



# Chain of Custody—Recommendations for Acceptance and Analysis of Evidentiary Geochemical Samples



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*Mineral Resource Survey Program Committee report  
detailing the guidelines for acceptance and handling  
of evidentiary geochemical samples*



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## **EXECUTIVE SUMMARY**

This report details the procedure for handling samples submitted to the Mineral Resource Survey Program (MRSP), formerly the Branch of Geochemistry (BGC). In addition, there are rules required by law when the samples are used as evidence. This report covers both evidentiary and routine samples.

This report includes:

- Sample control personnel procedures for routine handling of samples
- Designation of samples in need of special handling
- Submitter's procedure for communicating the need for special handling
- Laboratory personnel procedures for handling evidentiary samples
- Personnel policies and responsibilities
- Security measures

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## INTRODUCTION

Personnel from the Analytical Chemistry Services Group (ACSG), Mineral Resource Survey Program (MRSP), formed a team to determine the policies for acceptance and analysis of geochemical samples. This team contacted law enforcement agencies that handle litigious samples, laboratories that work with samples of a special nature, and the Solicitor General, Department of the Interior. Using the knowledge from these agencies as well as the expertise of our personnel, the following policies have been enacted.

## SAMPLE CONTROL ROUTINE PROCEDURES

Sample control personnel are responsible for maintaining the chain of custody for all samples submitted to MRSP from submittal to eventual storage. Samples used in litigation are controlled by an even more rigorous set of guidelines to ensure their security. Policies for both the routine chain of custody (COC) procedures and the evidentiary COC procedures are detailed below.

All samples submitted to MRSP must be accompanied by a completed request for analysis (RFA) form (figs. 1A and 1B). The RFA accompanies the samples through the entire system as the accountable record. All important information, such as the evidentiary nature of a sample or high elemental concentration in a sample, is noted on this form along with the requested analysis. All fields noted on the RFA as mandatory must be completed prior to acceptance by sample control.

### Acceptance of Samples (Nonevidentiary)

Samples accepted by sample control personnel are scanned for radioactivity. If samples are above the safe levels defined by the MRSP safety officer, samples are placed in an alternate storage area, and the safety officer is notified. If the safety officer deems the samples unacceptable, the submitter is asked to retrieve them within 30 days. Other samples that might pose a threat to the safety of personnel, such as hazardous waste material, are also referred to the safety officer.

Samples are counted and checked against the RFA. Discrepancies are resolved prior to formal acceptance. The number of samples is recorded in a sample control log book.

The samples are placed on numbered shelves in a holding area for unprepared samples. The shelf number is noted on the RFA and the RFA is forwarded for data entry into the computer.

The information from the RFA is entered in a computer and a job number is issued to each batch. Individual sample numbers are also issued (laboratory numbers). The job number and laboratory numbers are added to the RFA.

A computer printout of the requested analysis, the assigned job number, the laboratory numbers, the submitter's identifying numbers (usually the field

U.S. Geological Survey  
 Mineral Resource Survey Program, P.O. Box 25046  
 Denver Federal Center, MS 928  
 Denver, CO 80225-0046

REQUEST FOR ANALYSIS (RFA) <sup>1</sup>

Submitter<sup>2</sup> \_\_\_\_\_  
 Address \_\_\_\_\_  
 Phone number \_\_\_\_\_  
 E-Mail Address \_\_\_\_\_  
 Project title \_\_\_\_\_  
 Project number \_\_\_\_\_  
 Program number \_\_\_\_\_  
 If previous work was done on these samples,  
 list job numbers: \_\_\_\_\_  
 Results needed by \_\_\_\_\_

Branch Chief approved  
 (if required by Submitter's Branch) \_\_\_\_\_  
 Number of samples \_\_\_\_\_  
 Preparation instructions: \_\_\_\_\_  
 Special requirements: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 Disposition of bulk:  
 Discard  
 Return to submitter  
 (Submitter must supply container)

For MRSP Use Only  
 Job number \_\_\_\_\_  
 Lab number \_\_\_\_\_  
 Date received \_\_\_\_\_  
 Counted and scanned by \_\_\_\_\_  
 Shelf \_\_\_\_\_  
 Prepared by \_\_\_\_\_  
 Prep Lab \_\_\_\_\_  
 N des \_\_\_\_\_  
 O C \_\_\_\_\_  
 M mineralogy by \_\_\_\_\_

Contact the Sample Control specialist (303) 236-2479 for tracking progress of your samples.

ACSG METHODS

Check technique(s) necessary for your study. Contact the Chief (ACSG), (303) 236-1804, for further information. Nonroutine methods are available through arrangement with the ACSG Liaison, (303) 236-1923 (note on reverse side).

| Constituent, Method  | Analyst/Date |
|--|--------------|
| <input type="checkbox"/> 40-element, ICP-AES   |              |
| <input type="checkbox"/> 35/37-element, dc-ARC OES   |              |
| <input type="checkbox"/> 12-element, EDXRF   |              |
| <input type="checkbox"/> Rb, Sr, Y, Nb, Zr   |              |
| <input type="checkbox"/> Ba, La, Ce  |              |
| <input type="checkbox"/> Cu, Ni, Zn  |              |
| <input type="checkbox"/> Cr  |              |
| <input type="checkbox"/> 10-element, ICP-AES   |              |
| <input type="checkbox"/> Major elements as oxides, WDXRF   |              |
| <input type="checkbox"/> As, AA hydride generation   |              |
| <input type="checkbox"/> Sb-Hydride  |              |
| <input type="checkbox"/> Au, AA flame  |              |
| <input type="checkbox"/> Au, AA graphite furnace   |              |
| <input type="checkbox"/> Hg, AA cold vapor   |              |
| <input type="checkbox"/> Organic C, computed from the difference of total C and carbonate C determinations |              |
| <input type="checkbox"/> Total C, combustion   |              |
| <input type="checkbox"/> REE ICP-MS  |              |
| <input type="checkbox"/> CHN   |              |
| <input type="checkbox"/> Coal Package  |              |
| <input type="checkbox"/> Low level W, Nb, Mo chemical separation-ICP                                       |              |
| <input type="checkbox"/> C O <sub>2</sub> (carbonate carbon), coulometric titration                        |              |
| <input type="checkbox"/> Cl <sup>-</sup> , ion-selective electrode   |              |
| <input type="checkbox"/> FeO, potentiometric titration   |              |
| <input type="checkbox"/> H <sub>2</sub> O, heat/weight loss  |              |
| <input type="checkbox"/> K <sub>2</sub> O, flame photometric   |              |
| <input type="checkbox"/> Na <sub>2</sub> O, flame photometric  |              |
| <input type="checkbox"/> P group, ICP-MS   |              |
| <input type="checkbox"/> Total S, combustion   |              |
| <input type="checkbox"/> Forms of Sulfur   |              |
| <input type="checkbox"/> Se, AA hydride generation   |              |
| <input type="checkbox"/> Te, AA flame  |              |
| <input type="checkbox"/> TL, AA flame  |              |
| <input type="checkbox"/> U & Th, DNAA  |              |
| <input type="checkbox"/> W, visible absorption   |              |
| <input type="checkbox"/> INAA long count   |              |
| <input type="checkbox"/> INAA short count  |              |
| <input type="checkbox"/> Cd, AA  |              |
| <input type="checkbox"/> Ag, AA  |              |
| <input type="checkbox"/> Percent ash   |              |
| <input type="checkbox"/> Ge, chemical separation   |              |

<sup>1</sup>Additional information is available in the "Sample Submittal Manual" and the "Catalog of Services."

