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STREAM SEDIMENT DETAILED GEOCHEMICAL SURVEY FOR MARYSVALE, UTAH

T. R. Butz, J. L. Vreeland, C. S. Bard,
R. N. Helgerson, J. G. Grimes, and P. M. Pritz
Uranium Resource Evaluation Project

July 31, 1980

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ABSTRACT

Results of the Marysvale detailed geochemical survey are reported. Field and laboratory data are presented for 397 stream sediment samples and 160 radiometric readings. Statistical and areal distributions of uranium and possible uranium-related variables are displayed. A generalized geologic map of the area is provided, and pertinent geologic factors which may be of significance in evaluating the potential for uranium mineralization are briefly discussed.

Stream sediments containing significant amounts of soluble uranium (≧16.93 ppm) occur in numerous areas, the most prevalent being in the western portion of the survey area, within and surrounding the Mount Belknap Caldera. Thorium, beryllium, cerium, manganese, molybdenum, niobium, potassium, yttrium, zinc, and zirconium occur in concentrations ≧84th percentile in many sediment samples taken from within and surrounding the Mount Belknap Caldera. The uranium and related variables are associated with highly silicic intrusions and extrusions of the Mount Belknap Volcanics, as well as hydrothermal activity which has occurred in the Marysvale volcanic field.

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STREAM SEDIMENT DETAILED GEOCHEMICAL SURVEY FOR MARYSVALE, UTAH

INTRODUCTION

The National Uranium Resource Evaluation (NURE) Program was established by the U. S. Atomic Energy Commission (AEC), now the U. S. Department of Energy (DOE), in the spring of 1973 to assess uranium resources and to identify favorable areas for detailed uranium exploration throughout the United States. The principal objectives of the NURE Program are: (1) to provide a comprehensive in-depth assessment of the nation's uranium resources for national energy planning, and (2) to identify areas favorable for uranium resources. A NURE Program report covering uranium resource assessment in 116 National Topographic Map Series (NTMS) 1° x 2° quadrangles, which contain 100% of the currently estimated uranium resources, is targeted for 1980. The complete resource assessment of the 272 highest-priority quadrangles is scheduled for completion in 1985, and the first comprehensive assessment report of the entire United States is scheduled for completion in 1988. This program, which is being administered by DOE, is expected to increase the activity of commercial exploration for uranium in the United States.

The NURE Program consists of five parts:

1. Hydrogeochemical and Stream Sediment Reconnaissance (HSSR) Program,
2. Aerial Radiometric and Magnetic Survey,
3. Surface Geologic Investigations,
4. Drilling for Geologic Information, and
5. Geophysical Technology Development.

The objective of the HSSR Program is to provide information to be used in accomplishing the overall NURE Program objectives. This is accomplished by a reconnaissance of surface water, groundwater, stream sediment, and lake sediment. The survey is being conducted by three Government-owned laboratories. Union Carbide Corporation, Nuclear Division (UCC-ND), under contract with DOE, is conducting its survey in 154 NTMS 1° x 2° quadrangles which cover approximately 2,500,000 km^2 (1,000,000 mi^2) of the Central United States. This area includes most of the states of Texas, Oklahoma, Kansas, Nebraska, South Dakota, North Dakota, Minnesota, Wisconsin, Michigan, Indiana, Illinois, and Iowa, as well as parts of Arkansas, Missouri, New Mexico, and Ohio.

As a part of the HSSR Program, detailed geochemical surveys were initiated in the Fall of 1978 to supply comprehensive detailed geochemical data from specific areas. These surveys are designed to characterize the hydrogeochemistry; stream sediment geochemistry; and/or radiometric patterns of known or potential uranium occurrences. The information can be used to interpret data from the 1° x 2° NTMS quadrangle basic data surveys. Described herein are the results of work done by UCC-ND in the Marysvale area of Utah (Figure 1).

GEOLOGY

LOCATION AND PHYSIOGRAPHY

The Marysvale detailed geochemical survey covers an area of about 1,300 km^2 (502 mi^2) in west central Utah. The project area lies in the eastern half of the Richfield 1° x 2° NTMS Quadrangle. The area described is outlined on the generalized geologic map of Utah (Figure 2) and lies within lat. 38°18'30" and 38°43'02" N. and long. 112°00'00" and 112°35'00" W., which includes portions of Sevier, Piute, and Beaver Counties. A geologic map of the area, along with a stratigraphic column listing geologic unit codes used in the report, is presented in Figure 3 and Plate 4.

The project area lies within the High Plateau Subprovince of the Colorado Plateau Physiographic Province that forms the transition between the Colorado Plateau and the Basin and Range Province. The topography is characterized by peaks of the Marysvale volcanic field, which occupies regions to the east and west of the Sevier River. The Sevier River flows on a north-northwest meandering course through the central portion of the area sampled. The Sevier River Valley lies at an elevation of about 1,800 m (6,000 ft). The valley is bounded on the east by the Sevier Plateau and on the west by the Tushar Mountains (Figure 4). The Sevier and Tushar Faults (Figure 4), on the east and west side of the valley, respectively, form steep scarps and talus piles and result in a decrease of 1,800 m (6,000 ft) from the summits of the Sevier Plateau and Tushar Mountains to the valley floor. Summits in the Tushar Mountains are over 3,700 m (12,000 ft) in elevation. The Antelope Range (Figure 4), a series of low, rounded hills, lies within the Sevier River Valley approximately 6 km (3.7 mi) north-northeast of Marysvale. These hills have been eroded extensively by the Sevier River, resulting in steep canyon walls.

The higher elevations within the project area lie within Fishlake National Forest. Although the peaks of many of the mountains are barren with sparsely vegetated slopes, stands of pine and aspen grow in the valleys. The Sevier River Valley and Antelope Hills are covered with sagebrush and a sparse growth of junipers and pinon pines.

CLIMATE

Climatological data have been collected in Richfield and Beaver, towns which occupy the valleys north and southwest of the project area, respectively. Mean annual temperatures are 9.7°C (49.5°F) in Richfield

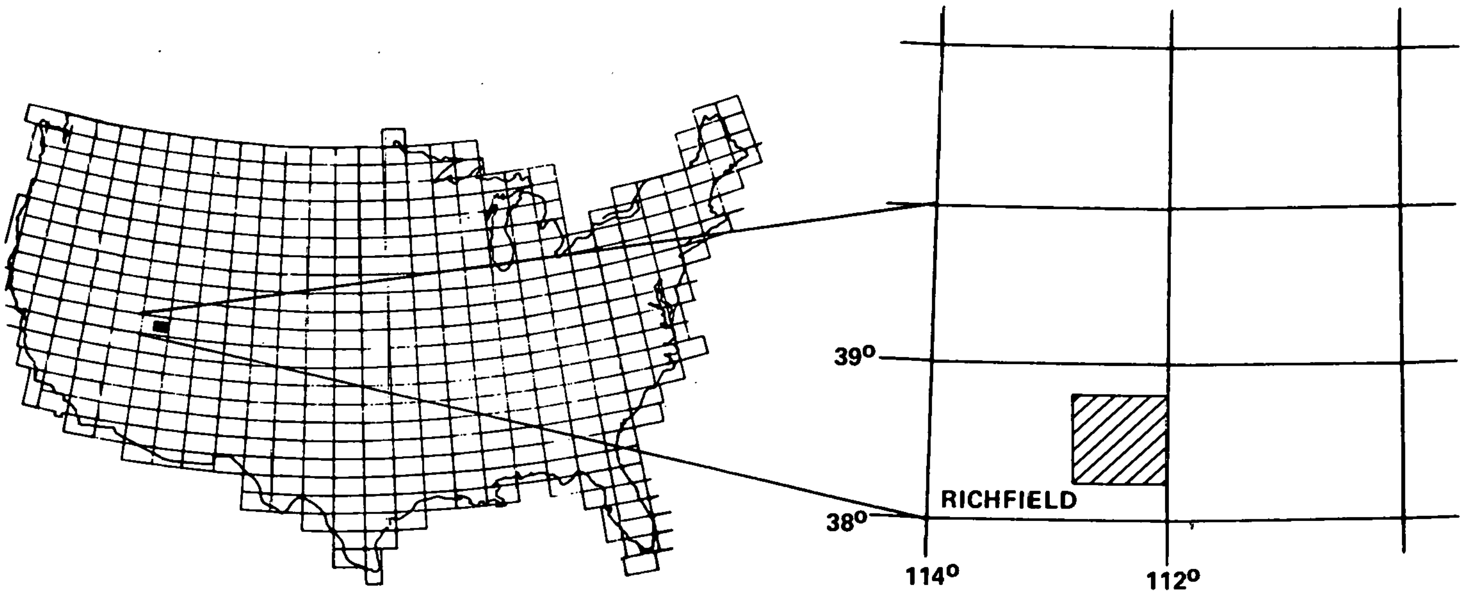

Figure 1

INDEX MAP SHOWING THE MAP BOUNDARIES FOR THE MARYSVALE DETAILED GEOCHEMICAL SURVEY, UTAH

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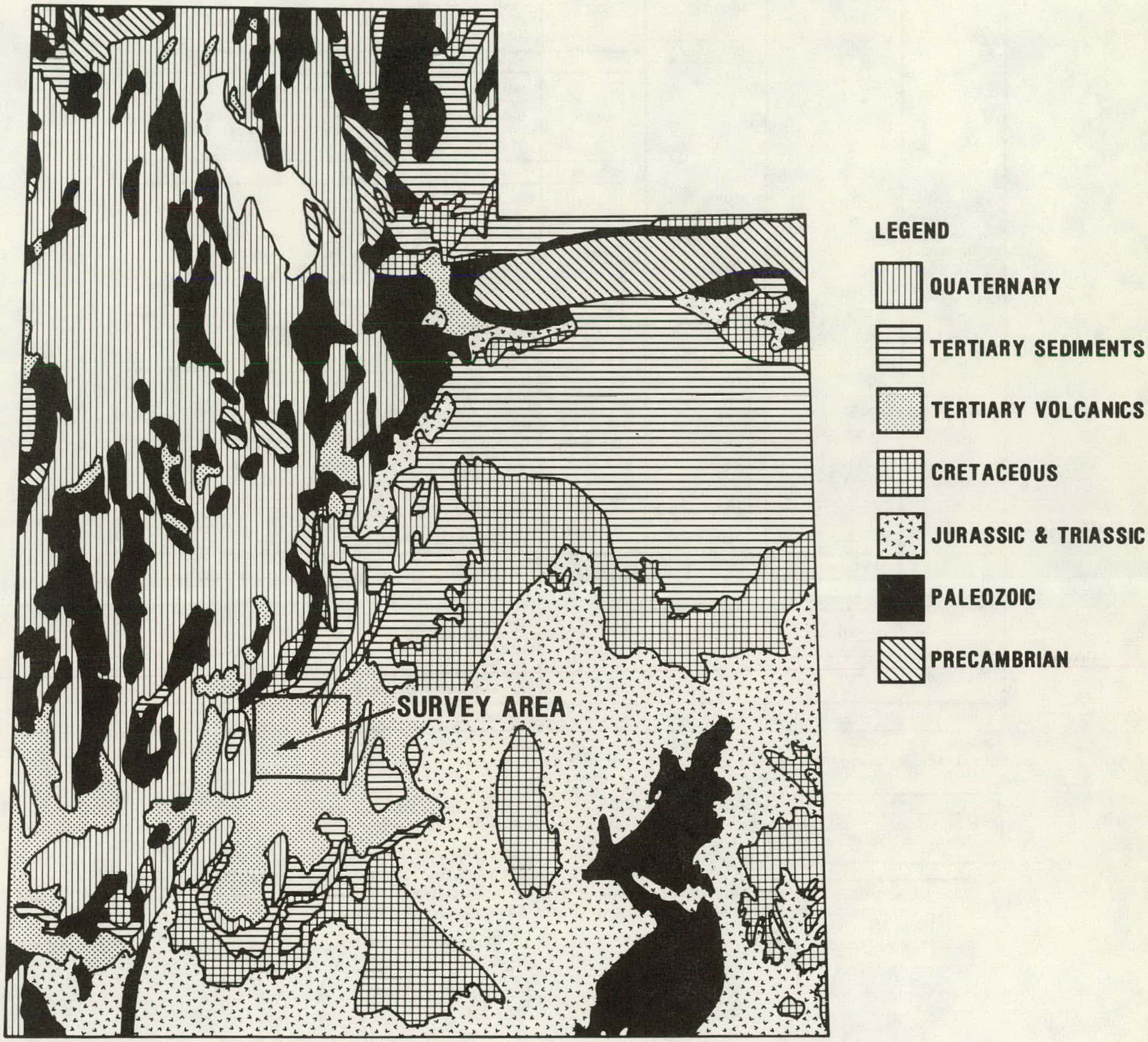

Figure 2

GENERALIZED GEOLOGIC MAP OF UTAH WITH LOCATION
OF THE MARYSVALE DETAILED GEOCHEMICAL SURVEY, UTAH
(AFTER KING, ET AL, 1974)

STRATIGRAPHIC COLUMN FOR THE MARYSVALE DETAILED GEOCHEMICAL SURVEY

ERA	SYSTEM	SERIES	NURE CODE	DESCRIPTION
CENOZOIC	QUATERNARY	RECENT PLEISTOCENE	QD	ALLUVIAL DEPOSITS, TRAVERTINE, LANDSLIDE DEBRIS, TERRACE GRAVEL, SEVIER RIVER FORMATION (LOWER PLEISTOCENE TO MIOCENE)
	TERTIARY	PLIOCENE (?)	PB	BASALT LAVA FLOWS
		MIOCENE	MMB: MMBR	MOUNT BELKNAP VOLCANICS – RHYOLITE LAVA FLOWS (MOUNT BALDY RHYOLITE, BLUE LAKE RHYOLITE MEMBER, GRAY HILLS RHYOLITE MEMBER AND PORPHYRITIC LAVA FLOWS, LOWER HETEROGENEOUS MEMBER, AND FLOW BANDED RHYOLITE)
			MMB: MBV	VOLCANICLASTIC ROCKS
			MMB: MMBT	MOUNT BELKNAP VOLCANICS – ASH-FLOW TUFFS (UPPER GRAY TUFF MEMBER, UPPER RED TUFF MEMBER, CRYSTAL-RICH MEMBER, RED HILLS TUFF MEMBER, JOE LOTT TUFF MEMBER, UPPER TUFF MEMBER, MIDDLE TUFF MEMBER, LOWER TUFF MEMBER, AND TUFFACEOUS RHYOLITE OR WELDED TUFF)
			MMB: MMBI	MOUNT BELKNAP VOLCANICS – INTRUSIVES (DIKES, LAVA FLOWS AND SMALL STOCKS, INTRUSIVE ROCKS, FINE GRAINED GRANITE AND INTRUSIVE DOMES)
			MTL	DRY HOLLOW FORMATION (PLIOCENE ?) ROGER PARK BASALTIC BRECCIA (PLIOCENE ?), OSIRIS TUFF AND VOLCANIC ROCKS OF LITTLE TABLE (MIOCENE AND OLIGOCENE)
			TI	RHYOLITE DIKES, RHYODACITE DIKES, INTRUSIVE ROCKS, INTRUSIVE LATITE, QUARTZ MONZONITE, AND INTRUSIVE ROCKS (MIOCENE AND OLDER),
			MBCV	BULLION CANYON VOLCANICS
		OLIGOCENE	ONR	NEEDLES RANGE FORMATION
	CRETACEOUS (?)		EOSC	CONGLOMERATE
MESOZOIC	JURASSIC		UJAN	ARAPIEN FORMATION NAVAJO SANDSTONE CHINLE FORMATION SHINARUMP MEMBER MOENKOPI FORMATION KAIBAB LIMESTONE TOROWEAP FORMATION QUEANTOWEAP SANDSTONE
	TRIASSIC			
PALEOZOIC	PERMIAN			
			UNKN	UNKNOWN

SOURCES:

1. CALLAGHAN, E. AND PARKER, R. L.; GEOLOGIC MAP OF PART OF THE BEAVER QUADRANGLE, UTAH (1961a).
2. ______________; GEOLOGIC MAP OF THE MONROE QUADRANGLE, UTAH (1961b).
3. ______________; GEOLOGIC MAP OF THE DELANO PEAK QUADRANGLE, UTAH (1962).
4. CUNNINGHAM, C. G., AND STEVEN, T. A.; GEOLOGIC MAP OF THE DELANO PEAK NW QUADRANGLE, WEST-CENTRAL UTAH (1978).
5. ______________; GEOLOGIC MAP OF THE DELANO PEAK NE QUADRANGLE, WEST-CENTRAL UTAH (1979a).
6. ______________; GEOLOGIC MAP OF THE MARYSVALE NW QUADRANGLE, WEST-CENTRAL UTAH (1979b).
7. STEVEN, T. A.; GEOLOGIC MAP OF THE SEVIER SW QUADRANGLE, WEST-CENTRAL UTAH (1978).
8. STEVEN, T.A., AND CUNNINGHAM, C. G.; GEOLOGIC MAP OF THE SEVIER SE QUADRANGLE, WEST-CENTRAL UTAH (1979).
9. WILLARD, M. E., AND CALLAGHAN, E.; GEOLOGIC MAP OF THE MARYSVALE QUADRANGLE, UTAH (1962).

LEGEND FOR FIGURE 3

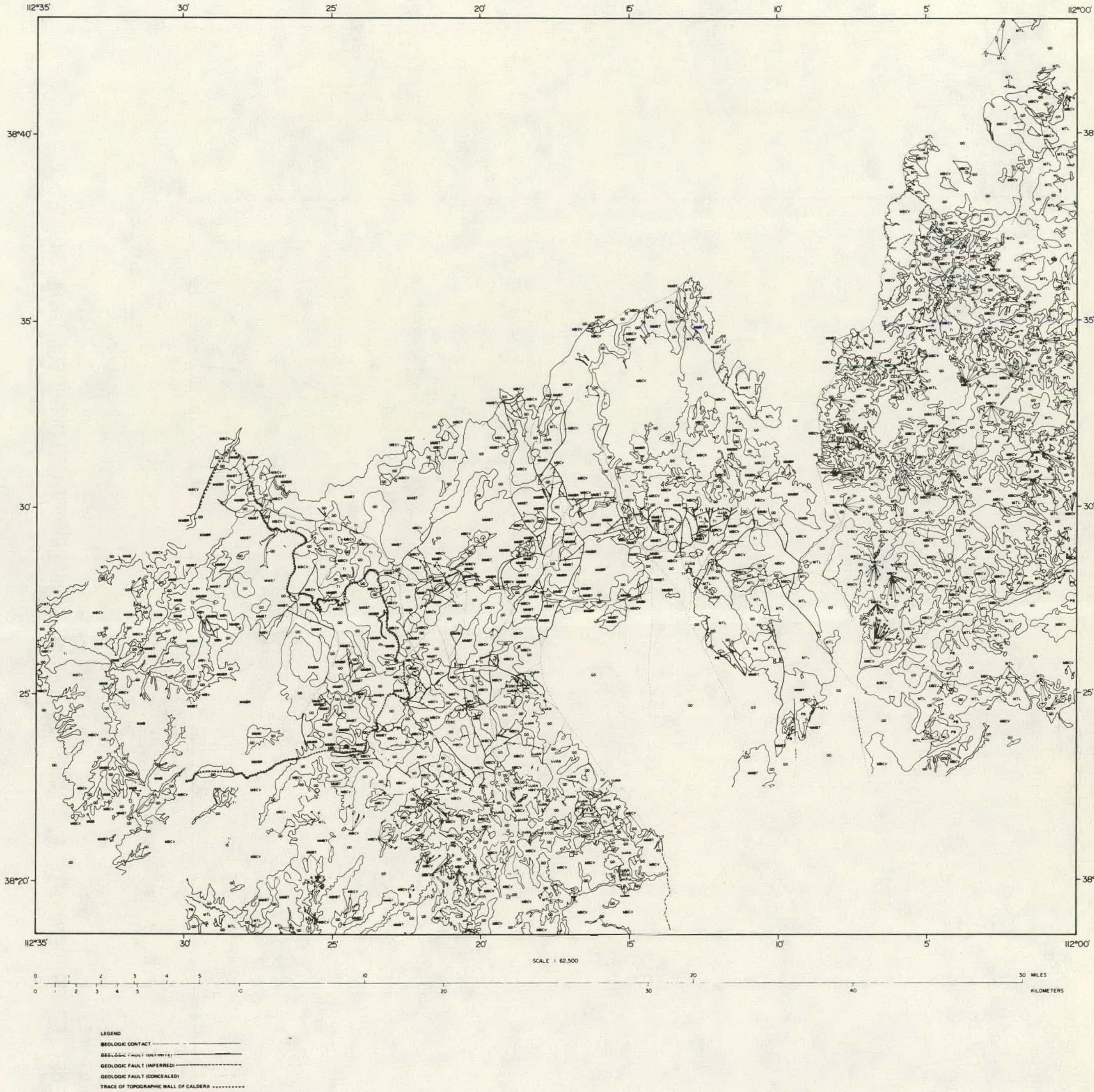

Figure 3

GENERALIZED GEOLOGIC MAP OF THE MARYSVALE DETAILED GEOCHEMICAL SURVEY, UTAH

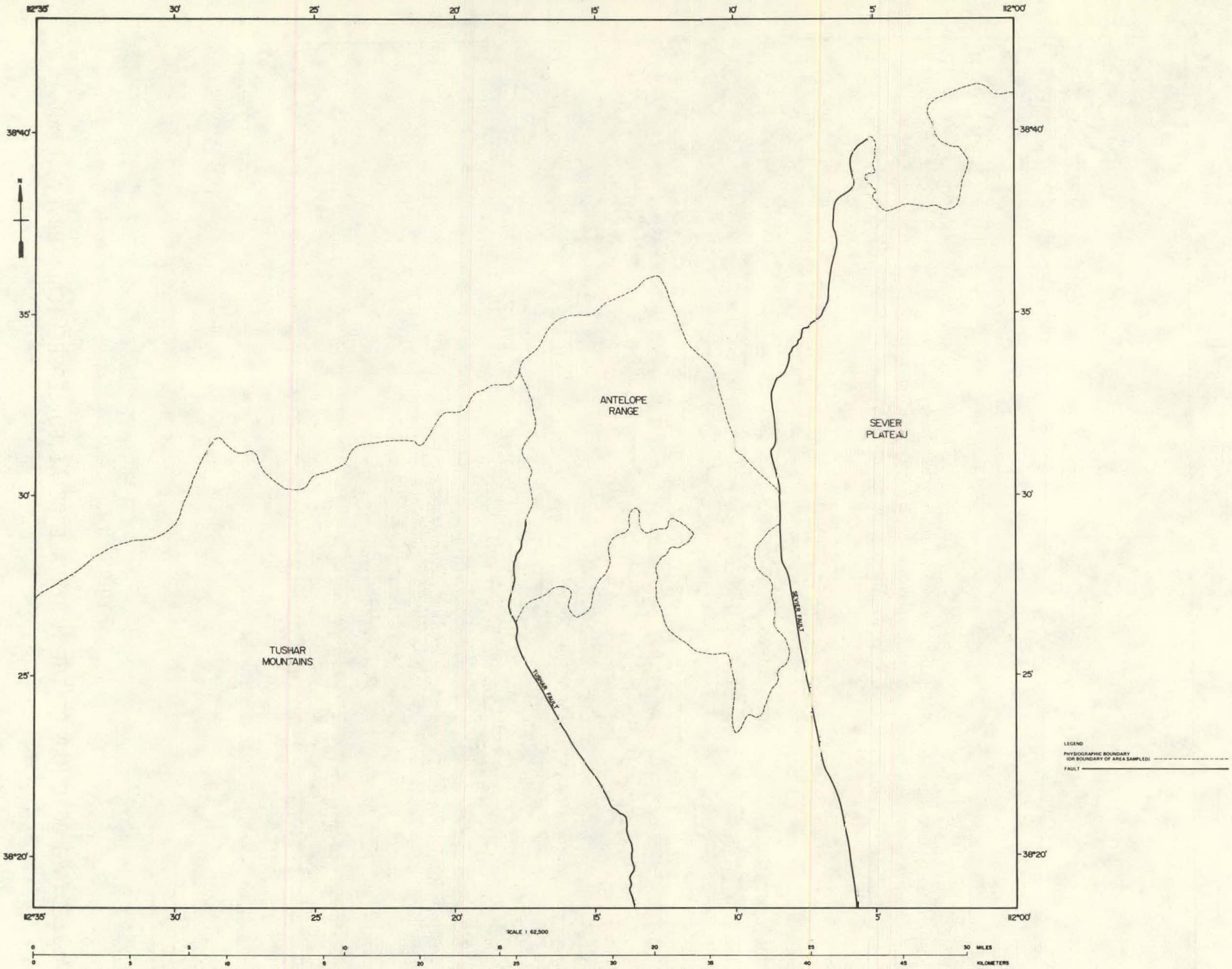

Figure 4

SELECTED TOPOGRAPHIC FEATURES IN THE MARYSVALE DETAILED GEOCHEMICAL SURVEY, UTAH and 8.4°C (47.2°F) in Beaver (National Oceanic and Atmospheric Administration, 1974). The majority of the project area is mountainous, and temperatures can be estimated by using about a 1.7°C (3°F) decrease in mean annual temperature for each 300 m (1,000 ft) increase in altitude, and 0.9°C (1.5°F) to 1.1°C (2.0°F) decrease for each 1° increase in latitude (National Oceanic and Atmospheric Administration, 1974). Mean annual precipitation is 20.8 cm (8.19 in.) for Richfield and 29.9 cm (11.77 in.) for Beaver.

RELATED STUDIES

The mineral resources of the Marysvale area have been recognized since the late 1800's. Silver ores associated with lead and zinc sulfides were first mined from the area, and shortly afterwards, gold was discovered and mined. Alunite was first identified in the area in 1910. Butler and Gale (1912) and Loughlin (1915) published reports on the location, description, and origin of the alunite deposits, as well as the general geology of the Tushar Range.

The first comprehensive studies of the volcanic sequence and alunite deposits in the Marysvale area were done by Callaghan (1938, 1939). The basic volcanic stratigraphy was established through Callaghan's field investigations, petrographic descriptions, and chemical analyses of rocks. During World War II, investigations of the alunite deposits continued (Hild, 1946; Willard and Proctor, 1946).

In June 1949, uranium ore was discovered in the Antelope Range, about 5 km (3 mi) north of Marysvale. This discovery led to a period of intense study of the Marysvale area sponsored by the Division of Raw Materials of the U.S. Atomic Energy Commission. Reports resulting from this work have been summarized by Kerr, et al (1957). Numerous other publications resulted from work done in the Marysvale uranium area during this time (Gruner, et al, 1951; Taylor, et al, 1951; Walker and Osterwald, 1955; Steinhauser and Myerson, 1955; Gilbert, 1957, 1958).

In the early 1960's, four 15-min topographic quadrangles which have a common corner near the uranium district of Marysvale were mapped by members of the U. S. Geological Survey (USGS) (Callaghan and Parker, 1961b, 1962a,b; Willard and Callaghan, 1962). In addition to these, part of the Beaver 15-min quadrangle was also mapped (Callaghan and Parker, 1961a). These publications include descriptions of the formations and discussions of the structure, geologic history, and mineral deposits for each quadrangle. These publications rearranged some of the sequence of rock units originally established by Callaghan, and this sequence was only slightly modified by most geologists working the area for the next 10 to 15 years.

Studies of the Marysvale area continued through the 1960's, resulting in numerous publications. Molloy and Kerr (1962) used a stratigraphic sequence which disagreed with that previously used (it still does not fit present interpretations) in their study of the Tushar uranium area. Bassett, et al (1963) published absolute ages of Tertiary volcanic rocks and mineralization that were determined by potassium-argon dating. Radtke, et al (1967) reported on the mineralogical and chemical associations of bismuth and tin minerals in gold- and silver-bearing sulfide ores of the Ohio mining district. Kerr (1968) reported further on the origin of ore bodies, mineralogy, and alteration within the Marysvale uranium deposits. The mineral resource potential of Piute County, assessed by Callaghan (1973), includes a large portion of the project area.

The reported interpretation of the volcanic sequence of the Marysvale volcanic pile became questioned as workers in surrounding regions attempted to correlate the Marysvale stratigraphy with their observations. Cunningham and Steven investigated the regional stratigraphy, structure, and petrologic evolution of the volcanic field in the Marysvale area starting in 1975. A revision of the stratigraphy and age data are reported by Steven, et al (1979). Five 7-1/2-min topographic quadrangles have been remapped in accordance with the revised stratigraphy (Cunningham and Steven, 1978a, 1979a, 1979b; Steven, 1978; Steven and Cunningham, 1979a).

Part of a regional investigation by the USGS involves the study of the central mining area in Marysvale. Many recent publications have resulted as this work progressed (Cunningham and Steven, 1978b, 1979c, 1979d, 1979e; Cunningham, et al, 1978, 1980; Steven and Cunningham, 1978, 1979b; Steven, et al, 1978). Other works that have recently been published include the following : a petrologic investigation of the presilicic calc-alkaline suite of volcanic rocks in the Marysvale area (Wender and Nash, 1979); an aerial radiometric and magnetic survey (Geodata International, Inc., 1979); and a hydrogeochemical and stream sediment reconnaissance of the Delta and Richfield 1° x 2° NTMS areas, Utah (Jones, 1979).

STRATIGRAPHY

The geologic map of the project area (Plate 4 and Figure 3) is a composite of areas that have been mapped by several authors. Units from the older maps have been grouped with units from the revised maps and assigned NURE codes according to lithologic descriptions and geochemistry of specific rock types.

The oldest rocks in the project area are Paleozoic sedimentary rocks (UJAN) of the Colorado Plateau. These rocks are best exposed within the project area along the west side of the Tushar Fault between Bullion and Tenmile Creek Canyons (lat. 38°20' - 38°25' N. and long. 112°15' - 112°20' W.). These Permian, Triassic, and Jurassic rocks are represented by orthoquartzite, dolomite, limestone, sandstone, quartzite, siltstone, shale, mudstone, and intraformational conglomerate. In some areas, these sedimentary rocks are overlain by a conglomerate (EOSC).

This conglomerate is characterized by rounded clasts of sandstones and limestones of the underlying Mesozoic and Paleozoic rocks and, in places, may contain tuffaceous sandstone. There are discrepancies about the age of this conglomerate; however, Callaghan and Parker (1962a), and Cunningham and Steven (1979a) generally agree on its lithology.

The Needles Range Formation is a crystal-rich quartz latite ash-flow tuff which crops out in the Sevier SE 7-1/2-min quadrangle. This formation is exposed in areas surrounding the area which was sampled, but it does not seem to have accumulated within it.

The Oligocene-Miocene Bullion Canyon Volcanics (MBCV) are treated as a single formational unit within the project area. These volcanics accumulated around a cluster of volcanoes centered in the Tushar Mountains, Antelope Range, and northern Sevier Plateau, and they interleave with ash-flow tuffs of local and distant origins (Steven, et al, 1979). This unit is composed predominantly of calc-alkaline lava flows, ash-flow tuffs, volcanic breccias, and volcanic mudflow breccias (Cunningham and Steven, 1979d). These rocks range from coarse-grained porphyritic rhyodacite to fine-grained, dark, intermediate-composition rocks, the main difference being between individual volcanic centers. The coarse-grained rocks contain phenocrysts of plagioclase, biotite, and augite, and the fine-grained rocks contain small phenocrysts of plagioclase and augite.

Tertiary intrusives (TI) intrude the Bullion Canyon Volcanics and older units. These intrusives generally consist of acidic stocks, dikes, and plugs. Although the quartz monzonitic intrusives exhibit different textures, colors, and appearance, they have a fairly constant mineralogic composition. Callaghan and Parker (1961b, 1962a) and Willard and Callaghan (1962) reported the quartz monzonite to be composed of calcic oligoclase, orthoclase, quartz, augite, and biotite, with accessory magnetite, apatite, and sphene; and later tourmaline, epidote, chlorite, and sericite. The intrusive rocks mapped by Cunningham and Steven (1978a, 1979a,b) are chiefly quartz monzonite consisting of plagioclase, orthoclase, quartz, and augite, with or without hornblende and/or biotite. Accessory minerals in these intrusives are zircon, apatite, and Fe-Ti oxides. Intrusive latite sills (Callaghan and Parker, 1962a) are exposed in the south central portion of the project area.

A generalized grouping of Miocene tuffs and lavas has been made and assigned the code MTL. Among the units included in this group is the Dry Hollow Formation. This formational division has been abandoned by Steven, et al (1979) because of its lateral equivalence with the Bullion Canyon Volcanics, however, the older maps distinguished between the two formations. The Dry Hollow Formation is mainly characterized by porphyritic latite, quartz latite, and crystal tuff. Other members of this grouping are the Roger Park Basaltic Breccia, Osiris Tuff, and volcanic rocks of Little Table.

The Mount Belknap Volcanics are characterized by silicic alkali rhyolite intrusives, lava flows, and ash-flow tuffs. These rocks were erupted from two source areas, a western source area in the central Tushar Mountains, and an eastern source area in the southern Antelope Range. Continued eruptions from both source areas resulted in subsidence of the major Mount Belknap Caldera (lat. 38°22' - 38°32'N. and long. 112°24' - 112°30'W.) (western source area) and the minor Red Hills Caldera (eastern source area) (lat. 38°30'N. and long. 112°14'W.) (Cunningham and Steven, 1979d).

Steven, et al (1979) have recognized individual units of lava flows and ash-flow tuffs from both source areas as a complex outflow facies of the Mount Belknap Volcanics. The Mount Belknap Caldera has been filled with an intraCaldera facies characterized by ash-flow tuffs, lava flows, and volcanic mud-flow breccias. Associated rhyolite or granitic intrusive rocks were emplaced in the two source areas and often cut both the outflow and intraCaldera facies.

NURE codes have been assigned to groupings of the Mount Belknap Volcanics. The ash-flow tuffs (MMBT) include those individual formal and informal ash-flow tuff members of the Mount Belknap Volcanics that have been recently mapped, those rocks distinguished as tuffs of the Mount Belknap rhyolite on the older maps, and the unit previously mapped as the Joe Lott Tuff. Callaghan and Parker (1961a) did not differentiate between lava flows and tuffs when mapping the Mount Belknap rhyolite. These undifferentiated Mount Belknap Volcanics have been assigned the code MMB. Those rocks distinguished as the rhyolite lava flows of the Mount Belknap Volcanics (MMBR) include the formal and informal members recently mapped as flows and those rocks which were mapped as rhyolite on the older maps. Volcaniclastic rocks of the Mount Belknap Volcanics have been assigned the code MBV. These rocks, according to Cunningham and Steven (1978a), are dominantly laharic mud-flow breccias which have been derived from the Mount Baldy Rhyolite Member (MMBR).

Alteration and mineralization is widespread within the project area. This alteration and mineralization took place during separate periods of hydrothermal activity which, in some places, has been superimposed.

Many of the well known alunite deposits of the Marysvale area occur in local areas of intensely altered and mineralized rocks in the southern Antelope Range and adjacent eastern Tushar Mountains. Earlier workers assumed these alunite deposits were formed at approximately the same time. However, more recent work shows that they formed during different periods of hydrothermal activity which were probably unrelated (Steven, et al, 1979). The majority of the alunitic rocks are limited to the Bullion Canyon Volcanics. Alunite occurs along the margins of exposed quartz monzonite intrusives and also in altered areas in the surrounding volcanic rocks which mark centers of hydrothermal activity.

Three episodes of alunitic alteration are observed within the area sampled. The first episode is the alunitic alteration of the Bullion Canyon Volcanics. The second episode resulted in younger natroalunite in the southern Antelope Range. Alunite deposits in the eastern Tushar Mountains, along Alunite Ridge (lat. 38°22' N. and long. 112°17' W.), are possibly correlative with the younger natroalunite (Steven, et al, 1979). Volcanic rocks of the Deer Trail Mountain-Alunite Ridge Mining Area consist of a centralized zone of alunite which grades outward to kaolinitic and pervasive propylitic alteration mineral assemblages (Cunningham, et al, 1978). The third type and youngest alunitic alteration occurs on the western base of the Tushar Mountains (lat. 38°23' N. and long. 112°34' W.). Here, an alunite deposit formed in the flow-banded rhyolite typical of the Mount Belknap Volcanics (Steven, et al, 1979).

Hydrothermal activity is also associated with rhyolite and fine-grained granite intrusions which were emplaced during the Mount Belknap period of volcanism. Since the later Mount Belknap intrusions occurred in the same general area occupied by the older monzonitic intrusions and altered rocks in the Antelope Range, mineralized materials of both ages are often superimposed. Local bodies of rock have been largely altered to clay and silica, and veins which contain significant quantities of uranium, molybdenum, and fluorine have been deposited (Steven, et al, 1979). At the deepest levels exposed within the central mining area (lat. 38°30' N. and long. 112°12' W.), kaolinitic alteration products have formed through interaction of the fluids and wall rocks (Cunningham, et al, 1980).

Rocks on the north side of the Tushar Mountains exhibit two periods of hydrothermal activity which could possibly be superimposed. The first period of alteration and mineralization is displayed in the Kimberly area (lat. 38°28' N. and long. 112°25' W.) by gold- and silver-bearing quartz-carbonate veins which occur in the Bullion Canyon Volcanics. The Bullion Canyon Volcanics are cut by small monzonitic intrusions and are widely propylitized. To the north of the Kimberly area, the Joe Lott Tuff Member of the Mount Belknap Volcanics has been intensely altered, resulting in the formation of kaolinite deposits (Steven, et al, 1979).

