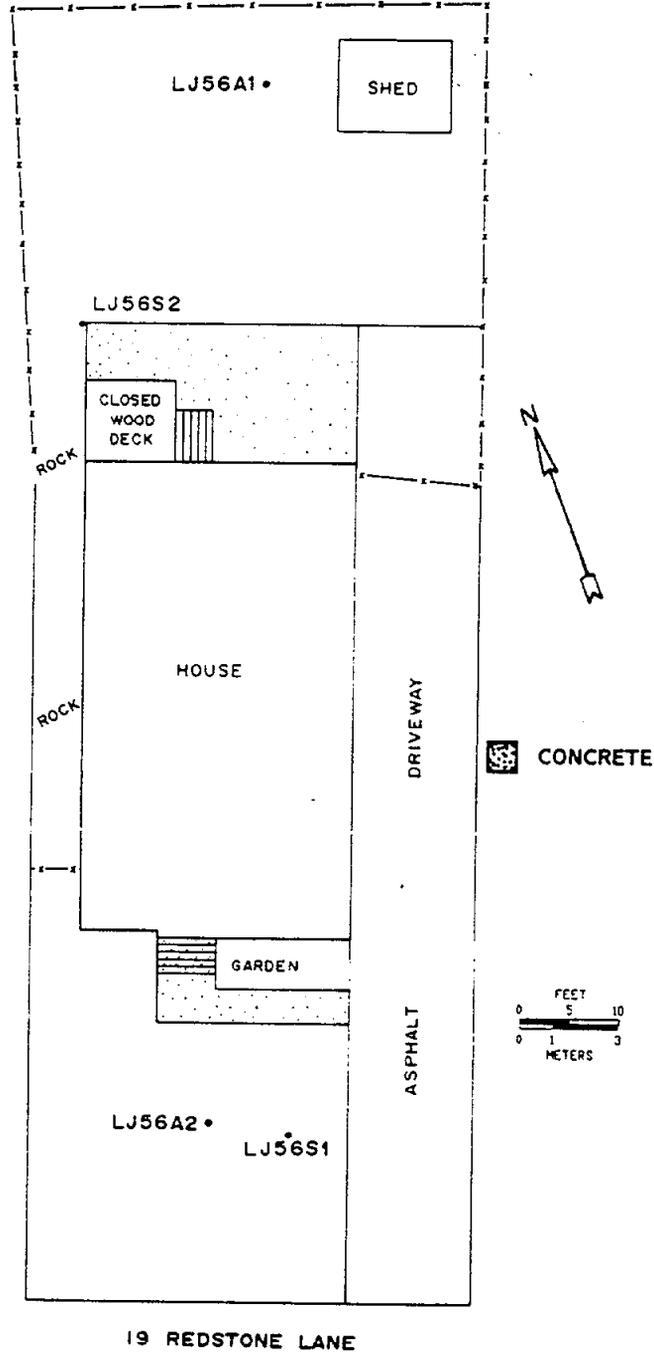


Fig. 2. Diagram showing locations of soil samples taken at 19 Redstone Lane, Lodi, New Jersey (LJ056).

