DPST-62-200-X

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HISTORY OF THE SAVANNAH RIVER LABORATORY

VOLUME X - NATIONAL URANIUM RESOURCE EVALUATION

Issue Date: December 1982

This volume summarizes major activities and accomplishments in National Uranium Resource Evaluation at the Savannah River Laboratory. It is arranged in sections, which are issued and attached in chronological order. Sections included in this volume are:

Other volumes in this series are:

DPST-62-200-I	Production Reactor, Fuel, and Target Technology
DPST-62-200-II	Separations Technology
DPST-62-200-III	Power Reactor and Fuel Technology
DPST-62-200-IV	General
DPST-62-200-V	Weapon Data Technology
DPST-62-200-VI	Isotope Technology (No work in 1981)
DPST-62-200-VII	Gas Centrifuge Technology (No work in 1981)
DPST-62-200-VIII	Environmental Activities
DPST-62-200-IX	LWR Technology
DPST-62-200-XI	Defense Waste Management
DPST-62-200-XII	Spent Fuel Technology
DPST-62-200-XIII	Isotope Separation
DPST-62-200-XIV	Naval Fuel Technology

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SECTION 1. JANUARY 1977 - DECEMBER 1977

1.1 INTRODUCTION

The National Uranium Resource Evaluation (NURE) Program was established to evaluate domestic uranium resources in the continental United States and to identify areas favorable for commercial exploration. The objectives of the NURE program are:

- To prepare, based on existing data, a preliminary evaluation of domestic uranium resources and favorable exploration areas
- To complete a more comprehensive assessment of the uranium reserves of the United States as rapidly as possible.
- To identify areas favorable for uranium resources.
- To develop new and improved technologies for resource assessments.

The NURE program consists of five parts:

- Hydrogeochemical and stream sediment reconnaissance survey
- Aerial radiometric survey
- Surface geologic investigations
- Drilling for geologic information
- Geophysical technology

SRL has responsibility for hydrogeochemical and stream sediment reconnaissance (HSSR) of 2.2 million square kilometers in 30 eastern states.

Earlier work on the NURE program was reported in DPST-62-200-II, pages 319, 350-3, 372-7.

1.2 RECONNAISSANCE

During 1977, reconnaissance samples were collected in ~600,000 square kilometers from Alabama to Maine. Samples were collected at a minimum density of one site per 25 square kilometers; however densities were increased to as much as one site per 13 square kilometers in selected areas depending upon geology and sample type. Approximately 22,000 ground water samples and ~13,000 samples of stream sediment and water were collected. A total of seven subcontractors and 44 sampling teams were trained and supplied through the warehouse base in Building 711-U. Sampling plans were coordinated with a priority ordering of quadrangles (1°x 2° NTMS sheets) received from DOE-Grand Junction. Bids were reviewed and contracts were written for ground water and surface sampling covering an additional 625,000 square kilometers. Sampling in this area will begin in February 1978.

A plan was developed for anomaly verification in reconnaissance areas.

1.3 ORIENTATION STUDIES

Orientation studies preceed reconnaissance sampling in any new physiographic or geologic province. Orientation studies are necessary to determine the requirements for recognition of valid anomalies and to test the applicability of new techniques.

Orientation studies were conducted in the following areas: Leesville, South Carolina; Jasper, South Carolina; Soddy-Daisy, Tennessee; St. Francois Mountains, Missouri; Little Rock, Arkansas; Bentonville, Arkansas; North Carolina Coastal Plain; and Dover-Foxcroft, Maine. Results from these studies will help in planning reconnaissance sampling during 1978 and 1979.

A method was developed for determining helium/neon ratios in well water samples. Helium anomalies may be useful indicators of uranium deposits. The ratio is used as an internal reference and to reduce any variation from changes in instrumental response or sample collection procedures. Preliminary results show that the system works well and could be very useful in coastal plain areas where other types of samples would be limited. Radon-in-water measurements may be useful in locating uranium deposits in some areas. A radon detector was designed and built for measuring radon concentrations in ground water. Radon measurements were taken in several orientation studies.

The ratio ln(U)/[ln(Th) + ln(Hf) + ln(Dy)] was shown to be a key parameter in interpreting uranium distribution in stream sediments from the Kings Mountain, North Carolina, area. A cluster analysis treatment of titanium, vanadium, and manganese analyses successfully grouped a high percentage of stream sediment samples according to the rock units surrounding the sampling site.

Analyses of 25 dark coastal plain shales from South Carolina to New Jersey averaged 4.5 ppm uranium, with none exceeding 9.2 ppm. These shales had previously been proposed as a potential uranium resource similar to the Chattanooga shale.

1.4 FIELD TECHNOLOGY

Methods were developed for surface water sampling, and a procedure manual was written and open-filed for sampling stream sediment and water. Stream water samples were routinely collected at all surface sites. Training sessions were held for seven sampling subcontractors and 44 field teams. Acceptable sampling densities were established for crystalline and sedimentary areas.

A method was developed for collection of ground water samples for helium analysis. Samples will be collected for helium analysis in coastal plain areas where other types of samples (such as surface water) would not be useful. A device was designed and built to measure radon concentrations in ground water. The radon counter was field-tested in several orientation studies.

1.5 SAMPLE PREPARATION

During 1977, routine sample preparation was turned over to SRL-certified subcontractors. Approximately 14,000 sediment samples were prepared and packaged for neutron activation analysis (NAA) by one subcontractor. Another subcontractor packaged 24,000 resin samples for NAA. Specifications were written and contracts let for preparation of an additional 50,000 resin samples and 15,000 sediment samples.

