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NATIONAL URANIUM RESOURCE EVALUATION
ATHENS QUADRANGLE, GEORGIA AND SOUTH CAROLINA

Bendix Field Engineering Corporation
Grand Junction Operations

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PREPARED FOR THE U.S. DEPARTMENT OF ENERGY
Assistant Secretary for Resource Applications
Grand Junction Office, Colorado

This report is a result of work performed by Bendix Field Engineering Corporation, Operating Contractor for the U.S. Department of Energy, as part of the National Uranium Resource Evaluation. NURE is a program of the U.S. Department of Energy's Grand Junction, Colorado, Office to acquire and compile geologic and other information with which to assess the magnitude and distribution of uranium resources and to determine areas favorable for the occurrence of uranium in the United States.

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ABSTRACT

Reconnaissance and detailed geologic and radiometric investigations were conducted throughout the Athens Quadrangle, Georgia and South Carolina, to evaluate the uranium favorability using National Uranium Resource Evaluation criteria. Surface and subsurface studies were augmented by aerial radiometric surveys, emanometry studies and hydrogeochemical and stream-sediment reconnaissance studies.

The results of the investigations indicate environments favorable for allogenic deposits in metamorphic rocks adjacent to granite plutons, and Texas roll-type sandstone deposits in the Coastal Plain Province.

Environments considered unfavorable for uranium deposits are the placers of the Monazite Belt, pegmatites, and base- and precious-metal veins associated with faults and shear zones in metamorphic rocks.

INTRODUCTION

PURPOSE

The Athens Quadrangle, northeastern Georgia and southwestern South Carolina (Fig. 1), was evaluated for environments favorable for uranium. Selection of a favorable environment is based on the similarity of its geologic characteristics (recognition criteria) to those found in close association with known uranium deposits as described in Mickle and Mathews (eds., 1978). The study was conducted by Bendix Field Engineering Corporation (BFEC) for the National Uranium Resource Evaluation (NURE) program, managed by the Grand Junction, Colorado, Office of the U.S. Department of Energy (DOE).

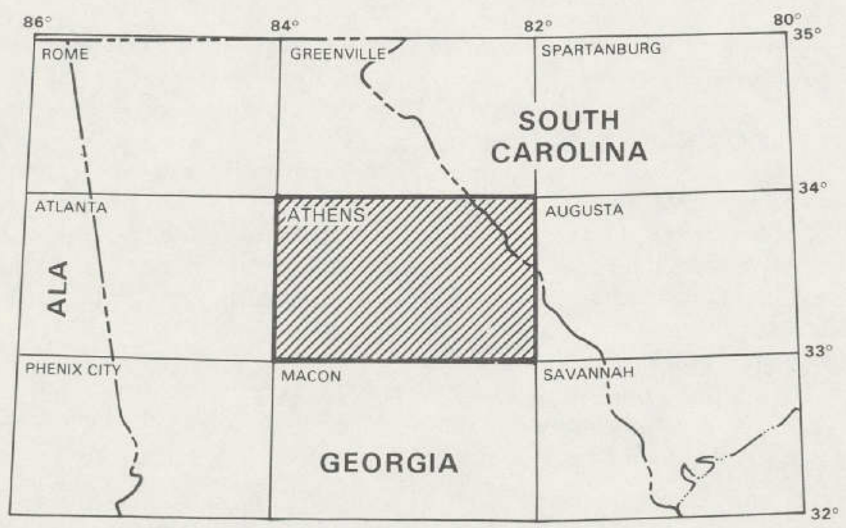

FIGURE 1. Athens Quadrangle location map.

ACKNOWLEDGMENTS

The author acknowledges the following contributions to the work. Valuable information on the location of abandoned mines was supplied by David E. Howell, Columbia, South Carolina. Cores and cuttings from test wells in the Coastal Plain were made available for study by the Geologic and Water Resources Division, Georgia Department of Natural Resources, Atlanta, Georgia. Cores from two Georgia copper mines were made available for inspection by the U.S. Bureau of Mines Twin City Core Library, Minneapolis, Minnesota.

SCOPE

Preliminary aerial followup studies (Lee, 1976) and surface reconnaissance were conducted during early 1977. Phase I, the planning portion of the project, was begun November 1, 1977, and completed January 15, 1978. Phase II, the evaluation portion, was conducted from January 15 to November 11, 1978. One man-month was expended for literature and data search, and 12 man-months were spent in field investigations and data evaluation. Approximately 1,700 scintillometer and spectrometer readings were taken, and 365 samples were collected for chemical and petrographic analyses (Pl. 5). Phase III, data compilation and preparation of the final report, including drafting and typing, required approximately 4 man-months.

PROCEDURES

The methods of evaluation used in the Athens Quadrangle were reconnaissance and detailed surface study, subsurface study, aerial radiometric surface followup studies, Track Etch™ emanometry, and computer analyses of hydrogeochemical and stream-sediment reconnaissance (HSSR) data.

Surface Study

The surface study combined a general reconnaissance survey with detailed studies of several selected environments. The general reconnaissance included scintillometer and spectrometer surveys, and a sampling program for the entire quadrangle. Extensive highway and railway systems throughout the area provided access that allowed excellent coverage in minimum time. Preliminary studies revealed areas containing reported uranium occurrences and indicated several environments similar to uranium-bearing provinces in other parts of the world. Environments selected for detailed geologic, radiometric, and emanometry studies were metamorphic rocks, Coastal Plain sediments, granite pegmatites, Monazite Belt rocks, and mineralized zones in metamorphic rocks.

Subsurface Study

Subsurface data from the Coastal Plain are restricted to general lithologic logs compiled by Herrick (1961) from 17 test wells totaling 2400 m, and cuttings and cores from 30 water, oil, and gas test wells totaling approximately 4100 m. Subsurface information from the Piedmont Province is limited to approximately 1000 m of core from 10 holes at the Chambers and Magruder base-metal sulfide mines in Wilkes and Lincoln Counties, Georgia. Scintillometer and gamma-ray spectrometer studies of the Coastal Plain cuttings and cores were conducted at the Georgia Geological Survey Repository in Atlanta, Georgia. The Piedmont core was examined by gamma-ray spectroscopy at the U.S. Bureau of Mines Twin City Core Library in Minneapolis, Minnesota. Cuttings and core samples that indicated anomalous radioactivity were analyzed for chemical uranium content (Samples MHD 090 to 100, Appendices B-2 and B-3).

Aerial Radiometric Surface Followup Studies

Aerial spectrometric and magnetic surveys of the entire quadrangle were flown by Geodata International, Inc. (1975), for the U.S. Energy Research and Development Administration (ERDA). Gross gamma radiometric surveys were flown by geoMetrics, Inc., for the Coastal Plains Regional Commission (CPRC) and the U.S. Geological Survey (USGS) during 1975 and 1976. Surface followup geologic and radiometric studies were conducted in areas of anomalous radioactivity delineated by the aerial surveys (Geodata International, Inc., 1975; Lee, 1976). Results of these studies, which consisted of scintillometer and gamma-ray spectrometer surveys and chemical and petrographic analyses of selected samples, are found in Plates 3a and 3b and Appendices B-1 through B-6.

Track Etch™ Emanometry

Two emanometry studies were conducted in the quadrangle to determine areas of anomalous radon emission. Both areas are dissected by faults and shear zones, contain sulfide mineralization, and are adjacent to granites that contain as much as 40 ppm U_3O_8. The radon is believed to be associated with allogenic uranium deposits similar to those found elsewhere in the world (Mathews, 1978a). In the Oglethorpe County area, 100 Track Etch™ cups were distributed over 0.30 km² (Pl. 10); in the Hancock County area, 150 cups were placed in 1.25 km² (Pl. 11). The Oglethorpe County locality is also the site of an inactive gold and base-metal sulfide mine.

Computer Analyses of HSSR Data

Data from the HSSR program for the Athens Quadrangle (Savannah River Laboratory, 1979) were not received in time to be field checked for this report. Although preliminary statistical analyses of these data indicate possible favorable areas (Pl. 4) that coincide with those on Plate 1, no verified correlation is possible at this time.

According to D. Shettel, BFEC (written comm., 1979), selection of the favorable areas shown on Plate 4 is based on the coincidence of the following parameters:

- High uranium concentration in ground water
- High uranium-to-conductivity ratios in ground water
- Positive uranium-fluorine association in ground water
- Low thorium-to-uranium ratios in stream sediments

At least three of these parameters are present in each area considered favorable.

GEOLOGIC SETTING

The Athens Quadrangle includes approximately 17,300 km² of the Piedmont Province and 4000 km² of the Coastal Plain Province (Pl. 7). The oldest rocks in the area are upper Precambrian metamorphic and igneous rocks of the Piedmont Province (Overstreet and Bell, 1965). The eroded surface of these crystalline rocks slopes gently (about 17 m/km) southeastward and is overlain by unaltered Coastal Plain sediments (Fig. 2).

SYSTEM	SERIES		FORMATION		LITHOLOGY	DESCRIPTION
QUATERNARY			Quaternary (undiff.)			Stream alluvium and terrace deposits.
TERTIARY	MIOCENE		"Hawthorne"? Neogene (undiff.)			Bluish-green to red, blocky, sandy clay.
TERTIARY	EOCENE	UPPER	BARNWELL	Upper sand		Gray to red, coarse-grained quartzose sand interbedded with gray clay stringers. Basal sand contains flat, rounded beach pebbles.
TERTIARY	EOCENE	UPPER	BARNWELL	Irwinton-Twiggs		Buff to red, fine- to coarse-grained quartzose sand interbedded with gray micaceous clay. Pale-green to gray blocky clay with fine- to medium-grained sand stringers
TERTIARY	EOCENE	UPPER	BARNWELL	"Clinch-field"		Red to gray, fine- to medium grained, massive to bedded, poorly consolidated, calcareous, fossiliferous quartzose sand.
TERTIARY	EOCENE	MIDDLE	McBean			Greenish-yellow, fine-grained, calcareous clayey sand and marl.
CRETACEOUS			Cretaceous (undiff.)			Pink and white, fine- to coarse-grained, massive to slightly bedded, kaolinitic, micaceous quartzose sand.
PRECAMBRIAN						Gneisses, schists, quartzites, phyllites, and granite intrusives.

FIGURE 2. Generalized stratigraphic column of Coastal Plain rocks in the Athens Quadrangle. Based on P. F. Huddlestun, Georgia Department of Natural Resources (written comm., 1978).

The predominant Piedmont rocks are complex amphibolite-grade (Medlin and Hurst, 1967) felsic and mafic gneisses and schists interbedded with amphibolites, all of which have been intruded by Paleozoic granite rocks and Triassic diabase dikes.

Argillites, phyllites, and muscovite-sericite schists of the Little River Series (Crickmay, 1952), thought to be lower Paleozoic (Salotti and Fouts, 1967), form a belt extending from the northeastern to the south-central part of the quadrangle. These low-grade metavolcanic and metasedimentary rocks of the greenschist facies (McLemore, 1965) are intruded by Paleozoic granites and syenites. The predominant gold and base-metal sulfide mines in the study area are within these units.

Upper Cretaceous sediments unconformably overlie the Piedmont crystalline rocks south of the Fall Line and in turn are unconformably overlain by upper Eocene beds (Fig. 2 and Pl. 7). According to Dennison and Wheeler (1972), some Coastal Plain sandstones in the southeastern United States exhibit characteristics elsewhere associated with uranium deposition.

Although folding is the predominant form of deformation in the Piedmont Province, two large fault systems and numerous smaller faults are known (Woolsey, 1973). At least two periods of deformation have been recognized in the study area by Gardner (1961). During the first period of deformation, in the late Precambrian, extensive folding and faulting occurred which produced the present structure and formed cataclasites and mylonites. Many granite pegmatites were intruded into the joints and fractures that formed. The second period, in the late Paleozoic, was less intense than the first and probably postdated all regional metamorphic events. Faulting predominated over folding, and flinty crush rock developed along shear zones (Fountain, 1961).

ENVIRONMENTS FAVORABLE FOR URANIUM DEPOSITS

Favorable environments, as determined by surface and subsurface investigations, are those that could contain uranium deposits of at least 100 tons U_3O_8 in rocks with an average grade not less than 100 ppm U_3O_8. The Athens Quadrangle contains environments favorable for allogenic deposits (Class 370, Mathews, 1978a) in metamorphic rocks adjacent to granite plutons (Areas A through E, Pl. 1) and Texas roll-type deposits (Subclass 242, Austin and D'Andrea, 1978) in the Coastal Plain Province (Area F, Pl. 1).

ALLOGENIC URANIUM DEPOSITS

This type deposit (Class 370) forms when uranium from an orthomagmatic, pegmatitic, or autometasomatic source is remobilized, transported by solution, and deposited in a near-surface, reducing environment in suitable host rocks adjacent to the source. Allogenic deposits (Areas A through E, Pl. 1) may occur in the quadrangle.

Five plutons in the quadrangle that may be uranium source rocks intruded low- to medium-grade metasedimentary and metavolcanic country rocks (Pl. 7) of late Precambrian to early Paleozoic age (Austin, 1965; Salotti and Fouts, 1967). Regional retrograde metamorphism occurred later in the north-central part of the quadrangle (Medlin and Hurst, 1967). These metamorphic rocks may be hosts for allogenic uranium deposits.

Possible uranium host rocks of the greenschist facies include micaceous, sericitic, chloritic, and ferruginous schists and phyllites. Amphibolite-grade rocks include granitic, biotitic, amphibolitic, and graphitic schists and gneisses (App. B-3). A strong foliation with a prevailing northeast trend characterizes these rocks. The dip of the foliation is commonly southeast, but northwest dips are found in some areas. Metamorphism in the Piedmont Province was accompanied by extensive faulting and shearing, the probable cause of the foliation.

Hematite and magnetite are ubiquitous in the metamorphic rocks, pyrite is disseminated in many, and ferromagnesian minerals

TABLE 1. CHEMICAL ANALYSES OF METASEDIMENTARY AND METAVOLCANIC ROCKS (IN PERCENT)*

Rock type	SiO_2	Al_2O_3	FeO	MgO	CaO	Na_2O	K_2O	TiO_2	P_2O_5
Phyllite	71.30	15.06	8.90	0.70	1.10	0.52	1.57	0.36	tr
Phyllite	61.28	24.10	17.92	0.51	—	0.18	0.14	0.54	0.05
Phyllite	67.02	18.17	7.90	0.55	—	0.23	0.09	0.73	0.10
Phyllite	59.50	20.79	15.78	1.51	0.18	0.09	1.22	0.91	0.16
Phyllite	65.09	21.69	4.66	tr	—	0.36	0.20	1.08	0.42
Chlorite-mica schist	62.45	15.91	5.87	1.76	3.70	2.33	0.40	0.82	0.13
Chlorite schist	61.25	17.18	7.03	2.21	3.78	2.50	1.60	0.92	0.02
Chlorite schist	58.71	14.96	6.29	3.19	4.90	3.24	0.94	0.83	0.04
Epidote gneiss	38.45	25.00	10.81	7.48	15.00	0.60	0.85	0.50	0.50
Hornblende gneiss	41.40	16.38	12.06	1.13	25.62	0.40	1.20	0.60	0.54
Hornblende schist	47.06	20.14	12.26	7.82	10.68	4.34	0.20	1.80	—
Mica schist	67.92	16.20	4.73	tr	—	1.06	2.86	0.32	0.11

* From Crickmay, 1952

are present in most (MAK 160, 179, 182, and 183, MAT 014 and 119; App. D). Graphite schists occur in parts of the quadrangle (MAK 144, App. B-3).

Chemical analyses reveal high percentages of FeO and MgO (Table 1). In surface samples of metasedimentary and metavolcanic rocks taken adjacent to source plutons, radiometric thorium and uranium average 11.9 and 4.6 ppm, respectively. The thorium-to-uranium ratio averages 2.6 (Table 2).

Two emanometry studies were conducted at areas in low-grade mica-sericite schists, one adjacent to the Elberton batholith in Oglethorpe County, Georgia, and the other adjacent to the Sparta Granite in Hancock County, Georgia (App. E, Pl. 10 and 11). Both areas are intensely faulted and contain abundant disseminated pyrite and hematite. A gold and base-metal sulfide mine was once active at the Oglethorpe County site. Aerial radiometric surveys (Geodata, 1975; CPRC and USGS, 1975) show increased radioactivity near the test sites.

Of the emanometry test sites in Oglethorpe County, 17% have alpha-track counts considered anomalous. Anomalous counts are those equal to or greater than three standard deviations above the mean number of tracks per square millimeter for test sites within the project. Some sites show alpha counts up to 12 times background (App. E). Three percent of the Hancock County sites are considered anomalous (App. E). Chemical analyses of samples from emanometry holes in both projects reveal an average 5.8 ppm U_3O_8 in Oglethorpe County and 5.4 ppm U_3O_8 in Hancock County (App. B-5 and B-6). Regression analyses of the alpha-track counts from each test hole, with their respective U_3O_8 values, show $0.08 < r^2 < 0.51$ (where r^2 is the coefficient of determination) at the 95% confidence level for Oglethorpe County and $0.13 < r^2 < 0.44$ at the 95% confidence level for Hancock County. This low correlation between near-surface U_3O_8 content and radon alpha-counts indicates that the alpha activity is largely independent of near-surface radon sources and must be related to some deeper source. The distribution and intensity of the radon anomalies suggest fault or shear conduits along which radon ascends from some subsurface source. Overstreet (1970) states that the surface expression of potential mineral deposits in the southeastern United States has been destroyed by deep weathering. This situation may be true for allogenic deposits in the quadrangle.

SANDSTONE-TYPE URANIUM DEPOSITS

All uranium deposits in sandstone require a uranium source, conduits for transmission of uranium in solution, and a precipitating mechanism. These requirements are met in varying degrees by the sediments of the Georgia Coastal Plain Province (Area F, Pl. 1), an environment considered favorable for Texas roll-type deposits (Subclass 242) despite the lack of demonstrable faults.

In the study area, Cretaceous sands derived from the granitic and metamorphic Piedmont basement rocks are unconformable with both the overlying Tertiary sediments and the underlying basement rocks (Fig. 2). The Cretaceous sediments form a wedge that thickens to the southeast and dips less than 1° SE. The sediments are nonmarine, arkosic, generally massive to bedded, poorly consolidated channel sands (LaMoreaux, 1946; Dennison and Wheeler, 1972) composed of angular to subrounded, medium- to coarse-grained quartz in an argillaceous-micaceous matrix interlayered with clay stringers. The feldspar content of the rocks suggests a nearby source. According to LeGrand and Furcron (1956), these sediments are the best aquifers in the Coastal Plain.

