Background Geochemistry of Some Rocks, Soils, Plants, and Vegetables in the Conterminous United States

GEOLOGICAL SURVEY PROFESSIONAL PAPER 574-F

Background Geochemistry of Some Rocks, Soils, Plants, and Vegetables in the Conterminous United States

By JON J. CONNOR *and* HANSFORD T. SHACKLETTE

With sections on FIELD STUDIES

By RICHARD J. EBENS, JAMES A. ERDMAN, A. T. MIESCH, RONALD R. TIDBALL, *and* HARRY A. TOURTELOT

STATISTICAL STUDIES IN FIELD GEOCHEMISTRY

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Geochemical summaries for 147 landscape units sampled in 25 field studies

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BACKGROUND GEOCHEMISTRY OF SOME ROCKS, SOILS, PLANTS, AND VEGETABLES IN THE CONTERMINOUS UNITED STATES

By Jon J. Connor, Hansford T. Shacklette, and others

ABSTRACT

Geochemical summary statistics for 48 elements in natural materials from 147 landscape units have been compiled based on field and laboratory studies since 1958. Each landscape unit is briefly identified as to kind and location, and the expected concentration for one or more elements is given together with factors indicating the degree of observed variation in the study and the degree of laboratory or "analytical" variation. Also listed are the observed range and the total number of element analyses made in each study. The data on which these summaries are based have three attributes in common: They represent "large-scale" or regional geochemical studies; they represent background or "ordinary" natural geochemical variation; and they were collected according to objective sampling designs. The summaries clearly demonstrate the wide diversity to be expected in elemental properties of landscape units and suggest that published element abundances for broad categories like "soil" or "carbonate rock" may be misleading.

INTRODUCTION

Increased public concern about real or suspected chemical deterioration of the environment, together with a growing awareness of the role of trace elements in health and nutrition, underscores the need for realistic data on the chemistry, particularly the trace element chemistry, of the natural environment. A moderately voluminous literature exists in which geochemical abundances of many trace elements are summarized, but it deals largely with rocks; less seems to be known (or at least less has been published) about the distribution of trace elements in soil, plants, and waters. Some of the standard references on trace element abundances in these materials are Goldschmidt (1954), Rankama and Sahama (1955), Mason (1958), and Turekian and Wedepohl (1961). More recent summaries include Wedepohl (1967–1973), Shacklette, Hamilton, Boerngen, and Bowles (1971) and Durum, Hem, and Heidel (1971). In addition to these, the U.S. Geological Survey is currently revising Clarke's (1924) Data of Geochemistry. The revision is being published as separate chapters of U.S. Geological Survey Professional Paper 440. Nearly a third of the projected chapters have been published to date, including chapters summarizing the composition of rocks (Parker, 1967) and waters (White, Hem, and Waring, 1963; Livingstone, 1963). Because of its well-known toxicity, mercury in the environment has received as much or more attention than any other trace metal. Three general references to mercury in the environment are U.S. Geological Survey (1970), Shacklette, Boerngen, and Turner (1971), and Jenne (1972). General summaries of trace elements in soils and in plant tissue are rare, although Shacklette, Sauer, and Miesch (1970) gave trace element averages for a variety of both, including foodstuffs, in Georgia.

Much of the extant information describing the "natural condition" of the geochemical environment is of unknown reliability. Generally, many of the data (particularly the older data) on which the published summaries are based were not collected to serve as guides to background geochemistry. Rather, they may have been collected to study such things as specific geochemical processes, or to delineate mineralized areas, or perhaps to estimate the degree of chemical pollution; in short, samples of natural materials tend to be collected for a variety of scientific reasons but only rarely for the purpose of describing the ordinary properties of the natural chemical environment.

One long-term U.S. Geological Survey effort, however, has for its goal precisely this purpose. For more than a decade now, personnel of the U.S. Geological Survey have been engaged in several field projects in regional geochemistry, the primary purpose of which has been to describe the geochemical variation of broad natural units in the United States. Fundamental to all these studies has been the conscious attempt to measure the geochemical variation *as it occurs in nature*. Some of this work has been published, but most of it has not. Many studies are currently underway, and we anticipate that such studies will continue.

One such study merits special mention. The U.S. Geological Survey has recently completed a geochemical survey of the State of Missouri, many aspects of which are unique to environmental geochemistry. It not only is a survey of a broad, geologically diverse area, but it was undertaken partly in support of active, trace-element related epidemiologic studies sponsored by the University of Missouri. Moreover, we think it is the first study of its kind in which an attempt has been made to characterize rocks, waters, soils, and plants chemically by a unified team approach using (and in part testing) efficient and objective sampling designs. Connor and others (1972) described this work in a preliminary way. Details of the study are available in a series of limited-distribution progress reports (U.S. Geological Survey, 1972a–f, 1973).

The data tabulated in the present report represent the work of many people. Principal investigators are listed with a short description of each study, and authorship is cited for all published data. All unpublished data are preliminary. The reader is cautioned that some of the data summaries given here may be subject to minor revision. The sampling designs, data analyses, and geochemical summaries on which this report is based are statistical in nature; extended discussions of these subjects can be found in Miesch (1967a, b, 1972), Connor and others (1972), and Connor and Myers (1973).

A proper list of acknowledgments for this report would comprise more than 100 people including computer programmers, specialists in data handling, and assistants in the field, laboratory, and office. Unquestionably, the most important contributors are the chemists, spectrographers, and other laboratory personnel who catalogued, prepared, and measured the concentrations of up to 69 elements in more than 8,000 samples of rocks, soils, and plant material over a period of more than 10 years. They are: Lowell Artis, Phillip Aruscavage, J.W. Baker, A.J. Bartel, S.D. Botts, L.A. Bradley, Floyd Brown, Mike Brown, J.W. Budinsky, G.T. Burrow, C.L. Burton, Alice Caemmerer, J.P. Cahill, E.Y. Campbell, G.W. Chloe, Don Cole, E.F. Cooley, N.M. Conklin, W.B. Crandell, Maurice DeValliere, J.I. Dinnin, P.L.D. Elmore, E.J. Fennelly, W.H. Ficklin, J.L. Finley, F.J. Flanagan, L.D. Forshey, I.C. Frost, Johnnie Gardner, J.L. Glenn, W.D. Goss, Frank Grimaldi, J.C. Hamilton, T.F. Harms, J.L. Harris, A.G. Haubert, R.G. Havens, R.H. Heidel, A.W. Helz, M.B. Hinkle, Claude Huffman, Jr., R.L. James, L.B. Jenkins, James Kelsey, Herbert Kirschenbaum, B.W. Lanthorn, L.M. Lee, K.W. Leong, H.H. Lipp, Irving May, B.A. McCall, R.E. McGregor, J.B. McHugh, J.D. Mensik, V.M. Merritt, Leung Mei, H.T. Millard, Jr., D.E. Moore, Roosevelt Moore, John Moreland, Wayne Mountjoy, A.T. Myers, H.M. Nakagawa, H.G. Neiman, W.W. Niles, D.R. Norton, Uteana Oda, C.S.E. Papp, L.F. Rader, R.L. Rahill, L.B. Riley, E.J. Rowe, J.J. Rowe, V.E. Shaw, G.D. Shipley, Leonard Shapiro, F.O. Simon, H. Smith, M.W. Solt, A.L. Sutton, Jr., D. Taylor, J.A. Thomas, Barbara Tobin, J.E. Troxel, J.H. Turner, R.L. Turner, R.E. Van Loenen, G.H. VanSickle, J.S. Wahlberg, F.N. Ward, E.P. Welsch, Roberta Wilkie, T.L. Yager, R.J. Young, and R.A. Zielinski.

METHODS OF STUDY

OBJECTIVES

The summary data listed herein have three common characteristics and only data consistent with these attributes have been included in the tables:

1. The data represent large-scale studies, in which an assessment of regional geochemical effects is one of the objects of study. The definition of large-scale or regional is somewhat arbitrary, but all studies listed herein involved a conceptual natural unit whose geographic extension in at least one direction is of the order of 80 km or more.

2. The data represent background concentrations. Data known or suspected to reflect epigenetic mineralization, or pollution and other man-induced effects have been intentionally excluded. Because of intimate contact with the atmosphere, plants may be more susceptible to the effects of low-level, broad-scale chemical pollution than are soils and rocks. The geochemistry of cultivated soils may, of course, reflect agricultural practices. Nevertheless, only data believed to be essentially free of unusual geochemical effects have been summarized in these tables.

3. The data were collected according to objective experimental designs in an attempt to insure that unbiased estimates of the "natural" variation were obtained. The suit of samples underlying each summary statistic includes varietal samples in approximately the same proportion that these varieties occur in nature. Commonly, such objectivity has been approached through introduction of randomization procedures into selection of the sampling sites. Nearly all of the sample suites were analyzed in a randomized sequence to circumvent any potential effects of systematic laboratory error.

COLLECTION PROCEDURES

The samples on which these tabulations are based were collected according to two general kinds of sampling design. The more conventional design is one in which a single sample of the material of interest was collected at each of numerous sites spread rather evenly over the area of study. A large number of studies, however, were based on a second, more complicated sample design, one in which an effort was made to quantify the effects of "regional" variation and the factors underlying such variation. Sample collection in these latter studies was based on hierarchical designs in which samples were "nested" at various geographic scales in order to assess the proportion of geochemical variation exhibited at each scale.

Krumbein and Slack (1956) discussed such designs and the requisite mathematics in detail. The particular sample design used for each field study is given under the description of that study in the following section.

Collection procedures in the field tended to be consistent from study to study. All rock samples were taken from outcrop as single samples of a few kilograms weight. They were collected from atrificial exposures as well as from natural outcrop. These samples were trimmed in the field or laboratory in an attempt to exclude all visible weathering rinds or surface effects. Admittedly, not all weathering effects are necessarily excluded thereby.

For the most part, soils were collected at or near the surface as single samples weighing about 1 kg. They were commonly taken from shallow holes dug with spade, geologic pick, or other metal tools. Special collection procedures were used in Studies 16, 18, and 19. Soils collected from deeper parts of the soil horizon were commonly taken from sides of large pits dug specifically for sampling. Attempts were made to take soil that had not been in contact with metal collecting tools. In studies 16, 18, and 19 the samples of soil material were sieved to remove rock particles larger than 2 mm in diameter before the samples were pulverized. In the other soil studies the rocks were removed from the samples by hand sorting; therefore rock particles somewhat larger than 2 mm in diameter may have been pulverized with the soil material of some samples.

Samples of native plants were commonly collected from the terminal parts of branches over as much of the plant as practical. In deciduous woody plants, stems of the previous few years' growth were always collected; leaves were rarely collected. For conifers, leaves (needles) and stems were collected together. No attempt was made to wash or otherwise clean the collected materials prior to analysis. Elemental analysis of the cultivated plant samples was performed on the edible parts of the plant prepared as for eating but uncooked.

DESCRIPTIONS OF FIELD STUDIES

The locations of the individual field studies on which the data in this report are based are shown in figures 1 and 2 and briefly described below by the principal investigators who provided the data given in tables 5–53.

STUDY NO. 1

[Granitic rocks of Precambrian age in the St. Francois Mountains, Missouri]

By RICHARD J. EBENS

Samples weighing a few kilograms each were collected from outcrops of granite and rhyolite of Precambrian age in the St. Francois Mountains of southeastern Missouri in the fall of 1970. Two samples were collected from each of 15 randomly selected sampling localities in the granites of the area, and a similar suite of samples was collected from the rhyolites of the area. Ten randomly selected samples were split into 2 parts and the entire suite of 70 was placed in a random sequence prior to analysis. Preliminary results of this study are given in U.S. Geological Survey (1972e, p. 13). Study conducted by Richard J. Ebens.

STUDY NO. 2

[Arkose of the Fountain Formation of Permian and Pennsylvanian age in central Colorado]

By A. T. MIESCH

Samples weighing a few kilograms each were collected during the summer of 1966 from outcrops of arkose of the Fountain Formation of Pennsylvanian and Permian age east of the Front Range in central Colorado. Ten randomly located samples were collected from each of 8 stratigraphic sections of the Fountain Formation. The length of the outcrop belt was divided into four approximately equal parts and two sections were randomly located in each part. Twenty samples were split and the total suite of 100 was placed in a random sequence prior to analysis. Study conducted by A. T. Miesch, Jon J. Connor, and Terry Quinlan.

STUDY NO. 3

[Sandstone, shale, and carbonate rocks of the Sauk sequence of Precambrian, Cambrian, and Ordovician age on the cratonic part of the Western United States]

By A. T. MIESCH

Samples weighing a few kilograms each were collected from outcrops of the Sauk sequence of Sloss (1963) in the Western United States during 1962–66. The stratigraphic sequence consists largely of rocks of Cambrian and Early Ordovician age although along the western edge of the study area some rocks of late Precambrian age are included. Throughout the study area the interval typically comprises a basal transgressive sandstone that is typified by the Prospect Mountain Quartzite, Tapeats Sandstone, and Flathead Sandstone, a thin overlying shale typified by the Bright Angel and Pioche Shales, and a thick upper carbonate interval typified by the Pogonip Group. Each of the three lithic parts of this sequence exhibits a variety of formational names in different places, and each lithology was treated as a separate problem although the same sampling design was used for each part. Ten major sampling localities approximately 400 km from each other were distributed over the study area. In each locality, eight stratigraphic sections were located in the following manner. Two sections were located approximately 3 km apart, another pair of two sections (also 3 km apart) was located about 15 km from the first pair; another group of four sections was located in a similar manner 80 km away. Where possible within each section, 2 samples were randomly located in the basal sandstone, 2 more in the shale interval, and 2 in the overlying carbonate rocks for a maximum of 6 samples per section and 48 per sampling locality. In addition to the 10 major sampling localities, 10 minor localities were dispersed over the study area in an attempt to occupy wide gaps between the major sampling

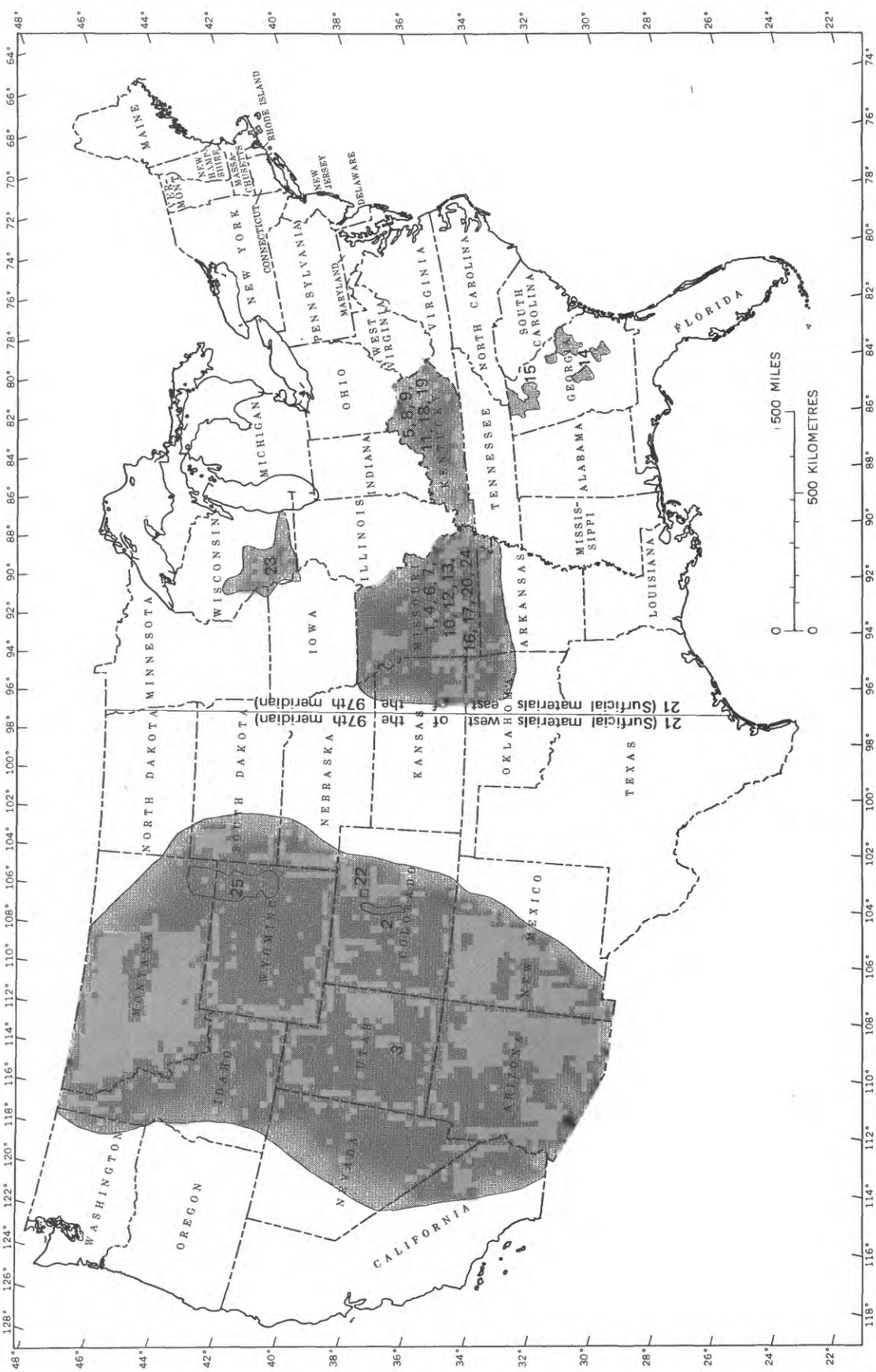

FIGURE 1.—Location of study areas where data were obtained. Numbers on the map refer to studies that are described in the text. (Sampling in area 3 was limited to rocks of the Sauk sequence.)

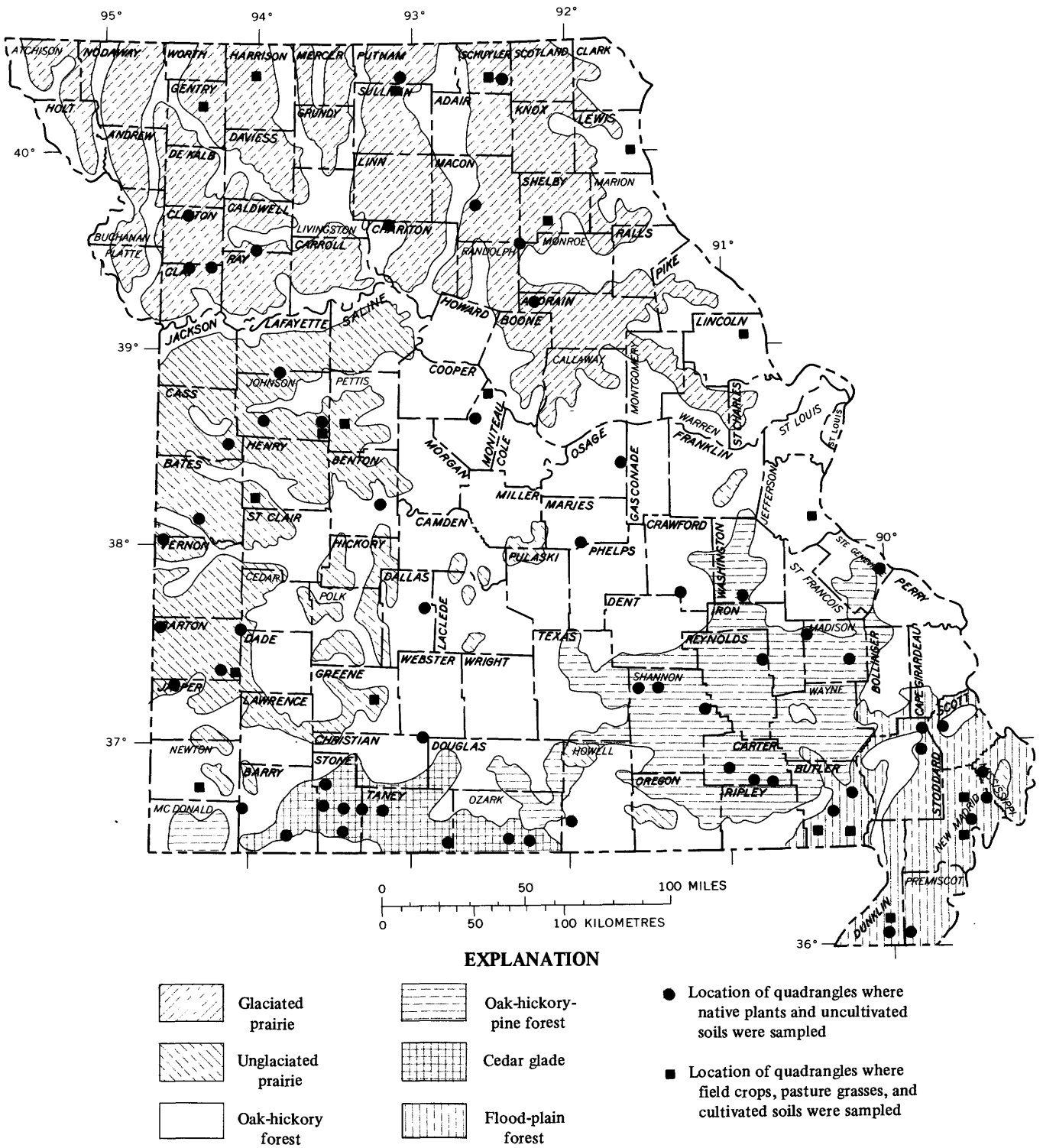

FIGURE 2.—Vegetation-type areas in Missouri, and location of quadrangles where plants and soils were sampled for Studies 17, 20, and 24. Map modified from Küchler (1964).

localities. Each minor locality consisted of only two stratigraphic sections spaced about 3 km apart. In all, 200 samples of sandstone, 168 samples of shale, and 196 samples of carbonate rock were collected. The samples of each lithic type were split into two parts and the entire suite of each placed in a random sequence prior to analysis. Study conducted by A. T. Miesch and Jon J. Connor.

STUDY NO. 4

[Sandstone and carbonate rocks of the Sauk sequence of Cambrian and Ordovician age in Missouri and northern Arkansas]

By JON J. CONNOR

Samples weighing a few kilograms each were collected from outcrops of the Sauk sequence of Sloss (1963) in Missouri and Arkansas in the fall of 1970. The stratigraphic sequence consists largely of dolomitic rocks of Cambrian and Early Ordovician age and involves numerous named formations (Howe and Koenig, 1961) of which the Bonneterre and Jefferson City Dolomites are typical. Samples of carbonate rock were collected from six composite stratigraphic sections radiating outward from the St. Francois Mountains region. Each section was subdivided into 10 parts of approximately equal thickness, and 2 of these were randomly selected for similar subdivision into 10 parts. Two of these latter parts (about 5 to 10 m in thickness) were randomly selected for sampling, and 2 samples were randomly collected from each, for a total of 8 samples per section or 48 samples in all. A second study based on the same stratigraphic sections consisted of collecting 2 randomly located samples of sandstone from the Roubidoux Formation from each section, for a total of 12 samples. The carbonate rock samples were analyzed along with other carbonate rocks from Missouri (Study Nos. 6, 7, and 10). Fifteen samples of the total were split and the entire batch randomized prior to analysis. The sandstone samples were analyzed along with other sandstones and chert from Missouri (Study Nos. 6 and 7). Fifteen samples of the total were split and the entire suite of samples randomized prior to analysis. Preliminary results of these two studies are given in U.S. Geological Survey (1972e, p. 13–17). Study conducted by Jon J. Connor and Richard J. Ebens.

STUDY NO. 5

[Sandstone, shale, and carbonate rocks of Paleozoic age in Kentucky]

By JON J. CONNOR

Samples weighing a few kilograms each were collected from outcrops of the following eight rock units in Kentucky in 1964–65: Limestone of Late Ordovician age; limestone of Early Mississippian age; shale, limestone, and sandstone of Late Mississippian age; and shale, limestone, and sandstone of Pennsylvanian age. These strata include a large number of named formations, particularly those of Mississippian age in western Kentucky where Chesterian rocks are well developed. Each unit was sampled according to the following design: The State was subdivided along latitude and longitude lines so that each part of the State underlain by rocks of Paleozoic age was assigned to the appropriate 1-degree "cell" (or part of a cell). In each cell, two 7½-minute quadrangles were randomly selected from all those in the cell which had been geologically mapped since 1960 and which are underlain in part by the particular unit to be sampled. Two localities of a size about 300 by 450 m were randomly selected from those parts of the 7½-minute quadrangles containing outcrops of the unit of interest and two samples were collected from randomly located sites in each locality. In all, 227 samples of carbonate rocks, 147 of shale, and 136 of sandstone were collected. Each sample was split into two parts for estimation of analytical error. Not all samples were submitted for analysis at the same time, but the samples in each submittal were placed in a random sequence prior to analysis. Because of their sideritic nature, 15 of the carbonate rock samples collected in this study have been placed in a separate lithic category in this compilation (Study No. 11). Published work based on parts of this study includes Connor (1969), Connor and Trace (1970), and Connor and Ebens (1972). Study conducted by Jon J. Connor.

STUDY NO. 6

[Sandstone, shale, and limestone of Pennsylvanian age in Missouri, Kansas, and Oklahoma]

By JON J. CONNOR

Samples weighing a few kilograms each were collected of sandstone, shale, and limestone of Pennsylvanian age in Missouri, Kansas, and northwestern Oklahoma in the fall of 1970. Samples of each lithic type were collected from four composite stratigraphic sections; two are located about 80 km apart in northwestern Missouri and northeastern Kansas and the other two are located in northeastern Oklahoma about 80 km apart. Each section was subdivided into 10 parts of approximately equal thickness. Two of these parts which contained the lithology to be sampled were selected randomly and themselves similarly subdivided into 10 parts, of which 2 were randomly selected. In each of these latter parts, which were 2–10 m thick, 2 samples of the requisite lithic type were taken, making a total of 32 samples each of limestone, sandstone, and shale. The samples of limestone, sandstone, and shale were analyzed along with other suites of carbonate rocks (Study Nos. 4, 7, and 10), sandstone, chert (Study Nos. 4 and 7), and shale (Study No. 7). Fifteen samples of each suite were split into 2 parts and each lithic suite was placed in a random sequence prior to analysis. Preliminary results of this study are in U.S. Geological Survey (1972e, p. 22–24), and Connor and Ebens (1972). Study conducted by Jon J. Connor and Richard J. Ebens.

STUDY NO. 7

[Carbonate rocks, shale, and chert of Mississippian age in Missouri, Oklahoma, and Arkansas]

By JON J. CONNOR

Samples weighing a few kilograms each were collected from outcrops of carbonate rocks of Mississippian age in Missouri, northeastern Oklahoma, and northern Arkansas in the fall of 1970. The outcrop belt was divided into five approximately equal segments and two stratigraphic sections about 80 km apart were located in each segemnt. Each section was subdivided into 10 approximately equal stratigraphic parts and 2 randomly located samples of carbonate rock were taken from each of 2 randomly chosen stratigraphic parts in each section, for a total of 40 samples. These samples were analyzed along with other carbonate rocks from the same general area (Study Nos. 4, 6, and 10) and all were submitted for analysis in a randomized sequence. Fifteen samples of the entire suite were split prior to analysis to estimate analytical error. A geochemical study of chert and shale interbedded with these rocks was also undertaken. For chert, a sample weighing a few kilograms was collected from the same outcrop and approximately the same beds from which each pair of carbonate rock samples was collected, resulting in a total of 20 chert samples. For shale, 2 samples each weighing a few kilograms were randomly collected from 9 of the 10 stratigraphic sections, resulting in a total of 18 samples. The samples of chert were analyzed along with other siliceous rocks (Study Nos. 4 and 6) and samples of shale were pooled with other aluminous rocks (Study No. 6), and all samples in each lithic type were submitted for analysis in a randomized sequence. Also, 15 samples in each lithic suite were split into 2 parts for estimation of analytical error. Preliminary results of this study are in U.S. Geological Survey (1972e). Study conducted by Jon J. Connor and Richard J. Ebens.

STUDY NO. 8

[Shale of Early Mississippian age in Kentucky]

By JON J. CONNOR

Samples weighing a few kilograms each were collected from outcrops of shale of Early Mississippian age in Kentucky in the fall of 1965. As in Study No. 5, the State was divided into cells, each consisting of a 1-degree quadrangle. In each quadrangle, two 7½-minute quadrangles were randomly selected from all those in the cell which had been geologically mapped since 1960 and which are underlain in part by shale of Early Mississippian age. Two stratigraphic sections were randomly located in each 7½-minute quadrangle and 2 randomly located samples were collected from each section for a total of 38 samples. Each was split into 2 parts and the resulting 76 samples were submitted to the laboratory in a randomized sequence. Study conducted by Jon J. Connor.

STUDY NO. 9

[Black shale of Devonian and Mississippian age in Kentucky]

By JON J. CONNOR

Samples weighing a few kilograms each were collected in Kentucky from outcrops of the Ohio, Sunbury, New Albany, and Chattanooga Shales, of Devonian and Mississippian age, in the fall of 1966. Eight randomly located samples were collected in each of 11 sampling localities distributed about 55 km apart around the outcrop belt in Kentucky. Each locality consisted of an area approximately the size of a 7½-minute quadrangle. Twenty-two of the 88 samples were split into 2 parts, and the entire suite of 110 samples was placed in a randomized sequence prior to analysis. Study conducted by Jon J. Connor and Harry A. Tourtelot.

STUDY NO. 10

[Limestone of the Tippecanoe sequence of Ordovician, Silurian, and Devonian ages in Missouri]

By JON J. CONNOR

Trimmed samples weighing a few kilograms each were collected from outcrops of the Tippecanoe sequence (Sloss, 1963) in eastern Missouri in the fall of 1970. The sequence in Missouri is composed predominantly of limestone and consists of a variety of named formations of Ordovician, Silurian, and Devonian ages (Howe and Koenig, 1961). The three sampled sections are located near Hannibal, Festus, and Cape Girardeau. Each section was subdivided into 10 parts of approximately equal thickness and 2 randomly chosen parts in each section were sampled in duplicate for a total of 12 samples. These samples were analyzed along with other carbonate rocks from Missouri (Study Nos. 4, 6, and 7) and all had been submitted for analysis in a randomized sequence. Fifteen samples in the suite were split prior to analysis to estimate analytical error. Preliminary results of this study are contained in U.S. Geological Survey (1972e). Study conducted by Jon J. Connor and Richard J. Ebens.

STUDY NO. 11

[Sideritic rocks of Mississippian and Pennsylvanian age in Kentucky]

By JON J. CONNOR

The collection of carbonate rocks of Late Mississippian and Pennsylvanian ages in outcrops from eastern Kentucky (Study No. 5) provided a small suite of siderite or sideritic rocks. The rocks occur as lenses or nodules in shales near or above the Mississippian-Pennsylvanian boundary as mapped. They are probably diagenetic in origin and their chemical contrast to the more common carbonate rocks of the Paleozoic section in Kentucky requires that they be treated separately. Fifteen samples were collected, and were analyzed as part of the carbonate rock collection from Kentucky (Study No. 5). Study conducted by Jon J. Connor.

STUDY NO. 12

[Residuum on carbonate rocks of Cambrian, Ordovician, and Mississippian ages in southern Missouri and northern Arkansas]

By RICHARD J. EBENS

Samples weighing about 2 kg each of cherty residuum (terra rossa) developed on carbonate rock units were collected in southern Missouri and northern Arkansas in the spring of 1972. The seven areas sampled are underlain by dolomites of the (1) Bonneterre, (2) Eminence or Potosi, (3) Gasconade, (4) Roubidoux, and (5) Jefferson City, Cotter, or Powell Formations, and by limestones of (6) Osagean and (7) Meramecian ages. Two samples were collected in each of 2 randomly selected sites in each of 6 randomly selected sampling localities in each of these 7 areas for a total of 168 samples. Twenty-five of the samples were split into 2 parts and then all 193 samples were arranged in a randomized sequence prior to analysis. Preliminary results of this work were published in Ebens (1973) and U.S. Geological Survey (1972e, 1973).

Residuum overlying the Bonneterre, Eminence, and Potosi Formations tends to be elevated in barium, lead, and zinc, and locally contains visible barite; therefore it was excluded from this compilation. Study conducted by Richard J. Ebens.

STUDY NO. 13

[Quaternary loess in Missouri]

By JON J. CONNOR

Samples weighing about 2 kg each were collected from thick deposits of Quaternary loess in bluffs adjacent to the Mississippi and Missouri Rivers in Missouri in the fall of 1970. The 2 river courses were divided into 6 segments, each about 150 km in length; 2 localities were randomly selected in each segment and 2 samples were randomly collected from a single vertical section in each locality for a total of 24 samples. Preliminary results of this work were published in Ebens (1973) and U.S. Geological Survey (1972e). Study conducted by Jon J. Connor and Richard J. Ebens.

STUDY NO. 14

[Garden soils, vegetables, native plants, and uncultivated soils in central and south-central Georgia]

By HANSFORD T. SHACKLETTE

This study and the following one were done in June and July 1965 and constitute a geochemical survey of two areas in Georgia that exhibit contrasting rates of cardiovascular mortality in humans. The counties sampled in this study were Bacon, Bleckley, Burke, Dodge, Emanuel, Jeff Davis, Jefferson, Jenkins, and Warren, all having high mortality rates. Vegetables and garden soils were sampled in 30 sites. Stems (terminal parts of branches 20–30 cm long) and leaves of native plants (trees and shrubs) and 3 soil horizons were also sampled at 30 sites. Selection of sampling sites, sampling methods, laboratory preparation and analysis of samples, and statistical treatment of the chemical data were discussed by Shacklette, Sauer, and Miesch (1970) and Shacklette, Erdman, and Keith (1973). Study conducted by Hansford T. Shacklette, Herbert I. Sauer, and A. T. Miesch.

STUDY NO. 15

[Garden soils, vegetables, native plants, and uncultivated soils in northern Georgia]

By HANSFORD T. SHACKLETTE

This study was conducted as the corollary of Study No. 14. The counties sampled were Cherokee, Fannin, Forsyth, Gilmer, Hall, Murray, Pickens, Towns, and Union, all having extremely low mortality rates. The sampling plan, sampling media, sample preparation, and analysis were the same as described for Study No. 14. Study conducted by Hansford T. Shacklette, Herbert I. Sauer, and A. T. Miesch.

STUDY NO. 16

[Agricultural soils in Missouri]

By RONALD R. TIDBALL

The study was conducted with the cooperation of the Missouri Agricultural Extension Service in collecting samples. The surface horizon (0–15 cm depth) of cultivated agricultural soils at 10 sites in each of the 114 counties of the State was sampled during 1970. Each sample is a composite taken over a single field prior to planting. Analysis was made of air-dried soil material less than 2 mm in diameter, pulverized to -100-mesh particle size in a ceramic mill. Sixty of the 1,140 samples were split for estimation of analytical error and the entire suite of 1,200 was submitted to the laboratory in a randomized sequence. Sampling plan, analytical results, and plotted maps of the distribution of element concentrations were reported by U.S. Geological Survey (1972b–f, 1973) and Tidball (1973). Study conducted by Ronald R. Tidball.

STUDY NO. 17

[Crop plants and associated soils in Missouri]

By HANSFORD T. SHACKLETTE

Mature corn grains and soybean seeds, and composite samples of the plow zone (0–15 cm) of cultivated soils, were collected in Missouri in September 1970. Insofar as possible, samples were taken at two randomly selected sites within each of five randomly selected 7½-minute quadrangles in each of the Floodplain Forest, Glaciated Prairie, Unglaciated Prairie, and Oak-hickory Forest vegetation-type areas in Missouri (fig. 2). Samples, including replicates (splits), were analyzed in a sequence random with respect to geographical origin. Sampling plan, results of chemical analyses, and statistical studies of the data were reported by U.S. Geological Survey (1972e, 1973) and Shacklette, Erdman, and Keith (1973). Study conducted by Hansford T. Shacklette, John R. Keith, and James A. Erdman.

STUDY NO. 18

[Soils and plants in Kentucky — I]

By RONALD R. TIDBALL

A reconnaissance study of the chemistry of soils and plants in Kentucky was made in the spring of 1965. Channel samples of the A, B, and C soil horizons were collected from profiles of Red-Yellow Podzolic soils. Randomly selected profile sites were located according to a hierarchical design, as follows: Two sites within a 2½-minute quadrangle, two 2½-minute quadrangles within a 7½-minute quadrangle within a 15-minute quadrangle, and two 15-minute quadrangles within a physiographic province. Samples were collected from 6 of the 12 physiographic provinces (Nos. 4, 5, 6, 7, 11, and 12) as defined by Bailey and Winsor (1964). Samples of mature stems (terminal parts of branches, about 30 cm in length) were also collected from both oak and hickory trees at each of the sites from which soil samples were collected. Fifty of the 288 soil samples and 30 of the 192 plant samples were split into 2 parts and the entire sample suite of each material was submitted to the laboratory in a randomized sequence. Study conducted by Ronald R. Tidball.

STUDY NO. 19

[Soils and plants in Kentucky — II]

By RONALD R. TIDBALL

This study used a sampling design based on the results of Study No. 18. Sampling was performed in the spring of 1967. Channel samples of the A horizon of representative profiles of Red-Yellow Podzolic soils were collected in Kentucky according to the following design. Eighteen 30-minute quadrangles were selected for sampling across southern Kentucky from long 84° to 88° W., and from lat 36° to 37° N. A random selection of sites was made as follows: Six 7½-minute quadrangles selected within each 30-minute quadrangle, one 2½-minute quadrangle within each 7½-minute quadrangle, and one site sampled within each 2½-minute quadrangle. Samples of mature stems (terminal parts of branches about 30 cm in length) were also collected from both oak and hickory trees at each site where soil was sampled. Thirty samples each of soil and plant material were split into 2 parts and the resulting sample suites of 138 soils and 276 plants were submitted to the laboratory in randomized sequence. Study conducted by Ronald R. Tidball.

STUDY NO. 20

[Native vegetation and uncultivated soils in Missouri]

By JAMES A. ERDMAN

This study was made in September and October 1970. The sampling plan was based on a hierarchical design in which the conceptual units at the top level were potential vegetation types as defined by Küchler (1964), with modifications (U.S. Geological Survey, 1972a, p. 18). The stratified sampling plan required the selection of 5 sites in each of 10 randomly selected 7½-minute quadrangles within each of the 6 vegetation-type areas in Missouri (fig. 2). Plant sampling was based on (a) ubiquitous (smooth sumac) or widespread (buckbrush) species in all vegetation-type areas, and (b) species characteristic of each vegetation type. Stems (terminal parts of branches) 10–30 cm in length of these species were collected at as many sites as possible, were dried and pulverized, and part of each sample was burned to ash for chemical analysis. The B horizon of uncultivated soil was sampled at each site, dried, pulverized, and analyzed. Fifty of the 950 plant samples and 30 of the 300 soil samples were split into 2 parts, and the resulting sample suites of 1,000 plants and 330 soils were analyzed in a sequence random with respect to geographic origin. Descriptions of the sampling plan, results of chemical analyses, plotted maps of the distribution of element concentrations, and statistical studies of the data were reported by U.S. Geological Survey (1972a–f, 1973), Erdman and Shacklette (1973), and Ebens and others (1973). Study conducted by James A. Erdman, Hansford T. Shacklette, and John R. Keith.

STUDY NO. 21

[Surficial materials in the conterminous United States]

By HANSFORD T. SHACKLETTE

As many as 1,000 samples of soils or other surficial materials, taken at a depth of approximately 20 cm from locations about 80 km apart on routes of travel across the United States were analyzed for 43 elements. Samples were collected during 1958–70 by personnel of the U.S. Geological Survey. The sampling program was designed to give estimates of the range of element abundance in surficial materials that were unaltered or very little altered from their natural condition. Even though most samples were collected in the vicinity of roads, the data for lead in this study are included in this report, because an independent study by Connor, Erdman, Sims, and Ebens (1970) had suggested that lead accumulation in subsurface soil 20 to 30 m laterally from the road surface could not be demonstrated by the analytical methods used. Results of this study were reported by Shacklette, Hamilton, Boerngen, and Bowles (1971), Shacklette, Boerngen, and Turner (1971), Shacklette, Boerngen, Cahill, and Rahill (1973), and Shacklette, Boerngen, and Keith (1974). Study conducted by Hansford T. Shacklette and Josephine G. Boerngen.

STUDY NO. 22

[Surficial materials, Longmont, Colorado, area]

By HARRY A. TOURTELOT

As a pilot study preparatory to investigating the geochemistry of the Front Range Urban Corridor (extending from Fort Collins south to Fountain, Colorado), 168 samples of surficial materials, 4 in each of 42 localities arranged in a grid pattern over twelve 7½-minute quad-

rangles, were collected and analyzed. These quadrangles were centered on Longmont and spanned the Corridor, from within the mountains eastward onto the plains. The surficial materials were collected during November 1971 through February 1972 and were sampled to a depth of 15 cm. They ranged from well-developed agricultural soils to unconsolidated sediments and rock disintegration products. Samples, including 60 replicates (splits), were analyzed in a sequence random with respect to geographical origin. Preliminary results of this study were reported by Tourtelot (1973). Study conducted by Harry A. Tourtelot.

STUDY NO. 23

[Garden vegetables and field corn in Wisconsin, Minnesota, and Iowa]

By HANSFORD T. SHACKLETTE

A variety of vegetables and field corn was collected in September 1961, from up to 27 sampling sites in home and institutional gardens and commercial plantings, principally in Wisconsin. One home garden in Iowa and a cornfield in Minnesota, both near the Wisconsin boundary, were also sampled. For brevity, these collections are listed in the summary tables as being from Wisconsin only. The selection of gardens to sample was based on availability of the desired kinds of vegetables in a garden, the facility of obtaining permission to sample, and the time available. Large gardens at the county hospitals of Dane, Grant, Iowa, and Richland Counties, and a commercial truck farm in Racine County, were sampled; other sites were family gardens. Corn was sampled in fields in which the grains were mature at the time of the study. The vegetable samples were prepared as for table use (but without cooking), and the mature grains of corn were removed from the cob. The samples were dried, pulverized, and burned to ash, and the ash was analyzed by semiquantitative spectrographic and other methods. See also Shacklette, Erdman, and Keith (1973). Study conducted by Hansford T. Shacklette.

STUDY NO. 24

[Cedar in Missouri]

By JAMES A. ERDMAN

Red cedar was sampled in August and September of 1969 at two randomly selected sites within each of five randomly selected 7½-minute quadrangles within each vegetation-type area of Missouri (fig. 2). The terminal 20–30 cm part of branches, including both stems and leaves, was collected and the samples were analyzed by spectrographic and other methods, as reported by U.S. Geological Survey (1972b), in a random sequence unknown to the analyst. Application of these data to a contamination study was reported by Ebens, Erdman, Feder, Case, and Selby (1973). Study conducted by James A. Erdman, Hansford T. Shacklette, and John R. Keith.

STUDY NO. 25

[Surface soils and sagebrush, Wyoming and Montana]

By JON J. CONNOR

Forty-eight samples of soil and sagebrush were collected in May 1973 from the Powder River Basin according to a hierarchical design. The basin was divided into 12 parts, each approximately 70 km on a side. Two townships were selected randomly from each part; a total of three sections were selected randomly in the two townships, and a total of four sampling sites were selected in the three sections. At each site a sample of the top 2 cm of undisturbed soil and a sample of the terminal stems and leaves of a living sagebrush were collected. Selected samples of each material were split into two parts and the samples in each resulting suite were analyzed in a randomized sequence. A few preliminary results of this study were given by Anderson, Keith, and Connor (1974). Study conducted by Jon J. Connor, John R. Keith, and Barbara M. Anderson.

METHODS OF ANALYSIS

A wide variety of analytical methods was used to generate the data underlying the tabulations in this report. In the earlier studies, the common metals in rocks and soils were generally determined by rapid spectrophotometric techniques (Shapiro and Brannock, 1962), or atomic absorption spectrophotometric methods (Shapiro, 1967). More recently, and particularly for studies in Missouri, many of these metals were analyzed by rapid X-ray fluorescence techniques. Trace-metal analysis in all work has relied heavily on both a semiquantitative emission spectrographic procedure slightly modified from that described by Myers, Havens, and Dunton, and a direct-reading emission spectrographic technique (Havens and Myers, 1973). Elements in plant ash not measured spectrographically were measured by atomic absorption, colorimetric, selective-ion electrode, or other special methods as listed in table 1. All analytical work was performed in laboratories of the U.S. Geological Survey. The analytical technique used for each entry in the summary tables 5–53 is identified by the appropriate number listed in table 1.

Forty-eight elements are listed in the summary tables. Of these, about 10 were detected in only a relatively few samples of only a few studies. Approximate limits of determination for a variety of elements commonly looked for in spectrographic work but seldom or never detected are listed in table 2.

For various reasons, 24 of the 92 naturally occurring elements were never analyzed for in any of these studies. They are the six noble gases (helium, neon, argon, krypton, xenon, and radon), nitrogen, oxygen, sulfur, chlorine, bromine, technetium, ruthenium, rhodium, cesium, promethium, osmium, iridium, polonium, astatine, francium, radium, actinium, and protactinium.

TABLE 1.—*Analytical methods used*

[Number in the first column identifies the method used for determining chemical data reported in tables 5–53. Leaders (...) indicate no data available]

No.	Name of method	Materials analyzed, and elements commonly reported	Principal references	Remarks
1	Six-step emission spectrographic.	Geologic materials, soils, and plant ash: Ag, B, Ba, Be, Ce, Co, Cr, Cu, Ga, Fe, La, Mn, Mo, Nd, Ni, Pb, Sc, Sn, Sr, Ti, V, Y, Yb, and Zr. Geologic materials and soils only: Nb. Geologic materials and plant ash only: Ca. Soils only: Bi and Sb. Soils and plant ash only: Al and W. Plant ash only: Mg.	Myers, Havens, and Dunton, 1961	Concentrations reported as midpoints of six geometric classes per order of magnitude.
2	Direct-reading emission spectrographic.	Geologic materials, soils, and plant ash: B, Ba, Be, Cr, Cu, La, Mn, Mo, Pb, and Y. Geologic materials only: Fe and Zn. Geologic materials and soils only: Co, Ga, Nb, Ni, Sc, Sr, V, and Zr. Geologic materials and plant ash only: Ti. Plant ash only: Ag.	Havens and Myers, 1973	Concentrations reported as actual values, rather than as classes of values.
3	Atomic absorption, flame	Geologic materials, soils, and plant ash: Cd, Li, Mg, Na, and Zn. Geologic materials only: Ag. Plant ash only: Ca, Co, Fe, K, and Rb.	Ward, Nakagawa, Harms, and Van Sickle, 1969; Shacklette, Boerngen, Cahill, and Rahill, 1973.	Second reference describes methods for Cd and Li only.
4	Atomic absorption, flameless.	Geologic materials, soils, and dry plants: Hg	Vaughn and McCarthy, 1964.	Unpublished modification used for dry plants.
5	X-ray fluorescence	Geologic materials and soils only: Al, Ca, Fe, K, P, Se, and Si	Liebhofsky, Pfeiffer, Winslow, and Zemany, 1960.	
6	Colorimetric	Geologic materials, soils, and dry plants: As. Soils and plant ash only: Cu, P, Pb, and Zn. Plant ash only: Si.	Ward, Lakin, Canney, and others, 1963.	Use for Pb, Cu, and Zn discontinued in 1967.
7	Catalytic	Dry plants only: I	Cuthbert and Ward, 1964.	Oxygen combustion-ceric sulfate method.
8	Neutron activation	Geologic materials only: Au. Geologic materials and soils only: I. Soils only: Th and U.	Rowe and Simon, 1968	Used in conjunction with fire assay for Au.
9	Selective-ion electrode	Geologic materials, soils, and dry plants: F	Ingram, 1970	
10	Gasometric	Geologic materials and soils only: Carbonate C	Scott, 1950	
11	Calculated	Geologic materials and soils only: Organic C		Total C minus carbonate C.
12	Flame emission (photometric).	Soils only: Na. Soils and plant ash only: K	Shapiro and Brannock, 1962.	Use discontinued in 1967.
13	EDTA titration	Soils and plant ash only: Ca and Mg	do	Use discontinued in 1967.
14	2-3 diaminonaphthalene	Dry plants only: Se		Unpublished method.
15	Gravimetric	Dry plants only: Ash	Ward, Lakin, Canney, and others, 1963.	Aliquots of dry plants weighed, burned to ash, and the ash weighed and calculated as percentage of dry weight.
16	"Rapid rock"	Geologic materials only: Carbonate C and Mn. Geologic materials and soils only: Al, Ca, Fe, K, Mg, Na, P, Si, and Tri.	Shapiro, 1967; Shapiro and Brannock, 1962.	All elements determined in aliquots of a single solution of the sample.

TABLE 2.—*Elements commonly looked for, but rarely or never detected, by multi-element spectrographic analysis, and their approximate lower limits of determination in parts per million*

[Values apply to analyses by the semiquantitative spectrographic method, except values in parentheses, which apply to analyses by the quantitative (direct-reading) spectrographic method. Leaders (—) in a figure column indicate that the element is commonly detected in the sample material listed in the column heading]

Element	Material analyzed: Rocks and soils	Material analyzed: Plant ash
Antimony	150 (300)	300
Arsenic	1,000	2,000
Bismuth	10 (10)	20
Cadmium	20 (70)	50
Cerium	150	300
Dysprosium	[1]50	[1]100
Erbium	50	100
Europium[2]	100	200
Gadolinium	[1]50	[1]100
Gallium	—	5
Germanium	10 (50)	20
Gold	20	50
Hafnium	100	200
Holmium	[1]20	[1]50
Indium	10 (10)	20
Lithium	50	100
Lutetium	[1]30	[1]70
Neodymium	[2]70	[2]70
Niobium	10	20
Palladium	1 (5)	2
Platinum	30	70
Praseodymium	[2]100	[2]200
Rhenium	30 (70)	70
Samarium	[1]100	[1]200
Silver	.5 (2)	.5
Scandium	—	5
Tantalum	200	500
Tellurium	2,000	5,000
Terbium	[1]300	[1]700
Thallium	50 (50)	500
Thorium	200	500
Thulium	[1]20	[1]50
Tin	10 (20)	15
Tungsten	100 (300)	300
Uranium	500	1,000
Zinc	200 (300)	—

[1]Looked for if yttrium is greater than 50 ppm.
[2]Looked for if lanthanum or cerium is found.

The total elemental variation observed in a specific study always includes variation due to laboratory ("analytical") procedures as well as variation due to natural effects. The inclusion of hidden and randomly sequenced sample splits in many of the laboratory submittals provided data for the estimation of total laboratory variance from the equation:

$$S_a^2 = \frac{\sum_{i=1}^{n}(X_{1_i} - X_{2_i})^2}{2_n} \quad (1)$$

where S_a^2 represents the error variance, X_1, and X_2 represent the concentrations (or their logarithms) of an element in the two splits of the ith sample and n is the number of samples split. Where an error was not formally defined, it resides in the estimate of total variability and remains unknowable.

GEOCHEMICAL SUMMARIES

ORGANIZATION AND USE OF DATA

The geochemical summaries tabulated herein are alphabetically arranged by the English spelling of each element. Summaries for each element are presented, as appropriate, for each of four broad environmental categories—rocks, unconsolidated geologic deposits, soils, and plants. Listed within each category are the summary results for one or more individual studies. Studies on rocks and unconsolidated geologic deposits are grouped by gross lithologic character. Soils are subdivided into those under active cultivation and those not under active cultivation when sampled; within each group, soil studies are listed by horizon or depth. In Studies 10 and 22, soils from both cultivated and uncultivated sites were included without differentiation. Plants are grouped as cultivated or native species and are listed within either group by their common names; scientific names and plant parts sampled are given in tables 3 and 4. For cultivated plants, entries in the summary tables are given for analysis of the plant as commonly prepared for eating but prior to cooking. All entries in the summary tables are given a general location, commonly the State.

Each entry in each table is identified by a study number, with which the user may find a brief description of the work in the section entitled "Descriptions of Field Studies," and a number identifying the analytical method used (from table 1). Also given are the following: a ratio, which indicates the number of samples in which the element was determined in relation to the total number analyzed; the mean, which estimates the most probable concentration to be expected in the analyzed material; the deviation, a factor which indicates the degree of variability observed; the error, a factor which indicates the reproducibility of the analytical method; and finally, the range of concentrations observed in the study.

Geometric and arithmetic means, standard deviations, standard errors, and observed ranges are given in units of percent, parts per million (ppm), or parts per billion (ppb). A part per million is 10^{-4} percent and a part per billion is 10^{-7} percent. Geometric deviations and geometric errors are factors.

The mean for each entry in the summary tables is commonly give to two significant figures. It is conventional in geochemical summaries to give an arithmetic average for the mean, and a few such entries

TABLE 3.—*Percentage of ash obtained by burning dry material of cultivated plants*

[Explanation of column headings: Study No. refers to study described in text. Plant parts designated as S, stems; L, leaves; F, fruits; SD, seeds; G, grains; R, roots; T, tubers; and B, bulbs. Mean, geometric mean. Deviation, geometric deviation. Error, geometric error attributed to laboratory procedures. Leaders (—) in figure column indicate no data available]

Common and scientific name, and collection locality	Study No.	Plant part	Mean (percent)	Deviation	Error	Observed range (percent)
Asparagus (*Asparagus officinalis* L.);						
Wisconsin	23	S	8.2	1.17	—	6.3–10
Bean, lima (*Phaseolus limensis* Macfad.);						
Georgia	14	SD	5.5	1.13	—	4.4– 7.2
	15	SD	6.7	1.18	—	5.4–10
Bean, snap (*Phaseolus vulgaris* L.); Georgia	14	F	8.4	1.34	—	4.8–15
	15	F	6.8	1.14	—	5.3– 8.9
Beet, red (*Beta vulgaris* L.); Wisconsin	23	R	9.5	1.64	—	5.5–14
Blackeyed pea (*Vigna sinensis* Endl.);						
Georgia	14	SD	5.9	1.26	—	4.2–12
	15	SD	5.2	1.09	—	4.7– 5.8
Cabbage (*Brassica oleracea* L.);						
Georgia	14	L	19	1.41	—	9.6–35
	15	L	21	1.16	—	15 –29
Wisconsin	23	L	9.4	1.19	—	7.0–13
Carrot (*Daucus carota* var. *sativa* DC.);						
Wisconsin	23	R	9.8	1.38	—	5.3–15
Corn (*Zea mays* L.);						
Georgia	14	G	4.4	1.47	—	2.3– 9.0
	15	G	3.7	1.55	—	2.0– 7.8
Missouri						
Floodplain Forest	17	G	1.8	1.17	1.09	1.4– 2.2
Glaciated Prairie	17	G	1.6	1.23	1.09	1.0– 2.1
Unglaciated Prairie	17	G	1.5	1.19	1.09	1.3– 2.1
Oak-hickory Forest	17	G	1.6	1.19	1.09	1.2– 2.0
Wisconsin	23	G	1.8	1.14	—	1.3– 6.3
Cucumber (*Cucumis sativus* L.); Wisconsin	23	F	11	1.25	—	8.3–14
Onion (*Allium cepa* L.); Wisconsin	23	B	4.8	1.11	—	4.3– 5.5
Pepper, sweet (*Capsicum frutescens* var. *grossum* Bailey); Wisconsin	23	F	7.0	1.08	—	6.5– 7.8
Potato (*Solanum tuberosum* L.); Wisconsin	23	T	5.0	1.31	—	3.8– 8.5
Tomato (*Lycopersicum esculentum* Mill.);						
Georgia	14	F	11	1.40	—	4.6–20
	15	F	9.8	1.20	—	4.9–13
Soybean (*Glycine max* Merr.); Missouri						
Floodplain Forest	17	SD	5.1	1.10	1.09	4.3– 5.8
Glaciated Prairie	17	SD	5.5	1.06	1.09	4.9– 6.0
Unglaciated Prairie	17	SD	5.3	1.06	1.09	4.8– 5.8
Oak-hickory Forest	17	SD	5.2	1.07	1.09	4.6– 5.8

here do so; an example is aluminum in cultivated surface horizon soils of Missouri (table 5, Study No. 16). However, the tendency for elements in natural materials, particularly trace elements, to exhibit positively skewed frequency distributions, suggests that the geometric mean is the more proper measure of central tendency. The geometric mean is the antilog of the arithmetic mean of the logarithmic values and, for lognormal distributions, the geometric mean is the mode.

A common problem in trace-element summaries is the necessity to summarize data which contain non-numeric concentration values such as "trace" or "less than" some specified limit. Such data are said to be censored, and, under such circumstances, the mean has been computed using special procedures described by Cohen (1959) and applied to geochemical problems by Miesch (1967b). These procedures involve an adjustment of the summary statistics computed for the non-censored part of the data. For some entries, censoring is so severe that such adjustment is unreliable or even impossible. Under these circumstances, the median of the distribution is given as the mean, or the mean is simply listed as "less than" some limiting lower value.

The use of special procedures to quantify estimates of the central tendency where part of the data is censored sometimes leads to estimates of the mean at levels below the limit of detection. For example, aluminum in dolomite of the Sauk sequence in Missouri and Arkansas (table 5, Study No. 4) is estimated to have a mean of 0.30 percent although the lowest measured concentration in 48 samples was 0.53 percent. This feature of the data analysis obviously permits a greater utilization of data which may be initially viewed as rather limited because of analytical constraints.

For those rare entries where the arithmetic average is given for the mean, it is also thought to reflect an unbiased estimate of elemental abundance. Where the geometric mean is given, the abundance may be estimated from the

TABLE 4.—*Percentage of ash obtained by burning dry material of native plant species*

[Explanation of column headings: Study No. refers to study described in text. Plant parts designated as S, stems; L, leaves; and SL, stems and leaves combined. Mean, geometric mean. Deviation, geometric deviation. Error, geometric error attributed to laboratory procedures. Leaders (—) in figure column indicate no data available]

Common and scientific name, and collection locality	Study No.	Plant part	Mean (percent)	Deviation	Error	Observed range (percent)
Black cherry (*Prunus serotina* Ehrh.);						
Georgia	14	S	2.0	1.71	——	0.19– 5.2
	15	S	2.3	1.30	——	1.3 - 5.4
	14	L	5.4	1.22	——	2.9 - 7.6
	15	L	6.5	1.21	——	4.8 - 9.6
Blackgum (*Nyssa sylvatica* Marsh.);						
Georgia	14	S	2.4	1.26	——	1.5 - 4.4
	15	S	2.8	1.21	——	2.0 - 4.1
	14	L	4.3	1.25	——	2.5 - 6.6
	15	L	5.9	1.18	——	4.8 - 9.1
Buckbush (*Symphoricarpos orbiculatus* Moench); Missouri						
Glaciated Prairie	20	S	6.0	1.16	1.10	4.6 - 8.5
Unglaciated Prairie	20	S	5.9	1.27	1.10	3.8 - 8.8
Cedar Glade	20	S	5.1	1.15	1.10	4.5 - 6.8
Oak-hickory Forest	20	S	6.3	1.17	1.10	5.5 - 8.0
Oak-hickory-pine Forest	20	S	5.6	1.14	1.10	4.5 - 6.3
Cedar (*Juniperus virginiana* L.); Missouri						
Cedar Glade	20	SL	6.0	1.16	——	4.6 - 8.5
Glaciated Prairie	24	SL	5.9	1.27	1.10	3.8 - 8.8
Unglaciated Prairie	24	SL	5.1	1.15	1.10	4.5 - 6.8
Cedar Glade	24	SL	5.9	1.09	1.10	5.3 - 6.8
Oak-hickory Forest	24	SL	6.3	1.17	1.10	5.5 - 8.0
Oak-hickory-pine Forest	24	SL	5.6	1.14	1.10	4.5 - 6.3
Hickory, pignut (*Carya glabra* (Mill.) Sweet); Kentucky	18	S	4.5	1.33	1.10	2.0 - 7.3
	19	S	5.3	1.28	1.05	2.8 -11
Hickory, shagbark (*Carya ovata* (Mill.) Koch); Kentucky	18	S	4.2	1.32	1.10	2.5 - 7.5
	19	S	5.0	1.30	1.05	2.9 - 8.0
Missouri						
Oak-hickory Forest	20	S	5.3	1.29	1.10	3.6 - 9.0
Oak-hickory-pine Forest	20	S	5.1	1.77	1.10	4.1 - 6.1
Oak, black (*Quercus velutina* Lam.); Kentucky	18	S	3.6	1.25	1.05	2.4 - 6.2
	19	S	3.9	1.20	1.05	2.5 - 5.8
Oak, post (*Quercus stellata* Wang.); Missouri	20	S	4.2	1.31	1.10	2.5 - 8.4
Oak, red (*Quercus rubra* L.); Kentucky	18	S	3.6	1.28	1.05	2.0 - 4.9
	19	S	3.7	1.32	1.05	2.5 - 6.6
Oak, white (Quercus alba L.)						
Kentucky	18	S	3.3	1.24	1.05	2.0 - 4.5
	19	S	3.5	1.20	1.05	2.2 - 5.5
Missouri						
Oak-hickory Forest	20	S	3.6	1.28	1.10	2.4 - 7.6
Oak-hickory-pine Forest	20	S	3.4	1.14	1.10	2.4 - 4.7
Oak, willow (*Quercus phellos* L.); Missouri						
Floodplain Forest	20	S	2.4	1.29	1.10	1.4 - 4.2
Persimmon (*Diospyros virginiana* L.);						
Georgia	14	S	3.1	1.23	——	2.2 - 5.4
	15	S	3.0	1.18	——	2.2 - 4.3
	14	L	6.0	1.27	——	3.4 - 9.5
	15	L	7.3	1.27	——	5.2 -13
Pine, shortleaf (*Pinus echinata* Mill.);						
Missouri	20	SL	2.7	1.23	1.10	1.7 - 4.2
Sagebrush (*Artemisia tridentata* Nutt.); Powder River Basin, Wyoming and						
Montana	25	SL	5.8	1.19	——	3.3 - 8.8
Sassafras (*Sassafras albidum* (Nutt.) Nees);						
Georgia	14	S	1.9	1.31	——	1.2 - 3.7
	15	S	1.9	1.26	——	1.1 - 3.6
	14	L	4.7	1.21	——	3.3 - 5.9
	14	L	5.7	1.13	——	4.6 - 6.8
Sumac, smooth (*Rhus glabra* L.); Missouri						
Floodplain Forest	20	S	3.5	1.19	1.10	2.7 - 5.2
Glaciated Prairie	20	S	4.2	1.19	1.10	2.8 - 6.7
Unglaciated Prairie	20	S	3.8	1.18	1.10	2.1 - 5.4
Cedar Glade	20	S	3.6	1.18	1.10	2.5 - 4.8
Oak-hickory Forest	20	S	3.6	1.18	1.10	2.7 - 4.9
Oak-hickory-pine Forest	20	S	3.4	1.18	1.10	2.1 - 5.6

TABLE 4.—*Percentage of ash obtained by burning dry material of native plant species*—Continued

Common and scientific name, and collection locality	Study No.	Plant part	Mean (percent)	Deviation	Error	Observed range (percent)
Sumac, winged (*Rhus copallina* L.); Georgia	14	S	3.6	1.22	——	2.5 - 5.4
	15	S	3.8	1.24	——	2.5 - 6.1
	14	L	4.6	1.20	——	2.8 - 6.2
	15	L	4.8	1.32	——	2.7 - 9.6
Sweetgum (*Liquidambar styraciflua* L.); Georgia	14	S	4.8	1.32	——	3.1 - 7.7
	15	S	4.1	1.37	——	2.6 - 9.0
	14	L	5.6	1.15	——	4.0 - 7.2
	15	L	5.6	1.21	——	4.3 - 8.2
Missouri Floodplain Forest	20	S	4.6	1.43	1.10	2.0 -12

following relation:

$$t = \tau M, \quad (2)$$

where t estimates the abundance (as Sichel's t, see Miesch, 1967b), M is the geometric mean, and τ is an adjustment factor and is read from figure 3. For example, aluminum in the sandstones of the Sauk sequence, Western United States (table 5, Study No. 3), is estimated to have a geometric mean of 0.77 percent and a geometric deviation of 2.49. These statistics are based on 400 analyses.[1] Reading from figure 3, where D=2.49 and n=400, τ is estimated to be 1.5 and t (abundance) from equation (2) is estimated as 1.16 percent aluminum.