1.6 NEUTRON ACTIVATION ANALYSIS

The Pilot Scale Reactor Activation Facility (PSRAF) began routine operation during 1977. Changes to the system significantly improved operation and reliability, and sample production averaged 850

samples per week while C Reactor was operating. The PSRAF processed over 19,000 samples during 1977.

A full-scale Reactor Activation Facility (RAF) was designed based on the knowledge and experience gained during operation of the PSRAF. The PSRAF was dismantled in November to allow for installation of the more highly automated and expanded RAF. Checkout and calibration of hardware and software systems of the RAF began in December, and operation is scheduled to begin in March, 1978. Production capacity of the RAF is expected to exceed 3500 samples per week.

An extensive software system was designed to automate all phases of the RAF. The spectrum reduction program RAGS and the data reduction program RICHES were rewritten for operation on the SEL 32-55 computer. Data reduction was previously done on the IBM 360/195. Restructuring of the data reduction programs should produce savings of $300,000 to $500,000 in computer charges over the life of the program.

1.7 OTHER ANALYTICAL TECHNIQUES

A project was approved to acquire a direct-reading emission spectrometer (DRES). Capacity of the computer-operated DRES is expected to be 200 samples per week. The SRL instrument, scheduled for installation in mid-1978, will be used primarily for NURE quality assurance and analysis of special NURE samples.

Specifications were written for analysis of 19 elements in 35,000 sediment samples. Elements not obtained by NAA will be analyzed. Analytical capabilities of the low bidder are being evaluated. Analysis should begin early in 1978.

An automated electron microprobe was installed to aid in mineralogical analyses of selected stream sediments. The microprobe was calibrated using metallurgical standards. Programming and calibration for particle analysis were initiated.

1.8 QUALITY ASSURANCE PROGRAM

Routine quality assurance procedures cover all phases of the NURE program. Three new stream sediment standards, SRL 2.2, 3.1, and 4.1 were prepared and sent to several offsite laboratories for analysis. These standards will replace SRL 2

and SRL 2.1 as routine quality assurance standards. Seventeen elements were verified as being reliably determined in sediments by the SRL-NAA system. Ten elements are determined in water (resin) samples. Precision of uranium analyses was very good during 1977 (~3% in sediments at 8 ppm uranium and ~8% in water at 0.3 ppb.)

The field quality assurance program included site verification and resampling. Subcontractor evaluation forms were utilized to maintain performance records. Sampling subcontractor work continues to be of good quality. Quality assurance evaluation showed sample preparation subcontractor work to be good.

1.9 NURE DATA MANAGEMENT SYSTEM

The SRL-NURE Data Management System (NDMS) processes all SRL reconnaissance data. Capabilities of the NDMS were enlarged to include an expanded query function for searching the SRL-NURE data base and a general purpose interface for linking the NDMS with output modules. A program was written to scrub field data before entry into the NDMS.

1.10 DATA ANALYSIS

Programming was written to facilitate production of reconnaissance raw data reports. Routines were completed for semi-automated generation of tables, figures, and quality assurance data for raw data releases. A routine for producing transverse Mercator projections was installed. Subroutines were written to display statistical data, such as histograms and cumulative frequency plots, for reports. An enlarger to produce full-scale (1:250,000) maps from 35 mm film and a processor to facilitate report generation were purchased. Report-generating hardware and software operated successfully in the production of two reconnaissance raw data releases.

1.11 REPORTS

SRL Quarterly Reports[1] documented the work on the hydrogeochemical and stream sediment reconnaissance program.

Preliminary raw data releases were completed for reconnaissance sampling of the Winston-Salem[2] and Spartanburg[3] 1° x 2°

quadrangles and transmitted to the DOE office, Grand Junction, Colorado, for open filing. Raw data from orientation studies in Spruce-Pine, Johnston, and Moore, North Carolina, areas were released.[4]

Field manuals were written for stream water and sediment reconnaissance[5] and for orientation studies.

A technical paper concerning the Kings Mountain, North Carolina, study was presented at the 1977 Southeastern Sectional Meeting of the Geological Society of America in Winston-Salem, North Carolina.

Five papers treating all major phases of the SRL HSSR program were presented at the ERDA-Bendix, "Symposium on Hydrogeochemical and Stream Sediment Reconnaissance for Uranium in the United States."[6]

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1. DPST-77-138-1, 2, 3, 4
2. DPST-77-146-1
3. DPST-77-146-2
4. DPST-77-141-1
5. DPST-77-363
6. GJBX 77(77)

Section 2. Januray 1978 - December 1978

2.1 INTRODUCTION AND SUMMARY

The National Uranium Resourse Evaluation (NURE) Program was established to evaluate domestic uranium resources in the continental United States and to identify areas favorable for commercial exploration.

The reporting schedule for the NURE program was accelerated to cover only 116 of the geologically most favorable 1° x 2° NTMS quadrangles. Reports on these quadrangles are scheduled to be completed by the end of FY-1980. SRL was given responsibility for sampling in and reporting on priority quadrangles in seven western states (California, Washington, Oregon, Nevada, Utah, and Arizona). Responsibility for hydrogeochemical and stream sediment reconnaissance (HSSR) increased to 2.6 million square kilometers in 37 states. Reconnaissance sampling in the eastern U.S. continued.