Surface studies discovered only limited uranium reductants, but carbonaceous trash and pyrite are present in subsurface samples

TABLE 2. URANIUM AND THORIUM ANALYSES OF METASEDIMENTARY AND METAVOLCANIC ROCKS ADJACENT TO GRANITE PLUTONS (IN PPM)

Sample no.	eU	eTh	Th/U
MAK 167	2.6	7.8	3.0
MAK 168	7.3	35.6	4.9
MAT 002	3.2	7.3	2.3
MAT 003	1.1	3.7	3.4
MAT 009	4.4	27.6	6.3
MAT 011	7.5	16.9	2.3
MAT 012	1.7	3.9	2.3
MAT 064	4.3	5.2	1.2
MAT 065	13.0	24.0	1.9
MAT 066	3.8	12.0	3.2
MAT 067	3.5	10.3	2.9
MAT 068	3.4	10.7	3.2
MAT 136	4.6	7.1	1.5
MAT 144	1.4	7.5	5.4
MAT 147	4.1	9.5	2.3
MHD 006	10.2	19.8	1.9
MHD 007	4.2	10.8	2.6
MHD 009	2.9	9.2	3.2
MHD 010	5.2	12.2	2.4
MHD 011	5.7	14.0	2.5
MHD 012	4.3	9.9	2.3
MHD 013	4.4	10.0	2.3
MHD 014	3.8	9.3	2.5
MHD 015	4.6	9.9	2.2
MHD 017	3.9	7.5	1.9
MHD 018	5.0	10.8	2.2
MHD 019	4.5	8.2	1.8
Average	4.6	11.9	2.6

TABLE 3. WELL LOGS FROM GEORGIA COASTAL PLAIN*

County	Well no.	Total depth (m)	Permeable units	Thickness of permeable units (m)	Reductant-bearing units	Thickness of reductant-bearing units	Reductant
Burke	139	52	Eocene	9	—	—	—
	220	282	Eocene	1	Eocene	13	Carbonaceous trash
			Cretaceous	35	—	—	—
	316	313	Eocene	13	—	—	—
			Cretaceous	23	Cretaceous	1	Carbonaceous trash
	520	213	Cretaceous	9	Eocene	12	Carbonaceous trash
Columbia	264	41	Cretaceous	3	—	—	—
Jefferson	133	167	Eocene	9	Eocene	14	Carbonaceous trash
			Cretaceous	9	—	—	—
	219	77	Eocene	14	Eocene	18	Carbonaceous trash
	480	229	Eocene	9	Cretaceous	107	Pyrite
			Cretaceous	24	—	—	—
	554	113	Eocene	15	Eocene	52	Carbonaceous trash
					Cretaceous	11	Pyrite
Richmond	129	49	Cretaceous	6	—	—	—
	130	93	Cretaceous	6	—	—	—
	309	48	Cretaceous	9	—	—	—
	371	80	Cretaceous	14	—	—	—
	526	107	Cretaceous	14	—	—	—
Washington	94	266	Eocene	6	Eocene	5	Carbonaceous trash
			Cretaceous	79	Cretaceous	56	Carbonaceous trash
	152	160	Eocene	4	—	—	—
			Cretaceous	79	—	—	—
	223	120	—	—	—	—	—

* From Herrick, 1961

(Table 3). Oxidation of iron minerals and alteration of feldspars to clay account for the red to brown and white mottling of outcrops. Considerably less alteration is observed in the subsurface samples which are mostly white to gray and pink.

Tertiary sediments, eroded from Cretaceous sands and the crystalline rocks, unconformably overlie the Cretaceous rocks and, in some parts of the quadrangle, fill channels in the basement rocks (LaMoreaux, 1946). The Tertiary sediments consist primarily of fossiliferous, carbonaceous, marine to marginal-marine, massive to bedded, poorly consolidated, interlayered sands and clays of the Eocene Barnwell Formation (Fig. 2). These sediments are composed of angular to subrounded, fine- to coarse-grained quartz in an argillaceous-micaceous matrix. The outcrops in the study area do not contain appreciable feldspar or reductants usually associated with uranium deposits; however, carbonaceous material is present in the subsurface (Table 3). The description of alteration characteristics of the Cretaceous rocks applies equally to the Tertiary sediments.

ENVIRONMENTS UNFAVORABLE FOR URANIUM DEPOSITS

In the Athens Quadrangle, unfavorable environments include placers of the Monazite Belt (Class 110, Jones, 1978b), pegmatites (Class 320, Mathews, 1978a), and gold and base-metal veins associated with fault and shear zones in metamorphic rocks (Class 720, Mathews, 1978b).

PLACER-TYPE URANIUM DEPOSITS

Monazite occurs in the Georgia Piedmont Province in a belt of Precambrian to Paleozoic crystalline rocks and in stream sediments on crystalline rocks (Overstreet, 1967; Mertie, 1953). Although the Monazite Belt contains anomalous radioactivity (Pl. 3a), Mertie (1953) reported that monazite-bearing crystalline rocks in the southeastern United States contain an average 0.006% monazite with an average U_3O_8 content of 0.38%. Applying these averages, the monazite fraction of the crystalline rocks contributes less than 0.3 ppm to the total U_3O_8 content.

Fluviatile monazite placers (Class 110) in the quadrangle occur in flood plains of the Oconee River drainage basin in parts of Oconee, Clarke, Barrow, Jackson, and Oglethorpe Counties, Georgia. Some of these flood plains are as much as 600 m wide and have an average alluvium thickness of 3 to 4 m. Overstreet (1967) reports that because of the silt and clay content of the sediment (average: 3% gravel, 41% sand, and 56% silt and clay), these areas are unfavorable for mineable monazite deposits. Although some areas in the Monazite Belt of Georgia may be suitable for small-scale mining operations, the tonnage and grade of individual monazite deposits are too low for large operations.

Whole-rock analyses of intrusive, metamorphic, and saprolitic samples from the Monazite Belt (App. B-4) show that the U_3O_8 averages 8.5 ppm, equivalent thorium averages 28.0 ppm, equivalent uranium averages 8.9 ppm, and the thorium-to-uranium ratio averages 3.3. Given these values and the improbability of monazite mining and byproduct uranium, the Monazite Belt is considered unfavorable for uranium deposits.

PEGMATITIC URANIUM DEPOSITS

Pegmatites (Class 320) in the quadrangle occur primarily in amphibolite-grade metamorphic rocks, commonly near large granite intrusions (Furcron and Teague, 1943). However, some pegmatites intrude mafic bodies in Monroe and Jasper Counties, Georgia (Prather, 1971; Matthews, 1967), and the Sparta Granite pluton in Hancock County, Georgia (Lee, 1976). A belt of granite pegmatites extends from the southwestern corner to the north-central part of the quadrangle. Rocks from this belt contain the two uranium occurrences reported for the study area (Furcron, 1955). Only one of these occurrences (App. A) could be confirmed for this report.

Age dates and strontium ratios for pegmatites in this area (Jones and others, 1974) indicate these rocks are genetically and temporally related to postmetamorphic, epizonal-mesozonal granites. The pegmatites are both conformable and disconformable, tabular, and have no apparent preferred strike orientation but commonly dip steeply to the west (Prather, 1971; Matthews, 1967).

The pegmatite bodies consist of quartz, feldspar, and muscovite, with accessory biotite, garnet, tourmaline, beryl, apatite, and allanite. A multiple-oxide, uranium-bearing mineral was found in Greene County, Georgia (MAT 140 and 141, App. D). The quartz occurs as clear to smoky masses and as graphic intergrowths in the feldspars. Pink to gray, coarsely crystalline, graphic microcline is the most common feldspar, but albite and albite-oligoclase are present at many locations as perthitic intergrowths in the microcline or as coarse crystalline masses. Muscovite occurs as large, clear books and as twisted masses with inclusions of quartz, biotite, and magnetite. Some pegmatites contain a quartz core, a feldspar wall zone, and muscovite on the border zone near the contact (Prather, 1971).

No chemical analyses for the major constituent oxides are available; however, based on the mineralogy, the pegmatites probably contain high SiO_2, Al_2O, Na_2O, and K_2O, and low CaO, FeO, and Fe_2O_3. These rocks are probably subaluminous to peralkaline. Results from additional chemical analyses (Table 4) show values of uranium, thorium, lithium, beryllium, molybdenum, tungsten, zircon, tin, and niobium below those expected in pegmatites, and well below those of uraniferous pegmatites.

TABLE 4. ANALYSES OF PEGMATITES FOR SELECTED ELEMENTS (IN PPM)

Sample No.	eU	eTh	Th/U	Be	Li	Mo	Nb	Sn	W	Zr
MAE 418	21.0	21.0	1.0	—	—	—	—	—	—	—
MAE 419	22.9	18.2	0.8	—	—	—	—	—	—	—
MAE 427	13.8	11.7	0.9	—	—	—	—	—	—	—
MAE 428	3.6	1.1	0.3	—	—	—	—	—	—	—
MAK 127	5.8	58.8	10.1	—	—	—	—	—	—	—
MAK 150	3.9	8.8	2.3	30	<10	<10	50	<10	<100	300
MAK 152	8.9	30.2	3.4	15	<10	<10	<20	<10	<100	300
MAK 153	8.9	26.6	3.0	20	<10	<10	50	<10	<100	300
MAK 193	1.8	3.2	1.8	7	<10	<10	20	<10	<100	<10
MAT 041	3.0	121.1	40.4	<10	20	<10	<20	<10	<100	10
MAT 051	2.9	8.2	2.8	<10	30	<10	<20	<10	<100	<10
MAT 053	1.0	5.9	5.9	<10	15	<10	<20	200	<100	<10
MAT 055	0.2	4.0	20.0	<10	15	<10	<20	<10	<100	<10
MAT 063	1.2	9.0	7.5	15	<10	<10	<20	<10	<100	<10
MAT 114	1.7	6.3	3.7	<10	35	<10	<20	<10	<100	<10
MAT 160	1.6	2.8	1.8	<10	<10	<10	<20	<10	<100	<10
MAT 161	4.3	39.6	9.2	<10	<10	<10	<20	<10	<100	<10
MAT 164	1.5	27.8	18.5	<10	<10	<10	<20	<10	<100	50
MAT 168	0.9	1.3	1.4	3	<10	16	16	14	47	<10

These pegmatites have several characteristics described by Mathews (1978a) as favorable for uranium deposits in pegmatites. However, extensive field investigation and literature search failed to disclose the presence of fluorite, hematite, sodic amphiboles, or pyroxenes cited by Mathews (1978a) as criteria for distinguishing between uraniferous and nonuraniferous pegmatites. Pegmatites in the Athens Quadrangle are therefore considered unfavorable for uranium deposits.

VEIN-TYPE URANIUM DEPOSITS IN METAMORPHIC ROCKS

Mineralized veins associated with fault and shear zones in the metamorphic rocks (Class 720) of the quadrangle were examined for uranium deposits. The metamorphosed rocks in the study area range from felsic to mafic, foliated to nonfoliated, and metasedimentary to metavolcanic. The rocks grade from greenschist to upper amphibolite facies due to prograde and retrograde metamorphism and include gneisses, schists, phyllites, argillites, and quartzites. The mineral assemblages contain quartz, feldspar, biotite, muscovite, hornblende, and accessory minerals.

Several granitic plutons and pegmatites, mafic plutons and dikes, and quartz veins have intruded the metamorphic rocks. Major fault and shear zones are found in the western part of the quadrangle. The major base- and precious-metal deposits associated with minor fault and shear zones are found in the metavolcanic rocks in the north-central and eastern parts of the quadrangle. According to Hurst (1970), movements along the major faults partly predate and partly postdate the late Paleozoic Appalachian orogeny. These fault and shear zones are characterized by a northeast trend, steep dips, and blastomylonitic rocks. The smaller fault and shear zones commonly trend northeast or northwest (Pl. 8), dip steeply, and contain associated brecciated zones.

Surface and subsurface investigations of the metamorphic rocks and their associated structural and mineralized zones revealed some chloritization (MAK 130, App. D) and trace amounts of hematite alteration. No evidence of feldspathization was observed, and no indication of uranium mineralization was apparent in aerial and ground radiometric or preliminary HSSR data. Thorium and uranium contents of the metamorphic rocks average 15.1 and 2.9 ppm, respectively, with an average thorium-to-uranium ratio of 5.2 (App. B-3). Three quartz samples contained an average of 5.5 ppm equivalent thorium and 1.7 ppm equivalent uranium with an average thorium-to-uranium ratio of 3.2 (range: 2.0 to 18.5).

Most veins in the study area associated with fault and shear zones are in upper Precambrian to Paleozoic rocks. However, the quadrangle is not part of a Precambrian shield area, which is the prevalent environment for vein-type deposits in metamorphic rocks (Mathews, 1978b). In addition, a distinct lack of feldspathization, hematitization, and uranium minerals, and moderate to high thorium-to-uranium ratios (2.0 to 18.5) indicate no favorability for uranium deposits.

RECOMMENDATIONS TO IMPROVE EVALUATIONS

Several favorable areas are suggested from preliminary statistical evaluation of HSSR data. However, because no followup studies were possible due to the late receipt of these data, field checking of possible favorable areas is recommended as a first step toward improving the evaluation. The field investigations should include detailed ground-water and stream-sediment sampling and analyses accompanied by radiometric surveys and, possibly, detailed geologic mapping in the areas designated on Plate 4. The suite of analyses should include molybdenum, selenium, arsenic, and phosphate.

Because so few subsurface data are available for the quadrangle, drilling is needed to properly evaluate the area at depth. Drilling is recommended for the Oglethorpe and Hancock Counties, Georgia, project areas, based on the results of this investigation. Test holes, cored and logged, ranging from 60 to 150 m in depth at sites within the two areas, would provide lithologic, structural, mineralogic, and radiometric data on inferred allogenic deposits. A drilling program in the Coastal Plain would provide similar data on sandstone deposits. Eight holes on 8-km centers across the paleoslope southeast of the Fall Line in Burke and Washington Counties, Georgia, would provide a starting point for more detailed drilling. The exact locations are not critical provided they are in a line down the paleoslope.

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APPENDIX A. URANIUM OCCURRENCES IN THE ATHENS QUADRANGLE

Occurrence no.	Name	Location Lat. (N)	Location Long. (W)	Host rock	Deposit class or subclass (no.)	Production	Reference
1	Poss Pegmatite	38 38 02	83 00 29	Amphibolite/ biotite gneiss	Pegmatitic (320)*	a**	Furcron, 1955