Finally, most of the element concentrations in plant tissue were summarized on an ash weight basis. The user who wishes to convert the mean element concentration in ash to a dry weight basis may apply the following formula:

$$M_D = (M_A \times M_P) / 100, \quad (3)$$

where M_D approximates the mean in dry weight, M_A is the mean in ash weight, and M_P is the mean of the percent ash measured in that study (from tables 3 or 4). For example, asparagus stems collected in Wisconsin (table 5, Study No. 23) exhibit a mean aluminum concentration in ash of 0.40 percent, and a mean ash content (from table 3) of 8.2 percent. Based on equation (3) the approximate expected concentration of aluminum in dry weight is 0.033 percent.

Equally as important as the mean in background geochemical studies, however, is the magnitude of the scatter to be expected about the mean. A useful measure of this scatter in lognormal distributions is the geometric deviation, a factor which may be used to estimate the range of variation expected for any element in any unit. The geometric deviation is the antilog of the standard deviation of the logarithmic values. About 68 percent of the samples in a randomly selected suite should fall within

[1]In this particular study, the 400 analyses are of only 200 samples and, therefore, are not independent. However, the curves on figure 3 show that use of n=400 or n=200 gives essentially the same value of τ.

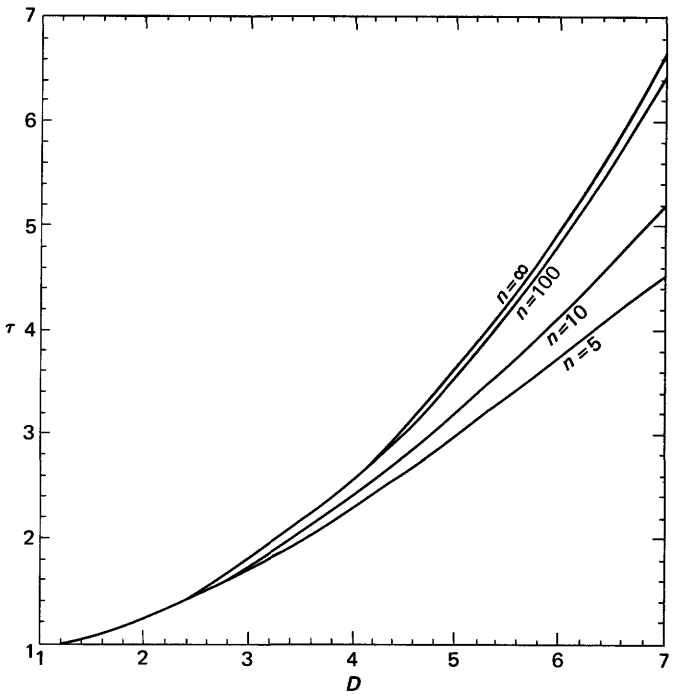

FIGURE 3.—Graphs of τ as a function of number of analyses, n, and the geometric deviation, D (from Miesch, 1967b).

the limits, M/D and $M \cdot D$, where M stands for the geometric mean and D stands for geometric deviation. About 95 percent should fall between M/D^2 and $M \cdot D.^2$, and about 99.7 percent between M/D^3 and $M \cdot D^3$. For example, aluminum in granites of Precambrian age in Missouri (table 5, Study No. 1) has a geometric mean of 6.7 percent and a geometric deviation of 1.06. Thus, the most likely concentration for aluminum in a suite of randomly selected granite samples collected in outcrop in the St. Francois Mountains of southeastern Missouri is 6.7 percent; in addition, about 68 percent of the collected samples, if analyzed by emission spectrographic techniques in the U. S. Geological Survey laboratories, should range from about 6.3 (M/D) to about 7.1 ($M \cdot D$) percent aluminum. About 95 percent will fall between 6.0 (M/D^2)

and 7.5 $(M \cdot D^2)$ percent aluminum, and more than 99 percent between 5.6 (M/D^3) and 8.0 $(M \cdot D^3)$.

The deviation in censored data has been computed using procedures described by Cohen (1959) and Miesch (1967b). A number of entries in the tables of this report give no estimate of variability because of insufficient data. Nevertheless, for some of these entries, a rough estimate of the upper limit of the 68 and 95 percent ranges may be obtained. About 16 percent of the samples in a randomly collected suite are expected to fall above the 68-percent range, and about 2.5 percent should fall above the 95-percent range. Thus, where element concentrations are censored on the low side and no geometric deviation is listed, detection ratios of 0.16 and 0.025 indicate that the limit of determination approximates the upper end of the 68- and 95-percent concentration ranges, respectively, for that element in that material. For example, aluminum in chert of Mississippian age in Missouri, Oklahoma, and Arkansas (table 5, Study No. 7) was detected at a concentration of 0.53 percent in only 5 percent (1 of 20) of the samples analyzed. This suggests that the limit of analytical determination (0.53 percent) lies somewhere between the upper end of the 68-percent range and the upper end of the 95-percent range, and probably very close to the latter.

As already stated, the deviation listed for each study includes variation arising from laboratory procedures as well as variation arising from nature. Where the sampling design so permits, an estimate of that part of the total observed variation due solely to laboratory effects is given as the error, and an estimate of the variation attributed solely to natural effects may be computed from:

$$D_n = \text{antilog} \sqrt{(\log D)^2 - (\log E)^2}, \quad (4)$$

where D_n estimates the geometric deviation corrected for laboratory effects, and D and E are the geometric deviation and geometric error, respectively, taken from the summary tables. For entries consisting of the arithmetic mean, the standard deviation and the standard error, variation due to natural effects is estimated as:

$$D_n = \sqrt{(D)^2 - (E)^2}, \quad (5)$$

where D_n estimates the standard deviation corrected for laboratory effects, and D and E are the standard deviation and the standard error, respectively.

For example, D_n for aluminum in the Missouri granites (table 5, Study No. 1) is estimated from equation (4) to be 1.04, and the expected approximate 68, 95, and 99.7 percent ranges corrected for analytical variation are 6.4–7.0, 6.2–7.2, and 6.0–7.5 percent aluminum, respectively. D_n for aluminum in surface horizons of cultivated soils of Missouri (table 5, Study No. 16) is estimated from equation (5) as 1.14, and the expected approximate 68, 95, and 99.7 percent ranges corrected for analytical variation are 3.0–5.2, 1.8–6.4, and 0.7–7.5 percent aluminum, respectively.

For some entries, the listed error is larger than the listed deviation and D_n cannot be calculated. This occurs because the deviation and the error are themselves only estimates and are each subject to errors inherent in estimation. Where variation due to laboratory procedures forms a large part of the total observed variation, the estimate of the error may exceed the estimate of the total variability. In these circumstances, the only conclusion to be drawn is that the material under study is relatively uniform in composition and further attempts to examine its natural variability must be based on laboratory procedures more precise than those used here.

All entries lacking an estimate of the error must be used judiciously. Little can be said about the natural variation of these materials without some assumptions as to the magnitude of the laboratory effects that might be present.

CONCLUDING REMARKS

The summary statistics in this report are not those conventionally used and an attempt has been made to permit the user to estimate a "reasonable range" of concentrations, using the estimated deviation. The data given in the summary tables (tables 5–53) are meant to provide a realistic guide to expected elemental concentrations in a variety of common environmental materials under "ordinary" or natural conditions.

The reader contemplating use of these data should bear in mind several points. Because the data were analyzed by a variety of analytical methods over a long period of time, there may well be analytical bias from entry to entry, but no work has been done to measure any such potential bias. Also, although the summary data for each entry are meant to reflect something of the natural geochemical character of that entry, a collection of entries in any given category must not be viewed as representative of that category as a whole. The entries are heavily weighted to specific areas of the country. For this reason, comparisons among major categories should be made cautiously. In addition, all data in these tables are based on total element content, regardless of the forms in which the element may occur in nature.

However, one comparison in these data that is of great interest to environmental geochemistry is the marked difference in average concentration for a host of elements measured in both vegetables and native plant material. Expected concentrations of barium, calcium, lead, manganese, sodium, strontium, titanium, and yttrium are clearly higher in native trees and shrubs than in garden foodstuffs prepared for eating. These differences undoubtedly reflect the contrast in plant parts (terminal stems versus roots, leaves, and seeds), but some of the

difference may well reflect a tendency for perennial plants to "build up" concentrations over the years (Shacklette, Sauer, and Miesch, 1970, p. 25).

Another aspect to keep in mind when using these summaries is that the long agricultural and industrial history of this country may well have altered the "natural" background for some elements in some materials. The widespread atmospheric effects attendant upon combustion of leaded gasoline, for example, conceivably may alter the element content of plant tissue collected far from any pollution sources. Likewise, agricultural practices may affect trace elements in vegetables, but there seems to be no alternative to collecting vegetables as they are grown and terming their element burdens "background." The summary data on lead are probably most suspect in this sense.

Finally, the use of the summary statistics assumes some specific features about expected frequency distributions of elements in mature. To the extent that such assumptions are not valid, predictions of the expected concentration and expected range will be in error. In particular, entries exhibiting large deviations (near 5.0 or greater) may reflect unusual distributions. The most commonly encountered problem is probably that of the presence of multiple modes in the distribution.

Perhaps the greatest use of these data will be to point up the large compositional diversity to be expected routinely in ordinary materials. Even though a large part of the studies used in this compilation was undertaken in only four States (Georgia, Kentucky, Missouri, and Wisconsin), the data on sedimentary rocks, soils, native plants, and vegetables clearly illustrate this diversity. The following summary tabulates the ratio of the highest mean to the lowest mean for six elements in the seven common materials reported on in this paper:

Material	Element ratios					
	Ba	Cu	Fe	Mn	K	Sr
Rocks, sandstone	4.5	7.0	21	10	8.0	7.3
shale	2.3	10	2.5	6.5	2.5	2.2
carbonate	29	14	240	20	5.3	9.9
Soils, uncultivated	13	3.9	2.0	7.5	41	42
cultivated	8.6	3.8	9.1	18	36	28
Plant ash, vegetable	30	11	5.1	8.4	2.3	63
native species	41	5.4	11	30	7.9	17

The greatest contrast in the above summary is reflected in a ratio of 240 for the element iron in carbonate rocks. This extreme reflects the difference between iron-rich siderite (Study No. 11) and iron-poor limestone and dolomite, but other trace elements, like copper and manganese, are still seen to be highly variable within each of the three common sedimentary rock types. Expected differences within the two soil categories and the two kinds of vegetation also can be extreme, as for potassium or strontium in soils and barium or strontium in plant ash. The differences reflected in the above ratios include the effects of laboratory procedures, but the pitfalls of assigning some single average concentration to an entire category of material (such as "carbonate rocks" or "soil"), as tends to be common in published tables of element abundances, are quite apparent.

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TABLES 5–53

Tables giving concentration of elements in rocks, unconsolidated geologic deposits, soils, and plants

TABLE 5.—*Aluminum in rocks, unconsolidated geologic deposits, soils, and plant ash*

[Explanation of column headings: Study No. refers to study described in text; method of analysis (in parentheses) refers to method listed in table 1. Ratio, number of samples in which the element was found in measurable concentrations to number of samples analyzed. Mean, geometric mean except that values preceded by asterisk are arithmetic mean. Deviation, geometric deviation except that values preceded by asterisk are standard deviation. Error, geometric error attributed to laboratory procedures except that values preceded by asterisk are standard error. Leaders (--) in figure column indicate no data available]

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (percent)	Deviation	Error	Observed range (percent)
ROCKS						
Granite						
Precambrian; Missouri	1 (5)	30:30	6.7	1.06	1.04	6.3 - 7.9
Rhyolite						
Precambrian; Missouri	1 (5)	30:30	6.6	1.10	1.04	5.3 - 7.9
Sandstone						
Sauk sequence; Western United States	3 (16)	400:400	.77	2.49	1.29	.058 - 8.2
Roubidoux Formation; Missouri	4 (5)	6:12	.43	1.75	1.14	<.53 - 1.1
Pope Megagroup;[1] Kentucky	5 (16)	120:120	1.6	1.78	1.34	.24 - 5.6
Pennsylvanian; Kentucky	5 (16)	152:152	2.5	2.12	1.33	.53 - 8.3
Pennsylvanian; Missouri, Kansas, and Oklahoma	6 (5)	32:32	3.0	2.30	1.14	.53 - 6.9
Chert						
Mississippian; Missouri, Oklahoma, and Arkansas	7 (5)	1:20	<.53	--	--	<.53 - .53
Shale						
Sauk sequence; Western United States	3 (16)	336:336	7.7	1.61	1.17	1.32 - 15.2
Lower Mississippian; Kentucky	8 (16)	76:76	5.4	1.49	--	2.0 - 9.2
Upper Mississippian; Kentucky	5 (16)	142:142	7.9	1.29	--	3.3 - 13
Mississippian; Missouri, Oklahoma, and Arkansas	7 (5)	18:18	4.4	1.64	1.05	1.6 - 10
Pennsylvanian; Kentucky	5 (16)	152:152	9.2	1.40	1.12	2.4 - 17
Pennsylvanian; Missouri, Kansas, and Oklahoma	6 (5)	32:32	8.5	1.24	1.05	5.3 - 11
Limestone and dolomite						
Sauk sequence; Western United States	3 (16)	386:392	.45	3.62	1.59	<.021 - 7.2
Sauk sequence; Missouri and Arkansas	4 (5)	16:48	.30	2.19	1.22	<.53 - 2.1
Upper Ordovician; Kentucky	5 (16)	80:80	.84	2.08	1.24	.13 - 3.8
Tippecanoe sequence; Missouri	10 (5)	3:12	<.53	--	--	<.53 - 1.6
Lower Mississippian; Kentucky	5 (16)	111:112	.62	3.10	1.76	<.0053 - 3.0
Upper Mississippian; Kentucky	5 (16)	139:152	.23	5.39	2.72	<.0053 - 5.1
Mississippian; Missouri, Oklahoma, and Arkansas	7 (5)	9:40	.17	3.52	1.22	<.53 - 2.1
Pennsylvanian; Kentucky	5 (16)	80:80	2.0	2.56	1.22	.079 - 4.8
Pennsylvanian; Missouri, Kansas, and Oklahoma	6 (5)	16:32	.44	2.50	1.22	<.53 - 3.2
Siderite						
Upper Paleozoic; Kentucky	11 (16)	30:30	2.8	1.83	--	.44 - 6.1

[1] Of Swann and Willman (1961).

TABLE 5.—*Aluminum in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (percent)	Deviation	Error	Observed range (percent)
UNCONSOLIDATED GEOLOGIC DEPOSITS						
Carbonate residuum (terra rossa)						
On Gasconade Formation; Missouri	12 (5)	24:24	7.9	1.33	1.03	4.5 - 14
On Roubidoux Formation; Missouri	12 (5)	24:24	6.6	1.56	1.03	2.1 - 11
On Jefferson City, Cotter, and Powell Formations; Missouri	12 (5)	24:24	8.0	1.24	1.03	5.0 - 13
On Osagean rocks; Missouri	12 (5)	24:24	9.9	1.20	1.03	7.6 - 15
On Meramecian rocks; Missouri	12 (5)	24:24	10	1.27	1.03	5.1 - 13
Loess						
Missouri	13 (5)	24:24	5.2	1.10	--	4.2 - 5.8
SOILS						
Cultivated						
Plow zone, garden; Georgia	14 (1)	30:30	0.9	1.88	--	0.2 - 5
	15 (1)	30:30	4.6	1.70	--	1.5 - 7
Plow zone, corn field; Missouri						
Floodplain Forest	17 (5)	8:8	4.0	1.21	1.03	3.1 - 5.2
Glaciated Prairie	17 (5)	10:10	4.8	1.16	1.03	3.7 - 6.1
Unglaciated Prairie	17 (5)	10:10	3.4	1.32	1.03	2.0 - 4.8
Oak-hickory Forest	17 (5)	10:10	3.9	1.30	1.03	2.2 - 5.0
Plow zone, soybean field; Missouri						
Floodplain Forest	17 (5)	10:10	4.0	1.25	1.03	2.9 - 5.6
Glaciated Prairie	17 (5)	10:10	5.2	1.08	1.03	4.7 - 5.8
Unglaciated Prairie	17 (5)	8:8	3.8	1.29	1.03	2.4 - 4.9
Oak-hickory Forest	17 (5)	9:9	3.8	1.23	1.03	2.6 - 5.0
Plow zone, pasture field; Missouri						
Floodplain Forest	17 (5)	10:10	4.2	1.25	1.03	3.0 - 6.9
Glaciated Prairie	17 (5)	10:10	4.7	1.11	1.03	3.8 - 5.7
Unglaciated Prairie	17 (5)	10:10	3.8	1.24	1.03	2.8 - 5.5
Oak-hickory Forest	17 (5)	10:10	3.9	1.33	1.03	2.2 - 5.7
Surface horizon; Missouri	16 (5)	1,140:1,140	*4.1	*1.19	*.34	1.1 - 7.9
Uncultivated						
Surface horizon; Powder River Basin, Wyoming and Montana	25 (5)	48:48	6.3	1.39	1.25	2 - 10
A horizon; Georgia	14 (1)	29:30	1.1	2.00	--	.3 - >10
	15 (1)	30:30	4.4	1.97	--	.7 - 7
A horizon; Kentucky	18 (16)	96:96	3.8	1.27	1.02	2.0 - 6.5
	19 (16)	108:108	3.2	1.28	1.03	1.6 - 14
B horizon; Georgia	14 (1)	30:30	1.1	1.86	--	.3 - 5
	15 (1)	30:30	5.7	2.00	--	.7 - 7
B horizon; Kentucky	18 (16)	96:96	5.9	1.30	1.02	2.8 - 11
B horizon; Missouri						
Floodplain Forest	20 (5)	50:50	4.5	1.29	1.13	2.6 - 7.9

TABLE 5.—*Aluminum in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (percent)	Deviation	Error	Observed range (percent)
SOILS--Continued						
Uncultivated--Continued						
B horizon; Missouri--Continued						
Glaciated Prairie	20 (5)	50:50	6.5	1.21	1.13	5.7 - 9.0
Unglaciated Prairie	20 (5)	50:50	4.7	1.34	1.13	2.1 - 9.0
Cedar Glade	20 (5)	50:50	3.2	1.42	1.13	1.6 - 5.8
Oak-hickory Forest	20 (5)	50:50	2.7	1.47	1.13	1.1 - 5.3
Oak-hickory-pine Forest	20 (5)	50:50	2.1	1.63	1.13	.5 - 5.8
C horizon; Georgia	14 (1)	30:30	1.7	2.61	--	.3 - 7
C horizon; Kentucky	18 (16)	96:96	6.1	1.39	1.02	2.5 - 12
Cultivated and uncultivated						
Surface horizon; Colorado	22 (5)	168:168	5.7	1.29	1.03	1.3 - 7.6
B horizon; Eastern United States	21 (1)	285:307	3.3	2.70	--	.7 - >10
B horizon; Western United States	21 (1)	399:484	5.4	2.02	--	.5 - >10
PLANT ASH						
Cultivated plants						
Asparagus; Wisconsin	23 (1)	5:5	0.40	1.55	--	0.3 - 0.7
Bean, lima; Georgia	14 (1)	30:30	.03	2.43	--	.01 - .2
	15 (1)	15:15	.14	3.11	--	.03 - 3
Bean, snap; Georgia	14 (1)	30:30	.09	2.18	--	.015 - .5
	15 (1)	30:30	.15	2.28	--	.02 - .7
Beet, red; Wisconsin	23 (1)	3:3	.15	2.07	--	.07 - .3
Blackeyed pea; Georgia	14 (1)	29:29	.06	2.03	--	.015 - .2
	15 (1)	4:4	.05	1.64	--	.03 - .7
Cabbage; Georgia	15 (1)	30:30	.4	2.45	--	.05 - 1.5
Cabbage; Wisconsin	23 (1)	11:11	.11	2.22	--	.03 - .7
Carrot; Wisconsin	23 (1)	8:8	.15	2.04	--	.07 - .7
Corn; Georgia	14 (1)	29:29	.07	2.03	--	.015 - .2
	15 (1)	30:30	.07	1.99	--	.015 - .3
Corn; Missouri						
Glaciated Prairie	17 (1)	10:10	.02	1.99	1.75	.005 - .05
Unglaciated Prairie	17 (1)	10:10	.02	1.99	1.75	.005 - .05
Oak-hickory Forest	17 (1)	10:10	.02	1.98	1.75	.005 - .07
Corn; Wisconsin	23 (1)	27:27	.1	1.57	--	.03 - .15
Cucumber; Wisconsin	23 (1)	4:4	.17	3.16	--	.03 - .3
Onion; Wisconsin	23 (1)	7:7	.15	2.40	--	.07 - .7
Potato; Wisconsin	23 (1)	10:10	.1	1.69	--	.07 - .3
Soybean; Missouri						
Floodplain Forest	17 (1)	10:10	.04	2.20	1.75	.005 - .07
Glaciated Prairie	17 (1)	10:10	.05	1.29	1.75	.03 - .07
Unglaciated Prairie	17 (1)	8:8	.04	1.51	1.75	.02 - .07
Oak-hickory Forest	17 (1)	9:9	.06	2.00	1.75	.01 - .1

TABLE 5.—*Aluminum in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (percent)	Deviation	Error	Observed range (percent)
PLANT ASH--Continued						
Cultivated plants--Continued						
Tomato; Georgia	14 (1)	30:30	0.07	2.96	--	0.015 - 0.2
	15 (1)	30:30	.04	2.60	--	.007 - .15
Native species						
Black cherry, stems; Georgia	14 (1)	30:30	.15	2.64	--	.01 - 1
	15 (1)	30:30	.24	2.26	--	.02 - .7
Black cherry, leaves; Georgia	14 (1)	30:30	.23	1.90	--	.1 - 1.5
	15 (1)	30:30	.29	1.94	--	.05 - 1
Blackgum, stems; Georgia	14 (1)	30:30	.52	1.69	--	.15 - 1
	15 (1)	30:30	.63	1.41	--	.3 - 1.5
Blackgum, leaves; Georgia	14 (1)	30:30	.91	2.12	--	.1 - 2
	15 (1)	30:30	1.1	1.58	--	.5 - 3
Buckbush; Missouri						
Glaciated Prairie	20 (1)	47:47	1.3	1.35	1.61	.7 - 2
Unglaciated Prairie	20 (1)	48:48	1.4	1.44	1.61	.5 - 5
Cedar Glade	20 (1)	50:50	1.0	1.46	1.61	.5 - 2
Oak-hickory Forest	20 (1)	49:49	1.2	1.33	1.61	.7 - 2
Oak-hickory-pine Forest	20 (1)	41:41	1.0	1.40	1.61	.5 - 2
Cedar; Missouri						
Cedar Glade	20 (1)	50:50	.41	2.07	1.61	.15 - 10
Glaciated Prairie	24 (1)	9:9	.75	1.75	--	.2 - 1.5
Unglaciated Prairie	24 (1)	10:10	.71	1.46	--	.5 - 1.5
Cedar Glade	24 (1)	10:10	.35	1.60	--	.2 - .7
Oak-hickory Forest	24 (1)	10:10	.47	1.61	--	.2 - 1
Oak-hickory-pine Forest	24 (1)	6:6	.32	1.89	--	.15 - .7
Hickory, pignut; Kentucky	18 (1)	64:64	.72	1.70	1.18	.2 - 7
Hickory, shagbark; Kentucky	18 (1)	40:40	.73	1.58	1.18	.2 - 2
Hickory, shagbark; Missouri						
Oak-hickory Forest	20 (1)	19:19	.29	2.27	1.61	.07 - .5
Oak-hickory-pine Forest	20 (1)	7:7	.36	1.76	1.61	.1 - 1
Maple, red, stems; Georgia	14 (1)	30:30	.14	1.67	--	.07 - .7
	15 (1)	30:30	.17	1.63	--	.07 - .5
Maple, red, leaves; Georgia	14 (1)	30:30	.19	2.44	--	.01 - 1.5
	15 (1)	30:30	.37	1.92	--	.07 - 1
Oak, black; Kentucky	18 (1)	25:25	.24	1.55	1.34	.1 - .7
Oak, post; Cedar Glade, Missouri	20 (1)	50:50	.26	1.87	1.61	.07 - 1
Oak, red; Kentucky	18 (1)	28:28	.27	1.74	1.34	.15 - 1.0
Oak, white; Kentucky	18 (1)	49:49	.27	1.50	1.34	.10 - 1.4
Oak, white; Missouri						
Oak-hickory Forest	20 (1)	50:50	.19	1.62	1.61	.07 - .5
Oak-hickory-pine Forest	20 (1)	49:49	.19	1.57	1.61	.1 - 1
Oak, willow; Floodplain Forest, Missouri	20 (1)	46:46	.24	1.90	1.61	.07 - 1.5
Persimmon, stems; Georgia	14 (1)	30:30	.17	2.07	--	.02 - .7
	15 (1)	30:30	.24	1.93	--	.05 - .7

TABLE 5.—*Aluminum in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (percent)	Deviation	Error	Observed range (percent)
PLANT ASH--Continued						
Native species--Continued						
Pine, shortleaf; Oak-hickory-pine Forest, Missouri	20 (1)	49:49	3.9	1.65	1.61	1.5 - 10
Sassafras, stems; Georgia	14 (1)	17:17	.39	2.42	--	.05 - 2
	15 (1)	27:27	.37	2.67	--	.05 - 2
Sassafras, leaves; Georgia	14 (1)	17:17	.43	2.26	--	.15 - 2
	15 (1)	27:27	.63	2.04	--	.15 - 2
Sumac, winged, stems; Georgia	14 (1)	30:30	.19	1.73	--	.07 - .7
	15 (1)	30:30	.23	1.90	--	.07 - 1
Sumac, winged, leaves; Georgia	14 (1)	30:30	.26	1.86	--	.1 - 1.5
	15 (1)	30:30	.51	2.12	--	.15 - 2
Sumac, smooth; Missouri						
Floodplain Forest	20 (1)	48:48	.11	2.55	1.61	.02 - 1
Glaciated Prairie	20 (1)	50:50	.13	2.09	1.61	.01 - .5
Unglaciated Prairie	20 (1)	49:49	.11	2.29	1.61	.02 - 1.5
Cedar Glade	20 (1)	49:49	.10	1.92	1.61	.02 - .5
Oak-hickory Forest	20 (1)	50:50	.12	2.11	1.61	.02 - .7
Oak-hickory-pine Forest	20 (1)	49:49	.13	1.99	1.61	.02 - .7
Sweetgum, stems; Georgia	14 (1)	28:28	.20	1.48	--	.1 - .5
	15 (1)	27:27	.37	1.77	--	.15 - 1.5
Sweetgum, leaves; Georgia	14 (1)	28:28	.62	1.54	--	.2 - 1.5
	15 (1)	27:27	.85	1.77	--	.1 - 2
Sweetgum; Floodplain Forest, Missouri	20 (1)	47:47	.18	1.85	1.61	.05 - .5

TABLE 6.—*Antimony in soils*

[Explanation of column headings: Study No. refers to study described in text; method of analysis (in parentheses) refers to method listed in table 1. Ratio, number of samples in which the element was found in measurable concentrations to number of samples analyzed. Mean, geometric mean. Deviation, geometric deviation. Error, geometric error attributed to laboratory procedures. Leaders (--) in figure column indicate no data available]

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
Cultivated and uncultivated B horizon; Eastern United States	21 (1)	1:362	<150	--	--	<150 - 500

TABLE 7.—*Arsenic in rocks, unconsolidated geologic deposits, soils, and dry plants*

[Explanation of column headings: Study No. refers to study described in text; method of analysis (in parentheses) refers to method listed in table 1. Ratio, number of samples in which the element was found in measurable concentrations to number of samples analyzed. Mean, geometric mean. Deviation, geometric deviation. Error, geometric error attributed to laboratory procedures. Leaders (--) in figure column indicate no data available]

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
ROCKS						
Granite						
Precambrian; Missouri	1 (6)	29:30	2.9	2.11	1.12	<1 - 19
Rhyolite						
Precambrian; Missouri	1 (6)	28:30	4.7	4.01	1.12	<1 - 300
Sandstone						
Roubidoux Formation; Missouri	4 (6)	7:12	1.1	1.57	1.62	<1 - 2.7
Pennsylvanian; Missouri, Kansas, and Oklahoma	6 (6)	29:32	4.3	2.51	1.62	<1 - 25
Chert						
Mississippian; Missouri, Oklahoma, and Arkansas	7 (6)	7:20	<1	--	--	<1 - 4.3
Shale						
Mississippian; Missouri, Oklahoma, and Arkansas	7 (6)	18:18	6.4	2.22	1.21	1.7 - 18
Pennsylvanian; Missouri, Kansas, and Oklahoma	6 (6)	32:32	9.0	2.11	1.21	1.4 - 27
Limestone and dolomite						
Sauk sequence; Missouri and Arkansas	4 (6)	28:48	1.2	2.62	1.26	<1 - 17
Tippecanoe sequence; Missouri	10 (6)	3:12	.74	1.53	1.26	<1 - 1.5
Mississippian; Missouri, Oklahoma, and Arkansas	7 (6)	17:40	.83	2.58	1.26	<1 - 6.3
Pennsylvanian; Missouri, Kansas, and Oklahoma	6 (6)	27:32	2.5	2.95	1.26	<1 - 39
UNCONSOLIDATED GEOLOGIC DEPOSITS						
Carbonate residuum (terra rossa)						
On Gasconade Formation; Missouri	12 (6)	24:24	18	1.36	1.19	11 - 31
On Roubidoux Formation; Missouri	12 (6)	24:24	15	1.88	1.19	3.7 - 42
On Jefferson City, Cotter, and Powell Formations; Missouri and Arkansas	12 (6)	24:24	19	1.74	1.19	7.9 - 61
On Osagean rocks; Missouri	12 (6)	24:24	21	1.38	1.19	12 - 33
On Meramecian rocks; Missouri	12 (6)	24:24	21	1.37	1.19	8.7 - 34
Loess						
Missouri	13 (6)	24:24	8.3	1.38	--	3 - 13

TABLE 7.—*Arsenic in rocks, unconsolidated geologic deposits, soils, and dry plants*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
SOILS						
Cultivated						
Plow zone, corn field; Missouri						
Floodplain Forest	17 (6)	8:8	5.5	1.68	1.10	1.8 - 9.1
Glaciated Prairie	17 (6)	10:10	10	1.32	1.10	7.0 - 14
Unglaciated Prairie	17 (6)	10:10	10	1.47	1.10	4.8 - 15
Oak-hickory Forest	17 (6)	10:10	8.8	1.23	1.10	6.1 - 14
Plow zone, soybean field; Missouri						
Floodplain Forest	17 (6)	10:10	5.9	1.70	1.10	2.7 - 15
Glaciated Prairie	17 (6)	10:10	12	1.31	1.10	7.6 - 17
Unglaciated Prairie	17 (6)	8:8	11	1.52	1.10	5.5 - 24
Oak-hickory Forest	17 (6)	9:9	7.1	1.38	1.10	4.1 - 12
Plow zone, pasture field; Missouri						
Floodplain Forest	17 (6)	10:10	6.4	2.25	1.10	1.6 - 36
Glaciated Prairie	17 (6)	10:10	12	1.63	1.10	7.1 - 27
Unglaciated Prairie	17 (6)	10:10	9.3	1.41	1.10	5.1 - 14
Oak-hickory Forest	17 (6)	10:10	8.5	1.22	1.10	6.4 - 13
Surface horizon; Missouri	16 (6)	1,140:1,140	8.7	1.46	1.16	2.5 - 72
Uncultivated						
B horizon; Missouri						
Floodplain Forest	20 (6)	50:50	7.5	2.03	1.21	2.4 - 170
Glaciated Prairie	20 (6)	50:50	13	1.27	1.21	7.2 - 20
Unglaciated Prairie	20 (6)	50:50	12	1.55	1.21	3.4 - 38
Cedar Glade	20 (6)	50:50	8.4	1.73	1.21	2.6 - 22
Oak-hickory Forest	20 (6)	50:50	8.0	1.83	1.21	2.4 - 28
Oak-hickory-pine Forest	20 (6)	50:50	6.7	1.67	1.21	2.7 - 44
Cultivated and uncultivated						
Surface horizon; Colorado	22 (6)	168:168	5.4	2.20	1.36	1.2 - 24
B horizon; Eastern United States	21 (6)	413:420	5.4	2.24	--	<.2 - 73
B horizon; Western United States	21 (6)	489:490	6.1	1.82	--	<.2 - 97
DRY PLANTS						
Native species						
Buckbush; Oak-hickory Forest, Missouri	20 (6)	1:14	<0.25	--	--	<0.25 - 0.25
Sumac, smooth; Glaciated Prairie, Missouri	20 (6)	1:9	<.25	--	--	<.25 - 1.5

TABLE 8.—*Barium in rocks, unconsolidated geologic deposits, soils, and plant ash*

[Explanation of column headings: Study No. refers to study described in text; method of analysis (in parentheses) refers to method listed in table 1. Ratio, number of samples in which the element was found in measurable concentrations to number of samples analyzed. Mean, geometric mean. Deviation, geometric deviation. Error, geometric error attributed to laboratory procedures. Leaders (--) in figure column indicate no data available]

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
ROCKS						
Granite						
Precambrian; Missouri	1 (1)	30:30	550	2.57	1.07	50 - 2,000
Rhyolite						
Precambrian; Missouri	1 (1)	30:30	640	1.98	1.07	200 - 2,000
Arkose						
Fountain Formation; Colorado	2 (2)	80:80	540	2.10	1.17	90 - 6,700
Sandstone						
Sauk sequence; Western United States-	3 (2)	397:399	100	2.97	1.25	<10 - 7,500
Roubidoux Formation; Missouri	4 (1)	12:12	38	1.92	1.24	10 - 100
Pope Megagroup;[1] Kentucky	5 (2)	120:120	100	1.87	1.26	10 - 340
Pennsylvanian; Kentucky	5 (2)	152:152	140	2.13	1.20	30 - 1,700
Pennsylvanian; Missouri, Kansas, and Oklahoma	6 (1)	32:32	170	2.17	1.24	50 - 700
Chert						
Mississippian; Missouri, Oklahoma, and Arkansas	7 (1)	20:20	23	1.52	1.24	10 - 50
Shale						
Sauk sequence; Western United States-	3 (2)	336:336	510	1.86	1.12	60 - 3,900
Lower Mississippian; Kentucky	8 (2)	76:76	300	1.68	--	80 - 1,000
Upper Mississippian; Kentucky	5 (2)	142:142	250	1.46	--	110 - 1,500
Mississippian; Missouri, Oklahoma, and Arkansas	7 (1)	18:18	220	2.15	1.26	70 - 700
Pennsylvanian; Kentucky	5 (2)	152:152	410	1.53	1.11	90 - 970
Pennsylvanian; Missouri, Kansas, and Oklahoma	6 (1)	32:32	430	1.48	1.26	200 - 700
Black shale						
Devonian and Mississippian; Kentucky-	9 (2)	88:88	510	1.79	1.14	150 - 4,200
Limestone and dolomite						
Sauk sequence; Western United States-	3 (2)	198:392	26	7.40	1.24	<30 - 1,400
Sauk sequence; Missouri and Arkansas-	4 (1)	48:48	9.2	3.48	1.30	1 - 100
Upper Ordovician; Kentucky	5 (1)	80:80	65	3.12	1.71	10 - 3,000
Tippecanoe sequence; Missouri	10 (1)	10:12	5.6	5.04	1.30	<1 - 70
Lower Mississippian; Kentucky	5 (1)	112:112	54	2.59	1.24	10 - 300
Upper Mississippian; Kentucky	5 (1)	152:152	29	2.32	1.34	5 - 300
Pennsylvanian; Kentucky	5 (1)	80:80	160	1.99	1.24	30 - 500
Pennsylvanian; Missouri, Kansas, and Oklahoma	6 (1)	32:32	44	3.01	1.30	10 - 500

[1] Of Swann and Willman (1961).

TABLE 8.—*Barium in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
ROCKS--Continued						
Siderite						
Upper Paleozoic; Kentucky	11 (1)	30:30	160	1.50	--	70 - 300
UNCONSOLIDATED GEOLOGIC DEPOSITS						
Carbonate residuum (terra rossa)						
On Gasconade Formation; Missouri	12 (1)	24:24	140	1.30	1.19	70 - 200
On Roubidoux Formation; Missouri	12 (1)	24:24	170	1.38	1.19	70 - 300
On Jefferson City, Cotter, and Powell Formations; Missouri and Arkansas	12 (1)	24:24	190	1.37	1.19	100 - 500
On Osagean rocks: Missouri	12 (1)	24:24	150	1.39	1.19	100 - 300
On Meramecian rocks; Missouri	12 (1)	24:24	170	1.24	1.19	100 - 300
Loess						
Missouri	13 (1)	24:24	840	1.30	--	500 - 1,000
SOILS						
Cultivated						
Plow zone, garden; Georgia	14 (1)	30:30	63	1.42	--	30 - 150
	15 (1)	30:30	250	1.52	--	100 - 500
Plow zone, corn field; Missouri						
Floodplain Forest	17 (1)	8:8	800	1.20	1.14	700 - 1,000
Glaciated Prairie	17 (1)	10:10	810	1.28	1.14	500 - 1,000
Unglaciated Prairie	17 (1)	10:10	600	1.39	1.14	300 - 1,000
Oak-hickory Forest	17 (1)	10:10	700	1.26	1.14	500 - 1,000
Plow zone, soybean field; Missouri						
Floodplain Forest	17 (1)	10:10	630	1.26	1.14	500 - 1,000
Glaciated Prairie	17 (1)	10:10	700	1.26	1.14	500 - 1,000
Unglaciated Prairie	17 (1)	8:8	650	1.28	1.14	500 - 1,000
Oak-hickory Forest	17 (1)	9:9	640	1.51	1.14	300 - 1,000
Plow zone, pasture field; Missouri						
Floodplain Forest	17 (1)	10:10	700	1.18	1.14	500 - 1,000
Glaciated Prairie	17 (1)	10:10	780	1.33	1.14	500 - 1,000
Unglaciated Prairie	17 (1)	10:10	670	1.46	1.14	300 - 1,000
Oak-hickory Forest	17 (1)	10:10	590	1.58	1.14	300 - 1,000
Surface horizon; Missouri	16 (1)	1,140:1,140	580	1.46	1.28	100 - 1,500
Uncultivated						
Surface horizon; Powder River Basin, Wyoming and Montana	25 (1)	48:48	740	1.36	1.29	500 - 3,000
A horizon; Georgia	14 (1)	30:30	100	1.73	--	50 - 500
	15 (1)	30:30	290	1.85	--	70 - 1,500
A horizon; Kentucky	18 (2)	96:96	296	1.46	1.09	90 - 520
	19 (2)	108:108	350	1.47	1.04	110 - 740

TABLE 8.—*Barium in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
SOILS--Continued						
Uncultivated--Continued						
B horizon; Georgia	14 (1)	30:30	86	1.68	--	50 - 300
	15 (1)	30:30	270	2.00	--	30 - 700
B horizon; Kentucky	18 (2)	96:96	300	1.41	1.09	110 - 690
B horizon; Missouri						
Floodplain Forest	20 (1)	50:50	660	1.43	1.30	300 - 5,000
Glaciated Prairie	20 (1)	50:50	560	1.46	1.30	200 - 1,000
Unglaciated Prairie	20 (1)	50:50	490	1.58	1.30	200 - 1,000
Cedar Glade	20 (1)	50:50	250	1.61	1.30	100 - 700
Oak-hickory Forest	20 (1)	50:50	390	1.78	1.30	100 - 1,000
Oak-hickory-pine Forest	20 (1)	50:50	340	1.96	1.30	70 - 1,500
C horizon; Georgia	14 (1)	30:30	94	1.83	--	50 - 500
	15 (1)	30:30	290	1.77	--	70 - 700
C horizon; Kentucky	18 (2)	96:96	250	1.54	1.09	80 - 640
Cultivated and uncultivated						
Surface horizon; Colorado	22 (1)	168:168	550	1.71	1.26	150 - 1,500
B horizon; Eastern United States	21 (1)	371:371	300	2.19	--	15 - 1,000
B horizon; Western United States	21 (1)	492:492	560	1.80	--	70 - 5,000
PLANT ASH						
Cultivated plants						
Asparagus; Wisconsin	23 (1)	5:5	290	1.86	--	100 - 700
Bean, lima; Georgia	14 (1)	30:30	100	2.14	--	50 - 300
	15 (1)	15:15	190	2.67	--	20 - 200
Bean, snap; Georgia	14 (1)	30:30	170	2.73	--	70 - 300
Beet, red; Wisconsin	23 (1)	4:4	360	1.34	--	300 - 500
Blackeyed pea; Georgia	14 (1)	29:29	130	2.06	--	70 - 500
Cabbage; Georgia	14 (1)	28:28	320	2.95	--	30 - 500
	15 (1)	30:30	450	1.67	--	200 - 1,500
Cabbage; Wisconsin	23 (1)	11:11	160	1.69	--	50 - 300
Carrot; Wisconsin	23 (1)	8:8	320	2.56	--	50 - 1,000
Corn; Georgia	14 (1)	29:29	54	2.37	--	10 - 300
	15 (1)	30:30	47	2.12	--	10 - 200
Corn; Missouri						
Floodplain Forest	17 (1)	8:8	21	2.55	1.26	5 - 100
Glaciated Prairie	17 (1)	10:10	15	1.88	1.26	7 - 50
Unglaciated Prairie	17 (1)	10:10	16	1.92	1.26	5 - 50
Oak-hickory Forest	17 (1)	10:10	21	2.82	1.26	5 - 70
Corn; Wisconsin	23 (1)	27:27	32	2.10	--	10 - 150
Cucumber; Wisconsin	23 (1)	4:4	140	2.00	--	50 - 200
Onion; Wisconsin	23 (1)	7:7	200	1.62	--	100 - 500
Pepper, sweet; Wisconsin	23 (1)	4:4	62	1.67	--	30 - 100
Potato; Wisconsin	23 (1)	10:10	120	2.79	--	30 - 700

TABLE 8.—*Barium in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
PLANT ASH--Continued						
Cultivated plants--Continued						
Soybean; Missouri						
Floodplain Forest	17 (1)	10:10	440	2.33	1.26	100 - 1,500
Glaciated Prairie	17 (1)	10:10	220	2.43	1.26	30 - 500
Unglaciated Prairie	17 (1)	8:8	290	2.18	1.26	70 - 700
Oak-hickory Forest	17 (1)	9:9	230	1.82	1.26	150 - 1,000
Tomato; Georgia	14 (1)	30:30	60	2.43	--	7 - 300
	15 (1)	30:30	38	1.80	--	15 - 150
Native species						
Black cherry, stems; Georgia	14 (1)	30:30	3,600	2.93	--	300 - 10,000
	15 (1)	30:30	3,000	3.12	--	300 - 15,000
Black cherry, leaves; Georgia	14 (1)	30:30	2,400	2.50	--	50 7,000
	15 (1)	30:30	2,100	2.80	--	200 - 10,000
Blackgum, stems; Georgia	14 (1)	30:30	7,200	2.18	--	200 - 15,000
	15 (1)	30:30	9,800	1.67	--	1,500 - 20,000
Blackgum, leaves; Georgia	14 (1)	30:30	2,800	2.54	--	50 - 7,000
	15 (1)	30:30	4,100	1.73	--	1,000 - 10,000
Buckbush; Missouri						
Glaciated Prairie	20 (1)	47:47	2,700	1.52	1.49	1,000 - 5,000
Unglaciated Prairie	20 (1)	48:48	2,500	1.48	1.49	1,000 - 7,000
Cedar Glade	20 (1)	50:50	1,200	1.84	1.49	300 - 7,000
Oak-hickory Forest	20 (1)	49:49	3,800	1.63	1.49	1,500 - 10,000
Oak-hickory-pine Forest	20 (1)	41:41	4,500	1.87	1.49	2,000 - 30,000
Cedar; Missouri						
Cedar Glade	20 (1)	49:49	320	2.50	1.49	100 - 7,000
Glaciated Prairie	24 (1)	9:9	2,000	1.63	--	1,000 - 5,000
Unglaciated Prairie	24 (1)	10:10	2,900	2.09	--	700 - 7,000
Cedar Glade	24 (1)	10:10	370	2.50	--	200 - 3,000
Oak-hickory Forest	24 (1)	10:10	3,800	2.04	--	1,500 - 10,000
Oak-hickory-pine Forest	24 (1)	6:6	4,100	1.44	--	3,000 - 7,000
Hickory, pignut; Kentucky	18 (1)	64:64	11,000	1.40	1.14	7,000 - 20,000
Hickory, shagbark; Kentucky	18 (1)	40:40	9,300	1.65	1.14	2,000 - 20,000
Hickory, shagbark; Missouri						
Oak-hickory Forest	20 (1)	19:19	7,700	2.38	1.49	500 - 20,000
Maple, red, stems; Georgia	14 (1)	30:30	3,500	2.82	--	50 - 15,000
	15 (1)	30:30	3,600	2.17	--	300 - 10,000
Maple, red, leaves; Georgia	14 (1)	30:30	1,400	2.73	--	70 - 5,000
	15 (1)	30:30	1,300	2.02	--	300 - 7,000
Oak, black; Kentucky	18 (1)	25:25	3,500	1.56	1.21	1,500 - 7,000
	19 (2)	21:22	4,300	2.03	1.06	840 - >10,000
Oak, post; Cedar Glade, Missouri	20 (1)	50:50	660	2.31	1.49	100 - 5,000
Oak, red; Kentucky	18 (1)	28:28	4,700	1.70	1.21	500 - 10,000
	19 (2)	8:8	5,300	1.75	1.06	1,700 - 10,000
Oak, white; Kentucky	18 (1)	49:49	5,500	1.43	1.21	2,000 - 15,000
	19 (2)	73:75	5,500	1.63	1.06	890 - >10,000

TABLE 8.—*Barium in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
PLANT ASH--Continued						
Native species--Continued						
Oak, white; Missouri						
Oak-hickory Forest	20 (1)	50:50	4,200	1.58	1.49	1,000 - 10,000
Oak-hickory-pine Forest	20 (1)	49:49	5,000	1.44	1.49	3,000 - 15,000
Oak, willow; Floodplain Forest, Missouri	20 (1)	46:46	2,700	1.57	1.49	1,000 - 5,000
Persimmon, stems; Georgia	14 (1)	30:30	2,500	2.29	--	150 - 10,000
	15 (1)	30:30	1,900	2.40	--	500 - 20,000
Persimmon, leaves; Georgia	14 (1)	30:30	970	2.09	--	70 - 3,000
	15 (1)	30:30	710	2.57	--	30 - 7,000
Pine, shortleaf; Oak-hickory-pine Forest, Missouri	20 (1)	49:49	1,100	1.79	1.49	300 - 5,000
Sassafras, stems; Georgia	14 (1)	17:17	3,000	2.26	--	700 - 10,000
	15 (1)	27:27	2,600	2.37	--	500 - 10,000
Sassafras, leaves; Georgia	14 (1)	17:17	800	1.99	--	300 - 3,000
	15 (1)	27:27	710	1.76	--	300 - 2,000
Sumac, winged, stems; Georgia	14 (1)	30:30	4,500	1.97	--	700 - 15,000
	15 (1)	30:30	3,200	2.60	--	300 - 10,000
Sumac, winged, leaves; Georgia	14 (1)	30:30	1,900	1.84	--	700 - 7,000
	15 (1)	30:30	1,300	2.42	--	300 - 7,000
Sumac, smooth; Missouri						
Floodplain Forest	20 (1)	48:48	3,500	1.84	1.49	1,500 - 10,000
Glaciated Prairie	20 (1)	50:50	2,600	1.60	1.49	700 - 7,000
Unglaciated Prairie	20 (1)	49:49	2,600	1.78	1.49	700 - 10,000
Cedar Glade	20 (1)	49:49	270	2.35	1.49	70 - 3,000
Oak-hickory Forest	20 (1)	50:50	3,400	2.33	1.49	200 - 10,000
Oak-hickory-pine Forest	20 (1)	49:49	4,500	2.00	1.49	1,000 - 50,000
Sweetgum, stems; Georgia	14 (1)	28:28	2,500	1.99	--	700 - 7,000
	15 (1)	27:27	2,800	2.03	--	1,000 - 10,000
Sweetgum, leaves; Georgia	14 (1)	28:28	1,400	1.99	--	300 - 5,000
	15 (1)	27:27	1,300	2.39	--	300 - 7,000
Sweetgum, Floodplain Forest, Missouri	20 (1)	47:47	2,000	1.61	1.49	500 - 5,000

TABLE 9.—*Beryllium in rocks, unconsolidated geologic deposits, soils, and plant ash*

[Explanation of column headings: Study No. refers to study described in text; method of analysis (in parentheses) refers to method listed in table 1. Ratio, number of samples in which the element was found in measurable concentrations to number of samples analyzed. Mean, geometric mean. Deviation, geometric deviation. Error, geometric error attributed to laboratory procedures. Leaders (--) in figure column indicate no data available]

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
ROCKS						
Granite						
Precambrian; Missouri	1 (1)	29:30	2.0	1.48	1.20	<1 - 3
Rhyolite						
Precambrian; Missouri	1 (1)	25:30	1.5	1.54	1.20	<1 - 3
Sandstone						
Sauk sequence; Western United States	3 (2)	38:400	<1	--	--	<1 - 12
Pennsylvanian; Missouri, Kansas, and Oklahoma	6 (1)	14:32	.80	1.77	--	<1 - 1.5
Shale						
Upper Mississippian; Kentucky	5 (2)	1:142	<5	--	--	<5 - 5
Mississippian; Missouri, Oklahoma, and Arkansas	7 (1)	12:18	1.1	1.64	1.27	<1 - 3
Pennsylvanian; Kentucky	5 (2)	2:152	<5	--	--	<5 - 5
Pennsylvanian; Missouri, Kansas, and Oklahoma	6 (1)	31:32	1.7	1.44	1.27	<1 - 3
Limestone and dolomite						
Upper Ordovician; Kentucky	5 (1)	1:80	<5	--	--	<5 - 5
Upper Mississippian; Kentucky	5 (1)	1:152	<2	--	--	<2 - 2
Pennsylvanian; Kentucky	5 (1)	4:80	<2	--	--	<2 - 10
Pennsylvanian; Missouri, Kansas, and Oklahoma	6 (1)	1:32	<1	--	--	<1 - 1
Siderite						
Upper Paleozoic; Kentucky	11 (1)	13:30	1.7	1.29	--	<2 - 3
UNCONSOLIDATED GEOLOGIC DEPOSITS						
Carbonate residuum (terra rossa)						
On Gasconade Formation; Missouri	12 (1)	15:24	<1	--	--	<1 - 5
On Roubidoux Formation; Missouri	12 (1)	12:24	<1	--	--	<1 - 2
On Jefferson City, Cotter, and Powell Formations; Missouri and Arkansas	12 (1)	19:24	1.0	1.19	1.16	<1 - 2
On Osagean rocks; Missouri	12 (1)	15:24	1.1	1.30	1.16	<1 - 3
On Meramecian rocks; Missouri	12 (1)	22:24	1.7	1.23	1.16	<1 - 3
Loess						
Missouri	13 (1)	18:24	.95	1.22	--	<1 - 1.5

TABLE 9.—*Beryllium in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
SOILS						
Cultivated						
Plow zone, garden; Georgia	15 (1)	2:30	<1.5	--	--	<1.5 - 5
Plow zone, corn field; Missouri						
Glaciated Prairie	17 (1)	4:10	1.2	1.26	--	<1.5 - 1.5
Unglaciated Prairie	17 (1)	3:10	1.1	1.31	--	<1.5 - 1.5
Oak-hickory Forest	17 (1)	2:10	<1.5	--	--	<1.5 - 1.5
Plow zone, soybean field; Missouri						
Floodplain Forest	17 (1)	1:10	<1.5	--	--	<1.5 - 1.5
Glaciated Prairie	17 (1)	4:10	1.2	1.26	--	<1.5 - 1.5
Unglaciated Prairie	17 (1)	2:8	1.0	1.34	--	<1.5 - 1.5
Oak-hickory Forest	17 (1)	1:9	<1.5	--	--	<1.5 - 1.5
Plow zone, pasture field; Missouri						
Glaciated Prairie	17 (1)	3:10	1.1	1.31	--	<1.5 - 1.5
Unglaciated Prairie	17 (1)	1:10	<1.5	--	--	<1.5 - 1.5
Oak-hickory Forest	17 (1)	1:10	<1.5	--	--	<1.5 - 1.5
Surface horizon; Missouri	16 (1)	520:1,140	.8	1.43	1.16	<1 - 2
Uncultivated						
A horizon; Georgia	14 (1)	1:30	<1	--	--	<1 - 1.5
	15 (1)	1:30	<1	--	--	<1 - 1.5
A horizon; Kentucky	18 (2)	10:96	<2	--	--	<2 - 2
B horizon; Kentucky	18 (2)	13:96	<2	--	--	<2 - 3
B horizon; Missouri						
Floodplain Forest	20 (1)	33:50	.99	1.46	--	<1 - 2
Glaciated Prairie	20 (1)	46:50	1.2	1.29	--	<1 - 2
Unglaciated Prairie	20 (1)	47:50	1.3	1.27	--	<1 - 2
Cedar Glade	20 (1)	27:50	.88	1.47	--	<1 - 1.5
Oak-hickory Forest	20 (1)	20:50	.76	1.42	--	<1 - 1.5
Oak-hickory-pine Forest	20 (1)	21:50	.77	1.47	--	<1 - 1.5
C horizon; Georgia	14 (1)	1:30	<1	--	--	<1 - 1.5
	15 (1)	1:30	<1	--	--	<1 - 1.5
C horizon; Kentucky	18 (2)	18:96	<2	--	--	<2 - 3
Cultivated and uncultivated						
Surface horizon; Colorado	22 (1)	115:168	1.4	1.52	1.16	<1.5 - 7
B horizon; Eastern United States	21 (1)	121:371	.6	2.53	--	<1 - 7
B horizon; Western United States	21 (1)	166:492	.6	2.47	--	<1 - 7
PLANT ASH						
Native species						
Hickory, pignut; Kentucky	19 (2)	11:88	<4	--	--	<4 - 6
Hickory, shagbark; Kentucky	18 (1)	11:40	.64	4.47	--	<2 - 7
	19 (2)	2:20	<4	--	--	<4 - 6
Hickory, shagbark; Missouri						
Oak-hickory Forest	20 (1)	3:19	<2	--	--	<2 - 2
Oak-hickory-pine Forest	20 (1)	4:7	2.0	2.18	--	<2 - 7

TABLE 9.—*Beryllium in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
PLANT ASH--Continued						
Native species--Continued						
Oak, black; Kentucky	19 (2)	2:22	<4	--	--	<4 - 5
Oak, red; Kentucky	18 (1)	1:27	<2	--	--	<2 - 2
Oak, white; Kentucky	19 (2)	9:73	<4	--	--	<4 - 5

TABLE 10.—*Bismuth in soils*

[Explanation of column headings: Study No. refers to study described in text; method of analysis (in parentheses) refers to method listed in table 1. Ratio, number of samples in which the element was found in measurable concentrations to number of samples analyzed. Mean, geometric mean. Deviation, geometric deviation. Error, geometric error attributed to laboratory procedures. Leaders (--) in figure column indicate no data available]

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
Cultivated and uncultivated B horizon; Western United States	21 (1)	2:492	<10	--	--	<10 - 15

TABLE 11.—*Boron in rocks, unconsolidated geologic deposits, soils, and plant ash*

[Explanation of column headings: Study No. refers to study described in text; method of analysis (in parentheses) refers to method listed in table 1. Ratio, number of samples in which the element was found in measurable concentrations to number of samples analyzed. Mean, geometric mean. Deviation, geometric deviation. Error, geometric error attributed to laboratory procedures. Leaders (--) in figure column indicate no data available]

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
ROCKS						
Granite						
Precambrian; Missouri	1 (1)	5:30	<20	--	--	<20 - 20
Rhyolite						
Precambrian; Missouri	1 (1)	6:30	<20	--	--	<20 - 30
Arkose						
Fountain Formation; Colorado	2 (2)	22:80	3.2	3.46	--	<7 - 68

TABLE 11.—*Boron in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
ROCKS--Continued						
Sandstone						
Roubidoux Formation; Missouri--------	4 (1)	6:12	18	1.78	1.40	<20 - 50
Pope Megagroup;[1] Kentucky----------	5 (2)	57:120	18	1.70	1.42	<20 - 54
Pennsylvanian; Kentucky----------	5 (2)	86:152	20	1.72	1.54	<20 - 90
Pennsylvanian; Missouri, Kansas, and Oklahoma----------	6 (1)	26:32	36	2.00	1.40	<20 - 70
Chert						
Mississippian; Missouri, Oklahoma, and Arkansas----------	7 (1)	18:20	39	1.80	1.40	<20 - 70
Shale						
Sauk sequence; Western United States-	3 (2)	216:336	43	2.41	1.15	<30 - 220
Lower Mississippian; Kentucky--------	8 (2)	60:76	66	2.06	--	<33 - 150
Upper Mississippian; Kentucky--------	5 (2)	130:142	68	1.61	--	<30 - 170
Mississippian; Missouri, Oklahoma, and Arkansas----------	7 (1)	18:18	64	1.73	1.73	20 - 150
Pennsylvanian; Kentucky----------	5 (2)	149:152	56	1.39	1.20	<30 - 160
Pennsylvanian; Missouri, Kansas, and Oklahoma----------	6 (1)	32:32	72	1.34	1.73	50 - 150
Black shale						
Devonian and Mississippian; Kentucky-	9 (2)	87:88	110	1.28	1.09	<30 - 190
Limestone and dolomite						
Sauk sequence; Western United States-	3 (2)	16:392	<46	--	--	<46 - 130
Upper Ordovician; Kentucky----------	5 (1)	25:80	31	1.58	--	<50 - 100
Tippecanoe sequence; Missouri--------	10 (1)	1:12	<20	--	--	<20 - 20
Lower Mississippian; Kentucky--------	5 (1)	32:112	29	1.66	--	<50 - 100
Upper Mississippian; Kentucky--------	5 (1)	15:152	<50	--	--	<50 - 100
Mississippian; Missouri, Oklahoma, and Arkansas----------	7 (1)	2:40	<20	--	--	<20 - 300
Pennsylvanian; Kentucky----------	5 (1)	18:80	<50	--	--	<50 - 100
Pennsylvanian; Missouri, Kansas, and Oklahoma----------	6 (1)	1:32	<20	--	--	<20 - 20
Siderite						
Upper Paleozoic; Kentucky----------	11 (1)	3:30	<50	--	--	<50 - 50
UNCONSOLIDATED GEOLOGIC DEPOSITS						
Carbonate residuum (terra rossa)						
On Gasconade Formation; Missouri------	12 (1)	8:24	22	1.09	1.05	<20 - 20
On Roubidoux Formation; Missouri------	12 (1)	8:24	22	1.09	1.05	<20 - 20
On Jefferson City, Cotter, and Powell Formations; Missouri and Arkansas---	12 (1)	16:24	21	1.05	1.05	<20 - 20
On Osagean rocks; Missouri----------	12 (1)	2:24	<20	--	--	<20 - 20
On Meramecian rocks; Missouri---------	12 (1)	5:24	<20	--	--	<20 - 30

[1] Of Swann and Willman (1961).