A full-scale Reactor Activation Facility (RAF) was put into production. The RAF is capable of analyzing approximately 12,000 samples per month. Uranium and up to 19 other elements are reported from sediment and water (resin) analyses performed at the RAF.

2.2 RECONNAISSANCE

Approximately 45,000 ground water, 30,000 stream sediment, and 20,000 stream water, as well as 12,000 helium samples, were collected over ∿690,000 km^2 in the eastern U.S. Minimum densities of one ground water sample per 13 km^2 and one surface sample per 25 km^2 were generally applied. Nine subcontractors and 85 sampling teams were trained and supplied. One contract was terminated due to unsatisfactory performance. Bids were received for 1979 sampling of 35 quadrangles in the east; however, only two were acted upon due to DOE redirection of the program in favor of western territories.

NURE geologists made three one-week trips to the west to assess the areas to be sampled. Sampling specifications for western states were prepared and bids were received.

Anomaly verification studies were begun in six areas within the Greenville, Spartanburg, Charlotte, and Greensboro quadrangles. Anomaly verification of the area near Kings Mountain, N.C. was completed. Preliminary results from this study show that intuitive methods of data interpretation incorporated in previous SRL reports are valid.

2.3 ORIENTATION STUDIES

Analysis of samples from the Leesville, Jasper, Sody-Daisy, St. Francois Mountains, Little Rock, Bentonville, North Carolina Coastal Plain and Dover-Foxcraft orientation studies was completed. One orientation study in Florida was initiated.

A computer system for the reduction and formating of field data from orientation studies was implemented.

2.4 FIELD TECHNOLOGY

SRL was given responsibility for sampling in seven western states. New sampling specifications were prepared. Major departures from previous sampling methods included additional seiving of samples to discriminate against windblown material, scintillometer readings at all sites, and the requirement, in certain areas, that samplers provide geologic information on field forms. To develop these procedures, the SRL geologic staff spent approximately eight man-weeks studying western environments.

Acceptable sampling densities were fixed at 1 sample/5 mi^2 for sediments and 1 sample/10 mi^2 for ground water in crystalline terrain. In areas where sedimentary rock is predominant, densities of 1 sample/5 mi^2 for ground water and 1 sample/8 mi^2 for sediments were used. Thirteen training sessions for 85 sampling teams were held. Plans were outlined for three-day training sessions in the west.

2.5 SAMPLE PREPARATION

Approximately 19,000 sediment, 16,200 stream water, and 21,000 ground water samples were packaged by approved subcontractors.

2.6 NEUTRON ACTIVATION ANALYSIS

A full-scale Reactor Activation Facility (RAF) became operational in August. The RAF is capable of analyzing for 26 elements. Due to "debugging" of the facility, August-September production was limited to about, 5,000 samples. October sample processing rose to the peak production rate of 13,000 samples. Fully loaded, the facility is capable of unattended activation of about 2,400 samples in a 72-hour period. An automatic unloader, which will further facilitate sample processing, was designed and required only software support before being put into operation.

Four additional pulse height analyzers (PHA) were installed, bringing the total to ten. An extensive fail-safe/ABORT system was installed. This system initiates a shut-down of the facility when abnormalities in any of the operating systems are detected. The core capacity of the SEL 32-55 computer, which supports the RAF, was expanded to its maximum of 128K words. To avoid delays in production due to component failure, certain critical spare parts were purchased for the computer.

An additional magnetic tape and disk drive were installed to speed data transfer and to reduce the potential for loss of data and software in the event of a disk failure.

2.7 OTHER ANALYTICAL TECHNIQUES

A direct reading emission spectrometer (DRES) was purchased; it arrived in September. The DRES is equipped with an automatic sample changer, which can facilitate the sequential DC arc analysis of 40 samples. The DRES is programmed for the determination of 34 elements in soils and sediments. Primary functions of the DRES are to verify standard analyses obtained from the RAF and to analyze anomalous soil and sediment samples.

By September approximately 10,000 ground water samples from the eastern coastal plain had been analyzed for "effective" helium concentrations. Helium analyses from September to December kept pace with shipments of ground water samples to SRL.

Approximately 3000 sediment samples were submitted to approved subcontractors for supplemental elemental analyses. Subcontractors analyze samples for 19 elements not available from the RAF.

A field-portable laser fluorescence spectrometer (LFS) was purchased. The LFS performs onsite uranium analyses of stream and ground water. The LFS has a detection limit of 0.05 ppb U and an accuracy of ±15% at the 1 ppb level and above. The unit will be used primarily in connection with SRL anomaly verification studies.

Analysis of NURE samples by the automated electron microprobe (AEM) began. The AEM is capable of analyzing for 39 elements in a 20-minute period. Coupled with a PDP-11 computer, the AEM can perform unattended analyses of multiple samples for periods of several hours.

2.8 DATA MANAGEMENT AND ANALYSIS

Statistical treatment of reconnaissance data was expanded. Multielement regression techniques were used to predict uranium residuals in the southeastern U.S. Multielement discriminant function analysis was utilized in isolating areas of similar geology that show favorable uranium potential.

In order to meet BFEC specifications for maps in basic data reports, a 105-mm camera was purchased and installed. To reduce the cost of folding 2000 maps required for each basic data release, a Bruning Versafold map folder, with a folding rate of 400 maps per hour, was purchased.

The BMDP statistical package was procured and was used to perform preliminary statistical interpretation of reconnaissance data. CLUSTRAN, a cluster analysis software package, and SURFACE II, a statistical and graphics software package, were purchased and await installation.

