LA-7237-MS

Informal Report

GJDX-106 '78

MASTER

Special Distribution

Issued: June 1978

MASTER

**Uranium Hydrogeochemical and Stream Sediment
Reconnaissance of The
Cheyenne NTMS Quadrangle, Wyoming**

Pam K. Trexler

los alamos
scientific laboratory
of the University of California
LOS ALAMOS, NEW MEXICO 87545

An Affirmative Action/Equal Opportunity Employer

NOTICE

PORTIONS OF THIS SERIES ARE UNRECOVERABLE. It has been determined that no further copies are available to permit the prompt and possible availability.

UNITED STATES
DEPARTMENT OF ENERGY
CONTRACT W-7405-ENG. 36

CONTENTS

LIST OF ILLUSTRATIONS	iv
LIST OF TABLES	iv
ABSTRACT	1
I. INTRODUCTION	2
II. DESCRIPTION OF THE STUDY AREA	2
Geographic Setting	2
Climate	4
III. GEOLOGY	5
Hydrology	5
Uranium Occurrences	7
IV. STATISTICAL AND EMPIRICAL EVALUATION FOR URANIUM IN SAMPLES	9
Uranium Concentrations in Waters	9
Uranium Concentrations in Sediments	11
V. SUMMARY	13
ACKNOWLEDGMENTS	15
REFERENCES CITED	16
APPENDIX A Summary of Standard LASL HSSR Field and Analytical Procedures	19
APPENDIX B Listings of Field Data and Uranium Concentrations for Water Samples	23
APPENDIX C Listings of Field Data and Uranium Concentrations for Sediment Samples	47
APPENDIX D Code to Data Listings	61
D-I Explanation of Codes Used	62
D-II Key to Sample Types	66

NOTICE

This report was prepared as an account of work sponsored by the United States Government. Neither the United States nor the United States Department of Energy, nor any of their employees, nor any of their contractors, subcontractors, or their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness or usefulness of any information, apparatus, product or process disclosed, or represents that its use would not infringe privately owned rights.

LIST OF ILLUSTRATIONS

Fig. No.

1.	Location map of the Cheyenne quadrangle, Wyoming.	3
2.	Drainage map of the Cheyenne quadrangle, Wyoming.	6
3.	Distribution of uranium concentrations in water samples, Cheyenne quadrangle, Wyoming.	10
4.	Distribution of uranium concentrations in sediment samples, Cheyenne quadrangle, Wyoming.	12

Plate No.

I.	Geologic map of the Cheyenne NTMS quadrangle, Wyoming.	pocket
II.	Sample location overlay for the Cheyenne NTMS quadrangle, Wyoming.	pocket
III.	Uranium concentrations (ppb) in waters - overlay to the Cheyenne NTMS quadrangle, Wyoming.	pocket
IV.	Uranium concentrations (ppm) in sediments - overlay to the Cheyenne NTMS quadrangle, Wyoming.	pocket

LIST OF TABLES

Table No.

I.	Reported Uranium Occurrences in the Cheyenne NTMS Quadrangle, Wyoming	8
II.	Summary of Uranium Concentrations in Water Samples, Cheyenne Quadrangle, Wyoming	9
III.	Summary of Uranium Concentrations in Sediment Samples, Cheyenne Quadrangle, Wyoming	11
IV.	Summary of Sediment Samples Containing Greater Than 14 ppm Uranium, Cheyenne Quadrangle, Wyoming	13

URANIUM HYDROGEOCHEMICAL AND STREAM SEDIMENT RECONNAISSANCE OF THE CHEYENNE NTMS QUADRANGLE, WYOMING

by
Pam K. Trexler

ABSTRACT

Between June 1976 and October 1977, 1138 water and 600 sediment samples were systematically collected from 1498 locations in the Cheyenne NTMS quadrangle of southeast Wyoming. The samples were analyzed for total uranium at the Los Alamos Scientific Laboratory. The uranium concentration in waters ranged from 0.01 to 296.30 parts per billion (ppb), with a median of 3.19 ppb and a mean of 8.34 ppb. The uranium in sediments ranged from 0.8 to 83.0 parts per million (ppm) with a median of 3.4 ppm and a mean of 4.5 ppm.

Arbitrary anomaly thresholds were selected to isolate those water and sediment samples containing uranium concentrations above those of 98% of the population sampled. Using this procedure, 23 water samples above 54.50 ppb and 12 sediment samples above 14.0 ppm were considered anomalous.

Several areas appear favorable for further investigation for possible uranium mineralization. High uranium concentrations were detected in waters from the northeast corner of the Cheyenne quadrangle. High uranium concentrations were detected in sediments from locations in the southern and central Laramie Mountains and along the southeast and east-central edges of the study area.

I. INTRODUCTION

This is a summary of work performed in the Cheyenne, Wyoming, National Topographic Map Series (NTMS) quadrangle (1:250 000 scale) by the Los Alamos Scientific Laboratory (LASL) as part of the nationwide Hydrogeochemical and Stream Sediment Reconnaissance (HSSR). The HSSR, a part of the National Uranium Resource Evaluation (NURE) program sponsored by the US Department of Energy (DOE), is designed to identify areas having higher than normal concentrations of uranium in ground waters, surface waters, and water-transported sediments. The HSSR data will ultimately be combined with data from other NURE programs (e.g., from airborne radiometric surveys and geological investigations) to prepare an improved assessment of the potential uranium resources in the US and to indicate areas favorable for uranium exploration by the private sector. The LASL is responsible for conducting the HSSR in the Rocky Mountain states of New Mexico, Colorado, Wyoming, Montana, and in Alaska.

Between June 1976 and October 1977, 1498 locations, selected by the LASL, were visited to obtain 1138 water and 600 sediment samples from the Cheyenne reconnaissance area. A private contractor, Professional Consultants, Incorporated, collected samples at the majority of the locations in the western half of the study area from mid-June to mid-July 1976. In mid-December 1976 and early June 1977, Mowater Services sampled locations selected to complete coverage in the western half. Locations in the eastern half of the quadrangle were sampled from September to October 1977 by Bendix Field Engineering Corporation. Throughout the study, standardized field and analytical procedures developed by LASL (Sharp, 1977), and summarized in Appendix A, were used so that the data from the Cheyenne reconnaissance might be compared to those in LASL HSSR reports on surrounding areas.

The plates (all at 1:250 000 scale) in the rear pocket are: a geologic map of the study area on Plate I, a sample location overlay on Plate II, a uranium concentration overlay for waters on Plate III, and a uranium concentration overlay for sediments on Plate IV.

II. DESCRIPTION OF THE STUDY AREA

The Cheyenne NTMS quadrangle, bounded by latitudes 41° and 42°N and longitudes 104° and 106°W, covers an area of approximately 18 750 km² in southeast Wyoming, southwest Nebraska, and northeast Colorado (Fig. 1). The reconnaissance area encompasses portions of four Wyoming counties (Albany, Laramie, Platte, and Goshen), three Nebraskan counties (Kimball, Banner, and Scotts Bluff), and a small part of Weld County, Colorado.

Access to the area is provided by numerous paved and graded roads. Interstate 80 traverses the area from east to west and US Highways 85, 87, and 287 serve as the major north-south arterials.

The population in the Cheyenne quadrangle is approximately 84 000. Cheyenne, the capitol of Wyoming, has over 46 650 inhabitants; Laramie, 23 500; and Pine Bluffs, over a thousand residents (1975 estimates). Approximately 9% of the land area is federally owned, 7% is state owned, and 84% is privately owned (State of Wyoming, 1975).

Geographic Setting

Portions of the Great Plains, Southern Rocky Mountains, and Wyoming Basin geomorphic provinces are found in the Cheyenne reconnaissance area.

Fig. 1. Location map of the Cheyenne quadrangle, Wyoming.

The High Plains section of the Great Plains province, also referred to as the northern Denver Basin, occupies the eastern half of the study area. Its flat, northeast sloping surface has resulted from extensive stream redistribution of the Miocene strata that blanket much of the area. In the northeast corner of the quadrangle lies Goshen Hole, an erosional lowland that is generally defined by escarpments. The Goshen Hole lowland is a great wedge-shaped widening of the valley along the North Platte River.

In the central portion of the Cheyenne quadrangle lie the north-trending Laramie Mountains, which are an extension of the Southern Rocky Mountain geomorphic province. The mountain relief is moderate, and few peaks rise above the surface of an east-sloping, dissected surface that ranges between 2590 and 2745 m in elevation (Morris and Babcock, 1960). The mountains to the north are lower in elevation but are more rugged.

The Laramie Basin, the part of the Wyoming Basin province that separates the Southern from the Middle Rocky Mountains, is an extension of the Great Plains and has similar geology and topography. This intermontane basin is only 56 km long by 32 km wide and lies at an average elevation of 2165 m, nearly 550 m above the average elevation in the Denver Basin.

The vegetation in the study area is altitudinally zoned. Above timberline much of the ground is bare, with a few herbs and grasses growing in sheltered areas. Just below timberline, fir and Engelman spruce are prevalent. At lower elevations, the vegetation grades from a zone of lodgepole pine to a zone of Douglas fir and yellow pine. Pinon and juniper predominate on the lower mountain slopes, giving way to short grasses and sagebrush in the basins (Hunt, 1974).

Climate

Climate in the Cheyenne NTMS quadrangle is semiarid, windy, and cool. The weather is controlled and moderated by the prevailing westerly winds that blow most of the year. The air loses much of its moisture over the mountains to the west and brings little precipitation into the area.

Nearly half the annual precipitation falls during May and June. At that time the strength of the westerlies is diminished, and northern and southern winds bring moisture into the area. The amount of rainfall diminishes in late June; during July and August, it either slightly decreases, as in the Laramie Basin, or levels off, as in the mountains and east into the northern Denver Basin. During the winter, precipitation is at a minimum. The average annual precipitation is over 355 mm in the Denver Basin, 400 mm in the mountains, and 290 mm in the Laramie Basin. The average annual runoff varies from over 65 mm in the mountains, to 25 mm in the Laramie Basin, to less than 5 mm in the extreme southeast. The average temperatures during the winter range from lows around -15°C to highs around 5°C. Summer high temperatures average 30°C and lows average 10°C.

During the sampling period, temperatures were higher than normal and the precipitation was somewhat less than normal. Both temperature and general weather data were recorded at each sample location and are included in the data listings of Appendixes B and C. Codes to these data listings are provided in Appendix D. Additional information on the climate in the Cheyenne area is available from Becker and Alyea (1964a and 1964b) and the National Oceanic and Atmospheric Administration (1976 and 1977).

III. GEOLOGY

The geologic history and stratigraphy of the Cheyenne quadrangle have been extensively covered by Thomas (1949), Littleton (1950), McGrew (1953), Rapp et al (1957), Bjorklund (1959), Morris and Babcock (1960), Lowry and Crist (1967), Houston (1969), Gill et al (1970), and Blackstone (1975a) and therefore will be discussed only briefly. The geologic map provided in the rear pocket (Plate I) illustrates outcrop patterns and provides stratigraphic relations and lithologic descriptions for units exposed in the reconnaissance area.

The major structural features in the Cheyenne area were formed during the Laramide orogeny, which was initiated in the late Cretaceous and extended into the Eocene. Subsequent highland erosion distributed Eocene and Oligocene sediments over the Laramie and Denver Basins. By early Miocene time, the mountains were reduced to a series of rounded monadnocks. Uplift in the Rocky Mountain region resumed in the Pliocene, rejuvenating the streams that dissected the Miocene erosion surface, forming terraces and sculpturing the topography of recent time (Morris and Babcock, 1960).

The nearly horizontal Upper Cretaceous and Tertiary strata of the northern Denver Basin lie unconformably atop Paleozoic and Mesozoic rocks that have been folded into a trough extending from Cheyenne to Colorado Springs, Colorado. The axis of this trough lies east of the mountain front and plunges toward the south (Blackstone, 1971).

Structurally, the Laramie Mountains are similar to other Southern Rocky Mountain ranges. The mountains are the remnants of an asymmetric anticlinal uplift, along the core of which the oldest rocks in the study area are exposed. The oldest rocks consist of Precambrian granites in the south and schist or anorthosite in the north. The Precambrian core is flanked by Paleozoic and Mesozoic strata. The strata on the west limb of the range dip at a shallow angle, while those on the east limb dip sharply or are overturned and cut by thrust faults. On the western flank, approximately 430 m of Paleozoic and 3960 m of Mesozoic strata are exposed. Late Cretaceous and as much as 3000 m of Tertiary strata extensively blanket these older units in the eastern half of the study area. Along the basin margins, many secondary faults and folds are present (Tudor, 1953).