*Mathews, 1978
**Production category: a. 0 to 20,000 lb U_3O_8

APPENDIX B-1. CHEMICAL ANALYSES OF INTRUSIVE ROCKS

Sample number	Rock unit	Sample description	U_3O_8 (ppm)	eU (ppm)	K (%)	eTh (ppm)	As (ppm)	Ba (ppm)	Be (ppm)	Co (ppm)	Cr (ppm)	Cu (ppm)	Fe (%)	Mg (%)	Mn (ppm)	Mo (ppm)	Ni (ppm)	Pb (ppm)	Se (ppm)	Sr (ppm)	V (ppm)	Zn (ppm)	Zr (ppm)	CaO (%)	CO_3 (%)	FeO (%)	Fe_2O_3 (%)	K_2O (%)	Na_2O (%)	P_2O_5 (%)	SO_4 (%)	TiO_2 (%)
MAE 407	gg	Granite	22	17.7	4.8	14.2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	<.001	–	–
408	gg	Granite gneiss	16	12.5	4.3	16.5	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	<.001	–	–
416	grl	Granite saprolite	11	11.3	3.2	31.7	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
417	grl	Granite	4	3.1	3.9	20.9	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
418	grl	Granite pegmatite	19	21.0	4.7	21.0	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
MAE 419	grl	Granite pegmatite	40	22.9	4.3	18.2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
422	gg	Porphyritic granite	3	2.8	3.4	17.9	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
423	gg	Granite saprolite	5	4.2	3.2	17.9	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
424	gg	Porphyritic granite	6	5.3	4.3	20.4	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
425	gg	Granite saprolite	4	1.6	0.2	9.2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
MAE 426	mm	Quartz dike	3	2.8	3.8	20.0	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
427	gg	Pegmatitic granite	18	13.8	4.5	11.7	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
428	gg	Pegmatitic granite	6	3.6	4.4	1.1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
MAK 126	grla	Granite saprolite	5	5.2	2.4	73.9	–	–	–	–	20	–	–	–	–	2	–	25	<2	–	70	–	–	0.05	0.4	0.31	0.39	0.36	0.11	0.55	<0.1	0.82
127	grla	Granite pegmatite	6	5.8	5.7	58.8	–	–	–	–	10	–	–	–	–	2	–	20	<2	–	30	–	–	0.04	0.4	0.35	0.22	0.48	0.18	0.28	<0.1	0.70
MAK 128	grla	Granite porphyry	4	4.7	4.5	41.9	–	0.15*	15	0	16	7	2.0	0.70	300	<3	15	56	<0.5	500	192	0	500	1.25	–	–	–	–	2.50	–	–	0.2
129	grl	Granite	2	1.9	3.2	13.8	–	700	5	0	5	7	2.0	0.70	500	<3	5	46	<0.5	100	142	0	0	0.58	–	–	–	–	0.85	–	–	0.1
132	grl	Granite	2	1.4	4.4	4.9	–	0.10*	7	0	5	0	1.5	0.50	200	<3	<5	62	<0.5	200	92	0	0.10*	0.83	–	–	–	–	0.85	–	–	0.1
133	grla	Porphyritic granite	2	2.7	4.2	22.4	–	0.10*	10	0	7	15	2.0	0.70	500	<3	7	42	<0.5	500	176	0	500	1.25	–	–	–	–	1.27	–	–	0.2
142	grl	Granite gneiss	4	2.8	4.7	26.1	–	0.15*	10	0	7	15	2.0	0.70	300	<3	7	56	<0.5	500	137	0	300	1.25	–	–	–	–	1.27	–	–	0.2
MAK 143	grl	Granite gneiss	4	3.9	3.1	11.1	–	0.10*	15	0	16	15	2.0	1.00	700	4	10	50	<0.5	500	192	0	200	1.66	–	–	–	–	1.70	–	–	0.2
145	grla	Granite porphyry	6	6.0	5.1	46.0	–	0.15*	10	0	7	15	2.0	0.70	300	5	10	56	<0.5	200	352	0	300	0.58	–	–	–	–	0.60	–	–	0.2
146	gr	Syenite	3	2.7	5.1	7.4	–	<10	15	0	5	<5	3.0	0.30	700	4	5	44	<0.5	100	662	0	>0.10*	1.25	–	–	–	–	1.27	–	–	0.1
148	gg	Granite	2	1.4	5.1	16.7	–	700	10	0	3	15	1.5	0.50	200	<3	7	63	<0.5	200	260	0	500	0.42	–	–	–	–	0.04	–	–	0.2
150	gg	Granite pegmatite	3	3.9	3.4	8.8	–	200	30	0	2	<5	1.0	0.50	200	<3	20	50	<0.5	100	365	0	300	1.25	–	–	–	–	1.27	–	–	0.1
MAK 151	gg	Granite	3	2.0	4.7	23.5	–	300	15	0	9	<5	2.0	0.50	300	<3	7	52	<0.5	100	159	<200	500	0.58	–	–	–	–	1.70	–	–	0.2
152	grl	Granite pegmatite	8	8.9	4.1	30.2	–	300	15	0	14	<5	2.0	0.50	300	<3	30	52	<0.5	100	143	<200	300	0.17	–	–	–	–	1.70	–	–	0.1
153	fg	Pegmatite dike	8	8.9	2.6	26.6	–	100	20	0	11	15	2.0	0.30	700	<3	20	54	<0.5	100	121	<200	300	1.25	–	–	–	–	2.55	–	–	0.1
156	fg	Granite gneiss	11	9.4	4.1	16.0	–	0.10*	10	0	3	5	2.0	0.50	300	<3	15	83	<0.5	200	314	<200	200	1.25	–	–	–	–	2.55	–	–	0.1
157	gr2	Granite saprolite	44	77.7	0.1	554.0	–	–	–	0	200	–	–	–	–	4	–	60	<2	–	70	<200	–	0.04	–	0.04	2.1	0.15	<0.01	–	<0.10	1.3
MAK 158	gr2	Granite saprolite	40	64.7	0.1	449.1	–	–	–	–	150	–	–	–	–	4	–	45	<2	–	100	<200	–	0.04	–	0.22	3.0	0.55	<0.01	–	<0.10	2.1
159	gr2	Granite saprolite	42	75.7	0.3	483.9	–	–	–	0	125	–	–	–	–	2	–	45	<2	–	50	<200	–	0.04	–	0.29	1.3	0.10	<0.01	–	<0.10	2.8
164	grl	Granite	6	5.8	4.1	29.4	–	0.10*	15	0	9	5	1.5	0.50	500	9	–	42	<0.5	200	115	<200	300	1.25	–	–	–	–	2.55	–	–	0.1
170	gr2	Granite	10	6.2	4.8	40.3	–	700	10	0	8	5	2.0	0.50	100	<3	5	77	<0.5	100	109	<200	300	0.58	–	–	–	–	1.70	–	–	0.1
173	gg	Granite	6	4.2	6.2	2.5	–	300	15	0	6	7	0.7	0.10	70	2	5	46	<0.5	100	56	<200	00	0.58	–	–	–	–	1.70	–	–	0.0
MAK 178	fg	Granite gneiss	1	2.2	7.0	31.6	–	0.10*	2	0	7	5	1.0	0.30	300	3	<5	63	<0.5	200	46	<200	100	0.04	–	–	–	–	0.85	–	–	0.1
180	fg	Granite gneiss	3	3.2	6.2	0.2	–	200	10	0	5	5	0.3	0.02	300	1	<5	66	<0.5	100	7	<200	00	1.25	–	–	–	–	1.70	–	–	0.1
185	gg	Granite gneiss	4	4.8	8.7	12.5	–	700	15	0	12	5	1.5	0.50	200	1	30	20	<0.5	100	27	<200	200	1.25	–	–	–	–	2.55	–	–	0.1
187	v	Granite gneiss	8	1.7	2.1	3.1	–	0.15*	7	20	43	15	2.0	–	100	2	30	22	<0.5	300	71	<200	100	1.66	–	–	–	–	1.70	–	–	0.2
188	grl	Granite saprolite	10	4.5	0.4	28.5	–	–	–	0	24	–	2.0	–	–	3	–	25	<0.5	–	45	<200	–	0.08	–	–	–	–	0.05	–	–	0.2
MAK 189	grl	Granite	15	4.5	3.8	27.4	–	100	15	0	12	15	1.0	–	100	2	20	32	<0.5	–	9	<200	<100	0.41	–	–	–	–	3.40	–	–	0.0
192	Rd	Diabase	3	3.8	2.6	14.4	–	0.15*	10	10	42	30	3.0	2.00	500	1	30	22	<0.5	200	120	200	<200	2.00	–	–	–	–	2.00		–	0.2
193	pms	Granite pegmatite	2	1.8	5.5	3.2	–	500	7	0	10	–	1.0	0.15	100	3	10	150	<0.5	<100	67	<200	–	1.25	–	–	–	–	2.55	–	–	0.0
MAT 001	gg	Granite gneiss	1	1.6	4.2	12.9	–	500	<10	<10	<10	10	2.0	–	500	5	10	23	<0.5	150	36	<200	15	0.41	–	–	–	–	0.60	–	–	0.2
002	gg	Granite gneiss	1	1.1	1.1	3.7	–	300	<10	<10	<10	10	1.5	–	100	3	<10	<10	<0.5	<100	16	<200	15	0.58	–	–	–	–	0.68	–	–	0.2
MAT 003	gg	Granite gneiss	3	3.2	1.6	7.3	–	300	<10	<10	18	25	3.0	–	700	5	20	<10	<0.5	150	130	<200	<10	2.50	–	–	–	–	0.68	–	–	0.2
004	gg	Granite gneiss	1	2.0	4.8	14.4	–	150	<10	<10	398	<10	0.1	–	100	3	<10	27	<0.5	<100	16	<200	<10	0.16	–	–	–	–	0.60	–	–	0.0
006	grl	Granite gneiss	4	2.6	4.8	17.3	–	0.10*	<10	<10	<10	<10	0.7	–	150	3	<10	35	<0.5	100	24	<200	<10	0.83	–	–	–	–	0.60	–	–	0.1
007	fg	Granite saprolite	5	5.6	2.0	75.3	–	–	<10	–	39	–	5.0	–	–	6	–	42	0.7	–	130	<200	–	0.01	–	0.58	6.36	–	0.13	–	0.15	1.2
008	fg	Granite	2	4.5	4.6	60.8	–	0.30*	<10	<10	20	15	2.0	–	250	7	10	35	<0.5	150	85	<200	300	0.83	–	–	–	–	0.55	–	–	0.5
MAT 010	grla	Porphyritic granite	7	6.7	4.4	31.8	–	500	<10	<10	13	<10	1.5	–	200	4	<10	31	<0.5	100	32	<200	<10	0.83	–	–	–	–	0.68	–	–	0.1
017	pms	Granite gneiss saprolite	1	2.2	2.8	6.4	–	500	<10	<10	10	25	2.0	–	50	<10	30	150	–	200	<10	<200	<10	0.08	–	–	–	–	0.75	–	–	0.0
018	pms	Granite gneiss	2	1.9	3.4	20.3	–	600	<10	20	50	15	10.0	–	800	<10	20	40	–	200	500	<200	150	0.41	–	–	–	–	0.73	–	–	0.5
020	gg	Granite	1	0.4	0.3	1.2	–	100	<10	10	50	20	6.0	–	0.20*	<10	50	10	–	250	300	<200	<10	0.06	–	–	–	–	0.82	–	–	0.4
023	gg	Granite gneiss	2	2.2	2.3	12.1	–	600	<10	10	50	20	2.0	–	0.10*	<10	10	20	–	200	150	<200	30	8.33	–	–	–	–	0.77	–	–	0.4
MAT 025	gg	Granite gneiss saprolite	1	2.1	3.1	42.3	–	500	<10	10	20	10	6.0	–	300	<10	10	60	–	150	100	<200	15	0.04	–	–	–	–	0.60	–	–	0.5
041	mm	Granite pegmatite	1	3.0	6.4	121.1	–	0.10*	<10	<10	<10	<10	1.5	–	200	<10	<10	60	–	150	10	<200	<10	0.01	–	–	–	–	0.62	–	–	0.1
043	mm	Granite gneiss saprolite	2	1.3	3.9	13.6	–	600	<10	<10	<10	<10	0.7	–	200	<10	<10	10	–	200	<10	<200	<10	0.41	–	–	–	–	0.78	–	–	0.1
045	fg	Granite gneiss saprolite	3	2.5	2.8	12.4	–	400	<10	10	10	<10	5.0	–	0.10*	<10	<10	20	–	150	100	<200	50	0.41	–	–	–	–	0.68	–	–	0.4
046	grl	Granite saprolite	7	7.1	3.7	23.8	–	500	<10	<10	<10	<10	5.0	–	300	<10	<10	60	–	200	10	<200	10	0.58	–	–	–	–	0.77	–	–	0.1
MAT 047	fg	Granite gneiss saprolite	2	1.3	4.9	28.9	–	800	<10	<10	<10	<10	1.5	–	300	<10	<10	30	–	150	10	<200	40	0.41	–	–	–	–	0.71	–	–	0.2
048	fg	Granite	4	3.4	4.6	98.6	–	800	<10	<10	<10	<10	2.0	–	800	<10	<10	40	–	200	30	<200	150	0.58	–	–	–	–	0.77	–	–	0.2
051	fg	Granite pegmatite	1	2.9	4.9	8.2	–	200	<10	50	10	<10	5.0	–	0.10*	<10	50	60	–	250	50	<200	<10	0.01	–	–	–	–	0.69	–	–	0.2
053	fg	Granite pegmatite	1	1.0	2.4	5.9	–	0.10*	<10	<10	10	<10	1.0	–	200	<10	10	60	–	100	10	<200	<10	0.83	–	–	–	–	0.62	–	–	0.1
055	mm	Granite pegmatite	1	0.2	6.7	4.0	–	700	<10	<10	<10	<10	0.5	–	20	<10	<10	30	–	150	<10	<200	<10	0.08	–	–	–	–	0.71	–	–	0.0
MAT 056	gg	Granite gneiss saprolite	2	3.3	2.0	33.4	–	400	<10	20	50	35	10.0	–	300	<10	50	20	–	250	300	<200	15	0.01	–	–	–	–	0.73	–	–	0.1
057	gg	Granite gneiss	1	0.9	3.4	2.8	–	700	<10	<10	10	10	1.0	–	50	<10	<10	20	–	150	<10	<200	15	0.83	–	–	–	–	0.68	–	–	0.0
060	c2	Flinty crush rock	1	0.8	0.9	2.4	–	50	<10	<10	20	<10	1.0	–	100	<10	20	<10	–	90	10	<200	<10	0.01	–	–	–	–	0.61	–	–	0.0
063	mpl	Granite pegmatite	1	1.2	0.8	9.0	–	20	<10	<10	<10	10	0.3	–	50	<10	<10	20	–	200	<10	<200	<10	1.66	–	–	–	–	0.85	–	–	0.0
070	fg	Granite gneiss	1	0.6	0.4	3.5	–	300	<10	<10	10	20	1.5	–	0.20*	<10	10	10	–	150	20	<200	150	0.83	–	–	–	–	0.77	–	–	0.2
MAT 071	gg	Granite gneiss	1	1.3	1.3	8.4	–	600	<10	<10	10	<10	2.0	–	0.10*	<10	10	10	–	150	20	<200	200	0.83	–	–	–	–	0.79	–	–	0.2
072	gg	Granite gneiss saprolite	8	8.4	1.3	9.5	–	300	<10	20	20	25	15.0	–	200	<10	20	30	–	250	100	<200	15	0.21	–	–	–	–	0.76	0.06	–	0.5
073	fg	Granite gneiss saprolite	3	3.4	3.2	26.5	–	0.10*	<10	10	10	15	3.0	–	500	20	10	50	–	250	50	<200	75	1.25	–	–	–	–	0.81	–	–	0.2
075	gg	Granite gneiss	1	0.5	3.5	10.3	–	0.10*	<10	<10	10	10	1.5	–	300	<10	20	50	–	200	20	<200	50	0.58	–	–	–	–	0.77	–	–	0.1
076	gg	Granite gneiss saprolite	2	2.5	0.9	8.3	–	300	<10	10	10	10	5.0	–	500	<10	20	30	–	250	100	<200	40	0.83	–	–	–	–	0.83	–	–	0.2

APPENDIX B-1. CHEMICAL ANALYSES OF INTRUSIVE ROCKS (Continued)

Sample number	Rock unit	Sample description	U_3O_8 (ppm)	eU (ppm)	K (%)	eTh (ppm)	As (ppm)	Ba (ppm)	Be (ppm)	Co (ppm)	Cr (ppm)	Cu (ppm)	Fe (%)	Mg (%)	Mn (ppm)	Mo (ppm)	Ni (ppm)	Pb (ppm)	Se (ppm)	Sr (ppm)	V (ppm)	Zn (ppm)	Zr (ppm)	CaO (%)	CO_3 (%)	FeO (%)	Fe_2O_3 (%)	K_2O (%)	Na_2O (%)	P_2O_5 (%)	SO_4 (%)	TiO_2 (%)
MAT 078	gg	Granite gneiss saprolite	1	0.5	5.2	19.7	-	0.20*	<10	<10	10	25	1.5	-	100	<10	20	20	-	200	30	<200	40	0.17	-	-	-	-	0.74	-	-	0.1
079	gg	Granite gneiss	4	6.5	3.6	9.3	-	500	<10	<10	10	25	1.5	-	500	<10	20	30	-	200	30	<200	<10	0.83	-	-	-	-	0.85	-	-	0.8
080	gg	Granite gneiss saprolite	1	1.6	0.1	7.1	-	20	<10	20	20	75	6.0	-	0.20*	<10	20	<10	-	300	150	<200	20	0.01	-	-	-	-	0.85	-	-	0.4
081	gg	Granite gneiss	2	1.0	4.9	2.4	-	0.10*	<10	<10	20	<10	1.0	-	200	<10	20	50	-	150	<10	<200	<10	0.06	-	-	-	-	0.73	-	-	0.0
082	fg	Granite gneiss saprolite	1	1.6	1.2	40.1	-	400	<10	<10	20	10	1.5	-	150	<10	20	20	-	200	30	<200	50	0.83	-	-	-	-	0.71	-	-	0.2
MAT 084	fg	Granite gneiss saprolite	2	2.1	4.6	30.1	-	400	<10	<10	10	<10	1.5	-	50	<10	20	40	-	200	20	<200	15	0.01	-	-	-	-	0.85	-	-	0.1
087	gg	Granite gneiss	2	2.4	1.5	24.1	-	400	<10	<10	10	20	2.0	-	200	<10	10	20	-	250	75	<200	15	0.42	-	-	-	-	8.50	-	-	0.2
088	fg	Granite gneiss saprolite	2	2.8	1.2	48.4	-	300	<10	<10	50	15	2.0	-	200	<10	30	20	-	150	75	<200	150	0.01	-	-	-	-	0.77	-	-	0.4
092	fg	Granite gneiss	1	0.6	0.6	1.1	-	200	<10	<10	<10	<10	1.0	-	200	<10	<10	10	-	200	10	<200	20	1.25	-	-	-	-	0.85	-	-	0.0
096	grl	Granite	6	7.3	4.4	30.6	-	500	<10	<10	20	<10	1.0	-	800	<10	10	40	-	200	<10	<200	10	0.42	-	-	-	-	0.85	-	-	0.1
MAT 113	gr2	Granite	8	6.1	4.3	20.0	-	700	<10	<10	40	10	3.0	-	0.10*	<10	30	40	-	200	50	<200	40	0.83	-	-	-	-	0.82	-	-	0.2
114	gla	Granite pegmatite	4	1.7	4.8	6.3	-	30	<10	<10	10	<10	0.5	-	0.20*	<10	10	20	-	200	40	<200	<10	0.42	-	-	-	-	0.80	-	-	0.0
117	mm	Granite gneiss	3	1.5	4.5	15.1	-	700	<10	<10	10	<10	0.5	-	200	<10	<10	30	-	200	10	<200	10	0.17	-	-	-	-	0.78	-	-	0.0
139	grla	Granite saprolite	19	19.2	0.8	70.8	-	300	<10	10	<10	20	5.0	-	50	<10	10	20	-	<100	50	<200	30	0.01	-	-	-	-	0.34	-	-	0.4
140	mm	Granite saprolite	490	534.8	0.5	77.5	-	50	<10	<10	<10	<10	0.1	-	200	<10	<10	20	-	<100	<10	<200	<10	0.83	-	-	-	-	3.49	0.02	-	0.0
MAT 141	mm	Granite saprolite	620	605.2	0.4	91.4	-	50	<10	<10	<10	<10	0.1	-	300	<10	<10	70	-	<100	<10	<200	10	0.83	-	-	-	-	1.97	<0.001	-	0.0
143	grl	Porphyritic granite	2	0.5	3.7	2.8	-	30	<10	<10	<10	<10	2.0	-	50	<10	<10	30	-	<100	<10	<200	<10	0.83	-	-	-	-	1.66	-	-	0.0
145	grl	Granite	2	0.9	2.7	10.4	-	500	<10	<10	10	10	1.5	-	800	<10	10	30	-	<100	20	<200	15	0.12	-	-	-	-	1.60	-	-	0.1
146	grla	Granite	5	3.3	5.0	49.6	-	0.10*	<10	<10	10	10	1.5	-	200	<10	10	40	-	<100	30	<200	50	0.04	-	-	-	-	0.76	-	-	0.2
148	grl	Granite	17	17.9	3.8	35.4	-	300	<10	<10	<10	10	1.0	-	200	<10	<10	50	-	<100	10	<200	20	0.05	-	-	-	-	1.66	0.43	-	0.0
MAT 149	grl	Granite saprolite	10	5.2	4.2	43.8	-	50	<10	<10	<10	10	1.0	-	100	<10	<10	30	-	<100	<10	<200	30	0.02	-	-	-	-	1.57	0.03	-	0.0
150	TRd	Diabase	2	1.1	0.0	3.1	-	300	<10	20	20	100	5.0	2.00	2,000	<10	40	10	-	210	300	0	<200	7.00	-	-	-	-	3.10	-	-	0.2
160	mm	Granite pegmatite	2	1.6	9.0	2.8	-	0.10*	<10	<10	10	10	0.5	-	20	<10	<10	100	-	<100	<10	<200	<10	0.01	-	-	-	-	0.69	-	-	0.0
161	gla	Granite pegmatite	7	4.3	5.1	39.6	-	300	<10	<10	<10	10	0.5	-	70	<10	<10	30	-	<100	<10	<200	<10	0.83	-	-	-	-	1.83	-	-	0.0
164	mm	Granite pegmatite	4	1.5	6.8	27.8	-	0.20*	<10	<10	<10	10	1.0	-	50	<10	<10	50	-	<100	20	<200	50	0.04	-	-	-	-	0.85	-	-	0.1
MAT 168	fg	Granite pegmatite	1	0.9	1.5	1.3	-	17	<10	11	67	<1	14.0	-	205	16	28	61	-	110	32	44	<10	0.02	-	-	-	-	0.09	-	-	0.1
MHD 021	gg	Granite gneiss	3	-	-	-	-	0.39*	15	16	6	8	3.1	-	-	23	13	150	-	100	18	140	8	-	-	-	-	-	-	-	-	0.3
028	gg	Granite gneiss	6	-	-	-	-	83	8	3	2	6	1.0	-	-	25	6	73	-	<100	6	36	18	-	-	-	-	-	-	-	-	0.0
029	gg	Granite saprolite	3	-	-	-	-	54	22	20	57	24	4.5	-	-	16	13	155	-	<100	125	74	93	-	-	-	-	-	-	-	-	0.3
030	gg	Granite gneiss saprolite	7	-	-	-	-	575	36	13	13	20	3.0	-	-	26	20	220	-	<100	15	0.63*	18	-	-	-	-	-	-	-	-	0.2
MHD 031	gg	Granite saprolite	6	6.5	2.8	75.7	-	140	10	8	10	6	1.9	-	-	23	12	125	-	<100	13	68	14	-	-	-	-	-	-	-	-	0.3
032	gg	Granite saprolite	3	-	-	-	-	185	8	6	9	8	1.7	-	-	23	9	140	-	<100	15	93	16	-	-	-	-	-	-	-	-	0.1
033	gg	Granite gneiss	3	-	-	-	-	585	7	6	8	13	3.4	-	-	16	8	105	-	<100	10	43	18	-	-	-	-	-	-	-	-	0.2
038	gg	Granite gneiss	4	-	-	-	-	635	7	4	7	17	1.0	0.02	-	14	6	105	-	<100	12	59	50	-	-	-	-	-	-	-	-	0.1
042	gg	Granite gneiss	1	-	-	-	-	0.32*	25	20	25	140	5.7	0.20	-	25	16	120	-	100	77	175	13	-	-	-	-	-	-	-	-	0.1
MHD 046	gg	Granite	1	-	-	-	-	33	4	2	24	10	1.0	0.01	-	4	8	27	-	<100	15	27	5	-	-	-	-	-	-	-	-	0.1
048	grl	Granite gneiss	4	-	-	-	-	0.30*	15	23	22	11	3.3	0.05	-	20	18	125	-	<100	68	110	16	-	-	-	-	-	-	-	-	0.3
049	grl	Granite gneiss	2	-	-	-	-	77	13	9	13	14	3.8	0.01	-	19	13	120	-	<100	13	66	19	-	-	-	-	-	-	-	-	0.3
050	grl	Granite porphyry	3	-	-	-	-	435	7	7	16	12	1.5	0.03	-	17	10	125	-	100	22	64	22	-	-	-	-	-	-	-	-	0.2
052	gg	Granite gneiss	2	-	-	-	-	0.12*	13	14	16	15	2.3	0.02	-	19	14	145	-	<100	49	70	27	-	-	-	-	-	-	-	-	0.2
MHD 054	fg	Granite gneiss	3	-	-	-	-	0.16*	12	20	14	12	2.8	0.03	-	23	19	135	-	<100	58	95	9	-	-	-	-	-	-	-	-	0.1
060	TKu	Sand	2	-	-	-	-	265	23	22	44	28	3.6	0.03	-	17	27	67	-	<100	93	115	31	-	-	-	-	-	-	-	-	0.3
063	gg	Granite gneiss	1	-	-	-	-	0.20*	31	25	31	8	4.7	0.03	-	23	23	90	-	<100	46	120	10	-	-	-	-	-	-	-	-	0.4
064	grl	Granite	7	-	-	-	-	530	18	15	46	26	2.6	0.03	-	24	25	76	-	<100	32	500	29	-	-	-	-	-	-	-	-	0.2

*These values are percentages.