<sup>2</sup>Use asterisk (\*) to denote contact person for multiple submitters (two-line limit). If more than one copy of final report is needed, please note quantity \_\_\_\_\_.

<sup>3</sup>Please note known or suspected mineralized samples on coding sheet (specify elements).

<sup>4</sup>Contact the Quality Assurance Coordinator for special requirements.

Figure 1A. Front of Request for Analysis coding sheet form.

**Important: Use coding as defined in the Fourth Edition of the Sample Submittal Manual. Copies of the manual are available from MRSP Sample Control and ACSR Liaisons.**

**General Description of Column Entries:**  
 11 Enter "N" if sample is from NURE collection  
 \* 12 Character of sample (grab, composite, etc.)  
 \* 13 Source (outcrop, float, mine dump, etc.)  
 14 Age (if certain) or

15 & 16 Age (if uncertain, give as range—e.g. Cambrian-Silurian)  
 17 Economic geology (mineralized, alteration, etc.)  
 \* 19 Category (rock type, soil, plant, etc.)  
 20 - 39 Detailed description  
 60 - 65 Free coding

| Lab No. ** | Field No. * | LAT *<br>Deg. Min. Sec. | LONG *<br>Deg. Min. Sec. | State, County<br>or<br>Country, State*<br>Prov., if not USA | Formation<br>Name | Sample Description<br>and Comments* | 11 | 12* | 13* | 14 | 15 | 16 | 17 | 19* | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 35 | 36 | 37 | 38 | 39 | 60 | 61 | 62 | 63 | 64 | 65 |
|------------|-------------|-------------------------|--------------------------|---|-------------------|-------------------------------------|----|-----|-----|----|----|----|----|-----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
|            |             |                         |                          |   |                   |                                     |    |     |     |    |    |    |    |     |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |

\* Required information      \* Provide previously assigned lab no. along with other information if sample is submitted from a previous lab.

**Figure 1B. Back of Request for Analysis coding sheet form.**



numbers), and a list of the contact laboratory personnel is sent to the submitter for verification. A photocopy of the RFA with the relevant information is sent with the computer printout to the submitter. The original RFA, a computer printout of the requested analysis, and self-adhesive labels (fig. 2) are placed with the samples in the preparation holding area. Two labels are made for each sample: one for the side of the sample container and the second for the top of the container. The samples and paperwork remain in a sample control holding area until requested by the sample preparation laboratory personnel.

A photocopy of the RFA and computer printout are placed in a loose leaf notebook filed by job number in the sample control area.

Three, 3"x5" cards are typed and filed (fig. 3). One card is filed in job number order and used for tracking routine samples. A second card is filed in alphabetical order by submitter name and is used to record the date each analysis is completed. The final card is filed in order by lab number as a cross reference permanent storage card.

|   |                               |
|---|-------------------------------|
| JOB NO. AA01<br>LAB NO. D-000001<br>FIELD NO. ABC001<br>REQUESTOR SUBMITTER, J. | D-000001<br>SUBMITTER<br>AA01 |
| JOB NO. AA01<br>LAB NO. D-000002<br>FIELD NO. ABC002<br>REQUESTOR SUBMITTER, J. | D-000002<br>SUBMITTER<br>AA01 |
| JOB NO. AA01<br>LAB NO. D-000003<br>FIELD NO. ABC003<br>REQUESTOR SUBMITTER, J. | D-000003<br>SUBMITTER<br>AA01 |
| JOB NO. AA01<br>LAB NO. D-000004<br>FIELD NO. ABC004<br>REQUESTOR SUBMITTER, J. | D-000004<br>SUBMITTER<br>AA01 |
| JOB NO. AA01<br>LAB NO. D-000005<br>FIELD NO. ABC005<br>REQUESTOR SUBMITTER, J. | D-000005<br>SUBMITTER<br>AA01 |

**Figure 2.** Self-adhesive labels.

|            |               |   |                 |
|------------|---------------|---|-----------------|
| AA01       | Joe Submitter | 5 | D-000001-000005 |
| Rock       | Colorado      |   | Evidence        |
| LAGD(5901) |               |   |                 |
| LAQS(5005) |               |   |                 |

*Figure 3.* 3"x5" sample control card.

As laboratory personnel request work, sample control personnel note on the tracking card the location and the date each job is moved. When the samples are returned, the last entry is crossed out with a single line indicating that the samples have been returned to sample control. The samples are then filed numerically by job number on the sample control pending shelves.

The card filed by the submitter name is the record of the chain of analysis. As each requested analysis is completed, the date is noted on the card. Three months after all requested work for a job has been completed, the card is filed in the card permanent storage.

When all work on a job has been completed, sample control personnel file all of the original paperwork in loose leaf computer notebooks by job number. Six months after the completion of analysis, samples of completed jobs are moved to the permanent storage facility.

## **POLICIES REQUIRED PRIOR TO ACCEPTANCE OF EVIDENTIARY SAMPLES**

### **Pre-Assessment Meeting**

Prior to sample submittal the project leader(s) requiring strict chain of custody (COC) must meet with all relevant laboratory personnel to discuss details of the project, including the handling, analysis, and final disposition of samples. At this meeting, any concerns, such as the capability of the laboratory to meet the submitters' needs, are discussed and resolved.

The meeting should include representatives from sample control, computer group, sample preparation laboratory, analytical laboratories, and quality assurance (QA). Items to be discussed include the following: the exact number of samples to be analyzed, the anticipated submittal dates, required data delivery

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date, necessary sample preparation, laboratory techniques, and a plan to notify the MRSP when litigation is complete. The project leader should discuss the possible hazardous nature of the samples when applicable and any special precautions laboratory personnel should follow when handling the samples. Any desired modifications of the laboratory's established QA guidelines or data reporting protocols should be clarified. Any changes in the QA guidelines require approval by the laboratory's QA coordinator. Costs of the routine laboratory work and sample disposal are calculated by the MRSP and the project leader and are presented at this meeting. All meeting information is reported on the pre-assessment meeting form (fig. 4). If the project is a multi-phase or multi-year study, pre-assessment meetings are convened prior to the submittal of samples for each phase or year of the study. The pre-assessment form must be signed by the chief scientist prior to acceptance of COC samples.

Pre-assessment meetings for all projects originating from other Federal agencies (OFA) are conducted by a representative from the requesting agency and a designated MRSP liaison. If an MRSP liaison is the meeting leader, it is his/her responsibility to provide all pertinent information, especially that which relates to the hazardous nature of the samples. The laboratory reserves the right at any time to refuse any sample that exceeds laboratory safety guidelines.

If it is determined at the pre-assessment meeting that the numbers of samples being submitted for COC analysis exceeds the current laboratory capacity, the meeting information is forwarded to a panel convened by the MRSP laboratory manager to resolve the problem. Project leaders and laboratory management incorporate panel recommendations in the final plan.