West of the Mount Belknap Caldera, some vein-type uranium deposits occur in or near quartz monzonite that has intruded the Bullion Canyon Volcanics on either side of Indian Creek (lat. 38°26' N. and long. 112°34' W.). The Bullion Canyon Volcanics, adjacent to the pluton, are cut by gold-bearing quartz veins and are locally altered. It seems probable that this area along Indian Creek has been affected by at least two periods of mineralization which have been superimposed (Steven, et al, 1979).

The basalt lava flows (PB) are the youngest volcanic rocks in the Marysvale area although there is some discrepancy about the age. These lava flows are dark-gray to black, vesicular or amygdaloidal olivine basalt. They have been reported to include some scoria (Cunningham and Steven, 1979b) and altered olivine phenocrysts (Steven, 1978; Cunningham and Steven, 1979e). In some localities, these basalt flows interleave with sediments of the Sevier River Formation.

The Sevier River Formation has been grouped with alluvial deposits, travertine, landslide debris, and terrace gravel, all of which are assigned the code QD. The Sevier River Formation is mostly of local origin and mainly consists of fluviatile and minor lacustrine sediments. Ash-fall tuffs and basalt flows are interlayered with the Sevier River Formation, indicating episodic volcanism.

STRUCTURE

The project area lies within the High Plateau physiographic subprovince which lies between the Basin and Range and Colorado Plateau physiographic provinces. Deformation is typical of this region. The composite volcanic center of Tertiary igneous rocks has been disrupted by Basin and Range Faults.

The Red Hills Caldera and the Mount Belknap Caldera were formed in response to eruptions of the Mount Belknap Volcanics. In the eastern source area (the Red Hills Caldera), there was only one episode of violent eruptions resulting in the deposition of ash-flows. These ash-flows were of small volume so that the width of the resulting Caldera which developed was only about 1,200 m (4,000 ft) (Cunningham and Steven, 1979d). However, magmatic pressures in the western source area (the Mount Belknap Caldera) built up enough for many tens of cubic kilometers of ash-flow tuff to erupt. In response to this, a major Caldera [8 to 9 km (5 to 5.6 mi) across] was developed (Cunningham and Steven, 1979d). The walls caved inward from the structural margin of the Caldera, resulting in a very irregular shaped Caldera that is about 13 km (8.1 mi) wide (east to west) and 17 km (10.6 mi) long (north to south). There was no resurgence, but the core may have subsided in several periods. After eruption of the Mount Baldy Rhyolite Member, subsidence occurred as a tilted trap-door block. This block was hinged on the west and bounded by arcuate faults on the east. These faults may mark the main buried ring fracture zone on the east side of the Caldera (Cunningham and Steven, 1979d).

The structural features within the project area which are typical of the Basin and Range Province are faults and monoclinal flexures (Willard and Callaghan, 1962). The Antelope Range occurs as an anticlinal cross structure with an east plunging axis which terminates along the Sevier Fault (Callaghan and Parker, 1961b). The volcanic rocks of the Tushar Mountains are gently inclined, undulating, and locally displaced by normal faults. The volcanics of the Mount Belknap period dip gently west, north, and east, generally corresponding to the topographic slope

(Callaghan and Parker, 1962a). The Basin and Range faults trend north-northwest and north-northeast. The major faults are the Sevier and Tushar Faults which form the east and west sides, respectively, of the graben occupied by the Sevier River. The rocks within the central mining area of the Marysvale district are cut by Basin and Range faults and by local faults that trend east-northeast (Cunningham and Steven, 1978b, 1979e). This fracture pattern has been interpreted by Cunningham and Steven (1979e) as reflecting local distension, superimposed on regional late Cenozoic east to west Basin and Range extension. This local distension was most likely caused by an underlying magma chamber. Steven, et al (1979) report the regional Basin and Range faulting to have begun after eruption of the Mount Belknap Volcanics and to have continued through much of Cenozoic time.

SURFACE DRAINAGE

The Piute-Beaver County line follows along the ridges in the Tushar Mountains, which form a drainage divide within the project area. The majority of the streams south and west of the divide (in Beaver County) flow southwestward into Minersville Reservoir. Those streams in the extreme northwestern section of the project area flow to the northwest. All streams north and east of the divide ultimately flow into the Sevier River. Most of those streams draining off of the Sevier Plateau flow into the Sevier River to the west.

Stream gradients are generally high in the higher altitudes, decreasing in the lower valleys. The ruggedness of the terrain allows for well defined drainage basins.

URANIUM OCCURRENCES

In 1949, uranium ore was discovered north-northeast of the town of Marysvale in rocks of the Antelope Range. Early mining operations started as small cuts along the Prospector vein and the Bullion Monarch open pit (Kerr, 1968) (lat. 38°30' N. and long. 112°12' W.). Since that time, one million pounds of U_3O_8 have been produced from the central mining area. The majority of this U_3O_8 has been produced from the Prospector, Freedom Nos. 1 and 2, Bullion Monarch, Farmer John, Cloys, Potts, Wilhelm, and Sunnyside mines (Cunningham and Steven, 1978b). The central mining area is an oval-shaped area about 460 by 1,200 m (1,500 by 4,000 ft) within the eastern source area of the Mount Belknap Volcanics. Ore has been mined to depths of about 180 m (600 ft), and Callaghan (1973) reports ore to be present at about 460 m (1,500 ft), as indicated by drilling.

Most of the uranium was deposited in open fractures by ascending acidic fluorine-rich hydrothermal (150°C) fluids. These fluids interacted with wall rocks of the granitoid intrusives to form kaolinitic alteration products. Uraninite, coffinite, jordisite, molybdenite, and umohoite have been deposited in open fractures at depth in a matrix of purple fluorite, quartz, and minor pyrite. As the fluids rose, they cooled, became oxygen-rich, and pH increased. In the higher levels, fluorite and sooty pitchblend were deposited as the main vein minerals. Near the surface, uranium phosphate minerals of hypogene and supergene origin have been deposited (Cunningham, et al, 1980).

In the western source area, the Mount Belknap Caldera is filled with rhyolitic ash-flow tuffs, lava flows, volcanic domes, and volcanic breccias. These uranium-bearing rocks have been widely altered by post-Caldera hydrothermal activity. Much of the uranium from these rocks has been mobilized and some either redeposited within the Caldera fill or transported elsewhere (Cunningham, et al, 1980). Small uranium deposits in fractures cutting older volcanic rocks in the walls of the Caldera have been prospected and mined (Callaghan, 1973).

Uranium deposits occur in the western portion of the project area in the canyons of Indian Creek (lat. 38°25' N. and long. 112°29' - 112°35' W.) and the North Fork of North Creek (lat. 38°24' N. and long. 112°28' - 112°35' W.). The Mystery-Sniffer mine (lat. 38°26' N. and long. 112°33' W.) is the principal mine in this area. Autunite, torbernite, and pitchblend occur with purple fluorite, pyrite, and quartz along an intensely argillized fault zone. This normal fault separates the Bullion Canyon Volcanics from the Mount Belknap Volcanics (Callaghan and Parker, 1961a).

The "Richfield 1° x 2° Uranium Distribution Map" (Larson, et al, 1977) delineates those areas which contain high concentrations of uranium. Areas which have been discussed in this section are located on that map, along with a few other scattered areas of anamolous radioactivity.

SAMPLE COLLECTION

CHRONOLOGY OF THE SURVEY

Sampling of the Marysvale detailed geochemical survey began in August 1979 and was completed in November 1979. Laboratory analysis, as well as compilation and verification of field and laboratory data, continued throughout the sampling period. The final field and laboratory data base used to prepare the statistical and areal distribution of uranium and other related variables for this report was completed in April 1980.

FIELD PROCEDURES

Field sampling was performed by personnel of UCC-ND. A total of 397 stream sediment samples and 160 radiometric readings were taken within the area. Of these radiometric readings, 60 were taken with the four-channel gamma ray spectrometer; the remainder were taken using a broad-band gamma ray scintillometer. Plates 1 and 5 show the site locations for stream sediment samples and radiometric readings, respectively.

Drainage basins are drawn on Plate 1 to indicate the area represented by the stream sediment samples. Detailed information regarding techniques in sample collection, recording site data, field equipment, and field measurements may be found in the following reports: "Hydrogeochemical and Stream Sediment Reconnaissance Procedure of the Uranium Resource Evaluation Project" (Arendt, et al, December 1979); "Procedures Manual for Stream Sediment Reconnaissance Sampling" (Uranium Resource Evaluation Project, May 1978). Field observations are recorded on the field form shown in Table B-2 and are included in the microfiche in Appendix C.

CONTAMINATION

Precautions were taken to avoid the possibility of collecting contaminated samples. Sediment samples were collected upstream of road crossings, where possible. Several samples were collected in basins draining and/or adjacent to the central mining area and other prospects which occur in the area sampled. These mines and prospects were the major contributors to contamination and, where occurring, were noted as such on the field form.

CHEMICAL ANALYSIS

All samples collected in the project area were returned to the URE Project laboratory in Oak Ridge, Tennessee for preparation and analysis. The elements determined and the analytical techniques used along with the appropriate detection limits are given in Table 1. These detection limits are considered the best average during normal operation; however, some variables have values reported below these limits. Stream sediment samples were dried overnight at 85°C and sieved to collect the <150-μm fraction. Part of the sediment sample was dissolved in 10 ml of 1:1 nitric-hydrofluoric acid. The analytical procedures which were used have been described by Cagle (1977) and Arendt, et al (December 1979). All observed data from all samples are included in the microfiche in Appendix C.

QUALITY CONTROL

MEASUREMENTS CONTROL

The procedures used to analyze URE Project samples require that calibration standards, check samples, and blanks be analyzed along with normal samples to ensure the validity of the reported results. A measurements control program provides information concerning precision and reliability of these measurements. Control samples of two sediment batches are submitted anonymously along with routine samples on a daily basis. A statistical summary of results reported on control samples, which were analyzed along with the samples included in this survey, is given in Table 2. Results of uranium analysis of sediment control samples obtained from the Ames Laboratory as part of the Multilaboratory

Table 1

DETECTION LIMITS OF VARIABLES DETERMINED IN WATER AND SEDIMENT SAMPLES

Variable	Method	Detection Limits Sediment (ppm)	Detection Limits Water (ppb)
U-FL	Fluorometry	0.25	0.2
U-MS	Mass Spectrometry-Isotope Dilution	--	0.02
U-NT	Neutron Activation-Delayed Neutron Count	0.02	--
As	Atomic Absorption	0.1	0.5
Se	Atomic Absorption	0.1	0.2
Ag	Plasma Source Emission Spectrometry	2	2
Al	Plasma Source Emission Spectrometry	0.05[a]	10
B	Plasma Source Emission Spectrometry	10	4
Ba	Plasma Source Emission Spectrometry	2	2
Be	Plasma Source Emission Spectrometry	1	1
Ca	Plasma Source Emission Spectrometry	0.05[a]	0.1[b]
Ce	Plasma Source Emission Spectrometry	10	30
Co	Plasma Source Emission Spectrometry	4	2
Cr	Plasma Source Emission Spectrometry	1	4
Cu	Plasma Source Emission Spectrometry	2	2
Fe	Plasma Source Emission Spectrometry	0.05[a]	10
Hf	Plasma Source Emission Spectrometry	15	--
K	Plasma Source Emission Spectrometry	0.05[a]	0.1[b]
La	Plasma Source Emission Spectrometry	2	--
Li	Plasma Source Emission Spectrometry	1	2
Mg	Plasma Source Emission Spectrometry	0.05[a]	0.1[b]
Mn	Plasma Source Emission Spectrometry	4	2
Mo	Plasma Source Emission Spectrometry	4	4
Na	Plasma Source Emission Spectrometry	0.05[a]	0.1[b]
Nb	Plasma Source Emission Spectrometry	4	--
Ni	Plasma Source Emission Spectrometry	2	4
P	Plasma Source Emission Spectrometry	5	40
Pb	Plasma Source Emission Spectrometry	10	--
Sc	Plasma Source Emission Spectrometry	1	1
Si	Plasma Source Emission Spectrometry	--	0.1[b]
Sr	Plasma Source Emission Spectrometry	1	2
Th	Plasma Source Emission Spectrometry	2	--
Ti	Plasma Source Emission Spectrometry	10	2
V	Plasma Source Emission Spectrometry	2	4
Y	Plasma Source Emission Spectrometry	1	1
Zn	Plasma Source Emission Spectrometry	2	4
Zr	Plasma Source Emission Spectrometry	2	2
SO_4	Spectrophotometry	--	5[b]
Cl	Spectrophotometry	--	10[b]

[a] Detection limits expressed in percent.
[b] Detection limits expressed in ppm.

Table 2

SUMMARY OF MEASUREMENT CONTROL RESULTS OBTAINED WITH STREAM SEDIMENT SAMPLES FROM THE MARYSVALE DETAILED GEOCHEMICAL SURVEY, UTAH

		Batch Q-1				Batch R-3				Batch S-3			
Element	Method	No. of Samples	Mean (ppm)	Standard Deviation (ppm)	Coefficient of Variation	No. of Samples	Mean (ppm)	Standard Deviation (ppm)	Coefficient of Variation	No. of Samples	Mean (ppm)	Standard Deviation (ppm)	Coefficient of Variation
U	FL[a]	40	0.79	0.268	0.34	37	4.26	0.469	0.11	38	28.52	2.674	0.09
U	NT[b]	39	0.67	0.160	0.24	50	4.91	0.102	0.02	35	26.25	0.797	0.03
AS	AA[c]	17	1.8	0.25	0.14	27	3.6	0.64	0.18	19	26.4	3.11	0.12
SE	AA	12	0.5	0.31	0.57	28	0.2	0.43	2.02	20	1.4	0.62	0.45
AL	PS[d]	36	9,700.0	490.0	0.05	39	34,100.0	2,730.0	0.08	30	48,700.0	3,430.0	0.07
B	PS	38	7.0	3.5	0.46	34	20.0	7.1	0.34	30	61.0	10.3	0.17
BA	PS	38	130.0	14.6	0.11	39	454.0	51.0	0.11	32	314.0	31.1	0.10
BE	PS	37	0.0	0.6	0.94	40	0.0	10.3	10.27	32	2.0	4.0	1.74
CA	PS	38	1,200.0	100.0	0.08	40	3,100.0	300.0	0.10	31	16,900.0	80.0	0.06
CE	PS	37	19.08	3.677	0.19	39	68.82	7.196	0.10	29	55.59	4.968	0.09
CO	PS	38	4.0	2.7	0.59	40	10.0	2.2	0.20	31	33.0	3.1	0.09
CR	PS	38	14.0	2.1	0.14	39	28.0	3.2	0.11	32	65.0	6.6	0.10
CU	PS	35	3.0	0.8	0.22	38	20.0	1.5	0.07	30	69.0	2.9	0.04
FE	PS	37	9,700.0	390.0	0.04	40	18,000.0	1,070.0	0.06	30	40,800.0	2,070.0	0.05
K	PS	37	1,900.0	190.0	0.10	38	9,900.0	930.0	0.09	31	17,200.0	2,000.0	0.12
LI	PS	37	9.0	0.8	0.08	39	23.0	1.8	0.08	32	35.0	3.6	0.10
MG	PS	38	1,100.0	50.0	0.05	39	2,200.0	110.0	0.05	32	5,600.0	260.0	0.05
MN	PS	37	317.0	9.9	0.03	40	1,909.0	87.8	0.05	30	404.0	15.9	0.04
MO	PS	1	0.0	0.0	0.0	40	2.0	0.9	0.41	29	43.0	3.7	0.08
NA	PS	1	0.0	0.0	0.0	40	1,600.0	190.0	0.13	31	1,600.0	220.0	0.14
NB	PS	37	2.0	0.7	0.32	41	8.0	4.3	0.49	33	2.0	1.6	0.58
NI	PS	37	6.0	1.0	0.16	41	20.0	3.1	0.15	30	108.0	6.3	0.06
P	PS	36	70.0	6.0	0.09	35	2,149.0	217.3	0.10	28	1,441.0	83.8	0.06
PB	PS	28	5.0	3.0	0.50	27	38.0	5.6	0.14	28	21.0	3.6	0.16
SC	PS	38	1.0	0.5	0.31	41	5.0	0.8	0.15	32	10.0	0.8	0.08
SR	PS	36	19.17	1.320	0.07	39	55.33	4.054	0.07	32	85.56	6.133	0.07
TH	PS	38	2.0	1.7	0.74	41	8.0	2.8	0.34	33	8.0	2.5	0.30
TI	PS	38	572.0	54.8	0.10	39	3,321.0	369.9	0.11	32	2,123.0	174.9	0.08
V	PS	35	20.0	0.9	0.04	38	55.0	4.4	0.08	30	166.0	6.7	0.04
Y	PS	37	4.0	0.3	0.08	39	20.0	1.7	0.08	30	33.0	1.6	0.05
ZN	PS	36	13.0	2.1	0.16	35	93.0	7.5	0.08	29	185.0	12.0	0.06
ZR	PS	38	30.0	2.9	0.10	38	136.0	10.9	0.08	31	83.0	6.0	0.07
HF	PS	27	2.11	1.577	0.75	27	3.83	2.685	0.70	28	1.95	1.455	0.75
LA	PS	28	20.89	3.023	0.14	27	78.00	15.056	0.19	28	90.61	4.787	0.05

(a) Fluorometric analysis.
(b) Neutron activation delayed neutron count.
(c) Atomic absorption.
(d) Plasma source emission spectroscopy.

Analytical Quality Control for the HSSR Program are reported by D'Silva, et al (1980).

PRINCIPAL COMPONENT ERROR ANALYSIS

A principal component analysis of data from stream sediment samples was used to produce an ordered list of samples using the eigenvalue statistics as described by Kane, et al (1977), where the most extreme samples were listed first. Additional samples were identified if single-element measurements were outside a three standard deviation confidence interval around the mean. The laboratory and field data from the samples identified by this procedure were reviewed. Six stream sediment samples (911223, 911339, 911340, 911341, 911345, and 911399) were submitted for reanalysis. The original results were compared to the results from reanalysis. Of the more than 200 individual analyses that were compared, the only results which were considered to be in error in the original analysis and thus require corrections were U-FL values for Sediment Samples 911339 and 911399, and multielement values for Sediment Samples 911339, 911340, 911341, 911345, and 911399. This low error rate indicates a high level of reliability for the laboratory measurements.

GEOCHEMICAL RESULTS

A statistical summary of all geochemical variables determined and the correlation matrix of selected variables for stream sediment samples collected in the Marysvale project area are presented in Appendix A. Areal distribution maps, log frequency, lognormal probability, percentile plots, and tabular data listings for selected variables are also included. All field and laboratory data for stream sediment samples may be found on microfiche in Appendix C. Details of all sampling, analytical, and statistical procedures are discussed in Report K/UR-100 (Arendt, et al, December 1979).

For discussion purposes, the 16th and 84th percentile concentrations are contoured on the areal distribution maps for all elements (except molybdenum) to indicate areas of low and high concentrations (Appendix A). These concentrations represent values of approximately one standard deviation below and above the mean for a normally distributed population. For more careful evaluation of the data presented, concentration levels considered to be anomalous should be determined separately for each geologic unit within the project area.

GEOCHEMICAL DISTRIBUTIONS IN STREAM SEDIMENTS

Sample site locations and the outline of drainage basins from which stream sediment samples were collected in the Marysvale detailed geochemical survey are shown on Plate 1. Areal distribution maps for hot-acid-soluble uranium (U-FL) as determined by fluorometric analysis, and for thorium are presented at the same scale on Plates 2 and 3, and

Figure A-1b and A-2b, respectively. Stream sediment data used to generate the tables and figures in Appendix A include all sediment samples collected within the Marysvale area. The number of samples collected from each of the geologic units in the survey area is presented in Table 3.

Observed data for hot-acid-soluble uranium determined by fluorometric analysis (U-FL) [U on Table A-3], total uranium determined by neutron activation (U-NT), thorium, U-FL/U-NT, TH/U-NT, molybdenum, beryllium, yttrium, cerium, niobium, and manganese are given in Table A-3. The figures in Appendix A present log frequency, lognormal probability, percentile, and areal distribution plots for these variables and potassium, zinc, and zirconium. All data for the sediment samples are included on microfiche in Appendix C.

Uranium

The areal distribution of U-FL values (Plate 2 and Figure A-1b) indicates that concentrations of soluble uranium ≧84th percentile (16.93 ppm) occur in stream sediments in canyons in the southwestern portion of the area sampled, in scattered areas just north of that, and in scattered sites in the eastern portion of the area sampled. In the southwestern section of the area sampled, significant values of soluble uranium occur in the general area of lat. 38°21' to 38°25' N. and long. 112°23' to 112°32' W. This area includes sediment samples collected within: the South Fork of North Creek and its tributary Pine Creek; the North Fork of North Creek (where the highest U-FL values occur) and its tributary Pole Creek; and the headwaters of Indian Creek. Significant soluble uranium concentrations also occur in stream sediment samples to the north of this area along Shingle Creek, Line Canyon, and Picnic Creek (lat. 38°29' to 38°31' N. and long. 112°27' to 112°30' W.). Sediment samples along Deer Creek (lat. 38°27' to 38°29' N. and long. 112°17' to 112°23' W.) exhibit anomalously high U-FL values. In the eastern portion of the area sampled, high U-FL values are scattered between lat. 38°28' to 38°33' N. and long. 112°00' to 112°05' W.

The percentile plot in Figure A-1a indicates the highest average U-FL concentrations are located in sediment derived from the rhyolite lava flows of the Mount Belknap Volcanics (MMBR). The occurrence of anomalously high soluble uranium values in the sediments in the western section of the area coincides with the location of the Mount Belknap Caldera. The intraCaldera facies consists of interlayered ash-flow tuffs, rhyolite lava flows, and volcanic breccias which exhibit hydrothermal alteration in many areas. Several small stocks cut the intra-Caldera facies, the largest stock being located in the headwaters of the North Fork of North Creek (Cunningham and Steven, 1979d).

Other stream sediment samples which have high uranium values in the western portion of the area sampled are derived from the Bullion Canyon Volcanics (MBCV), other members of the Mount Belknap Volcanics (MMB,

Table 3

DISTRIBUTION OF SAMPLES BY GEOLOGIC UNIT FROM THE MARYSVALE DETAILED GEOCHEMICAL SURVEY, UTAH

Geologic Unit Code*	No. of Sediment Samples	No. of Radiometrics
QD	169	-
MMBR	28	11
MMBT	29	23
MMBI	-	1
MMB	8	4
MTL	15	11
TI	10	11
MBCV	126	88
UJAN	6	11
UNKN	6	-
Total	397	160

*See Figure 3 for description of geologic unit.

MMBT, and MMBR), and Quaternary deposits (QD). Stream sediment samples collected in the eastern portion of the area that have high uranium values are derived from the Bullion Canyon Volcanics (MBCV), Miocene tuffs and lavas (MTL), Tertiary intrusives (TI), and Quaternary deposits (QD).

The areal distribution plot for total uranium [analyzed by neutron activation (U-NT)] (Figure A-2b) delineates those sediment samples containing uranium values ≧84th percentile (18.75 ppm). Areas of high U-NT values are generally the same areas as those delineated by the upper contour level of U-FL, however, the area contoured by ≧84th percentile U-NT is more extensive. The percentile plot in Figure A-2a indicates the highest average U-NT concentrations are located in sediments derived from the rhyolite lava flows of the Mount Belknap Volcanics (MMBR).

The U-FL/U-NT value indicates the percentage of total uranium in sediments which is present in a hot-acid-soluble form. A sample with a high U-FL/ U-NT value and a high U-NT value indicates anomalous accumulations of soluble (mobile) uranium. Low U-FL/U-NT values in samples with a high U-NT value indicate that the uranium is probably associated with resistate minerals.

The areal distribution plot of U-FL/U-NT (Figure A-3b) delineates sediment samples containing ≧80% soluble uranium. This plot illustrates that the majority of anomalously high uranium values occurring within the area sampled are soluble (mobile) uranium occurrences. Those sediment samples with both high U-NT values and low U-FL/U-NT generally occur within the center of the Mount Belknap Caldera along the Indian Creek drainage (lat. 38°25' to 38°26' N. and long. 112°27' to 112°33' W.). Sediment samples draining the edge of the Caldera generally have both high U-NT and U-FL/U-NT values.

The correlation matrix, Table A-2, indicates a significant positive correlation (>0.30), for both Pearson and Spearman correlations, between the natural logs of both U-FL, U-NT, and yttrium, thorium, cerium, potassium, niobium, molybdenum, and zirconium. A significant positive Pearson correlation (>0.30) for both U-FL, U-NT, and manganese and zinc is also indicated. A significant positive correlation (>0.30) for both Pearson and Spearman correlations is found between U-FL and U-FL/ U-NT. A significant negative correlation (<-0.30), for both Pearson and Spearman correlations, is indicated between both U-FL, U-NT, and magnesium, scandium, iron, vanadium, strontium, phosphorus, calcium, and thorium/U-NT. Titanium and barium display a negative Pearson correlation (<-0.30) with both U-FL and U-NT. A signficant negative Pearson and Spearman correlation (<-0.30) is found between U-NT and chromium. Copper displays a significant negative Pearson correlation (<-0.30) with U-FL and a significant negative Pearson and Spearman correlation (<-0.30) with U-NT.

Thorium

The areal distribution plot of thorium in stream sediments (Plate 2 and Figure A-4b) delineates those areas in which the stream sediment samples contain concentrations ≧34 ppm thorium (84th percentile). In the western portion of the area sampled, high thorium values generally occur along the drainage divide within the Mount Belknap Caldera. In the eastern portion of the area sampled, thorium is present in scattered samples draining into Dry Canyon, Monroe Creek, and the North Fork of Box Creek (lat. 38°29' to 38°33' N. and long. 112°00' to 112°05' W.).

The percentile plot in Figure A-4a indicates the highest average thorium concentrations are located in sediment derived from the rhyolite lava flows of the Mount Belknap Volcanics (MMBR).

The correlation matrix (Figure A-2) indicates a significant positive Pearson or Spearman correlation (>0.30) between the natural logs of thorium and U-FL, U-NT, yttrium, cerium, potassium, zirconium, and niobium. Molybdenum and thorium have a significant Spearman correlation. There is a significant negative Pearson and Spearman correlation (<-0.30) between thorium and magnesium, scandium, iron, vanadium, strontium, barium, phosphorous, copper, and calcium. Cobalt, chromium, titanium, and aluminum have a significant negative Spearman correlation with thorium.

Figure A-5, an areal distribution plot of thorium/U-NT, can be used to delineate those areas which have been depleted or enriched in uranium. The thorium/uranium value generally remains about 3.5 throughout differentiation of igneous rocks, however, hydrothermal veins tend to have lower thorium/uranium values. Relatively higher concentrations of uranium occur in hydrothermal veins, because thorium is less efficiently separated into late stage fluids (Levinson, 1980). Assuming a normal thorium/uranium value ranges between 3 and 7, a low value (≦1.17, the 16th percentile) for thorium/uranium value indicates uranium enrichment with respect to thorium. Areas of low thorium/uranium values occur predominantly in the western half of the area sampled (only four samples with low thorium/uranium values occur in the eastern half). Of these areas, the largest coincides with the southern portions of the high thorium and the central portion of the high uranium trends in the Mount Belknap Caldera.

Related Variables

In addition to U-FL, U-NT, U-FL/U-NT, thorium, and thorium/U-NT, other variables are found in stream sediment samples which may be useful in identifying areas of potential uranium mineralization. The elements which appear to have a relationship to the uranium mineralization within the area sampled include the following: beryllium, cerium, manganese, molybdenum, niobium, potassium, yttrium, zinc, and zirconium. Elements which have high values (≧84th percentile) occurring in sediment samples from the western section of the area sampled are as follows: beryllium (≧8 ppm), manganese (≧135 ppm), molybdenum (≧91st percentile, 5 ppm), niobium (≧30 ppm), zinc (≧130 ppm), and yttrium (≧32 ppm). Cerium, zirconium, and potassium (≧ 109 ppm, 164 ppm, and 2.46%, respectively) also occur in concentrations ≧84th percentile in sediment samples from the western section of the area sampled, but they are also dispersed throughout other areas.

The Mount Belknap Volcanics are generally the major source of the sediments containing anomalously high amounts of beryllium, cerium, manganese, molybdenum, niobium, yttrium, and zinc (Figures A-6a, A-7a, A-9a, A-10a, A-11a, A-12a, and A-13a, respectively). As previously discussed, high uranium and thorium sediment samples occur within and surrounding the Mount Belknap Caldera. All of these elements which occur with high values within and surrounding the Mount Belknap Cladera are lithophile elements. Mason and Berry (1968) list specific lithophile elements which become enriched in residual liquid of magmatic crystallization, eventually crystallizing as components of minerals in pegmatites and hydrothermal veins. Among these elements which remain in solution are beryllium, niobium, thorium, uranium, and rare earths. In a geochemical discussion, Herrmann (1969) includes yttrium with the lanthanides because their chemical behavior is very similar. Hence, yttrium can be included among those elements which are late stage differentiates.

Accumulations of high beryllium values (Figure A-6b) occur in the western portion of the area sampled, including the Mount Belknap Caldera and surrounding basins to the southwest and northeast. The percentile plot (Figure A-6a) illustrates that the Mount Belknap Volcanics are the main contributor of beryllium to the stream sediment samples.

High values of niobium are concentrated mainly within the area of the Mount Belknap Caldera (Figure A-11b). Significant niobium values are also found to occur along Beaver Creek, and in a few canyons on the west side of the Sevier River north of Beaver Creek (lat. 38°27' to 38°29' N. and long. 112°13' to 112°18' W.). The Mount Belknap Volcanics are the major contributor to sediments which are high in niobium (Figure A-11a).

Accumulations of significant concentrations of cerium (Figure A-7b) occur in clusters within the Mount Belknap Caldera, in the Kimberly area along Mill Creek (lat. 38°29' to 38°30' N. and long. 112°23' to 112°24' W.), north and west of Marysvale (lat. 38°29' to 38°31' N. and long. 112°09' 112°13' W.), along Dry Canyon, the North Fork of Box Creek, Box Creek, the headwaters of Manning Vale Creek, and the headwaters of Monroe Creek (lat. 38°27' to 28°33' N. and long. 113°00' to 112°06' W.). A few single anomalously high values of cerium are scattered throughout the area. The percentile plot for cerium (Figure A-7a) illustrates that the sediment with the highest values of cerium is derived from the rhyolite lava flows of the Mount Belknap Volcanics (MMBR), but that all other units, with the exception of the Paleozoic and sedimentary rocks (UJAN), contribute cerium fairly equally.

The majority of sediment samples containing high values of yttrium occur in the western portion of the area (Figure A-12b). Other sediment samples containing significant yttrium values are in the eastern portion of the area and occur within lat. 38°33' to 38°39' N. and long. 112°00' to 112°05' W. The major units contributing yttrium to sediment samples are the rhyolite lava flows of the Mount Belknap Volcanics (MMBR) (Figure A-12a). Other members of the Mount Belknap Volcanics (MMBT and MMB) also contribute yttrium to sediments and are followed closely by the other units.

The areal distribution plot of molybdenum (Figure A-10b) delineates sediment samples with high molybdenum values in the area of low thorium/U-NT values in the southwestern section of the area sampled, along Bullion Canyon (lat. 38°24' N. and long. 112°20' W.), and in scattered samples in the central and eastern portions of the area. Molybdenum is associated with uranium mineralization and occurs as a by-product within the roots of the vein system in the central mining area (Cunningham and Steven, 1979e).

The areal distribution plot for zinc (Figure A-13b) delineates the southern portion of the Mount Belknap Caldera. Greater than 84th percentile concentrations of zinc (130 ppm) are also located within Bullion Canyon (lat. 38°24' N. and long. 112°20' W.), Tenmile Creek (lat. 38°19' N. and long. 112°17' W.), and scattered throughout the eastern portion of the area. The zinc within the vicinity of the Mount Belknap Caldera in the southwestern portion of the area sampled may be associated with hydrothermal veins. Lead-zinc-copper veins have been mined from Bullion Canyon (Callaghan, 1973). Anomalously high copper values also occur in stream sediment samples taken from Bullion Canyon.

Areas with sediment concentrations of ≧84th percentile manganese (1,352 ppm) (Figure A-9b) are located in the southern portion of the Mount Belknap Caldera, Bullion Canyon (lat. 38°23' to 38°25' N. and long. 112°18' to 112°21' W.) and Tenmile Creek (lat. 38°19' N. and long. 112°17' W.) in the western half of the area, and along Dry Canyon (lat. 38°25' N. and long. 112°02' W.), Box Creek (lat. 38°27' to 38°29' N. and long. 112°00' to 112°02' W.), the headwaters of Monroe Creek (lat. 38°34' N. and long. 112°01' W.), and in the northeasternmost portion of the area. Manganese residues are constituents of the weathered parts of the hydrothermal epigenetic mineral deposits in the Marysvale region (Callaghan, 1973). Observations by field geologists in the southwestern portion of the area sampled include dendritic psilomelane on rock of the Mount Belknap Volcanics. A deposit was also observed which was associated with uranium mineralization within the area of the Mount Belknap Caldera.

Zirconium occurs in concentrations ≧84th percentile (164 ppm) in a few localities in the western portion of the area sampled and also in a rather extensive area in the eastern portion (Figure A-14b). The percentile plot (Figure A-14a) illustrates that the Miocene tuffs and lavas (MTL) are anomalous.

The areal distribution plot of potassium (Figure A-8b) delineates those areas in which the stream sediment contains ≧84th percentile potassium (2.46%). Potassium is widespread because it is a constituent of alunite, the widespread alteration product in the Marysvale volcanic field.

Summary of Stream Sediment Data

The observations of data for stream sediments collected in the Marysvale project area indicate that an area of significant soluble uranium accumulation in the western portion of the project area occurs within and surrounding the Mount Belknap Caldera. Thorium, beryllium, cerium, manganese, molybdenum, niobium, potassium, zinc, yttrium, and some zirconium occur in concentrations ≧84th percentile in many sediment samples taken from within and surrounding the Mount Belknap Caldera. This Caldera consists of interlayered ash-flow tuffs, rhyolite lava flows, and volcanic breccias, which have been cut in many areas by small stocks and exhibit hydrothermal alteration. Coinciding with the geology, many of the elements associated with the uranium within and surrounding the Caldera are typically late stage magmatic differentiates.

In the east-central portion of the survey area, anomalously high uranium values are scattered between lat. 38°28' to 38°33' N. and long. 112°00' to 112°05' W. Cerium, thorium, and zirconium also occur in significant concentrations in stream sediment samples collected in this area. The main units contributing sediment to this area are the Bullion Canyon Volcanics (MBCV and MTL).

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APPENDIX A

STREAM SEDIMENT

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APPENDIX A

STREAM SEDIMENT

LIST OF TABLES

LIST OF FIGURES

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Table A-1

STATISTICAL SUMMARY FOR STREAM SEDIMENT OF THE MARYSVALE DETAILED GEOCHEMICAL SURVEY, UTAH

ELEMENT	NO. SAMPLES ANALYZED: MEASURABLE VALUES	NO. SAMPLES ANALYZED: BELOW DETECTION LIMIT	DETECTION LIMIT	MINIMUM VALUE	MAXIMUM VALUE	MEAN	MEDIAN	MODE	STANDARD DEVIATION	COEFFICIENT OF VARIATION	LN TRANSFORMATION: MEAN	LN TRANSFORMATION: S. D.	LN TRANSFORMATION: ROBUST MEAN	LN TRANSFORMATION: ROBUST S. D.
U-FL	396	1	<0.25	<0.25	279.20	11.45	7.15	4.29	18.411	1.608	1.99	0.88	1.97	0.88
U-NT	397			1.60	235.20	13.26	8.99	5.58	17.640	1.330	2.21	0.80	2.18	0.84
TH	389	8	<2	<2	75	22	21	25	12.2	0.9	2.93	0.65	2.93	0.73
U/TU	397			0.07	1.66	0.85	0.88	0.90	0.272	0.319	-0.23	0.42	-0.19	0.37
TH/U	397			0.19	7.23	2.26	2.19	2.34	1.127	0.500	0.66	0.61	0.70	0.60
AG	15	382	<2	<2	34	5	<2	<2	8.3	1.5	1.25	0.83		
AL	397			3.55	9.25	6.49	6.53	6.81	0.799	0.123	1.86	0.13	1.87	0.13
AS	396			0.4	48.0	6.4	4.5	2.0	5.92	0.92	1.55	0.79	1.55	0.77
B	209	188	<10	<10	121	23	<10	<10	17.9	0.8	2.96	0.55		
BA	397			45	1579	708	750	792	282.0	0.4	6.43	0.59	6.49	0.60
BE	397			1	53	4	3	1	5.0	1.0	1.32	0.70	1.30	0.83
CA	397			0.15	19.29	1.74	1.44	0.64	1.501	0.863	0.28	0.77	0.30	0.82
CE	397			28	1509	96	86	78	86.1	0.9	4.47	0.37	4.45	0.31
CO	342	55	<4	<4	24254	152	11	10	1836.7	12.0	2.45	0.73	2.32	0.55
CR	397			3	252	47	44	48	29.9	0.6	3.67	0.68	3.69	0.67
CU	397			2	345	30	29	32	22.6	0.7	3.23	0.68	3.26	0.70
FE	397			0.57	11.07	3.91	3.82	3.69	1.726	0.442	1.25	0.51	1.27	0.52
K	397			0.98	3.37	2.05	2.10	2.26	0.450	0.220	0.69	0.24	0.70	0.25
LI	397			14	90	32	32	28	9.2	0.3	3.44	0.28	3.44	0.29
MG	397			0.09	2.37	0.96	0.92	0.85	0.466	0.485	-0.20	0.63	-0.15	0.66
MN	397			239	86102	1607	902	865	5084.8	3.2	6.92	0.63	6.85	0.54
MO	77	320	<4	<4	331	16	<4	<4	41.7	2.6	2.07	0.90		
NA	397			0.25	2.47	1.27	1.30	1.28	0.348	0.273	0.20	0.32	0.22	0.32
NB	300	97	<4	<4	106	18	8	<4	17.1	0.9	2.60	0.81	2.12	1.09
NI	395	2	<2	<2	70	18	17	15	10.0	0.5	2.75	0.62	2.77	0.65
P	397			65	3180	1181	1205	1489	563.3	0.5	6.90	0.70	6.96	0.73
SC	397			1	23	8	9	10	3.6	0.4	2.05	0.50	2.07	0.53
SE	383	13	<0.1	<0.1	2.3	0.5	0.4	0.3	0.28	0.61	-0.94	0.59	-0.98	0.69
SR	397			21	943	369	382	495	194.5	0.5	5.70	0.77	5.76	0.79
TI	397			654	11936	4134	4086	3738	1830.5	0.4	8.22	0.50	8.23	0.52
V	397			6	404	109	107	99	64.4	0.6	4.46	0.80	4.51	0.84
Y	397			5	262	27	21	20	25.4	0.9	3.15	0.49	3.11	0.47
ZN	397			43	3792	136	94	94	241.9	1.8	4.67	0.49	4.62	0.39
ZR	397			12	351	114	113	109	50.1	0.4	4.63	0.50	4.65	0.51

NOTE: Refer to Table 1, Page 28 and Table B-1, Page B-4 for concentration units and symbol definitions.