The Laramie Basin is a complex trough, up to 11 km deep (Blackstone, 1971), trending roughly parallel to US Highway 287 and plunging toward the northwest. Small scale folding in the basin consists of a north-trending series in the central and a northeast-trending series in the southwestern portion of the basin. From the study of LANDSAT imagery, Blackstone (1975b) has concluded that these younger basin structures are controlled by linear elements in the Precambrian basement.

Hydrology

The eastern part of the Cheyenne quadrangle is drained by the eastward-flowing streams of Bear and Horse Creeks in the North Platte drainage system and of Lodgepole, Crow, and Lone Tree Creeks in the South Platte drainage system (Fig. 2). The western and north-central portions of the quadrangle are drained by the Little Laramie River, Sybille Creek, and Chugwater Creek, which are north-flowing tributaries of the Laramie River, and the Laramie River, which flows into North Platte River north of the reconnaissance area.

Monthly records from a gaging station along the Laramie River west of Jelm Mountain indicate that stream discharge is lowest during February and

Fig. 2. Drainage map of the Cheyenne quadrangle, Wyoming.

highest during June. This pattern is thought to be representative of streams in the entire region (Lowry et al, 1973).

In the Denver Basin, the most significant aquifers are shallow sandstones, siltstones, and gravels found in the Cretaceous Lance formation; Tertiary Brule, White River, Arikaree, and Ogallala formations; and Quaternary terrace and floodplain deposits. Most ground water in the Denver Basin and north-central regions of the reconnaissance area flows eastward (Lowry and Crist, 1967; Weeks, 1964). In the Laramie Mountains, ground water is found at shallow depths, where permeability has been provided by weathering and fracturing of igneous and metamorphic rocks.

The most significant aquifers in the Laramie Basin are sandstones and shales of the Permian Satanka and Casper formations, the Triassic Chugwater formation, the Cretaceous Mesaverde group, the Tertiary Wind River formation, and Quaternary terrace and floodplain deposits (Lowry et al, 1973). In those aquifers that yield greater than 100 gallons per minute to wells in the basin, secondary permeability is known to be a factor.

In most parts of the Cheyenne quadrangle there is free exchange between surface and ground waters. In the Laramie Basin, however, the bedrock underlying the floodplain of the Little Laramie and Laramie Rivers is not sufficiently permeable to allow exchange between surface waters and ground waters (Lowry et al, 1973).

In general, both ground and surface waters are of the calcium bicarbonate type. Along the lower reaches of streams in the basins, however, return from irrigation is a considerable contribution to stream flow and water is of the calcium sulfate or calcium and sodium sulfate type. Ground water from deep aquifers and ground waters with long residence periods are usually high in sodium (Lowry et al, 1973).

Streams heading in the Laramie Mountains generally contain less than 300 parts per million (ppm) dissolved solids. The dissolved solid content of surface waters is usually less than 480 ppm in the Denver and Laramie Basins and increases downstream. The dissolved solids content in ground water varies within each aquifer and from one aquifer to another and ranges from 150 to 700 ppm (Lowry et al, 1973; Lowry and Crist, 1967; and Rapp et al, 1957). A rough estimate of dissolved solid content, in ppm, may be estimated from the specific conductance values measured in $\mu\text{mho/cm}$ at each water sample location listed in Appendix A. To obtain the estimated dissolved solids content at each location, multiply the specific conductance value by 0.7 (Davis and De Wiest, 1966).

More detailed information on both surface and ground water is provided by Littleton (1950), Rapp et al (1957), Bjorklund (1959), Morris and Babcock (1960), Weeks (1964), US Geological Survey and Wyoming Natural Resources Board (1971), Lowry and Crist (1967), and Lowry et al (1973).

Uranium Occurrences

Although uranium has been found in every major stratigraphic unit in Wyoming (Finnell and Parrish, 1958), the most economically important deposits have been found in strata of early Eocene age. The Laramie Mountains are considered to be an important source for these Tertiary uranium deposits (Houston, 1969). Shannon and Ruzycki (1957) consider the most favorable uranium host rocks in the southern Laramie Basin to be the upper sandstone member of the Cretaceous Cloverly formation, which also crops out in the central and south-eastern regions of the study area.

Those formations that have been cited to contain uranium deposits elsewhere in Wyoming include: the Pennsylvanian Tensleep sandstone; the Triassic Chugwater formation; the Jurassic Morrison formation; the Cretaceous Cloverly

formation, Mesaverde group, Medicine Bow formation, and Lance formation; the Eocene Wind River formation; the Oligocene White River, Chadron, and Brule formations; and the Pliocene North Park formation (Finch, 1967).

The ten uranium occurrences noted in the literature of this area are listed in Table I and located on Plate IV. These occurrences are described more fully by Finch (1967), Mardirosian (1967), Smith (1954), Shannon and Ruzycki (1957), Wilson (1960), Osterwald et al (1966), and Elevatorski (1976).

Six uranium occurrences have been reported in the Laramie Mountains (A through F on Plate IV). They are associated with metalliferous veins, quartz veins, and pegmatites cutting Precambrian granite and anorthosite.

Of the sandstone units that crop out in the reconnaissance area, only the Morrison and Cloverly formations are reportedly uraniferous. Four uranium occurrences have been discovered where these units crop out in the northeast portion of the quadrangle and along a north-plunging syncline in the southern Laramie Basin (occurrences G-J on Plate IV). The Desert Rose claim (I on Plate IV) in the Cloverly formation contains from 0.1 to 0.14% U_3O_8 (Osterwald et al, 1966) and is the only mineralized area in the quadrangle from which uranium has been produced.

TABLE I

Reported Uranium Occurrences in the Cheyenne NTMS Quadrangle, Wyoming

<u>Name</u>	<u>Location (T, R, sec)</u>	<u>Latitude</u>	<u>Longitude</u>	<u>Comments</u>
A. Silver Crown District (Hecla)	T14N, R70W, sec 14 23-26, 35, 36	41°09'N	105°11'W	Autunite and tobernite in fractured diorite dikes cutting Precambrian granites and schist; no radiometric anomaly detected (Smith, 1954).
B. Buford Area	T13N, R71W, sec 1	41°08'N	105°18'W	Uraniferous granitic pegmatites.
C. Tie Siding Area	T12 and 13N, R71 and and 72W	41°03'N	105°25'W	Uraniferous feldspar-rich pegmatites cutting Precambrian Sherman granite; radiometric readings of 9.0 mR/hr over background of 0.01 mR/hr (Smith, 1954).
D. Dale Creek Area	T14N, R72W, sec 11	41°11'N	105°29'W	Uraniferous quartz monzonite.
E. Unnamed	T15N, R71W, sec 1 and 2	41°18'N	105°18'W	Uraniferous Precambrian rock cut by pegmatites.
F. Big Mac Claim (Wheatland)	T23N, R69W, sec 19	41°57'N	105°10'W	Allanite in association with biotite occurring in orthoclase pegmatite; radiometric readings of 1.0 mR/hr over background of 0.01-0.02 mR/hr (Smith, 1954).
G. Unnamed	T14N, R74W, NW¼, sec. 13, SE¼, sec 27	41°10'N	105°40'W	Uraniferous Cloverly sandstone.
H. Unnamed	T13N, R75W, NW¼, sec 15	41°07'N	105°47'W	Uraniferous Morrison formation.
I. Desert Rose Claim	T13N, R76W, sec 9	41°07'N	105°56'W	Meta-tyuyamunite in fractured Cloverly sandstone with 0.1-0.14% U_3O_8 (Osterwald et al, 1966); past production.
J. Unnamed	T22N, R76W, sec 5	41°54'N	105°57'W	Uraniferous Morrison formation.

IV. STATISTICAL AND EMPIRICAL EVALUATION FOR URANIUM IN SAMPLES

Field data and measured uranium concentrations for waters and sediments collected from the Cheyenne quadrangle are given in Appendixes B and C, respectively. An explanation for the codes used in Appendixes B and C is given in Appendix D. In the rear pocket, overlays to the Cheyenne NTMS map sheet at 1:250 000 scale are provided for geology (Plate I), sample locations (Plate II), uranium concentrations in water (Plate III), and uranium concentrations in sediment (Plate IV). Note that on Plate II, the first two alphanumeric characters have been dropped from each of the sample location numbers as set forth in the data listings of Appendixes B and C. The largest symbol on the concentration overlays (Plates III and IV) designates those uranium concentrations above the 98th percentile of the total water and sediment populations, respectively. Likewise, the next symbol interval designates those uranium concentrations between the 95th and 98th percentile of the total populations. The remaining intervals were selected in an attempt to provide the best possible definition of lower uranium concentrations in the quadrangle. All plates may be used in conjunction with the Cheyenne NTMS map sheet published by the US Geological Survey.

The following discussion of uranium concentrations in waters and sediments is limited to a summary of the data and verification of their validity. It is not intended to be a comprehensive assessment of the potential uranium resource in the quadrangle.

Uranium Concentrations in Waters

Water samples were collected from 1138 locations in the Cheyenne reconnaissance area. Each water sample was analyzed for total uranium at the LASL as set forth in Appendix A. For each water type sampled, the population size, range, median, and mean are shown in Table II. The semilogarithmic-scale histogram of uranium concentrations in waters (Fig. 3) shows that the distribution approaches log-normality. Of the 1138 water samples collected, 96 were from springs, 850 from wells, 166 from streams, 8 from natural ponds, and 18 from artificial ponds. The uranium concentrations range from 0.10 to 296.30 parts per billion (ppb), with a median of 3.19 ppb and mean of 8.34 ppb uranium. Concentration of uranium, possibly as a result of evaporation, is reflected in the generally higher uranium values in pond waters (Table II).

TABLE II

Summary of Uranium Concentrations in Water Samples,
Cheyenne Quadrangle, Wyoming

<u>Sample Source</u>	<u>Number of Samples</u>	<u>Range (ppb)</u>	<u>Median (ppb)</u>	<u>Mean (ppb)</u>
All Waters	1138	0.01 - 296.30	3.19	8.34
Springs	96	0.03 - 30.60	2.79	3.64
Wells	850	0.01 - 296.30	3.89	3.13
Streams	166	0.01 - 48.70	1.77	9.97
Natural Ponds	8	0.61 - 26.40	7.65	9.26
Artificial Ponds	18	0.21 - 18.10	3.58	4.27

Fig. 3. Distribution of uranium concentrations in water samples, Cheyenne quadrangle, Wyoming.

The uranium concentration varies among the different geologic and physiographic regions in the study area. The greatest range of uranium concentrations was found in samples from the Denver Basin.

The surface water samples were subject to seasonal climatic variations, which may have some effect on the uranium concentrations (Doi et al, 1975; Germanov et al, 1958). Therefore the uranium values from surface water samples are not necessarily directly comparable. However, 75% of the samples collected were from wells and are likely to be relatively free of possible seasonal variation.

The value of the anomaly threshold for uranium concentrations in waters is difficult to determine, particularly in an area such as the Cheyenne quadrangle where background concentrations vary from region to region. Some geochemists have selected a value of two standard deviations above the mean (or the high side of the 95% confidence limit), while others have used three standard deviations above the mean (or the high side of the 99% confidence limit) for the anomaly threshold (Wainerdi and Uken, 1971). Such systems are useful in selecting the threshold for normal distributions. However, waters from the Cheyenne reconnaissance follow a non-normal distribution, and for this reason it was arbitrarily determined that those samples containing concentrations of uranium higher than that of 98% of the total population (or the highest 2%, which are above 54.50 ppb) would be considered anomalous.

A total of 23 well water samples from the reconnaissance area contained uranium concentrations greater than 54.50 ppb and are considered anomalous. Of these, 21 were collected from locations in the northeast corner of the study area where Cretaceous Lance, Oligocene Brule, and Oligocene Chadron formations crop out. Most wells in the Goshen Hole lowland penetrate aquifers in the Lance formation (Rapp et al, 1957), which contains numerous thin coal beds. These coal seams may control the occurrence of uranium in the waters collected from the area. Some deeper wells in that area may penetrate aquifers in the Wind River formation, a known uranium host in Wyoming. The frequency of

anomalous samples from locations in the northeast portion of the quadrangle suggests that further exploration of this region may be warranted.