## **SAMPLE CONTROL EVIDENTIARY PROCEDURES**

Samples that might involve litigation are handled as evidence. A specific set of COC procedures are maintained on all such samples. These samples are subject to the following rules:

- The sample control custodian (SCC) is the designated custodian of evidentiary samples and maintains all COC samples, forms, and tracking cards. These are located in a specially designated, locked evidentiary area in the sample control area.
- The SCC is responsible for the primary keys for this area and keeps an extra set of keys locked in a cabinet in the sample control area. The sample control area is entered using a key card; entry is monitored by the Federal Protective Service (FPS). If the custodian is unavailable, a sample control employee will be authorized to maintain custody and will be given the keys. The security of this area is detailed later in this document.
- If emergency personnel, janitorial personnel, or others require access to the sample control area, a visitors log is signed with date, time, and reason for entry. Analysts withdrawing COC samples, who enter the sample control office, also sign the visitors log.

Pre-assessment meeting information

Project meeting date \_\_\_\_\_ Project ID \_\_\_\_\_

Est. Collection date \_\_\_\_\_ Est. submittal date \_\_\_\_\_

Est. total number of COC samples \_\_\_\_\_

| <u>Techniques required</u> | <u># COC samples</u> | <u># reg. samples</u> | <u>Initials of rep. present</u> | <u>Estimated completion date</u> |
|----------------------------|----------------------|-----------------------|---------------------------------|----------------------------------|
| _____                      | _____                | _____                 | _____                           | _____                            |
| _____                      | _____                | _____                 | _____                           | _____                            |
| _____                      | _____                | _____                 | _____                           | _____                            |
| _____                      | _____                | _____                 | _____                           | _____                            |
| _____                      | _____                | _____                 | _____                           | _____                            |
| _____                      | _____                | _____                 | _____                           | _____                            |

Hazardous material Yes \_\_\_\_\_ No \_\_\_\_\_

(If yes, identify suspected hazardous compounds or items) \_\_\_\_\_  
\_\_\_\_\_

Submitters \_\_\_\_\_ Priority Yes \_\_\_\_\_ No \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_ Estimated Cost \$ \_\_\_\_\_  
\_\_\_\_\_

Comments \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Figure 4. Pre-Assessment Form.

---

## Acceptance of Samples

While the submitter or designated agent of the submitter is present, sample control personnel count and check the samples against the RFA. Any discrepancies are resolved prior to official acceptance of the samples. The SCC has the right to refuse samples as evidentiary, if the sample containers are improperly sealed, damaged, leaking, or the samples themselves are above the levels of toxicity or radioactivity predetermined by the MRSP safety officer. Samples that arrive with incomplete or incorrect paperwork may also be refused. The identifying numbers are recorded on the sample control COC Form (fig. 5), which is maintained in a bound book. Information required includes the number of samples, the type of sample media, the submitter name, and the date and time of acceptance. Both the submitter and the receiver (or the receiver in the presence of the submitter) sign this form. The submitter signs on the line indicating the release of samples; the SCC signs on the line indicating the acceptance of samples. Special notes such as the condition of seals are added to the form prior to both parties signing.

Samples that require drying in an oven are placed in the oven secured with chains and a padlock. Samples that require refrigeration are placed in the refrigerator, which is located in a secured sample preparation laboratory.

Samples that require no refrigeration or drying are locked in the sample control evidentiary holding area. Formally accepted samples are entered into the system as described in the routine section above. The exceptions to the routine procedures are that laboratory and job numbers are added to the COC form, and a fourth 3"x5" card is created. All four cards indicate that these samples are evidentiary. Three of the cards are filed and kept as in the routine procedure. The fourth card is filed in a small file that is kept in the COC area. This card is identical to the other tracking card held in sample control except that individuals requesting custody of samples must sign the COC tracking card with name and date.

## Withdrawal of Samples

Analysts authorized to work with COC samples must contact the SCC to request withdrawal of COC samples prior to arriving in the sample control area. The analyst meets the SCC in the sample control area and signs the visitors log. The analyst inspects the evidence seals to check that the samples meet standard evidence rules. Samples, either individually sealed or sealed in trays by job, are given to the analyst after the analyst signs the tracking card and the bottom section of the COC form with name, date, time, reason for withdrawal, amount to be used in analysis, and where the samples are to be moved. Samples may then be moved to another secured area. Samples must be returned to sample control as soon as the amount required for analysis has been removed and weighed. Samples are never left unattended or unsecured. The analyst adds any additional notes, such as increased amount of sample withdrawn, to the COC form when the samples are returned to sample control.

Mineral Resource Survey Program  
Chain-of-Custody Form

\_\_\_\_\_ of \_\_\_\_\_ Pages

|                            |   |
|----------------------------|---|
| <u>Submitted By:</u>       | <u>Number of Samples:</u>   |
| <u>Received By:</u>        | <u>Sample Media:</u>  |
| <u>Date/Time Received:</u> | <u>Job Number:</u> <span style="float: right;"><u>Lab Numbers:</u></span> |

List Sample Identification Numbers

|  |  |  |  |
|--|--|--|--|
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |

Custodial Locations

| Received By:<br>(Time and Date) | Purpose: | Location: | Returned To:<br>(Time and Date) |
|---------------------------------|----------|-----------|---------------------------------|
|                                 |          |           |                                 |
|                                 |          |           |                                 |
|                                 |          |           |                                 |
|                                 |          |           |                                 |
|                                 |          |           |                                 |
|                                 |          |           |                                 |
|                                 |          |           |                                 |
|                                 |          |           |                                 |
|                                 |          |           |                                 |
|                                 |          |           |                                 |
|                                 |          |           |                                 |

**Figure 5.** Chain-of-Custody (COC) Form.

---

If it is necessary to complete analysis in an area that has been secured with a padlock or dead bolt lock, the analyst signs the tracking card for both the samples and the key for the secured lock. The SCC is the only other individual who has a key to these locks. The analyst must return the key to the SCC as soon as the analysis is complete. When COC samples are in a laboratory, no other samples are permitted in that laboratory to eliminate any possibility of cross-contamination with COC samples. Anyone entering a secured area while COC samples are present must sign a log book with name, date, time, and reason for entry.

## **SAMPLE PREPARATION OF CHAIN-OF-CUSTODY SAMPLES**

COC sample preparation protocol only differs from the standard operating procedure for sample preparation by the additional security and documentation. Physical sample preparation of COC samples is performed in accordance with the quality assurance manual for the Branch of Geochemistry (Arbogast, 1990). Any special preparation instructions, the amount of sample to be prepared, the disposal of excess material and the cost for disposal of any hazardous materials is agreed upon at the pre-assessment meeting.

If any excess sample is being returned to the submitter, a 3-oz unaltered split of the sample is maintained in the locked sample control area until the litigation is completed. All other excess sample is either returned to the submitter or discarded. If hazardous materials/waste disposal costs are incurred, the submitter is responsible.

A trained and certified sample preparation technician accepts the sample(s) from the SCC. The samples are taken to the COC sample preparation laboratory and prepared for analysis. Upon completion of preparation the technician notes on the RFA any problems such as broken seals. The sample preparer's log book details all steps taken in the processing of samples to allow for recall of these specific samples. The samples and excess bulk, if any, are secured with evidence tape, initialed and dated. They are then returned to the SCC. The SCC checks to ensure all samples are present and sealed properly and signs the bottom section of the COC form, next to the analyst's name, to indicate the resumption of custody.