The SAS data output program and the DISPLA plotting program were linked in order to reduce the time required to produce figures and tables for basic data reports. Five report-writing programs and a map generation program were modified to meet new BFEC specifications.

The NURE data manager was expanded to a two-tape system. The data manager now contains information for more than 120,000 sampling sites.

2.9 QUALITY ASSURANCE PROGRAM

Routine quality assurance procedures cover all phases of the NURE program. The field quality assurance program included site verification and/or resampling by members of the SRL staff and three approved subcontractors of ∿6,000 surface and ground water sites. Overall, sampling by subcontractors was good. One contract was canceled due to unsatisfactory performance.

2.10 REPORTS

An SRL Quarterly Report[1] and a Semi-Annual Report[2] were issued. These reports documented the work on the hydrogeochemical and stream sediment reconnaissance program.

Preliminary raw data releases were completed for reconnaissance sampling of the Charlotte[3], Greenville[4], and Greensboro[5] 1° x 2° NTMS quadrangles and transmitted to the DOE office, Grand Junction, Colorado, for open filing. A report containing ground water analyses for the Winston-Salem[6] quadrangle was also released. Data from one orientation study in Leesville[7], S.C., and a report entitled "Geology of the Raleigh Quadrangle, North Carolina"[8] were open-filed.

A technical paper, entitled "NURE Geochemical Investigations in the Eastern United States"[9], was presented at the 7th International Geochemical Exploration Symposium in Golden, Colorado. A paper, entitled "The Use of NURE Regional Geochemical Data in Geologic Mapping"[10], was incorporated in the Carolina Geological Society Field Trip Guidebook 1978.

Two sets of sampling specifications for the eastern United States and one for the western United States were issued in 1978.

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1. DPST-78-138-1
2. DPST-78-138-2
3. DPST-78-146-1
4. DPST-78-146-2
5. DPST-78-146-4
6. DPST-78-146-3
7. DPST-78-141-1
8. DP-1490
9. DP-MS-77-101
10. DP-MS-78-78

SECTION 3. - JANUARY 1979 - DECEMBER 1979

CONTENTS

3.1 SUMMARY

In 1979 the major emphasis shifted to the westerm U.S. Program priorities are reporting of 116 favorable 1° x 2° NTMS quadrangles by the end of FY-1980. SRL is responsible for nine of these quadrangles in the East and 23 in the West. In 1979, the nine eastern "116" reports were completed as was sampling on all 23, and analyses of ten of the western "116" quadrangles.

These and other aspects of sampling, analyses, and reporting are discussed in more detail below.

3.2 DETAILED, ORIENTATION, AND ANOMALY VERIFICATION STUDIES

Orientation and anomaly verification studies were deferred in order to direct our resources to western work. These studies are in various stages of completion.

Several areas were selected by quadrangle evaluators as likely to prove amenable to detailed geochemical sampling. SRL collected closely spaced sediment, soil, rock and/or botanical samples in five such areas in South Carolina, New York, Nevada, and Washington. Analysis and reporting of samples will be delayed until reconnaissance samples from priority areas are completed.

3.3 SAMPLE COLLECTION

Sampling in western states began in March 1979. Eastern sampling was reduced to "cleanup" of unfinished projects. About 32,000 sediment, 2000 stream water, and 6300 groundwater samples were collected in the West.

Several changes in sampling were incorporated into 1979 operations. Training sessions for samplers were held near actual sampling areas. Topographic maps were used instead of county maps, and all sampling sites were photographed. Groundwater and surface sampling of any quadrangle was contracted with the same contractor. Acidified water samples were collected to permit analysis for geochemically important elements not analyzed by neutron activation.

3.4 SAMPLE PREPARATION

During 1979 approximately 90,000 samples were packaged in irradiation capsules as follows:

	Western Samples	Eastern Samples	Detailed Studies
Sediment	22,000	20,000	5,500
Stream water	1,500	11,000	1,600
Ground water	5,100	23,000	2,100

3.5 NEUTRON ACTIVIATION ANALYSIS

Nearly 70,00 samples were analyzed by the Reactor Activation Facility (RAF) this year. In January, 16,500 samples were analyzed when near ideal system operating conditions were available. An extended reactor shutdown (five months) and other less extensive operating problems limited the RAF to six months of production time. However, the RAF has demonstrated the projected capacity of 100,000 samples per year under normal reactor operations.

During the extended shutdown, several improvements to enhance the reliability of the RAF were made. An automatic sample loading device was incorporated into the storage stack system, which allows 2400 samples to be loaded at one time. An automatic sample unloading station was also incorporated into the stack system. This device is capable of storing about 10,000 samples, reduces personnel radiation exposure, and speeds unloading procedures. The RAF was modified to allow dual-disk operation. All vital process control and data information is written to two disks simultaneously. This prevents a disk crash from destroying irreplaceable data.

3.6 OTHER ANALYTICAL TECHNIQUES

The direct reading emission spectrometer (DRES) was installed and calibrated for the range of matrices expected in many soil and sediment samples. A study is in progress which uses the DRES to provide quality assurance checks on offsite NURE sediment analyses. A plasma source has been purchased and is scheduled for delivery and installation early in 1980.

Favorable results prompted us to continue analyzing all groundwater samples for He. Most recent samples have also been analyzed for light alkanes but no regional evaluation of these data has been made.