A cluster of waters containing uranium concentrations higher than local background is located in the east-central Laramie Basin, in the vicinity of latitude 41°29' and longitude 105°57'. Wells and springs in this area may yield water from aquifers in the Tertiary Wind River formation, which crops out to the north.

Two anomalous water samples from locations W23488 and W23218, containing 74.60 ppb and 56.60 ppb uranium, respectively, were collected from locations lying in the northwest portion of the study area. Either of these samples may have come from an aquifer associated with the Morrison formation, which is known to be uraniferous in the northwest portion of the study area (J on Plate IV). Detailed study of local backgrounds through contouring or other evaluation techniques may reveal that the other known uranium occurrences are detectable in water sampling results at lower uranium concentration levels than were studied here.

Uranium Concentrations in Sediments

Sediment samples were collected from 600 locations in the Cheyenne reconnaissance area. These were analyzed for total uranium at the LASL using the delayed neutron counting (DNC) procedure described in Appendix A. The geologic characteristics of the eastern half of the quadrangle and the abundance of wells led to the choice of ground water as the preferred sample type; thus few sediment samples were taken in this half.

For each sediment type sampled, the population size, range, median, and mean are shown in Table III. The uranium concentrations in sediments are shown in Fig. 4 as a semilogarithmic-scale histogram. It should be noted from Fig. 4 that the distribution of uranium in sediments is skewed to the right by a few high-uranium samples.

Of the 600 sediment samples collected, 54 were from wet springs, 160 from wet streams, 10 from wet natural ponds, 18 from wet artificial ponds, 243 from dry streams, 42 from dry natural ponds, 56 from dry artificial ponds, and 17

TABLE III

Summary of Uranium Concentrations in Sediment Samples,
Cheyenne Quadrangle, Wyoming

<u>Sample Source</u>	<u>Number of Samples</u>	<u>Range (ppm)</u>	<u>Median (ppm)</u>	<u>Mean (ppm)</u>
All Sediments	600	0.8 - 83.0	3.4	4.5
Wet Springs	54	1.9 - 17.0	3.8	4.7
Wet Streams	160	0.8 - 21.0	4.1	5.2
Wet Natural Ponds	10	2.2 - 7.6	3.8	4.0
Wet Artificial Ponds	18	1.5 - 10.5	3.6	4.6
Dry Streams	243	1.5 - 83.0	3.2	4.4
Dry Natural Ponds	42	1.7 - 8.7	3.4	3.6
Dry Artificial Ponds	56	2.0 - 8.5	3.1	3.5
Dry Springs (Other)	17	1.9 - 10.6	3.3	4.4

Fig. 4. Distribution of uranium concentrations in sediment samples, Cheyenne quadrangle, Wyoming.

from dry springs. Uranium concentrations range from 0.8 parts per million (ppm) to 83.0 ppm, with a median of 3.4 ppm and mean of 4.5 ppm. Only 25 sediments were collected from the eastern half of the study area. These were included in the data of Table III but are of little value in defining any regions of high uranium concentrations.

Twelve samples containing uranium concentrations greater than 14 ppm (the upper 2% uranium concentrations) are arbitrarily considered anomalous. These include samples collected from two springs, three wet streams, and seven dry streams. A summary of these samples is given in Table IV.

Five anomalous samples were collected from the western flank of the Laramie Mountains and two more from a nearby section of the Laramie Basin. These fall into two high-uranium concentration sample clusters. One cluster includes anomalous samples from locations W23422 (24.3 ppm), W22784 (16.4 ppm), and W22990 (14.3 ppm) and encompasses the areas of known mineralization at Silver Crown, Buford, and an unnamed occurrence (labeled A, B, and E on Plate IV). This large north-south trending cluster is roughly convex lens-shaped and encompasses much of the southern Laramie Mountains. Southwest of this cluster, the second cluster includes the anomalous samples from locations W22903 (17.7 ppm), W22780 (39.5 ppm), W23424 (15.0 ppm), and W23415 (17.0 ppm). The known uranium mineralization at Tie Siding lies along the southeastern edge of this egg-shaped cluster (latitude 41°11'N, longitude 106°00'W).

In the southwest near Sheep Mountain, a very highly anomalous dry stream sediment from location W23133 (83.0 ppm) and an anomalous spring sediment from location W23365 (16.2 ppm) were collected. Moderately high uranium concentrations were also detected on the western slopes of Sheep Mountain in the Rawlins quadrangle reconnaissance area (Weaver et al, 1978).

A small cluster of samples with relatively high uranium content were collected from the east-central Laramie Mountains near latitude 41°32'N and longitude 105°57'W. This cluster roughly follows the outcrop of the Tertiary Wind River formation.

TABLE IV

**Summary of Sediment Samples Containing Greater Than 14 ppm Uranium,
Cheyenne Quadrangle, Wyoming**

<u>Sample Location Number</u>	<u>Sample Type</u>	<u>Uranium (ppm)</u>	<u>Comments</u>
W22780	Dry Stream	39.6	Collected along Dale Creek, which drains Precambrian anorthosites in the southern Laramie Mountains.
W22784	Dry Stream	16.4	Collected along the Middle Fork of Crow Creek, which drains Precambrian anorthosites in the southern Laramie Mountains.
W22903	Wet Stream	17.7	Downstream of 22780 along Dale Creek, which drains Precambrian anorthosites in the southern Laramie Mountains.
W22990	Dry Stream	14.3	From Brush Creek, which drains Precambrian anorthosites at Green Mountain in the southern Laramie Mountains.
W23009	Wet Stream	17.3	Isolated anomalous sample from along Brush Creek, which drains Tertiary and Quaternary strata in the northern Laramie Mountains.
W23085	Wet Stream	21.0	Isolated anomalous sample from along Mule Creek, which drains Precambrian granites in the central Laramie Mountains.
W23111	Dry Stream	20.5	Isolated anomalous sample from along a tributary to Chugwater Creek in the central Laramie Mountains.
W23133	Dry Stream	83.0	From the northeastern flank of Sheep Mountain.
W23365	Spring	16.2	From the eastern flank of Sheep Mountain.
W23415	Spring	17.0	Southwest flank of southern Laramie Mountains.
W23422	Dry Stream	24.3	Collected along Lone Tree Creek, which drains a uranium mineralized area at Buford.
W23424	Dry Stream	15.0	Collected along Harney Creek, which drains Precambrian anorthosites on the west flank of the southern Laramie Mountains.

Two samples with anomalously high uranium concentrations from locations W23111 and W23085 with concentrations of 20.5 ppm and 21.0 ppm, respectively, are included in a cluster of high uranium concentration samples from locations in the central Laramie Mountains. Precambrian granite crops out upstream and to the west of these locations.

Three known uranium occurrences in the quadrangle were detected in sediment sampling results. Detailed study of sediment sampling results by contouring or similar evaluation techniques may detect the other known occurrences at lower uranium concentration levels than were studied here.

V. SUMMARY

The Cheyenne reconnaissance area includes 18 750 km² in southeast Wyoming, southwest Nebraska, and northeast Colorado and encompasses parts of eight counties. The climate in the report area is semiarid, windy, and cool. Portions of the Great Plains, Southern Rocky Mountains, and Wyoming Basin geomorphic provinces are in the report area. These are represented by the Denver Basin on the east, the north-trending Laramie Mountains in the central region, and the Laramie Basin in the west. Each province is characterized by a different geology: in the Denver Basin, only strata of Late Cretaceous,

Tertiary, and Quaternary age are exposed; the Laramie Mountains are primarily Precambrian granites, anorthosite and schist; and the Laramie Basin strata are predominately Mesozoic and Paleozoic in age.

Uranium mineralization has been reported at 10 locations in the study area. Of these, four are in the Jurassic Morrison and Cretaceous Cloverly formations in the Laramie Basin and six are vein deposits in the Precambrian rocks of the Laramie Mountains. In the southern Laramie Basin, Shannon and Ruzycki (1957) consider the upper Cretaceous Cloverly formation to be the most favorable uranium host rock. The most economically important deposits in Wyoming are from strata of early Eocene age (Houston, 1969).

In the study area, 1138 water and 600 sediment samples were collected from 1493 locations. The uranium concentrations in water ranged from 0.01 to 296.30 ppb with a median of 3.19 ppb and mean of 8.34 ppb. Waters from 23 wells, 21 of which lie in the northeast portion of the Cheyenne quadrangle, contain uranium concentrations greater than 54.50 ppb (the highest 2% of the sampled population) and were arbitrarily considered anomalous. Most wells in the northeast corner of the quadrangle penetrate aquifers in the carboniferous Cretaceous Lance formation. Some deeper wells in the area may penetrate aquifers in the Wind River formation, which is known to be uraniferous in other parts of Wyoming. Two isolated anomalous well samples were collected in the northwest part of the study area. These samples may have come from ground water aquifers associated with the uraniferous Morrison formation that crops out farther west. One known occurrence was detected at the uranium levels studied here. Detailed study of lower concentration levels may reveal that other uranium occurrences were detected in the water-sampling results.

The majority of the sediment samples were collected from locations in the western half of the quadrangle. The uranium concentration in sediments ranged from 0.8 to 83.0 ppm with a median of 3.4 ppm and mean of 4.5 ppm. Samples containing more than 14 ppm uranium (highest 2% of the uranium concentrations) are arbitrarily considered anomalous. These include 12 sediment samples that were collected from two springs, three wet streams, and seven dry streams. Seven anomalous sediments were collected from sites on the western flank of the southern Laramie Mountains and two anomalous sediments were collected near Sheep Mountain in the southwest. High-uranium sediments were also collected in the central Laramie Mountains and along the west-central edge of the study area. Three known uranium occurrences were detected in the sediment sampling results at the uranium levels studied here. Detailed study of lower concentration levels may reveal that other uranium occurrences were detected.

Further exploration into the occurrence of uranium may be warranted by the high-uranium water and sediment samples collected from these areas. Because of the variety of lithologies in the study region, greater definition of variation in uranium concentration with respect to local background may be obtained by using contouring or similar evaluation techniques. In this report, the statistical treatment of the uranium concentration data and the correlation of these data with the known occurrences and geology of the Cheyenne quadrangle are limited. Analyses and correlations necessary to use the uranium concentration data herein for a thorough resource assessment are left to the reader.

ACKNOWLEDGMENTS

The author gratefully acknowledges the help and encouragement of the following groups and individuals at the LASL. A. L. Henicksman and William H. Ashley of the Analytical Chemistry Group, CMB-1, led by Glenn R. Waterbury, performed the fluorometric analyses of the waters. Michael M. Minor of the Research Reactor Experiments Group, P-2, led by Merle E. Bunker, was responsible for the DNC analysis of samples. Jesse Cheadle III and Carlotta McInteer, of the Statistics Group, S-1, were responsible for all data base management functions and for the generation of the sample and concentration overlay plates.

Special thanks are due the following members of the Geochemical Applications Group, G-5. Mary E. Luke digitized the sample locations, Mary Ann Olson prepared the illustrations, and Judy A. Wilkinson, Tita S. Montoya, and Patricia R. O'Rourke typed the report. The suggestions from R. R. Sharp, Jr., Thomas A. Weaver, and Richard G. Warren were greatly appreciated. The efforts of Wayne A. Morris and Henry P. Nunes, of Group G-5, who selected locations and supervised the collection of samples, were appreciated.

Thanks are also extended to the employees of the private contractors who collected the samples. Sincere appreciation is expressed to the many land-owners who granted permission to enter and sample their property. Without their kind cooperation, this reconnaissance study would not have been possible.