TABLE 11.—*Boron in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
UNCONSOLIDATED GEOLOGIC DEPOSITS--Continued						
Loess						
Missouri	13 (1)	24:24	35	1.46	--	30 - 70
SOILS						
Cultivated						
Plow zone, garden; Georgia	14 (1)	15:30	25	1.91	--	<30 - 100
	15 (1)	17:30	31	2.47	--	<30 - 150
Plow zone, corn field; Missouri						
Glaciated Prairie	17 (1)	9:10	25	1.53	1.51	<20 - 50
Unglaciated Prairie	17 (1)	10:10	29	1.52	1.51	20 - 50
Oak-hickory Forest	17 (1)	10:10	41	1.39	1.51	20 - 50
Plow zone, soybean field; Missouri						
Floodplain Forest	17 (1)	8:10	21	1.46	1.51	<20 - 50
Glaciated Prairie	17 (1)	10:10	29	1.52	1.51	20 - 50
Unglaciated Prairie	17 (1)	8:8	31	1.53	1.51	20 - 50
Oak-hickory Forest	17 (1)	8:9	27	1.54	1.51	<20 - 50
Plow zone, pasture field; Missouri						
Floodplain Forest	17 (1)	7:10	21	1.56	1.51	<20 - 50
Glaciated Prairie	17 (1)	9:10	28	1.60	1.51	<20 - 50
Unglaciated Prairie	17 (1)	10:10	36	1.47	1.51	20 - 50
Oak-hickory Forest	17 (1)	10:10	26	1.46	1.51	20 - 50
Surface horizon; Missouri	16 (1)	1,113:1,140	31	1.34	1.46	<20 - 700
Uncultivated						
Surface horizon; Powder River Basin, Wyoming and Montana	25 (1)	44:48	29	1.54	1.23	<20 - 70
A horizon; Georgia	14 (1)	10:30	18	2.55	--	<30 - 100
	15 (1)	13:30	22	3.08	--	<30 - 150
A horizon; Kentucky	18 (2)	87:96	45	1.46	--	<20 - 78
	19 (2)	107:108	63	1.26	1.16	<30 - 90
B horizon; Georgia	14 (1)	10:30	20	1.85	--	<30 - 50
	15 (1)	14:30	25	2.87	--	<30 - 150
B horizon; Kentucky	18 (2)	89:96	39	1.49	--	<20 - 130
B horizon; Missouri						
Floodplain Forest	20 (1)	46:50	29	1.44	1.31	<20 - 50
Glaciated Prairie	20 (1)	49:50	33	1.38	1.31	<20 - 70
Unglaciated Prairie	20 (1)	50:50	35	1.40	1.31	20 - 70
Cedar Glade	20 (1)	43:50	27	1.48	1.31	<20 - 50
Oak-hickory Forest	20 (1)	49:50	39	1.41	1.31	<20 - 70
Oak-hickory-pine Forest	20 (1)	49:50	32	1.43	1.31	<20 - 50
C horizon; Georgia	14 (1)	9:30	18	2.03	--	<30 - 70
	15 (1)	12:30	20	2.94	--	<30 - 200
C horizon; Kentucky	18 (2)	79:96	34	1.72	--	<20 - 140

TABLE 11.—*Boron in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
SOILS--Continued						
Cultivated and uncultivated						
Surface horizon; Colorado	22 (1)	70:168	<20	--	--	<20 - 70
B horizon; Eastern United States	21 (1)	295:371	32	1.92	--	<10 - 150
B horizon; Western United States	21 (1)	303:492	22	2.09	--	<10 - 300
PLANT ASH						
Cultivated plants						
Asparagus; Wisconsin	23 (1)	5:5	540	1.73	--	200 - 1,000
Bean, lima; Georgia	14 (1)	30:30	94	1.54	--	50 - 300
	15 (1)	15:15	70	1.75	--	20 - 200
Bean, snap; Georgia	14 (1)	30:30	160	1.53	--	70 - 300
	15 (1)	30:30	140	1.30	--	70 - 200
Beet, red; Wisconsin	23 (1)	1:3	44	1.96	--	<30 - 70
Blackeyed pea; Georgia	14 (1)	29:29	220	1.54	--	70 - 500
	15 (1)	4:4	140	1.22	--	100 - 150
Cabbage; Georgia	14 (1)	27:28	83	1.72	--	<30 - 300
	15 (1)	25:30	53	2.29	--	<30 - 300
Cabbage; Wisconsin	23 (1)	11:11	110	1.29	--	70 - 150
Carrot; Wisconsin	23 (1)	7:8	62	1.80	--	<30 - 100
Corn; Georgia	14 (1)	26:29	56	1.78	--	<30 - 150
	15 (1)	22:30	37	2.25	--	<30 - 150
Corn; Missouri						
Floodplain Forest	17 (1)	8:8	62	1.29	1.32	50 - 100
Glaciated Prairie	17 (1)	10:10	68	1.29	1.32	50 - 100
Unglaciated Prairie	17 (1)	10:10	59	1.19	1.32	50 - 70
Oak-hickory Forest	17 (1)	10:10	68	1.35	1.32	50 - 100
Corn; Wisconsin	23 (1)	19:27	37	1.76	--	<30 - 100
Onion; Wisconsin	23 (1)	7:7	120	1.51	--	70 - 200
Pepper, sweet; Wisconsin	23 (1)	4:4	64	1.18	--	50 - 70
Potato; Wisconsin	23 (1)	6:10	37	2.27	--	<30 - 100
Soybean; Missouri						
Floodplain Forest	17 (1)	10:10	170	1.34	1.32	100 - 200
Glaciated Prairie	17 (1)	10:10	220	1.26	1.32	150 - 300
Unglaciated Prairie	17 (1)	8:8	210	1.44	1.32	100 - 300
Oak-hickory Forest	17 (1)	9:9	240	1.36	1.32	150 - 300
Tomato; Georgia	14 (1)	27:30	56	1.73	--	<20 - 150
	15 (1)	24:30	38	1.88	--	<20 - 70
Native species						
Black cherry, stems; Georgia	14 (1)	30:30	360	1.75	--	50 - 1,000
	15 (1)	30:30	340	1.48	--	150 - 700
Black cherry, leaves; Georgia	14 (1)	30:30	290	1.43	--	70 - 500
	15 (1)	30:30	230	1.27	--	150 - 300

TABLE 11.—*Boron in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
PLANT ASH--Continued						
Native species--Continued						
Blackgum, stems; Georgia	14 (1)	30:30	430	1.57	--	100 - 700
	15 (1)	30:30	360	1.40	--	150 - 700
Blackgum, leaves; Georgia	14 (1)	30:30	600	1.75	--	70 - 1,500
	15 (1)	30:30	410	1.50	--	200 - 700
Buckbush; Missouri						
Glaciated Prairie	20 (1)	47:47	180	1.37	1.31	100 - 300
Unglaciated Prairie	20 (1)	48:48	170	1.29	1.31	100 - 300
Cedar Glade	20 (1)	50:50	180	1.35	1.31	70 - 300
Oak-hickory Forest	20 (1)	49:49	170	1.35	1.31	100 - 300
Oak-hickory-pine Forest	20 (1)	41:41	180	1.29	1.31	100 - 300
Cedar; Missouri						
Cedar Glade	20 (1)	50:50	160	1.33	1.31	100 - 300
Glaciated Prairie	24 (1)	9:9	210	1.53	--	100 - 500
Unglaciated Prairie	24 (1)	10:10	220	1.26	--	150 - 300
Cedar Glade	24 (1)	10:10	210	1.14	--	200 - 300
Oak-hickory Forest	24 (1)	10:10	210	1.30	--	150 - 300
Oak-hickory-pine Forest	24 (1)	6:6	220	1.31	--	150 - 300
Hickory, pignut; Kentucky	18 (1)	64:64	370	1.72	1.81	15 - 700
	19 (2)	88:88	160	1.26	1.24	97 - 290
Hickory, shagbark; Kentucky	18 (1)	40:40	410	1.47	1.81	200 - 700
	19 (2)	20:20	170	1.27	1.24	100 - 270
Hickory, shagbark; Missouri						
Oak-hickory Forest	20 (1)	19:19	190	1.48	1.31	100 - 500
Oak-hickory-pine Forest	20 (1)	7:7	190	1.11	1.31	150 - 200
Maple, red, stems; Georgia	14 (1)	30:30	370	1.36	--	300 - 700
	15 (1)	30:30	350	1.34	--	200 - 500
Maple, red, leaves; Georgia	14 (1)	30:30	420	1.73	--	50 - 700
	15 (1)	30:30	360	1.67	--	100 - 1,000
Oak, black; Kentucky	18 (1)	25:25	410	1.33	1.26	200 - 500
	19 (2)	22:22	140	1.29	1.24	75 - 190
Oak, post; Cedar Glade, Missouri	20 (1)	50:50	180	1.41	1.31	70 - 300
Oak, red; Kentucky	18 (1)	28:28	500	1.34	1.26	300 - 1,000
	19 (2)	8:8	180	1.34	1.24	140 - 330
Oak, white; Kentucky	18 (1)	49:49	420	1.41	1.26	200 - 700
	19 (2)	75:75	140	1.37	1.24	90 - 500
Oak, white; Missouri						
Oak-hickory Forest	20 (1)	50:50	190	1.47	1.31	100 - 500
Oak-hickory-pine Forest	20 (1)	49:49	190	1.26	1.31	100 - 300
Oak, willow; Floodplain Forest, Missouri	20 (1)	46:46	220	1.34	1.31	100 - 500
Persimmon, stems; Georgia	14 (1)	30:30	320	1.53	--	150 - 700
	15 (1)	30:30	220	1.71	--	50 - 700
Persimmon, leaves; Georgia	14 (1)	30:30	450	1.66	--	70 - 1,000
	15 (1)	30:30	360	1.80	--	70 - 700
Pine, shortleaf; Oak-hickory-pine Forest, Missouri	20 (1)	49:49	230	1.34	1.31	100 - 500

TABLE 11.—*Boron in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
PLANT ASH--Continued						
Native species--Continued						
Sassafras, stems; Georgia	14 (1)	17:17	320	1.70	--	70 - 700
	15 (1)	27:27	250	1.64	--	70 - 500
Sassafras, leaves; Georgia	14 (1)	17:17	300	1.51	--	150 - 700
	15 (1)	27:27	150	1.46	--	70 - 300
Sumac, winged, stems; Georgia	14 (1)	30:30	300	1.48	--	150 - 500
	15 (1)	30:30	230	1.67	--	50 - 500
Sumac, winged, leaves; Georgia	14 (1)	30:30	320	1.54	--	150 - 700
	15 (1)	30:30	250	1.84	--	100 - 700
Sumac, smooth; Missouri						
Floodplain Forest	20 (1)	48:48	230	1.31	1.31	150 - 500
Glaciated Prairie	20 (1)	50:50	230	1.44	1.31	150 - 500
Unglaciated Prairie	20 (1)	49:49	230	1.33	1.31	150 - 500
Cedar Glade	20 (1)	49:49	220	1.37	1.31	100 - 500
Oak-hickory Forest	20 (1)	50:50	200	1.26	1.31	100 - 300
Oak-hickory-pine Forest	20 (1)	49:49	210	1.38	1.31	100 - 500
Sweetgum, stems; Georgia	14 (1)	28:28	260	1.38	--	150 - 500
	15 (1)	27:27	190	1.39	--	100 - 300
Sweetgum, leaves; Georgia	14 (1)	28:28	400	1.51	--	200 - 700
	15 (1)	27:27	280	1.48	--	150 - 500
Sweetgum; Floodplain Forest, Missouri	20 (1)	47:47	160	1.47	1.31	50 - 300

TABLE 12.—*Cadmium in rocks, unconsolidated geologic deposits, soils, and plant ash*

[Explanation of column headings: Study No. refers to study described in text; method of analysis (in parentheses) refers to method listed in table 1. Ratio, number of samples in which the element was found in measurable concentrations to number of samples analyzed. Mean, geometric mean. Deviation, geometric deviation. Error, geometric error attributed to laboratory procedures. Leaders (--) in figure column indicate no data available]

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
ROCKS						
Shale						
Mississippian; Missouri, Oklahoma, and Arkansas	7 (3)	2:18	<1	--	--	<1 - 5
Limestone and dolomite						
Mississippian; Missouri, Oklahoma, and Arkansas	7 (3)	1:40	<1	--	--	<1 - 1

TABLE 12.—*Cadmium in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
ROCKS--Continued						
Limestone and dolomite--Continued						
Pennsylvanian; Missouri, Kansas, and Oklahoma	6 (3)	2:32	<1	--	--	<1 - 12
UNCONSOLIDATED GEOLOGIC DEPOSITS						
Carbonate residuum (terra rossa)						
On Gasconade Formation; Missouri	12 (3)	2:24	<1	--	--	<1 - 4
On Roubidoux Formation; Missouri	12 (3)	2:24	<1	--	--	<1 - 1.5
On Jefferson City, Cotter, and Powell Formations; Missouri and Arkansas	12 (3)	1:24	<1	--	--	<1 - 1
On Osagean rocks; Missouri	12 (3)	4:24	<1	--	--	<1 - 3
On Meramecian rocks; Missouri	12 (3)	6:24	.42	3.40	--	<1 - 6
SOILS						
Cultivated						
Plow zone, corn field; Oak-hickory Forest, Missouri	17 (3)	1:10	<1	--	--	<1 - 1.5
Plow zone, soybean field; Missouri						
Glaciated Prairie	17 (3)	1:10	<1	--	--	<1 - 1.0
Unglaciated Prairie	17 (3)	1:8	<1	--	--	<1 - 2.5
Plow zone, pasture field; Missouri						
Floodplain Forest	17 (3)	1:10	<1	--	--	<1 - 1.0
Glaciated Prairie	17 (3)	1:10	<1	--	--	<1 - 4.5
Oak-hickory Forest	17 (3)	1:10	<1	--	--	<1 - 2.5
Surface horizon; Missouri	16 (3)	12:1,140	<1	--	--	<1 - 11
Cultivated and uncultivated						
Surface horizon; Colorado	22 (3)	10:168	<1	--	--	<1 - 4
B horizon; Eastern United States	21 (3)	2:420	<1	--	--	<1 - 1
B horizon; Western United States	21 (3)	9:492	<1	--	--	<1 - 10
PLANT ASH						
Cultivated plants						
Corn; Missouri						
Floodplain Forest	17 (3)	6:8	0.37	1.72	1.42	<0.2 - 4.4
Glaciated Prairie	17 (3)	9:10	.62	2.34	1.42	<.2 - 8.2
Unglaciated Prairie	17 (3)	9:10	.40	1.49	1.42	<.2 - 4.0
Oak-hickory Forest	17 (3)	9:10	.64	3.56	1.42	<.2 - 5.2
Soybean; Missouri						
Floodplain Forest	17 (3)	10:10	2.3	2.33	1.42	.7 - 7.0
Glaciated Prairie	17 (3)	10:10	.60	2.04	1.42	.3 - 1.6
Unglaciated Prairie	17 (3)	8:8	.80	1.53	1.42	.4 - 1.2
Oak-hickory Forest	17 (3)	9:9	.68	1.93	1.42	.2 - 1.7

TABLE 12.—*Cadmium in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
PLANT ASH--Continued						
Native species						
Buckbush; Missouri						
Glaciated Prairie	20 (3)	47:47	12	1.91	1.21	2.8 - 50
Unglaciated Prairie	20 (3)	48:48	14	2.08	1.21	3.2 - 60
Cedar Glade	20 (3)	50:50	6.2	1.43	1.21	3.6 - 15
Oak-hickory Forest	20 (3)	49:49	12	1.69	1.21	3.4 - 36
Oak-hickory-pine Forest	20 (3)	41:41	10	1.86	1.21	2.8 - 40
Cedar; Missouri						
Cedar Glade	20 (3)	50:50	1.5	1.52	1.21	.050 - 3.4
Glaciated Prairie	24 (3)	9:9	3.2	1.92	--	1.5 - 9.8
Unglaciated Prairie	24 (3)	10:10	5.0	1.70	--	1.4 - 8.4
Cedar Glade	24 (3)	10:10	.95	1.60	--	.5 - 2.6
Oak-hickory Forest	24 (3)	10:10	2.6	2.64	--	.6 - 12
Oak-hickory-pine Forest	24 (3)	4:4	1.4	1.36	--	1.0 - 2.0
Hickory, shagbark; Missouri						
Oak-hickory Forest	20 (3)	19:19	18	1.80	1.21	3.2 - 40
Oak-hickory-pine Forest	20 (3)	7:7	20	1.60	1.21	9.4 - 33
Oak, post; Cedar Glade, Missouri	20 (3)	50:50	2.3	1.51	1.21	1.2 - 10
Oak, white; Missouri						
Oak-hickory Forest	20 (3)	50:50	4.1	1.39	1.21	2.0 - 7.6
Oak-hickory-pine Forest	20 (3)	49:49	3.9	1.44	1.21	1.6 - 10
Oak, willow; Floodplain Forest, Missouri	20 (3)	46:46	8.3	1.85	1.21	2.7 - 60
Pine, shortleaf; Oak-hickory-pine Forest, Missouri	20 (3)	49:49	14	1.61	1.21	4 - 38
Sagebrush; Powder River Basin, Wyoming and Montana	25 (3)	48:48	5.2	1.92	--	1.3 - 30
Sumac, smooth; Missouri						
Floodplain Forest	20 (3)	48:48	4.4	2.09	1.21	1.2 - 28
Glaciated Prairie	20 (3)	50:50	3.1	1.88	1.21	1.2 - 60
Unglaciated Prairie	20 (3)	49:49	4.2	1.83	1.21	1.2 - 12
Cedar Glade	20 (3)	49:49	1.7	1.48	1.21	.8 - 5.6
Oak-hickory Forest	20 (3)	50:50	2.8	1.63	1.21	1.0 - 11
Oak-hickory-pine Forest	20 (3)	49:49	2.2	1.60	1.21	.8 - 7.8
Sweetgum; Floodplain Forest, Missouri	20 (3)	47:47	6.0	2.00	1.21	1.4 - 21

TABLE 13.—*Calcium in rocks, unconsolidated geologic deposits, soils, and plant ash*

[Explanation of column headings: Study No. refers to study described in text; method of analysis (in parentheses) refers to method listed in table 1. Ratio, number of samples in which the element was found in measurable concentrations to number of samples analyzed. Mean, geometric mean. Deviation, geometric deviation. Error, geometric error attributed to laboratory procedures. Leaders (--) in figure column indicate no data available]

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (percent)	Deviation	Error	Observed range (percent)
ROCKS						
Granite						
Precambrian; Missouri	1 (5)	30:30	0.41	2.25	1.02	0.07 - 1.2
Rhyolite						
Precambrian; Missouri	1 (5)	23:30	.22	3.33	1.02	<.07 - 1.3
Sandstone						
Sauk sequence; Western United States	3 (16)	392:400	.22	5.70	1.90	<.014 - 14
Pope Megagroup;[1] Kentucky	5 (16)	112:120	.13	7.59	2.69	<.0072 - 15
Pennsylvanian; Kentucky	5 (16)	146:152	.094	4.45	2.09	<.0072 - 12
Chert						
Mississippian; Missouri, Oklahoma, and Arkansas	7 (5)	15:20	.42	8.55	1.32	<.07 - 9.3
Shale						
Sauk sequence; Western United States	3 (16)	332:336	.97	4.34	1.89	<.014 - 29
Lower Mississippian; Kentucky	8 (16)	74:76	.80	6.83	--	<.0072 - 14
Upper Mississippian; Kentucky	5 (16)	133:142	.49	6.98	--	<.0072 - 16
Pennsylvanian; Kentucky	5 (16)	139:152	.13	3.71	3.20	<.0072 - 4.0
Pennsylvanian; Missouri, Kansas, and Oklahoma	6 (5)	32:32	1.1	4.15	1.05	.14 - 13
Siderite						
Upper Paleozoic; Kentucky	11 (16)	30:30	4.1	2.23	--	1.4 - 30
UNCONSOLIDATED GEOLOGIC DEPOSITS						
Carbonate residuum (terra rossa)						
On Gasconade Formation; Missouri	12 (1)	23:24	0.059	4.11	1.07	<0.002 - 5
On Roubidoux Formation; Missouri	12 (1)	24:24	.041	3.36	1.07	.005 - 3
On Jefferson City, Cotter, and Powell Formations; Missouri and Arkansas	12 (1)	24:24	.086	2.15	1.07	.015 - 1.5
On Osagean rocks; Missouri	12 (1)	24:24	.031	4.76	1.07	.002 - 1.5
On Meramecian rocks; Missouri	12 (1)	24:24	.11	2.75	1.07	.015 - 1.5
Loess						
Missouri	13 (5)	24:24	.88	2.22	--	.29 - 4.2

[1] Of Swann and Willman (1961).

TABLE 13.—*Calcium in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (percent)	Deviation	Error	Observed range (percent)
SOILS						
Cultivated						
Plow zone, garden; Georgia	14 (13)	30:30	0.08	2.16	--	0.02 - 0.5
	15 (13)	30:30	.17	2.19	--	.03 - 1
Plow zone, corn field; Missouri						
Floodplain Forest	17 (5)	8:8	.48	1.38	1.03	.35 - .83
Glaciated Prairie	17 (5)	10:10	.57	1.30	1.03	.40 - .89
Unglaciated Prairie	17 (5)	10:10	.39	2.43	1.03	.14 - 3.1
Oak-hickory Forest	17 (5)	10:10	.44	2.30	1.03	.16 - 2.0
Plow zone, soybean field; Missouri						
Floodplain Forest	17 (5)	10:10	.47	1.49	1.03	.22 - .81
Glaciated Prairie	17 (5)	10:10	.58	1.33	1.03	.42 - .97
Unglaciated Prairie	17 (5)	8:8	.38	1.76	1.03	.17 - 1.0
Oak-hickory Forest	17 (5)	9:9	.51	2.18	1.03	.31 - 3.9
Plow zone, pasture field; Missouri						
Floodplain Forest	17 (5)	10:10	.48	1.46	1.03	.21 - .89
Glaciated Prairie	17 (5)	10:10	.66	1.38	1.03	.48 - 1.2
Unglaciated Prairie	17 (5)	10:10	.47	2.34	1.03	.14 - 4.1
Oak-hickory Forest	17 (5)	10:10	.44	1.55	1.03	.21 - .86
Surface horizon; Missouri	16 (5)	1,114:1,140	.33	2.03	1.12	<.07 - 5.6
Uncultivated						
Surface horizon; Powder River Basin, Wyoming and Montana	25 (5)	48:48	.62	3.18	1.20	.05 - 7
A horizon; Georgia	14 (13)	23:30	.12	1.80	--	<.01 - .4
	15 (13)	29:30	.31	1.44	--	<.01 - .65
A horizon; Kentucky	18 (16)	91:96	.14	3.23	1.56	<.01 - 3.4
	19 (16)	105:108	.26	2.60	1.83	<.035 - 1.1
B horizon; Georgia	14 (13)	21:30	.10	1.51	--	<.01 - .25
	15 (13)	30:30	.33	1.37	--	.2 - .6
B horizon; Kentucky	18 (16)	91:96	.12	3.02	1.56	<.01 - 1.2
B horizon; Missouri						
Floodplain Forest	20 (5)	50:50	.42	1.76	1.36	.07 - 1.5
Glaciated Prairie	20 (5)	50:50	.38	1.36	1.36	.21 - .86
Unglaciated Prairie	20 (5)	49:50	.24	1.79	1.36	<.07 - .57
Cedar Glade	20 (5)	49:50	1.7	4.52	1.36	<.07 - 30
Oak-hickory Forest	20 (5)	46:50	.15	2.80	1.36	<.07 - 8.6
Oak-hickory-pine Forest	20 (5)	28:50	.065	2.44	1.36	<.07 - .57
C horizon; Georgia	14 (13)	23:30	.12	1.81	--	<.01 - .35
	15 (13)	30:30	.35	1.28	--	.2 - .5
Cultivated and uncultivated						
Surface horizon; Colorado	22 (5)	167:168	.9	2.37	1.04	<.01 - 25
B horizon; Eastern United States	21 (13)	363:370	.32	2.87	--	<.01 - 16
B horizon; Western United States	21 (13)	491:491	1.8	2.93	--	.01 - 40

TABLE 13.—*Calcium in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (percent)	Deviation	Error	Observed range (percent)
PLANT ASH						
Cultivated plants						
Bean, lima; Georgia	14 (13)	30:30	3	1.32	--	2.1 - 8.3
	15 (13)	15:15	3.7	1.63	--	1.9 - 8.6
Bean, snap; Georgia	14 (13)	30:30	5.3	1.39	--	2.4 - 12
	15 (13)	30:30	6.5	1.31	--	3.8 - 10
Beet, red; Wisconsin	23 (1)	3:3	1.8	1.74	--	1.0 - 3.0
Blackeyed pea; Georgia	14 (13)	29:29	6.6	1.31	--	3.6 - 12
	15 (13)	4:4	4.7	1.29	--	3.7 - 6.7
Cabbage; Georgia	14 (13)	28:28	16	1.38	--	5.5 - 23
	15 (13)	30:30	20	1.19	--	13 - 26
Cabbage; Wisconsin	23 (1)	3:11	>10	--	--	5 - >10
Corn; Georgia	14 (13)	29:29	1.8	1.44	--	.8 - 3.6
	15 (13)	30:30	1.7	1.51	--	.8 - 3.4
Corn; Missouri						
Floodplain Forest	17 (3)	8:8	.30	1.33	1.09	.2 - .44
Glaciated Prairie	17 (3)	10:10	.31	1.27	1.09	.18 - .42
Unglaciated Prairie	17 (3)	10:10	.29	1.29	1.09	.20 - .42
Oak-hickory Forest	17 (3)	10:10	.32	1.22	1.09	.24 - .42
Corn; Wisconsin	23 (1)	27:27	.70	1.99	--	.3 - 5
Onion; Wisconsin	23 (1)	5:7	6.6	2.11	--	3 - >10
Pepper, sweet; Wisconsin	23 (1)	4:4	2.7	2.19	--	1 - 5
Potato; Wisconsin	23 (1)	10:10	.81	1.63	--	.5 - 3
Soybean; Missouri						
Floodplain Forest	17 (3)	10:10	5.0	1.14	1.09	4.2 - 6.4
Glaciated Prairie	17 (3)	10:10	5.0	1.16	1.09	3.4 - 5.8
Unglaciated Prairie	17 (3)	8:8	6.2	1.12	1.09	5.0 - 7.4
Oak-hickory Forest	17 (3)	9:9	5.6	1.11	1.09	4.6 - 6.4
Tomato; Georgia	14 (13)	30:30	1.7	1.44	--	.8 - 4.6
	15 (13)	30:30	1.5	1.27	--	.8 - 2.1
Native species						
Black cherry, stems; Georgia	14 (13)	30:30	26	1.17	--	17 - 33
	15 (13)	30:30	25	1.23	--	17 - 34
Black cherry, leaves; Georgia	14 (13)	30:30	23	1.16	--	16 - 34
	15 (13)	30:30	21	1.20	--	14 - 28
Blackgum, stems; Georgia	14 (13)	30:30	25	1.14	--	20 - 32
	15 (13)	30:30	26	1.14	--	19 - 33
Blackgum, leaves; Georgia	14 (13)	30:30	17	1.21	--	11 - 24
	15 (13)	30:30	16	1.26	--	7.8 - 25
Buckbush; Missouri						
Glaciated Prairie	20 (3)	47:47	15	1.11	1.10	12 - 19
Unglaciated Prairie	20 (3)	48:48	15	1.12	1.10	12 - 20
Cedar Glade	20 (3)	50:50	18	1.15	1.10	13 - 26
Oak-hickory Forest	20 (3)	49:49	15	1.22	1.10	9.2 - 24
Oak-hickory-pine Forest	20 (3)	41:41	15	1.27	1.10	6.8 - 23

TABLE 13.—*Calcium in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (percent)	Deviation	Error	Observed range (percent)
PLANT ASH--Continued						
Native species--Continued						
Cedar; Missouri						
Cedar Glade	20 (3)	50:50	31	1.09	1.10 24	- 36
Glaciated Prairie	24 (3)	9:9	25	1.08	-- 23	- 29
Unglaciated Prairie	24 (3)	10:10	25	1.10	-- 21	- 30
Cedar Glade	24 (3)	10:10	31	1.04	-- 29	- 33
Oak-hickory Forest	24 (3)	10:10	26	1.13	-- 23	- 33
Oak-hickory-pine Forest	24 (3)	6:6	28	1.11	-- 23	- 30
Hickory, pignut; Kentucky	18 (3)	60:60	30	1.11	1.04 19	- 34
	19 (3)	88:88	31	1.08	1.05 24	- 37
Hickory, shagbark; Kentucky	18 (3)	40:40	28	1.12	1.04 21	- 34
	19 (3)	20:20	31	1.11	1.05 21	- 37
Hickory, shagbark; Missouri						
Oak-hickory Forest	20 (3)	19:19	34	1.07	1.10 30	- 40
Oak-hickory-pine Forest	20 (3)	7:7	35	1.04	1.10 34	- 37
Maple, red, stems; Georgia	14 (13)	30:30	24	1.19	-- 16	- 31
	15 (13)	30:30	25	1.20	-- 13	- 32
Maple, red, leaves; Georgia	14 (13)	30:30	17	1.21	-- 11	- 24
	15 (13)	30:30	16	1.26	-- 9	- 24
Oak, black; Kentucky	18 (3)	25:25	29	1.09	1.06 21	- 37
	19 (3)	22:22	30	1.06	1.05 27	- 34
Oak, post; Cedar Glade, Missouri	20 (3)	50:50	32	1.11	1.10 23	- 38
Oak, red; Kentucky	18 (3)	27:27	30	1.09	1.06 26	- 36
	19 (3)	9:9	29	1.10	1.05 25	- 33
Oak, white; Kentucky	18 (3)	48:48	28	1.12	1.06 19	- 33
	19 (3)	76:76	28	1.08	1.05 23	- 36
Oak, white; Missouri						
Oak-hickory Forest	20 (3)	50:50	33	1.08	1.10 26	- 38
Oak-hickory-pine Forest	20 (3)	49:49	34	1.06	1.10 30	- 37
Oak, willow; Floodplain Forest, Missouri	20 (3)	46:46	28	1.12	1.10 21	- 35
Persimmon, stems; Georgia	14 (13)	30:30	23	1.24	-- 13	- 33
	15 (13)	30:30	20	1.28	-- 12	- 28
Persimmon, leaves; Georgia	14 (13)	30:30	15	1.55	-- 2.3	- 25
	15 (13)	30:30	16	1.30	-- 9.7	- 25
Pine, shortleaf; Oak-hickory-pine Forest, Missouri	20 (3)	49:49	13	1.31	1.10 6.4	- 23
Sassafras, stems; Georgia	14 (13)	17:17	21	1.35	-- 8.3	- 28
	15 (13)	27:27	19	1.37	-- 9.1	- 26
Sassafras, leaves; Georgia	14 (13)	17:17	19	1.25	-- 11	- 26
	15 (13)	27:27	15	1.27	-- 7.9	- 25
Sumac, winged, stems; Georgia	14 (13)	30:30	25	1.27	-- 12	- 34
	15 (13)	30:30	24	1.27	-- 9.8	- 35
Sumac, winged, leaves; Georgia	14 (13)	30:30	19	1.21	-- 12	- 26
	15 (13)	30:30	18	1.22	-- 13	- 26

TABLE 13.—*Calcium in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (percent)	Deviation	Error	Observed range (percent)
PLANT ASH--Continued						
Native species--Continued						
Sumac, smooth; Missouri						
Floodplain Forest	20 (3)	48:48	24	1.20	1.10	15 - 34
Glaciated Prairie	20 (3)	50:50	26	1.14	1.10	19 - 31
Unglaciated Prairie	20 (3)	49:49	26	1.14	1.10	17 - 33
Cedar Glade	20 (3)	49:49	29	1.12	1.10	21 - 37
Oak-hickory Forest	20 (3)	50:50	24	1.20	1.10	12 - 31
Oak-hickory-pine Forest	20 (3)	49:49	27	1.11	1.10	19 - 32
Sweetgum, stems; Georgia	14 (13)	28:28	26	1.17	--	16 - 32
	15 (13)	27:27	23	1.31	--	12 - 35
Sweetgum, leaves; Georgia	14 (13)	28:28	19	1.16	--	11 - 23
	15 (13)	27:27	16	1.23	--	9.3 - 23
Sweetgum; Floodplain Forest, Missouri	20 (3)	47:47	27	1.14	1.10	20 - 36

TABLE 14.—*Carbon (carbonate) in rocks, unconsolidated geologic deposits, and soils*

[Explanation of column headings: Study No. refers to study described in text; method of analysis (in parentheses) refers to method listed in table 1. Ratio, number of samples in which the element was found in measurable concentrations to number of samples analyzed. Mean, geometric mean except that values preceded by asterisk are arithmetic mean. Deviation, geometric deviation except that values preceded by asterisk are standard deviation. Error, geometric error attributed to laboratory procedures except that values preceded by asterisk are standard error. Leaders (--) in figure column indicate no data available]

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (percent)	Deviation	Error	Observed range (percent)
ROCKS						
Sandstone						
Pope Megagroup;[1] Kentucky	5 (16)	22:120	<0.014	--	--	<0.014 - 4.9
Pennsylvanian; Kentucky	5 (16)	12:152	<.014	--	--	<.014 - 3.6
Pennsylvanian; Missouri, Kansas, and Oklahoma	6 (10)	24:32	.01	--	--	<.01 - 9.4
Shale						
Pennsylvanian; Kentucky	5 (16)	41:152	<.014	--	--	<.014 - .44
Pennsylvanian; Missouri, Kansas, and Oklahoma	6 (10)	31:32	.16	5.07	1.41	<.01 - 4.3
Black shale						
Devonian and Mississippian; Kentucky-	9 (10)	28:28	.060	4.16	--	.005 - 5.1

[1] Of Swann and Willman (1961).

TABLE 14.—*Carbon (carbonate) in rocks, unconsolidated geologic deposits, and soils*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (percent)	Deviation	Error	Observed range (percent)
ROCKS--Continued						
Siderite						
Upper Paleozoic; Kentucky	11 (16)	30:30	*7.1	*1.96	--	2.8 - 11
UNCONSOLIDATED GEOLOGIC DEPOSITS						
Loess						
Missouri	13 (10)	22:24	0.088	5.80	--	<0.01 - 2.3
SOILS						
Cultivated						
Plow zone, corn field; Missouri						
Floodplain Forest	17 (10)	2:8	<0.01	--	--	<0.01 - .14
Glaciated Prairie	17 (10)	4:10	.0075	4.28	--	<.01 - .06
Unglaciated Prairie	17 (10)	4:10	<.01	--	--	<.01 - .75
Oak-hickory Forest	17 (10)	4:10	<.01	--	--	<.01 - .50
Plow zone, soybean field; Missouri						
Floodplain Forest	17 (10)	2:10	<.01	--	--	<.01 - .06
Glaciated Prairie	17 (10)	2:10	<.01	--	--	<.01 - .05
Unglaciated Prairie	17 (10)	3:8	<.01	--	--	<.01 - .15
Oak-hickory Forest	17 (10)	4:9	<.01	--	--	<.01 - .93
Plow zone, pasture field; Missouri						
Glaciated Prairie	17 (10)	4:10	<.01	--	--	<.01 - .18
Unglaciated Prairie	17 (10)	3:10	<.01	--	--	<.01 - .05
Oak-hickory Forest	17 (10)	3:10	<.01	--	--	<.01 - .06
Surface horizon; Missouri	16 (10)	946:1,140	.028	2.85	2.31	<.01 - 2.9
Uncultivated						
B horizon; Missouri						
Floodplain Forest	20 (10)	45:50	.046	3.06	2.73	<.01 - .51
Glaciated Prairie	20 (10)	44:50	.055	2.95	2.73	<.01 - .29
Unglaciated Prairie	20 (10)	42:50	.046	3.34	2.73	<.01 - .25
Oak-hickory Forest	20 (10)	44:50	.054	4.14	2.73	<.01 - 4.7
Oak-hickory-pine Forest	20 (10)	45:50	.055	3.11	2.73	<.01 - .34
Cultivated and uncultivated						
Surface horizon; Colorado	22 (10)	90:168	.01	8.90	1.71	<.01 - 6.4

TABLE 15.—*Carbon (organic) in rocks, unconsolidated geologic deposits, and soils*

[Explanation of column headings: Study No. refers to study described in text; method of analysis (in parentheses) refers to method listed in table 1. Ratio, number of samples in which the element was found in measurable concentrations to number of samples analyzed. Mean, geometric mean. Deviation, geometric deviation. Error, geometric error attributed to laboratory procedures. Leaders (--) in figure column indicate no data available]

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (percent)	Deviation	Error	Observed range (percent)
ROCKS						
Sandstone						
Roubidoux Formation; Missouri	4 (11)	11:12	0.30	3.13	1.93	<0.1 - 4.5
Pennsylvanian; Missouri, Kansas, and Oklahoma	6 (11)	32:32	.35	2.07	1.93	.1 - 1.4
Chert						
Mississippian; Missouri, Oklahoma, and Arkansas	7 (11)	20:20	.44	2.26	1.93	.2 - 1.4
Shale						
Mississippian; Missouri, Oklahoma, and Arkansas	7 (11)	16:18	.27	3.89	1.71	<.1 - 7.2
Pennsylvanian; Missouri, Kansas, and Oklahoma	6 (11)	27:32	.32	2.57	1.71	<.1 - 1
Black shale						
Devonian and Mississippian; Kentucky	9 (11)	88:88	10	1.58	1.15	1.7 - 21
Limestone and dolomite						
Sauk sequence; Missouri and Arkansas	4 (11)	24:48	.11	2.58	2.38	<.1 - .60
Tippecanoe sequence; Missouri	10 (11)	12:12	.28	2.55	2.38	.1 - 1.6
Mississippian; Missouri, Oklahoma, and Arkansas	7 (11)	34:40	.22	2.31	2.38	<.1 - 1
Pennsylvanian; Missouri, Kansas, and Oklahoma	6 (11)	19:32	.10	2.77	2.38	<.1 - .11
UNCONSOLIDATED GEOLOGIC DEPOSITS						
Loess						
Missouri	13 (11)	24:24	0.13	1.62	--	0.1 - 0.3
SOILS						
Cultivated						
Plow zone, corn field; Missouri						
Floodplain Forest	17 (11)	8:8	0.91	1.32	1.32	0.6 - 1.3
Glaciated Prairie	17 (11)	10:10	1.7	1.26	1.32	1.1 - 2.2
Unglaciated Prairie	17 (11)	10:10	1.4	1.33	1.32	1.0 - 2.0
Oak-hickory Forest	17 (11)	10:10	1.4	1.56	1.32	.8 - 2.8
Plow zone, soybean field; Missouri						
Floodplain Forest	17 (11)	10:10	.93	1.57	1.32	.4 - 1.7
Glaciated Prairie	17 (11)	10:10	1.6	1.32	1.32	.9 - 2.2
Unglaciated Prairie	17 (11)	8:8	1.6	1.48	1.32	1.0 - 3.1
Oak-hickory Forest	17 (11)	9:9	1.1	1.60	1.32	.4 - 1.8

TABLE 15.—*Carbon (organic) in rocks, unconsolidated geologic deposits, and soils*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (percent)	Deviation	Error	Observed range (percent)
SOILS--Continued						
Cultivated--Continued						
Plow zone, pasture field; Missouri						
Floodplain Forest	17 (11)	10:10	1.1	1.69	1.32	0.5 - 3.1
Glaciated Prairie	17 (11)	10:10	2.2	1.22	1.32	1.6 - 3.0
Unglaciated Prairie	17 (11)	10:10	1.7	1.29	1.32	1.1 - 2.7
Oak-hickory Forest	17 (11)	10:10	1.5	1.60	1.32	.7 - 3.2
Surface horizon; Missouri	16 (11)	1,140:1,140	1.3	1.53	1.11	.08 - 5.2
Uncultivated						
B horizon; Missouri						
Floodplain Forest	20 (11)	50:50	.89	2.09	1.34	.1 - 4.0
Glaciated Prairie	20 (11)	50:50	.83	1.69	1.34	.2 - 2.4
Unglaciated Prairie	20 (11)	50:50	.98	1.48	1.34	.5 - 1.9
Cedar Glade	20 (11)	50:50	2.8	1.64	1.34	.7 - 5.9
Oak-hickory Forest	20 (11)	50:50	.96	1.69	1.34	.4 - 3.8
Oak-hickory-pine Forest	20 (11)	50:50	.70	1.81	1.34	.2 - 2.9
Cultivated and uncultivated						
Surface horizon; Colorado	22 (11)	168:168	1.1	2.43	1.02	.4 - 1.5

TABLE 16.—*Cerium in rocks, unconsolidated geologic deposits, soils, and plant ash*

[Explanation of column headings: Study No. refers to study described in text; method of analysis (in parentheses) refers to method listed in table 1. Ratio, number of samples in which the element was found in measurable concentrations to number of samples analyzed. Mean, geometric mean. Deviation, geometric deviation. Error, geometric error attributed to laboratory procedures. Leaders (--) in figure column indicate no data available]

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
ROCKS						
Granite						
Precambrian; Missouri	1 (1)	20:30	150	--	--	<150 - 150
Rhyolite						
Precambrian; Missouri	1 (1)	23:30	150	--	--	<150 - 150
Sandstone						
Pennsylvanian; Missouri, Kansas, and Oklahoma	6 (1)	10:32	<150	--	--	<150 - 300

TABLE 16.—*Cerium in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
ROCKS--Continued						
Shale						
Mississippian; Missouri, Oklahoma, and Arkansas	7 (1)	2:18	<100	--	--	<100 - 100
Pennsylvanian; Kentucky	5 (1)	6:35	<150	--	--	<150 - 150
Pennsylvanian; Missouri, Kansas, and Oklahoma	6 (1)	9:32	<100	--	--	<100 - 150
Limestone and dolomite						
Pennsylvanian; Kentucky	5 (1)	1:80	<500	--	--	<500 - 500
UNCONSOLIDATED GEOLOGIC DEPOSITS						
Carbonate residuum (terra rossa)						
On Gasconade Formation; Missouri	12 (1)	1:24	<150	--	--	<150 - 200
On Jefferson City, Cotter, and Powell Formations; Missouri and Arkansas	12 (1)	1:24	<150	--	--	<150 - 200
On Osagean rocks; Missouri	12 (1)	5:24	<150	--	--	<150 - 300
On Meramecian rocks; Missouri	12 (1)	1:24	<150	--	--	<150 - 200
Loess						
Missouri	13 (1)	2:24	<100	--	--	<100 - 100
SOILS						
Cultivated						
Plow zone, garden; Georgia	14 (1)	5:30	<150	--	--	<150 - 500
Surface horizon; Missouri	16 (1)	435:1,140	120	1.27	--	<150 - 300
Uncultivated						
A horizon; Georgia	14 (1)	6:30	<150	--	--	<150 - 500
	15 (1)	5:30	79	1.58	--	<150 - 200
B horizon; Georgia	14 (1)	4:30	50	2.19	--	<150 - 300
	15 (1)	6:30	58	2.43	--	<150 - 500
B horizon; Missouri						
Glaciated Prairie	20 (1)	11:50	97	1.36	--	<150 - 150
Unglaciated Prairie	20 (1)	16:50	110	1.34	--	<150 - 200
Cedar Glade	20 (1)	5:50	<150	--	--	<150 - 200
Oak-hickory Forest	20 (1)	6:50	78	1.45	--	<150 - 150
Oak-hickory-pine Forest	20 (1)	2:50	<150	--	--	<150 - 150
C horizon; Georgia	14 (1)	6:30	76	1.76	--	<150 - 200
	15 (1)	3:30	58	1.81	--	<150 - 200
Cultivated and uncultivated						
Surface horizon; Colorado	22 (1)	15:168	<200	--	--	<200 - 700
B horizon; Eastern United States	21 (1)	65:322	78	1.70	--	<150 - 300
B horizon; Western United States	21 (1)	76:485	74	1.64	--	<150 - 300

TABLE 16.—*Cerium in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
PLANT ASH						
Cultivated plants						
Tomato; Georgia	14 (1)	1:30	<150	--	--	<150 - 300
Native species						
Hickory, shagbark; Oak-hickory-pine Forest, Missouri	20 (1)	4:6	350	1.69	--	<150 - 700

TABLE 17.—*Chromium in rocks, unconsolidated geologic deposits, soils, and plant ash*

[Explanation of column headings: Study No. refers to study described in text; method of analysis (in parentheses) refers to method listed in table 1. Ratio, number of samples in which the element was found in measurable concentrations to number of samples analyzed. Mean, geometric mean. Deviation, geometric deviation. Error, geometric error attributed to laboratory procedures. Leaders (--) in figure column indicate no data available]

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
ROCKS						
Granite						
Precambrian; Missouri	1 (1)	12:30	<1	--	--	<1 - 7
Rhyolite						
Precambrian; Missouri	1 (1)	14:30	.83	3.86	--	<1 - 15
Arkose						
Fountain Formation; Colorado	2 (2)	80:80	15	1.82	1.17	1 - 87
Sandstone						
Sauk sequence; Western United States	3 (2)	398:400	6.5	2.09	1.33	<1 - 130
Roubidoux Formation; Missouri	4 (1)	10:12	2.0	2.47	1.33	<1 - 7
Pope Megagroup;[1] Kentucky	5 (2)	120:120	39	2.00	1.75	3 - 210
Pennsylvanian; Kentucky	5 (2)	152:152	26	2.06	1.36	3 - 210
Pennsylvanian; Missouri, Kansas, and Oklahoma	6 (1)	32:32	7.4	2.25	1.33	5 - 100
Shale						
Sauk sequence; Western United States	3 (2)	336:336	75	1.76	1.11	15 - 260
Lower Mississippian; Kentucky	8 (2)	76:76	62	1.43	--	26 - 130
Upper Mississippian; Kentucky	5 (2)	142:142	96	1.30	--	34 - 160
Mississippian; Missouri, Oklahoma, and Arkansas	7 (1)	18:18	130	2.28	1.18	50 - 700
Pennsylvanian; Kentucky	5 (2)	152:152	88	1.35	1.10	35 - 230

[1] Of Swann and Willman (1961).

TABLE 17.—*Chromium in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
ROCKS--Continued						
Shale--Continued						
Pennsylvanian; Missouri, Kansas, and Oklahoma	6 (1)	32:32	95	1.26	1.18	70 - 150
Black shale						
Devonian and Mississippian; Kentucky	9 (2)	88:88	84	1.38	1.06	46 - 190
Limestone and dolomite						
Sauk sequence; Western United States	3 (2)	308:392	11	2.87	1.16	<5 - 150
Sauk sequence; Missouri and Arkansas	4 (1)	48:48	3.6	2.09	1.29	1 - 20
Upper Ordovician; Kentucky	5 (1)	80:80	11	1.82	1.39	2 - 30
Tippecanoe sequence; Missouri	10 (1)	11:12	2.7	2.60	1.29	<1 - 15
Lower Mississippian; Kentucky	5 (1)	112:112	19	2.33	1.33	5 - 150
Upper Mississippian; Kentucky	5 (1)	152:152	17	1.82	1.37	2 - 70
Mississippian; Missouri, Oklahoma, and Arkansas	7 (1)	38:40	9.4	3.27	1.29	<1 - 70
Pennsylvanian; Kentucky	5 (1)	80:80	29	1.78	1.33	10 - 70
Pennsylvanian; Missouri, Kansas, and Oklahoma	6 (1)	32:32	16	2.09	1.29	7 - 70
Siderite						
Upper Paleozoic; Kentucky	11 (1)	30:30	21	1.76	--	10 - 70
UNCONSOLIDATED GEOLOGIC DEPOSITS						
Carbonate residuum (terra rossa)						
On Gasconade Formation; Missouri	12 (1)	24:24	57	1.39	1.18	30 - 100
On Roubidoux Formation; Missouri	12 (1)	24:24	54	1.54	1.18	20 - 100
On Jefferson City, Cotter and Powell Formations; Missouri and Arkansas	12 (1)	24:24	70	1.26	1.18	50 - 100
On Meramecian rocks; Missouri	12 (1)	24:24	95	1.27	1.18	70 - 150
Loess						
Missouri	13 (1)	24:24	70	1.16	--	50 - 100
SOILS						
Cultivated						
Plow zone, garden; Georgia	14 (1)	30:30	15	2.00	--	7 - 150
	14 (1)	30:30	48	1.62	--	15 - 150
Plow zone, corn field; Missouri						
Floodplain Forest	17 (1)	8:8	43	1.56	1.13	20 - 70
Glaciated Prairie	17 (1)	10:10	70	1.18	1.13	50 - 100
Unglaciated Prairie	17 (1)	10:10	63	1.18	1.13	50 - 70
Oak-hickory Forest	17 (1)	10:10	66	1.24	1.13	50 - 100

TABLE 17.—*Chromium in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
SOILS--Continued						
Cultivated--Continued						
Plow zone, soybean field; Missouri						
Floodplain Forest	17 (1)	10:10	40	1.77	1.13	15 - 100
Glaciated Prairie	17 (1)	10:10	63	1.18	1.13	50 - 70
Unglaciated Prairie	17 (1)	8:8	67	1.13	1.13	50 - 70
Oak-hickory Forest	17 (1)	9:9	65	1.16	1.13	50 - 70
Plow zone, pasture field; Missouri						
Floodplain Forest	17 (1)	10:10	39	1.54	1.13	20 - 70
Glaciated Prairie	17 (1)	10:10	63	1.18	1.13	50 - 70
Unglaciated Prairie	17 (1)	10:10	59	1.19	1.13	50 - 70
Oak-hickory Forest	17 (1)	10:10	70	1.26	1.13	50 - 100
Surface horizon; Missouri	16 (1)	1,140:1,140	54	1.44	1.27	10 - 150
Uncultivated						
Surface horizon; Powder River Basin, Wyoming and Montana	25 (1)	48:48	45	1.49	1.28	20 - 100
A horizon; Georgia	14 (1)	30:30	11	1.99	--	3 - 100
	15 (1)	30:30	41	1.79	--	30 - 100
A horizon; Kentucky	18 (2)	96:96	60	1.31	1.07	26 - 140
	19 (2)	108:108	60	1.29	1.15	29 - 140
B horizon; Georgia	14 (1)	30:30	11	1.81	--	3 - 50
	15 (1)	30:30	44	1.63	--	15 - 150
B horizon; Kentucky	18 (2)	96:96	76	1.30	1.07	37 - 170
B horizon; Missouri						
Floodplain Forest	20 (1)	50:50	38	1.80	1.24	7 - 70
Glaciated Prairie	20 (1)	50:50	66	1.15	1.24	50 - 100
Unglaciated Prairie	20 (1)	50:50	65	1.23	1.24	30 - 100
Cedar Glade	20 (1)	50:50	42	1.51	1.24	20 - 70
Oak-hickory Forest	20 (1)	50:50	43	1.45	1.24	20 - 100
Oak-hickory-pine Forest	20 (1)	50:50	30	1.67	1.24	10 - 70
C horizon; Georgia	14 (1)	30:30	16	2.08	--	3 - 50
	15 (1)	30:30	47	1.56	--	10 - 100
C horizon; Kentucky	18 (2)	96:96	78	1.45	1.07	20 - 170
Cultivated and uncultivated						
Surface horizon; Colorado	22 (1)	168:168	31	2.07	1.26	7 - 84
B horizon; Eastern United States	21 (1)	371:371	36	2.52	--	1 - 100
B horizon; Western United States	21 (1)	492:492	38	2.16	--	3 - 1,500
PLANT ASH						
Cultivated plants						
Asparagus; Wisconsin	23 (1)	5:5	6.6	1.15	--	5 - 7
Bean, lima; Georgia	14 (1)	4:30	.42	3.53	--	<2 - 7
	15 (1)	6:15	<2	--	--	<2 - 50

TABLE 17.—*Chromium in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
PLANT ASH--Continued						
Cultivated plants--Continued						
Blackeyed pea; Georgia	14 (1)	12:29	<2	--	--	<2 - 30
	15 (1)	1:4	<2	--	--	<2 - 2
Cabbage; Georgia	14 (1)	20:28	2.2	1.66	--	<2 - 7
	15 (1)	26:30	5.7	2.61	--	<2 30
Cabbage; Wisconsin	23 (1)	3:11	<2	--	--	<2 - 15
Carrot; Wisconsin	23 (1)	2:8	<2	--	--	<2 - 10
Corn; Georgia	14 (1)	9:29	<2	--	--	<2 - 5
	15 (1)	10:30	1.4	1.83	--	<2 - 5
Corn; Floodplain Forest	17 (1)	2:8	<2	--	--	<2 - 5
Corn; Wisconsin	23 (1)	11:27	1.5	2.24	--	<2 - 7
Cucumber; Wisconsin	23 (1)	2:4	1.8	1.11	--	<2 - 2
Onion; Wisconsin	23 (1)	3:7	1.6	2.20	--	<2 - 5
Pepper, sweet; Wisconsin	23 (1)	4:4	4.2	1.52	--	3 - 7
Potato; Wisconsin	23 (1)	5:10	1.7	3.73	--	<2 - 10
Tomato; Georgia	14 (1)	19:30	2.4	2.54	--	<2 - 15
	15 (1)	5:30	<2	--	--	<2 - 5
Native species						
Black cherry, stems; Georgia	14 (1)	29:30	5.0	1.69	--	<2 - 15
	15 (1)	28:30	6.1	1.99	--	<2 - 15
Black cherry, leaves; Georgia	14 (1)	28:30	3.7	1.83	--	<2 - 30
	15 (1)	28:30	5.1	1.92	--	<2 - 15
Blackgum, stems; Georgia	14 (1)	30:30	7.8	2.37	--	2 - 100
	15 (1)	30:30	7.9	1.70	--	3 - 15
Blackgum, leaves; Georgia	14 (1)	29:30	6.4	2.13	--	<2 - 70
	15 (1)	30:30	10	2.00	--	3 - 50
Buckbush; Missouri						
Glaciated Prairie	20 (1)	47:47	20	1.52	1.51	7 - 50
Unglaciated Prairie	20 (1)	48:48	22	1.49	1.51	10 - 50
Cedar Glade	20 (1)	49:49	14	1.38	1.51	7 - 30
Oak-hickory Forest	20 (1)	49:49	21	1.57	1.51	10 - 70
Oak-hickory-pine Forest	20 (1)	41:41	19	1.72	1.51	7 - 50
Cedar, Missouri						
Cedar Glade	20 (1)	50:50	7.5	1.76	1.51	3 - 30
Glaciated Prairie	24 (1)	9:9	15	1.62	--	5 - 30
Unglaciated Prairie	24 (1)	10:10	12	1.73	--	5 - 30
Cedar Glade	24 (1)	10:10	5.9	1.93	--	3 - 15
Oak-hickory Forest	24 (1)	10:10	9.8	1.81	--	5 - 20
Oak-hickory-pine Forest	24 (1)	6:6	6.3	2.36	--	2 - 20
Hickory, pignut; Kentucky	18 (1)	64:64	7.0	1.86	1.52	2 - 50
Hickory, shagbark; Kentucky	18 (1)	40:40	8.1	1.72	1.52	2 - 30
	19 (2)	15:20	11	1.32	1.26	<10 - 21
Hickory, shagbark; Missouri						
Oak-hickory Forest	20 (1)	17:19	2.9	1.83	1.51	<2 - 10
Oak-hickory-pine Forest	20 (1)	6:7	2.9	1.92	1.51	<2 - 7

TABLE 17.—*Chromium in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
PLANT ASH--Continued						
Native species--Continued						
Maple, red, stems; Georgia	14 (1)	27:30	3.9	2.15	--	<2 - 70
	15 (1)	29:30	4.6	1.77	--	<2 - 10
Maple, red, leaves; Georgia	14 (1)	28:30	4.1	1.67	--	<2 - 15
	15 (1)	30:30	6.0	1.80	--	<2 - 20
Oak, black; Kentucky	18 (1)	25:25	7.9	1.51	1.66	5 - 20
	19 (2)	4:22	<10	--	--	<10 - 28
Oak, post; Cedar Glade, Missouri	20 (1)	49:50	4.9	1.97	1.51	<2 - 20
Oak, red; Kentucky	18 (1)	28:28	7.6	1.95	1.66	3 - 50
	19 (2)	2:8	<11	--	--	<11 - 11
Oak, white; Kentucky	18 (1)	49:49	9.6	2.00	1.66	3 - 70
	19 (2)	24:75	<7	--	--	<7 - 60
Oak, white; Missouri						
Oak-hickory Forest	20 (1)	46:50	3.5	1.85	1.51	<2 - 15
Oak-hickory-pine Forest	20 (1)	47:49	3.6	2.00	1.51	<2 - 70
Oak, willow; Floodplain Forest, Missouri	20 (1)	46:46	6.0	1.90	1.51	2 - 20
Persimmon, stems; Georgia	14 (1)	28:30	4.0	1.81	--	<2 - 15
	15 (1)	27:30	5.1	2.57	--	<2 - 50
Persimmon, leaves; Georgia	14 (1)	27:30	3.4	1.79	--	<2 - 10
	15 (1)	29:30	5.0	2.02	--	<2 - 20
Pine, shortleaf; Oak-hickory-pine Forest, Missouri	20 (1)	49:49	13	1.60	1.51	5 - 30
Sassafras, stems; Georgia	14 (1)	16:17	10	1.99	--	<2 - 30
	15 (1)	27:27	10	2.47	--	2 - 70
Sassafras, leaves; Georgia	14 (1)	17:17	7.6	1.78	--	3 - 30
	15 (1)	27:27	13	1.90	--	3 - 30
Sumac, winged, stems; Georgia	14 (1)	30:30	5.2	1.67	--	2 - 20
Sumac, winged, leaves; Georgia	14 (1)	30:30	5.2	1.67	--	2 - 15
	15 (1)	27:30	4.0	2.07	--	<2 - 20
Sumac, smooth; Missouri						
Floodplain Forest	20 (1)	37:48	4.7	2.86	1.51	<2 - 150
Glaciated Prairie	20 (1)	40:50	3.2	1.83	1.51	<2 - 20
Unglaciated Prairie	20 (1)	36:49	3.3	1.98	1.51	<2 - 30
Cedar Glade	20 (1)	31:49	2.2	2.05	1.51	<2 - 15
Oak-hickory Forest	20 (1)	40:50	2.7	1.95	1.51	<2 - 15
Oak-hickory-pine Forest	20 (1)	43:49	3.1	1.87	1.51	<2 - 20
Sweetgum, stems; Georgia	14 (1)	28:28	4.5	1.60	--	2 - 15
	15 (1)	27:27	5.9	1.73	--	3 - 30
Sweetgum, leaves; Georgia	14 (1)	28:28	5.6	1.62	--	2 - 20
	15 (1)	27:27	9.1	2.19	--	2 - 100
Sweetgum; Floodplain Forest, Missouri	20 (1)	47:47	3.9	1.84	1.51	2 - 15

TABLE 18.—*Cobalt in rocks, unconsolidated geologic deposits, soils, and plant ash*

[Explanation of column headings: Study No. refers to study described in text; method of analysis (in parentheses) refers to method listed in table 1. Ratio, number of samples in which the element was found in measurable concentrations to number of samples analyzed. Mean, geometric mean. Deviation, geometric deviation. Error, geometric error attributed to laboratory procedures. Leaders (--) in figure column indicate no data available]

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
ROCKS						
Granite						
Precambrian; Missouri	1 (1)	8:30	<3	--	--	<3 - 7
Rhyolite						
Precambrian; Missouri	1 (1)	5:30	<3	--	--	<3 - 5
Arkose						
Fountain Formation; Colorado	2 (2)	6:80	<1	--	--	<1 - 9
Sandstone						
Sauk sequence; Western United States	3 (2)	281:400	1.6	2.76	1.59	<1 - 20
Roubidoux Formation; Missouri	4 (1)	1:12	<3	--	--	<3 - 3
Pope Megagroup;[1] Kentucky	5 (2)	43:120	1.9	2.87	1.34	<3 - 14
Pennsylvanian; Kentucky	5 (2)	85:152	2.4	2.98	1.33	<2 - 15
Pennsylvanian; Missouri, Kansas, and Oklahoma	6 (1)	29:32	7.4	2.71	1.27	<3 - 15
Shale						
Sauk sequence; Western United States	3 (2)	275:336	13	1.69	1.17	<8 - 65
Lower Mississippian; Kentucky	8 (2)	60:76	9.5	1.67	--	<8 - 30
Upper Mississippian; Kentucky	5 (2)	112:142	11	1.83	--	<8 - 51
Mississippian; Missouri, Oklahoma, and Arkansas	7 (1)	18:18	4.8	1.91	1.26	2 - 15
Pennsylvanian; Kentucky	5 (2)	100:152	9.0	2.17	1.31	<8 - 71
Pennsylvanian; Missouri, Kansas, and Oklahoma	6 (1)	32:32	12	1.67	1.26	2 - 20
Black shale						
Devonian and Mississippian; Kentucky	9 (2)	52:88	8.1	3.31	1.20	<8 - 57
Limestone and dolomite						
Sauk sequence; Western United States	3 (2)	4:392	<20	--	--	<20 - 23
Sauk sequence; Missouri and Arkansas	4 (1)	4:48	<3	--	--	<3 - 5
Upper Ordovician; Kentucky	5 (1)	12:80	3.3	1.63	--	<7 - 10
Tippecanoe sequence; Missouri	10 (1)	1:12	<3	--	--	<3 - 3
Lower Mississippian; Kentucky	5 (1)	19:112	3.6	1.59	--	<7 - 10
Upper Mississippian; Kentucky	5 (1)	8:152	<7	--	--	<7 - 10
Mississippian; Missouri, Oklahoma, and Arkansas	7 (1)	2:40	<3	--	--	<3 - 5
Pennsylvanian; Kentucky	5 (1)	54:80	7.1	1.61	1.20	<7 - 30
Pennsylvanian; Missouri, Kansas, and Oklahoma	6 (1)	12:32	1.3	3.34	--	<3 - 7
Siderite						
Upper Paleozoic; Kentucky	11 (1)	14:30	5.5	1.90	--	<7 - 15

[1] Of Swann and Willman (1961).

TABLE 18.—*Cobalt in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
UNCONSOLIDATED GEOLOGIC DEPOSITS						
Carbonate residuum (terra rossa)						
On Gasconade Formation; Missouri	12 (1)	19:24	7.7	2.14	1.17	<3 - 50
On Roubidoux Formation; Missouri	12 (1)	17:24	5.9	1.52	1.17	<3 - 15
On Jefferson City, Cotter, and Powell Formations; Missouri and Arkansas	12 (1)	20:24	6.3	1.70	1.17	<3 - 20
On Osagean rocks; Missouri	12 (1)	14:24	5.6	2.10	1.17	<3 - 20
On Meramecian rocks; Missouri	12 (1)	21:24	6.7	1.87	1.17	<3 - 30
Loess						
Missouri	13 (1)	24:24	9.8	1.29	--	7 - 15
SOILS						
Cultivated						
Plow zone, garden; Georgia	14 (1)	4:30	1.3	2.68	--	<5 - 10
	15 (1)	28:30	9.9	1.68	--	<5 - 30
Plow zone, corn field; Missouri						
Floodplain Forest	17 (1)	6:8	5.2	1.51	1.20	<5 - 10
Glaciated Prairie	17 (1)	10:10	8.1	1.28	1.20	5 - 10
Unglaciated Prairie	17 (1)	10:10	9.7	1.81	1.20	5 - 30
Oak-hickory Forest	17 (1)	10:10	8.7	1.41	1.20	5 - 15
Plow zone, soybean field; Missouri						
Floodplain Forest	17 (1)	8:10	5.6	1.44	1.20	<5 - 10
Glaciated Prairie	17 (1)	10:10	10	1.42	1.20	5 - 15
Unglaciated Prairie	17 (1)	7:8	10	2.31	1.20	<5 - 50
Oak-hickory Forest	17 (1)	9:9	7.7	1.42	1.20	5 - 15
Plow zone, pasture field; Missouri						
Floodplain Forest	17 (1)	10:10	6.0	1.42	1.20	5 - 15
Glaciated Prairie	17 (1)	10:10	8.7	1.46	1.20	5 - 20
Unglaciated Prairie	17 (1)	10:10	8.5	1.53	1.20	5 - 15
Oak-hickory Forest	17 (1)	10:10	8.8	1.48	1.20	5 - 15
Surface horizon; Missouri	16 (1)	1,139:1,140	10	1.50	1.27	<3 - 30
Uncultivated						
Surface horizon; Powder River Basin, Wyoming and Montana	25 (1)	46:48	6.2	1.36	1.09	<3 - 10
A horizon; Georgia	14 (1)	6:30	1.5	3.08	--	<5 - 10
	15 (1)	28:30	9.8	1.74	--	<5 - 30
A horizon; Kentucky	18 (2)	96:96	10	1.45	1.09	4 - 27
	19 (2)	104:108	10	1.73	1.18	<3 - 33
B horizon; Georgia	14 (1)	4:30	1.0	3.19	--	<5 - 10
	15 (1)	29:30	10	1.81	--	<5 - 30
B horizon; Kentucky	18 (2)	96:96	8.4	1.39	1.09	2 - 17

TABLE 18.—*Cobalt in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
SOILS--Continued						
Uncultivated--Continued						
B horizon; Missouri						
Floodplain Forest	20 (1)	50:50	8.3	1.72	1.29	3 - 30
Glaciated Prairie	20 (1)	50:50	11	1.55	1.29	3 - 30
Unglaciated Prairie	20 (1)	50:50	14	1.83	1.29	3 50
Cedar Glade	20 (1)	50:50	9.5	1.48	1.29	5 - 30
Oak-hickory Forest	20 (1)	49:50	10	1.71	1.29	<3 - 30
Oak-hickory-pine Forest	20 (1)	50:50	9.5	1.89	1.29	3 - 50
C horizon; Georgia	14 (1)	7:30	1.9	2.60	--	<5 - 10
	15 (1)	11:30	11	1.64	--	<5 - 30
C horizon; Kentucky	18 (2)	95:96	7.6	1.61	1.09	<2 - 37
Cultivated and uncultivated						
Surface horizon; Colorado	22 (1)	109:168	5	1.66	1.15	<5 - 10
B horizon; Eastern United States	21 (1)	286:371	7	2.55	--	<3 - 70
B horizon; Western United States	21 (1)	445:492	8	2.01	--	<3 - 50
PLANT ASH						
Cultivated plants						
Bean, lima; Georgia	14 (1)	1:29	<7	--	--	<7 - 10
	15 (1)	5:15	4.6	1.63	--	<7 - 10
Bean, snap; Georgia	14 (1)	6:30	2.4	2.79	--	<7 - 15
	15 (1)	15:30	6.2	3.31	--	<7 - 70
Blackeyed pea; Georgia	14 (1)	1:29	<7	--	--	<7 - 10
Cabbage; Georgia	15 (1)	1:30	<7	--	--	<7 - 10
Corn; Missouri						
Floodplain Forest	17 (3)	3:8	<1	--	--	<1 - 1
Glaciated Prairie	17 (3)	5:10	1.0	--	--	<1 - 9
Unglaciated Prairie	17 (3)	3:7	.50	4.06	1.24	<1 - 5
Oak-hickory Forest	17 (3)	2:10	<1	--	--	<1 - 2
Soybean; Missouri						
Floodplain Forest	17 (3)	7:10	1.0	--	--	<1 - 6
Glaciated Prairie	17 (3)	8:10	2.0	2.97	1.24	<1 - 8
Unglaciated Prairie	17 (3)	6:8	2.1	3.75	1.24	<1 - 13
Oak-hickory Forest	17 (3)	8:9	2.1	2.39	1.24	<1 - 12
Tomato; Georgia	15 (1)	1:30	<7	--	--	<7 - 7
Native species						
Black cherry, stems; Georgia	14 (1)	5:30	<7	--	--	<7 - 100
	15 (1)	9:30	3.7	2.39	--	<7 - 20
Blackgum, stems; Georgia	14 (1)	28:30	120	3.54	--	<7 - 1,500
	15 (1)	27:30	190	6.14	--	<7 - 1,500
Blackgum, leaves; Georgia	14 (1)	27:30	290	5.83	--	<7 - 5,000
	15 (1)	27:30	400	7.67	--	<7 - 10,000

TABLE 18.—*Cobalt in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
	PLANT ASH--Continued					
Native species--Continued						
Buckbush; Missouri						
Glaciated Prairie	20 (3)	47:47	4.0	1.43	1.41	2 - 8
Unglaciated Prairie	20 (3)	47:48	4.8	1.76	1.41	<1 - 18
Cedar Glade	20 (3)	50:50	4.4	1.42	1.41	2 - 12
Oak-hickory Forest	20 (3)	49:49	4.7	1.68	1.41	2 - 20
Oak-hickory-pine Forest	20 (3)	41:41	5.4	1.91	1.41	2 - 30
Cedar; Missouri						
Cedar Glade	20 (3)	45:50	1.2	1.48	--	<1 - 4
Glaciated Prairie	24 (1)	7:9	6.5	1.90	--	<5 - 15
Unglaciated Prairie	24 (1)	3:10	2.1	3.68	--	<5 - 15
Oak-hickory Forest	24 (1)	2:10	1.9	2.43	--	<5 - 7
Oak-hickory-pine Forest	24 (1)	1:6	<5	--	--	<5 - 10
Hickory, pignut; Kentucky	18 (1)	58:64	18	2.47	1.24	<7 - 150
	19 (2)	72:88	23	1.70	1.09	<15 - 110
Hickory, shagbark; Kentucky	18 (1)	38:40	21	2.55	1.24	<7 - 150
	19 (2)	14:20	21	2.08	1.09	<15 - 100
Hickory, shagbark; Missouri						
Oak-hickory Forest	20 (3)	18:19	5.9	2.07	1.41	<1 - 16
Oak-hickory-pine Forest	20 (3)	7:7	7.4	1.93	1.41	2 - 16
Maple, red, stems; Georgia	14 (1)	1:30	<7	--	--	<7 - 10
Oak, black; Kentucky	18 (1)	19:25	8.1	1.71	1.20	<7 - 20
	19 (2)	7:22	11	2.07	1.09	<15 - 37
Oak, post; Cedar Glade, Missouri	20 (3)	30:50	.95	1.97	1.41	<1 - 4
Oak, red; Kentucky	18 (1)	18:28	7.7	2.20	1.20	<7 - 50
	19 (2)	2:8	<15	--	--	<15 - 15
Oak, white; Kentucky	18 (1)	22:49	5.7	2.02	1.20	<7 - 70
	19 (2)	11:75	<7	--	--	<7 - 37
Oak, white; Missouri						
Oak-hickory Forest	20 (3)	45:50	2.0	2.09	1.41	<1 - 9
Oak-hickory-pine Forest	20 (3)	47:49	2.7	2.20	1.41	<1 - 12
Oak, willow; Floodplain Forest, Missouri	20 (3)	44:46	.95	1.97	1.41	<1 - 12
Persimmon, stems; Georgia	14 (1)	5:30	<7	--	--	<7 - 1,000
	15 (1)	7:30	2.2	3.63	--	<7 - 30
Persimmon, leaves; Georgia	14 (1)	3:30	<7	--	--	<7 - 2,000
Pine, shortleaf; Oak-hickory-pine Forest, Missouri	20 (3)	49:49	9.7	1.75	1.41	2 - 30
Sagebrush; Powder River Basin; Wyoming and Montana	25 (3)	43:43	2.0	1.74	--	1 - 6
Sassafras stems; Georgia	15 (1)	1:27	<7	--	--	<7 - 15
Sumac, smooth; Missouri						
Floodplain Forest	20 (3)	23:48	.75	2.80	1.41	<1 - 7
Glaciated Prairie	20 (3)	18:50	.65	1.88	1.41	<1 - 3
Unglaciated Prairie	20 (3)	23:49	.78	2.10	1.41	<1 - 4
Cedar Glade	20 (3)	16:49	.71	1.42	1.41	<1 - 2
Oak-hickory Forest	20 (3)	35:50	1.1	1.75	1.41	<1 - 3
Oak-hickory-pine Forest	20 (3)	30:49	.97	2.17	1.41	<1 - 7

TABLE 18.—*Cobalt in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
PLANT ASH--Continued						
Native species--Continued						
Sweetgum, stems; Georgia	14 (1)	6:28	2.0	3.72	--	<7 - 30
	15 (1)	3:27	2.5	1.92	--	<7 - 10
Sweetgum, leaves; Georgia	14 (1)	2:28	<7	--	--	<7 - 7
Sweetgum; Floodplain Forest, Missouri	20 (3)	37:47	1.5	2.36	1.41	<1 - 11

TABLE 19.—*Copper in rocks, unconsolidated geologic deposits, soils, and plant ash*

[Explanation of column headings: Study No. refers to study described in text; method of analysis (in parentheses) refers to method listed in table 1. Ratio, number of samples in which the element was found in measurable concentrations to number of samples analyzed. Mean, geometric mean. Deviation, geometric deviation. Error, geometric error attributed to laboratory procedures. Leaders (--) in figure column indicate no data available]

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
ROCKS						
Granite						
Precambrian; Missouri	1 (1)	28:30	2.2	1.98	1.18	<1 - 10
Rhyolite						
Precambrian; Missouri	1 (1)	20:30	1.6	2.18	1.18	<1 - 7
Arkose						
Fountain Formation; Colorado	2 (2)	80:80	8.1	1.70	1.36	2 - 26
Sandstone						
Sauk sequence; Western United States	3 (2)	380:400	5.0	2.76	1.79	<1 - 210
Roubidoux Formation; Missouri	4 (1)	8:12	1.2	2.14	1.23	<1 - 5
Pope Megagroup;[1] Kentucky	5 (2)	120:120	8.0	1.75	1.30	3 - 47
Pennsylvanian; Kentucky	5 (2)	152:152	7.7	1.59	1.27	1 - 27
Pennsylvanian; Missouri, Kansas, and Oklahoma	6 (1)	32:32	8.4	2.52	1.23	1.5 - 30
Chert						
Mississippian; Missouri, Oklahoma, and Arkansas	7 (1)	12:20	1.1	2.02	1.23	<1 - 5
Shale						
Sauk sequence; Western United States	3 (2)	305:336	14	2.75	1.12	<3 - 98
Lower Mississippian; Kentucky	8 (2)	73:76	14	2.04	--	<3 - 55
Upper Mississippian; Kentucky	5 (2)	137:142	16	1.94	--	<4 - 60
Mississippian; Missouri, Oklahoma, and Arkansas	6 (1)	18:18	13	2.83	1.23	5 - 100

[1] Of Swann and Willman (1961).