Table A-2

CORRELATION MATRIX FOR STREAM SEDIMENT OF THE MARYSVALE DETAILED GEOCHEMICAL SURVEY, UTAH

	L-U	LUNT	L-Y	L-TH	L-CE	L-K	L-ZR	L-MN	L-ZN	L-MO	L-CO	LUTU	L-MG	L-SC	L-FE
L-U	1.00 (396)														
LUNT	0.89*** 0.88*** (396)	1.00 (397)													
L-Y	0.69*** 0.63*** (396)	0.76*** 0.69*** (397)	1.00 (397)												
L-TH	0.63*** 0.68*** (388)	0.72*** 0.79*** (389)	0.57*** 0.67*** (389)	1.00 (389)											
L-CE	0.58*** 0.53*** (396)	0.63*** 0.59*** (397)	0.61*** 0.52*** (397)	0.61*** 0.68*** (389)	1.00 (397)										
L-K	0.47*** 0.53*** (396)	0.58*** 0.60*** (397)	0.29*** 0.42*** (397)	0.58*** 0.62*** (389)	0.36*** 0.50*** (397)	1.00 (397)									
L-ZR	0.36*** 0.38*** (396)	0.34*** 0.38*** (397)	0.30*** 0.46*** (397)	0.47*** 0.40*** (389)	0.25*** 0.40*** (397)	0.42*** 0.40*** (397)	1.00 (397)								
L-MN	0.38*** 0.06 (396)	0.33*** 0.02 (397)	0.57*** 0.30*** (397)	0.19*** 0.04 (389)	0.53*** 0.17*** (397)	-0.08 -0.14*** (397)	-0.01 0.06 (397)	1.00 (397)							
L-ZN	0.36*** 0.05 (396)	0.35*** 0.00 (397)	0.59*** 0.26*** (397)	0.16*** -0.04 (389)	0.52*** 0.14*** (397)	-0.11** -0.18*** (397)	-0.08 -0.00 (397)	0.83*** 0.68*** (397)	1.00 (397)						
L-MO	0.39*** 0.36*** (76)	0.37*** 0.32*** (77)	0.44*** 0.37*** (77)	0.21* 0.37*** (76)	0.63*** 0.40*** (77)	-0.23** -0.10 (77)	-0.25** -0.18 (77)	0.68*** 0.58*** (77)	0.78*** 0.69*** (77)	1.00 (77)					
L-CO	0.06 -0.28*** (341)	0.05 -0.34*** (342)	0.24*** -0.02 (342)	-0.06 -0.33*** (334)	0.33*** -0.14** (342)	-0.22*** -0.36*** (342)	-0.04 0.05 (342)	0.48*** 0.36*** (342)	0.44*** 0.48*** (342)	0.51*** 0.01 (60)	1.00 (342)				
LUTU	0.43*** 0.45*** (396)	-0.01 0.06 (397)	0.05 0.09* (397)	0.03 -0.01 (389)	0.04 0.05 (397)	-0.08* -0.07 (397)	0.18*** 0.13** (397)	0.13*** 0.13*** (397)	0.11** 0.13** (397)	0.18 0.21* (77)	0.06 0.06 (342)	1.00 (397)			
L-MG	-0.60*** -0.63*** (396)	-0.71*** -0.74*** (397)	-0.65*** -0.49*** (397)	-0.61*** -0.68*** (389)	-0.33*** -0.35*** (397)	-0.49*** -0.60*** (397)	-0.14*** -0.14*** (397)	-0.26*** 0.06 (397)	-0.24*** 0.16*** (397)	-0.32*** -0.31*** (77)	0.12** 0.60*** (342)	0.08 0.03 (397)	1.00 (397)		
L-SC	-0.48*** -0.51*** (396)	-0.60*** -0.63*** (397)	-0.48*** -0.33*** (397)	-0.51*** -0.59*** (389)	-0.14*** -0.21*** (397)	-0.52*** -0.57*** (397)	-0.02 0.03 (397)	-0.10* 0.15*** (397)	-0.07 0.25*** (397)	-0.10 -0.22* (77)	0.42*** 0.76*** (342)	0.13*** 0.11** (397)	0.92*** 0.89*** (397)	1.00 (397)	
L-FE	-0.43*** -0.45*** (396)	-0.54*** -0.56*** (397)	-0.45*** -0.35*** (397)	-0.40*** -0.58*** (389)	-0.10* -0.19*** (397)	-0.49*** -0.52*** (397)	-0.06 -0.02 (397)	-0.02 0.18*** (397)	0.06 0.36*** (397)	-0.01 -0.15 (77)	0.37*** 0.78*** (342)	0.11** 0.09* (397)	0.84*** 0.77*** (397)	0.90*** 0.85*** (397)	1.00 (397)
L-V	-0.49*** -0.45*** (396)	-0.61*** -0.57*** (397)	-0.61*** -0.36*** (397)	-0.51*** -0.58*** (389)	-0.26*** -0.23*** (397)	-0.41*** -0.49*** (397)	0.02 0.06 (397)	-0.26*** 0.09* (397)	-0.22*** 0.27*** (397)	-0.39*** -0.40*** (77)	0.14** 0.73*** (342)	0.11** 0.09* (397)	0.91*** 0.80*** (397)	0.92*** 0.87*** (397)	0.93*** 0.95*** (397)
L-SR	-0.49*** -0.40*** (396)	-0.61*** -0.52*** (397)	-0.63*** -0.35*** (397)	-0.45*** -0.48*** (389)	-0.27*** -0.17*** (397)	-0.38*** -0.42*** (397)	0.12** 0.23*** (397)	-0.35*** 0.00 (397)	-0.36*** 0.00 (397)	-0.47*** -0.52*** (77)	0.00 0.43*** (342)	0.11** 0.12** (397)	0.86*** 0.68*** (397)	0.86*** 0.76*** (397)	0.80*** 0.69*** (397)
L-TI	-0.33*** -0.20*** (396)	-0.44*** -0.30*** (397)	-0.47*** -0.14*** (397)	-0.30*** -0.31*** (389)	-0.14*** 0.02 (397)	-0.23*** -0.24*** (397)	0.30*** 0.40*** (397)	-0.28*** 0.03 (397)	-0.25*** 0.17*** (397)	-0.48*** -0.50*** (77)	0.09 0.54*** (342)	0.14*** 0.15*** (397)	0.70*** 0.59*** (397)	0.82*** 0.74*** (397)	[illegible] 0.79*** (397)
L-BA	-0.40*** -0.25*** (396)	-0.49*** -0.30*** (397)	-0.61*** -0.40*** (397)	-0.39*** -0.32*** (389)	-0.09* 0.14*** (397)	-0.22*** -0.08 (397)	-0.01 0.18*** (397)	-0.28*** -0.10** (397)	-0.25*** -0.05 (397)	-0.25** -0.36*** (77)	0.03 0.22*** (342)	0.06 -0.01 (397)	0.80*** 0.43*** (397)	0.60*** 0.51*** (397)	0.78*** 0.50*** (397)
L-P	-0.40*** -0.33*** (396)	-0.50*** -0.41*** (397)	-0.60*** -0.39*** (397)	-0.45*** -0.48*** (389)	-0.13*** -0.02 (397)	-0.29*** -0.27*** (397)	-0.02 0.10** (397)	-0.21*** 0.03 (397)	-0.19*** 0.13*** (397)	-0.30*** -0.37*** (77)	0.10* 0.45*** (342)	0.06 0.06 (397)	0.84*** 0.66*** (397)	0.82*** 0.66*** (397)	0.84*** 0.74*** (397)
L-CU	-0.34*** -0.28*** (396)	-0.43*** -0.35*** (397)	-0.51*** -0.35*** (397)	-0.38*** -0.38*** (388)	-0.10** -0.00 (397)	-0.21*** -0.17*** (397)	0.00 0.15*** (397)	-0.16*** -0.00 (397)	-0.11** 0.12** (397)	-0.06 -0.22* (77)	0.21*** 0.47*** (342)	0.09* 0.08 (397)	0.78*** 0.56*** (397)	0.80*** 0.64*** (397)	0.76*** 0.62*** (397)
L-NR	0.50*** 0.56*** (300)	0.61*** 0.66*** (300)	0.63*** 0.69*** (300)	0.64*** 0.71*** (299)	0.18*** 0.18*** (300)	0.40*** 0.43*** (300)	0.15** 0.08 (300)	0.26*** 0.13** (300)	0.24*** 0.06 (300)	0.24** 0.35*** (88)	-0.17*** -0.45*** (285)	-0.06 -0.05 (300)	-0.78*** -0.73*** (300)	-0.79*** -0.73*** (300)	-0.76*** -0.70*** (300)
L-CR	-0.30*** -0.25*** (396)	-0.38*** -0.33*** (397)	-0.42*** -0.23*** (397)	-0.28*** -0.32*** (389)	-0.06 0.01 (397)	-0.32*** -0.34*** (397)	0.07 0.16*** (397)	-0.19*** -0.02 (397)	-0.12** 0.16*** (397)	-0.25** -0.27** (77)	0.16*** 0.50*** (342)	0.13** 0.09* (397)	0.78*** 0.67*** (397)	0.81*** 0.73*** (397)	0.78*** 0.69*** (397)
L-NI	-0.20*** -0.21*** (394)	-0.28*** -0.28*** (395)	-0.29*** -0.17*** (395)	-0.24*** -0.27*** (387)	0.10* 0.07 (395)	-0.30*** -0.32*** (395)	0.02 0.11** (396)	-0.01 0.06 (396)	0.06 0.25*** (396)	0.14 -0.02 (77)	0.55*** 0.65*** (347)	0.17*** 0.09* (395)	0.71*** 0.61*** (395)	0.79*** 0.70*** (395)	0.74*** 0.65*** (395)
L-CA	-0.54*** -0.49*** (396)	-0.64*** -0.61*** (397)	-0.53*** -0.34*** (397)	-0.48*** -0.51*** (389)	-0.35*** -0.25*** (397)	-0.47*** -0.49*** (397)	0.08 0.13*** (397)	-0.31*** -0.04 (397)	-0.33*** -0.05 (397)	-0.42*** -0.47*** (77)	0.00 0.35*** (342)	0.08 0.07 (397)	0.82*** 0.75*** (397)	0.75*** 0.70*** (397)	0.64*** 0.58*** (397)
L-LI	0.15*** 0.19*** (396)	0.19*** 0.22*** (397)	0.22*** 0.27*** (397)	0.13** 0.24*** (389)	0.08 0.05 (397)	0.18*** 0.17*** (397)	-0.11** -0.03 (397)	0.04 0.05 (397)	0.02 -0.01 (397)	0.12 0.17 (77)	-0.06 -0.15*** (342)	-0.02 -0.06 (397)	-0.18*** -0.18*** (397)	-0.21*** -0.18*** (397)	-0.32*** -0.32*** (397)
LTUN	-0.36*** -0.39*** (396)	-0.43*** -0.42*** (397)	-0.31*** -0.17*** (397)	0.15*** 0.06 (389)	-0.05 0.04 (397)	-0.03 -0.12** (397)	0.19*** 0.10* (397)	-0.23*** -0.09* (397)	-0.30*** -0.14*** (397)	-0.31*** -0.32*** (77)	-0.10* 0.13** (342)	0.05 -0.07 (397)	0.23*** 0.26*** (397)	0.19*** 0.23*** (397)	0.13*** 0.13*** (397)
L-SE	0.12** 0.13** (382)	0.08 0.09* (383)	0.04 0.02 (383)	-0.07 -0.04 (375)	0.00 -0.01 (383)	-0.04 -0.00 (383)	-0.06 -0.02 (383)	0.08 0.08 (383)	0.13** 0.15*** (383)	-0.00 -0.02 (76)	0.01 -0.03 (328)	0.05 0.19*** (383)	0.00 -0.05 (383)	0.01 -0.03 (383)	0.06 0.06 (383)
L-NA	-0.16*** -0.17*** (396)	-0.18*** -0.18*** (397)	-0.05 0.06 (397)	-0.07 -0.07 (389)	-0.18*** -0.16*** (397)	-0.03 -0.07 (397)	0.16*** 0.05 (397)	-0.15*** 0.04 (397)	-0.25*** -0.07 (397)	-0.32*** -0.09 (77)	-0.12** 0.06 (342)	-0.02 -0.05 (397)	0.08 0.19*** (397)	0.03 0.16*** (397)	-0.03 0.07 (397)
L-AL	-0.21*** -0.25*** (396)	-0.26*** -0.29*** (397)	-0.28*** -0.27*** (397)	-0.25*** -0.32*** (389)	0.15*** 0.11** (397)	0.03 -0.03 (397)	0.06 0.05 (397)	-0.04 0.02 (397)	-0.03 0.08 (397)	-0.03 -0.14 (77)	0.19*** 0.25*** (342)	0.02 0.04 (397)	0.51*** 0.43*** (397)	0.58*** 0.54*** (397)	0.54*** 0.46*** (397)
L-AS	-0.06 -0.05 (395)	-0.08 -0.07 (396)	-0.28*** -0.32*** (396)	-0.08 -0.11** (388)	0.18*** 0.20*** (396)	0.08* 0.04 (396)	-0.19*** -0.11** (396)	-0.00 -0.03 (396)	0.03 0.01 (396)	0.12 -0.08 (77)	0.06 0.06 (341)	-0.02 -0.00 (396)	0.28*** 0.19*** (396)	0.27*** 0.17*** (396)	0.30*** 0.29*** (396)

NOTE: (1) Pearson correlation/Spearman correlation/(sample size). If either element has a concentration below the laboratory detection limits, it is omitted from the pairwise computations.
(2) Significance levels: *-10%, **-5%, ***-1%.

	L-V	L-SR	L-TI	L-BA	L-P	L-CU	L-NB	L-CR	L-NI	L-CA	L-LI	L-TUN	L-SE	L-NA	L-AL	L-AS
L-V	1.00 (397)															
L-SR	0.90*** 0.76*** (397)	1.00 (397)														
L-TI	0.93*** 0.87*** (397)	0.86*** 0.77*** (397)	1.00 (397)													
L-BA	0.84*** 0.52*** (397)	0.00*** 0.63*** (397)	0.78*** 0.56*** (397)	1.00 (397)												
L-P	0.89*** 0.75*** (397)	0.85*** 0.65*** (397)	0.80*** 0.66*** (397)	0.89*** 0.67*** (397)	1.00 (397)											
L-CU	0.88*** 0.63*** (397)	0.73*** 0.54*** (397)	0.69*** 0.57*** (397)	0.83*** 0.63*** (397)	0.87*** 0.75*** (397)	1.00 (397)										
L-NB	-0.76*** -0.70*** (300)	-0.78*** -0.69*** (300)	-0.56*** -0.57*** (300)	-0.83*** -0.76*** (300)	-0.78*** -0.69*** (300)	-0.77*** -0.68*** (300)	1.00 (300)									
L-CR	0.83*** 0.73*** (397)	0.74*** 0.60*** (397)	0.80*** 0.74*** (397)	0.74*** 0.51*** (397)	0.75*** 0.57*** (397)	0.65*** 0.49*** (397)	-0.66*** -0.57*** (300)	1.00 (397)								
L-NI	0.72*** 0.62*** (395)	0.63*** 0.47*** (395)	0.66*** 0.61*** (395)	0.70*** 0.47*** (395)	0.70*** 0.52*** (395)	0.69*** 0.54*** (395)	-0.67*** -0.57*** (298)	0.88*** 0.87*** (395)	1.00 (395)							
L-CA	0.75*** 0.66*** (397)	0.84*** 0.80*** (397)	0.70*** 0.67*** (397)	0.66*** 0.43*** (397)	0.67*** 0.53*** (397)	0.59*** 0.46*** (397)	-0.72*** -0.68*** (300)	0.63*** 0.56*** (397)	0.54*** 0.47*** (395)	1.00 (397)						
L-LI	-0.31*** -0.35*** (397)	-0.32*** -0.30*** (397)	-0.34*** -0.37*** (397)	-0.28*** -0.30*** (397)	-0.31*** -0.33*** (397)	-0.19*** -0.21*** (397)	0.42*** 0.42*** (300)	-0.12** -0.10** (397)	-0.10** -0.07 (395)	-0.30*** -0.34*** (397)	1.00 (397)					
L-TUN	0.21*** 0.17*** (397)	0.28*** 0.26*** (397)	0.25*** 0.13*** (397)	0.18*** 0.13*** (397)	0.13*** 0.09* (397)	0.13** 0.11** (397)	-0.23*** -0.23*** (300)	0.18*** 0.21*** (397)	0.11** 0.19*** (395)	0.34*** 0.37*** (397)	-0.14*** -0.12** (397)	1.00 (397)				
L-SE	0.03 0.03 (383)	-0.01 -0.04 (383)	-0.01 -0.00 (383)	0.01 -0.05 (383)	0.06 0.04 (383)	0.07 0.04 (383)	0.04 0.06 (290)	-0.02 -0.05 (383)	-0.04 -0.09* (381)	-0.06 -0.11** (383)	-0.02 0.01 (383)	-0.23*** -0.26*** (383)	1.00 (383)			
L-NA	0.06 0.13*** (397)	0.1[illegible]*** 0.32*** (397)	0.12** 0.13** (397)	-0.13*** -0.10** (397)	-0.08 -0.02 (397)	-0.21*** -0.22*** (397)	0.22*** 0.20*** (300)	0.05 0.10* (397)	-0.14*** -0.07 (395)	0.16*** 0.24*** (397)	0.13** 0.15*** (397)	0.17*** 0.18*** (397)	-0.14*** -0.17*** (383)	1.00 (397)		
L-AL	0.63*** 0.45*** (397)	0.55*** 0.50*** (397)	0.40*** 0.38*** (397)	0.63*** 0.63*** (397)	0.56*** 0.51*** (397)	0.56*** 0.49*** (397)	-0.48*** -0.49*** (300)	0.37*** 0.29*** (397)	0.40*** 0.28*** (395)	0.23*** 0.22*** (397)	-0.06 -0.09* (397)	0.05 0.03 (397)	0.04 0.06 (383)	0.08 0.12** (397)	1.00 (397)	
L-AS	0.31*** 0.22*** (396)	0.23*** 0.09* (396)	0.21*** 0.13*** (396)	0.48*** 0.49*** (396)	0.48*** 0.49*** (396)	0.50*** 0.48*** (396)	-0.44*** -0.44*** (299)	0.25*** 0.20*** (396)	0.30*** 0.28*** (394)	0.02 -0.03 (396)	-0.02 -0.06 (396)	-0.04 -0.03 (396)	0.17*** 0.12** (383)	-0.36*** -0.36*** (396)	0.38*** 0.36*** (396)	1.00 (396)

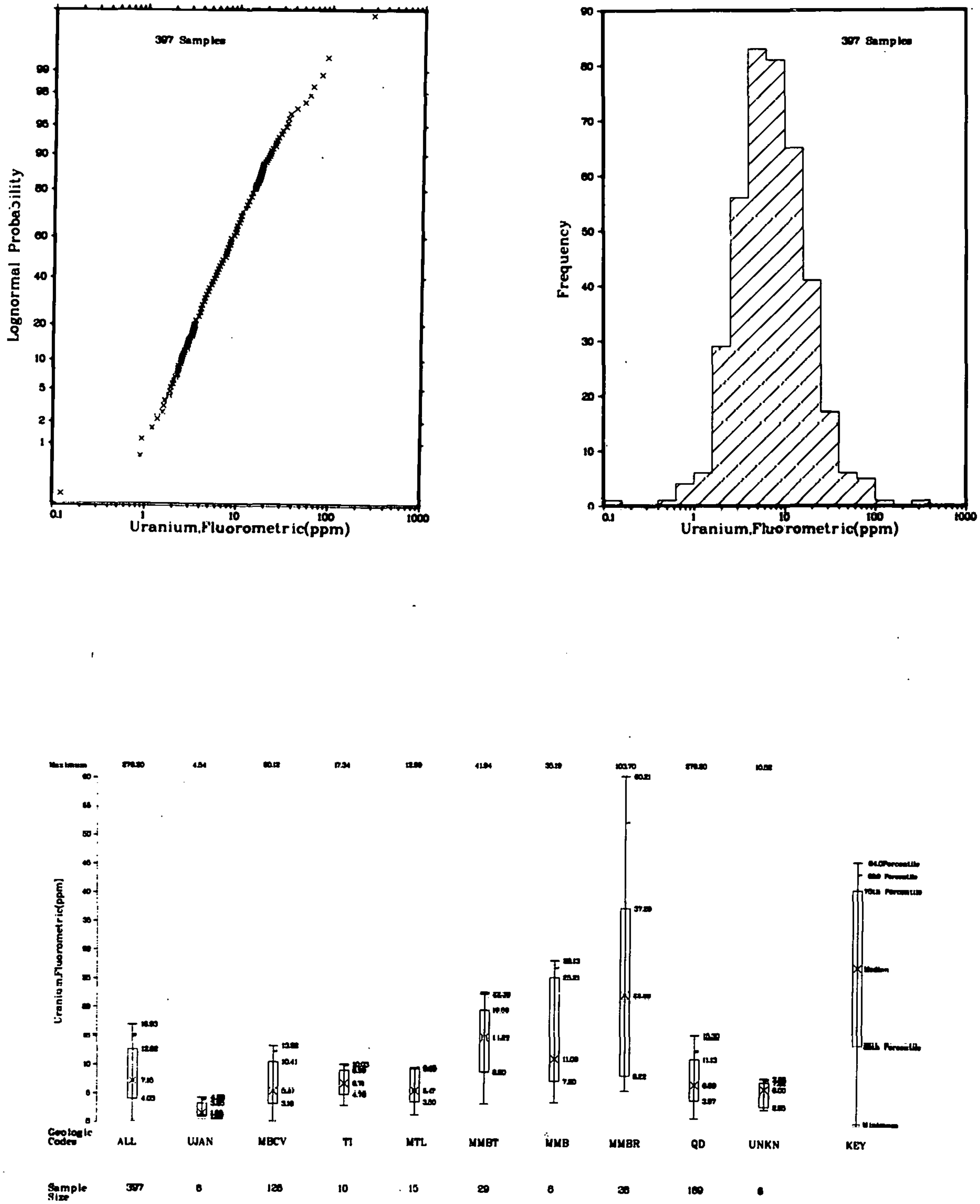


Figure A-1a

PROBABILITY, FREQUENCY, AND PERCENTILE PLOTS FOR SOLUBLE URANIUM (PPM) IN STREAM SEDIMENT OF THE MARYSVALE DETAILED GEOCHEMICAL SURVEY, UTAH

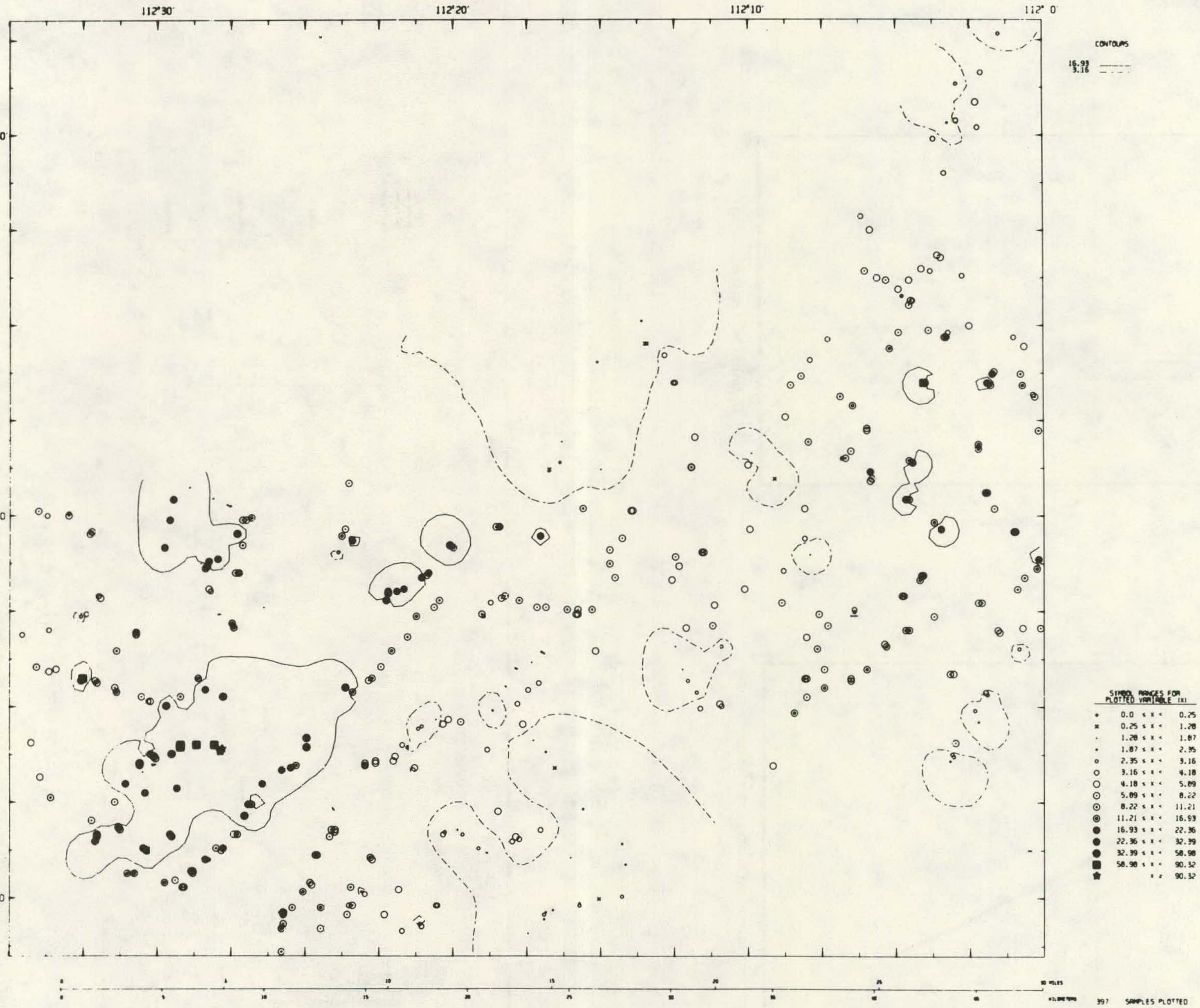


Figure A-1b

GEOCHEMICAL DISTRIBUTION OF SOLUBLE URANIUM (PPM) IN STREAM SEDIMENT
OF THE MARYSVALE DETAILED GEOCHEMICAL SURVEY, UTAH

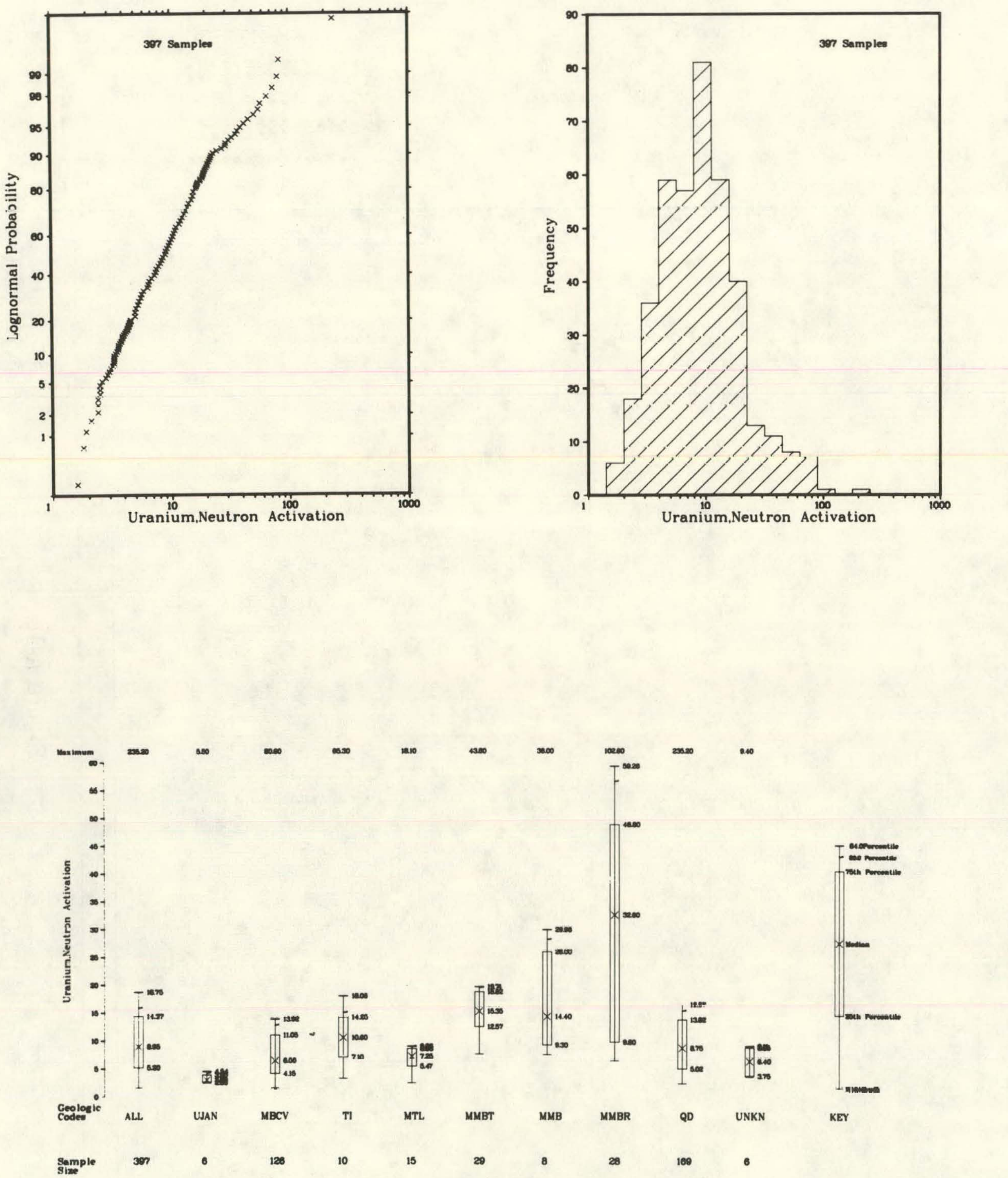


Figure A-2a

PROBABILITY, FREQUENCY, AND PERCENTILE PLOTS FOR URANIUM BY NEUTRON ACTIVATION IN STREAM SEDIMENT OF THE MARYSVALE DETAILED GEOCHEMICAL SURVEY, UTAH

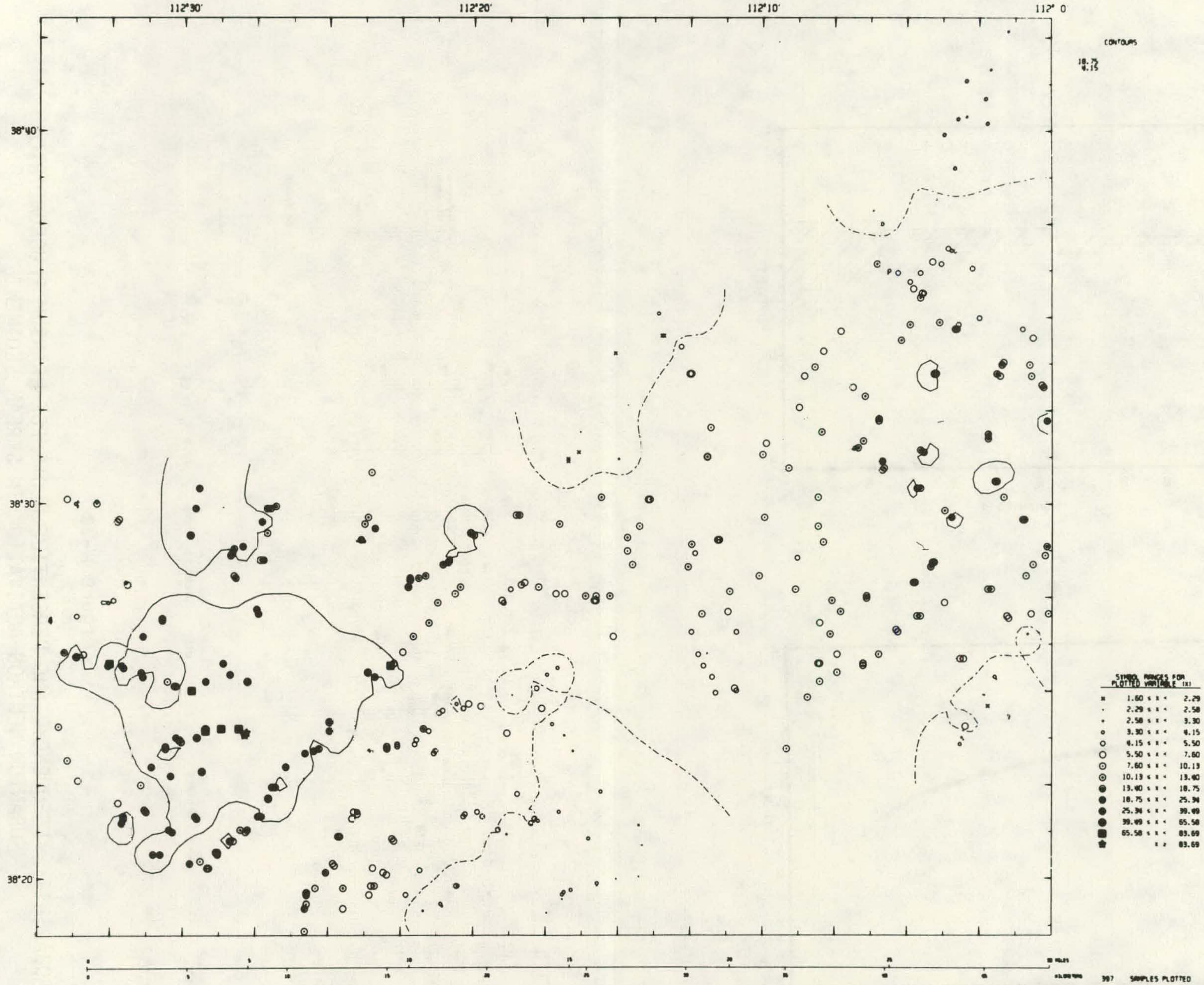


Figure A-2b

GEOCHEMICAL DISTRIBUTION OF URANIUM BY NEUTRON ACTIVATION IN STREAM SEDIMENT OF THE MARYSVALE DETAILED GEOCHEMICAL SURVEY, UTAH