Water samples stabilized with 2% 8N HNO_3 have been collected at about 10,000 western U.S. sites. These samples are being analyzed at ORGDP by plasma-source DRES for 28 elements.

Methods have been developed for analysis of uranium in plant tissues using a laser fluorescence spectrometer. Over 6000 plant samples from reconnaissance and detailed studies will be analyzed for uranium in 1980.

3.7 DATA MANAGEMENT AND ANALYSIS

During 1979, the use of factor analysis and other statistical techniques on reconnaissance data was expanded. A contract was let to analyze reconnaissance data using advanced cluster analysis software.

An OS (SAS) data set was acquired in which reconnaissance data for a block of northeastern quadrangles will be stored. Preliminary statistical treatment and display of the data have been performed. A second SAS data set was obtained for the storage of data concerning the analyses of standards.

Job control language (JCL) was composed which circumvents the need to produce multiple data sets for a given sample type in a quadrangle. The new JCL should reduce the amount of text editor space utilized by the NURE group for the storage of data.

3.8 QUALITY ASSURANCE PROGRAM

Routine quality assurance procedures cover all phases of the NURE program. The field quality assurance program included site verification and/or resampling by members of the SRL staff and two approved subcontractors of ~ 4000 surface and groundwater sites. The quality of sampling by subcontractors was good in 1979.

Analytical quality assurance included analysis of a standard and a blank with each 23 samples. Analyses of uranium and multi-element standards continued at the RAF in 1979. While these are useful in spotting some problems, the volume of data is generally too large to be handled except by computer techniques. Hence, SAS data sets were created to store and statistically treat the data from the five different standards, and blanks. Data are stored and sorted by date as well as the detectors used in the analyses. Thus, the performance of each of the RAF's ten detectors can be tracked with time.

3.9 REPORTS

Two semiannual reports (DPST-79-138-1 and DPST-79-138-2) were issued documenting work on the Hydrogeochemical and Stream Sediment Reconnaissance protion of the NURE program.

Data reports of neutron activation analyses were released for the following quadrangles:

Knoxville	DPST-78-146-5
Scranton	DPST-78-146-6
Athens	DPST-78-146-7
Harrisburg	DPST-79-146-1
Portland	DPST-79-146-2
Glens Falls	DPST-79-146-3
Augusta	DPST-79-146-4
Dyersburg	DPST-79-146-5
Popular Bluff	DPST-79-146-6
Hartford	DPST-79-146-7
Williamsport	DPST-79-146-8
Albany	DPST-79-146-10
Atlanta	DPST-79-146-11
Delta, Richfield (LLL samples)	DPST-79-146-12

A Supplemental Analyses Report for the Athens, Charlotte, Greenvile, and Spartanburg 1° x 2° NTMS quadrangles was released (DPST-79-155-1). Other reports were "Uraniferous Gorceixite Occurrences in Aiken County, South Carolina" (DPST-79-318), and "Geology of the Birmingham, Gadsden, and Montgomery 1° x 2° NTMS Quadrangles, Alabama" (DP-1530).

3.10 GORCEIXITE IDENTIFICATION

X-ray diffraction and scanning electron microprobe quantometer analysis were used to identify gorceixite (a rare, uranium-bearing mineral) from several locations near Aiken, South Carolina.

SECTION 4. JANUARY 1980 - DECEMBER 1980

CONTENTS

4.1 PROGRAM

In June, we learned that the NURE program was being curtailed and in September, it became apparent that FY-1981 would be SRL's last year to provide geochemical reconnaissance support for the Grand Junction Office of the Department of Energy (GJO). In October, we met with a representative of GJO to establish priorities for FY-1981.

Our objectives as discussed at that meeting include:

- Analyzing as many samples from our backlog as possible.
- Reporting as many areas as possible. A priority list was agreed upon. Unreported data will be transferred to GJO by data tape in September 1981.
- Orderly transfer of all samples, maps, and essential field data to Oak Ridge Gaseous Diffusion Plant (ORGDP).
- Reporting miscellaneous data and results from SRL development studies. Unreported data include RAF analyses for Au, W, and Ta, and hydrocarbon analyses of ground water samples.

4.2 SAMPLING AND SAMPLE PREPARATION

Sampling in western states continued. In the eastern U.S. ground water, stream water, and stream sediment samples (~1500 of each) were collected from the Bangor-Bath-Eastport area of Maine. About 53,000 samples were collected from 200,000 square miles.

	East	West	
Sediments	69,470	64,745	
Stream Waters	35,951	2,967	
Ground Waters	74,703	14,468	
Vegetation	-	1,365	
Totals	180,124	83,545	263,669

Essentially all samples have been packaged in irradiation capsules.

Sampling proceeded fairly smoothly. Onsite training sessions resulted in better prepared samples. Improvements in the field data cards reduced errors in recording field data. Polaroid® photographs of each site sampled made QA checks much more straightforward.

In retrospect, one very important lesson was learned about subcontracted sampling: Contractors with good personnel delivered a product up to SRL Specifications and made money. Personnel must understand basic principles of geology, must be able to make simple chemical measurements (e.g., pH, alkalinity) in the field, and must be able to judge when these measurements are incongruous with one another or with the geologic setting. In SRL bidding documents we specify that samplers must have a background that includes a minimum of one year of college level training in geology and chemistry.

We dealt with about 15 subcontractors during the past several years. A few presented personnel for SRL training who did not meet the above specifications. In every case where we accepted a deviation from the specifications we got poor work on the overall contract.