TABLE 19.—*Copper in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
ROCKS--Continued						
Black shale						
Devonian and Mississippian; Kentucky-	9 (2)	88:88	130	1.62	1.06	25 - 400
Limestone and dolomite						
Sauk sequence; Western United States-	3 (2)	302:392	2.3	4.33	1.60	<1 - 94
Sauk sequence; Missouri and Arkansas-	4 (1)	39:48	2.0	2.53	1.30	<1 - 20
Upper Ordovician; Kentucky----------	5 (1)	78:80	5.3	1.78	1.36	<2 - 20
Tippecanoe sequence; Missouri--------	10 (1)	6:12	.84	3.51	1.30	<1 - 5
Lower Mississippian; Kentucky--------	5 (1)	108:112	4.0	2.09	1.56	<2 - 70
Upper Mississippian; Kentucky--------	5 (1)	120:152	2.6	1.90	1.47	<2 - 15
Mississippian; Missouri, Oklahoma, and Arkansas----------	7 (1)	20:40	.85	2.04	1.30	<1 - 7
Pennsylvanian; Kentucky----------	5 (1)	80:80	12	1.77	1.26	2 - 50
Pennsylvanian; Missouri, Kansas, and Oklahoma----------	6 (1)	32:32	3.5	2.14	1.30	1.5 - 15
Siderite						
Upper Paleozoic; Kentucky----------	11 (1)	30:30	12	1.92	--	2 - 50
UNCONSOLIDATED GEOLOGIC DEPOSITS						
Carbonate residuum (terra rossa)						
On Gasconade Formation; Missouri-----	12 (1)	24:24	36	1.81	1.18	15 - 100
On Roubidoux Formation; Missouri-----	12 (1)	24:24	21	2.04	1.18	7 - 150
On Jefferson City, Cotter, and Powell Formations; Missouri----------	12 (1)	24:24	22	1.48	1.18	10 - 50
On Osagean rocks; Missouri----------	12 (1)	24:24	18	1.30	1.18	15 - 30
On Meramecian rocks; Missouri--------	12 (1)	24:24	17	1.36	1.18	10 - 30
Loess						
Missouri----------	13 (1)	24:24	18	1.31	--	10 - 30
SOILS						
Cultivated						
Plow zone, garden; Georgia----------	14 (6)	30:30	9.9	1.85	--	2 - 50
	15 (6)	30:30	39	2.01	--	15 - 700
Plow zone, corn field; Missouri						
Floodplain Forest----------	17 (1)	8:8	11	1.82	1.14	3 - 20
Glaciated Prairie----------	17 (1)	10:10	18	1.41	1.14	10 - 30
Unglaciated Prairie----------	17 (1)	10:10	14	1.33	1.14	10 - 20
Oak-hickory Forest----------	17 (1)	10:10	19	1.51	1.14	10 - 50
Plow zone, soybean field; Missouri						
Floodplain Forest----------	17 (1)	10:10	12	1.53	1.14	5 - 20
Glaciated Prairie----------	17 (1)	10:10	19	1.13	1.14	15 - 20
Unglaciated Prairie----------	17 (1)	8:8	14	1.34	1.14	10 - 20
Oak-hickory Forest----------	17 (1)	9:9	16	1.33	1.14	10 - 20

TABLE 19.—*Copper in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
SOILS--Continued						
Cultivated--Continued						
Plow zone, pasture field; Missouri						
Floodplain Forest	17 (1)	10:10	12	1.54	1.14	7 - 30
Glaciated Prairie	17 (1)	10:10	18	1.16	1.14	15 - 20
Unglaciated Prairie	17 (1)	10:10	16	1.23	1.14	10 - 20
Oak-hickory Forest	17 (1)	10:10	16	1.25	1.14	10 - 20
Surface horizon; Missouri	16 (1)	1,140:1,140	13	1.55	1.28	5 - 150
Uncultivated						
Surface horizon; Powder River Basin, Wyoming and Montana	25 (1)	48:48	14	1.63	1.15	3 - 30
A horizon; Georgia	14 (6)	30:30	8.7	1.77	--	3 - 50
	15 (6)	30:30	26	1.72	--	15 - 100
A horizon; Kentucky	18 (2)	96:96	13	1.40	1.05	7 - 42
	19 (2)	108:108	12	1.32	1.10	6 - 26
B horizon; Georgia	14 (6)	30:30	8.8	1.77	--	3 - 50
	15 (6)	30:30	29	1.80	--	15 - 100
B horizon; Kentucky	18 (2)	96:96	20	1.51	1.05	8 - 100
B horizon; Missouri						
Floodplain Forest	20 (1)	50:50	15	1.99	1.54	3 - 100
Glaciated Prairie	20 (1)	50:50	23	1.66	1.54	10 - 70
Unglaciated Prairie	20 (1)	50:50	18	1.63	1.54	7 - 50
Cedar Glade	20 (1)	50:50	17	1.94	1.54	7 - 100
Oak-hickory Forest	20 (1)	50:50	13	1.99	1.54	3 - 70
Oak-hickory-pine Forest	20 (1)	50:50	12	1.88	1.54	5 - 70
C horizon; Georgia	14 (6)	30:30	11	2.04	--	3 - 50
	15 (6)	30:30	33	1.88	--	10 - 100
C horizon; Kentucky	18 (2)	96:96	19	1.63	1.05	5 - 300
Cultivated and uncultivated						
Surface horizon; Colorado	22 (1)	168:168	13	2.17	1.31	3 - 100
B horizon; Eastern United States	21 (6)	361:371	14	2.54	--	<1 - 150
B horizon; Western United Statas	21 (6)	492:492	21	2.00	--	2 - 300
PLANT ASH						
Cultivated plants						
Asparagus; Wisconsin	23 (6)	5:5	93	1.34	--	70 - 150
Bean, lima; Georgia	14 (6)	30:30	93	1.29	--	70 - 150
	15 (6)	15:15	94	1.34	--	70 - 150
Bean, snap; Georgia	14 (6)	30:30	85	1.47	--	30 - 200
	15 (6)	30:30	110	1.40	--	70 - 300
Beet, red; Wisconsin	23 (6)	3:3	73	1.74	--	40 - 120
Blackeyed pea; Georgia	14 (6)	29:29	96	1.37	--	70 - 150

TABLE 19.—*Copper in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
PLANT ASH--Continued						
Cultivated plants--Continued						
Cabbage; Georgia	14 (6)	28:28	22	1.57	--	10 - 70
	15 (6)	30:30	21	2.04	--	10 - 300
Cabbage; Wisconsin	23 (6)	11:11	29	2.03	--	20 - 150
Carrot; Wisconsin	23 (6)	8:8	110	1.43	--	20 - 120
Corn; Georgia	14 (6)	29:29	100	1.35	--	70 - 150
	15 (6)	30:30	94	1.37	--	50 - 150
Corn; Missouri						
Floodplain Forest	17 (1)	8:8	70	1.30	1.25	50 - 100
Glaciated Prairie	17 (1)	10:10	69	1.49	1.25	30 - 100
Unglaciated Prairie	17 (1)	10:10	94	1.35	1.25	70 - 150
Oak-hickory Forest	17 (1)	10:10	81	1.42	1.25	50 - 150
Corn; Wisconsin	23 (6)	27:27	150	1.37	--	60 - 220
Cucumber; Wisconsin	23 (6)	4:4	77	1.38	--	60 - 120
Onion; Wisconsin	23 (6)	7:7	96	1.62	--	40 - 150
Pepper, sweet; Wisconsin	23 (6)	4:4	98	1.26	--	80 - 120
Potato; Wisconsin	23 (6)	10:10	94	1.57	--	40 - 150
Soybean; Missouri						
Floodplain Forest	17 (1)	10:10	170	1.26	1.25	100 - 200
Glaciated Prairie	17 (1)	10:10	180	1.26	1.25	100 - 200
Unglaciated Prairie	17 (1)	8:8	210	1.30	1.25	150 - 300
Oak-hickory Forest	17 (1)	9:9	230	1.30	1.25	150 - 300
Tomato; Georgia	14 (6)	30:30	79	1.48	--	30 - 150
	15 (6)	30:30	86	1.71	--	50 - 500
Native species						
Black cherry, stems; Georgia	14 (6)	30:30	170	1.60	--	70 - 500
	15 (6)	30:30	180	1.52	--	100 - 7,000
Black cherry, leaves; Georgia	14 (6)	30:30	77	1.50	--	30 - 300
	15 (6)	30:30	69	1.39	--	30 - 150
Blackgum, stems; Georgia	14 (6)	30:30	240	1.88	--	20 - 700
	15 (6)	30:30	270	1.80	--	70 - 700
Blackgum, leaves; Georgia	14 (6)	30:30	130	1.90	--	70 - 2,000
	15 (6)	30:30	100	1.37	--	50 - 200
Buckbush; Missouri						
Glaciated Prairie	20 (1)	47:47	190	1.61	1.36	100 - 1,500
Unglaciated Prairie	20 (1)	48:48	200	1.46	1.36	100 - 700
Cedar Glade	20 (1)	49:49	160	1.32	1.36	100 - 300
Oak-hickory Forest	20 (1)	49:49	180	1.45	1.36	100 - 700
Oak-hickory-pine Forest	20 (1)	41:41	160	1.40	1.36	100 - 500
Cedar; Missouri						
Cedar Glade	20 (1)	50:50	50	1.63	1.36	20 - 200
Glaciated Prairie	24 (1)	9:9	110	1.35	--	70 - 150
Unglaciated Prairie	24 (1)	10:10	97	1.32	--	70 - 150
Cedar Glade	24 (1)	10:10	59	1.27	--	50 - 100
Oak-hickory Forest	24 (1)	10:10	66	1.71	--	30 - 150
Oak-hickory-pine Forest	24 (1)	6:6	79	1.33	--	50 - 100

TABLE 19.—*Copper in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
PLANT ASH--Continued						
Native species--Continued						
Hickory, pignut; Kentucky	18 (1)	64:64	110	1.54	1.17	50 - 500
	19 (2)	88:88	98	1.49	1.10	46 - 500
Hickory, shagbark; Kentucky	18 (1)	40:40	130	1.52	1.17	50 - 500
	19 (2)	20:20	96	1.33	1.10	55 - 160
Hickory, shagbark; Missouri						
Oak-hickory Forest	20 (1)	19:19	90	1.53	1.36	50 - 200
Oak-hickory-pine Forest	20 (1)	7:7	100	1.25	1.36	70 - 150
Maple, red, stems; Georgia	14 (6)	30:30	150	1.27	--	100 - 300
	15 (6)	30:30	150	1.51	--	70 - 500
Maple, red, leaves; Georgia	14 (6)	30:30	140	1.86	--	20 - 300
	15 (6)	30:30	150	1.45	--	70 - 300
Oak, black; Kentucky	18 (1)	25:25	120	1.68	1.23	70 - 500
	19 (2)	22:22	99	1.21	1.10	61 - 150
Oak, post; Cedar Glade, Missouri	20 (1)	50:50	130	1.49	1.36	50 - 500
Oak, red; Kentucky	18 (1)	28:28	120	1.33	1.23	70 - 200
	19 (2)	8:8	95	1.31	1.10	60 - 120
Oak, white; Kentucky	18 (1)	49:49	130	1.31	1.23	70 - 200
	19 (2)	75:75	120	1.20	1.10	60 - 180
Oak, white; Missouri						
Oak-hickory Forest	20 (1)	50:50	130	1.57	1.36	50 - 300
Oak-hickory-pine Forest	20 (1)	49:49	140	1.34	1.36	70 - 200
Oak, willow; Floodplain Forest, Missouri	20 (1)	46:46	200	1.61	1.36	70 - 700
Persimmon, stems; Georgia	14 (6)	29:30	230	2.00	--	<10 - 2,000
	15 (6)	30:30	250	1.59	--	100 - 700
Persimmon, leaves; Georgia	14 (6)	30:30	70	1.52	--	20 - 150
	15 (6)	30:30	64	1.49	--	20 - 100
Pine, shortleaf; Oak-hickory-pine Forest, Missouri	20 (1)	49:49	160	1.44	1.36	50 - 500
Sassafras, stems; Georgia	14 (6)	17:17	160	2.63	--	20 - 1,500
	15 (6)	27:27	170	1.34	--	100 - 300
Sassafras, leaves; Georgia	14 (6)	17:17	140	2.21	--	50 - 1,500
	15 (6)	27:27	120	1.34	--	70 - 200
Sumac, winged, stems; Georgia	14 (6)	30:30	160	1.56	--	70 - 500
	15 (6)	30:30	160	1.49	--	70 - 300
Sumac, winged, leaves; Georgia	14 (6)	30:30	86	1.47	--	30 - 150
	15 (6)	30:30	84	1.44	--	50 - 200
Sumac, smooth; Missouri						
Floodplain Forest	20 (1)	48:48	110	1.40	1.36	50 - 200
Glaciated Prairie	20 (1)	50:50	110	1.41	1.36	50 - 200
Unglaciated Prairie	20 (1)	49:49	100	1.46	1.36	30 - 150
Cedar Glade	20 (1)	49:49	86	1.58	1.36	30 - 300
Oak-hickory Forest	20 (1)	50:50	89	1.43	1.36	50 - 200
Oak-hickory-pine Forest	20 (1)	49:49	97	1.51	1.36	50 - 300

TABLE 19.—*Copper in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
PLANT ASH--Continued						
Native species--Continued						
Sweetgum, stems; Georgia	14 (6)	28:28	130	2.20	--	30 - 3,000
	15 (6)	27:27	150	1.46	--	50 - 300
Sweetgum, leaves; Georgia	14 (6)	28:28	130	1.92	--	70 - 2,000
	15 (6)	27:27	130	1.42	--	70 - 200
Sweetgum; Floodplain Forest, Missouri	20 (1)	47:47	130	1.90	1.36	20 - 700

TABLE 20.—*Fluorine in rocks, unconsolidated geologic deposits, soils, and dry plants*

[Explanation of column headings: Study No. refers to study described in text; method of analysis (in parentheses) refers to method listed in table 1. Ratio, number of samples in which the element was found in measurable concentrations to number of samples analyzed. Mean, geometric mean. Deviation, geometric deviation. Error, geometric error attributed to laboratory procedures. Leaders (--) in figure column indicate no data available]

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
ROCKS						
Granite						
Precambrian; Missouri	1 (9)	28:30	390	3.59	3.48	<10 - 1,400
Rhyolite						
Precambrian; Missouri	1 (9)	29:30	350	2.87	3.48	<10 - 1,400
Sandstone						
Roubidoux Formation; Missouri	4 (9)	6:12	9.8	4.83	1.34	<10 - 90
Pennsylvanian; Missouri, Kansas, and Oklahoma	6 (9)	29:32	120	4.07	1.34	<10 - 920
Chert						
Mississippian; Missouri, Oklahoma, and Arkansas	7 (9)	6:20	<10	--	--	<10 - 50
Shale						
Pennsylvanian; Missouri, Kansas, and Oklahoma	6 (9)	32:32	700	1.66	2.28	300 - 1,400
Limestone and dolomite						
Sauk sequence; Missouri and Arkansas	4 (9)	45:48	89	3.03	1.63	<10 - 340
Tippecanoe sequence; Missouri	10 (9)	10:12	67	5.77	1.63	<10 - 620
Mississippian; Missouri, Oklahoma, and Arkansas	7 (9)	27:40	38	6.01	1.63	<10 - 830
Pennsylvanian; Missouri, Kansas, and Oklahoma	6 (9)	29:32	100	3.46	1.63	<10 - 450

TABLE 20.—*Fluorine in rocks, unconsolidated geologic deposits, soils, and dry plants*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
UNCONSOLIDATED GEOLOGIC DEPOSITS						
Carbonate residuum (terra rossa)						
On Gasconade Formation; Missouri	12 (9)	24:24	820	1.82	1.26	330 - 5,900
On Roubidoux Formation; Missouri	12 (9)	24:24	770	2.09	1.26	100 - 2,800
On Jefferson City, Cotter, and Powell Formations; Missouri and Arkansas	12 (9)	24:24	1,000	1.40	1.26	500 - 1,800
On Osagean rocks; Missouri	12 (9)	24:24	700	1.48	1.26	360 - 1,900
On Meramecian rocks; Missouri	12 (9)	24:24	770	1.42	1.26	390 - 1,800
Loess						
Missouri	13 (9)	24:24	290	1.47	--	150 - 460
SOILS						
Cultivated						
Plow zone, corn field; Missouri						
Floodplain Forest	17 (9)	8:8	210	1.82	1.86	110 - 590
Glaciated Prairie	17 (9)	10:10	440	1.95	1.86	240 - 2,020
Unglaciated Prairie	17 (9)	10:10	220	1.57	1.86	120 - 520
Oak-hickory Forest	17 (9)	10:10	200	1.56	1.86	70 - 330
Plow zone, soybean field; Missouri						
Floodplain Forest	17 (9)	10:10	160	1.89	1.86	70 - 420
Glaciated Prairie	17 (9)	10:10	360	1.43	1.86	220 - 890
Unglaciated Prairie	17 (9)	8:8	220	1.63	1.86	100 - 540
Oak-hickory Forest	17 (9)	9:9	250	1.76	1.86	110 - 640
Plow zone, pasture field; Missouri						
Floodplain Forest	17 (9)	10:10	170	1.93	1.86	60 - 580
Glaciated Prairie	17 (9)	10:10	290	1.60	1.86	140 - 780
Unglaciated Prairie	17 (9)	10:10	290	2.32	1.86	140 - 2,310
Oak-hickory Forest	17 (9)	10:10	240	1.73	1.86	100 - 530
Surface horizon; Missouri	16 (9)	1,140:1,140	270	2.22	1.86	10 - 6,400
Uncultivated						
B horizon; Missouri						
Floodplain Forest	20 (9)	50:50	250	2.21	2.43	30 - 1,900
Glaciated Prairie	20 (9)	50:50	480	1.54	2.43	190 - 1,100
Unglaciated Prairie	20 (9)	50:50	360	1.71	2.43	110 - 950
Cedar Glade	20 (9)	50:50	410	2.18	2.43	40 - 480
Oak-hickory Forest	20 (9)	50:50	190	2.40	2.43	50 - 1,800
Oak-hickory-pine Forest	20 (9)	50:50	160	2.66	2.43	10 - 1,000
Cultivated and uncultivated						
Surface horizon; Colorado	22 (9)	168:168	420	2.21	1.33	40 - 2,840
B horizon; Eastern United States	21 (9)	374:420	120	4.38	--	<10 - 3,680
B horizon; Western United States	21 (9)	479:491	250	2.66	--	<10 - 1,900

TABLE 20.—*Fluorine in rocks, unconsolidated geologic deposits, soils, and dry plants*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
DRY PLANTS						
Cultivated plants						
Corn; Missouri						
Floodplain Forest	17 (9)	1:8	<0.5	--	--	<0.5 - 0.5
Glaciated Prairie	17 (9)	1:10	<.5	--	--	<.5 - .5
Unglaciated Prairie	17 (9)	1:10	<.5	--	--	<.5 - .5
Oak-hickory Forest	17 (9)	2:10	.43	1.12	--	<.5 - .5
Soybean; Missouri						
Floodplain Forest	17 (9)	5:10	.46	1.86	--	<.5 - 1
Glaciated Prairie	17 (9)	5:10	.47	1.07	--	<.5 - .5
Unglaciated Prairie	17 (9)	6:8	.49	1.04	--	<.5 - .5
Oak-hickory Forest	17 (9)	3:9	<.5	--	--	<.5 - 1
Native species						
Buckbush; Missouri						
Glaciated Prairie	20 (9)	11:11	1.6	1.49	--	1 - 3
Unglaciated Prairie	20 (9)	3:3	1.4	2.56	--	.5 - 3
Cedar Glade	20 (9)	5:5	1.1	1.79	--	.5 - 2
Oak-hickory Forest	20 (9)	13:13	1.4	1.64	--	.5 - 3
Oak-hickory-pine Forest	20 (9)	7:7	1.3	1.45	--	1 - 2
Cedar; Cedar Glade, Missouri	20 (9)	11:11	1.6	1.58	--	1 - 3
Hickory, shagbark; Oak-hickory Forest, Missouri	20 (9)	3:4	.78	1.54	--	<.5 - 1
Oak, post; Cedar Glade, Missouri	20 (9)	6:6	1.1	1.69	--	.5 - 2
Oak, white; Missouri						
Oak-hickory Forest	20 (9)	10:12	.5	--	--	<.5 - 1
Oak-hickory-pine Forest	20 (9)	10:11	.71	1.49	--	<.5 - 1
Oak, willow; Floodplain Forest, Missouri	20 (9)	9:11	.77	1.72	--	<.5 - 2
Pine, shortleaf; Oak-hickory-pine Forest, Missouri	20 (9)	4:4	.84	1.41	--	.5 - 1
Sumac, smooth; Missouri						
Floodplain Forest	20 (9)	7:9	.5	--	--	<.5 - 1
Glaciated Prairie	20 (9)	5:8	.5	--	--	<.5 - 1
Unglaciated Prairie	20 (9)	9:11	.5	--	--	<.5 - 1
Cedar Glade	20 (9)	10:11	.76	1.67	--	<.5 - 2
Oak-hickory Forest	20 (9)	5:9	.5	--	--	<.5 - 1
Oak-hickory-pine Forest	20 (9)	5:8	.5	--	--	<.5 - 1
Sweetgum; Floodplain Forest, Missouri	20 (9)	11:14	.66	1.58	--	<.5 - 1

TABLE 21.—*Gallium in rocks, unconsolidated geologic deposits, soils, and plant ash*

[Explanation of column headings: Study No. refers to study described in text; method of analysis (in parentheses) refers to method listed in table 1. Ratio, number of samples in which the element was found in measurable concentrations to number of samples analyzed. Mean, geometric mean. Deviation, geometric deviation. Error, geometric error attributed to laboratory procedures. Leaders (--) in figure column indicate no data available]

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
ROCKS						
Granite						
Precambrian; Missouri	1 (1)	30:30	29	1.11	1.14	20 - 30
Rhyolite						
Precambrian; Missouri	1 (1)	30:30	28	1.20	1.14	15 - 30
Arkose						
Fountain Formation; Colorado	2 (2)	69:80	7.6	1.87	1.33	<3 - 23
Sandstone						
Sauk sequence; Western United States	3 (2)	108:400	<2	--	--	<2 - 25
Pope Megagroup;[1] Kentucky	5 (2)	13:120	1.5	2.91	1.08	<8 - 13
Pennsylvanian; Kentucky	5 (2)	70:152	3.8	2.86	1.22	<5 - 21
Pennsylvanian; Missouri, Kansas, and Oklahoma	6 (1)	29:32	10	2.06	1.05	<5 - 30
Shale						
Sauk sequence; Western United States	3 (2)	306:336	24	1.65	1.13	<10 - 48
Lower Mississippian; Kentucky	8 (2)	62:76	15	1.66	--	<10 - 30
Upper Mississippian; Kentucky	5 (2)	138:142	22	1.38	--	<10 - 36
Mississippian; Missouri, Oklahoma, and Arkansas	7 (1)	18:18	16	1.81	1.14	7 - 50
Pennsylvanian; Kentucky	5 (2)	144:152	26	1.54	1.11	<11 - 60
Pennsylvanian; Missouri, Kansas, and Oklahoma	6 (1)	32:32	30	1.45	1.14	15 - 50
Black shale						
Devonian and Mississippian; Kentucky	9 (2)	87:88	22	1.25	1.11	<15 - 33
Limestone and dolomite						
Sauk sequence; Western United States	3 (2)	35:392	<10	--	--	<10 - 20
Sauk sequence; Missouri and Arkansas	4 (1)	2:48	<5	--	--	<5 - 7
Upper Ordovician; Kentucky	5 (1)	12:80	5.4	1.49	--	<10 - 15
Tippecanoe sequence; Missouri	10 (1)	1:12	<5	--	--	<5 - 7
Lower Mississippian; Kentucky	5 (1)	19:112	5.6	1.50	--	<10 - 15
Upper Mississippian; Kentucky	5 (1)	11:152	<10	--	--	<10 - 20
Mississippian; Missouri, Oklahoma, and Arkansas	7 (1)	2:40	<5	--	--	<5 - 7
Pennsylvanian; Kentucky	5 (1)	52:80	10	1.71	1.34	<10 - 20
Pennsylvanian; Missouri, Kansas, and Oklahoma	6 (1)	8:32	2.2	2.34	--	<5 - 10
Siderite						
Upper Paleozoic; Kentucky	11 (1)	28:30	13	1.66	--	<10 - 50

[1] Of Swann and Willman (1961).

TABLE 21.—*Gallium in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
UNCONSOLIDATED GEOLOGIC DEPOSITS						
Carbonate residuum (terra rossa)						
On Gasconade Formation; Missouri	12 (1)	24:24	20	1.49	1.19	10 - 50
On Roubidoux Formation; Missouri	12 (1)	23:24	16	1.67	1.19	<5 - 30
On Jefferson City, Cotter, and Powell Formations; Missouri and Arkansas	12 (1)	24:24	21	1.39	1.19	10 - 50
On Osagean rocks; Missouri	12 (1)	24:24	26	1.33	1.19	20 - 50
On Meramecian rocks; Missouri	12 (1)	24:24	26	1.39	1.19	15 - 50
Loess						
Missouri	13 (1)	24:24	16	1.15	--	15 - 20
SOILS						
Cultivated						
Plow zone, garden; Georgia	14 (1)	8:30	<1.5	--	--	<1.5 - 10
	15 (1)	30:30	20	1.78	--	3 - 50
Plow zone, corn field; Missouri						
Floodplain Forest	17 (1)	8:8	12	1.23	1.19	10 - 15
Glaciated Prairie	17 (1)	10:10	15	1.21	1.19	10 - 20
Unglaciated Prairie	17 (1)	10:10	11	1.35	1.19	7 - 15
Oak-hickory Forest	17 (1)	10:10	12	1.37	1.19	7 - 20
Plow zone, soybean field; Missouri						
Floodplain Forest	17 (1)	10:10	12	1.36	1.19	7 - 20
Glaciated Prairie	17 (1)	10:10	16	1.15	1.19	15 - 20
Unglaciated Prairie	17 (1)	8:8	11	1.28	1.19	7 - 15
Oak-hickory Forest	17 (1)	9:9	11	1.22	1.19	10 - 15
Plow zone, pasture field; Missouri						
Floodplain Forest	17 (1)	10:10	12	1.23	1.19	10 - 15
Glaciated Prairie	17 (1)	10:10	15	1.18	1.19	10 - 20
Unglaciated Prairie	17 (1)	10:10	11	1.28	1.19	7 - 15
Oak-hickory Forest	17 (1)	10:10	12	1.24	1.19	10 - 15
Surface horizon; Missouri	16 (1)	1,111:1,140	11	1.49	1.22	<5 - 30
Uncultivated						
Surface horizon; Powder River Basin, Wyoming and Montana	25 (1)	48:48	12	1.31	1.13	7 - 20
A horizon; Georgia	14 (1)	10:30	15	3.57	--	<1.5 - 30
	15 (1)	29:30	17	2.32	--	<1.5 - 50
A horizon; Kentucky	18 (2)	83:96	7.5	1.53	1.10	<5 - 21
	19 (2)	68:108	11	1.31	1.15	<10 - 23
B horizon; Georgia	14 (1)	10:30	1.9	2.31	--	<1.5 - 7
	15 (1)	30:30	21	1.96	--	3 - 50
B horizon; Kentucky	18 (2)	94:96	15	1.57	1.10	<5 - 42
B horizon; Missouri						
Floodplain Forest	20 (1)	50:50	12	1.53	1.29	5 - 30
Glaciated Prairie	20 (1)	50:50	19	1.40	1.29	7 - 30
Unglaciated Prairie	20 (1)	50:50	14	1.51	1.29	5 - 30

TABLE 21.—*Gallium in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
SOILS--Continued						
Uncultivated--Continued						
B horizon; Missouri--Continued						
Cedar Glade	20 (1)	47:50	11	1.64	1.29	<5 - 20
Oak-hickory Forest	20 (1)	48:50	8.4	1.54	1.29	<5 - 20
Oak-hickory-pine Forest	20 (1)	37:50	5.9	1.92	1.29	<5 - 20
C horizon; Georgia	14 (1)	19:30	3.7	2.21	--	<1.5 - 15
	15 (1)	30:30	29	1.85	--	5 - 70
C horizon; Kentucky	18 (2)	93:96	15	1.67	1.10	<5 - 46
Cultivated and uncultivated						
Surface horizon; Colorado	22 (1)	168:168	17	1.52	1.17	5 - 30
B horizon; Eastern United States	21 (1)	301:370	10	2.53	--	<3 - 70
B horizon; Western United States	21 (1)	483:492	18	1.71	--	<3 - 70
PLANT ASH						
Native species						
Blackgum, stems; Georgia	15 (1)	2:30	<5	--	--	<5 - 100
Blackgum, leaves; Georgia	15 (1)	2:30	<5	--	--	<5 - 200
Buckbush; Missouri						
Glaciated Prairie	20 (1)	11:47	2.8	1.54	--	<5 - 7
Unglaciated Prairie	20 (1)	9:48	2.4	1.73	--	<5 - 7
Oak-hickory Forest	20 (1)	9:49	2.7	1.51	--	<5 - 7
Oak-hickory-pine Forest	20 (1)	5:41	1.5	2.24	--	<5 - 10
Persimmon, leaves; Georgia	15 (1)	1:30	<5	--	--	<5 - 5
Sassafras, leaves; Georgia	15 (1)	1:27	<5	--	--	<5 - 5
Sumac, winged, leaves; Georgia	15 (1)	1:30	<5	--	--	<5 - 5

TABLE 22.—*Gold in rocks*

[Explanation of column headings: Study No. refers to study described in text; method of analysis (in parentheses) refers to method listed in table 1. Ratio, number of samples in which the element was found in measurable concentrations to number of samples analyzed. Mean, geometric mean. Deviation, geometric deviation. Error, geometric error attributed to laboratory procedures. Leaders (--) in figure column indicate no data available]

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppb)	Deviation	Error	Observed range (ppb)
Arkose						
Fountain Formation; Colorado	2 (8)	80:80	0.26	2.14	2.11	0.06 - 1.6

TABLE 23.—*Iodine in unconsolidated geologic deposits, soils, and dry plants*

[Explanation of column headings: Study No. refers to study described in text; method of analysis (in parentheses) refers to method listed in table 1. Ratio, number of samples in which the element was found in measurable concentrations to number of samples analyzed. Mean, geometric mean except that values preceded by asterisk are arithmetic mean. Deviation, geometric deviation except that values preceded by asterisk are standard deviation. Error, geometric error attributed to laboratory procedures except that values preceded by asterisk are standard error. Leaders (--) in figure column indicate no data available]

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
UNCONSOLIDATED GEOLOGIC DEPOSITS						
Loess						
Missouri	13 (8)	24:24	1.2	1.83	1.09	0.20 - 4.7
SOILS						
Cultivated						
Surface horizon; Missouri	16 (8)	114:114	*4.3	*1.65	*0.46	1.2 - 11
DRY PLANTS						
Cultivated plants						
Corn; Missouri						
Floodplain Forest	17 (7)	8:8	5.4	1.16	1.12	4 - 6
Glaciated Prairie	17 (7)	10:10	5.7	1.17	1.12	5 - 7
Unglaciated Prairie	17 (7)	10:10	5.3	1.22	1.12	4 - 7
Oak-hickory Forest	17 (7)	10:10	4.6	1.24	1.12	3 - 6
Soybean; Missouri						
Floodplain Forest	17 (7)	10:10	13	1.14	1.12	10 - 16
Glaciated Prairie	17 (7)	10:10	13	1.14	1.12	10 - 16
Unglaciated Prairie	17 (7)	8:8	12	1.15	1.12	10 - 14
Oak-hickory Forest	17 (7)	9:9	13	1.15	1.12	10 - 16
Native species						
Buckbush; Missouri						
Glaciated Prairie	20 (7)	11:11	4.7	1.11	--	4 - 5
Unglaciated Prairie	20 (7)	7:7	5.4	1.10	--	5 - 6
Cedar Glade	20 (7)	8:8	4.7	1.16	--	4 - 6
Oak-hickory Forest	20 (7)	16:16	5.1	1.13	--	4 - 6
Oak-hickory-pine Forest	20 (7)	10:10	4.6	1.16	--	4 - 5
Cedar; Missouri						
Cedar Glade	20 (7)	11:11	5.0	1.18	--	4 - 6
Glaciated Prairie	24 (7)	9:9	5.4	1.29	--	4 - 10
Unglaciated Prairie	24 (7)	10:10	4.4	1.12	--	4 - 5
Cedar Glade	24 (7)	10:10	4.5	1.12	--	4 - 5
Oak-hickory Forest	24 (7)	10:10	4.4	1.12	--	4 - 5
Oak-hickory-pine Forest	24 (7)	6:6	4.3	1.23	--	3 - 5
Hickory, pignut; Kentucky	18 (7)	64:64	3.2	1.29	1.31	2 - 5
Hickory, shagbark; Kentucky	18 (7)	40:40	3.2	1.28	1.31	2 - 5
Hickory, shagbark; Oak-hickory Forest, Missouri	20 (7)	4:4	4.2	1.12	--	4 - 5

TABLE 23.—*Iodine in unconsolidated geologic deposits, soils, and dry plants*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
DRY PLANTS--Continued						
Native species--Continued						
Oak, black; Kentucky	18 (7)	25:25	2.8	1.39	1.29	2 - 5
Oak, post; Cedar Glade, Missouri	20 (7)	8:8	4.2	1.19	--	3 - 5
Oak, red; Kentucky	18 (7)	28:28	3.1	1.26	1.29	2 - 5
Oak, white; Kentucky	18 (7)	49:49	3.3	1.33	1.29	2 - 5
Oak, white; Missouri						
Oak-hickory Forest	20 (7)	12:12	4.6	1.22	--	3 - 6
Oak-hickory-pine Forest	20 (7)	11:11	4.6	1.12	--	4 - 5
Oak, willow; Floodplain Forest, Missouri	20 (7)	12:12	4.6	1.15	--	4 - 6
Pine, shortleaf; Oak-hickory-pine Forest, Missouri	20 (7)	4:4	4.9	1.18	--	4 - 6
Sumac, smooth; Missouri						
Floodplain Forest	20 (7)	9:9	4.8	1.10	--	4 - 5
Glaciated Prairie	20 (7)	9:9	4.6	1.16	--	4 - 6
Unglaciated Prairie	20 (7)	11:11	4.6	1.18	--	3 - 5
Cedar Glade	20 (7)	11:11	4.3	1.18	--	3 - 5
Oak-hickory Forest	20 (7)	9:9	4.6	1.12	--	4 - 5
Oak-hickory-pine Forest	20 (7)	8:8	4.0	1.24	--	3 - 5
Sweetgum; Floodplain Forest, Missouri	20 (7)	14:14	4.1	1.20	--	3 - 6

TABLE 24.—*Iron in rocks, unconsolidated geologic deposits, soils, and plant ash*

[Explanation of column headings: Study No. refers to study described in text; method of analysis (in parentheses) refers to method listed in table 1. Ratio, number of samples in which the element was found in measurable concentrations to number of samples analyzed. Mean, geometric mean except that values preceded by asterisk are arithmetic mean. Deviation, geometric deviation except that values preceded by asterisk are standard deviation. Error, geometric error attributed to laboratory procedures except that values preceded by asterisk are standard error. Leaders (--) in figure column indicate no data available]

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (percent)	Deviation	Error	Observed range (percent)
ROCKS						
Granite						
Precambrian; Missouri	1 (5)	30:30	1.7	1.60	1.03	0.84 - 3.5
Rhyolite						
Precambrian; Missouri	1 (5)	30:30	1.9	1.27	1.03	1.2 - 3.1

TABLE 24.—*Iron in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (percent)	Deviation	Error	Observed range (percent)
ROCKS--Continued						
Arkose						
Fountain Formation; Colorado	2 (2)	80:80	0.63	2.50	1.12	0.03 - 4.3
Sandstone						
Roubidoux Formation; Missouri	4 (5)	7:12	.090	3.26	1.15	<.070 - .42
Pope Megagroup;[1] Kentucky	5 (2)	120:120	.96	2.43	1.09	.090 - 5.5
Pennsylvanian; Kentucky	5 (2)	152:152	1.0	3.20	1.14	.080 - 9.9
Pennsylvanian; Missouri, Kansas, and Oklahoma	6 (5)	32:32	1.9	2.06	1.15	.56 - 7.7
Chert						
Mississippian; Missouri, Oklahoma, and Arkansas	7 (5)	10:20	.081	1.96	1.15	<.070 - .21
Shale						
Lower Mississippian; Kentucky	8 (2)	76:76	3.5	1.95	--	.75 - 8.6
Upper Mississippian; Kentucky	5 (2)	142:142	4.2	1.72	--	.80 - 10
Mississippian; Missouri, Oklahoma, and Arkansas	7 (5)	18:18	1.8	1.58	1.03	.77 - 3.4
Pennsylvanian; Kentucky	5 (2)	152:152	4.5	1.93	1.28	.45 - 10
Pennsylvanian; Missouri, Kansas, and Oklahoma	6 (5)	32:32	3.8	1.50	1.03	.91 - 8.4
Black shale						
Devonian and Mississippian; Kentucky	9 (2)	88:88	3.3	1.74	1.36	.83 - 10
Limestone and dolomite						
Sauk sequence; Western United States	3 (2)	387:392	.63	2.77	1.81	<.05 - 5.6
Sauk sequence; Missouri and Arkansas	4 (5)	46:48	.17	2.44	1.04	<.070 - .27
Upper Ordovician; Kentucky	5 (1)	78:80	.90	1.95	--	.2 - >10
Tippecanoe sequence; Missouri	10 (5)	10:12	.11	2.79	1.04	<.070 - .56
Lower Mississippian; Kentucky	5 (1)	112:112	.54	2.38	--	.05 - 3
Upper Mississippian; Kentucky	5 (1)	152:152	.37	2.56	--	.05 - 3
Mississippian; Missouri, Oklahoma, and Arkansas	7 (5)	30:40	.15	3.71	1.04	<.070 - 1.4
Pennsylvanian; Kentucky	5 (1)	80:80	2.1	1.84	--	.5 - 10
Pennsylvanian; Missouri, Kansas, and Oklahoma	6 (5)	32:32	.96	2.49	1.04	.21 - 3.7
Siderite						
Upper Paleozoic; Kentucky	11 (16)	30:30	*26	*9.36	--	8.0 - 39
UNCONSOLIDATED GEOLOGIC DEPOSITS						
Carbonate residuum (terra rossa)						
On Gasconade Formation; Missouri	12 (5)	24:24	4.3	1.30	1.02	2.5 - 7.0
On Roubidoux Formation; Missouri	12 (5)	24:24	3.5	1.60	1.02	1.1 - 5.9
On Jefferson City, Cotter, and Powell Formations; Missouri and Arkansas	12 (5)	24:24	3.9	1.25	1.02	2.1 - 5.7

[1] Of Swann and Willman (1961).

TABLE 24.—*Iron in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (percent)	Deviation	Error	Observed range (percent)
UNCONSOLIDATED GEOLOGIC DEPOSITS--Continued						
Carbonate residuum (terra rossa)--Continued						
On Osagean rocks; Missouri	12 (5)	24:24	5.3	1.30	1.02	3.3 - 8.0
On Meramecian rocks; Missouri	12 (5)	24:24	5.7	1.34	1.02	2.7 - 11
Loess						
Missouri	13 (5)	24:24	2.4	1.11	--	2.1 - 3.1
SOILS						
Cultivated						
Plow zone, garden; Georgia	15 (1)	30:30	2.0	1.54	--	1 - 5
Plow zone, corn field; Missouri						
Floodplain Forest	17 (5)	8:8	1.4	1.80	1.03	.4 - 3.1
Glaciated Prairie	17 (5)	10:10	2.4	1.28	1.03	1.6 - 3.3
Unglaciated Prairie	17 (5)	10:10	2.3	1.32	1.03	1.6 - 3.8
Oak-hickory Forest	17 (5)	10:10	2.1	1.14	1.03	1.7 - 2.6
Plow zone, soybean field; Missouri						
Floodplain Forest	17 (5)	10:10	1.4	1.96	1.03	.3 - 4.6
Glaciated Prairie	17 (5)	10:10	2.8	1.13	1.03	2.2 - 3.1
Unglaciated Prairie	17 (5)	8:8	2.5	1.42	1.03	1.7 - 5.1
Oak-hickory Forest	17 (5)	9:9	1.9	1.12	1.03	1.6 - 2.3
Plow zone, pasture field; Missouri						
Floodplain Forest	17 (5)	10:10	1.6	1.96	1.03	.4 - 4.6
Glaciated Prairie	17 (5)	10:10	2.3	1.20	1.03	2.0 - 3.4
Unglaciated Prairie	17 (5)	10:10	2.0	1.28	1.03	1.3 - 2.8
Oak-hickory Forest	17 (5)	10:10	2.2	1.23	1.03	1.5 - 2.9
Surface horizon; Missouri	16 (5)	1,140:1,140	*2.1	*.64	*.12	.49 - 5.4
Uncultivated						
Surface horizon; Powder River Basin, Wyoming and Montana	25 (1)	48:48	1.9	1.58	1.26	.7 - 10
A horizon; Georgia	14 (1)	30:30	.47	2.27	--	.1 - 3
	15 (1)	30:30	2.1	1.68	--	.5 - 5
A horizon; Kentucky	18 (16)	96:96	2.1	1.62	1.06	.47 - 6
	19 (16)	108:108	2.1	1.54	1.27	.77 - 13
B horizon; Georgia	14 (1)	30:30	.48	2.04	--	.15 - 2
	15 (1)	30:30	2.6	1.74	--	.7 - 7
B horizon; Kentucky	18 (16)	96:96	4.2	1.55	1.06	.62 - 9.7
B horizon; Missouri						
Floodplain Forest	20 (5)	50:50	2.1	1.69	1.10	.7 - 9.4
Glaciated Prairie	20 (5)	50:50	3.5	1.26	1.10	1.8 - 5.1
Unglaciated Prairie	20 (5)	50:50	3.5	1.53	1.10	1.4 - 12.3
Cedar Glade	20 (5)	50:50	1.9	1.43	1.10	.8 - 3.8
Oak-hickory Forest	20 (5)	50:50	1.9	1.43	1.10	.8 - 5.3
Oak-hickory-pine Forest	20 (5)	50:50	1.5	1.51	1.10	.7 - 3.9

TABLE 24.—*Iron in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (percent)	Deviation	Error	Observed range (percent)
SOILS--Continued						
Uncultivated--Continued						
C horizon; Georgia	15 (1)	30:30	3.0	1.59	--	1 - 5
C horizon; Kentucky	18 (16)	96:96	4.3	1.63	1.06	.60 - 11
Cultivated and uncultivated						
Surface horizon; Colorado	22 (5)	168:168	2.0	1.61	1.04	.6 - 5
B horizon; Eastern United States	21 (1)	369:370	1.5	2.76	--	.01 - >10
B horizon; Western United States	21 (1)	490:491	2.0	1.90	--	.15 - >10
PLANT ASH						
Cultivated plants						
Asparagus; Wisconsin	23 (1)	5:5	0.27	1.60	--	0.15 - 0.5
Bean, lima; Georgia	14 (1)	30:30	.11	1.27	--	.07 - .15
	15 (1)	15:15	.16	2.15	--	.07 - 1
Bean, snap; Georgia	14 (1)	30:30	.099	1.36	--	.07 - .2
	15 (1)	30:30	.14	1.96	--	.03 - .7
Beet, red; Wisconsin	23 (1)	4:4	.063	1.21	--	.05 - .07
Blackeyed pea; Georgia	14 (1)	29:29	.11	1.43	--	.03 - .15
	15 (1)	4:4	.11	1.55	--	.07 - .2
Cabbage; Georgia	14 (1)	28:28	.071	1.46	--	.03 - .3
	15 (1)	30:30	.19	2.13	--	.03 - .7
Cabbage; Wisconsin	23 (1)	11:11	.076	2.16	--	.03 - .3
Carrot; Wisconsin	23 (1)	8:8	.060	2.15	--	.02 - .2
Corn; Georgia	14 (1)	29:29	.086	1.57	--	.05 - .5
	15 (1)	30:30	.099	1.65	--	.03 - .3
Corn; Missouri						
Floodplain Forest	17 (1)	8:8	.17	1.67	1.23	.1 - .5
Glaciated Prairie	17 (1)	10:10	.13	1.28	1.23	.1 - .2
Unglaciated Prairie	17 (1)	10:10	.16	1.13	1.23	.15 - .2
Oak-hickory Forest	17 (1)	10:10	.13	1.30	1.23	.1 - .2
Corn; Wisconsin	23 (1)	27:27	.13	1.45	--	.05 - .3
Cucumber; Wisconsin	23 (1)	4:4	.077	1.20	--	.07 - .1
Onion; Wisconsin	23 (1)	7:7	.094	1.83	--	.03 - .2
Pepper, sweet; Wisconsin	23 (1)	4:4	.16	1.15	--	.15 - .2
Potato; Wisconsin	23 (1)	10:10	.063	1.56	--	.03 - .15
Soybean; Missouri						
Floodplain Forest	17 (1)	10:10	.10	1.14	1.23	.1 - .15
Glaciated Prairie	17 (1)	10:10	.12	1.24	1.23	.1 - .15
Unglaciated Prairie	17 (1)	8:8	.13	1.23	1.23	.1 - .15
Oak-hickory Forest	17 (1)	9:9	.13	1.28	1.23	.1 - .2
Tomato; Georgia	14 (1)	30:30	.078	2.21	--	.02 - 1.5
	15 (1)	30:30	.053	1.56	--	.02 - .2

TABLE 24.—*Iron in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (percent)	Deviation	Error	Observed range (percent)
PLANT ASH--Continued						
Native species						
Black cherry, stems; Georgia	14 (1)	30:30	0.15	1.81	--	0.07 - 0.7
	15 (1)	30:30	.19	2.52	--	.01 - 1.5
Black cherry, leaves; Georgia	14 (1)	30:30	.14	1.75	--	.07 - 1.5
	15 (1)	30:30	.21	1.63	--	.1 - .7
Blackgum, stems; Georgia	14 (1)	30:30	.14	1.69	--	.07 - .5
	15 (1)	30:30	.19	2.33	--	.015 - 1.0
Blackgum, leaves; Georgia	14 (1)	30:30	.18	1.84	--	.07 - 1.5
	15 (1)	30:30	.26	2.47	--	.03 - 2.0
Buckbush; Missouri						
Glaciated Prairie	20 (1)	47:47	.76	1.74	1.45	.05 - 2
Unglaciated Prairie	20 (1)	48:48	.93	1.64	1.45	.3 - 5
Cedar Glade	20 (1)	50:50	.56	1.44	1.45	.3 - 1
Oak-hickory Forest	20 (1)	49:49	.69	1.58	1.45	.3 - 2
Oak-hickory-pine Forest	20 (1)	41:41	.56	1.96	1.45	.05 - 1.5
Cedar; Missouri						
Cedar Glade	20 (1)	50:50	.28	1.66	1.45	.1 - 1
Glaciated Prairie	24 (1)	9:9	.72	1.58	--	.03 - 1.5
Unglaciated Prairie	24 (1)	10:10	.59	1.77	--	.3 - 1.5
Cedar Glade	24 (1)	10:10	.28	1.43	--	.2 - .5
Oak-hickory Forest	24 (1)	10:10	.35	1.71	--	.2 - .7
Oak-hickory-pine Forest	24 (1)	6:6	.24	1.60	--	.15 - .5
Hickory, pignut; Kentucky	18 (3)	60:60	.12	1.46	1.23	.06 - .39
	19 (3)	88:88	.12	1.44	1.07	.05 - .31
Hickory, shagbark; Kentucky	18 (3)	40:40	.12	1.54	1.23	.06 - .27
	19 (3)	20:20	.15	1.44	1.07	.09 - .34
Hickory, shagbark; Missouri						
Oak-hickory Forest	20 (1)	19:19	.13	1.67	1.45	.05 - .3
Oak-hickory-pine Forest	20 (1)	7:7	.16	1.57	1.45	.1 - .3
Maple, red, stems; Georgia	14 (1)	30:30	.094	1.47	--	.05 - .3
	15 (1)	30:30	.14	1.59	--	.07 - .3
Maple, red, leaves; Georgia	14 (1)	30:30	.17	1.96	--	.1 - 1.5
	15 (1)	30:30	.28	1.89	--	.1 - 1.0
Oak, black; Kentucky	18 (3)	25:25	.13	1.66	1.24	.06 - .38
	19 (3)	22:22	.10	1.32	1.07	.06 - .16
Oak, post; Cedar Glade, Missouri	20 (1)	50:50	.19	1.57	1.45	.07 - .5
Oak, red; Kentucky	18 (3)	27:27	.12	1.50	1.24	.08 - .52
	19 (3)	9:9	.09	1.33	1.07	.06 - .13
Oak, white; Kentucky	18 (3)	47:47	.14	1.47	1.24	.06 - .35
	19 (3)	76:76	.12	1.41	1.07	.06 - .34
Oak, white; Missouri						
Oak-hickory Forest	20 (1)	50:50	.14	1.88	1.45	.01 - .3
Oak-hickory-pine Forest	20 (1)	49:49	.16	1.43	1.45	.07 - .5
Oak, willow; Floodplain Forest, Missouri	20 (1)	46:46	.25	1.59	1.45	.1 - .7

TABLE 24.—*Iron in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (percent)	Deviation	Error	Observed range (percent)
PLANT ASH-Continued						
Native species--Continued						
Persimmon, stems; Georgia	14 (1)	30:30	0.10	1.46	--	0.07 - 3
	15 (1)	30:30	.15	2.34	--	.015 - 2
Persimmon, leaves; Georgia	14 (1)	30:30	.13	1.56	--	.07 - .3
	15 (1)	30:30	.19	2.18	--	.03 - 1
Pine, shortleaf; Oak-hickory-pine Forest, Missouri	20 (1)	49:49	.52	1.59	1.45	.2 - 1.5
Sassafras, stems; Georgia	14 (1)	17:17	.19	2.27	--	.05 - 1.5
	15 (1)	27:27	.25	3.21	--	.03 - 2
Sassafras, leaves; Georgia	14 (1)	17:17	.22	2.35	--	.1 - 1.5
	15 (1)	27:27	.35	2.24	--	.1 - 1.5
Sumac, winged, stems; Georgia	14 (1)	30:30	.12	1.66	--	.07 - .7
	15 (1)	30:30	.16	1.92	--	.07 - 1
Sumac, winged, leaves; Georgia	14 (1)	30:30	.15	1.91	--	.07 - 1.5
	15 (1)	30:30	.29	2.25	--	.07 - 1.5
Sumac, smooth; Missouri						
Floodplain Forest	20 (1)	48:48	.11	1.98	1.45	.005 - .5
Glaciated Prairie	20 (1)	50:50	.13	1.52	1.45	.05 - .5
Unglaciated Prairie	20 (1)	49:49	.13	1.74	1.45	.05 - .5
Cedar Glade	20 (1)	49:49	.10	1.68	1.45	.05 - .5
Oak-hickory Forest	20 (1)	50:50	.11	1.89	1.45	.005 - .3
Oak-hickory-pine Forest	20 (1)	49:49	.12	1.66	1.45	.05 - .5
Sweetgum, stems; Georgia	14 (1)	28:28	.081	1.48	--	.03 - .2
	15 (1)	27:27	.11	2.00	--	.03 - .7
Sweetgum, leaves; Georgia	14 (1)	28:28	.15	2.06	--	.07 - 2
	15 (1)	27:27	.19	1.89	--	.07 - 1.5
Sweetgum; Floodplain Forest, Missouri	20 (1)	47:47	.13	1.68	1.45	.02 - .3

TABLE 25.—*Lanthanum in rocks, unconsolidated geologic deposits, soils, and plant ash*

[Explanation of column headings: Study No. refers to study described in text; method of analysis (in parentheses) refers to method listed in table 1. Ratio, number of samples in which the element was found in measurable concentrations to number of samples analyzed. Mean, geometric mean. Deviation, geometric deviation. Error, geometric error attributed to laboratory procedures. Leaders (--) in figure column indicate no data available]

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
ROCKS						
Granite						
Precambrian; Missouri	1 (1)	29:30	54	1.49	1.18	<30 - 100

TABLE 25.—*Lanthanum in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
ROCKS--Continued						
Rhyolite						
Precambrian; Missouri	1 (1)	29:30	59	1.55	1.18	<30 - 150
Arkose						
Fountain Formation; Colorado	2 (2)	67:80	21	1.92	1.46	<10 - 100
Sandstone						
Sauk sequence; Western United States-	3 (2)	127:400	6	3.16	1.24	<10 - 140
Pope Megagroup;[1] Kentucky	5 (2)	1:120	<50	--	--	<50 - 54
Pennsylvanian; Kentucky	5 (2)	9:152	<50	--	--	<50 - 60
Pennsylvanian; Missouri, Kansas, and Oklahoma	6 (1)	26:32	36	1.88	1.14	<30 - 100
Chert						
Mississippian; Missouri, Oklahoma, and Arkansas	7 (1)	1:20	<30	--	--	<30 - 30
Shale						
Sauk sequence; Western United States-	3 (2)	153:336	67	1.33	1.14	<10 - 150
Lower Mississippian; Kentucky	8 (2)	4:76	<70	--	--	<70 - 90
Upper Mississippian; Kentucky	5 (2)	21:142	29	1.85	--	<70 - 110
Mississippian; Missouri, Oklahoma, and Arkansas	7 (1)	14:18	30	--	--	<30 - 150
Pennsylvanian; Kentucky	5 (2)	40:152	41	1.67	--	<70 - 140
Pennsylvanian; Missouri, Kansas, and Oklahoma	6 (1)	32:32	49	1.37	1.19	30 - 70
Black shale						
Devonian and Mississippian; Kentucky-	9 (2)	3:88	<70	--	--	<70 - 98
Limestone and dolomite						
Sauk sequence; Western United States-	3 (2)	12:392	<60	--	--	<60 - 66
Lower Mississippian; Kentucky	5 (1)	5:112	<70	--	--	<70 - 300
Mississippian; Missouri, Oklahoma, and Arkansas	7 (1)	11:40	<30	--	--	<30 - 30
Pennsylvanian; Kentucky	5 (1)	6:80	<70	--	--	<70 - 150
Pennsylvanian; Missouri, Kansas, and Oklahoma	6 (1)	5:32	24	1.20	--	<30 - 70
Siderite						
Upper Paleozoic; Kentucky	11 (1)	3:30	<70	--	--	<70 - 70
UNCONSOLIDATED GEOLOGIC DEPOSITS						
Carbonate residuum (terra rossa)						
On Gasconade Formation; Missouri	12 (1)	3:24	<30	--	--	<30 - 100
On Roubidoux Formation; Missouri	12 (1)	2:24	<30	--	--	<30 - 50
On Jefferson City, Cotter, and Powell Formations; Missouri and Arkansas	12 (1)	2:24	<30	--	--	<30 - 70

[1] Of Swann and Willman (1961).

TABLE 25.—*Lanthanum in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
UNCONSOLIDATED GEOLOGIC DEPOSITS--Continued						
Carbonate residuum (terra rossa)--Continued						
On Osagean rocks; Missouri	12 (1)	17:24	63	2.45	--	<30 - 1,000
On Meramecian rocks; Missouri	12 (1)	18:24	50	--	--	<30 - 500
Loess						
Missouri	13 (1)	24:24	42	1.33	--	30 - 70
SOILS						
Cultivated						
Plow zone, garden; Georgia	14 (1)	11:30	18	2.86	--	<30 - 150
	15 (1)	18:30	33	2.14	--	<30 - 200
Plow zone, corn field; Missouri						
Glaciated Prairie	17 (1)	9:10	49	1.09	1.18	<50 - 50
Unglaciated Prairie	17 (1)	7:10	45	1.18	1.18	<50 - 50
Oak-hickory Forest	17 (1)	7:10	45	1.18	1.18	<50 - 50
Plow zone, soybean field; Missouri						
Floodplain Forest	17 (1)	3:10	33	1.39	1.18	<50 - 50
Glaciated Prairie	17 (1)	5:10	40	1.28	1.18	<50 - 50
Oak-hickory Forest	17 (1)	6:9	44	1.20	1.18	<50 - 50
Plow zone, pasture field; Missouri						
Floodplain Forest	17 (1)	2:10	28	1.48	1.18	<50 - 50
Glaciated Prairie	17 (1)	6:10	43	1.23	1.18	<50 - 50
Unglaciated Prairie	17 (1)	8:10	47	1.14	1.18	<50 - 50
Oak-hickory Forest	17 (1)	5:10	40	1.42	1.18	<50 - 70
Surface horizon; Missouri	16 (1)	1,136:1,140	41	1.39	1.26	<30 - 150
Uncultivated						
Surface horizon; Powder River Basin, Wyoming and Montana	25 (1)	38:48	30	--	--	<30 - 70
A horizon; Georgia	14 (1)	16:30	26	2.40	--	<30 - 200
	15 (1)	20:30	34	1.73	--	<30 - 100
A horizon; Kentucky	18 (2)	85:96	39	1.26	--	<30 - 81
	19 (2)	35:108	43	1.51	1.05	<50 - 75
B horizon; Georgia	14 (1)	14:30	26	2.40	--	<30 - 100
	15 (1)	22:30	34	1.73	--	<30 - 200
B horizon; Kentucky	18 (2)	84:96	39	1.29	--	<30 - 84
B horizon; Missouri						
Floodplain Forest	20 (1)	45:50	32	1.23	1.22	<30 - 50
Glaciated Prairie	20 (1)	50:50	39	1.35	1.22	30 - 50
Unglaciated Prairie	20 (1)	50:50	45	1.37	1.22	30 - 70
Cedar Glade	20 (1)	45:50	33	1.36	1.22	<30 - 70
Oak-hickory Forest	20 (1)	46:50	35	1.37	1.22	<30 - 70
Oak-hickory-pine Forest	20 (1)	40:50	30	1.31	1.22	<30 - 70
C horizon; Georgia	14 (1)	17:30	30	2.03	--	<30 - 100
	15 (1)	20:30	32	1.64	--	<30 - 100

TABLE 25.—*Lanthanum in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
SOILS--Continued						
Uncultivated--Continued						
C horizon; Kentucky	18 (2)	81:96	41	1.35	--	<30 - 80
Cultivated and uncultivated						
Surface horizon; Colorado	22 (1)	86:168	40	1.59	1.41	<50 - 200
B horizon; Eastern United States	21 (1)	226:370	33	1.90	--	<30 - 200
B horizon; Western United States	21 (1)	345:492	35	1.81	--	<30 - 200
PLANT ASH						
Native species						
Black cherry, stems; Georgia	15 (1)	10:30	14	5.14	--	<30 - 300
Black cherry, leaves; Georgia	14 (1)	4:30	<30	--	--	<30 - 200
	15 (1)	11:30	17	4.73	--	<30 - 200
Buckbush; Missouri						
Oak-hickory Forest	20 (1)	5:49	34	1.48	--	<70 - 70
Oak-hickory-pine Forest	20 (1)	8:41	43	1.39	--	<70 - 70
Hickory, pignut; Kentucky	18 (1)	59:64	200	3.82	1.25	<70 - 2,000
	19 (2)	85:88	270	1.82	1.03	<100 - 1,000
Hickory, shagbark; Kentucky	18 (2)	37:40	180	3.62	1.25	<70 - 1,000
	19 (2)	17:20	190	1.66	1.03	<120 - 420
Hickory, shagbark; Missouri						
Oak-hickory Forest	20 (1)	16:19	110	1.70	--	<70 - 300
Oak-hickory-pine	20 (1)	7:7	270	2.20	--	100 - 700
Oak, black; Kentucky	18 (1)	1:25	<30	--	--	<30 - 100
	19 (2)	1:22	<100	--	--	<100 - 240
Oak, red; Kentucky	18 (1)	1:28	<30	--	--	<30 - 300
Oak, white; Kentucky	19 (2)	2:73	<130	--	--	<130 - 310
Persimmon, stems; Georgia	14 (1)	4:30	<30	--	--	<30 - 300
	15 (1)	5:30	<30	--	--	<30 - 150
Persimmon, leaves; Georgia	14 (1)	5:30	<30	--	--	<30 - 300
	15 (1)	12:30	22	3.03	--	<30 - 100
Sumac, winged, stems; Georgia	15 (1)	9:30	<30	--	--	<30 - 150
Sumac, winged, leaves; Georgia	14 (1)	5:30	<30	--	--	<30 - 300
	15 (1)	13:30	24	4.59	--	<30 - 200
Sweetgum, stems; Georgia	14 (1)	4:28	<30	--	--	<30 - 150
	15 (1)	11:27	22	3.04	--	<30 - 150
Sweetgum, leaves; Georgia	15 (1)	11:27	22	3.23	--	<30 - 100

TABLE 26.—*Lead in rocks, unconsolidated geologic deposits, soils, and plant ash*

[Explanation of column headings: Study No. refers to study described in text; method of analysis (in parentheses) refers to method listed in table 1. Ratio, number of samples in which the element was found in measurable concentrations to number of samples analyzed. Mean, geometric mean except that values preceded by asterisk are arithmetic mean. Deviation, geometric deviation except that values preceded by asterisk are standard deviation. Error, geometric error attributed to laboratory procedures except that values preceded by asterisk are standard error. Leaders (--) in figure column indicate no data available]

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
ROCKS						
Granite						
Precambrian; Missouri	1 (1)	30:30	21	1.50	1.50	10 - 70
Rhyolite						
Precambrian; Missouri	1 (1)	30:30	18	1.50	1.50	10 - 70
Arkose						
Fountain Formation; Colorado	2 (2)	72:80	10	2.12	1.58	<3 - 35
Sandstone						
Sauk sequence; Western United States	3 (2)	321:400	5	2.54	1.60	<3 - 680
Pope Megagroup;[1] Kentucky	5 (2)	27:120	<7	--	--	<7 - 190
Pennsylvanian; Kentucky	5 (2)	78:152	6	1.87	1.50	<7 - 25
Pennsylvanian; Missouri, Kansas, and Oklahoma	6 (1)	29:32	17	2.01	1.22	<10 - 150
Chert						
Mississippian; Missouri, Oklahoma, and Arkansas	7 (1)	2:20	<10	--	--	<10 - 10
Shale						
Sauk sequence; Western United States	3 (2)	107:336	<3	--	--	<3 - 1,300
Lower Mississippian; Kentucky	8 (2)	30:76	16	1.50	--	<20 - 42
Upper Mississippian; Kentucky	5 (2)	89:142	21	1.76	--	<20 - 150
Mississippian; Missouri, Oklahoma, and Arkansas	7 (1)	13:18	11	1.58	1.34	<10 - 30
Pennsylvanian; Kentucky	5 (2)	119:152	24	1.37	1.37	<20 - 53
Pennsylvanian; Missouri, Kansas, and Oklahoma	6 (1)	30:32	17	1.92	1.34	<10 - 100
Black shale						
Devonian and Mississippian; Kentucky	9 (2)	63:88	23	1.67	1.37	<20 - 110
Limestone and dolomite						
Sauk sequence; Western United States	3 (2)	49:392	<20	--	--	<20 - 540
Sauk sequence; Missouri and Arkansas	4 (1)	8:48	<10	--	--	<10 - 150
Upper Ordovician; Kentucky	5 (1)	41:80	18	1.14	1.14	<20 - 30
Tippecanoe sequence; Missouri	10 (1)	2:12	4.0	2.06	1.35	<10 - 15
Lower Mississippian; Kentucky	5 (1)	34:112	<20	--	--	<20 - 50
Upper Mississippian; Kentucky	5 (1)	27:152	14	1.26	--	<20 - 30
Mississippian; Missouri, Oklahoma, and Arkansas	7 (1)	5:40	<10	--	--	<10 - 7,000

[1] Of Swann and Willman (1961).