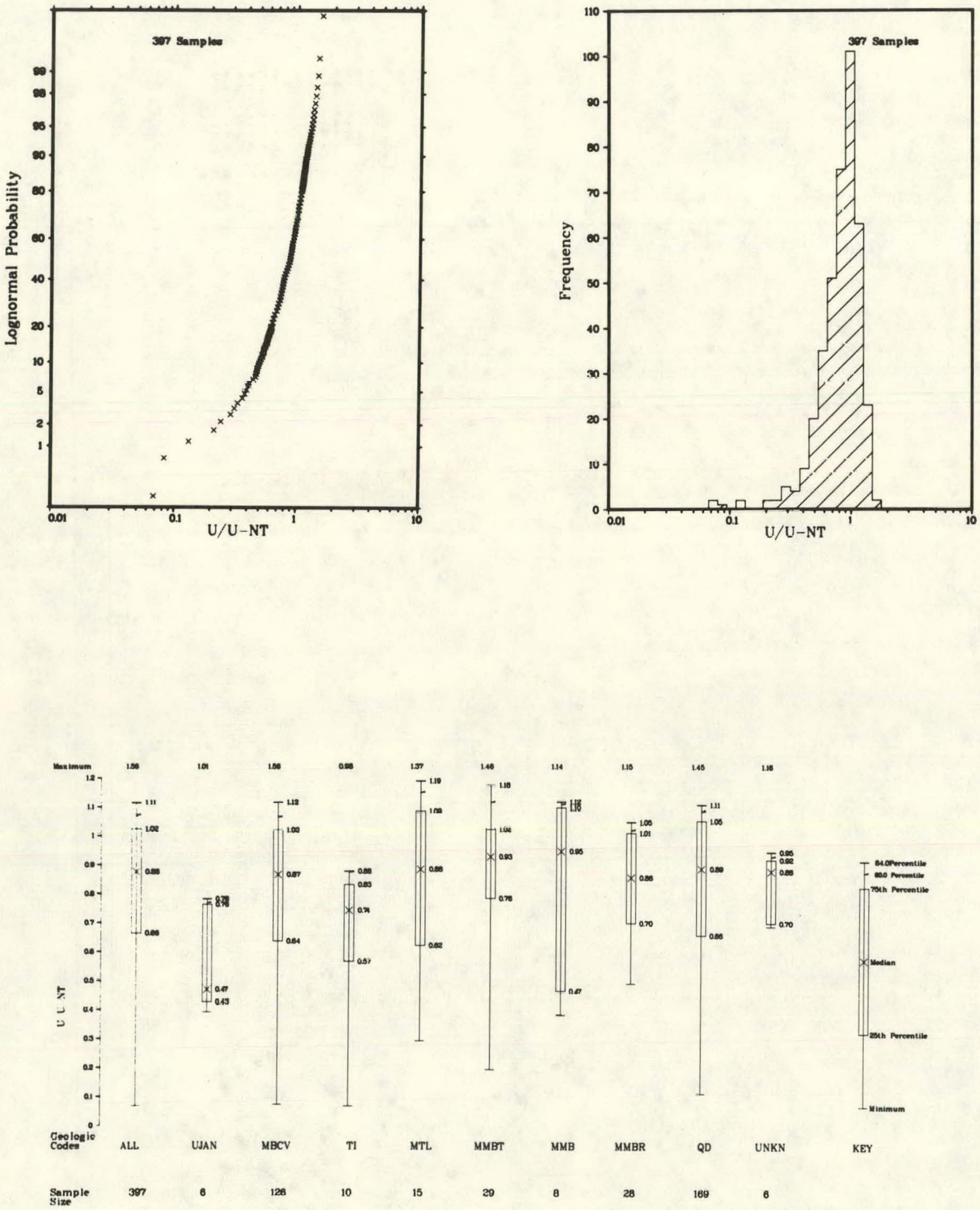


Figure A-3a

PROBABILITY, FREQUENCY, AND PERCENTILE PLOTS FOR URANIUM FLUOROMETRIC/
URANIUM NEUTRON ACTIVATION IN STREAM SEDIMENT
OF THE MARYSVALE DETAILED GEOCHEMICAL SURVEY, UTAH

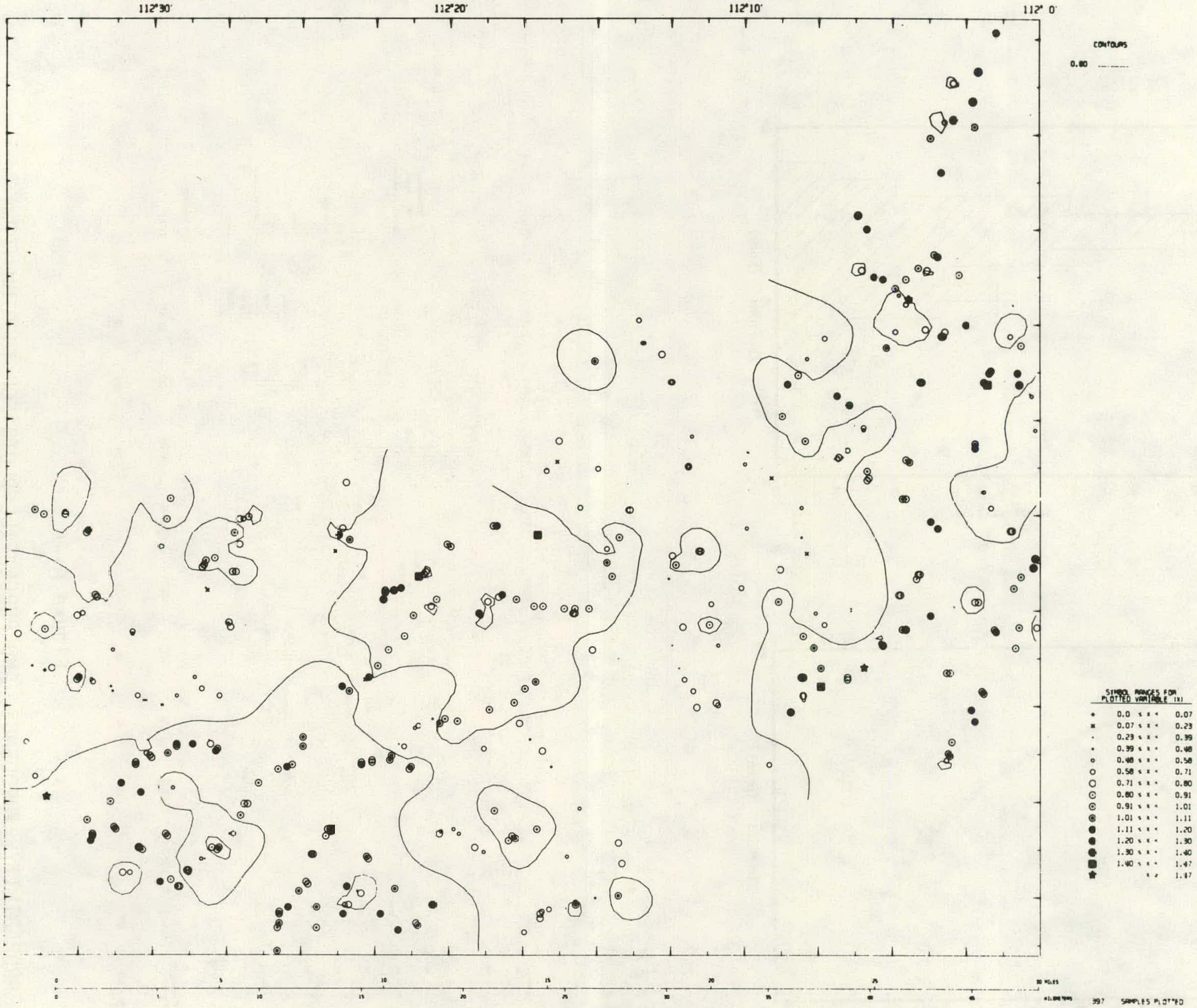
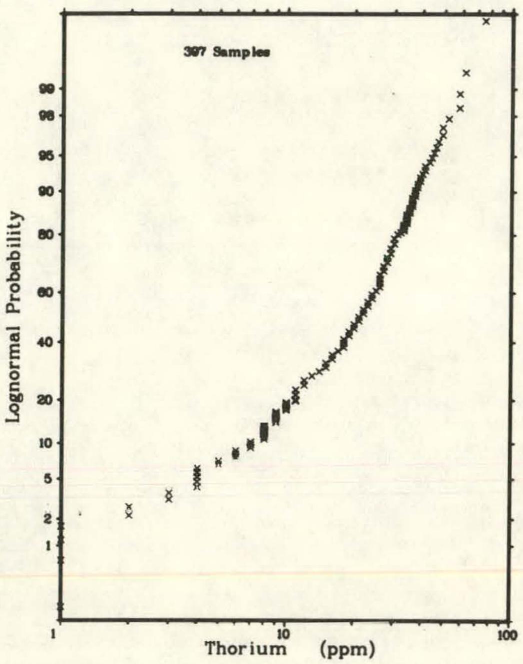
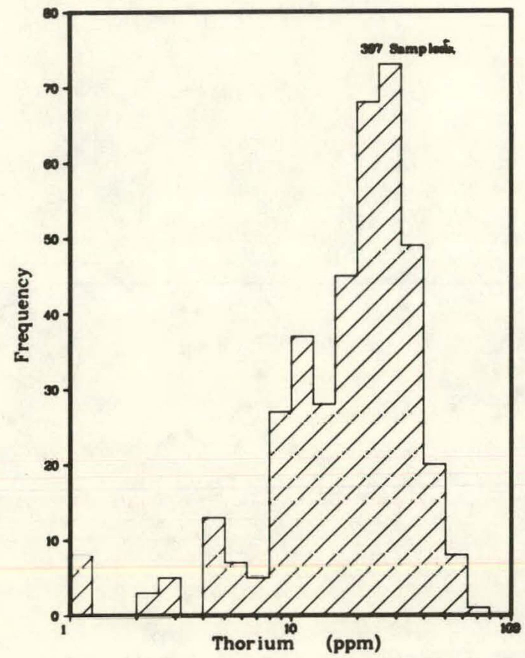


Figure A-3b

GEOCHEMICAL DISTRIBUTION OF URANIUM FLUOROMETRIC/URANIUM NEUTRON ACTIVATION IN STREAM SEDIMENT OF THE MARYSVALE DETAILED GEOCHEMICAL SURVEY, UTAH





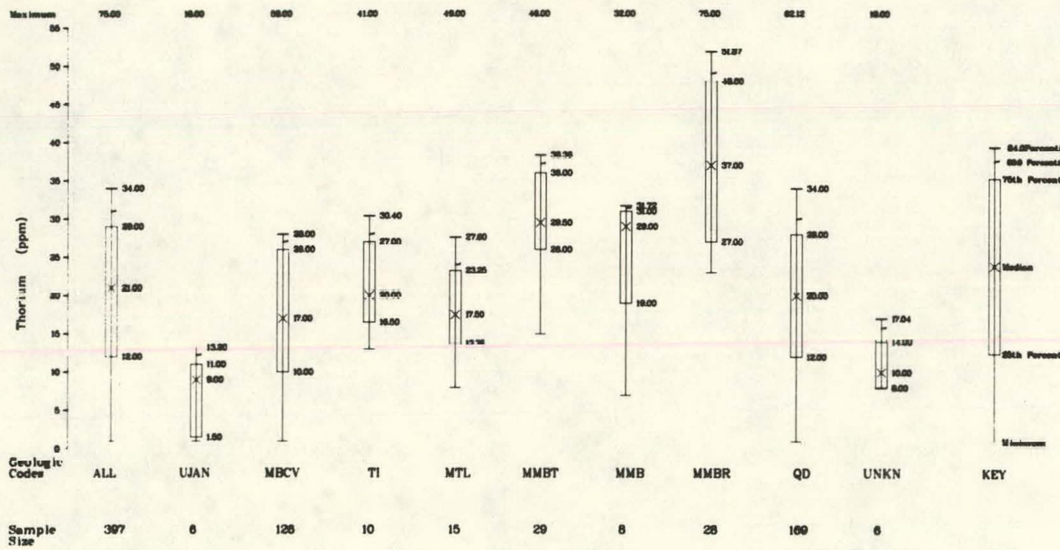


Figure A-4a

PROBABILITY, FREQUENCY, AND PERCENTILE PLOTS FOR THORIUM (PPM) IN STREAM SEDIMENT OF THE MARYSVALE DETAILED GEOCHEMICAL SURVEY, UTAH

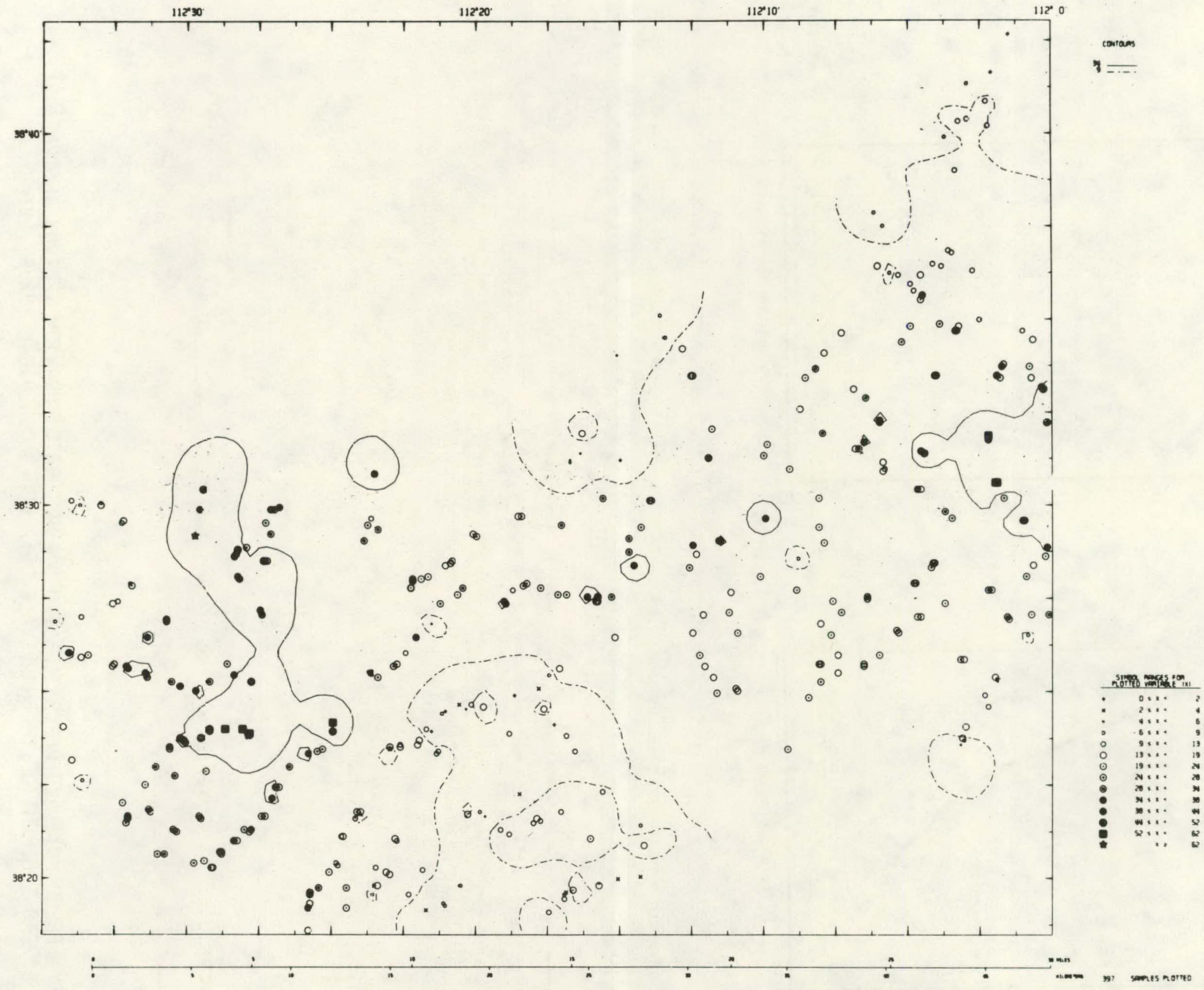


Figure A-4b

GEOCHEMICAL DISTRIBUTION OF THORIUM (PPM) IN STREAM SEDIMENT
OF THE MARYSVALE DETAILED GEOCHEMICAL SURVEY, UTAH

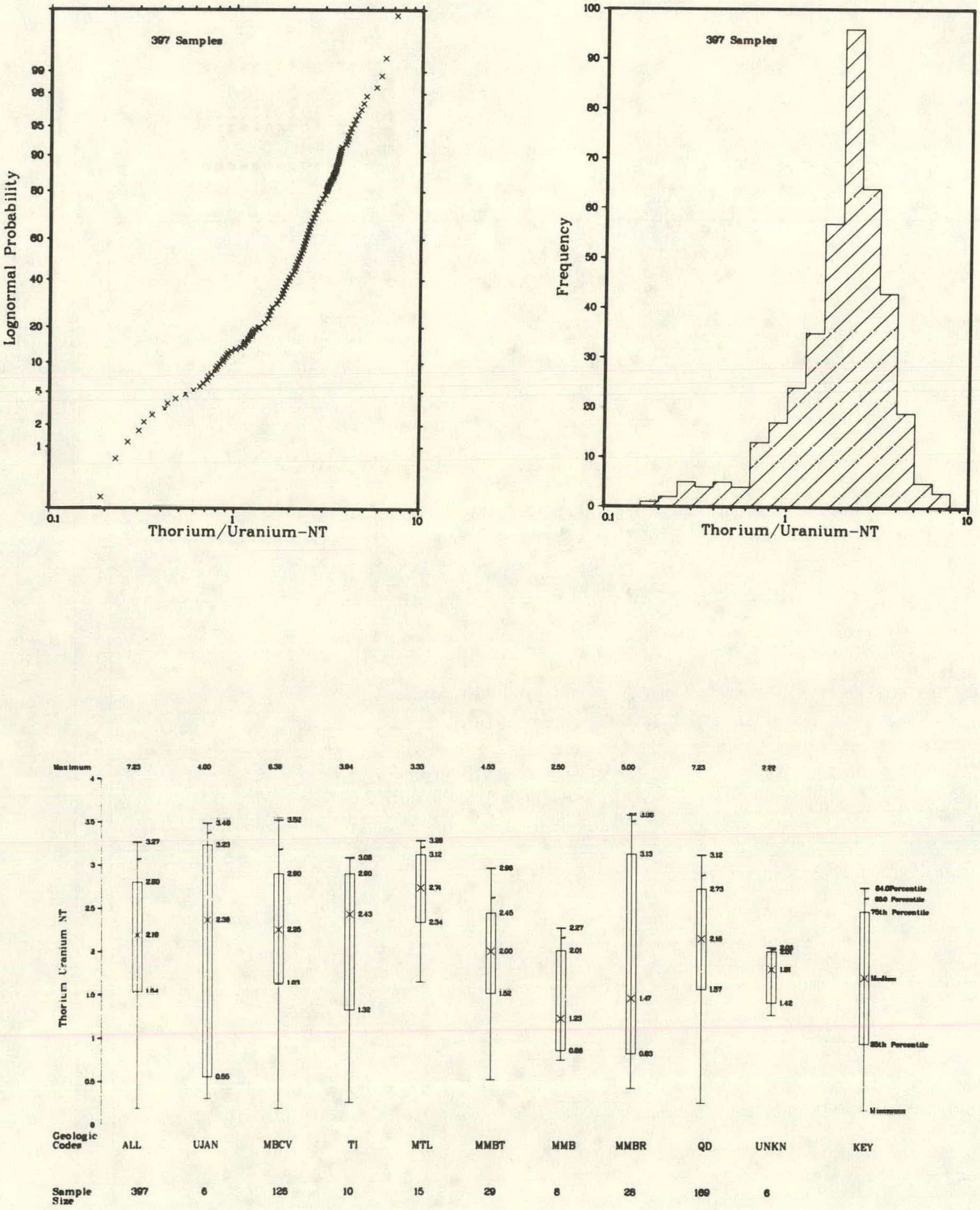


Figure A-5a

PROBABILITY, FREQUENCY, AND PERCENTILE PLOTS FOR THORIUM/URANIUM NEUTRON ACTIVATION IN STREAM SEDIMENT OF THE MARYSVALE DETAILED GEOCHEMICAL SURVEY, UTAH

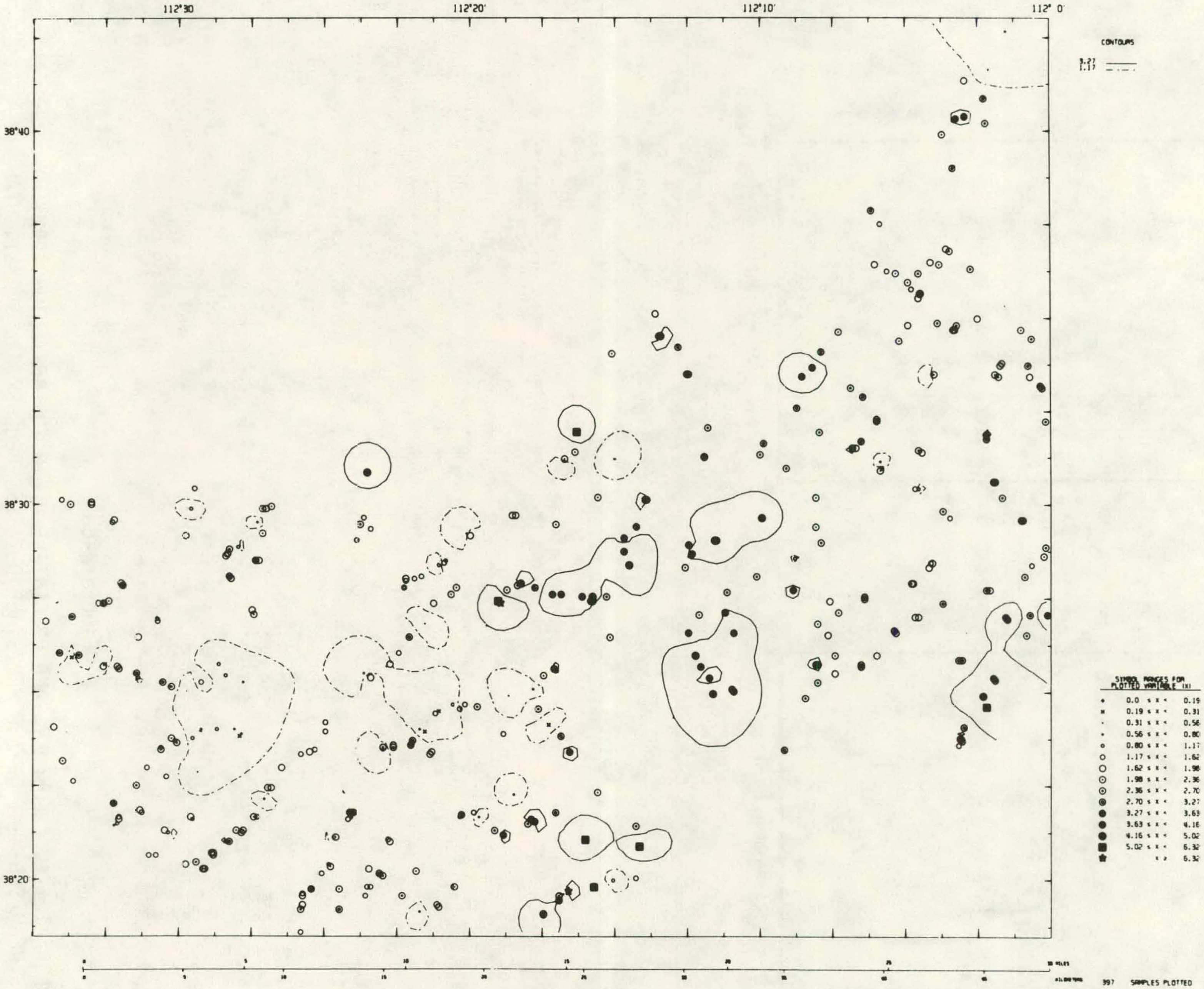
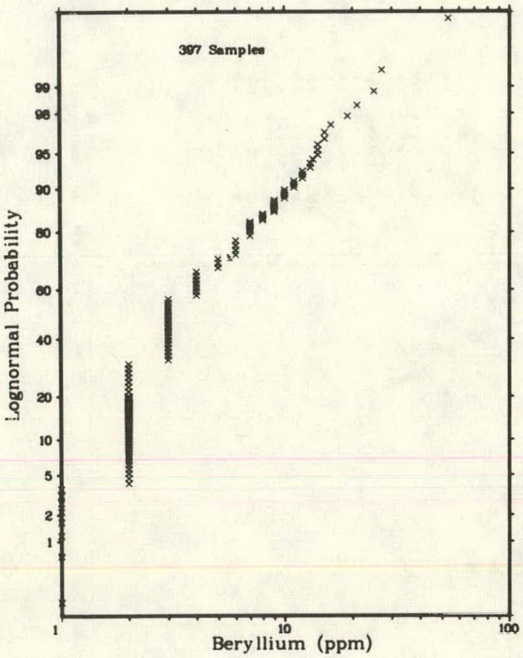
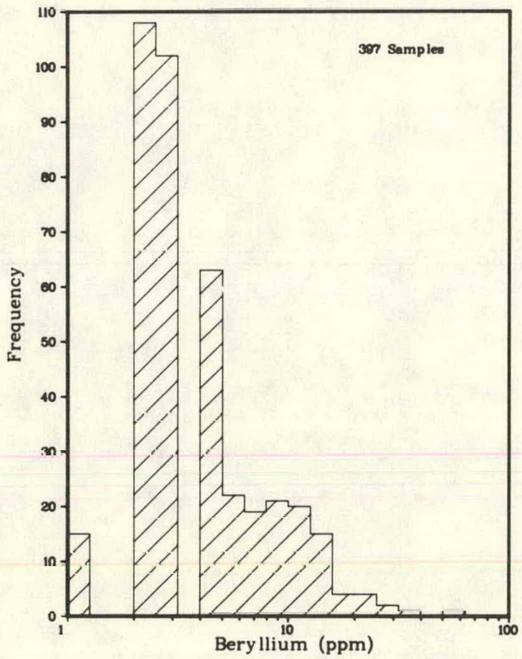


Figure A-5b

GEOCHEMICAL DISTRIBUTION OF THORIUM/URANIUM NEUTRON ACTIVATION IN STREAM SEDIMENT
OF THE MARYSVALE DETAILED GEOCHEMICAL SURVEY, UTAH





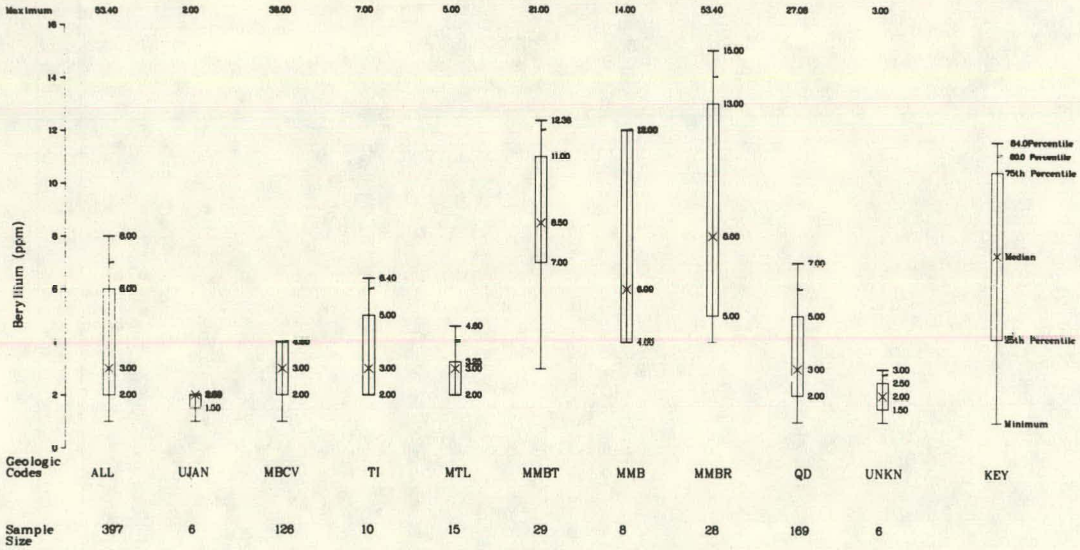


Figure A-6a

PROBABILITY, FREQUENCY, AND PERCENTILE PLOTS FOR BERYLLIUM (PPM)
IN STREAM SEDIMENT OF THE MARYSVALE DETAILED GEOCHEMICAL SURVEY, UTAH

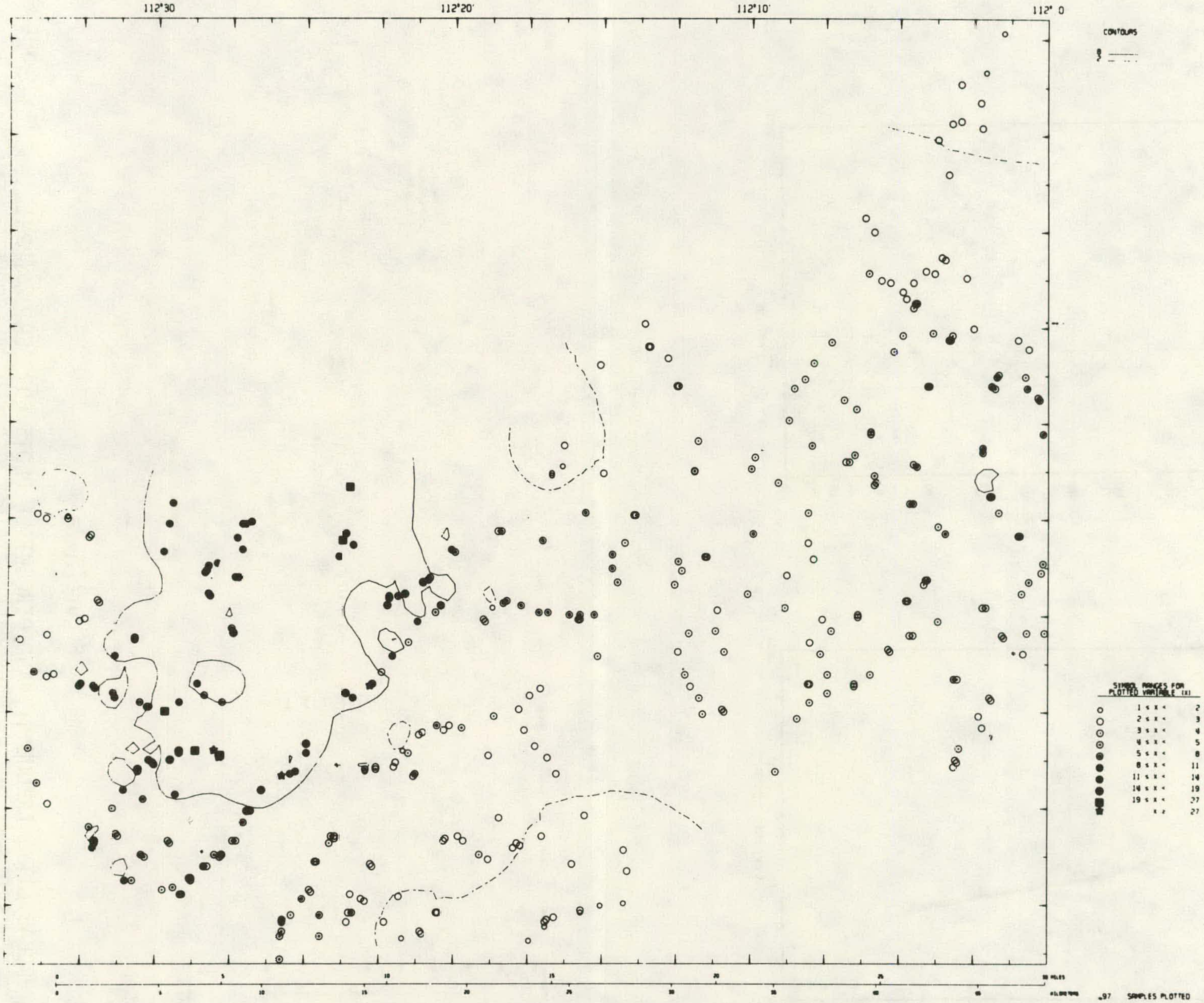
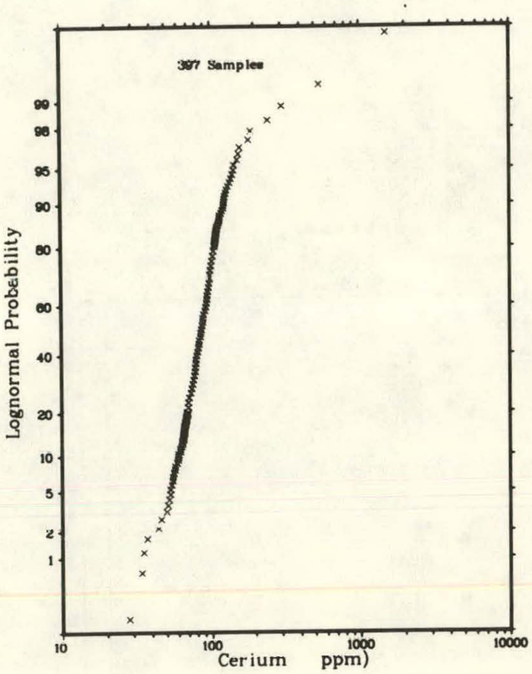
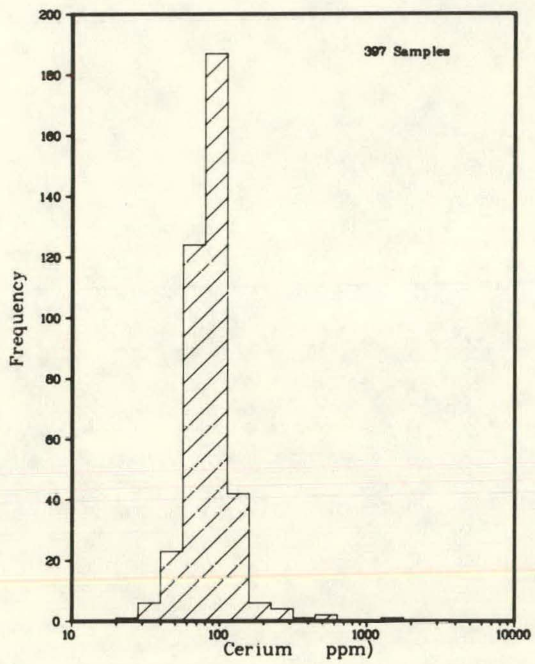


Figure A-6b

GEOCHEMICAL DISTRIBUTION OF BERYLLIUM (PPM) IN STREAM SEDIMENT
OF THE MARYSVALE DETAILED GEOCHEMICAL SURVEY, UTAH





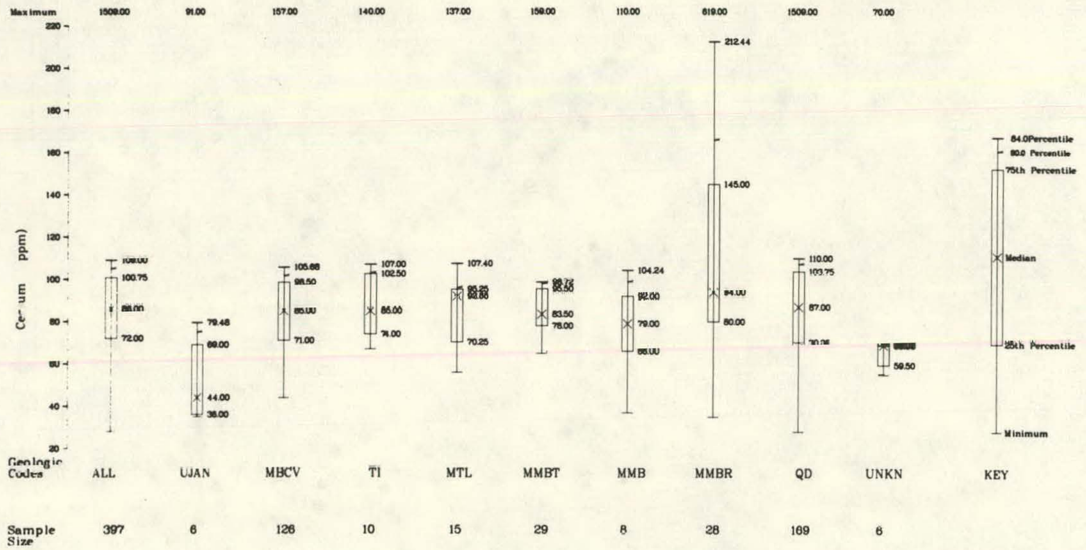


Figure A-7a

PROBABILITY, FREQUENCY, AND PERCENTILE PLOTS FOR CERIUM (PPM)
IN STREAM SEDIMENT OF THE MARYSVALE DETAILED GEOCHEMICAL SURVEY, UTAH