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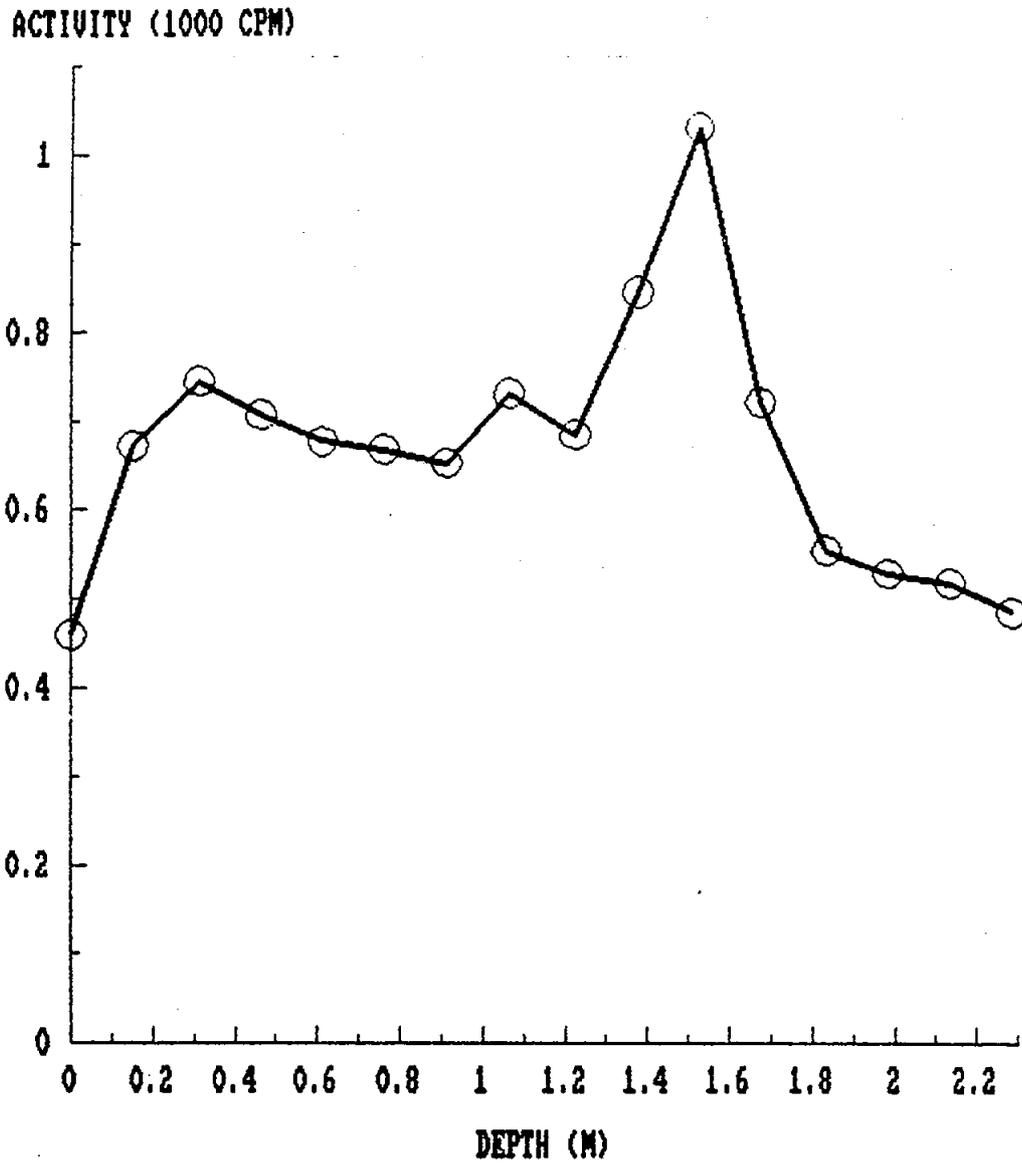


Fig. 3. Gamma profile for auger hole 1 (LJ056A1) at 19 Redstone Lane, Lodi, New Jersey.

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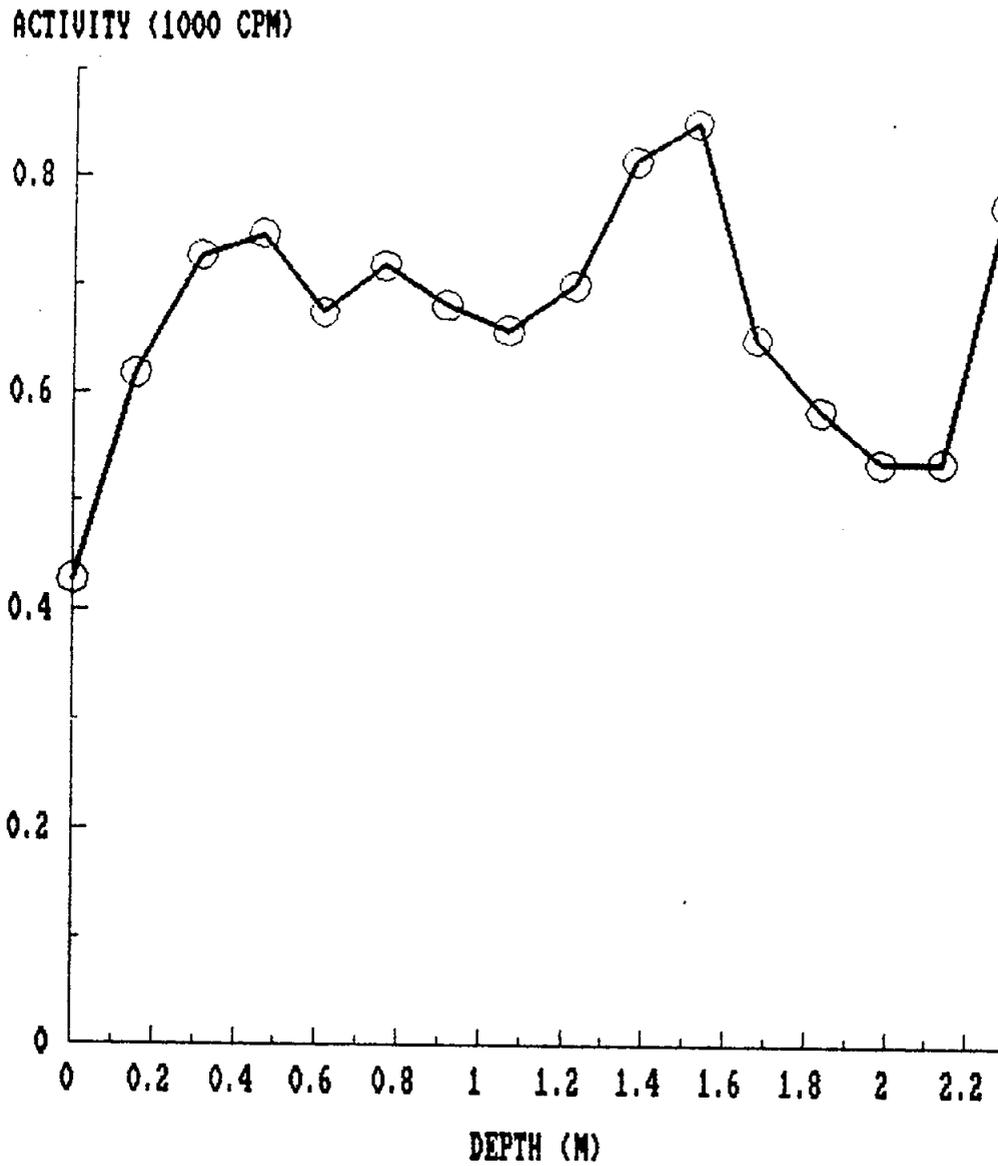