REFERENCES CITED

- Becker, C. F., and Alyea, J. D., 1964a, Temperature probabilities in Wyoming, Univ. of Wyoming Agr. Exp. Station Bull. 415, Laramie, WY, 157 p.
- Becker, C. F., and Alyea, J. D., 1964b, Precipitation probabilities in Wyoming, Univ. of Wyoming Agr. Exp. Station Bull. 416, Laramie, WY, 97 p.
- Bjorklund, L. J., 1959, Geology and ground water resources of the upper Lodgepole Creek drainage basin, Wyoming, with a section on chemical quality of the water by R. A. Krieger and E. R. Jochens, US Geol. Survey Water Supply Paper 1483, Washington, DC, 40 p.
- Blackstone, D. L., Jr., 1971, Traveler's guide to the geology of Wyoming, Geological Survey of Wyoming, Bull. 55, Laramie, WY, pp. 9 and 15.
- Blackstone, D. L., Jr., 1975a, Late Cretaceous and Cenozoic history of Laramie Basin region, southeast Wyoming, Geol. Soc. Amer. Mem. 144, Washington, DC, pp. 249-279.
- Blackstone, D. L., Jr., 1975b, Mapping of linear structural elements from remote sensing imagery, Contrib. to Geol., v. 14, Laramie, WY, pp. 1-6.
- Davis, S. N., and De Wiest, R. J. M., 1966, Hydrogeology, John Wiley and Sons, Inc., New York, NY, pp. 84.
- Doi, K., Hirono, S., and Sakamaki, Y., 1975, Uranium mineralization by ground water in sedimentary rocks, Japan, Econ. Geol. v. 70, pp. 628-646.
- Elevatorski, E. A., (Comp), 1976, Uranium guidebook for Wyoming, MINOBRAS, Dana Point, CA, 63 p.
- Finch, W. I., 1967, Geology of epigenetic uranium deposits in sandstone in the United States, US Geol. Survey Prof. Paper 538, Washington, DC, 121 p.
- Finnell, T. L., and Parrish, I. S., 1958, Uranium deposits and principal ore-bearing formations of the central Cordilleran foreland region, US Geol. Survey Min. Investigation Map MF 120, Washington, DC.
- Germanov, A. E., Batulin, S. G., Volkov, G. A., Lisitsin, A. K., and Serebrennikov, V. S., 1958, Some regularities of uranium distribution in underground water, Proc. 2nd UN Int. Conf. on Atomic Energy, Geneva, v. 23, pp. 161-177.
- Gill, J. R., Merewether, E. A., and Cobban, W. A., 1970, Stratigraphy and nomenclature of some Upper Cretaceous and Lower Tertiary rocks in south-central Wyoming, US Geol. Survey Prof. Paper 667, Washington, DC, pp. 1-53.
- Houston, R. S., 1969, Aspects of the geologic history of Wyoming related to the formation of uranium deposits, Contrib. to Geol., Wyoming uranium issue, Univ. of Wyoming, v. 8 (2), pt. 1, Laramie, WY, pp 67-79.

- Hunt, C. B., 1974, Natural Regions of the United States and Canada, W. H. Freeman and Co., San Francisco, CA, pp. 393-394.
- Intrasearch, 1977, Geology of the Cheyenne quadrangle, 1:250 000-scale map prepared for Bendix Field Engineering Corp. according to BFEC Specification 1125, Grand Junction, CO.
- Littleton, R. T., 1950, Reconnaissance of the geology and ground water hydrology of the Laramie Basin, Wyoming, US Geol. Survey Circ. 80, Washington, DC, 37 p.
- Lowry, M. E., and Crist, M. A., 1967, Geology and ground water resources of Laramie County, Wyoming, with a section on chemical quality of ground water and surface water by J. R. Tilstra, US Geol. Survey Water Supply Paper 1834, Washington, DC, 71 p.
- Lowry, M. E., Rucker, S. J., IV, and Wahl, K. L., 1973, Water resources of the Laramie, Shirley, Hanna Basins, and adjacent areas, southeastern Wyoming, US Geol. Survey Hydrol. Invest. Atlas HA-471, Washington, DC.
- Mardirosian, C. A., 1967, Mining districts and mineral deposits of Wyoming, a map at 1:1 000 000 scale.
- McGrew, P. O., 1953, Tertiary deposits of southeastern Wyoming, Wyoming Geol. Assoc. Guidebook, 8th Field Conf., Laramie, WY, pp. 61-64.
- Morris, D. A., and Babcock, H. M., 1960, Geology and ground water resources of Platte County, Wyoming, with a section on chemical quality of the water by R. H. Langford, US Geol. Survey Water Supply Paper 1490, Washington, DC, 195 p.
- National Oceanic and Atmospheric Administration, 1976, Climatological data, Wyoming, US Dept. of Commerce, NOAA, v. 81 (nos. 6, 7, and 12), Asheville, NC.
- National Oceanic and Atmospheric Administration, 1977, Climatological data, Wyoming, US Dept. of Commerce, NOAA, v. 82 (nos. 6, 9, and 10), Asheville, NC.
- Osterwald, F. W., Osterwald, D. B., Long, J. S., Jr., and Wilson, W. H., 1966, Mineral resources of Wyoming, Geol. Survey of Wyoming Bull. 50, Laramie, WY, 287 p.
- Rapp, J. R., Visher, F. N., and Littleton, R. T., 1957, Geology and ground water resources of Goshen County, Wyoming, with a section on chemical quality of the ground water by W. H. Durum, US Geol. Survey Water Supply Paper 1377, Washington, DC, 145 p.
- Shannon, S. S., Jr., and Ruzyski, J., 1957, An airborne radiometric survey of parts of Albany and Carbon Counties, Wyoming, US AEC Open File Tech. Mem. TM-1-D-15, Grand Junction, CO, 16 p.

- Sharp, R. R., Jr., 1977, The LASL approach to uranium geochemical reconnaissance, in Symposium on Hydrogeochemical and Stream Sediment Reconnaissance for Uranium in the United States, US DOE Report GJBX-77(77), Grand Junction, CO, pp. 353-373.
- Smith, E. W., 1954, Reconnaissance for uraniferous deposits in the Laramie Mountains, Wyoming, US AEC Open File Report RME-1048, Grand Junction, CO, 17 p.
- State of Wyoming, 1975, Wyoming Data Handbook, Department of Administration and Fiscal Control, Cheyenne, WY, 154 p.
- Thomas, H. D., 1949, The geological history and geological structure of Wyoming, Geol. Survey of Wyoming Bull. 42, Laramie, WY, 28 p.
- Tudor, M. S., 1953, Structural geology of west-central flank of the Laramie Range, Wyoming Geol. Assoc. Guidebook, 8th Field Conf., Casper, WY, pp. 101-102.
- US Geological Survey and Wyoming Natural Resources Board, 1971, Chemical quality of water in southeastern Wyoming, A basic-data release, Washington, DC, 67 p.
- US Geological Survey, 1967, State of Wyoming base map (scale 1:500 000), Washington, DC.
- Wainerdi, K. E., and Uken, E. A., 1971, Modern methods of geochemical analysis, Plenum Press, New York, NY, 379 p.
- Weaver, T. A., Morris, W. A., and Trexler, P. K., 1978, Uranium hydrogeochemical and stream sediment reconnaissance of the Rawlins NTMS quadrangle (in progress).
- Weeks, E. P., 1964, Hydrologic conditions in the Wheatland Flats area, Platte County, Wyoming, US Geol. Survey Water Supply Paper 1783, Washington, DC, 80 p.
- Wilson, W. H., 1960, Radioactive mineral deposits of Wyoming, Geol. Survey of Wyoming, Report of Invest. No. 7, Laramie, WY, 41 p.

APPENDIX A

SUMMARY OF STANDARD LASL HSSR FIELD AND ANALYTICAL PROCEDURES

APPENDIX A

SUMMARY OF STANDARD LASL HSSR FIELD AND ANALYTICAL PROCEDURES

I. FIELD PROCEDURES

Water Sampling

Water samples are taken directly from the source wherever possible, filtered through a 0.45- μ membrane filter into one each, prewashed and sealed, 41-ml reactor "rabbit" and 25-ml vial (both polyethylene), and both are then acidified to a pH of ≤ 1 with 8N, reagent-grade, HNO_3 . All sample containers are doubly labeled with preprinted, adhesive labels carrying the same sample location number preprinted on the field data form. Springs are sampled as near to their point of emergence as possible; stream waters are taken from fast-flowing current away from the bank; ponds (including small lakes and reservoirs) are sampled from just below the surface, away from the bank; and well waters are taken near the wellhead if the well is pumping or from a holding tank if not.

Sediment Sampling (Wet or Dry)

Enough fine-grained, organic-rich, water-transported sediment to yield a composite sample of 25 g after processing (as indicated below) is taken from beneath the water level (where water exists) at three closely adjacent spots at each location. This is done with a polyethylene scoop, after the water sample (if any) is taken. The sediment is put into a new, clean, and originally sealed, rip-top polyethylene bag and properly double-labeled for delivery (with the field data form) to the contractor's drying facility. After drying at $\leq 100^\circ\text{C}$, each sample is sieved through stainless steel sieves to -100 mesh. The -100 mesh fraction is put into a prewashed, 25-ml polyethylene vial, appropriately double-labeled (using labels from the data form), and sealed for shipment to the LASL.

Field Measurements

The air temperature, taken in the shade at the time of sampling, is recorded to the nearest whole degree Celsius. The water temperature is measured in the source water and recorded to the nearest one-tenth degree Celsius. All temperature measurements are made with quality, precalibrated thermometers. The pH of the source water is measured with a calibrated, portable pH meter or multi-range pH paper, and recorded to the nearest one-tenth of a pH unit. The specific conductance ($\mu\text{mho/cm}$) of the source water is measured with a calibrated, temperature compensated (25°C) portable meter after the attached sample cup has first been rinsed three times in the source water. The scintillometer readings, taken on a flat, dry spot within a few meters of the sample location, are measured with a portable scintillometer. Two readings are recorded, the first with a radiation shield in place (blocking out ground radiation), and the second with the shield removed. The readings (in counts/s) are converted by computer (using a calibration factor obtained from testing of the specific scintillometer on a calibration block) to give the equivalent uranium (eU) value set forth in the data listing.

Field Observations

These represent the best subjective judgment of the field sampler on location, and include very general descriptions of the local bedrock, sediment, water, vegetation, terrain, weather, possible contaminants, and water well configuration, if applicable. Since these observations are subjective and made quickly in the field they should be held subordinate to any formally documented information such as that provided by published topographic or geologic maps, etc.

Sample Location Verification

Each contractor is supplied field maps with the desired sample types and locations symbolically premarked at the LASL. The maps are normally USGS quadrangles (either 7.5' or 15'), but where not available, Forest Service, State Highway, or other reasonably detailed maps are provided. As each location is sampled, a unique sample location number, preprinted on transparent adhesive labels provided with the identically numbered field data forms, is pasted over the precisely marked site on the field map. The latitude and longitude of each location is computed by the sampling contractor. Every location is later checked (and corrected if necessary) at the LASL by overlaying computer-produced location plots on the field maps used. The latitudes and/or longitudes are corrected if the overlay locations are displaced by more than 300 m from the locations marked on the field maps. When a desired location cannot be sampled as specified, an alternate sample type or location as near as possible to the original one is picked, and the new sample type and/or location is/are marked on the field map and properly labeled as above. The verification, then, is carried out in the same manner.

II. ANALYTICAL PROCEDURES

Water Samples Analyzed for Uranium by Fluorometry

In a controlled laboratory environment, two NaF (98%)-LiF (2%) flux pellets are prepared and placed on platinum dishes. The 25-ml water vial is shaken vigorously and two 0.20-ml aliquots of water are withdrawn and dropped onto the flux pellets, then evaporated under a heat lamp. The sample fluxes are then heated until fused. After they cool, they are excited with ultraviolet radiation in the fluorometer, and the fluorescence of each is read, recorded, and put through a computer routine using standards and blanks run at the same time to obtain the two uranium concentrations. The single uranium concentration of the water samples given in the data listing is the average obtained from the duplicate aliquots. The lower limit of detection for each aliquot by the normal procedure is 0.2 ppb. Water samples which have uranium concentrations below 0.2 ppb are concentrated by a factor of 10 using evaporative methods and are then analyzed by fluorometry to a lower limit of 0.02 ppb. When a concentration lower than 0.02 ppb is found in an aliquot, it is arbitrarily averaged into the data listings as 0.01 ppb. Therefore, whenever the uranium concentration in a water sample run by fluorometry is given as some value less than 0.02 ppb, one of the two aliquots had a uranium concentration that was too low to detect. If the listed uranium value is 0.01 ppb, both aliquots were below the detectable limit. Analytical precision at the lower limit of detection is ~30%; however, it improves to ~10% one order of magnitude above the lower limit.

Water Samples Analyzed for Uranium by Delayed-Neutron Counting

Only waters with >10 ppb uranium are normally assayed using DNC. Samples taken in the 41-ml rabbits are thoroughly cleaned (exterior) before analysis. Samples received in 25-ml vials (used exclusively in some of the early work) are transferred to clean, labeled, 41-ml rabbits before being analyzed. Each water sample is weighed, and its weight (less that of the rabbit) and location number are recorded. The rabbits are then loaded into a 25-sample transfer clip. The reactor pneumatic transfer system and background radiation levels are checked, and the system is calibrated using four standards. The transfer clip is installed on the pneumatic feed line, and the count control is set (typically, a 60-s irradiation, a 30-s delay, and a 60-s count are used, but this can be changed to accommodate abnormally high or low uranium concentrations). The samples are cycled through the system and the uranium concentration is automatically measured, computed in ppb, and entered into the data base. Analytical precision for those few waters analyzed by the DNC method is as good or better than that by fluorometry. All water-sample uranium concentrations that have been determined by DNC are denoted by an asterisk after the uranium value in Appendix B.