4.3 NEUTRON ACTIVATION ANALYSIS

Approximately 100,000 samples were analyzed by the Reactor Activation Facility (RAF) this year. In March a peak of 18,565 samples was obtained. Sustained operation at about 15,000 samples per month allows for minor hardware problems.

After an extended shutdown, C-reactor started up in late November. Approximately 16,000 samples were irradiated in December. Routine quality assurance checks identified several problems which caused us to reduce sample throughput until certain hardware modifications can be made during the late January 1981 reactor shutdown.

An activation system under manual control has been designed and partially constructed. This system makes use of one of the RAF's 6 irradiation tubes and will irradiate samples for up to 24 hours. It is designed primarily to support studies of defense waste immobilization forms and will be discussed elsewhere.

4.4 OTHER ANALYTICAL TECHNIQUES

A plasma source has been installed on the direct reading emission spectrometer. This instrument has not been used significantly in the NURE program and appropriate modifications are being made for its use in support of defense waste management.

Approximately 1500 samples of conifer needles have been analyzed for uranium by laser-induced fluorescence after ashing and leaching. Results look promising. A report will be issued discussing these results in 1981 and some 5000 unanalyzed samples will be transferred to ORGDP.

4.5 DATA MANAGEMENT AND ANALYSIS

Modifications of queuing procedures resulted in significant savings in computer costs in late 1980. The original NURE data manager system proved cumbersome and expensive to operate with large numbers of samples. "High level" queries - for example for data from entire regions rather than for single reports - yield subsets of the main data base which can be maintained and manipulated quickly from disc-storage.

Coding was completed to include factor analysis (including an inter-element correlation matrix) as a regular part of SRL NURE data reports.

4.6 QUALITY ASSURANCE

As noted above, field quality assurance was improved by requiring photographs of each site. Results indicate that sampling has been very good.

Analytical (RAF) quality assurance was improved in two ways. A program was written for the SEL 32/55 RAF control computer so that standards data could be examined within a few minutes of running the standards. Previous turnaround time was approximately 2 weeks or 8000 samples later.

SAS programs have been written to produce graphic displays of standards data each time RAF data are transferred to the IBM 360 (normally once per week). These displays plot elements from each of three spectra versus the date of analysis and the detector.

The ability to continually compare data from different detectors is allowing us to compensate for detector drift (or sensitivity changes) and maintain the same calibration on all detectors without shutting down for periodic calibration checks. This will greatly improve analytical precision.

Fast examination of standards data in mid-December 1980, allowed us to spot a hardware failure which was causing about one-sixth of all samples not to be irradiated. Prior to mid-1980, such a failure might have gone unnoticed for some time and resulted in erroneously low analytical values for many samples.

4.7 REPORTING

A semiannual report (DPST-80-138-1) was issued documenting SRL's work on the Hydrogeochemical and Stream Sediment Reconnaissance part of the NURE program through March 1980.

Thirty-three reconnaissance data reports were issued in 1980 (see table). The format of these reports was abbreviated to one in which nearly all data are on microfiche. Printed pages were reduced from about 160 to about 18 and up to ten 24- x 30-inch folded plates were reduced to four 4" x 5" negatives.

Production effort for the abbreviated reports is only a fraction of that for the fully printed reports because all tables, data maps, and sample location maps are produced by a computer output microfiche (COM) unit and reproduced by a machine to give 150 copies of each.

All data and figures available in the full-sized reports (and in addition, as noted above for reports after December 1980, a fuller statistical analysis of data) are included in the abbreviated form.

4.8 1980 NURE RECONNAISSANCE REPORTS

Quadrangle	SRL Doc. No.
Neutron Activation Data	
Walker Lake	DPST-79-146-13
McDermitt-Wells (LLL samples)	DPST-79-146-14
Reno	DPST-79-146-15
Death Valley	DPST-79-146-16
Flagstaff	DPST-79-146-17
Marble Canyon	DPST-79-146-18
Grand Canyon	DPST-79-146-19
Pocatello	DPST-79-146-20
Mesa	DPST-80-146-1
Salton Sea	DPST-80-146-2
Ritzville	DPST-80-146-3
Elko	DPST-80-146-4
Challis	DPST-80-146-5
Klamath Falls	DPST-80-146-6
Salina	DPST-80-146-7
Escalante	DPST-80-146-8
Price	DPST-80-146-9
McDermitt	DPST-80-146-10
Wells	DPST-80-146-11
Delta	DPST-80-146-12
Okanogan	DPST-80-146-13
Spokane	DPST-80-146-15
Richfield	DPST-80-146-16
Trona	DPST-80-146-17
Lewiston	DPST-80-146-18
Boston	DPST-80-146-19
Providence	DPST-80-146-20
Rocky Mount-Manteo	DPST-80-146-21
Beaufort	DPST-80-146-22
Richmond Eastville	DPST-80-146-24
Supplemental Data	
Mesa	DPST-80-146-1S
Salton Sea	DPST-80-146-2S
Spokane	DPST-80-146-15S

SECTION 5. JANUARY 1981 - DECEMBER 1981

CONTENTS

5. INTRODUCTION AND SUMMARY

The National Uranium Resource Evaluation (NURE) program was established to evaluate domestic uranium resources in the Continental United States and to identify areas favorable for commercial exploration.