APPENDIX B-2. CHEMICAL ANALYSES OF COASTAL PLAIN SEDIMENTS

Sample number	Rock unit	Sample description	U_3O_8 (ppm)	eU (ppm)	K (%)	eTh (ppm)	As (ppm)	Ba (ppm)	Be (ppm)	Co (ppm)	Cr (ppm)	Cu (ppm)	Fe (%)	Mg (%)	Mn (ppm)	Mo (ppm)	Ni (ppm)	Pb (ppm)	Se (ppm)	Sr (ppm)	V (ppm)	Zn (ppm)	Zr (ppm)	CaO (%)	CO_3 (%)	FeO (%)	Fe_2O_3 (%)	K_2O (%)	Na_2O (%)	P_2O_5 (%)	SO_4 (%)	TiO_2 (%)
MAK 134	TKu	Gravel	5	13.1	0.2	103.4	<200	-	-	-	70	-	-	-	-	2	-	20	-	-	100	-	-	0.05	0.3	0.16	0.31	0.01	0.03	0.00	-	2.4
135	TKu	Gravel	28	57.6	0.0	393.5	<200	-	-	-	75	-	-	-	-	2	-	32	-	-	60	-	-	0.04	0.2	0.22	0.36	0.01	0.01	0.54	-	3.0
136	Etw	Clay	4	4.2	0.1	19.5	<200	-	-	-	150	-	-	-	-	4	-	35	-	-	200	-	-	0.03	0.4	0.18	8.10	0.01	0.01	2.75	-	1.0
137	Etw	Clay	2	3.3	0.1	25.2	<200	-	-	-	100	-	-	-	-	4	-	55	-	-	100	-	-	0.03	0.2	0.24	4.40	0.01	0.04	0.60	-	1.0
138	Ei	Sand	2	2.3	0.1	14.9	<200	-	-	-	50	-	-	-	-	2	-	20	-	-	30	-	-	0.04	0.3	0.27	1.80	0.01	0.01	0.0	-	0.7
MAK 139	TKu	Sand	4	5.7	0.2	41.1	<200	-	-	-	20	-	-	-	-	<2	-	25	-	-	20	-	-	0.15	0.4	0.20	0.32	0.04	0.03	0.46	-	0.7
140	TKu	Sand	8	16.6	0.1	104.7	<200	-	-	-	<10	-	-	-	-	<2	-	15	-	-	15	-	-	0.04	0.3	0.18	0.03	0.01	0.01	0.00	-	1.0
141	TKu	Clay	46	78.5	0.2	567.6	<200	-	-	-	70	-	-	-	-	34	-	105	-	-	100	-	-	0.04	0.3	0.20	24.10	<0.01	0.03	0.82	-	7.9
155	TKu	Sand	46	80.6	0.1	576.2	<200	-	-	-	50	-	-	-	-	4	-	45	-	-	50	-	-	0.01	<0.2	0.31	2.40	0.02	<0.01	0.19	-	1.7
161	Ei	Sand	5	7.1	0.1	60.4	<200	-	-	-	30	-	-	-	-	2	-	10	-	-	20	-	-	0.03	0.3	0.31	0.77	<0.01	0.01	0.0	-	0.6
MAT 098	Ei	Clay	7	6.3	0.2	22.5	<200	0.15*	<10	<10	50	25	5.0	-	50	<10	20	200	-	250	200	-	200	0.01	-	-	-	-	0.70	-	-	0.2
099	Nu	Clay	4	3.3	0.1	12.8	<200	50	<10	<10	50	25	10.0	-	30	<10	40	40	-	200	300	-	200	0.01	-	-	-	-	0.60	-	-	0.3
100	Ei	Sand	4	3.4	0.1	14.6	<200	20	<10	<10	50	30	7.0	-	30	<10	20	10	-	200	200	-	200	0.02	-	-	-	-	0.60	-	-	0.3
101	Etw	Clay	2	2.8	0.1	15.5	<200	20	<10	<10	30	10	5.0	-	30	<10	20	20	-	150	200	-	200	0.01	-	-	-	-	0.60	-	-	0.3
102	Nu	Clay	2	4.4	0.1	17.2	<200	20	<10	<10	50	10	10.0	-	100	<10	20	10	-	250	200	-	200	0.01	-	-	-	-	0.60	-	-	0.3
MAT 103	Etw	Clay	10	6.7	0.1	4.2	<200	20	30	100	100	10	>20.0	-	800	<10	30	10	-	700	100	-	0	0.01	-	-	-	-	0.70	0.50	-	0.0
104	Etw	Sand	2	3.3	0.1	12.4	<200	30	<10	<10	20	<10	1.0	-	75	<10	10	<10	-	100	50	-	0.10*	0.01	-	-	-	-	0.60	-	-	0.2
105	Ei	Sand	3	2.3	0.1	10.8	<200	100	<10	<10	40	10	2.0	-	100	<10	20	10	-	100	75	-	100	0.01	-	-	-	-	0.50	-	-	0.2
106	Etw	Clay	4	4.3	0.2	19.3	<200	300	<10	<10	40	15	2.0	-	50	<10	40	10	-	150	150	-	200	0.01	-	-	-	-	0.50	-	-	0.3
107	TKu	Sand	1	0.9	0.1	2.5	<200	40	<10	<10	10	<10	0.7	-	30	<10	10	<10	-	150	20	-	0	0.01	-	-	-	-	0.70	-	-	0.1
MAT 108	Etw	Sand	3	2.8	0.1	13.5	<200	50	<10	<10	20	<10	1.0	-	50	<10	20	10	-	150	30	-	0	0.03	-	-	-	-	0.70	-	-	0.1
109	TKu	Sand	5	8.3	0.0	51.2	<200	20	<10	<10	20	<10	0.5	-	75	<10	10	10	-	150	50	-	300	0.01	-	-	-	-	0.70	-	-	0.3
110	TKu	Sand	2	2.1	0.2	7.9	<200	20	<10	<10	20	<10	3.0	-	50	<10	20	<10	-	150	20	-	0	0.01	-	-	-	-	0.70	-	-	0.6
120	Ei	Sand	1	1.0	0.4	5.9	<200	200	<10	<10	20	<10	2.0	-	50	<10	<10	20	-	<100	20	-	0	0.01	-	-	-	-	0.10	-	-	0.0
121	Ei	Sand	4	4.1	0.0	13.1	<200	0.10*	<10	<10	100	10	3.0	-	50	<10	10	10	-	<100	120	-	500	0.01	-	-	-	-	0.10	-	-	0.0

APPENDIX B-2. CHEMICAL ANALYSES OF COASTAL PLAIN SEDIMENTS (Continued)

Sample number	Rock unit	Sample description	U_3O_8 (ppm)	eU (ppm)	K (%)	eTh (ppm)	As (ppm)	Ba (ppm)	Be (ppm)	Co (ppm)	Cr (ppm)	Cu (ppm)	Fe (%)	Mg (%)	Mn (ppm)	Mo (ppm)	Ni (ppm)	Pb (ppm)	Se (ppm)	Sr (ppm)	V (ppm)	Zn (ppm)	Zr (ppm)	CaO (%)	CO_3 (%)	FeO (%)	Fe_2O_3 (%)	K_2O (%)	Na_2O (%)	P_2O_5 (%)	SO_4 (%)	TiO_2 (%)
MAT 122	Ei	Sand	3	3.0	0.1	7.2	–	100	<10	<10	70	<10	2.0	–	70	<10	10	<10	–	<100	60	–	200	0.01	–	–	–	–	0.20	–	–	0.2
123	Etw	Clay	4	5.4	0.5	14.7	–	300	<10	<10	100	20	4.0	–	70	<10	10	10	–	<100	120	–	700	0.04	–	–	–	–	0.20	–	–	0.3
124	Ei	Sand	2	1.7	0.0	10.2	–	100	<10	<10	50	25	4.0	–	50	<10	10	<10	–	<100	60	–	200	0.01	–	–	–	–	0.20	–	–	0.1
125	TKu	Clay	2	2.1	0.0	8.9	–	100	<10	<10	50	<10	1.0	–	50	<10	10	10	–	<100	80	–	500	0.01	–	–	–	–	0.30	–	–	0.3
126	Etw	Clay	4	5.6	0.4	16.7	–	500	<10	<10	70	30	5.0	–	100	<10	20	40	–	<100	100	–	700	0.01	–	–	–	–	0.30	–	–	0.6
MAT 127	TKu	Clay	2	3.0	0.1	14.8	–	500	<10	<10	70	10	1.5	–	50	<10	10	20	–	<100	100	–	300	0.01	–	–	–	–	0.20	–	–	0.6
128	Ei	Sand	2	3.2	0.0	18.9	–	100	<10	<10	70	10	5.0	–	100	<10	20	20	–	<100	150	–	500	0.01	–	–	–	–	0.20	–	–	0.6
129	Etw	Sand	2	1.1	0.0	6.8	–	150	<10	<10	10	10	1.0	–	70	<10	20	150	–	<100	30	–	300	0.01	–	–	–	–	0.10	–	–	0.1
130	Ei	Sand	4	3.7	0.0	20.5	–	50	<10	<10	70	35	6.0	–	100	<10	40	20	–	<100	200	–	300	0.01	–	–	–	–	0.20	–	–	0.6
131	Ei	Clay	3	3.7	0.1	21.8	–	300	<10	<10	70	20	6.0	–	100	<10	40	40	–	<100	150	–	300	0.01	–	–	–	–	0.10	–	–	0.6
MAT 132	TKu	Sand	1	0.0	0.0	5.3	–	50	<10	<10	10	<10	1.0	–	20	<10	<10	<10	–	<100	10	–	0	0.01	–	–	–	–	0.10	–	–	0.1
133	Etw	Clay	4	3.7	0.1	15.5	–	200	<10	<10	50	10	5.0	–	50	<10	10	40	–	<100	50	–	100	0.01	–	–	–	–	0.20	–	–	0.3
134	TKu	Sand	4	2.2	0.2	9.5	–	200	<10	<10	50	10	3.0	–	50	<10	10	10	–	<100	50	–	0	0.01	–	–	–	–	0.20	–	–	0.2
135	Ei	Sand	4	3.8	0.1	16.3	–	150	<10	<10	70	20	5.0	–	70	<10	20	50	–	<100	100	–	200	0.01	–	–	–	–	0.20	–	–	0.3
151	Ei	Sand	4	4.0	0.1	22.1	–	100	<10	<10	50	10	5.0	–	100	<10	30	40	–	<100	100	–	100	0.01	–	–	–	–	0.30	–	–	0.3
MAT 152	Etw	Clay	7	4.4	0.2	9.0	–	100	<10	<10	30	<10	1.5	–	50	<10	10	<10	–	<100	50	–	0	0.01	–	–	–	–	0.10	–	–	0.1
153	Ei	Sand	4	2.4	0.0	16.3	–	100	<10	<10	50	10	4.0	–	50	<10	10	40	–	<100	100	–	200	0.01	–	–	–	–	0.20	–	–	0.2
154	Etw	Clay	4	5.4	0.1	27.7	–	100	<10	<10	50	10	3.0	–	20	<10	10	40	–	<100	100	–	100	0.01	–	–	–	–	0.30	–	–	0.3
155	Ei	Sand	3	2.7	0.1	10.7	–	30	<10	<10	10	<10	1.5	–	20	<10	<10	<10	–	<100	30	–	0	0.01	–	–	–	–	0.10	–	–	0.1
156	TKu	Clay	4	3.4	0.2	18.0	–	300	<10	<10	30	<10	1.5	–	20	<10	10	20	–	<100	100	–	200	0.01	–	–	–	–	0.10	–	–	0.3
MAT 157	Ei	Sand	8	7.3	0.2	19.9	–	300	<10	<10	100	10	3.0	–	50	<10	10	20	–	<100	100	–	200	0.01	–	–	–	–	0.30	0.02	–	0.2
158	Etw	Clay	3	3.3	0.1	15.0	–	200	<10	<10	50	10	3.0	–	70	<10	10	10	–	<100	100	–	100	0.01	–	–	–	–	0.20	–	–	0.2
159	TKu	Sand	3	3.1	0.2	13.5	–	100	<10	<10	20	10	1.5	–	50	<10	10	100	–	<100	50	–	100	0.01	–	–	–	–	0.20	–	–	0.1
MHD 051	Etw	Clay	50	36.4	0.1	5.6	220	135	200	135	95	<1	–	–	–	43	190	250	–	320	195	–	–	–	–	–	–	–	–	–	–	0.04
061	TKu	Sand	2	–	–	–	245	831	32	16	74	8	5.0	–	72	20	34	98	–	<100	125	–	40	0.03	–	–	–	–	0.04	–	–	0.22
MHD 062	TKu	Sand	13	–	–	–	84	32	13	28	76	35	2.0	–	270	14	25	79	–	<100	73	–	75	0.03	–	–	–	–	0.04	–	–	0.61
065	Qal	Sand	3	–	–	–	225	470	13	20	63	32	2.0	–	305	16	29	66	–	<100	71	–	44	0.07	–	–	–	–	0.13	–	–	0.34
066	TKu	Sand	2	–	–	–	235	69	12	15	77	31	2.0	–	145	17	26	65	–	<100	53	–	40	0.05	–	–	–	–	0.08	–	–	0.25
067	Ei	Sand	1	–	–	–	17	44	7	8	35	30	1.0	–	135	5	22	39	–	<100	16	–	17	0.04	–	–	–	–	0.04	–	–	0.14
068	Ei	Clay	3	–	–	–	150	325	21	16	71	28	3.0	–	135	15	38	63	–	<100	84	–	41	0.02	–	–	–	–	0.04	–	–	0.20
MHD 069	Etw	Clay	2	–	–	–	480	415	24	24	84	7	4.0	–	145	26	31	92	–	<100	100	–	79	0.04	–	–	–	–	0.04	–	–	0.40
099	Ei	Sand	1	–	–	–	0	300	7	5	100	30	2.0	–	200	0	20	30	–	0.10*	20	–	200	8.33	–	–	–	–	0.60	–	–	0.30
100	Ei	Sand	1	–	–	–	0	150	2	0	70	5	0.7	–	500	0	5	10	–	200	15	–	200	16.67	–	–	–	–	0.13	–	–	0.20

*These values are percentages.