Statistical treatments of uranium concentrations obtained on the same suites of samples both by fluorometry and DNC have shown that there is no significant difference between results of the two analytical methods as used at the LASL. This analytical comparability is rechecked periodically.

Uranium Analysis of Sediment Samples

All sediment samples are analyzed for total uranium by DNC. A split of each sample (dried and sieved as described) is transferred to a clean 4-ml rabbit, weighed (less the tare), and recorded along with the appropriate location number. The readied rabbits are loaded into a 50-sample transfer clip. The reactor pneumatic transfer system and background radiation levels are checked, and the system is calibrated as above. The transfer clip is installed and the count control is set (typically, a 20-s irradiation, a 10-s delay, and a 20-s count are used). The samples are cycled through the system and the uranium concentration is automatically measured, computed in ppm, and entered into the data base. The lower detection limit for uranium in sediment analyzed by the DNC method is 0.5 ppb (not ppm), and is so low that it has never been reached with a natural sediment sample. Using the DNC method for uranium in sediments, the precision is 4% or better for all analyses.

APPENDIX B

LISTINGS OF FIELD DATA AND URANIUM CONCENTRATIONS FOR WATER SAMPLES

(See Appendix D for code to data listings)

APPENDIX B. Field Data and Uranium Concentrations for Water Samples

[illegible]

APPENDIX B (continued). Field Data and Uranium Concentrations for Water Samples

DOE SAMPLE NUMBER					TIME SAMPLED		LASH SAMPLE LOCATION NUMBER AND FIELD DATA																				U CONCENTRATION																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
STATE	LATITUDE	LONGITUDE	DOE LAB	SAMPLE DATE	DATE	TIME	AS	TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE	WATER TEMPERATURE

APPENDIX B (continued). Field Data and Uranium Concentrations for Water Samples

STATE	LATITUDE	DOE SAMPLE NUMBER	WATER SAMPLE LOCATION, NUMBER AND FIELD DATA										ANALYZED BY EJUDOMETRY OR DVC	CONCENTRATION UNITS IN PPB
			DATE	TIME	WIND	WAVE	SEA	WIND	WAVE	SEA	WIND	WAVE		
56-41.6204-104.2478-2-08		0-422103-10/06/77-11	14-15.0	0	0	0	0	0	0	0	0	0	5.73	
56-41.5822-104.2400-2-08		0-422104-10/06/77-11	14-9.0	0	0	0	0	0	0	0	0	0	21.700	
56-41.6086-104.2400-2-08		0-422105-10/06/77-11	14-13.0	0	0	0	0	0	0	0	0	0	10.700	
56-41.5825-104.2440-2-08		0-422106-10/06/77-11	14-10.0	0	0	0	0	0	0	0	0	0	13.400	
56-41.5836-104.2310-2-08		0-422107-10/06/77-12	14-9.0	0	0	0	0	0	0	0	0	0	14.400	
56-41.5781-104.2011-2-08		0-422108-10/06/77-12	17-13.5	0	0	0	0	0	0	0	0	0	11.800	
56-41.5431-104.3178-2-08		0-422109-10/06/77-13	14-16.0	0	0	0	0	0	0	0	0	0	8.47	
56-41.5519-104.3494-2-08		0-422110-10/06/77-14	14-16.0	0	0	0	0	0	0	0	0	0	1.46	
56-41.5600-104.3686-2-08		0-422111-10/06/77-14	14-16.0	0	0	0	0	0	0	0	0	0	17.100	
56-41.5208-104.3411-2-08		0-422112-10/06/77-14	15-14.5	0	0	0	0	0	0	0	0	0	3.82	
56-41.5233-104.3234-2-08		0-422113-10/06/77-14	15-17.0	0	0	0	0	0	0	0	0	0	16.800	
56-41.5283-104.3492-2-08		0-422114-10/06/77-15	15-13.0	0	0	0	0	0	0	0	0	0	9.73	
56-41.5142-104.2581-2-08		0-422115-10/06/77-15	15-14.0	0	0	0	0	0	0	0	0	0	6.87	
56-41.5142-104.2481-2-08		0-422116-10/06/77-15	19-17.0	0	0	0	0	0	0	0	0	0	7.03	
56-41.5142-104.2250-2-08		0-422117-10/06/77-15	19-14.0	0	0	0	0	0	0	0	0	0	54.900	
56-41.5119-104.1811-2-08		0-422118-10/06/77-16	19-15.0	0	0	0	0	0	0	0	0	0	4.73	
56-41.5469-104.2704-2-08		0-422119-10/06/77-16	19-14.0	0	0	0	0	0	0	0	0	0	27.300	
56-41.5422-104.2531-2-08		0-422120-10/06/77-17	19-15.0	0	0	0	0	0	0	0	0	0	0.41	
56-41.5536-104.2097-2-08		0-422121-10/06/77-18	17-15.0	0	0	0	0	0	0	0	0	0	19.400	
56-41.5469-104.2022-2-08		0-422122-10/06/77-18	15-14.0	0	0	0	0	0	0	0	0	0	3.31	
56-41.4894-104.0594-2-08		0-422123-09/20/77-12	32	0	0	0	0	0	0	0	0	0	3.39	
56-41.4844-104.0194-2-08		0-422124-09/20/77-12	25-15.0	0	0	0	0	0	0	0	0	0	8.78	
56-41.4296-104.0531-2-08		0-422125-09/20/77-13	28	0	0	0	0	0	0	0	0	0	1.59	
56-41.4311-104.0872-2-08		0-422126-09/20/77-13	28-18.0	0	0	0	0	0	0	0	0	0	19.000	
56-41.4478-104.1101-2-08		0-422127-09/20/77-14	28-17.0	0	0	0	0	0	0	0	0	0	7.34	
56-41.4808-104.1101-2-08		0-422128-09/20/77-14	27-17.0	0	0	0	0	0	0	0	0	0	17.200	
56-41.4978-104.1489-2-08		0-422129-09/20/77-14	29-14.0	0	0	0	0	0	0	0	0	0	48.700	
56-41.4978-104.0754-2-08		0-422130-09/20/77-15	25-13.0	0	0	0	0	0	0	0	0	0	1.000	
56-41.4925-104.0450-2-08		0-422131-09/20/77-15	28-13.0	0	0	0	0	0	0	0	0	0	15.700	
56-41.4925-104.0134-2-08		0-422132-09/20/77-16	28-13.0	0	0	0	0	0	0	0	0	0	48.700	
56-41.4944-104.0161-2-08		0-422133-09/21/77-16	27-18.0	0	0	0	0	0	0	0	0	0	20.100	
56-41.4944-104.1872-2-08		0-422134-09/21/77-16	17-15.0	0	0	0	0	0	0	0	0	0	3.05	
56-41.4978-104.1489-2-08		0-422135-09/21/77-16	18-14.0	0	0	0	0	0	0	0	0	0	0.31	
56-41.4978-104.1454-2-08		0-422136-09/21/77-16	22-17.0	0	0	0	0	0	0	0	0	0	0.76	
56-41.4944-104.1450-2-08		0-422137-09/21/77-16	9	17	0	0	0	0	0	0	0	0	0.39	
56-41.4913-104.1483-2-08		0-422138-09/21/77-16	23-14.0	0	0	0	0	0	0	0	0	0	15.4100	
56-41.4913-104.1830-2-08		0-422139-09/21/77-16	24-16.5	0	0	0	0	0	0	0	0	0	2.28	
56-41.4863-104.1324-2-08		0-422140-09/21/77-16	23-19.0	0	0	0	0	0	0	0	0	0	12.100	
56-41.4863-104.0044-2-08		0-422141-09/21/77-16	21-14.0	0	0	0	0	0	0	0	0	0	44.500	
56-41.4863-104.0433-2-08		0-422142-09/21/77-16	26-17.0	0	0	0	0	0	0	0	0	0	0.93	
56-41.4863-104.0774-2-08		0-422143-09/21/77-16	22-18.0	0	0	0	0	0	0	0	0	0	41.700	
56-41.4863-104.0850-2-08		0-422144-09/21/77-16	26-17.1	0	0	0	0	0	0	0	0	0	0.17	
56-41.4863-104.0792-2-08		0-422145-09/21/77-16	26-17.1	0	0	0	0	0	0	0	0	0	0.43	
56-41.4825-104.1311-2-08		0-422146-09/21/77-16	23-13.0	0	0	0	0	0	0	0	0	0	0.01	
56-41.4861-104.1480-2-08		0-422147-09/21/77-16	23-13.0	0	0	0	0	0	0	0	0	0	19.500	
56-41.4839-104.2283-2-08		0-422148-09/21/77-16	23-18.0	0	0	0	0	0	0	0	0	0	2.36	
56-41.4839-104.2255-2-08		0-422149-09/21/77-16	25-22.0	0	0	0	0	0	0	0	0	0	47.800	
56-41.4813-104.2201-2-08		0-422150-09/21/77-16	18-13.0	0	0	0	0	0	0	0	0	0	23.700	
56-41.4875-104.1292-2-08		0-422151-09/22/77-16	9	18-11.0	0	0	0	0	0	0	0	0	0.47	
56-41.4823-104.1080-2-08		0-422152-09/22/77-16	9	18-13.0	0	0	0	0	0	0	0	0	3.80	
56-41.4813-104.1439-2-08		0-422153-09/22/77-16	18-15.0	0	0	0	0	0	0	0	0	0	0.01	

APPENDIX B (continued). Field Data and Uranium Concentrations for Water Samples

[illegible]

APPENDIX B (continued). Field Data and Uranium Concentrations for Water Samples

DOE SAMPLE NUMBER	DOE SAMPLE LOCATION NUMBER AND FIELD DATA	CONCENTRATION	WATTP	SAMPLES	ANALYZED BY	FLUORESCENCE	OR DND	UNITS
1	1	1	1	1	1	1	1	1
2	2	2	2	2	2	2	2	2
3	3	3	3	3	3	3	3	3
4	4	4	4	4	4	4	4	4
5	5	5	5	5	5	5	5	5
6	6	6	6	6	6	6	6	6
7	7	7	7	7	7	7	7	7
8	8	8	8	8	8	8	8	8
9	9	9	9	9	9	9	9	9
10	10	10	10	10	10	10	10	10
11	11	11	11	11	11	11	11	11
12	12	12	12	12	12	12	12	12
 

[illegible]

APPENDIX B (continued). Field Data and Uranium Concentrations for Water Samples

[illegible]

APPENDIX B (continued). Field Data and Uranium Concentrations for Water Samples

[illegible]

APPENDIX B (continued). Field Data and Uranium Concentrations for Water Samples

[illegible]

APPENDIX B (continued). Field Data and Uranium Concentrations for Water Samples

[illegible]

33

[illegible]

[illegible]