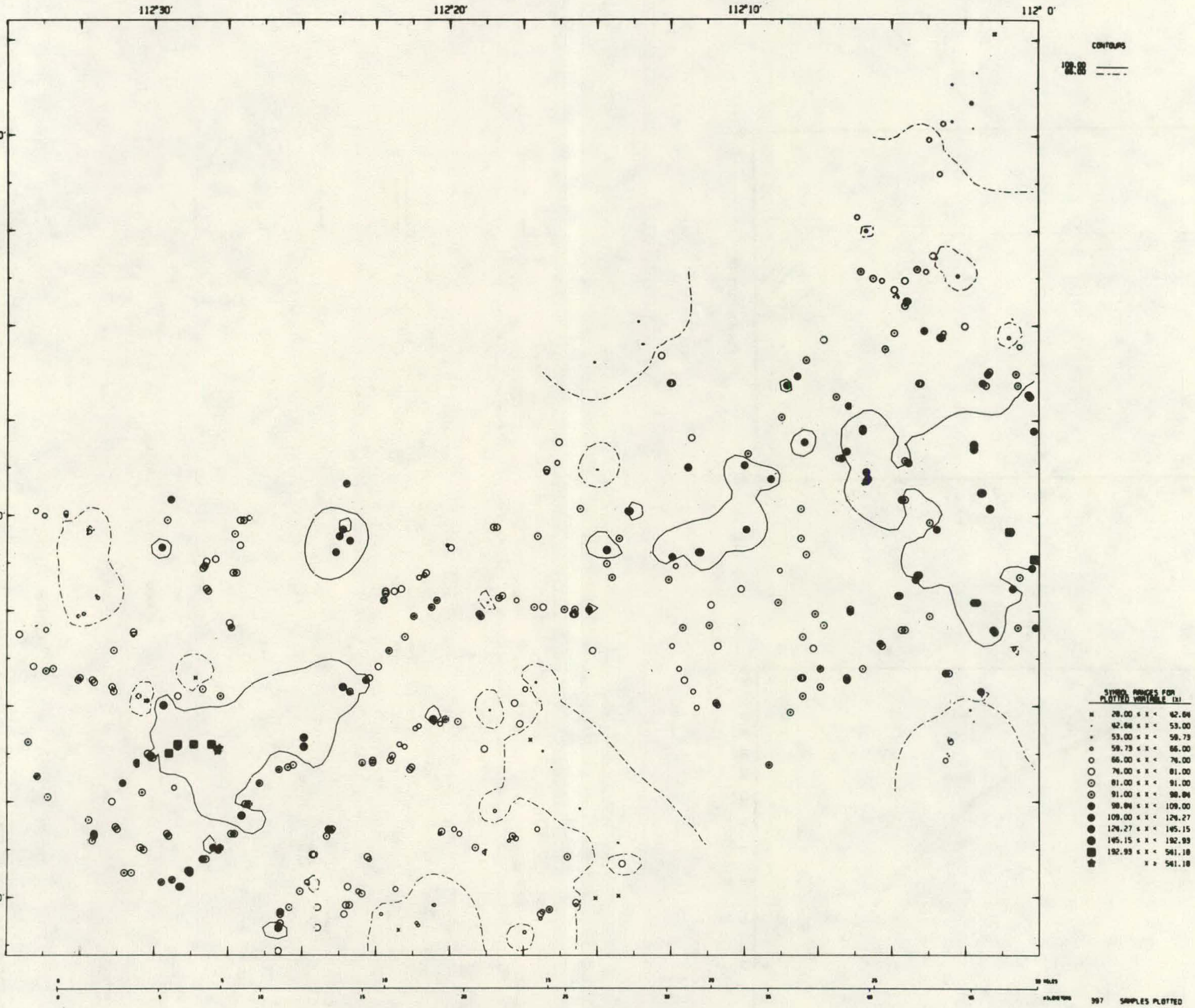


Figure A-7b

GEOCHEMICAL DISTRIBUTION OF CERIUM (PPM) IN STREAM SEDIMENT
OF THE MARYSVALE DETAILED GEOCHEMICAL SURVEY, UTAH

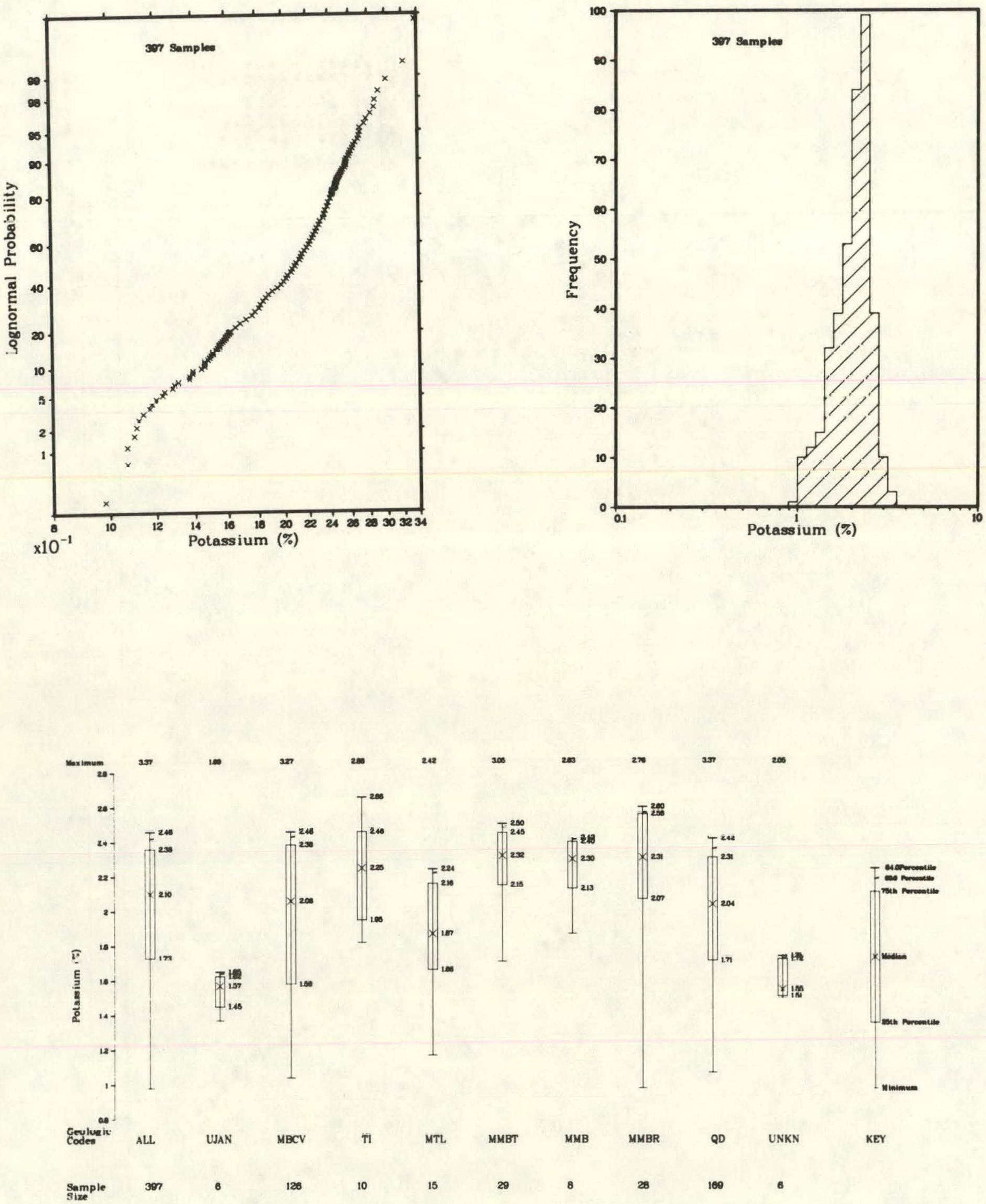


Figure A-8a

PROBABILITY, FREQUENCY, AND PERCENTILE PLOTS FOR POTASSIUM (%)
IN STREAM SEDIMENT OF THE MARYSVALE DETAILED GEOCHEMICAL SURVEY, UTAH

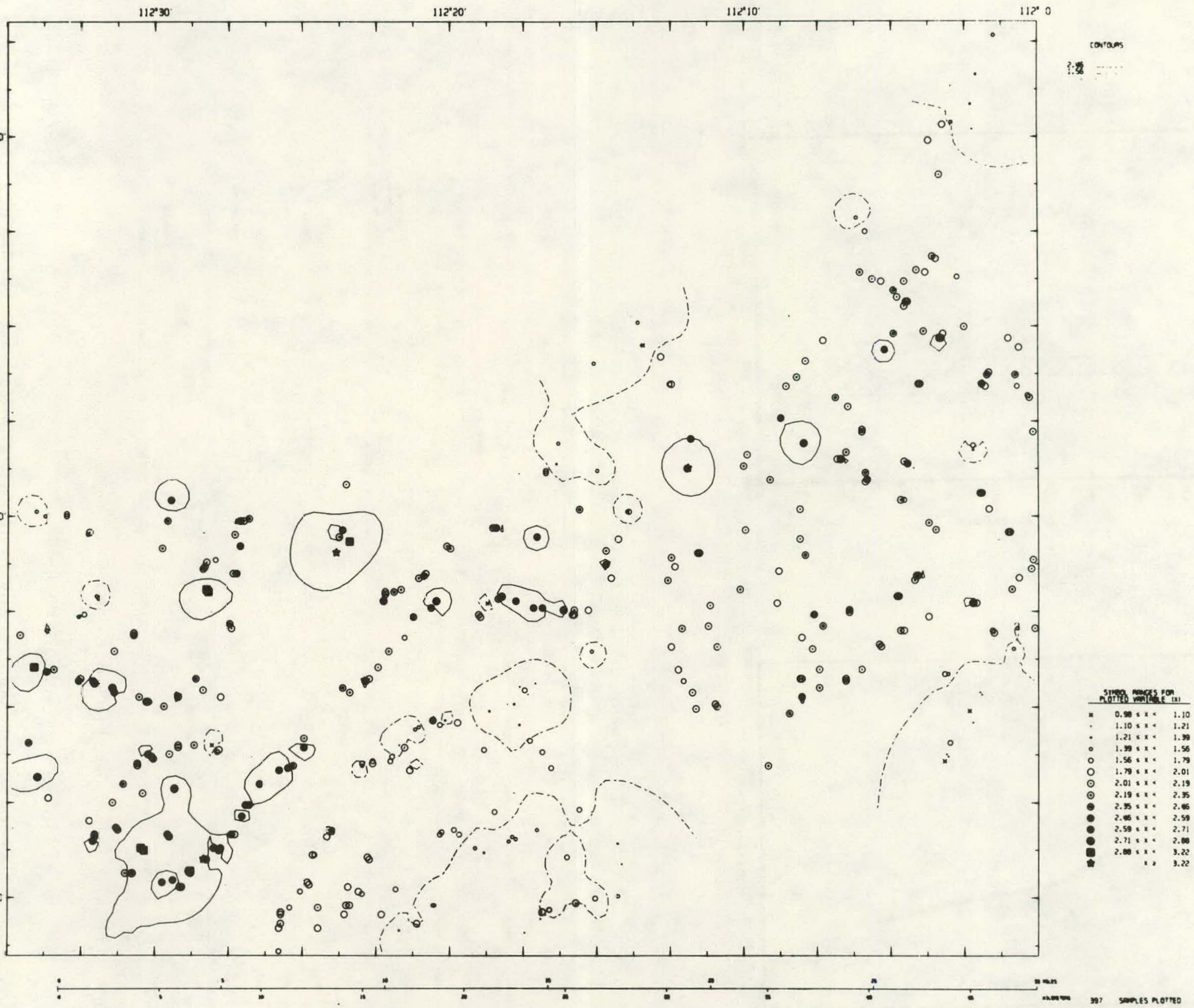


Figure A-8b

GEOCHEMICAL DISTRIBUTION OF POTASSIUM (%) IN STREAM SEDIMENT OF THE MARYSVALE DETAILED GEOCHEMICAL SURVEY, UTAH

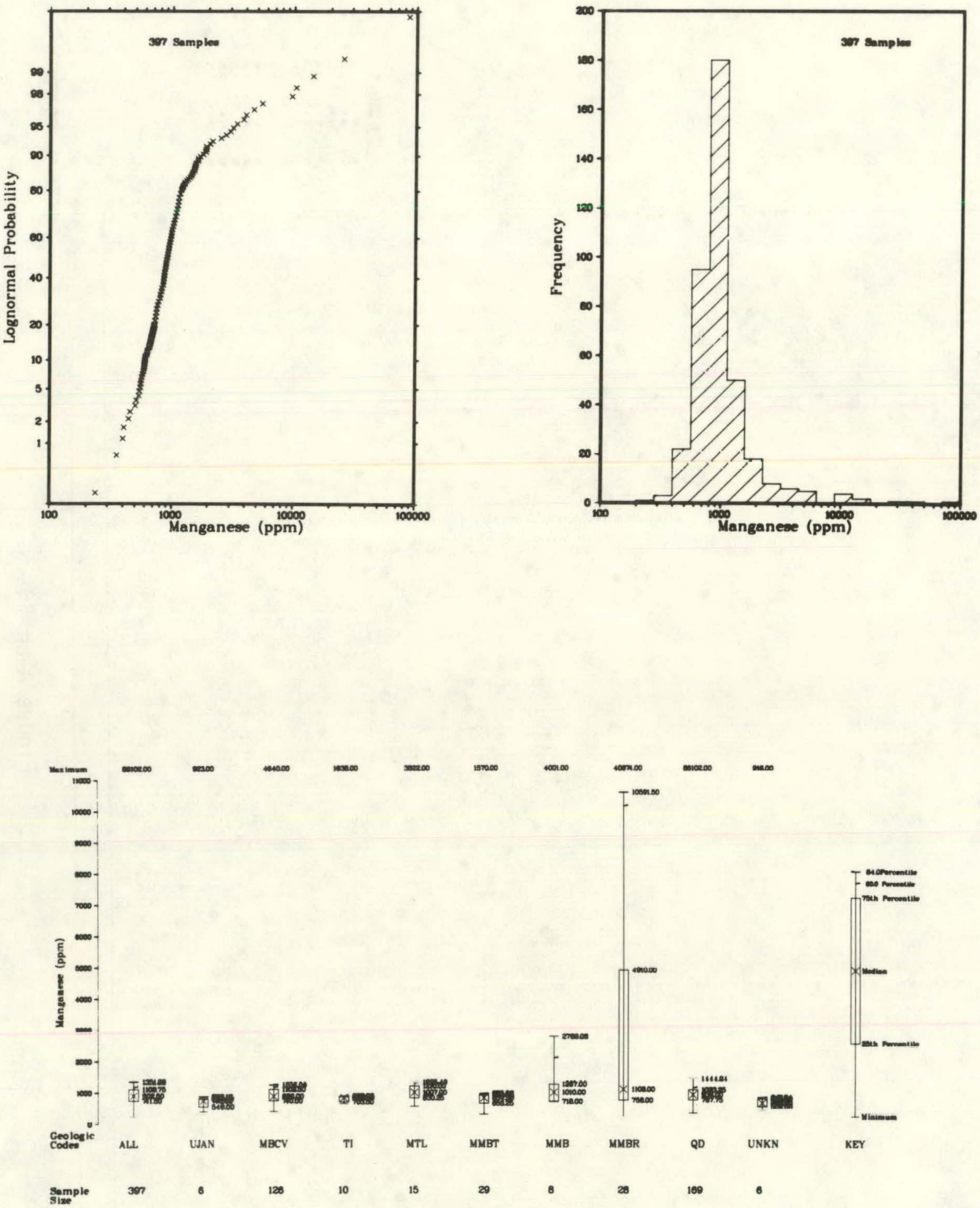


Figure A-9a

PROBABILITY, FREQUENCY, AND PERCENTILE PLOTS FOR MANGANESE (PPM) IN STREAM SEDIMENT OF THE MARYSVALE DETAILED GEOCHEMICAL SURVEY, UTAH

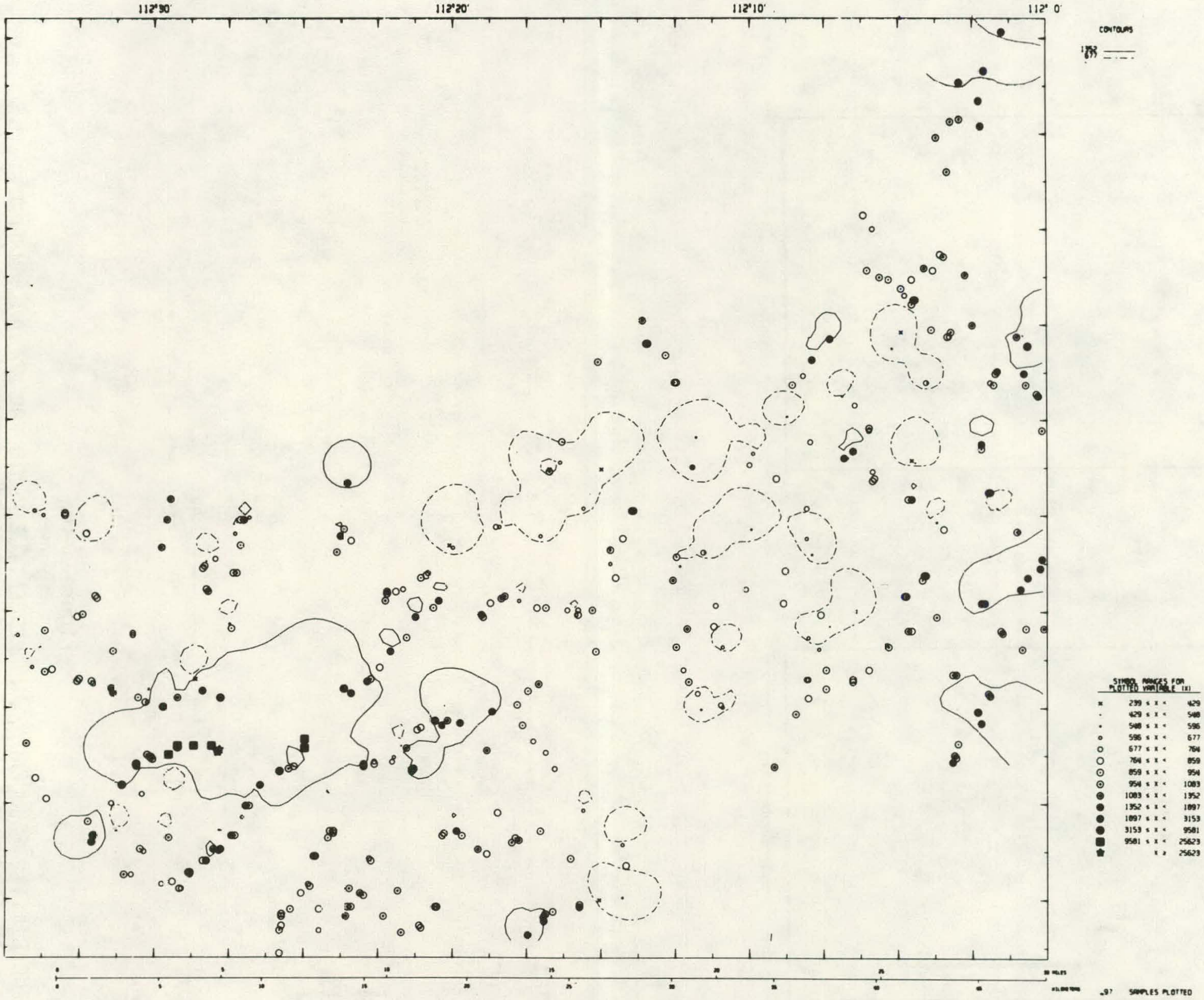
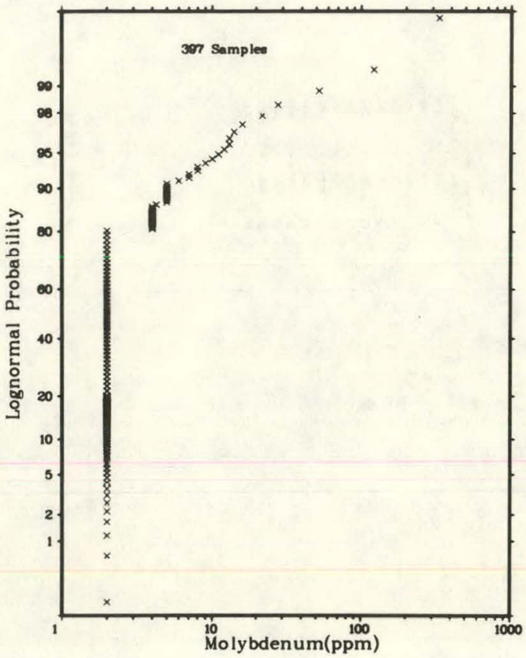
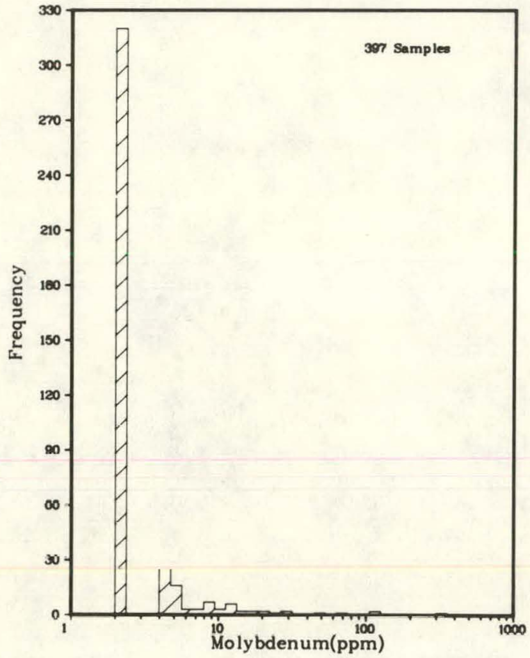


Figure A-9b

GEOCHEMICAL DISTRIBUTION OF MANGANESE (PPM) IN STREAM SEDIMENT
OF THE MARYSVALE DETAILED GEOCHEMICAL SURVEY, UTAH





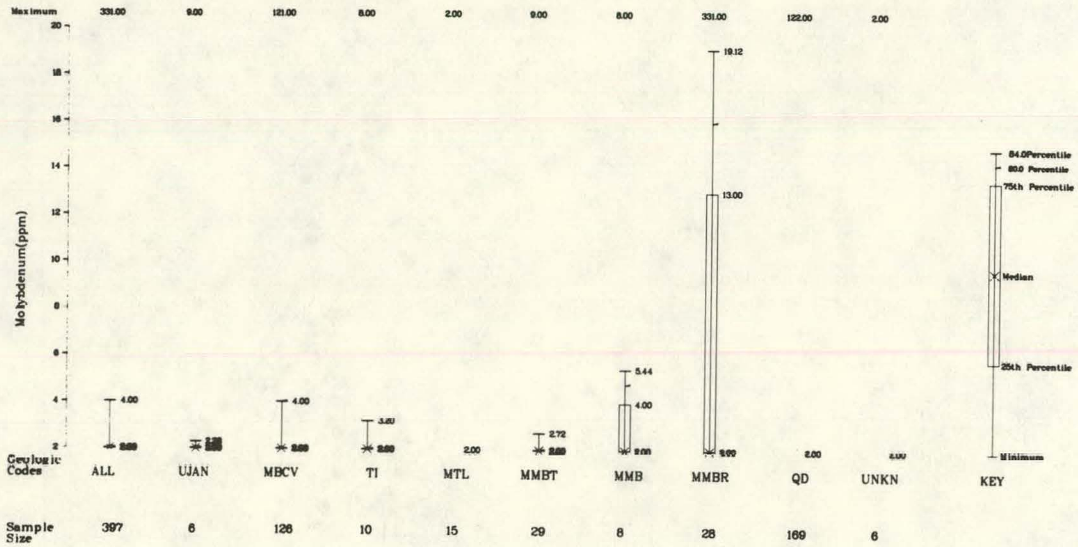


Figure A-10a

PROBABILITY, FREQUENCY, AND PERCENTILE PLOTS FOR MOLYBDENUM (PPM) IN STREAM SEDIMENT OF THE MARYSVALE DETAILED GEOCHEMICAL SURVEY, UTAH

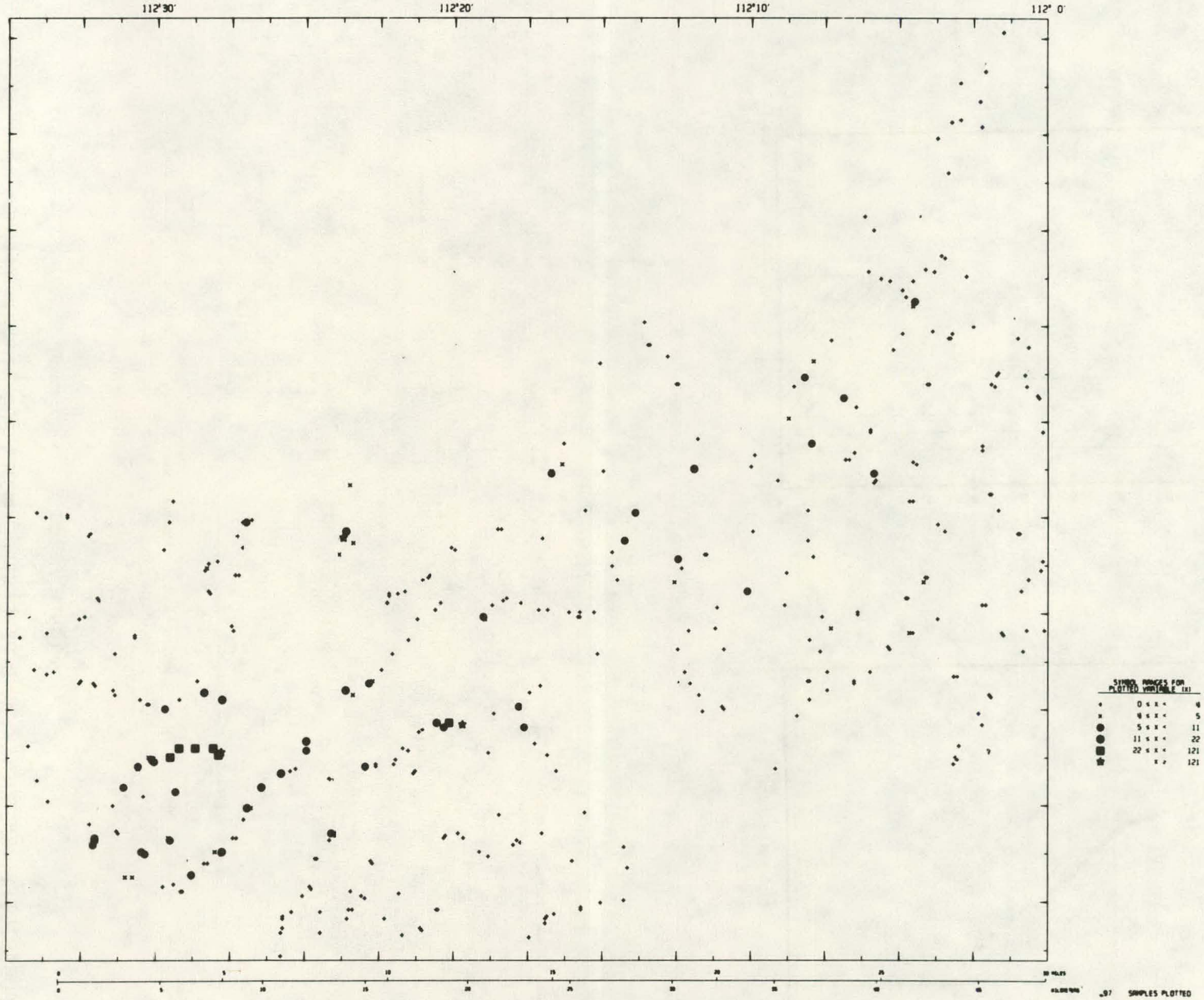


Figure A-10b

GEOCHEMICAL DISTRIBUTION OF MOLYBDENUM (PPM) IN STREAM SEDIMENT
OF THE MARYSVALE DETAILED GEOCHEMICAL SURVEY, UTAH

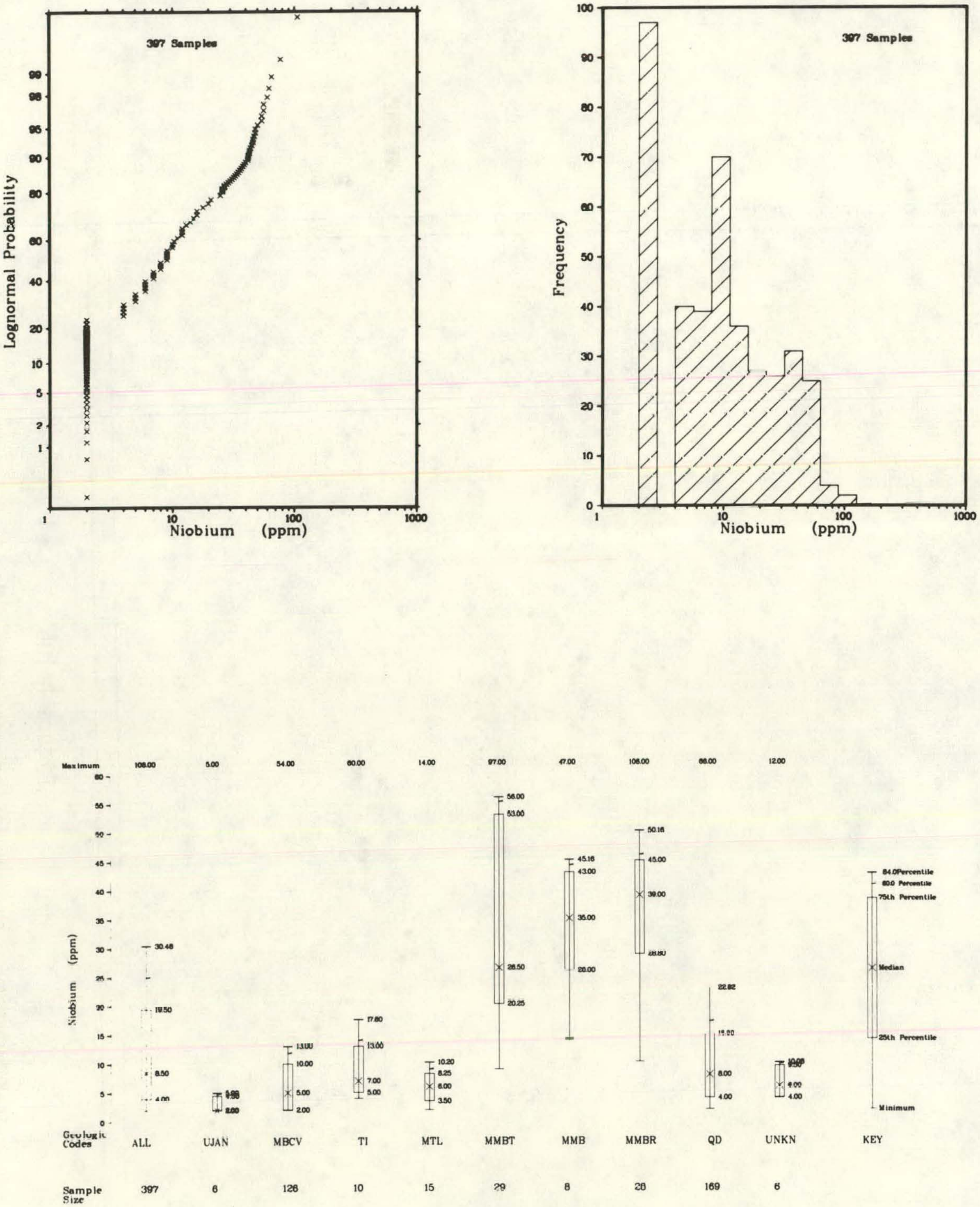


Figure A-11a

PROBABILITY, FREQUENCY, AND PERCENTILE PLOTS FOR NIOBIUM (PPM) IN STREAM SEDIMENT OF THE MARYSVALE DETAILED GEOCHEMICAL SURVEY, UTAH

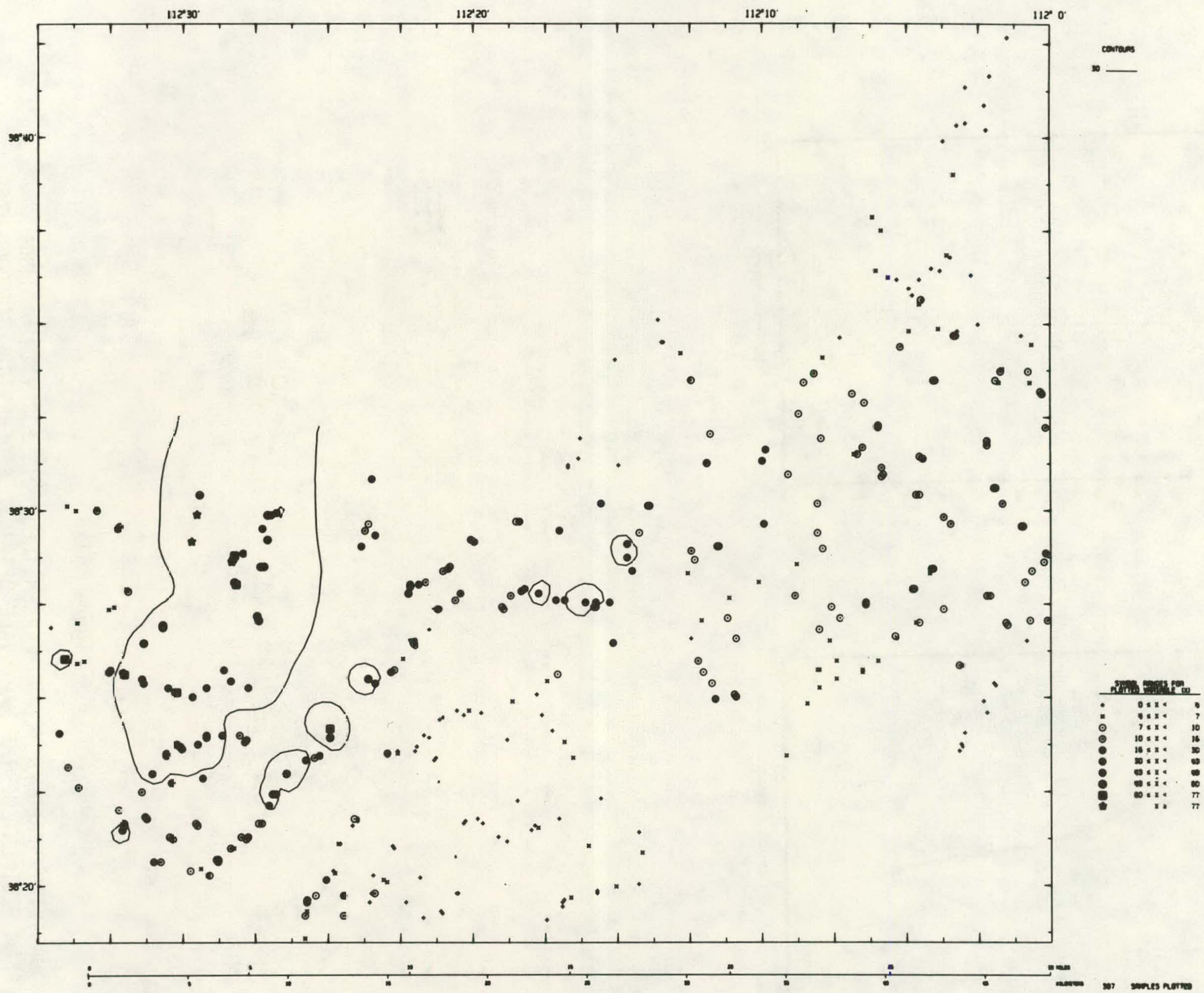


Figure A-11b

GEOCHEMICAL DISTRIBUTION OF NIOBIUM (PPM) IN STREAM SEDIMENT
OF THE MARYSVALE DETAILED GEOCHEMICAL SURVEY, UTAH

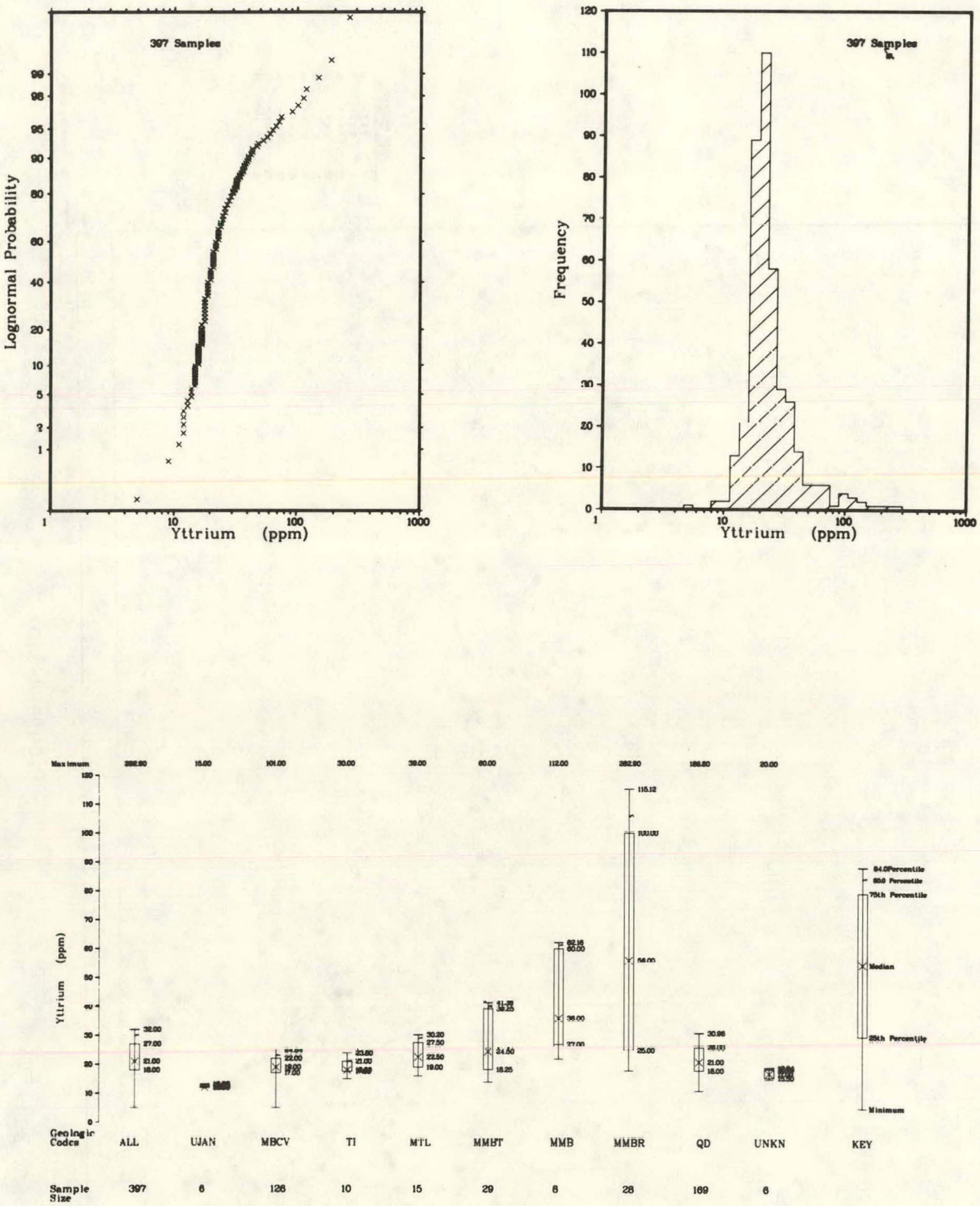


Figure A-12a

PROBABILITY, FREQUENCY, AND PERCENTILE PLOTS FOR YTTRIUM (PPM)
IN STREAM SEDIMENT OF THE MARYSVALE DETAILED GEOCHEMICAL SURVEY, UTAH