APPENDIX B-3. CHEMICAL ANALYSES OF METAMORPHIC ROCKS

Sample number	Rock unit	Sample description	U_3O_8 (ppm)	eU (ppm)	K (%)	eTh (ppm)	As (ppm)	Ba (ppm)	Be (ppm)	Co (ppm)	Cr (ppm)	Cu (ppm)	Fe (%)	Mg (%)	Mn (ppm)	Mo (ppm)	Ni (ppm)	Pb (ppm)	Se (ppm)	Sr (ppm)	V (ppm)	Zn (ppm)	Zr (ppm)	CaO (%)	CO_3 (%)	FeO (%)	Fe_2O_3 (%)	K_2O (%)	Na_2O (%)	P_2O_5 (%)	SO_4 (%)	TiO_2 (%)
MAK 130	v	Mica schist	2	1.0	0.6	0.9	0	500	–	30	48	150	7.0	0	700	<3	70	52	–	700	411	0	200	0.50	–	–	–	–	0.70	–	–	0.1
131	gg	Mn-rich nodule	4	4.0	1.4	15.4	<1	–	–	–	–	–	–	–	2.50*	2	–	90	–	–	100	–	–	–	–	–	–	–	–	–	–	0.60
144	grl	Graphite schist	2	4.1	4.7	14.7	<200	0.15*	10	0	150	70	3.0	0.30	70	13	20	63	–	200	271	0	200	0.06	–	–	–	–	0.74	–	–	0.15
147	gg	Mica schist	17	18.6	3.8	44.2	<200	500	7	50	167	70	15.0	3.30	700	6	70	71	–	<100	928	500	0.1*	0.04	–	–	–	–	0.37	–	–	0.74
149	pal	Sillimanite schist	7	7.4	3.0	34.1	<200	0.10*	7	30	98	70	7.0	3.00	500	3	70	61	–	<100	274	200	500	0.03	–	–	–	–	0.37	–	–	–
MAK 154	fg	Biotite gneiss	8	6.4	0.8	8.9	<200	500	15	20	135	100	7.0	3.00	700	<3	50	65	–	500	167	0	200	1.67	–	–	–	–	1.4[illegible]	–	–	–
160	gr2	Biotite gneiss saprolite	13	38.1	0.2	227.2	<200	–	–	0	70	0	–	–	–	6	0	30	–	–	70	0	–	0.03	0.20	0.22	1.8	0.06	0.03	1.97	<0.1	4.50
165	fg	Biotite gneiss saprolite	5	7.0	3.3	69.0	<200	–	–	0	10	0	–	–	–	4	0	20	–	–	30	0	–	0.11	0.2	0.27	3.0	0.23	0.15	–	<0.1	0.5
167	pms	Mica schist saprolite	26	2.6	3.4	7.8	<200	–	–	0	10	0	–	–	–	6	0	20	–	–	30	0	–	0.03	0.3	0.27	4.4	0.19	0.19	0.52	<0.1	0.4
168	pms	Mica schist saprolite	4	7.3	0.8	35.6	<200	–	–	0	50	0	–	–	–	6	0	20	–	–	70	0	–	0.04	0.3	0.42	6.8	0.01	0.08	–	<0.1	1.5
MAK 175	fg	Mica schist saprolite	4	2.2	0.3	21.2	<200	–	–	0	118	0	–	–	–	3	0	31	–	–	173	0	–	0.01	<0.01	0.18	9.3	0.33	0.09	0.13	0.22	0.8
176	fg	Mica schist saprolite	3	2.6	0.4	56.3	<200	–	–	0	44	0	–	–	–	2	0	28	–	–	236	0	–	0.01	<0.01	0.23	13.2	0.34	0.09	0.27	0.47	1.9
179	fg	Mica schist saprolite	10	9.9	1.7	100.5	<200	–	–	0	58	0	–	–	–	2	0	20	–	–	120	0	–	0.01	<0.01	1.33	7.9	1.66	0.08	0.12	1.10	2.0
181	fg	Biotite gneiss	2	1.3	0.8	1.2	<200	0.01*	3	20	66	50	5.0	3.00	0.15*	3	0	9	–	<100	482	0	0	1.67	–	–	–	–	0.74	–	–	0.8
190	v	Mica schist saprolite	7	2.4	1.6	11.9	0	–	–	–	65	–	5.6	–	–	3	–	20	–	–	151	–	–	0.30	–	–	–	–	0.20	36.30	–	0.7
MAK 191	v	Phyllite	6	3.1	2.3	11.7	0	0.15*	–	10	50	30	3.0	–	200	3	30	30	–	100	142	0	300	1.50	–	–	–	–	2.00	–	–	0.3
194	pms	Biotite gneiss	1	1.1	2.3	7.5	<200	0.10*	7	10	34	0	3.0	1.0	200	4	30	30	–	200	126	<200	300	1.25	–	–	–	–	1.63	–	–	0.2
195	pms	Biotite gneiss	4	5.8	2.5	11.2	<200	0.10*	15	0	21	5	2.0	0.7	200	3	15	100	–	200	45	<200	50	1.66	–	–	–	–	2.22	–	–	0.1
198	fg	Mica schist	12	3.8	2.5	22.6	<200	500	<10	10	50	10	6.0	–	500	4	30	16	–	150	134	<200	100	0.01	–	–	–	–	0.02	–	–	0.4
199	fg	Mica schist saprolite	12	11.9	0.7	117.8	<200	–	–	–	37	–	6.0	–	–	3	–	38	–	–	117	–	–	0.01	0.40	2.39	5.49	0.79	0.09	0.03	0.09	4.0
MAT 005	fg	Biotite gneiss saprolite	18	13.6	0.5	14.6	<200	–	–	–	112	–	8.0	–	–	3	–	51	–	–	186	–	<200	<0.01	0.24	0.12	10.77	0.57	0.08	<0.01	0.35	1.5
013	fg	Biotite schist	2	2.8	2.4	15.8	<200	400	<10	10	50	10	3.0	–	800	5	20	30	–	100	105	100	<200	0.05	–	–	–	–	0.30	–	–	0.4
015	pms	Biotite gneiss saprolite	4	5.9	2.6	190.2	<200	300	<10	<10	20	<10	20.0	–	200	<10	10	150	–	250	50	50	<200	0.01	–	–	–	–	0.66	–	–	0.5
016	mm	Hornblende gneiss	1	0.1	0.1	0.6	<200	200	<10	40	150	40	15.0	–	0.20*	<10	50	<10	–	250	700	<10	<200	0.07	–	–	–	–	0.64	–	–	0.4
019	mm	Mica schist	2	2.4	2.9	24.4	<200	600	<10	<10	10	15	1.5	–	0.10*	<10	10	30	–	150	50	50	<200	0.42	–	–	–	–	0.58	–	–	0.2
MAT 021	bg2	Mica schist saprolite	1	0.6	0.0	12.6	<200	25	<10	<10	10	10	3.0	–	70	<10	10	<10	–	100	30	20	<200	0.01	–	–	–	–	0.55	–	–	0.3
022	bgl	Mica schist	2	1.4	2.5	8.5	<200	600	<10	10	50	<10	2.0	–	0.15*	<10	20	20	–	150	200	30	<200	8.33	–	–	–	–	0.60	–	–	0.5
042	mm	Mica schist saprolite	1	0.6	1.5	8.6	<200	300	<10	10	10	<10	6.0	–	800	<10	10	20	–	150	100	40	<200	0.83	–	–	–	–	0.53	–	–	0.5
044	bgl	Biotite schist saprolite	11	2.5	2.9	10.6	<200	200	<10	50	50	50	15.0	–	0.10*	<10	150	20	–	200	300	60	300	0.01	–	–	–	–	0.50	–	–	1.1
050	mm	Hornblende gneiss	1	0.6	0.6	3.2	<200	75	<10	50	50	15	20.0	–	0.10*	<10	20	10	–	200	400	10	<200	2.49	–	–	–	–	0.67	–	–	0.5
MAT 052	gg	Biotite gneiss	2	1.6	0.6	16.1	<200	400	<10	<10	10	<10	2.0	–	0.10*	<10	<10	30	–	150	40	20	<200	1.67	–	–	–	–	0.62	–	–	0.2
054	mm	Biotite gneiss	2	1.5	2.9	11.5	<200	500	<10	10	20	30	2.0	–	500	<10	20	30	–	200	100	60	<200	0.83	–	–	–	–	0.66	–	–	0.4
058	fg	Biotite gneiss saprolite	2	2.6	2.8	19.2	<200	400	<10	20	60	10	10.0	–	500	<10	40	20	–	250	300	500	200	0.41	–	–	–	–	0.66	–	–	0.5
059	pms	Mica schist saprolite	2	3.3	1.4	16.7	<200	200	<10	20	60	35	10.0	–	200	<10	40	20	–	200	300	500	500	0.08	–	–	–	–	0.68	–	–	0.5
069	fg	Amphibolite	1	0.0	0.1	0.6	<200	20	<10	20	50	<10	20.0	–	0.30*	<10	30	10	–	300	150	<200	<10	8.33	–	–	–	–	0.64	–	–	0.2

APPENDIX B-3. CHEMICAL ANALYSES OF METAMORPHIC ROCKS (Continued)

Sample number	Rock unit	Sample description	U_3O_8 (ppm)	eU (ppm)	K (%)	eTh (ppm)	As (ppm)	Ba (ppm)	Be (ppm)	Co (ppm)	Cr (ppm)	Cu (ppm)	Fe (%)	Mg (%)	Mn (ppm)	Mo (ppm)	Ni (ppm)	Pb (ppm)	Se (ppm)	Sr (ppm)	V (ppm)	Zn (ppm)	Zr (ppm)	CaO (%)	CO_2 (%)	FeO (%)	Fe_2O_3 (%)	K_2O (%)	Na_2O (%)	P_2O_5 (%)	SO_4 (%)	TiO_2 (%)
MAT 074	fg	Biotite gneiss	3	4.2	3.4	28.1	<200	700	<10	<10	10	10	2.0	–	500	<10	10	50	–	200	30	<200	50	1.24	–	–	–	–	0.69	–	–	0.20
077	fg	Biotite gneiss saprolite	1	0.9	1.3	3.8	<200	500	–	20	10	75	7.0	–	800	<10	50	20	–	450	100	<200	40	2.49	–	–	–	–	0.81	–	–	0.30
083	fg	Biotite gneiss saprolite	1	2.2	0.9	15.6	<200	200	<10	20	50	25	20.0	–	700	<10	50	20	–	250	150	<200	50	0.08	–	–	–	–	0.69	–	–	0.50
085	fg	Biotite gneiss saprolite	3	3.4	2.1	20.8	<200	300	<10	10	40	25	3.0	–	200	<10	50	10	–	250	40	<200	30	0.08	–	–	–	–	0.66	–	–	0.20
091	gg	Mica schist saprolite	5	3.8	1.9	8.7	<200	300	<10	30	50	25	5.0	–	100	<10	60	10	–	200	200	<200	50	0.08	–	–	–	–	0.61	–	–	0.20
MAT 093	fg	Biotite gneiss	2	3.4	1.7	4.0	<200	300	<10	<10	<10	<10	0.5	–	200	<10	<10	50	–	150	<10	<200	10	0.83	–	–	–	–	0.72	–	–	0.00
097	v	Meta-argillite saprolite	7	2.1	0.2	7.9	<200	700	–	10	50	25	5.0	–	200	<10	20	20	–	300	200	<200	150	0.01	–	–	–	–	1.20	–	–	0.50
111	v	Mica schist saprolite	3	2.0	1.2	12.7	<200	500	–	10	30	10	5.0	–	100	<10	20	30	–	150	100	<200	15	0.01	–	–	–	–	0.50	–	–	0.20
112	v	Argillite	4	2.4	0.6	15.5	<200	200	–	<10	50	20	7.0	–	100	<10	20	20	–	300	100	<200	15	0.01	–	–	–	–	0.70	–	–	0.10
115	qla	Mica schist	2	2.3	2.6	11.9	<200	500	–	10	20	<10	1.0	–	100	<10	10	10	–	150	30	<200	20	0.01	–	–	–	–	0.60	–	–	0.10
MAT 116	v	Argillite	1	0.7	0.1	2.2	<200	200	–	10	20	20	5.0	–	300	<10	20	10	–	250	150	<200	10	0.36	–	–	–	–	0.70	–	–	0.20
118	mm	Hornblende gneiss saprolite	1	1.9	0.8	8.5	<200	500	<10	10	20	10	3.0	–	500	<10	20	10	–	300	100	<200	<10	0.42	–	–	–	–	0.81	–	–	0.3
137	gg	Amphibolite	2	0.5	0.1	5.0	<200	50	<10	10	70	40	5.0	–	0.10*	<10	30	20	–	210	300	<200	10	5.81	–	–	–	–	1.58	–	–	0.2
138	mm	Quartzite	1	0.2	0.1	3.7	<200	200	–	<10	10	20	5.0	–	300	<10	<10	20	–	<100	70	<200	10	0.36	–	–	–	–	0.60	–	–	0.30
142	qla	Quartzite	4	2.0	0.2	3.9	500	100	–	<10	50	60	20.0	–	100	<10	<10	20	–	120	300	<200	<10	0.01	–	–	–	–	0.70	–	–	0.40
MAT 144	gg	Biotite schist	2	1.4	1.6	7.5	<200	500	<10	<10	<10	<10	1.5	–	800	<10	<10	30	–	<100	20	<200	15	2.50	–	–	–	–	1.65	–	–	0.20
147	v	Argillite	5	4.1	0.5	9.5	<200	300	–	<10	10	30	5.0	–	100	<10	10	10	–	<100	150	<200	15	0.04	–	–	–	–	0.40	–	–	0.30
162	qla	Mica schist	2	1.1	1.2	4.1	<200	400	–	20	20	15	5.0	–	0.15*	<10	20	20	–	160	150	<200	150	0.71	–	–	–	–	1.60	–	–	0.60
163	mm	Mica schist	2	1.7	1.2	21.2	<200	200	–	20	50	20	3.0	–	800	<10	30	<10	–	<100	100	<200	150	0.01	–	–	–	–	0.20	–	–	0.20
165	mm	Quartzite	3	2.9	0.1	8.9	<200	100	–	<10	10	30	2.0	–	100	<10	30	20	–	<100	50	<200	50	0.01	–	–	–	–	0.30	–	–	0.10
MAT 166	v	Phyllite	1	1.5	3.5	8.1	<1	0.13*	–	51	95	2	5.8	–	0.12*	25	55	65	–	150	205	120	15	0.20	–	–	–	–	0.70	–	–	0.30
167	v	Sericite schist	2	3.4	4.5	5.7	<1	0.13*	–	24	18	<1	2.7	–	200	51	20	96	–	110	28	89	29	0.03	–	–	–	–	0.20	–	–	0.30
169	fg	Biotite schist saprolite	7	11.5	0.7	59.0	<1	78	11	61	89	20	5.0	–	820	38	88	100	–	50	20	84	74	0.02	–	–	–	–	0.05	–	–	0.40
MHD 001	v	Quartzite	1	–	–	–	6	23	2	<1	13	16	–	–	–	2	6	30	–	<100	4	34	<1	–	–	–	–	–	–	–	–	0.00
002	v	Sericite schist	2	–	–	–	130	800	8	4	6	20	–	–	–	13	6	56	–	<100	45	38	42	–	–	–	–	–	–	–	–	0.20
MHD 003	v	Sericite schist	1	–	–	–	130	700	34	7	13	42	–	–	–	125	9	125	–	<100	72	67	19	–	–	–	–	–	–	–	–	0.10
004	v	Phyllite	2	–	–	–	165	200	36	12	9	11	–	–	–	23	30	98	–	<100	54	0.3*	82	–	–	–	–	–	–	–	–	0.20
005	v	Mica schist	7	2.7	3.0	5.6	93	460	20	35	30	255	4.5	–	30*	27	25	3.3*	–	<100	83	3.3*	95	–	–	–	–	–	–	–	–	0.20
020	fg	Biotite gneiss saprolite	4	–	–	–	140	225	20	15	56	6	4.1	–	230	14	23	88	–	<100	105	67	35	0.11	–	–	–	–	0.41	–	–	0.40
024	grl	Mica schist	5	–	–	–	425	880	26	38	84	42	5.2	–	245	36	32	170	–	<100	145	73	13	0.04	–	–	–	–	1.02	–	–	0.50
MHD 025	mm	Biotite gneiss	2	–	–	–	165	265	18	13	145	2	7.4	–	690	29	15	155	–	<100	125	140	13	0.50	–	–	–	–	0.78	–	–	0.2
026	mm	Biotite gneiss	2	–	–	–	210	725	8	7	4	1	3.6	–	235	15	10	135	–	<100	27	87	43	0.40	–	–	–	–	0.78	–	–	0.1
027	gg	Mica schist	1	–	–	–	29	63	6	3	26	17	1.4	–	85	3	13	24	–	<100	20	43	4	0.02	–	–	–	–	0.11	–	–	0.3
039	v	Mica schist	2	–	–	–	210	100	–	15	14	23	–	–	–	19	23	99	–	<100	150	250	16	–	–	–	–	–	–	–	–	0.20
040	fg	Mica schist	1	–	–	–	155	770	13	22	250	24	2.9	–	650	15	99	83	–	<100	65	150	42	0.28	–	–	–	–	1.96	–	–	0.20
MHD 041	gg	Quartzite	3	–	–	–	250	700	–	10	12	12	–	–	–	23	13	145	–	<100	55	870	15	–	–	–	–	–	–	–	–	0.10
043	v	Mica schist saprolite	1	–	–	–	480	0.32*	–	25	49	110	–	–	–	25	29	120	–	<100	145	92	26	–	–	–	–	–	–	–	–	0.30
044	v	Mica schist	1	–	–	–	425	100	–	28	145	74	–	–	–	14	53	180	–	120	285	82	15	–	–	–	–	–	–	–	–	0.30
045	v	Phyllite	1	–	–	–	55	200	–	3	12	5	–	–	–	5	6	32	–	<100	12	33	13	–	–	–	–	–	–	–	–	0.10
047	v	Quartzite	1	–	–	–	27	0	–	3	15	12	–	–	–	3	7	37	–	<100	4	43	3	–	–	–	–	–	–	–	–	0.00
MHD 053	v	Quartzite	1	–	–	–	15	100	–	3	13	15	–	–	–	4	9	13	–	<100	6	53	2	–	–	–	–	–	–	–	–	0.00
090	qla	Mica gneiss/schist	1	–	–	–	0	100	1	30	70	70	5.0	–	700	0	20	30	–	300	200	0	20	–	–	–	–	–	–	–	–	0.30
091	qla	Mica gneiss/schist	1	–	–	–	0	150	2	20	50	150	3.0	–	0.20*	0	20	70	–	100	100	700	20	–	–	–	–	–	–	–	–	0.30
092	qla	Mica gneiss/schist	1	–	–	–	0	50	1	20	50	70	3.0	–	0.15*	0	20	150	–	200	100	0.15*	70	–	–	–	–	–	–	–	–	0.30
093	qla	Mica gneiss/schist	1	–	–	–	0	100	2	15	50	0.15*	3.0	–	0.15*	0	0	70	–	100	15	10.00*	70	–	–	–	–	–	–	–	–	0.20
MHD 094	qla	Mica gneiss/schist	2	–	–	–	0	0.20*	7	15	20	0.15*	3.0	–	700	150	0	70	–	100	15	0.10*	70	–	–	–	–	–	–	–	–	0.30
095	qla	Mica gneiss/schist	1	–	–	–	0	700	2	20	20	150	3.0	–	700	0	0	50	–	<100	20	300	70	–	–	–	–	–	–	–	–	0.30
096	qla	Mica gneiss/schist	1	–	–	–	0	>0.50*	1	30	100	700	3.0	–	0.30*	0	50	150	–	300	100	0.15*	20	–	–	–	–	–	–	–	–	0.30
097	qla	Mica gneiss/schist	1	–	–	–	0	700	5	20	10	30	5.0	–	700	0	0	50	–	500	100	200	50	–	–	–	–	–	–	–	–	0.60
098	qla	Mica gneiss/schist	1	–	–	–	0	700	0	50	150	50	7.0	–	0.10*	0	50	0	–	500	200	200	100	–	–	–	–	–	–	–	–	1.00

*These values are percentages.