DOE SAMPLE NUMBER		DATE LAB		LABORATORY		CONTAINER		TIME SAMPLED		LASS SAMPLE LOCATION NUMBER AND FIELD DATA		WATER SAMPLES ANALYZED BY FLUORIMETER OR DDC - UNITS IN PPB	
STATE	COUNTY	DATE LAB	LABORATORY	CONTAINER	TIME SAMPLED	LASS SAMPLE LOCATION NUMBER AND FIELD DATA	WATER SAMPLES ANALYZED BY FLUORIMETER OR DDC - UNITS IN PPB						
56	41	07/17/10	4	0167-2-08	0-W22564-10/01/77-13	23-14-00	9.0						
56	41	07/17/10	4	0167-2-08	0-W22565-09/30/77-14	18-15-2	7.2						
56	41	07/17/10	4	0167-2-08	0-W22566-09/30/77-14	18-15-2	7.2						
56	41	07/17/10	4	0167-2-08	0-W22567-09/30/77-15	17-16-0	9.3						
56	41	07/17/10	4	0167-2-08	0-W22568-09/30/77-15	17-13-0	7.5						
56	41	07/17/10	4	0167-2-08	0-W22569-09/30/77-15	18-12-0	7.3						
56	41	07/17/10	4	0167-2-08	0-W22570-09/30/77-16	20-19-6	7.3						
56	41	07/17/10	4	0167-2-08	0-W22571-09/30/77-15	18-17-0	7.8						
56	41	07/17/10	4	0167-2-08	0-W22572-09/30/77-17	18-16-5	7.7						
56	41	07/17/10	4	0167-2-08	0-W22573-09/30/77-17	17-13-0	7.9						
56	41	07/17/10	4	0167-2-08	0-W22574-10/01/77-10	12-16-5	8.5						
56	41	07/17/10	4	0167-2-08	0-W22575-10/01/77-10	12-13-5	7.4						
56	41	07/17/10	4	0167-2-08	0-W22576-10/01/77-11	12-17-1	7.4						
56	41	07/17/10	4	0167-2-08	0-W22577-10/01/77-11	13-16-0	7.6						
56	41	07/17/10	4	0167-2-08	0-W22578-10/01/77-11	13-15-0	7.6						
56	41	07/17/10	4	0167-2-08	0-W22579-10/01/77-11	13-16-0	7.4						
56	41	07/17/10	4	0167-2-08	0-W22580-10/01/77-12	13-12-2	7.2						
56	41	07/17/10	4	0167-2-08	0-W22581-10/01/77-12	14-13-0	7.0						
56	41	07/17/10	4	0167-2-08	0-W22582-10/01/77-12	13-19-0	7.1						
56	41	07/17/10	4	0167-2-08	0-W22583-10/01/77-14	14-17-1	7.3						
56	41	07/17/10	4	0167-2-08	0-W22584-10/01/77-15	15-14-0	7.2						
56	41	07/17/10	4	0167-2-08	0-W22585-10/01/77-15	15-14-2	7.2						
56	41	07/17/10	4	0167-2-08	0-W22586-10/01/77-15	15-13-1	7.2						
56	41	07/17/10	4	0167-2-08	0-W22587-10/02/77-10	7-16-5	7.0						
56	41	07/17/10	4	0167-2-08	0-W22588-10/02/77-10	15-14-0	6.9						
56	41	07/17/10	4	0167-2-08	0-W22589-10/02/77-11	15-10-0	7.3						
56	41	07/17/10	4	0167-2-08	0-W22590-10/02/77-11	15-12-0	7.3						
56	41	07/17/10	4	0167-2-08	0-W22591-10/02/77-11	15-17-2	7.0						
56	41	07/17/10	4	0167-2-08	0-W22592-10/02/77-11	15-13-2	7.1						
56	41	07/17/10	4	0167-2-08	0-W22593-10/02/77-11	15-17-3	6.9						
56	41	07/17/10	4	0167-2-08	0-W22594-10/02/77-12	15-13-3	7.7						
56	41	07/17/10	4	0167-2-08	0-W22595-10/02/77-12	15-17-1	7.6						
56	41	07/17/10	4	0167-2-08	0-W22596-10/02/77-12	15-20-0	7.6						
56	41	07/17/10	4	0167-2-08	0-W22597-10/02/77-14	17-16-2	6.9						
56	41	07/17/10	4	0167-2-08	0-W22598-10/02/77-14	17-11-0	7.3						
56	41	07/17/10	4	0167-2-08	0-W22599-10/02/77-14	17-14-1	7.4						
56	41	07/17/10	4	0167-2-08									

DOE SAMPLE NUMBER		DATE SAMPLED		LAST SAMPLE LOCATION NUMBER AND FIELD DATA		CONCENTRATION	
DATE	TIME	DATE	TIME	DATE	TIME	WATER SAMPLES	ANALYZED BY / FIELD MEASUREMENTS
10/26/91	1334-104	10/26/91	1043/77-13	19-21.0	7.1	200	1.62
10/26/91	1334-104	10/26/91	1043/77-13	21-21.0	7.2	200	0.82
10/26/91	1334-104	10/26/91	1043/77-13	21-21.0	7.2	200	0.79
10/26/91	1334-104	10/26/91	1043/77-13	24-20.0	7.3	200	0.52
10/26/91	1334-104	10/26/91	1043/77-13	25-19.5	7.2	200	0.49
10/26/91	1334-104	10/26/91	1043/77-13	25-11.0	7.3	200	0.57
10/26/91	1334-104	10/26/91	1043/77-13	25-11.0	7.3	200	0.71
10/26/91	1334-104	10/26/91	1043/77-13	21-16.4	7.2	200	0.54
10/26/91	1334-104	10/26/91	1043/77-13	21-16.4	7.2	200	1.17
10/26/91	1334-104	10/26/91	1043/77-13	21-26.3	7.0	500	1.25
10/26/91	1334-104	10/26/91	1043/77-13	20-12.2	7.2	200	1.60
10/26/91	1334-104	10/26/91	1043/77-13	20-11.1	7.2	200	0.76
10/26/91	1334-104	10/26/91	1043/77-13	20-15.0	7.0	200	0.99
10/26/91	1334-104	10/26/91	1043/77-13	16-11.8	7.6	200	1.37
10/26/91	1334-104	10/26/91	1043/77-13	16-14.5	7.2	200	3.10
10/26/91	1334-104	10/26/91	1043/77-13	16-20.7	7.3	200	5.72
10/26/91	1334-104	10/26/91	1043/77-13	16-22.5	7.6	200	2.13
10/26/91	1334-104	10/26/91	1043/77-13	16-24.3	7.1	400	3.96
10/26/91	1334-104	10/26/91	1043/77-13	16-19.3	8.0	400	4.52
10/26/91	1334-104	10/26/91	1043/77-13	16-17.4	7.6	200	4.50
10/26/91	1334-104	10/26/91	1043/77-13	16-22.8	7.5	200	5.72
10/26/91	1334-104	10/26/91	1043/77-13	16-15.9	7.5	450	3.76
10/26/91	1334-104	10/26/91	1043/77-13	16-20.5	7.3	200	4.52
10/26/91	1334-104	10/26/91	1043/77-13	12-14.8	7.2	200	4.50
10/26/91	1334-104	10/26/91	1043/77-13	10-13.9	7.2	200	5.72
10/26/91	1334-104	10/26/91	1043/77-13	8-11.4	7.5	200	2.62
10/26/91	1334-104	10/26/91	1043/77-13	9-10.4	7.2	200	2.62
10/26/91	1334-104	10/26/91	1043/77-13	9-12.7	7.0	400	2.66
10/26/91	1334-104	10/26/91	1043/77-13	9-14.3	7.2	450	5.94
10/26/91	1334-104	10/26/91	1043/77-13	9-11.0	7.3	200	3.17
10/26/91	1334-104	10/26/91	1043/77-13	11-13.9	7.2	200	5.92
10/26/91	1334-104	10/26/91	1043/77-13	11-18.9	7.3	200	5.36
10/26/91	1334-104	10/26/91	1043/77-13	11-11.5	7.3	200	1.25
10/26/91	1334-104	10/26/91	1043/77-13	11-10.0	7.8	200	3.38
10/26/91	1334-104	10/26/91	1043/77-13	11-11.3	7.8	200	3.16
10/26/91	1334-104	10/26/91	1043/77-13	11-10.9	7.5	200	4.08
10/26/91	1334-104	10/26/91	1043/77-13	13-14.2	7.3	200	2.85
10/26/91	1334-104						

APPENDIX B (continued). Field Data and Uranium Concentrations for Water Samples

[illegible]

APPENDIX B (continued). Field Data and Uranium Concentrations for Water Samples

[illegible]

APPENDIX B (continued). Field Data and Uranium Concentrations for Water Samples

[illegible]

APPENDIX B (continued). Field Data and Uranium Concentrations for Water Samples

DOE SAMPLE NUMBER										LAST SAMPLE LOCATION NUMBER AND FIELD DATA										CONCENTRATION	
DATE	LATITUDE	LONGITUDE	DEPTH	TIME SAMPLED	WIND	WAVE	TEMP	PRESS	REL. HUM.	WIND	WAVE	TEMP	PRESS	REL. HUM.	WIND	WAVE	TEMP	PRESS	REL. HUM.	WATER SAMPLES ANALYZED BY FLUOROMETRY OR DDC	UNITS N ppb
56-41.8272-105.4672-2-07																					9.60
56-41.8692-105.4683-2-07																					3.77
56-41.8681-105.4658-2-07																					5.05
56-41.7539-105.4211-2-07																					0.96
56-41.7528-105.4219-2-07																					0.99
56-41.0431-105.9778-2-06																					1.90
56-41.0550-105.9569-2-06																					0.37
56-41.0161-105.9683-2-06																					4.61
56-41.0075-105.9522-2-06																					3.85
56-41.0806-105.9111-2-10																					7.20
56-41.2217-105.9764-2-07																					4.27
56-41.2164-105.9789-2-06																					4.38
56-41.1278-105.4986-2-08																					0.66
56-41.1364-105.6864-2-08																					7.54
56-41.1528-105.6939-2-08																					2.75
56-41.1625-105.6800-2-08																					8.38
56-41.1639-105.6611-2-08																					0.38
56-41.1806-105.6431-2-08																					3.69
56-41.2417-105.6444-2-08																					3.99
56-41.1153-105.6522-2-06																					14.30
56-41.1022-105.6431-2-06																					4.62
56-41.1153-105.6667-2-06																					3.11
56-41.0653-105.6533-2-07																					1.93
56-41.0694-105.4484-2-06																					1.31
56-41.0556-105.6583-2-10																					0.37
56-41.6528-105.5872-2-06																					10.90
56-41.5297-105.7253-2-09																					3.09
56-41.9106-105.5239-2-06																					3.13
56-41.9161-105.5161-2-06																					2.20
56-41.9231-105.4942-2-06																					2.72
56-41.9156-105.4603-2-06																					3.14
56-41.9011-105.4406-2-07																					2.96
56-41.8997-105.4381-2-07																					1.92
56-41.8978-105.3983-2-07																					2.30
56-41.9261-105.6053-2-06																					2.67
56-41.9428-105.5578-2-06																					3.66
56-41.9756-105.5081-2-06																					2.99
56-41.9731-105.5067-2-06																					3.63
56-41.9847-105.4958-2-06																					4.61
56-41.9756-105.4847-2-06																					3.19
56-41.9769-105.4581-2-06																					2.10
56-41.9383-105.4675-2-06																					2.32
56-41.8406-105.5083-2-07																					2.63
56-41.8308-105.5528-2-07																					2.85
56-41.7975-105.5500-2-07																					2.77
56-41.9206-105.4604-2-08																					3.23
56-41.9464-105.6858-2-08																					3.60
56-41.9256-105.7514-2-06																					3.93
56-41.9592-105.8567-2-08																					3.77
56-41.9447-105.9000-2-08																					6.57
56-41.9733-105.8983-2-08																					12.30

APPENDIX B (continued). Field Data and Uranium Concentrations for Water Samples

[illegible]

APPENDIX B (continued). Field Data and Uranium Concentrations for Water Samples

DOE SAMPLE NUMBER				LASL SAMPLE LOCATION NUMBER AND FIELD DATA														U CONCENTRATION																																																																																																																																																																																																																																																																																																																																																																																																																		
STATE	COUNTY	TOWNSHIP	SECTION	TIME SAMPLED		DATE	TIME	WIND	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	WIND SPC	WIND DIR	W

APPENDIX B (continued). Field Data and Uranium Concentrations for Water Samples

[illegible]

APPENDIX C

LISTINGS OF FIELD DATA AND URANIUM CONCENTRATIONS FOR SEDIMENT SAMPLES

(See Appendix D for code to data listings)

APPENDIX C. Field Data and Uranium Concentrations for Sediment Samples

[illegible]

419

[illegible]

50

APPENDIX C (Continued). Field Data and Uranium Concentrations for Sediment Samples

DOE SAMPLE NUMBER					LAST SAMPLE LOCATION NUMBER AND FIELD DATA																			CONCENTRATION																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
STATE	LATITUDE	LONGITUDE	DOE LAB	SAMPLE TYPE	DATE	TIME SAMPLED	DOE NUMBER	DOE NAME	DOE ADDRESS	DOE CITY	DOE STATE	DOE ZIP	DOE PHONE	DOE FAX	DOE EMAIL	DOE WEBSITE	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL	DOE URL

APPENDIX C (continued). Field Data and Uranium Concentrations for Sediment Samples

[illegible]

APPENDIX C (continued). Field Data and Uranium Concentrations for Sediment Samples

[illegible]

53

[illegible]