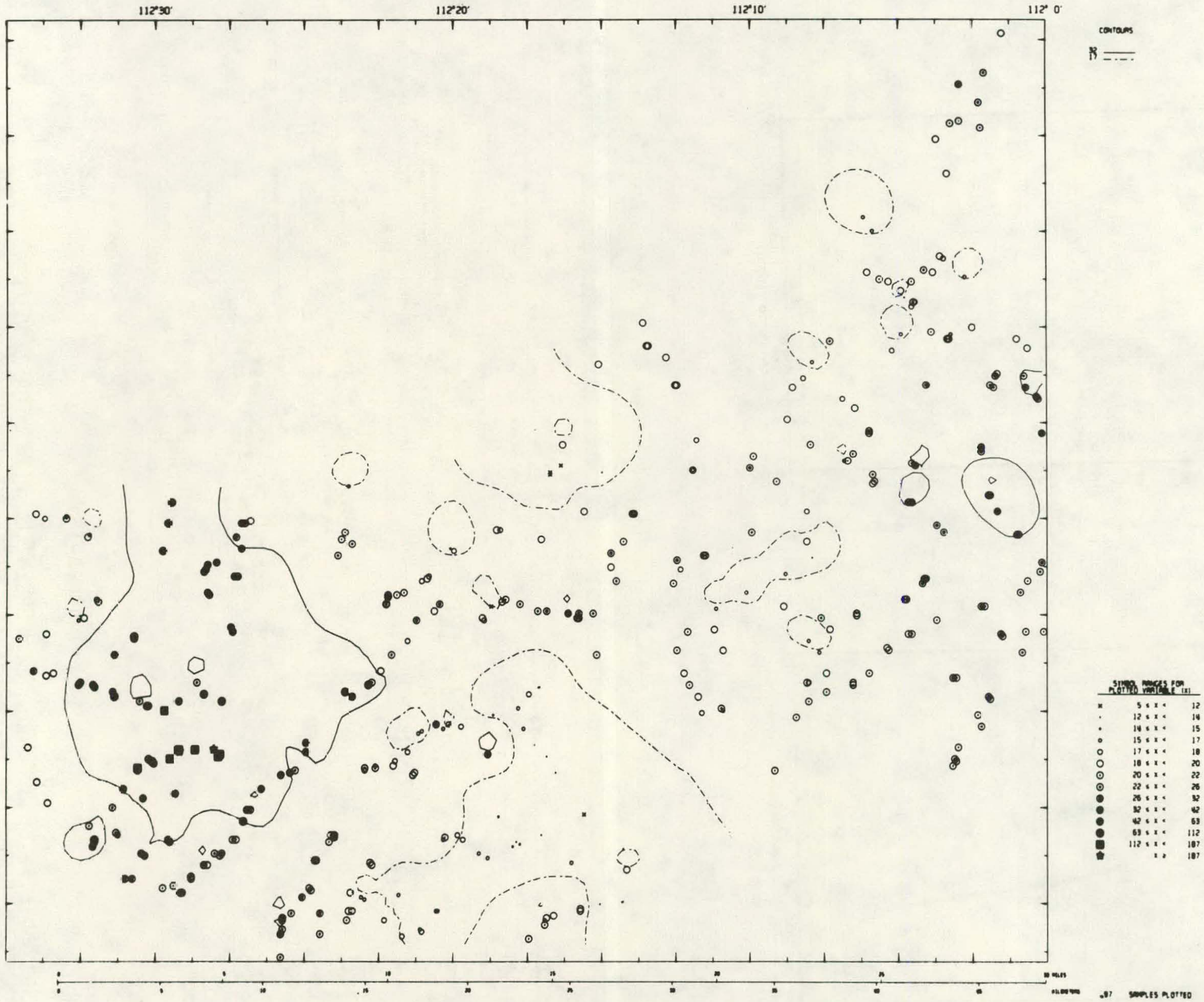


Figure A-12b

GEOCHEMICAL DISTRIBUTION OF YTTRIUM (PPM) IN STREAM SEDIMENT OF THE MARYSVALE DETAILED GEOCHEMICAL SURVEY, UTAH

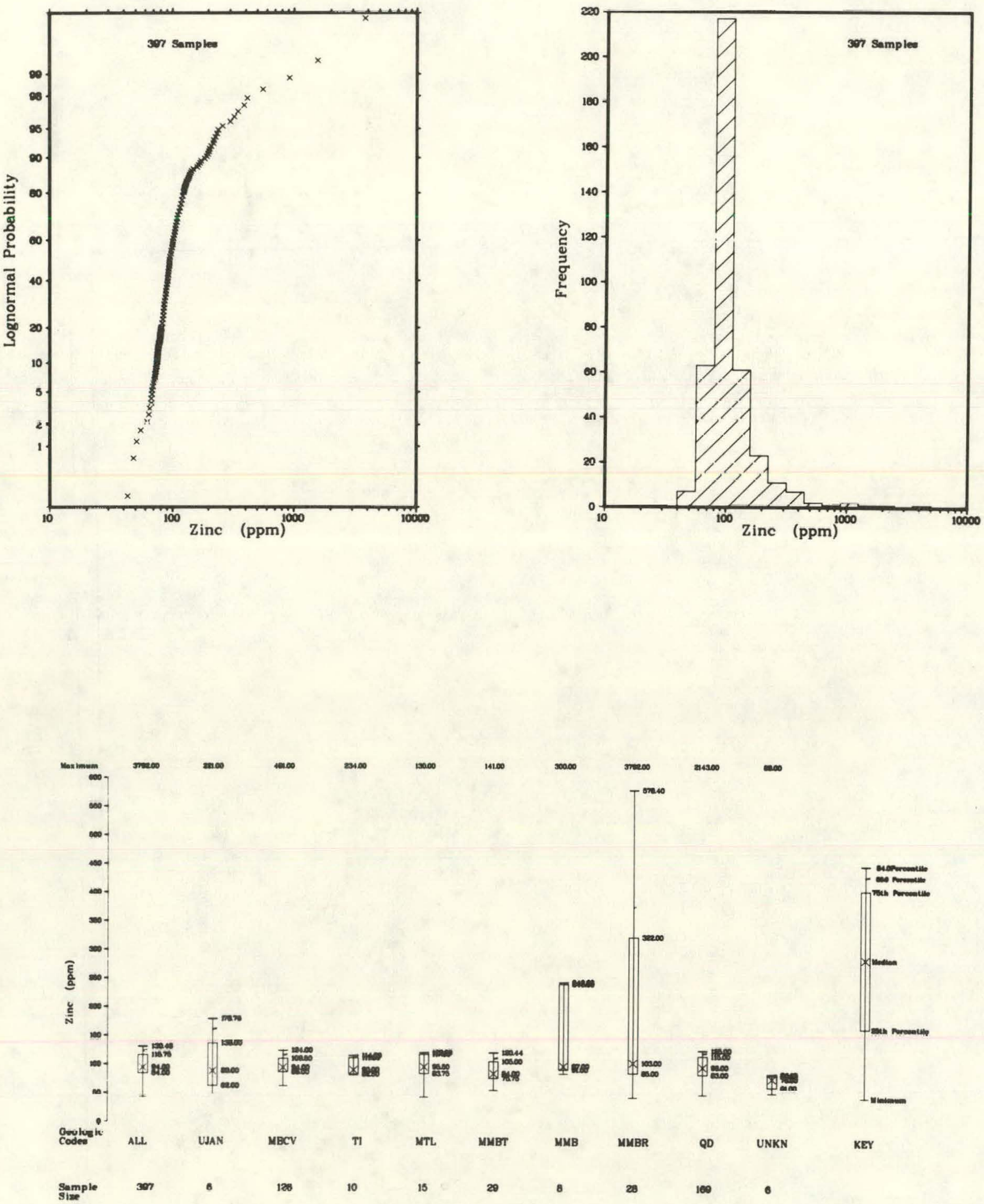


Figure A-13a

PROBABILITY, FREQUENCY, AND PERCENTILE PLOTS FOR ZINC (PPM)
IN STREAM SEDIMENT OF THE MARYSVALE DETAILED GEOCHEMICAL SURVEY, UTAH

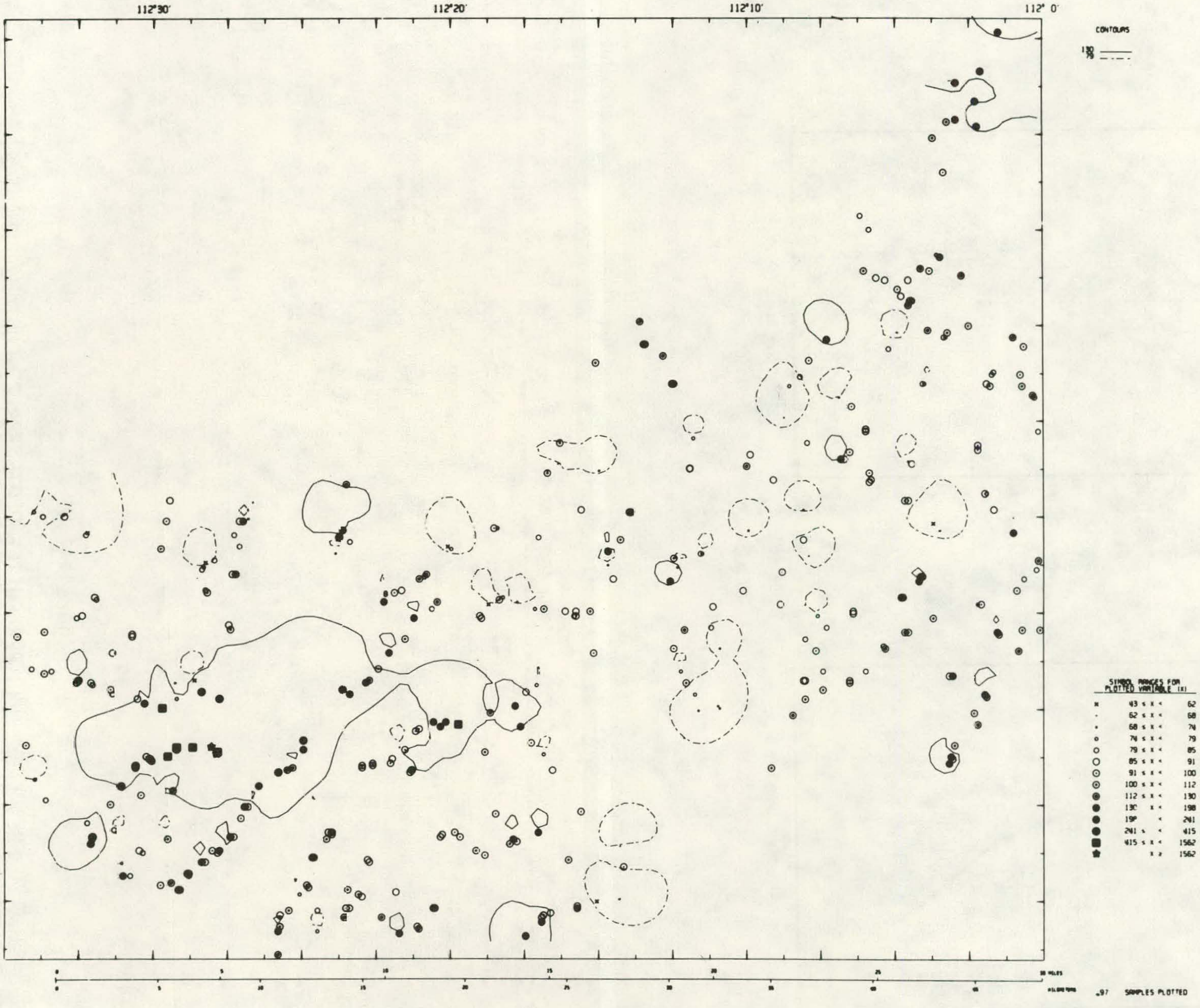
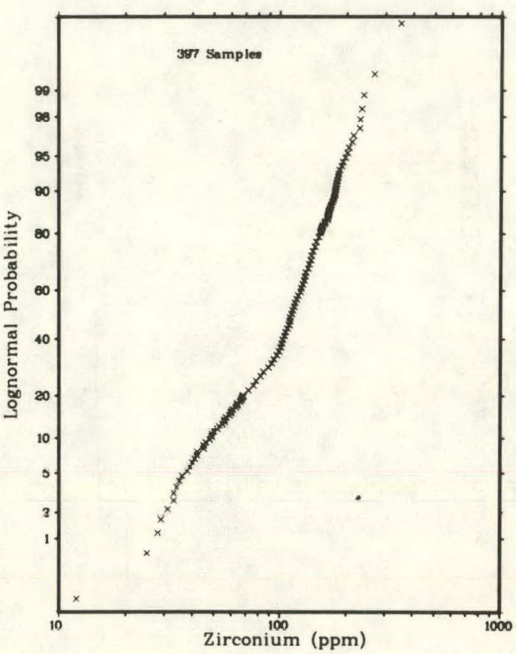
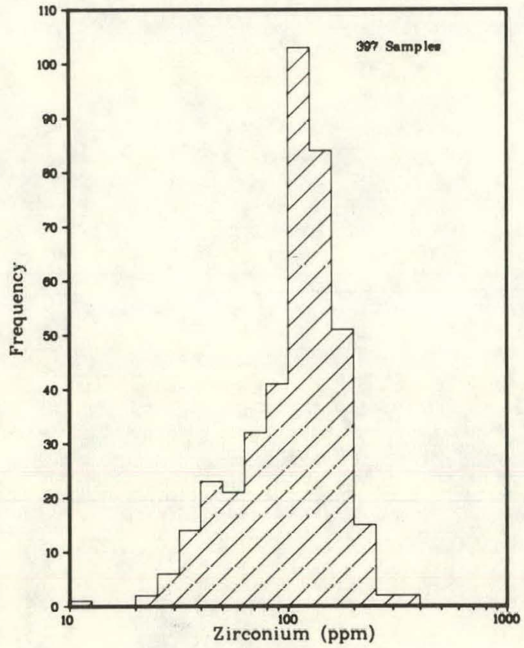


Figure A-13b

GEOCHEMICAL DISTRIBUTION OF ZINC (PPM) IN STREAM SEDIMENT
OF THE MARYSVALE DETAILED GEOCHEMICAL SURVEY, UTAH





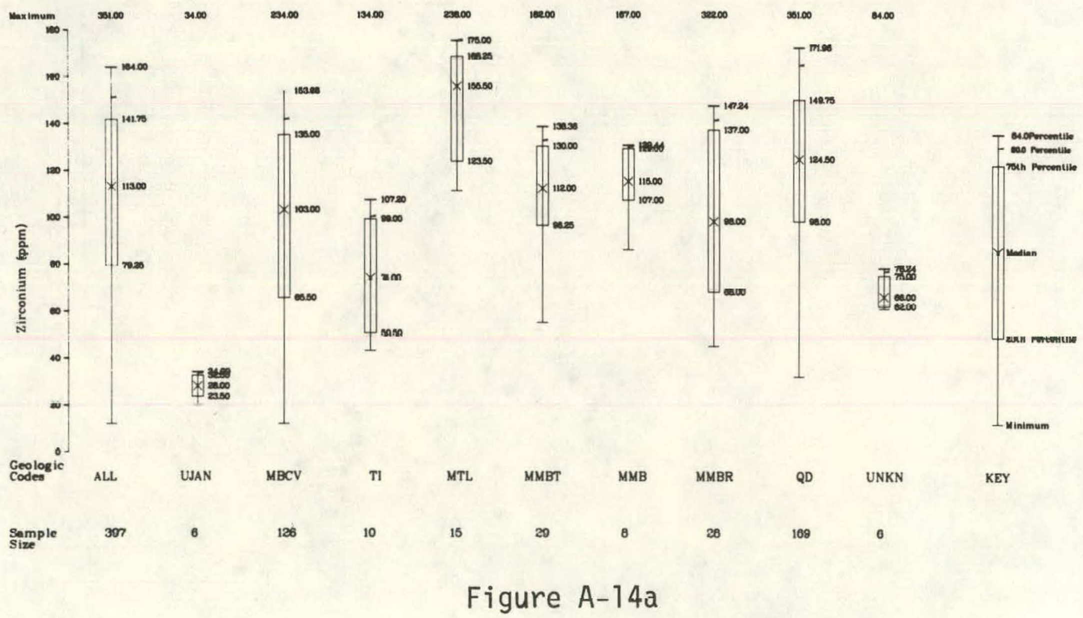


Figure A-14a

PROBABILITY, FREQUENCY, AND PERCENTILE PLOTS FOR ZIRCONIUM (PPM)
IN STREAM SEDIMENT OF THE MARYSVALE DETAILED GEOCHEMICAL SURVEY, UTAH

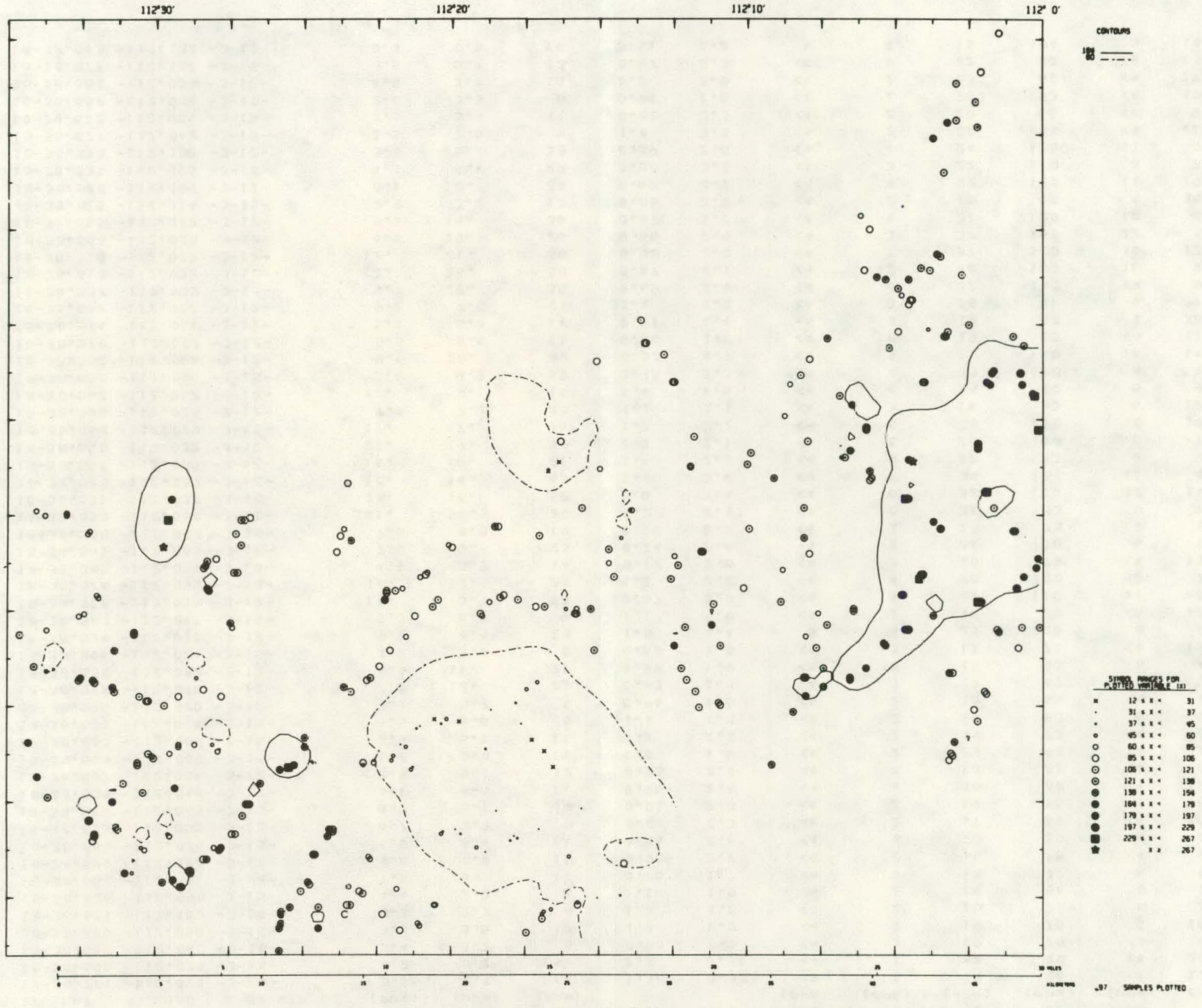


Figure A-14b

GEOCHEMICAL DISTRIBUTION OF ZIRCONIUM (PPM) IN STREAM SEDIMENT
OF THE MARYSVALE DETAILED GEOCHEMICAL SURVEY, UTAH

Table A-3

PARTIAL DATA LISTING FOR STREAM SEDIMENT OF THE MARYSVALE DETAILED GEOCHEMICAL SURVEY, UTAH

OR SAMPLE NUMBER	D. O. E. SAMPLE NUMBER ST LAT	LONG	L TY REP	U (PPM)	U-NT (PPM)	TH (PPM)	U/TU	TH/U	MO (PPM)	BE (PPM)	Y (PPM)	CE (PPM)	NB (PPM)	MN (PPM)
911000	18-38.711	-112.025	-3-15-	3.0	2.7	<2	1.1	0.37	<4	1	18	28	<4	1200
911002	18-38.694	-112.035	-3-15-	4.2	3.2	<2	1.3	0.31	<4	1	22	49	<4	1900
911003	18-38.665	-112.062	-3-15-	3.4	3.7	8	0.93	2.2	<4	2	19	70	<4	970
911004	18-38.650	-112.056	-3-15-	3.8	3.6	10	1.1	2.8	<4	2	18	70	5	1000
911005	18-38.631	-112.103	-3-15-	3.3	2.5	8	1.3	3.2	<4	2	16	72	5	850
911007	18-38.625	-112.098	-3-15-	4.4	3.9	6	1.1	1.5	<4	2	16	65	4	700
911009	18-38.607	-112.101	-3-12-	7.8	10.	17	0.76	1.7	<4	3	18	92	6	940
911010	18-38.599	-112.082	-3-12-	4.6	5.0	11	0.92	2.2	<4	2	19	78	<4	920
911012	18-38.603	-112.076	-3-15-	4.5	5.4	14	0.84	2.6	<4	2	20	80	<4	800
911014	18-38.613	-112.058	-3-12-	4.7	3.9	9	1.2	2.3	<4	2	17	55	<4	1000
911015	18-38.614	-112.060	-3-15-	4.7	5.1	10	0.91	2.0	<4	2	19	76	4	860
911016	18-38.605	-112.046	-3-12-	4.1	4.5	11	0.90	2.4	<4	2	16	60	<4	1200
911017	18-38.607	-112.064	-3-12-	3.8	5.1	12	0.75	2.4	<4	2	18	71	<4	820
911018	18-38.608	-112.069	-3-15-	5.8	5.8	11	1.0	1.9	<4	2	23	98	<4	1200
911020	18-38.603	-112.089	-3-15-	5.9	5.1	11	1.2	2.2	<4	2	19	73	<4	890
911021	18-38.604	-112.094	-3-15-	4.5	4.0	6	1.1	1.5	<4	2	20	83	4	990
911023	18-38.596	-112.080	-3-12-	3.1	5.7	9	0.54	1.6	<4	2	13	59	<4	740
911024	18-38.592	-112.076	-3-12-	7.5	12.	21	0.63	1.8	4	3	17	87	4	930
911025	18-38.580	-112.082	-3-12-	6.4	11.	21	0.59	1.9	<4	3	15	90	6	400
911026	18-38.594	-112.074	-3-15-	3.2	5.0	5	0.65	1.0	<4	3	17	71	<4	1200
911027	18-38.594	-112.075	-3-12-	9.7	6.4	28	1.5	4.4	5	4	25	120	8	990
911028	18-38.583	-112.042	-3-15-	5.3	4.7	9	1.1	1.9	<4	2	18	78	<4	1200
911029	18-38.578	-112.056	-3-12-	11.	13.	29	0.87	2.3	<4	4	21	110	11	800
911030	18-38.578	-112.055	-3-12-	16.	13.	29	1.2	2.2	<4	4	20	100	10	740
911032	18-38.580	-112.054	-3-15-	4.1	5.3	14	0.77	2.6	<4	3	16	72	<4	1000
911034	18-38.581	-112.065	-3-15-	7.6	10.	25	0.74	2.4	<4	3	21	100	6	880
911036	18-38.558	-112.067	-3-15-	7.5	8.5	19	0.88	2.2	<4	3	15	75	7	550
911037	18-38.558	-112.068	-3-12-	61.	51.	29	1.2	0.57	<4	6	31	83	9	720
911038	18-38.531	-112.037	-3-15-	16.	16.	52	1.0	3.4	<4	6	32	190	12	1900
911039	18-38.529	-112.037	-3-12-	16.	14.	43	1.1	3.0	<4	7	30	150	11	890
911041	18-38.557	-112.030	-3-12-	14.	10.	21	1.4	2.1	<4	4	22	83	6	930
911042	18-38.558	-112.032	-3-12-	21.	17.	36	1.3	2.1	<4	5	23	100	8	720
911043	18-38.562	-112.029	-3-12-	17.	17.	36	1.0	2.2	<4	5	26	110	10	1000
911044	18-38.563	-112.028	-3-12-	7.9	7.3	15	1.1	2.1	<4	3	19	83	6	1200
911045	18-38.557	-112.012	-3-12-	12.	9.1	15	1.4	1.6	<4	5	34	92	6	980
911046	18-38.553	-112.006	-3-15-	3.4	9.0	30	0.38	3.3	<4	4	39	120	8	990
911047	18-38.552	-112.005	-3-12-	9.4	18.	49	0.52	2.7	<4	5	29	140	14	1400
911048	18-38.578	-112.017	-3-12-	3.5	5.4	11	0.66	2.0	<4	2	19	60	<4	1100
911050	18-38.574	-112.011	-3-12-	5.3	5.8	14	0.91	2.4	<4	2	18	68	4	3800
911052	18-38.562	-112.013	-3-12-	9.2	7.6	21	1.2	2.8	<4	3	25	92	9	2100
911053	18-38.537	-112.003	-3-12-	9.7	20.	50	0.49	2.5	<4	5	32	140	12	980
911054	18-38.510	-112.033	-3-12-	13.	28.	58	0.47	2.1	<4	12	46	150	16	980
911055	18-38.510	-112.032	-3-12-	12.	21.	60	0.58	2.8	<4	7	27	120	16	1300
911057	18-38.503	-112.028	-3-12-	6.6	10.	26	0.66	2.6	<4	3	37	180	12	500
911058	18-38.525	-112.112	-3-12-	8.3	18.	30	0.47	1.7	<4	4	21	120	10	560
911059	18-38.525	-112.114	-3-15-	2.9	3.3	13	0.88	3.9	<4	2	15	68	4	1600
911061	18-38.528	-112.109	-3-12-	8.1	12.	39	0.66	3.1	<4	4	22	120	11	1900
911062	18-38.537	-112.100	-3-15-	4.8	8.4	29	0.58	3.5	<4	3	22	110	8	710
911063	18-38.538	-112.100	-3-12-	8.8	15.	38	0.59	2.6	<4	4	24	120	11	990
911064	18-38.673	-112.049	-3-15-	3.5	2.6	9	1.4	3.5	<4	2	20	55	<4	1100
911066	18-38.672	-112.054	-3-15-	2.1	3.3	11	0.62	3.3	<4	2	20	66	<4	980
911067	18-38.689	-112.049	-3-15-	2.6	3.3	6	0.78	1.8	<4	2	26	53	<4	1900
911068	18-38.681	-112.038	-3-12-	4.5	3.4	10	1.3	2.9	<4	2	23	60	<4	1200
911070	18-38.577	-112.122	-3-15-	3.8	5.7	13	0.67	2.3	<4	3	22	80	<4	1500
911072	18-38.568	-112.132	-3-15-	3.3	6.5	18	0.51	2.8	4	3	15	94	5	1400

Table A-3, Continued

PARTIAL DATA LISTING FOR STREAM SEDIMENT OF THE MARYSVALE DETAILED GEOCHEMICAL SURVEY, UTAH

OR SAMPLE NUMBER	D. O. E. SAMPLE NUMBER ST LAT	LONG	L TY REP	U (PPM)	U-NT (PPM)	TH (PPM)	U/TU	TH/U	MO (PPM)	BE (PPM)	Y (PPM)	CE (PPM)	NB (PPM)	MN (PPM)
911073	18-38.532	-112.133	-3-15-	10.	11.	28	0.98	2.6	5	4	21	110	9	690
911075	18-38.543	-112.146	-3-15-	5.4	5.9	18	0.91	3.1	4	3	18	96	7	590
911076	18-38.557	-112.143	-3-15-	7.4	6.4	23	1.2	3.6	<4	3	18	110	7	930
911077	18-38.561	-112.137	-3-15-	6.4	7.6	30	0.84	3.9	5	3	17	110	10	680
911078	18-38.519	-112.098	-3-15-	19.	19.	15	0.99	0.79	5	4	24	130	12	730
911079	18-38.516	-112.097	-3-12-	9.7	11.	12	0.91	1.1	<4	4	22	140	9	850
911080	18-38.515	-112.098	-3-12-	6.7	7.7	16	0.88	2.1	<4	3	18	100	7	870
911084	18-38.548	-112.108	-3-15-	13.	11.	30	1.3	2.9	<4	3	19	100	9	730
911085	18-38.552	-112.115	-3-15-	8.6	7.5	18	1.1	2.4	6	3	17	92	8	590
911088	18-38.363	-112.400	-3-12-	7.7	5.3	19	1.4	3.6	4	2	22	99	<4	810
911089	18-38.363	-112.402	-3-12-	8.3	8.3	25	1.0	3.0	6	4	21	110	9	900
911090	18-38.362	-112.400	-3-12-	4.3	5.6	4	0.77	0.71	<4	2	21	62	<4	960
911092	18-38.360	-112.403	-3-12-	6.0	7.5	9	0.80	1.2	<4	3	20	81	<4	900
911093	18-38.352	-112.410	-3-12-	6.3	7.5	14	0.84	1.9	<4	3	21	79	<4	950
911094	18-38.352	-112.411	-3-12-	15.	15.	12	1.0	0.81	<4	3	23	79	5	1100
911095	18-38.340	-112.414	-3-12-	8.3	9.3	10	0.89	1.1	<4	3	21	68	<4	730
911096	18-38.339	-112.413	-3-15-	5.3	5.5	12	0.96	2.2	<4	2	23	55	4	860
911097	18-38.336	-112.418	-3-12-	15.	14.	20	1.1	1.4	<4	6	27	87	28	820
911098	18-38.329	-112.424	-3-12-	11.	8.7	30	1.2	3.4	<4	3	22	90	7	900
911099	18-38.585	-112.227	-3-15-	2.0	3.3	6	0.61	1.8	<4	2	19	56	<4	1100
911100	18-38.575	-112.225	-3-15-	0.93	1.8	5	0.52	2.8	<4	2	19	52	<4	1100
911101	18-38.575	-112.224	-3-15-	0.90	1.6	7	0.56	4.4	<4	2	19	51	<4	1100
911102	18-38.570	-112.214	-3-15-	4.0	5.3	15	0.76	2.8	<4	2	18	74	4	930
911103	18-38.558	-112.209	-3-15-	3.5	5.6	16	0.62	2.9	<4	2	18	83	<4	940
911104	18-38.558	-112.208	-3-15-	4.2	7.1	24	0.59	3.4	<4	3	19	79	7	770
911105	18-38.521	-112.199	-3-15-	8.2	11.	36	0.74	3.2	14	4	16	110	9	550
911106	18-38.521	-112.199	-3-15-	4.4	8.4	27	0.53	3.2	<4	3	19	96	10	740
911108	18-38.534	-112.197	-3-15-	4.9	9.0	22	0.54	2.4	<4	3	17	79	9	560
911110	18-38.520	-112.250	-3-15-	1.9	2.9	<2	0.64	0.34	<4	2	12	51	<4	360
911111	18-38.503	-112.135	-3-12-	5.2	9.6	20	0.54	2.1	<4	3	17	87	8	700
911112	18-38.516	-112.152	-3-12-	0.90	8.0	20	0.11	2.5	<4	3	21	110	8	770
911113	18-38.522	-112.167	-3-15-	4.3	9.0	24	0.48	2.7	<4	4	26	130	20	690
911114	18-38.527	-112.165	-3-15-	1.6	6.9	22	0.23	3.2	<4	3	21	97	16	660
911115	18-38.490	-112.135	-3-15-	3.5	8.6	20	0.41	2.3	<4	2	18	87	8	660
911116	18-38.483	-112.132	-3-15-	1.7	7.9	20	0.22	2.5	<4	2	12	85	7	590
911118	18-38.459	-112.107	-3-12-	4.1	11.	28	0.37	2.5	<4	3	20	94	8	540
911119	18-38.458	-112.107	-3-12-	2.7	11.	26	0.24	2.4	<4	3	18	100	8	540
911121	18-38.452	-112.122	-3-15-	7.4	12.	25	0.63	2.1	4	3	18	86	9	520
911122	18-38.457	-112.127	-3-15-	6.2	11.	20	0.58	1.9	<4	2	23	95	8	770
911123	18-38.451	-112.202	-3-15-	5.7	7.6	17	0.75	2.2	<4	3	21	92	6	1200
911126	18-38.472	-112.210	-3-15-	5.8	12.	27	0.48	2.2	4	3	21	98	4	1100
911127	18-38.461	-112.186	-3-15-	5.0	7.6	18	0.66	2.4	<4	2	16	75	4	760
911128	18-38.468	-112.169	-3-15-	5.0	8.0	19	0.62	2.4	5	3	15	79	6	740
911129	18-38.476	-112.147	-3-15-	3.9	5.3	6	0.74	1.1	<4	2	15	69	4	850
911130	18-38.462	-112.148	-3-15-	7.0	7.6	26	0.92	3.4	<4	3	18	97	10	800
911131	18-38.447	-112.134	-3-15-	5.7	6.2	13	0.91	2.1	<4	2	15	82	8	650
911132	18-38.442	-112.128	-3-15-	11.	10.	19	1.0	1.8	<4	3	16	76	4	630
911133	18-38.433	-112.124	-3-15-	8.0	7.5	15	1.1	2.0	<4	3	18	100	5	930
911134	18-38.425	-112.124	-3-12-	13.	9.3	17	1.4	1.8	<4	3	20	93	5	900
911135	18-38.482	-112.208	-3-15-	8.2	11.	34	0.74	3.1	8	4	28	140	12	870
911137	18-38.478	-112.206	-3-15-	4.7	5.1	18	0.93	3.5	<4	3	17	73	9	590
911138	18-38.452	-112.187	-3-15-	5.9	6.6	22	0.90	3.3	<4	3	19	96	8	850
911139	18-38.485	-112.245	-3-15-	7.4	11.	33	0.70	3.1	<4	5	30	160	44	1000
911143	18-38.479	-112.245	-3-15-	8.5	7.7	31	1.1	4.0	<4	6	18	81	34	670
911145	18-38.502	-112.232	-3-15-	5.9	8.2	25	0.72	3.0	5	3	30	130	12	1100