The principal objectives of the NURE program were:

- Increase geologic knowledge of U.S. uranium resources in regions where uranium ore bodies are known to exist and are candidate supplies under present and near-term market conditions.
- Complete assessment of lower cost potential uranium resources in the conterminous U.S. and Alaska.
- Improve reliability and valid resource estimates and increase confidence levels.
- Expand scope of uranium assessment to include higher cost and relatively unknown domestic resources that may be feasible uranium supply alternatives.
- Apply advanced technologies for detection and assessment of uranium resources.

The NURE program was terminated in September 1981. The major goals for NURE in this year were:

(1) Reduce the sample backlog as much as possible.

(2) Transfer all samples to the Oak Ridge Gaseous Diffusion Plant (ORGDP).

(3) Report as much data as possible.

(4) Document miscellaneous data and results from SRL development studies.

In the seven years of operation, 315,920 samples were collected and 263,167 samples were analyzed. All of the unanalyzed samples were stream sediment samples, principally from the western states. 194,120 samples were collected in the east and 121,800 samples collected in the west. All of the samples were labeled and the sample I.D. was written onto a magnetic tape along with the latitude and longitude of the sampling site, and the sample type. These samples were then transferred to ORGDP for archival storage. The archival preparations and transfer were handled by an independent contractor.

During 1981, several analysis techniques were developed to analyze NURE samples. These techniques are now used extensively by ACD for routine analyses. The ICP plasma unit was contained so that radioactive samples could be analyzed. The Manual Reactor Activation System (MRAS) was brought online this year. New sample preparation techniques and upgraded computer analysis programs allow MRAS the flexibility necessary for general chemical analysis. In addition to the hardware to analyze samples, computer techniques were developed to manipulate large data bases. The data reduction and report generating codes were invaluable in this final year.

The NURE group has published a total of 153 reports. These reports may be categorized as follows:

	75	76	77	78	79	80	81
Period Reports	4	4	4	2	2	1	
1° x 2° Quadrangle			2	8	26	32	21
State Reports							8
Anomaly & Orientation							40

The large number of reports generated in 1981 was due in part to the contingent of summer employees. The data on all the samples analyzed by NURE was filed in Grand Junction. A list of all reports published by NURE is included here for reference.

REFERENCES

SRL-138, Savannah River Laboratory Quarterly and Semiannual Reports, Hydrogeochemical and Stream Sediment Reconnaissance, National Uranium Resource Evaluation Program: E. I. du Pont de Nemours & Co., Savannah River Laboratory, Aiken, S.C.

Period	SRL Doc. No.	DOE-GJO Doc. No.*
January-March 1975	DPST-75-138-1	GJBX-5(76)
April-June 1975	DPST-75-138-2	GJBX-6(76)
July-September 1975	DPST-75-138-3	GJBX-7(76)
October-December 1975	DPST-75-138-4	GJBX-8(76)
January-March 1976	DPST-76-138-1	GJBX-17(76)
April-June 1976	DPST-76-138-2	GJBX-27(76)
July-September 1976	DPST-76-138-3	GJBX-63(76)
October-December 1976	DPST-76-138-4	GJBX-6(77)
January-March 1977	DPST-77-138-1	GJBX-35(77)
April-June 1977	DPST-77-138-2	GJBX-55(77)
July-September 1977	DPST-77-138-3	GJBX-90(77)
October-December 1977	DPST-77-138-4	GJBX-37(78)
January-March 1978	DPST-78-138-1	GJBX-66(78)
April-September 1978	DPST-78-138-2	GJBX-13(79)
October 1978-March 1979	DPST-79-138-1	GJBX-86(79)
April-September 1979	DPST-79-138-2	GJBX-160(79)
October 1979-March 1980	DPST-80-138-1	GJBX-146(80)

SRL-146, **SRL-NURE Data Reports**, E. I. du Pont de Nemours & Co., Savannah River Laboratory, Aiken, S.C.

NTMS 1° x 2° Quadrangle	SRL Doc. No.	DOE-GJO Doc. No.*
Winston-Salem†	DPST-77-146-1	GJBX-6(77)
Spartanburg	DPST-77-146-2	GJBX-09(78)
Charlotte	DPST-78-146-1	GJBX-40(78)
Greenville	DPST-78-146-2	GJBX-47(78)
Winston-Salem††	DPST-78-146-3	GJBX-58(78)
Greensboro	DPST-78-146-4	GJBX-74(78)
Knoxville	DPST-78-146-5	GJBX-75(79)
Scranton	DPST-78-146-6	GJBX-02(79)
Scranton	DPST-78-146-6S	GJBX-24(81)
Athens	DPST-78-146-7	GJBX-20(79)
Harrisburg	DPST-79-146-1	GJBX-31(79)
Portland	DPST-79-146-2	GJBX-28(79)
Portland	DPST-79-146-2S	GJBX-106(81)