TABLE 26.—*Lead in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
ROCKS--Continued						
Limestone and dolomite--Continued						
Pennsylvanian; Kentucky	5 (1)	58:80	<20	--	--	<20 - 200
Pennsylvanian; Missouri, Kansas, and Oklahoma	6 (1)	9:32	4.2	3.13	1.35	<10 - 70
Siderite						
Upper Paleozoic; Kentucky	11 (1)	19:30	19	1.24	--	<20 - 30
UNCONSOLIDATED GEOLOGIC DEPOSITS						
Carbonate residuum (terra rossa)						
On Gasconade Formation; Missouri	12 (1)	24:24	29	1.89	1.23	15 - 150
On Roubidoux Formation; Missouri	12 (1)	23:24	22	2.05	1.23	<10 - 150
On Jefferson City, Cotter, and Powell Formations; Missouri and Arkansas	12 (1)	24:24	22	1.59	1.23	15 - 50
On Osagean rocks; Missouri	12 (1)	24:24	24	1.59	1.23	15 - 100
On Meramecian rocks; Missouri	12 (1)	24:24	26	1.49	1.23	15 - 70
Loess						
Missouri	13 (1)	24:24	15	1.30	1.23	10 - 20
SOILS						
Cultivated						
Plow zone, garden; Georgia	14 (6)	4:30	2.6	2.77	--	<10 - 15
	15 (6)	28:30	26	2.31	--	<10 - 300
Plow zone, corn field; Missouri						
Floodplain Forest	17 (1)	8:8	18	1.16	1.25	15 - 20
Glaciated Prairie	17 (1)	10:10	20	1.29	1.25	15 - 30
Unglaciated Prairie	17 (1)	10:10	23	1.28	1.25	15 - 30
Oak-hickory Forest	17 (1)	10:10	27	1.91	1.25	15 - 150
Plow zone, soybean field; Missouri						
Floodplain Forest	17 (1)	10:10	18	1.15	1.25	15 - 20
Glaciated Prairie	17 (1)	10:10	25	1.41	1.25	15 - 30
Unglaciated Prairie	17 (1)	8:8	31	1.82	1.25	15 - 100
Oak-hickory Forest	17 (1)	9:9	25	1.48	1.25	15 - 50
Plow zone, pasture field; Missouri						
Floodplain Forest	17 (1)	10:10	18	1.16	1.25	15 - 20
Glaciated Prairie	17 (1)	10:10	25	1.63	1.25	15 - 30
Unglaciated Prairie	17 (1)	10:10	22	1.33	1.25	15 - 30
Oak-hickory Forest	17 (1)	10:10	25	1.41	1.25	15 - 50
Surface horizon; Missouri	16 (1)	1,130:1,130	20	1.38	1.22	10 - 70
Uncultivated						
Surface horizon; Powder River Basin, Wyoming and Montana	25 (1)	48:48	17	1.24	1.22	10 - 30

TABLE 26.—*Lead in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
SOILS--Continued						
Uncultivated--Continued						
A horizon; Georgia	14 (6)	7:30	2.8	4.24	--	<10 - 70
	15 (6)	27:30	21	1.83	--	<10 - 70
A horizon; Kentucky	18 (2)	93:96	14	1.51	1.21	<7 - 96
	19 (2)	102:108	17	1.33	1.20	<10 - 30
B horizon; Georgia	14 (6)	3:30	<10	--	--	<10 - 15
	15 (6)	25:30	17	1.68	--	<10 - 50
B horizon; Kentucky	18 (2)	88:96	12	1.60	1.21	<7 - 33
B horizon; Missouri						
Floodplain Forest	20 (1)	49:50	19	1.56	1.23	<10 - 100
Glaciated Prairie	20 (1)	50:50	19	1.31	1.23	15 - 50
Unglaciated Prairie	20 (1)	50:50	24	1.50	1.23	15 - 70
Cedar Glade	20 (1)	50:50	25	1.52	1.23	10 - 70
Oak-hickory Forest	20 (1)	50:50	23	1.50	1.23	15 - 100
Oak-hickory-pine Forest	20 (1)	49:50	18	1.64	1.23	<10 - 200
C horizon; Georgia	14 (6)	6:30	2.6	4.12	--	<10 - 30
	15 (6)	26:30	17	1.58	--	<10 - 30
C horizon; Kentucky	18 (2)	85:96	*15	*6.1	*1.21	<7 - 37
Cultivated and uncultivated						
Surface horizon; Colorado	22 (1)	168:168	28	1.62	1.25	15 - 150
B horizon; Eastern United States	21 (1)	291:371	14	1.96	--	<7 - 300
B horizon; Western United States	21 (1)	440:492	18	1.93	--	<7 - 700
PLANT ASH						
Cultivated plants						
Asparagus; Wisconsin	23 (6)	5:5	87	2.79	--	25 - 300
Bean, lima; Georgia	14 (6)	1:30	<10	--	--	<10 - 50
	15 (6)	1:15	<10	--	--	<10 - 50
Bean, snap; Georgia	14 (6)	2:30	<10	--	--	<10 - 70
	15 (6)	2:30	<10	--	--	<10 - 30
Beet, red; Wisconsin	23 (6)	2:3	<10	--	--	<10 - 25
Blackeyed pea; Georgia	14 (6)	4:29	<10	--	--	<10 - 70
Cabbage; Georgia	14 (6)	1:28	<10	--	--	<10 - 20
	15 (6)	1:30	<10	--	--	<10 - 20
Carrot; Wisconsin	23 (6)	3:8	<10	--	--	<10 - 25
Corn; Georgia	14 (6)	6:29	7.1	3.11	--	<10 - 70
	15 (6)	1:30	<10	--	--	<10 - 70
Corn; Missouri						
Floodplain Forest	17 (1)	1:8	<20	--	--	<20 - 50
Glaciated Prairie	17 (1)	1:10	<20	--	--	<20 - 30
Corn; Wisconsin	23 (6)	10:27	<10	--	--	<10 - 150
Onion; Wisconsin	23 (6)	2:7	<10	--	--	<10 - 25
Potato; Wisconsin	23 (6)	7:10	<10	--	--	<10 - 50
Tomato; Georgia	14 (6)	8:30	<10	--	--	<10 - 300

TABLE 26.—*Lead in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
PLANT ASH--Continued						
Native species						
Black cherry, stems; Georgia	14 (6)	30:30	210	2.71	--	30 - 1,000
	15 (6)	29:30	270	4.64	--	<10 - 2,000
Black cherry, leaves; Georgia	14 (6)	23:30	33	4.65	--	<10 - 700
	15 (6)	29:30	58	2.40	--	<10 - 500
Blackgum, stems; Georgia	14 (6)	29:30	250	2.88	--	<10 - 1,000
	15 (6)	30:30	480	2.34	--	70 - 3,000
Blackgum, leaves; Georgia	14 (6)	29:30	57	2.01	--	<10 - 2,000
	15 (6)	30:30	96	2.56	--	10 - 1,000
Buckbush; Missouri						
Glaciated Prairie	20 (1)	47:47	200	1.76	1.59	50 - 500
Unglaciated Prairie	20 (1)	48:48	210	1.91	1.59	70 - 1,000
Cedar Glade	20 (1)	50:50	300	1.85	1.59	100 - 2,000
Oak-hickory Forest	20 (1)	49:49	260	1.88	1.59	70 - 1,000
Oak-hickory-pine Forest	20 (1)	41:41	420	1.84	1.59	150 - 1,500
Cedar; Missouri						
Cedar Glade	20 (1)	50:50	100	2.06	1.59	30 - 1,500
Glaciated Prairie	24 (1)	9:9	86	1.54	--	50 - 200
Unglaciated Prairie	24 (1)	10:10	91	1.42	--	70 - 150
Cedar Glade	24 (1)	10:10	70	1.26	--	50 - 100
Oak-hickory Forest	24 (1)	10:10	120	3.25	--	50 - 1,500
Oak-hickory-pine Forest	24 (1)	6:6	64	2.16	--	20 - 200
Hickory, pignut; Kentucky	18 (1)	64:64	210	1.61	1.19	100 - 700
	19 (2)	88:88	260	1.51	1.32	120 - 940
Hickory, shagbark; Kentucky	18 (1)	40:40	170	1.57	1.19	70 - 500
	19 (2)	20:20	220	1.65	1.32	88 - 510
Hickory, shagbark; Missouri						
Oak-hickory Forest	20 (1)	19:19	100	1.66	1.59	30 - 200
Oak-hickory-pine Forest	20 (1)	7:7	190	1.65	1.59	100 - 300
Maple, red, stems; Georgia	14 (6)	29:30	120	2.59	--	<10 - 700
	15 (6)	30:30	230	3.13	--	30 - 2,000
Maple, red, leaves; Georgia	14 (6)	26:30	41	2.92	--	<10 - 300
	15 (6)	30:30	100	2.21	--	30 - 700
Oak, black; Kentucky	18 (1)	25:25	150	1.63	1.12	70 - 500
	19 (2)	22:22	140	1.46	1.32	63 - 240
Oak, post; Cedar Glade, Missouri	20 (1)	50:50	80	1.87	1.59	30 - 700
Oak, red; Kentucky	18 (1)	28:28	120	1.34	1.12	70 - 200
	19 (2)	8:8	150	1.52	1.32	90 - 260
Oak, white; Kentucky	18 (1)	49:49	150	1.92	1.12	10 - 700
	19 (2)	75:75	180	1.49	1.32	50 - 440
Oak, white; Missouri						
Oak-hickory Forest	20 (1)	50:50	100	1.85	1.59	30 - 500
Oak-hickory-pine Forest	20 (1)	49:49	140	1.72	1.59	50 - 1,000
Oak, willow; Floodplain Forest, Missouri	20 (1)	46:46	120	1.85	1.59	30 - 500

TABLE 26.—*Lead in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
		PLANT ASH--Continued				
Native species--Continued						
Persimmon, stems; Georgia	14 (6)	29:30	110	2.90	--	<10 - 700
	15 (6)	29:30	150	3.85	--	<10 - 1,500
Persimmon, leaves; Georgia	14 (6)	22:30	24	4.13	--	<10 - 700
	15 (6)	29:30	68	2.59	--	<10 - 500
Pine, shortleaf; Oak-hickory-pine Forest, Missouri	20 (1)	49:49	250	1.70	1.59	100 - 1,500
Sassafras, stems; Georgia	14 (6)	17:17	210	2.37	--	30 - 700
	15 (6)	25:27	140	4.91	--	<10 - 1,000
Sassafras, leaves; Georgia	14 (6)	17:17	83	1.66	--	30 - 200
	15 (6)	27:27	95	2.28	--	30 - 500
Sumac, winged, stems; Georgia	14 (6)	27:30	110	3.91	--	<10 - 1,500
	15 (6)	29:30	110	3.09	--	<10 - 700
Sumac, winged, leaves; Georgia	14 (6)	29:30	67	2.29	--	<10 - 500
	15 (6)	30:30	120	2.25	--	30 - 700
Sumac, smooth; Missouri						
Floodplain Forest	20 (1)	34:48	26	2.28	1.59	<20 - 200
Glaciated Prairie	20 (1)	42:50	32	1.82	1.59	<20 - 100
Unglaciated Prairie	20 (1)	38:49	28	2.11	1.59	<20 - 150
Cedar Glade	20 (1)	43:49	42	2.17	1.59	<20 - 300
Oak-hickory Forest	20 (1)	37:50	30	2.36	1.59	<20 - 150
Oak-hickory-pine Forest	20 (1)	46:49	61	2.23	1.59	<20 - 300
Sweetgum, stems; Georgia	14 (6)	27:28	120	2.86	--	<10 - 700
	15 (6)	26:27	110	3.31	--	<10 - 700
Sweetgum, leaves; Georgia	14 (6)	25:28	45	2.47	--	<10 - 200
	15 (6)	27:27	91	2.07	--	20 - 300
Sweetgum; Floodplain Forest, Missouri	20 (1)	45:47	65	2.09	1.59	<20 - 300

TABLE 27.—*Lithium in rocks, unconsolidated geologic deposits, soils, and plant ash*

[Explanation of column headings: Study No. refers to study described in text; method of analysis (in parentheses) refers to method listed in table 1. Ratio, number of samples in which the element was found in measurable concentrations to number of samples analyzed. Mean, geometric mean. Deviation, geometric deviation. Error, geometric error attributed to laboratory procedures. Leaders (--) in figure column indicate no data available]

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
ROCKS						
Granite						
Precambrian; Missouri	1 (3)	13:30	<5	--	--	<5 - 31
Rhyolite						
Precambrian; Missouri	1 (3)	16:30	5.2	2.19	--	<5 - 14
Sandstone						
Roubidoux Formation; Missouri	4 (3)	3:12	2.1	2.47	1.26	<5 - 9
Pennsylvanian; Missouri, Kansas, and Oklahoma	6 (3)	31:32	17	2.30	1.26	<5 - 53
Chert						
Mississippian; Missouri, Oklahoma, and Arkansas	7 (3)	6:20	2.8	2.01	1.26	<5 - 7
Shale						
Mississippian; Missouri, Oklahoma, and Arkansas	7 (3)	18:18	25	1.84	1.13	11 - 110
Pennsylvanian; Kansas, Missouri, and Oklahoma	6 (3)	32:32	79	1.48	1.03	36 - 120
Limestone and dolomite						
Sauk sequence; Missouri and Arkansas	4 (3)	5:48	1.1	2.67	--	<5 - 9
Tippecanoe sequence; Missouri	10 (3)	3:12	<5	--	--	<5 - 18
Mississippian; Missouri, Oklahoma, and Arkansas	7 (3)	5:40	.78	3.87	--	<5 - 18
Pennsylvanian; Missouri, Kansas, and Oklahoma	6 (3)	11:32	2.6	2.93	--	<5 - 21
UNCONSOLIDATED GEOLOGIC DEPOSITS						
Carbonate residuum (terra rossa)						
On Gasconade Formation; Missouri	12 (3)	24:24	44	1.35	1.06	24 - 76
On Roubidoux Formation; Missouri	12 (3)	24:24	34	1.71	1.06	9 - 62
On Jefferson City, Cotter, and Powell Formations; Missouri and Arkansas	12 (3)	24:24	46	1.40	1.06	24 - 71
On Osagean rocks; Missouri	12 (3)	24:24	38	1.49	1.06	18 - 68
On Meramecian rocks; Missouri	12 (3)	24:24	44	1.46	1.06	19 - 70
Loess						
Missouri	13 (3)	24:24	23	1.24	--	17 - 34

TABLE 27.—*Lithium in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
SOILS						
Cultivated						
Plow zone, corn field; Missouri						
Floodplain Forest	17 (3)	8:8	15	1.32	1.03	9 - 22
Glaciated Prairie	17 (3)	10:10	22	1.22	1.03	18 - 34
Unglaciated Prairie	17 (3)	10:10	18	1.22	1.03	12 - 25
Oak-hickory Forest	17 (3)	10:10	19	1.17	1.03	16 - 26
Plow zone, soybean field; Missouri						
Floodplain Forest	17 (3)	10:10	15	1.42	1.03	8 - 24
Glaciated Prairie	17 (3)	10:10	24	1.12	1.03	20 - 30
Unglaciated Prairie	17 (3)	8:8	20	1.20	1.03	16 - 27
Oak-hickory Forest	17 (3)	9:9	18	1.17	1.03	13 - 22
Plow zone, pasture field; Missouri						
Floodplain Forest	17 (3)	10:10	16	1.49	1.03	8 - 39
Glaciated Prairie	17 (3)	10:10	21	1.12	1.03	18 - 26
Unglaciated Prairie	17 (3)	10:10	20	1.16	1.03	16 - 24
Oak-hickory Forest	17 (3)	10:10	20	1.21	1.03	16 - 28
Surface horizon; Missouri	16 (3)	1,140:1,140	22	1.28	1.05	7 - 47
Uncultivated						
B horizon; Missouri						
Floodplain Forest	20 (3)	50:50	20	1.63	1.06	7 - 49
Glaciated Prairie	20 (3)	50:50	32	1.21	1.06	21 - 58
Unglaciated Prairie	20 (3)	50:50	29	1.33	1.06	16 - 66
Cedar Glade	20 (3)	50:50	23	1.55	1.06	7 - 120
Oak-hickory Forest	20 (3)	50:50	18	1.33	1.06	10 - 31
Oak-hickory-pine Forest	20 (3)	50:50	15	1.41	1.06	6 - 31
Cultivated and uncultivated						
Surface horizon; Colorado	22 (3)	168:168	22	1.87	1.06	7 - 88
B horizon; Eastern United States	21 (3)	336:360	17	2.10	--	<5 - 136
B horizon; Western United States	21 (3)	447:447	23	1.62	--	6 - 130
PLANT ASH						
Native species						
Buckbush; Missouri						
Glaciated Prairie	20 (3)	42:47	5.3	1.37	--	<4 - 12
Unglaciated Prairie	20 (3)	41:46	5.2	1.38	--	<4 - 10
Cedar Glade	20 (3)	31:47	4.0	--	--	<4 - 8
Oak-hickory Forest	20 (3)	34:46	4.5	1.43	--	<4 - 10
Oak-hickory-pine Forest	20 (3)	26:39	4.0	--	--	<4 - 12
Cedar; Missouri						
Cedar Glade	20 (3)	5:49	<4	--	--	<4 - 4

TABLE 27.—*Lithium in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
PLANT ASH--Continued						
Native species--Continued						
Hickory, pignut; Kentucky	18 (3)	61:64	11	1.95	1.84	<4.6 - 60
	19 (3)	68:88	6.4	2.06	1.68	<4.6 - 42
Hickory, shagbark; Kentucky	18 (3)	39:40	14	2.30	1.84	<4.6 - 130
	19 (3)	15:20	6.1	1.68	1.54	<4.6 - 14
Hickory, shagbark; Missouri						
Oak-hickory Forest	20 (3)	10:19	4.0	--	--	<4 - 12
Oak-hickory-pine Forest	20 (3)	4:7	4.6	1.52	--	<4 - 8
Oak, black; Kentucky	18 (3)	23:25	15	2.63	1.71	<4.6 - 84
	19 (3)	19:22	8.4	2.07	1.68	<4.6 - 37
Oak, red; Kentucky	18 (3)	27:28	12	2.00	1.71	<4.6 - 60
	19 (3)	8:9	8.3	2.11	1.68	<4.6 - 23
Oak, white; Kentucky	18 (3)	48:49	15	1.86	1.71	<4.6 - 65
	19 (3)	72:76	14	1.82	1.68	<4.6 - 46
Pine, shortleaf; Oak-hickory-pine Forest, Missouri	20 (3)	19:48	<4	--	--	<4 - 10
Sagebrush; Powder River Basin, Wyoming and Montana	25 (3)	48:48	9.4	1.82	--	2.0 - 48

TABLE 28.—*Magnesium in rocks, unconsolidated geologic deposits, soils, and plant ash*

[Explanation of column headings: Study No. refers to study described in text; method of analysis (in parentheses) refers to method listed in table 1. Ratio, number of samples in which the element was found in measurable concentrations to number of samples analyzed. Mean, geometric mean. Deviation, geometric deviation. Error, geometric error attributed to laboratory procedures. Leaders (--) in figure column indicate no data available]

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (percent)	Deviation	Error	Observed range (percent)
ROCKS						
Granite						
Precambrian; Missouri	1 (3)	30:30	0.092	2.65	1.07	0.012 - .45
Rhyolite						
Precambrian; Missouri	1 (3)	30:30	.059	2.85	1.07	.0060 - .48
Sandstone						
Sauk sequence; Western United States-	3 (16)	367:400	.17	3.17	2.36	<.03 - 4.3
Pope Megagroup;[1] Kentucky	5 (16)	119:120	.13	3.69	1.58	<.0060 - 1.7

[1] Of Swann and Willman (1961).

TABLE 28.—*Magnesium in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (percent)	Deviation	Error	Observed range (percent)
ROCKS--Continued						
Sandstone--Continued						
Pennsylvanian; Kentucky	5 (16)	147:152	0.091	3.62	1.69	<0.0060 - 0.84
Pennsylvanian; Missouri, Kansas, and Oklahoma	6 (3)	32:32	.21	4.29	1.54	.024 - 3.8
Shale						
Sauk sequence; Western United States	3 (16)	336:336	1.0	2.25	1.27	.024 - 9.8
Lower Mississippian; Kentucky	8 (16)	76:76	1.1	1.90	--	.30 - 4.2
Upper Mississippian; Kentucky	5 (16)	142:142	1.0	1.61	--	.42 - 4.6
Mississippian; Missouri, Oklahoma, and Arkansas	7 (3)	18:18	1.6	2.62	1.22	.43 - 6.8
Pennsylvanian; Kentucky	5 (16)	152:152	.61	1.83	1.16	.090 - 1.4
Pennsylvanian; Missouri, Kansas, and Oklahoma	6 (3)	32:32	.95	1.45	1.22	.28 - 1.8
Siderite						
Upper Paleozoic; Kentucky	11 (16)	30:30	1.6	1.46	--	.66 - 3.3
UNCONSOLIDATED GEOLOGIC DEPOSITS						
Carbonate residuum (terra rossa)						
On Gasconade Formation; Missouri	12 (3)	24:24	0.50	1.92	1.04	0.19 - 5.5
On Roubidoux Formation; Missouri	12 (3)	24:24	.43	2.13	1.04	.11 - 4.0
On Jefferson City, Cotter, and Powell Formations; Missouri and Arkansas	12 (3)	24:24	.60	1.47	1.04	.28 - 1.7
On Osagean rocks; Missouri	12 (3)	24:24	.40	1.41	1.04	.23 - .75
On Meramecian rocks; Missouri	12 (3)	24:24	.43	1.30	1.04	.24 - .59
Loess						
Missouri	12 (3)	24:24	.63	1.83	--	.31 - 2.1
SOILS						
Cultivated						
Plow zone, garden; Georgia	14 (13)	30:30	0.027	1.84	--	0.01 - 0.1
	15 (13)	30:30	.24	1.95	--	.07 - 1
Plow zone, corn field; Missouri						
Floodplain Forest	17 (3)	8:8	.27	1.82	1.09	.10 - .65
Glaciated Prairie	17 (3)	10:10	.36	1.36	1.09	.25 - .59
Unglaciated Prairie	17 (3)	10:10	.21	1.38	1.09	.13 - .34
Oak-hickory Forest	17 (3)	10:10	.26	1.56	1.09	.11 - .52
Plow zone, soybean field; Missouri						
Floodplain Forest	17 (3)	10:10	.26	1.81	1.09	.11 - .74
Glaciated Prairie	17 (3)	10:10	.38	1.18	1.09	.31 - .51
Unglaciated Prairie	17 (3)	8:8	.22	1.37	1.09	.14 - .36
Oak-hickory Forest	17 (3)	9:9	.23	1.47	1.09	.11 - .31
Plow zone, pasture field; Missouri						
Floodplain Forest	17 (3)	10:10	.25	1.91	1.09	.08 - .81
Glaciated Prairie	17 (3)	10:10	.35	1.36	1.09	.26 - .71

TABLE 28.—*Magnesium in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (percent)	Deviation	Error	Observed range (percent)
SOILS--Continued						
Cultivated--Continued						
Plow zone, pasture field; Missouri--Continued						
Unglaciated Prairie	17 (3)	10:10	0.25	1.43	1.09	0.14 - 0.42
Oak-hickory Forest	17 (3)	10:10	.27	1.60	1.09	.11 - .51
Surface horizon; Missouri	16 (3)	1,140:1,140	.26	1.65	1.10	.05 - 2.8
Uncultivated						
Surface horizon; Powder River Basin, Wyoming and Montana	25 (3)	48:48	.50	1.71	1.17	.15 - 2
A horizon; Georgia	14 (13)	30:30	.026	2.48	--	.01 - .3
	15 (13)	30:30	.25	2.19	--	.03 - .7
A horizon; Kentucky	18 (16)	96:96	.19	1.57	1.08	.05 - .6
	19 (16)	108:108	.18	1.37	1.22	.08 - .73
B horizon; Georgia	14 (13)	30:30	.025	2.17	--	.01 - .2
	15 (13)	30:30	.29	2.16	--	.03 - .7
B horizon; Kentucky	18 (16)	96:96	.35	1.49	1.08	.07 - .9
B horizon; Missouri						
Floodplain Forest	20 (3)	50:50	.31	1.80	1.19	.14 - 1.1
Glaciated Prairie	20 (3)	50:50	.54	1.38	1.19	.23 - 1.0
Unglaciated Prairie	20 (3)	50:50	.35	1.57	1.19	.14 - .78
Cedar Glade	20 (3)	50:50	.84	3.06	1.19	.07 - 7.5
Oak-hickory Forest	20 (3)	50:50	.18	2.25	1.19	.04 - 4.8
Oak-hickory-pine Forest	20 (3)	50:50	.11	1.67	1.19	.04 - .58
C horizon; Georgia	14 (13)	30:30	.041	3.05	--	.005 - .5
	15 (13)	30:30	.37	2.09	--	.1 - 2
C horizon; Kentucky	18 (16)	96:96	.34	1.89	1.08	.01 - 2
Cultivated and uncultivated						
Surface horizon; Colorado	22 (3)	168:168	.4	2.21	1.22	.1 - 1.9
B horizon; Eastern United States	21 (13)	358:358	.23	3.39	--	.005 - 5
B horizon; Western United States	21 (13)	491:492	.78	2.21	--	.5 - >10
PLANT ASH						
Cultivated plants						
Asparagus; Wisconsin	23 (13)	5:5	5.7	1.41	--	3 - 7
Bean, lima; Georgia	14 (13)	30:30	3.4	1.53	--	1.5 - 7
	15 (13)	15:15	2.8	1.15	--	2 - 3
Bean, snap; Georgia	14 (13)	30:30	3.6	1.42	--	1.5 - 7
	15 (13)	30:30	4.3	1.49	--	2 - 12
Beet, red; Wisconsin	23 (13)	3:3	2.6	1.26	--	2 - 3
Blackeyed pea; Georgia	14 (13)	29:29	5.0	1.62	--	2 - 12
	15 (13)	4:4	5.2	1.49	--	3 - 7
Cabbage; Georgia	14 (13)	28:28	2.7	1.90	--	.5 - 7
	15 (13)	30:30	2.2	1.68	--	.7 - 7

TABLE 28.—*Magnesium in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (percent)	Deviation	Error	Observed range (percent)
PLANT ASH--Continued						
Cultivated plants--Continued						
Cabbage; Wisconsin	23 (13)	11:11	2.3	1.27	--	1.5 - 3
Carrot; Wisconsin	23 (13)	8:8	2.1	1.80	--	1 - 5
Corn; Georgia	14 (13)	29:29	3.7	1.66	--	1 - 12
	15 (13)	30:30	4.0	1.41	--	2 - 7
Corn; Missouri						
Floodplain Forest	17 (1)	8:8	6.2	1.19	1.20	5 - 7
Glaciated Prairie	17 (1)	10:10	6.3	1.18	1.20	5 - 7
Unglaciated Prairie	17 (1)	10:10	6.5	1.15	1.20	5 - 7
Oak-hickory Forest	17 (1)	10:10	5.9	1.19	1.20	5 - 7
Corn; Wisconsin	23 (13)	12:27	13	2.20	--	3 - >10
Cucumber; Wisconsin	23 (13)	4:4	2.7	1.22	--	2 - 3
Onion; Wisconsin	23 (13)	7:7	2.7	1.40	--	2 - 5
Pepper, sweet; Wisconsin	23 (13)	4:4	2.5	1.26	--	2 - 3
Potato; Wisconsin	23 (13)	10:10	2.2	1.56	--	1 - 5
Soybean; Missouri						
Floodplain Forest	17 (1)	10:10	2.5	1.43	1.20	1 - 3
Glaciated Prairie	17 (1)	10:10	3.0	1.24	1.20	2 - 5
Unglaciated Prairie	17 (1)	8:8	3.2	1.35	1.20	2 - 5
Oak-hickory Forest	17 (1)	9:9	3.6	1.40	1.20	2 - 5
Tomato; Georgia	14 (13)	30:30	1.7	1.41	--	.7 - 3
	15 (13)	30:30	1.5	1.38	--	.7 - 3
Native species						
Black cherry, stems; Georgia	14 (13)	26:30	4.8	1.73	--	1.5 - >10
	15 (13)	30:30	4.0	1.49	--	1.5 - 7
Black cherry, leaves; Georgia	14 (13)	21:30	6.8	1.73	--	1.5 - >10
	15 (13)	24:30	6.7	1.26	--	5 - >10
Blackgum, stems; Georgia	14 (13)	29:30	5.7	1.45	--	2 - >10
	15 (13)	27:30	5.9	1.33	--	3 - >10
Blackgum, leaves; Georgia	14 (13)	6:30	>10	--	--	2 - >10
	15 (13)	12:30	8.9	1.27	--	5 - >10
Buckbush; Missouri						
Glaciated Prairie	20 (1)	47:47	3.5	1.56	1.34	1.5 - 7
Unglaciated Prairie	20 (1)	48:48	3.8	1.51	1.34	2 - 7
Cedar Glade	20 (1)	50:50	4.7	1.55	1.34	2 - 10
Oak-hickory Forest	20 (1)	49:49	3.6	1.65	1.34	1 - 7
Oak-hickory-pine Forest	20 (1)	41:41	3.4	1.59	1.34	1.5 - 7
Cedar; Missouri						
Cedar Glade	20 (1)	50:50	3.0	1.81	1.34	.7 - 7
Glaciated Prairie	24 (1)	9:9	4.7	1.51	--	3 - 10
Unglaciated Prairie	24 (1)	10:10	4.6	1.46	--	2 - 7
Cedar Glade	24 (1)	10:10	6.1	1.19	--	5 - 7
Oak-hickory Forest	24 (1)	10:10	4.7	1.42	--	3 - 7
Oak-hickory-pine Forest	24 (1)	6:6	3.9	1.70	--	2 - 7

TABLE 28.—*Magnesium in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (percent)	Deviation	Error	Observed range (percent)
PLANT ASH--Continued						
Native species--Continued						
Hickory, pignut; Kentucky	18 (3)	60:60	2.7	2.15	1.37	0.72 - 22
	19 (3)	88:88	1.8	1.50	1.05	.4 - 3.5
Hickory, shagbark; Kentucky	18 (3)	40:40	3.0	1.77	1.37	1.1 - 24
	19 (3)	20:20	1.6	1.45	1.05	.66 - 3.4
Hickory, shagbark; Missouri						
Oak-hickory Forest	20 (1)	19:19	2.5	2.11	1.34	.5 - 10
Oak-hickory-pine Forest	20 (1)	7:7	2.2	1.63	1.34	1 - 5
Maple, red, stems; Georgia	14 (13)	30:30	2.5	1.50	--	1 - 6
	15 (13)	30:30	2.3	1.50	--	1 - 7
Maple, red, leaves; Georgia	14 (13)	30:30	5.1	1.56	--	2 - 10
	15 (13)	30:30	4.9	1.45	--	2 - 7
Oak, black; Kentucky	18 (3)	25:25	2.4	2.00	1.96	1.1 - 11
	19 (3)	22:22	1.7	1.34	1.05	.98 - 2.9
Oak, post; Cedar Glade, Missouri	20 (1)	50:50	3.1	2.02	1.34	.7 - 7
Oak, red; Kentucky	18 (3)	27:27	2.2	1.78	1.96	1.1 - 13
	19 (3)	9:9	1.7	1.37	1.05	1.0 - 2.4
Oak, white; Kentucky	18 (3)	47:47	2.0	1.90	1.96	.84 - 12
	19 (3)	76:76	1.6	1.27	1.05	.92 - 2.6
Oak, white; Missouri						
Oak-hickory Forest	20 (1)	50:50	1.8	1.86	1.34	.5 - 7
Oak-hickory-pine Forest	20 (1)	49:49	1.6	1.50	1.34	.7 - 7
Oak, willow; Floodplain Forest, Missouri	20 (1)	46:46	3.4	1.54	1.34	1.5 - 7
Persimmon, stems; Georgia	14 (13)	27:29	5.3	1.43	--	3 - >10
	15 (13)	30:30	4.4	1.37	--	3 - 10
Persimmon, leaves; Georgia	14 (13)	18:30	7.3	1.67	--	3 - >10
	15 (13	28:30	5.5	1.43	--	3 - >10
Pine, shortleaf; Oak-hickory-pine Forest, Missouri	20 (1)	49:49	3.5	1.40	1.34	1.5 - 5
Sassafras, stems; Georgia	14 (13)	17:17	3.2	1.69	--	.7 - 7
	15 (13)	27:27	3.0	1.61	--	1 - 7
Sassafras, leaves; Georgia	14 (13)	25:27	4.7	1.46	--	3 - >10
	15 (13)	25:27	4.7	1.46	--	3 - >10
Sumac, winged, stems; Georgia	14 (13)	30:30	2.9	1.53	--	1.5 - 7
	15 (13)	30:30	2.3	1.41	--	1.5 - 7
Sumac, winged, leaves; Georgia	14 (13)	27:30	5.2	1.55	--	2 - >10
	15 (13)	30:30	3.6	1.49	--	1.5 - 7
Sumac, smooth; Missouri						
Floodplain Forest	20 (1)	48:48	2.9	1.48	1.34	1.5 - 7
Glaciated Prairie	20 (1)	50:50	2.2	1.54	1.34	1.0 - 7
Unglaciated Prairie	20 (1)	49:49	2.3	1.40	1.34	1.5 - 5
Cedar Glade	20 (1)	49:49	2.2	1.69	1.34	.7 - 7
Oak-hickory Forest	20 (1)	50:50	2.0	1.43	1.34	.7 - 5
Oak-hickory-pine Forest	20 (1)	49:49	2.0	1.50	1.34	1.0 - 5

TABLE 28.—*Magnesium in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (percent)	Deviation	Error	Observed range (percent)
PLANT ASH--Continued						
Native species--Continued						
Sweetgum, stems; Georgia	14 (13)	28:28	2.6	1.46	--	1.5 - 7
	15 (13)	27:27	3.1	1.63	--	1 - 7
Sweetgum; Floodplain Forest, Missouri	20 (1)	47:47	2.7	1.85	1.34	.7 - 7

TABLE 29.—*Manganese in rocks, unconsolidated geologic deposits, soils, and plant ash*

[Explanation of column headings: Study No. refers to study described in text; method of analysis (in parentheses) refers to method listed in table 1. Ratio, number of samples in which the element was found in measurable concentrations to number of samples analyzed. Mean, geometric mean. Deviation, geometric deviation. Error, geometric error attributed to laboratory procedures. Leaders (--) in figure column indicate no data available]

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
ROCKS						
Granite						
Precambrian; Missouri	1 (1)	30:30	290	2.18	1.23	70 - 1,500
Rhyolite						
Precambrian; Missouri	1 (1)	30:30	320	2.46	1.23	70 - 1,500
Arkose						
Fountain Formation; Colorado	2 (2)	80:80	210	2.92	1.54	18 - 1,700
Sandstone						
Sauk sequence; Western United States-	3 (16)	265:400	120	3.52	1.79	<77 - 10,000
Roubidoux Formation; Missouri	4 (1)	12:12	29	3.42	2.25	2 - 150
Pope Megagroup;[1] Kentucky	5 (2)	120:120	87	4.41	1.11	9 - 2,300
Pennsylvanian; Kentucky	5 (2)	152:152	89	4.26	1.22	5 - 1,700
Pennsylvanian; Missouri, Kansas, and Oklahoma	6 (1)	32:32	300	4.60	2.25	7 - 3,000
Chert						
Mississippian; Missouri, Oklahoma, and Arkansas	7 (1)	20:20	49	4.38	2.25	.5 - 200
Shale						
Sauk sequence; Western United States-	3 (16)	303:336	420	2.19	2.35	<155 - 6,600
Lower Mississippian; Kentucky	8 (2)	76:76	190	1.79	--	77 - 1,600

[1] Of Swann and Willman (1961).

TABLE 29.—*Manganese in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
ROCKS--Continued						
Shale--Continued						
Upper Mississippian; Kentucky	5 (2)	142:142	130	2.50	--	19 - 4,600
Mississippian; Missouri, Oklahoma, and Arkansas	7 (1)	18:18	140	2.05	1.18	20 - 300
Pennsylvanian; Kentucky	5 (2)	152:152	180	3.11	1.48	12 - 1,000
Pennsylvanian; Missouri, Kansas, and Oklahoma	6 (1)	32:32	170	1.97	1.18	30 - 500
Black shale						
Devonian and Mississippian; Kentucky	9 (2)	88:88	65	2.02	1.09	27 - 780
Limestone and dolomite						
Sauk sequence; Western United States	3 (2)	392:392	320	3.20	1.27	11 - 4,500
Sauk sequence; Missouri and Arkansas	4 (1)	48:48	83	3.04	1.29	15 - 2,000
Upper Ordovician; Kentucky	5 (1)	80:80	520	1.80	1.55	50 - 1,500
Tippecanoe sequence; Missouri	10 (1)	12:12	110	2.62	1.29	30 - 300
Lower Mississippian; Kentucky	5 (1)	112:112	160	2.75	1.50	10 - 1,500
Upper Mississippian; Kentucky	5 (1)	152:152	140	2.41	1.34	15 - 1,000
Mississippian; Missouri, Oklahoma, and Arkansas	7 (1)	40:40	160	2.05	1.29	15 - 700
Pennsylvanian; Kentucky	5 (1)	80:80	910	1.63	1.41	200 - 3,000
Pennsylvanian; Missouri, Kansas, and Oklahoma	6 (1)	32:32	830	2.37	1.29	200 - 7,000
Siderite						
Upper Paleozoic; Kentucky	11 (1)	30:30	1,700	1.69	--	500 - 3,000
UNCONSOLIDATED GEOLOGIC DEPOSITS						
Carbonate residuum (terra rossa)						
On Gasconade Formation; Missouri	12 (1)	24:24	95	2.23	1.23	30 - 1,500
On Roubidoux Formation; Missouri	12 (1)	24:24	79	1.96	1.23	30 - 500
On Jefferson City, Cotter, and Powell Formations; Missouri and Arkansas	12 (1)	24:24	91	2.30	1.23	30 - 500
On Osagean rocks; Missouri	12 (1)	24:24	110	2.34	1.23	20 - 700
On Meramecian rocks; Missouri	12 (1)	24:24	150	2.47	1.23	30 - 1,000
Loess						
Missouri	13 (1)	24:24	510	1.69	--	150 - 1,000
SOILS						
Cultivated						
Plow zone, garden; Georgia	14 (1)	30:30	99	2.14	--	20 - 700
	15 (1)	30:30	410	1.84	--	150 - 2,000
Plow zone, corn field; Missouri						
Floodplain Forest	17 (1)	8:8	460	2.32	1.28	100 - 1,000
Glaciated Prairie	17 (1)	10:10	590	1.73	1.28	200 - 1,500

TABLE 29.—*Manganese in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
SOILS--Continued						
Cultivated--Continued						
Plow zone, corn field; Missouri--Continued						
Unglaciated Prairie	17 (1)	10:10	530	1.94	1.28	150 - 1,500
Oak-hickory Forest	17 (1)	10:10	530	1.41	1.28	300 - 700
Plow zone, soybean field; Missouri						
Floodplain Forest	17 (1)	10:10	350	2.31	1.28	70 - 1,500
Glaciated Prairie	17 (1)	10:10	500	2.20	1.28	150 - 1,500
Unglaciated Prairie	17 (1)	8:8	590	1.89	1.28	300 - 1,500
Oak-hickory Forest	17 (1)	9:9	650	2.09	1.28	200 - 1,500
Plow zone, pasture field; Missouri						
Floodplain Forest	17 (1)	10:10	350	2.02	1.28	100 - 1,500
Glaciated Prairie	17 (1)	10:10	580	1.89	1.28	200 - 1,500
Unglaciated Prairie	17 (1)	10:10	600	1.33	1.28	300 - 700
Oak-hickory Forest	17 (1)	10:10	490	1.50	1.28	300 - 1,000
Surface horizon; Missouri	16 (1)	1,140:1,140	740	1.83	1.30	15 - 3,000
Uncultivated						
Surface horizon; Powder River Basin, Wyoming and Montana	25 (1)	48:48	250	1.63	--	70 - 1,000
A horizon; Georgia	14 (1)	30:30	130	1.86	--	50 - 700
	15 (1)	30:30	320	1.64	--	100 - 700
A horizon; Kentucky	18 (2)	96:96	400	2.17	1.06	46 - 1,800
	19 (2)	103:108	600	1.90	1.45	<150 - 2,200
B horizon; Georgia	14 (1)	30:30	85	2.03	--	20 - 700
	15 (1)	30:30	280	1.95	--	100 - 1,500
B horizon; Kentucky	18 (2)	96:96	170	1.91	1.06	39 - 620
B horizon; Missouri						
Floodplain Forest	20 (1)	49:50	710	2.72	1.41	100 - >20,000
Glaciated Prairie	20 (1)	50:50	430	2.25	1.41	70 - 2,000
Unglaciated Prairie	20 (1)	50:50	780	2.29	1.41	150 - 7,000
Cedar Glade	20 (1)	50:50	1,100	1.57	1.41	500 - 5,000
Oak-hickory Forest	20 (1)	50:50	730	2.16	1.41	70 - 3,000
Oak-hickory-pine Forest	20 (1)	50:50	660	2.09	1.41	150 - 2,000
C horizon; Georgia	14 (1)	30:30	61	1.87	--	20 - 300
	15 (1)	30:30	220	1.76	--	50 - 700
C horizon; Kentucky	18 (2)	96:96	140	2.47	1.06	19 - 2,000
Cultivated and uncultivated						
Surface horizon; Colorado	22 (1)	168:168	210	1.59	1.21	100 - 700
B horizon; Eastern United States	21 (1)	369:370	290	3.65	--	<2 - 7,000
B horizon; Western United States	21 (1)	491:491	390	1.94	--	30 - 5,000

TABLE 29.—*Manganese in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
PLANT ASH						
Cultivated plants						
Asparagus; Wisconsin	23 (1)	5:5	470	1.78	--	200 - 1,000
Bean, lima; Georgia	14 (1)	30:30	320	1.68	--	150 - 1,000
	15 (1)	15:15	350	1.61	--	200 - 1,000
Bean, snap; Georgia	14 (1)	30:30	370	1.88	--	150 - 1,000
	15 (1)	30:30	340	1.70	--	150 - 1,000
Beet, red; Wisconsin	23 (1)	3:3	250	1.88	--	150 - 500
Blackeyed pea; Georgia	14 (1)	29:29	810	1.64	--	300 - 2,000
	15 (1)	4:4	480	1.42	--	300 - 700
Cabbage; Georgia	14 (1)	28:28	450	2.40	--	70 - 2,000
	15 (1)	30:30	400	2.26	--	100 - 1,500
Cabbage; Wisconsin	23 (1)	11:11	220	1.71	--	150 - 700
Carrot; Wisconsin	23 (1)	8:8	96	2.00	--	20 - 150
Corn; Georgia	14 (1)	29:29	350	1.64	--	15 - 1,000
	15 (1)	30:30	230	1.87	--	100 - 700
Corn; Missouri						
Glaciated Prairie	17 (1)	10:10	260	1.40	1.16	200 - 500
Unglaciated Prairie	17 (1)	10:10	320	1.31	1.16	200 - 500
Oak-hickory Forest	17 (1)	10:10	290	1.14	1.16	200 - 300
Corn; Wisconsin	23 (1)	27:27	290	1.48	--	150 - 700
Cucumber; Wisconsin	23 (1)	4:4	110	1.55	--	70 - 200
Onion; Wisconsin	23 (1)	7:7	220	2.05	--	100 - 700
Pepper, sweet; Wisconsin	23 (1)	4:4	200	1.98	--	100 - 500
Potato; Wisconsin	23 (1)	10:10	110	1.55	--	50 - 150
Soybean; Missouri						
Floodplain Forest	17 (1)	10:10	400	1.57	1.16	200 - 1,000
Glaciated Prairie	17 (1)	10:10	320	1.31	1.16	200 - 500
Unglaciated Prairie	17 (1)	8:8	310	1.42	1.16	200 - 500
Oak-hickory Forest	17 (1)	9:9	360	1.29	1.16	300 - 500
Tomato; Georgia	14 (1)	30:30	170	1.94	--	70 - 500
	15 (1)	30:30	100	1.49	--	50 - 300
Native species						
Black cherry, stems; Georgia	14 (1)	30:30	5,700	2.46	--	300 - 20,000
	15 (1)	30:30	5,600	2.27	--	1,000 - 30,000
Black cherry, leaves; Georgia	14 (1)	30:30	5,700	2.44	--	150 - 15,000
	15 (1)	30:30	3,700	2.07	--	500 - 15,000
Blackgum, stems; Georgia	14 (1)	30:30	8,400	2.69	--	150 - 30,000
	15 (1)	30:30	9,500	1.86	--	500 - 20,000
Blackgum, leaves; Georgia	14 (1)	30:30	9,300	2.53	--	500 - 20,000
	15 (1)	30:30	9,600	2.11	--	1,000 - 30,000
Buckbush; Missouri						
Glaciated Prairie	20 (1)	47:47	4,900	2.03	1.38	500 - 15,000
Unglaciated Prairie	20 (1)	48:48	5,100	1.88	1.38	1,000 - 15,000
Cedar Glade	20 (1)	50:50	6,300	1.61	1.38	2,000 - 20,000

TABLE 29.—*Manganese in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
PLANT ASH--Continued						
Native species--Continued						
Buckbush; Missouri--Continued						
Oak-hickory Forest	20 (1)	49:49	10,000	1.62	1.38	3,000 - 20,000
Oak-hickory-pine Forest	20 (1)	41:41	10,000	1.55	1.38	5,000 - 30,000
Cedar; Missouri						
Cedar Glade	20 (1)	50:50	1,700	2.21	1.38	300 - 30,000
Glaciated Prairie	24 (1)	9:9	4,800	2.21	--	1,500 - 15,000
Unglaciated Prairie	24 (1)	10:10	5,300	2.40	--	700 - 15,000
Cedar Glade	24 (1)	10:10	1,600	1.85	--	700 - 7,000
Oak-hickory Forest	24 (1)	10:10	5,700	1.92	--	2,000 - 15,000
Oak-hickory-pine Forest	24 (1)	6:6	6,700	1.53	--	5,000 - 15,000
Hickory, pignut; Kentucky	18 (1)	64:64	8,800	1.61	1.21	2,000 - 30,000
	19 (2)	88:88	7,300	1.86	1.11	1,900 - 27,000
Hickory, shagbark; Kentucky	18 (1)	40:40	10,000	1.85	1.21	1,500 - 30,000
	19 (2)	20:20	7,500	1.95	1.11	2,300 - 25,000
Hickory, shagbark; Missouri						
Oak-hickory Forest	20 (1)	19:19	8,300	1.89	1.38	2,000 - 20,000
Oak-hickory-pine Forest	20 (1)	7:7	12,000	1.42	1.38	7,000 - 20,000
Maple, red, stems; Georgia	14 (1)	30:30	6,800	1.80	--	1,000 - 15,000
	15 (1)	30:30	6,800	1.92	--	1,500 - 20,000
Maple, red, leaves; Georgia	14 (1)	30:30	8,200	2.63	--	150 - 20,000
	15 (1)	30:30	6,700	2.37	--	500 - 20,000
Oak, black; Kentucky	18 (1)	25:25	13,000	2.05	1.21	1,000 - 30,000
	19 (2)	22:22	9,000	2.08	1.11	1,500 - 32,000
Oak, post; Cedar Glade, Missouri	20 (1)	50:50	3,200	2.36	1.38	500 - 20,000
Oak, red; Kentucky	18 (1)	28:28	13,000	1.71	1.21	5,000 - 50,000
	19 (2)	8:8	8,900	2.54	1.11	3,500 - 37,000
Oak, white; Kentucky	18 (1)	49:49	13,000	1.60	1.21	5,000 - 50,000
	19 (2)	75:75	11,000	1.75	1.11	3,700 - 38,000
Oak, white; Missouri						
Oak-hickory Forest	20 (1)	50:50	12,000	1.74	1.38	1,000 - 30,000
Oak-hickory-pine Forest	20 (1)	49:49	13,000	1.57	1.38	5,000 - 30,000
Persimmon, stems; Georgia	14 (1)	30:30	7,200	1.99	--	1,000 - 20,000
	15 (1)	30:30	6,200	1.86	--	1,500 - 20,000
Persimmon, leaves; Georgia	14 (1)	30:30	8,900	2.35	--	500 - 30,000
	15 (1)	30:30	8,000	1.97	--	1,500 - 20,000
Pine, shortleaf; Oak-hickory-pine Forest, Missouri	20 (1)	49:49	14,000	1.59	1.38	3,000 - 30,000
Sassafras, stems; Georgia	14 (1)	17:17	2,100	2.07	--	500 - 7,000
	15 (1)	27:27	3,300	2.14	--	700 - 10,000
Sassafras, leaves; Georgia	14 (1)	17:17	2,700	2.19	--	700 - 15,000
	15 (1)	27:27	4,300	1.89	--	1,500 - 10,000
Sumac, winged, stems; Georgia	14 (1)	30:30	2,800	2.14	--	700 - 15,000
	15 (1)	30:30	2,000	2.26	--	300 - 10,000

TABLE 29.—*Manganese in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
PLANT ASH--Continued						
Native species--Continued						
Sumac, winged, leaves; Georgia	14 (1)	30:30	1,400	1.62	--	500 - 5,000
	15 (1)	30:30	970	1.85	--	300 - 5,000
Sumac, smooth; Missouri						
Floodplain Forest	20 (1)	48:48	760	1.74	1.38	300 - 2,000
Glaciated Prairie	20 (1)	50:50	550	1.68	1.38	200 - 1,500
Unglaciated Prairie	20 (1)	49:49	640	1.62	1.38	300 - 2,000
Cedar Glade	20 (1)	49:49	470	1.62	1.38	200 - 1,500
Oak-hickory Forest	20 (1)	50:50	690	1.60	1.38	150 - 2,000
Oak-hickory-pine Forest	20 (1)	49:49	770	1.58	1.38	200 - 2,000
Sweetgum, stems; Georgia	14 (1)	28:28	4,100	1.99	--	700 - 15,000
	15 (1)	27:27	6,800	1.74	--	1,500 - 20,000
Sweetgum, leaves; Georgia	14 (1)	28:28	9,600	1.90	--	1,500 - 30,000
	15 (1)	27:27	13,000	1.67	--	5,000 - 30,000
Sweetgum; Floodplain Forest, Missouri	20 (1)	47:47	6,300	2.11	1.38	1,000 - 30,000

TABLE 30.—*Mercury in rocks, unconsolidated geologic deposits, soils, and dry plants*

[Explanation of column headings: Study No. refers to study described in text; method of analysis (in parentheses) refers to method listed in table 1. Ratio, number of samples in which the element was found in measurable concentrations to number of samples analyzed. Mean, geometric mean. Deviation, geometric deviation. Error, geometric error attributed to laboratory procedures. Leaders (--) in figure column indicate no data available]

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppb)	Deviation	Error	Observed range (ppb)
ROCKS						
Granite						
Precambrian; Missouri	1 (4)	26:30	14	1.71	1.47	<10 - 700
Rhyolite						
Precambrian; Missouri	1 (4)	23:30	15	1.82	1.47	<10 - 740
Sandstone						
Roubidoux Formation; Missouri	4 (4)	6:12	7.9	2.82	1.35	<10 - 50
Pennsylvanian; Missouri, Kansas, and Oklahoma	6 (4)	24:32	16	2.40	1.35	<10 - 150
Chert						
Mississippian; Missouri, Oklahoma, and Arkansas	7 (4)	18:20	17	2.28	1.35	<10 - 60

TABLE 30.—*Mercury in rocks, unconsolidated geologic deposits, soils, and dry plants*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppb)	Deviation	Error	Observed range (ppb)
ROCKS--Continued						
Shale						
Pennsylvanian; Missouri, Kansas, and Oklahoma	6 (4)	30:32	45	2.60	1.44	<10 - 190
Black shale						
Devonian and Mississippian; Kentucky-	9 (4)	84:88	340	3.37	2.18	<40 - 1,500
Limestone and dolomite						
Sauk sequence; Missouri and Arkansas-	4 (4)	47:48	28	2.05	1.34	<10 - 110
Tippecanoe sequence; Missouri	10 (4)	11:12	22	2.57	1.34	<10 - 100
Mississippian; Missouri, Oklahoma, and Arkansas	7 (4)	38:40	30	2.37	1.34	<10 - 130
Pennsylvanian; Missouri, Kansas, and Oklahoma	6 (4)	30:32	30	2.96	1.34	<10 - 170
UNCONSOLIDATED GEOLOGIC DEPOSITS						
Carbonate residuum (terra rossa)						
On Gasconade Formation; Missouri	12 (4)	24:24	68	1.63	1.30	20 - 170
On Roubidoux Formation; Missouri	12 (4)	20:24	35	2.85	1.30	<10 - 290
On Jefferson City, Cotter, and Powell Formations; Missouri and Arkansas-	12 (4)	24:24	40	1.79	1.30	20 - 120
On Osagean rocks; Missouri	12 (4)	24:24	53	1.94	1.30	10 - 150
On Meramecian rocks; Missouri	12 (4)	24:24	48	2.13	1.39	10 - 140
Loess						
Missouri	13 (4)	23:24	35	1.79	--	<10 - 80
SOILS						
Cultivated						
Plow zone, corn field; Missouri						
Floodplain Forest	17 (4)	8:8	37	1.93	1.41	10 - 90
Glaciated Prairie	17 (4)	10:10	51	1.81	1.41	30 - 210
Unglaciated Prairie	17 (4)	10:10	42	1.70	1.41	20 - 140
Oak-hickory Forest	17 (4)	10:10	38	1.56	1.41	20 - 70
Plow zone, soybean field; Missouri						
Floodplain Forest	17 (4)	10:10	42	2.00	1.41	10 - 100
Glaciated Prairie	17 (4)	10:10	51	1.89	1.41	10 - 110
Unglaciated Prairie	17 (4)	8:8	46	1.72	1.41	20 - 130
Oak-hickory Forest	17 (4)	9:9	30	2.29	1.41	10 - 70
Plow zone, pasture field; Missouri						
Floodplain Forest	17 (4)	10:10	53	2.16	1.41	20 - 260
Glaciated Prairie	17 (4)	10:10	69	1.51	1.41	40 - 120
Unglaciated Prairie	17 (4)	10:10	38	1.21	1.41	30 - 50
Oak-hickory Forest	17 (4)	10:10	57	1.68	1.41	30 - 140
Surface horizon; Missouri	16 (4)	1,124:1,140	39	1.80	1.53	<10 - 800

TABLE 30.—*Mercury in rocks, unconsolidated geologic deposits, soils, and dry plants*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppb)	Deviation	Error	Observed range (ppb)
SOILS-Continued						
Uncultivated						
B horizon; Missouri						
Floodplain Forest	20 (4)	50:50	57	2.07	1.82	20 - 500
Glaciated Prairie	20 (4)	50:50	68	1.70	1.82	30 - 260
Unglaciated Prairie	20 (4)	50:50	46	1.76	1.82	10 - 310
Cedar Glade	20 (4)	50:50	160	2.39	1.82	30 - 1,500
Oak-hickory Forest	20 (4)	50:50	55	1.91	1.82	10 - 260
Oak-hickory-pine Forest	20 (4)	50:50	45	2.05	1.82	10 - 500
Cultivated and uncultivated						
Surface horizon; Colorado	22 (4)	153:168	35	3.84	1.66	<10 - 420
B horizon; Eastern United States	21 (4)	420:420	96	2.53	--	10 - 3,400
B horizon; Western United States	21 (4)	491:492	55	2.46	--	<10 - 4,600
DRY PLANTS						
Native species						
Buckbush; Missouri						
Glaciated Prairie	20 (4)	1:23	<25	--	--	<25 - 50
Oak-hickory Forest	20 (4)	2:29	<25	--	--	<25 - 50
Cedar; Cedar Glade, Missouri	20 (4)	2:28	<25	--	--	<25 - 25
Oak, post; Cedar Glade, Missouri	20 (4)	1:25	<25	--	--	<25 - 25
Pine, shortleaf; Oak-hickory-pine Forest, Missouri	20 (4)	3:25	<25	--	--	<25 - 25

TABLE 31.—*Molybdenum in rocks, unconsolidated geologic deposits, soils, and plant ash*

[Explanation of column headings: Study No. refers to study described in text; method of analysis (in parentheses) refers to method listed in table 1. Ratio, number of samples in which the element was found in measurable concentrations to number of samples analyzed. Mean, geometric mean. Deviation, geometric deviation. Error, geometric error attributed to laboratory procedures. Leaders (--) in figure column indicate no data available]

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
ROCKS						
Granite						
Precambrian; Missouri	1 (1)	12:30	<3	--	--	<3 - 15
Rhyolite						
Precambrian; Missouri	1 (1)	5:30	<3	--	--	<3 - 3

TABLE 31.—*Molybdenum in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
ROCKS--Continued						
Sandstone						
Sauk sequence; Western United States-	3 (2)	49:400	<4	--	--	<4 - 30
Pennsylvanian; Missouri, Kansas, and Oklahoma----------	6 (1)	4:32	<3	--	--	<3 - 30
Shale						
Mississippian; Missouri, Oklahoma, and Arkansas----------	7 (1)	6:18	<3	--	--	<3 - 10
Black shale						
Devonian and Mississippian; Kentucky-	9 (2)	82:88	72	2.16	1.12	<22 - 290
Limestone and dolomite						
Sauk sequence; Missouri and Arkansas-	4 (1)	7:48	.79	2.98	--	<3 - 7
Upper Ordovician; Kentucky----------	5 (1)	2:80	<7	--	--	<7 - 15
Lower Mississippian; Kentucky--------	5 (1)	2:112	<7	--	--	<7 - 30
Upper Mississippian; Kentucky--------	5 (1)	12:152	<7	--	--	<7 - 20
Mississippian; Missouri, Oklahoma, and Arkansas----------	7 (1)	3:40	<3	--	--	<3 - 7
Pennsylvanian; Kentucky----------	5 (1)	6:80	<7	--	--	<7 - 20
Pennsylvanian; Missouri, Kansas, and Oklahoma----------	6 (1)	3:32	<3	--	--	<3 - 3
Siderite						
Upper Paleozoic; Kentucky----------	11 (1)	19:30	7.2	1.68	--	<7 - 20
UNCONSOLIDATED GEOLOGIC DEPOSITS						
Carbonate residuum (terra rossa)						
On Gasconade Formation; Missouri-----	12 (1)	1:24	<3	--	--	<3 - 3
On Roubidoux Formation; Missouri-----	12 (1)	1:24	<3	--	--	<3 - 3
On Jefferson City, Cotter, and Powell Formations; Missouri and Arkansas--	12 (1)	6:24	<3	--	--	<3 - 3
On Osagean rocks; Missouri----------	12 (1)	2:24	<3	--	--	<3 - 3
On Meramecian rocks; Missouri--------	12 (1)	2:24	<3	--	--	<3 - 7
SOILS						
Cultivated						
Surface horizon; Missouri----------	16 (1)	16:1,140	<3	--	--	<3 - 15
Uncultivated						
Surface horizon; Powder River Basin, Wyoming and Montana----------	25 (1)	3:48	<3	--	--	<3 - 20
A horizon; Kentucky----------	18 (2)	2:96	<8	--	--	<8 - 86
B horizon; Kentucky----------	18 (2)	3:96	<8	--	--	<8 - 170

TABLE 31.—*Molybdenum in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
SOILS--Continued						
Uncultivated--Continued						
B horizon; Missouri						
Floodplain Forest	20 (1)	1:50	<3	--	--	<3 - 10
Glaciated Prairie	20 (1)	4:50	<3	--	--	<3 - 7
Cedar Glade	20 (1)	3:50	<3	--	--	<3 - 5
Oak-hickory Forest	20 (1)	2:50	<3	--	--	<3 - 30
Oak-hickory-pine Forest	20 (1)	1:50	<3	--	--	<3 - 7
C horizon; Kentucky	18 (2)	4:96	<8	--	--	<8 - 170
Cultivated and uncultivated						
Surface horizon; Colorado	22 (1)	7:168	<3	--	--	<3 - 7
B horizon; Eastern United States	21 (1)	32:371	<3	--	--	<3 - 7
B horizon; Western United States	21 (1)	48:492	<3	--	--	<3 - 7
PLANT ASH						
Cultivated plants						
Asparagus; Wisconsin	23 (1)	4:6	9.9	1.45	--	<5 - 15
Bean, lima; Georgia	14 (1)	20:30	9.5	4.88	--	<5 - 150
	15 (1)	8:15	5.1	3.29	--	<5 - 20
Bean, snap; Georgia	14 (1)	15:30	4.7	5.29	--	<5 - 50
	15 (1)	11:30	<5	--	--	<5 - 30
Blackeyed pea; Georgia	14 (1)	8:29	<5	--	--	<5 - 70
Cabbage; Georgia	14 (1)	7:28	<5	--	--	<5 - 30
	15 (1)	6:30	<5	--	--	<5 - 20
Cabbage; Wisconsin	23 (1)	10:11	15	1.51	--	<5 - 30
Corn; Georgia	14 (1)	10:29	2.5	3.69	--	<5 - 15
	15 (1)	1:30	<5	--	--	<5 - 20
Corn; Missouri						
Floodplain Forest	17 (1)	8:8	18	1.66	1.35	7 - 30
Glaciated Prairie	17 (1)	9:10	11	1.83	1.35	<5 - 20
Unglaciated Prairie	17 (1)	7:10	7.9	2.72	1.35	<5 - 30
Oak-hickory Forest	17 (1)	8:10	11	2.19	1.35	<5 - 30
Corn; Wisconsin	23 (1)	22:27	16	1.94	--	<5 - 70
Onion; Wisconsin	23 (1)	4:7	10	1.88	--	<5 - 20
Pepper, sweet; Wisconsin	23 (1)	3:4	10	1.37	--	<5 - 15
Potato; Wisconsin	23 (1)	2:10	6.6	1.32	--	<5 - 10
Soybean; Missouri						
Floodplain Forest	17 (1)	7:10	10	3.77	1.35	<5 - 70
Glaciated Prairie	17 (1)	8:10	17	3.95	1.35	<5 - 70
Unglaciated Prairie	17 (1)	6:8	9.4	3.16	1.35	<5 - 50
Oak-hickory Forest	17 (1)	9:9	20	2.04	1.35	5 - 70
Tomato; Georgia	14 (1)	3:30	<5	--	--	<5 - 30