Table A-3, Continued

PARTIAL DATA LISTING FOR STREAM SEDIMENT OF THE MARYSVALE DETAILED GEOCHEMICAL SURVEY, UTAH

OR SAMPLE NUMBER	D. O. E. SAMPLE ST LAT	LONG	NUMBER L TY REP	U (PPM)	U-NT (PPM)	TH (PPM)	U/TU	TH/U	MO (PPM)	BE (PPM)	Y (PPM)	CE (PPM)	NB (PPM)	MN (PPM)
911146	18-38.502	-112.233	-3-15-	4.2	5.9	21	0.71	3.6	<4	2	23	93	7	1100
911148	18-38.490	-112.238	-3-15-	7.5	8.0	26	0.94	3.3	9	3	21	96	9	850
911150	18-38.484	-112.193	-3-15-	6.9	7.7	33	0.89	4.3	<4	3	22	130	13	690
911151	18-38.484	-112.192	-3-15-	8.7	9.6	35	0.91	3.6	<4	4	20	120	17	570
911152	18-38.456	-112.062	-3-15-	8.1	6.6	19	1.2	2.9	<4	3	20	85	7	1000
911153	18-38.450	-112.078	-3-12-	11.	11.	19	1.1	1.8	4	3	21	88	4	1200
911154	18-38.450	-112.076	-3-15-	14.	11.	21	1.3	1.9	<4	3	22	94	7	790
911157	18-38.443	-112.089	-3-12-	13.	9.3	23	1.4	2.5	<4	3	21	88	<4	1100
911158	18-38.444	-112.090	-3-12-	5.5	8.6	26	0.64	3.0	<4	3	19	110	7	600
911160	18-38.433	-112.100	-3-12-	16.	11.	20	1.5	1.8	<4	3	20	89	6	830
911161	18-38.428	-112.109	-3-12-	8.5	9.7	23	0.88	2.4	<4	3	21	100	5	930
911162	18-38.429	-112.109	-3-15-	6.9	8.6	23	0.80	2.7	<4	3	19	95	6	840
911165	18-38.351	-112.380	-3-15-	11.	11.	15	1.1	1.4	<4	2	23	77	<4	690
911166	18-38.350	-112.379	-3-12-	5.1	5.6	10	0.91	1.8	<4	2	18	72	<4	920
911167	18-38.329	-112.408	-3-12-	12.	12.	25	1.0	2.1	<4	5	26	74	20	780
911168	18-38.320	-112.408	-3-12-	6.1	6.4	20	0.95	3.1	<4	4	23	80	15	740
911169	18-38.395	-112.051	-3-12-	2.5	2.4	6	1.0	2.5	<4	2	22	46	<4	940
911170	18-38.396	-112.052	-3-12-	3.0	2.9	14	1.0	4.8	<4	2	22	44	<4	1200
911171	18-38.401	-112.050	-3-12-	6.5	6.5	18	1.0	2.8	<4	3	20	68	<4	920
911172	18-38.410	-112.037	-3-12-	2.1	1.9	12	1.1	6.3	<4	2	23	58	<4	2100
911173	18-38.415	-112.039	-3-12-	3.0	2.5	11	1.2	4.4	<4	2	21	53	<4	5400
911174	18-38.422	-112.032	-3-12-	2.7	2.5	8	1.1	3.2	<4	2	24	56	<4	1300
911175	18-38.423	-112.033	-3-15-	3.9	3.9	16	1.0	4.1	<4	3	27	110	<4	1100
911176	18-38.431	-112.053	-3-15-	8.2	8.5	24	0.97	2.8	<4	5	31	120	11	970
911177	18-38.431	-112.051	-3-15-	4.8	5.5	17	0.87	3.1	<4	3	24	89	5	1100
911178	18-38.451	-112.012	-3-15-	5.9	6.1	19	0.96	3.1	<4	3	21	97	8	890
911179	18-38.442	-112.014	-3-15-	2.5	3.1	8	0.81	2.6	<4	2	23	64	<4	1000
911180	18-38.466	-112.370	-3-12-	22.	19.	31	1.1	1.6	<4	10	23	88	23	1000
911181	18-38.467	-112.370	-3-12-	18.	17.	30	1.1	1.8	<4	9	27	80	24	1600
911182	18-38.463	-112.371	-3-12-	12.	13.	20	0.96	1.6	<4	5	24	88	17	1000
911183	18-38.463	-112.371	-3-12-	21.	19.	18	1.1	0.95	<4	8	23	70	18	460
911185	18-38.383	-112.441	-3-12-	19.	19.	33	0.96	1.7	13	16	33	100	51	3000
911186	18-38.374	-112.449	-3-12-	18.	20.	38	0.88	1.9	13	18	33	96	43	2500
911187	18-38.374	-112.447	-3-12-	14.	16.	27	0.89	1.7	4	7	30	110	25	1100
911189	18-38.361	-112.455	-3-12-	13.	21.	27	0.61	1.3	<4	4	21	100	11	990
911190	18-38.361	-112.457	-3-12-	5.6	13.	27	0.42	2.0	<4	4	23	98	9	1400
911193	18-38.350	-112.471	-3-12-	2.4	7.5	22	0.31	2.9	<4	3	19	95	6	2100
911194	18-38.350	-112.473	-3-12-	22.	39.	35	0.56	0.89	<4	9	39	110	13	860
911207	18-38.377	-112.560	-3-15-	10.	6.6	8	1.6	1.2	<4	2	19	89	13	840
911208	18-38.386	-112.566	-3-15-	5.4	8.7	18	0.62	2.1	<4	4	18	110	14	810
911209	18-38.401	-112.571	-3-15-	5.7	9.1	18	0.63	2.0	<4	4	19	92	21	950
911212	18-38.427	-112.534	-3-12-	11.	16.	38	0.70	2.4	<4	8	36	78	65	710
911214	18-38.429	-112.542	-3-15-	90.	73.	21	1.2	0.29	<4	10	48	98	14	850
911215	18-38.428	-112.543	-3-12-	11.	12.	23	0.87	1.9	<4	6	32	95	25	940
911216	18-38.433	-112.557	-3-15-	5.1	6.5	20	0.79	3.1	<4	2	18	85	5	840
911217	18-38.432	-112.561	-3-15-	4.4	65.	17	0.07	0.26	<4	2	18	96	5	890
911219	18-38.434	-112.568	-3-12-	6.0	15.	41	0.40	2.7	<4	7	30	80	60	650
911221	18-38.456	-112.316	-3-15-	2.9	4.7	34	0.61	7.2	4	3	17	100	12	1100
911222	18-38.457	-112.317	-3-15-	8.3	6.9	37	1.2	5.4	7	3	19	110	14	1400
911223	18-38.462	-112.312	-3-12-	3.6	4.8	11	0.75	2.3	<4	1	11	43	12	860
911224	18-38.441	-112.253	-3-15-	5.0	6.5	15	0.76	2.3	<4	3	20	79	26	880
911225	18-38.427	-112.285	-3-12-	4.1	3.8	13	1.1	3.4	<4	2	13	57	9	1100
911226	18-38.424	-112.291	-3-15-	3.4	3.5	8	0.97	2.3	<4	2	17	78	5	910
911227	18-38.418	-112.297	-3-15-	4.1	4.3	3	0.94	0.70	5	2	15	78	<4	940
911228	18-38.415	-112.311	-3-15-	2.3	2.4	<2	0.94	0.42	<4	3	14	53	4	1500

Table A-3, Continued

PARTIAL DATA LISTING FOR STREAM SEDIMENT OF THE MARYSVALE DETAILED GEOCHEMICAL SURVEY, UTAH

OR SAMPLE NUMBER	D. O. E. SAMPLE ST LAT	LONG	NUMBER L TY REP	U (PPM)	U-NT (PPM)	TH (PPM)	U/TU	TH/U	MO (PPM)	BE (PPM)	Y (PPM)	CE (PPM)	NB (PPM)	MN (PPM)
911229	18-38.411	-112.336	-3-12-	5.5	5.7	9	0.97	1.6	28	2	17	100	6	1200
911230	18-38.409	-112.339	-3-12-	4.4	4.2	5	1.0	1.2	10	2	15	70	<4	1500
911232	18-38.330	-112.390	-3-12-	9.6	13.	18	0.77	1.4	<4	5	23	89	10	1100
911234	18-38.330	-112.392	-3-12-	3.9	5.6	8	0.70	1.4	<4	2	18	74	<4	970
911235	18-38.326	-112.393	-3-12-	7.5	6.5	8	1.2	1.2	<4	2	20	78	<4	1100
911236	18-38.457	-112.540	-3-12-	3.7	5.2	12	0.71	2.3	<4	2	19	64	6	860
911237	18-38.456	-112.543	-3-15-	2.8	3.8	14	0.75	3.7	<4	2	15	65	5	800
911238	18-38.448	-112.576	-3-12-	3.2	4.1	8	0.79	2.0	<4	2	21	77	<4	680
911239	18-38.501	-112.550	-3-12-	2.5	3.6	8	0.69	2.2	<4	1	16	70	4	920
911240	18-38.500	-112.550	-3-12-	6.7	9.4	17	0.71	1.8	<4	3	20	64	10	850
911242	18-38.493	-112.537	-3-12-	11.	9.1	18	1.2	2.0	<4	2	15	69	9	450
911243	18-38.345	-112.481	-3-15-	11.	13.	23	0.84	1.8	<4	3	16	85	9	800
911244	18-38.345	-112.480	-3-12-	14.	17.	33	0.85	2.0	8	11	25	88	33	1600
911245	18-38.344	-112.480	-3-15-	6.1	10.	23	0.60	2.3	<4	3	18	100	8	760
911249	18-38.344	-112.513	-3-15-	15.	23.	28	0.67	1.2	4	4	28	88	13	760
911250	18-38.344	-112.517	-3-12-	14.	19.	26	0.76	1.4	4	11	26	97	17	1000
911251	18-38.429	-112.477	-3-12-	15.	28.	24	0.55	0.85	<4	8	25	35	39	240
911253	18-38.421	-112.463	-3-15-	34.	58.	46	0.58	0.80	16	6	100	98	42	3200
911254	18-38.424	-112.473	-3-12-	22.	37.	34	0.60	0.91	12	7	71	82	46	2400
911255	18-38.421	-112.487	-3-15-	10.	21.	32	0.49	1.5	<4	6	56	74	44	1100
911256	18-38.417	-112.495	-3-15-	34.	83.	36	0.41	0.43	10	25	150	190	42	9600
911257	18-38.419	-112.505	-3-15-	3.5	9.3	7	0.38	0.75	<4	6	36	37	26	860
911258	18-38.419	-112.504	-3-12-	4.8	14.	35	0.33	2.4	<4	6	28	60	66	610
911259	18-38.421	-112.509	-3-15-	6.0	9.3	29	0.64	3.1	<4	6	24	66	42	920
911260	18-38.423	-112.523	-3-15-	15.	32.	29	0.47	0.92	<4	12	63	82	40	1300
911261	18-38.425	-112.524	-3-15-	6.0	13.	38	0.45	2.8	<4	7	31	81	45	1100
911262	18-38.449	-112.512	-3-12-	18.	30.	34	0.60	1.1	<4	13	74	76	48	750
911263	18-38.448	-112.512	-3-15-	10.	20.	31	0.49	1.5	<4	9	49	68	48	730
911264	18-38.441	-112.523	-3-12-	11.	22.	35	0.50	1.6	<4	5	47	85	48	870
911265	18-38.428	-112.535	-3-12-	8.1	15.	34	0.53	2.2	<4	7	32	83	38	870
911266	18-38.381	-112.489	-3-12-	28.	49.	23	0.58	0.47	5	13	43	70	29	430
911268	18-38.364	-112.522	-3-12-	17.	16.	28	1.1	1.8	<4	4	24	98	18	550
911269	18-38.443	-112.182	-3-15-	2.9	5.0	20	0.58	4.0	<4	3	18	74	9	600
911270	18-38.423	-112.196	-3-15-	2.9	5.0	14	0.58	2.8	<4	3	18	65	9	740
911271	18-38.443	-112.208	-3-15-	1.3	4.4	13	0.29	3.0	<4	2	20	71	<4	1000
911272	18-38.433	-112.204	-3-15-	1.6	5.0	21	0.32	4.2	<4	3	19	73	10	720
911273	18-38.428	-112.201	-3-15-	2.9	4.5	16	0.65	3.6	<4	2	21	80	7	990
911274	18-38.416	-112.194	-3-15-	3.4	4.7	22	0.73	4.7	<4	3	17	73	16	600
911276	18-38.417	-112.182	-3-15-	3.3	5.0	17	0.65	3.4	<4	3	16	66	17	620
911277	18-38.418	-112.183	-3-15-	4.9	6.7	26	0.74	3.9	<4	3	23	100	12	750
911278	18-38.474	-112.069	-3-12-	10.	13.	20	0.80	1.5	<4	3	24	110	9	1500
911279	18-38.474	-112.068	-3-12-	14.	16.	26	0.87	1.7	<4	4	26	130	10	980
911280	18-38.472	-112.070	-3-12-	14.	15.	26	0.91	1.7	4	3	27	110	6	930
911281	18-38.465	-112.079	-3-12-	9.1	10.	20	0.87	1.9	<4	3	23	100	7	1300
911282	18-38.465	-112.080	-3-12-	9.2	12.	26	0.78	2.2	<4	3	20	95	7	810
911283	18-38.462	-112.037	-3-12-	7.6	11.	29	0.71	2.7	<4	3	26	120	12	1800
911284	18-38.462	-112.035	-3-12-	9.9	12.	26	0.82	2.1	<4	4	23	110	10	1900
911285	18-38.468	-112.015	-3-12-	9.6	10.	26	0.95	2.6	<4	3	23	120	9	1600
911286	18-38.473	-112.011	-3-12-	9.7	10.	16	0.96	1.6	<4	4	21	83	8	2500
911287	18-38.477	-112.004	-3-12-	13.	9.5	22	1.3	2.3	<4	3	22	100	9	1500
911288	18-38.481	-112.003	-3-12-	21.	15.	40	1.3	2.6	<4	4	30	270	16	1700
911289	18-38.493	-112.016	-3-12-	17.	21.	39	0.82	1.9	<4	7	32	120	13	640
911290	18-38.493	-112.017	-3-12-	8.2	11.	37	0.73	3.3	<4	3	37	240	15	980
911291	18-38.327	-112.429	-3-12-	19.	21.	28	0.89	1.3	<4	8	40	100	33	890
911292	18-38.326	-112.429	-3-12-	17.	16.	29	1.0	1.8	<4	7	29	89	25	890

Table A-3, Continued

PARTIAL DATA LISTING FOR STREAM SEDIMENT OF THE MARYSVALE DETAILED GEOCHEMICAL SURVEY, UTAH

OR SAMPLE NUMBER	D. O. E. SAMPLE ST LAT	LONG	NUMBER L TY REP	U (PPM)	U-NF (PPM)	TH (PPM)	U/TU	TH/U	MO (PPM)	BE (PPM)	Y (PPM)	CE (PPM)	NB (PPM)	MN (PPM)
911293	18-38.322	-112.429	-3-12-	9.5	9.3	18	1.0	1.9	<4	4	24	83	6	860
911295	18-38.320	-112.430	-3-15-	14.	14.	34	0.99	2.4	<4	4	35	160	15	940
911296	18-38.310	-112.430	-3-12-	10.	9.8	15	1.1	1.5	<4	4	23	76	6	770
911298	18-38.459	-112.255	-3-12-	9.4	11.	28	0.90	2.7	<4	6	25	120	26	1000
911299	18-38.459	-112.269	-3-15-	10.	12.	41	0.87	3.5	<4	7	34	94	40	710
911300	18-38.459	-112.263	-3-15-	7.9	9.6	45	0.81	4.6	<4	6	30	93	39	760
911302	18-38.457	-112.263	-3-15-	5.6	7.2	17	0.78	2.4	<4	3	20	83	20	820
911303	18-38.457	-112.264	-3-15-	5.6	6.6	25	0.85	3.8	<4	4	24	78	31	600
911304	18-38.391	-112.422	-3-12-	17.	17.	27	0.98	1.6	<4	5	25	88	16	920
911305	18-38.399	-112.416	-3-15-	36.	33.	49	1.1	1.5	7	12	57	160	54	10000
911306	18-38.403	-112.416	-3-15-	49.	46.	58	1.1	1.3	16	15	61	180	61	10000
911309	18-38.390	-112.425	-3-12-	17.	15.	26	1.1	1.7	<4	7	28	94	12	970
911310	18-38.389	-112.430	-3-12-	25.	25.	37	0.99	1.5	14	27	42	100	46	3800
911311	18-38.369	-112.451	-3-12-	51.	56.	36	0.91	0.64	<4	6	91	150	32	620
911312	18-38.355	-112.467	-3-15-	11.	12.	27	0.88	2.3	4	4	24	120	13	1100
911313	18-38.355	-112.453	-3-12-	20.	19.	39	1.1	2.1	11	15	35	100	43	2000
911314	18-38.354	-112.464	-3-12-	8.0	9.1	22	0.88	2.4	<4	3	20	99	8	720
911317	18-38.338	-112.486	-3-12-	8.1	8.4	19	0.96	2.3	<4	4	22	95	6	800
911318	18-38.338	-112.485	-3-12-	6.5	8.2	17	0.79	2.1	<4	3	20	96	8	730
911319	18-38.341	-112.490	-3-12-	7.1	7.9	19	0.90	2.4	<4	4	21	100	5	800
911320	18-38.340	-112.496	-3-12-	17.	14.	24	1.2	1.7	<4	3	21	95	8	720
911322	18-38.467	-112.365	-3-12-	22.	17.	22	1.3	1.3	<4	7	21	78	21	860
911323	18-38.468	-112.361	-3-12-	22.	18.	21	1.2	1.2	<4	14	21	78	15	730
911324	18-38.473	-112.351	-3-12-	25.	17.	15	1.5	0.88	<4	14	17	73	10	880
911325	18-38.474	-112.348	-3-12-	9.8	13.	20	0.73	1.5	<4	7	18	67	23	840
911326	18-38.475	-112.347	-3-15-	17.	23.	26	0.77	1.2	<4	6	17	80	14	720
911327	18-38.487	-112.325	-3-12-	42.	44.	23	0.96	0.53	<4	9	14	65	20	310
911328	18-38.486	-112.333	-3-12-	14.	14.	26	1.00	1.8	<4	6	17	80	23	660
911330	18-38.495	-112.309	-3-15-	9.6	10.	18	0.93	1.7	<4	3	19	81	8	740
911331	18-38.495	-112.307	-3-12-	18.	14.	27	1.3	2.0	<4	6	17	79	21	630
911333	18-38.491	-112.284	-3-12-	18.	13.	30	1.4	2.3	<4	7	18	84	21	600
911334	18-38.503	-112.260	-3-12-	9.0	13.	28	0.67	2.1	<4	5	18	90	20	600
911335	18-38.355	-112.508	-3-15-	20.	15.	28	1.3	1.9	5	5	26	87	11	930
911336	18-38.354	-112.505	-3-15-	33.	34.	31	0.98	0.91	5	4	34	86	13	710
911337	18-38.361	-112.493	-3-15-	17.	18.	33	0.95	1.8	4	3	32	95	12	510
911338	18-38.360	-112.492	-3-15-	29.	30.	30	0.96	1.0	5	4	43	94	15	970
911339	18-38.397	-112.465	-3-12-	280.	240.	62	1.2	0.26	64	27	190	1500	27	86000
911340	18-38.398	-112.464	-3-12-	100.	100.	62	1.0	0.60	330	22	170	620	29	41000
911341	18-38.400	-112.468	-3-12-	63.	82.	55	0.77	0.66	52	53	260	540	10	11000
911342	18-38.400	-112.478	-3-12-	78.	70.	58	1.1	0.83	28	19	130	400	35	25000
911343	18-38.400	-112.487	-3-15-	67.	61.	44	1.1	0.73	23	15	120	310	37	18000
911345	18-38.399	-112.487	-3-15-	81.	79.	34	1.0	0.43	4	13	220	120	42	1300
911346	18-38.396	-112.504	-3-15-	9.4	14.	29	0.65	2.0	4	6	32	74	47	1000
911348	18-38.383	-112.518	-3-12-	29.	26.	32	1.1	1.2	8	12	60	110	43	4000
911350	18-38.379	-112.507	-3-12-	25.	22.	32	1.1	1.4	<4	6	36	92	26	720
911351	18-38.363	-112.521	-3-15-	17.	15.	23	1.1	1.5	<4	3	17	85	16	540
911352	18-38.573	-112.087	-3-12-	12.	11.	25	1.1	2.3	<4	3	17	91	11	560
911353	18-38.494	-112.058	-3-12-	25.	22.	27	1.1	1.2	<4	5	29	120	11	860
911354	18-38.497	-112.062	-3-12-	13.	11.	30	1.1	2.7	<4	3	27	95	12	570
911355	18-38.507	-112.075	-3-12-	16.	16.	16	1.0	1.0	<4	7	38	98	8	1500
911356	18-38.507	-112.073	-3-12-	23.	22.	34	1.0	1.5	<4	6	32	120	11	880
911357	18-38.523	-112.074	-3-12-	26.	25.	47	1.0	1.9	<4	6	38	130	16	500
911358	18-38.524	-112.076	-3-12-	12.	14.	34	0.91	2.5	<4	4	25	98	12	400
911359	18-38.670	-112.037	-3-12-	3.4	3.6	9	0.93	2.5	<4	2	21	51	<4	1300
911360	18-38.567	-112.252	-3-15-	1.9	1.8	4	1.1	2.2	<4	2	19	55	<4	970

Table A-3, Continued

PARTIAL DATA LISTING FOR STREAM SEDIMENT OF THE MARYSVALE DETAILED GEOCHEMICAL SURVEY, UTAH

OR SAMPLE NUMBER	D. O. E. ST LAT	SAMPLE LONG	NUMBER L TY REP	U (PPM)	U-NT (PPM)	TH (PPM)	U/TH	TH/U	MO (PPM)	BE (PPM)	Y (PPM)	CE (PPM)	NB (PPM)	MN (PPM)
911366	18-38.396	-112.492	-3-15-	57.	56.	48	1.0	0.86	22	15	110	250	42	14000
911367	18-38.394	-112.501	-3-15-	11.	12.	30	0.91	2.5	9	5	29	79	46	1000
911368	18-38.395	-112.502	-3-12-	37.	40.	45	0.93	1.1	13	11	76	150	45	4900
911369	18-38.392	-112.510	-3-15-	35.	36.	31	0.98	0.86	6	14	110	110	46	3400
911370	18-38.391	-112.510	-3-15-	11.	10.	24	1.1	2.4	4	4	27	66	35	1100
911371	18-38.375	-112.524	-3-12-	7.2	7.6	19	0.95	2.5	<4	4	22	79	14	720
911372	18-38.361	-112.534	-3-12-	30.	30.	36	1.0	1.2	5	14	65	120	42	4500
911373	18-38.360	-112.534	-3-12-	14.	14.	25	1.0	1.8	5	4	24	89	17	670
911374	18-38.367	-112.537	-3-15-	6.3	6.7	22	0.94	3.3	<4	4	20	85	8	930
911375	18-38.358	-112.535	-3-12-	26.	22.	24	1.2	1.1	8	9	39	86	43	2800
911376	18-38.425	-112.394	-3-12-	59.	52.	35	1.1	0.68	13	16	67	150	49	5500
911377	18-38.423	-112.390	-3-12-	15.	14.	27	1.1	1.9	4	13	36	110	30	3100
911378	18-38.428	-112.381	-3-15-	6.7	81.	26	0.08	0.32	5	36	100	130	32	1600
911379	18-38.429	-112.379	-3-12-	11.	9.7	19	1.2	2.0	4	7	22	77	12	980
911380	18-38.434	-112.374	-3-12-	6.4	6.6	10	0.97	1.5	<4	3	18	78	5	840
911384	18-38.319	-112.362	-3-12-	3.4	2.8	2	1.2	0.71	<4	1	17	34	<4	1000
911385	18-38.330	-112.342	-3-12-	4.1	3.3	7	1.3	2.1	<4	2	16	60	<4	1000
911386	18-38.321	-112.351	-3-12-	3.5	3.2	7	1.1	2.2	<4	2	17	65	<4	1100
911387	18-38.326	-112.372	-3-12-	5.5	4.6	11	1.2	2.4	<4	2	17	63	<4	1000
911388	18-38.338	-112.391	-3-12-	8.3	6.6	12	1.3	1.8	<4	2	19	78	<4	1000
911389	18-38.336	-112.385	-3-15-	2.2	5.5	15	0.41	2.7	<4	2	16	65	6	1100
911390	18-38.335	-112.383	-3-15-	4.0	5.7	15	0.71	2.6	<4	2	16	87	4	890
911391	18-38.465	-112.533	-3-15-	3.7	3.8	8	0.97	2.1	<4	2	17	53	4	850
911392	18-38.464	-112.532	-3-12-	4.6	6.1	21	0.76	3.4	<4	3	20	60	10	760
911393	18-38.450	-112.561	-3-12-	3.9	4.4	12	0.89	2.7	<4	2	18	70	5	950
911394	18-38.500	-112.562	-3-12-	3.4	3.9	8	0.88	2.1	<4	2	17	65	4	670
911395	18-38.492	-112.538	-3-12-	7.8	8.6	11	0.90	1.3	<4	3	19	55	12	770
911396	18-38.502	-112.567	-3-12-	6.0	6.4	10	0.94	1.6	<4	2	18	69	6	650
911398	18-38.393	-112.377	-3-12-	4.4	5.0	9	0.88	1.8	<4	2	16	86	<4	680
911399	18-38.392	-112.377	-3-15-	4.9	5.4	14	0.91	2.5	<4	4	23	92	5	830
911400	18-38.393	-112.367	-3-12-	5.7	5.3	16	1.1	3.0	<4	2	18	82	<4	740
911401	18-38.395	-112.366	-3-12-	5.3	5.2	16	1.0	3.1	<4	2	17	83	<4	680
911403	18-38.390	-112.355	-3-12-	5.4	5.2	11	1.0	2.1	<4	6	19	84	<4	4600
911404	18-38.389	-112.356	-3-12-	3.5	4.3	10	0.81	2.3	<4	3	18	88	<4	860
911405	18-38.507	-112.491	-3-12-	27.	33.	49	0.82	1.5	<4	9	68	95	56	1100
911406	18-38.489	-112.390	-3-12-	20.	20.	29	1.0	1.5	4	12	23	110	20	810
911407	18-38.484	-112.398	-3-12-	2.5	19.	30	0.13	1.6	4	8	25	140	25	1100
911408	18-38.514	-112.392	-3-12-	7.4	9.5	43	0.77	4.5	4	21	16	110	22	1600
911409	18-38.486	-112.496	-3-12-	30.	42.	75	0.70	1.8	<4	10	71	120	110	1200
911410	18-38.498	-112.493	-3-12-	32.	39.	37	0.82	0.94	<4	11	100	85	77	1100
911411	18-38.498	-112.452	-3-12-	11.	14.	34	0.79	2.5	<4	10	33	79	54	880
911412	18-38.467	-112.470	-3-12-	3.3	17.	39	0.19	2.3	<4	12	60	94	62	1200
911413	18-38.468	-112.471	-3-15-	4.2	13.	36	0.34	2.9	<4	9	40	86	58	820
911414	18-38.475	-112.454	-3-15-	18.	20.	33	0.92	1.7	<4	13	40	98	48	970
911415	18-38.475	-112.456	-3-15-	11.	13.	46	0.83	3.5	<4	9	37	89	54	910
911416	18-38.532	-112.272	-3-15-	1.8	2.3	13	0.79	5.7	<4	2	19	78	<4	900
911417	18-38.519	-112.279	-3-15-	1.4	2.1	<2	0.65	0.48	5	1	9	69	<4	970
911418	18-38.520	-112.279	-3-15-	0.59	1.9	4	0.31	2.1	4	1	9	81	<4	410
911421	18-38.523	-112.273	-3-15-	<0.25	1.7	4	0.07	2.4	4	1	5	73	<4	600
911422	18-38.390	-112.276	-3-15-	1.2	2.6	9	0.46	3.5	<4	2	12	44	4	740
911432	18-38.491	-112.396	-3-12-	12.	10.	26	1.1	2.5	120	21	21	130	14	1500
911433	18-38.494	-112.394	-3-12-	7.4	10.	12	0.73	1.2	12	8	21	110	9	1100
911434	18-38.397	-112.281	-3-15-	2.3	3.0	9	0.75	3.0	<4	2	13	59	5	700
911435	18-38.473	-112.242	-3-15-	7.8	8.2	41	0.95	5.0	<4	4	22	97	25	800
911440	18-38.334	-112.238	-3-12-	2.4	2.4	3	1.0	1.3	<4	1	12	34	<4	580

Table A-3, Continued

PARTIAL DATA LISTING FOR STREAM SEDIMENT OF THE MARYSVALE DETAILED GEOCHEMICAL SURVEY, UTAH

OR SAMPLE NUMBER	D. O. E. SAMPLE ST LAT	LONG	NUMBER L TY REP	U (PPM)	U-NT (PPM)	TH (PPM)	U/TU	TH/U	MO (PPM)	BE (PPM)	Y (PPM)	CE (PPM)	NB (PPM)	MN (PPM)
911507	18-38.451	-112.002	-3-15-	6.7	9.1	33	0.74	3.6	<4	3	21	100	13	1100
911508	18-38.450	-112.026	-3-15-	7.6	7.2	28	1.1	3.9	<4	3	27	140	9	1000
911509	18-38.449	-112.025	-3-15-	6.7	5.8	24	1.2	4.1	<4	3	23	110	9	1100
911512	18-38.414	-112.141	-3-12-	12.	9.3	23	1.3	2.5	<4	3	21	96	4	1100
911513	18-38.421	-112.134	-3-12-	7.0	9.3	25	0.75	2.7	<4	3	20	93	6	840
911514	18-38.429	-112.134	-3-15-	7.5	5.6	20	1.3	3.6	<4	2	17	77	6	700
911515	18-38.429	-112.135	-3-15-	9.5	6.9	23	1.4	3.3	<4	3	20	93	6	750
911516	18-38.391	-112.153	-3-15-	5.1	8.2	23	0.62	2.8	<4	3	21	99	6	1100
911518	18-38.494	-112.166	-3-15-	5.0	8.9	43	0.56	4.8	<4	6	23	130	28	580
911519	18-38.330	-112.343	-3-12-	3.3	4.3	5	0.76	1.2	<4	2	16	54	<4	950
911520	18-38.322	-112.352	-3-12-	2.9	3.7	8	0.78	2.2	<4	2	15	62	<4	800
911522	18-38.337	-112.364	-3-12-	4.4	4.3	10	1.0	2.3	<4	2	15	71	<4	990
911523	18-38.460	-112.286	-3-15-	6.3	7.4	26	0.86	3.5	<4	5	25	86	27	810
911524	18-38.463	-112.296	-3-15-	8.2	8.3	26	0.99	3.1	<4	5	24	69	38	630
911526	18-38.465	-112.304	-3-15-	7.5	6.5	27	1.2	4.2	<4	6	21	88	27	1100
911527	18-38.464	-112.306	-3-12-	7.5	9.8	24	0.77	2.4	<4	7	21	98	27	1200
911528	18-38.460	-112.281	-3-15-	6.2	7.4	27	0.84	3.6	<4	5	28	80	31	900
911529	18-38.460	-112.344	-3-12-	6.7	8.8	19	0.76	2.2	<4	4	18	110	10	890
911530	18-38.463	-112.341	-3-12-	11.	13.	28	0.87	2.2	<4	14	27	110	29	1500
911531	18-38.453	-112.458	-3-15-	15.	19.	36	0.80	1.9	<4	7	43	75	55	560
911532	18-38.451	-112.457	-3-12-	16.	20.	41	0.78	2.0	<4	14	47	100	50	860
911534	18-38.492	-112.455	-3-12-	33.	37.	27	0.91	0.74	<4	10	30	84	37	630
911535	18-38.487	-112.452	-3-12-	9.7	13.	29	0.73	2.2	<4	8	26	77	56	890
911537	18-38.447	-112.359	-3-12-	10.	11.	4	0.89	0.36	<4	3	17	83	<4	910
911539	18-38.441	-112.368	-3-12-	11.	13.	35	0.88	2.7	<4	12	24	100	36	1600
911541	18-38.456	-112.354	-3-12-	12.	13.	24	0.94	1.8	<4	10	26	110	33	1500
911542	18-38.357	-112.238	-3-15-	2.0	2.8	7	0.72	2.5	<4	2	13	52	<4	600
911543	18-38.351	-112.267	-3-15-	1.8	3.5	22	0.53	6.3	<4	2	16	93	5	890
911546	18-38.348	-112.236	-3-15-	1.9	2.5	15	0.75	6.0	<4	2	18	77	5	830
911547	18-38.318	-112.291	-3-12-	1.6	2.4	12	0.66	5.0	<4	1	21	64	<4	1700
911548	18-38.327	-112.281	-3-15-	2.3	3.7	2	0.62	0.54	<4	2	19	70	<4	1100
911549	18-38.326	-112.282	-3-12-	2.6	3.3	8	0.79	2.4	<4	2	15	79	<4	740
911551	18-38.324	-112.282	-3-12-	1.9	2.5	10	0.76	4.0	<4	1	21	63	<4	1600
911552	18-38.328	-112.277	-3-15-	2.3	3.6	23	0.64	6.4	<4	2	18	99	6	890
911554	18-38.330	-112.262	-3-12-	2.4	2.4	14	1.0	5.8	<4	1	18	62	<4	1200
911555	18-38.331	-112.262	-3-15-	2.3	3.6	4	0.64	1.1	<4	2	19	76	<4	860
911556	18-38.333	-112.251	-3-15-	0.98	2.5	2	0.39	0.80	<4	3	12	35	5	400
911568	18-38.411	-112.343	-3-15-	1.4	3.6	3	0.39	0.83	21	7	32	160	<4	3400
911569	18-38.407	-112.353	-3-12-	2.5	5.2	8	0.48	1.5	<4	2	16	69	<4	780
911570	18-38.399	-112.359	-3-12-	2.6	4.4	<2	0.59	0.23	<4	3	17	66	<4	1100
911571	18-38.400	-112.362	-3-12-	4.1	14.	11	0.29	0.78	<4	1	13	66	<4	510
911572	18-38.408	-112.351	-3-15-	3.0	4.8	<2	0.63	0.21	<4	2	15	66	<4	820
911574	18-38.410	-112.329	-3-15-	6.2	6.8	17	0.91	2.5	120	4	17	87	<4	3100
911575	18-38.362	-112.338	-3-12-	2.7	5.0	18	0.54	3.6	<4	2	20	88	<4	860
911576	18-38.361	-112.339	-3-12-	3.3	4.6	4	0.71	0.87	<4	2	16	62	<4	950
911578	18-38.363	-112.331	-3-12-	2.2	4.4	6	0.50	1.4	<4	2	17	68	<4	1500
911579	18-38.361	-112.328	-3-12-	2.8	5.1	4	0.55	0.78	<4	2	17	67	<4	880
911581	18-38.355	-112.319	-3-12-	3.0	4.2	11	0.71	2.6	<4	3	16	88	<4	1200
911582	18-38.353	-112.314	-3-12-	1.6	3.1	11	0.53	3.5	<4	2	16	65	<4	780
911584	18-38.371	-112.308	-3-12-	4.5	4.6	3	0.97	0.65	<4	2	14	61	<4	840
911586	18-38.358	-112.300	-3-12-	3.4	4.2	11	0.80	2.6	<4	2	14	65	<4	1000
911589	18-38.499	-112.447	-3-12-	13.	16.	34	0.85	2.2	<4	11	19	69	26	670
911590	18-38.498	-112.450	-3-12-	11.	16.	30	0.69	1.9	5	10	26	93	40	2700
911592	18-38.481	-112.466	-3-15-	25.	30.	27	0.84	0.91	<4	9	41	79	34	680
911593	18-38.480	-112.471	-3-12-	17.	18.	46	0.96	2.6	<4	9	42	79	65	440

Table A-3, Continued

PARTIAL DATA LISTING FOR STREAM SEDIMENT OF THE MARYSVALE DETAILED GEOCHEMICAL SURVEY, UTAH

OR SAMPLE NUMBER	D. O. E. SAMPLE ST LAT	LONG	NUMBER L TY REP	U (PPM)	U-NT (PPM)	TH (PPM)	U/TU	TH/U	MO (PPM)	BE (PPM)	Y (PPM)	CE (PPM)	NB (PPM)	MN (PPM)
911594	18-38.477	-112.473	-3-12-	13.	15.	37	0.84	2.4	<4	8	32	83	97	780
911595	18-38.478	-112.472	-3-12-	23.	23.	38	1.00	1.6	4	11	53	92	56	960
911596	18-38.409	-112.294	-3-15-	4.3	5.5	13	0.77	2.4	9	2	15	79	<4	870
911597	18-38.402	-112.288	-3-15-	1.5	3.3	<2	0.47	0.30	<4	2	12	37	<4	740
911615	18-38.391	-112.383	-3-12-	18.	16.	3	1.1	0.19	<4	1	17	57	<4	1800
911616	18-38.392	-112.383	-3-12-	9.0	11.	26	0.83	2.4	7	5	22	94	20	1300
911618	18-38.372	-112.260	-3-12-	2.0	3.9	9	0.51	2.3	<4	2	11	57	<4	670
911619	18-38.363	-112.284	-3-12-	4.1	4.1	12	0.99	2.9	<4	2	12	67	<4	940
911620	18-38.359	-112.296	-3-15-	3.6	3.3	12	1.1	3.6	<4	2	14	73	4	1100
911621	18-38.360	-112.298	-3-12-	4.5	4.5	18	1.0	4.0	<4	2	12	91	<4	920
911624	18-38.398	-112.314	-3-12-	4.0	5.8	9	0.69	1.6	<4	2	35	76	<4	1100
911630	18-38.393	-112.053	-3-12-	2.3	3.3	4	0.70	1.2	<4	2	21	67	<4	1400

APPENDIX B

FIELD FORM AND DETECTION LIMITS

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APPENDIX B

FIELD FORM AND DETECTION LIMITS

LIST OF TABLES

Table B-1

COMPUTER CODE LIST OF GEOCHEMICAL VARIABLES

Variable[a]	Code	Variable[a]	Code
Uranium Measured by Fluorometry[b]	U-FL	Scandium	SC
		Silicon	SI
Uranium Measured by Mass Spectrometry[b]	U-MS	Strontium	SR
Uranium Measured by Neutron Activation	U-NT	Thorium	TH
		Titanium	TI
Arsenic	AS	Vanadium	V
Selenium	SE	Yttrium	Y
Silver	AG	Zinc	ZN
Aluminum	AL	Zirconium	ZR
Boron	B	Sulfate (ppm)	SO_4
Barium	BA	Chloride (ppm)	CL
Beryllium	BE	Conductivity from Lab (µmhos/cm)	CT-L
Calcium	CA	Conductivity from Field (µmhos/cm)	CT-F
Cerium	CE	Dissolved Oxygen (ppm)	DO
Cobalt	CO	Air Temperature (°C)	ATEM
Chromium	CR	Water Temperature (°C)	WTEM
Copper	CU	pH	PH
Iron	FE	pH Measured by Lo Ion Paper	PH-P
Hafnium	HF	Total Alkalinity (ppm)	T-AK
Potassium	K	M-Alkalinity (ppm)	M-AK
Lanthanum	LA	P-Alkalinity (ppm)	P-AK
Lithium	LI	Carbonate (ppm)[c]	CB
Mangesium	MG	Bicarbonate (ppm)[c]	BC
Manganese	MN	Undissociated Carbonic Acid (ppm)[c]	CAB
Molybdenum	MO	U-NT/U-FL	TU/U
Sodium	NA	U-FL/U-NT	U/TU
Niobium	NB	TH/U-NT	TH/U
Nickel	NI	1,000·U/SP	U/SP
Phosphorus	P	1,000·U/B	U/B
Lead	PB	1,000·U/SO	U/SO
Platinum	PT		

(a) If natural logarithm of variable is used, L or L- precedes the variable code.

(b) If method is not specified for waters, U-FL is used, except where value is below laboratory detection limit in which case U-MS is substituted if it is available.

(c) These variables were approximated using cubic spline functions to fit the curves in Hem (1970), p. 155.