## **CHAIN-OF-CUSTODY SAMPLE LABORATORY ANALYSIS**

After the prepared samples are returned to sample control, laboratory analysts withdraw samples following the procedure discussed above. Samples are moved to secured laboratory areas. Any sample removed from the custodial sample (for example, 10 g for Au analysis) is documented on the COC form. If analysis requires formation of solutions, the solution may be kept in the secured area, but the original sample is returned to sample control as soon as the amount needed for analysis has been weighed and removed.

---

Routine techniques validated in the quality assurance manual for the Branch of Geochemistry (Arbogast, 1990) are used for the majority of analyses of COC samples. Nonroutine techniques may also be used for the analysis of COC samples, but it then becomes the responsibility of the research scientist to provide the necessary QA/QC information and method references for validation of the research technique to the SCC to be filed with the samples on which the analysis is performed.

Instrument calibration and maintenance are performed according to quality assurance manual (Arbogast, 1990). Instrument calibrations are documented in log books or on computer printouts. The laboratory chief maintains a log of localities for all paperwork not filed with COC samples.

Lab books and log books are bound, and entries are recorded in permanent ink. Lab books contain pertinent information such as job number, name of submitter, sample number, weight of sample, date of preparation, and method of dissolution. A visitor's log book is kept at the entrance to each COC laboratory to record any entry and departure of non-COC personnel into the secured areas during preparation and (or) analysis of COC samples. The analyst is responsible for placing all data in a secured area during sample analysis (for example, strip charts or graphs). When the analysis is complete, all original data not contained in a notebook is given to the SCC for storage.

## **CHAIN-OF-CUSTODY SAMPLE NEUTRON ACTIVATION ANALYSIS**

Samples are checked out from the SCC in the manner previously described. The samples are then taken directly to Building 15 at the Denver Federal Center, which is a controlled access building where the outside doors are locked at all times. The samples are prepared by heat-sealing the sample split in a polyethylene vial, which protects the integrity of the sample. The sample vials are also imprinted with a sample and irradiation code using a permanent marker. The prepared sample splits are placed in a locked cabinet in the analyst's office, and any sample beyond the amount needed for this analysis is returned to the SCC. The key for the cabinet is in the possession of the analyst.

Prior to irradiation, the samples are given to the reactor staff for loading in the reactor. The samples remain in the reactor overnight and then are placed in a locked, lead-shielded container in the reactor bay area. This container remains locked until the analyst, who has the only key, removes the samples. The samples are allowed to decay in this container for about 5 or 6 days. After signing the appropriate forms required by the Nuclear Regulatory Commission (NRC), the samples are taken by the analyst to the laboratory in Building 15 and analyzed by routine procedures described in Baedeker and McKown (1987). NRC security procedures are similar to standard evidentiary regulations.



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During the analysis, unprocessed spectral data of the samples are transferred from the analyzer to a VAX 750 computer. This spectral data is also copied to a floppy disk. The data disks are locked in the COC cabinet in the analyst office. All of the principal data reduction is performed using the spectral data residing on the VAX computer. Selected data reduction routines are performed on a computer using the spectral data stored on the floppy disks and independent software to verify the primary results. The laboratory and office of the analyst is locked after business hours, and the keys to these areas are held by the analyst.

## **SAMPLE COMPLETION AND MISCELLANEOUS INFORMATION**

Samples that are insufficient for all requested analyses are noted on the RFA and the COC form when they become insufficient. All requested splits are kept in the secured areas with the original samples. Should a portion of the sample be requested for litigation, a split can be made available after permission has been granted by the Solicitor General. The amount of sample removed and the date and time is noted on the COC form.

When all requested analyses are complete, computer printouts of the results are filed in a loose leaf book in the secured sample control area. The samples and all related paperwork are secured until all litigation is complete.

Sample submitters are contacted annually to ascertain the status of the litigation process. When litigation is complete, the submitter is notified to retrieve the samples. A split of the original sample is maintained by MRSP for permanent archive but as a nonevidentiary sample. The evidentiary samples and a copy of all RFA documentation, computer printouts, and results are returned to the submitter who signs the COC card and the COC form, which is filed in sample control.

A room in the preparation area has been provided for sorting large batches of samples which are COC. As this room is shared, there is a limited time available for its use.

Samples that have a short viability (such as water samples) will be held for 6 weeks. At that time they will be returned to the submitter along with a copy of all documentation. The submitter will be required to sign for the samples on the COC card and form.

Samples that are sent through the mail room with evidence tape will not be released by the mail room personnel to anyone but the SCC or designated backup individual (fig. 6).

If the litigation is not completed, the samples and all related documents continue to be held as evidence with all appropriate safe guards. Storage charges may be assessed if storage of more than two years is anticipated or incurred.



# United States Department of the Interior

GEOLOGICAL SURVEY  
BOX 25046 M.S. 207  
DENVER FEDERAL CENTER  
DENVER, COLORADO 80225



IN REPLY REFER TO:

August 15, 1996

To: Warehouse Delivery Personnel  
Chuck Hooper, Gary Halterman, Al White, Bill Duddleson

From: Raymond Cowles *Raymond Cowles*  
Supply Management Officer

Subject: Update Delivery Instructions,  
Sample Control  
Chris Murphy, MS 928

Effective immediately any Federal Express packages received by the warehouse addressed to: Sample Control, Chris Murphy MS 928, that are identified as evidence, can only be signed for by Chris Murphy. The evidence packages will be identified with warning tape that is either red or black and white striped, and marked **warning evidence**. Chris estimates that they may be receiving one or two of these packages a month.

The sample Control area is a secured facility. All deliveries addressed to Sample Control, other than the ones identified as evidence can be signed for by personnel in the administrative office (MS 973), BLDG. 20 Room E-1120, and then taken to room H-1536 and placed on the table in the hallway. If you have any Federal Express identified as evidence, contact Chris Murphy at 6-2479 or ring the buzzer that will be installed in room H-1536 and she will come sign for the package. **Do not leave any package that is identified as evidence without getting a signature from Chris Murphy.** If she can not be contacted the package will have to be brought back to the warehouse and secured in one of the safes, until arrangements can be made with them to make the delivery.

CC: Chris Murphy, MS 928  
Rayleen Cruz, MS 201

Figure 6. Deliveries to sample control.

---

Information regarding the samples may be released to the submitter only. Any requests for information from anyone other than the submitter are referred to the Solicitor General.

## **PERSONNEL POLICY GOVERNING CHAIN-OF-CUSTODY SAMPLES**

Employee conduct is governed by the Ethics Reform Act of 1989. Details of this act are available in the local personnel office of the U.S. Geological Survey. The guidelines set forth in this act are to be followed by all private (contract) and government employees working on COC samples in this laboratory.

The supervisory sample control specialist serves as the principal COC custodian for the laboratory and is responsible for the coordination of sample submittal, retrieval and storage (short and long term) of samples. A designated individual from sample control serves as a backup COC custodian.