TABLE 31.—*Molybdenum in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
PLANT ASH--Continued						
Native species						
Black cherry, stems; Georgia	14 (1)	1:30	<5	--	--	<5 - 10
Black cherry, leaves; Georgia	14 (1)	1:30	<5	--	--	<5 - 20
Blackgum, stems; Georgia	14 (1)	1:30	<5	--	--	<5 - 10
Blackgum, leaves; Georgia	14 (1)	1:30	<5	--	--	<5 - 15
Buckbush; Missouri						
Glaciated Prairie	20 (1)	11:47	2.0	2.48	--	<5 - 20
Cedar Glade	20 (1)	34:50	6.5	2.68	--	<5 - 30
Oak-hickory Forest	20 (1)	7:49	1.4	2.49	--	<5 - 10
Oak-hickory-pine Forest	20 (1)	9:41	1.6	3.12	--	<5 - 15
Cedar; Missouri						
Cedar Glade	20 (1)	22:50	3.4	2.43	--	<5 - 30
Glaciated Prairie	24 (1)	4:9	2.2	4.59	--	<3 - 15
Unglaciated Prairie	24 (1)	4:10	2.0	3.45	--	<3 - 15
Cedar Glade	24 (1)	8:10	7.6	2.39	--	<3 - 30
Oak-hickory Forest	24 (1)	3:10	1.3	4.35	--	<3 - 10
Oak-hickory-pine Forest	24 (1)	4:6	5.3	2.68	--	<3 - 15
Hickory, pignut; Kentucky	18 (1)	5:64	<10	--	--	<10 - 300
	19 (2)	1:88	<30	--	--	<30 - 39
Hickory, shagbark; Kentucky	18 (1)	4:40	<3	--	--	<3 - 200
Maple, red, stems; Georgia	14 (1)	1:30	<5	--	--	<5 - 10
	15 (1)	1:30	<5	--	--	<5 - 7
Maple, red, leaves; Georgia	14 (1)	1:30	<5	--	--	<5 - 20
Oak, black; Kentucky	18 (1)	6:25	.76	1.82	--	<3 - 100
	19 (2)	1:22	<30	--	--	<30 - 90
Oak, red; Kentucky	18 (1)	2:28	<3	--	--	<3 - 70
Oak, white; Kentucky	18 (1)	3:49	<3	--	--	<3 - 20
	19 (2)	1:72	<30	--	--	<30 - 120
Persimmon, stems; Georgia	14 (1)	2:30	<5	--	--	<5 - 20
	15 (1)	2:30	<5	--	--	<5 - 15
Persimmon, leaves; Georgia	14 (1)	1:30	<5	--	--	<5 - 20
Sassafras, stems; Georgia	14 (1)	3:17	1.6	3.87	--	<5 - 20
	15 (1)	6:27	<5	--	--	<5 - 50
Sassafras, leaves; Georgia	15 (1)	1:27	<5	--	--	<5 - 7
Sumac, winged, stems; Georgia	14 (1)	1:30	<5	--	--	<5 - 20
	15 (1)	1:30	<5	--	--	<5 - 7
Sumac, winged, leaves; Georgia	14 (1)	2:30	<5	--	--	<5 - 15
	15 (1)	1:30	<5	--	--	<5 - 15
Sumac, smooth; Missouri						
Floodplain Forest	20 (1)	6:48	.91	3.38	--	<5 - 15
Glaciated Prairie	20 (1)	7:50	.76	4.27	--	<5 - 20
Unglaciated Prairie	20 (1)	3:49	<5	--	--	<5 - 5
Cedar Glade	20 (1)	21:49	3.3	2.80	--	<5 - 30
Oak-hickory Forest	20 (1)	3:50	<5	--	--	<5 - 20
Oak-hickory-pine Forest	20 (1)	4:49	<5	--	--	<5 - 70

TABLE 32.—*Neodymium in rocks, unconsolidated geologic deposits, soils, and plant ash*

[Explanation of column headings: Study No. refers to study described in text; method of analysis (in parentheses) refers to method listed in table 1. Ratio, number of samples in which the element was found in measurable concentrations to number of samples analyzed. Mean, geometric mean. Deviation, geometric deviation. Error, geometric error attributed to laboratory procedures. Leaders (--) in figure column indicate no data available]

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
ROCKS						
Granite						
Precambrian; Missouri	1 (1)	25:30	75	1.33	1.17	<70 - 150
Rhyolite						
Precambrian; Missouri	1 (1)	28:30	77	1.31	1.17	<70 - 150
UNCONSOLIDATED GEOLOGIC DEPOSITS						
Loess						
Missouri	13 (1)	5:24	<50	--	--	<50 - 70
SOILS						
Cultivated						
Plow zone, garden; Georgia	14 (1)	3:30	<70	--	--	<70 - 150
	15 (1)	2:30	<70	--	--	<70 - 300
Plow zone, pasture field; Missouri						
Floodplain Forest	17 (1)	1:10	<70	--	--	<70 - 70
Oak-hickory Forest	17 (1)	1:10	<70	--	--	<70 - 70
Surface horizon; Missouri	16 (1)	739:1,140	63	1.17	--	<70 - 150
Uncultivated						
A horizon; Georgia	14 (1)	4:30	9.2	4.85	--	<70 - 300
	15 (1)	2:30	<70	--	--	<70 - 150
B horizon; Georgia	14 (1)	2:30	<70	--	--	<70 - 150
	15 (1)	6:30	28	2.33	--	<70 - 150
B horizon; Missouri						
Glaciated Prairie	20 (1)	27:50	60	1.21	--	<70 - 70
Unglaciated Prairie	20 (1)	30:50	61	1.18	--	<70 - 70
Cultivated and uncultivated						
Surface horizon; Colorado	22 (1)	65:168	47	1.73	--	<70 - 300
PLANT ASH						
Cultivated plants						
Tomato; Georgia	14 (1)	1:30	<70	--	--	<70 - 150

TABLE 32.—*Neodynium in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
PLANT ASH--Continued						
Native species						
Black cherry, leaves, Georgia--------	14 (1)	1:30	<70	--	--	<70 - 150
	15 (1)	1:30	<70	--	--	<70 - 200
Hickory, shagbark; Oak-hickory-pine Forest, Missouri----------	20 (1)	3:7	<150	--	--	<150 - 150
Maple, red, stems; Georgia----------	14 (1)	1:30	<70	--	--	<70 - 150
Persimmon, stems; Georgia----------	14 (1)	1:30	<70	--	--	<70 - 700
Persimmon, leaves; Georgia----------	14 (1)	2:30	<70	--	--	<70 - 300
Sumac, winged, stems; Georgia--------	14 (1)	1:30	<70	--	--	<70 - 300
Sumac, winged, leaves; Georgia-------	14 (1)	2:30	<70	--	--	<70 - 300
	15 (1)	3:30	<70	--	--	<70 - 300
Sweetgum, stems; Georgia------------	14 (1)	3:28	<70	--	--	<70 - 200
Sweetgum, leaves; Georgia------------	14 (1)	1:28	<70	--	--	<70 - 150
	15 (1)	3:27	<70	--	--	<70 - 200

TABLE 33.—*Nickel in rocks, unconsolidated geologic deposits, soils, and plant ash*

[Explanation of column headings: Study No. refers to study described in text; method of analysis (in parentheses) refers to method listed in table 1. Ratio, number of samples in which the element was found in measurable concentrations to number of samples analyzed. Mean, geometric mean. Deviation, geometric deviation. Error, geometric error attributed to laboratory procedures. Leaders (--) in figure column indicate no data available]

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
ROCKS						
Granite						
Precambrian; Missouri----------	1 (1)	1:30	<5	--	--	<5 - 7
Rhyolite						
Precambrian; Missouri----------	1 (1)	1:30	<5	--	--	<5 - 5
Arkose						
Fountain Formation; Colorado---------	2 (2)	30:80	1.2	5.46	--	<2 - 24
Sandstone						
Sauk sequence; Western United States-	3 (2)	258:400	3.0	2.64	1.45	<2 - 48

TABLE 33.—*Nickel in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
ROCKS--Continued						
Sandstone--Continued						
Roubidoux Formation; Missouri	4 (1)	1:12	<5	--	--	<5 - 5
Pope Megagroup;[1] Kentucky	5 (2)	116:120	11	1.96	1.30	<3 - 39
Pennsylvanian; Kentucky	5 (2)	147:152	9.4	1.93	1.31	<3 - 31
Pennsylvanian; Missouri, Kansas, and Oklahoma	6 (1)	29:32	18	1.62	1.44	<5 - 150
Chert						
Mississippian; Missouri, Oklahoma, and Arkansas	7 (1)	1:20	<5	--	--	<5 - 7
Shale						
Sauk sequence; Western United States	3 (2)	330:336	26	1.70	1.07	<7 - 74
Lower Mississippian; Kentucky	8 (2)	76:76	43	1.81	--	17 - 270
Upper Mississippian; Kentucky	5 (2)	142:142	39	1.45	--	13 - 85
Mississippian; Missouri, Oklahoma, and Arkansas	7 (1)	18:18	21	2.34	1.22	10 - 100
Pennsylvanian; Kentucky	5 (2)	149:152	30	1.71	1.15	<10 - 83
Pennsylvanian; Missouri, Kansas, and Oklahoma	6 (1)	32:32	38	1.50	1.22	10 - 70
Black shale						
Devonian and Mississippian; Kentucky	9 (2)	88:88	110	2.04	1.09	13 - 420
Limestone and dolomite						
Sauk sequence; Western United States	3 (2)	236:392	6.4	1.99	1.23	<7 - 41
Sauk sequence; Missouri and Arkansas	4 (1)	2:48	<5	--	--	<5 - 7
Upper Ordovician; Kentucky	5 (1)	38:80	7.6	1.67	1.32	<10 - 20
Tippecanoe sequence; Missouri	10 (1)	1:12	<5	--	--	<5 - 5
Lower Mississippian; Kentucky	5 (1)	76:112	11	2.03	1.37	<10 - 70
Upper Mississippian; Kentucky	5 (1)	52:152	6.4	1.95	1.30	<10 - 50
Mississippian; Missouri, Oklahoma, and Arkansas	7 (1)	11:40	2.3	2.43	1.09	<5 - 15
Pennsylvanian; Kentucky	5 (1)	72:80	16	1.90	1.31	<10 - 100
Pennsylvanian; Missouri, Kansas, and Oklahoma	6 (1)	17:32	4.3	2.24	1.09	<5 - 15
Siderite						
Upper Paleozoic; Kentucky	11 (1)	26:30	13	1.69	--	<10 - 50
UNCONSOLIDATED GEOLOGIC DEPOSITS						
Carbonate residuum (terra rossa)						
On Gasconade Formation; Missouri	12 (1)	24:24	24	1.72	1.32	15 - 150
On Roubidoux Formation; Missouri	12 (1)	24:24	17	1.87	1.32	10 - 150
On Jefferson City, Cotter, and Powell Formations; Missouri and Arkansas	12 (1)	24:24	20	1.47	1.32	15 - 50
On Osagean rocks; Missouri	12 (1)	24:24	23	1.46	1.32	10 - 50
On Meramecian rocks; Missouri	12 (1)	24:24	29	1.73	1.32	15 - 100

[1] Of Swann and Willman (1961).

TABLE 33.—*Nickel in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
UNCONSOLIDATED GEOLOGIC DEPOSITS--Continued						
Loess						
Missouri	13 (1)	24:24	22	1.03	--	15 - 30
SOILS						
Cultivated						
Plow zone, garden; Georgia	14 (1)	11:30	1.8	4.02	--	<3 - 20
	15 (1)	30:30	18	1.70	--	5 - 50
Plow zone, corn field; Missouri						
Floodplain Forest	17 (1)	6:8	8.4	2.36	1.23	<5 - 20
Glaciated Prairie	17 (1)	10:10	14	1.51	1.23	7 - 30
Unglaciated Prairie	17 (1)	9:10	10	1.96	1.23	<5 - 20
Oak-hickory Forest	17 (1)	9:10	11	2.16	1.23	<5 - 30
Plow zone, soybean field; Missouri						
Floodplain Forest	17 (1)	9:10	9.8	1.67	1.23	<5 - 15
Glaciated Prairie	17 (1)	10:10	16	1.40	1.23	10 - 30
Unglaciated Prairie	17 (1)	6:8	8.4	2.44	1.23	<5 - 20
Oak-hickory Forest	17 (1)	9:9	11	1.80	1.23	5 - 30
Plow zone, pasture field; Missouri						
Floodplain Forest	17 (1)	10:10	10	1.53	1.23	5 - 15
Glaciated Prairie	17 (1)	10:10	14	1.23	1.23	10 - 20
Unglaciated Prairie	17 (1)	9:10	9.7	1.77	1.23	<5 - 20
Oak-hickory Forest	17 (1)	9:10	13	2.01	1.23	<5 - 30
Surface horizon; Missouri	16 (1)	1,131:1,140	14	1.59	1.24	<5 - 70
Uncultivated						
Surface horizon; Powder River Basin, Wyoming and Montana	25 (1)	46:48	13	1.60	1.23	<5 - 30
A horizon; Georgia	14 (1)	8:30	<3	--	--	<3 - 50
	15 (1)	29:30	14	2.10	--	<3 - 70
A horizon; Kentucky	18 (2)	96:96	13	1.34	1.03	6 - 31
	19 (2)	108:108	13	1.49	1.09	5 - 40
B horizon; Georgia	15 (1)	29:30	17	1.95	--	<3 - 50
B horizon; Kentucky	18 (2)	96:96	20	1.42	1.03	9 - 47
B horizon; Missouri						
Floodplain Forest	20 (1)	50:50	18	1.65	1.26	7 - 50
Glaciated Prairie	20 (1)	50:50	23	1.49	1.26	15 - 70
Unglaciated Prairie	20 (1)	49:50	20	1.88	1.26	<5 - 70
Cedar Glade	20 (1)	49:50	23	2.31	1.26	<5 - 300
Oak-hickory Forest	20 (1)	47:50	12	1.82	1.26	<5 - 50
Oak-hickory-pine Forest	20 (1)	47:50	8.8	1.75	1.26	<5 - 30
C horizon; Georgia	14 (1)	18:30	4.4	3.30	--	<3 - 20
	15 (1)	30:30	21	1.65	--	3 - 50
C horizon; Kentucky	18 (2)	96:96	20	1.66	1.03	6 - 110

TABLE 33.—*Nickel in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
SOILS--Continued						
Cultivated and uncultivated						
Surface horizon; Colorado	22 (1)	126:168	7.9	2.32	1.28	<5 - 30
B horizon; Eastern United States	21 (1)	317:371	13	2.60	--	<3 - 700
B horizon; Western United States	21 (1)	482:492	16	2.03	--	<3 - 700
PLANT ASH						
Cultivated plants						
Asparagus; Wisconsin	23 (1)	3:6	5.8	2.00	--	<5 - 15
Bean, lima; Georgia	14 (1)	30:30	19	1.93	--	7 - 70
	15 (1)	15:15	21	2.17	--	7 - 70
Bean, snap; Georgia	14 (1)	28:30	15	2.27	--	<5 - 100
	15 (1)	28:30	17	2.37	--	<5 - 70
Beet, red; Wisconsin	23 (1)	2:3	10	2.22	--	<5 - 20
Blackeyed pea; Georgia	14 (1)	29:29	18	1.60	--	7 - 50
	15 (1)	3:4	17	2.74	--	<5 - 30
Cabbage; Georgia	15 (1)	5:30	3	1.87	--	<5 - 30
Cabbage; Wisconsin	23 (1)	9:11	12	2.04	--	<5 - 30
Carrot; Wisconsin	23 (1)	5:8	6.5	1.64	--	<5 - 15
Corn; Georgia	14 (1)	14:29	2.7	3.22	--	<5 - 30
	15 (1)	16:30	5.8	1.51	--	<5 - 15
Corn; Missouri						
Floodplain Forest	17 (1)	7:8	12	1.95	1.52	<5 - 30
Glaciated Prairie	17 (1)	10:10	23	2.04	1.52	5 - 70
Unglaciated Prairie	17 (1)	10:10	32	1.73	1.52	20 - 70
Oak-hickory Forest	17 (1)	10:10	28	2.03	1.52	7 - 50
Corn; Wisconsin	23 (1)	24:27	14	1.94	--	<5 - 50
Cucumber; Wisconsin	23 (1)	3:4	16	2.88	--	<5 - 50
Onion; Wisconsin	23 (1)	4:7	6.2	1.77	--	<5 - 15
Pepper, sweet; Wisconsin	23 (1)	4:4	29	2.76	--	5 - 70
Potato; Wisconsin	23 (1)	8:10	12	1.92	--	<5 - 30
Soybean; Missouri						
Floodplain Forest	17 (1)	10:10	130	2.62	1.52	30 - 500
Glaciated Prairie	17 (1)	10:10	94	1.50	1.52	50 - 200
Unglaciated Prairie	17 (1)	8:8	110	1.50	1.52	70 - 200
Oak-hickory Forest	17 (1)	9:9	87	1.71	1.52	50 - 200
Native species						
Black cherry, stems; Georgia	14 (1)	22:30	6.2	2.94	--	<5 - 50
	15 (1)	21:30	5.8	3.02	--	<5 - 50
Black cherry, leaves; Georgia	14 (1)	30:30	14	1.65	--	7 - 30
	15 (1)	29:30	16	2.24	--	<5 - 70
Blackgum, stems; Georgia	14 (1)	29:30	31	2.24	--	<5 - 150
	15 (1)	29:30	60	2.91	--	<5 - 500

TABLE 33.—*Nickel in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
PLANT ASH--Continued						
Native species--Continued						
Blackgum, leaves; Georgia	14 (1)	29:30	62	3.31	--	<5 - 1,300
	15 (1)	29:30	120	3.20	--	<5 - 700
Buckbush; Missouri						
Glaciated Prairie	20 (1)	47:47	12	1.51	1.36	7 - 30
Unglaciated Prairie	20 (1)	48:48	12	1.49	1.36	5 - 20
Cedar Glade	20 (1)	49:49	7.5	1.45	1.36	5 - 30
Oak-hickory Forest	20 (1)	49:49	11	1.49	1.36	5 - 30
Oak-hickory-pine Forest	20 (1)	41:41	12	1.62	1.36	5 - 50
Cedar; Missouri						
Cedar Glade	20 (1)	41:50	5.6	2.89	1.36	<2 - 70
Glaciated Prairie	24 (1)	9:9	62	1.47	--	30 - 100
Unglaciated Prairie	24 (1)	10:10	82	1.65	--	50 - 200
Cedar Glade	24 (1)	9:10	7	--	--	<7 - 50
Oak-hickory Forest	24 (1)	10:10	37	2.03	--	10 - 100
Oak-hickory-pine Forest	24 (1)	6:6	33	1.23	--	30 - 50
Hickory, pignut; Kentucky	18 (1)	64:64	100	1.91	1.36	30 - 500
	19 (2)	88:88	92	1.92	1.16	20 - 380
Hickory, shagbark; Kentucky	18 (1)	40:40	95	1.89	1.36	30 - 300
	19 (2)	20:20	78	1.94	1.16	30 - 260
Hickory, shagbark; Missouri						
Oak-hickory Forest	20 (1)	19:19	60	2.42	1.36	10 - 200
Oak-hickory-pine Forest	20 (1)	7:7	70	2.13	1.36	15 - 150
Maple, red, stems; Georgia	14 (1)	25:30	7.5	2.26	--	<5 - 30
	15 (1)	27:30	8.6	2.22	--	<5 - 50
Maple, red, leaves; Georgia	14 (1)	18:30	4.0	3.15	--	<5 - 30
	15 (1)	20:30	5.0	3.13	--	<5 - 50
Oak, black; Kentucky	18 (1)	25:25	33	1.86	1.22	7 - 70
	19 (2)	22:22	25	2.04	1.16	12 - 200
Oak, post; Cedar Glade, Missouri	20 (1)	49:50	8.6	1.71	1.36	<2 - 30
Oak, red; Kentucky	18 (1)	28:28	28	1.86	1.22	10 - 150
	19 (2)	8:8	19	1.91	1.16	8 - 62
Oak, white; Kentucky	18 (1)	49:49	28	1.85	1.22	10 - 200
	19 (2)	75:75	24	1.55	1.16	10 - 87
Oak, white; Missouri						
Oak-hickory Forest	20 (1)	50:50	21	1.80	1.36	5 - 70
Oak-hickory-pine Forest	20 (1)	49:49	20	1.63	1.36	7 - 70
Oak, willow; Floodplain Forest, Missouri	20 (1)	46:46	130	1.77	1.36	30 - 300
Persimmon, stems; Georgia	14 (1)	30:30	27	1.88	--	5 - 100
	15 (1)	30:30	43	2.20	--	10 - 150
Persimmon, leaves; Georgia	14 (1)	30:30	18	2.25	--	7 - 300
	15 (1)	30:30	19	1.87	--	7 - 70
Pine, shortleaf; Oak-hickory-pine Forest, Missouri	20 (1)	49:49	50	1.82	1.36	15 - 200

TABLE 33.—*Nickel in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
PLANT ASH--Continued						
Native species--Continued						
Sassafras, stems; Georgia	14 (1)	17:17	12	1.55	--	7 - 30
	15 (1)	27:27	14	1.72	--	7 - 50
Sassafras, leaves; Georgia	14 (1)	17:17	14	1.70	--	7 - 50
	15 (1)	27:27	18	1.80	--	7 - 50
Sumac, winged, stems; Georgia	14 (1)	25:30	7.4	2.36	--	<5 - 30
	15 (1)	23:30	7.9	3.23	--	<5 - 100
Sumac, winged, leaves; Georgia	14 (1)	19:30	4.2	3.15	--	<5 - 70
	15 (1)	21:30	5.5	3.06	--	<5 - 50
Sumac, smooth; Missouri						
Floodplain Forest	20 (1)	46:48	17	2.51	1.36	<2 - 100
Glaciated Prairie	20 (1)	48:50	11	2.15	1.36	<2 - 50
Unglaciated Prairie	20 (1)	47:49	11	1.93	1.36	<2 - 30
Cedar Glade	20 (1)	13:49	.81	3.56	1.36	<2 - 10
Oak-hickory Forest	20 (1)	36:50	4.0	2.82	1.36	<2 - 30
Oak-hickory-pine Forest	20 (1)	35:49	3.9	2.68	1.36	<2 - 30
Sweetgum, stems; Georgia	14 (1)	27:28	12	1.93	--	<5 - 30
	15 (1)	27:27	30	2.34	--	7 - 150
Sweetgum, leaves; Georgia	14 (1)	28:28	29	2.07	--	7 - 150
	15 (1)	27:27	63	2.11	--	15 - 300
Sweetgum; Floodplain Forest, Missouri	20 (1)	47:47	50	1.93	1.36	10 - 150

TABLE 34.—*Niobium in rocks, unconsolidated geologic deposits, and soils*

[Explanation of column headings: Study No. refers to study described in text; method of analysis (in parentheses) refers to method listed in table 1. Ratio, number of samples in which the element was found in measurable concentrations to number of samples analyzed. Mean, geometric mean. Deviation, geometric deviation. Error, geometric error attributed to laboratory procedures. Leaders (--) in figure column indicate no data available]

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
ROCKS						
Granite						
Precambrian; Missouri	1 (1)	26:30	11	1.31	1.15	<10 - 20
Rhyolite						
Precambrian; Missouri	1 (1)	28:30	12	1.29	1.15	<10 - 20

TABLE 34.—*Niobium in rocks, unconsolidated geologic deposits, and soils*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
ROCKS--Continued						
Sandstone						
Sauk sequence; Western United States-	3 (2)	21:400	<20	--	--	<20 - 62
Pope Megagroup;[1] Kentucky----------	5 (2)	4:120	<20	--	--	<20 - 40
Pennsylvanian; Kentucky----------	5 (2)	16:152	<20	--	--	<20 - 28
Pennsylvanian; Missouri, Kansas, and Oklahoma----------	6 (1)	18:32	8.8	1.35	1.26	<10 - 15
Shale						
Sauk sequence; Western United States-	3 (2)	16:336	<30	--	--	<30 - 42
Upper Mississippian; Kentucky--------	5 (2)	1:142	<30	--	--	<30 - 30
Mississippian; Missouri, Oklahoma, and Arkansas----------	7 (1)	3:18	<10	--	--	<10 - 10
Pennsylvanian; Kentucky----------	5 (2)	4:152	<30	--	--	<30 - 43
Pennsylvanian; Missouri, Kansas, and Oklahoma----------	6 (1)	11:32	7.7	1.25	--	<10 - 10
UNCONSOLIDATED GEOLOGIC DEPOSITS						
Carbonate residuum (terra rossa)						
On Roubidoux Formation; Missouri-----	12 (1)	1:24	<10	--	--	<10 - 10
On Osagean rocks; Missouri----------	12 (1)	1:24	<10	--	--	<10 - 10
Loess						
Missouri----------	13 (1)	4:24	<10	--	--	<10 - 10
SOILS						
Cultivated						
Plow zone, garden; Georgia----------	14 (1)	20:25	13	1.34	--	<10 - 20
	15 (1)	20:25	16	1.52	--	<10 - 30
Plow zone, corn field; Missouri						
Floodplain Forest----------	17 (1)	3:8	7.9	1.24	1.18	<10 - 10
Glaciated Prairie----------	17 (1)	4:10	8.0	1.23	1.18	<10 - 10
Unglaciated Prairie----------	17 (1)	8:10	9.5	1.10	1.18	<10 - 10
Plow zone, soybean field; Missouri						
Floodplain Forest----------	17 (1)	2:10	6.6	1.33	1.18	<10 - 10
Glaciated Prairie----------	17 (1)	3:10	7.4	1.27	1.18	<10 - 10
Unglaciated Prairie----------	17 (1)	6:8	9.4	1.11	1.18	<10 - 10
Oak-hickory Forest----------	17 (1)	8:9	9.8	1.07	1.18	<10 - 10
Plow zone, pasture field; Missouri						
Floodplain Forest----------	17 (1)	4:10	8.0	1.23	1.18	<10 - 10
Glaciated Prairie----------	17 (1)	5:10	8.5	1.19	1.18	<10 - 10
Unglaciated Prairie----------	17 (1)	8:10	9.5	1.10	1.18	<10 - 10
Oak-hickory Forest----------	17 (1)	6:10	8.9	1.16	1.18	<10 - 10
Surface horizon; Missouri----------	16 (1)	375:1,140	7.2	1.38	1.11	<10 - 15

[1] Of Swann and Willman (1961).

TABLE 34.—*Niobium in rocks, unconsolidated geologic deposits, and soils*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
SOILS--Continued						
Uncultivated						
Surface horizon; Powder River Basin, Wyoming and Montana	25 (1)	26:48	8.7	1.18	--	<10 - 10
A horizon; Georgia	14 (1)	26:30	12	1.33	--	<10 - 20
	15 (1)	25:30	16	1.43	--	<10 - 30
A horizon; Kentucky	18 (2)	77:96	12	1.33	--	<10 - 28
B horizon; Georgia	14 (1)	27:30	13	1.34	--	<10 - 20
	15 (1)	28:30	18	1.43	--	<10 - 30
B horizon; Kentucky	18 (2)	78:96	12	1.27	--	<10 - 21
B horizon; Missouri						
Floodplain Forest	20 (1)	7:50	5.8	1.38	--	<10 - 10
Glaciated Prairie	20 (1)	19:50	7.9	1.24	--	<10 - 10
Unglaciated Prairie	20 (1)	22:50	8.1	1.26	--	<10 - 15
Cedar Glade	20 (1)	1:50	<10	--	--	<10 - 10
Oak-hickory Forest	20 (1)	22:50	8.0	1.38	--	<10 - 15
Oak-hickory-pine Forest	20 (1)	21:50	7.9	1.36	--	<10 - 15
C horizon; Georgia	14 (1)	24:30	13	1.51	--	<10 - 30
	15 (1)	29:30	19	1.40	--	<10 - 50
C horizon; Kentucky	18 (2)	56:96	10	1.31	--	<10 - 22
Cultivated and uncultivated						
Surface horizon; Colorado	22 (1)	57:168	6.7	1.48	--	<10 - 20
B horizon; Eastern United States	21 (1)	264:328	13	1.54	--	<7 - 20
B horizon; Western United States	21 (1)	339:492	11	1.74	--	<7 - 100

TABLE 35.—*Phosphorus in rocks, unconsolidated geologic deposits, soils, and plant ash*

[Explanation of column headings: Study No. refers to study described in text; method of analysis (in parentheses) refers to method listed in table 1. Ratio, number of samples in which the element was found in measurable concentrations to number of samples analyzed. Mean, geometric mean. Deviation, geometric deviation. Error, geometric error attributed to laboratory procedures. Leaders (--) in figure column indicate no data available]

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (percent)	Deviation	Error	Observed range (percent)
ROCKS						
Granite						
Precambrian; Missouri	1 (5)	19:30	0.030	2.75	1.55	<0.017 - 0.17

TABLE 35.—*Phosphorus in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (percent)	Deviation	Error	Observed range (percent)
ROCKS--Continued						
Rhyolite						
Precambrian; Missouri	1 (5)	22:30	0.024	2.77	1.55	<0.017 - 0.17
Sandstone						
Sauk sequence; Western United States	3 (16)	393:400	.096	2.49	2.15	<.0087 - .96
Roubidoux Formation; Missouri	4 (5)	5:12	.010	2.22	1.47	<.013 - .035
Pope Megagroup;[1] Kentucky	5 (16	106:120	.017	2.96	1.24	<.0044 - .14
Pennsylvanian; Kentucky	5 (16)	145:152	.024	2.58	1.90	<.0044 - .13
Pennsylvanian; Missouri, Kansas, and Oklahoma	6 (5)	30:32	.057	2.24	1.47	<.013 - .17
Shale						
Sauk sequence; Western United States	3 (16)	335:336	.069	2.24	1.50	<.013 - 4.5
Lower Mississippian; Kentucky	8 (16)	74:76	.027	2.15	--	<.0044 - .24
Upper Mississippian; Kentucky	5 (16)	140:142	.035	2.02	--	<.0044 - .25
Mississippian; Missouri, Oklahoma, and Arkansas	7 (5)	13:18	.030	2.95	1.47	<.013 - 1.6
Pennsylvanian; Kentucky	5 (16)	152:152	.048	1.97	1.47	.0087 - .18
Pennsylvanian; Missouri, Kansas, and Oklahoma	6 (5)	32:32	.061	1.89	1.22	.017 - .17
Limestone and dolomite						
Sauk sequence; Western United States	3 (16)	310:392	.015	5.55	1.73	<.0044 - .70
Sauk sequence; Missouri and Arkansas	4 (5)	12:48	.0044	4.21	2.03	<.013 - .044
Upper Ordovician; Kentucky	5 (16)	76:80	.064	2.98	1.90	<.0044 - .29
Tippecanoe sequence; Missouri	10 (5)	4:12	<.013	--	--	<.013 - .22
Lower Mississippian; Kentucky	5 (16)	75:112	.0090	4.47	2.65	<.0044 - .79
Upper Mississippian; Kentucky	5 (16)	92:152	.0061	3.45	2.50	<.0044 - .087
Mississippian; Missouri, Oklahoma, and Arkansas	7 (5)	17:40	.0092	6.35	2.03	<.013 - .30
Pennsylvanian; Kentucky	5 (16)	74:80	.045	3.53	2.13	<.0044 - 1.4
Pennsylvanian; Missouri, Kansas, and and Oklahoma	6 (5)	24:32	.034	3.69	2.03	<.013 - .31
Siderite						
Upper Paleozoic; Kentucky	11 (16)	29:30	.18	2.94	--	<.0044 - .70
UNCONSOLIDATED GEOLOGIC DEPOSITS						
Carbonate residuum (terra rossa)						
On Gasconade Formation; Missouri	12 (5)	9:24	0.019	1.35	--	<0.022 - 0.033
On Roubidoux Formation; Missouri	12 (5)	7:24	.017	1.42	--	<.022 - .031
On Jefferson City, Cotter, and Powell Formations; Missouri and Arkansas	12 (5)	4:24	.011	1.78	--	<.022 - .036
On Osagean rocks; Missouri	12 (5)	16:24	.027	1.79	--	<.022 - .075
On Meramecian rocks; Missouri	12 (5)	13:24	.024	2.67	--	<.022 - .13
Loess						
Missouri	13 (5)	24:24	.061	1.55	--	.030 - .13

[1] Of Swann and Willman (1961).

TABLE 35.—*Phosphorus in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (percent)	Deviation	Error	Observed range (percent)
SOILS						
Cultivated						
Plow zone, garden; Georgia	14 (6)	30:30	0.017	2.10	--	0.004 - 0.09
	15 (6)	30:30	.043	1.73	--	.012 - .09
Plow zone, corn field; Missouri						
Floodplain Forest	17 (5)	8:8	.074	1.64	1.63	.038 - .15
Glaciated Prairie	17 (5)	9:10	.063	1.66	1.63	<.022 - .11
Unglaciated Prairie	17 (5)	8:10	.041	2.04	1.63	<.022 - .15
Oak-hickory Forest	17 (5)	10:10	.059	1.87	1.63	.023 - .12
Plow zone, soybean field; Missouri						
Floodplain Forest	17 (5)	10:10	.078	1.57	1.63	.041 - .17
Glaciated Prairie	17 (5)	10:10	.066	1.60	1.63	.024 - .14
Unglaciated Prairie	17 (5)	7:8	.048	1.59	1.63	<.022 - .092
Oak-hickory Forest	17 (5)	7:9	.041	1.80	1.63	<.022 - .083
Plow zone, pasture field; Missouri						
Floodplain Forest	17 (5)	10:10	.067	1.52	1.63	.031 - .14
Glaciated Prairie	17 (5)	10:10	.067	1.53	1.63	.038 - .14
Unglaciated Prairie	17 (5)	9:10	.038	1.52	1.63	<.022 - .074
Oak-hickory Forest	17 (5)	8:10	.050	1.98	1.63	<.022 - .10
Surface horizon; Missouri	16 (5)	1,130:1,140	.059	1.61	1.30	<.01 - .61
Uncultivated						
A horizon; Georgia	14 (6)	30:30	.0065	1.86	--	.002 - .03
	15 (6)	30:30	.020	2.09	--	.002 - .09
A horizon; Kentucky	18 (16)	96:96	.03	1.47	1.12	.013 - .13
	19 (16)	108:108	.025	1.40	1.16	.009 - .061
B horizon; Georgia	14 (6)	27:30	.0038	1.90	--	<.002 - .012
	15 (6)	30:30	.014	2.08	--	.002 - .044
B horizon; Kentucky	18 (16)	96:96	.03	1.53	1.12	.009 - .140
B horizon; Missouri						
Floodplain Forest	20 (5)	49:50	.068	1.86	1.48	<.017 - .44
Glaciated Prairie	20 (5)	44:50	.033	1.58	1.48	<.017 - .065
Unglaciated Prairie	20 (5)	47:50	.038	1.56	1.48	<.017 - .079
Cedar Glade	20 (5)	50:50	.083	1.73	1.48	.022 - .22
Oak-hickory Forest	20 (5)	40:50	.033	1.88	1.48	<.017 - .12
Oak-hickory-pine Forest	20 (5)	42:50	.030	1.67	1.48	<.017 - .096
C horizon; Georgia	14 (6)	26:30	.0035	2.28	--	<.002 - .030
	15 (6)	30:30	.014	2.14	--	.002 - .060
C horizon; Kentucky	18 (16)	96:96	.02	1.69	1.12	.009 - .205
Cultivated and uncultivated						
Surface horizon; Colorado	22 (5)	166:168	.10	1.87	1.17	<.020 - .50
B horizon; Eastern United States	21 (6)	367:371	.018	3.03	--	<.002 - .60
B horizon; Western United States	21 (6)	489:491	.032	2.33	--	<.002 - .45

TABLE 35.—*Phosphorus in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (percent)	Deviation	Error	Observed range (percent)
PLANT ASH						
Cultivated plants						
Asparagus; Wisconsin	23 (6)	6:6	1.7	1.33	--	1.0 - 2.0
Bean, lima; Georgia	14 (6)	30:30	6.7	1.25	--	4.8 - 9.0
	15 (6)	15:15	4.7	1.28	--	3.6 - 6.0
Bean, snap; Georgia	14 (6)	30:30	4.9	1.30	--	1.8 - 9.0
	15 (6)	30:30	5.2	1.25	--	3.6 - 7.5
Blackeyed pea; Georgia	14 (6)	29:29	7.0	1.30	--	3.6 - 9.0
	15 (6)	4:4	7.8	1.21	--	6.0 - 9.0
Cabbage; Georgia	14 (6)	28:28	2.1	1.63	--	.90 - 6.0
	15 (6)	30:30	1.2	1.38	--	.60 - 2.4
Cabbage; Wisconsin	23 (6)	11:11	2.2	1.42	--	1.5 - 5.0
Carrot; Wisconsin	23 (6)	8:8	2.4	1.46	--	1.5 - 5.0
Corn; Georgia	14 (6)	29:29	11	1.19	--	9.0 - 18
	15 (6)	30:30	10	1.26	--	6.0 - 15
Corn; Missouri						
Floodplain Forest	17 (6)	8:8	22	1.16	1.12	18 - 24
Glaciated Prairie	17 (6)	10:10	21	1.16	1.12	18 - 24
Unglaciated Prairie	17 (6)	10:10	20	1.16	1.12	18 - 24
Oak-hickory Forest	17 (6)	10:10	21	1.16	1.12	18 - 24
Cucumber; Wisconsin	23 (6)	4:4	2.2	1.22	--	2.0 - 3.0
Onion; Wisconsin	23 (6)	7:7	3.7	1.31	--	3.0 - 5.0
Pepper, sweet; Wisconsin	23 (6)	4:4	1.9	1.15	--	1.5 - 2.0
Potato; Wisconsin	23 (6)	10:10	2.2	1.26	--	1.5 - 3.0
Soybean; Missouri						
Glaciated Prairie	17 (6)	10:10	9.1	1.43	1.12	6.0 - 12
Unglaciated Prairie	17 (6)	8:8	10	1.38	1.12	6.0 - 12
Tomato; Georgia	14 (6)	30:30	4.9	1.30	--	2.4 - 6.0
	15 (6)	30:30	5.2	1.25	--	1.8 - 3.6
Native species						
Black cherry, stems; Georgia	14 (6)	30:30	2.1	1.60	--	.60 - 3.6
	15 (6)	30:30	2.3	1.48	--	1.2 - 4.8
Black cherry, leaves; Georgia	14 (6)	30:30	2.0	1.48	--	.90 - 4.8
	15 (6)	30:30	1.9	1.36	--	1.2 - 3.6
Blackgum, stems; Georgia	14 (6)	30:30	1.3	1.37	--	.60 - 2.4
	15 (6)	30:30	1.2	1.21	--	.60 - 1.8
Blackgum, leaves; Georgia	14 (6)	30:30	1.7	1.33	--	1.2 - 2.4
	15 (6)	30:30	1.6	1.28	--	1.2 - 2.4
Buckbush; Missouri						
Glaciated Prairie	20 (6)	47:47	2.6	1.30	1.18	1.8 - 4.8
Unglaciated Prairie	20 (6)	48:48	2.4	1.40	1.18	.60 - 4.8
Cedar Glade	20 (6)	50:50	1.7	1.28	1.18	1.2 - 3.6
Oak-hickory Forest	20 (6)	49:49	2.1	1.27	1.18	1.2 - 3.6
Oak-hickory-pine Forest	20 (6)	41:41	1.8	1.32	1.18	1.2 - 3.6
Cedar; Missouri						
Cedar Glade	20 (6)	50:50	1.3	1.25	1.18	.6 - 1.8
Glaciated Prairie	24 (6)	9:9	2.3	1.33	--	1.7 - 3.6

PHOSPHORUS

TABLE 35.—*Phosphorus in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (percent)	Deviation	Error	Observed range (percent)
PLANT ASH--Continued						
Native species--Continued						
Cedar; Missouri--Continued						
Unglaciated Prairie	24 (6)	10:10	2.3	1.29	--	1.8 - 3.6
Cedar Glade	24 (6)	10:10	1.4	1.30	--	.80 - 2.0
Oak-hickory Forest	24 (6)	10:10	1.9	1.31	--	1.2 - 2.4
Oak-hickory-pine Forest	24 (6)	6:6	1.9	1.28	--	1.6 - 3.2
Hickory, pignut; Kentucky	18 (6)	64:64	.76	1.43	1.17	.04 - 1.8
	19 (6)	88:88	1.2	1.34	1.09	.47 - 2.4
Hickory, shagbark; Kentucky	18 (6)	40:40	.84	1.44	1.17	.44 - 1.8
	19 (6)	20:20	1.2	1.21	1.09	.76 - 1.6
Hickory, shagbark; Missouri						
Oak-hickory Forest	20 (6)	19:19	.83	1.43	1.18	.60 - 1.2
Oak-hickory-pine Forest	20 (6)	7:7	.98	1.45	1.18	.60 - 1.2
Maple, red, stems; Georgia	14 (6)	30:30	1.4	1.51	--	.60 - 3.6
	15 (6)	30:30	1.6	1.44	--	.90 - 3.0
Maple, red, leaves; Georgia	14 (6)	30:30	1.8	1.30	--	1.2 - 3.0
	15 (6)	30:30	2.1	1.26	--	1.5 - 3.6
Oak, black; Kentucky	18 (6)	25:25	.88	1.41	1.16	.44 - 1.8
	19 (6)	22:22	1.1	1.33	1.09	.51 - 2.5
Oak, post; Cedar Glade, Missouri	20 (6)	50:50	.94	1.44	1.18	.60 - 1.8
Oak, red; Kentucky	18 (6)	28:28	.85	1.47	1.16	.60 - 1.8
	19 (6)	9:9	.89	1.48	1.09	.56 - 1.9
Oak, white; Kentucky	18 (6)	49:49	1.2	1.41	1.16	.60 - 2.4
	19 (6)	77:77	1.2	1.30	1.09	.62 - 2.7
Oak, white; Missouri						
Oak-hickory Forest	20 (6)	50:50	1.3	1.42	1.18	.60 - 3.2
Oak-hickory-pine Forest	20 (6)	49:49	1.1	1.35	1.18	.60 - 1.8
Oak, willow; Floodplain Forest, Missouri	20 (6)	46:46	2.1	1.32	1.18	1.2 - 3.6
Persimmon, stems; Georgia	14 (6)	30:30	1.5	1.60	--	.60 - 4.8
	15 (6)	30:30	2.0	1.51	--	1.2 - 4.8
Persimmon, leaves; Georgia	14 (6)	30:30	1.4	1.28	--	.90 - 2.4
	15 (6)	30:30	1.6	1.36	--	.90 - 3.0
Pine, shortleaf; Oak-hickory-pine Forest, Missouri	20 (6)	49:49	2.3	1.24	1.18	1.8 - 3.6
Sagebrush; Powder River Basin, Wyoming and Montana	25 (6)	48:48	3.1	1.34	--	.8 - 4.8
Sassafras, stems; Georgia	14 (6)	17:17	2.0	1.31	--	1.2 - 3.6
	15 (6)	27:27	2.5	1.36	--	1.2 - 4.8
Sassafras, leaves; Georgia	14 (6)	17:17	2.3	1.30	--	1.8 - 4.8
	15 (6)	27:27	2.2	1.28	--	1.2 - 3.6
Sumac, winged, stems; Georgia	14 (6)	28:28	.71	1.76	--	.30 - 2.4
	15 (6)	27:27	1.2	1.66	--	.48 - 2.4
Sumac, winged, leaves; Georgia	14 (6)	28:28	1.4	1.42	--	.90 - 3.6
	15 (6)	27:27	1.9	1.33	--	1.2 - 3.0

TABLE 35.—*Phosphorus in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (percent)	Deviation	Error	Observed range (percent)
PLANT ASH--Continued						
Native species--Continued						
Sumac, smooth; Missouri						
Floodplain Forest	20 (6)	48:48	2.3	1.27	1.18	1.2 - 3.6
Glaciated Prairie	20 (6)	50:50	1.2	1.20	1.18	1.2 - 3.6
Unglaciated Prairie	20 (6)	49:49	1.7	1.24	1.18	1.2 - 3.6
Cedar Glade	20 (6)	49:49	1.2	1.45	1.18	.60 - 2.4
Oak-hickory Forest	20 (6)	50:50	1.8	1.30	1.18	1.2 - 3.6
Oak-hickory-pine Forest	20 (6)	49:49	1.4	1.34	1.18	.6 - 2.4
Sweetgum, stems; Georgia	14 (6)	28:28	.71	1.76	--	.30 - 2.4
	15 (6)	27:27	1.2	1.66	--	.48 - 2.4
Sweetgum, leaves; Georgia	14 (6)	28:28	1.4	1.42	--	.90 - 3.6
	15 (6)	27:27	1.9	1.33	--	1.2 - 3.0
Sweetgum; Floodplain Forest, Missouri	20 (6)	47:47	.96	1.63	1.18	.30 - 2.6

TABLE 36.—*Potassium in rocks, unconsolidated geologic deposits, soils, and plant ash*

[Explanation of column headings: Study No. refers to study described in text; method of analysis (in parentheses) refers to method listed in table 1. Ratio, number of samples in which the element was found in measurable concentrations to number of samples analyzed. Mean, geometric mean except that values preceded by asterisk are arithmetic mean. Deviation, geometric deviation except that values preceded by asterisk are standard deviation. Error, geometric error attributed to laboratory procedures except that values preceded by asterisk are standard error. Leaders (--) in figure column indicate no data available]

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (percent)	Deviation	Error	Observed range (percent)
ROCKS						
Granite						
Precambrian; Missouri	1 (5)	30:30	4.3	1.11	1.01	3.2 - 5.1
Rhyolite						
Precambrian; Missouri	1 (5)	30:30	4.8	1.35	1.01	2.2 - 8.1
Sandstone						
Sauk sequence; Western United States-	3 (16)	385:400	.32	4.67	1.86	<.0083 - 4.5
Roubidoux Formation; Missouri	4 (5)	7:12	.083	2.99	1.01	<.083 - .42
Pope Megagroup;[1] Kentucky	5 (16)	117:120	.30	3.02	1.79	<.0083 - 1.2
Pennsylvanian; Kentucky	5 (16)	148:152	.51	3.55	2.16	<.0083 - 2.4
Pennsylvanian; Missouri, Kansas, and Oklahoma	6 (5)	31:32	.66	2.81	1.01	<.083 - 2.0

[1] Of Swann and Willman (1961).

TABLE 36.—*Potassium in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (percent)	Deviation	Error	Observed range (percent)
ROCKS--Continued						
Chert						
Mississippian; Missouri, Oklahoma, and Arkansas	7 (5)	2:20	<0.083	--	--	<0.083 - 0.17
Shale						
Sauk sequence; Western United States	3 (16)	336:336	5.4	1.54	1.23	.91 - 11
Lower Mississippian; Kentucky	8 (16)	76:76	1.8	1.59	--	.42 - 3.5
Upper Mississippian; Kentucky	5 (16)	142:142	2.3	1.40	--	1.0 - 5.1
Mississippian; Missouri, Oklahoma, and Arkansas	7 (5)	18:18	2.2	1.56	1.03	.91 - 3.5
Pennsylvanian; Kentucky	5 (16)	152:152	2.3	1.59	1.13	.33 - 4.0
Pennsylvanian; Missouri, Kansas, and Oklahoma	6 (5)	32:32	2.7	1.29	1.03	1.5 - 3.7
Limestone and dolomite						
Sauk sequence; Western United States	3 (16)	383:392	.32	3.69	1.66	<.017 - 4.2
Sauk sequence; Missouri and Arkansas	4 (5)	39:48	.20	3.57	1.11	<.083 - 1.6
Upper Ordovician; Kentucky	5 (16)	80:80	.40	2.05	1.28	.083 - 1.7
Tippecanoe sequence; Missouri	10 (5)	8:12	.12	3.41	1.11	<.083 - 1.4
Lower Mississippian; Kentucky	5 (16)	109:112	.30	3.02	2.34	<.0083 - 1.4
Upper Mississippian; Kentucky	5 (16)	145:152	.17	3.21	2.78	<.0083 - 2.1
Pennsylvanian; Kentucky	5 (16)	80:80	.56	2.49	1.32	.025 - 1.6
Pennsylvanian; Missouri, Kansas, and Oklahoma	6 (5)	28:32	.16	2.52	1.11	<.083 - 1.0
Siderite						
Upper Paleozoic; Kentucky	11 (16)	30:30	.64	1.69	--	.22 - 1.4
UNCONSOLIDATED GEOLOGIC DEPOSITS						
Carbonate residuum (terra rossa)						
On Gasconade Formation; Missouri	12 (5)	24:24	1.0	1.47	1.03	0.46 - 1.8
On Roubidoux Formation; Missouri	12 (5)	24:24	1.1	2.10	1.03	.19 - 3.0
On Jefferson City, Cotter, and Powell Formations; Missouri and Arkansas	12 (5)	24:24	1.7	1.57	1.03	.65 - 4.7
On Osagean rocks; Missouri	12 (5)	24:24	.91	1.57	1.03	.37 - 1.8
On Meramecian rocks; Missouri	12 (5)	24:24	1.1	1.36	1.03	.53 - 2.2
Loess						
Missouri	13 (5)	24:24	1.9	1.13	--	1.2 - 2.2
SOILS						
Cultivated						
Plow zone, garden; Georgia	14 (12)	30:30	0.041	2.30	--	0.01 - 0.4
	15 (12)	30:30	.92	1.91	--	.16 - 2.6
Plow zone, corn field; Missouri						
Floodplain Forest	17 (5)	8:8	1.7	1.15	1.01	1.4 - 2.1
Glaciated Prairie	17 (5)	10:10	1.7	1.12	1.01	1.4 - 2.0
Unglaciated Prairie	17 (5)	10:10	1.2	1.41	1.01	.60 - 1.7

TABLE 36.—*Potassium in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (percent)	Deviation	Error	Observed range (percent)
SOILS--Continued						
Cultivated--Continued						
Plow zone, corn field; Missouri--Continued						
Oak-hickory Forest	17 (5)	10:10	1.5	1.43	1.01	0.86 - 2.2
Plow zone, soybean field; Missouri						
Floodplain Forest	17 (5)	10:10	1.7	1.09	1.01	1.4 - 1.8
Glaciated Prairie	17 (5)	10:10	1.6	1.08	1.01	1.5 - 1.7
Unglaciated Prairie	17 (5)	8:8	1.2	1.41	1.01	.68 - 1.7
Oak-hickory Forest	17 (5)	9:9	1.5	1.30	1.01	1.1 - 2.2
Plow zone, pasture field; Missouri						
Floodplain Forest	17 (5)	10:10	1.7	1.10	1.01	1.4 - 1.8
Glaciated Prairie	17 (5)	10:10	1.6	1.13	1.01	1.5 - 2.0
Unglaciated Prairie	17 (5)	10:10	1.3	1.34	1.01	.66 - 1.7
Oak-hickory Forest	17 (5)	10:10	1.5	1.40	1.01	.83 - 2.1
Surface horizon; Missouri	16 (5)	1,140:1,140	*1.4	*.40	*.07	.33 - 3.7
Uncultivated						
Surface horizon; Powder River Basin, Wyoming and Montana	25 (5)	48:48	2.6	1.25	1.16	2 - 5
A horizon; Georgia	14 (12)	30:30	.073	2.85	--	.02 - 1.0
	15 (12)	30:30	1.2	1.98	--	.17 - 3.7
A horizon; Kentucky	18 (16)	96:96	1.0	1.55	1.14	.20 - 2.1
	19 (16)	108:108	1.0	1.42	1.14	.39 - 2.0
B horizon; Georgia	14 (12)	30:30	.079	2.84	--	.02 - 1.4
	15 (12)	30:30	1.1	1.99	--	.18 - 2.5
B horizon; Kentucky	18 (16)	96:96	1.2	1.70	1.14	.07 - 3.2
B horizon; Missouri						
Floodplain Forest	20 (5)	50:50	1.8	1.14	1.25	1.2 - 2.2
Glaciated Prairie	20 (5)	50:50	1.5	1.28	1.25	.75 - 2.5
Unglaciated Prairie	20 (5)	50:50	1.3	1.45	1.25	.58 - 3.1
Cedar Glade	20 (5)	50:50	1.7	1.50	1.25	.50 - 3.5
Oak-hickory Forest	20 (5)	50:50	1.1	1.61	1.25	.42 - 2.1
Oak-hickory-pine Forest	20 (5)	50:50	.86	1.96	1.25	.17 - 4.4
C horizon; Georgia	14 (12)	30:30	.089	2.83	--	.02 - 1.6
	15 (12)	30:30	1.2	1.97	--	.18 - 2.8
C horizon; Kentucky	18 (16)	96:96	1.1	1.68	1.14	.080 - 4.3
Cultivated and uncultivated						
Surface horizon; Colorado	22 (5)	168:168	2.9	1.40	1.01	.5 - 4.9
B horizon; Eastern United States	21 (12)	370:370	.74	3.56	--	.005 - 3.7
B horizon; Western United States	21 (12)	491:491	1.7	1.60	--	.19 - 6.3

TABLE 36.—*Potassium in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (percent)	Deviation	Error	Observed range (percent)
PLANT ASH						
Cultivated plants						
Bean, lima; Georgia	14 (12)	30:30	35	1.05	--	30 - 39
	15 (12)	15:15	34	1.08	--	28 - 38
Bean, snap; Georgia	14 (12)	30:30	33	1.10	--	23 - 37
	15 (12)	30:30	33	1.08	--	28 - 39
Blackeyed pea; Georgia	14 (12)	29:29	31	1.09	--	27 - 36
	15 (12)	4:4	33	1.05	--	31 - 34
Cabbage; Georgia	14 (12)	28:28	21	1.33	--	9.2 - 33
	15 (12)	30:30	18	1.24	--	12 - 27
Corn; Georgia	14 (12)	29:29	35	1.09	--	26 - 39
	15 (12)	30:30	36	1.07	--	31 - 40
Corn; Missouri						
Floodplain Forest	17 (3)	8:8	29	1.09	1.05	24 - 32
Glaciated Prairie	17 (3)	10:10	30	1.07	1.05	26 - 33
Unglaciated Prairie	17 (3)	10:10	31	1.05	1.05	30 - 35
Oak-hickory Forest	17 (3)	10:10	31	1.06	1.05	30 - 35
Soybean; Missouri						
Floodplain Forest	17 (3)	10:10	41	1.06	1.05	38 - 45
Glaciated Prairie	17 (3)	10:10	40	1.06	1.05	37 - 46
Unglaciated Prairie	17 (3)	8:8	39	1.03	1.05	38 - 40
Oak-hickory Forest	17 (3)	9:9	41	1.06	1.05	38 - 45
Tomato; Georgia	14 (12)	30:30	38	1.07	--	30 - 42
	15 (12)	30:30	40	1.08	--	34 - 51
Native species						
Black cherry, stems; Georgia	14 (12)	30:30	12	1.45	--	6.0 - 28
	15 (12)	30:30	14	1.51	--	4.2 - 26
Black cherry, leaves; Georgia	14 (12)	30:30	14	1.37	--	5.6 - 27
	15 (12)	30:30	17	1.27	--	11 - 28
Blackgum, stems; Georgia	14 (12)	30:30	11	1.30	--	6.2 - 16
	15 (12)	30:30	11	1.31	--	5.8 - 21
Blackgum, leaves; Georgia	14 (12)	30:30	16	1.23	--	11 - 23
	15 (12)	30:30	19	1.25	--	10 - 28
Buckbush; Missouri						
Glaciated Prairie	20 (3)	47:47	16	1.15	1.16	12 - 20
Unglaciated Prairie	20 (3)	48:48	16	1.16	1.16	11 - 20
Cedar Glade	20 (3)	50:50	15	1.16	1.16	9.6 - 18
Oak-hickory Forest	20 (3)	49:49	15	1.21	1.16	9.2 - 22
Oak-hickory-pine Forest	20 (3)	41:41	15	1.24	1.16	8.6 - 22
Cedar; Missouri						
Cedar Glade	20 (3)	50:50	6.3	1.26	1.16	3.6 - 10
Glaciated Prairie	24 (3)	9:9	8.9	1.31	--	5.0 - 14
Unglaciated Prairie	24 (3)	10:10	11	1.39	--	6.0 - 15
Cedar Glade	24 (3)	10:10	6.8	1.20	--	5.0 - 8.0
Oak-hickory Forest	24 (3)	10:10	9.8	1.32	--	6.0 - 14
Oak-hickory-pine Forest	24 (3)	6:6	9.1	1.37	--	6.4 - 16

TABLE 36.—*Potassium in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (percent)	Deviation	Error	Observed range (percent)
PLANT ASH--Continued						
Native species--Continued						
Hickory, pignut; Kentucky	18 (3)	64:64	5.9	1.44	1.07	3.3 - 17
	19 (3)	88:88	6.0	1.34	1.13	2.7 - 12
Hickory, shagbark; Kentucky	18 (3)	40:40	6.7	1.45	1.07	3.0 - 16
	19 (3)	20:20	6.3	1.35	1.13	4.2 - 16
Hickory, shagbark; Missouri						
Oak-hickory Forest	20 (3)	19:19	3.4	1.31	1.16	2.4 - 5.4
Oak-hickory-pine Forest	20 (3)	7:7	2.9	1.21	1.16	2.2 - 4.0
Maple, red, stems; Georgia	14 (12)	30:30	11	1.51	--	5.6 - 26
	15 (12)	30:30	12	1.44	--	5.8 - 32
Maple, red, leaves; Georgia	14 (12)	30:30	12	1.26	--	5.6 - 17
	15 (12)	30:30	15	1.31	--	8.6 - 24
Oak, black; Kentucky	18 (3)	25:25	7.5	1.28	1.08	4.1 - 13
	19 (3)	22:22	7.9	1.23	1.13	5.5 - 12
Oak, post; Cedar Glade, Missouri	20 (3)	50:50	4.4	1.38	1.16	2.0 - 11
Oak, red; Kentucky	18 (3)	28:28	6.7	1.27	1.08	4.5 - 11
	19 (3)	9:9	7.3	1.60	1.13	3.0 - 14
Oak, white; Kentucky	18 (3)	49:49	8.4	1.32	1.08	4.9 - 15
	19 (3)	76:76	9.1	1.27	1.13	4.4 - 15
Oak, white; Missouri						
Oak-hickory Forest	20 (3)	50:50	5.1	1.29	1.16	3.0 - 9.6
Oak-hickory-pine Forest	20 (3)	49:49	4.9	1.22	1.16	3.0 - 6.9
Oak, willow; Floodplain Forest, Missouri	20 (3)	46:46	7.8	1.37	1.16	4.4 - 14
Persimmon, stems; Georgia	14 (12)	30:30	16	1.31	--	7.8 - 30
	15 (12)	30:30	19	1.25	--	15 - 29
Persimmon, leaves; Georgia	14 (12)	30:30	21	1.24	--	14 - 31
	15 (12)	30:30	23	1.19	--	15 - 32
Pine, shortleaf; Oak-hickory-pine Forest, Missouri	20 (3)	49:49	11	1.35	1.16	5.6 - 20
Sassafras, stems; Georgia	14 (12)	17:17	19	1.28	--	13 - 32
	15 (12)	27:27	20	1.33	--	13 - 34
Sassafras, leaves; Georgia	14 (12)	17:17	19	1.27	--	12 - 29
	15 (12)	27:27	23	1.22	--	14 - 32
Sumac, winged, stems; Georgia	14 (12)	30:30	14	1.53	--	5.2 - 30
	15 (12)	30:30	16	1.41	--	7.6 - 34
Sumac, winged, leaves; Georgia	14 (12)	30:30	19	1.29	--	10 - 29
	15 (12)	30:30	21	1.25	--	12 - 31
Sumac, smooth; Missouri						
Floodplain Forest	20 (3)	48:48	13	1.34	1.16	5.6 - 22
Glaciated Prairie	20 (3)	50:50	13	1.26	1.16	8.0 - 20
Unglaciated Prairie	20 (3)	49:49	13	1.24	1.16	8.6 - 22
Cedar Glade	20 (3)	49:49	10	1.32	1.16	3.8 - 16
Oak-hickory Forest	20 (3)	50:50	13	1.20	1.16	9.2 - 19
Oak-hickory-pine Forest	20 (3)	49:49	12	1.22	1.16	7.4 - 19

TABLE 36.—*Potassium in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (percent)	Deviation	Error	Observed range (percent)
PLANT ASH--Continued						
Native species--Continued						
Sweetgum, stems; Georgia	14 (12)	28:28	6.1	1.89	--	2.4 - 26
	15 (12)	27:27	11	2.10	--	1.3 - 28
Sweetgum, leaves; Georgia	14 (12)	28:28	10	1.31	--	7.0 - 23
	15 (12)	27:27	14	1.28	--	9.6 - 21
Sweetgum; Floodplain Forest, Missouri	20 (3)	47:47	4.1	1.59	1.16	1.2 - 12

TABLE 37.—*Rubidium in plant ash*

[Explanation of column headings: Study No. refers to study described in text; method of analysis (in parentheses) refers to method listed in table 1. Ratio, number of samples in which the element was found in measurable concentrations to number of samples analyzed. Mean, geometric mean. Deviation, geometric deviation. Error, geometric error attributed to laboratory procedures. Leaders (--) in figure column indicate no data available]

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
Native species						
Hickory, pignut; Kentucky	18 (3)	64:64	56	1.61	1.17	18 - 155
	19 (3)	88:88	56	1.62	1.11	18 - 170
Hickory, shagbark; Kentucky	18 (3)	40:40	51	1.68	1.17	18 - 192
	19 (3)	20:20	55	1.70	1.11	18 - 110
Oak, black; Kentucky	18 (3)	25:25	72	1.72	1.42	37 - 210
	19 (3)	22:22	94	1.39	1.11	55 - 190
Oak, red; Kentucky	18 (3)	28:28	74	1.62	1.42	37 - 260
	19 (3)	9:9	87	1.42	1.11	64 - 160
Oak, white; Kentucky	18 (3)	49:49	93	1.55	1.42	37 - 230
	19 (3)	76:76	110	1.65	1.11	37 - 400

TABLE 38.—*Scandium in rocks, unconsolidated geologic deposits, soils, and plant ash*

[Explanation of column headings: Study No. refers to study described in text; method of analysis (in parentheses) refers to method listed in table 1. Ratio, number of samples in which the element was found in measurable concentrations to number of samples analyzed. Mean, geometric mean. Deviation, geometric deviation. Error, geometric error attributed to laboratory procedures. Leaders (--) in figure column indicate no data available]

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
ROCKS						
Granite						
Precambrian; Missouri	1 (1)	18:30	5.3	2.39	1.28	<5 - 15
Rhyolite						
Precambrian; Missouri	1 (1)	24:30	6.5	1.99	1.28	<5 - 15
Arkose						
Fountain Formation; Colorado	2 (2)	16:80	1.7	1.95	--	<3 - 9
Sandstone						
Sauk sequence; Western United States	3 (2)	237:400	3.2	1.76	1.24	<3 - 25
Pope Megagroup;[1] Kentucky	5 (2)	19:120	2.1	2.68	1.16	<8 - 14
Pennsylvanian; Kentucky	5 (2)	93:152	5.0	1.92	1.29	<5 - 16
Pennsylvanian; Missouri, Kansas, and Oklahoma	6 (1)	26:32	7.2	2.12	--	<5 - 15
Shale						
Sauk sequence; Western United States	3 (2)	331:336	18	1.26	1.07	<10 - 28
Lower Mississippian; Kentucky	8 (2)	74:76	15	1.26	--	<10 - 22
Upper Mississippian; Kentucky	5 (2)	141:142	17	1.19	--	<10 - 22
Mississippian; Missouri, Oklahoma, and Arkansas	7 (1)	17:18	8.2	1.60	1.21	<10 - 20
Pennsylvanian; Kentucky	5 (2)	152:152	18	1.21	1.09	10 - 26
Pennsylvanian; Missouri, Kansas, and Oklahoma	6 (1)	32:32	15	1.26	1.21	10 - 20
Black shale						
Devonian and Mississippian; Kentucky	9 (2)	88:88	15	1.15	1.08	10 - 21
Limestone and dolomite						
Upper Ordovician; Kentucky	5 (1)	3:80	<10	--	--	<10 - 10
Lower Mississippian; Kentucky	5 (1)	22:112	6.1	1.45	--	<10 - 15
Upper Mississippian; Kentucky	5 (1)	5:152	<10	--	--	<10 - 15
Mississippian; Missouri, Oklahoma, and Arkansas	7 (1)	3:40	<5	--	--	<5 - 7
Pennsylvanian; Kentucky	5 (1)	49:80	9.0	1.45	1.14	<10 - 30
Pennsylvanian; Missouri, Kansas, and Oklahoma	6 (1)	4:32	<5	--	--	<5 - 7
Siderite						
Upper Paleozoic; Kentucky	11 (1)	15:30	8.4	1.80	--	<10 - 20

[1] Of Swann and Willman (1961).