Fig. 4. Gamma profile for auger hole 2 (LJ056A2) at 19 Redstone Lane, Lodi, New Jersey.

Table 1. Applicable guidelines for protection against radiation^a

Mode of exposure	Exposure conditions	Guideline value
Radionuclide concentrations in soil	Maximum permissible concentration of the following radionuclides in soil above background levels averaged over 100 m ² area ²³² Th ²³⁰ Th ²²⁸ Ra ²²⁶ Ra ²³⁸ U	5 pCi/g averaged over the first 15-cm of soil below the surface; 15 pCi/g when averaged over 15-cm thick soil layers more than 15 cm below the surface Derived (site specific)

^aReference 3.**Table 2. Background radiation levels for the northern New Jersey area**

Type of radiation measurement or sample	Radiation level or radionuclide concentration ^a
Gamma exposure at 1 m above ground surface (μ R/h)	8 ^b
Concentration of radionuclides in soil (pCi/g)	
²²⁶ Ra	0.9 ^c
²³² Th	0.9 ^c
²³⁸ U	0.9 ^c

^aThese values represent an average of normal radionuclide concentrations in this part of the state. Actual values may fluctuate.

^bReference 4.^cReference 5.

**Table 3. Concentrations of radionuclides in soil at
19 Redstone Lane, Lodi, New Jersey (LJ056)**

Sample ^a	Depth (cm)	Radionuclide concentration (pCi/g)		
		²²⁶ Ra ^b	²³² Th ^b	²³⁸ U ^c
<i>Systematic samples^d</i>				
S1	0-15	0.58±0.04	0.68±0.1	0.60
S2	0-15	0.65±0.08	0.78±0.3	0.70
<i>Auger samples^e</i>				
A1A	60-90	0.64±0.2	0.81±0.1	f
A1B	120-150	0.68±0.05	0.86±0.09	f
A1C	150-185	1.5 ±0.04	3.2 ±0.04	f
A2A	60-90	0.68±0.06	0.91±0.3	f
A2B	120-150	1.0 ±0.04	1.1 ±0.3	f
A2C	150-185	2.8 ±0.2	1.1 ±0.3	f

^aLocations of soil samples are shown on Fig. 2.

^bIndicated counting error is at the 95% confidence level ($\pm 2\sigma$).

^cTotal analytical error of measurement results is less than $\pm 5\%$ (95% confidence level).

^dSystematic samples are taken at locations irrespective of gamma exposure rates.

^eAuger samples are taken from holes drilled to further define the depth and extent of radioactive material. Holes are drilled where the surface may or may not be contaminated.

^fSample was not analyzed for ²³⁸U.

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