APPENDIX C (continued). Field Data and Uranium Concentrations for Sediment Samples

[illegible]

55

[illegible]

APPENDIX C (continued). Field Data and Uranium Concentrations for Sediment Samples

[illegible]

57

[illegible]

[illegible]

APPENDIX C (continued). Field Data and Uranium Concentrations for Sediment Samples

DOE SAMPLE NUMBER						LASL SAMPLE LOCATION NUMBER AND FIELD DATA																								U CONCENTRATION			
STATE	LATITUDE	LONGITUDE	DOE LAB	SAMPLE TYPE	DPR CAT	LASL SAMPLE LOCATION NUMBER	TIME SAMPLED		A.P. TEMPERATURE	WATER TEMPERATURE	COMMENTS	SPECIFIC CONDUCTANCE	SEC. 101	SEC. 102	SEC. 103	SEC. 104	SEC. 105	SEC. 106	SEC. 107	SEC. 108	SEC. 109	SEC. 110	SEC. 111	SEC. 112	SEC. 113	SEC. 114	SEC. 115	SEC. 116	SEC. 117	SEC. 118	SEC. 119	SEC. 120	SEDIMENT SAMPLES ANALYZED BY DELAYED NEUTRON COUNTING (DNC) UNITS IN ppm
							DATE	TIME																									
56-41	4492-105	0675-2-15				0-023447-12/16/77-12	10																										3.60
56-41	4044-105	0036-2-97				0-023449-12/16/77-13	10																										4.00
56-41	5743-105	0367-2-11				0-023460-06/16/77-9	27	17																									3.30
56-41	6903-105	0647-2-14				0-023461-06/04/77-11	28	10				7.9	650																				3.20
56-41	6903-105	0391-2-11				0-023462-06/04/77-12	30	14				7.1	750																				3.10
56-41	6839-105	0040-2-24				0-023463-06/04/77-12	32																										2.50
56-41	7319-105	0031-2-97				0-023464-06/04/77-16	33																										2.70
56-41	7272-105	0256-2-12				0-023465-06/04/77-16	34	35				7.2	300																				11.30
56-41	7167-105	0773-2-11				0-023466-06/04/77-15	35	12				7.1	320																				3.10
56-41	7011-105	0793-2-11				0-023467-06/04/77-16	37	10				6.7	600																				4.40
56-41	6939-105	1103-2-14				0-023468-06/04/77-17	32	32				6.0	500																				2.40
56-41	4106-105	0172-2-15				0-023469-06/05/77-9	24																										3.20
56-41	5908-105	0601-2-13				0-023470-06/05/77-9	26																										2.60
56-41	4842-105	0722-2-15				0-023471-06/05/77-11	31																										3.60
56-41	4603-105	0032-2-15				0-023472-06/05/77-15	25																										2.00
56-41	4736-105	0017-2-15				0-023473-06/05/77-15	25																										2.70
56-41	4841-105	0159-2-15				0-023474-06/05/77-15	26																										2.40
56-41	4339-105	0056-2-12				0-023475-06/05/77-16	26	10				9.2	700																				3.20
56-41	3649-105	0628-2-15				0-023476-06/06/77-9	24																										3.60
56-41	3792-105	1769-2-15				0-023477-06/06/77-14	32																										2.20
56-41	2319-105	0025-2-15				0-023478-06/07/77-9	27																										3.70
56-41	1767-105	0019-2-12				0-023479-06/07/77-10	20	30				7.1	50																				7.80
56-41	1400-105	1003-2-12				0-023480-06/07/77-11	30	15				6.7	500																				4.20
56-41	1911-105	1730-2-15				0-023481-06/07/77-12	30																										3.40
56-41	2353-105	0047-2-15				0-023482-06/07/77-13	20																										5.20
56-41	2228-105	1017-2-12				0-023483-06/07/77-13	27	17				7.4	33																				2.20
56-41	1616-105	1050-2-15				0-023484-06/07/77-14	20																										4.20
56-41	1275-105	2017-2-12				0-023485-06/07/77-16	27	16				7.5	13																				5.30
56-41	1300-105	2222-2-12				0-023486-06/07/77-16	27	16				7.0	29																				10.30
56-41	1061-105	1556-2-15				0-023487-06/07/77-17	24																										5.10
56-41	8075-105	0073-2-46				0-023488-06/07/77-13	20																										3.20
56-41	8619-105	0433-2-14				0-023489-06/08/77-16	24	15				3.4	500																				3.80
56-41	8562-105	0253-2-13				0-023490-06/08/77-17	25																										7.60
56-41	8208-105	0546-2-13				0-023491-06/08/77-17	25	15				7.5	1700																				3.10
56-41	9839-105	0039-2-48				0-023492-06/08/77-9	20																										3.60
56-41	9686-105	0223-2-36				0-023493-06/07/77-9	22																										5.60
56-41	9978-105	0036-2-11				0-023494-06/07/77-10	23	30				7.4	250																				4.20
56-41	8844-105	0242-2-46				0-023495-06/08/77-11	20																										4.80
56-41	8854-105	0576-2-15				0-023496-06/08/77-12	31																										6.70

APPENDIX D
CODE TO DATA LISTINGS

APPENDIX D-I
EXPLANATION OF CODES USED

APPENDIX D-II
KEY TO SAMPLE TYPES

APPENDIX D-I

EXPLANATION OF CODES USED

DOE SAMPLE NUMBER

STATE: A two-digit Federal Information Processing Standards (FIPS) code, designating the state from which each sample came. For the states being covered by the LASL, the code numbers are:

Alaska	= 02	Montana	= 30	South Dakota	= 48
Arizona	= 04	Nebraska	= 31	Texas	= 48
Colorado	= 08	New Mexico	= 35	Utah	= 49
Idaho	= 15	North Dakota	= 38	Wyoming	= 56
Kansas	= 20	Oklahoma	= 40		

LATITUDE AND LONGITUDE: Sample location, in degrees and decimal degrees to four places. Although generally much better, locational accuracy cannot be guaranteed closer than about 300 m (1000 ft).

DOE LAB: A Department of Energy (DOE) one-digit identifier designating the DOE laboratory responsible for taking the samples and data shown in the listings, as well as providing the analyses of the uranium and other elemental concentrations, if any. The LASL is designated by the numeral 2.

SAMPLE TYPE: A two-digit identifier which specifically designates the pertinent properties defining the sample type to which the listed data relate. For explanation of the code used, refer to the attached "Key to Sample Types," Appendix D-II.

REPLICATE: A three-digit sequential number assigned to indicate a multiple sample of a single sample type from a single location. The largest number in use indicates the most recent sample taken, and there will always be smaller sequential numbers representing earlier samples back to 000, which is the initial sample from any given location. Except in the case of special studies, there will be no replicate samples and this entry will therefore be 000.

LASL SAMPLE LOCATION NUMBER AND FIELD DATA

LASL SAMPLE LOCATION NUMBER: A unique six-place alphanumeric designator permanently assigned by the LASL to every location sampled. For internal use, these numbers are assigned in blocks to the various areas individually treated and reported upon, and therefore serve to generally locate the samples within various areas for which the LASL is responsible as follows.

<u>Location Numbers</u>	<u>State</u>
N00 001 through N99 999	= Principally New Mexico
C00 001 through C99 999	= Principally Colorado
W00 001 through W99 999	= Principally Wyoming
M00 001 through M99 999	= Principally Montana
A00 001 and above	= Alaska only
L00 001 and above	= Areas beyond the western boundary of LASL's region as established by DOE in 1977.
Ø00 001 and above	= Areas beyond the eastern boundary of LASL's region as established by DOE in 1977.

TIME SAMPLED: The DATE that the sample was taken, in terms of the number of the MONTH, followed by the DAY and finally the YEAR, separated by slashes, and then the TIME it was taken on that date to the nearest whole HOUR on a 24-hour clock.

AIR TEMPERATURE: The temperature that was measured in the shade at the time of sampling, to the nearest whole degree Celsius ($^{\circ}\text{C}$).

WATER TEMPERATURE: The temperature that was measured in the sample water (in situ whenever possible) at the time of sampling, to the nearest one-tenth of a degree Celsius (0.1°C).

COMMENTS: A "C" in this column indicates that some secondary comment not included in the listing was recorded at the sample location. This information will be used by the LASL in evaluating the data, and if appropriate, it will be mentioned in the final report.

SPECIAL MEASUREMENTS: An "S" in this column indicates that one or more field measurements in addition to those listed were made at the sample location. A description of any special parameters measured and the measured value at each sample location will be included in the final HSSR survey report on the area.

pH: The pH, to the nearest one-tenth (0.1) of a pH unit, that was measured in the water at the sample location at the time of sampling.

SPECIFIC CONDUCTANCE: The conductivity, in $\mu\text{mho/cm}$, that was measured in the water at the sample location at the time of sampling.

SCINTILLOMETER: The equivalent uranium (eU), in parts per million (ppm), as measured on a flat ground surface within 10 m of the sample location using a scintillometer fitted with a differential gamma sampler (DGS). The effect of the DGS is to introduce a fixed geometry into the measurement and remove the background.

ROCK TYPE: The single digit in this column provides a general description of the dominant lithologic regime at or near the sample location, as given below.

1 = Sedimentary	3 = Igneous
2 = Metamorphic	4 = Unknown

ROCK COLOR: The single digit in this column provides an indication of the observed dominant color of local bedrock exposures at or near the sample location, as given below.

1 = White/Buff	4 = Pink/Red	7 = Gray
2 = Yellow	5 = Green	8 = Black
3 = Orange	6 = Brown	9 = Other

SEDIMENT TYPE: The single digit in this column provides a subjective evaluation of the dominant sediment type at the sample location, as given below.

1 = Boulders	4 = Sand	7 = Other
2 = Cobbles	5 = Mud	
3 = Gravel	6 = Muck	

SEDIMENT COLOR: The single digit in this column indicates the observed dominant color of the bottom sediment (stream channel, lake bed, etc.) at the sample location at the time of sampling, as given below.

1 = White/Buff	4 = Pink/Red	7 = Gray
2 = Yellow	5 = Green	8 = Black
3 = Orange	6 = Brown	9 = Other

WATER FLOW: The single digit in this column provides a subjective evaluation of the water movement at the sample location at the time of sampling, as given below.

1 = Stagnant	3 = Moderate	5 = Torrent
2 = Slow	4 = Fast	

WATER LEVEL: The single digit in this column provides a subjective estimate of water quantity at the time of sampling, relative to its usual condition at the sample location, as given below.

1 = Dry	3 = Normal	5 = Flood
2 = Low	4 = High	

WATER COLOR: The single digit in this column provides a subjective evaluation of suspended load in the sample water as, given below.

1 = Clear	3 = Cloudy	5 = Algal
2 = Murky	4 = Muddy	6 = Other

STREAM CHANNEL: The single digit here gives a subjective evaluation of stream channel character at the sample location at the time of sampling, as given below.

1 = Depositing	2 = Eroding	3 = Unknown
----------------	-------------	-------------

VEGETATION TYPE: The single digit in this column provides a subjective evaluation of the dominant plant type in the vicinity of the sample location, as given below.

1 = Conifers	4 = Grass	7 = Other
2 = Deciduous	5 = Moss	
3 = Brush	6 = Marsh	

VEGETATION DENSITY: The single digit in this column provides a subjective estimate of the amount of plant cover in the vicinity of the sample location, as given below.

1 = Barren	3 = Moderate	5 = Very Dense
2 = Sparse	4 = Dense	

RELIEF: The single digit in this column provides a subjective evaluation of the topography within a few hundred meters of the sample location, as given below.

1 = Flat	3 = Gentle (15-60 m)	5 = High (>300 m)
2 = Low (<15 m)	4 = Moderate (60-300 m)	6 = Other

WEATHER: The single digit in this column gives the observed climatic condition at the sample location at the time of sampling, as given below.

1 = Clear	3 = Overcast	5 = Snowy
2 = Partly cloudy	4 = Rainy	6 = Other

OWNERSHIP: When shown, the single digit here gives a broad classification of administrative responsibility or general ownership of the land at the sample location, as given below.

1 = Federal	3 = Private	5 = Other
2 = State	4 = Indian	

CONTAMINANTS: The single digit here indicates known or suspected local factors likely to influence analytical results, as given below.

1 = None	4 = Industry	7 = Urban
2 = Mining	5 = Sewage	8 = Recreation
3 = Agriculture	6 = Power generation	9 = Other

WELL TYPE: If a well water sample, the single digit in this column provides a general description of the type of well from which the sample was taken as given below.