TABLE 38.—*Scandium in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
UNCONSOLIDATED GEOLOGIC DEPOSITS						
Carbonate residuum (terra rossa)						
On Gasconade Formation; Missouri	12 (1)	24:24	9.1	1.32	1.12	5 - 15
On Roubidoux Formation; Missouri	12 (1)	22:24	7.8	1.44	1.12	<5 - 15
On Jefferson City, Cotter, and Powell Formations; Missouri and Arkansas	12 (1)	24:24	9.2	1.34	1.12	5 - 15
On Osagean rocks; Missouri	12 (1)	24:24	15	1.29	1.12	7 - 20
On Meramecian rocks; Missouri	12 (1)	24:24	12	1.40	1.12	7 - 20
Loess						
Missouri	13 (1)	24:24	9.0	1.18	--	7 - 10
SOILS						
Cultivated						
Plow zone, garden; Georgia	14 (1)	8:30	2.8	1.65	--	<5 - 7
	15 (1)	30:30	9.0	1.35	--	5 - 15
Plow zone, corn field; Missouri						
Floodplain Forest	17 (1)	7:8	5.2	1.24	1.09	<5 - 7
Glaciated Prairie	17 (1)	10:10	8.1	1.20	1.09	7 - 10
Unglaciated Prairie	17 (1)	9:10	6.3	1.25	1.09	<5 - 7
Oak-hickory Forest	17 (1)	9:10	6.3	1.33	1.09	<5 - 10
Plow zone, soybean field; Missouri						
Floodplain Forest	17 (1)	8:10	5.1	1.31	1.09	<5 - 7
Glaciated Prairie	17 (1)	10:10	8.4	1.21	1.09	7 - 10
Unglaciated Prairie	17 (1)	8:8	6.7	1.25	1.09	5 - 10
Oak-hickory Forest	17 (1)	9:9	6.5	1.16	1.09	5 - 7
Plow zone, pasture field; Missouri						
Floodplain Forest	17 (1)	8:10	5.1	1.31	1.09	<5 - 7
Glaciated Prairie	17 (1)	10:10	7.3	1.12	1.09	7 - 10
Unglaciated Prairie	17 (1)	10:10	6.3	1.18	1.09	5 - 7
Oak-hickory Forest	17 (1)	10:10	6.3	1.26	1.09	5 - 10
Surface horizon; Missouri	16 (1)	1,092:1,140	7.6	1.34	1.16	<5 - 15
Uncultivated						
Surface horizon; Powder River Basin, Wyoming and Montana	25 (1)	44:48	7.3	1.43	1.16	<5 - 15
A horizon; Georgia	14 (1)	8:30	2.1	2.64	--	<5 - 15
	15 (1)	29:30	8.6	1.47	--	<5 - 15
A horizon; Kentucky	18 (2)	96:96	10	1.21	1.06	7 - 17
	19 (2)	47:108	4.9	2.22	1.05	<5 - 15
B horizon; Georgia	14 (1)	9:30	2.6	2.06	--	<5 - 15
B horizon; Kentucky	18 (2)	96:96	13	1.24	1.06	7 - 22
B horizon; Missouri						
Floodplain Forest	20 (1)	42:50	7.1	1.58	1.23	<5 - 15
Glaciated Prairie	20 (1)	50:50	12	1.34	1.23	7 - 15

TABLE 38.—*Scandium in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
SOILS--Continued						
Uncultivated--Continued						
B horizon; Missouri--Continued						
Unglaciated Prairie	20 (1)	50:50	10	1.33	1.23	7 - 20
Cedar Glade	20 (1)	43:50	6.8	1.59	1.23	<5 - 20
Oak-hickory Forest	20 (1)	37:50	5.4	1.49	1.23	<5 - 10
Oak-hickory-pine Forest	20 (1)	30:50	4.7	1.78	1.23	<5 - 15
C horizon; Georgia	14 (1)	20:30	5.0	1.67	--	<5 - 15
	15 (1)	30:30	11	1.43	--	5 - 20
C horizon; Kentucky	18 (2)	96:96	13	1.30	1.06	7 - 20
Cultivated and uncultivated						
Surface horizon; Colorado	22 (1)	123:168	5.9	1.79	1.3	<5 - 15
B horizon; Eastern United States	21 (1)	282:371	7.0	1.85	--	<5 - 30
B horizon; Western United States	21 (1)	437:492	9.0	1.74	--	<5 - 50
PLANT ASH						
Native species						
Blackgum, leaves; Georgia	15 (1)	1:30	<5	--	--	<5 - 10
Sassafras, stems; Georgia	15 (1)	1:27	<5	--	--	<5 - 10
Sassafras, leaves; Georgia	14 (1)	1:17	<5	--	--	<5 - 10
Sumac, winged, leaves; Georgia	14 (1)	1:30	<5	--	--	<5 - 10

TABLE 39.—*Selenium in rocks, unconsolidated geologic deposits, soils, and dry plants*

[Explanation of column headings: Study No. refers to study described in text; method of analysis (in parentheses) refers to method listed in table 1. Ratio, number of samples in which the element was found in measurable concentrations to number of samples analyzed. Mean, geometric mean. Deviation, geometric deviation. Error, geometric error attributed to laboratory procedures. Leaders (--) in figure column indicate no data available]

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
ROCKS						
Granite						
Precambrian; Missouri	1 (5)	18:30	0.12	1.64	1.73	<0.1 - 0.4
Rhyolite						
Precambrian; Missouri	1 (5)	15:30	.11	1.76	1.73	<.1 - .4

TABLE 39.—*Selenium in rocks, unconsolidated geologic deposits, soils, and dry plants*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
ROCKS--Continued						
Sandstone						
Roubidoux Formation; Missouri	4 (5)	6:12	0.086	2.06	1.67	<0.1 - 0.2
Pennsylvanian; Missouri, Kansas, and Oklahoma	6 (5)	19:32	.11	2.80	1.67	<.1 - 1.7
Chert						
Mississippian; Missouri, Oklahoma, and Arkansas	7 (5)	12:20	.11	1.76	1.67	<.1 - .3
Shale						
Mississippian; Missouri, Oklahoma, and Arkansas	7 (5)	18:18	.64	3.47	1.73	.2 - 9
Pennsylvanian; Missouri, Kansas, and Oklahoma	6 (5)	29:32	.46	3.63	1.73	<.1 - 12
Limestone and dolomite						
Sauk sequence; Missouri and Arkansas	4 (5)	35:48	.18	2.21	1.96	<.1 - .8
Tippecanoe sequence; Missouri	10 (5)	9:12	.16	1.97	1.96	<.1 - .3
Mississippian; Missouri, Oklahoma, and Arkansas	7 (5)	32:40	.19	2.28	1.96	<.1 - 1
Pennsylvanian; Missouri, Kansas, and Oklahoma	6 (5)	29:32	.31	2.69	1.96	<.1 - 7.4
UNCONSOLIDATED GEOLOGIC DEPOSITS						
Carbonate residuum (terra rossa)						
On Gasconade Formation; Missouri	12 (5)	23:24	0.29	1.69	1.72	<0.1 - 0.7
On Roubidoux Formation; Missouri	12 (5)	20:24	.22	2.12	1.72	<.1 - .8
On Jefferson City, Cotter, and Powell Formations; Missouri and Arkansas	12 (5)	20:24	.25	2.00	1.72	<.1 - .5
On Osagean rocks; Missouri	12 (5)	21:24	.40	2.43	1.72	<.1 - 1.9
On Meramecian rocks; Missouri	12 (5)	24:24	.38	1.74	1.72	.2 - 1.4
Loess						
Missouri	13 (5)	19:24	.17	2.02	--	<.1 - .4
SOILS						
Cultivated						
Plow zone, corn field; Missouri						
Floodplain Forest	17 (5)	8:8	.31	1.51	1.25	.2 - 0.6
Glaciated Prairie	17 (5)	10:10	.67	1.67	1.25	.3 - 1.5
Unglaciated Prairie	17 (5)	10:10	.52	1.48	1.25	.3 - 1.1
Oak-hickory Forest	17 (5)	10:10	.31	1.43	1.25	.2 - .6
Plow zone, soybean field; Missouri						
Floodplain Forest	17 (5)	10:10	.33	1.67	1.25	.1 - .6
Glaciated Prairie	17 (5)	10:10	.74	1.71	1.25	.4 - 1.4
Unglaciated Prairie	17 (5)	8:8	.67	1.56	1.25	.3 - 1.2
Oak-hickory Forest	17 (5)	9:9	.31	1.31	1.25	.2 - .4

TABLE 39.—*Selenium in rocks, unconsolidated geologic deposits, soils, and dry plants*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
SOILS--Continued						
Cultivated--Continued						
Plow zone, pasture field; Missouri						
Floodplain Forest	17 (5)	10:10	0.28	1.65	1.25	0.1 - 0.7
Glaciated Prairie	17 (5)	10:10	.62	1.68	1.25	.3 - 1.5
Unglaciated Prairie	17 (5)	10:10	.47	1.39	1.25	.3 - .8
Oak-hickory Forest	17 (5)	10:10	.38	1.43	1.25	.2 - .6
Surface horizon; Missouri	16 (5)	925:1,140	.28	2.54	1.67	<.1 - 2.7
Uncultivated						
B horizon; Missouri						
Floodplain Forest	20 (5)	42:50	.31	2.78	1.52	<.1 - 2.4
Glaciated Prairie	20 (5)	49:50	.73	2.11	1.52	<.1 - 3.4
Unglaciated Prairie	20 (5)	50:50	.67	1.64	1.52	.2 - 3.1
Cedar Glade	20 (5)	46:50	.31	2.10	1.52	<.1 - 1.4
Oak-hickory Forest	20 (5)	48:50	.31	1.90	1.52	<.1 - 1.0
Oak-hickory-pine Forest	20 (5)	46:50	.27	2.01	1.52	<.1 - 1.0
Cultivated and uncultivated						
Surface horizon; Colorado	22 (5)	143:168	.23	2.88	1.60	<.1 - 1.4
B horizon; Eastern United States	21 (5)	390:420	.39	2.17	--	<.1 - 1.4
B horizon; Western United States	21 (5)	413:492	.25	2.53	--	<.1 - 4.3
DRY PLANTS						
Cultivated plants						
Corn; Missouri						
Floodplain Forest	17 (14)	8:8	0.062	2.41	1.09	0.01 - 0.2
Glaciated Prairie	17 (14)	10:10	.072	2.61	1.09	.02 - .4
Unglaciated Prairie	17 (14)	10:10	.047	1.88	1.09	.02 - .15
Oak-hickory Forest	17 (14)	10:10	.040	2.96	1.09	.02 - .50
Soybean; Missouri						
Floodplain Forest	17 (14)	10:10	.17	2.68	1.09	.06 - 1.25
Glaciated Prairie	17 (14)	10:10	.098	1.83	1.09	.04 - .25
Unglaciated Prairie	17 (14)	8:8	.097	2.28	1.09	.04 - .35
Oak-hickory Forest	17 (14)	9:9	.077	1.94	1.09	.04 - .40
Native species						
Buckbush; Missouri						
Glaciated Prairie	20 (14)	47:47	.043	1.45	1.22	.02 - .08
Unglaciated Prairie	20 (14)	46:46	.038	1.49	1.22	.02 - .08
Cedar Glade	20 (14)	49:49	.023	1.33	1.22	.02 - .04
Oak-hickory Forest	20 (14)	46:46	.032	1.47	1.22	.02 - .08
Oak-hickory-pine Forest	20 (14)	39:39	.031	1.47	1.22	.02 - .06
Cedar; Cedar Glade, Missouri	20 (14)	50:50	.021	1.36	1.22	.01 - .04
Hickory, shagbark; Missouri						
Oak-hickory Forest	20 (14)	19:19	.022	1.52	1.22	.02 - .04
Oak-hickory-pine Forest	20 (14)	7:7	.027	1.45	1.22	.02 - .04

TABLE 39.—*Selenium in rocks, unconsolidated geologic deposits, soils, and dry plants*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
DRY PLANTS--Continued						
Native species--Continued						
Oak, post; Cedar Glade, Missouri-----	20 (14)	46:49	0.020	1.56	1.22	<0.01 - 0.04
Oak, white; Missouri						
Oak-hickory Forest----------	20 (14)	48:50	.018	1.43	1.22	<.01 - .04
Oak-hickory-pine Forest----------	20 (14)	48:49	.019	1.43	1.22	<.01 - .04
Oak, willow; Floodplain Forest, Missouri----------	20 (14)	45:45	.032	2.02	1.22	.01 - .3
Pine, shortleaf; Oak-hickory-pine Forest, Missouri----------	20 (14)	49:49	.062	1.71	1.22	.02 - .2
Sagebrush; Powder River Basin, Wyoming and Montana----------	25 (14)	48:48	.42	2.47	--	.08 - 4.8
Sumac, smooth; Missouri						
Floodplain Forest----------	20 (14)	47:48	.027	1.98	1.22	<.01 - .25
Glaciated Prairie----------	20 (14)	49:50	.022	1.83	1.22	<.01 - .10
Unglaciated Prairie----------	20 (14)	39:49	.013	1.67	1.22	<.01 - .04
Sweetgum; Floodplain Forest, Missouri	20 (14)	47:47	.065	2.36	1.22	.01 - .4

TABLE 40.—*Silicon in rocks, unconsolidated geologic deposits, soils, and plant ash*

[Explanation of column headings: Study No. refers to study described in text; method of analysis (in parentheses) refers to method listed in table 1. Ratio, number of samples in which the element was found in measurable concentrations to number of samples analyzed. Mean, geometric mean except that values preceded by asterisk are arithmetic mean. Deviation, geometric deviation except that values preceded by asterisk are standard deviation. Error, geometric error attributed to laboratory procedures except that values preceded by asterisk are standard error. Leaders (--) in figure column indicate no data available]

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (percent)	Deviation	Error	Observed range (percent)
ROCKS						
Granite						
Precambrian; Missouri----------	1 (5)	30:30	*35	*1.22	*1.08	33 - 37
Rhyolite						
Precambrian; Missouri----------	1 (5)	30:30	*35	*1.37	*1.08	33 - 37
Shale						
Sauk sequence; Western United States-	3 (16)	336:336	*27	*5.89	*1.29	5.3 - 39
Lower Mississippian; Kentucky--------	8 (16)	76:76	*31	*4.27	--	20 - 39
Upper Mississippian; Kentucky--------	5 (16)	142:142	*29	*4.54	--	17 - 39
Mississippian; Missouri, Oklahoma, and Arkansas----------	7 (5)	18:18	23	1.40	1.02	13 - 37

TABLE 40.—*Silicon in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (percent)	Deviation	Error	Observed range (percent)
ROCKS--Continued						
Shale--Continued						
Pennsylvanian; Kentucky	5 (16)	152:152	*30	*4.30	*0.51	23 - 42
Pennsylvanian; Missouri, Kansas, and Oklahoma	6 (5)	32:32	27	1.15	1.02	19 - 37
Limestone and dolomite						
Sauk sequence; Western United States	3 (16)	388:392	2.3	4.24	1.47	<.056 - 24
Sauk sequence; Missouri and Arkansas	4 (5)	40:48	1.6	3.44	1.07	<.47 - 31
Upper Ordovician; Kentucky	5 (16)	80:80	3.4	2.56	1.09	.56 - 15
Tippecanoe sequence; Missouri	10 (5)	9:12	1.0	4.53	1.07	<.47 - 12
Lower Mississippian; Kentucky	5 (16)	112:112	8.0	2.35	1.04	1.2 - 30
Upper Mississippian; Kentucky	5 (16)	152:152	2.7	2.58	1.11	.45 - 26
Mississippian; Missouri, Oklahoma, and Arkansas	7 (5)	28:40	1.1	4.53	1.07	<.47 - 24
Pennsylvanian; Kentucky	5 (16)	80:80	7.2	2.41	1.08	.70 - 21
Pennsylvanian; Missouri, Kansas, and Oklahoma	6 (5)	32:32	2.9	2.98	1.07	.47 - 17
Siderite						
Upper Paleozoic; Kentucky	11 (16)	30:30	6.8	1.95	--	1.6 - 26
UNCONSOLIDATED GEOLOGIC DEPOSITS						
Carbonate residuum (terra rossa)						
On Gasconade Formation; Missouri	12 (5)	24:24	29	1.21	1.03	15 - 36
On Roubidoux Formation; Missouri	12 (5)	24:24	31	1.21	1.03	18 - 43
On Jefferson City, Cotter, and Powell Formations; Missouri and Arkansas	12 (5)	24:24	30	1.09	1.03	24 - 36
On Osagean rocks; Missouri	12 (5)	24:24	26	1.17	1.03	21 - 34
On Meramecian rocks; Missouri	12 (5)	24:24	25	1.19	1.03	19 - 36
Loess						
Missouri	13 (5)	24:24	34	1.05	--	30 - 36
SOILS						
Cultivated						
Plow zone, corn field; Missouri						
Floodplain Forest	17 (5)	8:8	*38	*3.09	--	31 - 42
Glaciated Prairie	17 (5)	10:10	*35	*1.64	--	32 - 37
Unglaciated Prairie	17 (5)	10:10	*37	*2.35	--	35 - 42
Oak-hickory Forest	17 (5)	10:10	*38	*2.23	--	35 - 41
Plow zone, soybean field; Missouri						
Floodplain Forest	17 (5)	10:10	*37	*2.94	--	33 - 42
Glaciated Prairie	17 (5)	10:10	*35	*.83	--	33 - 36
Unglaciated Prairie	17 (5)	8:8	*37	*2.29	--	36 - 41
Oak-hickory Forest	17 (5)	9:9	*38	*2.39	--	33 - 41

TABLE 40.—*Silicon in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (percent)	Deviation	Error	Observed range (percent)
SOILS--Continued						
Cultivated--Continued						
Surface horizon; Missouri	16 (5)	1,140:1,140	*35	*2.77	*1.32	23 - 43
Uncultivated						
A horizon; Kentucky	18 (16)	96:96	*38	*2.24	*.40	28 - 41
	19 (16)	108:108	39	1.04	1.01	31 - 42
B horizon; Kentucky	18 (16)	96:96	*35	*2.93	*.40	26 - 41
B horizon; Missouri						
Floodplain Forest	20 (5)	50:50	*36	*3.60	--	27 - 42
Glaciated Prairie	20 (5)	50:50	*32	*2.36	--	27 - 37
Unglaciated Prairie	20 (5)	50:50	*34	*3.18	--	26 - 40
Cedar Glade	20 (5)	50:50	*29	*8.14	--	7 - 43
Oak-hickory Forest	20 (5)	50:50	*39	*3.47	--	22 - 43
Oak-hickory-pine Forest	20 (5)	50:50	*41	*2.65	--	33 - 44
C horizon; Kentucky	18 (16)	96:96	*34	*3.87	*.40	25 - 42
Cultivated and uncultivated						
Surface horizon; Colorado	22 (5)	168:168	33	1.16	1.02	10 - 42
PLANT ASH						
Native species						
Hickory, pignut; Kentucky	19 (6)	88:88	1.3	1.48	1.81	0.50 - 3.8
Hickory, shagbark; Kentucky	18 (6)	2:2	.83	1.25	--	.71 - .98
	19 (6)	20:20	1.3	1.38	1.81	.69 - 2.5
Oak, red; Kentucky	19 (6)	8:9	.29	2.74	1.81	<.34 - 3.7

TABLE 41.—*Silver in rocks, soils, and plant ash*

[Explanation of column headings: Study No. refers to study described in text; method of analysis (in parentheses) refers to method listed in table 1. Ratio, number of samples in which the element was found in measurable concentrations to number of samples analyzed. Mean, geometric mean. Deviation, geometric deviation. Error, geometric error attributed to laboratory procedures. Leaders (--) in figure column indicate no data available]

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
ROCKS						
Shale						
Mississippian; Missouri, Oklahoma, and Arkansas	7 (1)	3:18	<0.5	--	--	<0.5 - 3

TABLE 41.—*Silver in rocks, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
ROCKS--Continued						
Black shale						
Devonian and Mississippian; Kentucky-	9 (3)	43:88	0.18	2.22	1.66	<0.2 - 0.90
Limestone and dolomite						
Lower Mississippian; Kentucky--------	5 (1)	1:112	<10	--	--	<10 - 10
SOILS						
Cultivated						
Surface horizon; Missouri----------	16 (1)	4:1,140	<0.5	--	--	<0.5 - 3
Uncultivated						
B horizon; Oak-hickory Forest, Missouri----------	20 (1)	1:50	<.5	--	--	<.5 - 3
Cultivated and uncultivated						
Surface horizon; Colorado----------	22 (1)	3:168	<.5	--	--	<.5 - 1.5
B horizon; Western United States-----	21 (1)	4:477	<.5	--	--	<.5 - 5
PLANT ASH						
Cultivated plants						
Bean, snap; Georgia----------	14 (1)	1:30	<0.5	--	--	<0.5 - 2
Cabbage; Georgia----------	14 (1)	1:28	<.5	--	--	<.5 - 2
Tomato; Georgia----------	14 (1)	3:30	<.5	--	--	<.5 - 7
Native species						
Black cherry, stems; Georgia---------	14 (1)	1:30	< 5	--	--	<.5 - 2
Black cherry, leaves; Georgia--------	14 (1)	1:30	<.5	--	--	<.5 - 5
Blackgum, stems; Georgia----------	14 (1)	4:30	<.5	--	--	<.5 - 5
Blackgum, leaves; Georgia----------	14 (1)	2:30	<.5	--	--	<.5 - 2
Cedar; Missouri						
Oak-hickory Forest----------	20 (1)	2:10	<1	--	--	<1 - 5
Oak-hickory-pine Forest----------	20 (1)	1:10	<1	--	--	<1 - 1.5
Hickory, pignut; Kentucky----------	18 (2)	1:64	<.4	--	--	<.4 - 7
Maple, red, stems; Georgia----------	14 (1)	1:30	<.5	--	--	<.5 - 3
Oak, red; Kentucky----------	18 (2)	2:28	<.4	--	--	<.4 - 20
Oak, white; Kentucky----------	18 (2)	3:49	<.4	--	--	<.4 - 3
Pine, shortleaf; Oak-hickory-pine Forest, Missouri----------	20 (1)	14:49	.5	2.53	--	<1 - 3
Sassafras, leaves; Georgia----------	14 (1)	1:17	<.5	--	--	<.5 - 3
Sweetgum, stems; Georgia----------	15 (1)	1:27	<.5	--	--	<.5 - 2

TABLE 42.—*Sodium in rocks, unconsolidated geologic deposits, soils, and plant ash*

[Explanation of column headings: Study No. refers to study described in text; method of analysis (in parentheses) refers to method listed in table 1. Ratio, number of samples in which the element was found in measurable concentrations to number of samples analyzed. Mean, geometric mean except that values preceded by asterisk are arithmetic mean. Deviation, geometric deviation except that values preceded by asterisk are standard deviation. Error, geometric error attributed to laboratory procedures except that values preceded by asterisk are standard error. Leaders (--) in figure column indicate no data available]

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (percent)	Deviation	Error	Observed range (percent)
ROCKS						
Granite						
Precambrian; Missouri	1 (3)	30:30	2.8	1.38	1.03	2.1 - 3.5
Sandstone						
Roubidoux Formation; Missouri	4 (3)	12:12	.013	2.53	1.45	.0074 - .059
Pope Megagroup;[1] Kentucky	5 (16)	108:120	.098	5.03	3.53	<.0074 - 2.2
Pennsylvanian; Kentucky	5 (16)	143:152	.19	4.93	3.01	<.0074 - 1.6
Chert						
Mississippian; Missouri, Oklahoma, and Arkansas	7 (3)	19:20	.013	1.71	1.45	<.0074 - .022
Shale						
Sauk sequence; Western United States	3 (16	326:336	.17	3.15	2.21	<.015 - 2.8
Lower Mississippian; Kentucky	8 (16)	76:76	.39	1.86	--	.074 - 1.0
Upper Mississippian; Kentucky	5 (16)	134:142	.15	2.93	--	<.0074 - .89
Mississippian; Missouri, Oklahoma, and Arkansas	7 (3)	18:18	.088	2.16	1.54	.03 - .41
Pennsylvanian; Kentucky	5 (16)	150:152	.27	2.40	1.91	<.0074 - 1.4
Pennsylvanian; Missouri, Kansas, and Oklahoma	6 (3)	32:32	.50	1.67	1.54	.30 - 1.1
Limestone and dolomite						
Sauk sequence; Missouri and Arkansas	4 (3)	48:48	.027	1.48	1.44	.015 - .58
Upper Ordovician; Kentucky	5 (16)	69:80	.077	4.10	3.09	<.0074 - .51
Tippecanoe sequence; Missouri	10 (3)	12:12	.013	2.33	1.44	.0074 - .55
Lower Mississippian; Kentucky	5 (16)	79:112	.028	6.45	3.62	<.0074 - .44
Upper Mississippian; Kentucky	5 (16)	103:152	.020	6.10	3.84	<.0074 - .59
Mississippian; Missouri, Oklahoma, and Arkansas	7 (3)	38:40	.017	2.63	1.44	<.0074 - .096
Pennsylvanian; Kentucky	5 (16)	75:80	.17	3.82	2.29	<.0074 - .74
Pennsylvanian; Missouri, Kansas, and Oklahoma	6 (3)	32:32	.045	2.43	1.44	.015 - .27
UNCONSOLIDATED GEOLOGIC DEPOSITS						
Carbonate residuum (terra rossa)						
On Gasconade Formation; Missouri	12 (3)	24:24	0.032	1.58	1.14	0.015 - 0.18
On Roubidoux Formation; Missouri	12 (3)	24:24	.035	1.57	1.14	.015 - .13

[1] Of Swann and Willman (1961).

TABLE 42.—*Sodium in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (percent)	Deviation	Error	Observed range (percent)
UNCONSOLIDATED GEOLOGIC DEPOSITS--Continued						
Carbonate residuum (terra rossa)--Continued						
On Jefferson City, Cotter, and Powell Formations; Missouri and Arkansas--	12 (3)	24:24	0.038	1.25	1.14 0.022	- 0.074
On Osagean rocks; Missouri----------	12 (3)	24:24	.036	1.51	1.14 .015	- .074
On Meramecian rocks; Missouri--------	12 (3)	24:24	.045	1.42	1.14 .022	- .16
Loess						
Missouri----------	13 (3)	24:24	.95	1.21	-- .53	- 1.2
SOILS						
Cultivated						
Plow zone, corn field; Missouri						
Floodplain Forest----------	17 (3)	8:8	0.79	1.11	1.02 0.68	- 0.93
Glaciated Prairie----------	17 (3)	10:10	.69	1.13	1.02 .54	- .78
Unglaciated Prairie----------	17 (3)	10:10	.45	1.84	1.02 .16	- .85
Oak-hickory Forest----------	17 (3)	10:10	.55	1.68	1.02 .23	- .91
Plow zone, soybean field; Missouri						
Floodplain Forest----------	17 (3)	10:10	.76	1.15	1.02 .60	- .96
Glaciated Prairie----------	17 (3)	10:10	.68	1.09	1.02 .58	- .76
Unglaciated Prairie----------	17 (3)	8:8	.56	1.50	1.02 .30	- .89
Oak-hickory Forest----------	17 (3)	9:9	.53	1.49	1.02 .22	- .76
Plow zone, pasture field; Missouri						
Floodplain Forest----------	17 (3)	10:10	.74	1.22	1.02 .49	- .94
Glaciated Prairie----------	17 (3)	10:10	.70	1.11	1.02 .57	- .82
Unglaciated Prairie----------	17 (3)	10:10	.50	1.50	1.02 .26	- .76
Oak-hickory Forest----------	17 (3)	10:10	.51	1.67	1.02 .21	- .94
Surface horizon; Missouri----------	16 (3)	1,140:1,140	*.53	*.23	*.03 .07	- 1.2
Uncultivated						
A horizon; Georgia----------	14 (12)	6:30	<.02	--	-- <.02	- .15
	15 (12)	29:30	.21	2.82	-- <.02	- .7
A horizon; Kentucky----------	18 (16)	92:96	.25	3.07	1.35 <.02	- 1.3
B horizon; Georgia----------	14 (12)	3:30	<.02	--	-- <.02	- .7
	15 (12)	29:30	.20	2.86	-- <.02	- 1.0
B horizon; Kentucky----------	18 (16)	89:96	.24	3.25	1.35 <.02	- 1.1
B horizon; Missouri						
Floodplain Forest----------	20 (3)	50:50	.62	1.65	1.42 .04	- 1.0
Glaciated Prairie----------	20 (3)	50:50	.50	1.45	1.42 .13	- .81
Unglaciated Prairie----------	20 (3)	50:50	.38	1.62	1.42 .10	- .81
Cedar Glade----------	20 (3)	50:50	.13	1.70	1.42 .06	- .74
Oak-hickory Forest----------	20 (3)	50:50	.27	2.01	1.42 .04	- .78
Oak-hickory-pine Forest----------	20 (3)	50:50	.19	1.86	1.42 .06	- .89
C horizon; Georgia----------	14 (12)	3:30	<.05	--	-- <.05	- .1
	15 (12)	30:30	.20	2.35	-- .03	- .7
C horizon; Kentucky----------	18 (16)	86:96	.16	4.64	1.35 <.01	- 1.4

TABLE 42.—*Sodium in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (percent)	Deviation	Error	Observed range (percent)
SOILS--Continued						
Cultivated and uncultivated						
Surface horizon; Colorado	22 (3)	168:168	0.98	1.70	1.05 0.12	- 2.2
B horizon; Eastern United States	21 (12)	245:304	.26	4.11	-- <.02	- 1.5
B horizon; Western United States	21 (12)	484:484	1.0	1.98	-- .05	- 10
PLANT ASH						
Cultivated plants						
Corn; Missouri						
Floodplain Forest	17 (3)	8:8	0.0039	1.67	1.23 0.0025	- 0.010
Glaciated Prairie	17 (3)	10:10	.0032	1.51	1.23 .0025	- .0075
Unglaciated Prairie	17 (3)	7:10	.0025	--	-- <.0025	- .0050
Oak-hickory Forest	17 (3)	8:10	.0025	--	-- <.0025	- .0050
Soybean; Missouri						
Floodplain Forest	17 (3)	10:10	.0033	1.43	1.23 .0025	- .0050
Glaciated Prairie	17 (3)	8:10	.0025	--	-- <.0025	- .0050
Unglaciated Prairie	17 (3)	8:8	.0037	1.56	1.23 .0025	- .0075
Oak-hickory Forest	17 (3)	8:9	.0033	1.77	1.23 <.0025	- .0075
Native species						
Buckbush; Missouri						
Glaciated Prairie	20 (3)	47:47	.097	1.40	1.36 .03	- .20
Unglaciated Prairie	20 (3)	46:46	.096	1.28	1.36 .05	- .15
Cedar Glade	20 (3)	47:47	.064	1.27	1.36 .04	- .10
Oak-hickory Forest	20 (3)	44:44	.082	1.36	1.36 .05	- .17
Oak-hickory-pine Forest	20 (3)	39:39	.077	1.27	1.36 .05	- .16
Cedar; Missouri						
Cedar Glade	20 (3)	49:49	.022	1.46	1.36 .01	- .05
Glaciated Prairie	24 (3)	9:9	.28	1.36	-- .16	- .40
Unglaciated Prairie	24 (3)	10:10	.31	1.33	-- .20	- .42
Cedar Glade	24 (3)	10:10	.20	1.25	-- .12	- .26
Oak-hickory Forest	24 (3)	10:10	.27	1.65	-- .14	- .48
Oak-hickory-pine Forest	24 (3)	6:6	.27	1.34	-- .20	- .42
Hickory, pignut; Kentucky	18 (3)	64:64	.11	1.45	1.47 .06	- .26
	19 (3)	88:88	.10	1.31	1.36 .06	- .27
Hickory, shagbark; Kentucky	18 (3)	40:40	.11	1.52	1.47 .05	- .30
	19 (3)	20:20	.10	1.27	1.36 .06	- .14
Hickory, shagbark; Missouri						
Oak-hickory Forest	20 (3)	19:19	.028	1.55	1.36 .02	- .05
Oak-hickory-pine Forest	20 (3)	7:7	.032	1.33	1.36 .02	- .05
Oak, black; Kentucky	18 (3)	25:25	.13	1.52	1.47 .06	- .39
	19 (3)	22:22	.12	1.36	1.36 .08	- .87
Oak, post; Cedar Glade, Missouri	20 (3)	49:49	.042	1.46	1.36 .02	- .16
Oak, red; Kentucky	18 (3)	28:28	.14	1.59	1.47 .06	- .60
	19 (3)	9:9	.13	1.37	1.36 .09	- .24
Oak, white; Kentucky	18 (3)	49:49	.16	1.58	1.47 .08	- .50
	19 (3)	76:76	.15	1.43	1.36 .05	- .34

TABLE 42.—*Sodium in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (percent)	Deviation	Error	Observed range (percent)
PLANT ASH--Continued						
Native species--Continued						
Oak, white; Missouri						
Oak-hickory Forest	20 (3)	50:50	0.038	1.33	1.36 0.02	- 0.07
Oak-hickory-pine Forest	20 (3)	49:49	.034	1.30	1.36 .02	- .06
Oak, willow; Floodplain Forest, Missouri	20 (3)	46:46	.084	1.54	1.36 .03	- .26
Pine, shortleaf; Oak-hickory-pine Forest, Missouri	20 (3)	48:48	.058	1.45	1.36 .02	- .15
Sumac, smooth; Missouri						
Floodplain Forest	20 (3)	48:48	.031	1.64	1.36 .01	- .10
Glaciated Prairie	20 (3)	50:50	.025	1.60	1.36 .01	- .12
Unglaciated Prairie	20 (3)	49:49	.022	1.88	1.36 .01	- .14
Cedar Glade	20 (3)	48:48	.023	1.60	1.36 .01	- .16
Oak-hickory Forest	20 (3)	50:50	.023	1.46	1.36 .01	- .04
Oak-hickory-pine Forest	20 (3)	49:49	.028	1.57	1.36 .01	- .07
Sweetgum; Floodplain Forest, Missouri	20 (3)	47:47	.067	1.57	1.36 .03	- .22

TABLE 43.—*Strontium in rocks, unconsolidated geologic deposits, soils, and plant ash*

[Explanation of column headings: Study No. refers to study described in text; method of analysis (in parentheses) refers to method listed in table 1. Ratio, number of samples in which the element was found in measurable concentrations to number of samples analyzed. Mean, geometric mean. Deviation, geometric deviation. Error, geometric error attributed to laboratory procedures. Leaders (--) in figure column indicate no data available]

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
ROCKS						
Granite						
Precambrian; Missouri	1 (1)	30:30	81	2.12	1.16	15 - 300
Rhyolite						
Precambrian; Missouri	1 (1)	30:30	64	2.18	1.16	20 - 300
Arkose						
Fountain Formation; Colorado	2 (2)	79:80	99	2.12	1.22	<10 - 440
Sandstone						
Sauk sequence; Western United States	3 (2)	329:400	31	3.37	1.31	<10 - 2,200
Roubidoux Formation; Missouri	4 (1)	12:12	13	2.23	1.25	5 - 50

TABLE 43.—*Strontium in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
ROCKS--Continued						
Sandstone--Continued						
Pope Megagroup;[1] Kentucky	5 (2)	94:120	34	2.53	1.45	<20 - 300
Pennsylvanian; Kentucky	5 (2)	145:152	43	2.51	1.49	<10 - 380
Pennsylvanian; Missouri, Kansas, and Oklahoma	6 (1)	32:32	95	4.19	1.25	7 - 700
Chert						
Mississippian; Missouri, Oklahoma, and Arkansas	7 (1)	16:20	8.1	2.55	1.25	<5 - 70
Shale						
Sauk sequence; Western United States	3 (2)	327:336	150	2.08	1.13	<30 - 4,000
Lower Mississippian; Kentucky	8 (2)	73:76	92	1.60	--	<30 - 260
Upper Mississippian; Kentucky	5 (2)	139:142	110	1.80	--	<30 - 960
Mississippian; Missouri, Oklahoma, and Arkansas	7 (1)	18:18	150	1.87	1.17	70 - 700
Pennsylvanian; Kentucky	5 (2)	149:152	120	1.62	1.22	<30 - 260
Pennsylvanian; Missouri, Kansas, and Oklahoma	6 (1)	32:32	200	1.65	1.17	100 - 1,000
Black shale						
Devonian and Mississippian; Kentucky	9 (2)	88:88	90	1.39	1.14	30 - 220
Limestone and dolomite						
Sauk sequence; Missouri and Arkansas	4 (1)	48:48	100	1.56	1.23	30 - 200
Upper Ordovician; Kentucky	5 (1)	80:80	450	2.23	1.49	100 - 2,000
Tippecanoe sequence; Missouri	10 (1)	12:12	360	2.27	1.23	150 - 1,500
Lower Mississippian; Kentucky	5 (1)	112:112	360	2.04	1.25	70 - 1,500
Upper Mississippian; Kentucky	5 (1)	152:152	540	1.85	1.45	100 - 5,000
Mississippian; Missouri, Oklahoma, and Arkansas	7 (1)	40:40	270	3.62	1.23	70 - 10,000
Pennsylvanian; Kentucky	5 (1)	80:80	480	1.89	1.29	200 - 5,000
Pennsylvanian; Missouri, Kansas, and Oklahoma	6 (1)	32:32	990	3.86	1.23	70 - 5,000
Siderite						
Upper Paleozoic; Kentucky	11 (1)	30:30	190	1.48	--	100 - 500
UNCONSOLIDATED GEOLOGIC DEPOSITS						
Carbonate residuum (terra rossa)						
On Gasconade Formation; Missouri	12 (1)	24:24	40	1.52	1.25	20 - 100
On Roubidoux Formation; Missouri	12 (1)	24:24	50	1.52	1.25	10 - 300
On Jefferson City, Cotter, and Powell Formations; Missouri and Arkansas	12 (1)	24:24	44	1.40	1.25	30 - 70
On Osagean rocks; Missouri	12 (1)	24:24	62	1.52	1.25	30 - 150
On Meramecian rocks; Missouri	12 (1)	24:24	51	1.57	1.25	30 - 150
Loess						
Missouri	13 (1)	24:24	220	1.28	--	150 - 300

[1] Of Swann and Willman (1961).

TABLE 43.—*Strontium in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
SOILS						
Cultivated						
Plow zone, garden; Georgia	14 (1)	5:30	3.6	2.35	--	<5 - 15
	15 (1)	29:30	33	2.21	--	<5 - 200
Plow zone, corn field; Missouri						
Floodplain Forest	17 (1)	8:8	150	1.21	1.14	100 - 200
Glaciated Prairie	17 (1)	10:10	150	1.21	1.14	100 - 200
Unglaciated Prairie	17 (1)	10:10	110	1.64	1.14	50 - 200
Oak-hickory Forest	17 (1)	10:10	120	1.53	1.14	50 - 200
Plow zone, soybean field; Missouri						
Floodplain Forest	17 (1)	10:10	140	1.19	1.14	100 - 150
Glaciated Prairie	17 (1)	10:10	140	1.14	1.14	100 - 150
Unglaciated Prairie	17 (1)	8:8	120	1.55	1.14	50 - 150
Oak-hickory Forest	17 (1)	9:9	110	1.48	1.14	50 - 150
Plow zone, pasture field; Missouri						
Floodplain Forest	17 (1)	10:10	140	1.14	1.14	100 - 150
Glaciated Prairie	17 (1)	10:10	150	1.21	1.14	100 - 200
Unglaciated Prairie	17 (1)	10:10	110	1.58	1.14	50 - 200
Oak-hickory Forest	17 (1)	10:10	120	1.57	1.14	50 - 200
Surface horizon; Missouri	16 (1)	1,140:1,140	110	1.60	1.25	20 - 500
Uncultivated						
Surface horizon; Powder River Basin, Wyoming and Montana	25 (1)	48:48	160	1.53	1.23	50 - 500
A horizon; Georgia	14 (1)	11:30	5.7	2.73	--	<5 - 50
	15 (1)	29:30	30	2.22	--	<5 - 150
A horizon; Kentucky	18 (2)	95:96	82	1.72	1.10	<5 - 350
	19 (2)	99:108	67	1.81	1.16	<5 - 170
B horizon; Georgia	14 (1)	9:30	6.5	1.61	--	<5 - 15
	15 (1)	29:30	27	1.98	--	<5 - 100
B horizon; Kentucky	18 (2)	96:96	95	1.53	1.10	20 - 240
B horizon; Missouri						
Floodplain Forest	20 (1)	50:50	120	1.32	1.33	70 - 200
Glaciated Prairie	20 (1)	50:50	120	1.35	1.33	70 - 200
Unglaciated Prairie	20 (1)	50:50	95	1.51	1.33	30 - 200
Cedar Glade	20 (1)	50:50	72	1.51	1.33	20 - 150
Oak-hickory Forest	20 (1)	50:50	66	1.66	1.33	30 - 150
Oak-hickory-pine Forest	20 (1)	50:50	42	1.90	1.33	10 - 150
C horizon; Georgia	14 (1)	17:30	9.0	1.84	--	<5 - 50
	15 (1)	30:30	29	1.82	--	10 - 70
C horizon; Kentucky	18 (2)	95:96	88	1.89	1.10	<5 - 330
Cultivated and uncultivated						
Surface horizon; Colorado	22 (1)	168:168	160	1.70	1.29	50 - 500
B horizon; Eastern United States	21 (1)	343:371	51	3.56	--	<5 - 700
B horizon; Western United States	21 (1)	492:492	210	2.12	--	10 - 3,000

TABLE 43.—*Strontium in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
		PLANT ASH				
Cultivated plants						
Asparagus; Wisconsin	23 (1)	5:5	590	2.38	--	300 - 2,000
Bean, lima; Georgia	14 (1)	30:30	88	1.63	--	30 - 300
	15 (1)	15:15	140	2.28	--	50 - 1,000
Bean, snap; Georgia	14 (1)	30:30	210	1.80	--	50 - 700
	15 (1)	30:30	290	1.75	--	100 - 700
Beet, red; Wisconsin	23 (1)	3:3	420	1.34	--	300 - 500
Blackeyed pea; Georgia	14 (1)	29:29	180	1.81	--	50 - 500
	15 (1)	4:4	130	1.40	--	100 - 200
Cabbage; Georgia	14 (1)	28:28	620	2.34	--	100 - 3,000
	15 (1)	30:30	880	1.89	--	200 - 3,000
Cabbage; Wisconsin	23 (1)	11:11	410	3.10	--	30 - 1,500
Carrot; Wisconsin	23 (1)	8:8	300	2.68	--	30 - 700
Corn; Georgia	14 (1)	24:29	52	1.75	--	<7 - 150
	15 (1)	30:30	50	1.95	--	15 - 150
Corn; Missouri						
Floodplain Forest	17 (1)	6:8	14	2.73	1.22	<7 - 50
Glaciated Prairie	17 (1)	9:10	17	1.72	1.22	<7 - 30
Unglaciated Prairie	17 (1)	10:10	15	1.55	1.22	7 - 30
Oak-hickory Forest	17 (1)	9:10	17	2.04	1.22	<7 - 50
Corn; Wisconsin	23 (1)	21:21	21	2.02	--	7 - 70
Cucumber; Wisconsin	23 (1)	4:4	340	1.29	--	300 - 500
Onion; Wisconsin	23 (1)	7:7	370	1.72	--	200 - 700
Pepper, sweet; Wisconsin	23 (1)	4:4	93	1.58	--	50 - 150
Potato; Wisconsin	23 (1)	10:10	75	2.53	--	30 - 700
Soybean; Missouri						
Floodplain Forest	17 (1)	10:10	330	1.72	1.22	150 - 700
Glaciated Prairie	17 (1)	10:10	290	1.63	1.22	200 - 500
Unglaciated Prairie	17 (1)	8:8	430	1.38	1.22	300 - 700
Oak-hickory Forest	17 (1)	9:9	170	1.83	1.22	70 - 500
Tomato; Georgia	14 (1)	29:30	71	1.96	--	<7 - 300
	15 (1)	30:30	69	2.00	--	15 - 700
Native species						
Black cherry, stems; Georgia	14 (1)	30:30	1,900	1.68	--	700 - 7,000
	15 (1)	30:30	2,400	2.29	--	300 - 7,000
Black cherry, leaves; Georgia	14 (1)	30:30	1,200	1.74	--	500 - 5,000
	15 (1)	30:30	1,600	2.11	--	300 - 5,000
Blackgum, stems; Georgia	14 (1)	30:30	1,900	1.93	--	700 - 7,000
	15 (1)	30:30	3,500	2.14	--	1,000 - 20,000
Blackgum, leaves; Georgia	14 (1)	30:30	930	1.72	--	300 - 3,000
	15 (1)	30:30	1,900	1.94	--	700 - 10,000
Buckbush; Missouri						
Glaciated Prairie	20 (1)	47:47	1,800	1.43	1.31	700 - 5,000
Unglaciated Prairie	20 (1)	48:48	1,700	1.46	1.31	700 - 5,000

TABLE 43.—*Strontium in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
PLANT ASH--Continued						
Native species--Continued						
Buckbush; Missouri--Continued						
Cedar Glade	20 (1)	50:50	340	1.52	1.31	200 - 1,500
Oak-hickory Forest	20 (1)	49:49	1,500	1.96	1.31	300 - 5,000
Oak-hickory-pine Forest	20 (1)	41:41	1,500	1.72	1.31	500 - 3,000
Cedar; Missouri						
Cedar Glade	20 (1)	50:50	340	1.63	1.31	200 - 1,000
Glaciated Prairie	24 (1)	9:9	2,200	1.55	--	1,000 - 5,000
Unglaciated Prairie	24 (1)	10:10	2,600	1.50	--	1,500 - 5,000
Cedar Glade	24 (1)	10:10	410	1.55	--	300 - 1,000
Oak-hickory Forest	24 (1)	10:10	2,300	2.01	--	700 - 5,000
Oak-hickory-pine Forest	24 (1)	6:6	2,500	1.72	--	1,000 - 5,000
Hickory, pignut; Kentucky	18 (1)	64:64	5,300	1.54	1.23	1,000 - 10,000
Hickory, shagbark; Kentucky	18 (1)	40:40	4,600	1.70	1.23	1,000 - 10,000
Hickory, shagbark; Missouri						
Oak-hickory Forest	20 (1)	19:19	3,200	2.03	1.31	500 - 7,000
Oak-hickory-pine Forest	20 (1)	7:7	5,100	1.56	1.31	2,000 - 7,000
Maple, red, stems; Georgia	14 (1)	30:30	1,500	1.87	--	700 - 7,000
	15 (1)	30:30	1,800	1.91	--	500 - 10,000
Maple, red, leaves; Georgia	14 (1)	30:30	680	1.97	--	300 - 3,000
	15 (1)	30:30	770	2.04	--	150 - 5,000
Oak, black; Kentucky	18 (1)	25:25	1,900	1.45	1.15	700 - 3,000
Oak, post; Cedar Glade, Missouri	20 (1)	50:50	320	1.53	1.31	200 - 1,500
Oak, red; Kentucky	18 (1)	28:28	1,800	1.55	1.15	1,000 - 5,000
Oak, white; Kentucky	18 (1)	49:49	2,000	1.70	1.15	700 - 7,000
Oak, white; Missouri						
Oak-hickory Forest	20 (1)	50:50	1,800	1.59	1.31	500 - 5,000
Oak-hickory-pine Forest	20 (1)	49:49	2,300	1.88	1.31	500 - 7,000
Oak, willow; Floodplain Forest, Missouri	20 (1)	46:46	1,800	1.36	1.31	1,000 - 3,000
Persimmon, stems; Georgia	14 (1)	30:30	1,100	1.91	--	500 - 5,000
	15 (1)	30:30	1,100	1.96	--	300 - 7,000
Persimmon, leaves; Georgia	14 (1)	30:30	540	2.03	--	150 - 20,000
	15 (1)	30:30	620	1.98	--	200 - 5,000
Pine, shortleaf; Oak-hickory-pine Forest, Missouri	20 (1)	49:49	570	1.85	1.31	200 - 2,000
Sassafras, stems; Georgia	14 (1)	17:17	1,800	2.30	--	300 - 10,000
	15 (1)	27:27	1,700	1.85	--	500 - 7,000
Sassafras, leaves; Georgia	14 (1)	17:17	1,100	2.33	--	300 - 10,000
	15 (1)	27:27	930	1.91	--	200 - 3,000
Sumac, winged, stems; Georgia	14 (1)	30:30	2,200	1.71	--	700 - 7,000
	15 (1)	30:30	2,300	2.22	--	500 - 7,000
Sumac, winged, leaves; Georgia	14 (1)	30:30	1,100	1.59	--	500 - 3,000
	15 (1)	30:30	1,100	1.59	--	500 - 3,000
Sumac, smooth; Missouri						
Floodplain Forest	20 (1)	48:48	3,400	1.62	1.31	1,000 - 10,000
Glaciated Prairie	20 (1)	50:50	3,500	1.49	1.31	2,000 - 7,000

TABLE 43.—*Strontium in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
PLANT ASH--Continued						
Native species--Continued						
Sumac, smooth; Missouri--Continued						
Unglaciated Prairie	20 (1)	49:49	3,700	1.46	1.31	1,500 - 5,000
Cedar Glade	20 (1)	49:49	400	1.72	1.31	200 - 3,000
Oak-hickory Forest	20 (1)	50:50	2,700	2.19	1.31	300 - 10,000
Oak-hickory-pine Forest	20 (1)	49:49	3,100	1.79	1.31	700 - 7,000
Sweetgum, stems; Georgia	14 (1)	18:28	1,200	1.87	--	500 - 7,000
	15 (1)	27:27	1,500	2.03	--	300 - 7,000
Sweetgum, leaves; Georgia	14 (1)	28:28	620	1.80	--	200 - 2,000
	15 (1)	27:27	750	1.98	--	200 - 3,000
Sweetgum; Floodplain Forest, Missouri	20 (1)	47:47	2,000	1.51	1.31	1,000 - 7,000

TABLE 44.—*Thorium in soils*

[Explanation of column headings: Study No. refers to study described in text; method of analysis (in parentheses) refers to method listed in table 1. Ratio, number of samples in which the element was found in measurable concentrations to number of samples analyzed. Mean, geometric mean. Deviation, geometric deviation. Error, geometric error attributed to laboratory procedures. Leaders (--) in figure column indicate no data available]

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
Uncultivated						
Surface horizon; Powder River Basin, Wyoming and Montana	25 (8)	48:48	9.4	1.26	--	5.3 - 15

TABLE 45.—*Tin in rocks, soils, and plant ash*

[Explanation of column headings: Study No. refers to study described in text; method of analysis (in parentheses) refers to method listed in table 1. Ratio, number of samples in which the element was found in measurable concentrations to number of samples analyzed. Mean, geometric mean. Deviation, geometric deviation. Error, geometric error attributed to laboratory procedures. Leaders (--) in figure column indicate no data available]

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
ROCKS						
Rhyolite						
Precambrian; Missouri	1 (1)	1:30	<10	--	--	<10 - 20
SOILS						
Cultivated						
Plow zone, garden; Georgia	14 (1)	2:30	<10	--	--	<10 - 20
	15 (1)	3:30	<10	--	--	<10 - 20
Plow zone, corn field; Missouri						
Glaciated Prairie	17 (1)	1:10	<10	--	--	<10 - 10
Oak-hickory Forest	17 (1)	1:10	<10	--	--	<10 - 100
Plow zone, soybean field; Missouri						
Glaciated Prairie	17 (1)	1:10	<10	--	--	<10 - 10
Unglaciated Prairie	17 (1)	1:8	<10	--	--	<10 - 70
Plow zone, pasture field; Glaciated Prairie, Missouri	17 (1)	1:10	<10	--	--	<10 - 30
Surface horizon; Missouri	16 (1)	9:1,140	<10	--	--	<10 - 50
Cultivated and uncultivated						
Surface horizon; Colorado	22 (1)	4:168	<10	--	--	<10 - 30
B horizon; Eastern United States	21 (1)	2:371	<10	--	--	<10 - 15
B horizon; Western United States	21 (1)	7:492	<10	--	--	<10 - 20
PLANT ASH						
Cultivated plants						
Carrot; Wisconsin	23 (1)	1:8	<15	--	--	<15 - 20
Corn; Wisconsin	23 (1)	1:27	<15	--	--	<15 - 30
Beet, red; Wisconsin	23 (1)	1:3	<15	--	--	<15 - 20
Native species						
Buckbush; Missouri						
Glaciated Prairie	20 (1)	1:47	<15	--	--	<15 - 30
Unglaciated Prairie	20 (1)	1:48	<15	--	--	<15 - 20

TABLE 46.—*Titanium in rocks, unconsolidated geologic deposits, soils, and plant ash*

[Explanation of column headings: Study No. refers to study described in text; method of analysis (in parentheses) refers to method listed in table 1. Ratio, number of samples in which the element was found in measurable concentrations to number of samples analyzed. Mean, geometric mean. Deviation, geometric deviation. Error, geometric error attributed to laboratory procedures. Leaders (--) in figure column indicate no data available]

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
ROCKS						
Granite						
Precambrian; Missouri	1 (1)	30:30	1,200	1.83	1.10	500 - 5,000
Rhyolite						
Precambrian; Missouri	1 (1)	30:30	1,400	1.47	1.10	700 - 3,000
Arkose						
Fountain Formation; Colorado	2 (2)	80:80	600	1.79	1.26	180 - 2,900
Sandstone						
Sauk sequence; Western United States	3 (16)	373:400	570	4.21	1.76	<60 - 17,000
Roubidoux Formation; Missouri	4 (1)	12:12	83	5.63	1.29	20 - 5,000
Pope Megagroup;[1] Kentucky	5 (16)	120:120	1,800	1.75	2.45	480 - 5,900
Pennsylvanian; Kentucky	5 (16)	152:152	2,200	2.15	1.39	120 - 6,600
Pennsylvanian; Missouri, Kansas, and Oklahoma	6 (1)	32:32	2,200	2.79	1.29	70 - 7,000
Chert						
Mississippian; Missouri, Oklahoma, and Arkansas	7 (1)	20:20	20	5.15	1.29	2 - 200
Shale						
Sauk sequence; Western United States	3 (16)	336:336	3,900	1.66	1.23	600 - 17,000
Lower Mississippian; Kentucky	8 (16)	76:76	3,600	1.55	--	1,000 - 6,600
Upper Mississippian; Kentucky	5 (16)	142:142	4,700	1.23	--	2,200 - 7,200
Mississippian; Missouri, Oklahoma, and Arkansas	7 (1)	18:18	2,300	1.76	1.17	700 - 5,000
Pennsylvanian; Kentucky	5 (16)	152:152	5,700	1.21	1.05	2,400 - 13,000
Pennsylvanian; Missouri, Kansas, and Oklahoma	6 (1)	32:32	4,200	1.41	1.17	2,000 - 5,000
Black shale						
Devonian and Mississippian; Kentucky	9 (2)	88:88	3,900	1.30	1.15	1,300 - 7,400
Limestone and dolomite						
Sauk sequence; Western United States	3 (2)	375:392	170	3.49	1.22	<20 - 2,800
Sauk sequence; Missouri and Arkansas	4 (1)	47:48	34	4.96	1.38	<2 - 200
Upper Ordovician; Kentucky	5 (1)	80:80	390	2.47	1.48	50 - 2,000
Tippecanoe sequence; Missouri	10 (1)	10:12	31	8.60	1.38	<2 - 500
Lower Mississippian; Kentucky	5 (1)	112:112	280	2.99	1.37	50 - 3,000
Upper Mississippian; Kentucky	5 (1)	152:152	140	2.90	1.50	10 - 2,000
Pennsylvanian; Kentucky	5 (1)	80:80	810	2.74	1.31	100 - 3,000
Pennsylvanian; Missouri, Kansas, and Oklahoma	6 (1)	32:32	180	3.16	1.38	30 - 1,000

[1] Of Swann and Willman (1961).