Table B-2

OAK RIDGE GEOCHEMICAL SAMPLING FORM
SHOWING FIELD DATA RECORDED ON MICROFICHE

OAK RIDGE GEOCHEMICAL SAMPLING FORM

1 — 1 Card Number

GENERAL SITE DATA

Attach Identical Sample Number Here (2 3 4 5 6 7)

8 9 10 11 Site Number

12 13 14 15 – 16 17 Map Code

Sample Type (18)

M	Stream Sediment
H	Lake Sediment
S	Stream Water
W	Well Water
P	Spring Water
L	Lake Water
A	Bog Water
B	Plant
F	Soil (Use Remarks)
G	Rock
Ø	Other

19 Replicate Letter (A–Z)

Hour		Day		Month		Year	
20	21	22	23	24	25	26	27

28 29 30 Collector's Initials

31 Phase (P, 1, 2, or G)

Field Sheet Status (32)

Ø	Original
C	Correction
V	Voiding

Control Sample (33)

A	Sediment, High U
B	Sediment, Low U
C	Water, High U
D	Water, Low U
Ø	Other

34 35 36 37 Air Temperature (°C)

Location

Latitude						Longitude					
Deg.		Min.		Sec.		Deg.		Min.		Sec.	
38	39	40	41	42	43	44	45	46	47	48	50

51 52 53 54 Surface Geologic Unit Code

UCN-11882
(1 8-77)

Type of Vegetation (55) (Within 1 Km Upstream)

C	Conifer
&	Conifer & Deciduous
D	Deciduous
B	Brush
G	Grass
M	Moss
L	Lichen
Ø	Other

Density of Vegetation (56) (Within 1 Km Upstream)

B	Barren
S	Sparse
M	Moderate
D	Dense
V	Very Dense

Local Relief (57) (Within 1 Km Upstream)

F	Flat	(<2m)
L	Low	(2–15m)
G	Gentle	(15–60m)
M	Moderate	(60–300m)
H	High	(>300m)
Ø	Other	

Weather

58		59	
C	Calm	C	Clear
P	Lt Wind	L	Pt Cldy
V	Windy	W	Overcst
R	V. Windy	V	Rainy
S	Gale	G	Snowy

Classes of Contaminants (60)

N	None
M	Mining (Use Remarks)
A	Agriculture
F	Oil Field
I	Industry
S	Sewage
P	Power Plant
U	Urban
Ø	Other

Average Stream Velocity (m/sec) (61 62 63)

N = No Visible Movement
P = Stagnant Pool

64 65 66 Water Width (m)

67 68 69 Average Depth (m)

Water Level

70		70	
D	Dry	N	Normal
P	Pools	H	High
L	Low	F	Flood

Dominant Bed Material (71)

B	Boulder
C	Cobble
P	Pebble
S	Sand
T	Silt
Y	Clay
N	None (Use Remarks)

Sample Color (Except Plants)

Adj		Noun		
72	73	74	75	76

V	V Lt	PK	Pink
L	Light	RD	Red
M	Medium	GN	Green
D	Dark	BU	Blue
		BN	Brown
CL	Clear	GY	Gray
WH	White	BK	Black
YL	Yellow	ØT	Other
ØR	Orange		

Odor of Sampled Material (77)

N	None
S	H_2S
Ø	Other

Results Request (78)

R (Use Remarks)

1 — 2 Card Number

PLANT SAMPLE

18 19 Number of Plants Sampled (Number of grabs for moss)

20 21 22 Trunk Diameter (m) (1 m above ground)

23 24 25 Plant Height (m) (Average of Plants Sampled)

Name of Tree, Deciduous

26		26	
R	Alto Verde	U	Locust
A	Ash	P	Maple
B	Beech	M	Mesquite
I	Birch	K	Oak, Other
D	Box Elder	V	Olive
F	Cherry	Y	Poplar
N	Cottonwood	S	Sycamore
E	Elm	T	Salt Cedar
H	Hackberry	G	Walnut
C	Hickory	X	Willow
W	Huisache	Ø	Other
L	Live Oak		

Name of Tree, Conifer

27		27	
A	N. Wh. Cedar	L	Larch
C	Cedar, Other	P	Pine
F	Fir	S	Spruce
H	Hemlock	Ø	Other
J	Juniper		

Name of Bush

28		28	
A	Alder	W	Witch Hazel
B	Blueberry	Y	Yew
P	Pussy Willow	Ø	Other

Name of Moss (29)

P	Peat
S	Sphagnum (live)
Ø	Other

Algae (30)

G	Blue-Green
B	Brown
Ø	Other

Table B-2, Continued

OAK RIDGE GEOCHEMICAL SAMPLING FORM
SHOWING FIELD DATA RECORDED ON MICROFICHE

STREAM OR LAKE SEDIMENT

Sample Condition (31)
- D Dry
- W Wet

Sample Treatment (32)
- N None
- S Sieved
- Ø Other

(33–34) Number of Grabs

(35–36) % Organic Material (Field Estimate)

GENERAL WATER SAMPLES

Water Sample Treatment (37)
- N None
- F Filtered Only
- C Acidified Only
- A Acidified and Filtered
- Ø Other

Depth of Visibility (m) (38–40) C = Clear

(41–45) Conductivity (μmhos/cm)

(46–48) Dissolved O_2 (ppm)

(49–51) Temperature (°C)

(52–54) pH

(55) P pH by Lo-Ion Paper

(56–59) Total Alkalinity (ppm)

(60–63) P Alkalinity (ppm)

(64–67) M Alkalinity (ppm)

Appearance of Water (68)
- C Clear
- M Murky
- A Algal
- Ø Other

(69–73) Discharge (liters/min)

(74–77) Identification of Producing Horizon (Geologic Unit Code)

Confidence of Producing Horizon Identification (78)
- H High Degree
- R Probable
- S Possible

Source of Producing Horizon Identification (79)
- P Publication
- W Owner
- U User
- G Geologic Inference
- Ø Other

(1) 3 Card Number

WELL WATER

Type of Well (18)
- D Drilled
- P Drive Point
- G Dug
- U Unknown
- Ø Other

Power Classification (19)
- A Artesian Flow
- E Electric
- G Gasoline
- W Wind
- H Hand
- Ø Other

Casing (20)
- N None (Below Water Table)
- S Steel
- G Galvanized
- P Plastic
- U Unknown
- Ø Other

Pipe Composition (21)
- F Steel
- Z Galvanized
- C Copper
- P Plastic
- U Unknown
- Ø Other

Sample Location (22–24) Meters from Well Head
H = Holding Tank (Use Remarks)

Where Sample Taken With Respect To Pressure Tank (25)
- B Before
- A After
- N No Pressure Tank
- F From Pressure Tank (Use Remarks)

Use of Well (26)
- M Municipal
- H Household
- S Stock
- I Irrigation
- A All of above
- X H and S
- Y H and I
- Z S and I
- N None
- Ø Other

Frequency of Pumping (27)
- C Constant (hourly)
- F Frequent (daily)
- I Infrequent (weekly)
- R Rare (no recent use)

Depth to top of Producing Horizon (28–31) (Meters)

Confidence of Producing Depth (32)
- H High
- R Probable
- S Possible

Source of Producing Depth Information (33)
- P Publication
- W Owner
- U User
- G Geologic Inference
- Ø Other

Total Well Depth (34–37) (Meters)

Confidence of Total Depth (38)
- H High
- R Probable
- S Possible

Source of Total Depth Information (39)
- P Publications
- W Owner
- U User
- G Geologic Inference
- Ø Other

LAKE WATER

Type of Lake (65)
- N Natural
- M Manmade

Lake Area (66–69) (sq km)

REMARKS (Card 4)

Table B-2, Continued

OAK RIDGE GEOCHEMICAL SAMPLING FORM
SHOWING FIELD DATA RECORDED ON MICROFICHE

OAK RIDGE GEOCHEMICAL SAMPLING FORM

FIELD DATA SUPPLEMENT

Attach Identical Sample Number Here

1	2	3	4	5	6

Sequence Number

7
1

Procedure Number

8	9

Results for Procedure 31

16	17	18	19	20	
					Total Gamma - Scintillometer (counts/minute)

Results for Procedures 34-41

16	17	18	19	20	
			•		Variables and Procedures are listed below

Results for Procedure 32 Gamma Spectrometer

16	17	18	19	20	
					TOTAL COUNTS (CPM)
22	23	24	25	26	
			•		e POTASSIUM (%)
28	29	30	31	32	
					POTASSIUM (CPM)
34	35	36	37	38	
			•		e URANIUM (ppm)
40	41	42	43	44	
					URANIUM (CPM)
46	47	48	49	50	
			•		e THORIUM (ppm)
52	53	54	55	56	
					THORIUM (CPM)

Note To Sampler: Blocks 16-20 Not Used Should Be Marked Out.

DO NOT KEYPUNCH

Procedures 34—41

34 Uranium (ppb)
35 Fluoride (ppm)
36 Nitrate (ppm)
37 Sulphate (ppm)
38 Phosphate (ppm)
39 Ferrous Iron (ppm)
40 Total Iron (ppm)
41 Turbidity (% T)

Readings made in Counts per ____________

VARIABLE	READING		BACKGROUND		RESULTS
	ACTUAL	CPM	ACTUAL	CPM	
TOTAL COUNTS					
POTASSIUM					
URANIUM					
THORIUM					

UCN-11992A
(1 3-79)

APPENDIX C

MICROFICHE OF FIELD AND LABORATORY DATA

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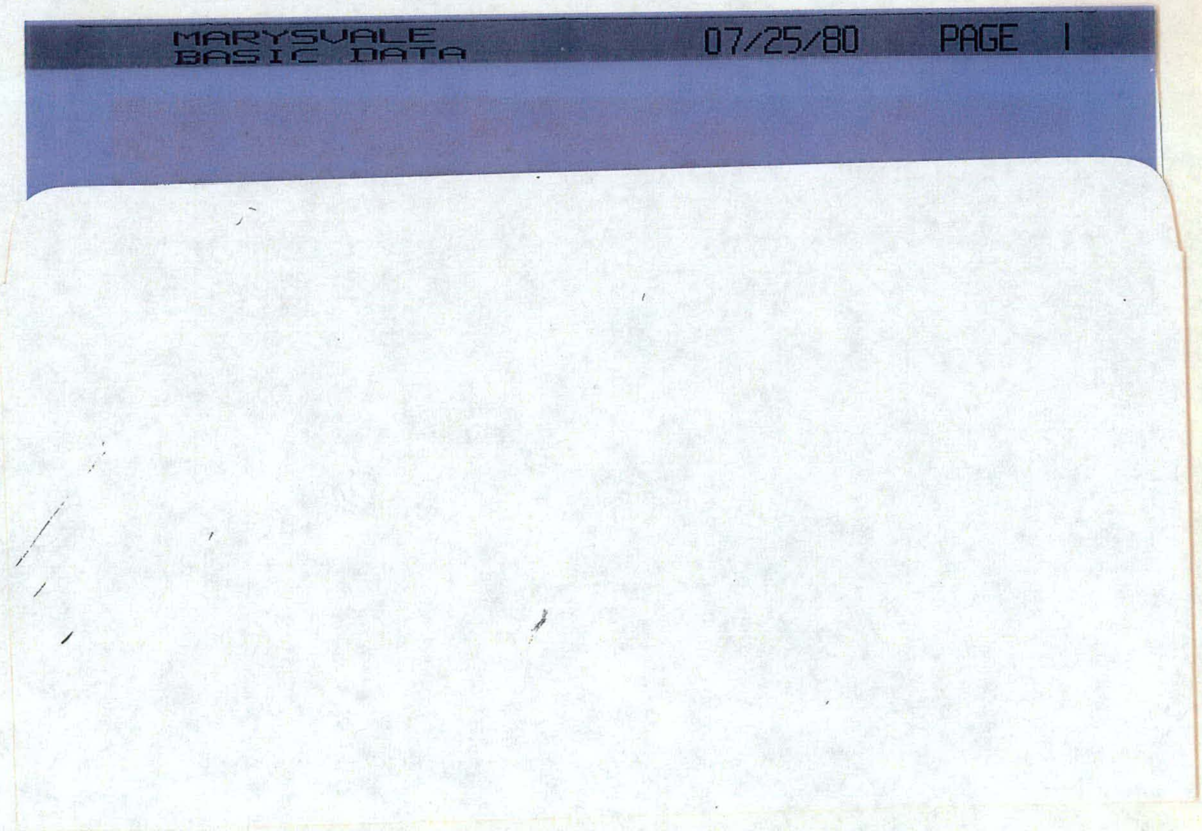
MICROFICHE OF FIELD AND LABORATORY DATA

CONTENTS



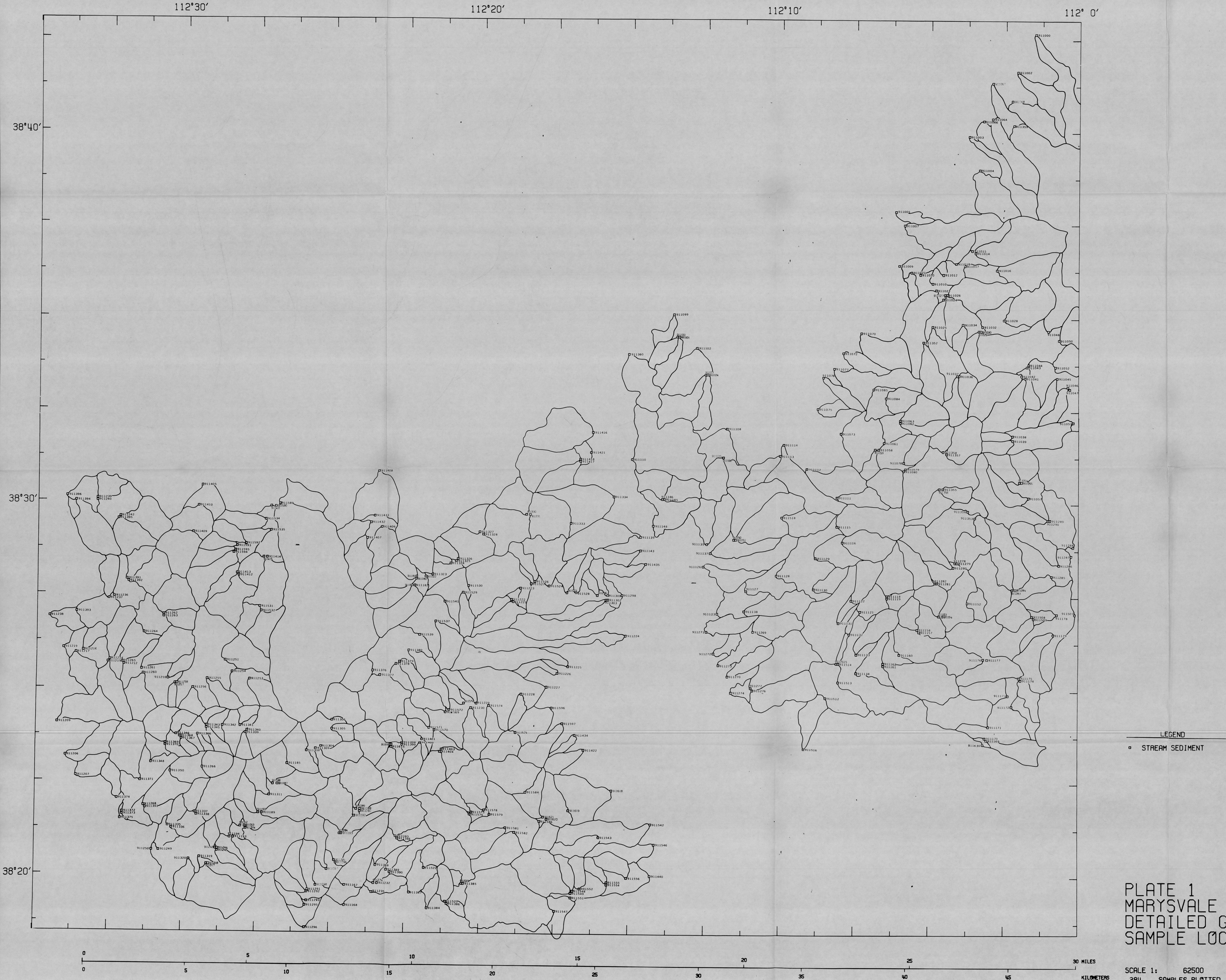
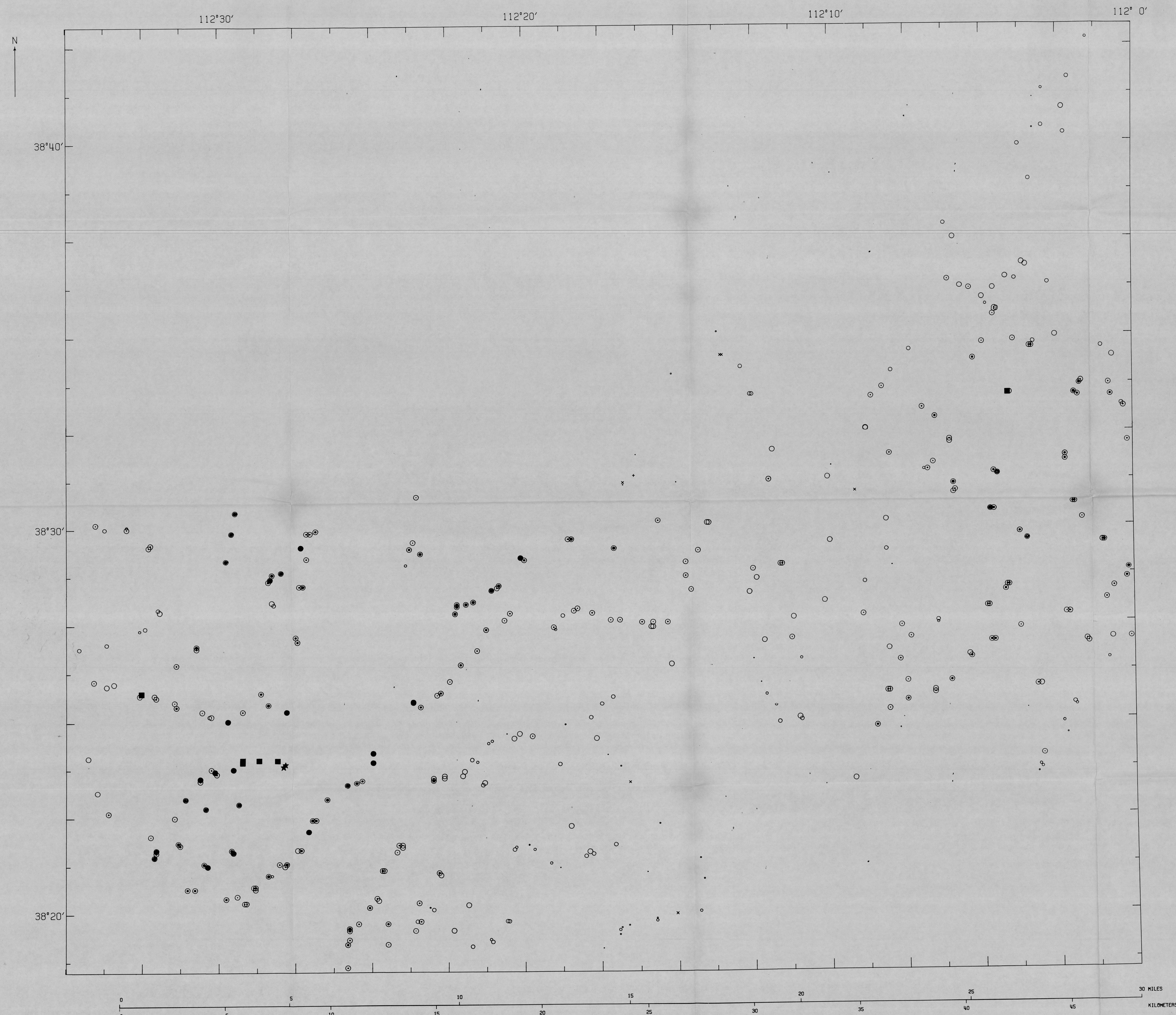


PLATE 1
MARYSVALE
DETAILED GEØCHEMICAL SURVEY
SAMPLE LØCATIØN AND DRAINAGE BASIN MAP

SCALE 1: 62500
384 SAMPLES PLØTTED

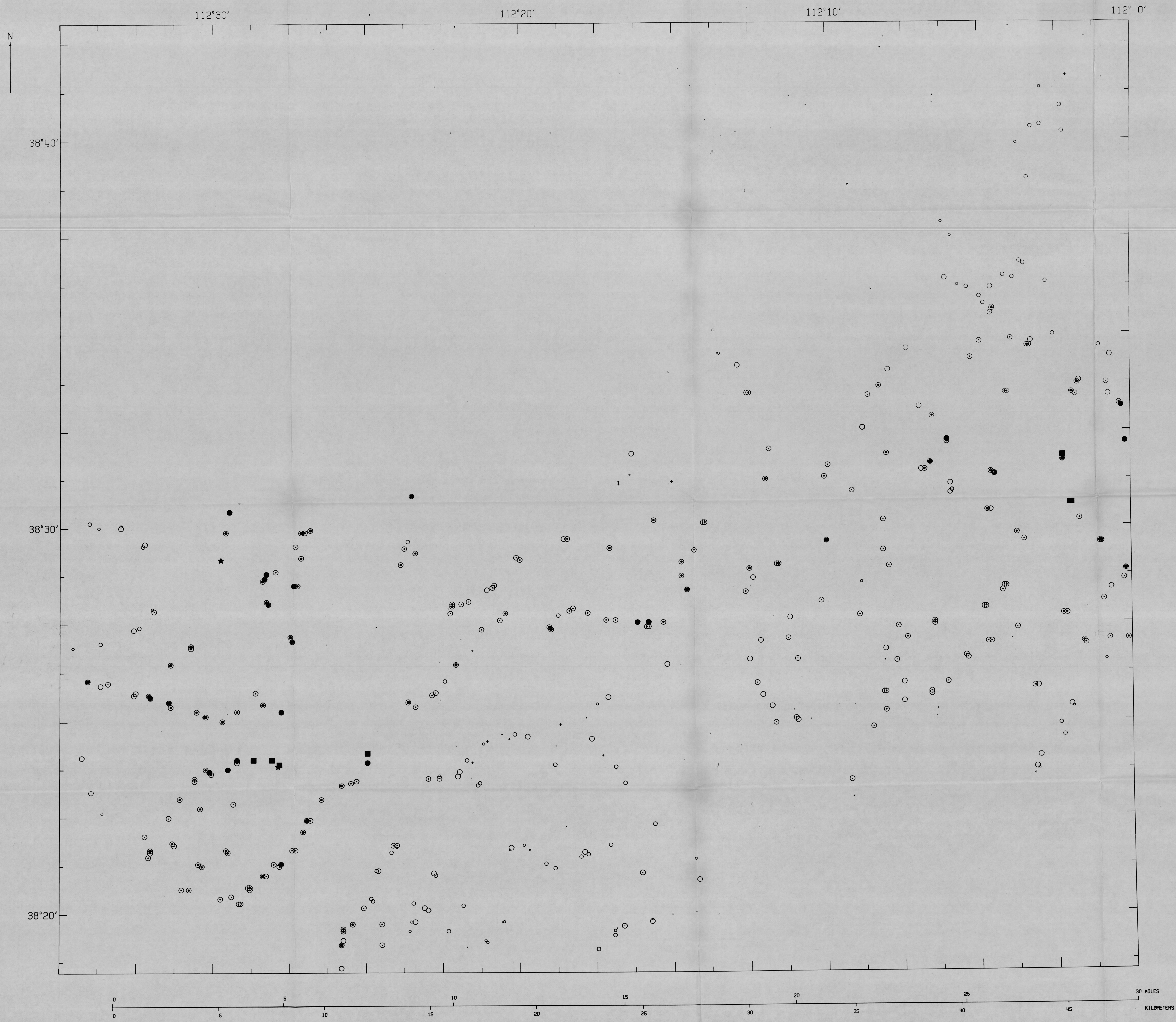


SYMBØL RANGES FØR PLØTTED VARIABLE (X)

+	0.0	≤ X <	0.25
×	0.25	≤ X <	1.28
·	1.28	≤ X <	1.87
∘	1.87	≤ X <	2.35
o	2.35	≤ X <	3.16
○	3.16	≤ X <	4.18
○	4.18	≤ X <	5.89
⊙	5.89	≤ X <	8.22
⊙	8.22	≤ X <	11.21
◉	11.21	≤ X <	16.93
◉	16.93	≤ X <	22.36
◉	22.36	≤ X <	32.39
●	32.39	≤ X <	58.98
■	58.98	≤ X <	90.32
★		X ≥	90.32

PLATE 2
MARYSVALE
DETAILED GEØCHEMICAL SURVEY
SYMBØL PLØT, SEDIMENT
URANIUM (PPM)

SCALE 1: 62500
397 SAMPLES PLØTTED

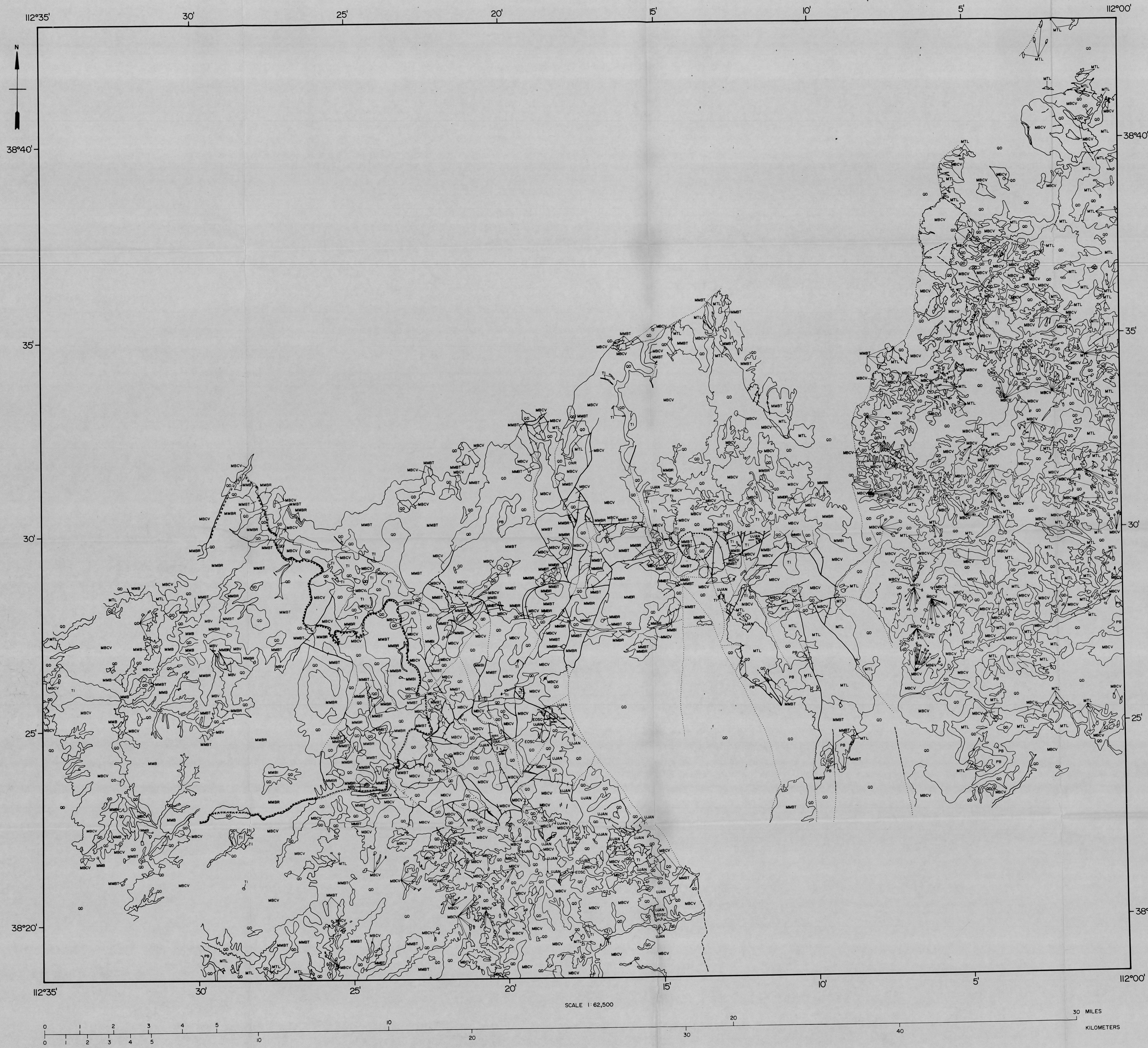


SYMBOL RANGES FOR PLOTTED VARIABLE (X)

0 ≤ X < 2
2 ≤ X < 4
4 ≤ X < 6
6 ≤ X < 9
9 ≤ X < 13
13 ≤ X < 19
19 ≤ X < 24
24 ≤ X < 28
28 ≤ X < 34
34 ≤ X < 38
38 ≤ X < 44
44 ≤ X < 52
52 ≤ X < 62
X ≥ 62

PLATE 3
MARYSVALE
DETAILED GEOCHEMICAL SURVEY
SYMBOL PLOT, SEDIMENT
THORIUM (PPM)

SCALE 1: 62500
397 SAMPLES PLOTTED



STRATIGRAPHIC COLUMN FOR THE MARYSVALE DETAILED GEOCHEMICAL SURVEY

ERA	SYSTEM	SERIES	NURE CODE		DESCRIPTION
CENOZOIC	QUATERNARY	RECENT PLEISTOCENE	QD		ALLUVIAL DEPOSITS, TRAVERTINE, LANDSLIDE DEBRIS, TERRACE GRAVEL, SEVIER RIVER FORMATION (LOWER PLEISTOCENE TO MIOCENE)
	TERTIARY	PLIOCENE (?)	PB		BASALT LAVA FLOWS
		MIOCENE	MMB	MMBR	MOUNT BELKNAP VOLCANICS – RHYOLITE LAVA FLOWS (MOUNT BALDY RHYOLITE, BLUE LAKE RHYOLITE MEMBER, GRAY HILLS RHYOLITE MEMBER AND PORPHYRITIC LAVA FLOWS, LOWER HETEROGENEOUS MEMBER, AND FLOW BANDED RHYOLITE)
				MBV	VOLCANICLASTIC ROCKS
				MMBT	MOUNT BELKNAP VOLCANICS – ASH-FLOW TUFFS (UPPER GRAY TUFF MEMBER, UPPER RED TUFF MEMBER, CRYSTAL-RICH MEMBER, RED HILLS TUFF MEMBER, JOE LOTT TUFF MEMBER, UPPER TUFF MEMBER, MIDDLE TUFF MEMBER, LOWER TUFF MEMBER, AND TUFFACEOUS RHYOLITE OR WELDED TUFF)
				MMBI	MOUNT BELKNAP VOLCANICS – INTRUSIVES (DIKES, LAVA FLOWS AND SMALL STOCKS, INTRUSIVE ROCKS, FINE-GRAINED GRANITE, AND INTRUSIVE DOMES)
			MTL		DRY HOLLOW FORMATION (PLIOCENE ?) ROGER PARK BASALTIC BRECCIA (PLIOCENE ?), OSIRIS TUFF AND VOLCANIC ROCKS OF LITTLE TABLE (MIOCENE AND OLIGOCENE)
			TI		RHYOLITE DIKES, RHYODACITE DIKES, INTRUSIVE ROCKS, INTRUSIVE LATITE, QUARTZ MONZONITE, AND INTRUSIVE ROCKS (MIOCENE AND OLDER).
		OLIGOCENE	MBCV		BULLION CANYON VOLCANICS
			ONR		NEEDLES RANGE FORMATION
MESOZOIC	CRETACEOUS (?)		EOSC		CONGLOMERATE
	JURASSIC		UJAN		ARAPIEN FORMATION NAVAJO SANDSTONE CHINLE FORMATION SHINARUMP MEMBER MOENKOPI FORMATION KAIBAB LIMESTONE TOROWEAP FORMATION QUEANTOWEAP SANDSTONE
	TRIASSIC				
PALEOZOIC	PERMIAN				
			UNKN		UNKNOWN

SOURCES:

1. CALLAGHAN, E. AND PARKER, R. L.; GEOLOGIC MAP OF PART OF THE BEAVER QUADRANGLE, UTAH (1961a).
2. ______; GEOLOGIC MAP OF THE MONROE QUADRANGLE, UTAH (1961b).
3. ______; GEOLOGIC MAP OF THE DELANO PEAK QUADRANGLE, UTAH (1962).
4. CUNNINGHAM, C. G., AND STEVEN, T. A.; GEOLOGIC MAP OF THE DELANO PEAK NW QUADRANGLE, WEST-CENTRAL UTAH (1978).
5. ______; GEOLOGIC MAP OF THE DELANO PEAK NE QUADRANGLE, WEST-CENTRAL UTAH (1979a)
6. ______; GEOLOGIC MAP OF THE MARYSVALE NW QUADRANGLE, WEST-CENTRAL UTAH (1979b).
7. STEVEN, T. A.; GEOLOGIC MAP OF THE SEVIER SW QUADRANGLE, WEST-CENTRAL UTAH (1978)
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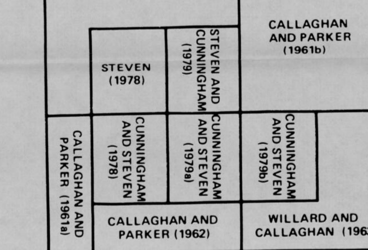
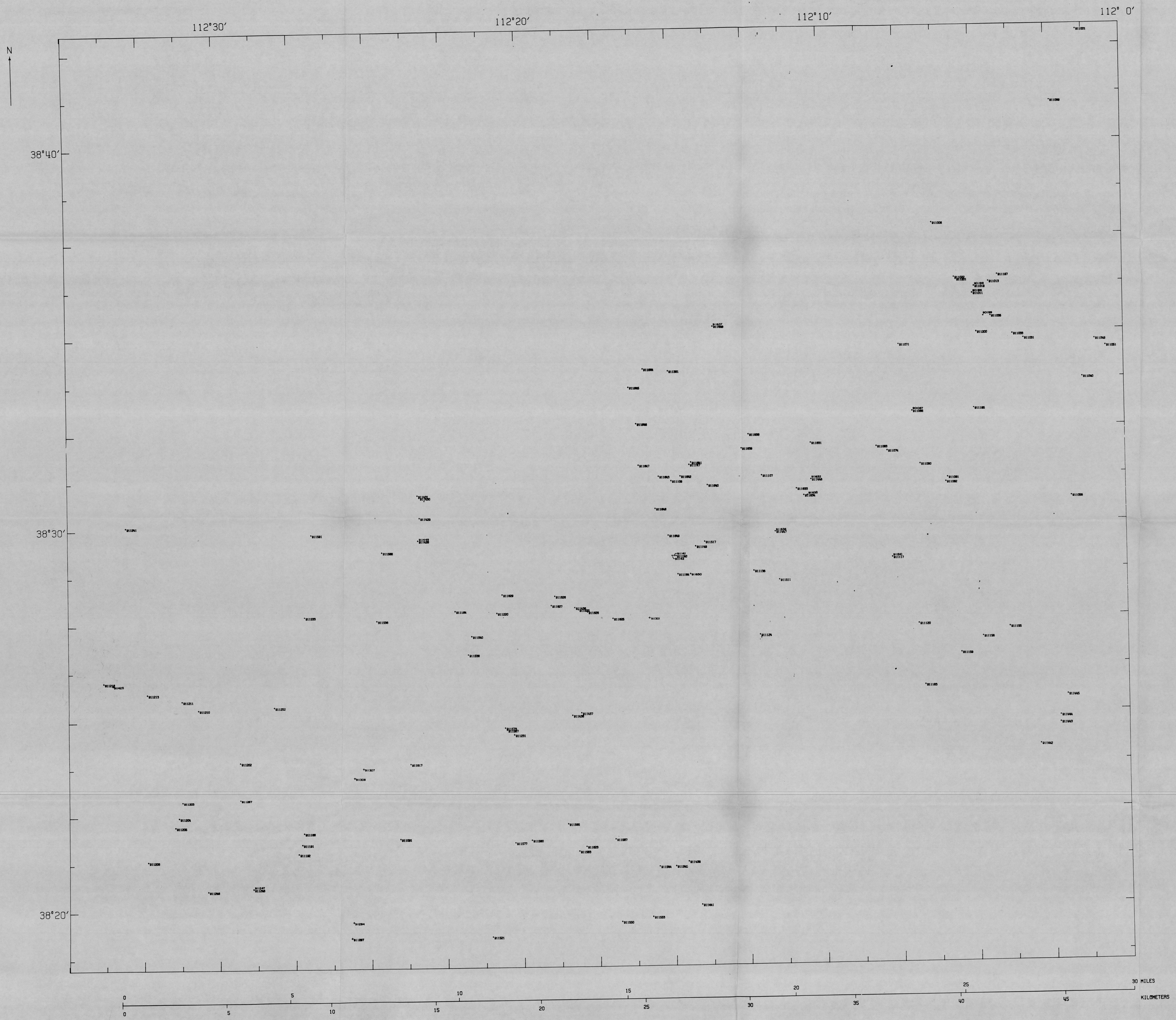


SOURCES OF GEOLOGIC INFORMATION

LEGEND

GEOLOGIC CONTACT
GEOLOGIC FAULT (DEFINITE)
GEOLOGIC FAULT (INFERRED)
GEOLOGIC FAULT (CONCEALED)
TRACE OF TOPOGRAPHIC WALL OF CALDERA

PLATE 4
GENERALIZED GEOLOGIC MAP OF THE MARYSVALE DETAILED GEOCHEMICAL SURVEY, UTAH



LEGEND

+ SOIL, ROCK, AND OTHER

PLATE 5
MARYSVALE
DETAILED GEOCHEMICAL SURVEY
RADIOMETRIC SAMPLE LOCATION MAP

SCALE 1: 62500
160 SAMPLES PLOTTED