Training documents identify the qualified analysts who can perform a particular procedure or parts of a procedure. Only qualified analysts will perform the requested analyses. Training documentation (fig. 7) is kept and maintained by the quality assurance (QA) coordinator. Analyst performance is routinely checked using quality control (QC) results to demonstrate that the analyst performs under the guidelines set forth under the QA Manual for the MRSP.

COC analysis personnel have work plans that include a critical element governing compliance with COC guidelines. These individuals are all certified by the laboratory chief to handle COC samples.

The chief scientist or the MRSP laboratory manager represent the lab in all court cases where routine procedures are used to analyze COC samples. When nonroutine techniques are used in the analysis of samples it is the research scientist's responsibility to provide all necessary documentation, QA/QC information, and testimony at any legal proceedings.

## **GENERAL POLICIES GOVERNING PHYSICAL SECURITY OF CHAIN-OF-CUSTODY SAMPLES**

### **Federal Center Security**

The MRSP COC protocol includes three levels of security. The first level controls passage onto the Denver Federal Center (DFC) with a fenced enclosure and entrance guards who record all access of nongovernment employees and all access of government employees after normal business hours. A second level of security is provided by regular police patrols of the DFC by the Federal Protective Service (FPS). The final level is provided by our building security, which is described in detail below.

## Low-level Au Analysis

Name \_\_\_\_\_

Job title/Grade \_\_\_\_\_

Supervisor \_\_\_\_\_

Date of training initiation \_\_\_\_\_

TRAINER MUST INITIAL AND DATE

| PROCEDURE                                 | Not yet trained | In process | Proficient |
|---|-----------------|------------|------------|
| 1. Sample weighing                        |                 |            |            |
| a. Cleaning crucibles and sample weighing |                 |            |            |
| 2. Sample digestion                       |                 |            |            |
| a. Cook samples                           |                 |            |            |
| b. Dissolution of samples                 |                 |            |            |
| 3. Au Extractions                         |                 |            |            |
| a. Organic extraction                     |                 |            |            |
| b. HBr extraction                         |                 |            |            |
| 4. Flame AA                               |                 |            |            |
| a. Calibration                            |                 |            |            |
| b. Run samples                            |                 |            |            |
| 5. GFAA                                   |                 |            |            |
| a. Calibration                            |                 |            |            |
| b. Run samples                            |                 |            |            |
| 6. Cleanup                                |                 |            |            |
| 7. QC paperwork                           |                 |            |            |
| 8. Data sheets                            |                 |            |            |
|   |                 |            |            |
|   |                 |            |            |
|   |                 |            |            |

**Figure 7.** Low-level Au analysis Form.

---

## **Building Security**

Security for COC samples restricts access to three distinct areas in the laboratory facility. These include sample control/sample storage, sample preparation, and a portion of the analytical laboratories. In all three areas, access is controlled through card readers, motion detectors, or deadbolt locks. Only designated personnel that have been approved by management have access to these secured areas. The security system in all three areas can be modified to accommodate approved changes in laboratory personnel. All security measures that have been installed in this facility have been approved by the FPS, who will monitor the installation.

## **Sample Control Security**

The sample control area (app. 2) is secured by three card-reader monitors and a one-way alarm door. In addition to these security measures, MRSP restricts access to this area to authorized sample control personnel and those authorized by the SCC.

## **Sample Preparation Security**

Three rooms are designated for sample preparation (app. 2). The rooms include a special preparation/sorting and drying room used by sample submitters, a room designed for sample crushing and grinding, and a room used for preparation of biologic materials. These rooms are equipped with special combination locks and (or) card readers. A motion detector is in place in the plant laboratory providing additional security.

## **Laboratory Security**

Four laboratories are used for COC analytical work. These laboratories include ICP-AES, ICP-MS, CV-AAS for mercury determination, and AA-hydride generation for determination of arsenic, antimony, and selenium (app. 2). Because these laboratories were constructed with solid walls that run from floor to ceiling, securing them for COC work required monitoring only the entry to the laboratory. This was accomplished by the installation of card reader monitors and (or) special door combination locks. These security measures provide adequate electronic monitoring while providing reasonable access for an approved analyst. In addition, they can be deactivated when noncustodial samples are being analyzed. The easy installation of these door security systems allows for a “phased” installation. Thus laboratories can be secured as other techniques are added to the suite of approved COC work.

## **Backup Chain-of-Custody Sample Storage Devices**

A set of three storage lockers are located outside of sample control to serve as temporary sample storage units. These lockers can be used by analysts or sample submitters if samples cannot be secured in the sample control area by

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the close of business. After these lockers have been closed, only the SCC can reopen them.

### **Computer Security for Chain of Custody**

Computer access to the COC information stored in MRSP computers requires a valid user identification and a password. Authorized computer access is limited to selected personnel.

When a COC job is entered into the laboratory information management system (LIMS), the assigned job number and laboratory numbers are sent to personnel who work with these samples. No one has authority to access this data without special permission.

Analytical data are printed as they are generated. This hard copy is considered the original (primary) document. The analytical results are also stored in the computer as a backup to the primary document. Data storage is a design feature of LIMS.

A password is required to access the system. Additional precautions may be taken such as storing data on separate electronic storage devices, if it becomes apparent that the computer security that is currently in place has been breached.

### **REFERENCES**

- Arbogast, B.F., editor, 1990, Quality assurance manual for the Branch of Geochemistry, U.S. Geological Survey: U.S. Geological Survey Open-File Report 90-668, 184 p.
- Baedecker, P.A., and McKown, D.M., 1987, Instrumental neutron activation analysis of geochemical samples, *in* Baedecker, P.A. (ed.), Methods for geochemical analysis: U.S. Geological Survey Bulletin 1770, p. H1-H14.