APPENDIX B-4. CHEMICAL ANALYSES OF MONAZITE BELT ROCKS

Sample number	Rock unit	Sample description	U_3O_8 (ppm)	eU (ppm)	K (%)	eTh (ppm)	As (ppm)	Ba (ppm)	Be (ppm)	Co (ppm)	Cr (ppm)	Cu (ppm)	Fe (%)	Mg (%)	Mn (ppm)	Mo (ppm)	Ni (ppm)	Pb (ppm)	Se (ppm)	Sr (ppm)	V (ppm)	Zn (ppm)	Zr (ppm)	CaO (%)	CO_2 (%)	FeO (%)	Fe_2O_3 (%)	K_2O (%)	Na_2O (%)	P_2O_5 (%)	SO_4 (%)	TiO_2 (%)
MAE 401	gg	Granite pegmatite	29	14.3	3.8	12.8	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
402	gg	Mica schist	28	23.0	3.0	17.8	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
403	fg	Biotite/granite gneiss	17	11.5	0.5	0.4	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
404	gg	Granite gneiss	7	8.7	3.8	15.2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
405	gg	Granite gneiss	20	9.9	4.8	35.0	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
MAE 413	gg	Granite pegmatite	25	18.4	2.1	55.1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
414	gg	Granite saprolite	15	13.6	0.8	19.8	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.22	–	–
415	gg	Granite saprolite	10	8.3	0.9	18.0	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.19	–	–
429	pal	Mica schist	11	8.6	3.0	26.8	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
430	fg	Quartzite	2	0.5	0.0	1.5	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
MAE 431	fg	Mica schist	30	28.2	0.8	140.6	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.14	–	–
432	pal	Biotite gneiss	3	2.2	3.1	12.4	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
453	fg	Granite pegmatite	5	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
454	fg	Gneiss-feldspar fraction	15	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
455	fg	Gneiss-mica fraction	15	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
MAK 169	pal	Sillimanite schist	8	6.4	2.8	22.7	0	0.10*	–	10	76	70	5.0	–	–	4	15	56	–	100	445	0	200	0.04	–	–	–	–	0.5	–	–	0.4
177	fg	Granite gneiss	6	6.4	5.3	39.1	0	0.10*	–	0	8	5	1.5	–	–	8	5	48	–	200	46	0	300	0.50	–	–	–	–	1.5	–	–	0.1
182	fg	Biotite gneiss saprolite	13	16.0	0.2	93.7	–	–	–	–	76	–	–	–	–	2	–	9	–	–	149	–	–	0.10	–	–	–	–	0.2	0.11	–	1.1
183	fg	Biotite gneiss saprolite	3	4.9	0.3	20.5	–	–	–	–	37	–	–	–	–	5	–	15	–	–	173	–	–	0.01	–	–	–	–	0.1	0.06	–	1.2
184	fg	Granite gneiss	12	11.9	2.0	33.2	0	0.10*	–	2	38	5	2.0	–	–	5	2	35	–	100	203	–	500	0.05	–	–	–	–	0.2	–	–	0.4

APPENDIX B-4. CHEMICAL ANALYSES OF MONAZITE BELT ROCKS (Continued)

Sample number	Rock unit	Sample description	U_3O_8 (ppm)	eU (ppm)	K (%)	eTh (ppm)	As (ppm)	Ba (ppm)	Be (ppm)	Co (ppm)	Cr (ppm)	Cu (ppm)	Fe (%)	Mg (%)	Mn (ppm)	Mo (ppm)	Ni (ppm)	Pb (ppm)	Se (ppm)	Sr (ppm)	V (ppm)	Zn (ppm)	Zr (ppm)	CaO (%)	CO_2 (%)	FeO (%)	Fe_2O_3 (%)	K_2O (%)	Na_2O (%)	P_2O_5 (%)	SO_4 (%)	TiO_2 (%)
MAK 186	fg	Granite gneiss	10	2.7	3.6	29.0	–	0.10	–	–	13	–	1.0	–	–	1	2	48	–	100	13	–	100	1.10	–	–	–	–	3.0	–	–	–
196	fg	Granite schist	9	7.9	0.0	8.8	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
197	fg	Granite gneiss	8	3.0	3.7	4.7	–	0.10	–	10	13	–	1.0	–	–	2	10	35	–	100	28	–	10	0.01	–	–	–	–	0.5	<0.10	–	0.1
200	fg	Granite gneiss saprolite	7	6.0	3.7	29.6	–	–	–	–	<10	–	0.9	–	–	3	–	57	–	–	24	–	–	0.01	–	–	–	–	0.2	–	–	0.2
MAT 024	pms	Mica schist saprolite	2	3.5	2.3	21.9	<200	200	–	10	30	25	5.0	–	–	<10	10	20	–	200	200	300	30	0.01	–	–	–	–	0.50	–	–	0.4
MAT 062	grl	Biotite granite	8	4.8	4.4	35.9	<200	0.10*	–	10	200	10	5.0	–	–	<10	30	20	–	200	100	<200	–	0.36	–	–	–	–	0.60	–	–	0.6
086	mm	Sillimanite schist saprolite	5	4.7	3.0	25.8	<200	400	–	20	40	25	5.0	–	–	<10	10	20	–	300	100	<200	20	0.01	–	–	–	–	0.70	–	–	0.2
089	fg	Granite gneiss saprolite	3	3.1	4.2	20.1	<200	700	–	10	10	<10	3.0	–	–	<10	20	50	–	200	75	<200	100	0.36	–	–	–	–	0.70	–	–	0.2
090	fg	Granite gneiss	3	2.1	4.6	6.4	<200	0.10*	–	<10	20	<10	0.7	–	–	<10	20	75	–	200	10	<200	10	0.36	–	–	–	–	0.70	–	–	0.0
094	gg	Granite gneiss	3	2.7	7.2	9.5	<200	400	–	<10	10	30	0.5	–	–	<10	30	20	–	200	200	<200	10	0.14	–	–	–	–	0.70	–	–	0.0
MAT 095	pal	Sillimanite schist saprolite	5	3.8	4.9	26.7	<200	500	–	30	20	30	10.0	–	–	<10	30	20	–	300	200	<200	20	0.01	–	–	–	–	0.70	–	–	0.2
MHD 022	gg	Granite gneiss saprolite	3	–	–	–	130	100	–	13	13	10	2.5	–	–	12	17	80	–	100	57	78	30	–	–	–	–	–	–	–	–	0.1
023	pal	Granite gneiss	2	–	–	–	165	700	–	12	12	5	2.8	–	–	15	18	105	–	100	54	92	20	–	–	–	–	–	–	–	–	0.1
034	fg	Granite	4	–	–	–	245	400	–	3	4	4	0.5	–	–	17	6	130	–	100	5	33	20	–	–	–	–	–	–	–	–	0.0
035	fg	Granite/amphibolite contact	11	13.2	0.5	13.8	825	300	–	26	63	28	5.0	–	–	52	53	265	–	100	170	305	30	–	–	–	–	–	–	<0.001	–	0.2
MHD 036	fg	Amphibolite	7	–	–	–	135	300	–	58	35	73	10.0	–	–	32	48	175	–	200	470	335	20	–	–	–	–	–	–	–	–	18.8
037	fg	Mica schist saprolite	4	–	–	–	135	400	–	24	78	74	4.0	–	–	13	42	160	–	100	170	350	20	–	–	–	–	–	–	–	–	0.1
055	fg	Granite gneiss	3	–	–	–	235	0.14*	–	12	13	3	4.0	–	–	20	13	145	–	100	35	110	60	–	–	–	–	–	–	–	–	0.1
056	fg	Granite gneiss	1	–	–	–	125	300	–	14	42	72	2.5	–	–	28	10	145	–	100	29	95	10	–	–	–	–	–	–	–	–	0.2
057	mm	Granite gneiss	3	–	–	–	240	200	–	26	42	5	4.2	–	–	20	26	130	–	100	90	260	20	–	–	–	–	–	–	–	–	0.3
MHD 058	fg	Granite gneiss	2	–	–	–	155	300	–	23	53	10	3.6	–	–	16	26	96	–	100	72	88	10	–	–	–	–	–	–	–	–	0.3
059	fg	Granite gneiss	4	–	–	–	170	200	–	4	10	10	0.6	–	–	14	8	105	–	100	6	39	20	–	–	–	–	–	–	–	–	0.0
070	fg	Biotite gneiss saprolite	3	–	–	–	480	100	–	17	31	12	5.4	–	–	29	23	100	–	<100	145	105	15	0.03	–	–	–	–	0.04	–	–	0.2
071	fg	Granite gneiss	1	–	–	–	385	0.11*	–	13	33	13	2.0	–	–	23	20	97	–	<100	30	115	17	0.43	–	–	–	–	1.32	–	–	0.1
072	pal	Biotite gneiss saprolite	4	–	–	–	175	400	–	24	44	19	2.3	–	–	13	26	69	–	<100	50	89	32	0.03	–	–	–	–	0.11	–	–	0.3
MHD 073	fg	Granite gneiss saprolite	3	–	–	–	595	300	–	20	51	20	3.7	–	–	34	37	115	–	<100	68	260	30	0.04	–	–	–	–	0.10	–	–	0.2
074	fg	Mica schist	6	–	–	–	575	800	–	46	185	34	5.7	–	–	35	56	195	–	<100	290	185	17	0.05	–	–	–	–	0.17	–	–	0.8

*These values are percentages.

APPENDIX B-5. CHEMICAL ANALYSES OF OGLETHORPE COUNTY, GEORGIA, PROJECT

Sample number	Rock unit	Sample description	U_3O_8 (ppm)	eU (ppm)	K (%)	eTh (ppm)	As (ppm)	Ba (ppm)	Be (ppm)	Co (ppm)	Cr (ppm)	Cu (ppm)	Fe (%)	Mg (%)	Mn (ppm)	Mo (ppm)	Ni (ppm)	Pb (ppm)	Se (ppm)	Sr (ppm)	V (ppm)	Zn (ppm)	Zr (ppm)	CaO (%)	CO_2 (%)	FeO (%)	Fe_2O_3 (%)	K_2O (%)	Na_2O (%)	P_2O_5 (%)	SO_4 (%)	TiO_2 (%)
MAT 009	gr2	Granite gneiss saprolite	6	4.4	3.0	27.6	–	–	–	–	18	–	2.4	–	–	3	–	37	0.5	–	69	–	–	0.01	<0.1	0.38	3.02	3.34	0.20	0.03	0.07	0.62
011	v	Sand	6	7.5	1.9	16.9	–	–	–	–	46	–	2.6	–	–	3	–	35	0.4	–	109	–	–	0.09	0.2	1.45	2.04	2.07	0.41	0.11	0.05	1.07
012	v	Sand	3	1.7	1.0	3.9	–	–	–	–	15	–	0.9	–	–	<2	–	20	0.5	–	49	–	–	0.09	0.5	0.57	0.64	1.21	0.18	0.09	0.10	0.71
026	gr2	Granite	3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
027	v	Sericite schist	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
MAT 028	gr2/v	Granite saprolite	15	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
029	gr2	Granite	3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
030	gr2	Granite	3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
031	gr2/v	Soil	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
032	gr2/v	Soil	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
MAT 033	gr2/v	Soil	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
034	gr2/v	Soil	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
035	gr2/v	Soil	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
036	gr2/v	Soil	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
037	gr2	Stream sediment	5	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
MAT 038	gr2	Stream sediment	4	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
039	gr2	Stream sediment	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
040	gr2	Stream sediment	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
136	gr2	Porphyritic granite	9	4.6	3.1	7.1	1.5	100	<10	<10	10	<10	–	–	<200	<10	<10	50	–	<100	<10	<200	10	0.05	–	–	–	–	1.00	–	–	–
MHD 006	gr2/v	Soil	9	10.2	3.4	19.8	–	0.1*	33	25	49	23	–	–	175	37	22	170	–	<100	86	0.37*	70	–	–	–	–	–	–	0.13	–	0.07
MHD 007	gr2/v	Soil	6	4.2	2.6	10.8	–	0.32*	8	36	27	13	–	–	130	30	32	83	–	<100	60	57	37	–	–	–	–	–	–	–	–	0.43
008	gr2/v	Soil	9	–	–	–	–	0.33*	32	24	43	18	–	–	375	35	20	125	–	<100	85	93	62	–	–	–	–	–	–	–	–	0.66
009	gr2/v	Soil	4	2.9	1.0	9.2	–	53	34	23	29	46	–	–	135	33	35	94	–	<100	320	79	50	–	–	–	–	–	–	–	–	0.43
010	gr2/v	Soil	7	5.2	1.7	12.2	–	840	34	24	43	20	–	–	140	32	39	90	–	<100	96	52	58	–	–	–	–	–	–	–	–	0.56
011	gr2/v	Soil	6	5.7	1.8	14.0	–	940	15	22	53	31	–	–	180	16	23	130	–	<100	110	0.30*	60	–	–	–	–	–	–	–	–	0.74
MHD 012	gr2/v	Soil	5	4.3	1.7	9.9	–	890	19	15	47	42	–	–	165	35	23	145	–	<100	145	80	54	–	–	–	–	–	–	–	–	0.60
013	gr2/v	Soil	5	4.4	1.1	10.0	–	580	14	13	45	30	–	–	125	33	20	85	–	<100	310	95	55	–	–	–	–	–	–	–	–	0.54
014	gr2/v	Soil	5	3.8	1.3	9.3	–	495	13	18	10	23	–	–	105	9	14	70	–	<100	90	795	46	–	–	–	–	–	–	–	–	0.46
015	gr2/v	Soil	5	4.7	1.9	11.0	–	0.33*	13	20	29	16	–	–	85	8	10	83	–	<100	99	125	48	–	–	–	–	–	–	–	–	0.64
016	gr2/v	Soil	5	4.6	1.2	9.9	–	635	12	23	13	17	–	–	99	9	17	83	–	<100	75	77	50	–	–	–	–	–	–	–	–	0.43
MHD 017	gr2/v	Soil	4	3.9	1.2	7.5	–	390	7	12	26	10	–	–	69	7	12	58	–	<100	49	49	48	–	–	–	–	–	–	–	–	0.36
018	gr2/v	Soil	5	5.0	2.2	10.8	–	0.01*	14	26	15	28	–	–	165	13	17	99	–	<100	130	65	57	–	–	–	–	–	–	–	–	0.57
019	gr2/v	Soil	6	4.5	2.0	8.2	–	950	18	13	18	19	–	–	162	14	20	100	–	<100	140	83	63	–	–	–	–	–	–	–	–	0.58

*These values are percentages.

APPENDIX B-6. CHEMICAL ANALYSES OF HANCOCK COUNTY, GEORGIA, PROJECT

Sample number	Rock unit	Sample description	U_3O_8 (ppm)	eU (ppm)	K (%)	eTh (ppm)	As (ppm)	Ba (ppm)	Be (ppm)	Co (ppm)	Cr (ppm)	Cu (ppm)	Fe (%)	Mg (%)	Mn (ppm)	Mo (ppm)	Ni (ppm)	Pb (ppm)	Se (ppm)	Sr (ppm)	V (ppm)	Zn (ppm)	Zr (ppm)	CaO (%)	CO_3 (%)	FeO (%)	Fe_2O_3 (%)	K_2O (%)	Na_2O (%)	P_2O_5 (%)	SO_4 (%)	TiO_2 (%)
MAE 416	grl	Granite saprolite	11	11.3	3.2	31.7	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
417	grl	Granite	4	3.1	3.9	20.9	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
418	grl	Granite pegmatite	19	21.0	4.7	21.0	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
419	grl	Granite pegmatite	40	22.9	4.3	18.2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
MAK 162	grl	Granite porphyry	4	5.6	3.9	15.6	0	100	–	0	10	0	2.0	–	500	<3	15	46	<0.5	500	319	0	300	1.30	–	–	–	–	1.50	–	–	0.00
MAK 163	grl	Porphyritic granite	8	11.2	3.6	5.1	0	10	–	0	5	5	1.0	–	700	3	15	63	<0.5	100	41	0	0	0.40	–	–	–	–	3.00	–	–	0.10
MAT 064	Ei	Sandstone	7	4.3	0.4	5.2	<200	<10	–	<10	50	15	20.0	–	20	<10	<10	10	–	350	50	<200	<10	0.01	–	–	–	–	0.85	–	–	0.10
065	grl	Porphyritic granite	28	13.0	3.7	24.0	<200	200	–	<10	<10	10	1.0	–	500	<10	<10	20	–	150	10	<200	20	0.50	–	–	–	–	0.85	<0.001	–	0.15
066	grl	Granite gneiss	3	3.8	3.7	12.0	<200	100	–	<10	<10	<10	1.0	–	800	<10	<10	10	–	150	<10	<200	30	0.03	–	–	–	–	0.89	–	–	0.05
067	v	Mica schist	4	3.5	2.6	10.3	<200	500	–	<10	50	30	5.0	–	50	<10	<10	30	–	150	150	<200	50	0.01	–	–	–	–	0.78	–	–	0.50
MAT 068	ppl	Mica schist saprolite	3	3.4	0.4	10.7	<200	150	–	<10	60	25	15.0	–	100	<10	20	10	–	200	700	<200	50	0.01	–	–	–	–	0.86	–	–	1.00
MHD 075	grl	Granite saprolite	3	–	–	–	230	145	70	10	54	31	3.2	–	245	15	23	42	–	<100	39	68	75	0.04	–	–	–	–	0.22	0.26	–	0.19
076	grl	Granite saprolite	4	–	–	–	265	235	41	10	41	33	1.9	–	295	15	32	39	–	<100	32	99	56	0.07	–	–	–	–	0.47	0.11	–	0.21
077	grl	Granite saprolite	7	–	–	–	340	355	89	25	92	39	4.0	–	1,580	23	39	96	–	<100	47	100	57	0.06	–	–	–	–	0.20	0.09	–	0.23
078	grl	Granite saprolite	10	–	–	–	295	330	46	7	34	32	2.1	–	220	16	30	48	–	<100	19	76	54	0.06	–	–	–	–	0.49	0.04	–	0.12
MHD 079	grl	Granite saprolite	4	–	–	–	775	325	84	13	45	34	3.8	–	195	36	35	96	–	<100	52	135	78	0.06	–	–	–	–	0.66	0.10	–	0.24
080	grl	Granite saprolite	6	–	–	–	380	340	54	10	41	31	2.4	–	425	21	30	57	–	<100	28	110	45	0.14	–	–	–	–	1.19	0.20	–	0.15
081	grl	Granite saprolite	4	–	–	–	315	345	45	6	30	36	2.1	–	455	17	23	50	–	<100	18	190	57	0.11	–	–	–	–	1.52	0.06	–	0.12
082	grl	Granite saprolite	8	–	–	–	610	195	67	11	41	42	3.1	–	235	29	38	89	–	<100	44	165	65	0.07	–	–	–	–	0.45	0.25	–	0.19
083	grl	Granite saprolite	9	–	–	–	310	175	59	13	51	45	2.7	–	365	17	43	50	–	<100	43	105	62	0.06	–	–	–	–	0.16	0.06	–	0.26
MHD 084	grl	Granite saprolite	6	–	–	–	465	360	58	9	35	35	2.6	–	395	22	29	78	–	<100	25	135	61	0.09	–	–	–	–	0.99	0.04	–	0.14
085	TKu	Sand	3	–	–	–	150	160	53	10	45	35	2.5	–	285	11	27	32	–	<100	26	89	57	0.04	–	–	–	–	0.23	0.06	–	0.22
086	grl	Granite saprolite	3	–	–	–	375	97	65	14	57	39	3.0	–	215	20	37	50	–	<100	67	93	55	0.06	–	–	–	–	0.15	0.05	–	0.38
087	grl	Granite saprolite	3	–	–	–	225	195	55	17	70	41	2.5	–	950	14	40	52	–	<100	54	150	65	0.08	–	–	–	–	0.20	0.23	–	0.42
088	grl	Granite saprolite	5	–	–	–	425	305	65	8	51	64	2.9	–	730	24	37	67	–	<100	21	115	51	0.12	–	–	–	–	2.50	0.05	–	0.13
MHD 089	grl	Granite saprolite	4	–	–	–	99	135	79	31	47	32	3.6	–	1,320	8	36	50	–	<100	130	160	97	0.09	–	–	–	–	0.36	0.51	–	0.59