1 = Windmill-stock	4 = Suction pump	7 = Hand bail
2 = Windmill-domestic	5 = Jet pump	8 = Unknown
3 = Submersible pump	6 = Large turbine	9 = Other

WELL DIAMETER: When shown, the one or two digits in this column give the measured or estimated inside diameter, in inches, of the well casing from which the water sample came.

WELL DEPTH: When shown, the one, two, or three digits in this column give the total drilled depth from the surface, in feet, of the well from which the sample came. Three 9s in this column indicates a well depth greater than 1000 ft.

WATER DEPTH: When shown, the one, two, or three digits in this column give the known depth, in feet, from the surface to the standing water in the well. A -1 in this column indicates a flowing artesian well.

URANIUM CONCENTRATION: The value given in this column is the analytically derived value of the total uranium concentration found in the water sample in parts per billion (ppb), or in the sediment sample in parts per million (ppm). Those uranium concentrations in water that are shown with an asterisk were measured using a delayed-neutron counting method, while those without an asterisk were determined fluorometrically. The uranium analyses as determined by both of these methods at the LASL are directly comparable, as described in Appendix A.

APPENDIX D-II

KEY TO SAMPLE TYPES

This numerical key provides the necessary tie between the specific type or form of each sample taken and each individual suite of field and laboratory data to which the sample relates. It defines the various sample types collected by the LASL in the DOE HSSR for uranium.

The two-digit key number assigned to each sample type designates three distinct properties of the samples taken. These properties are: (a) The general sample source (spring or stream or dry stream, etc.); (b) The sample medium (water or sediment, etc.); and (c) The treatment given the sample in the field or laboratory prior to its analysis by the LASL.

The key numbers are inserted in the appropriate columns of the specially formatted DOE sample numbering system to positively identify the sample type for all LASL sample data submitted.

KEY NO.	SOURCE / MEDIUM / TREATMENT
01 -	<u>Spring water</u> sample <u>untreated</u> .
02 -	<u>Stream water</u> sample <u>untreated</u> .
03 -	<u>Well water</u> sample <u>untreated</u> .
04 -	<u>Natural pond water</u> sample <u>untreated</u> .
05 -	<u>Artificial pond water</u> sample <u>untreated</u> .
06 -	<u>Spring water</u> sample <u>filtered</u> through an 0.45- μ membrane filter <u>and acidified</u> to a pH of ≤ 1 with reagent-grade nitric acid (HNO_3).
07 -	<u>Stream water</u> sample <u>filtered</u> through an 0.45- μ membrane filter <u>and acidified</u> to a pH of ≤ 1 with reagent-grade nitric acid (HNO_3).
08 -	<u>Well water</u> sample <u>filtered</u> through an 0.45- μ membrane filter <u>and acidified</u> to a pH of ≤ 1 with reagent-grade nitric acid (HNO_3).
09 -	<u>Natural pond water</u> sample <u>filtered</u> through an 0.45- μ membrane filter <u>and acidified</u> to a pH of ≤ 1 with reagent-grade nitric acid (HNO_3).
10 -	<u>Artificial pond water</u> sample <u>filtered</u> through an 0.45- μ membrane filter <u>and acidified</u> to a pH of ≤ 1 with reagent-grade nitric acid (HNO_3).
11 -	<u>Wet spring sediment</u> sample <u>dried</u> at $\leq 100^\circ\text{C}$ <u>and sieved to -100 mesh</u> through stainless steel sieves.
12 -	<u>Wet stream sediment</u> sample <u>dried</u> at $\leq 100^\circ\text{C}$ <u>and sieved to -100 mesh</u> through stainless steel sieves.

- 13 - Wet natural pond sediment sample dried at $\leq 100^{\circ}\text{C}$ and sieved to -100 mesh through stainless steel sieves.
- 14 - Wet artificial pond sediment sample dried at $\leq 100^{\circ}\text{C}$ and sieved to -100 mesh through stainless steel sieves.
- 15 - Dry stream sediment sample dried at $\leq 100^{\circ}\text{C}$ (if necessary) and sieved to -100 mesh through stainless steel sieves.
- 96 - Dry natural pond sediment sample dried at $\leq 100^{\circ}\text{C}$ (if necessary) and sieved to -100 mesh through stainless steel sieves.
- 97 - Dry artificial pond sediment sample dried at $\leq 100^{\circ}\text{C}$ (if necessary) and sieved to -100 mesh through stainless steel sieves.
- 98 - Other water These key numbers are to be used only for water (98) or sediment (99) samples coming from a special source and/or given a special treatment not described for any of the types of samples above. When used in the listings published herein, the source and treatment given the samples so designated are described in the text.
- 99 - Other sediment

LA - 7237 - MS

15'

105°00'

F

17.3

21.0

20.5

2

PLATE IV

PLATE IV

LEGEND

SYMBOLS

- WET SPRING
- WET STREAM
- WET NATURAL LAKE OR POND
- WET ARTIFICIAL LAKE OR POND

CONCENTRATIONS (ppm)

- 83.0
- 16.2
- 15.0
- 17.0

17.7

6

15'

105°00'

SCALE 1: 250 000

0 -	2.0
1 -	4.0
2 -	5.0
3 -	6.0
4 -	8.0
5 -	10.0

URANIUM CONCENTRATIONS (ppm) IN SE
OVERLAY TO THE

30'

15'

5 MILES

NTS

los alamos
scientific laboratory
of the University of California
LOS ALAMOS, NEW MEXICO 87545

An Affirmative Action Equal Opportunity Employer

Los Alamos
scientific laboratory
of the University of California
LOS ALAMOS, NEW MEXICO 87545

An Affirmative Action Equal Opportunity Employer

8

LEGEND

SYMBOLS	CONCENTRATIONS (ppm)
◇ WET SPRING	◇
□ WET STREAM	□
△ WET NATURAL LAKE OR POND	△
▽ WET ARTIFICIAL LAKE OR POND	▽
⊠ DRY STREAM	⊠
○ DRY NATURAL LAKE OR POND	○
⊕ DRY ARTIFICIAL LAKE OR POND	⊕
+ OTHER SEDIMENT	+

9

54.9

The numbers adjacent to the largest symbols denote uranium concentration

Denotes uranium occurrences discussed in the text and listed in Table

SCALE 1: 250 000

0.0-	2.0
2.1-	4.0
4.1-	5.0
5.1-	6.0
6.1-	8.0
8.1-	10.0
0.1-	14.0
>	14.0

URANIUM CONCENTRATIONS (ppm) IN OVERLAY TO THE CHEYENNE NTMS QUADRANGLE, WY

in ppm.

10

30'

15'

25 MILES

MENTS

NG

An Affirmative Action Equal Opportunity Employer

los alamos
scientific laboratory
of the University of California
LOS ALAMOS NEW MEXICO 87545

An Affirmative Action Equal Opportunity Employer

12

LA - 7237 - MS

BLANK PAGE

15'

105°00'

45'

54.9

79.0

2

PLATE III

30'

15'

5

6

62.1

55.0

7

62.1

55.0

30'

15'

8

LEGEND

SYMBOLS		CONCENTRATIONS (ppb)
SURFACE STREAM						0.00
		2.51
NATURAL LAKE OR POND						5.01
		10.01
ARTIFICIAL LAKE OR POND						15.01
		25.01
SPRING						34.01
		>
WELL						

55.01

The numbers adjacent to the largest symbols denote uranium concentration

10

105°00'

SCALE 1: 250 000

URANIUM CONCENTRATIONS (ppb) IN WA
OVERLAY TO THE
CHEYENNE NTMS QUADRANGLE, WYOMI

2.50
5.00
10.00
15.00
25.00
34.00
54.50
54.50

in ppb.

45'

30'

15'

25 MILES

METERS

WATERS

OMING

An Affirmative Action / Equal Opportunity Employer

los alamos
scientific laboratory
of the University of California
LOS ALAMOS, NEW MEXICO 87545

An Affirmative Action Equal Opportunity Employer

12

O

45

PLATE II

PLATE II

NOTE: The first two alphanumeric characters have been dropped from each sample location number as listed in Appendixes B and C.

6

SAMPLE LOCATION OVERLAY FOR THE
CHEYENNE NTMS QUADRANGLE, WYOMING

25 MILES

Los Alamos
scientific laboratory
of the University of California
LOS ALAMOS, NEW MEXICO 87545
An Affirmative Action Equal Opportunity Employer

LA - 7237 - MS

105°00'

45'

PLATE I

115° 110° 108° 106°

10°

30'

15'

Tb

Tc

Tb

Tc

Tc

KI

KI

Tb

Tc

KI

Tc

KI

KI

Tb

Tc

KI

Tc

Tb

KI

Tb

Tc

KI

Tc

To

KI

Tc

KI

Tc

KI

Tb

Tc

KI

Tb

Tc

KI

KI

Tc

KI

Tb

Tc

KI

KI

Tc

KI

Tb

Tc

KI

+

+

Tb

To

To

Tb

Tc

To

To

Tb

To

Tb

Tb

To

Tb

To

To

To

To

To

Qi

Qi

Qi

Qi

Qi

To

To

To

To

To

To

To

To

To

To

To

To

To

To

To

To

To

To

To

To

To

To

To

To

To

To

To

To

Tb

To

To

To

To

To

To

To

To

To

To

To

Tb

To

To

To

To

To

To

To

To

To

To

To

+

+

To

Qi

Qi

Qi

Qi

Qi

Qi

Qi

Qi

Qi

Qi

Qi

3

NEBRASKA

EXPLANATION

SEDIMENTARY

Qol, Qs, Qf, Qm, Qc
Including a variety of loess, sand, silt, clay, and gravel. May be cemented.

Ot
Including sand, gravel, silt, clay, and oolitic limestone.

Tm
Tertiary mudstone, siltstone, and claystone. May be cemented.

Tc
Tertiary calcarenite, very fine-grained to fine-grained.

Tr
Tertiary river, siltstone and shale. Layers of salmon to orange and white buff.

Td
Tertiary dolomite, siltstone, and claystone.

Tl
Tertiary limestone, siltstone, and claystone.

Tg
Tertiary gravel, siltstone, and claystone.

Tn
Tertiary sandstone, siltstone, and claystone.

Tc
Tertiary calcarenite, very fine-grained to fine-grained.

Tm
Tertiary mudstone, siltstone, and claystone. May be cemented.

Tc
Tertiary calcarenite, very fine-grained to fine-grained.

QUATERNARY

MIocene - Pliocene

OLIGOCENE

Eocene

PALEOCENE

TERTIARY

CRETACEOUS

IGNEOUS

pCgr
Pink to pinkish-gray granite and quartz monzonite.

pCqd
Pink to light brown quartz diorite and quartz monzonite.

pCno
Quartz and nepheline.

pCg
Granite and quartz monzonite.

PRECAMBRIAN

OLDER PRECAMBRIAN

METAMORPHIC

pCs
Black to gray amphibolite and slate, chlorite and amphibole, white massive quartzite, biotite, calcite, marble and serpentine schists.

pCgn
Augen, quartz-feldsparitic, biotite and hornblende gneiss.

PRECAMBRIAN

OLDER PRECAMBRIAN

PROTEROZOIC

PROTEROZOIC

ZOIC

CENOZOIC

04°00'
42°00'

30'

45'

Tb

Tc

Tb

STRATIGRAPHIC LEGEND

10

SCALE 1 250 000

GEOLOGIC MAP OF THE CHEYENNE NTMS QUADRANGLE, WYOMING.

(After Intrasearch 1977)

WYOMING
COLORADO

30'

15'

25 MILES

Los Alamos
scientific laboratory
of the University of California
LOS ALAMOS, NEW MEXICO 87544
An Affirmative Action / Equal Opportunity Employer

12

WYOMING

	112°	110°	108°
46°	BOZEMAN NL 12-8	BILLINGS NL 12-9	HARDIN NL 13-7
45°	ASHTON NL 12-11	CODY NL 12-12	SHERIDAN NL 13-10
44°	DRIGGS NK 12-2	THERMOPOLIS NK 12-3	ARMINTO NK 13-1
43°	PRESTON NK 12-5	LANDER NK 12-6	CASPER NK 13-4
42°	OGDEN NK 12-8	ROCK SPRINGS NK 12-9	RAWLINS NK 13-7
41°	SALT LAKE CITY NK 12-11	VERNAL NK 12-12	CRAIG NK 13-4
40°			
	112°	110°	108°