**APPENDIX 1**  
**Government Cost Estimate**

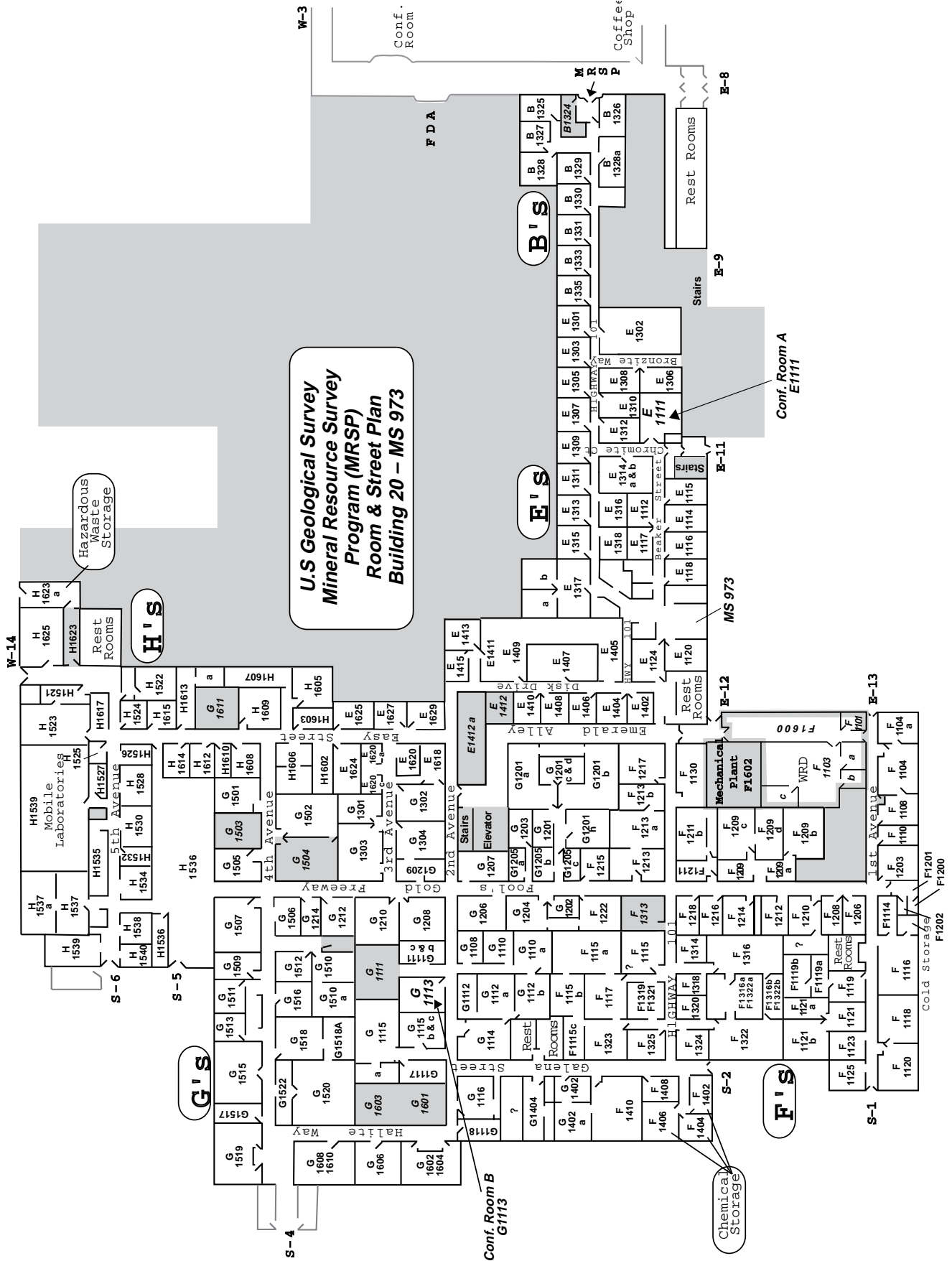
2/17/94

Bldg 20

Rev 4/22/94  
Alt Rev 4/22/94  
Alt 1 Rev 4/22/94  
Rev 4/26/94

| Item                   | Cost     | Quan | Total       | Hrs | Labor Cost | Total      | Grand Total |
|------------------------|----------|------|-------------|-----|------------|------------|-------------|
| Prox 941               | \$433.00 | 16   | \$6,928.00  | 4   | \$35.00    | \$2,240.00 | \$9,168.00  |
| Strike                 | 250.00   | 11   | 2,750.00    | 4   | 35.00      | 1,540.00   | 4,290.00    |
| Xmfr                   | 25.00    | 11   | 275.00      | 1   | 35.00      | 385.00     | 660.00      |
| Special I/F            | 75.00    | 16   | 1,200.00    | 2   | 35.00      | 1,120.00   | 2,320.00    |
| Micro 4                | 2,317.00 | 1    | 2,317.00    | 8   | 35.00      | 280.00     | 2,597.00    |
| 8RP board              | 1,031.00 | 2    | 2,062.00    | 1   | 35.00      | 70.00      | 2,132.00    |
| 6000 ID cap            | 250.00   | 1    | 250.00      | 2   | 35.00      | 70.00      | 320.00      |
| Modem                  | 450.00   | 2    | 900.00      | 2   | 35.00      | 140.00     | 1,040.00    |
| PIR                    | 95.00    | 6    | 570.00      | 3   | 35.00      | 630.00     | 1,200.00    |
| Balanced Contact       | 65.00    | 7    | 455.00      | 3   | 35.00      | 735.00     | 1,190.00    |
| Exit switch            | 50.00    | 3    | 150.00      | 2   | 35.00      | 210.00     | 360.00      |
| Power Supply           | 125.00   | 1    | 125.00      | 4   | 35.00      | 140.00     | 265.00      |
| Moose MPI-775          | 60.00    | 2    | 120.00      | 1   | 35.00      | 70.00      | 190.00      |
| Siren                  | 40.00    | 1    | 40.00       | 2   | 35.00      | 70.00      | 110.00      |
|                        |          |      | 0.00        |     | 35.00      | 0.00       | 0.00        |
| Wire                   | 0.75     | 1500 | 1,125.00    |     |            |            | 1,125.00    |
| Miscellaneous expenses |          |      | 250.00      |     |            |            | 250.00      |
| Total                  |          |      | \$19,517.00 |     |            | \$7,700.00 | \$27,217.00 |

# APPENDIX 2 Building 20 Street Plan Map





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## APPENDIX 3

### Shortened Version of Chain-of-Custody Policies

#### INTRODUCTION

The Mineral Resource Survey Program (MRSP), formerly the Branch of Geochemistry (BGC), provides support expertise for geologic/analytical products. This includes the following:

- Development and application of single element and multi-element methods used in geochemical investigations.
- Development and application of geochemical techniques for environmental programs.
- Expert testimony on sample handling and on the methods used.
- Maintenance of an up-to-date quality assurance program.

To ensure the integrity of evidentiary samples, policies have been established and are outlined below.

#### SAMPLE CONTROL ROUTINE PROCEDURES

Sample control personnel are responsible for maintaining the chain of custody for all samples submitted to MRSP. Samples involved in litigation are controlled more rigorously to ensure their admissibility as evidence in court.

All samples submitted to MRSP must be accompanied by a completed request for analysis (RFA) form. This form is the record of accountability. Information, such as the evidentiary nature of a sample or high elemental concentrations in a sample, are noted on this form along with the requested analysis.

#### ACCEPTANCE OF ROUTINE SAMPLES (NONEVIDENTIARY)

Samples are counted and checked against the RFA. Discrepancies are resolved prior to formal acceptance. The information from the RFA is entered in the computer and numbers are issued for each batch (job number) and each individual sample numbers (laboratory numbers).

A computer printout of the information from the RFA and the information generated by the computer is sent to the submitter for verification. The samples and paperwork remain in a sample control holding area until requested by the sample preparation laboratory personnel.

The policies used in processing routine samples are documented and maintained in the sample control office. Copies of this information are available upon request.

When all work on a job has been completed, sample control personnel file all of the original paperwork in loose leaf computer notebooks by job number. Six

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months after the completion of analysis, samples from completed jobs are then moved to the permanent storage facility.

## **POLICIES REQUIRED PRIOR TO ACCEPTANCE OF EVIDENTIARY SAMPLES**

### **Pre-Assessment Meeting**

Prior to sample submittal, the project leader(s) requesting strict chain of custody (COC) conducts a meeting with all relevant laboratory personnel to discuss details of the project relating to the handling, analysis, and final disposition of samples.

The laboratory reserves the right to refuse any sample that exceeds laboratory safety guidelines.

## **SAMPLE CONTROL EVIDENTIARY PROCEDURES**

Samples that might involve litigation are handled as evidence. A specific set of COC procedures are maintained on all such samples. The process for handling these samples requires additional precautions. Specific rules are detailed below.