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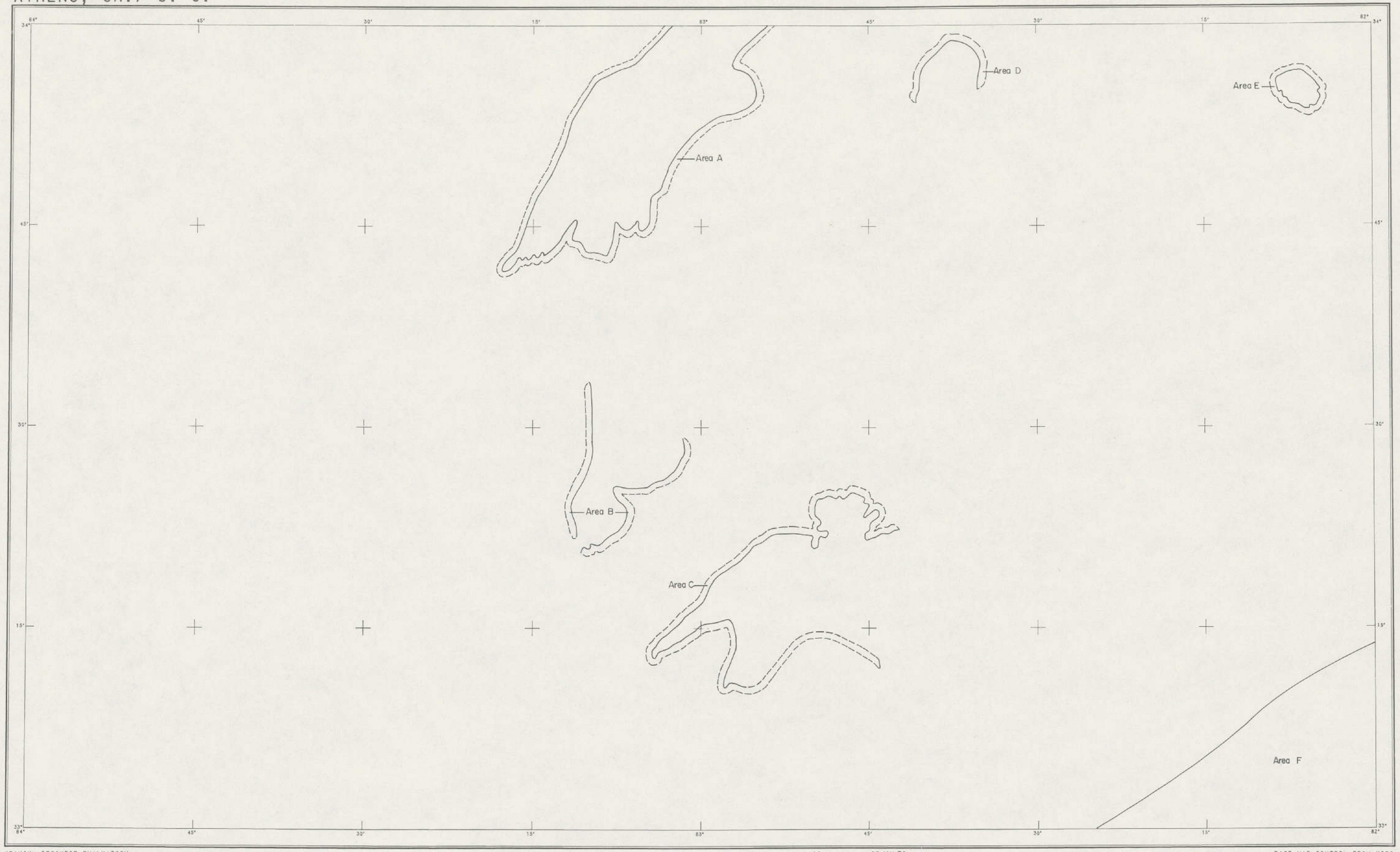


EXPLANATION

Area A Favorable for allogenic deposits near Elberton Granite

Area B Favorable for allogenic deposits near Siloam Granite

Area C Favorable for allogenic deposits near Sparta Granite

Area D Favorable for allogenic deposits near Danburg Granite

Area E Favorable for allogenic deposits near Cuffytown Creek Granite

Area F Favorable for sandstone deposits in the Coastal Plain

——— Outcrop

– – – Subsurface extent of areas favorable for allogenic deposits

URANIUM RESOURCE EVALUATION
ISSUED BY THE U.S. DEPARTMENT OF ENERGY

5 0 5 10 15 20 25 MILES

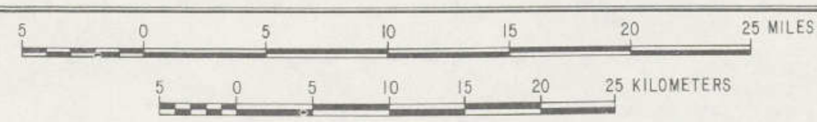
5 0 5 10 15 20 25 KILOMETERS

BASE MAP CONTROL FROM USGS

Plate I. AREAS FAVORABLE FOR URANIUM DEPOSITS

URANIUM RESOURCE EVALUATION
ISSUED BY THE U.S. DEPARTMENT OF ENERGY

BASE MAP CONTROL FROM USGS



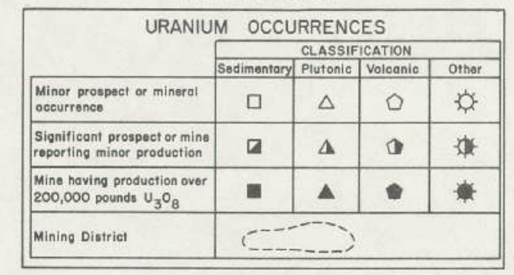
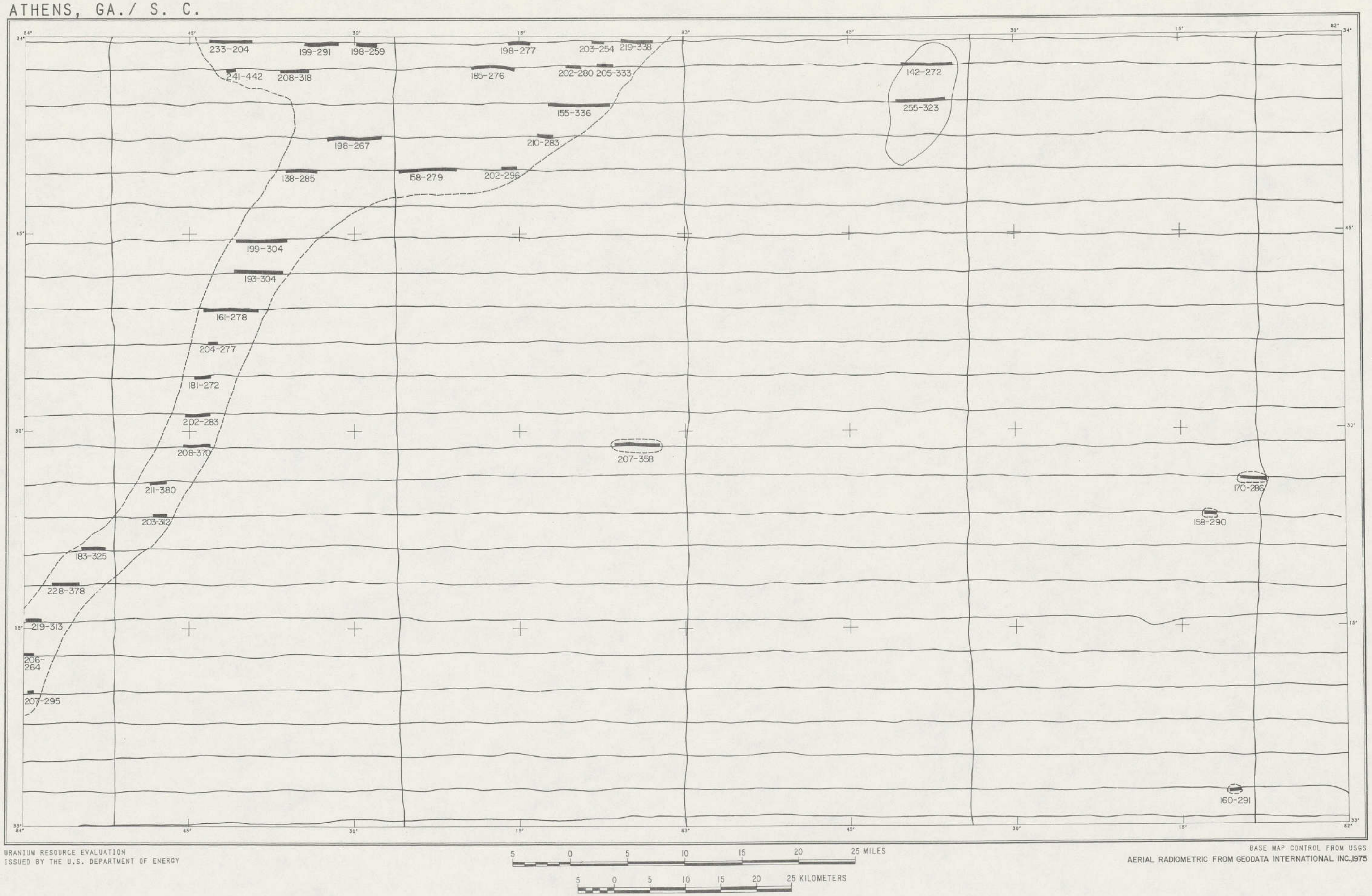


Plate 2. URANIUM OCCURRENCE

ATHENS, GA./ S. C.



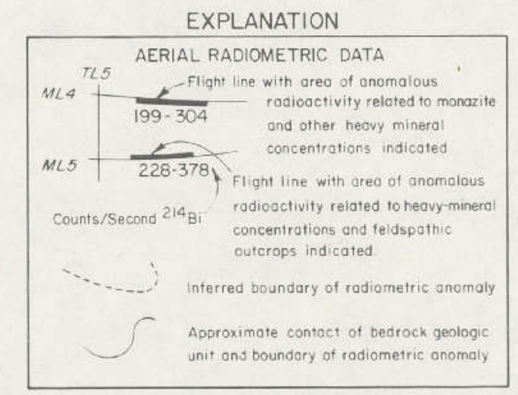
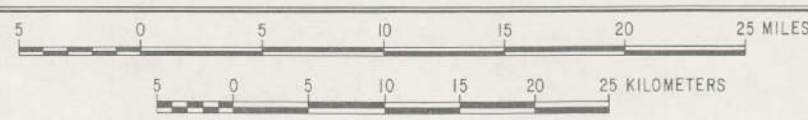


Plate 3a. INTERPRETATION OF AERIAL RADIOMETRIC DATA

URANIUM RESOURCE EVALUATION
ISSUED BY THE U.S. DEPARTMENT OF ENERGY

BASE MAP CONTROL FROM USGS



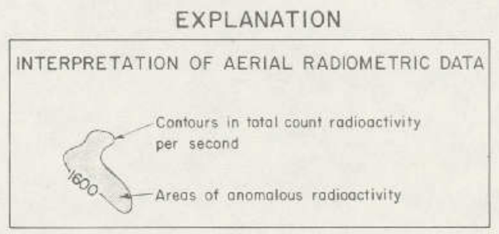
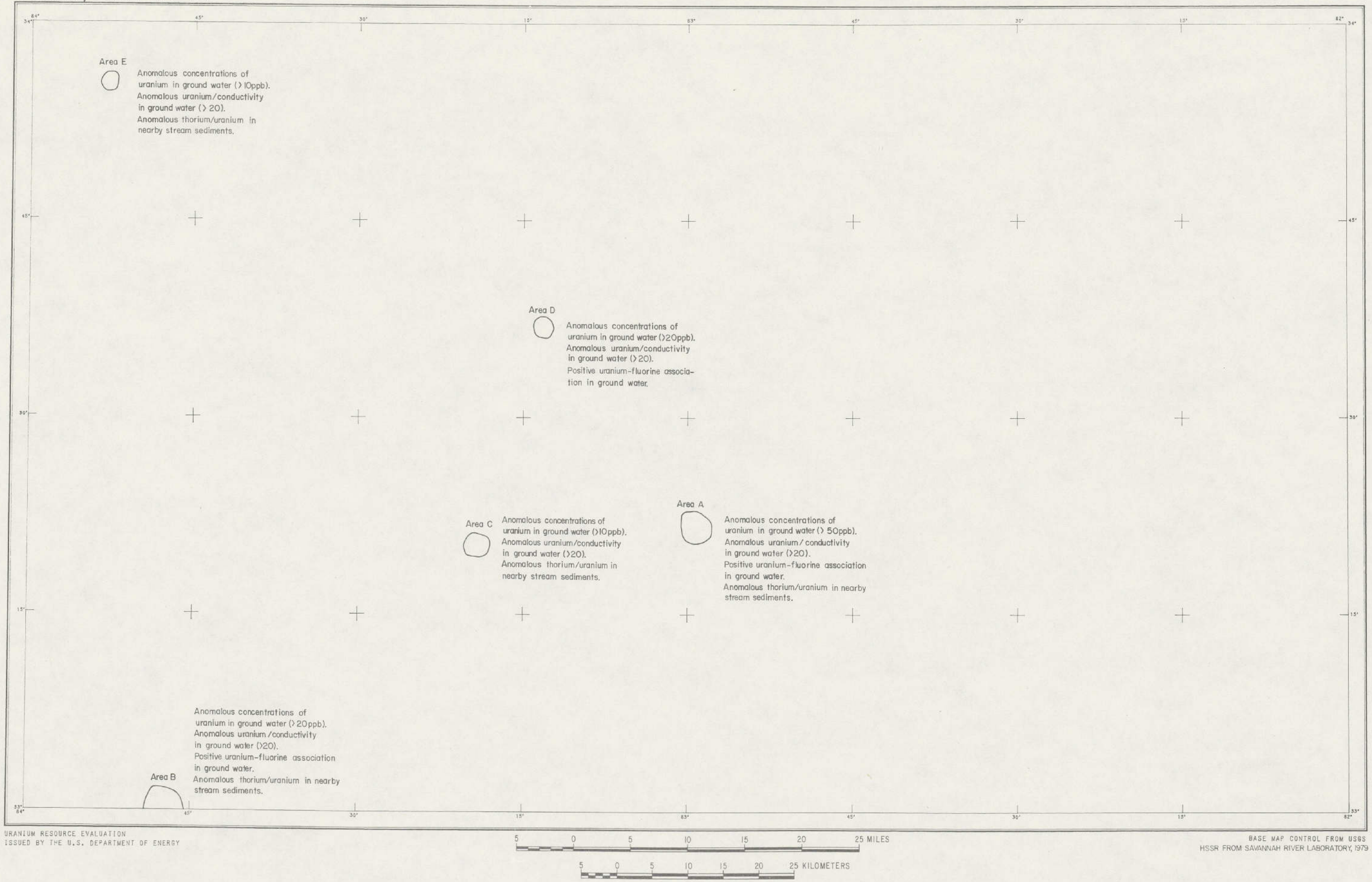


Plate 3b. INTERPRETATION OF AERIAL RADIOMETRIC DATA

ATHENS, GA./ S. C.



EXPLANATION

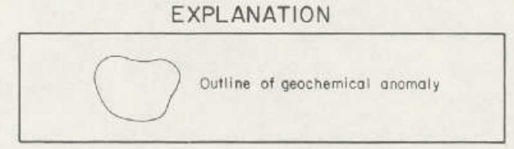


Plate 4. INTERPRETATION OF DATA FROM HYDROGEOCHEMICAL AND STREAM-SEDIMENT RECONNAISSANCE

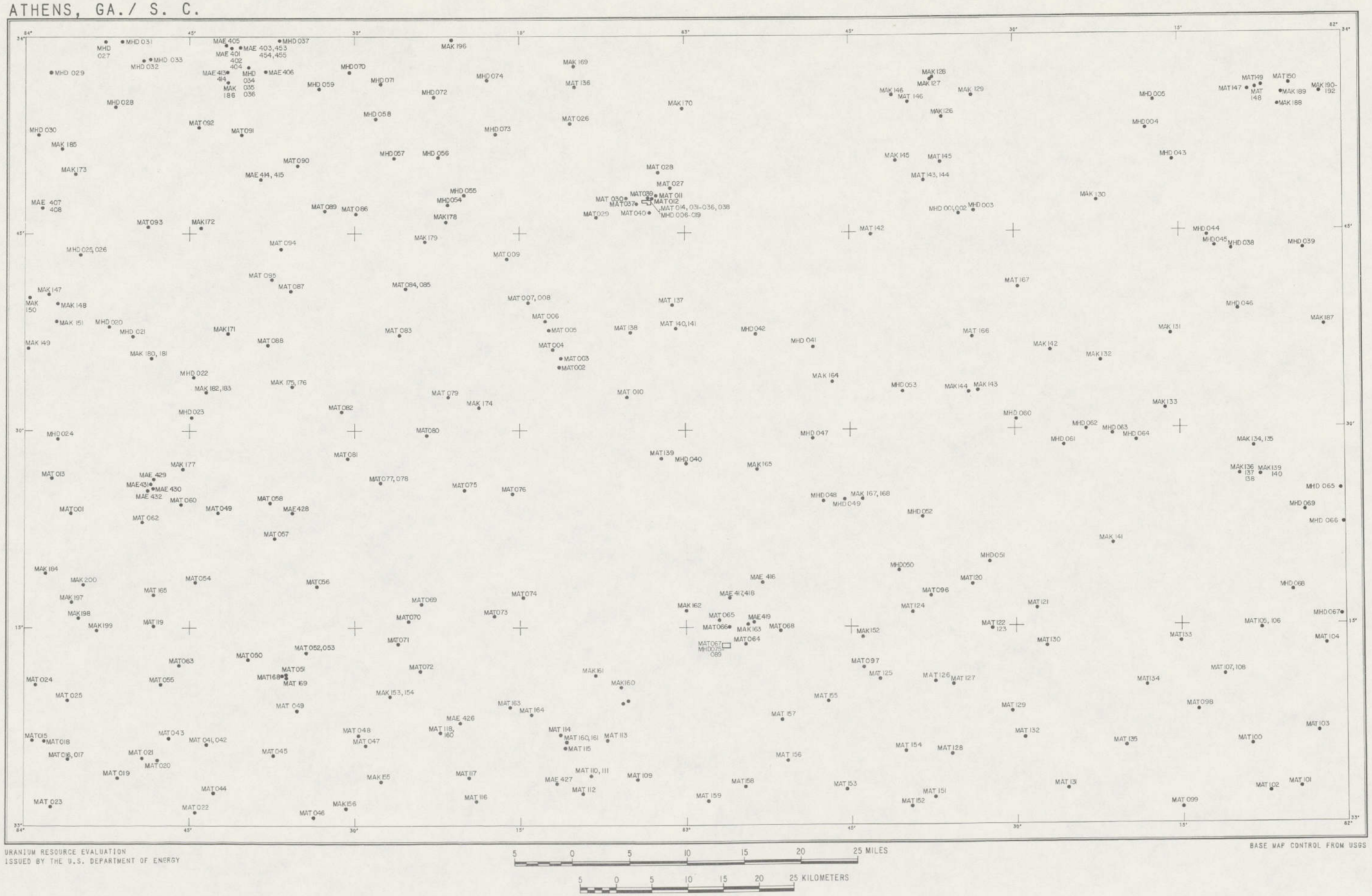


Plate 5. LOCATION MAP OF GEOCHEMICAL SAMPLES

URANIUM RESOURCE EVALUATION
ISSUED BY THE U.S. DEPARTMENT OF ENERGY

5 0 5 10 15 20 25 MILES

5 0 5 10 15 20 25 KILOMETERS

BASE MAP CONTROL FROM USGS

Plate 6. DRAINAGE

ATHENS, GA./ S. C.