NTMS 1° x 2° Quadrangle	SRL Doc. No.	DOE-GJO Doc. No.*
Glens Falls	DPST-79-146-3	GJBX-44(79)
Glens Falls	DPST-79-146-3S	GJBX-70(81)
Augusta	DPST-79-146-4	GJBX-45(79)
Dyersburg	DPST-79-146-5	GJBX-58(79)
Poplar Bluff	DPST-79-146-6	GJBX-63(79)
Hartford	DPST-79-146-7	GJBX-94(79)
Williamsport	DPST-79-146-8	GJBX-152(79)
Williamsport	DPST-79-146-8S	GJBX-313(81)
Newark	DPST-79-146-9	GJBX-128(80)
Newark	DPST-79-146-9S	GJBX-71(81)
Albany	DPST-79-146-10	GJBX-140(79)
Albany	DPST-79-146-10S	GJBX-107(81)
Atlanta	DPST-79-146-11	GJBX-129(79)
Delta, Richfield†††	DPST-79-146-12	GJBX-161(79)
Walker Lake	DPST-79-146-13	GJBX-107(80)
McDermitt, Wells††††	DPST-79-146-14	GJBX-117(80)
Reno	DPST-79-146-15	GJBX-108(80)
Death Valley	DPST-79-146-16	GJBX-135(80)
Flagstaff	DPST-80-146-17	GJBX-137(81)
Marble Canyon	DPST-80-146-18	GJBX-138(81)
Grand Canyon	DPST-79-146-19	GJBX-142(80)
Pocatello	DPST-79-146-20	GJBX-161(80)
Mesa	DPST-80-146-1	GJBX-216(80)
Mesa	DPST-80-146-1S	GJBX-81(80)
Salton Sea	DPST-80-146-2	GJBX-217(80)
Salton Sea	DPST-80-146-2S	GJBX-113(80)
Ritzville	DPST-80-146-3	GJBX-162(80)
Elko	DPST-80-146-4	GJBX-163(80)
Challis	DPST-80-146-5	GJBX-91(80)
Klamath Falls†††††	DPST-80-146-6	GJBX-171(80)
Salina†††††	DPST-80-146-7	GJBX-218(80)
Escalante†††††	DPST-80-146-8	GJBX-209(80)
Price†††††	DPST-80-146-9	GJBX-172(80)
McDermitt††††††	DPST-80-146-10	GJBX-173(80)
Wells†††††	DPST-80-146-11	GJBX-174(80)
Delta†††††	DPST-80-146-12	GJBX-198(80)
Okanogan†††††	DPST-80-146-13	GJBX-210(80)
Johnson City†††††	DPST-80-146-14	GJBX-26(81)
Spokane†††††	DPST-80-146-15	GJBX-211(80)
Spokane	DPST-80-146-15S	GJBX-195(80)
Richfield†††††	DPST-80-146-16	GJBX-242(80)
Trona†††††	DPST-80-146-17	GJBX-243(80)
Lewiston†††††	DPST-80-146-18	GJBX-14(81)
Boston†††††	DPST-80-146-19	GJBX-255(80)
Boston	DPST-80-146-19S	GJBX-72(81)

NTMS 1° x 2° Quadrangle	SRL Doc. No.	DOE-GJO Doc. No.*
Providence††††	DPST-80-146-20	GJBX-15(81)
Rocky Mount-Manteo††††	DPST-80-146-21	GJBX-16(81)
Beaufort††††	DPST-80-146-22	GJBX-17(81)
Macon††††	DPST-80-146-23	GJBX-40(81)
Richmond and Eastville††††	DPST-80-146-24	GJBX-18(81)
Rome††††	DPST-80-146-25	GJBX-25(81)
Dothan, Waycross and Brunswick††††	DPST-80-146-26	GJBX-27(81)
Roanoke††††	DPST-80-146-27	GJBX-73(81)
Gadsden and Tupelo††††	DPST-81-146-1	GJBX-213(81)
Lake Champlain††††	DPST-81-146-2	GJBX-108(81)
Lake Champlain	DPST-81-146-2S	GJBX-282(81)
Montgomery and Parts of Meridian, Hattiesburg, and Andalusia††††	DPST-81-146-3	GJBX-190(81)
Birmingham and West Point†††††	DPST-81-146-4	GJBX-191(81)
Charlottesville††††	DPST-81-146-5	GJBX-175(81)
Baker††††	DPST-81-146-6	GJBX-231(81)
Needles††††	DPST-81-146-7	GJBX-232(81)
Binghamton††††	DPST-81-146-8	GJBX-192(81)
Raleigh††††	DPST-81-146-9	GJBX-233(81)
Norfolk and Southern Eastville†††††	DPST-81-146-10	GJBX-283(81)
Bluefield††††	DPST-81-146-11	GJBX-234(81)
Washington††††	DPST-81-146-12	GJBX-284(81)
Vya††††	DPST-81-146-13	GJBX-285(81)
Baltimore††††	DPST-81-146-14	GJBX-286(81)
Cumberland and Pittsburgh†††††	DPST-81-146-15	GJBX-287(81)
Santa Cruz††††	DPST-81-146-16	GJBX-314(81)
Little Rock, El Dorado, and Adjacent Areas††††	DPST-81-146-17	GJBX-349(81)

NTMS 1° x 2° Quadrangle	SRL Doc. No.	DOE-GJO Doc. No.*
Phoenix††††	DPST-81-147-18	GJBX-315(81)
Phenix City††††	DPST-81-147-19	GJBX-316(81)
San Bernardino††††	DPST-81-146-20	GJBX-317(81)

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† Sediment only.

†† Ground water only.

††† SRL analyses of samples collected by Lawrence Livermore National Laboratory.

†††† Abbreviated report; geology, hydrology, and data discussion sections are omitted.

S Supplemental Data Reports.

* DOE-GJO reports are available on microfiche from the Grand Junction Office, DOE, for $6.00. Prepaid orders should be sent to: Bendix Field Engineering Corporation, Technical Library, P.O. 1569, Grand Junction, CO 81501. Checks or money orders should be made out to Bendix Field Engineering Corporation, the operations contractor for DOE's Grand Junction Office.

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