The sample control specialist (SCC) or designated representative is the custodian of evidentiary samples and maintains all COC samples, forms, and tracking cards in a secured area.

### **Acceptance of Evidentiary Samples**

While the submitter is present, sample control personnel count and check the samples against the RFA. Any discrepancies are resolved prior to official acceptance of the samples. The SCC has the right to refuse samples as evidentiary, if the sample containers are improperly sealed, damaged, leaking, above the levels of toxicity or radioactivity pre-determined by the MRSP safety officer or arrive with incomplete or incorrect paperwork. The identifying numbers are recorded on the sample control COC Form, which is maintained in a bound book. The samples are photographed, and this photograph is preserved with the RFA.

Samples are locked in the sample control evidentiary holding area. Formally accepted samples are entered into the system according to the documentation in the sample control office. The exceptions to the routine procedure are that laboratory and job numbers are added to the COC form, and a tracking card is created for evidence. This card is filed in a small file that is kept in the COC area. This card must be signed by individuals with name and date before samples will be released by the SCC.

### **Withdrawal of Evidentiary Samples**

Analysts authorized to work with COC samples must contact the SCC for withdrawal of COC samples prior to arriving in the sample control area. The analyst comes to the sample control area and inspects the evidence seals to assure

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that the samples meet standard evidence rules. Samples are given to the analyst after the analyst signs the tracking card and the bottom section of the COC form with name, date, time, reason for withdrawal, amount to be used in analysis, and location to where the samples are to be moved. Samples may then be moved to another secured area. Samples are returned to sample control as soon as the amount required for analysis has been weighed and removed. Samples are not left unattended and (or) unsecured. The analyst adds any additional notes, such as increased amount of sample withdrawn, to the COC form when the samples are returned to sample control.

When COC samples are in a laboratory, no other samples are permitted in that laboratory to eliminate any possibility of cross-contamination of COC samples.

## **SAMPLE PREPARATION OF CHAIN-OF-CUSTODY SAMPLES**

COC sample preparation protocol differs from the standard operating procedure for the ACSG sample preparation only by the additional security and documentation involved. Physical sample preparation of COC samples is performed in accordance with the quality assurance manual (Arbogast, 1990).

Any special preparation instructions, the amount of sample to be prepared, the disposal of excess material, and the cost for disposal of any hazardous materials is agreed upon at the pre-assessment meeting.

If excess sample is being returned to the submitter, a 3-oz unaltered split of the sample is retained and safeguarded until the litigation is completed. This prepared sample is maintained by the ACSG and used for analytical work. All other excess sample is either returned to the submitter or discarded. If hazardous materials/waste disposal costs are incurred, the submitter is held responsible as agreed upon at the pre-assessment meeting.

A trained and certified sample preparation technician accepts the sample(s) from the sample custodian. The samples are taken to the ACSG's COC sample preparation laboratory and prepared for analysis. Upon completion, the technician notes on the RFA any problems such as broken seals. The samples and excess bulk, if any, are secured with evidence tape, initialed and dated. They are then returned to the sample custodian. The sample custodian checks to ensure all samples are present and sealed properly and signs the bottom section of the COC form next to the analyst's name to indicate the resumption of custody.

## **CHAIN-OF-CUSTODY SAMPLE LABORATORY ANALYSIS**

After the prepared samples are returned to sample control, laboratory analysts withdraw samples following the same rules. Samples can be only moved to secured areas of the building. Any sample removed from the custodial sample (for example, 10 g for Au analysis) is documented on the COC form. If analysis requires formation of solutions, the solution may be kept in the secured area, but

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the original sample is returned to sample control as soon as the amount needed for analysis has been weighed and removed.

Routine techniques validated in Arbogast (1990) are used for the majority of analyses of COC samples. Nonroutine techniques may also be used for the analysis of COC samples, but it then becomes the responsibility of the research scientist to provide the necessary QA/QC information and method references for validation of the research technique.

Instrument calibration and maintenance are performed according to Arbogast (1990). Instrument calibrations are documented in log books or on computer printouts. Lab books and log books are bound with entries recorded in permanent ink. Lab books contain pertinent information such as job number, name of submitter, sample numbers, weight of sample, date of preparation, and method of dissolution. The analyst is responsible for placing all data in a secured area during sample analysis (such as strip chart and graphs). When the analysis is complete, all original data are given to the COC custodian, who is responsible for the storage of the information.

## **SAMPLE COMPLETION AND MISCELLANEOUS INFORMATION**

Samples that are insufficient for all requested analyses are noted on the RFA and the COC form when they become insufficient. All requested splits are kept in the secured areas with the original samples. Should a portion of the sample be requested for litigation, a split is made available upon request and permission of the Solicitor General. The amount of sample removed and the date and time is noted on the COC form.

When all requested analyses are complete, computer printouts of the results are filed in a sample control loose leaf book in the sample control secured area. The samples and all related paperwork are secured until all litigation is complete.

Sample submitters are contacted on an annual basis to ascertain the status of the litigation process. When the litigation is complete, the submitter is notified to retrieve the samples. A split of the original sample is maintained by the MRSP for permanent archive but on a nonevidentiary basis. The evidentiary samples and a copy of all RFA documentation, computer printouts, and results are returned to the submitter who signs the COC card and the COC form, which is filed in sample control.

Samples that have a short viability (such as water samples) will be held for 6 weeks. At that time, they will be returned to the submitter along with a copy of all documentation. The submitter will be required to sign for the samples on the COC card and form.

Samples that are sent through the mail room with evidence tape will not be released by the mail room personnel to anyone but the SCC or the designated backup individual.

---

If the litigation is not completed, the samples and all related documents continue to be held as evidence with all appropriate safeguards.

Storage charges may be assessed if storage times of more than 2 years are anticipated or incurred.

Information regarding the samples may only be released to the submitter. Any requests for information from anyone other than the submitter are referred to the Solicitor General.

## **PERSONNEL POLICY GOVERNING CHAIN-OF-CUSTODY SAMPLES**

Employee conduct is governed by the Ethics Reform Act of 1989. Details of this act are available in the local personnel office of The U.S. Geological Survey. The guidelines set forth in this act are to be followed by all private (contract) and government employees working on COC samples in this laboratory.

The supervisory sample control specialist serves as the principal sample COC custodian for the laboratory and is responsible for the coordination of sample submittal, retrieval and storage (short and long term). A designated individual from sample control acts as a backup COC custodian.

Training documents identify those analysts who are qualified to perform a particular procedure or parts of a procedure. Only analysts who are documented as qualified will perform the requested analyses. Training documents are kept and maintained by the quality assurance coordinator.

The analyst's performance is routinely checked using Quality Control (QC) results to demonstrate that the analyst performs under the guidelines set forth under the Quality Assurance (QA) Manual for Branch of Geochemistry (Arbogast, 1990).

Individuals involved with COC analyses have work plans that include a critical element governing compliance with COC guidelines. These individuals are all certified by the laboratory chief as qualified to handle COC samples.

The chief scientist or the MRSP laboratory manager represent the lab in all court cases where routine procedures are used to analyze COC samples.

When nonroutine techniques are used in the analysis of samples, it is the research scientist's responsibility to provide all necessary documentation, QA/QC information, and testimony at any legal proceedings.