URANIUM RESOURCE EVALUATION
ISSUED BY THE U. S. DEPARTMENT OF ENERGY

BASE MAP CONTROL FROM USGS

5 0 5 10 15 20 25 MILES

5 0 5 10 15 20 25 KILOMETERS

Plate 7. GEOLOGIC MAP

LEGEND:

QUATERNARY
- Qal — Stream alluvium and terrace deposits

TERTIARY
- Nu — Neogene undifferentiated indurated sandstone and claystone
- Ei — Irwinton Sand
- Etw — Twiggs Clay

CRETACEOUS
- TKu — Lower Tertiary-Cretaceous undifferentiated

TRIASSIC
- d — Diabase dikes

PRECAMBRIAN THROUGH PERMIAN
- gr1 — Granite undifferentiated
- gr1a — Porphyritic granite
- gr2 — Granite/granite-biotite gneiss
- gr3 — Syenite
- gg — Granitic gneiss undifferentiated
- fg — Biotite gneiss/feldspathic biotite gneiss
- bg1 — Biotite gneiss
- bg2 — Biotite gneiss/mica schist
- mm — Hornblende gneiss/amphibolite/biotitic gneiss/quartzite/mica schist/hornfels
- pms — Mica schist/gneiss
- pp1 — Meta-argillite/phyllite
- pa1 — Sillimanite schist
- q1 — Quartzite
- q1a — Quartzite/mica schist
- q2 — Epidote quartzite
- v — Metavolcanics undifferentiated
- v1 — Mafic-intermediate metavolcanics
- um — Ultramafic rocks undifferentiated
- mp1 — Gabbro/amphibolite
- c1 — Mylonite/ultramylonite
- c2 — Flinty crush rock

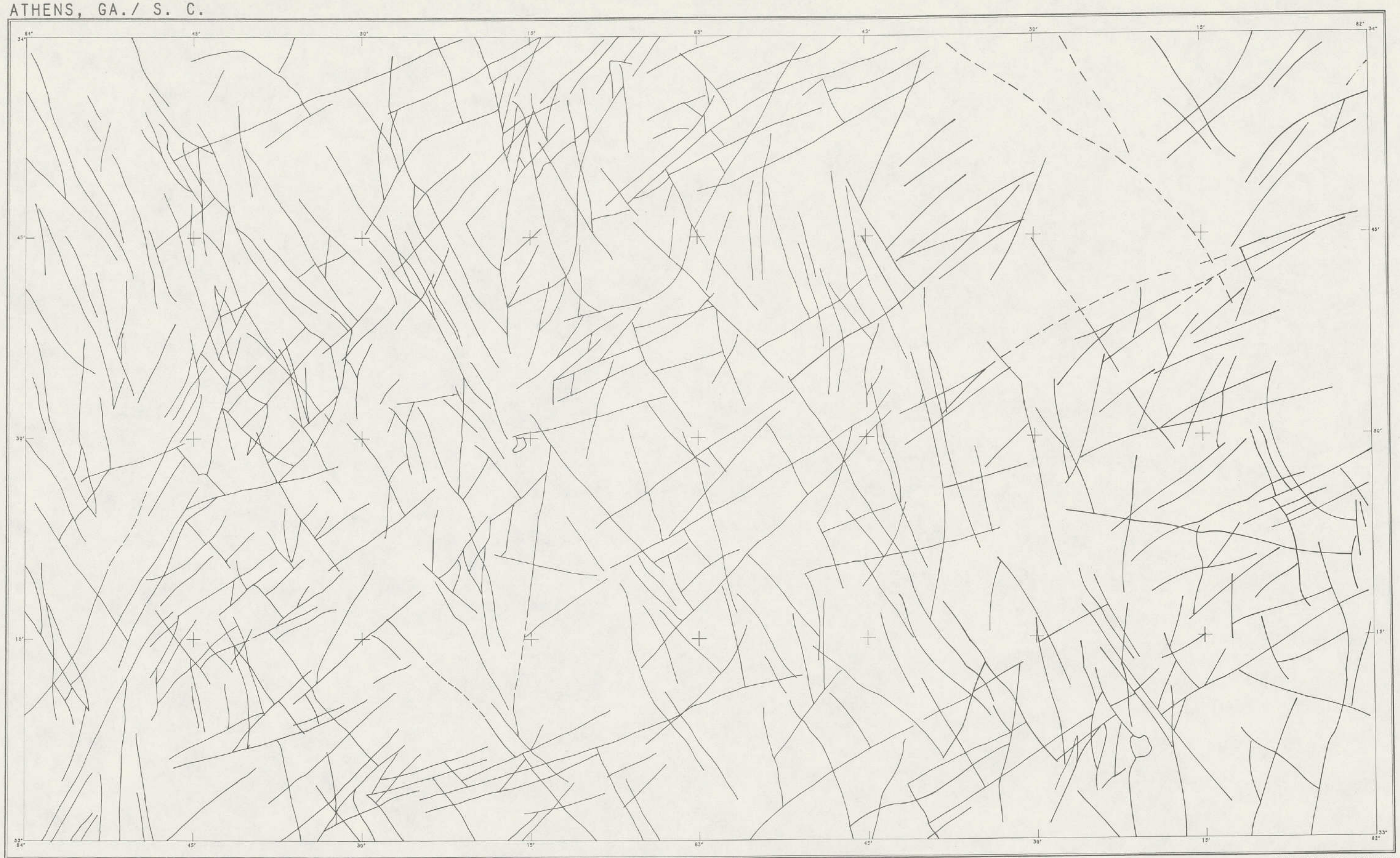
Shear zone

Microbreccia zone

Fault

Inferred fault

ATHENS, GA./ S. C.



URANIUM RESOURCE EVALUATION
ISSUED BY THE U.S. DEPARTMENT OF ENERGY

BASE MAP CONTROL FROM USGS

5 0 5 10 15 20 25 MILES

5 0 5 10 15 20 25 KILOMETERS

Plate 8. LINEATIONS FROM LANDSAT

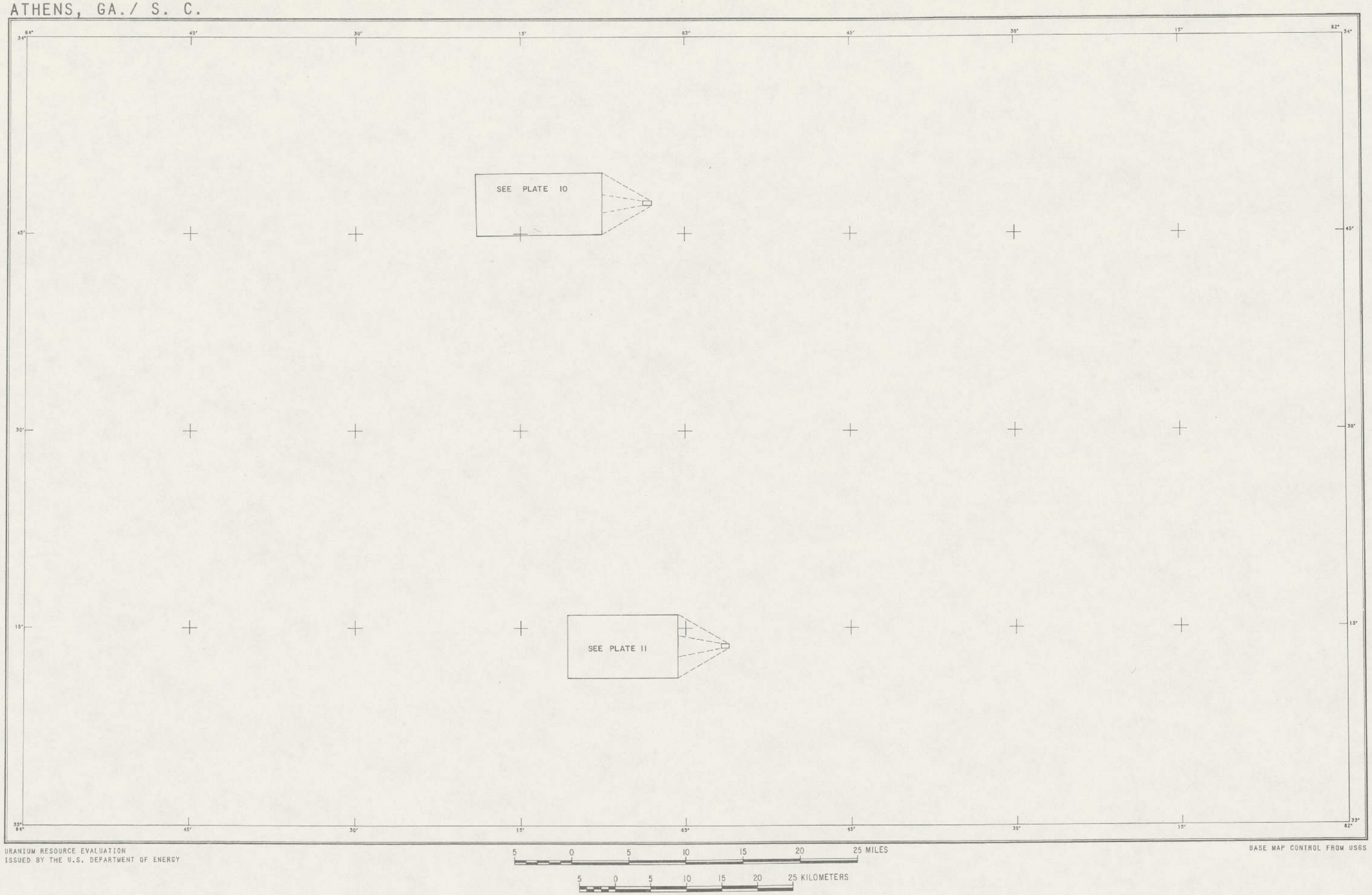
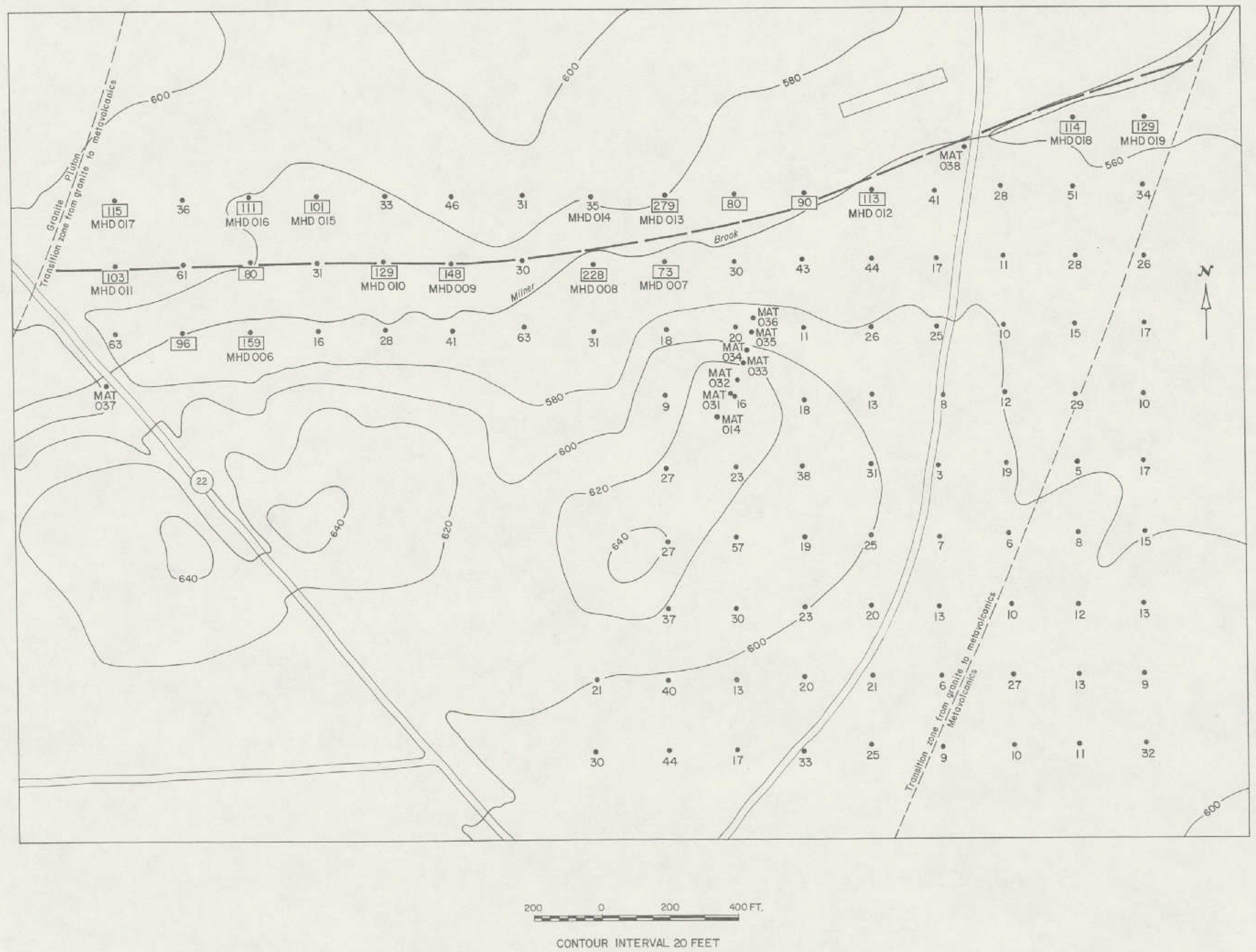


Plate 9. INDEX TO LARGE-SCALE TRACK ETCH™ STUDY MAPS



EXPLANATION

•	Detector readings (tracks/mm^2)
• 96 (boxed)	Detector readings ≥ 3 std. dev. above the mean
• MHD 006	Geochemical-sample locations and sample-ticket numbers
— —	Inferred fault or shear zones based on Track Etch study

Plate 10. TRACK ETCH™ STUDY, OGLETHORPE COUNTY, GEORGIA

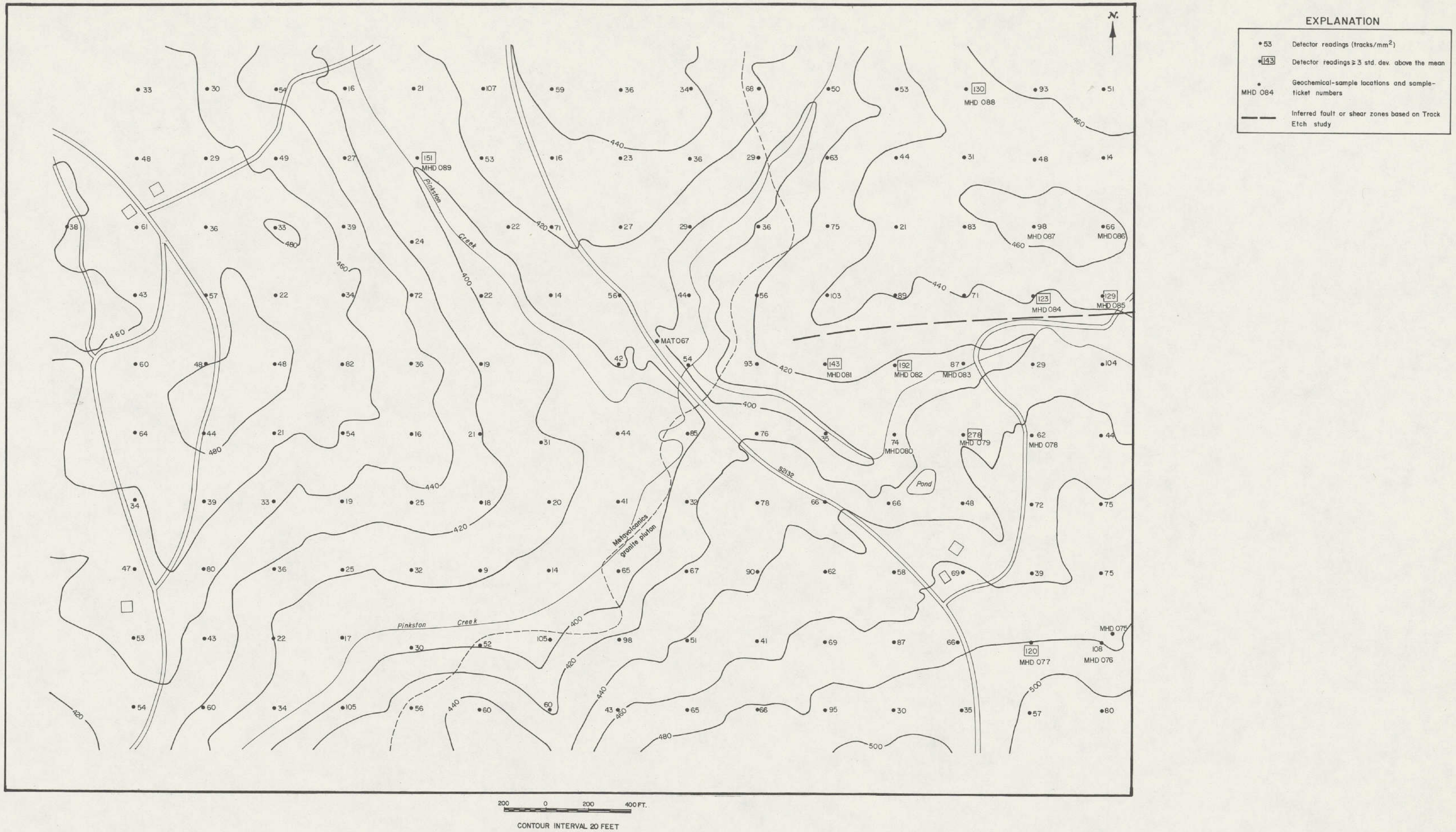


Plate 11. TRACK ETCH™ STUDY, HANCOCK COUNTY, GEORGIA

INDEX

1. Austin, 1965, scale 1:31,680.
2. Carpenter and Prather, 1971, scale 1:126,720.
3. Cook, 1967, scale 1:31,680.
4. Cooke, 1943, scale 500,000.
5. Crawford, Hurst, and Ramspott, 1966, scale 1:24,000.
6. Fountain, 1961, scale 1:80,000.
7. Fouts, 1966, scale 1:28,000.
8. Gardner, 1961, scale 1:24,000.
9. Herrick and Counts, 1968, scale 1:316,800.
10. Hooker and Duvall, 1966, scale 1:633,600.
11. Humphrey, 1970, scale 1:190,000.
12. Hurst, 1959, scale 1:18,000.
13. La Moreaux, 1946, scale 1:145,000.
14. Lawton, 1969, scale 1:35,000.
15. Lawton, Marsalis, and others, 1976, scale 1:500,000.
16. MacKallor, 1963, scale 1:250,000.
17. Matthews, 1967, scale 1:35,000.
18. McCollum, 1966, scale 1:62,500.
19. McLemore, 1965, scale 1:250,000.
20. Medlin and Hurst, 1967, scale 1:20,000.
21. Myers, 1968, scale 1:31,680.
22. Overstreet and Bell, 1965, scale 1:250,000.
23. Prather, 1971, scale 1:62,500.
24. Reade, 1960, scale 1:63,360.
25. Sandy, Carver, and Crawford, 1966, scale 1:100,000.
26. Schultz, 1961, scale 1:63,360.
27. Wagener, 1977, scale 1:126,720.
28. Woolsey, 1973, scale 1:62,500.

Plate 12. GEOLOGIC-MAP INDEX

ATHENS, GA./ S. C.

Plate 13. GENERALIZED LAND STATUS

INDEX

G. Government Installations
- G-1 Fort Gordon Military Reservation
- G-2 U. S. Army Corps of Engineers Clark Hill Reservation
- G-3 U. S. Department of Agriculture Experimental Station

J. National Wildlife Refuges
- J-1 Piedmont National Wildlife Refuge

M. State Withdrawals
- M-1 Animal Breeding and Holding Facility
- M-2 Fort Yargo State Park
- M-3 Hard Labor Creek State Park
- M-4 Walton State Fish Hatchery
- M-5 Indian Springs State Park
- M-6 Nancy Hart State Park
- M-7 Alexander H. Stephens Memorial State Park
- M-8 Hamburgh Millpond State Park
- M-9 Elijah Clark State Park
- M-10 De La Howe State School
- M-11 Keg Creek State Park
- M-12 Mistletoe State Park

N. National Forests
- N-1 Oconee National Forest
- N-2 Sumter National Forest

URANIUM RESOURCE EVALUATION
ISSUED BY THE U.S. DEPARTMENT OF ENERGY

BASE MAP CONTROL FROM USGS

5 0 5 10 15 20 25 MILES

5 0 5 10 15 20 25 KILOMETERS

Plate 14. CULTURE