TABLE 46.—*Titanium in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
ROCKS--Continued						
Siderite						
Upper Paleozoic; Kentucky	11 (1)	30:30	750	2.08	--	150 - 3,000
UNCONSOLIDATED GEOLOGIC DEPOSITS						
Carbonate residuum (terra rossa)						
On Gasconade Formation; Missouri	12 (1)	24:24	1,400	1.26	1.11	700 - 2,000
On Roubidoux Formation; Missouri	12 (1)	24:24	1,400	1.30	1.11	1,000 - 3,000
On Jefferson City, Cotter, and Powell Formations; Missouri and Arkansas	12 (1)	24:24	1,500	1.17	1.11	1,000 - 2,000
On Osagean rocks; Missouri	12 (1)	24:24	1,500	1.14	1.11	1,000 - 2,000
On Meramecian rocks; Missouri	12 (1)	24:24	1,500	1.17	1.11	1,000 - 2,000
Loess						
Missouri	13 (1)	24:24	3,800	1.37	--	2,000 - 7,000
SOILS						
Cultivated						
Plow zone, garden; Georgia	14 (1)	30:30	1,900	1.36	--	1,000 - 3,000
	15 (1)	30:30	3,200	1.41	--	2,000 - 7,000
Plow zone, corn field; Missouri						
Floodplain Forest	17 (1)	8:8	2,200	1.49	1.36	1,500 - 5,000
Glaciated Prairie	17 (1)	10:10	2,700	1.35	1.36	2,000 - 5,000
Unglaciated Prairie	17 (1)	10:10	3,100	1.49	1.36	1,500 - 5,000
Oak-hickory Forest	17 (1)	10:10	3,400	1.35	1.36	2,000 - 5,000
Plow zone, soybean field; Missouri						
Floodplain Forest	17 (1)	10:10	1,800	1.34	1.36	1,000 - 3,000
Glaciated Prairie	17 (1)	10:10	2,600	1.36	1.36	2,000 - 5,000
Unglaciated Prairie	17 (1)	8:8	3,100	1.42	1.36	2,000 - 5,000
Oak-hickory Forest	17 (1)	9:9	4,000	1.31	1.36	3,000 - 5,000
Plow zone, pasture field; Missouri						
Floodplain Forest	17 (1)	10:10	1,700	1.34	1.36	1,000 - 3,000
Glaciated Prairie	17 (1)	10:10	2,700	1.39	1.36	1,500 - 3,000
Unglaciated Prairie	17 (1)	10:10	3,700	1.30	1.36	3,000 - 5,000
Oak-hickory Forest	17 (1)	10:10	2,900	1.29	1.36	2,000 - 5,000
Surface horizon; Missouri	16 (1)	1,140:1,140	3,300	1.31	1.20	1,500 - 7,000
Uncultivated						
Surface horizon; Powder River Basin, Wyoming and Montana	25 (1)	48:48	1,900	1.21	1.12	1,500 - 3,000
A horizon; Georgia	14 (1)	30:30	1,700	1.94	--	700 - 7,000
	15 (1)	30:30	2,900	1.50	--	700 - 5,000
A horizon; Kentucky	18 (16)	96:96	6,600	1.31	1.04	2,700 - 12,000
	19 (16)	108:108	5,600	1.13	1.07	3,700 - 7,800

TABLE 46.—*Titanium in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
SOILS--Continued						
Uncultivated--Continued						
B horizon; Georgia	14 (1)	30:30	1,800	1.64	--	700 - 7,000
	15 (1)	30:30	3,600	1.55	--	1,000 - 7,000
B horizon; Kentucky	18 (16)	96:96	6,100	1.33	1.04	2,600 - 11,000
B horizon; Missouri						
Floodplain Forest	20 (1)	50:50	2,600	1.51	1.19	1,000 - 5,000
Glaciated Prairie	20 (1)	50:50	3,700	1.30	1.19	3,000 - 7,000
Unglaciated Prairie	20 (1)	50:50	3,900	1.34	1.19	3,000 - 7,000
Cedar Glade	20 (1)	50:50	1,900	1.43	1.19	700 - 3,000
Oak-hickory Forest	20 (1)	50:50	3,500	1.44	1.19	1,500 - 7,000
Oak-hickory-pine Forest	20 (1)	50:50	3,300	1.61	1.19	1,000 - 7,000
C horizon; Georgia	14 (1)	30:30	2,100	1.65	--	700 - 10,000
	15 (1)	30:30	3,600	1.47	--	1,500 - 7,000
C horizon; Kentucky	18 (16)	96:96	5,200	1.40	1.04	1,600 - 10,000
Cultivated and uncultivated						
Surface horizon; Colorado	22 (1)	168:168	1,600	1.58	1.22	500 - 3,000
B horizon; Western United States	21 (1)	491:491	2,100	1.82	--	500 - 10,000
PLANT ASH						
Cultivated plants						
Asparagus; Wisconsin	23 (1)	5:5	180	1.16	--	150 - 200
Bean, lima; Georgia	14 (1)	26:30	8.3	3.93	--	<2 - 200
Bean, snap; Georgia	14 (1)	30:30	73	2.69	--	3 - 500
	15 (1)	30:30	70	2.59	--	5 - 700
Beet, red; Wisconsin	23 (1)	3:3	27	2.65	--	10 - 70
Blackeyed pea; Georgia	14 (1)	29:29	37	2.53	--	5 - 200
	15 (1)	4:4	18	2.96	--	5 - 700
Cabbage; Georgia	14 (1)	28:28	85	2.37	--	15 - 700
	15 (1)	30:30	250	2.82	--	15 - 1,500
Cabbage; Wisconsin	23 (1)	11:11	25	3.77	--	7 - 700
Carrot; Wisconsin	23 (1)	8:8	28	2.67	--	10 - 200
Corn; Georgia	14 (1)	26:29	20	5.00	--	<2 - 500
	15 (1)	29:30	21	3.79	--	<2 - 300
Corn; Missouri						
Floodplain Forest	17 (1)	3:8	<5	--	--	<5 - 700
Glaciated Prairie	17 (1)	2:10	<5	--	--	<5 - 10
Unglaciated Prairie	17 (1)	3:10	<5	--	--	<5 - 200
Corn; Wisconsin	23 (1)	26:27	20	2.11	--	<2 - 150
Cucumber; Wisconsin	23 (1)	4:4	19	1.72	--	10 - 30
Onion; Wisconsin	23 (1)	7:7	41	2.92	--	10 - 200
Pepper, sweet; Wisconsin	23 (1)	4:4	110	1.82	--	50 - 200
Potato; Wisconsin	23 (1)	10:10	18	2.87	--	7 - 200

TABLE 46.—*Titanium in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
PLANT ASH--Continued						
Cultivated plants--Continued						
Soybean; Missouri						
Floodplain Forest	17 (1)	2:10	<5	--	--	<5 - 20
Glaciated Prairie	17 (1)	6:10	5	--	--	<5 - 200
Unglaciated Prairie	17 (1)	5:8	4.7	2.33	--	<5 - 20
Oak-hickory Forest	17 (1)	8:9	11	3.67	--	<5 - 100
Tomato; Georgia	14 (1)	29:30	32	4.31	--	<2 - 700
	15 (1)	24:30	5.6	4.25	--	<2 - 70
Native species						
Black cherry, stems; Georgia	14 (1)	30:30	130	1.82	--	50 - 700
	15 (1)	30:30	110	2.37	--	10 - 700
Black cherry, leaves; Georgia	14 (1)	30:30	170	1.92	--	70 - 1,500
	15 (1)	30:30	140	1.95	--	20 - 500
Blackgum, stems; Georgia	14 (1)	30:30	150	1.81	--	70 - 700
	15 (1)	30:30	140	1.81	--	50 - 500
Blackgum, leaves; Georgia	14 (1)	30:30	200	2.22	--	20 - 1,500
	15 (1)	30:30	240	2.23	--	70 - 2,000
Buckbush; Missouri						
Glaciated Prairie	20 (1)	47:47	980	1.57	1.49	500 - 3,000
Unglaciated Prairie	20 (1)	48:48	1,200	1.76	1.49	150 - 3,000
Cedar Glade	20 (1)	50:50	710	1.51	1.49	300 - 2,000
Oak-hickory Forest	20 (1)	49:49	1,200	1.73	1.49	500 - 3,000
Oak-hickory-pine Forest	20 (1)	41:41	1,000	1.91	1.49	300 - 3,000
Cedar; Missouri						
Cedar Glade	20 (1)	50:50	330	1.67	1.49	150 - 1,500
Glaciated Prairie	24 (1)	9:9	630	1.73	--	300 - 1,500
Unglaciated Prairie	24 (1)	10:10	620	1.79	--	300 - 1,500
Cedar Glade	24 (1)	10:10	250	1.30	--	150 - 300
Oak-hickory Forest	24 (1)	10:10	300	2.04	--	70 - 700
Oak-hickory-pine Forest	24 (1)	6:6	280	2.32	--	100 - 1,000
Hickory, pignut; Kentucky	18 (1)	64:64	120	1.91	1.37	20 - 1,000
	19 (2)	88:88	91	1.43	1.10	30 - 220
Hickory, shagbark; Kentucky	18 (1)	40:40	130	1.60	1.37	50 - 500
	19 (2)	20:20	110	1.45	1.10	60 - 250
Hickory, shagbark; Missouri						
Oak-hickory Forest	20 (1)	19:19	110	1.92	1.49	30 - 200
Oak-hickory-pine Forest	20 (1)	7:7	120	1.57	1.49	70 - 200
Maple, red, stems; Georgia	14 (1)	30:30	86	1.81	--	20 - 300
	15 (1)	30:30	93	1.85	--	5 - 700
Maple, red, leaves; Georgia	14 (1)	30:30	140	2.33	--	30 - 700
	15 (1)	30:30	210	1.84	--	70 - 1,000
Oak, black; Kentucky	18 (1)	25:25	110	1.53	1.36	50 - 200
	19 (2)	22:22	80	1.23	1.10	50 - 110
Oak, post; Cedar Glade, Missouri	20 (1)	50:50	220	1.75	1.49	50 - 500

TABLE 46.—*Titanium in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
PLANT ASH--Continued						
Native species--Continued						
Oak, red; Kentucky	18 (1)	28:28	81	1.99	1.36	10 - 300
	19 (2)	8:8	78	1.25	1.10	50 - 100
Oak, white; Kentucky	18 (1)	49:49	120	1.87	1.36	10 - 1,000
	19 (2)	75:75	89	1.31	1.10	50 - 200
Oak, white; Missouri						
Oak-hickory Forest	20 (1)	50:50	160	1.68	1.49	50 - 700
Oak-hickory-pine Forest	20 (1)	49:49	150	1.68	1.49	70 - 1,000
Oak, willow; Floodplain Forest, Missouri	20 (1)	46:46	190	1.72	1.49	70 - 1,000
Persimmon, stems; Georgia	14 (1)	29:29	96	2.09	--	<2 - 3,000
	15 (1)	30:30	100	2.18	--	20 - 300
Persimmon, leaves; Georgia	14 (1)	30:30	130	2.27	--	5 - 700
	15 (1)	30:30	150	1.99	--	50 - 1,000
Pine, shortleaf; Oak-hickory-pine Forest, Missouri	20 (1)	49:49	630	2.07	1.49	200 - 2,000
Sassafras, stems; Georgia	14 (1)	17:17	320	2.09	--	70 - 1,500
	15 (1)	27:27	200	3.64	--	15 - 2,000
Sassafras, leaves; Georgia	14 (1)	17:17	300	2.17	--	70 - 1,500
	15 (1)	27:27	280	2.42	--	30 - 1,500
Sumac, winged, stems; Georgia	14 (1)	30:30	150	2.27	--	20 - 700
	15 (1)	30:30	110	2.09	--	30 - 700
Sumac, winged, leaves; Georgia	14 (1)	30:30	200	2.01	--	70 - 1,500
	15 (1)	30:30	250	2.47	--	20 - 1,000
Sumac, smooth; Missouri						
Floodplain Forest	20 (1)	48:48	98	2.54	1.49	10 - 700
Glaciated Prairie	20 (1)	50:50	120	1.65	1.49	20 - 300
Unglaciated Prairie	20 (1)	49:49	120	1.99	1.49	20 - 1,000
Cedar Glade	20 (1)	49:49	94	1.77	1.49	30 - 300
Oak-hickory Forest	20 (1)	50:50	130	2.15	1.49	30 - 700
Oak-hickory-pine Forest	20 (1)	49:49	170	1.89	1.49	50 - 1,500
Sweetgum, stems; Georgia	14 (1)	28:28	77	1.84	--	30 - 200
	15 (1)	27:27	69	2.40	--	7 - 300
Sweetgum, leaves; Georgia	14 (1)	28:28	120	1.94	--	30 - 700
	15 (1)	27:27	140	2.09	--	30 - 700
Sweetgum; Floodplain Forest, Missouri	20 (1)	47:47	120	2.02	1.49	30 - 700

TABLE 47.—*Tungsten in soils and plant ash*

[Explanation of column headings: Study No. refers to study described in text; method of analysis (in parentheses) refers to method listed in table 1. Ratio, number of samples in which the element was found in measurable concentrations to number of samples analyzed. Mean, geometric mean. Deviation, geometric deviation. Error, geometric error attributed to laboratory procedures. Leaders (--) in figure column indicate no data available]

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
SOILS						
Cultivated and uncultivatad						
B horizon; Western United States-----	21 (1)	1:492	<100	--	--	<100 - 1,000
PLANT ASH						
Native species						
Sassafras, leaves; Georgia----------	14 (1)	1:17	<30	--	--	<30 - 50
Sweetgum, stems; Georgia----------	14 (1)	1:28	<30	--	--	<30 - 30
Sweetgum, leaves; Georgia----------	14 (1)	1:28	<30	--	--	<30 - 70

TABLE 48.—*Uranium in soils*

[Explanation of column headings: Study No. refers to study described in text; method of analysis (in parentheses) refers to method listed in table 1. Ratio, number of samples in which the element was found in measurable concentrations to number of samples analyzed. Mean, geometric mean. Deviation, geometric deviation. Error, geometric error attributed to laboratory procedures. Leaders (--) in figure column indicate no data available]

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
Uncultivated						
Surface horizon; Powder River Basin, Wyoming and Montana----------	25 (8)	48:48	3.0	1.28	--	1.7 - 7.0

TABLE 49.—*Vanadium in rocks, unconsolidated geologic deposits, soils, and plant ash*

[Explanation of column headings: Study No. refers to study described in text; method of analysis (in parentheses) refers to method listed in table 1. Ratio, number of samples in which the element was found in measurable concentrations to number of samples analyzed. Mean, geometric mean. Deviation, geometric deviation. Error, geometric error attributed to laboratory procedures. Leaders (--) in figure column indicate no data available]

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
ROCKS						
Granite						
Precambrian; Missouri	1 (1)	10:30	<7	--	--	<7 - 30
Rhyolite						
Precambrian; Missouri	1 (1)	14:30	<7	--	--	<7 - 70
Arkose						
Fountain Formation; Colorado	2 (2)	80:80	24	1.75	1.16	8 - 96
Sandstone						
Sauk sequence; Western United States	3 (2)	387:400	11	2.40	1.44	<2 - 270
Roubidoux Formation; Missouri	4 (1)	5:12	5.3	1.43	1.06	<7 - 10
Pope Megagroup;[1] Kentucky	5 (2)	109:120	16	2.22	1.43	<6 - 290
Pennsylvanian; Kentucky	5 (2)	149:152	20	2.18	1.20	<5 - 78
Pennsylvanian; Missouri, Kansas, and Oklahoma	6 (1)	32:32	38	2.24	1.06	7 - 150
Shale						
Sauk sequence; Western United States	3 (2)	336:336	74	1.68	1.13	15 - 310
Lower Mississippian; Kentucky	8 (2)	76:76	110	1.61	--	40 - 390
Upper Mississippian; Kentucky	5 (2)	142:142	100	1.40	--	34 - 230
Mississippian; Missouri, Oklahoma, and Arkansas	7 (1)	18:18	120	1.87	1.14	50 - 500
Pennsylvanian; Kentucky	5 (2)	152:152	110	1.52	1.11	25 - 250
Pennsylvanian; Missouri, Kansas, and Oklahoma	6 (1)	32:32	140	1.36	1.14	70 - 200
Black shale						
Devonian and Mississippian; Kentucky	9 (2)	76:88	400	2.34	1.10	120 - >1,100
Limestone and dolomite						
Sauk sequence; Western United States	3 (2)	285:392	14	2.39	1.20	<10 - 150
Sauk sequence; Missouri and Arkansas	4 (1)	29:48	6.5	1.70	1.22	<7 - 50
Upper Ordovician; Kentucky	5 (1)	58:80	16	1.70	1.25	<15 - 50
Tippecanoe sequence; Missouri	10 (1)	4:12	3.9	2.42	1.22	<7 - 15
Lower Mississippian; Kentucky	5 (1)	101:112	26	2.26	1.29	<15 - 150
Upper Mississippian; Kentucky	5 (1)	134:152	24	2.15	1.26	<15 - 200
Mississippian; Missouri, Oklahoma, and Arkansas	7 (1)	25:40	7.5	2.11	1.22	<7 - 70
Pennsylvanian; Kentucky	5 (1)	77:80	40	1.87	1.36	<15 - 100
Pennsylvanian; Missouri, Kansas, and Oklahoma	6 (1)	29:32	15	2.29	1.22	<7 - 50
Siderite						
Upper Paleozoic; Kentucky	11 (1)	29:30	35	2.16	--	<15 - 150

[1] Of Swann and Willman (1961).

TABLE 49.—*Vanadium in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
UNCONSOLIDATED GEOLOGIC DEPOSITS						
Carbonate residuum (terra rossa)						
On Gasconade Formation; Missouri	12 (1)	24:24	110	1.42	1.18	70 - 200
On Roubidoux Formation; Missouri	12 (1)	24:24	86	1.66	1.18	30 - 150
On Jefferson City, Cotter, and Powell Formations; Missouri and Arkansas	12 (1)	24:24	99	1.27	1.18	70 - 150
On Osagean rocks; Missouri	12 (1)	24:24	130	1.32	1.18	70 - 200
On Meramecian rocks; Missouri	12 (1)	24:24	130	1.33	1.18	70 - 200
Loess						
Missouri	13 (1)	24:24	93	1.22	--	70 - 150
SOILS						
Cultivated						
Plow zone, garden; Georgia	14 (1)	30:30	20	1.92	--	10 - 100
	15 (1)	30:30	65	1.38	--	30 - 100
Plow zone, corn field; Missouri						
Floodplain Forest	17 (1)	8:8	52	1.74	1.16	20 - 100
Glaciated Prairie	17 (1)	10:10	84	1.21	1.16	70 - 100
Unglaciated Prairie	17 (1)	10:10	63	1.26	1.16	50 - 100
Oak-hickory Forest	17 (1)	10:10	78	1.35	1.16	50 - 100
Plow zone, soybean field; Missouri						
Floodplain Forest	17 (1)	10:10	42	1.65	1.16	15 - 70
Glaciated Prairie	17 (1)	10:10	93	1.16	1.16	70 - 100
Unglaciated Prairie	17 (1)	8:8	71	1.47	1.16	50 - 150
Oak-hickory Forest	17 (1)	9:9	60	1.19	1.16	50 - 70
Plow zone, pasture field; Missouri						
Floodplain Forest	17 (1)	10:10	48	1.49	1.16	20 - 70
Glaciated Prairie	17 (1)	10:10	78	1.33	1.16	50 - 100
Unglaciated Prairie	17 (1)	10:10	68	1.29	1.16	50 - 100
Oak-hickory Forest	17 (1)	10:10	63	1.18	1.16	50 - 70
Surface horizon; Missouri	16 (1)	1,140:1,140	69	1.50	1.25	15 - 150
Uncultivated						
Surface horizon; Powder River Basin, Wyoming and Montana	25 (1)	48:48	77	1.36	1.21	30 - 150
A horizon; Georgia	14 (1)	26:30	15	2.14	--	<5 - 150
	15 (1)	30:30	57	1.58	--	15 - 100
A horizon; Kentucky	18 (2)	96:96	42	1.52	1.04	15 - 120
	19 (2)	108:108	48	1.37	1.08	21 - 130
B horizon; Georgia	14 (1)	26:30	16	1.90	--	<5 - 70
	15 (1)	30:30	66	1.40	--	30 - 100
B horizon; Kentucky	18 (2)	96:96	83	1.54	1.04	22 - 260
B horizon; Missouri						
Floodplain Forest	20 (1)	50:50	64	1.87	1.18	15 - 150
Glaciated Prairie	20 (1)	50:50	110	1.34	1.18	70 - 150

TABLE 49.—*Vanadium in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
SOILS--Continued						
Uncultivated--Continued						
B horizon; Missouri--Continued						
Unglaciated Prairie	20 (1)	50:50	92	1.39	1.18	50 - 150
Cedar Glade	20 (1)	50:50	59	1.58	1.18	20 - 150
Oak-hickory Forest	20 (1)	50:50	53	1.48	1.18	20 - 100
Oak-hickory-pine Forest	20 (1)	50:50	37	1.70	1.18	15 - 100
C horizon; Georgia	14 (1)	26:30	25	2.43	--	<5 - 70
	15 (1)	30:30	77	1.36	--	10 - 50
C horizon; Kentucky	18 (2)	96:96	84	1.70	1.04	19 - 320
Cultivated and uncultivated						
Surface horizon; Colorado	22 (1)	168:168	54	1.88	1.21	15 - 200
B horizon; Eastern United States	21 (1)	356:371	46	2.41	--	<5 - 300
B horizon; Western United States	21 (1)	492:492	66	1.91	--	7 - 500
PLANT ASH						
Cultivated plants						
Asparagus; Wisconsin	23 (1)	2:6	<5	--	--	<5 - 20
Bean, lima; Georgia	15 (1)	1:30	<5	--	--	<5 - 30
Bean, snap; Georgia	14 (1)	1:30	<5	--	--	<5 - 700
	15 (1)	1:30	<5	--	--	<5 - 200
Blackeyed pea; Georgia	14 (1)	1:29	<5	--	--	<5 - 20
Cabbage; Georgia	14 (1)	3:30	<5	--	--	<5 - 20
	15 (1)	5:30	<5	--	--	<5 - 50
Corn; Floodplain Forest, Missouri	17 (1)	1:8	<5	--	--	<5 - 15
Tomato; Georgia	14 (1)	3:30	<5	--	--	<5 - 30
Native species						
Black cherry, stems; Georgia	14 (1)	4:30	3	3.45	--	<5 - 30
	15 (1)	4:30	6.7	1.68	--	<5 - 20
Black cherry, leaves; Georgia	14 (1)	2:30	<5	--	--	<5 - 50
Blackgum, stems; Georgia	14 (1)	7:30	6.9	2.24	--	<5 - 30
	15 (1)	6:30	7.0	1.98	--	<5 - 20
Blackgum, leaves; Georgia	14 (1)	2:30	<5	--	--	<5 - 50
	15 (1)	7:30	5.8	2.80	--	<5 - 50
Buckbush; Missouri						
Glaciated Prairie	20 (1)	47:47	22	1.48	--	10 - 50
Unglaciated Prairie	20 (1)	48:48	23	1.55	--	10 - 50
Cedar Glade	20 (1)	50:50	14	1.52	--	5 - 30
Oak-hickory Forest	20 (1)	49:49	19	1.50	--	10 - 50
Oak-hickory-pine Forest	20 (1)	41:41	18	1.63	--	7 - 50
Cedar; Missouri						
Cedar Glade	20 (1)	17:50	2.6	3.08	--	<5 - 20
Glaciated Prairie	24 (1)	7:9	14	1.81	--	<5 - 30

TABLE 49.—*Vanadium in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
PLANT ASH--Continued						
Native species--Continued						
Cedar; Missouri--Continued						
Unglaciated Prairie	24 (1)	5:10	8.6	2.23	--	<5 - 30
Oak-hickory Forest	24 (1)	5:10	8.6	1.60	--	<5 - 15
Oak-hickory-pine Forest	24 (1)	1:6	<5	--	--	<5 - 10
Hickory, shagbark; Kentucky	18 (1)	1:40	<5	--	--	<5 - 10
Maple, red, stems; Georgia	14 (1)	4:30	4.6	2.35	--	<5 - 20
	15 (1)	1:30	<5	--	--	<5 - 20
Maple, red, leaves; Georgia	14 (1)	2:30	<5	--	--	<5 - 30
	15 (1)	2:30	<5	--	--	<5 - 30
Oak, black; Kentucky	18 (1)	1:25	<5	--	--	<5 - 15
Oak, red; Kentucky	18 (1)	1:27	<5	--	--	<5 - 20
Oak, white; Kentucky	18 (1)	3:49	<5	--	--	<5 - 20
Persimmon, stems; Georgia	14 (1)	4:29	4.6	2.35	--	<5 - 20
	15 (1)	5:30	6.0	2.07	--	<5 - 20
Persimmon, leaves; Georgia	14 (1)	1:30	<5	--	--	<5 - 30
	15 (1)	4:30	4.0	2.65	--	<5 - 30
Pine, shortleaf; Oak-hickory-pine Forest, Missouri	20 (1)	41:49	10	2.12	--	<5 - 30
Sassafras, stems; Georgia	14 (1)	10:17	15	1.83	--	<5 - 50
	15 (1)	9:27	7.4	3.13	--	<5 - 70
Sassafras, leaves; Georgia	14 (1)	5:17	7.0	2.95	--	<5 - 50
Sumac, winged, stems; Georgia	14 (1)	3:30	<5	--	--	<5 - 30
	15 (1)	2:30	<5	--	--	<5 - 30
Sumac, winged, leaves; Georgia	14 (1)	3:30	<5	--	--	<5 - 50
	15 (1)	7:17	6.2	2.59	--	<5 - 30
Sweetgum, stems; Georgia	14 (1)	3:28	4.0	2.45	--	<5 - 20
Sweetgum, leaves; Georgia	14 (1)	1:28	<5	--	--	<5 - 20
	15 (1)	2:27	<5	--	--	<5 - 30

TABLE 50.—*Ytterbium in rocks, unconsolidated geologic deposits, soils, and plant ash*

[Explanation of column headings: Study No. refers to study described in text; method of analysis (in parentheses) refers to method listed in table 1. Ratio, number of samples in which the element was found in measurable concentrations to number of samples analyzed. Mean, geometric mean. Deviation, geometric deviation. Error, geometric error attributed to laboratory procedures. Leaders (--) in figure column indicate no data available]

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
ROCKS						
Granite						
Precambrian; Missouri	1 (1)	30:30	6.9	1.24	1.18	3 - 10
Rhyolite						
Precambrian; Missouri	1 (1)	30:30	7.7	1.31	1.18	3 - 15
Sandstone						
Pennsylvanian; Missouri, Kansas, and Oklahoma	6 (1)	29:32	1.9	1.98	1.14	<1 - 7
Shale						
Mississippian; Missouri, Oklahoma, and Arkansas	7 (1)	18:18	2.3	1.93	1.31	1 - 10
Pennsylvanian; Kentucky	5 (1)	35:35	3.8	1.32	--	2 - 5
Pennsylvanian; Missouri, Kansas, and Oklahoma	6 (1)	32:32	3.4	1.49	1.31	2 - 7
Limestone and dolomite						
Upper Ordovician; Kentucky	5 (1)	14:80	<2	--	--	<2 - 2
Lower Mississippian; Kentucky	8 (1)	21:112	<2	--	--	<2 - 7
Upper Mississippian; Kentucky	5 (1)	8:152	<2	--	--	<2 - 2
Mississippian; Missouri, Oklahoma, and Arkansas	7 (1)	18:40	<1	--	--	<1 - 3
Pennsylvanian; Kentucky	5 (1)	51:80	<2	--	--	<2 - 10
Pennsylvanian; Missouri, Kansas, and Oklahoma	6 (1)	9:32	<1	--	--	<1 - 2
Siderite						
Upper Paleozoic; Kentucky	11 (1)	28:30	3.4	1.80	--	<2 - 7
UNCONSOLIDATED GEOLOGIC DEPOSITS						
Carbonate residuum (terra rossa)						
On Gasconade Formation; Missouri	12 (1)	22:24	1.5	1.64	1.18	<1 - 7
On Roubidoux Formation; Missouri	12 (1)	18:24	1.3	1.60	1.18	<1 - 3
On Jefferson City, Cotter, and Powell Formations; Missouri and Arkansas	12 (1)	18:24	1.3	1.61	1.18	<1 - 3
On Osagean rocks; Missouri	12 (1)	24:24	2.6	1.98	1.18	1 - 20
On Meramecian rocks; Missouri	12 (1)	24:24	2.5	1.93	1.18	1 - 10
Loess						
Missouri	13 (1)	24:24	3.5	2.75	--	2 - 7

TABLE 50.—*Ytterbium in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
SOILS						
Cultivated						
Plow zone, garden; Georgia	14 (1)	30:30	2.7	1.76	--	1 - 20
	15 (1)	30:30	2.8	1.45	--	1.5 - 7
Plow zone, corn field; Missouri						
Floodplain Forest	17 (1)	8:8	2.0	1.56	1.23	1 - 5
Glaciated Prairie	17 (1)	10:10	2.7	1.22	1.23	2 - 3
Unglaciated Prairie	17 (1)	10:10	3.0	1.24	1.23	2 - 5
Plow zone, soybean field; Missouri						
Floodplain Forest	17 (1)	10:10	1.5	1.48	1.23	1 - 3
Glaciated Prairie	17 (1)	10:10	2.9	1.14	1.23	2 - 3
Unglaciated Prairie	17 (1)	8:8	3.6	1.30	1.23	3 - 5
Oak-hickory Forest	17 (1)	9:9	3.8	1.31	1.23	3 - 5
Plow zone, pasture field; Missouri						
Floodplain Forest	17 (1)	10:10	1.7	1.47	1.23	1 - 3
Glaciated Prairie	17 (1)	10:10	2.7	1.35	1.23	2 - 5
Unglaciated Prairie	17 (1)	10:10	3.7	1.30	1.23	3 - 5
Oak-hickory Forest	17 (1)	10:10	3.0	1.24	1.23	2 - 5
Surface horizon; Missouri	16 (1)	1,138:1,140	3.2	1.31	1.25	<1 - 7
Uncultivated						
Surface horizon; Powder River Basin, Wyoming and Montana	25 (1)	47:47	1.8	1.31	1.29	1 - 5
A horizon; Georgia	14 (1)	30:30	2.5	1.95	--	1 - 15
	15 (1)	30:30	3.5	2.01	--	1 - 30
B horizon; Georgia	14 (1)	30:30	2.5	1.66	--	1 - 10
	15 (1)	30:30	3.4	1.97	--	1.5 - 50
B horizon; Missouri						
Floodplain Forest	20 (1)	48:50	2.1	1.56	1.24	<1 - 5
Glaciated Prairie	20 (1)	50:50	3.0	1.27	1.24	2 - 5
Unglaciated Prairie	20 (1)	50:50	3.4	1.42	1.24	1.5 - 7
Cedar Glade	20 (1)	49:50	2.0	1.66	1.24	<1 - 7
Oak-hickory Forest	20 (1)	50:50	2.8	1.44	1.24	1 - 5
Oak-hickory-pine Forest	20 (1)	50:50	2.4	1.69	1.24	1 - 7
C horizon; Georgia	15 (1)	30:30	28	1.62	--	1 - 70
Cultivated and uncultivated						
Surface horizon; Colorado	22 (1)	164:168	2.4	1.73	1.31	<1 - 7
B horizon; Eastern United States	21 (1)	299:317	3.0	2.03	--	<1 - 50
B horizon; Western United States	21 (1)	469:478	3.0	1.67	--	<1 - 20

TABLE 50.—*Ytterbium in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
		PLANT ASH				
Cultivated plants						
Cabbage; Georgia	14 (1)	2:28	<2	--	--	<2 - 30
	15 (1)	2:30	<2	--	--	<2 - 5
Corn; Georgia	14 (1)	1:29	<2	--	--	<2 - 500
Native species						
Black cherry, stems; Georgia	14 (1)	3:30	<2	--	--	<2 - 5
	15 (1)	3:30	<2	--	--	<2 - 3
Black cherry, leaves; Georgia	14 (1)	6:30	<2	--	--	<2 - 7
	15 (1)	4:30	<2	--	--	<2 - 3
Blackgum, stems; Georgia	14 (1)	4:30	<2	--	--	<2 - 7
	15 (1)	3:30	<2	--	--	<2 - 5
Blackgum, leaves; Georgia	14 (1)	5:30	<2	--	--	<2 - 3
	15 (1)	3:30	<2	--	--	<2 3
Buckbush; Missouri						
Glaciated Prairie	20 (1)	11:47	1.6	1.18	--	<2 - 2
Unglaciated Prairie	20 (1)	18:48	1.7	1.21	--	<2 - 3
Oak-hickory Forest	20 (1)	13:49	1.4	1.42	--	<2 - 3
Oak-hickory-pine Forest	20 (1)	13:41	1.5	1.51	--	<2 - 3
Hickory, pignut; Kentucky	18 (1)	32:64	1.8	1.98	1.09	<2 - 7
Hickory, shagbark; Kentucky	18 (1)	19:40	1.7	2.41	1.09	<2 - 10
Hickory, shagbark; Missouri						
Oak-hickory Forest	20 (1)	4:19	1.6	1.19	--	<2 - 2
Oak-hickory-pine Forest	20 (1)	4:7	<2	--	--	<2 - 7
Persimmon, stems; Georgia	14 (1)	5:30	<2	--	--	<2 - 7
	15 (1)	1:30	<2	--	--	<2 - 3
Persimmon, leaves; Georgia	14 (1)	7:30	<2	--	--	<2 - 20
	15 (1)	3:30	<2	--	--	<2 - 2
Pine, shortleaf; Oak-hickory-pine Forest, Missouri	20 (1)	6:49	1.4	1.23	--	<2 - 3
Sumac, winged, stems; Georgia	14 (1)	3:30	<2	--	--	<2 - 300
Sumac, winged, leaves; Georgia	15 (1)	6:30	<2	--	--	<2 - 7
Sweetgum, stems; Georgia	14 (1)	6:28	<2	--	--	<2 - 7
	15 (1)	5:27	<2	--	--	<2 - 3
Sweetgum, leaves; Georgia	14 (1)	6:28	<2	--	--	<2 - 300
	15 (1)	14:27	1.1	3.51	--	<2 - 7

TABLE 51.—*Yttrium in rocks, unconsolidated geologic deposits, soils, and plant ash*

[Explanation of column headings: Study No. refers to study described in text; method of analysis (in parentheses) refers to method listed in table 1. Ratio, number of samples in which the element was found in measurable concentrations to number of samples analyzed. Mean, geometric mean. Deviation, geometric deviation. Error, geometric error attributed to laboratory procedures. Leaders (--) in figure column indicate no data available]

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
ROCKS						
Granite						
Precambrian; Missouri	1 (1)	30:30	69	1.32	1.15	30 - 100
Rhyolite						
Precambrian; Missouri	1 (1)	30:30	67	1.42	1.15	20 - 100
Arkose						
Fountain Formation; Colorado	2 (2)	58:80	9.4	2.45	--	<5 - 57
Sandstone						
Sauk sequence; Western United States	3 (2)	297:400	9	2.79	1.54	<5 - 140
Pope Megagroup;[1] Kentucky	5 (2)	33:120	11	2.23	1.21	<20 - 60
Pennsylvanian; Kentucky	5 (2)	123:152	12	2.27	1.45	<7 - 87
Pennsylvanian; Missouri, Kansas, and Oklahoma	6 (1)	28:32	22	2.14	1.06	<10 - 50
Chert						
Mississippian; Missouri, Oklahoma, and Arkansas	7 (1)	1:20	<10	--	--	<10 - 15
Shale						
Sauk sequence; Western United States	3 (2)	292:336	35	1.65	1.17	<20 - 200
Lower Mississippian; Kentucky	8 (2)	71:76	30	1.39	--	<20 - 81
Upper Mississippian; Kentucky	5 (2)	130:142	30	1.40	--	<20 - 94
Mississippian; Missouri, Oklahoma, and Arkansas	7 (1)	18:18	25	1.87	1.19	10 - 150
Pennsylvanian; Kentucky	5 (2)	150:152	38	1.49	1.16	<20 - 480
Pennsylvanian; Missouri, Kansas, and Oklahoma	6 (1)	32:32	30	1.61	1.19	10 - 70
Black shale						
Devonian and Mississippian; Kentucky	9 (2)	88:88	38	1.32	1.17	20 - 80
Limestone and dolomite						
Sauk sequence; Western United States	3 (2)	29:392	<25	--	--	<25 - 60
Upper Ordovician; Kentucky	5 (1)	11:80	14	1.22	--	<20 - 20
Tippecanoe sequence; Missouri	10 (1)	1:12	<10	--	--	<10 - 15
Lower Mississippian; Kentucky	5 (1)	21:112	<20	--	--	<20 - 70
Upper Mississippian; Kentucky	5 (1)	6:152	<20	--	--	<20 - 20
Mississippian; Missouri, Oklahoma, and Arkansas	7 (1)	34:40	17	1.97	1.09	<10 - 70
Pennsylvanian; Kentucky	5 (1)	50:80	20	--	--	<20 - 500

[1] Of Swann and Willman (1961).

TABLE 51.—*Yttrium in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
ROCKS--Continued						
Limestone and dolomite--Continued						
Pennsylvanian; Missouri, Kansas, and Oklahoma	6 (1)	15:32	8.0	2.39	1.09	<10 - 50
Siderite						
Upper Paleozoic; Kentucky	11 (1)	25:30	37	3.09	--	<20 - 700
UNCONSOLIDATED GEOLOGIC DEPOSITS						
Carbonate residuum (terra rossa)						
On Gasconade Formation; Missouri	12 (1)	16:24	10	--	--	<10 - 70
On Roubidoux Formation; Missouri	12 (1)	14:24	10	1.58	1.15	<10 - 30
On Jefferson City, Cotter, and Powell Formations; Missouri and Arkansas	12 (1)	13:24	10	--	--	<10 - 50
On Osagean rocks; Missouri	12 (1)	24:24	27	2.62	1.15	10 - 500
On Meramecian rocks; Missouri	12 (1)	23:24	27	2.54	1.15	<10 - 50
Loess						
Missouri	13 (1)	24:24	32	1.41	--	20 - 50
SOILS						
Cultivated						
Plow zone, garden; Georgia	14 (1)	29:30	22	1.99	--	<10 - 200
	15 (1)	30:30	25	1.44	--	15 - 50
Plow zone, corn field; Missouri						
Floodplain Forest	17 (1)	8:8	16	1.46	1.26	10 - 30
Glaciated Prairie	17 (1)	10:10	22	1.26	1.26	15 - 30
Unglaciated Prairie	17 (1)	10:10	25	1.37	1.26	20 - 50
Oak-hickory Forest	17 (1)	10:10	27	1.35	1.26	20 - 50
Plow zone, soybean field; Missouri						
Floodplain Forest	17 (1)	10:10	15	1.43	1.26	10 - 30
Glaciated Prairie	17 (1)	10:10	21	1.30	1.26	15 - 30
Unglaciated Prairie	17 (1)	8:8	32	1.35	1.26	20 - 50
Oak-hickory Forest	17 (1)	9:9	27	1.37	1.26	20 - 50
Plow zone, pasture field; Missouri						
Floodplain Forest	17 (1)	10:10	15	1.43	1.26	10 - 30
Glaciated Prairie	17 (1)	10:10	22	1.58	1.26	10 - 50
Unglaciated Prairie	17 (1)	10:10	31	1.36	1.26	20 - 50
Surface horizon; Missouri	16 (1)	1,138:1,140	32	1.35	1.25	<10 - 70
Uncultivated						
Surface horizon; Powder River Basin, Wyoming and Montana	25 (1)	48:48	17	1.28	1.18	10 - 50
A horizon; Georgia	14 (1)	29:30	21	2.04	--	<10 - 200
	15 (1)	30:30	26	1.83	--	10 - 150

TABLE 51—*Yttrium in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
SOILS--Continued						
Uncultivated--Continued						
A horizon; Kentucky	18 (2)	96:96	33	1.26	1.08	19 - 60
	19 (2)	108:108	39	1.25	1.09	17 - 66
B horizon; Georgia	14 (1)	30:30	20	1.77	--	10 - 100
	15 (1)	30:30	26	2.00	--	10 - 500
B horizon; Kentucky	18 (2)	96:96	28	1.29	1.08	12 - 58
B horizon; Missouri						
Floodplain Forest	20 (1)	48:50	23	1.63	1.20	<10 - 50
Glaciated Prairie	20 (1)	50:50	30	1.30	1.20	15 - 50
Unglaciated Prairie	20 (1)	50:50	37	1.35	1.20	20 - 70
Cedar Glade	20 (1)	49:50	22	1.79	1.20	<10 - 70
Oak-hickory Forest	20 (1)	50:50	27	1.50	1.20	15 - 70
Oak-hickory-pine Forest	20 (1)	49:50	22	1.69	1.20	<10 - 70
C horizon; Georgia	14 (1)	29:30	25	2.30	--	<10 - 200
	15 (1)	30:30	21	1.57	--	10 - 50
C horizon; Kentucky	18 (2)	96:96	26	1.48	1.08	9 - 100
Cultivated and uncultivated						
Surface horizon; Colorado	22 (1)	159:168	18	1.77	1.37	<10 - 50
B horizon; Eastern United States	21 (1)	342:361	23	1.93	--	<5 - 200
B horizon; Western United States	21 (1)	480:492	25	1.66	--	<10 - 150
PLANT ASH						
Cultivated plants						
Bean, snap; Georgia	14 (1)	2:30	<5	--	--	<5 - 30
Blackeyed pea; Georgia	14 (1)	1:29	<5	--	--	<5 - 20
Cabbage; Georgia	14 (1)	3:28	<5	--	--	<5 - 100
	15 (1)	4:30	<5	--	--	<5 - 30
Tomato; Georgia	14 (1)	2:30	<5	--	--	<5 - 30
Native species						
Black cherry, stems; Georgia	14 (1)	7:30	<5	--	--	<5 - 70
	15 (1)	9:30	<5	--	--	<5 - 70
Black cherry, leaves; Georgia	14 (1)	8:30	<5	--	--	<5 - 150
	15 (1)	10:30	<5	--	--	<5 - 70
Blackgum, stems; Georgia	14 (1)	6:30	<5	--	--	<5 - 70
Blackgum, leaves; Georgia	14 (1)	5:30	<5	--	--	<5 - 70
Buckbush; Missouri						
Glaciated Prairie	20 (1)	14:47	17	1.16	--	<20 - 50
Unglaciated Prairie	20 (1)	17:48	16	1.28	--	<20 - 30
Oak-hickory Forest	20 (1)	16:49	15	1.21	--	<20 - 30
Oak-hickory-pine Forest	20 (1)	17:41	17	1.39	--	<20 - 30
Hickory, pignut; Kentucky	18 (1)	56:64	45	2.90	1.23	<20 - 500
	19 (2)	84:88	47	1.74	1.02	<20 - 160

TABLE 51.—*Yttrium in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
PLANT ASH--Continued						
Native species--Continued						
Hickory, shagbark; Kentucky	18 (1)	34:40	41	3.14	1.23	<20 - 300
	19 (2)	19:20	35	1.48	1.02	<21 - 78
Hickory, shagbark; Missouri						
Oak-hickory Forest	20 (1)	14:19	23	1.69	--	<20 - 70
Oak-hickory-pine Forest	20 (1)	7:7	46	2.11	--	20 - 150
Oak, black; Kentucky	18 (1)	5:25	2.1	5.40	--	<10 - 30
	19 (2)	3:22	<10	--	--	<10 - 41
Oak, red; Kentucky	18 (1)	8:27	3.2	5.89	--	<10 - 100
Oak, white; Kentucky	18 (1)	12:49	3.0	4.52	--	<10 - 50
	19 (2)	3:74	<10	--	--	<10 - 54
Persimmon, stems; Georgia	14 (1)	7:30	<5	--	--	<5 - 300
	15 (1)	4:30	<5	--	--	<5 - 50
Persimmon, leaves; Georgia	14 (1)	8:30	<5	--	--	<5 - 300
	15 (1)	10:30	5.4	3.38	--	<5 - 30
Sumac, winged, stems; Georgia	14 (1)	5:30	<5	--	--	<5 - 70
Sumac, winged, leaves; Georgia	14 (1)	9:30	<5	--	--	<5 - 150
Sweetgum, stems; Georgia	14 (1)	6:28	<5	--	--	<5 - 150
	15 (1)	7:27	<5	--	--	<5 - 50
Sweetgum, leaves; Georgia	14 (1)	7:28	<5	--	--	<5 - 300

TABLE 52.—*Zinc in rocks, unconsolidated geologic deposits, soils, and plant ash*

[Explanation of column headings: Study No. refers to study described in text; method of analysis (in parentheses) refers to method listed in table 1. Ratio, number of samples in which the element was found in measurable concentrations to number of samples analyzed. Mean, geometric mean. Deviation, geometric deviation. Error, geometric error attributed to laboratory procedures. Leaders (--) in figure column indicate no data available]

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
ROCKS						
Granite						
Precambrian; Missouri	1 (3)	30:30	51	2.29	1.04	15 - 310
Rhyolite						
Precambrian; Missouri	1 (3)	30:30	42	2.46	1.04	10 - 120

TABLE 52.—*Zinc in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
ROCKS--Continued						
Sandstone						
Sauk sequence; Western United States-	3 (2)	58:400	<50	--	--	<50 - 530
Roubidoux Formation; Missouri--------	4 (3)	2:12	5.2	1.61	1.14	<10 - 12
Pennsylvanian; Missouri, Kansas, and Oklahoma----------	6 (3)	27:32	31	2.95	1.14	<10 - 280
Chert						
Mississippian; Missouri, Oklahoma, and Arkansas----------	7 (3)	5:20	<10	--	--	<10 - 90
Shale						
Lower Mississippian; Kentucky--------	8 (2)	4:76	<500	--	--	<500 - 650
Upper Mississippian; Kentucky--------	5 (2)	7:142	<500	--	--	<500 - 1,500
Mississippian; Missouri, Oklahoma, and Arkansas----------	7 (3)	18:18	55	3.09	1.08	6 - 250
Pennsylvanian; Kentucky----------	5 (2)	4:152	<500	--	--	<500 - 780
Pennsylvanian; Missouri, Kansas, and Oklahoma----------	6 (3)	32:32	82	1.47	1.08	25 - 130
Black shale						
Devonian and Mississippian; Kentucky-	9 (2)	8:8	<500	--	--	<500 - 2,300
Limestone and dolomite						
Sauk sequence; Western United States-	3 (2)	8:392	<500	--	--	<500 - 1,300
Sauk sequence; Missouri and Arkansas-	4 (3)	17:48	6.3	2.05	1.72	<10 - 50
Tippecanoe sequence; Missouri--------	10 (3)	9:12	12	1.53	1.72	<10 - 22
Mississippian; Missouri, Oklahoma, and Arkansas----------	7 (3)	38:40	19	1.68	1.72	<10 - 100
Pennsylvanian; Missouri, Kansas, and Oklahoma----------	6 (3)	31:32	24	2.32	1.72	<10 - 140
UNCONSOLIDATED GEOLOGIC DEPOSITS						
Carbonate residuum (terra rossa)						
On Gasconade Formation; Missouri-----	12 (3)	24:24	92	1.99	1.04	32 - 370
On Roubidoux Formation; Missouri-----	12 (3)	24:24	66	2.15	1.04	20 - 250
On Jefferson City, Cotter, and Powell Formations; Missouri and Arkansas--	12 (3)	24:24	50	1.35	1.04	30 - 100
On Osagean rocks; Missouri----------	12 (3)	24:24	110	1.69	1.04	42 - 400
On Meramecian rocks; Missouri--------	12 (3)	24:24	120	1.97	1.04	44 - 1,000
Loess						
Missouri----------	13 (3)	24:24	61	1.27	--	37 - 90
SOILS						
Cultivated						
Plow zone, garden; Georgia----------	14 (6)	1:30	<25	--	--	<25 - 700
	15 (6)	29:30	64	1.82	--	<25 - 1,000

TABLE 52.—*Zinc in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
SOILS--Continued						
Cultivated--Continued						
Plow zone, corn field; Missouri						
Floodplain Forest	17 (3)	8:8	37	1.69	1.07	13 - 62
Glaciated Prairie	17 (3)	10:10	55	1.29	1.07	34 - 74
Unglaciated Prairie	17 (3)	10:10	41	1.29	1.07	30 - 57
Oak-hickory Forest	17 (3)	10:10	53	1.43	1.07	31 - 100
Plow zone, soybean field; Missouri						
Floodplain Forest	17 (3)	10:10	42	1.74	1.07	16 - 74
Glaciated Prairie	17 (3)	10:10	61	1.26	1.07	45 - 92
Unglaciated Prairie	17 (3)	8:8	63	2.11	1.07	41 - 360
Oak-hickory Forest	17 (3)	9:9	41	1.41	1.07	26 - 65
Plow zone, pasture field; Missouri						
Floodplain Forest	17 (3)	10:10	45	1.70	1.07	20 - 147
Glaciated Prairie	17 (3)	10:10	68	1.74	1.07	37 - 300
Unglaciated Prairie	17 (3)	10:10	41	1.29	1.07	31 - 66
Oak-hickory Forest	17 (3)	10:10	58	1.74	1.07	27 - 235
Surface horizon; Missouri	16 (3)	1,140:1,140	49	1.55	1.08	18 - 640
Uncultivated						
A horizon; Georgia	14 (6)	7:30	<25	--	--	<25 - 50
	15 (6)	29:30	40	1.64	--	<25 - 100
A horizon; Kentucky	18 (3)	80:96	27	1.43	1.04	<20 - 75
	19 (3)	89:108	26	1.46	1.08	<20 - 135
B horizon; Georgia	14 (6)	3:30	<25	--	--	<25 - 25
	15 (6)	28:30	41	1.61	--	<25 - 75
B horizon; Kentucky	18 (3)	86:96	36	1.55	1.04	<20 - 110
B horizon; Missouri						
Floodplain Forest	20 (3)	50:50	54	1.67	1.12	18 - 153
Glaciated Prairie	20 (3)	50:50	67	1.44	1.12	31 - 194
Unglaciated Prairie	20 (3)	50:50	51	1.41	1.12	22 - 116
Cedar Glade	20 (3)	50:50	54	1.71	1.12	22 - 275
Oak-hickory Forest	20 (3)	50:50	36	1.59	1.12	12 - 190
Oak-hickory-pine Forest	20 (3)	50:50	30	1.62	1.12	10 - 138
C horizon; Georgia	14 (6)	3:30	<25	--	--	<25 - 50
	15 (6)	30:30	43	1.59	--	25 - 100
C horizon; Kentucky	18 (3)	86:96	33	1.74	1.04	<20 - 180
Cultivated and uncultivated						
Surface horizon; Colorado	22 (3)	168:168	58	1.70	1.07	16 - 300
B horizon; Eastern United States	21 (6)	314-371	36	1.89	--	<5 - 400
B horizon; Western United States	21 (6)	481:492	51	1.78	--	<10 - 2,000

TABLE 52.—*Zinc in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
PLANT ASH						
Cultivated plants						
Asparagus; Wisconsin	23 (6)	5:5	280	1.46	--	200 - 400
Bean, lima; Georgia	14 (6)	30:30	600	1.18	--	400 - 1,000
	15 (6)	15:15	390	1.47	--	200 - 700
Bean, snap; Georgia	14 (6)	30:30	530	1.36	--	200 - 1,000
	15 (6)	30:30	520	1.23	--	300 - 800
Beet, red; Wisconsin	23 (6)	3:3	390	1.29	--	300 - 500
Blackeyed pea; Georgia	14 (6)	29:29	750	1.27	--	400 - 1,200
	15 (6)	4:4	650	1.09	--	600 - 700
Cabbage; Georgia	14 (6)	28:28	340	2.57	--	100 - 5,000
	15 (6)	30:30	210	2.39	--	100 - 6,000
Cabbage; Wisconsin	23 (6)	11:11	250	1.53	--	100 - 400
Carrot; Wisconsin	23 (6)	8:8	180	1.46	--	100 - 300
Corn; Georgia	14 (6)	29:29	840	1.44	--	400 - 2,000
	15 (6)	30:30	850	1.38	--	600 - 2,000
Corn; Missouri						
Floodplain Forest	17 (3)	8:8	1,700	1.14	1.11	1,400 - 2,200
Glaciated Prairie	17 (3)	10:10	1,800	1.29	1.11	1,200 - 2,800
Unglaciated Prairie	17 (3)	10:10	1,900	1.11	1.11	1,600 - 2,300
Oak-hickory Forest	17 (3)	10:10	1,900	1.25	1.11	1,400 - 2,500
Corn; Wisconsin	23 (6)	27:27	1,000	1.30	--	500 - 1,600
Cucumber; Wisconsin	23 (6)	4:4	310	1.39	--	200 - 400
Onion; Wisconsin	23 (6)	7:7	330	1.44	--	200 - 500
Pepper, sweet; Wisconsin	23 (6)	4:4	260	1.40	--	200 - 400
Potato; Wisconsin	23 (6)	10:10	280	1.41	--	200 - 400
Soybean; Missouri						
Floodplain Forest	17 (3)	10:10	890	1.17	1.11	700 - 1,140
Glaciated Prairie	17 (3)	10:10	870	1.09	1.11	840 - 960
Unglaciated Prairie	17 (3)	8:8	1,100	1.19	1.11	1,000 - 1,500
Oak-hickory Forest	17 (3)	9:9	1,100	1.08	1.11	920 - 1,200
Tomato; Georgia	14 (6)	30:30	290	1.40	--	200 - 600
	15 (6)	30:30	210	1.39	--	100 - 400
Native species						
Black cherry, stems; Georgia	14 (6)	30:30	1,300	1.59	--	300 - 3,000
	15 (6)	30:30	1,100	1.64	--	500 - 4,000
Black cherry, leaves; Georgia	14 (6)	30:30	220	1.66	--	100 - 2,000
	15 (6)	30:30	200	1.38	--	100 - 300
Blackgum, stems; Georgia	14 (6)	30:30	910	1.65	--	400 - 3,000
	15 (6)	30:30	970	1.47	--	500 - 2,000
Blackgum, leaves; Georgia	14 (6)	30:30	260	1.39	--	100 - 500
	15 (6)	30:30	270	1.37	--	200 - 600
Buckbush; Missouri						
Glaciated Prairie	20 (3)	47:47	1,400	1.48	1.21	580 - 3,200
Unglaciated Prairie	20 (3)	48:48	1,800	1.79	1.21	640 - 7,400
Cedar Glade	20 (3)	50:50	1,200	1.40	1.21	440 - 2,800

TABLE 52.—*Zinc in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
PLANT ASH--Continued						
Native species--Continued						
Buckbush; Missouri--Continued						
Oak-hickory Forest	20 (3)	49:49	1,400	1.41	1.21	600 - 3,400
Oak-hickory-pine Forest	20 (3)	41:41	1,400	1.53	1.21	530 - 3,500
Cedar; Missouri						
Cedar Glade	20 (3)	50:50	310	1.27	1.21	200 - 520
Glaciated Prairie	24 (3)	9:9	640	2.02	--	340 - 3,600
Unglaciated Prairie	24 (3)	10:10	740	1.54	--	380 - 1,440
Cedar Glade	24 (3)	10:10	320	1.22	--	280 - 540
Oak-hickory Forest	24 (3)	10:10	480	1.67	--	300 - 1,800
Oak-hickory-pine Forest	24 (3)	6:6	380	1.26	--	280 - 560
Hickory, pignut; Kentucky	18 (3)	60:60	1,500	1.75	1.09	400 - 10,000
	19 (3)	88:88	1,000	2.05	1.15	200 - 4,700
Hickory, shagbark; Kentucky	18 (3)	40:40	1,600	1.72	1.09	400 - 3,700
	19 (3)	20:20	1,000	1.82	1.15	300 - 2,300
Hickory, shagbark; Missouri						
Oak-hickory Forest	20 (3)	19:19	1,500	1.65	1.21	440 - 3,800
Oak-hickory-pine Forest	20 (3)	7:7	1,600	1.24	1.21	1,180 - 2,200
Maple, red, stems; Georgia	14 (6)	30:30	480	1.40	--	300 - 1,200
	15 (6)	30:30	690	1.30	--	400 - 1,200
Maple, red, leaves; Georgia	14 (6)	30:30	450	1.41	--	200 - 1,200
	15 (6)	30:30	570	1.29	--	400 - 1,200
Oak, black; Kentucky	18 (3)	25:25	540	1.65	1.14	200 - 1,200
	19 (3)	22:22	430	1.60	1.15	200 - 1,500
Oak, post; Cedar Glade, Missouri	20 (3)	50:50	300	1.43	1.21	160 - 620
Oak, red; Kentucky	18 (3)	27:27	460	1.63	1.14	200 - 2,100
	19 (3)	9:9	410	1.37	1.15	200 - 600
Oak, white; Kentucky	18 (3)	48:48	430	1.67	1.14	180 - 2,100
	19 (3)	76:76	400	1.57	1.15	100 - 2,400
Oak, white; Missouri						
Oak-hickory Forest	20 (3)	50:50	320	1.31	1.21	160 - 500
Oak-hickory-pine Forest	20 (3)	49:49	350	1.39	1.21	160 - 600
Oak, willow; Floodplain Forest, Missouri	20 (3)	46:46	440	1.59	1.21	160 - 2,200
Persimmon, stems; Georgia	14 (6)	30:30	790	1.46	--	400 - 2,000
	15 (6)	30:30	1,100	1.61	--	400 - 3,000
Persimmon, leaves; Georgia	14 (6)	30:30	170	1.58	--	100 - 500
	15 (6)	30:30	200	1.32	--	100 - 300
Pine, shortleaf; Oak-hickory-pine Forest, Missouri	20 (3)	49:49	1,200	1.41	1.21	360 - 2,100
Sagebrush; Powder River Basin, Wyoming and Montana	25 (3)	48:48	421	1.30	--	200 - 800
Sassafras, stems; Georgia	14 (6)	17:17	1,600	1.94	--	600 - 6,000
	15 (6)	27:27	1,300	1.68	--	400 - 3,000
Sassafras, leaves; Georgia	14 (6)	17:17	550	1.67	--	300 - 2,000
	15 (6)	27:27	460	1.28	--	300 - 1,000

TABLE 52.—*Zinc in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
PLANT ASH--Continued						
Native species--Continued						
Sumac, winged, stems; Georgia--------	14 (6)	30:30	740	1.43	--	300 - 1,600
	15 (6)	30:30	780	1.64	--	300 - 2,100
Sumac, winged, leaves; Georgia-------	14 (6)	30:30	360	1.33	--	200 - 700
	15 (6)	30:30	370	1.44	--	200 - 1,000
Sumac, smooth; Missouri						
Floodplain Forest----------	20 (3)	48:48	770	1.63	1.21	300 - 3,100
Glaciated Prairie----------	20 (3)	50:50	860	1.44	1.21	360 - 1,800
Unglaciated Prairie----------	20 (3)	49:49	820	1.42	1.21	460 - 2,200
Cedar Glade----------	20 (3)	49:49	520	1.59	1.21	160 - 1,600
Oak-hickory Forest----------	20 (3)	50:50	660	1.41	1.21	360 - 1,600
Oak-hickory-pine Forest----------	20 (3)	49:49	500	1.56	1.21	160 - 1,400
Sweetgum, stems; Georgia----------	14 (6)	28:28	560	1.56	--	200 - 1,200
	15 (6)	27:27	710	1.57	--	400 - 2,000
Sweetgum, leaves; Georgia----------	14 (6)	28:28	560	1.41	--	300 - 1,200
	15 (6)	27:27	760	1.35	--	400 - 1,200

TABLE 53.—*Zirconium in rocks, unconsolidated geologic deposits, soils, and plant ash*

[Explanation of column headings: Study No. refers to study described in text; method of analysis (in parentheses) refers to method listed in table 1. Ratio, number of samples in which the element was found in measurable concentrations to number of samples analyzed. Mean, geometric mean. Deviation, geometric deviation. Error, geometric error attributed to laboratory procedures. Leaders (--) in figure column indicate no data available]

Sample and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
ROCKS						
Granite						
Precambrian; Missouri----------	1 (1)	30:30	140	1.56	1.39	70 - 500
Rhyolite						
Precambrian; Missouri----------	1 (1)	30:30	200	1.76	1.39	20 - 500
Arkose						
Fountain Formation; Colorado---------	2 (2)	80:80	55	1.72	1.37	18 - 170
Sandstone						
Sauk sequence; Western United States-	3 (2)	400:400	74	2.49	1.42	10 - 880

TABLE 53.—*Zirconium in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
ROCKS--Continued						
Sandstone--Continued						
Roubidoux Formation; Missouri--------	4 (1)	12:12	22	1.63	1.32	10 - 30
Pope Megagroup;[1] Kentucky----------	5 (2)	120:120	130	2.04	1.34	21 - 720
Pennsylvanian; Kentucky--------------	5 (2)	152:152	120	2.44	1.30	22 - 1,000
Pennsylvanian; Missouri, Kansas, and Oklahoma----------	6 (1)	32:32	170	2.28	1.32	30 - 700
Chert						
Mississippian; Missouri, Oklahoma, and Arkansas----------	7 (1)	3:20	1.1	6.90	1.32	<10 - 30
Shale						
Sauk sequence; Western United States-	3 (2)	327:336	190	1.98	1.15	<36 - 840
Lower Mississippian; Kentucky--------	8 (2)	76:76	150	1.96	--	48 - 770
Upper Mississippian; Kentucky--------	5 (2)	142:142	180	1.62	--	79 - 720
Mississippian; Missouri, Oklahoma, and Arkansas----------	7 (1)	18:18	95	2.00	1.46	30 - 300
Pennsylvanian; Kentucky--------------	5 (2)	151:152	230	1.63	1.13	93 - >1,000
Pennsylvanian; Missouri, Kansas, and Oklahoma----------	6 (1)	32:32	110	1.48	1.46	70 - 300
Black shale						
Devonian and Mississippian; Kentucky-	9 (2)	88:88	140	1.25	1.10	75 - 280
Limestone and dolomite						
Sauk sequence; Western United States-	3 (2)	231:392	23	2.21	1.19	<25 - 160
Sauk sequence; Missouri and Arkansas-	4 (1)	21:48	7.2	1.98	1.15	<10 - 30
Upper Ordovician; Kentucky-----------	5 (1)	55:80	32	2.28	1.52	<20 - 100
Tippecanoe sequence; Missouri--------	10 (1)	4:12	<10	--	--	<10 - 50
Lower Mississippian; Kentucky--------	5 (1)	47:112	12	6.12	1.19	<20 - 1,000
Upper Mississippian; Kentucky--------	5 (1)	34:152	6.5	3.79	--	<20 - 150
Mississippian; Missouri, Oklahoma, and Arkansas----------	7 (1)	18:40	6.7	4.79	1.15	<10 - 30
Pennsylvanian; Kentucky--------------	5 (1)	58:80	42	2.77	1.33	<20 - 200
Pennsylvanian; Missouri, Kansas, and Oklahoma----------	6 (1)	25:32	14	2.28	1.15	<10 - 70
Siderite						
Upper Paleozoic; Kentucky------------	11 (1)	23:30	32	2.47	--	<20 - 150
UNCONSOLIDATED GEOLOGIC DEPOSITS						
Carbonate residuum (terra rossa)						
On Gasconade Formation; Missouri-----	12 (1)	24:24	61	1.40	1.20	30 - 150
On Roubidoux Formation; Missouri-----	12 (1)	24:24	67	1.46	1.20	30 - 150
On Jefferson City, Cotter, and Powell Formations; Missouri and Arkansas--	12 (1)	24:24	65	1.33	1.20	30 - 100
On Osagean rocks; Missouri-----------	12 (1)	24:24	67	1.26	1.20	50 - 100
On Meramecian rocks; Missouri--------	12 (1)	24:24	67	1.23	1.20	50 - 100

[1] Of Swann and Willman (1961).

TABLE 53.—*Zirconium in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
UNCONSOLIDATED GEOLOGIC DEPOSITS--Continued						
Loess						
Missouri	13 (1)	24:24	230	1.32	--	150 - 300
SOILS						
Cultivated						
Plow zone, garden; Georgia	14 (1)	30:30	310	1.59	--	150 - 700
	15 (1)	30:30	180	1.48	--	70 - 300
Plow zone, corn field; Missouri						
Floodplain Forest	17 (1)	8:8	190	1.77	1.32	100 - 700
Glaciated Prairie	17 (1)	10:10	180	1.16	1.32	150 - 200
Unglaciated Prairie	17 (1)	10:10	240	1.23	1.32	200 - 300
Oak-hickory Forest	17 (1)	10:10	260	1.61	1.32	100 - 500
Plow zone, soybean field; Missouri						
Floodplain Forest	17 (1)	10:10	150	1.39	1.32	70 - 200
Glaciated Prairie	17 (1)	10:10	180	1.34	1.32	100 - 300
Unglaciated Prairie	17 (1)	8:8	270	1.37	1.32	200 - 500
Oak-hickory Forest	17 (1)	9:9	360	1.40	1.32	200 - 500
Plow zone, pasture field; Missouri						
Floodplain Forest	17 (1)	10:10	140	1.36	1.32	100 - 200
Glaciated Prairie	17 (1)	10:10	190	1.30	1.32	100 - 300
Unglaciated Prairie	17 (1)	10:10	290	1.29	1.32	200 - 500
Oak-hickory Forest	17 (1)	10:10	240	1.30	1.32	150 - 300
Surface horizon; Missouri	16 (1)	1,140:1,140	310	1.53	1.35	70 - 700
Uncultivated						
Surface horizon; Powder River Basin, Wyoming and Montana	25 (1)	48:48	150	1.45	1.20	70 - 500
A horizon; Georgia	14 (1)	30:30	260	1.60	--	100 - 700
A horizon; Kentucky	18 (2)	96:96	440	1.30	--	210 - 800
	19 (2)	108:108	460	1.34	1.14	160 - 890
B horizon; Georgia	14 (1)	30:30	290	1.62	--	100 - 700
	15 (1)	30:30	210	1.51	--	70 - 500
B horizon; Kentucky	18 (2)	96:96	330	1.40	--	140 - 860
B horizon; Missouri						
Floodplain Forest	20 (1)	50:50	160	1.93	1.48	30 - 500
Glaciated Prairie	20 (1)	50:50	210	1.42	1.48	100 - 500
Unglaciated Prairie	20 (1)	50:50	300	1.52	1.48	150 - 700
Cedar Glade	20 (1)	50:50	120	1.68	1.48	50 - 500
Oak-hickory Forest	20 (1)	50:50	300	1.63	1.48	70 - 700
Oak-hickory-pine Forest	20 (1)	50:50	260	1.74	1.48	70 - 500
C horizon; Kentucky	18 (2)	96:96	280	1.56	--	100 - 660

TABLE 53.—*Zirconium in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
SOILS--Continued						
Cultivated and uncultivated						
Surface horizon; Colorado	22 (1)	168:168	135	1.80	1.29	46 - 500
B horizon; Eastern United States	21 (1)	371:371	250	1.95	--	30 - 2,000
B horizon; Western United States	21 (1)	491:492	170	1.78	--	<30 - 1,500
PLANT ASH						
Cultivated plants						
Bean, lima; Georgia	14 (1)	1:30	<20	--	--	<20 - 70
	15 (1)	1:15	<20	--	--	<20 - 50
Bean, snap; Georgia	14 (1)	5:30	<20	--	--	<20 - 150
	15 (1)	1:30	<20	--	--	<20 - 30
Blackeyed pea; Georgia	14 (1)	1:29	<20	--	--	<20 - 20
Cabbage; Georgia	14 (1)	6:28	<20	--	--	<20 - 700
	15 (1)	9:30	<20	--	--	<20 - 500
Corn; Georgia	14 (1)	1:29	<20	--	--	<20 - 20
Corn; Floodplain Forest, Missouri	17 (1)	1:8	<20	--	--	<20 - 20
Tomato; Georgia	14 (1)	1:30	<20	--	--	<20 - 20
Native species						
Black cherry, stems; Georgia	14 (1)	3:30	<20	--	--	<20 - 30
Black cherry, leaves; Georgia	14 (1)	7:30	<20	--	--	<20 - 70
	15 (1)	1:30	<20	--	--	<20 - 30
Blackgum, stems; Georgia	14 (1)	7:30	<20	--	--	<20 - 50
	15 (1)	4:30	<20	--	--	<20 - 30
Blackgum, leaves; Georgia	14 (1)	15:30	9.7	4.11	--	<20 - 70
	15 (1)	11:30	<20	--	--	<20 - 150
Buckbush; Missouri						
Glaciated Prairie	20 (1)	47:47	69	1.78	--	20 - 200
Unglaciated Prairie	20 (1)	48:48	85	1.71	--	30 - 200
Cedar Glade	20 (1)	48:50	44	1.68	--	<20 - 150
Oak-hickory Forest	20 (1)	49:49	79	2.16	--	20 - 500
Oak-hickory-pine Forest	20 (1)	41:41	66	2.32	--	20 - 200
Cedar; Missouri						
Glaciated Prairie	24 (1)	8:9	44	1.86	--	<20 - 100
Unglaciated Prairie	24 (1)	10:10	44	1.72	--	20 - 70
Cedar Glade	24 (1)	5:10	18	1.52	--	<20 - 30
Oak-hickory Forest	24 (1)	8:10	29	1.89	--	<20 - 70
Oak-hickory-pine Forest	24 (1)	3:6	17	2.59	--	<20 - 70
Hickory, shagbark; Oak-hickory-pine Forest; Missouri	20 (1)	2:19	7.6	1.97	--	<20 - 30
Maple, red, stems; Georgia	14 (1)	3:30	<20	--	--	<20 - 30
	15 (1)	1:30	<20	--	--	<20 - 20

TABLE 53.—*Zirconium in rocks, unconsolidated geologic deposits, soils, and plant ash*—Continued

Sample, and collection locality	Study No. and method of analysis	Ratio	Mean (ppm)	Deviation	Error	Observed range (ppm)
PLANT ASH--Continued						
Native species--Continued						
Maple, red, leaves; Georgia----------	14 (1)	12:30	6.5	4.19	--	<20 - 70
	15 (1)	3:30	<20	--	--	<20 - 150
Persimmon, stems; Georgia----------	14 (1)	6:30	2.4	4.61	--	<20 - 30
	15 (1)	1:30	<20	--	--	<20 - 20
Persimmon, leaves; Georgia----------	14 (1)	7:30	2.7	4.91	--	<20 - 30
	15 (1)	3:30	<20	--	--	<20 - 70
Pine, shortleaf; Oak-hickory-pine Forest; Missouri----------	20 (1)	36:49	29	2.62	--	<20 - 150
Sassafras, stems; Georgia----------	14 (1)	7:17	<20	--	--	<20 - 150
	15 (1)	7:27	<20	--	--	<20 - 70
Sassafras, leaves; Georgia----------	14 (1)	7:17	<20	--	--	<20 - 150
	15 (1)	6:27	<20	--	--	<20 - 150
Sumac, winged, stems; Georgia--------	14 (1)	7:30	<20	--	--	<20 - 100
	15 (1)	3:30	<20	--	--	<20 - 70
Sumac, winged, leaves; Georgia-------	14 (1)	12:30	6.2	5.00	--	<20 - 100
	15 (1)	7:30	<20	--	--	<20 - 150
Sumac, smooth; Missouri Floodplain Forest----------	20 (1)	6:48	4.1	3.49	--	<20 - 50
Oak-hickory Forest----------	20 (1)	11:50	11	1.85	--	<20 - 50
Sweetgum; Floodplain Forest, Missouri	20 (1)	6:47	6.7	2.30	--	<20 - 50

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