## **GENERAL POLICIES GOVERNING PHYSICAL SECURITY OF CHAIN-OF-CUSTODY SAMPLES**

### **Federal Center Security**

The COC protocol includes three levels of security. The first level controls of entrance and exit of the Denver Federal Center (DFC) with a fenced enclosure

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and guards who record all access after normal business hours. A second level of security is provided by regular police patrols of the DFC by the Federal Protective Service (FPS), and a final level is provided by our building security system.

### **Building Security**

Security for COC samples restricts access to three distinct areas in the laboratory facility. In all areas, security equipment was recommended, installed, and is monitored by the FPS. Only designated individuals who have been approved by MRSP management have access to these secured areas. The security system in all three areas can be modified to accommodate changes in laboratory personnel without endangering the security of COC samples.

### **Sample Control Security**

The sample control area is secured by various methods recommended by the FPS and installed under their supervision. In addition to these security improvements, MRSP restricts access to this area to authorized sample control personnel and those authorized by the SCC.

### **Sample Preparation Security**

Three rooms are designated for sample preparation. The rooms include a special preparation/sorting and drying room used by sample submitters, a room designed for sample crushing and grinding, and a room used for preparation of biologic materials. The security of these rooms was also installed under the supervision of FPS.

### **Laboratory Security**

Four laboratories are used for COC analytical work. Electronic security measures provide complete monitoring but still provide reasonable access for an approved analyst. In addition, the security can be deactivated when noncustodial samples are being analyzed. Access is monitored by FPS anytime COC samples are being analyzed.

### **Backup Chain-of-Custody Sample Storage Devices**

A set of three storage lockers are located outside of sample control to serve as temporary sample storage units. These lockers are used by analysts or sample submitters if samples cannot be secured in the sample control area by the close of business. After these lockers have been closed, only the sample custodian can reopen them.

### **Computer Security for Chain of Custody**

Computer access to the COC information stored in computers requires a valid user identification and a password. Authorized computer access is limited to selected MRSP personnel.

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When a COC job is entered into the laboratory information management system (LIMS), the assigned job number and laboratory numbers are sent to the personnel who work with these samples. No one has authority to access this data without special permission.

Analytical data are printed as they are generated from laboratory instruments. This hard copy is considered the original (primary) document. The analytical results are also stored in the computer as a backup to the primary document. Data storage is a design feature of LIMS. A password is required to access the system. Additional precautions may be taken such as storing data on separate electronic storage devices, if it becomes apparent that the computer security that is currently in place has been breached.

## REFERENCE

Arbogast, B.F., editor, 1990, Quality assurance manual for the Branch of Geochemistry, U.S. Geological Survey: U.S. Geological Survey Open-File Report 90-668, 184 p.

## ACKNOWLEDGMENTS

We especially want to thank the following people for sharing their expertise:

|                  |  |
|------------------|--|
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| Steve McDanal    | Mineral Resource Survey Program                                |
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| Jon Werkmeister  | Federal Protective Service                                     |
| Peter Mang       | Colorado Bureau of Investigation                               |
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| Bob Huestis      | Lakewood Police Department                                     |
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| Anthony Palizzi  | Enesco   |
| Jerry Porr       | Enesco   |
| Bruce Binkley    | Environmental Protection Agency                                |
| Eric Nottingham  | Environmental Protection Agency                                |

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## Technical Books and Reports

**Professional Papers** are mainly comprehensive scientific reports of wide and lasting interest and importance to professional scientists and engineers. Included are reports on the results of resource studies and of topographic, hydrologic, and geologic investigations. They also include collections of related papers addressing different aspects of a single scientific topic.

**Bulletins** contain significant data and interpretations that are of lasting scientific interest but are generally more limited in scope or geographic coverage than Professional Papers. They include the results of resource studies and of geologic and topographic investigations; as well as collections of short papers related to a specific topic.

**Water-Supply Papers** are comprehensive reports that present significant interpretive results of hydrologic investigations of wide interest to professional geologists, hydrologists, and engineers. The series covers investigations in all phases of hydrology, including hydrology, availability of water, quality of water, and use of water.

**Circulars** present administrative information or important scientific information of wide popular interest in a format designed for distribution at no cost to the public. Information is usually of short-term interest.

**Water-Resources Investigations Reports** are papers of an interpretive nature made available to the public outside the formal USGS publications series. Copies are reproduced on request unlike formal USGS publications, and they are also available for public inspection at depositories indicated in USGS catalogs.

**Open-File Reports** include unpublished manuscript reports, maps, and other material that are made available for public consultation at depositories. They are a nonpermanent form of publication that may be cited in other publications as sources of information.

## Maps

**Geologic Quadrangle Maps** are multicolor geologic maps on topographic bases in 7 1/2- or 15-minute quadrangle formats (scales mainly 1:24,000 or 1:62,500) showing bedrock, surficial, or engineering geology. Maps generally include brief texts; some maps include structure and columnar sections only.

**Geophysical Investigations Maps** are on topographic or planimetric bases at various scales, they show results of surveys using geophysical techniques, such as gravity, magnetic, seismic, or radioactivity, which reflect subsurface structures that are of economic or geologic significance. Many maps include correlations with the geology.

**Miscellaneous Investigations Series Maps** are on planimetric or topographic bases of regular and irregular areas at various scales; they present a wide variety of format and subject matter. The series also includes 7 1/2-minute quadrangle photogeologic maps on planimetric bases which show geology as interpreted from aerial photographs. The series also includes maps of Mars and the Moon.

**Coal Investigations Maps** are geologic maps on topographic or planimetric bases at various scales showing bedrock or surficial geology, stratigraphy, and structural relations in certain coal-resource areas.

**Oil and Gas Investigations Charts** show stratigraphic information for certain oil and gas fields and other areas having petroleum potential.

**Miscellaneous Field Studies Maps** are multicolor or black-and-white maps on topographic or planimetric bases on quadrangle or irregular areas at various scales. Pre-1971 maps show bedrock geology in relation to specific mining or mineral-deposit problems; post-1971 maps are primarily black-and-white maps on various subjects such as environmental studies or wilderness mineral investigations.

**Hydrologic Investigations Atlases** are multicolored or black-and-white maps on topographic or planimetric bases presenting a wide range of geohydrologic data of both regular and irregular areas; the principal scale is 1:24,000, and regional studies are at 1:250,000 scale or smaller.

## Catalogs

Permanent catalogs, as well as some others, giving comprehensive listings of U.S. Geological Survey publications are available under the conditions indicated below from USGS Map Distribution, Box 25286, Building 810, Denver Federal Center, Denver, CO 80225. (See latest Price and Availability List.)

“**Publications of the Geological Survey, 1879-1961**” may be purchased by mail and over the counter in paperback book form and as a set microfiche.

“**Publications of the Geological Survey, 1962-1970**” may be purchased by mail and over the counter in paperback book form and as a set of microfiche.

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**Supplements** for 1982, 1983, 1984, 1985, 1986, and for subsequent years since the last permanent catalog may be purchased by mail and over the counter in paperback book form.

**State catalogs**, “List of U.S. Geological Survey Geologic and Water-Supply Reports and Maps For (State),” may be purchased by mail and over the counter in paperback booklet form only.

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